Australian Orthopaedic Association National Joint Replacement Registry

2024 ANNUAL REPORT

Hip, Knee and Shoulder Arthroplasty

CELEBRATING 25TH Edition

AOA AUSTRALIAN ORTHOPAEDIC ASSOCIATION

Australian Orthopaedic Association National Joint Replacement Registry

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Australian Orthopaedic Association National Joint Replacement Registry

2024 ANNUAL REPORT

Data Period 1 September 1999 – 31 December 2023

Hip, Knee and Shoulder Arthroplasty

Preface

It is with great pride that I present the 2024 Hip, Knee, and Shoulder Arthroplasty Report, marking the 25th edition of this annual publication.

This year's analysis, based on over 2.1 million procedures, underscores the pivotal role of the Australian Orthopaedic Association National Joint Replacement Registry (AOANJRR) in advancing the standards of joint replacement surgery across Australia.

The journey that began over two decades ago with the establishment of the Registry has led us to this moment—a comprehensive, robust dataset that provides invaluable insights into the evolving landscape of hip, knee, shoulder, ankle, spine, elbow and wrist arthroplasty. The Registry, through collaboration with hospitals nationwide, continues to serve as a cornerstone for evidence-based surgical decision-making. We are particularly proud to report that shoulder arthroplasty, which has been included in the Registry since 2017, has now reached nearly 100,000 recorded procedures. This milestone underscores the growing significance of shoulder arthroplasty within the field and highlights the Registry's expanding capacity to drive improvements in patient outcomes across a broader range of joint replacement surgeries.

The 2024 Annual Report reflects our commitment to quality care and innovation. The data not only informs best practices but also highlights areas requiring further scrutiny, ensuring continuous improvement. This year, we also provide 14 supplementary reports that delve deeper into key aspects of arthroplasty, including prosthesis performance, patient-reported outcomes, and regional variations. These reports are a testament to the multifaceted impact of our data and how it informs clinicians, healthcare providers, and policymakers alike.

A new addition to this year's report is the special chapter on "Arthroplasty Practice Variation in Australia." This chapter explores the differences in hip and knee arthroplasty practices across the country, emphasising the importance of understanding regional variations to improve clinical practices and patient outcomes. By examining factors such as patient demographics, surgical techniques, and prosthesis selection, this analysis brings to light significant variations between states, territories, and urban versus rural areas. It is only by understanding these differences that we can work toward more consistent and improved outcomes for all patients, regardless of where they receive care.

The success of the Registry would not be possible without the dedication and expertise of the Registry Clinical Director Paul Smith, Deputy Clinical Directors Peter Lewis, Chris Vertullo and Michael McAuliffe, Assistant Deputy Clinical Directors Chris Wall, David Gill and James Stoney, and the Registry Executive Manager Kathy Hill. Their unwavering commitment to ensuring the highest standards of data collection, analysis, and reporting has been instrumental in the Registry's ongoing evolution and success. Their leadership and collaboration with surgeons, hospitals, and healthcare partners across Australia have been crucial in driving the improvements and innovations that continue to enhance patient outcomes nationwide.

As President of the AOA, I am deeply grateful for the ongoing support of the Commonwealth Government, our healthcare partners, and the many surgeons whose expertise and collaboration enrich the Registry's contributions to arthroplasty. I also commend the dedicated teams at the AOANJRR and SAHMRI for their tireless efforts in ensuring the accuracy, comprehensiveness, and accessibility of the data.

Looking ahead, the AOANJRR remains an essential tool in shaping the future of joint replacement surgery. As we continue to adapt to new challenges and embrace technological advancements, I am confident that the insights gained from this report will further enhance patient outcomes, surgical practices, and healthcare efficiencies.

Thank you for your continued engagement with and support of the Registry. Together, we will ensure that Australia remains at the forefront of global orthopaedic excellence.

Sincerely,

Michael Johnson

President, Australian Orthopaedic Association

AOANJRR Data Snapshot 2023

2,131,050
Total number of joint replacement procedures reported by the Registry at the end of 2023

Infection is the No.1 reason for hip and knee prosthesis revision

$ $ $ $
Over a billion dollars of estimated benefit to the national health system accruing from AOANJRR activities

Joint replacement procedures performed in 2023

58,529 Hips

78,125 Knees

10,141 Shoulders

337 Data Reports

3,721 Automated Reports

66 Hospital Audit Reports

1,112 Individual Surgeon Reports

43 Conference presentations

16 Journal Articles Published

National PROMs Data Collection

June 2024 Update

Participating Hospitals
244

Pre-Op PROMs
118,171

Post-Op PROMs
83,476

Pre-Op Completion Rate
73.7%

Post-Op Completion Rate
62.7%

816
Total number of surgeons participating

Total Number of Hospitals Onboard per State /Territory:

- SA: **29**
- ACT: **6**
- NSW: **66**
- VIC: **66**
- NT: **3**
- WA: **22**
- QLD: **45**
- TAS: **7**

% patient-reported change following hip, knee, or shoulder joint replacement as "much better"
84.9%

% patient "very satisfied" or "satisfied" following hip, knee, or shoulder joint replacement
87.3%

129,054
Patient participation through AOANJRR patient dashboards

Executive Summary

This summary provides a brief overview of some of the major findings from the 2024 Annual Report, a milestone edition as it marks the 25th report in our series. As with last year's Annual Report, to ensure that the relevance and currency of AOANJRR data are maintained, almost all analyses (unless specifically stated) have been confined to hip, knee and shoulder prostheses that were still being used in 2023. Again, historic data are still available in previous Annual Reports on the AOANJRR website.

In addition to the main report, the Registry continues to publish Supplementary Reports. The Supplementary Reports are listed in the introductory chapter and will be available on the AOANJRR website https://aoanjrr.sahmri.com/ annual-reports-2024 from 1 October 2024. They include a Lay Summary of the main report and 13 additional reports on arthroplasty topics, as well as detailed analyses of all prostheses identified as having a higher than anticipated rate of revision. The impact of COVID-19 is no longer presented.

Ten, Fifteen and Twenty Year Outcomes

This section of the report provides 10 and 15 year benchmarks for prostheses used in >350 procedures in primary total conventional hip and primary total knee replacement undertaken for osteoarthritis. This is the second year that, 10 year benchmarks for prostheses used in total stemmed anatomic shoulder replacement for osteoarthritis and primary total stemmed reverse shoulder replacement performed for any diagnosis are included. This chapter reports 20 year outcomes for a small number of prostheses that are still used. All analyses in this chapter are restricted to modern prostheses.

The 10 year benchmark standard is 4.3% for hips and 4.6% for knees. For shoulders, the 10 year benchmark is 7.5% for total stemmed anatomic and 5.5% for total stemmed reverse. The calculated 15 year benchmark standard is 6.1% and for both hips and knees. The benchmarks reflect proven long- term success.

The AOANJRR uses the benchmark approach recommended by the ISAR International Prosthesis Benchmarking Working Group to identify those devices that have superior and non-inferior performance at 10 years and 15 years. Of those hip, knee and shoulder prosthesis combinations with a sufficient number of procedures and follow-up, 24.4% of hip and 21.6% of knee prosthesis combinations achieved a 10 year superiority benchmark. There were no shoulder prosthesis combinations, in either procedure type, that achieved a 10 year superiority benchmark. However, 1 total stemmed anatomic shoulder prosthesis combination and 2 total stemmed reverse shoulder prosthesis combinations qualified for a 10 year non-inferiority benchmark. At 15 years, 26.9% of hip and 21.1% of knee prosthesis combinations still in use achieve a superiority benchmark.

Special Chapter: Arthroplasty Practice Variation in Australia

This year, a special chapter on "Practice Variation" in the AOANJRR 2024 report explores the differences in hip and knee arthroplasty practices across Australia. It highlights the significance of understanding regional variations to improve clinical practices and patient outcomes.

This variation in hip replacement section highlights similarities and some differences in hip replacement patients across Australian states and territories, as well as among the surgeons performing these procedures. Patient demographics such as age, gender, ASA, and BMI are consistent nationwide, but notable differences exist in IRSAD ratings. Over the last decade, there has been a national increase in the number of surgeons performing hip replacements, though the proportions of those with less experience and low procedure volumes have decreased, with this latter group contributing less than 20% of total procedures. The incidence of hip replacements has risen across Australia, with the proportion of private procedures exceeding 80% in all states by 2023. Prosthesis choices have evolved, with national trends showing fewer fully cemented procedures, greater use of larger head sizes, and a shift toward ceramic/polyethylene bearings. Additionally, the use of technology assistance and newer technologies has increased, particularly in the last five years.

Regional analysis reveals that hip replacement rates and patient characteristics are generally consistent between rural/remote and metropolitan/regional areas, though some differences in IRSAD ratings and prosthesis use are noted. The revision rate for hip replacements shows minor differences, favouring metropolitan/regional hospitals in the first month, but no significant differences are observed for public hospitals. Overall, the trends in revision procedures, including an increase in revisions for infection and a shift toward fewer major revisions, are similar across states and regions.

While demographic factors for knee replacement patients show some variation, such as younger patients and more males in certain regions, other factors, such as BMI categories, have remained stable over the past decade. However, the increase in patients with significant comorbidities is concerning, especially in states like SA and VIC, where almost 50% of patients fall into higher ASA classes. Surgeon numbers and experience have remained consistent across the country, with a notable reduction in less experienced surgeons.

Knee replacement rates per 100,000 population vary, with TAS having the highest rate and the NT the lowest. Public sector procedures now make up less than 25% of knee replacements in most states, and revision rates show only minor differences between public and private sectors. Prosthesis selection varies slightly, but the majority of states use a similar range of components. Trends in technology use, such as robotic and computer-assisted surgeries, show an increase, especially in TAS and the ACT. Infections requiring revision have risen over the past decade, and rural hospitals perform fewer procedures overall, though the distribution of patient characteristics and technology use is similar between rural and metropolitan hospitals.

This chapter highlights significant variability in hip and knee arthroplasty across Australia, influenced by patient demographics, surgeon practices, prosthesis selection, surgical techniques, and differences in healthcare systems and hospitals. Changes in these factors over time have been observed, along with disparities between states, territories, and urban versus rural areas.

Hip Replacement

There has been minimal change in the number of hip replacements undertaken in 2023 compared to 2022. The revision burden in 2023 is 7.1% which is the lowest burden yet reported by the Registry. This year, the partial hip data usually found in the partial hip supplementary report has been incorporated back into the main report. The use of bipolar hip replacement continues to increase at the expense of unipolar modular partial hip replacement. Bipolar prostheses continue to be associated with the lowest rate of revision for the management of femoral neck fractures requiring arthroplasty. For the first time since the pandemic, primary total hip replacement has increased rather than decreased. There have been 47,932 total conventional hip replacement procedures in 2023 since the last report and a 177.1% increase since 2003. Of the two types of primary total hip replacement, total conventional hip has a lower cumulative percent revision than total resurfacing hip replacement. For total conventional hip replacement, the 20 year cumulative percent revision for currently used prostheses undertaken for osteoarthritis is 8.1%. Age has an impact on the risk of revision, particularly in females. Updated information on the effect of ASA score and BMI are provided with the cumulative percent revision increasing with increasing ASA score and increasing BMI category. There is little difference in outcomes based on fixation except for patients aged ≥75 years where the revision rate is lower when either hybrid or cemented fixation is used.

There continues to be an increase in the use of dual mobility prostheses and they have the same risk of revision as standard acetabular prostheses when used in the management of osteoarthritis but have half the risk of being revised for dislocation.

When adjusted for age, gender, ASA score, BMI category, femoral fixation, and head size, the anterior approach has a lower rate of revision compared to the lateral and posterior approaches. The posterior approach has a lower rate of revision compared to the lateral approach. There are also differences in the reasons for revision. The anterior approach has a higher rate of revision for loosening and early fracture compared to the posterior and lateral approach and a lower rate of revision for infection and dislocation.

Data on the outcomes of primary total hip replacement used for the management of femoral neck fracture are also provided and the cumulative percent revision of primary total conventional hip replacement for fractured neck of femur is 9.0% at 15 years.

A summary table indexing statistically significant characteristic comparisons in hip replacements is located at the beginning of the Hip Chapter, while a comprehensive bibliography of hip replacement research utilising AOANJRR data from 2020-2024 is provided at the chapter's conclusion.

Knee Replacement

In 2023, knee replacement increased by 19.2% compared to the previous year. The revision burden decreased to 6.8%. There has been a decrease in the use of partial knee replacement, and in 2023 it remains a small proportion (7.1%) of all knee replacement procedures. As with hips, this year the information from the partial knees supplementary report has been incorporated into the main report.

Younger age and male gender are associated with higher rates of revision for patella/trochlea knee replacement. Whereas younger age and female gender are associated with higher rates of revision for unicompartmental knee replacement. When adjusted for age, gender, ASA, BMI, and mobility, there is no difference in the rate of revision when robotic assistance is used in patella/trochlea knee replacement or when used in unicompartmental knee replacement. Mobile bearings increase revision risk for unicompartmental knee replacement, but their use is restricted to only two prostheses. There is no difference in revision risk between medial and lateral unicompartmental knee replacement.

Primary total knee replacement increased by 20.7% in 2023. The 20 year cumulative percent revision of knee prostheses still used in 2023 for the management of osteoarthritis is 7.6%. The impact of patient and prosthesis factors on the outcome of knee replacement surgery is similar to previous reports.

There are higher revision rates in younger patients and males, and there is an increased risk of revision for infection associated with increasing ASA score and BMI category. There is a reduced rate of revision when patella resurfacing is used, and when a patella component is used the revision rate is lowest with an all-polyethylene rather than a metal-backed prosthesis.

With respect to bearing surface, the use of XLPE continues to increase. Its impact on the revision rate varies depending on the prosthesis but it is never detrimental and often associated with a reduced revision rate. Femoral components with an alternate bearing surface (that is not cobalt-chrome) have a higher rate of revision, but the rate varies with the material used.

There is no difference in the rate of revision when medial pivot design prostheses are compared to minimally stabilised prostheses. However, when the patella is not resurfaced, medial pivot design prostheses have a higher rate of revision than minimally stabilised knee prostheses. Medial pivotdesigns have a lower rate of revision compared to posterior stabilised prostheses

The effect of fixation varies depending on prosthesis stability and often with time. For minimally stabilised prostheses, hybrid and cemented fixation have the lowest rates of revision. For posterior stabilised prostheses, cement fixation initially has the lowest revision rate. For medial pivot prostheses, the use of cement for tibial fixation is associated with a lower early rate of revision. There has been renewed interest in cementless fixation over the last few years but, at least for minimally stabilised prostheses, cementless tibial component fixation has a higher rate of revision for all age groups and both genders.

Analyses of the use of computer navigation and robotic assistance to aid knee replacement insertion have been undertaken with hazard ratios adjusted for age, gender, ASA, BMI, bearing surface, patella component usage and stability. There is no difference in the rate of revision when procedures using computer navigation are compared to procedures with no technology assistance. Similarly, with the same adjustments for potential confounding factors, there is no difference in the rate of revision when procedures using robotic assistance are compared to procedures with no technology assistance.

A summary table indexing statistically significant characteristic comparisons in knee replacements is located at the beginning of the Knee Chapter, while a comprehensive bibliography of knee replacement research utilising AOANJRR data from 2020-2024 is provided at the chapter's conclusion.

Shoulder Replacement

In 2023, shoulder replacement increased by 13.9% compared to the previous year. The revision burden decreased to 6.9% following the previous lowest reported revision burden of 7.4% in 2021. Compared to the period before 2015, total stemmed reverse replacements have lower revision rates. Summary data for partial shoulder anatomic procedures are in the Annual Report and a full analysis in the Partial Shoulder Arthroplasty Supplementary Report.

Of the three classes of primary total shoulder replacement (total stemmed anatomic, total stemless anatomic, and total stemmed reverse) total stemmed reverse shoulder replacement is by far the most common type of total shoulder replacement undertaken in Australia and accounts for 72.7% of all total shoulder procedures. Total stemless anatomic is more frequently utilised than total stemmed anatomic shoulder replacements.

A special clinical analysis was undertaken comparing the outcomes of all total shoulder classes for patients with osteoarthritis including hemi stemmed anatomic prostheses with pyrocarbon humeral heads. Total stemless anatomic with a polyethylene glenoid and total stemmed reverse shoulder replacements with lateralised or standard glenospheres have the lowest rates of revision.

The most common primary anatomic shoulder replacement, total stemless had differing outcomes depending upon the age or BMI stratified by gender and ASA score. Prosthetic factors including fixation and glenoid component type influenced outcome. By contrast, the outcome of primary total stemmed anatomic shoulders changed depending upon age, gender and gender stratified by ASA score and BMI. There were also many implant factors that were associated with the revision rate including glenoid component type, augmentation, and fixation, along with bearing surface, humeral head size and humeral stem length.

The rate of revision for total reverse shoulder replacement is higher when used for rotator cuff arthropathy compared to osteoarthritis. Younger age, male gender, ASA score and BMI are associated with an increased risk of revision. Technology assistance, bearing surface, glenosphere size, humeral stem length, and fixation influence the outcome depending on the primary diagnosis.

The Registry continues to report on the impact of glenoid morphology on the different types of shoulder replacement. At this point, it appears to have little effect on the early revision rates. This is true for each of the three most common total shoulder designs.

A summary table indexing statistically significant characteristic comparisons in total shoulder replacement is located at the beginning of the Shoulder Chapter, while a comprehensive bibliography of shoulder replacement research utilising AOANJRR data is provided at the chapter's conclusion.

Prostheses with Higher than Anticipated Rates of Revision

Each year, the AOANJRR identifies prostheses with higher than anticipated rates of revision. This year, 1 partial hip prosthesis, 1 total conventional hip prosthesis, 1 total knee prosthesis, 2 total stemmed anatomic shoulder prostheses, and 1 total ankle prosthesis have been newly identified.

Acknowledgements

The Registry continues to receive support and invaluable assistance from the Australian Government, state and territory health departments and orthopaedic companies.

The Registry acknowledges the cooperation and support provided by those undertaking the surgery and completing the data forms, in particular, all orthopaedic surgeons, registrars and nursing staff.

The Registry acknowledges the ongoing support of all hospitals, both public and private, that undertake arthroplasty surgery nationally. The support provided by each hospital through their nominated coordinator(s) is appreciated. A complete list of participating hospitals and coordinators is presented at the end of the Hip, Knee and Shoulder Arthroplasty Annual Report.

The Registry greatly appreciates the participation of all joint replacement patients throughout Australia. Their contribution allows ongoing improvements in arthroplasty outcomes to be achieved.

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Contents

Introduction

The 2024 Hip, Knee and Shoulder Arthroplasty Report, celebrating its 25th edition, is based on the analysis of 2,131,050 (910,050 hip, 1,125,214 knee and 95,786 shoulder) primary and revision procedures recorded by the Registry, with a procedure date up to and including 31 December 2023. Shoulder arthroplasty has been included in this report with hip and knee arthroplasty since 2017.

In addition, there are 14 supplementary reports that complete the AOANJRR Annual Report for 2024:

1. Lay Summary – Hip, Knee & Shoulder Replacement
2. Patient Reported Outcome Measures (PROMs): Hip, Knee & Shoulder Arthroplasty
3. Demographics of Hip, Knee & Shoulder Arthroplasty
4. Cement in Hip and Knee Arthroplasty
5. Mortality of Hip and Knee Arthroplasty
6. Revision of Hip and Knee Arthroplasty
7. Metal/Metal Bearing Surface in Total Conventional Hip Arthroplasty
8. Prosthesis Types with No or Minimal Use
9. Demographics and Outcome of Elbow and Wrist Arthroplasty
10. Demographics and Outcome of Ankle Arthroplasty
11. Demographics of Spinal Disc Arthroplasty
12. Analysis of State and Territory Health Data
13. Partial Shoulder Arthroplasty
14. Comparative Prosthesis Performance

In addition to the 14 supplementary reports, investigations of prostheses with higher than anticipated rates of revision are published on https://aoanjrr.sahmri.com/annual-reports-2024.

All hospitals, public and private, undertaking joint replacement submit their data to the Registry. Currently, there are 319 participating hospitals. However, this may vary from time to time due to hospital closures, new hospitals, or changes to services within hospitals.

Background

The Australian Orthopaedic Association (AOA) recognised the need to establish a national joint replacement registry in 1993. At that time, the outcome of joint replacement in Australia was unknown. Patient demographics were not available, and the types of prostheses and techniques used to implant them were unknown.

The need to establish a Registry was, in part, based on the documented success of a number of arthroplasty registries in other countries. In particular, the Swedish arthroplasty registries. In Sweden, the ability to identify factors important in achieving successful outcomes has resulted in both improved standards and significant cost savings.

In 1998, the then Commonwealth Department of Health (DoH) funded the AOA to establish the Registry. The Department of Health & Aged Care continues to provide funding to maintain the Registry. In June 2009, Federal Parliament passed legislation to enable the government to cost recover this funding from the orthopaedic industry. This legislation was updated in 2015.

The Registry began hip and knee data collection on 1 September 1999. Implementation was undertaken in a staged manner in each of the Australian states and territories, becoming national during 2002. The first year of full national data collection for shoulder procedures was 2008 (Appendix 6).

The AOA contracts the South Australian Health and Medical Research Institute (SAHMRI) to provide data management and independent data analysis services for the Registry. The SAHMRI team contribute crucial data management and analysis expertise through the Registry Working Group and a variety of project working groups.

The AOA also contracts the University of South Australia to provide specific expertise in the ongoing development of analytical techniques for Registry data.

Purpose

The purpose of the Registry is to define, improve and maintain the quality of care for individuals receiving joint replacement surgery. This is achieved by collecting a defined minimum data set that enables outcomes to be determined based on patient characteristics, prosthesis type and features, method of prosthesis fixation and surgical technique used.

The principal outcome measure is time to first revision surgery. This is an unambiguous measure of the need for further intervention. Combined with a careful analysis of potential confounding factors, this can be used as an accurate measure of the success, or otherwise, of a procedure. The Registry also monitors mortality of patients, which is critical when determining the rate of revision.

Introduction

Aims

1. Establish demographic data related to joint replacement surgery in Australia.
2. Provide accurate information on the use of different types of prostheses.
3. Determine regional variation in the practice of joint surgery.
4. Identify the demographic and diagnostic characteristics of patients that affect outcomes.
5. Analyse the effectiveness of different prostheses and treatment for specific diagnoses.
6. Evaluate the effectiveness of the large variety of prostheses currently on the market by analysing their survival rates.
7. Educate orthopaedic surgeons on the most effective prostheses and techniques to improve patient outcomes.
8. Provide surgeons with an auditing facility.
9. Provide information that can instigate tracking of patients if necessary.
10. Provide information for the comparison of the practice of joint replacement in Australia and other countries.

Benefits

Since its inception, the Registry has enhanced the outcome of joint replacement surgery in Australia.

There are many factors known to influence the outcome of joint replacement surgery. Some of these include age, gender, diagnosis, ASA score and BMI of patients, as well as the type of prosthesis and surgical technique used.

Another coexisting influence is the rapid rate of change in medical technology. There is continual development and use of new types of prostheses and surgical techniques, for many of which the outcome remains uncertain.

Information obtained by the analysis of Registry data is used to benefit the community. The Registry releases this information through publicly available annual and supplementary reports, journal publications and data reports. These data reports are specific analyses requested by surgeons, hospitals, academic institutions, government, and government agencies as well as orthopaedic companies.

The Registry provides surgeons with access to their individual data and downloadable reports through a secure online portal. Separate online facilities are available for orthopaedic companies to monitor their own prostheses, and for Australian and regulatory bodies in other countries to monitor prostheses used in Australia. The data obtained through the online facilities are updated daily and are over 90% complete within six weeks of the procedure date.

The percentage of revision hip procedures has declined from a peak of 12.9% in 2003 to 7.1% in 2023. The percentage of revision knee procedures has declined from a peak of 8.8% in 2004 to 6.8% in 2023. Revision shoulder arthroplasty peaked at 10.9% in 2012 and has declined to 6.9% in 2023.

A major reason for the reduction in revision following hip, knee and shoulder joint replacement is the increased use of the type and class of prostheses shown to have better outcomes, and an associated decline in use of prostheses when less satisfactory outcomes are identified.

There are many examples of AOANJRR data enhancing the outcome of joint replacement surgery in Australia. These include:

- The identification of high revision rates associated with the use of Austin Moore hemiarthroplasty for the treatment of fractured neck of femur (2003). Its use subsequently reduced, particularly in younger patients with this diagnosis.
- The reduction in the use of unicompartmental knee replacement. This reduction followed the identification of high revision rates (2004) and subsequent reporting, that the results of revision of primary unicompartmental knee replacement, were similar to revising primary total knee replacements.
- The identification of the high revision rate associated with unispacer use (2004).
- The AOANJRR was the first to identify ASR Resurfacing and ASR XL THR as protheses with higher than anticipated rates of revision (2007/2008). These prostheses were subsequently removed from the market in Australia, a year earlier than the global recall.
- The importance of gender, age, and femoral head size to the outcomes of resurfacing prostheses (2007/2008).
- The identification of the entire class of large head metal/metal conventional total hip prostheses (2010).
- The reduction in revision associated with patella resurfacing (2010).
- Detailed analysis of the revision rates relating to bearing surface, including the improved outcomes associated with XLPE for both hips (2011), knees (2013) and shoulders (2017).
- Determining that the rate of revision for total stemmed anatomic shoulder replacement class is confounded by modular metal back glenoids.
- The identification of large numbers of prostheses with higher than anticipated rates of revision. This is almost always associated with a rapid reduction in use. Many of these devices have subsequently been removed from the market.
- The increasing adoption of Registry-identified best practice and use of better performing devices.

Governance

The AOANJRR is an initiative of the AOA funded by the Commonwealth Government. In 2009, the Commonwealth established the AOANJRR Consultative Committee, which was administered and chaired by the Department of Health. The purpose was to provide advice on the overall strategic direction of the Registry. The Consultative Committee has been under review and is not currently meeting.

The National Board of the AOA established the AOA Registry Committee to review and recommend AOANJRR policies to the Board. The Committee reports to the AOA Board. Members include the Chair, Registry Clinical Director with the three Deputy Registry Clinical Directors and four Assistant Deputy Registry Clinical Directors in attendance. In addition, an orthopaedic surgeon from each state, the ACT, and a representative from each of the AOA specialty arthroplasty groups are included. A complete list of the current AOA Registry Committee is provided in the acknowledgements section of this report.

The Registry Clinical Director, Deputy Registry Clinical Directors and Assistant Deputy Registry Clinical Directors are appointed by the AOA Board and are responsible for providing strategic and clinical guidance. Additionally, the Registry Clinical Directors are responsible for ensuring the cooperation of hospitals, surgeons, and government, maintaining the profile and reputation of the Registry, continued collaboration with other arthroplasty registries internationally, and sustaining the current level of excellence.

The AOANJRR staff include the Registry Executive Manager, Registry Nested Clinical Studies (RNCS) Manager, Project Coordinators, Project Officers, PROMs and Core Data Manager, PROMs Coordinators, PROMs Officer, Data Requests and Publications Manager, Publications Officer, Executive Assistant and Administrative Coordinator. The AOANJRR team are responsible for the day-to-day operations, implementing new strategies, provision of data reports, research, and publications activity, and coordinating the preparation of the Annual Report.

Data Collection

Hospitals provide joint replacement data on specific Registry forms which are completed in theatre at the time of surgery. The completed forms are submitted to the Registry each month. Examples of these forms are available on the website: https://aoanjrr.sahmri.com/data-collection.

Hard copy forms are sent to the Registry where a small team of expert data entry staff enter the data directly into the database. Onsite Data Managers are available to resolve queries at the time of data entry to reduce any potential data entry errors. The Registry data entry system uses a predictive text function which greatly reduces the possibility of transcription errors and enables the experienced data entry staff to enter the data rapidly and accurately.

The Registry has also established mechanisms to collect data electronically when it becomes feasible for contributing hospitals to do so. To date, there are no hospitals providing data electronically.

Data Validation

The Registry validates data collected from both public and private hospitals by comparing it to data provided by state and territory health departments. Validation of Registry data is a sequential multi-level matching process against health department unit record data.

Data Quality

The validation process identifies:

1. Registry procedure records for procedures notified to state/territory health departments by hospitals.
2. State/territory records for procedures not submitted to the Registry by hospitals.
3. 'Exact match' procedures, that is, records held by the Registry and state/territory health departments.
4. Procedures that match on some parameters, but which require additional checking with hospitals to enable verification.

Initial validation is performed using hospital and patient identity numbers with subsequent verification undertaken on relevant procedure codes and appropriate admission periods.

Data errors can occur within Government or Registry data at any of these levels; that is, errors in patient identification, coding, or admission period attribution by either the hospital, state/ territory health department or the Registry. Data mismatches are managed depending on the nature of the error. For example, a health department record for a primary 'knee' may match a Registry-held record for a 'hip' on all parameters except procedure type. The Registry would regard the Registry data to be correct in this instance as the Registry record contains details of the prostheses implanted. Other errors may be resolved by contacting hospitals for clarification. Most commonly, this may include a reassessment of procedure codes or admission period.

The validation process identifies procedures not submitted to the Registry. As in previous years, the majority of these procedures have an ICD10 code for hemiarthroplasty of the femur. Sufficient information is provided in the state unit record data to enable the Registry to request hospitals to provide forms for unreported procedures.

Following verification against health department data, checking of unmatched data and subsequent retrieval of unreported procedures, the Registry is able to obtain an almost complete dataset (98.8%) of hip, knee and shoulder replacement in Australia.

Outcome Assessment

The Registry describes the time to first revision using the Kaplan-Meier estimates of survivorship. The cumulative percent revision (CPR) at a certain time, for example, 5 years, is the complement in probability) of the Kaplan-Meier survivorship function at that time, multiplied by 100. The cumulative percent revision accounts for right censoring due to death and 'closure' of the database at the time of analysis. Closure of the database occurs in April of the report year for procedures up to 31 December of the preceding year. Due to delays in receipt of the procedure form, some procedures are not included until the following annual report.

Mortality information is obtained by matching all procedures with the National Death Index (NDI) biannually. The NDI is the national mortality database maintained by the Australian Institute of Health and Welfare (AIHW). The AIHW requires ethics approval for access to the NDI data.

Prior to 2013, the Registry reported the revisions per 100 observed component years. This statistic provides a good estimate of the overall rate of revision. However, it does not allow for changes in the rate of revision over time. A more informative estimate of the rate of revision over time is the cumulative percent revision.

Confidence intervals for the cumulative percent revision are unadjusted point-wise Greenwood estimates and should not be used to infer significant differences in revision between groups. Reported hazard ratios should be used when judging statistical significance.

Hazard ratios (HR) from Cox proportional hazards models, adjusting for age and gender where appropriate, are used to compare rates of revision. For each model, the assumption of proportional hazards is checked analytically. If the interaction between the predictor and the log of time is statistically significant in the standard Cox model, then a time varying model is estimated. Time points are iteratively chosen until the assumption of proportionality is met, then the hazard ratios are calculated for each selected time period. If no time period is specified, then the hazard ratio is over the entire follow-up period. All tests are two-tailed at the 5% level of significance.

The cumulative percent revision is displayed until the number at risk for the group reaches 40, unless the initial number for the group is less than 100, in which case the cumulative percent revision is reported until 10% of the initial number at risk remains. This avoids uninformative, imprecise estimates at the right tail of the distribution where the number at risk is low. Analytical comparisons of revision rates using the proportional hazards model are based on all available data.[1]

In the presence of a competing risk for revision, the Kaplan-Meier method is known to overestimate the true probability of revision. Death of the patient before revision presents such a competing risk. In circumstances where the risk of death is high, e.g., in elderly patients with fractured neck of femur, the bias in the Kaplan-Meier estimates may be substantial and the reported cumulative percent revision should be interpreted with caution.

Cumulative incidence is one method of estimating the probability of revision in the presence of competing risks. Cumulative incidence revision diagnosis graphs deal with the competing risks of reasons for revision, highlighting the differences between groups in the pattern of revision over time. They also provide important insight into different mechanisms of failure. A further approach to address the issue of death is to assess the probability of revision in only those patients that are still alive at the time of assessment. This is referred to as conditional probability.

More detailed information on the statistical methods used in this report is presented in Appendix 2.

An important Registry focus has been the continued development of a standardised algorithm to identify prostheses or combination of prostheses not performing to the level of others in the same class. The Registry refers to this group as 'prostheses with a higher than anticipated rate of revision'. A three-stage approach has been developed and is outlined in detail in the relevant chapter of the report.

Annual Report Review Prior To Publication

Prior to publication, three workshops were held to review, comment, and provide advice on all sections of the Annual Report. Members of the AOA, Arthroplasty Society, and Shoulder and Elbow Society were invited to attend these surgeon workshops.

The hip, knee and shoulder surgeon workshops were held in Adelaide on the weekend of the 3 and 4 August 2024. In addition to AOANJRR and SAHMRI staff, 17 hip, 16 knee and 4 shoulder arthroplasty specialists from the AOA membership attended the workshops.

Following these meetings, the Annual Report was provided to the AOA Board for consideration and final approval prior to publication.

[1] Pocock SJ, Clayton TC, Altman DG. Survival plots of time to event outcomes in clinical trials: good practice and pitfalls, Lancet 2002; 359: 1686-89.

Ten, Fifteen and Twenty Year Prosthesis Outcomes

Ten, Fifteen and Twenty Year Prosthesis Outcomes

Ten Year Outcomes

The Registry first reported 10 year outcomes in 2011. Since that time, the Registry has reported on an increasing number of hip and knee prostheses that have achieved this length of follow-up. This outcome is widely regarded as an important milestone in assessing the performance of prostheses.

Since the Registry commenced data collection revision rates have declined and many prostheses are no longer used. In order to keep Registry data contemporaneous, only procedures using prostheses that have been available and used in 2023 (described as modern prostheses) are included in the analyses, unless clearly specified. This approach has been applied both to the calculation of the benchmark standard used to identify superior and non-inferior performance and the selection of prostheses combinations reported. In addition, the Registry has excluded prostheses where a single surgeon performed more than 50% of procedures.

Detailed information on prostheses that are no longer used is available in the supplementary report 'Comparative Prosthesis Performance' on the AOANJRR website: https://aoanjrr.sahmri.com/annual-reports-2024

HIP REPLACEMENT

Individual femoral and acetabular prosthesis combinations are reported. A combination is included if >350 procedures have been reported and the follow-up period is ≥10 years.

There are 45 femoral and acetabular combinations with 10 year outcome data. These prosthesis combinations have been used in 79.9% of all primary total conventional hip procedures performed for osteoarthritis.

The 10 year cumulative percent revision for the individual prosthesis combinations ranges from 2.5% to 8.0%. In the past, when assessing superior and non-inferior performance the commonly accepted benchmark standard of 5% cumulative percent revision at 10 years was used. In the 2021 Annual Report, the AOANJRR changed the approach to determining the benchmark so that it is now calculated each year and is based on the aggregate performance of modern prostheses. The 10 year benchmark for this year is 4.3%.

Approaches to benchmarking hip and knee prostheses have been reviewed by the ISAR International Prosthesis Benchmarking Working Group.[2] An important recommendation was to use confidence intervals for individual prostheses rather than the estimated rate of revision. The reason for this is that the confidence interval inherently reflects the quality of the data for each prosthesis.

The superiority and inferiority approaches suggested by the ISAR International Prosthesis Benchmarking Working Group are utilised in this chapter to identify better performing hip prosthesis combinations.

Superiority approach: the upper confidence interval is less than, or equal to, the benchmark standard. Using the benchmark of 4.3% for modern prostheses at 10 years, 11 (24.4%) hip prosthesis combinations qualify for the superiority benchmark. These are highlighted in green in Table BM1.

Non-inferiority approach: the permitted upper confidence interval level is 20% above the benchmark standard. For the benchmark standard of 4.3% at 10 years, the accepted upper confidence interval is 5.1% or less. Using this approach, an additional 9 prosthesis combinations can be benchmarked, i.e., 20 (44.4%) prosthesis combinations would receive either a superiority or non-inferiority benchmark. The additional 10 devices with a non-inferiority benchmark are highlighted in blue in Table BM1.

It is important to emphasise that there are many reasons why a prosthesis combination may not achieve a benchmark standard. These include being used in small numbers, higher revision rates due to factors other than the prostheses used, as well as less satisfactory performance. However, it is clear that those prosthesis combinations that have achieved a benchmark standard have done so because they have revision rates that are comparatively lower.

[2] Report by ISAR International Prosthesis Benchmarking Working Group May 2018: https://www.isarhome.org/publications

Table BM1 Cumulative Percent Revision of Primary Total Conventional Hip Replacement Prosthesis Combinations with 10 Year Data (Primary Diagnosis OA)

Femoral Component	Acetabular Component	N Revised	N Total	Type of Revision THR	Femoral	Acetabular	Other	2 Yrs	5 Yrs	10 Yrs
Accolade II	Trident (Shell)	389	16178	38	131	61	159	2.2 (1.9, 2.4)	2.8 (2.5, 3.1)	3.7 (3.0, 4.5)
Alloclassic	Allofit	159	3372	16	87	19	37	1.8 (1.4, 2.3)	2.6 (2.1, 3.2)	4.3 (3.6, 5.1)
Anthology	R3	267	8072	27	75	53	112	2.3 (2.0, 2.7)	2.8 (2.5, 3.2)	3.7 (3.3, 4.2)
Avenir	Continuum	67	1669	5	15	12	35	3.3 (2.5, 4.2)	3.7 (2.9, 4.8)	4.6 (3.6, 5.9)
C-Stem AMT	Marathon	10	496	2	2	3	3	0.8 (0.3, 2.2)	1.5 (0.7, 3.2)	2.6 (1.4, 4.9)
C-Stem AMT	PINNACLE	147	5096	14	61	15	57	1.6 (1.3, 2.0)	2.7 (2.3, 3.3)	4.4 (3.6, 5.4)
CORAIL	PINNACLE	2294	60141	208	873	343	870	2.0 (1.9, 2.2)	3.0 (2.8, 3.1)	4.6 (4.4, 4.8)
CORAIL	Trident (Shell)	25	595	4	5	3	13	3.3 (2.1, 5.2)	4.6 (3.0, 7.0)	7.0 (4.4, 11.3)
CPCS	R3	247	7512	25	74	48	100	2.3 (2.0, 2.7)	3.1 (2.7, 3.6)	4.4 (3.8, 5.1)
CPCS	Reflection (Cup)	86	851	27	5	41	13	1.6 (0.9, 2.7)	2.9 (1.9, 4.3)	8.0 (6.0, 10.6)
CPCS	Reflection (Shell)	110	2812	14	48	14	34	0.9 (0.6, 1.4)	1.6 (1.2, 2.2)	3.2 (2.6, 4.0)
CPT	Allofit	57	1733	7	27	5	18	1.4 (0.9, 2.1)	3.0 (2.2, 4.1)	4.6 (3.5, 6.0)
CPT	Continuum	144	2806	9	55	19	61	3.2 (2.6, 3.9)	4.2 (3.5, 5.0)	5.9 (5.0, 7.0)
CPT	Trabecular Metal (Shell)	115	2089	11	49	18	37	2.7 (2.1, 3.5)	4.0 (3.2, 5.0)	6.5 (5.3, 7.9)
CPT	Trilogy	416	7872	47	162	42	165	2.3 (2.0, 2.7)	3.5 (3.1, 4.0)	5.4 (4.9, 6.0)
CPT	ZCA	41	867	14	10	10	7	1.2 (0.6, 2.2)	2.4 (1.6, 3.7)	4.6 (3.2, 6.4)
Exeter V40	Contemporary	312	4609	85	48	145	34	2.1 (1.8, 2.6)	3.2 (2.7, 3.8)	5.5 (4.8, 6.3)
Exeter V40	Exeter	137	1538	32	17	66	22	1.3 (0.8, 2.0)	2.9 (2.1, 3.9)	4.6 (3.6, 5.9)
Exeter V40	Exeter Contemporary	173	2970	58	35	57	23	1.9 (1.4, 2.4)	3.0 (2.4, 3.7)	4.6 (3.8, 5.4)
Exeter V40	Exeter X3 Rimfit	123	4519	31	35	32	25	1.8 (1.4, 2.2)	2.6 (2.1, 3.1)	3.4 (2.8, 4.1)
Exeter V40	Trabecular Metal (Shell)	21	485	2	3	2	14	2.7 (1.6, 4.7)	3.8 (2.4, 6.0)	4.8 (3.1, 7.5)
Exeter V40	Trident (Shell)	2334	78525	316	757	290	971	1.5 (1.4, 1.6)	2.3 (2.2, 2.4)	3.5 (3.4, 3.7)
Exeter V40	Trident/Tritanium (Shell)	149	5054	15	35	27	72	1.9 (1.5, 2.3)	2.8 (2.3, 3.3)	3.9 (3.2, 4.7)
H-Max	Delta-TT	75	1708	6	34	11	24	2.4 (1.8, 3.3)	3.8 (2.9, 4.9)	6.0 (4.7, 7.8)
M/L Taper	Continuum	61	1517	6	18	10	27	2.8 (2.1, 3.8)	3.7 (2.8, 4.7)	4.2 (3.3, 5.5)
MS 30	Fitmore	17	613	0	2	8	7	1.4 (0.7, 2.8)	2.6 (1.5, 4.5)	3.5 (2.1, 5.8)
Metafix	Trinity	380	18403	42	103	78	157	1.8 (1.6, 2.0)	2.4 (2.2, 2.7)	3.3 (2.8, 3.9)
MiniHip	Trinity	40	1245	2	21	10	7	2.8 (2.0, 3.9)	3.2 (2.3, 4.3)	3.5 (2.6, 4.8)
Polarstem	R3	531	19222	31	176	81	243	2.2 (2.0, 2.4)	2.9 (2.7, 3.2)	3.9 (3.5, 4.4)
Quadra-C	Versafitcup CC	32	1949	5	7	7	13	1.5 (1.0, 2.1)	1.7 (1.2, 2.5)	2.5 (1.5, 4.3)
Quadra-H	Versafitcup CC	388	10728	43	176	71	98	2.1 (1.8, 2.4)	3.0 (2.7, 3.4)	5.2 (4.6, 5.9)
S-Rom	PINNACLE	158	2636	15	89	15	39	2.9 (2.3, 3.6)	4.4 (3.7, 5.3)	5.7 (4.8, 6.7)
SL-Plus	EP-Fit Plus	48	1123	3	20	9	16	2.0 (1.3, 3.0)	2.9 (2.1, 4.1)	4.1 (3.1, 5.5)
SL-Plus	R3	102	1687	6	27	24	45	3.1 (2.4, 4.1)	4.2 (3.4, 5.3)	6.0 (4.9, 7.4)
Secur-Fit	Trident (Shell)	519	9845	38	228	94	159	2.4 (2.1, 2.8)	3.6 (3.2, 4.0)	4.8 (4.4, 5.3)
Secur-Fit Plus	Trident (Shell)	243	6014	18	67	59	99	1.6 (1.4, 2.0)	2.3 (2.0, 2.8)	3.4 (2.9, 3.9)
Spectron EF	R3	101	2162	18	19	20	44	2.4 (1.9, 3.2)	3.9 (3.1, 4.8)	5.1 (4.1, 6.2)
Spectron EF	Reflection (Cup)	127	1405	49	12	57	9	1.3 (0.8, 2.0)	2.9 (2.1, 4.0)	7.2 (5.8, 8.9)
Summit	PINNACLE	194	5709	15	45	32	102	1.8 (1.5, 2.2)	2.3 (2.0, 2.8)	3.5 (3.0, 4.1)
Synergy	R3	181	5239	6	51	45	79	2.1 (1.8, 2.6)	2.7 (2.3, 3.2)	3.5 (3.0, 4.1)
Synergy	Reflection (Shell)	403	7312	34	85	133	151	2.0 (1.7, 2.3)	2.6 (2.2, 2.9)	3.8 (3.4, 4.3)
Taper Fit	Trinity	102	4808	10	35	14	43	1.7 (1.3, 2.1)	2.7 (2.2, 3.3)	4.7 (2.8, 8.1)
Tri-Fit TS	Trinity	119	4873	14	55	17	33	1.8 (1.5, 2.2)	2.4 (2.0, 2.9)	2.9 (2.4, 3.5)
Tri-Lock	PINNACLE	29	1096	0	10	8	11	1.6 (1.0, 2.5)	2.4 (1.6, 3.6)	3.4 (2.2, 5.1)

Ten, Fifteen and Twenty Year Prosthesis Outcomes

Femoral Component	Acetabular Component	N Revised	N Total	Type of Revision THR	Femoral	Acetabular	Other	2 Yrs	5 Yrs	10 Yrs
twinSys (cless)	RM Cup	53	1485	5	13	6	29	2.5 (1.8, 3.4)	3.3 (2.4, 4.3)	4.6 (3.3, 6.3)
TOTAL		11726	330640	1373	3902	2134	4317			

Note: Only prostheses with >350 procedures have been listed.
Green: prosthesis combination qualifies for a superiority benchmark.
Blue: prosthesis combination qualifies for non-inferiority benchmark. Restricted to modern prostheses

KNEE REPLACEMENT

The Registry has information on individual femoral and tibial prosthesis combinations. A combination is included if >350 procedures have been reported to the Registry and the follow-up is ≥10 years.

The listed prostheses most often represent a family of devices that have a range of different femoral and tibial components, combined with different tibial inserts, listed under one prosthesis name. Prosthesis types are further characterised according to whether they are minimally stabilised (cruciate retaining) or posteriorly stabilised.

As with hips, to ensure that the data reflects contemporary practice only procedures using modern prostheses are included in the analyses. This approach has been applied both to the calculation of the benchmark standard used to identify superior and non-inferior performance and the selection of prosthesis combinations reported. In addition, the Registry has excluded prostheses where a single surgeon performed more than 50% of procedures.

Detailed information on prostheses that are no longer used is available in the supplementary report 'Comparative Prosthesis Performance' on the AOANJRR website: https://aoanjrr.sahmri.com/annual-reports-2024

There are 37 total knee replacement combinations with 10 year outcome data. These prosthesis combinations were used in 89.2% of all primary total knee replacement procedures performed for osteoarthritis.

The 10 year cumulative percent revision ranges from 2.8% to 9.2%. In the past, as with primary total conventional hip replacement, when assessing superior and non-inferior performance the benchmark standard used was a cumulative percent revision at 10 years of 5%. The cumulative percent revision benchmark at 10 years, calculated this year based on the aggregate performance of modern prostheses within the AOANJRR is 4.6%.

The superiority and inferiority approaches suggested by the ISAR International Prosthesis Benchmarking Working Group are utilised in this chapter to identify better performing knee prosthesis combinations.

Applying the recommendations of the ISAR International Prosthesis Benchmarking Working Group, using the new benchmark of 4.6% at 10 years, then 8 (21.6%) knee prosthesis combinations qualify for the superiority benchmark. These are highlighted in green in Table BM2.

To assess non-inferiority, the permitted upper confidence interval level is 20% above the new benchmark standard which is 5.5% or less. An additional 9 knee prosthesis combinations can be benchmarked, i.e., 17 (45.9%) prosthesis combinations would receive either a superiority or a non-inferiority benchmark. The additional 9 devices with a non-inferiority benchmark are highlighted in blue (Table BM2).

It is important to emphasise that there are many reasons why a prosthesis combination may not achieve a benchmark standard. These include being used in small numbers, patella resurfacing rates, higher revision rates due to factors other than the prostheses used, as well as less satisfactory performance. However, those prosthesis combinations that have achieved a benchmark standard have done so because they have revision rates that are comparatively lower.

Table BM2 Cumulative Percent Revision of Primary Total Knee Replacement Prosthesis Combinations with 10 Year Data (Primary Diagnosis OA)

Femoral Component	Tibial Component	N Revised	N Total	Type of Revision: TKR	Femoral	Tibial	Other	2 Yrs	5 Yrs	10 Yrs
ACS	ACS Fixed	157	3654	41	10	21	85	2.8 (2.3, 3.4)	4.3 (3.6, 5.0)	5.3 (4.5, 6.3)
ACS	ACS Mobile	103	2157	36	9	4	54	3.1 (2.4, 3.9)	4.8 (3.9, 5.9)	6.1 (5.0, 7.5)
Active Knee	Active Knee	897	10825	269	29	43	556	2.4 (2.1, 2.7)	4.6 (4.2, 5.0)	7.9 (7.3, 8.5)
Apex Knee CR	Apex Knee	219	12702	47	19	12	141	1.3 (1.1, 1.5)	2.1 (1.8, 2.5)	2.8 (2.3, 3.4)
Apex Knee PS	Apex Knee	192	6839	75	7	11	99	1.7 (1.4, 2.0)	3.1 (2.7, 3.6)	5.7 (4.5, 7.3)
Attune CR	Attune	698	32013	172	36	45	445	1.6 (1.5, 1.8)	2.8 (2.6, 3.0)	3.6 (3.3, 4.0)
Attune PS	Attune	343	15350	107	19	43	174	1.6 (1.4, 1.8)	2.6 (2.3, 2.9)	5.9 (4.2, 8.2)
BalanSys	BalanSys	141	4746	48	7	9	77	1.4 (1.1, 1.8)	2.5 (2.0, 3.0)	3.9 (3.3, 4.7)
Columbus	Columbus	225	7336	60	9	10	146	1.9 (1.6, 2.3)	3.7 (3.2, 4.4)	6.3 (5.2, 7.5)
E.Motion	E.Motion	74	1020	20	9	4	41	4.4 (3.3, 5.9)	6.6 (5.2, 8.4)	8.2 (6.6, 10.3)
Evolution	Evolution	332	12504	79	3	15	235	1.7 (1.4, 1.9)	2.9 (2.6, 3.3)	4.2 (3.6, 5.0)
GMK Primary	GMK Primary	132	3615	37	3	16	76	2.5 (2.0, 3.1)	3.8 (3.1, 4.5)	5.1 (4.2, 6.1)
GMK Sphere Primary	GMK Primary	514	21590	108	14	30	362	2.1 (1.9, 2.3)	3.2 (2.9, 3.5)	4.2 (3.6, 4.8)
Genesis II CR	Genesis II	1264	26274	269	78	57	860	2.0 (1.8, 2.2)	3.5 (3.2, 3.7)	5.0 (4.7, 5.3)
Genesis II Oxinium CR (ctd)	Genesis II	633	11066	123	35	27	448	1.9 (1.6, 2.2)	3.5 (3.1, 3.8)	5.9 (5.4, 6.4)
Genesis II Oxinium PS (ctd)	Genesis II	1495	22342	222	37	175	1061	2.8 (2.5, 3.0)	4.9 (4.6, 5.2)	7.2 (6.8, 7.6)
Genesis II PS	Genesis II	981	20811	180	33	62	706	2.0 (1.8, 2.2)	3.6 (3.3, 3.8)	5.0 (4.7, 5.3)
LCS CR	LCS	635	8345	261	24	90	260	2.5 (2.1, 2.8)	4.5 (4.0, 5.0)	6.4 (5.9, 7.0)
Legion CR	Genesis II	320	9453	63	24	14	219	2.1 (1.8, 2.4)	3.7 (3.3, 4.2)	5.4 (4.7, 6.2)
Legion Oxinium CR	Genesis II	314	11445	77	24	11	202	1.7 (1.5, 2.0)	3.3 (2.9, 3.7)	4.2 (3.7, 4.8)
Legion Oxinium PS	Genesis II	755	18337	113	21	64	557	2.2 (2.0, 2.4)	3.8 (3.6, 4.2)	5.4 (5.0, 5.9)
Legion PS	Genesis II	215	6262	55	4	8	148	2.0 (1.7, 2.4)	3.1 (2.6, 3.5)	4.1 (3.5, 4.7)
MRK	MRK	33	844	9	1	0	23	2.0 (1.2, 3.2)	2.7 (1.8, 4.2)	4.7 (3.2, 6.8)
Natural Knee Flex	Natural Knee II	185	6267	49	8	9	119	1.5 (1.2, 1.8)	2.4 (2.0, 2.8)	3.3 (2.8, 3.8)
Nexgen CR Flex	Nexgen	1731	60432	446	118	137	1030	1.4 (1.3, 1.5)	2.3 (2.2, 2.4)	3.1 (2.9, 3.3)
Nexgen CR Flex	Nexgen TM CR	379	12310	134	23	30	192	1.2 (1.0, 1.4)	2.2 (1.9, 2.5)	3.1 (2.8, 3.5)
Nexgen LCCK	Nexgen	56	976	9	3	1	43	3.0 (2.1, 4.3)	4.7 (3.5, 6.3)	6.2 (4.7, 8.3)
Nexgen LPS Flex	Nexgen	1473	31639	410	63	212	788	1.9 (1.7, 2.0)	3.2 (3.0, 3.4)	5.0 (4.8, 5.3)
Nexgen RH	Nexgen	37	752	3	5	4	25	2.9 (1.9, 4.5)	4.8 (3.3, 6.9)	7.9 (5.6, 11.2)
Persona PS	Persona	119	5654	21	8	4	86	1.8 (1.4, 2.2)	2.7 (2.3, 3.3)	2.9 (2.4, 3.6)
SAIPH	SAIPH	102	5998	26	4	0	72	1.0 (0.8, 1.3)	2.1 (1.7, 2.6)	2.9 (2.1, 4.1)
Score	Score	424	6169	174	22	12	216	3.0 (2.6, 3.5)	5.7 (5.2, 6.4)	9.2 (8.3, 10.2)
Trekking	Trekking	72	1274	33	7	3	29	3.0 (2.2, 4.1)	4.7 (3.7, 6.1)	6.3 (5.0, 7.9)
Triathlon CR	Triathlon	3802	164229	708	149	187	2758	1.4 (1.4, 1.5)	2.4 (2.3, 2.5)	3.6 (3.4, 3.7)
Triathlon FS	Triathlon	25	448	7	2	1	15	4.8 (3.1, 7.4)	6.9 (4.6, 10.0)	6.9 (4.6, 10.0)
Triathlon PS	Triathlon	677	14957	128	35	84	430	2.3 (2.1, 2.6)	3.8 (3.5, 4.1)	5.4 (5.0, 5.9)
Vanguard CR	Vanguard	1157	27179	278	44	72	763	1.7 (1.6, 1.9)	2.9 (2.7, 3.1)	4.7 (4.4, 5.0)
TOTAL		20911	607814	4897	946	1527	13541			

Note: Only prostheses with >350 procedures have been listed.
CR 'cruciate retaining' refers to minimally stabilised.
Green: prosthesis combination qualifies for a superiority benchmark.
Blue: prosthesis combination qualifies for non-inferiority benchmark.
Restricted to modern prostheses

Ten, Fifteen and Twenty Year Prosthesis Outcomes

SHOULDER REPLACEMENT

The Registry is reporting 10 year outcomes for primary total shoulder replacements. Individual humeral and glenoid prosthesis combinations are reported. A combination is included if >50 procedures have been reported to the Registry and the follow-up is ≥10 years.

As with hips and knees, to ensure that the data reflects contemporary practice only procedures using modern prostheses are included in the analyses. This approach has been applied both to the calculation of the benchmark standard used to identify superior and non-inferior performance and the selection of prosthesis combinations reported. In addition, the Registry has excluded prostheses where a single surgeon performed more than 50% of procedures.

Detailed information on prostheses that are no longer used is available in the supplementary report 'Comparative Prosthesis Performance' on the AOANJRR website: https://aoanjrr.sahmri.com/annual-reports-2024

Total Stemmed Anatomic Shoulder Replacement
There are 4 total stemmed anatomic shoulder replacement combinations with a primary diagnosis of osteoarthritis with 10 year outcomes. These prosthesis combinations were used in 52% of all primary total stemmed anatomic shoulder replacement procedures performed for osteoarthritis.

The 10 year cumulative percent revision ranges from 6.3% to 20.2%. The cumulative percent revision benchmark at 10 years, calculated this year is based on the aggregate performance of modern prostheses where cemented polyethylene glenoid components are used for a primary diagnosis of osteoarthritis, which is 7.5%.

Using the benchmark of 7.5% at 10 years, then no total stemmed anatomic shoulder prosthesis combinations qualify for the superiority benchmark.

To assess non-inferiority, the permitted upper confidence interval level is 20% above the new benchmark standard which is 9.0% or less. Only 1 total stemmed anatomic shoulder prosthesis combination qualifies for a non-inferiority benchmark (Table BM3).

Primary Total Stemmed Reverse Shoulder Replacement
There are 5 total stemmed reverse shoulder replacement combinations undertaken for all diagnoses with 10 year outcomes.

These prosthesis combinations were used in 64.3% of primary total stemmed reverse shoulder replacement procedures performed for any diagnosis reported to the Registry.

The 10 year cumulative percent revision ranges from 4.1% to 6.8%. The cumulative percent revision benchmark at 10 years, calculated this year based on the aggregate performance of modern prostheses with cementless fixation is 5.5%.

Applying a benchmark of 5.5% at 10 years then no total stemmed reverse shoulder prosthesis combinations qualify for the superiority benchmark.

To assess non-inferiority, the permitted upper confidence interval level is 20% above the new benchmark standard which is 6.6% or less. Two total stemmed reverse shoulder prosthesis combinations qualify for a non-inferiority benchmark (Table BM4).

It is important to emphasise that there are many reasons why a prosthesis combination may not achieve a benchmark standard. These include being used in small numbers, higher revision rates due to factors other than the prostheses used, as well as less satisfactory performance. However, it is clear that those prosthesis combinations that have achieved a benchmark standard have done so because they have revision rates that are comparatively lower.

Table BM3 Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement Combinations with 10 Year Data (Primary Diagnosis OA)

Humeral Component	Glenoid Component	N Revised	N Total	Type of Revision: TSR	Type of Revision: Humeral	Type of Revision: Glenoid	Type of Revision: Other	2 Yrs	5 Yrs	10 Yrs
Affinis	Affinis	20	188	6	1	7	6	1.1 (0.3, 4.3)	5.1 (2.7, 9.6)	9.0 (5.5, 14.5)
Comprehensive	Comprehensive	49	873	35	4	1	9	4.8 (3.5, 6.4)	5.5 (4.2, 7.4)	7.6 (5.4, 10.7)
SMR	SMR	31	502	24	1	1	5	4.3 (2.8, 6.5)	5.2 (3.5, 7.6)	6.3 (4.4, 9.0)
SMR	SMR L1	409	2273	10	381	1	17	8.8 (7.7, 10.1)	13.2 (11.9, 14.8)	20.2 (18.3, 22.2)
TOTAL		509	3836	75	387	10	37			

Note: Only prostheses with >50 procedures have been listed.
Green: prosthesis combination qualifies for a superiority benchmark.
Blue: prosthesis combination qualifies for non-inferiority benchmark.
Restricted to modern prostheses

Table BM4 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement Combinations with 10 Year Data (All Diagnoses)

Humeral Component	Glenoid Component	N Revised	N Total	Type of Revision				2 Yrs	5 Yrs	10 Yrs
				TSR	Humeral	Glenoid	Other			
Aequalis	Aequalis	205	4343	13	37	16	139	2.9 (2.4, 3.4)	4.5 (3.9, 5.3)	6.8 (5.8, 7.9)
Comprehensive	Comprehensive Reverse	118	6595	39	54	3	22	1.7 (1.4, 2.1)	2.6 (2.1, 3.1)	4.1 (2.2, 7.4)
Delta Xtend	Delta Xtend	453	11512	23	68	28	334	2.8 (2.5, 3.1)	3.7 (3.4, 4.1)	5.1 (4.6, 5.7)
SMR	SMR L1	458	10939	32	100	33	293	3.6 (3.3, 4.0)	4.3 (3.9, 4.7)	5.4 (4.8, 6.0)
Trabecular Metal	Trabecular Metal	95	1916	2	8	32	53	3.5 (2.8, 4.5)	5.0 (4.1, 6.2)	5.9 (4.7, 7.3)
TOTAL		1329	35305	109	267	112	841			

Note: Only prostheses with >50 procedures have been listed.
Green: prosthesis combination qualifies for a superiority benchmark.
Blue: prosthesis combination qualifies for non-inferiority benchmark.
Restricted to modern prostheses
The SMR/SMR L1 has a HTARR in the first 3 months only, no difference from 3 months to 2 years, and a lower rate of revision from 2 years onwards after the primary procedure

Fifteen Year Outcomes

This year, the Registry is reporting 15 year outcomes for 26 hip and 19 knee prosthesis combinations. A combination is included if >350 procedures have been reported to the Registry, and the follow-up period is 15 or more years.

Detailed information on prostheses that are no longer used is available in the supplementary report 'Comparative Prosthesis Performance' on the AOANJRR website: https://aoanjrr.sahmri.com/annual-reports-2024

HIP REPLACEMENT

The 26 listed prosthesis combinations were used in 55.6% of all primary total conventional hip replacement procedures performed for osteoarthritis.

The 15 year cumulative percent revision ranges from 4.4% to 17.8%. The benchmark used to assess superiority and non-inferiority performance at 15 years was calculated based on modern prostheses. The 15 year benchmark is 6.1%. There are 7 (26.9%) hip prosthesis combinations that qualify for a superiority benchmark and these are highlighted in green (Table BM5).

An additional 5 prosthesis combinations qualify for a non-inferiority benchmark, i.e., 12 (46.2%) qualify for either a superiority or non-inferiority benchmark. Those prosthesis combinations that qualify for a non-inferiority benchmark are highlighted in blue (Table BM5).

KNEE REPLACEMENT

The listed 19 prosthesis combinations were used in 68.4% of all primary total knee replacement procedures performed for osteoarthritis.

The 15 year cumulative percent revision ranges from 4.0% to 11.4%. The benchmark used to assess superiority and non-inferiority at 15 years is 6.1%. There are 4 (21.1%) knee prosthesis combinations that qualify for a superiority benchmark and these are highlighted in green (Table BM6).

There are an additional 5 prosthesis combinations that qualify for a non-inferiority benchmark, i.e., 9 (47.4%) qualify for either a superiority or non-inferiority benchmark. Those prostheses that qualify for a non-inferiority benchmark are highlighted in blue (Table BM6).

Ten, Fifteen and Twenty Year Prosthesis Outcomes

Table BM5 Cumulative Percent Revision of Primary Total Conventional Hip Replacement Prosthesis Combinations with 15 Year Data (Primary Diagnosis OA)

Femoral Component	Acetabular Component	N Revised	N Total	Type of Revision: THR	Type of Revision: Femoral	Type of Revision: Acetabular	Type of Revision: Other	5 Yrs	10 Yrs	15 Yrs
Alloclassic	Allofit	159	3372	16	87	19	37	2.6 (2.1, 3.2)	4.3 (3.6, 5.1)	6.0 (5.1, 7.0)
Anthology	R3	267	8072	27	75	53	112	2.8 (2.5, 3.2)	3.7 (3.3, 4.2)	4.5 (3.8, 5.4)
C-Stem AMT	PINNACLE	147	5096	14	61	15	57	2.7 (2.3, 3.3)	4.4 (3.6, 5.4)	7.6 (4.7, 12.2)
CORAIL	PINNACLE	2294	60141	208	873	343	870	3.0 (2.8, 3.1)	4.6 (4.4, 4.8)	7.3 (6.9, 7.9)
CPCS	R3	247	7512	25	74	48	100	3.1 (2.7, 3.6)	4.4 (3.8, 5.1)	5.3 (4.4, 6.3)
CPCS	Reflection (Cup)	86	851	27	5	41	13	2.9 (1.9, 4.3)	8.0 (6.0, 10.6)	17.8 (14.2, 22.2)
CPCS	Reflection (Shell)	110	2812	14	48	14	34	1.6 (1.2, 2.2)	3.2 (2.6, 4.0)	5.5 (4.5, 6.8)
CPT	Allofit	57	1733	7	27	5	18	3.0 (2.2, 4.1)	4.6 (3.5, 6.0)	5.2 (3.9, 6.9)
CPT	Trabecular Metal (Shell)	115	2089	11	49	18	37	4.0 (3.2, 5.0)	6.5 (5.3, 7.9)	9.1 (7.2, 11.4)
CPT	Trilogy	416	7872	47	162	42	165	3.5 (3.1, 4.0)	5.4 (4.9, 6.0)	7.0 (6.3, 7.7)
CPT	ZCA	41	867	14	10	10	7	2.4 (1.6, 3.7)	4.6 (3.2, 6.4)	6.3 (4.4, 8.8)
Exeter V40	Contemporary	312	4609	85	48	145	34	3.2 (2.7, 3.8)	5.5 (4.8, 6.3)	8.8 (7.8, 10.0)
Exeter V40	Exeter	137	1538	32	17	66	22	2.9 (2.1, 3.9)	4.6 (3.6, 5.9)	10.0 (8.2, 12.0)
Exeter V40	Exeter Contemporary	173	2970	58	35	57	23	3.0 (2.4, 3.7)	4.6 (3.8, 5.4)	7.6 (6.5, 9.0)
Exeter V40	Trabecular Metal (Shell)	21	485	2	3	2	14	3.8 (2.4, 6.0)	4.8 (3.1, 7.5)	5.3 (3.4, 8.1)
Exeter V40	Trident (Shell)	2334	78525	316	757	290	971	2.3 (2.2, 2.4)	3.5 (3.4, 3.7)	5.0 (4.8, 5.3)
MS 30	Fitmore	17	613	0	2	8	7	2.6 (1.5, 4.5)	3.5 (2.1, 5.8)	4.6 (2.5, 8.4)
S-Rom	PINNACLE	158	2636	15	89	15	39	4.4 (3.7, 5.3)	5.7 (4.8, 6.7)	7.0 (6.0, 8.3)
SL-Plus	EP-Fit Plus	48	1123	3	20	9	16	2.9 (2.1, 4.1)	4.1 (3.1, 5.5)	4.6 (3.5, 6.1)
SL-Plus	R3	102	1687	6	27	24	45	4.2 (3.4, 5.3)	6.0 (4.9, 7.4)	7.6 (6.2, 9.4)
Secur-Fit	Trident (Shell)	519	9845	38	228	94	159	3.6 (3.2, 4.0)	4.8 (4.4, 5.3)	6.3 (5.8, 7.0)
Secur-Fit Plus	Trident (Shell)	243	6014	18	67	59	99	2.3 (2.0, 2.8)	3.4 (2.9, 3.9)	4.4 (3.9, 5.1)
Spectron EF	Reflection (Cup)	127	1405	49	12	57	9	2.9 (2.1, 4.0)	7.2 (5.8, 8.9)	13.0 (10.8, 15.5)
Summit	PINNACLE	194	5709	15	45	32	102	2.3 (2.0, 2.8)	3.5 (3.0, 4.1)	5.1 (4.3, 6.1)
Synergy	R3	181	5239	6	51	45	79	2.7 (2.3, 3.2)	3.5 (3.0, 4.1)	5.0 (4.1, 6.0)
Synergy	Reflection (Shell)	403	7312	34	85	133	151	2.6 (2.2, 2.9)	3.8 (3.4, 4.3)	5.5 (4.9, 6.1)
TOTAL		8908	230127	1087	2957	1644	3220			

Note: Only prostheses with >350 procedures have been listed.
Green: prosthesis combination qualifies for a superiority benchmark.
Blue: prosthesis combination qualifies for non-inferiority benchmark.
Restricted to modern prostheses

Table BM6 Cumulative Percent Revision of Primary Total Knee Replacement Prosthesis Combinations with 15 Year Data (Primary Diagnosis OA)

Femoral Component	Tibial Component	N Revised	N Total	Type of Revision: TKR	Type of Revision: Femoral	Type of Revision: Tibial	Type of Revision: Other	5 Yrs	10 Yrs	15 Yrs
Active Knee	Active Knee	897	10825	269	29	43	556	4.6 (4.2, 5.0)	7.9 (7.3, 8.5)	11.4 (10.6, 12.2)
BalanSys	BalanSys	141	4746	48	7	9	77	2.5 (2.0, 3.0)	3.9 (3.3, 4.7)	5.5 (4.0, 7.6)
Columbus	Columbus	225	7336	60	9	10	146	3.7 (3.2, 4.4)	6.3 (5.2, 7.5)	8.8 (7.0, 11.1)
Genesis II CR	Genesis II	1264	26274	269	78	57	860	3.5 (3.2, 3.7)	5.0 (4.7, 5.3)	6.1 (5.8, 6.5)
Genesis II Oxinium CR (ctd)	Genesis II	633	11066	123	35	27	448	3.5 (3.1, 3.8)	5.9 (5.4, 6.4)	8.3 (7.7, 9.1)
Genesis II Oxinium PS (ctd)	Genesis II	1495	22342	222	37	175	1061	4.9 (4.6, 5.2)	7.2 (6.8, 7.6)	9.4 (8.9, 10.0)
Genesis II PS	Genesis II	981	20811	180	33	62	706	3.6 (3.3, 3.8)	5.0 (4.7, 5.3)	6.4 (5.9, 6.9)
LCS CR	LCS	635	8345	261	24	90	260	4.5 (4.0, 5.0)	6.4 (5.9, 7.0)	8.1 (7.5, 8.8)
Legion Oxinium CR	Genesis II	314	11445	77	24	11	202	3.3 (2.9, 3.7)	4.2 (3.7, 4.8)	5.8 (4.5, 7.3)
Legion Oxinium PS	Genesis II	755	18337	113	21	64	557	3.8 (3.6, 4.2)	5.4 (5.0, 5.9)	7.9 (6.6, 9.4)
Natural Knee Flex	Natural Knee II	185	6267	49	8	9	119	2.4 (2.0, 2.8)	3.3 (2.8, 3.8)	4.4 (3.6, 5.4)
Nexgen CR Flex	Nexgen	1731	60432	446	118	137	1030	2.3 (2.2, 2.4)	3.1 (2.9, 3.3)	4.0 (3.7, 4.2)
Nexgen CR Flex	Nexgen TM CR	379	12310	134	23	30	192	2.2 (1.9, 2.5)	3.1 (2.8, 3.5)	4.1 (3.7, 4.6)
Nexgen LCCK	Nexgen	56	976	9	3	1	43	4.7 (3.5, 6.3)	6.2 (4.7, 8.3)	10.4 (7.1, 15.2)
Nexgen LPS Flex	Nexgen	1473	31639	410	63	212	788	3.2 (3.0, 3.4)	5.0 (4.8, 5.3)	6.6 (6.2, 7.0)
Score	Score	424	6169	174	22	12	216	5.7 (5.2, 6.4)	9.2 (8.3, 10.2)	10.8 (9.6, 12.2)
Triathlon CR	Triathlon	3802	164229	708	149	187	2758	2.4 (2.3, 2.5)	3.6 (3.4, 3.7)	4.8 (4.6, 5.1)
Triathlon PS	Triathlon	677	14957	128	35	84	430	3.8 (3.5, 4.1)	5.4 (5.0, 5.9)	6.8 (6.2, 7.5)
Vanguard CR	Vanguard	1157	27179	278	44	72	763	2.9 (2.7, 3.1)	4.7 (4.4, 5.0)	6.8 (6.3, 7.4)
TOTAL		17224	465685	3958	762	1292	11212			

Note: Only prostheses with >350 procedures have been listed.
Green: prosthesis combination qualifies for a superiority benchmark.
Blue: prosthesis combination qualifies for non-inferiority benchmark.
Restricted to modern prostheses

Ten, Fifteen and Twenty Year Prosthesis Outcomes

Twenty Year Outcomes

The Registry is able to report 20 year outcomes for 12 hip and 6 knee prosthesis combinations. A combination is included if >350 procedures have been reported to the Registry, the follow-up period is ≥20 years, and the prosthesis is still used with the exception of those eligible prostheses where a single surgeon performed more than 50% of procedures.

Detailed information on prostheses that are no longer used is available in the supplementary report 'Comparative Prosthesis Performance' on the AOANJRR website: https://aoanjrr.sahmri.com/annual-reports-2024

HIP REPLACEMENT

The 12 listed prosthesis combinations have been used in 30.7% of all primary total conventional hip replacement procedures performed for osteoarthritis. The 20 year cumulative percent revision ranges from 5.4% to 16.3% (Table BM7).

KNEE REPLACEMENT

The 6 listed prosthesis combinations were used in 14.6% of all primary total knee replacement procedures performed for osteoarthritis. The 20 year cumulative percent revision ranges from 7.3% to 14.0% (Table BM8).

Table BM7 Cumulative Percent Revision of Primary Total Conventional Hip Replacement Prosthesis Combinations with 20 Year Data (Primary Diagnosis OA)

Femoral Component	Acetabular Component	N Revised	N Total	Type of Revision: THR	Femoral	Acetabular	Other	10 Yrs	15 Yrs	20 Yrs
Alloclassic	Allofit	159	3372	16	87	19	37	4.3 (3.6, 5.1)	6.0 (5.1, 7.0)	7.2 (5.9, 8.9)
CPCS	Reflection (Shell)	110	2812	14	48	14	34	3.2 (2.6, 4.0)	5.5 (4.5, 6.8)	8.4 (6.4, 11.0)
CPT	Trilogy	416	7872	47	162	42	165	5.4 (4.9, 6.0)	7.0 (6.3, 7.7)	8.2 (7.1, 9.4)
CPT	ZCA	41	867	14	10	10	7	4.6 (3.2, 6.4)	6.3 (4.4, 8.8)	9.0 (6.2, 13.1)
Exeter V40	Contemporary	312	4609	85	48	145	34	5.5 (4.8, 6.3)	8.8 (7.8, 10.0)	13.8 (11.9, 16.0)
Exeter V40	Exeter	137	1538	32	17	66	22	4.6 (3.6, 5.9)	10.0 (8.2, 12.0)	15.9 (13.2, 19.1)
Exeter V40	Exeter Contemporary	173	2970	58	35	57	23	4.6 (3.8, 5.4)	7.6 (6.5, 9.0)	11.3 (8.9, 14.4)
Exeter V40	Trident (Shell)	2334	78525	316	757	290	971	3.5 (3.4, 3.7)	5.0 (4.8, 5.3)	6.5 (6.0, 7.0)
Secur-Fit	Trident (Shell)	519	9845	38	228	94	159	4.8 (4.4, 5.3)	6.3 (5.8, 7.0)	7.8 (7.0, 8.8)
Secur-Fit Plus	Trident (Shell)	243	6014	18	67	59	99	3.4 (2.9, 3.9)	4.4 (3.9, 5.1)	5.4 (4.7, 6.2)
Spectron EF	Reflection (Cup)	127	1405	49	12	57	9	7.2 (5.8, 8.9)	13.0 (10.8, 15.5)	16.3 (13.2, 20.0)
Synergy	Reflection (Shell)	403	7312	34	85	133	151	3.8 (3.4, 4.3)	5.5 (4.9, 6.1)	7.5 (6.8, 8.4)
TOTAL		4974	127141	721	1556	986	1711			

Note: Restricted to modern prostheses

Table BM8 Cumulative Percent Revision of Primary Total Knee Replacement Combinations with 20 Year Data (Primary Diagnosis OA)

Femoral Component	Tibial Component	N Revised	N Total	Type of Revision: TKR	Femoral	Tibial	Other	10 Yrs	15 Yrs	20 Yrs
Active Knee	Active Knee	897	10825	269	29	43	556	7.9 (7.3, 8.5)	11.4 (10.6, 12.2)	14.0 (12.9, 15.1)
Genesis II CR	Genesis II	1264	26274	269	78	57	860	5.0 (4.7, 5.3)	6.1 (5.8, 6.5)	7.5 (6.9, 8.1)
Genesis II Oxinium CR (ctd)	Genesis II	633	11066	123	35	27	448	5.9 (5.4, 6.4)	8.3 (7.7, 9.1)	10.4 (9.4, 11.5)
Genesis II Oxinium PS (ctd)	Genesis II	1495	22342	222	37	175	1061	7.2 (6.8, 7.6)	9.4 (8.9, 10.0)	12.1 (10.2, 14.3)
Genesis II PS	Genesis II	981	20811	180	33	62	706	5.0 (4.7, 5.3)	6.4 (5.9, 6.9)	7.3 (6.7, 8.0)
LCS CR	LCS	635	8345	261	24	90	260	6.4 (5.9, 7.0)	8.1 (7.5, 8.8)	9.3 (8.6, 10.0)
TOTAL		5905	99663	1324	236	454	3891			

Note: Restricted to modern prostheses. CR 'cruciate retaining' refers to minimally stabilised

Practice Variation

Arthroplasty Practice Variation in Australia

Introduction

The exchange of knowledge in all fields is vital to attain improvements. Surgeons often discuss their arthroplasty experiences under the assumption that their practice is readily translatable and equivalent to that of another surgeon, and therefore the challenges and successes of surgery are homogenous. This chapter challenges that notion and explores how arthroplasty practice varies throughout Australia. Variation in practice offers a valuable learning opportunity.

Variation can be due to differences between patients, between the surgeons treating them, and between the hospitals in which treatment occurs. Decisions about treatment are based on the surgeon's knowledge, experience and interpretation of the available evidence. What is appropriate for one individual may not be for another. Resources, including available equipment and workforce, can also influence what is offered and subsequently performed. There is no attempt to judge these differences, nor assess "best practices" as these are very difficult to determine. We simply attempt to describe some of the differences in current arthroplasty practice in Australia. Understanding the significance of these practice variations will require further research.

This chapter begins by describing variation in hip replacement practice. Differences in patient characteristics are described, then surgeon factors, prosthesis and technique factors and finally service and hospital factors. The format is then repeated to describe knee replacement practice variation.

Characteristics of patients and procedures for hip and knee replacement are compared, firstly divided by state/territory and later comparing metropolitan and rural practice. Many factors are assessed using procedure numbers and others by proportions. It is evident that states with larger populations (New South Wales [NSW], Victoria [VIC] and Queensland [QLD]) generally show smaller percentage changes by year. Data from the states or territories with smaller populations (Tasmania [TAS], Northern Territory [NT] and the Australian Capital Territory [ACT]) can show greater percentage change from year to year.

Practice Variation in Hip Replacement Classes

Primary total conventional hip replacement undertaken for any diagnosis currently forms 82.0% of all primary hip replacement procedures nationally. Unipolar modular and bipolar hip replacements contribute 7.1% and 4.9%, respectively (Table N1 and Figure N1).

Similar usage per class is seen across the individual states. TAS has a higher usage of total conventional hip replacement with a lower usage of bipolar and unipolar modular prostheses compared to other states. Resurfacing total hip replacement continues at low numbers in all states. In TAS, no resurfacing procedures have been recorded since 2013 and in NT resurfacing procedures were recorded in 2012 only (Table N1 and Figure N2).

Figure N1 Primary Hip Replacement in Australia by Class (All Diagnoses)

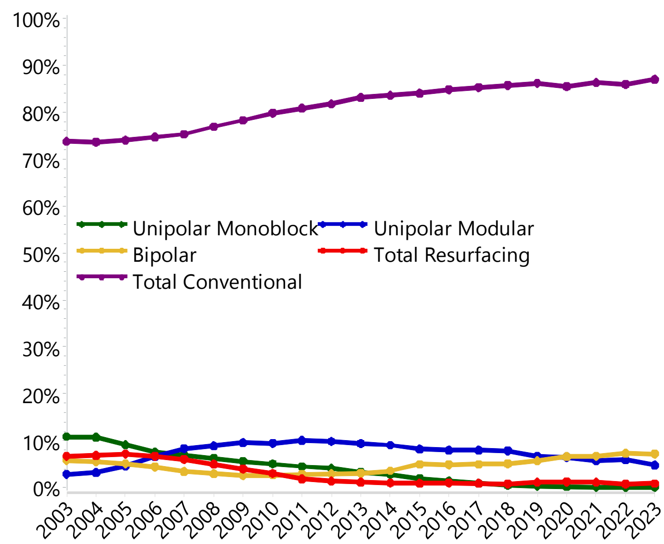
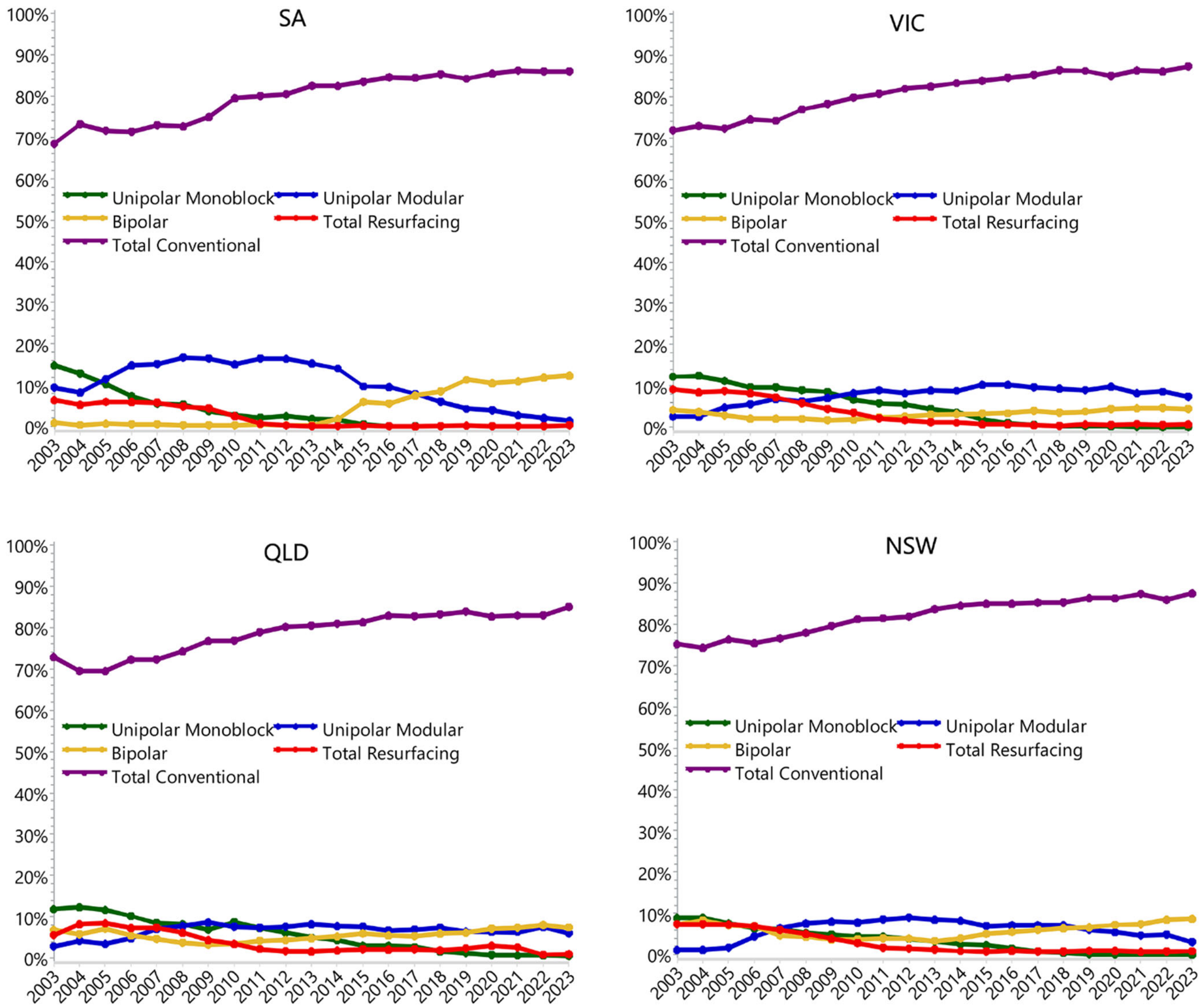
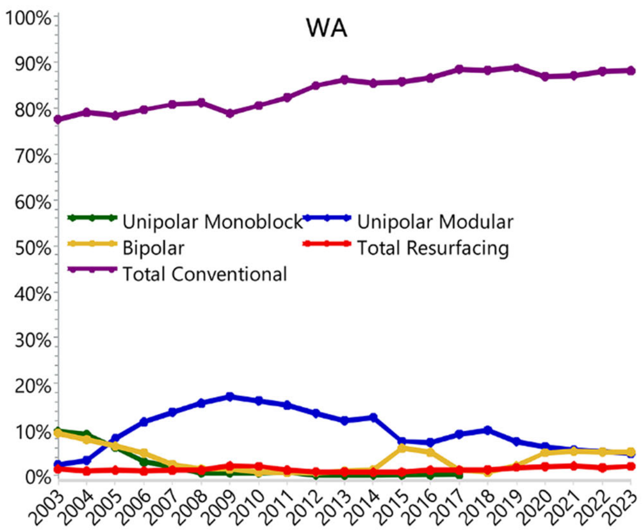


Table N1 Primary Hip Replacement by State/Territory and Class (All Diagnoses)

State	Unipolar Monoblock		Unipolar Modular		Bipolar		Total Resurfacing		Total Conventional		TOTAL	
	N	Row%	N	Row%	N	Row%	N	Row%	N	Row%	N	Row%
SA	2983	3.9	7005	9.1	3922	5.1	1443	1.9	61880	80.1	77233	100.0
QLD	6823	4.8	9450	6.6	8258	5.8	4329	3.0	113454	79.7	142314	100.0
VIC	9724	4.5	16586	7.6	7353	3.4	6333	2.9	176867	81.6	216863	100.0
NSW	7251	3.0	14364	5.9	14738	6.0	5949	2.4	202924	82.7	245226	100.0
WA	1454	1.6	7895	8.8	3249	3.6	1320	1.5	75641	84.5	89559	100.0
TAS	747	2.8	1867	6.9	824	3.0	105	0.4	23585	86.9	27128	100.0
NT	37	1.8	288	13.6	260	12.3	1	0.0	1525	72.2	2111	100.0
ACT	314	1.8	242	1.4	1569	8.8	754	4.2	15008	83.9	17887	100.0
TOTAL	29333	3.6	57697	7.1	40173	4.9	20234	2.5	670884	82.0	818321	100.0

Figure N2 Primary Hip Replacement by State/Territory and Class (All Diagnoses)




WA
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Unipolar Monoblock
Unipolar Modular
Bipolar
Total Resurfacing
Total Conventional
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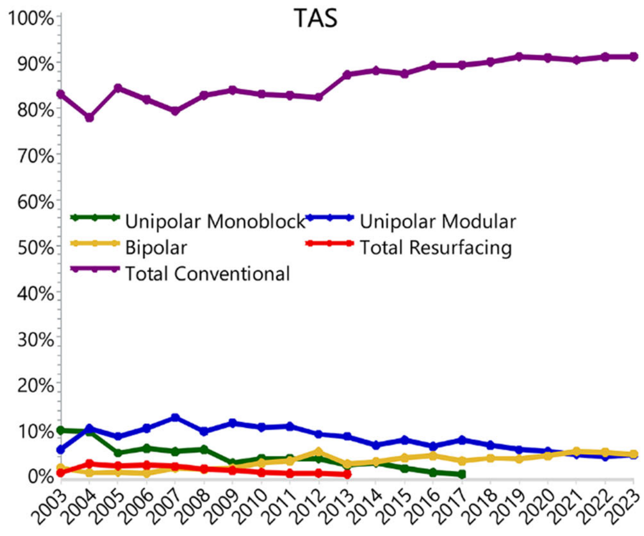
TAS
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Unipolar Monoblock
Unipolar Modular
Bipolar
Total Resurfacing
Total Conventional
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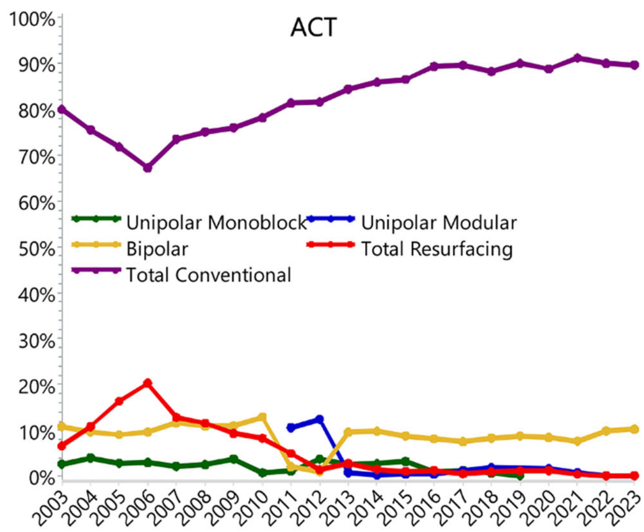
ACT
100%
90%
80%
70%
60%
50%
40%
30%
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10%
0%
Unipolar Monoblock
Unipolar Modular
Bipolar
Total Resurfacing
Total Conventional
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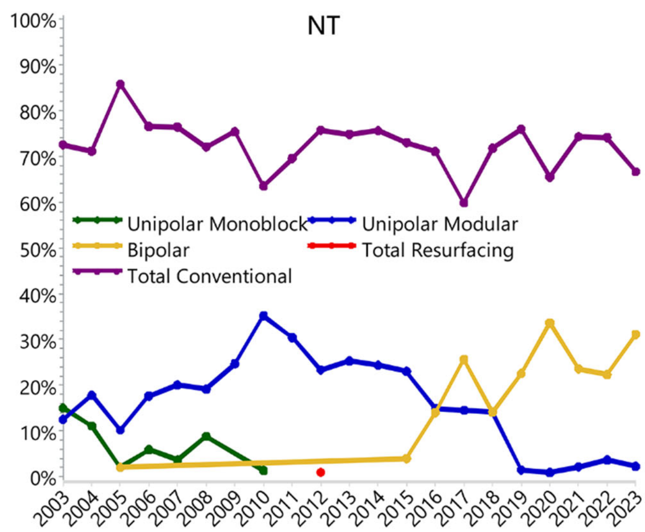
NT
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Unipolar Monoblock
Unipolar Modular
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Total Resurfacing
Total Conventional
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VARIATION IN PATIENT CHARACTERISTICS

Age and Gender

The average age for patients undergoing primary total conventional hip replacement for osteoarthritis is 68 years. NT differs from all other states and territories with patients who are younger and higher percentage of males. The proportion of patients in each age cohort likewise varies very little between other states/territory, and with more females having had hip replacements than males (Table N2).

ASA Score

All states/territories have shown a trend over the last decade for increasing co-morbidity in patients undergoing hip replacement. There are fewer patients with ASA score 1 in all states/territories and there has been a concomitant rise in patients with moderate and severe co-morbidity (an ASA score of 3 or 4).

Nationally, 38.0% of patients have ASA scores of 3 or 4 (Table N3), while in both South Australia (SA) and VIC, over or approaching 40.0% of patients are in these categories. TAS has the lowest percentage (27.5%) of patients with an ASA score of 3 or 4. The national trends over time are displayed in Figure N3.

BMI Category

Since 2015 and throughout the different states, the distribution in BMI category is similar. All states and territories have shown a small decrease in the number of pre-obese and normal weight patients when comparing 2023 to 2015 data. The national trends over time as seen in Figure N4. The proportion in each BMI category by state/territory is displayed in Table N3.

Table N2 Summary of Primary Total Conventional Hip Replacement Patient Characteristics Since 2014 by State/Territory (Primary Diagnosis OA)

Variable	SA	QLD	VIC	NSW	WA	TAS	NT	ACT	TOTAL
Age									
Mean ± SD	68.7 ± 10.4	68 ± 10.5	68 ± 10.8	68.1 ± 10.8	67.8 ± 10.8	67.5 ± 10.3	65.1 ± 9.8	67 ± 11.3	68 ± 10.7
Median (IQR)	69 (62, 76)	69 (61, 75)	69 (61, 76)	69 (61, 76)	69 (61, 75)	68 (61, 75)	65 (59, 72)	68 (60, 75)	69 (61, 76)
Age Group									
<55	2,934 (9.5%)	6,171 (10.5%)	9,916 (11.2%)	11,332 (11%)	4,357 (11.3%)	1,399 (11.3%)	122 (14.3%)	1,165 (14.1%)	37,396 (11%)
55-64	6,949 (22.6%)	14,015 (23.9%)	21,317 (24%)	24,582 (23.9%)	9,477 (24.6%)	3,212 (25.9%)	276 (32.3%)	1,994 (24.1%)	81,822 (24%)
65-74	11,534 (37.4%)	21,872 (37.3%)	31,735 (35.7%)	36,611 (35.6%)	13,797 (35.8%)	4,514 (36.3%)	315 (36.8%)	2,875 (34.8%)	123,253 (36.1%)
≥75	9,385 (30.5%)	16,622 (28.3%)	25,833 (29.1%)	30,358 (29.5%)	10,932 (28.3%)	3,300 (26.6%)	142 (16.6%)	2,231 (27%)	98,803 (29%)
Gender									
Male	13,832 (44.9%)	28,662 (48.8%)	40,126 (45.2%)	48,567 (47.2%)	18,065 (46.8%)	5,657 (45.5%)	452 (52.9%)	3,520 (42.6%)	158,881 (46.6%)
Female	16,970 (55.1%)	30,018 (51.2%)	48,675 (54.8%)	54,316 (52.8%)	20,498 (53.2%)	6,768 (54.5%)	403 (47.1%)	4,745 (57.4%)	182,393 (53.4%)
TOTAL	30,802	58,680	88,801	102,883	38,563	12,425	855	8,265	341,274

Abbreviations: SD - standard deviation, IQR - interquartile range

Table N3 **Summary of ASA Score and BMI Category in Primary Total Conventional Hip Replacement Since 2014 by State/Territory (Primary Diagnosis OA)**

Variable	SA N (%)	QLD N (%)	VIC N (%)	NSW N (%)	WA N (%)	TAS N (%)	NT N (%)	ACT N (%)	TOTAL N (%)
ASA Score[a]									
ASA 1	2,246 (7.3%)	4,329 (7.4%)	7,900 (8.9%)	9,262 (9.1%)	2,957 (7.7%)	757 (6.2%)	75 (8.8%)	733 (8.9%)	28,259 (8.3%)
ASA 2	15,328 (50%)	32,553 (55.8%)	45,393 (51.3%)	53,503 (52.3%)	22,153 (57.7%)	8,129 (66.3%)	519 (61.1%)	4,618 (55.9%)	182,196 (53.7%)
ASA 3	12,772 (41.7%)	20,749 (35.5%)	33,525 (37.9%)	38,019 (37.2%)	12,880 (33.6%)	3,263 (26.6%)	253 (29.8%)	2,861 (34.6%)	124,322 (36.6%)
ASA 4	305 (1%)	751 (1.3%)	1,612 (1.8%)	1,490 (1.5%)	393 (1%)	112 (0.9%)	3 (0.4%)	47 (0.6%)	4,713 (1.4%)
ASA 5	4 (0%)	2 (0%)	4 (0%)	7 (0%)	1 (0%)	1 (0%)			19 (0%)
BMI Category[b]									
Underweight	164 (0.6%)	398 (0.8%)	544 (0.7%)	689 (0.8%)	255 (0.8%)	77 (0.7%)	6 (0.9%)	67 (0.9%)	2,200 (0.7%)
Normal	5,098 (18.4%)	10,461 (20%)	16,363 (20.9%)	18,805 (20.9%)	7,010 (21.4%)	2,421 (21.6%)	129 (18.3%)	1,723 (22.9%)	62,010 (20.6%)
Pre Obese	10,134 (36.5%)	18,954 (36.2%)	28,741 (36.7%)	32,961 (36.7%)	12,184 (37.2%)	4,327 (38.7%)	230 (32.6%)	2,629 (34.9%)	110,160 (36.7%)
Obese Class 1	7,370 (26.6%)	13,906 (26.5%)	19,853 (25.4%)	22,918 (25.5%)	8,432 (25.8%)	2,755 (24.6%)	187 (26.5%)	1,835 (24.4%)	77,256 (25.7%)
Obese Class 2	3,431 (12.4%)	5,970 (11.4%)	8,476 (10.8%)	9,685 (10.8%)	3,439 (10.5%)	1,079 (9.6%)	105 (14.9%)	800 (10.6%)	32,985 (11%)
Obese Class 3	1,534 (5.5%)	2,730 (5.2%)	4,319 (5.5%)	4,872 (5.4%)	1,421 (4.3%)	526 (4.7%)	48 (6.8%)	480 (6.4%)	15,930 (5.3%)
TOTAL	30,802	58,680	88,801	102,883	38,563	12,425	855	8,265	341,274

Abbreviations: ASA - American Society of Anesthesiologists,
BMI - Body Mass Index (kg/m^2): Underweight (<18.50), Normal (18.50-24.99), Pre Obese (25.00-29.99), Obese Class 1 (30.00-34.99), Obese Class 2 (35.00-39.99), Obese Class 3 (≥40.00)
BMI category recorded from 2015
[a]Excludes 1,765 procedures with unknown ASA score
[b]Excludes 40,733 procedures with unknown BMI category

Figure N3 **ASA Score of Primary Total Conventional Hip Replacement (Primary Diagnosis OA)**

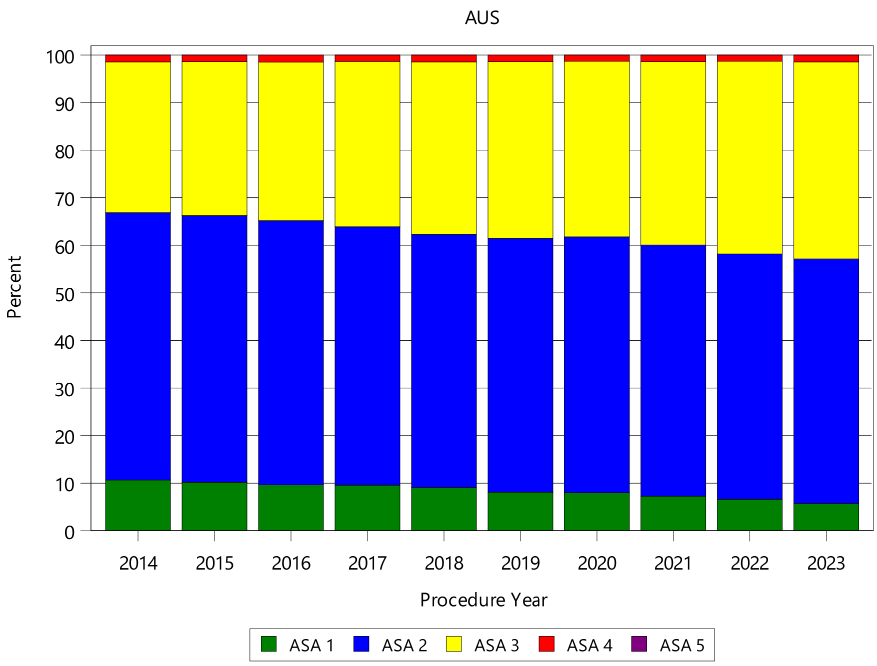
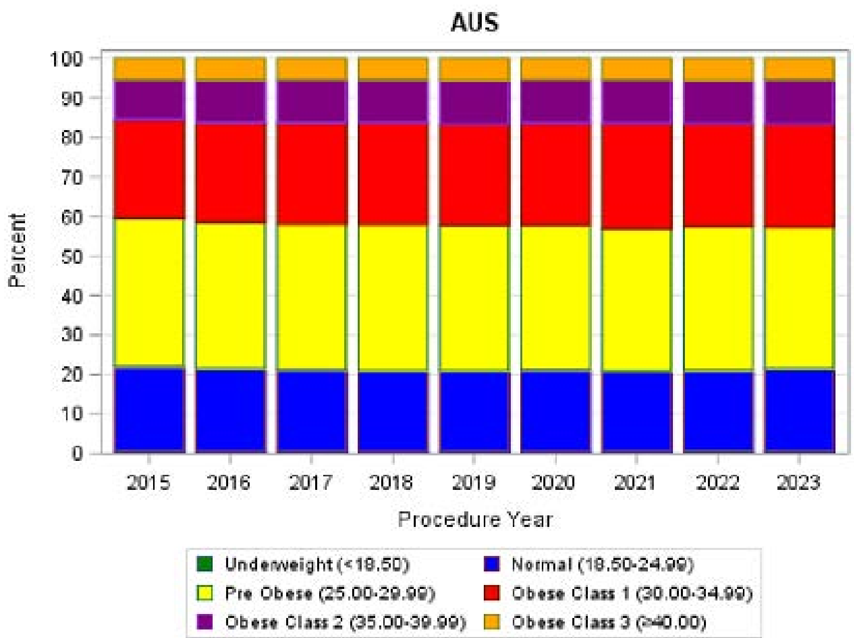


Figure N4 **BMI Category of Primary Total Conventional Hip Replacement** (Primary Diagnosis OA)



VARIATION IN SOCIOECONOMIC DISADVANTAGE

The Index of Relative Socio-economic Advantage and Disadvantage (IRSAD) is created by the Australian Bureau of Statistics as a summary measure of the socioeconomic status for each geographical area.[3] An IRSAD rating of 1 indicates the most socioeconomically disadvantaged region, while a rating of 10 indicates the most advantaged. Each Australian region has differing rates of social advantage and disadvantage.

In 2023, the proportion of patients from regions rated most economically disadvantaged (IRSAD 1 or 2) undergoing primary total conventional hip replacement in TAS is 39.3%. In SA and QLD this is 20.4% and 20.3%, respectively, while in NSW it is 14.6%, NT 11.4%, VIC 11.0%, with WA it is 6.2%, and ACT is 1.2% (Figure N5).

Over the last decade approximately 30.0% of hip replacement patients in Victoria, NSW and WA are from areas rated IRSAD 9 or 10 (the highest deciles). In the ACT, the proportion of the population having hip replacement from areas rated IRSAD 9 or 10 has reduced from 69.1% to 47.1% over the past 10 years. Conversely, in TAS less than 10% of hip replacement patients are within the 9-10 IRSAD decile (Figure N6). We are unable to comment on whether these findings reflect population differences or variations in access to arthroplasty.

Figure N5 **Percentage of Primary Total Conventional Hip Replacement Procedures from regions rated IRSAD 1 and 2 by State/Territory (Primary Diagnosis OA)**

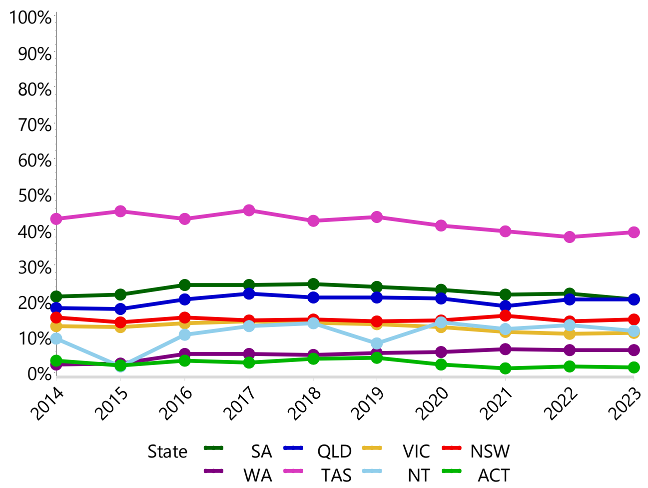
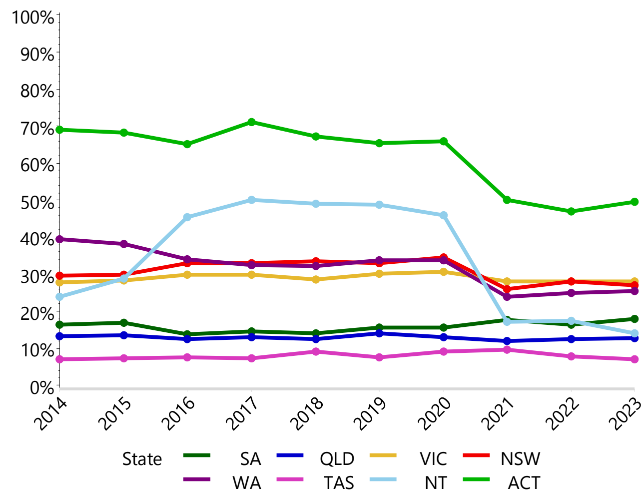


Figure N6 **Percentage of Primary Total Conventional Hip Replacement Procedures from regions rated IRSAD 9 and 10 by State/Territory (Primary Diagnosis OA)**



[3] https://www.abs.gov.au/statistics/people/people-and-communities/socio-economic-indexes-areas-seifa-australia/latest-release.

SURGEON VARIATION

Variation in Surgeon Volume

Over the past decade, the number of surgeons performing total conventional hip replacements has risen across all states and territories. Although the increase in the number of surgeons was much smaller in NT, ACT and TAS (Figure N7).

Although the volume of total conventional hip replacement procedures varies by year, between 30.0% and 50.0% of surgeons in most states perform <20 hip replacement procedures per year (Figure N8). The proportion of surgeons performing over 100 hip replacements per year varies between 5.0% and 25.0% depending on state and year (Figure N9). The percentage of hip replacements that lower volume surgeons (<20 total conventional hip replacements per year) contribute to the total state cohort is typically 10% or less (Figure N10). In 2023, the percentage of hip replacements that higher volume surgeons contribute to the total state cohort ranges from 27.1% in QLD to 62.7% in the ACT (Figure N11).

Variation in Surgeon Experience

In each state there has been a reduction in the proportion of surgeons undertaking total conventional hip replacement with less than 4 years' experience. In the less populous territories, the numbers of surgeons with less than 4 years' experience has remained constant in the ACT and has fluctuated in NT (Figure N12).

Figure N7 Number of Surgeons Performing Primary Total Conventional Hip Replacement by State/Territory (All Diagnoses)

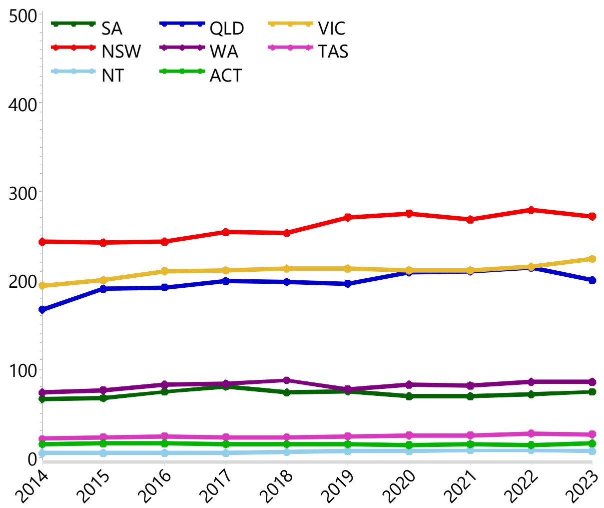


Figure N9 Percentage of Surgeons with ≥100 Primary Total Conventional Hip Replacement Procedures/Year by State/Territory (All Diagnoses)

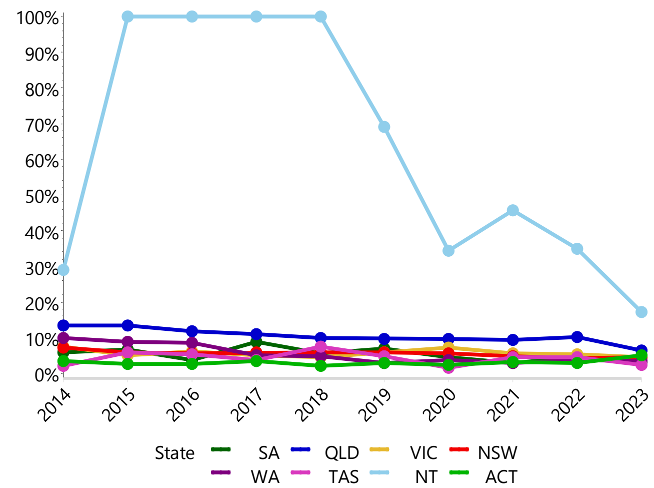


Figure N8 Percentage of Surgeons with <20 Primary Total Conventional Hip Replacement Procedures/Year by State/Territory (All Diagnoses)

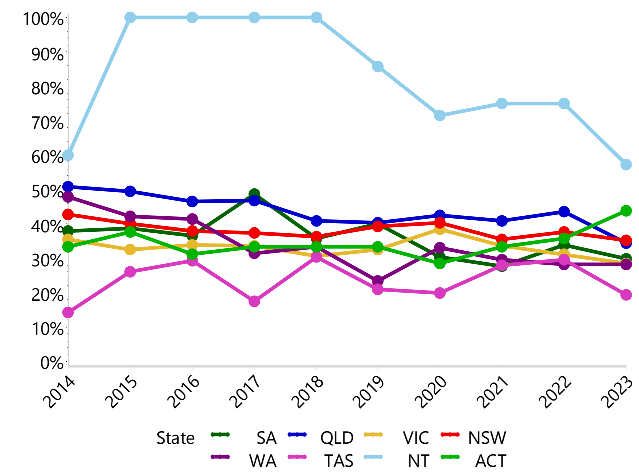


Figure N10 Percentage of Primary Total Conventional Hip Replacements by Surgeons with <20 Procedures/Year by State/Territory (All Diagnoses)

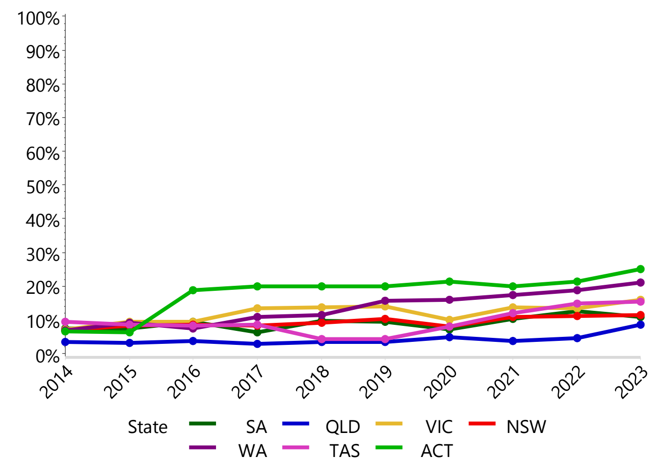


Figure N11 **Percentage of Primary Total Conventional Hip Replacements by Surgeons with ≥100 Procedures/Year by State/Territory (All Diagnoses)**

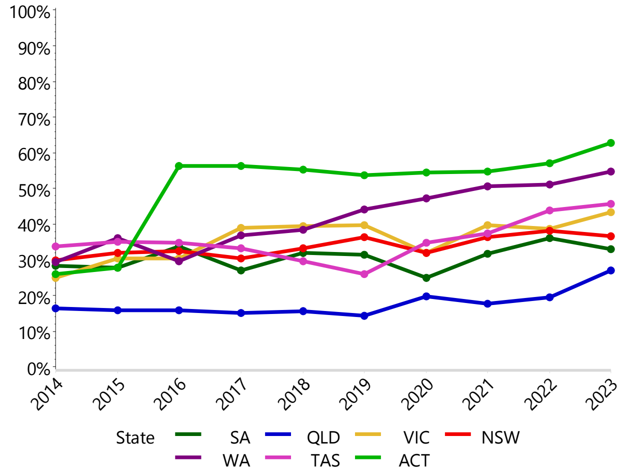
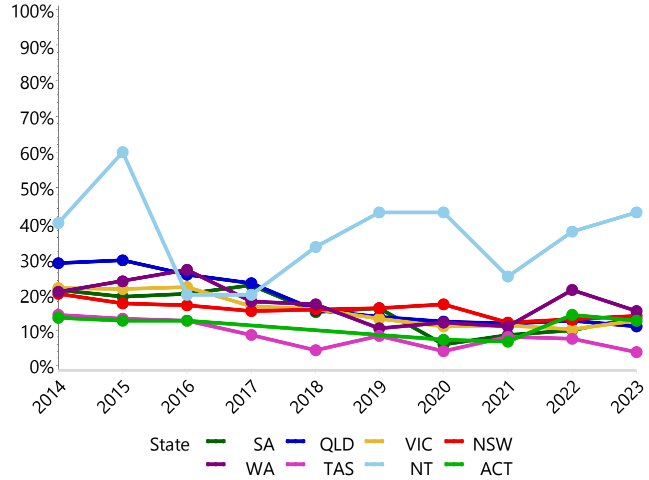


Figure N12 **Percentage of Surgeons with <4 Years Experience in Primary Total Conventional Hip Replacement by State/Territory (All Diagnoses)**



VARIATION IN PROCEDURE NUMBERS AND INCIDENCE

The number of primary total conventional hip replacement procedures has increased nationally for many years with most of this increase due to larger increases in procedure numbers in the three most populous states. Increases in procedure numbers are much less apparent in TAS and the ACT (Figure N13).

Variation in Incidence of Hip Replacement
When the incidence of primary total conventional hip replacement per 100,000 residents is considered, the less populous states and territories have recorded greater increases. For example, TAS has recorded changes of 130/100,000 to 301/100,000 between 2003 and 2023 compared to 82/100,000 and 164/100,000 in NSW over the same time period (Figure N14).

Figure N13 **Primary Total Conventional Hip Replacement in Australia by State/Territory**

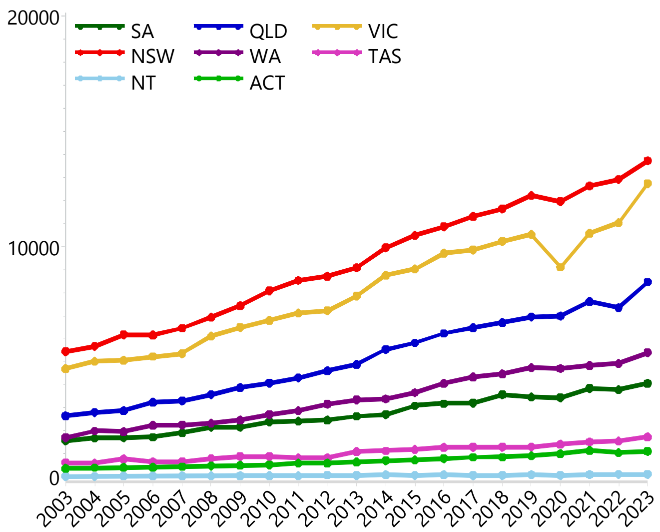
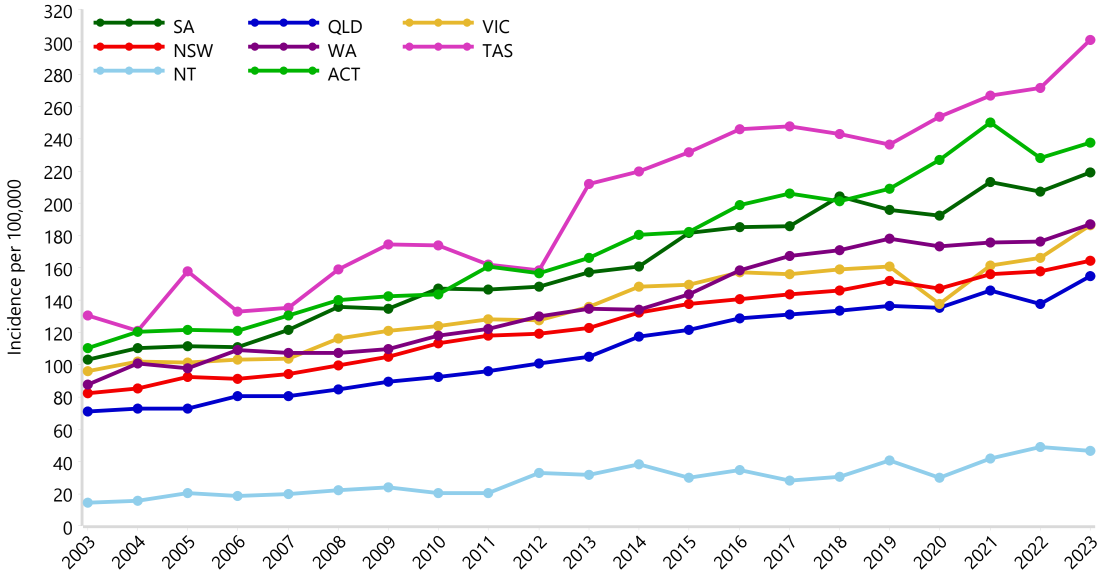


Figure N14 **Incidence of Total Conventional Hip Replacement per 100,000 persons between 2003 to 2023 by State/Territory**



Variation in Cumulative Percent Revision

The following analyses include primary total conventional hip replacement procedures performed for osteoarthritis and using prostheses that have been available and used in 2023 (described as modern prostheses). All procedures using a metal/metal bearing surface have been excluded.

The following analyses examine primary total conventional hip replacement undertaken across all hospital systems with adjustments for age, gender, ASA score and BMI category.

When the comparisons are made to NSW (the state with the largest number of procedures), SA, QLD, WA and NT all have higher rates of revision, VIC and TAS have lower rates of revision, while there is no difference when the ACT is compared to NSW (Table N4 and Figure N15).

Variation in Public/Private Hospital Procedures

The proportion of hip replacement procedures for OA undertaken in the public and private systems shows little variation between the states and territories. During 2023, all states apart from NT, had between 74.1% and 86.5% of hip replacement procedures in the private system (Figure N16).

When examining primary total conventional hip replacement undertaken within the public hospital system, compared to NSW, QLD has a higher rate of revision, VIC has a lower rate of revision, and the remaining states show no difference (Table N5 and Figure N17).

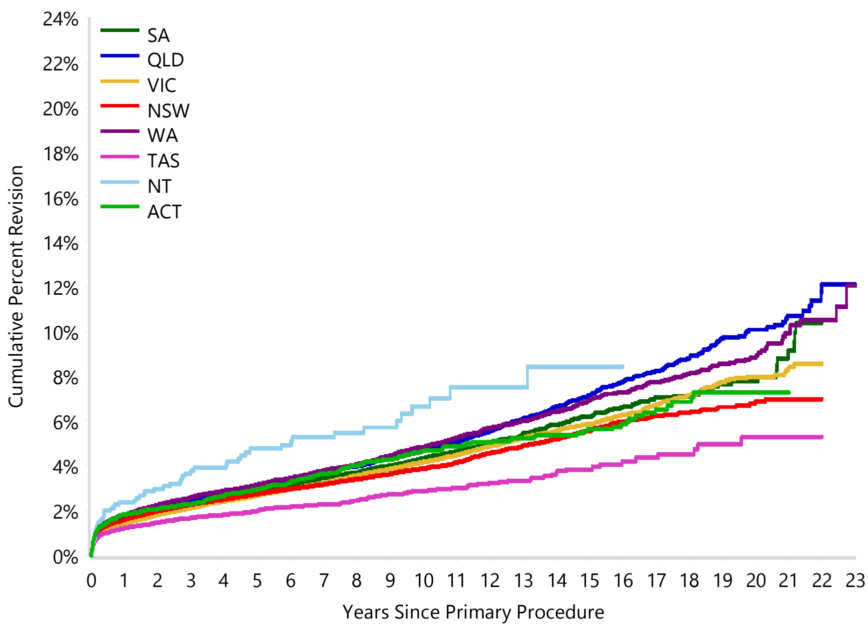
When compared to NSW in the private system, SA, WA and NT have higher rates of revision, VIC and TAS have lower rates of revision, and there is no difference for QLD or the ACT (Table N5 and Figure N18).

Table N4 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by State/Territory (Primary Diagnosis OA)

State	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
SA	1558	44179	1.7 (1.5, 1.8)	2.4 (2.2, 2.5)	2.9 (2.8, 3.1)	4.3 (4.1, 4.6)	6.2 (5.8, 6.6)	7.8 (7.1, 8.6)
QLD	3109	81435	1.7 (1.6, 1.8)	2.5 (2.4, 2.6)	3.1 (2.9, 3.2)	4.7 (4.5, 4.9)	7.2 (6.8, 7.5)	10.1 (9.4, 10.8)
VIC	4002	123247	1.4 (1.3, 1.5)	2.1 (2.0, 2.2)	2.7 (2.6, 2.8)	4.2 (4.0, 4.3)	5.9 (5.6, 6.1)	8.0 (7.5, 8.5)
NSW	4238	137435	1.6 (1.5, 1.7)	2.3 (2.2, 2.4)	2.7 (2.7, 2.8)	3.9 (3.7, 4.0)	5.6 (5.3, 5.8)	6.9 (6.4, 7.3)
WA	2178	55679	1.8 (1.7, 1.9)	2.6 (2.4, 2.7)	3.2 (3.0, 3.3)	4.8 (4.6, 5.1)	6.9 (6.5, 7.3)	8.8 (8.2, 9.5)
TAS	367	16481	1.2 (1.1, 1.4)	1.7 (1.5, 1.9)	2.0 (1.8, 2.2)	2.9 (2.5, 3.2)	3.8 (3.3, 4.5)	5.3 (4.2, 6.7)
NT	59	1174	2.4 (1.6, 3.4)	3.8 (2.8, 5.1)	4.8 (3.6, 6.3)	6.6 (5.0, 8.8)	8.4 (6.0, 11.8)	
ACT	424	12025	1.8 (1.6, 2.1)	2.3 (2.0, 2.6)	2.9 (2.6, 3.3)	4.7 (4.2, 5.2)	5.6 (5.0, 6.4)	7.3 (6.2, 8.6)
TOTAL	15935	471655						

Note: Restricted to modern prostheses. All procedures using metal/metal prostheses have been excluded

Figure N15 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by State/Territory (Primary Diagnosis OA)



HR – adjusted for age, gender, BMI and ASA

SA vs NSW
Entire Period: HR=1.21 (1.12, 1.32), p<0.001

QLD vs NSW
Entire Period: HR=1.10 (1.03, 1.18), p=0.007

TAS vs NSW
Entire Period: HR=0.64 (0.55, 0.76), p<0.001

NT vs NSW
Entire Period: HR=1.77 (1.23, 2.55), p=0.002

ACT vs NSW
Entire Period: HR=1.08 (0.93, 1.24), p=0.329

VIC vs NSW
Entire Period: HR=0.89 (0.83, 0.94), p<0.001

WA vs NSW
Entire Period: HR=1.09 (1.01, 1.18), p=0.033

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
SA	44179	39572	31887	25007	11104	3049	485
QLD	81435	72259	57743	44463	18753	6240	1082
VIC	123247	109661	88151	68883	28680	8512	1443
NSW	137435	122162	96734	73553	27954	8061	1022
WA	55679	49758	40241	31212	13652	4475	958
TAS	16481	14572	11431	8763	3349	930	235
NT	1174	1030	798	621	256	66	16
ACT	12025	10730	8505	6567	2813	1007	192

Note: Restricted to modern prostheses. All procedures using metal/metal prostheses have been excluded

Figure N16 **Percentage of Primary Total Conventional Hip Procedures in Private Hospitals by State/Territory (Primary Diagnosis OA)**

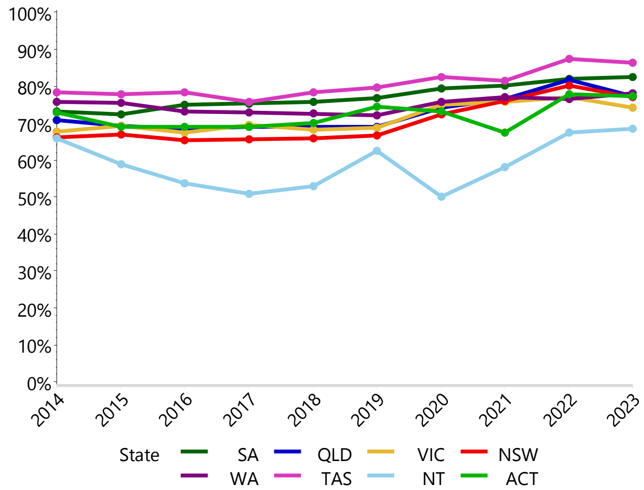
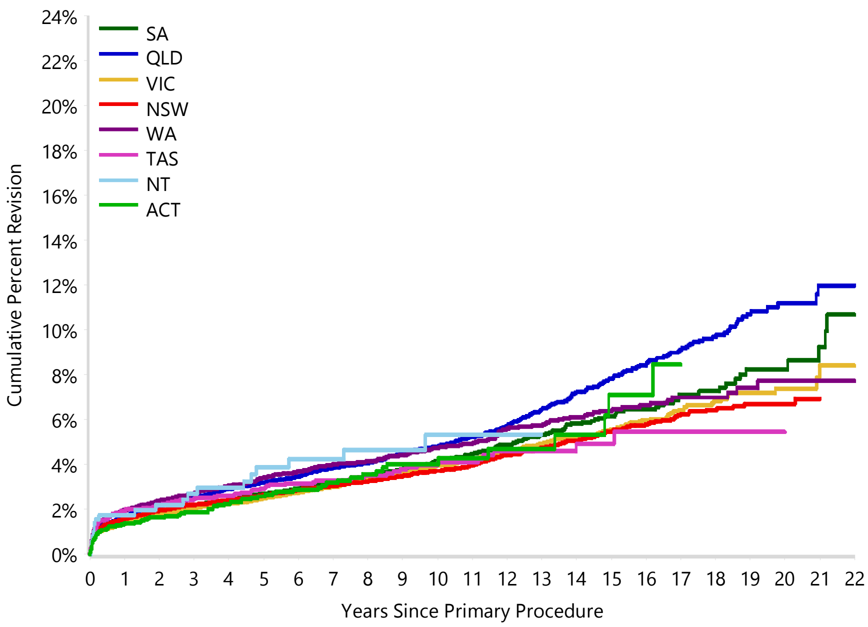


Table N5 **Cumulative Percent Revision of Primary Total Conventional Hip Replacement by State/Territory and Hospital System (Primary Diagnosis OA)**

State	Hospital Setting	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
SA	Public Hospital	483	12874	1.5 (1.3, 1.7)	2.2 (1.9, 2.5)	2.7 (2.4, 3.0)	4.1 (3.7, 4.6)	6.1 (5.5, 6.9)	8.2 (7.1, 9.6)
	Private Hospital	1075	31305	1.7 (1.6, 1.9)	2.5 (2.3, 2.7)	3.1 (2.9, 3.3)	4.4 (4.1, 4.7)	6.2 (5.7, 6.7)	7.3 (6.5, 8.3)
QLD	Public Hospital	1066	24710	1.7 (1.5, 1.8)	2.5 (2.3, 2.7)	3.2 (3.0, 3.4)	4.8 (4.5, 5.1)	7.8 (7.2, 8.5)	11.2 (10.1, 12.5)
	Private Hospital	2043	56725	1.7 (1.6, 1.8)	2.5 (2.3, 2.6)	3.0 (2.9, 3.2)	4.6 (4.4, 4.9)	6.8 (6.4, 7.2)	9.4 (8.5, 10.3)
VIC	Public Hospital	1231	38752	1.4 (1.3, 1.5)	2.0 (1.9, 2.2)	2.5 (2.3, 2.7)	3.9 (3.7, 4.2)	5.6 (5.2, 6.0)	7.4 (6.6, 8.3)
	Private Hospital	2771	84495	1.4 (1.3, 1.5)	2.2 (2.1, 2.3)	2.8 (2.7, 2.9)	4.3 (4.1, 4.5)	6.0 (5.7, 6.3)	8.2 (7.6, 8.9)
NSW	Public Hospital	1456	45625	1.6 (1.5, 1.7)	2.2 (2.1, 2.4)	2.6 (2.5, 2.8)	3.7 (3.5, 3.9)	5.5 (5.1, 5.9)	6.7 (6.1, 7.3)
	Private Hospital	2782	91810	1.6 (1.5, 1.7)	2.3 (2.2, 2.4)	2.8 (2.7, 2.9)	4.0 (3.8, 4.1)	5.6 (5.3, 5.9)	7.0 (6.3, 7.7)
WA	Public Hospital	577	14711	2.0 (1.8, 2.2)	2.7 (2.5, 3.0)	3.4 (3.1, 3.7)	4.7 (4.3, 5.2)	6.4 (5.7, 7.1)	7.7 (6.6, 9.0)
	Private Hospital	1601	40968	1.7 (1.6, 1.9)	2.5 (2.4, 2.7)	3.1 (2.9, 3.3)	4.9 (4.6, 5.2)	7.1 (6.7, 7.6)	9.2 (8.5, 10.1)
TAS	Public Hospital	108	3313	1.9 (1.5, 2.5)	2.5 (2.0, 3.1)	2.9 (2.4, 3.6)	4.0 (3.2, 4.9)	4.9 (3.8, 6.3)	5.4 (4.1, 7.3)
	Private Hospital	259	13168	1.0 (0.9, 1.2)	1.5 (1.3, 1.7)	1.7 (1.5, 2.0)	2.6 (2.2, 3.0)	3.6 (3.0, 4.3)	5.2 (3.9, 6.8)
NT	Public Hospital	22	518	1.8 (0.9, 3.3)	2.7 (1.6, 4.6)	3.9 (2.4, 6.2)	5.3 (3.3, 8.5)		
	Private Hospital	37	656	2.9 (1.8, 4.5)	4.7 (3.2, 6.8)	5.5 (3.8, 7.8)	7.8 (5.4, 11.1)		
ACT	Public Hospital	81	2815	1.4 (1.0, 1.9)	1.9 (1.4, 2.5)	2.6 (2.0, 3.3)	4.0 (3.1, 5.2)	7.1 (4.6, 10.8)	
	Private Hospital	343	9210	2.0 (1.7, 2.3)	2.4 (2.1, 2.8)	3.1 (2.7, 3.5)	4.8 (4.3, 5.4)	5.5 (4.9, 6.3)	7.0 (5.9, 8.3)
TOTAL		15935	471655						

Note: Restricted to modern prostheses. All procedures using metal/metal prostheses have been excluded

Figure N17 Cumulative Percent Revision of Primary Total Conventional Hip Replacement Procedures in Public Hospitals by State/Territory (Primary Diagnosis OA)



HR – adjusted for age, gender, BMI and ASA

SA vs NSW

Entire Period: HR=1.12 (0.95, 1.34), p=0.183

QLD vs NSW

Entire Period: HR=1.13 (1.00, 1.28), p=0.049

TAS vs NSW

Entire Period: HR=1.00 (0.74, 1.34), p=0.996

NT vs NSW

Entire Period: HR=1.52 (0.81, 2.83), p=0.191

ACT vs NSW

Entire Period: HR=0.87 (0.65, 1.18), p=0.367

VIC vs NSW

Entire Period: HR=0.79 (0.70, 0.89), p<0.001

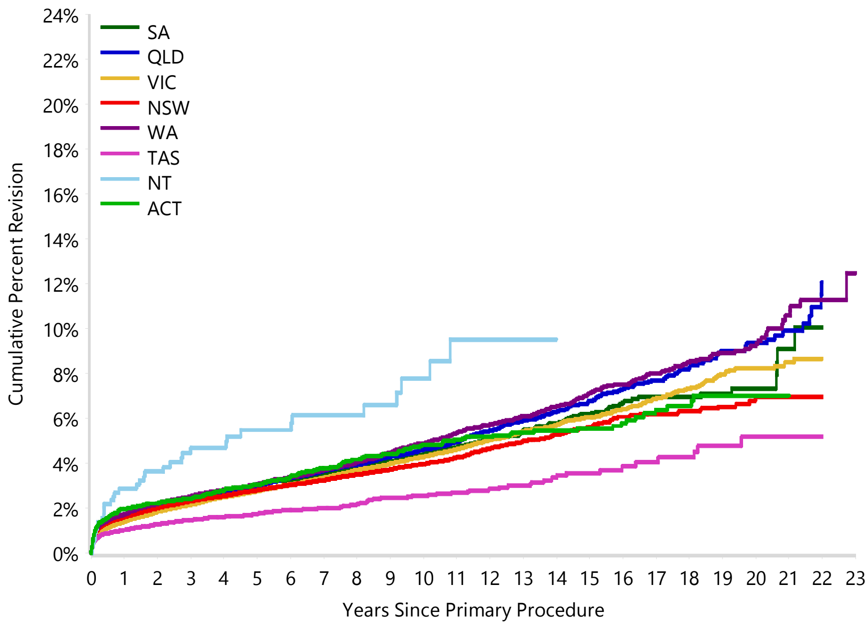
WA vs NSW

Entire Period: HR=1.01 (0.87, 1.18), p=0.891

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
SA	12874	11929	10225	8494	4219	1301	251
QLD	24710	22449	19029	15082	6716	2456	412
VIC	38752	34978	29402	23579	9941	2749	363
NSW	45625	41672	35330	27762	11237	3630	458
WA	14711	13276	10936	8507	3684	1200	194
TAS	3313	2994	2447	1940	799	192	40
NT	518	473	380	297	134	28	5
ACT	2815	2521	1905	1390	352	101	14

Note: Restricted to modern prostheses. All procedures using metal/metal prostheses have been excluded

Figure N18 Cumulative Percent Revision of Primary Total Conventional Hip Replacement Procedures in Private Hospitals by State/Territory (Primary Diagnosis OA)



HR – adjusted for age, gender, BMI and ASA

SA vs NSW
Entire Period: HR=1.24 (1.13, 1.36), p<0.001

QLD vs NSW
Entire Period: HR=1.08 (0.99, 1.17), p=0.080

TAS vs NSW
Entire Period: HR=0.56 (0.46, 0.67), p<0.001

NT vs NSW
Entire Period: HR=1.95 (1.24, 3.06), p=0.004

ACT vs NSW
Entire Period: HR=1.15 (0.97, 1.36), p=0.098

VIC vs NSW
Entire Period: HR=0.92 (0.86, 0.99), p=0.034

WA vs NSW
Entire Period: HR=1.12 (1.02, 1.23), p=0.017

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
SA	31305	27643	21662	16513	6885	1748	234
QLD	56725	49810	38714	29381	1203	3784	670
VIC	84495	74683	58749	45304	18739	5763	1080
NSW	91810	80490	61404	45791	16717	4431	564
WA	40968	36482	29305	22705	9968	3275	764
TAS	13168	11578	8984	6823	2550	738	195
NT	656	557	418	324	122	38	11
ACT	9210	8209	6600	5177	2461	906	178

Note: Restricted to modern prostheses. All procedures using metal/metal prostheses have been excluded

Variation In Prosthesis Characteristics

The most commonly used femoral stems in primary total conventional hip replacement are shown in Table N6.

The three most used femoral stems in primary conventional hip replacement for each state or territory over the past 4 years, as well as in 2003, are shown in Table N7. Within each state or territory there has been little change in these component choices since 2020.

Variation in Prosthesis Choice

States vary in the proportion of procedures that use one of the 10 most commonly used prostheses for each year. The percentage of procedures not using one of the 10 most commonly used prostheses (referred to as less commonly used prostheses) for each state is displayed in Figure N19. Comparing 2014 to 2023 increases in less commonly used prostheses are apparent in QLD, WA, ACT and the NT. In SA, VIC and NSW there has been little change, while TAS has shown a decrease.

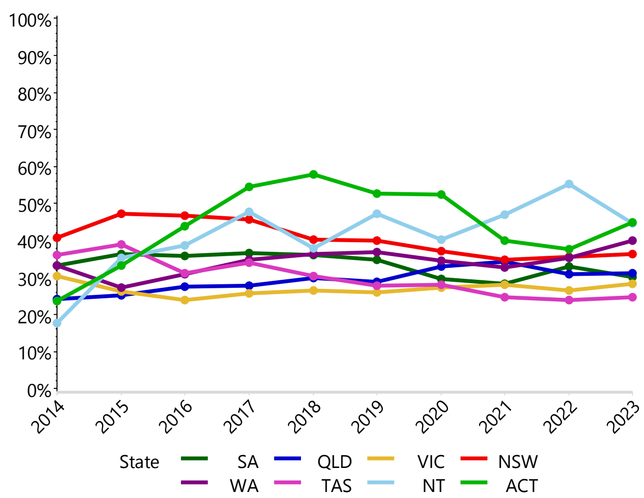
Table N6 Most Used Femoral Stems in Primary Total Conventional Hip Replacement in Australia

2003		2020		2021		2022		2023	
N	Model	N	Model	N	Model	N	Model	N	Model
3901	Exeter V40	7144	Exeter V40	7607	Exeter V40	7834	Exeter V40	8278	Exeter V40
1029	ABGII	4550	CORAIL	4451	CORAIL	3908	CORAIL	4620	Accolade II
1000	Synergy	2631	Accolade II	3621	Accolade II	3782	Accolade II	4306	CORAIL
819	Alloclassic	2630	Metafix	2792	Polarstem	3309	Metafix	3420	Metafix
809	VerSys	2474	Polarstem	2690	Metafix	2832	Polarstem	2937	Polarstem
780	Spectron EF	1763	Quadra-H	1819	Quadra-H	1557	Quadra-H	1973	Paragon
713	Secur-Fit Plus	1339	CPT	1455	Paragon	1513	Paragon	1728	Quadra-C
618	Omnifit	1236	Paragon	1445	Quadra-C	1506	Quadra-C	1532	CPT
565	C-Stem	1148	Quadra-C	1409	CPT	1448	AMIStem H	1483	AMIStem H
485	S-Rom	983	CPCS	1276	AMIStem H	1328	CPT	1419	Quadra-H
10 Most Used									
10719	(10) 62.8%	25898	(10) 67.0%	28565	(10) 67.7%	29017	(10) 68.0%	31696	(10) 67.0%
Remainder									
6353	(73) 37.2%	12783	(80) 33.0%	13649	(81) 32.3%	13661	(77) 32.0%	15616	(74) 33.0%
TOTAL									
17072	(83) 100.0%	38681	(90) 100.0%	42214	(91) 100.0%	42678	(87) 100.0%	47312	(84) 100.0%

Table N7 3 Most Used Femoral Stems in Primary Total Conventional Hip Replacement in Australia by State/Territory and Year

State	2003		2020		2021		2022		2023	
	N	Model	N	Model	N	Model	N	Model	N	Model
SA	326	Exeter V40	693	Exeter V40	651	Exeter V40	677	Exeter V40	711	Exeter V40
	257	Mallory-Head	332	Quadra-C	431	Quadra-C	413	Quadra-C	545	Quadra-C
	198	Spectron EF	307	AMIStem H	399	AMIStem H	364	AMIStem H	355	Polarstem
QLD	897	Exeter V40	1630	Exeter V40	1742	Exeter V40	1627	Exeter V40	1823	Exeter V40
	180	Spectron EF	1069	CORAIL	1024	CORAIL	855	CORAIL	993	CORAIL
	157	CORAIL	718	Polarstem	741	Polarstem	684	Accolade II	825	Accolade II
VIC	1268	Exeter V40	2543	Exeter V40	2828	Exeter V40	3086	Exeter V40	3249	Exeter V40
	455	Alloclassic	1360	CORAIL	1384	CORAIL	1210	CORAIL	1440	CORAIL
	261	C-Stem	615	Quadra-H	693	Accolade II	733	Metafix	1123	Accolade II
NSW	1025	Exeter V40	1744	Metafix	1604	Metafix	1986	Metafix	1941	Metafix
	770	ABGII	1532	Exeter V40	1588	Exeter V40	1633	Exeter V40	1611	Exeter V40
	308	VerSys	1059	CORAIL	1085	CORAIL	1108	Accolade II	1338	Accolade II
WA	279	Secur-Fit Plus	817	CORAIL	731	Accolade II	641	Accolade II	713	Accolade II
	246	Exeter V40	570	Accolade II	635	CORAIL	565	CORAIL	621	Paragon
	147	VerSys	505	Exeter V40	491	Exeter V40	512	Exeter V40	575	Exeter V40
TAS	158	Alloclassic	517	Polarstem	508	Polarstem	561	Polarstem	693	Polarstem
	105	Synergy	127	Accolade II	148	Accolade II	161	Accolade II	148	Taperloc
	101	ABGII	104	CPT	130	CPT	149	Exeter V40	143	Accolade II
ACT	154	Synergy	255	Evolve	267	Evolve	231	Evolve	235	Evolve
	81	Exeter V40	142	Exeter V40	182	Accolade II	225	Accolade II	195	Polarstem
	34	Spectron EF	132	Taper Fit	175	Exeter V40	145	Exeter V40	175	Accolade II
NT	9	Omnifit	26	CORAIL	30	CORAIL	39	Metafix	37	Metafix
	8	Spectron EF	16	Secur-Fit	19	Metafix	22	M/L Taper	17	Secur-Fit
	7	Synergy	8	Exeter V40	18	M/L Taper	20	Secur-Fit	13	M/L Taper

Figure N19 Percentage of Less Commonly Used Femoral Stems in Primary Total Conventional Hip Replacement by State/Territory (Primary Diagnosis OA)



Variation in Prosthesis Fixation

Fixation for primary total conventional hip replacement in each state and territory over the last 10 years is shown in Figure N20, Figure N21 and Figure N22. Cementless fixation is most common in all states except for the ACT where hybrid fixation is preferred. Cementless fixation has increased in the ACT from 6.4% in 2014 to 39.5% in 2023. WA, TAS and VIC have shown increased use of hybrid fixation over the last decade.

Fully cemented primary total conventional hip replacement has decreased in all states. Its most common usage was in QLD in 2014 where it was used in 7.5% of primary total conventional hips. It is now used in 1.7, 1.8 and 2.0 % of procedures in QLD, VIC and TAS whereas in other states it is either not utilised or used in less than 1% of cases.

Figure N20 Percentage of Cementless Primary Total Conventional Hip Replacement by State/Territory (Primary Diagnosis OA)

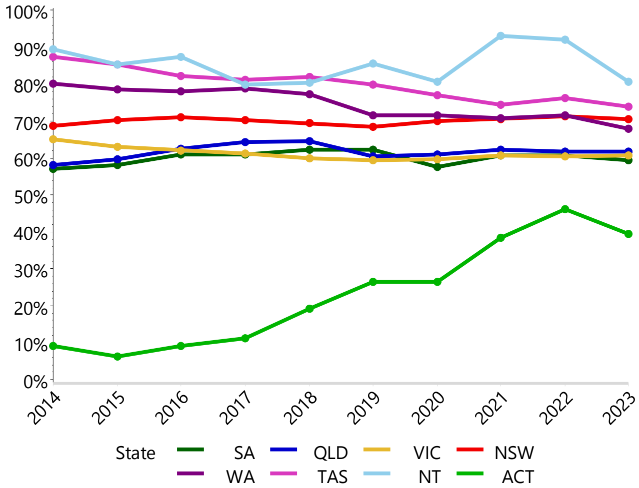


Figure N22 Percentage of Cemented Primary Total Conventional Hip Replacement by State/Territory (Primary Diagnosis OA)

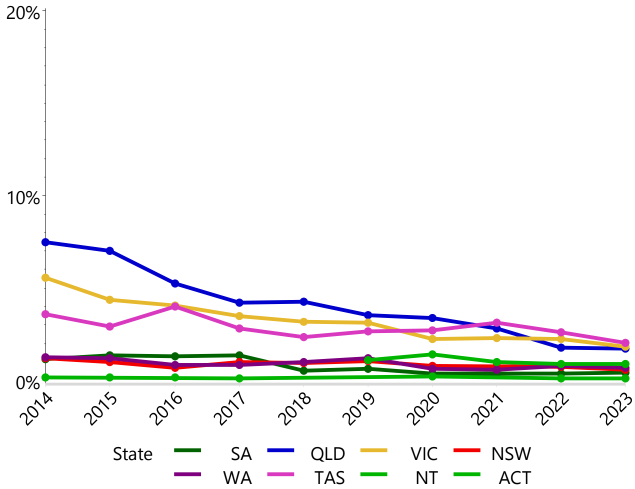
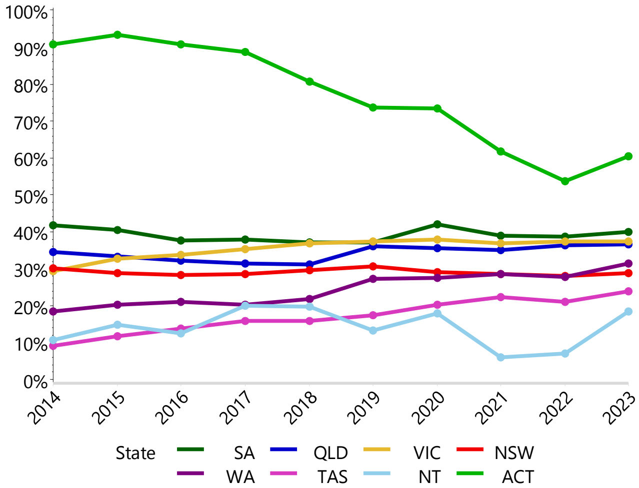


Figure N21 Percentage of Hybrid Primary Total Conventional Hip Replacement by State/Territory (Primary Diagnosis OA)



Arthroplasty Practice Variation in Australia

Variation in Head Size

Head sizes <32mm, 32mm and >32mm for primary total conventional hip replacement in each state and territory over the last 10 years are shown in Figure N23, Figure N24, and Figure N25. Throughout the country head size <32mm has been used in less than 20.0% of primary hip replacement. There has been a small increase in the last 3-4 years in the ACT, TAS, VIC and WA, possibly related to increased use of dual mobility bearings in these states. There has been a decline in the proportional use of head size 32mm in all states and territories, while the use of head sizes >32mm has increased in all states apart from NSW where use has remained constant, and in ACT where it has decreased. In 2023, head size >32mm is used in all states for 58.0% to 66.0% of total conventional hip replacement procedures.

Figure N23 **Percentage of <32mm in Primary Total Conventional Hip by State (Primary Diagnosis OA)**

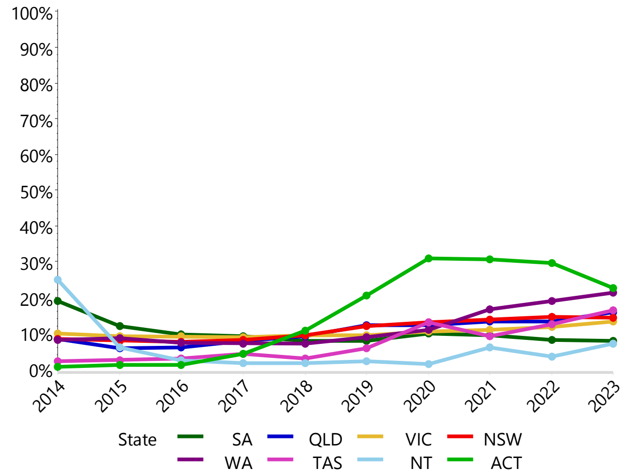


Figure N24 **Percentage of 32mm in Primary Total Conventional Hip by State/Territory (Primary Diagnosis OA)**

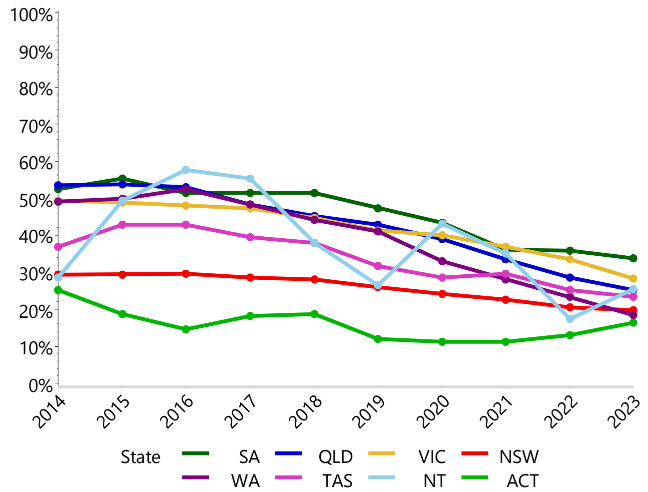
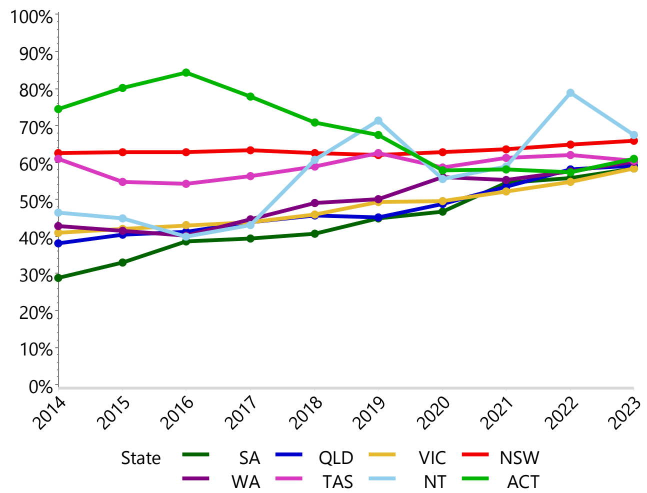


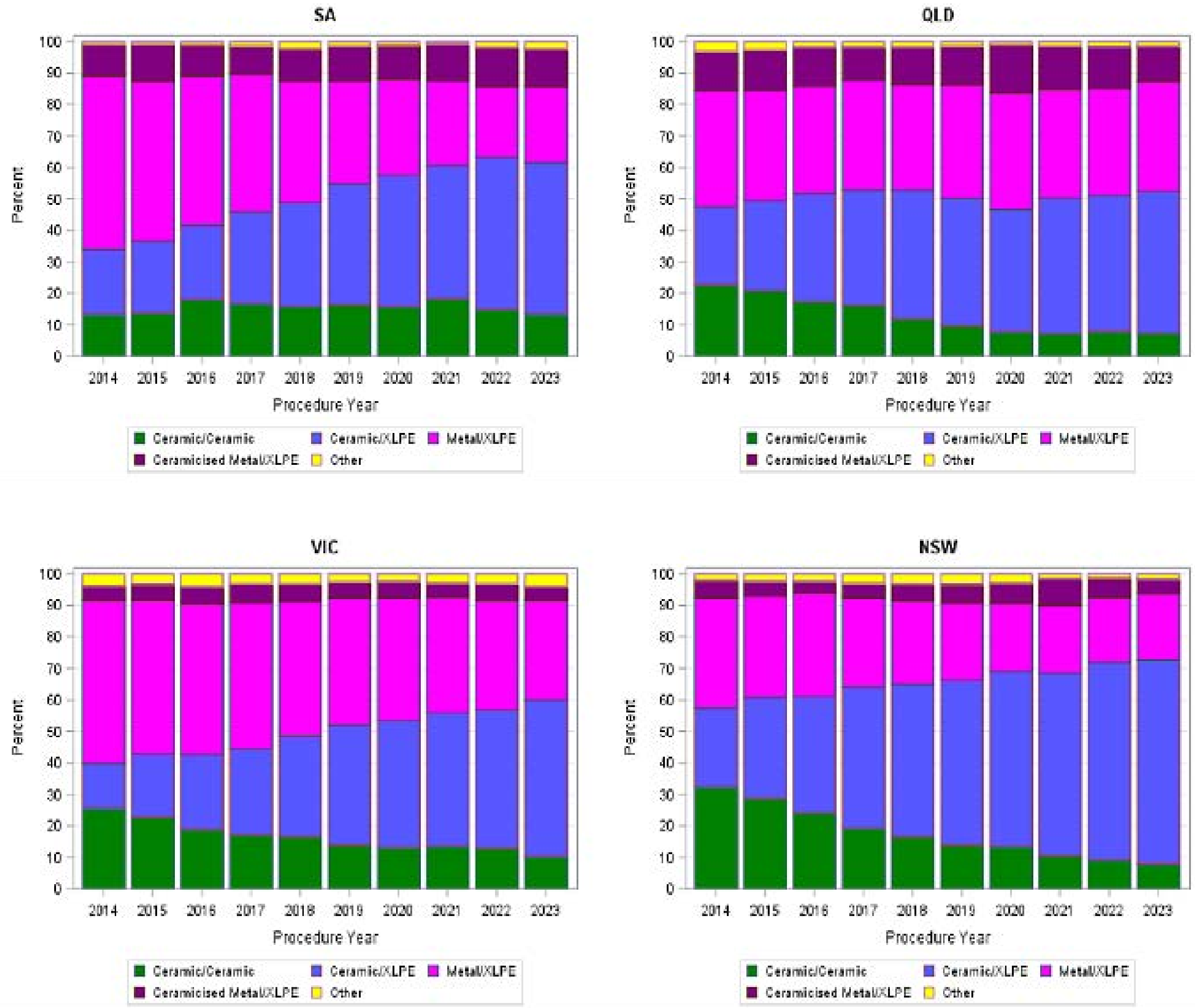
Figure N25 **Percentage of >32mm in Primary Total Conventional Hip by State/Territory (Primary Diagnosis OA)**

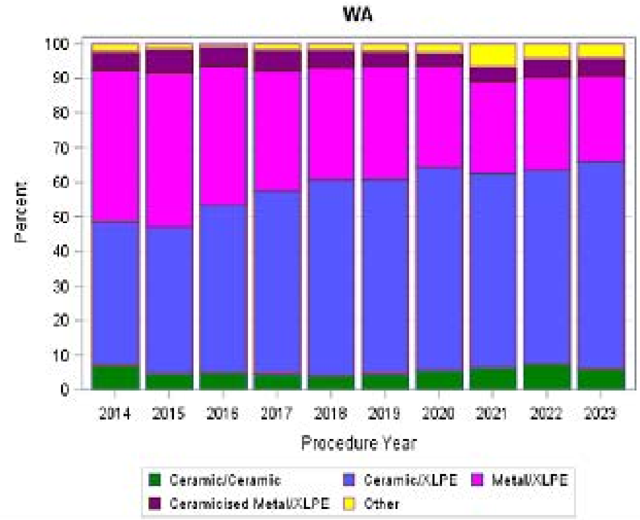


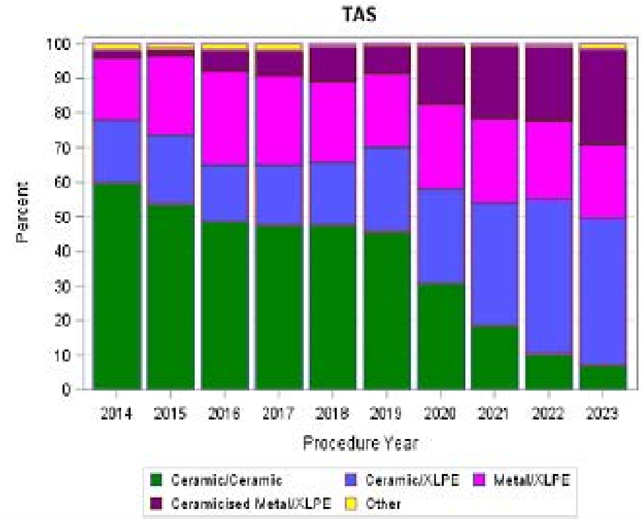
Variation in Bearing Surface

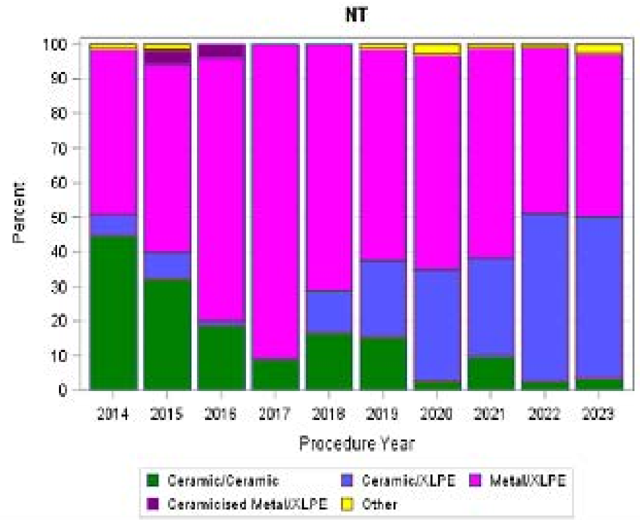
The choice of bearing surface varies noticeably between states despite having patients with similar age, BMI and ASA class (Figure N26). Ceramic/ceramic bearing usage has shown a decrease from a high of 60.1% in TAS in 2014 to 2023 where it is used in 10.0% or less of procedures in most states. In 2023, Ceramic/XLPE is the most common single bearing choice varying from 42.3% in TAS to 64.7% in NSW. In 2014, metal/XLPE was the most common bearing surface in SA, NSW, VIC, WA, NT and QLD, but the proportional use of this bearing has decreased over time in most states except for TAS and QLD where this has changed little. In 2023, ceramicised metal heads are utilised in 27.7% and 19.3% of cases in TAS and the ACT, respectively, but in less than 12.0% in SA, QLD and WA, while in NSW, VIC and NT they are used in less than 5.0% of primary total conventional hip replacements.

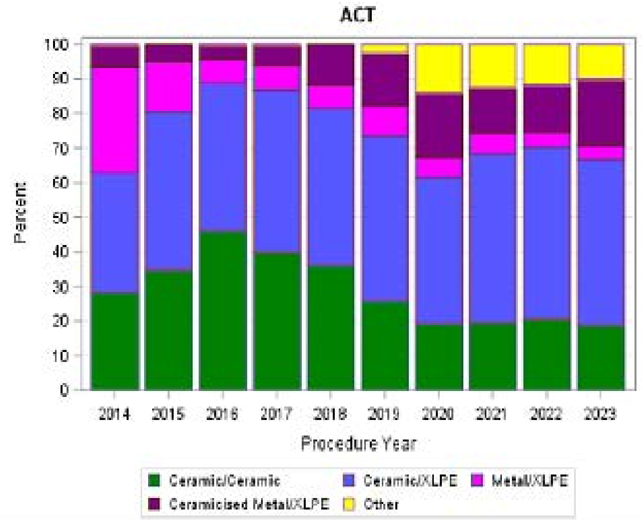
Figure N26 Bearing Surface of Primary Total Conventional Hip Replacement by State/Territory (Primary Diagnosis OA)











Note: Other includes non XLPE, ceramicised metal/ceramic, metal/metal, and metal/ceramic bearing surfaces

Variation in use of Technology Assistance

Most primary conventional hip replacements in Australia are performed without the use of technological assistance (Figure N27). Technology assistance includes computer navigation, image derived instrumentation (IDI) and robotic assistance. However, adjunctive technologies are being increasingly used for primary total conventional hip replacement in all states. By 2023, the percentage of total conventional hip replacements using technology assistance reached 38.0% in NSW (highest) and 10.0% in TAS (lowest). Robotic assistance for primary total conventional hip replacement is more frequently used in ACT, QLD and SA and the ACT whereas IDI usage is the most common form of technology in NT, NSW and VIC (Figure N28 and Figure N29). There is little use of computer navigation for hip replacement (Figure N30).

Figure N27 **Percentage of Primary Total Conventional Hip Replacement using Technology Assistance by State/Territory (Primary Diagnosis OA)**

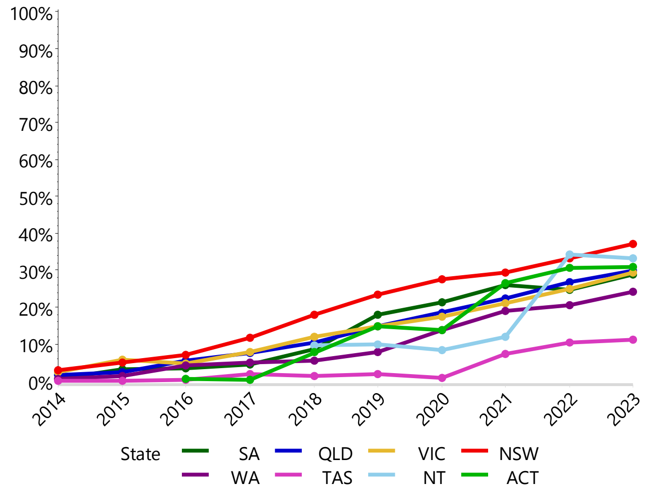


Figure N29 **Percentage of Primary Total Conventional Hip Replacement using IDI by State/Territory (Primary Diagnosis OA)**

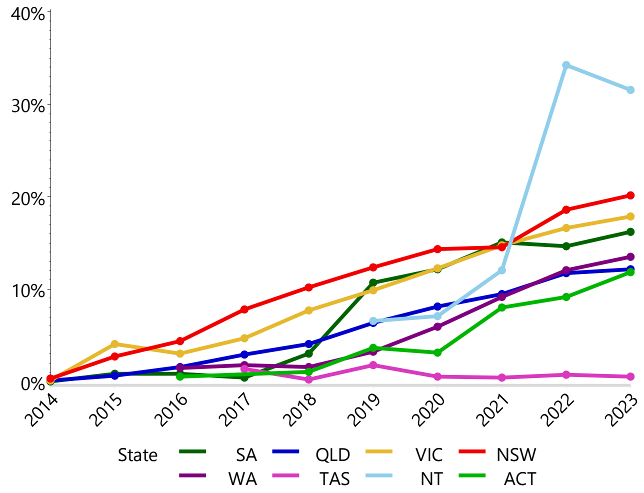


Figure N28 **Percentage of Primary Total Conventional Hip Replacement using Robotic Assistance by State/Territory (Primary Diagnosis OA)**

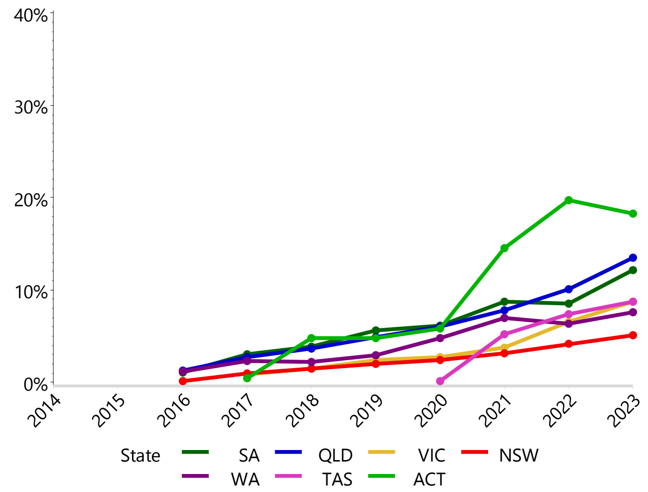
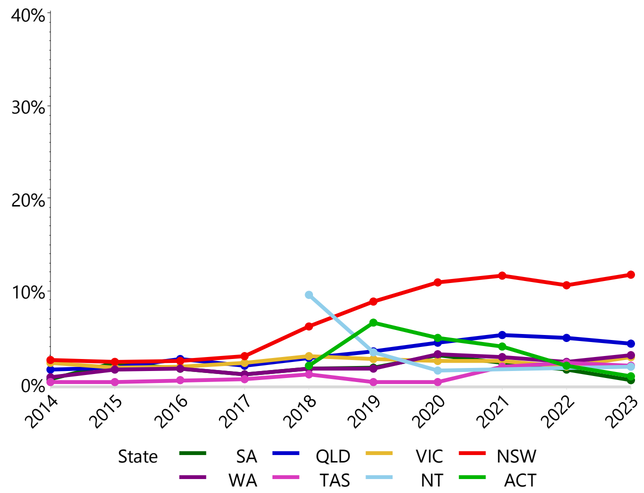
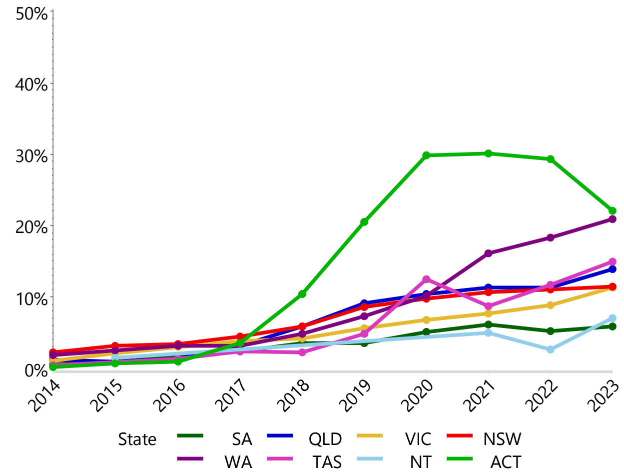


Figure N30 **Percentage of Primary Total Conventional Hip Replacement using Computer Navigation by State/Territory (Primary Diagnosis OA)**



Variation in use of Dual Mobility Articulations
Each state and territory have seen an increase in the usage of dual mobility bearings (Figure N31). Prior to 2018, these devices were utilised in less than 5.0% of cases in each state. The largest increases in dual mobility usage have been in WA and the ACT where over 20.0% of cases are performed with dual mobility devices in 2023.

Figure N31 Percentage of Dual Mobility in Primary Total Conventional Hip Replacement by State/Territory (Primary Diagnosis OA)



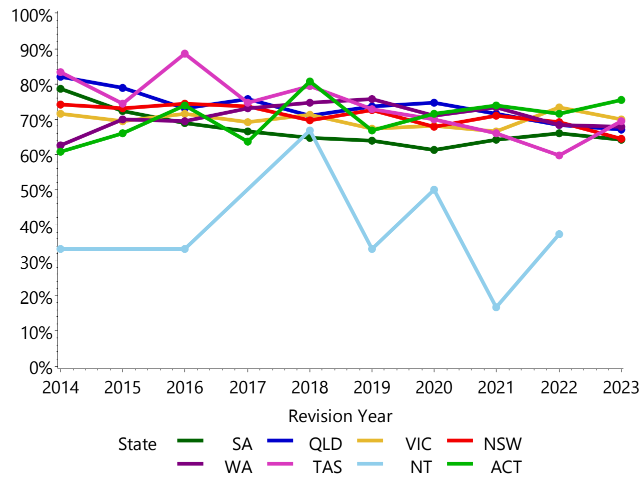
VARIATION IN HIP REPLACEMENT REVISION

Variation in Revision Class
Major revisions are procedures where one or more of the major components fixed to bone are either removed or exchanged. These can be major partial revisions where only one major component is revised, or major total revisions where both major components are revised. Minor revisions include procedures that exchange the minor components such as the head and/or acetabular insert. All states have shown a small decrease in major revisions, except for the ACT where the proportion of major revisions has increased (Figure N32).

Variation in Revision Diagnosis
The proportions of the common 1st revision diagnoses of known primary procedures over the last decade are displayed in Figure N33.

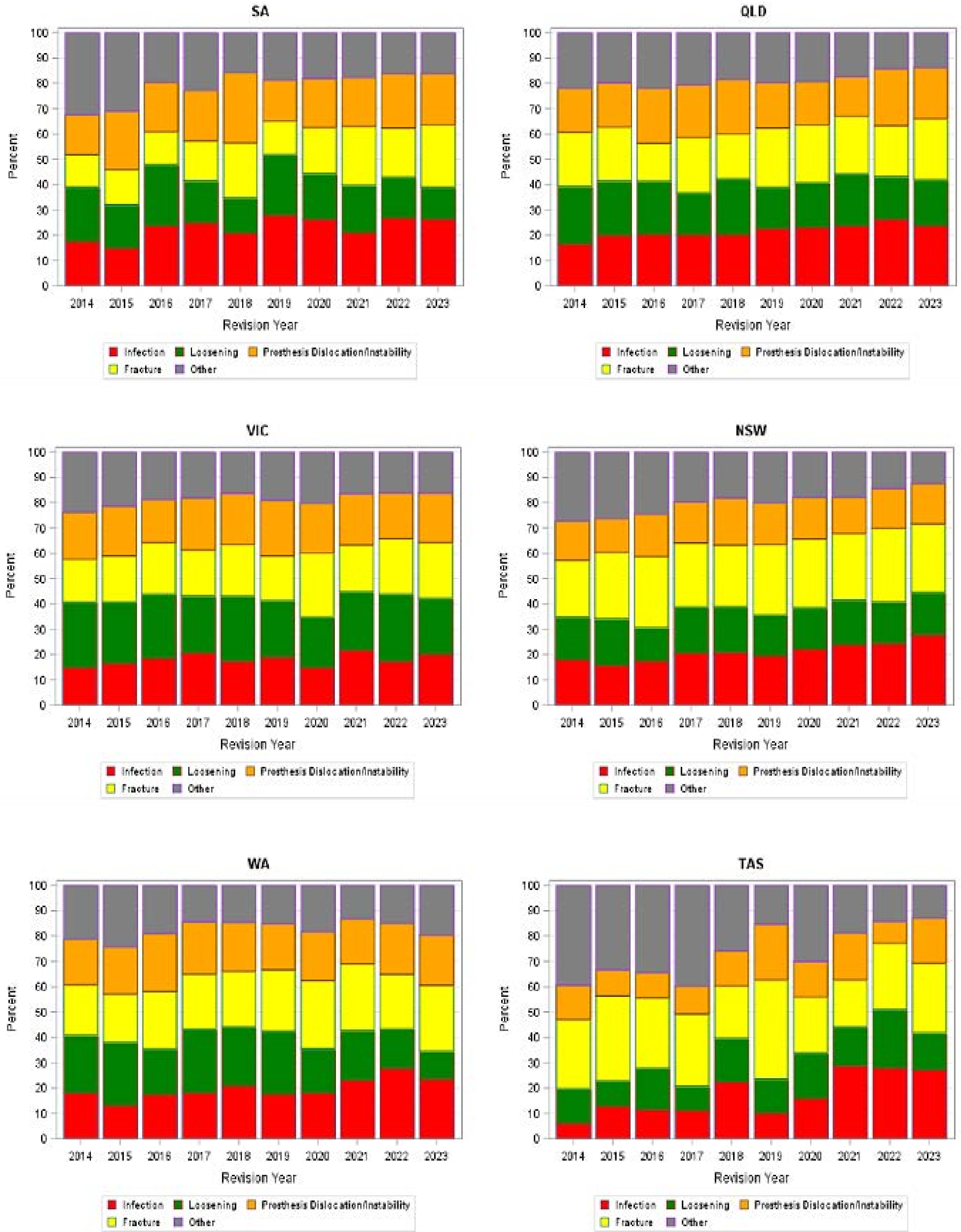
The revision diagnosis varies with time. Increasing revision for infection is seen in all the states. In 2023 revision for infection accounts for between 20.0% and 30.0% of annual 1st revisions, except in NT. The incidence of revision for both fracture and dislocation/instability shows year to year variation with no clear trends for the different states.

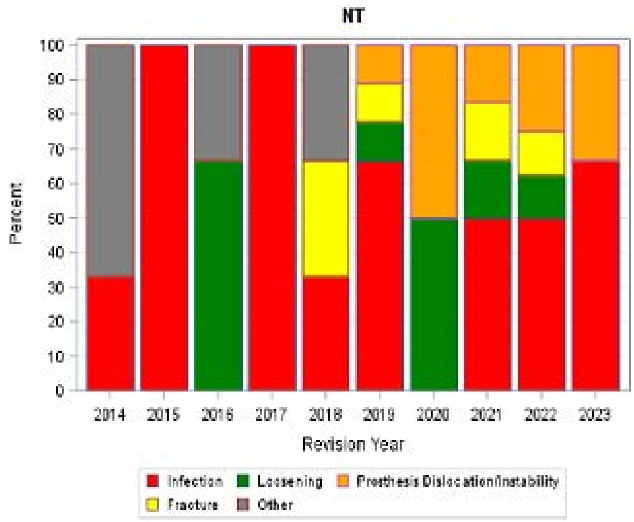
Figure N32 Percentage of Major Revision in 1st Revision Hip Replacement of Primary Total Conventional Hip Replacement by State/Territory (All Diagnoses)

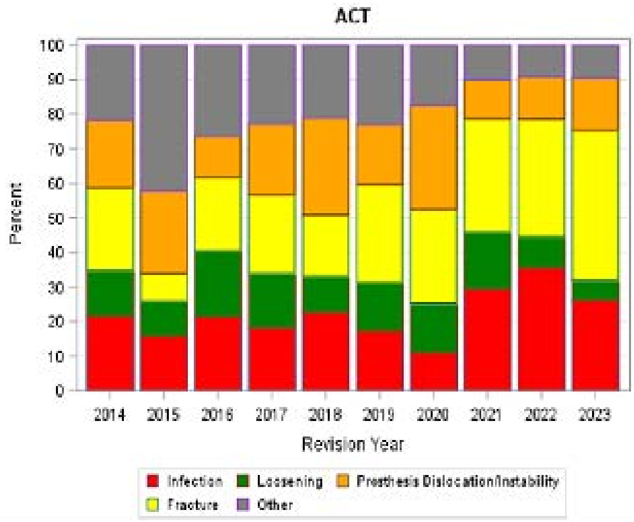


Note: Restricted to revision procedures with known primaries. There were no major revisions recorded in NT in 2015, 2017 and 2023

Figure N33 **Revision Diagnosis of 1st Revision Hip Replacement of Known Primary Total Conventional Hip Replacement by State/Territory (All Diagnoses)**







Note: Restricted to revision procedures with known primaries

VARIATION IN HIP REPLACEMENT BY HOSPITAL LOCALITY

The Modified Monash Model (MMM)[4] defines whether a location is metropolitan, regional, rural, remote or very remote. The model measures remoteness and population size on a scale of Modified Monash (MM) categories MM1 to MM7. MM1 is a major city and MM7 is very remote.

Primary Hip Replacement by Class (All Diagnoses)
The class of hip replacement is similar between metropolitan and larger regional centres (MM1 and MM2) compared to more rural and remote settings (MM3-7). Primary total conventional hip replacement predominates with most of the remainder being bipolar and unipolar modular hip replacements (Figure N34 and Figure N35).

Primary Hip Replacement by Hospital Locality
The majority of total conventional hip replacement for osteoarthritis is undertaken in larger metropolitan/regional centres. In most states the percentage of surgery undertaken in MM3-7 settings has been stable over the last decade.

The most populous states undertake the most rural/remote surgery. In 2023, 23.5% of hip replacements procedures in NSW are performed in rural/remote locations (MM3-7), whilst in VIC 15.1% of hip replacements occur in the same rural/remote designations. In SA, QLD, WA and the ACT more than 90.0% of hip replacement procedures are performed in MM1- 2 settings (Figure N36 and Figure N37).

Figure N34 **Primary Hip Replacement in Metropolitan and Regional (MM1 and MM2) Hospitals by Class (All Diagnoses)**

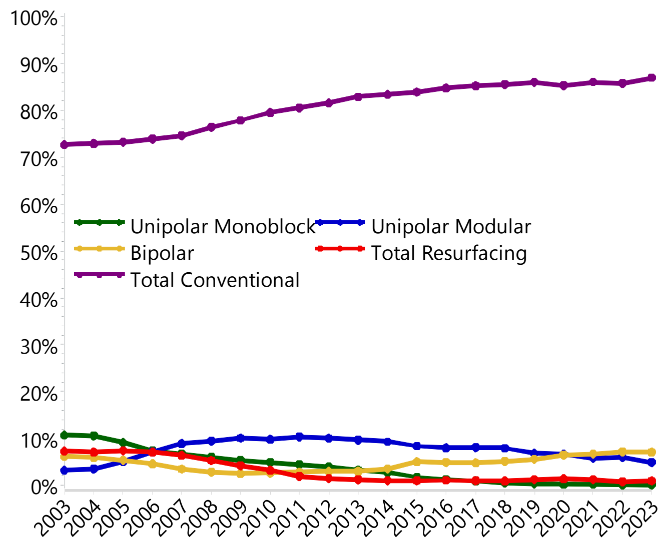
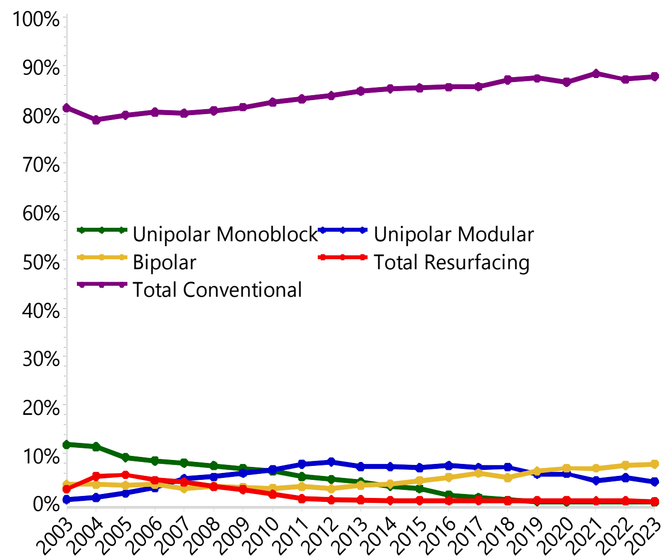


Figure N35 **Primary Hip Replacement in Rural-Remote (MM3-7) Hospitals by Class (All Diagnoses)**



[4] https://www.health.gov.au/topics/rural-health-workforce/classifications/mmm

Figure N36 **Percentage of Primary Total Conventional Hip Replacement in Metropolitan and Regional (MM1 and MM2) Hospitals by State/Territory (Primary Diagnosis OA)**

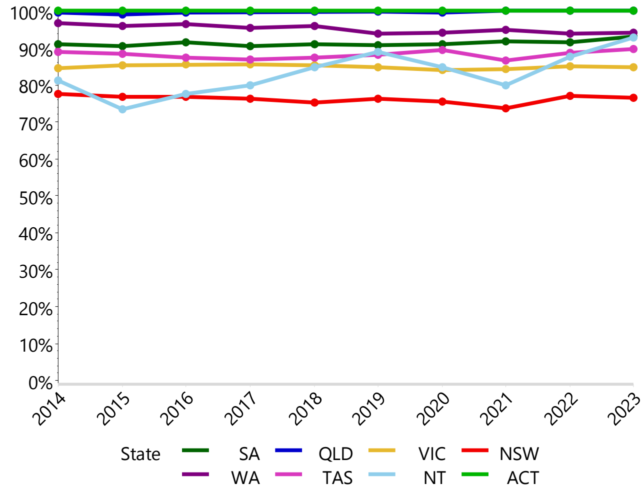
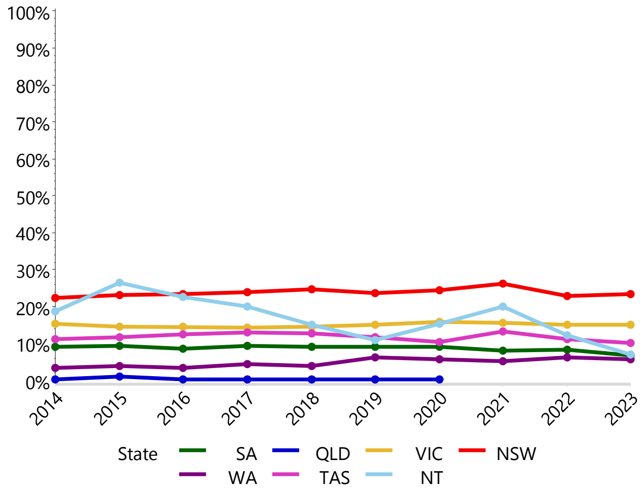


Figure N37 **Percentage of Primary Total Conventional Hip Replacement in Rural-Remote (MM3-7) Hospitals by State/Territory (Primary Diagnosis OA)**



Patient Factors by Hospital Locality

There is little difference in patient age, gender, ASA score or BMI category for hip replacement procedures performed in MM1 and MM2 regions when compared to MM3-7 (Table N8 and Table N9).

Table N8 **Summary of Primary Total Conventional Hip Replacement Since 2014 by Hospital Locality (Primary Diagnosis OA)**

Variable		Metropolitan and Regional (MM1 and MM2)	Rural-Remote (MM3-7)	TOTAL
Age				
	Mean ± SD	67.8 ± 10.8	69.2 ± 9.9	68 ± 10.7
	Median (IQR)	69 (61, 76)	70 (63, 76)	69 (61, 76)
Age Group				
	<55	33,896 (11.4%)	3,500 (7.9%)	37,396 (11%)
	55-64	71,819 (24.2%)	10,003 (22.6%)	81,822 (24%)
	65-74	106,587 (35.9%)	16,666 (37.7%)	123,253 (36.1%)
	≥75	84,799 (28.5%)	14,004 (31.7%)	98,803 (29%)
Gender				
	Male	138,045 (46.5%)	20,836 (47.2%)	158,881 (46.6%)
	Female	159,056 (53.5%)	23,337 (52.8%)	182,393 (53.4%)
TOTAL		297,101	44,173	341,274

Note: Abbreviations: SD - standard deviation, IQR - interquartile range

Table N9 Summary of Primary Total Conventional Hip Replacement Since 2014 by Hospital Locality (Primary Diagnosis OA)

	Variable	Metropolitan and Regional (MM1 and MM2)	Rural-Remote (MM3-7)	TOTAL
ASA Score[a]				
	ASA 1	25,687 (8.7%)	2,572 (5.9%)	28,259 (8.3%)
	ASA 2	157,794 (53.4%)	24,402 (55.6%)	182,196 (53.7%)
	ASA 3	107,992 (36.5%)	16,330 (37.2%)	124,322 (36.6%)
	ASA 4	4,140 (1.4%)	573 (1.3%)	4,713 (1.4%)
	ASA 5	16 (0%)	3 (0%)	19 (0%)
BMI Category[b]				
	Underweight (<18.50)	1,965 (0.8%)	235 (0.6%)	2,200 (0.7%)
	Normal (18.50-24.99)	55,062 (21.1%)	6,948 (17.7%)	62,010 (20.6%)
	Pre Obese (25.00-29.99)	96,054 (36.8%)	14,106 (35.9%)	110,160 (36.7%)
	Obese Class 1 (30.00-34.99)	66,337 (25.4%)	10,919 (27.8%)	77,256 (25.7%)
	Obese Class 2 (35.00-39.99)	28,047 (10.7%)	4,938 (12.6%)	32,985 (11%)
	Obese Class 3 (≥40.00)	13,772 (5.3%)	2,158 (5.5%)	15,930 (5.3%)
TOTAL		297,101	44,173	341,274

Note: Abbreviations: ASA - American Society of Anesthesiologists, BMI - Body Mass Index (kg/m^2)
[a]Excludes 1,765 procedures with unknown ASA score
[b]Excludes 12,173 procedures with unknown BMI category

Socio-Economic Disadvantage by Hospital Locality
The Index of Relative Socio-economic Advantage and Disadvantage (IRSAD)[5] summarises information about the economic and social conditions of people and households within an area. An IRSAD rating of 1 indicates the most socioeconomically disadvantaged region, while a rating of 10 indicates the most advantaged.

Almost 30.0% of rural/remote procedures are for patients IRSAD 1 or 2, while just over 10.0% have these ratings in metropolitan/regional procedures (Figure N38).

Conversely, about 30.0% of procedures from metropolitan/regional hospitals are for patients from areas with IRSAD rating of 9 or 10, while less than 5.0% of procedures in rural/remote areas have this rating (Figure N39).

Figure N38 Percentage of Primary Total Conventional Hip Replacement from Regions Rated IRSAD 1 and 2 by Hospital Locality (Primary Diagnosis OA)

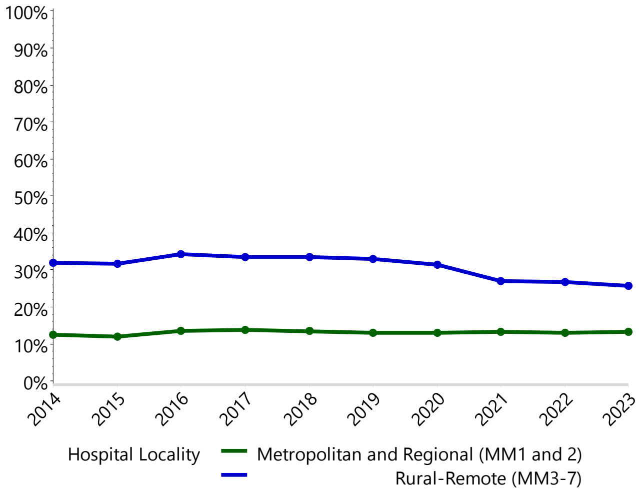
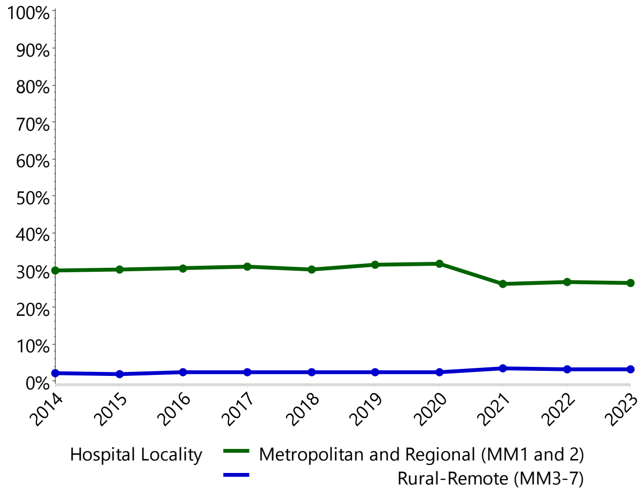


Figure N39 Percentage of in Primary Total Conventional Hip Replacement from Regions Rated IRSAD 9 and 10 by Hospital Locality (Primary Diagnosis OA)



[5] https://www.abs.gov.au/statistics/people/people-and-communities/socio-economic-indexes-areas-seifa-australia/latest-release.

Variation in Surgeon Volume by Hospital Locality
The proportion of surgeons undertaking less than 20 hip replacements annually is higher in 2023 in metropolitan/regional (MM1-2) areas (33.2%) than in rural/remote (MM3-7) regions (24.8%) (Figure N40). The percentage of hip replacements undertaken by low volume surgeons is low in both rural/remote regions (3.7%) and metropolitan/regional areas (4.7%) (Figure N41).

The proportion of high volume surgeons (>100 hip replacements per year) has gradually increased over the past decade in rural/remote regions (11.4% in 2023) and in metropolitan/ regional areas (13.3% in 2023) (Figure N42). The proportion of hip replacements performed by high volume surgeons is higher in metropolitan/regional areas (40.7%) than in rural/remote areas (28.2%) (Figure N43).

Variation in Surgeon Experience by Hospital Locality
The percentage difference between surgeons in rural/remote and metropolitan/regional areas with less than 4 years' experience in hip replacement has declined over the past 10 years. In 2023, there are more surgeons in rural/remote regions (14.3%) with <4 years' experience in hip replacement than in metropolitan/regional centres (12.8%) (Figure N44).

The proportion of hip replacements undertaken by surgeons with less than 4 years of experience is low in 2023 (6.8% in rural/remote areas; and 5.0% in metropolitan/regional areas) (Figure N45).

Figure N40 Percentage of Surgeons with <20 Primary Total Conventional Hip Procedures/Year by Hospital Locality (All Diagnoses)

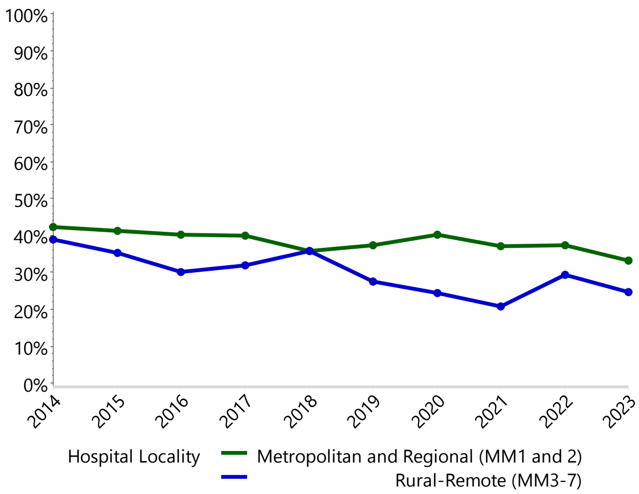


Figure N41 Percentage of Primary Total Conventional Hip Replacements by Surgeons with <20 Procedures/Year by Hospital Locality (All Diagnoses)

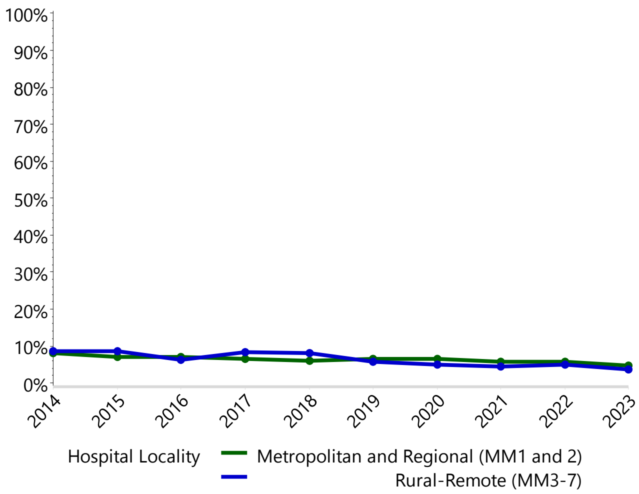


Figure N42 Percentage of Surgeons with ≥100 Primary Total Conventional Hip Procedures/Year by Hospital Locality (All Diagnoses)

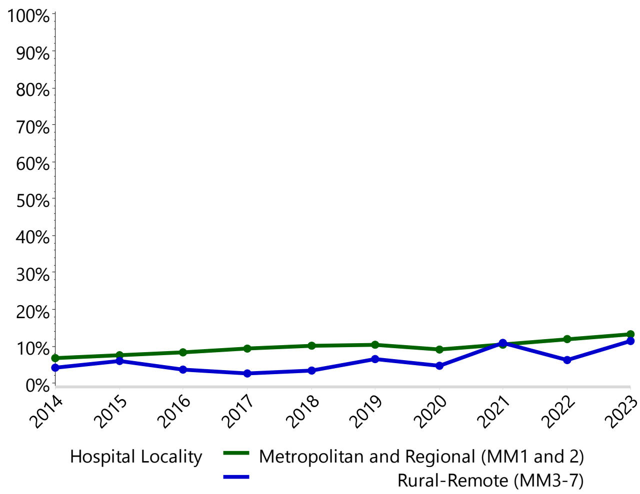


Figure N43 Percentage of Primary Total Conventional Hip Replacements by Surgeons with ≥100 Procedures/Year by Hospital Locality (All Diagnoses)

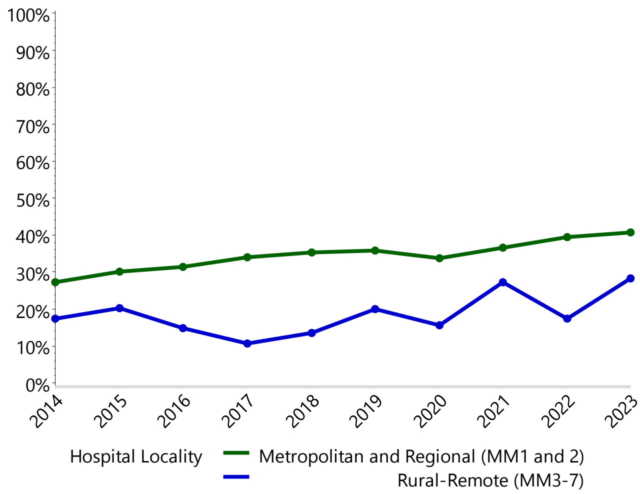


Figure N44 **Percentage of Surgeons with <4 Years Experience in Primary Total Conventional Hip Replacement by Hospital Locality (All Diagnoses)**

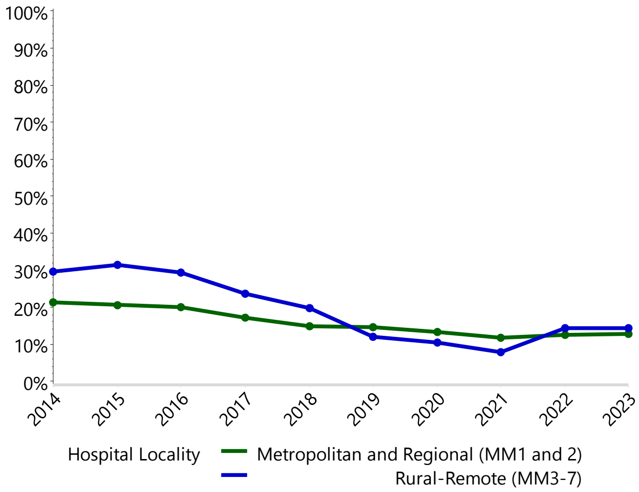
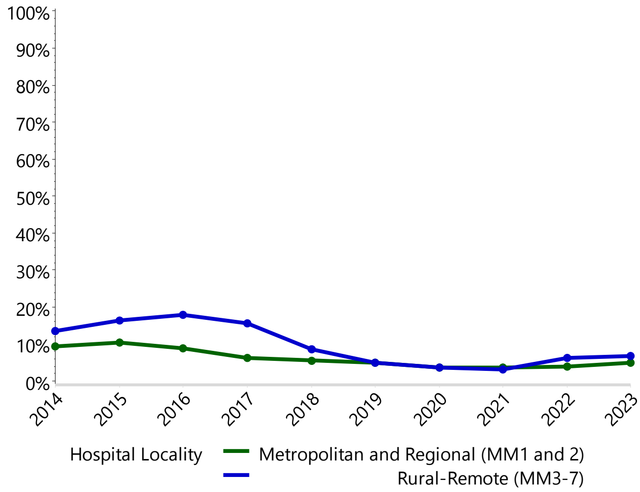


Figure N45 **Percentage of Procedures for Surgeons with <4 Years Experience in Primary Total Conventional Hip by Hospital Locality (All Diagnoses)**



Variation in Cumulative Percent Revision by Hospital Locality
MM1-2 centres have a lower rate of revision compared to MM3–7 centres in the first month only, with no difference after this time (Table N10 and Figure N46).

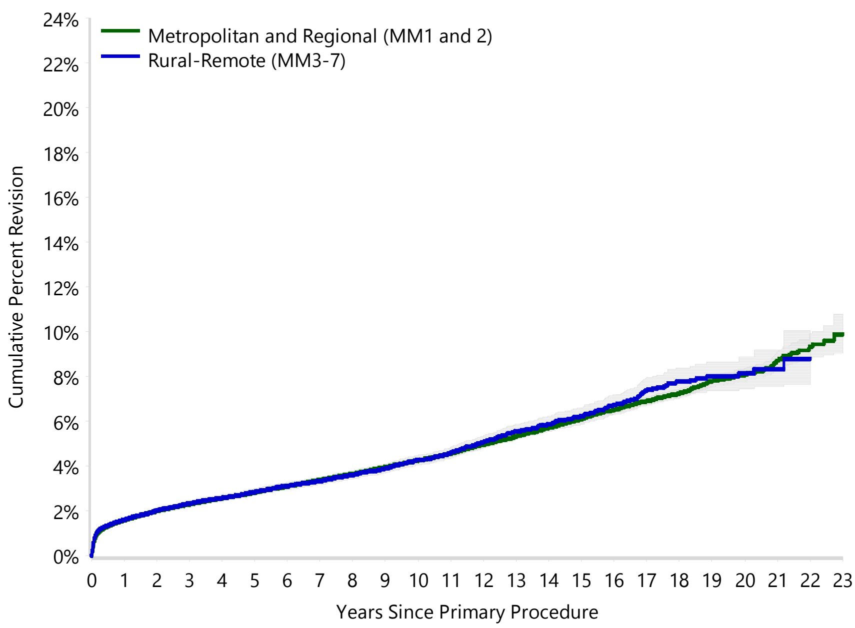
Variation in Hospital System by Hospital Locality
When public and private hospital procedures are considered along with locality, there is no difference in revision rate for public hip replacement procedures with location (Table N11 and Figure N47). There is a marginally lower rate of revision for private metropolitan/regional (MM1-2 centres) procedures compared to rural/remote procedures (Table N11 and Figure N48). It should be noted that at each comparison point in the private sector over the last 8 years the volumes of surgery in MM1-2 private centres exceeds that in the MM3-7 private centres by 10 times or more.

Table N10 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Hospital Locality (Primary Diagnosis OA)

Hospital Locality	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Metropolitan and Regional (MM1 and MM2)	13861	410268	1.6 (1.5, 1.6)	2.3 (2.3, 2.3)	2.8 (2.8, 2.9)	4.3 (4.2, 4.3)	6.1 (6.0, 6.3)	8.1 (7.8, 8.4)
Rural-Remote (MM3-7)	2074	61387	1.6 (1.5, 1.7)	2.3 (2.2, 2.5)	2.8 (2.7, 3.0)	4.3 (4.1, 4.5)	6.2 (5.9, 6.6)	8.1 (7.5, 8.9)
TOTAL	15935	471655						

Note: All procedures using metal/metal prostheses have been excluded. Restricted to modern prostheses

Figure N46 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Hospital Locality (Primary Diagnosis OA)



HR – adjusted for age, gender, ASA score and BMI category

Metropolitan and Regional (MM1 and MM2) vs Rural-Remote (MM3-7)

0-1 Mth: HR=0.76 (0.67,0.85), p<0.001

1 Mth+: HR=1.08 (0.99,1.17), p=0.073

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Metropolitan and Regional (MM1 and MM2)	410268	364979	291946	225668	93208	28237	4880
Rural-Remote (MM3-7)	61387	54765	43544	33401	13353	4103	553

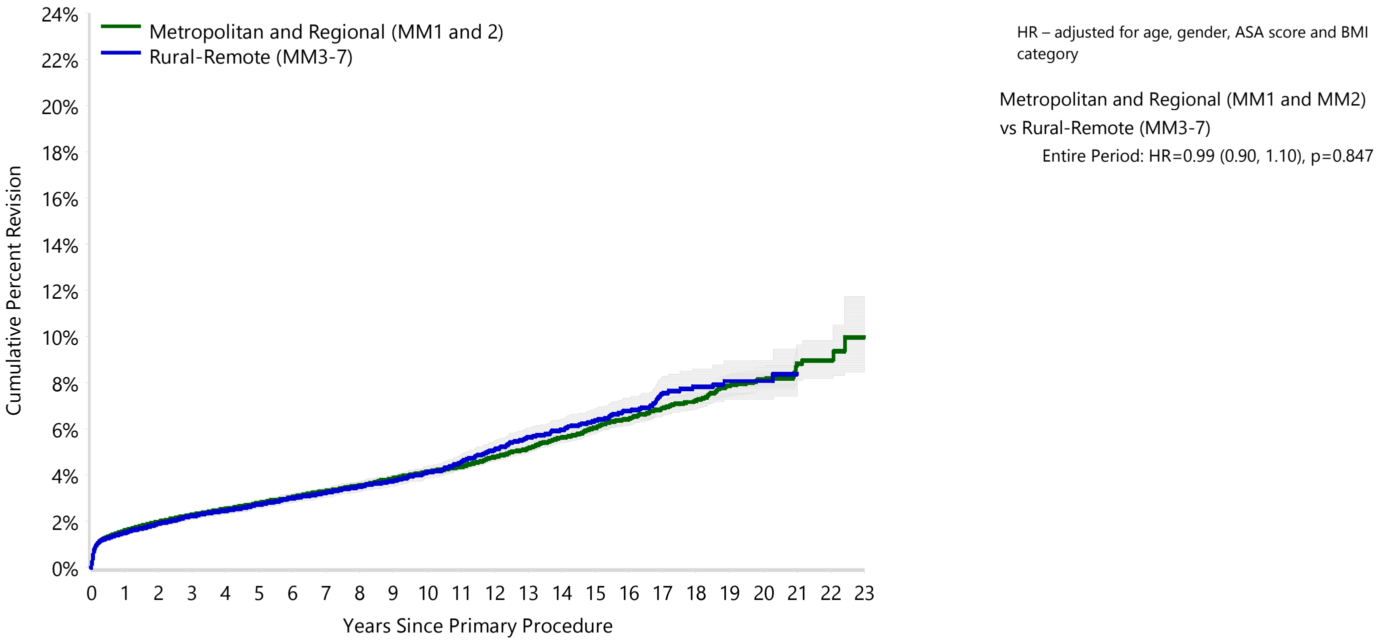
Note: All procedures using metal/metal prostheses have been excluded. Restricted to modern prostheses

Table N11 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Hospital Locality and Hospital System (Primary Diagnosis OA)

Hospital Locality	Hospital Setting	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Metropolitan and Regional (MM1 and MM2)	**Public Hospital**	3815	107619	1.6 (1.5, 1.7)	2.3 (2.2, 2.4)	2.8 (2.7, 2.9)	4.1 (4.0, 4.3)	6.1 (5.8, 6.3)	8.1 (7.6, 8.7)
	Private Hospital	10046	302649	1.6 (1.5, 1.6)	2.3 (2.3, 2.4)	2.8 (2.8, 2.9)	4.3 (4.2, 4.4)	6.1 (6.0, 6.3)	8.0 (7.7, 8.4)
Rural-Remote (MM3-7)	**Public Hospital**	1209	35699	1.5 (1.4, 1.6)	2.2 (2.1, 2.4)	2.7 (2.6, 2.9)	4.1 (3.9, 4.4)	6.4 (5.9, 6.9)	8.1 (7.3, 8.9)
	Private Hospital	865	25688	1.7 (1.6, 1.9)	2.5 (2.3, 2.7)	3.0 (2.8, 3.2)	4.5 (4.1, 4.8)	6.0 (5.4, 6.6)	8.2 (7.0, 9.6)
TOTAL		15935	471655						

Note: All procedures using metal/metal prostheses have been excluded. Restricted to modern prostheses

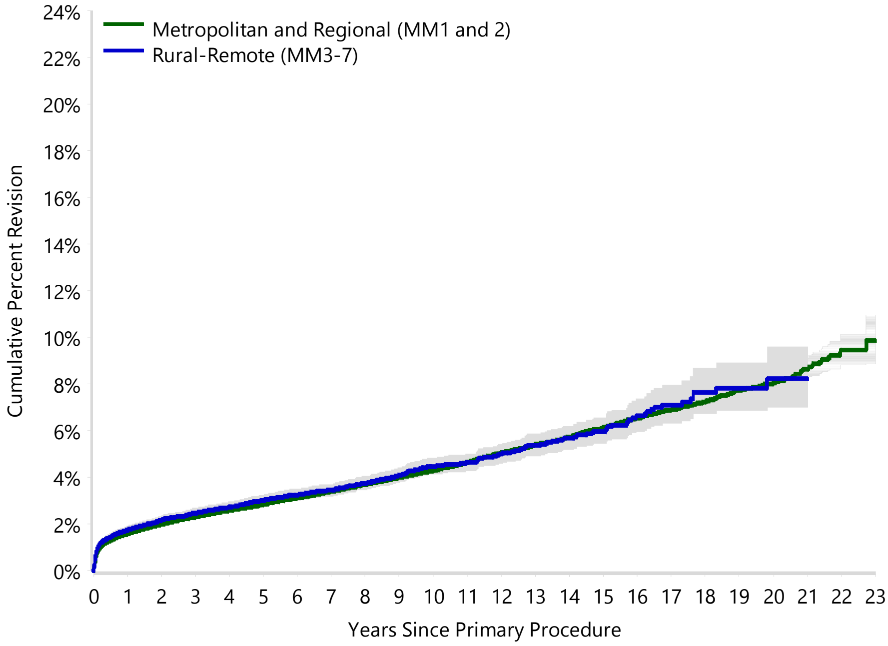
Figure N47 Cumulative Percent Revision of Primary Total Conventional Hip Replacement in Public Hospitals by Hospital Locality (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Metropolitan and Regional (MM1 and MM2)	107619	98102	83405	66746	28853	9079	1382
Rural-Remote (MM3-7)	35699	32190	26249	20305	8229	2578	355

Note: All procedures using metal/metal prostheses have been excluded. Restricted to modern prostheses

Figure N48 Cumulative Percent Revision of Primary Total Conventional Hip Replacement in Private Hospitals by Hospital Locality (Primary Diagnosis OA)



HR – adjusted for age, gender, ASA score and BMI category

Metropolitan and Regional (MM1 and MM2) vs Rural-Remote (MM3-7)

Entire Period: HR=0.89 (0.81, 0.98), p=0.019

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Metropolitan and Regional (MM1 and MM2)	302649	266878	208542	158923	64356	19158	3498
Rural-Remote (MM3-7)	25688	22574	17294	13095	5123	1525	198

Note: All procedures using metal/metal prostheses have been excluded. Restricted to modern prostheses

VARIATION IN PROSTHESIS CHARACTERISTICS BY HOSPITAL LOCALITY

An overview of prosthesis characteristics by metropolitan/regional and rural/remote settings is summarised in Table N12.

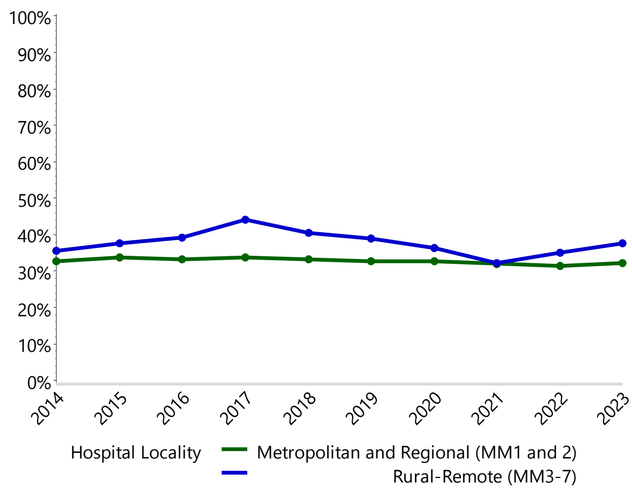
Variations in Prosthesis Use by Hospital Locality
Over the past decade there has been a higher rate of usage of less common prostheses in hip replacements performed in a rural area compared to a metropolitan setting (Figure N49).

Table N12 Summary of Primary Total Conventional Hip Replacement Since 2014 by Hospital Locality (Primary Diagnosis OA)

Variable		Metropolitan-Regional (MM1 and MM2)	Rural-Remote (MM3-7)	TOTAL
Fixation				
	Cemented	6,084 (2%)	859 (1.9%)	6,943 (2%)
	Cementless	196,416 (66.1%)	26,108 (59.1%)	222,524 (65.2%)
	Hybrid	94,601 (31.8%)	17,206 (39%)	111,807 (32.8%)
Headsize[1]				
	<32mm	31,875 (10.7%)	5,066 (11.5%)	36,941 (10.8%)
	32mm	105,804 (35.6%)	15,219 (34.5%)	121,023 (35.5%)
	>32mm	159,363 (53.6%)	23,879 (54.1%)	183,242 (53.7%)
Bearing Surface				
	Ceramic/Ceramic	49,723 (16.7%)	3,190 (7.2%)	52,913 (15.5%)
	Ceramic/XLPE	126,245 (42.5%)	15,571 (35.3%)	141,816 (41.6%)
	Metal/XLPE	91,215 (30.7%)	21,469 (48.6%)	112,684 (33%)
	Ceramicised Metal/XLPE	22,494 (7.6%)	3,168 (7.2%)	25,662 (7.5%)
	Other	7,424 (2.5%)	775 (1.8%)	8,199 (2.4%)
Dual Mobility				
	Dual Mobility Prosthesis	21,445 (7.2%)	2,460 (5.6%)	23,905 (7%)
	Other Acetabular Prosthesis	275,656 (92.8%)	41,713 (94.4%)	317,369 (93%)
TOTAL		297,101	44,173	341,274

[1]Excludes 68 procedures with unknown head size

Figure N49 Percentage of Less Commonly Used Femoral Stems in Primary Total Conventional Hip Replacement by Hospital Locality (Primary Diagnosis OA)



Variation in Fixation by Hospital Locality

Cementless fixation is used for a greater proportion and hybrid fixation for a smaller proportion of hip replacement in metropolitan/regional centres compared to rural and remote regions. Fixation trends in metropolitan/regional and rural/remote areas have been largely unchanged over the last decade with limited differences seen with hospital locality (Figure N50 and Figure N51). Fully cemented fixation is rarely used in either location.

Figure N50 Percentage of Cementless Primary Total Conventional Hip Replacement by Hospital Locality (Primary Diagnosis OA)

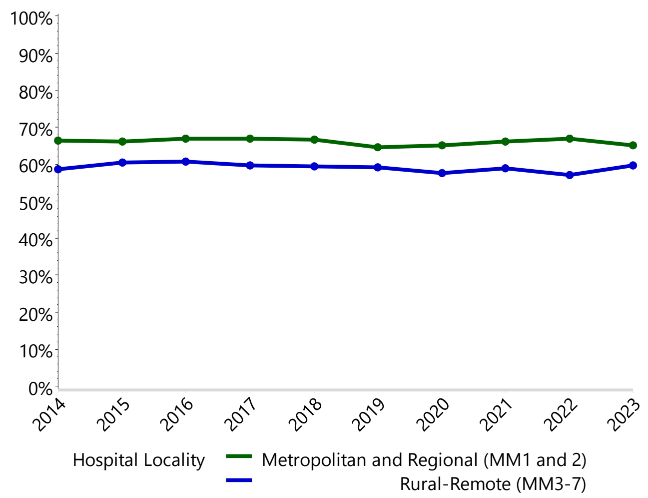
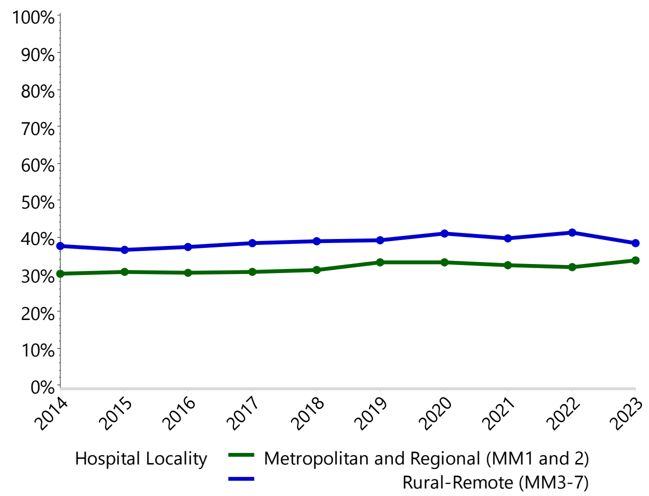


Figure N51 Percentage of Hybrid Primary Total Conventional Hip Replacement by Hospital Locality (Primary Diagnosis OA)



Variation in Head Size by Hospital Locality

The proportions of head sizes <32,mm, 32mm and >32mm used for conventional hip replacement in metropolitan/regional and rural/remote areas over the past decade are shown in Figure N52, Figure N53 and Figure N54.

Both regions have seen similar changes. These are low use with a recent small increase in head size <32mm, a decline in use of 32mm heads and an increase in head size >32mm. In 2023, head size >32mm is used for over 60.0% of primary conventional hip replacement procedures in both localities.

Figure N52 Percentage of 32mm in Primary Total Conventional Hip by Hospital Locality (Primary Diagnosis OA)

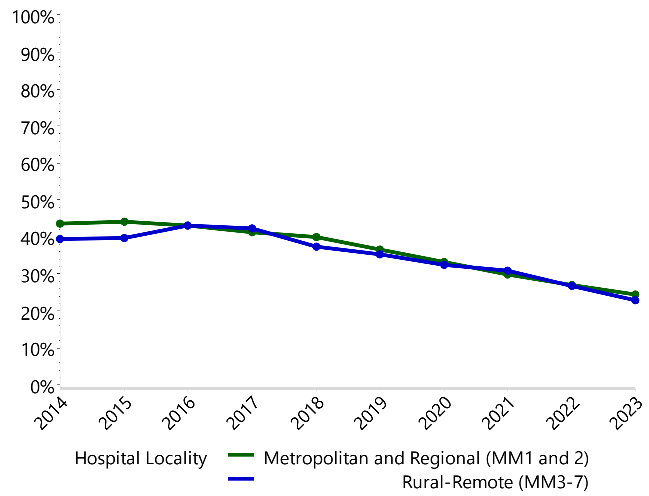


Figure N53 **Percentage of <32mm Head Size in Primary Total Conventional Hip Replacement by Hospital Locality (Primary Diagnosis OA)**

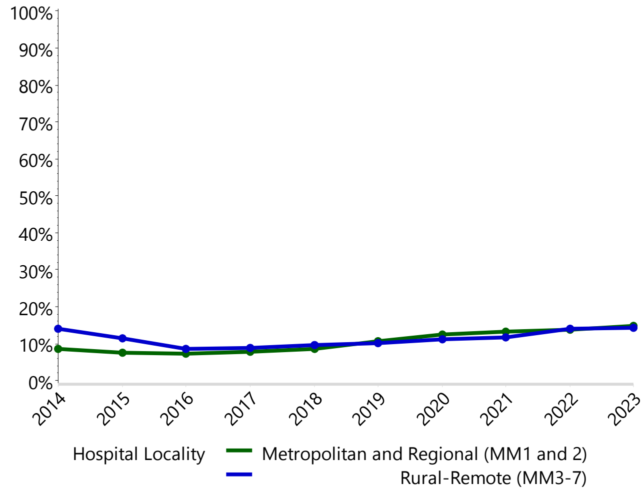
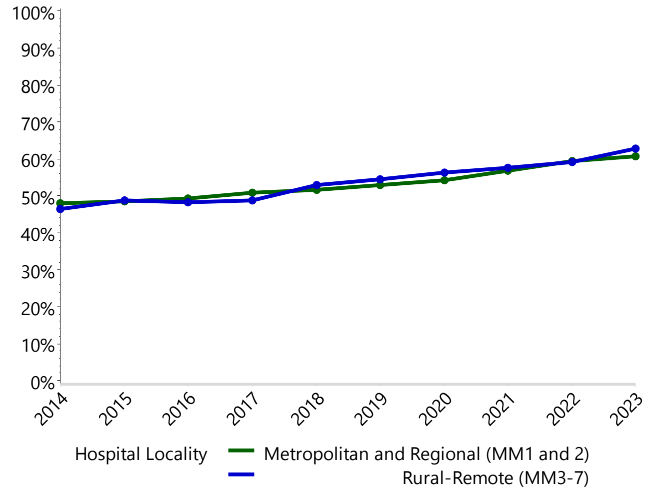


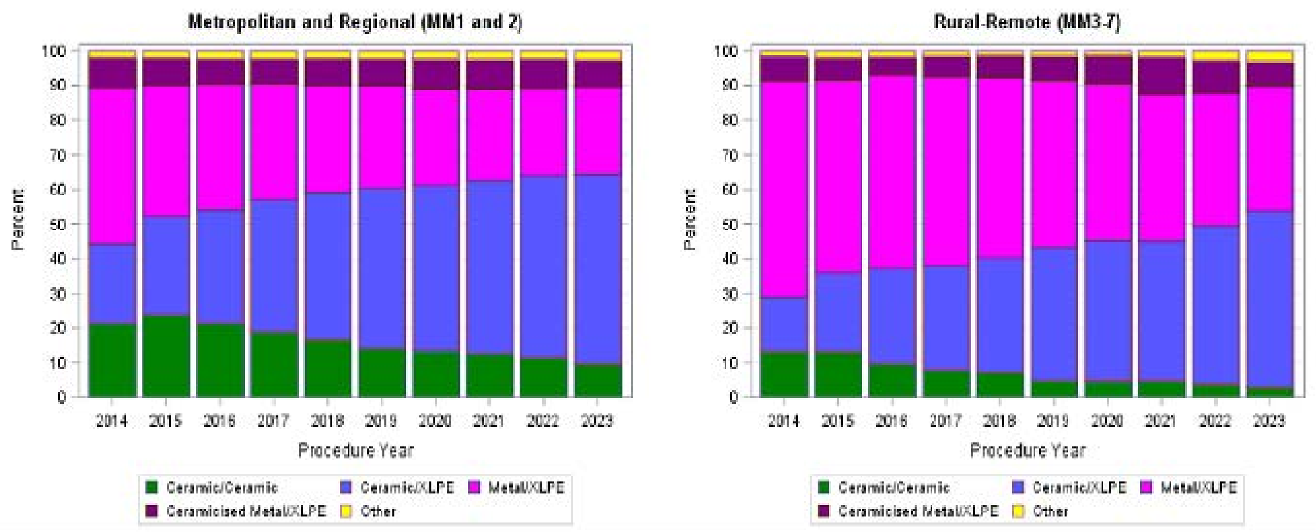
Figure N54 **Percentage of >32mm Head Size in Primary Total Conventional Hip Replacement by Hospital Locality (Primary Diagnosis OA)**



Variation in Bearing Surface by Hospital Locality
There has been a decline in the use of both ceramic/ceramic and metal/XLPE bearings and an increase in the use of ceramic/XLPE in hip replacements performed in both metropolitan/regional and rural/remote hospitals over the past 10 years.

The proportion of metal/XLPE bearings used in rural-remote procedures remain higher than in MM1 and MM2 hospitals (Figure N55).

Figure N55 **Bearing Surface of Primary Total Conventional Hip Replacement by Hospital Locality**



Note: Other includes non XLPE, ceramicised metal/ceramic, metal/metal, and metal/ceramic bearing surface

Variation in Technology Assistance by Hospital Locality

The use of technology assistance for primary total conventional hip replacement has increased in both metropolitan/regional and rural/remote settings. In 2023, technology assistance is used in 30.0% of metropolitan/regional hip replacement procedures, while this is less than 20.0% for rural/remote procedures (Figure N56). Robotic assistance has been used in small numbers over the last 2 years for procedures performed in rural/remote areas (Figure N57). There is little difference in the proportion of hip replacement procedures using computer navigation (Figure N58). IDI is the most frequently used technology in both hospital locality settings for primary total conventional hip replacement but is less frequently used in rural/remote areas (Figure N59).

Figure N56 Percentage of Technology Assisted Primary Total Conventional Hip by Hospital Locality (Primary Diagnosis OA)

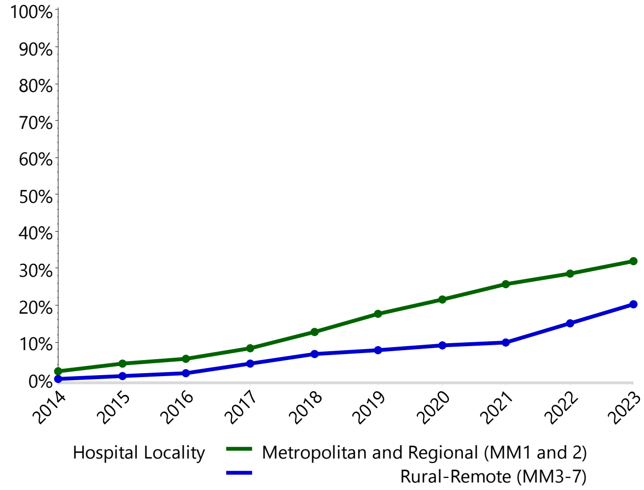


Figure N58 Percentage of Primary Total Conventional Hip Replacement using Computer Navigation by Hospital Locality (Primary Diagnosis OA)

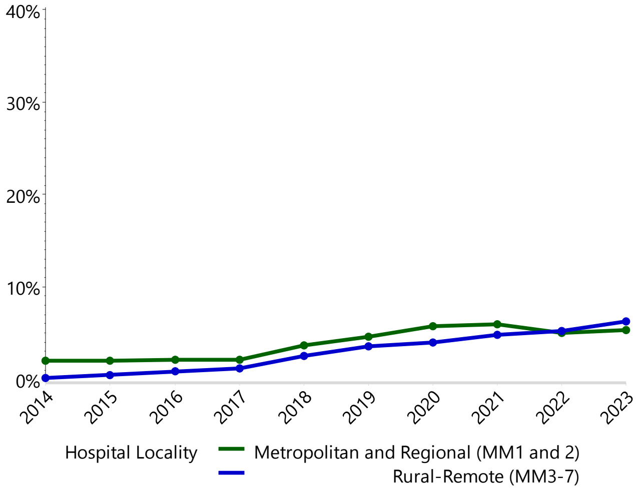


Figure N57 Percentage of Primary Total Conventional Hip Replacement using Robotic Assistance by Hospital Locality (Primary Diagnosis OA)

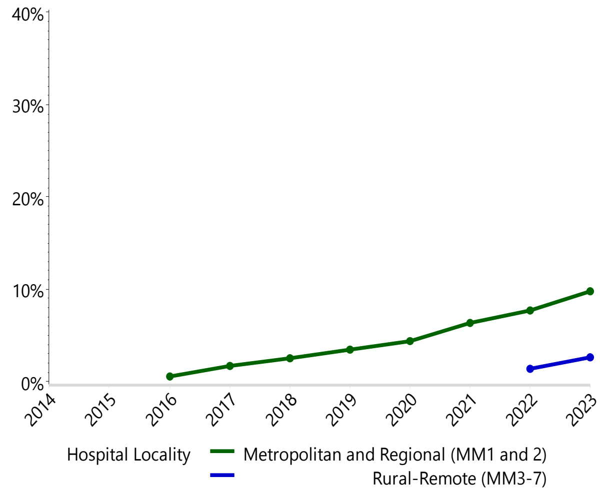
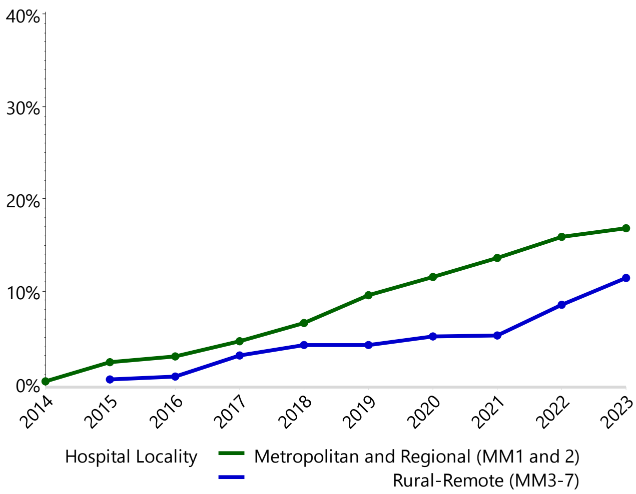


Figure N59 Percentage of Primary Total Conventional Hip Replacement using IDI by Hospital Locality (Primary Diagnosis OA)



Revision Procedures and Diagnoses by Hospital Locality

Over the last 10 years major revision has decreased in both hospital locality groups (Figure N60). Whilst individual diagnoses vary year to year, revision for infection is increasing in both localities (Figure N61).

Figure N60 Percentage of Major Revision in 1st Revision Hip Replacement of Primary Total Conventional Hip Replacement by Hospital Locality (All Diagnoses)

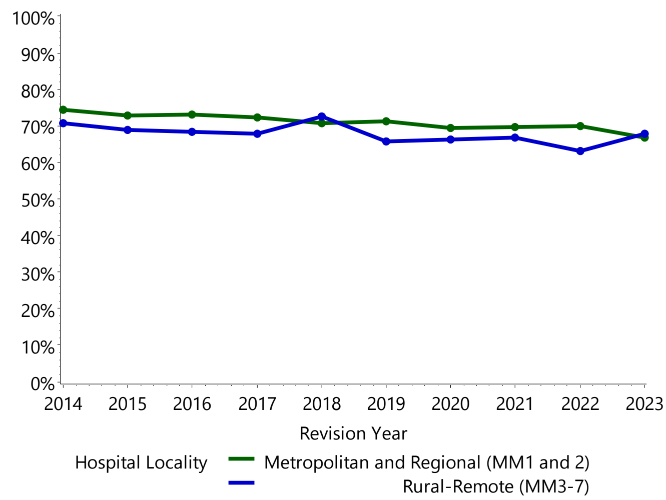
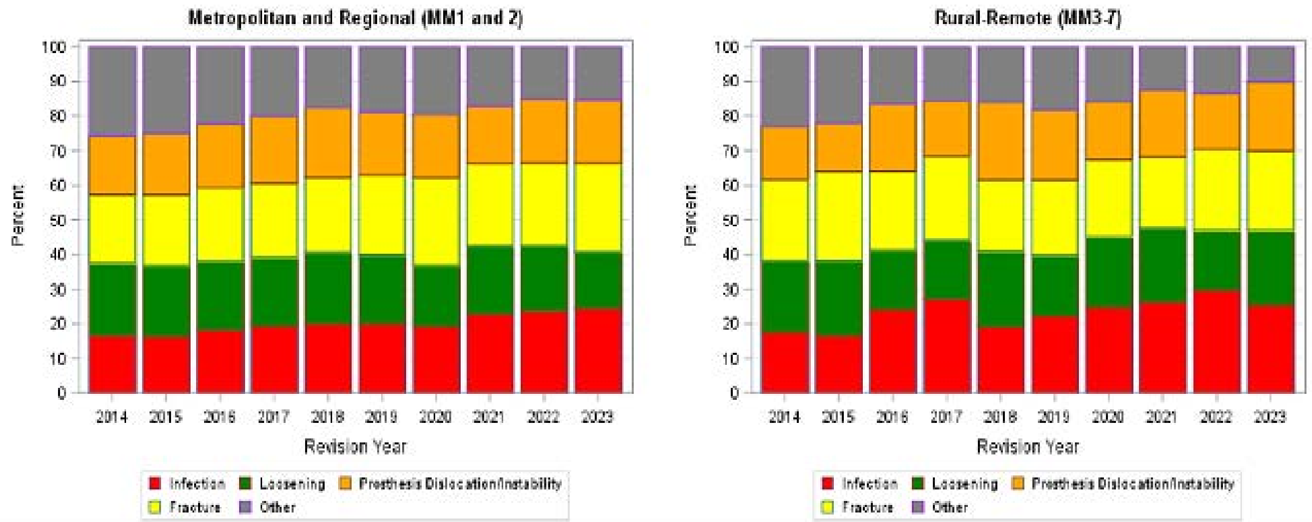


Figure N61 Revision Diagnosis of 1st Revision Hip Replacement of Primary Total Conventional Hip Replacement by Hospital Locality (All Diagnoses)



HIP REPLACEMENT VARIATION SUMMARY

This section has shown many similarities, along with a few differences, in patients undergoing hip replacement in the states and territories of Australia, as well as the surgeons performing these procedures. There is similarity in patient age, gender, ASA and BMI across all states, but quite noticeable differences in proportions with the highest and lowest IRSAD ratings. There has been a gradual increase nationally in the number of surgeons performing hip replacement during the last decade, but the proportions of both those with <4 years' experience, and <20 procedures/year are decreasing, and this latter group contributes to <20% of the total volume of hip replacements/year.

The incidence of hip replacement per 100,000 population has increased over the last decade, and in 2023 ranges from 40/100,000 in the NT to 301/100,000 in TAS. These calculations, however, do not consider the age distribution differences between the states or other factors that may influence the prevalence of osteoarthritis. The proportion of private hip replacement procedures has increased over the last 10 years and is over 80% in all states in 2023. There are some small differences in the cumulative percent revision between the states and these vary for hip replacement in the private and public systems.

Prostheses are chosen from the 10 most commonly used stems in 60%-75% of hip replacements, and there are common national trends over the last decade for fewer fully cemented procedures, increasing use of >32mm head size, and a change from metal/polyethylene and ceramic/ceramic bearings to more ceramic/polyethylene. There has been increased use of technology assistance (mostly robotic assistance and IDI) and also newer technologies (such as dual mobility bearings) particularly in the last 5 years, but there is some variability in the rate of change between the states/territories.

Analysis of revision hip replacement shows a small shift to fewer major revisions with time, which may reflect the increase in revisions for infection in all states, and an increase in DAIR (debridement and implant retention) to manage this problem.

The proportion of hip replacement procedures in rural/remote hospitals varies between states, and is highest at 25% for NSW, but this, in general, relates to each state's population and distribution. Patients from rural/remote areas are similar to metropolitan/regional patients in age, gender, ASA and BMI, but there are differences in IRSAD rating, with more disadvantaged patients in rural/remote areas. There are many surgeon similarities regarding procedure volume and experience in both localities.

There are minor differences in revision rate of hip replacement for the first month only favouring metropolitan/regional hospitals overall, with no differences for public hospital procedures, and a marginally lower rate of revision for private hospitals in metropolitan/regional areas. Prosthesis use between regions shows similar proportions of less commonly used stems, similar head sizes, but increased use of cemented stems, fewer ceramic heads and lower use with slower uptake of technology assistance in the country regions. Revision procedures reflect similar changes to the state analysis, with a minor decrease in major revision and increased revision for infection over the past decade in both localities.

Arthroplasty Practice Variation in Australia

Practice Variation in Knee Replacement

When all primary knee replacement procedures are considered for all diagnoses, the majority are total knee replacement, with unicompartmental and patella/trochlear replacements far less common (Table N13 and Figure N62). From 2016 onward there has been a small increase in the proportion of unicompartmental knee replacement. Each state or territory follows the national trends in classes of primary knee procedures (Figure N63).

Figure N62 Primary Knee Replacement in Australia by Class (All Diagnoses)

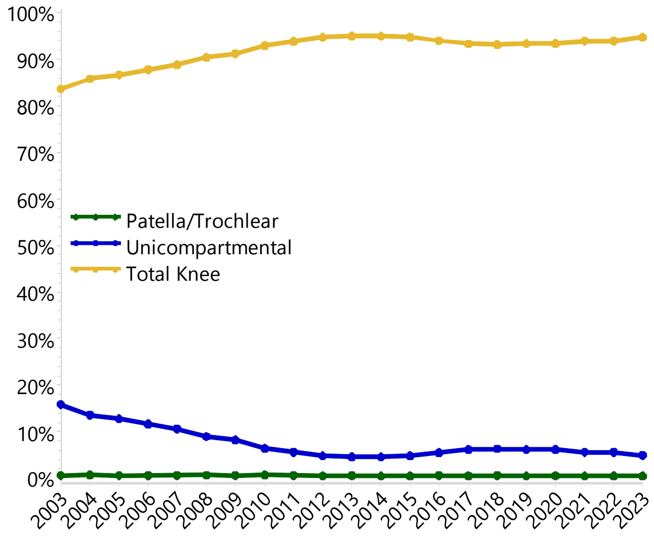
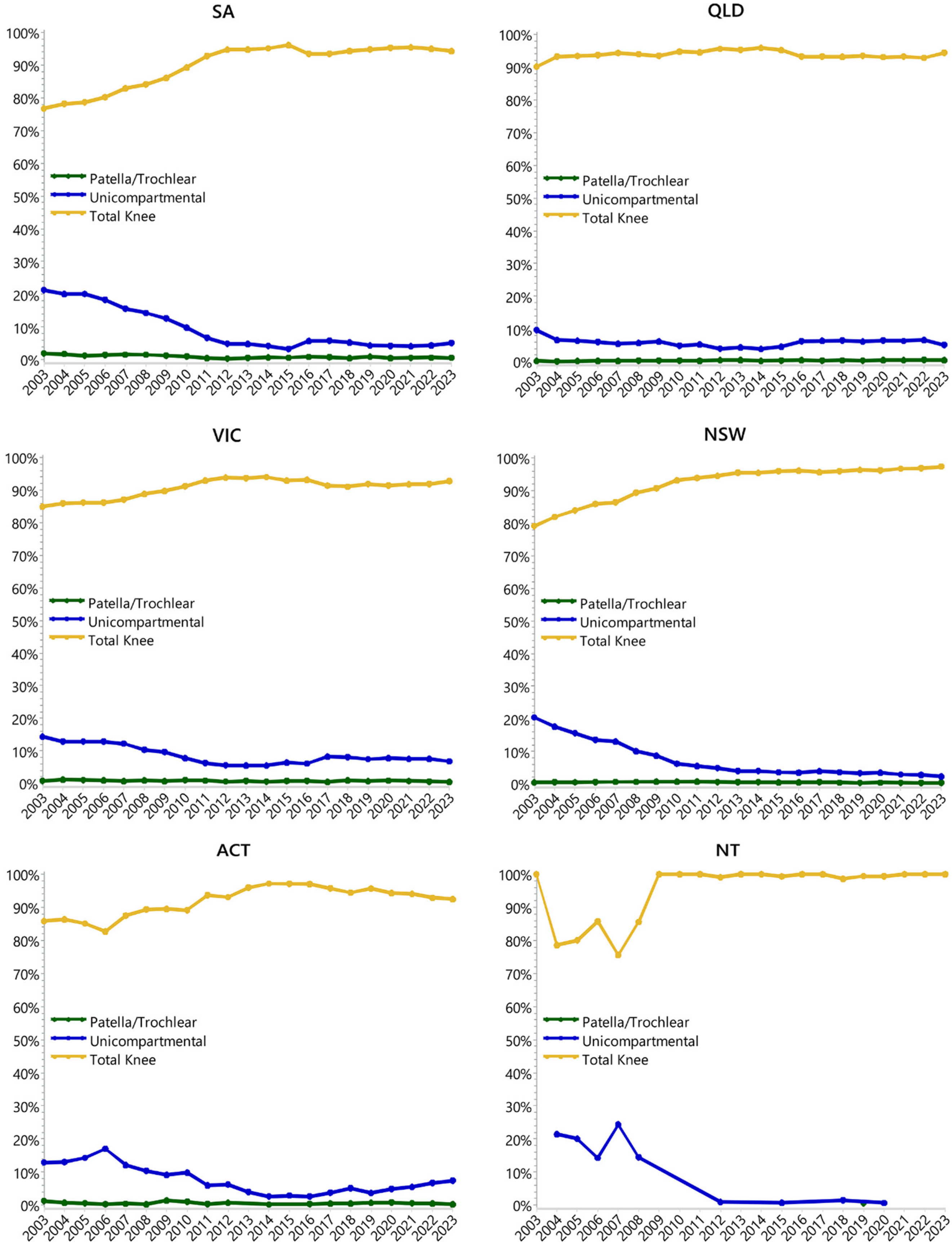


Table N13 Primary Knee Replacement by State/Territory and Class (All Diagnoses)

State	Patella/Trochlear		Unicompartmental		Total Knee		TOTAL	
	N	Row%	N	Row%	N	Row%	N	Row%
SA	794	0.9	7920	8.5	84271	90.6	92985	100.0
QLD	759	0.4	12642	6.0	197675	93.7	211076	100.0
VIC	1571	0.7	17952	8.4	193324	90.8	212847	100.0
NSW	1731	0.5	23105	6.6	327472	93.0	352308	100.0
WA	364	0.3	8871	7.8	103942	91.8	113177	100.0
TAS	84	0.3	2269	8.2	25277	91.5	27630	100.0
NT	1	0.0	61	2.4	2525	97.6	2587	100.0
ACT	121	0.5	1686	7.2	21689	92.3	23496	100.0
TOTAL	5425	0.5	74506	7.2	956175	92.3	1036106	100.0

Figure N63 Primary Knee Replacement by Class and State/Territory (All Diagnoses)



Note: ACT has no patella/trochlear procedures in 2013 and 2015; NT has one patella/trochlear procedures in 2019, and no unicompartmental procedures in 2003, 2009-2011, 2013-2014, 2016-2017, 2019, and after 2020.

VARIATION IN PATIENT CHARACTERISTICS

Age and Gender

The average age for patients undergoing primary total knee replacement for osteoarthritis in most states is 68 years, however, it is slightly younger in the ACT and NT. The proportion of patients in each age cohort likewise varies very little between states, but both territories have a higher proportion of patients <55 years of age and a smaller proportion of patients ≥75 years undergoing knee replacement. Apart from NT, in each state, more females have had knee replacements than males (Table N14).

ASA Score

Over the last decade there has been an increase in co-morbidity of patients undergoing knee replacement. There are fewer patients with ASA score 1 and 2 and there has been a concomitant rise in patients with severe co-morbidity (an ASA score of 3 or 4).

Nationally, 41.0% of patients have ASA scores of 3 or 4 (Table N15), while in 2023 both SA and VIC, over 49.0% of patients are in these categories. TAS and NT currently have the lowest percentage (31.7% and 31.8%) of patients with an ASA score of 3 or 4. The ASA trends over time are displayed in Figure N64.

BMI Category

Since 2014 and throughout the different states, the distribution in BMI category is similar (Table N15). The percentage of patients who are normal weight or pre-obese compared to above these BMI categories is displayed in Figure N65.

Table N14 Summary of Primary Total Knee Replacement Patient Characteristics Since 2014 by State/Territory (Primary Diagnosis OA)

Variable	SA	QLD	VIC	NSW	WA	TAS	NT	ACT	TOTAL
Age									
Mean ± SD	67.9 ± 9.2	68.3 ± 8.6	68.8 ± 8.9	68.6 ± 8.9	67.8 ± 9.1	67.9 ± 8.9	65.6 ± 8.6	66.6 ± 9.3	68.4 ± 8.9
Median (IQR)	68 (62, 74)	69 (62, 74)	69 (63, 75)	69 (63, 75)	68 (62, 74)	68 (62, 74)	66 (60, 72)	67 (60, 73)	69 (62, 75)
Age Group									
<55	3,655 (7.6%)	6,684 (5.8%)	6,402 (5.9%)	11,398 (6.1%)	4,481 (7.5%)	1,035 (6.9%)	166 (9.9%)	1,297 (10.2%)	35,118 (6.4%)
55-64	13,340 (27.7%)	31,020 (27%)	27,648 (25.5%)	48,839 (26%)	16,616 (27.9%)	4,356 (29%)	568 (33.8%)	3,950 (31%)	146,337 (26.7%)
65-74	19,188 (39.9%)	49,159 (42.8%)	44,766 (41.3%)	77,796 (41.3%)	24,053 (40.4%)	6,070 (40.4%)	685 (40.7%)	4,846 (38%)	226,563 (41.3%)
≥75	11,948 (24.8%)	27,930 (24.3%)	29,563 (27.3%)	50,114 (26.6%)	14,447 (24.2%)	3,581 (23.8%)	262 (15.6%)	2,651 (20.8%)	140,496 (25.6%)
Gender									
Male	20,953 (43.5%)	53,818 (46.9%)	46,545 (42.9%)	85,299 (45.3%)	28,052 (47.1%)	6,814 (45.3%)	895 (53.2%)	5,543 (43.5%)	247,919 (45.2%)
Female	27,178 (56.5%)	60,975 (53.1%)	61,834 (57.1%)	102,848 (54.7%)	31,545 (52.9%)	8,228 (54.7%)	786 (46.8%)	7,201 (56.5%)	300,595 (54.8%)
TOTAL	**48,131**	**114,793**	**108,379**	**188,147**	**59,597**	**15,042**	**1,681**	**12,744**	**548,514**

Table N15 Summary of ASA Score and BMI Category in Primary Total Knee Replacement Since 2014 by State/Territory (Primary Diagnosis OA)

Variable	SA N (%)	QLD N (%)	VIC N (%)	NSW N (%)	WA N (%)	TAS N (%)	NT N (%)	ACT N (%)	TOTAL N (%)
ASA Category[a]									
ASA 1	2,376 (5%)	5,725 (5%)	5,359 (5%)	10,315 (5.5%)	3,621 (6.1%)	603 (4.1%)	105 (6.2%)	922 (7.2%)	29,026 (5.3%)
ASA 2	24,285 (50.7%)	62,858 (54.9%)	54,027 (50.1%)	99,636 (53.2%)	33,995 (57.2%)	9,730 (66.1%)	1,008 (60%)	7,267 (57%)	292,806 (53.6%)
ASA 3	20,916 (43.7%)	44,844 (39.2%)	46,839 (43.4%)	75,341 (40.2%)	21,382 (36%)	4,298 (29.2%)	564 (33.6%)	4,496 (35.3%)	218,680 (40%)
ASA 4	291 (0.6%)	1,050 (0.9%)	1,604 (1.5%)	2,022 (1.1%)	432 (0.7%)	98 (0.7%)	4 (0.2%)	52 (0.4%)	5,553 (1%)
ASA 5	1 (0%)	4 (0%)	4 (0%)	5 (0%)	1 (0%)			1 (0%)	16 (0%)
BMI Category[b]									
Underweight	76 (0.2%)	172 (0.2%)	178 (0.2%)	302 (0.2%)	99 (0.2%)	35 (0.3%)	1 (0.1%)	29 (0.3%)	892 (0.2%)
Normal	4,047 (9.3%)	9,873 (9.6%)	9,991 (10.4%)	17,911 (10.9%)	5,823 (11.5%)	1,561 (11.5%)	128 (8.9%)	1,397 (12.1%)	50,731 (10.5%)
Pre Obese	12,828 (29.5%)	31,178 (30.4%)	29,751 (31.1%)	52,461 (31.8%)	16,554 (32.8%)	4,379 (32.1%)	411 (28.5%)	3,558 (30.7%)	151,120 (31.2%)
Obese Class 1	13,945 (32%)	32,585 (31.8%)	28,936 (30.2%)	50,269 (30.5%)	15,658 (31%)	3,998 (29.3%)	484 (33.6%)	3,565 (30.8%)	149,440 (30.9%)
Obese Class 2	8,118 (18.7%)	18,312 (17.9%)	16,361 (17.1%)	26,952 (16.4%)	8,007 (15.9%)	2,207 (16.2%)	272 (18.9%)	1,769 (15.3%)	81,998 (17%)
Obese Class 3	4,506 (10.4%)	10,403 (10.1%)	10,500 (11%)	16,924 (10.3%)	4,334 (8.6%)	1,443 (10.6%)	144 (10%)	1,266 (10.9%)	49,520 (10.2%)
TOTAL	48,131	114,793	108,379	188,147	59,597	15,042	1,681	12,744	548,514

Abbreviations: ASA - American Society of Anesthesiologists, BMI - Body Mass Index (kg/m^2): Underweight (<18.50), Normal (18.50-24.99), Pre Obese (25.00-29.99), Obese Class 1 (30.00-34.99), Obese Class 2 (35.00-39.99), Obese Class 3 (≥40.00)
BMI category recorded from 2015
[a]Excludes 2,433 procedures with unknown ASA score
[b]Excludes 64,813 procedures with unknown BMI category

Figure N64 ASA Score of Primary Total Knee Replacement (Primary Diagnosis OA)

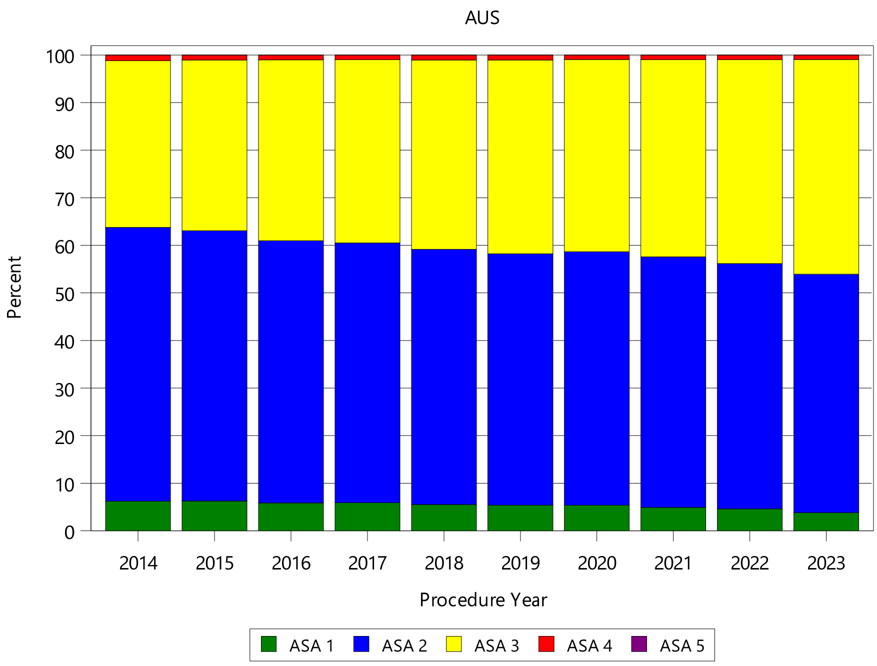
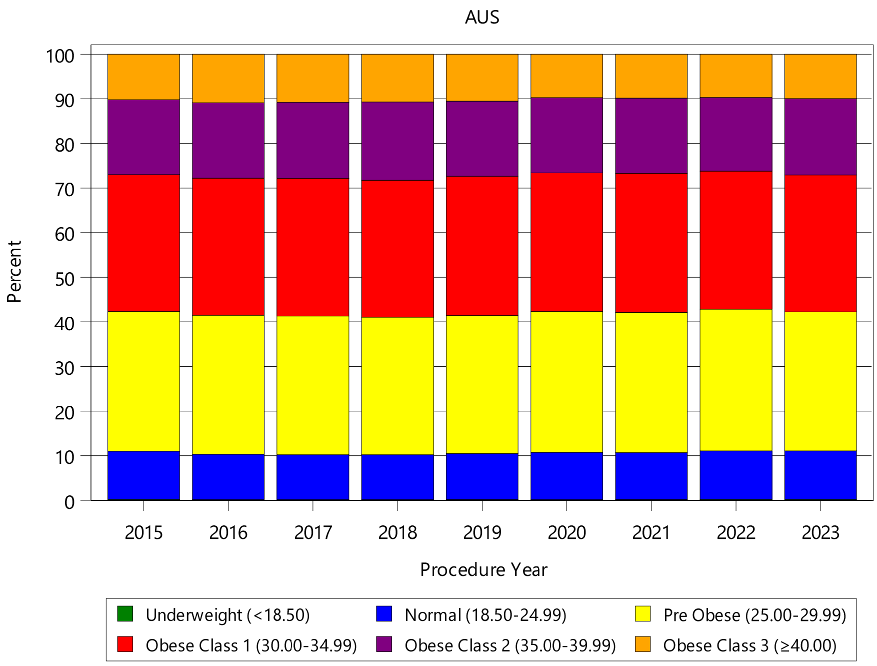


Figure N65 BMI Category of Primary Total Knee Replacement (Primary Diagnosis OA)



Variation in Socioeconomic Disadvantage
The Index of Relative Socio-economic Advantage and Disadvantage (IRSAD) is created by the Australian Bureau of Statistics as a summary measure of the socioeconomic status for each geographical area.[6] An IRSAD rating of 1 indicates the most socioeconomically disadvantaged region, while a rating of 10 indicates the most advantaged.

Each Australian region has differing rates of social advantage and disadvantage. In 2023, the proportion of patients from regions rated most economically disadvantaged (IRSAD 1 or 2) undergoing knee replacement in TAS is 40.9%% compared to SA and QLD where it is 21.9% and 21.8%, respectively, while in NSW it is 18.5%, NT 13.3%, VIC 13.0%, with WA 7.2%, and ACT 1.5% (Figure N66).

Over the last decade 22.0% to 37.0% of patients undergoing knee replacement are from areas rated IRSAD 9 or 10 (the highest deciles) in VIC, NSW and WA. In the ACT the proportion of the population having knee replacement from areas rated IRSAD 9 or 10 has reduced from 70.0% to 45.0% over the past 10 years. Conversely, in TAS, less than 10% of patients having knee replacement are from areas in the highest two deciles (Figure N67).

We are unable to comment on whether these findings reflect population differences or variations in access to arthroplasty.

Figure N66 **Percentage of Primary Total Knee from Regions Rated IRSAD 1 and 2 by State/Territory (Primary Diagnosis OA)**

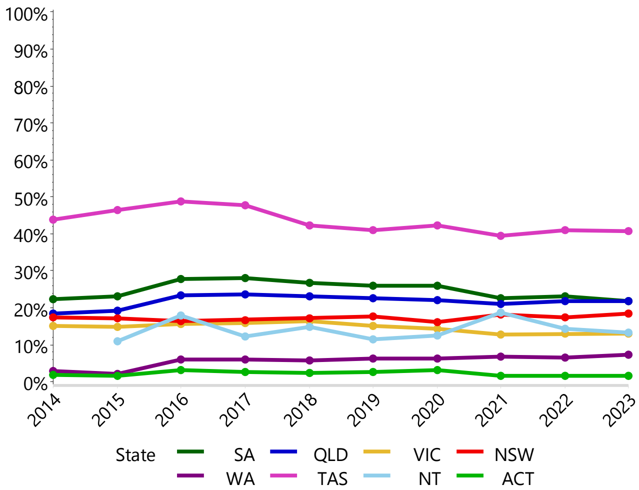
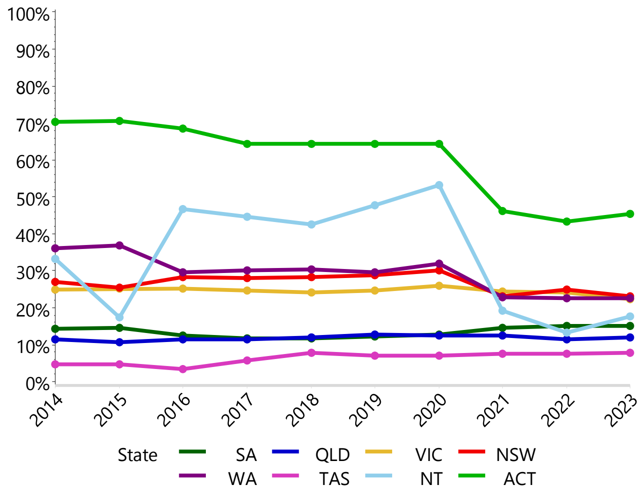


Figure N67 **Percentage of Primary Total Knee from Regions Rated IRSAD 9 and 10 by State/Territory (Primary Diagnosis OA)**



[6] https://www.abs.gov.au/statistics/people/people-and-communities/socio-economic-indexes-areas-seifa-australia/latest-release.

SURGEON VARIATION

Variation in Surgeon Volume

Over the last 10 years the number of surgeons performing total knee replacement has increased by 15% in Australia overall, although in SA and NT the number of surgeons has marginally reduced (Figure N68).

The proportion of surgeons undertaking less than 20 knee replacement procedures per year varies widely, from only 8.0% in TAS to 42.9% in the NT in 2023 (Figure N69). The proportion of knee replacement performed by surgeons undertaking <20 knee replacement procedures/year is less than 10.0%, apart from the NT (Figure N70).

Again, with the exception of the NT, in all states there is an increase in the proportion of procedures performed by higher volume surgeons (≥100/total knee replacements/year) (Figure N71). The ACT has the highest proportion of high volume knee replacement surgeons (42.9%) in 2023 (Figure N72).

Variation in Surgeon Experience

In each mainland state there has been a reduction in the proportion of surgeons undertaking knee replacement with less than 4 years' experience. In the less populous TAS, NT and ACT the proportion of surgeons with less than 4 years' experience has remained relatively constant (Figure N73).

Figure N68 **Number of Surgeons Performing Primary Total Knee Replacement by State/Territory (All Diagnoses)**

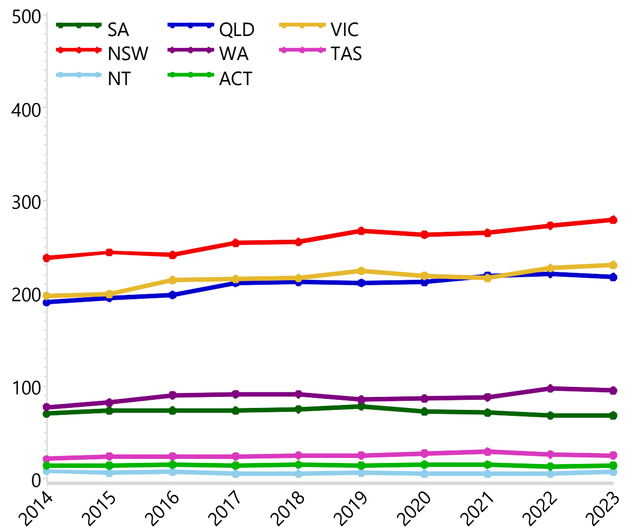


Figure N69 **Percentage of Surgeons with <20 Primary Total Knee Replacement procedures/Year by State/Territory (All Diagnoses)**

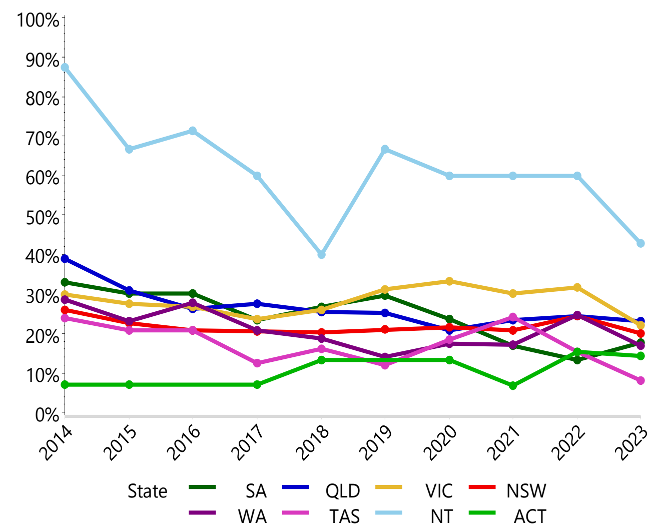


Figure N70 **Percentage of Primary Total Knee Replacements by Surgeons with <20 Procedures/Year by State/Territory (All Diagnoses)**

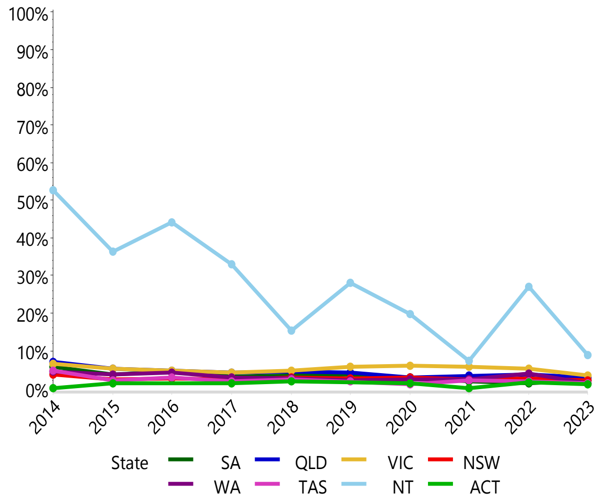


Figure N72 **Percentage of Surgeons with ≥100 Primary Total Knee Replacement Procedures/year by State/Territory (All Diagnoses)**

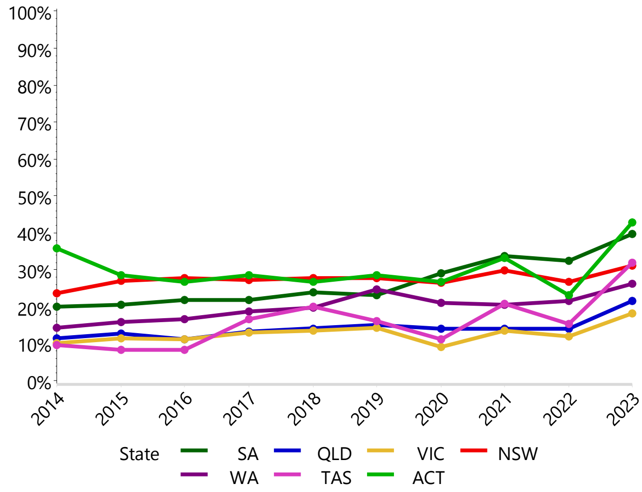


Figure N71 **Percentage of Primary Total Knee Replacements by Surgeons with ≥100 Procedures/Year by State/Territory (All Diagnoses)**

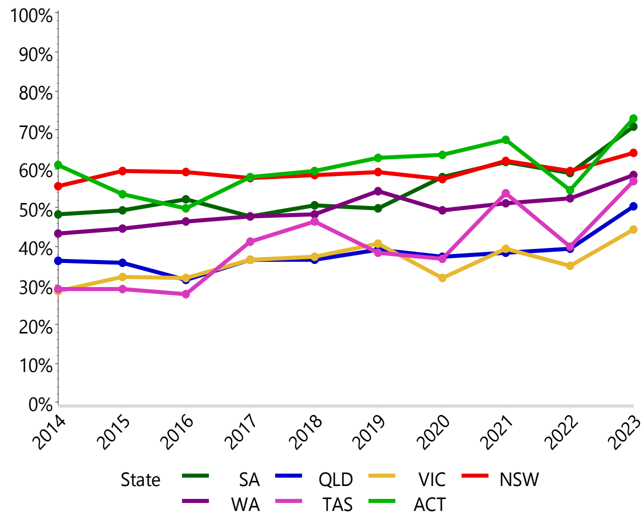
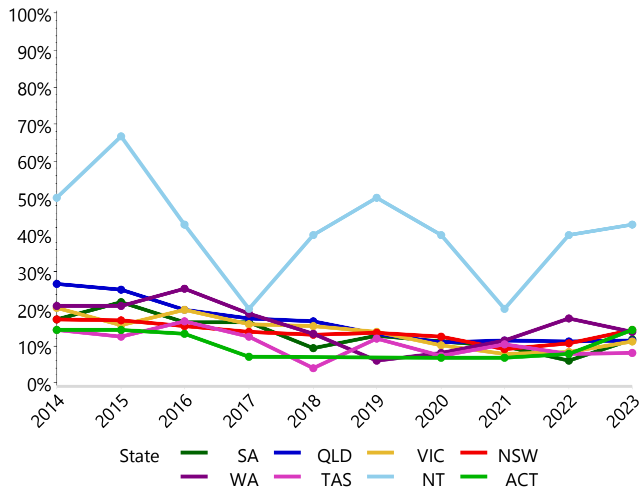


Figure N73 **Percentage of Surgeons with <4 Years Experience in Primary Total Knee Replacement by State/Territory (All Diagnoses)**



Arthroplasty Practice Variation in Australia

VARIATION IN PROCEDURE NUMBERS AND INCIDENCE

The following analyses include primary total knee replacement procedures performed for osteoarthritis.

The numbers of total knee replacement procedures have increased nationally for many years with most of this increase due to larger increases in procedure numbers in the three most populous states. Increases in procedure numbers are much less apparent in TAS, the ACT and NT (Figure N74).

Variation in Incidence of Knee Replacement

When the incidence of total knee replacement per 100,000 residents is considered the least populous states and territories have recorded much greater increases. The incidence in TAS has more than tripled and in the NT has increased by over 5 times over the past 20 years. In 2023, the incidence ranges from 105.9 per 100,000 residents in NT to 353.8 per 100,000 residents in TAS (Figure N75).

Figure N74 **Primary Total Knee Replacement in Australia by State/Territory**

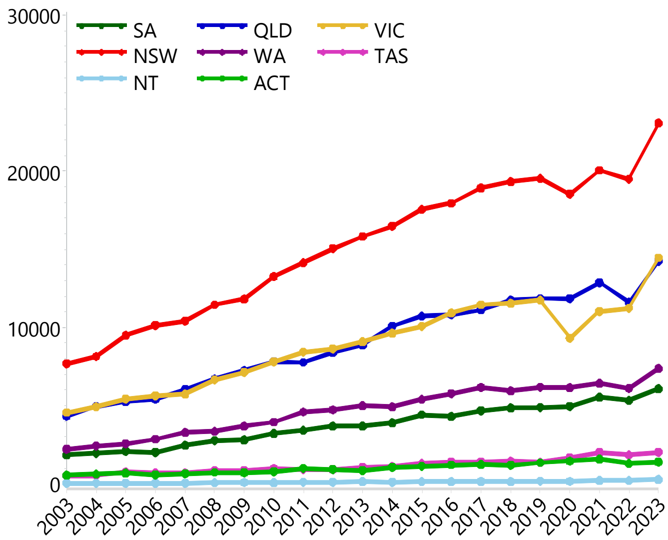
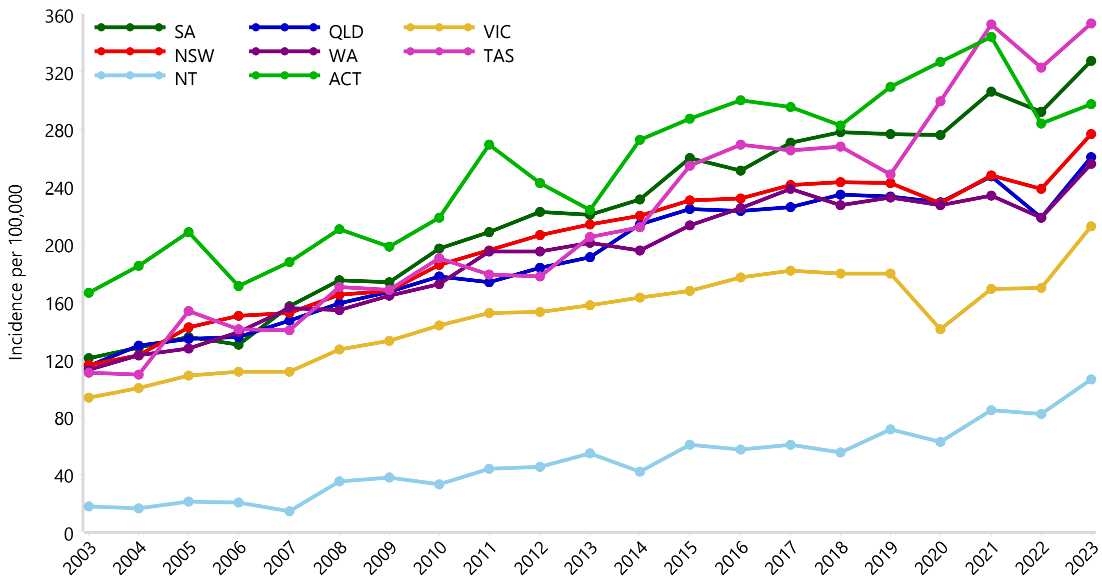


Figure N75 **Incidence of Knee Replacement per 100,000 persons between 2003 to 2023**



Variation in Cumulative Percent Revision
The following analyses include primary total knee procedures performed for osteoarthritis and using prostheses that have been available and used in 2023 (described as modern prostheses).

The following analyses have been undertaken with adjustments for age, gender, ASA score and BMI category. In comparison to NSW (the most populous state), ACT has a lower rate of revision. Also compared to NSW, the NT, WA, QLD and TAS all have higher rates of revision, while SA and VIC also have higher revision rates but not for the entire period (Table N16 and Figure N76).

Variation in Public/Private Hospital Procedures
While the amount of surgery undertaken in the private system varies between the states and territories it has typically been more than two thirds for the past decade. There has been a general decline in the proportion of knee replacements performed in the public sector. In 2023, in SA and TAS less than 20% of knee replacements are performed in public hospitals, with between 20.0% and 25.0% in public hospitals in QLD, WA, NSW and ACT (Figure N77).

In the public hospital system, when comparing to NSW (the most populous state) and adjusting for age, gender, ASA and BMI, WA, NT and QLD have higher rates of revision over the whole period. SA has a higher rate of revision after 6 months in comparison with NSW. There is no difference in revision rates comparing NSW with VIC, TAS or ACT (Table N17 and Figure N78).

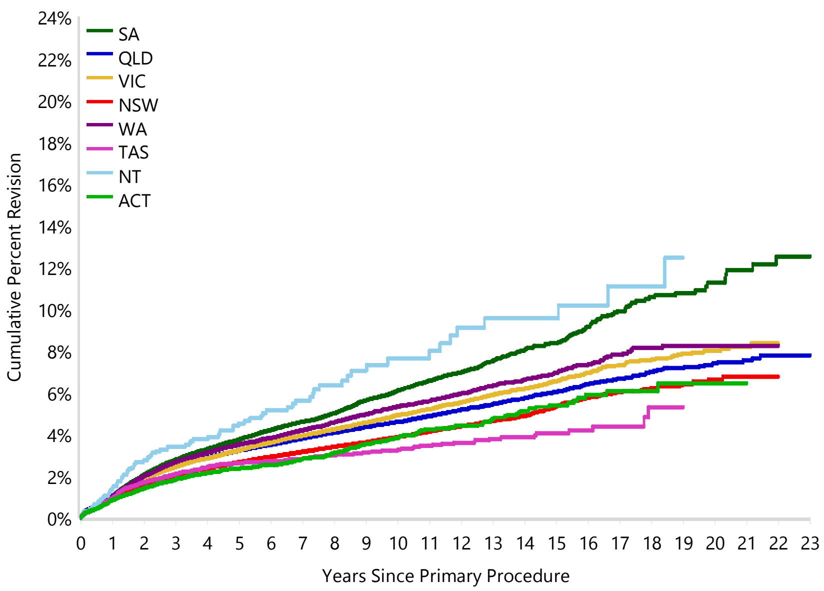
A difference in the CPR is seen when comparing knee replacement undertaken within the private system between states. Compared with NSW, WA, QLD, SA and TAS have higher rates of revision. VIC has a higher rate of revision than NSW between 1 and 3 months and after 6 months. There is no difference in revision rate comparing NT and NSW. ACT has a lower rate of revision than NSW (Table N17 and Figure N79).

Table N16 **Cumulative Percent Revision of Primary Total Knee Replacement by State/Territory (Primary Diagnosis OA)**

State	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
SA	2688	62942	1.0 (1.0, 1.1)	2.8 (2.7, 2.9)	3.7 (3.6, 3.9)	6.1 (5.8, 6.4)	8.4 (7.9, 8.8)	11.3 (10.3, 12.3)
QLD	5195	150388	1.0 (1.0, 1.1)	2.5 (2.4, 2.6)	3.2 (3.1, 3.3)	4.6 (4.5, 4.7)	6.0 (5.8, 6.3)	7.4 (7.0, 7.8)
VIC	5150	144367	0.9 (0.9, 1.0)	2.4 (2.4, 2.5)	3.2 (3.1, 3.3)	4.9 (4.8, 5.1)	6.5 (6.3, 6.8)	8.0 (7.6, 8.5)
NSW	7092	247039	0.9 (0.9, 0.9)	2.0 (2.0, 2.1)	2.7 (2.6, 2.7)	3.9 (3.8, 4.0)	5.3 (5.2, 5.5)	6.6 (6.2, 7.1)
WA	2986	78928	1.0 (0.9, 1.1)	2.7 (2.5, 2.8)	3.5 (3.4, 3.7)	5.3 (5.1, 5.5)	6.9 (6.6, 7.3)	8.2 (7.6, 8.9)
TAS	439	18144	0.9 (0.8, 1.1)	2.1 (1.9, 2.3)	2.6 (2.4, 2.9)	3.3 (2.9, 3.6)	4.0 (3.5, 4.6)	
NT	91	1896	1.4 (1.0, 2.1)	3.4 (2.6, 4.4)	4.5 (3.5, 5.8)	7.6 (6.0, 9.7)	9.5 (7.4, 12.3)	
ACT	485	17418	0.8 (0.7, 1.0)	1.8 (1.6, 2.1)	2.4 (2.1, 2.6)	3.8 (3.5, 4.2)	5.4 (4.8, 6.1)	6.4 (5.4, 7.7)
TOTAL	24126	721122						

Note: Restricted to modern prostheses

Figure N76 **Cumulative Percent Revision of Primary Total Knee Replacement by State/Territory (Primary Diagnosis OA)**



HR - adjusted for age, gender, ASA, and BMI

QLD vs NSW
Entire Period: HR=1.21 (1.15,1.28), p<0.001

SA vs NSW
0-0.5Yr: HR=1.06 (0.91,1.22), p=0.457
0.5Yr-1.5Yr: HR=1.45 (1.29,1.62), p<0.001
1.5Yr-3Yr: HR=1.52 (1.34,1.71), p<0.001
3Yr+: HR=1.80 (1.59,2.04), p<0.001

WA vs NSW
0-1.5Yr: HR=1.11 (1.02,1.22), p=0.021
1.5Yr+: HR=1.38 (1.26,1.52), p<0.001

NT vs NSW
Entire Period: HR=1.64 (1.22, 2.22), p=0.001

TAS vs NSW
Entire Period: HR=1.25 (1.10,1.41), p<0.001

VIC vs NSW
0-2Wk: HR=0.56 (0.38,0.82), p=0.003
2Wk-3Mth: HR=1.18 (1.03,1.35), p=0.017
3Mth-6Mth: HR=0.84 (0.69,1.02), p=0.086
6Mth-2Yr: HR=1.15 (1.06,1.25), p<0.001
2Yr+: HR=1.29 (1.18,1.40), p<0.001

ACT vs NSW
Entire Period: HR=0.79(0.68,0.91),p=0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
SA	62942	56078	44160	33950	13166	2794	471
QLD	150388	134124	106627	81633	33050	9768	1530
VIC	144367	128276	102887	80290	31610	7958	1095
NSW	247039	220833	176511	136006	53227	11854	844
WA	78928	70539	56233	43039	16291	3258	223
TAS	18144	15888	11785	8651	3214	751	18
NT	1896	1599	1151	823	303	145	26
ACT	17418	15833	12663	9630	4014	1036	77

Note: Restricted to modern prostheses.

Figure N77 Percentage of Primary Total Knee in Private Hospitals by State/Territory (Primary Diagnosis OA)

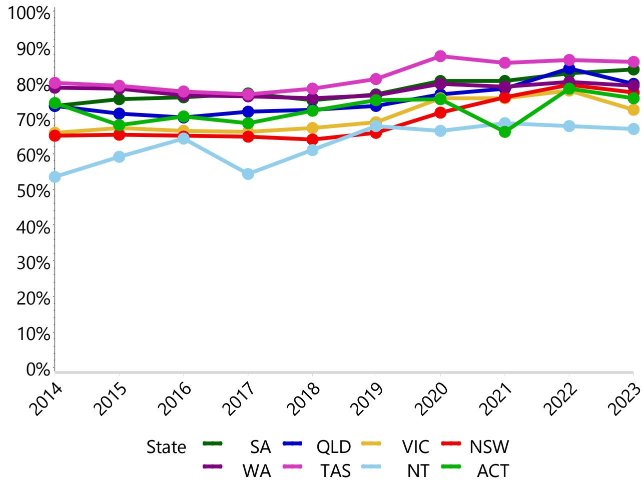
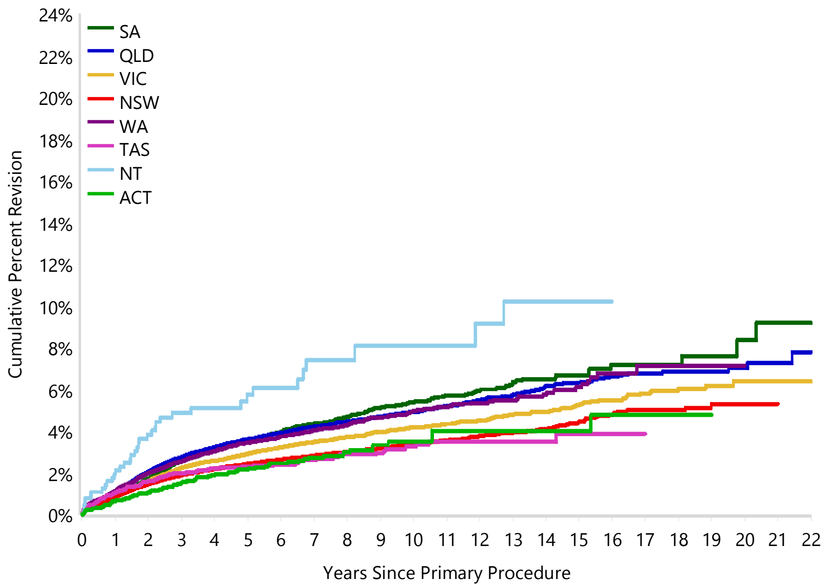


Table N17 Cumulative Percent Revision of Primary Total Knee Replacement by State/Territory and Hospital System (Primary Diagnosis OA)

State	Hospital Setting	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
SA	Public Hospital	545	13703	0.8 (0.7, 1.0)	2.6 (2.3, 2.9)	3.5 (3.2, 3.9)	5.4 (4.9, 5.9)	6.7 (6.0, 7.4)	8.4 (6.6, 10.5)
	Private Hospital	2143	49239	1.1 (1.0, 1.2)	2.8 (2.7, 3.0)	3.8 (3.6, 4.0)	6.3 (6.0, 6.6)	8.9 (8.4, 9.5)	12.2 (11.1, 13.4)
QLD	Public Hospital	1556	39843	1.1 (1.0, 1.2)	2.7 (2.6, 2.9)	3.6 (3.4, 3.8)	4.9 (4.7, 5.2)	6.3 (5.9, 6.7)	7.0 (6.4, 7.7)
	Private Hospital	3639	110545	1.0 (1.0, 1.1)	2.4 (2.3, 2.5)	3.1 (3.0, 3.2)	4.5 (4.3, 4.6)	5.9 (5.7, 6.2)	7.5 (7.0, 8.0)
VIC	Public Hospital	1405	44353	0.8 (0.8, 0.9)	2.2 (2.1, 2.4)	2.9 (2.7, 3.1)	4.2 (4.0, 4.4)	5.3 (4.9, 5.6)	6.4 (5.7, 7.2)
	Private Hospital	3745	100014	1.0 (0.9, 1.0)	2.5 (2.4, 2.6)	3.4 (3.3, 3.5)	5.3 (5.1, 5.5)	7.1 (6.8, 7.5)	8.8 (8.2, 9.3)
NSW	Public Hospital	2148	80352	0.9 (0.8, 0.9)	1.9 (1.8, 2.0)	2.4 (2.3, 2.5)	3.4 (3.2, 3.5)	4.5 (4.2, 4.7)	5.3 (4.7, 5.9)
	Private Hospital	4944	166687	0.9 (0.9, 1.0)	2.1 (2.1, 2.2)	2.8 (2.7, 2.9)	4.1 (4.0, 4.3)	5.8 (5.6, 6.1)	7.3 (6.8, 7.9)
WA	Public Hospital	646	17938	1.1 (1.0, 1.3)	2.5 (2.3, 2.8)	3.4 (3.1, 3.7)	4.9 (4.5, 5.4)	6.1 (5.4, 6.8)	7.1 (6.0, 8.4)
	Private Hospital	2340	60990	1.0 (0.9, 1.1)	2.7 (2.6, 2.8)	3.5 (3.4, 3.7)	5.4 (5.2, 5.7)	7.2 (6.8, 7.6)	8.5 (7.8, 9.3)
TAS	Public Hospital	95	3861	1.0 (0.8, 1.4)	2.0 (1.6, 2.5)	2.3 (1.8, 2.9)	3.2 (2.6, 4.0)	3.9 (2.9, 5.1)	
	Private Hospital	344	14283	0.9 (0.8, 1.1)	2.1 (1.9, 2.4)	2.7 (2.4, 3.0)	3.2 (2.9, 3.6)	4.1 (3.5, 4.8)	
NT	Public Hospital	37	663	1.9 (1.1, 3.4)	4.9 (3.4, 7.0)	5.7 (4.0, 8.2)	8.1 (5.6, 11.5)	10.2 (6.8, 15.1)	
	Private Hospital	54	1233	1.2 (0.7, 2.0)	2.6 (1.8, 3.8)	3.9 (2.8, 5.4)	7.3 (5.3, 10.1)	9.1 (6.5, 12.7)	
ACT	Public Hospital	91	4139	0.6 (0.4, 0.9)	1.5 (1.2, 2.0)	2.1 (1.7, 2.7)	3.5 (2.7, 4.4)	4.0 (3.0, 5.3)	
	Private Hospital	394	13279	0.9 (0.8, 1.1)	1.9 (1.7, 2.2)	2.4 (2.2, 2.7)	3.9 (3.5, 4.4)	5.6 (4.9, 6.4)	6.8 (5.5, 8.3)
TOTAL		24126	721122						

Note: Restricted to modern prostheses

Figure N78 **Cumulative Percent Revision of Primary Total Knee Replacement in the Public Hospital System by State/Territory (Primary Diagnosis OA)**



HR - adjusted for age, gender, ASA, BMI

ACT vs NSW
Entire Period: HR=0.80(0.61,1.06),p=0.118

WA vs NSW
Entire Period: HR=1.31(1.15,1.50), p<0.001

NT vs NSW
Entire Period: HR=2.54(1.63,3.95), p<0.001

VIC vs NSW
0-2.5Yr: HR=1.03(0.91,1.17), p=0.652
2.5Yr+: HR=1.17(0.97,1.40), p=0.100

SA vs NSW
0-6Mth: HR=0.87(0.60,1.25), p=0.445
6Mth-2Yr: HR=1.41(1.10,1.79), p=0.006
2Yr+: HR=2.07(1.68,2.55), p<0.001

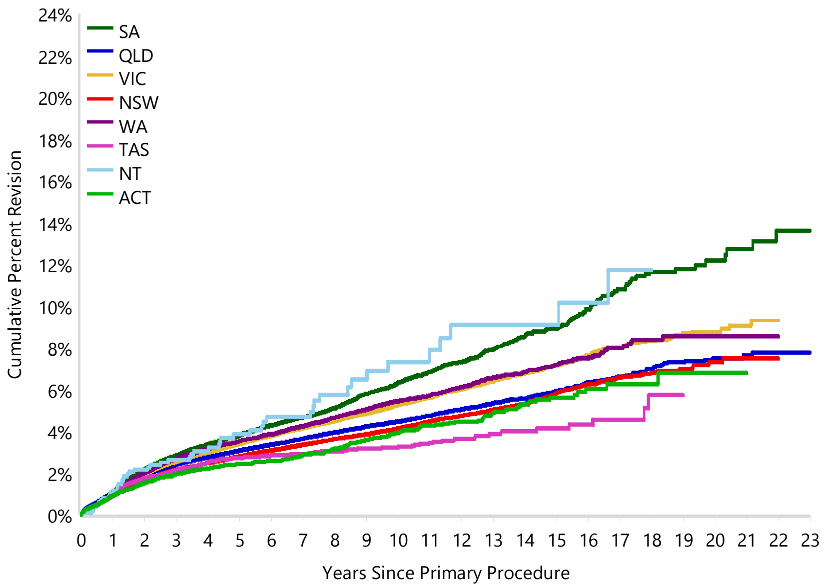
TAS vs NSW
Entire Period: HR=1.13(0.85,1.49), p=0.404

QLD vs NSW
Entire Period: HR=1.39(1.26,1.54), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
SA	13703	12507	10268	8102	3419	718	116
QLD	39843	36308	30454	23841	9581	2704	402
VIC	44353	39802	33357	26640	10461	2564	391
NSW	80352	73900	62869	49359	19217	3996	241
WA	17938	16120	13048	10058	3776	635	47
TAS	3861	3499	2860	2315	891	183	6
NT	663	561	410	295	106	58	10
ACT	4139	3754	2861	2081	455	140	14

Note: Restricted to modern prostheses

Figure N79 Cumulative Percent Revision of Primary Total Knee Replacement in the Private Hospital System by State/Territory (Primary Diagnosis OA)



HR- adjusted for age, gender, ASA, BMI

ACT vs NSW

Entire Period: HR=1.77(0.65,0.92), p=0.004

WA vs NSW

Entire Period: HR=1.19(1.10,1.29), p<0.001

TAS vs NSW

Entire Period: HR=1.25(1.09,1.43), p=0.001

SA vs NSW

0-1.5Yr: HR=1.30(1.18,1.44), p<0.001

1.5Yr-3.5Yr: HR=1.50(1.32,1.70), p<0.001

3.5Yr+: HR=1.57(1.34,1.84), p<0.001

NT vs NSW

Entire Period: HR=1.26(0.84,1.91), p=0.263

VIC vs NSW

0-1Mth: HR=0.89(0.71,1.12), p=0.310

1Mth-3Mth: HR=1.33(1.09,1.63), p=0.005

3Mth-6Mth: HR=0.90(0.72,1.12), p=0.353

6Mth+: HR=1.24(1.15,1.33), p<0.001

QLD vs NSW

Entire Period: HR=1.14(1.07,1.21), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
SA	49239	43571	33892	25848	9747	2076	355
QLD	110545	97816	76173	57792	23469	7064	1128
VIC	100014	88474	69530	53650	21149	5394	704
NSW	166687	146933	113642	86647	34010	7858	603
WA	60990	54419	43185	32981	12515	2623	176
TAS	14283	12389	8925	6336	2323	568	12
NT	1233	1038	741	528	197	87	16
ACT	13279	12079	9802	7549	3559	896	63

Note: Restricted to modern prostheses

VARIATION IN PROSTHESIS CHARACTERISTICS

States vary in the proportion of procedures that use one of the 10 most commonly used prostheses for each year. The most commonly used femoral components used in primary total knee replacement are shown in Table N18. In each state there has been little change in the three most commonly used femoral components over the past 4 years (Table N19).

Variation in Prosthesis Choice

States vary in the proportion of procedures that use one of the 10 most commonly used prostheses for each year. The number and percentage of procedures not using one of the 10 most commonly used prostheses (referred to as less commonly used prostheses) for each state is displayed in Figure N80. Comparing 2014 to 2023 increases in less commonly used prostheses are apparent in SA and the NT. In other states and territories there has been a decrease in the use of less commonly used components over this time period.

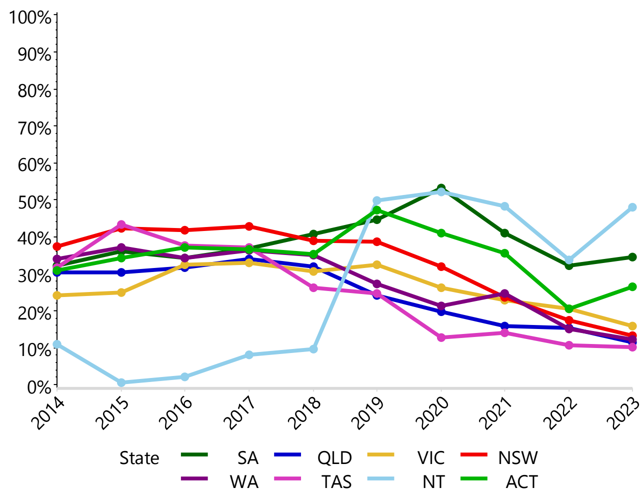
Table N18 Most Used Femoral Components in Primary Total Knee Replacement in Australia

2003			2020			2021			2022			2023		
N	Model		N	Model		N	Model		N	Model		N	Model	
3183	LCS CR		13772	Triathlon CR		16438	Triathlon CR		17061	Triathlon CR		22429	Triathlon CR	
2846	Duracon		8439	Persona CR		11611	Persona CR		13054	Persona CR		16491	Persona CR	
2150	Nexgen CR		3257	GMK Sphere Primary		4212	Attune CR		4373	Attune CR		5115	Attune CR	
1419	PFC Sigma CR		3150	Attune CR		3677	GMK Sphere Primary		3777	GMK Sphere Primary		4894	GMK Sphere Primary	
1354	Scorpio CR		2390	Nexgen CR Flex		2240	Attune PS		2053	Attune PS		2317	Attune PS	
1058	Genesis II CR		1783	Attune PS		1690	Nexgen CR Flex		1519	Apex Knee CR		1675	Apex Knee CR	
1002	Natural Knee II		1606	Apex Knee CR		1628	Apex Knee CR		1248	Legion Oxinium CR		1452	Legion Oxinium CR	
902	Nexgen LPS		1406	LCS CR		1600	Legion Oxinium CR		1112	Legion Oxinium PS		1318	Evolution	
883	Profix		1367	Legion Oxinium CR		1228	Legion Oxinium PS		1080	Columbus		1241	Journey II Oxinium	
751	Scorpio PS		1222	Evolution		1116	Legion CR		1060	Evolution		1183	Legion Oxinium PS	
10 Most Used														
15548	(10)	71.5%	38392	(10)	71.0%	45440	(10)	76.1%	46337	(10)	81.1%	58115	(10)	84.3%
Remainder														
6185	(47)	28.5%	15701	(65)	29.0%	14279	(66)	23.9%	10770	(65)	18.9%	10820	(60)	15.7%
TOTAL														
21733	(57)	100.0%	54093	(75)	100.0%	59719	(76)	100.0%	57107	(75)	100.0%	68935	(70)	100.0%

Table N19 3 Most Used Femoral Components in Primary Total Knee Replacement in Australia by State/Territory

State	2003		2020		2021		2022		2023	
	N	Model	N	Model	N	Model	N	Model	N	Model
SA	283	LCS CR	778	Triathlon CR	1051	Triathlon CR	1297	Triathlon CR	1696	Triathlon CR
	266	Maxim	608	GMK Sphere Primary	609	Persona CR	683	Persona CR	884	Persona CR
	227	Nexgen CR	572	Columbus	600	Columbus	620	Columbus	732	GMK Sphere Primary
QLD	1207	LCS CR	2709	Triathlon CR	3285	Persona CR	3367	Persona CR	4197	Persona CR
	470	Nexgen LPS	2645	Persona CR	3285	Triathlon CR	2975	Triathlon CR	4052	Triathlon CR
	393	Duracon	944	Attune CR	1118	Attune CR	1068	Attune CR	1162	GMK Sphere Primary
VIC	558	LCS CR	2920	Triathlon CR	3603	Triathlon CR	3933	Triathlon CR	5930	Triathlon CR
	485	Duracon	1396	Persona CR	2022	Persona CR	2380	Persona CR	3195	Persona CR
	457	Genesis II CR	558	Attune CR	920	Attune CR	921	Attune CR	846	Attune CR
NSW	1003	Nexgen CR	4123	Triathlon CR	4854	Triathlon CR	5358	Triathlon CR	6716	Persona CR
	915	Duracon	3014	Persona CR	4362	Persona CR	5206	Persona CR	6389	Triathlon CR
	783	PFC Sigma CR	1101	GMK Sphere Primary	1422	GMK Sphere Primary	1310	GMK Sphere Primary	1835	GMK Sphere Primary
WA	925	Duracon	2141	Triathlon CR	2135	Triathlon CR	2135	Triathlon CR	2676	Triathlon CR
	331	Scorpio CR	759	Attune CR	1016	Attune CR	1016	Attune CR	1232	Attune CR
	269	LCS CR	582	Persona CR	463	Persona CR	463	Persona CR	632	Persona CR
TAS	275	Nexgen CR	753	Triathlon CR	883	Triathlon CR	795	Triathlon CR	892	Triathlon CR
	83	Scorpio CR	241	Nexgen CR Flex	453	Persona CR	673	Persona CR	786	Persona CR
	66	LCS CR	181	Apex Knee CR	196	Apex Knee CR	111	GMK Sphere Primary	113	GMK Sphere Primary
ACT	225	Profix	461	Triathlon CR	601	Triathlon CR	552	Triathlon CR	772	Triathlon CR
	93	Profix Oxinium	384	Persona CR	298	Persona CR	282	Persona CR	191	Genus
	67	LCS CR	250	Columbus	297	Columbus	140	Genus	101	Columbus
NT	19	LCS CR	63	Nexgen LPS Flex	84	Apex Knee CR	84	Apex Knee CR	99	Apex Knee CR
	9	Genesis II Oxinium CR	52	Triathlon CR	59	Nexgen LPS Flex	59	Nexgen LPS Flex	90	Persona PS
	6	RBK	17	Apex Knee CR	22	Columbus	30	Columbus	31	Columbus

Figure N80 Percentage of Less Commonly Used Femoral Components in Primary Total Knee Replacement by State/Territory (Primary Diagnosis OA)



Variation in Prosthesis Fixation

Over the last decade the proportion of total knee replacement using fully cemented fixation has increased in SA, VIC, TAS, ACT and NT. In NSW and WA there has been little change, while in QLD it has decreased. In 2023 throughout the mainland states and the ACT the proportion using fully cemented fixation is approximately 60% while in TAS it is only 27.0% and in NT it is 82.0% (Figure N81).

The proportion of cementless total knee replacement has decreased over the past 10 years in SA, NT and TAS. An increase in cementless knee replacement over this time has occurred in QLD, VIC, WA and ACT, while there has been little change in NSW (Figure N82). In 2023, most states use cementless fixation in less than 25.0% of total knee replacement, except for TAS where it is used in 59.0%.

There has been a decrease in hybrid (tibia cemented) total knee replacement in all states and territories except TAS over the past decade (Figure N83). In 2023, hybrid fixation is used in less than 22.0% of total knee replacement in all states and territories.

Figure N81 Percentage of Fully Cemented Primary Total Knee Replacement by State/Territory (Primary Diagnosis OA)

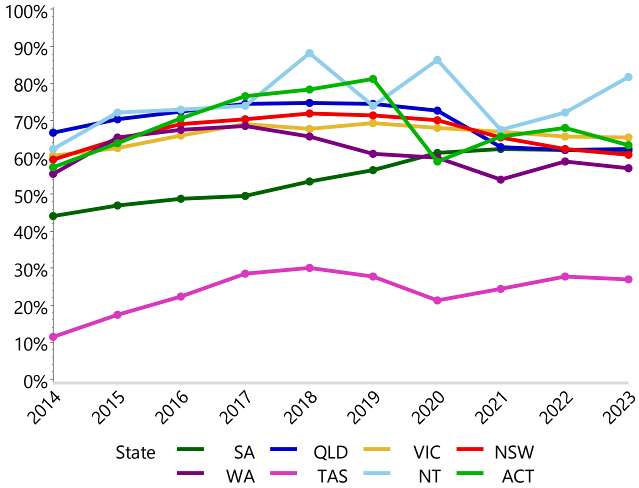


Figure N83 Percentage of Hybrid Primary Total Knee Replacement by State/Territory (Primary Diagnosis OA)

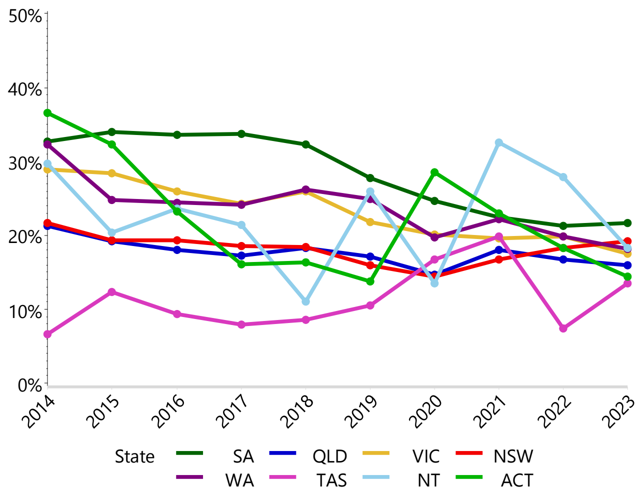
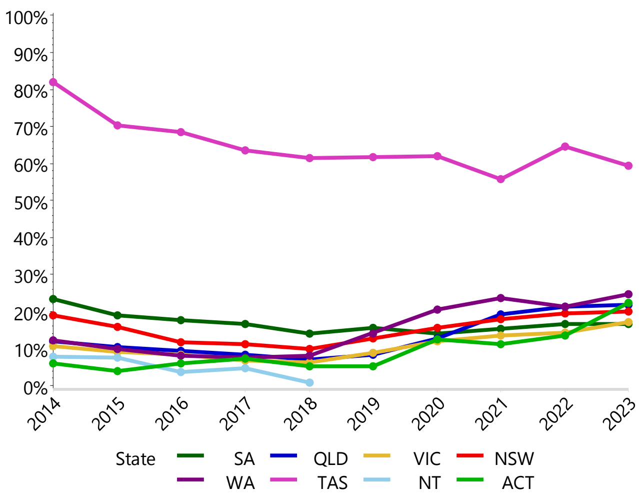


Figure N82 Percentage of Cementless Primary Total Knee Replacement by State/Territory (Primary Diagnosis OA)



Note: There have been no cementless procedures recorded in NT since 2019

Variation in Prosthesis Stability

Minimally stabilised knee replacement is the most commonly used stability variant in all states and territories, with the proportion in 2023 varying from the lowest in NT (60.2%) to the highest in TAS (91.4%) (Figure N84).

Medial pivot design knee replacement has seen a small increase in use in all states and territories except ACT over the past 10 years. In 2023 it is most used in WA (12.5%) and SA (12.2%). It is used in small numbers in TAS and NT and there is no use of this design in the ACT (Figure N85).

The use of posterior stabilised knee replacement has declined over the past 10 years in SA, QLD, VIC, NSW, ACT and WA. In 2023 its use is highest in the NT (35.0%) and it is rarely used in TAS (3.4%) (Figure N86).

Figure N84 Percentage of Minimally Stabilised Primary Total Knee Replacement by State/Territory (Primary Diagnosis OA)

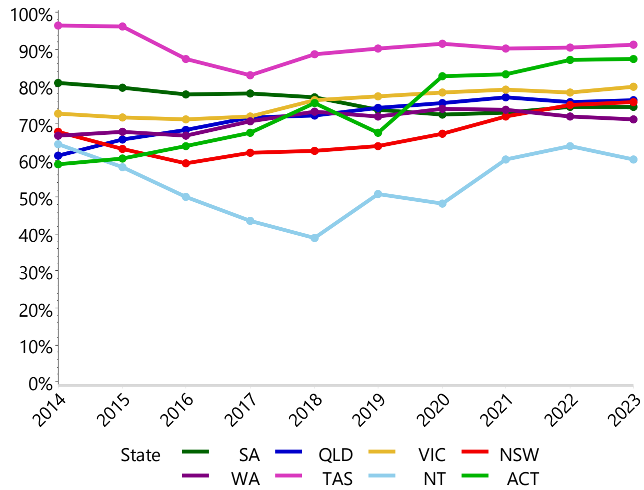


Figure N85 Percentage of Medial Pivot Design Primary Total Knee Replacement by State/Territory (Primary Diagnosis OA)

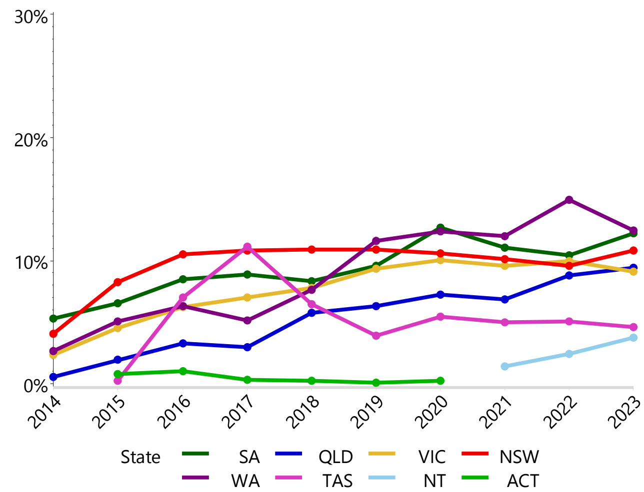
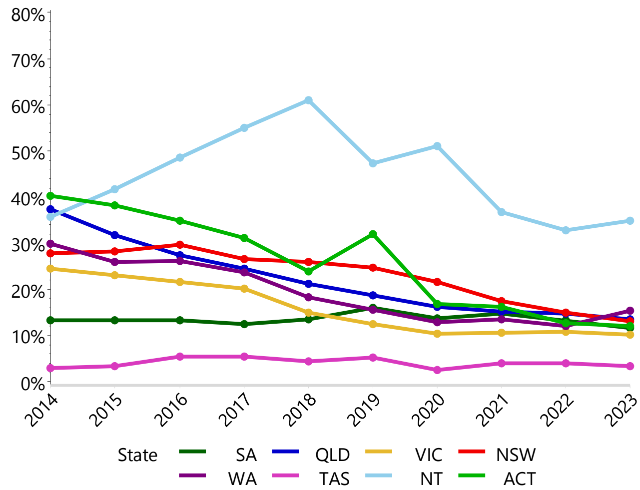


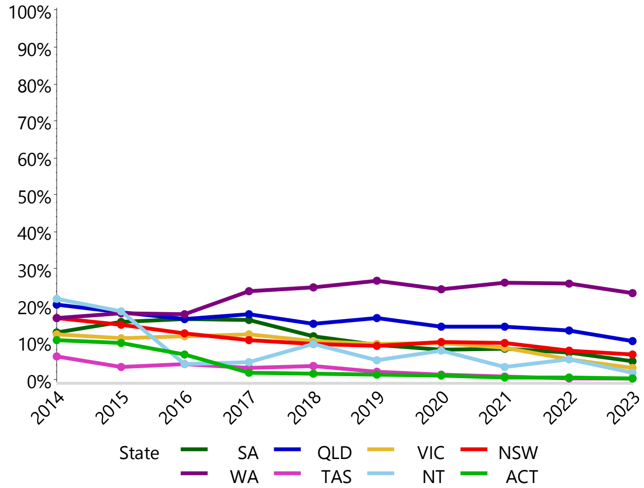
Figure N86 Percentage of Posterior Stabilised Primary Total Knee Replacement by State/Territory (Primary Diagnosis OA)



Arthroplasty Practice Variation in Australia

Variation in Bearing Mobility
There has been a gradual decline in use of mobile bearings in most states over the last decade, except for WA where there has been a small increase. In 2023 mobile bearings are used for less than 10.0% of total knee replacement in SA, VIC, NSW, TAS, NT and ACT but they are used in just over this amount in QLD and in 23.0% of knee replacements in WA (Figure N87).

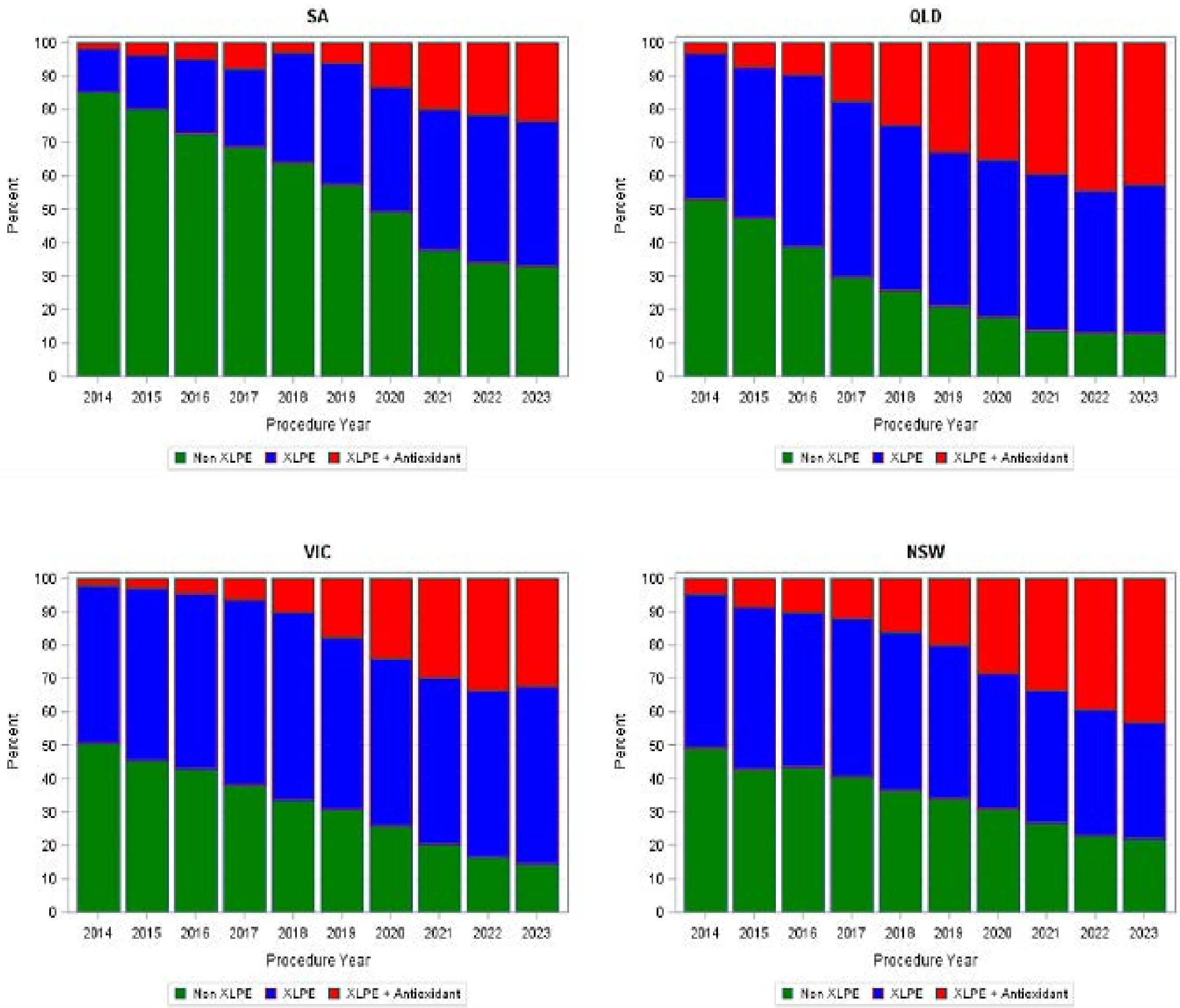
Figure N87 Percentage of Mobile Bearing Primary Total Knee Replacement by State/Territory (Primary Diagnosis OA)

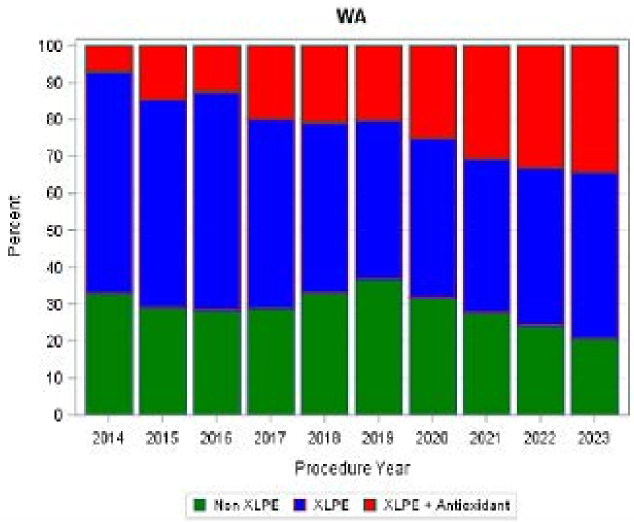


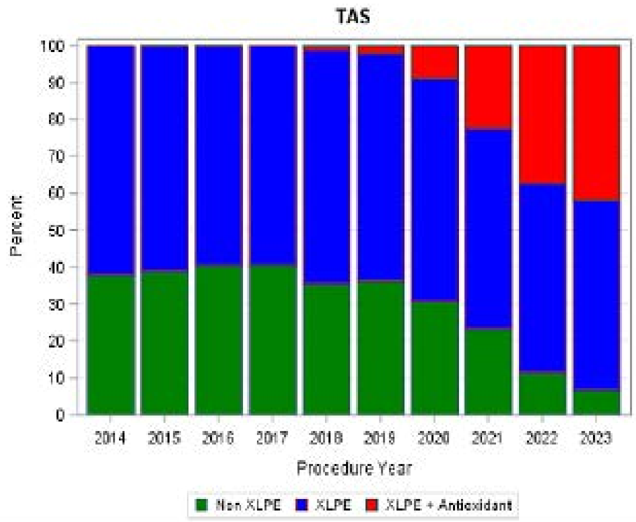
Variation in Bearing Surface

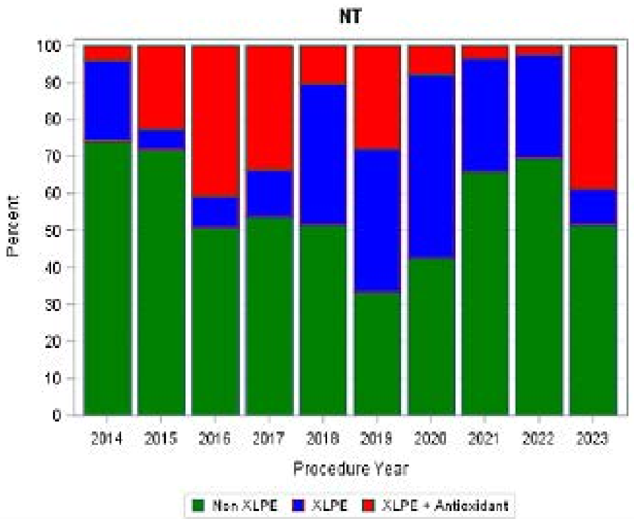
The choice of bearing surface for primary total knee replacement varies between states. Over the last decade use of XLPE has increased in SA and VIC, while it has changed little in QLD and the ACT, and decreased in NSW, WA, TAS and NT. In 2023 the ACT has the highest proportion of usage of XLPE in knee replacement at 72.1%. This contrasts with NT where 10.0% of knee replacements use XLPE. The percentage of knee replacements undertaken with XLPE+ antioxidant has steadily risen over the past 10 years in all states and territories except for the ACT, with the highest usage seen in NSW at 43.0% in 2023 (Figure N88).

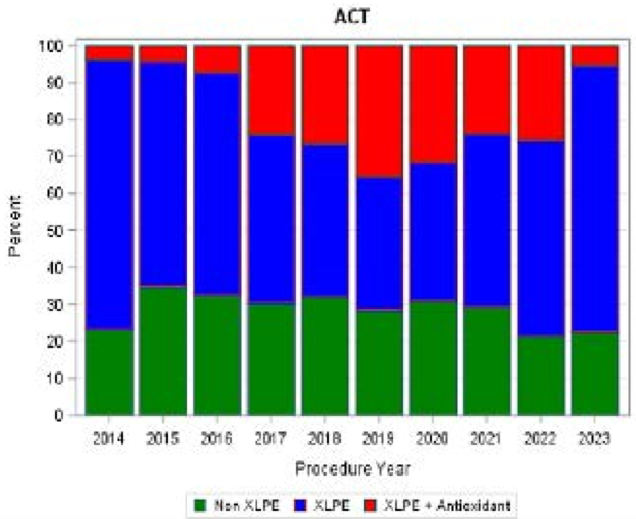
Figure N88 **Bearing Surface of Primary Total Knee Replacement by State/ Territory (Primary Diagnosis OA)**




WA
Percent
Procedure Year
Non XLPE
XLPE
XLPE + Antioxidant

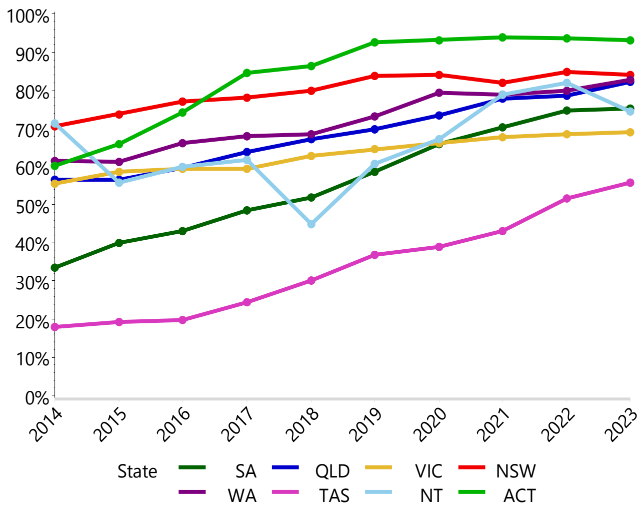

TAS
Percent
Procedure Year
Non XLPE
XLPE
XLPE + Antioxidant


NT
Percent
Procedure Year
Non XLPE
XLPE
XLPE + Antioxidant


ACT
Percent
Procedure Year
Non XLPE
XLPE
XLPE + Antioxidant

Variation in Patella Component Usage
Without exception all states have seen an increase in use of patella components for primary total knee replacement over the last 10 years. In 2023 more than 75.0% of knee replacements have a primary patella resurfacing in SA, QLD, NSW, WA and ACT, while the proportion is 74.0% in NT, 69.0% in VIC but only 56.0% in TAS (Figure N89).

Figure N89 Percentage of Patella Used in Primary Total Knee Replacement by State/Territory (Primary Diagnosis OA)



Variation in use of Technology Assistance
In 2023 over 60.0% of primary total knee replacements in all states of Australia are performed with the use of technological assistance (Figure N90).

The past 10 years have seen a progressive increase in the use of robotic assistance in knee replacement surgery in all states and territories, with the exception of the NT. The ACT (51.6%) and TAS (52.8%) have the highest proportion of knee replacements performed with robotic assistance (Figure N91).

The use of computer navigation is highest in the NT (55.4%) and the ACT (38.6%) in 2023. Computer navigation has reduced in TAS, WA, VIC and NSW over the past 10 years, while in SA usage has slightly increased. The use of computer navigation in QLD peaked at 46.1% in 2019 and has since declined to 29.3% (Figure N92).

The use of IDI in primary total knee replacement has increased over the past 10 years in the more populous mainland states. Its use is highest in SA at 18.9%. Its use in TAS has declined to 7.3% and there is very little use of IDI in the NT (3.7%) or the ACT (0.9%) (Figure N93).

Figure N90 Percentage of Primary Total Knee Replacement using Technology Assistance by State/Territory (Primary Diagnosis OA)

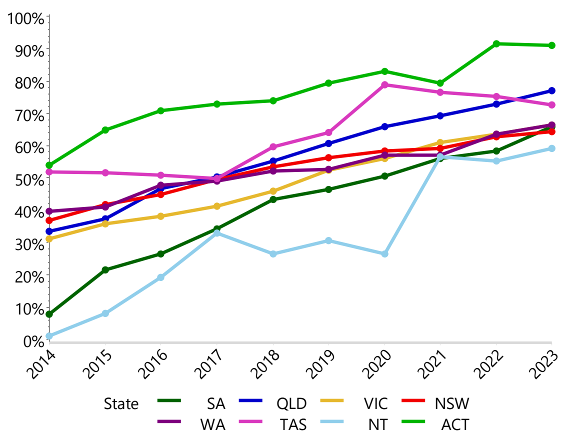
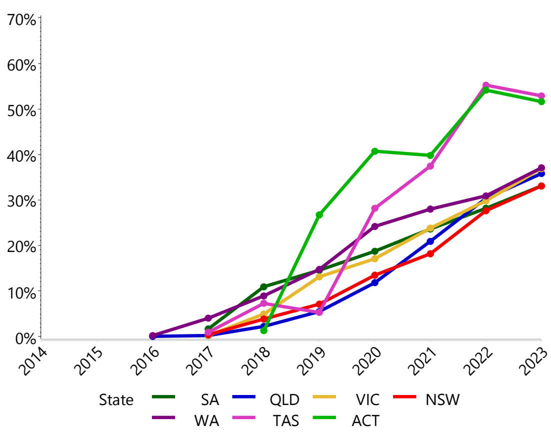


Figure N91 Percentage of Primary Total Knee Replacement using Robotic Assistance by State/Territory (Primary Diagnosis OA)



Note: There are no robotic procedures recorded for NT

Figure N92 **Percentage of Primary Total Knee Replacement using Computer Navigation by State/Territory (Primary Diagnosis OA)**

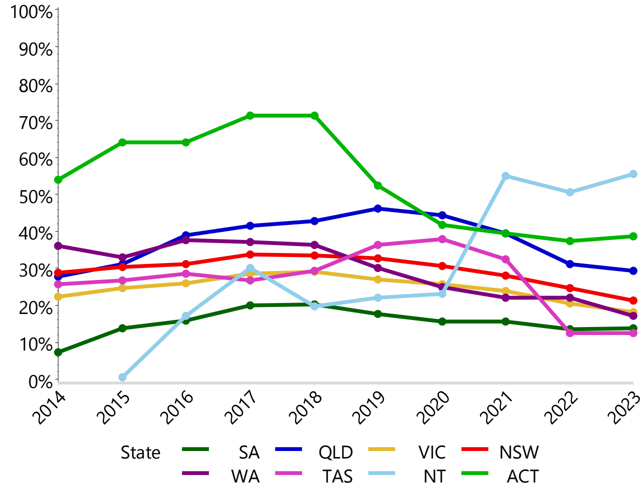
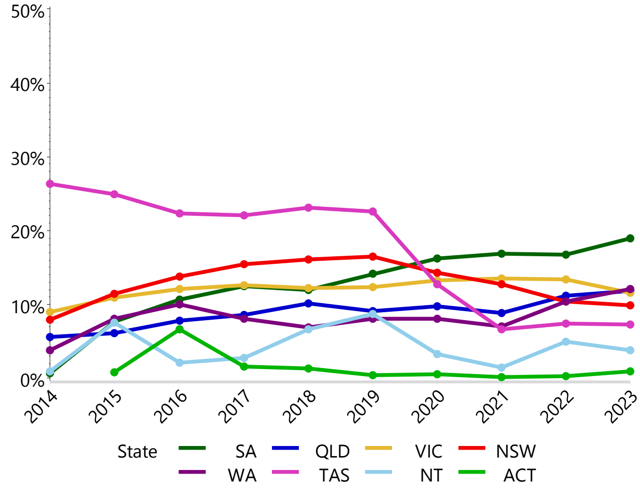


Figure N93 **Percentage of Primary Total Knee Replacement using IDI by State/Territory (Primary Diagnosis OA)**



VARIATION IN KNEE REPLACEMENT REVISION

Variation in Revision Class

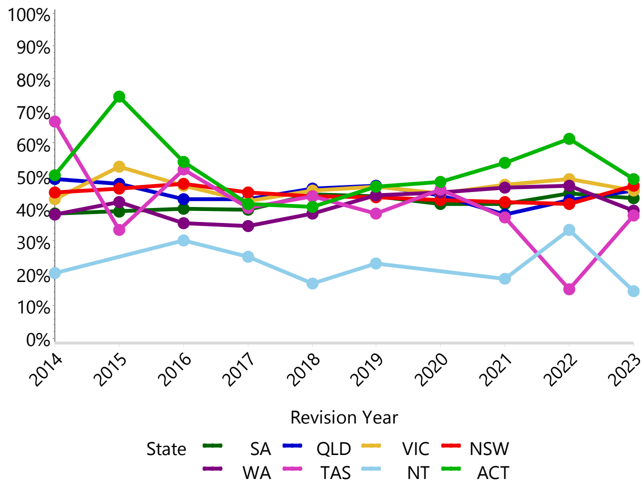
Major revisions are procedures where one or more of the major components fixed to bone are either removed or exchanged. These can be major partial revisions where only one major component is revised, or major total revisions where both major components are revised. Minor revisions include procedures that exchange the minor components such as the polyethylene insert or add a patella component.

While there have been some fluctuations, all the mainland states and the ACT have shown a relative consistency in major revisions in the past 10 years. In 2023 the percentage of major revisions is lowest in NT (20.0%) (Figure N94).

Variation in Revision Diagnosis

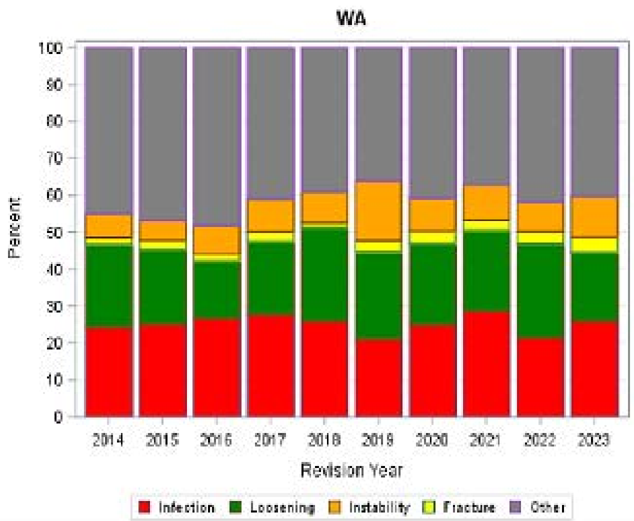
The revision diagnosis varies with time. Revision for both fracture and instability show year to year variation with no clear trends for the different states over the past decade. In 2023, the proportion of 1st revision for infection across the states range from a low of 21.0% in TAS to a high of 30.3% in QLD, while it is higher still in the two territories (35.8% in the ACT and 85.7% in the NT). The proportions of the common 1st revision diagnoses of known primary procedures over the last decade are displayed in Figure N95.

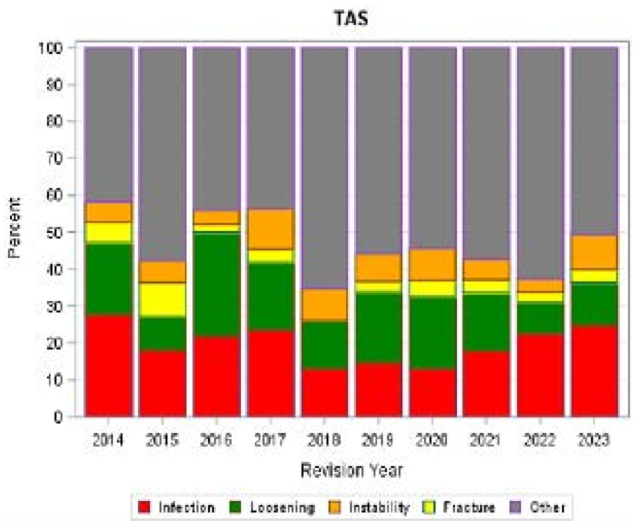
Figure N94 **Percentage of Major Revision in 1st Revision Knee Replacement of Primary Total Knee Replacement by State/Territory (All Diagnoses)**



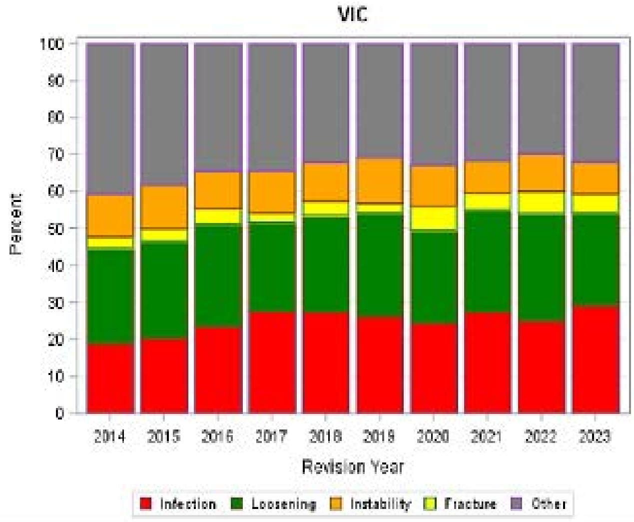
Note: There were no major revisions in NT in 2015 or 2020
Restricted to 1st revision procedures with known primaries

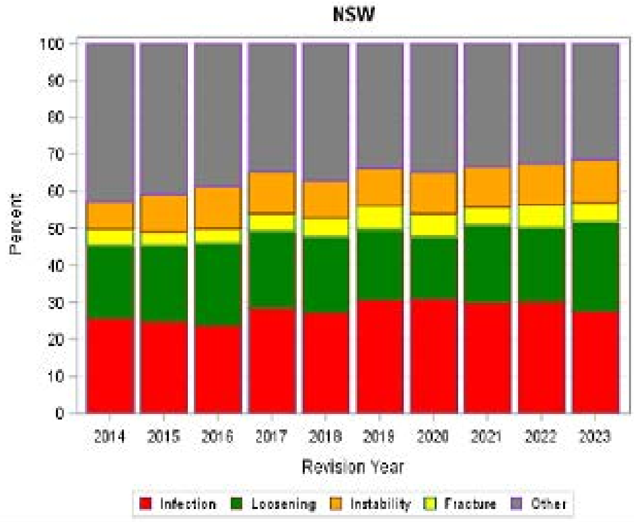
Figure N95 **Revision Diagnosis of 1st Revision Knee Replacement of Known Primary Total Knee Replacement by State/Territory (All Diagnoses)**

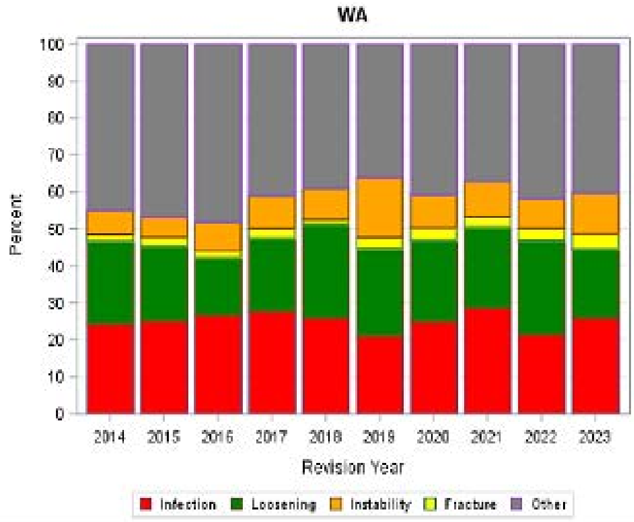


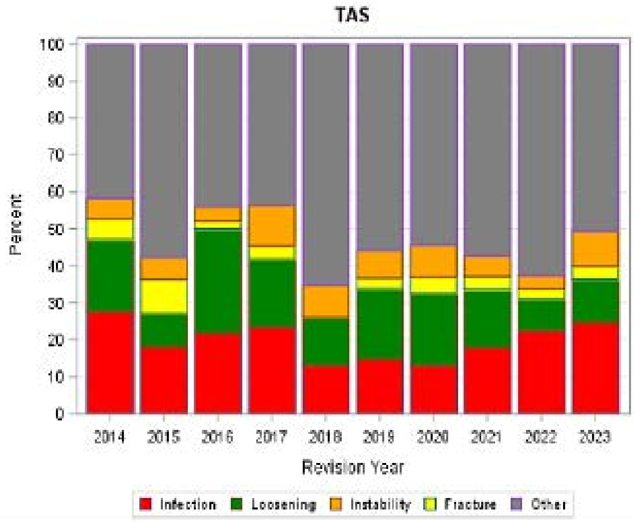


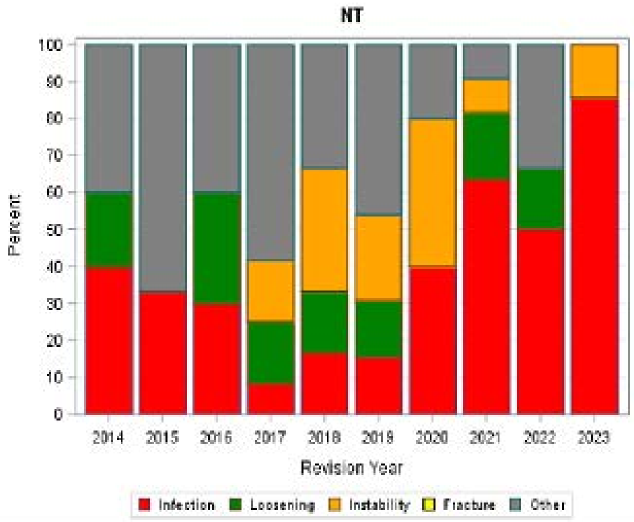
Arthroplasty Practice Variation in Australia

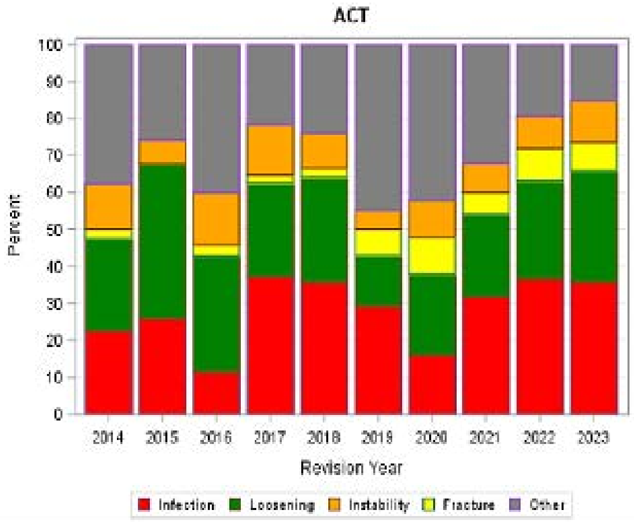












Note: Restricted to 1st revision procedures with known primaries

VARIATION IN KNEE REPLACEMENT BY HOSPITAL LOCALITY

The Modified Monash Model (MMM)[7] defines whether a location is metropolitan, rural, remote or very remote. The model measures remoteness and population size on a scale of Modified Monash (MM) categories MM1 to MM7. MM1 is a major city and MM7 is very remote.

Primary Knee Replacement by Class

The class of knee replacement is similar between metropolitan and larger regional centres (MM1 and MM2) compared to more rural and remote settings (MM3-7). Primary total knee replacement predominates in both metropolitan and rural settings, followed by unicompartmental knee replacement (Figure N96 and Figure N97).

Primary Knee Replacement by Hospital Locality

The majority of total knee replacement for osteoarthritis is undertaken in larger metropolitan and regional centres. In most states the percentage of surgery undertaken in MM3-7 settings has been stable over the last decade. In SA, QLD, WA and the ACT more than 90.0% of knee replacement procedures are performed in MM1-2 hospitals (Figure N98).

The most populous states, NSW and VIC, perform 23.6% and 16.7% of total knee replacement procedures in rural and remote locations (MM3-7) in 2023, respectively (Figure N99).

Figure N96 **Primary Knee Replacement in Metropolitan and Regional (MM1 and MM2) Hospitals by Class (All Diagnoses)**

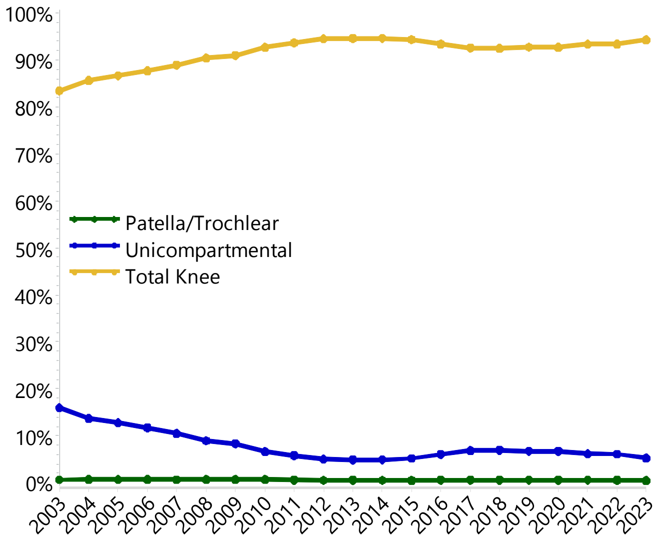
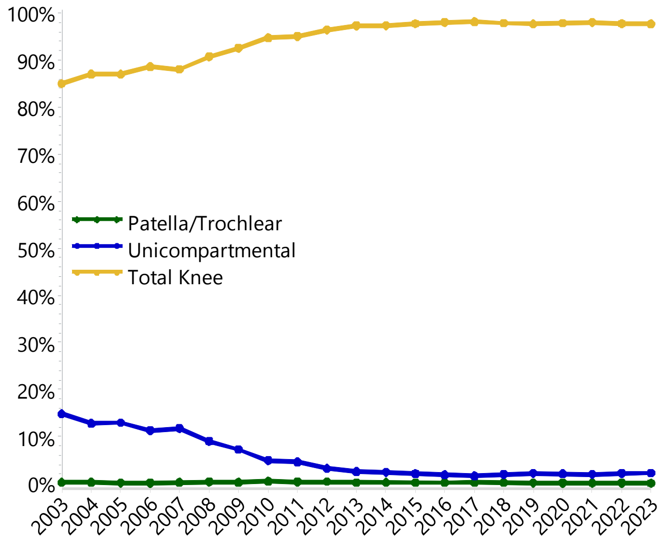


Figure N97 **Primary Knee Replacement in Rural-Remote (MM3-7) Hospitals by Class (All Diagnoses)**



[7] https://www.health.gov.au/topics/rural-health-workforce/classifications/mmm

Figure N98 **Percentage of Primary Total Knee Replacement in Metropolitan and Regional (MM1 and MM2) Hospitals by State/Territory (Primary Diagnosis OA)**

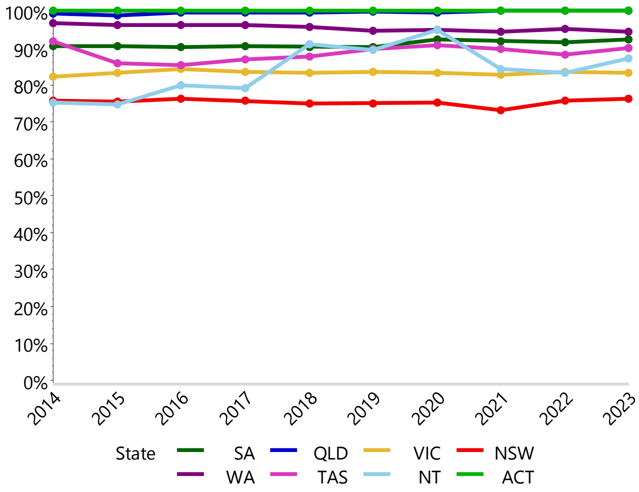
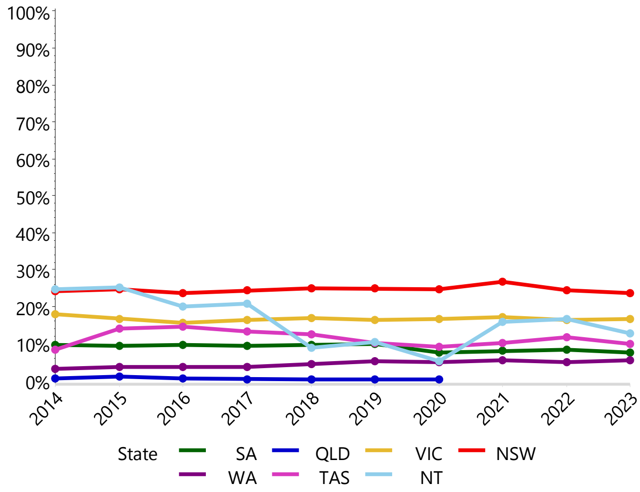


Figure N99 **Percentage of Primary Total Knee Replacement in Rural-Remote (MM3-7) Hospitals by State/Territory (Primary Diagnosis OA)**



Note: There are no procedures in rural-remote QLD after 2020

Patient Factors by Hospital Locality

There is little difference in age, gender, ASA score or BMI for knee replacement procedures performed in MM1 and MM2 regions when compared to MM3-7 (Table N20 and Table N21).

Table N20 **Summary of Primary Total Knee Replacement Since 2014 by Hospital Locality (Primary Diagnosis OA)**

Variable		Metropolitan and Regional (MM1 and MM2)	Rural-Remote (MM3-7)	TOTAL
Age				
	Mean ± SD	68.3 ± 8.9	68.7 ± 8.8	68.4 ± 8.9
	Median (IQR)	69 (62, 75)	69 (63, 75)	69 (62, 75)
Age Group				
	<55	30,791 (6.5%)	4,327 (5.9%)	35,118 (6.4%)
	55-64	127,403 (26.8%)	18,934 (25.7%)	146,337 (26.7%)
	65-74	195,817 (41.2%)	30,746 (41.7%)	226,563 (41.3%)
	≥75	120,763 (25.4%)	19,733 (26.8%)	140,496 (25.6%)
Gender				
	Male	213,575 (45%)	34,344 (46.6%)	247,919 (45.2%)
	Female	261,199 (55%)	39,396 (53.4%)	300,595 (54.8%)
TOTAL		**474,774**	**73,740**	**548,514**

Note: Abbreviations: SD - standard deviation, IQR - interquartile range.

Table N21 Summary of Primary Total Knee Replacement Since 2014 by Hospital Locality (Primary Diagnosis OA)

Variable	Metropolitan and Regional (MM1 and MM2) N (%)	Rural-Remote (MM3-7) N (%)	TOTAL N (%)
ASA Score[a]			
ASA 1	25,604 (5.4%)	3,422 (4.7%)	29,026 (5.3%)
ASA 2	251,488 (53.2%)	41,318 (56.3%)	292,806 (53.6%)
ASA 3	190,689 (40.3%)	27,991 (38.2%)	218,680 (40%)
ASA 4	4,934 (1%)	619 (0.8%)	5,553 (1%)
ASA 5	13 (0%)	3 (0%)	16 (0%)
BMI Category[b]			
Underweight (<18.50)	806 (0.2%)	86 (0.1%)	892 (0.2%)
Normal (18.50-24.99)	44,918 (10.7%)	5,813 (8.9%)	50,731 (10.5%)
Pre Obese (25.00-29.99)	131,563 (31.5%)	19,557 (29.9%)	151,120 (31.2%)
Obese Class 1 (30.00-34.99)	128,096 (30.6%)	21,344 (32.6%)	149,440 (30.9%)
Obese Class 2 (35.00-39.99)	69,666 (16.7%)	12,332 (18.8%)	81,998 (17%)
Obese Class 3 (≥40.00)	43,141 (10.3%)	6,379 (9.7%)	49,520 (10.2%)
TOTAL	**474,774**	**73,740**	**548,514**

Note: Abbreviations: ASA - American Society of Anesthesiologists, BMI - Body Mass Index (kg/m^2)
[a]Excludes 2,433 procedures with unknown ASA score
[b]Excludes 64,813 procedures with unknown BMI category

Socio-Economic Disadvantage by Hospital Locality

The Index of Relative Socio-economic Advantage and Disadvantage (IRSAD) is created by the Australian Bureau of Statistics as a summary measure of the socioeconomic status for each geographical area.[8] An IRSAD rating of 1 indicates the most socioeconomically disadvantaged region, while a rating of 10 indicates the most advantaged.

Rural and remote (MM3-7) areas have higher rates of patients undergoing knee replacement with socio-economic disadvantage (IRSAD 1-2) than metropolitan and regional (MM1-2) areas, although in the past decade this difference has reduced (Figure N100).

In 2023, metropolitan and regional areas (MM1-2) have a much higher percentage (22.5%) than rural and remote areas (2.6%) of patients undergoing knee replacement in the higher IRSAD categories (9-10) (Figure N101).

Figure N100 Percentage of Primary Total Knee Replacement from Regions Rated IRSAD 1 and 2 by Hospital Locality (Primary Diagnosis OA)

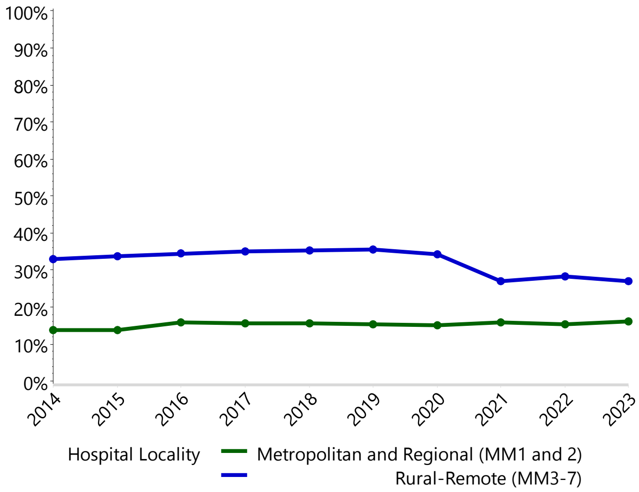
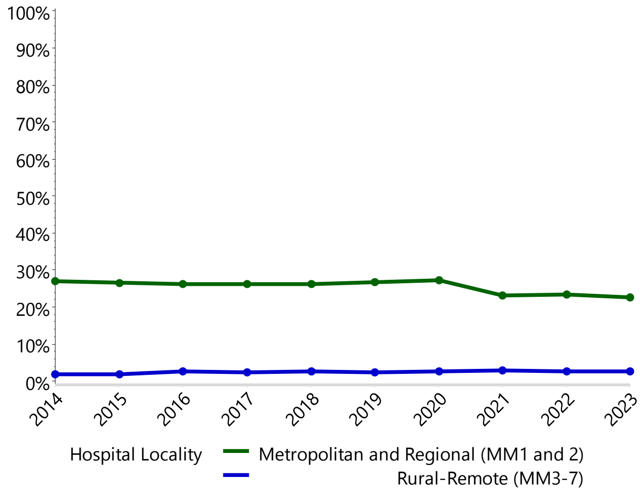


Figure N101 Percentage of Primary Total Knee Replacement from Regions Rated IRSAD 9 and 10 by Hospital Locality (Primary Diagnosis OA)



[8] https://www.abs.gov.au/statistics/people/people-and-communities/socio-economic-indexes-areas-seifa-australia/latest-release.

Variation in Surgeon Volume by Hospital Locality
The proportion of surgeons undertaking less than 20 knee replacements annually is higher in 2023 in metropolitan (MM1-2) regions (21.3%) than in rural (MM3-7) regions (14.4%) (Figure N102). Conversely, in 2023 the proportion of high volume surgeons (≥100 knee replacements per year) is higher in rural and remote regions (31.7%) than in metropolitan regions (25.2%) (Figure N103). In 2023, surgeons performing less than 20 procedures per year accounted for 2.6% and 1.7% of knee replacements in metropolitan/regional and rural/remote areas respectively (Figure N104). Surgeons performing 100 or more procedures/year accounted for 56.7% of total knee replacements in metropolitan and regional (MM1-2) and 57.6% in rural and remote (MM3-7) regions (Figure N105).

Variation in Surgeon Experience by Hospital Locality
The numbers of surgeons in both rural and metropolitan regions with <4 years' experience in knee replacement has reduced over the past 10 years. Over the last decade there has usually been a greater percentage of surgeons with <4 years' experience in a rural rather than metropolitan setting. In 2023, there is a higher percentage of surgeons in rural regions (18.3%) with <4 years' experience in knee replacement than in metropolitan centres (12.0%) (Figure N106).

Figure N102 Percentage of Surgeons with <20 Primary Total Knee Replacement Procedures/Year by Hospital Locality (All Diagnoses)

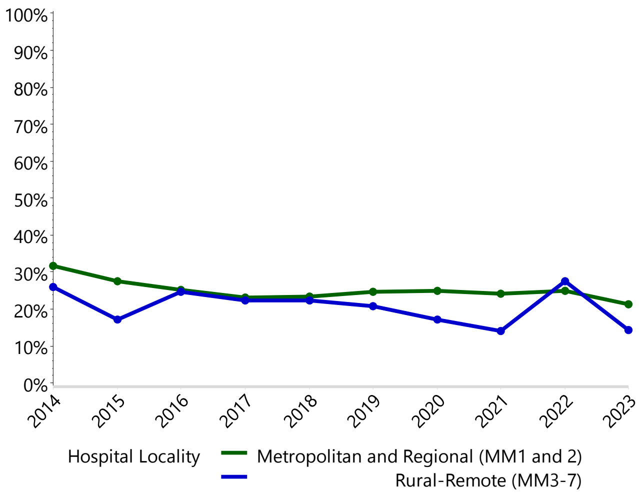


Figure N103 Percentage of Surgeon with ≥100 Primary Total Knee Replacement Procedures/Year by Hospital Locality (All Diagnoses)

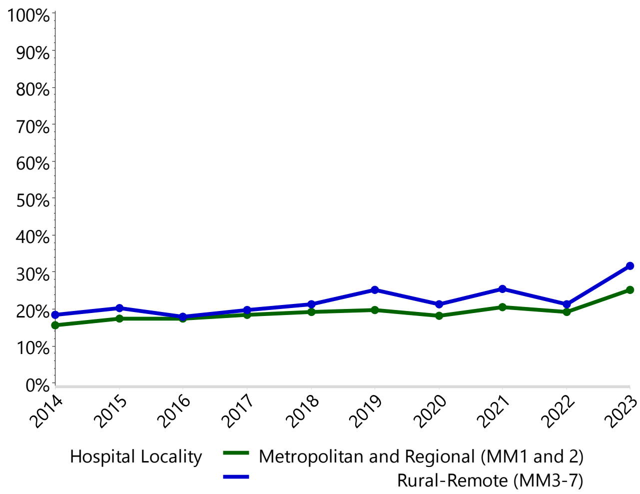


Figure N104 **Percentage of Primary Total Knee Replacements by Surgeons with <20 Procedures/Year by Hospital Locality (All Diagnoses)**

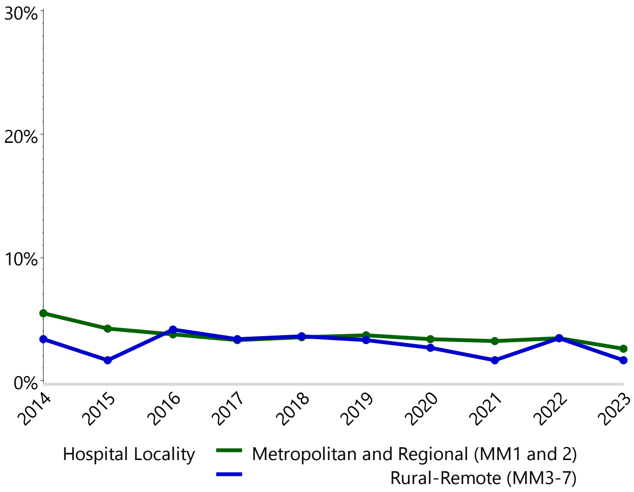


Figure N105 **Percentage of Primary Total Knee Replacements by Surgeons with >100 procedures/Year by Hospital Locality (All Diagnoses)**

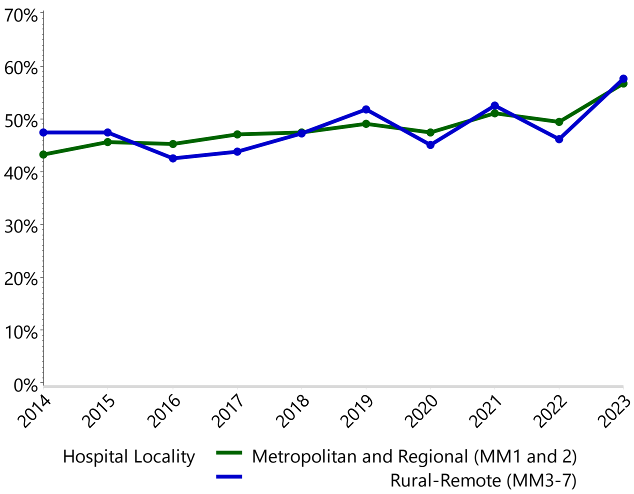
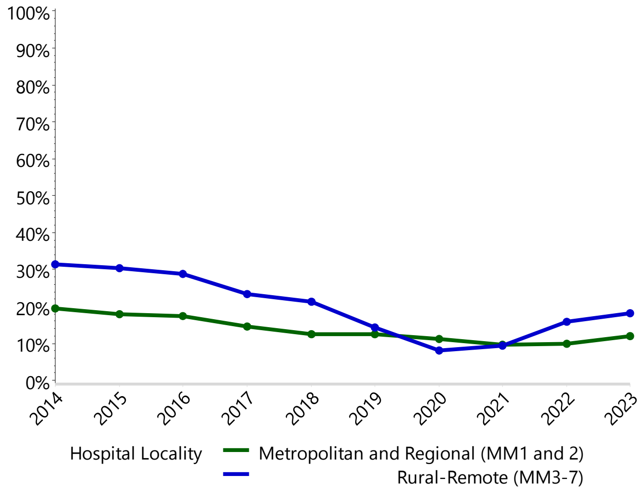


Figure N106 **Percentage of Surgeons with <4 Years' Experience in Primary Total Knee Replacement by Hospital Locality (All Diagnoses)**



Variation in Cumulative Percent Revision by Hospital Locality

When analyses are adjusted for age, gender, ASA and BMI, there is no difference in the rate of revision of primary total knee procedures comparing MM1-2 hospitals to MM3-7 hospitals (Table N22 and Figure N107).

Variation in Hospital System by Hospital Locality

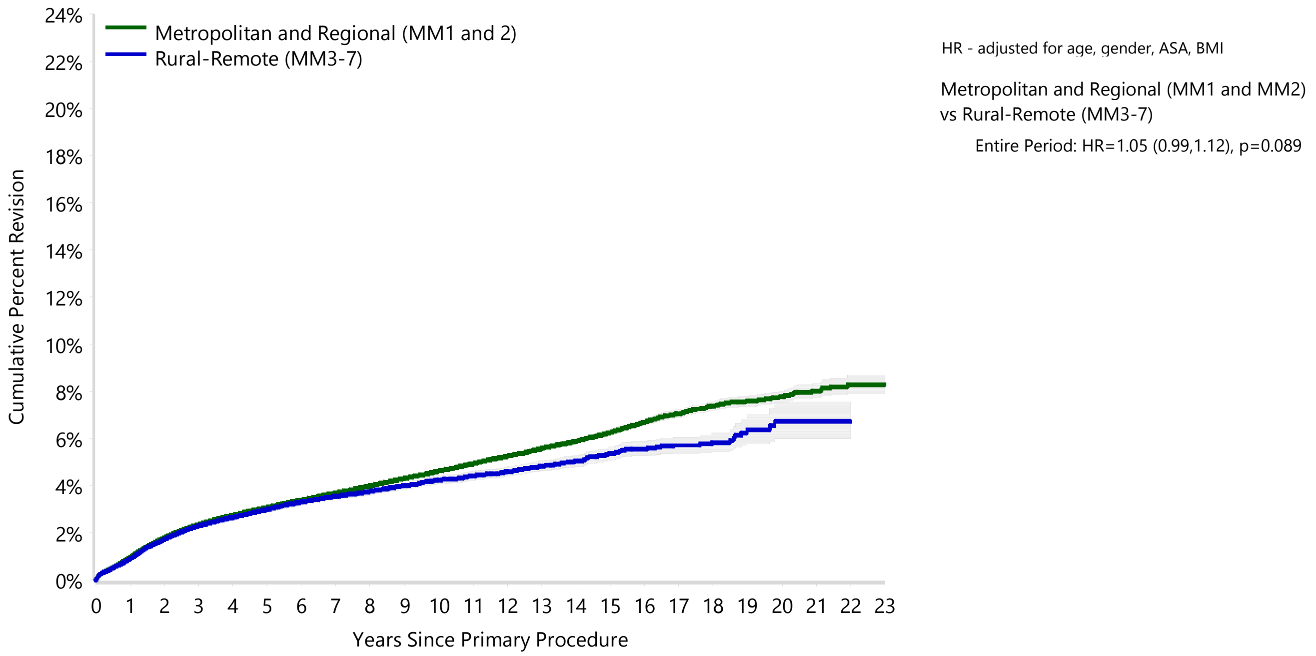
When procedures by hospital system are considered along with locality there is no difference in the rate of revision in either the public or private hospital systems when hospital localities are compared (Table N23, Figure N108 and Figure N109).

Table N22 Cumulative Percent Revision of Primary Total Knee Replacement by Hospital Locality (Primary Diagnosis OA)

Hospital Locality	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Metropolitan and Regional (MM1 and MM2)	21189	626168	1.0 (0.9, 1.0)	2.4 (2.3, 2.4)	3.1 (3.0, 3.1)	4.6 (4.6, 4.7)	6.3 (6.1, 6.4)	7.8 (7.5, 8.0)
Rural-Remote (MM3-7)	2937	94954	0.9 (0.8, 1.0)	2.3 (2.2, 2.4)	3.0 (2.9, 3.1)	4.2 (4.1, 4.4)	5.4 (5.1, 5.6)	6.7 (6.0, 7.5)
TOTAL	**24126**	**721122**						

Note: Restricted to modern prostheses

Figure N107 Cumulative Percent Revision of Primary Total Knee Replacement by Hospital Locality (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Metropolitan and Regional (MM1 and MM2)	626168	558439	445220	342538	134592	33075	3840
Rural-Remote (MM3-7)	94954	84731	66797	51484	20283	4489	444

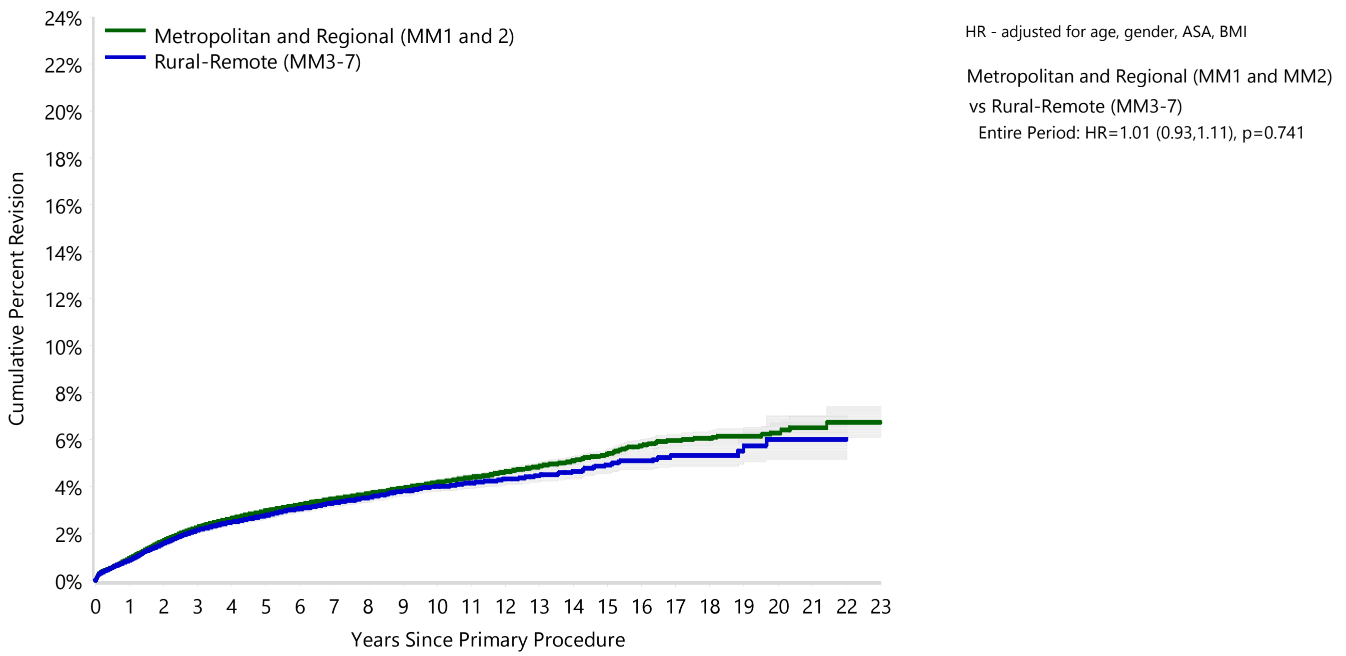
Note: Restricted to modern prostheses

Table N23 Cumulative Percent Revision of Primary Total Knee Replacement by Hospital Locality and Hospital System (Primary Diagnosis OA)

Hospital Locality	Hospital Setting	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Metropolitan and Regional (MM1 and MM2)	Public Hospital	5034	153873	0.9 (0.9, 1.0)	2.3 (2.2, 2.3)	3.0 (2.9, 3.0)	4.2 (4.1, 4.3)	5.4 (5.2, 5.6)	6.3 (5.9, 6.7)
	Private Hospital	16155	472295	1.0 (0.9, 1.0)	2.4 (2.3, 2.4)	3.1 (3.1, 3.2)	4.8 (4.7, 4.9)	6.6 (6.4, 6.7)	8.3 (8.0, 8.6)
Rural-Remote (MM3-7)	Public Hospital	1489	50979	0.9 (0.8, 0.9)	2.1 (2.0, 2.3)	2.8 (2.6, 2.9)	4.0 (3.8, 4.2)	4.9 (4.6, 5.3)	6.0 (5.2, 7.0)
	Private Hospital	1448	43975	1.0 (0.9, 1.1)	2.5 (2.3, 2.7)	3.3 (3.1, 3.5)	4.5 (4.3, 4.8)	5.9 (5.5, 6.3)	7.6 (6.4, 9.0)
TOTAL		24126	721122						

Note: Restricted to modern prostheses

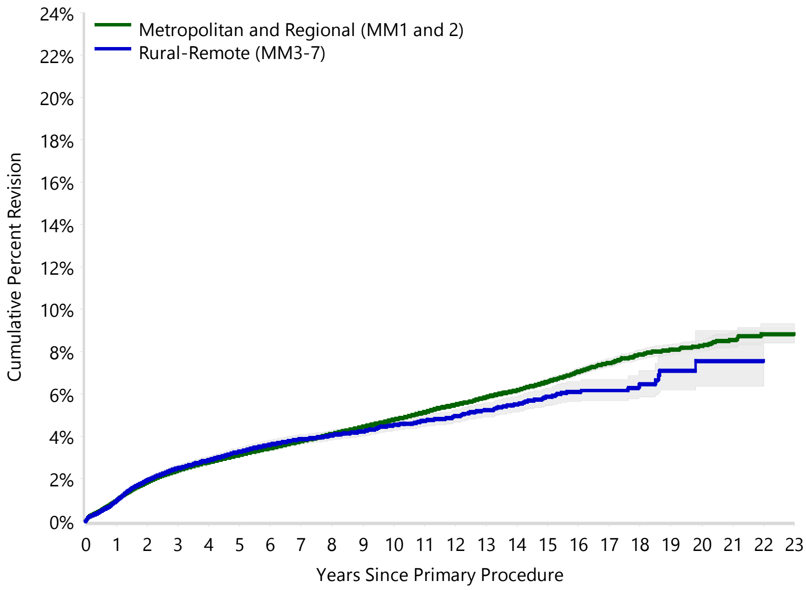
Figure N108 Cumulative Percent Revision of Primary Total Knee Replacement in Public Hospitals by Hospital Locality (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Metropolitan and Regional (MM1 and MM2)	153873	140451	119007	94083	37080	8733	957
Rural-Remote (MM3-7)	50979	46000	37120	28608	10826	2265	270

Note: Restricted to modern prostheses

Figure N109 Cumulative Percent Revision of Primary Total Knee Replacement in Private Hospitals by Hospital Locality (Primary Diagnosis OA)



HR - adjusted for age, gender, ASA score and BMI category

Metropolitan and Regional (MM1 and MM2) vs Rural-Remote (MM3-7)

Entire Period: HR=1.02 (0.94,1.11), p=0.633

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Metropolitan and Regional (MM1 and MM2)	472295	417988	326213	248455	97512	24342	2883
Rural-Remote (MM3-7)	43975	38731	29677	22876	9457	2224	174

Note: Restricted to modern prostheses

VARIATION IN PROSTHESIS CHARACTERISTICS BY HOSPITAL LOCALITY

An overview of prosthesis characteristics by metropolitan/regional and rural/remote settings is summarised in Table N24.

Variation in Prosthesis Use by Hospital Locality

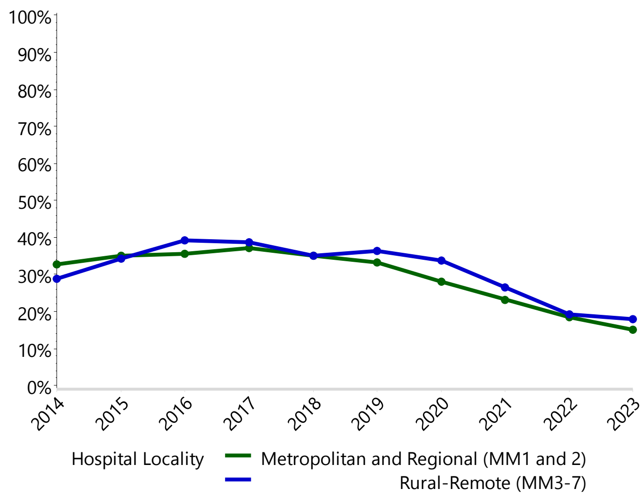
The usage of less common prostheses occurs at very similar rates in metropolitan/regional and rural/remote settings. Since 2019, a steady decline in the use of these prostheses has been seen in both areas. In 2023, less common prostheses were used in 15.1% and 17.9% of cases in metropolitan/regional and rural/remote settings, respectively. This compares to 37.2% and 39.3% of cases at peak usage of less common prostheses in these areas (Figure N110).

Table N24 Summary of Primary Total Knee Replacement Since 2014 by Hospital Locality (Primary Diagnosis OA)

Variable		Metropolitan-Regional (MM1 and MM2)	Rural-Remote (MM3-7)	TOTAL
Fixation				
	Cemented	305,540 (64.4%)	47,315 (64.2%)	352,855 (64.3%)
	Cementless	72,119 (15.2%)	12,037 (16.3%)	84,156 (15.3%)
	Hybrid	97,115 (20.5%)	14,388 (19.5%)	111,503 (20.3%)
Bearing Surface[1]				
	Non XLPE	156,770 (33.1%)	24,944 (33.9%)	181,714 (33.2%)
	XLPE	216,075 (45.6%)	34,692 (47.2%)	250,767 (45.8%)
	XLPE + Antioxidant	101,210 (21.3%)	13,910 (18.9%)	115,120 (21%)
Stability[2]				
	Fully Stabilised	2,392 (0.5%)	233 (0.3%)	2,625 (0.5%)
	Hinged	1,433 (0.3%)	138 (0.2%)	1,571 (0.3%)
	Medial Pivot Design	38,984 (8.2%)	5,063 (6.9%)	44,047 (8%)
	Minimally Stabilised	334,873 (70.5%)	58,992 (80%)	393,865 (71.8%)
	Posterior Stabilised	96,992 (20.4%)	9,304 (12.6%)	106,296 (19.4%)
Bearing Mobility[3]				
	Fixed	416,011 (87.6%)	65,033 (88.2%)	481,044 (87.7%)
	Mobile	58,663 (12.4%)	8,697 (11.8%)	67,360 (12.3%)
Patella Usage				
	Patella Used	342,992 (72.2%)	44,569 (60.4%)	387,561 (70.7%)
	No Patella	131,782 (27.8%)	29,171 (39.6%)	160,953 (29.3%)
TOTAL		474,774	73,740	548,514

[1]Excludes 913 procedures with unknown bearing surface
[2]Excludes 110 procedures with unknown stability
[3]Excludes 110 procedures with unknown bearing mobility

Figure N110 **Percentage of Less Commonly Used Femoral Components in Primary Total Knee Replacement by Hospital Locality (Primary Diagnosis OA)**



Variation in Fixation by Hospital Locality

In 2023, there are higher rates of cementless fixation for knee replacements in metropolitan/regional (MM1-2) areas (21.7%) than rural/remote (MM3-7) areas (16.9%) (Figure N111). Hybrid fixation is performed equivalently in both settings (Figure N112). Fully cemented fixation is used more commonly in rural/remote (64.9%) than in metropolitan/regional areas (60.3%) (Figure N113).

Figure N111 Percentage of Cementless Primary Total Knee Replacement by Hospital Locality (Primary Diagnosis OA)

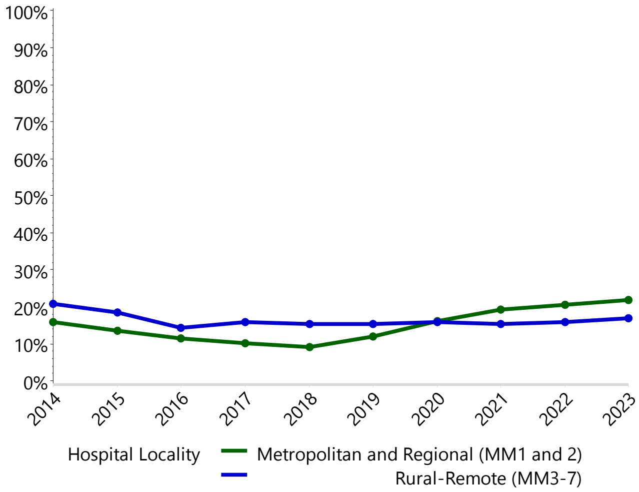


Figure N112 Percentage of Hybrid Primary Total Knee Replacement by Hospital Locality (Primary Diagnosis OA)

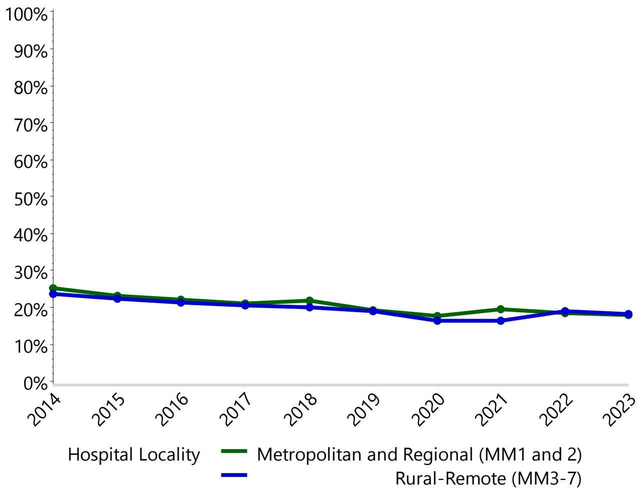
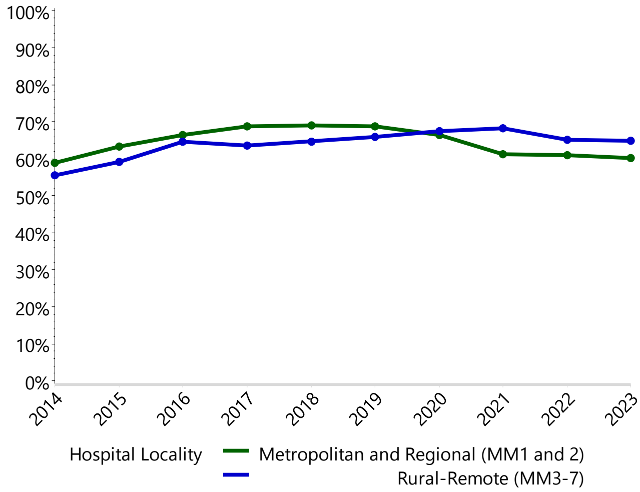


Figure N113 Percentage of Fully Cemented Primary Total Knee Replacement by Hospital Locality (Primary Diagnosis OA)



Variation in Prosthesis Stability by Hospital Locality
There are only minor differences in implant stability choice comparing metropolitan/regional and rural/remote regions. Minimally stabilised knee replacement predominates in both metropolitan/regional (MM1-2) (76.5%) and rural/remote (MM3-7) (78.3%) settings in 2023 (Figure N114). Medial pivot design knee replacement has slowly increased in the past decade and in 2023 is performed in approximately 10.0% of cases in both metropolitan/regional and rural/remote settings (Figure N115). Posterior stabilised knee replacement is similar in proportion to medial pivot design knee replacement. The use of posterior stabilised knees has diminished in metropolitan/regional compared to rural/remote settings over the last decade (Figure N116).

Figure N114 Percentage of Minimally Stabilised Primary Total Knee Replacement by Hospital Locality (Primary Diagnosis OA)

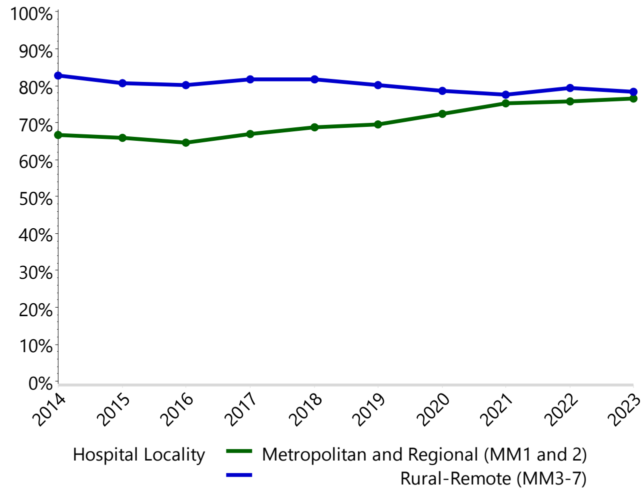


Figure N116 Percentage of Posterior Stabilised Primary Total Knee Replacement by Hospital Locality (Primary Diagnosis OA)

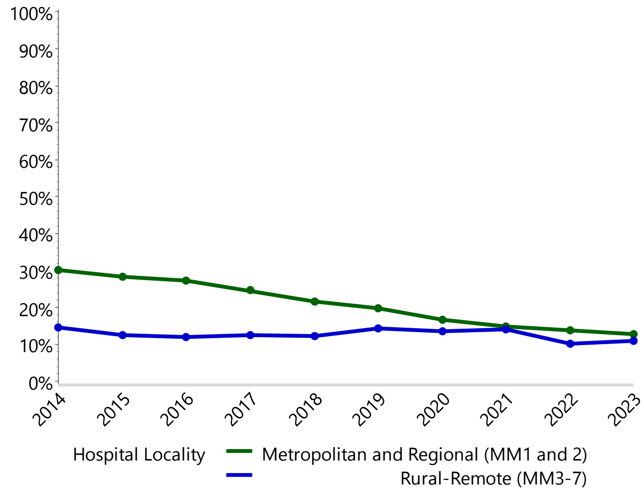
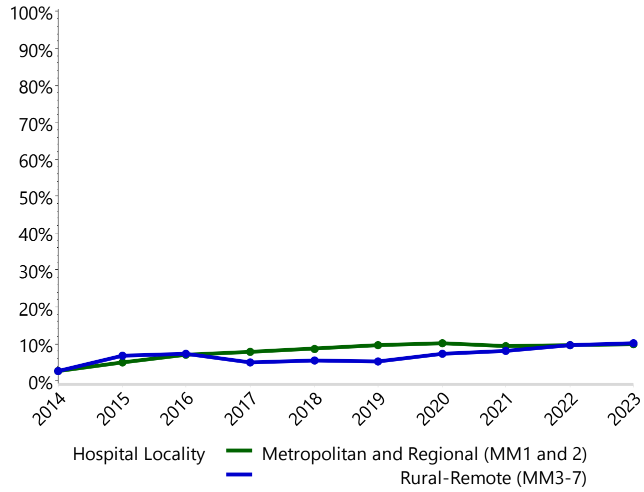


Figure N115 Percentage of Medial Pivot Design Primary Total Knee Replacement by Hospital Locality (Primary Diagnosis OA)



Variation in Bearing Mobility by Hospital Locality
Use of mobile bearing primary total knee replacement has declined in both metropolitan/regional (MM1-2) and rural/remote areas (MM3-7), and now makes up only 8.4% and 6.0% of procedures, respectively in these locations (Figure N117).

Variation in Bearing Surface by Hospital Locality
The usage of XLPE in knee replacement in metropolitan/regional (MM1-2) areas has remained steady at approximately 45.0% over the past decade. The usage of XLPE in knee replacement in rural/remote (MM3-7) areas has declined from 48.1% to 35.9% over the past decade (Figure N118).

The usage of XLPE+ antioxidant has risen steadily in both metropolitan/regional and rural/remote areas over the past 10 years to 36.2% and 42.0%, respectively (Figure N118).

Figure N117 **Percentage of Mobile Bearing Primary Total Knee Replacement by Hospital Locality (Primary Diagnosis OA)**

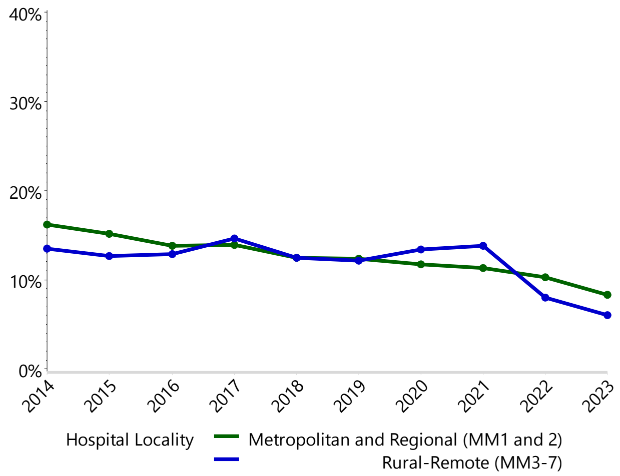
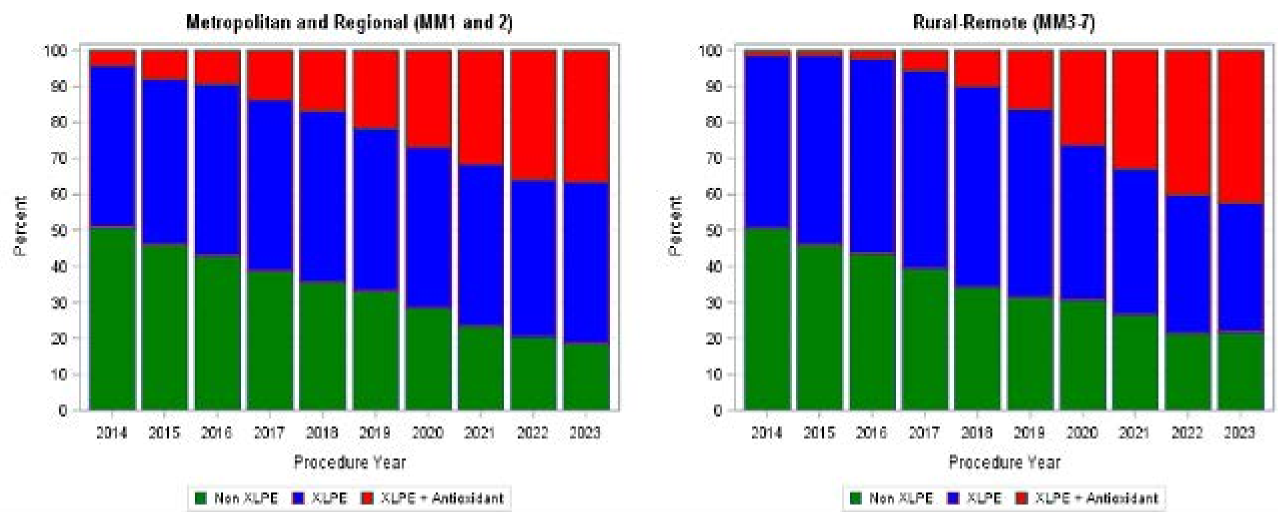
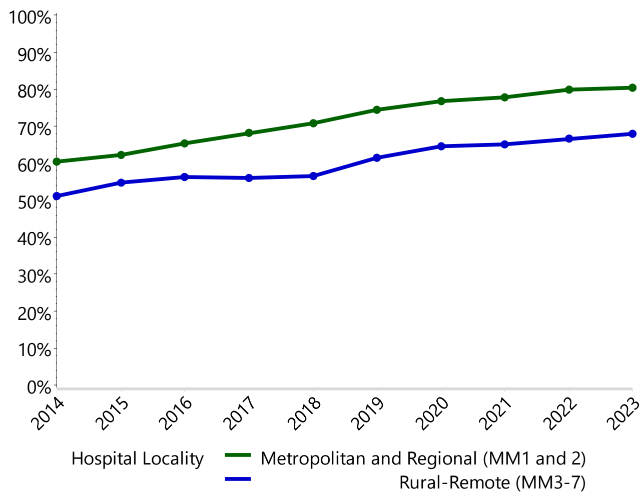


Figure N118 **Bearing Surface of Primary Total Conventional Hip Replacement by Hospital Locality (Primary Diagnosis OA)**



Variation in Patella Usage by Hospital Locality
The use of patella components in primary total knee replacement has increased over the last 10 years in both metropolitan and regional hospitals and in rural and remote areas. In 2023, the proportion using a patella component remains higher in metropolitan and regional areas (80.6%) compared to rural and remote areas (68.0%) (Figure N119).

Figure N119 Percentage of Patella Usage in Primary Total Knee Replacement by Hospital Locality (Primary Diagnosis OA)



Variation in Technology Assistance by Hospital Locality
There has been a steady rise in the use of technology assistance in both metropolitan (MM1-2) and rural (MM3-7) areas over the past 10 years (Figure N120). Robotic assistance is now used in 38.4% of knee replacements procedures in metropolitan areas and 17.6% in rural areas (Figure N121).

In 2023 computer navigation is used more commonly in rural areas (26.1%) than in metropolitan areas (20.7%) (Figure N122). IDI is used in a similar proportion of cases performed in both metropolitan and rural areas (Figure N123).

Figure N120 Percentage of Technology Assisted Primary Total Knee Replacement by Hospital Locality (Primary Diagnosis OA)

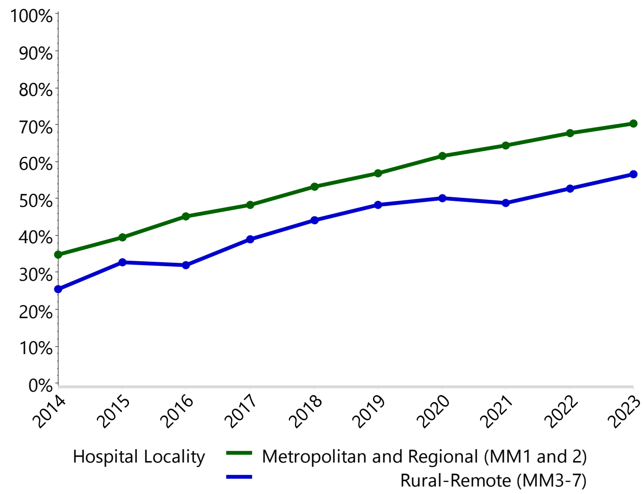


Figure N121 Percentage of Primary Total Knee Replacement using Robotic Assistance by Hospital Locality (Primary Diagnosis OA)

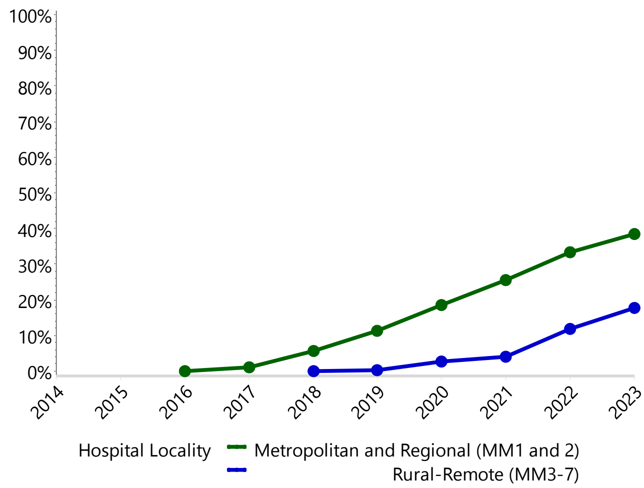


Figure N122 Percentage of Primary Total Knee Replacement using Computer Navigation by Hospital Locality (Primary Diagnosis OA)

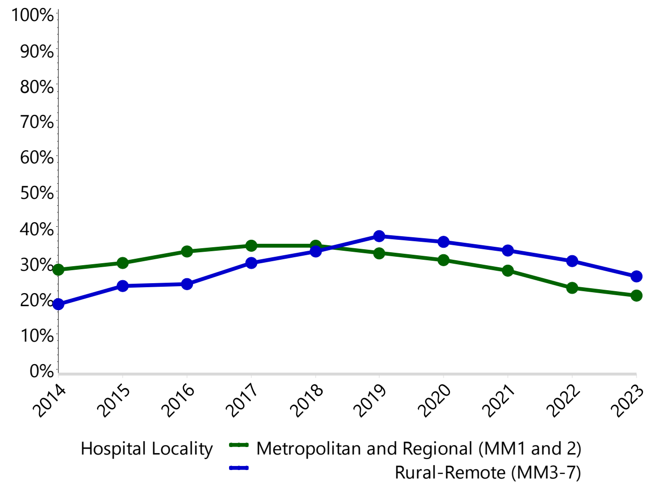
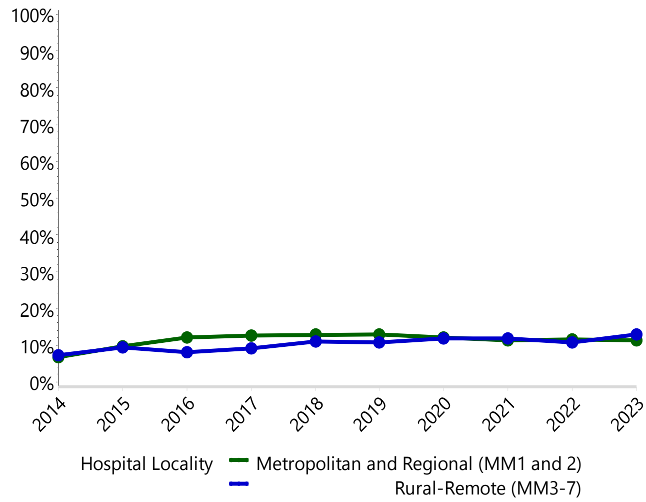


Figure N123 Percentage of Primary Total Knee Replacement using IDI by Hospital Locality (Primary Diagnosis OA)



Revision Procedures and Diagnoses by Hospital Locality

Over the last 10 years the proportion of major revision has changed little in MM1 and MM2 regions but increased from 35.0% to 42.0% in rural and remote areas (Figure N124). Whilst individual diagnoses vary year to year, revision for infection has increased in both metropolitan and rural localities (Figure N125).

Figure N124 Percentage of Major Revision of 1st Revision Knee Replacement of Known Primary Total Knee Replacement by Hospital Locality (All Diagnoses)

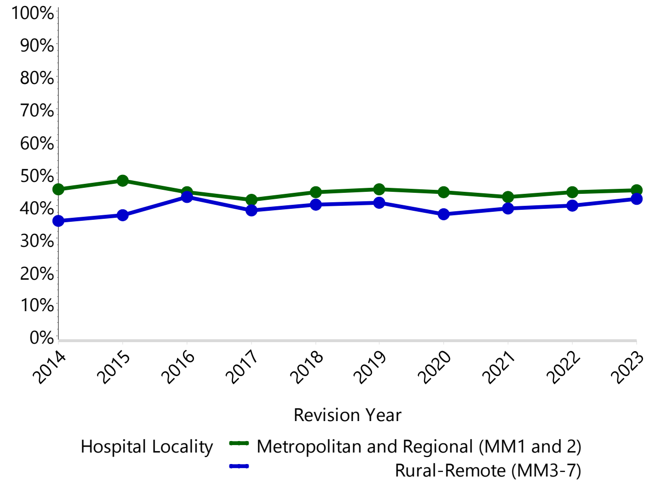
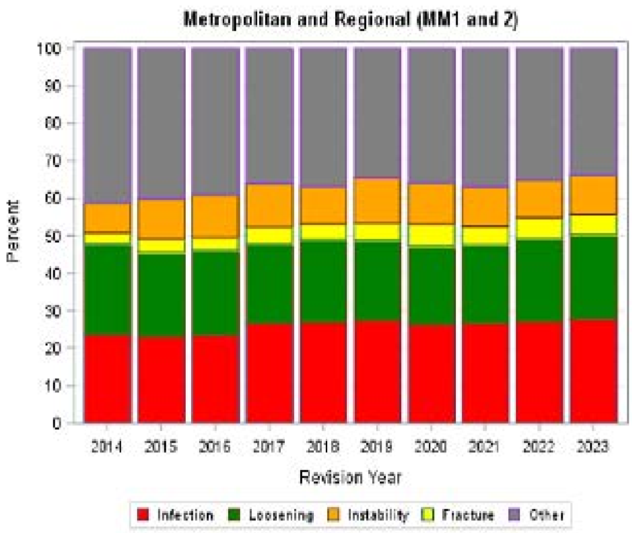
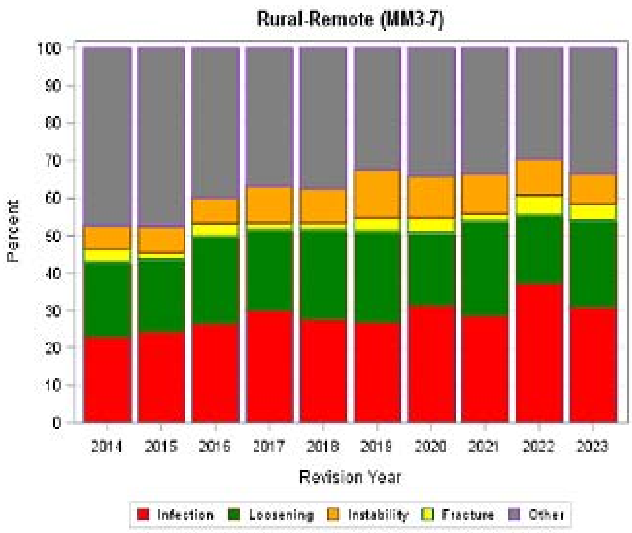


Figure N125 Revision Diagnosis of 1st Revision Knee Replacement of Known Primary Total Knee Replacement by Hospital Locality (All Diagnoses)





KNEE REPLACEMENT VARIATION SUMMARY

In parallel to the previous hip replacement segment, this section has shown that both similarities and differences exist with respect to knee replacement surgery within Australia. Unlike for hips, there is some variation in demographic factors for knee replacement patients, with slightly younger patients in the two territories and more male patients in the NT, which most likely reflects underlying population characteristics. While BMI categories have remained at a stable ratio for the last 10 years and between states, of some concern is the increase in patients with significant comorbidity (ASA class 3 and 4) where the proportion in 2023 is almost 50% in SA and VIC. The IRSAD rating disparities between the states mirror the findings for hip replacement patients.

Across the nation the number of surgeons performing knee replacement has remained static during the last 10 years, as have the proportions of surgeons with <20 procedures/year, and this group contributes to <10% of knee replacement in most states. Most states have seen a reduction in surgeons with <4 years' experience.

The incidence of knee replacement per 100,000 population ranges from 105.9 in NT to 353.8 in TAS. Simple calculations such as these, however, may be confounded by differences in age distribution within states as well as differences in factors affecting osteoarthritis. Like hip replacement, the proportion of knee replacements in the public sector has fallen to be <25% in most states, and also like hip replacement there are small differences between states/territories in cumulative percent revision seen in both public and private sectors.

There is some variability in prostheses amongst the states, but apart from in the NT, between 60% and 85% are chosen from the 10 most commonly used components. Most states have seen a small rise in the proportion of fully cemented knee replacement, but cementless fixation has also increased in QLD, VIC, WA and the ACT, with a corresponding decrease in the use of hybrid fixation. There have been common national trends in decreased use of mobile bearings, posterior stabilised prostheses and non-XLPE inserts, while there have been increases in patella component use and technology assistance. However, technology type varies widely. In 2023 robotic assistance was used for over 50% of knee replacements in TAS and the ACT, but this is yet to be recorded in the NT where 55% of procedures use computer navigation. States apart from the NT, have similar proportions (with minor fluctuations) of major revision procedures, and all have seen an increase in revision for infection over the last decade.

In a similar finding to hip replacements, rural and remote hospitals contribute <10% of knee replacement procedures in most states, but the proportion is higher in NSW (23.6%) and VIC (16.7%). These differences are felt to reflect the state's population distribution. Patient age, gender, ASA and BMI are similar in both localities, suggesting that the more comorbid or obese patients are not selectively referred to the metropolitan hospitals. Proportionally more patients from socially disadvantaged regions have procedures in rural/remote hospitals. Metropolitan/regional and rural/remote hospitals have similar surgeon percentages performing <20 procedures/year, and with <4 years' experience.

Commonly used prostheses are chosen in similar proportions, with similar use of cemented fixation, polyethylene choice and bearing mobility. While there were some differences in prosthesis constraint 10 years ago, there is a convergence to similarity between localities in 2023. The increase in patella component use with time is similar in both localities, but the percentage using a patella component is lower in rural/remote hospitals at 68.0% in 2023. The growth in use of technology assistance for knee replacement in both localities is comparable, and even in rural/remote hospitals some technology assistance is used for over 40% of procedures in 2023. The type used varies, with a larger proportion of robotic assistance in the metropolitan/regional and more computer navigation in rural/remote hospitals. The proportion of major revisions is similar in both localities, with a small rise in revision for infection independent of region.

Chapter Summary

In summary, this chapter has shown that across Australia hip and knee arthroplasty varies in many ways, with some differences in patient demographics, some related to surgeon factors, others regarding prosthesis choice or surgical technique and yet others related to hospitals and the health care system. We have shown changes in these factors over time, and highlighted differences that occur between the states/territories, and with rurality. Understanding the reasons for, and the significance of these variations requires further research.

Hip Replacement

Hip Replacement

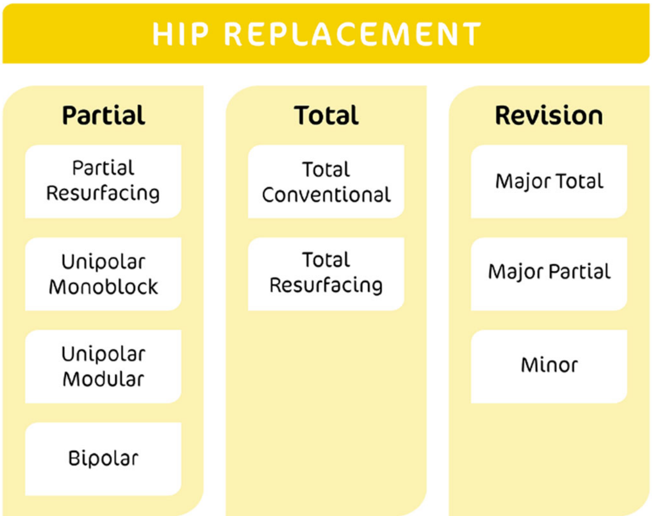
Categories of Hip Replacement

Hip replacement is grouped into three broad categories: primary partial, primary total and revision hip replacement.

A primary replacement is an initial replacement procedure undertaken on a joint and involves replacing either part (partial) or all (total) of the articular surface.

Primary partial and primary total hip replacement are further subcategorised into classes depending on the type of prostheses used. Partial hip classes include partial resurfacing, unipolar monoblock, unipolar modular, and bipolar. Total hip classes include total conventional and total resurfacing. Definitions for each of these classes are detailed in the subsequent sections.

Revision hip replacements are re-operations of previous hip replacements where one or more of the prosthetic components are replaced, removed, or one or more components are added. Revisions include re-operations of primary partial, primary total, or previous revision procedures. Hip revisions are subcategorised into three classes: major total, major partial, or minor revisions.



Detailed information on demographics of each category of hip replacement is available in the supplementary report 'Demographics of Hip, Knee and Shoulder Arthroplasty' on the AOANJRR website: https://www.aoanjrr.sahmri.com/annual-reports-2024

Executive Summary Reference Tables

This year, new tables (Table H1, Table H2 and Table H3) have been added which index the analyses within this chapter. Variables are listed, and where there is a significant finding for a comparison, a red diamond is shown in the table. There are hyperlinks to the relevant tables and figures.

Table H1 Indexing Significant Characteristic Comparisons: Partial Hip Replacements

Characteristic	Variable	Partial Hip Fractured NoF		Unipolar Monoblock Fractured NoF		Unipolar Modular Fractured NoF		Bipolar Fractured NoF	
		Significant HR	Figure	Significant HR	Figure	Significant HR	Figure	Significant HR	Figure
	Class	♦	Figure HP2	NT		NT		NT	
	Class and Age	♦	Figure HP3	NT		NT		NT	
Patient									
	Age	NT		♦	Figure HP7	♦	Figure HP13	♦	Figure HP20
	Gender	NT			Figure HP8	♦	Figure HP14		Figure HP21
Prosthesis									
	Fixation	NT		♦	Figure HP9	♦	Figure HP15	♦	Figure HP22

♦ Significant Hazard Ratio difference between categories where $p<0.05$
N T Not tested: Insufficient numbers to make statistical comparisons

Table H2 Indexing Significant Characteristic Comparisons: Total Hip Replacements

Characteristic	Variable	Total Conventional Hip Osteoarthritis		Total Conventional Hip All Diagnoses		Total Conventional Hip Fractured NoF		Hip Fractured NoF	
		Significant HR	Table/ Figure	Significant HR	Table/ Figure	Significant HR	Table/ Figure	Significant HR	Table/ Figure
	Primary Diagnosis	NT		♦	Figure HT4	NT		NT	
	Class	NT		NT		♦	Figure HT82	♦	Figure HT82
	Class and Age <70	NT		NT		NT		♦	Figure HT83
	Class and Age ≥70	NT		NT		NT		♦	Figure HT84
	Class and Gender	NT		NT		NT		NT	
Patient									
	Age	♦	Figure HT7	NT		♦	Figure HT63	NT	
	Gender	♦	Figure HT8	NT		♦	Figure HT64	NT	
	Gender by Age	♦	Figure HT9 Figure HT10	NT		♦	Figure HT65 Figure HT66	NT	
	ASA Score	♦	Figure HT14	NT		♦	Figure HT70	NT	
	BMI	♦	Figure HT17	NT		♦	Figure HT73	NT	
Prosthesis									
	Fixation	♦	Figure HT20	NT		♦	Figure HT75	NT	
	Fixation and age <55		Figure HT21	NT		NT		NT	
	Fixation and age 55-64	♦	Figure HT22	NT		NT		NT	
	Fixation and age 65-74	♦	Figure HT23	NT		NT		NT	
	Fixation and age ≥75	♦	Figure HT24	NT		NT		NT	
	Fixation and age <70	NT		NT		♦	Figure HT76	NT	
	Fixation and age ≥70	NT		NT		♦	Figure HT77	NT	
	Stem Collar	♦	Figure HT25	NT		NT		NT	
	Surgical Approach and Stem Collar Use	♦	Table HT26	NT		NT		NT	
	Fixation and Stem Collar Use	♦	Table HT28	NT		NT		NT	
	Mini Stems	♦	Figure HT27	NT		NT		NT	
	Mini Stems and Age	♦	Figure HT28						
	Mini Stems and Obesity	♦	Figure HT29						
	Mini Stems Revision for Loosening	♦	Figure HT31	NT		NT		NT	
	Mini Stems Revision for Fracture	♦	Figure HT32	NT		NT		NT	
	Bearing Surface	♦	Figure HT34	NT		NT		NT	
	Polyethylene Type	♦	Figure HT36 Figure HT42	NT		NT		NT	
	Head Size	NT		NT			Figure HT78	NT	
	Head Size and Revision for Prosthesis Dislocation/Instability	NT		NT		♦	Figure HT79	NT	
	Non XLPE Polyethylene and Head Size		Figure HT38	NT		NT		NT	
	XLPE Polyethylene Type and Head Size	♦	Figure HT39	NT		NT		NT	
	Polyethylene Type and Acetabular Component	♦	Table HT39	NT		NT		NT	
	Mixed ceramic Bearings by Head Size	♦	Figure HT46	NT		NT		NT	

Table H2 ***Cont.***

Characteristic	Variable	Total Conventional Hip Osteoarthritis Significant HR	Total Conventional Hip Osteoarthritis Table/ Figure	Total Conventional Hip All Diagnoses Significant HR	Total Conventional Hip All Diagnoses Table/ Figure	Total Conventional Hip Fractured NoF Significant HR	Total Conventional Hip Fractured NoF Table/ Figure	Hip Fractured NoF Significant HR	Hip Fractured NoF Table/ Figure
	Acetabular Type	NT		♦	Figure HT48		Figure HT80	NT	
	Acetabular Components	♦	Table HT49	NT		NT		NT	
	Acetabular Type and Gender		Table HT58	NT		NT		NT	
	Dual Mobility		Table HT58	♦	Figure HT50		Figure HT81	NT	
	Dual Mobility and Age		Table HT58	NT		NT		NT	
	Dual Mobility and Gender	♦	Figure HT51	NT		NT		NT	
	Dual Mobility and Fixation		Table HT58	NT		NT		NT	
	Dual Mobility and Reason for Revision	♦	Table HT58	NT		NT		NT	
	Surgical Approach	♦	Figure HT53	NT		NT		NT	
	Surgical Approach Major Revision	♦	Figure HT54	NT		NT		NT	
	Surgical Approach Revision for Loosening	♦	Figure HT56	NT		NT		NT	
	Surgical Approach Revision for Fracture	♦	Figure HT57	NT		NT		NT	
	Surgical Approach Revision for Infection	♦	Figure HT58	NT		NT		NT	
	Surgical Approach Revision for Instability	♦	Figure HT59	NT		NT		NT	

♦ Significant Hazard Ratio difference between categories where p<0.05

N T Not tested: Insufficient numbers to make statistical comparisons

Hip Replacement

Table H3 Indexing Significant Characteristic Comparisons: Total Hip Replacements

Characteristic	Variable	Total Resurfacing Hip All Diagnoses Significant HR	Total Resurfacing Hip All Diagnoses Figure	Total Resurfacing Hip Osteoarthritis Significant HR	Total Resurfacing Hip Osteoarthritis Figure	Primary Total Hip Osteoarthritis Significant HR	Primary Total Hip Osteoarthritis Figure
	Primary Diagnosis	♦	Figure HT87	NT		NT	
	Class	NT		NT		♦	Figure HT97
	Class and Gender	NT		NT		♦	Figure HT98
Patient							
	Age	NT		♦	Figure HT90	NT	
	Gender	NT		♦	Figure HT91	NT	
	Male Gender by Age	NT		♦	Figure HT92	NT	
	Female Gender by Age	NT			Figure HT93	NT	
Prosthesis							
	Head Size	NT		♦	Figure HT94	NT	
	Head Size and Gender	NT		♦	Figure HT95	NT	

♦ Significant Hazard Ratio difference between categories where p<0.05. Not tested (NT): Insufficient numbers to make statistical comparisons

Use of Hip Replacement

There are 910,050 hip replacements with a procedure date up to and including 31 December 2023. This is an additional 59,447 hip procedures compared to the number reported last year. The relative frequency of each type of hip procedure is provided in Table H4.

For further information on the **closure of the database** please see the **Glossary** of this report.

Table H4 Number of Hip Replacements

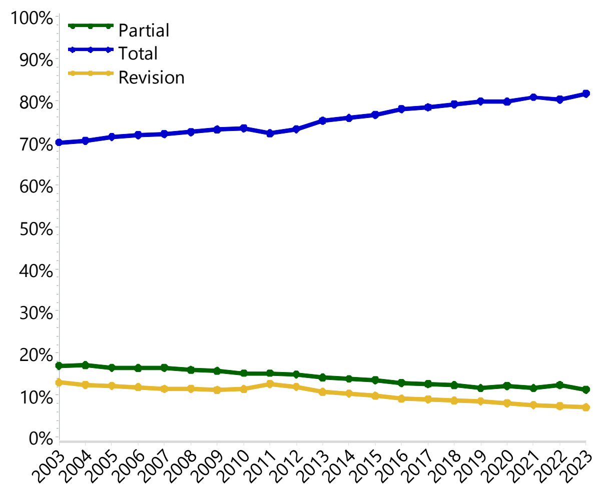
Hip Category	Number	Percent
Partial	127218	14.0
Total	691376	76.0
Revision	91456	10.0
TOTAL	**910050**	**100.0**

The number of hip replacement procedures undertaken in 2023 is a 120% increase since 2003. The corresponding increase in primary total hip replacement is 156.4%, for primary partial it is 45.7% and for revision hip replacement it is 20.7%.

There have been 4,902 more hip replacement procedures undertaken in 2023 compared to the previous year. During this time, the use of primary total hip replacement increased by 11.0%, accounting for 81.6% of all hip replacement procedures in 2023. Primary partial hip replacement decreased by 0.6%, accounting for 11.3% of hip procedures in 2023.

The proportion of revision hip procedures has declined from a peak of 12.9% in 2003 to 7.1% in 2023. This equates to 3,421 fewer revision procedures in 2023 than would have been expected if the proportion of revision procedures had remained at the level reported in 2003 (Figure H1).

Figure H1 Proportion of Hip Replacement



ASA Score and BMI in Hip Replacement

Data are reported on hip replacement procedures for both the American Society of Anaesthesiologists – Physical Status Classification (ASA score) and Body Mass Index (BMI). ASA score and BMI are both known to impact the outcome of hip replacement surgery. The Registry commenced collection of ASA score in 2012 and BMI data in 2015.

There are ASA score data on 521,872 hip replacement procedures and BMI data on 403,735 hip replacement procedures. Since its initial collection, ASA score has been recorded for 96.9% of procedures. BMI has been recorded for 88.7% of procedures since collection commenced.

ASA Score

There are five ASA score classifications:[9]

1. A normal healthy patient
2. A patient with mild systemic disease
3. A patient with severe systemic disease
4. A patient with severe systemic disease that is a constant threat to life
5. A moribund patient who is not expected to survive without the operation

There is a difference in ASA score depending on the class of hip replacement. Partial hip replacement procedures have a higher proportion of patients with ASA scores 3 and 4 compared to patients undergoing primary total or revision hip replacement. Total hip replacement procedures have more patients with ASA scores 1 and 2 (Table H5).

BMI Category

BMI for adults is classified by the World Health Organisation into six main categories:[10]

Underweight	<18.50
Normal	18.50 – 24.99
Pre-obese	25.00 – 29.99
Obese Class 1	30.00 – 34.99
Obese Class 2	35.00 – 39.99
Obese Class 3	≥40.00

The majority of hip replacement procedures are undertaken in patients who have a normal BMI or are pre-obese (Table H6).

Table H5 ASA Score for Hip Replacement

ASA Score	Partial		Total		Revision		TOTAL	
	N	Col%	N	Col%	N	Col%	N	Col%
ASA 1	182	0.3	35491	8.6	1635	3.7	37308	7.1
ASA 2	6367	9.9	214973	52.1	14756	33.0	236096	45.2
ASA 3	39078	60.6	153836	37.3	24433	54.6	217347	41.6
ASA 4	18633	28.9	8266	2.0	3891	8.7	30790	5.9
ASA 5	270	0.4	33	0.0	28	0.1	331	0.1
TOTAL	**64530**	**100.0**	**412599**	**100.0**	**44743**	**100.0**	**521872**	**100.0**

Table H6 BMI Category for Hip Replacement

BMI Category	Partial		Total		Revision		TOTAL	
	N	Col%	N	Col%	N	Col%	N	Col%
Underweight	3032	9.8	3661	1.1	547	1.7	7240	1.8
Normal	15359	49.4	75391	22.1	7601	23.9	98351	24.4
Pre Obese	8873	28.5	124434	36.5	10863	34.2	144170	35.7
Obese Class 1	2772	8.9	84563	24.8	7489	23.6	94824	23.5
Obese Class 2	757	2.4	35596	10.4	3299	10.4	39652	9.8
Obese Class 3	295	0.9	17242	5.1	1961	6.2	19498	4.8
TOTAL	**31088**	**100.0**	**340887**	**100.0**	**31760**	**100.0**	**403735**	**100.0**

Note: BMI has not been presented for patients aged ≤19 years

[9] https://www.asahq.org/standards-and-practice-parameters/statement-on-asa-physical-status-classification-system

[10] https://www.who.int/europe/news-room/fact-sheets/item/a-healthy-lifestyle---who-recommendations

Primary Partial Hip Replacement

Classes of Partial Hip Replacement

There are four classes of primary partial hip replacement. These are defined by the type of prostheses used.

Partial resurfacing involves the use of one or more button prostheses to replace part of the natural articulating surface on one or both sides of the hip joint. These prostheses are no longer used.

Unipolar monoblock involves the use of a femoral stem prosthesis with a fixed large head that replaces the natural femoral head.

Unipolar modular involves the use of a femoral stem and exchangeable large head prosthesis that replaces the natural femoral head.

Bipolar involves the use of a femoral stem and standard head prosthesis that articulates with a non-fixed component replacing the natural femoral head.

Use of Partial Hip Replacement

The most common class of primary partial hip replacement is unipolar modular followed by bipolar and unipolar monoblock (Table HP1).

Table HP1 Primary Partial Hip Replacement by Class

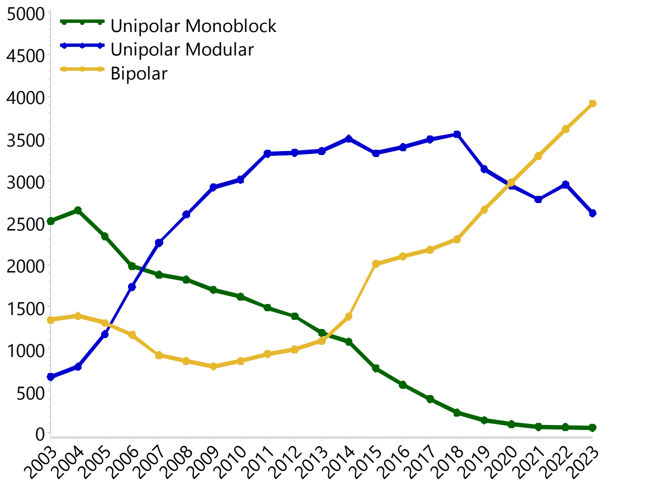
Hip Class	Number	Percent
Unipolar Monoblock	29333	23.1
Unipolar Modular	57697	45.4
Bipolar	40173	31.6
TOTAL	**127203**	**100.0**

Note: Excludes 15 partial resurfacing hip procedures.
Partial resurfacing hip procedures have not been performed since 2014

In 2023, bipolar hip replacement was more commonly used than unipolar modular. The use of unipolar monoblock has declined to 1% (Figure HP1). The 10 most used femoral prostheses for partial hip replacement are listed in Table HP2. The Exeter V40, CPT and CPCS were the most frequently used femoral prostheses.

Detailed demographic information on primary partial hip replacement is available in the supplementary report 'Demographics of Hip, Knee and Shoulder Arthroplasty' on the AOANJRR website: https://aoanjrr.sahmri.com/annual-reports-2024

Figure HP1 Primary Partial Hip Replacement by Class



Detailed information on partial resurfacing hip replacement is available in the supplementary report 'Prosthesis Types with No or Minimal Use' on the AOANJRR website: https://aoanjrr.sahmri.com/annual-reports-2024

Table HP2 10 Most Used Femoral Prostheses in Primary Partial Hip Replacement

2003		2020		2021		2022		2023	
N	Model	N	Model	N	Model	N	Model	N	Model
1988	Austin-Moore Type	2936	Exeter V40	3111	Exeter V40	3467	Exeter V40	3268	Exeter V40
810	Exeter V40	860	CPT	875	CPT	870	CPT	897	CPT
526	Thompson Type	769	CPCS	725	CPCS	731	CPCS	766	CPCS
186	Alloclassic	477	C-Stem AMT	500	C-Stem AMT	496	C-Stem AMT	485	C-Stem AMT
127	Elite Plus	123	Short Exeter V40	132	CORAIL	204	Short Exeter V40	209	Taper Fit
105	CPT	108	CORAIL	130	Short Exeter V40	184	CORAIL	162	CORAIL
95	Spectron EF	92	ETS	93	Absolut	102	Quadra-C	145	Short Exeter V40
74	C-Stem	86	Taper Fit	74	Taper Fit	82	Taper Fit	107	Quadra-C
65	CPCS	77	twinSys (ctd)	72	ETS	68	ETS	92	MS 30
63	Omnifit	61	Quadra-C	72	Quadra-C	59	Polarstem	72	Polarstem
10 Most Used									
4039	(10) 89.3%	5589	(10) 92.9%	5784	(10) 94.2%	6263	(10) 94.5%	6203	(10) 94.2%
Remainder									
482	(52) 10.7%	429	(36) 7.1%	356	(38) 5.8%	365	(39) 5.5%	385	(35) 5.8%
TOTAL									
4521	(62) 100.0%	6018	(46) 100.0%	6140	(48) 100.0%	6628	(49) 100.0%	6588	(45) 100.0%

Note: Excludes partial resurfacing

Primary Partial Hip Replacement

Outcome for Fractured Neck of Femur

In order to keep Registry data contemporaneous, only procedures using prostheses that have been available and used in 2023 (described as modern prostheses) are included in the analyses, unless clearly specified.

Fractured neck of femur is the principal diagnosis for the three main classes of primary partial hip replacement: unipolar monoblock (97.7%), unipolar modular (96.3%) and bipolar (94.6%). A comparative analysis of partial hip replacement and total conventional hip replacement has been undertaken for fractured neck of femur and is presented after the primary total conventional hip replacement for osteoarthritis section of this report.

The outcome of primary partial hip replacement varies depending on the class. Outcomes are restricted to 10 years because of the high mortality in this group. The prosthesis class variation in mortality is almost certainly due to patient selection (Table HP3).

At 10 years, bipolar has the lowest cumulative percent revision for fractured neck of femur, followed by unipolar modular and unipolar monoblock (Table HP4 and Figure HP2). The difference in outcome between classes is most apparent in patients aged <75 years (Table HP5 and Figure HP3).

The rate of revision for fractured neck of femur in primary total conventional hip replacement compared to primary partial hip replacement can be found later in this chapter in the following section: **Outcome of Total Conventional Compared to Partial Hip Replacement**.

Table HP3 Cumulative Percent Mortality of Primary Partial Hip Replacement by Class (Primary Diagnosis Fractured NOF)

Hip Class	N Deceased	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Monoblock	19871	21366	38.3 (37.6, 38.9)	51.5 (50.8, 52.2)	62.2 (61.5, 62.8)	78.1 (77.5, 78.7)	87.3 (86.9, 87.8)	94.2 (93.9, 94.5)
Unipolar Modular	34181	46382	27.4 (27.0, 27.8)	38.9 (38.5, 39.4)	49.2 (48.7, 49.6)	65.5 (65.1, 66.0)	76.9 (76.4, 77.3)	86.9 (86.5, 87.3)
Bipolar	18760	31291	25.0 (24.5, 25.5)	36.2 (35.7, 36.8)	46.0 (45.4, 46.6)	61.8 (61.2, 62.5)	72.8 (72.2, 73.5)	83.6 (83.0, 84.2)
TOTAL	**72812**	**99039**						

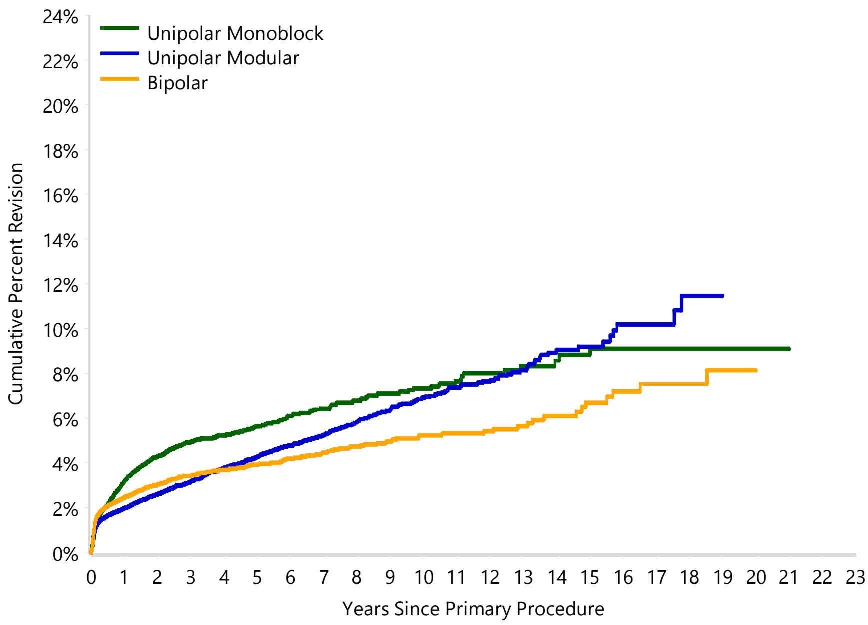
Note: Restricted to modern prostheses
Restricted to first procedure performed per patient

Table HP4 **Cumulative Percent Revision of Primary Partial Hip Replacement by Class (Primary Diagnosis Fractured NOF)**

Hip Class	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Monoblock	844	21871	3.2 (2.9, 3.4)	4.3 (4.0, 4.6)	4.9 (4.6, 5.3)	5.6 (5.2, 6.1)	6.4 (5.9, 7.0)	7.3 (6.7, 8.0)
Unipolar Modular	1530	48016	2.0 (1.8, 2.1)	2.6 (2.5, 2.8)	3.2 (3.0, 3.4)	4.3 (4.0, 4.5)	5.3 (4.9, 5.6)	6.9 (6.4, 7.4)
Bipolar	954	32184	2.5 (2.3, 2.6)	3.0 (2.8, 3.3)	3.4 (3.2, 3.7)	3.9 (3.7, 4.2)	4.4 (4.1, 4.8)	5.2 (4.8, 5.8)
TOTAL	**3328**	**102071**						

Note: Restricted to modern prostheses

Figure HP2 **Cumulative Percent Revision of Primary Partial Hip Replacement by Class (Primary Diagnosis Fractured NOF)**



HR - adjusted for age and gender

Unipolar Monoblock vs Unipolar Modular
Entire Period: HR=1.45 (1.34, 1.58), p<0.001

Unipolar Monoblock vs Bipolar
0 - 2Wk: HR=1.69 (1.28, 2.23), p<0.001
2Wk - 3Mth: HR=0.92 (0.79, 1.08), p=0.315
3Mth+: HR=2.16 (1.90, 2.46), p<0.001

Bipolar vs Unipolar Modular
0 - 2Wk: HR=0.88 (0.66, 1.16), p=0.353
2Wk - 1Mth: HR=1.55 (1.30, 1.84), p<0.001
1Mth - 3Mth: HR=1.24 (1.05, 1.46), p=0.009
3Mth - 1Yr: HR=0.84 (0.70, 1.00), p=0.054
1Yr - 2.5Yr: HR=0.79 (0.66, 0.96), p=0.016
2.5Yr+: HR=0.54 (0.45, 0.66), p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Monoblock	21871	13045	10082	7777	4413	2472	1057
Unipolar Modular	48016	32203	25308	19755	11695	6676	2763
Bipolar	32184	20635	15414	11457	6257	3460	1405

Note: Restricted to modern prostheses

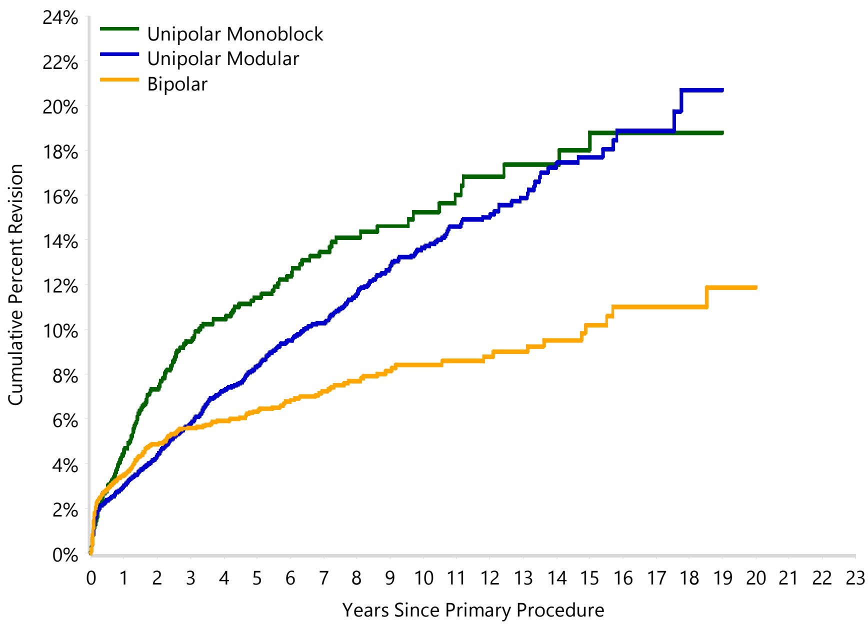
Primary Partial Hip Replacement

Table HP5 Cumulative Percent Revision of Primary Partial Hip Replacement in Patients Aged <75 Years by Class (Primary Diagnosis Fractured NOF)

Hip Class	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Monoblock	167	1858	4.5 (3.6, 5.7)	7.3 (6.1, 8.9)	9.5 (8.0, 11.2)	11.4 (9.7, 13.4)	13.5 (11.5, 15.8)	15.3 (13.0, 17.9)
Unipolar Modular	529	6728	3.0 (2.6, 3.5)	4.3 (3.8, 4.9)	5.8 (5.2, 6.5)	8.4 (7.6, 9.2)	10.3 (9.4, 11.3)	13.6 (12.4, 15.0)
Bipolar	296	5515	3.5 (3.0, 4.0)	4.9 (4.3, 5.5)	5.6 (5.0, 6.4)	6.3 (5.6, 7.2)	7.2 (6.4, 8.2)	8.4 (7.3, 9.6)
TOTAL	**992**	**14101**						

Note: Restricted to modern prostheses

Figure HP3 Cumulative Percent Revision of Primary Partial Hip Replacement in Patients Aged <75 Years by Class (Primary Diagnosis Fractured NOF)



HR - adjusted for age and gender

Unipolar Monoblock vs Unipolar Modular

Entire Period: HR=1.28 (1.07, 1.52), p=0.006

Unipolar Monoblock vs Bipolar

0 - 3Mth: HR=0.81 (0.56, 1.19), p=0.284

3Mth+: HR=2.39 (1.91, 2.98), p<0.001

Unipolar Modular vs Bipolar

0 - 1Mth: HR=0.74 (0.53, 1.03), p=0.071

1Mth - 1.5Yr: HR=0.91 (0.73, 1.13), p=0.404

1.5Yr - 3Yr: HR=1.56 (1.13, 2.16), p=0.007

3Yr+: HR=3.04 (2.33, 3.97), p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Monoblock	1858	1232	1013	859	595	428	249
Unipolar Modular	6728	5038	4250	3597	2561	1796	1013
Bipolar	5515	3852	3047	2458	1620	1102	596

Note: Restricted to modern prostheses

Unipolar Monoblock

DEMOGRAPHICS

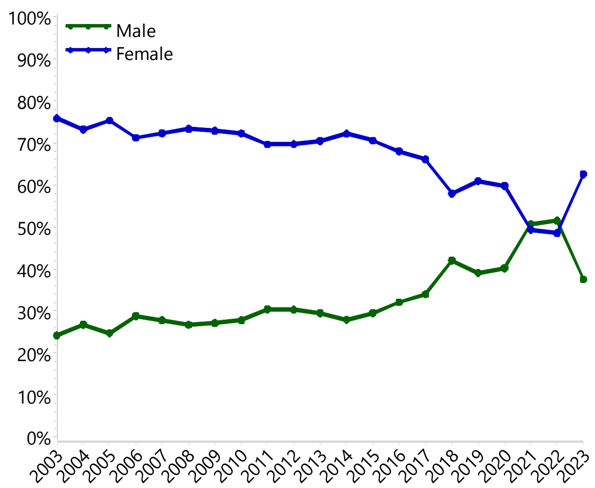
The Registry has recorded 29,333 unipolar monoblock procedures. This is an additional 76 procedures compared to the previous report.

The use of unipolar monoblock hip replacement in Australia continues to decline. The number of procedures reported in 2023 has decreased by 5.9% compared to 2022 and decreased by 97.5% compared to 2003.

Fractured neck of femur is the principal diagnosis for primary unipolar monoblock hip replacement (97.7%).

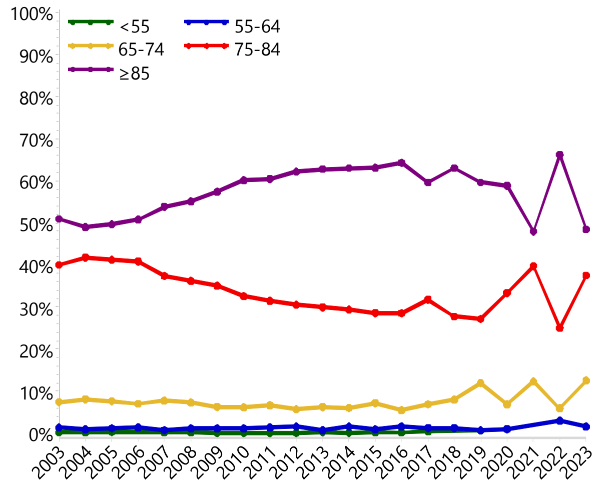
The majority of patients are female (72.6%) and aged ≥75 years (91.2%).

Figure HP4 Primary Unipolar Monoblock Hip Replacement by Gender



The proportion of patients aged ≥85 years has decreased from 51.0% in 2003 to 48.4% in 2023. The mean age of patients is 84.5 years (Table HP6, Figure HP4, and Figure HP5).

Figure HP5 Primary Unipolar Monoblock Hip Replacement by Age



The Exeter Trauma Stem (ETS) is the most used unipolar monoblock prosthesis in 2023. However, the use of the ETS has decreased by 7.4% compared to 2022 (Table HP7).

Table HP6 Age and Gender of Primary Unipolar Monoblock Hip Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	8029	27.4%	32	107	84	83.5	7.8
Female	21304	72.6%	16	108	86	85.0	7.2
TOTAL	**29333**	**100.0%**	**16**	**108**	**85**	**84.5**	**7.4**

Table HP7 Most Used Prostheses in Primary Unipolar Monoblock Hip Replacement

2003		2020		2021		2022		2023	
N	**Model**	**N**	**Model**	**N**	**Model**	**N**	**Model**	**N**	**Model**
1988	Austin-Moore Type	92	ETS	72	ETS	68	ETS	63	ETS
526	Thompson Type	9	Austin-Moore Type	1	Austin-Moore Type			1	Austin-Moore Type
		1	Thompson Type						
Most Used									
2514 (2) 100.0%		102 (3) 100.0%		73 (2) 100.0%		68 (1) 100.0%		64 (2) 100.0%	

Outcome for Fractured Neck of Femur

The cumulative percent revision at 10 years for unipolar monoblock replacement undertaken for fractured neck of femur is 7.3% (Table HP8 and Figure HP6).

The main reason for revision is loosening (43.2%), followed by fracture (22.7%), and infection (10.4%) (Table HP9). Of the revisions of unipolar monoblock hip replacements, the majority are revised to a total hip replacement (57.7%). Revision to another unipolar hip replacement (femoral component only) has occurred in 20.3% of revisions (Table HP10).

Age is a risk factor for revision. The rate of revision decreases with increasing age (Table HP11 and Figure HP7).

There is no difference in the rate of revision between males and females (Table HP12 and Figure HP8).

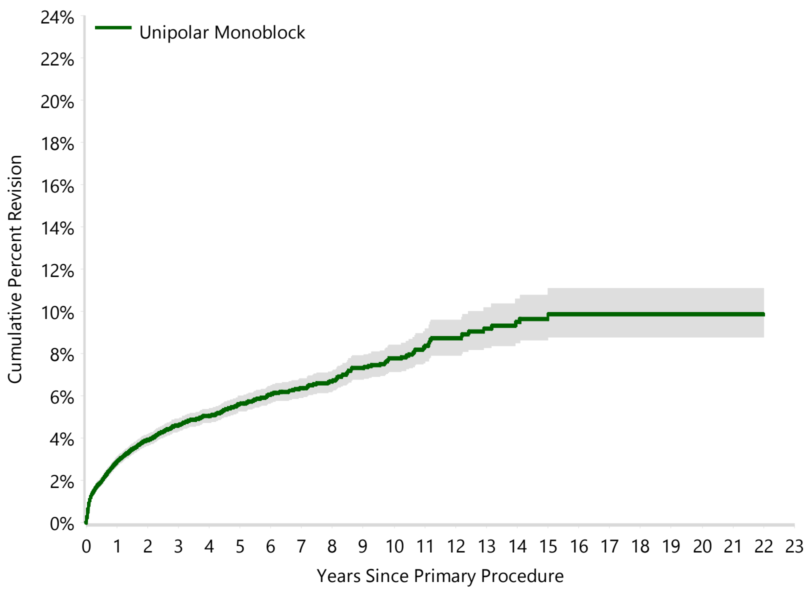
Fixation is a risk factor for revision. Cementless fixation has a higher rate of revision compared to cemented fixation (Table HP13 and Figure HP9).

Table HP8 Cumulative Percent Revision of Primary Unipolar Monoblock Hip Replacement (Primary Diagnosis Fractured NOF)

Hip Type	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Monoblock	844	21871	3.2 (2.9, 3.4)	4.3 (4.0, 4.6)	4.9 (4.6, 5.3)	5.6 (5.2, 6.1)	6.4 (5.9, 7.0)	7.3 (6.7, 8.0)
TOTAL	**844**	**21871**						

Note: Restricted to modern prostheses

Figure HP6 Cumulative Percent Revision of Primary Unipolar Monoblock Hip Replacement (Primary Diagnosis Fractured NOF)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Monoblock	21871	13045	10082	7777	4413	2472	1057

Note: Restricted to modern prostheses

Table HP9 Primary Unipolar Monoblock Hip Replacement by Reason for Revision (Primary Diagnosis Fractured NOF)

Reason for Revision	Number	Percent
Loosening	365	43.2
Fracture	192	22.7
Infection	88	10.4
Prosthesis Dislocation/Instability	86	10.2
Pain	61	7.2
Chondrolysis/Acetab. Erosion	32	3.8
Malposition	9	1.1
Lysis	4	0.5
Other	7	0.8
TOTAL	**844**	**100.0**

Note: Restricted to modern prostheses

Table HP10 Primary Unipolar Monoblock Hip Replacement by Type of Revision (Primary Diagnosis Fractured NOF)

Type of Revision	Number	Percent
THR (Femoral/Acetabular)	487	57.7
Femoral Component	171	20.3
Bipolar Head and Femoral	86	10.2
Removal of Prostheses	42	5.0
Cement Spacer	38	4.5
Minor Components	15	1.8
Reinsertion of Components	4	0.5
Bipolar Only	1	0.1
TOTAL	**844**	**100.0**

Note: Restricted to modern prostheses. Femoral heads are usually replaced when the acetabular component and/or femoral stem is revised

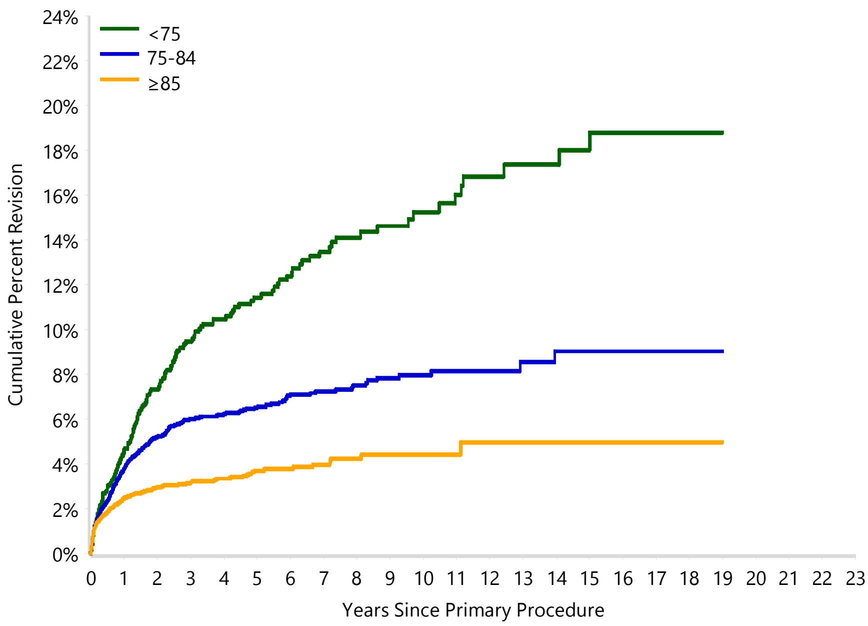
Primary Partial Hip Replacement

Table HP11 Cumulative Percent Revision of Primary Unipolar Monoblock Hip Replacement by Age (Primary Diagnosis Fractured NOF)

Age	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<75	167	1858	4.5 (3.6, 5.7)	7.3 (6.1, 8.9)	9.5 (8.0, 11.2)	11.4 (9.7, 13.4)	13.5 (11.5, 15.8)	15.3 (13.0, 17.9)
75-84	386	8063	3.8 (3.3, 4.3)	5.2 (4.7, 5.8)	6.0 (5.4, 6.7)	6.5 (5.9, 7.2)	7.2 (6.5, 8.1)	8.0 (7.1, 9.0)
≥85	291	11950	2.5 (2.2, 2.8)	3.0 (2.6, 3.3)	3.2 (2.8, 3.6)	3.7 (3.2, 4.2)	4.0 (3.5, 4.6)	4.4 (3.7, 5.3)
TOTAL	**844**	**21871**						

Note: Restricted to modern prostheses

Figure HP7 Cumulative Percent Revision of Primary Unipolar Monoblock Hip Replacement by Age (Primary Diagnosis Fractured NOF)



HR - adjusted for gender

<75 vs 75-84
- 0 - 1.5Yr: HR=1.33 (1.05, 1.67), p=0.017
- 1.5Yr+: HR=2.74 (2.05, 3.66), p<0.001

<75 vs ≥85
- 0 - 1Mth: HR=1.01 (0.60, 1.69), p=0.969
- 1Mth - 1Yr: HR=2.36 (1.71, 3.25), p<0.001
- 1Yr - 1.5Yr: HR=6.21 (3.72, 10.37), p<0.001
- 1.5Yr+: HR=5.65 (3.95, 8.07), p<0.001

75-84 vs ≥85
- 0 - 1Mth: HR=0.97 (0.72, 1.31), p=0.843
- 1Mth - 6Mth: HR=1.59 (1.19, 2.12), p=0.001
- 6Mth - 2Yr: HR=2.62 (2.02, 3.38), p<0.001
- 2Yr+: HR=1.92 (1.30, 2.83), p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<75	1858	1232	1013	859	595	428	249
75-84	8063	5169	4140	3315	2065	1230	544
≥85	11950	6644	4929	3603	1753	814	264

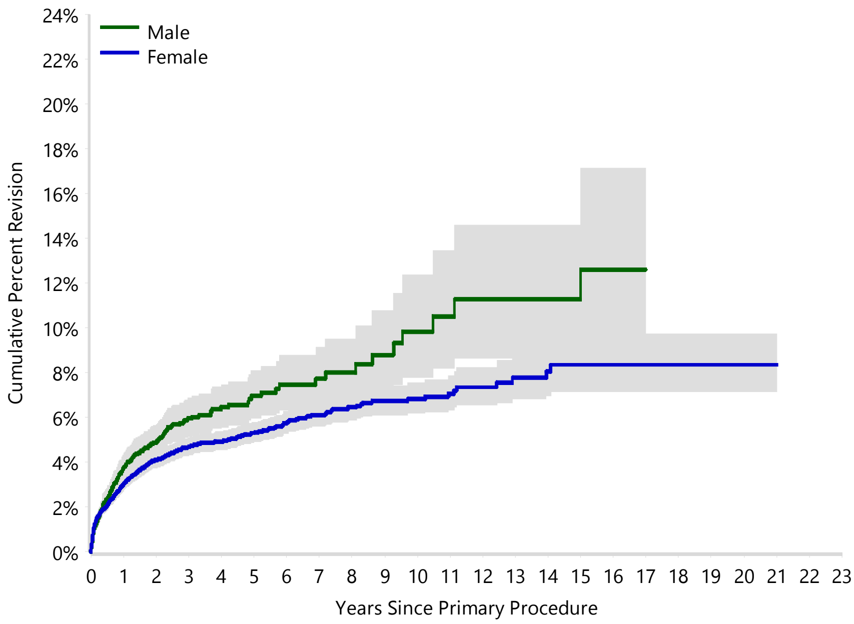
Note: Restricted to modern prostheses

Table HP12 Cumulative Percent Revision of Primary Unipolar Monoblock Hip Replacement by Gender (Primary Diagnosis Fractured NOF)

Gender	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Male	221	6055	3.7 (3.2, 4.4)	4.9 (4.2, 5.7)	6.0 (5.1, 6.9)	7.0 (6.0, 8.1)	7.7 (6.5, 9.1)	9.8 (7.8, 12.4)
Female	623	15816	3.0 (2.7, 3.3)	4.1 (3.8, 4.5)	4.7 (4.3, 5.1)	5.3 (4.9, 5.8)	6.1 (5.6, 6.7)	6.8 (6.2, 7.5)
TOTAL	**844**	**21871**						

Note: Restricted to modern prostheses

Figure HP8 **Cumulative Percent Revision of Primary Unipolar Monoblock Hip Replacement by Gender (Primary Diagnosis Fractured NOF)**



HR - adjusted for age

Male vs Female

Entire Period: HR=1.11 (0.95, 1.30), p=0.191

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Male	6055	2781	1879	1336	666	351	146
Female	15816	10264	8203	6441	3747	2121	911

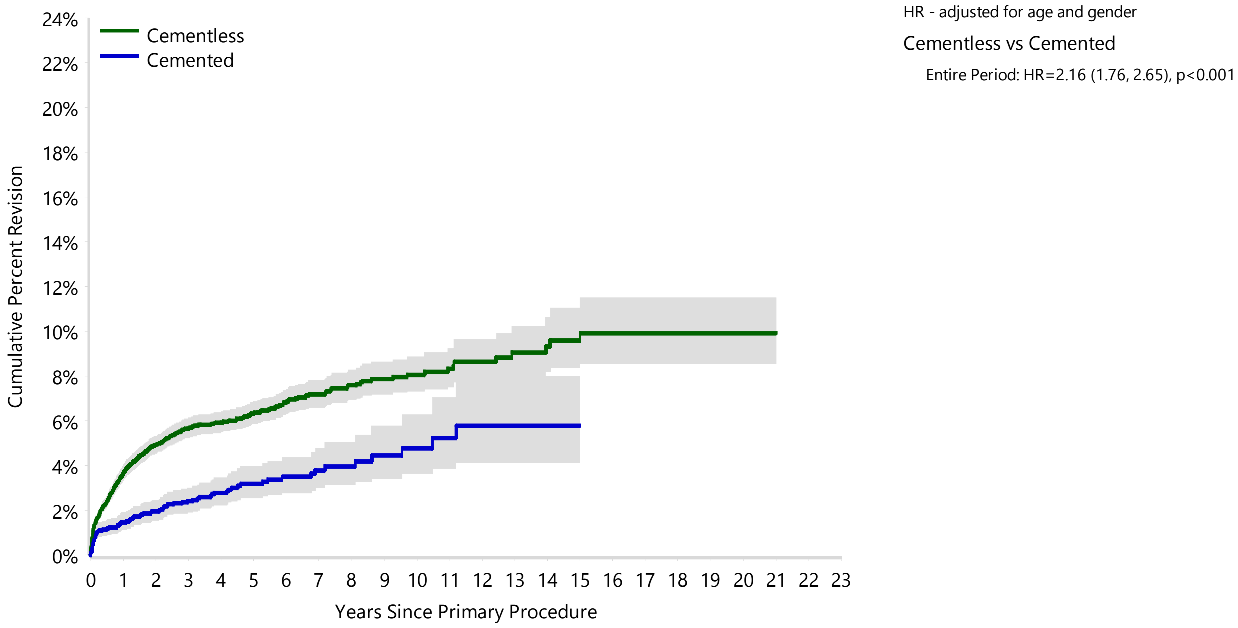
Note: Restricted to modern prostheses

Table HP13 **Cumulative Percent Revision of Primary Unipolar Monoblock Hip Replacement by Femoral (Primary Diagnosis Fractured NOF)**

Femoral Fixation	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Cementless	741	17116	3.6 (3.3, 4.0)	4.9 (4.6, 5.3)	5.7 (5.2, 6.1)	6.3 (5.9, 6.8)	7.2 (6.6, 7.8)	8.1 (7.3, 8.9)
Cemented	103	4751	1.5 (1.1, 1.9)	2.0 (1.5, 2.5)	2.4 (1.9, 3.0)	3.2 (2.5, 4.0)	3.8 (3.0, 4.8)	4.8 (3.6, 6.3)
TOTAL	844	21867						

Note: Restricted to modern prostheses. Four ETS procedures that were cementless have been excluded

Figure HP9 **Cumulative Percent Revision of Primary Unipolar Monoblock Hip Replacement by Femoral Fixation (Primary Diagnosis Fractured NOF)**



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Cementless	17116	10101	7752	5953	3360	1877	814
Cemented	4751	2943	2329	1823	1052	595	243

Note: Restricted to modern prostheses

Unipolar Modular

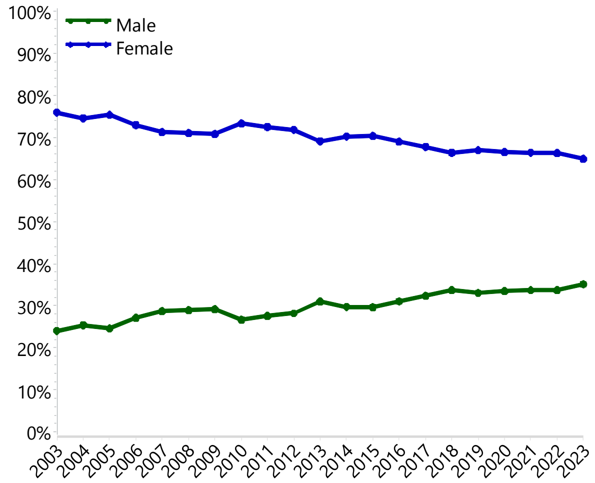
Demographics

There have been 57,697 unipolar modular procedures reported to the Registry. This is an additional 2,669 procedures compared to the previous report.

In 2023, the number of unipolar modular procedures decreased by 340 procedures (11.5%) compared to 2022 and increased by 292% since 2003.

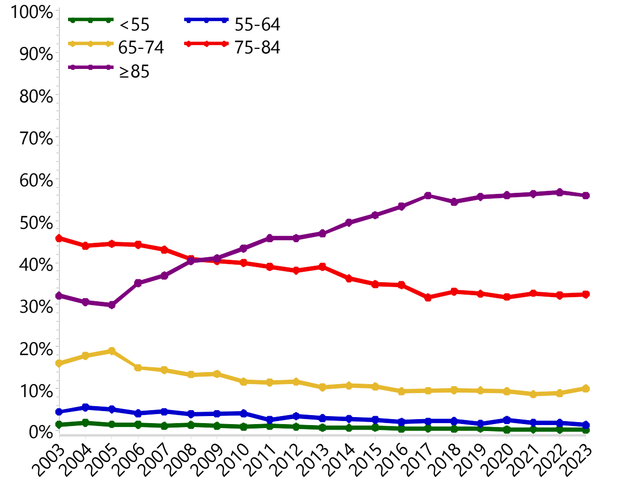
Fractured neck of femur is the principal diagnosis for primary unipolar modular hip replacement (96.1%).

Figure HP10 Primary Unipolar Modular Hip Replacement by Gender



The majority of patients are female (69.6%) and aged ≥75 years (85.0 %). The proportion of patients aged ≥85 years has increased from 32.1% in 2003 to 56.0% in 2023. The mean age of patients is 82.9 years (Table HP14, Figure HP10 and Figure HP11).

Figure HP11 Primary Unipolar Modular Hip Replacement by Age



Overall, there have been 252 unipolar modular head and stem combinations recorded by the Registry. The 10 most frequently used unipolar modular head prostheses and femoral stems are listed in Table HP15 and Table HP16.

In 2023, 15 different unipolar modular head prostheses were used. The Unitrax head is the most frequently used (68.7%). The 10 most used unipolar modular head prostheses account for 99.7% of all primary unipolar modular hip procedures (Table HP15).

There were 21 different stem prostheses used in 2023. The most frequently used stem is the Exeter V40 (65.7%). The 10 most used femoral stems account for 98.9% of all primary unipolar modular hip procedures (Table HP16).

The cumulative percent revision of unipolar modular head/stem prosthesis combinations with more than 100 procedures is detailed in Table HP17.

Table HP14 Age and Gender of Primary Unipolar Modular Hip Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	17563	30.4%	5	106	84	82.0	9.3
Female	40134	69.6%	18	108	84	83.4	8.4
TOTAL	**57697**	**100.0%**	**5**	**108**	**84**	**82.9**	**8.7**

Primary Partial Hip Replacement

Table HP15 10 Most Used Unipolar Head Prostheses in Primary Unipolar Modular Hip Replacement

2003		2020		2021		2022		2023	
N	Model	N	Model	N	Model	N	Model	N	Model
193	Unitrax	1880	Unitrax	1846	Unitrax	2072	Unitrax	1794	Unitrax
142	Unipolar Head (Zimmer)	460	Unipolar Head (S&N)	438	Unipolar Head (S&N)	410	Unipolar Head (S&N)	396	Unipolar Head (S&N)
127	Unipolar Head (S&N)	349	Cathcart	322	Cathcart	317	Cathcart	298	Cathcart
75	VerSys	92	VerSys	101	VerSys	97	VerSys	65	VerSys
64	Unipolar Head (Mathys)	76	Unipolar Head (Mathys)	37	Unipolar Head (Mathys)	25	Unipolar Head (Mathys)	18	Unipolar Head (Mathys)
46	Elite	51	Unipolar Head (Signature)	16	Unipolar Head (Signature)	15	Unipolar Head (Signature)	16	Unipolar Head (Signature)
16	Ultima	16	Unipolar Head (Corin)	6	Femoral Head (Stryker)	6	Femoral Head (Stryker)	8	Femoral Head (Stryker)
1	Metasul	8	Femoral Head (Stryker)	4	Articul/Eze	3	Articul/Eze	4	Femoral Head (S&N)
1	Optimom	3	Unipolar Head (Lima)	2	Femoral Head (S&N)	2	Femoral Head (S&N)	3	Femoral Head (Zimmer)
1	Unipolar Head (Sulzer)	2	Femoral Head (S&N)	1	Generic Unipolar Head	1	Articul/Eze Zir	2	Articul/Eze
10 Most Used									
666	(10) 100.0%	2937	(10) 99.9%	2773	(10) 99.9%	2948	(10) 99.9%	2604	(10) 99.7%
Remainder									
0	(0) 0%	2	(2) 0.1%	2	(2) 0.1%	3	(3) 0.1%	7	(5) 0.3%
TOTAL									
666	(10) 100.0%	2939	(12) 100.0%	2775	(12) 100.0%	2951	(13) 100.0%	2611	(15) 100.0%

Table HP16 10 Most Used Femoral Stem Prostheses in Primary Unipolar Modular Hip Replacement

2003		2020		2021		2022		2023	
N	Model	N	Model	N	Model	N	Model	N	Model
180	Exeter V40	1799	Exeter V40	1760	Exeter V40	1959	Exeter V40	1715	Exeter V40
111	Alloclassic	395	CPCS	371	CPCS	359	CPCS	344	CPCS
91	CPT	324	C-Stem AMT	297	C-Stem AMT	278	C-Stem AMT	271	C-Stem AMT
70	Spectron EF	88	CPT	98	CPT	109	Short Exeter V40	78	Short Exeter V40
49	Fullfix	81	Short Exeter V40	80	Short Exeter V40	93	CPT	59	CPT
38	SL-Plus	70	twinSys (ctd)	37	twinSys (ctd)	43	CORAIL	42	Polarstem
33	Elite Plus	46	Spectron EF	36	Spectron EF	29	Polarstem	31	CORAIL
18	Basis	28	Evolve	26	CORAIL	23	twinSys (ctd)	18	twinSys (ctd)
15	CCA	25	CORAIL	24	Polarstem	13	Spectron EF	16	Evolve
15	Thompson Modular Stem	20	Absolut	14	Evolve	12	Evolve	8	Accolade II
10 Most Used									
620	(10) 93.1%	2876	(10) 97.9%	2743	(10) 98.8%	2918	(10) 98.9%	2582	(10) 98.9%
Remainder									
46	(13) 6.9%	63	(16) 2.1%	32	(12) 1.2%	33	(15) 1.1%	29	(11) 1.1%
TOTAL									
666	(23) 100.0%	2939	(26) 100.0%	2775	(22) 100.0%	2951	(25) 100.0%	2611	(21) 100.0%

Table HP17 Cumulative Percent Revision of Primary Unipolar Modular Hip Replacement by Prosthesis Combination

Unipolar Head	Femoral Component	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Cathcart	C-Stem AMT	54	2589	1.7 (1.2, 2.3)	2.0 (1.5, 2.7)	2.3 (1.7, 3.1)	3.9 (2.7, 5.6)	4.3 (2.9, 6.2)	
	CORAIL	98	1642	3.1 (2.3, 4.1)	4.3 (3.3, 5.6)	5.5 (4.4, 7.0)	6.7 (5.4, 8.5)	9.3 (7.4, 11.6)	11.5 (9.0, 14.6)
Unipolar Head (Mathys)	twinSys (ctd)	6	258	2.8 (1.2, 6.1)	2.8 (1.2, 6.1)	2.8 (1.2, 6.1)			
Unipolar Head (S&N)	CPCS	201	7414	1.9 (1.6, 2.3)	2.3 (2.0, 2.8)	2.8 (2.4, 3.2)	3.8 (3.2, 4.4)	4.5 (3.8, 5.3)	5.4 (4.5, 6.5)
	Polarstem	7	215	1.2 (0.3, 4.8)	2.1 (0.7, 6.7)	5.3 (2.1, 13.2)			
	SL-Plus	55	1128	2.4 (1.6, 3.5)	3.3 (2.3, 4.6)	4.5 (3.3, 6.1)	4.9 (3.6, 6.6)	6.0 (4.4, 8.1)	10.3 (7.2, 14.7)
	Spectron EF	125	3147	1.6 (1.2, 2.1)	2.5 (2.0, 3.2)	2.9 (2.3, 3.7)	4.0 (3.3, 5.0)	5.4 (4.4, 6.6)	7.6 (6.1, 9.4)
Unipolar Head (Signature)	E2	1	107	1.0 (0.1, 6.6)	1.0 (0.1, 6.6)	1.0 (0.1, 6.6)			
	Evolve	7	193	2.4 (0.9, 6.3)	4.5 (2.0, 10.1)	5.8 (2.7, 12.2)			
Unitrax	Exeter V40	842	27047	2.0 (1.8, 2.2)	2.6 (2.4, 2.8)	3.2 (2.9, 3.4)	4.3 (4.0, 4.7)	5.3 (4.9, 5.7)	6.9 (6.3, 7.6)
	Short Exeter V40	11	552	1.8 (1.0, 3.5)	1.8 (1.0, 3.5)	2.3 (1.2, 4.5)	3.2 (1.6, 6.3)		
VerSys	CPT	188	4981	2.0 (1.6, 2.5)	2.9 (2.4, 3.5)	3.5 (2.9, 4.1)	4.6 (4.0, 5.5)	5.8 (4.9, 6.8)	6.9 (5.8, 8.3)
	VerSys	7	184	4.1 (1.8, 9.1)	4.1 (1.8, 9.1)	4.1 (1.8, 9.1)			
Other (42)		16	392	3.6 (2.0, 6.2)	4.5 (2.6, 7.5)	4.5 (2.6, 7.5)	6.0 (3.6, 10.1)		
TOTAL		1618	49849						

Note: Restricted to modern prostheses. Only combinations with >100 procedures have been listed

Primary Partial Hip Replacement

Outcome for Fractured Neck of Femur

The cumulative percent revision at 10 years for unipolar modular hip replacement, when undertaken for fractured neck of femur, is 6.9% (Table HP18 and Figure HP12).

The Registry has recorded 1,530 revisions of primary unipolar modular hip replacement with a primary diagnosis of fractured neck of femur.

The main reasons for revision are infection (25.0%), prosthesis dislocation/instability (21.0%), fracture (16.1%), chondrolysis/acetabular erosion (15.9%), pain (10.0%) and loosening (8.1%) (Table HP19).

Most revisions are acetabular only (40.7%), followed by head only (16.7%) (Table HP20).

Age, gender, and femoral stem fixation are risk factors for revision. The rate of revision decreases with increasing age (Table HP21 and Figure HP13). Males have a higher rate of revision than females (Table HP22 and Figure HP14).

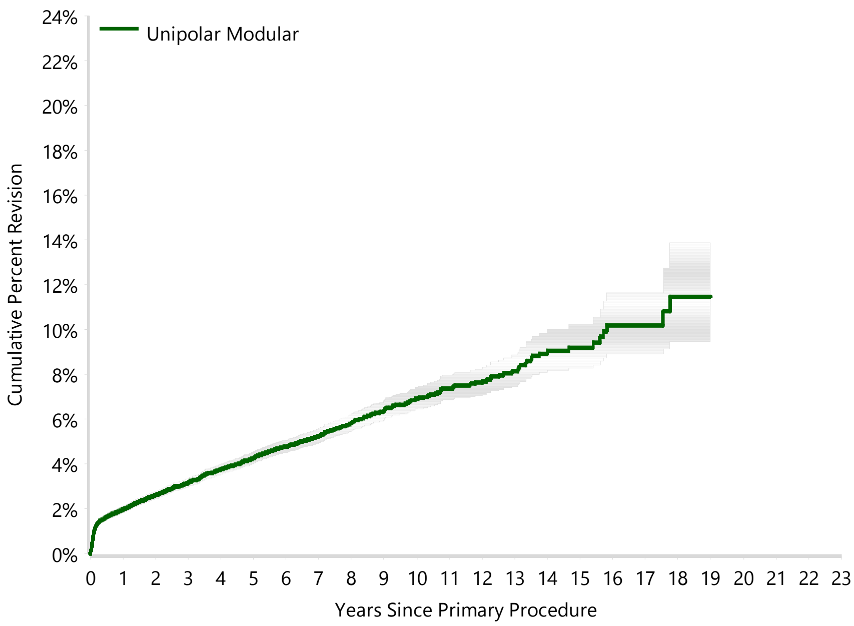
Cementless fixation has a higher rate of revision compared to cemented fixation (Table HP23 and Figure HP15). The cumulative incidence for pain, fracture and chondrolysis/acetabular erosion is higher for cementless compared to cemented fixation (Figure HP16).

Table HP18 Cumulative Percent Revision of Primary Unipolar Modular Hip Replacement (Primary Diagnosis Fractured NOF)

Hip Type	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Modular	1530	48016	2.0 (1.8, 2.1)	2.6 (2.5, 2.8)	3.2 (3.0, 3.4)	4.3 (4.0, 4.5)	5.3 (4.9, 5.6)	6.9 (6.4, 7.4)
TOTAL	**1530**	**48016**						

Note: Restricted to modern prostheses

Figure HP12 Cumulative Percent Revision of Primary Unipolar Modular Hip Replacement (Primary Diagnosis Fractured NOF)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Modular	48016	32203	25308	19755	11695	6676	2763

Note: Restricted to modern prostheses

Table HP19 Primary Unipolar Modular Hip Replacement by Reason for Revision (Primary Diagnosis Fractured NOF)

Reason for Revision	Number	Percent
Infection	383	25.0
Prosthesis Dislocation/Instability	321	21.0
Fracture	247	16.1
Chondrolysis/Acetab. Erosion	243	15.9
Pain	153	10.0
Loosening	124	8.1
Lysis	16	1.0
Malposition	4	0.3
Other	39	2.5
TOTAL	**1530**	**100.0**

Note: Restricted to modern prostheses

Table HP20 Primary Unipolar Modular Hip Replacement by Type of Revision (Primary Diagnosis Fractured NOF)

Type of Revision	Number	Percent
Acetabular Component	622	40.7
Head Only	256	16.7
THR (Femoral/Acetabular)	251	16.4
Femoral Component	156	10.2
Bipolar Head and Femoral	73	4.8
Cement Spacer	56	3.7
Removal of Prostheses	48	3.1
Minor Components	41	2.7
Bipolar Only	19	1.2
Reinsertion of Components	6	0.4
Head/Insert	2	0.1
TOTAL	**1530**	**100.0**

Note: Restricted to modern prostheses
Femoral heads are usually replaced when the acetabular component and/or femoral stem is revised

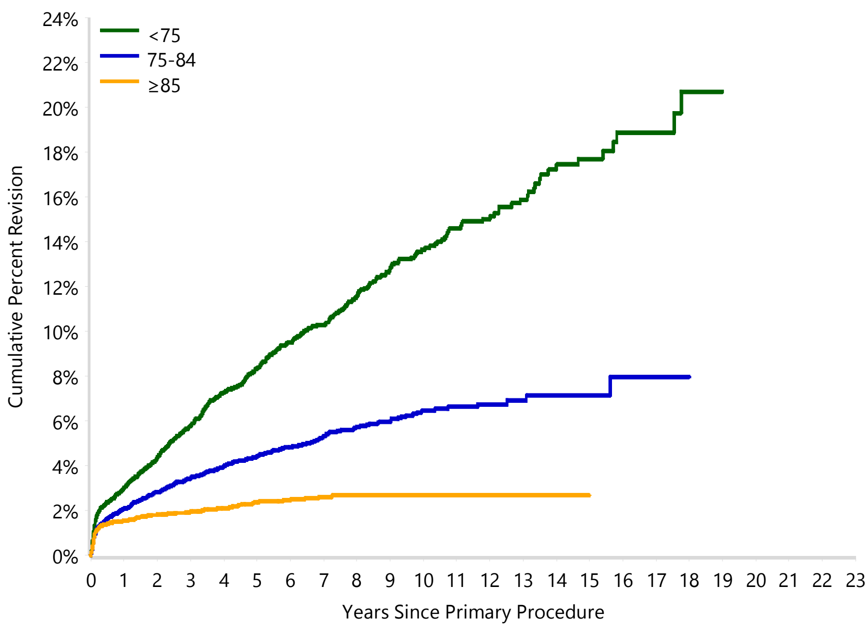
Primary Partial Hip Replacement

Table HP21 Cumulative Percent Revision of Primary Unipolar Modular Hip Replacement by Age (Primary Diagnosis Fractured NOF)

Age	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<75	529	6728	3.0 (2.6, 3.5)	4.3 (3.8, 4.9)	5.8 (5.2, 6.5)	8.4 (7.6, 9.2)	10.3 (9.4, 11.3)	13.6 (12.4, 15.0)
75-84	607	17409	2.1 (1.9, 2.3)	2.8 (2.6, 3.1)	3.4 (3.1, 3.8)	4.4 (4.0, 4.8)	5.3 (4.9, 5.8)	6.5 (5.8, 7.1)
≥85	394	23879	1.5 (1.4, 1.7)	1.8 (1.6, 2.0)	1.9 (1.7, 2.2)	2.4 (2.1, 2.6)	2.6 (2.3, 3.0)	2.7 (2.3, 3.1)
TOTAL	**1530**	**48016**						

Note: Restricted to modern prostheses

Figure HP13 Cumulative Percent Revision of Primary Unipolar Modular Hip Replacement by Age (Primary Diagnosis Fractured NOF)



HR - adjusted for gender

<75 vs 75-84

0 - 3Mth: HR=1.50 (1.21, 1.87), p<0.001

3Mth - 2Yr: HR=1.45 (1.17, 1.81), p<0.001

2Yr+: HR=2.78 (2.32, 3.32), p<0.001

<75 vs ≥85

0 - 3Mth: HR=1.54 (1.25, 1.90), p<0.001

3Mth - 1.5Yr: HR=4.09 (3.09, 5.43), p<0.001

1.5Yr - 2Yr: HR=5.39 (3.34, 8.69), p<0.001

2Yr+: HR=8.29 (6.53, 10.52), p<0.001

75-84 vs ≥85

0 - 3Mth: HR=1.03 (0.86, 1.23), p=0.783

3Mth+: HR=2.99 (2.44, 3.65), p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<75	6728	5038	4250	3597	2561	1796	1013
75-84	17409	12587	10274	8316	5323	3178	1314
≥85	23879	14578	10784	7842	3811	1702	436

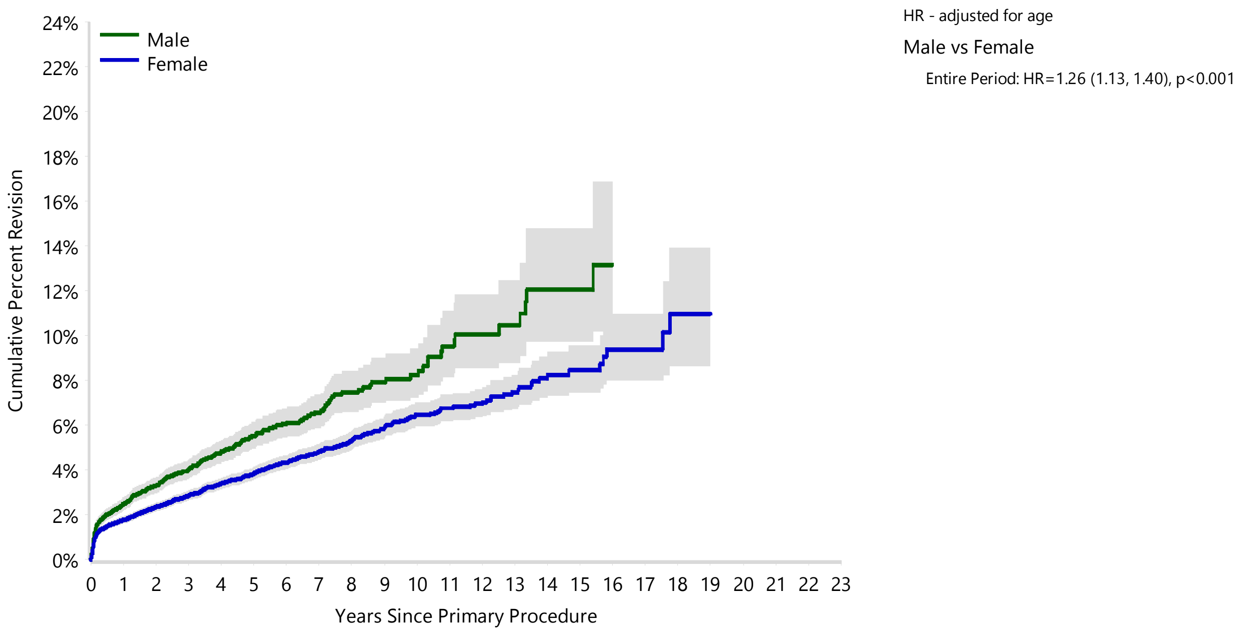
Note: Restricted to modern prostheses

Table HP22 Cumulative Percent Revision of Primary Unipolar Modular Hip Replacement by Gender (Primary Diagnosis Fractured NOF)

Gender	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Male	503	14729	2.5 (2.2, 2.8)	3.3 (3.0, 3.6)	4.0 (3.6, 4.5)	5.5 (5.0, 6.1)	6.6 (5.9, 7.3)	8.2 (7.2, 9.4)
Female	1027	33287	1.8 (1.6, 1.9)	2.4 (2.2, 2.5)	2.8 (2.6, 3.1)	3.8 (3.6, 4.1)	4.8 (4.5, 5.2)	6.5 (5.9, 7.0)
TOTAL	**1530**	**48016**						

Note: Restricted to modern prostheses

Figure HP14 Cumulative Percent Revision of Primary Unipolar Modular Hip Replacement by Gender (Primary Diagnosis Fractured NOF)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Male	14729	8476	6169	4522	2403	1276	489
Female	33287	23727	19139	15233	9292	5400	2274

Note: Restricted to modern prostheses

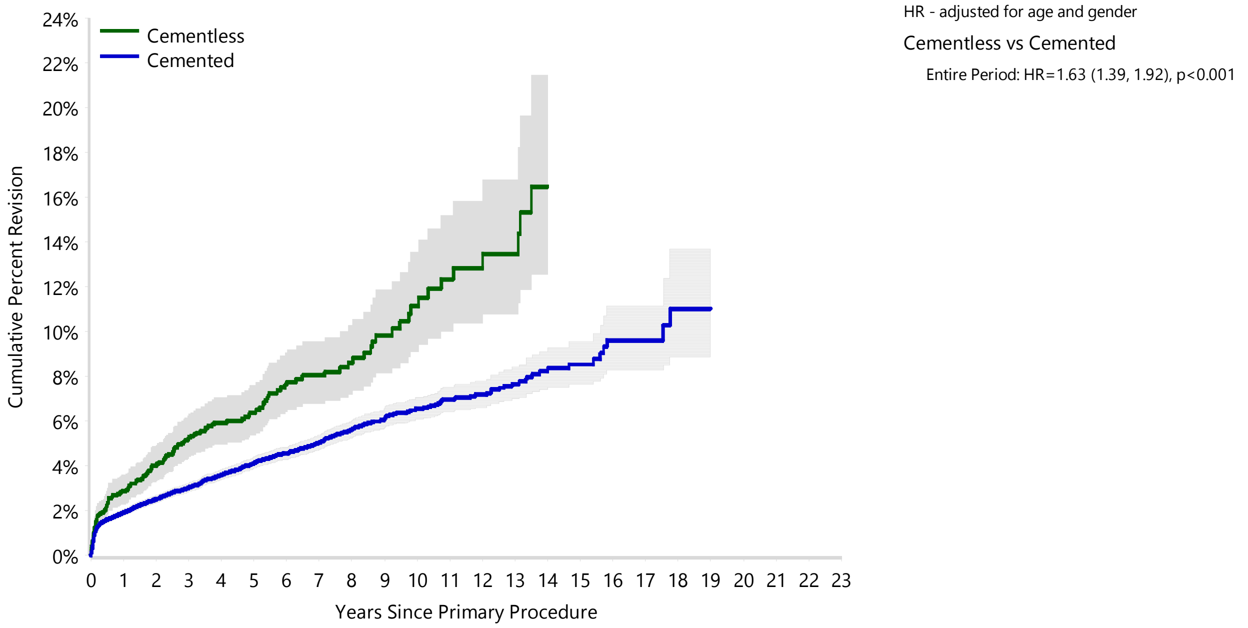
Primary Partial Hip Replacement

Table HP23 Cumulative Percent Revision of Primary Unipolar Modular Hip Replacement by Femoral Fixation (Primary Diagnosis Fractured NOF)

Femoral Fixation	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Cementless	166	2972	2.9 (2.3, 3.6)	4.0 (3.3, 4.9)	5.3 (4.4, 6.3)	6.4 (5.4, 7.6)	8.0 (6.8, 9.5)	11.1 (9.1, 13.6)
Cemented	1364	45044	1.9 (1.8, 2.1)	2.5 (2.4, 2.7)	3.0 (2.8, 3.2)	4.1 (3.9, 4.4)	5.0 (4.7, 5.4)	6.6 (6.1, 7.1)
TOTAL	**1530**	**48016**						

Note: Restricted to modern prostheses

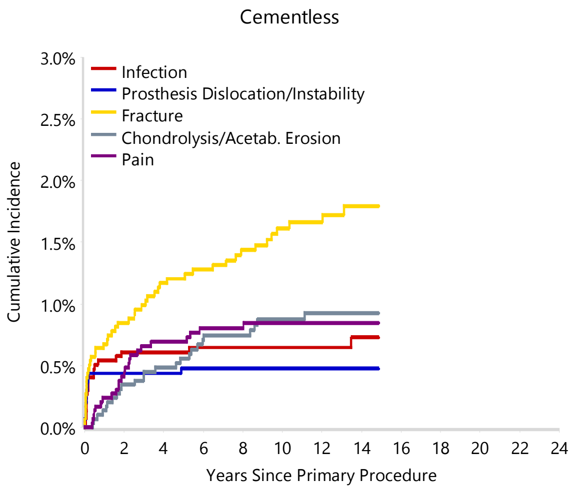
Figure HP15 Cumulative Percent Revision of Primary Unipolar Modular Hip Replacement by Femoral Fixation (Primary Diagnosis Fractured NOF)

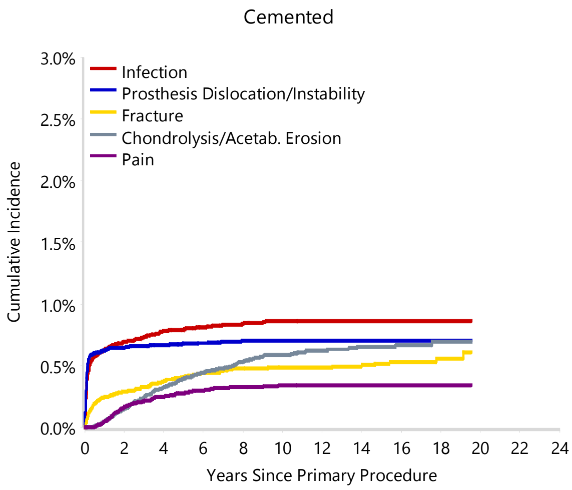


Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Cementless	2972	2105	1722	1423	934	562	241
Cemented	45044	30098	23586	18332	10761	6114	2522

Note: Restricted to modern prostheses

Figure HP16 Cumulative Incidence Revision Diagnosis of Primary Unipolar Modular Hip Replacement by Femoral Fixation (Primary Diagnosis Fractured NOF)





Note: Restricted to modern prostheses

Bipolar

DEMOGRAPHICS

There have been 40,173 bipolar hip replacement procedures reported to the Registry. This is an additional 4,025 procedures compared to the previous report.

Since 2010, there has been an increase in the number of bipolar procedures undertaken each year, with 8.4% more procedures in 2023 compared to 2022. The total number of bipolar procedures has increased by 191.8% since 2003.

Fractured neck of femur is the principal diagnosis for bipolar hip replacement (93.6%).

The majority of patients are female (68.2%) and aged ≥75 years (80.4%). The proportion of patients aged ≥85 years has increased from 26.0% in 2003 to 46.5% in 2023.

The mean age of patients is 81.6 years (Table HP24, Figure HP17, and Figure HP18).

Figure HP17 Primary Bipolar Hip Replacement by Gender

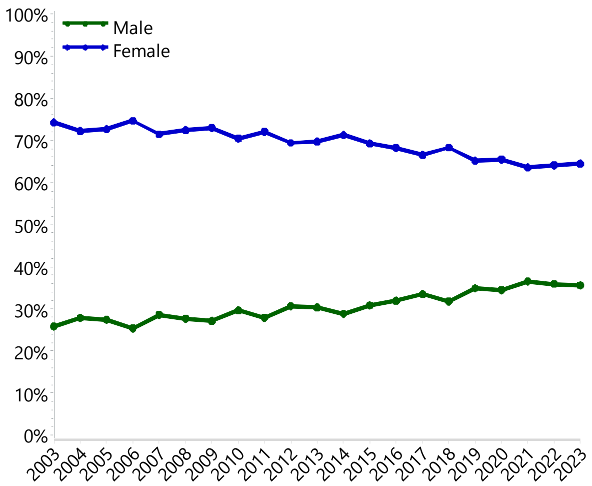
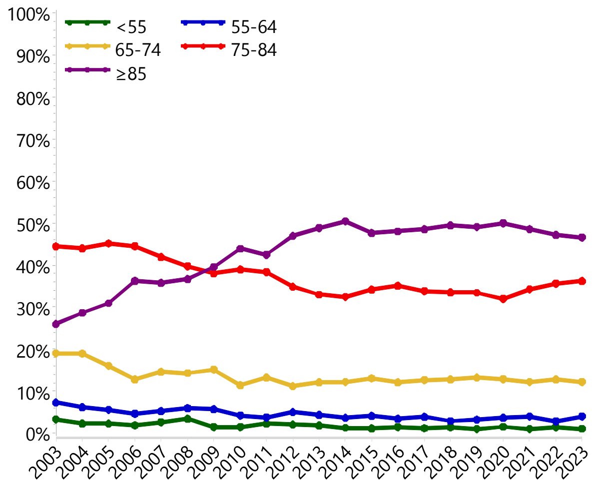


Figure HP18 Primary Bipolar Hip Replacement by Age



Overall, there have been 322 bipolar head and stem combinations recorded by the Registry. In 2023, there were 10 different bipolar heads and 42 different femoral stem prostheses used.

In 2023, the UHR remains the most frequently used bipolar head (42.5%) (Table HP25). The Exeter V40 is the most frequently used femoral stem (39.7%). The 10 most used femoral stems account for 93.7% of all bipolar hip procedures (Table HP26).

The cumulative percent revision of bipolar head/stem prosthesis combinations with >100 procedures is detailed in Table HP27.

Table HP24 Age and Gender of Primary Bipolar Hip Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	12791	31.8%	9	105	83	80.7	10.7
Female	27382	68.2%	9	107	83	82.0	9.5
TOTAL	**40173**	**100.0%**	**9**	**107**	**83**	**81.6**	**9.9**

Primary Partial Hip Replacement

Table HP25 10 Most Used Bipolar Head Prostheses in Primary Bipolar Hip Replacement

2003		2020		2021		2022		2023	
N	Model	N	Model	N	Model	N	Model	N	Model
760	UHR	1242	UHR	1441	UHR	1643	UHR	1664	UHR
140	Hastings	833	Multipolar Bipolar	843	Multipolar Bipolar	851	Multipolar Bipolar	959	Multipolar Bipolar
115	Convene	406	Tandem	384	Tandem	409	Tandem	453	Tandem
91	Bipolar Head	245	Self-Centering	317	Self-Centering	374	Self-Centering	354	Self-Centering
87	Self-Centering	108	BioBall	180	BioBall	143	BioBall	257	BioBall
59	Multipolar Bipolar	104	Bipolar Head	90	Bipolar Head	137	Bipolar Head	184	Bipolar Head
39	Bipolar Head	18	Bipolar Head	22	Bipolar Head	24	Bipolar Head	14	Bipolar Head
19	Bipolar Head (Lima)	12	Bipolar Head	8	Bipolar Head	20	Bipolar Head	11	Bipolar Head
19	Ringloc	9	Bipolar Head	7	Bipolar Head	8	Bipolar Head	9	Bipolar Head
5	UHL							8	Vario-Cup (Bipolar Head)
10 Most Used									
1334	(10) 99.5%	2977	(9) 100.0%	3292	(9) 100.0%	3609	(9) 100.0%	3913	(10) 100.0%
Remainder									
7	(2) 0.5%	0	(0) 0%	0	(0) 0%	0	(0) 0%	0	(0) 0%
TOTAL									
1341	(12) 100.0%	2977	(9) 100.0%	3292	(9) 100.0%	3609	(9) 100.0%	3913	(10) 100.0%

Table HP26 10 Most Used Femoral Stem Prostheses in Primary Bipolar Hip Replacement

2003		2020		2021		2022		2023	
N	Model	N	Model	N	Model	N	Model	N	Model
630	Exeter V40	1137	Exeter V40	1351	Exeter V40	1508	Exeter V40	1553	Exeter V40
94	Elite Plus	772	CPT	777	CPT	777	CPT	838	CPT
75	Alloclassic	374	CPCS	354	CPCS	372	CPCS	422	CPCS
65	CPCS	153	C-Stem AMT	203	C-Stem AMT	218	C-Stem AMT	214	C-Stem AMT
61	C-Stem	83	CORAIL	106	CORAIL	141	CORAIL	206	Taper Fit
59	Omnifit	70	Taper Fit	91	Absolut	102	Quadra-C	131	CORAIL
33	VerSys	61	Quadra-C	73	Taper Fit	95	Short Exeter V40	107	Quadra-C
26	ABGII	42	Short Exeter V40	72	Quadra-C	82	Taper Fit	89	MS 30
25	CCA	37	Accolade II	50	Short Exeter V40	49	Absolut	67	Short Exeter V40
25	Spectron EF	29	Absolut	29	MS 30	37	MS 30	41	Evolve
10 Most Used									
1093	(10) 81.5%	2758	(10) 92.6%	3106	(10) 94.3%	3381	(10) 93.7%	3668	(10) 93.7%
Remainder									
248	(46) 18.5%	219	(28) 7.4%	186	(32) 5.7%	228	(33) 6.3%	245	(32) 6.3%
TOTAL									
1341	(56) 100.0%	2977	(38) 100.0%	3292	(42) 100.0%	3609	(43) 100.0%	3913	(42) 100.0%

Table HP27 Cumulative Percent Revision of Primary Bipolar Hip Replacement by Prosthesis Combination

Bipolar Head	Femoral Component	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
BioBall	Absolut	4	179	1.9 (0.6, 5.8)	2.8 (1.1, 7.5)				
	Taper Fit	9	435	2.7 (1.4, 5.3)	2.7 (1.4, 5.3)				
Bipolar Head (Lima)	H-Max	8	192	2.8 (1.2, 6.7)	4.4 (2.1, 9.2)	4.4 (2.1, 9.2)	5.7 (2.8, 11.6)		
Bipolar Head (Medacta)	Quadra-C	15	749	2.1 (1.2, 3.6)	2.3 (1.4, 3.9)	2.3 (1.4, 3.9)	2.3 (1.4, 3.9)	4.1 (1.7, 9.7)	
	X-Acta	3	192	2.0 (0.6, 6.1)	2.0 (0.6, 6.1)	2.0 (0.6, 6.1)			
Multipolar Bipolar	Alloclassic	10	230	4.3 (2.3, 8.1)	4.3 (2.3, 8.1)	4.3 (2.3, 8.1)	5.2 (2.8, 9.7)	5.2 (2.8, 9.7)	
	Avenir	4	101	3.2 (1.0, 9.6)	3.2 (1.0, 9.6)	3.2 (1.0, 9.6)			
	CPT	229	6815	3.0 (2.6, 3.5)	3.8 (3.3, 4.3)	4.0 (3.5, 4.6)	4.7 (4.1, 5.4)	5.0 (4.2, 5.8)	6.4 (4.7, 8.6)
	MS 30	5	274	1.6 (0.6, 4.2)	1.6 (0.6, 4.2)	1.6 (0.6, 4.2)			
	VerSys	6	292	0.9 (0.2, 3.8)	2.8 (1.2, 6.8)	2.8 (1.2, 6.8)	2.8 (1.2, 6.8)	2.8 (1.2, 6.8)	
Self-Centering	C-Stem AMT	33	1245	2.2 (1.5, 3.3)	3.3 (2.3, 4.8)	3.6 (2.5, 5.1)	3.6 (2.5, 5.1)		
	CORAIL	52	1389	3.6 (2.7, 4.8)	4.2 (3.2, 5.6)	4.5 (3.4, 6.0)	4.5 (3.4, 6.0)	5.0 (3.7, 6.9)	
Tandem	CPCS	103	3692	2.3 (1.8, 2.9)	2.8 (2.3, 3.5)	3.2 (2.6, 4.0)	3.8 (3.0, 4.7)	4.8 (3.7, 6.2)	5.1 (3.9, 6.7)
	Polarstem	2	139	1.5 (0.4, 5.9)	1.5 (0.4, 5.9)				
	Spectron EF	8	210	2.1 (0.8, 5.6)	3.5 (1.6, 7.6)	4.2 (2.0, 8.6)	5.1 (2.5, 10.0)	5.1 (2.5, 10.0)	
UHR	Accolade II	0	190	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)			
	Exeter V40	480	16332	2.2 (2.0, 2.5)	2.8 (2.5, 3.1)	3.2 (2.9, 3.6)	3.8 (3.4, 4.1)	4.3 (3.8, 4.7)	5.1 (4.5, 5.8)
	GMRS	17	221	2.0 (0.8, 5.3)	5.1 (2.5, 10.1)	7.0 (3.7, 12.9)	10.7 (6.1, 18.4)		
	Short Exeter V40	8	336	1.7 (0.7, 4.0)	2.3 (1.0, 5.1)	2.3 (1.0, 5.1)			
Other (88)		32	825	2.8 (1.8, 4.3)	3.9 (2.5, 5.8)	4.2 (2.8, 6.2)	5.1 (3.4, 7.7)	6.0 (3.8, 9.5)	
TOTAL		1028	34038						

Note: Only combinations with >100 procedures have been listed.
*denotes prosthesis combination with no recorded use in primary bipolar hip replacement in 2023

Primary Partial Hip Replacement

OUTCOME FOR FRACTURED NECK OF FEMUR

The cumulative percent revision at 10 years for primary bipolar hip replacement undertaken for fractured neck of femur is 5.2% (Table HP28 and Figure HP19).

The Registry has recorded 954 revisions of primary bipolar hip replacement procedures with a primary diagnosis of fractured neck of femur.

The main reasons for revision are infection (31.7%), prosthesis dislocation/instability (26.0%), fracture (17.8%), loosening (8.1%), and chondrolysis/acetabular erosion (8.0%) (Table HP29).

The most frequent type of revision is acetabular component only (30.7%), followed by bipolar only (22.1%), total hip replacement (femoral/acetabular) (17.2%), and bipolar head and femoral stem replacement (13.9%) (Table HP30).

Age is a risk factor for revision. Patients aged <75 years have a higher rate of revision compared to the two older age groups (Table HP31 and Figure HP20). Males have a similar rate of revision to females (Table HP32 and Figure HP21).

Cementless fixation has a higher rate of revision compared to cemented fixation.

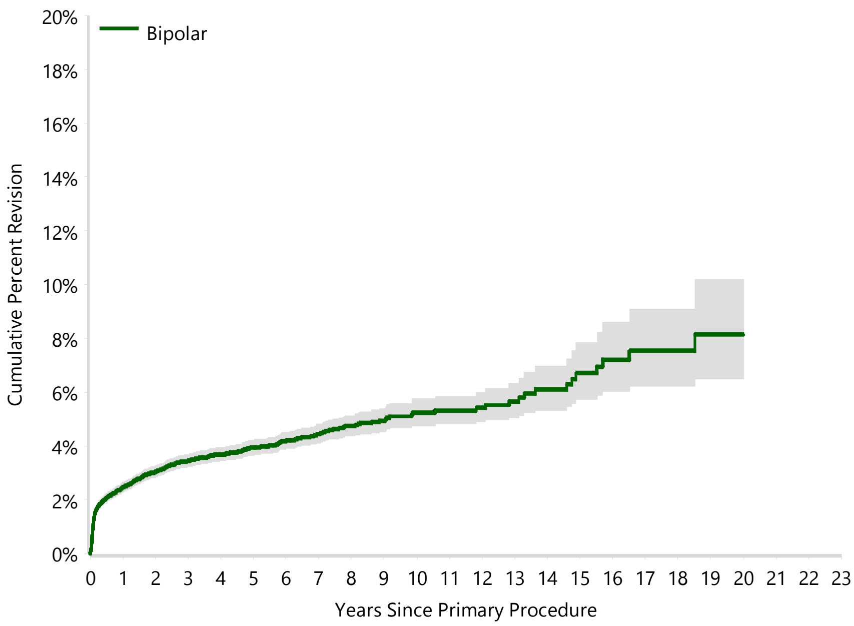
Fixation is a risk factor for revision. Cementless fixation has a higher rate of revision compared to cemented fixation for the first 3 months only (Table HP33 and Figure HP22). The cumulative incidence of fracture and prosthesis dislocation/instability for cementless fixation is higher than for cemented fixation (Figure HP23).

Table HP28 Cumulative Percent Revision of Primary Bipolar Hip Replacement (Primary Diagnosis Fractured NOF)

Hip Type	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Bipolar	954	32184	2.5 (2.3, 2.6)	3.0 (2.8, 3.3)	3.4 (3.2, 3.7)	3.9 (3.7, 4.2)	4.4 (4.1, 4.8)	5.2 (4.8, 5.8)
TOTAL	**954**	**32184**						

Note: Restricted to modern prostheses

Figure HP19 Cumulative Percent Revision of Primary Bipolar Hip Replacement (Primary Diagnosis Fractured NOF)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Bipolar	32184	20635	15414	11457	6257	3460	1405

Note: Restricted to modern prostheses

Table HP29 Bipolar Hip Replacement by Reason for Revision (Primary Diagnosis Fractured NOF)

Reason for Revision	Number	Percent
Infection	302	31.7
Prosthesis Dislocation/Instability	248	26.0
Fracture	170	17.8
Loosening	77	8.1
Chondrolysis/Acetab. Erosion	76	8.0
Pain	55	5.8
Lysis	3	0.3
Malposition	3	0.3
Other	20	2.1
TOTAL	**954**	**100.0**

Note: Restricted to modern prostheses

Table HP30 Primary Bipolar Hip Replacement by Type of Revision (Primary Diagnosis Fractured NOF)

Type of Revision	Number	Percent
Acetabular Component	293	30.7
Bipolar Only	211	22.1
THR (Femoral/Acetabular)	164	17.2
Bipolar Head and Femoral	133	13.9
Cement Spacer	39	4.1
Femoral Component	35	3.7
Head Only	35	3.7
Removal of Prostheses	23	2.4
Minor Components	20	2.1
Head/Insert	1	0.1
TOTAL	**954**	**100.0**

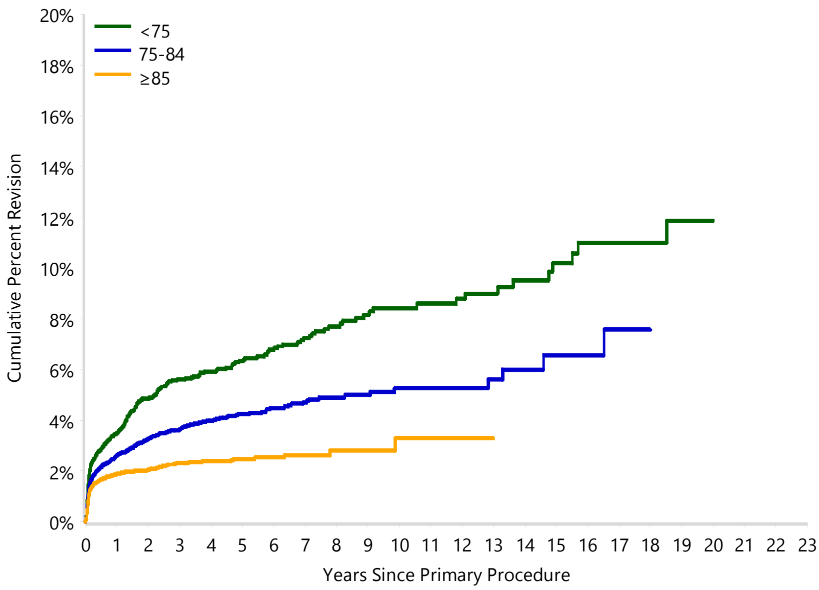
Note: Restricted to modern prostheses
Femoral heads are usually replaced when the acetabular component and/or femoral stem is revised

Table HP31 **Cumulative Percent Revision of Primary Bipolar Hip Replacement by Age (Primary Diagnosis Fractured NOF)**

Age	N	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<75	296	5515	3.5 (3.0, 4.0)	4.9 (4.3, 5.5)	5.6 (5.0, 6.4)	6.3 (5.6, 7.2)	7.2 (6.4, 8.2)	8.4 (7.3, 9.6)
75-84	381	11633	2.6 (2.3, 2.9)	3.3 (2.9, 3.6)	3.6 (3.3, 4.0)	4.2 (3.8, 4.7)	4.7 (4.2, 5.3)	5.3 (4.6, 6.0)
≥85	277	15036	1.9 (1.7, 2.2)	2.1 (1.8, 2.3)	2.3 (2.0, 2.6)	2.5 (2.2, 2.8)	2.6 (2.3, 3.0)	3.3 (2.4, 4.6)
TOTAL	**954**	**32184**						

Note: Restricted to modern prostheses

Figure HP20 **Cumulative Percent Revision of Primary Bipolar Hip Replacement by Age (Primary Diagnosis Fractured NOF)**



HR - adjusted for gender

<75 vs 75-84

Entire Period: HR=1.50 (1.29, 1.75), p<0.001

<75 vs ≥85

0 - 1Mth: HR=1.72 (1.29, 2.29), p<0.001

1Mth - 3Mth: HR=1.63 (1.19, 2.23), p=0.002

3Mth - 1Yr: HR=2.72 (1.86, 3.97), p<0.001

1Yr+: HR=4.47 (3.28, 6.08), p<0.001

75-84 vs ≥85

0 - 3Mth: HR=1.26 (1.04, 1.54), p=0.021

3Mth+: HR=2.24 (1.72, 2.90), p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<75	5515	3852	3047	2458	1620	1102	596
75-84	11633	7896	6067	4683	2729	1576	621
≥85	15036	8887	6300	4316	1908	782	188

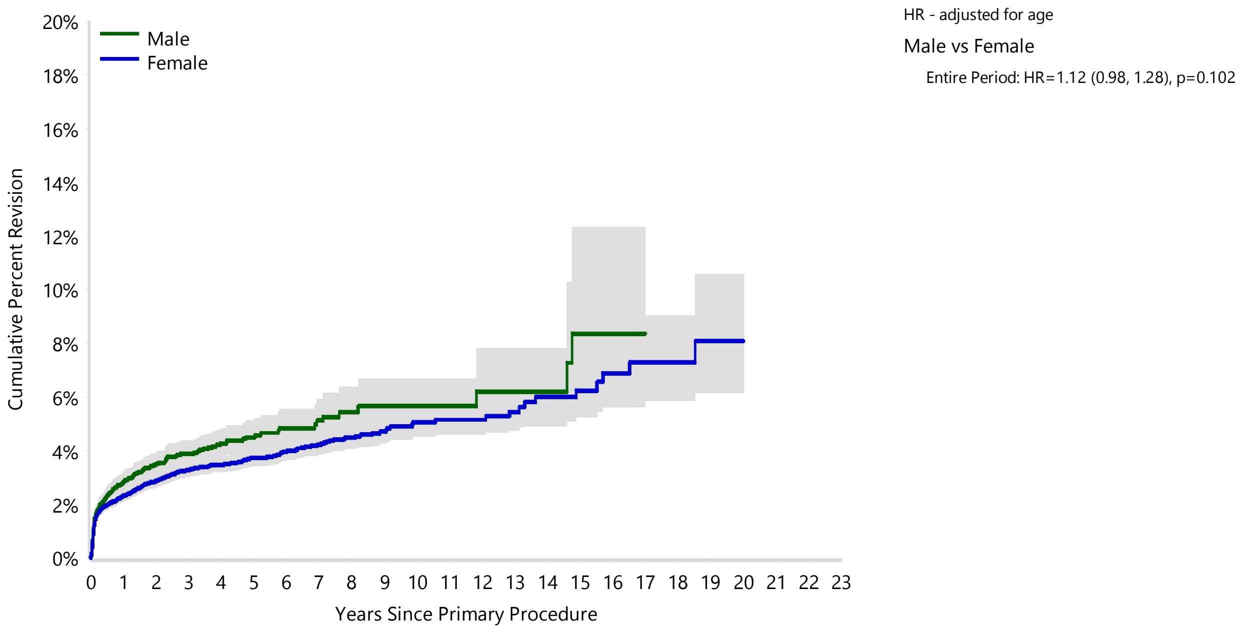
Note: Restricted to modern prostheses

Table HP32 Cumulative Percent Revision of Primary Bipolar Hip Replacement by Gender (Primary Diagnosis Fractured NOF)

Gender	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Male	311	10378	2.8 (2.5, 3.2)	3.5 (3.1, 3.9)	3.9 (3.4, 4.4)	4.5 (3.9, 5.1)	5.1 (4.4, 5.9)	5.6 (4.7, 6.7)
Female	643	21806	2.3 (2.1, 2.5)	2.9 (2.6, 3.1)	3.3 (3.0, 3.5)	3.7 (3.4, 4.0)	4.2 (3.8, 4.6)	5.0 (4.5, 5.6)
TOTAL	**954**	**32184**						

Note: Restricted to modern prostheses

Figure HP21 Cumulative Percent Revision of Primary Bipolar Hip Replacement by Gender (Primary Diagnosis Fractured NOF)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Male	10378	5760	3971	2696	1290	679	250
Female	21806	14875	11443	8761	4967	2781	1155

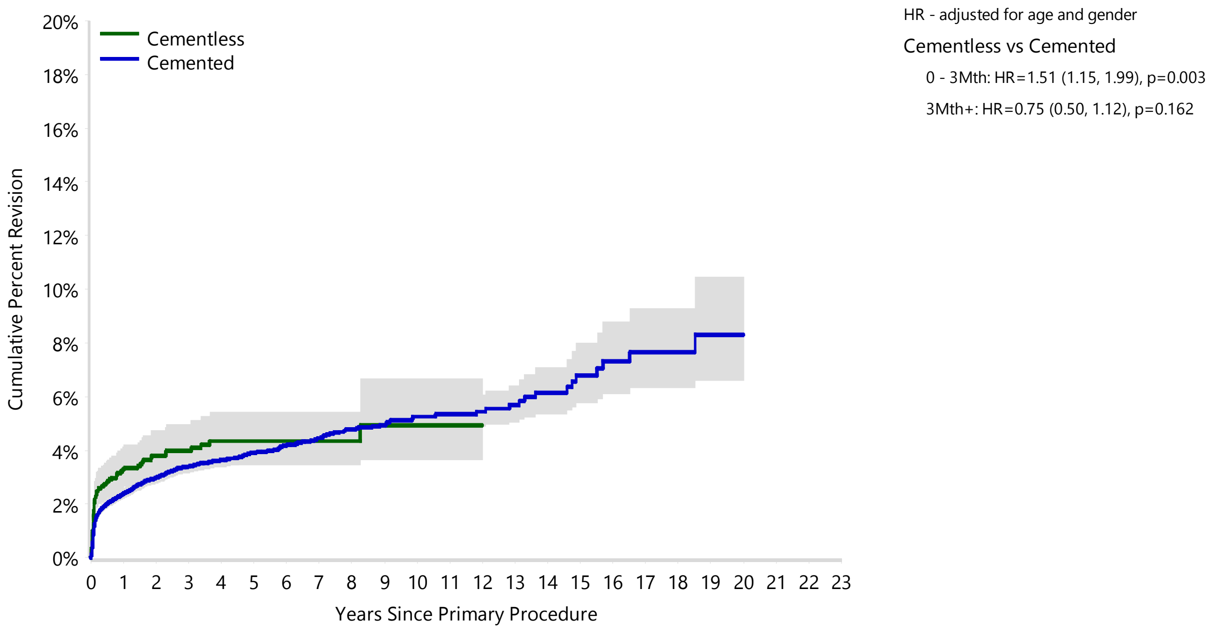
Note: Restricted to modern prostheses

Table HP33 Cumulative Percent Revision of Primary Bipolar Hip Replacement by Femoral Fixation (Primary Diagnosis Fractured NOF)

Femoral Fixation	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Cementless	82	2374	3.3 (2.6, 4.1)	3.8 (3.0, 4.7)	4.0 (3.2, 5.0)	4.3 (3.5, 5.4)	4.3 (3.5, 5.4)	4.9 (3.6, 6.7)
Cemented	872	29810	2.4 (2.2, 2.6)	3.0 (2.8, 3.2)	3.4 (3.2, 3.7)	3.9 (3.6, 4.2)	4.5 (4.1, 4.8)	5.3 (4.8, 5.8)
TOTAL	**954**	**32184**						

Note: Restricted to modern prostheses

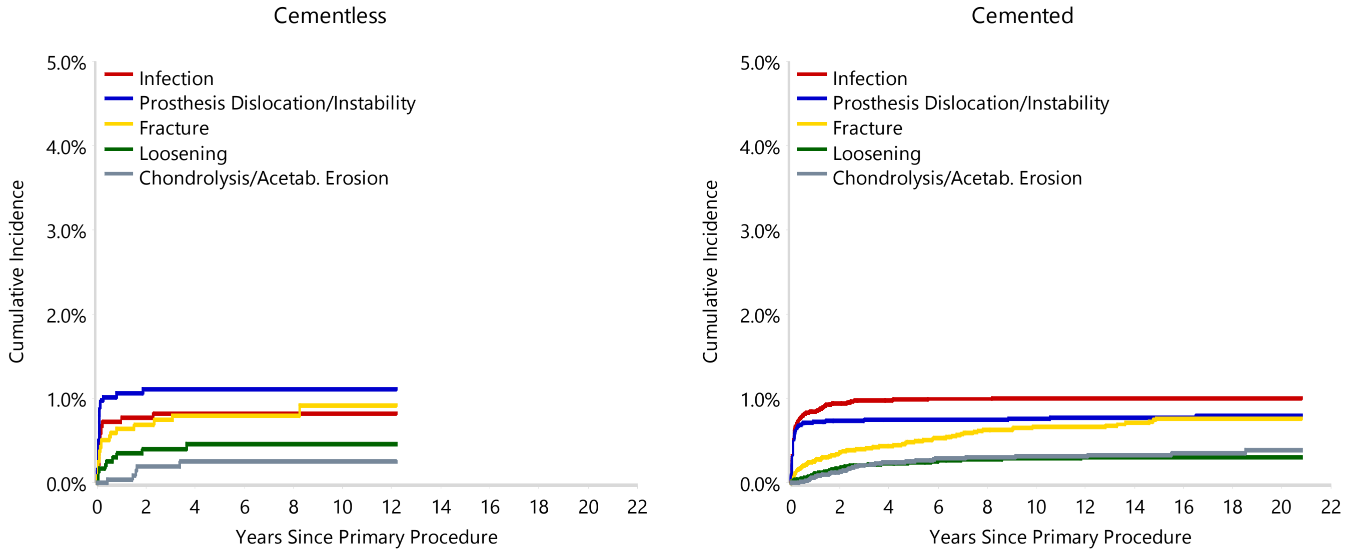
Figure HP22 Cumulative Percent Revision of Primary Bipolar Hip Replacement by Femoral Fixation (Primary Diagnosis Fractured NOF)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Cementless	2374	1527	1150	873	491	263	78
Cemented	29810	19108	14264	10584	5766	3197	1327

Note: Restricted to modern prostheses

Figure HP23 Cumulative Incidence Revision Diagnosis of Primary Bipolar Hip Replacement by Femoral Fixation (Primary Diagnosis Fractured NOF)



Note: Restricted to modern prostheses

Primary Total Hip Replacement

Classes of Total Hip Replacement

A total hip procedure replaces both the femoral and acetabular articular surfaces. Primary total hip replacement is subcategorised into two classes. These are defined by the type of femoral prosthesis used.

Total conventional involves acetabular replacement combined with resection of the femoral head and replacement with a stemmed femoral prosthesis and femoral head prosthesis.

Total resurfacing involves acetabular replacement and the use of a femoral prosthesis that replaces the femoral articular surface without resecting the head.

Detailed demographic information on primary total hip replacement is available in the supplementary report 'Demographics of Hip, Knee & Shoulder Arthroplasty' on the AOANJRR website: https://aoanjrr.sahmri.com/annual-reports-2024

Use of Total Hip Replacement

There are 691,118 primary total hip replacement procedures. Of these, total conventional is the most common class, followed by total resurfacing (Table HT1).

Table HT1 Primary Total Hip Replacement by Class

Total Hip Class	Number	Percent
Total Conventional	670884	97.1
Total Resurfacing	20234	2.9
TOTAL	**691118**	**100.0**

Osteoarthritis is the principal diagnosis for primary total hip replacement (88.2%).

Total conventional hip replacement (all bearing surfaces included) has a lower cumulative percent revision compared to total resurfacing at 20 years (Table HT2).

Table HT2 Cumulative Percent Revision of Primary Total Hip Replacement by Class

Total Hip Class	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Total Resurfacing	2181	20234	1.7 (1.5, 1.9)	3.1 (2.8, 3.3)	4.7 (4.4, 5.0)	8.8 (8.4, 9.2)	12.0 (11.5, 12.5)	14.3 (13.7, 14.9)
Total Conventional	32282	670884	1.8 (1.7, 1.8)	2.7 (2.7, 2.7)	3.5 (3.5, 3.5)	5.6 (5.6, 5.7)	8.3 (8.2, 8.4)	11.2 (11.0, 11.4)
TOTAL	**34463**	**691118**						

Primary Total Conventional Hip Replacement

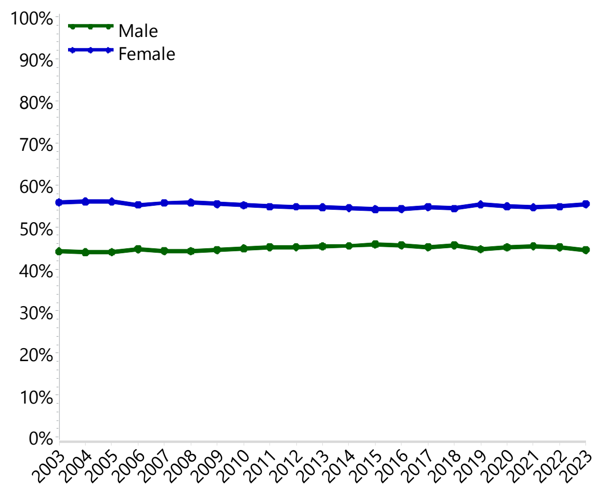
DEMOGRAPHICS

There are 670,884 primary total conventional hip replacement procedures. This is an additional 47,932 procedures compared to the previous report.

For further information on the **closure of the database** please see the **Glossary** of this report.

The proportion of males and females has been stable for many years with a female predominance. This is primarily due to larger numbers of females compared to males in older age groups (Figure HT1).

Figure HT1 Primary Total Conventional Hip Replacement by Gender



The mean age of patients is 67.8 years. There has been minimal change in the proportion of patients aged 55–64 years (21.9% in 2003 to 22.7% in 2023) and for patients aged <55 years (11.7% in 2003 to 11.5% in 2023) (Table HT3 and Figure HT2).

Primary total conventional hip replacement increased by 10.9% in 2023 compared to the previous year and by 177.1% since 2003.

The use of cementless fixation has increased from 51.3% in 2003 to 61.3% in 2023. Hybrid fixation has increased from 34.8% to 37.0% and cemented fixation has declined from 13.9% to 1.7% (Figure HT3).

Figure HT2 Primary Total Conventional Hip Replacement by Age

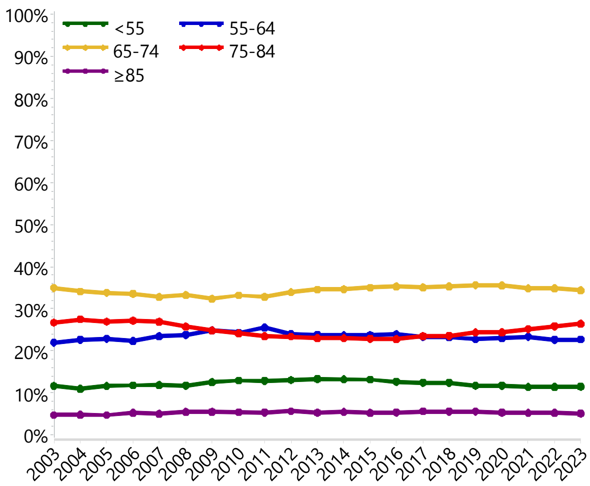


Figure HT3 Primary Total Conventional Hip Replacement by Fixation

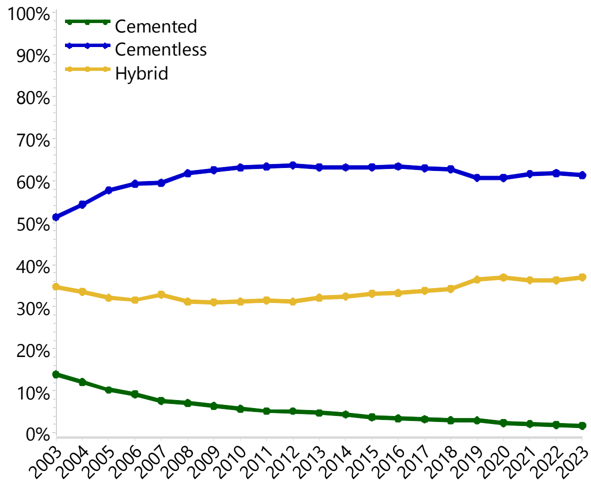


Table HT3 Age and Gender of Primary Total Conventional Hip Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	302164	45.0%	11	108	67	66.4	11.5
Female	368720	55.0%	11	103	70	69.0	11.3
TOTAL	**670884**	**100.0%**	**11**	**108**	**69**	**67.8**	**11.5**

Primary Total Hip Replacement

The Exeter V40, Accolade II, and CORAIL are the most used femoral stems for primary total conventional hip replacement (Table HT4). In 2023, 67.0% of primary total conventional hip replacements used stems in the 10 most used femoral component list. Seven of these stems are cementless. The 10 most used cemented and cementless stems are listed in Table HT5 and Table HT6, respectively. The 10 most used cemented stems account for 93.9% of cemented stem procedures. The 10 most used cementless stems account for 78.9% of cementless stem procedures.

The Trident (Shell), Trinity and PINNACLE are the most frequently used acetabular prostheses for primary total conventional hip replacement. In 2023, 87.8% of primary total conventional hip procedures used acetabular components from the 10 most used list (Table HT7). All of the acetabular components in this list are cementless prostheses. The 10 most used cemented and cementless acetabular prostheses are listed separately in Table HT8 and Table HT9, respectively.

Table HT4 10 Most Used Femoral Components in Primary Total Conventional Hip Replacement

2003			2020			2021			2022			2023		
N	Model		N	Model		N	Model		N	Model		N	Model	
3901	Exeter V40		7144	Exeter V40		7607	Exeter V40		7834	Exeter V40		8278	Exeter V40	
1029	ABGII		4550	CORAIL		4451	CORAIL		3908	CORAIL		4620	Accolade II	
1000	Synergy		2631	Accolade II		3621	Accolade II		3782	Accolade II		4306	CORAIL	
819	Alloclassic		2630	Metafix		2792	Polarstem		3309	Metafix		3420	Metafix	
809	VerSys		2474	Polarstem		2690	Metafix		2832	Polarstem		2937	Polarstem	
780	Spectron EF		1763	Quadra-H		1819	Quadra-H		1557	Quadra-H		1973	Paragon	
713	Secur-Fit Plus		1339	CPT		1455	Paragon		1513	Paragon		1728	Quadra-C	
618	Omnifit		1236	Paragon		1445	Quadra-C		1506	Quadra-C		1532	CPT	
565	C-Stem		1148	Quadra-C		1409	CPT		1448	AMIStem H		1483	AMIStem H	
485	S-Rom		983	CPCS		1276	AMIStem H		1328	CPT		1419	Quadra-H	
10 Most Used														
10719	(10)	62.8%	25898	(10)	67.0%	28565	(10)	67.7%	29017	(10)	68.0%	31696	(10)	67.0%
Remainder														
6353	(73)	37.2%	12783	(80)	33.0%	13649	(81)	32.3%	13661	(77)	32.0%	15616	(74)	33.0%
TOTAL														
17072	(83)	100.0%	38681	(90)	100.0%	42214	(91)	100.0%	42678	(87)	100.0%	47312	(84)	100.0%

Table HT5 10 Most Used Cemented Femoral Components in Primary Total Conventional Hip Replacement

2003		2020		2021		2022		2023	
N	Model	N	Model	N	Model	N	Model	N	Model
3901	Exeter V40	7144	Exeter V40	7607	Exeter V40	7834	Exeter V40	8278	Exeter V40
780	Spectron EF	1339	CPT	1445	Quadra-C	1506	Quadra-C	1728	Quadra-C
565	C-Stem	1148	Quadra-C	1409	CPT	1328	CPT	1532	CPT
477	CPT	983	CPCS	976	CPCS	922	Short Exeter V40	1179	Taper Fit
445	Elite Plus	789	Taper Fit	900	Short Exeter V40	901	CPCS	1134	Short Exeter V40
358	MS 30	785	Short Exeter V40	798	Taper Fit	853	Taper Fit	927	CPCS
338	Omnifit	734	C-Stem AMT	705	C-Stem AMT	591	Evolve	680	X-Acta
321	Charnley	532	Evolve	636	Evolve	555	C-Stem AMT	676	Evolve
245	CPCS	367	MS 30	368	MS 30	367	MS 30	590	C-Stem AMT
122	Exeter	310	Absolut	322	X-Acta	360	X-Acta	415	MS 30
10 Most Used									
7552	(10) 91.7%	14131	(10) 93.2%	15166	(10) 93.8%	15217	(10) 93.5%	17139	(10) 93.9%
Remainder									
680	(26) 8.3%	1024	(18) 6.8%	1010	(20) 6.2%	1055	(20) 6.5%	1116	(21) 6.1%
TOTAL									
8232	(36) 100.0%	15155	(28) 100.0%	16176	(30) 100.0%	16272	(30) 100.0%	18255	(31) 100.0%

Table HT6 10 Most Used Cementless Femoral Components in Primary Total Conventional Hip Replacement

2003		2020		2021		2022		2023	
N	Model	N	Model	N	Model	N	Model	N	Model
1029	ABGII	4550	CORAIL	4450	CORAIL	3867	CORAIL	4620	Accolade II
980	Synergy	2631	Accolade II	3621	Accolade II	3782	Accolade II	4225	CORAIL
819	Alloclassic	2630	Metafix	2690	Metafix	3309	Metafix	3420	Metafix
739	VerSys	2377	Polarstem	2573	Polarstem	2592	Polarstem	2559	Polarstem
713	Secur-Fit Plus	1763	Quadra-H	1819	Quadra-H	1557	Quadra-H	1973	Paragon
485	S-Rom	1236	Paragon	1455	Paragon	1513	Paragon	1483	AMIStem H
482	Secur-Fit	933	AMIStem H	1276	AMIStem H	1448	AMIStem H	1419	Quadra-H
376	CORAIL	885	Taperloc	958	Taperloc Microplasty	1001	Taperloc	1194	Taperloc
334	Accolade I	784	Taperloc Microplasty	918	Taperloc	860	Taperloc Microplasty	1057	Taperloc Microplasty
334	Mallory-Head	477	Optimys	588	Origin	849	Origin	978	ACTIS
10 Most Used									
6291	(10) 71.2%	18266	(10) 77.6%	20348	(10) 78.1%	20778	(10) 78.7%	22928	(10) 78.9%
Remainder									
2549	(47) 28.8%	5260	(58) 22.4%	5690	(57) 21.9%	5628	(53) 21.3%	6129	(52) 21.1%
TOTAL									
8840	(57) 100.0%	23526	(68) 100.0%	26038	(67) 100.0%	26406	(63) 100.0%	29057	(62) 100.0%

Primary Total Hip Replacement

Table HT7 10 Most Used Acetabular Components in Primary Total Conventional Hip Replacement

2003			2020			2021			2022			2023		
N	Model		N	Model		N	Model		N	Model		N	Model	
3986	Trident (Shell)		8865	Trident (Shell)		9839	Trident (Shell)		9469	Trident (Shell)		9372	Trident (Shell)	
1748	Reflection (Shell)		5268	PINNACLE		5409	Trinity		6203	Trinity		6930	Trinity	
1524	Trilogy		4854	Trinity		5156	PINNACLE		4631	PINNACLE		5173	PINNACLE	
955	Vitalock		3937	R3		4199	R3		3967	R3		4833	G7	
907	Duraloc		2927	G7		3620	G7		3893	G7		4134	Mpact	
827	ABGII		2831	Mpact		3380	Mpact		3533	Mpact		3992	R3	
793	Allofit		1375	Versafitcup CC		1735	Versafitcup CC		1644	Versafitcup CC		2964	Trident II/Tritanium (Shell)	
729	Mallory-Head		1353	Logical G		1553	Trident/Tritanium (Shell)		1395	Logical G		1819	Versafitcup CC	
539	Contemporary		1155	Trident/Tritanium (Shell)		1326	Logical G		1395	Trident/Tritanium (Shell)		1482	Logical G	
537	PINNACLE		719	RM Cup		802	RM Cup		783	Trident II/ Tritanium (Shell)		843	Trident/Tritanium (Shell)	
10 Most Used														
12545	(10)	73.5%	33284	(10)	86.0%	37019	(10)	87.7%	36913	(10)	86.5%	41542	(10)	87.8%
Remainder														
4527	(69)	26.5%	5397	(61)	14.0%	5195	(62)	12.3%	5765	(63)	13.5%	5770	(64)	12.2%
TOTAL														
17072	(79)	100.0%	38681	(71)	100.0%	42214	(72)	100.0%	42678	(73)	100.0%	47312	(74)	100.0%

Table HT8 10 Most Used Cemented Acetabular Components in Primary Total Conventional Hip Replacement

2003			2020			2021			2022			2023		
N	Model		N	Model		N	Model		N	Model		N	Model	
539	Contemporary		512	Exeter X3 Rimfit		489	Exeter X3 Rimfit		427	Exeter X3 Rimfit		375	Exeter X3 Rimfit	
256	Exeter		52	Marathon		57	Avantage		76	Avantage		122	Avantage	
251	Reflection (Cup)		50	Reflection (Cup)		50	Marathon		41	Reflection (Cup)		38	Reflection (Cup)	
227	Exeter Contemporary		42	Avantage		40	Reflection (Cup)		40	Marathon		35	Marathon	
199	Charnley Ogee		40	ZCA		27	Apricot		30	Muller		24	Apricot	
149	Elite Plus LPW		39	Novae E		26	Contemporary		25	Apricot		23	BI-MENTUM	
130	Low Profile Cup		24	Apricot		25	Novae E		17	Exeter Contemporary		23	Exeter Contemporary	
109	Elite Plus Ogee		24	Muller		23	Muller		16	Trident (Cup)		21	Dual Mobility Cup	
102	Charnley		22	Contemporary		19	Exeter Contemporary		15	Novae E		20	Polarcup	
90	ZCA		21	Polarcup		19	ZCA		15	ZCA		19	ZCA	
10 Most Used														
2052	(10)	85.4%	826	(10)	88.6%	775	(10)	86.9%	702	(10)	85.8%	700	(10)	86.5%
Remainder														
351	(16)	14.6%	106	(19)	11.4%	117	(18)	13.1%	116	(19)	14.2%	109	(18)	13.5%
TOTAL														
2403	(26)	100.0%	932	(29)	100.0%	892	(28)	100.0%	818	(29)	100.0%	809	(28)	100.0%

Table HT9 10 Most Used Cementless Acetabular Components in Primary Total Conventional Hip Replacement

2003		2020		2021		2022		2023	
N	Model	N	Model	N	Model	N	Model	N	Model
3986	Trident (Shell)	8865	Trident (Shell)	9838	Trident (Shell)	9468	Trident (Shell)	9372	Trident (Shell)
1748	Reflection (Shell)	5267	PINNACLE	5409	Trinity	6203	Trinity	6930	Trinity
1524	Trilogy	4854	Trinity	5155	PINNACLE	4631	PINNACLE	5173	PINNACLE
955	Vitalock	3936	R3	4199	R3	3967	R3	4833	G7
907	Duraloc	2927	G7	3620	G7	3893	G7	4134	Mpact
827	ABGII	2831	Mpact	3380	Mpact	3533	Mpact	3992	R3
793	Allofit	1375	Versafitcup CC	1735	Versafitcup CC	1644	Versafitcup CC	2964	Trident II/Tritanium (Shell)
729	Mallory-Head	1353	Logical G	1553	Trident/Tritanium (Shell)	1395	Logical G	1819	Versafitcup CC
537	PINNACLE	1155	Trident/Tritanium (Shell)	1326	Logical G	1395	Trident/Tritanium (Shell)	1482	Logical G
521	Fitmore	719	RM Cup	802	RM Cup	783	Trident II /Tritanium (Shell)	843	Trident/Tritanium (Shell)
10 Most Used									
12527	(10) 85.4%	33282	(10) 88.2%	37017	(10) 89.6%	36912	(10) 88.2%	41542	(10) 89.3%
Remainder									
2142	(43) 14.6%	4467	(39) 11.8%	4305	(42) 10.4%	4948	(41) 11.8%	4961	(43) 10.7%
TOTAL									
14669	(53) 100.0%	37749	(49) 100.0%	41322	(52) 100.0%	41860	(51) 100.0%	46503	(53) 100.0%

Note: In 2023, no shells in the cementless group were inserted with cement

OUTCOME FOR ALL DIAGNOSES

Hip replacement prosthesis use and availability changes with time. In order to keep data contemporaneous, only procedures using prostheses that have been available and used in 2023 (described as modern prostheses) are included in the analyses, unless clearly specified. This has resulted in 110,428 (17%) hip procedures being excluded from the analysis for the 2024 Annual Report.

Detailed information on prostheses that are no longer used is available in the supplementary report 'Comparative Prosthesis Performance' on the AOANJRR website: https://aoanjrr.sahmri.com/annual-reports-2024

Osteoarthritis is the principal diagnosis for primary total conventional hip replacement, followed by fractured neck of femur, osteonecrosis, developmental dysplasia, rheumatoid arthritis, and tumour (Table HT10). Osteoarthritis has a lower rate of revision compared to fractured neck of femur, rheumatoid arthritis and osteonecrosis. Osteoarthritis also has a lower rate of revision compared to developmental dysplasia. However, this difference is only evident in the first 2 weeks and between 3 months to 2.5 years (Figure HT4).

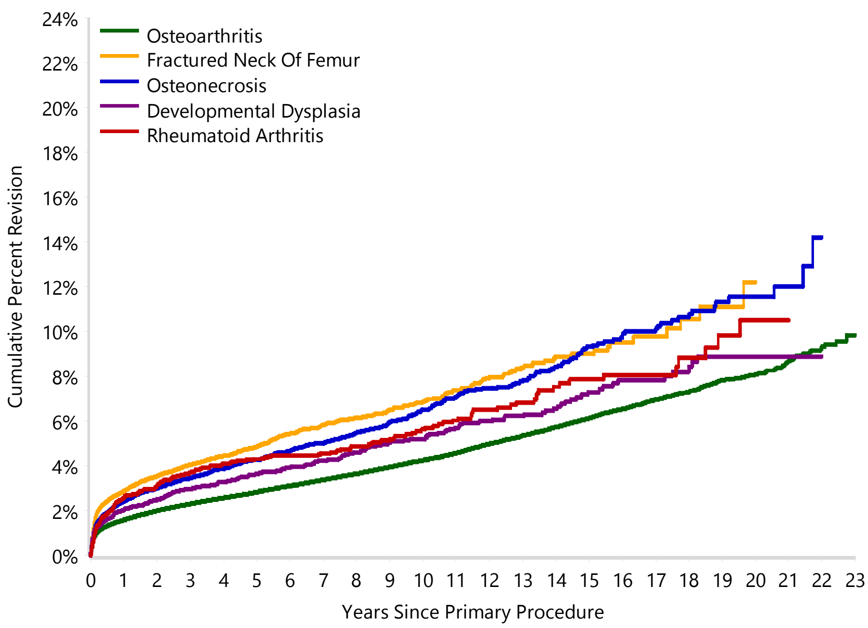
Primary Total Hip Replacement

Table HT10 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Primary Diagnosis

Primary Diagnosis	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Osteoarthritis	15935	471655	1.6 (1.6, 1.6)	2.3 (2.3, 2.3)	2.8 (2.8, 2.9)	4.3 (4.2, 4.3)	6.1 (6.0, 6.3)	8.1 (7.8, 8.3)
Fractured Neck of Femur	1419	30174	2.9 (2.7, 3.1)	4.0 (3.8, 4.3)	4.9 (4.6, 5.1)	6.9 (6.4, 7.3)	9.0 (8.2, 9.8)	12.2 (9.7, 15.3)
Osteonecrosis	859	17211	2.4 (2.2, 2.7)	3.5 (3.2, 3.8)	4.3 (4.0, 4.6)	6.5 (6.0, 7.0)	9.3 (8.5, 10.2)	11.5 (10.2, 13.0)
Developmental Dysplasia	312	7217	2.0 (1.7, 2.4)	3.0 (2.6, 3.4)	3.6 (3.2, 4.1)	5.2 (4.6, 5.9)	7.3 (6.3, 8.4)	8.9 (7.5, 10.5)
Rheumatoid Arthritis	208	4040	2.6 (2.1, 3.1)	3.7 (3.1, 4.3)	4.3 (3.7, 5.0)	5.6 (4.8, 6.5)	7.8 (6.7, 9.3)	10.5 (8.2, 13.3)
Tumour	149	2854	4.3 (3.6, 5.3)	6.3 (5.2, 7.6)	7.2 (5.9, 8.7)	14.2 (11.0, 18.3)	16.4 (12.2, 21.8)	
Other Inflammatory Arthritis	106	2125	2.2 (1.6, 2.9)	3.3 (2.6, 4.2)	4.1 (3.3, 5.1)	6.0 (4.9, 7.5)	8.2 (6.4, 10.4)	12.5 (8.8, 17.6)
Failed Internal Fixation	151	2094	4.8 (3.9, 5.8)	6.8 (5.7, 8.0)	7.8 (6.6, 9.2)	9.2 (7.7, 10.9)	11.4 (8.9, 14.6)	
Other (3)	85	979	6.0 (4.6, 7.7)	8.2 (6.5, 10.3)	9.1 (7.3, 11.3)	11.6 (9.1, 14.7)	12.6 (9.6, 16.5)	
TOTAL	**19224**	**538349**						

Note: Restricted to modern prostheses. All procedures using metal/metal prostheses have been excluded. Only primary diagnoses with >2,000 procedures have been listed

Figure HT4 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Primary Diagnosis



HR - adjusted for age and gender

Fractured Neck Of Femur vs Osteoarthritis
Entire Period: HR=1.76 (1.67, 1.86), p<0.001

Osteonecrosis vs Osteoarthritis
Entire Period: HR=1.48 (1.38, 1.58), p<0.001

Developmental Dysplasia vs Osteoarthritis
0 - 2Wk: HR=1.72 (1.21, 2.45), p=0.002
2Wk - 1Mth: HR=1.33 (0.97, 1.83), p=0.074
1Mth - 3Mth: HR=0.67 (0.44, 1.02), p=0.060
3Mth - 2.5Yr: HR=1.41 (1.15, 1.72), p<0.001
2.5Yr+: HR=1.09 (0.91, 1.31), p=0.341

Rheumatoid Arthritis vs Osteoarthritis
Entire Period: HR=1.37 (1.20, 1.58), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Osteoarthritis	471655	419744	335490	259069	106561	32340	5433
Fractured Neck of Femur	30174	24876	17657	11719	3215	635	65
Osteonecrosis	17211	15019	11734	8844	3664	1230	272
Developmental Dysplasia	7217	6293	5046	3955	1900	793	190
Rheumatoid Arthritis	4040	3644	3052	2441	1259	483	110

Note: Restricted to modern prostheses. Only the 5 most common primary diagnoses have been listed.

Prosthesis Types

There are 1,543 different stem and acetabular combinations for primary total conventional hip replacement. This is an increase of 79 prosthesis combinations since the previous report.

The cumulative percent revision of the 112 prosthesis combinations with >500 procedures are listed in Table HT11 to Table HT13. Although the listed combinations are a small proportion of the possible combinations, they represent 93.1% of all primary total conventional hip replacement procedures. A large number of prosthesis combinations have been used in small numbers and have no recorded use in 2023.

The 'Other' group consists of all prosthesis combinations with ≤500 procedures. This group accounts for 6.9% of all primary total conventional hip replacement procedures.

There are 9 cemented primary total conventional stem and acetabular combinations with >500 procedures. The CPT/ZCA has the lowest 15 year cumulative percent revision of 7.3% (n=1,068) (Table HT11).

There are 69 cementless primary total conventional stem and acetabular combinations listed. The Alloclassic/Trilogy has the lowest 15 year cumulative percent revision of 3.2% (n=946). At 20 years, the Secur-Fit Plus/Trident (shell) has a cumulative percent revision of 5.7% (n=6,509) (Table HT12).

There are 34 combinations of primary total hip replacement with hybrid fixation. The Exeter V40 /Trilogy has the lowest cumulative percent revision at 15 years of 3.8% (n=606) followed by the Exeter V40 /PINNACLE with a cumulative percent revision of 4.7% (n=2,800) (Table HT13).

Table HT11 Cumulative Percent Revision of Primary Total Conventional Hip Replacement with Cemented Fixation by Prosthesis Combination

Femoral Component	Acetabular Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
C-Stem AMT	Marathon	20	659	1.9 (1.1, 3.3)	2.5 (1.5, 4.1)	2.9 (1.8, 4.6)	3.8 (2.4, 6.0)		
CPCS	Reflection (Cup)	108	1162	2.1 (1.4, 3.1)	3.1 (2.2, 4.3)	3.9 (2.9, 5.3)	8.4 (6.5, 10.7)	17.6 (14.2, 21.6)	
CPT	ZCA	54	1068	1.0 (0.6, 1.9)	2.4 (1.6, 3.5)	3.0 (2.1, 4.2)	4.9 (3.6, 6.6)	7.3 (5.3, 10.1)	11.3 (8.0, 15.9)
Exeter V40	Contemporary	399	5727	1.7 (1.4, 2.1)	2.9 (2.5, 3.4)	3.6 (3.1, 4.1)	6.1 (5.4, 6.8)	9.7 (8.7, 10.8)	14.8 (13.0, 16.9)
	Exeter	158	1726	0.8 (0.5, 1.4)	1.9 (1.3, 2.7)	3.1 (2.4, 4.1)	5.0 (4.0, 6.2)	10.3 (8.7, 12.3)	16.5 (13.9, 19.5)
	Exeter Contemporary	209	3479	1.4 (1.1, 1.9)	2.3 (1.9, 2.9)	3.1 (2.6, 3.8)	4.8 (4.1, 5.6)	8.0 (6.9, 9.3)	11.3 (9.2, 13.8)
	Exeter X3 Rimfit	177	5913	1.6 (1.3, 2.0)	2.4 (2.0, 2.9)	3.0 (2.5, 3.5)	3.9 (3.3, 4.5)		
Short Exeter V40	Exeter X3 Rimfit	15	568	1.5 (0.7, 2.9)	2.6 (1.5, 4.4)	3.2 (1.9, 5.3)			
Spectron EF	Reflection (Cup)	141	1669	1.1 (0.7, 1.7)	1.8 (1.3, 2.6)	2.9 (2.1, 3.8)	7.2 (5.9, 8.8)	12.8 (10.7, 15.2)	16.7 (13.6, 20.3)
Other (269)		285	5280	3.1 (2.7, 3.7)	4.4 (3.8, 5.0)	5.1 (4.4, 5.8)	7.5 (6.6, 8.6)	11.1 (9.3, 13.3)	13.8 (11.2, 16.9)
TOTAL		**1566**	**27251**						

Note: Restricted to modern prostheses
Some cementless components have been cemented
Procedures using metal/metal prostheses have been included
Only prostheses with >500 procedures have been listed

Table HT12 Cumulative Percent Revision of Primary Total Conventional Hip Replacement with Cementless Fixation by Prosthesis Combination

Femoral Component	Acetabular Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
ACTIS	PINNACLE	18	1418	1.5 (0.9, 2.3)					
AMIStem H	Mpact	95	4285	1.6 (1.3, 2.1)	2.4 (1.9, 2.9)	2.9 (2.3, 3.7)			
	Versafitcup CC	101	4167	1.4 (1.1, 1.8)	1.8 (1.4, 2.3)	2.6 (2.1, 3.2)			
Accolade II	Trident (Shell)	430	17319	1.8 (1.6, 2.0)	2.5 (2.2, 2.7)	2.9 (2.6, 3.2)	4.0 (3.2, 5.0)		
	Trident II/ Tritanium (Shell)	35	1941	2.1 (1.5, 2.9)					
	Trident/ Tritanium (Shell)	141	4207	2.2 (1.8, 2.7)	3.2 (2.7, 3.8)	3.9 (3.3, 4.6)			
Alloclassic	Allofit	203	3973	1.6 (1.2, 2.0)	2.4 (1.9, 2.9)	2.9 (2.4, 3.5)	4.9 (4.2, 5.6)	6.6 (5.7, 7.7)	7.8 (6.5, 9.4)
	Fitmore*	55	727	4.4 (3.1, 6.2)	5.4 (4.0, 7.3)	5.8 (4.3, 7.8)	7.7 (5.9, 10.1)	8.3 (6.3, 10.9)	
	Trabecular Metal (Shell)*	55	1060	2.3 (1.5, 3.4)	2.9 (2.0, 4.1)	4.0 (3.0, 5.4)	5.0 (3.8, 6.6)	5.9 (4.5, 7.8)	
	Trilogy*	25	946	0.6 (0.3, 1.4)	0.9 (0.4, 1.7)	1.1 (0.6, 2.0)	2.7 (1.8, 4.1)	3.2 (2.1, 4.7)	
Anthology	R3	300	8758	2.1 (1.8, 2.4)	2.6 (2.3, 3.0)	2.9 (2.6, 3.3)	3.8 (3.4, 4.3)	4.7 (4.0, 5.5)	
	Reflection (Shell)*	32	907	1.9 (1.2, 3.0)	2.2 (1.4, 3.4)	2.6 (1.7, 3.8)	3.4 (2.4, 4.9)	3.8 (2.7, 5.4)	
Avenir	Continuum	71	1818	2.7 (2.0, 3.6)	3.1 (2.4, 4.0)	3.6 (2.8, 4.6)	4.5 (3.5, 5.7)		
	G7	17	777	2.1 (1.3, 3.5)	2.5 (1.5, 4.3)	3.2 (1.8, 5.7)			
	Trilogy*	15	626	1.0 (0.4, 2.1)	1.1 (0.5, 2.3)	1.3 (0.6, 2.6)	2.6 (1.5, 4.5)		
C2	Delta-TT	32	1271	1.2 (0.7, 2.0)	2.0 (1.3, 3.0)	2.3 (1.6, 3.4)	3.0 (2.0, 4.5)		
CLS	Allofit*	31	501	1.8 (0.9, 3.4)	3.4 (2.1, 5.5)	4.1 (2.6, 6.2)	5.4 (3.7, 7.8)	6.9 (4.8, 9.8)	
	Fitmore	24	716	1.3 (0.7, 2.4)	2.6 (1.6, 4.1)	3.0 (1.9, 4.7)	4.2 (2.7, 6.6)	4.2 (2.7, 6.6)	
CORAIL	Fitmore*	15	514	2.1 (1.2, 3.8)	2.3 (1.3, 4.1)	2.3 (1.3, 4.1)	3.4 (2.0, 5.8)		
	G7	8	695	0.7 (0.3, 1.7)	1.2 (0.6, 2.5)				
	PINNACLE	2597	65885	1.7 (1.6, 1.8)	2.5 (2.4, 2.7)	3.1 (3.0, 3.3)	4.8 (4.6, 5.0)	7.4 (7.0, 7.9)	
	PINNACLE*MoM	151	966	2.2 (1.4, 3.3)	3.7 (2.6, 5.1)	5.9 (4.6, 7.6)	12.3 (10.3, 14.7)	18.3 (15.7, 21.2)	
	Trident (Shell)	29	676	2.7 (1.7, 4.3)	4.0 (2.7, 5.9)	4.7 (3.1, 6.9)	6.9 (4.4, 10.7)		
	Trinity	21	1448	1.3 (0.8, 2.0)	1.5 (1.0, 2.3)	1.5 (1.0, 2.3)			
EVOK	Logical G	33	840	2.8 (1.9, 4.2)	4.5 (3.2, 6.5)	4.9 (3.4, 6.9)			
H-Max	Delta-TT	87	1809	1.9 (1.4, 2.6)	3.4 (2.6, 4.3)	4.1 (3.2, 5.1)	6.5 (5.1, 8.2)		
HACTIV	Logical G	70	1355	3.8 (2.9, 5.0)	4.9 (3.8, 6.2)	5.1 (4.0, 6.5)			
	Saturne	22	953	1.5 (0.9, 2.6)	2.3 (1.4, 3.6)	2.6 (1.6, 4.2)			
M/L Taper	Allofit*	26	752	1.6 (0.9, 2.8)	1.9 (1.1, 3.2)	2.2 (1.3, 3.5)	3.5 (2.3, 5.4)		
	Continuum	71	1667	2.4 (1.8, 3.3)	3.5 (2.7, 4.5)	3.8 (3.0, 4.9)	4.6 (3.6, 5.8)		
	Trilogy	36	922	1.3 (0.7, 2.3)	1.6 (1.0, 2.7)	2.7 (1.8, 4.0)	3.8 (2.7, 5.3)	4.7 (3.3, 6.8)	
MasterLoc	Mpact	17	1226	1.3 (0.8, 2.1)	1.4 (0.9, 2.3)	1.6 (1.0, 2.7)			
	Versafitcup CC	14	971	1.1 (0.6, 2.0)	1.8 (1.0, 3.0)	1.8 (1.0, 3.0)			
Metafix	Trinity	421	19849	1.5 (1.3, 1.6)	2.2 (2.0, 2.4)	2.5 (2.3, 2.8)	3.5 (3.0, 4.1)		
MiniHip	Trinity	44	1279	2.6 (1.9, 3.7)	3.2 (2.4, 4.4)	3.4 (2.5, 4.6)	3.7 (2.8, 5.0)		

Table HT12 ***Continued***

Femoral Component	Acetabular Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Nanos	R3	13	671	1.2 (0.6, 2.4)	1.5 (0.8, 2.8)	1.5 (0.8, 2.8)	1.8 (1.0, 3.2)		
Optimys	RM Cup	63	2817	1.8 (1.3, 2.3)	2.2 (1.7, 2.9)	2.6 (2.0, 3.3)			
	seleXys	16	643	0.8 (0.3, 1.9)	1.7 (0.9, 3.1)	2.9 (1.7, 4.8)			
Origin	Logical G	126	4035	2.2 (1.8, 2.7)	3.2 (2.7, 3.8)	3.7 (3.1, 4.5)			
Paragon	Acetabular Shell (Global)	111	4411	1.5 (1.2, 2.0)	2.0 (1.6, 2.4)	2.4 (2.0, 2.9)			
	Novae	24	871	0.9 (0.5, 1.8)	2.0 (1.2, 3.2)	2.3 (1.4, 3.5)	5.2 (2.8, 9.4)		
	Trinity	83	4819	1.7 (1.3, 2.1)	1.9 (1.5, 2.3)	1.9 (1.5, 2.3)			
Polarstem	EP-Fit Plus	13	2781	0.2 (0.1, 0.4)	0.4 (0.2, 0.7)	0.5 (0.3, 0.9)	0.7 (0.4, 1.4)		
	Polarcup	12	553	1.3 (0.6, 2.7)	1.7 (0.9, 3.3)	2.5 (1.3, 4.6)			
	R3	575	19849	2.0 (1.8, 2.2)	2.6 (2.4, 2.8)	3.0 (2.8, 3.3)	4.1 (3.7, 4.5)		
Profemur L	Dynasty	102	1924	3.5 (2.8, 4.4)	4.6 (3.7, 5.6)	5.1 (4.2, 6.2)			
	Procotyl L	32	1884	1.0 (0.7, 1.6)	1.6 (1.1, 2.3)	2.2 (1.5, 3.2)			
Quadra-H	Mpact	245	6524	2.0 (1.7, 2.4)	3.0 (2.6, 3.5)	4.2 (3.6, 4.8)			
	Trident (Shell)*	26	712	1.5 (0.9, 2.8)	2.7 (1.7, 4.2)	3.2 (2.1, 4.8)			
	Versafitcup CC	413	11338	1.8 (1.6, 2.0)	2.5 (2.2, 2.8)	3.1 (2.8, 3.4)	5.4 (4.7, 6.2)		
	Versafitcup DM	50	1168	2.9 (2.1, 4.1)	4.3 (3.2, 5.8)	4.7 (3.5, 6.3)			
Quadra-P	Mpact	8	703	0.9 (0.4, 2.0)	1.5 (0.7, 3.2)				
S-Rom	PINNACLE	245	3815	2.5 (2.0, 3.0)	4.1 (3.5, 4.7)	4.8 (4.2, 5.6)	6.2 (5.5, 7.1)	7.6 (6.7, 8.7)	8.6 (7.5, 9.9)
SL-Plus	EP-Fit Plus	50	1228	1.6 (1.0, 2.4)	2.1 (1.4, 3.0)	2.7 (1.9, 3.8)	3.8 (2.8, 5.1)	4.3 (3.3, 5.7)	
	R3	118	1842	2.5 (1.9, 3.3)	4.0 (3.2, 5.0)	4.3 (3.5, 5.4)	6.3 (5.2, 7.6)	8.2 (6.7, 9.8)	
Secur-Fit	Trident (Shell)	575	10635	1.9 (1.7, 2.2)	3.0 (2.7, 3.3)	3.7 (3.4, 4.1)	4.9 (4.5, 5.4)	6.5 (5.9, 7.1)	8.1 (7.3, 9.1)
Secur-Fit Plus	Trident (Shell)	276	6509	1.3 (1.1, 1.6)	2.0 (1.7, 2.4)	2.5 (2.1, 2.9)	3.5 (3.1, 4.0)	4.7 (4.1, 5.3)	5.7 (5.0, 6.5)
Summit	PINNACLE	218	6130	1.5 (1.2, 1.8)	2.2 (1.9, 2.6)	2.5 (2.1, 2.9)	3.7 (3.2, 4.2)	5.4 (4.6, 6.3)	
	PINNACLE*MoM	99	784	1.5 (0.9, 2.7)	2.2 (1.4, 3.5)	3.5 (2.4, 5.1)	8.7 (6.8, 11.0)	11.7 (9.5, 14.4)	
Synergy	R3	211	5710	1.8 (1.5, 2.2)	2.5 (2.1, 2.9)	2.9 (2.5, 3.4)	3.8 (3.3, 4.4)	5.2 (4.4, 6.2)	
	Reflection (Shell)	449	7912	1.5 (1.3, 1.8)	2.3 (2.0, 2.7)	2.7 (2.3, 3.0)	3.9 (3.5, 4.4)	5.6 (5.1, 6.2)	7.7 (7.0, 8.5)
Taperloc	Continuum	17	747	1.5 (0.8, 2.6)	2.2 (1.3, 3.5)	2.3 (1.5, 3.8)			
	G7	158	6048	2.2 (1.9, 2.6)	2.7 (2.3, 3.2)	2.9 (2.4, 3.4)			
Taperloc Microplasty	Continuum	19	641	2.5 (1.5, 4.1)	2.9 (1.8, 4.5)	3.1 (2.0, 4.9)			
	G7	78	4746	1.4 (1.1, 1.8)	1.8 (1.4, 2.3)	1.9 (1.5, 2.4)			
Tri-Fit TS	Trinity	129	5072	1.4 (1.1, 1.7)	2.2 (1.8, 2.6)	2.5 (2.1, 3.0)	3.0 (2.5, 3.6)		
Tri-Lock	PINNACLE	37	1229	1.6 (1.0, 2.4)	2.3 (1.6, 3.3)	2.7 (1.9, 3.8)	3.8 (2.6, 5.4)		
VerSys	Trilogy*	283	4498	2.6 (2.2, 3.1)	3.4 (2.9, 4.0)	4.0 (3.5, 4.7)	5.4 (4.7, 6.1)	6.4 (5.7, 7.2)	7.7 (6.8, 8.7)
twinSys (cless)	RM Cup	61	1586	2.4 (1.7, 3.2)	3.1 (2.3, 4.1)	3.4 (2.6, 4.5)	4.9 (3.7, 6.6)		
Other (597)		820	19735	2.4 (2.2, 2.6)	3.5 (3.2, 3.8)	4.0 (3.7, 4.3)	5.5 (5.1, 6.0)	7.1 (6.4, 7.8)	8.4 (7.3, 9.6)
TOTAL		**11097**	**311794**						

Note: Restricted to modern prostheses. Procedures using metal/metal prostheses have been included. MoM denotes metal/metal prostheses with head size >32mm
* denotes prosthesis combination with no reported use in primary total conventional hip procedures in 2023. Only prostheses with >500 procedures have been listed.

Primary Total Hip Replacement

Table HT13 Cumulative Percent Revision of Primary Total Conventional Hip Replacement with Hybrid Fixation by Prosthesis Combination

Femoral Component	Acetabular Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Absolut	Acetabular Shell (Global)*	32	865	1.5 (0.9, 2.6)	2.3 (1.5, 3.6)	3.0 (2.1, 4.5)			
	Trinity	22	846	2.0 (1.3, 3.2)	2.6 (1.7, 4.1)				
C-Stem AMT	PINNACLE	221	6794	1.6 (1.3, 2.0)	2.5 (2.1, 2.9)	3.2 (2.8, 3.7)	5.0 (4.2, 5.9)	7.9 (5.1, 12.0)	
CPCS	R3	351	9544	2.2 (1.9, 2.5)	2.9 (2.6, 3.3)	3.5 (3.1, 3.9)	5.1 (4.5, 5.7)	6.0 (5.1, 6.9)	
	Reflection (Shell)	133	3187	0.9 (0.6, 1.3)	1.3 (0.9, 1.7)	1.7 (1.3, 2.2)	3.5 (2.8, 4.3)	5.9 (4.9, 7.2)	9.1 (7.0, 11.9)
CPT	Allofit	72	1915	1.5 (1.0, 2.1)	2.1 (1.5, 2.8)	3.4 (2.6, 4.4)	5.0 (3.9, 6.4)	5.8 (4.5, 7.6)	
	Continuum	191	3403	2.9 (2.4, 3.5)	4.0 (3.4, 4.7)	4.8 (4.1, 5.5)	6.5 (5.6, 7.5)		
	G7	131	4372	2.5 (2.1, 3.1)	3.4 (2.9, 4.1)	4.5 (3.6, 5.6)			
	Trabecular Metal (Shell)	146	2560	2.4 (1.9, 3.1)	3.5 (2.8, 4.3)	4.4 (3.7, 5.4)	6.8 (5.7, 8.1)	9.0 (7.4, 11.0)	
	Trilogy	490	8968	1.9 (1.7, 2.2)	2.9 (2.5, 3.2)	3.7 (3.3, 4.1)	5.7 (5.2, 6.2)	7.4 (6.7, 8.1)	8.4 (7.4, 9.6)
Evolve	Logical G	77	2779	1.9 (1.4, 2.5)	2.5 (1.9, 3.1)	3.1 (2.4, 3.9)			
Exeter V40	Fixa	39	903	2.8 (1.9, 4.1)	3.4 (2.4, 4.9)	3.7 (2.6, 5.2)	5.3 (3.8, 7.3)		
	PINNACLE	82	2800	1.5 (1.1, 2.0)	2.0 (1.6, 2.6)	2.4 (1.9, 3.1)	3.9 (3.1, 5.0)	4.7 (3.5, 6.1)	
	R3	114	2809	2.1 (1.7, 2.7)	3.0 (2.4, 3.7)	3.8 (3.1, 4.6)	4.4 (3.6, 5.3)	5.7 (4.5, 7.3)	
	Trabecular Metal (Shell)	31	620	2.8 (1.7, 4.4)	3.3 (2.2, 5.1)	4.0 (2.6, 5.9)	5.6 (3.9, 8.0)	6.6 (4.5, 9.5)	
	Trident (Shell)	2946	92563	1.3 (1.3, 1.4)	2.0 (1.9, 2.1)	2.5 (2.4, 2.7)	3.9 (3.7, 4.0)	5.4 (5.2, 5.7)	6.8 (6.4, 7.3)
	Trident II (Shell)	9	866	1.0 (0.5, 2.0)					
	Trident II/ Tritanium (Shell)	21	1414	2.0 (1.2, 3.1)					
	Trident/ Tritanium (Shell)	241	6840	1.9 (1.6, 2.2)	2.8 (2.4, 3.2)	3.4 (3.0, 3.9)	4.7 (4.1, 5.5)		
	Trilogy*	20	606	1.7 (0.9, 3.1)	2.4 (1.4, 4.0)	2.6 (1.5, 4.2)	3.5 (2.2, 5.4)	3.8 (2.4, 5.9)	
MS 30	Allofit*	54	1337	1.1 (0.6, 1.8)	1.6 (1.0, 2.4)	2.2 (1.5, 3.1)	3.7 (2.7, 5.0)	5.8 (4.3, 7.8)	
	Continuum	22	1024	1.6 (1.0, 2.6)	1.8 (1.1, 2.8)	2.1 (1.3, 3.2)			
	Fitmore	25	717	1.4 (0.8, 2.6)	2.1 (1.2, 3.5)	3.1 (2.0, 4.9)	4.2 (2.8, 6.3)	5.8 (3.5, 9.4)	
	G7	27	1416	1.5 (1.0, 2.3)	2.3 (1.5, 3.4)	2.6 (1.7, 3.9)			
Polarstem	R3	16	849	1.6 (0.9, 2.8)	2.9 (1.6, 5.3)				
Quadra-C	Mpact	92	6072	1.1 (0.9, 1.4)	1.8 (1.4, 2.2)	1.9 (1.5, 2.4)			
	Versafitcup CC	38	2167	1.4 (1.0, 2.0)	1.6 (1.1, 2.2)	1.9 (1.3, 2.6)	2.7 (1.7, 4.3)		
Short Exeter V40	Trident (Shell)	97	4813	1.3 (1.0, 1.7)	2.0 (1.6, 2.5)	2.6 (2.1, 3.2)			
Spectron EF	R3	114	2438	1.8 (1.4, 2.4)	3.0 (2.4, 3.7)	3.7 (3.0, 4.6)	5.4 (4.4, 6.6)		
	Reflection (Shell)*	378	5210	1.1 (0.9, 1.4)	2.0 (1.6, 2.4)	2.8 (2.4, 3.3)	5.5 (4.8, 6.2)	9.2 (8.3, 10.3)	12.6 (11.2, 14.2)
Taper Fit	Trinity	124	5538	1.6 (1.3, 1.9)	2.3 (1.9, 2.7)	2.9 (2.4, 3.5)	4.7 (2.8, 7.8)		
X-Acta	Mpact	21	1326	1.3 (0.8, 2.1)	1.9 (1.2, 3.0)	2.2 (1.4, 3.4)			
	Versafitcup CC	14	842	1.1 (0.6, 2.1)	1.3 (0.7, 2.3)	1.7 (0.9, 3.0)			
twinSys (ctd)	RM Cup	21	760	2.1 (1.3, 3.5)	3.0 (1.9, 4.5)	3.0 (1.9, 4.5)			
Other (566)		462	12431	2.1 (1.9, 2.4)	3.1 (2.8, 3.5)	3.9 (3.5, 4.4)	5.8 (5.1, 6.5)	8.4 (7.2, 9.8)	13.2 (10.1, 17.1)
TOTAL		6874	201594						

Note: Restricted to modern prostheses. Procedures using metal/metal prostheses have been included. MoM denotes metal/metal prostheses with head size >32mm
* denotes prosthesis combination with no reported use in primary total conventional hip procedures in 2023. Only prostheses with >500 procedures have been listed.

OUTCOME FOR OSTEOARTHRITIS – PATIENT CHARACTERISTICS

The 20 year cumulative percent revision of primary total conventional hip replacement undertaken for osteoarthritis is 8.1% (Table HT14 and Figure HT5).

Reason for Revision

Dislocation and instability are combined together for the analyses as they both reflect a similar reason for revision. Periprosthetic joint infection is the most common reason for revision of primary total conventional hip replacement followed by fracture, dislocation/instability, and loosening (Table HT15).

The most common reasons for revision vary with time. In the first 11 years, infection and dislocation/instability are the most frequent reasons for revision. After 11 years, loosening and fracture are the predominant reasons for revision (Figure HT6).

The aetiology of loosening changes with time. Loosening reported in the first few years most likely reflects failure to gain fixation. Loosening reported in later years is often due to loss of fixation secondary to lysis and bone resorption.

Loosening and lysis are reported separately. The diagnosis of loosening is used when loosening is reported either alone or in combination with lysis. The diagnosis of lysis is used for procedures that report only this diagnosis.

Type of Revision

The five most common types of revision are femoral component, head and insert, acetabular component, total hip replacement (femoral/acetabular), and head only (Table HT16).

Age and Gender

There is a difference in the rate of revision with respect to age and this varies with time. Compared to all other age groups patients aged ≥75 years have a brief early period of a higher rate of revision, however this reverses and after 3 months they have a lower rate of revision when compared to patients aged <55 years, and also after 6 months when compared to patients 55-64 years. There is also a lower rate of revision compared to patients 65-74 years but only between 9 months and 1.5 years (Table HT17 and Figure HT7).

Compared to males, females have a higher rate of revision in the first 2 weeks. From 2 weeks to 3 months and 6 months onwards, females have a lower rate of revision. The cumulative percent revision at 20 years is 8.7% for males and 7.6% for females (Table HT18 and Figure HT8).

There is a difference in the rate of revision between age groups within gender. Males aged ≥75 years have a higher rate of revision when compared to those aged 55–64 years and aged 65–74 years, but when compared to those aged <55 years, the higher rate of revision is only for the period between 2 weeks and 3 months (Table HT18 and Figure HT9).

Females aged ≥75 years compared to all other age groups have a brief early period of a higher rate of revision but then have a lower rate of revision after 3 months compared to those aged <55 years, and after 6 months for those aged 55-64 and 65-74 years (Table HT18 and Figure HT10).

For both males and females <65 years of age, loosening is the most common reason for revision. For patients aged ≥65 years, the most common reason for revision is fracture (Figure HT11 and Figure HT12).

ASA and BMI

ASA scores are an indication of comorbidity and have been collected since 2012. The definitions for these scores can be found in the introductory portion of this chapter. There are 336,891 primary total conventional hip replacement procedures for osteoarthritis with these scores.

The majority of patients have an ASA score of 2 or 3. There has been an increase in patients with an ASA score of 3 (Figure HT13). When compared to patients with an ASA score of 1, patients in all other ASA groups have a higher rate of revision (Table HT19 and Figure HT14). The difference in revision rate for each ASA score is partially due to an increase in revision for infection with increasing ASA score (Figure HT15).

BMI data have been collected since 2015. There are 290,673 primary total conventional hip replacement procedures for osteoarthritis with BMI data.

Over 80% of patients are in the normal, pre-obese or obese class 1 category, and there has been little change in BMI over time (Figure HT16).

When compared to patients in the normal BMI category, there is no difference in the rate of revision for patients who are underweight or pre-obese. The rate of revision is increased for obese class 1 and obese class 3 compared to normal body weight, and for obese class 2 for the first 3 months and from 6 to 18 months with no difference outside of these time points (Table HT20 and Figure HT17).

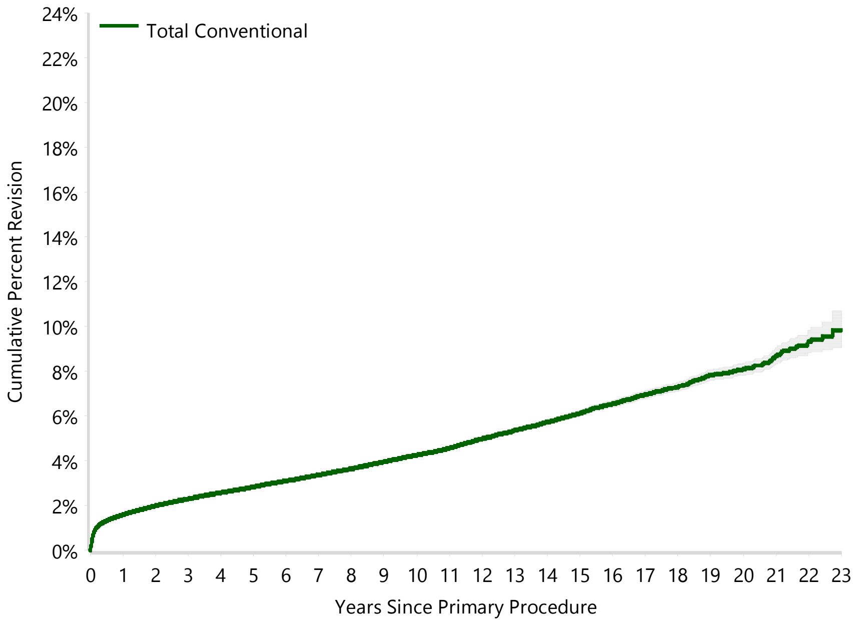
The most common reasons for revision are shown in Figure HT18. There is an increasing rate of revision for infection with increasing obesity class. At 3 years, the cumulative incidence of revision for infection is 0.8% for obese class 1, 1.4% for obese class 2, and 2.3% for obese class 3. The cumulative incidence of revision for infection for patients in obese class 3 is over 5-fold compared to patients with a normal BMI (Figure HT18).

Table HT14 Cumulative Percent Revision of Primary Total Conventional Hip Replacement (Primary Diagnosis OA)

Hip Class	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Total Conventional	15935	471655	1.6 (1.6, 1.6)	2.3 (2.3, 2.3)	2.8 (2.8, 2.9)	4.3 (4.2, 4.3)	6.1 (6.0, 6.3)	8.1 (7.8, 8.3)
TOTAL	**15935**	**471655**						

Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded

Figure HT5 Cumulative Percent Revision of Primary Total Conventional Hip Replacement (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Total Conventional	471655	419744	335490	259069	106561	32340	5433

Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded

Table HT15 Primary Total Conventional Hip Replacement by Reason for Revision (Primary Diagnosis OA)

Reason for Revision	Number	Percent
Infection	3769	23.7
Fracture	3538	22.2
Prosthesis Dislocation/Instability	3420	21.5
Loosening	3259	20.5
Pain	298	1.9
Leg Length Discrepancy	254	1.6
Malposition	241	1.5
Lysis	196	1.2
Implant Breakage Stem	161	1.0
Implant Breakage Acetabular Insert	117	0.7
Wear Acetabular Insert	99	0.6
Incorrect Sizing	91	0.6
Metal Related Pathology	70	0.4
Implant Breakage Acetabular	53	0.3
Implant Breakage Head	27	0.2
Progression Of Disease	1	0.0
Other	341	2.1
TOTAL	**15935**	**100.0**

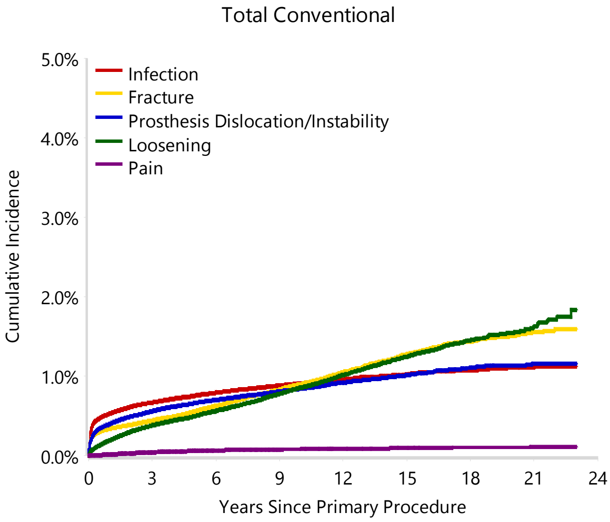
Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded

Table HT16 Primary Total Conventional Hip Replacement by Type of Revision (Primary Diagnosis OA)

Type of Revision	Number	Percent
Femoral Component	5317	33.4
Head/Insert	4021	25.2
Acetabular Component	2944	18.5
THR (Femoral/Acetabular)	1828	11.5
Head Only	780	4.9
Cement Spacer	531	3.3
Minor Components	260	1.6
Insert Only	147	0.9
Removal of Prostheses	72	0.5
Reinsertion of Components	21	0.1
Bipolar Head and Femoral	5	0.0
Total Femoral	4	0.0
Bipolar Only	2	0.0
Cement Only	1	0.0
Saddle	1	0.0
Head/Neck	1	0.0
TOTAL	**15935**	**100.0**

Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded
Femoral heads are usually replaced when the acetabular component or femoral stem is revised

Figure HT6 Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement (Primary Diagnosis OA)



Note: Restricted to modern prostheses

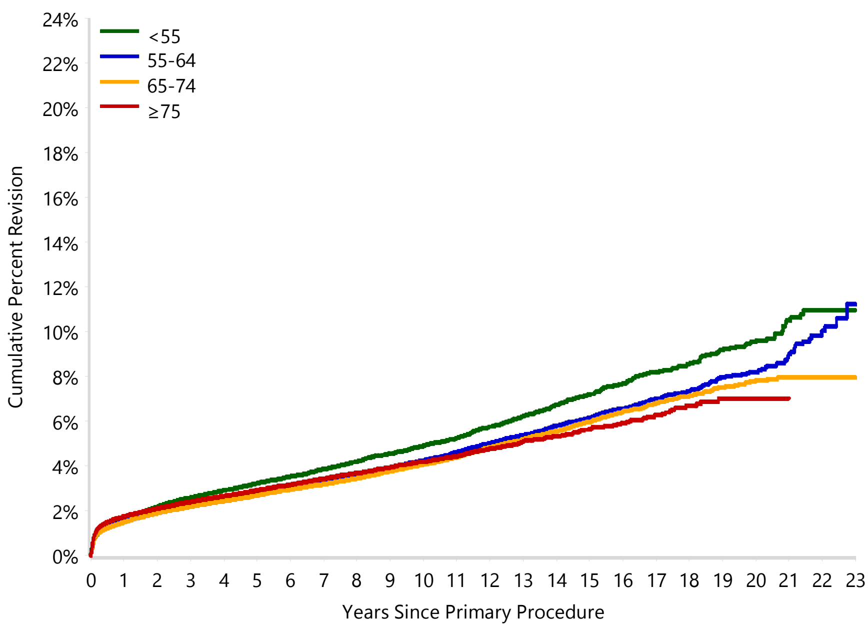
Primary Total Hip Replacement

Table HT17 **Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Age (Primary Diagnosis OA)**

Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
<55	2012	49203	1.6 (1.5, 1.7)	2.6 (2.4, 2.7)	3.2 (3.1, 3.4)	4.9 (4.6, 5.1)	7.2 (6.8, 7.6)	9.5 (8.9, 10.3)
55-64	3954	111300	1.5 (1.5, 1.6)	2.2 (2.2, 2.3)	2.8 (2.7, 2.9)	4.3 (4.1, 4.4)	6.2 (5.9, 6.4)	8.2 (7.7, 8.6)
65-74	5565	169149	1.5 (1.4, 1.5)	2.2 (2.1, 2.3)	2.7 (2.6, 2.8)	4.1 (4.0, 4.2)	6.0 (5.8, 6.2)	7.8 (7.4, 8.2)
≥75	4404	142003	1.7 (1.7, 1.8)	2.4 (2.3, 2.5)	2.9 (2.8, 3.0)	4.2 (4.1, 4.3)	5.6 (5.4, 5.9)	7.0 (6.4, 7.7)
TOTAL	**15935**	**471655**						

Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded

Figure HT7 **Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Age (Primary Diagnosis OA)**



HR - adjusted for gender

<55 vs ≥75
0 - 2Wk: HR=1.13 (0.95, 1.35), p=0.163
2Wk - 3Mth: HR=0.71 (0.63, 0.80), p<0.001
3Mth+: HR=1.32 (1.24, 1.41), p<0.001

55-64 vs ≥75
0 - 2Wk: HR=0.84 (0.72, 0.97), p=0.016
2Wk - 1Mth: HR=0.72 (0.63, 0.81), p<0.001
1Mth - 6Mth: HR=0.92 (0.83, 1.00), p=0.058
6Mth+: HR=1.11 (1.05, 1.17), p<0.001

65-74 vs ≥75
0 - 1Mth: HR=0.80 (0.73, 0.87), p<0.001
1Mth - 3Mth: HR=0.85 (0.77, 0.94), p=0.001
3Mth - 9Mth: HR=0.94 (0.84, 1.04), p=0.229
9Mth - 1.5Yr: HR=1.14 (1.02, 1.28), p=0.020
1.5Yr - 2.5Yr: HR=0.98 (0.87, 1.10), p=0.757
2.5Yr+: HR=1.04 (0.98, 1.11), p=0.173

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
<55	49203	44112	36002	28797	12733	4488	1215
55-64	111300	99784	81099	64432	29544	10431	2086
65-74	169149	151393	122074	95046	40901	13015	1858
≥75	142003	124455	96315	70794	23383	4406	274

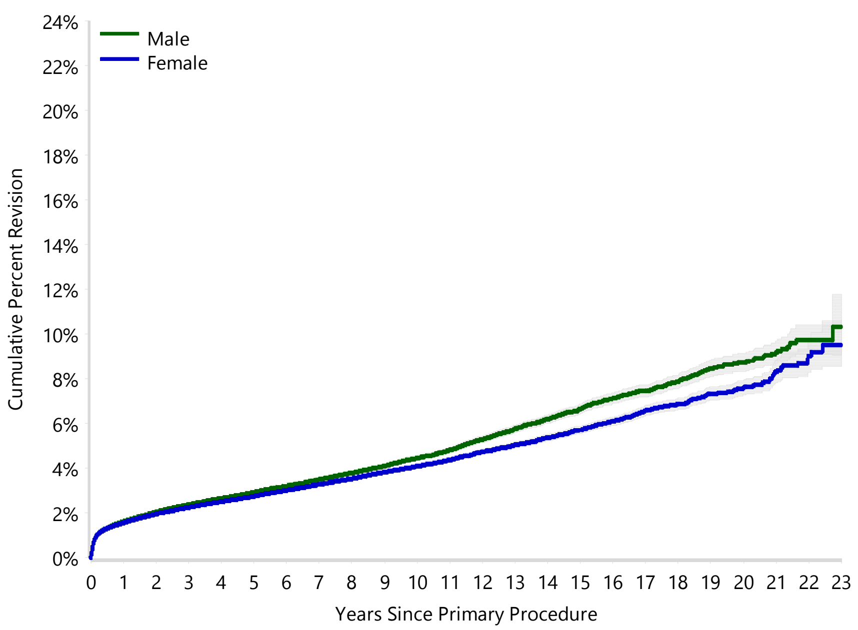
Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded

Table HT18 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Gender and Age (Primary Diagnosis OA)

Gender	Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Male		**7560**	**216601**	**1.6 (1.6, 1.7)**	**2.4 (2.3, 2.4)**	**2.9 (2.9, 3.0)**	**4.5 (4.3, 4.6)**	**6.7 (6.4, 6.9)**	**8.7 (8.3, 9.1)**
	<55	1063	27788	1.5 (1.4, 1.7)	2.4 (2.2, 2.6)	3.0 (2.8, 3.2)	4.6 (4.3, 4.9)	7.1 (6.6, 7.7)	9.7 (8.7, 10.8)
	55-64	1973	56516	1.5 (1.4, 1.6)	2.2 (2.1, 2.4)	2.7 (2.6, 2.9)	4.2 (4.0, 4.4)	6.4 (6.1, 6.8)	8.4 (7.8, 9.1)
	65-74	2592	75996	1.5 (1.5, 1.6)	2.2 (2.1, 2.3)	2.8 (2.7, 2.9)	4.3 (4.1, 4.5)	6.4 (6.1, 6.7)	8.4 (7.7, 9.1)
	≥75	1932	56301	1.9 (1.8, 2.0)	2.7 (2.5, 2.8)	3.3 (3.1, 3.5)	4.9 (4.6, 5.2)	6.9 (6.4, 7.5)	8.5 (7.3, 9.9)
Female		**8375**	**255054**	**1.6 (1.5, 1.6)**	**2.3 (2.2, 2.3)**	**2.8 (2.7, 2.8)**	**4.1 (4.0, 4.2)**	**5.7 (5.5, 5.9)**	**7.6 (7.3, 7.9)**
	<55	949	21415	1.7 (1.6, 1.9)	2.8 (2.6, 3.0)	3.5 (3.3, 3.8)	5.3 (4.9, 5.7)	7.3 (6.8, 7.9)	9.4 (8.5, 10.4)
	55-64	1981	54784	1.5 (1.4, 1.6)	2.3 (2.1, 2.4)	2.8 (2.7, 3.0)	4.3 (4.1, 4.5)	5.9 (5.6, 6.3)	8.0 (7.4, 8.7)
	65-74	2973	93153	1.4 (1.4, 1.5)	2.1 (2.0, 2.2)	2.6 (2.5, 2.7)	3.9 (3.7, 4.1)	5.6 (5.4, 5.9)	7.4 (6.9, 8.0)
	≥75	2472	85702	1.7 (1.6, 1.7)	2.2 (2.1, 2.3)	2.7 (2.6, 2.8)	3.8 (3.6, 4.0)	5.0 (4.7, 5.3)	6.3 (5.6, 7.1)
TOTAL		**15935**	**471655**						

Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded

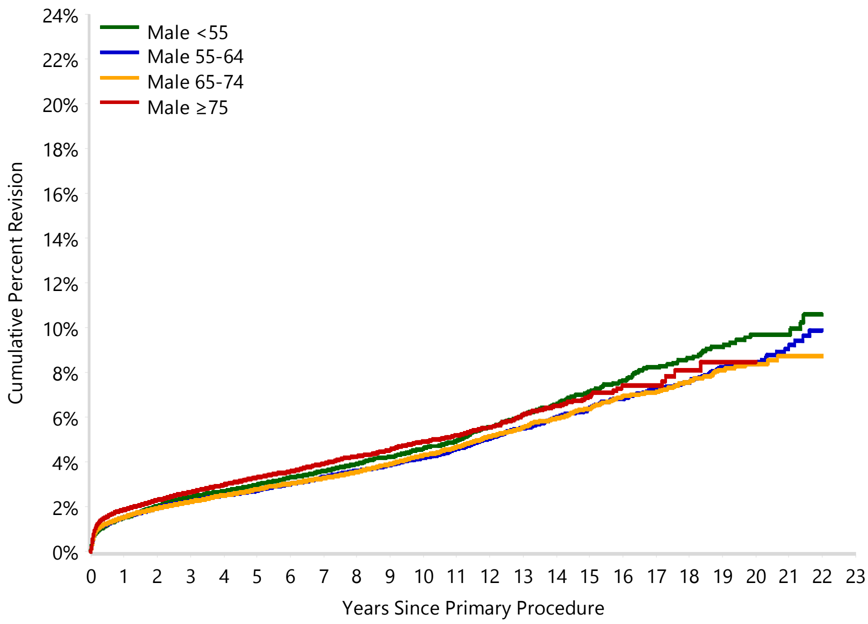
Figure HT8 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Gender (Primary Diagnosis OA)



HR - adjusted for age
Male vs Female
0 - 2Wk: HR=0.83 (0.74, 0.94), p=0.002
2Wk - 3Mth: HR=1.07 (1.00, 1.14), p=0.037
3Mth - 6Mth: HR=0.96 (0.85, 1.09), p=0.542
6Mth+: HR=1.14 (1.09, 1.18), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Male	216601	192532	152725	117055	46312	13679	2492
Female	255054	227212	182765	142014	60249	18661	2941

Figure HT9 **Cumulative Percent Revision of Primary Total Conventional Hip Replacement in Males by Age (Primary Diagnosis OA)**



Male <55 vs Male ≥75
0 - 2Wk: HR=1.19 (0.94, 1.51), p=0.156
2Wk - 3Mth: HR=0.66 (0.56, 0.77), p<0.001
3Mth+: HR=1.01 (0.93, 1.10), p=0.745

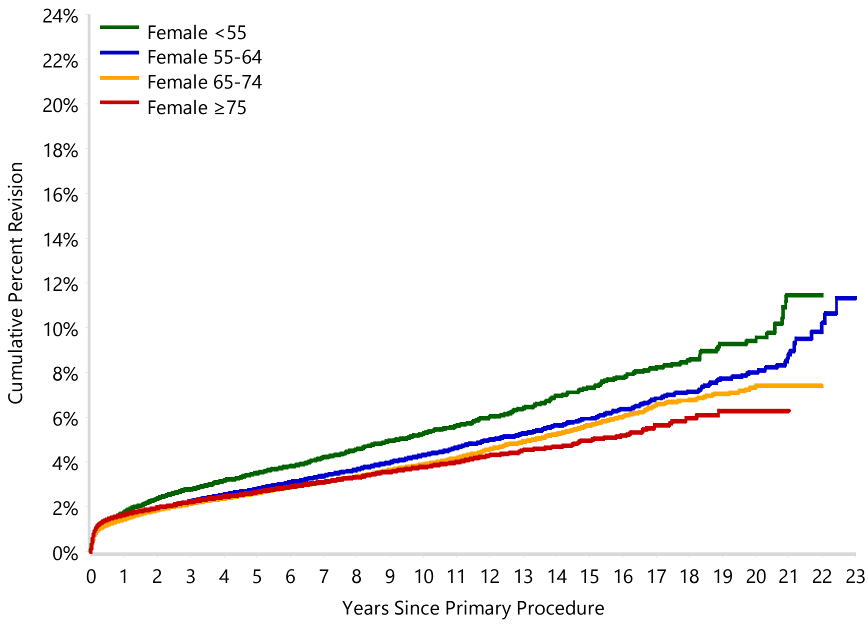
Male 55-64 vs Male ≥75
Entire Period: HR=0.86 (0.81, 0.92), p<0.001

Male 65-74 vs Male ≥75
Entire Period: HR=0.86 (0.81, 0.91), p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Male	**<55**	27788	24966	20278	16151	6780	2252	628
	55-64	56516	50480	40680	32026	14053	4724	1032
	65-74	75996	68063	54696	42435	17796	5424	759
	≥75	56301	49023	37071	26443	7683	1279	73

Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded

Figure HT10 Cumulative Percent Revision of Primary Total Conventional Hip Replacement in Females by Age (Primary Diagnosis OA)



Female <55 vs Female ≥75
- 0 - 2Wk: HR=1.20 (0.94, 1.53), p=0.150
- 2Wk - 3Mth: HR=0.83 (0.70, 0.98), p=0.029
- 3Mth+: HR=1.62 (1.49, 1.78), p<0.001

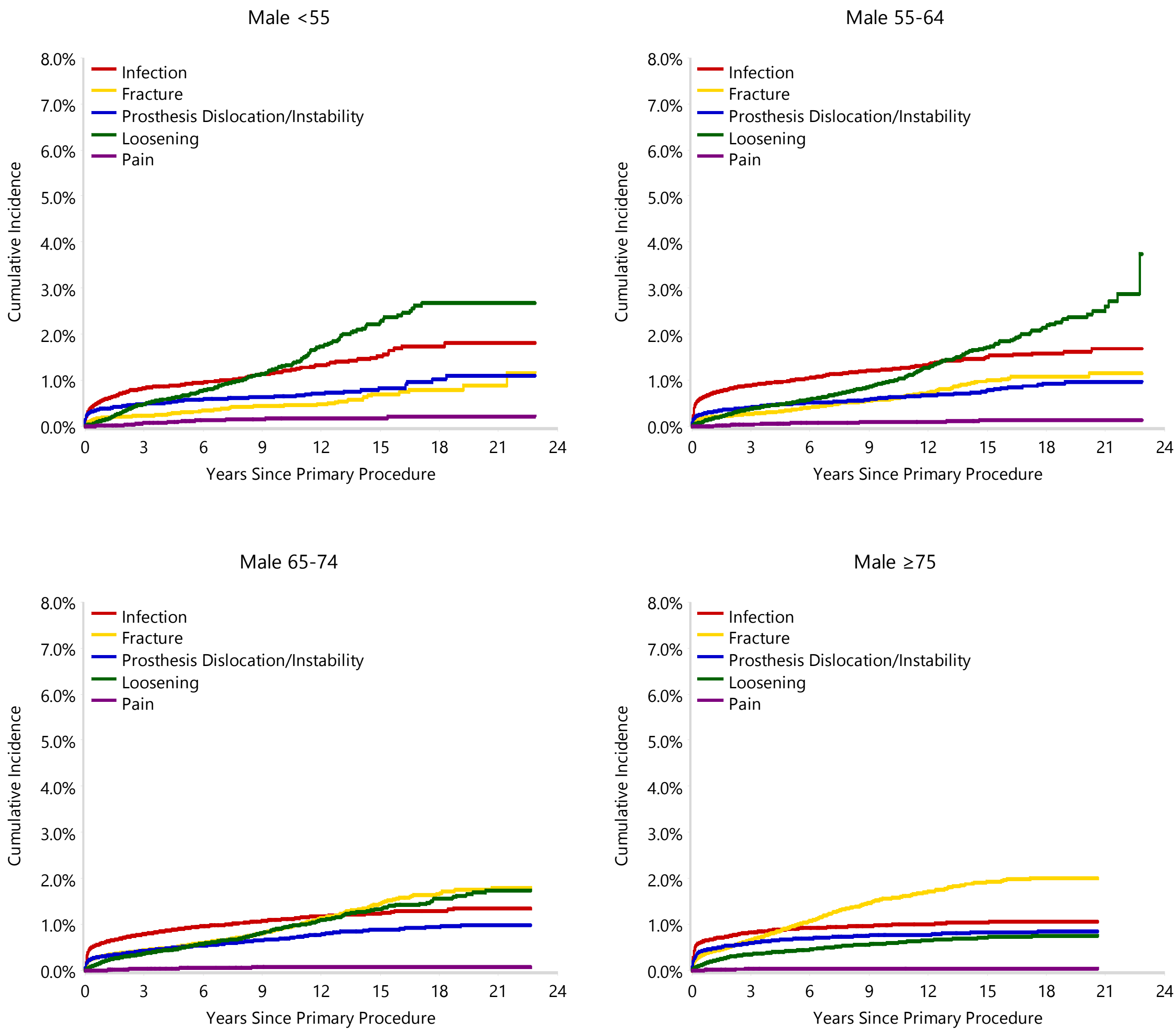
Female 55-64 vs Female ≥75
- 0 - 2Wk: HR=0.87 (0.72, 1.05), p=0.153
- 2Wk - 1Mth: HR=0.72 (0.61, 0.85), p<0.001
- 1Mth - 6Mth: HR=1.00 (0.88, 1.14), p=0.966
- 6Mth+: HR=1.29 (1.19, 1.39), p<0.001

Female 65-74 vs Female ≥75
- 0 - 1Mth: HR=0.79 (0.70, 0.88), p<0.001
- 1Mth - 6Mth: HR=0.92 (0.82, 1.03), p=0.137
- 6Mth+: HR=1.17 (1.09, 1.25), p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Female	**<55**	21415	19146	15724	12646	5953	2236	587
	55-64	54784	49304	40419	32406	15491	5707	1054
	65-74	93153	83330	67378	52611	23105	7591	1099
	≥75	85702	75432	59244	44351	15700	3127	201

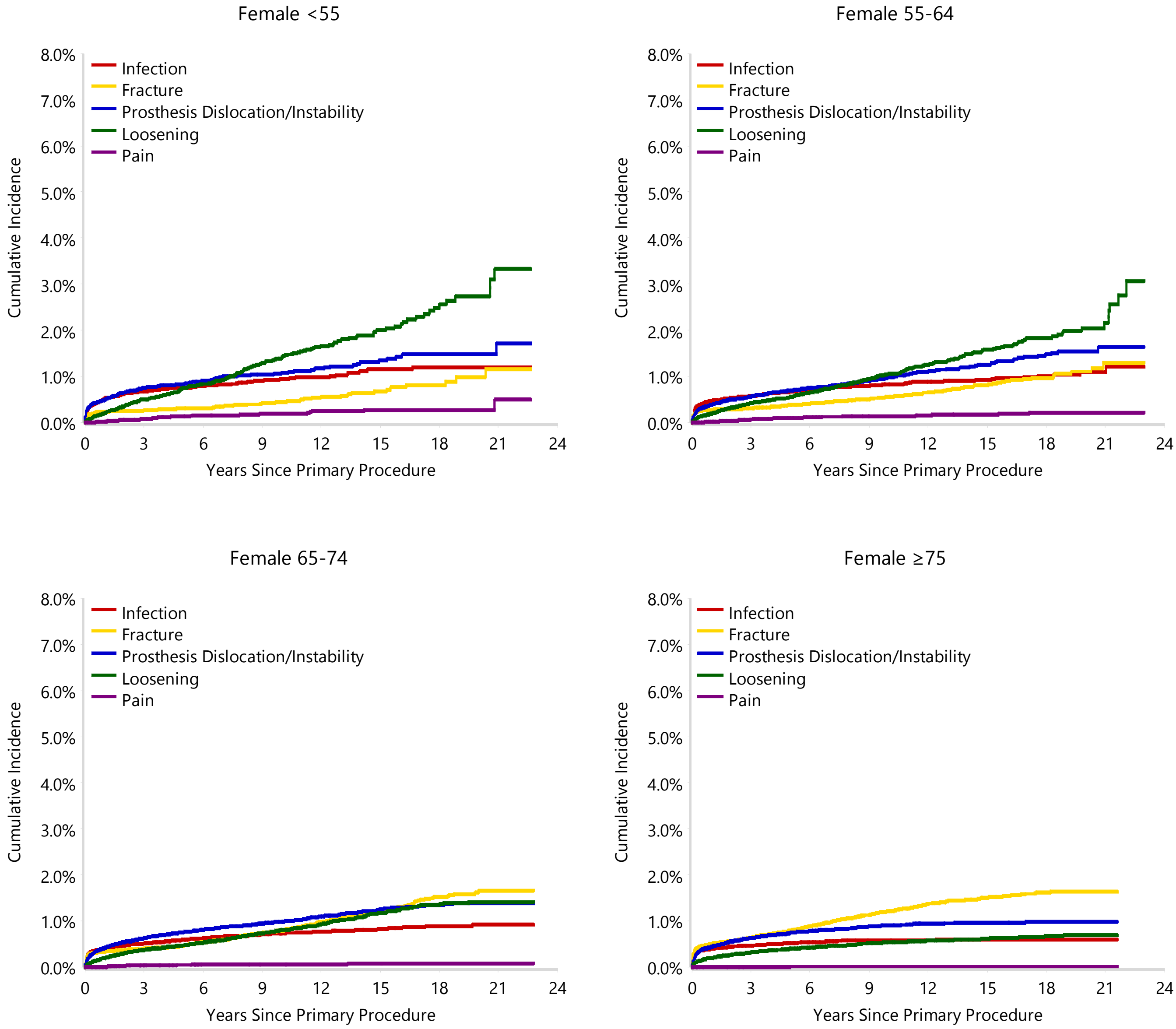
Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded

Figure HT11 Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement in Males by Age (Primary Diagnosis OA)



Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded

Figure HT12 Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement in Females by Age (Primary Diagnosis OA)



Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded

Figure HT13 Primary Total Conventional Hip Replacement by ASA Score (Primary Diagnosis OA)

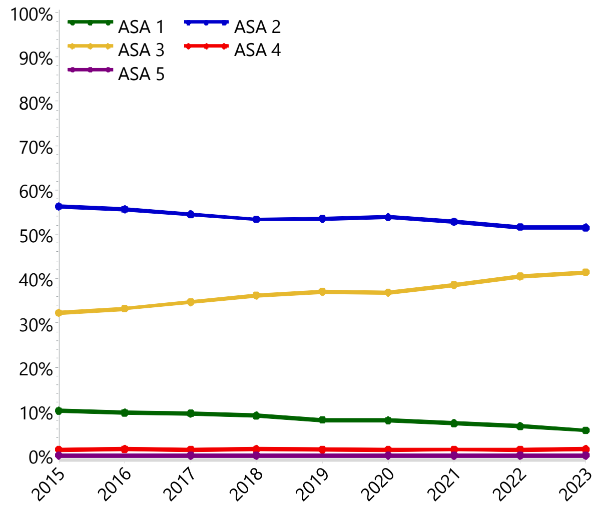
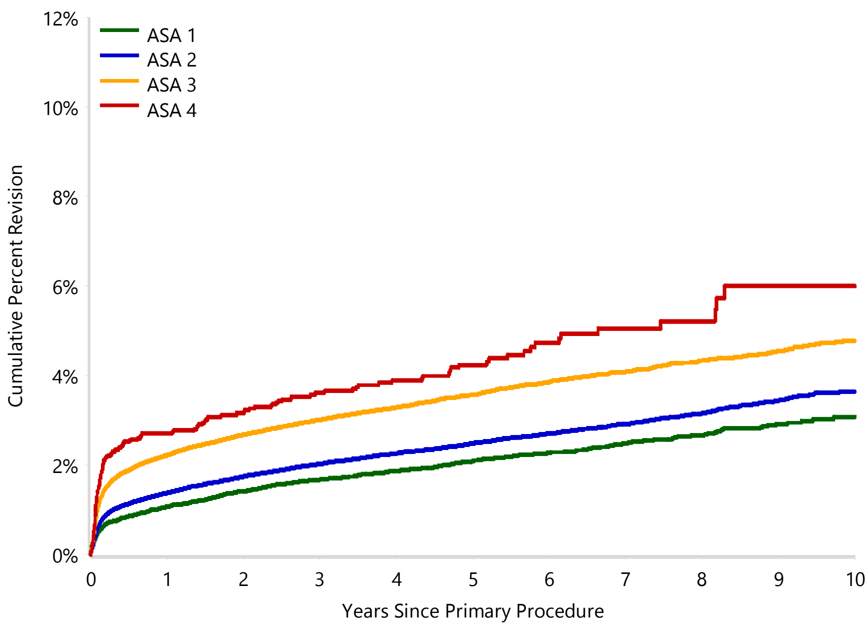


Table HT19 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by ASA Score (Primary Diagnosis OA)

ASA Score	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	9 Yrs
ASA 1	582	27875	1.1 (1.0, 1.2)	1.4 (1.3, 1.6)	1.7 (1.5, 1.8)	2.1 (1.9, 2.3)	2.5 (2.3, 2.7)	2.9 (2.7, 3.2)
ASA 2	4283	181250	1.4 (1.3, 1.4)	1.7 (1.7, 1.8)	2.0 (2.0, 2.1)	2.5 (2.4, 2.6)	2.9 (2.8, 3.0)	3.4 (3.3, 3.6)
ASA 3	3957	123057	2.2 (2.1, 2.3)	2.7 (2.6, 2.8)	3.0 (2.9, 3.1)	3.6 (3.5, 3.7)	4.1 (3.9, 4.2)	4.6 (4.4, 4.7)
ASA 4	179	4690	2.7 (2.3, 3.2)	3.2 (2.7, 3.7)	3.6 (3.1, 4.2)	4.2 (3.6, 5.0)	5.1 (4.3, 6.0)	6.0 (4.9, 7.4)
ASA 5	1	19	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	16.7 (2.5, 72.7)	
TOTAL	**9002**	**336891**						

Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded

Figure HT14 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by ASA Score (Primary Diagnosis OA)



HR - adjusted for age and gender

ASA 2 vs ASA 1

Entire Period: HR=1.27 (1.16, 1.39), p<0.001

ASA 3 vs ASA 1

0 - 2Wk: HR=1.86 (1.60, 2.18), p<0.001

2Wk - 1Mth: HR=2.48 (2.18, 2.83), p<0.001

1Mth - 3Mth: HR=2.18 (1.92, 2.47), p<0.001

3Mth - 6Mth: HR=2.11 (1.78, 2.49), p<0.001

6Mth - 1.5Yr: HR=1.79 (1.57, 2.05), p<0.001

1.5Yr+: HR=1.55 (1.39, 1.73), p<0.001

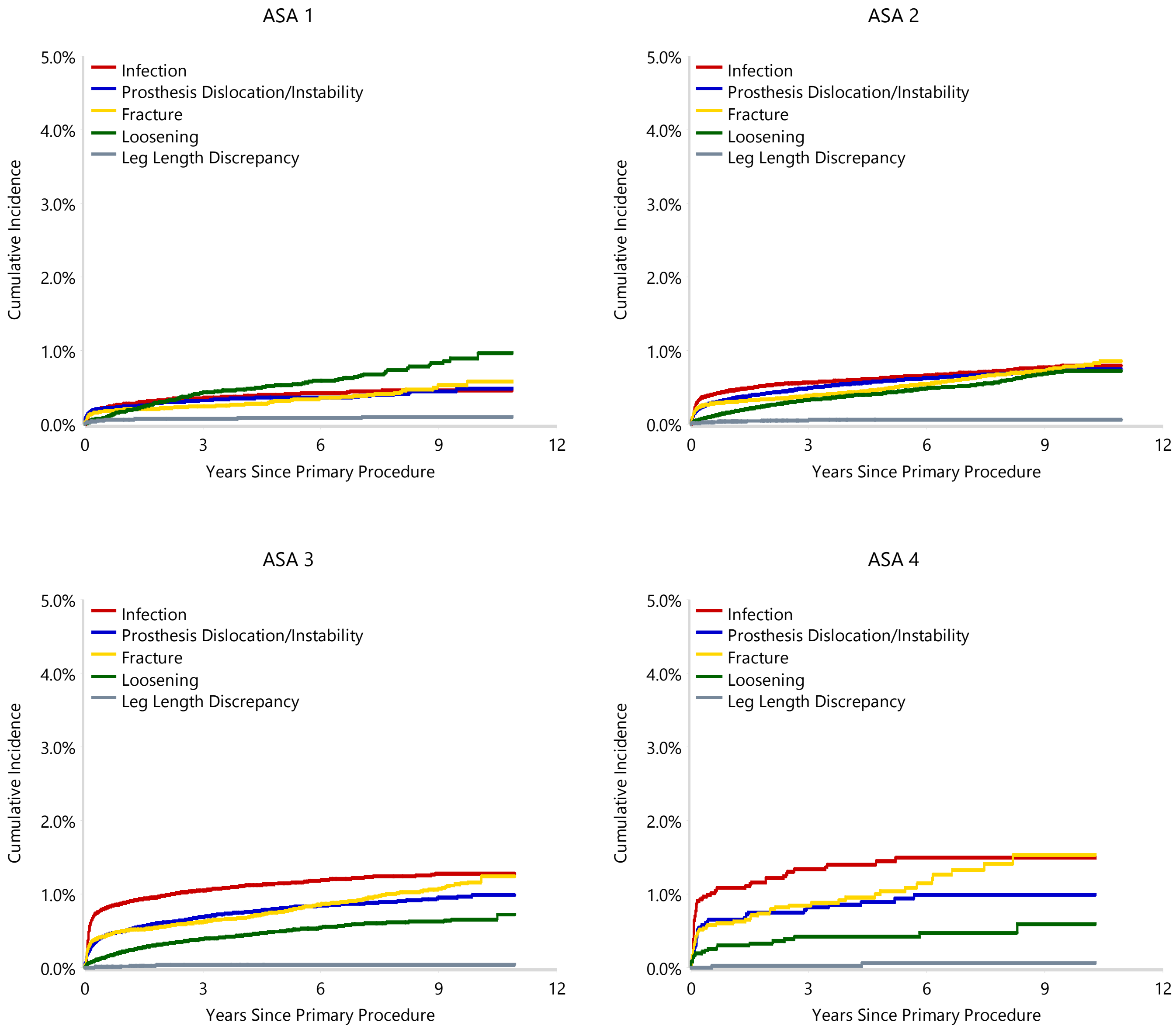
ASA 4 vs ASA 1

Entire Period: HR=2.45 (2.07, 2.90), p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	9 Yrs
ASA 1	27875	25207	22666	19936	14501	8750	3399
ASA 2	181250	157192	137102	116874	79904	46139	16920
ASA 3	123057	102230	85814	70335	44039	22599	7485
ASA 4	4690	3763	3109	2447	1430	672	224

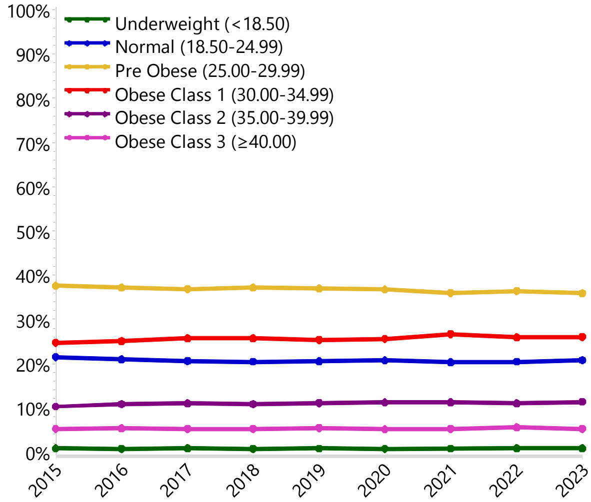
Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded

Figure HT15 Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement by ASA Score (Primary Diagnosis OA)



Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded

Figure HT16 Primary Total Conventional Hip Replacement by BMI Category (Primary Diagnosis OA)



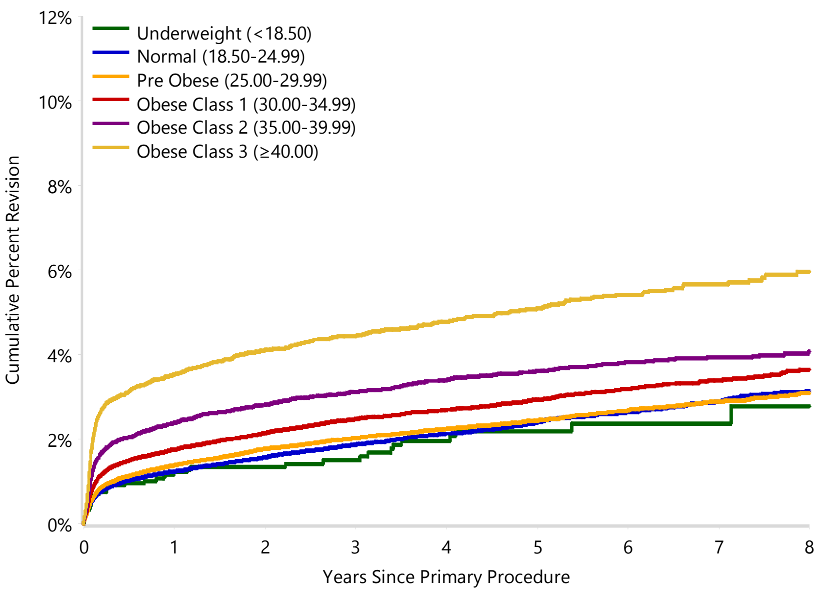
Note: BMI has not been presented for patients aged ≤19 years

Table HT20 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by BMI Category (Primary Diagnosis OA)

BMI Category	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	7 Yrs
Underweight (<18.50)	38	2126	1.2 (0.8, 1.8)	1.3 (0.9, 2.0)	1.5 (1.0, 2.2)	2.0 (1.4, 2.8)	2.2 (1.6, 3.1)	2.4 (1.7, 3.4)
Normal (18.50-24.99)	1236	59966	1.2 (1.1, 1.3)	1.6 (1.5, 1.7)	1.9 (1.8, 2.0)	2.1 (2.0, 2.3)	2.4 (2.3, 2.5)	2.9 (2.7, 3.1)
Pre Obese (25.00-29.99)	2295	106594	1.4 (1.3, 1.5)	1.8 (1.7, 1.9)	2.0 (1.9, 2.1)	2.2 (2.1, 2.3)	2.4 (2.3, 2.6)	2.9 (2.8, 3.0)
Obese Class 1 (30.00-34.99)	1935	74661	1.8 (1.7, 1.9)	2.1 (2.0, 2.3)	2.5 (2.4, 2.6)	2.7 (2.6, 2.8)	2.9 (2.8, 3.1)	3.4 (3.2, 3.6)
Obese Class 2 (35.00-39.99)	1020	31937	2.4 (2.2, 2.6)	2.8 (2.6, 3.0)	3.1 (2.9, 3.3)	3.4 (3.2, 3.6)	3.6 (3.4, 3.8)	3.9 (3.7, 4.2)
Obese Class 3 (≥40.00)	711	15389	3.5 (3.2, 3.8)	4.1 (3.8, 4.4)	4.4 (4.1, 4.8)	4.8 (4.4, 5.2)	5.1 (4.7, 5.5)	5.7 (5.2, 6.1)
TOTAL	**7235**	**290673**						

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses
BMI has not been presented for patients aged ≤19 years

Figure HT17 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by BMI Category (Primary Diagnosis OA)



HR - adjusted for age and gender

Underweight (<18.50) vs Normal (18.50-24.99)
Entire Period: HR=0.90 (0.65, 1.24), p=0.525

Pre Obese (25.00-29.99) vs Normal (18.50-24.99)
Entire Period: HR=1.03 (0.96, 1.11), p=0.396

Obese Class 1 (30.00-34.99) vs Normal (18.50-24.99)
0 - 3Mth: HR=1.43 (1.30, 1.57), p<0.001
3Mth+: HR=1.13 (1.04, 1.24), p=0.006

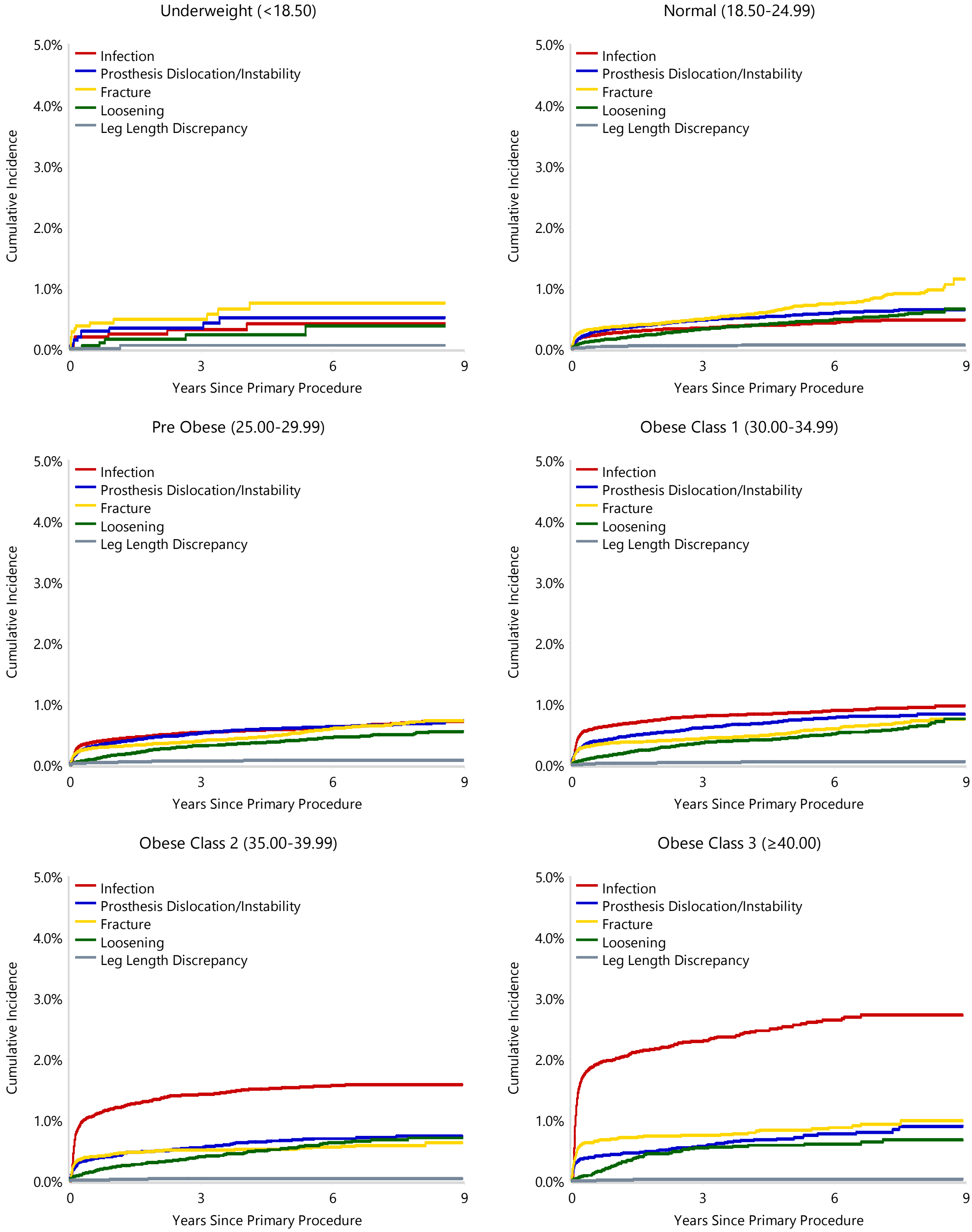
Obese Class 2 (35.00-39.99) vs Normal (18.50-24.99)
0 - 3Mth: HR=2.07 (1.86, 2.30), p<0.001
3Mth - 6Mth: HR=1.25 (0.97, 1.60), p=0.084
6Mth - 1.5Yr: HR=1.46 (1.23, 1.74), p<0.001
1.5Yr+: HR=1.05 (0.90, 1.22), p=0.554

Obese Class 3 (≥40.00) vs Normal (18.50-24.99)
0 - 3Mth: HR=3.31 (2.95, 3.72), p<0.001
3Mth+: HR=1.55 (1.36, 1.78), p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	7 Yrs
Underweight (<18.50)	2126	1755	1424	1127	889	635	258
Normal (18.50-24.99)	59966	50319	42333	34483	27460	20586	8838
Pre Obese (25.00-29.99)	106594	89959	75831	62227	49865	37569	16166
Obese Class 1 (30.00-34.99)	74661	62517	52585	42567	34038	25555	10766
Obese Class 2 (35.00-39.99)	31937	26494	22294	18148	14426	10777	4569
Obese Class 3 (≥40.00)	15389	12699	10602	8690	6986	5217	2257

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses
BMI has not been presented for patients aged ≤19 year

Figure HT18 Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement by BMI Category (Primary Diagnosis OA)



Note: All procedures using metal/metal prostheses have been excluded. Restricted to modern prostheses. BMI has not been presented for patients aged ≤19 years

OUTCOME FOR OSTEOARTHRITIS – PROSTHESIS CHARACTERISTICS

Fixation

The analysis of prosthesis fixation was performed for prosthesis combinations using only modern bearing surfaces with recorded use in 2023. These bearing surfaces include mixed ceramic/mixed ceramic and all femoral head materials used in conjunction with cross-linked polyethylene (XLPE). Modern bearing surfaces account for 96.9% of all primary total conventional hip procedures performed in 2023.

There is no difference in the rate of revision for cemented compared to hybrid fixation. Cementless fixation has a higher rate of revision than hybrid fixation for the first month, no difference at 1-9 months and a higher rate of revision from 9 months to 3 years. From 3 years to 3.5 years cementless fixation has a lower rate of revision compared to hybrid fixation and after this time there is no difference. Cementless fixation has a higher rate of revision than cemented fixation for the first month and after this time there is no difference (Table HT21 and Figure HT20).

The outcome with respect to fixation varies with age.

For patients aged <55 years, cemented fixation showed no difference when the rate of revision is compared to cementless and hybrid fixation. For patients aged 55–64 years there is a higher rate of revision in the first month for cementless fixation compared to hybrid fixation and after this time cementless fixation has a lower rate of revision. Cementless fixation has a higher rate of revision compared to hybrid fixation in the first 3 months for patients aged 65–74 years. After this time, there is no difference. Cementless fixation has a higher rate of revision for patients aged ≥75 years compared to hybrid and cemented fixation for all time periods. There is no difference between cemented and hybrid fixation for patients aged ≥75 years (Table HT22 and Figure HT21 to Figure HT24).

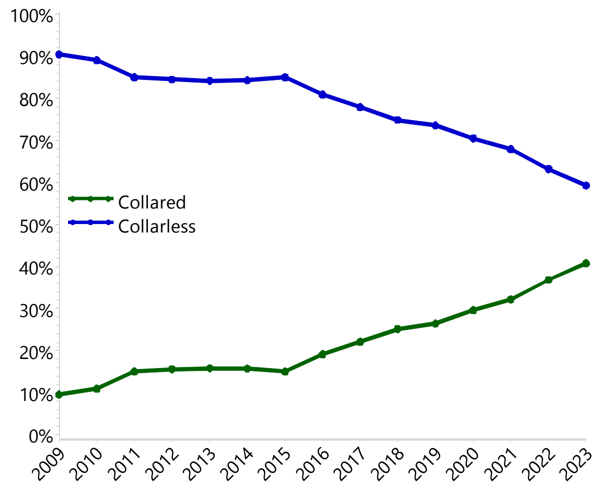
Collared and Collarless Cementless Stems

An analysis has been performed comparing collared and collarless cementless stems. There has been a steady increase in the use of collared cementless stems since 2015 (Figure HT19). The cumulative percent revision at 15 years is 5.1% for collared stems and 6.0% for collarless stems. Collarless stems have a higher rate of revision compared to collared stems (Table HT23 and Figure HT25). Collarless stems have a higher rate of revision for fracture and loosening (Figure HT26). The types of revision are presented in Table HT24.

An additional analysis was undertaken to determine the effect of surgical approach on the outcome for collared versus collarless stems. For the posterior and lateral approaches, collarless stems have a higher rate of revision for the first 3 months, with no difference after this time. For the anterior approach, collarless stems have a higher rate of revision for the entire period (Table HT25 and Table HT26).

The outcome of cementless femoral components with and without collar use are listed in Table HT27 and Table HT28.

Figure HT19 Primary Total Conventional Hip Replacement with Cementless Stems by Collar Use (Primary Diagnosis OA)



Mini Stems

A mini stem is a short cementless femoral stem where fixation is designed to be entirely metaphyseal. These stems may enable femoral neck sparing.

There have been 10,523 procedures using a mini stem prosthesis undertaken for osteoarthritis. This represents 2.2% of all primary total conventional hip procedures. There are 1,417 procedures recorded in 2023 using a mini stem prosthesis. This is an increase of 4.3% compared to 2022. The 9 year cumulative percent revision for primary total conventional hip replacement using a mini stem is 2.8% compared to 4.0% for other cementless femoral stems. Mini stems have a reduced rate of revision from 1 to 1.5 years and from 2 years onwards, with no difference outside of these time points (Table HT29 and Figure HT27).

Patients aged <65 years have a lower rate of revision in the first month only compared to patients aged ≥65 years when a mini stem is used. From 6 months onwards, patients aged ≥65 years with a mini stem have a lower rate of revision compared to patients aged ≥65 years with other cementless femoral stems (Table HT30 and Figure HT28). Obesity is not a risk factor for revision when a mini stem is used (Table HT31 and Figure HT29).

The reasons for revision and type of revision are shown in Figure HT30 and Table HT32. Mini stems have a lower rate of revision for loosening from 1.5 years onwards compared to other cementless femoral stems (Table HT33 and Figure HT31). There is no difference in the rate of revision between mini stems and other cementless femoral stems prior to this time.

Mini stems have a higher rate of revision for fracture in the first 3 months compared to other cementless femoral stems. From 3 months onwards, mini stems have a lower rate of revision than other cementless femoral stems (Table HT24 and Figure HT32).

There were 6 different mini stem prostheses used in 2023. Rates of revision vary depending on the type of prosthesis used (Table HT35).

Femoral Stems with Exchangeable Necks

A femoral stem with an exchangeable neck has a separate neck that connects proximally to the stem. There were 31 procedures reported in 2023 which comprised 0.1% of all primary total conventional hip procedures. Due to the very small utilisation of these prostheses, the analyses have been removed from the Annual Report and appear in the Supplementary Report ‘Prostheses with No or Minimal Use’.

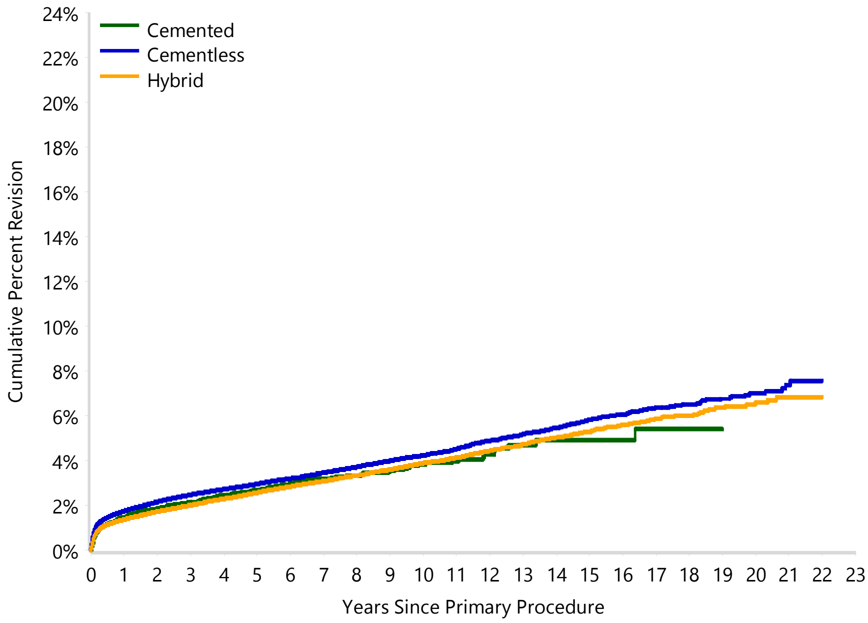
Detailed information on femoral stems with exchangeable neck is available in the supplementary report ‘Prosthesis Types with No or Minimal Use’ on the AOANJRR website: https://aoanjrr.sahmri.com/annual-reports-2024

Table HT21 **Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Fixation (Primary Diagnosis OA)**

Fixation	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Cemented	247	8148	1.5 (1.2, 1.8)	2.1 (1.8, 2.5)	2.7 (2.3, 3.1)	3.8 (3.4, 4.4)	4.9 (4.1, 5.9)	
Cementless	8709	268071	1.8 (1.7, 1.8)	2.5 (2.4, 2.5)	3.0 (2.9, 3.0)	4.2 (4.1, 4.3)	5.8 (5.6, 6.0)	7.0 (6.6, 7.4)
Hybrid	4621	157492	1.4 (1.3, 1.4)	2.0 (1.9, 2.1)	2.6 (2.5, 2.7)	3.9 (3.8, 4.0)	5.3 (5.1, 5.5)	6.6 (6.2, 7.1)
TOTAL	**13577**	**433711**						

Note: Includes mixed ceramic/mixed ceramic and cross-linked polyethylene (XLPE) bearing surfaces
Restricted to modern prostheses

Figure HT20 **Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Fixation (Primary Diagnosis OA)**



HR - adjusted for age and gender

Cemented vs Hybrid
Entire Period: HR=1.01 (0.89, 1.15), p=0.827

Cementless vs Cemented
0 - 2Wk: HR=1.99 (1.65, 2.40), p<0.001
2Wk - 1Mth: HR=1.30 (1.11, 1.53), p=0.001
1Mth+: HR=1.03 (0.91, 1.17), p=0.660

Cementless vs Hybrid
0 - 2Wk: HR=2.02 (1.76, 2.33), p<0.001
2Wk - 1Mth: HR=1.32 (1.20, 1.46), p<0.001
1Mth - 6Mth: HR=1.07 (0.99, 1.15), p=0.099
6Mth - 9Mth: HR=1.17 (0.99, 1.38), p=0.061
9Mth - 3Yr: HR=1.15 (1.06, 1.24), p<0.001
3Yr - 3.5Yr: HR=0.79 (0.65, 0.96), p=0.015
3.5Yr+: HR=0.98 (0.91, 1.04), p=0.448

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Cemented	8148	7486	6236	4931	1756	286	12
Cementless	268071	236524	185245	140082	50339	11864	1348
Hybrid	157492	139853	111341	84692	33954	9266	1068

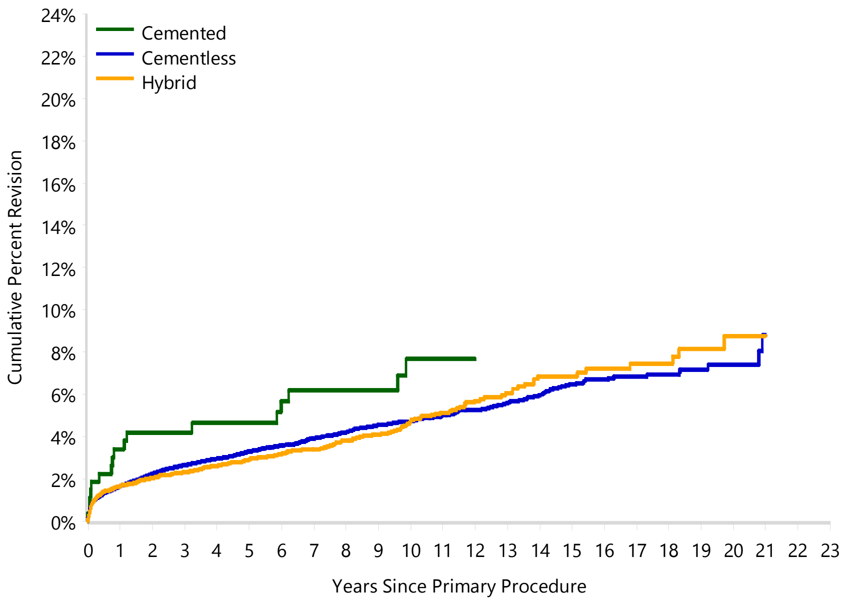
Note: Includes mixed ceramic/mixed ceramic and cross-linked polyethylene (XLPE) bearing surfaces
Restricted to modern prostheses

Table HT22 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Age and Fixation (Primary Diagnosis OA)

Age	Fixation	N	N	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
<55		**1628**	**44517**	**1.7 (1.5, 1.8)**	**2.6 (2.4, 2.7)**	**3.2 (3.0, 3.4)**	**4.7 (4.5, 5.0)**	**6.6 (6.1, 7.0)**	**7.8 (7.0, 8.6)**
	Cemented	18	270	3.4 (1.8, 6.5)	4.2 (2.3, 7.5)	4.6 (2.7, 8.0)	7.7 (4.7, 12.3)		
	Cementless	1308	36004	1.7 (1.5, 1.8)	2.6 (2.5, 2.8)	3.3 (3.1, 3.5)	4.7 (4.4, 5.0)	6.5 (6.0, 7.0)	7.4 (6.6, 8.2)
	Hybrid	302	8243	1.6 (1.4, 2.0)	2.3 (2.0, 2.7)	2.9 (2.5, 3.3)	4.7 (4.1, 5.4)	6.8 (5.9, 8.0)	8.8 (7.0, 11.0)
55-64		**3271**	**10160**	**1.6 (1.5, 1.6)**	**2.3 (2.2, 2.4)**	**2.8 (2.7, 2.9)**	**4.1 (4.0, 4.3)**	**5.6 (5.3, 5.9)**	**6.9 (6.4, 7.4)**
	Cemented	32	829	1.9 (1.1, 3.1)	2.7 (1.7, 4.0)	3.1 (2.1, 4.6)	3.8 (2.6, 5.5)	5.3 (3.5, 8.0)	
	Cementless	2356	75942	1.6 (1.5, 1.7)	2.3 (2.2, 2.4)	2.7 (2.6, 2.9)	4.0 (3.8, 4.2)	5.4 (5.1, 5.7)	6.5 (5.9, 7.0)
	Hybrid	883	24832	1.5 (1.3, 1.6)	2.1 (2.0, 2.3)	2.8 (2.6, 3.0)	4.5 (4.1, 4.8)	6.1 (5.6, 6.6)	7.8 (6.9, 8.7)
65-74		**4735**	**15666**	**1.5 (1.4, 1.6)**	**2.2 (2.1, 2.2)**	**2.7 (2.6, 2.8)**	**3.9 (3.8, 4.0)**	**5.4 (5.2, 5.6)**	**6.5 (6.1, 7.0)**
	Cemented	84	2433	1.5 (1.1, 2.1)	2.2 (1.6, 2.8)	2.7 (2.1, 3.5)	4.2 (3.4, 5.3)	5.5 (4.1, 7.4)	
	Cementless	3013	98785	1.6 (1.6, 1.7)	2.3 (2.2, 2.4)	2.8 (2.7, 2.9)	4.0 (3.8, 4.1)	5.5 (5.2, 5.8)	6.7 (6.1, 7.5)
	Hybrid	1638	55449	1.2 (1.1, 1.3)	1.9 (1.8, 2.0)	2.5 (2.3, 2.6)	3.7 (3.5, 4.0)	5.2 (4.9, 5.5)	6.3 (5.7, 7.0)
≥75		**3943**	**13092**	**1.8 (1.7, 1.8)**	**2.4 (2.3, 2.5)**	**2.9 (2.8, 3.0)**	**4.1 (4.0, 4.3)**	**5.5 (5.2, 5.8)**	**6.7 (6.1, 7.4)**
	Cemented	113	4616	1.3 (1.0, 1.6)	1.9 (1.5, 2.4)	2.5 (2.1, 3.1)	3.3 (2.7, 4.0)	3.5 (2.8, 4.4)	
	Cementless	2032	57340	2.2 (2.1, 2.3)	2.9 (2.7, 3.0)	3.4 (3.2, 3.5)	4.8 (4.5, 5.0)	6.7 (6.2, 7.3)	8.8 (7.4, 10.4)
	Hybrid	1798	68968	1.4 (1.3, 1.5)	2.0 (1.9, 2.1)	2.5 (2.4, 2.7)	3.6 (3.4, 3.8)	4.6 (4.3, 5.0)	5.4 (4.8, 6.1)
TOTAL		13577	433711						

Note: Includes mixed ceramic/mixed ceramic and cross-linked polyethylene (XLPE) bearing surfaces. Restricted to modern prostheses

Figure HT21 Cumulative Percent Revision of Primary Total Conventional Hip Replacement in Patients Aged <55 Years by Fixation (Primary Diagnosis OA)



HR - adjusted for age and gender

Cemented vs Cementless

Entire Period: HR=1.51 (0.95, 2.41), p=0.082

Cemented vs Hybrid

Entire Period: HR=1.56 (0.97, 2.51), p=0.067

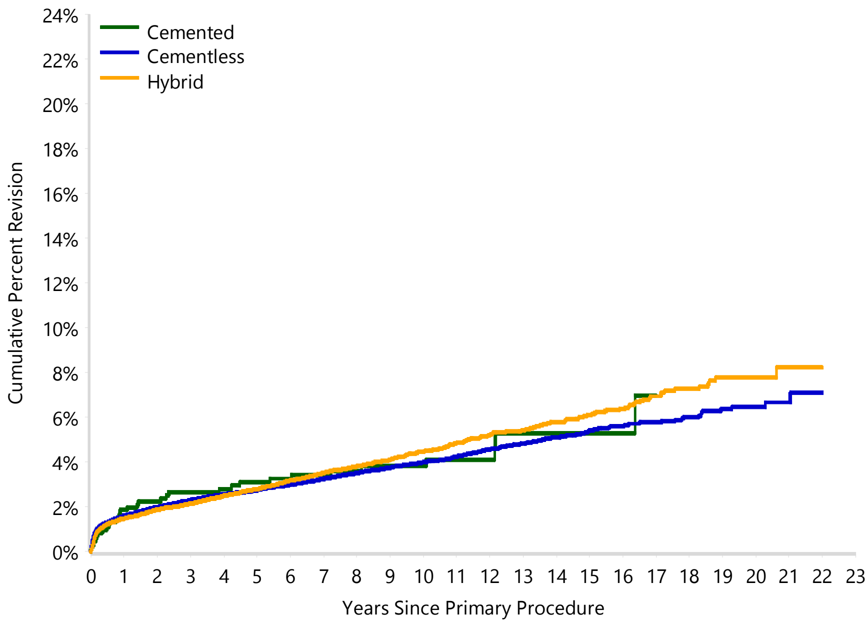
Cementless vs Hybrid

Entire Period: HR=1.03 (0.91, 1.17), p=0.628

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Cemented	270	246	225	203	115	18	3
Cementless	36004	31927	25397	19799	7573	1915	290
Hybrid	8243	7400	6083	4763	1948	585	137

Note: Includes mixed ceramic/mixed ceramic and cross-linked polyethylene (XLPE) bearing surfaces. Restricted to modern prostheses

Figure HT22 Cumulative Percent Revision of Primary Total Conventional Hip Replacement in Patients Aged 55–64 Years by Fixation (Primary Diagnosis OA)



HR - adjusted for age and gender

Cemented vs Hybrid

Entire Period: HR=0.96 (0.67, 1.36), p=0.815

Cemented vs Cementless

Entire Period: HR=1.04 (0.74, 1.48), p=0.805

Cementless vs Hybrid

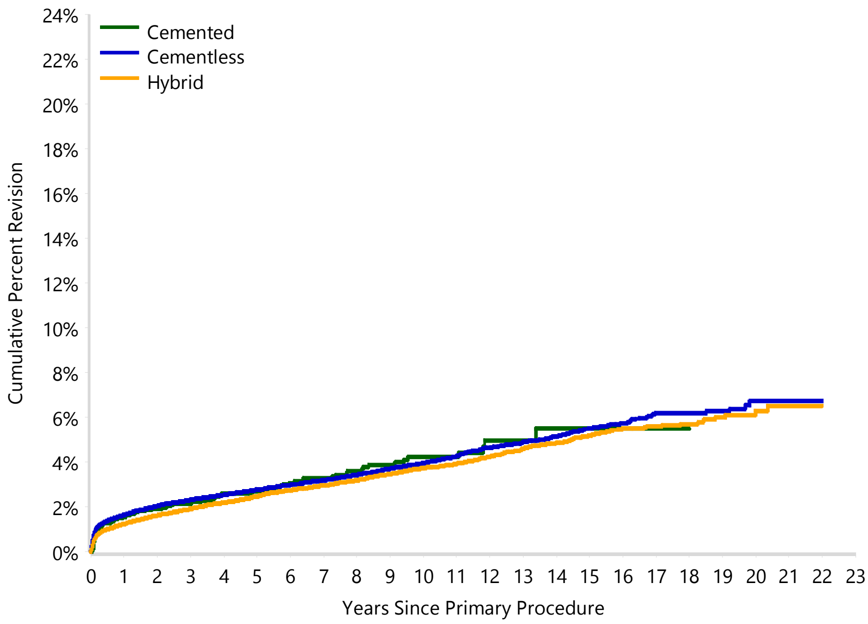
0 - 1Mth: HR=1.66 (1.34, 2.05), p<0.001

1Mth+: HR=0.84 (0.77, 0.91), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Cemented	829	772	694	619	332	73	2
Cementless	75942	67340	53362	41173	16056	4197	563
Hybrid	24832	22329	18240	14406	6641	2205	329

Note: Includes mixed ceramic/mixed ceramic and cross-linked polyethylene (XLPE) bearing surfaces
Restricted to modern prostheses

Figure HT23 **Cumulative Percent Revision of Primary Total Conventional Hip Replacement in Patients Aged 65–74 Years by Fixation (Primary Diagnosis OA)**



HR - adjusted for age and gender

Cemented vs Hybrid

Entire Period: HR=1.12 (0.90, 1.39), p=0.321

Cementless vs Hybrid

0 - 2Wk: HR=2.10 (1.64, 2.70), p<0.001

2Wk - 3Mth: HR=1.30 (1.15, 1.46), p<0.001

3Mth+: HR=0.99 (0.92, 1.06), p=0.697

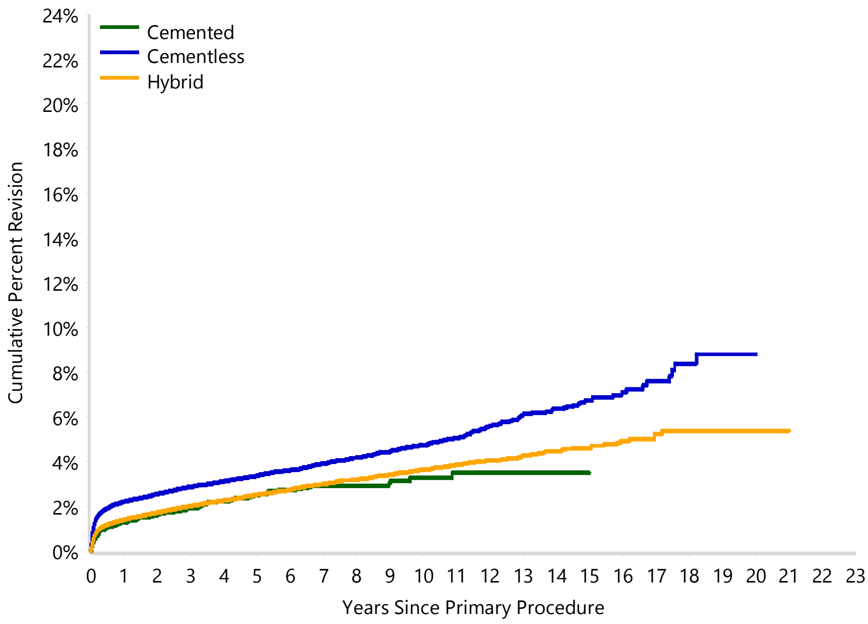
Cementless vs Cemented

Entire Period: HR=0.99 (0.80, 1.23), p=0.949

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Cemented	2433	2286	1979	1655	683	133	6
Cementless	98785	87371	68606	51787	18713	4512	442
Hybrid	55449	49880	40604	31724	14364	4522	493

Note: Includes mixed ceramic/mixed ceramic and cross-linked polyethylene (XLPE) bearing surfaces
Restricted to modern prostheses

Figure HT24 Cumulative Percent Revision of Primary Total Conventional Hip Replacement in Patients Aged ≥75 Years by Fixation (Primary Diagnosis OA)



HR - adjusted for age and gender

Cemented vs Hybrid

Entire Period: HR=0.93 (0.77, 1.12), p=0.433

Cementless vs Hybrid

0 - 2Wk: HR=2.57 (2.05, 3.21), p<0.001

2Wk - 1Mth: HR=1.64 (1.40, 1.91), p<0.001

1Mth+: HR=1.23 (1.14, 1.32), p<0.001

Cementless vs Cemented

0 - 2Wk: HR=2.77 (2.08, 3.69), p<0.001

2Wk+: HR=1.40 (1.15, 1.69), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Cemented	4616	4182	3338	2454	626	62	1
Cementless	57340	49886	37880	27323	7997	1240	53
Hybrid	68968	60244	46414	33799	11001	1954	109

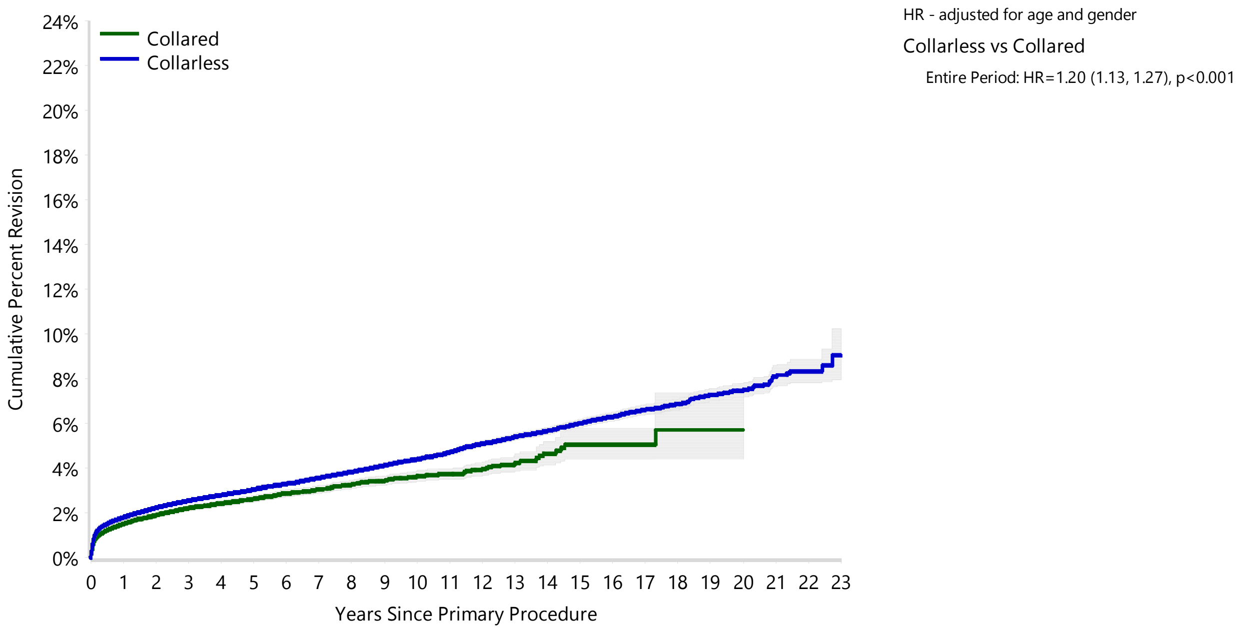
Note: Includes mixed ceramic/mixed ceramic and cross-linked polyethylene (XLPE) bearing surfaces
Restricted to modern prostheses

Table HT23 **Cumulative Percent Revision of Cementless Primary Total Conventional Hip Replacement by Stem Collar Use (Primary Diagnosis OA)**

Stem Collar Use	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	9 Yrs	15 Yrs	20 Yrs
Collared	1541	64879	1.5 (1.4, 1.6)	2.2 (2.1, 2.3)	2.6 (2.5, 2.8)	3.4 (3.2, 3.7)	5.1 (4.4, 5.8)	5.7 (4.4, 7.4)
Collarless	7953	218639	1.8 (1.7, 1.9)	2.6 (2.5, 2.6)	3.1 (3.0, 3.1)	4.1 (4.0, 4.2)	6.0 (5.8, 6.2)	7.5 (7.2, 7.8)
TOTAL	**9494**	**283518**						

Note: Restricted to modern prostheses

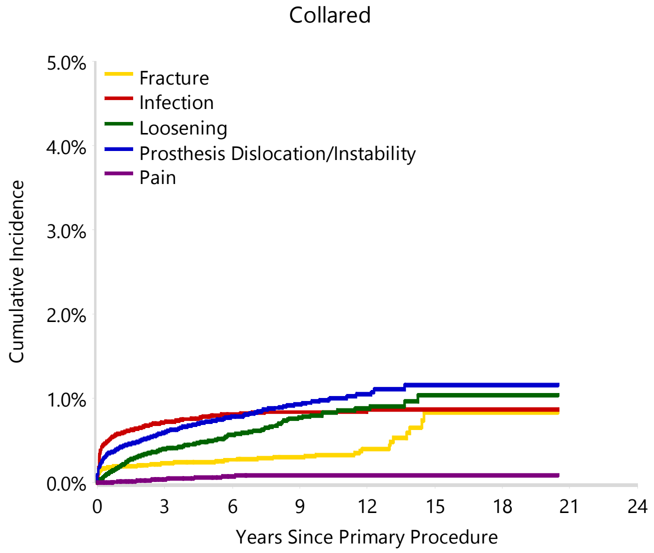
Figure HT25 **Cumulative Percent Revision of Cementless Primary Total Conventional Hip Replacement by Stem Collar Use (Primary Diagnosis OA)**



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	9 Yrs	15 Yrs	20 Yrs
Collared	64879	52852	35553	23069	7463	487	63
Collarless	218639	198046	162592	128578	64245	16558	3040

Note: Restricted to modern prostheses

Figure HT26 Cumulative Incidence Revision Diagnosis of Cementless Primary Total Conventional Hip Replacement by Stem Collar Use (Primary Diagnosis OA)



Note: Restricted to modern prostheses

Table HT24 Cementless Primary Total Conventional Hip Replacement by Type of Revision and Stem Collar Use (Primary Diagnosis OA)

Type of Revision	Collared			Collarless		
	Number	% Primaries Revised	% Revisions	Number	% Primaries Revised	% Revisions
Femoral Component	358	0.6	23.2	3050	1.4	38.4
Head/Insert	570	0.9	37.0	1847	0.8	23.2
Acetabular Component	286	0.4	18.6	1437	0.7	18.1
THR (Femoral/Acetabular)	162	0.2	10.5	646	0.3	8.1
Head Only	68	0.1	4.4	460	0.2	5.8
Cement Spacer	49	0.1	3.2	262	0.1	3.3
Minor Components	17	0.0	1.1	134	0.1	1.7
Insert Only	21	0.0	1.4	69	0.0	0.9
Removal of Prostheses	6	0.0	0.4	31	0.0	0.4
Reinsertion of Components	2	0.0	0.1	9	0.0	0.1
Total Femoral				3	0.0	0.0
Bipolar Head and Femoral	2	0.0	0.1	2	0.0	0.0
Bipolar Only				2	0.0	0.0
Head/Neck				1	0.0	0.0
N Revision	**1541**	**2.4**	**100.0**	**7953**	**3.6**	**100.0**
N Primary	**64879**			**218639**		

Note: Restricted to modern prostheses

Table HT25 Cumulative Percent Revision of Cementless Primary Total Conventional Hip Replacement by Surgical Approach and Stem Collar Use (Primary Diagnosis OA)

Approach	Stem Collar Use	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	6 Yrs	7 Yrs
Anterior	Collared	254	17140	1.1 (0.9, 1.3)	1.6 (1.4, 1.9)	1.9 (1.6, 2.2)	2.2 (1.9, 2.5)	2.3 (2.0, 2.8)
	Collarless	1374	52252	1.7 (1.6, 1.8)	2.4 (2.3, 2.5)	2.9 (2.7, 3.0)	3.1 (2.9, 3.3)	3.3 (3.1, 3.5)
Lateral	Collared	155	6198	1.5 (1.2, 1.8)	2.3 (2.0, 2.8)	2.9 (2.4, 3.4)	3.2 (2.7, 3.7)	3.2 (2.7, 3.7)
	Collarless	595	17659	2.2 (2.0, 2.4)	3.0 (2.7, 3.2)	3.4 (3.1, 3.7)	3.7 (3.4, 4.0)	3.9 (3.6, 4.3)
Posterior	Collared	730	31558	1.7 (1.6, 1.9)	2.4 (2.2, 2.6)	2.7 (2.5, 3.0)	2.9 (2.7, 3.2)	3.1 (2.8, 3.3)
	Collarless	1894	66618	2.0 (1.9, 2.1)	2.7 (2.6, 2.9)	3.2 (3.0, 3.3)	3.4 (3.2, 3.5)	3.6 (3.4, 3.7)
TOTAL		**5002**	**191425**					

Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded
Only procedures with a known surgical approach have been included

Table HT26 Comparisons of Revision Rates of Cementless Primary Total Conventional Hip Replacement by Surgical Approach and Stem Collar Use (Primary Diagnosis OA)

Comparison	Hazard Ratio - adjusted for age and gender
Anterior Collarless vs Anterior Collared	Entire Period: HR=1.48 (1.29, 1.69), p<0.001
Lateral Collarless vs Lateral Collared	0 - 3Mth: HR=1.64 (1.24, 2.15), p<0.001
	3Mth+: HR=1.03 (0.81, 1.30), p=0.825
Posterior Collarless vs Posterior Collared	0 - 3Mth: HR=1.33 (1.17, 1.50), p<0.001
	3Mth+: HR=1.02 (0.91, 1.15), p=0.708

Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded
Only procedures with a known surgical approach have been included

Primary Total Hip Replacement

Table HT27 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Cementless Femoral Component and Stem Collar Use (Primary Diagnosis OA)

Femoral Component	Stem Collar Use	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
AMIStem H	Collared	31	2116	1.2 (0.8, 1.8)	1.7 (1.2, 2.5)	1.7 (1.2, 2.5)	2.2 (1.3, 3.6)	2.2 (1.3, 3.6)
	Collarless	164	6620	1.5 (1.3, 1.9)	1.7 (1.4, 2.0)	2.0 (1.7, 2.4)	2.2 (1.9, 2.6)	2.8 (2.4, 3.3)
CORAIL	Collared	1126	40956	1.5 (1.4, 1.7)	1.9 (1.8, 2.1)	2.3 (2.1, 2.4)	2.5 (2.4, 2.7)	2.7 (2.5, 2.9)
	Collarless	1285	23778	1.7 (1.6, 1.9)	2.2 (2.0, 2.4)	2.6 (2.4, 2.9)	3.0 (2.8, 3.2)	3.3 (3.1, 3.5)
HACTIV	Collared	60	1354	3.3 (2.5, 4.4)	4.1 (3.1, 5.3)	4.4 (3.4, 5.7)	4.4 (3.4, 5.7)	4.8 (3.7, 6.3)
	Collarless	45	1279	2.3 (1.6, 3.3)	2.8 (2.0, 3.9)	3.0 (2.2, 4.1)	3.1 (2.2, 4.2)	3.2 (2.3, 4.3)
Metafix	Collared	168	11537	1.2 (1.0, 1.4)	1.5 (1.2, 1.7)	1.7 (1.5, 2.0)	1.8 (1.5, 2.1)	1.9 (1.6, 2.3)
	Collarless	219	7257	1.8 (1.5, 2.2)	2.3 (2.0, 2.7)	2.7 (2.3, 3.1)	2.9 (2.5, 3.3)	3.1 (2.7, 3.5)
Origin	Collared	18	1267	1.5 (0.9, 2.5)	1.6 (1.0, 2.7)	2.3 (1.2, 4.2)		
	Collarless	103	2719	2.5 (2.0, 3.2)	3.2 (2.6, 4.0)	3.5 (2.9, 4.3)	3.8 (3.1, 4.7)	4.1 (3.3, 5.0)
Paragon	Collared	48	2834	1.5 (1.1, 2.1)	1.8 (1.4, 2.5)	1.9 (1.4, 2.6)	1.9 (1.4, 2.6)	2.2 (1.5, 3.2)
	Collarless	163	7108	1.6 (1.3, 1.9)	1.9 (1.6, 2.2)	2.0 (1.7, 2.4)	2.1 (1.8, 2.5)	2.4 (2.0, 2.8)
Polarstem	Collared	32	1731	1.8 (1.3, 2.6)	2.0 (1.4, 2.9)	2.3 (1.6, 3.4)	2.3 (1.6, 3.4)	
	Collarless	520	20286	1.8 (1.6, 1.9)	2.0 (1.8, 2.2)	2.2 (2.0, 2.4)	2.4 (2.2, 2.7)	2.6 (2.4, 2.9)
TOTAL		**3982**	**130842**					

Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded
Only prostheses with >500 procedures each have been included

Table HT28 Comparisons of Revision Rates of Primary Total Conventional Hip Replacement by Cementless Femoral Component and Stem Collar Use (Primary Diagnosis OA)

Comparison	Hazard Ratio - adjusted for age and gender
AMIStem H Collarless vs AMIStem H Collared	Entire Period: HR=1.08 (0.73, 1.60), p=0.712
CORAIL Collarless vs CORAIL Collared	0 - 6Mth: HR=1.03 (0.90, 1.19), p=0.646
	6Mth - 1.5Yr: HR=1.28 (1.04, 1.57), p=0.019
	1.5Yr - 8.5Yr: HR=1.52 (1.33, 1.73), p<0.001
	8.5Yr - 10.5Yr: HR=2.64 (1.64, 4.27), p<0.001
	10.5Yr - 11Yr: HR=11.17 (1.52, 82.12), p=0.017
	11Yr+: HR=2.10 (1.32, 3.33), p=0.001
HACTIV Collarless vs HACTIV Collared	Entire Period: HR=0.63 (0.42, 0.95), p=0.025
Metafix Collarless vs Metafix Collared	Entire Period: HR=1.68 (1.37, 2.06), p<0.001
Origin Collarless vs Origin Collared	Entire Period: HR=1.93 (1.16, 3.22), p=0.011
Paragon Collarless vs Paragon Collared	Entire Period: HR=1.03 (0.74, 1.43), p=0.871
Polarstem Collarless vs Polarstem Collared	Entire Period: HR=1.03 (0.72, 1.48), p=0.865

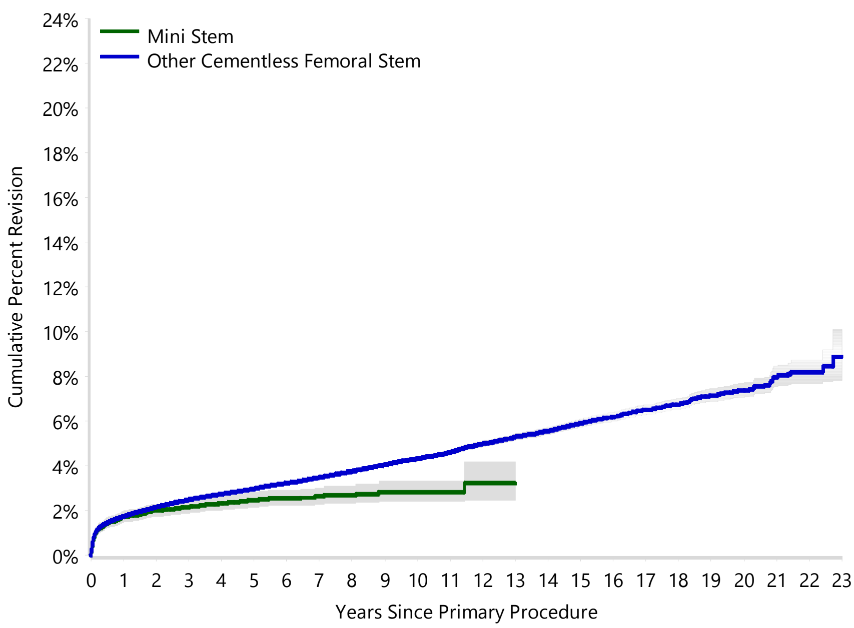
Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded
Only prostheses with >500 procedures each have been included

Table HT29 Cumulative Percent Revision of Cementless Primary Total Conventional Hip Replacement by Stem Type (Primary Diagnosis OA)

Stem Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	9 Yrs	15 Yrs	20 Yrs
Mini Stem	233	10523	1.7 (1.5, 2.0)	2.2 (1.9, 2.5)	2.5 (2.2, 2.8)	2.8 (2.4, 3.3)		
Other Cementless Femoral Stem	9301	273612	1.7 (1.7, 1.8)	2.5 (2.4, 2.5)	3.0 (2.9, 3.1)	4.0 (4.0, 4.1)	5.9 (5.7, 6.1)	7.4 (7.1, 7.7)
TOTAL	**9534**	**284135**						

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Figure HT27 Cumulative Percent Revision of Cementless Primary Total Conventional Hip Replacement by Stem Type (Primary Diagnosis OA)



HR - adjusted for age and gender

Mini Stem vs Other Cementless Femoral Stem

0 - 1Mth: HR=0.92 (0.73, 1.17), p=0.504

1Mth - 6Mth: HR=1.06 (0.84, 1.34), p=0.620

6Mth - 9Mth: HR=0.70 (0.38, 1.27), p=0.236

9Mth - 1Yr: HR=1.38 (0.83, 2.28), p=0.210

1Yr - 1.5Yr: HR=0.52 (0.28, 0.96), p=0.038

1.5Yr - 2Yr: HR=0.89 (0.52, 1.51), p=0.665

2Yr+: HR=0.46 (0.33, 0.64), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	9 Yrs	15 Yrs	20 Yrs
Mini Stem	10523	8921	5981	3637	1017	0	0
Other Cementless Femoral Stem	273612	242532	192624	148352	70835	17071	3113

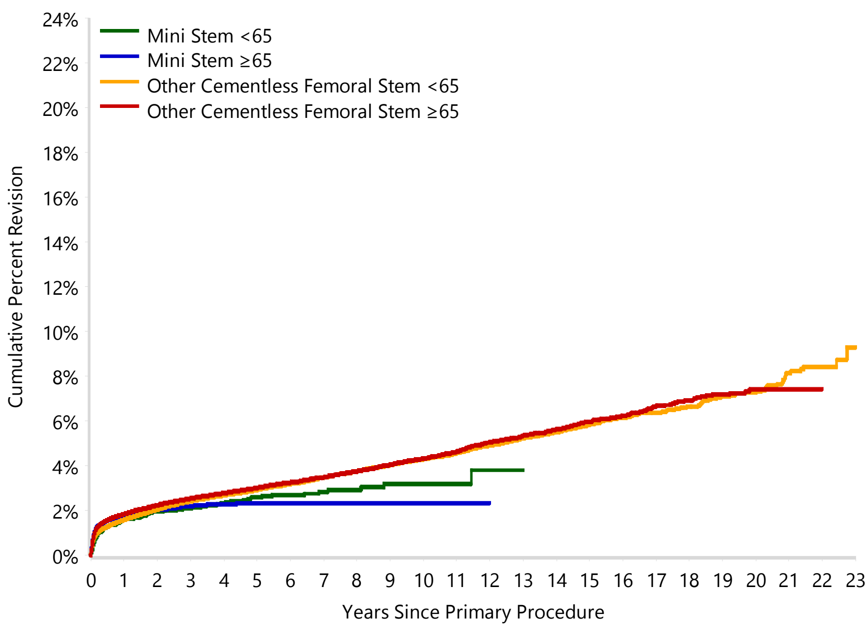
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT30 Cumulative Percent Revision of Cementless Primary Total Conventional Hip Replacement by Stem Type and Age (Primary Diagnosis OA)

Stem Type	Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	9 Yrs	15 Yrs	20 Yrs
Mini Stem	<65	117	4986	1.6 (1.3, 2.0)	2.1 (1.7, 2.6)	2.6 (2.1, 3.1)	3.2 (2.6, 4.0)		
	≥65	116	5537	1.8 (1.5, 2.2)	2.2 (1.8, 2.7)	2.3 (1.9, 2.8)	2.3 (1.9, 2.8)		
Other Cementless Femoral Stem	<65	4011	115151	1.6 (1.5, 1.7)	2.4 (2.3, 2.5)	2.9 (2.8, 3.0)	4.0 (3.9, 4.2)	5.8 (5.6, 6.1)	7.3 (6.9, 7.7)
	≥65	5290	158461	1.8 (1.8, 1.9)	2.5 (2.5, 2.6)	3.0 (2.9, 3.1)	4.0 (3.9, 4.2)	6.0 (5.7, 6.2)	7.4 (6.9, 7.9)
TOTAL		**9534**	**284135**						

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Figure HT28 Cumulative Percent Revision of Cementless Primary Total Conventional Hip Replacement by Stem Type and Age (Primary Diagnosis OA)



HR - adjusted for gender

Mini Stem <65 vs Mini Stem ≥65
0 - 1Mth: HR=0.63 (0.40, 0.99), p=0.043
1Mth+: HR=1.30 (0.98, 1.72), p=0.067

Mini Stem <65 vs
Other Cementless Femoral Stem <65
Entire Period: HR=0.85 (0.70, 1.02), p=0.075

Mini Stem ≥65 vs
Other Cementless Femoral Stem ≥65
0 - 3Mth: HR=0.91 (0.74, 1.13), p=0.395
3Mth - 6Mth: HR=1.04 (0.81, 1.34), p=0.769
6Mth - 3Yr: HR=0.68 (0.51, 0.92), p=0.012
3Yr - 3.5Yr: HR=0.44 (0.27, 0.74), p=0.001
3.5Yr+: HR=0.38 (0.24, 0.59), p<0.001

Other Cementless Femoral Stem <65 vs
Other Cementless Femoral Stem ≥65
0 - 2Wk: HR=0.90 (0.79, 1.03), p=0.124
2Wk - 3Mth: HR=0.77 (0.71, 0.83), p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	9 Yrs	15 Yrs	20 Yrs
Mini Stem	<65	4986	4332	3078	2020	599	0	0
	≥65	5537	4589	2903	1617	418	0	0
Other Cementless Femoral Stem	<65	115151	102757	82923	65640	33861	9647	2197
	≥65	158461	139775	109701	82712	36974	7424	916

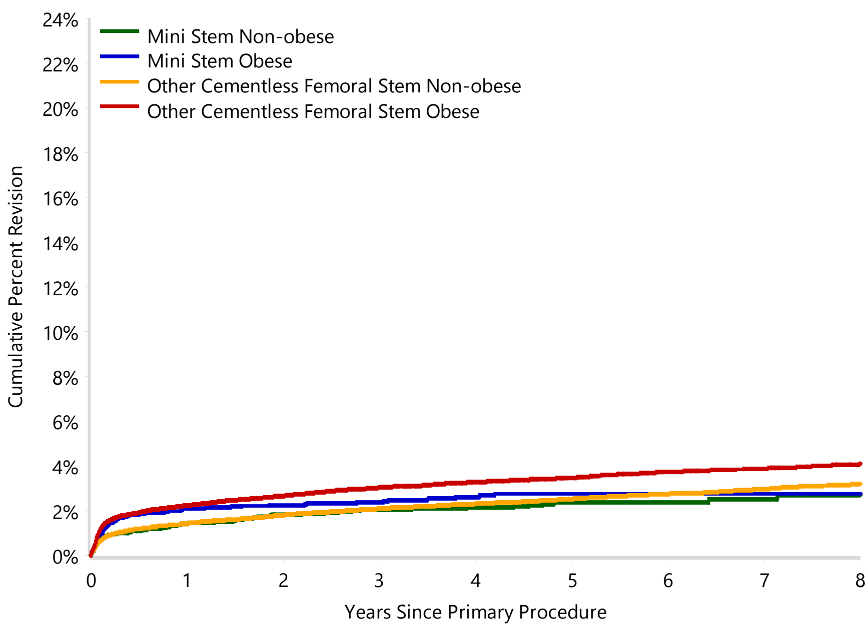
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT31 Cumulative Percent Revision of Cementless Primary Total Conventional Hip Replacement by Stem Type and BMI Category (Primary Diagnosis OA)

Stem Type	BMI Category	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	8 Yrs
Mini Stem	Non-obese	105	5342	1.4 (1.1, 1.8)	2.0 (1.7, 2.5)	2.4 (1.9, 2.9)	2.5 (2.0, 3.1)	2.7 (2.1, 3.5)
	Obese	92	3819	2.1 (1.7, 2.6)	2.4 (1.9, 2.9)	2.8 (2.2, 3.4)	2.8 (2.2, 3.4)	2.8 (2.2, 3.4)
Other Cementless Femoral Stem	Non-obese	2268	101575	1.4 (1.4, 1.5)	2.1 (2.0, 2.2)	2.5 (2.4, 2.6)	3.0 (2.8, 3.1)	3.2 (3.0, 3.4)
	Obese	2409	77512	2.2 (2.1, 2.3)	3.0 (2.9, 3.2)	3.5 (3.3, 3.6)	3.9 (3.7, 4.1)	4.1 (3.9, 4.3)
TOTAL		**4874**	**188248**					

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Figure HT29 Cumulative Percent Revision of Cementless Primary Total Conventional Hip Replacement by Stem Type and BMI Category (Primary Diagnosis OA)



HR - adjusted for age and gender

Mini Stem Non-obese vs Mini Stem Obese
Entire Period: HR=0.79 (0.60, 1.05), p=0.101

Mini Stem Non-obese vs
Other Cementless Femoral Stem Non-obese
Entire Period: HR=0.93 (0.76, 1.13), p=0.449

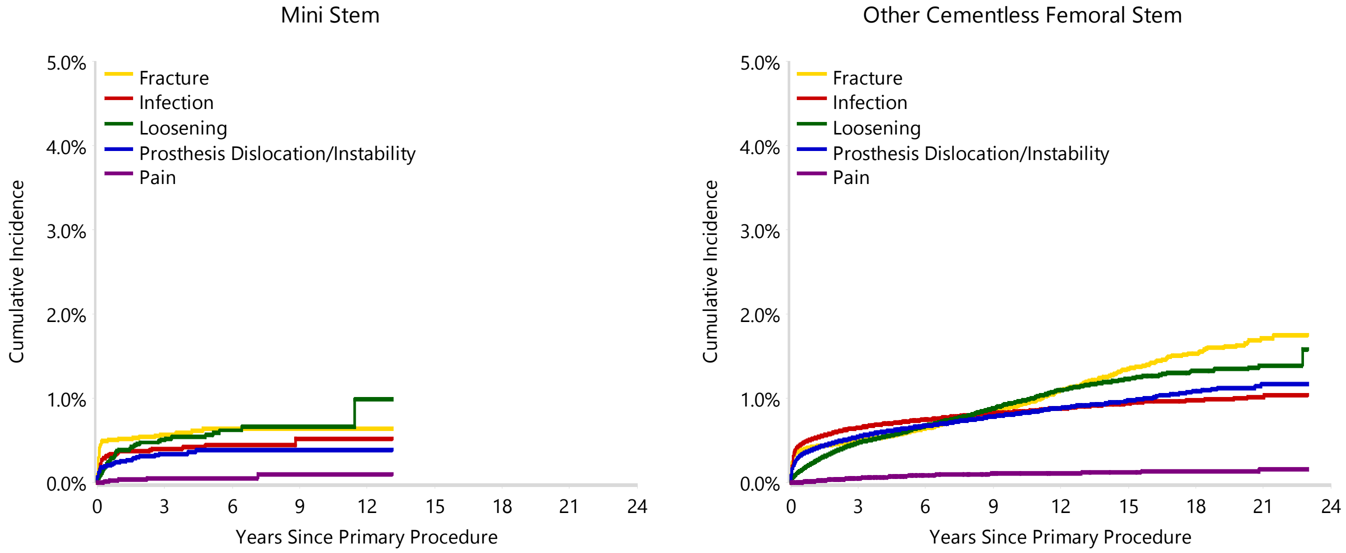
Mini Stem Obese vs
Other Cementless Femoral Stem Obese
Entire Period: HR=0.82 (0.66, 1.00), p=0.054

Other Cementless Femoral Stem Non-obese vs
Other Cementless Femoral Stem Obese
0 - 3Mth: HR=0.59 (0.54, 0.64), p<0.001
3Mth - 6Mth: HR=0.85 (0.69, 1.04), p=0.104
6Mth - 1.5Yr: HR=0.73 (0.64, 0.85), p<0.001
1.5Yr - 2Yr: HR=0.99 (0.78, 1.27), p=0.949
2Yr - 2.5Yr: HR=0.68 (0.52, 0.88), p=0.003
2.5Yr+: HR=0.94 (0.82, 1.08), p=0.386

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	8 Yrs
Mini Stem	Non-obese	5342	4471	2809	1459	508	216
	Obese	3819	3138	1903	961	289	96
Other Cementless Femoral Stem	Non-obese	101575	85828	59628	36679	16016	7117
	Obese	77512	64640	44206	26812	11458	5058

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Figure HT30 **Cumulative Incidence Revision Diagnosis of Cementless Primary Total Conventional Hip Replacement by Stem Type (Primary Diagnosis OA)**



Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT32 **Cementless Primary Total Conventional Hip Replacement by Type of Revision and Stem Type (Primary Diagnosis OA)**

Type of Revision	Mini Stem			Other Cementless Femoral Stem		
	Number	% Primaries Revised	% Revisions	Number	% Primaries Revised	% Revisions
Femoral Component	98	0.9	42.1	3321	1.2	35.7
Head/Insert	37	0.4	15.9	2386	0.9	25.7
Acetabular Component	41	0.4	17.6	1695	0.6	18.2
THR (Femoral/Acetabular)	26	0.2	11.2	788	0.3	8.5
Head Only	25	0.2	10.7	505	0.2	5.4
Cement Spacer	4	0.0	1.7	308	0.1	3.3
Minor Components	1	0.0	0.4	151	0.1	1.6
Other	1	0.0	0.4	147	0.1	1.6
N Revision	**233**	**2.2**	**100.0**	**9301**	**3.4**	**100.0**
N Primary	**10523**			**273612**		

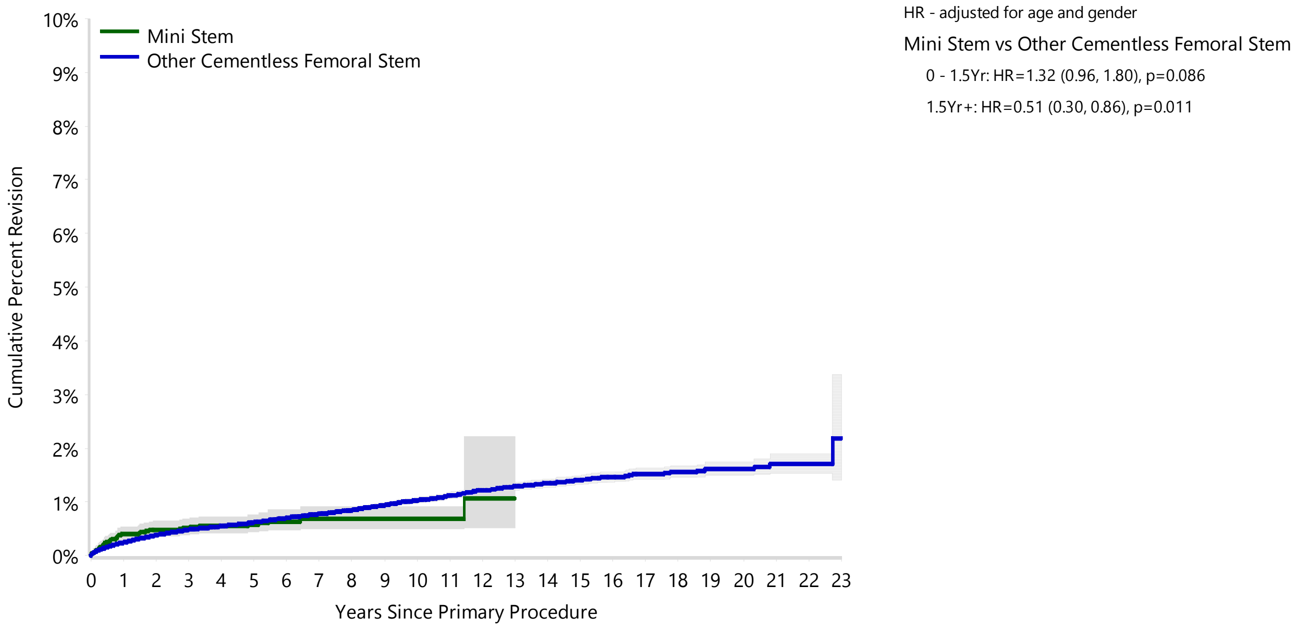
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT33 Cumulative Percent Revision of Cementless Primary Total Conventional Hip Replacement by Stem Type (Primary Diagnosis OA, Revision for Loosening)

Stem Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Mini Stem	55	10523	0.4 (0.3, 0.5)	0.5 (0.4, 0.7)	0.6 (0.4, 0.8)	0.7 (0.5, 0.9)		
Other Cementless Femoral Stem	1962	273612	0.2 (0.2, 0.3)	0.5 (0.5, 0.5)	0.6 (0.6, 0.7)	1.0 (1.0, 1.1)	1.4 (1.3, 1.5)	1.6 (1.5, 1.7)
TOTAL	**2017**	**284135**						

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Figure HT31 Cumulative Percent Revision of Cementless Primary Total Conventional Hip Replacement by Stem Type (Primary Diagnosis OA, Revision for Loosening)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Mini Stem	10523	8921	5981	3637	665	0	0
Other Cementless Femoral Stem	273612	242532	192624	148352	57964	17071	3113

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

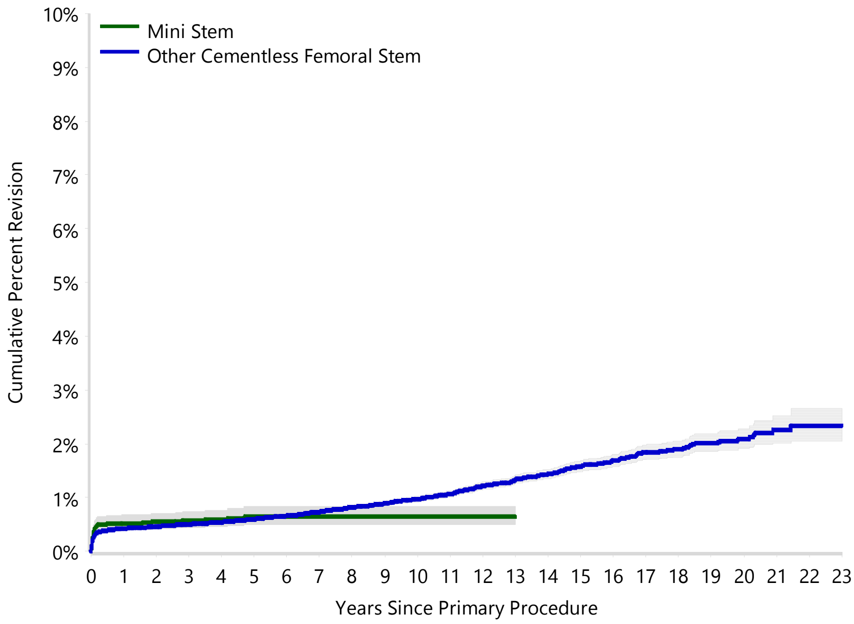
Primary Total Hip Replacement

Table HT34 Cumulative Percent Revision of Cementless Primary Total Conventional Hip Replacement by Stem Type (Primary Diagnosis OA, Revision for Fracture)

Stem Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Mini Stem	61	10523	0.5 (0.4, 0.7)	0.6 (0.4, 0.7)	0.6 (0.5, 0.8)	0.6 (0.5, 0.8)		
Other Cementless Femoral Stem	2101	273612	0.4 (0.4, 0.5)	0.5 (0.5, 0.5)	0.6 (0.6, 0.6)	1.0 (0.9, 1.0)	1.6 (1.5, 1.7)	2.1 (1.9, 2.3)
TOTAL	**2162**	**284135**						

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Figure HT32 Cumulative Percent Revision of Cementless Primary Total Conventional Hip Replacement by Stem Type (Primary Diagnosis OA, Revision for Fracture)



HR - adjusted for age and gender
Mini Stem vs Other Cementless Femoral Stem
0 - 3Mth: HR=1.50 (1.13, 1.98), p=0.004
3Mth+: HR=0.43 (0.22, 0.82), p=0.010

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Mini Stem	10523	8921	5981	3637	665	0	0
Other Cementless Femoral Stem	273612	242532	192624	148352	57964	17071	3113

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT35 Cumulative Percent Revision of Cementless Primary Total Conventional Hip Replacement by Mini Stem Femoral Component (Primary Diagnosis OA)

Femoral Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
MiniHip	48	1375	2.5 (1.8, 3.5)	3.1 (2.3, 4.2)	3.5 (2.6, 4.7)	3.8 (2.9, 5.1)		
Nanos	13	683	1.2 (0.6, 2.3)	1.5 (0.8, 2.7)	1.5 (0.8, 2.7)	1.8 (1.0, 3.1)		
Optimys	74	3358	1.5 (1.2, 2.0)	2.0 (1.6, 2.6)	2.7 (2.1, 3.4)			
Taperloc Microplasty	97	5087	1.7 (1.3, 2.1)	2.0 (1.7, 2.5)	2.2 (1.8, 2.7)			
Other (2)	1	20	5.3 (0.8, 31.9)	5.3 (0.8, 31.9)	5.3 (0.8, 31.9)			
TOTAL	**233**	**10523**						

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses
Only prostheses with >50 procedures have been listed

Bearing Surface

Bearing surface is a combination of the material used for the femoral head and acetabular insert or cup. There are 3 types of femoral head (metal, ceramic, and ceramicised metal) and 4 types of acetabular articular surface (XLPE, non XLPE, ceramic, and metal). Metal/metal bearing surface includes large head sizes >32mm and head sizes ≤32mm. The following analyses comprises all prosthesis combinations including those with no recorded use in 2023. XLPE is classified as ultra-high molecular weight polyethylene that has been irradiated by high dose (≥50kGy) gamma or electron beam radiation.

During the last 10 years, there has been an increase in the use of ceramic/XLPE bearing surface, while both ceramic/ceramic and metal/XLPE have decreased. The proportional use of bearing surfaces over time are shown in Figure HT33.

Comparison of Bearing Surfaces

There are 10 bearing surfaces, 8 of which have been used in >5,000 procedures. Comparing the rates of revision for these bearings, ceramicised metal/XLPE has the lowest rate of revision at 10 years. However, the results should be interpreted with caution as this bearing is a single company product, used with a small number of femoral stem and acetabular component combinations. This may have a confounding effect, making it unclear if the lower rate of revision is an effect of the bearing surface or reflects the limited combinations of femoral and acetabular prostheses.

Ceramic/XLPE has a lower rate of revision compared to metal/XLPE after 2 years (Table HT36 and Figure HT34).

Detailed information on the analysis of metal/metal and metal/ceramic bearing surfaces are available in the supplementary reports 'Metal/Metal Bearing Surface in Total Conventional Hip Arthroplasty' and 'Prosthesis Types with No or Minimal Use' on the AOANJRR website: https://aoanjrr.sahmri.com/annual-reports-2024

Figure HT33 Proportion of Primary Total Conventional Hip Replacement by Bearing Surface (Primary Diagnosis OA)

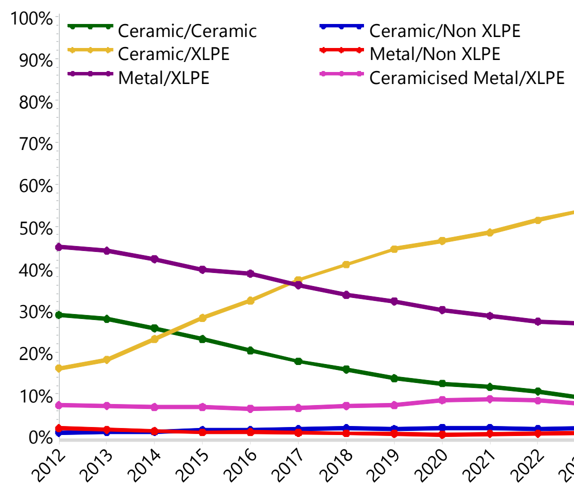
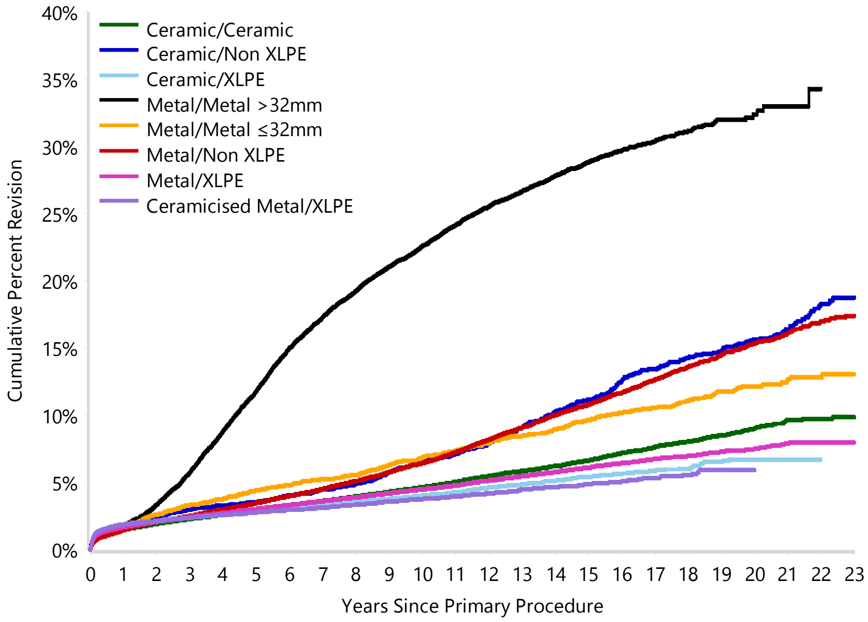


Table HT36 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Bearing Surface (Primary Diagnosis OA)

Bearing Surface	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Ceramic/Ceramic	5165	110883	1.5 (1.4, 1.5)	2.3 (2.2, 2.4)	2.9 (2.8, 3.0)	4.6 (4.5, 4.8)	6.6 (6.4, 6.8)	9.0 (8.7, 9.4)
Ceramic/Non XLPE	743	10753	1.7 (1.5, 2.0)	3.0 (2.7, 3.3)	3.5 (3.2, 3.9)	6.6 (6.0, 7.3)	11.1 (10.2, 12.1)	15.6 (14.4, 17.0)
Ceramic/XLPE	4667	166186	1.7 (1.6, 1.7)	2.4 (2.3, 2.5)	2.9 (2.8, 3.0)	4.0 (3.9, 4.1)	5.4 (5.1, 5.7)	6.7 (6.1, 7.3)
Ceramic/Metal	30	299	1.7 (0.7, 4.0)	3.7 (2.1, 6.6)	4.4 (2.6, 7.4)	8.3 (5.7, 12.2)	11.5 (8.0, 16.5)	
Metal/Metal >32mm	3847	14424	1.7 (1.5, 1.9)	5.7 (5.3, 6.1)	11.8 (11.3, 12.3)	22.6 (21.9, 23.3)	28.8 (28.0, 29.6)	32.4 (31.2, 33.6)
Metal/Metal ≤32mm	502	5143	1.6 (1.3, 2.0)	3.3 (2.9, 3.8)	4.4 (3.9, 5.0)	6.8 (6.2, 7.6)	9.6 (8.8, 10.5)	12.1 (11.1, 13.3)
Metal/Non XLPE	3250	36113	1.4 (1.3, 1.6)	2.5 (2.3, 2.7)	3.5 (3.3, 3.7)	6.4 (6.1, 6.7)	10.8 (10.4, 11.2)	15.3 (14.8, 15.9)
Metal/XLPE	7999	207814	1.7 (1.6, 1.7)	2.4 (2.3, 2.5)	3.0 (2.9, 3.1)	4.5 (4.4, 4.6)	6.1 (5.9, 6.3)	7.5 (7.2, 7.8)
Ceramicised Metal/Non XLPE	60	312	1.6 (0.7, 3.8)	3.6 (2.0, 6.4)	4.0 (2.3, 6.9)	12.3 (8.8, 17.0)	21.3 (16.4, 27.4)	
Ceramicised Metal/XLPE	1176	37758	1.9 (1.7, 2.0)	2.4 (2.2, 2.5)	2.8 (2.6, 2.9)	3.8 (3.5, 4.0)	4.9 (4.5, 5.3)	5.9 (5.3, 6.6)
TOTAL	**27439**	**589685**						

Note: Excludes 279 procedures with unknown bearing surfaces, 2 procedures with ceramicised metal/ceramic bearing surface, 8 procedures with metal/ceramic bearing surface

Figure HT34 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Bearing Surface (Primary Diagnosis OA)



HR - adjusted for age and gender

Ceramic/Ceramic vs Metal/XLPE
Entire Period: HR=0.98 (0.95, 1.02), p=0.387

Ceramic/Non XLPE vs Metal/XLPE
0 - 2Yr: HR=1.16 (1.02, 1.32), p=0.026
2Yr - 3.5Yr: HR=1.42 (1.11, 1.83), p=0.005
3.5Yr - 5Yr: HR=0.90 (0.63, 1.29), p=0.567
5Yr - 8Yr: HR=1.49 (1.19, 1.86), p<0.001
8Yr+: HR=2.65 (2.36, 2.97), p<0.001

Ceramic/XLPE vs Metal/XLPE
0 - 2Yr: HR=1.01 (0.97, 1.06), p=0.617
2Yr+: HR=0.76 (0.72, 0.81), p<0.001

Metal/Metal >32mm vs Metal/XLPE
0 - 2Wk: HR=1.28 (0.96, 1.69), p=0.087
2Wk - 1Mth: HR=0.45 (0.31, 0.66), p<0.001
1Mth - 9Mth: HR=0.95 (0.79, 1.15), p=0.604
9Mth - 1.5Yr: HR=2.82 (2.38, 3.33), p<0.001
1.5Yr - 2Yr: HR=4.40 (3.66, 5.29), p<0.001
2Yr - 3Yr: HR=6.46 (5.73, 7.28), p<0.001
3Yr - 8Yr: HR=9.49 (8.95, 10.05), p<0.001
8Yr - 10Yr: HR=5.99 (5.35, 6.71), p<0.001
10Yr - 12Yr: HR=4.96 (4.39, 5.61), p<0.001
12Yr+: HR=3.36 (3.02, 3.74), p<0.001

Metal/Metal ≤32mm vs Metal/XLPE
Entire Period: HR=1.44 (1.32, 1.58), p<0.001

Metal/Non XLPE vs Metal/XLPE
0 - 1Mth: HR=0.73 (0.62, 0.85), p<0.001
1Mth - 6Mth: HR=0.90 (0.78, 1.04), p=0.145
6Mth - 3.5Yr: HR=1.42 (1.30, 1.54), p<0.001
3.5Yr - 5Yr: HR=1.57 (1.37, 1.81), p<0.001
5Yr - 7Yr: HR=1.74 (1.54, 1.96), p<0.001
7Yr - 10Yr: HR=2.15 (1.95, 2.38), p<0.001
10Yr+: HR=2.60 (2.42, 2.79), p<0.001

Ceramicised Metal/XLPE vs Metal/XLPE
0 - 6Mth: HR=1.17 (1.07, 1.28), p<0.001
6Mth - 1Yr: HR=1.03 (0.84, 1.25), p=0.789
1Yr+: HR=0.62 (0.57, 0.68), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Ceramic/Ceramic	110883	105160	94772	83649	48132	17459	4241
Ceramic/Non XLPE	10753	9718	8080	6612	3712	2216	1003
Ceramic/XLPE	166184	140708	101851	69562	19319	4434	576
Metal/Metal >32mm	14424	14063	13212	11973	9295	5479	267
Metal/Metal ≤32mm	5143	5022	4841	4653	3980	2879	1071
Metal/Non XLPE	36113	34632	32153	29458	21118	12175	4263
Metal/XLPE	207814	190898	162953	134374	63972	19115	2755
Ceramicised Metal/XLPE	37758	33779	26857	20952	9518	2778	143

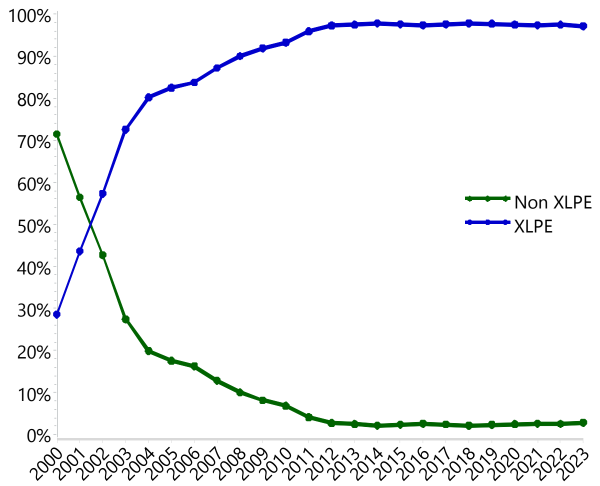
Note: Only bearing surfaces with >5,000 procedures have been listed

Primary Total Hip Replacement

Cross-linked Polyethylene (XLPE)

XLPE has been used in 372,859 procedures. This includes 52,258 procedures that have XLPE with the addition of an antioxidant. In 2023, when polyethylene was used as a bearing surface in primary total conventional hip procedures, the proportion of XLPE was 97.1% (Figure HT35).

Figure HT35 Primary Total Conventional Hip Replacement by Polyethylene Type (Primary Diagnosis OA)



XLPE has a lower rate of revision compared to non XLPE after 9 months (Table HT37 and Figure HT36). The difference increases with time and at 20 years the cumulative percent revision is 6.9% and 17.0%, respectively.

At 20 years the cumulative percent revision of total conventional hip replacement with XLPE is 6.9% compared to 17.0% for non XLPE.

The cumulative incidence of loosening and prosthesis dislocation/instability at 20 years is 1.0% and 1.2% for XLPE, compared to 4.7% and 1.4% for non XLPE bearings, respectively (Figure HT37).

For non XLPE, there is no difference in the rate of revision between head sizes <32mm and 32mm. Head sizes >32mm are rarely used with non XLPE (Table HT37 and Figure HT38). The use of XLPE has been associated with an increased use of larger head sizes when compared to non XLPE. Head sizes ≥32mm have been used in 83.9% of XLPE procedures and in only 17.3% of non XLPE procedures.

For XLPE, 32mm has a lower rate of revision than <32mm after 1.5 years. When compared to >32mm head size, 32mm has a lower rate of revision after 1 month (Table HT37 and Figure HT39). The increased use of larger head sizes with XLPE is likely to be the reason for a reduction in revision for dislocation/instability compared to non XLPE (Figure HT40).

XLPE and non XLPE are combined with three different femoral head bearing surfaces: ceramic, metal, and ceramicised metal. Within each bearing surface, XLPE has a lower rate of revision than non XLPE (Figure HT41).

Prosthesis-Specific Analysis

Further analysis has been undertaken for specific acetabular prostheses that have both XLPE and non XLPE bearing options and ≥500 procedures in each group. Two prostheses fulfil these criteria: the Reflection (Cup) and the Reflection (Shell). Both have a reduced rate of revision when XLPE is used (Table HT38 and Table HT39).

XLPE + Antioxidant

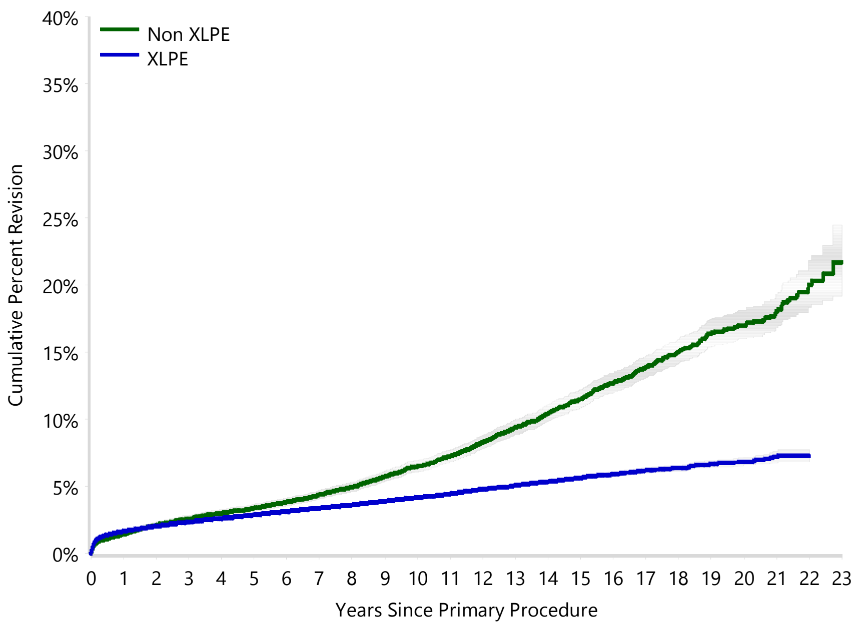
Acetabular components that have both XLPE and XLPE with antioxidant have been compared. There has been a 18.5% increase in procedures using antioxidant compared to 2022. Non XLPE has a higher rate of revision compared to XLPE + antioxidant after 9 months. XLPE has a higher rate of revision compared to XLPE + antioxidant after 1 year (Table HT40 and Figure HT42). The reasons for revision are shown in Table HT41 and Figure HT43.

Table HT37 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Polyethylene Type and Head Size (Primary Diagnosis OA)

Polyethylene Type	Head Size	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Non XLPE		**1475**	**20488**	**1.4 (1.3, 1.6)**	**2.6 (2.4, 2.8)**	**3.4 (3.1, 3.7)**	**6.5 (6.1, 6.9)**	**11.5 (10.8, 12.2)**	**17.0 (16.0, 18.1)**
	<32mm	1285	16949	1.4 (1.2, 1.6)	2.6 (2.3, 2.8)	3.4 (3.1, 3.7)	6.6 (6.2, 7.1)	11.8 (11.1, 12.5)	17.4 (16.3, 18.6)
	32mm	189	3510	1.6 (1.2, 2.1)	2.7 (2.2, 3.3)	3.4 (2.8, 4.1)	5.9 (5.1, 7.0)	9.3 (7.8, 11.1)	
	>32mm	1	29	0.0 (0.0, 0.0)	5.9 (0.9, 35.0)	5.9 (0.9, 35.0)			
XLPE		**11766**	**372859**	**1.7 (1.6, 1.7)**	**2.3 (2.3, 2.4)**	**2.9 (2.8, 2.9)**	**4.2 (4.1, 4.3)**	**5.7 (5.5, 5.8)**	**6.9 (6.6, 7.2)**
	<32mm	2357	59912	1.6 (1.5, 1.7)	2.4 (2.2, 2.5)	3.0 (2.8, 3.1)	4.4 (4.2, 4.6)	6.0 (5.7, 6.2)	7.3 (6.9, 7.7)
	32mm	4432	143910	1.6 (1.5, 1.7)	2.3 (2.2, 2.3)	2.7 (2.6, 2.8)	3.9 (3.8, 4.0)	5.2 (4.9, 5.4)	5.9 (5.4, 6.4)
	>32mm	4977	169037	1.7 (1.7, 1.8)	2.4 (2.3, 2.5)	3.0 (2.9, 3.0)	4.3 (4.2, 4.5)	5.9 (5.6, 6.2)	6.9 (6.3, 7.6)
TOTAL		**13241**	**393347**						

Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded

Figure HT36 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Polyethylene Type (Primary Diagnosis OA)

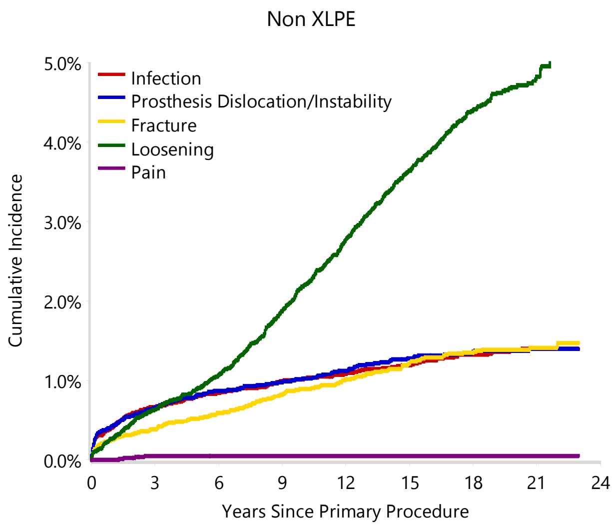


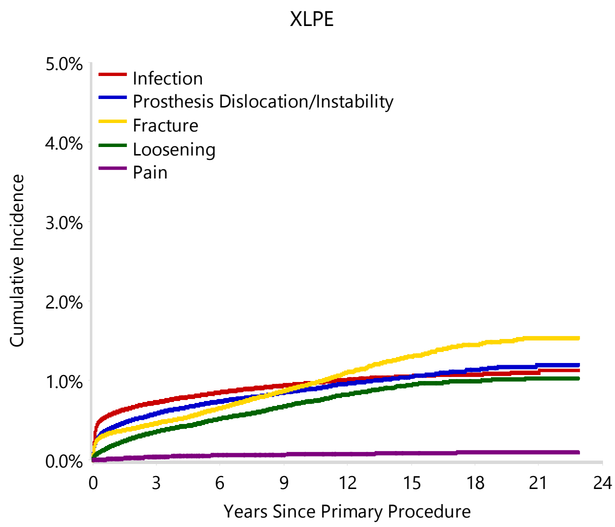
HR - adjusted for age and gender
Non XLPE vs XLPE
0 - 3Mth: HR=0.81 (0.70, 0.94), p=0.005
3Mth - 6Mth: HR=0.71 (0.50, 1.02), p=0.062
6Mth - 9Mth: HR=1.24 (0.89, 1.72), p=0.200
9Mth - 1.5Yr: HR=1.76 (1.44, 2.15), p<0.001
1.5Yr - 2Yr: HR=1.50 (1.12, 2.01), p=0.006
2Yr - 6.5Yr: HR=1.65 (1.46, 1.86), p<0.001
6.5Yr - 11.5Yr: HR=2.74 (2.44, 3.09), p<0.001
11.5Yr+: HR=4.40 (3.85, 5.02), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Non XLPE	20488	18789	16085	13672	8299	4048	1055
XLPE	372859	327647	255592	191233	72059	19258	2410

Note: Restricted to modern prostheses

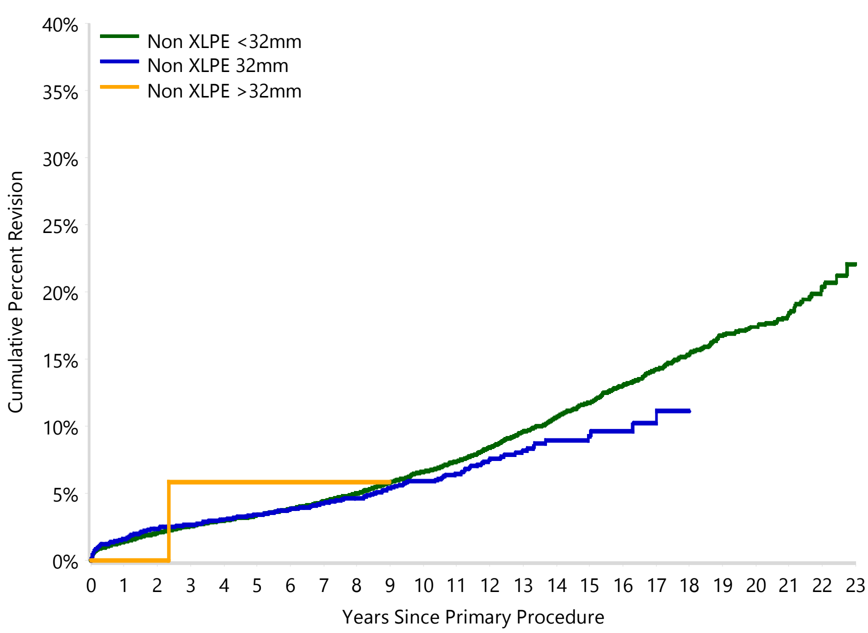
Figure HT37 Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement by Polyethylene Type (Primary Diagnosis OA)





Note: Restricted to modern prostheses

Figure HT38 Cumulative Percent Revision of Primary Total Conventional Hip Replacement using Non XLPE by Head Size (Primary Diagnosis OA)



HR - adjusted for age and gender

Non XLPE 32mm vs Non XLPE <32mm

Entire Period: HR=0.96 (0.83, 1.13), p=0.647

Non XLPE >32mm vs Non XLPE <32mm

Entire Period: HR=0.93 (0.13, 6.60), p=0.940

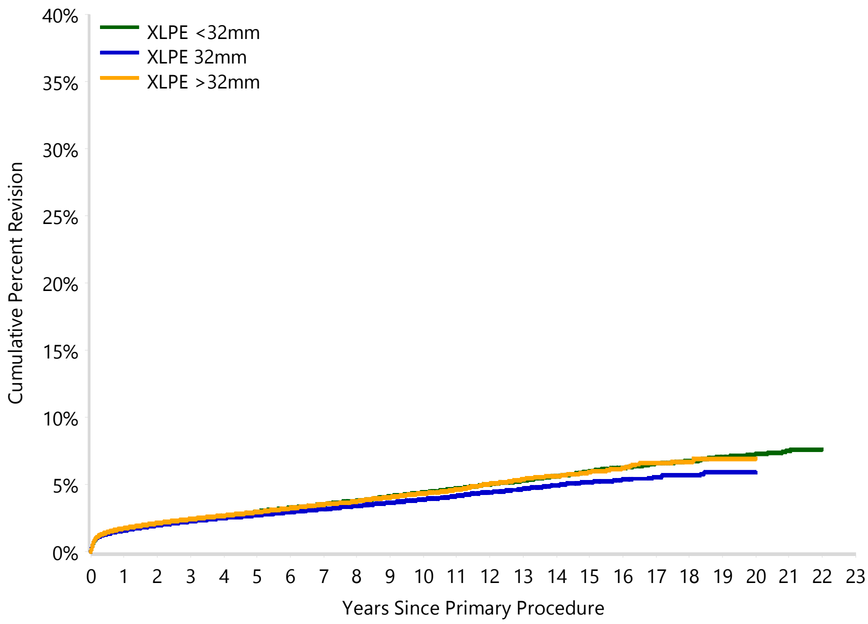
Non XLPE >32mm vs Non XLPE 32mm

Entire Period: HR=0.96 (0.13, 6.87), p=0.969

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Non XLPE	<32mm	16949	15433	13111	11102	7068	3782	1044
	32mm	3510	3331	2962	2562	1228	265	11
	>32mm	29	25	12	8	3	1	0

Note: Restricted to modern prostheses

Figure HT39 Cumulative Percent Revision of Primary Total Conventional Hip Replacement using XLPE by Head Size (Primary Diagnosis OA)



HR - adjusted for age and gender

XLPE <32mm vs XLPE 32mm
- 0 - 1Mth: HR=0.96 (0.86, 1.08), p=0.507
- 1Mth - 3Mth: HR=1.06 (0.93, 1.21), p=0.356
- 3Mth - 1.5Yr: HR=1.10 (0.99, 1.23), p=0.078
- 1.5Yr+: HR=1.20 (1.12, 1.29), p<0.001

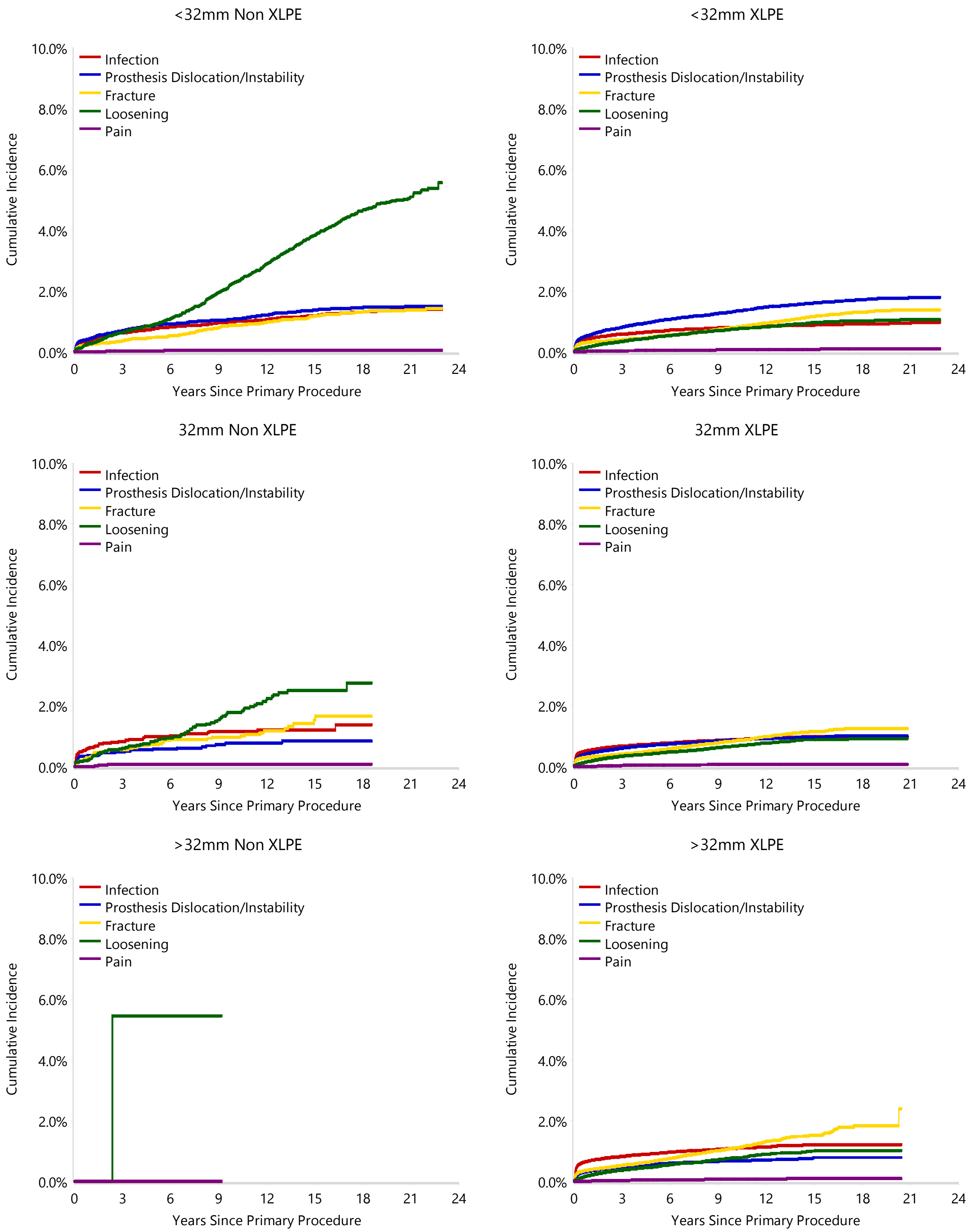
XLPE >32mm vs XLPE 32mm
- 0 - 1Mth: HR=0.96 (0.88, 1.05), p=0.347
- 1Mth+: HR=1.13 (1.07, 1.18), p<0.001

XLPE >32mm vs XLPE <32mm
- Entire Period: HR=0.98 (0.93, 1.03), p=0.452

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
XLPE	**<32mm**	59912	53399	43601	35746	22485	10824	2157
	32mm	143910	131568	109080	84713	28895	5343	166
	>32mm	169037	142680	102911	70774	20679	3091	87

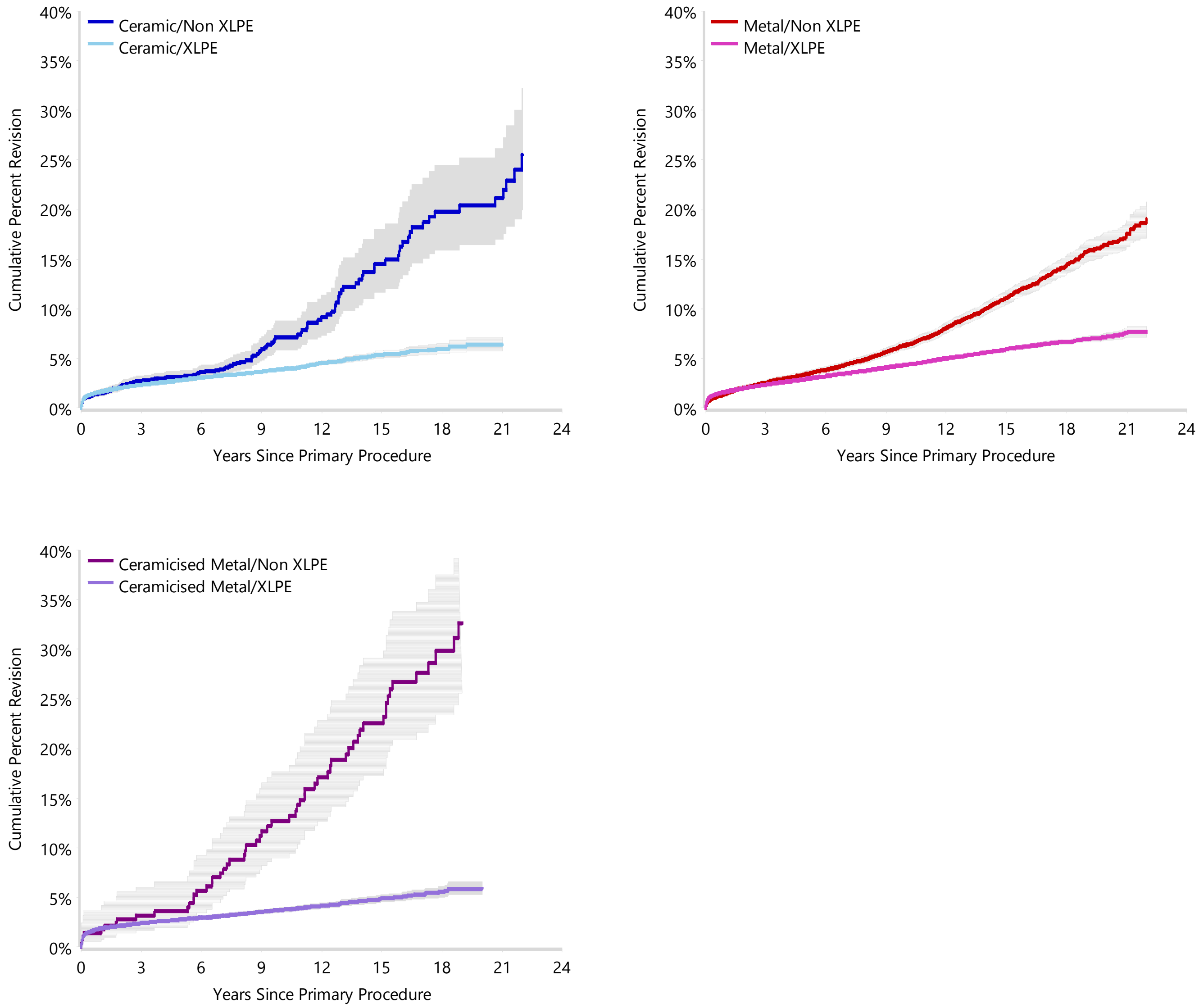
Note: Restricted to modern prostheses

Figure HT40 Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement by Head Size and Polyethylene Type (Primary Diagnosis OA)



Note: Restricted to modern prostheses

Figure HT41 **Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Head Surface and Polyethylene Type (Primary Diagnosis OA)**



Note: Restricted to modern prostheses

Table HT38 **Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Acetabular Component and Polyethylene Type (Primary Diagnosis OA)**

Acetabular Component	Polyethylene Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Reflection (Cup)		**225**	**2359**	**1.0 (0.7, 1.5)**	**1.9 (1.4, 2.6)**	**3.0 (2.4, 3.8)**	**7.7 (6.5, 9.0)**	**14.8 (12.9, 17.0)**	**20.0 (17.1, 23.3)**
	Non XLPE	172	1028	0.6 (0.3, 1.3)	2.0 (1.3, 3.1)	3.2 (2.3, 4.6)	11.0 (9.0, 13.4)	22.9 (19.7, 26.4)	29.6 (25.5, 34.2)
	XLPE	53	1331	1.4 (0.9, 2.2)	1.9 (1.2, 2.8)	2.8 (2.0, 3.9)	4.5 (3.3, 6.0)	5.6 (4.2, 7.5)	
Reflection (Shell)		**812**	**14360**	**1.3 (1.1, 1.5)**	**1.9 (1.7, 2.2)**	**2.4 (2.2, 2.7)**	**4.2 (3.9, 4.6)**	**6.6 (6.1, 7.1)**	**9.3 (8.6, 10.2)**
	Non XLPE	360	2227	1.7 (1.2, 2.3)	3.3 (2.6, 4.1)	4.4 (3.6, 5.4)	9.8 (8.6, 11.3)	17.3 (15.5, 19.2)	24.2 (21.8, 26.8)
	XLPE	452	12133	1.2 (1.0, 1.4)	1.7 (1.5, 1.9)	2.1 (1.8, 2.3)	3.2 (2.9, 3.5)	4.4 (4.0, 4.9)	5.5 (5.0, 6.2)
TOTAL		**1037**	**16719**						

Note: Restricted to modern prostheses

Table HT39 **Comparisons of Revision Rates for Primary Total Conventional Hip Replacement by Acetabular Component and Polyethylene Type (Primary Diagnosis OA)**

Comparison	Hazard Ratio adjusted for age and gender
Reflection (Cup) Non XLPE vs Reflection (Cup) XLPE	0 - 2Yr: HR=0.53 (0.25, 1.11), p=0.092
	2Yr - 5Yr: HR=2.22 (1.07, 4.60), p=0.032
	5Yr - 8Yr: HR=5.94 (2.48, 14.21), p<0.001
	8Yr - 8.5Yr: HR=10.97 (1.40, 85.66), p=0.022
	8.5Yr+: HR=7.36 (4.03, 13.41), p<0.001
Reflection (Shell) Non XLPE vs Reflection (Shell) XLPE	0 - 1Mth: HR=1.59 (0.95, 2.65), p=0.075
	1Mth - 3Mth: HR=0.57 (0.20, 1.59), p=0.279
	3Mth - 3.5Yr: HR=2.53 (1.82, 3.52), p<0.001
	3.5Yr - 6.5Yr: HR=4.02 (2.74, 5.90), p<0.001
	6.5Yr - 9Yr: HR=4.81 (3.22, 7.19), p<0.001
	9Yr - 12Yr: HR=8.74 (6.07, 12.58), p<0.001
	12Yr+: HR=6.81 (5.06, 9.16), p<0.001

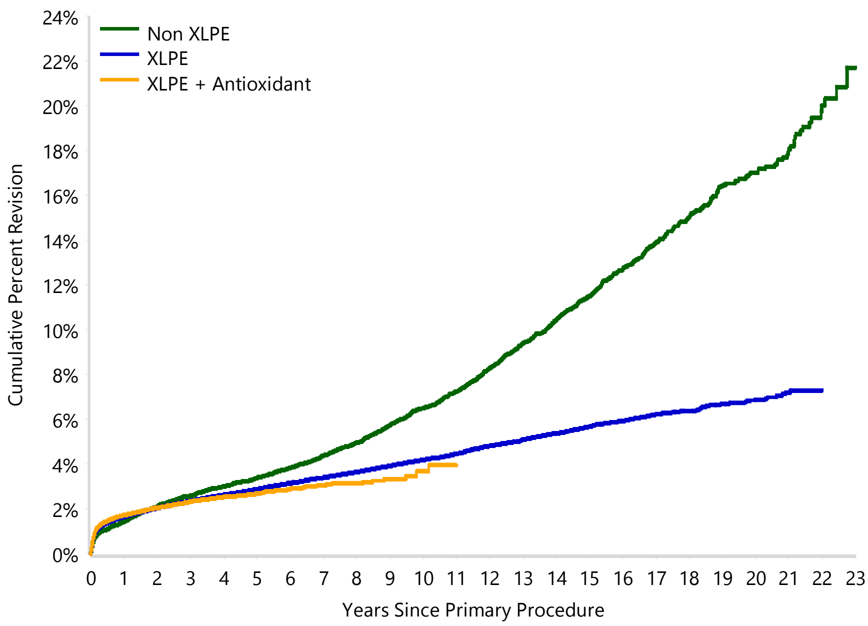
Note: Restricted to modern prostheses

Table HT40 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Polyethylene Type (Primary Diagnosis OA)

Polyethylene Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Non XLPE	1475	20488	1.4 (1.3, 1.6)	2.6 (2.4, 2.8)	3.4 (3.1, 3.7)	6.5 (6.1, 6.9)	11.5 (10.8, 12.2)	17.0 (16.0, 18.1)
XLPE	10613	320601	1.6 (1.6, 1.7)	2.4 (2.3, 2.4)	2.9 (2.8, 2.9)	4.2 (4.1, 4.3)	5.7 (5.5, 5.8)	6.9 (6.6, 7.2)
XLPE + Antioxidant	1153	52258	1.7 (1.6, 1.8)	2.3 (2.2, 2.5)	2.7 (2.5, 2.9)	3.7 (3.1, 4.3)		
TOTAL	**13241**	**393347**						

Note: Restricted to modern prostheses

Figure HT42 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Polyethylene Type (Primary Diagnosis OA)



HR - adjusted for age and gender

Non XLPE vs XLPE + Antioxidant
- 0 - 9Mth: HR=0.82 (0.71, 0.94), p=0.005
- 9Mth - 7Yr: HR=2.02 (1.77, 2.31), p<0.001
- 7Yr - 12Yr: HR=3.46 (2.94, 4.07), p<0.001
- 12Yr+: HR=5.42 (4.53, 6.50), p<0.001

XLPE vs XLPE + Antioxidant
- 0 - 1Yr: HR=0.97 (0.90, 1.04), p=0.433
- 1Yr+: HR=1.22 (1.09, 1.36), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Non XLPE	20488	18789	16085	13672	8299	4048	1055
XLPE	320601	287170	232700	180783	71649	19258	2410
XLPE + Antioxidant	52258	40477	22892	10450	410	0	0

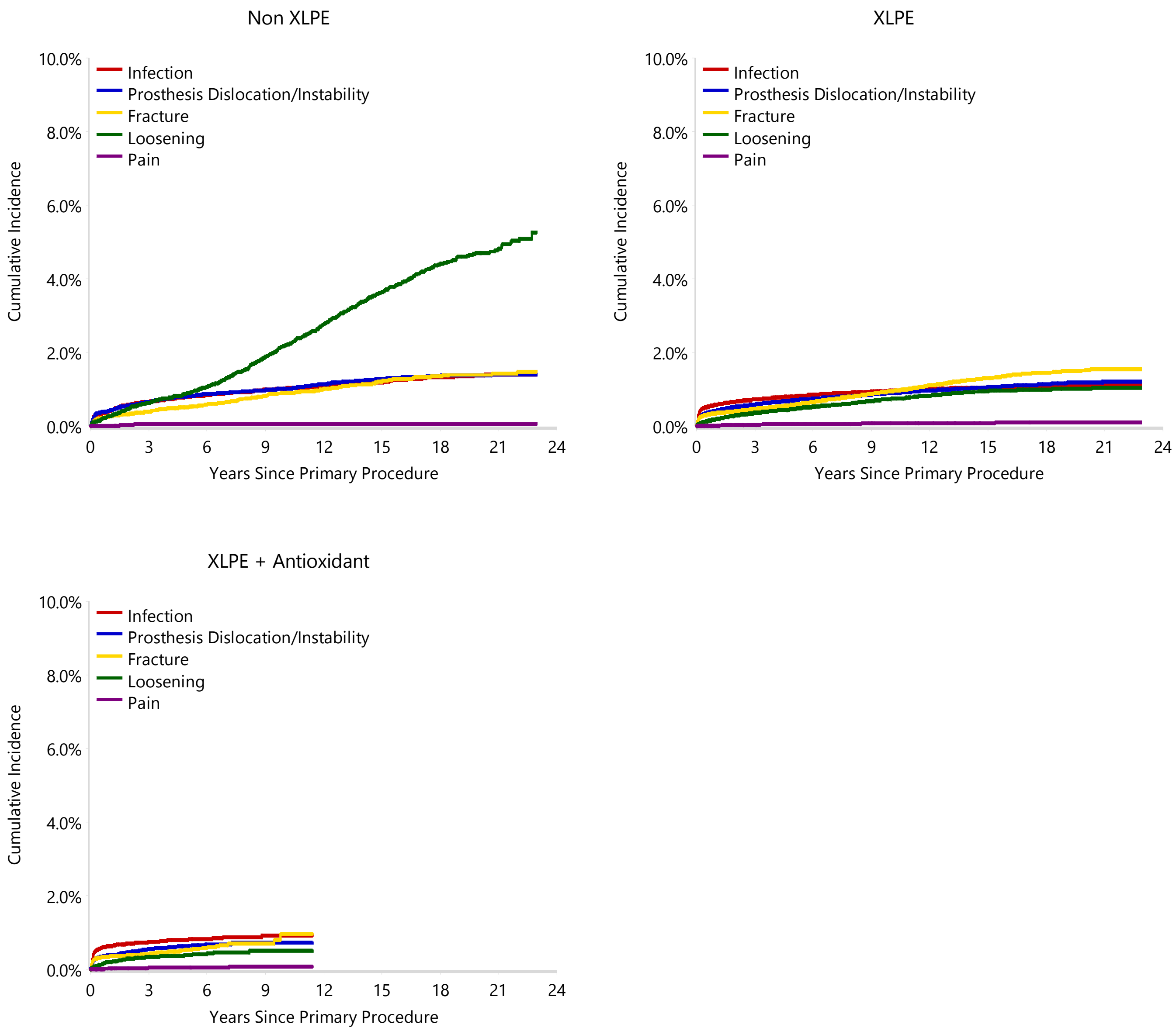
Note: Restricted to modern prostheses

Table HT41 Revision Diagnosis of Primary Total Conventional Hip Replacement by Polyethylene Type (Primary Diagnosis OA, Follow-up Limited to 12.8 Years)

Revision Diagnosis	Non XLPE			XLPE			XLPE + Antioxidant		
	Number	% Primaries Revised	% Revisions	Number	% Primaries Revised	% Revisions	Number	% Primaries Revised	% Revisions
Infection	200	1.0	17.2	2704	0.8	26.3	373	0.7	32.4
Prosthesis Dislocation/Instability	208	1.0	17.9	2405	0.8	23.4	268	0.5	23.2
Fracture	174	0.8	15.0	2386	0.7	23.2	234	0.4	20.3
Loosening	458	2.2	39.4	1797	0.6	17.5	159	0.3	13.8
Pain	10	0.0	0.9	174	0.1	1.7	19	0.0	1.6
Leg Length Discrepancy	8	0.0	0.7	150	0.0	1.5	29	0.1	2.5
Malposition	8	0.0	0.7	136	0.0	1.3	29	0.1	2.5
Implant Breakage Stem	12	0.1	1.0	82	0.0	0.8	4	0.0	0.3
Lysis	46	0.2	4.0	69	0.0	0.7	1	0.0	0.1
Incorrect Sizing	2	0.0	0.2	55	0.0	0.5	7	0.0	0.6
Implant Breakage Acetabular Insert	4	0.0	0.3	43	0.0	0.4	2	0.0	0.2
Metal Related Pathology	3	0.0	0.3	35	0.0	0.3	3	0.0	0.3
Wear Acetabular Insert	17	0.1	1.5	32	0.0	0.3	1	0.0	0.1
Implant Breakage Acetabular	1	0.0	0.1	21	0.0	0.2	2	0.0	0.2
Heterotopic Bone	2	0.0	0.2	17	0.0	0.2	2	0.0	0.2
Tumour	1	0.0	0.1	13	0.0	0.1	1	0.0	0.1
Implant Breakage Head				4	0.0	0.0			
Wear Acetabulum	2	0.0	0.2	4	0.0	0.0			
Wear Head				2	0.0	0.0			
Progression Of Disease				1	0.0	0.0			
Synovitis				1	0.0	0.0			
Other	6	0.0	0.5	154	0.0	1.5	19	0.0	1.6
N Revision	**1162**	**5.7**	**100.0**	**10285**	**3.2**	**100.0**	**1153**	**2.2**	**100.0**
N Primary	**20488**			**320601**			**52258**		

Note: Restricted to modern prostheses
Restricted to revisions within 12.8 years for all groups to allow a time-matched comparison of revisions

Figure HT43 Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement by Polyethylene Type (Primary Diagnosis OA)



Note: Restricted to modern prostheses

Ceramic/Ceramic Bearings

Ceramic/ceramic bearings have been used in 77,809 primary total conventional hip replacement procedures undertaken for osteoarthritis. This is the second most common bearing. This analysis has been restricted to procedures with mixed ceramic femoral heads and mixed ceramic acetabular bearing surfaces. In 2023, mixed ceramic accounted for 99.7% of all procedures with a ceramic/ceramic bearing surface (Figure HT44).

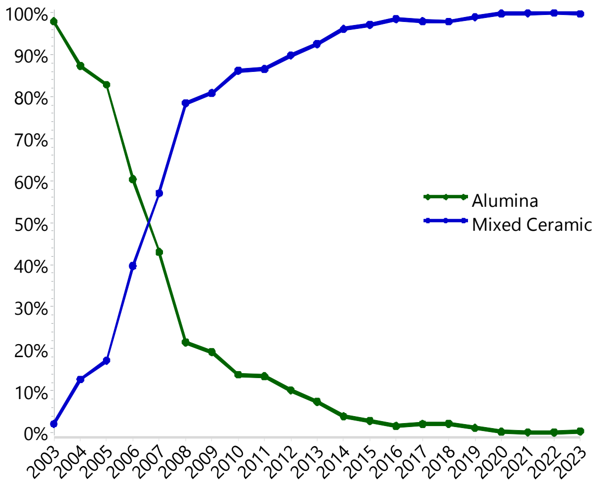
Head Size

To evaluate the effect of head size, an analysis was undertaken comparing four head size groups (≤28mm, 32mm, 36–38mm, and ≥40mm). Head sizes 36mm and 38mm have been combined in this analysis. The proportional use of head sizes of mixed ceramic/mixed ceramic over time is shown in Figure HT45.

Mixed ceramic heads with head sizes ≤28mm have a higher rate of revision than 32mm heads in the first 3 months only. When compared to 32mm head sizes, there is no difference in the rate of revision for 36–38mm and ≥40mm head sizes over the entire period. There is no difference in the rate of revision between 36–38mm and ≥40mm head sizes (Table HT42 and Figure HT46).

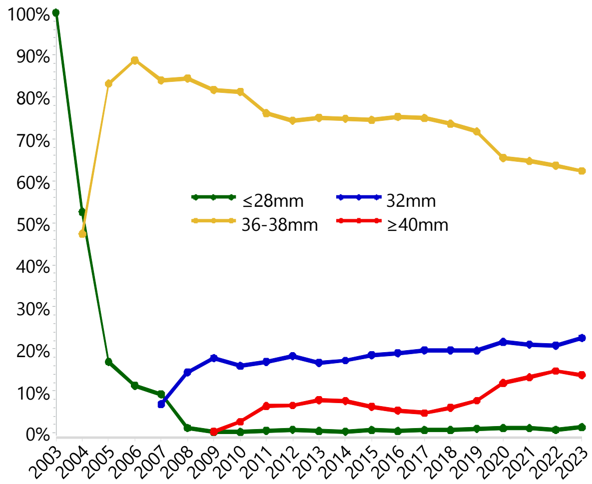
At 1 year, the cumulative incidence of prosthesis dislocation/instability is 1.4% for head sizes ≤28mm compared to 0.3% for 32mm, 0.3% for 36–38mm, and 0.1% for head sizes ≥40mm (Figure HT47).

Figure HT44 Primary Total Conventional Hip Replacement with Ceramic Femoral Heads by Ceramic Type (Primary Diagnosis OA)



Note: Restricted to modern prostheses

Figure HT45 Mixed Ceramic/Mixed Ceramic Primary Total Conventional Hip Replacement by Head Size (Primary Diagnosis OA)



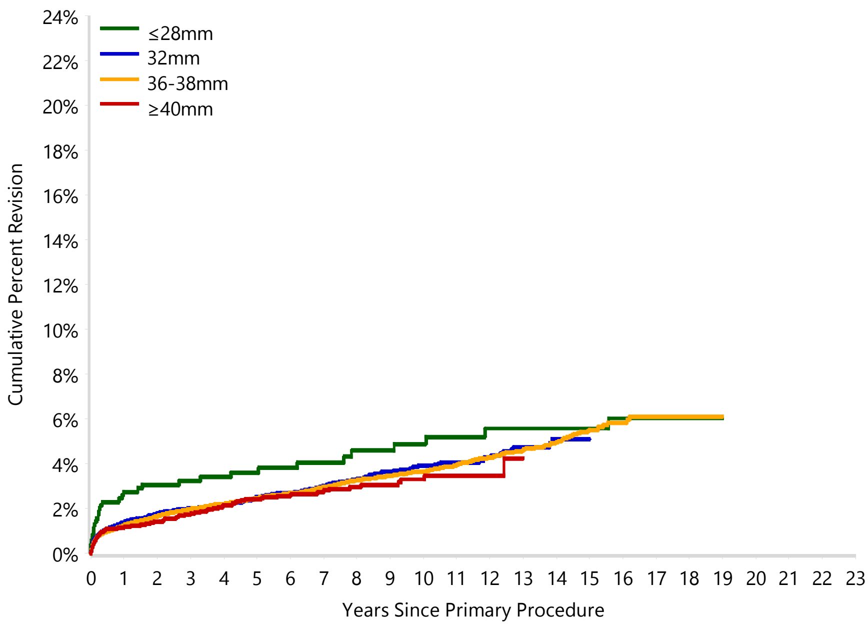
Note: Restricted to modern prostheses

Table HT42 Cumulative Percent Revision of Mixed Ceramic/Mixed Ceramic Primary Total Conventional Hip Replacement by Head Size (Primary Diagnosis OA)

Head Size	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
≤28mm	32	705	2.8 (1.8, 4.3)	3.2 (2.1, 4.9)	3.6 (2.4, 5.4)	4.9 (3.4, 7.0)	5.6 (3.9, 8.0)	
32mm	329	11383	1.4 (1.2, 1.6)	2.0 (1.8, 2.3)	2.5 (2.2, 2.8)	3.9 (3.5, 4.4)	5.1 (4.3, 6.0)	
36-38mm	1348	44198	1.3 (1.2, 1.4)	2.0 (1.9, 2.1)	2.5 (2.3, 2.6)	3.6 (3.4, 3.9)	5.5 (5.1, 6.0)	
≥40mm	102	4566	1.2 (0.9, 1.5)	1.8 (1.4, 2.2)	2.4 (1.9, 3.0)	3.3 (2.6, 4.1)		
TOTAL	**1811**	**60852**						

Note: Restricted to modern prostheses

Figure HT46 Cumulative Percent Revision of Mixed Ceramic/Mixed Ceramic Primary Total Conventional Hip Replacement by Head Size (Primary Diagnosis OA)



HR - adjusted for age and gender

≤28mm vs 32mm

0 - 3Mth: HR=2.39 (1.39, 4.10), p=0.001

3Mth+: HR=0.84 (0.52, 1.36), p=0.483

36-38mm vs 32mm

Entire Period: HR=0.98 (0.86, 1.12), p=0.788

≥40mm vs 32mm

Entire Period: HR=0.89 (0.70, 1.13), p=0.339

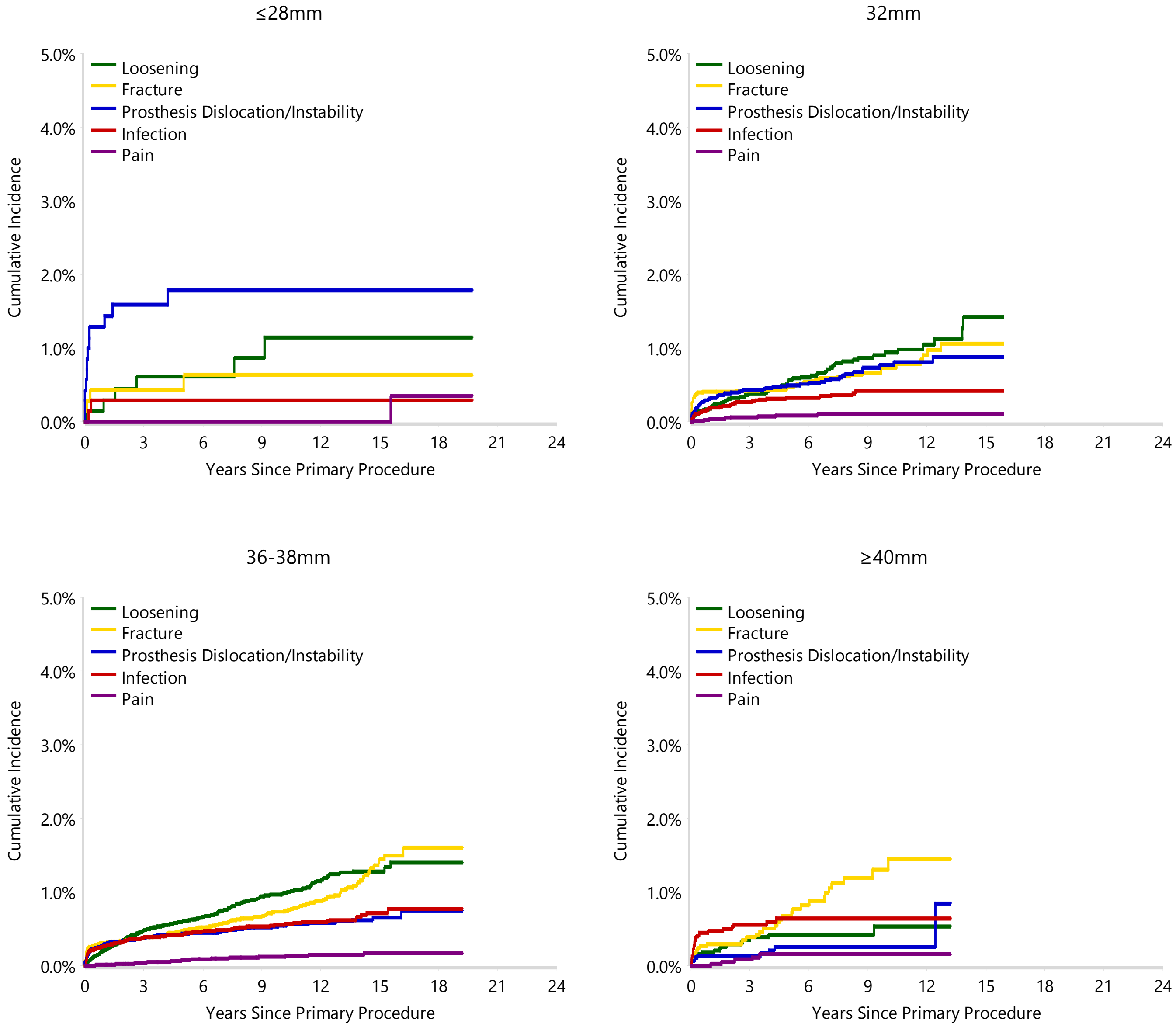
36-38mm vs ≥40mm

Entire Period: HR=1.10 (0.90, 1.35), p=0.348

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
≤28mm	705	636	551	460	299	217	18
32mm	11383	10380	8574	6816	2232	209	0
36-38mm	44198	41219	35301	29204	10874	1732	0
≥40mm	4566	3981	2804	1992	585	0	0

Note: Restricted to modern prostheses

Figure HT47 Cumulative Incidence Revision Diagnosis of Mixed Ceramic/Mixed Ceramic Primary Total Conventional Hip Replacement by Head Size (Primary Diagnosis OA)



Note: Restricted to modern prostheses

Constrained Acetabular Prostheses

Constrained acetabular prostheses have a mechanism to lock the femoral head into the acetabular component. Although often considered revision components, there have been 965 procedures using constrained acetabular prostheses for primary total conventional hip replacement. Of these, 760 procedures were constrained acetabular inserts and 205 procedures were constrained cups. There were 56 procedures reported in 2023. This is a decrease of 27.3% compared to 2022. The most commonly used constrained prostheses are presented in Table HT43.

Constrained acetabular prostheses are proportionally used more frequently for fractured neck of femur, tumour, failed internal fixation, and fracture/dislocation compared to all other acetabular components (Table HT44).

When all diagnoses are included (Table HT45 and Figure HT48), and when used only for osteoarthritis (Table HT46), constrained acetabular prostheses have a higher rate of revision compared to other acetabular prostheses (Table HT49). Gender and age are not risk factors for revision (Table HT47 to Table HT49). The small number of cemented acetabular constrained prostheses and the low number of revisions make it difficult to compare outcomes of these devices based on acetabular fixation.

Table HT43 Cumulative Percent Revision of Constrained Primary Total Conventional Hip Replacement by Component (All Diagnoses)

Constrained Prosthesis	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
G7/G7	7	148	5.2 (2.5, 10.7)	5.2 (2.5, 10.7)				
PINNACLE/PINNACLE	10	141	4.4 (2.0, 9.6)	6.0 (3.1, 11.7)	7.5 (3.9, 14.4)			
Trabecular Metal (Shell)/Longevity	6	99	2.1 (0.5, 8.2)	5.8 (2.4, 13.5)	7.6 (3.4, 16.5)	7.6 (3.4, 16.5)		
Trident (Cup)	10	164	6.0 (3.2, 11.3)	6.0 (3.2, 11.3)				
Trident (Shell)/Trident	15	193	5.6 (3.0, 10.1)	6.3 (3.5, 11.2)	8.2 (4.8, 14.0)			
Other Constrained Prosthesis	16	220	4.6 (2.4, 8.6)	6.6 (3.8, 11.4)	9.6 (5.7, 15.8)			
TOTAL	**64**	**965**						

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT44 Primary Total Conventional Hip Replacement by Primary Diagnosis and Acetabular Type

Primary Diagnosis	Constrained Prosthesis		Other Acetabular Prosthesis	
	N	Col%	N	Col%
Osteoarthritis	373	38.7	471282	87.7
Fractured Neck of Femur	260	26.9	29914	5.6
Osteonecrosis	36	3.7	17175	3.2
Developmental Dysplasia	22	2.3	7195	1.3
Rheumatoid Arthritis	8	0.8	4032	0.8
Tumour	118	12.2	2736	0.5
Other Inflammatory Arthritis	4	0.4	2121	0.4
Failed Internal Fixation	108	11.2	1986	0.4
Fracture/Dislocation	29	3.0	745	0.1
Arthrodesis Takedown	3	0.3	86	0.0
Other	4	0.4	112	0.0
TOTAL	965	100.0	537384	100.0

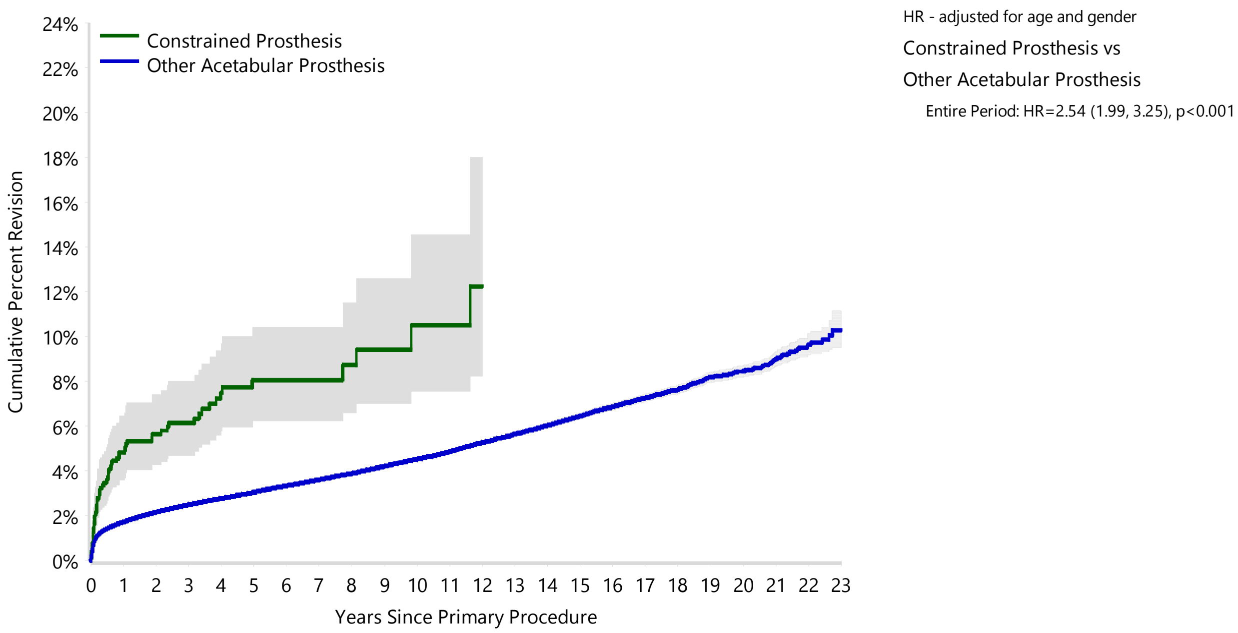
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT45 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Acetabular Type (All Diagnoses)

Acetabular Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Constrained Prosthesis	64	965	4.8 (3.6, 6.5)	6.1 (4.7, 8.0)	8.1 (6.2, 10.4)	10.5 (7.5, 14.5)		
Other Acetabular Prosthesis	19160	537384	1.7 (1.7, 1.8)	2.5 (2.5, 2.5)	3.0 (3.0, 3.1)	4.5 (4.5, 4.6)	6.4 (6.3, 6.6)	8.5 (8.2, 8.7)
TOTAL	**19224**	**538349**						

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Figure HT48 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Acetabular Type (All Diagnoses)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Constrained Prosthesis	965	741	484	284	78	16	2
Other Acetabular Prosthesis	537384	474718	376505	288521	117592	35837	6147

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT46 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Acetabular Type (Primary Diagnosis OA)

Acetabular Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Constrained Prosthesis	21	373	2.8 (1.5, 5.2)	4.9 (3.0, 7.9)	6.4 (4.1, 9.9)	7.5 (4.6, 12.0)		
Other Acetabular Prosthesis	15914	471282	1.6 (1.6, 1.6)	2.3 (2.3, 2.3)	2.8 (2.8, 2.9)	4.2 (4.2, 4.3)	6.1 (6.0, 6.3)	8.1 (7.8, 8.3)
TOTAL	15935	471655						

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT47 Cumulative Percent Revision of Constrained Primary Total Conventional Hip Replacement by Gender (Primary Diagnosis OA)

Acetabular Type	Gender	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Constrained Prosthesis	Male	10	137	3.9 (1.6, 9.2)	7.0 (3.5, 13.6)	10.1 (5.4, 18.4)			
	Female	11	236	2.2 (0.9, 5.2)	3.7 (1.9, 7.4)	4.5 (2.3, 8.6)	6.0 (3.0, 11.7)		
TOTAL		21	373						

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT48 Cumulative Percent Revision of Constrained Primary Total Conventional Hip Replacement by Age (Primary Diagnosis OA)

Acetabular Type	Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Constrained Prosthesis	<70	7	83	1.3 (0.2, 8.8)	6.8 (2.9, 15.5)	8.4 (3.8, 17.8)	8.4 (3.8, 17.8)		
	≥70	14	290	3.3 (1.7, 6.2)	4.2 (2.3, 7.5)	5.6 (3.2, 9.6)			
TOTAL		21	373						

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT49 Comparisons of Primary Total Conventional Hip Replacement using Constrained Acetabular Components (Primary Diagnosis OA)

Comparison	Hazard Ratio - adjusted for age and gender
Constrained Prosthesis vs Other Acetabular Prosthesis	Entire Period: HR=2.02 (1.32, 3.10), p=0.001
Constrained Prosthesis Female vs Constrained Prosthesis Male	Entire Period: HR=0.54 (0.23, 1.29), p=0.163
Constrained Prosthesis ≥70 vs Constrained Prosthesis <70	Entire Period: HR=0.69 (0.28, 1.73), p=0.432

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Dual Mobility Acetabular Prostheses

Dual mobility prostheses have a femoral head which moves within a polyethylene component, which also moves within a fixed acetabular shell.

There are 33,780 primary total conventional hip replacement procedures using dual mobility prostheses. This is an increase of 21.1% (n=7,264) since 2022 (Figure HT49). The commonly used dual mobility prostheses are presented in Table HT50. Compared to other acetabular prostheses, dual mobility acetabular prostheses are proportionally used more frequently for fractured neck of femur, tumour, and failed internal fixation (Table HT51).

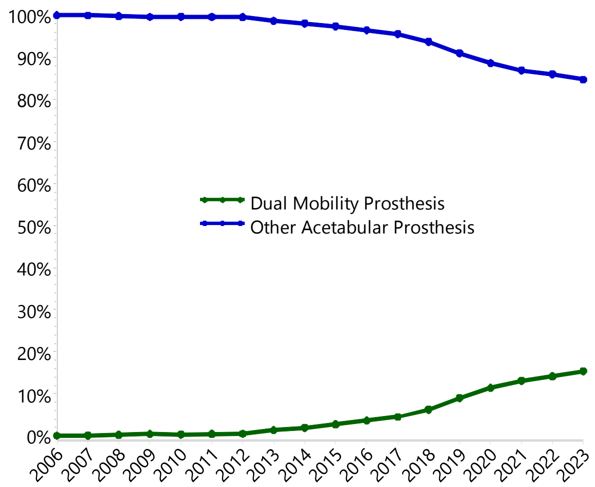
When all diagnoses are included, dual mobility prostheses have a higher rate of revision compared to other acetabular prostheses (Table HT52 and Figure HT50).

For the diagnosis of osteoarthritis, there is no difference in the overall rate of revision when dual mobility prostheses are used (Table HT53 and Table HT58). Dual mobility prostheses have a lower rate of revision for dislocation/instability compared to all other acetabular prostheses (Table HT54 and Table HT58).

Males have a higher risk of revision than females when dual mobility prostheses are used for a diagnosis of osteoarthritis (Table HT55 and Figure HT51). However, age is not a risk factor for revision (Table HT56 and Table HT58).

The majority of dual mobility prostheses are inserted with cementless acetabular fixation. However, there is no difference in the rate of revision when types of acetabular fixation are compared (Table HT57 and Table HT58).

Figure HT49 Primary Total Conventional Hip Replacement by Dual Mobility (All Diagnoses)



Note: Restricted to modern prostheses

Table HT50 Cumulative Percent Revision of Dual Mobility Primary Total Conventional Hip Replacement by Component (All Diagnoses)

Dual Mobility Insert	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
2M	25	527	2.5 (1.5, 4.3)	4.1 (2.6, 6.2)	4.7 (3.0, 7.3)			
Active Articulation	191	7657	2.1 (1.8, 2.5)	2.8 (2.4, 3.3)	3.3 (2.8, 3.9)			
Avantage	17	445	3.5 (2.1, 5.9)	4.0 (2.4, 6.6)	5.4 (3.2, 9.0)			
BI-MENTUM	22	880	2.5 (1.6, 3.9)					
MDM (Dual Mobility)	134	5814	1.9 (1.5, 2.3)	2.5 (2.1, 3.0)	3.4 (2.7, 4.1)	4.7 (3.5, 6.3)		
MobiliT CUP	2	151	1.5 (0.4, 6.0)					
Novae E	41	1778	1.0 (0.6, 1.6)	2.0 (1.4, 2.8)	2.2 (1.5, 3.0)	5.3 (3.2, 8.6)		
Polarcup	55	1338	2.3 (1.6, 3.3)	3.8 (2.8, 5.1)	4.5 (3.4, 6.0)	6.4 (4.5, 9.1)		
Restoration	208	5439	2.6 (2.2, 3.0)	3.4 (2.9, 3.9)	4.4 (3.8, 5.1)	7.0 (4.6, 10.6)		
Saturne	46	1606	1.5 (1.0, 2.3)	2.6 (1.9, 3.6)	3.4 (2.5, 4.7)			
SignaSure	9	609	1.3 (0.6, 2.8)					
Trinity	90	5397	1.4 (1.1, 1.8)	1.8 (1.5, 2.2)	2.4 (1.8, 3.3)			
Versafit	64	2072	2.3 (1.7, 3.0)	3.2 (2.5, 4.2)	3.7 (2.9, 4.9)			
Other (3)	1	67	1.5 (0.2, 10.1)					
TOTAL	**905**	**33780**						

Note: All procedures using metal/metal prostheses have been excluded
Only prostheses with >50 procedures have been listed
Restricted to modern prostheses

Table HT51 Primary Total Conventional Hip Replacement by Primary Diagnosis and Acetabular Mobility

Primary Diagnosis	Dual Mobility Prosthesis		Other Acetabular Prosthesis	
	N	Col%	N	Col%
Osteoarthritis	23541	69.7	448114	88.8
Fractured Neck of Femur	6524	19.3	23650	4.7
Osteonecrosis	1381	4.1	15830	3.1
Developmental Dysplasia	689	2.0	6528	1.3
Rheumatoid Arthritis	178	0.5	3862	0.8
Tumour	688	2.0	2166	0.4
Other Inflammatory Arthritis	120	0.4	2005	0.4
Failed Internal Fixation	441	1.3	1653	0.3
Fracture/Dislocation	180	0.5	594	0.1
Arthrodesis Takedown	15	0.0	74	0.0
Other	23	0.1	93	0.0
TOTAL	**33780**	**100.0**	**504569**	**100.0**

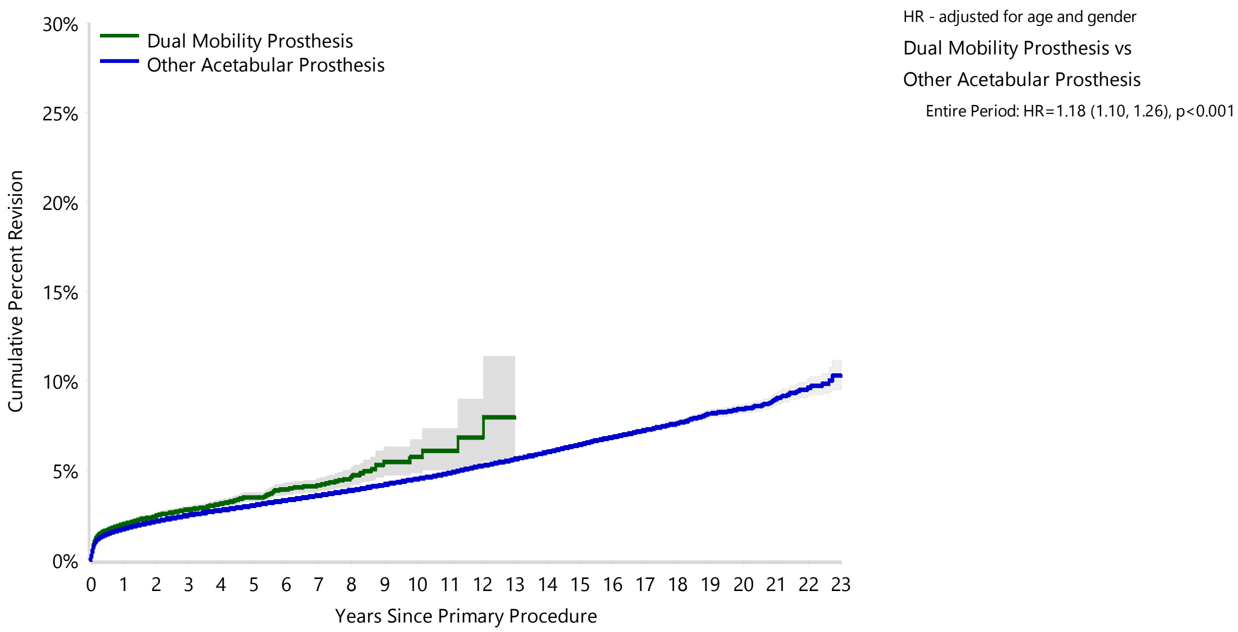
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT52 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Acetabular Mobility (All Diagnoses)

Acetabular Mobility	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Dual Mobility Prosthesis	905	33780	2.0 (1.8, 2.1)	2.8 (2.6, 3.0)	3.5 (3.2, 3.8)	5.7 (4.9, 6.7)		
Other Acetabular Prosthesis	18319	504569	1.7 (1.7, 1.8)	2.5 (2.4, 2.5)	3.0 (3.0, 3.1)	4.5 (4.4, 4.6)	6.4 (6.3, 6.6)	8.4 (8.2, 8.7)
TOTAL	**19224**	**538349**						

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Figure HT50 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Acetabular Mobility (All Diagnoses)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Dual Mobility Prosthesis	33780	25128	13164	5532	306	16	0
Other Acetabular Prosthesis	504569	450331	363825	283273	117364	35837	6149

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT53 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Acetabular Mobility (Primary Diagnosis OA)

Acetabular Mobility	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Dual Mobility Prosthesis	521	23541	1.6 (1.4, 1.7)	2.2 (2.0, 2.5)	2.9 (2.6, 3.2)	4.8 (3.9, 5.8)		
Other Acetabular Prosthesis	15414	448114	1.6 (1.6, 1.6)	2.3 (2.3, 2.4)	2.8 (2.8, 2.9)	4.2 (4.2, 4.3)	6.1 (6.0, 6.2)	8.1 (7.8, 8.3)
TOTAL	**15935**	**471655**						

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT54 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Acetabular Mobility (Primary Diagnosis OA, Revision for Prosthesis Dislocation/Instability)

Acetabular Mobility	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Dual Mobility Prosthesis	76	23541	0.2 (0.2, 0.3)	0.3 (0.2, 0.4)	0.5 (0.4, 0.6)	0.5 (0.4, 0.6)		
Other Acetabular Prosthesis	3344	448114	0.4 (0.4, 0.4)	0.6 (0.6, 0.6)	0.7 (0.7, 0.7)	0.9 (0.9, 0.9)	1.2 (1.1, 1.2)	1.4 (1.3, 1.5)
TOTAL	**3420**	**471655**						

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

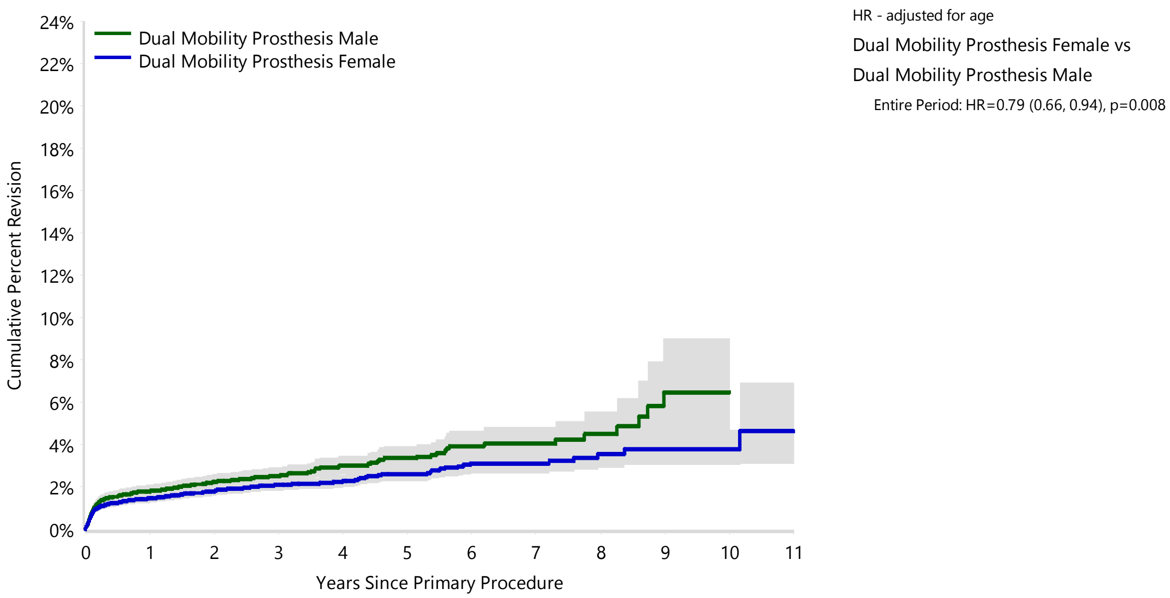
Primary Total Hip Replacement

Table HT55 Cumulative Percent Revision of Dual Mobility Primary Total Conventional Hip Replacement by Gender (Primary Diagnosis OA)

Acetabular Mobility	Gender	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs
Dual Mobility Prosthesis	**Male**	224	8794	1.8 (1.5, 2.1)	2.5 (2.2, 2.9)	3.4 (2.9, 3.9)	6.5 (4.6, 9.0)
	Female	297	14747	1.5 (1.3, 1.7)	2.1 (1.8, 2.4)	2.6 (2.3, 3.0)	3.8 (3.0, 4.7)
TOTAL		**521**	**23541**				

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Figure HT51 Cumulative Percent Revision of Dual Mobility Primary Total Conventional Hip Replacement by Gender (Primary Diagnosis OA)



Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Dual Mobility Prosthesis	**Male**	8794	6601	3463	1459	588	67
	Female	14747	11152	5949	2420	890	126

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT56 Cumulative Percent Revision of Dual Mobility Primary Total Conventional Hip Replacement by Age (Primary Diagnosis OA)

Acetabular Mobility	Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Dual Mobility Prosthesis	<70	231	9371	1.7 (1.5, 2.0)	2.5 (2.2, 2.9)	3.1 (2.7, 3.6)	4.3 (3.4, 5.4)		
	≥70	290	14170	1.5 (1.3, 1.7)	2.1 (1.8, 2.4)	2.7 (2.4, 3.2)	5.4 (3.9, 7.3)		
TOTAL		**521**	**23541**						

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT57 **Cumulative Percent Revision of Dual Mobility Primary Total Conventional Hip Replacement by Acetabular Fixation (Primary Diagnosis OA)**

Acetabular Mobility	Acetabular Fixation	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Dual Mobility Prosthesis	Cementless	507	23132	1.6 (1.4, 1.8)	2.2 (2.0, 2.5)	2.9 (2.6, 3.2)	4.7 (3.8, 5.8)		
	Cemented	14	409	1.5 (0.7, 3.3)	2.3 (1.1, 4.6)	3.5 (1.8, 6.7)			
TOTAL		**521**	**23541**						

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT58 **Comparisons of Revision Rates of Primary Total Conventional Hip Replacement by Acetabular Mobility (Primary Diagnosis OA)**

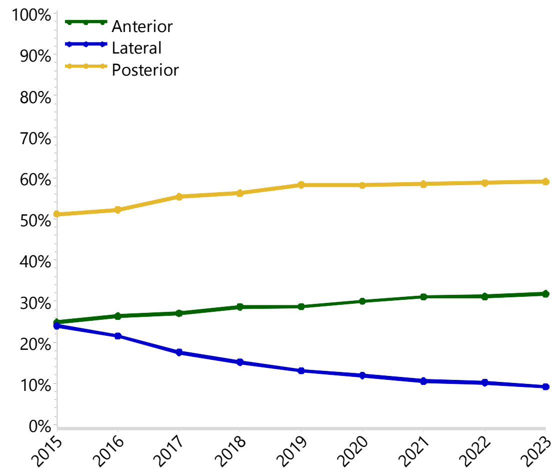
Diagnosis/Outcome	Comparison	Hazard Ratio - adjusted for age and gender
All Cause Revision	Dual Mobility Prosthesis vs Other Acetabular Prosthesis	Entire Period: HR=1.04 (0.95, 1.13), p=0.403
Revision for Prosthesis Dislocation/Instability	Dual Mobility Prosthesis vs Other Acetabular Prosthesis	Entire Period: HR=0.59 (0.47, 0.74), p<0.001
All Cause Revision	Dual Mobility Prosthesis Female vs Dual Mobility Prosthesis Male	Entire Period: HR=0.79 (0.66, 0.94), p=0.008
	Dual Mobility Prosthesis ≥70 vs Dual Mobility Prosthesis <70	Entire Period: HR=0.90 (0.75, 1.07), p=0.212
	Dual Mobility Prosthesis Cemented Acetabular vs Dual Mobility Prosthesis Cementless Acetabular	Entire Period: HR=1.51 (0.88, 2.57), p=0.131

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Surgical Approach

Collection of surgical approach data began in 2015 and the outcome of 86,278 anterior, 41,710 lateral, and 168,056 posterior total conventional hip replacement procedures for osteoarthritis can be compared. The proportional use of anterior, lateral and posterior approaches over time is shown in Figure HT52.

Figure HT52 **Primary Total Conventional Hip Replacement by Approach (Primary Diagnosis OA)**



Note: Restricted to modern prostheses

The anterior approach is used more often in younger patients than the posterior and lateral approaches, and in a higher proportion of patients with lower BMI and ASA scores (Table HT59 to Table HT61).

The following analyses were performed with hazard ratios adjusted for age, gender, ASA score, BMI category, femoral fixation, and head size. When compared to the anterior approach, the lateral and posterior approaches have a higher rate of revision. The lateral approach also has a higher rate of revision compared to the posterior approach (Table HT62 and Figure HT53). There are also differences in the types of revision and reasons for revision between the approaches.

Major Revisions

The posterior approach has a lower rate of major revision compared to the anterior approach and the lateral approach. There is no difference between the lateral and anterior approaches (Table HT63 and Figure HT54).

Reasons for Revision

The most common reasons for revision of primary total hip replacement in the first 9 years include loosening, fracture, infection, and dislocation/instability (Figure HT55).

Revision for Loosening
The posterior approach has a lower rate of revision for loosening compared to the lateral approach and when compared to the anterior approach. There is a higher rate of revision for loosening with the anterior approach compared to the lateral approach (Table HT64 and Figure HT56).

Revision for Fracture
The anterior approach also has a higher rate of revision for fracture in the first 3 months when compared to both the lateral approach and to the posterior approach. After this time, the anterior approach has a lower rate of revision. There is no difference when the posterior approach is compared to the lateral approach (Table HT65 and Figure HT57).

Revision for Infection
There is a lower rate of revision for infection for the anterior approach compared to both the posterior approach and lateral approach. There is no difference between the posterior and lateral approaches (Table HT66 and Figure HT58).

Revision for Dislocation/Instability
The anterior approach has a lower rate of revision for dislocation/instability compared to both the posterior approach and the lateral approach. There is no difference when the posterior is compared to the lateral approach (Table HT67 and Figure HT59).

Table HT59 Primary Total Conventional Hip Replacement by Age and Surgical Approach (Primary Diagnosis OA)

Age	Anterior		Lateral		Posterior	
	N	Col%	N	Col%	N	Col%
<55	10588	12.3	4187	10.0	17110	10.2
55-64	22152	25.7	9555	22.9	39176	23.3
65-74	31306	36.3	15172	36.4	60495	36.0
≥75	22232	25.8	12796	30.7	51275	30.5
TOTAL	**86278**	**100.0**	**41710**	**100.0**	**168056**	**100.0**

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT60 Primary Total Conventional Hip Replacement by BMI Category and Surgical Approach (Primary Diagnosis OA)

BMI	Anterior		Lateral		Posterior	
	N	Col%	N	Col%	N	Col%
Underweight (<18.50)	656	0.8	293	0.7	1160	0.7
Normal (18.50-24.99)	20250	23.9	7735	19.3	31430	19.3
Pre Obese (25.00-29.99)	33557	39.6	14131	35.3	57830	35.5
Obese Class 1 (30.00-34.99)	20319	24.0	10674	26.7	42927	26.3
Obese Class 2 (35.00-39.99)	7149	8.4	4826	12.1	19621	12.0
Obese Class 3 (≥40.00)	2733	3.2	2352	5.9	10162	6.2
TOTAL	**84664**	**100.0**	**40011**	**100.0**	**163130**	**100.0**

Note: All procedures using metal/metal prostheses have been excluded
BMI has not been presented for patients aged ≤19 years
Restricted to modern prostheses

Table HT61 Primary Total Conventional Hip Replacement by ASA Score and Surgical Approach (Primary Diagnosis OA)

ASA Score	Anterior		Lateral		Posterior	
	N	Col%	N	Col%	N	Col%
ASA 1	9121	10.6	3040	7.3	11619	6.9
ASA 2	48260	56.0	21680	52.1	88004	52.4
ASA 3	27906	32.4	16263	39.1	65599	39.1
ASA 4	868	1.0	628	1.5	2574	1.5
ASA 5	3	0.0	2	0.0	10	0.0
TOTAL	**86158**	**100.0**	**41613**	**100.0**	**167806**	**100.0**

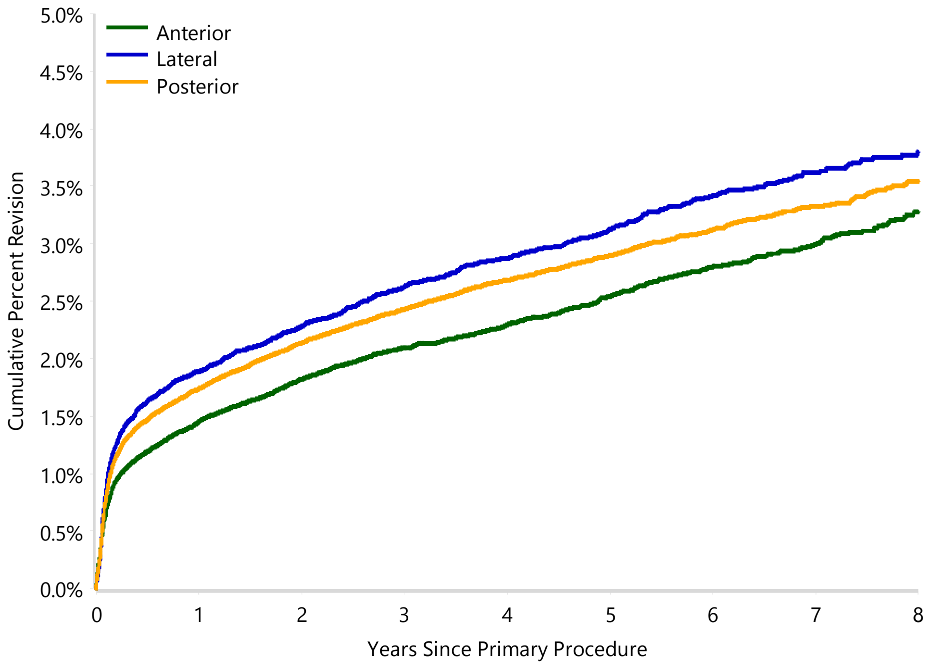
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT62 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Surgical Approach (Primary Diagnosis OA)

Surgical Approach	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	8 Yrs
Anterior	1850	84574	1.5 (1.4, 1.5)	2.1 (2.0, 2.2)	2.5 (2.4, 2.7)	3.0 (2.8, 3.2)	3.3 (3.1, 3.5)
Lateral	1183	39938	1.9 (1.8, 2.0)	2.6 (2.5, 2.8)	3.1 (2.9, 3.3)	3.6 (3.4, 3.8)	3.8 (3.6, 4.0)
Posterior	4102	162936	1.7 (1.7, 1.8)	2.4 (2.4, 2.5)	2.9 (2.8, 3.0)	3.3 (3.2, 3.4)	3.5 (3.4, 3.7)
TOTAL	**7135**	**287448**					

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses
Excludes procedures with unknown ASA Score, BMI category or head size

Figure HT53 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Surgical Approach (Primary Diagnosis OA)



HR - adjusted for age, gender, ASA score and BMI category, femoral fixation and head size

Lateral vs Anterior
Entire Period: HR=1.20 (1.11, 1.29),p<0.001

Posterior vs Anterior
Entire Period: HR=1.11 (1.05, 1.17),p<0.001

Posterior vs Lateral
Entire Period: HR=0.92 (0.87, 0.99),p=0.016

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	8 Yrs
Anterior	84574	70130	46634	27168	10966	4641
Lateral	39938	35211	27015	18398	8927	4132
Posterior	162936	135368	90804	52327	20937	8984

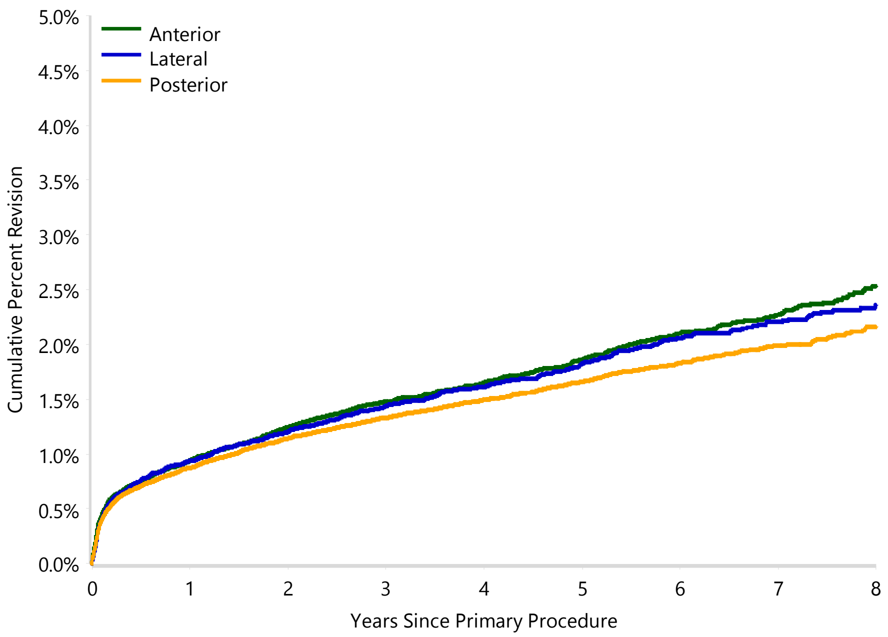
Note: All procedures using metal/metal prostheses have been excluded
Excludes procedures with unknown ASA score, BMI category or head size
Due to low numbers, ASA score 1–2 and 3–5 have been combined
Due to low numbers BMI category underweight and normal have been combined
Restricted to modern prostheses

Table HT63 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Surgical Approach (Primary Diagnosis OA, Major Revisions)

Surgical Approach	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	8 Yrs
Anterior	1330	84574	0.9 (0.9, 1.0)	1.5 (1.4, 1.6)	1.9 (1.8, 2.0)	2.3 (2.1, 2.4)	2.5 (2.4, 2.7)
Lateral	681	39938	0.9 (0.8, 1.0)	1.4 (1.3, 1.6)	1.8 (1.7, 2.0)	2.2 (2.0, 2.4)	2.4 (2.2, 2.6)
Posterior	2287	162936	0.9 (0.8, 0.9)	1.3 (1.3, 1.4)	1.7 (1.6, 1.7)	2.0 (1.9, 2.1)	2.2 (2.0, 2.3)
TOTAL	**4298**	**287448**					

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses
Excludes procedures with unknown ASA Score, BMI category or head size

Figure HT54 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Surgical Approach (Primary Diagnosis OA, Major Revisions)



HR - adjusted for age, gender, ASA score and BMI category, femoral fixation and head size

Lateral vs Anterior
Entire Period: HR=0.96 (0.87, 1.06),p=0.404

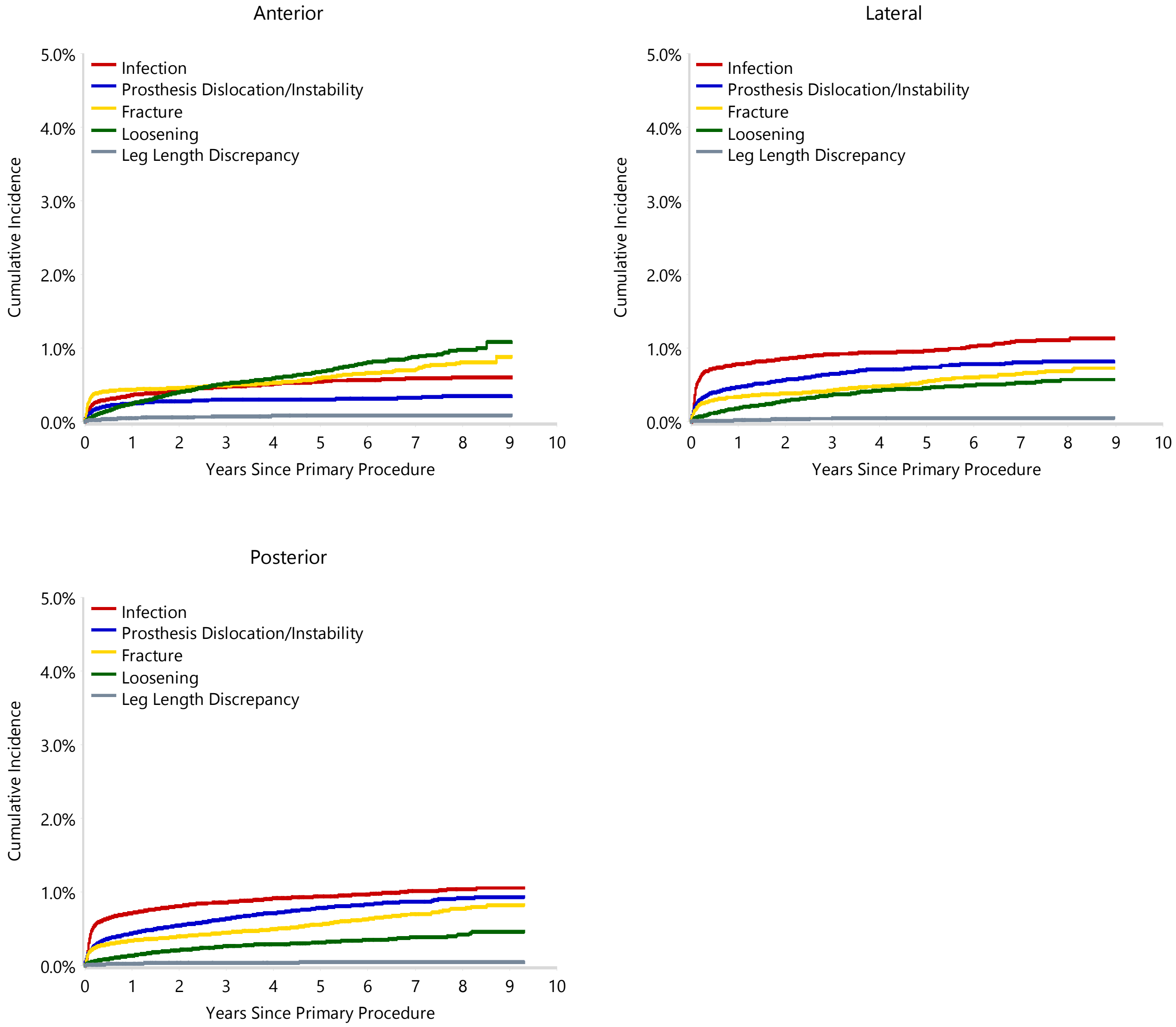
Posterior vs Anterior
Entire Period: HR=0.88 (0.82, 0.94),p<0.001

Posterior vs Lateral
Entire Period: HR=0.91 (0.84, 1.00),p=0.040

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	8 Yrs
Anterior	84574	70130	46634	27168	10966	4641
Lateral	39938	35211	27015	18398	8927	4132
Posterior	162936	135368	90804	52327	20937	8984

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses
Excludes procedures with unknown ASA Score, BMI category or head size
Due to low numbers ASA score 1–2 and 3–5 have been combined
Due to low numbers BMI category underweight and normal have been combined

Figure HT55 **Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement by Surgical Approach (Primary Diagnosis OA)**



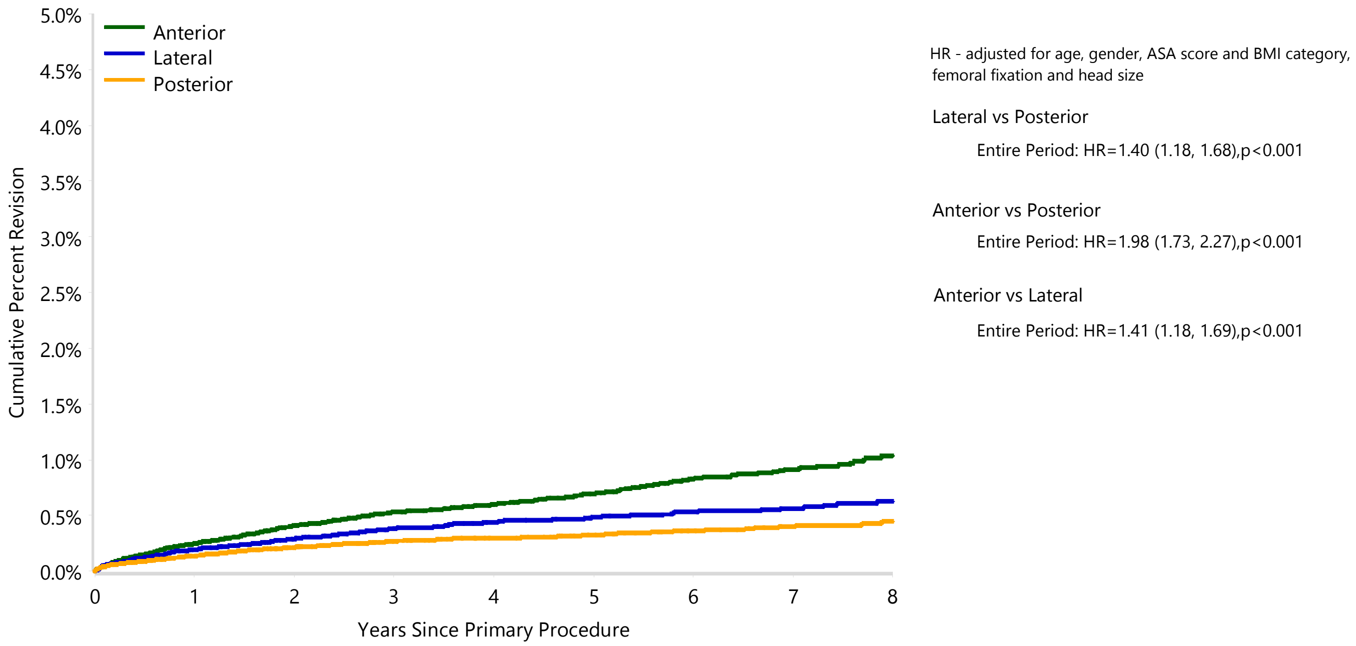
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT64 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Surgical Approach (Primary Diagnosis OA, Revision for Loosening)

Surgical Approach	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	8 Yrs
Anterior	474	84574	0.2 (0.2, 0.3)	0.5 (0.5, 0.6)	0.7 (0.6, 0.8)	0.9 (0.8, 1.0)	1.0 (0.9, 1.2)
Lateral	171	39938	0.2 (0.2, 0.2)	0.4 (0.3, 0.5)	0.5 (0.4, 0.6)	0.6 (0.5, 0.7)	0.6 (0.5, 0.7)
Posterior	438	162936	0.1 (0.1, 0.2)	0.3 (0.2, 0.3)	0.3 (0.3, 0.4)	0.4 (0.4, 0.5)	0.4 (0.4, 0.5)
TOTAL	**1083**	**287448**					

Note: All procedures using metal/metal prostheses have been excluded
Excludes procedures with unknown ASA score, BMI category or head size
Restricted to modern prostheses

Figure HT56 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Surgical Approach (Primary Diagnosis OA, Revision for Loosening)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	8 Yrs
Anterior	84574	70130	46634	27168	10966	4641
Lateral	39938	35211	27015	18398	8927	4132
Posterior	162936	135368	90804	52327	20937	8984

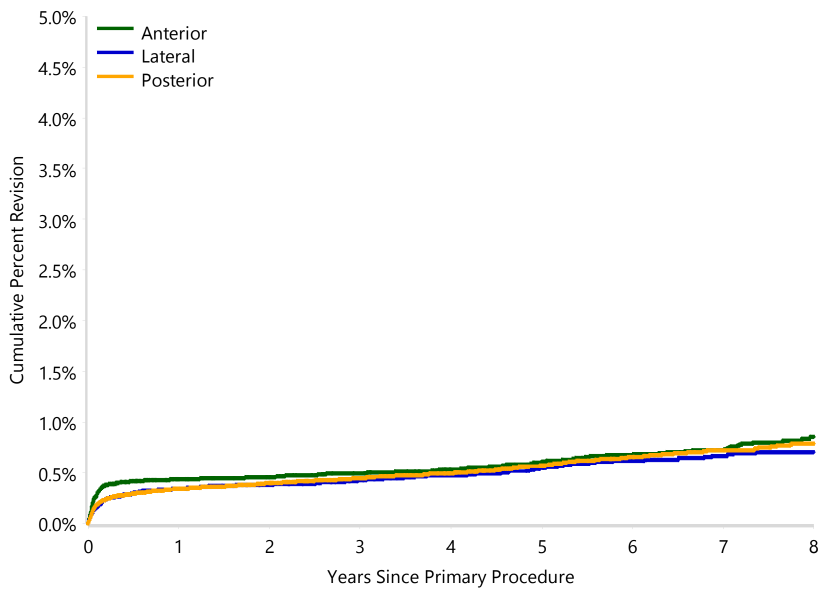
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses
Excludes procedures with unknown ASA Score, BMI category or head size
Due to low numbers ASA score 1–2 and 3–5 have been combined
Due to low numbers BMI category underweight and normal have been combined

Table HT65 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Surgical Approach (Primary Diagnosis OA, Revision for Fracture)

Surgical Approach	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	8 Yrs
Anterior	470	84574	0.4 (0.4, 0.5)	0.5 (0.4, 0.5)	0.6 (0.5, 0.7)	0.7 (0.6, 0.8)	0.9 (0.7, 1.0)
Lateral	209	39938	0.3 (0.3, 0.4)	0.4 (0.4, 0.5)	0.5 (0.5, 0.6)	0.7 (0.6, 0.8)	0.7 (0.6, 0.8)
Posterior	814	162936	0.3 (0.3, 0.4)	0.4 (0.4, 0.5)	0.6 (0.5, 0.6)	0.7 (0.7, 0.8)	0.8 (0.7, 0.9)
TOTAL	**1493**	**287448**					

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses
Excludes procedures with unknown ASA score, BMI category or head size

Figure HT57 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Surgical Approach (Primary Diagnosis OA, Revision for Fracture)



HR - adjusted for age, gender, ASA score and BMI category, femoral fixation and head size

Posterior vs Lateral
Entire Period: HR=1.07 (0.92, 1.24),p=0.410

Anterior vs Lateral
0-3Mth: HR=1.59 (1.32, 1.92),p<0.001
3Mth+: HR=0.75 (0.60, 0.93),p=0.009

Anterior vs Posterior
0-3Mth: HR=1.49 (1.29, 1.72),p<0.001
3Mth+: HR=0.70 (0.58, 0.85),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	8 Yrs
Anterior	84574	70130	46634	27168	10966	4641
Lateral	39938	35211	27015	18398	8927	4132
Posterior	162936	135368	90804	52327	20937	8984

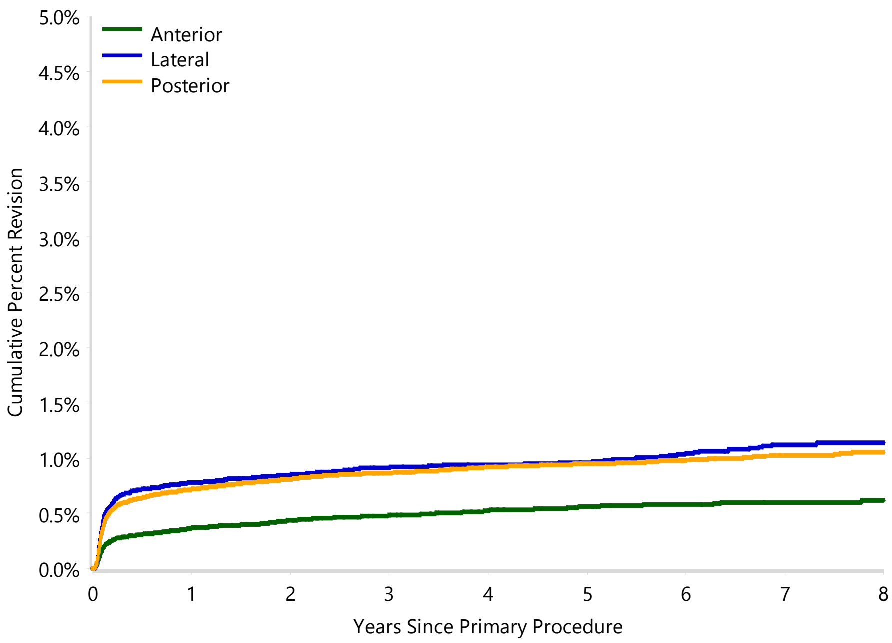
Note: All procedures using metal/metal prostheses have been excluded
Excludes procedures with unknown ASA Score, BMI category or head size
Due to low numbers ASA score 1–2 and 3–5 have been combined
Due to low numbers BMI category underweight and normal have been combined
Restricted to modern prostheses

Table HT66 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Surgical Approach (Primary Diagnosis OA, Revision for Infection)

Surgical Approach	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	8 Yrs
Anterior	404	84574	0.4 (0.3, 0.4)	0.5 (0.4, 0.5)	0.6 (0.5, 0.6)	0.6 (0.5, 0.7)	0.6 (0.6, 0.7)
Lateral	382	39938	0.8 (0.7, 0.9)	0.9 (0.8, 1.0)	1.0 (0.9, 1.1)	1.1 (1.0, 1.3)	1.1 (1.0, 1.3)
Posterior	1399	162936	0.7 (0.7, 0.8)	0.9 (0.8, 0.9)	0.9 (0.9, 1.0)	1.0 (1.0, 1.1)	1.1 (1.0, 1.1)
TOTAL	**2185**	**287448**					

Note: All procedures using metal/metal prostheses have been excluded
Excludes procedures with unknown ASA score, BMI category or head size
Restricted to modern prostheses

Figure HT58 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Surgical Approach (Primary Diagnosis OA, Revision for Infection)



HR - adjusted for age, gender, ASA score and BMI category, femoral fixation and head size

Lateral vs Anterior
Entire Period: HR=1.62 (1.41, 1.87),p<0.001

Posterior vs Anterior
Entire Period: HR=1.51 (1.35, 1.69),p<0.001

Posterior vs Lateral
Entire Period: HR=0.93 (0.83, 1.04),p=0.200

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	8 Yrs
Anterior	84574	70130	46634	27168	10966	4641
Lateral	39938	35211	27015	18398	8927	4132
Posterior	162936	135368	90804	52327	20937	8984

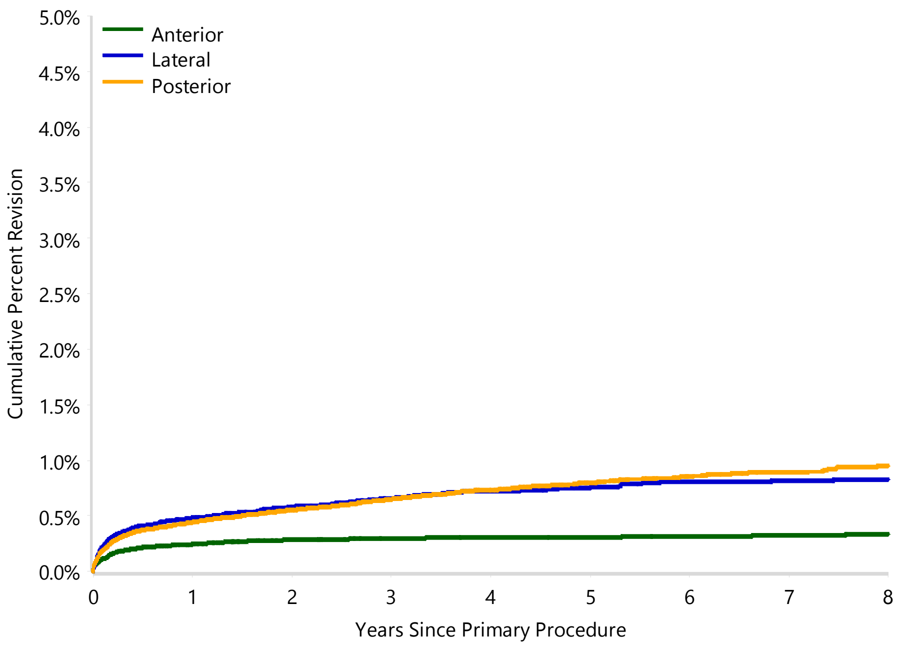
Note: All procedures using metal/metal prostheses have been excluded
Excludes procedures with unknown ASA Score, BMI category or head size
Due to low numbers ASA score 1–2 and 3–5 have been combined
Due to low numbers BMI category underweight and normal have been combined
Restricted to modern prostheses

Table HT67 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Surgical Approach (Primary Diagnosis OA, Revision for Dislocation/Instability)

Surgical Approach	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	8 Yrs
Anterior	240	84574	0.2 (0.2, 0.3)	0.3 (0.3, 0.3)	0.3 (0.3, 0.4)	0.3 (0.3, 0.4)	0.3 (0.3, 0.4)
Lateral	276	39938	0.5 (0.4, 0.6)	0.7 (0.6, 0.7)	0.8 (0.7, 0.8)	0.8 (0.7, 0.9)	0.8 (0.7, 0.9)
Posterior	1083	162936	0.4 (0.4, 0.5)	0.7 (0.6, 0.7)	0.8 (0.8, 0.9)	0.9 (0.8, 1.0)	1.0 (0.9, 1.0)
TOTAL	**1599**	**287448**					

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses
Excludes procedures with unknown ASA score, BMI category or head size

Figure HT59 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Surgical Approach (Primary Diagnosis OA, Revision for Dislocation/Instability)



HR - adjusted for age, gender, ASA score and BMI category, femoral fixation and head size

Lateral vs Anterior
0-2wk: HR=1.53 (1.06, 2.21),p=0.023
2wk-1Mth: HR=2.55 (1.78, 3.64),p<0.001
1Mth-6Mth: HR=1.75 (1.33, 2.32),p<0.001
6Mth+: HR=3.16 (2.35, 4.23),p<0.001

Posterior vs Anterior
0-3Mth: HR=1.64 (1.37, 1.97),p<0.001
3Mth-9Mth: HR=2.03 (1.53, 2.69),p<0.001
9Mth+: HR=4.34 (3.32, 5.67),p<0.001

Posterior vs Lateral
Entire Period: HR=1.06 (0.93, 1.21),p=0.417

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	8 Yrs
Anterior	84574	70130	46634	27168	10966	4641
Lateral	39938	35211	27015	18398	8927	4132
Posterior	162936	135368	90804	52327	20937	8984

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses
Excludes procedures with unknown ASA Score, BMI category or head size
Due to low numbers ASA score 1–2 and 3–5 have been combined
Due to low numbers BMI category underweight and normal have been combined

OUTCOME FOR FRACTURED NECK OF FEMUR

There have been 30,174 primary total conventional hip replacement procedures undertaken for a diagnosis of fractured neck of femur.

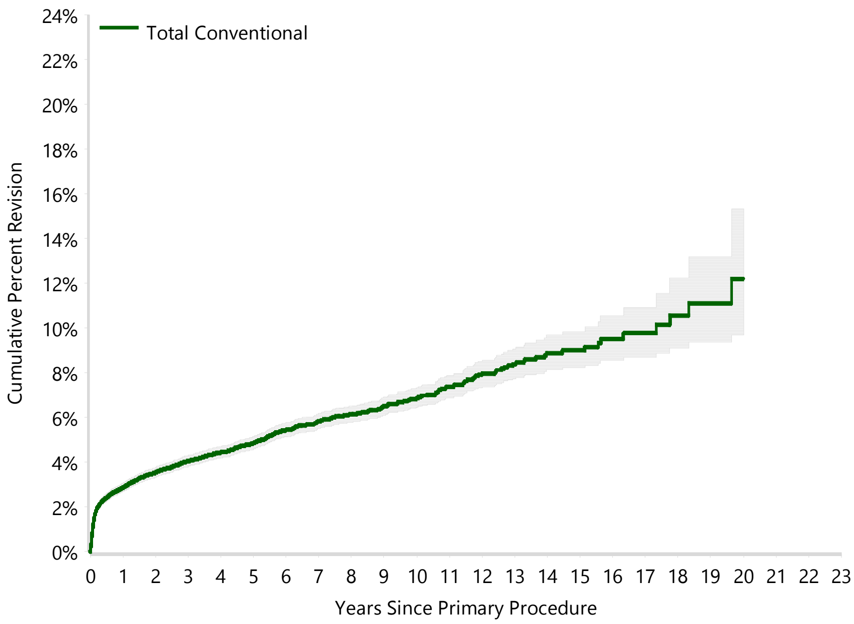
The cumulative percent revision of primary total conventional hip replacement for fractured neck of femur is 12.2% at 20 years (Table HT68 and Figure HT60). At 20 years, the cumulative percent survival of patients is 21.1% (Table HT69 and Figure HT61).

Table HT68 Cumulative Percent Revision of Primary Total Conventional Hip Replacement (Primary Diagnosis Fractured NOF)

Hip Class	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Total Conventional	1419	30174	2.9 (2.7, 3.1)	4.0 (3.8, 4.3)	4.9 (4.6, 5.1)	6.9 (6.4, 7.3)	9.0 (8.2, 9.8)	12.2 (9.7, 15.3)
TOTAL	**1419**	**30174**						

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Figure HT60 Cumulative Percent Revision of Primary Total Conventional Hip Replacement (Primary Diagnosis Fractured NOF)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Total Conventional	30174	24876	17657	11719	3215	635	65

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

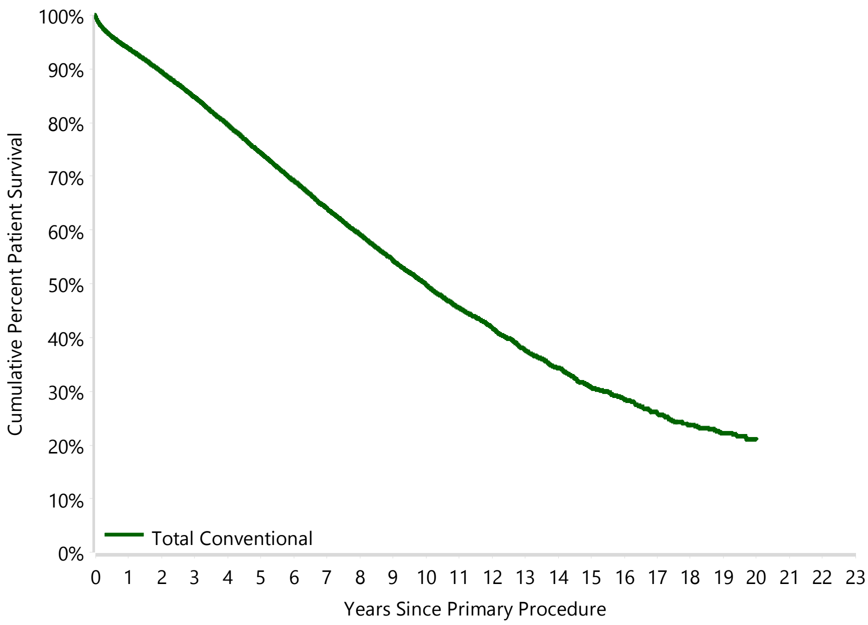
Primary Total Hip Replacement

Table HT69 Cumulative Percent Survival of Patients with Primary Total Conventional Hip Replacement (Primary Diagnosis Fractured NOF)

Hip Class	N Deceased	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Total Conventional	9334	30174	93.8 (93.5, 94.0)	84.7 (84.3, 85.1)	74.3 (73.7, 74.9)	49.8 (48.9, 50.7)	30.7 (29.4, 32.0)	21.1 (19.2, 23.2)
TOTAL	**9334**	**30174**						

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Figure HT61 Cumulative Percent Survival of Patients with Primary Total Conventional Hip Replacement (Primary Diagnosis Fractured NOF)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Total Conventional	30174	24876	17657	11719	3215	635	65

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Reasons for Revision

Prosthesis dislocation/instability is the most common reason for revision, followed by fracture, infection, and loosening (Table HT70 and Figure HT62).

Table HT70 Primary Total Conventional Hip Replacement by Reason for Revision (Primary Diagnosis Fractured NOF)

Reason for Revision	Number	Percent
Prosthesis Dislocation/Instability	452	31.9
Fracture	429	30.2
Infection	270	19.0
Loosening	187	13.2
Leg Length Discrepancy	11	0.8
Pain	10	0.7
Malposition	8	0.6
Implant Breakage Acetabular	7	0.5
Implant Breakage Stem	7	0.5
Implant Breakage Acetabular Insert	7	0.5
Lysis	6	0.4
Tumour	4	0.3
Metal Related Pathology	3	0.2
Incorrect Sizing	2	0.1
Heterotopic Bone	1	0.1
Progression Of Disease	1	0.1
Wear Head	1	0.1
Other	13	0.9
TOTAL	**1419**	**100.0**

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Type of Revision

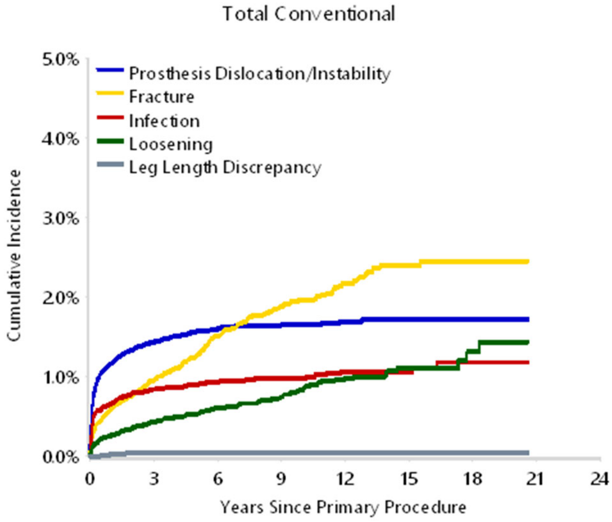
The most common type of revision is of the femoral component only, followed by head and insert, acetabular only, and total hip replacement (femoral/acetabular) (Table HT71).

Table HT71 Primary Total Conventional Hip Replacement by Type of Revision (Primary Diagnosis Fractured NOF)

Type of Revision	Number	Percent
Femoral Component	520	36.6
Head/Insert	369	26.0
Acetabular Component	230	16.2
THR (Femoral/Acetabular)	144	10.1
Head Only	60	4.2
Cement Spacer	37	2.6
Minor Components	30	2.1
Insert Only	18	1.3
Removal of Prostheses	6	0.4
Total Femoral	3	0.2
Reinsertion of Components	1	0.1
Bipolar Head and Femoral	1	0.1
TOTAL	**1419**	**100.0**

Note: Femoral heads are usually replaced when the acetabular component or femoral stem is revised
All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Figure HT62 Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement (Primary Diagnosis Fractured NOF)



Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Age and Gender

There is a difference in the rate of revision with respect to age with younger patients aged <55 years having a higher rate of revision compared to patients aged ≥75 years. There are no differences between patients aged ≥75 years and the other two age groups (Table HT72 and Figure HT63). Males have a higher rate of revision compared to females except for the first month (Table HT73 and Figure HT64).

Males aged 75 years and older have a higher rate of revision compared to males aged 65-74 years from one month onwards, with no difference prior to this time. There are no other differences for males aged ≥75 years compared to the other age groups (Table HT73 and Figure HT65).

Females aged <55 years have a higher rate of revision compared to females aged ≥75 years after one month with no difference prior to this time. There are no differences when other age groups are compared to females aged ≥75 (Table HT73 and Figure HT66).

The most common reasons for revision by gender and age are shown in Figure HT67 and Figure HT68.

ASA and BMI

ASA scores are an indication of comorbidity and have been collected since 2012. The definitions for these scores can be found in the introductory section of this chapter. The outcome of 23,106 primary total conventional hip replacement procedures for fractured neck of femur are reported in relation to these scores.

The majority of patients having a primary conventional hip replacement for fracture have an ASA score of 2 or 3, and this has changed little over time (Figure HT69).

When compared to patients with an ASA score of 1, patients with an ASA score of 2, 3 and 4 have higher rates of revision (Table HT74 and Figure HT70). The most common reasons for revision for each ASA score are shown in Figure HT71. The difference in the rate of revision is partially due to an increase in revision for dislocation/instability and infection with increasing ASA score.

There is a larger proportion of fractured neck of femur patients with an ASA score of 3 or 4 than patients with osteoarthritis (Table HT75).

BMI data have been collected since 2015. The revision outcomes are reported for 14,729 primary total conventional hip replacement procedures for fractured neck of femur.

Over 75% of patients having a hip replacement for fracture are in the normal or pre-obese category, and there has been little change in BMI over time (Figure HT72).

Patients in obese class 2 and 3 have a higher rate of revision compared to patients in the normal BMI class (Table HT76 and Figure HT73). The most common reasons for revision are shown in Figure HT74.

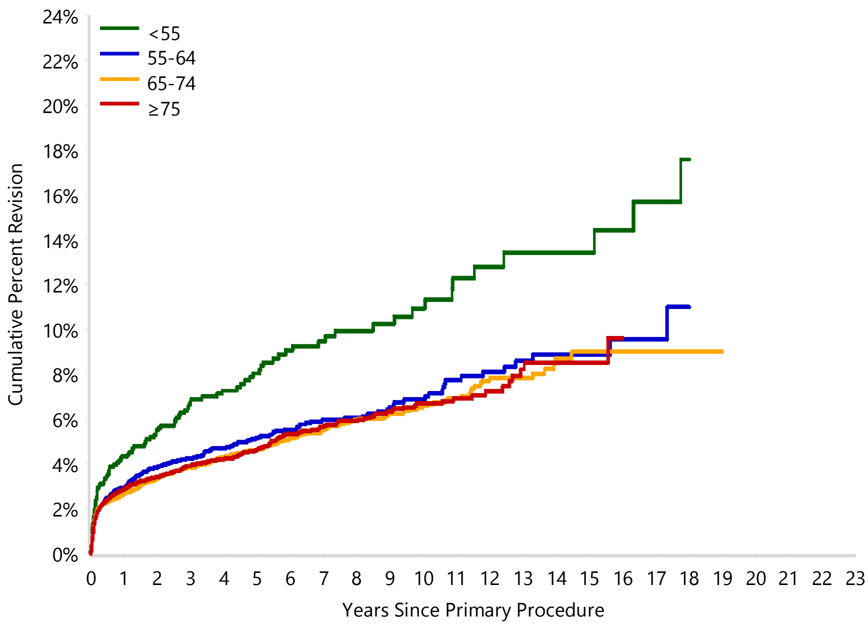
Primary Total Hip Replacement

Table HT72 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Age (Primary Diagnosis Fractured NOF)

Age	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<55	108	1286	4.3 (3.3, 5.6)	5.5 (4.3, 7.0)	6.7 (5.4, 8.4)	8.0 (6.5, 9.9)	9.5 (7.7, 11.6)	10.9 (8.8, 13.5)
55-64	224	4269	2.9 (2.5, 3.5)	3.8 (3.3, 4.5)	4.2 (3.6, 4.9)	5.2 (4.5, 5.9)	6.0 (5.2, 6.9)	6.9 (5.9, 8.0)
65-74	436	9350	2.7 (2.3, 3.0)	3.3 (3.0, 3.7)	3.8 (3.4, 4.2)	4.6 (4.2, 5.1)	5.5 (5.0, 6.1)	6.6 (5.9, 7.4)
≥75	651	15269	2.9 (2.6, 3.2)	3.4 (3.1, 3.7)	3.9 (3.6, 4.2)	4.6 (4.3, 5.0)	5.7 (5.2, 6.2)	6.7 (6.0, 7.4)
TOTAL	**1419**	**30174**						

Note: All procedures using metal/metal prostheses have been excluded. Restricted to modern prostheses

Figure HT63 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Age (Primary Diagnosis Fractured NOF)



HR - adjusted for gender

<55 vs ≥75

Entire Period: HR=1.57 (1.28, 1.93), p<0.001

55-64 vs ≥75

Entire Period: HR=1.05 (0.90, 1.22), p=0.565

65-74 vs ≥75

Entire Period: HR=0.98 (0.87, 1.11), p=0.751

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<55	1286	1040	897	779	569	405	229
55-64	4269	3589	3118	2703	1954	1357	706
65-74	9350	7920	6763	5822	4053	2609	1230
≥75	15269	12327	10278	8353	5143	2878	1050

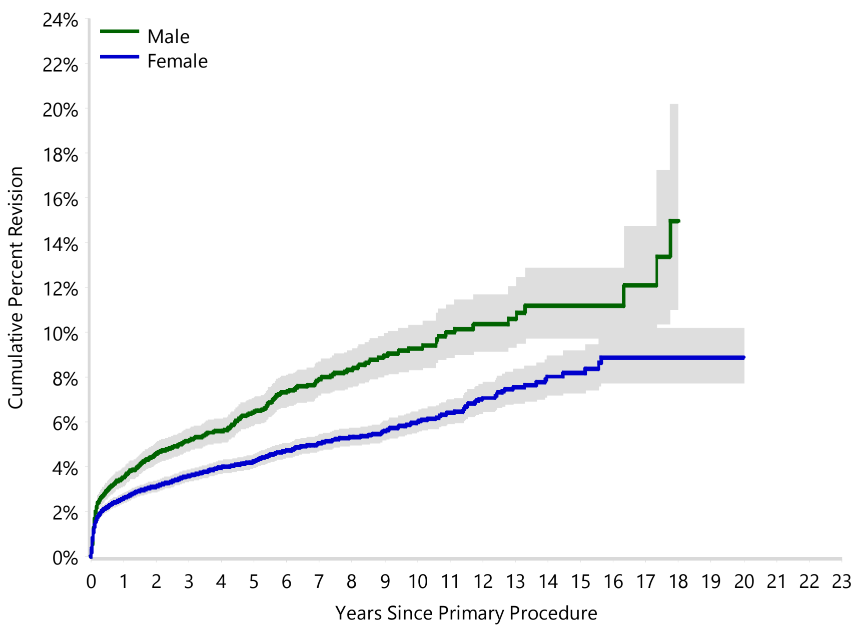
Note: All procedures using metal/metal prostheses have been excluded. Restricted to modern prostheses

Table HT73 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Gender and Age (Primary Diagnosis Fractured NOF)

Gender	Age	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Male		**520**	**8963**	**3.5 (3.2, 3.9)**	**4.6 (4.1, 5.1)**	**5.2 (4.7, 5.7)**	**6.5 (5.9, 7.1)**	**7.9 (7.2, 8.7)**	**9.3 (8.3, 10.3)**
	<55	56	614	5.1 (3.6, 7.2)	6.8 (5.0, 9.2)	8.0 (5.9, 10.6)	9.5 (7.2, 12.5)	9.9 (7.5, 13.0)	10.9 (8.2, 14.3)
	55-64	84	1405	3.5 (2.7, 4.6)	4.8 (3.8, 6.1)	5.0 (4.0, 6.4)	6.0 (4.7, 7.5)	6.5 (5.2, 8.2)	6.8 (5.4, 8.6)
	65-74	137	2619	3.1 (2.5, 3.8)	4.1 (3.3, 4.9)	4.5 (3.7, 5.4)	5.7 (4.7, 6.8)	6.8 (5.6, 8.1)	8.4 (6.8, 10.3)
	≥75	243	4325	3.6 (3.1, 4.2)	4.5 (3.9, 5.2)	5.3 (4.6, 6.1)	6.7 (5.8, 7.8)	9.4 (8.0, 10.9)	11.6 (9.7, 13.9)
Female		**899**	**21211**	**2.6 (2.4, 2.8)**	**3.1 (2.9, 3.4)**	**3.6 (3.3, 3.9)**	**4.2 (3.9, 4.5)**	**5.1 (4.7, 5.4)**	**6.0 (5.5, 6.5)**
	<55	52	672	3.6 (2.4, 5.4)	4.3 (3.0, 6.3)	5.7 (4.0, 7.9)	6.7 (4.9, 9.2)	9.1 (6.7, 12.2)	11.0 (8.0, 15.0)
	55-64	140	2864	2.6 (2.1, 3.3)	3.4 (2.7, 4.1)	3.8 (3.2, 4.6)	4.8 (4.0, 5.7)	5.7 (4.7, 6.8)	6.8 (5.6, 8.2)
	65-74	299	6731	2.5 (2.1, 2.9)	3.1 (2.7, 3.5)	3.6 (3.1, 4.1)	4.2 (3.7, 4.8)	5.1 (4.5, 5.8)	6.0 (5.2, 6.8)
	≥75	408	10944	2.6 (2.3, 2.9)	3.0 (2.7, 3.4)	3.4 (3.1, 3.8)	3.9 (3.5, 4.3)	4.5 (4.1, 5.0)	5.3 (4.7, 6.0)
TOTAL		**1419**	**30174**						

Note: All procedures using metal/metal prostheses have been excluded. Restricted to modern prostheses

Figure HT64 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Gender (Primary Diagnosis Fractured NOF)



HR - adjusted for age

Male vs Female

0 - 1Mth: HR=1.04 (0.83, 1.31), p=0.720

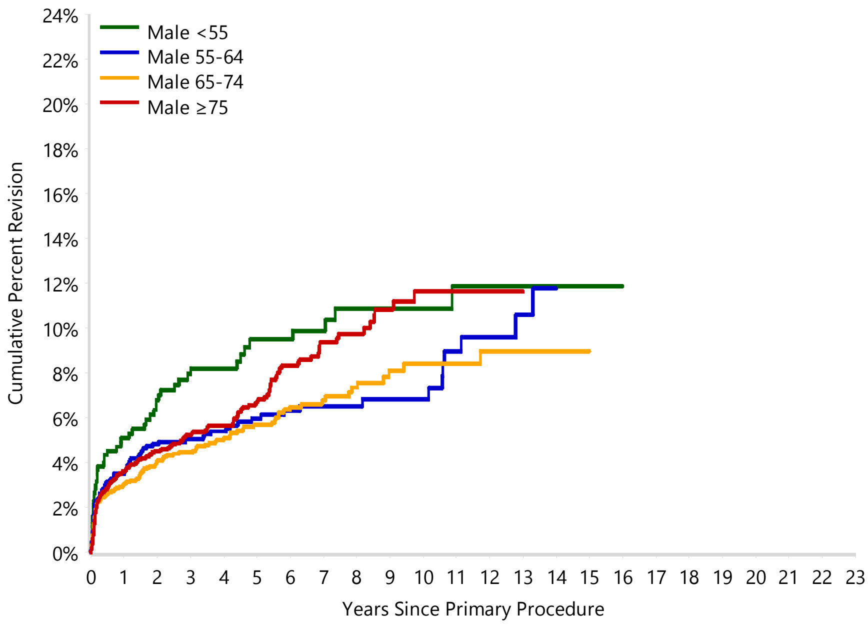
1Mth - 3Mth: HR=1.76 (1.38, 2.25), p<0.001

3Mth+: HR=1.61 (1.39, 1.85), p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Male	8963	7056	5747	4688	2918	1703	748
Female	21211	17820	15309	12969	8801	5546	2467

Note: All procedures using metal/metal prostheses have been excluded. Restricted to modern prostheses

Figure HT65 Cumulative Percent Revision of Primary Total Conventional Hip Replacement in Males by Age (Primary Diagnosis Fractured NOF)



Male <55 vs Male ≥75
Entire Period: HR=1.25 (0.93, 1.67), p=0.145

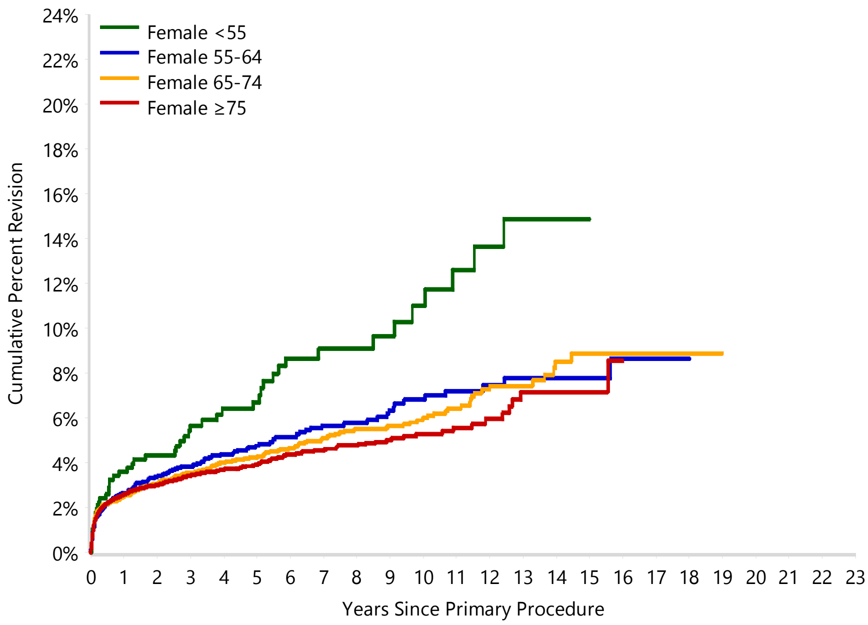
Male 55-64 vs Male ≥75
0 - 1Mth: HR=1.54 (0.93, 2.54), p=0.092
1Mth - 3Mth: HR=0.65 (0.36, 1.16), p=0.144
3Mth+: HR=0.78 (0.57, 1.08), p=0.137

Male 65-74 vs Male ≥75
0 - 1Mth: HR=1.17 (0.74, 1.83), p=0.502
1Mth+: HR=0.73 (0.58, 0.93), p=0.009

Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Male	<55	614	489	422	370	265	192	108
	55-64	1405	1166	983	840	582	395	196
	65-74	2619	2138	1775	1500	980	573	263
	≥75	4325	3263	2567	1978	1091	543	181

Note: All procedures using metal/metal prostheses have been excluded. Restricted to modern prostheses

Figure HT66 Cumulative Percent Revision of Primary Total Conventional Hip Replacement in Females by Age (Primary Diagnosis Fractured NOF)



Female <55 vs Female ≥75
0 - 1Mth: HR=0.98 (0.46, 2.09), p=0.962
1Mth+: HR=2.19 (1.60, 2.99), p<0.001

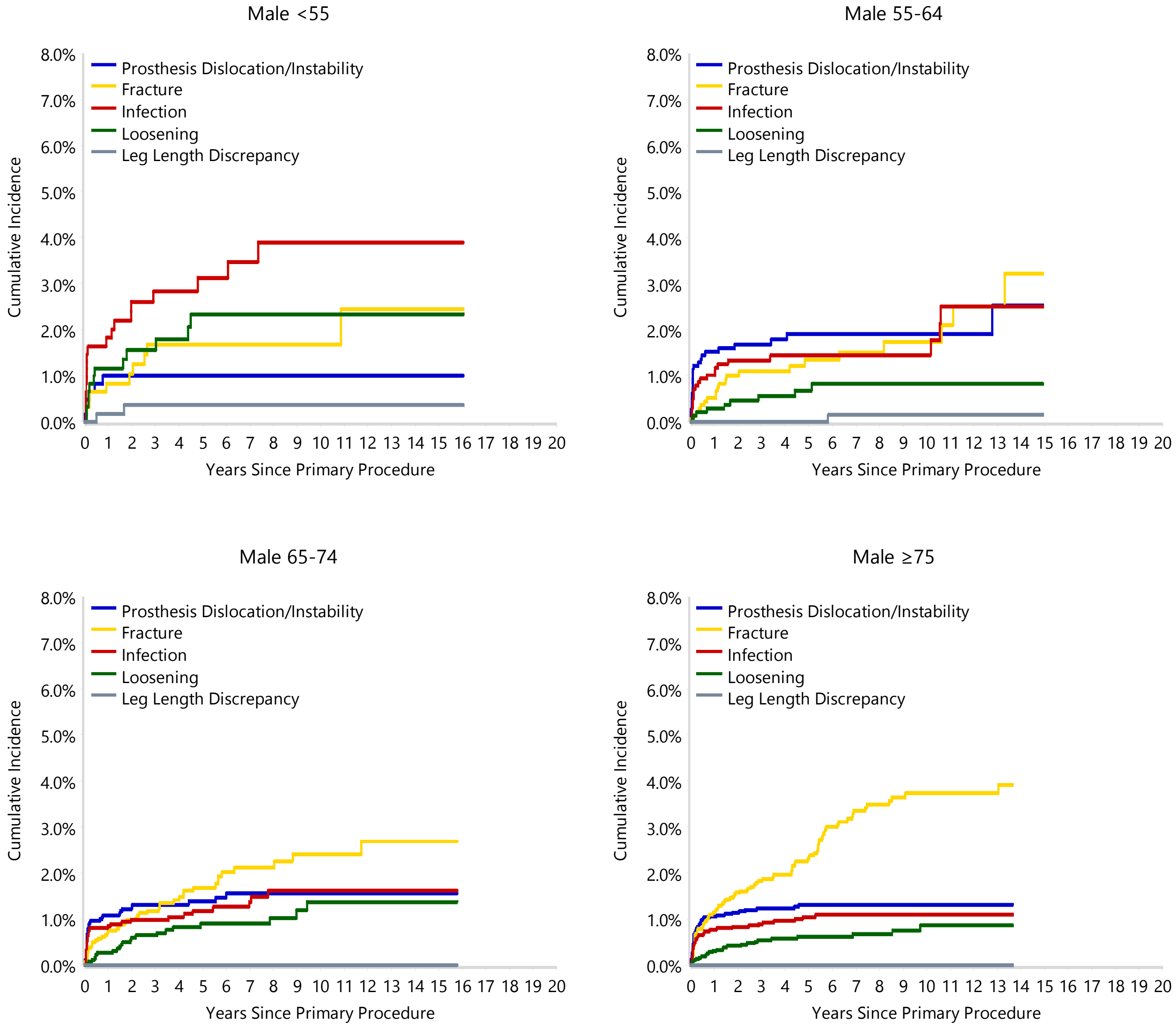
Female 55-64 vs Female ≥75
Entire Period: HR=1.16 (0.96, 1.41), p=0.131

Female 65-74 vs Female ≥75
Entire Period: HR=1.09 (0.94, 1.26), p=0.278

Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Female	<55	672	551	475	409	304	213	121
	55-64	2864	2423	2135	1863	1372	962	510
	65-74	6731	5782	4988	4322	3073	2036	967
	≥75	10944	9064	7711	6375	4052	2335	869

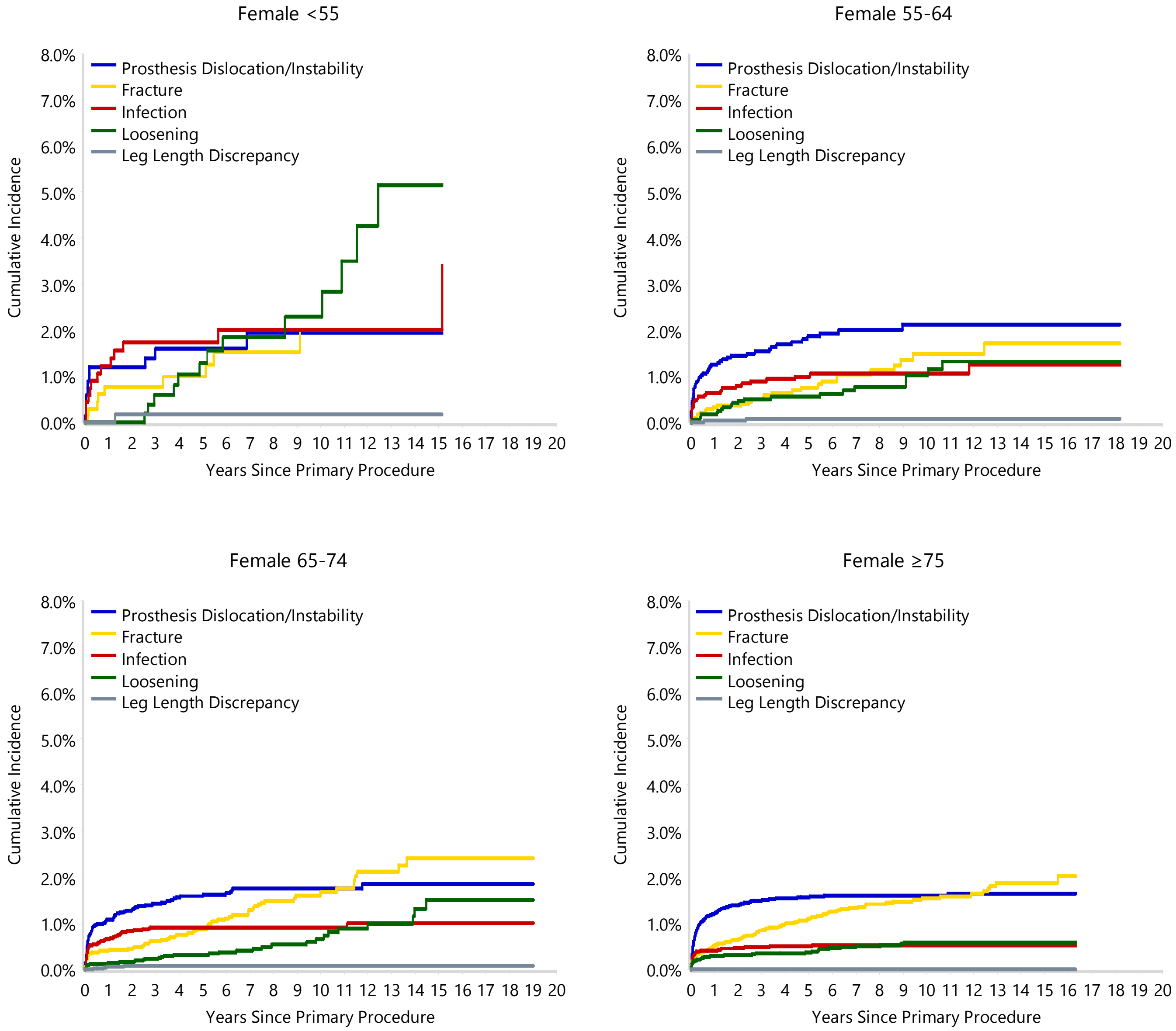
Note: All procedures using metal/metal prostheses have been excluded. Restricted to modern prostheses

Figure HT67 Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement in Males by Age (Primary Diagnosis Fractured NOF)



Note: All procedures using metal/metal prostheses have been excluded. Restricted to modern prostheses

Figure HT68 Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement in Females by Age (Primary Diagnosis Fractured NOF)



Note: All procedures using metal/metal prostheses have been excluded. Restricted to modern prostheses

Figure HT69 Primary Total Conventional Hip Replacement by ASA Score (Primary Diagnosis Fractured NOF)

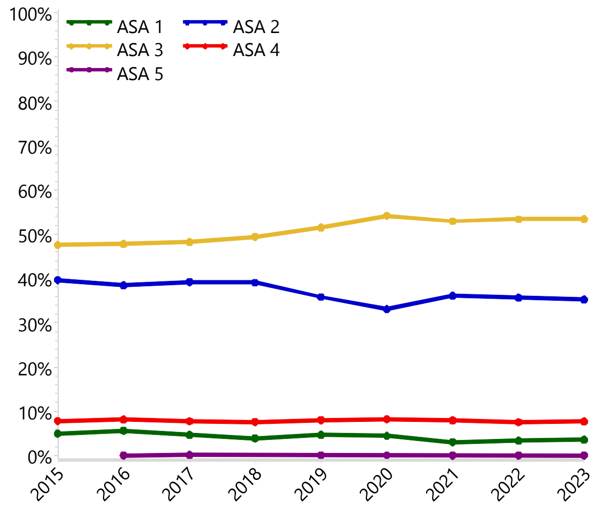
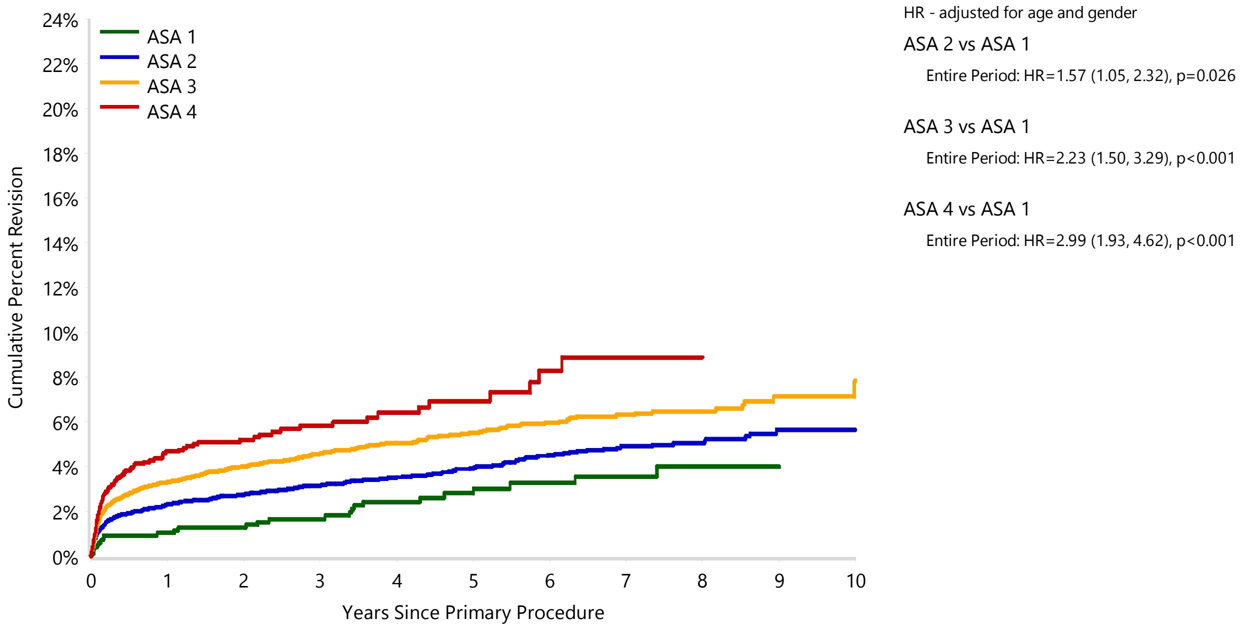


Table HT74 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by ASA Score (Primary Diagnosis Fractured NOF)

ASA Score	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	7 Yrs
ASA 1	27	981	1.0 (0.6, 1.9)	1.3 (0.7, 2.2)	1.7 (1.0, 2.8)	2.4 (1.6, 3.8)	2.8 (1.8, 4.3)	3.6 (2.4, 5.3)
ASA 2	311	8500	2.3 (2.0, 2.7)	2.8 (2.4, 3.1)	3.2 (2.8, 3.6)	3.5 (3.1, 4.0)	3.9 (3.5, 4.4)	4.9 (4.3, 5.5)
ASA 3	542	11795	3.3 (3.0, 3.7)	4.0 (3.6, 4.4)	4.6 (4.2, 5.0)	5.1 (4.6, 5.5)	5.5 (5.0, 6.0)	6.3 (5.7, 7.0)
ASA 4	95	1819	4.7 (3.7, 5.8)	5.2 (4.2, 6.5)	5.8 (4.7, 7.2)	6.4 (5.1, 7.9)	6.9 (5.5, 8.7)	8.9 (6.7, 11.7)
ASA 5	0	11	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)				
TOTAL	**975**	**23106**						

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

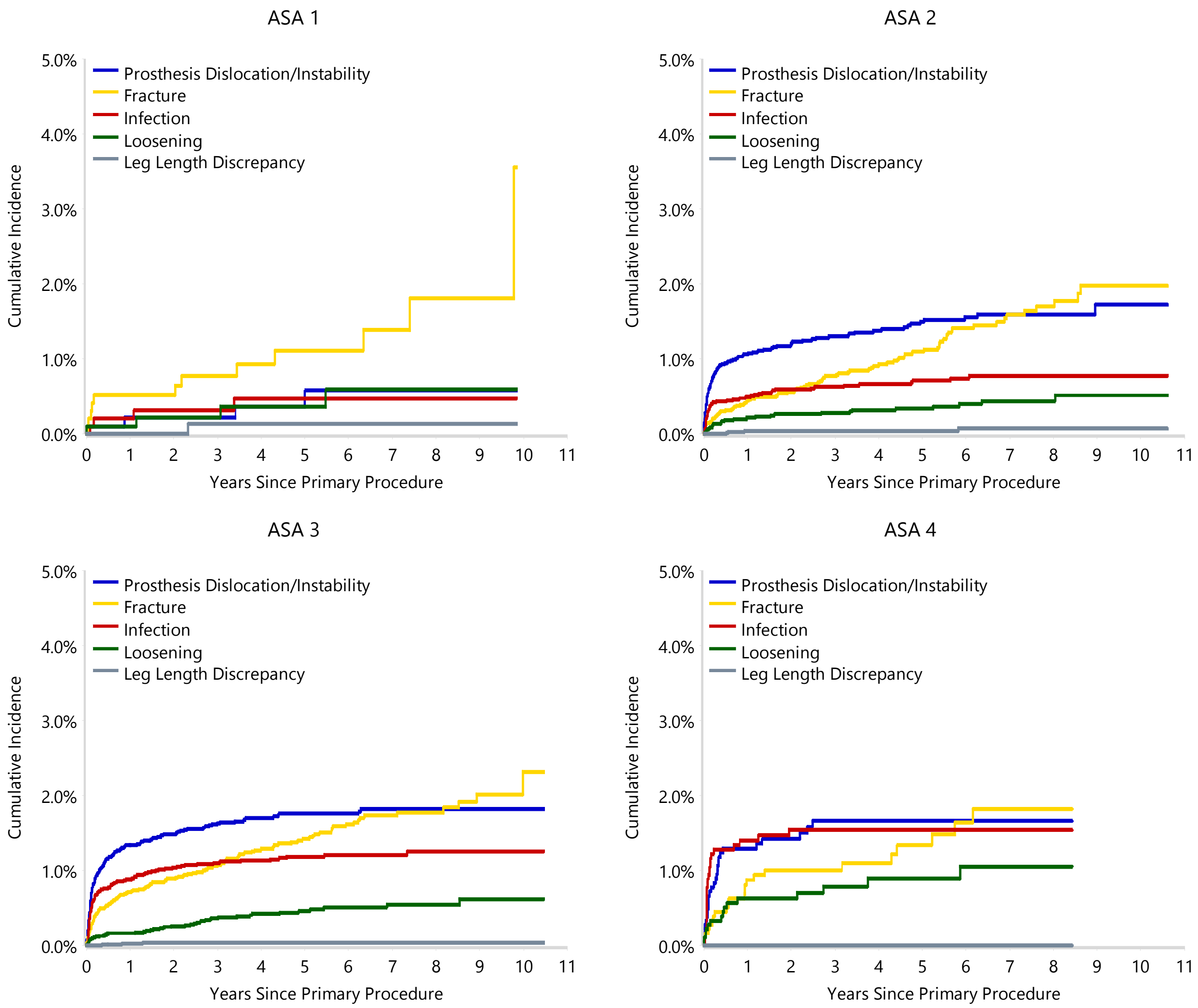
Figure HT70 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by ASA Score (Primary Diagnosis Fractured NOF)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	7 Yrs
ASA 1	981	870	766	682	564	453	262
ASA 2	8500	7230	6151	5129	4239	3301	1657
ASA 3	11795	9294	7428	5800	4317	3078	1365
ASA 4	1819	1190	865	611	409	269	99

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Figure HT71 Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement by ASA Score (Primary Diagnosis Fractured NOF)



Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT75 Primary Total Conventional Hip Replacement by ASA Score and Primary Diagnosis

ASA Score	Fractured Neck of Femur		Osteoarthritis		TOTAL	
	N	Col%	N	Col%	N	Col%
ASA 1	981	4.2	27875	8.3	28856	8.0
ASA 2	8500	36.8	181250	53.8	189750	52.7
ASA 3	11795	51.0	123057	36.5	134852	37.5
ASA 4	1819	7.9	4690	1.4	6509	1.8
ASA 5	11	0.0	19	0.0	30	0.0
TOTAL	**23106**	**100.0**	**336891**	**100.0**	**359997**	**100.0**

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Figure HT72 Primary Total Conventional Hip Replacement by BMI Category (Primary Diagnosis Fractured NOF)

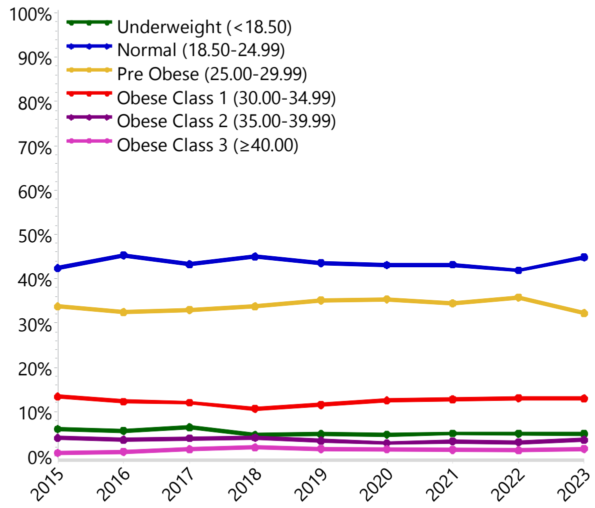
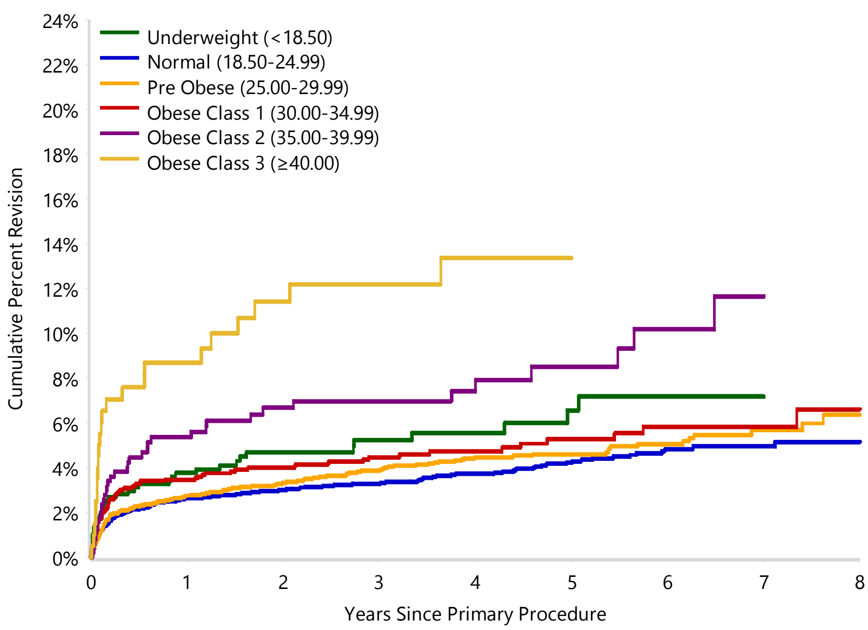


Table HT76 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by BMI Category (Primary Diagnosis Fractured NOF)

BMI Category	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	6 Yrs	7 Yrs	8 Yrs
Underweight (<18.50)	38	762	3.8 (2.6, 5.4)	5.2 (3.7, 7.3)	6.6 (4.6, 9.3)	7.2 (5.0, 10.3)	7.2 (5.0, 10.3)	
Normal (18.50-24.99)	221	6416	2.6 (2.3, 3.1)	3.3 (2.9, 3.8)	4.2 (3.7, 4.9)	4.8 (4.2, 5.6)	5.0 (4.2, 5.8)	5.2 (4.4, 6.1)
Pre Obese (25.00-29.99)	195	5021	2.8 (2.3, 3.3)	3.9 (3.3, 4.5)	4.6 (4.0, 5.3)	5.1 (4.3, 5.9)	5.7 (4.8, 6.8)	6.4 (5.1, 7.9)
Obese Class 1 (30.00-34.99)	81	1815	3.5 (2.7, 4.5)	4.5 (3.6, 5.6)	5.3 (4.2, 6.7)	5.8 (4.5, 7.5)	5.8 (4.5, 7.5)	6.6 (4.8, 9.1)
Obese Class 2 (35.00-39.99)	38	511	5.4 (3.7, 7.8)	7.0 (5.0, 9.8)	8.5 (6.0, 11.9)	10.2 (7.1, 14.5)	11.7 (7.8, 17.2)	
Obese Class 3 (≥40.00)	24	204	8.7 (5.5, 13.6)	12.2 (8.1, 18.0)	13.4 (8.9, 19.7)			
TOTAL	**597**	**14729**						

Note: All procedures using metal/metal prostheses have been excluded. Restricted to modern prostheses. BMI has not been presented for patients aged ≤19 years

Figure HT73 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by BMI Category (Primary Diagnosis Fractured NOF)



HR - adjusted for age and gender

Underweight (<18.50) vs Normal (18.50-24.99)
Entire Period: HR=1.59 (1.13, 2.25), p=0.008

Pre Obese (25.00-29.99) vs Normal (18.50-24.99)
Entire Period: HR=1.08 (0.89, 1.32), p=0.411

Obese Class 1 (30.00-34.99) vs Normal (18.50-24.99)
Entire Period: HR=1.26 (0.97, 1.62), p=0.078

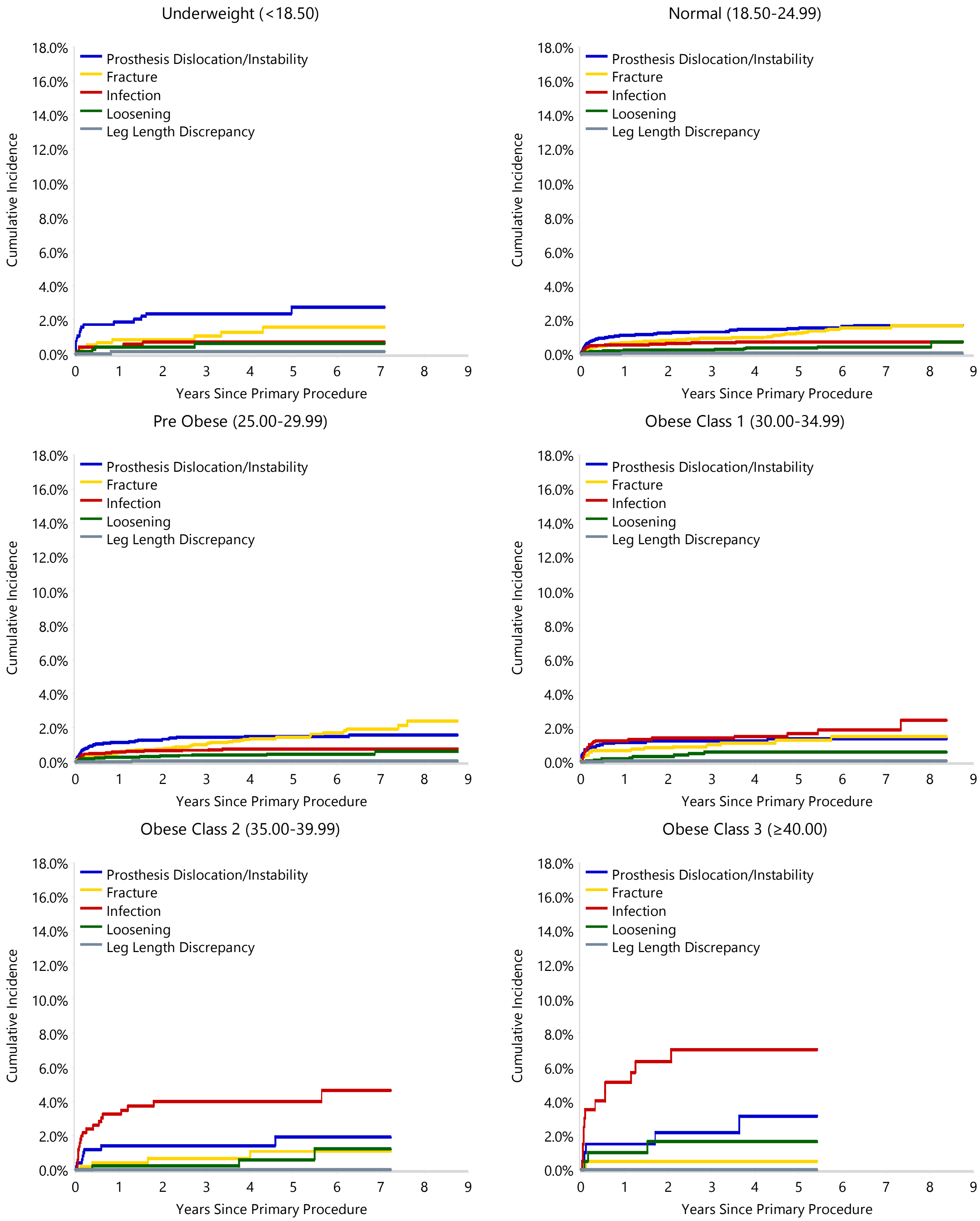
Obese Class 2 (35.00-39.99) vs Normal (18.50-24.99)
Entire Period: HR=2.13 (1.51, 3.01), p<0.001

Obese Class 3 (≥40.00) vs Normal (18.50-24.99)
Entire Period: HR=3.63 (2.38, 5.54), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	6 Yrs	7 Yrs	8 Yrs
Underweight (<18.50)	762	566	329	157	103	47	11
Normal (18.50-24.99)	6416	5017	3073	1565	992	529	196
Pre Obese (25.00-29.99)	5021	4019	2423	1229	780	429	166
Obese Class 1 (30.00-34.99)	1815	1424	849	442	302	165	65
Obese Class 2 (35.00-39.99)	511	391	249	133	84	47	21
Obese Class 3 (≥40.00)	204	145	93	46	26	9	0

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses
BMI has not been presented for patients aged ≤19 years

Figure HT74 Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement by BMI Category (Primary Diagnosis Fractured NOF)



Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses
BMI has not been presented for patients aged ≤19 years

Fixation

The analysis for fractured neck of femur and fixation has been performed for modern prostheses with modern bearing surfaces and restricted to mixed ceramic/mixed ceramic and all femoral head materials used in combination with XLPE.

There are 1,633 procedures with cemented fixation, 6,928 with cementless fixation and 19,131 with hybrid fixation. Cemented fixation has a lower rate of revision compared to cementless fixation, but there is no difference compared to hybrid fixation. Cementless fixation has a higher rate of revision than hybrid fixation for the first 3 months only, with no difference after this time (Table HT77 and Figure HT75).

There are differences in outcome with respect to fixation and age. For patients aged <70 years, there is no difference in the rate of revision between cemented and cementless fixation. For the first month, cementless fixation has a higher rate of revision than hybrid fixation for this age group. From 1 month onwards, this reverses and hybrid fixation has a higher rate of revision compared to cementless fixation (Table HT78 and Figure HT76).

For patients aged ≥70 years, there is an 84.0% higher rate of revision for cementless fixation compared to hybrid fixation for the first 3 months.

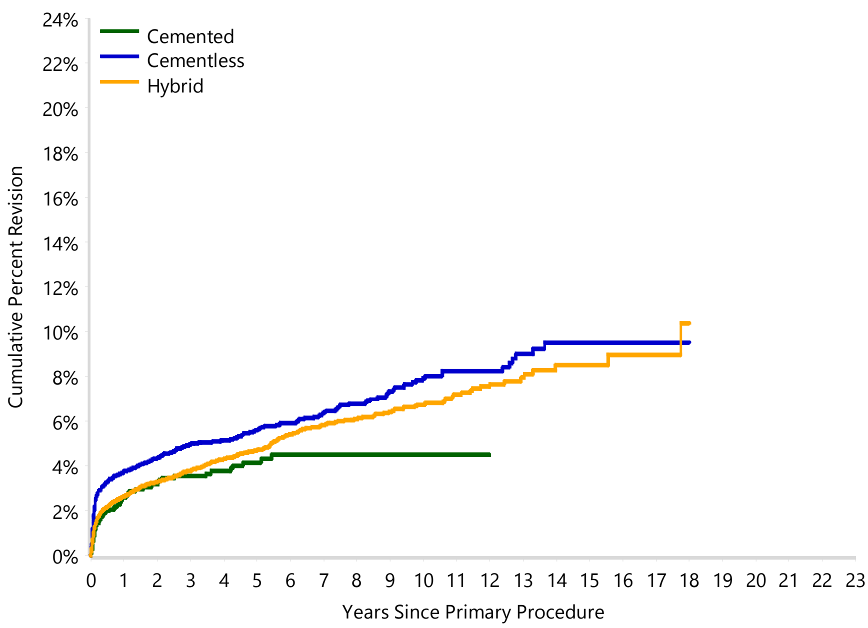
However, for patients aged ≥70 years, cementless fixation has a higher rate of revision than cemented fixation over the entire period, and for the first 3 months compared to hybrid fixation. There is no difference in the rate of revision when hybrid fixation is compared to cemented fixation (Table HT78 and Figure HT77).

Table HT77 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Fixation (Primary Diagnosis Fractured NOF)

Fixation	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Cemented	58	1633	2.6 (1.9, 3.5)	3.2 (2.4, 4.2)	3.6 (2.7, 4.7)	4.2 (3.2, 5.4)	4.5 (3.4, 5.8)	4.5 (3.4, 5.8)
Cementless	397	6928	3.8 (3.3, 4.3)	4.3 (3.9, 4.9)	5.0 (4.5, 5.5)	5.6 (5.0, 6.2)	6.4 (5.7, 7.1)	7.9 (7.1, 8.9)
Hybrid	836	19131	2.6 (2.4, 2.9)	3.3 (3.0, 3.6)	3.8 (3.5, 4.1)	4.7 (4.4, 5.1)	5.8 (5.4, 6.3)	6.7 (6.2, 7.3)
TOTAL	**1291**	**27692**						

Note: Includes mixed ceramic/mixed ceramic and XLPE bearing surfaces
Restricted to modern prostheses

Figure HT75 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Fixation (Primary Diagnosis Fractured NOF)



HR - adjusted for age and gender

Cementless vs Cemented

Entire Period: HR=1.38 (1.04, 1.82), p=0.024

Cementless vs Hybrid

0 - 3Mth: HR=1.58 (1.32, 1.88), p<0.001

3Mth+: HR=0.91 (0.77, 1.07), p=0.243

Hybrid vs Cemented

Entire Period: HR=1.19 (0.91, 1.55), p=0.209

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Cemented	1633	1319	1136	973	622	344	116
Cementless	6928	5888	5177	4487	3202	2074	975
Hybrid	19131	15653	13021	10703	6803	4043	1605

Note: Includes mixed ceramic/mixed ceramic and XLPE bearing surfaces
Restricted to modern prostheses

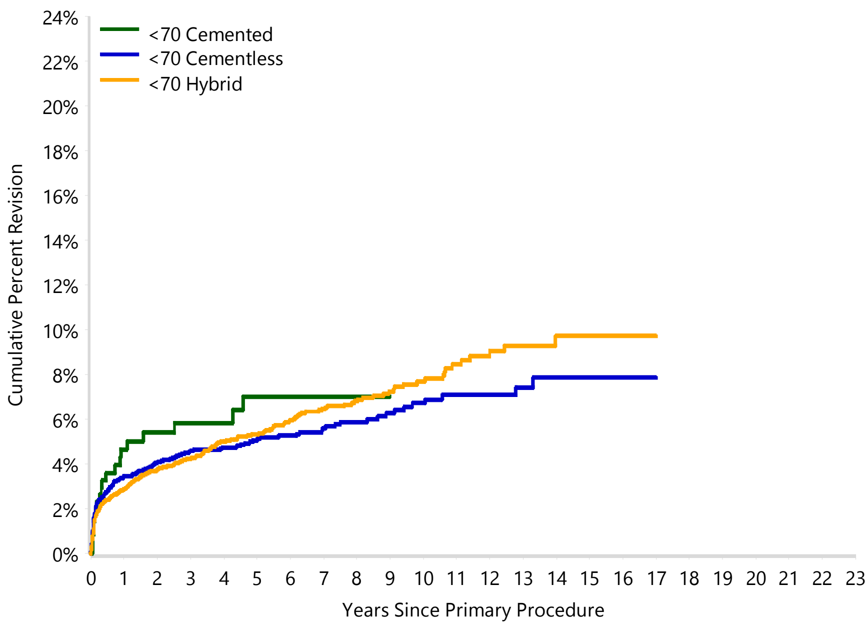
Primary Total Hip Replacement

Table HT78 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Age and Fixation (Primary Diagnosis Fractured NOF)

Age	Fixation	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<70		**478**	**9063**	**3.1 (2.8, 3.5)**	**3.9 (3.5, 4.3)**	**4.4 (4.0, 4.9)**	**5.3 (4.8, 5.8)**	**6.2 (5.6, 6.8)**	**7.3 (6.6, 8.1)**
	Cemented	20	356	4.7 (2.8, 7.6)	5.4 (3.4, 8.6)	5.8 (3.7, 9.2)	7.0 (4.5, 10.8)	7.0 (4.5, 10.8)	
	Cementless	150	2835	3.5 (2.8, 4.2)	4.0 (3.4, 4.9)	4.6 (3.9, 5.5)	5.1 (4.3, 6.0)	5.6 (4.7, 6.6)	6.7 (5.6, 8.0)
	Hybrid	308	5872	2.9 (2.5, 3.3)	3.8 (3.3, 4.3)	4.2 (3.7, 4.8)	5.3 (4.7, 6.0)	6.5 (5.7, 7.3)	7.7 (6.7, 8.8)
≥70		**813**	**18629**	**2.8 (2.6, 3.1)**	**3.4 (3.1, 3.7)**	**3.9 (3.6, 4.2)**	**4.7 (4.4, 5.1)**	**5.7 (5.3, 6.2)**	**6.8 (6.2, 7.4)**
	Cemented	38	1277	2.0 (1.4, 3.0)	2.6 (1.8, 3.7)	2.9 (2.1, 4.1)	3.4 (2.4, 4.7)	3.8 (2.7, 5.3)	3.8 (2.7, 5.3)
	Cementless	247	4093	4.0 (3.4, 4.6)	4.5 (3.9, 5.3)	5.2 (4.6, 6.0)	6.0 (5.2, 6.8)	7.0 (6.1, 8.0)	9.0 (7.7, 10.6)
	Hybrid	528	13259	2.5 (2.3, 2.8)	3.1 (2.8, 3.4)	3.6 (3.3, 3.9)	4.4 (4.0, 4.8)	5.5 (5.0, 6.1)	6.2 (5.6, 6.9)
TOTAL		**1291**	**27692**						

Note: Includes mixed ceramic/mixed ceramic and XLPE bearing surfaces
Restricted to modern prostheses

Figure HT76 Cumulative Percent Revision of Primary Total Conventional Hip Replacement in Patients Aged <70 Years by Fixation (Primary Diagnosis Fractured NOF)



HR - adjusted for gender

<70 Cemented vs <70 Hybrid
Entire Period: HR=1.17 (0.74, 1.84), p=0.493

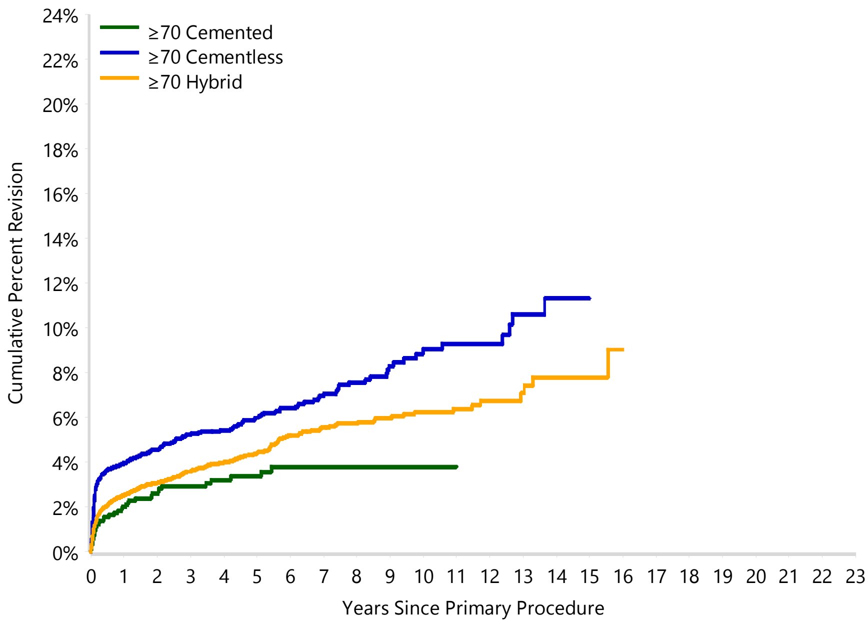
<70 Cemented vs <70 Cementless
Entire Period: HR=1.29 (0.81, 2.06), p=0.289

<70 Cementless vs <70 Hybrid
0 - 1Mth: HR=1.53 (1.04, 2.26), p=0.030
1Mth+: HR=0.76 (0.60, 0.95), p=0.016

Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<70	Cemented	356	268	224	201	147	85	35
	Cementless	2835	2477	2216	1981	1487	1050	538
	Hybrid	5872	4866	4116	3483	2412	1554	717

Note: Includes mixed ceramic/mixed ceramic and XLPE bearing surfaces
Restricted to modern prostheses

Figure HT77 Cumulative Percent Revision of Primary Total Conventional Hip Replacement in Patients Aged ≥70 Years by Fixation (Primary Diagnosis Fractured NOF)



HR - adjusted for gender

≥70 Cementless vs ≥70 Cemented
Entire Period: HR=1.84 (1.31, 2.60), p<0.001

≥70 Cementless vs ≥70 Hybrid
0 - 3Mth: HR=1.87 (1.51, 2.32), p<0.001
3Mth+: HR=1.06 (0.86, 1.31), p=0.598

≥70 Hybrid vs ≥70 Cemented
Entire Period: HR=1.34 (0.96, 1.86), p=0.084

Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
≥70	**Cemented**	1277	1051	912	772	475	259	81
	Cementless	4093	3411	2961	2506	1715	1024	437
	Hybrid	13259	10787	8905	7220	4391	2489	888

Note: Includes mixed ceramic/mixed ceramic and XLPE bearing surfaces
Restricted to modern prostheses

Head Size

When used for fractured neck of femur, there is no difference in the overall rate of revision between head sizes 32mm, <32mm, and >32mm (Table HT79 and Figure HT78). However, there is higher rate of revision for prosthesis dislocation/instability for head size 32mm when compared to >32mm head sizes (Table HT80 and Figure HT79).

Constrained Acetabular Prostheses

When used for fractured neck of femur, there is no difference in the rate of revision for constrained prostheses compared to other acetabular prostheses (Table HT81 and Figure HT80). However, constrained prostheses are used in less than 1% of procedures.

Dual Mobility

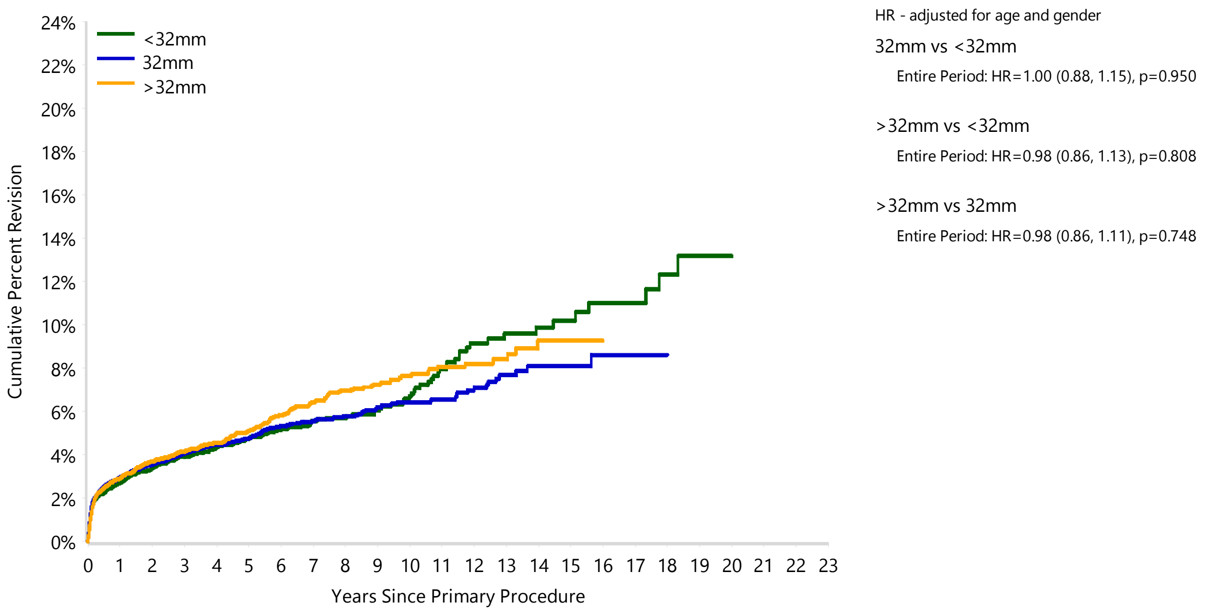
There is no difference in the rate of revision when dual mobility prostheses are used compared to other acetabular components (Table HT82 and Figure HT81).

Table HT79 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Head Size (Primary Diagnosis Fractured NOF)

Head Size	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<32mm	391	9146	2.7 (2.4, 3.1)	3.4 (3.0, 3.8)	3.9 (3.5, 4.4)	4.8 (4.3, 5.3)	5.6 (4.9, 6.3)	6.7 (5.8, 7.7)
32mm	527	10793	3.0 (2.7, 3.3)	3.5 (3.2, 3.9)	4.1 (3.7, 4.5)	4.8 (4.3, 5.2)	5.5 (5.1, 6.1)	6.4 (5.8, 7.1)
>32mm	500	10210	2.9 (2.6, 3.3)	3.7 (3.3, 4.1)	4.1 (3.8, 4.6)	5.1 (4.6, 5.6)	6.4 (5.8, 7.1)	7.6 (6.9, 8.5)
TOTAL	**1418**	**30149**						

Note: All procedures using metal/metal prostheses have been excluded, Restricted to modern prostheses. Excludes 27 procedures with unknown head size

Figure HT78 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Head Size (Primary Diagnosis Fractured NOF)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<32mm	9146	7117	5608	4375	2596	1579	750
32mm	10793	9384	8391	7387	5276	3316	1434
>32mm	10210	8356	7039	5879	3833	2342	1027

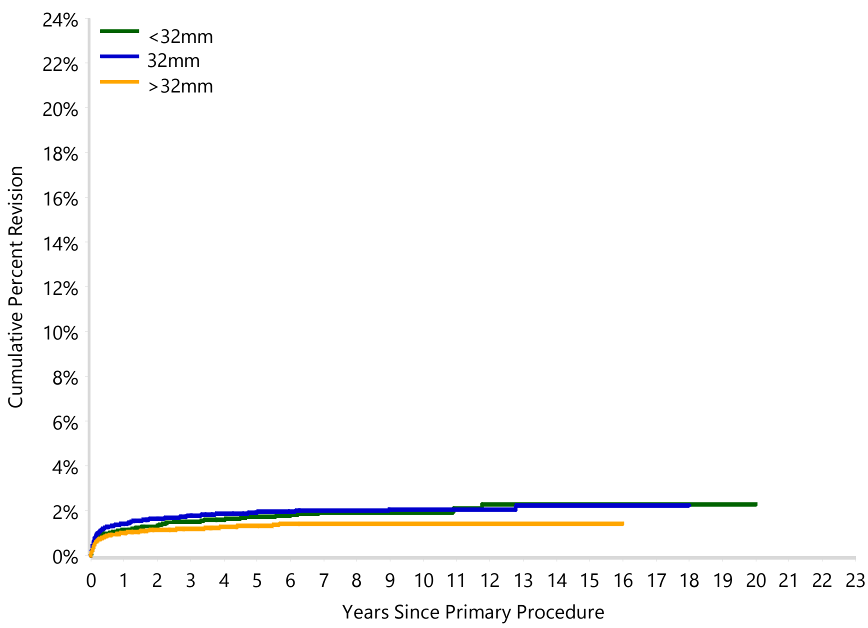
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT80 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Head Size (Primary Diagnosis Fractured NOF, Revision for Prosthesis Dislocation/Instability)

Head Size	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<32mm	134	9146	1.1 (0.9, 1.4)	1.3 (1.1, 1.6)	1.5 (1.3, 1.8)	1.7 (1.4, 2.1)	1.9 (1.6, 2.4)	1.9 (1.6, 2.4)
32mm	195	10793	1.4 (1.2, 1.7)	1.6 (1.4, 1.9)	1.8 (1.5, 2.1)	1.9 (1.7, 2.2)	2.0 (1.7, 2.3)	2.1 (1.8, 2.4)
>32mm	122	10210	1.0 (0.8, 1.2)	1.2 (1.0, 1.4)	1.2 (1.0, 1.4)	1.3 (1.1, 1.6)	1.4 (1.2, 1.7)	1.4 (1.2, 1.7)
TOTAL	**451**	**30149**						

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Figure HT79 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Head Size (Primary Diagnosis Fractured NOF, Revision for Prosthesis Dislocation/Instability)



HR - adjusted for age and gender

<32mm vs >32mm
Entire Period: HR=1.27 (0.99, 1.64), p=0.056

32mm vs >32mm
Entire Period: HR=1.44 (1.14, 1.82), p=0.002

32mm vs <32mm
0 - 3Mth: HR=1.18 (0.89, 1.55), p=0.246
3Mth+: HR=1.07 (0.79, 1.45), p=0.669

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<32mm	9146	7117	5608	4375	2596	1579	750
32mm	10793	9384	8391	7387	5276	3316	1434
>32mm	10210	8356	7039	5879	3833	2342	1027

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

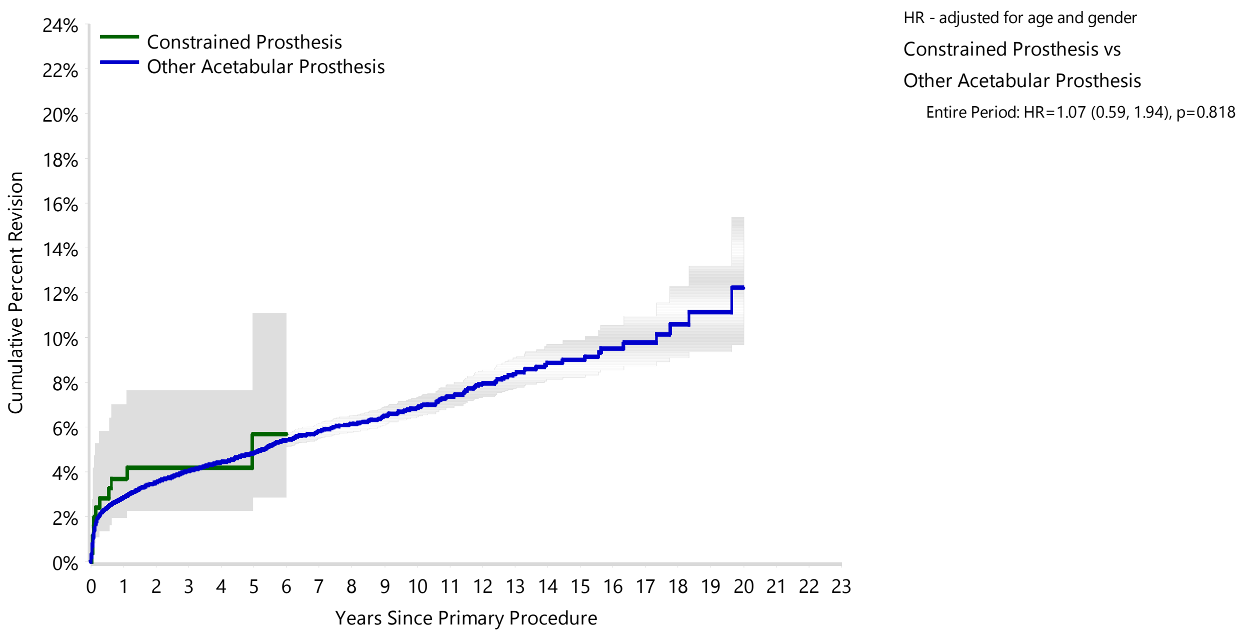
Primary Total Hip Replacement

Table HT81 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Acetabular Type (Primary Diagnosis Fractured NOF)

Acetabular Type	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Constrained Prosthesis	11	260	3.7 (1.9, 7.0)	4.2 (2.3, 7.7)	4.2 (2.3, 7.7)	5.7 (2.9, 11.1)		
Other Acetabular Prosthesis	1408	29914	2.9 (2.7, 3.1)	3.5 (3.3, 3.8)	4.0 (3.8, 4.3)	4.8 (4.6, 5.1)	5.8 (5.5, 6.2)	6.9 (6.4, 7.3)
TOTAL	1419	30174						

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Figure HT80 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Acetabular Type (Primary Diagnosis Fractured NOF)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Constrained Prosthesis	260	204	164	123	62	38	15
Other Acetabular Prosthesis	29914	24672	20892	17534	11657	7211	3200

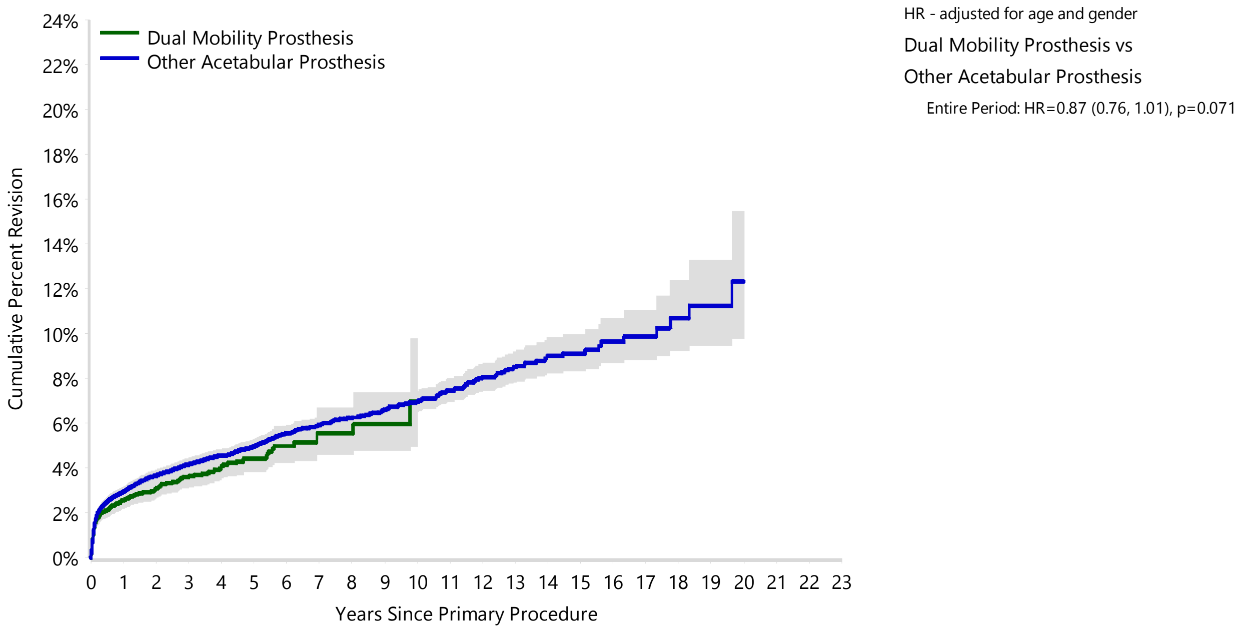
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT82 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Acetabular Type (Primary Diagnosis Fractured NOF)

Acetabular Mobility	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Dual Mobility Prosthesis	221	6524	2.6 (2.2, 3.0)	3.1 (2.7, 3.6)	3.6 (3.1, 4.2)	4.4 (3.8, 5.2)	5.6 (4.6, 6.7)	7.0 (4.9, 9.8)
Other Acetabular Prosthesis	1198	23650	2.9 (2.7, 3.2)	3.7 (3.4, 3.9)	4.2 (3.9, 4.4)	5.0 (4.7, 5.3)	5.9 (5.6, 6.3)	7.0 (6.5, 7.4)
TOTAL	1419	30174						

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Figure HT81 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Acetabular Mobility (Primary Diagnosis Fractured NOF)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Dual Mobility Prosthesis	6524	4822	3524	2470	1099	443	71
Other Acetabular Prosthesis	23650	20054	17532	15187	10620	6806	3144

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

OUTCOME OF TOTAL CONVENTIONAL COMPARED TO PARTIAL HIP REPLACEMENT

The rate of revision for fractured neck of femur in primary total conventional hip replacement and in primary unipolar monoblock, primary unipolar modular, and primary bipolar partial hip replacement procedures are compared. These comparisons have not considered the competing risk of death, which increases with age.

Unipolar monoblock partial hip replacement has a higher rate of revision than total conventional hip from 3 months onwards.

Unipolar modular partial hip replacement has a lower rate of revision than total conventional hip replacement for the first month but after 1.5 years unipolar modular has a higher rate of revision.

There is no difference in the rate of revision when comparing bipolar partial to total conventional hip replacement (Table HT83 and Figure HT82).

The rates of revision for each type of hip replacement for patients aged <70 years and ≥70 years are provided in Table HT84, Figure HT83 and Figure HT84.

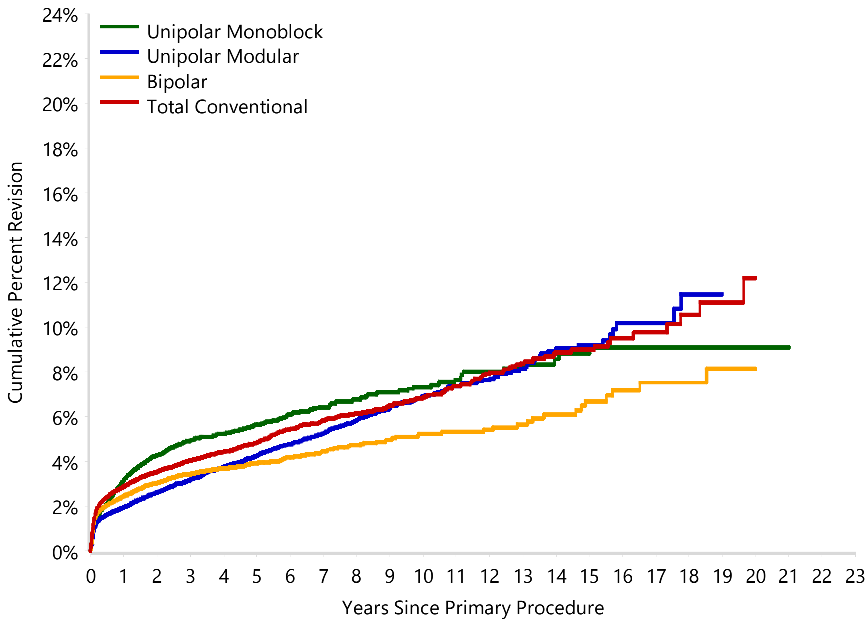
For patients aged <70 years bipolar has a higher rate of revision compared to total conventional hip replacement. Unipolar monoblock has a higher rate of revision compared to total conventional hip replacement from 3 months until 3.5 years. Unipolar modular has a higher rate of revision compared to total conventional hip replacement after 2 years. For patients aged ≥70 years, bipolar hip replacement has a lower rate of revision than conventional hip replacement. Unipolar monoblock has a higher rate of revision compared to total conventional hip replacement from 3 months to 2 years. Unipolar modular has a lower rate of revision compared to total conventional hip replacement for the first year, with no difference after this time.

Table HT83 Cumulative Percent Revision of Primary Hip Replacement by Class (Primary Diagnosis Fractured NOF)

Hip Class	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Monoblock	844	21871	3.2 (2.9, 3.4)	4.3 (4.0, 4.6)	4.9 (4.6, 5.3)	5.6 (5.2, 6.1)	6.4 (5.9, 7.0)	7.3 (6.7, 8.0)
Unipolar Modular	1530	48016	2.0 (1.8, 2.1)	2.6 (2.5, 2.8)	3.2 (3.0, 3.4)	4.3 (4.0, 4.5)	5.3 (4.9, 5.6)	6.9 (6.4, 7.4)
Bipolar	954	32184	2.5 (2.3, 2.6)	3.0 (2.8, 3.3)	3.4 (3.2, 3.7)	3.9 (3.7, 4.2)	4.4 (4.1, 4.8)	5.2 (4.8, 5.8)
Total Conventional	1419	30174	2.9 (2.7, 3.1)	3.5 (3.3, 3.8)	4.0 (3.8, 4.3)	4.9 (4.6, 5.1)	5.8 (5.5, 6.2)	6.9 (6.4, 7.3)
TOTAL	4747	132245						

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Figure HT82 Cumulative Percent Revision of Primary Hip Replacement by Class (Primary Diagnosis Fractured NOF)



HR - adjusted for age and gender

Unipolar Monoblock vs Total Conventional
- 0 - 3Mth: HR=1.06 (0.93, 1.22), p=0.386
- 3Mth - 6Mth: HR=1.99 (1.54, 2.56), p<0.001
- 6Mth - 1Yr: HR=3.08 (2.51, 3.78), p<0.001
- 1Yr - 2.5Yr: HR=2.16 (1.80, 2.59), p<0.001
- 2.5Yr+: HR=1.29 (1.06, 1.58), p=0.012

Unipolar Modular vs Total Conventional
- 0 - 1Mth: HR=0.75 (0.65, 0.87), p<0.001
- 1Mth - 3Mth: HR=1.00 (0.86, 1.16), p=0.980
- 3Mth - 9Mth: HR=0.88 (0.73, 1.07), p=0.217
- 9Mth - 1.5Yr: HR=1.05 (0.87, 1.28), p=0.602
- 1.5Yr - 3Yr: HR=1.35 (1.12, 1.61), p=0.001
- 3Yr+: HR=1.76 (1.53, 2.03), p<0.001

Bipolar vs Total Conventional
- Entire Period: HR=1.02 (0.93, 1.11), p=0.712

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Monoblock	21871	13045	10082	7777	4413	2472	1057
Unipolar Modular	48016	32203	25308	19755	11695	6676	2763
Bipolar	32184	20635	15414	11457	6257	3460	1405
Total Conventional	30174	24876	21056	17657	11719	7249	3215

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

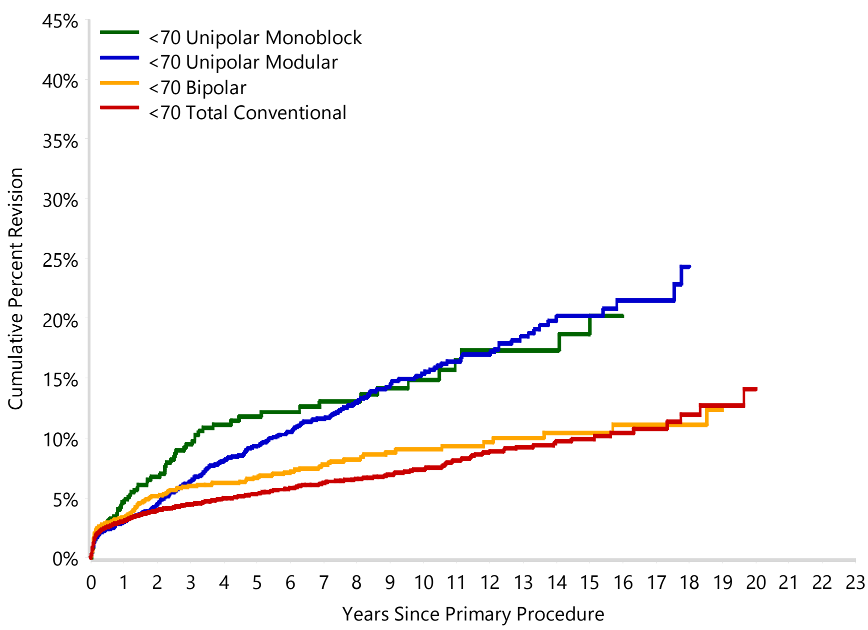
Primary Total Hip Replacement

Table HT84 Cumulative Percent Revision of Primary Hip Replacement by Age and Class (Primary Diagnosis Fractured NOF)

Age	Hip Class	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<70		1065	16508	3.2 (2.9, 3.5)	4.3 (4.0, 4.7)	5.2 (4.9, 5.6)	6.5 (6.1, 7.0)	7.8 (7.3, 8.3)	9.5 (8.9, 10.2)
	Unipolar Monoblock	67	708	4.6 (3.2, 6.7)	6.8 (4.9, 9.2)	9.5 (7.2, 12.4)	11.8 (9.1, 15.2)	13.1 (10.1, 16.8)	14.9 (11.5, 19.1)
	Unipolar Modular	294	3196	3.0 (2.4, 3.7)	4.4 (3.7, 5.3)	6.4 (5.5, 7.4)	9.3 (8.2, 10.7)	11.6 (10.2, 13.2)	15.4 (13.6, 17.4)
	Bipolar	167	2889	3.4 (2.8, 4.1)	5.1 (4.3, 6.1)	6.0 (5.0, 7.0)	6.7 (5.6, 7.9)	7.8 (6.6, 9.2)	9.0 (7.6, 10.8)
	Total Conventional	537	9715	3.1 (2.7, 3.4)	3.9 (3.6, 4.4)	4.5 (4.0, 4.9)	5.3 (4.8, 5.8)	6.2 (5.7, 6.8)	7.4 (6.7, 8.1)
≥70		3682	115737	2.4 (2.3, 2.5)	3.0 (2.9, 3.1)	3.5 (3.3, 3.6)	4.2 (4.0, 4.3)	4.9 (4.8, 5.1)	5.9 (5.7, 6.2)
	Unipolar Monoblock	777	21163	3.1 (2.9, 3.4)	4.2 (3.9, 4.5)	4.8 (4.4, 5.1)	5.4 (5.0, 5.8)	6.1 (5.6, 6.6)	6.9 (6.3, 7.6)
	Unipolar Modular	1236	44820	1.9 (1.8, 2.0)	2.5 (2.3, 2.6)	2.9 (2.7, 3.1)	3.8 (3.5, 4.0)	4.6 (4.3, 4.9)	5.8 (5.3, 6.2)
	Bipolar	787	29295	2.4 (2.2, 2.6)	2.8 (2.6, 3.0)	3.2 (2.9, 3.4)	3.6 (3.3, 3.9)	4.0 (3.7, 4.4)	4.7 (4.2, 5.2)
	Total Conventional	882	20459	2.8 (2.6, 3.0)	3.3 (3.1, 3.6)	3.8 (3.6, 4.1)	4.6 (4.3, 5.0)	5.6 (5.2, 6.0)	6.6 (6.1, 7.2)
TOTAL		4747	132245						

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Figure HT83 Cumulative Percent Revision of Primary Hip Replacement in Patients Aged <70 Years by Class (Primary Diagnosis Fractured NOF



HR - adjusted for gender

<70 Unipolar Monoblock vs <70 Total Conventional
- 0 - 3Mth: HR=1.00 (0.58, 1.71), p=0.999
- 3Mth - 2Yr: HR=2.47 (1.60, 3.81), p<0.001
- 2Yr - 3.5Yr: HR=5.10 (3.01, 8.67), p<0.001
- 3.5Yr+: HR=1.70 (0.99, 2.94), p=0.056

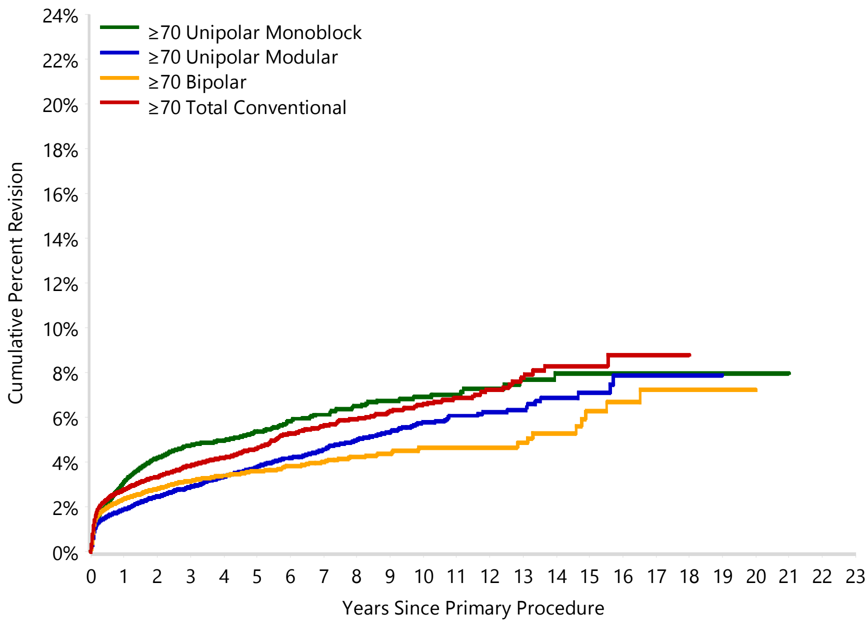
<70 Unipolar Modular vs <70 Total Conventional
- 0 - 3Mth: HR=0.92 (0.70, 1.22), p=0.581
- 3Mth - 2Yr: HR=1.25 (0.94, 1.68), p=0.129
- 2Yr+: HR=3.20 (2.62, 3.92), p<0.001

<70 Bipolar vs <70 Total Conventional
- Entire Period: HR=1.19 (1.00, 1.42), p=0.045

Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<70	Unipolar Monoblock	708	475	400	343	242	180	115
	Unipolar Modular	3196	2412	2043	1760	1311	930	534
	Bipolar	2889	2051	1618	1312	899	628	345
	Total Conventional	9715	8153	7029	6100	4414	2994	1530

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Figure HT84 Cumulative Percent Revision of Primary Hip Replacement in Patients Aged ≥70 Years by Class (Primary Diagnosis Fractured NOF)



HR - adjusted for gender

≥70 Unipolar Monoblock vs ≥70 Total Conventional
- 0 - 2Wk: HR=1.17 (0.90, 1.53), p=0.233
- 2Wk - 1Mth: HR=0.74 (0.60, 0.92), p=0.007
- 1Mth - 3Mth: HR=0.66 (0.53, 0.81), p<0.001
- 3Mth - 6Mth: HR=1.45 (1.11, 1.90), p=0.007
- 6Mth - 1Yr: HR=2.22 (1.77, 2.77), p<0.001
- 1Yr - 2Yr: HR=1.93 (1.52, 2.45), p<0.001
- 2Yr+: HR=0.98 (0.80, 1.19), p=0.811

≥70 Unipolar Modular vs ≥70 Total Conventional
- 0 - 3Mth: HR=0.64 (0.57, 0.72), p<0.001
- 3Mth - 9Mth: HR=0.65 (0.53, 0.80), p<0.001
- 9Mth - 1Yr: HR=0.71 (0.50, 1.00), p=0.050
- 1Yr - 1.5Yr: HR=1.00 (0.76, 1.32), p=0.995
- 1.5Yr - 2Yr: HR=0.97 (0.70, 1.33), p=0.828
- 2Yr+: HR=1.06 (0.91, 1.23), p=0.470

≥70 Bipolar vs ≥70 Total Conventional
- Entire Period: HR=0.78 (0.70, 0.86), p<0.001

	Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
≥70	**Unipolar Monoblock**	21163	12570	9682	7434	4171	2292	942
	Unipolar Modular	44820	29791	23265	17995	10384	5746	2229
	Bipolar	29295	18584	13796	10145	5358	2832	1060
	Total Conventional	20459	16723	14027	11557	7305	4255	1685

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Primary Total Hip Replacement

Primary Total Resurfacing Hip Replacement

DEMOGRAPHICS

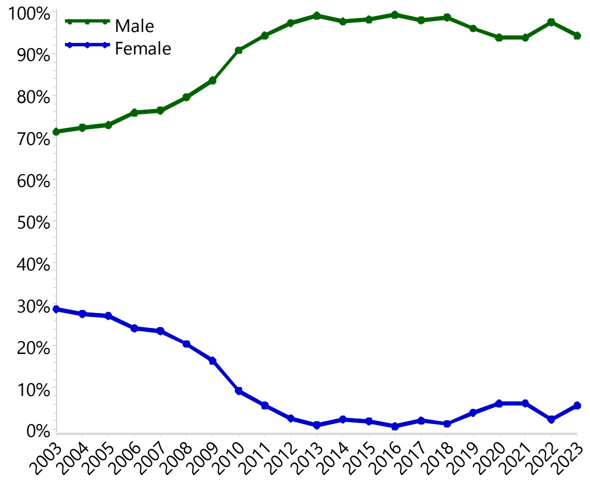
There are 20,234 primary total resurfacing hip replacement procedures. This is an additional 482 procedures compared to the previous report.

For further information on the **closure of the database** please see the **Glossary** of this report.

In 2023, the number of primary total resurfacing procedures is 26.5% more than in 2022, and 74.3% less than in 2005 when the use of hip resurfacing peaked. Primary total resurfacing hip replacement represents 0.8% of all hip replacements performed in 2023.

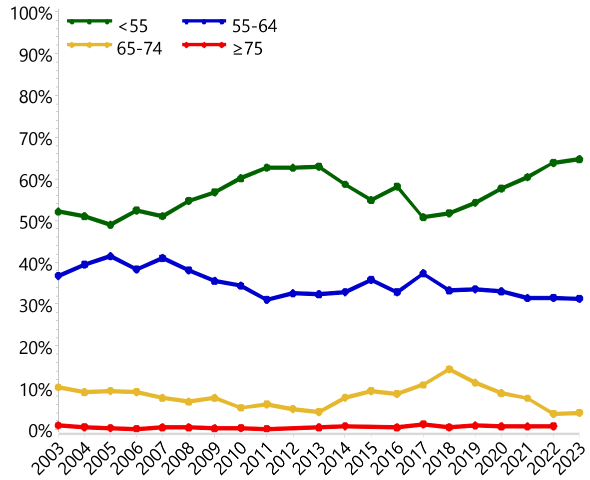
In 2023, 94.3% of primary total resurfacing hip replacements were undertaken in males (Table HT85 and Figure HT85.

Figure HT85 Primary Total Resurfacing Hip Replacement by Gender



The changes in usage of primary total resurfacing hip replacement for each age group are provided in Figure HT86.

Figure HT86 Primary Total Resurfacing Hip Replacement by Age



There were only three types of resurfacing prostheses used in 2023, with the Adept the most commonly used. The ReCerf resurfacing head was used for the first time in 2018 (Table HT86).

Table HT85 Age and Gender of Primary Total Resurfacing Hip Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	16520	81.6%	13	84	54	53.2	9.1
Female	3714	18.4%	14	81	52	51.5	8.6
TOTAL	**20234**	**100.0%**	**13**	**84**	**53**	**52.9**	**9.1**

Table HT86 Most Used Resurfacing Heads in Primary Total Resurfacing Hip Replacement

2003		2020		2021		2022		2023	
N	Model	N	Model	N	Model	N	Model	N	Model
1359	BHR	318	Adept	322	Adept	234	Adept	284	Adept
58	Durom	156	BHR	127	ReCerf	97	BHR	103	ReCerf
43	ASR	93	ReCerf	114	BHR	43	ReCerf	86	BHR
42	Cormet								
38	Cormet 2000 HAP								
7	Conserve Plus								
Most Used									
1547 (6)	100.0%	567 (3)	100.0%	563 (3)	100.0%	374 (3)	100.0%	473 (3)	100.0%

OUTCOME FOR ALL DIAGNOSES

Primary Diagnosis

Again, this analysis is restricted to modern resurfacing prostheses in current use. The principal diagnosis for primary total resurfacing hip replacement is osteoarthritis (95.7%), followed by developmental dysplasia (2.0%), and osteonecrosis (1.6%).

Primary total resurfacing hip replacement for osteoarthritis has a lower rate of revision compared to developmental dysplasia from 6 months up to 5 years. There is a higher rate of revision for osteonecrosis compared to osteoarthritis (Table HT87 and Figure HT87).

Prosthesis Types

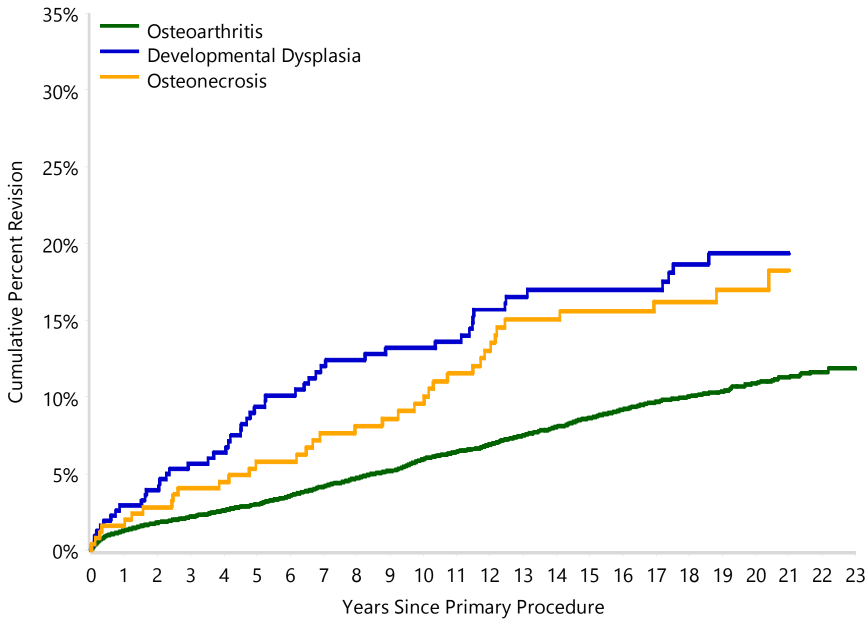
The cumulative percent revision of the three different primary total resurfacing hip prosthesis combinations with >100 procedures is listed in Table HT88.

Table HT87 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement by Primary Diagnosis

Primary Diagnosis	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Osteoarthritis	1141	15184	1.3 (1.1, 1.5)	2.2 (2.0, 2.4)	3.0 (2.8, 3.3)	5.9 (5.5, 6.4)	8.6 (8.1, 9.2)	10.9 (10.2, 11.6)
Developmental Dysplasia	50	316	2.9 (1.5, 5.5)	5.7 (3.6, 8.9)	9.3 (6.5, 13.4)	13.2 (9.7, 17.8)	17.0 (13.0, 22.0)	19.3 (14.9, 24.9)
Osteonecrosis	37	250	1.6 (0.6, 4.2)	4.0 (2.2, 7.4)	5.8 (3.5, 9.6)	9.5 (6.4, 14.2)	15.6 (11.4, 21.1)	17.0 (12.5, 22.9)
Other (6)	17	119	2.5 (0.8, 7.6)	3.4 (1.3, 8.8)	6.1 (3.0, 12.5)	12.7 (7.5, 20.9)	15.1 (9.3, 24.0)	
TOTAL	1245	15869						

Note: Only primary diagnoses with >100 procedures have been listed
Restricted to modern prostheses

Figure HT87 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement by Primary Diagnosis



HR - adjusted for age and gender

Developmental Dysplasia vs Osteoarthritis
0 - 6Mth: HR=1.24 (0.54, 2.80), p=0.612
6Mth - 5Yr: HR=2.25 (1.43, 3.52), p<0.001
5Yr+: HR=0.88 (0.58, 1.34), p=0.546

Developmental Dysplasia vs Osteonecrosis
Entire Period: HR=0.72 (0.47, 1.10), p=0.128

Osteonecrosis vs Osteoarthritis
Entire Period: HR=1.72 (1.24, 2.41), p=0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Osteoarthritis	15184	14525	13436	12208	9805	6818	2323
Developmental Dysplasia	316	290	270	241	213	177	91
Osteonecrosis	250	244	230	213	184	156	72

Note: Only primary diagnoses with >100 procedures have been listed
Restricted to modern prostheses

Table HT88 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement by Prosthesis Combination (All Diagnoses)

Head Component	Acetabular Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Adept	Adept	96	3180	1.2 (0.9, 1.6)	1.7 (1.3, 2.3)	2.3 (1.8, 2.9)	4.8 (3.8, 6.1)	6.1 (4.7, 8.0)	
BHR	BHR	1147	12238	1.4 (1.2, 1.7)	2.5 (2.2, 2.8)	3.5 (3.1, 3.8)	6.5 (6.0, 6.9)	9.3 (8.8, 9.9)	11.6 (10.9, 12.3)
ReCerf	ReCerf	2	450	0.2 (0.0, 1.6)	0.6 (0.1, 2.3)				
Other (1)		0	1						
TOTAL		1245	15869						

Note: Only combinations with >100 procedures have been listed
Restricted to modern prostheses

OUTCOME FOR OSTEOARTHRITIS

The cumulative percent revision at 20 years for primary total resurfacing hip replacement undertaken for osteoarthritis is 10.9% (Table HT89 and Figure HT88).

Reasons for Revision

The main reasons for revision of primary total resurfacing hip replacement are loosening, metal related pathology, and fracture (Table HT90).

> Loosening is the most common reason for revision after 12 years.

The five most common reasons for revision are shown in Figure HT89. The cumulative incidence of fracture increases rapidly in the first year. After this time, the incidence increases at a slower rate. The cumulative incidence of loosening increases to become the most common reason for revision after 12 years.

Type of Revision

The most common type of revision for total resurfacing hip replacement is revision of both the femoral and acetabular components. Femoral only revision is much less common and acetabular only revision is rarely undertaken (Table HT91).

Age and Gender

In the first 6 months, patients aged ≥65 years have a higher rate of revision compared to patients aged <55 years and those 55-64 years. Patients aged 55-64 years have a higher rate of revision compared to patients aged <55 years for the first 18 months only (Table HT92 and Figure HT90).

Females have a higher rate of revision compared to males (Table HT93 and Figure HT91). Males aged ≥65 years have a higher rate of revision compared to males aged <55 years and those 55-64 years for the first 6 months only. After this time, there is no difference (Table HT93 and Figure HT92). Age is not a risk factor for revision for female patients (Table HT93 and Figure HT93).

Head Size

The rate of revision decreases as the femoral component head size increases. Femoral head sizes ≥55mm have a lower rate of revision compared to all other head size groups (Table HT94 and Figure HT94). This effect of femoral component head size is evident in both males and females (Table HT95 and Figure HT95).

The reason for revision varies with head size. Head sizes <50mm have a higher cumulative incidence of metal related pathology, loosening, fracture, infection, and lysis compared to head sizes ≥50mm (Figure HT96).

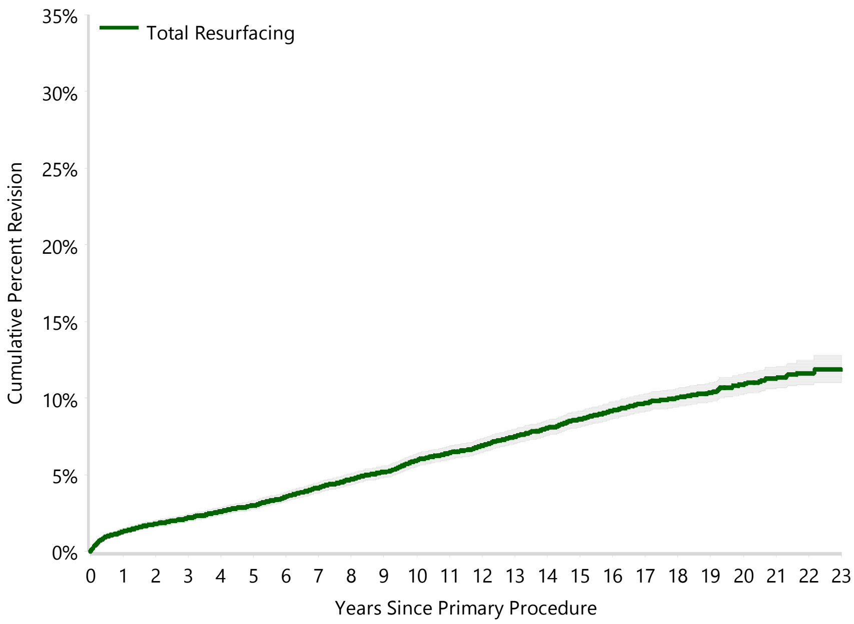
Primary Total Hip Replacement

Table HT89 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement (Primary Diagnosis OA)

Hip Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Total Resurfacing	1141	15184	1.3 (1.1, 1.5)	2.2 (2.0, 2.4)	3.0 (2.8, 3.3)	5.9 (5.5, 6.4)	8.6 (8.1, 9.2)	10.9 (10.2, 11.6)
TOTAL	1141	15184						

Note: Restricted to modern prostheses

Figure HT88 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Total Resurfacing	15184	14525	13436	12208	9805	6818	2323

Note: Restricted to modern prostheses

Table HT90 Primary Total Resurfacing Hip Replacement by Reason for Revision (Primary Diagnosis OA)

Reason for Revision	Number	Percent
Loosening	289	25.3
Metal Related Pathology	250	21.9
Fracture	229	20.1
Lysis	118	10.3
Infection	74	6.5
Pain	67	5.9
Prosthesis Dislocation/Instability	29	2.5
Osteonecrosis	28	2.5
Other (11)	57	5.0
TOTAL	**1141**	**100.0**

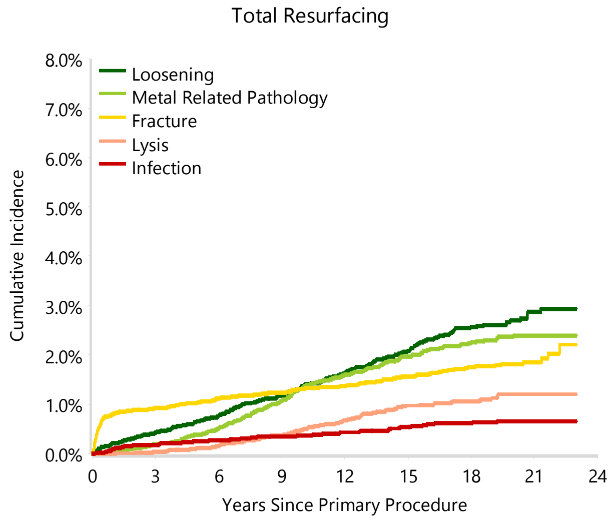
Note: Restricted to modern prostheses

Table HT91 Primary Total Resurfacing Hip Replacement by Type of Revision (Primary Diagnosis OA)

Type of Revision	Number	Percent
THR (Femoral/Acetabular)	777	68.1
Femoral Component	299	26.2
Acetabular Component	30	2.6
Cement Spacer	26	2.3
Removal of Prostheses	7	0.6
Head/Insert	1	0.1
Minor Components	1	0.1
TOTAL	**1141**	**100.0**

Note: Restricted to modern prostheses

Figure HT89 Cumulative Incidence Revision Diagnosis of Primary Total Resurfacing Hip Replacement (Primary Diagnosis OA)



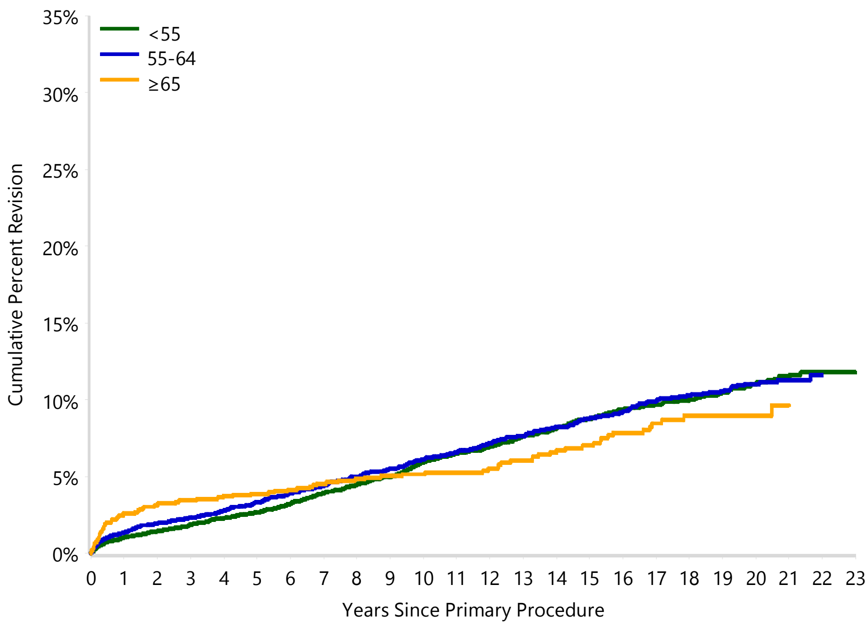
Note: Restricted to modern prostheses

Table HT92 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement by Age (Primary Diagnosis OA)

Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
<55	605	8147	1.0 (0.8, 1.3)	1.9 (1.6, 2.2)	2.7 (2.3, 3.1)	5.9 (5.4, 6.5)	8.8 (8.1, 9.5)	11.0 (10.1, 12.0)
55-64	444	5640	1.4 (1.1, 1.7)	2.3 (1.9, 2.7)	3.3 (2.9, 3.8)	6.1 (5.5, 6.8)	8.8 (8.0, 9.7)	11.0 (10.0, 12.2)
≥65	92	1397	2.6 (1.9, 3.6)	3.5 (2.6, 4.6)	3.9 (3.0, 5.1)	5.1 (4.1, 6.5)	7.0 (5.6, 8.7)	8.9 (7.2, 11.1)
TOTAL	**1141**	**15184**						

Note: Restricted to modern prostheses

Figure HT90 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement by Age (Primary Diagnosis OA)



HR - adjusted for gender

55-64 vs <55
0 - 1.5Yr: HR=1.38 (1.05, 1.81), p=0.021
1.5Yr+: HR=0.98 (0.85, 1.12), p=0.740

≥65 vs <55
0 - 3Mth: HR=2.65 (1.52, 4.60), p<0.001
3Mth - 6Mth: HR=4.13 (2.13, 7.99), p<0.001
6Mth+: HR=0.86 (0.66, 1.11), p=0.248

≥65 vs 55-64
0 - 3Mth: HR=1.82 (1.05, 3.17), p=0.033
3Mth - 6Mth: HR=2.84 (1.47, 5.50), p=0.002
6Mth+: HR=0.86 (0.66, 1.12), p=0.252

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
<55	8147	7769	7134	6483	5213	3561	1302
55-64	5640	5418	5050	4605	3757	2673	859
≥65	1397	1338	1252	1120	835	584	162

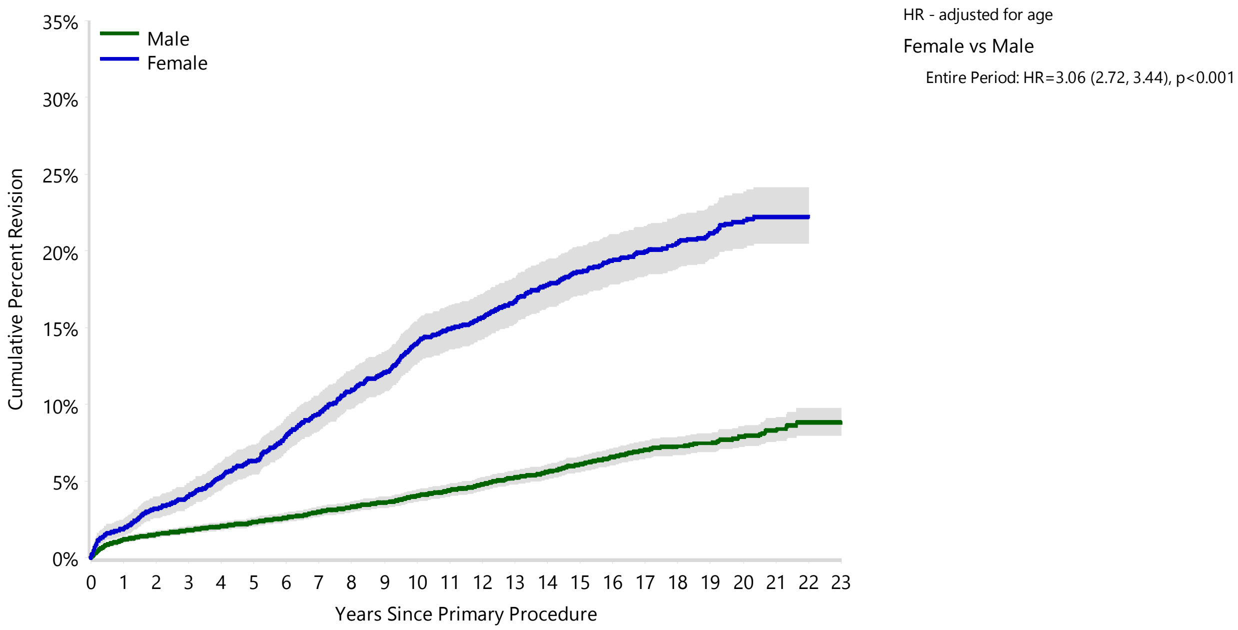
Note: Restricted to modern prostheses

Table HT93 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement by Gender and Age (Primary Diagnosis OA)

Gender	Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Male		**655**	**12693**	**1.2 (1.0, 1.4)**	**1.8 (1.6, 2.1)**	**2.3 (2.1, 2.6)**	**4.0 (3.7, 4.4)**	**6.1 (5.6, 6.6)**	**7.9 (7.2, 8.6)**
	<55	330	6723	1.0 (0.7, 1.2)	1.5 (1.2, 1.8)	2.0 (1.7, 2.4)	3.8 (3.3, 4.3)	6.0 (5.3, 6.7)	7.9 (7.0, 8.8)
	55-64	247	4677	1.1 (0.9, 1.5)	1.8 (1.5, 2.2)	2.4 (2.0, 2.9)	4.2 (3.6, 4.8)	6.1 (5.4, 7.0)	7.8 (6.8, 8.9)
	≥65	78	1293	2.6 (1.8, 3.6)	3.4 (2.5, 4.5)	3.7 (2.8, 4.9)	4.8 (3.7, 6.2)	6.3 (4.9, 8.0)	8.3 (6.5, 10.5)
Female		**486**	**2491**	**1.9 (1.4, 2.5)**	**4.0 (3.3, 4.9)**	**6.3 (5.4, 7.4)**	**13.9 (12.6, 15.4)**	**18.6 (17.1, 20.3)**	**21.9 (20.1, 23.7)**
	<55	275	1424	1.5 (1.0, 2.3)	3.5 (2.7, 4.6)	5.7 (4.6, 7.1)	14.1 (12.3, 16.1)	18.7 (16.7, 20.9)	21.8 (19.6, 24.3)
	55-64	197	963	2.4 (1.6, 3.6)	4.7 (3.5, 6.3)	7.3 (5.8, 9.2)	14.3 (12.2, 16.7)	19.1 (16.7, 21.8)	22.6 (19.9, 25.7)
	≥65	14	104	2.9 (0.9, 8.7)	4.8 (2.0, 11.2)	5.8 (2.6, 12.4)	8.8 (4.7, 16.2)	13.4 (8.0, 22.1)	
TOTAL		**1141**	**15184**						

Note: Restricted to modern prostheses

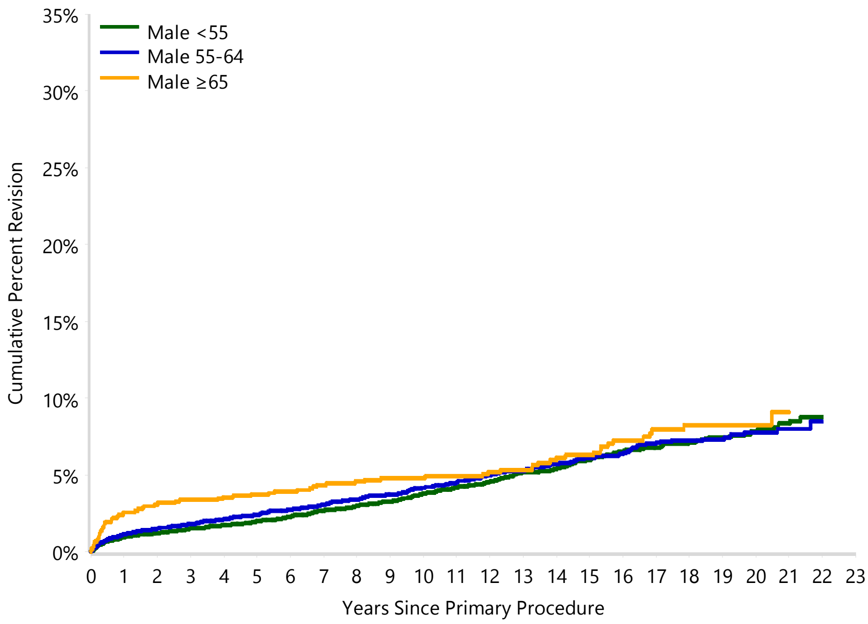
Figure HT91 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement by Gender (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Male	12693	12112	11125	10008	7841	5157	1671
Female	2491	2413	2311	2200	1964	1661	652

Note: Restricted to modern prostheses

Figure HT92 **Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement in Males by Age (Primary Diagnosis OA)**



Male 55-64 vs Male <55

Entire Period: HR=1.04 (0.88, 1.22), p=0.680

Male ≥65 vs Male <55

0 - 3Mth: HR=2.36 (1.31, 4.28), p=0.004

3Mth - 6Mth: HR=3.28 (1.64, 6.57), p<0.001

6Mth+: HR=0.99 (0.74, 1.33), p=0.949

Male ≥65 vs Male 55-64

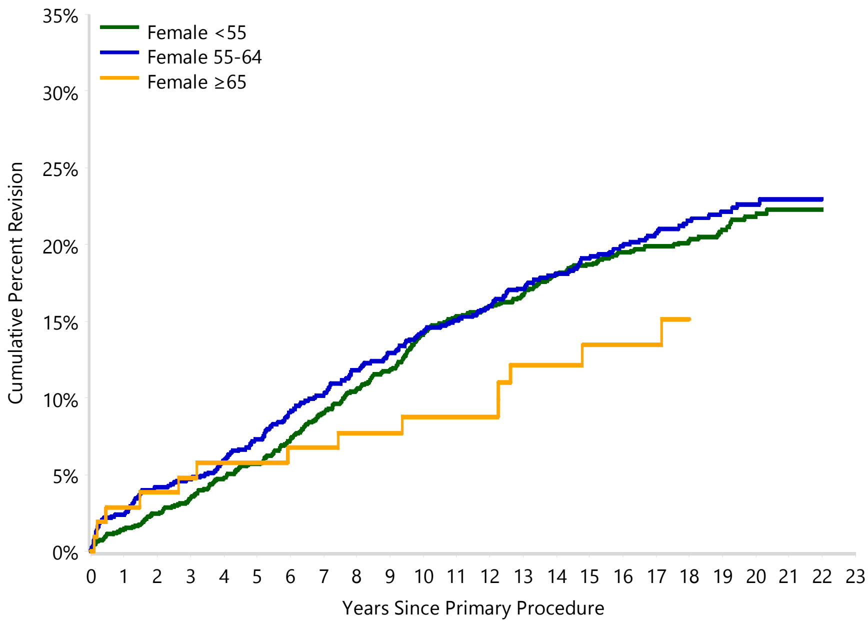
0 - 6Mth: HR=2.60 (1.65, 4.11), p<0.001

6Mth+: HR=0.96 (0.71, 1.29), p=0.772

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Male	**<55**	6723	6387	5810	5231	4098	2608	929
	55-64	4677	4488	4161	3754	2993	2032	606
	≥65	1293	1237	1154	1023	750	517	136

Note: Restricted to modern prostheses

Figure HT93 **Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement in Females by Age (Primary Diagnosis OA)**



Female 55-64 vs Female <55
Entire Period: HR=1.06 (0.88, 1.27), p=0.551

Female ≥65 vs Female <55
Entire Period: HR=0.68 (0.40, 1.16), p=0.156

Female ≥65 vs Female 55-64
Entire Period: HR=0.64 (0.37, 1.10), p=0.108

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Female	**<55**	1424	1382	1324	1252	1115	953	373
	55-64	963	930	889	851	764	641	253
	≥65	104	101	98	97	85	67	26

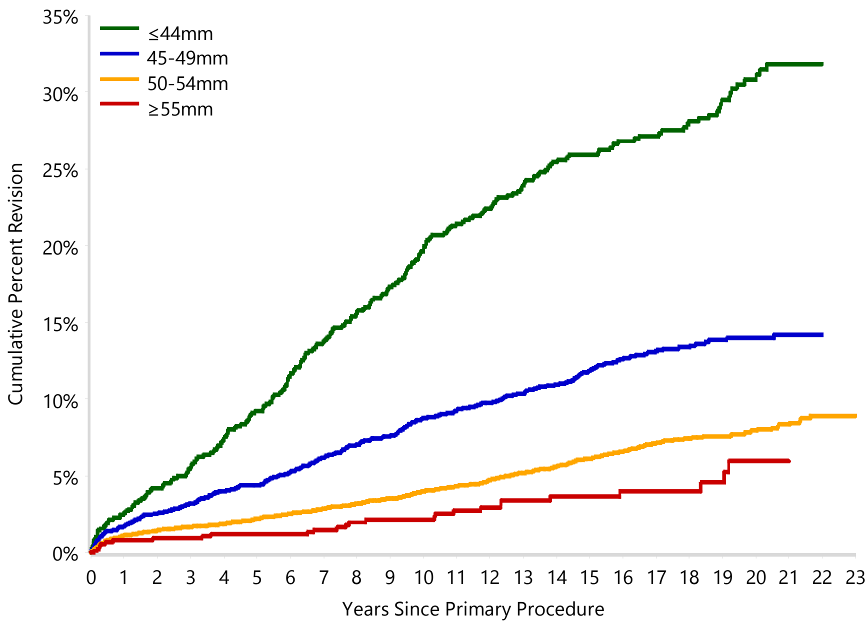
Note: Restricted to modern prostheses

Table HT94 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement by Head Size (Primary Diagnosis OA)

Head Size	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
≤44mm	245	892	2.6 (1.7, 3.9)	5.6 (4.2, 7.3)	9.2 (7.5, 11.3)	19.6 (17.1, 22.4)	26.0 (23.1, 29.1)	30.8 (27.6, 34.4)
45-49mm	319	3007	1.7 (1.3, 2.2)	3.2 (2.6, 3.9)	4.4 (3.7, 5.2)	8.7 (7.7, 9.9)	11.8 (10.6, 13.2)	14.0 (12.5, 15.6)
50-54mm	550	10394	1.1 (0.9, 1.3)	1.7 (1.5, 2.0)	2.2 (1.9, 2.5)	4.0 (3.6, 4.4)	6.1 (5.6, 6.7)	8.0 (7.3, 8.7)
≥55mm	27	891	0.8 (0.4, 1.7)	0.9 (0.5, 1.8)	1.2 (0.6, 2.2)	2.1 (1.3, 3.5)	3.6 (2.4, 5.5)	5.9 (3.7, 9.4)
TOTAL	**1141**	**15184**						

Note: Restricted to modern prostheses

Figure HT94 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement by Head Size (Primary Diagnosis OA)



HR - adjusted for age and gender

≤44mm vs ≥55mm

Entire Period: HR=4.18 (2.71, 6.44), p<0.001

45-49mm vs ≥55mm

Entire Period: HR=2.26 (1.50, 3.40), p<0.001

50-54mm vs ≥55mm

Entire Period: HR=1.57 (1.07, 2.32), p=0.021

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
≤44mm	892	859	817	764	664	541	221
45-49mm	3007	2885	2685	2458	2015	1458	481
50-54mm	10394	9931	9169	8301	6613	4507	1515
≥55mm	891	850	765	685	513	312	106

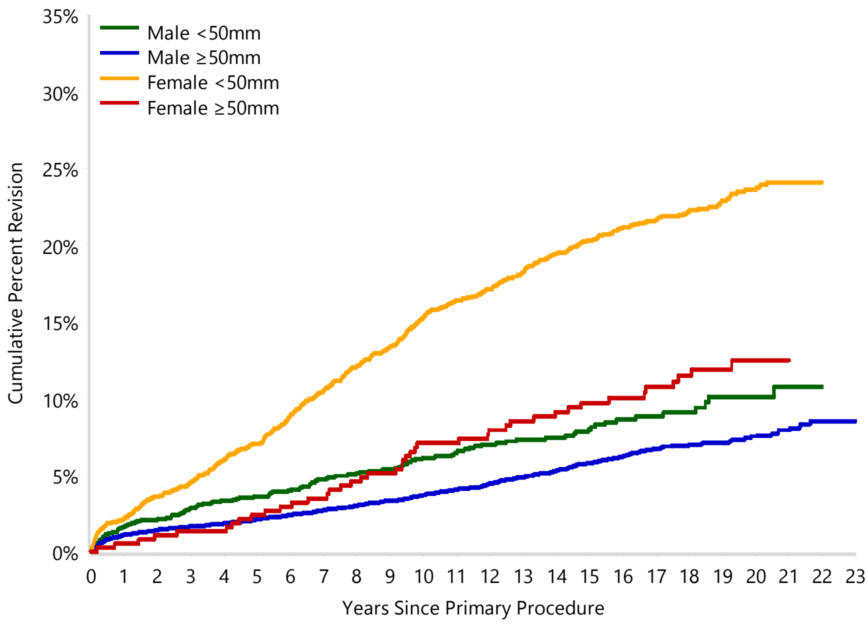
Note: Restricted to modern prostheses

Table HT95 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement by Gender and Femoral Head Size (Primary Diagnosis OA)

Gender	Femoral Head Size	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Male		**655**	**12693**	**1.2 (1.0, 1.4)**	**1.8 (1.6, 2.1)**	**2.3 (2.1, 2.6)**	**4.0 (3.7, 4.4)**	**6.1 (5.6, 6.6)**	**7.9 (7.2, 8.6)**
	<50mm	120	1795	1.6 (1.1, 2.3)	2.8 (2.2, 3.7)	3.6 (2.8, 4.6)	6.1 (5.0, 7.5)	8.0 (6.6, 9.6)	10.1 (8.2, 12.4)
	≥50mm	535	10898	1.1 (0.9, 1.3)	1.6 (1.4, 1.9)	2.1 (1.9, 2.4)	3.7 (3.3, 4.1)	5.8 (5.3, 6.3)	7.5 (6.9, 8.3)
Female		**486**	**2491**	**1.9 (1.4, 2.5)**	**4.0 (3.3, 4.9)**	**6.3 (5.4, 7.4)**	**13.9 (12.6, 15.4)**	**18.6 (17.1, 20.3)**	**21.9 (20.1, 23.7)**
	<50mm	444	2104	2.1 (1.6, 2.9)	4.5 (3.7, 5.5)	7.1 (6.0, 8.3)	15.2 (13.7, 16.9)	20.3 (18.5, 22.1)	23.6 (21.7, 25.7)
	≥50mm	42	387	0.5 (0.1, 2.1)	1.3 (0.5, 3.1)	2.4 (1.3, 4.6)	7.1 (4.9, 10.2)	9.7 (7.1, 13.3)	12.5 (9.3, 16.6)
TOTAL		**1141**	**15184**						

Note: Restricted to modern prostheses

Figure HT95 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement by Gender and Femoral Head Size (Primary Diagnosis OA)



HR - adjusted for age

Male <50mm vs Male ≥50mm
Entire Period: HR=1.45 (1.19, 1.77), p<0.001

Male <50mm vs Female <50mm
Entire Period: HR=0.41 (0.33, 0.50), p<0.001

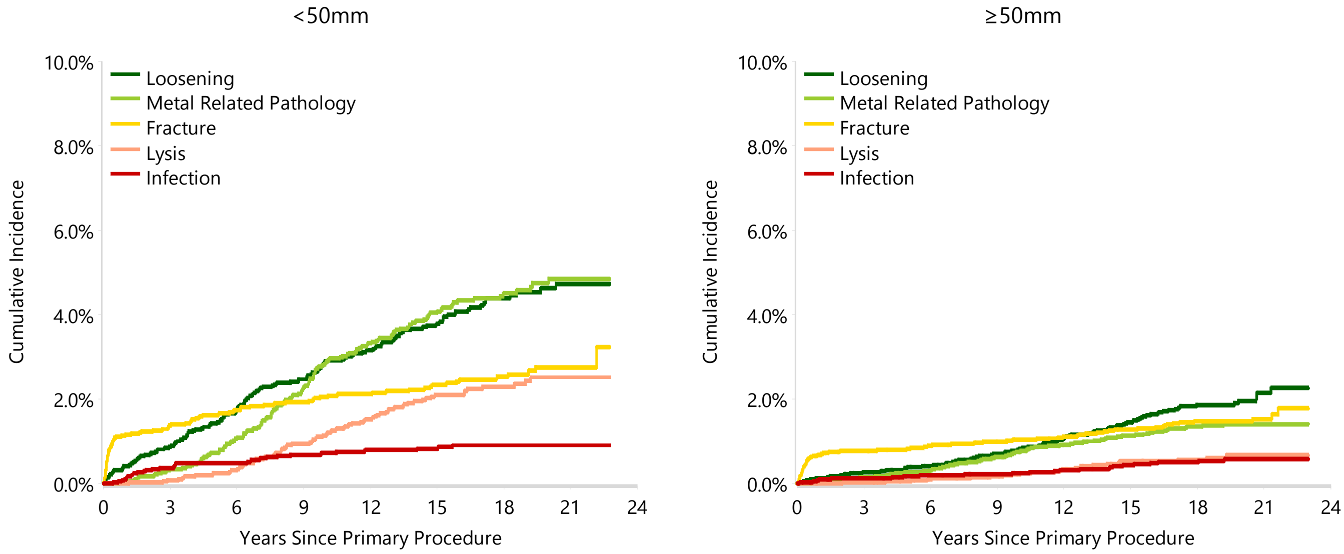
Male ≥50mm vs Female ≥50mm
Entire Period: HR=0.60 (0.44, 0.82), p=0.001

Female <50mm vs Female ≥50mm
Entire Period: HR=2.14 (1.56, 2.93), p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Male	<50mm	1795	1710	1556	1381	1048	627	174
	≥50mm	10898	10402	9569	8627	6793	4530	1497
Female	<50mm	2104	2034	1946	1841	1631	1372	528
	≥50mm	387	379	365	359	333	289	124

Note: Restricted to modern prostheses

Figure HT96 **Cumulative Incidence Revision Diagnosis of Primary Total Resurfacing Hip Replacement by Head Size (Primary Diagnosis OA)**



Note: Restricted to modern prostheses

OUTCOME OF PRIMARY TOTAL RESURFACING COMPARED TO PRIMARY TOTAL CONVENTIONAL HIP REPLACEMENT

The rate of revision for osteoarthritis in primary total resurfacing and primary total conventional hip replacement are compared using only modern prostheses.

Primary total resurfacing has a lower rate of revision than primary total conventional hip replacement in the first month.

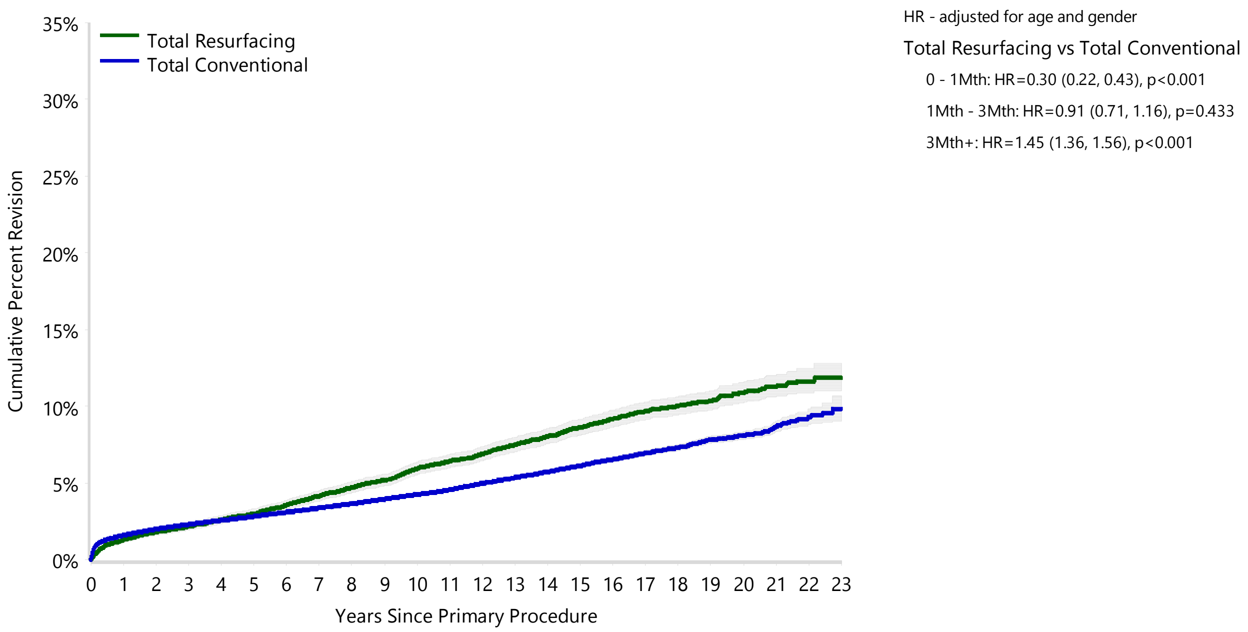
After 3 months, primary total resurfacing has a higher rate of revision (Table HT96 and Figure HT97). When analysed by gender, females with hip resurfacing have a higher rate of revision. Males with hip resurfacing have a lower rate of revision compared to males with a total conventional hip replacement for the first month, with no difference after this time (Table HT97 and Figure HT98).

Table HT96 Cumulative Percent Revision of Primary Total Hip Replacement by Class (Primary Diagnosis OA)

Total Hip Class	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Total Resurfacing	1141	15184	1.3 (1.1, 1.5)	2.2 (2.0, 2.4)	3.0 (2.8, 3.3)	5.9 (5.5, 6.4)	8.6 (8.1, 9.2)	10.9 (10.2, 11.6)
Total Conventional	15935	471655	1.6 (1.6, 1.6)	2.3 (2.3, 2.3)	2.8 (2.8, 2.9)	4.3 (4.2, 4.3)	6.1 (6.0, 6.3)	8.1 (7.8, 8.3)
TOTAL	**17076**	**486839**						

Note: All primary total conventional procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Figure HT97 Cumulative Percent Revision of Primary Total Hip Replacement by Class (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Total Resurfacing	15184	14525	13436	12208	9805	6818	2323
Total Conventional	471655	419744	335490	259069	106561	32340	5433

Note: All primary total conventional procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

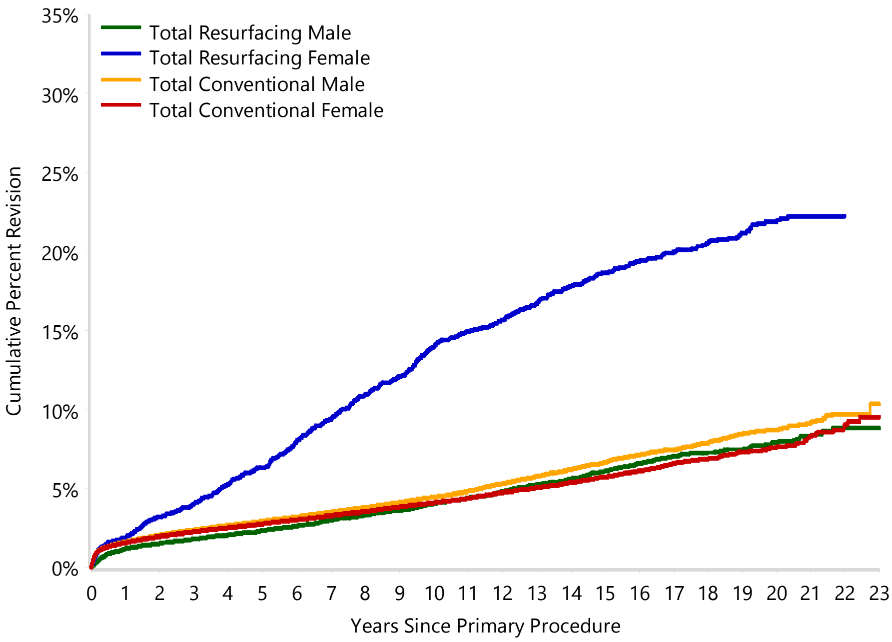
Primary Total Hip Replacement

Table HT97 Cumulative Percent Revision of Primary Total Hip Replacement by Class and Gender (Primary Diagnosis OA)

Total Hip Class	Gender	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Total Resurfacing		**1141**	**15184**	**1.3 (1.1, 1.5)**	**2.2 (2.0, 2.4)**	**3.0 (2.8, 3.3)**	**5.9 (5.5, 6.4)**	**8.6 (8.1, 9.2)**	**10.9 (10.2, 11.6)**
	Male	655	12693	1.2 (1.0, 1.4)	1.8 (1.6, 2.1)	2.3 (2.1, 2.6)	4.0 (3.7, 4.4)	6.1 (5.6, 6.6)	7.9 (7.2, 8.6)
	Female	486	2491	1.9 (1.4, 2.5)	4.0 (3.3, 4.9)	6.3 (5.4, 7.4)	13.9 (12.6, 15.4)	18.6 (17.1, 20.3)	21.9 (20.1, 23.7)
Total Conventional		**15935**	**471655**	**1.6 (1.6, 1.6)**	**2.3 (2.3, 2.3)**	**2.8 (2.8, 2.9)**	**4.3 (4.2, 4.3)**	**6.1 (6.0, 6.3)**	**8.1 (7.8, 8.3)**
	Male	7560	216601	1.6 (1.6, 1.7)	2.4 (2.3, 2.4)	2.9 (2.9, 3.0)	4.5 (4.3, 4.6)	6.7 (6.4, 6.9)	8.7 (8.3, 9.1)
	Female	8375	255054	1.6 (1.5, 1.6)	2.3 (2.2, 2.3)	2.8 (2.7, 2.8)	4.1 (4.0, 4.2)	5.7 (5.5, 5.9)	7.6 (7.3, 7.9)
TOTAL		**17076**	**486839**						

Note: Restricted to modern prostheses
All primary total conventional procedures using metal/metal prostheses have been excluded

Figure HT98 Cumulative Percent Revision of Primary Total Hip Replacement by Class and Gender (Primary Diagnosis OA)



HR - adjusted for age

Total Resurfacing Male vs Total Resurfacing Female
Entire Period: HR=0.33 (0.29, 0.37), p<0.001

Total Resurfacing Male vs Total Conventional Male
0 - 1Mth: HR=0.25 (0.16, 0.38), p<0.001
1Mth - 3Mth: HR=0.76 (0.57, 1.02), p=0.066
3Mth+: HR=0.97 (0.89, 1.06), p=0.535

Total Resurfacing Female vs Total Conventional Female
0 - 1Mth: HR=0.68 (0.48, 0.98), p=0.036
1Mth - 6Mth: HR=2.99 (2.66, 3.36), p<0.001
6Mth+: HR=3.28 (2.98, 3.62), p<0.001

Total Conventional Male vs Total Conventional Female
0 - 2Wk: HR=0.84 (0.75, 0.94), p=0.002
2Wk - 3Mth: HR=1.06 (0.99, 1.13), p=0.074
3Mth - 6Mth: HR=0.98 (0.87, 1.10), p=0.718
6Mth+: HR=1.14 (1.09, 1.18), p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Total Resurfacing	Male	12693	12112	11125	10008	7841	5157	1671
	Female	2491	2413	2311	2200	1964	1661	652
Total Conventional	Male	216601	192532	152725	117055	46312	13679	2492
	Female	255054	227212	182765	142014	60249	18661	2941

Note: Restricted to modern prostheses
All primary total conventional procedures using metal/metal prostheses have been excluded

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Knee Replacement

Knee Replacement

Categories of Knee Replacement

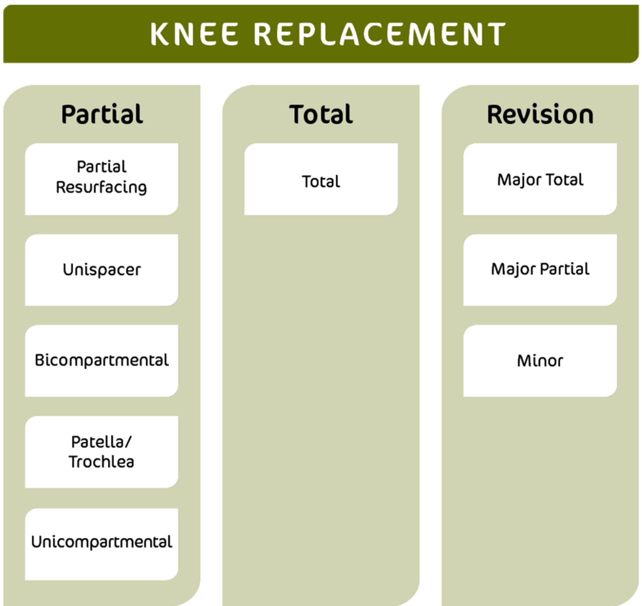
Knee replacement is grouped into three broad categories: primary partial, primary total and revision knee replacement.

A primary replacement is an initial replacement procedure undertaken on a joint and involves replacing either part (partial) or all (total) of the articular surface. The patella may or may not be resurfaced as part of a total replacement.

Primary partial knees are subcategorised into classes depending on the type of prosthesis used. The classes of primary partial knee replacement are partial resurfacing, unispacer, bicompartmental, patella/trochlea and unicompartmental. These are defined in the subsequent sections.

Revision knee replacements are re-operations of previous knee replacements where one or more of the prosthetic components are replaced, removed, or one or more components are added. Revisions include re-operations of primary partial, primary total or previous revision procedures. Knee revisions are subcategorised into three classes: major total, major partial, and minor revisions.

Detailed demographic information on knee replacement is available in the supplementary report 'Demographics of Hip, Knee and Shoulder Arthroplasty' on the AOANJRR website: https://aoanjrr.sahmri.com/annual-reports-2024



Executive Summary Reference Tables

This year, new tables (Table K1 and Table K2) have been added which index the analyses within this chapter. Variables are listed, and where there is a significant finding for a comparison, a red diamond is shown in the table. There are hyperlinks to the relevant tables and figures.

Table K1 Indexing Significant Characteristic Comparisons: Partial Knee Replacements

Characteristic	Variable	Patella/Trochlear Knee Osteoarthritis		Unicompartmental Knee Osteoarthritis	
		Significant HR	Figure no.	Significant HR	Figure no.
Patient					
	Age	♦	Figure KP6	♦	Figure KP19
	Gender	♦	Figure KP7	♦	Figure KP20
	Gender by Age	♦	Figure KP8	♦	Figure KP22 Figure KP23
	ASA Score		Figure KP9	♦	Figure KP24
	BMI	♦	Figure KP10	♦	Figure KP26
Prosthesis					
	Robotic Assistance		Figure KP12		Figure KP30
	Bearing Mobility	NT		♦	Figure KP28
	Fixation	NT		♦	Figure KP29
	Position	NT			Figure KP32
	Mobility	NT		♦	Figure KP33

♦ Significant Hazard Ratio difference between categories where p<0.05

NT Not Tested: Insufficient numbers to make statistical comparisons

Knee Replacement

Table K2 Indexing Significant Characteristic Comparisons: Total Knee Replacements

Characteristic	Variable	Total Knee Osteoarthritis Significant HR	Total Knee Osteoarthritis Table/Figure no.	Total Knee All Diagnoses Significant HR	Total Knee All Diagnoses Table/Figure no.
	Diagnosis	NT		♦	Figure KT6
	Class	NT		NT	
	Class and Age	NT		NT	
	Class and Gender	NT		NT	
Patient					
	Age	♦	Figure KT9	NT	
	Gender	♦	Figure KT10	NT	
	Gender and Revision for Infection	♦	Figure KT12	NT	
	Gender by Age	♦	Figure KT13 Figure KT14	NT	
	ASA Score	♦	Figure KT15	NT	
	ASA by Gender	♦	Figure KT17		
	BMI	♦	Figure KT18	NT	
	BMI by Gender	♦	Figure KT20	NT	
Prosthesis					
	Fixed Bearing Type	♦	Figure KT21	NT	
	Bearing Mobility	♦	Figure KT22	NT	
	Stability	♦	Figure KT24 Figure KT29	♦	Figure KT28
	Polyethylene Conformity		Figure KT26	NT	
	Polyethylene Insert Shape and prosthesis combination	♦	Table KT28	NT	
	Patella Component Usage	♦	Figure KT31	NT	
	Patella Type	♦	Figure KT32	NT	
	Patella Component Usage and Prosthesis Combination	♦	Table KT36	NT	
	Patella Component Usage and Stability	♦	Figure KT33 Figure KT34	NT	
	Stability and Fixation	♦	Figure KT35 Figure KT38 Figure KT39	NT	
	Stability and Fixation by Age	♦	Figure KT36	NT	
	Stability and Fixation by Gender	♦	Figure KT37	NT	
	Polyethylene Type	♦	Figure KT42	NT	
	Polyethylene Type and Revision Diagnosis	♦	Figure KT44 Figure KT45	NT	
	Polyethylene Type and Age	♦	Figure KT46	NT	
	Polyethylene Type and Prosthesis Combination		Table KT47	NT	
	XLPE by Polyethylene Type		Figure KT47	NT	
	Femoral Bearing Surface	♦	Figure KT49	NT	
	Femoral Material	♦	Figure KT51 Figure KT53	NT	

Table K2 ***Cont.***

Characteristic	Variable	Total Knee Osteoarthritis Significant HR	Total Knee Osteoarthritis Table/Figure no.	Total Knee All Diagnoses Significant HR	Total Knee All Diagnoses Table/Figure no.
	Computer Navigation		Figure KT55	NT	
	Computer Navigation and Age	♦	Figure KT57	NT	
	Computer Navigation with Patella by Prosthesis Combination	♦	Table KT55	NT	
	IDI	♦	Figure KT58	NT	
	IDI and Age	♦	Figure KT60	NT	
	IDI with Patella by Prosthesis Combination	♦	Table KT59	NT	
	Robotic Assistance		Figure KT61	NT	
	Robotic Assistance and Age		Figure KT63	NT	
	XLPE by Technology Assistance		Figure KT64	NT	
	Persona CR/Persona Prosthesis Combination with XLPE by Technology Assistance		Figure KT65	NT	
	Persona CR/Persona Prosthesis Combination with XLPE by Patella Usage and Technology Assistance		Figure KT67 Figure KT66	NT	
	Triathlon CR/Triathlon Prosthesis Combination with XLPE by Technology Assistance	♦	Figure KT68	NT	
	Triathlon CR/Triathlon Prosthesis Combination with XLPE without a Patella by Technology Assistance		Figure KT69	NT	
	Triathlon CR/Triathlon Prosthesis Combination with XLPE with a Patella by Technology Assistance	♦	Figure KT70	NT	

♦ Significant Hazard Ratio difference between categories where $p<0.05$

NT Not Tested: Insufficient numbers to make statistical comparisons

Knee Replacement

Use of Knee Replacement

This report analyses 1,125,214 knee replacements with a procedure date up to and including 31 December 2023. This is an additional 78,967 knee procedures since the last report. The relative frequency of each category of knee replacement is provided in Table K3.

For further information on the **closure of the database** please see the **Glossary** of this report.

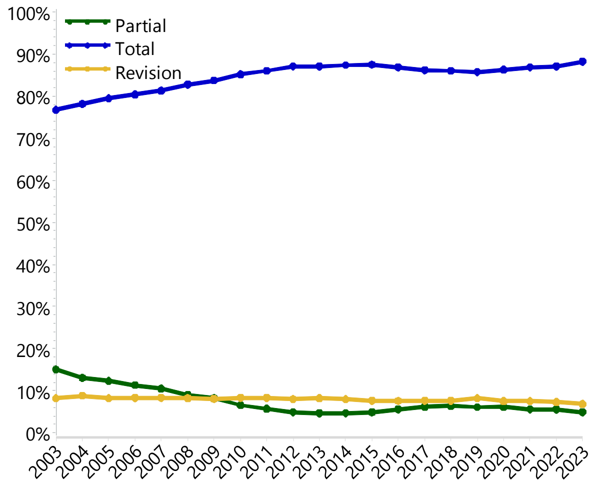
Table K3 Number of Knee Replacements

Knee Category	Number	Percent
Partial	80382	7.1
Total	956175	85.0
Revision	88657	7.9
TOTAL	**1125214**	**100.0**

In 2023, the number of knee replacements undertaken has increased by 12,570 (19.2%) compared to 2022. During the last year, primary partial knee replacement increased by 4.5% and primary total knee replacement increased by 20.7%. Revision knee replacement increased by 12.1%.

In 2023, primary total knee replacement accounted for 88.2% of all knee replacement procedures, primary partial knee replacement accounted for 4.9%, and the proportion of revision knee procedures was 6.8%. This equates to 1,552 fewer revision procedures in 2023 than would have been expected if the proportion of revision procedures had remained at the level reported in 2004 (Figure K1).

Figure K1 Proportion of Knee Replacements



ASA Score and BMI in Knee Replacement

Data are reported on knee replacement procedures for both the American Society of Anaesthesiologists Physical Status Classification (ASA score) and Body Mass Index (BMI). ASA score and BMI are both known to impact the outcome of knee replacement surgery. The Registry commenced the collection of ASA score in 2012 and BMI data in 2015.

There are ASA score data on 676,915 and BMI data on 565,352 knee replacement procedures. Since its initial collection, ASA score has been recorded for 97.4% of procedures. BMI has been recorded for 95.9% of procedures since collection commenced.

ASA SCORE

There are five ASA score classifications:[1]

1. A normal healthy patient
2. A patient with mild systemic disease
3. A patient with severe systemic disease
4. A patient with severe systemic disease that is a constant threat to life
5. A moribund patient who is not expected to survive without the operation

Overall, in 93.2% of knee replacement procedures, patients have an ASA score of 2 or 3, 5.6% have a score of 1 and 1.3% have a score of 4. Very few procedures are recorded where patients have an ASA score of 5.

There is a difference in ASA score depending on the class of knee replacement. There are more patients undergoing partial knee replacement procedures with ASA scores 1 or 2, than those having primary total knee replacement procedures. For patients undergoing revision knee replacement surgery, there are lower proportions with ASA scores of 1 or 2 (Table KT4).

BMI CATEGORY

BMI for adults is classified by the World Health Organisation into six main categories:[2]

Underweight	<18.50
Normal	18.50–24.99
Pre-obese	25.00–29.99
Obese Class 1	30.00–34.99
Obese Class 2	35.00–39.99
Obese Class 3	≥40.00

For all knee replacements, the majority of procedures are undertaken in patients that are either pre-obese or obese class 1. There is very little difference in BMI for patients when primary total and revision knee replacement are compared. However, for partial knee replacement, patients generally have a lower BMI (Table K5).

Table K4 ASA Score for Knee Replacement

ASA Score	Partial		Total		Revision		TOTAL	
	N	Col%	N	Col%	N	Col%	N	Col%
ASA 1	4416	11.7	31562	5.4	1681	3.3	37659	5.6
ASA 2	22926	60.7	315479	53.6	20737	40.6	359142	53.1
ASA 3	10235	27.1	234794	39.9	26424	51.7	271453	40.1
ASA 4	173	0.5	6251	1.1	2201	4.3	8625	1.3
ASA 5	.	.	17	0.0	19	0.0	36	0.0
TOTAL	**37750**	**100.0**	**588103**	**100.0**	**51062**	**100.0**	**676915**	**100.0**

Note: A further 448,299 procedures did not have ASA score recorded

Table K5 BMI Category for Knee Replacement

BMI Category	Partial		Total		Revision		TOTAL	
	N	Col%	N	Col%	N	Col%	N	Col%
Underweight (<18.50)	62	0.2	1002	0.2	144	0.4	1208	0.2
Normal (18.50-24.99)	4878	15.0	52292	10.6	4475	11.1	61645	10.9
Pre Obese (25.00-29.99)	13187	40.4	154002	31.3	12158	30.2	179347	31.7
Obese Class 1 (30.00-34.99)	9872	30.3	151784	30.8	12223	30.4	173879	30.8
Obese Class 2 (35.00-39.99)	3396	10.4	83222	16.9	6844	17.0	93462	16.5
Obese Class 3 (≥40.00)	1217	3.7	50213	10.2	4381	10.9	55811	9.9
TOTAL	**32612**	**100.0**	**492515**	**100.0**	**40225**	**100.0**	**565352**	**100.0**

Note: BMI has not been presented for patients aged ≤19 years. A further 559,862 procedures did not have BMI recorded or the patient is aged ≤19 years

[1] https://www.asahq.org/standards-and-practice-parameters/statement-on-asa-physical-status-classification-system
[2] https://www.who.int/europe/news-room/fact-sheets/item/a-healthy-lifestyle---who-recommendations

Primary Partial Knee Replacement

Classes of Partial Knee Replacement

Partial knee replacement is subcategorised into five classes. These are defined by the types of prostheses used.

Partial resurfacing involves the use of one or more button prostheses to replace part of the natural articulating surface on one or more sides of the joint, in one or more articular compartments of the knee.

Unispacer involves the use of a medial or lateral femorotibial compartment articular spacer.

Bicompartmental involves the replacement of the medial femoral and trochlear articular surface of the knee with a single femoral prosthesis, as well as the medial tibial articular surface with a unicompartmental tibial prosthesis. It may also include the use of a patellar prosthesis.

Patella/trochlea involves the use of a trochlear prosthesis to replace the femoral trochlear articular surface and, on most occasions, a patellar prosthesis.

Unicompartmental involves the replacement of the femoral and tibial articular surface of either the medial or lateral femorotibial compartment using unicompartmental femoral and tibial prostheses.

Use of Partial Knee Replacement

Unicompartmental knee replacement remains the most common class of primary partial knee replacement, accounting for 92.7% of all partial knee replacement procedures. The second most common class is patella/trochlear replacement (6.7%). Within the remaining three classes (partial resurfacing, unispacer and bicompartmental knee replacement) only small numbers of procedures have been reported (Table KP1).

Table KP1 Partial Knee Replacement by Class

Partial Knee Class	Number	Percent
Partial Resurfacing	246	0.3
Unispacer	40	0.1
Bicompartmental	165	0.2
Patella/Trochlea	5425	6.7
Unicompartmental	74506	92.7
TOTAL	**80382**	**100.0**

The unispacer procedure has not been used since 2005 and has the highest revision rate of any class of partial knee replacement. Bicompartmental knee replacement has not been used since 2012. There were no partial resurfacing procedures undertaken in 2023. These classes of partial knee replacement are not presented in detail in this report.

Detailed information on unispacer, bicompartmental and partial resurfacing knee replacement is available in the supplementary report 'Prosthesis Types with No or Minimal Use' on the AOANJRR website: https://aoanjrr.sahmri.com/annual-reports-2024

Patella/Trochlear

DEMOGRAPHICS

There are 5,425 patella/trochlear knee replacement procedures undertaken for all diagnoses. This is an additional 306 procedures compared to the previous report.

For further information on the **closure of the database** please see the **Glossary** of this report.

Patella/trochlear knee replacement accounted for 7.9% of all partial knee replacement procedures in 2023. Although the proportion of patella/trochlear knee replacements has increased from 2003 when it was 3.5%, it has changed little since 2016 (Figure KP1).

Figure KP1 Primary Patella/Trochlea Knee Replacement by Knee Class (All Diagnoses)

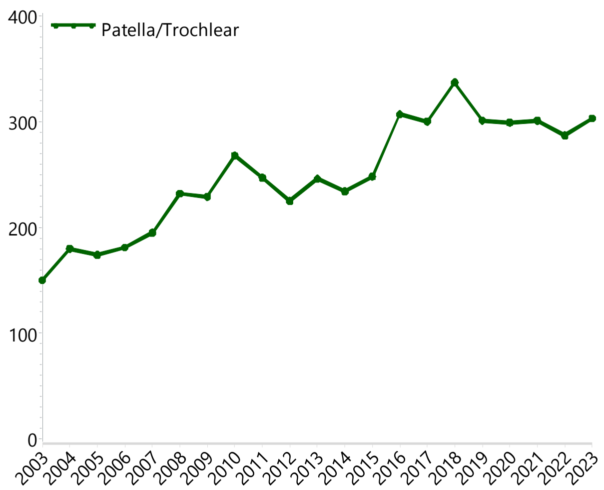


Figure KP2 Primary Patella/Trochlea Knee Replacement by Gender

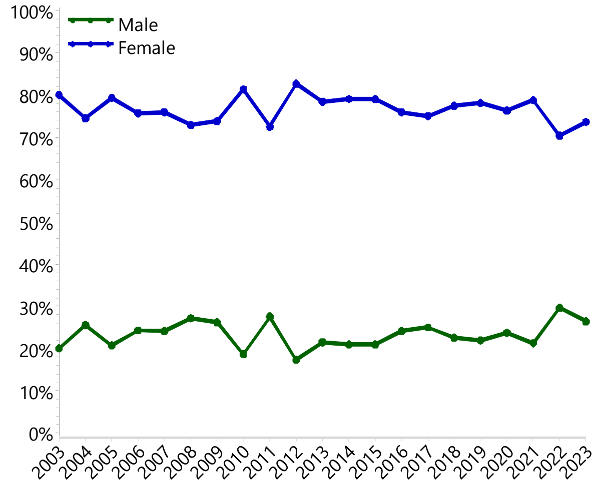
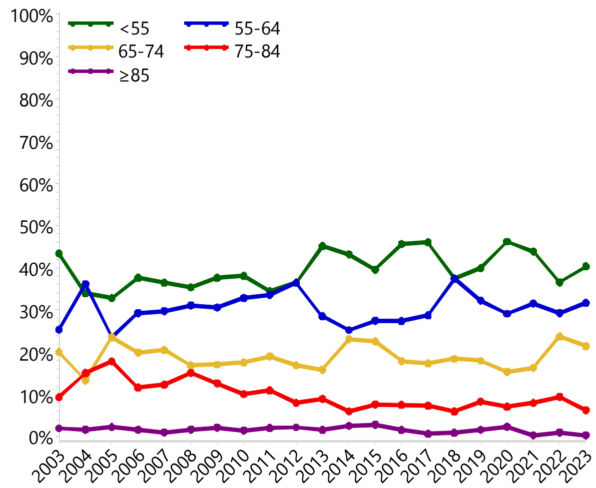


Figure KP3 Primary Patella/Trochlea Knee Replacement by Age



The principal diagnosis for patella/trochlea procedures is osteoarthritis. The proportion of males and females has remained relatively stable over the years (Figure KP2). The mean age of patients is 58.4 years, with this procedure undertaken more frequently in females (Table KP2). The age distribution has remained relatively stable since 2003 (Figure KP3).

In 2023, there were four resurfacing trochlea prostheses used in patella/trochlear knee replacement. The Gender Solutions and Restoris MCK are the most used prostheses in 2023 (Table KP3).

The outcomes of patella/trochlea knee prosthesis combinations used in 2023 are presented in Table KP4.

Table KP2 Age and Gender of Primary Patella/Trochlea Knee Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	1276	23.5%	24	95	61	60.9	12.8
Female	4149	76.5%	21	95	57	57.7	11.7
TOTAL	**5425**	**100.0%**	**21**	**95**	**58**	**58.4**	**12.1**

Table KP3 Most Used Resurfacing Trochlea Prostheses used in Primary Patella/Trochlea Knee Replacement

2003		2020		2021		2022		2023	
N	Model	N	Model	N	Model	N	Model	N	Model
56	LCS	168	Gender Solutions	159	Gender Solutions	128	Restoris MCK	145	Gender Solutions
43	Avon	77	Restoris MCK	93	Restoris MCK	115	Gender Solutions	112	Restoris MCK
29	Lubinus	40	Journey	39	Journey	42	Journey	45	Journey
13	Themis	10	RBK	7	Avon	2	Avon	1	Avon
8	MOD III	4	Avon	3	RBK				
1	RBK								
Most Used									
150	(6) 100.0%	299	(5) 100.0%	301	(5) 100.0%	287	(4) 100.0%	303	(4) 100.0%

Table KP4 Cumulative Percent Revision of Primary Patella/Trochlea Knee Replacement by Prosthesis Combination

Resurfacing Trochlear	Patella	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs
Avon	Avon	113	396	1.0 (0.4, 2.7)	6.7 (4.6, 9.7)	12.0 (9.1, 15.7)	22.8 (18.7, 27.6)	35.4 (29.6, 41.9)
	Triathlon*	10	99	0.0 (0.0, 0.0)	2.0 (0.5, 7.8)	5.3 (2.2, 12.2)	11.0 (5.3, 22.3)	
Gender Solutions	Nexgen	207	1541	1.3 (0.8, 2.0)	6.2 (5.0, 7.6)	9.4 (7.9, 11.1)	21.6 (18.7, 24.8)	
	Persona	6	203	1.2 (0.3, 4.7)	3.5 (1.2, 9.9)			
Journey	Genesis II	158	743	2.1 (1.3, 3.5)	8.1 (6.3, 10.5)	12.4 (10.1, 15.3)	25.2 (21.5, 29.5)	41.6 (35.3, 48.5)
Restoris MCK	Restoris MCK	41	501	1.1 (0.5, 2.7)	6.1 (4.1, 9.1)	10.7 (7.6, 14.9)		
	Triathlon	3	160	1.3 (0.3, 5.1)	2.6 (0.8, 8.6)			
Other (7)		9	31	0.0 (0.0, 0.0)	18.3 (7.3, 41.8)	18.3 (7.3, 41.8)	30.5 (14.7, 56.4)	
TOTAL		**547**	**3674**					

* denotes prosthesis combination with no reported use in patella/trochlea knee replacement in 2023
Note: Restricted to modern prostheses. Only prostheses with over 20 procedures have been listed.

OUTCOME FOR OSTEOARTHRITIS - PATIENT CHARACTERISTICS

In order to keep Registry data contemporaneous, only procedures using prostheses that have been available and used in 2023 (described as modern prostheses) are included in the analyses, unless clearly specified.

There are 540 revisions of 3,626 primary patella/trochlear knee replacement procedures for osteoarthritis. The cumulative percent revision for patella/trochlear replacement at 15 years is 35.6% (Table KP5 and Figure KP4).

Reasons for Revision

The main reasons for revision of patella/trochlear knee replacement are progression of disease, pain and loosening (Table KP6 and Figure KP5). The main type of revision is to a total knee replacement (Table KP7).

Age and Gender

Age and gender are factors affecting the outcome of primary patella/trochlear knee replacement. Patients aged <65 years have a higher rate of revision compared to patients aged ≥65 years (Table KP8 and Figure KP6). Males have a higher rate of revision than females for the first 5.5 years, with no difference after this time (Table KP9 and Figure KP7).

Males aged <65 years have a higher rate of revision than males ≥65 years and females <65 years. Females aged <65 years have a higher rate of revision compared to females ≥65 years (Table KP9 and Figure KP8).

ASA and BMI

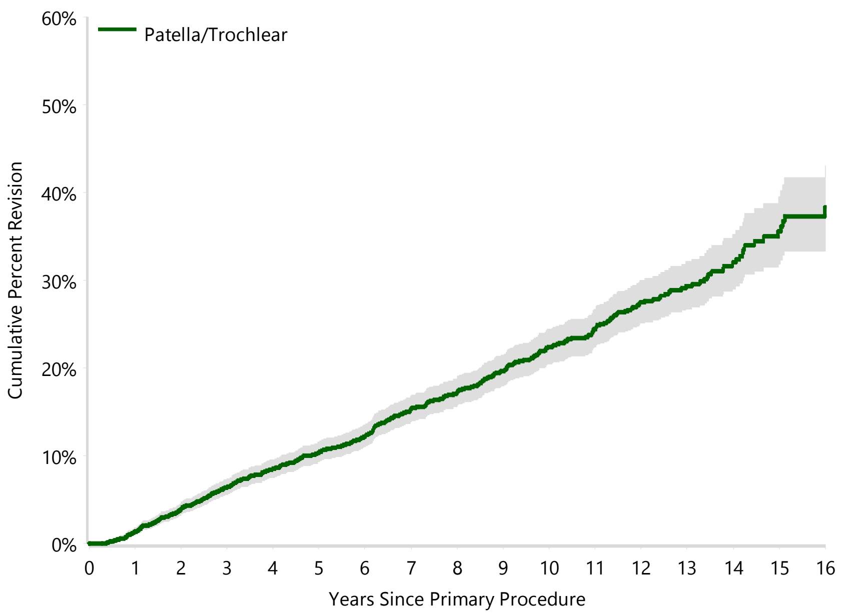
Patient ASA score is not a risk factor for revision (Table KP10 and Figure KP9). When patient BMI category was assessed, obese class 2 and 3 patients have a higher rate of revision compared to patients with a normal BMI (Table KP11 and Figure KP10).

Table KP5 Cumulative Percent Revision of Primary Patella/Trochlear Knee Replacement (Primary Diagnosis OA)

Knee Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	15 Yrs
Patella/Trochlear	540	3626	1.4 (1.0, 1.8)	6.4 (5.6, 7.4)	10.4 (9.3, 11.6)	15.3 (13.9, 16.8)	22.4 (20.4, 24.4)	35.6 (31.9, 39.5)
TOTAL	**540**	**3626**						

Note: Restricted to modern prostheses

Figure KP4 Cumulative Percent Revision of Primary Patella/Trochlear Knee Replacement (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	15 Yrs
Patella/Trochlear	3626	3271	2532	1913	1311	701	111

Note: Restricted to modern prostheses

Primary Partial Knee Replacement

Table KP6 **Primary Patella/Trochlear Knee Replacement by Reason for Revision (Primary Diagnosis OA)**

Reason for Revision	Number	Percent
Progression Of Disease	349	64.6
Pain	57	10.6
Loosening	56	10.4
Infection	16	3.0
Malalignment	10	1.9
Wear Patella	9	1.7
Lysis	5	0.9
Implant Breakage Patella	4	0.7
Wear Tibial Insert	2	0.4
Implant Breakage Femoral	1	0.2
Arthrofibrosis	1	0.2
Other	30	5.6
TOTAL	**540**	**100.0**

Note: Restricted to modern prostheses

Table KP7 **Primary Patella/Trochlear Knee Replacement by Type of Revision (Primary Diagnosis OA)**

Type of Revision	Number	Percent
TKR (Tibial/Femoral)	487	90.2
Patella Only	25	4.6
UKR (Uni Tibial/Uni Femoral)	11	2.0
Patella/Trochlear Resurfacing	8	1.5
Cement Spacer	3	0.6
Removal of Prostheses	3	0.6
Femoral Component	2	0.4
Minor Components	1	0.2
TOTAL	**540**	**100.0**

Note: Restricted to modern prostheses

Figure KP5 **Cumulative Incidence Revision Diagnosis of Primary Patella/Trochlear Knee Replacement by Reason for Revision (Primary Diagnosis OA)**

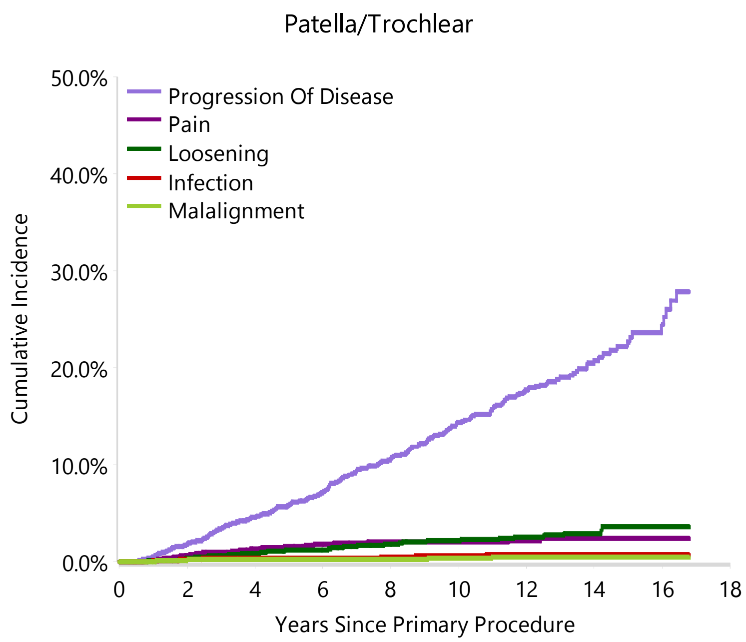
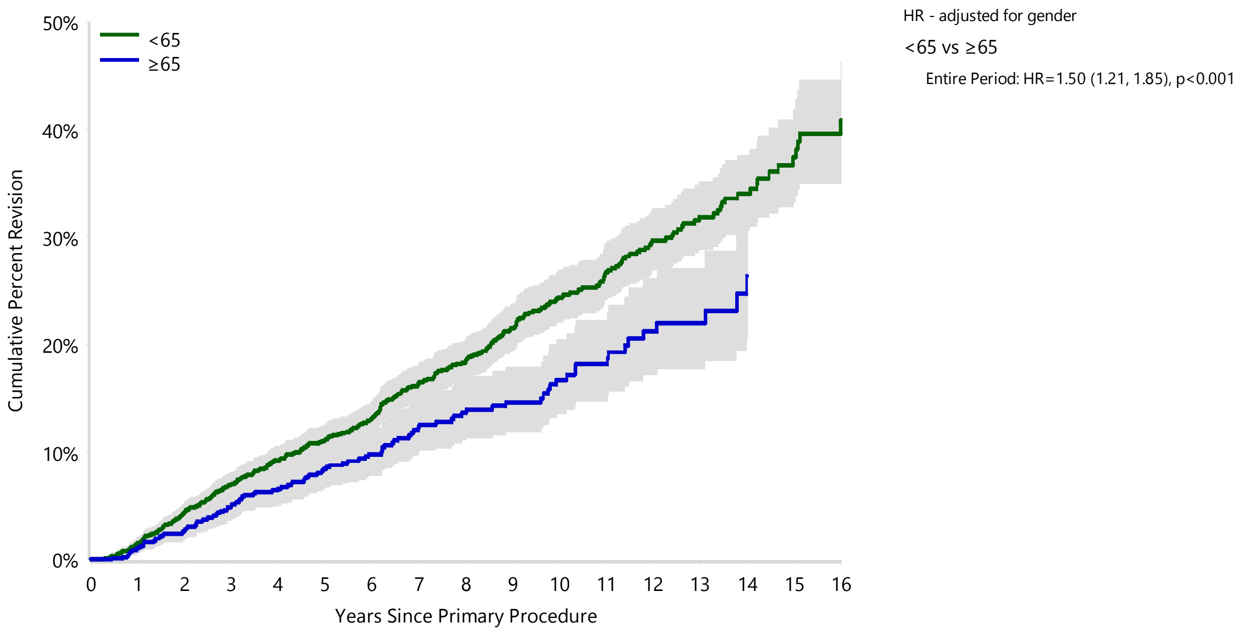


Table KP8 **Cumulative Percent Revision of Primary Patella/Trochlear Knee Replacement by Age (Primary Diagnosis OA)**

Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	15 Yrs
<65	431	2614	1.5 (1.1, 2.1)	7.0 (6.0, 8.1)	11.1 (9.8, 12.5)	16.4 (14.7, 18.3)	24.4 (22.1, 26.9)	37.4 (33.3, 41.9)
≥65	109	1012	1.1 (0.6, 2.0)	5.0 (3.7, 6.7)	8.4 (6.6, 10.7)	12.3 (9.9, 15.1)	16.7 (13.6, 20.5)	
TOTAL	**540**	**3626**						

Note: Restricted to modern prostheses

Figure KP6 **Cumulative Percent Revision of Primary Patella/Trochlea Knee Replacement by Age (Primary Diagnosis OA)**



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	15 Yrs
<65	2614	2364	1843	1394	958	514	86
≥65	1012	907	689	519	353	187	25

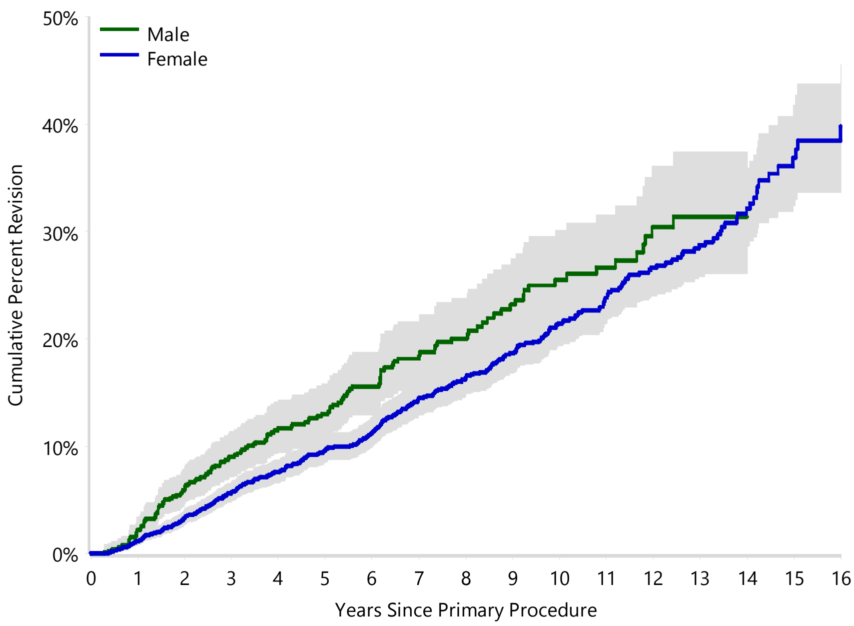
Note: Restricted to modern prostheses

Table KP9 **Cumulative Percent Revision of Primary Patella/Trochlear Knee Replacement by Gender and Age (Primary Diagnosis OA)**

Gender	Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	15 Yrs
Male		**138**	**849**	**2.2 (1.4, 3.5)**	**9.0 (7.1, 11.4)**	**13.0 (10.6, 15.9)**	**18.2 (15.2, 21.6)**	**25.5 (21.4, 30.1)**	
	<65	105	519	2.3 (1.3, 4.1)	11.3 (8.6, 14.7)	15.1 (11.9, 18.9)	21.3 (17.3, 26.0)	31.3 (25.8, 37.6)	
	≥65	33	330	2.0 (0.9, 4.4)	5.4 (3.3, 8.8)	9.8 (6.6, 14.3)	13.0 (9.1, 18.4)	14.8 (10.4, 20.9)	
Female		**402**	**2777**	**1.1 (0.8, 1.6)**	**5.7 (4.8, 6.7)**	**9.6 (8.4, 10.9)**	**14.5 (12.9, 16.2)**	**21.5 (19.3, 23.8)**	**36.9 (32.4, 41.7)**
	<65	326	2095	1.3 (0.9, 1.9)	6.0 (5.0, 7.2)	10.2 (8.8, 11.7)	15.3 (13.5, 17.3)	22.8 (20.3, 25.5)	37.8 (32.8, 43.2)
	≥65	76	682	0.6 (0.2, 1.7)	4.8 (3.3, 7.0)	7.8 (5.7, 10.5)	11.9 (9.1, 15.4)	17.3 (13.4, 22.1)	
TOTAL		**540**	**3626**						

Note: Restricted to modern prostheses

Figure KP7 **Cumulative Percent Revision of Primary Patella/Trochlea Knee Replacement by Gender (Primary Diagnosis OA)**



HR - adjusted for age

Male vs Female

0 - 5Yr: HR=1.51 (1.17, 1.94), p=0.001

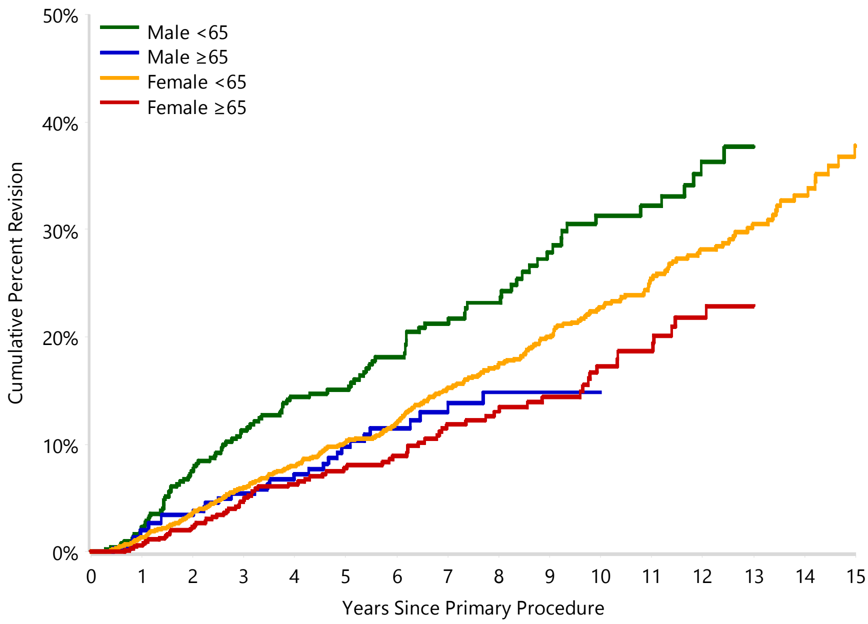
5Yr - 5.5Yr: HR=6.03 (2.19, 16.60), p<0.001

5.5Yr+: HR=0.86 (0.62, 1.21), p=0.388

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	15 Yrs
Male	849	749	555	428	281	142	31
Female	2777	2522	1977	1485	1030	559	80

Note: Restricted to modern prostheses

Figure KP8 **Cumulative Percent Revision of Primary Patella/Trochlear Knee Replacement by Gender and Age (Primary Diagnosis OA)**



Male <65 vs Male ≥65

Entire Period: HR=1.92 (1.30, 2.84), p=0.001

Male <65 vs Female <65

0 - 1.5Yr: HR=2.11 (1.32, 3.38), p=0.002

1.5Yr+: HR=1.29 (1.01, 1.65), p=0.043

Male ≥65 vs Female ≥65

Entire Period: HR=0.99 (0.66, 1.49), p=0.966

Female <65 vs Female ≥65

Entire Period: HR=1.34 (1.05, 1.73), p=0.020

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	15 Yrs
Male	<65	519	461	333	261	176	90	23
	≥65	330	288	222	167	105	52	8
Female	<65	2095	1903	1510	1133	782	424	63
	≥65	682	619	467	352	248	135	17

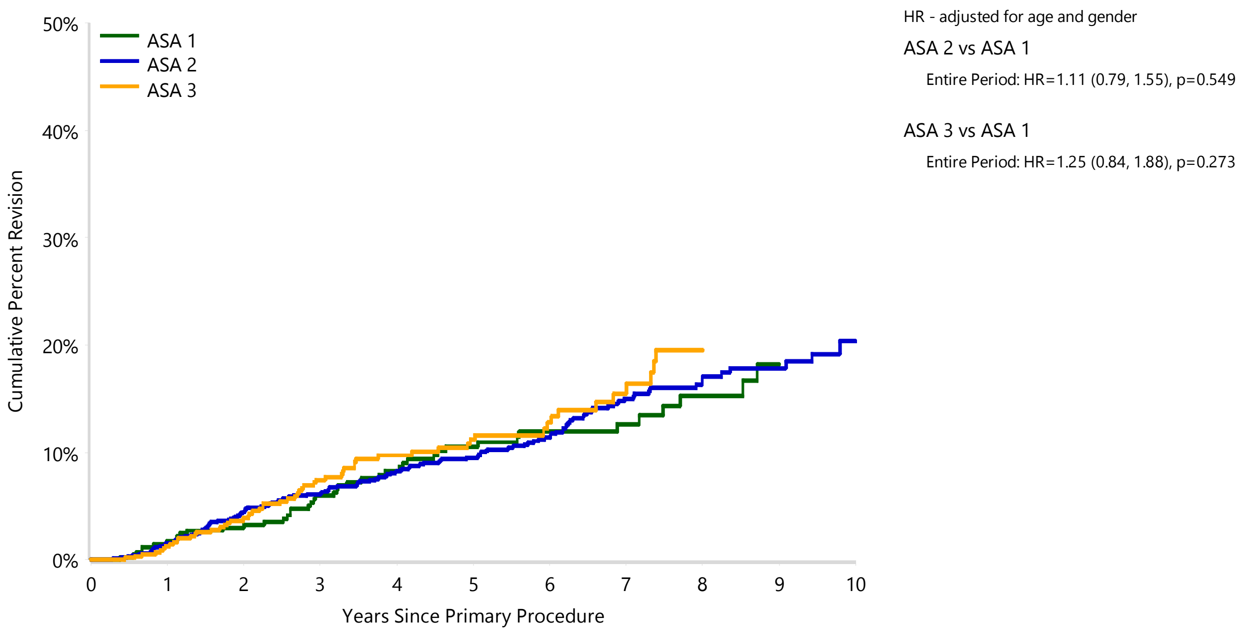
Note: Restricted to modern prostheses

Table KP10 Cumulative Percent Revision of Primary Patella/Trochlear Knee Replacement by ASA Score (Primary Diagnosis OA)

ASA Score	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs
ASA 1	44	440	1.7 (0.8, 3.5)	6.0 (4.0, 8.9)	10.5 (7.6, 14.4)	12.7 (9.3, 17.2)	
ASA 2	161	1645	1.5 (1.0, 2.3)	6.1 (5.0, 7.5)	9.5 (7.9, 11.3)	15.0 (12.7, 17.6)	20.4 (16.6, 24.9)
ASA 3	59	614	1.3 (0.6, 2.6)	7.4 (5.4, 10.2)	11.2 (8.5, 14.8)	15.5 (11.7, 20.4)	
ASA 4	2	8	0.0 (0.0, 0.0)	33.3 (9.6, 80.5)			
TOTAL	**266**	**2707**					

Note: Excludes 919 procedures with unknown ASA score
Restricted to modern prostheses

Figure KP9 Cumulative Percent Revision of Primary Patella/Trochlear Knee Replacement by ASA Score (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs
ASA 1	440	390	303	211	116	18
ASA 2	1645	1440	1034	692	375	53
ASA 3	614	530	354	224	92	5

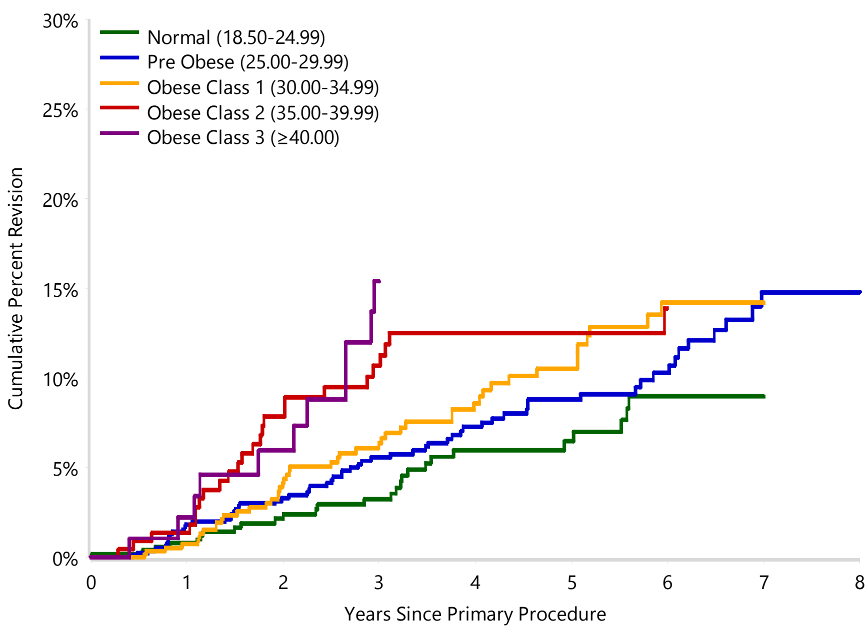
Note: Excludes 919 procedures with unknown ASA score
Restricted to modern prostheses

Table KP11 **Cumulative Percent Revision of Primary Patella/Trochlear Knee Replacement by BMI Category (Primary Diagnosis OA)**

BMI Category	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs
Underweight (<18.50)	0	13	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	
Normal (18.50-24.99)	29	538	0.8 (0.3, 2.1)	2.2 (1.2, 4.0)	3.2 (1.9, 5.4)	6.0 (3.9, 9.0)	6.5 (4.3, 9.8)	9.0 (6.0, 13.2)	9.0 (6.0, 13.2)
Pre Obese (25.00-29.99)	63	844	1.8 (1.1, 3.1)	3.3 (2.2, 4.9)	5.6 (4.1, 7.6)	7.3 (5.5, 9.7)	8.8 (6.7, 11.5)	10.3 (7.8, 13.4)	14.8 (11.2, 19.4)
Obese Class 1 (30.00-34.99)	50	588	0.7 (0.3, 2.0)	4.1 (2.7, 6.4)	6.4 (4.5, 9.1)	8.6 (6.2, 11.8)	10.5 (7.8, 14.1)	14.2 (10.6, 18.9)	14.2 (10.6, 18.9)
Obese Class 2 (35.00-39.99)	30	235	1.4 (0.4, 4.2)	7.9 (4.9, 12.5)	10.7 (7.1, 15.9)	12.5 (8.5, 18.1)	12.5 (8.5, 18.1)	13.9 (9.4, 20.3)	
Obese Class 3 (≥40.00)	14	102	2.2 (0.6, 8.7)	6.0 (2.5, 13.7)	15.4 (8.7, 26.3)				
TOTAL	**186**	**2320**							

Note: BMI has not been presented for patients 19 years or less
Excludes 1,306 procedures with unknown BMI
Restricted to modern prostheses

Figure KP10 **Cumulative Percent Revision of Primary Patella/Trochlear Knee Replacement by BMI Category (Primary Diagnosis OA)**



HR - adjusted for age and gender

Pre Obese (25.00-29.99) vs Normal (18.50-24.99)
Entire Period: HR=1.25 (0.80, 1.96), p=0.326

Obese Class 1 (30.00-34.99) vs Normal (18.50-24.99)
Entire Period: HR=1.47 (0.92, 2.35), p=0.110

Obese Class 2 (35.00-39.99) vs Normal (18.50-24.99)
Entire Period: HR=2.16 (1.29, 3.62), p=0.003

Obese Class 3 (≥40.00) vs Normal (18.50-24.99)
Entire Period: HR=2.90 (1.52, 5.52), p=0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs
Normal (18.50-24.99)	538	470	387	307	241	180	111	71
Pre Obese (25.00-29.99)	844	713	608	495	404	305	206	108
Obese Class 1 (30.00-34.99)	588	510	416	336	254	196	115	66
Obese Class 2 (35.00-39.99)	235	207	174	149	116	88	62	38
Obese Class 3 (≥40.00)	102	82	68	49	33	25	18	11

Note: BMI has not been presented for patients 19 years or less. Excludes 1,306 procedures with unknown BMI. Restricted to modern prostheses.

Primary Partial Knee Replacement

Outcome by Prosthesis Characteristics

Robotic Assistance

Robotic assistance for patella/trochlea knee replacement was first recorded in 2015. Use of robotic assistance increased to 48.6% of patella/trochlea procedures in 2022. In 2023, 40.1% of patella/trochlea knee procedures use robotic assistance (Figure KP11). There are 767 robotically assisted patella/trochlea knee replacement procedures undertaken for osteoarthritis. There are 8 patella/trochlea combinations that can be used with robotic assistance.

When adjusted for age, gender, ASA and BMI there is no difference in the rate of revision for patella/trochlea knee procedures using robotic assistance compared to patella/trochlea procedures without technology assistance (Table KP12 and Figure KP12).

Figure KP11 Primary Patella/Trochlear Knee Replacement by Robotic Assistance (Primary Diagnosis OA)

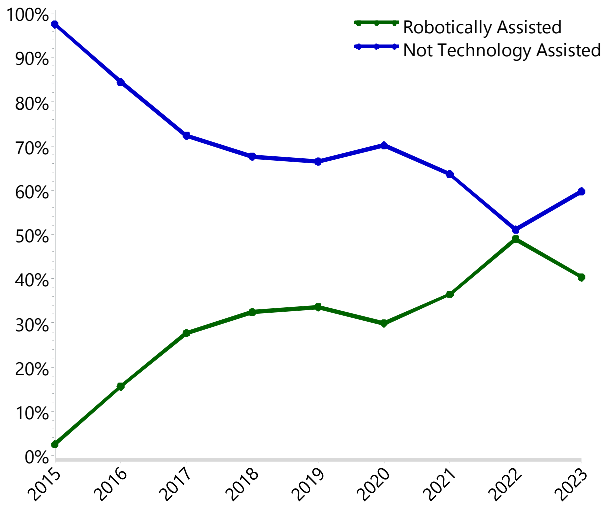
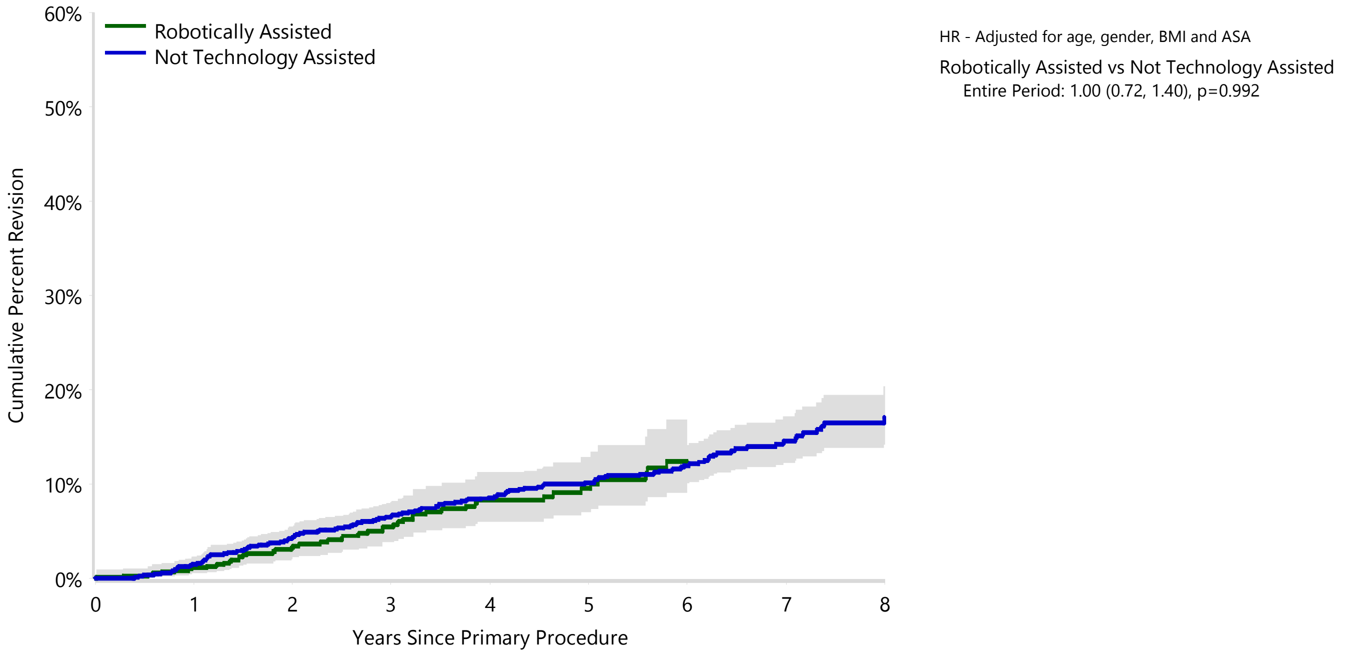


Table KP12 Cumulative Percent Revision of Primary Patella/Trochlear Knee Replacement Since 2015 by Technology (Primary Diagnosis OA)

Technology	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Robotically Assisted	51	767	1.2 (0.6, 2.3)	3.2 (2.1, 5.0)	5.5 (3.8, 7.8)	8.3 (6.1, 11.3)	9.5 (7.0, 12.9)	12.5 (9.2, 16.8)
Not Technology Assisted	156	1635	1.5 (1.0, 2.3)	4.3 (3.4, 5.5)	6.6 (5.4, 8.1)	8.6 (7.2, 10.3)	10.1 (8.5, 12.0)	12.0 (10.1, 14.1)
TOTAL	**207**	**2402**						

Note: Restricted to modern prostheses

Figure KP12 Cumulative Percent Revision of Primary Patella/Trochlear Knee Replacement Since 2015 by Technology (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Robotically Assisted	767	640	489	376	284	194	103
Not Technology Assisted	1635	1431	1251	1042	841	668	474

Note: Restricted to modern prostheses

Primary Partial Knee Replacement

Unicompartmental

DEMOGRAPHICS

There are 74,506 primary unicompartmental knee procedures recorded. This is an additional 3,581 procedures compared to the last report.

For further information on the **closure of the database** please see the **Glossary** of this report.

The use of unicompartmental knee replacement has decreased to 4.5% of all knee procedures in 2023. Although the proportion of unicompartmental knee replacements has increased from 2014 when it was 4.2%, it is still considerably less than in 2003 (14.5%).

Osteoarthritis is the principal diagnosis. This procedure is undertaken more often in males (55.1%) (Table KP13). The proportion of males has increased to 62.5% in 2023 (Figure KP13). Unicompartmental knee replacement is most frequently undertaken in patients aged 55–74 years. The age distribution has remained relatively stable since 2003 (Figure KP14). The mean age of patients is 65.5 years (Table KP13).

Figure KP13 Primary Unicompartmental Knee Replacement by Gender

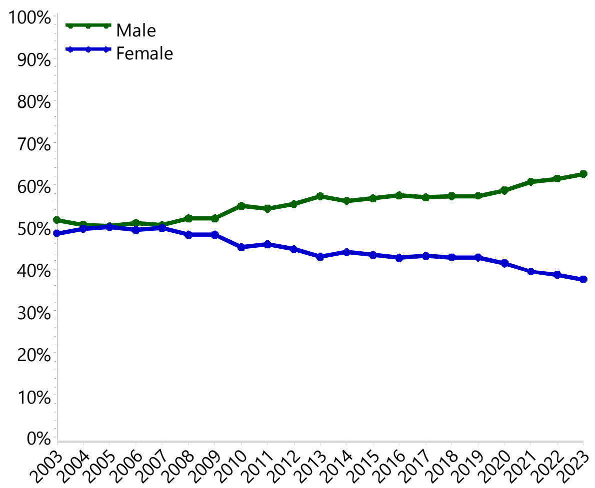
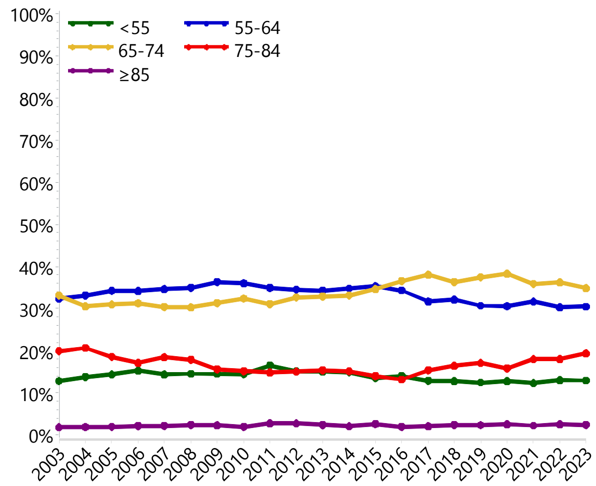


Figure KP14 Primary Unicompartmental Knee Replacement by Age



The use of mobile unicompartmental knee replacement has declined over time and in 2023 accounted for 23.4% of unicompartmental knee procedures (Figure KP15). The proportion of unicompartmental knee replacements using robotic assistance increased to 48.1% in 2023 (Figure KP16).

In 2023, the 10 most used tibial prostheses account for 99.8% of all unicompartmental procedures. The Restoris MCK, Persona and Oxford (cementless) are the most used prostheses in 2023 (Table KP14).

The outcomes of unicompartmental knee prosthesis combinations with >200 procedures are presented in Table KP15.

Figure KP15 Primary Unicompartmental Knee Replacement by Mobility

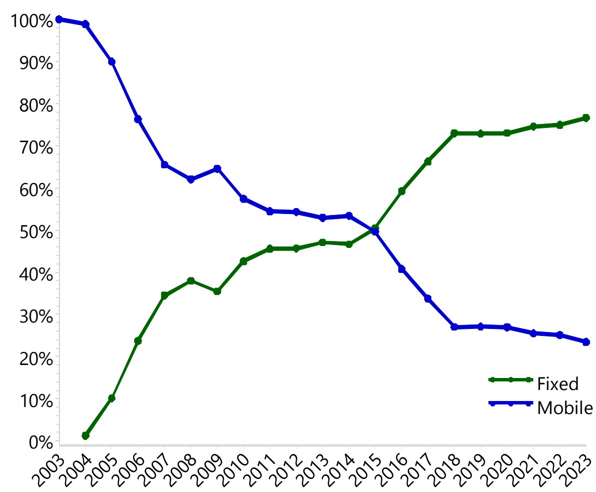


Figure KP16 Primary Unicompartmental Knee Replacement by Robotic Assistance (Primary Diagnosis OA)

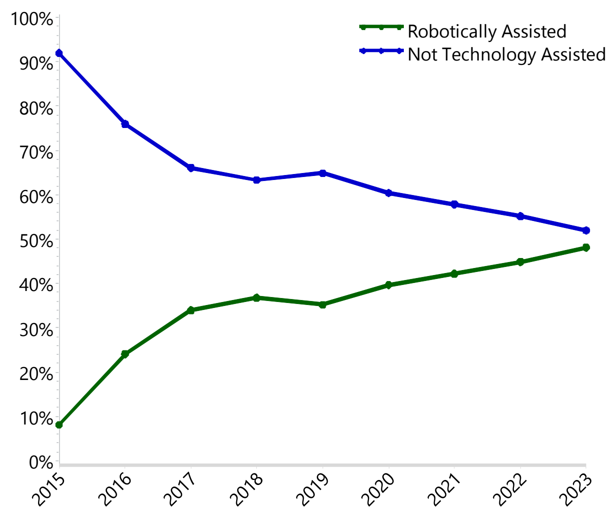


Table KP13 Age and Gender of Primary Unicompartmental Knee Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	41018	55.1%	24	98	66	65.9	9.6
Female	33488	44.9%	13	98	65	65.0	10.2
TOTAL	**74506**	**100.0%**	**13**	**98**	**65**	**65.5**	**9.9**

Table KP14 10 Most Used Tibial Prostheses in Primary Unicompartmental Knee Replacement

2003		2020		2021		2022		2023	
N	Model	N	Model	N	Model	N	Model	N	Model
1365	Oxford (ctd)	1148	Restoris MCK	1201	Restoris MCK	1272	Restoris MCK	1342	Restoris MCK
444	Repicci II	813	Oxford (cless)	776	Oxford (cless)	745	Oxford (cless)	773	Persona
373	Preservation Fixed	712	ZUK	533	Persona	698	Persona	749	Oxford (cless)
353	M/G	176	BalanSys Uni Fixed	281	ZUK	146	Journey Uni (v2)	193	Journey Uni (v2)
336	Allegretto Uni	168	Sigma HP	177	Sigma HP	134	Sigma HP	133	Sigma HP
321	GRU	153	Journey Uni (v2)	163	BalanSys Uni Fixed	125	BalanSys Uni Fixed	116	BalanSys Uni Fixed
275	Genesis	138	Oxford (ctd)	158	Journey Uni (v2)	111	Genus	103	Genus
260	Unix	130	Genus	124	Oxford (ctd)	108	Oxford (ctd)	89	Oxford (ctd)
121	Preservation Mobile	68	Persona	107	Genus	31	ZUK	24	ZUK
101	Endo-Model Sled	20	Endo-Model Sled	10	Journey Uni All Poly	17	Moto	23	Moto
10 Most Used									
3949	(10) 96.2%	3526	(10) 98.7%	3530	(10) 99.3%	3387	(10) 99.6%	3545	(10) 99.8%
Remainder									
158	(7) 3.8%	46	(6) 1.3%	24	(5) 0.7%	13	(5) 0.4%	7	(2) 0.2%
TOTAL									
4107	(17) 100.0%	3572	(16) 100.0%	3554	(15) 100.0%	3400	(15) 100.0%	3552	(12) 100.0%

Primary Partial Knee Replacement

Table KP15 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement by Prosthesis Combination

Uni Femoral	Uni Tibial	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
BalanSys Uni	BalanSys Uni Fixed	80	1326	1.9 (1.3, 2.8)	4.0 (3.0, 5.3)	5.1 (3.9, 6.6)	8.8 (6.6, 11.6)	13.9 (10.2, 18.7)	
Genus	Genus	27	610	3.4 (2.2, 5.3)	5.0 (3.4, 7.3)				
Journey Uni	Journey Uni (v2)	92	1548	2.3 (1.7, 3.2)	5.0 (3.9, 6.3)	6.3 (5.0, 7.8)	10.5 (8.0, 13.7)		
	Journey Uni All Poly	49	349	1.4 (0.6, 3.4)	6.5 (4.3, 9.7)	9.1 (6.5, 12.8)	15.4 (11.6, 20.4)		
Oxford (cless)	Oxford (cless)	725	9752	2.6 (2.3, 2.9)	4.5 (4.1, 5.0)	5.8 (5.3, 6.3)	10.3 (9.5, 11.2)	19.1 (16.7, 21.9)	
	Oxford (ctd)	60	512	3.2 (2.0, 5.2)	6.4 (4.6, 9.0)	9.2 (6.9, 12.2)	13.9 (10.6, 18.2)		
Oxford (ctd)	Oxford (ctd)	2789	13711	2.2 (1.9, 2.4)	5.7 (5.3, 6.1)	8.1 (7.7, 8.6)	14.6 (14.0, 15.2)	22.0 (21.2, 22.9)	30.4 (29.2, 31.5)
Persona	Persona	38	2072	1.5 (1.0, 2.2)	3.3 (2.3, 4.6)				
Restoris MCK	Restoris MCK	291	8985	1.1 (0.9, 1.4)	3.2 (2.8, 3.6)	4.4 (3.9, 5.0)			
Sigma HP	Sigma HP	104	1914	1.1 (0.7, 1.7)	3.0 (2.3, 4.0)	4.6 (3.6, 5.8)	7.8 (6.2, 9.7)	12.4 (9.5, 16.0)	
Triathlon PKR	Triathlon PKR	38	381	3.2 (1.8, 5.5)	6.6 (4.5, 9.7)	8.1 (5.7, 11.4)	12.2 (8.7, 16.9)		
ZUK	ZUK	711	9639	1.5 (1.3, 1.8)	3.4 (3.1, 3.8)	4.6 (4.2, 5.0)	8.0 (7.4, 8.7)	12.5 (11.4, 13.6)	
Other (5)		23	247	4.3 (2.3, 7.8)	6.5 (3.9, 10.8)	9.1 (5.8, 14.2)			
TOTAL		**5027**	**51046**						

Note: Restricted to modern prostheses
Only prostheses with >200 procedures have been listed

OUTCOME FOR OSTEOARTHRITIS – PATIENT CHARACTERISTICS

In order to keep Registry data contemporaneous, only procedures using prostheses that have been available and used in 2023 (described as modern prostheses) are included in the analyses, unless clearly specified.

There are 4,978 revisions of primary unicompartmental knee replacements with an initial diagnosis of osteoarthritis. The cumulative percent revision for primary unicompartmental knee replacement undertaken for osteoarthritis is 11.3% at 10 years and 27.1% at 20 years (Table KP16 and Figure KP17).

Reasons for Revision

The main reasons for revision of unicompartmental knee replacement are progression of disease, loosening and pain (Table KP17 and Figure KP18). The main type of revision is to a total knee replacement (Table KP18).

Age and Gender

Age is a major factor affecting the outcome of primary unicompartmental knee replacement, with the rate of revision decreasing with increasing age (Table KP19 and Figure KP19). Females have a higher rate of revision than males (Table KP20 and Figure KP20). The main reason for this difference is an increased cumulative incidence for progression of disease (Figure KP21). The effect of age on the rate of revision is evident in both males and females (Table KP20, Figure KP22 and Figure KP23).

ASA and BMI

ASA scores are an indication of comorbidity and have been collected since 2012. The definitions for these scores can be found in the introductory part of this chapter. There are 32,658 primary unicompartmental knee replacement procedures for osteoarthritis with these scores. When compared to patients with an ASA score of 1, patients with an ASA score of 3 have a higher rate of revision in the first 9 months only (Table KP21 and Figure KP24). The most common reasons for revision are shown in Figure KP25.

BMI data have been collected since 2015. There are revision outcomes for 28,882 primary unicompartmental knee replacement procedures for osteoarthritis in relation to BMI category. When compared to patients with normal BMI, patients in obese class 2 have a higher rate of revision for the first 2 years with no difference after this time (Table KP22 and Figure KP26). The most common reasons for revision are shown in Figure KP27.

Primary Partial Knee Replacement

Table KP16 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement (Primary Diagnosis OA)

Knee Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Unicompartmental	4978	50625	1.9 (1.8, 2.0)	4.4 (4.2, 4.6)	6.1 (5.9, 6.3)	11.3 (10.9, 11.7)	18.4 (17.8, 19.0)	27.1 (26.0, 28.2)
TOTAL	**4978**	**50625**						

Note: Restricted to modern prostheses

Figure KP17 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement (Primary Diagnosis OA)

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Unicompartmental	50625	46036	37700	29631	14143	5871	1321

Note: Restricted to modern prostheses

Table KP17 Primary Unicompartmental Knee Replacement by Reason for Revision (Primary Diagnosis OA)

Reason for Revision	Number	Percent
Progression Of Disease	1867	37.5
Loosening	1545	31.0
Pain	357	7.2
Infection	269	5.4
Bearing Dislocation	187	3.8
Fracture	151	3.0
Instability	98	2.0
Lysis	91	1.8
Wear Tibial Insert	79	1.6
Malalignment	63	1.3
Implant Breakage Tibial Insert	50	1.0
Other (14)	221	4.4
TOTAL	**4978**	**100.0**

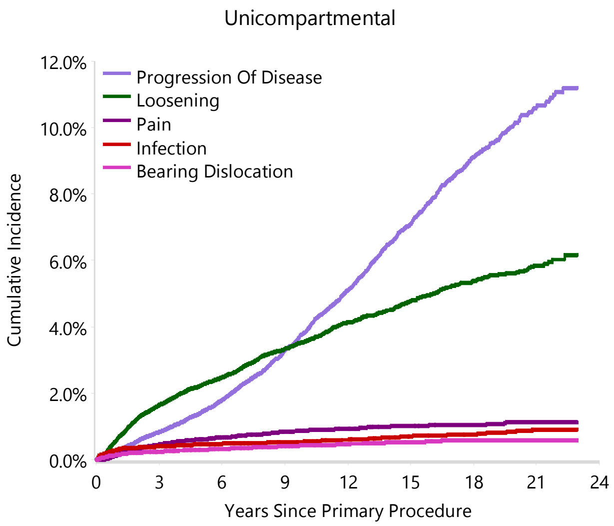
Note: Restricted to modern prostheses

Table KP18 Primary Unicompartmental Knee Replacement by Type of Revision (Primary Diagnosis OA)

Type of Revision	Number	Percent
TKR (Tibial/Femoral)	4175	83.9
Uni Insert Only	549	11.0
Uni Tibial Component	94	1.9
Uni Femoral Component	51	1.0
Cement Spacer	39	0.8
UKR (Uni Tibial/Uni Femoral)	35	0.7
Patella/Trochlear Resurfacing	20	0.4
Removal of Prostheses	5	0.1
Reinsertion of Components	4	0.1
Femoral Component*	4	0.1
Tibial Component	1	0.0
Patella Only	1	0.0
TOTAL	**4978**	**100.0**

Note: Restricted to modern prostheses. *Bicompartmental component

Figure KP18 Cumulative Incidence Revision Diagnosis of Primary Unicompartmental Knee Replacement (Primary Diagnosis OA)



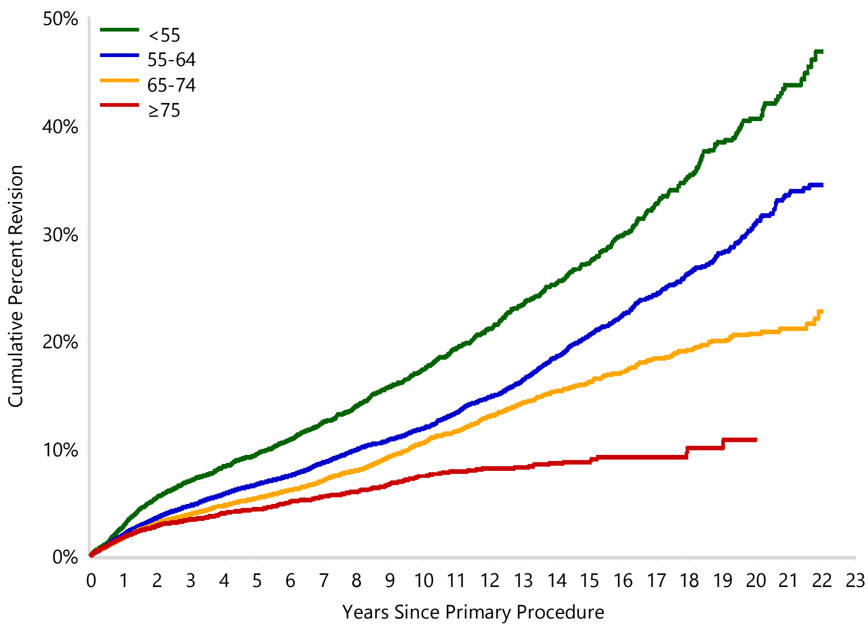
Note: Restricted to modern prostheses

Table KP19 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement by Age (Primary Diagnosis OA)

Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
<55	1074	6590	2.8 (2.4, 3.2)	7.0 (6.3, 7.6)	9.4 (8.7, 10.2)	17.3 (16.1, 18.5)	27.1 (25.4, 28.9)	40.6 (37.8, 43.5)
55-64	1949	16606	2.0 (1.8, 2.2)	4.6 (4.3, 5.0)	6.6 (6.2, 7.0)	11.8 (11.2, 12.4)	20.4 (19.4, 21.5)	30.8 (29.1, 32.6)
65-74	1476	17833	1.6 (1.5, 1.8)	3.8 (3.5, 4.1)	5.3 (4.9, 5.7)	10.4 (9.8, 11.0)	16.1 (15.2, 17.1)	20.6 (19.2, 22.1)
≥75	479	9596	1.7 (1.5, 2.0)	3.3 (3.0, 3.7)	4.3 (3.9, 4.8)	7.4 (6.7, 8.1)	8.6 (7.7, 9.6)	10.7 (8.8, 13.1)
TOTAL	**4978**	**50625**						

Note: Restricted to modern prostheses

Figure KP19 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement by Age (Primary Diagnosis OA)



HR - adjusted for gender

<55 vs ≥75
0 - 1Yr: HR=1.83 (1.50, 2.23), p<0.001
1Yr - 1.5Yr: HR=2.48 (1.91, 3.20), p<0.001
1.5Yr - 6Yr: HR=2.60 (2.23, 3.04), p<0.001
6Yr - 7Yr: HR=2.94 (2.15, 4.02), p<0.001
7Yr - 13.5Yr: HR=3.34 (2.77, 4.02), p<0.001
13.5Yr+: HR=7.01 (5.29, 9.30), p<0.001

55-64 vs ≥75
0 - 2Yr: HR=1.34 (1.16, 1.55), p<0.001
2Yr - 11.5Yr: HR=2.06 (1.81, 2.36), p<0.001
11.5Yr - 13Yr: HR=2.39 (1.78, 3.20), p<0.001
13Yr - 13.5Yr: HR=4.04 (2.53, 6.44), p<0.001
13.5Yr+: HR=5.11 (3.94, 6.63), p<0.001

65-74 vs ≥75
0 - 2Yr: HR=1.13 (0.97, 1.31), p=0.105
2Yr - 7Yr: HR=1.55 (1.33, 1.80), p<0.001
7Yr+: HR=2.11 (1.78, 2.49), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
<55	6590	5957	4855	3876	1953	889	229
55-64	16606	15213	12671	10257	5312	2397	571
65-74	17833	16280	13379	10402	4827	1978	446
≥75	9596	8586	6795	5096	2051	607	75

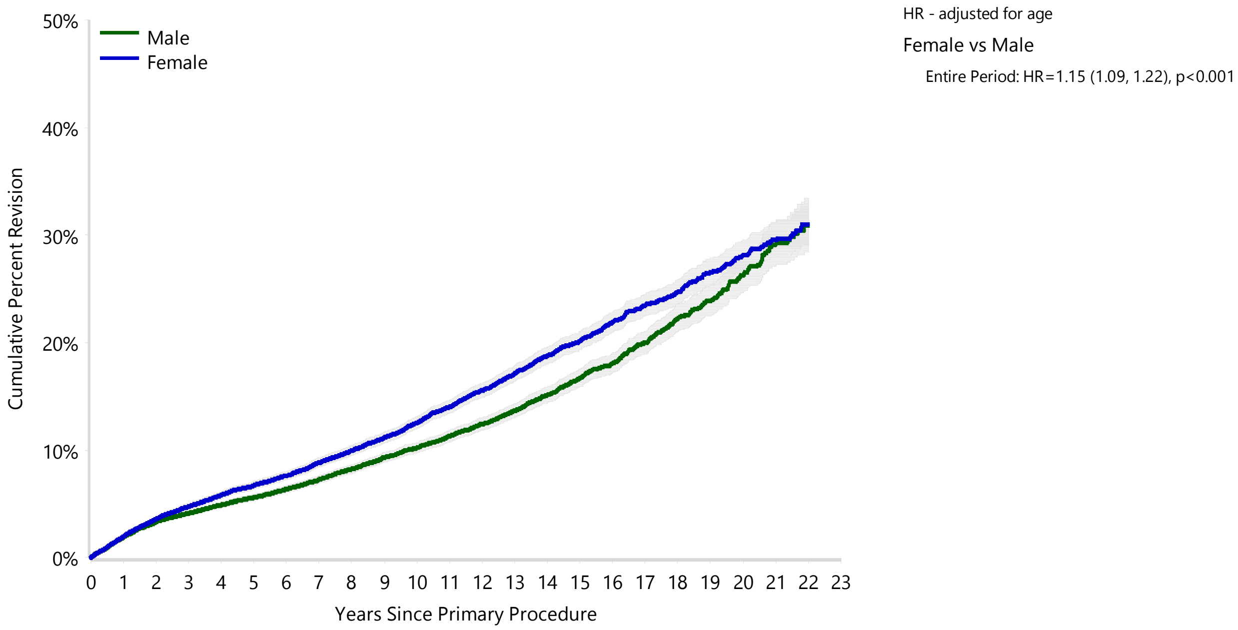
Note: Restricted to modern prostheses

Table KP20 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement by Gender and Age (Primary Diagnosis OA)

Gender	Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Male		**2394**	**28276**	**1.9 (1.7, 2.0)**	**4.1 (3.9, 4.4)**	**5.6 (5.3, 5.9)**	**10.2 (9.7, 10.7)**	**16.7 (15.9, 17.5)**	**26.2 (24.6, 27.9)**
	<55	461	3183	2.9 (2.3, 3.5)	6.5 (5.7, 7.5)	8.6 (7.6, 9.7)	16.6 (14.9, 18.5)	26.6 (24.0, 29.5)	42.7 (37.9, 47.9)
	55-64	979	9351	2.0 (1.7, 2.3)	4.5 (4.0, 4.9)	6.2 (5.7, 6.7)	11.2 (10.4, 12.0)	18.9 (17.6, 20.4)	30.1 (27.6, 32.8)
	65-74	725	10305	1.6 (1.4, 1.9)	3.6 (3.2, 4.0)	5.0 (4.5, 5.4)	9.0 (8.3, 9.8)	14.1 (12.9, 15.4)	18.8 (16.7, 21.0)
	≥75	229	5437	1.6 (1.3, 2.0)	3.1 (2.6, 3.6)	3.9 (3.3, 4.5)	6.2 (5.4, 7.2)	7.5 (6.3, 9.0)	
Female		**2584**	**22349**	**1.9 (1.8, 2.1)**	**4.7 (4.5, 5.0)**	**6.7 (6.4, 7.1)**	**12.5 (12.0, 13.1)**	**20.1 (19.3, 21.0)**	**28.1 (26.7, 29.5)**
	<55	613	3407	2.7 (2.2, 3.3)	7.3 (6.5, 8.3)	10.1 (9.1, 11.3)	17.8 (16.2, 19.4)	27.6 (25.4, 29.9)	39.4 (36.0, 43.0)
	55-64	970	7255	1.9 (1.6, 2.2)	4.9 (4.4, 5.4)	7.1 (6.5, 7.8)	12.5 (11.6, 13.4)	22.0 (20.6, 23.5)	31.6 (29.2, 34.1)
	65-74	751	7528	1.7 (1.4, 2.0)	4.1 (3.6, 4.6)	5.7 (5.2, 6.3)	12.1 (11.1, 13.1)	18.4 (17.0, 19.9)	22.7 (20.8, 24.9)
	≥75	250	4159	1.8 (1.4, 2.3)	3.6 (3.0, 4.2)	4.9 (4.2, 5.6)	8.5 (7.5, 9.8)	9.8 (8.6, 11.3)	11.5 (9.3, 14.2)
TOTAL		**4978**	**50625**						

Note: Restricted to modern prostheses

Figure KP20 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement by Gender (Primary Diagnosis OA)

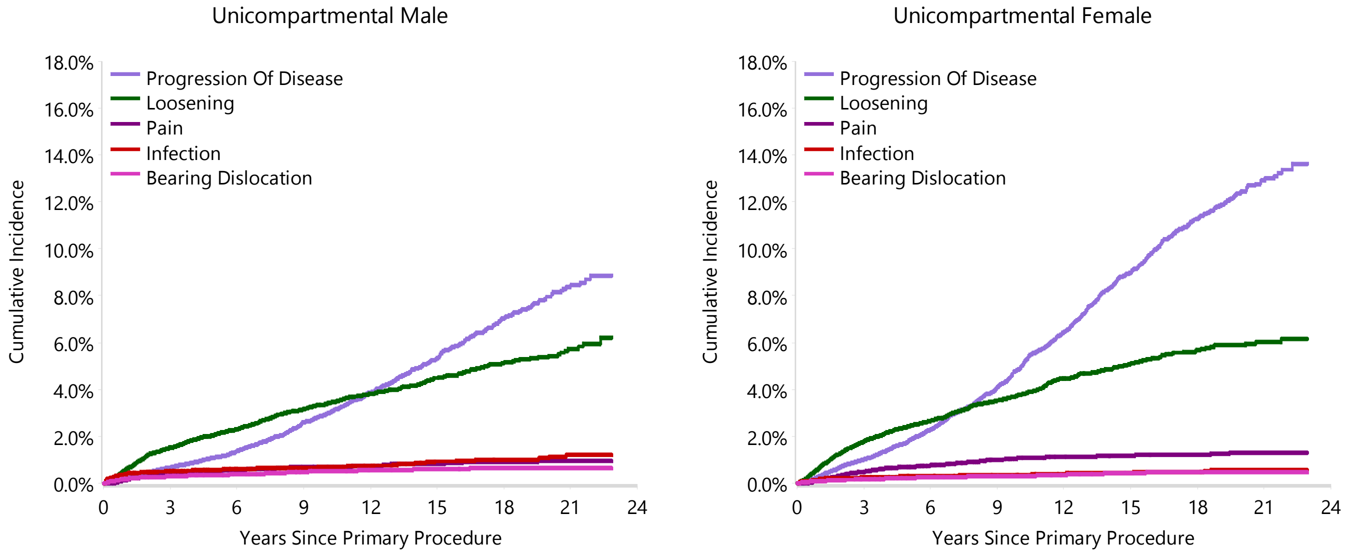


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Male	28276	25463	20454	15815	7075	2757	576
Female	22349	20573	17246	13816	7068	3114	745

Note: Restricted to modern prostheses

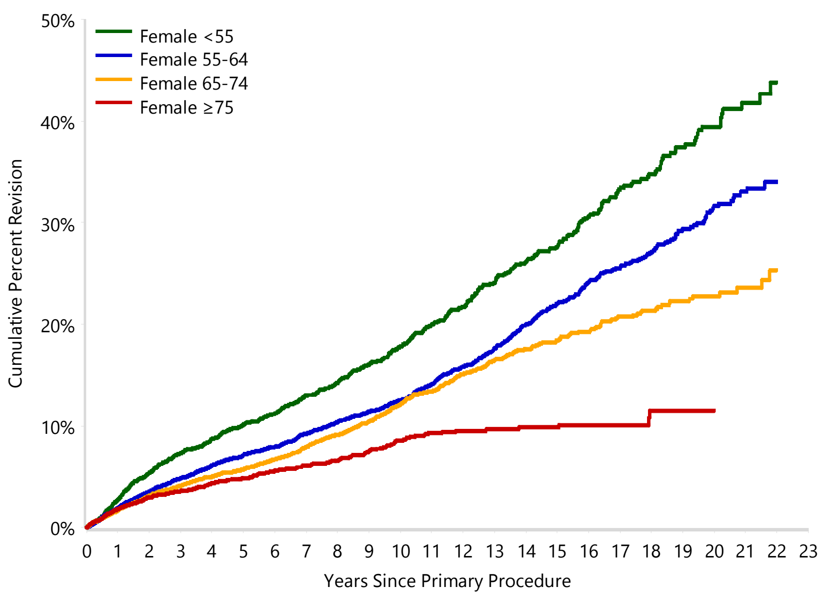
Primary Partial Knee Replacement

Figure KP21 Cumulative Incidence Revision Diagnosis of Primary Unicompartmental Knee Replacement by Gender (Primary Diagnosis OA)



Note: Restricted to modern prostheses

Figure KP22 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement for Females by Age (Primary Diagnosis OA)



Female <55 vs Female ≥75
0 - 9Mth: HR=1.54 (1.12, 2.12), p=0.007
9Mth - 1.5Yr: HR=2.33 (1.72, 3.17), p<0.001
1.5Yr - 2Yr: HR=1.54 (1.00, 2.37), p=0.051
2Yr - 3Yr: HR=3.06 (2.17, 4.31), p<0.001
3Yr - 11.5Yr: HR=2.69 (2.17, 3.33), p<0.001
11.5Yr - 13Yr: HR=4.32 (2.59, 7.18), p<0.001
13Yr+: HR=6.90 (4.58, 10.40), p<0.001

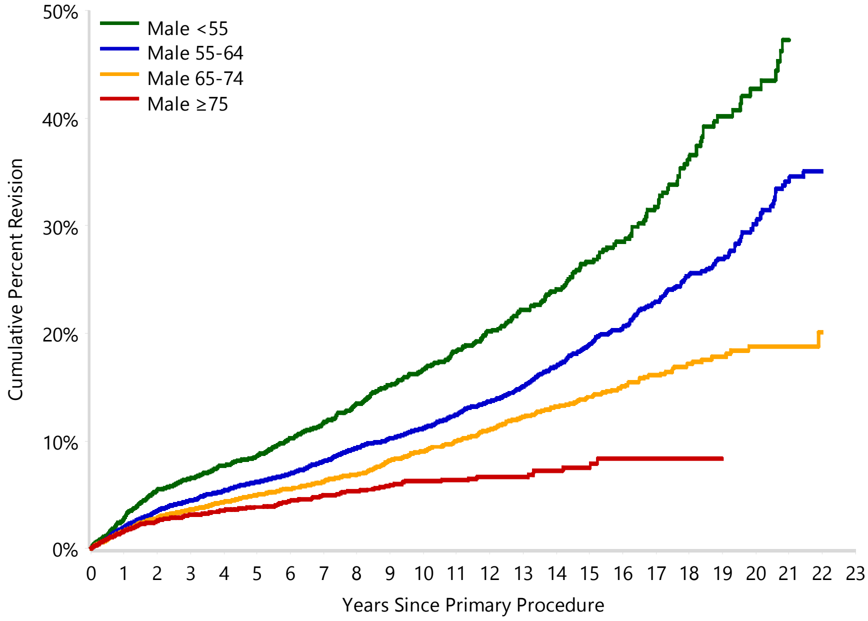
Female 55-64 vs Female ≥75
0 - 2Yr: HR=1.20 (0.96, 1.49), p=0.113
2Yr - 11Yr: HR=1.92 (1.58, 2.34), p<0.001
11Yr - 11.5Yr: HR=3.27 (1.88, 5.68), p<0.001
11.5Yr - 13Yr: HR=3.03 (1.90, 4.83), p<0.001
13Yr+: HR=5.65 (3.83, 8.32), p<0.001

Female 65-74 vs Female ≥75
0 - 2Yr: HR=1.05 (0.84, 1.31), p=0.677
2Yr - 6Yr: HR=1.54 (1.22, 1.95), p<0.001
6Yr - 7.5Yr: HR=2.09 (1.51, 2.90), p<0.001
7.5Yr - 10Yr: HR=2.12 (1.58, 2.84), p<0.001
10Yr+: HR=2.44 (1.80, 3.32), p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Female	<55	3407	3119	2638	2140	1150	537	152
	55-64	7255	6716	5726	4697	2616	1227	299
	65-74	7528	6950	5803	4590	2235	990	244
	≥75	4159	3788	3079	2389	1067	360	50

Note: Restricted to modern prostheses

Figure KP23 **Cumulative Percent Revision of Primary Unicompartmental Knee Replacement for Males by Age (Primary Diagnosis OA)**



Male <55 vs Male ≥75

0 - 1.5Yr: HR=1.89 (1.47, 2.44), p<0.001

1.5Yr - 2Yr: HR=4.14 (2.68, 6.39), p<0.001

2Yr - 5.5Yr: HR=3.06 (2.29, 4.08), p<0.001

5.5Yr - 7Yr: HR=3.68 (2.45, 5.52), p<0.001

7Yr - 8.5Yr: HR=4.53 (2.95, 6.95), p<0.001

8.5Yr - 11Yr: HR=3.26 (2.17, 4.90), p<0.001

11Yr - 11.5Yr: HR=2.71 (1.10, 6.63), p=0.029

11.5Yr - 13Yr: HR=4.20 (2.42, 7.29), p<0.001

13Yr - 15Yr: HR=4.84 (2.76, 8.49), p<0.001

15Yr+: HR=8.08 (5.07, 12.86), p<0.001

Male 55-64 vs Male ≥75

0 - 1.5Yr: HR=1.23 (0.99, 1.54), p=0.066

1.5Yr - 7Yr: HR=2.39 (1.92, 2.98), p<0.001

7Yr - 7.5Yr: HR=2.95 (1.69, 5.14), p<0.001

7.5Yr - 11.5Yr: HR=2.27 (1.71, 3.02), p<0.001

11.5Yr - 13Yr: HR=2.22 (1.38, 3.58), p=0.001

13Yr - 15Yr: HR=3.91 (2.47, 6.20), p<0.001

15Yr+: HR=4.69 (3.07, 7.18), p<0.001

Male 65-74 vs Male ≥75

0 - 1.5Yr: HR=1.05 (0.84, 1.31), p=0.692

1.5Yr+: HR=1.81 (1.47, 2.22), p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Male	<55	3183	2838	2217	1736	803	352	77
	55-64	9351	8497	6945	5560	2696	1170	272
	65-74	10305	9330	7576	5812	2592	988	202
	≥75	5437	4798	3716	2707	984	247	25

Note: Restricted to modern prostheses

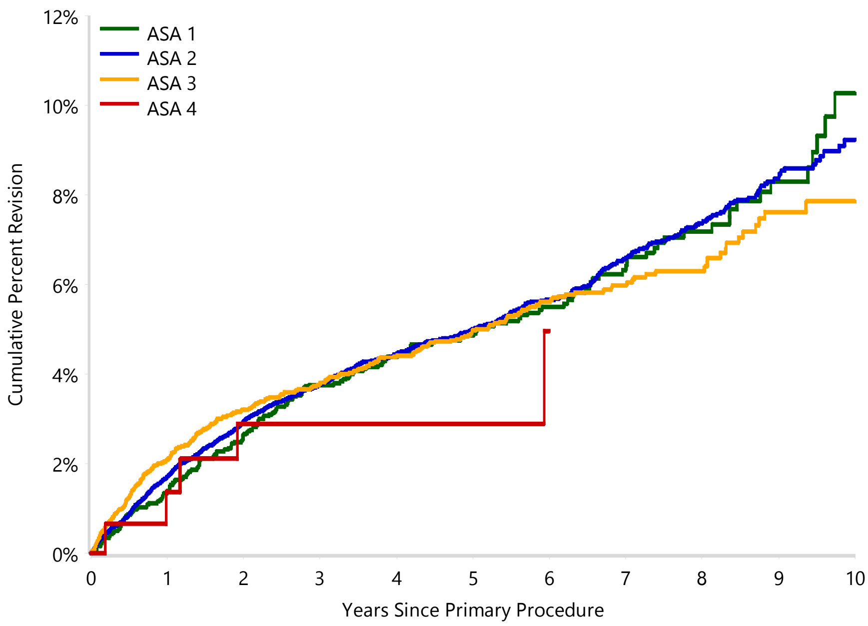
Primary Partial Knee Replacement

Table KP21 **Cumulative Percent Revision of Primary Unicompartmental Knee Replacement by ASA Score (Primary Diagnosis OA)**

ASA Score	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs
ASA 1	183	3561	1.4 (1.0, 1.8)	3.8 (3.1, 4.5)	4.9 (4.1, 5.7)	6.3 (5.4, 7.4)	10.3 (8.2, 12.8)
ASA 2	963	19902	1.7 (1.5, 1.9)	3.8 (3.5, 4.1)	5.0 (4.7, 5.4)	6.6 (6.1, 7.1)	9.2 (8.4, 10.1)
ASA 3	395	9040	2.1 (1.8, 2.4)	3.8 (3.4, 4.2)	5.0 (4.5, 5.5)	6.0 (5.4, 6.7)	7.9 (6.8, 9.1)
ASA 4	7	155	1.4 (0.3, 5.4)	2.9 (1.1, 7.6)	2.9 (1.1, 7.6)		
TOTAL	**1548**	**32658**					

Note: Excludes 17,967 procedures with unknown ASA score. Restricted to modern prostheses

Figure KP24 **Cumulative Percent Revision of Primary Unicompartmental Knee Replacement by ASA Score (Primary Diagnosis OA)**



HR - adjusted for age and gender

ASA 2 vs ASA 1

Entire Period: HR=1.15 (0.98, 1.35), p=0.083

ASA 3 vs ASA 1

0 - 6Mth: HR=1.84 (1.40, 2.42), p<0.001

6Mth - 9Mth: HR=1.71 (1.18, 2.48), p=0.004

9Mth+: HR=1.04 (0.85, 1.27), p=0.724

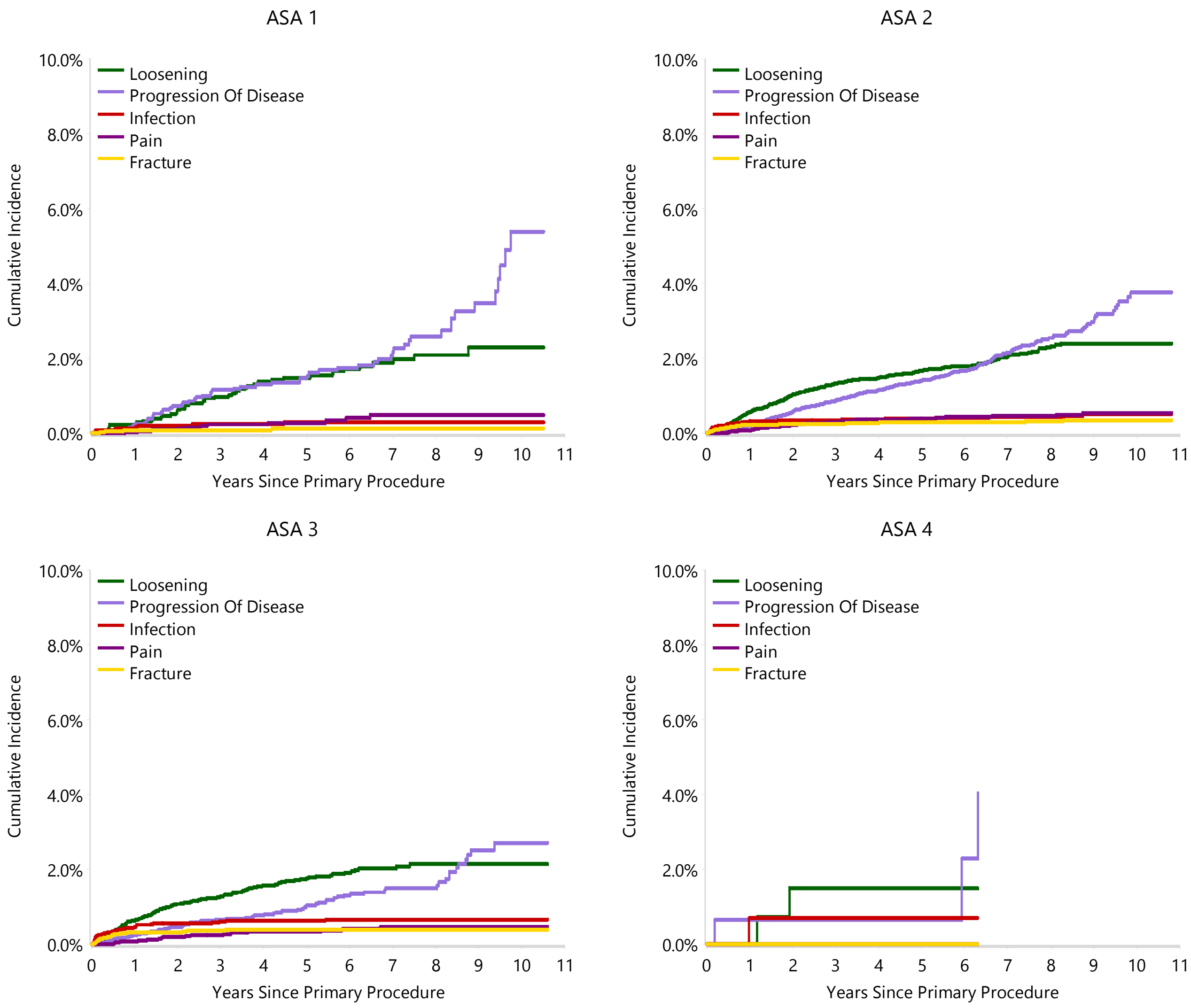
ASA 4 vs ASA 1

Entire Period: HR=1.41 (0.66, 3.01), p=0.375

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs
ASA 1	3561	3233	2498	1785	965	128
ASA 2	19902	17493	13038	8608	4379	549
ASA 3	9040	7671	5433	3353	1607	217
ASA 4	155	138	102	61	26	5

Note: Excludes 17,967 procedures with unknown ASA score. Restricted to modern prostheses

Figure KP25 **Cumulative Incidence Revision Diagnosis of Primary Unicompartmental Knee Replacement by ASA Score (Primary Diagnosis OA)**



Note: Excludes 17,967 procedures with unknown ASA score. Restricted to modern prostheses

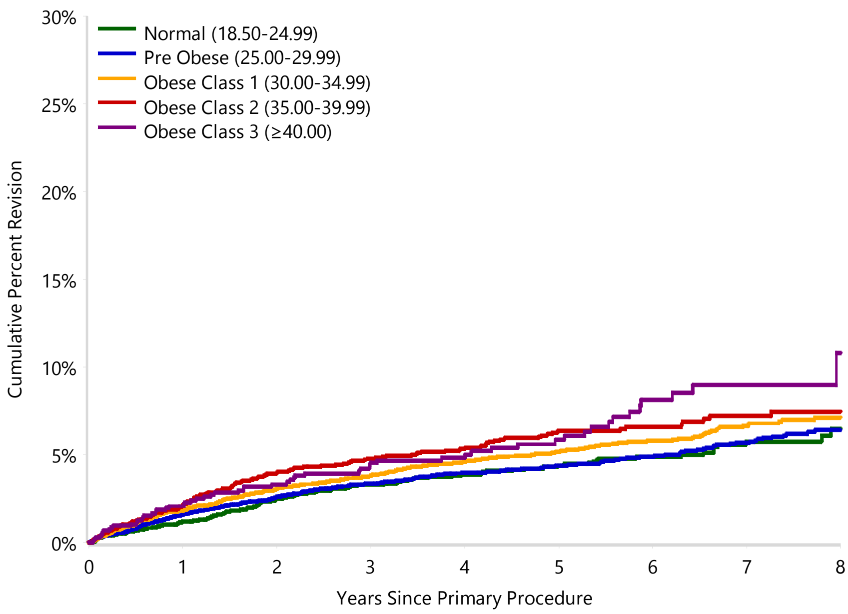
Primary Partial Knee Replacement

Table KP22 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement by BMI Category (Primary Diagnosis OA)

BMI Category	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs
Underweight (<18.50)	3	46	2.2 (0.3, 14.7)	2.2 (0.3, 14.7)	8.9 (2.9, 25.5)	8.9 (2.9, 25.5)	8.9 (2.9, 25.5)	8.9 (2.9, 25.5)	
Normal (18.50-24.99)	148	4075	1.2 (0.9, 1.6)	2.5 (2.0, 3.1)	3.3 (2.7, 4.0)	3.9 (3.2, 4.6)	4.4 (3.7, 5.2)	4.9 (4.1, 5.8)	5.8 (4.8, 7.0)
Pre Obese (25.00-29.99)	451	11781	1.6 (1.4, 1.9)	2.6 (2.3, 2.9)	3.3 (3.0, 3.7)	4.0 (3.6, 4.4)	4.4 (4.0, 4.8)	4.9 (4.4, 5.4)	5.7 (5.1, 6.4)
Obese Class 1 (30.00-34.99)	396	8888	1.8 (1.6, 2.2)	3.1 (2.7, 3.5)	3.8 (3.4, 4.3)	4.6 (4.1, 5.1)	5.2 (4.7, 5.8)	5.8 (5.2, 6.4)	6.7 (5.9, 7.4)
Obese Class 2 (35.00-39.99)	155	3030	2.1 (1.7, 2.7)	4.0 (3.3, 4.8)	4.8 (4.0, 5.7)	5.3 (4.5, 6.3)	6.4 (5.4, 7.5)	6.6 (5.6, 7.8)	7.2 (6.1, 8.6)
Obese Class 3 (≥40.00)	59	1062	2.1 (1.4, 3.2)	3.3 (2.4, 4.7)	4.5 (3.3, 6.1)	4.8 (3.6, 6.5)	5.8 (4.4, 7.8)	8.1 (6.2, 10.8)	9.0 (6.8, 11.9)
TOTAL	**1212**	**28882**							

Note: Excludes 21,743 procedures with unknown BMI.
BMI has not been presented for patients aged ≤19 years.
Restricted to modern prostheses

Figure KP26 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement by BMI Category (Primary Diagnosis OA)



HR - adjusted for age and gender

Pre Obese (25.00-29.99) vs Normal (18.50-24.99)
Entire Period: HR=1.00 (0.83, 1.21), p=0.972

Obese Class 1 (30.00-34.99) vs Normal (18.50-24.99)
Entire Period: HR=1.11 (0.91, 1.34), p=0.299

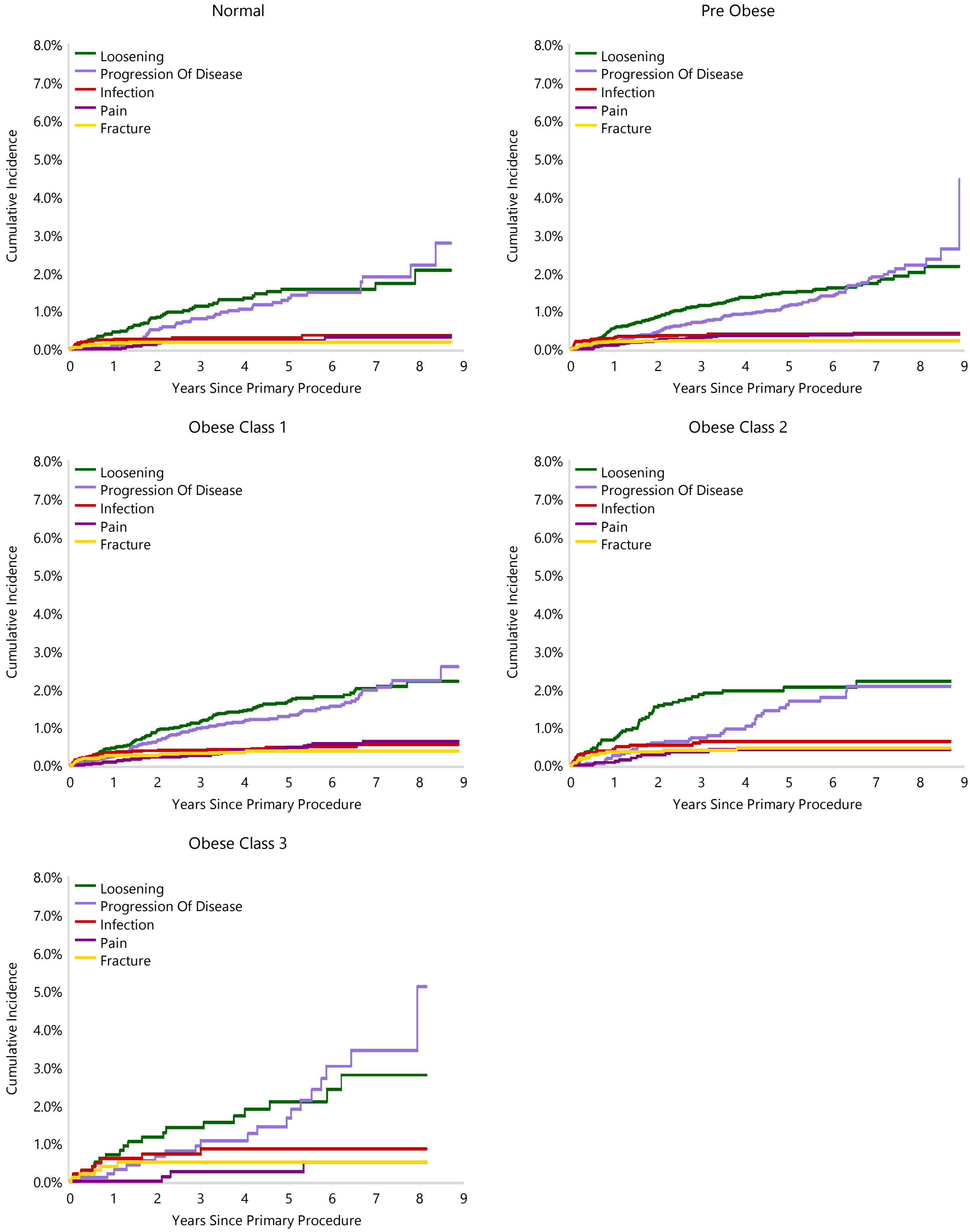
Obese Class 2 (35.00-39.99) vs Normal (18.50-24.99)
0 - 1.5Yr: HR=1.35 (1.02, 1.78), p=0.033
1.5Yr - 2Yr: HR=1.67 (1.02, 2.72), p=0.042
2Yr+: HR=0.99 (0.71, 1.39), p=0.976

Obese Class 3 (≥40.00) vs Normal (18.50-24.99)
Entire Period: HR=1.24 (0.91, 1.69), p=0.166

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs
Normal (18.50-24.99)	4075	3518	2976	2429	1938	1375	919	519
Pre Obese (25.00-29.99)	11781	10127	8633	7199	5766	4342	2961	1610
Obese Class 1 (30.00-34.99)	8888	7703	6584	5481	4366	3293	2206	1254
Obese Class 2 (35.00-39.99)	3030	2585	2196	1818	1467	1086	744	434
Obese Class 3 (≥40.00)	1062	909	792	656	525	404	260	143

Note: Excludes 21,743 procedures with unknown BMI. BMI has not been presented for patients aged ≤19 years. Restricted to modern prostheses

Figure KP27 Cumulative Incidence Revision Diagnosis of Primary Unicompartmental Knee Replacement by BMI Category (Primary Diagnosis OA)



Note: Excludes 21,743 procedures with unknown BMI. BMI has not been presented for patients aged ≤19 years. Restricted to modern prostheses.

OUTCOME BY PROSTHESIS CHARACTERISTICS

Bearing Mobility
Fixed bearings are used in 52.7% of unicompartmental knee replacements, while in the remainder the bearing insert is mobile.

There are two prostheses using mobile bearings in 2023. Fixed bearing prostheses have a lower rate of revision compared to mobile bearing prostheses (Table KP23 and Figure KP28).

Fixation
Cement fixation is used for 78.4% of unicompartmental knee replacements, cementless fixation for 20.1%, with hybrid fixation used rarely. In 2023, there are 2 prostheses used with cementless fixation. For the first 6 months cemented fixation has a lower rate of revision, but between 1.5 and 4 years cementless fixation has a lower rate of revision. Outside of these times there is no difference (Table KP24 and Figure KP29).

Robotic Assistance
There are 9,760 robotically assisted unicompartmental knee replacement procedures undertaken for osteoarthritis recorded since 2015. In 2023, 48.1% of unicompartmental knee procedures use robotic assistance.

When adjusted for age, gender, ASA, BMI, and mobility, unicompartmental knee procedures using robotic assistance have no difference in the rate of revision compared to unicompartmental procedures not technology assisted (Table KP25 and Figure KP30).

The most common reasons for revision with and without robotic assistance are shown in Table KP26 and Figure KP31.

There are only two unicompartmental combinations that can be used both with and without robotic assistance. The results of these combinations are shown in Table KP27.

Position
There are 1,186 lateral unicompartmental knee procedures undertaken for osteoarthritis. There is no difference in the rate of revision when lateral unicompartmental knee replacement is compared to medial unicompartmental knee replacement (Table KP28 and Figure KP32). When lateral unicompartmental knee replacement is assessed for bearing mobility, fixed bearing prostheses have a lower rate of revision compared to mobile bearings (Table KP29 and Figure KP33).

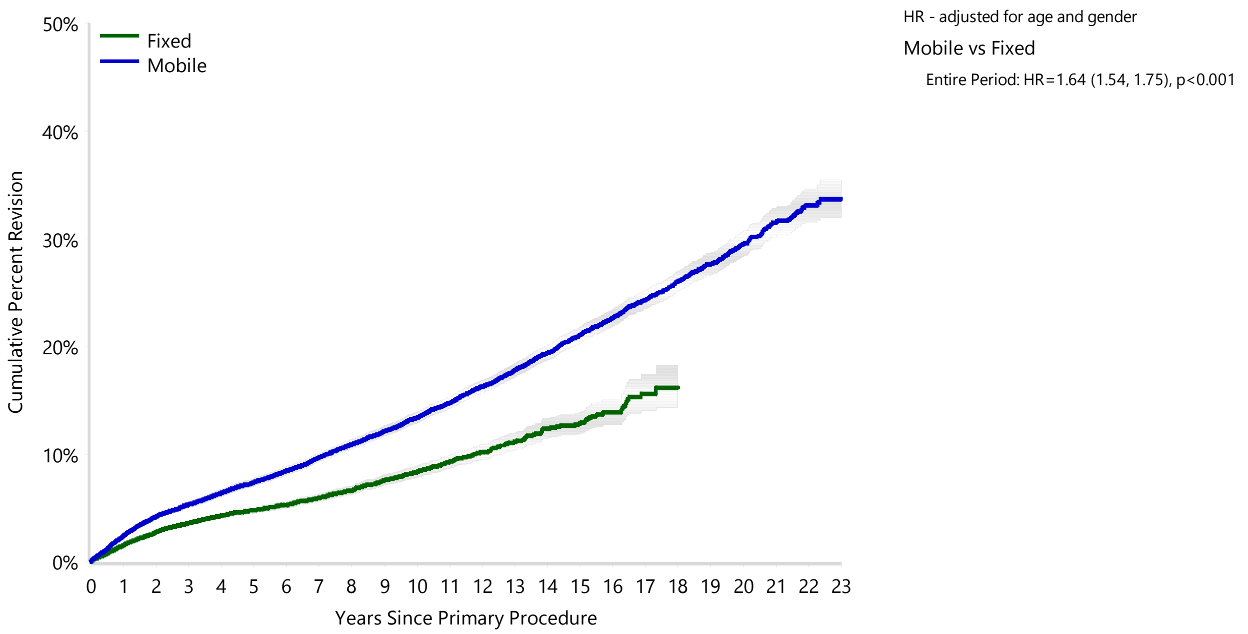
The most common reasons for revision of both lateral and medial unicompartmental knees are progression of disease and loosening (Table KP30 and Figure KP34).

Table KP23 **Cumulative Percent Revision of Primary Unicompartmental Knee Replacement by Mobility (Primary Diagnosis OA)**

Mobility	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Fixed	1416	26691	1.5 (1.3, 1.6)	3.6 (3.3, 3.8)	4.8 (4.5, 5.1)	8.3 (7.8, 8.8)	12.8 (11.9, 13.8)	
Mobile	3557	23908	2.4 (2.2, 2.6)	5.3 (5.0, 5.6)	7.3 (7.0, 7.7)	13.4 (12.9, 13.9)	21.0 (20.3, 21.7)	29.5 (28.4, 30.6)
TOTAL	**4973**	**50599**						

Note: Excludes 26 primary unicompartmental knee procedures with unknown/missing mobility
Restricted to modern prostheses

Figure KP28 **Cumulative Percent Revision of Primary Unicompartmental Knee Replacement by Mobility (Primary Diagnosis OA)**



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Fixed	26691	23569	17888	12480	3993	952	0
Mobile	23908	22447	19797	17137	10138	4915	1320

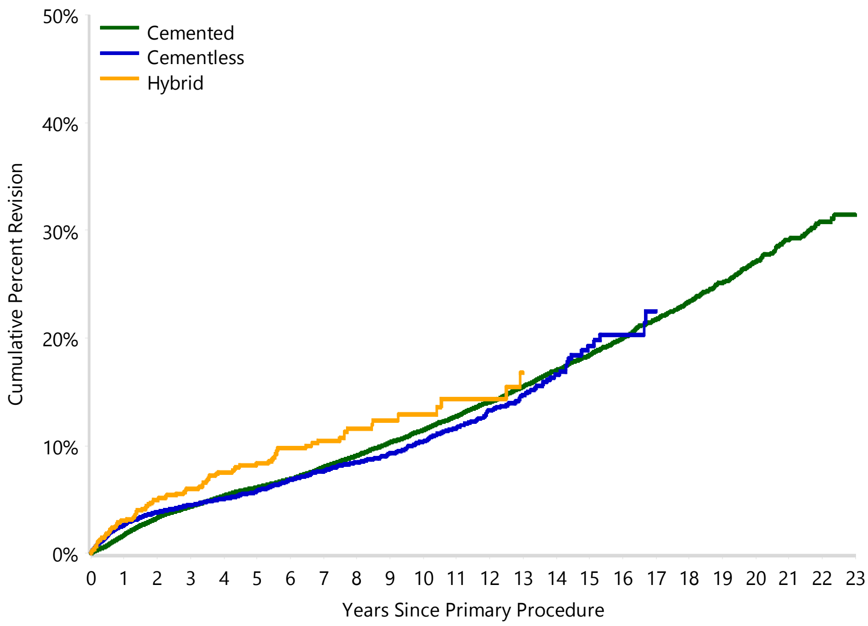
Note: Restricted to modern prostheses

Table KP24 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement by Fixation (Primary Diagnosis OA)

Fixation	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Cemented	4153	39685	1.7 (1.6, 1.8)	4.3 (4.1, 4.6)	6.1 (5.9, 6.4)	11.4 (11.0, 11.8)	18.4 (17.8, 19.0)	27.1 (26.0, 28.2)
Cementless	739	10159	2.6 (2.3, 3.0)	4.5 (4.1, 4.9)	5.8 (5.3, 6.3)	10.4 (9.5, 11.3)	19.3 (16.8, 22.0)	
Hybrid	86	781	3.0 (2.0, 4.5)	6.0 (4.5, 8.0)	8.4 (6.5, 10.7)	12.9 (10.2, 16.1)		
TOTAL	**4978**	**50625**						

Note: Restricted to modern prostheses

Figure KP29 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement by Fixation (Primary Diagnosis OA)



HR - adjusted for age and gender

Cementless vs Cemented
- 0 - 6Mth: HR=2.28 (1.88, 2.76), p<0.001
- 6Mth - 9Mth: HR=1.30 (0.97, 1.73), p=0.079
- 9Mth - 1.5Yr: HR=0.85 (0.69, 1.05), p=0.129
- 1.5Yr - 2.5Yr: HR=0.60 (0.46, 0.78), p<0.001
- 2.5Yr - 4Yr: HR=0.66 (0.51, 0.85), p=0.001
- 4Yr+: HR=0.94 (0.83, 1.07), p=0.354

Hybrid vs Cemented
- 0 - 3Mth: HR=2.88 (1.48, 5.62), p=0.001
- 3Mth - 1.5Yr: HR=1.27 (0.82, 1.96), p=0.282
- 1.5Yr - 2Yr: HR=1.34 (0.63, 2.85), p=0.439
- 2Yr+: HR=1.09 (0.82, 1.45), p=0.542

Hybrid vs Cementless
- Entire Period: HR=1.27 (1.01, 1.59), p=0.037

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Cemented	39685	36265	29889	23796	12361	5679	1317
Cementless	10159	9051	7182	5297	1650	174	1
Hybrid	781	720	629	538	132	18	3

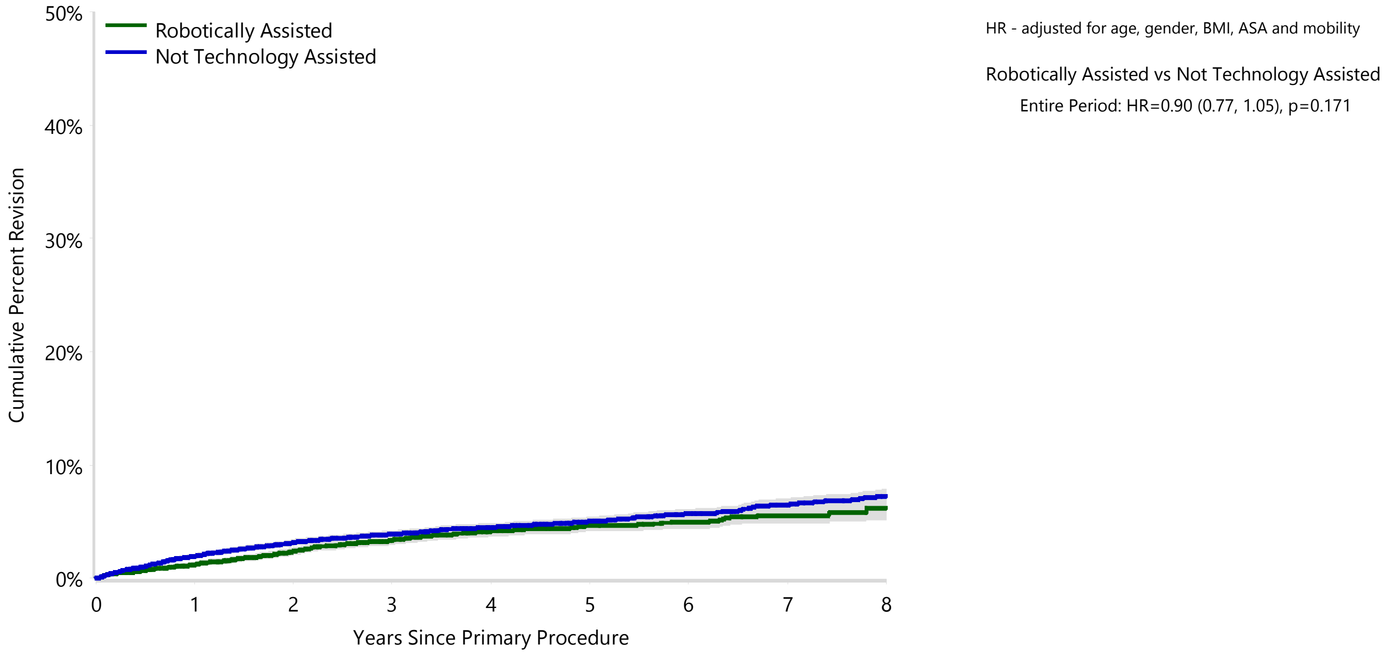
Note: Restricted to modern prostheses

Table KP25 **Cumulative Percent Revision of Primary Unicompartmental Knee Replacement Since 2015 by Robotic Assistance (Primary Diagnosis OA)**

Robotic Assistance	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs	8 Yrs
Robotically Assisted	331	9760	1.2 (1.0, 1.4)	2.4 (2.1, 2.7)	3.4 (3.0, 3.8)	4.1 (3.7, 4.6)	4.6 (4.1, 5.2)	4.9 (4.4, 5.6)	5.6 (4.9, 6.3)	6.2 (5.1, 7.5)
Not Technology Assisted	789	16799	1.9 (1.7, 2.2)	3.2 (2.9, 3.4)	3.9 (3.6, 4.2)	4.5 (4.2, 4.8)	5.0 (4.7, 5.4)	5.7 (5.3, 6.1)	6.5 (6.0, 7.0)	7.2 (6.7, 7.9)
TOTAL	**1120**	**26559**								

Note: Restricted to modern prostheses

Figure KP30 **Cumulative Percent Revision of Primary Unicompartmental Knee Replacement Since 2015 by Robotic Assistance (Primary Diagnosis OA)**



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs	8 Yrs
Robotically Assisted	9760	8140	6666	5292	4032	2873	1713	705	134
Not Technology Assisted	16799	14843	12963	11063	9153	6995	4999	3123	1470

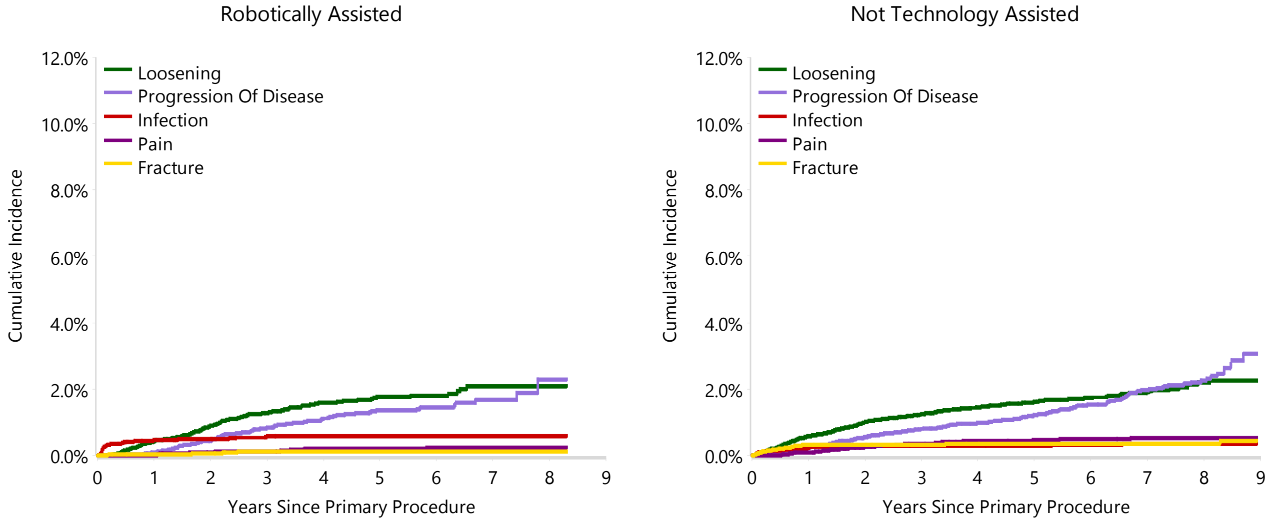
Note: Restricted to modern prostheses
Excludes 5 procedure with unknown mobility

Table KP26 Revision Diagnosis of Primary Unicompartmental Knee Replacement Since 2015 by Robotic Assistance (Primary Diagnosis OA)

Revision Diagnosis	Robotically Assisted			Not Technology Assisted		
	Number	% Primaries Revised	% Revisions	Number	% Primaries Revised	% Revisions
Loosening	123	1.3	37.2	244	1.5	30.9
Progression Of Disease	89	0.9	26.9	209	1.2	26.5
Bearing Dislocation				65	0.4	8.2
Pain	14	0.1	4.2	65	0.4	8.2
Fracture	9	0.1	2.7	58	0.3	7.4
Infection	52	0.5	15.7	51	0.3	6.5
Instability	10	0.1	3.0	30	0.2	3.8
Malalignment	5	0.1	1.5	17	0.1	2.2
Prosthesis Dislocation	1	0.0	0.3	8	0.0	1.0
Lysis	7	0.1	2.1	7	0.0	0.9
Incorrect Sizing				4	0.0	0.5
Patellofemoral Pain	1	0.0	0.3	4	0.0	0.5
Wear Tibial Insert	2	0.0	0.6	4	0.0	0.5
Implant Breakage Tibial	3	0.0	0.9	2	0.0	0.3
Implant Breakage Tibial Insert	1	0.0	0.3	2	0.0	0.3
Metal Related Pathology	1	0.0	0.3	2	0.0	0.3
Osteonecrosis	2	0.0	0.6	2	0.0	0.3
Patella Erosion				2	0.0	0.3
Synovitis	1	0.0	0.3	2	0.0	0.3
Arthrofibrosis	1	0.0	0.3	1	0.0	0.1
Tumour	1	0.0	0.3			
Wear Femoral				1	0.0	0.1
Other	8	0.1	2.4	9	0.1	1.1
N Revision	**331**	**3.4**	**100.0**	**789**	**4.7**	**100.0**
N Primary	**9760**			**16799**		

Note: Restricted to modern prostheses

Figure KP31 Cumulative Incidence Revision Diagnosis of Primary Unicompartmental Knee Replacement Since 2015 by Robotic Assistance (Primary Diagnosis OA)



Note: Restricted to modern prostheses

Primary Partial Knee Replacement

Table KP27 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement Since 2015 by Prosthesis Combination and Robotic Assistance (Primary Diagnosis OA)

Prosthesis Combination	Robotic Assistance	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Journey Uni/ Journey Uni	Robotically Assisted	40	724	1.7 (0.9, 3.0)	4.0 (2.6, 5.9)	5.4 (3.8, 7.7)	7.5 (5.4, 10.3)	7.5 (5.4, 10.3)	10.3 (7.0, 15.0)
	Not Robotically Assisted	53	797	2.6 (1.7, 4.0)	4.0 (2.8, 5.7)	5.1 (3.7, 7.0)	6.0 (4.5, 8.0)	6.8 (5.1, 9.1)	7.4 (5.6, 9.7)
Persona/ Persona	Robotically Assisted	3	88	3.2 (0.8, 12.3)	5.4 (1.7, 16.3)				
	Not Robotically Assisted	34	1962	1.4 (1.0, 2.2)	2.8 (2.0, 4.1)	3.0 (2.1, 4.4)			
TOTAL		**130**	**3571**						

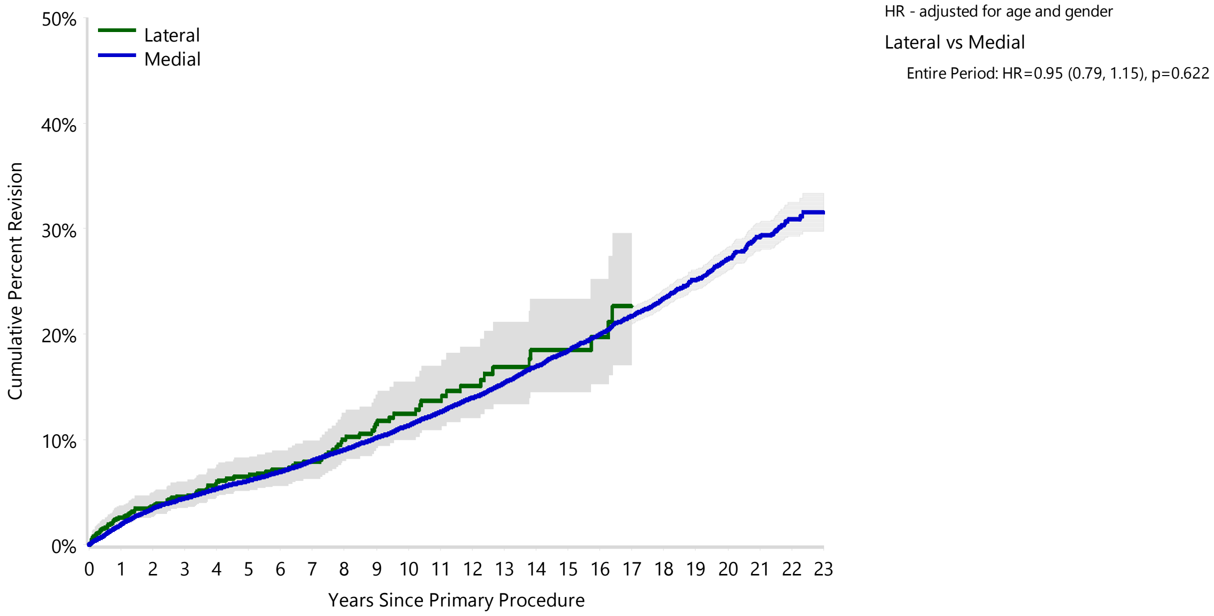
Note: Restricted to modern prostheses

Table KP28 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement by Position (Primary Diagnosis OA)

Position	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Lateral	107	1186	2.6 (1.8, 3.7)	4.6 (3.5, 6.0)	6.5 (5.1, 8.2)	12.4 (10.0, 15.4)	18.4 (14.5, 23.3)	
Medial	4866	49217	1.9 (1.8, 2.0)	4.4 (4.2, 4.6)	6.1 (5.9, 6.3)	11.3 (10.9, 11.7)	18.4 (17.8, 19.0)	27.1 (26.0, 28.2)
TOTAL	**4973**	**50403**						

Note: Excludes 222 primary unicompartmental knee procedures with unknown/missing position
Restricted to modern prostheses

Figure KP32 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement by Position (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Lateral	1186	1065	872	651	227	78	23
Medial	49217	44780	36710	28939	13916	5793	1298

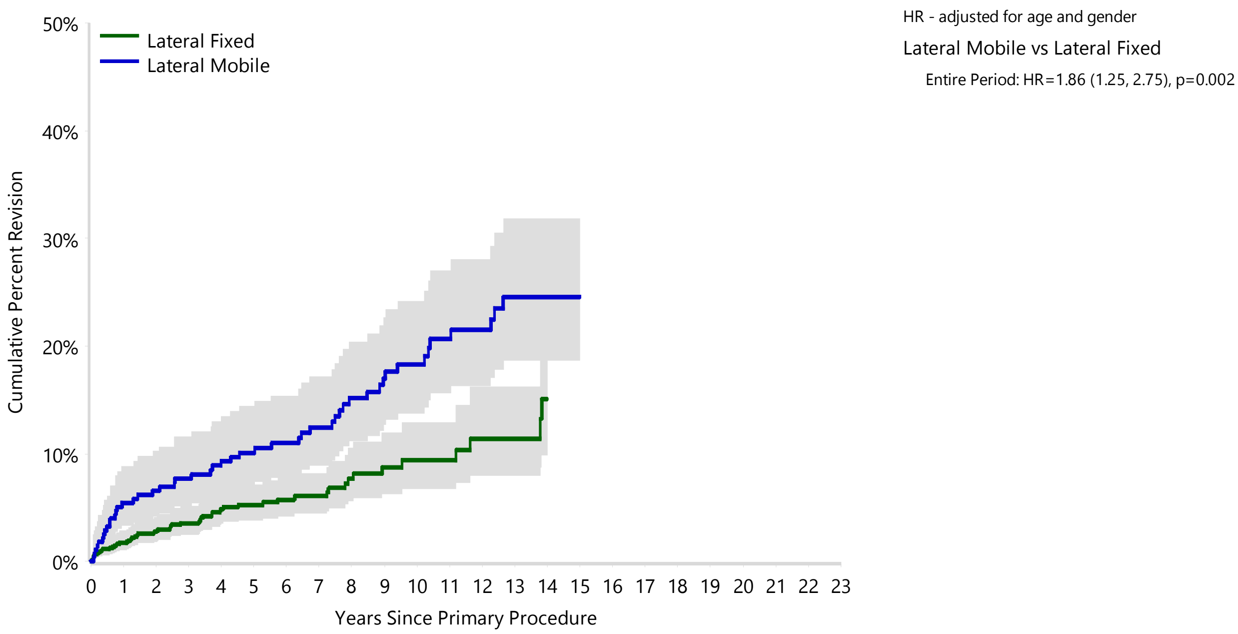
Note: Restricted to modern prostheses

Table KP29 Cumulative Percent Revision of Lateral Primary Unicompartmental Knee Replacement by Mobility (Primary Diagnosis OA)

Position	Mobility	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs
Lateral	Fixed	56	903	1.7 (1.0, 2.8)	3.6 (2.5, 5.1)	5.3 (3.8, 7.2)	9.4 (6.7, 12.9)	
	Mobile	51	281	5.4 (3.3, 8.8)	7.7 (5.1, 11.6)	10.1 (7.0, 14.4)	18.3 (13.7, 24.2)	24.5 (18.7, 31.8)
TOTAL		**107**	**1184**					

Note: Excludes 248 primary unicompartmental knee procedures with unknown/missing position or mobility
Restricted to modern prostheses

Figure KP33 Cumulative Percent Revision of Lateral Primary Unicompartmental Knee Replacement by Mobility (Primary Diagnosis OA)



Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Lateral	Fixed	903	809	632	441	118	35	0
	Mobile	281	255	240	210	109	43	23

Note: Restricted to modern prostheses

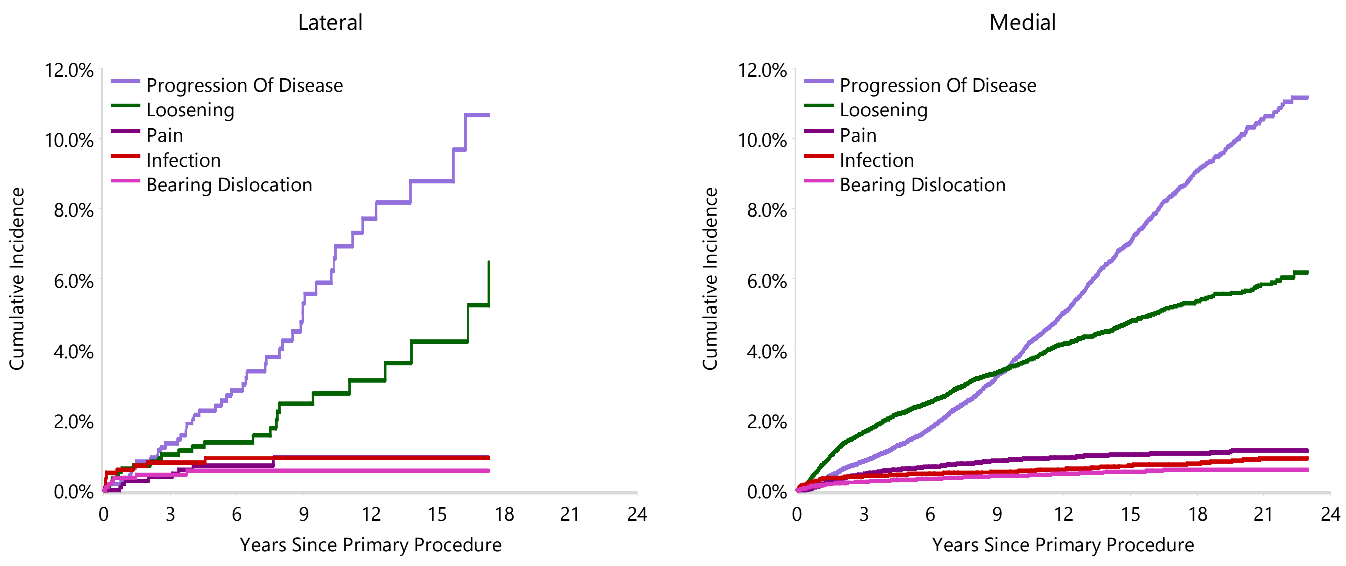
Primary Partial Knee Replacement

Table KP30 Reason for Revision of Primary Unicompartmental Knee Replacement by Position (Primary Diagnosis OA)

Revision Diagnosis	Lateral			Medial		
	Number	% Primaries Revised	% Revisions	Number	% Primaries Revised	% Revisions
Progression Of Disease	49	4.1	45.8	1817	3.7	37.3
Loosening	25	2.1	23.4	1518	3.1	31.2
Pain	8	0.7	7.5	348	0.7	7.2
Infection	10	0.8	9.3	259	0.5	5.3
Bearing Dislocation	6	0.5	5.6	181	0.4	3.7
Fracture	1	0.1	0.9	149	0.3	3.1
Instability	2	0.2	1.9	96	0.2	2.0
Lysis				91	0.2	1.9
Wear Tibial Insert	1	0.1	0.9	78	0.2	1.6
Malalignment	3	0.3	2.8	60	0.1	1.2
Other	2	0.2	1.9	269	0.5	5.5
N Revision	**107**	**9.0**	**100.0**	**4866**	**9.9**	**100.0**
N Primary	**1186**			**49217**		

Note: Restricted to modern prostheses

Figure KP34 Cumulative Incidence Revision Diagnosis of Primary Unicompartmental Knee Replacement by Position (Primary Diagnosis OA)



Note: Restricted to modern prostheses

Primary Total Knee Replacement

Class of Total Knee Replacement

Total knee replacement is defined as a replacement of the entire femorotibial articulation using a single femoral and a single tibial prosthesis. This may or may not be combined with a patella resurfacing replacement.

In this report, the outcome of total knee replacement based on specific patient, prosthesis and technique factors is shown. In addition, the outcome for different types of total knee prostheses is presented.

Most total knee systems have a variety of individual prostheses within the system that vary based on distinguishing prosthesis characteristics. Where possible, knee systems are subdivided into the specific prosthesis types. The initial characteristic used is fixation. Further subdivision is based on mobility, stability and flexion capacity. However, this further subdivision is not uniformly applied to all knee systems at this time and is dependent on the number of procedures reported for each system.

High use prosthesis systems are subdivided. This enables the identification of differences or potential differences in outcome between prostheses with different characteristics within each of these systems.

Low use systems are unlikely to be subdivided. This is because of small numbers or insufficient follow-up. The exception is if the entire system is identified as having a higher than anticipated rate of revision. A catalogue range-specific analysis is then undertaken to determine if the higher than anticipated rate of revision is associated with specific prosthesis attributes within that system.

To enable range-specific analyses to be undertaken uniformly across all knee systems, it is necessary to link the different catalogue ranges to the specific prosthesis characteristics for every prosthesis within the system. This is an ongoing process with increasing numbers of systems being subdivided.

DEMOGRAPHICS

There are 956,175 primary total knee replacement procedures recorded. This is an additional 69,639 procedures compared to the last report.

For further information on the **closure of the database** please see the **Glossary** of this report.

In 2023, there is an increase of 20.7% in primary total knee replacement procedures when compared to 2022. As a proportion of all knee replacement procedures, primary total knee replacement increased to 88.2% in 2023.

Osteoarthritis is the most common diagnosis for primary total knee replacement.

Primary total knee replacement remains more common in females (55.9%). This proportion has shown little change from 2003. The mean age of patients is 68.5 years (Table KT1 and Figure KT1).

Figure KT1 Primary Total Knee Replacement by Gender

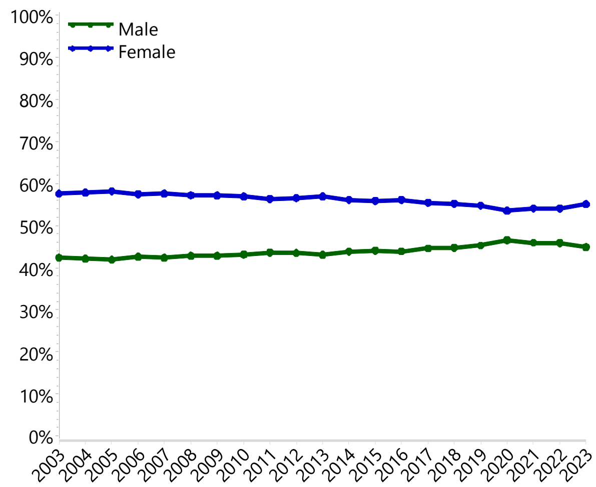


Table KT1 Age and Gender of Primary Total Knee Replacement

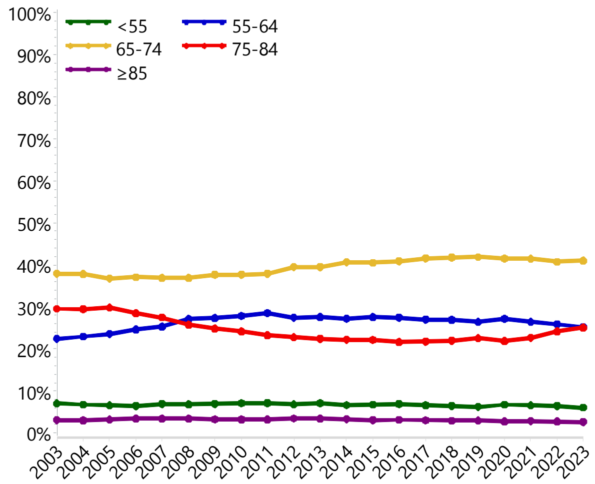
Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	421970	44.1%	8	101	68	68.1	9.0
Female	534205	55.9%	8	107	69	68.8	9.3
TOTAL	**956175**	**100.0%**	**8**	**107**	**69**	**68.5**	**9.2**

There are 956,175 primary total knee replacement procedures.
This is an increase of 69,639 procedures compared to the last report.

Primary Total Knee Replacement

There has been little change in the proportion of patients aged 75-84 years. The proportion of patients aged <55 years remains small and there has been little change in that proportion (Figure KT2).

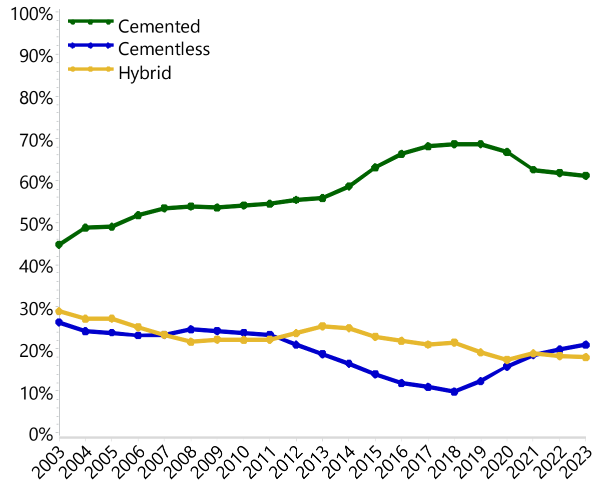
Figure KT2 Primary Total Knee Replacement by Age



Detailed demographic information on primary total knee replacement is available in the supplementary report 'Demographics of Hip, Knee and Shoulder Arthroplasty' on the AOANJRR website: https://aoanjrr.sahmri.com/annual-reports-2024

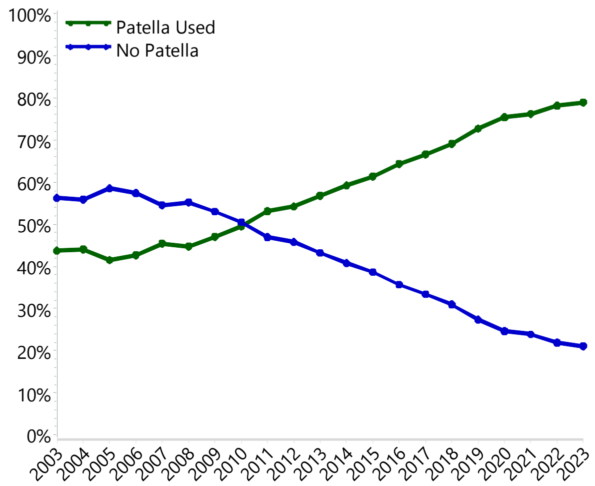
The most common method of fixation is cemented fixation for both femoral and tibial components. This accounts for 61.1% of procedures in 2023. The use of cementless fixation decreased to 9.8% of all primary total knee replacement in 2018 but has increased to 20.9% in 2023 (Figure KT4). Hybrid fixation for primary total knee replacement (femoral cementless) was used in 18.0% of procedures in 2023.

Figure KT4 Primary Total Knee Replacement by Fixation



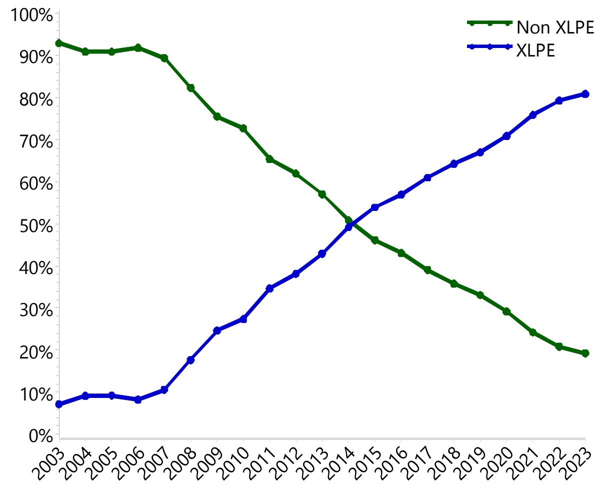
Patella resurfacing at the time of the primary total knee replacement has increased to 78.9% in 2023 (Figure KT3).

Figure KT3 Primary Total Knee Replacement by Patella Component Usage



The use of cross-linked polyethylene (XLPE) in primary total knee replacement increased to 80.8% in 2023 (Figure KT5).

Figure KT5 Primary Total Knee Replacement by Polyethylene Type



Cruciate retaining (CR) and posterior stabilised (PS) prostheses are reported separately for the majority of total knee prostheses. This reporting is based on the design of the femoral component. In 2023, the most commonly used femoral prostheses are the Triathlon CR, Persona CR and Attune CR (Table KT2). The most used cemented and cementless femoral components are listed in Table KT3 and Table KT4, respectively. The most used tibial components in 2023 are the Triathlon, Persona and Attune (Table KT5). The most used tibial prostheses are also reported based on fixation in Table KT6 and Table KT7.

Table KT2 10 Most Used Femoral Prostheses in Primary Total Knee Replacement

2003		2020		2021		2022		2023	
N	Model	N	Model	N	Model	N	Model	N	Model
3183	LCS CR	13772	Triathlon CR	16438	Triathlon CR	17061	Triathlon CR	22429	Triathlon CR
2846	Duracon	8439	Persona CR	11611	Persona CR	13054	Persona CR	16491	Persona CR
2150	Nexgen CR	3257	GMK Sphere Primary	4212	Attune CR	4373	Attune CR	5115	Attune CR
1419	PFC Sigma CR	3150	Attune CR	3677	GMK Sphere Primary	3777	GMK Sphere Primary	4894	GMK Sphere Primary
1354	Scorpio CR	2390	Nexgen CR Flex	2240	Attune PS	2053	Attune PS	2317	Attune PS
1058	Genesis II CR	1783	Attune PS	1690	Nexgen CR Flex	1519	Apex Knee CR	1675	Apex Knee CR
1002	Natural Knee II	1606	Apex Knee CR	1628	Apex Knee CR	1248	Legion Oxinium CR	1452	Legion Oxinium CR
902	Nexgen LPS	1406	LCS CR	1600	Legion Oxinium CR	1112	Legion Oxinium PS	1318	Evolution
883	Profix	1367	Legion Oxinium CR	1228	Legion Oxinium PS	1080	Columbus	1241	Journey II Oxinium
751	Scorpio PS	1222	Evolution	1116	Legion CR	1060	Evolution	1183	Legion Oxinium PS
10 Most Used									
15548 (10)	71.5%	38392 (10)	71.0%	45440 (10)	76.1%	46337 (10)	81.1%	58115 (10)	84.3%
Remainder									
6185 (47)	28.5%	15701 (65)	29.0%	14279 (66)	23.9%	10770 (65)	18.9%	10820 (60)	15.7%
TOTAL									
21733 (57)	100.0%	54093 (75)	100.0%	59719 (76)	100.0%	57107 (75)	100.0%	68935 (70)	100.0%

Table KT3 10 Most Used Cemented Femoral Prostheses in Primary Total Knee Replacement

2003		2020		2021		2022		2023	
N	Model	N	Model	N	Model	N	Model	N	Model
1222	Duracon	6247	Triathlon CR	7175	Triathlon CR	7163	Triathlon CR	9472	Triathlon CR
942	LCS CR	4918	Persona CR	6372	Persona CR	6727	Persona CR	8249	Persona CR
827	Nexgen LPS	3257	GMK Sphere Primary	3677	GMK Sphere Primary	3777	GMK Sphere Primary	4894	GMK Sphere Primary
765	Nexgen CR	2876	Attune CR	2322	Attune CR	2304	Attune CR	2473	Attune CR
693	Nexgen LPS Flex	1696	Attune PS	2137	Attune PS	1924	Attune PS	2172	Attune PS
645	Genesis II CR	1367	Legion Oxini um CR	1600	Legion Oxinium CR	1248	Legion Oxinium CR	1452	Legion Oxinium CR
515	PFC Sigma PS	1225	Nexgen CR Flex	1228	Legion Oxinium PS	1112	Legion Oxinium PS	1297	Evolution
497	Profix	1144	Evolution	1104	Columbus	1080	Columbus	1241	Journey II Oxinium
479	Genesis II Oxinium CR	1115	Columbus	1011	Evolution	1019	Evolution	1183	Legion Oxinium PS
419	Genesis II PS	1076	Genesis II Oxinium PS	886	Genesis II Oxinium PS	868	Apex Knee CR	1077	Columbus
10 Most Used									
7004 (10)	71.6%	24921 (10)	68.6%	27512 (10)	72.2%	27222 (10)	76.0%	33510 (10)	78.9%
Remainder									
2778 (38)	28.4%	11417 (63)	31.4%	10615 (64)	27.8%	8616 (60)	24.0%	8943 (57)	21.1%
TOTAL									
9782 (48)	100.0%	36338 (73)	100.0%	38127 (74)	100.0%	35838 (70)	100.0%	42453 (67)	100.0%

Primary Total Knee Replacement

Table KT4 10 Most Used Cementless Femoral Prostheses in Primary Total Knee Replacement

2003		2020		2021		2022		2023	
N	Model	N	Model	N	Model	N	Model	N	Model
2241	LCS CR	7525	Triathlon CR	9263	Triathlon CR	9898	Triathlon CR	12957	Triathlon CR
1624	Duracon	3521	Persona CR	5239	Persona CR	6327	Persona CR	8242	Persona CR
1385	Nexgen CR	1165	Nexgen CR Flex	1890	Attune CR	2069	Attune CR	2642	Attune CR
1075	PFC Sigma CR	992	LCS CR	808	Nexgen CR Flex	651	Apex Knee CR	765	Apex Knee CR
1059	Scorpio CR	771	Apex Knee CR	786	Apex Knee CR	498	Legion CR	499	Legion CR
746	Natural Knee II	449	PFC Sigma CR	587	LCS CR	294	GMK Primary	312	GMK Primary
633	Active Knee	413	Legion CR	514	Legion CR	279	Nexgen CR Flex	177	ACS
425	Maxim	381	Vanguard CR	393	Score	196	Genesis II CR	173	Triathlon PS
413	Genesis II CR	365	Score	291	GMK Primary	184	Triathlon PS	167	Anatomic
386	Profix	274	Attune CR	246	Genesis II CR	142	BalanSys	145	Attune PS
10 Most Used									
9987	(10) 83.6%	15856	(10) 89.3%	20017	(10) 92.7%	20538	(10) 96.6%	26079	(10) 98.5%
Remainder									
1964	(28) 16.4%	1899	(24) 10.7%	1575	(24) 7.3%	731	(26) 3.4%	403	(18) 1.5%
TOTAL									
11951	(38) 100.0%	17755	(34) 100.0%	21592	(34) 100.0%	21269	(36) 100.0%	26482	(28) 100.0%

Table KT5 10 Most Used Tibial Components in Primary Total Knee Replacement

2003		2020		2021		2022		2023	
N	Model	N	Model	N	Model	N	Model	N	Model
3755	Nexgen	14548	Triathlon	17137	Triathlon	17804	Triathlon	23286	Triathlon
2843	Duracon	9062	Persona	12191	Persona	13803	Persona	17511	Persona
2039	Genesis II	6330	Genesis II	6963	Genesis II	6514	Attune	7505	Attune
1364	MBT	4987	Attune	6502	Attune	5236	Genesis II	5590	Genesis II
1362	LCS	3143	Nexgen	3518	GMK Primary	3638	GMK Primary	4626	GMK Primary
1360	Series 7000	2958	GMK Primary	2363	Apex Knee	2109	Apex Knee	2474	Apex Knee
1168	PFC Sigma	2375	Apex Knee	2218	Nexgen	1080	Columbus	1290	Evolution
1060	MBT Duofix	1256	MBT	1104	Columbus	1028	Evolution	1241	Journey
1002	Natural Knee II	1209	Evolution	1018	Evolution	789	Journey	1077	Columbus
894	Profix	1115	Columbus	937	MBT	749	Nexgen	640	SAIPH
10 Most Used									
16847	(10) 77.5%	46983	(10) 86.9%	53951	(10) 90.3%	52750	(10) 92.4%	65240	(10) 94.6%
Remainder									
4886	(38) 22.5%	7110	(47) 13.1%	5768	(47) 9.7%	4357	(45) 7.6%	3695	(44) 5.4%
TOTAL									
21733	(48) 100.0%	54093	(57) 100.0%	59719	(57) 100.0%	57107	(55) 100.0%	68935	(54) 100.0%

Table KT6 10 Most Used Cemented Tibial Components in Primary Total Knee Replacement

2003		2020		2021		2022		2023	
N	Model	N	Model	N	Model	N	Model	N	Model
3010	Nexgen	9457	Triathlon	10721	Triathlon	11133	Persona	14136	Persona
2348	Duracon	7574	Persona	10021	Persona	10825	Triathlon	13861	Triathlon
1992	Genesis II	6310	Genesis II	6961	Genesis II	5235	Genesis II	5589	Genesis II
1168	PFC Sigma	4693	Attune	4543	Attune	4639	Attune	5553	Attune
1067	MBT	2859	Nexgen	3323	GMK Primary	3421	GMK Primary	4400	GMK Primary
1033	LCS	2851	GMK Primary	2339	Apex Knee	2062	Apex Knee	2467	Apex Knee
1007	Series 7000	2368	Apex Knee	2088	Nexgen	1080	Columbus	1290	Evolution
719	Profix	1209	Evolution	1104	Columbus	1028	Evolution	1241	Journey
587	AGC	1115	Columbus	1018	Evolution	789	Journey	1077	Columbus
478	Natural Knee II	1029	Vanguard	789	MBT	673	Nexgen	640	SAIPH
10 Most Used									
13409	(10) 84.9%	39465	(10) 87.6%	42907	(10) 90.3%	40885	(10) 91.3%	50254	(10) 93.7%
Remainder									
2382	(31) 15.1%	5593	(41) 12.4%	4602	(41) 9.7%	3904	(42) 8.7%	3389	(41) 6.3%
TOTAL									
15791	(41) 100.0%	45058	(51) 100.0%	47509	(51) 100.0%	44789	(52) 100.0%	53643	(51) 100.0%

Table KT7 10 Most Used Cementless Tibial Components in Primary Total Knee Replacement

2003		2020		2021		2022		2023	
N	Model	N	Model	N	Model	N	Model	N	Model
1060	MBT Duofix	5091	Triathlon	6416	Triathlon	6979	Triathlon	9425	Triathlon
745	Nexgen	1488	Persona	2170	Persona	2670	Persona	3375	Persona
524	Natural Knee II	430	MBT Duofix	1959	Attune	1875	Attune	1952	Attune
495	Duracon	418	Nexgen TM CR	362	Nexgen TM CR	217	GMK Primary	226	GMK Primary
487	Active Knee	304	MBT	296	Score	124	Nexgen TM CR	128	ACS Fixed
353	Series 7000	294	Attune	195	GMK Primary	90	Score	87	Legion
329	LCS	284	Nexgen	148	MBT	87	Legion	72	Score
305	RBK	184	Score	130	Nexgen	77	ACS Fixed	8	Nexgen TM CR
297	MBT	107	GMK Primary	98	Legion	76	Nexgen	7	Apex Knee
242	Profix Mobile	100	RBK	90	RBK	47	Apex Knee	3	LCS
10 Most Used									
4837	(10) 81.4%	8700	(10) 96.3%	11864	(10) 97.2%	12242	(10) 99.4%	15283	(10) 99.9%
Remainder									
1105	(18) 18.6%	335	(13) 3.7%	346	(14) 2.8%	76	(10) 0.6%	9	(6) 0.1%
TOTAL									
5942	(28) 100.0%	9035	(23) 100.0%	12210	(24) 100.0%	12318	(20) 100.0%	15292	(16) 100.0%

Primary Total Knee Replacement

OUTCOME FOR ALL DIAGNOSES

Primary Diagnosis

Usage and availability of knee prostheses changes with time. In order to keep data contemporaneous, only procedures using prostheses that have been available and used in 2023 (described as modern prostheses) are included in the analyses, unless clearly specified. This has resulted in 220,092 (23%) procedures being excluded from the analysis for the 2024. The most common primary diagnosis for total knee replacement is osteoarthritis. Comparisons of revision rates for other primary diagnoses compared to osteoarthritis are shown in Table KT8 and Figure KT6.

There are variations in the rate of revision when comparing osteoarthritis to other primary diagnoses.

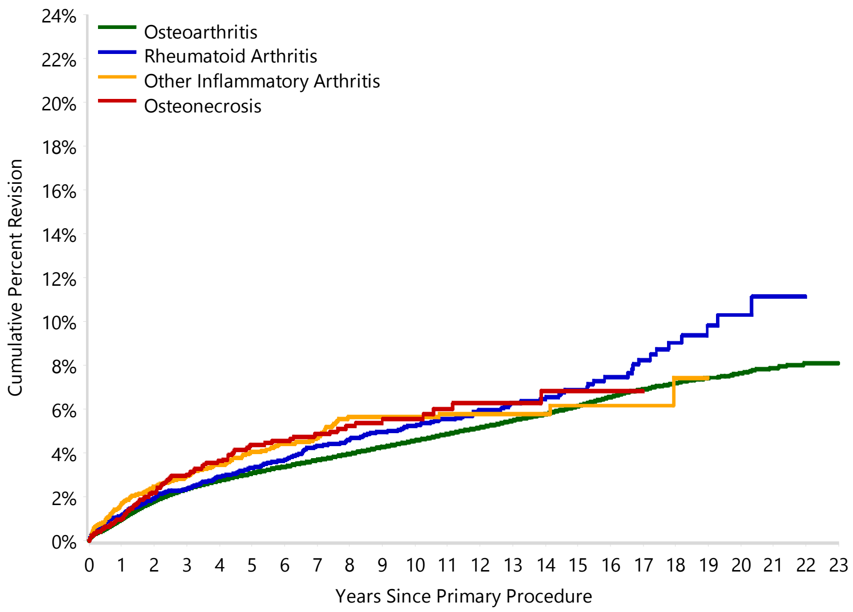
Detailed information on those prostheses that are no longer used is available in the supplementary report 'Comparative Prosthesis Performance' on the AOANJRR website: https://aoanjrr.sahmri.com/annual-reports-2024

Table KT8 Cumulative Percent Revision of Primary Total Knee Replacement by Primary Diagnosis

Primary Diagnosis	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Osteoarthritis	24126	721122	1.0 (0.9, 1.0)	2.3 (2.3, 2.4)	3.1 (3.0, 3.1)	4.6 (4.5, 4.6)	6.1 (6.0, 6.2)	7.6 (7.4, 7.9)
Rheumatoid Arthritis	313	7242	1.1 (0.9, 1.4)	2.4 (2.0, 2.8)	3.3 (2.9, 3.8)	5.2 (4.6, 5.9)	6.9 (6.0, 7.9)	10.3 (8.4, 12.7)
Other Inflammatory Arthritis	153	3740	1.7 (1.3, 2.2)	2.9 (2.4, 3.6)	4.1 (3.4, 4.8)	5.6 (4.8, 6.7)	6.2 (5.1, 7.5)	
Osteonecrosis	89	2069	1.0 (0.6, 1.5)	3.0 (2.3, 3.9)	4.4 (3.5, 5.5)	5.5 (4.4, 6.9)	6.8 (5.2, 8.9)	
Other (4)	250	1910	4.6 (3.7, 5.7)	9.6 (8.2, 11.2)	13.4 (11.7, 15.4)	21.6 (18.8, 24.7)	31.3 (26.6, 36.6)	
TOTAL	**24931**	**736083**						

Note: Restricted to modern prostheses

Figure KT6 Cumulative Percent Revision of Primary Total Knee Replacement by Primary Diagnosis



HR - adjusted for age and gender

Rheumatoid Arthritis vs Osteoarthritis
- 0 - 3Mth: HR=1.52 (1.12, 2.06), p=0.007
- 3Mth - 9Mth: HR=1.05 (0.74, 1.48), p=0.792
- 9Mth - 2.5Yr: HR=0.79 (0.63, 0.99), p=0.038
- 2.5Yr+: HR=1.04 (0.89, 1.21), p=0.662

Other Inflammatory Arthritis vs Osteoarthritis
- 0 - 1Yr: HR=1.68 (1.31, 2.16), p<0.001
- 1Yr+: HR=0.96 (0.78, 1.17), p=0.675

Osteonecrosis vs Osteoarthritis
- Entire Period: HR=1.26 (1.02, 1.55), p=0.032

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Osteoarthritis	721122	643170	512017	394022	154875	37564	4284
Rheumatoid Arthritis	7242	6596	5575	4504	2113	750	130
Other Inflammatory	3740	3322	2616	1996	720	208	36
Osteonecrosis	2069	1899	1524	1178	456	123	14

Note: Only primary diagnoses with >1,000 procedures have been listed; Restricted to modern prostheses

PROSTHESIS TYPES

Overall, there are 271 femoral and tibial prosthesis combinations that meet the definition of a modern prosthesis in primary total knee replacement.

The cumulative percent revision of the 92 combinations with >400 procedures by fixation are listed in Table KT9 to Table KT11. Although the listed combinations are a small proportion of all possible combinations, they represent 98.7%of all primary total knee replacement procedures. The 'other' group is the combined outcome of the remaining 179 prosthesis combinations with ≤400 procedures per combination.

There are 49 cemented femoral and tibial prosthesis combinations with >400 procedures (Table KT9).

There are 19 cementless femoral and tibial prosthesis combinations with >400 procedures (Table KT10).

There are 24 combinations of primary total knee replacement using hybrid fixation with >400 procedures (Table KT11).

Table KT9 Cumulative Percent Revision of Cemented Primary Total Knee Replacement by Prosthesis Combination

Femoral Component	Tibial Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
ACS	ACS Fixed	26	823	1.7 (1.0, 2.9)	2.9 (1.9, 4.3)	3.5 (2.4, 5.1)	3.5 (2.4, 5.1)		
	ACS Mobile	50	1621	1.1 (0.7, 1.8)	2.2 (1.6, 3.1)	3.4 (2.5, 4.7)	4.3 (3.2, 5.8)		
Active Knee	Active Knee	142	3783	0.8 (0.6, 1.2)	2.6 (2.1, 3.2)	3.5 (2.9, 4.2)	5.2 (4.4, 6.3)	6.7 (5.0, 8.9)	
Anatomic	Anatomic	51	1576	1.3 (0.8, 2.0)	3.2 (2.4, 4.3)	3.9 (3.0, 5.2)			
Apex Knee CR	Apex Knee	91	6716	0.5 (0.4, 0.7)	1.3 (1.0, 1.6)	1.8 (1.5, 2.3)	2.2 (1.7, 2.8)		
Apex Knee PS	Apex Knee	198	6956	0.7 (0.6, 1.0)	2.2 (1.9, 2.7)	3.2 (2.7, 3.7)	5.8 (4.6, 7.4)		
Attune CR	Attune	623	25172	0.9 (0.8, 1.0)	2.1 (1.9, 2.3)	2.8 (2.6, 3.0)	3.6 (3.3, 4.0)		
Attune PS	Attune	320	14130	0.8 (0.7, 1.0)	2.0 (1.8, 2.3)	2.6 (2.3, 2.9)	5.9 (4.2, 8.2)		
BalanSys	BalanSys	73	2396	0.5 (0.3, 0.9)	1.7 (1.2, 2.3)	2.1 (1.5, 2.8)	3.6 (2.8, 4.6)	5.0 (3.6, 6.8)	
Columbus	Columbus	130	6636	0.9 (0.7, 1.2)	2.0 (1.7, 2.5)	2.8 (2.3, 3.4)	4.1 (2.9, 5.9)		
E.Motion	E.Motion	31	612	2.0 (1.1, 3.5)	3.9 (2.6, 5.8)	4.0 (2.7, 6.0)	6.5 (4.5, 9.4)		
Evolis	Evolis	29	1234	0.3 (0.1, 0.9)	1.1 (0.6, 1.9)	1.7 (1.1, 2.7)	3.2 (2.2, 4.7)		
Evolution	Evolution	335	12377	0.8 (0.7, 1.0)	2.3 (2.0, 2.6)	3.0 (2.7, 3.3)	4.3 (3.6, 5.1)		
GMK Primary	GMK Primary	30	793	1.0 (0.5, 2.1)	2.6 (1.6, 4.0)	3.7 (2.5, 5.4)	4.4 (3.1, 6.3)		
GMK Sphere Primary	GMK Primary	525	21949	1.2 (1.1, 1.4)	2.6 (2.4, 2.9)	3.2 (2.9, 3.5)	4.2 (3.6, 4.8)		
	GMK Sphere Primary	95	3452	0.8 (0.5, 1.1)	2.6 (2.1, 3.3)	3.8 (3.1, 4.8)			
Genesis II CR	Genesis II	718	17297	0.9 (0.8, 1.1)	2.3 (2.1, 2.5)	2.9 (2.7, 3.2)	4.4 (4.0, 4.7)	5.4 (5.0, 5.9)	6.6 (6.0, 7.4)
Genesis II Oxinium CR	Genesis II	627	11169	1.1 (0.9, 1.3)	2.6 (2.3, 3.0)	3.4 (3.1, 3.8)	5.8 (5.3, 6.3)	8.3 (7.6, 9.0)	10.3 (9.3, 11.4)
Genesis II Oxinium PS	Genesis II	1511	22825	1.4 (1.3, 1.6)	3.5 (3.3, 3.8)	4.8 (4.5, 5.1)	7.1 (6.7, 7.5)	9.4 (8.9, 9.9)	12.1 (10.3, 14.2)
Genesis II PS	Genesis II	897	20273	1.1 (1.0, 1.3)	2.6 (2.4, 2.8)	3.5 (3.2, 3.7)	4.7 (4.4, 5.1)	6.0 (5.6, 6.5)	6.7 (6.1, 7.3)
Journey II Oxinium	Journey	18	2231	0.4 (0.2, 0.8)	4.1 (2.0, 8.2)	6.3 (3.5, 11.3)			
LCS CR	LCS	340	3943	1.0 (0.7, 1.4)	3.7 (3.2, 4.4)	5.1 (4.4, 5.8)	7.3 (6.5, 8.2)	9.4 (8.5, 10.5)	10.7 (9.6, 11.9)
	MBT*	652	13326	0.9 (0.7, 1.0)	2.6 (2.4, 2.9)	3.6 (3.3, 3.9)	5.3 (4.9, 5.7)	6.2 (5.7, 6.7)	8.3 (6.9, 10.0)
Legion CR	Genesis II	130	4781	1.1 (0.8, 1.5)	2.3 (1.9, 2.8)	3.3 (2.8, 3.9)	4.0 (3.2, 5.0)		

Table KT9 ***Cont***

Femoral Component	Tibial Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Legion Oxinium CR	Genesis II	319	11562	0.9 (0.7, 1.1)	2.4 (2.1, 2.8)	3.3 (2.9, 3.7)	4.3 (3.8, 4.8)	5.8 (4.5, 7.3)	
Legion Oxinium PS	Genesis II	762	18579	1.0 (0.9, 1.2)	2.9 (2.7, 3.2)	3.8 (3.5, 4.1)	5.4 (5.0, 5.8)	8.0 (6.7, 9.6)	
Legion PS	Genesis II	220	6410	1.4 (1.1, 1.7)	2.5 (2.1, 2.9)	3.1 (2.7, 3.5)	4.1 (3.6, 4.7)		
MRK	MRK	26	763	1.1 (0.5, 2.1)	2.3 (1.4, 3.7)	2.5 (1.5, 4.0)	4.6 (3.0, 6.9)		
Natural Knee Flex	Natural Knee II	93	2608	1.2 (0.9, 1.7)	2.7 (2.1, 3.4)	3.1 (2.5, 3.9)	4.0 (3.2, 5.0)		
Nexgen CR Flex	Natural Knee II*	18	806	0.4 (0.1, 1.2)	1.0 (0.5, 2.0)	1.3 (0.7, 2.3)	2.3 (1.4, 3.8)		
	Nexgen	784	30431	0.7 (0.6, 0.8)	1.6 (1.4, 1.7)	2.1 (1.9, 2.2)	2.9 (2.7, 3.1)	3.8 (3.4, 4.2)	
Nexgen LCCK	Nexgen	66	1115	2.1 (1.4, 3.1)	3.7 (2.7, 5.0)	5.0 (3.8, 6.5)	6.4 (4.9, 8.3)	10.6 (7.5, 14.9)	
Nexgen LPS Flex	Nexgen	1421	30444	1.0 (0.9, 1.1)	2.4 (2.2, 2.5)	3.2 (3.0, 3.4)	5.0 (4.8, 5.3)	6.5 (6.2, 6.9)	
Nexgen RH	Nexgen	44	865	2.2 (1.4, 3.5)	4.2 (2.9, 5.9)	5.0 (3.6, 6.9)	7.6 (5.5, 10.5)		
Optetrak Logic CR	Optetrak Logic	44	741	0.8 (0.4, 1.8)	3.3 (2.2, 4.9)	5.5 (4.0, 7.7)			
Optetrak Logic PS	Optetrak Logic	35	651	1.8 (1.1, 3.2)	3.4 (2.3, 5.2)	4.6 (3.2, 6.7)			
	Optetrak Logic RBK	46	1094	1.5 (0.9, 2.4)	3.2 (2.3, 4.5)	5.2 (3.9, 7.1)			
Persona CR	Nexgen	13	510	1.0 (0.4, 2.3)	2.2 (1.2, 3.9)	2.4 (1.4, 4.3)			
	Persona	459	32982	0.8 (0.7, 0.9)	1.8 (1.6, 2.0)	2.2 (2.0, 2.5)			
Persona PS	Persona	121	5803	1.1 (0.8, 1.4)	2.1 (1.8, 2.6)	2.7 (2.2, 3.3)	2.9 (2.4, 3.5)		
SAIPH	SAIPH	104	6071	0.6 (0.4, 0.8)	1.6 (1.3, 1.9)	2.1 (1.7, 2.6)	2.9 (2.1, 4.1)		
Score	Score	52	1267	1.5 (1.0, 2.4)	2.9 (2.0, 4.0)	3.9 (2.9, 5.3)	5.6 (4.2, 7.4)		
Trekking	Trekking	30	416	2.4 (1.3, 4.5)	4.5 (2.9, 7.0)	6.2 (4.2, 9.1)	8.2 (5.8, 11.6)		
Triathlon CR	Triathlon	1871	80304	0.8 (0.7, 0.8)	1.8 (1.7, 1.9)	2.3 (2.2, 2.4)	3.5 (3.3, 3.7)	4.6 (4.3, 5.0)	
Triathlon FS	Triathlon	32	524	2.8 (1.7, 4.7)	5.8 (4.0, 8.4)	7.1 (5.0, 10.1)	8.8 (5.9, 12.9)		
Triathlon PS	Triathlon	489	10930	1.4 (1.2, 1.7)	2.9 (2.6, 3.3)	3.7 (3.4, 4.1)	5.5 (5.0, 6.1)	6.9 (6.2, 7.7)	
Unity Knee	Unity Knee	5	951	0.4 (0.2, 1.1)	0.4 (0.2, 1.1)	0.7 (0.3, 1.8)			
Vanguard CR	Vanguard	502	12382	0.7 (0.6, 0.9)	2.1 (1.9, 2.4)	2.7 (2.4, 3.0)	4.5 (4.1, 4.9)	7.0 (6.1, 7.9)	
iTotal	iTotal	8	700	1.0 (0.4, 2.3)	2.5 (1.1, 5.4)				
Other (84)		414	5242	3.3 (2.8, 3.9)	7.0 (6.3, 7.9)	9.6 (8.6, 10.7)	14.4 (12.8, 16.1)	21.4 (18.0, 25.4)	
TOTAL		**15620**	**470222**						

Note: Restricted to modern prostheses
Some cementless components have been cemented
Only combinations with >400 procedures have been listed
* denotes prosthesis combinations that have not had any reported use in primary total knee procedures in 2023

Table KT10 Cumulative Percent Revision of Cementless Primary Total Knee Replacement by Prosthesis Combination

Femoral Component	Tibial Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
ACS	ACS Fixed	58	1299	1.5 (0.9, 2.3)	3.9 (2.9, 5.1)	4.5 (3.4, 5.9)	5.6 (4.3, 7.3)		
Active Knee	Active Knee	603	4899	1.3 (1.1, 1.7)	4.0 (3.4, 4.5)	5.6 (5.0, 6.3)	9.6 (8.8, 10.5)	13.2 (12.2, 14.3)	16.0 (14.7, 17.4)
Apex Knee CR	Apex Knee	30	523	2.5 (1.5, 4.3)	5.2 (3.6, 7.6)	5.7 (3.9, 8.1)	6.2 (4.4, 8.8)		
Attune CR	Attune	55	4745	0.9 (0.6, 1.2)	1.8 (1.3, 2.5)	2.3 (1.4, 3.7)			
Columbus	Columbus	70	500	3.2 (2.0, 5.2)	7.7 (5.6, 10.4)	9.7 (7.4, 12.7)	13.1 (10.4, 16.5)	15.8 (12.5, 19.8)	
GMK Primary	GMK Primary	70	1934	1.2 (0.8, 1.8)	3.1 (2.3, 4.0)	3.7 (2.9, 4.8)	5.8 (4.4, 7.6)		
Genesis II CR	Genesis II	49	749	1.5 (0.8, 2.6)	3.8 (2.6, 5.4)	4.6 (3.3, 6.4)	7.1 (5.3, 9.4)	8.4 (6.0, 11.6)	
Genesis II PS	Genesis II	34	420	1.7 (0.8, 3.5)	3.3 (2.0, 5.6)	4.1 (2.5, 6.5)	6.4 (4.4, 9.2)	10.0 (7.0, 14.0)	
LCS CR	LCS	175	2387	1.4 (1.0, 2.0)	3.4 (2.8, 4.2)	4.4 (3.6, 5.3)	6.2 (5.3, 7.3)	7.4 (6.3, 8.6)	8.8 (7.6, 10.2)
	MBT*	527	9395	1.1 (0.9, 1.3)	3.4 (3.1, 3.8)	4.2 (3.8, 4.6)	5.4 (4.9, 5.9)	7.4 (6.7, 8.2)	10.1 (8.7, 11.8)
Natural Knee Flex	Natural Knee II	54	1769	0.7 (0.4, 1.2)	1.6 (1.1, 2.3)	2.2 (1.6, 3.0)	3.3 (2.5, 4.4)	4.8 (3.4, 6.6)	
Nexgen CR Flex	Nexgen	360	8754	1.1 (0.9, 1.4)	2.7 (2.4, 3.1)	3.3 (2.9, 3.7)	4.3 (3.8, 4.8)	5.0 (4.4, 5.6)	
	Nexgen TM CR	356	11473	0.5 (0.4, 0.7)	1.7 (1.5, 2.0)	2.3 (2.0, 2.6)	3.2 (2.9, 3.6)	4.2 (3.7, 4.7)	
Nexgen LPS Flex	Nexgen	54	1199	2.6 (1.8, 3.7)	3.9 (3.0, 5.2)	4.2 (3.2, 5.5)	5.1 (3.8, 6.7)		
Persona CR	Persona	140	8591	1.2 (1.0, 1.5)	2.4 (2.0, 2.9)	3.0 (2.4, 3.8)			
Score	Score	251	2990	1.5 (1.1, 2.0)	4.7 (4.0, 5.5)	6.4 (5.6, 7.4)	10.4 (9.1, 11.8)	12.4 (10.7, 14.3)	
Triathlon CR	Triathlon	1123	46640	1.0 (0.9, 1.1)	2.2 (2.0, 2.3)	2.8 (2.6, 3.0)	4.1 (3.8, 4.4)	5.4 (5.0, 5.9)	
Triathlon PS	Triathlon	76	1525	1.8 (1.2, 2.6)	3.4 (2.6, 4.5)	4.3 (3.4, 5.6)	5.4 (4.3, 6.9)	7.1 (5.4, 9.2)	
Vanguard CR	Vanguard	111	1695	1.4 (1.0, 2.1)	4.1 (3.3, 5.2)	4.8 (3.8, 5.9)	6.4 (5.3, 7.7)		
Other (35)		146	2342	2.0 (1.5, 2.6)	5.2 (4.3, 6.3)	6.5 (5.5, 7.7)	8.1 (6.8, 9.5)		
TOTAL		**4342**	**113829**						

Note: Restricted to modern prostheses
Only combinations with >400 procedures have been listed
* denotes prosthesis combinations that have not had any reported use in primary total knee procedures in 2023

Table KT11 Cumulative Percent Revision of Hybrid Primary Total Knee Replacement by Prosthesis Combination

Femoral Component	Tibial Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
ACS	ACS Fixed	74	1579	1.2 (0.8, 1.9)	3.6 (2.7, 4.6)	4.4 (3.5, 5.6)	6.0 (4.7, 7.6)		
Active Knee	Active Knee	173	2359	0.6 (0.4, 1.1)	2.7 (2.2, 3.5)	3.8 (3.1, 4.7)	6.8 (5.7, 7.9)	10.3 (8.7, 12.1)	12.0 (10.0, 14.3)
Anatomic	Anatomic	12	519	1.6 (0.8, 3.4)	2.2 (1.2, 4.3)	2.6 (1.4, 4.8)			
Apex Knee CR	Apex Knee	99	5582	0.9 (0.7, 1.2)	1.7 (1.3, 2.1)	2.1 (1.7, 2.6)	3.6 (2.4, 5.6)		
Attune CR	Attune	30	2484	0.9 (0.6, 1.4)	2.3 (1.5, 3.6)				
Attune PS	Attune	29	1085	1.8 (1.1, 2.9)	3.2 (2.2, 4.5)				
BalanSys	BalanSys	71	2436	1.0 (0.7, 1.5)	2.2 (1.7, 2.9)	2.9 (2.2, 3.7)	4.2 (3.2, 5.5)		
GMK Primary	GMK Primary	35	955	1.1 (0.6, 2.0)	3.4 (2.4, 4.9)	3.7 (2.6, 5.3)	4.6 (3.3, 6.4)		
Genesis II CR	Genesis II	528	8847	1.0 (0.8, 1.2)	3.3 (2.9, 3.6)	4.3 (3.9, 4.8)	6.0 (5.5, 6.5)	7.3 (6.7, 8.0)	9.0 (8.0, 10.0)
Genesis II PS	Genesis II	72	707	1.7 (1.0, 3.0)	4.4 (3.1, 6.2)	5.6 (4.1, 7.6)	9.0 (7.0, 11.4)	10.8 (8.6, 13.6)	
LCS CR	LCS	156	2364	1.0 (0.7, 1.5)	2.7 (2.1, 3.5)	3.8 (3.1, 4.7)	5.5 (4.6, 6.6)	6.9 (5.8, 8.1)	8.2 (6.9, 9.6)
	MBT*	416	11102	0.7 (0.6, 0.9)	2.2 (1.9, 2.5)	2.8 (2.5, 3.1)	4.0 (3.6, 4.5)	4.7 (4.2, 5.2)	5.5 (4.8, 6.3)
Legion CR	Genesis II	196	4779	1.3 (1.0, 1.7)	3.3 (2.8, 3.9)	4.2 (3.6, 4.9)	6.7 (5.6, 7.9)		
Natural Knee Flex	Natural Knee II	46	1997	0.4 (0.2, 0.8)	1.2 (0.8, 1.8)	1.7 (1.2, 2.4)	2.6 (1.9, 3.4)		
Nexgen CR Flex	Nexgen	625	22221	0.7 (0.6, 0.8)	1.8 (1.6, 2.0)	2.2 (2.0, 2.4)	3.0 (2.8, 3.3)	4.0 (3.6, 4.4)	
	Nexgen TM CR	28	881	0.7 (0.3, 1.5)	1.5 (0.9, 2.6)	1.7 (1.1, 2.9)	2.4 (1.6, 3.8)	3.4 (2.3, 5.0)	
Nexgen LPS Flex	Nexgen	58	933	2.3 (1.5, 3.4)	4.3 (3.2, 5.8)	5.5 (4.2, 7.1)	7.1 (5.4, 9.3)		
Optetrak Logic CR	Optetrak Logic	110	1122	1.2 (0.7, 2.0)	4.8 (3.6, 6.2)	9.5 (7.7, 11.6)			
Persona CR	Persona	264	18539	0.9 (0.8, 1.1)	1.9 (1.7, 2.2)	2.4 (2.1, 2.8)			
Score	Score	123	1942	1.3 (0.9, 2.0)	3.7 (3.0, 4.7)	5.7 (4.7, 6.9)	8.7 (7.2, 10.7)		
Trekking	Trekking	24	564	1.1 (0.5, 2.4)	2.9 (1.8, 4.6)	3.5 (2.2, 5.4)	4.7 (3.1, 7.1)		
Triathlon CR	Triathlon	885	40038	0.7 (0.6, 0.8)	1.6 (1.4, 1.7)	2.1 (2.0, 2.3)	3.2 (2.9, 3.4)	4.8 (4.2, 5.5)	
Triathlon PS	Triathlon	137	3161	1.6 (1.2, 2.2)	2.7 (2.2, 3.3)	3.6 (2.9, 4.3)	5.0 (4.2, 6.0)	6.0 (4.9, 7.4)	
Vanguard CR	Vanguard	563	13484	0.8 (0.6, 0.9)	2.2 (2.0, 2.5)	2.9 (2.6, 3.2)	4.8 (4.4, 5.2)	6.7 (6.0, 7.4)	
Other (60)		215	2352	3.1 (2.5, 3.9)	6.7 (5.7, 7.8)	8.1 (7.0, 9.3)	10.3 (9.0, 11.8)	12.1 (10.4, 14.0)	
TOTAL		**4969**	**152032**						

Note: Restricted to modern prostheses
Only combinations with >400 procedures have been listed
* denotes prosthesis combinations that have not had any reported use in primary total knee procedures in 2023

OUTCOME FOR OSTEOARTHRITIS – PATIENT CHARACTERISTICS

Primary total knee replacement has the lowest rate of revision compared to all other classes of primary knee replacement. At 20 years, the cumulative percent revision of all primary total knee replacement procedures undertaken for osteoarthritis is 7.6% (Table KT12 and Figure KT7).

Reasons for Revision

Infection is the most common reason for revision followed by loosening, instability, pain, and patellofemoral erosion (Table KT13 and Figure KT8).

Types of Revision

The most common types of revision are insert only, both femoral and tibial components, and patella only (Table KT14).

Age and Gender

The rate of revision decreases with increasing age. This difference becomes more evident with time. Compared to patients aged ≥75 years patients aged <55 years have almost 3 times the rate of revision after 6 months and this increases to nearly 5 times after 8 years (Table KT15 and Figure KT9).

Males have a higher rate of revision compared to females for the first 1.5 years and after 9years with no difference between these time periods (Table KT16 and Figure KT10). Loosening is the most common reason for revision in females. Males have a higher incidence of revision for infection (Figure KT11,

Table KT17 and Figure KT12).

Age-related differences in the rate of revision are evident for both males and females (Table KT16, Figure KT13 and Figure KT14).

ASA and BMI

ASA scores are an indication of comorbidity and have been collected since 2012. The definitions for these scores can be found in the introductory part of this chapter. There are 536,722 primary total knee replacement procedures for osteoarthritis with these scores. When compared to patients with an ASA score of 1, patients in all other ASA groups have a higher rate of revision (Table KT18 and Figure KT15). The difference in the rate of revision for each ASA score is partially due to an increase in the cumulative incidence of infection with increasing ASA score (Figure KT16).

When patients with ASA scores 3-5 are compared, males have a higher rate of revision than females. Male patients with ASA scores 1-2 have a higher rate of revision compared to female patients with these scores only until 1.5 years, and after this time there is no longer a difference (Table KT19 and Figure KT17).

BMI data have been collected since 2015. There are revision outcomes for 460,298 primary total knee replacement procedures for osteoarthritis in relation to BMI category. When compared to patients with normal BMI, there is no difference in the rate of revision for patients who are pre-obese or obese class 1. However, there is an early increase in the rate of revision for patients in obese class 2 and obese class 3 (Table KT20 and Figure KT18).

The most common reasons for revision are shown in Figure KT19.

Compared to patients who have BMI <30, patients in obese classes 1-3 have an increased rate of early revision until 3 months for females, and until 2 years for males. There is an increased rate of revision for obese male patients compared to obese female patients (Table KT21 and Figure KT20).

Males have a higher rate of revision which is largely due to an increased incidence of infection.

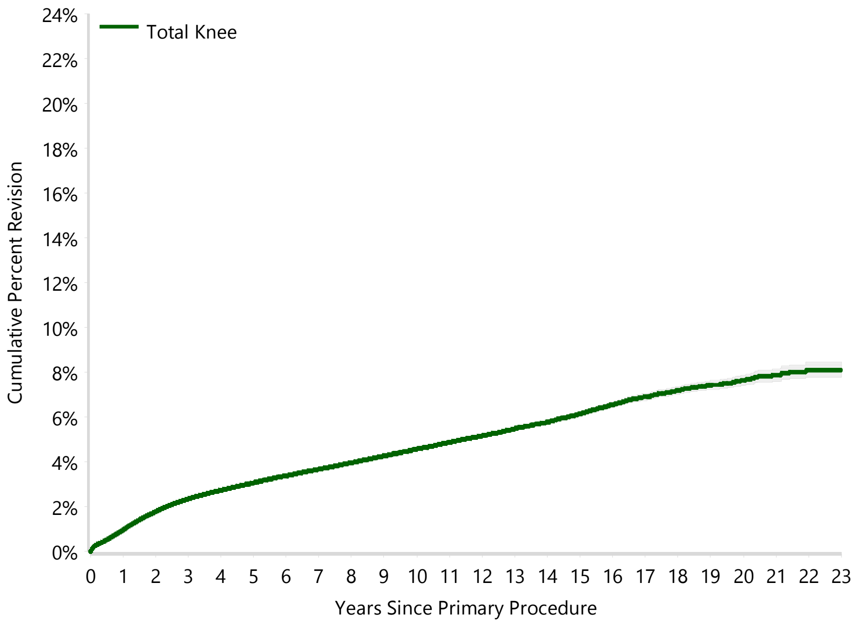
Primary Total Knee Replacement

Table KT12 Cumulative Percent Revision of Primary Total Knee Replacement (Primary Diagnosis OA)

Knee Class	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Total Knee	24126	721122	1.0 (0.9, 1.0)	2.3 (2.3, 2.4)	3.1 (3.0, 3.1)	4.6 (4.5, 4.6)	6.1 (6.0, 6.2)	7.6 (7.4, 7.9)
TOTAL	**24126**	**721122**						

Note: Restricted to modern prostheses

Figure KT7 Cumulative Percent Revision of Primary Total Knee Replacement (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Total Knee	721122	643170	512017	394022	154875	37564	4284

Note: Restricted to modern prostheses

Table KT13 Primary Total Knee Replacement by Reason for Revision (Primary Diagnosis OA)

Reason for Revision	Number	Percent
Infection	6740	27.9
Loosening	5134	21.3
Instability	2501	10.4
Pain	1798	7.5
Patella Erosion	1751	7.3
Patellofemoral Pain	1585	6.6
Arthrofibrosis	1013	4.2
Fracture	938	3.9
Malalignment	505	2.1
Wear Tibial Insert	334	1.4
Lysis	275	1.1
Incorrect Sizing	223	0.9
Metal Related Pathology	96	0.4
Other	1233	5.1
TOTAL	**24126**	**100.0**

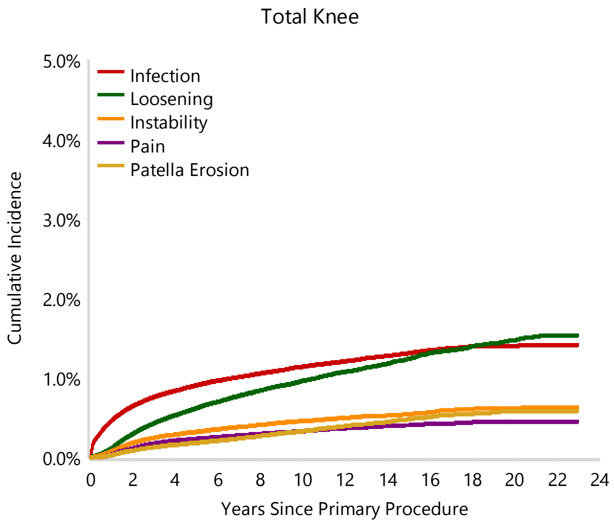
Note: Restricted to modern prostheses

Table KT14 Primary Total Knee Replacement by Type of Revision (Primary Diagnosis OA)

Type of Revision	Number	Percent
Insert Only	7231	30.0
TKR (Tibial/Femoral)	5799	24.0
Patella Only	4214	17.5
Insert/Patella	2600	10.8
Tibial Component	1795	7.4
Femoral Component	1161	4.8
Cement Spacer	1133	4.7
Removal of Prostheses	121	0.5
Minor Components	46	0.2
Total Femoral	14	0.1
Reinsertion of Components	7	0.0
Cement Only	5	0.0
TOTAL	**24126**	**100.0**

Note: Restricted to modern prostheses

Figure KT8 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement (Primary Diagnosis OA)



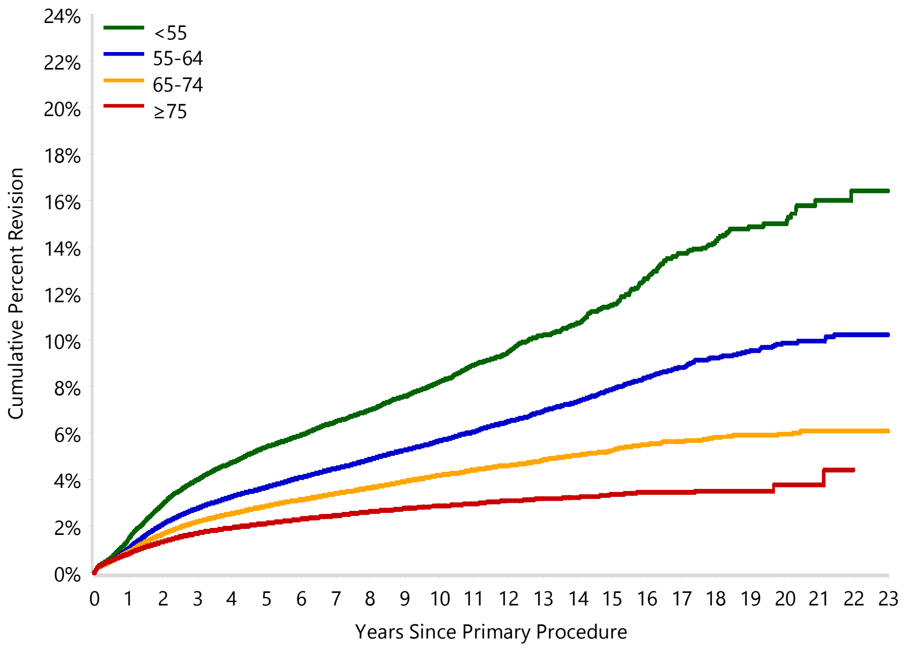
Note: Restricted to modern prostheses

Table KT15 Cumulative Percent Revision of Primary Total Knee Replacement by Age (Primary Diagnosis OA)

Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
<55	3024	46844	1.5 (1.3, 1.6)	4.0 (3.8, 4.2)	5.4 (5.2, 5.7)	8.2 (7.9, 8.5)	11.5 (11.0, 12.0)	15.0 (14.1, 15.9)
55-64	8326	192647	1.0 (1.0, 1.1)	2.8 (2.7, 2.9)	3.7 (3.6, 3.8)	5.7 (5.5, 5.8)	7.9 (7.7, 8.1)	9.9 (9.5, 10.3)
65-74	8850	291474	0.9 (0.9, 0.9)	2.2 (2.1, 2.3)	2.9 (2.8, 2.9)	4.2 (4.1, 4.3)	5.3 (5.1, 5.4)	5.9 (5.7, 6.2)
≥75	3926	190157	0.8 (0.8, 0.9)	1.7 (1.6, 1.8)	2.1 (2.1, 2.2)	2.9 (2.8, 3.0)	3.4 (3.2, 3.5)	3.8 (3.3, 4.3)
TOTAL	**24126**	**721122**						

Note: Restricted to modern prostheses

Figure KT9 Cumulative Percent Revision of Primary Total Knee Replacement by Age (Primary Diagnosis OA)



HR - adjusted for gender

<55 vs ≥75
0 - 6Mth: HR=1.24 (1.09, 1.42), p<0.001
6Mth - 1.5Yr: HR=2.70 (2.45, 2.98), p<0.001
1.5Yr - 2Yr: HR=3.13 (2.70, 3.61), p<0.001
2Yr - 2.5Yr: HR=2.87 (2.45, 3.36), p<0.001
2.5Yr - 4Yr: HR=3.38 (3.01, 3.80), p<0.001
4Yr - 5Yr: HR=3.82 (3.26, 4.47), p<0.001
5Yr - 8Yr: HR=3.35 (2.97, 3.79), p<0.001
8Yr - 12Yr: HR=4.53 (3.96, 5.18), p<0.001
12Yr+: HR=7.12 (5.92, 8.58), p<0.001

55-64 vs ≥75
0 - 6Mth: HR=0.96 (0.88, 1.05), p=0.357
6Mth - 1.5Yr: HR=1.86 (1.73, 2.01), p<0.001
1.5Yr - 2Yr: HR=2.06 (1.84, 2.30), p<0.001
2Yr - 2.5Yr: HR=1.82 (1.61, 2.05), p<0.001
2.5Yr - 3.5Yr: HR=2.17 (1.96, 2.39), p<0.001
3.5Yr - 4.5Yr: HR=2.31 (2.06, 2.58), p<0.001
4.5Yr - 9Yr: HR=2.45 (2.26, 2.66), p<0.001
9Yr - 12Yr: HR=3.02 (2.67, 3.42), p<0.001
12Yr - 13Yr: HR=3.82 (2.96, 4.93), p<0.001
13Yr+: HR=4.11 (3.44, 4.91), p<0.001

65-74 vs ≥75
0 - 6Mth: HR=0.94 (0.87, 1.02), p=0.139
6Mth - 1.5Yr: HR=1.41 (1.30, 1.51), p<0.001
1.5Yr - 2.5Yr: HR=1.44 (1.31, 1.57), p<0.001
2.5Yr+: HR=1.67 (1.56, 1.77), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
<55	46844	42100	33789	26779	12135	3607	590
55-64	192647	173271	140056	110348	48129	13389	1790
65-74	291474	260093	207428	159847	63031	15402	1607
≥75	190157	167706	130744	97048	31580	5166	297

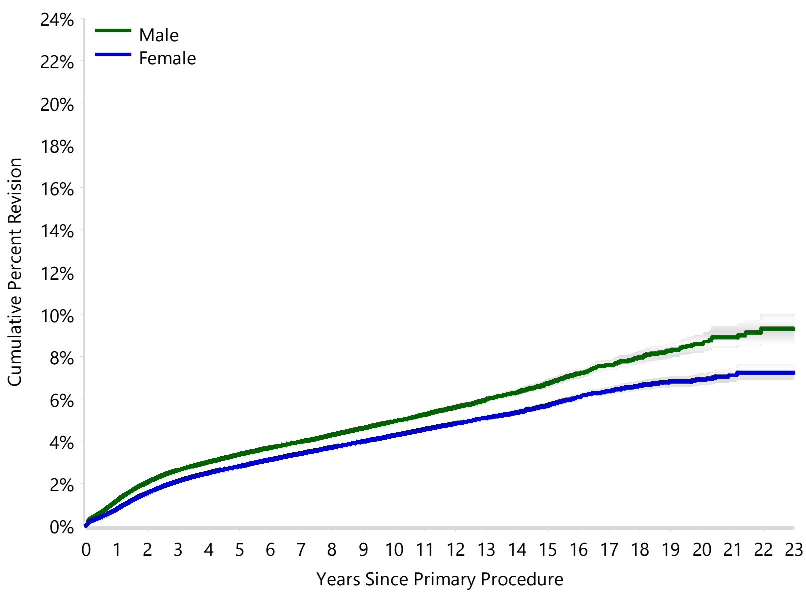
Note: Restricted to modern prostheses

Table KT16 Cumulative Percent Revision of Primary Total Knee Replacement by Gender and Age (Primary Diagnosis OA)

Gender	Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Male		**11570**	**320972**	**1.2 (1.1, 1.2)**	**2.6 (2.6, 2.7)**	**3.4 (3.3, 3.4)**	**4.9 (4.8, 5.0)**	**6.7 (6.6, 6.9)**	**8.6 (8.2, 9.0)**
	<55	1354	20108	1.8 (1.6, 2.0)	4.3 (4.0, 4.6)	5.6 (5.3, 6.0)	8.5 (8.0, 9.0)	11.9 (11.1, 12.7)	15.6 (14.2, 17.1)
	55-64	4083	90734	1.2 (1.2, 1.3)	3.0 (2.9, 3.2)	3.9 (3.8, 4.1)	6.0 (5.8, 6.2)	8.4 (8.1, 8.8)	10.9 (10.2, 11.7)
	65-74	4348	131942	1.1 (1.1, 1.2)	2.5 (2.4, 2.6)	3.2 (3.1, 3.3)	4.5 (4.4, 4.7)	5.8 (5.6, 6.0)	6.5 (6.1, 6.9)
	≥75	1785	78188	1.0 (0.9, 1.1)	2.0 (1.9, 2.1)	2.4 (2.3, 2.6)	3.1 (3.0, 3.3)	3.7 (3.4, 4.0)	4.8 (3.2, 7.1)
Female		**12556**	**400150**	**0.8 (0.8, 0.8)**	**2.1 (2.1, 2.2)**	**2.8 (2.8, 2.9)**	**4.3 (4.2, 4.4)**	**5.7 (5.6, 5.8)**	**6.9 (6.7, 7.2)**
	<55	1670	26736	1.2 (1.1, 1.4)	3.8 (3.5, 4.0)	5.2 (5.0, 5.6)	8.0 (7.6, 8.4)	11.2 (10.6, 11.9)	14.5 (13.4, 15.7)
	55-64	4243	101913	0.9 (0.8, 0.9)	2.6 (2.4, 2.7)	3.5 (3.3, 3.6)	5.4 (5.3, 5.6)	7.5 (7.2, 7.8)	9.1 (8.6, 9.6)
	65-74	4502	159532	0.7 (0.7, 0.8)	2.0 (1.9, 2.1)	2.6 (2.5, 2.7)	3.9 (3.8, 4.0)	4.8 (4.7, 5.0)	5.5 (5.2, 5.9)
	≥75	2141	111969	0.7 (0.7, 0.8)	1.5 (1.4, 1.6)	1.9 (1.8, 2.0)	2.7 (2.6, 2.8)	3.2 (3.0, 3.4)	3.3 (3.0, 3.6)
TOTAL		**24126**	**721122**						

Note: Restricted to modern prostheses

Figure KT10 Cumulative Percent Revision of Primary Total Knee Replacement by Gender (Primary Diagnosis OA)



HR - adjusted for age

Male vs Female

0 - 9Mth: HR=1.50 (1.42, 1.58), p<0.001

9Mth - 1.5Yr: HR=1.25 (1.18, 1.33), p<0.001

1.5Yr - 9Yr: HR=1.03 (0.99, 1.07), p=0.104

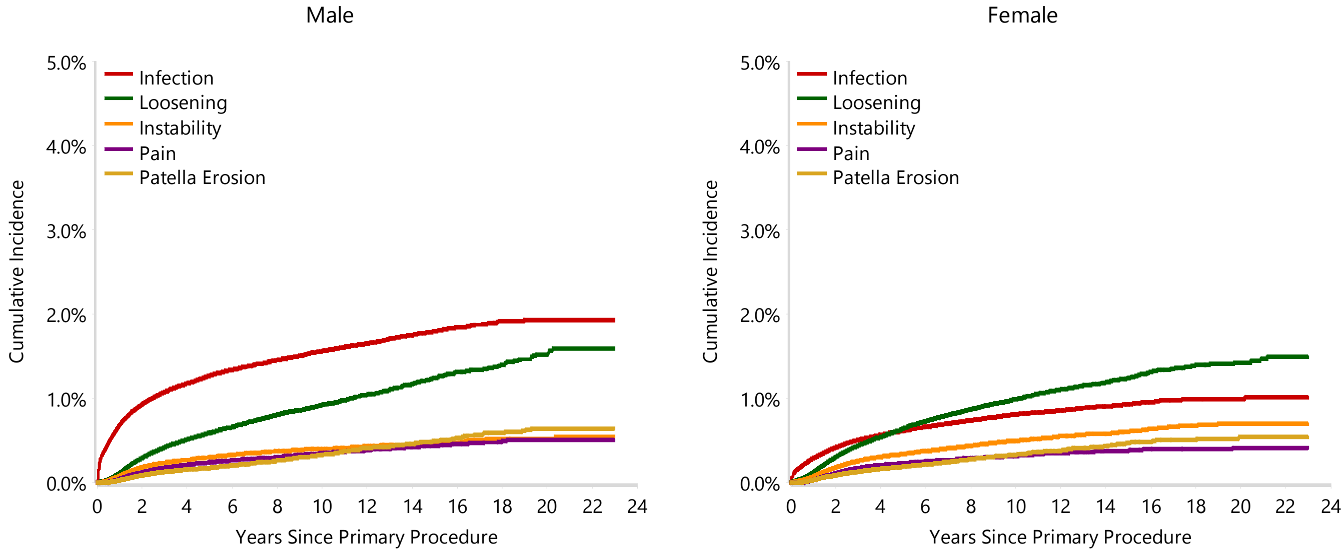
9Yr+: HR=1.21 (1.12, 1.32), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Male	320972	284836	223635	168893	63860	14902	1677
Female	400150	358334	288382	225129	91015	22662	2607

Note: Restricted to modern prostheses

Primary Total Knee Replacement

Figure KT11 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by Gender (Primary Diagnosis OA)



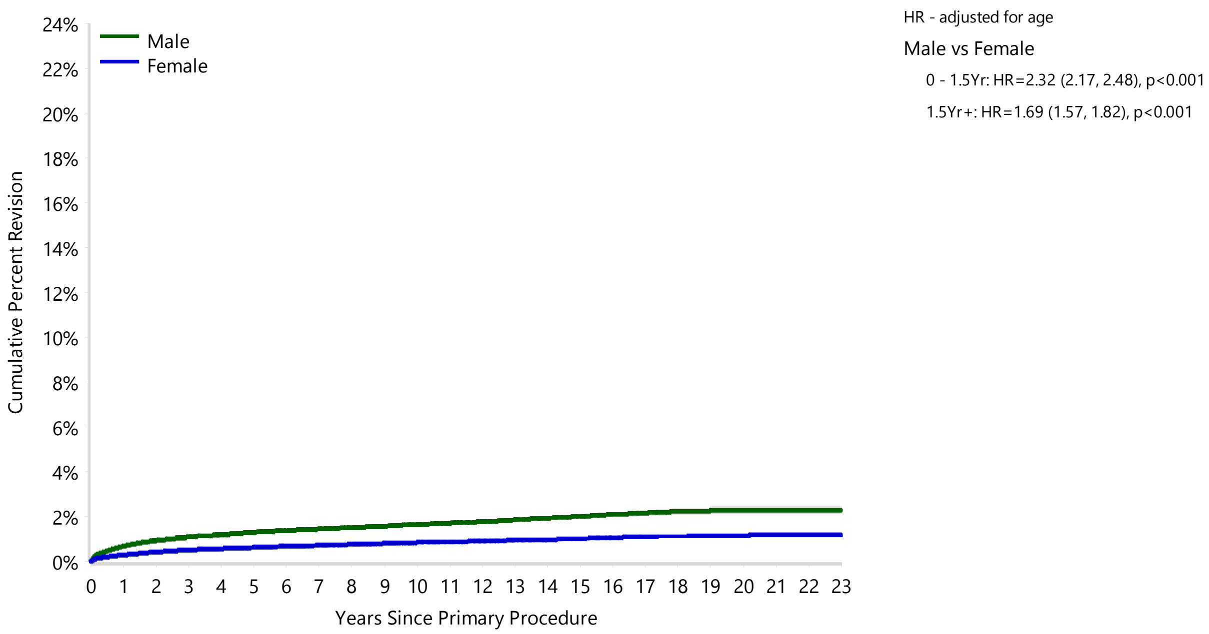
Note: Restricted to modern prostheses

Table KT17 Cumulative Percent Revision of Primary Total Knee Replacement by Gender (Primary Diagnosis OA, Revision for Infection)

Gender	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Male	4135	320972	0.7 (0.7, 0.7)	1.1 (1.0, 1.1)	1.3 (1.3, 1.3)	1.6 (1.6, 1.7)	2.0 (1.9, 2.1)	2.3 (2.1, 2.4)
Female	2605	400150	0.3 (0.3, 0.3)	0.5 (0.5, 0.5)	0.6 (0.6, 0.7)	0.9 (0.8, 0.9)	1.0 (1.0, 1.1)	1.1 (1.1, 1.2)
TOTAL	**6740**	**721122**						

Note: Restricted to modern prostheses

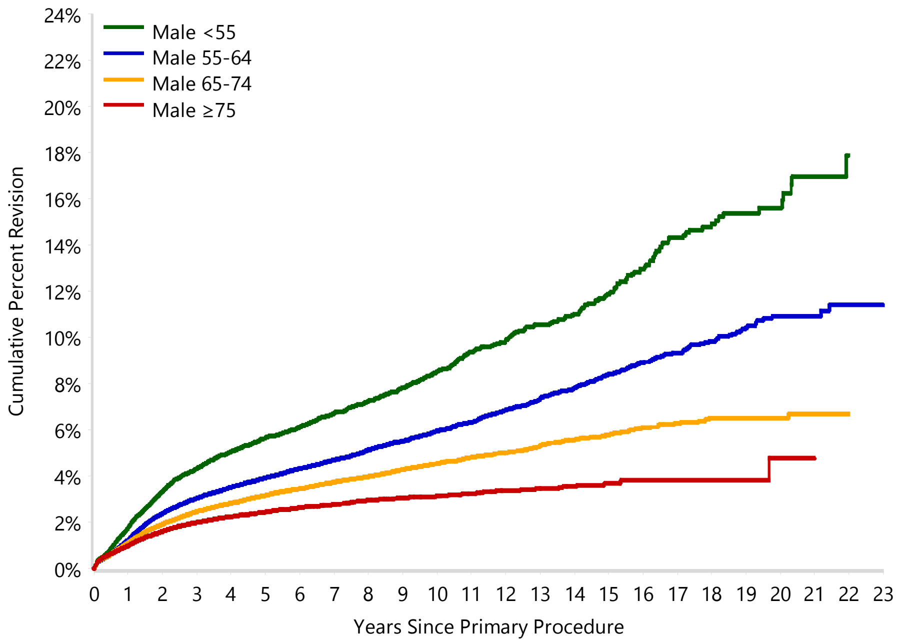
Figure KT12 Cumulative Percent Revision of Primary Total Knee Replacement by Gender (Primary Diagnosis OA, Revision for Infection)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Male	320972	284836	223635	168893	63860	14902	1677
Female	400150	358334	288382	225129	91015	22662	2607

Note: Restricted to modern prostheses

Figure KT13 Cumulative Percent Revision of Primary Total Knee Replacement in Males by Age (Primary Diagnosis OA)



Male <55 vs Male ≥75
0 - 3Mth: HR=1.06 (0.85, 1.33), p=0.597
3Mth - 6Mth: HR=2.01 (1.56, 2.59), p<0.001
6Mth - 3.5Yr: HR=2.69 (2.44, 2.96), p<0.001
3.5Yr - 7.5Yr: HR=3.16 (2.73, 3.66), p<0.001
7.5Yr - 10Yr: HR=4.11 (3.25, 5.21), p<0.001
10Yr - 15Yr: HR=5.32 (4.16, 6.81), p<0.001
15Yr+: HR=9.37 (6.27, 14.00), p<0.001

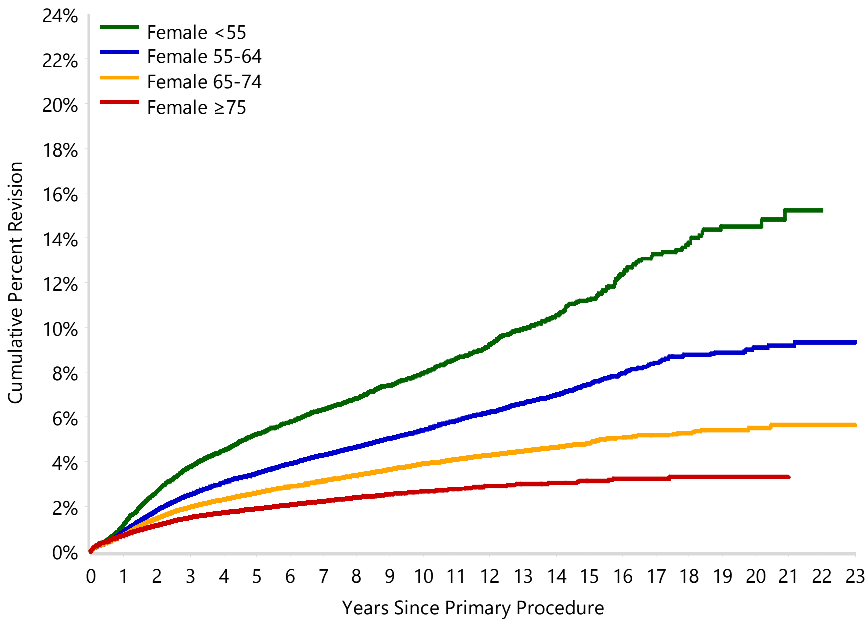
Male 55-64 vs Male ≥75
0 - 3Mth: HR=0.92 (0.80, 1.06), p=0.253
3Mth - 6Mth: HR=1.10 (0.92, 1.33), p=0.301
6Mth - 9Mth: HR=1.69 (1.45, 1.99), p<0.001
9Mth - 1Yr: HR=1.73 (1.47, 2.03), p<0.001
1Yr - 5.5Yr: HR=1.91 (1.78, 2.06), p<0.001
5.5Yr - 10Yr: HR=2.71 (2.35, 3.12), p<0.001
10Yr - 12Yr: HR=3.32 (2.60, 4.24), p<0.001
12Yr - 13Yr: HR=3.60 (2.49, 5.21), p<0.001
13Yr+: HR=4.26 (3.25, 5.59), p<0.001

Male 65-74 vs Male ≥75
0 - 6Mth: HR=0.97 (0.87, 1.09), p=0.601
6Mth - 2.5Yr: HR=1.36 (1.26, 1.47), p<0.001
2.5Yr - 5Yr: HR=1.57 (1.42, 1.74), p<0.001
5Yr+: HR=1.80 (1.58, 2.04), p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Male	**<55**	20108	18048	14385	11277	5100	1527	267
	55-64	90734	81097	64714	50071	21188	5699	740
	65-74	131942	117222	92349	70085	26596	6135	591
	≥75	78188	68469	52187	37460	10976	1541	79

Note: Restricted to modern prostheses

Figure KT14 **Cumulative Percent Revision of Primary Total Knee Replacement in Females by Age (Primary Diagnosis OA)**



Female <55 vs Female ≥75
- 0 - 6Mth: HR=1.12 (0.92, 1.36), p=0.246
- 6Mth - 3Yr: HR=3.19 (2.91, 3.49), p<0.001
- 3Yr - 9Yr: HR=3.57 (3.22, 3.97), p<0.001
- 9Yr - 12Yr: HR=4.62 (3.73, 5.72), p<0.001
- 12Yr - 14Yr: HR=7.27 (5.18, 10.21), p<0.001
- 14Yr+: HR=8.37 (6.11, 11.48), p<0.001

Female 55-64 vs Female ≥75
- 0 - 3Mth: HR=0.84 (0.71, 0.98), p=0.024
- 3Mth - 6Mth: HR=1.06 (0.87, 1.29), p=0.559
- 6Mth - 2Yr: HR=2.06 (1.90, 2.23), p<0.001
- 2Yr - 3.5Yr: HR=2.15 (1.95, 2.37), p<0.001
- 3.5Yr - 10Yr: HR=2.43 (2.23, 2.65), p<0.001
- 10Yr - 12Yr: HR=3.17 (2.56, 3.93), p<0.001
- 12Yr+: HR=4.13 (3.31, 5.15), p<0.001

Female 65-74 vs Female ≥75
- 0 - 6Mth: HR=0.89 (0.79, 1.00), p=0.048
- 6Mth - 5Yr: HR=1.54 (1.45, 1.65), p<0.001
- 5Yr+: HR=1.61 (1.46, 1.78), p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Female	**<55**	26736	24052	19404	15502	7035	2080	323
	55-64	101913	92174	75342	60277	26941	7690	1050
	65-74	159532	142871	115079	89762	36435	9267	1016
	≥75	111969	99237	78557	59588	20604	3625	218

Note: Restricted to modern prostheses

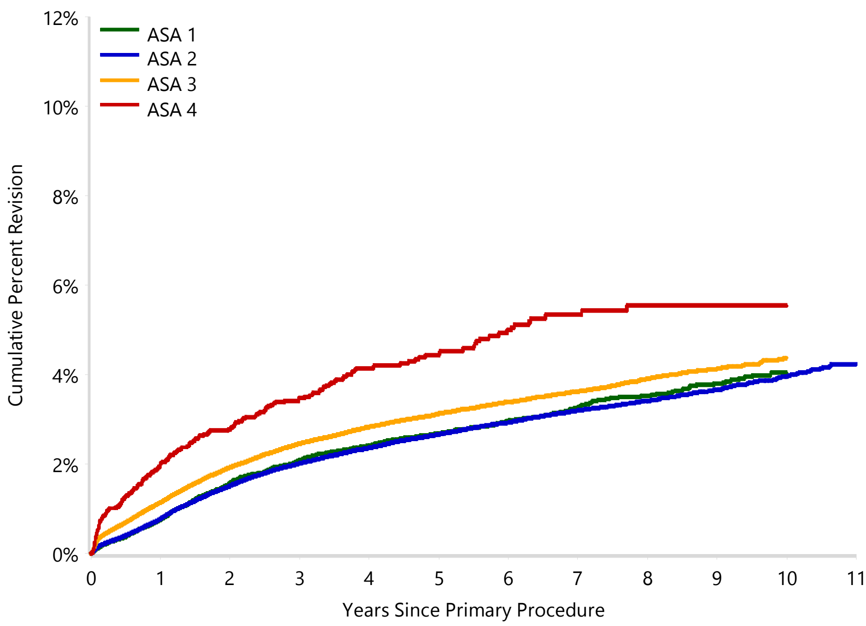
Primary Total Knee Replacement

Table KT18 Cumulative Percent Revision of Primary Total Knee Replacement by ASA Score (Primary Diagnosis OA)

ASA Score	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	9 Yrs
ASA 1	748	28793	0.8 (0.7, 0.9)	1.6 (1.4, 1.7)	2.1 (1.9, 2.3)	2.7 (2.5, 2.9)	3.3 (3.0, 3.5)	3.8 (3.5, 4.1)
ASA 2	6905	288693	0.8 (0.7, 0.8)	1.5 (1.5, 1.6)	2.0 (2.0, 2.1)	2.7 (2.6, 2.7)	3.2 (3.1, 3.3)	3.7 (3.6, 3.8)
ASA 3	5613	213735	1.1 (1.1, 1.2)	1.9 (1.9, 2.0)	2.5 (2.4, 2.5)	3.1 (3.0, 3.2)	3.6 (3.5, 3.7)	4.1 (4.0, 4.3)
ASA 4	208	5487	2.0 (1.7, 2.4)	2.8 (2.4, 3.3)	3.5 (3.0, 4.0)	4.4 (3.8, 5.1)	5.3 (4.6, 6.2)	5.5 (4.8, 6.4)
ASA 5	1	14	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	11.1 (1.6, 56.7)	11.1 (1.6, 56.7)	
TOTAL	**13475**	**536722**						

Note: Restricted to modern prostheses
Excludes 184,400 procedures with unknown ASA score

Figure KT15 Cumulative Percent Revision of Primary Total Knee Replacement by ASA Score (Primary Diagnosis OA)



HR - adjusted for age and gender

ASA 2 vs ASA 1
Entire Period: HR=1.16 (1.07, 1.25), p<0.001

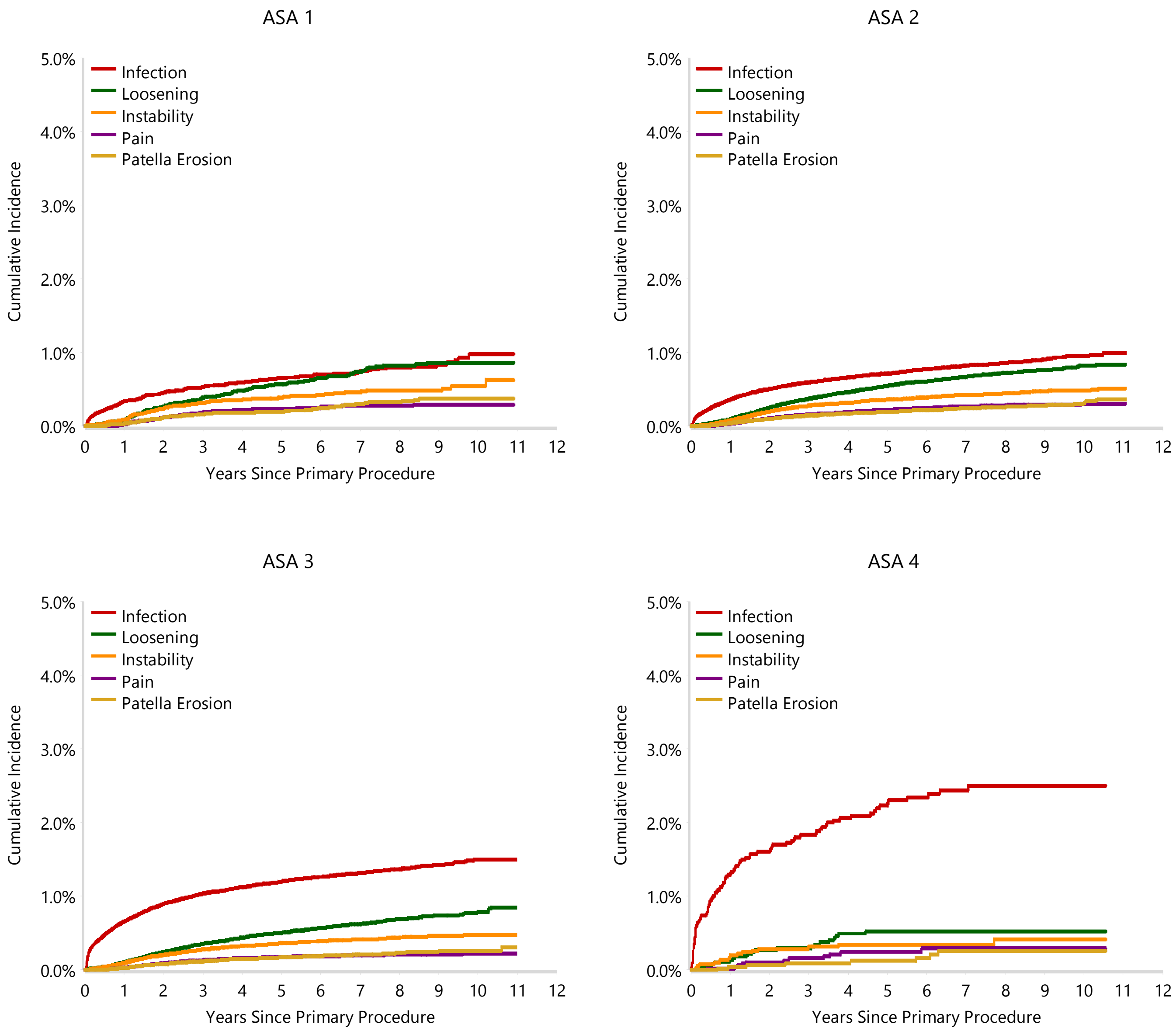
ASA 3 vs ASA 1
0 - 6Mth: HR=2.17 (1.96, 2.41), p<0.001
6Mth+: HR=1.32 (1.22, 1.43), p<0.001

ASA 4 vs ASA 1
0 - 3Mth: HR=4.76 (3.57, 6.35), p<0.001
3Mth - 1.5Yr: HR=2.31 (1.82, 2.92), p<0.001
1.5Yr+: HR=1.66 (1.32, 2.10), p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	9 Yrs
ASA 1	28793	25978	23179	20209	14454	8761	3643
ASA 2	288693	251911	220563	188379	130476	76137	29946
ASA 3	213735	179646	152901	126821	81848	43223	15273
ASA 4	5487	4591	3878	3172	1995	1077	411

Note: Restricted to modern prostheses
Excludes 184,400 procedures with unknown ASA score

Figure KT16 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by ASA Score (Primary Diagnosis OA)



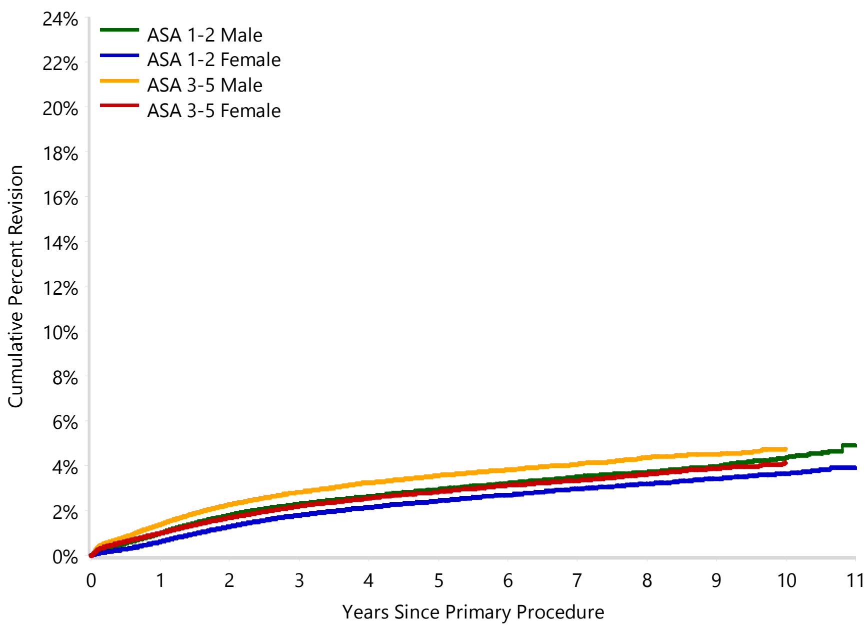
Note: Restricted to modern prostheses
Excludes 184,400 procedures with unknown ASA score

Table KT19 Cumulative Percent Revision of Primary Total Knee Replacement by Gender and ASA Score (Primary Diagnosis OA)

ASA Category	Gender	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs
ASA 1-2	Male	3821	144076	1.0 (0.9, 1.0)	2.3 (2.2, 2.4)	2.9 (2.8, 3.0)	3.5 (3.4, 3.6)	4.4 (4.2, 4.6)
	Female	3832	173410	0.6 (0.6, 0.6)	1.8 (1.7, 1.9)	2.4 (2.4, 2.5)	3.0 (2.9, 3.1)	3.7 (3.5, 3.8)
ASA 3-5	Male	2875	97497	1.4 (1.3, 1.5)	2.8 (2.7, 3.0)	3.6 (3.4, 3.7)	4.1 (3.9, 4.2)	4.8 (4.5, 5.0)
	Female	2947	121739	1.0 (0.9, 1.1)	2.2 (2.1, 2.3)	2.8 (2.7, 3.0)	3.3 (3.2, 3.5)	4.1 (3.9, 4.3)
TOTAL		**13475**	**536722**					

Note: Restricted to modern prostheses
Excludes 184,400 procedures with unknown ASA score

Figure KT17 Cumulative Percent Revision of Primary Total Knee Replacement by Gender and ASA Score (Primary Diagnosis OA)



HR - adjusted for age

ASA 1-2 Male vs ASA 1-2 Female
0 - 3Mth: HR=1.93 (1.67, 2.23), p<0.001
3Mth - 1Yr: HR=1.37 (1.25, 1.49), p<0.001
1Yr - 1.5Yr: HR=1.24 (1.12, 1.38), p<0.001
1.5Yr+: HR=1.03 (0.97, 1.09), p=0.325

ASA 1-2 Male vs ASA 3-5 Male
0 - 1Mth: HR=0.50 (0.43, 0.58), p<0.001
1Mth - 9Mth: HR=0.65 (0.59, 0.71), p<0.001
9Mth+: HR=0.83 (0.78, 0.88), p<0.001

ASA 1-2 Female vs ASA 3-5 Female
0 - 3Mth: HR=0.38 (0.33, 0.44), p<0.001
3Mth - 6Mth: HR=0.62 (0.53, 0.73), p<0.001
6Mth+: HR=0.89 (0.85, 0.94), p<0.001

ASA 3-5 Male vs ASA 3-5 Female
0 - 1.5Yr: HR=1.38 (1.29, 1.48), p<0.001
1.5Yr+: HR=1.13 (1.05, 1.21), p=0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs
ASA 1-2	Male	144076	125608	93201	63663	36696	5474
	Female	173410	152281	115387	81267	48202	7458
ASA 3-5	Male	97497	81609	56609	35546	18320	2218
	Female	121739	102641	73393	48303	25984	3401

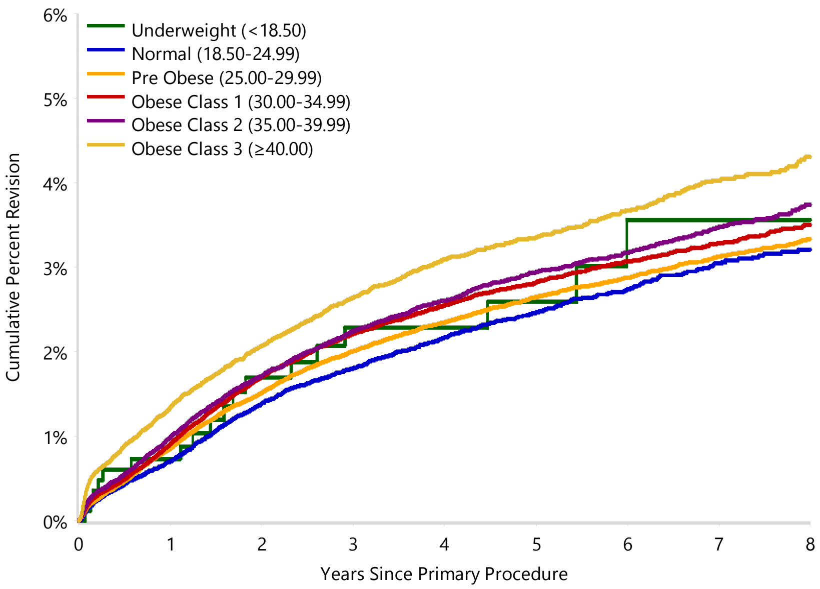
Note: Restricted to modern prostheses
Excludes 184,400 procedures with unknown ASA score

Table KT20 Cumulative Percent Revision of Primary Total Knee Replacement by BMI Category (Primary Diagnosis OA)

BMI Category	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Underweight (<18.50)	18	852	0.7 (0.3, 1.6)	1.7 (1.0, 3.0)	2.3 (1.4, 3.8)	2.3 (1.4, 3.8)	2.6 (1.6, 4.3)	3.6 (2.1, 6.0)
Normal (18.50-24.99)	938	48439	0.7 (0.6, 0.8)	1.4 (1.3, 1.5)	1.8 (1.7, 1.9)	2.2 (2.0, 2.3)	2.5 (2.3, 2.6)	2.7 (2.6, 2.9)
Pre Obese (25.00-29.99)	3023	143942	0.9 (0.8, 0.9)	1.5 (1.4, 1.6)	2.0 (1.9, 2.1)	2.3 (2.3, 2.4)	2.6 (2.5, 2.7)	2.9 (2.8, 3.0)
Obese Class 1 (30.00-34.99)	3217	142280	0.9 (0.9, 1.0)	1.7 (1.6, 1.8)	2.2 (2.1, 2.3)	2.5 (2.5, 2.6)	2.8 (2.7, 2.9)	3.1 (3.0, 3.2)
Obese Class 2 (35.00-39.99)	1830	77742	1.0 (0.9, 1.1)	1.7 (1.6, 1.8)	2.2 (2.1, 2.4)	2.6 (2.5, 2.7)	2.9 (2.8, 3.1)	3.2 (3.0, 3.3)
Obese Class 3 (≥40.00)	1322	47043	1.3 (1.2, 1.5)	2.1 (1.9, 2.2)	2.6 (2.5, 2.8)	3.1 (2.9, 3.3)	3.4 (3.2, 3.5)	3.7 (3.5, 3.9)
TOTAL	10348	460298						

Note: Restricted to modern prostheses
BMI has not been presented for patients aged ≤19 years
Excludes 260,824 procedures with an unknown BMI

Figure KT18 Cumulative Percent Revision of Primary Total Knee Replacement by BMI Category (Primary Diagnosis OA)



HR - adjusted for age and gender

Underweight (<18.50) vs Normal (18.50-24.99)
Entire Period: HR=1.22 (0.76, 1.94), p=0.406

Pre Obese (25.00-29.99) vs Normal (18.50-24.99)
Entire Period: HR=0.99 (0.92, 1.07), p=0.870

Obese Class 1 (30.00-34.99) vs Normal (18.50-24.99)
0 - 1Yr: HR=1.04 (0.95, 1.15), p=0.399
1Yr - 1.5Yr: HR=1.13 (0.99, 1.28), p=0.070
1.5Yr - 3Yr: HR=1.06 (0.96, 1.17), p=0.269
3Yr+: HR=0.90 (0.81, 1.01), p=0.075

Obese Class 2 (35.00-39.99) vs Normal (18.50-24.99)
0 - 1Mth: HR=1.30 (1.07, 1.58), p=0.007
1Mth - 6Mth: HR=1.04 (0.89, 1.21), p=0.615
6Mth - 1Yr: HR=1.09 (0.94, 1.26), p=0.235
1Yr - 1.5Yr: HR=1.06 (0.91, 1.23), p=0.475
1.5Yr+: HR=0.99 (0.90, 1.09), p=0.851

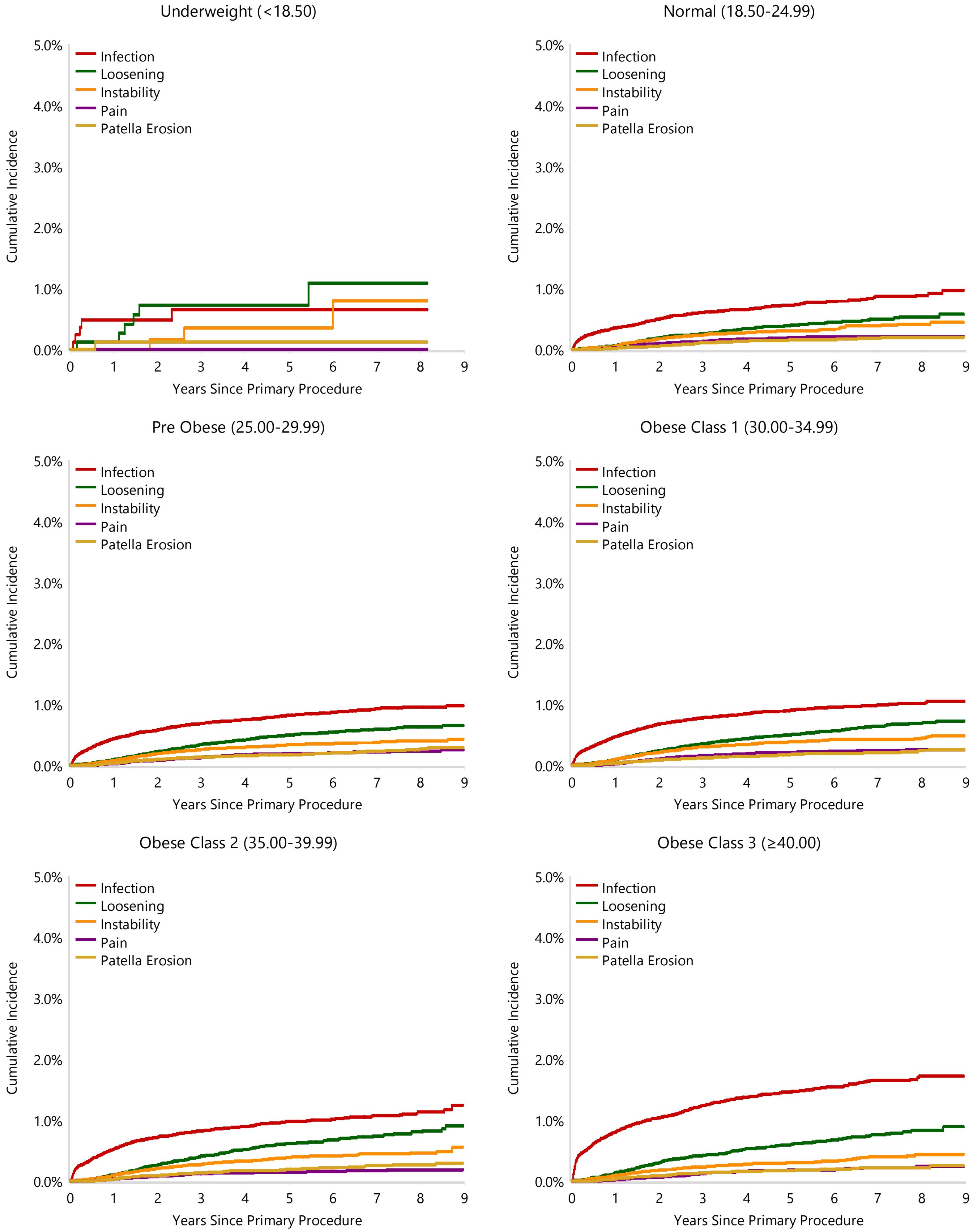
Obese Class 3 (≥40.00) vs Normal (18.50-24.99)
0 - 1Mth: HR=2.34 (1.94, 2.82), p<0.001
1Mth - 6Mth: HR=1.50 (1.28, 1.75), p<0.001
6Mth - 9Mth: HR=1.04 (0.83, 1.31), p=0.714
9Mth - 1Yr: HR=1.17 (0.94, 1.47), p=0.161
1Yr+: HR=1.03 (0.93, 1.14), p=0.518

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Underweight (<18.50)	852	690	561	448	359	259	177
Normal (18.50-24.99)	48439	40519	33913	27466	21743	16185	11189
Pre Obese (25.00-29.99)	143942	121265	102241	83257	66511	50120	34927
Obese Class 1 (30.00-34.99)	142280	119937	101436	82684	66313	49840	34852
Obese Class 2 (35.00-39.99)	77742	65275	55398	45338	36492	27580	19011
Obese Class 3 (≥40.00)	47043	39627	33819	27906	22758	17246	12003

Note: Restricted to modern prostheses
BMI has not been presented for patients aged ≤19 years
Excludes 260,824 procedures with an unknown BMI

Primary Total Knee Replacement

Figure KT19 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by BMI Category (Primary Diagnosis OA)



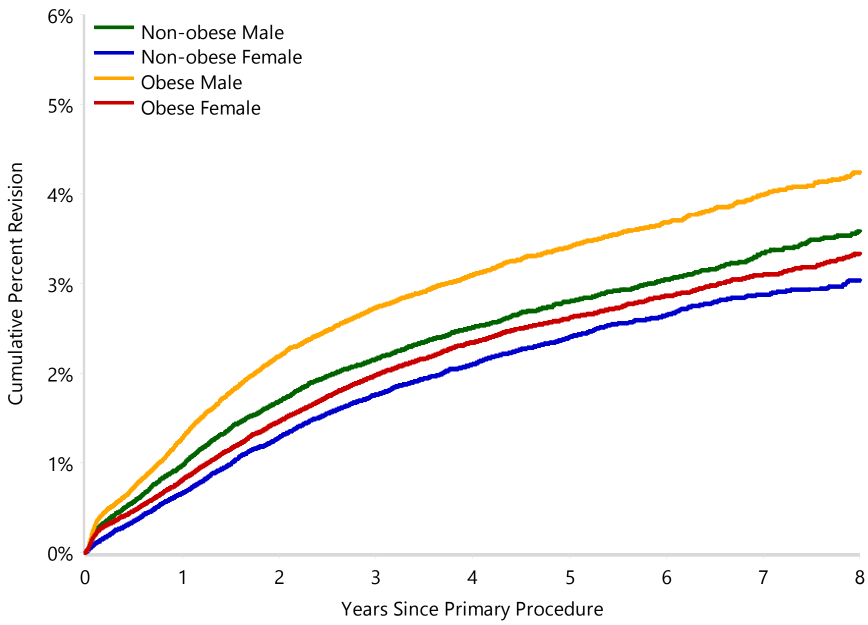
Note: Restricted to modern prostheses. BMI has not been presented for patients aged ≤19 years. Excludes 260,824 procedures with an unknown BMI

Table KT21 Cumulative Percent Revision of Primary Total Knee Replacement by Gender and BMI Category (Primary Diagnosis OA)

BMI Category	Gender	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Non-obese	Male	2149	95453	1.0 (0.9, 1.0)	1.7 (1.6, 1.8)	2.2 (2.1, 2.3)	2.5 (2.4, 2.6)	2.8 (2.7, 2.9)	3.0 (2.9, 3.2)
	Female	1830	97780	0.7 (0.6, 0.7)	1.3 (1.2, 1.4)	1.8 (1.7, 1.9)	2.1 (2.0, 2.2)	2.4 (2.3, 2.5)	2.6 (2.5, 2.8)
Obese	Male	3111	112910	1.3 (1.2, 1.3)	2.2 (2.1, 2.3)	2.7 (2.6, 2.8)	3.1 (3.0, 3.2)	3.4 (3.3, 3.5)	3.7 (3.5, 3.8)
	Female	3258	154155	0.8 (0.8, 0.9)	1.5 (1.4, 1.5)	2.0 (1.9, 2.1)	2.3 (2.3, 2.4)	2.6 (2.5, 2.7)	2.9 (2.8, 3.0)
TOTAL		10348	460298						

Note: Restricted to modern prostheses
BMI has not been presented for patients aged ≤19 years
Excludes 260,824 procedures with an unknown BMI
Non-obese group includes underweight, normal and pre-obese
Obese group includes obese class 1, 2 and 3

Figure KT20 Cumulative Percent Revision of Primary Total Knee Replacement by Gender and BMI Category (Primary Diagnosis OA)



HR - adjusted for age

Non-obese Male vs Non-obese Female
0 - 3Mth: HR=1.89 (1.58, 2.25), p<0.001
3Mth - 1.5Yr: HR=1.23 (1.12, 1.35), p<0.001
1.5Yr+: HR=0.99 (0.91, 1.08), p=0.891

Non-obese Male vs Obese Male
0 - 2Yr: HR=0.85 (0.79, 0.91), p<0.001
2Yr+: HR=0.97 (0.89, 1.07), p=0.542

Non-obese Female vs Obese Female
0 - 2Wk: HR=0.54 (0.41, 0.72), p<0.001
2Wk - 1Mth: HR=0.68 (0.54, 0.85), p<0.001
1Mth - 3Mth: HR=0.71 (0.58, 0.87), p<0.001
3Mth+: HR=1.06 (1.00, 1.13), p=0.059

Obese Male vs Obese Female
0 - 2Yr: HR=1.47 (1.38, 1.56), p<0.001
2Yr+: HR=1.09 (1.00, 1.18), p=0.042

Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Non-obese	Male	95453	80243	67472	54682	43149	32306	22437
	Female	97780	82231	69243	56489	45464	34258	23856
Obese	Male	112910	94563	79453	64339	51061	38024	26108
	Female	154155	130276	111200	91589	74502	56642	39758

Note: Restricted to modern prostheses
BMI has not been presented for patients aged ≤19 years
Excludes 260,824 procedures with an unknown BMI
Non-obese group includes underweight, normal and pre-obese
Obese group includes obese class 1, 2 and 3

OUTCOME FOR OSTEOARTHRITIS – PROSTHESIS CHARACTERISTICS

Bearing Mobility

Tibial prostheses are either modular or non-modular. Modular prostheses have a metal baseplate and tibial insert, which may be fixed or mobile. Non-modular prostheses are either all-polyethylene or polyethylene moulded to a metal baseplate. In 2023, few all-polyethylene and non-modular tibial components were used. Moulded non-modular components have a lower rate of revision for all except the period between 1 and 1.5 years when compared to fixed modular prostheses (Table KT22 and Figure KT21).

Mobile bearing prostheses have a modular design where the tibial insert is designed to move relative to the baseplate. Fixed bearings include non-modular tibial prostheses, as well as modular designs with fixed inserts that do not move relative to the baseplate.

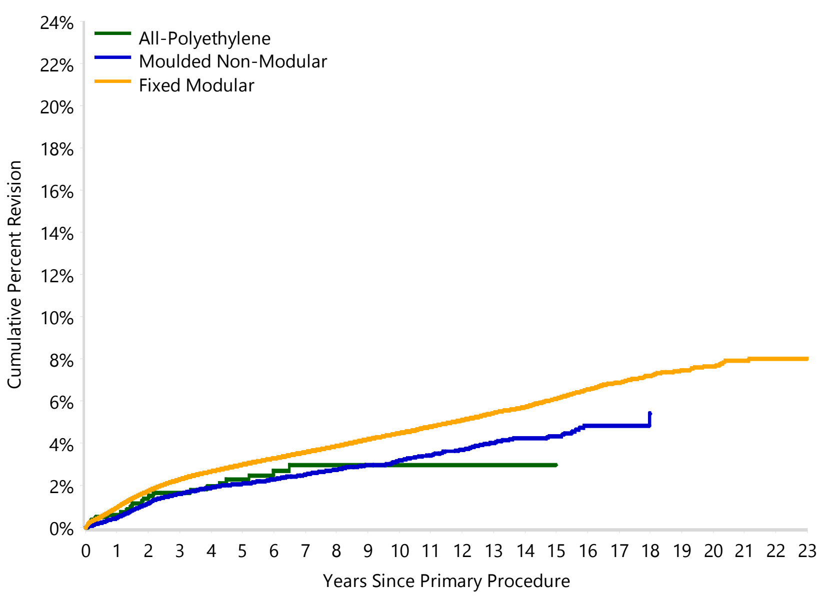
When adjusted for age, gender, fixation, and patella component usage, fixed bearing prostheses have a lower rate of revision compared to mobile bearing prostheses (Table KT23 and Figure KT22).

Table KT22 Cumulative Percent Revision of Primary Total Knee Replacement by Fixed Bearing Type (Primary Diagnosis OA)

Fixed Bearing Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
All-Polyethylene	20	814	0.6 (0.3, 1.5)	1.7 (1.0, 2.8)	2.3 (1.4, 3.7)	3.0 (1.9, 4.6)	3.0 (1.9, 4.6)	
Moulded Non-Modular	470	14908	0.5 (0.4, 0.6)	1.6 (1.4, 1.8)	2.1 (1.9, 2.3)	3.2 (2.9, 3.5)	4.3 (3.9, 4.8)	
Fixed Modular	19716	616347	1.0 (0.9, 1.0)	2.3 (2.2, 2.3)	3.0 (2.9, 3.0)	4.5 (4.4, 4.6)	6.1 (6.0, 6.2)	7.6 (7.4, 7.9)
TOTAL	20206	632069						

Note: Restricted to modern prostheses

Figure KT21 Cumulative Percent Revision of Primary Total Knee Replacement by Fixed Bearing Type (Primary Diagnosis OA)



HR - adjusted for age and gender

All-Polyethylene vs Fixed Modular
Entire Period: HR=0.84 (0.54, 1.30), p=0.431

All-Polyethylene vs Moulded Non-Modular
Entire Period: HR=1.23 (0.78, 1.92), p=0.368

Moulded Non-Modular vs Fixed Modular
0 - 1Yr: HR=0.48 (0.38, 0.61), p<0.001
1Yr - 1.5Yr: HR=0.77 (0.58, 1.01), p=0.061
1.5Yr+: HR=0.74 (0.67, 0.83), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
All-Polyethylene	814	781	702	544	87	44	2
Moulded Non-Modular	14908	14729	13781	12323	7152	1536	0
Fixed Modular	616347	545575	430445	327719	122887	27282	1911

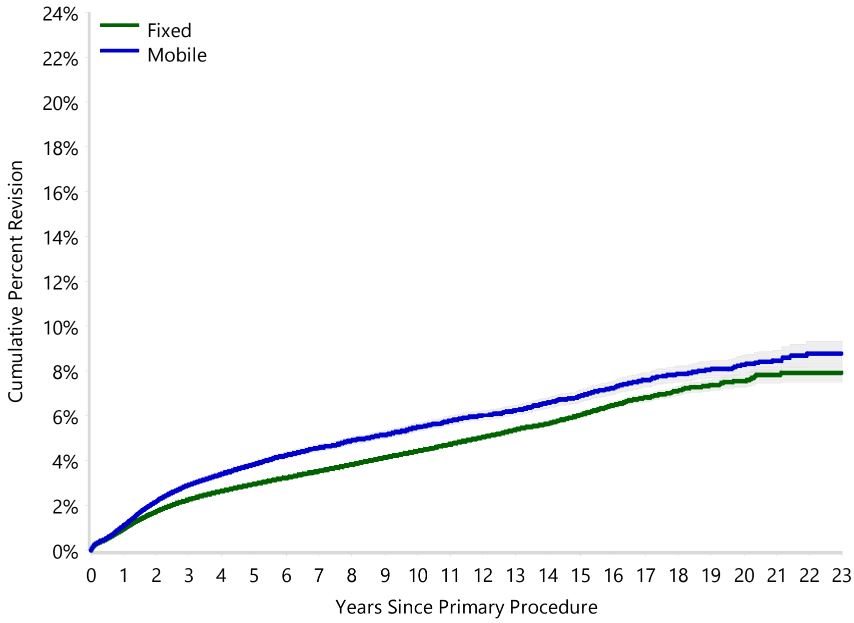
Note: Restricted to modern prostheses

Table KT23 **Cumulative Percent Revision of Primary Total Knee Replacement by Bearing Mobility (Primary Diagnosis OA)**

Bearing Mobility	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Fixed	20206	632069	0.9 (0.9, 1.0)	2.3 (2.2, 2.3)	3.0 (2.9, 3.0)	4.4 (4.4, 4.5)	6.0 (5.9, 6.2)	7.5 (7.3, 7.8)
Mobile	3914	88885	1.1 (1.0, 1.2)	2.9 (2.8, 3.0)	3.8 (3.7, 4.0)	5.5 (5.3, 5.7)	6.9 (6.6, 7.2)	8.3 (7.9, 8.7)
TOTAL	24120	720954						

Note: Excludes 168 procedures with unknown bearing mobility
Restricted to modern prostheses

Figure KT22 **Cumulative Percent Revision of Primary Total Knee Replacement by Bearing Mobility (Primary Diagnosis OA)**



HR - adjusted for age, gender, fixation, and patella component usage

Mobile vs Fixed

Entire Period: HR=1.20 (1.16, 1.24), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Fixed	632069	561085	444928	340586	130126	28862	1913
Mobile	88885	81945	66987	53350	24698	8684	2367

Note: Excludes 168 procedures with unknown bearing mobility
Restricted to modern prostheses

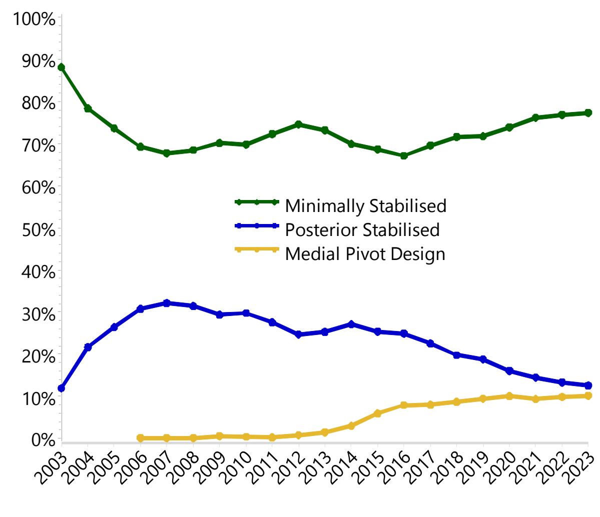
Stability
Stability refers to particular prosthetic features intended to substitute for the intrinsic stability of knee ligaments. In 2018, the classification of stability was expanded to include medial pivot design. The five categories are: minimally stabilised, medial pivot design, posterior stabilised, fully stabilised, and hinged prostheses.

The five major categories for stability are minimally stabilised, medial pivot design, posterior stabilised, fully stabilised, and hinged prostheses.

Minimally stabilised prostheses are defined as those that have a flat or dished tibial articulation, regardless of congruency. Medial pivot design prostheses have a ball-and-socket medial portion of the articulation. Posterior stabilised prostheses provide additional posterior stability, most commonly using a peg and box design.

The use of minimally stabilised prostheses has remained relatively constant over the last 10 years. In 2023, these accounted for 77.3% of primary procedures. The use of posterior stabilised prostheses has declined to 12.6% in 2023. The use of medial pivot design prostheses has increased since 2013. In 2023, medial pivot design prostheses accounted for 10.1% of primary procedures (Figure KT23).

Figure KT23 Primary Total Knee Replacement by Stability (Primary Diagnosis OA)



Note: Restricted to modern prostheses

Posterior stabilised prostheses have higher rates of revision compared to minimally stabilised prostheses. Medial pivot design prostheses have a lower rate of revision compared to posterior stabilised prostheses. There is no difference in the rate of revision when minimally stabilised prostheses and medial pivot design prostheses are compared (Table KT24 and Figure KT24).

The cumulative incidence for the different reasons for revision varies depending on stability. Posterior stabilised prostheses have a higher cumulative incidence of revision for infection and for loosening when compared to minimally stabilised and medial pivot design prostheses.

Medial pivot design prostheses have a higher cumulative incidence of revision for instability compared to minimally stabilised prostheses (Figure KT25). The outcomes of the 4 different prostheses within the medial pivot design group are shown in Table KT25.

Prosthesis performance can also be analysed by polyethylene insert shape. Some prostheses offer tibial polyethylene inserts with differing levels of conformity to be used with a cruciate retaining femoral component. Conceptually, these sit between the minimally stabilised and posterior stabilised designs. These are described as 'anterior lipped', 'anterior stabilised', 'asymmetrically stabilised', 'medially stabilised', 'deep dish' or 'ultra-congruent' designs which are intended to provide additional stability.

When prostheses with low polyethylene conformity are compared to those with high polyethylene conformity using XLPE there is no difference in the rate of revision (Table KT26 and Figure KT26). The most common reasons for revision are shown in Figure KT27. The outcome of total knee replacement with XLPE by prosthesis combination and polyethylene insert shape is presented in Table KT27 and Table KT28.

Fully Stabilised and Hinged Prostheses
Fully stabilised (large peg and box design) and hinged knees are uncommonly used prostheses that provide additional collateral, as well as posterior ligament stability. While these designs of knee prostheses are usually considered to be revision components, they can also be used in complex primary clinical situations.

Fully constrained and hinged knee designs are used in 0.7% of primary procedures. Whereas osteoarthritis is the major diagnosis for all primary total knee replacements, fully stabilised prostheses are used in a higher proportion for rheumatoid arthritis. Hinged prostheses are used proportionally more for tumour, fracture, osteonecrosis, and other inflammatory arthritis (Table KT29).

Fully stabilised prostheses have been used in 3,281 and hinged prostheses in 3,194 primary procedures. For these two knee designs, the cumulative percent revision for all diagnoses are shown in Table KT30 and Figure KT28.

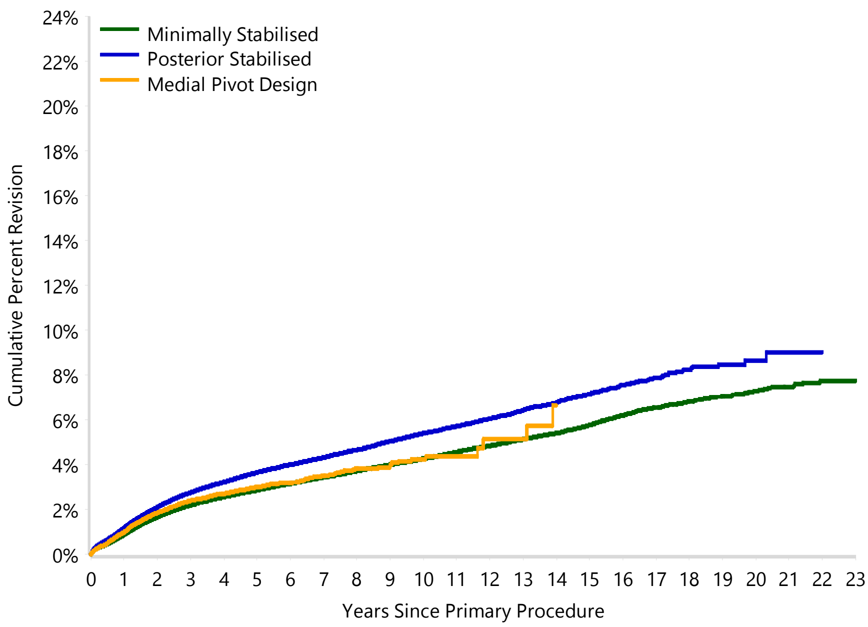
When the outcome for osteoarthritis is considered, fully stabilised and hinged knee prostheses both have higher rates of revision compared to minimally stabilised prostheses (Table KT24 and Figure KT29). For both of these designs, infection is the most common reason for revision, followed by loosening, and instability for fully stabilised and fracture for hinged Table KT31 and Figure KT30).

Table KT24 Cumulative Percent Revision of Primary Total Knee Replacement by Stability (Primary Diagnosis OA)

Stability	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Minimally Stabilised	16198	521410	0.9 (0.8, 0.9)	2.2 (2.2, 2.2)	2.9 (2.8, 2.9)	4.3 (4.2, 4.3)	5.8 (5.6, 5.9)	7.3 (7.0, 7.5)
Posterior Stabilised	6538	150178	1.2 (1.1, 1.2)	2.8 (2.7, 2.8)	3.6 (3.5, 3.8)	5.4 (5.3, 5.6)	7.1 (6.9, 7.4)	8.7 (8.1, 9.3)
Medial Pivot Design	1080	44467	1.0 (0.9, 1.1)	2.4 (2.2, 2.6)	3.0 (2.8, 3.2)	4.3 (3.9, 4.7)		
Fully Stabilised	170	3005	2.7 (2.2, 3.3)	4.8 (4.0, 5.6)	6.0 (5.1, 7.0)	7.8 (6.6, 9.2)		
Hinged	134	1894	3.0 (2.3, 3.9)	6.4 (5.3, 7.7)	8.1 (6.7, 9.7)	11.4 (9.4, 13.8)		
TOTAL	24120	720954						

Note: Excludes 168 procedures with unknown stability
Restricted to modern prostheses

Figure KT24 Cumulative Percent Revision of Primary Total Knee Replacement by Stability (Primary Diagnosis OA)



HR - adjusted for age and gender

Posterior Stabilised vs Minimally Stabilised
0 - 1Yr: HR=1.34 (1.27, 1.42), p<0.001
1Yr+: HR=1.24 (1.19, 1.28), p<0.001

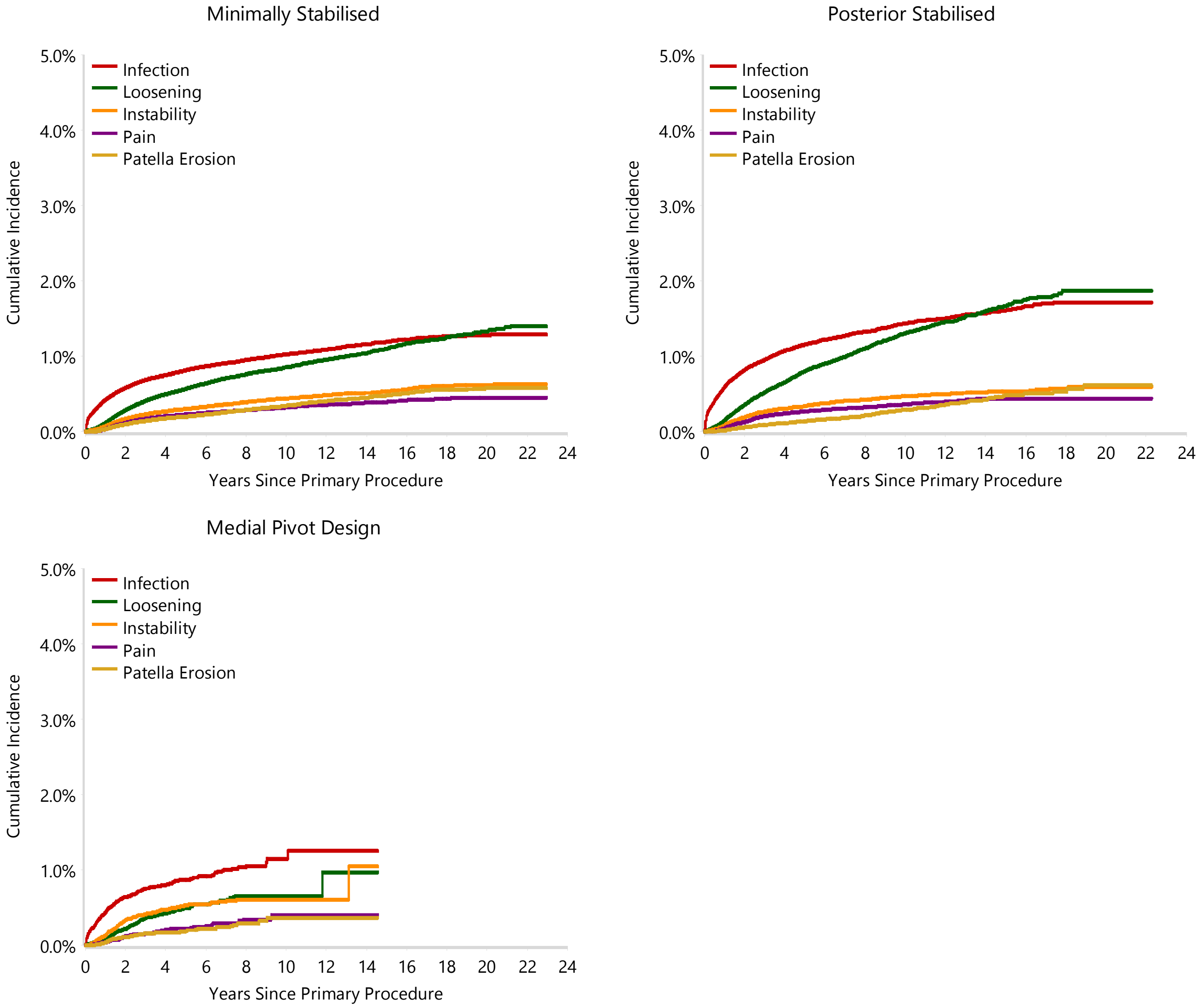
Posterior Stabilised vs Medial Pivot Design
Entire Period: HR=1.22 (1.14, 1.30), p<0.001

Medial Pivot Design vs Minimally Stabilised
Entire Period: HR=1.04 (0.98, 1.11), p=0.212

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Minimally Stabilised	521410	462612	364283	279432	113282	28209	3948
Posterior Stabilised	150178	139123	118990	97147	40208	9257	327
Medial Pivot Design	44467	37138	25623	15345	825	18	0

Note: Restricted to modern prostheses

Figure KT25 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by Stability (Primary Diagnosis OA)



Note: Restricted to modern prostheses

Table KT25 Cumulative Percent Revision of Primary Total Knee Replacement with Medial Pivot Design by Insert (Primary Diagnosis OA)

Insert	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs
Evolution	334	12599	0.8 (0.7, 1.0)	2.3 (2.0, 2.6)	2.9 (2.6, 3.3)	4.2 (3.6, 5.0)
GMK Sphere Primary	611	25027	1.2 (1.0, 1.3)	2.6 (2.4, 2.9)	3.3 (3.0, 3.6)	4.3 (3.8, 4.9)
MRK	33	844	1.1 (0.6, 2.1)	2.6 (1.7, 4.0)	2.7 (1.8, 4.2)	4.7 (3.2, 6.8)
SAIPH	102	5997	0.6 (0.4, 0.8)	1.6 (1.3, 1.9)	2.1 (1.7, 2.6)	2.9 (2.1, 4.1)
TOTAL	**1080**	**44467**				

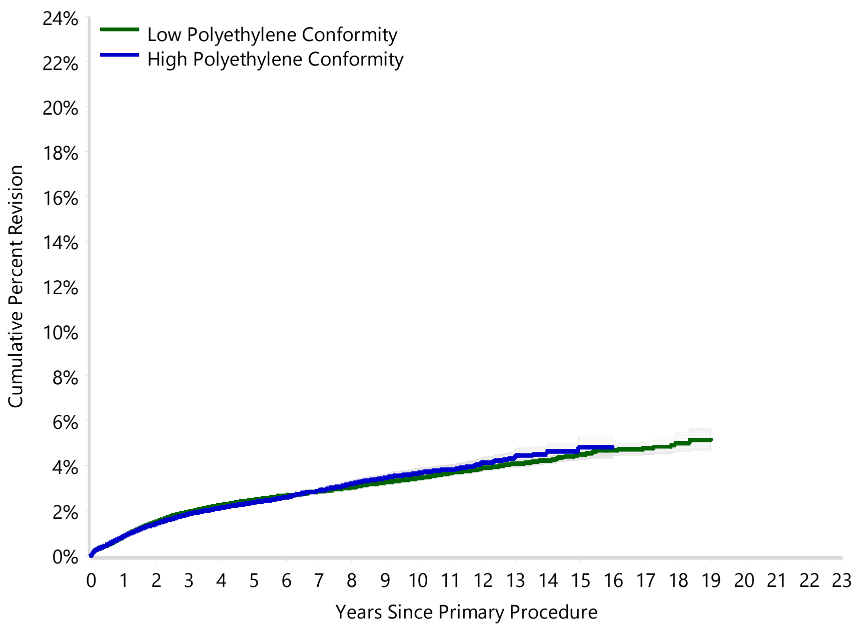
Note: Restricted to modern prostheses

Table KT26 **Cumulative Percent Revision of Primary Total Knee Replacement with XLPE by Polyethylene Conformity (Primary Diagnosis OA)**

Poly Shape	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Low Polyethylene Conformity	4767	192267	0.8 (0.8, 0.9)	1.9 (1.9, 2.0)	2.5 (2.4, 2.6)	3.4 (3.3, 3.6)	4.5 (4.3, 4.7)	
High Polyethylene Conformity	2377	126800	0.8 (0.8, 0.9)	1.9 (1.8, 1.9)	2.4 (2.3, 2.5)	3.7 (3.5, 3.9)	4.8 (4.3, 5.3)	
TOTAL	**7144**	**319067**						

Note: Restricted to modern prostheses

Figure KT26 **Cumulative Percent Revision of Primary Total Knee Replacement with XLPE by Polyethylene Conformity (Primary Diagnosis OA)**



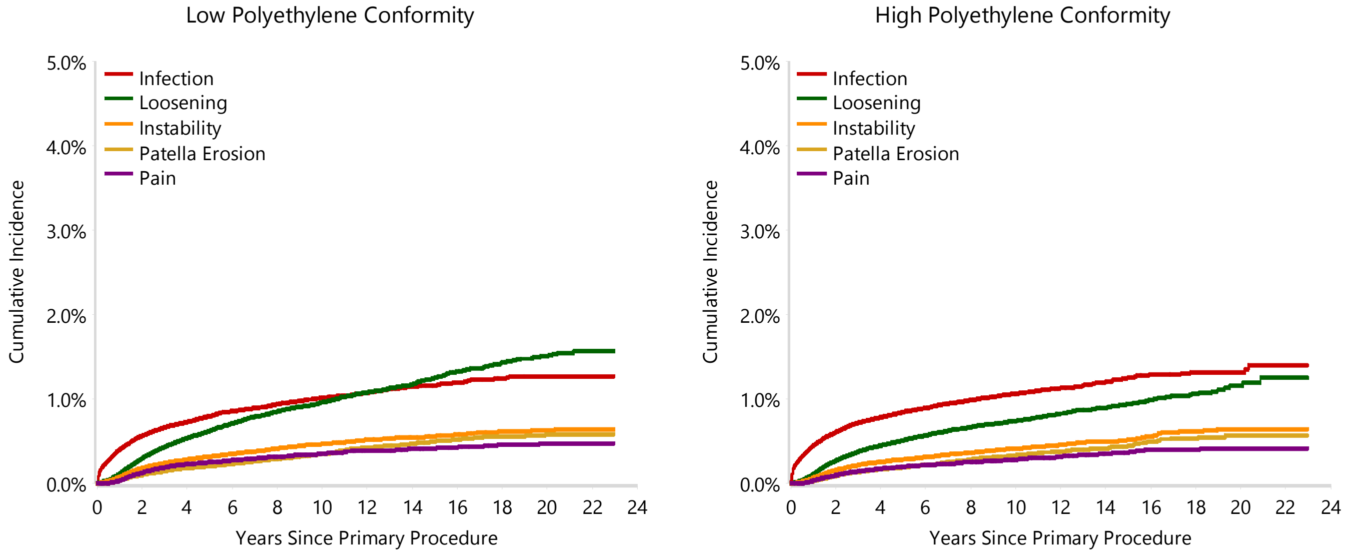
HR - adjusted for age and gender
Low Polyethylene Conformity vs High Polyethylene Conformity
Entire Period: HR=1.00 (0.95, 1.05), p=0.978

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Low Polyethylene Conformity	192267	172296	136588	101187	31180	4356	3
High Polyethylene Conformity	126800	98852	60061	36357	9931	564	0

Note: Restricted to modern prostheses

Primary Total Knee Replacement

Figure KT27 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement with XLPE by Polyethylene Conformity (Primary Diagnosis OA)



Note: Restricted to modern prostheses

Table KT27 Cumulative Percent Revision of Primary Total Knee Replacement with XLPE by Prosthesis Combination and Polyethylene Insert Shape (Primary Diagnosis OA)

Prothesis Combination	Polyethylene Shape	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	15 Yrs
Genesis II/ Genesis II	CR High Flex	234	8433	1.0 (0.8, 1.3)	2.3 (2.0, 2.7)	2.9 (2.5, 3.3)	3.4 (3.0, 3.9)	4.7 (3.9, 5.5)	
	Deep Dish	11	935	0.9 (0.4, 1.8)	1.6 (0.8, 2.9)				
Legion Oxinium/ Genesis II	Cruciate Retaining	219	8405	0.8 (0.7, 1.1)	2.4 (2.1, 2.8)	3.4 (3.0, 3.9)	4.2 (3.6, 4.9)	4.7 (3.9, 5.5)	
	Ultra-Congruent	16	915	1.0 (0.5, 2.0)	2.5 (1.5, 4.1)				
Legion/ Genesis II	Cruciate Retaining	172	5979	1.2 (0.9, 1.5)	2.6 (2.2, 3.1)	3.6 (3.1, 4.2)	4.0 (3.4, 4.7)	4.1 (3.5, 4.9)	
	Ultra-Congruent	24	1110	1.3 (0.8, 2.3)	3.0 (2.0, 4.7)				
Natural Knee/ Natural Knee II	Cruciate Retaining	139	4536	0.8 (0.6, 1.2)	2.0 (1.7, 2.5)	2.6 (2.2, 3.1)	3.0 (2.5, 3.6)	3.4 (2.9, 4.1)	4.6 (3.6, 5.8)
	Ultra-Congruent	39	1416	0.7 (0.4, 1.3)	1.5 (1.0, 2.3)	1.7 (1.2, 2.6)	2.1 (1.5, 3.1)	3.0 (2.1, 4.1)	4.2 (2.8, 6.3)
Persona	Cruciate Retaining	782	54677	0.9 (0.8, 1.0)	1.9 (1.8, 2.1)	2.4 (2.2, 2.7)	2.7 (2.3, 3.0)		
	Ultra-Congruent	86	5222	0.9 (0.7, 1.3)	1.9 (1.5, 2.4)	2.2 (1.8, 2.8)	2.3 (1.9, 3.0)		
Triathlon/ Triathlon	Condylar Stabilising	1763	82039	0.8 (0.8, 0.9)	1.8 (1.7, 1.9)	2.4 (2.3, 2.5)	2.8 (2.7, 3.0)	3.7 (3.5, 3.9)	4.8 (4.3, 5.4)
	Cruciate Retaining	1633	70246	0.8 (0.7, 0.9)	1.8 (1.7, 2.0)	2.4 (2.3, 2.5)	2.9 (2.8, 3.1)	3.5 (3.3, 3.7)	5.1 (4.5, 5.8)
TOTAL		5118	243913						

Note: Restricted to modern prostheses. Only prosthesis that have >500 procedures in each conformity category with a follow-up of >3 years are shown

Table KT28 Comparisons of Revision Rates for Primary Total Knee Replacement with XLPE by Prosthesis Combination and Polyethylene Insert Shape (Primary Diagnosis OA)

Prothesis Combination	Comparison	Hazard Ratio – adjusted for age and gender
Genesis II/Genesis II	Deep Dish vs CR High Flex	0 - 2Wk: HR=9.74 (2.43, 38.93), p=0.001
		2Wk+: HR=0.51 (0.24, 1.08), p=0.080
Legion Oxinium/Genesis II	Ultra-Congruent vs Cruciate Retaining	Entire Period: HR=0.96 (0.58, 1.61), p=0.883
Legion/Genesis II	Ultra-Congruent vs Cruciate Retaining	Entire Period: HR=1.07 (0.69, 1.65), p=0.768
Natural Knee/ Natural Knee II	Ultra-Congruent vs Cruciate Retaining	Entire Period: HR=0.82 (0.58, 1.18), p=0.289
Persona	Ultra-Congruent vs Cruciate Retaining	Entire Period: HR=0.96 (0.77, 1.20), p=0.716
Triathlon/Triathlon	Condylar Stabilising vs Cruciate Retaining	Entire Period: HR=1.01 (0.94, 1.08), p=0.757

Note: Restricted to modern prostheses

Primary Total Knee Replacement

Table KT29 Primary Total Knee Replacement by Primary Diagnosis and Stability

Primary Diagnosis	Fully Stabilised		Hinged		TOTAL	
	N	Col%	N	Col%	N	Col%
Osteoarthritis	3005	91.6	1894	59.3	4899	75.7
Tumour	9	0.3	719	22.5	728	11.2
Fracture	49	1.5	335	10.5	384	5.9
Rheumatoid Arthritis	135	4.1	91	2.8	226	3.5
Other Inflammatory Arthritis	35	1.1	43	1.3	78	1.2
Osteonecrosis	29	0.9	46	1.4	75	1.2
Other	19	0.6	66	2.1	85	1.3
TOTAL	3281	100.0	3194	100.0	6475	100.0

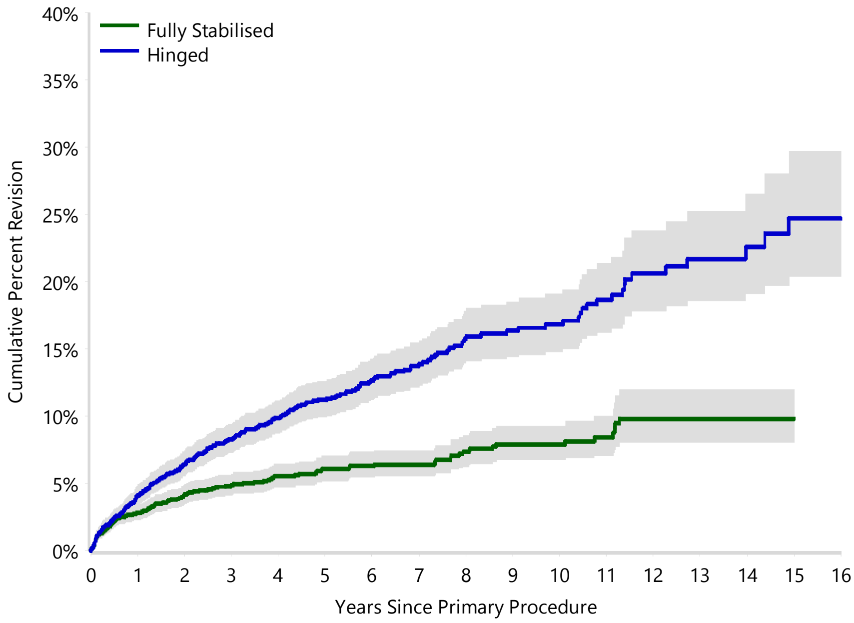
Note: Restricted to modern prostheses

Table KT30 Cumulative Percent Revision of Primary Total Knee Replacement by Stability (All Diagnoses)

Stability	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	15 Yrs
Fully Stabilised	189	3281	2.8 (2.3, 3.4)	4.8 (4.1, 5.7)	6.1 (5.2, 7.0)	6.4 (5.5, 7.4)	7.9 (6.7, 9.3)	9.8 (8.0, 12.0)
Hinged	319	3194	4.1 (3.4, 4.9)	8.3 (7.3, 9.4)	11.2 (9.9, 12.6)	13.9 (12.3, 15.6)	16.8 (14.8, 19.1)	24.7 (20.4, 29.7)
TOTAL	508	6475						

Note: Restricted to modern prostheses

Figure KT28 Cumulative Percent Revision of Primary Total Knee Replacement by Stability (All Diagnoses)



HR - adjusted for age and gender

Hinged vs Fully Stabilised

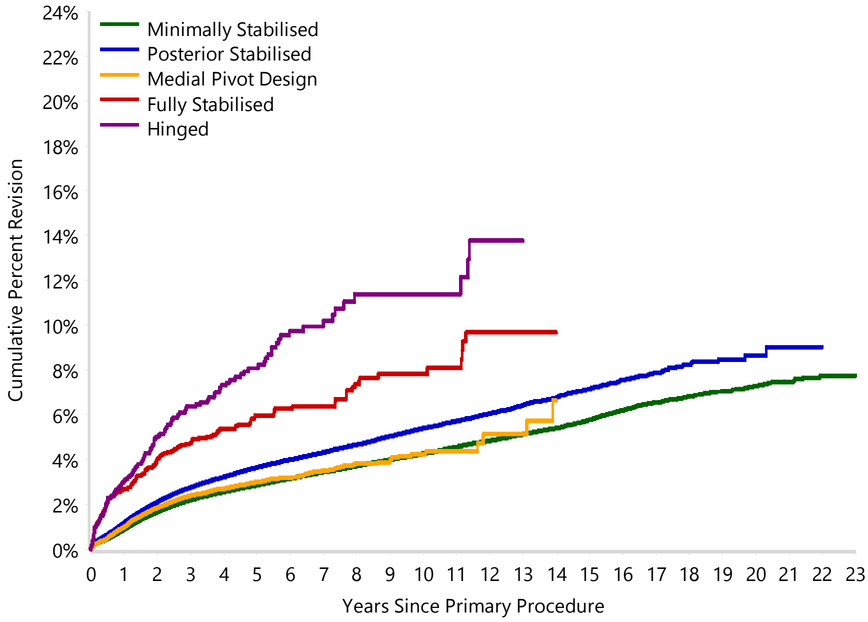
0 - 2Yr: HR=1.27 (1.00, 1.60), p=0.049

2Yr+: HR=2.42 (1.78, 3.28), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	15 Yrs
Fully Stabilised	3281	2840	2153	1498	956	390	49
Hinged	3194	2533	1697	1044	617	310	64

Note: Restricted to modern prostheses

Figure KT29 Cumulative Percent Revision of Primary Total Knee Replacement by Stability (Primary Diagnosis OA)



HR - adjusted for age and gender

Posterior Stabilised vs Minimally Stabilised
0 - 1Yr: HR=1.34 (1.27, 1.42), p<0.001
1Yr+: HR=1.24 (1.19, 1.28), p<0.001

Medial Pivot Design vs Minimally Stabilised
Entire Period: HR=1.04 (0.98, 1.11), p=0.215

Fully Stabilised vs Minimally Stabilised
0 - 6Mth: HR=4.44 (3.44, 5.72), p<0.001
6Mth - 1.5Yr: HR=1.49 (1.05, 2.10), p=0.025
1.5Yr+: HR=1.70 (1.36, 2.13), p<0.001

Hinged vs Minimally Stabilised
0 - 6Mth: HR=4.64 (3.38, 6.36), p<0.001
6Mth - 1.5Yr: HR=2.12 (1.45, 3.09), p<0.001
1.5Yr+: HR=2.93 (2.31, 3.72), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Minimally Stabilised	521410	462612	364283	279432	113282	28209	3948
Posterior Stabilised	150178	139123	118990	97147	40208	9257	327
Medial Pivot Design	44467	37138	25623	15345	825	18	0
Fully Stabilised	3005	2601	1976	1385	348	38	4
Hinged	1894	1556	1043	627	161	24	1

Note: Restricted to modern prostheses

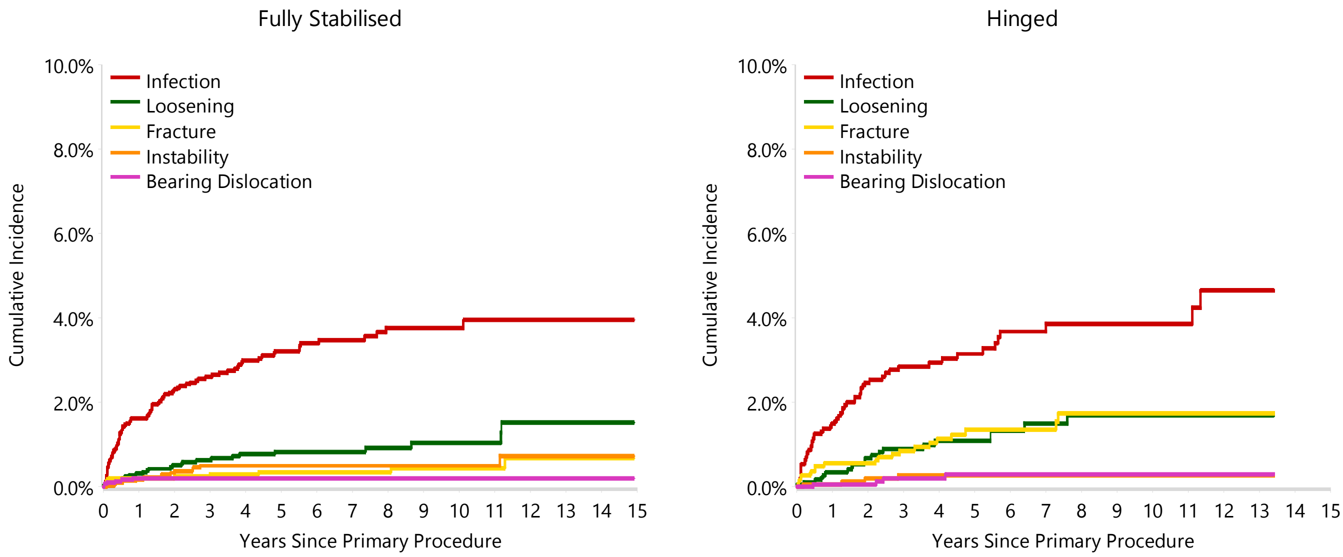
Primary Total Knee Replacement

Table KT31 Revision Diagnosis of Primary Total Knee Replacement by Stability (Primary Diagnosis OA)

Revision Diagnosis	Fully Stabilised			Hinged		
	Number	% Primaries Revised	% Revisions	Number	% Primaries Revised	% Revisions
Infection	92	3.1	54.1	57	3.0	42.5
Loosening	25	0.8	14.7	20	1.1	14.9
Fracture	11	0.4	6.5	21	1.1	15.7
Instability	14	0.5	8.2	4	0.2	3.0
Bearing Dislocation	6	0.2	3.5	4	0.2	3.0
Patella Erosion	3	0.1	1.8	4	0.2	3.0
Other	19	0.6	11.2	24	1.3	17.9
N Revision	170	5.7	100.0	134	7.1	100.0
N Primary	3005			1894		

Note: Restricted to modern prostheses

Figure KT30 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by Stability (Primary Diagnosis OA)



Note: Restricted to modern prostheses

Patellar Resurfacing
Primary total knee replacement procedures with patellar resurfacing have a lower rate of revision compared to procedures without patellar resurfacing from 6 months onwards (Table KT32 and Figure KT31).

When type of patella is assessed, metal backed patellae have a higher rate of revision compared to all polyethylene patellae (Table KT33 and Figure KT32).

Procedures with patellar resurfacing also have a lower rate of revision for each of the three common stability types. When resurfacing the patella, the rate of revision is lower for minimally stabilised compared to posterior stabilised prostheses. Posterior stabilised without patellar resurfacing has the highest rate of revision (Table KT34 and Figure KT33).

When the patella is resurfaced, there is no difference in the rate of revision for medial pivot design prostheses compared to minimally stabilised prostheses. When the patella is not resurfaced, medial pivot design prostheses have a higher rate of revision than minimally stabilised knee prostheses (Table KT34 and Figure KT34).

There are six prosthesis combinations that are used with and without patella resurfacing with >10,000 procedures in each patella usage group. There is prosthesis specific variation with patella use. These are shown in Table KT35 and Table KT36.

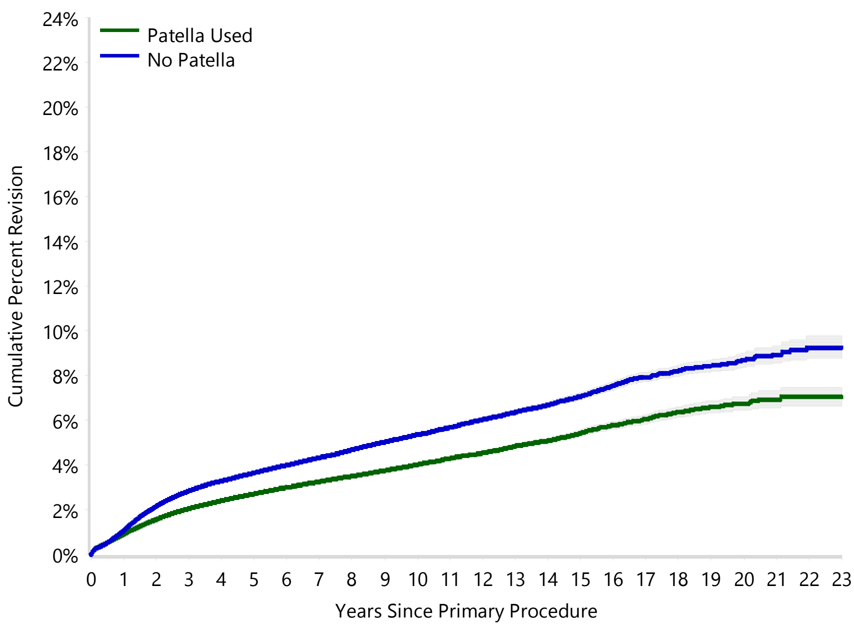
Procedures with a patella component have a lower rate of revision after 6 months.

Table KT32 Cumulative Percent Revision of Primary Total Knee Replacement by Patella Component Usage (Primary Diagnosis OA)

Patella Component Usage	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Patella Used	12688	466229	0.9 (0.9, 0.9)	2.0 (2.0, 2.1)	2.7 (2.7, 2.8)	4.0 (3.9, 4.1)	5.4 (5.3, 5.6)	6.8 (6.4, 7.1)
No Patella	11438	254893	1.1 (1.0, 1.1)	2.8 (2.8, 2.9)	3.7 (3.6, 3.7)	5.4 (5.3, 5.5)	7.1 (6.9, 7.2)	8.7 (8.4, 9.0)
TOTAL	24126	721122						

Note: Restricted to modern prostheses

Figure KT31 Cumulative Percent Revision of Primary Total Knee Replacement by Patella Component Usage (Primary Diagnosis OA)



HR - adjusted for age and gender
No Patella vs Patella Used
0 - 6Mth: HR=0.97 (0.90, 1.04), p=0.338
6Mth - 2Yr: HR=1.55 (1.48, 1.61), p<0.001
2Yr+: HR=1.28 (1.24, 1.33), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Patella Used	466229	406725	309785	225422	75904	16964	1801
No Patella	254893	236445	202232	168600	78971	20600	2483

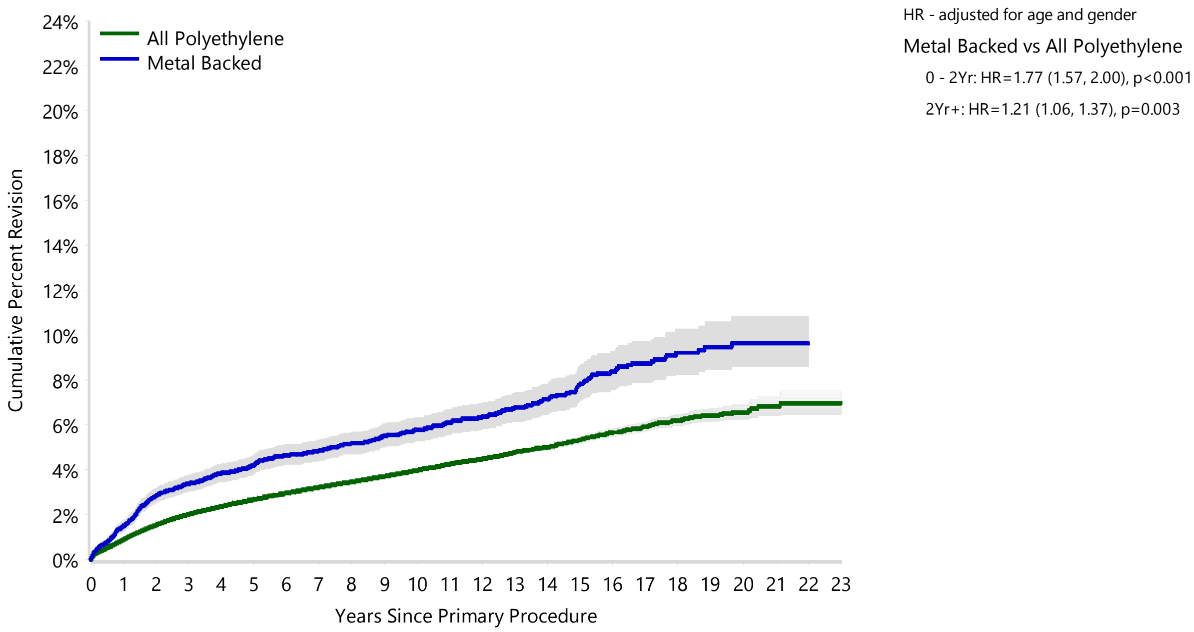
Note: Restricted to modern prostheses

Table KT33 Cumulative Percent Revision of Primary Total Knee Replacement by Patella Type (Primary Diagnosis OA)

Patella Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
All Polyethylene	12159	454674	0.9 (0.9, 0.9)	2.0 (2.0, 2.1)	2.7 (2.6, 2.7)	4.0 (3.9, 4.1)	5.3 (5.2, 5.5)	6.6 (6.3, 6.9)
Metal Backed	529	11535	1.5 (1.3, 1.7)	3.4 (3.0, 3.8)	4.2 (3.8, 4.6)	5.8 (5.3, 6.3)	7.8 (7.1, 8.7)	9.6 (8.6, 10.8)
TOTAL	**12688**	**466209**						

Note: Restricted to modern prostheses. Excludes 20 procedures with unknown patella type

Figure KT32 Cumulative Percent Revision of Primary Total Knee Replacement by Patella Type (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
All Polyethylene	454674	397697	302199	219273	72191	15503	1330
Metal Backed	11535	9014	7580	6146	3713	1461	471

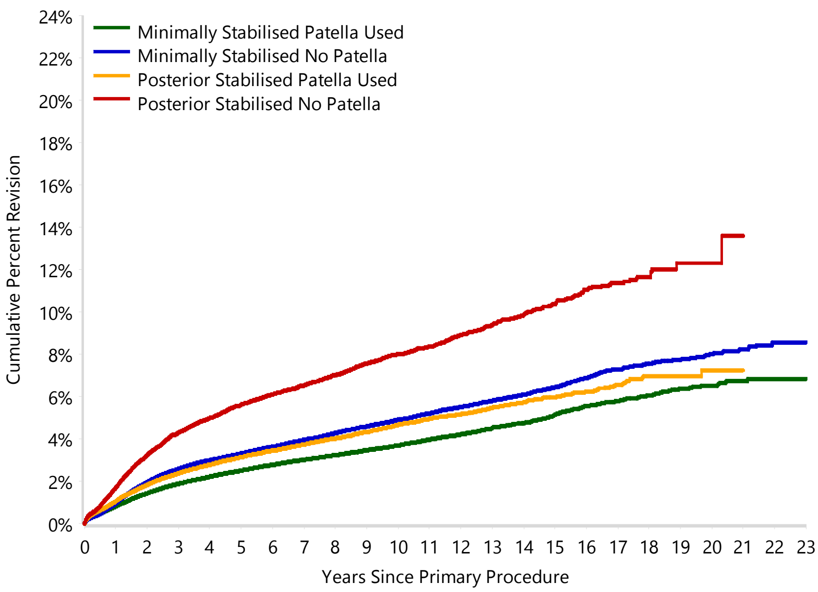
Note: Restricted to modern prostheses. Excludes 20 procedures with unknown patella type

Table KT34 Cumulative Percent Revision of Primary Total Knee Replacement by Stability and Patella Component Usage (Primary Diagnosis OA)

Stability	Patella Component Usage	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Minimally Stabilised	Patella Used	7573	310365	0.8 (0.8, 0.8)	1.9 (1.8, 1.9)	2.5 (2.4, 2.6)	3.7 (3.6, 3.8)	5.1 (5.0, 5.3)	6.5 (6.1, 6.9)
	No Patella	8625	211045	1.0 (0.9, 1.0)	2.6 (2.5, 2.7)	3.3 (3.2, 3.4)	4.9 (4.8, 5.0)	6.4 (6.3, 6.6)	8.0 (7.7, 8.3)
Posterior Stabilised	Patella Used	4347	122020	1.1 (1.0, 1.1)	2.4 (2.3, 2.5)	3.1 (3.0, 3.3)	4.7 (4.5, 4.8)	6.0 (5.7, 6.2)	7.2 (6.6, 8.0)
	No Patella	2191	28158	1.7 (1.6, 1.9)	4.3 (4.1, 4.5)	5.6 (5.4, 5.9)	8.0 (7.7, 8.4)	10.4 (9.9, 10.9)	12.3 (11.4, 13.3)
Medial Pivot Design	Patella Used	563	30044	0.9 (0.8, 1.0)	1.9 (1.8, 2.1)	2.4 (2.2, 2.7)	3.4 (2.9, 4.2)		
	No Patella	517	14423	1.2 (1.1, 1.4)	3.3 (2.9, 3.6)	4.0 (3.7, 4.4)	5.6 (5.0, 6.3)		
TOTAL		23816	716055						

Note: Restricted to modern prostheses

Figure KT33 Cumulative Percent Revision of Primary Total Knee Replacement by Stability and Patella Component Usage (Primary Diagnosis OA)



HR - adjusted for age and gender

Minimally Stabilised Patella Used
vs Minimally Stabilised No Patella
0 - 3Mth: HR=1.07 (0.98, 1.18), p=0.124
3Mth - 6Mth: HR=0.92 (0.81, 1.04), p=0.183
6Mth - 1.5Yr: HR=0.66 (0.62, 0.70), p<0.001
1.5Yr - 2Yr: HR=0.65 (0.59, 0.71), p<0.001
2Yr - 3.5Yr: HR=0.74 (0.69, 0.79), p<0.001
3.5Yr+: HR=0.84 (0.80, 0.88), p<0.001

Minimally Stabilised Patella Used
vs Posterior Stabilised Patella Used
0 - 6Mth: HR=0.81 (0.75, 0.88), p<0.001
6Mth - 9Mth: HR=0.81 (0.72, 0.92), p<0.001
9Mth - 2.5Yr: HR=0.76 (0.72, 0.80), p<0.001
2.5Yr+: HR=0.85 (0.81, 0.90), p<0.001

Minimally Stabilised No Patella
vs Posterior Stabilised No Patella
Entire Period: HR=0.61 (0.58, 0.64), p<0.001

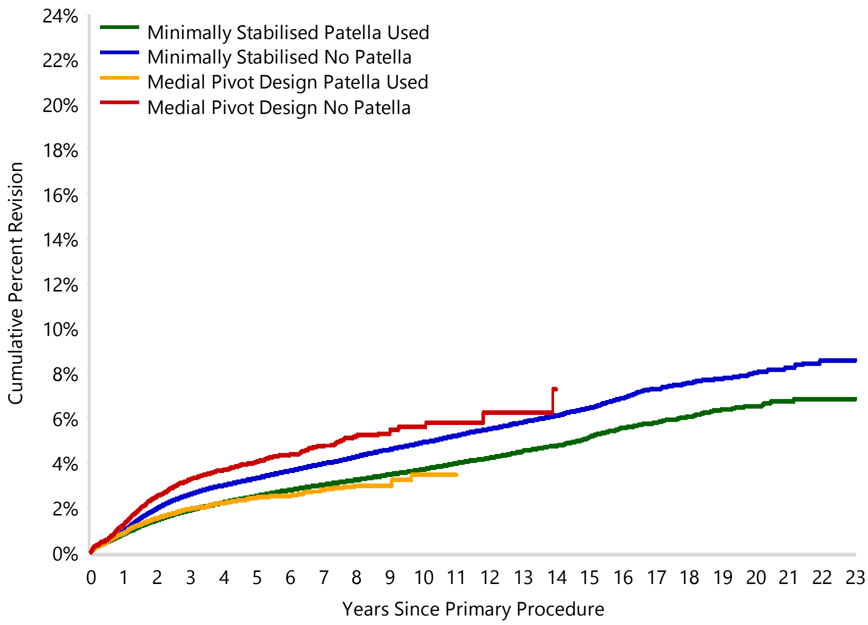
Posterior Stabilised Patella Used
vs Posterior Stabilised No Patella
Entire Period: HR=0.58 (0.55, 0.61), p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Minimally Stabilised	Patella Used	310365	266732	196896	140177	47837	11187	1555
	No Patella	211045	195880	167387	139255	65445	17022	2393
Posterior Stabilised	Patella Used	122020	112083	94316	74860	27454	5736	242
	No Patella	28158	27040	24674	22287	12754	3521	85

Note: Restricted to modern prostheses

Primary Total Knee Replacement

Figure KT34 **Cumulative Percent Revision of Primary Total Knee Replacement by Stability and Patella Component Usage (Primary Diagnosis OA)**



HR - adjusted for age and gender

Minimally Stabilised Patella Used vs
Minimally Stabilised No Patella
0 - 3Mth: HR=1.10 (1.00, 1.21), p=0.060
3Mth - 6Mth: HR=0.90 (0.78, 1.03), p=0.111
6Mth - 1Yr: HR=0.71 (0.65, 0.77), p<0.001
1Yr - 1.5Yr: HR=0.61 (0.56, 0.66), p<0.001
1.5Yr - 2Yr: HR=0.64 (0.58, 0.70), p<0.001
2Yr+: HR=0.80 (0.77, 0.84), p<0.001

Minimally Stabilised Patella Used vs
Medial Pivot Design Patella Used
Entire Period: HR=1.03 (0.95, 1.12), p=0.484

Minimally Stabilised No Patella vs
Medial Pivot Design No Patella
Entire Period: HR=0.83 (0.76, 0.91), p<0.001

Medial Pivot Design Patella Used vs
Medial Pivot Design No Patella
Entire Period: HR=0.62 (0.55, 0.70), p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Minimally Stabilised	Patella Used	310365	266732	196896	140177	47837	11187	1555
	No Patella	211045	195880	167387	139255	65445	17022	2393
Medial Pivot Design	Patella Used	30044	24711	16337	8954	295	6	0
	No Patella	14423	12427	9286	6391	530	12	0

Note: Restricted to modern prostheses

Table KT35 Cumulative Percent Revision of Primary Total Knee Replacement by Prosthesis Type and Patella Component Usage (Primary Diagnosis OA)

Prosthesis Combination	Patella Usage	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Genesis II CR/Genesis II	Patella Used	455	11531	1.0 (0.8, 1.2)	2.2 (1.9, 2.5)	2.9 (2.6, 3.2)	4.2 (3.8, 4.6)	5.1 (4.6, 5.7)	6.3 (5.5, 7.2)
	No Patella	809	14743	0.9 (0.8, 1.1)	3.0 (2.7, 3.3)	3.9 (3.6, 4.2)	5.6 (5.2, 6.0)	6.9 (6.4, 7.4)	8.3 (7.5, 9.1)
LCS CR/MBT	Patella Used	579	10532	1.1 (0.9, 1.3)	3.1 (2.8, 3.5)	4.1 (3.7, 4.5)	5.8 (5.3, 6.3)	7.4 (6.7, 8.2)	9.6 (8.2, 11.1)
	No Patella	978	22471	0.8 (0.7, 0.9)	2.5 (2.3, 2.7)	3.2 (2.9, 3.4)	4.5 (4.2, 4.8)	5.5 (5.1, 5.9)	7.4 (6.4, 8.5)
Nexgen CR Flex/Nexgen	Patella Used	795	31291	0.7 (0.6, 0.8)	1.6 (1.5, 1.8)	2.1 (1.9, 2.2)	2.8 (2.6, 3.0)	3.5 (3.2, 3.9)	
	No Patella	936	29141	0.8 (0.7, 0.9)	2.0 (1.8, 2.2)	2.5 (2.3, 2.7)	3.4 (3.2, 3.6)	4.4 (4.1, 4.8)	
Persona CR/Persona	Patella Used	600	44170	0.9 (0.8, 1.0)	1.8 (1.7, 2.0)	2.3 (2.1, 2.5)			
	No Patella	245	15094	1.0 (0.8, 1.1)	2.2 (1.9, 2.5)	2.7 (2.3, 3.1)			
Triathlon CR/Triathlon	Patella Used	1768	104268	0.7 (0.7, 0.8)	1.5 (1.4, 1.6)	1.9 (1.8, 2.0)	2.8 (2.6, 3.0)	4.1 (3.7, 4.6)	
	No Patella	2034	59961	1.0 (0.9, 1.1)	2.4 (2.3, 2.5)	3.0 (2.9, 3.2)	4.5 (4.3, 4.7)	5.7 (5.4, 6.1)	
Vanguard CR/Vanguard	Patella Used	482	13791	0.8 (0.6, 0.9)	2.0 (1.7, 2.2)	2.5 (2.3, 2.8)	3.9 (3.5, 4.3)	6.1 (5.3, 7.1)	
	No Patella	675	13388	0.8 (0.7, 1.0)	2.6 (2.4, 2.9)	3.3 (3.0, 3.6)	5.5 (5.1, 5.9)	7.5 (6.8, 8.3)	
TOTAL		10356	370381						

Note: Restricted to modern prostheses
Only prosthesis combinations with >10,000 procedures in both patella usage groups are listed

Table KT36 Comparisons of Revision Rates for Primary Total Knee Replacement by Prosthesis Combination and Patella Usage (Primary Diagnosis OA)

Comparison	HR -adjusted for age and gender
Genesis II CR/Genesis II Patella Used vs Genesis II CR/Genesis II No Patella	Entire Period: HR=0.78 (0.69, 0.87), p<0.001
LCS CR/MBT Patella Used vs LCS CR/MBT No Patella	Entire Period: HR=1.33 (1.20, 1.47), p<0.001
Nexgen CR Flex/Nexgen Patella Used vs Nexgen CR Flex/Nexgen No Patella	Entire Period: HR=0.83 (0.75, 0.91), p<0.001
Persona CR/Persona Patella Used vs Persona CR/Persona No Patella	Entire Period: HR=0.84 (0.73, 0.98), p=0.025
Triathlon CR/Triathlon Patella Used vs Triathlon CR/Triathlon No Patella	Entire Period: HR=0.65 (0.61, 0.69), p<0.001
Vanguard CR/Vanguard Patella Used vs Vanguard CR/Vanguard No Patella	Entire Period: HR=0.74 (0.66, 0.83), p<0.001

Fixation

The effect of fixation varies depending on prosthesis stability. For minimally stabilised prostheses, there is no difference between cemented and hybrid fixation. Cementless fixation has a higher rate of revision compared to both cemented fixation and hybrid fixation (Table KT37 and Figure KT35).

When minimally stabilised prostheses are further analysed by tibial fixation and age, patients aged <65 years with cementless tibial fixation have the highest rates of revision (Table KT38 and Figure KT36). Patients with minimally stabilised knees using cementless tibial fixation have a higher rate of revision regardless of gender. Males with cemented tibial fixation have a higher rate of revision compared to females with cemented tibial fixation in the first 1.5 years (Table KT39 and Figure KT37).

When a posterior stabilised knee is used, cemented fixation has a lower initial rate of revision compared to cementless fixation. After 1.5 years, cementless fixation has a lower rate of revision than cemented fixation. Cemented fixation has a lower rate of revision compared to hybrid fixation in the first 1.5 years only, with no difference after this time. There is no difference in the rate of revision when cementless fixation and hybrid fixation are compared (Table KT40 and Figure KT38).

Cementing the tibial component gives the best outcome for minimally stabilised knee replacement.

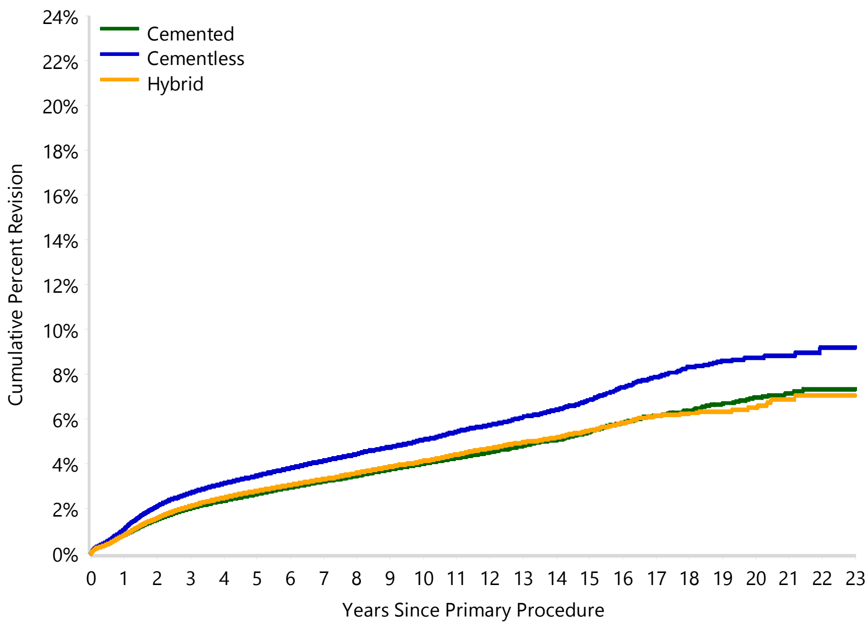
When a medial pivot design prosthesis is used, there is no difference in rate of revision between cemented and hybrid fixation. There are too few revisions of cementless fixation for an analysis to be undertaken (Table KT41 and Figure KT39).

Table KT37 Cumulative Percent Revision of Minimally Stabilised Primary Total Knee Replacement by Fixation (Primary Diagnosis OA)

Fixation	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Cemented	7637	269973	0.8 (0.8, 0.9)	2.0 (2.0, 2.1)	2.7 (2.6, 2.7)	4.0 (3.9, 4.1)	5.4 (5.3, 5.6)	7.0 (6.6, 7.3)
Cementless	4058	108538	1.1 (1.0, 1.1)	2.7 (2.6, 2.8)	3.5 (3.3, 3.6)	5.1 (4.9, 5.2)	6.8 (6.6, 7.1)	8.7 (8.2, 9.2)
Hybrid	4456	142793	0.8 (0.8, 0.9)	2.1 (2.0, 2.2)	2.8 (2.7, 2.9)	4.1 (4.0, 4.3)	5.5 (5.3, 5.7)	6.5 (6.1, 6.9)
TOTAL	**16151**	**521304**						

Note: Excluding cementless Genesis Oxinium femoral prostheses. Restricted to modern prostheses

Figure KT35 Cumulative Percent Revision of Minimally Stabilised Primary Total Knee Replacement by Fixation (Primary Diagnosis OA)



HR - adjusted for age and gender

Cementless vs Cemented
Entire Period: HR=1.19 (1.15, 1.24), p<0.001

Cementless vs Hybrid
Entire Period: HR=1.19 (1.14, 1.25), p<0.001

Hybrid vs Cemented
Entire Period: HR=1.00 (0.96, 1.04), p=0.988

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Cemented	269973	240367	189150	140764	50488	12900	1866
Cementless	108538	92955	69148	54055	29555	7619	1143
Hybrid	142793	129198	105924	84553	33192	7656	918

Note: Restricted to modern prostheses

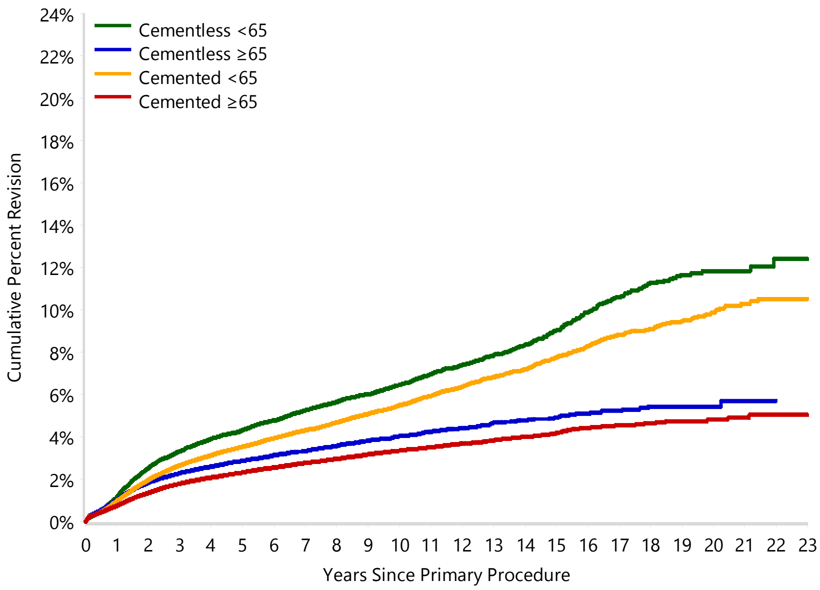
Primary Total Knee Replacement

Table KT38 Cumulative Percent Revision of Minimally Stabilised Primary Total Knee Replacement by Tibial Fixation and Age (Primary Diagnosis OA)

Tibial Fixation	Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Cementless	<65	2219	43651	1.2 (1.1, 1.3)	3.3 (3.1, 3.5)	4.3 (4.1, 4.5)	6.5 (6.2, 6.8)	9.0 (8.6, 9.5)	11.8 (11.1, 12.7)
	≥65	1924	67380	1.0 (0.9, 1.1)	2.3 (2.2, 2.4)	2.9 (2.7, 3.0)	4.0 (3.8, 4.2)	4.9 (4.6, 5.2)	5.4 (5.0, 5.9)
Cemented	<65	5358	129101	1.0 (0.9, 1.0)	2.6 (2.6, 2.7)	3.5 (3.4, 3.7)	5.5 (5.3, 5.7)	7.8 (7.5, 8.0)	9.9 (9.3, 10.4)
	≥65	6697	281278	0.8 (0.7, 0.8)	1.8 (1.7, 1.8)	2.3 (2.3, 2.4)	3.4 (3.3, 3.4)	4.2 (4.0, 4.3)	4.8 (4.5, 5.1)
TOTAL		16198	521410						

Note: Restricted to modern prostheses

Figure KT36 Cumulative Percent Revision of Minimally Stabilised Primary Total Knee Replacement by Tibial Fixation and Age (Primary Diagnosis OA)



HR - adjusted for gender

Cementless <65 vs Cementless ≥65
0 - 3Mth: HR=0.77 (0.64, 0.93), p=0.007
3Mth - 6Mth: HR=1.23 (0.99, 1.54), p=0.064
6Mth - 1Yr: HR=1.63 (1.42, 1.87), p<0.001
1Yr - 1.5Yr: HR=1.85 (1.62, 2.12), p<0.001
1.5Yr - 2Yr: HR=1.73 (1.48, 2.03), p<0.001
2Yr - 2.5Yr: HR=1.67 (1.40, 1.99), p<0.001
2.5Yr - 5.5Yr: HR=1.64 (1.47, 1.84), p<0.001
5.5Yr - 6Yr: HR=1.23 (0.88, 1.73), p=0.224
6Yr - 6.5Yr: HR=1.82 (1.35, 2.44), p<0.001
6.5Yr - 10Yr: HR=1.78 (1.54, 2.05), p<0.001
10Yr - 10.5Yr: HR=2.81 (1.92, 4.11), p<0.001
10.5Yr - 13Yr: HR=2.45 (1.98, 3.04), p<0.001
13Yr+: HR=3.24 (2.63, 4.00), p<0.001

Cementless <65 vs Cemented <65
Entire Period: HR=1.20 (1.14, 1.26), p<0.001

Cementless ≥65 vs Cemented ≥65
Entire Period: HR=1.22 (1.16, 1.28), p<0.001

Cemented <65 vs Cemented ≥65
0 - 6Mth: HR=1.00 (0.91, 1.09), p=0.990
6Mth - 1.5Yr: HR=1.68 (1.57, 1.80), p<0.001
1.5Yr - 2Yr: HR=1.83 (1.65, 2.04), p<0.001
2Yr - 2.5Yr: HR=1.46 (1.31, 1.64), p<0.001
2.5Yr - 5.5Yr: HR=1.65 (1.54, 1.77), p<0.001
5.5Yr - 6Yr: HR=2.06 (1.66, 2.55), p<0.001
6Yr - 7Yr: HR=1.73 (1.47, 2.03), p<0.001
7Yr - 8.5Yr: HR=1.95 (1.67, 2.27), p<0.001
8.5Yr - 9Yr: HR=1.56 (1.18, 2.07), p=0.002
9Yr - 12Yr: HR=2.48 (2.14, 2.87), p<0.001
12Yr+: HR=2.94 (2.44, 3.54), p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Cementless	<65	43651	37798	28549	22907	13937	4271	740
	≥65	67380	57373	42222	32458	16599	3851	419
Cemented	<65	129101	116759	94934	74156	30098	8493	1462
	≥65	281278	250682	198578	149911	52648	11594	1327

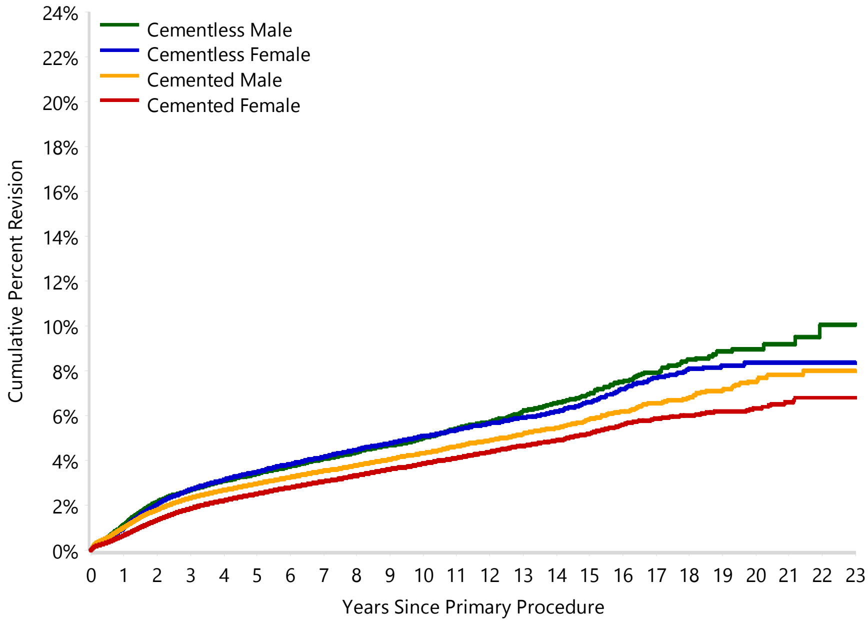
Note: Restricted to modern prostheses

Table KT39 Cumulative Percent Revision of Minimally Stabilised Primary Total Knee Replacement by Tibial Fixation and Gender (Primary Diagnosis OA)

Tibial Fixation	Gender	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Cementless	Male	2098	57728	1.2 (1.1, 1.2)	2.7 (2.5, 2.8)	3.4 (3.2, 3.6)	5.0 (4.8, 5.3)	7.0 (6.6, 7.4)	9.0 (8.2, 9.8)
	Female	2045	53303	1.0 (0.9, 1.1)	2.7 (2.6, 2.9)	3.5 (3.3, 3.7)	5.1 (4.8, 5.3)	6.6 (6.3, 7.0)	8.4 (7.7, 9.0)
Cemented	Male	5513	174957	1.0 (1.0, 1.1)	2.3 (2.3, 2.4)	3.0 (2.9, 3.1)	4.3 (4.2, 4.5)	5.9 (5.6, 6.1)	7.5 (7.0, 8.1)
	Female	6542	235422	0.7 (0.6, 0.7)	1.9 (1.8, 1.9)	2.5 (2.4, 2.6)	3.9 (3.8, 4.0)	5.2 (5.0, 5.4)	6.3 (6.0, 6.7)
TOTAL		**16198**	**521410**						

Note: Restricted to modern prostheses

Figure KT37 Cumulative Percent Revision of Minimally Stabilised Primary Total Knee Replacement by Tibial Fixation and Gender (Primary Diagnosis OA)



HR - adjusted for age

Cementless Male vs Cementless Female
Entire Period: HR=1.02 (0.96, 1.08), p=0.540

Cementless Male vs Cemented Male
Entire Period: HR=1.11 (1.06, 1.17), p<0.001

Cementless Female vs Cemented Female
0 - 1.5Yr: HR=1.50 (1.41, 1.60), p<0.001
1.5Yr+: HR=1.13 (1.07, 1.19), p<0.001

Cemented Male vs Cemented Female
0 - 9Mth: HR=1.50 (1.39, 1.61), p<0.001
9Mth - 1.5Yr: HR=1.35 (1.25, 1.46), p<0.001
1.5Yr+: HR=1.00 (0.96, 1.05), p=0.839

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Cementless	Male	57728	49018	35703	27192	14447	3670	507
	Female	53303	46153	35068	28173	16089	4452	652
Cemented	Male	174957	156553	124121	92995	32407	7519	1045
	Female	235422	210888	169391	131072	50339	12568	1744

Note: Restricted to modern prostheses

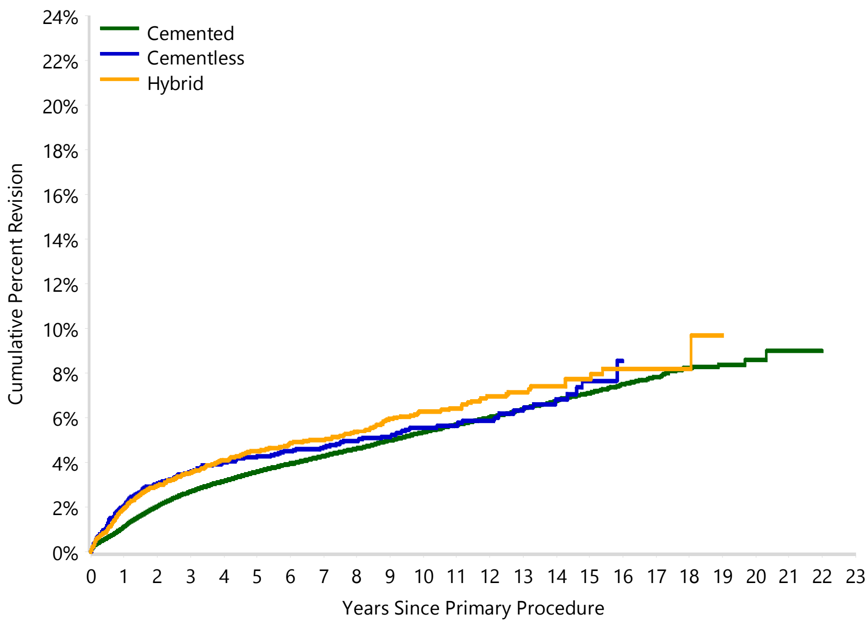
Primary Total Knee Replacement

Table KT40 Cumulative Percent Revision of Posterior Stabilised Primary Total Knee Replacement by Fixation (Primary Diagnosis OA)

Fixation	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Cemented	6025	140005	1.1 (1.1, 1.2)	2.7 (2.6, 2.8)	3.6 (3.5, 3.7)	5.4 (5.2, 5.5)	7.1 (6.9, 7.3)	8.6 (8.0, 9.2)
Cementless	187	3781	2.1 (1.6, 2.6)	3.6 (3.0, 4.2)	4.3 (3.7, 5.0)	5.5 (4.8, 6.5)	7.7 (6.3, 9.3)	
Hybrid	326	6392	1.9 (1.6, 2.3)	3.5 (3.1, 4.1)	4.5 (4.0, 5.1)	6.3 (5.6, 7.1)	7.8 (6.8, 8.9)	
TOTAL	**6538**	**150178**						

Note: Restricted to modern prostheses

Figure KT38 Cumulative Percent Revision of Posterior Stabilised Primary Total Knee Replacement by Fixation (Primary Diagnosis OA)



HR - adjusted for age and gender

Cementless vs Cemented

0 - 1.5Yr: HR=1.51 (1.23, 1.85), p<0.001

1.5Yr+: HR=0.72 (0.58, 0.89), p=0.002

Cementless vs Hybrid

Entire Period: HR=0.88 (0.74, 1.06), p=0.174

Hybrid vs Cemented

0 - 1.5Yr: HR=1.51 (1.28, 1.78), p<0.001

1.5Yr+: HR=0.92 (0.79, 1.07), p=0.281

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Cemented	140005	129814	111401	90639	36977	8565	298
Cementless	3781	3487	3007	2493	1295	259	3
Hybrid	6392	5822	4582	4015	1936	433	26

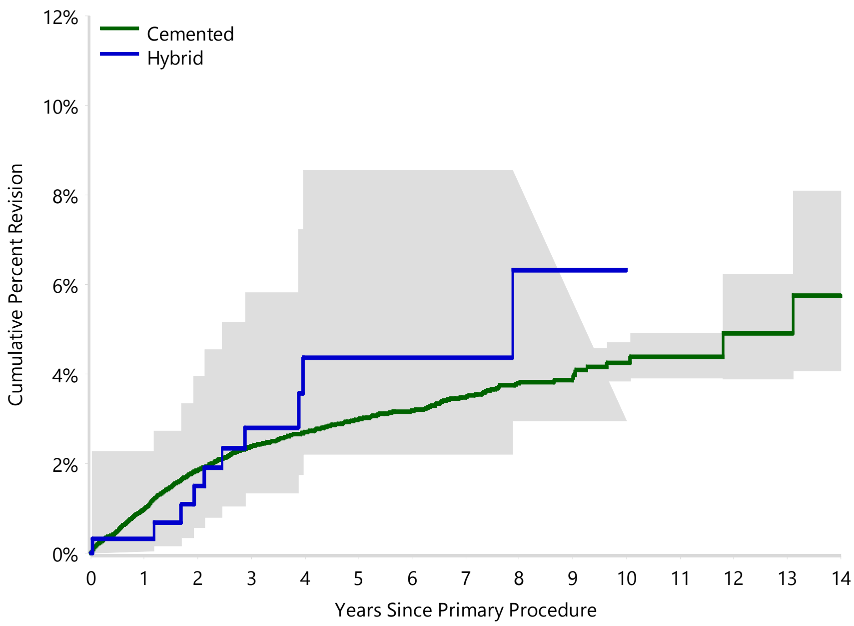
Note: Restricted to modern prostheses

Table KT41 Cumulative Percent Revision of Medial Pivot Design Primary Total Knee Replacement by Fixation (Primary Diagnosis OA)

Fixation	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs
Cemented	1067	44123	1.0 (0.9, 1.1)	2.4 (2.2, 2.5)	3.0 (2.8, 3.2)	4.3 (3.8, 4.7)	
Cementless	2	35	2.9 (0.4, 18.6)	2.9 (0.4, 18.6)	2.9 (0.4, 18.6)	2.9 (0.4, 18.6)	
Hybrid	11	309	0.3 (0.0, 2.3)	2.8 (1.3, 5.8)	4.4 (2.2, 8.6)	6.3 (3.0, 13.3)	
TOTAL	1080	44467					

Note: Restricted to modern prostheses

Figure KT39 Cumulative Percent Revision of Medial Pivot Design Primary Total Knee Replacement by Fixation (Primary Diagnosis OA)



HR - adjusted for age and gender

Hybrid vs Cemented

Entire Period: HR=1.28 (0.71, 2.33), p=0.410

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Cemented	44123	36818	25393	15215	751	16	0
Hybrid	309	286	197	98	45	0	0

Note: Restricted to modern prostheses

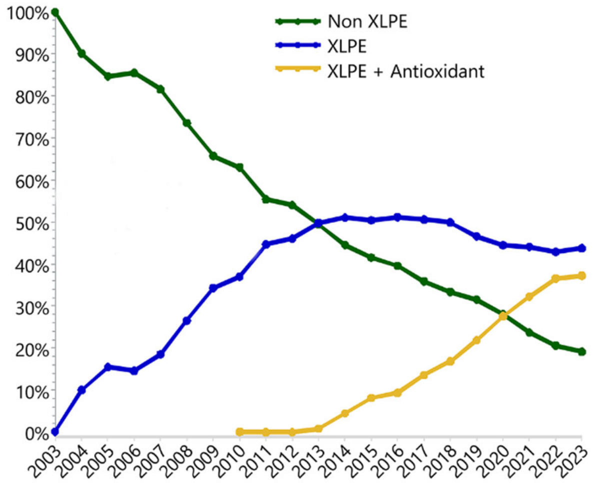
Primary Total Knee Replacement

BEARING SURFACE

Tibial Bearing Surface

There are two main polyethylene types used in primary total knee replacement procedures: cross-linked polyethylene (XLPE) and non cross-linked polyethylene (non XLPE). XLPE has been classified as ultrahigh molecular weight polyethylene that has been irradiated by high dose (≥50kGy) gamma or electron beam radiation. XLPE includes a sub-group which has antioxidant added (Figure KT40).

Figure KT40 Primary Total Knee Replacement by Polyethylene Type



There are 426,479 primary total knee procedures for osteoarthritis that have used XLPE. When adjusted for age, gender, fixation, bearing mobility, and patella usage, non XLPE group has a lower rate of revision compared to the XLPE group for the first 3 months. After 3 months, this reverses and the XLPE group has a lower rate of revision compared to the non XLPE group (Table KT42 and Figure KT42). The major reason for this difference is a reduced cumulative incidence of loosening (Figure KT43).

Primary total knee procedures that use non XLPE have a higher rate of revision for loosening than procedures that use XLPE (Table KT43 and Figure KT44). Procedures with XLPE have a higher rate of revision for infection in the first 6 months compared to non XLPE. From 6 months onwards XLPE has a lower rate of revision for infection compared to non XLPE (Table KT44 and Figure KT45).

The difference between XLPE and non XLPE is more evident in younger patients. The 15-year cumulative percent revision rate for patients aged <65 years for XLPE is 6.7% and for non XLPE is 9.9%. For patients aged ≥65 years, the 15 year cumulative percent revision for XLPE is 3.9% and for non XLPE is 5.2% (Table KT45 and Figure KT46).

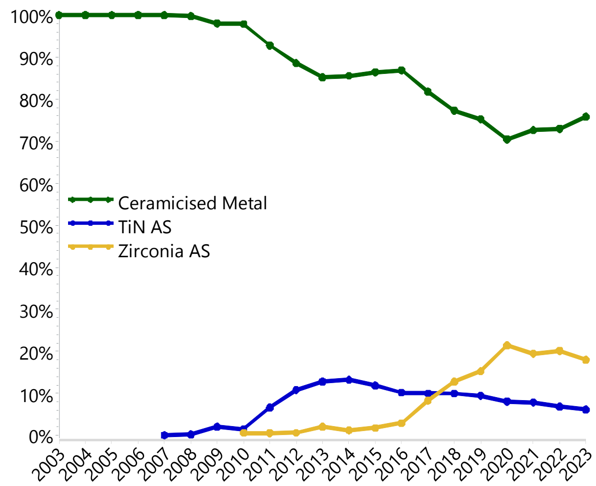
The outcomes of two prosthesis combinations used with both XLPE and non XLPE and with >10,000 procedures in each group are shown in Table KT46 and Table KT47.

When considering the XLPE sub-types there is no difference when XLPE is compared to XLPE with antioxidant (Table KT48 and Figure KT47). The most common reasons for revision of XLPE and XLPE with antioxidant are shown in Figure KT48.

Femoral Bearing Surface

In addition to the regularly used cobalt chrome metal, there are different materials used for the femoral bearing surface. These are often referred to as 'alternate surface' (AS) or 'ceramic surface' components. These can be made of a ceramicised metal or have a zirconia or titanium nitride coating. They are suggested for use in patients who have a metal allergy. The use of primary total knee procedures with an AS femoral component is shown in Figure KT41.

Figure KT41 Primary Total Knee Replacement by AS Femoral Material



Note: TiN (titanium nitride) surface

There are 79,822 procedures with an AS femoral component. When adjusted for age, gender, fixation, stability, bearing mobility, patella usage, and polyethylene type, procedures using an AS femoral component have a higher rate of revision compared to when these are not used (Table KT49 and Figure KT49). There are more revisions for loosening, pain and for patella erosion where an AS femoral component is used (Figure KT50).

There is variation in the revision rate depending on the type of material used in the AS. In 2023, there were 4 femoral prostheses used that used a zirconia-based AS, 11 that used a TiN (titanium nitride) surface, and 6 with a ceramicised metal surface.

TiN AS has a higher rate of revision compared to zirconia AS and when compared to other femoral components for the entire period. When compared to ceramicised metal, TiN AS has a higher revision rate for the first 1.5 years, with no difference after this time. Other femoral components have a higher revision rate than zirconia AS after 6 months, but a lower rate of revision compared to ceramicised metal after 9 months (Table KT50 and Figure KT51). The types of revision are shown in Figure KT52.

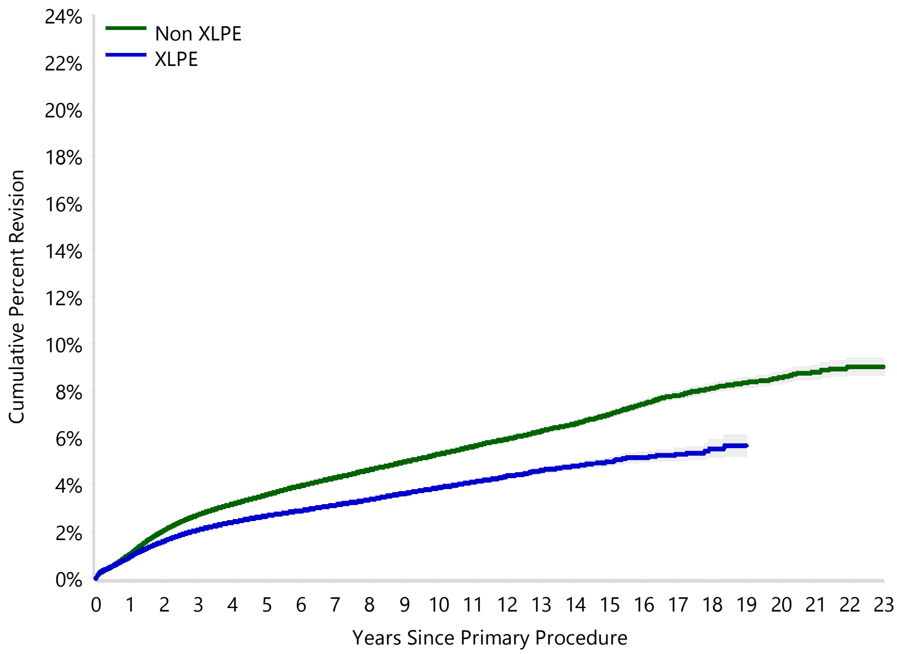
When revision for loosening was assessed, compared to other femoral components, ceramicised metal has a higher rate of revision for the first 5 years only, TiN AS has a higher rate of revision for the first 2.5 years only, and there is no difference for Zirconia AS. However, Zirconia AS has a lower rate of revision compared to ceramicised metal and when compared to TiN AS (Table KT51 and Figure KT53).

Table KT42 Cumulative Percent Revision of Primary Total Knee Replacement by Polyethylene Type (Primary Diagnosis OA)

Polyethylene Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Non XLPE	13534	293668	1.0 (1.0, 1.1)	2.7 (2.6, 2.8)	3.6 (3.5, 3.6)	5.3 (5.2, 5.4)	7.0 (6.8, 7.1)	8.5 (8.3, 8.8)
XLPE	10579	426479	0.9 (0.9, 0.9)	2.1 (2.0, 2.1)	2.7 (2.6, 2.7)	3.9 (3.8, 3.9)	5.0 (4.8, 5.2)	
TOTAL	24113	720147						

Note: Restricted to modern prostheses. Includes 115,254 procedures using cross-linked polyethylene with antioxidant
Excludes 975 procedures with unknown polyethylene

Figure KT42 Cumulative Percent Revision of Primary Total Knee Replacement by Polyethylene Type (Primary Diagnosis OA)



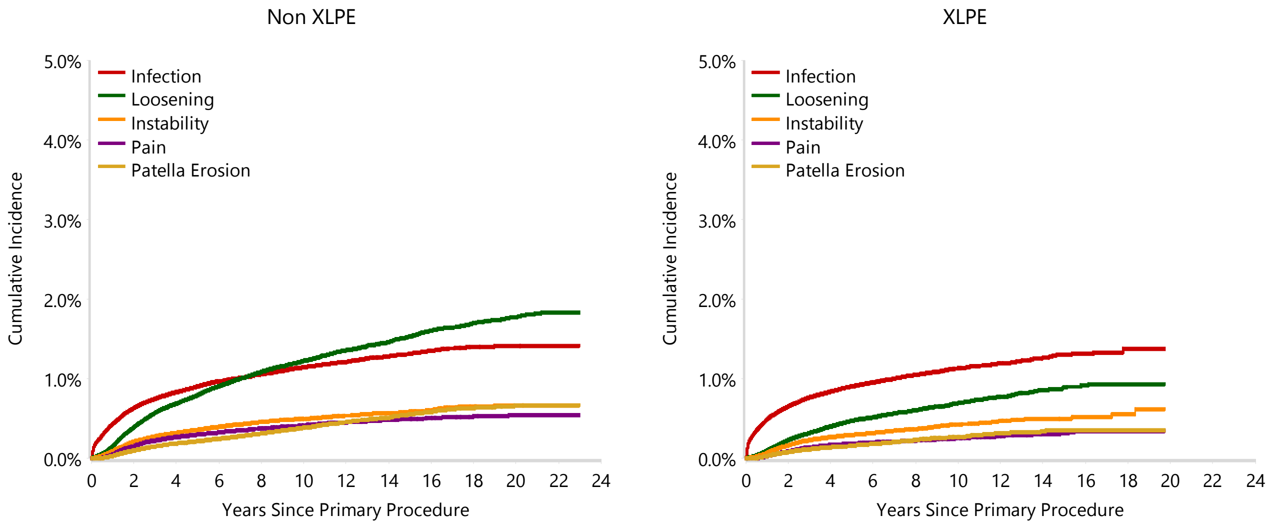
HR - adjusted for age, gender, fixation, bearing mobility, and patella usage

Non XLPE vs XLPE
0-3Mth: HR=0.88 (0.81, 0.95), p=0.001
3Mth-1Yr: HR=1.21 (1.14, 1.28), p<0.001
1Yr+: HR=1.41 (1.36, 1.45), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Non XLPE	293668	276095	241292	201990	101157	31612	4277
XLPE	426479	366547	270501	191911	53667	5934	3

Note: Restricted to modern prostheses

Figure KT43 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by Polyethylene Type (Primary Diagnosis OA)



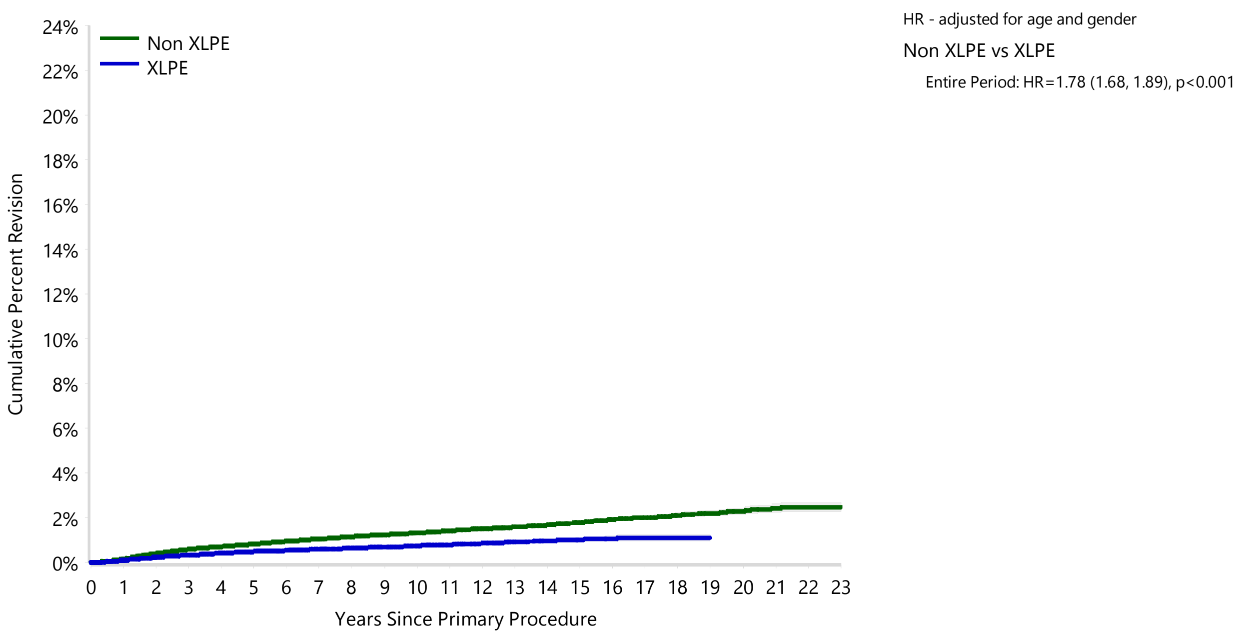
Note: Restricted to modern prostheses

Table KT43 Cumulative Percent Revision of Primary Total Knee Replacement by Polyethylene Type (Primary Diagnosis OA, Revision for Loosening)

Polyethylene Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Non XLPE	3266	293668	0.2 (0.1, 0.2)	0.6 (0.6, 0.6)	0.8 (0.8, 0.9)	1.3 (1.3, 1.4)	1.8 (1.7, 1.9)	2.3 (2.1, 2.4)
XLPE	1862	426479	0.1 (0.1, 0.1)	0.3 (0.3, 0.3)	0.5 (0.5, 0.5)	0.7 (0.7, 0.8)	1.0 (0.9, 1.1)	
TOTAL	**5128**	**720147**						

Note: Restricted to modern prostheses
Includes 115,254 procedures using cross-linked polyethylene with antioxidant
Excludes 975 procedures with unknown polyethylene

Figure KT44 Cumulative Percent Revision of Primary Total Knee Replacement by Polyethylene Type (Primary Diagnosis OA, Revision for Loosening)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Non XLPE	293668	276095	241292	201990	101157	31612	4277
XLPE	426479	366547	270501	191911	53667	5934	3

Note: Restricted to modern prostheses
Includes 115,254 procedures using cross-linked polyethylene with antioxidant
Excludes 975 procedures with unknown polyethylene

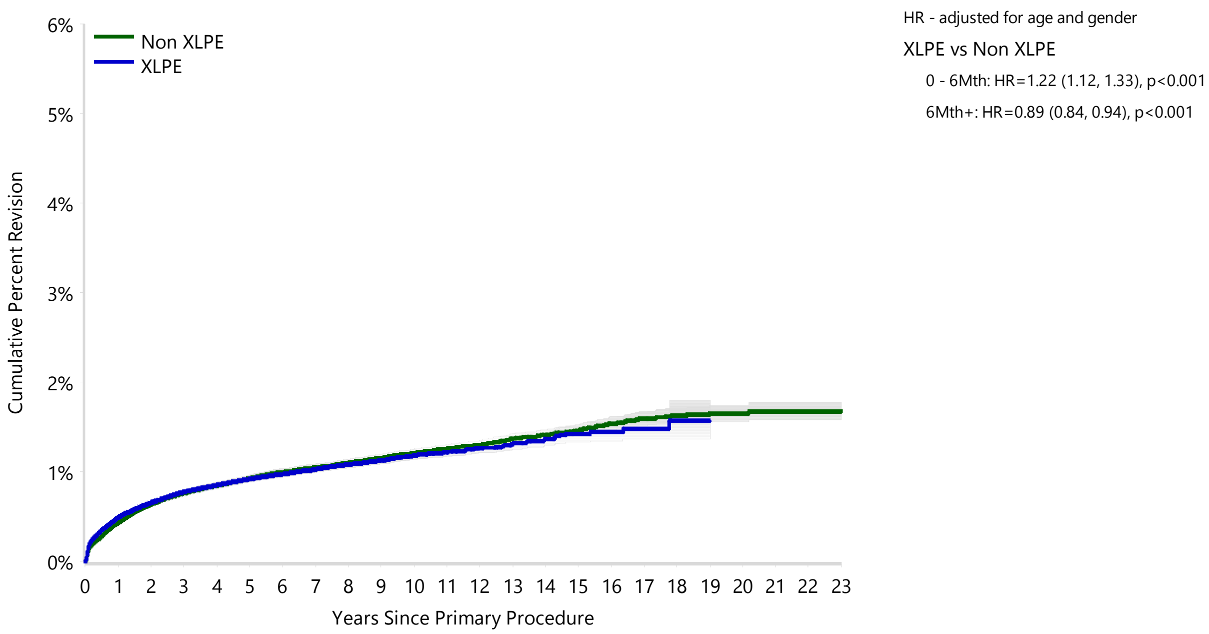
Primary Total Knee Replacement

Table KT44 Cumulative Percent Revision of Primary Total Knee Replacement by Polyethylene Type (Primary Diagnosis OA, Revision for Infection)

Polyethylene Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Non XLPE	3114	293668	0.4 (0.4, 0.5)	0.8 (0.7, 0.8)	0.9 (0.9, 1.0)	1.2 (1.2, 1.3)	1.5 (1.4, 1.5)	1.6 (1.6, 1.7)
XLPE	3622	426479	0.5 (0.5, 0.5)	0.8 (0.7, 0.8)	0.9 (0.9, 1.0)	1.2 (1.1, 1.2)	1.4 (1.3, 1.5)	
TOTAL	**6736**	**720147**						

Note: Restricted to modern prostheses. Includes 115,254 procedures using cross-linked polyethylene with antioxidant. Excludes 975 procedures with unknown polyethylene

Figure KT45 Cumulative Percent Revision of Primary Total Knee Replacement by Polyethylene Type (Primary Diagnosis OA, Revision for Infection)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Non XLPE	293668	276095	241292	201990	101157	31612	4277
XLPE	426479	366547	270501	191911	53667	5934	3

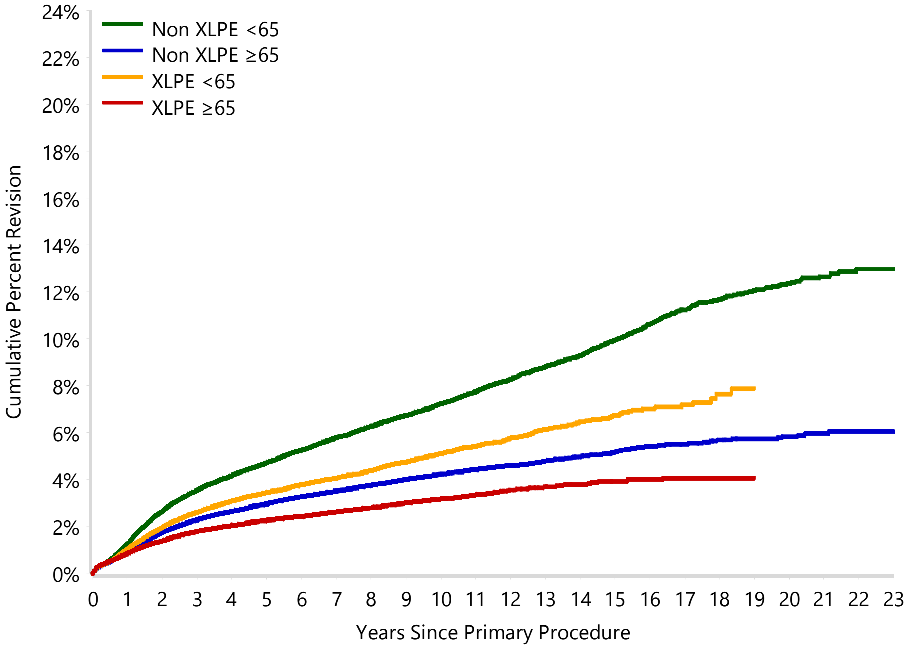
Note: Restricted to modern prostheses. Includes 115,254 procedures using cross-linked polyethylene with antioxidant. Excludes 975 procedures with unknown polyethylene

Table KT45 **Cumulative Percent Revision of Primary Total Knee Replacement by Polyethylene Type and Age (Primary Diagnosis OA)**

Polyethylene Type	Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Non XLPE		**13534**	**293668**	**1.0 (1.0, 1.1)**	**2.7 (2.6, 2.8)**	**3.6 (3.5, 3.6)**	**5.3 (5.2, 5.4)**	**7.0 (6.8, 7.1)**	**8.5 (8.3, 8.8)**
	<65	6619	97398	1.3 (1.2, 1.3)	3.5 (3.4, 3.7)	4.7 (4.6, 4.9)	7.2 (7.1, 7.4)	9.9 (9.7, 10.2)	12.4 (11.9, 12.8)
	≥65	6915	196270	0.9 (0.9, 0.9)	2.3 (2.2, 2.4)	3.0 (2.9, 3.0)	4.2 (4.1, 4.3)	5.2 (5.0, 5.3)	5.8 (5.6, 6.1)
XLPE		**10579**	**426479**	**0.9 (0.9, 0.9)**	**2.1 (2.0, 2.1)**	**2.7 (2.6, 2.7)**	**3.9 (3.8, 3.9)**	**5.0 (4.8, 5.2)**	
	<65	4722	141661	1.0 (1.0, 1.1)	2.6 (2.5, 2.7)	3.5 (3.3, 3.6)	5.1 (4.9, 5.3)	6.7 (6.4, 7.1)	
	≥65	5857	284818	0.8 (0.8, 0.9)	1.8 (1.7, 1.8)	2.3 (2.2, 2.3)	3.2 (3.1, 3.3)	3.9 (3.7, 4.1)	
TOTAL		**24113**	**720147**						

Note: Restricted to modern prostheses. Includes 115,254 procedures using cross-linked polyethylene with antioxidant. Excludes 975 procedures with unknown polyethylene

Figure KT46 Cumulative Percent Revision of Primary Total Knee Replacement by Polyethylene Type and Age (Primary Diagnosis OA)



HR - adjusted for gender

Non XLPE <65 vs Non XLPE ≥65
0 - 3Mth: HR=1.06 (0.94, 1.21), p=0.345
3Mth - 9Mth: HR=1.48 (1.34, 1.64), p<0.001
9Mth - 2Yr: HR=1.72 (1.62, 1.83), p<0.001
2Yr - 2.5Yr: HR=1.58 (1.41, 1.76), p<0.001
2.5Yr - 6Yr: HR=1.75 (1.65, 1.86), p<0.001
6Yr - 10Yr: HR=2.06 (1.90, 2.23), p<0.001
10Yr - 12.5Yr: HR=2.71 (2.37, 3.10), p<0.001
12.5Yr - 15.5Yr: HR=2.67 (2.26, 3.16), p<0.001
15.5Yr - 16.5: HR=5.00 (3.25, 7.68), p<0.001
16.5+: HR=4.15 (2.71, 6.36), p<0.001

Non XLPE <65 vs XLPE <65
0 - 3Mth: HR=0.96 (0.84, 1.09), p=0.507
3Mth - 1Yr: HR=1.37 (1.26, 1.49), p<0.001
1Yr - 1.5Yr: HR=1.56 (1.42, 1.72), p<0.001
1.5Yr - 5.5Yr: HR=1.42 (1.34, 1.51), p<0.001
5.5Yr - 6Yr: HR=1.50 (1.24, 1.81), p<0.001
6Yr - 8Yr: HR=1.67 (1.49, 1.86), p<0.001
8Yr - 8.5Yr: HR=1.14 (0.89, 1.46), p=0.305
8.5Yr - 15.5Yr: HR=1.69 (1.52, 1.88), p<0.001
15.5Yr+: HR=3.07 (2.24, 4.21), p<0.001

Non XLPE ≥65 vs XLPE ≥65
0 - 3Mth: HR=0.86 (0.79, 0.94), p=0.001
3Mth - 1Yr: HR=1.24 (1.15, 1.33), p<0.001
1Yr+: HR=1.45 (1.39, 1.51), p<0.001

XLPE <65 vs XLPE ≥65
0 - 3Mth: HR=0.96 (0.87, 1.05), p=0.337
3Mth - 6Mth: HR=1.17 (1.04, 1.33), p=0.010
6Mth - 1.5Yr: HR=1.55 (1.45, 1.66), p<0.001
1.5Yr+: HR=1.78 (1.69, 1.88), p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Non XLPE	**<65**	97398	92029	81396	69774	38943	14283	2375
	≥65	196270	184066	159896	132216	62214	17329	1902
XLPE	**<65**	141661	123083	92341	67295	21299	2705	3
	≥65	284818	243464	178160	124616	32368	3229	0

Note: Restricted to modern prostheses.

Table KT46 Cumulative Percent Revision of Primary Total Knee Replacement by Prosthesis Combination and Polyethylene Type (Primary Diagnosis OA)

Prosthesis Combination	Polyethylene Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Genesis II Oxinium PS /Genesis II	Non XLPE	985	11643	1.6 (1.4, 1.8)	3.9 (3.6, 4.3)	5.3 (4.9, 5.7)	7.5 (7.0, 8.0)	9.8 (9.1, 10.4)	12.4 (10.5, 14.6)
	XLPE	509	10695	1.3 (1.1, 1.6)	3.3 (2.9, 3.6)	4.4 (4.0, 4.9)	6.9 (6.2, 7.6)		
Triathlon CR/Triathlon	Non XLPE	408	11941	0.7 (0.6, 0.9)	1.8 (1.6, 2.1)	2.3 (2.1, 2.6)	3.4 (3.0, 3.7)	4.5 (4.0, 5.0)	
	XLPE	3394	152276	0.8 (0.8, 0.9)	1.8 (1.8, 1.9)	2.4 (2.3, 2.5)	3.6 (3.5, 3.7)	5.0 (4.6, 5.4)	
TOTAL		5296	186555						

Note: Restricted to modern prostheses. Only prosthesis combinations have more than 10,000 procedures in both groups are listed

Table KT47 Comparisons of Revision Rates for Primary Total Knee Replacement by Prosthesis Combination and Polyethylene Type (Primary Diagnosis OA)

Comparison	HR- adjusted for age and gender
Genesis II Oxinium PS/Genesis II Non XLPE vs Genesis II Oxinium PS/Genesis II XLPE	Entire Period: HR=1.11 (0.99, 1.24), p=0.066
Triathlon CR/Triathlon Non XLPE vs Triathlon CR/Triathlon XLPE	Entire Period: HR=0.95 (0.85, 1.05), p=0.331

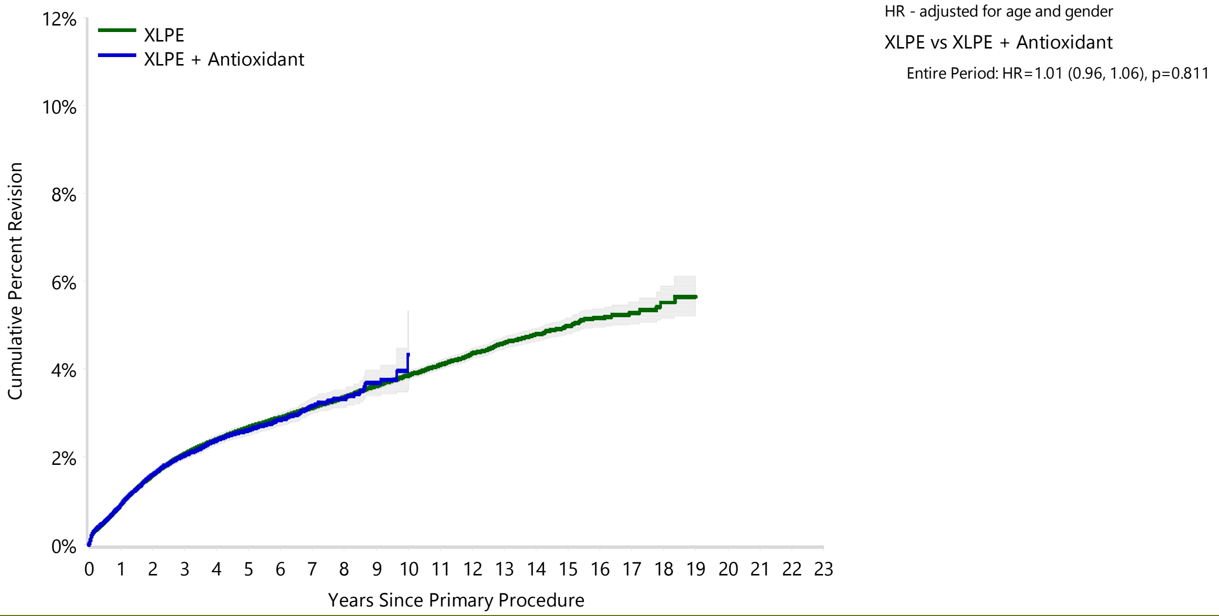
Primary Total Knee Replacement

Table KT48 Cumulative Percent Revision of XLPE Primary Total Knee Replacement by Polyethylene Type (Primary Diagnosis OA)

Polyethylene Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs
XLPE	8497	311225	0.9 (0.9, 0.9)	2.1 (2.0, 2.1)	2.7 (2.6, 2.7)	3.9 (3.8, 3.9)	5.0 (4.8, 5.2)
XLPE + Antioxidant	2082	115254	0.9 (0.9, 1.0)	2.0 (1.9, 2.1)	2.6 (2.5, 2.7)	4.3 (3.5, 5.3)	
TOTAL	10579	426479					

Note: Restricted to modern prostheses

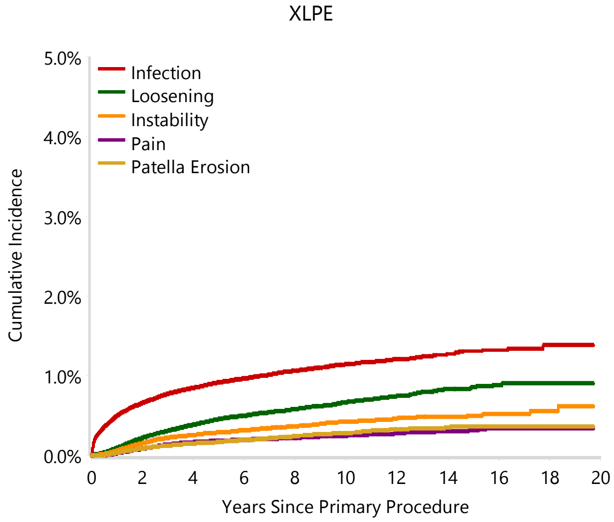
Figure KT47 Cumulative Percent Revision of XLPE Primary Total Knee Replacement by Polyethylene Type (Primary Diagnosis OA)

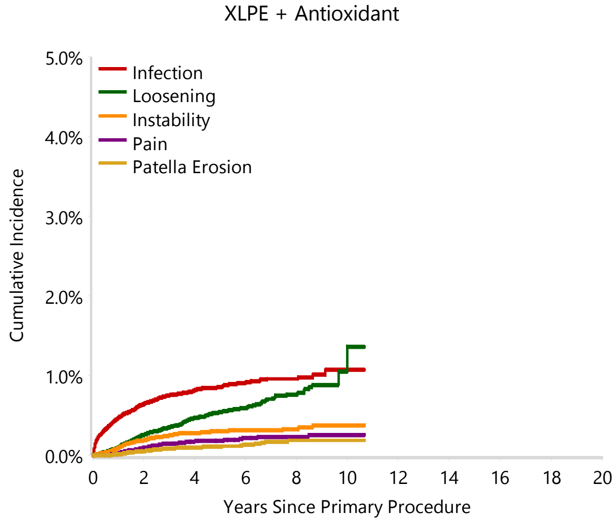


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs
XLPE	311225	277590	221566	168712	53415	5934
XLPE + Antioxidant	115254	88957	48935	23199	252	0

Note: Restricted to modern prostheses

Figure KT48 Cumulative Incidence Revision Diagnosis of XLPE Primary Total Knee Replacement by Polyethylene Type (Primary Diagnosis OA)





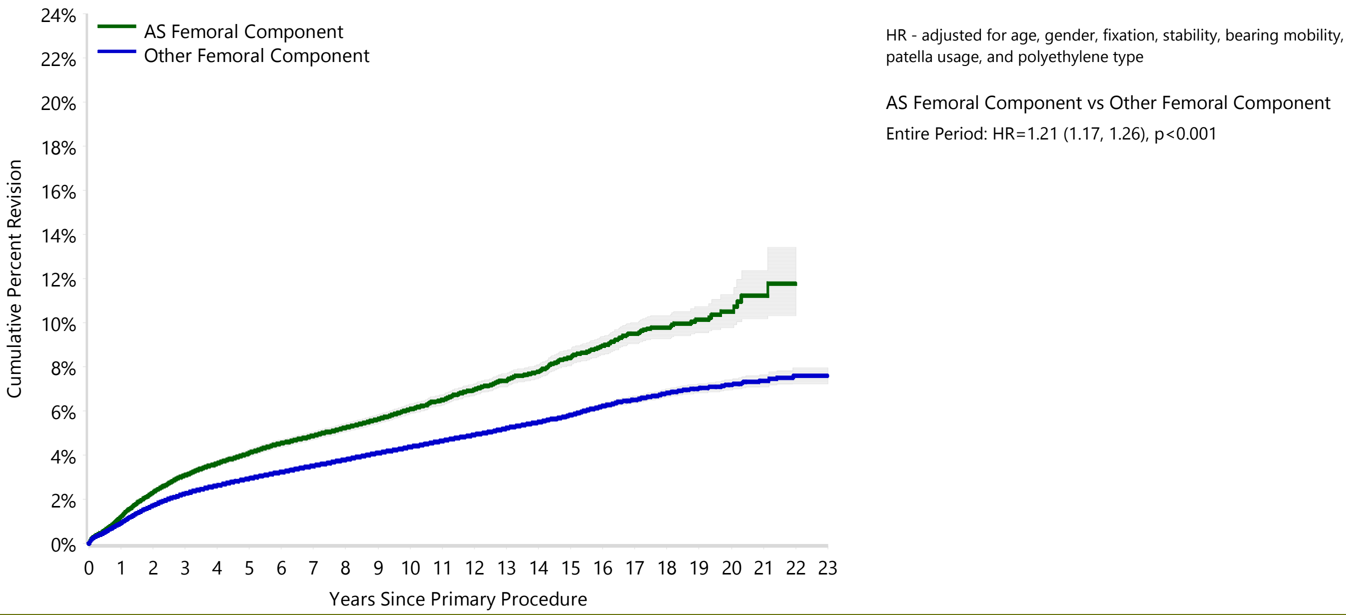
Note: Restricted to modern prostheses

Table KT49 Cumulative Percent Revision of Primary Total Knee Replacement by Femoral Bearing Surface (Primary Diagnosis OA)

Femoral Bearing Surface	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
AS Femoral Component	3759	79822	1.2 (1.1, 1.3)	3.1 (3.0, 3.2)	4.1 (4.0, 4.3)	6.1 (5.9, 6.3)	8.4 (8.1, 8.8)	10.5 (9.8, 11.3)
Other Femoral Component	20367	641300	0.9 (0.9, 1.0)	2.3 (2.2, 2.3)	2.9 (2.9, 3.0)	4.4 (4.3, 4.4)	5.8 (5.7, 5.9)	7.2 (7.0, 7.4)
TOTAL	**24126**	**721122**						

Note: Restricted to modern prostheses.

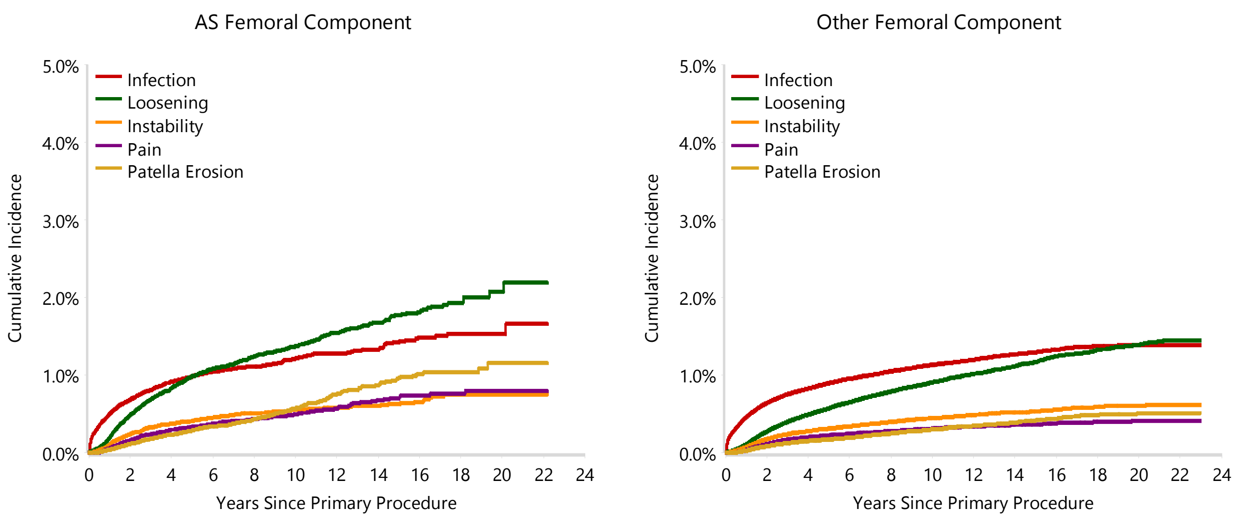
Figure KT49 Cumulative Percent Revision of Primary Total Knee Replacement by Femoral Bearing Surface (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
AS Femoral Component	79822	72205	58746	46258	19529	5363	443
Other Femoral Component	641300	570965	453271	347764	135346	32201	3841

Note: Restricted to modern prostheses.

Figure KT50 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by Femoral Bearing Surface (Primary Diagnosis OA)



Note: Restricted to modern prostheses.

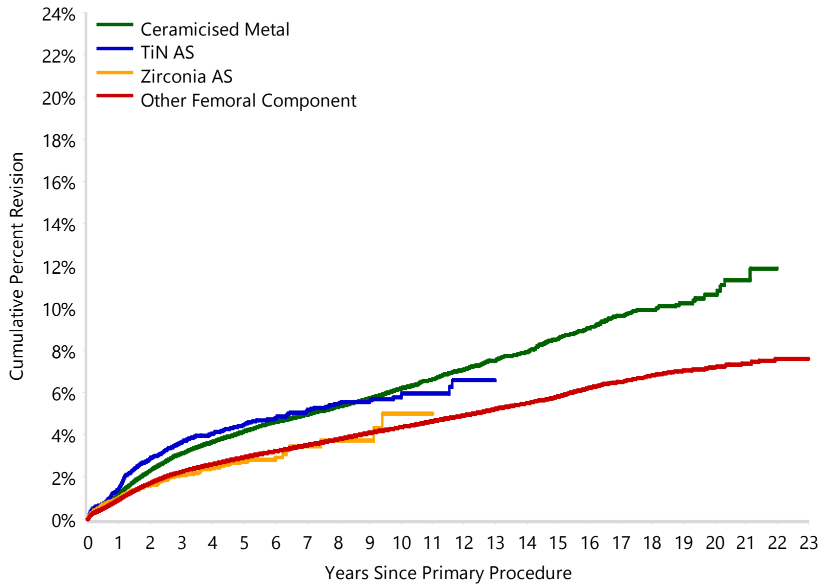
Primary Total Knee Replacement

Table KT50 Cumulative Percent Revision of Primary Total Knee Replacement by Femoral Material (Primary Diagnosis OA)

Femoral Material	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Ceramicised Metal	3323	66308	1.2 (1.1, 1.3)	3.1 (3.0, 3.3)	4.2 (4.0, 4.3)	6.2 (6.0, 6.4)	8.5 (8.2, 8.9)	10.6 (9.9, 11.4)
TiN AS	292	6405	1.5 (1.2, 1.8)	3.6 (3.2, 4.2)	4.5 (4.0, 5.1)	5.8 (5.1, 6.5)		
Zirconia AS	144	7109	1.0 (0.8, 1.3)	2.1 (1.7, 2.5)	2.8 (2.3, 3.3)	5.0 (3.3, 7.4)		
Other Femoral Component	20367	641300	0.9 (0.9, 1.0)	2.3 (2.2, 2.3)	2.9 (2.9, 3.0)	4.4 (4.3, 4.4)	5.8 (5.7, 5.9)	7.2 (7.0, 7.4)
TOTAL	**24126**	**721122**						

Note: Restricted to modern prostheses.

Figure KT51 Cumulative Percent Revision of Primary Total Knee Replacement by Femoral Material (Primary Diagnosis OA)



HR - adjusted for age and gender

Ceramicised Metal vs Other Femoral Component
0 - 9Mth: HR=1.09 (1.00, 1.19), p=0.058
9Mth+: HR=1.37 (1.31, 1.42), p<0.001

TiN AS vs Other Femoral Component
0 - 1.5Yr: HR=1.73 (1.47, 2.04), p<0.001
1.5Yr+: HR=1.23 (1.05, 1.45), p=0.012

Zirconia AS vs Other Femoral Component
0 - 6Mth: HR=1.33 (1.00, 1.76), p=0.052
6Mth+: HR=0.80 (0.65, 0.97), p=0.025

TiN AS vs Ceramicised Metal
0 - 1.5Yr: HR=1.43 (1.20, 1.69), p<0.001
1.5Yr+: HR=0.90 (0.76, 1.06), p=0.222

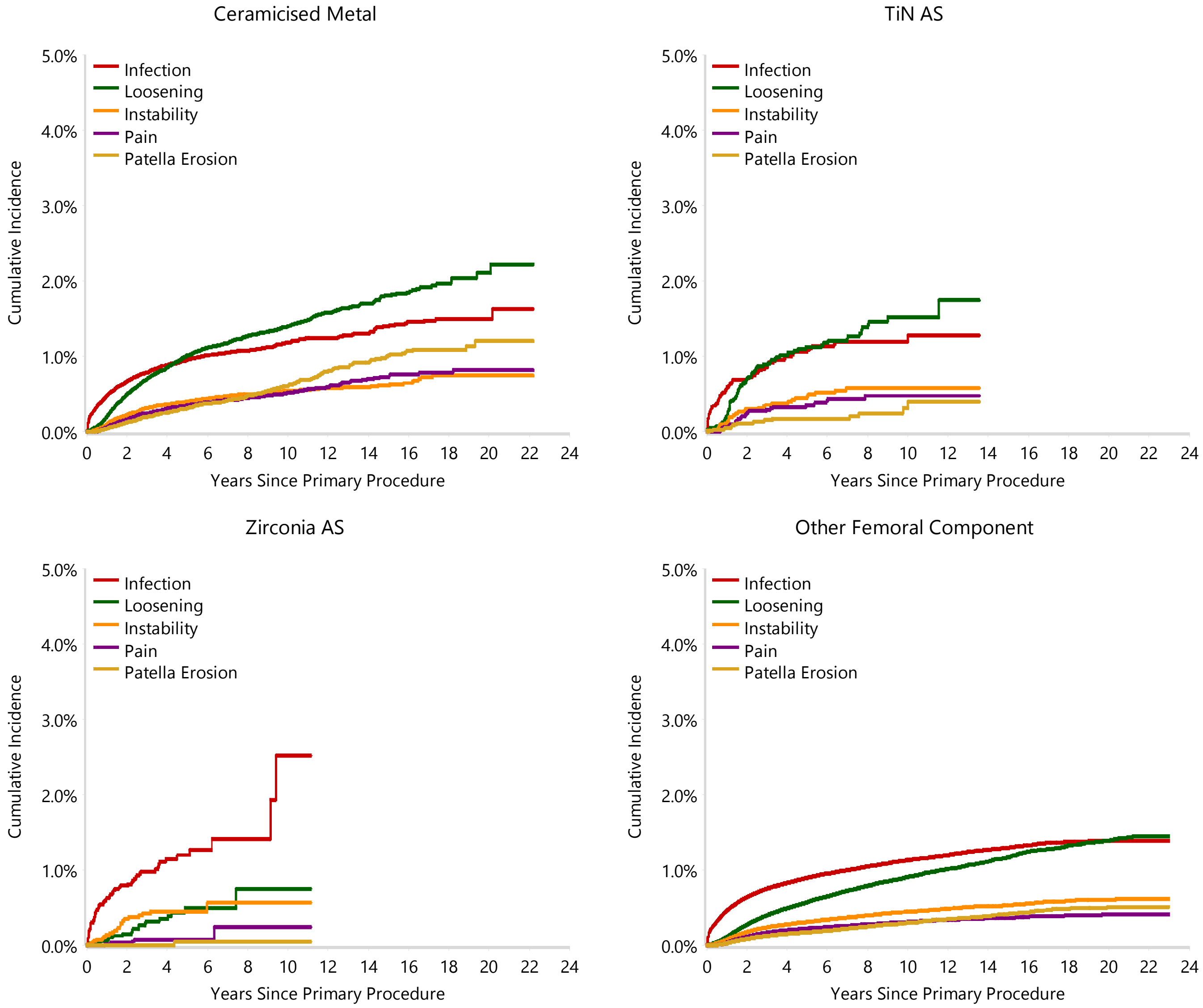
Zirconia AS vs Ceramicised Metal
0 - 6Mth: HR=1.22 (0.91, 1.63), p=0.193
6Mth+: HR=0.60 (0.49, 0.73), p<0.001

TiN AS vs Zirconia AS
Entire Period: HR=1.64 (1.34, 2.01), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Ceramicised Metal	66308	60448	50386	41028	18456	5359	443
TiN AS	6405	5893	4835	3731	957	4	0
Zirconia AS	7109	5864	3525	1499	116	0	0
Other Femoral Component	641300	570965	453271	347764	135346	32201	3841

Note: Restricted to modern prostheses.

Figure KT52 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by Femoral Material (Primary Diagnosis OA)



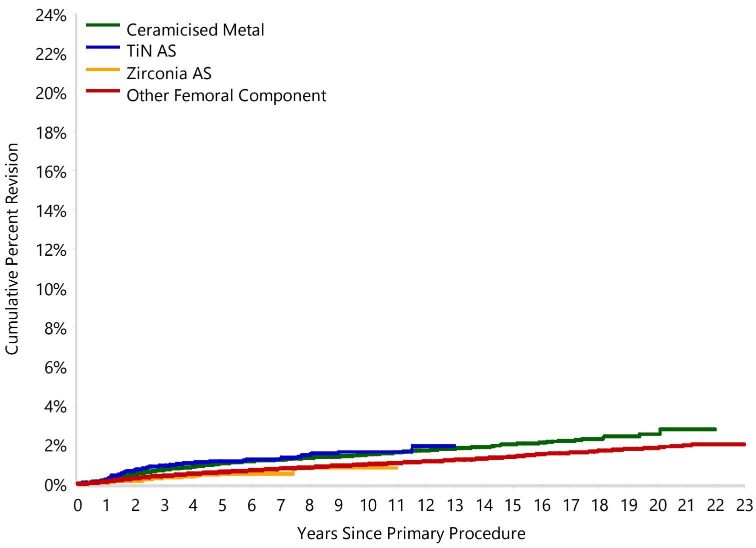
Note: Restricted to modern prostheses.

Table KT51 **Cumulative Percent Revision of AS Primary Total Knee Replacement by AS Femoral Material (Primary Diagnosis OA, Revision for Loosening)**

AS Femoral Material	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Ceramicised Metal	773	66308	0.2 (0.2, 0.2)	0.7 (0.6, 0.8)	1.0 (1.0, 1.1)	1.5 (1.4, 1.6)	2.0 (1.8, 2.2)	2.5 (2.2, 3.0)
TiN AS	75	6405	0.2 (0.1, 0.3)	0.9 (0.7, 1.2)	1.2 (0.9, 1.5)	1.6 (1.3, 2.1)		
Zirconia AS	21	7109	0.1 (0.0, 0.2)	0.3 (0.2, 0.5)	0.5 (0.3, 0.8)	0.8 (0.4, 1.7)		
Other Femoral Component	4265	641300	0.1 (0.1, 0.1)	0.4 (0.4, 0.4)	0.6 (0.6, 0.6)	1.0 (1.0, 1.0)	1.4 (1.3, 1.4)	1.8 (1.7, 2.0)
TOTAL	5134	721122						

Note: Restricted to modern prostheses

Figure KT53 **Cumulative Percent Revision of AS Primary Total Knee Replacement by AS Femoral Material (Primary Diagnosis OA, Revision for Loosening)**



HR - adjusted for age and gender

Ceramicised Metal vs Other Femoral Component
0 - 1.5Yr: HR=1.66 (1.44, 1.91), p<0.001
1.5Yr - 2.5Yr: HR=1.38 (1.14, 1.66), p<0.001
2.5Yr - 5Yr: HR=1.58 (1.36, 1.83), p<0.001
5Yr+: HR=1.02 (0.88, 1.18), p=0.768

TiN AS vs Other Femoral Component
0 - 2.5Yr: HR=2.43 (1.83, 3.21), p<0.001
2.5Yr+: HR=1.14 (0.77, 1.69), p=0.526

Zirconia AS vs Other Femoral Component
Entire Period: HR=0.71 (0.46, 1.08), p=0.112

TiN AS vs Ceramicised Metal
Entire Period: HR=1.23 (0.97, 1.56), p=0.083

Zirconia AS vs Ceramicised Metal
Entire Period: HR=0.46 (0.30, 0.71), p<0.001

TiN AS vs Zirconia AS
Entire Period: HR=2.52 (1.55, 4.09), p<0.001

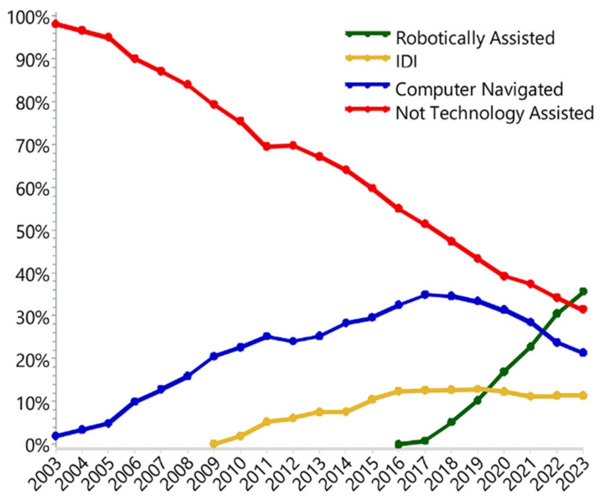
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Ceramicised Metal	66308	60448	50386	41028	18456	5359	443
TiN AS	6405	5893	4835	3731	957	4	0
Zirconia AS	7109	5864	3525	1499	116	0	0
Other Femoral Component	641300	570965	453271	347764	135346	32201	3841

Note: Restricted to modern prostheses

TECHNOLOGY ASSISTANCE

Computer navigation, image derived instrumentation (IDI) and robotic assistance, to aid implantation of knee replacements, have been grouped as 'technology assisted' methods. Procedures not using these methods have decreased to 31.5% of primary knee procedures in 2023. The increase in use of individual technology assisted methods is shown in Figure KT54. Results for primary total knee replacement for osteoarthritis with and without the use of these techniques are presented, followed by a comparison of the assistive technologies used with XLPE since 2016. Revision outcomes are analysed using each of these methods compared to where no assistive technology has been used.

Figure KT54 Primary Total Knee Replacement by Technology Assistance (Primary Diagnosis OA)



Note: Restricted to modern prostheses.

Computer Navigation

There have been 190,681 primary total knee replacement procedures using computer navigation. In 2023, computer navigation was used in 21.4% of all primary total knee replacement procedures.

When adjusted for age, gender, ASA, BMI, bearing surface, patella component usage and stability there is no difference in the rate of revision when procedures using computer navigation are compared to procedures with no technology assistance (Table KT52, Figure KT55 and Figure KT56).

Using the same adjustments, there is a lower rate of revision for patients aged <65 years when computer navigation is used compared to when no technology assistance is used. There is no difference when these comparisons are repeated for patients aged ≥65 years (Table KT53 and Figure KT57).

The outcomes of 9 prosthesis combinations used with computer navigation and without technology assistance and that have >5,000 procedures in each group are shown in Table KT54 and Table KT55.

Image Derived Instrumentation (IDI)

IDI is the use of custom-made pin guides or cutting blocks derived from CT or MRI images by 3D printing specifically for each patient.

There have been 66,238 primary total knee replacement procedures undertaken using IDI since 2009. In 2023, IDI was used in 11.4% of all primary total knee replacement procedures.

When procedures using IDI are compared to procedures without technology assistance and adjusted for age, gender, ASA, BMI, bearing surface, patella component usage and stability, IDI usage has a higher rate of revision (Table KT56 and Figure KT58). There is an increased proportion of revision for loosening when IDI is used (Figure KT59).

The effect of IDI on revision varies with age. Using the same adjustments, for patients aged ≥65 years where IDI is used, there is a higher rate of revision between 6 and 9 months and after 1.5 years compared to when no technology assistance is used. There is no difference with IDI use for patients aged <65 years (Table KT57 and Figure KT60).

The outcomes of 3 prosthesis combinations used with IDI and without technology assistance and that have >5,000 procedures in each group are shown in Table KT58 and Table KT59.

Robotic Assistance

Robotic assistance has been recorded for 71,906 total knee replacements since 2016. In 2023, robotic assistance was used in 35.7% of all primary total knee replacement procedures. There are 5 robotic systems that are used with a small number of prostheses, and many of these systems have limited follow-up.

When adjusted for age, gender, ASA, BMI, bearing surface, patella component usage and stability there is no difference in the rate of revision when procedures using robotic assistance are compared to procedures without technology assistance (Table KT60 and Figure KT61). There are fewer revisions for loosening and instability using robotic assistance (Figure KT62). Using the same adjustments, there is no difference in the rate of revision for patients aged <65 years or for patients aged ≥65 years when robotic assistance is used compared to when no assistive technology is used (Table KT61 and Figure KT63).

When adjusted for age, gender, ASA, BMI, bearing surface, patella component usage and stability there is no difference in the rate of revision when procedures using robotic assistance are compared to procedures without technology assistance.

Technology Assistance Compared
Total knee procedures since 2016 for osteoarthritis using XLPE with and without the use of assistive technology and adjusted for age, gender, ASA, BMI, patella component usage and stability are compared in Table KT62 and Figure KT64. There is no difference in the rate of revision when procedures using computer navigation, IDI, robotic assistance and no technology assistance are compared.

Prosthesis-Specific Analysis
There are two prostheses using XLPE that have been used both with and without technology assistance that have over 10,000 procedures in each group. The analyses for these two prostheses have been adjusted for age, gender, ASA, BMI, patella component usage and tibial fixation.

In addition, further analyses have been undertaken stratified by patella resurfacing.

There is no difference in the rate of revision when the Persona CR/Persona combination is used with robotic assistance compared to when computer navigation is used, and when compared to procedures without technology assistance (Table KT63 and Figure KT65).

There is also no difference in the rate of revision for the Persona CR/Persona combination when these analyses are repeated with or without use of a patella component (Table KT64, Figure KT66, Table KT65 and Figure KT67).

The Triathlon CR/Triathlon combination has a lower rate of revision when procedures using robotic assistance are compared to those using computer navigation and procedures without technology assistance, while there is no difference in the rate of revision when computer navigation is compared with no technology assistance (Table KT66 and Figure KT68).

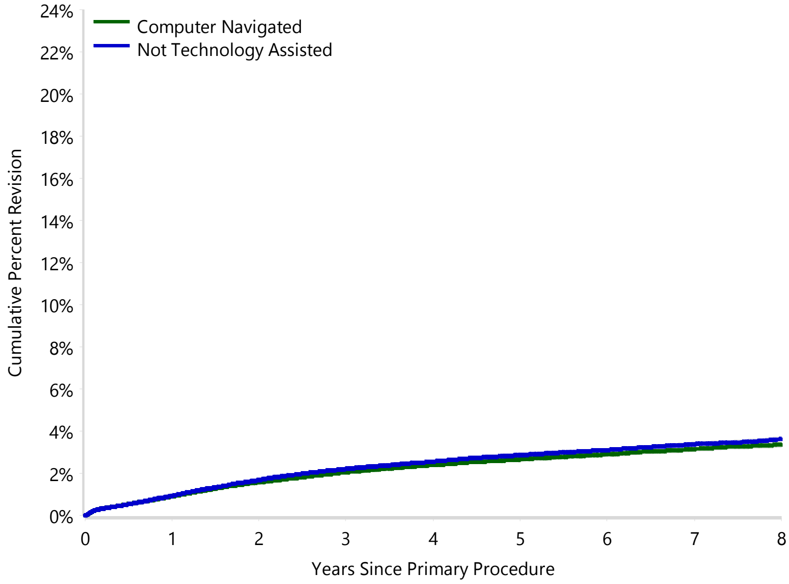
The rate of revision of the Triathlon CR/Triathlon combination, when using robotic assistance, is dependent on patellar resurfacing. When robotic assistance is used without patellar resurfacing, there is no difference in the rate of revision compared to using computer navigation or where no technology is used (Table KT67 and Figure KT69). When robotic assistance is used with patellar resurfacing, the rate of revision is lower than when computer navigation or no technology assistance is used (Table KT68 and Figure KT70).

Table KT52 Cumulative Percent Revision of Primary Total Knee Replacement Since 2015 by Computer Navigation (Primary Diagnosis OA)

Technology Assistance	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	6 Yrs	7 Yrs	8 Yrs
Computer Navigated	3159	137667	0.9 (0.9, 1.0)	2.1 (2.0, 2.1)	2.7 (2.6, 2.8)	2.9 (2.8, 3.0)	3.2 (3.0, 3.3)	3.4 (3.2, 3.5)
Not Technology Assisted	4839	194953	0.9 (0.9, 1.0)	2.2 (2.1, 2.3)	2.9 (2.8, 3.0)	3.1 (3.0, 3.2)	3.4 (3.3, 3.5)	3.6 (3.5, 3.7)
TOTAL	**7998**	**332620**						

Note: Restricted to modern prostheses. Restricted to procedures with known ASA, BMI, bearing surface, patella usage and stability.

Figure KT55 Cumulative Percent Revision of Primary Total Knee Replacement Since 2015 by Computer Navigation (Primary Diagnosis OA)



HR - adjusted for age, gender, ASA, BMI, bearing surface, patella component usage, and stability

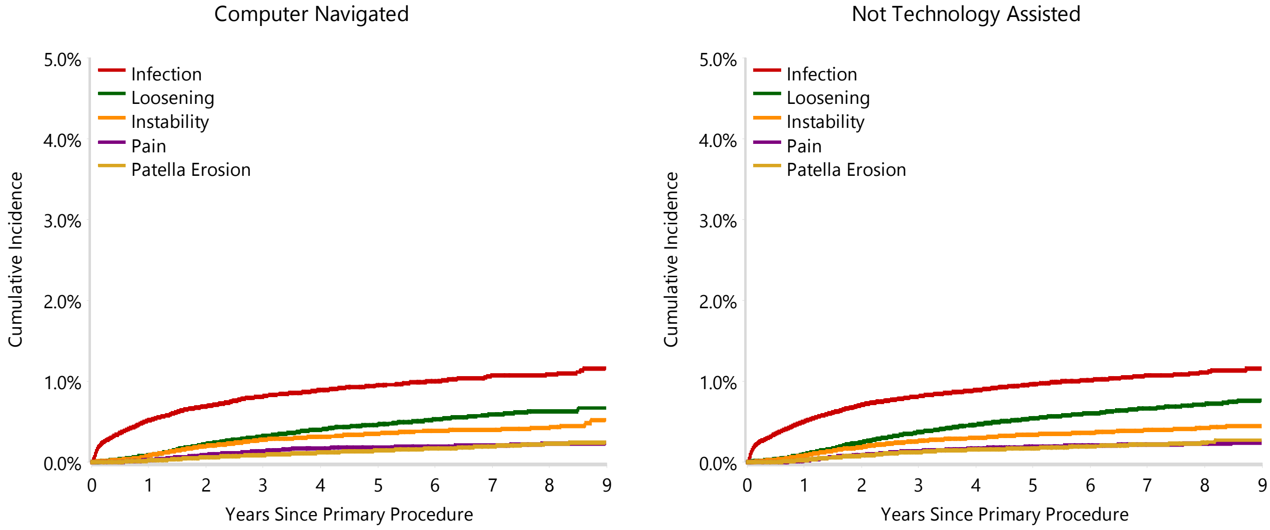
Non Technology Assisted vs Computer Navigated

Entire Period: HR= 0.98 (0.94, 1.03), p=0.453

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs	8 Yrs
Computer Navigated	137667	121530	106862	89462	72706	54925	37787	22043	9435
Not Technology Assisted	194953	171213	150033	127012	105861	82805	59728	37397	17212

Note: Restricted to modern prostheses. Restricted to procedures with known ASA, BMI, bearing surface, patella usage and stability.

Figure KT56 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement Since 2015 by Computer Navigation (Primary Diagnoses OA)



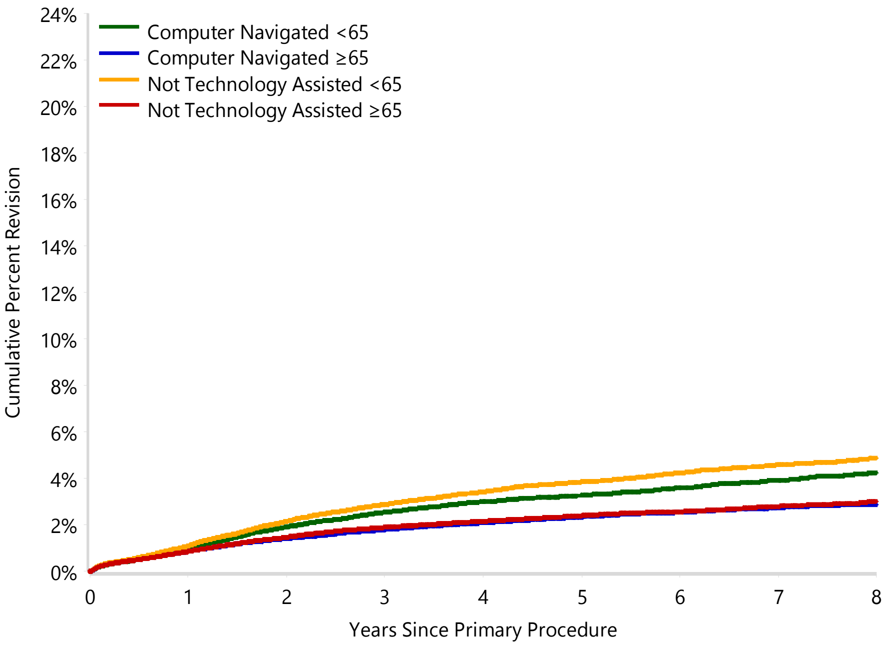
Note: Restricted to modern prostheses. Restricted to procedures with known ASA, BMI, bearing surface, patella usage and stability.

Table KT53 Cumulative Percent Revision of Primary Total Knee Replacement Since 2015 by Computer Navigation and Age (Primary Diagnosis OA)

Technology Assistance	Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	6 Yrs	7 Yrs	8 Yrs
Computer Navigated	<65	1359	46833	1.0 (0.9, 1.1)	2.5 (2.4, 2.7)	3.3 (3.1, 3.5)	3.6 (3.4, 3.8)	3.9 (3.7, 4.1)	4.3 (4.0, 4.5)
	≥65	1800	90834	0.9 (0.8, 0.9)	1.8 (1.7, 1.9)	2.3 (2.2, 2.5)	2.5 (2.4, 2.7)	2.8 (2.6, 2.9)	2.9 (2.7, 3.0)
Not Technology Assisted	<65	2085	61956	1.1 (1.0, 1.2)	2.9 (2.7, 3.0)	3.9 (3.7, 4.0)	4.2 (4.1, 4.4)	4.6 (4.4, 4.8)	4.9 (4.6, 5.1)
	≥65	2754	132997	0.9 (0.8, 0.9)	1.9 (1.8, 2.0)	2.4 (2.3, 2.5)	2.6 (2.5, 2.7)	2.8 (2.7, 2.9)	3.0 (2.9, 3.2)
TOTAL		7998	332620						

Note: Restricted to modern prostheses. Restricted to procedures with known ASA, BMI, bearing surface, patella usage and stability.

Figure KT57 Cumulative Percent Revision of Primary Total Knee Replacement Since 2015 by Computer Navigation and Age (Primary Diagnosis OA)



HR - adjusted for gender, ASA, BMI, bearing surface, patella component usage, and stability

Computer Navigated <65 vs Not Technology Assisted <65
Entire period: HR=0.93 (0.86, 0.99), p=0.031

Computer Navigated ≥65 vs Not Technology Assisted ≥65
Entire period: HR=1.04 (0.98, 1.10), p=0.226

Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs	8 Yrs
Computer Navigated	<65	46833	41815	37118	31531	26022	20054	14102	8371	3629
	≥65	90834	79715	69744	57931	46684	34871	23685	13672	5806
Not Technology Assisted	<65	61956	54869	48410	41241	34573	27600	20393	13135	6138
	≥65	132997	116344	101623	85771	71288	55205	39335	24262	11074

Note: Restricted to modern prostheses. Restricted to procedures with known ASA, BMI, bearing surface, patella usage and stability.

Table KT54 Cumulative Percent Revision of Primary Total Knee Replacement by Prosthesis Combination and Computer Navigation (Primary Diagnosis OA)

Prosthesis Combination	Technology Assistance	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Attune CR/Attune	Computer Navigated	188	9845	0.7 (0.6, 0.9)	1.8 (1.6, 2.2)	2.4 (2.1, 2.8)			
	Not Technology Assisted	471	18953	0.9 (0.8, 1.1)	2.3 (2.0, 2.5)	3.0 (2.7, 3.3)	3.8 (3.4, 4.2)		
Attune PS/Attune	Computer Navigated	135	6509	0.9 (0.7, 1.2)	2.0 (1.7, 2.4)	2.5 (2.0, 3.0)	4.5 (3.2, 6.4)		
	Not Technology Assisted	197	7936	0.8 (0.7, 1.1)	2.1 (1.8, 2.5)	2.7 (2.3, 3.1)	7.1 (4.3, 11.6)		
Genesis II Oxinium PS/ Genesis II	Computer Navigated	378	5801	1.3 (1.0, 1.6)	3.1 (2.6, 3.5)	4.5 (3.9, 5.0)	7.2 (6.5, 8.0)	10.0 (8.8, 11.2)	
	Not Technology Assisted	947	13629	1.5 (1.3, 1.7)	3.8 (3.4, 4.1)	5.0 (4.6, 5.4)	7.1 (6.6, 7.6)	9.2 (8.6, 9.9)	11.9 (10.0, 14.2)
Legion Oxinium PS/ Genesis II	Computer Navigated	188	5612	0.7 (0.5, 1.0)	2.3 (1.9, 2.7)	2.8 (2.4, 3.3)	4.3 (3.7, 5.1)		
	Not Technology Assisted	415	8656	1.3 (1.1, 1.5)	3.2 (2.8, 3.6)	4.2 (3.8, 4.7)	5.8 (5.2, 6.4)	8.2 (6.8, 9.9)	
Nexgen CR Flex/ Nexgen	Computer Navigated	395	15479	0.9 (0.7, 1.0)	1.9 (1.7, 2.1)	2.3 (2.0, 2.5)	3.0 (2.7, 3.4)	3.5 (3.0, 4.0)	
	Not Technology Assisted	1167	39491	0.7 (0.7, 0.8)	1.8 (1.6, 1.9)	2.2 (2.1, 2.4)	3.1 (2.9, 3.3)	4.0 (3.7, 4.3)	
Nexgen LPS Flex/ Nexgen	Computer Navigated	217	5335	1.3 (1.0, 1.6)	2.6 (2.2, 3.1)	3.4 (3.0, 4.0)	4.8 (4.2, 5.5)	5.3 (4.5, 6.2)	
	Not Technology Assisted	1185	23997	1.0 (0.9, 1.1)	2.4 (2.2, 2.6)	3.2 (3.0, 3.5)	5.2 (4.9, 5.5)	6.8 (6.4, 7.2)	
Persona CR/ Persona	Computer Navigated	254	15296	0.9 (0.7, 1.0)	1.8 (1.6, 2.1)	2.2 (1.9, 2.5)			
	Not Technology Assisted	285	19613	0.9 (0.8, 1.0)	2.0 (1.8, 2.3)	2.6 (2.3, 3.0)			
Triathlon CR/Triathlon	Computer Navigated	1788	68940	0.9 (0.8, 0.9)	2.0 (1.8, 2.1)	2.5 (2.4, 2.6)	3.7 (3.5, 3.9)	4.9 (4.4, 5.3)	
	Not Technology Assisted	1515	52018	0.8 (0.7, 0.9)	1.8 (1.7, 1.9)	2.4 (2.3, 2.5)	3.5 (3.3, 3.7)	4.9 (4.5, 5.2)	
Triathlon PS/ Triathlon	Computer Navigated	370	8454	1.5 (1.2, 1.8)	2.8 (2.4, 3.2)	3.6 (3.3, 4.1)	5.4 (4.8, 6.0)	7.1 (6.0, 8.3)	
	Not Technology Assisted	285	5289	1.6 (1.3, 2.0)	3.3 (2.8, 3.8)	4.1 (3.6, 4.7)	5.7 (5.1, 6.4)	6.9 (6.1, 7.9)	
TOTAL		10380	330853						

Note: Restricted to modern prostheses
Only prosthesis combinations with >5,000 procedures in both groups have been listed

Table KT55 Comparisons of Revision Rates for Primary Total Knee Replacement by Prosthesis Combination and Computer Navigation (Primary Diagnosis OA)

Comparison	HR -adjusted for age and gender
Attune CR/Attune Computer Navigated vs Attune CR/Attune Not Technology Assisted	Entire Period: HR=0.81 (0.68, 0.96), p=0.015
Attune PS/Attune Computer Navigated vs Attune PS/Attune Not Technology Assisted	Entire Period: HR=0.94 (0.76, 1.18), p=0.611
Genesis II Oxinium PS/Genesis II Computer Navigated vs Genesis II Oxinium PS/Genesis II Not Technology	0 - 3.5Yr: HR=0.79 (0.67, 0.94), p=0.006
	3.5Yr+: HR=1.22 (1.02, 1.45), p=0.025
Legion Oxinium PS/Genesis II Computer Navigated vs Legion Oxinium PS/Genesis II Not Technology Assisted	Entire Period: HR=0.71 (0.60, 0.85), p<0.001
Nexgen CR Flex/Nexgen Computer Navigated vs Nexgen CR Flex/Nexgen Not Technology Assisted	Entire Period: HR=0.97 (0.87, 1.09), p=0.631
Nexgen LPS Flex/Nexgen Computer Navigated vs Nexgen LPS Flex/Nexgen Not Technology Assisted	0 - 1.5Yr: HR=1.21 (0.97, 1.53), p=0.097
	1.5Yr+: HR=0.81 (0.67, 0.97), p=0.025
Persona CR/Persona Computer Navigated vs Persona CR/Persona Not Technology Assisted	Entire Period: HR=0.91 (0.77, 1.08), p=0.291
Triathlon CR/Triathlon Computer Navigated vs Triathlon CR/Triathlon Not Technology Assisted	0 - 3Yr: HR=1.05 (0.97, 1.15), p=0.238
	3Yr+: HR=0.95 (0.85, 1.06), p=0.383
Triathlon PS/Triathlon Computer Navigated vs Triathlon PS/Triathlon Not Technology Assisted	Entire Period: HR=0.90 (0.77, 1.05), p=0.185

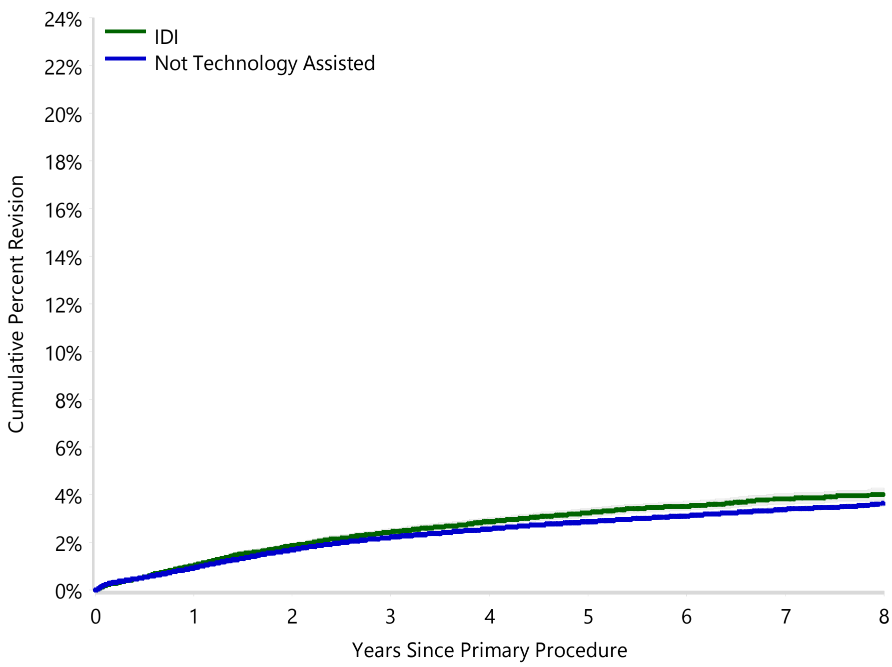
Primary Total Knee Replacement

Table KT56 Cumulative Percent Revision of Primary Total Knee Replacement Since 2015 by IDI Usage (Primary Diagnosis OA)

Technology Assistance	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	6 Yrs	7 Yrs	8 Yrs
IDI	1440	54686	1.0 (1.0, 1.1)	2.4 (2.3, 2.6)	3.2 (3.1, 3.4)	3.5 (3.3, 3.7)	3.8 (3.6, 4.0)	4.0 (3.8, 4.3)
Not Technology Assisted	4839	194953	0.9 (0.9, 1.0)	2.2 (2.1, 2.3)	2.9 (2.8, 3.0)	3.1 (3.0, 3.2)	3.4 (3.3, 3.5)	3.6 (3.5, 3.7)
TOTAL	6279	249639						

Note: Restricted to modern prostheses. Restricted to procedures with ASA, BMI, bearing surface, patella usage and known stability.

Figure KT58 Cumulative Percent Revision of Primary Total Knee Replacement Since 2015 by IDI Usage (Primary Diagnosis OA)



HR - adjusted for age, gender, ASA, BMI, bearing surface, patella component usage, and stability

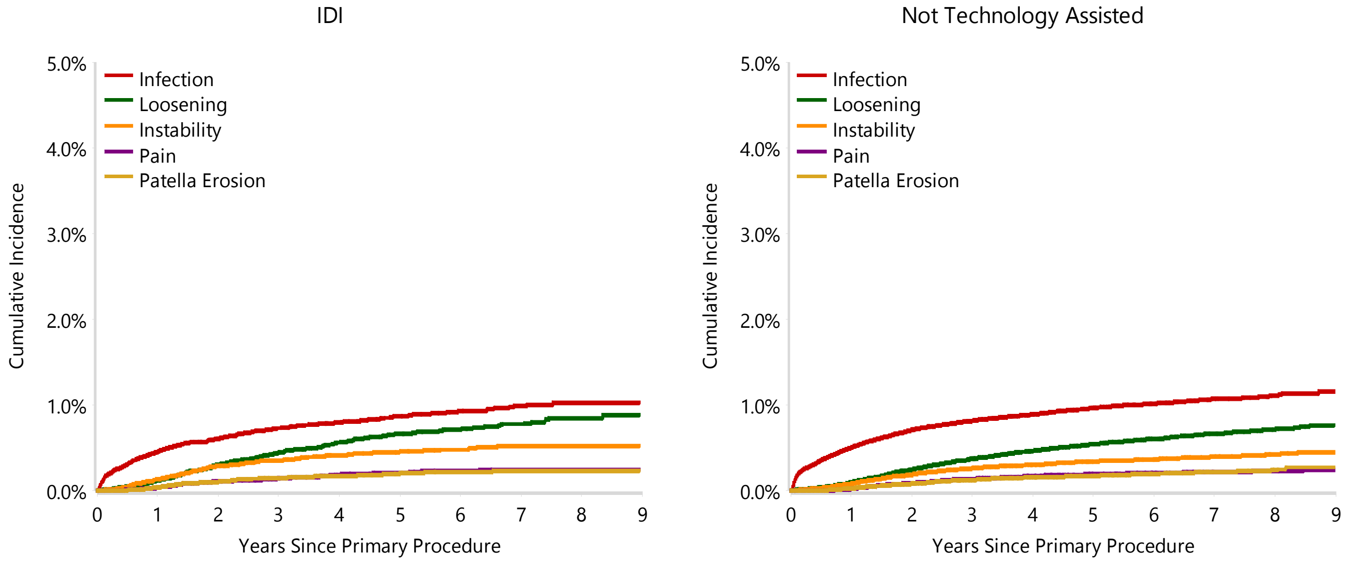
IDI Used vs Not Technology Assisted

Entire Period: HR=1.12 (1.05, 1.19), p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs	8 Yrs
IDI	54686	46749	40124	33376	27008	20204	13933	8212	3423
Not Technology Assisted	194953	171213	150033	127012	105861	82805	59728	37397	17212

Note: Restricted to modern prostheses. Restricted to procedures with known ASA, BMI, bearing surface, patella usage and stability.

Figure KT59 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement Since 2015 by IDI Usage (Primary Diagnosis OA)



Note: Restricted to modern prostheses. Restricted to procedures with known ASA, BMI, bearing surface, patella usage and stability.

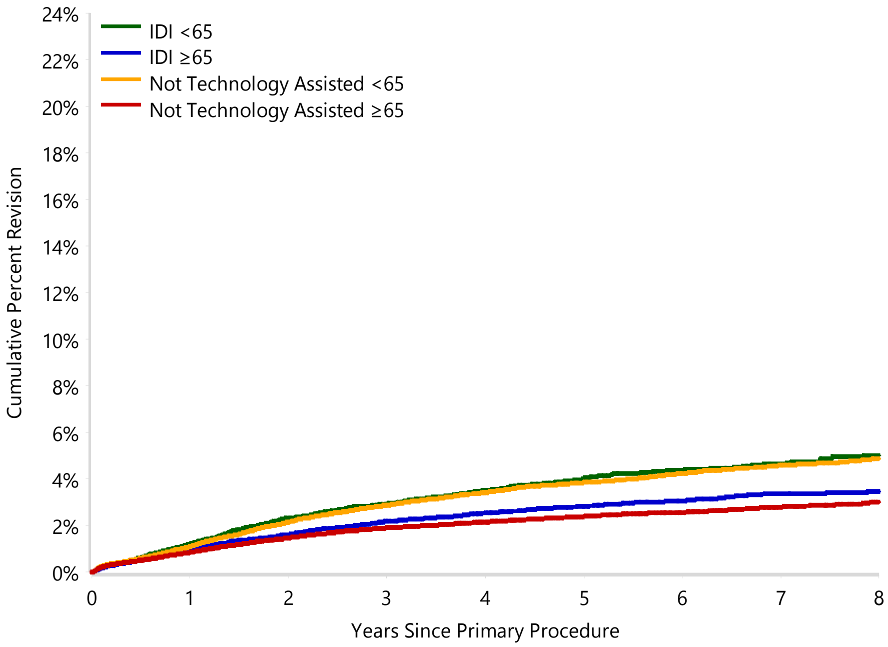
Primary Total Knee Replacement

Table KT57 Cumulative Percent Revision of Primary Total Knee Replacement Since 2015 by IDI Usage and Age (Primary Diagnosis OA)

Technology Assistance	Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	6 Yrs	7 Yrs	8 Yrs
IDI	<65	611	18413	1.2 (1.1, 1.4)	2.9 (2.7, 3.2)	4.0 (3.7, 4.4)	4.4 (4.0, 4.8)	4.7 (4.3, 5.1)	5.0 (4.6, 5.5)
	≥65	829	36273	0.9 (0.9, 1.1)	2.2 (2.0, 2.4)	2.8 (2.6, 3.0)	3.1 (2.8, 3.3)	3.4 (3.1, 3.6)	3.5 (3.2, 3.7)
Not Technology Assisted	<65	2085	61956	1.1 (1.0, 1.2)	2.9 (2.7, 3.0)	3.9 (3.7, 4.0)	4.2 (4.1, 4.4)	4.6 (4.4, 4.8)	4.9 (4.6, 5.1)
	≥65	2754	132997	0.9 (0.8, 0.9)	1.9 (1.8, 2.0)	2.4 (2.3, 2.5)	2.6 (2.5, 2.7)	2.8 (2.7, 2.9)	3.0 (2.9, 3.2)
TOTAL		6279	249639						

Note: Restricted to modern prostheses. Restricted to procedures with known ASA, BMI, bearing surface, patella usage and stability.

Figure KT60 Cumulative Percent Revision of Primary Total Knee Replacement Since 2015 by IDI Usage and Age (Primary Diagnosis OA)



HR - adjusted for gender, ASA, BMI, bearing surface, patella component usage, and stability

IDI <65 vs Not Technology Assisted <65
Entire Period: HR=1.06 (0.96, 1.16), p=0.257

IDI ≥65 vs Not Technology Assisted ≥65
0-6Mth: HR=1.02 (0.86, 1.20), p=0.818
6Mth-9Mth: HR=1.48 (1.16, 1.88) , p=0.002
9Mth-1.5Yr: HR=1.17 (1.00, 1.38), p=0.055
1.5Yr+: HR=1.22 (1.08, 1.36), p<0.001

Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs	8 Yrs
IDI	<65	18413	15922	13853	11654	9462	7183	5034	3059	1342
	≥65	36273	30827	26271	21722	17546	13021	8899	5153	2081
Not Technology Assisted	<65	61956	54869	48410	41241	34573	27600	20393	13135	6138
	≥65	132997	116344	101623	85771	71288	55205	39335	24262	11074

Note: Restricted to modern prostheses. Restricted to procedures with known ASA, BMI, bearing surface, patella usage and stability.

Table KT58 Cumulative Percent Revision of Primary Total Knee Replacement by Prosthesis Combination and IDI Usage (Primary Diagnosis OA)

Prosthesis Combination	Technology Assistance	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
GMK Sphere Primary/ GMK Primary	IDI	324	14710	1.3 (1.1, 1.5)	2.5 (2.3, 2.9)	3.0 (2.7, 3.4)	3.5 (3.0, 4.0)		
	Not Technology Assisted	190	6486	1.2 (1.0, 1.6)	3.0 (2.5, 3.5)	3.6 (3.1, 4.1)	4.2 (3.6, 4.9)	4.9 (4.1, 5.8)	
Nexgen CR Flex/ Nexgen	IDI	168	5420	0.8 (0.6, 1.0)	2.0 (1.7, 2.4)	2.5 (2.1, 3.0)	2.9 (2.5, 3.4)	3.4 (2.9, 4.0)	
	Not Technology Assisted	1167	39491	0.7 (0.7, 0.8)	1.8 (1.6, 1.9)	2.2 (2.1, 2.4)	2.6 (2.4, 2.7)	3.1 (2.9, 3.3)	3.7 (3.5, 4.0)
Persona CR/Persona	IDI	108	7105	0.9 (0.7, 1.2)	1.8 (1.5, 2.2)	2.3 (1.8, 2.8)			
	Not Technology Assisted	285	19613	0.9 (0.8, 1.0)	2.0 (1.8, 2.3)	2.6 (2.3, 3.0)	2.8 (2.3, 3.5)		
TOTAL		2242	92825						

Note: Restricted to modern prostheses. Only prosthesis combinations with >5,000 procedures in both groups are listed

Table KT59 Comparisons of Revision Rates for Primary Total Knee Replacement by Prosthesis Combination and IDI Usage (Primary Diagnosis OA)

Comparison	HR -adjusted for age and gender
GMK Sphere Primary/GMK Primary IDI vs GMK Sphere Primary/ GMK Primary Not Technology Assisted	0 - 9Mth: HR=1.31 (0.94, 1.81), p=0.110
	9Mth+: HR=0.67 (0.54, 0.84), p<0.001
Nexgen CR Flex/Nexgen IDI vs Nexgen CR Flex/ Nexgen Not Technology Assisted	Entire Period: HR=1.05 (0.90, 1.24), p=0.529
Persona CR/Persona IDI vs Persona CR/ Persona Not Technology Assisted	Entire Period: HR=0.85 (0.68, 1.06), p=0.149

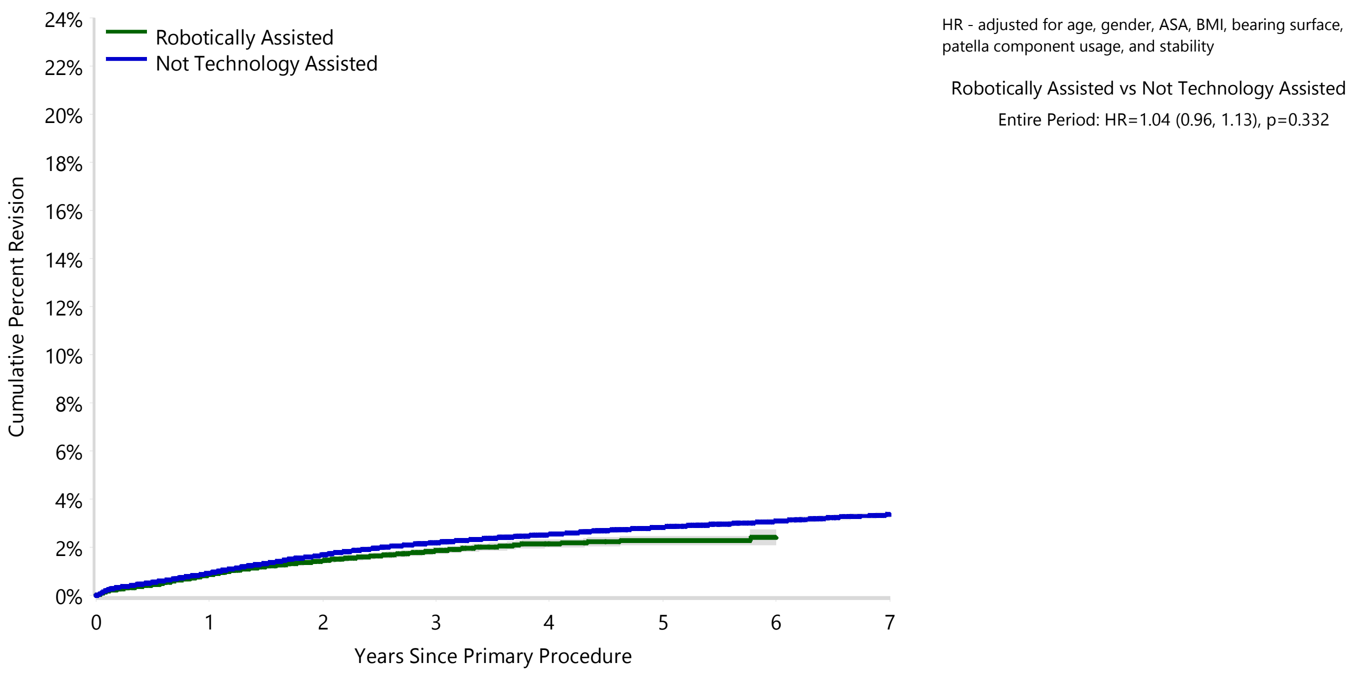
Primary Total Knee Replacement

Table KT60 Cumulative Percent Revision of Primary Total Knee Replacement Since 2016 by Robotic Assistance (Primary Diagnosis OA)

Technology Assistance	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Robotically Assisted	886	71505	0.9 (0.8, 0.9)	1.4 (1.3, 1.6)	1.9 (1.7, 2.0)	2.2 (2.0, 2.3)	2.3 (2.1, 2.5)	2.4 (2.1, 2.7)
Not Technology Assisted	4058	174394	0.9 (0.9, 1.0)	1.7 (1.6, 1.7)	2.2 (2.1, 2.3)	2.5 (2.5, 2.6)	2.8 (2.8, 2.9)	3.1 (3.0, 3.2)
TOTAL	**4944**	**245899**						

Note: Restricted to modern prostheses. Restricted to procedures with known ASA, BMI, bearing surface, patella usage and stability

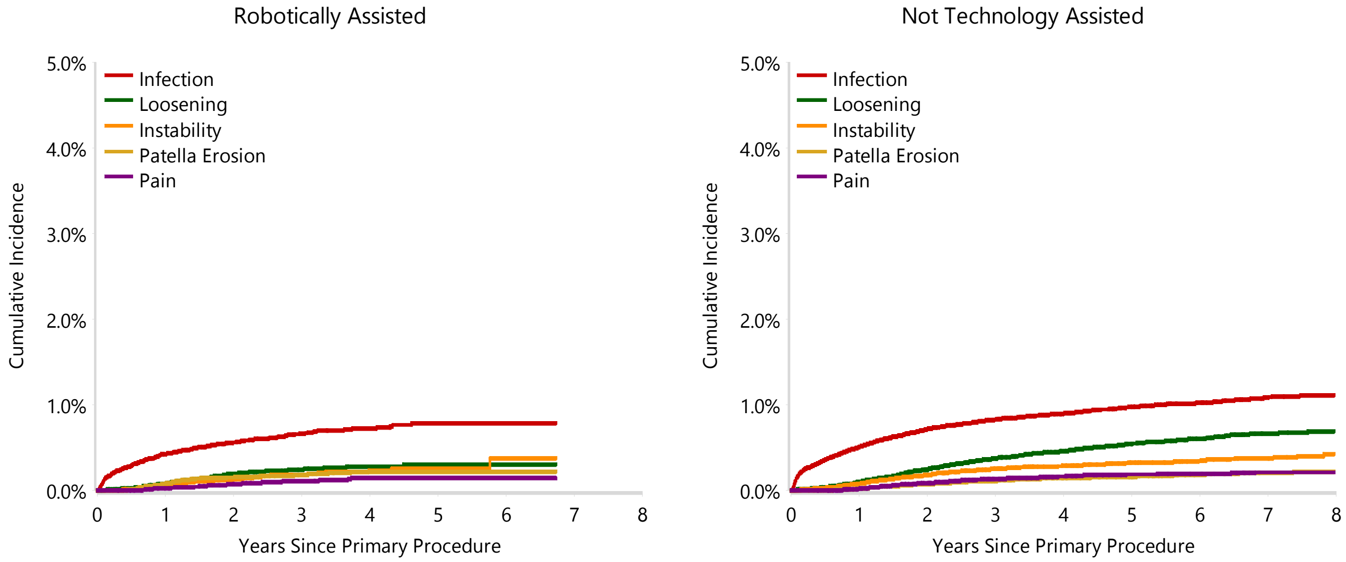
Figure KT61 Cumulative Percent Revision of Primary Total Knee Replacement Since 2016 by Robotic Assistance (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Robotically Assisted	71505	46837	29652	16648	8079	2872	379
Not Technology Assisted	174394	150969	130121	107448	86684	64019	41404

Note: Restricted to modern prostheses. Restricted to procedures with known ASA, BMI, bearing surface, patella usage and stability

Figure KT62 **Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement Since 2016 by Robotic Assistance (Primary Diagnoses OA)**



Note: Restricted to modern prostheses. Restricted to procedures with known ASA, BMI, bearing surface, patella usage and stability

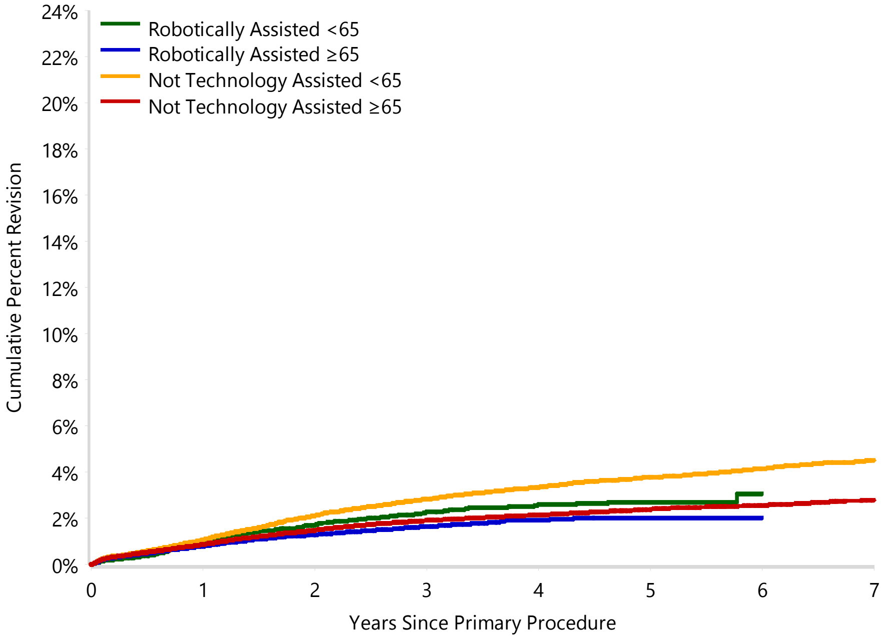
Primary Total Knee Replacement

Table KT61 Cumulative Percent Revision of Primary Total Knee Replacement Since 2016 by Robotic Assistance and Age (Primary Diagnosis OA)

Technology Assistance	Age	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Robotically Assisted	<65	357	24151	1.0 (0.9, 1.1)	1.7 (1.5, 1.9)	2.3 (2.0, 2.5)	2.6 (2.3, 2.9)	2.7 (2.4, 3.1)	3.1 (2.4, 4.0)
	≥65	529	47354	0.8 (0.7, 0.9)	1.3 (1.2, 1.4)	1.6 (1.5, 1.8)	1.9 (1.7, 2.1)	2.0 (1.8, 2.3)	2.0 (1.8, 2.3)
Not Technology Assisted	<65	1718	55203	1.1 (1.0, 1.2)	2.1 (2.0, 2.2)	2.8 (2.7, 3.0)	3.3 (3.2, 3.5)	3.8 (3.6, 4.0)	4.2 (4.0, 4.4)
	≥65	2340	119191	0.9 (0.8, 0.9)	1.5 (1.4, 1.6)	1.9 (1.8, 2.0)	2.1 (2.1, 2.2)	2.4 (2.3, 2.5)	2.6 (2.5, 2.7)
TOTAL		4944	245899						

Note: Restricted to modern prostheses. Restricted to procedures with known ASA, BMI, bearing surface, patella usage and mobility

Figure KT63 Cumulative Percent Revision of Primary Total Knee Replacement Since 2016 by Robotic Assistance and Age (Primary Diagnosis OA)



HR - adjusted for gender, ASA, BMI, bearing surface, patella component usage, and stability

Robotically Assisted <65 vs Not Technology Assisted <65
Entire Period: HR=0.91 (0.81, 1.02), p=0.116

Robotically Assisted ≥65 vs Not Technology Assisted ≥65
Entire Period: HR=1.02 (0.92, 1.12), p=0.737

Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Robotically Assisted	<65	24151	16271	10415	5915	2814	1059	147
	≥65	47354	30566	19237	10733	5265	1813	232
Not Technology Assisted	<65	55203	48223	41857	34767	28180	21271	14119
	≥65	119191	102746	88264	72681	58504	42748	27285

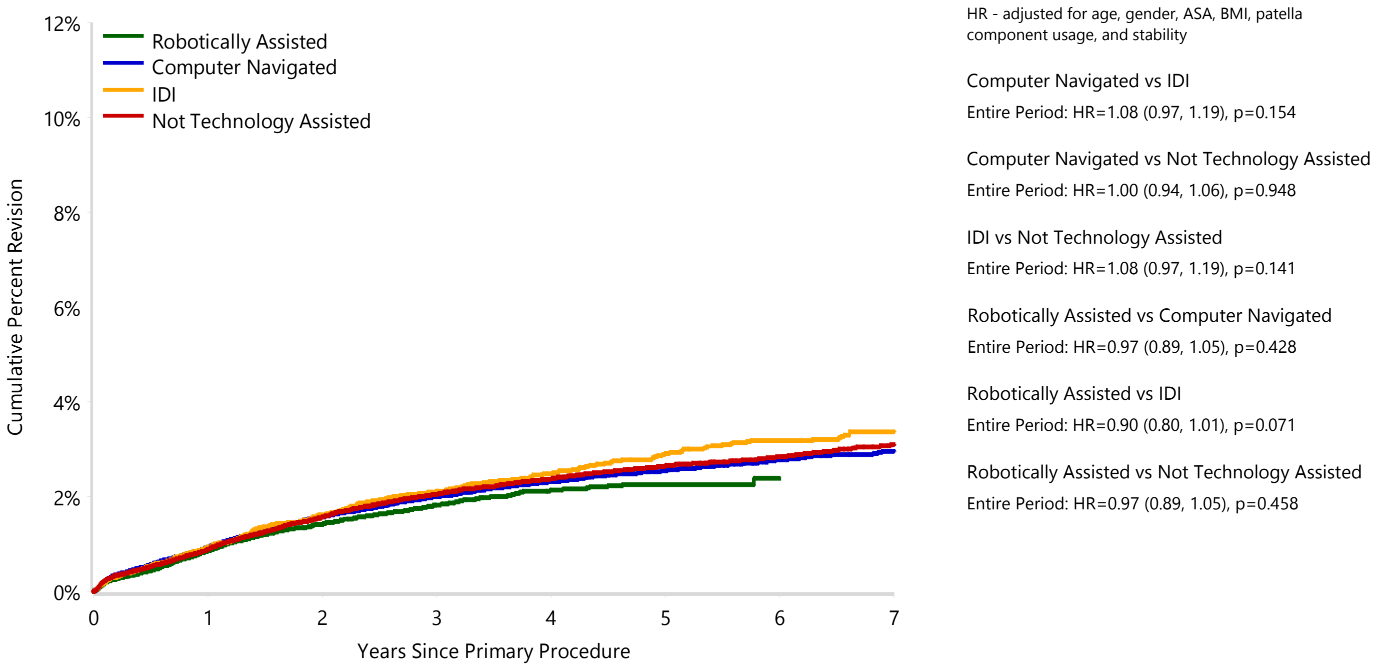
Note: Restricted to modern prostheses. Restricted to procedures with known ASA, BMI, bearing surface, patella usage and stability

Table KT62 Cumulative Percent Revision of Primary Total Knee Replacement Using XLPE Since 2016 by Technology Assistance (Primary Diagnosis OA)

Technology Assistance	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs
Robotically Assisted	865	70782	0.9 (0.8, 0.9)	1.4 (1.3, 1.5)	1.8 (1.7, 2.0)	2.1 (2.0, 2.3)	2.2 (2.1, 2.4)	2.4 (2.1, 2.7)	
Computer Navigated	2166	103976	0.9 (0.9, 1.0)	1.6 (1.5, 1.7)	2.0 (1.9, 2.1)	2.3 (2.2, 2.4)	2.6 (2.4, 2.7)	2.8 (2.7, 2.9)	3.0 (2.8, 3.1)
IDI	448	19435	0.9 (0.8, 1.1)	1.6 (1.4, 1.8)	2.1 (1.9, 2.3)	2.5 (2.2, 2.7)	2.9 (2.6, 3.2)	3.2 (2.9, 3.5)	3.4 (3.0, 3.7)
Not Technology Assisted	2285	109251	0.9 (0.8, 1.0)	1.6 (1.5, 1.7)	2.1 (2.0, 2.2)	2.4 (2.3, 2.5)	2.7 (2.5, 2.8)	2.8 (2.7, 3.0)	3.1 (3.0, 3.3)
TOTAL	**5764**	**303444**							

Note: Restricted to modern prostheses.
Only procedures with known ASA, BMI, patella usage and stability are included
Medial pivot design prostheses have been excluded due to small number of revisions

Figure KT64 Cumulative Percent Revision of Primary Total Knee Replacement Using XLPE Since 2016 by Technology Assistance (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs
Robotically Assisted	70782	46196	29098	16263	7812	2785	373	8
Computer Navigated	103976	90207	77814	63223	49661	35334	21660	9419
IDI	19435	16668	14328	11910	9576	6907	4394	1977
Not Technology Assisted	109251	92780	78287	63143	50105	36422	23050	10504

Note: Restricted to modern prostheses.

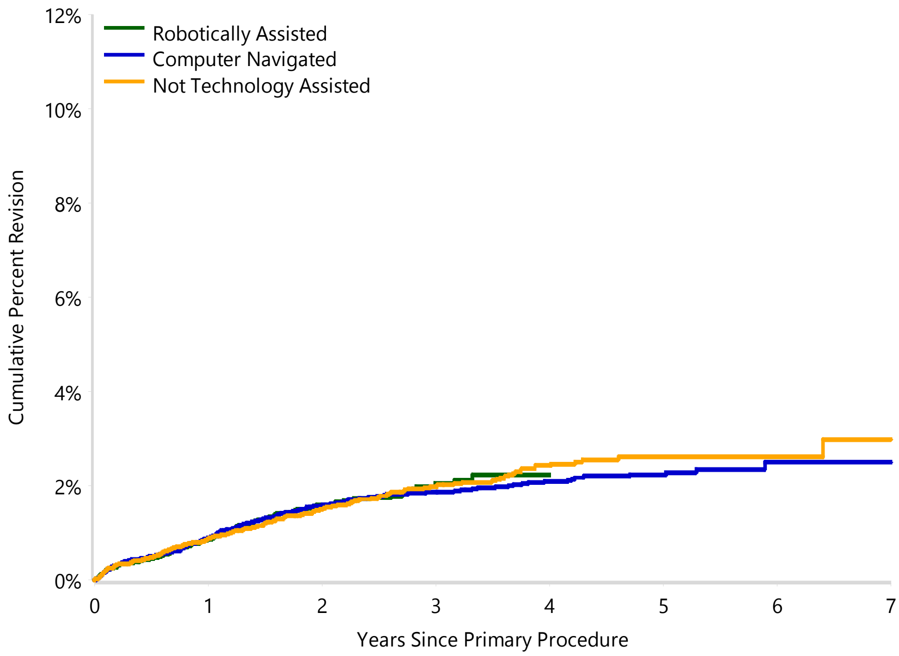
Primary Total Knee Replacement

Table KT63 **Cumulative Percent Revision of Persona CR/Persona Primary Total Knee Replacement Using XLPE Since 2016 by Technology Assistance (Primary Diagnosis OA)**

Technology Assistance	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs
Robotically Assisted	198	17187	0.9 (0.7, 1.0)	1.6 (1.4, 1.9)	2.0 (1.7, 2.4)	2.2 (1.8, 2.7)			
Computer Navigated	250	14929	0.9 (0.8, 1.1)	1.6 (1.4, 1.8)	1.9 (1.6, 2.1)	2.1 (1.8, 2.4)	2.2 (2.0, 2.6)	2.5 (2.1, 3.0)	2.5 (2.1, 3.0)
Not Technology Assisted	274	19152	0.9 (0.7, 1.0)	1.5 (1.3, 1.7)	2.0 (1.7, 2.3)	2.4 (2.1, 2.8)	2.6 (2.3, 3.0)	2.6 (2.3, 3.0)	3.0 (2.3, 3.9)
TOTAL	722	51268							

Note: Restricted to modern prostheses.
Restricted to procedures with known ASA and BMI

Figure KT65 **Cumulative Percent Revision of Persona CR/Persona Primary Total Knee Replacement Using XLPE Since 2016 by Technology Assistance (Primary Diagnosis OA)**



HR - adjusted for age, gender, ASA, BMI, patella component usage and tibial fixation

Computer Navigated vs Not Technology Assisted
Entire Period: HR=0.95 (0.80, 1.13), p=0.557

Robotically Assisted vs Computer Navigated Entire Period: HR=1.27 (0.87, 1.86), p=0.221

Robotically Assisted vs Not Technology Assisted
Entire Period: HR=0.94 (0.78, 1.14), p=0.553

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs
Robotically Assisted	17187	10485	5141	1770	146	1	0	0
Computer Navigated	14929	12070	10108	7377	4531	2046	593	77
Not Technology Assisted	19152	13574	8999	5077	2591	1172	426	116

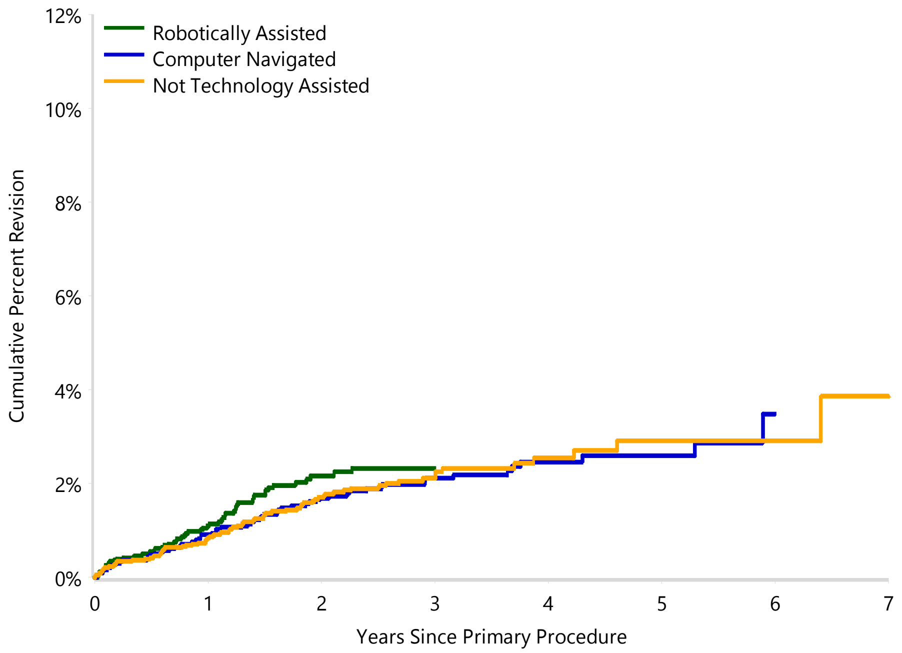
Note: Restricted to modern prostheses.

Table KT64 Cumulative Percent Revision of Persona CR/Persona Primary Total Knee Replacement Using XLPE without a Patella Component Since 2016 by Technology Assistance (Primary Diagnosis OA)

Technology Assistance	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs
Robotically Assisted	58	3938	1.1 (0.8, 1.5)	2.2 (1.7, 2.8)	2.3 (1.8, 3.0)				
Computer Navigated	61	3292	0.9 (0.6, 1.3)	1.7 (1.3, 2.3)	2.1 (1.6, 2.8)	2.5 (1.9, 3.2)	2.6 (2.0, 3.4)	3.5 (2.3, 5.3)	
Not Technology Assisted	85	5464	0.8 (0.6, 1.1)	1.7 (1.3, 2.2)	2.1 (1.7, 2.7)	2.5 (2.0, 3.3)	2.9 (2.2, 3.8)	2.9 (2.2, 3.8)	3.9 (2.3, 6.5)
TOTAL	204	12694							

Note: Restricted to modern prostheses
Restricted to procedures with known ASA and BMI

Figure KT66 Cumulative Percent Revision of Persona CR/Persona Primary Total Knee Replacement Using XLPE without a Patella Component Since 2016 by Technology Assistance (Primary Diagnosis OA)



HR - adjusted for age, gender, ASA, BMI, and tibial fixation

Computer Navigated vs Not Technology Assisted
Entire Period: HR=0.96 (0.69, 1.34), p=0.830

Robotically Assisted vs Computer Navigated
Entire Period: HR=1.27 (0.87, 1.86), p=0.221

Robotically Assisted vs Not Technology Assisted
Entire Period: HR=1.22 (0.86, 1.75), p=0.266

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs
Robotically Assisted	3938	2370	1373	471	5	0	0	0
Computer Navigated	3292	2582	2197	1561	892	442	137	22
Not Technology Assisted	5464	3917	2584	1480	764	361	160	43

Note: Restricted to modern prostheses.

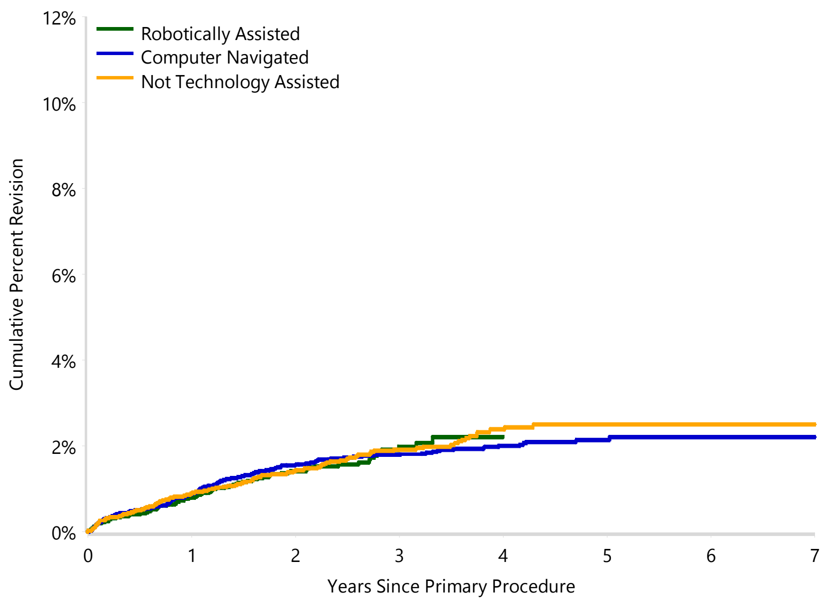
Primary Total Knee Replacement

Table KT65 **Cumulative Percent Revision of Persona CR/Persona Primary Total Knee Replacement Using XLPE with a Patella Component Since 2016 by Technology Assistance (Primary Diagnosis OA)**

Technology Assistance	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs
Robotically Assisted	140	13249	0.8 (0.7, 1.0)	1.4 (1.2, 1.7)	2.0 (1.6, 2.5)	2.2 (1.7, 2.8)			
Computer Navigated	189	11637	0.9 (0.7, 1.1)	1.6 (1.3, 1.8)	1.8 (1.5, 2.1)	2.0 (1.7, 2.3)	2.1 (1.8, 2.5)	2.2 (1.9, 2.6)	2.2 (1.9, 2.6)
Not Technology Assisted	189	13688	0.9 (0.7, 1.1)	1.4 (1.2, 1.7)	1.9 (1.6, 2.2)	2.4 (2.0, 2.8)	2.5 (2.1, 3.0)	2.5 (2.1, 3.0)	2.5 (2.1, 3.0)
TOTAL	518	38574							

Note: Restricted to modern prostheses.
Restricted to procedures with known ASA and BMI

Figure KT67 **Cumulative Percent Revision of Persona CR/Persona Primary Total Knee Replacement Using XLPE with a Patella Component Since 2016 by Technology Assistance (Primary Diagnosis OA)**



HR - adjusted for age, gender, ASA, BMI, and tibial fixation

Computer Navigated vs Not Technology Assisted
Entire Period: HR=0.95 (0.77, 1.16), p=0.610

Robotically Assisted vs Computer Navigated
Entire Period: HR=0.92 (0.73, 1.15), p=0.474

Robotically Assisted vs Not Technology Assisted
Entire Period: HR=0.87 (0.70, 1.09), p=0.236

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs
Robotically Assisted	13249	8115	3768	1299	141	1	0	0
Computer Navigated	11637	9488	7911	5816	3639	1604	456	55
Not Technology Assisted	13688	9657	6415	3597	1827	811	266	73

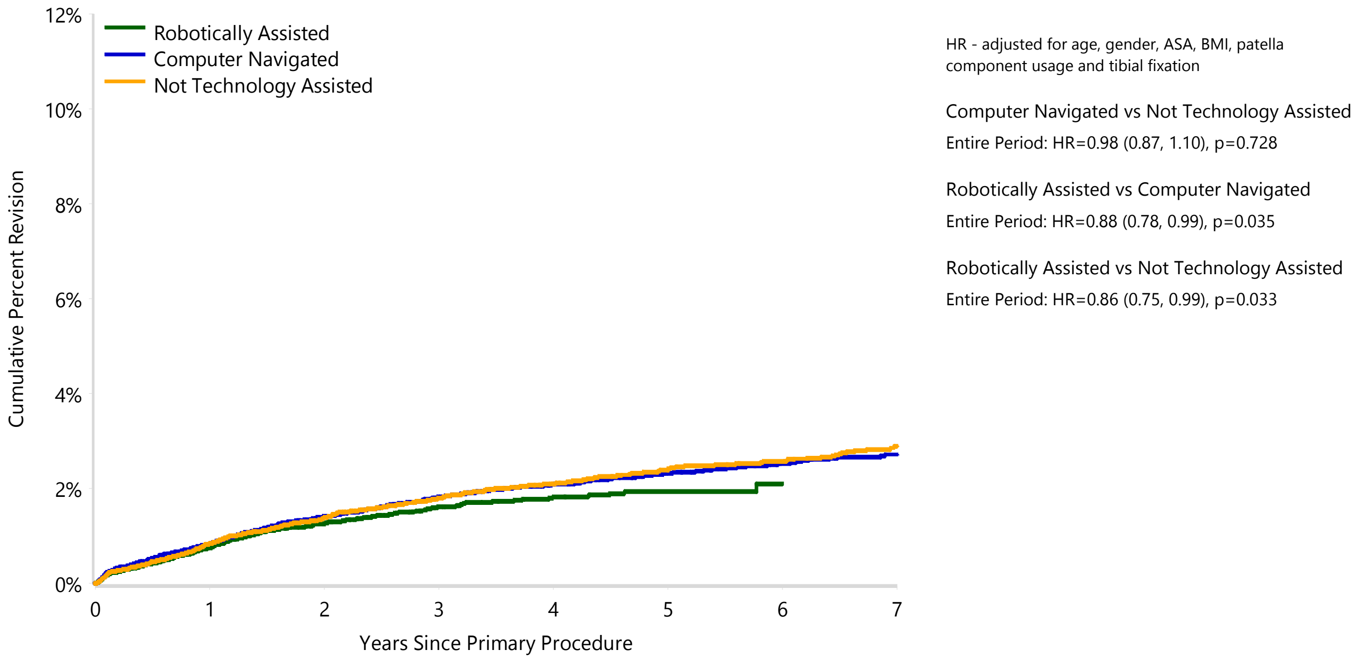
Note: Restricted to modern prostheses.

Table KT66 Cumulative Percent Revision of Triathlon CR/Triathlon Primary Total Knee Replacement Using XLPE Since 2016 by Technology Assistance (Primary Diagnosis OA)

Technology Assistance	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs
Robotically Assisted	486	42692	0.8 (0.7, 0.9)	1.3 (1.1, 1.4)	1.6 (1.5, 1.8)	1.8 (1.6, 2.0)	1.9 (1.7, 2.1)	2.1 (1.7, 2.5)	
Computer Navigated	812	43193	0.8 (0.8, 0.9)	1.4 (1.3, 1.5)	1.8 (1.7, 2.0)	2.1 (1.9, 2.2)	2.3 (2.2, 2.5)	2.5 (2.4, 2.7)	2.7 (2.5, 2.9)
Not Technology Assisted	464	23121	0.8 (0.7, 1.0)	1.4 (1.2, 1.6)	1.8 (1.6, 2.0)	2.1 (1.9, 2.3)	2.4 (2.2, 2.7)	2.6 (2.3, 2.8)	2.9 (2.6, 3.2)
TOTAL	1762	109006							

Note: Restricted to modern prostheses
Only procedures with known ASA, BMI are included
Excludes 33 procedures using IDI

Figure KT68 Cumulative Percent Revision of Triathlon CR/Triathlon Primary Total Knee Replacement Using XLPE Since 2016 by Technology Assistance (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs
Robotically Assisted	42692	29240	19742	11703	5989	2173	323	7
Computer Navigated	43193	36754	31446	25920	20891	15423	9749	4416
Not Technology Assisted	23121	20102	17632	15041	12522	9340	5949	2898

Note: Restricted to modern prostheses.

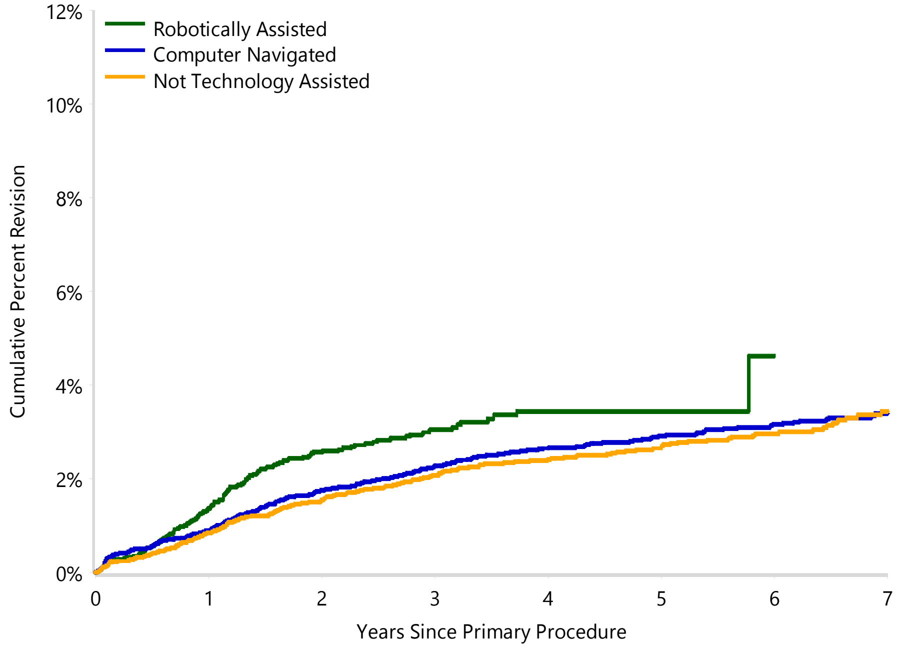
Primary Total Knee Replacement

Table KT67 Cumulative Percent Revision of Triathlon CR/Triathlon Primary Total Knee Replacement Using XLPE without a Patella Component Since 2016 by Technology Assistance (Primary Diagnosis OA)

Technology Assistance	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs
Robotically Assisted	161	7404	1.4 (1.1, 1.7)	2.6 (2.2, 3.0)	3.0 (2.6, 3.6)	3.4 (2.9, 4.1)	3.4 (2.9, 4.1)	4.6 (2.8, 7.7)	
Computer Navigated	363	14768	0.9 (0.8, 1.1)	1.8 (1.5, 2.0)	2.3 (2.0, 2.5)	2.7 (2.4, 3.0)	2.9 (2.6, 3.2)	3.2 (2.8, 3.5)	3.4 (3.0, 3.8)
Not Technology Assisted	231	9906	0.8 (0.7, 1.1)	1.6 (1.3, 1.8)	2.1 (1.8, 2.4)	2.4 (2.1, 2.8)	2.7 (2.4, 3.1)	3.0 (2.6, 3.4)	3.4 (3.0, 4.0)
TOTAL	755	32078							

Note: Restricted to modern prostheses
Only procedures with known ASA, BMI are included

Figure KT69 Cumulative Percent Revision of Triathlon CR/Triathlon Primary Total Knee Replacement Using XLPE without a Patella Component Since 2016 by Technology Assistance (Primary Diagnosis OA)



HR - adjusted for age, gender, ASA, BMI, and Tibial Fixation

Computer Navigated vs Not Technology Assisted
Entire Period: HR=0.99 (0.84, 1.17), p=0.908

Robotically Assisted vs Computer Navigated
Entire Period: HR=1.19 (0.98, 1.45), p=0.073

Robotically Assisted vs Not Technology Assisted
Entire Period: HR=1.18 (0.96, 1.46), p=0.124

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs
Robotically Assisted	7404	5199	3509	1965	939	360	42	0
Computer Navigated	14768	13016	11457	9625	7874	5880	3789	1778
Not Technology Assisted	9906	8649	7691	6619	5517	4030	2500	1177

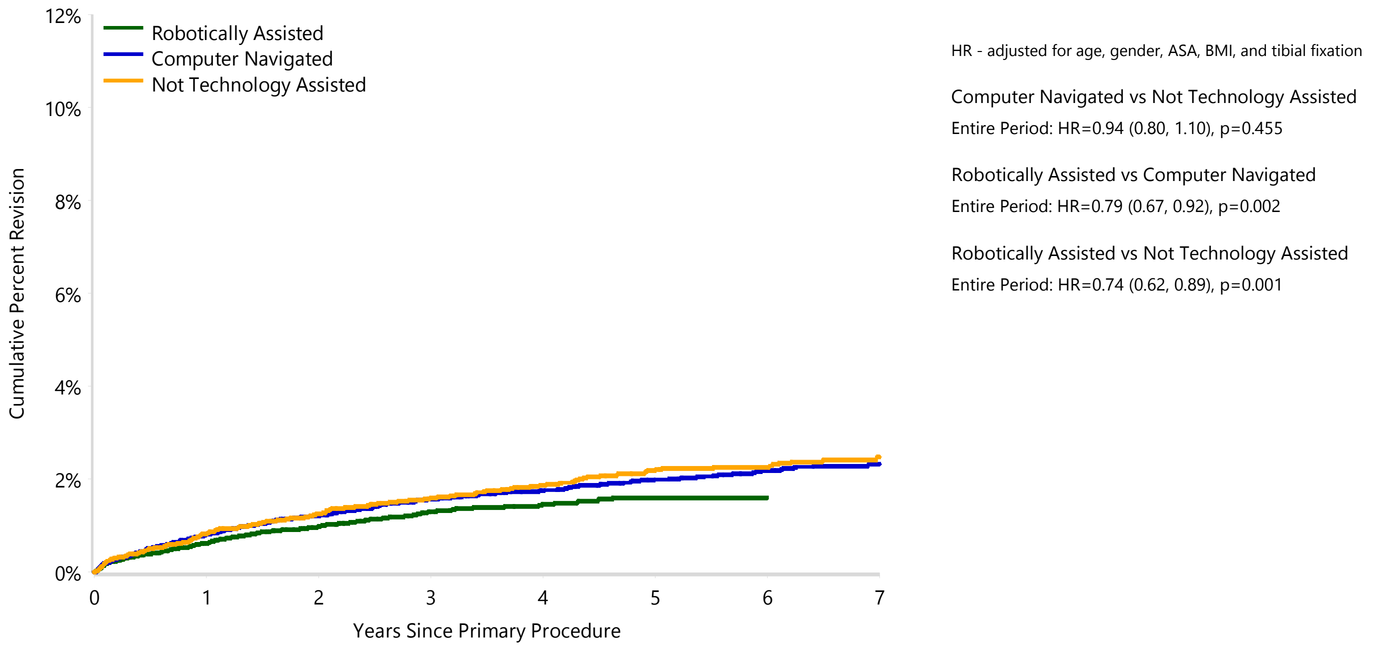
Note: Restricted to modern prostheses.

Table KT68 Cumulative Percent Revision of Triathlon CR/Triathlon Primary Total Knee Replacement Using XLPE with a Patella Component Since 2016 by Technology Assistance (Primary Diagnosis OA)

Technology Assistance	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs
Robotically Assisted	325	35288	0.6 (0.5, 0.7)	1.0 (0.9, 1.1)	1.3 (1.2, 1.5)	1.5 (1.3, 1.7)	1.6 (1.4, 1.8)	1.6 (1.4, 1.8)	
Computer Navigated	449	28425	0.8 (0.7, 0.9)	1.2 (1.1, 1.4)	1.6 (1.4, 1.7)	1.8 (1.6, 1.9)	2.0 (1.8, 2.2)	2.2 (2.0, 2.4)	2.3 (2.1, 2.6)
Not Technology Assisted	233	13215	0.8 (0.7, 1.0)	1.3 (1.1, 1.5)	1.6 (1.4, 1.8)	1.9 (1.6, 2.1)	2.2 (1.9, 2.5)	2.3 (2.0, 2.6)	2.5 (2.1, 2.8)
TOTAL	1007	76928							

Note: Restricted to modern prostheses.
Only procedures with known ASA, BMI are included

Figure KT70 Cumulative Percent Revision of Triathlon CR/Triathlon Primary Total Knee Replacement Using XLPE with a Patella Component Since 2016 by Technology Assistance (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs
Robotically Assisted	35288	24041	16233	9738	5050	1813	281	7
Computer Navigated	28425	23738	19989	16295	13017	9543	5960	2638
Not Technology Assisted	13215	11453	9941	8422	7005	5310	3449	1721

Note: Restricted to modern prostheses.
Posterior stabilised procedures have been excluded due to small numbers

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Shoulder Replacement

Shoulder Replacement

Categories of Shoulder Replacement

Shoulder replacement is grouped into three broad categories: primary partial, primary total, and revision shoulder replacement.

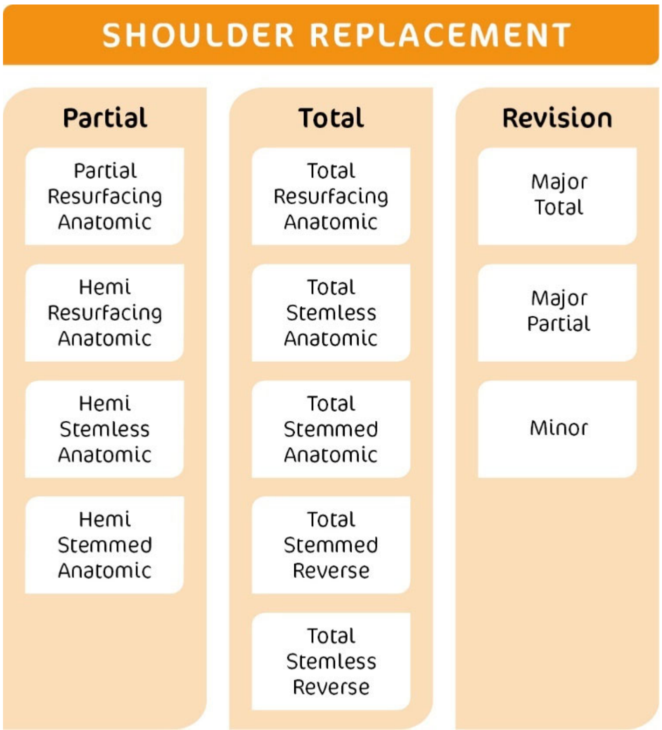
A primary replacement is an initial procedure undertaken on a joint and involves replacing either part (partial) or all (total) of the articular surface.

Primary partial and primary total shoulder replacements are further categorised into subclasses depending on the type of prosthesis used. Partial shoulder subclasses include partial resurfacing anatomic, hemi resurfacing anatomic, hemi stemless anatomic and hemi stemmed anatomic.

Primary total shoulder replacement is subcategorised into five classes. These are defined by the type of prosthesis used. The use of stemless anatomic shoulder replacement has been growing considerably. As such mid head humeral prostheses are now classified as stemless anatomic and stemless reverse to reflect their differing polarity.

Total shoulder subclasses include total resurfacing anatomic, total stemless anatomic, total stemmed anatomic, total stemmed reverse and total stemless reverse. Definitions for each of these classes are detailed in the subsequent sections.

Revision shoulder replacements are re-operations of previous shoulder replacements where one or more of the prosthetic components are replaced, removed, or another component is added. Revisions include subsequent operations of primary partial, primary total, or previous revision procedures. Shoulder revision procedures are categorised into three subclasses: major total, major partial and minor shoulder replacement.



Detailed demographic information on shoulder replacement is available in the supplementary report 'Demographics of Hip, Knee and Shoulder Arthroplasty' on the AOANJRR website: https://aoanjrr.sahmri.com/annual-reports-2024

Executive Summary Reference Tables

This year, new tables (Table S1 and Table S2) have been added which index the analyses within this chapter. Variables are listed, and where there is a significant finding for a comparison, a red diamond is shown in the table. There are hyperlinks to the relevant tables and figures.

Table S1 Indexing Significant Characteristic Comparisons: Total Shoulder Anatomic Replacements

Characteristic	Variable	Total Stemless Anatomic		Total Stemmed Anatomic	
		Significant HR	Figure No.	Significant HR	Figure No.
	Diagnosis				
	Comparison to pre- 2015	NT			
Patient					
	Age			♦	Figure ST36
	Gender by Age	♦	Figure ST14	♦	Figure ST38 Figure ST39
	Gender			♦	Figure ST37
	ASA Score	♦	Figure ST16		
	ASA by Gender	NT		♦	Figure ST42
	BMI				
	BMI by Gender	♦	Figure ST19	♦	Figure ST44
	Glenoid Morphology				
Prostheses					
	Fixation	♦	Figure ST21	♦	Figure ST47
	Glenoid Type	♦	Figure ST22	♦	Figure ST48
	Augmented Glenoid	NT		♦	Figure ST49
	Glenoid Morphology by Augmented Glenoid	NT		♦	Figure ST51
	Bearing Surface			♦	Figure ST52
	Humeral Head Size			♦	Figure ST53
	Humeral Stem Length	NT		♦	Figure ST55
	Technology Assistance				

♦ Significant Hazard Ratio difference between categories where p<0.05

N T Not tested: Insufficient numbers to make statistical comparisons

Table S2 Indexing Significant Characteristic Comparisons: Total Stemmed Reverse Shoulder Replacements

Characteristic	Variable	Total Stemmed Reverse					
		Osteoarthritis		Rotator Cuff Arthropathy		Fracture	
		Significant HR	Figure No.	Significant HR	Figure No.	Significant HR	Figure No.
	Diagnosis	♦	Figure ST62	♦	Figure ST62	♦	Figure ST62
	Comparison to pre-2015	♦	Figure ST65	♦	Figure ST90		
Patient							
	Age	♦	Figure ST67	♦	Figure ST92	♦	Figure ST117
	Gender by Age	♦	Figure ST70 Figure ST71	♦	Figure ST95 Figure ST96	♦	Figure ST121
	Gender	♦	Figure ST68	♦	Figure ST93	♦	Figure ST118
	ASA Score	♦	Figure ST72	♦	Figure ST97		
	ASA by Gender	♦	Figure ST74	♦	Figure ST99	♦	Figure ST124
	BMI	♦	Figure ST75			♦	Figure ST125
	BMI by Gender	♦	Figure ST77	♦	Figure ST102	♦	Figure ST127
	Glenoid Morphology						
Prostheses							
	Fixation						
	Bearing Surface			♦	Figure ST108	♦	Figure ST135
	Glenosphere Size	♦	Figure ST86			♦	Figure ST137
	Glenosphere Lateralisation						
	Glenoid Morphology by Augmented Glenoid						
	Humeral Stem Length	♦	Figure ST82				
	Humeral Stem Type					♦	Figure ST131
	Fixation by Humeral Stem Type	NT		NT		♦	Figure ST132
	Technology Assistance	♦	Figure ST89			NT	

♦ Significant Hazard Ratio difference between categories where p<0.05

N T Not tested: Insufficient numbers to make statistical comparisons

Use of Shoulder Replacement

There are 95,786 shoulder replacements with a procedure date up to and including 31 December 2023. This is an additional 10,436 shoulder procedures since the last report.

For further information on the **closure of the database** please see the **Glossary** of this report.

Registry shoulder data collection commenced in 2004 and full national collection was implemented by November 2007.

The number of shoulder replacement procedures undertaken in 2023 increased by 1,235 (13.9% compared to the previous year and has increased by 284.7% since 2008.

When considering all shoulder replacement procedures currently recorded by the Registry, primary total shoulder replacement is the most common, followed by primary partial and revision procedures (Table S3).

In 2023, the proportion of revision procedures has declined to 6.9%, this equates to 403 fewer revisions compared to the peak of 10.9%

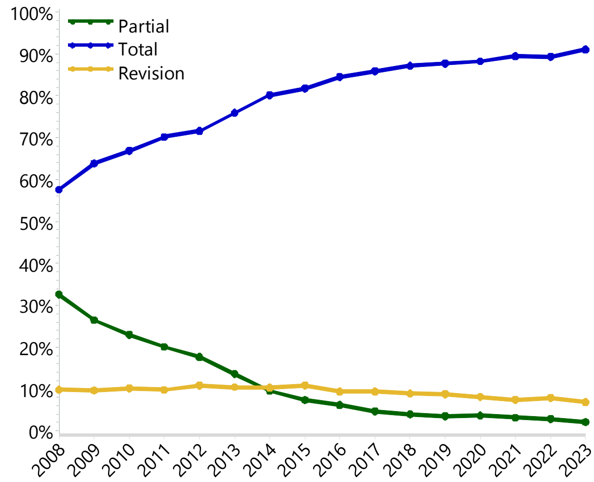
Table S3 Number of Shoulder Replacements

Shoulder Category	Number	Percent
Partial	8107	8.5
Total	79117	82.6
Revision	8562	8.9
TOTAL	95786	100.0

Since 2008, there has been a proportional increase in the use of total shoulder replacement, a continued decline in the use of partial shoulder replacement and a small decrease in the proportion of revision procedures (Figure S1).

The proportion of total shoulder replacements has increased from 57.6% in 2008 to 91.0% in 2023.

Figure S1 Proportion of Shoulder Replacements



ASA and BMI in Shoulder Replacement

Data are reported on shoulder replacement procedures for both the American Society of Anaesthesiologists Physical Status Classification (ASA score) and Body Mass Index (BMI). ASA score and BMI are both known to impact the outcome of shoulder replacement surgery. The Registry commenced collection of ASA score in 2012 and BMI data in 2015.

There are ASA score data on 74,323 and BMI data on 62,877 shoulder replacement procedures. Since its initial collection, ASA score has been recorded for 96.1% of procedures. BMI has been recorded for 92.0% of procedures since collection commenced.

ASA SCORE

There are five ASA score classifications: [11]

1. A normal healthy patient
2. A patient with mild systemic disease
3. A patient with severe systemic disease
4. A patient with severe systemic disease that is a constant threat to life
5. A moribund patient who is not expected to survive without the operation

Differences in ASA scores by procedure category are presented in Table S4. Whilst the proportions of normal and severely ill are not changing, ASA 3 is increasing with time (Figure S2).

BMI CATEGORY

BMI for adults is classified by the World Health Organisation into six main categories:[12]

Underweight	<18.50
Normal	18.50 – 24.99
Pre-obese	25.00 – 29.99
Obese Class 1	30.00 – 34.99
Obese Class 2	35.00 – 39.99
Obese Class 3	≥40.00

For all shoulder replacements, the majority of procedures are undertaken in patients who are pre-obese or obese class 1 (61.4%) (Table S5). Proportions of BMI classes over time are not changing (Figure S3).

Table S4 ASA Score for Shoulder Replacement

ASA Score	Partial		Total		Revision		TOTAL	
	N	Col%	N	Col%	N	Col%	N	Col%
ASA 1	400	12.1	2400	3.7	193	3.0	2993	4.0
ASA 2	1465	44.2	27774	43.0	2247	35.3	31486	42.4
ASA 3	1338	40.4	32675	50.5	3633	57.1	37646	50.7
ASA 4	109	3.3	1790	2.8	291	4.6	2190	2.9
ASA 5	.	.	8	0.0	.	.	8	0.0
TOTAL	3312	100.0	64647	100.0	6364	100.0	74323	100.0

Note: A further 21,463 procedures did not have ASA score recorded

Table S5 BMI Category for Shoulder Replacement

BMI Category	Partial		Total		Revision		TOTAL	
	N	Col%	N	Col%	N	Col%	N	Col%
Underweight (<18.50)	25	1.1	382	0.7	49	1.0	456	0.7
Normal (18.50-24.99)	427	19.0	9203	16.6	909	17.7	10539	16.8
Pre Obese (25.00-29.99)	784	34.8	18904	34.1	1653	32.1	21341	33.9
Obese Class 1 (30.00-34.99)	566	25.1	15239	27.5	1473	28.6	17278	27.5
Obese Class 2 (35.00-39.99)	275	12.2	7518	13.6	670	13.0	8463	13.5
Obese Class 3 (≥40.00)	175	7.8	4237	7.6	388	7.5	4800	7.6
TOTAL	**2252**	**100.0**	**55483**	**100.0**	**5142**	**100.0**	**62877**	**100.0**

Note: BMI has not been presented for patients aged ≤19 years

[11] https://www.asahq.org/standards-and-practice-parameters/statement-on-asa-physical-status-classification-system

[12] https://www.who.int/europe/news-room/fact-sheets/item/a-healthy-lifestyle---who-recommendations

Figure S2 Proportion of Shoulder Replacements by ASA Score

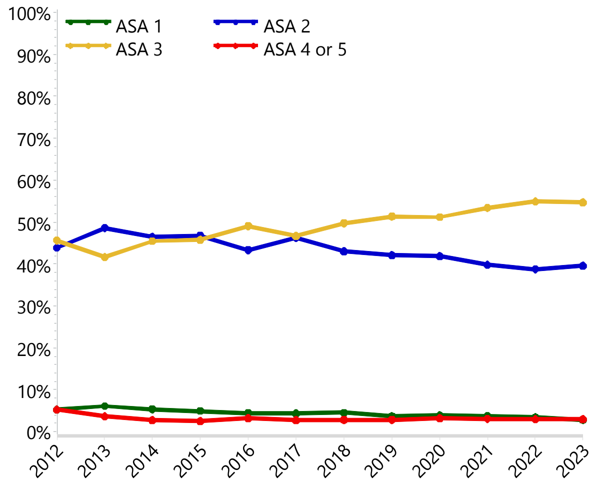
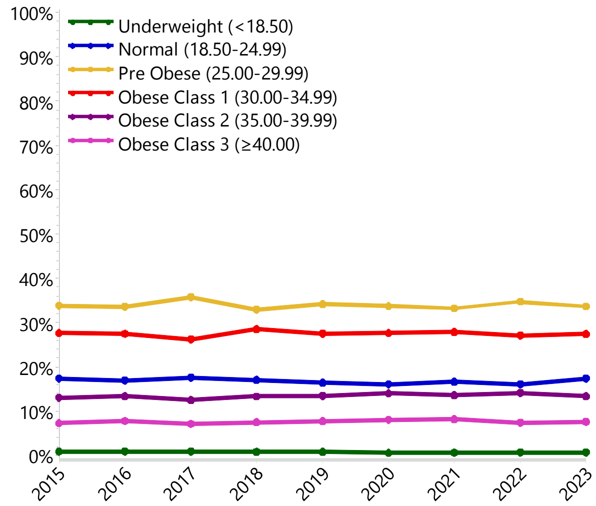


Figure S3 Proportion of Shoulder Replacements by BMI Category



CT Scan and Glenoid Morphology

Data are reported on shoulder replacement procedures for both CT scans and glenoid morphology. The Registry commenced collection of CT scan usage and glenoid morphology in January 2017.

The number of procedures with CT scan usage data and glenoid morphology data by shoulder procedure category are listed in Table S6 and Table S7.

CT SCANS

There is a difference depending on the class of shoulder replacement. Total shoulder replacement procedures have a higher proportion of CT scans compared to revision shoulder replacement and partial shoulder replacement. CT utilisation for shoulder replacement cases has risen from under 60% in 2017 to over 81% in 2023 (Figure S4). In contrast, the relative percentages of glenoid morphology categories have not changed (Figure S5).

> Overall, a CT scan was undertaken in 72.2% of shoulder replacements.

GLENOID MORPHOLOGY

There are 5 glenoid morphology categories based on the Walch classification:[13]

A1. Humeral head centred – minor erosion

A2. Humeral head centred – major erosion

B1. Humeral head posteriorly subluxated narrowing of the posterior joint space, subchondral sclerosis and osteophytes

B2. Humeral head posteriorly subluxated – posterior rim erosion with a biconcave glenoid

C. Glenoid retroversion of more than 25 degrees, regardless of the erosion

The most common glenoid morphology category is A1 for all shoulder procedure categories. The second most common is A2 for total and revision shoulder replacement with A2 and B2 for partial shoulder replacement (Table S7).

[13] Walch G, Badet R, Boulahia A, Khoury A. Morphologic study of the glenoid in primary glenohumeral osteoarthritis. J Arthroplasty. 1999 Sep 1;14(6):756-60.

Shoulder Replacement

Table S6 Usage of CT Scan for Shoulder Replacement

CT Scan Usage	Partial		Total		Revision		TOTAL	
	N	Col%	N	Col%	N	Col%	N	Col%
Yes	894	51.0	36507	76.1	1647	37.9	39048	72.2
No	809	46.1	10821	22.6	2410	55.5	14040	26.0
Unknown	50	2.9	650	1.4	286	6.6	986	1.8
TOTAL	1753	100.0	47978	100.0	4343	100.0	54074	100.0

Note: A further 41,712 procedures did not have CT scan usage recorded

Table S7 Glenoid Morphology for Shoulder Replacement

Glenoid Morphology	Partial		Total		Revision		TOTAL	
	N	Col%	N	Col%	N	Col%	N	Col%
A1	456	39.5	18212	43.5	586	39.0	19254	43.3
A2	234	20.3	9459	22.6	457	30.4	10150	22.8
B1	142	12.3	6327	15.1	157	10.5	6626	14.9
B2	235	20.3	5944	14.2	164	10.9	6343	14.3
C	88	7.6	1911	4.6	138	9.2	2137	4.8
TOTAL	1155	100.0	41853	100.0	1502	100.0	44510	100.0

Note: 141 procedures have been excluded where a glenoid morphology of B3 was recorded. A further 51,135 procedures did not have glenoid morphology recorded

Figure S4 Proportion of Shoulder Replacements by CT Scan Usage

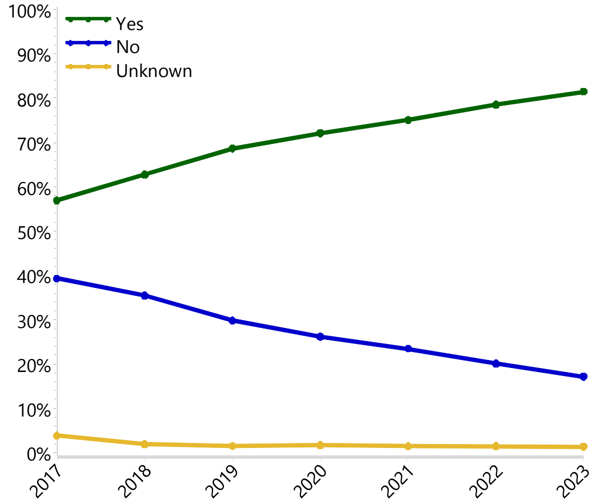
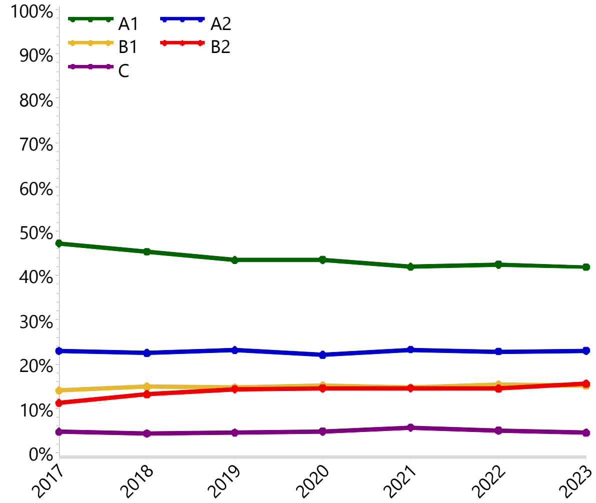


Figure S5 Proportion of Shoulder Replacements by Glenoid Morphology



Primary Partial Shoulder Replacement Summary

Introduction

This section provides summary information on partial shoulder replacement. Detailed information on partial shoulders is available on the AOANJRR website as a separate supplementary report.

Classes of Partial Shoulder Replacement

Primary partial shoulder replacement is subcategorised into four main classes. These are defined by the type of prostheses used.

Partial resurfacing anatomic involves the use of one or more button prostheses to replace part of the natural articulating surface, on one or both sides of the shoulder joint.

Hemi resurfacing anatomic involves the use of a humeral prosthesis that replaces the humeral articular surface only, without resecting the humeral head.

Hemi stemless anatomic involves resection of part of the humeral head and replacement with a humeral head and an epiphyseal fixation prosthesis.

Hemi stemmed anatomic involves the resection of the humeral head and replacement with a humeral head and a humeral stem prosthesis. A humeral stem prosthesis may have either metaphyseal or diaphyseal fixation.

Use of Partial Shoulder Replacement

There are 8,107 primary partial shoulder replacement procedures. This is an additional 231 procedures compared to the number reported last year.

For further information on the **closure of the database** please see the **Glossary** of this report.

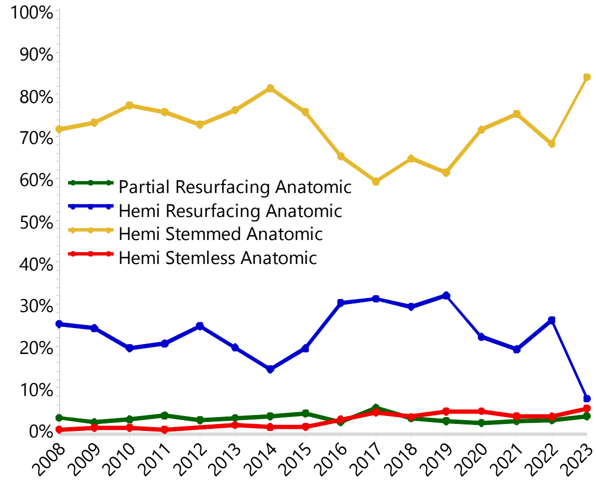
The most common class of primary partial shoulder replacement is hemi stemmed anatomic. This accounts for 72.9% of all partial shoulder replacements, followed by hemi resurfacing anatomic (23.1%), partial resurfacing anatomic (2.7%), and hemi stemless anatomic (1.3%) (Table SP1).

The use of the two main classes of primary partial shoulder replacement has declined over the last 8 years. The number of hemi resurfacing anatomic procedures decreased from 178 in 2012 to 16 in 2023. The number of hemi stemmed anatomic procedures decreased from 616 in 2008 to 180 in 2023, but its proportion has increased by 8.3% of partial shoulder replacements during that time interval (Figure SP1).

Table SP1 Primary Partial Shoulder Replacement by Class

Shoulder Class	Number	Percent
Partial Resurfacing Anatomic	218	2.7
Hemi Resurfacing Anatomic	1874	23.1
Hemi Stemmed Anatomic	5907	72.9
Hemi Stemless Anatomic	108	1.3
TOTAL	8107	100.0

Figure SP1 Primary Partial Shoulder Replacement by Class



Detailed demographic information on primary partial shoulder replacement is available in the supplementary report 'Demographics of Hip, Knee and Shoulder Arthroplasty' on the AOANJRR website: https://aoanjrr.sahmri.com/annual-reports-2024

Primary Partial Shoulder Replacement Summary

Primary Hemi Stemmed Anatomic Shoulder Replacement

There are 5,907 primary hemi stemmed anatomic shoulder replacement procedures. This is an additional 187 procedures compared to the last report.

For further information on the **closure of the database** please see the **Glossary** of this report.

This procedure is more commonly undertaken in females (67.7%). The mean age is 71.6 years for females and 62.2 years for males (Table SP2).

The most common primary diagnosis is fracture (53.9%), followed by osteoarthritis (30.8%). In 2023, the number of primary hemi stemmed anatomic shoulder replacements undertaken for fracture decreased by 90.5% compared to 2008. In 2023, the number of primary hemi stemmed anatomic shoulder replacements undertaken for osteoarthritis decreased by 38.2% compared to 2008 (Figure SP2).

In order to keep Registry data contemporaneous, only procedures using prostheses that have been available and used in 2023 (described as modern prostheses) are included in the following analyses, unless clearly specified.

The cumulative percent revision at 14 years for primary hemi stemmed anatomic shoulder replacement procedures undertaken for fracture is 16.5% and osteoarthritis is 12.4%. There is a higher rate of revision in the first 1.5 years when primary hemi stemmed anatomic shoulder replacement is performed for fracture compared to osteoarthritis. After this time, there is no difference (Table SP3 and Figure SP3).

There are 410 revisions of primary hemi stemmed anatomic shoulder replacement. Reasons for revision vary depending on the primary diagnosis. Revision for rotator cuff insufficiency occurs more frequently in primary hemi stemmed anatomic shoulder replacement undertaken for fracture (27.8%), whereas revision for glenoid erosion occurs more frequently in procedures undertaken for osteoarthritis (25.5%).

The most common type of revision is to a total shoulder replacement for both primary diagnoses (72.2% for fracture and 65.1% for osteoarthritis). Most were revised to a total reverse shoulder replacement (97.7% when used for fracture and 88.4% for osteoarthritis). Glenoid component only revision occurs more frequently in procedures undertaken for osteoarthritis (17.9% compared to 3.3% for fracture).

The outcomes of 13 prosthesis combinations used in primary hemi stemmed anatomic shoulder replacement are listed in Table SP4.

Table SP2 Age and Gender of Primary Hemi Stemmed Anatomic Shoulder Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	1968	33.3%	14	94	63	62.2	13.8
Female	3939	66.7%	13	101	73	71.6	11.6
TOTAL	5907	100.0%	13	101	70	68.5	13.2

Figure SP2 Primary Hemi Stemmed Anatomic Shoulder Replacement by Primary Diagnosis

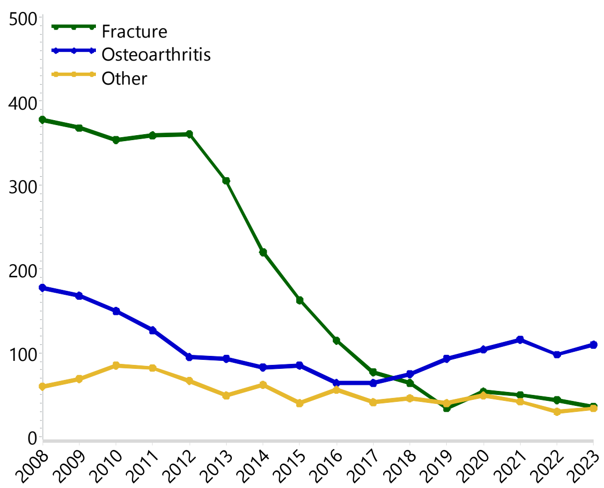


Figure SP3 Primary Hemi Stemmed Anatomic Shoulder Replacement by Gender

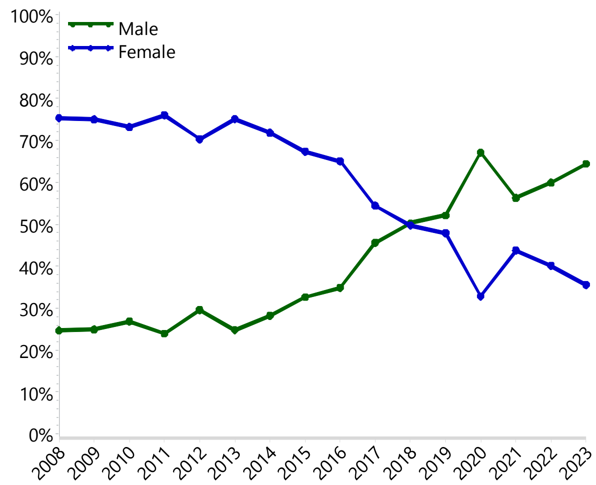
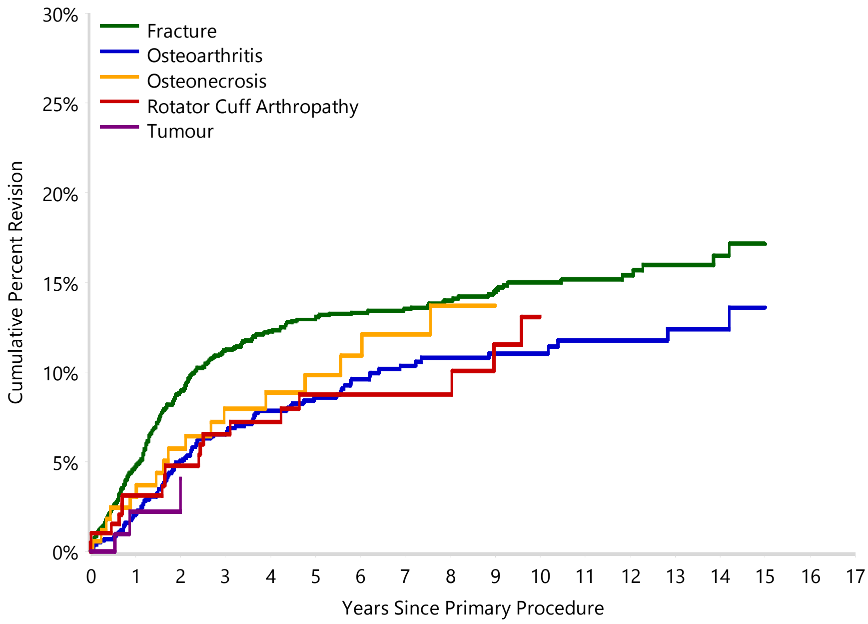


Table SP3 Cumulative Percent Revision of Primary Hemi Stemmed Anatomic Shoulder Replacement by Primary Diagnosis

Primary Diagnosis	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Fracture	245	1867	4.7 (3.9, 5.8)	11.2 (9.8, 12.8)	13.0 (11.5, 14.7)	13.5 (11.9, 15.3)	15.0 (13.3, 16.9)	16.5 (14.4, 18.9)
Osteoarthritis	106	1293	2.1 (1.5, 3.1)	6.6 (5.2, 8.2)	8.6 (7.0, 10.5)	10.4 (8.5, 12.6)	11.1 (9.1, 13.4)	12.4 (10.0, 15.3)
Rotator Cuff Arthropathy	18	196	3.1 (1.4, 6.8)	6.6 (3.8, 11.3)	8.8 (5.3, 14.2)	8.8 (5.3, 14.2)	13.1 (8.0, 21.0)	
Osteonecrosis	19	170	3.1 (1.3, 7.2)	8.0 (4.6, 13.6)	9.8 (5.9, 16.2)	12.1 (7.5, 19.3)		
Tumour	7	134	2.2 (0.6, 8.7)					
Other (4)	15	142	5.1 (2.5, 10.4)	8.9 (5.2, 15.2)	8.9 (5.2, 15.2)	10.3 (6.0, 17.3)		
TOTAL	**410**	**3802**						

Note: Only primary diagnoses with >100 procedures have been listed. Restricted to modern prostheses

Figure SP3 Cumulative Percent Revision of Primary Hemi Stemmed Anatomic Shoulder Replacement by Primary Diagnosis



HR - adjusted for age and gender

Fracture vs Osteoarthritis

0 - 6Mth: HR=2.87 (1.60, 5.14), p<0.001

6Mth - 1.5Yr: HR=2.10 (1.41, 3.11), p<0.001

1.5Yr+: HR=1.04 (0.77, 1.40), p=0.799

Osteonecrosis vs Osteoarthritis

Entire Period: HR=0.93 (0.56, 1.55), p=0.793

Rotator Cuff Arthropathy vs Osteoarthritis

Entire Period: HR=1.21 (0.73, 2.01), p=0.454

Tumour vs Osteoarthritis

Entire Period: HR=0.88 (0.40, 1.91), p=0.740

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Fracture	1867	1677	1356	1137	923	570	147
Osteoarthritis	1293	1137	842	606	433	265	84
Osteonecrosis	170	149	118	90	59	32	14
Rotator Cuff Arthropathy	196	181	143	113	85	49	6
Tumour	134	76	39	25	15	4	0

Note: Only primary diagnoses with >100 procedures have been listed Restricted to modern prostheses

Primary Partial Shoulder Replacement Summary

Table SP4 Cumulative Percent Revision of Primary Hemi Stemmed Anatomic Shoulder Replacement by Prosthesis Combinations

Humeral Head	Humeral Stem	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Aequalis	Aequalis	54	671	2.3 (1.4, 3.8)	6.4 (4.8, 8.6)	7.2 (5.4, 9.5)	8.0 (6.1, 10.5)	8.8 (6.8, 11.5)	9.7 (7.4, 12.7)
Affinis	Affinis	10	62	8.3 (3.5, 18.7)	13.7 (7.1, 25.6)	18.3 (10.2, 31.6)	18.3 (10.2, 31.6)	18.3 (10.2, 31.6)	
Ascend Flex	Ascend Flex	3	44	4.8 (1.2, 17.7)	4.8 (1.2, 17.7)	8.9 (2.8, 26.2)	8.9 (2.8, 26.2)		
Ascend Flex PyC	Ascend Flex	33	714	1.2 (0.6, 2.4)	4.8 (3.2, 7.0)	6.8 (4.6, 10.0)	9.9 (6.3, 15.4)		
Comprehensive	Comprehensive	16	160	4.6 (2.2, 9.5)	11.0 (6.8, 17.7)	11.0 (6.8, 17.7)			
Delta Xtend	Delta Xtend	14	78	6.5 (2.8, 15.0)	16.2 (9.6, 26.9)	16.2 (9.6, 26.9)	18.4 (11.0, 29.8)	21.3 (12.8, 34.2)	
Equinoxe	Equinoxe	11	93	6.6 (3.0, 14.1)	13.2 (7.5, 22.7)	13.2 (7.5, 22.7)			
Global AP CTA	Global AP	10	104	1.9 (0.5, 7.5)	9.1 (4.8, 16.7)	10.2 (5.6, 18.2)	10.2 (5.6, 18.2)	10.2 (5.6, 18.2)	
Global Unite	Global AP	1	23	0.0 (0.0, 0.0)	5.3 (0.8, 31.9)	5.3 (0.8, 31.9)			
	Global Unite	42	216	7.1 (4.3, 11.5)	17.3 (12.7, 23.2)	20.2 (15.2, 26.5)	20.2 (15.2, 26.5)		
Mutars	Mutars	2	62	0.0 (0.0, 0.0)	3.4 (0.5, 22.1)	3.4 (0.5, 22.1)	12.2 (2.8, 45.1)		
SMR	SMR	183	1286	4.0 (3.1, 5.3)	10.1 (8.6, 12.0)	12.6 (10.8, 14.6)	13.7 (11.8, 15.8)	15.9 (13.8, 18.3)	17.7 (15.2, 20.6)
SMR CTA	SMR	27	265	5.1 (3.0, 8.6)	9.2 (6.1, 13.6)	10.8 (7.4, 15.6)	10.8 (7.4, 15.6)	13.3 (8.9, 19.5)	
Other (4)		4	24	18.6 (7.3, 42.6)					
TOTAL		410	3802						

Note: Only prostheses with >20 procedures have been listed
Restricted to modern prostheses

More information regarding partial shoulder procedures is available in the 'Partial Shoulder Arthroplasty Supplementary Report' on the AOANJRR website: https://aoanjrr.sahmri.com/annual-reports-2024

Primary Total Shoulder Replacement

Classes of Total Shoulder Replacement

Primary total shoulder replacement is subcategorised into five classes. These are defined by the type of prosthesis used. The stemless anatomic class of shoulder replacement has increased considerably. As such, mid head humeral prostheses are now classified as stemless anatomic and stemless reverse to reflect their differing polarity.

Total Resurfacing Anatomic involves glenoid replacement and the use of a humeral prosthesis that replaces the humeral articular surface without resecting the humeral head.

Total Stemless Anatomic involves glenoid replacement combined with resection of the humeral head and replacement with a humeral head and an epiphyseal fixation prosthesis.

Total Stemmed Anatomic involves glenoid replacement combined with resection of the humeral head and replacement with humeral head and humeral stem prostheses. A humeral stem prosthesis may have metaphyseal or diaphyseal fixation.

Total Stemmed Reverse involves glenoid replacement with a glenosphere prosthesis combined with resection of the humeral head and replacement with humeral cup and humeral stem prosthesis. A humeral stem prosthesis may have metaphyseal or diaphyseal fixation.

Total Stemless Reverse involves glenoid replacement with a glenosphere combined resection of the humeral head with replacement by a humeral cup and an epiphyseal fixation humeral prosthesis.

Primary total resurfacing anatomic shoulder replacement is no longer used. Therefore, detailed information on primary total resurfacing anatomic shoulder replacement is available in the supplementary report 'Prosthesis Types with No or Minimal Use' on the AOANJRR website: https://aoanjrr.sahmri.com/annual-reports-2024

Primary total stemmed reverse shoulder replacement accounts for 72.7% of all primary total shoulder replacements.

Use of Total Shoulder Replacement

There are 78,882 primary total shoulder replacement procedures. Of these, total stemmed reverse is the most common, followed by total stemmed anatomic and total stemless anatomic. There have been no total resurfacing anatomic replacements in 2023.

The use of different prosthesis classes has changed over time with a major increase in the use of total stemmed reverse shoulder and a corresponding decline in the use of total stemmed anatomic shoulder replacement (Table ST1). Total stemless reverse replacements have been undertaken in Australia since 2016 (Figure ST1).

Figure ST1 **Primary Total Shoulder Replacement by Class**

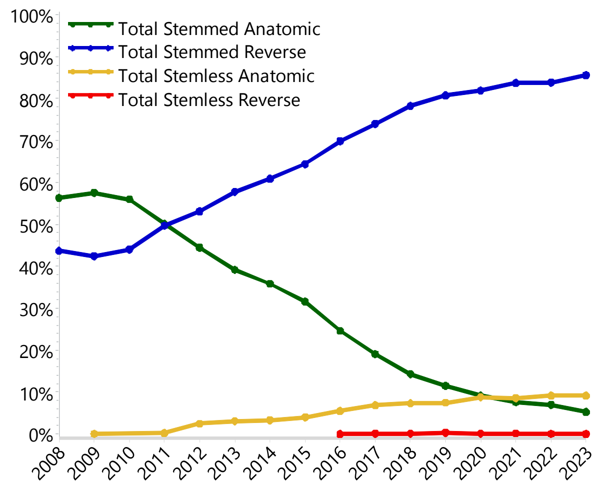


Table ST1 **Primary Total Shoulder Replacement by Class**

Shoulder Class	Number	Percent
Total Stemmed Anatomic	16519	20.9
Total Stemmed Reverse	57350	72.7
Total Stemless Anatomic	4946	6.3
Total Stemless Reverse	67	0.1
TOTAL	**78882**	**100.0**

Primary Total Shoulder Replacement

Primary total shoulder replacement is undertaken more often in females, and this is true of all classes except for total stemless reverse, although numbers in this class are small (Table ST2). The percentage of males undergoing primary total shoulder replacement has increased by 3.6% since 2015. The mean age for females is higher than for males (Table ST3).

Most patients are aged ≥65 years but the proportion in this age group varies depending on the class of shoulder replacement, with both total stemmed reverse and total stemless reverse shoulders having the highest proportion (Table ST4).

Osteoarthritis is the most common primary diagnosis followed by rotator cuff arthropathy and fracture (Table ST5).

Since 2015, the primary diagnosis osteoarthritis has decreased in proportion by 12.4% and rotator cuff arthropathy has increased by 10.7%.

The percentage of prostheses utilising highly crosslinked polyethylene (XLPE) and non-highly crosslinked polyethylene (non-XLPE) in 2023 for primary total shoulder replacement was 32.6% and 55.6%, respectively. The relative percentages are both increased (XLPE 2.4%, non-XLPE 0.6%) compared to 2022 proportions (Figure ST2).

To keep Registry data contemporaneous, only procedures using prostheses that have been available and used in 2023 (described as modern prostheses) are included in the analyses, unless clearly specified.

The rate of revision varies by class with total stemmed reverse and total stemless anatomic having a lower cumulative percent revision at 10 years than total stemmed anatomic shoulder replacement (Table ST6 and Figure ST3). Total stemmed anatomic shoulder replacements have a lower rate of revision excluding modular metal backed glenoids for patients with osteoarthritis (Table ST37 and Figure ST32).

Detailed demographic information on primary total shoulder replacement is available in the supplementary report 'Demographics of Hip, Knee & Shoulder Arthroplasty' on the AOANJRR website:
https://aoanjrr.sahmri.com/annual-reports-2024

Table ST2 Primary Total Shoulder Replacement by Class and Gender

Shoulder Class	Male		Female		TOTAL	
	N	Row%	N	Row%	N	Row%
Total Stemmed Anatomic	7115	43.1	9404	56.9	16519	100.0
Total Stemmed Reverse	21903	38.2	35447	61.8	57350	100.0
Total Stemless Anatomic	2449	49.5	2497	50.5	4946	100.0
Total Stemless Reverse	47	70.1	20	29.9	67	100.0
TOTAL	**31514**	**40.0**	**47368**	**60.0**	**78882**	**100.0**

Table ST3 Age and Gender of Primary Total Shoulder Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	31514	40.0%	14	96	71	70.2	9.0
Female	47368	60.0%	12	103	74	73.4	8.3
TOTAL	**78882**	**100.0%**	**12**	**103**	**73**	**72.1**	**8.7**

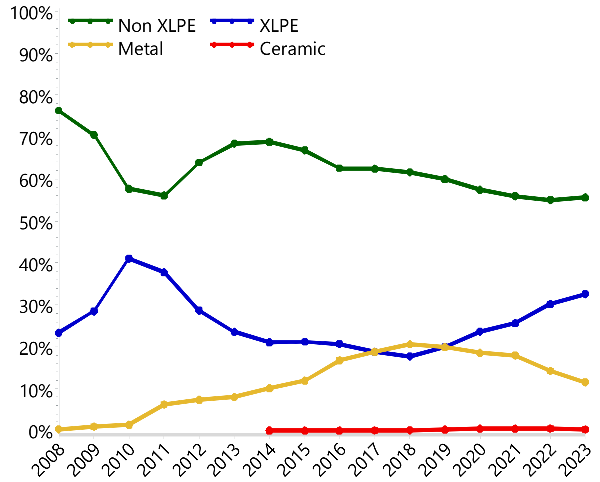
Table ST4 Primary Total Shoulder Replacement by Class and Age

Shoulder Class	<55		55-64		65-74		≥75		TOTAL	
	N	Row%	N	Row%	N	Row%	N	Row%	N	Row%
Total Stemmed Anatomic	960	5.8	3919	23.7	7294	44.2	4346	26.3	16519	100.0
Total Stemmed Reverse	970	1.7	6430	11.2	22497	39.2	27453	47.9	57350	100.0
Total Stemless Anatomic	516	10.4	1366	27.6	2144	43.3	920	18.6	4946	100.0
Total Stemless Reverse	2	3.0	9	13.4	46	68.7	10	14.9	67	100.0
TOTAL	2448	3.1	11724	14.9	31981	40.5	32729	41.5	78882	100.0

Table ST5 Primary Total Shoulder Replacement by Primary Diagnosis

Primary Diagnosis	Number	Percent
Osteoarthritis	45124	57.2
Rotator Cuff Arthropathy	21325	27.0
Fracture	8784	11.1
Rheumatoid Arthritis	1281	1.6
Osteonecrosis	1012	1.3
Instability	641	0.8
Other Inflammatory Arthritis	418	0.5
Tumour	278	0.4
Other	19	0.0
TOTAL	78882	100.0

Figure ST2 Primary Total Shoulder Replacement by Bearing Surface



Note: Bearing surface is the glenoid side for total anatomic, and humeral side for total reverse shoulder replacements

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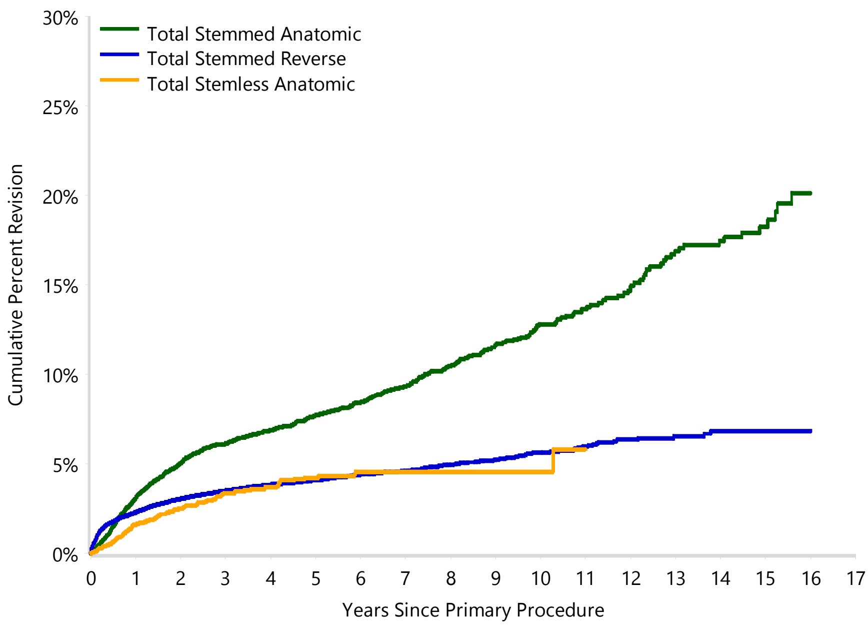
Primary Total Shoulder Replacement

Table ST6 Cumulative Percent Revision of Primary Total Shoulder Replacement by Class (All Diagnoses)

Shoulder Class	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Total Stemmed Anatomic	704	7878	3.1 (2.7, 3.5)	6.1 (5.6, 6.7)	7.7 (7.1, 8.4)	9.3 (8.6, 10.1)	12.8 (11.8, 13.9)	17.4 (15.7, 19.4)
Total Stemmed Reverse	2028	55394	2.3 (2.2, 2.4)	3.5 (3.3, 3.7)	4.1 (3.9, 4.3)	4.6 (4.4, 4.8)	5.6 (5.3, 6.0)	6.8 (6.2, 7.6)
Total Stemless Anatomic	138	4612	1.6 (1.3, 2.1)	3.4 (2.8, 4.0)	4.2 (3.5, 5.1)	4.6 (3.8, 5.5)	4.6 (3.8, 5.5)	
Total Stemless Reverse	2	67	1.5 (0.2, 10.3)	3.1 (0.8, 12.0)	3.1 (0.8, 12.0)			
TOTAL	2872	67951						

Note: Restricted to modern prostheses. Total stemmed anatomic class include modular metal backed glenoids.

Figure ST3 Cumulative Percent Revision of Primary Total Shoulder Replacement by Class (All Diagnoses)



HR - adjusted for age and gender

Total Stemmed Anatomic vs Total Stemless Anatomic

Entire Period: HR=2.20 (1.83, 2.65), p<0.001

Total Stemmed Anatomic vs Total Stemmed Reverse

0 - 3Mth: HR=0.41 (0.31, 0.54), p<0.001

3Mth - 6Mth: HR=1.79 (1.36, 2.36), p<0.001

6Mth+: HR=2.38 (2.14, 2.64), p<0.001

Total Stemmed Reverse vs Total Stemless Anatomic

0 - 3Mth: HR=5.41 (4.05, 7.22), p<0.001

3Mth+: HR=0.96 (0.80, 1.15), p=0.656

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Total Stemmed Anatomic	7878	7121	5700	4249	2787	1103	397
Total Stemmed Reverse	55394	45666	30909	19045	10171	3392	558
Total Stemless Anatomic	4612	3690	2254	1146	448	91	0

Note: Restricted to modern prostheses. Total stemmed anatomic class includes modular metal backed glenoids.

Primary Total Stemless Anatomic Shoulder Replacement

DEMOGRAPHICS

There have been 4,946 primary total stemless anatomic shoulder replacements. This is an additional 859 procedures compared to the previous report.

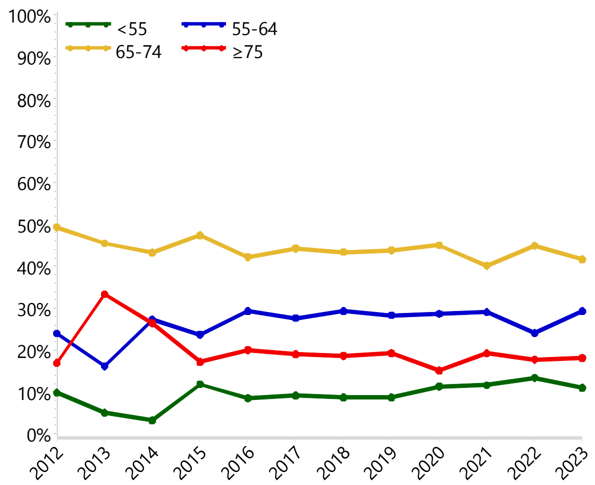
For further information on the **closure of the database** please see the **Glossary** of this report.

> The use of primary total stemless anatomic shoulder replacement has increased by 1090.1% since its first full year

Primary total stemless anatomic shoulder replacement is more commonly performed in patients aged 65–74 years of age (Figure ST4). Primary total stemless anatomic shoulder replacement is undertaken more often in females who are older on average than males (Table ST7). However, the proportion of men undergoing total stemless shoulder replacement has increased by 11% since 2015.

In 2023, 27% of total stemless shoulder replacements use cementless fixation, 72.3% hybrid (glenoid cemented) and 0.7% are cemented (Figure ST5).

Figure ST4 **Primary Total Stemless Anatomic Shoulder Replacement by Age Group**



XLPE polyethylene was more common in 2023 for total stemless anatomic replacement glenoid components (60.4%) compared to 39.6% for non-XLPE (Figure ST6).

Osteoarthritis is the most common primary diagnosis.

The most used total stemless anatomic prostheses are listed in Table ST8 and Table ST9.

Figure ST5 **Primary Total Stemless Anatomic Shoulder Replacement by Fixation**

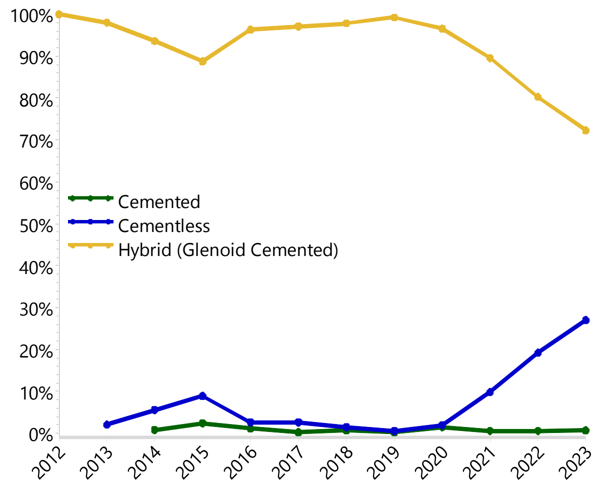
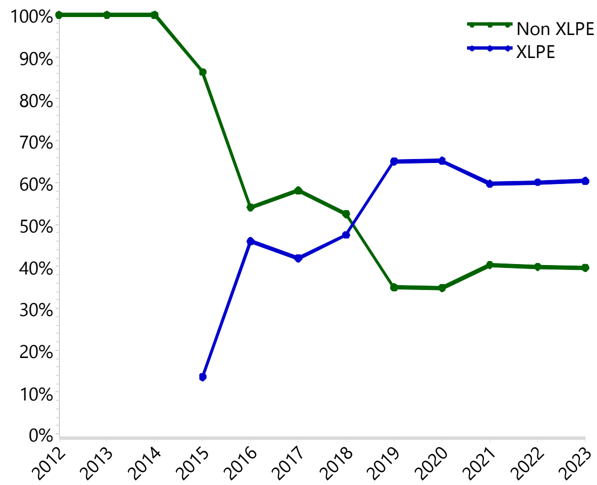


Figure ST6 **Primary Total Stemless Anatomic Shoulder Replacement by Polyethylene Type**



Primary Total Shoulder Replacement

Table ST7 Age and Gender of Primary Total Stemless Anatomic Shoulder Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	2449	49.5%	31	95	65	64.2	9.4
Female	2497	50.5%	32	94	69	68.7	8.3
TOTAL	4946	100.0%	31	95	67	66.5	9.2

Table ST8 Most Used Humeral Stem Prostheses in Primary Total Stemless Anatomic Shoulder Replacement

2011		2020		2021		2022		2023	
N	Model	N	Model	N	Model	N	Model	N	Model
2	Simpliciti	382	Affinis	378	Affinis	398	Affinis	442	Affinis
2	TESS	165	Simpliciti	203	Simpliciti	216	Simpliciti	257	Simpliciti
1	Affinis	35	Comprehensive	58	Comprehensive	48	Comprehensive	68	Global Icon
		13	Global Icon	21	Global Icon	37	Global Icon	50	Comprehensive
		13	SMR	6	Equinoxe	19	Equinoxe	24	Equinoxe
		2	Equinoxe	6	SMR	6	SMR	4	SMR
		1	Sidus						
Most Used									
5	(3) 100.0%	611	(7) 100.0%	672	(6) 100.0%	724	(6) 100.0%	845	(6) 100.0%

Table ST9 Most Used Glenoid Prostheses in Primary Total Stemless Anatomic Shoulder Replacement

2011		2020		2021		2022		2023	
N	Model	N	Model	N	Model	N	Model	N	Model
2	Aequalis	355	Affinis	349	Affinis	363	Affinis	412	Affinis
1	Affinis	164	Perform	203	Perform	216	Perform	257	Perform
1	Comprehensive	41	Global	51	Comprehensive	72	Global	98	Global
1	TESS	36	Comprehensive	50	Global	37	Comprehensive	36	Comprehensive
		9	SMR	6	Alliance	19	Equinoxe	24	Equinoxe
		3	SMR L1	6	Equinoxe	11	Alliance	14	Alliance
		2	Equinoxe	4	SMR	4	SMR L1	2	SMR
		1	Custom Made (Lima)	2	SMR L1	2	SMR	2	SMR L1
				1	Custom Made (Comprehensive)				
Most Used									
5	(4) 100.0%	611	(8) 100.0%	672	(9) 100.0%	724	(8) 100.0%	845	(8) 100.0%

OUTCOME FOR ALL DIAGNOSES

Primary Diagnosis

The usage and availability of prostheses change with time, reflecting design change and surgeon preference. In order to keep Registry data contemporaneous, only procedures utilising prostheses that have been available and used in 2023 (described as modern prostheses) are included in the analyses, unless clearly specified.

At 10 years, the cumulative percent revision for primary total stemless anatomic shoulder replacement undertaken for osteoarthritis is 4.4%.

The most common diagnosis for primary total stemless shoulder replacement is osteoarthritis. There is no difference in the rate of revision when osteonecrosis is compared to osteoarthritis. The number of procedures undertaken for other diagnoses is small (Table ST10 and Figure ST7).

Reason for Revision

The main reasons for revision are instability/dislocation, rotator cuff insufficiency, infection, and loosening (Table ST11 and Figure ST8). Males have a higher cumulative incidence of rotator cuff insufficiency for the first 7 years only, whereas females have a higher cumulative incidence of instability/dislocation (Figure ST9). However, compared to 2015, rotator cuff insufficiency has increased by 55.6%, while infection decreased by 11.1%, and instability/dislocation and loosening both reduced by 33.3%.

Type of Revision

The most common types of revision involve replacement of both the humeral and glenoid components (Table ST12). Overall, 89.7% of total stemless anatomic shoulder replacements were revised to a total reverse shoulder replacement. Both humeral/glenoid and humeral alone revisions have increased in proportion by 11.1% since 2015.

Prosthesis Types

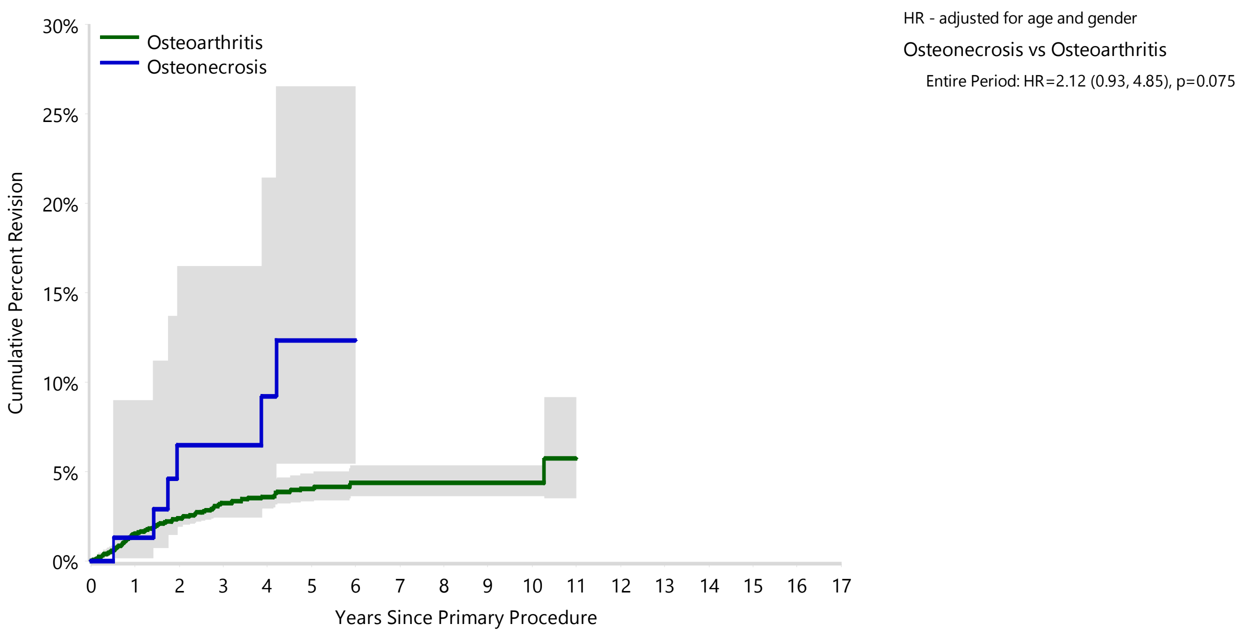
The outcomes of humeral stem and glenoid prosthesis combinations with >30 procedures used in primary total stemless anatomic shoulder replacement are listed in Table ST13.

Table ST10 **Cumulative Percent Revision of Primary Total Stemless Anatomic Shoulder Replacement by Primary Diagnosis**

Primary Diagnosis	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Osteoarthritis	127	4415	1.5 (1.2, 2.0)	3.3 (2.7, 3.9)	4.1 (3.4, 4.9)	4.4 (3.6, 5.3)	4.4 (3.6, 5.3)	
Osteonecrosis	6	83	1.3 (0.2, 9.0)	6.5 (2.5, 16.5)	12.4 (5.5, 26.5)			
Other (5)	5	114	4.8 (2.0, 11.2)	4.8 (2.0, 11.2)				
TOTAL	138	4612						

Note: Restricted to modern prostheses
Only primary diagnoses with >50 procedures have been listed

Figure ST7 **Cumulative Percent Revision of Primary Total Stemless Anatomic Shoulder Replacement by Primary Diagnosis**



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Osteoarthritis	4415	3539	2156	1092	430	85	0
Osteonecrosis	83	65	44	22	7	3	0

Note: Restricted to modern prostheses
Only primary diagnoses with >50 procedures have been listed

Table ST11 Primary Total Stemless Anatomic Shoulder Replacement by Reason for Revision (All Diagnoses)

Reason for Revision	Number	Percent
Instability/Dislocation	48	34.8
Rotator Cuff Insufficiency	38	27.5
Infection	21	15.2
Loosening	17	12.3
Pain	6	4.3
Malposition	2	1.4
Fracture	2	1.4
Lysis	1	0.7
Implant Breakage Humeral	1	0.7
Arthrofibrosis	1	0.7
Other	1	0.7
TOTAL	138	100.0

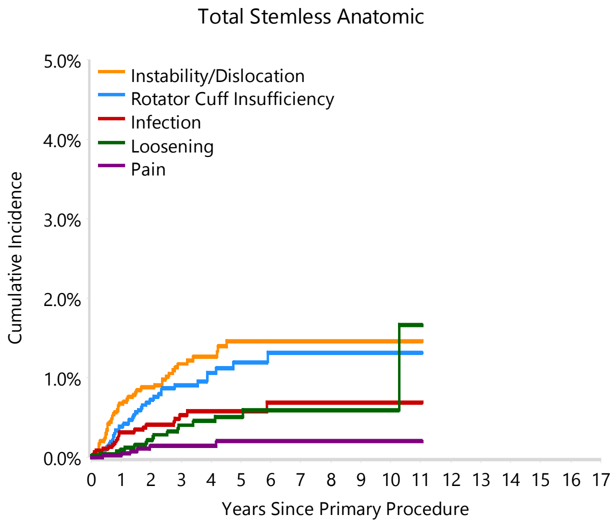
Note: Restricted to modern prostheses

Table ST12 Primary Total Stemless Anatomic Shoulder Replacement by Type of Revision (All Diagnoses)

Type of Revision	Number	Percent
Humeral/Glenoid	106	76.8
Cement Spacer	10	7.2
Humeral Component	10	7.2
Head Only	9	6.5
Removal of Prostheses	2	1.4
Reoperation	1	0.7
TOTAL	138	100.0

Note: Restricted to modern prostheses

Figure ST8 Cumulative Incidence Revision Diagnosis of Primary Total Stemless Anatomic Shoulder Replacement (All Diagnoses)



Note: Restricted to modern prostheses

Figure ST9 **Cumulative Incidence Revision Diagnosis of Primary Total Stemless Anatomic Shoulder Replacement by Gender**

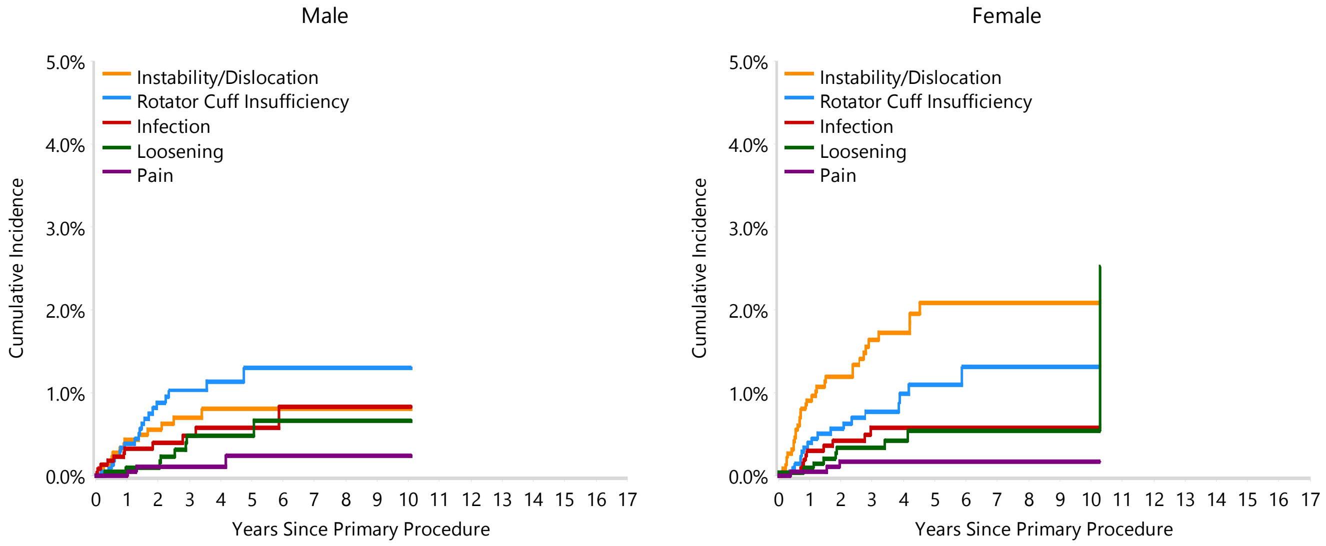


Table ST13 **Cumulative Percent Revision of Primary Total Stemless Anatomic Shoulder Replacement by Prosthesis Combination**

Humeral Stem	Glenoid	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Affinis	Affinis	94	2786	1.6 (1.2, 2.2)	3.6 (2.9, 4.5)	4.3 (3.5, 5.3)	4.7 (3.8, 5.8)	4.7 (3.8, 5.8)	
	Global	1	146	0.8 (0.1, 5.5)	0.8 (0.1, 5.5)				
Comprehensive	Alliance	0	31	0.0 (0.0, 0.0)					
	Comprehensive	20	277	4.6 (2.6, 7.9)	7.8 (4.9, 12.2)	9.5 (6.1, 14.7)			
Equinoxe	Equinoxe	0	51	0.0 (0.0, 0.0)					
Global Icon	Global	2	169	0.7 (0.1, 4.9)	2.3 (0.5, 9.8)				
SMR	SMR	4	57	3.6 (0.9, 13.8)	7.3 (2.8, 18.4)	7.3 (2.8, 18.4)			
	SMR L1	3	35	2.9 (0.4, 19.1)	6.8 (1.7, 25.0)	11.3 (3.7, 31.5)	11.3 (3.7, 31.5)		
Simpliciti	Perform	14	1058	0.9 (0.5, 1.9)	1.4 (0.8, 2.5)	2.7 (1.4, 5.1)			
Other (2)		0	2	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)				
TOTAL		138	4612						

Note: Restricted to modern prostheses. Only prostheses with >30 procedures have been listed

OUTCOME FOR OSTEOARTHRITIS – PATIENT CHARACTERISTICS

There are 4,415 (95.7%) primary total stemless anatomic shoulder replacement procedures with a primary diagnosis of osteoarthritis.

The cumulative percent revision of primary total stemless anatomic shoulder replacement for osteoarthritis at 10 years is 4.4% (Table ST14).

The main reasons for revision are instability/dislocation (33.9%), rotator cuff insufficiency (27.6%), infection (15.7%) and loosening (13.4%) (Table ST15 and Figure ST10). Males are more commonly revised for rotator cuff insufficiency and females for instability/dislocation (Figure ST11). The most common types of revision involve replacement of both the humeral and glenoid component with 95.9% being revised to a total stemmed reverse shoulder replacement (Table ST16).

Age and Gender
Age is not a risk factor for revision (Table ST17 and Figure ST12). There is no difference in the rate of revision for total stemless anatomic shoulder replacement between males and females (Figure ST13).

When gender is stratified by age, younger males have higher rates of revision compared males aged 65-74 years (Table ST17 and Figure ST14). There is no difference in revision risk in female categories (Table ST17 and Figure ST15).

The rate of revision is higher for females compared to males for osteoarthritis.

ASA and BMI
Most patients have an ASA score of 2 or 3. The cumulative percent revision at 7 years is 4.5% for ASA 2 and 5.0% for ASA 3 (Table ST18). There is an increased risk of revision of ASA 3 compared to ASA 1 patients (Figure ST16).

The most common BMI categories are pre-obese and obese class 1. BMI is not a risk factor for revision (Table ST19 and Figure ST17). The most common reasons for revision by BMI category are shown in Figure ST18. However, when BMI is stratified by gender, obese females have a higher rate of revision than a non-obese females and obese males (Table ST20 and Figure ST19).

Glenoid Morphology
Glenoid morphology is not a risk factor for revision (Table ST21 and Figure ST20).

Table ST14 **Cumulative Percent Revision of Primary Total Stemless Anatomic Shoulder Replacement (Primary Diagnosis OA)**

Shoulder Class	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Total Stemless Anatomic	127	4415	1.5 (1.2, 2.0)	3.3 (2.7, 3.9)	4.1 (3.4, 4.9)	4.4 (3.6, 5.3)	4.4 (3.6, 5.3)	
TOTAL	127	4415						

Primary Total Shoulder Replacement

Table ST15 Primary Total Stemless Anatomic Shoulder Replacement by Reason for Revision (Primary Diagnosis OA)

Reason for Revision	Number	Percent
Instability/Dislocation	43	33.9
Rotator Cuff Insufficiency	35	27.6
Infection	20	15.7
Loosening	17	13.4
Pain	5	3.9
Malposition	2	1.6
Fracture	2	1.6
Lysis	1	0.8
Implant Breakage Humeral	1	0.8
Arthrofibrosis	1	0.8
TOTAL	127	100.0

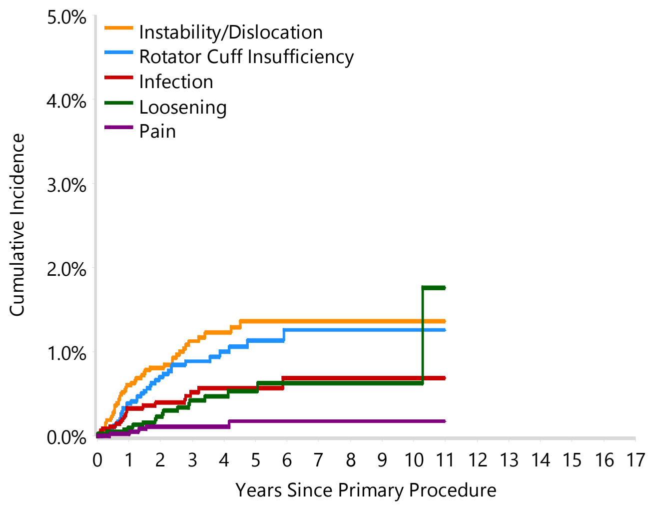
Note: Restricted to modern prostheses

Table ST16 Primary Total Stemless Anatomic Shoulder Replacement by Type of Revision (Primary Diagnosis OA)

Type of Revision	Number	Percent
Humeral/Glenoid	98	77.2
Humeral Component	10	7.9
Head Only	9	7.1
Cement Spacer	9	7.1
Removal of Prostheses	1	0.8
TOTAL	127	100.0

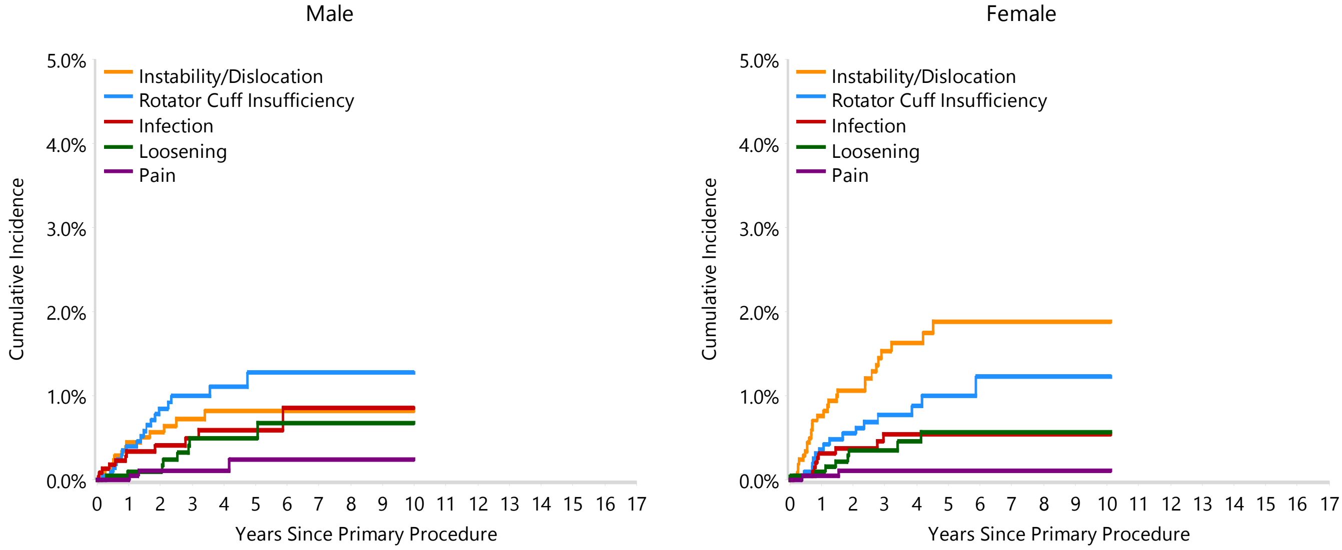
Note: Restricted to modern prostheses

Figure ST10 Cumulative Incidence Revision Diagnosis of Primary Total Stemless Anatomic Shoulder Replacement (Primary Diagnosis OA)



Note: Restricted to modern prostheses

Figure ST11 Cumulative Incidence Revision Diagnosis of Primary Total Stemless Anatomic Shoulder Replacement by Gender (Primary Diagnosis OA)



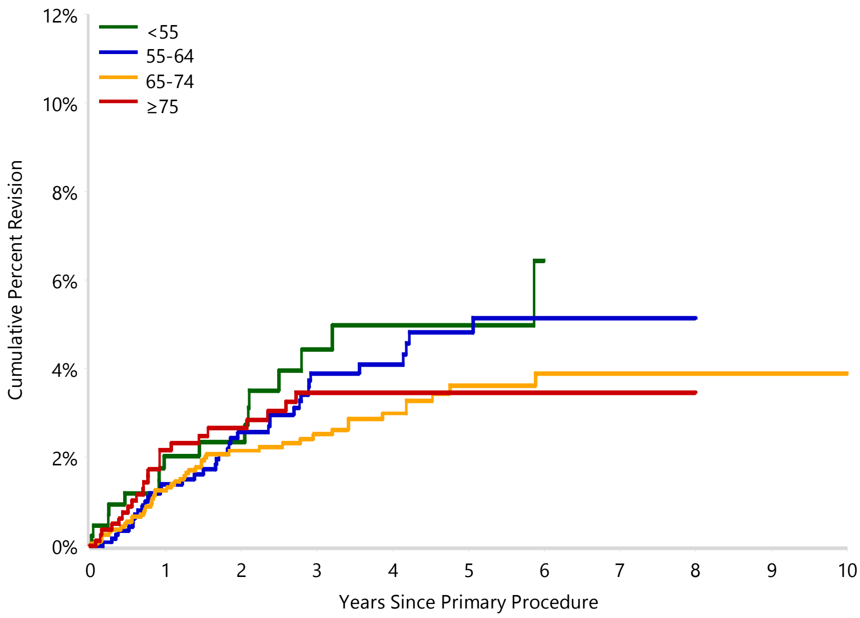
Note: Restricted to modern prostheses

Table ST17 Cumulative Percent Revision of Primary Total Stemless Anatomic Shoulder Replacement by Age and Gender (Primary Diagnosis OA)

Gender	Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Male		58	2235	1.4 (1.0, 2.1)	3.0 (2.3, 3.9)	3.6 (2.7, 4.8)	4.1 (3.0, 5.5)	4.1 (3.0, 5.5)	
	<55	13	330	2.4 (1.1, 4.9)	4.5 (2.5, 8.2)	5.3 (2.9, 9.3)			
	55-64	21	742	1.4 (0.7, 2.6)	3.4 (2.1, 5.3)	4.1 (2.6, 6.4)	4.6 (2.9, 7.3)		
	65-74	16	886	0.7 (0.3, 1.6)	2.0 (1.2, 3.4)	2.7 (1.6, 4.5)	2.7 (1.6, 4.5)		
	≥75	8	277	2.9 (1.4, 5.9)	3.4 (1.7, 6.7)	3.4 (1.7, 6.7)			
Female		69	2180	1.6 (1.2, 2.3)	3.5 (2.7, 4.6)	4.5 (3.5, 5.7)	4.7 (3.7, 6.1)	4.7 (3.7, 6.1)	
	<55	3	110	1.0 (0.1, 6.9)	4.1 (1.3, 12.5)				
	55-64	18	478	1.4 (0.6, 3.2)	4.7 (2.9, 7.7)	5.9 (3.7, 9.4)	5.9 (3.7, 9.4)		
	65-74	33	1041	1.7 (1.1, 2.8)	3.0 (2.0, 4.4)	4.4 (3.0, 6.4)	4.9 (3.3, 7.1)		
	≥75	15	551	1.8 (0.9, 3.5)	3.5 (2.1, 5.7)	3.5 (2.1, 5.7)	3.5 (2.1, 5.7)		
TOTAL		127	4415						

Note: Restricted to modern prostheses

Figure ST12 Cumulative Percent Revision of Primary Total Stemless Anatomic Shoulder Replacement by Age (Primary Diagnosis OA)



HR - adjusted for gender

55-64 vs <55

Entire Period: HR=0.80 (0.45, 1.43), p=0.454

65-74 vs <55

Entire Period: HR=0.60 (0.34, 1.06), p=0.080

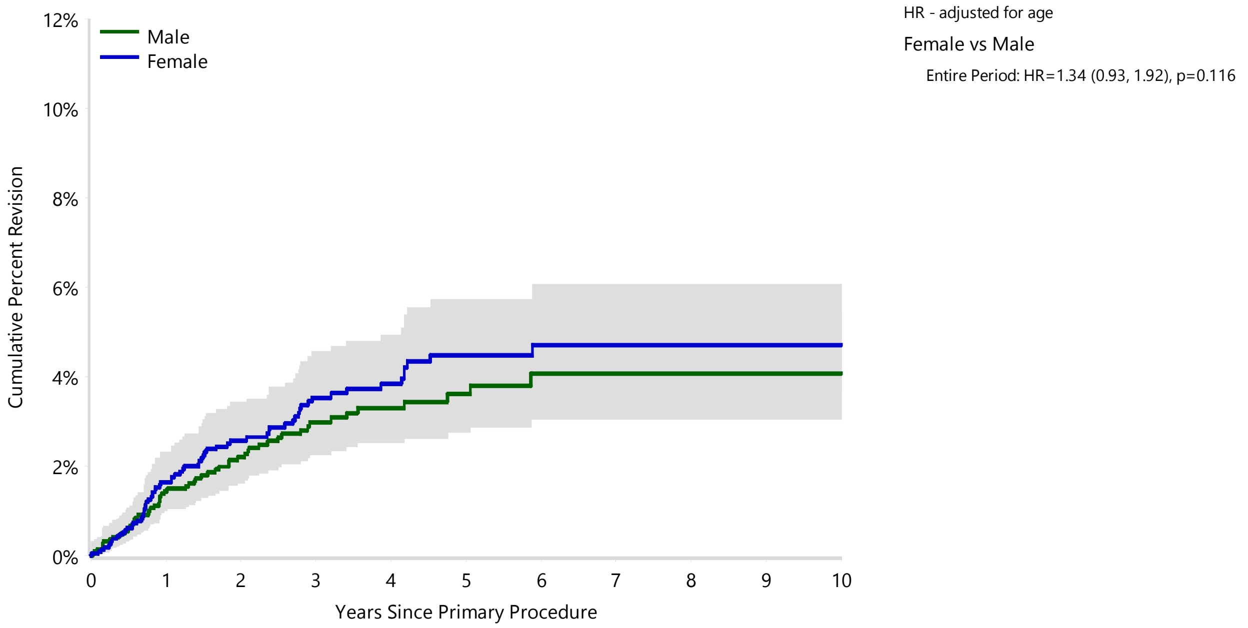
≥75 vs <55

Entire Period: HR=0.64 (0.33, 1.24), p=0.188

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
<55	440	347	189	94	35	6	0
55-64	1220	966	599	298	103	18	0
65-74	1927	1567	966	491	203	46	0
≥75	828	659	402	209	89	15	0

Note: Restricted to modern prostheses

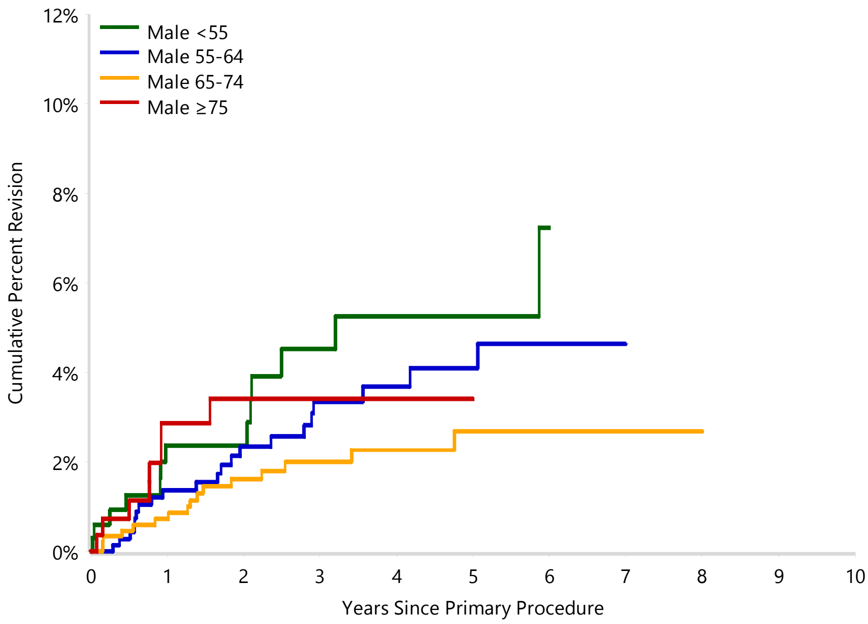
Figure ST13 Cumulative Percent Revision of Primary Total Stemless Anatomic Shoulder Replacement by Gender (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Male	2235	1798	1062	516	196	40	0
Female	2180	1741	1094	576	234	45	0

Note: Restricted to modern prostheses

Figure ST14 **Cumulative Percent Revision of Primary Total Stemless Anatomic Shoulder Replacement in Males by Age (Primary Diagnosis OA)**



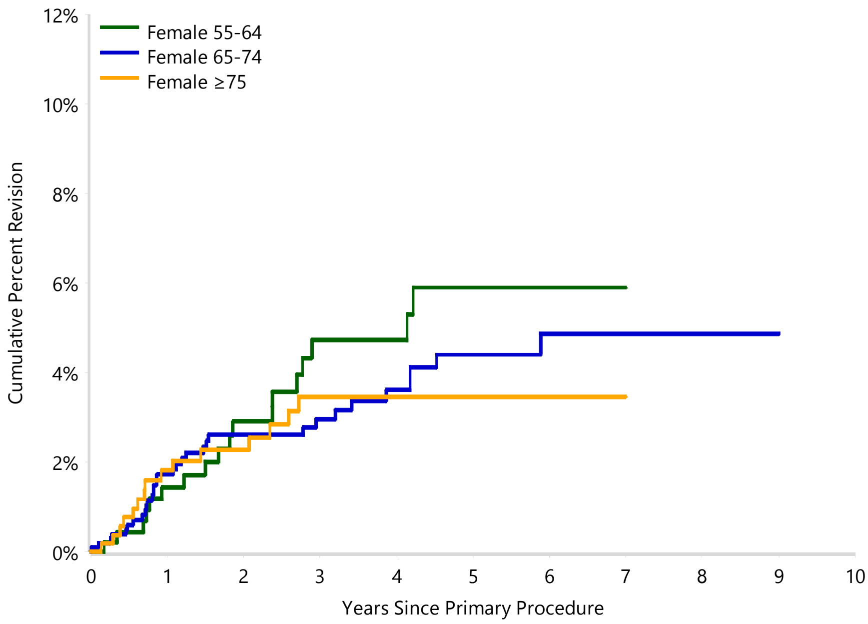
Male 55-64 vs Male <55
Entire Period: HR=0.68 (0.34, 1.35), p=0.267

Male 65-74 vs Male <55
Entire Period: HR=0.42 (0.20, 0.88), p=0.021

Male ≥75 vs Male <55
Entire Period: HR=0.72 (0.30, 1.73), p=0.457

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Male	**<55**	330	260	139	66	28	4	0
	55-64	742	589	360	181	59	12	0
	65-74	886	735	436	207	84	19	0
	≥75	277	214	127	62	25	5	0

Figure ST15 **Cumulative Percent Revision of Primary Total Stemless Anatomic Shoulder Replacement in Females by Age (Primary Diagnosis OA)**



Female 65-74 vs Female 55-64
Entire Period: HR=0.82 (0.46, 1.45), p=0.492

Female ≥75 vs Female 55-64
Entire Period: HR=0.71 (0.36, 1.40), p=0.317

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Female	**55-64**	478	377	239	117	44	6	0
	65-74	1041	832	530	284	119	27	0
	≥75	551	445	275	147	64	10	0

Note: Restricted to modern prostheses

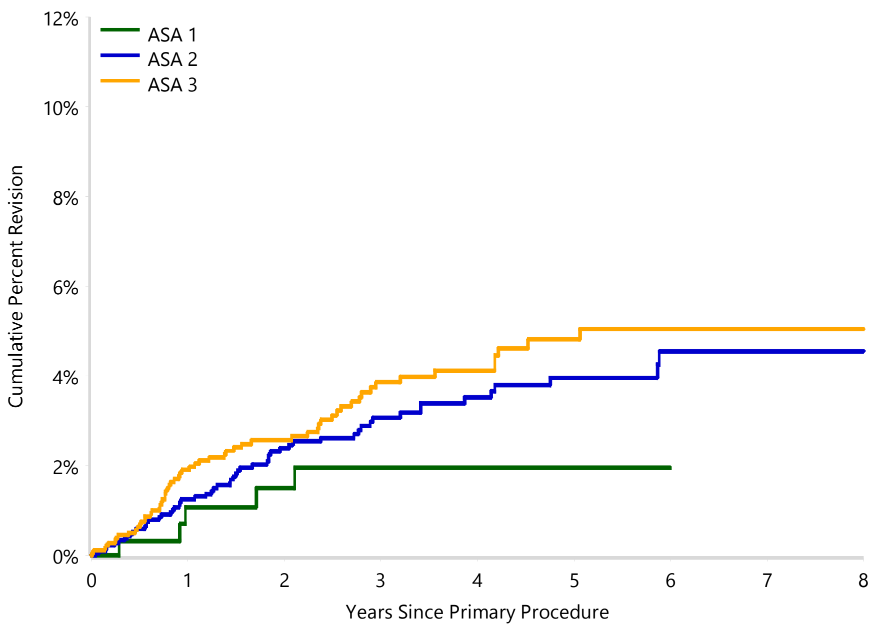
Primary Total Shoulder Replacement

Table ST18 Cumulative Percent Revision of Primary Total Stemless Anatomic Shoulder Replacement by ASA Score (Primary Diagnosis OA)

ASA Score	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	8 Yrs
ASA 1	5	318	1.1 (0.3, 3.3)	1.5 (0.6, 4.0)	2.0 (0.8, 4.6)	2.0 (0.8, 4.6)		
ASA 2	58	2138	1.3 (0.8, 1.9)	2.4 (1.8, 3.2)	3.1 (2.3, 4.1)	4.0 (3.0, 5.2)	4.5 (3.4, 6.1)	4.5 (3.4, 6.1)
ASA 3	60	1815	1.9 (1.3, 2.7)	2.6 (1.9, 3.5)	3.9 (2.9, 5.1)	4.8 (3.7, 6.3)	5.0 (3.8, 6.6)	5.0 (3.8, 6.6)
ASA 4	2	47	4.6 (1.2, 17.3)	4.6 (1.2, 17.3)	4.6 (1.2, 17.3)	4.6 (1.2, 17.3)		
TOTAL	125	4318						

Note: Restricted to modern prostheses

Figure ST16 Cumulative Percent Revision of Primary Total Stemless Anatomic Shoulder Replacement by ASA Score (Primary Diagnosis OA)



HR - adjusted for age and gender

ASA 2 vs ASA 1

Entire Period: HR=2.03 (0.81, 5.08), p=0.131

ASA 3 vs ASA 1

Entire Period: HR=2.62 (1.04, 6.61), p=0.040

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	8 Yrs
ASA 1	318	264	222	177	78	23	9
ASA 2	2138	1687	1341	1023	500	177	69
ASA 3	1815	1458	1127	845	424	150	64

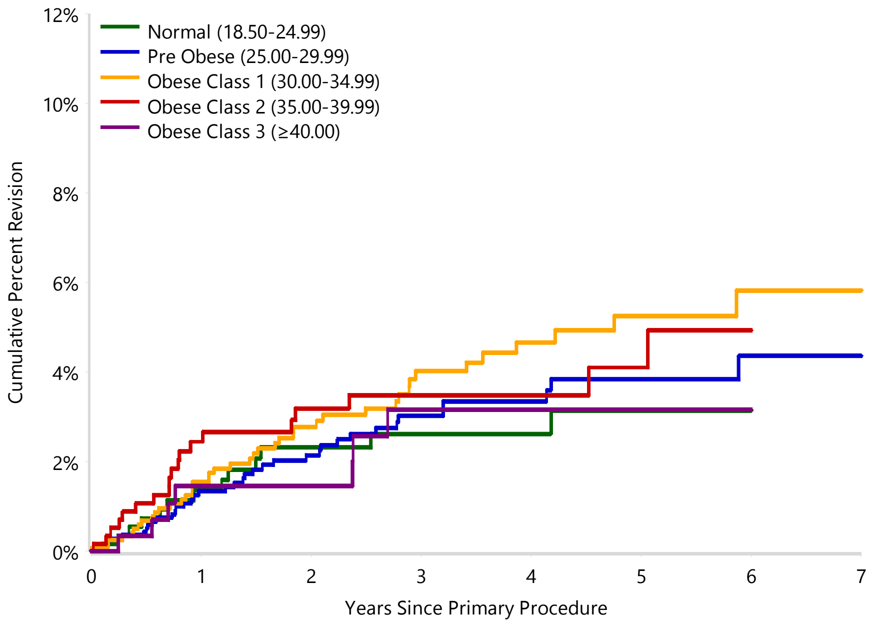
Note: Restricted to modern prostheses

Table ST19 Cumulative Percent Revision of Primary Total Stemless Anatomic Shoulder Replacement by BMI Category (Primary Diagnosis OA)

BMI Category	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Underweight (<18.50)	0	10	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)
Normal (18.50-24.99)	13	576	1.4 (0.6, 2.8)	2.3 (1.3, 4.2)	2.6 (1.5, 4.6)	2.6 (1.5, 4.6)	3.1 (1.8, 5.5)	3.1 (1.8, 5.5)
Pre Obese (25.00-29.99)	37	1428	1.3 (0.8, 2.2)	2.1 (1.5, 3.2)	3.0 (2.1, 4.3)	3.4 (2.4, 4.7)	3.8 (2.7, 5.4)	4.4 (3.0, 6.4)
Obese Class 1 (30.00-34.99)	42	1242	1.5 (1.0, 2.5)	2.8 (1.9, 4.0)	4.0 (2.9, 5.6)	4.7 (3.4, 6.4)	5.3 (3.8, 7.3)	5.8 (4.1, 8.2)
Obese Class 2 (35.00-39.99)	19	583	2.4 (1.4, 4.2)	3.2 (2.0, 5.2)	3.5 (2.2, 5.6)	3.5 (2.2, 5.6)	4.1 (2.5, 6.7)	4.9 (2.9, 8.3)
Obese Class 3 (≥40.00)	7	303	1.5 (0.6, 3.9)	1.5 (0.6, 3.9)	3.2 (1.5, 6.6)	3.2 (1.5, 6.6)	3.2 (1.5, 6.6)	3.2 (1.5, 6.6)
TOTAL	118	4142						

Note: Restricted to modern prostheses
BMI has not been presented for patients aged ≤19 years

Figure ST17 Cumulative Percent Revision of Primary Total Stemless Anatomic Shoulder Replacement by BMI Category (Primary Diagnosis OA)



HR - adjusted for age and gender

Pre Obese (25.00-29.99) vs Normal (18.50-24.99)
Entire Period: HR=1.17 (0.62, 2.21), p=0.632

Obese Class 1 (30.00-34.99) vs Normal (18.50-24.99)
Entire Period: HR=1.48 (0.79, 2.77), p=0.216

Obese Class 2 (35.00-39.99) vs Normal (18.50-24.99)
Entire Period: HR=1.34 (0.66, 2.72), p=0.421

Obese Class 3 (≥40.00) vs Normal (18.50-24.99)
Entire Period: HR=0.88 (0.35, 2.22), p=0.792

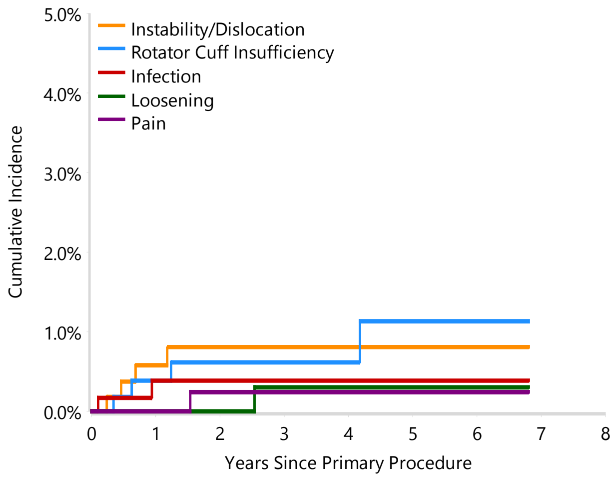
Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Normal (18.50-24.99)	576	453	358	275	205	127	69
Pre Obese (25.00-29.99)	1428	1116	872	646	433	290	175
Obese Class 1 (30.00-34.99)	1242	995	764	560	392	263	158
Obese Class 2 (35.00-39.99)	583	462	356	273	207	120	72
Obese Class 3 (≥40.00)	303	239	195	148	99	74	40

Note: Restricted to modern prostheses
BMI has not been presented for patients aged ≤19 years

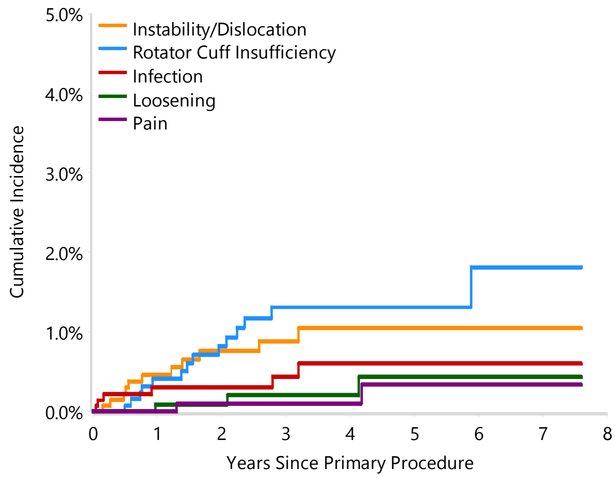
Primary Total Shoulder Replacement

Figure ST18 Cumulative Incidence Revision Diagnosis of Primary Total Stemless Anatomic Shoulder Replacement by BMI Category (Primary Diagnosis OA)

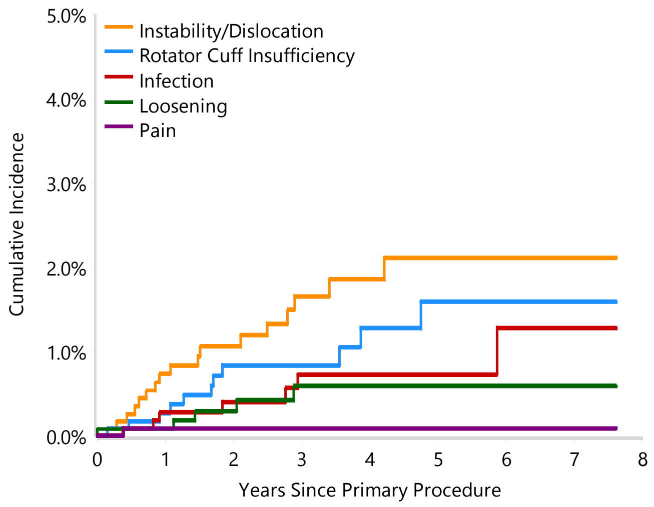
Normal (18.50-24.99)



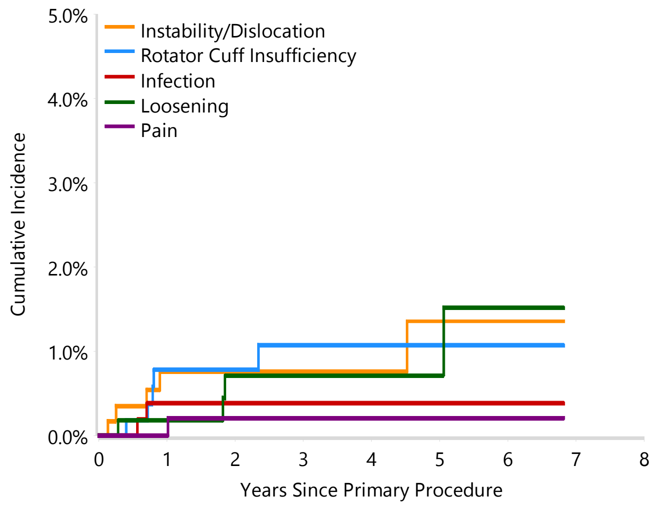
Pre Obese (25.00-29.99)



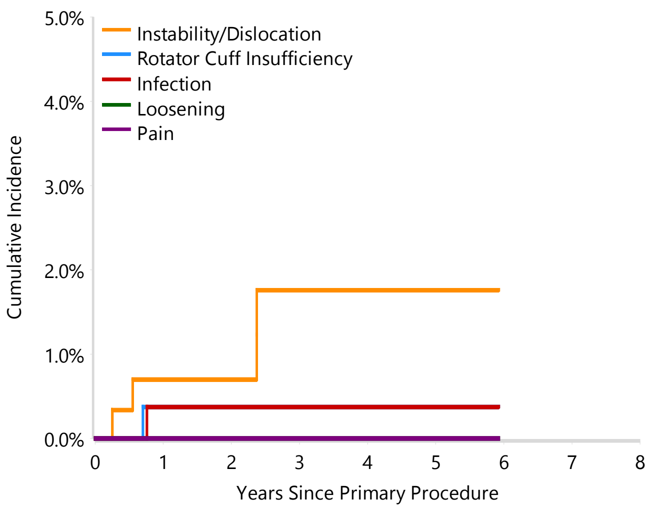
Obese Class 1 (30.00-34.99)



Obese Class 2 (35.00-39.99)



Obese Class 3 (≥40.00)



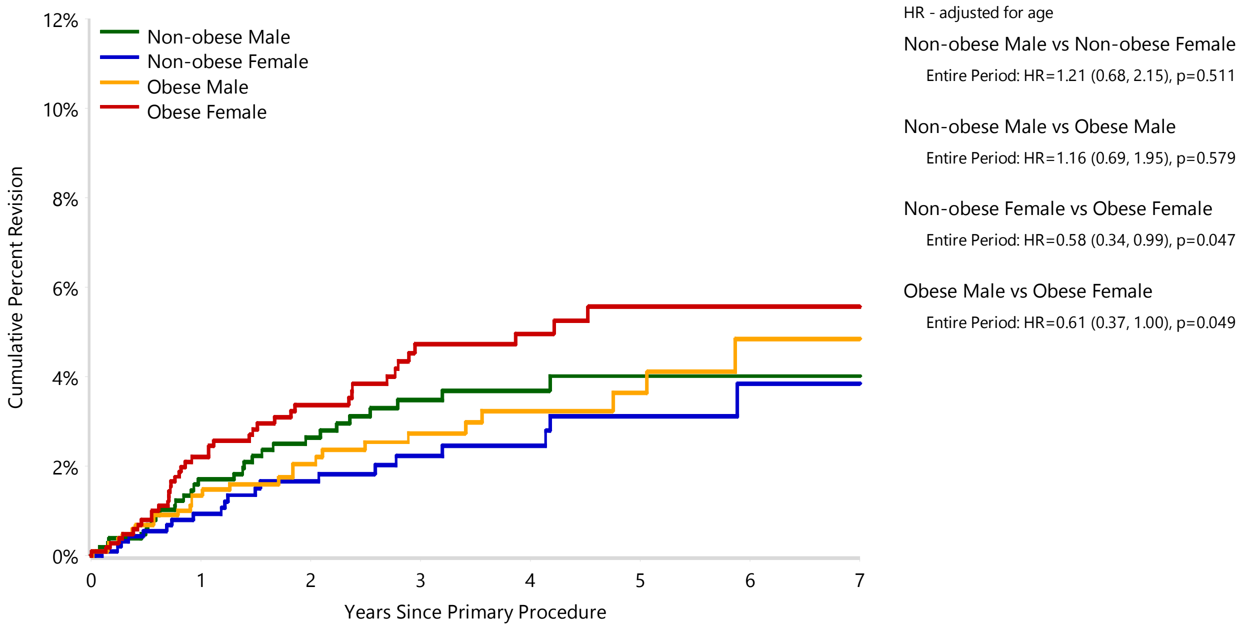
Note: Restricted to modern prostheses
BMI has not been presented for patients aged ≤19 years

Table ST20 Cumulative Percent Revision of Primary Total Stemless Anatomic Shoulder Replacement by BMI Category and Gender (Primary Diagnosis OA)

BMI Category	Gender	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Non-obese	Male	30	1055	1.7 (1.0, 2.8)	2.6 (1.8, 4.0)	3.5 (2.4, 5.0)	3.7 (2.6, 5.3)	4.0 (2.8, 5.8)	4.0 (2.8, 5.8)
	Female	20	959	0.9 (0.5, 1.9)	1.7 (1.0, 2.9)	2.2 (1.4, 3.6)	2.5 (1.5, 4.0)	3.1 (1.9, 5.0)	3.8 (2.3, 6.5)
Obese	Male	27	1064	1.4 (0.8, 2.3)	2.0 (1.3, 3.2)	2.7 (1.8, 4.2)	3.2 (2.1, 4.9)	3.6 (2.4, 5.6)	4.8 (3.0, 7.7)
	Female	41	1064	2.2 (1.4, 3.4)	3.4 (2.4, 4.8)	4.7 (3.4, 6.5)	5.0 (3.6, 6.8)	5.6 (4.0, 7.6)	5.6 (4.0, 7.6)
TOTAL		118	4142						

Note: Restricted to modern prostheses
BMI has not been presented for patients aged ≤19 years
Non-obese group includes underweight, normal and pre-obese
Obese group includes obese class 1, 2 and 3

Figure ST19 Cumulative Percent Revision of Primary Total Stemless Anatomic Shoulder Replacement by BMI Category and Gender (Primary Diagnosis OA)



Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Non-obese	Male	1055	832	657	488	324	213	120
	Female	959	746	582	442	322	210	128
Obese	Male	1064	851	637	469	323	212	119
	Female	1064	845	678	512	375	245	151

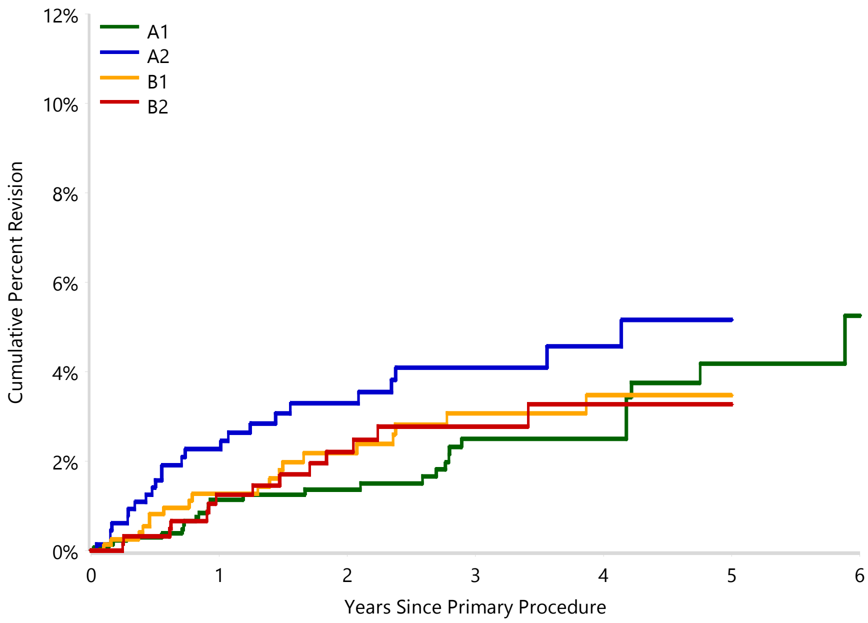
Note: Restricted to modern prostheses
BMI has not been presented for patients aged ≤19 years
Non-obese group includes underweight, normal and pre-obese
Obese group includes obese class 1, 2 and 3

Table ST21 Cumulative Percent Revision of Primary Total Stemless Anatomic Shoulder Replacement by Glenoid Morphology (Primary Diagnosis OA)

Glenoid Morphology	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
A1	28	1344	1.1 (0.7, 2.0)	1.4 (0.8, 2.3)	2.5 (1.6, 3.8)	2.5 (1.6, 3.8)	4.2 (2.7, 6.4)
A2	24	676	2.3 (1.3, 3.8)	3.3 (2.1, 5.1)	4.1 (2.7, 6.2)	4.6 (3.0, 7.0)	5.2 (3.3, 8.0)
B1	19	768	1.3 (0.7, 2.4)	2.2 (1.3, 3.7)	3.1 (1.9, 4.9)	3.5 (2.2, 5.5)	3.5 (2.2, 5.5)
B2	15	664	1.2 (0.6, 2.6)	2.2 (1.2, 4.0)	2.8 (1.6, 4.8)	3.3 (1.9, 5.6)	3.3 (1.9, 5.6)
C	1	85	1.4 (0.2, 9.6)	1.4 (0.2, 9.6)	1.4 (0.2, 9.6)	1.4 (0.2, 9.6)	1.4 (0.2, 9.6)
TOTAL	87	3537					

Note: Restricted to modern prostheses
Excludes 14 procedures where a glenoid morphology of B3 was recorded

Figure ST20 Cumulative Percent Revision of Primary Total Stemless Anatomic Shoulder Replacement by Glenoid Morphology (Primary Diagnosis OA)



HR - adjusted for age and gender

A2 vs A1
Entire Period: HR=1.69 (0.98, 2.92), p=0.058

B1 vs A1
Entire Period: HR=1.09 (0.61, 1.97), p=0.766

B2 vs A1
Entire Period: HR=1.06 (0.56, 2.02), p=0.849

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
A1	1344	1006	749	539	349	189
A2	676	519	387	269	170	90
B1	768	615	479	354	237	128
B2	664	508	364	251	149	82

Note: Restricted to modern prostheses
Excludes 14 procedures where a glenoid morphology of B3 was recorded

OUTCOME FOR OSTEOARTHRITIS – PROSTHESIS CHARACTERISTICS

Fixation
The majority of primary total stemless anatomic shoulder replacement procedures utilise hybrid (cementless humeral component with a cemented glenoid) fixation. Cemented primary stemless anatomic prostheses have a higher revision rate than hybrid fixation procedures (Table ST22 and Figure ST21).

Glenoid Types
There are four types of glenoids: modular metal backed glenoids and three polyethylene glenoid components. The following definitions have been refined for this report. Non-modular metal back glenoids have a polyethylene bearing surface and one or more metallic fixation pegs with or without backside integrated metallic coating. Cemented polyethylene glenoids with a modified central peg are all polyethylene but the central peg is further engineered for additional fixation to bone. All polyethylene glenoids are polyethylene fixed by cemented pegs or keels alone without further fixation features.

Cemented all polyethylene glenoids are the most common type of glenoid used (Table ST23). Non modular metal backed glenoids had a higher risk of revision than both cemented all polyethylene glenoids and modified central peg glenoids (Figure ST22).

Bearing Surface
There is no difference in the rate of revision when ceramic/non XLPE, ceramic/XLPE, metal/XLPE and metal/non XLPE bearing surfaces (humeral head/glenoid) are compared (Table ST24 and Figure ST23).

Humeral head size is not a risk factor for revision of primary total stemless anatomic shoulder replacement.

Humeral Heads
Humeral head size is not a risk factor for revision of primary total stemless anatomic shoulder replacement (Table ST25 and Figure ST24).

Technology Assistance
An image derived instrument (IDI) is defined as custom made pin guides or cutting blocks derived from CT or MRI images by 3D printing specifically for each patient. There are 1,306 total stemless anatomic shoulder replacements for osteoarthritis utilising an IDI since their first use in 2016. In 2023, IDI are used in 44.8% of all total stemless anatomic shoulder replacement procedures. There is no difference in the rate of revision when IDI is used compared to when IDI is not used (Table ST26 and Figure ST25).

The outcome of the most used primary total stemless anatomic prosthesis combinations are listed in Table ST27.

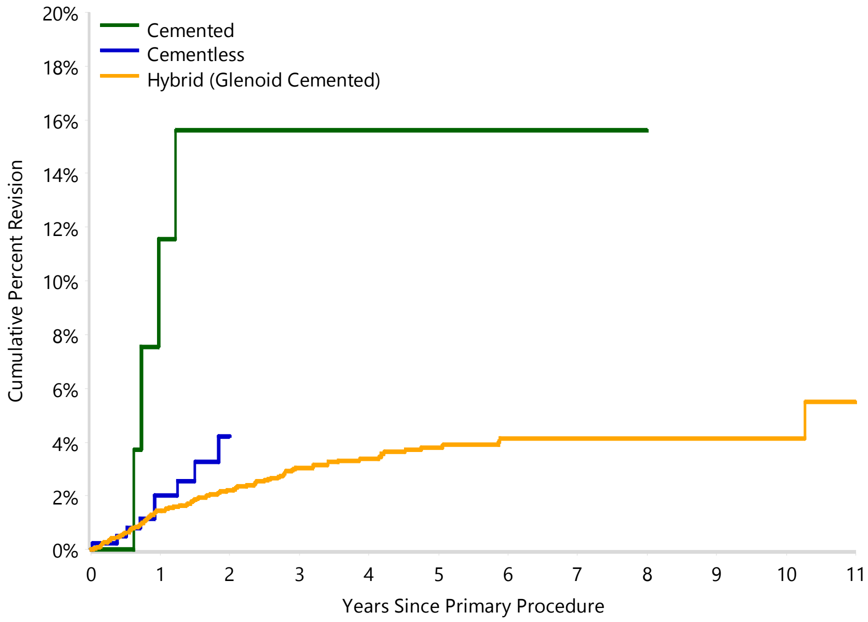
Primary Total Shoulder Replacement

Table ST22 Cumulative Percent Revision of Primary Total Stemless Anatomic Shoulder Replacement by Fixation (Primary Diagnosis OA)

Fixation	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Cemented	4	30	11.6 (3.9, 31.8)	15.6 (6.1, 36.4)	15.6 (6.1, 36.4)	15.6 (6.1, 36.4)		
Cementless	11	439	2.0 (0.9, 4.5)					
Hybrid (Glenoid Cemented)	112	3946	1.4 (1.1, 1.9)	3.1 (2.5, 3.7)	3.8 (3.1, 4.6)	4.2 (3.4, 5.1)	4.2 (3.4, 5.1)	
TOTAL	127	4415						

Note: Restricted to modern prostheses

Figure ST21 Cumulative Percent Revision of Primary Total Stemless Anatomic Shoulder Replacement by Fixation (Primary Diagnosis OA)



HR - adjusted for age and gender

Cemented vs Cementless

Entire Period: HR=2.96 (0.94, 9.33), p=0.063

Cemented vs Hybrid (Glenoid Cemented)

Entire Period: HR=4.98 (1.84, 13.50), p=0.001

Cementless vs Hybrid (Glenoid Cemented)

Entire Period: HR=1.68 (0.90, 3.15), p=0.104

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Cemented	30	22	16	9	6	0	0
Cementless	439	221	31	18	7	0	0
Hybrid (Glenoid Cemented)	3946	3296	2109	1065	417	85	0

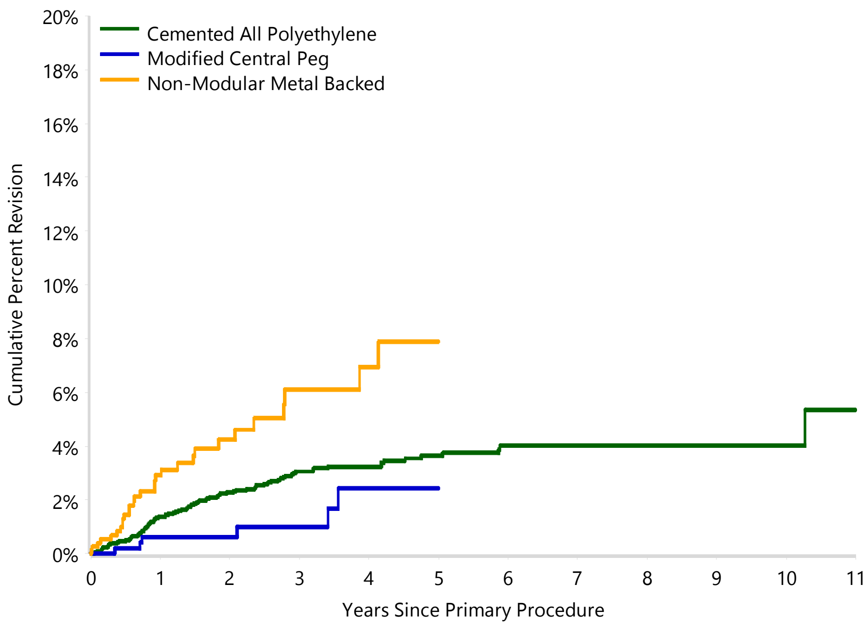
Note: Restricted to modern prostheses

Table ST23 Cumulative Percent Revision of Primary Total Stemless Anatomic Shoulder Replacement by Glenoid Type (Primary Diagnosis OA)

Glenoid Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Cemented All Polyethylene	89	3031	1.4 (1.0, 1.9)	3.1 (2.4, 3.8)	3.6 (2.9, 4.5)	4.0 (3.2, 5.0)	4.0 (3.2, 5.0)	
Modified Central Peg	6	584	0.6 (0.2, 1.9)	1.0 (0.4, 2.7)	2.4 (1.0, 6.0)			
Modular Metal Backed	3	32	3.2 (0.5, 20.8)	7.3 (1.8, 26.3)	11.7 (3.9, 32.3)	11.7 (3.9, 32.3)		
Non-Modular Metal Backed	29	768	2.9 (1.8, 4.6)	6.1 (4.0, 9.2)	7.9 (5.1, 12.2)			
TOTAL	127	4415						

Note: Restricted to modern prostheses

Figure ST22 Cumulative Percent Revision of Primary Total Stemless Anatomic Shoulder Replacement by Glenoid Type (Primary Diagnosis OA)



HR - adjusted for age and gender

Cemented All Polyethylene vs Modified Central Peg
Entire Period: HR=2.05 (0.90, 4.70), p=0.089

Non-Modular Metal Backed vs Cemented All Polyethylene
Entire Period: HR=2.04 (1.34, 3.13), p=0.001

Non-Modular Metal Backed vs Modified Central Peg
Entire Period: HR=4.19 (1.74, 10.10), p=0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Cemented All Polyethylene	3031	2631	1798	967	413	85	0
Modified Central Peg	584	412	184	50	0	0	0
Non-Modular Metal Backed	768	468	151	57	10	0	0

Note: Restricted to modern prostheses

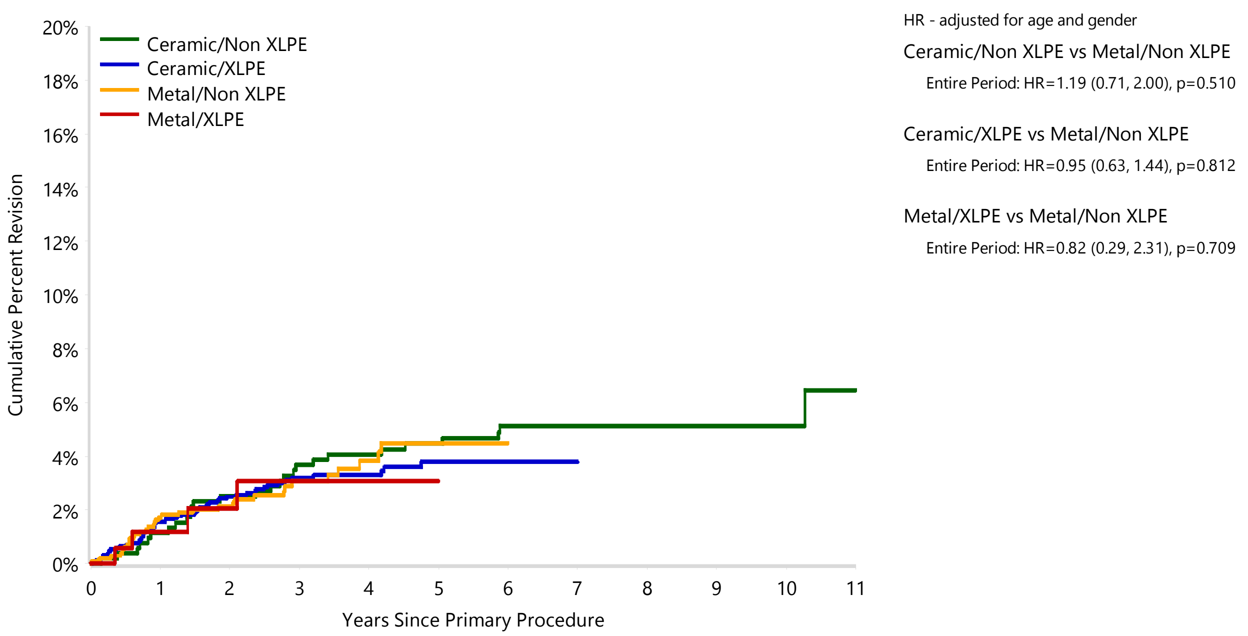
Primary Total Shoulder Replacement

Table ST24 Cumulative Percent Revision of Primary Total Stemless Anatomic Shoulder Replacement by Bearing Surface (Primary Diagnosis OA)

Bearing Surface	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Ceramic/Non XLPE	27	520	1.2 (0.5, 2.6)	3.7 (2.4, 5.7)	4.5 (3.0, 6.6)	5.1 (3.5, 7.5)	5.1 (3.5, 7.5)	
Ceramic/XLPE	60	2276	1.6 (1.1, 2.2)	3.2 (2.4, 4.1)	3.8 (2.9, 5.0)	3.8 (2.9, 5.0)		
Metal/Non XLPE	36	1414	1.7 (1.1, 2.6)	3.1 (2.1, 4.4)	4.5 (3.1, 6.5)			
Metal/XLPE	4	205	1.2 (0.3, 4.6)	3.1 (1.1, 8.2)	3.1 (1.1, 8.2)			
TOTAL	127	4415						

Note: Restricted to modern prostheses. Reported as humeral head/glenoid.

Figure ST23 Cumulative Percent Revision of Primary Total Stemless Anatomic Shoulder Replacement by Bearing Surface (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Ceramic/Non XLPE	520	514	493	472	287	84	0
Ceramic/XLPE	2276	1822	1066	420	119	0	0
Metal/Non XLPE	1414	1067	520	158	20	1	0
Metal/XLPE	205	136	77	42	4	0	0

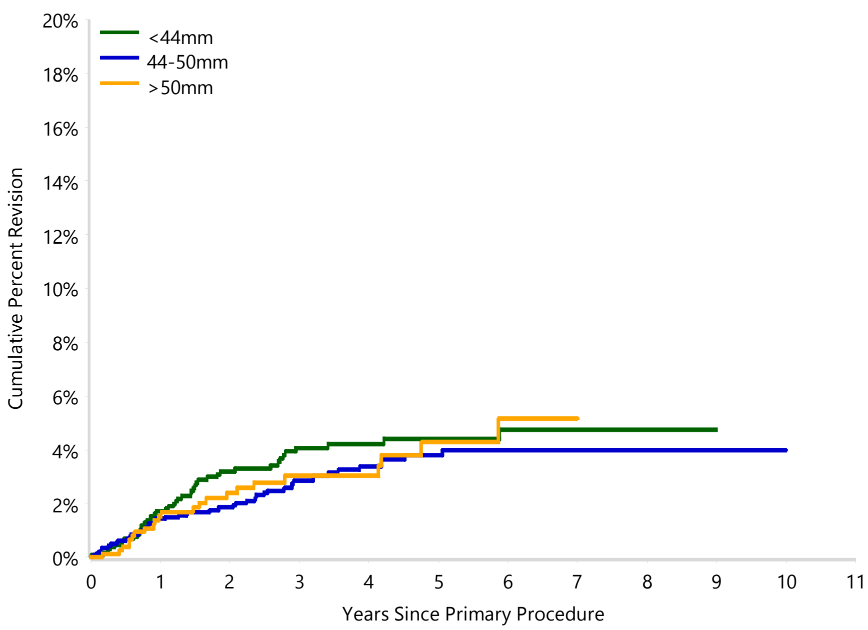
Note: Restricted to modern prostheses. Reported as humeral head/glenoid.

Table ST25 Cumulative Percent Revision of Primary Total Stemless Anatomic Shoulder Replacement by Humeral Head Size (Primary Diagnosis OA)

Humeral Head Size	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
<44mm	47	1372	1.7 (1.1, 2.6)	4.1 (3.0, 5.5)	4.4 (3.3, 5.9)	4.7 (3.5, 6.4)		
44-50mm	57	2218	1.4 (1.0, 2.1)	2.8 (2.1, 3.8)	3.8 (2.9, 5.0)	4.0 (3.0, 5.3)	4.0 (3.0, 5.3)	
>50m	23	822	1.5 (0.8, 2.7)	3.0 (1.9, 4.7)	4.3 (2.7, 6.7)	5.2 (3.1, 8.5)		
TOTAL	127	4412						

Note: Restricted to modern prostheses
Excludes 3 procedures with unknown head size

Figure ST24 Cumulative Percent Revision of Primary Total Stemless Anatomic Shoulder Replacement by Humeral Head Size (Primary Diagnosis OA)



HR - adjusted for age and gender
<44mm vs 44-50mm
Entire Period: HR=1.25 (0.79, 1.98), p=0.343

<44mm vs >50mm
Entire Period: HR=1.11 (0.59, 2.10), p=0.753

>50mm vs 44-50mm
Entire Period: HR=1.13 (0.68, 1.87), p=0.644

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
<44mm	1372	1100	704	400	183	31	0
44-50mm	2218	1788	1070	522	186	40	0
>50mm	822	651	382	170	61	14	0

Note: Restricted to modern prostheses
Excludes 3 procedures with unknown head size

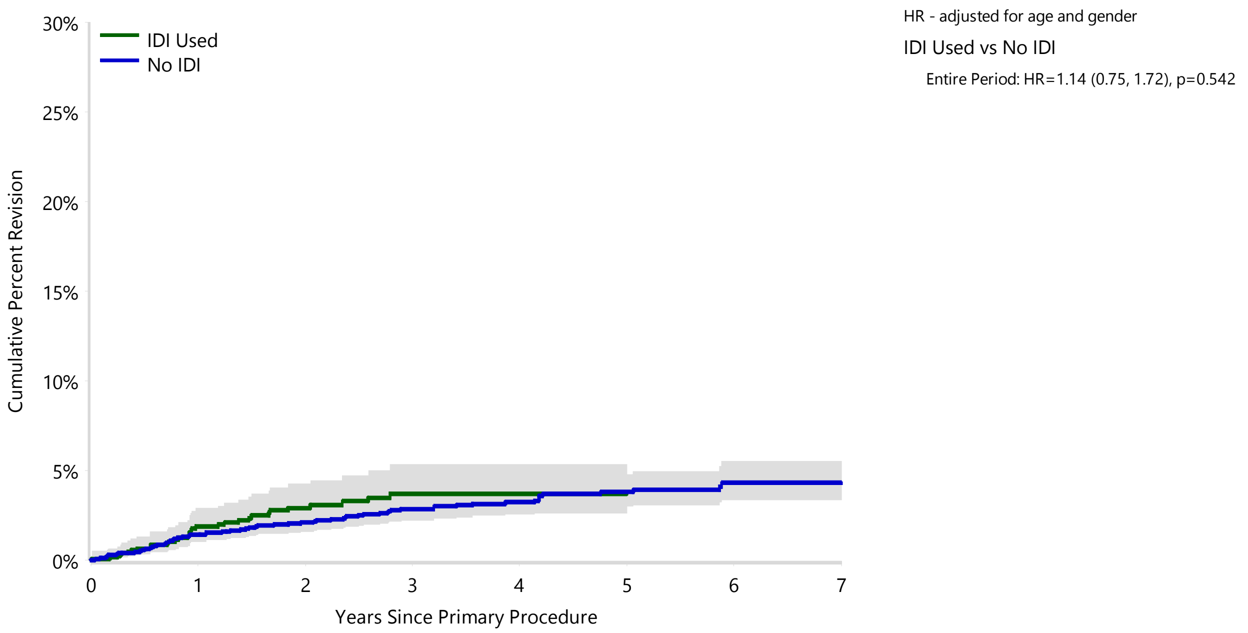
Primary Total Shoulder Replacement

Table ST26 Cumulative Percent Revision of Primary Total Stemless Anatomic Shoulder Replacement Since 2016 by IDI Usage (Primary Diagnosis OA)

IDI Use	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs
IDI Used	32	1306	1.9 (1.2, 2.9)	2.9 (2.0, 4.3)	3.7 (2.6, 5.3)	3.7 (2.6, 5.3)	
No IDI	80	2853	1.4 (1.0, 1.9)	2.1 (1.6, 2.7)	2.9 (2.2, 3.6)	3.8 (3.0, 4.8)	4.3 (3.4, 5.5)
TOTAL	112	4159					

Note: Restricted to modern prostheses

Figure ST25 Cumulative Percent Revision of Primary Total Stemless Anatomic Shoulder Replacement Since 2016 by IDI Usage (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs
IDI Used	1306	923	611	367	87	2
No IDI	2853	2364	1954	1550	779	208

Note: Restricted to modern prostheses

Table ST27 Cumulative Percent Revision of Primary Total Stemless Anatomic Shoulder Replacement by Prosthesis Combination (Primary Diagnosis OA)

Humeral Stem	Glenoid	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Affinis	**Affinis**	86	2655	1.5 (1.1, 2.1)	3.5 (2.8, 4.3)	4.1 (3.3, 5.1)	4.5 (3.6, 5.6)	4.5 (3.6, 5.6)	
	Global	1	141	0.8 (0.1, 5.6)	0.8 (0.1, 5.6)				
Comprehensive	**Alliance**	0	31	0.0 (0.0, 0.0)					
	Comprehensive	20	268	4.7 (2.7, 8.1)	8.0 (5.1, 12.6)	9.8 (6.3, 15.2)			
Equinoxe	**Equinoxe**	0	47	0.0 (0.0, 0.0)					
Global Icon	**Global**	2	165	0.7 (0.1, 5.0)	2.4 (0.5, 10.1)				
SMR	**SMR**	3	56	3.7 (0.9, 14.0)	5.6 (1.8, 16.3)	5.6 (1.8, 16.3)			
	SMR L1	3	32	3.2 (0.5, 20.8)	7.3 (1.8, 26.3)	11.7 (3.9, 32.3)	11.7 (3.9, 32.3)		
Simpliciti	**Perform**	12	1018	0.9 (0.4, 1.8)	1.4 (0.7, 2.5)	2.1 (1.1, 4.0)			
Other (2)		0	2	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)				
TOTAL		**127**	**4415**						

Note: Restricted to modern prostheses.
Only prostheses with >30 procedures have been listed

Primary Total Stemmed Anatomic Shoulder Replacement

DEMOGRAPHICS

There are 16,519 total stemmed anatomic shoulder replacement procedures. This is an additional 495 procedures compared to the previous report.

The majority of procedures are undertaken in females. However, the proportion of males has increased 2.5% since 2015. The mean age of females is older than males (Table ST28).

The majority of procedures are undertaken in the 65–74 year age group. The proportional use in patients aged ≥75 years has declined from 23.2% in 2022 to 22.6% in 2023 (Figure ST26).

Hybrid fixation with a cemented glenoid has increased from 55.8% in 2010 to 74.5% in 2023.

In 2023, non-XLPE polyethylene is more commonly used (66.2%) in total stemmed anatomic replacement glenoids than XLPE (33.8%) (Figure ST27).

The most common type of fixation is hybrid fixation (cementless humerus and cemented glenoid) (Figure ST28).

The 10 most used humeral stem and glenoid prostheses are listed in Table ST29 and Table ST30.

Table ST28 Age and Gender of Primary Total Stemmed Anatomic Shoulder Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	7115	43.1%	21	93	67	66.6	9.0
Female	9404	56.9%	19	96	71	70.3	8.5
TOTAL	**16519**	**100.0%**	**19**	**96**	**69**	**68.7**	**8.9**

Primary Total Shoulder Replacement

Figure ST26 Primary Total Stemmed Anatomic Shoulder Replacement by Age

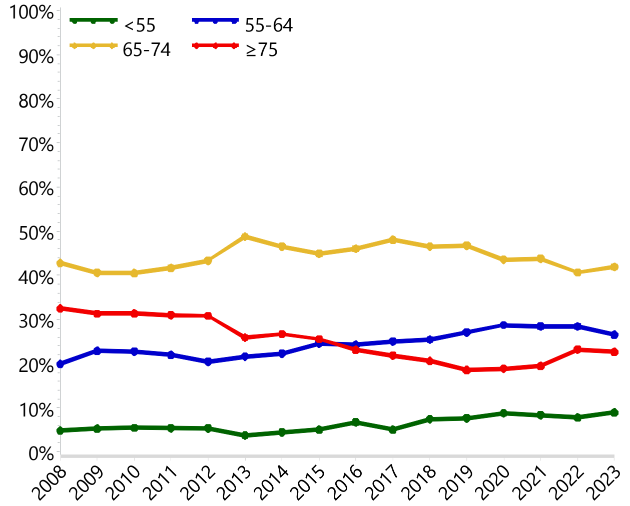


Figure ST28 Primary Total Stemmed Anatomic Shoulder Replacement by Fixation

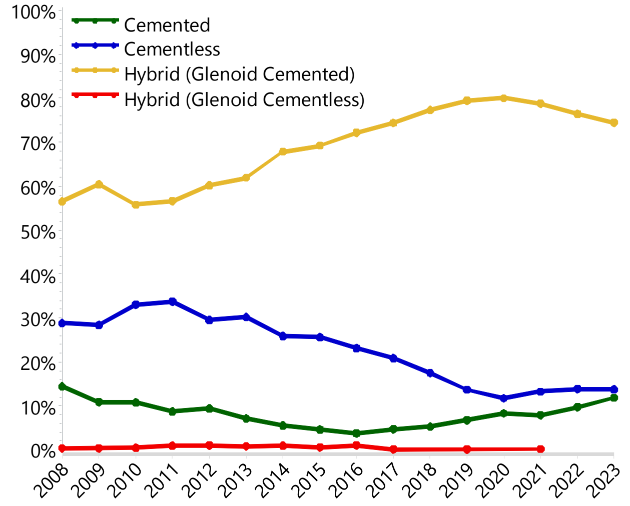


Figure ST27 Primary Total Stemmed Anatomic Shoulder Replacement by Polyethylene Type

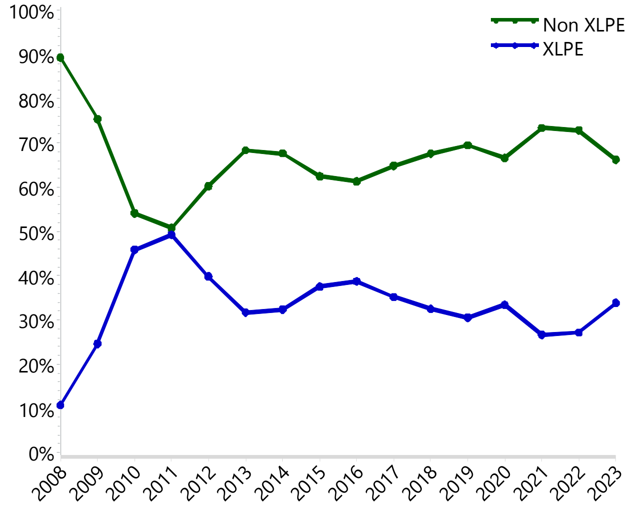


Table ST29 Most Used Humeral Stem Prostheses in Primary Total Stemmed Anatomic Shoulder Replacement

2008		2020		2021		2022		2023	
N	Model	N	Model	N	Model	N	Model	N	Model
298	SMR	143	Ascend Flex	179	Ascend Flex	185	Ascend Flex	148	Ascend Flex
167	Aequalis	111	Global Unite	92	Equinoxe	102	Global Unite	124	Global Unite
117	Global Advantage	94	Comprehensive	92	Global Unite	86	Equinoxe	78	SMR
91	Global AP	92	Equinoxe	86	Comprehensive	77	SMR	59	Comprehensive
40	Bigliani/Flatow	88	SMR	83	SMR	69	Comprehensive	47	Equinoxe
37	Bigliani/Flatow TM	77	Global AP	56	Global AP	30	Global AP	23	Global AP
32	Solar	19	Global Advantage	4	Bigliani/Flatow TM	4	Affinis	1	Affinis
27	Affinis	9	Bigliani/Flatow TM	3	Delta Xtend	2	Delta Xtend	1	Delta Xtend
11	Univers 3D	5	Turon	2	Global Advantage	1	Bigliani/Flatow TM	1	MSS
10	Cofield 2	2	Affinis	1	Affinis				
10 Most Used									
830	(10) 97.9%	640	(10) 100.0%	598	(10) 100.0%	556	(9) 100.0%	482	(9) 100.0%
Remainder									
18	(7) 2.1%	0	(0) 0%	0	(0) 0%	0	(0) 0%	0	(0) 0%
TOTAL									
848	(17) 100.0%	640	(10) 100.0%	598	(10) 100.0%	556	(9) 100.0%	482	(9) 100.0%

Primary Total Shoulder Replacement

Table ST30 Most Used Glenoid Prostheses in Primary Total Stemmed Anatomic Shoulder Replacement

2008		2020		2021		2022		2023	
N	Model	N	Model	N	Model	N	Model	N	Model
237	SMR L1	207	Global	180	Perform	184	Perform	148	Global
209	Global	143	Perform	151	Global	134	Global	148	Perform
167	Aequalis	92	Equinoxe	92	Equinoxe	86	Equinoxe	64	SMR L1
79	Bigliani/Flatow	91	Comprehensive	73	Comprehensive	65	SMR L1	47	Equinoxe
57	SMR	72	SMR L1	70	SMR L1	59	Comprehensive	45	Comprehensive
32	Solar	15	SMR	13	Alliance	12	SMR	14	Alliance
27	Affinis	8	Bigliani/Flatow	10	SMR	10	Alliance	14	SMR
11	Univers 3D	5	Turon	3	Bigliani/Flatow	5	Affinis	1	Affinis
10	Cofield 2	2	Affinis	2	SMR Axioma	1	Bigliani/Flatow	1	MSS
7	Promos	2	Alliance	1	Affinis				
10 Most Used									
836	(10) 98.6%	637	(10) 99.5%	595	(10) 99.5%	556	(9) 100.0%	482	(9) 100.0%
Remainder									
12	(6) 1.4%	3	(3) 0.5%	3	(3) 0.5%	0	(0) 0%	0	(0) 0%
TOTAL									
848	(16) 100.0%	640	(13) 100.0%	598	(13) 100.0%	556	(9) 100.0%	482	(9) 100.0%

OUTCOME FOR ALL DIAGNOSES

Primary Diagnosis

The most common diagnosis for primary total stemmed anatomic shoulder replacement is osteoarthritis (94.3%). There is no difference in the rate of revision between osteoarthritis, osteonecrosis and rheumatoid arthritis (Table ST31 and Figure ST29).

Reason for Revision

The main reasons for revision are rotator cuff insufficiency, instability/dislocation, and loosening (Table ST32 and Figure ST30). Since 2015, revision for infection has increased in proportion by 29.4% and instability/dislocation by 11.3%. In contrast, loosening decreased by 16.9% and rotator cuff insufficiency marginally reduced by 1.7%. The predominant reason for revision for both males and females was rotator cuff insufficiency (Figure ST31).

Type of Revision

The most common type of revision involves replacement of the humeral component (60.5%) (Table ST33). Since 2015, humeral component, and head only revisions decreased by 30.3% and 9.1%, respectively. Humeral/glenoid revisions have increased by 45.9%.

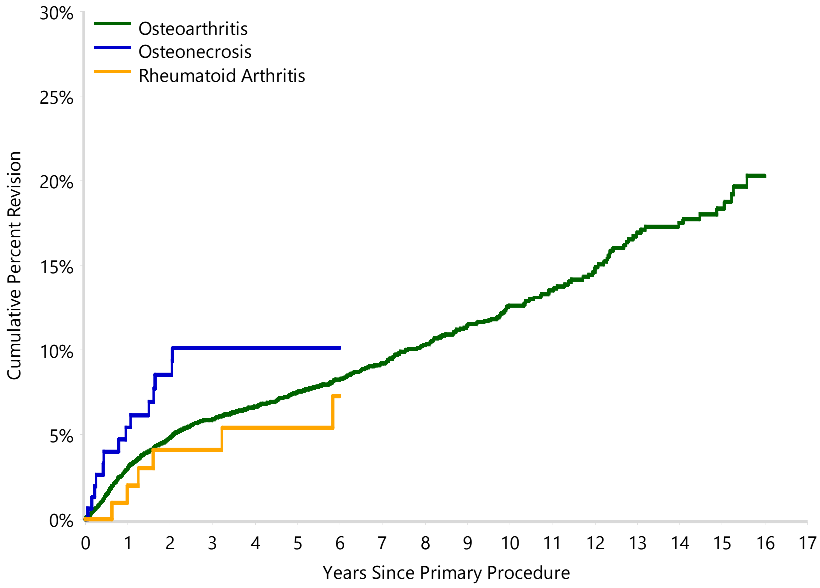
The majority of total stemmed anatomic replacements were revised to reverse replacements (93.5%) with 77.9% of those retaining the humeral stem.

Table ST31 Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement by Primary Diagnosis

Primary Diagnosis	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Osteoarthritis	654	7426	3.0 (2.6, 3.4)	5.9 (5.4, 6.5)	7.5 (6.9, 8.2)	9.2 (8.5, 10.0)	12.6 (11.6, 13.8)	17.5 (15.7, 19.6)
Osteonecrosis	15	156	5.4 (2.8, 10.6)	10.1 (6.1, 16.6)	10.1 (6.1, 16.6)			
Rheumatoid Arthritis	7	105	2.0 (0.5, 7.7)	4.1 (1.6, 10.6)	5.4 (2.3, 12.6)			
Fracture	12	67	9.4 (4.3, 19.7)	19.1 (11.3, 31.3)	19.1 (11.3, 31.3)	19.1 (11.3, 31.3)	19.1 (11.3, 31.3)	
Rotator Cuff Arthropathy	7	48	4.2 (1.1, 15.6)	11.0 (4.7, 24.5)	13.4 (6.2, 27.5)	13.4 (6.2, 27.5)	24.2 (9.4, 54.1)	
Other Inflammatory Arthritis	6	46	6.9 (2.3, 19.9)	6.9 (2.3, 19.9)	10.0 (3.8, 24.8)	10.0 (3.8, 24.8)		
Other (3)	3	30	0.0 (0.0, 0.0)	8.2 (2.1, 28.9)	14.3 (4.7, 39.0)	14.3 (4.7, 39.0)		
TOTAL	704	7878						

Note: Only primary diagnoses with >30 procedures have been listed
Restricted to modern prostheses

Figure ST29 Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement by Primary Diagnosis



HR - adjusted for age and gender
Osteonecrosis vs Osteoarthritis
0 - 1.5Yr: HR=1.38 (0.73, 2.62), p=0.317
1.5Yr+: HR=0.60 (0.25, 1.45), p=0.256

Osteonecrosis vs Rheumatoid Arthritis
Entire Period: HR=1.73 (0.71, 4.25), p=0.229

Rheumatoid Arthritis vs Osteoarthritis
Entire Period: HR=0.55 (0.26, 1.17), p=0.123

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Osteoarthritis	7426	6728	5389	4018	2644	1049	377
Osteonecrosis	156	130	101	70	37	15	6
Rheumatoid Arthritis	105	98	77	60	37	16	7

Note: Restricted to modern prostheses
Only primary diagnoses with >70 procedures have been listed

Primary Total Shoulder Replacement

Table ST32 Primary Total Stemmed Anatomic Shoulder Replacement by Reason for Revision (All Diagnoses)

Reason for Revision	Number	Percent
Rotator Cuff Insufficiency	255	36.2
Instability/Dislocation	193	27.4
Loosening	98	13.9
Infection	36	5.1
Fracture	20	2.8
Pain	18	2.6
Implant Breakage Glenoid Insert	13	1.8
Wear Glenoid Insert	12	1.7
Arthrofibrosis	11	1.6
Lysis	8	1.1
Implant Breakage Glenoid	8	1.1
Metal Related Pathology	8	1.1
Dissociation	7	1.0
Malposition	5	0.7
Incorrect Sizing	5	0.7
Progression Of Disease	2	0.3
Other	5	0.7
TOTAL	704	100.0

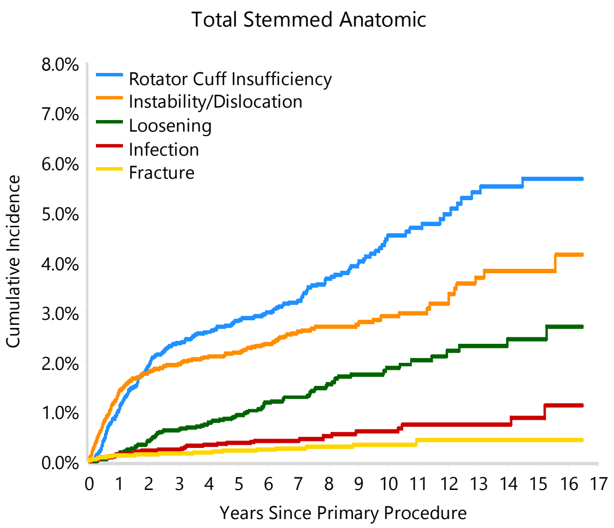
Note: Restricted to modern prostheses

Table ST33 Primary Total Stemmed Anatomic Shoulder Replacement by Type of Revision (All Diagnoses)

Type of Revision	Number	Percent
Humeral Component	426	60.5
Humeral/Glenoid	201	28.6
Head Only	35	5.0
Cement Spacer	17	2.4
Glenoid Component	15	2.1
Removal of Prostheses	4	0.6
Reoperation	2	0.3
Minor Components	2	0.3
Head/Insert	2	0.3
TOTAL	704	100.0

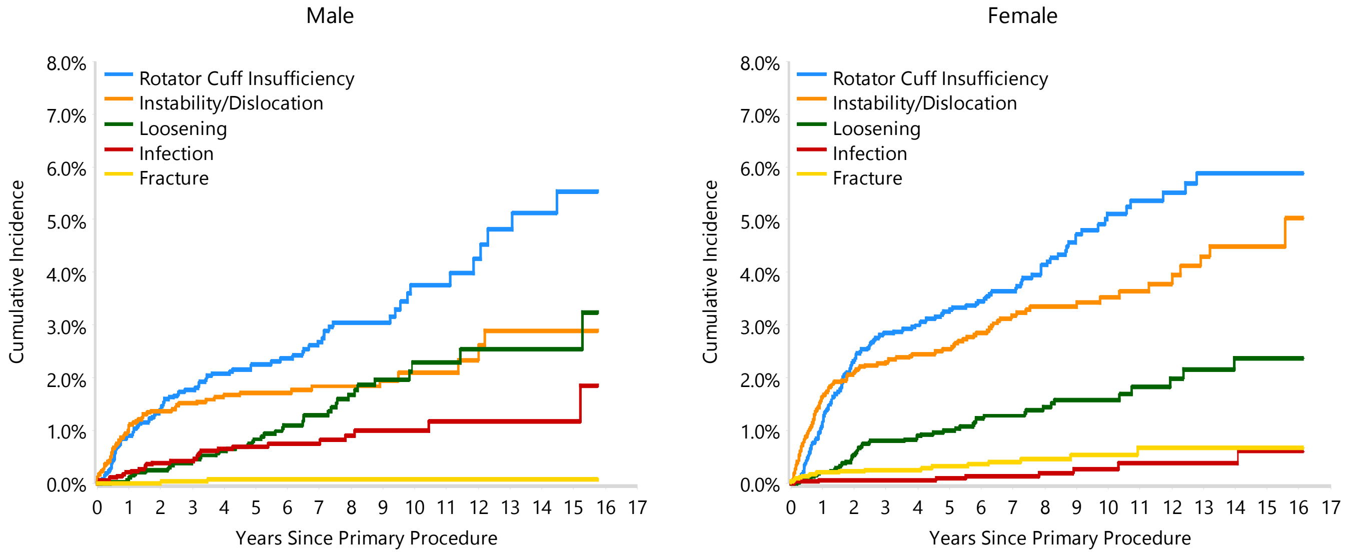
Note: Restricted to modern prostheses
Humeral heads are replaced when the humeral component is revised

Figure ST30 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Anatomic Shoulder Replacement (All Diagnoses)



Note: Restricted to modern prostheses

Figure ST31 **Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Anatomic Shoulder Replacement by Gender**



Note: Restricted to modern prostheses

Primary Total Shoulder Replacement

PROSTHESIS TYPES

The outcome of the most used humeral stem and glenoid prosthesis combinations used in primary total stemmed anatomic shoulder replacement are listed in Table ST34.

The most commonly used cementless prosthesis combinations are listed in Table ST35. Prosthesis combinations with hybrid (glenoid cemented) fixation are listed in Table ST36.

Table ST34 Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement by Prosthesis Combination

Humeral Stem	Glenoid	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Affinis	Affinis	21	198	0.0 (0.0, 0.0)	2.6 (1.1, 6.2)	5.4 (2.9, 9.8)	6.5 (3.8, 11.2)	9.1 (5.7, 14.5)	12.2 (8.0, 18.5)
Ascend Flex	Perform	36	1334	0.7 (0.4, 1.4)	2.3 (1.5, 3.3)	2.7 (1.8, 3.9)	4.1 (2.8, 6.1)		
Comprehensive	Comprehensive	50	918	3.7 (2.6, 5.1)	4.9 (3.6, 6.5)	5.4 (4.0, 7.1)	5.7 (4.3, 7.6)	7.4 (5.3, 10.4)	
Equinoxe	Equinoxe	70	734	3.0 (1.9, 4.5)	6.8 (5.1, 9.0)	10.4 (8.0, 13.3)	13.7 (10.6, 17.7)		
Global AP	Global	18	396	1.0 (0.4, 2.7)	3.9 (2.3, 6.6)	5.9 (3.7, 9.5)			
Global Unite	Global	30	1282	1.2 (0.8, 2.1)	1.9 (1.3, 2.9)	2.5 (1.7, 3.7)	3.0 (2.1, 4.4)		
SMR	SMR	32	527	1.9 (1.0, 3.6)	4.6 (3.0, 6.8)	5.0 (3.4, 7.3)	5.5 (3.8, 7.9)	6.4 (4.5, 9.0)	7.6 (5.3, 10.9)
	SMR L1	445	2432	5.9 (5.1, 7.0)	11.4 (10.2, 12.8)	13.7 (12.4, 15.2)	16.1 (14.6, 17.7)	20.5 (18.7, 22.5)	26.5 (23.8, 29.4)
Other (6)		2	57	4.6 (1.2, 17.2)	4.6 (1.2, 17.2)				
TOTAL		704	7878						

Note: Restricted to modern prostheses.
Only prostheses with >50 procedures have been listed

Table ST35 Cumulative Percent Revision of Cementless Primary Total Stemmed Anatomic Shoulder Replacement by Prosthesis Combination

Humeral Stem	Glenoid	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Equinoxe	Equinoxe	8	54	7.5 (2.9, 18.8)	11.7 (5.4, 24.3)	14.7 (7.2, 28.7)	14.7 (7.2, 28.7)		
SMR	SMR L1	437	2388	5.9 (5.0, 6.9)	11.4 (10.1, 12.7)	13.6 (12.3, 15.1)	16.0 (14.5, 17.6)	20.6 (18.7, 22.5)	26.6 (23.9, 29.5)
Other (2)		0	3	0.0 (0.0, 0.0)					
TOTAL		445	2445						

Note: Restricted to modern prostheses.
Only prostheses with >10 procedures have been listed

Table ST36 Cumulative Percent Revision of Hybrid (Glenoid Cemented) Primary Total Stemmed Anatomic Shoulder Replacement by Prosthesis Combination

Humeral Stem	Glenoid	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Affinis	Affinis	19	188	0.0 (0.0, 0.0)	1.7 (0.5, 5.0)	4.5 (2.3, 8.8)	5.7 (3.1, 10.4)	8.4 (5.0, 13.7)	11.5 (7.4, 17.8)
Ascend Flex	Perform	30	1146	0.6 (0.3, 1.4)	2.3 (1.5, 3.5)	2.7 (1.9, 4.1)	3.7 (2.4, 5.5)		
Comprehensive	Comprehensive	50	904	3.7 (2.7, 5.2)	5.0 (3.7, 6.6)	5.5 (4.1, 7.2)	5.8 (4.3, 7.7)	7.6 (5.3, 10.6)	
Equinoxe	Equinoxe	59	649	2.5 (1.6, 4.1)	6.1 (4.4, 8.4)	10.0 (7.5, 13.2)	14.0 (10.5, 18.5)		
Global AP	Global	17	383	1.0 (0.4, 2.8)	4.1 (2.4, 6.8)	5.8 (3.5, 9.4)			
Global Unite	Global	25	1145	1.0 (0.6, 1.8)	1.6 (1.0, 2.6)	2.3 (1.5, 3.5)	2.9 (1.9, 4.3)		
SMR	SMR	30	505	2.0 (1.1, 3.7)	4.3 (2.8, 6.6)	4.8 (3.2, 7.1)	5.3 (3.6, 7.8)	6.2 (4.3, 9.0)	7.5 (5.1, 10.9)
Other (7)		2	56	4.6 (1.2, 17.2)	4.6 (1.2, 17.2)				
TOTAL		232	4976						

Note: Restricted to modern prostheses.
Only prostheses with >50 procedures have been listed

OUTCOME FOR OSTEOARTHRITIS – PATIENT CHARACTERISTICS

There are 7,426 primary total stemmed anatomic shoulder replacement procedures with a primary diagnosis of osteoarthritis.

The cumulative percent revision of primary total stemmed anatomic shoulder replacement for osteoarthritis at 14 years is 17.5% (Table ST37). Total stemmed anatomic replacements with modular metal backed glenoids have a higher rate of revision than all other primary implants in this class combined (Figure ST32).

A polyethylene glenoid is defined by the Registry as all other glenoid components other than modular metal back prostheses in total anatomic shoulder procedures. When modular metal backed glenoids are excluded, there is no difference in the rate of revision for the period 2015-2023 compared to the period pre-2015 (Table ST38 and Figure ST33).

The most common reasons for revision are rotator cuff insufficiency (36.9%), instability/dislocation (27.1%), and loosening (14.4%) (Table ST39 and Figure ST34). Males and females are both predominately revised for rotator cuff insufficiency (Figure ST35).

The most common type of revision is of the humeral component (60.1%) (Table ST40). This may include the revision of a humeral component (epiphysis and/or humeral stem) and additional minor components, such as the humeral head/glenosphere and/or removal of the glenoid component. Almost all are revised to a total stemmed reverse shoulder replacement (93.3%) with retention of the original stem on most occasions (78.4%).

Age and Gender

Patients aged ≥65 years have a lower rate of revision compared to patients aged <55 years (Table ST41 and Figure ST36). Females have a higher rate of revision than males (Table ST42 and Figure ST37). When age is stratified by gender the rate of revision difference between age groups remains the same for males (Figure ST38). Females aged ≥75 years have a lower rate of revision compared to females aged <55 years (Figure ST39).

Females have a higher rate of revision compared to males.

ASA and BMI

Most patients have an ASA score of 2 or 3. ASA score is not a risk factor for revision (Table ST43 and Figure ST40). The most common reasons for revision by ASA score are presented in Figure ST41. Males with ASA scores 3-5 have a lower rate of revision than females with the same ASA scores (Table ST44 and Figure ST42).

The most common BMI categories are pre-obese and obese class 1. BMI is not a risk factor for revision (Table ST45 and Figure ST43). However, when gender is considered, obese females had a higher rate of revision than obese males (Table ST46 and Figure ST44). The most common reasons for revision by BMI category are shown in Figure ST45.

Glenoid Morphology

The category of glenoid morphology is not a risk factor for revision (Table ST47 and Figure ST46).

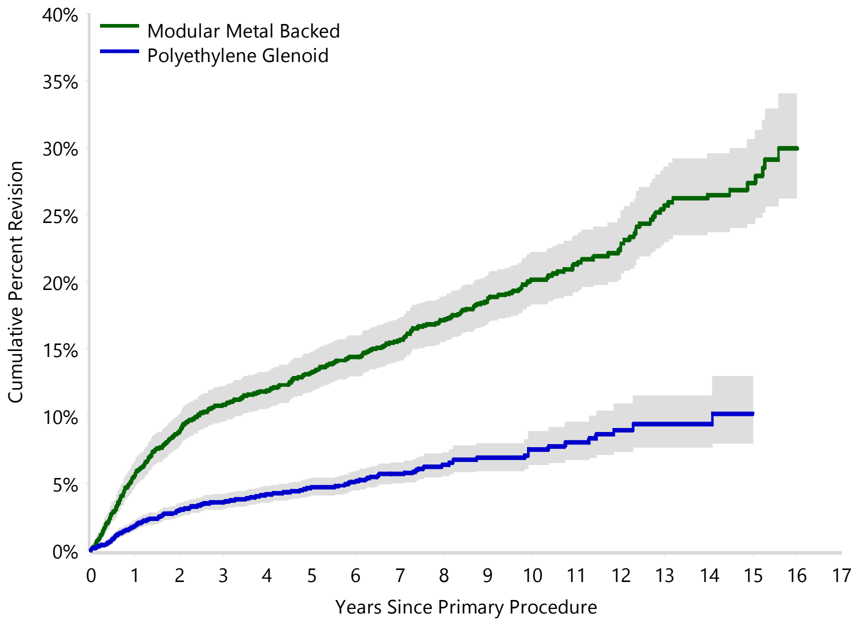
Primary Total Shoulder Replacement

Table ST37 Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement by Glenoid Type (Primary Diagnosis OA)

Glenoid Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Modular Metal Backed	409	2273	5.6 (4.7, 6.6)	10.8 (9.6, 12.2)	13.2 (11.9, 14.8)	15.6 (14.1, 17.3)	20.2 (18.3, 22.2)	26.5 (23.7, 29.5)
Polyethylene Glenoid	245	5153	1.8 (1.5, 2.2)	3.6 (3.1, 4.2)	4.7 (4.1, 5.4)	5.7 (5.0, 6.6)	7.5 (6.4, 8.9)	9.4 (7.6, 11.5)
TOTAL	654	7426						

Note: Restricted to modern prostheses

Figure ST32 Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement by Glenoid Type (Primary Diagnosis OA)



HR - adjusted for age and gender

Modular Metal Backed vs Polyethylene Glenoid

Entire Period: HR=2.98 (2.53, 3.49), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Modular Metal Backed	2273	2071	1801	1577	1248	632	261
Polyethylene Glenoid	5153	4657	3588	2441	1396	417	116

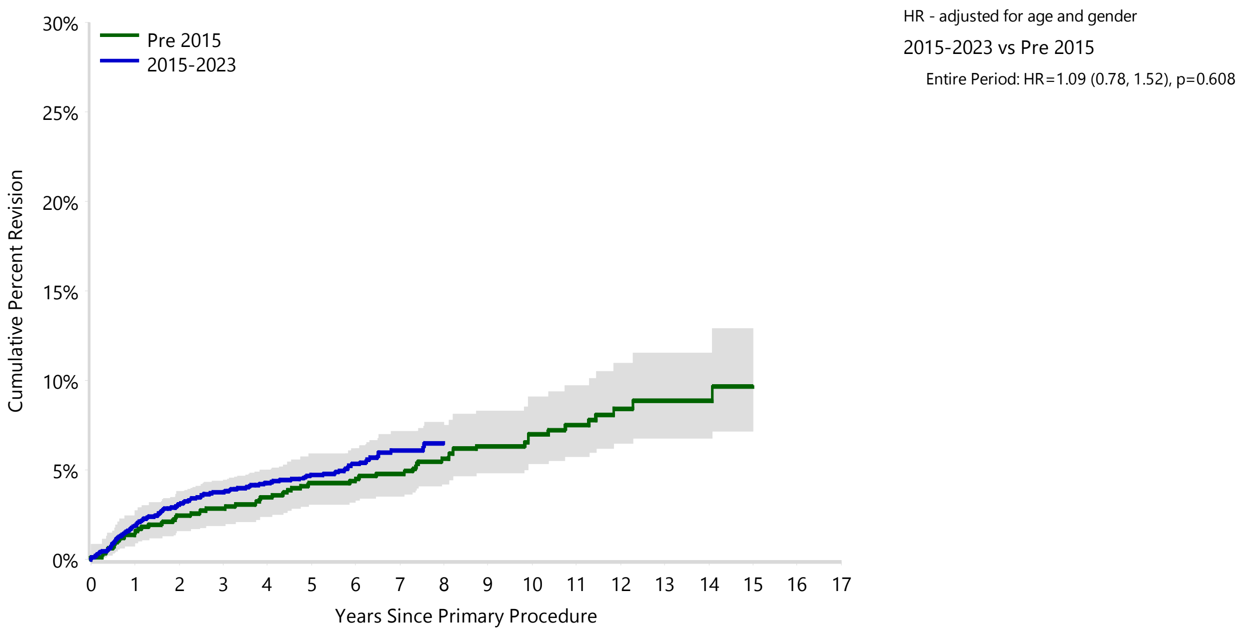
Note: Restricted to modern prostheses

Table ST38 **Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement with Polyethylene Glenoid by Procedure Year (Primary Diagnosis OA)**

Procedure Year	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Pre 2015	59	817	1.5 (0.8, 2.6)	2.8 (1.9, 4.2)	4.3 (3.1, 5.9)	4.8 (3.5, 6.5)	7.0 (5.3, 9.1)	8.8 (6.8, 11.5)
2015-2023	186	4336	1.9 (1.5, 2.3)	3.8 (3.2, 4.4)	4.7 (4.1, 5.5)	6.1 (5.2, 7.2)		
TOTAL	245	5153						

Note: Restricted to modern prostheses

Figure ST33 **Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement with Polyethylene Glenoid by Procedure Year (Primary Diagnosis OA)**



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Pre 2015	817	798	770	732	692	417	116
2015-2023	4336	3859	2818	1709	704	0	0

Note: Restricted to modern prostheses, polyethylene glenoids are all glenoid components excluding modular metal backed prostheses.

Primary Total Shoulder Replacement

Table ST39 Primary Total Stemmed Anatomic Shoulder Replacement by Reason for Revision (Primary Diagnosis OA)

Reason for Revision	Number	Percent
Rotator Cuff Insufficiency	241	36.9
Instability/Dislocation	177	27.1
Loosening	94	14.4
Infection	32	4.9
Pain	17	2.6
Fracture	17	2.6
Implant Breakage Glenoid Insert	13	2.0
Wear Glenoid Insert	10	1.5
Arthrofibrosis	8	1.2
Lysis	8	1.2
Implant Breakage Glenoid	8	1.2
Metal Related Pathology	7	1.1
Dissociation	6	0.9
Malposition	5	0.8
Incorrect Sizing	5	0.8
Progression Of Disease	1	0.2
Other	5	0.8
TOTAL	654	100.0

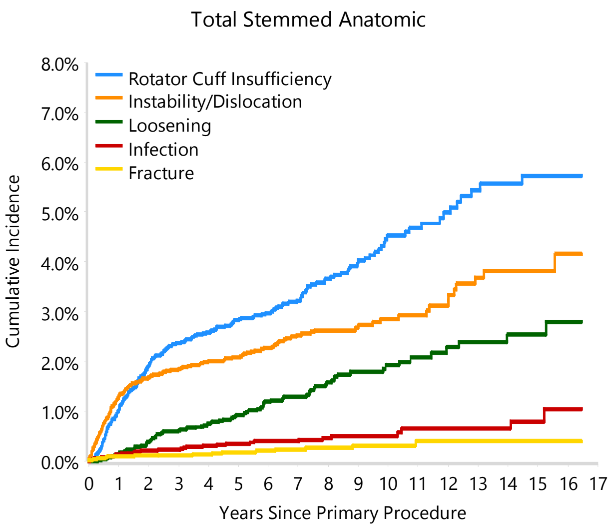
Note: Restricted to modern prostheses

Table ST40 Primary Total Stemmed Anatomic Shoulder Replacement by Type of Revision (Primary Diagnosis OA)

Type of Revision	Number	Percent
Humeral Component	393	60.1
Humeral/Glenoid	190	29.1
Head Only	32	4.9
Cement Spacer	17	2.6
Glenoid Component	13	2.0
Removal of Prostheses	3	0.5
Reoperation	2	0.3
Minor Components	2	0.3
Head/Insert	2	0.3
TOTAL	654	100.0

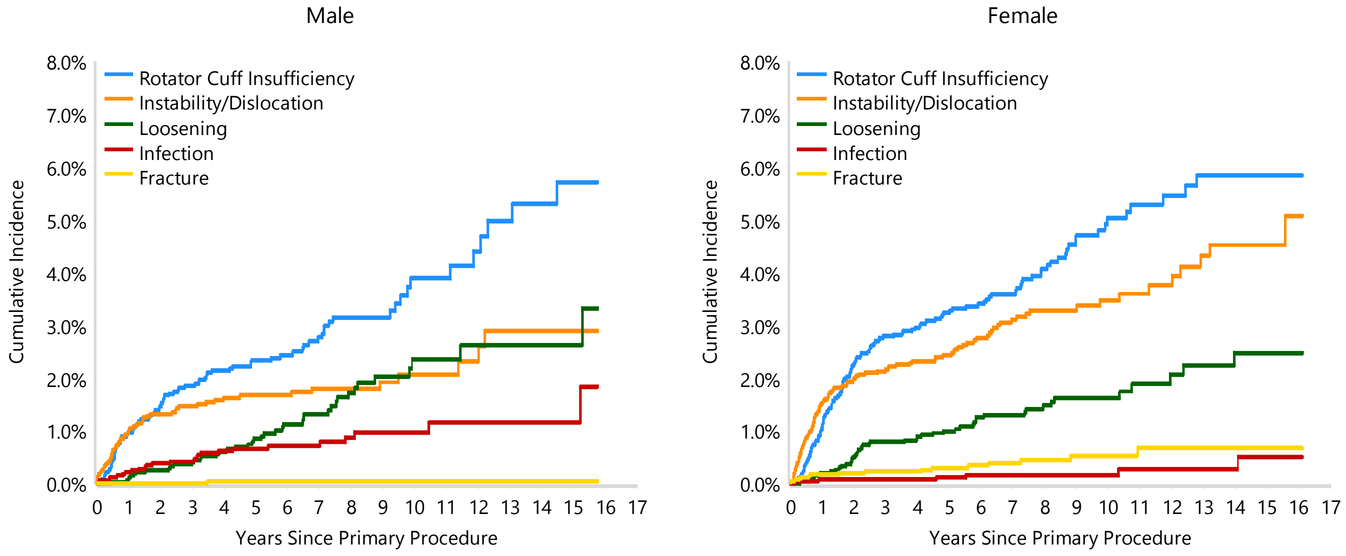
Note: Restricted to modern prostheses
Humeral heads are replaced when the humeral component is revised

Figure ST34 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Anatomic Shoulder Replacement (Primary Diagnosis OA)



Note: Restricted to modern prostheses

Figure ST35 **Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Anatomic Shoulder Replacement by Gender (Primary Diagnosis OA)**



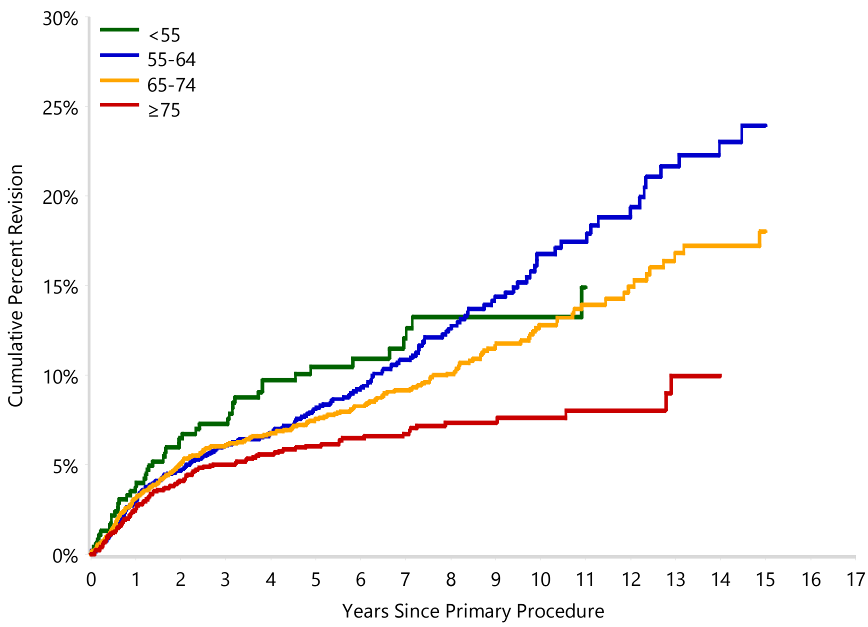
Primary Total Shoulder Replacement

Table ST41 Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement by Age (Primary Diagnosis OA)

Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
<55	54	465	3.8 (2.4, 6.0)	7.3 (5.2, 10.2)	10.5 (7.8, 14.0)	12.1 (9.0, 16.1)	13.2 (9.9, 17.6)	
55-64	200	1911	3.0 (2.3, 3.9)	6.1 (5.1, 7.3)	8.1 (6.9, 9.6)	10.8 (9.3, 12.6)	16.7 (14.2, 19.6)	23.0 (19.1, 27.7)
65-74	294	3309	3.1 (2.6, 3.8)	6.1 (5.3, 7.0)	7.5 (6.6, 8.6)	9.1 (8.1, 10.3)	12.8 (11.2, 14.6)	17.2 (14.6, 20.3)
≥75	106	1741	2.5 (1.9, 3.4)	5.0 (4.1, 6.2)	6.0 (4.9, 7.4)	6.7 (5.5, 8.2)	7.6 (6.2, 9.3)	10.0 (7.3, 13.6)
TOTAL	654	7426						

Note: Restricted to modern prostheses

Figure ST36 Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement by Age (Primary Diagnosis OA)



HR - adjusted for gender

55-64 vs <55

Entire Period: HR=0.84 (0.63, 1.14), p=0.273

65-74 vs <55

Entire Period: HR=0.69 (0.51, 0.92), p=0.012

≥75 vs <55

Entire Period: HR=0.47 (0.33, 0.65), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
<55	465	409	321	228	154	63	28
55-64	1911	1738	1372	1010	670	258	106
65-74	3309	3007	2445	1822	1178	471	173
≥75	1741	1574	1251	958	642	257	70

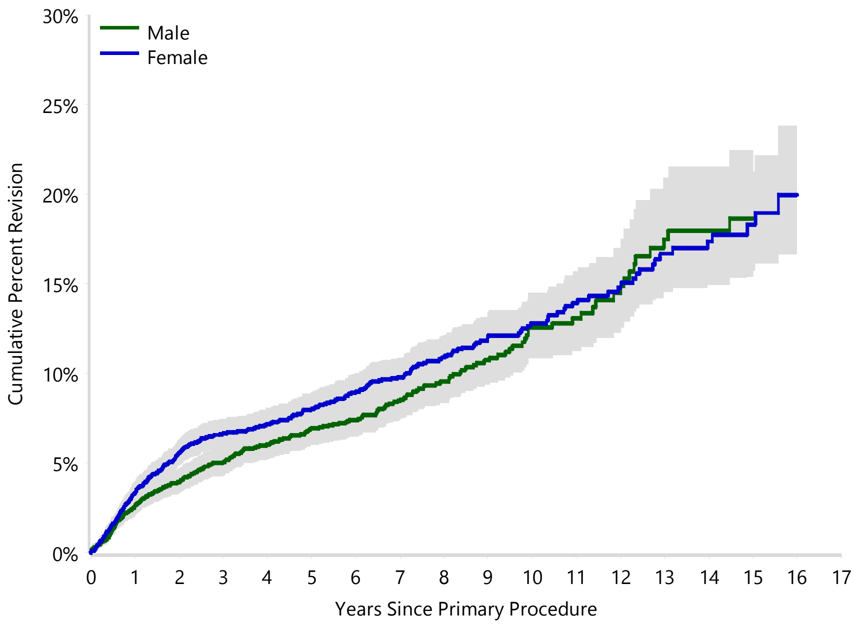
Note: Restricted to modern prostheses

Table ST42 **Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement by Gender and Age (Primary Diagnosis OA)**

Gender	Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Male		268	3336	2.6 (2.1, 3.2)	5.0 (4.3, 5.9)	6.9 (6.0, 8.0)	8.5 (7.4, 9.7)	12.5 (10.9, 14.5)	18.0 (14.9, 21.5)
	<55	35	323	3.8 (2.2, 6.6)	6.0 (3.8, 9.4)	9.8 (6.7, 14.2)	12.1 (8.4, 17.4)	13.9 (9.7, 19.7)	
	55-64	102	1072	2.5 (1.7, 3.7)	5.2 (3.9, 6.8)	7.3 (5.7, 9.2)	9.3 (7.4, 11.7)	16.8 (13.3, 21.1)	23.6 (18.1, 30.3)
	65-74	105	1379	2.8 (2.1, 3.9)	5.2 (4.1, 6.5)	6.7 (5.4, 8.3)	8.3 (6.8, 10.2)	11.3 (9.0, 14.0)	15.3 (11.3, 20.6)
	≥75	26	562	1.5 (0.8, 3.0)	3.9 (2.6, 6.0)	5.2 (3.5, 7.7)	5.2 (3.5, 7.7)	6.1 (4.0, 9.4)	
Female		386	4090	3.3 (2.8, 3.9)	6.6 (5.9, 7.5)	8.0 (7.1, 8.9)	9.8 (8.8, 10.9)	12.8 (11.4, 14.3)	17.4 (15.1, 20.0)
	<55	19	142	3.7 (1.5, 8.6)	10.0 (5.9, 16.6)	12.0 (7.4, 19.2)	12.0 (7.4, 19.2)		
	55-64	98	839	3.5 (2.5, 5.1)	7.2 (5.6, 9.3)	9.1 (7.3, 11.5)	12.6 (10.2, 15.6)	16.6 (13.4, 20.6)	22.3 (17.0, 29.1)
	65-74	189	1930	3.4 (2.6, 4.3)	6.8 (5.7, 8.0)	8.1 (6.9, 9.5)	9.7 (8.3, 11.4)	13.8 (11.7, 16.3)	18.5 (15.2, 22.4)
	≥75	80	1179	3.0 (2.1, 4.1)	5.6 (4.3, 7.1)	6.4 (5.1, 8.1)	7.4 (5.9, 9.3)	8.3 (6.6, 10.4)	11.1 (7.9, 15.4)
TOTAL		654	7426						

Note: Restricted to modern prostheses

Figure ST37 **Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement by Gender (Primary Diagnosis OA)**



HR - adjusted for age

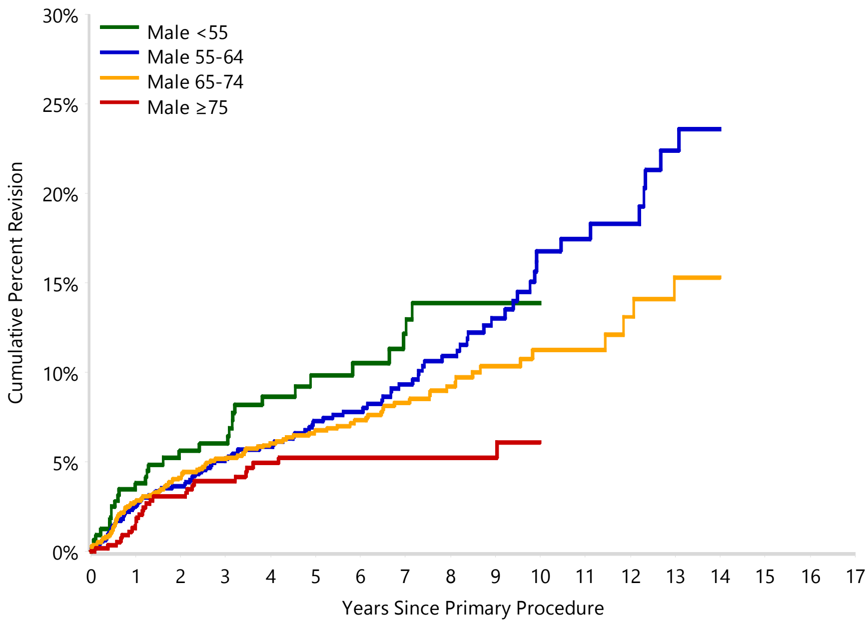
Female vs Male

Entire Period: HR=1.27 (1.08, 1.49), p=0.003

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Male	3336	3018	2403	1743	1149	423	150
Female	4090	3710	2986	2275	1495	626	227

Note: Restricted to modern prostheses

Figure ST38 **Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement in Males by Age (Primary Diagnosis OA)**



Male 55-64 vs Male <55
Entire Period: HR=0.84 (0.57, 1.24), p=0.385

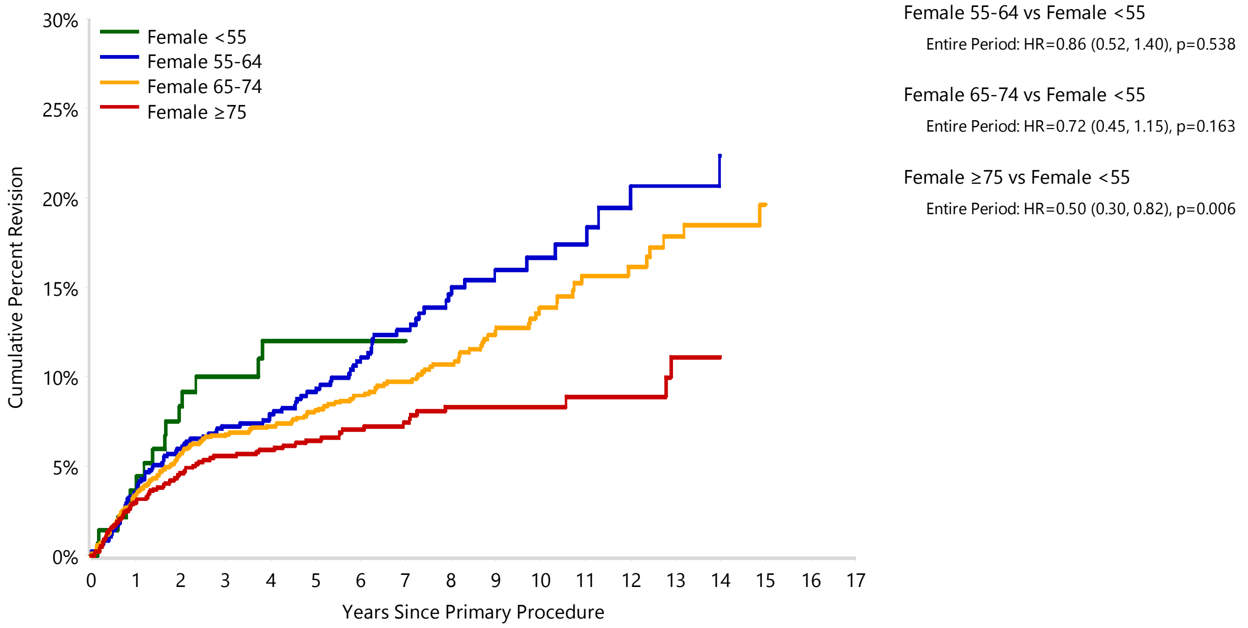
Male 65-74 vs Male <55
Entire Period: HR=0.67 (0.46, 0.99), p=0.041

Male ≥75 vs Male <55
Entire Period: HR=0.42 (0.26, 0.71), p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Male	**<55**	323	281	220	153	105	42	18
	55-64	1072	967	752	543	376	143	60
	65-74	1379	1261	1022	742	475	175	61
	≥75	562	509	409	305	193	63	11

Note: Restricted to modern prostheses

Figure ST39 **Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement in Females by Age (Primary Diagnosis OA)**



Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Female	**<55**	142	128	101	75	49	21	10
	55-64	839	771	620	467	294	115	46
	65-74	1930	1746	1423	1080	703	296	112
	≥75	1179	1065	842	653	449	194	59

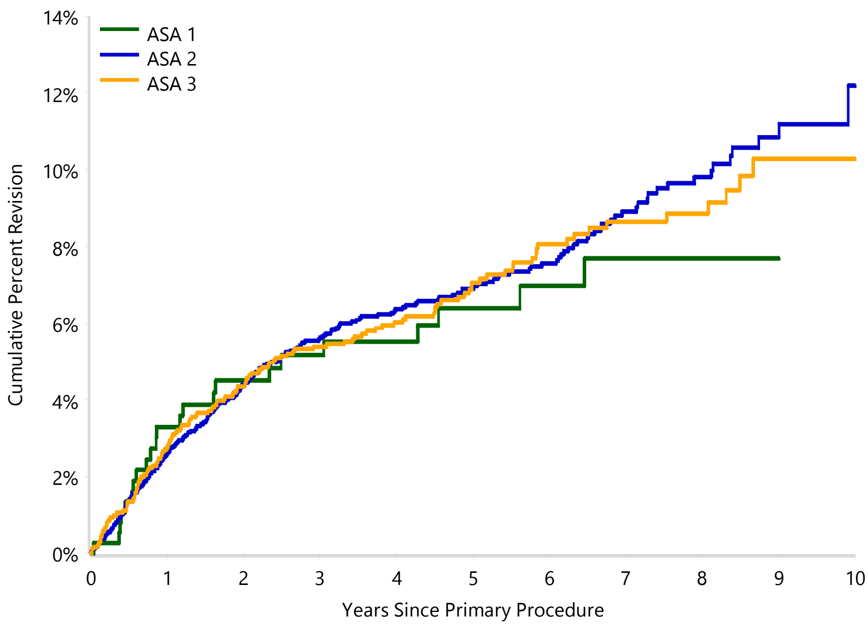
Note: Restricted to modern prostheses

Table ST43 Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement by ASA Score (Primary Diagnosis OA)

ASA Score	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	8 Yrs
ASA 1	23	376	3.3 (1.9, 5.7)	4.5 (2.8, 7.3)	5.2 (3.3, 8.1)	6.4 (4.2, 9.7)	7.7 (5.1, 11.6)	7.7 (5.1, 11.6)
ASA 2	232	3236	2.6 (2.1, 3.2)	4.4 (3.7, 5.2)	5.6 (4.8, 6.5)	6.9 (6.0, 7.9)	8.9 (7.8, 10.2)	9.8 (8.5, 11.3)
ASA 3	148	2270	2.8 (2.2, 3.5)	4.4 (3.6, 5.3)	5.4 (4.5, 6.5)	7.1 (6.0, 8.4)	8.6 (7.3, 10.2)	8.9 (7.5, 10.5)
ASA 4	3	56	4.0 (1.0, 15.1)	4.0 (1.0, 15.1)	4.0 (1.0, 15.1)	4.0 (1.0, 15.1)	12.7 (3.2, 43.5)	
ASA 5	0	1						
TOTAL	406	5939						

Note: Restricted to modern prostheses

Figure ST40 Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement by ASA Score (Primary Diagnosis OA)



HR - adjusted for age and gender

ASA 2 vs ASA 1

Entire Period: HR=1.30 (0.85, 2.01), p=0.230

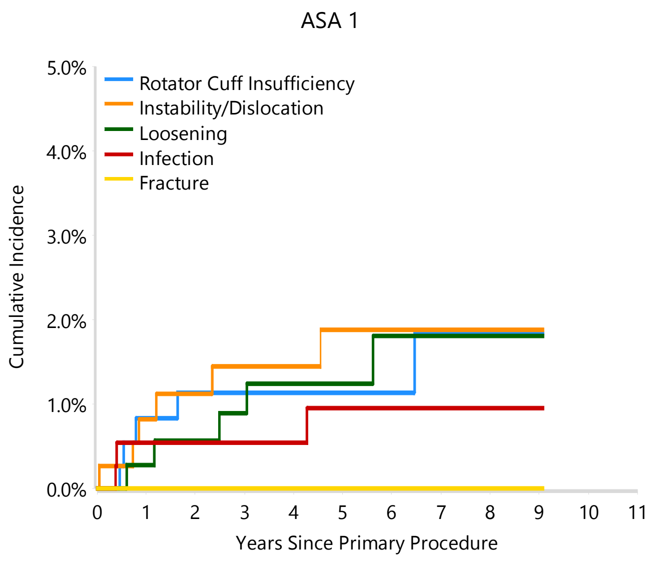
ASA 3 vs ASA 1

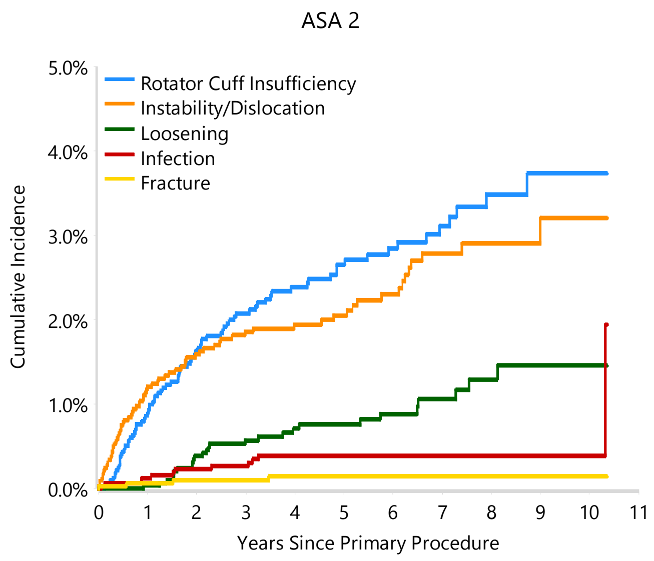
Entire Period: HR=1.33 (0.85, 2.08), p=0.208

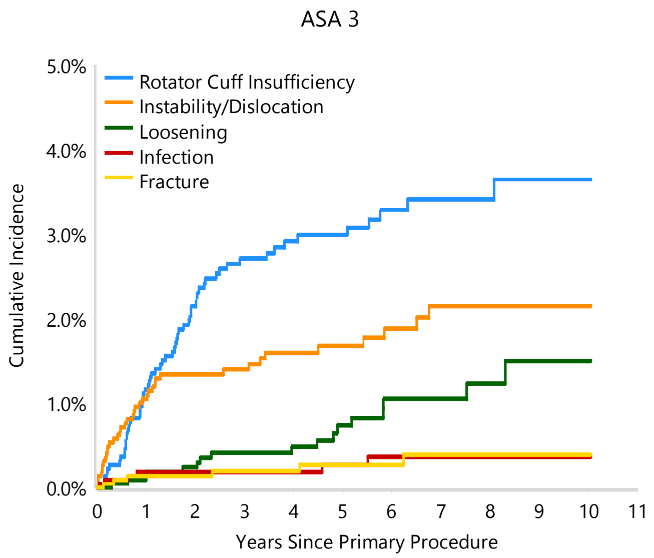
Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	8 Yrs
ASA 1	376	337	299	270	192	114	75
ASA 2	3236	2930	2627	2275	1566	838	545
ASA 3	2270	2001	1726	1483	985	532	337

Note: Restricted to modern prostheses

Figure ST41 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Anatomic Shoulder Replacement by ASA Score (Primary Diagnosis OA)







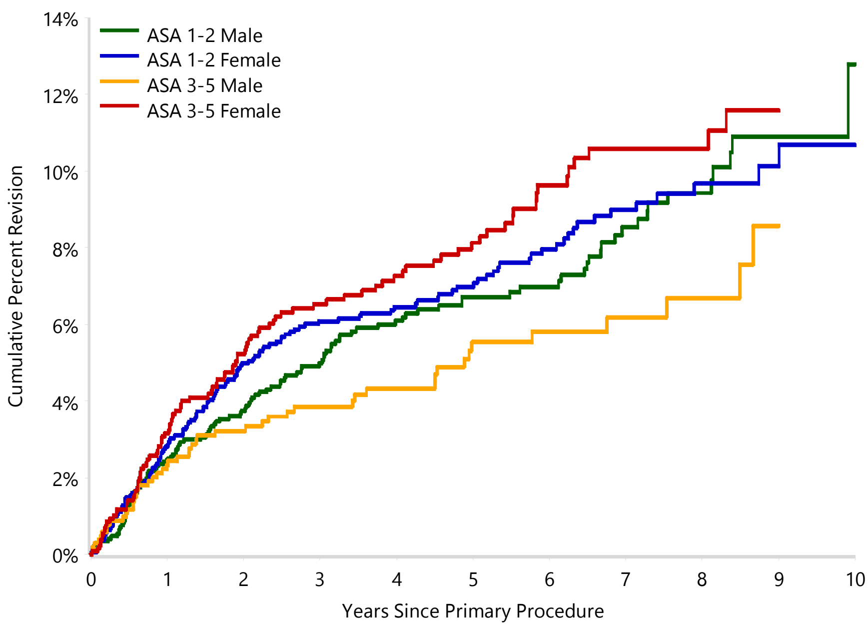
Note: Restricted to modern prostheses

Table ST44 **Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement by ASA Score and Gender (Primary Diagnosis OA)**

ASA Score	Gender	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	8 Yrs
ASA 1	Male	16	235	3.9 (2.1, 7.4)	5.4 (3.1, 9.3)	5.4 (3.1, 9.3)	6.6 (4.0, 11.0)	8.6 (5.2, 14.1)	8.6 (5.2, 14.1)
	Female	7	141	2.3 (0.7, 6.8)	3.0 (1.2, 7.9)	4.8 (2.2, 10.3)	5.9 (2.8, 12.1)		
ASA 2	Male	100	1467	2.3 (1.6, 3.2)	3.5 (2.6, 4.6)	4.9 (3.9, 6.2)	6.7 (5.4, 8.3)	8.5 (6.9, 10.6)	9.6 (7.7, 11.9)
	Female	132	1769	2.9 (2.2, 3.8)	5.1 (4.2, 6.3)	6.2 (5.1, 7.5)	7.1 (5.9, 8.5)	9.2 (7.7, 11.0)	10.0 (8.3, 12.0)
ASA 3	Male	49	1007	2.3 (1.5, 3.5)	3.2 (2.2, 4.6)	3.9 (2.8, 5.3)	5.6 (4.1, 7.5)	6.2 (4.6, 8.4)	6.7 (4.9, 9.2)
	Female	99	1263	3.1 (2.3, 4.3)	5.3 (4.1, 6.7)	6.6 (5.3, 8.2)	8.2 (6.7, 10.1)	10.5 (8.6, 12.9)	10.5 (8.6, 12.9)
ASA 4 or 5	Male	1	27	4.0 (0.6, 25.2)	4.0 (0.6, 25.2)	4.0 (0.6, 25.2)	4.0 (0.6, 25.2)	4.0 (0.6, 25.2)	
	Female	2	30	3.8 (0.6, 24.3)	3.8 (0.6, 24.3)	3.8 (0.6, 24.3)	3.8 (0.6, 24.3)	15.9 (3.5, 56.8)	
TOTAL		406	5939						

Note: Restricted to modern prostheses

Figure ST42 **Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement by ASA Score and Gender (Primary Diagnosis OA)**



HR - adjusted for age

ASA 1-2 Male vs ASA 1-2 Female
Entire Period: HR=0.84 (0.65, 1.08), p=0.167

ASA 1-2 Male vs ASA 3-5 Male
Entire Period: HR=1.19 (0.85, 1.67), p=0.302

ASA 1-2 Female vs ASA 3-5 Female
Entire Period: HR=0.83 (0.65, 1.08), p=0.166

ASA 3-5 Male vs ASA 3-5 Female
Entire Period: HR=0.59 (0.42, 0.82), p=0.002

Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	8 Yrs
ASA 1-2	Male	1702	1541	1375	1189	801	454	287
	Female	1910	1726	1551	1356	957	498	333
ASA 3-5	Male	1034	905	788	681	439	235	142
	Female	1293	1144	983	843	572	307	200

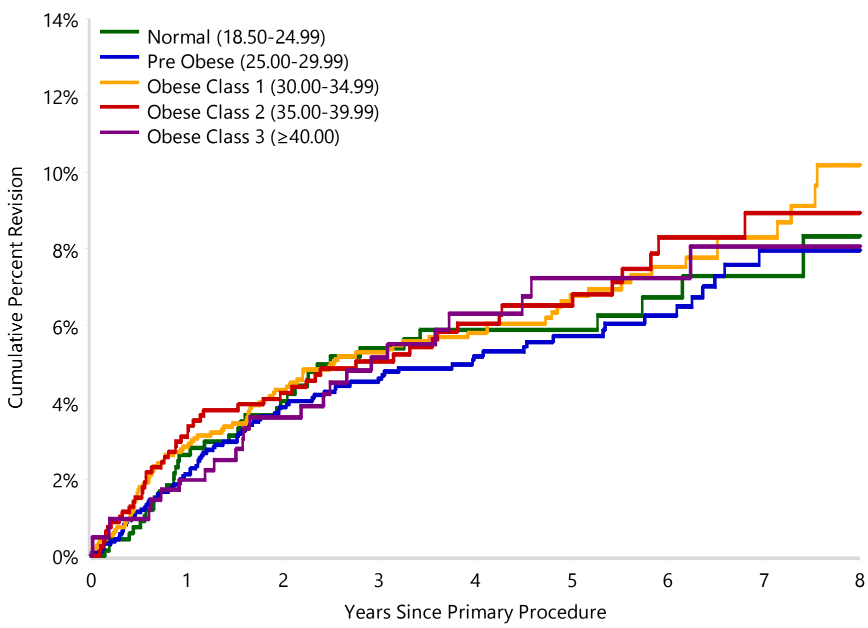
Note: Restricted to modern prostheses

Table ST45 Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement by BMI Category (Primary Diagnosis OA)

BMI Category	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Underweight (<18.50)	0	15	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)		
Normal (18.50-24.99)	38	688	2.6 (1.6, 4.2)	4.0 (2.7, 5.9)	5.4 (3.9, 7.6)	5.9 (4.2, 8.2)	5.9 (4.2, 8.2)	6.7 (4.8, 9.4)
Pre Obese (25.00-29.99)	85	1611	2.1 (1.5, 3.0)	3.9 (3.0, 5.0)	4.6 (3.6, 5.8)	5.2 (4.1, 6.5)	5.7 (4.6, 7.2)	6.3 (5.0, 7.8)
Obese Class 1 (30.00-34.99)	95	1507	2.8 (2.1, 3.8)	4.3 (3.4, 5.6)	5.3 (4.2, 6.6)	5.8 (4.7, 7.3)	6.8 (5.5, 8.4)	7.5 (6.1, 9.3)
Obese Class 2 (35.00-39.99)	51	797	3.1 (2.1, 4.6)	4.2 (3.0, 6.0)	5.1 (3.7, 6.9)	6.1 (4.5, 8.1)	6.5 (4.9, 8.7)	8.3 (6.2, 11.1)
Obese Class 3 (≥40.00)	25	419	2.0 (1.0, 3.9)	3.6 (2.1, 6.0)	5.2 (3.3, 8.0)	6.3 (4.2, 9.5)	7.2 (4.9, 10.7)	7.2 (4.9, 10.7)
TOTAL	294	5037						

Note: Restricted to modern prostheses
BMI has not been presented for patients aged ≤19 years

Figure ST43 Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement by BMI Category (Primary Diagnosis OA)



HR - adjusted for age and gender

Pre Obese (25.00-29.99) vs Normal (18.50-24.99)
Entire Period: HR=0.96 (0.65, 1.41), p=0.822

Obese Class 1 (30.00-34.99) vs Normal (18.50-24.99)
Entire Period: HR=1.13 (0.77, 1.64), p=0.539

Obese Class 2 (35.00-39.99) vs Normal (18.50-24.99)
Entire Period: HR=1.07 (0.70, 1.63), p=0.767

Obese Class 3 (≥40.00) vs Normal (18.50-24.99)
Entire Period: HR=0.92 (0.55, 1.53), p=0.742

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Normal (18.50-24.99)	688	600	514	420	349	273	184
Pre Obese (25.00-29.99)	1611	1426	1243	1058	866	635	416
Obese Class 1 (30.00-34.99)	1507	1324	1147	978	811	612	423
Obese Class 2 (35.00-39.99)	797	712	619	522	429	325	215
Obese Class 3 (≥40.00)	419	378	332	281	224	175	126

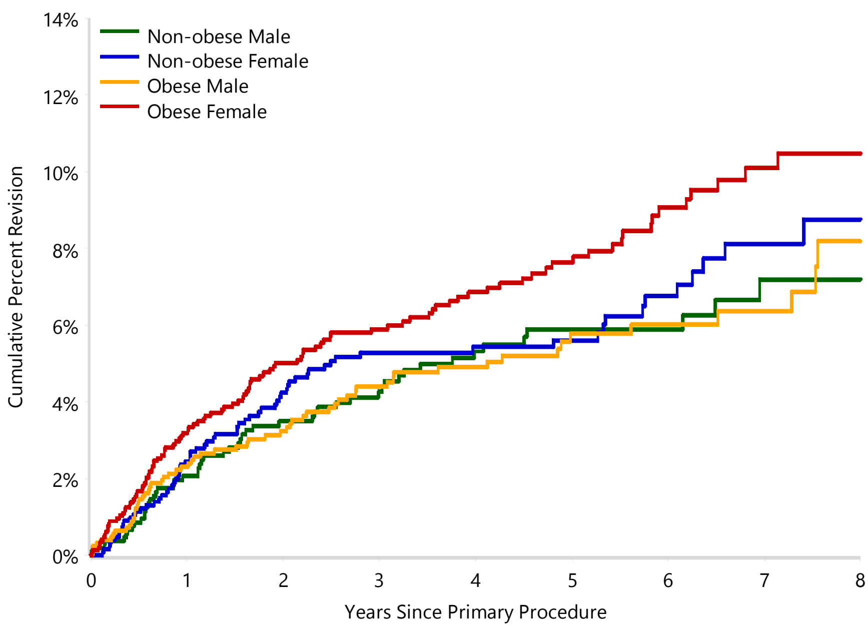
Note: Restricted to modern prostheses
BMI has not been presented for patients aged ≤19 years

Table ST46 Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement by BMI Category and Gender (Primary Diagnosis OA)

BMI Category	Gender	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Non-obese	Male	53	1067	2.1 (1.4, 3.1)	3.5 (2.5, 4.9)	4.3 (3.1, 5.8)	5.3 (4.0, 7.1)	5.9 (4.5, 7.8)	5.9 (4.5, 7.8)
	Female	70	1247	2.4 (1.7, 3.5)	4.2 (3.2, 5.6)	5.3 (4.1, 6.8)	5.4 (4.2, 7.0)	5.6 (4.4, 7.2)	6.8 (5.2, 8.7)
Obese	Male	65	1259	2.3 (1.6, 3.3)	3.2 (2.4, 4.4)	4.4 (3.3, 5.8)	4.9 (3.8, 6.4)	5.8 (4.4, 7.5)	6.0 (4.6, 7.8)
	Female	106	1464	3.2 (2.4, 4.3)	5.0 (4.0, 6.3)	5.9 (4.8, 7.3)	6.9 (5.6, 8.4)	7.6 (6.2, 9.3)	9.1 (7.4, 11.0)
TOTAL		294	5037						

Note: Restricted to modern prostheses
BMI has not been presented for patients aged ≤19 years

Figure ST44 Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement by BMI Category and Gender (Primary Diagnosis OA)



HR - adjusted for age

Non-obese Male vs Non-obese Female
Entire Period: HR=0.80 (0.56, 1.15), p=0.229

Non-obese Male vs Obese Male
Entire Period: HR=1.02 (0.71, 1.46), p=0.927

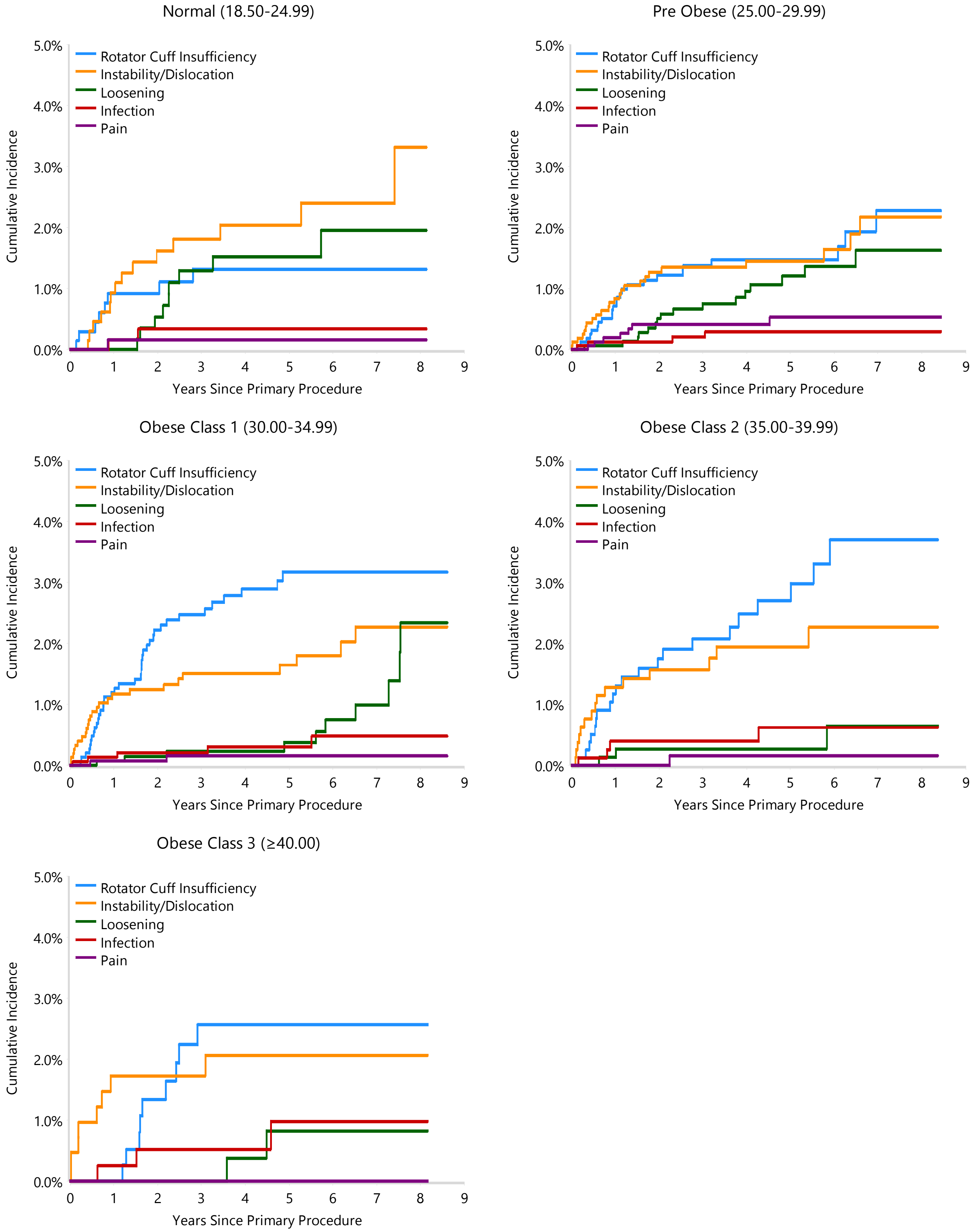
Non-obese Female vs Obese Female
Entire Period: HR=0.82 (0.61, 1.12), p=0.210

Obese Male vs Obese Female
Entire Period: HR=0.65 (0.48, 0.89), p=0.007

Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Non-obese	Male	1067	940	813	687	550	404	280
	Female	1247	1101	955	799	671	505	321
Obese	Male	1259	1115	968	811	655	490	334
	Female	1464	1299	1130	970	809	622	430

Note: Restricted to modern prostheses
BMI has not been presented for patients aged ≤19 years

Figure ST45 **Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Anatomic Shoulder Replacement by BMI Category (Primary Diagnosis OA)**



Note: Restricted to modern prostheses. BMI has not been presented for patients aged ≤19 years

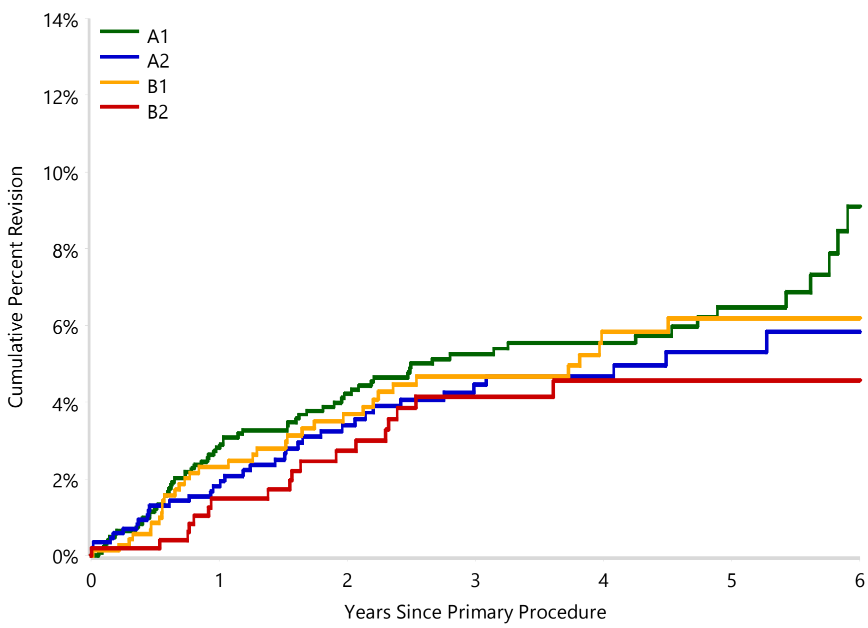
Primary Total Shoulder Replacement

Table ST47 Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement by Glenoid Morphology (Primary Diagnosis OA)

Glenoid Morphology	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
A1	68	1241	2.8 (2.0, 3.9)	4.2 (3.2, 5.6)	5.3 (4.1, 6.8)	5.5 (4.3, 7.1)	6.5 (5.0, 8.4)
A2	37	872	1.8 (1.1, 3.0)	3.4 (2.3, 5.0)	4.5 (3.2, 6.3)	4.7 (3.3, 6.5)	5.3 (3.8, 7.4)
B1	34	724	2.3 (1.4, 3.8)	3.7 (2.5, 5.5)	4.7 (3.3, 6.7)	5.8 (4.1, 8.2)	6.2 (4.4, 8.7)
B2	18	531	1.5 (0.7, 3.1)	2.7 (1.6, 4.8)	4.1 (2.6, 6.6)	4.6 (2.9, 7.2)	4.6 (2.9, 7.2)
C	3	93	2.2 (0.6, 8.5)	2.2 (0.6, 8.5)	2.2 (0.6, 8.5)	4.3 (1.3, 13.6)	4.3 (1.3, 13.6)
TOTAL	160	3461					

Note: Restricted to modern prostheses
Excludes 3 procedures with a recorded glenoid morphology of B3

Figure ST46 Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement by Glenoid Morphology (Primary Diagnosis OA)



HR - adjusted for age and gender

A2 vs A1
Entire Period: HR=0.82 (0.55, 1.22), p=0.322

B1 vs A1
Entire Period: HR=0.86 (0.57, 1.30), p=0.475

B2 vs A1
Entire Period: HR=0.64 (0.38, 1.08), p=0.094

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
A1	1241	1071	884	701	529	335
A2	872	738	612	469	348	213
B1	724	626	514	413	318	194
B2	531	443	359	283	203	113

Note: Restricted to modern prostheses

OUTCOME FOR OSTEOARTHRITIS – PROSTHESIS CHARACTERISTICS

Fixation

Cementless fixation has a higher rate of revision compared to both cemented and hybrid (glenoid cemented) fixation (Table ST48 and Figure ST47).

Non-modular metal backed glenoids have a higher rate of revision than other polyethylene glenoids.

Glenoid Types and Bearing Surfaces

There are four types of glenoids: modular metal backed glenoids and three polyethylene glenoid components. The following definitions have been refined for this report. Non-modular metal back glenoids have a polyethylene bearing surface and one or more metallic fixation pegs with or without backside integrated metallic coating. Cemented polyethylene glenoids with a modified central peg are all polyethylene but the central peg is further engineered for additional fixation to bone. All polyethylene glenoids are polyethylene fixed by cemented pegs or keels alone without further fixation features.

Modular Metal backed glenoids are the most common type of glenoid used. These prostheses have a higher rate of revision compared to all other glenoid types. Modified central peg glenoids have a lower rate of revision compared to non-modular metal backed glenoids (Table ST49 and Figure ST48).

A glenoid component is categorised as augmented if the backside has been modified for glenoid deformity (eg wedged, stepped, angulated, or lateralised). Augmented glenoids have a higher rate of revision than non-augmented prostheses excluding modular metal backed devices (Table ST50 and Figure ST49). The reasons for revision are shown in Figure ST50. Augmented glenoid components have a higher rate of revision for type A glenoid morphology compared to non-augmented glenoid components with type A morphology. There is no difference between augmented and non-augmented glenoid components for type B glenoid morphology (Table ST51 and Figure ST51).

Procedures with a metal/XLPE bearing surface (humeral head/glenoid) have a lower rate of revision compared to procedures with a metal/non XLPE bearing surface (Table ST52 and Figure ST52).

Metal/XLPE bearing surface has a lower rate of revision than metal/non XLPE.

Humeral Head Size and Stem Length

Humeral heads >50mm have a lower rate of revision compared to both <44mm and 44–50mm (Table ST53 and Figure ST53). The cumulative incidence revision diagnosis for the most common reasons for humeral head size revision is shown in Figure ST54.

Humeral stem length is categorized as short if the size is <100mm or conventional if the size is ≥100mm. Humeral stem length is a revision risk after 1.5 years when modular metal backed glenoid implants are excluded (Table ST54, Figure ST55 and Figure ST56).

Humeral head sizes <44mm have the highest rate of revision compared to ≥44mm head sizes.

Technology Assistance

An image derived instrument (IDI) is defined as custom made pin guides or cutting blocks derived from CT or MRI images by 3D printing specifically for each patient. There are 810 total stemmed anatomic shoulder replacements for osteoarthritis utilising an IDI since their first use in 2014. In 2023, IDI are used in 20.0% of all total stemmed anatomic procedures. There is no change in the revision rate associated with IDI usage (Table ST55 and Figure ST57).

The outcome of the most used prosthesis combinations are listed in Table ST56. The most commonly used cementless prosthesis combinations are listed in Table ST57. The most commonly used prosthesis combinations with hybrid (glenoid cemented) fixation are listed in Table ST58.

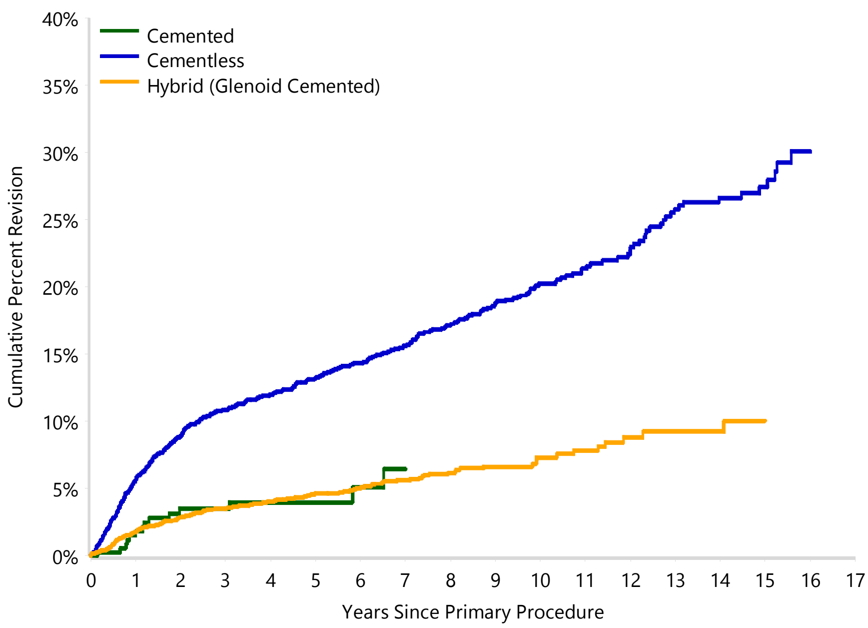
Primary Total Shoulder Replacement

Table ST48 Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement by Fixation (Primary Diagnosis OA)

Fixation	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Cemented	15	373	1.5 (0.6, 3.6)	3.5 (2.0, 6.3)	4.0 (2.3, 7.0)	6.4 (3.4, 11.9)		
Cementless	412	2299	5.6 (4.7, 6.6)	10.9 (9.6, 12.2)	13.2 (11.8, 14.7)	15.6 (14.1, 17.2)	20.2 (18.4, 22.2)	26.6 (23.8, 29.7)
Hybrid (Glenoid Cemented)	222	4725	1.8 (1.4, 2.2)	3.5 (3.0, 4.1)	4.6 (4.0, 5.3)	5.6 (4.9, 6.5)	7.3 (6.2, 8.7)	9.2 (7.4, 11.4)
Hybrid (Glenoid Cementless)	5	29	7.0 (1.8, 25.3)	10.7 (3.6, 29.8)	18.5 (8.1, 39.0)	18.5 (8.1, 39.0)	18.5 (8.1, 39.0)	
TOTAL	654	7426						

Note: Restricted to modern prostheses

Figure ST47 Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement by Fixation (Primary Diagnosis OA)



HR - adjusted for age and gender

Cemented vs Hybrid (Glenoid Cemented)
Entire Period: HR=1.12 (0.66, 1.89), p=0.671

Cementless vs Cemented
Entire Period: HR=2.73 (1.63, 4.58), p<0.001

Cementless vs Hybrid (Glenoid Cemented)
Entire Period: HR=3.06 (2.59, 3.61), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Cemented	373	313	214	123	57	16	3
Cementless	2299	2094	1808	1583	1249	622	259
Hybrid (Glenoid Cemented)	4725	4295	3343	2291	1318	402	113

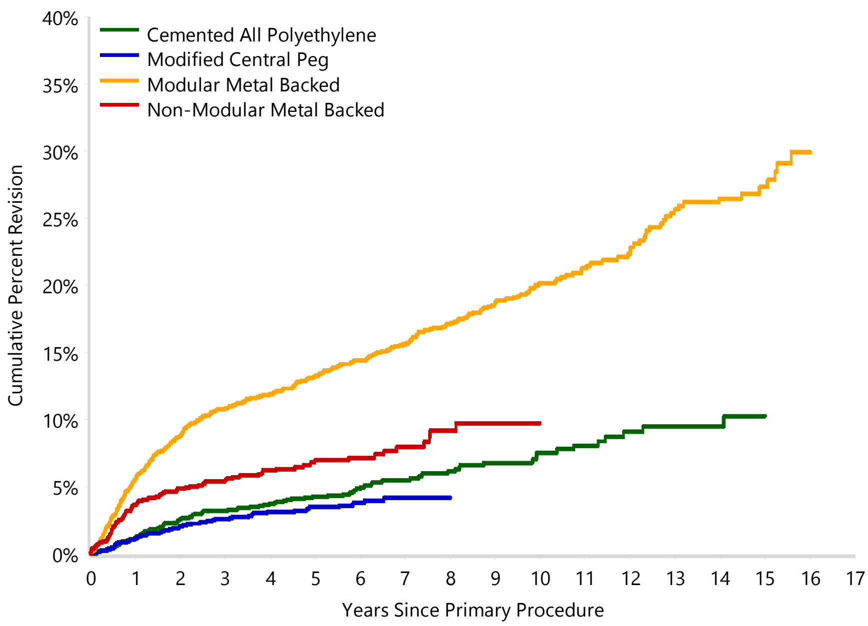
Note: Restricted to modern prostheses
Only fixations with >100 procedures have been listed

Table ST49 Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement by Glenoid Type (Primary Diagnosis OA)

Glenoid Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Cemented All	107	2163	1.2 (0.8, 1.8)	3.2 (2.5, 4.1)	4.3 (3.4, 5.3)	5.5 (4.4, 6.8)	7.5 (6.0, 9.3)	9.5 (7.5, 12.0)
Modified Central	51	1664	1.1 (0.7, 1.8)	2.6 (1.9, 3.5)	3.5 (2.6, 4.6)	4.2 (3.1, 5.6)		
Modular Metal	409	2273	5.6 (4.7, 6.6)	10.8 (9.6, 12.2)	13.2 (11.9, 14.8)	15.6 (14.1, 17.3)	20.2 (18.3, 22.2)	26.5 (23.7, 29.5)
Non-Modular Metal Backed	87	1326	3.7 (2.8, 4.8)	5.5 (4.4, 6.9)	7.0 (5.6, 8.7)	8.0 (6.3, 10.0)	9.7 (7.5, 12.5)	
TOTAL	654	7426						

Note: Restricted to modern prostheses

Figure ST48 Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement by Glenoid Type (Primary Diagnosis OA)



HR - adjusted for age and gender

Cemented All Polyethylene vs Modified Central Peg

Entire Period: HR=1.39 (1.00, 1.95), p=0.051

Modular Metal Backed vs Modified Central Peg

Entire Period: HR=4.28 (3.19, 5.74), p<0.001

Non-Modular Metal Backed vs Modified Central Peg

Entire Period: HR=2.03 (1.44, 2.87), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Cemented All Polyethylene	2163	1964	1517	1094	768	372	116
Modified Central Peg	1664	1496	1172	773	347	1	0
Modular Metal Backed	2273	2071	1801	1577	1248	632	261
Non-Modular Metal Backed	1326	1197	899	574	281	44	0

Note: Restricted to modern prostheses

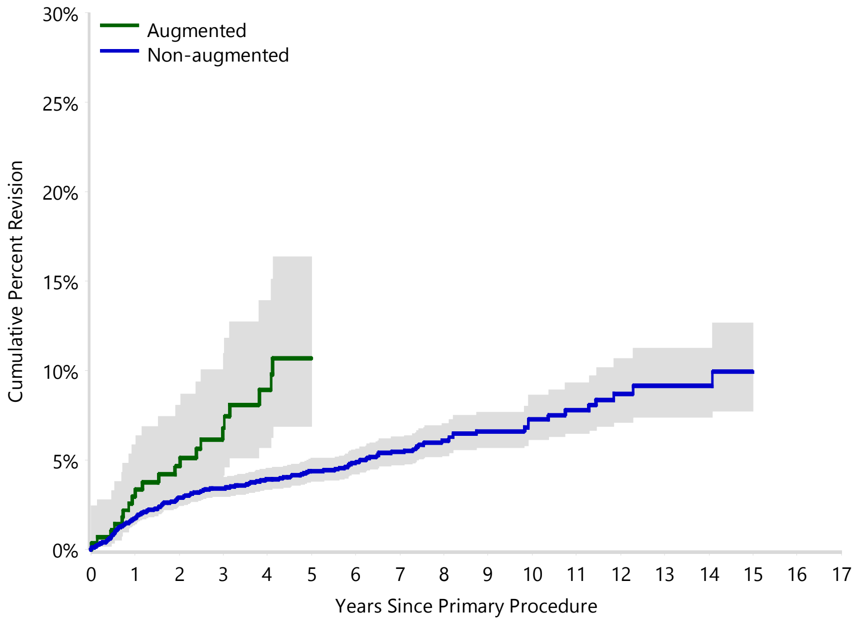
Primary Total Shoulder Replacement

Table ST50 **Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement by Glenoid Augmentation (Primary Diagnosis OA, Excluding Modular Metal Backed Glenoids)**

Glenoid Augmentation	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Augmented	21	283	3.0 (1.5, 5.9)	6.8 (4.2, 11.0)	10.7 (6.9, 16.4)			
Non-augmented	224	4870	1.8 (1.4, 2.2)	3.4 (2.9, 4.0)	4.4 (3.8, 5.1)	5.5 (4.7, 6.3)	7.3 (6.1, 8.6)	9.1 (7.4, 11.3)
TOTAL	245	5153						

Note: Restricted to modern prostheses.

Figure ST49 **Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement by Glenoid Augmentation (Primary Diagnosis OA, Excluding Modular Metal Backed Glenoids)**



HR - adjusted for age and gender

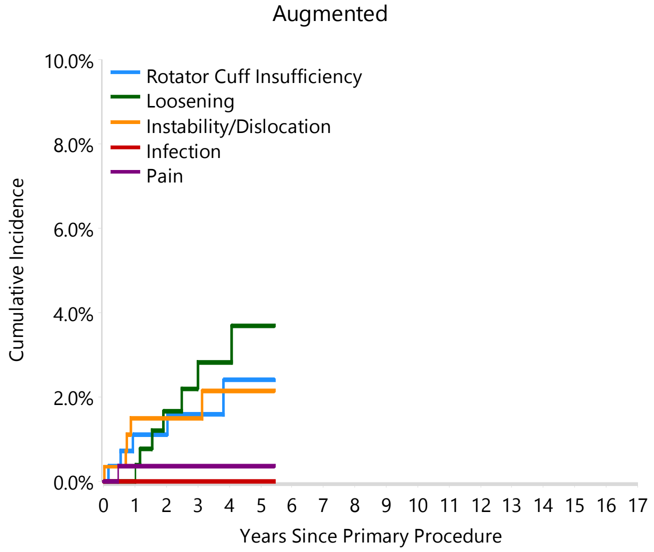
Augmented vs Non-augmented

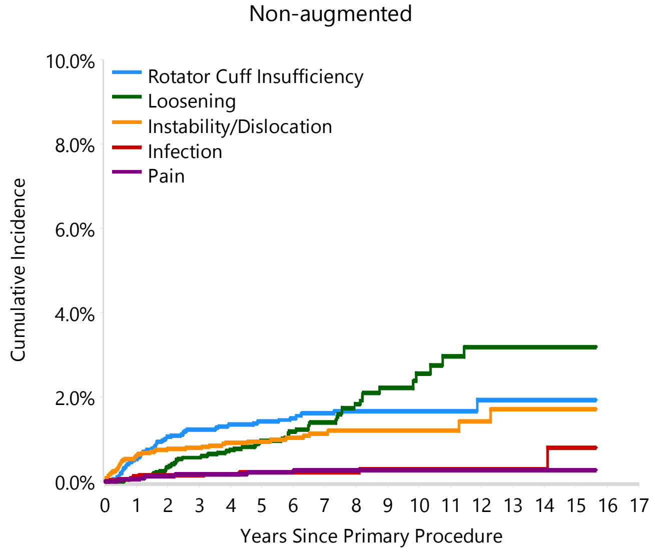
Entire Period: HR=1.95 (1.23, 3.10), p=0.004

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Augmented	283	250	147	54	15	0	0
Non-augmented	4870	4407	3441	2387	1381	417	116

Note: Restricted to modern prostheses

Figure ST50 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Anatomic Shoulder Replacement by Glenoid Augmentation (Primary Diagnosis OA, Excluding Modular Metal Backed Glenoids)





Note: Restricted to modern prostheses

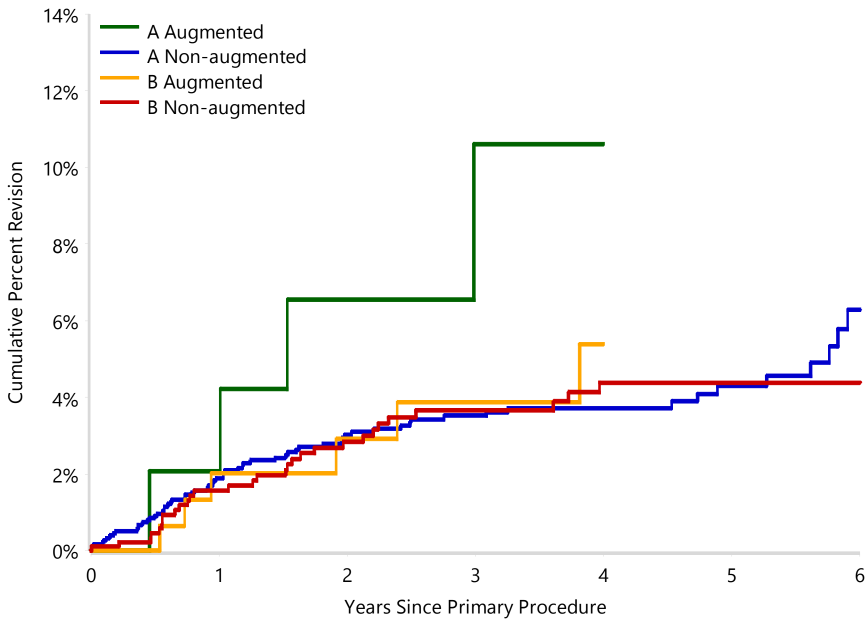
Primary Total Shoulder Replacement

Table ST51 Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement by Glenoid Morphology and Glenoid Augmentation (Primary Diagnosis OA, Excluding Modular Metal Backed Glenoids)

Glenoid Morphology	Glenoid Augmentation	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
A	Augmented	5	50	2.1 (0.3, 13.9)	6.5 (2.2, 19.0)	10.6 (3.9, 27.1)	10.6 (3.9, 27.1)	
	Non-augmented	66	1798	1.9 (1.3, 2.7)	3.0 (2.3, 4.0)	3.5 (2.7, 4.6)	3.7 (2.9, 4.8)	4.3 (3.3, 5.6)
B	Augmented	6	161	2.0 (0.7, 6.1)	2.9 (1.1, 7.6)	3.9 (1.6, 9.1)	5.4 (2.3, 12.1)	
	Non-augmented	30	885	1.6 (0.9, 2.7)	2.8 (1.9, 4.3)	3.7 (2.5, 5.3)	4.4 (3.1, 6.3)	4.4 (3.1, 6.3)
C	Augmented	1	22	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	14.3 (2.1, 66.6)	
	Non-augmented	1	61	1.7 (0.2, 11.4)	1.7 (0.2, 11.4)	1.7 (0.2, 11.4)	1.7 (0.2, 11.4)	1.7 (0.2, 11.4)
TOTAL		109	2977					

Note: Restricted to modern prostheses
Excludes 2,176 procedures with unknown glenoid augmentation or glenoid morphology

Figure ST51 Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement by Glenoid Morphology and Glenoid Augmentation (Primary Diagnosis OA, Excluding Modular Metal Backed Glenoids)



HR - adjusted for age and gender

A Augmented vs A Non-augmented
Entire Period: HR=2.82 (1.13, 7.05), p=0.027

A Augmented vs B Augmented
Entire Period: HR=3.06 (0.93, 10.08), p=0.065

A Non-augmented vs B Non-augmented
Entire Period: HR=1.10 (0.71, 1.70), p=0.670

B Augmented vs B Non-augmented
Entire Period: HR=1.01 (0.42, 2.46), p=0.980

Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
A	Augmented	50	46	36	22	14	3
	Non-augmented	1798	1532	1261	983	725	448
B	Augmented	161	140	108	82	59	27
	Non-augmented	885	762	627	501	373	220

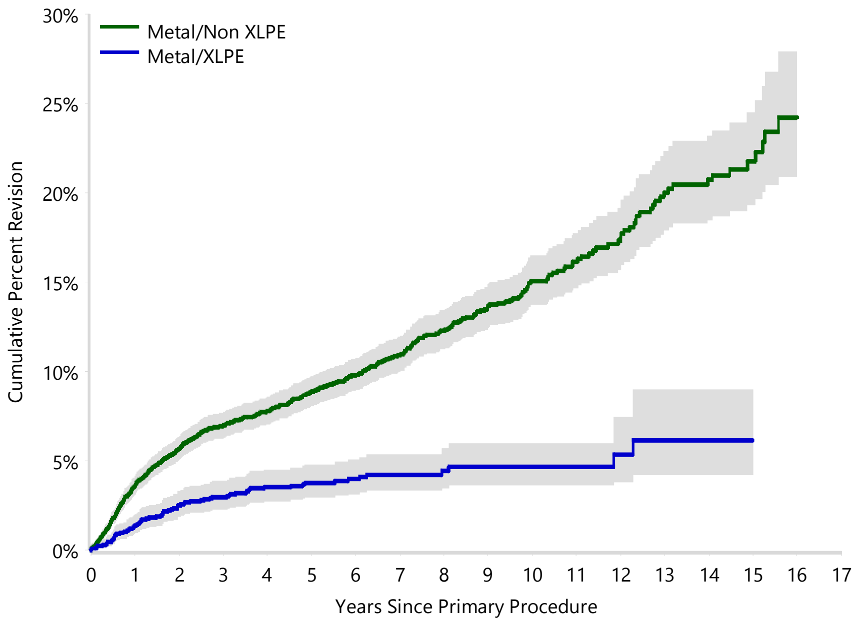
Note: Restricted to modern prostheses
Excludes 2,176 procedures with unknown glenoid augmentation or glenoid morphology

Table ST52 Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement by Bearing Surface (Primary Diagnosis OA)

Polyethylene Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Ceramic/XLPE	1	1						
Metal/Non XLPE	578	5398	3.6 (3.1, 4.1)	7.0 (6.3, 7.7)	8.9 (8.1, 9.7)	10.9 (10.0, 11.9)	15.1 (13.7, 16.5)	20.7 (18.5, 23.2)
Metal/XLPE	74	2025	1.4 (1.0, 2.0)	3.0 (2.3, 3.9)	3.8 (3.0, 4.8)	4.2 (3.3, 5.4)	4.7 (3.6, 6.0)	6.1 (4.2, 9.0)
TOTAL	653	7424						

Note: Restricted to modern prostheses. Reported as humeral head/glenoid.

Figure ST52 Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement Bearing Surface (Primary Diagnosis OA)



HR - adjusted for age and gender

Metal/Non XLPE vs Metal/XLPE

Entire Period: HR=2.78 (2.18, 3.54), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Metal/Non XLPE	5398	4881	3880	2935	1998	842	306
Metal/XLPE	2025	1846	1509	1083	646	207	71

Note: Restricted to modern prostheses. Reported as humeral head/glenoid.

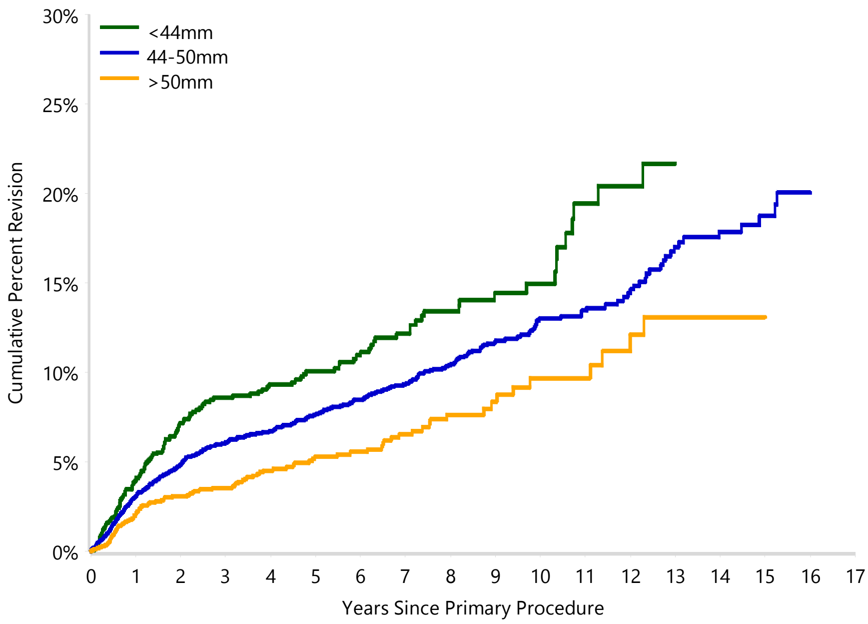
Primary Total Shoulder Replacement

Table ST53 Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement by Humeral Head Size (Primary Diagnosis OA)

Humeral Head Size	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
<44mm	131	1131	3.9 (2.9, 5.3)	8.6 (7.0, 10.4)	10.1 (8.3, 12.1)	12.2 (10.1, 14.6)	15.0 (12.3, 18.1)	
44-50mm	429	4664	3.1 (2.6, 3.6)	6.1 (5.4, 6.8)	7.6 (6.9, 8.5)	9.3 (8.4, 10.4)	13.0 (11.7, 14.5)	17.9 (15.6, 20.4)
>50mm	93	1627	2.0 (1.4, 2.8)	3.5 (2.7, 4.6)	5.3 (4.2, 6.7)	6.5 (5.2, 8.2)	9.7 (7.5, 12.5)	13.1 (9.6, 17.8)
TOTAL	653	7422						

Note: Restricted to modern prostheses
Excludes 4 procedures with unknown head size

Figure ST53 Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement by Humeral Head Size (Primary Diagnosis OA)



HR - adjusted for age and gender

<44mm vs >50mm
Entire Period: HR=2.19 (1.60, 2.98), p<0.001

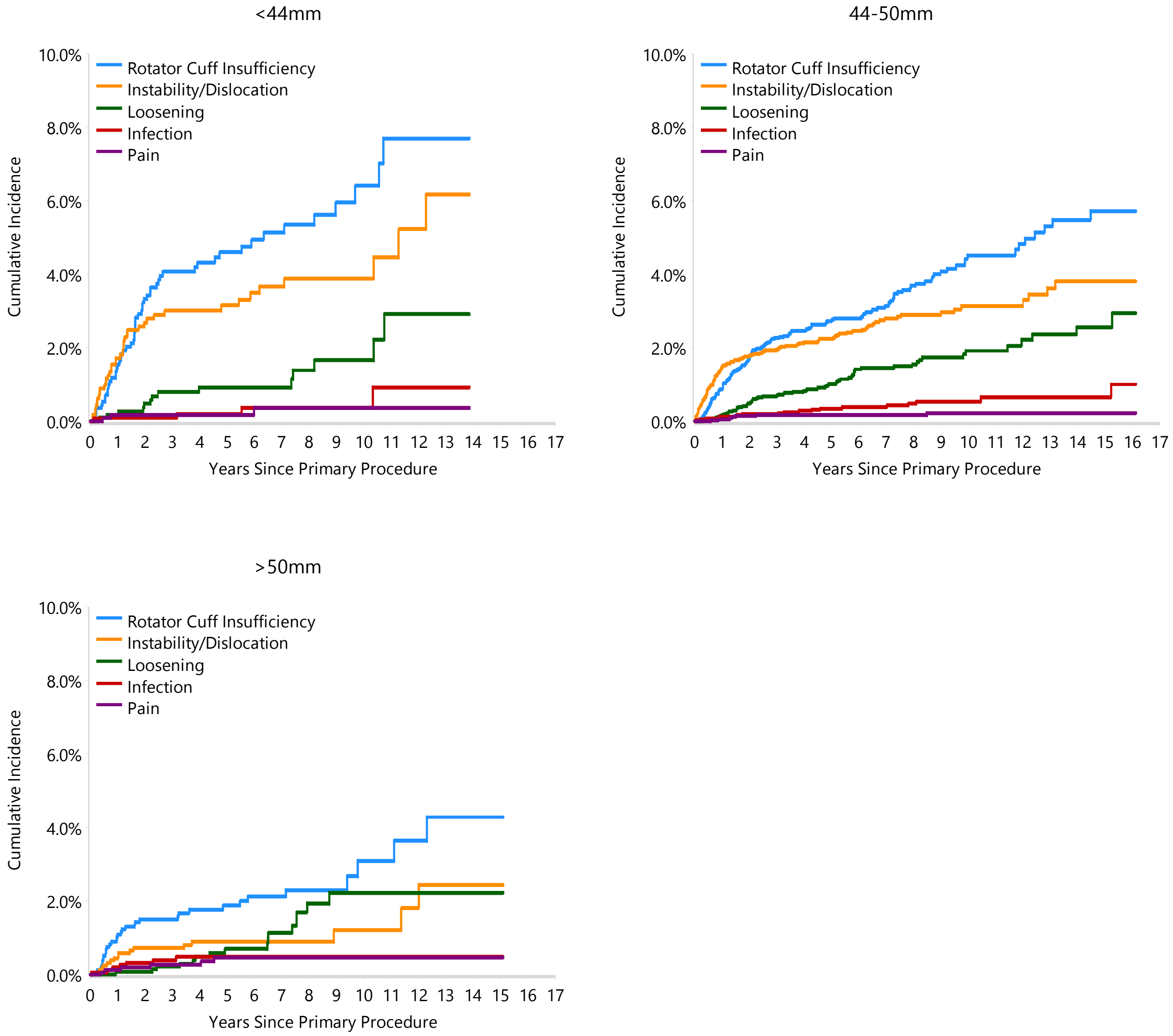
<44mm vs 44-50mm
Entire Period: HR=1.38 (1.12, 1.70), p=0.002

44-50mm vs >50mm
Entire Period: HR=1.59 (1.25, 2.02), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
<44mm	1131	1021	797	575	367	143	39
44-50mm	4664	4240	3430	2632	1773	737	267
>50mm	1627	1466	1162	811	504	169	71

Note: Restricted to modern prostheses
Excludes 4 procedures with unknown head size

Figure ST54 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Anatomic Shoulder Replacement by Humeral Head Size (Primary Diagnosis OA)



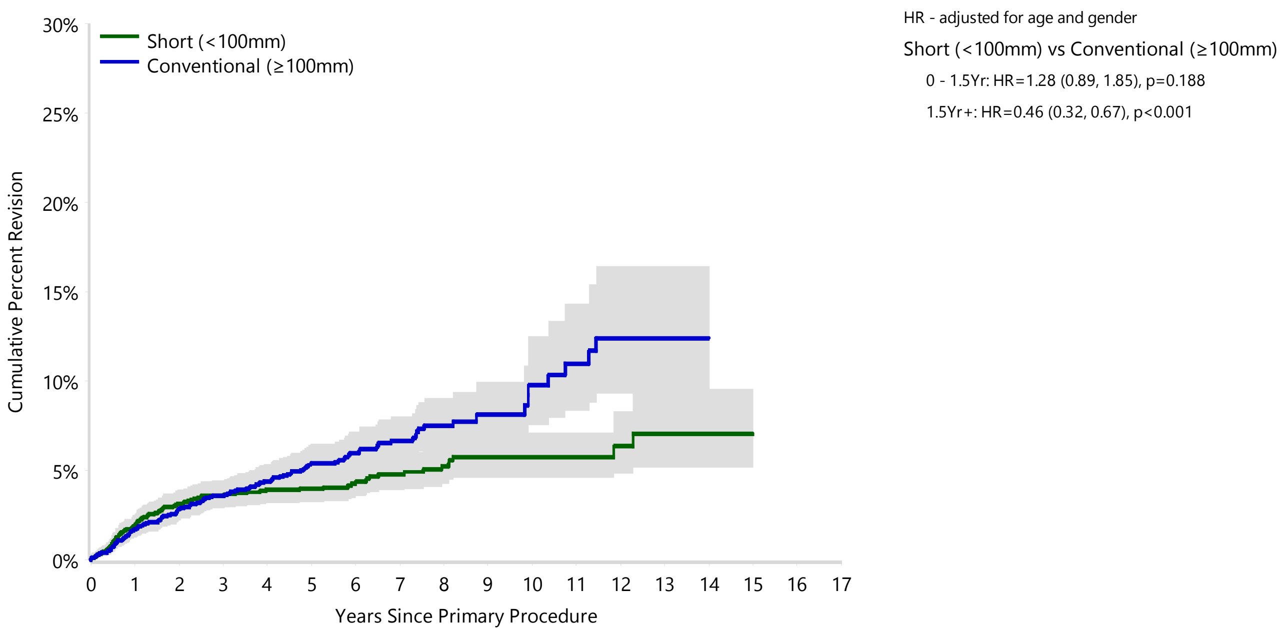
Note: Restricted to modern prostheses

Table ST54 Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement by Humeral Stem Length (Primary Diagnosis OA, Excluding Modular Metal Backed Glenoids)

Humeral Stem Length	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Short (<100mm)	109	2647	1.9 (1.5, 2.5)	3.6 (2.9, 4.5)	4.0 (3.3, 4.9)	4.8 (3.9, 5.9)	5.7 (4.6, 7.1)	7.0 (5.2, 9.6)
Conventional (≥100mm)	136	2505	1.7 (1.3, 2.3)	3.6 (2.9, 4.4)	5.4 (4.5, 6.5)	6.7 (5.5, 8.0)	9.8 (7.6, 12.5)	12.4 (9.3, 16.4)
TOTAL	245	5152						

Note: Excludes 1 procedures with unknown humeral stem length
Restricted to modern prostheses

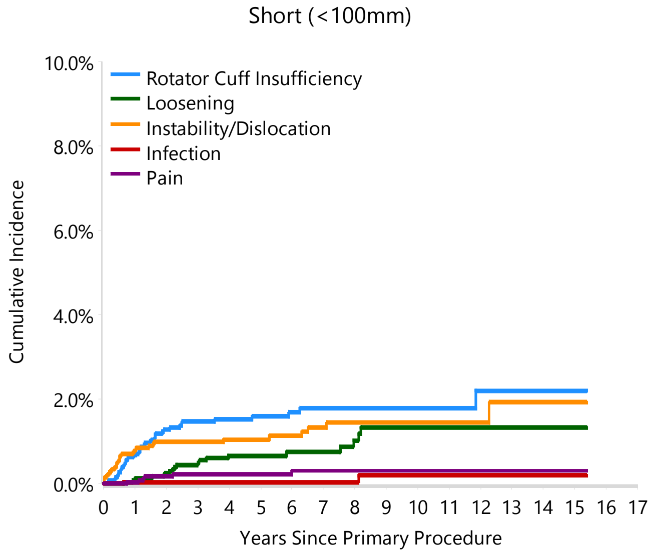
Figure ST55 Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement by Humeral Stem Length (Primary Diagnosis OA, Excluding Modular Metal Backed Glenoids)

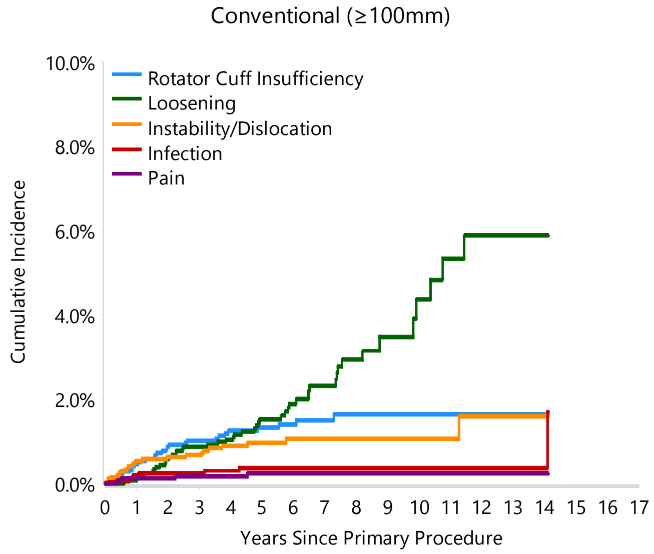


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Short (<100mm)	2647	2381	1802	1231	744	253	74
Conventional (≥100mm)	2505	2276	1786	1210	652	164	42

Note: Excludes 1 procedures with unknown humeral stem length
Restricted to modern prostheses

Figure ST56 **Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Anatomic Shoulder Replacement by Humeral Stem Length (Primary Diagnosis OA, Excluding Modular Metal Backed Glenoids)**





Note: Restricted to modern prostheses

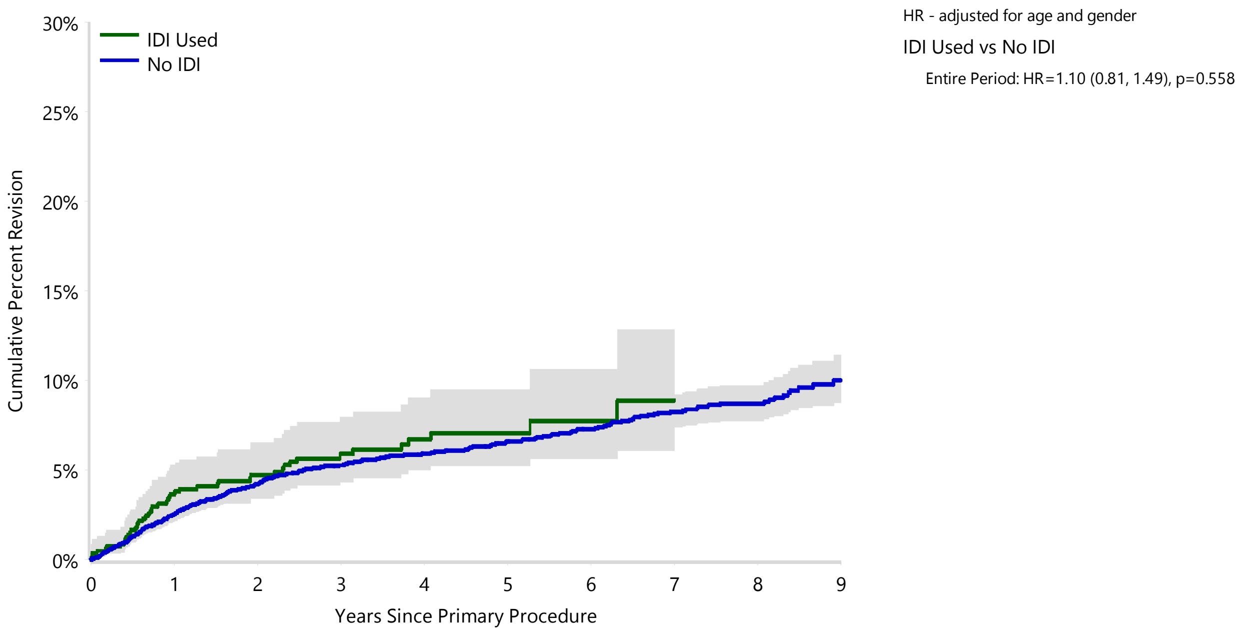
Primary Total Shoulder Replacement

Table ST55 Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement Since 2014 by IDI Usage (Primary Diagnosis OA)

IDI Use	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	8 Yrs	9 Yrs
IDI Used	48	810	3.7 (2.5, 5.3)	4.7 (3.4, 6.5)	5.9 (4.4, 8.0)	7.1 (5.2, 9.5)	8.9 (6.1, 12.9)		
No IDI	334	5035	2.5 (2.1, 3.0)	4.2 (3.7, 4.8)	5.3 (4.7, 6.0)	6.6 (5.9, 7.4)	8.3 (7.4, 9.2)	8.7 (7.8, 9.8)	10.0 (8.8, 11.4)
TOTAL	382	5845							

Note: Restricted to modern prostheses

Figure ST57 Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement Since 2014 by IDI Usage (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	8 Yrs	9 Yrs
IDI Used	810	692	558	409	164	44	22	5
No IDI	5035	4533	4055	3577	2529	1372	857	371

Note: Restricted to modern prostheses

Table ST56 **Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement by Prosthesis Combination (Primary Diagnosis OA)**

Humeral Stem	Glenoid	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Affinis	Affinis	20	188	0.0 (0.0, 0.0)	2.2 (0.8, 5.8)	5.1 (2.7, 9.6)	6.3 (3.5, 11.1)	9.0 (5.5, 14.5)	12.2 (7.9, 18.6)
Ascend Flex	Perform	31	1256	0.8 (0.4, 1.5)	2.1 (1.4, 3.2)	2.4 (1.6, 3.6)	4.0 (2.6, 6.0)		
Comprehensive	Comprehensive	49	873	3.8 (2.7, 5.3)	5.0 (3.7, 6.7)	5.5 (4.2, 7.4)	5.8 (4.4, 7.8)	7.6 (5.4, 10.7)	
Equinoxe	Equinoxe	67	704	3.1 (2.0, 4.7)	6.7 (5.0, 9.0)	10.3 (7.9, 13.3)	13.7 (10.5, 17.8)		
Global AP	Global	18	373	1.1 (0.4, 2.8)	4.1 (2.5, 6.9)	6.3 (3.9, 10.1)			
Global Unite	Global	27	1204	1.1 (0.6, 1.9)	1.8 (1.1, 2.8)	2.4 (1.6, 3.6)	3.0 (2.0, 4.4)		
SMR	SMR	31	502	2.0 (1.1, 3.7)	4.7 (3.2, 7.0)	5.2 (3.5, 7.6)	5.7 (3.9, 8.2)	6.3 (4.4, 9.0)	7.7 (5.2, 11.1)
	SMR L1	409	2273	5.6 (4.7, 6.6)	10.8 (9.6, 12.2)	13.2 (11.9, 14.8)	15.6 (14.1, 17.3)	20.2 (18.3, 22.2)	26.5 (23.7, 29.5)
Other (6)		2	53	5.0 (1.3, 18.6)	5.0 (1.3, 18.6)				
TOTAL		654	7426						

Note: Restricted to modern prostheses
Only prostheses with >50 procedures have been listed

Table ST57 **Cumulative Percent Revision of Cementless Primary Total Stemmed Anatomic Shoulder Replacement by Prosthesis Combination (Primary Diagnosis OA)**

Humeral Stem	Glenoid	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Equinoxe	Equinoxe	8	53	7.7 (2.9, 19.1)	12.0 (5.5, 24.8)	15.0 (7.3, 29.3)	15.0 (7.3, 29.3)		
SMR	SMR L1	404	2243	5.6 (4.7, 6.6)	10.8 (9.6, 12.2)	13.2 (11.8, 14.7)	15.6 (14.1, 17.3)	20.2 (18.3, 22.2)	26.6 (23.8, 29.7)
Other (2)		0	3	0.0 (0.0, 0.0)					
TOTAL		412	2299						

Note: Restricted to modern prostheses
Only prostheses with >10 procedures have been listed

Table ST58 **Cumulative Percent Revision of Hybrid (Glenoid Cemented) Primary Total Stemmed Anatomic Shoulder Replacement by Prosthesis Combination (Primary Diagnosis OA)**

Humeral Stem	Glenoid	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Affinis	Affinis	19	181	0.0 (0.0, 0.0)	1.7 (0.6, 5.2)	4.7 (2.4, 9.1)	5.9 (3.2, 10.7)	8.6 (5.2, 14.2)	11.9 (7.6, 18.4)
Ascend Flex	Perform	25	1086	0.7 (0.3, 1.4)	2.1 (1.3, 3.3)	2.4 (1.6, 3.7)	3.4 (2.2, 5.3)		
Comprehensive	Comprehensive	49	863	3.8 (2.7, 5.3)	5.1 (3.8, 6.8)	5.6 (4.2, 7.4)	5.9 (4.4, 7.9)	7.7 (5.5, 10.9)	
Equinoxe	Equinoxe	57	621	2.7 (1.6, 4.3)	6.2 (4.5, 8.6)	10.0 (7.5, 13.3)	14.1 (10.5, 18.8)		
Global AP	Global	17	361	1.1 (0.4, 2.9)	4.3 (2.6, 7.1)	6.1 (3.7, 10.0)			
Global Unite	Global	24	1078	1.0 (0.5, 1.8)	1.6 (1.0, 2.7)	2.3 (1.5, 3.6)	2.9 (1.9, 4.4)		
SMR	SMR	29	484	2.1 (1.1, 3.8)	4.5 (2.9, 6.8)	5.0 (3.3, 7.4)	5.5 (3.7, 8.0)	6.2 (4.2, 8.9)	7.5 (5.1, 11.1)
Other (6)		2	51	5.1 (1.3, 19.0)	5.1 (1.3, 19.0)				
TOTAL		222	4725						

Note: Restricted to modern prostheses
Only prostheses with >50 procedures have been listed

Primary Total Shoulder Replacement

Primary Total Stemless Reverse Shoulder Replacement

There are 67 total stemless reverse shoulder replacements performed since 2015 (Table ST59). This procedure is predominately undertaken in males for the treatment of osteoarthritis or rotator cuff arthropathy (Table ST60). The CPR at 4 years is 3.1% and there have been 2 revisions (Table ST61).

Table ST59 Age and Gender of Primary Total Stemless Reverse Shoulder Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	47	70.1%	44	79	69	68.3	6.0
Female	20	29.9%	52	82	70	69.7	6.2
TOTAL	67	100.0%	44	82	69	68.7	6.1

Note: Restricted to modern prostheses

Table ST60 Primary Total Stemless Reverse Shoulder Replacement by Primary Diagnosis

Primary Diagnosis	Number	Percent
Osteoarthritis	35	52.2
Rotator Cuff Arthropathy	30	44.8
Fracture	1	1.5
Rheumatoid Arthritis	1	1.5
TOTAL	67	100.0

Note: Restricted to modern prostheses

Table ST61 Cumulative Percent Revision of Primary Total Stemless Reverse Shoulder Replacement (All Diagnoses)

Shoulder Class	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs
Total Stemless Reverse	2	67	1.5 (0.2, 10.3)	3.1 (0.8, 12.0)	3.1 (0.8, 12.0)	3.1 (0.8, 12.0)
TOTAL	2	67				

Note: Restricted to modern prostheses

Primary Total Stemmed Reverse Shoulder Replacement

DEMOGRAPHICS

There are 57,350 primary total stemmed reverse shoulder replacement procedures. This is an increase of 8,120 procedures compared to the previous report.

For further information on the **closure of the database** please see the **Glossary** of this report.

Osteoarthritis is the most common diagnosis for primary total stemmed reverse shoulder replacement followed by rotator cuff arthropathy, and fracture (Figure ST58).

Primary total stemmed reverse shoulder replacement is more commonly undertaken in females, with females older on average than males (Table ST62). The percentage of male patients has increased by 5.6% compared to 2015.

The proportional use in patients aged ≥75 years has declined in recent years and is now similar to the proportional use in the 65–74 year age group (Figure ST59).

The majority of procedures use cementless fixation followed by hybrid (humerus cemented) fixation. There has been little variation in the type of fixation used since 2008 (Figure ST60).

The polyethylene type used in total stemmed reverse shoulder replacement continues to be predominately non-XLPE (56.7%) in 2023 (Figure ST61).

The most commonly used humeral stems are listed in Table ST63. The most used glenoid prostheses are listed in Table ST64.

The most common primary diagnoses are osteoarthritis, rotator cuff arthropathy, and fracture.

Figure ST58 Primary Total Stemmed Reverse Shoulder Replacement by Primary Diagnosis

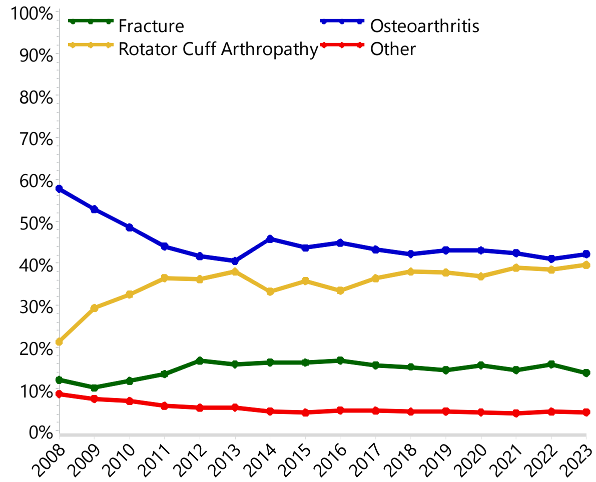


Table ST62 Age and Gender of Primary Total Stemmed Reverse Shoulder Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	21903	38.2%	14	96	73	72.0	8.3
Female	35447	61.8%	12	103	75	74.5	7.9
TOTAL	57350	100.0%	12	103	74	73.6	8.2

Primary Total Shoulder Replacement

Figure ST59 Primary Total Stemmed Reverse Shoulder Replacement by Age

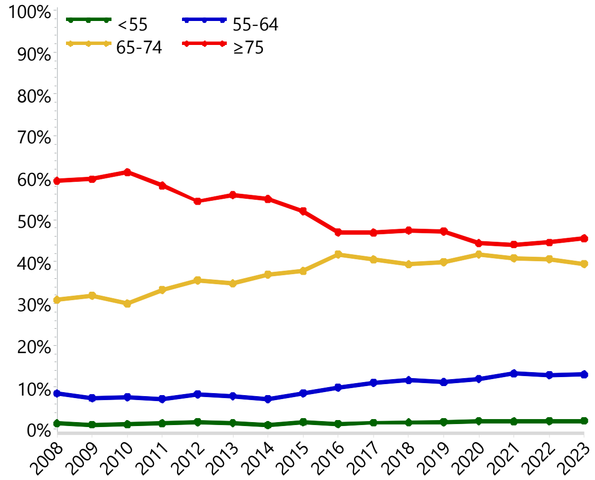


Figure ST60 Total Stemmed Reverse Shoulder Replacement by Fixation

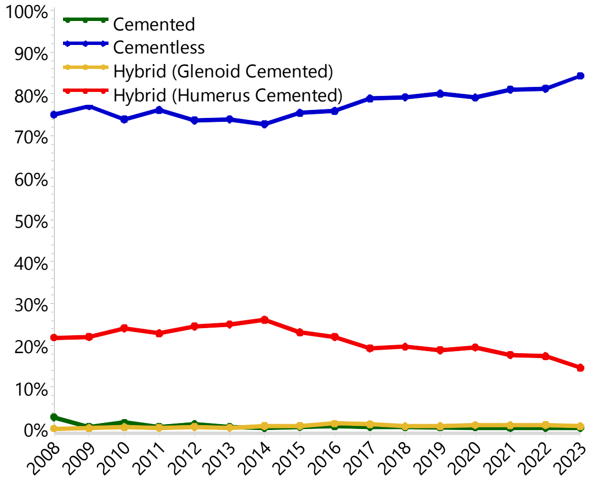


Figure ST61 Primary Total Stemmed Reverse Shoulder Replacement by Polyethylene Type

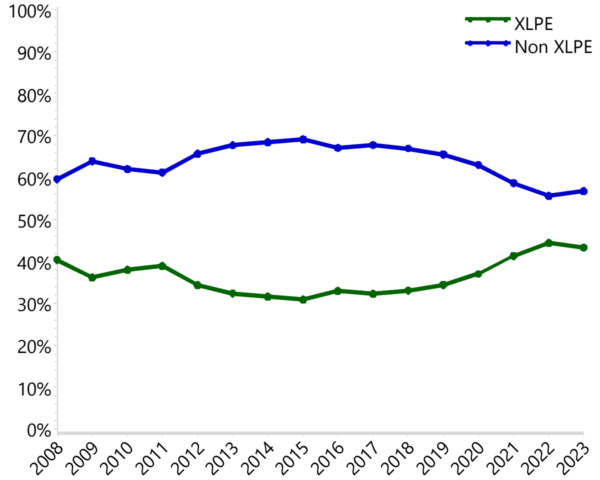


Table ST63 10 Most Used Humeral Stem Prostheses in Primary Total Stemmed Reverse Shoulder Replacement

2008		2020		2021		2022		2023	
N	Model	N	Model	N	Model	N	Model	N	Model
263	SMR	1058	SMR	1232	SMR	1280	Comprehensive	1648	Comprehensive
252	Delta Xtend	856	Equinoxe	1068	Comprehensive	1112	SMR	1316	Equinoxe
76	Aequalis	798	Comprehensive	956	Equinoxe	1054	Equinoxe	1309	Ascend Flex
42	Trabecular Metal	778	Delta Xtend	760	Ascend Flex	894	Ascend Flex	1057	SMR
21	Delta CTA	581	Ascend Flex	711	Delta Xtend	689	Delta Xtend	746	Delta Xtend
2	Custom Made (Lima)	361	Aequalis	536	AltiVate Reverse	547	AltiVate Reverse	654	AltiVate Reverse
1	Generic Humeral Stem	333	Affinis	344	Aequalis	385	Aequalis	350	Aequalis
1	Promos	280	RSP	294	Affinis	193	Global Unite	238	Global Unite
		255	AltiVate Reverse	246	Global Unite	149	Trabecular Metal	209	Trabecular Metal
		190	Global Unite	174	RSP	141	Affinis	111	Affinis
10 Most Used									
658	(8) 100.0%	5490	(10) 96.1%	6321	(10) 96.2%	6444	(10) 96.7%	7638	(10) 96.7%
Remainder									
0	(0) 0%	221	(7) 3.9%	252	(8) 3.8%	223	(7) 3.3%	260	(9) 3.3%
TOTAL									
658	(8) 100.0%	5711	(17) 100.0%	6573	(18) 100.0%	6667	(17) 100.0%	7898	(19) 100.0%

Table ST64 10 Most Used Glenoid Prostheses in Primary Total Stemmed Reverse Shoulder Replacement

2008		2020		2021		2022		2023	
N	Model	N	Model	N	Model	N	Model	N	Model
264	SMR L1	1009	SMR L1	1189	SMR L1	1327	Comprehensive Reverse	1753	Comprehensive Reverse
252	Delta Xtend	966	Delta Xtend	1114	Comprehensive Reverse	1053	Equinoxe	1317	Equinoxe
76	Aequalis	855	Equinoxe	956	Delta Xtend	1028	SMR L1	982	Delta Xtend
42	Trabecular Metal	819	Comprehensive Reverse	954	Equinoxe	911	Aequalis	919	SMR L1
21	Delta CTA	800	Aequalis	918	Aequalis	883	Delta Xtend	895	Aequalis
1	Generic Metaglene	536	RSP	733	RSP	688	RSP	795	Perform Reversed
1	Promos	333	Affinis	293	Affinis	390	Perform Reversed	764	RSP
1	SMR	145	Perform Reversed	200	Perform Reversed	140	Affinis	114	SMR
		142	Trabecular Metal	114	Trabecular Metal	95	Trabecular Metal	111	Affinis
		37	MSS	32	SMR Axioma	42	MSS	96	MSS
10 Most Used									
658	(8) 100.0%	5642	(10) 98.8%	6503	(10) 98.9%	6557	(10) 98.4%	7746	(10) 98.1%
Remainder									
0	(0) 0%	69	(7) 1.2%	70	(8) 1.1%	110	(7) 1.6%	152	(13) 1.9%
TOTAL									
658	(8) 100.0%	5711	(17) 100.0%	6573	(18) 100.0%	6667	(17) 100.0%	7898	(23) 100.0%

Primary Total Shoulder Replacement

OUTCOME FOR ALL DIAGNOSES

Primary Diagnosis

In order to keep Registry data contemporaneous, only procedures using prostheses that have been available and used in 2023 (described as modern prostheses) are included in the analyses, unless clearly specified.

Procedures undertaken for instability, rheumatoid arthritis and rotator cuff arthropathy have a higher risk of revision compared to those undertaken for osteoarthritis. Fracture also has a higher rate of revision compared to osteoarthritis, but only in the first 3 months (Table ST65 and Figure ST62).

Reason for Revision

The main reasons for revision are instability/dislocation, infection, loosening, and fracture (Table ST66, Figure ST63 and Figure ST64). Since 2015, the proportion of revisions for instability/dislocation has increased by 30.4%, but infection and loosening have decreased by 5.3% and 9.0%, respectively.

Type of Revision

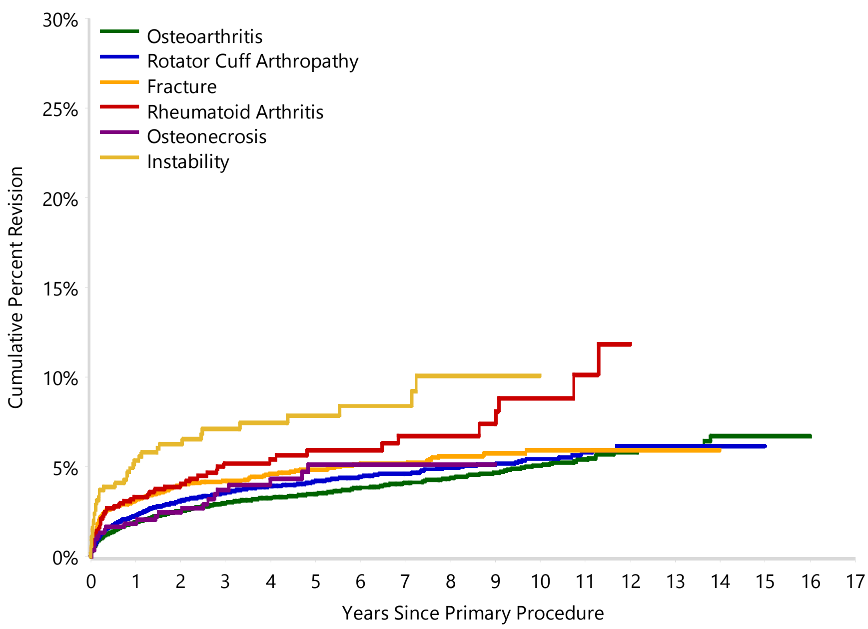
The most common types of revision involve replacement of the humeral component, replacement of the cup/head, cup only, and replacement of the humeral/glenoid (Table ST67). The majority of total stemmed reverse revisions were to a total stemmed reverse (86.6%) with 13.4% to anatomic shoulder replacement categories. Compared to 2015, humeral component revision increased by 13.8% and humerus/glenoid by 5.7%. In contrast, humeral head only revisions decreased by 10.4% and isolated glenoid components also decreased by 4.3%.

Table ST65 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Primary Diagnosis

Primary Diagnosis	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Osteoarthritis	768	23901	1.9 (1.7, 2.1)	3.0 (2.8, 3.2)	3.5 (3.2, 3.7)	4.1 (3.8, 4.4)	5.0 (4.6, 5.5)	6.7 (5.7, 7.9)
Rotator Cuff Arthropathy	744	20545	2.3 (2.1, 2.5)	3.6 (3.3, 3.8)	4.2 (3.9, 4.5)	4.6 (4.3, 5.0)	5.4 (4.9, 6.0)	6.1 (5.4, 7.0)
Fracture	357	8336	3.1 (2.8, 3.5)	4.2 (3.8, 4.7)	4.8 (4.4, 5.4)	5.2 (4.6, 5.8)	5.9 (5.2, 6.8)	5.9 (5.2, 6.8)
Rheumatoid Arthritis	51	908	3.3 (2.3, 4.7)	5.2 (3.8, 7.0)	5.9 (4.4, 7.9)	6.7 (4.9, 9.2)	8.8 (6.2, 12.5)	
Osteonecrosis	24	616	1.8 (1.0, 3.3)	3.7 (2.4, 5.8)	5.1 (3.4, 7.8)	5.1 (3.4, 7.8)		
Instability	41	547	5.4 (3.7, 7.7)	7.1 (5.1, 9.8)	7.9 (5.7, 10.8)	8.4 (6.1, 11.5)	10.1 (7.1, 14.2)	
Other (3)	43	541	4.0 (2.6, 6.2)	8.2 (5.8, 11.4)	9.6 (6.9, 13.2)	10.6 (7.5, 15.0)		
TOTAL	2028	55394						

Note: Only primary diagnoses with >300 procedures have been listed
Restricted to modern prostheses

Figure ST62 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Primary Diagnosis



HR - adjusted for age and gender

Rotator Cuff Arthropathy vs Osteoarthritis
Entire Period: HR=1.12 (1.01, 1.24), p=0.024

Fracture vs Osteoarthritis
0 - 3Mth: HR=2.64 (2.21, 3.14), p<0.001
3Mth+: HR=1.18 (1.00, 1.41), p=0.056

Rheumatoid Arthritis vs Osteoarthritis
Entire Period: HR=1.75 (1.31, 2.32), p<0.001

Osteonecrosis vs Osteoarthritis
Entire Period: HR=1.28 (0.85, 1.92), p=0.238

Instability vs Osteoarthritis
0 - 3Mth: HR=3.32 (2.12, 5.21), p<0.001
3Mth+: HR=1.76 (1.14, 2.73), p=0.010

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Osteoarthritis	23901	19954	13825	8696	4763	1630	308
Rotator Cuff Arthropathy	20545	16840	11248	6794	3518	1160	145
Fracture	8336	6790	4441	2674	1379	405	57
Rheumatoid Arthritis	908	744	526	341	213	97	24
Osteonecrosis	616	504	353	224	112	36	9
Instability	547	438	292	193	118	41	10

Note: Only primary diagnoses with >300 procedures have been listed
Restricted to modern prostheses

Primary Total Shoulder Replacement

Table ST66 Primary Total Stemmed Reverse Shoulder Replacement by Reason for Revision (All Diagnoses)

Reason for Revision	Number	Percent
Instability/Dislocation	651	32.1
Infection	524	25.8
Loosening	325	16.0
Fracture	221	10.9
Dissociation	71	3.5
Pain	42	2.1
Lysis	22	1.1
Malposition	22	1.1
Arthrofibrosis	20	1.0
Implant Breakage Glenoid	18	0.9
Incorrect Sizing	15	0.7
Metal Related Pathology	12	0.6
Heterotopic Bone	10	0.5
Rotator Cuff Insufficiency	9	0.4
Wear Humeral Cup	5	0.2
Tumour	5	0.2
Implant Breakage Humeral	4	0.2
Implant Breakage Glenoid Insert	3	0.1
Wear Glenoid Insert	1	0.0
Glenoid Erosion	1	0.0
Other	47	2.3
TOTAL	2028	100.0

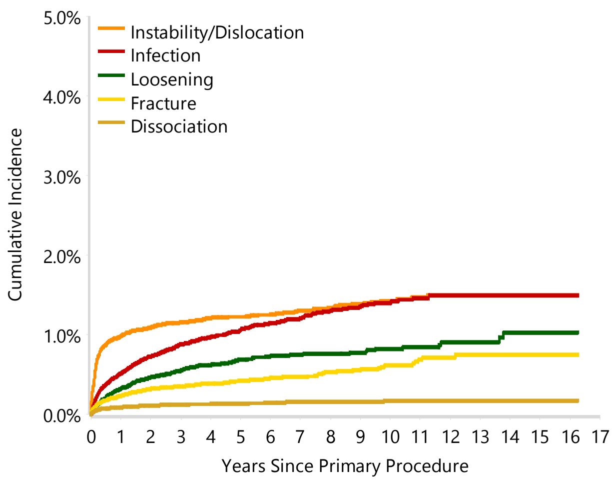
Note: Restricted to modern prostheses

Table ST67 Primary Total Stemmed Reverse Shoulder Replacement by Type of Revision (All Diagnoses)

Type of Revision	Number	Percent
Humeral Component	518	25.5
Cup/Head	396	19.5
Cup Only	331	16.3
Humeral/Glenoid	186	9.2
Cement Spacer	184	9.1
Humeral Head Only	179	8.8
Glenoid Component	146	7.2
Removal of Prostheses	35	1.7
Glenosphere Only	14	0.7
Minor Components	13	0.6
Reoperation	11	0.5
Cement Only	10	0.5
Reinsertion of Components	3	0.1
Head/Insert	2	0.1
TOTAL	2028	100.0

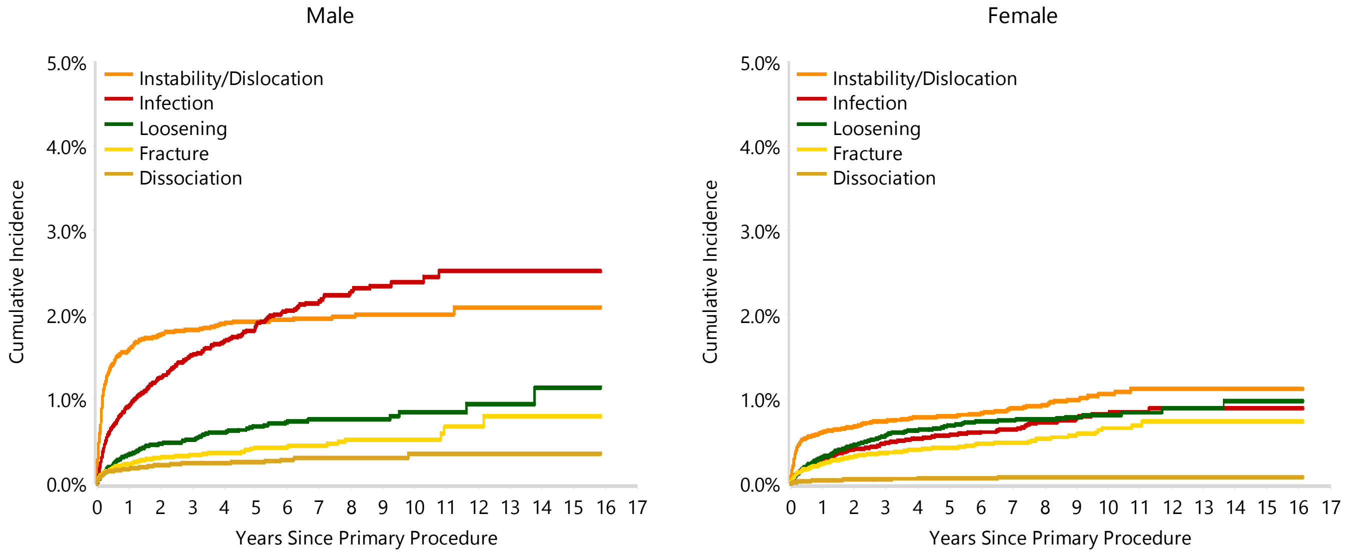
Note: Restricted to modern prostheses

Figure ST63 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Reverse Shoulder Replacement (All Diagnoses)



Note: Restricted to modern prostheses

Figure ST64 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Reverse Shoulder Replacement by Gender



Note: Restricted to modern prostheses

Primary Total Shoulder Replacement

PROSTHESIS TYPES

The outcomes of humeral stem and glenoid prosthesis combinations used in primary total stemmed reverse shoulder replacement are listed in Table ST68. The most commonly used cementless prosthesis combinations are listed in Table ST69. The most commonly used prosthesis combinations with hybrid (humerus cemented) fixation are listed in Table ST70.

Table ST68 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Prosthesis Combination

Humeral Stem	Glenoid Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Aequalis	Aequalis	205	4343	2.2 (1.8, 2.6)	3.5 (3.0, 4.2)	4.5 (3.9, 5.3)	5.3 (4.6, 6.1)	6.8 (5.8, 7.9)	7.5 (6.3, 9.0)
	Perform Reversed	4	306	0.8 (0.2, 3.3)	1.8 (0.7, 4.8)				
Aequalis Flex Revive	Perform Reversed	3	49	4.4 (1.1, 16.6)					
Affinis	Affinis	76	1980	1.8 (1.3, 2.5)	3.5 (2.8, 4.5)	4.4 (3.5, 5.5)	5.4 (3.9, 7.6)		
AltiVate	RSP	1	96	1.0 (0.1, 7.2)					
AltiVate Reverse	RSP	55	2073	2.3 (1.7, 3.1)	3.3 (2.5, 4.3)				
Ascend Flex	Aequalis	129	3481	2.6 (2.1, 3.2)	4.4 (3.7, 5.2)	4.8 (4.0, 5.8)	4.8 (4.0, 5.8)		
	Perform Reversed	28	1306	2.3 (1.5, 3.4)	3.5 (2.2, 5.4)				
Comprehensive	Comprehensive Reverse	118	6595	1.3 (1.0, 1.6)	2.0 (1.6, 2.4)	2.6 (2.1, 3.1)	2.9 (2.2, 3.7)	4.1 (2.2, 7.4)	
	Custom Made (Comprehensive)	5	73	5.5 (2.1, 14.1)	5.5 (2.1, 14.1)	7.7 (3.2, 18.0)			
	Trabecular Metal	2	84	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	3.7 (0.9, 14.2)			
Delta Xtend	Delta Xtend	453	11512	2.2 (2.0, 2.5)	3.2 (2.9, 3.6)	3.7 (3.4, 4.1)	4.3 (3.9, 4.7)	5.1 (4.6, 5.7)	6.6 (5.5, 7.9)
Equinoxe	Equinoxe	202	6005	2.2 (1.8, 2.6)	3.6 (3.1, 4.1)	4.3 (3.7, 5.0)	5.9 (4.8, 7.3)		
Global Unite	Delta Xtend	42	1480	1.6 (1.0, 2.4)	2.8 (2.0, 3.9)	3.6 (2.5, 5.0)	4.1 (2.9, 5.8)		
MSS	MSS	3	230	0.8 (0.1, 5.2)	1.5 (0.4, 5.9)				
Mets	Mets	24	132	12.2 (7.5, 19.4)	18.3 (12.0, 27.3)				
RSP	RSP	76	1813	2.7 (2.1, 3.6)	4.1 (3.2, 5.1)	4.6 (3.7, 5.8)			
SMR	Custom Made (Lima)	6	71	5.7 (2.2, 14.4)	7.3 (3.1, 16.8)				
	SMR	2	147						
	SMR Axioma	11	198	3.6 (1.7, 7.4)	6.6 (3.6, 11.8)				
	SMR L1	458	10939	2.9 (2.6, 3.2)	4.0 (3.6, 4.4)	4.3 (3.9, 4.7)	4.7 (4.3, 5.1)	5.4 (4.8, 6.0)	6.5 (5.4, 7.7)
Trabecular Metal	Comprehensive Reverse	18	436	3.7 (2.2, 6.1)	5.0 (3.1, 8.0)	5.0 (3.1, 8.0)			
	Trabecular Metal	95	1916	2.6 (2.0, 3.5)	4.3 (3.4, 5.3)	5.0 (4.1, 6.2)	5.3 (4.3, 6.5)	5.9 (4.7, 7.3)	8.4 (5.0, 13.9)
Verso	Verso	6	38	19.2 (8.9, 38.4)	19.2 (8.9, 38.4)				
Other (29)		6	91	6.1 (2.5, 14.2)	7.9 (3.6, 17.2)	7.9 (3.6, 17.2)	7.9 (3.6, 17.2)		
TOTAL		2028	55394						

Note: Restricted to modern prostheses
Only prostheses with >50 procedures have been listed

Table ST69 Cumulative Percent Revision of Cementless Primary Total Stemmed Reverse Shoulder Replacement by Prosthesis Combination

Humeral Stem	Glenoid Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Aequalis	Aequalis	134	2463	2.2 (1.6, 2.8)	3.9 (3.2, 4.8)	5.0 (4.1, 6.0)	5.9 (4.9, 7.0)	7.5 (6.2, 9.0)	8.5 (6.8, 10.5)
	Perform Reversed	0	184	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)				
Aequalis Flex Revive	Perform Reversed	1	41	2.6 (0.4, 17.2)					
Affinis	Affinis	41	975	1.7 (1.0, 2.7)	3.8 (2.7, 5.4)	4.8 (3.5, 6.5)	6.6 (4.1, 10.6)		
AltiVate	RSP	1	91	1.1 (0.2, 7.5)					
AltiVate Reverse	RSP	44	1703	2.2 (1.6, 3.1)	3.2 (2.3, 4.3)				
Ascend Flex	Aequalis	118	3035	2.6 (2.1, 3.2)	4.6 (3.8, 5.5)	5.1 (4.2, 6.2)	5.1 (4.2, 6.2)		
	Perform Reversed	24	1148	2.3 (1.5, 3.6)	3.0 (1.9, 4.8)				
Comprehensive	Comprehensive Reverse	88	5595	1.1 (0.8, 1.4)	1.8 (1.4, 2.2)	2.2 (1.7, 2.8)	2.6 (1.9, 3.5)	2.6 (1.9, 3.5)	
	Custom Made (Comprehensive)	3	66	3.0 (0.8, 11.6)	3.0 (0.8, 11.6)	5.4 (1.7, 16.3)			
	Trabecular Metal	2	69	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	4.5 (1.1, 17.0)			
Delta Xtend	Delta Xtend	317	8205	2.1 (1.8, 2.4)	3.2 (2.8, 3.6)	3.7 (3.3, 4.2)	4.3 (3.8, 4.8)	5.3 (4.6, 6.0)	7.3 (5.7, 9.4)
Equinoxe	Equinoxe	162	5203	2.0 (1.7, 2.5)	3.2 (2.7, 3.8)	3.9 (3.3, 4.6)	5.6 (4.4, 7.1)		
Global Unite	Delta Xtend	26	963	1.2 (0.7, 2.1)	2.5 (1.6, 3.8)	3.4 (2.3, 5.2)	3.8 (2.5, 5.8)		
MSS	MSS	3	224	0.8 (0.1, 5.4)	1.6 (0.4, 6.1)				
RSP	RSP	52	1432	2.5 (1.8, 3.5)	3.4 (2.6, 4.5)	4.0 (3.1, 5.3)			
SMR	Custom Made (Lima)	5	68	4.5 (1.5, 13.2)	6.2 (2.4, 15.6)	12.0 (4.2, 32.0)			
	SMR	2	144						
	SMR Axioma	9	192	3.2 (1.4, 6.9)	5.6 (2.9, 10.7)				
	SMR L1	426	10400	2.8 (2.5, 3.1)	3.8 (3.5, 4.2)	4.2 (3.8, 4.6)	4.6 (4.1, 5.1)	5.3 (4.7, 6.0)	6.5 (5.4, 7.8)
Trabecular Metal	Comprehensive Reverse	13	310	3.5 (1.9, 6.4)	5.1 (3.0, 8.8)	5.1 (3.0, 8.8)			
	Trabecular Metal	79	1543	2.8 (2.1, 3.8)	4.4 (3.5, 5.6)	5.1 (4.1, 6.4)	5.4 (4.3, 6.7)	6.1 (4.8, 7.7)	
Verso	Verso	6	36	20.1 (9.4, 39.8)	20.1 (9.4, 39.8)				
Other (23)		5	72	6.3 (2.4, 16.1)	8.5 (3.6, 19.8)	8.5 (3.6, 19.8)	8.5 (3.6, 19.8)		
TOTAL		1561	44162						

Note: Restricted to modern prostheses
Only prostheses with >50 procedures have been listed

Primary Total Shoulder Replacement

Table ST70 Cumulative Percent Revision of Hybrid (Humerus Cemented) Primary Total Stemmed Reverse Shoulder Replacement by Prosthesis Combination

Humeral Stem	Glenoid Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Aequalis	Aequalis	70	1830	2.2 (1.6, 3.0)	3.1 (2.4, 4.0)	3.9 (3.0, 5.0)	4.4 (3.4, 5.7)	5.7 (4.3, 7.5)	
	Perform Reversed	4	120	2.3 (0.6, 9.0)					
Affinis	Affinis	33	947	2.0 (1.3, 3.2)	3.3 (2.3, 4.7)	4.1 (2.9, 5.7)	4.1 (2.9, 5.7)		
AltiVate Reverse	RSP	10	336	2.7 (1.3, 5.3)	3.8 (2.0, 7.2)				
Ascend Flex	Aequalis	10	419	2.3 (1.2, 4.3)	2.6 (1.4, 4.9)	2.6 (1.4, 4.9)			
	Perform Reversed	3	146	1.3 (0.2, 8.8)					
Comprehensive	Comprehensive Reverse	26	935	2.1 (1.3, 3.3)	3.0 (2.0, 4.5)	4.2 (2.7, 6.4)	4.2 (2.7, 6.4)		
Delta Xtend	Delta Xtend	131	3198	2.6 (2.1, 3.2)	3.4 (2.9, 4.1)	3.8 (3.2, 4.6)	4.3 (3.6, 5.1)	4.9 (4.1, 5.9)	5.5 (4.4, 6.9)
Equinoxe	Equinoxe	35	752	3.2 (2.1, 4.8)	5.6 (4.0, 7.9)	6.2 (4.3, 8.9)			
Global Unite	Delta Xtend	15	478	2.2 (1.2, 4.1)	3.4 (2.0, 5.8)	3.4 (2.0, 5.8)			
Mets	Mets	23	126	12.7 (7.8, 20.2)	19.2 (12.6, 28.6)				
RSP	RSP	24	352	4.0 (2.4, 6.7)	6.9 (4.7, 10.3)	7.4 (5.0, 11.0)			
SMR	SMR L1	20	392	4.0 (2.4, 6.5)	5.6 (3.6, 8.6)	5.6 (3.6, 8.6)	5.6 (3.6, 8.6)	5.6 (3.6, 8.6)	
Trabecular Metal	Comprehensive Reverse	5	119	4.3 (1.8, 10.1)					
	Trabecular Metal	14	340	1.8 (0.8, 3.9)	3.6 (2.0, 6.4)	4.6 (2.7, 7.9)	5.2 (3.1, 8.9)	5.2 (3.1, 8.9)	
Other (22)		7	62	10.3 (4.8, 21.7)	13.2 (6.4, 26.3)				
TOTAL		430	10552						

Note: Restricted to modern prostheses
Only prostheses with >50 procedures have been listed

OUTCOME FOR OSTEOARTHRITIS – PATIENT CHARACTERISTICS

There are 23,901 primary total stemmed reverse shoulder replacement procedures with a primary diagnosis of osteoarthritis.

The cumulative percent revision of primary total stemmed reverse shoulder replacement for osteoarthritis at 14 years is 6.7% (Table ST71). Compared to the pre-2015 period, total stemmed reverse replacements 2015-2023 have a lower rate of revision (Table ST72 and Figure ST65).

The most common reasons for revision are infection (28.5%), instability/dislocation (27.5%), and loosening (18.5%) (Table ST73, Figure ST66). The most common types of revision are humeral component only (23.8%), replacement of both cup (liner) and glenosphere (20.4%), and cup only revisions (14.7%) (Table ST74). When only the humeral component is revised, this may be associated with exchange of the epiphysis and/or humeral stem and additional minor components such as the liner. Most revisions are to a total stemmed reverse replacement (84.4%).

Age and Gender

Primary total stemmed reverse shoulder replacement, when used for the management of osteoarthritis, is most common in patients aged ≥75 years. Patients aged ≥75 years have a lower rate of revision compared to patients aged <75 years (Table ST75 and Figure ST67).

Males have a higher rate of revision compared to females (Table ST76 and Figure ST68). The increase in the rate of revision is due to a higher cumulative incidence of infection and instability/dislocation (Figure ST69). Males aged ≥75 years have a lower rate of revision compared to patients aged<65 years. Females aged ≥75 years have a lower rate of revision compared to patients aged 55-74 years (Table ST76, Figure ST70, Figure ST71).

Males have a higher rate of revision compared to females. The increase in the rate of revision is due to a higher cumulative incidence of infection and

ASA and BMI

Patients with ASA scores 3 and 4 have higher rates of revision compared to patients with an ASA score of 1 (Table ST77 and Figure ST72). The most common reasons for revision of the different ASA scores are presented in Figure ST73. The rate of revision for instability/dislocation increases with increasing ASA score. Males have a higher rate of revision than females irrespective of the ASA score (Table ST78 and Figure ST74).

Patients who are underweight have a higher rate of revision compared to patients with a normal BMI. Obese class 3 patients have a higher rate of revision compared to normal weight patients in the first 3 months only, with no difference after this time (Table ST79 and Figure ST75). The most common reasons for revision for the different BMI categories are shown in Figure ST76.

When stratified by gender, obese and non-obese males have higher rates of revision than females in the equivalent BMI groups (Table ST80 and Figure ST77).

Glenoid Morphology

The outcome of the different morphology categories is presented in Table ST81. The category of glenoid morphology is not a risk factor for revision (Figure ST78).

Table ST71 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement (Primary Diagnosis OA)

Shoulder Class	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Total Stemmed Reverse	768	23901	1.9 (1.7, 2.1)	3.0 (2.8, 3.2)	3.5 (3.2, 3.7)	4.1 (3.8, 4.4)	5.0 (4.6, 5.5)	6.7 (5.7, 7.9)
TOTAL	768	23901						

Note: Restricted to modern prostheses

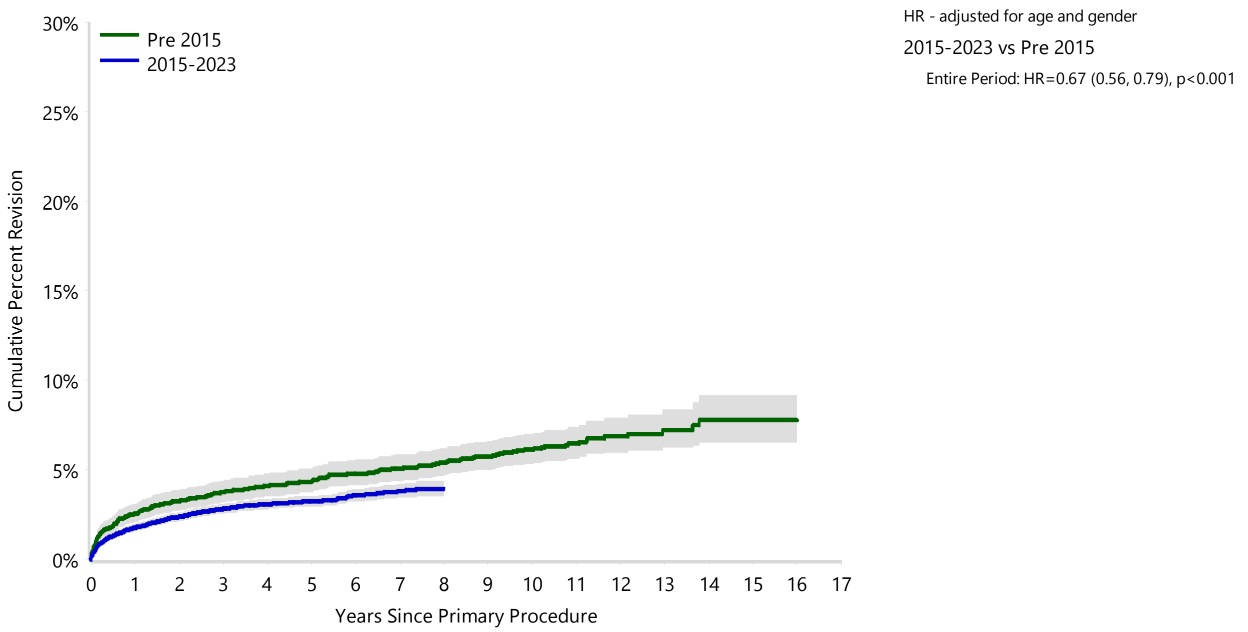
Primary Total Shoulder Replacement

Table ST72 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Procedure Year (Primary Diagnosis OA)

Procedure Year	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Pre 2015	225	3819	2.5 (2.1, 3.1)	3.7 (3.2, 4.4)	4.3 (3.7, 5.1)	5.1 (4.4, 5.8)	6.1 (5.4, 7.0)	7.8 (6.6, 9.2)
2015-2023	543	20082	1.8 (1.6, 2.0)	2.8 (2.6, 3.1)	3.3 (3.0, 3.6)	3.8 (3.5, 4.2)		
TOTAL	768	23901						

Note: Restricted to modern prostheses

Figure ST65 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Procedure Year (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Pre 2015	3819	3664	3448	3156	2792	1630	308
2015-2023	20082	16290	10377	5540	1971	0	0

Note: Restricted to modern prostheses

Table ST73 Primary Total Stemmed Reverse Shoulder Replacement by Reason for Revision (Primary Diagnosis OA)

Reason for Revision	Number	Percent
Infection	219	28.5
Instability/Dislocation	211	27.5
Loosening	142	18.5
Fracture	76	9.9
Dissociation	25	3.3
Pain	17	2.2
Lysis	10	1.3
Arthrofibrosis	9	1.2
Implant Breakage Glenoid	8	1.0
Malposition	8	1.0
Heterotopic Bone	6	0.8
Metal Related Pathology	5	0.7
Rotator Cuff Insufficiency	5	0.7
Incorrect Sizing	4	0.5
Wear Humeral Cup	3	0.4
Other	20	2.6
TOTAL	768	100.0

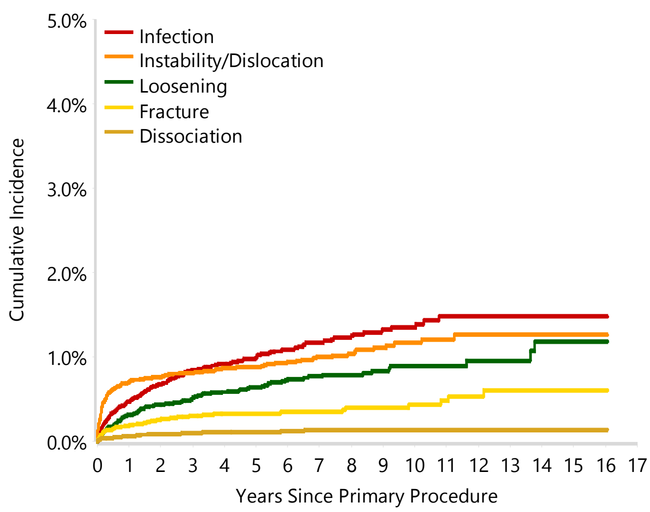
Note: Restricted to modern prostheses

Table ST74 Primary Total Stemmed Reverse Shoulder Replacement by Type of Revision (Primary Diagnosis OA)

Type of Revision	Number	Percent
Humeral Component	183	23.8
Cup/Head	157	20.4
Cup Only	113	14.7
Cement Spacer	86	11.2
Humeral Head Only	81	10.5
Humeral/Glenoid	69	9.0
Glenoid Component	56	7.3
Removal of Prostheses	10	1.3
Cement Only	5	0.7
Minor Components	4	0.5
Glenosphere Only	2	0.3
Reoperation	2	0.3
TOTAL	768	100.0

Note: Restricted to modern prostheses

Figure ST66 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Reverse Shoulder Replacement (Primary Diagnosis OA)



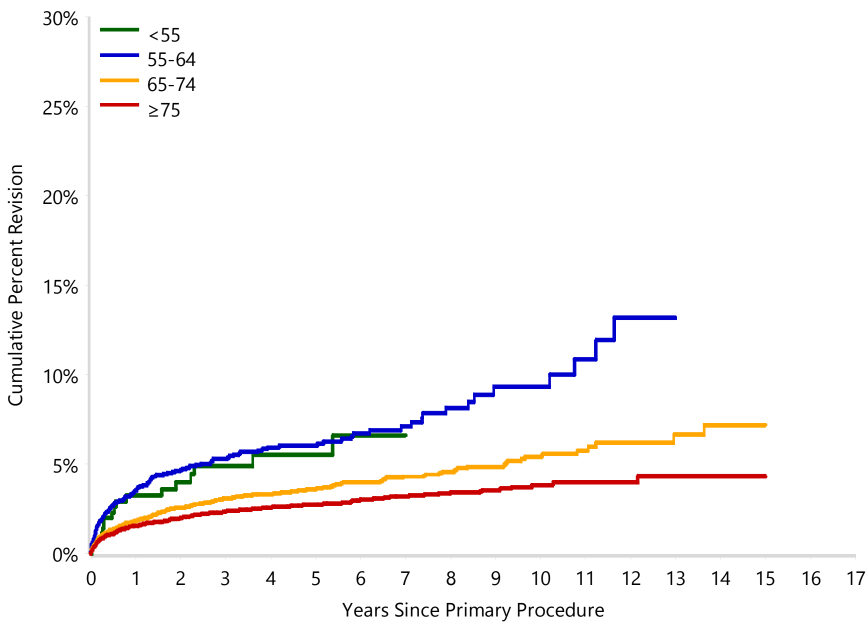
Note: Restricted to modern prostheses

Table ST75 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Age (Primary Diagnosis OA)

Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
<55	17	363	3.2 (1.8, 5.8)	4.9 (2.9, 8.0)	5.5 (3.4, 9.1)	6.6 (3.9, 11.1)		
55-64	145	2502	3.5 (2.8, 4.3)	5.3 (4.4, 6.3)	6.0 (5.1, 7.2)	7.1 (5.9, 8.6)	9.3 (7.4, 11.7)	
65-74	318	9553	1.8 (1.6, 2.1)	3.1 (2.7, 3.5)	3.6 (3.2, 4.1)	4.3 (3.8, 4.9)	5.4 (4.7, 6.3)	7.2 (5.6, 9.2)
≥75	288	11483	1.6 (1.3, 1.8)	2.4 (2.1, 2.7)	2.7 (2.4, 3.1)	3.2 (2.8, 3.6)	3.8 (3.3, 4.5)	4.3 (3.5, 5.3)
TOTAL	768	23901						

Note: Restricted to modern prostheses

Figure ST67 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Age (Primary Diagnosis OA)



HR - adjusted for gender

<55 vs ≥75

Entire Period: HR=1.69 (1.03, 2.75), p=0.037

55-64 vs ≥75

Entire Period: HR=2.10 (1.71, 2.57), p<0.001

65-74 vs ≥75

Entire Period: HR=1.24 (1.06, 1.46), p=0.008

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
<55	363	287	169	101	55	24	7
55-64	2502	2045	1315	807	414	147	35
65-74	9553	7979	5496	3477	1933	659	157
≥75	11483	9643	6845	4311	2361	800	109

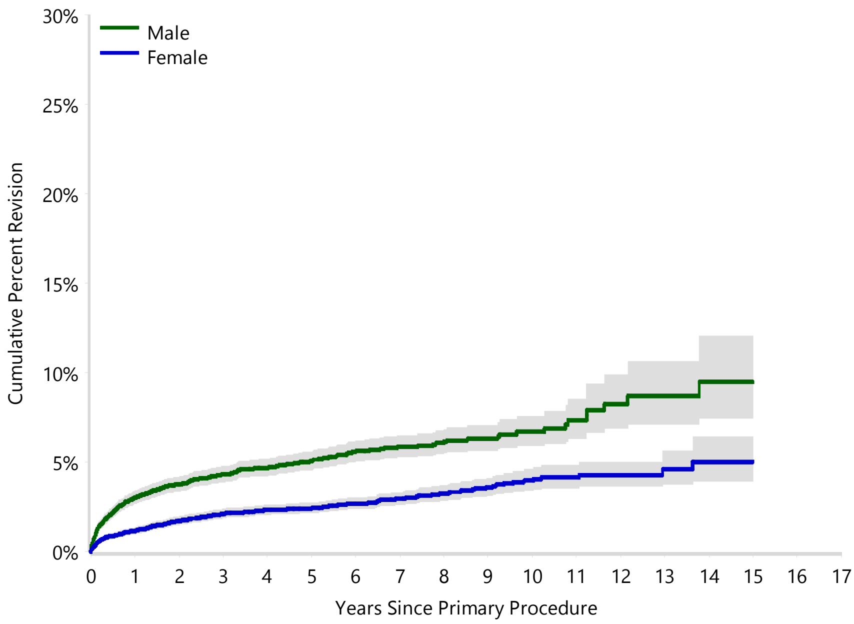
Note: Restricted to modern prostheses

Table ST76 **Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Gender and Age (Primary Diagnosis OA)**

Gender	Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Male		**435**	**9548**	**3.0 (2.7, 3.4)**	**4.3 (3.9, 4.8)**	**5.1 (4.6, 5.6)**	**5.9 (5.3, 6.5)**	**6.7 (5.9, 7.6)**	**9.5 (7.4, 12.0)**
	<55	15	230	4.2 (2.2, 8.0)	6.9 (4.0, 11.7)	8.0 (4.7, 13.5)			
	55-64	96	1410	4.9 (3.9, 6.2)	6.5 (5.3, 8.1)	7.3 (5.9, 9.0)	8.4 (6.8, 10.5)	9.2 (7.1, 11.9)	
	65-74	180	4155	2.5 (2.1, 3.1)	4.0 (3.4, 4.7)	4.9 (4.2, 5.7)	5.6 (4.8, 6.6)	7.0 (5.8, 8.6)	8.1 (6.3, 10.3)
	≥75	144	3753	2.8 (2.3, 3.4)	3.6 (3.1, 4.3)	4.3 (3.6, 5.1)	5.0 (4.1, 5.9)	5.2 (4.3, 6.3)	
Female		**333**	**14353**	**1.2 (1.0, 1.3)**	**2.1 (1.9, 2.4)**	**2.4 (2.2, 2.7)**	**3.0 (2.6, 3.3)**	**4.0 (3.4, 4.6)**	**5.0 (3.9, 6.4)**
	<55	2	133	1.6 (0.4, 6.3)	1.6 (0.4, 6.3)	1.6 (0.4, 6.3)			
	55-64	49	1092	1.7 (1.1, 2.7)	3.7 (2.7, 5.1)	4.4 (3.2, 6.0)	5.4 (3.9, 7.5)	9.1 (6.2, 13.2)	
	65-74	138	5398	1.3 (1.0, 1.6)	2.4 (2.0, 2.9)	2.6 (2.2, 3.2)	3.3 (2.7, 4.0)	4.2 (3.3, 5.2)	6.4 (4.3, 9.6)
	≥75	144	7730	1.0 (0.8, 1.2)	1.7 (1.5, 2.1)	2.0 (1.7, 2.4)	2.4 (2.0, 2.9)	3.2 (2.5, 4.0)	3.2 (2.5, 4.0)
TOTAL		**768**	**23901**						

Note: Restricted to modern prostheses

Figure ST68 **Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Gender (Primary Diagnosis OA)**



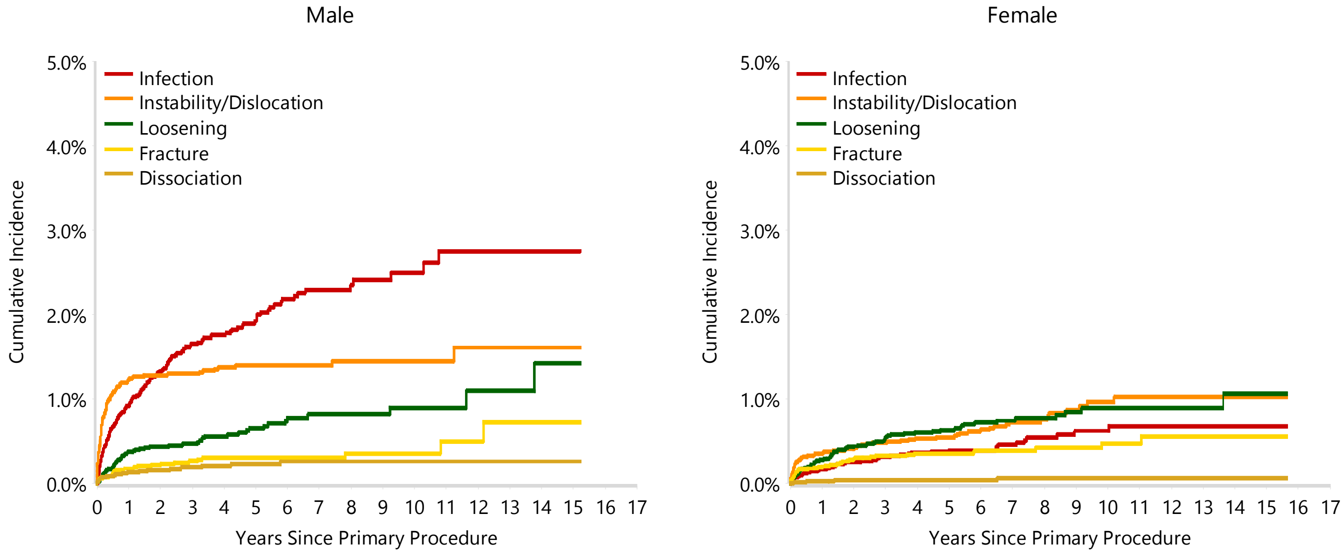
HR - adjusted for age
Male vs Female
0 - 3Mth: HR=2.11 (1.63, 2.73), p<0.001
3Mth - 1Yr: HR=2.87 (2.11, 3.89), p<0.001
1Yr+: HR=1.41 (1.13, 1.75), p=0.002

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Male	9548	7788	5268	3205	1690	556	109
Female	14353	12166	8557	5491	3073	1074	199

Note: Restricted to modern prostheses

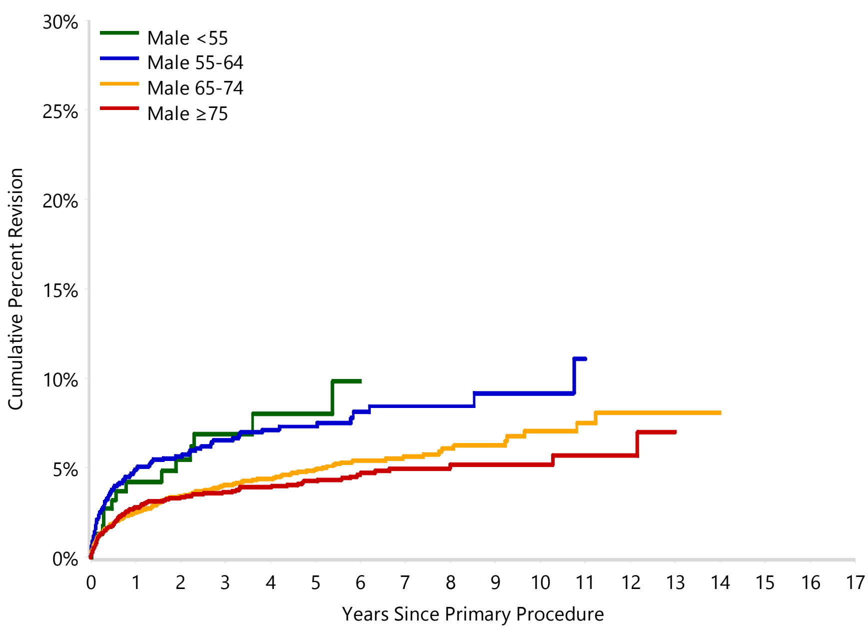
Primary Total Shoulder Replacement

Figure ST69 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Reverse Shoulder Replacement by Gender (Primary Diagnosis OA)



Note: Restricted to modern prostheses

Figure ST70 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement in Males by Age (Primary Diagnosis OA)



Male <55 vs Male ≥75

Entire Period: HR=1.85 (1.09, 3.15), p=0.023

Male 55-64 vs Male ≥75

Entire Period: HR=1.85 (1.43, 2.40), p<0.001

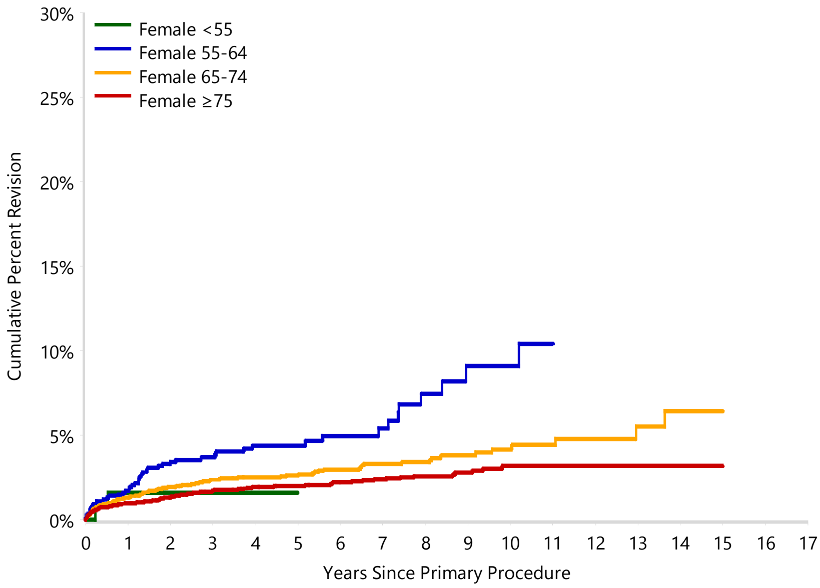
Male 65-74 vs Male ≥75

Entire Period: HR=1.12 (0.90, 1.40), p=0.308

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Male	<55	230	177	95	56	34	12	3
	55-64	1410	1120	712	428	204	71	20
	65-74	4155	3405	2319	1447	796	267	59
	≥75	3753	3086	2142	1274	656	206	27

Note: Restricted to modern prostheses

Figure ST71 **Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement in Females by Age (Primary Diagnosis OA)**



Female <55 vs Female ≥75
Entire Period: HR=0.84 (0.21, 3.40), p=0.808

Female 55-64 vs Female ≥75
Entire Period: HR=2.51 (1.82, 3.47), p<0.001

Female 65-74 vs Female ≥75
Entire Period: HR=1.39 (1.10, 1.76), p=0.005

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Female	**<55**	133	110	74	45	21	12	4
	55-64	1092	925	603	379	210	76	15
	65-74	5398	4574	3177	2030	1137	392	98
	≥75	7730	6557	4703	3037	1705	594	82

Note: Restricted to modern prostheses

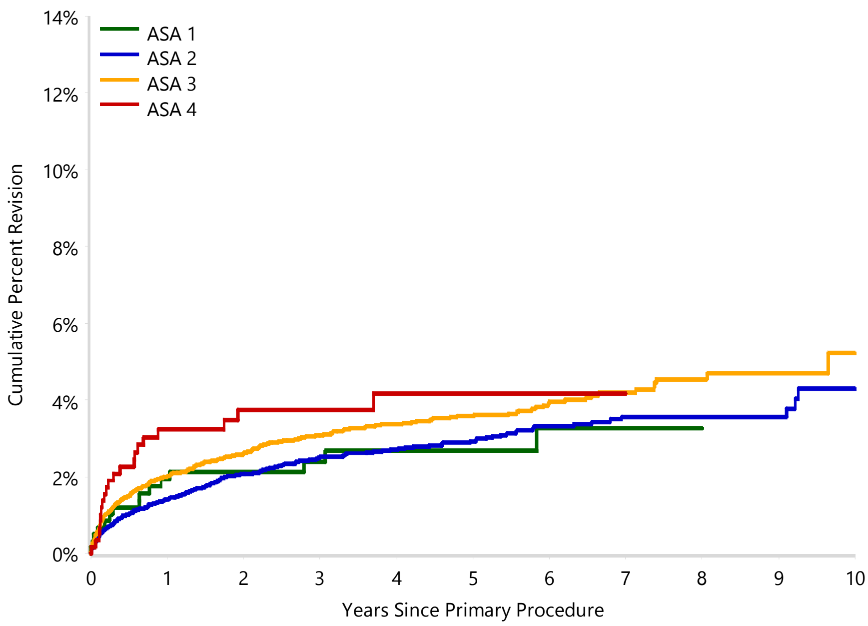
Primary Total Shoulder Replacement

Table ST77 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by ASA Score (Primary Diagnosis OA)

ASA Score	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	8 Yrs
ASA 1	15	592	1.9 (1.1, 3.5)	2.1 (1.2, 3.7)	2.4 (1.4, 4.1)	2.7 (1.6, 4.5)	2.7 (1.6, 4.5)	3.3 (1.9, 5.7)
ASA 2	225	8844	1.4 (1.2, 1.7)	2.1 (1.8, 2.4)	2.5 (2.2, 2.9)	2.7 (2.4, 3.1)	2.9 (2.5, 3.4)	3.6 (3.1, 4.1)
ASA 3	339	11184	2.0 (1.8, 2.3)	2.6 (2.3, 2.9)	3.1 (2.8, 3.5)	3.4 (3.0, 3.8)	3.6 (3.2, 4.0)	4.5 (4.0, 5.2)
ASA 4	21	591	3.2 (2.0, 5.1)	3.7 (2.4, 5.8)	3.7 (2.4, 5.8)	4.2 (2.7, 6.4)	4.2 (2.7, 6.4)	
ASA 5	0	2						
TOTAL	600	21213						

Note: Restricted to modern prostheses

Figure ST72 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by ASA Score (Primary Diagnosis OA)



HR - adjusted for age and gender

ASA 2 vs ASA 1

Entire Period: HR=1.31 (0.77, 2.21), p=0.314

ASA 3 vs ASA 1

Entire Period: HR=1.80 (1.07, 3.03), p=0.027

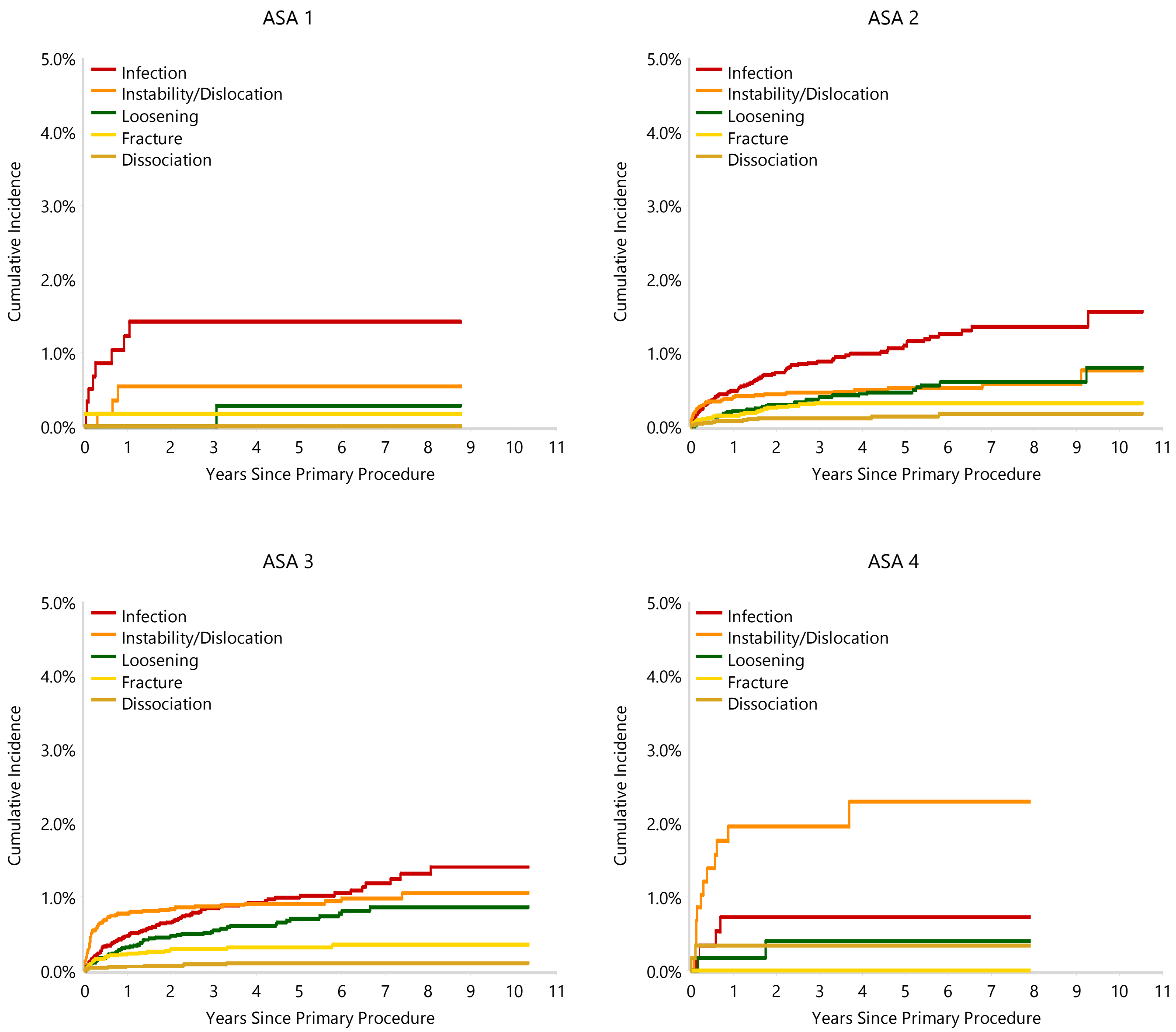
ASA 4 vs ASA 1

Entire Period: HR=2.25 (1.16, 4.39), p=0.017

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	8 Yrs
ASA 1	592	515	442	351	292	229	65
ASA 2	8844	7394	6243	5077	4054	3072	866
ASA 3	11184	9021	7372	5722	4333	3074	712
ASA 4	591	468	368	284	212	157	39

Note: Restricted to modern prostheses

Figure ST73 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Reverse Shoulder Replacement by ASA Score (Primary Diagnosis OA)



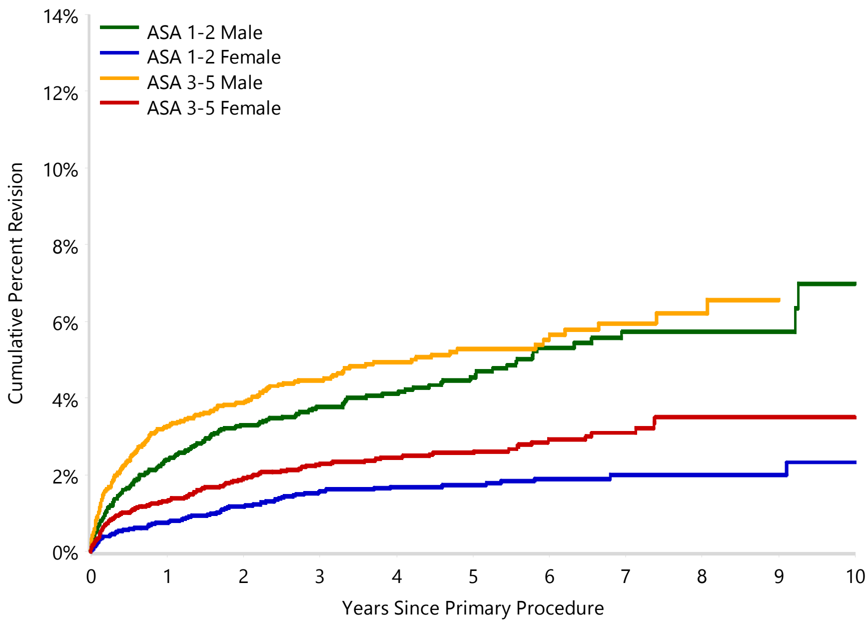
Note: Restricted to modern prostheses

Table ST78 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by ASA Score and Gender (Primary Diagnosis OA)

ASA Score	Gender	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	8 Yrs
ASA 1	Male	10	326	2.6 (1.3, 5.1)	2.9 (1.5, 5.5)	2.9 (1.5, 5.5)	2.9 (1.5, 5.5)	4.2 (2.0, 8.6)	
	Female	5	266	1.2 (0.4, 3.6)	1.2 (0.4, 3.6)	1.7 (0.6, 4.6)	2.3 (1.0, 5.6)	2.3 (1.0, 5.6)	
ASA 2	Male	149	3686	2.4 (1.9, 2.9)	3.3 (2.8, 4.0)	3.8 (3.2, 4.6)	4.7 (3.9, 5.6)	5.9 (4.9, 7.0)	5.9 (4.9, 7.0)
	Female	76	5158	0.7 (0.5, 1.0)	1.2 (0.9, 1.5)	1.6 (1.2, 2.0)	1.7 (1.3, 2.1)	2.0 (1.5, 2.5)	2.0 (1.5, 2.5)
ASA 3	Male	190	4346	3.2 (2.7, 3.8)	3.8 (3.3, 4.5)	4.5 (3.8, 5.2)	5.3 (4.5, 6.1)	6.0 (5.0, 7.1)	6.2 (5.2, 7.5)
	Female	149	6838	1.3 (1.0, 1.6)	1.9 (1.5, 2.2)	2.2 (1.9, 2.7)	2.5 (2.1, 3.0)	3.1 (2.6, 3.7)	3.5 (2.8, 4.3)
ASA 4 or 5	Male	11	226	4.7 (2.6, 8.6)	4.7 (2.6, 8.6)	4.7 (2.6, 8.6)	5.9 (3.2, 10.8)		
	Female	10	367	2.3 (1.2, 4.6)	3.1 (1.7, 5.8)	3.1 (1.7, 5.8)	3.1 (1.7, 5.8)		
TOTAL		600	21213						

Note: Restricted to modern prostheses

Figure ST74 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by ASA Score and Gender (Primary Diagnosis OA)



HR - adjusted for age

ASA 1-2 Male vs ASA 1-2 Female
Entire Period: HR=2.46 (1.88, 3.22), p<0.001

ASA 1-2 Male vs ASA 3-5 Male
Entire Period: HR=0.78 (0.63, 0.96), p=0.019

ASA 1-2 Female vs ASA 3-5 Female
Entire Period: HR=0.60 (0.46, 0.79), p<0.001

ASA 3-5 Male vs ASA 3-5 Female
Entire Period: HR=1.91 (1.55, 2.36), p<0.001

Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	8 Yrs
ASA 1-2	Male	4012	3303	2758	2207	1313	589	346
	Female	5424	4606	3927	3221	1988	962	585
ASA 3-5	Male	4572	3583	2901	2224	1145	468	265
	Female	7205	5907	4840	3783	2086	872	486

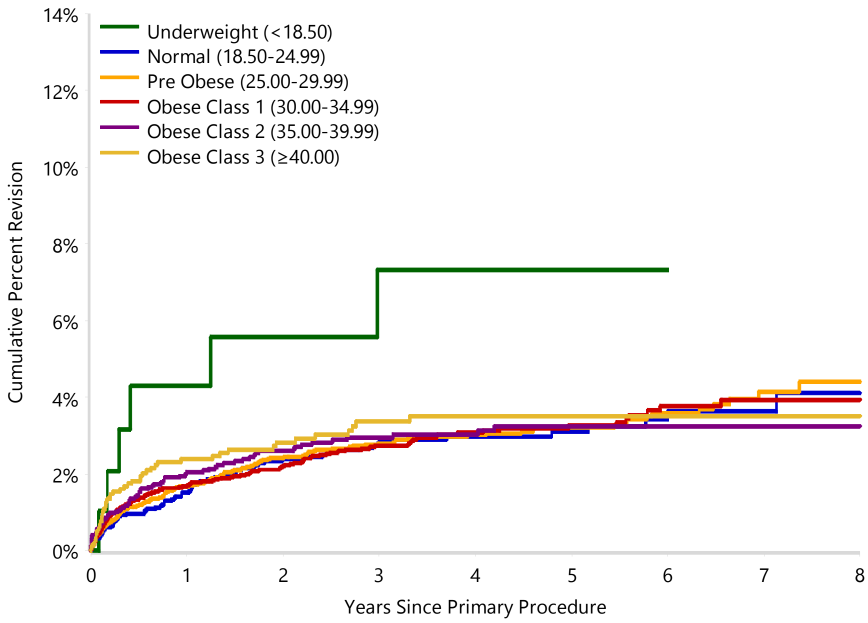
Note: Restricted to modern prostheses

Table ST79 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by BMI Category (Primary Diagnosis OA)

BMI Category	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Underweight (<18.50)	6	97	4.3 (1.6, 11.0)	5.6 (2.3, 12.9)	7.3 (3.3, 15.8)	7.3 (3.3, 15.8)	7.3 (3.3, 15.8)	7.3 (3.3, 15.8)
Normal (18.50-24.99)	73	2852	1.5 (1.1, 2.0)	2.4 (1.9, 3.1)	2.8 (2.2, 3.6)	3.0 (2.3, 3.8)	3.1 (2.4, 4.0)	3.6 (2.8, 4.7)
Pre Obese (25.00-29.99)	174	6501	1.7 (1.4, 2.0)	2.4 (2.0, 2.8)	2.8 (2.4, 3.3)	3.0 (2.6, 3.5)	3.2 (2.7, 3.8)	3.6 (3.0, 4.2)
Obese Class 1 (30.00-34.99)	138	5239	1.7 (1.4, 2.1)	2.2 (1.8, 2.7)	2.7 (2.3, 3.3)	3.1 (2.6, 3.7)	3.3 (2.7, 3.9)	3.8 (3.1, 4.6)
Obese Class 2 (35.00-39.99)	72	2690	2.0 (1.6, 2.7)	2.6 (2.0, 3.3)	3.0 (2.3, 3.7)	3.0 (2.4, 3.8)	3.2 (2.6, 4.1)	3.2 (2.6, 4.1)
Obese Class 3 (≥40.00)	47	1578	2.4 (1.7, 3.3)	2.8 (2.1, 3.8)	3.4 (2.5, 4.5)	3.5 (2.6, 4.7)	3.5 (2.6, 4.7)	3.5 (2.6, 4.7)
TOTAL	510	18957						

Note: BMI has not been presented for patients aged ≤19 years
Restricted to modern prostheses

Figure ST75 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by BMI Category (Primary Diagnosis OA)



HR - adjusted for age and gender

Underweight (<18.50) vs Normal (18.50-24.99)
Entire Period: HR=2.77 (1.20, 6.37), p=0.016

Pre Obese (25.00-29.99) vs Normal (18.50-24.99)
Entire Period: HR=0.88 (0.67, 1.16), p=0.367

Obese Class 1 (30.00-34.99) vs Normal (18.50-24.99)
Entire Period: HR=0.87 (0.66, 1.16), p=0.352

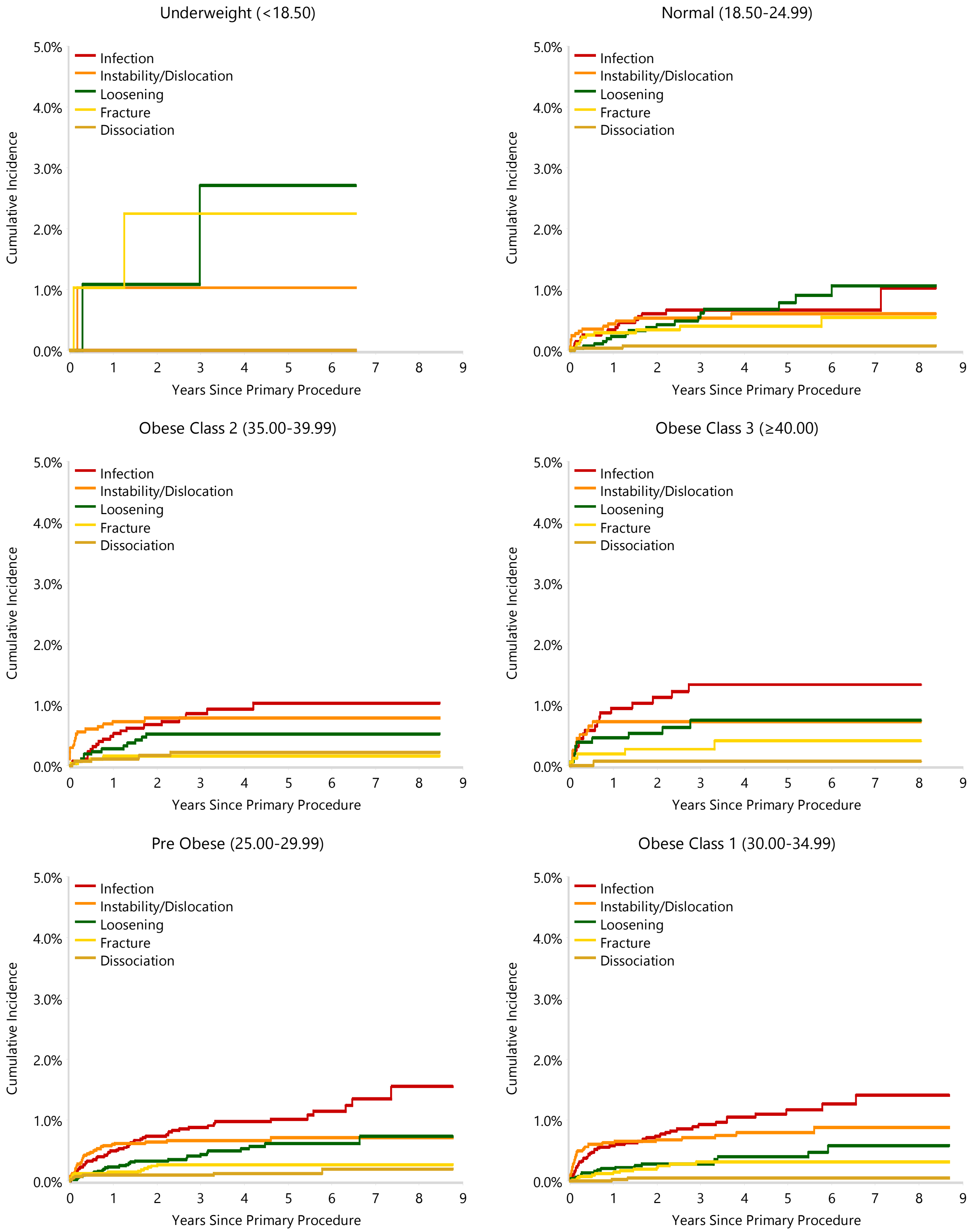
Obese Class 2 (35.00-39.99) vs Normal (18.50-24.99)
0 - 2Wk: HR=1.98 (0.97, 4.05), p=0.060
2Wk - 3Mth: HR=0.78 (0.43, 1.39), p=0.395
3Mth - 6Mth: HR=1.56 (0.83, 2.93), p=0.165
6Mth+: HR=0.77 (0.50, 1.17), p=0.220

Obese Class 3 (≥40.00) vs Normal (18.50-24.99)
0 - 3Mth: HR=1.69 (1.04, 2.75), p=0.034
3Mth+: HR=0.79 (0.49, 1.28), p=0.345

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Underweight (<18.50)	97	75	68	53	40	25	18
Normal (18.50-24.99)	2852	2274	1847	1413	1051	742	484
Pre Obese (25.00-29.99)	6501	5231	4239	3283	2457	1704	1054
Obese Class 1 (30.00-34.99)	5239	4217	3428	2606	1965	1327	782
Obese Class 2 (35.00-39.99)	2690	2177	1754	1350	963	654	410
Obese Class 3 (≥40.00)	1578	1271	1024	773	561	381	229

Note: BMI has not been presented for patients aged ≤19 years
Restricted to modern prostheses

Figure ST76 **Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Reverse Shoulder Replacement by BMI Category (Primary Diagnosis OA)**



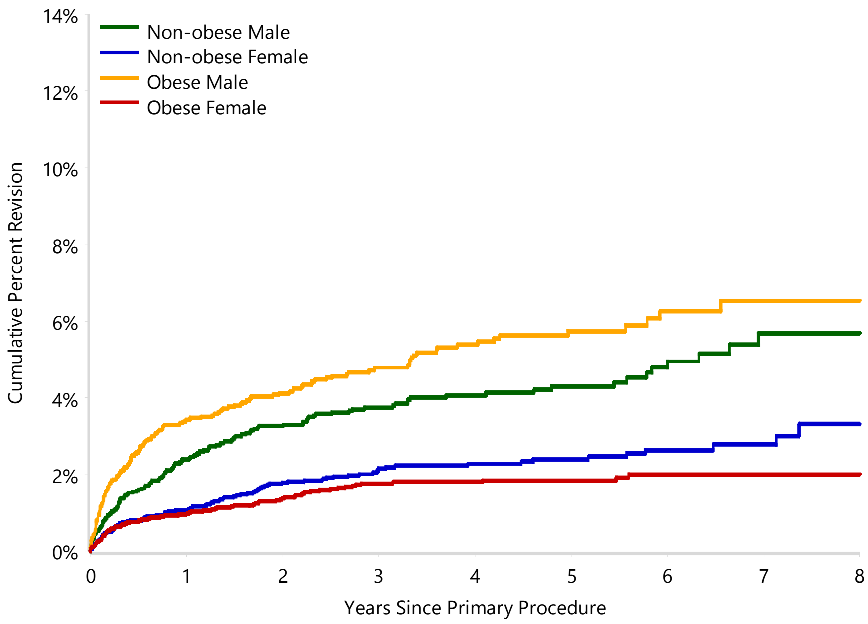
Note: BMI has not been presented for patients aged ≤19 years
Restricted to modern prostheses

Table ST80 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by BMI Category and Gender (Primary Diagnosis OA)

BMI Category	Gender	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Non-obese	Male	149	4170	2.4 (2.0, 2.9)	3.3 (2.7, 3.9)	3.7 (3.2, 4.4)	4.1 (3.4, 4.8)	4.3 (3.6, 5.1)	4.9 (4.1, 6.0)
	Female	104	5280	1.1 (0.8, 1.4)	1.8 (1.4, 2.2)	2.2 (1.8, 2.6)	2.3 (1.9, 2.8)	2.4 (1.9, 2.9)	2.6 (2.1, 3.3)
Obese	Male	166	3595	3.4 (2.9, 4.1)	4.1 (3.5, 4.9)	4.8 (4.1, 5.6)	5.4 (4.6, 6.3)	5.7 (4.9, 6.7)	6.3 (5.3, 7.5)
	Female	91	5912	1.0 (0.7, 1.3)	1.4 (1.1, 1.7)	1.8 (1.4, 2.2)	1.8 (1.5, 2.2)	1.8 (1.5, 2.3)	2.0 (1.6, 2.5)
TOTAL		510	18957						

Note: BMI has not been presented for patients aged ≤19 years
Restricted to modern prostheses

Figure ST77 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by BMI Category and Gender (Primary Diagnosis OA)



HR - adjusted for age

Non-obese Male vs Non-obese Female
Entire Period: HR=1.71 (1.33, 2.20), p<0.001

Non-obese Male vs Obese Male
Entire Period: HR=0.83 (0.66, 1.03), p=0.096

Non-obese Female vs Obese Female
Entire Period: HR=1.37 (1.03, 1.81), p=0.029

Obese Male vs Obese Female
Entire Period: HR=2.83 (2.18, 3.66), p<0.001

Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Non-obese	Male	4170	3293	2658	2032	1485	1027	632
	Female	5280	4287	3496	2717	2063	1444	924
Obese	Male	3595	2820	2259	1692	1223	806	468
	Female	5912	4845	3947	3037	2266	1556	953

Note: BMI has not been presented for patients aged ≤19 years
Restricted to modern prostheses

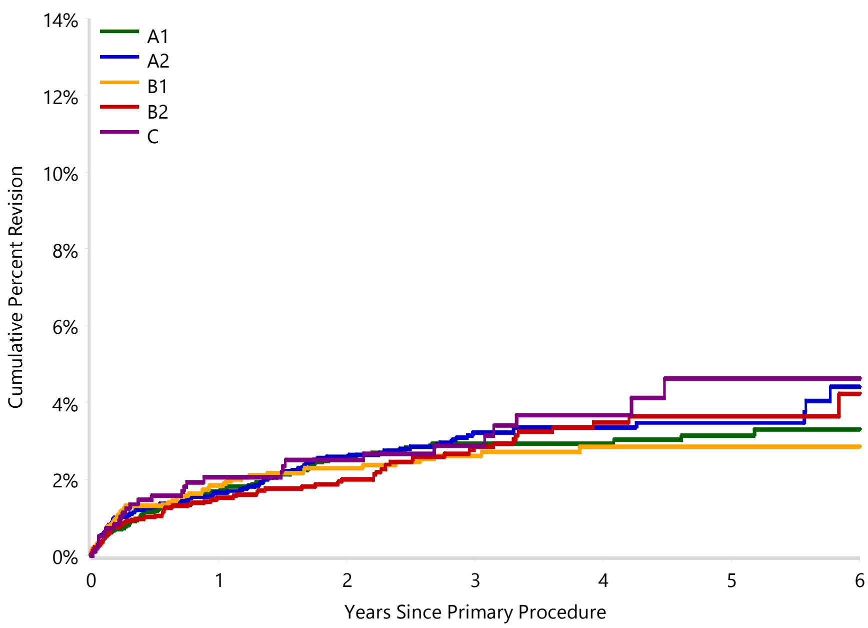
Primary Total Shoulder Replacement

Table ST81 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Glenoid Morphology (Primary Diagnosis OA)

Glenoid Morphology	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
A1	96	3872	1.7 (1.3, 2.1)	2.6 (2.1, 3.2)	2.9 (2.4, 3.6)	2.9 (2.4, 3.6)	3.1 (2.5, 3.9)
A2	96	3612	1.7 (1.3, 2.1)	2.6 (2.1, 3.2)	3.2 (2.6, 4.0)	3.4 (2.7, 4.1)	3.5 (2.8, 4.3)
B1	56	2459	1.8 (1.4, 2.5)	2.3 (1.7, 3.0)	2.6 (2.0, 3.4)	2.8 (2.2, 3.7)	2.8 (2.2, 3.7)
B2	69	2862	1.5 (1.1, 2.1)	2.0 (1.5, 2.6)	2.8 (2.2, 3.7)	3.5 (2.7, 4.5)	3.6 (2.8, 4.7)
C	29	991	2.0 (1.3, 3.2)	2.5 (1.6, 3.8)	2.9 (1.9, 4.3)	3.7 (2.5, 5.5)	4.6 (3.0, 7.0)
TOTAL	346	13796					

Note: Restricted to modern prostheses
Excludes 85 procedures with a recorded glenoid morphology of B3

Figure ST78 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Glenoid Morphology (Primary Diagnosis OA)



HR - adjusted for age and gender

A2 vs A1
Entire Period: HR=1.10 (0.83, 1.46), p=0.494

B1 vs A1
Entire Period: HR=0.91 (0.65, 1.26), p=0.559

B2 vs A1
Entire Period: HR=0.86 (0.63, 1.18), p=0.344

C vs A1
Entire Period: HR=0.98 (0.65, 1.49), p=0.934

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
A1	3872	2998	2330	1685	1170	668
A2	3612	2758	2099	1476	998	549
B1	2459	1873	1409	993	629	347
B2	2862	2153	1639	1112	720	392
C	991	770	578	404	261	142

Note: Restricted to modern prostheses

OUTCOME FOR OSTEOARTHRITIS – PROSTHESIS CHARACTERISTICS

Glenoid Baseplate

A glenoid baseplate is categorised as augmented if the backside has been modified for glenoid deformity (eg. wedged, stepped, angulated, or lateralised). When stratified by glenoid morphology, there is no difference in the rate of revision when augmented and non-augmented glenoid baseplates are compared (Table ST82, Figure ST79, and Figure ST80).

Humeral Fixation and Stem Length

A short humeral stem (<100 mm) has a lower rate of revision compared to a conventional stem (≥100mm) from 3 months onwards (Table ST84 and Figure ST82). Conventional stem lengths have higher cumulative incidence of infection compared to short stems (Figure ST83). Fixation has no effect on revision rates.

Polyethylene Type and Bearing Surface

Non XLPE is the most common type of polyethylene used in primary total stemmed reverse shoulder replacement for the management of osteoarthritis. There is no difference in the rate of revision when the different bearing surfaces (humeral cup/glenosphere) are compared (Table ST85 and Figure ST84). The reasons for revision for the different types of bearing surface are presented in Figure ST85.

Glenosphere Size and Lateralisation

Glenosphere sizes >40mm have a lower rate of revision compared to <38mm over the entire period and when compared to 38–40mm sizes in the first 3 months only. There is no difference in the rate of revision between <38mm and 38–40mm glenosphere sizes (Table ST86 and Figure ST86). The most common reasons for revision for the three different glenosphere size groups are presented in Figure ST87.

> Glenosphere sizes <38mm have a higher rate of revision compared to sizes >40mm.

If the radius of curvature of the articular surface of the glenosphere is displaced laterally by design, it is categorised as a lateralised glenosphere. There is no difference in the rate of revision for total stemmed reverse shoulder replacements with lateralised glenospheres when compared to total stemmed reverse shoulder replacements with standard glenospheres (Table ST87 and Figure ST88).

Technology Assistance

An image derived instrument (IDI) is defined as custom made pin guides or cutting blocks derived from CT or MRI images by 3D printing specifically for each patient. There are 5,266 total stemmed reverse shoulder replacements for osteoarthritis utilising an IDI since their first use in 2014. In 2023, IDI are used in 39.5% of all total stemmed reverse procedures. There is an increase in the revision rate when IDI is not used (Table ST88 and Figure ST89).

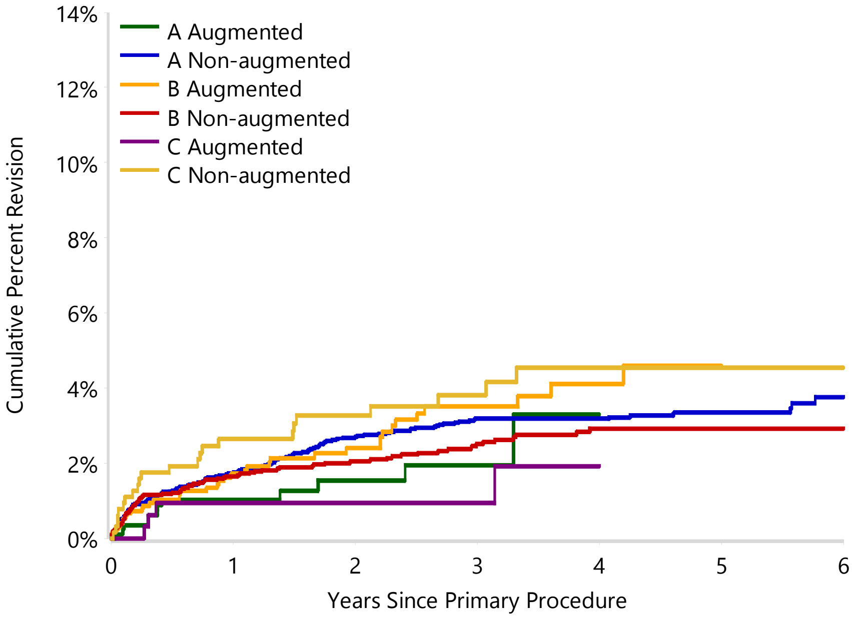
The outcomes of the most commonly used prosthesis combinations are listed in Table ST89. The most commonly used cementless prosthesis combinations are listed in Table ST90. The most commonly used hybrid (humerus cemented) prosthesis combinations are listed in Table ST91.

Table ST82 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Glenoid Morphology and Glenoid Augmentation (Primary Diagnosis OA)

Glenoid Morphology	Glenoid Augmentation	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
A	Augmented	14	888	1.0 (0.5, 2.0)	1.5 (0.8, 3.0)	2.0 (1.0, 3.8)	3.3 (1.7, 6.5)	
	Non-augmented	178	6596	1.7 (1.4, 2.1)	2.7 (2.3, 3.1)	3.2 (2.7, 3.7)	3.2 (2.7, 3.7)	3.3 (2.9, 3.9)
B	Augmented	40	1545	1.7 (1.1, 2.6)	2.4 (1.7, 3.5)	3.5 (2.5, 4.9)	4.1 (2.9, 5.9)	4.6 (3.1, 6.7)
	Non-augmented	85	3776	1.6 (1.3, 2.1)	2.0 (1.6, 2.6)	2.5 (2.0, 3.1)	2.9 (2.3, 3.7)	2.9 (2.3, 3.7)
C	Augmented	6	353	0.9 (0.3, 2.9)	0.9 (0.3, 2.9)	0.9 (0.3, 2.9)	1.9 (0.6, 6.0)	
	Non-augmented	23	637	2.6 (1.6, 4.3)	3.3 (2.1, 5.1)	3.8 (2.5, 5.8)	4.5 (3.0, 6.9)	4.5 (3.0, 6.9)
TOTAL		346	13795					

Note: Restricted to modern prostheses
Excludes 10,106 procedures with unknown glenoid augmentation or glenoid morphology

Figure ST79 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Glenoid Morphology and Glenoid Augmentation (Primary Diagnosis OA)



HR - adjusted for age and gender
A Augmented vs A Non-augmented
Entire Period: HR=0.70 (0.41, 1.21), p=0.202

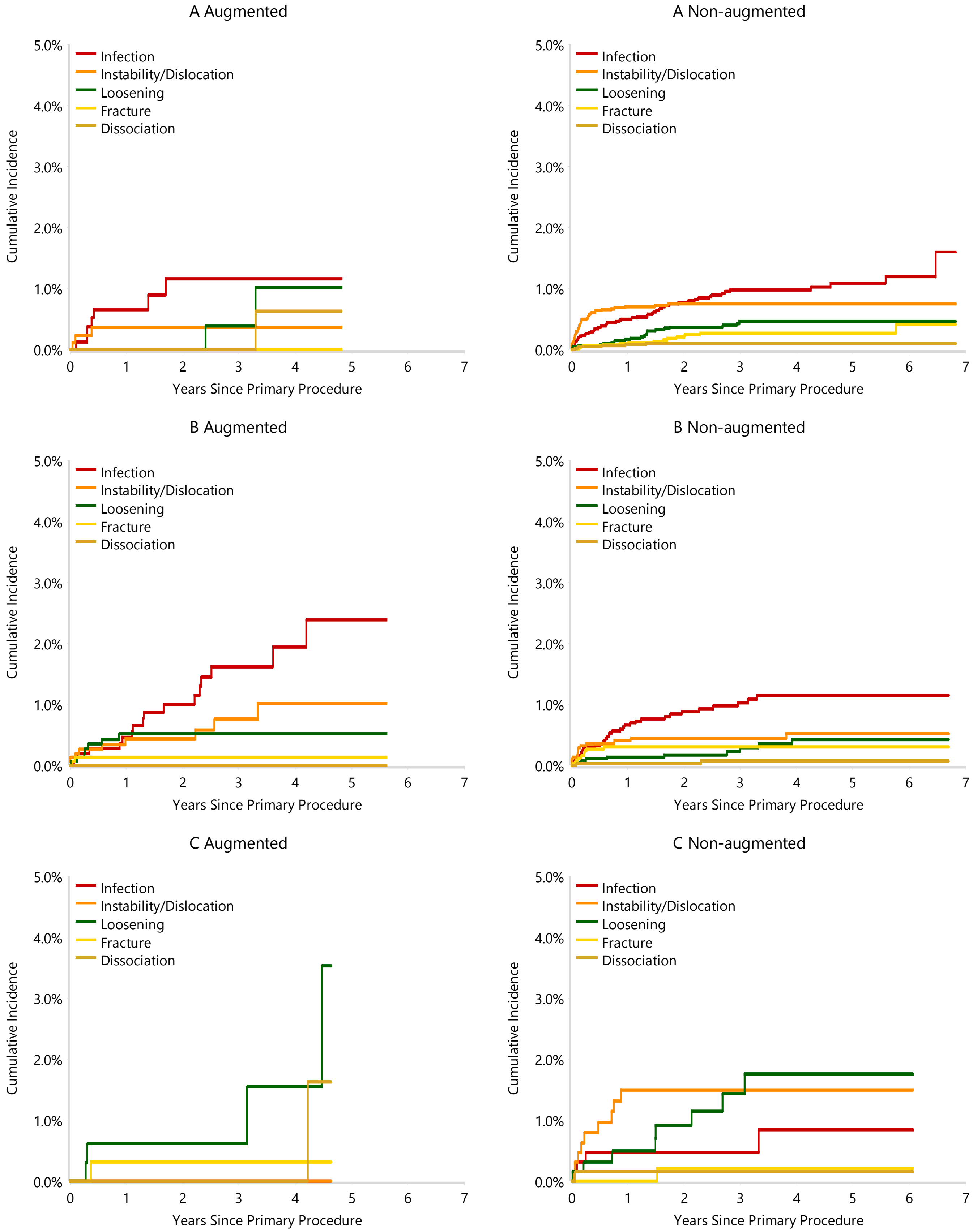
B Augmented vs B Non-augmented
Entire Period: HR=1.24 (0.85, 1.81), p=0.256

C Augmented vs C Non-augmented
Entire Period: HR=0.51 (0.21, 1.26), p=0.145

Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
A	Augmented	888	523	300	172	94	32
	Non-augmented	6596	5233	4129	2989	2074	1185
B	Augmented	1545	1037	706	445	227	104
	Non-augmented	3776	2989	2342	1660	1122	635
C	Augmented	353	248	172	115	64	27
	Non-augmented	637	522	406	289	197	115

Note: Restricted to modern prostheses
Excludes 10,106 procedures with unknown glenoid augmentation or glenoid morphology

Figure ST80 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Reverse Shoulder Replacement by Glenoid Morphology and Glenoid Augmentation (Primary Diagnosis OA)



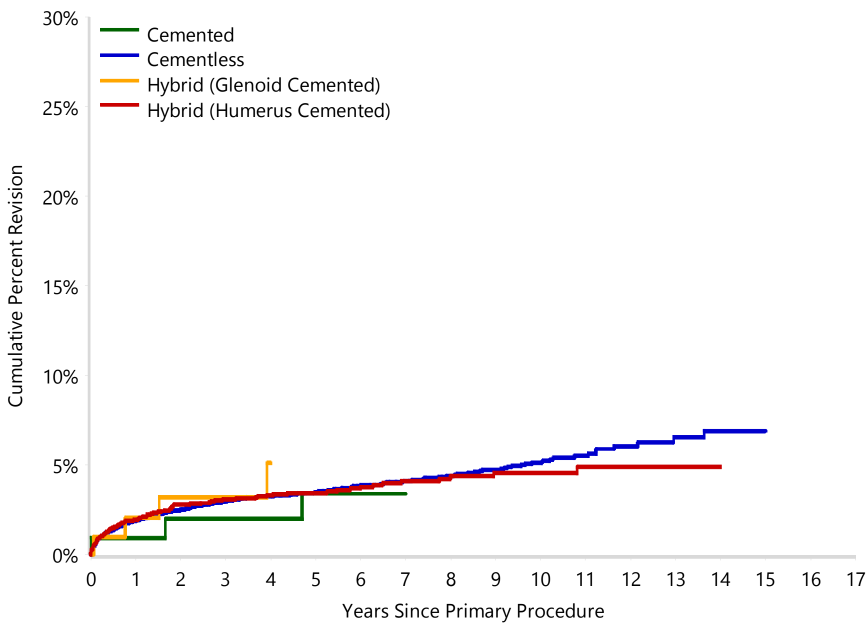
Note: Restricted to modern prostheses

Table ST83 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Fixation (Primary Diagnosis OA)

Fixation	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Cemented	4	108	0.9 (0.1, 6.4)	2.0 (0.5, 7.8)	3.4 (1.1, 10.3)	3.4 (1.1, 10.3)		
Cementless	666	21022	1.9 (1.7, 2.1)	3.0 (2.7, 3.2)	3.5 (3.2, 3.8)	4.1 (3.8, 4.5)	5.1 (4.6, 5.7)	6.9 (5.7, 8.3)
Hybrid (Glenoid Cemented)	5	104	2.0 (0.5, 7.9)	3.2 (1.0, 9.6)				
Hybrid (Humerus Cemented)	93	2667	1.9 (1.5, 2.5)	3.1 (2.5, 3.8)	3.4 (2.8, 4.3)	4.1 (3.3, 5.1)	4.5 (3.6, 5.7)	4.9 (3.8, 6.3)
TOTAL	768	23901						

Note: Restricted to modern prostheses

Figure ST81 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Fixation (Primary Diagnosis OA)



HR - adjusted for age and gender

Cemented vs Cementless
Entire Period: HR=0.84 (0.32, 2.25), p=0.733

Hybrid (Glenoid Cemented) vs Cementless
Entire Period: HR=1.77 (0.74, 4.28), p=0.201

Hybrid (Humerus Cemented) vs Cementless
Entire Period: HR=1.02 (0.82, 1.27), p=0.841

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Cemented	108	98	82	66	45	31	8
Cementless	21022	17387	11823	7273	3850	1229	231
Hybrid (Glenoid Cemented)	104	92	60	34	13	3	0
Hybrid (Humerus Cemented)	2667	2377	1860	1323	855	367	69

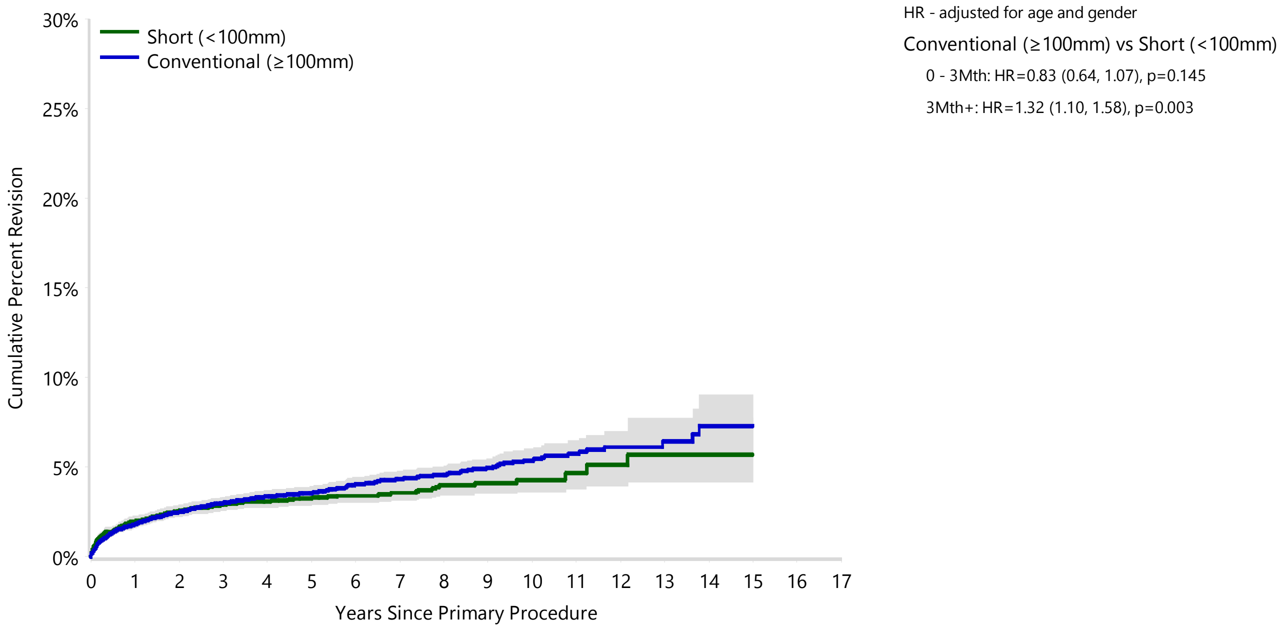
Note: Only fixations with >100 procedures have been listed
Restricted to modern prostheses

Table ST84 **Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Humeral Stem Length (Primary Diagnosis OA)**

Humeral Stem Length	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Short (<100mm)	289	10246	2.0 (1.7, 2.3)	2.9 (2.6, 3.3)	3.3 (2.9, 3.7)	3.6 (3.1, 4.1)	4.3 (3.6, 5.1)	5.7 (4.2, 7.7)
Conventional (≥100mm)	474	13598	1.8 (1.6, 2.1)	3.0 (2.7, 3.3)	3.6 (3.2, 3.9)	4.3 (3.9, 4.8)	5.4 (4.8, 6.0)	7.3 (5.9, 9.0)
TOTAL	763	23844						

Note: Excludes 57 procedures with unknown humeral stem length
Restricted to modern prostheses

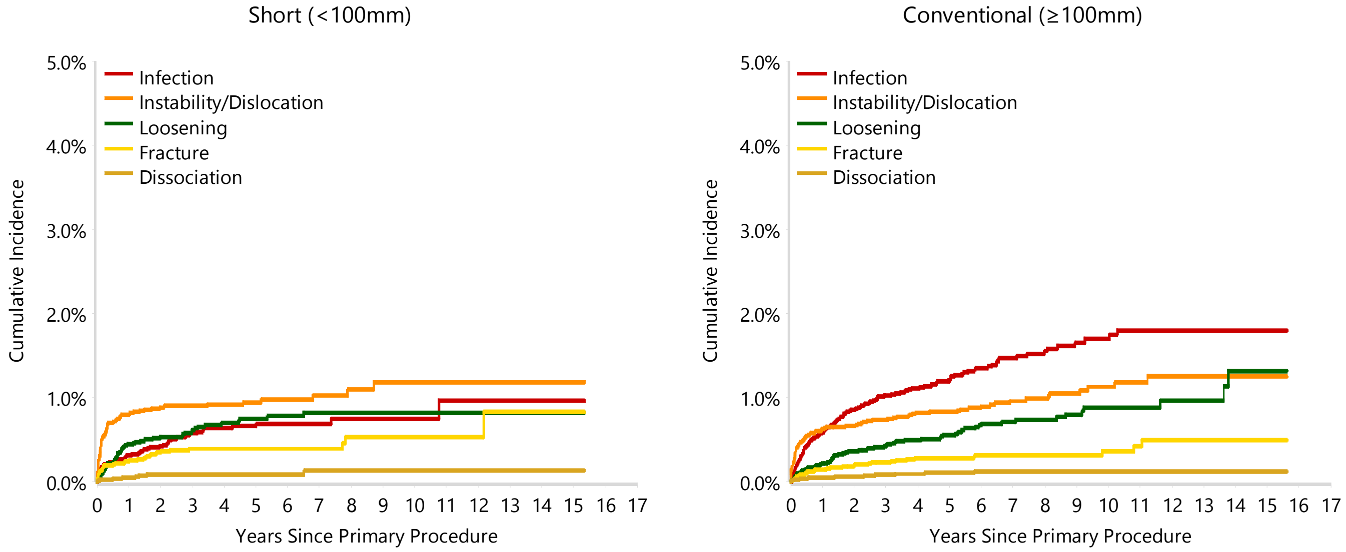
Figure ST82 **Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Humeral Stem Length (Primary Diagnosis OA)**



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Short (<100mm)	10246	8219	5227	2989	1492	407	121
Conventional (≥100mm)	13598	11718	8589	5704	3269	1222	187

Note: Excludes 57 procedures with unknown humeral stem length
Restricted to modern prostheses

Figure ST83 **Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Reverse Shoulder Replacement by Humeral Stem Length (Primary Diagnosis OA)**



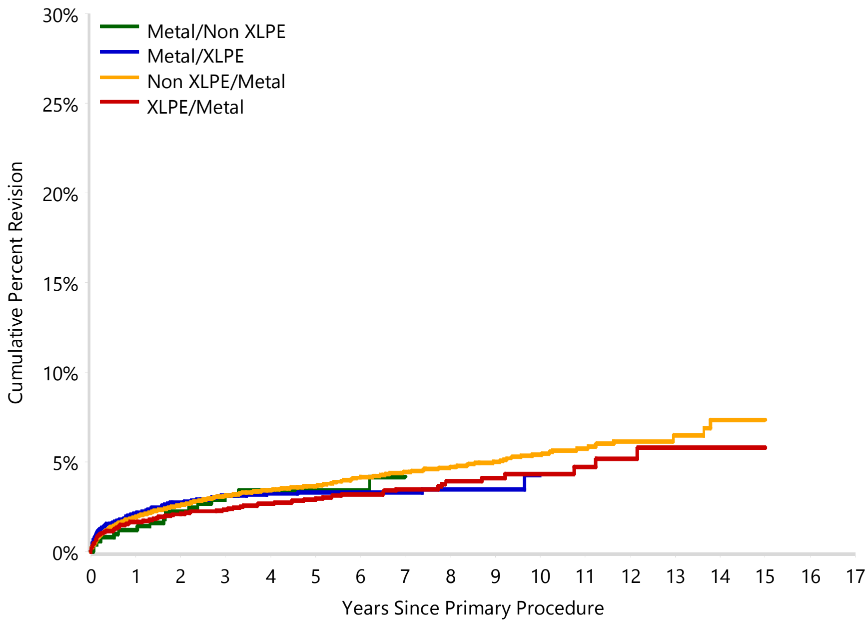
Note: Excludes 57 procedures with unknown humeral stem length
Restricted to modern prostheses

Table ST85 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Bearing Surface (Primary Diagnosis OA)

Bearing Surface	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Ceramic/Non XLPE	0	5	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)				
Ceramic/XLPE	3	62	1.7 (0.2, 11.6)	6.3 (2.1, 18.4)				
Metal/Non XLPE	18	501	1.2 (0.5, 2.7)	3.2 (1.9, 5.2)	3.4 (2.1, 5.5)	4.2 (2.5, 7.1)		
Metal/XLPE	119	4021	2.1 (1.7, 2.6)	3.1 (2.6, 3.8)	3.3 (2.7, 3.9)	3.3 (2.7, 3.9)	4.3 (2.9, 6.3)	
Non XLPE/Metal	505	14475	1.9 (1.7, 2.2)	3.1 (2.8, 3.4)	3.7 (3.3, 4.0)	4.4 (4.0, 4.9)	5.4 (4.8, 6.0)	7.3 (5.9, 9.1)
XLPE/Metal	123	4822	1.6 (1.3, 2.1)	2.3 (1.9, 2.9)	2.9 (2.4, 3.5)	3.5 (2.8, 4.3)	4.3 (3.4, 5.5)	5.8 (4.1, 8.1)
TOTAL	768	23886						

Note: Restricted to modern prostheses. Reported as humeral cup/glenosphere
Excludes 15 procedures with unknown bearing surface

Figure ST84 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Bearing Surface (Primary Diagnosis OA)



HR - adjusted for age and gender

Metal/Non XLPE vs XLPE/Metal
Entire Period: HR=1.25 (0.76, 2.05), p=0.374

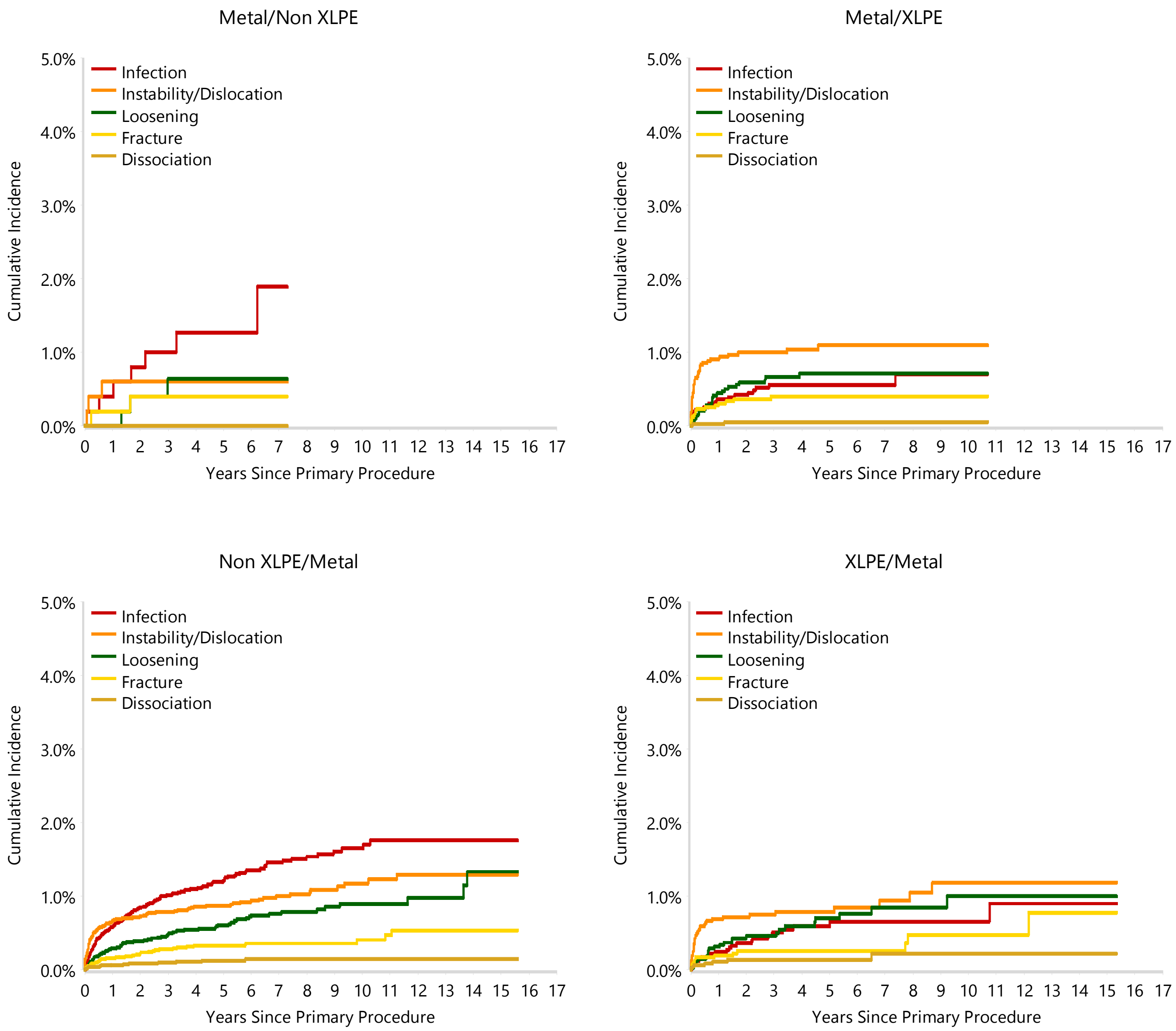
Metal/XLPE vs XLPE/Metal
Entire Period: HR=1.01 (0.78, 1.30), p=0.963

Non XLPE/Metal vs XLPE/Metal
Entire Period: HR=1.21 (0.99, 1.47), p=0.063

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Metal/Non XLPE	501	484	385	214	64	4	0
Metal/XLPE	4021	3469	2364	1384	614	87	4
Non XLPE/Metal	14475	12168	8745	5674	3235	1202	185
XLPE/Metal	4822	3771	2306	1414	844	334	118

Note: Restricted to modern prostheses. Reported as humeral cup/glenosphere.

Figure ST85 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Reverse Shoulder Replacement by Bearing Surface (Primary Diagnosis OA)



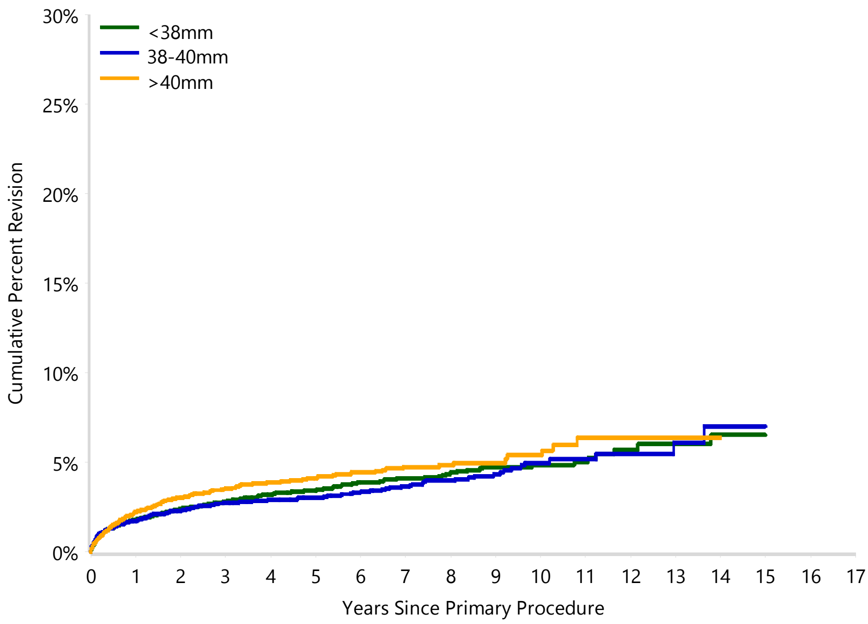
Note: Restricted to modern prostheses

Table ST86 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Glenosphere Size (Primary Diagnosis OA)

Glenosphere Size	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
<38mm	263	8315	1.8 (1.5, 2.1)	2.8 (2.5, 3.2)	3.4 (3.0, 3.9)	4.1 (3.6, 4.7)	4.9 (4.2, 5.6)	6.5 (5.1, 8.3)
38-40mm	268	8959	1.7 (1.5, 2.0)	2.7 (2.4, 3.1)	3.0 (2.7, 3.5)	3.6 (3.2, 4.2)	5.0 (4.2, 5.9)	7.0 (4.9, 9.9)
>40mm	207	5525	2.2 (1.9, 2.7)	3.5 (3.0, 4.1)	4.1 (3.6, 4.8)	4.7 (4.1, 5.5)	5.4 (4.5, 6.4)	6.4 (5.0, 8.0)
TOTAL	738	22799						

Note: Excludes 1,102 procedures with unknown glenosphere sizes
Restricted to modern prostheses

Figure ST86 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Glenosphere Size (Primary Diagnosis OA)



HR - adjusted for age and gender

<38mm vs 38-40mm
Entire Period: HR=1.10 (0.93, 1.31), p=0.254

>40mm vs 38-40mm
0 - 3Mth: HR=0.62 (0.45, 0.86), p=0.004
3Mth+: HR=0.99 (0.80, 1.23), p=0.927

>40mm vs <38mm
Entire Period: HR=0.78 (0.64, 0.95), p=0.014

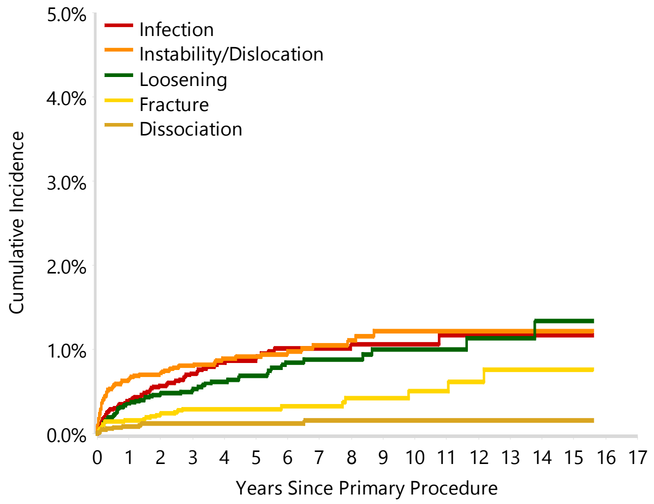
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
<38mm	8315	6886	4786	3096	1789	728	171
38-40mm	8959	7671	5461	3451	1860	552	87
>40mm	5525	4708	3378	2104	1111	349	49

Note: Restricted to modern prostheses

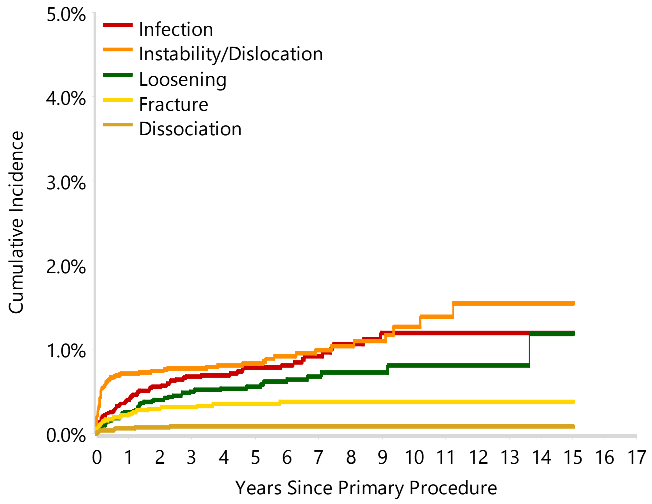
Primary Total Shoulder Replacement

Figure ST87 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Reverse Shoulder Replacement by Glenosphere Size (Primary Diagnosis OA)

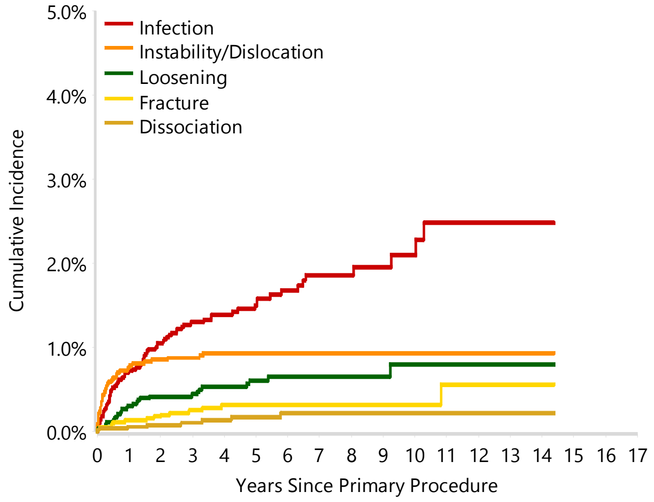
<38mm



38-40mm



>40mm



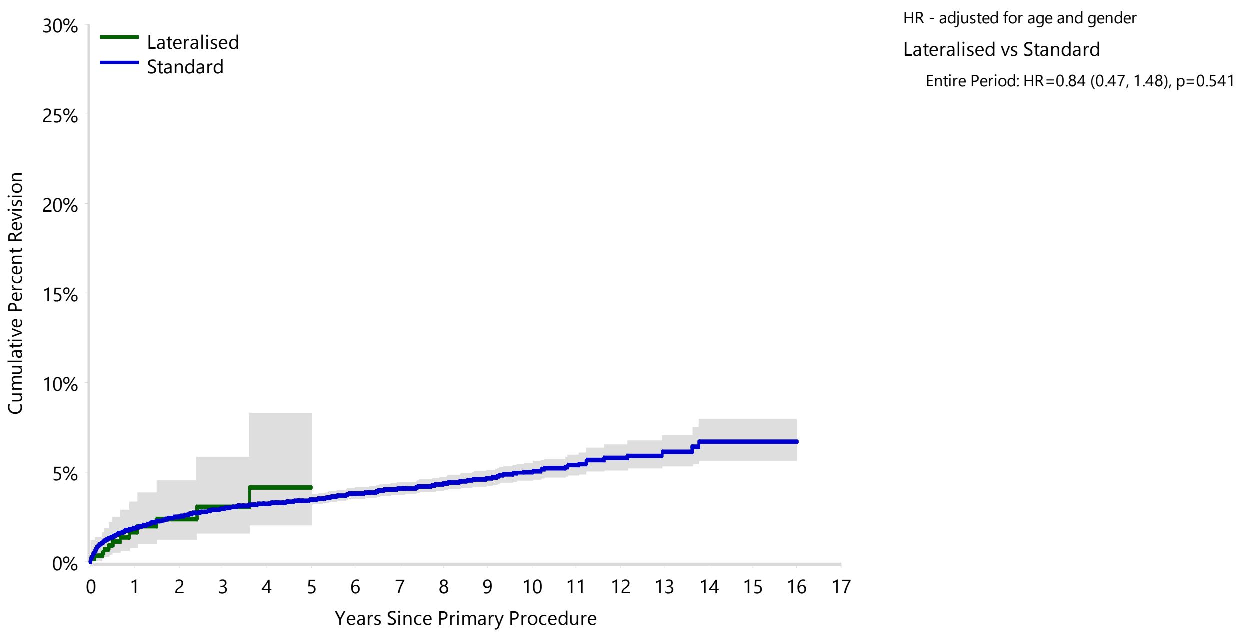
Note: Restricted to modern prostheses

Table ST87 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Glenosphere Lateralisation (Primary Diagnosis OA)

Glenoid Lateralisation	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Lateralised	12	598	1.7 (0.8, 3.4)	3.1 (1.6, 5.8)	4.2 (2.1, 8.3)			
Standard	754	23299	1.9 (1.7, 2.1)	3.0 (2.8, 3.2)	3.5 (3.2, 3.7)	4.1 (3.8, 4.4)	5.0 (4.6, 5.5)	6.7 (5.6, 7.9)
TOTAL	766	23897						

Note: Excludes 4 procedures with unknown lateralisation
Restricted to modern prostheses

Figure ST88 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Glenosphere Lateralisation (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Lateralised	598	321	112	43	12	3	0
Standard	23299	19632	13712	8653	4751	1627	308

Note: Excludes 4 procedures with unknown lateralisation
Restricted to modern prostheses

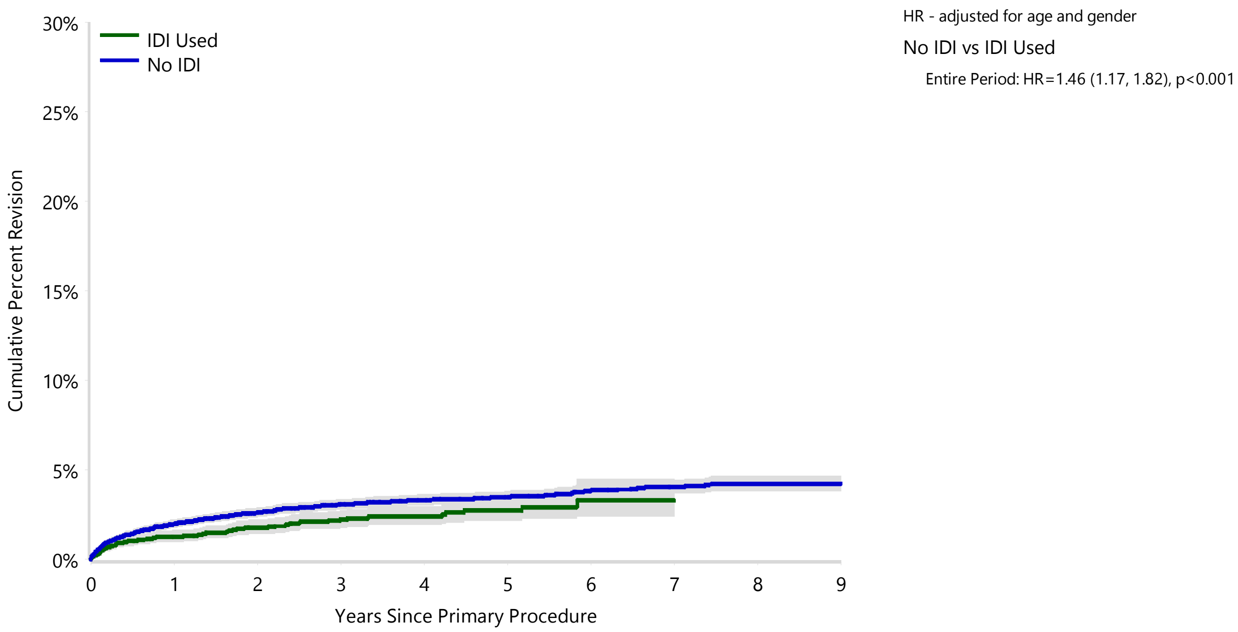
Primary Total Shoulder Replacement

Table ST88 Cumulative Percent Revision of Primary Total Stemmed Reverse Replacement Since 2014 by IDI Usage (Primary Diagnosis OA)

IDI Use	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	8 Yrs	9 Yrs
IDI Used	97	5266	1.3 (1.0, 1.6)	1.8 (1.4, 2.2)	2.2 (1.8, 2.7)	2.7 (2.2, 3.5)	3.3 (2.4, 4.5)		
No IDI	495	15805	2.0 (1.8, 2.2)	2.6 (2.4, 2.9)	3.1 (2.8, 3.4)	3.5 (3.2, 3.8)	4.1 (3.7, 4.5)	4.2 (3.8, 4.7)	4.2 (3.8, 4.7)
TOTAL	592	21071							

Note: Restricted to modern prostheses

Figure ST89 Cumulative Percent Revision of Primary Total Stemmed Reverse Replacement Since 2014 by IDI Usage (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	8 Yrs	9 Yrs
IDI Used	5266	3857	2744	1796	558	44	20	6
No IDI	15805	13381	11515	9466	5794	2647	1438	644

Note: Restricted to modern prostheses

Table ST89 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Prosthesis Combination (Primary Diagnosis OA)

Humeral Stem	Glenoid Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Aequalis	Aequalis	74	1551	2.0 (1.4, 2.8)	3.3 (2.5, 4.3)	3.9 (3.0, 5.0)	5.2 (4.1, 6.6)	6.0 (4.7, 7.7)	
	Perform Reversed	1	107	0.0 (0.0, 0.0)					
Affinis	Affinis	27	792	1.4 (0.8, 2.5)	3.4 (2.3, 5.0)	3.6 (2.4, 5.3)	4.3 (2.7, 6.8)		
AltiVate	RSP	1	34	2.9 (0.4, 19.1)					
AltiVate Reverse	RSP	10	811	1.1 (0.6, 2.2)	1.6 (0.8, 3.0)				
Ascend Flex	Aequalis	56	1684	2.2 (1.6, 3.1)	3.9 (2.9, 5.1)	4.4 (3.3, 5.8)	4.4 (3.3, 5.8)		
	Perform Reversed	12	551	2.7 (1.5, 5.0)	3.2 (1.8, 5.7)				
Comprehensive	Comprehensive Reverse	38	2846	0.9 (0.6, 1.4)	1.5 (1.0, 2.0)	1.8 (1.3, 2.6)	1.8 (1.3, 2.6)		
	Custom Made (Comprehensive)	2	44	2.3 (0.3, 15.1)	2.3 (0.3, 15.1)	5.3 (1.3, 20.0)			
	Trabecular Metal	1	30	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	5.9 (0.9, 35.0)			
Delta Xtend	Delta Xtend	182	5087	1.8 (1.5, 2.2)	2.8 (2.4, 3.3)	3.2 (2.8, 3.8)	3.8 (3.2, 4.4)	4.8 (4.1, 5.7)	6.5 (5.0, 8.6)
Equinoxe	Equinoxe	91	2954	1.8 (1.4, 2.4)	3.0 (2.4, 3.8)	3.8 (3.0, 4.8)	6.4 (4.7, 8.8)		
Global Unite	Delta Xtend	12	473	0.9 (0.3, 2.5)	3.0 (1.6, 5.3)	3.0 (1.6, 5.3)	3.7 (2.0, 6.9)		
MSS	MSS	1	122	0.0 (0.0, 0.0)					
RSP	RSP	28	768	2.4 (1.5, 3.8)	3.4 (2.3, 5.0)	3.9 (2.7, 5.7)			
SMR	Custom Made (Lima)	4	41	7.4 (2.4, 21.2)	7.4 (2.4, 21.2)				
	SMR	1	82	1.4 (0.2, 9.5)					
	SMR Axioma	5	109	1.9 (0.5, 7.2)	5.4 (2.3, 12.7)				
	SMR L1	176	4801	2.5 (2.1, 3.0)	3.4 (2.9, 4.0)	3.6 (3.1, 4.3)	4.0 (3.5, 4.7)	4.8 (4.0, 5.7)	6.2 (4.6, 8.3)
Trabecular Metal	Comprehensive Reverse	3	163	1.3 (0.3, 5.1)	2.6 (0.8, 8.4)				
	Trabecular Metal	33	785	1.7 (1.0, 2.9)	3.3 (2.2, 4.9)	4.4 (3.1, 6.3)	4.7 (3.3, 6.6)	5.2 (3.6, 7.4)	
Verso	Verso	5	30	21.3 (9.1, 45.0)	21.3 (9.1, 45.0)				
Other (19)		5	36	14.3 (6.2, 31.1)	14.3 (6.2, 31.1)	14.3 (6.2, 31.1)			
TOTAL		768	23901						

Note: Restricted to modern prostheses
Only prostheses with >25 procedures have been listed

Primary Total Shoulder Replacement

Table ST90 Cumulative Percent Revision of Cementless Primary Total Stemmed Reverse Shoulder Replacement by Prosthesis Combination (Primary Diagnosis OA)

Humeral Stem	Glenoid Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Aequalis	Aequalis	62	1173	2.0 (1.3, 3.0)	3.6 (2.7, 4.9)	4.2 (3.1, 5.5)	5.7 (4.4, 7.4)	6.6 (5.0, 8.7)	
	Perform Reversed	0	91	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)				
Affinis	Affinis	19	493	1.3 (0.6, 2.8)	3.8 (2.3, 6.1)	4.1 (2.6, 6.6)	5.1 (3.0, 8.8)		
AltiVate	RSP	1	33	3.0 (0.4, 19.6)					
AltiVate Reverse	RSP	8	738	1.1 (0.5, 2.3)	1.3 (0.6, 2.6)				
Ascend Flex	Aequalis	52	1507	2.2 (1.5, 3.1)	4.0 (3.0, 5.4)	4.6 (3.4, 6.1)	4.6 (3.4, 6.1)		
	Perform Reversed	11	491	2.7 (1.4, 5.0)	3.2 (1.7, 5.9)				
Comprehensive	Comprehensive Reverse	36	2731	1.0 (0.7, 1.4)	1.5 (1.1, 2.1)	1.8 (1.2, 2.5)	1.8 (1.2, 2.5)		
	Custom Made (Comprehensive)	2	43	2.3 (0.3, 15.4)	2.3 (0.3, 15.4)	5.5 (1.4, 20.5)			
	Trabecular Metal	1	28	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	6.3 (0.9, 36.8)			
Delta Xtend	Delta Xtend	143	3856	2.0 (1.6, 2.5)	3.0 (2.5, 3.6)	3.5 (2.9, 4.1)	3.9 (3.3, 4.7)	5.4 (4.4, 6.6)	8.1 (5.5, 11.7)
Equinoxe	Equinoxe	84	2812	1.8 (1.3, 2.4)	2.9 (2.3, 3.7)	3.7 (2.9, 4.8)	6.3 (4.5, 8.6)		
Global Unite	Delta Xtend	9	411	0.8 (0.3, 2.4)	2.5 (1.2, 5.0)	2.5 (1.2, 5.0)	3.3 (1.6, 6.8)		
MSS	MSS	1	121	0.0 (0.0, 0.0)					
RSP	RSP	23	662	2.5 (1.5, 4.0)	3.1 (2.0, 4.8)	3.8 (2.5, 5.6)			
SMR	Custom Made (Lima)	4	40	7.6 (2.5, 21.7)	7.6 (2.5, 21.7)	17.8 (5.4, 50.0)			
	SMR	1	81	1.4 (0.2, 9.6)					
	SMR Axioma	4	107	1.9 (0.5, 7.3)	4.4 (1.7, 11.6)				
	SMR L1	168	4683	2.4 (2.0, 2.9)	3.3 (2.8, 3.9)	3.5 (3.0, 4.2)	3.9 (3.4, 4.6)	4.7 (3.9, 5.7)	6.2 (4.5, 8.4)
Trabecular Metal	Comprehensive Reverse	2	151	0.7 (0.1, 4.7)	2.0 (0.5, 8.5)				
	Trabecular Metal	28	714	1.7 (1.0, 3.0)	3.2 (2.1, 4.8)	4.2 (2.9, 6.1)	4.4 (3.0, 6.4)	5.0 (3.3, 7.3)	
Verso	Verso	5	28	22.5 (9.8, 46.8)	22.5 (9.8, 46.8)				
Other (17)		2	28	7.1 (1.8, 25.7)	7.1 (1.8, 25.7)	7.1 (1.8, 25.7)			
TOTAL		666	21022						

Note Restricted to modern prostheses
Only prostheses with >25 procedures have been listed

Table ST91 **Cumulative Percent Revision of Hybrid (Humerus Cemented) Primary Total Stemmed Reverse Shoulder Replacement by Prosthesis Combination (Primary Diagnosis OA)**

Humeral Stem	Glenoid Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Aequalis	Aequalis	12	354	2.0 (1.0, 4.2)	2.4 (1.2, 4.7)	3.2 (1.7, 5.9)	3.7 (2.0, 6.7)	4.6 (2.5, 8.3)	
Affinis	Affinis	7	278	1.8 (0.8, 4.3)	2.7 (1.3, 5.5)	2.7 (1.3, 5.5)			
AltiVate Reverse	RSP	2	67	1.5 (0.2, 10.1)	4.2 (1.0, 16.5)				
Ascend Flex	Aequalis	4	162	2.6 (1.0, 6.9)	2.6 (1.0, 6.9)				
	Perform Reversed	1	56	3.2 (0.5, 20.8)	3.2 (0.5, 20.8)				
Comprehensive	Comprehensive Reverse	1	107	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)				
Delta Xtend	Delta Xtend	38	1169	1.5 (1.0, 2.4)	2.4 (1.7, 3.5)	2.6 (1.8, 3.7)	3.4 (2.4, 4.7)	3.8 (2.7, 5.3)	4.3 (3.0, 6.2)
Equinoxe	Equinoxe	6	130	2.5 (0.8, 7.5)	5.0 (2.1, 11.9)				
Global Unite	Delta Xtend	3	59	1.9 (0.3, 12.4)	6.3 (2.1, 18.4)	6.3 (2.1, 18.4)			
RSP	RSP	5	100	2.0 (0.5, 7.8)	5.4 (2.3, 12.5)	5.4 (2.3, 12.5)			
SMR	SMR L1	5	81	3.7 (1.2, 11.1)	6.5 (2.7, 14.9)	6.5 (2.7, 14.9)	6.5 (2.7, 14.9)	6.5 (2.7, 14.9)	
Trabecular Metal	Trabecular Metal	4	61	1.6 (0.2, 11.1)	6.0 (1.9, 17.7)	8.6 (3.3, 21.7)	8.6 (3.3, 21.7)	8.6 (3.3, 21.7)	
Other (12)		5	43	10.2 (3.9, 25.0)	13.6 (5.8, 30.1)				
TOTAL		93	2667						

Note Restricted to modern prostheses
Only prostheses with >25 procedures have been listed

Primary Total Shoulder Replacement

OUTCOME FOR ROTATOR CUFF ARTHROPATHY – PATIENT CHARACTERISTICS

There are 20,545 primary total stemmed reverse shoulder replacement procedures with a primary diagnosis of rotator cuff arthropathy.

The cumulative percent revision of primary total stemmed reverse shoulder replacement for rotator cuff arthropathy at 14 years is 6.1% (Table ST92). The rate of revision of total stemmed reverse replacements decreased in 2015-2023 compared to pre-2015 (Table ST93 and Figure ST90).

The most common reasons for revision are instability/dislocation (29.0%), infection (24.5%), and loosening (16.0%) (Table ST94 and Figure ST91). The most common types of revision are of the humeral component (21.6%), cup/head (20%) and cup only (15.7%) (Table ST95). Primary stemmed reverse replacements undertaken for rotator cuff arthropathy are predominately revised to another total stemmed reverse replacement (85.8%).

Age and Gender

For the diagnosis of rotator cuff arthropathy, patients aged 55–64 years have a higher rate of revision compared to patients ≥75 years after 3 months with no difference prior to this time (Table ST96 and Figure ST92). Males have a higher rate of revision compared to females (Table ST97 and Figure ST93). The increase in the rate of revision is due to a higher cumulative incidence of infection and instability/dislocation (Figure ST94).

There is no difference in the rate of revision between age categories for males, but females aged <55 years have a higher revision rate compared to females aged 65-74 years (Table ST97, Figure ST95 and Figure ST96).

The rate of instability/dislocation increases with increasing BMI category.

ASA and BMI

There is no difference in the rate of revision when patients with an ASA score of 2 are compared to patients with an ASA score of 1. Patients with an ASA score of 4 have a higher rate of revision than those with an ASA score of 1 (Table ST98 and Figure ST97). The most common reasons for revision for the different ASA scores are presented in Figure ST98. When stratified by gender males have a higher rate of revision compared to females (Table ST99 and Figure ST99).

BMI category is not a risk factor for revision (Table ST100 and Figure ST100). The most common reasons for revision for the different BMI categories are shown in Figure ST101. Obese and non-obese males have a higher rate of revision compared to females in the same BMI categories. Obese males have a higher rate of revision compared to non-obese males (Table ST101 and Figure ST102).

Glenoid Morphology

The cumulative percent revision for the different morphology categories is presented in Table ST102. The category of glenoid morphology is not a risk factor for revision (Figure ST103).

Table ST92 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement (Primary Diagnosis Rotator Cuff Arthropathy)

Shoulder Class	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Total Stemmed Reverse	744	20545	2.3 (2.1, 2.5)	3.6 (3.3, 3.8)	4.2 (3.9, 4.5)	4.6 (4.3, 5.0)	5.4 (4.9, 6.0)	6.1 (5.4, 7.0)
TOTAL	744	20545						

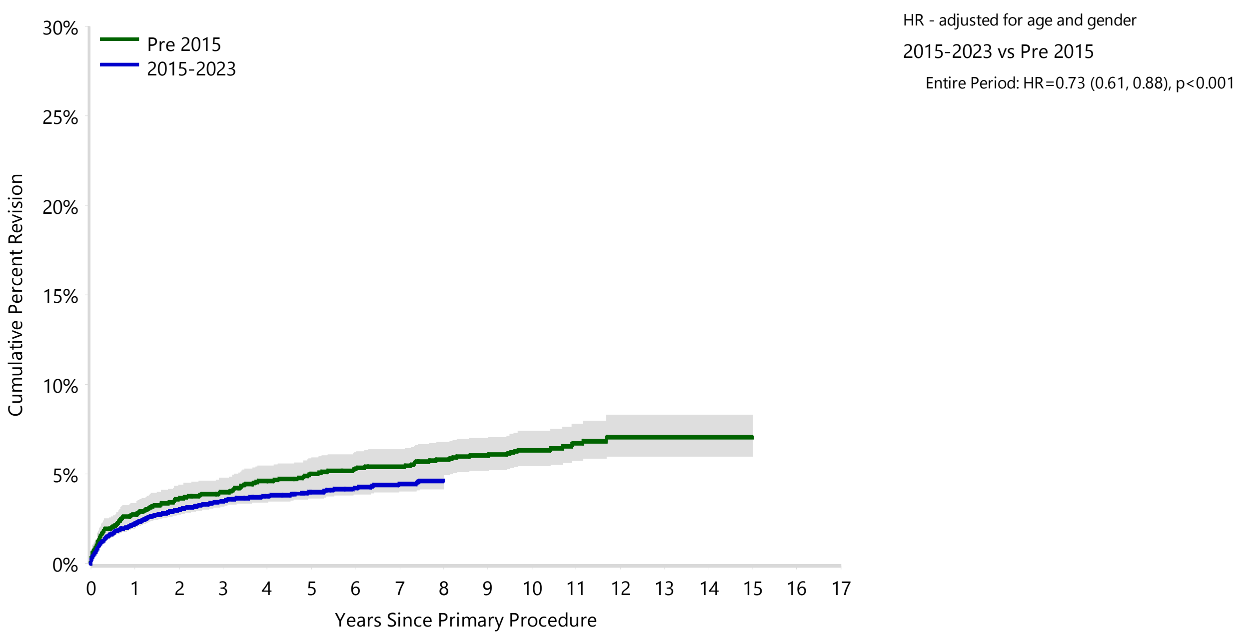
Note: Restricted to modern prostheses

Table ST93 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Procedure Year (Primary Diagnosis Rotator Cuff Arthropathy)

Procedure Year	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Pre 2015	168	2811	2.7 (2.2, 3.4)	4.0 (3.3, 4.8)	5.0 (4.2, 5.9)	5.4 (4.6, 6.4)	6.3 (5.5, 7.4)	7.0 (6.0, 8.3)
2015-2023	576	17734	2.2 (2.0, 2.5)	3.5 (3.2, 3.8)	4.0 (3.7, 4.4)	4.4 (4.0, 4.9)		
TOTAL	744	20545						

Note: Restricted to modern prostheses

Figure ST90 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Procedure Year (Primary Diagnosis Rotator Cuff Arthropathy)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Pre 2015	2811	2693	2512	2276	2029	1160	145
2015-2023	17734	14147	8736	4518	1489	0	0

Note: Restricted to modern prostheses

Primary Total Shoulder Replacement

Table ST94 Primary Total Stemmed Reverse Shoulder Replacement by Reason for Revision (Primary Diagnosis Rotator Cuff Arthropathy)

Reason for Revision	Number	Percent
Instability/Dislocation	216	29.0
Infection	182	24.5
Loosening	119	16.0
Fracture	87	11.7
Dissociation	32	4.3
Pain	22	3.0
Malposition	11	1.5
Incorrect Sizing	11	1.5
Lysis	8	1.1
Implant Breakage Glenoid	8	1.1
Metal Related Pathology	7	0.9
Rotator Cuff Insufficiency	4	0.5
Arthrofibrosis	4	0.5
Implant Breakage Humeral	3	0.4
Wear Humeral Cup	2	0.3
Implant Breakage Glenoid Insert	1	0.1
Glenoid Erosion	1	0.1
Heterotopic Bone	1	0.1
Other	25	3.4
TOTAL	744	100.0

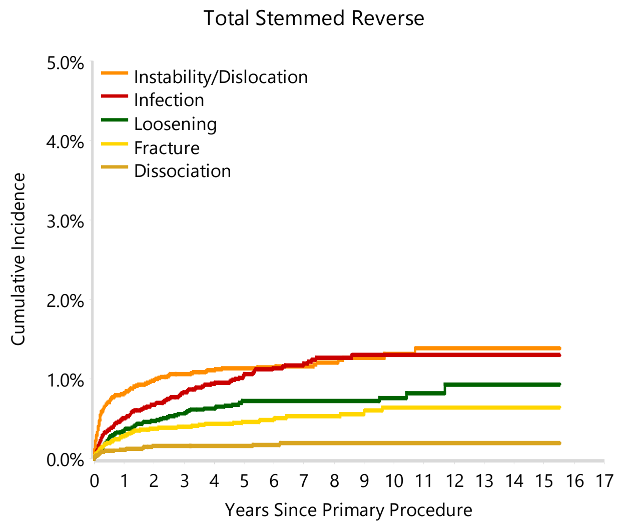
Note: Restricted to modern prostheses

Table ST95 Primary Total Stemmed Reverse Shoulder Replacement by Type of Revision (Primary Diagnosis Rotator Cuff Arthropathy)

Type of Revision	Number	Percent
Humeral Component	161	21.6
Cup/Head	149	20.0
Cup Only	117	15.7
Humeral/Glenoid	77	10.3
Glenoid Component	73	9.8
Humeral Head Only	72	9.7
Cement Spacer	57	7.7
Removal of Prostheses	13	1.7
Glenosphere Only	10	1.3
Reoperation	5	0.7
Cement Only	4	0.5
Minor Components	3	0.4
Reinsertion of Components	2	0.3
Head/Insert	1	0.1
TOTAL	744	100.0

Note: Restricted to modern prostheses

Figure ST91 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Reverse Shoulder Replacement (Primary Diagnosis Rotator Cuff Arthropathy)



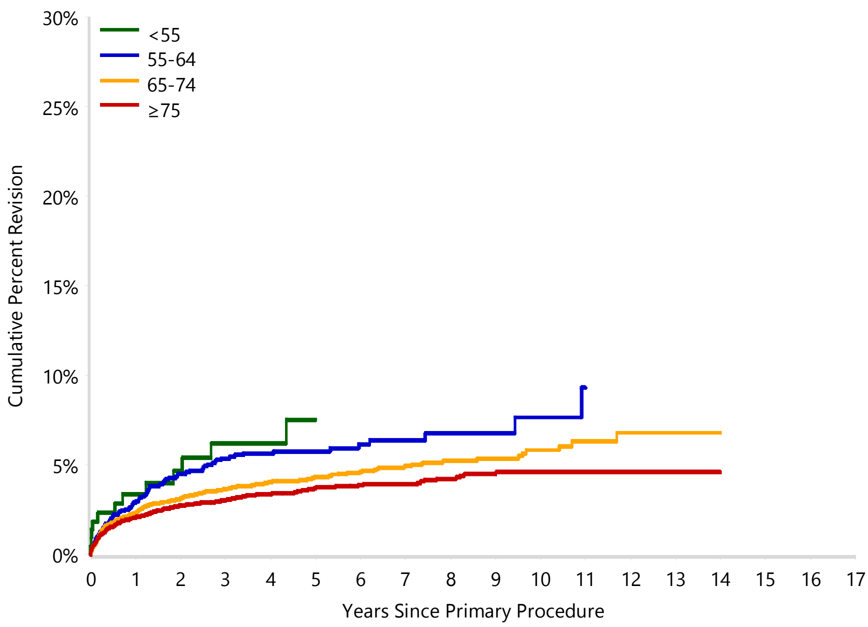
Note: Restricted to modern prostheses

Table ST96 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Age (Primary Diagnosis Rotator Cuff Arthropathy)

Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
<55	13	216	3.4 (1.6, 7.0)	6.2 (3.4, 11.1)	7.5 (4.2, 13.4)			
55-64	106	2190	3.0 (2.3, 3.8)	5.4 (4.4, 6.5)	5.8 (4.7, 7.0)	6.4 (5.2, 7.9)	7.7 (5.7, 10.3)	
65-74	312	8204	2.3 (2.0, 2.7)	3.7 (3.2, 4.1)	4.3 (3.8, 4.9)	4.9 (4.4, 5.6)	5.8 (5.0, 6.8)	6.8 (5.5, 8.4)
≥75	313	9935	2.1 (1.8, 2.4)	3.0 (2.7, 3.4)	3.7 (3.3, 4.2)	3.9 (3.5, 4.4)	4.6 (4.0, 5.3)	4.6 (4.0, 5.3)
TOTAL	744	20545						

Note: Restricted to modern prostheses

Figure ST92 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Age (Primary Diagnosis Rotator Cuff Arthropathy)



HR - adjusted for gender

<55 vs ≥75

Entire Period: HR=1.73 (0.99, 3.01), p=0.053

55-64 vs ≥75

0 - 3Mth: HR=1.02 (0.69, 1.52), p=0.903

3Mth+: HR=1.69 (1.30, 2.19), p<0.001

65-74 vs ≥75

Entire Period: HR=1.14 (0.97, 1.33), p=0.109

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
<55	216	165	105	58	25	8	1
55-64	2190	1689	1037	616	280	87	18
65-74	8204	6796	4560	2728	1451	509	67
≥75	9935	8190	5546	3392	1762	556	59

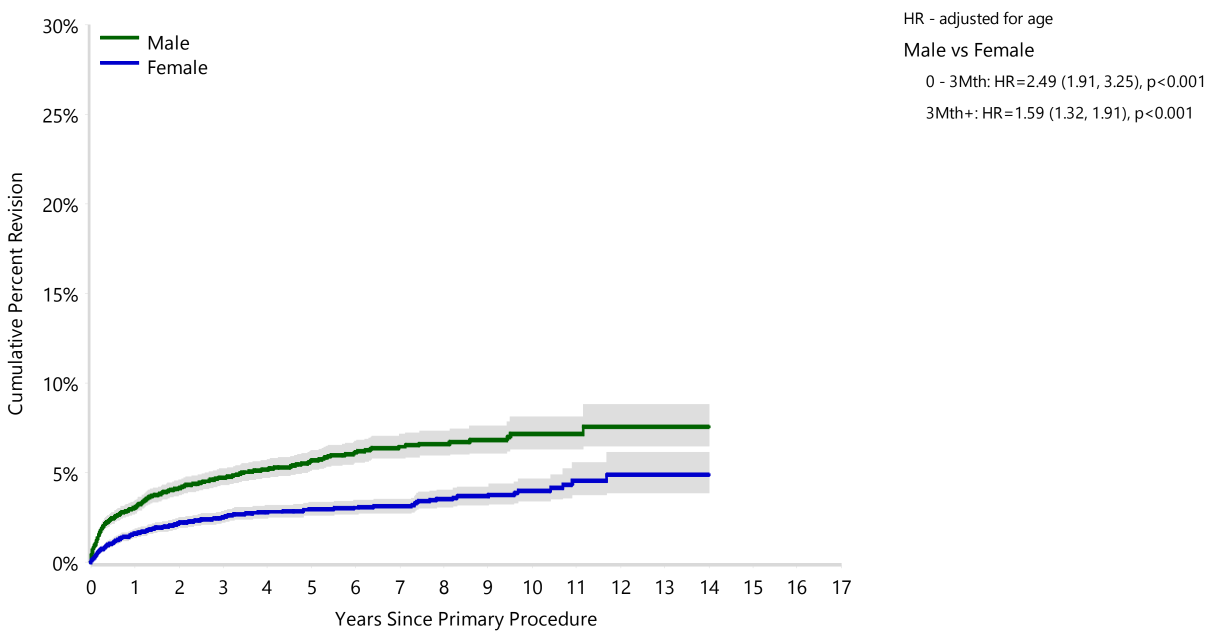
Note: Restricted to modern prostheses

Table ST97 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Gender and Age (Primary Diagnosis Rotator Cuff Arthropathy)

Gender	Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Male		459	9606	3.1 (2.7, 3.4)	4.7 (4.3, 5.2)	5.7 (5.2, 6.2)	6.5 (5.8, 7.1)	7.2 (6.3, 8.1)	7.6 (6.5, 8.8)
	<55	9	148	2.8 (1.1, 7.3)	6.9 (3.4, 13.5)				
	55-64	80	1371	3.3 (2.4, 4.4)	6.4 (5.1, 8.1)	7.1 (5.7, 8.9)	7.8 (6.1, 9.9)	10.0 (6.9, 14.3)	
	65-74	213	4072	3.4 (2.9, 4.0)	5.1 (4.4, 5.9)	6.0 (5.2, 7.0)	7.1 (6.1, 8.2)	7.8 (6.6, 9.3)	
	≥75	157	4015	2.7 (2.2, 3.3)	3.8 (3.2, 4.5)	4.8 (4.1, 5.7)	5.3 (4.4, 6.2)	5.5 (4.6, 6.6)	
Female		285	10939	1.6 (1.4, 1.9)	2.5 (2.2, 2.9)	3.0 (2.6, 3.3)	3.1 (2.8, 3.5)	4.0 (3.4, 4.7)	4.9 (3.9, 6.1)
	<55	4	68	4.6 (1.5, 13.8)	4.6 (1.5, 13.8)	8.8 (3.0, 24.4)	8.8 (3.0, 24.4)		
	55-64	26	819	2.4 (1.5, 3.8)	3.6 (2.4, 5.3)	3.6 (2.4, 5.3)	4.1 (2.7, 6.3)	4.1 (2.7, 6.3)	
	65-74	99	4132	1.3 (1.0, 1.7)	2.3 (1.8, 2.8)	2.7 (2.1, 3.3)	2.9 (2.3, 3.6)	3.9 (2.9, 5.2)	
	≥75	156	5920	1.7 (1.4, 2.1)	2.5 (2.1, 3.0)	3.0 (2.6, 3.6)	3.1 (2.6, 3.6)	4.0 (3.2, 4.8)	4.0 (3.2, 4.8)
TOTAL		744	20545						

Note: Restricted to modern prostheses

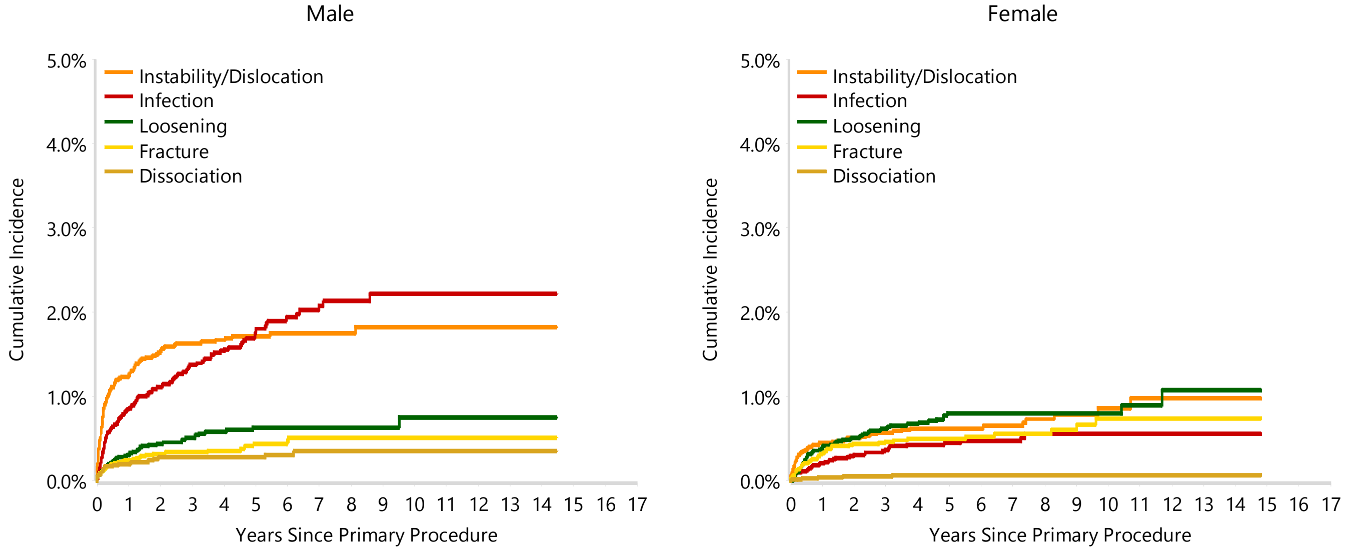
Figure ST93 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Gender (Primary Diagnosis Rotator Cuff Arthropathy)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Male	9606	7742	4949	2871	1394	421	50
Female	10939	9098	6299	3923	2124	739	95

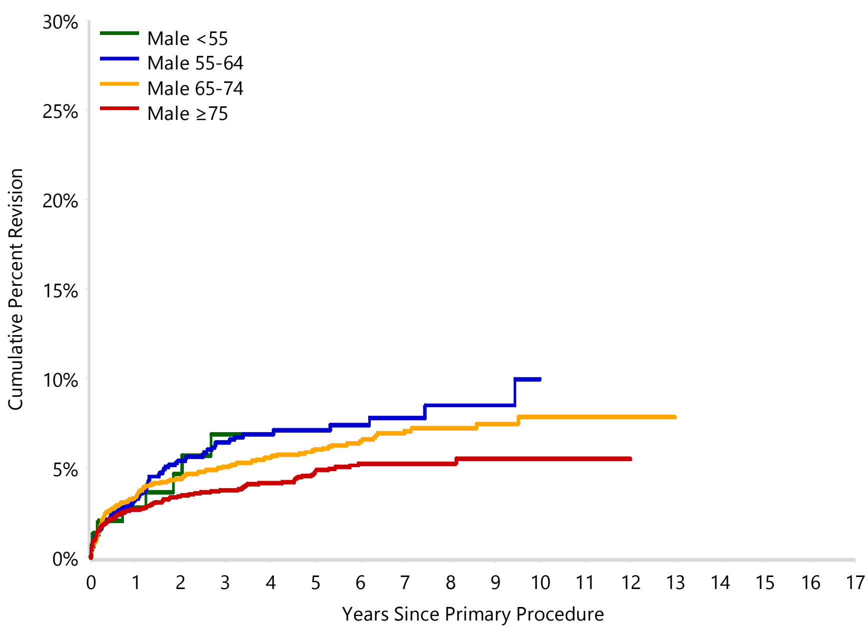
Note: Restricted to modern prostheses

Figure ST94 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Reverse Shoulder Replacement by Gender (Primary Diagnosis Rotator Cuff Arthropathy)



Note: Restricted to modern prostheses

Figure ST95 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement in Males by Age (Primary Diagnosis Rotator Cuff Arthropathy)



Male 55-64 vs Male <55
Entire Period: HR=0.97 (0.49, 1.94), p=0.940

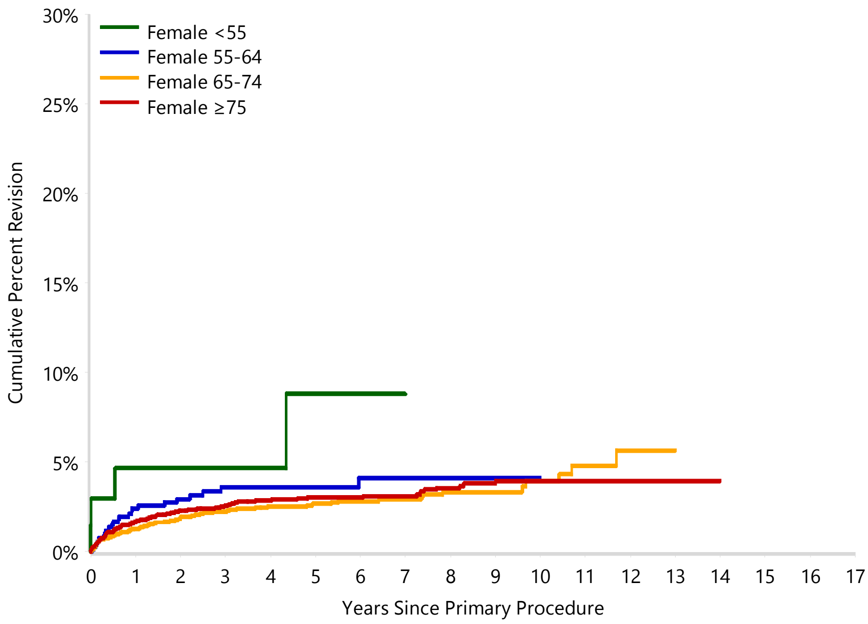
Male 65-74 vs Male <55
Entire Period: HR=0.83 (0.42, 1.61), p=0.572

Male ≥75 vs Male <55
Entire Period: HR=0.62 (0.32, 1.22), p=0.168

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Male	**<55**	148	115	71	38	14	4	1
	55-64	1371	1058	623	362	158	43	6
	65-74	4072	3315	2174	1271	634	211	29
	≥75	4015	3254	2081	1200	588	163	14

Note: Restricted to modern prostheses

Figure ST96 **Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement in Females by Age (Primary Diagnosis Rotator Cuff Arthropathy)**



Female 55-64 vs Female <55
Entire Period: HR=0.51 (0.18, 1.45), p=0.204

Female 65-74 vs Female <55
Entire Period: HR=0.35 (0.13, 0.96), p=0.041

Female ≥75 vs Female <55
Entire Period: HR=0.39 (0.14, 1.05), p=0.062

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Female	**<55**	68	50	34	20	11	4	0
	55-64	819	631	414	254	122	44	12
	65-74	4132	3481	2386	1457	817	298	38
	≥75	5920	4936	3465	2192	1174	393	45

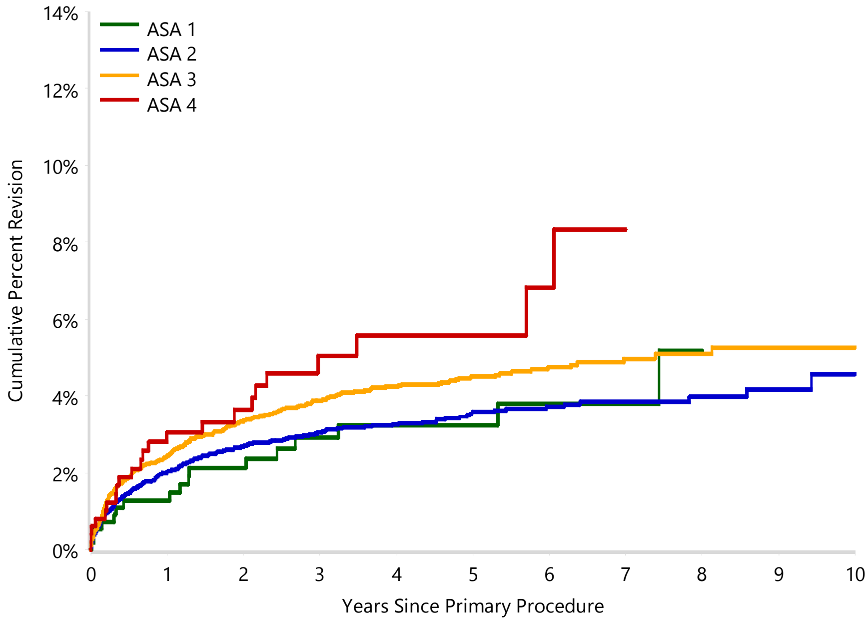
Note: Restricted to modern prostheses

Table ST98 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by ASA Score (Primary Diagnosis Rotator Cuff Arthropathy)

ASA Score	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	8 Yrs
ASA 1	17	556	1.3 (0.6, 2.7)	2.1 (1.2, 3.8)	2.9 (1.7, 4.9)	3.2 (1.9, 5.4)	3.2 (1.9, 5.4)	5.2 (2.7, 9.8)
ASA 2	232	7733	2.0 (1.7, 2.4)	2.7 (2.3, 3.1)	3.0 (2.7, 3.5)	3.3 (2.9, 3.7)	3.6 (3.1, 4.1)	4.0 (3.4, 4.6)
ASA 3	362	9969	2.4 (2.1, 2.8)	3.4 (3.0, 3.8)	3.9 (3.5, 4.3)	4.2 (3.8, 4.7)	4.5 (4.0, 5.0)	5.1 (4.5, 5.8)
ASA 4	23	497	3.1 (1.8, 5.1)	3.6 (2.2, 5.9)	5.0 (3.2, 7.8)	5.6 (3.6, 8.6)	5.6 (3.6, 8.6)	
ASA 5	0	1						
TOTAL	634	18756						

Note: Restricted to modern prostheses

Figure ST97 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by ASA Score (Primary Diagnosis Rotator Cuff Arthropathy)



HR - adjusted for age and gender

ASA 2 vs ASA 1

Entire Period: HR=1.18 (0.72, 1.93), p=0.511

ASA 3 vs ASA 1

Entire Period: HR=1.58 (0.97, 2.58), p=0.066

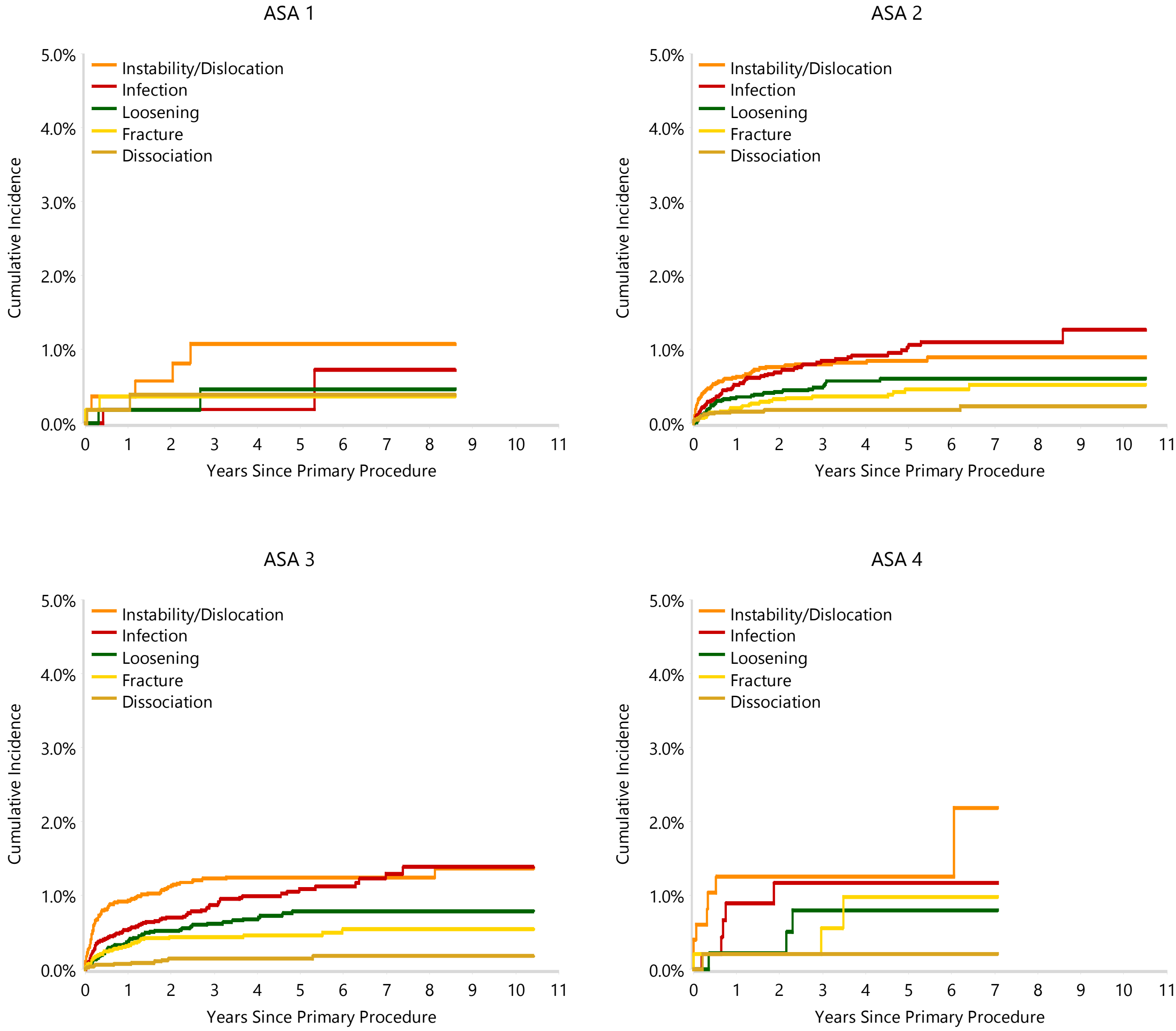
ASA 4 vs ASA 1

Entire Period: HR=2.08 (1.11, 3.90), p=0.022

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	8 Yrs
ASA 1	556	481	409	319	252	200	60
ASA 2	7733	6337	5302	4278	3383	2526	710
ASA 3	9969	7917	6322	4831	3623	2537	567
ASA 4	497	394	312	222	149	95	27

Note: Restricted to modern prostheses

Figure ST98 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Reverse Shoulder Replacement by ASA Score (Primary Diagnosis Rotator Cuff Arthropathy)



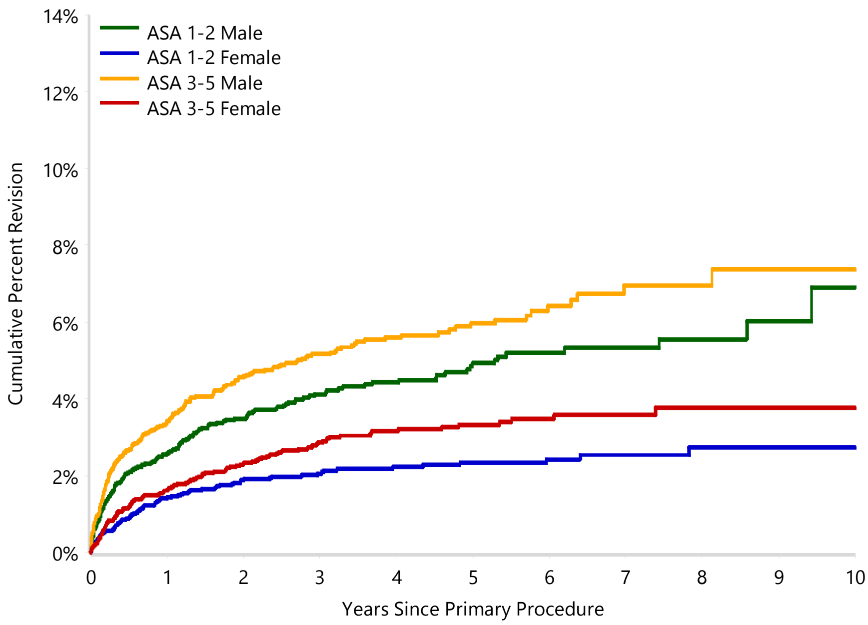
Note: Restricted to modern prostheses

Table ST99 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by ASA Score and Gender (Primary Diagnosis Rotator Cuff Arthropathy

ASA Score	Gender	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	8 Yrs
ASA 1	Male	16	338	1.8 (0.8, 4.0)	3.2 (1.7, 5.9)	4.5 (2.6, 7.7)	5.1 (3.0, 8.5)		
	Female	1	218	0.5 (0.1, 3.2)	0.5 (0.1, 3.2)	0.5 (0.1, 3.2)	0.5 (0.1, 3.2)	0.5 (0.1, 3.2)	
ASA 2	Male	146	3642	2.7 (2.2, 3.2)	3.5 (2.9, 4.2)	4.1 (3.4, 4.8)	4.9 (4.1, 5.8)	5.2 (4.4, 6.3)	5.2 (4.4, 6.3)
	Female	86	4091	1.5 (1.1, 1.9)	2.0 (1.6, 2.5)	2.1 (1.7, 2.7)	2.4 (2.0, 3.0)	2.7 (2.1, 3.3)	2.9 (2.2, 3.7)
ASA 3	Male	228	4672	3.4 (2.9, 4.0)	4.6 (4.0, 5.3)	5.2 (4.5, 6.0)	6.0 (5.2, 6.9)	6.9 (5.9, 8.1)	6.9 (5.9, 8.1)
	Female	134	5297	1.6 (1.3, 2.0)	2.3 (1.9, 2.8)	2.7 (2.3, 3.3)	3.2 (2.7, 3.8)	3.4 (2.8, 4.0)	3.6 (2.9, 4.4)
ASA 4 or 5	Male	11	243	3.7 (1.8, 7.2)	4.3 (2.2, 8.1)	4.3 (2.2, 8.1)	5.4 (2.8, 10.2)		
	Female	12	255	2.5 (1.1, 5.4)	3.0 (1.4, 6.2)	5.8 (3.2, 10.4)	5.8 (3.2, 10.4)		
TOTAL		634	18756						

Note: Restricted to modern prostheses

Figure ST99 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by ASA Score and Gender (Primary Diagnosis Rotator Cuff Arthropathy)



HR - adjusted for age

ASA 1-2 Male vs ASA 1-2 Female
Entire Period: HR=1.96 (1.51, 2.55), p<0.001

ASA 1-2 Male vs ASA 3-5 Male
Entire Period: HR=0.75 (0.61, 0.91), p=0.004

ASA 1-2 Female vs ASA 3-5 Female
Entire Period: HR=0.70 (0.53, 0.91), p=0.007

ASA 3-5 Male vs ASA 3-5 Female
0 - 3Mth: HR=2.21 (1.57, 3.10), p<0.001
3Mth+: HR=1.65 (1.30, 2.11), p<0.001

Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	8 Yrs
ASA 1-2	Male	3980	3222	2672	2096	1199	515	306
	Female	4309	3596	3039	2501	1527	702	464
ASA 3-5	Male	4915	3852	3019	2248	1138	420	243
	Female	5552	4460	3616	2806	1495	635	351

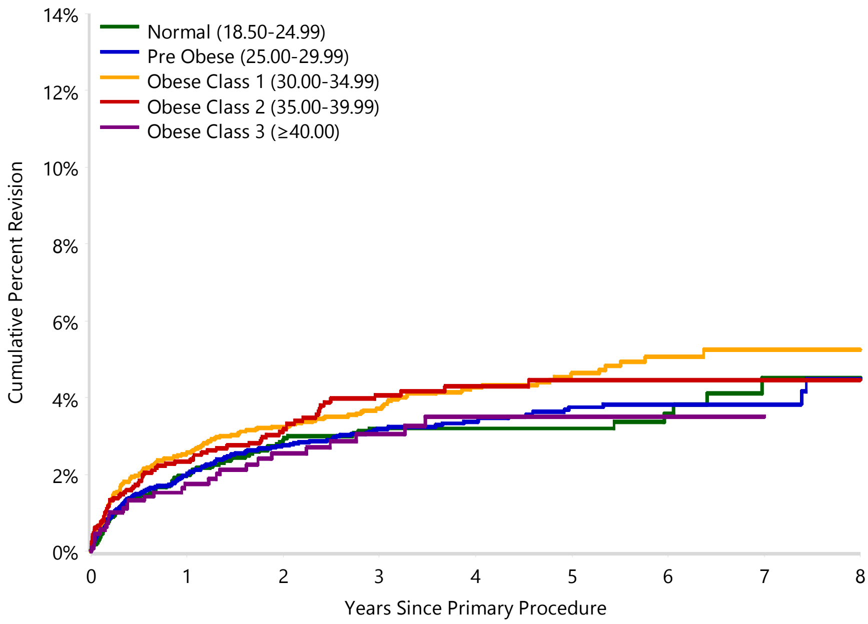
Note: Restricted to modern prostheses

Table ST100 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by BMI Category (Primary Diagnosis Rotator Cuff Arthropathy)

BMI Category	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Underweight (<18.50)	3	101	1.1 (0.1, 7.2)	3.7 (1.2, 11.2)	3.7 (1.2, 11.2)	3.7 (1.2, 11.2)		
Normal (18.50-24.99)	84	2954	2.0 (1.5, 2.6)	2.9 (2.3, 3.6)	3.2 (2.6, 4.0)	3.2 (2.6, 4.0)	3.2 (2.6, 4.0)	3.6 (2.8, 4.6)
Pre Obese (25.00-29.99)	177	6026	2.0 (1.7, 2.4)	2.8 (2.4, 3.3)	3.2 (2.7, 3.7)	3.4 (2.9, 3.9)	3.8 (3.2, 4.4)	3.8 (3.3, 4.5)
Obese Class 1 (30.00-34.99)	173	4690	2.6 (2.1, 3.1)	3.2 (2.7, 3.8)	3.7 (3.2, 4.4)	4.3 (3.6, 5.0)	4.6 (3.9, 5.4)	5.1 (4.3, 6.0)
Obese Class 2 (35.00-39.99)	74	2133	2.3 (1.8, 3.1)	3.2 (2.5, 4.1)	4.1 (3.2, 5.1)	4.3 (3.4, 5.4)	4.5 (3.5, 5.6)	4.5 (3.5, 5.6)
Obese Class 3 (≥40.00)	29	1090	1.8 (1.1, 2.8)	2.5 (1.7, 3.8)	3.0 (2.1, 4.5)	3.5 (2.4, 5.1)	3.5 (2.4, 5.1)	3.5 (2.4, 5.1)
TOTAL	540	16994						

Note: BMI has not been presented for patients aged ≤19 years
Restricted to modern prostheses

Figure ST100 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by BMI Category (Primary Diagnosis Rotator Cuff Arthropathy)



HR - adjusted for age and gender

Pre Obese (25.00-29.99) vs Normal (18.50-24.99)
Entire Period: HR=0.94 (0.72, 1.22), p=0.629

Obese Class 1 (30.00-34.99) vs Normal (18.50-24.99)
Entire Period: HR=1.17 (0.90, 1.53), p=0.229

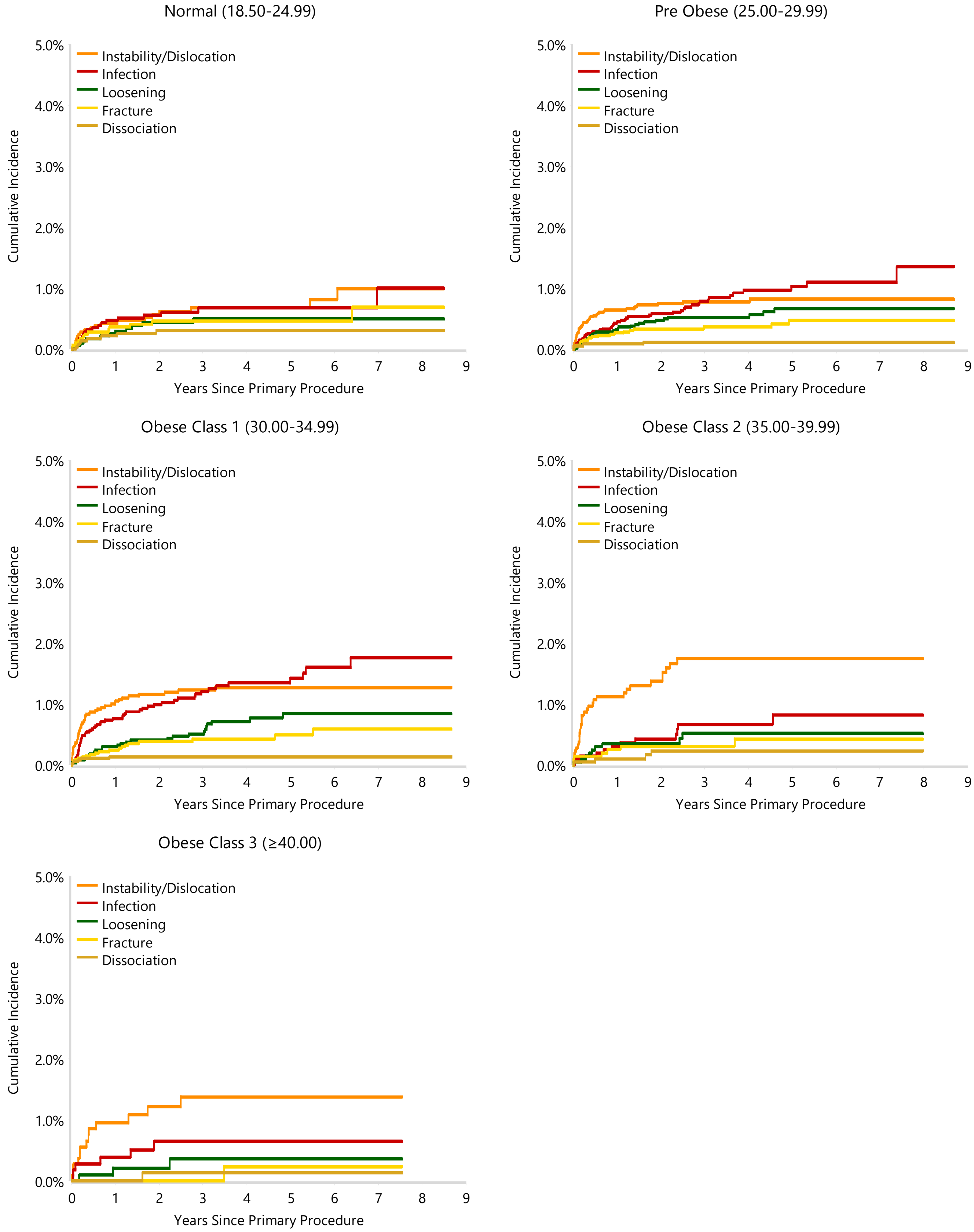
Obese Class 2 (35.00-39.99) vs Normal (18.50-24.99)
Entire Period: HR=1.15 (0.84, 1.57), p=0.395

Obese Class 3 (≥40.00) vs Normal (18.50-24.99)
Entire Period: HR=0.94 (0.61, 1.44), p=0.777

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Normal (18.50-24.99)	2954	2321	1862	1415	1067	737	431
Pre Obese (25.00-29.99)	6026	4825	3815	2900	2157	1453	892
Obese Class 1 (30.00-34.99)	4690	3715	3017	2318	1672	1139	665
Obese Class 2 (35.00-39.99)	2133	1685	1322	993	717	479	285
Obese Class 3 (≥40.00)	1090	843	679	490	355	226	137

Note: BMI has not been presented for patients aged ≤19 years
Restricted to modern prostheses

Figure ST101 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Reverse Shoulder Replacement by BMI Category (Primary Diagnosis Rotator Cuff Arthropathy)



Note: BMI has not been presented for patients aged ≤19 years
Restricted to modern prostheses

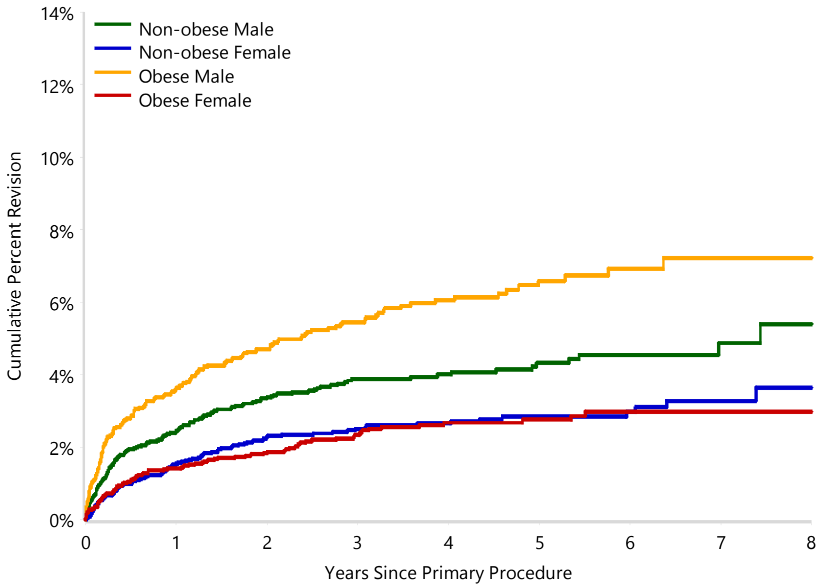
Primary Total Shoulder Replacement

Table ST101 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by BMI Category and Gender (Primary Diagnosis Rotator Cuff Arthropathy)

BMI Category	Gender	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Non-obese	Male	160	4583	2.4 (2.0, 3.0)	3.4 (2.9, 4.0)	3.9 (3.3, 4.6)	4.0 (3.4, 4.7)	4.3 (3.7, 5.1)	4.5 (3.8, 5.4)
	Female	104	4498	1.5 (1.2, 2.0)	2.3 (1.8, 2.8)	2.5 (2.0, 3.1)	2.6 (2.2, 3.2)	2.8 (2.3, 3.5)	3.0 (2.4, 3.7)
Obese	Male	181	3539	3.6 (3.0, 4.3)	4.7 (4.0, 5.5)	5.4 (4.7, 6.3)	6.1 (5.2, 7.0)	6.6 (5.6, 7.7)	6.9 (5.9, 8.1)
	Female	95	4374	1.4 (1.1, 1.8)	1.9 (1.5, 2.3)	2.3 (1.9, 2.9)	2.7 (2.2, 3.3)	2.8 (2.2, 3.4)	3.0 (2.4, 3.7)
TOTAL		540	16994						

Note: BMI has not been presented for patients aged ≤19 years
Restricted to modern prostheses

Figure ST102 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by BMI Category and Gender (Primary Diagnosis Rotator Cuff Arthropathy)



HR - adjusted for age

Non-obese Male vs Non-obese Female
0 - 2Wk: HR=1.89 (1.02, 3.49), p=0.043
2Wk+: HR=1.43 (1.11, 1.85), p=0.006

Non-obese Male vs Obese Male
Entire Period: HR=0.71 (0.57, 0.88), p=0.001

Non-obese Female vs Obese Female
Entire Period: HR=1.12 (0.85, 1.49), p=0.411

Obese Male vs Obese Female
Entire Period: HR=2.32 (1.81, 2.98), p<0.001

Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Non-obese	Male	4583	3635	2848	2119	1536	1036	600
	Female	4498	3593	2897	2245	1730	1179	738
Obese	Male	3539	2721	2164	1585	1127	745	424
	Female	4374	3522	2854	2216	1617	1099	663

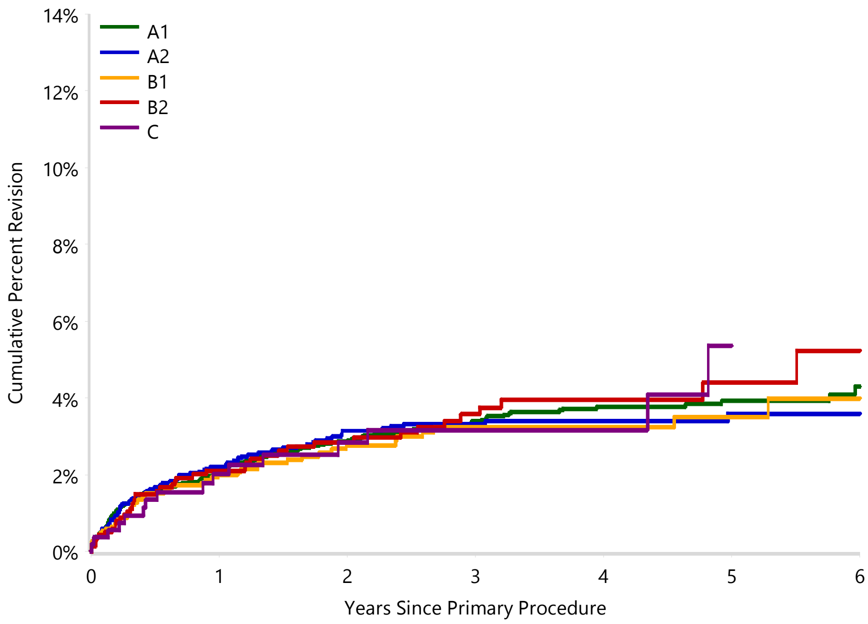
Note: BMI has not been presented for patients aged ≤19 years
Restricted to modern prostheses

Table ST102 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Glenoid Morphology (Primary Diagnosis Rotator Cuff Arthropathy)

Glenoid Morphology	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs
A1	204	6763	2.1 (1.8, 2.5)	2.9 (2.5, 3.3)	3.4 (2.9, 3.9)	3.8 (3.3, 4.4)
A2	93	3264	2.2 (1.7, 2.8)	3.1 (2.6, 3.9)	3.3 (2.7, 4.1)	3.4 (2.8, 4.2)
B1	49	1849	2.0 (1.4, 2.8)	2.8 (2.0, 3.7)	3.2 (2.4, 4.3)	3.2 (2.4, 4.3)
B2	43	1398	2.1 (1.4, 3.1)	2.8 (2.0, 4.0)	3.6 (2.6, 4.9)	3.9 (2.9, 5.4)
C	16	549	2.0 (1.1, 3.7)	2.8 (1.6, 4.9)	3.2 (1.9, 5.4)	3.2 (1.9, 5.4)
TOTAL	405	13823				

Note: Restricted to modern prostheses
Excludes 22 procedures with a recorded glenoid morphology of B3

Figure ST103 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Glenoid Morphology (Primary Diagnosis Rotator Cuff Arthropathy)



HR - adjusted for age and gender

A2 vs A1

Entire Period: HR=1.01 (0.79, 1.30), p=0.912

B1 vs A1

Entire Period: HR=0.91 (0.66, 1.24), p=0.543

B2 vs A1

Entire Period: HR=1.10 (0.79, 1.53), p=0.571

C vs A1

Entire Period: HR=1.03 (0.62, 1.71), p=0.919

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs
A1	6763	5252	4086	2958	2015
A2	3264	2488	1876	1314	879
B1	1849	1366	997	687	446
B2	1398	1039	795	545	348
C	549	416	304	202	128

Note: Restricted to modern prostheses
Excludes 22 procedures with a recorded glenoid morphology of B3

OUTCOME FOR ROTATOR CUFF ARTHROPATHY – PROSTHESIS CHARACTERISTICS

Glenoid Baseplate

A glenoid baseplate is categorised as augmented if the backside has been modified for glenoid deformity (eg. wedged, stepped, angulated, or lateralised). The revision rates of augmented and non-augmented glenoid baseplates did not differ across all glenoid morphology categories (Table ST103, Figure ST104, Figure ST105).

Humeral Fixation and Stem Length

Fixation is not a risk factor for revision (Table ST104 and Figure ST106). There was no difference in the rate of revision when conventional and short humeral stems were compared (Table ST105 and Figure ST107).

Polyethylene Type and Bearing Surface

Non XLPE is the most common polyethylene type used in primary total stemmed reverse shoulder replacement for the management of rotator cuff arthropathy. Metal/XLPE has a higher rate of revision than XLPE/metal in the first 2 weeks only, with no difference after that time (Table ST106 and Figure ST108). The reasons for revision for the different bearing surfaces are presented in Figure ST109.

Glenosphere Size and Lateralisation

Glenosphere size is not a risk factor for revision when total stemmed reverse shoulder replacement is used for the management of rotator cuff arthropathy (Table ST107 and Figure ST110). The cumulative incidence of the most common reasons for revision for the different glenosphere sizes is presented in Figure ST111.

If the radius of curvature of the articular surface of the glenosphere is displaced laterally by design, it is categorised as a lateralised glenosphere. There is no difference in the rate of revision when lateralised and standard glenospheres are compared (Table ST108, Figure ST112 and Figure ST113).

Technology Assistance

An image derived instrument (IDI) is defined as custom made pin guides or cutting blocks derived from CT or MRI images by 3D printing specifically for each patient. There are 4,735 total stemmed reverse shoulder replacements for rotator cuff arthropathy utilising an IDI since their first use in 2013. In 2023, IDI are used in 39.5% of all total stemmed reverse procedures. There is no change in the revision rate with IDI usage (Table ST109 and Figure ST114).

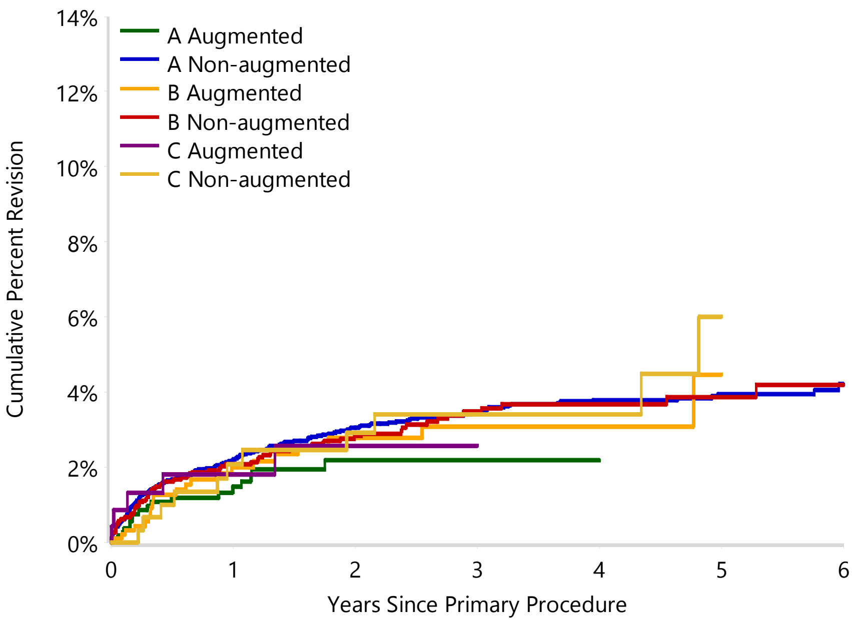
The outcomes of the most commonly used prosthesis combinations are listed in Table ST110. The most commonly used cementless prosthesis combinations are listed in Table ST111. The most commonly used hybrid (humerus cemented) prosthesis combinations are listed in Table ST112.

Table ST103 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Glenoid Morphology and Glenoid Augmentation (Primary Diagnosis Rotator Cuff Arthropathy)

Glenoid Morphology	Glenoid Augmentation	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
A	Augmented	18	1108	1.5 (0.9, 2.5)	2.2 (1.3, 3.5)	2.2 (1.3, 3.5)	2.2 (1.3, 3.5)	
	Non-augmented	279	8919	2.2 (1.9, 2.5)	3.0 (2.7, 3.5)	3.5 (3.1, 3.9)	3.8 (3.3, 4.3)	3.9 (3.5, 4.5)
B	Augmented	23	964	2.0 (1.2, 3.3)	2.8 (1.8, 4.3)	3.1 (2.0, 4.8)	3.1 (2.0, 4.8)	4.5 (2.3, 8.7)
	Non-augmented	69	2283	2.1 (1.6, 2.8)	2.8 (2.2, 3.7)	3.5 (2.7, 4.4)	3.7 (2.9, 4.7)	3.9 (3.0, 5.0)
C	Augmented	5	234	1.8 (0.7, 4.8)	2.6 (1.0, 6.2)	2.6 (1.0, 6.2)		
	Non-augmented	11	315	2.1 (0.9, 4.6)	2.9 (1.5, 5.8)	3.4 (1.8, 6.5)	3.4 (1.8, 6.5)	6.0 (3.0, 12.0)
TOTAL		405	13823					

Note: Excludes 6,722 procedures with unknown glenoid augmentation or glenoid morphology
Restricted to modern prostheses.

Figure ST104 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Glenoid Morphology and Glenoid Augmentation (Primary Diagnosis Rotator Cuff Arthropathy)



HR - adjusted for age and gender

A Augmented vs A Non-augmented
Entire Period: HR=0.67 (0.41, 1.07), p=0.094

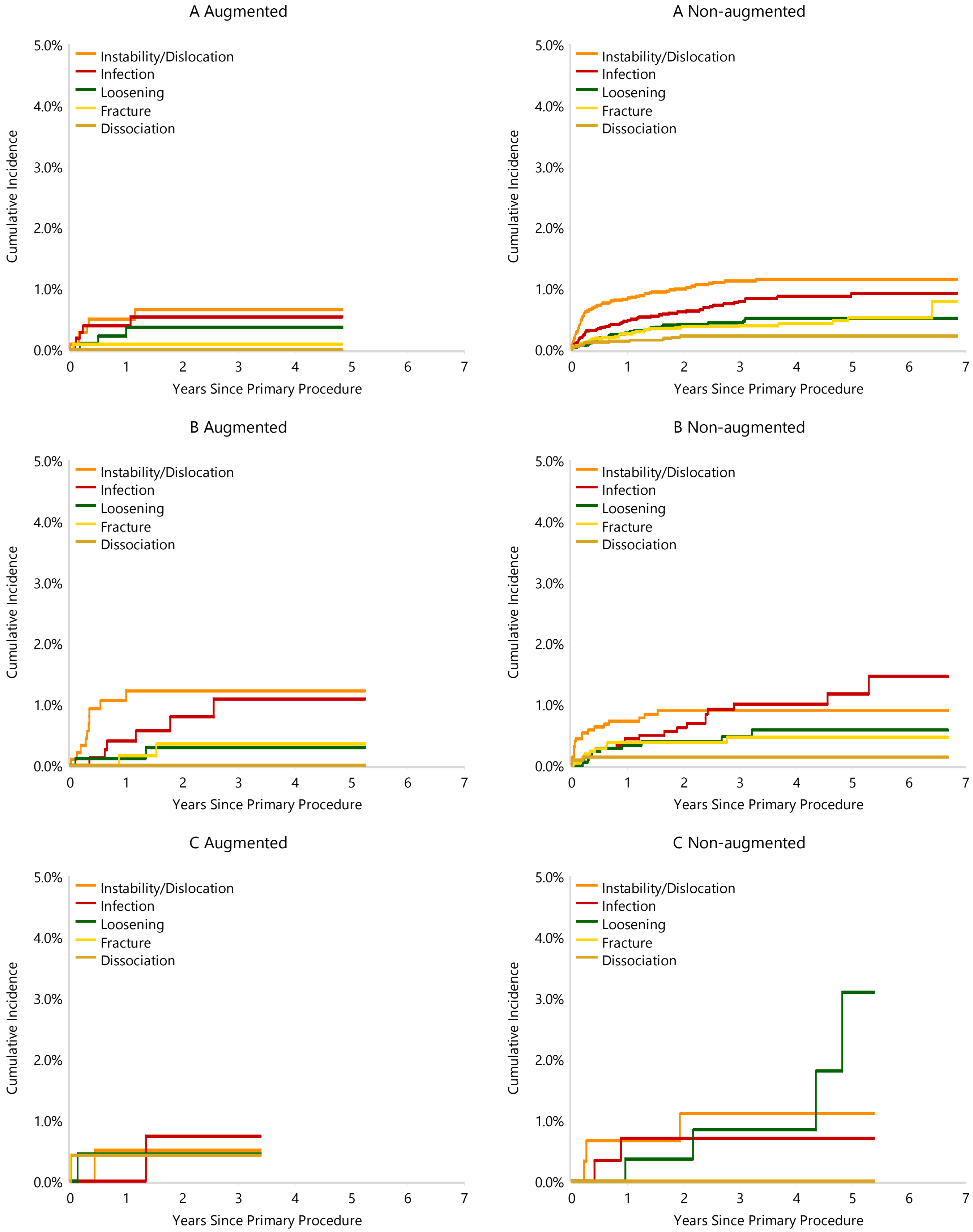
B Augmented vs B Non-augmented
Entire Period: HR=0.93 (0.58, 1.50), p=0.772

C Augmented vs C Non-augmented
Entire Period: HR=0.72 (0.25, 2.08), p=0.547

Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
A	Augmented	1108	669	378	196	95	31
	Non-augmented	8919	7071	5584	4076	2799	1640
B	Augmented	964	606	401	248	133	56
	Non-augmented	2283	1799	1391	984	661	387
C	Augmented	234	155	96	53	21	10
	Non-augmented	315	261	208	149	107	53

Note: Excludes 6,722 procedures with unknown glenoid augmentation or glenoid morphology.
Restricted to modern prostheses

Figure ST105 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Reverse Shoulder Replacement by Glenoid Morphology and Glenoid Augmentation (Primary Diagnosis Rotator Cuff Arthropathy)



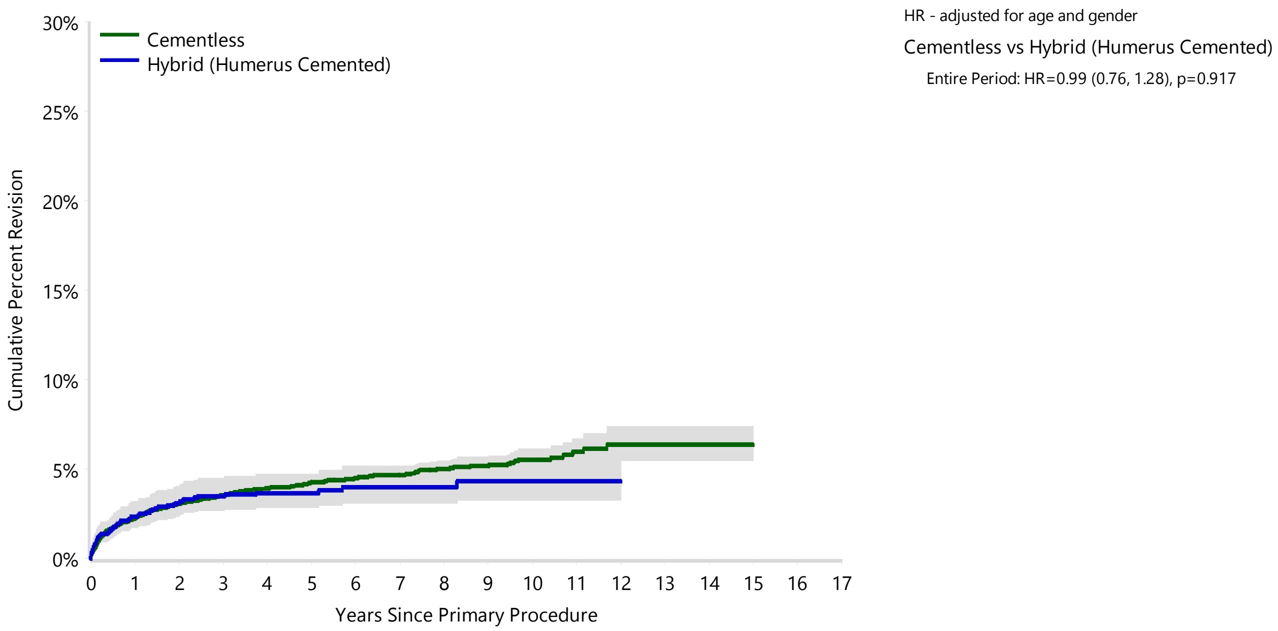
Note: Restricted to modern prostheses

Table ST104 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Fixation (Primary Diagnosis Rotator Cuff Arthropathy)

Fixation	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Cemented	1	28	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)		
Cementless	674	18647	2.3 (2.1, 2.5)	3.5 (3.3, 3.8)	4.3 (3.9, 4.6)	4.7 (4.3, 5.1)	5.5 (5.0, 6.1)	6.4 (5.5, 7.4)
Hybrid (Glenoid Cemented)	8	119	6.1 (2.9, 12.3)	7.0 (3.6, 13.6)	7.0 (3.6, 13.6)			
Hybrid (Humerus Cemented)	61	1751	2.4 (1.7, 3.2)	3.5 (2.7, 4.5)	3.7 (2.8, 4.7)	4.0 (3.1, 5.2)	4.3 (3.3, 5.7)	
TOTAL	744	20545						

Note: Restricted to modern prostheses

Figure ST106 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Fixation (Primary Diagnosis Rotator Cuff Arthropathy)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Cementless	18647	15192	10051	6067	3117	992	123
Hybrid (Humerus Cemented)	1751	1524	1098	675	381	162	20

Note: Only fixations with >120 procedures have been listed
Restricted to modern prostheses

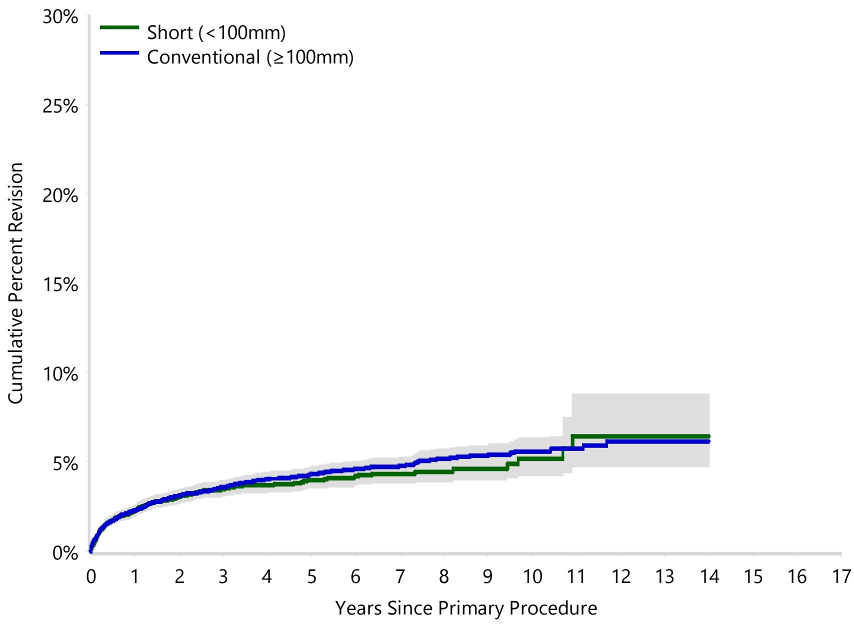
Primary Total Shoulder Replacement

Table ST105 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Humeral Stem Length (Primary Diagnosis Rotator Cuff Arthropathy)

Humeral Stem Length	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Short (<100mm)	286	8804	2.3 (2.0, 2.6)	3.5 (3.1, 3.9)	4.0 (3.5, 4.5)	4.3 (3.8, 4.9)	5.2 (4.2, 6.4)	6.4 (4.7, 8.8)
Conventional (≥100mm)	457	11702	2.3 (2.0, 2.6)	3.6 (3.3, 4.0)	4.3 (3.9, 4.8)	4.8 (4.3, 5.3)	5.6 (5.0, 6.3)	6.2 (5.3, 7.1)
TOTAL	743	20506						

Note: Excludes 39 procedures with unknown humeral stem length
Restricted to modern prostheses

Figure ST107 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Humeral Stem Length (Primary Diagnosis Rotator Cuff Arthropathy)



HR - adjusted for age and gender
Conventional (≥100mm) vs Short (<100mm)
Entire Period: HR=1.08 (0.93, 1.25), p=0.307

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Short (<100mm)	8804	6854	4051	2239	1049	257	59
Conventional (≥100mm)	11702	9976	7188	4548	2465	901	86

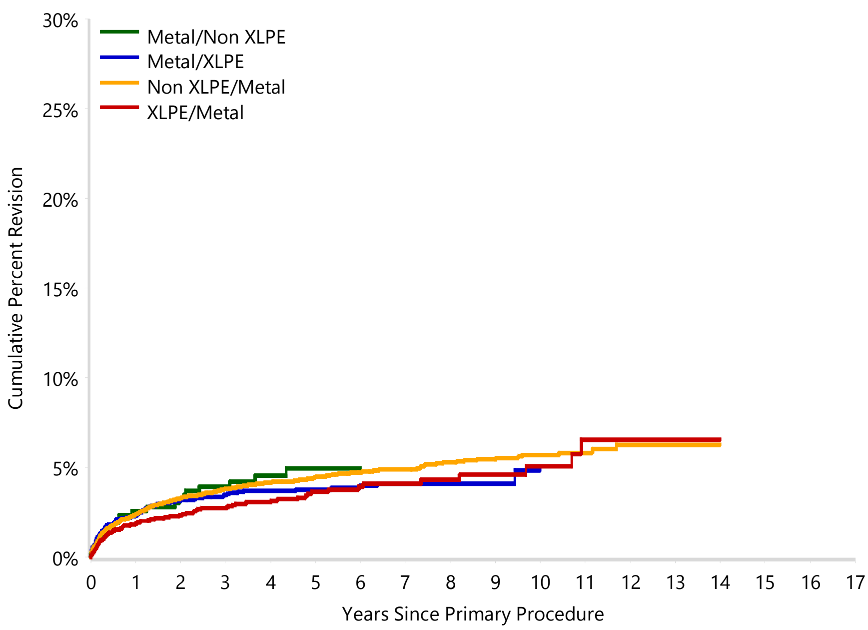
Note: Excludes 39 procedures with unknown humeral stem length
Restricted to modern prostheses

Table ST106 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Bearing Surface (Primary Diagnosis Rotator Cuff Arthropathy)

Bearing Surface	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Ceramic/Non XLPE	0	10	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)				
Ceramic/XLPE	1	71	0.0 (0.0, 0.0)	1.9 (0.3, 12.6)				
Metal/Non XLPE	22	468	2.6 (1.5, 4.5)	3.9 (2.5, 6.2)	5.0 (3.2, 7.6)			
Metal/XLPE	117	3413	2.3 (1.9, 2.9)	3.5 (2.9, 4.2)	3.8 (3.1, 4.5)	4.1 (3.4, 5.0)	4.9 (3.4, 6.9)	
Non XLPE/Metal	499	12696	2.4 (2.1, 2.7)	3.8 (3.5, 4.2)	4.5 (4.1, 4.9)	4.9 (4.4, 5.4)	5.7 (5.1, 6.4)	6.3 (5.4, 7.2)
XLPE/Metal	105	3872	1.9 (1.5, 2.4)	2.7 (2.2, 3.4)	3.7 (2.9, 4.6)	4.1 (3.3, 5.2)	5.1 (3.8, 6.8)	6.6 (4.5, 9.6)
TOTAL	744	20530						

Note: Restricted to modern prostheses, reported humeral cup/glenosphere
Excludes 15 procedures with unknown bearing surface

Figure ST108 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Bearing Surface (Primary Diagnosis Rotator Cuff Arthropathy)



HR - adjusted for age and gender

Metal/Non XLPE vs XLPE/Metal
Entire Period: HR=1.42 (0.90, 2.26), p=0.131

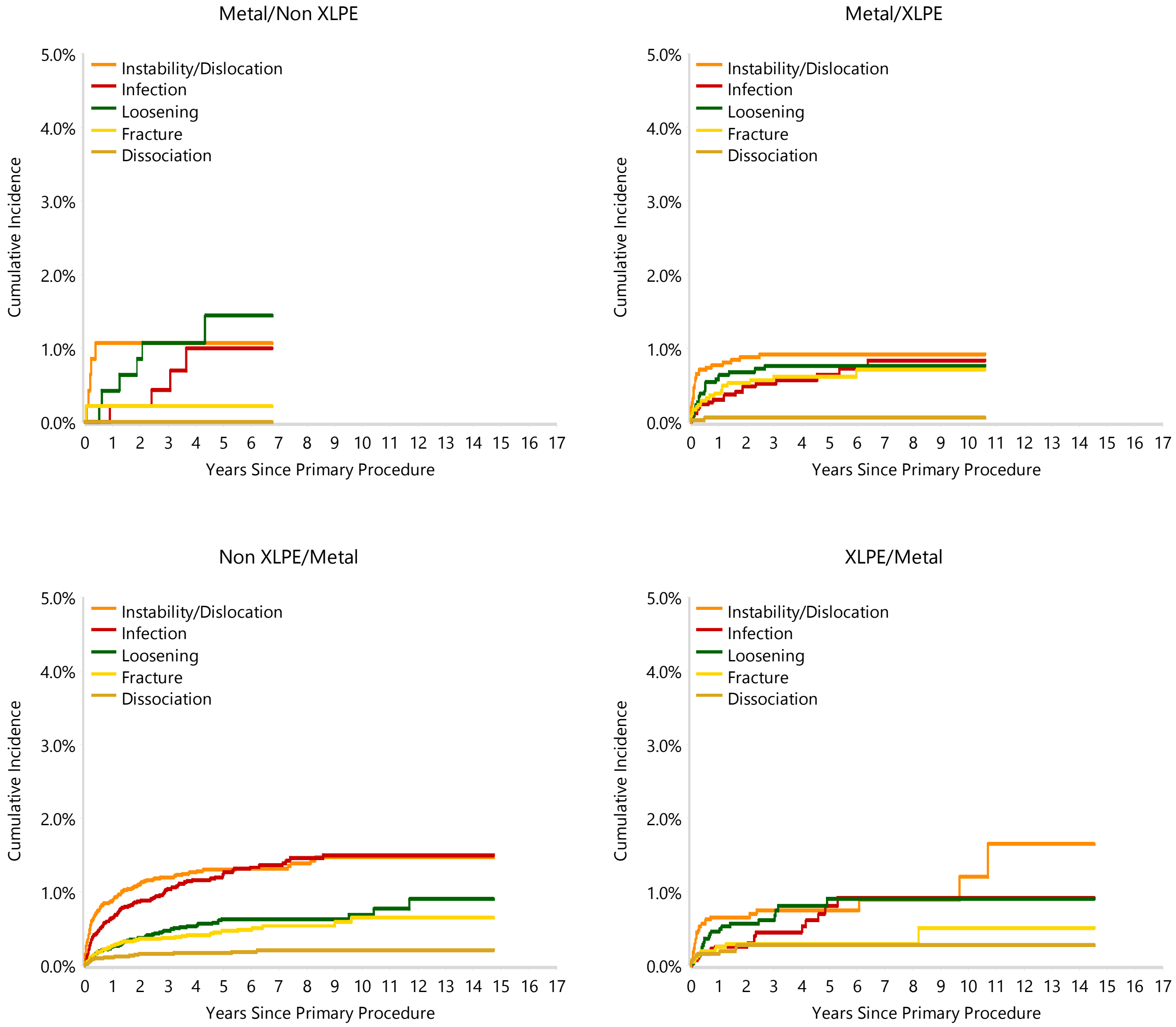
Metal/XLPE vs XLPE/Metal
0 - 2Wk: HR=1.99 (1.13, 3.49), p=0.016
2Wk+: HR=0.97 (0.73, 1.27), p=0.806

Non XLPE/Metal vs XLPE/Metal
Entire Period: HR=1.23 (1.00, 1.52), p=0.054

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Metal/Non XLPE	468	449	356	170	33	2	0
Metal/XLPE	3413	2913	1978	1176	519	82	2
Non XLPE/Metal	12696	10554	7343	4580	2484	890	86
XLPE/Metal	3872	2844	1523	852	473	185	56

Note: Restricted to modern prostheses, reported humeral cup/glenosphere

Figure ST109 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Reverse Shoulder Replacement by Bearing Surface (Primary Diagnosis Rotator Cuff Arthropathy)



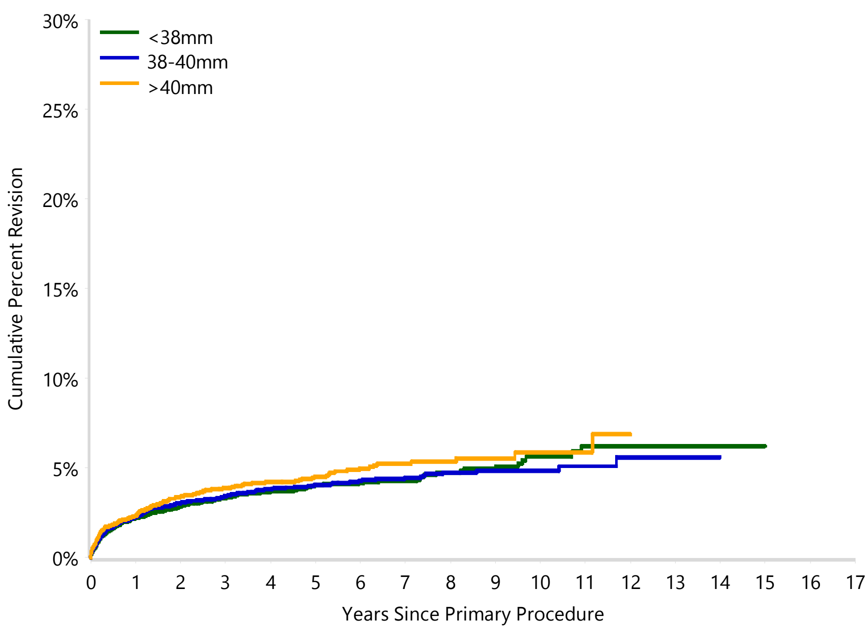
Note: Restricted to modern prostheses

Table ST107 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Glenosphere Size (Primary Diagnosis Rotator Cuff Arthropathy)

Glenosphere Size	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
<38mm	238	6999	2.2 (1.9, 2.6)	3.3 (2.9, 3.8)	4.0 (3.5, 4.6)	4.3 (3.7, 4.9)	5.6 (4.7, 6.7)	6.2 (5.0, 7.6)
38-40mm	270	7585	2.3 (1.9, 2.6)	3.4 (3.0, 3.9)	4.0 (3.6, 4.6)	4.4 (3.9, 5.0)	4.9 (4.2, 5.6)	5.6 (4.5, 7.0)
>40m	206	5132	2.3 (2.0, 2.8)	3.9 (3.3, 4.5)	4.5 (3.9, 5.2)	5.2 (4.5, 6.1)	5.9 (4.9, 7.1)	
TOTAL	714	19716						

Note: Excludes 829 procedures with unknown glenosphere sizes
Restricted to modern prostheses

Figure ST110 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Glenosphere Size (Primary Diagnosis Rotator Cuff Arthropathy)



HR - adjusted for age and gender

38-40mm vs <38mm
Entire Period: HR=0.99 (0.83, 1.18), p=0.922

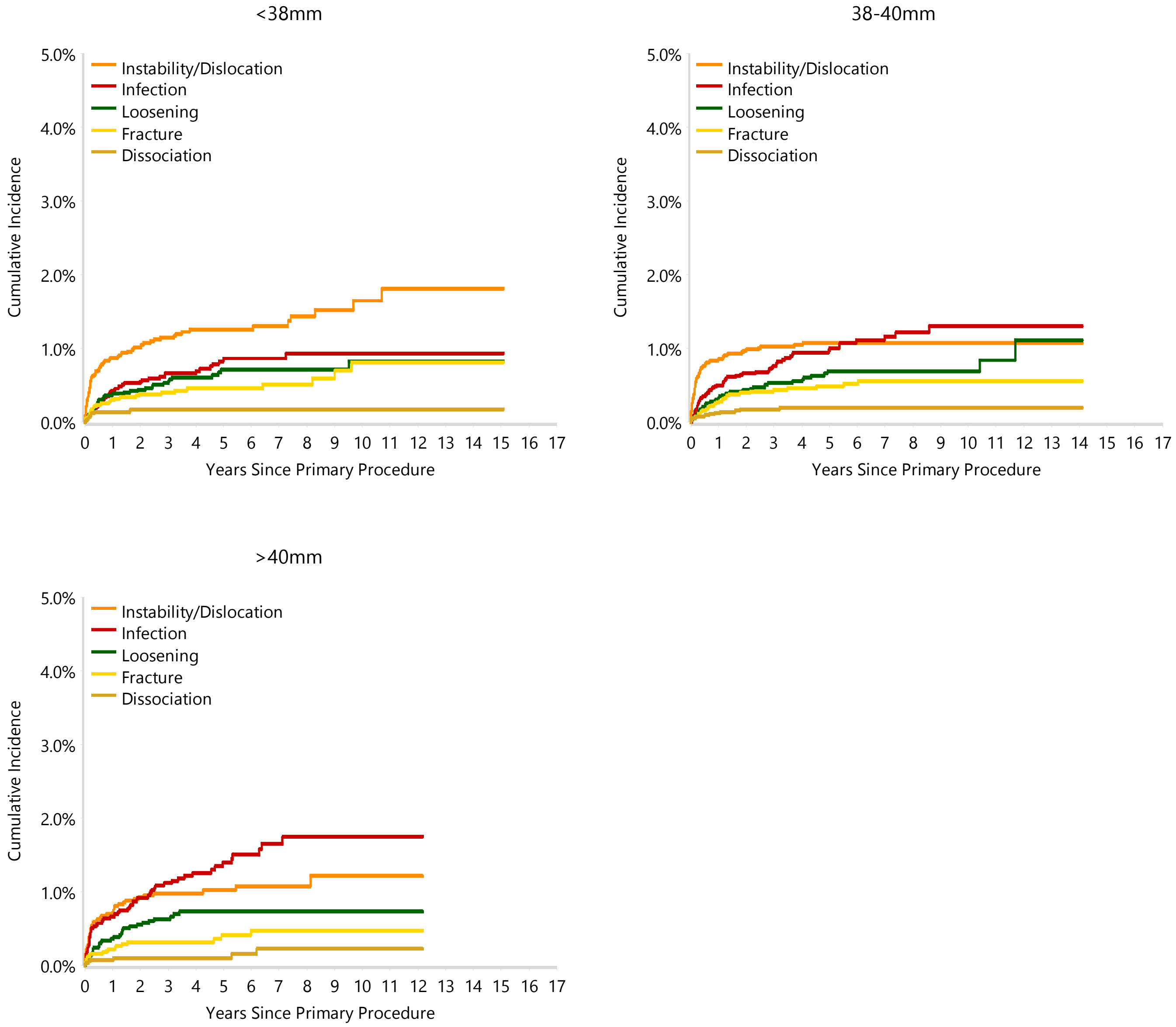
>40mm vs <38mm
Entire Period: HR=0.82 (0.68, 1.00), p=0.055

>40mm vs 38-40mm
Entire Period: HR=0.83 (0.69, 1.01), p=0.058

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
<38mm	6999	5642	3683	2269	1206	468	85
38-40mm	7585	6305	4431	2800	1488	471	44
>40mm	5132	4377	2961	1691	821	220	15

Note: Excludes 829 procedures with unknown glenosphere sizes
Restricted to modern prostheses

Figure ST111 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Reverse Shoulder Replacement by Glenosphere Size (Primary Diagnosis Rotator Cuff Arthropathy)



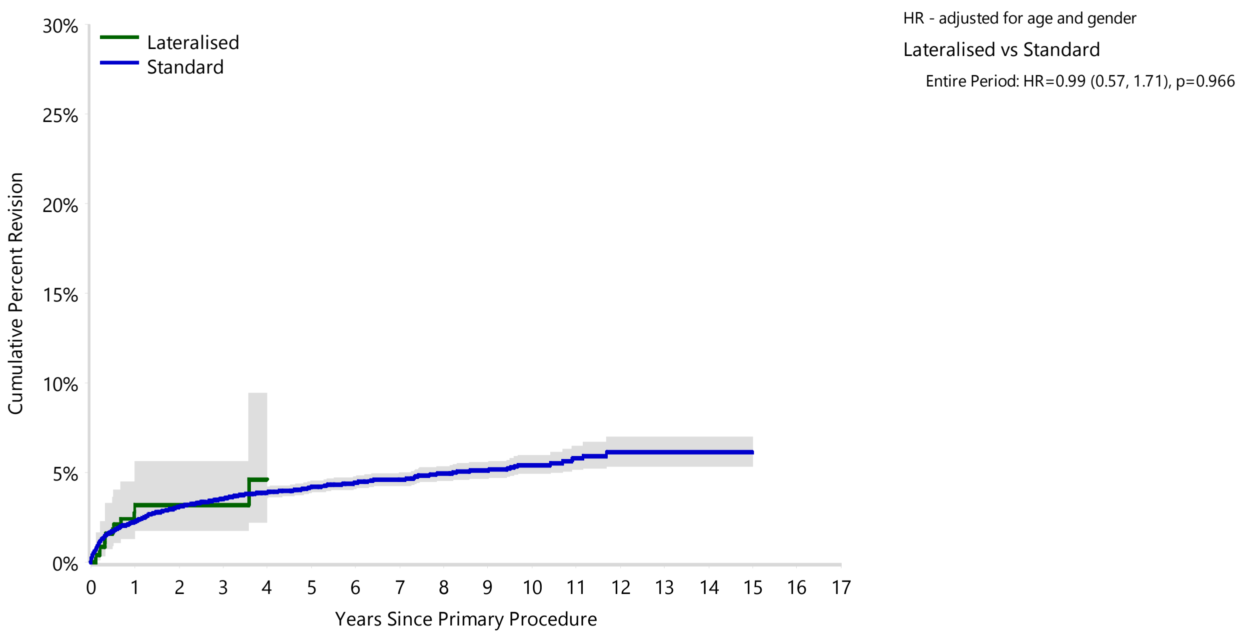
Note: Restricted to modern prostheses

Table ST108 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Glenosphere Lateralisation (Primary Diagnosis Rotator Cuff Arthropathy)

Glenoid Lateralisation	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Lateralised	13	498	3.2 (1.8, 5.6)	3.2 (1.8, 5.6)				
Standard	731	20046	2.3 (2.1, 2.5)	3.6 (3.3, 3.8)	4.2 (3.9, 4.5)	4.6 (4.3, 5.0)	5.4 (4.9, 6.0)	6.1 (5.4, 7.0)
TOTAL	744	20544						

Note: Excludes 1 procedures with unknown lateralisation
Restricted to modern prostheses

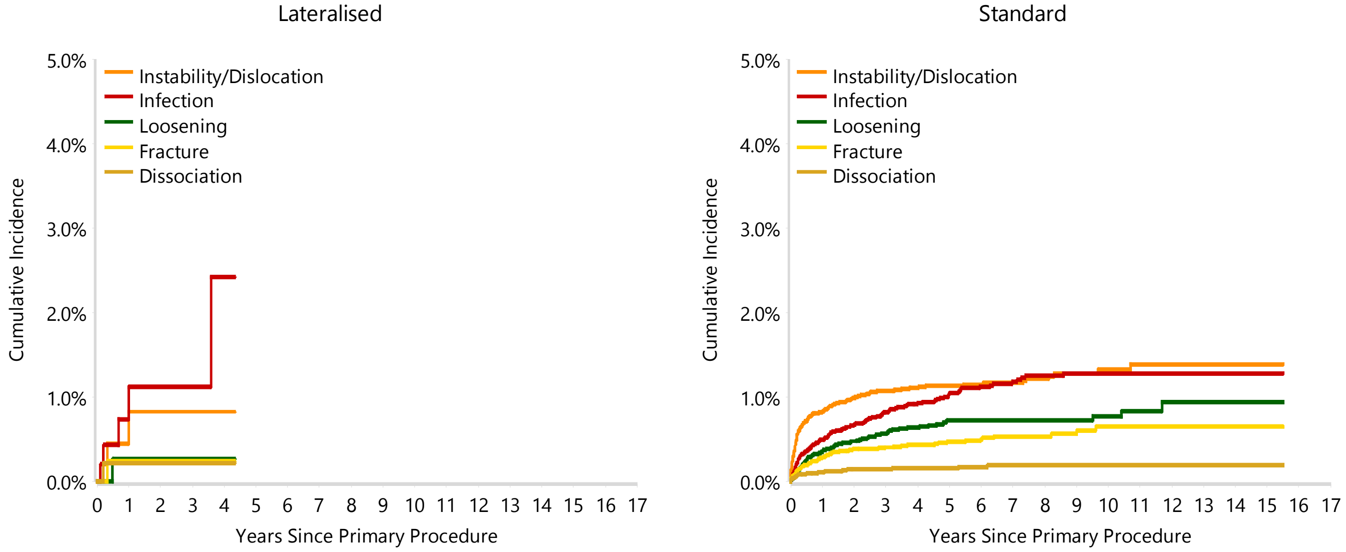
Figure ST112 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Glenosphere Lateralisation (Primary Diagnosis Rotator Cuff Arthropathy)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Lateralised	498	255	82	18	2	0	0
Standard	20046	16584	11166	6776	3516	1160	145

Note: Excludes 1 procedures with unknown lateralisation
Restricted to modern prostheses

Figure ST113 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Reverse Shoulder Replacement by Glenoid Lateralisation (Primary Diagnosis Rotator Cuff Arthropathy)



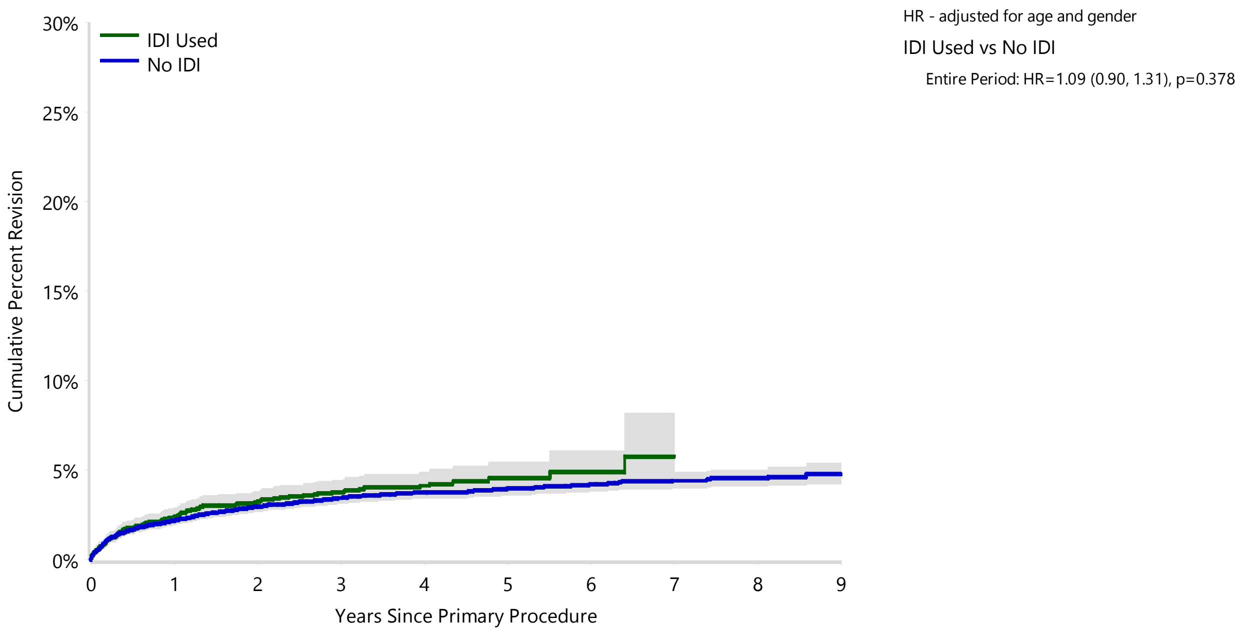
Note: Restricted to modern prostheses

Table ST109 Cumulative Percent Revision of Primary Total Stemmed Reverse Replacement Since 2014 by IDI Usage (Primary Diagnosis Rotator Cuff Arthropathy)

IDI Use	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	8 Yrs	9 Yrs
IDI Used	151	4735	2.4 (2.0, 2.9)	3.2 (2.7, 3.8)	3.8 (3.2, 4.4)	4.5 (3.8, 5.5)	5.8 (4.1, 8.2)		
No IDI	469	13722	2.2 (2.0, 2.5)	3.0 (2.7, 3.3)	3.4 (3.1, 3.8)	4.0 (3.6, 4.4)	4.4 (4.0, 4.9)	4.5 (4.1, 5.0)	4.8 (4.2, 5.4)
TOTAL	620	18457							

Note: Restricted to modern prostheses

Figure ST114 Cumulative Percent Revision of Primary Total Stemmed Reverse Replacement Since 2014 by IDI Usage (Primary Diagnosis Rotator Cuff Arthropathy)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	8 Yrs	9 Yrs
IDI Used	4735	3392	2407	1520	444	46	22	3
No IDI	13722	11443	9655	7856	4660	1973	1101	440

Note: Restricted to modern prostheses

Table ST110 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Prosthesis Combination (Primary Diagnosis Rotator Cuff Arthropathy)

Humeral Stem	Glenoid Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Aequalis	Aequalis	65	1296	2.2 (1.5, 3.2)	3.9 (3.0, 5.2)	5.1 (3.9, 6.6)	5.4 (4.2, 7.0)	7.1 (5.4, 9.3)	
	Perform Reversed	0	94	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)				
Affinis	Affinis	26	738	1.7 (0.9, 2.9)	2.9 (1.9, 4.5)	4.1 (2.8, 6.2)			
AltiVate	RSP	0	48	0.0 (0.0, 0.0)					
AltiVate Reverse	RSP	35	935	3.0 (2.0, 4.4)	4.6 (3.2, 6.5)				
Ascend Flex	Aequalis	64	1570	2.8 (2.1, 3.8)	4.9 (3.8, 6.2)	5.3 (4.1, 6.9)	5.3 (4.1, 6.9)		
	Perform Reversed	13	642	2.0 (1.1, 3.5)	3.2 (1.6, 6.3)				
Comprehensive	Comprehensive Reverse	45	2432	1.2 (0.9, 1.8)	2.1 (1.5, 2.9)	2.9 (2.0, 4.1)	3.2 (2.2, 4.7)		
	Trabecular Metal	1	37	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	3.8 (0.6, 24.3)			
Delta Xtend	Delta Xtend	169	4450	2.1 (1.7, 2.5)	3.2 (2.7, 3.8)	3.8 (3.2, 4.4)	4.3 (3.7, 5.1)	4.7 (4.0, 5.6)	5.7 (4.5, 7.1)
Equinoxe	Equinoxe	67	2199	2.0 (1.5, 2.8)	3.3 (2.6, 4.3)	3.9 (3.0, 5.1)	4.3 (3.2, 5.8)		
Global Unite	Delta Xtend	12	419	1.5 (0.7, 3.2)	2.8 (1.5, 5.2)	3.8 (2.1, 6.8)	3.8 (2.1, 6.8)		
MSS	MSS	2	92	2.0 (0.3, 13.6)	4.1 (1.0, 15.3)				
RSP	RSP	30	742	2.9 (1.9, 4.4)	3.9 (2.7, 5.7)	4.5 (3.1, 6.5)			
SMR	SMR	1	50	0.0 (0.0, 0.0)					
	SMR Axioma	3	54	5.6 (1.8, 16.3)	5.6 (1.8, 16.3)	5.6 (1.8, 16.3)			
	SMR L1	154	3836	2.7 (2.2, 3.2)	3.8 (3.2, 4.4)	4.2 (3.6, 4.9)	4.6 (3.9, 5.4)	5.5 (4.4, 6.8)	6.8 (4.9, 9.3)
Trabecular Metal	Comprehensive Reverse	12	135	8.0 (4.4, 14.4)	10.4 (6.0, 17.8)				
	Trabecular Metal	42	715	3.8 (2.6, 5.5)	5.2 (3.8, 7.1)	5.7 (4.2, 7.8)	6.0 (4.4, 8.1)	7.0 (5.0, 9.7)	
Other (20)		3	61	5.2 (1.7, 15.1)	5.2 (1.7, 15.1)	5.2 (1.7, 15.1)	5.2 (1.7, 15.1)		
TOTAL		744	20545						

Note Restricted to modern prostheses
Only prostheses with >25 procedures have been listed

Table ST111 Cumulative Percent Revision of Cementless Primary Total Stemmed Reverse Shoulder Replacement by Prosthesis Combination (Primary Diagnosis Rotator Cuff Arthropathy)

Humeral Stem	Glenoid Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Aequalis	Aequalis	54	1094	2.1 (1.4, 3.1)	3.8 (2.8, 5.2)	5.2 (3.9, 6.9)	5.5 (4.1, 7.2)	7.2 (5.3, 9.7)	
	Perform Reversed	0	75	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)				
Affinis	Affinis	18	440	1.6 (0.8, 3.3)	3.3 (1.9, 5.6)	4.9 (3.0, 8.0)			
AltiVate	RSP	0	48	0.0 (0.0, 0.0)					
AltiVate Reverse	RSP	33	879	3.0 (2.0, 4.5)	4.7 (3.3, 6.7)				
Ascend Flex	Aequalis	60	1384	3.0 (2.2, 4.1)	5.2 (4.0, 6.7)	5.7 (4.4, 7.4)	5.7 (4.4, 7.4)		
	Perform Reversed	12	588	2.1 (1.2, 3.8)	3.1 (1.5, 6.4)				
Comprehensive	Comprehensive Reverse	42	2367	1.2 (0.8, 1.7)	2.0 (1.4, 2.8)	2.8 (1.9, 4.0)	3.1 (2.1, 4.6)		
	Trabecular Metal	1	37	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	3.8 (0.6, 24.3)			
Delta Xtend	Delta Xtend	149	3784	2.1 (1.7, 2.6)	3.3 (2.7, 3.9)	3.9 (3.3, 4.7)	4.5 (3.8, 5.4)	5.0 (4.2, 5.9)	
Equinoxe	Equinoxe	63	2126	2.0 (1.5, 2.7)	3.2 (2.5, 4.2)	3.8 (2.9, 5.0)	4.2 (3.1, 5.7)		
Global Unite	Delta Xtend	11	380	1.6 (0.7, 3.6)	2.7 (1.4, 5.2)	3.8 (2.1, 7.1)	3.8 (2.1, 7.1)		
MSS	MSS	2	91	2.0 (0.3, 13.6)	4.1 (1.0, 15.3)				
RSP	RSP	27	680	2.7 (1.7, 4.2)	3.9 (2.6, 5.7)	4.5 (3.1, 6.6)			
SMR	SMR	1	49	0.0 (0.0, 0.0)					
	SMR Axioma	2	53	3.8 (1.0, 14.4)	3.8 (1.0, 14.4)	3.8 (1.0, 14.4)			
	SMR L1	145	3728	2.5 (2.1, 3.1)	3.6 (3.0, 4.3)	4.1 (3.4, 4.8)	4.5 (3.8, 5.3)	5.4 (4.3, 6.8)	6.7 (4.8, 9.4)
Trabecular Metal	Comprehensive Reverse	11	123	7.9 (4.2, 14.7)	10.3 (5.8, 18.0)				
	Trabecular Metal	41	667	3.9 (2.7, 5.7)	5.4 (3.9, 7.5)	6.0 (4.4, 8.2)	6.2 (4.6, 8.5)	7.3 (5.2, 10.2)	
Other (17)		2	54	3.8 (1.0, 14.4)	3.8 (1.0, 14.4)	3.8 (1.0, 14.4)	3.8 (1.0, 14.4)		
TOTAL		674	18647						

Note Restricted to modern prostheses
Only prostheses with >25 procedures have been listed

Table ST112 Cumulative Percent Revision of Hybrid (Humerus Cemented) Primary Total Stemmed Reverse Shoulder Replacement by Prosthesis Combination (Primary Diagnosis Rotator Cuff Arthropathy)

Humeral Stem	Glenoid Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Aequalis	Aequalis	11	198	3.1 (1.4, 6.7)	4.7 (2.5, 8.8)	4.7 (2.5, 8.8)	5.5 (3.0, 10.0)		
Affinis	Affinis	8	275	1.8 (0.8, 4.4)	2.7 (1.3, 5.5)	3.2 (1.6, 6.4)			
AltiVate Reverse	RSP	1	51	2.0 (0.3, 13.6)	2.0 (0.3, 13.6)				
Ascend Flex	Aequalis	3	181	1.1 (0.3, 4.5)	2.0 (0.6, 6.1)				
	Perform Reversed	1	51	0.0 (0.0, 0.0)					
Comprehensive	Comprehensive Reverse	3	62	3.2 (0.8, 12.3)	6.7 (2.0, 20.9)				
Delta Xtend	Delta Xtend	19	647	1.9 (1.1, 3.3)	2.8 (1.7, 4.4)	3.0 (1.9, 4.7)	3.3 (2.1, 5.2)	3.3 (2.1, 5.2)	
Equinoxe	Equinoxe	3	64	3.6 (0.9, 13.7)	5.8 (1.9, 17.2)	5.8 (1.9, 17.2)			
Global Unite	Delta Xtend	1	37	0.0 (0.0, 0.0)	3.7 (0.5, 23.5)	3.7 (0.5, 23.5)	3.7 (0.5, 23.5)		
RSP	RSP	3	59	5.2 (1.7, 15.2)	5.2 (1.7, 15.2)	5.2 (1.7, 15.2)			
SMR	SMR L1	4	44	6.8 (2.3, 19.7)	9.4 (3.6, 23.2)	9.4 (3.6, 23.2)	9.4 (3.6, 23.2)	9.4 (3.6, 23.2)	
Trabecular Metal	Trabecular Metal	1	43	2.3 (0.3, 15.4)	2.3 (0.3, 15.4)	2.3 (0.3, 15.4)	2.3 (0.3, 15.4)	2.3 (0.3, 15.4)	
Other (10)		3	39	8.1 (2.7, 23.1)	8.1 (2.7, 23.1)				
TOTAL		61	1751						

Note Restricted to modern prostheses
Only prostheses with >25 procedures have been listed

OUTCOME FOR FRACTURE – PATIENT CHARACTERISTICS

There are 8,336 primary total stemmed reverse shoulder replacement procedures with a primary diagnosis of fracture. The cumulative percent revision of primary total stemmed reverse shoulder replacement for fracture at 10 years is 5.9% (Table ST113). The rate of revision of total stemmed reverse replacements for fracture did not differ during 2015-2023 compared to pre-2015 (Table ST114 and Figure ST115).

The most common reasons for revision are instability/dislocation (45.4%), infection (24.1%), fracture (11.8%) and loosening (11.8%) (Table ST115 and Figure ST116). The most common types of revision are of the humeral component (34.2%) and cup only (22.1%) (Table ST116). When revised, the majority of total stemmed reverse for fracture remain total stemmed reverse replacements (94.1%).

Age and Gender

For the diagnosis of fracture, patients aged <75 years have a higher risk of revision than patients aged ≥75 years (Table ST117 and Figure ST117).

Males have a higher rate of revision than females (Table ST118 and Figure ST118). The higher rate of revision for males is due to an increased incidence of revision for instability/dislocation (Figure ST119). When stratified by gender, there is no difference in the rate of revision for males in different age groups, but females aged <55 years have a higher rate of revision risk than females aged ≥75 years (Table ST119, Figure ST120 and Figure ST121).

> At 1 year, the cumulative incidence of revision for instability/dislocation in males is 5.1% compared to 1.2% for females.

ASA and BMI

ASA score is not a risk factor for revision (Table ST120 and Figure ST122). The cumulative incidence for the most common reasons for revision of the different ASA scores are presented in Figure ST123. However, when stratified by gender, females with ASA scores of 1-2 have a lower rate of revision than females with ASA scores of 3-5. There was no difference for males (Table ST121 and Figure ST124).

There is no difference in the rate of revision when pre-obese and obese categories 1 and 2 are compared to patients with a normal BMI (Table ST122 and Figure ST125). Patients in obese class 3 have a higher rate of revision than patients with a normal BMI. The cumulative incidence for the most common reasons for revision of the different BMI categories are shown in Figure ST126. Non-obese males have a higher revision rate than non-obese females. Obese males have a higher rate of revision than obese females in the first 1.5 years, with no difference after this time (Table ST123 and Figure ST127).

Glenoid Morphology

The cumulative percent revision for the different morphology categories is presented in Table ST124. The category of glenoid morphology is not a risk factor for revision (Figure ST128).

Table ST113 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement (Primary Diagnosis Fracture)

Shoulder Class	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Total Stemmed Reverse	357	8336	3.1 (2.8, 3.5)	4.2 (3.8, 4.7)	4.8 (4.4, 5.4)	5.2 (4.6, 5.8)	5.9 (5.2, 6.8)	5.9 (5.2, 6.8)
TOTAL	357	8336						

Note: Restricted to modern prostheses

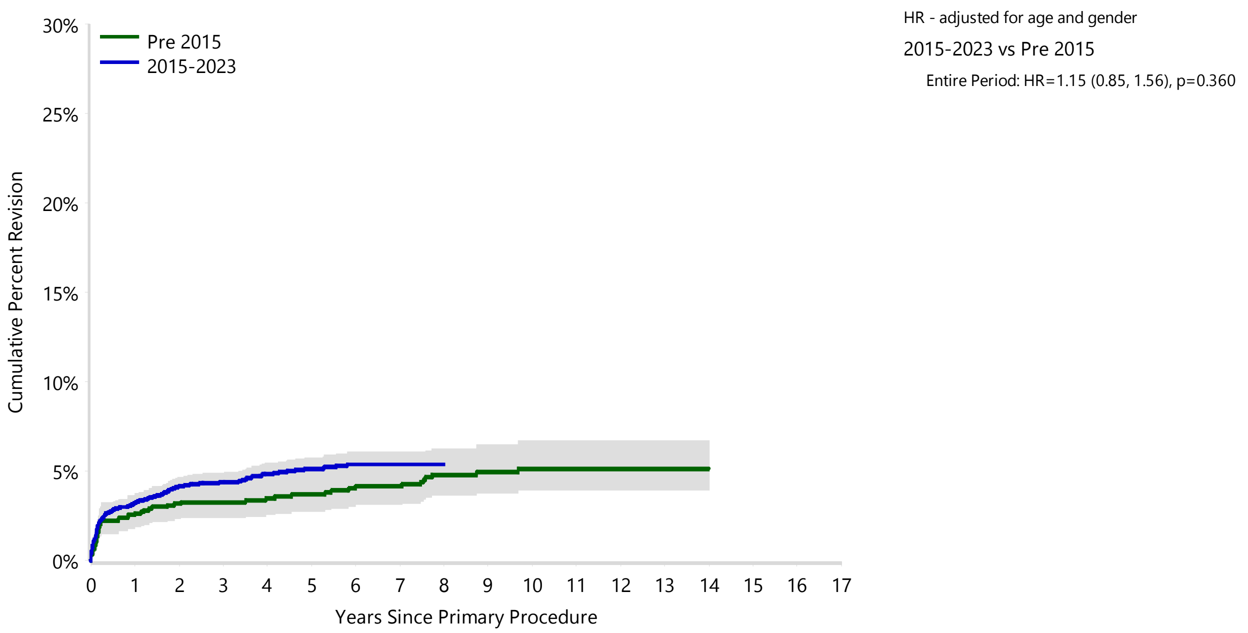
Primary Total Shoulder Replacement

Table ST114 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Procedure Year (Primary Diagnosis Fracture)

Procedure Year	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Pre 2015	53	1184	2.6 (1.9, 3.7)	3.3 (2.4, 4.5)	3.7 (2.7, 5.0)	4.1 (3.1, 5.5)	5.1 (3.9, 6.7)	5.1 (3.9, 6.7)
2015-2023	304	7152	3.2 (2.8, 3.7)	4.4 (3.9, 4.9)	5.1 (4.5, 5.8)	5.4 (4.8, 6.1)		
TOTAL	357	8336						

Note: Restricted to modern prostheses

Figure ST115 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Procedure Year (Primary Diagnosis Fracture)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Pre 2015	1184	1109	1004	883	766	405	57
2015-2023	7152	5681	3437	1791	613	0	0

Note: Restricted to modern prostheses

Table ST115 Primary Total Stemmed Reverse Shoulder Replacement by Reason for Revision (Primary Diagnosis Fracture)

Reason for Revision	Number	Percent
Instability/Dislocation	162	45.4
Infection	86	24.1
Loosening	42	11.8
Fracture	42	11.8
Arthrofibrosis	6	1.7
Dissociation	5	1.4
Heterotopic Bone	3	0.8
Implant Breakage Glenoid	2	0.6
Pain	2	0.6
Malposition	2	0.6
Lysis	2	0.6
Tumour	1	0.3
Implant Breakage Glenoid Insert	1	0.3
Other	1	0.3
TOTAL	357	100.0

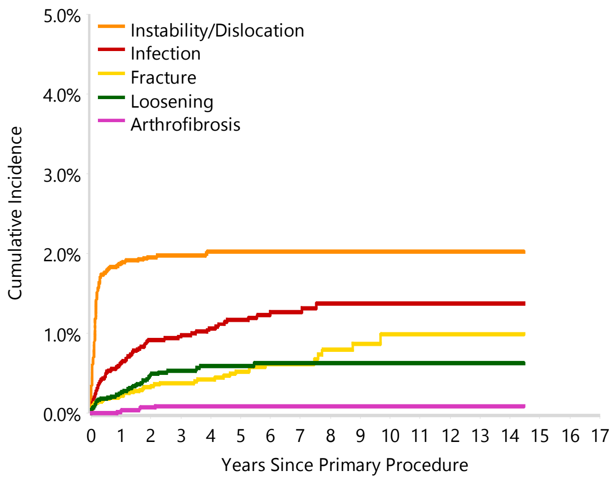
Note: Restricted to modern prostheses

Table ST116 Primary Total Stemmed Reverse Shoulder Replacement by Type of Revision (Primary Diagnosis Fracture)

Type of Revision	Number	Percent
Humeral Component	122	34.2
Cup Only	79	22.1
Cup/Head	65	18.2
Humeral/Glenoid	30	8.4
Cement Spacer	26	7.3
Humeral Head Only	9	2.5
Glenoid Component	9	2.5
Removal of Prostheses	8	2.2
Minor Components	4	1.1
Reoperation	2	0.6
Head/Insert	1	0.3
Glenosphere Only	1	0.3
Cement Only	1	0.3
TOTAL	357	100.0

Note: Restricted to modern prostheses

Figure ST116 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Reverse Shoulder Replacement (Primary Diagnosis Fracture)



Note: Restricted to modern prostheses

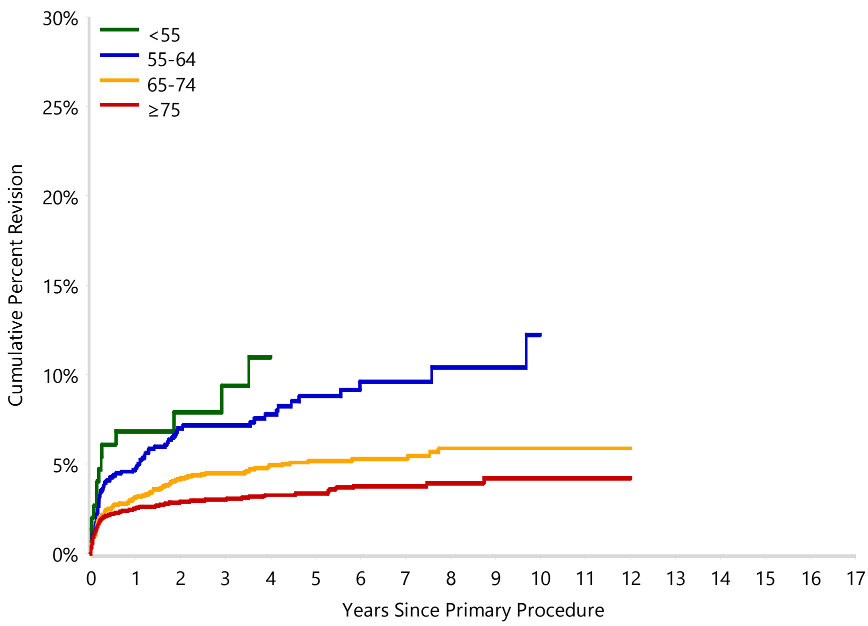
Primary Total Shoulder Replacement

Table ST117 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Age (Primary Diagnosis Fracture)

Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
<55	13	150	6.8 (3.7, 12.3)	9.4 (5.3, 16.3)				
55-64	80	1073	4.8 (3.7, 6.3)	7.1 (5.7, 9.0)	8.8 (7.0, 11.1)	9.6 (7.6, 12.2)	12.2 (8.5, 17.5)	
65-74	137	3049	3.2 (2.6, 3.9)	4.5 (3.8, 5.3)	5.2 (4.4, 6.2)	5.3 (4.5, 6.3)	5.9 (4.9, 7.1)	
≥75	127	4064	2.5 (2.1, 3.1)	3.0 (2.5, 3.6)	3.3 (2.8, 4.0)	3.8 (3.1, 4.6)	4.2 (3.4, 5.3)	
TOTAL	357	8336						

Note: Restricted to modern prostheses

Figure ST117 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Age (Primary Diagnosis Fracture)



HR - adjusted for gender

<55 vs ≥75

Entire Period: HR=2.22 (1.25, 3.95), p=0.006

55-64 vs ≥75

0 - 1Mth: HR=1.14 (0.61, 2.13), p=0.673

1Mth - 3Mth: HR=2.54 (1.59, 4.04), p<0.001

3Mth+: HR=2.67 (1.84, 3.89), p<0.001

65-74 vs ≥75

Entire Period: HR=1.36 (1.07, 1.73), p=0.012

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
<55	150	111	61	34	15	4	2
55-64	1073	851	531	302	139	46	13
65-74	3049	2495	1697	1064	554	161	22
≥75	4064	3333	2152	1274	671	194	20

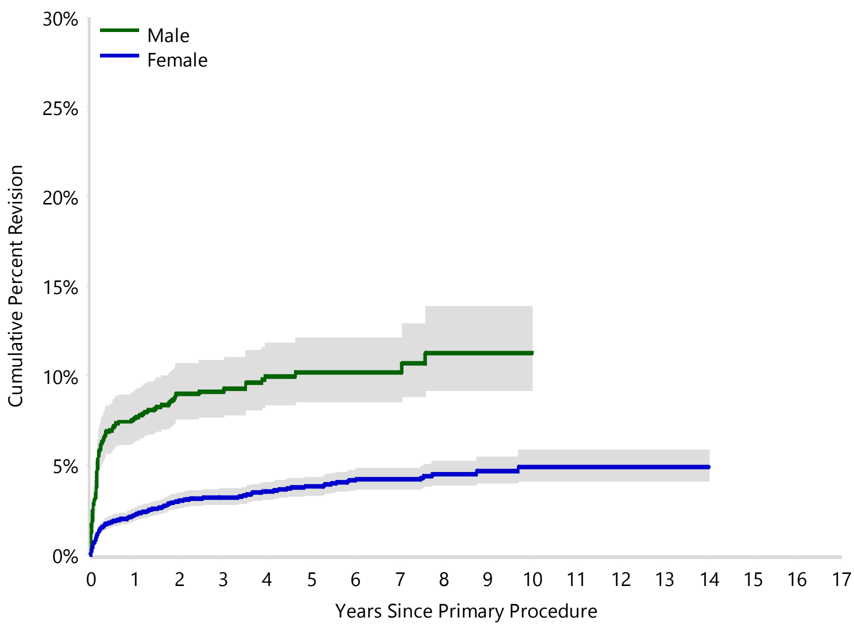
Note: Restricted to modern prostheses

Table ST118 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Gender (Primary Diagnosis Fracture)

Gender	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Male	126	1401	7.6 (6.3, 9.1)	9.1 (7.7, 10.8)	10.2 (8.5, 12.1)	10.2 (8.5, 12.1)	11.3 (9.2, 13.9)	
Female	231	6935	2.3 (1.9, 2.6)	3.2 (2.8, 3.7)	3.8 (3.3, 4.3)	4.2 (3.6, 4.8)	4.9 (4.1, 5.9)	4.9 (4.1, 5.9)
TOTAL	357	8336						

Note: Restricted to modern prostheses

Figure ST118 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Gender (Primary Diagnosis Fracture)

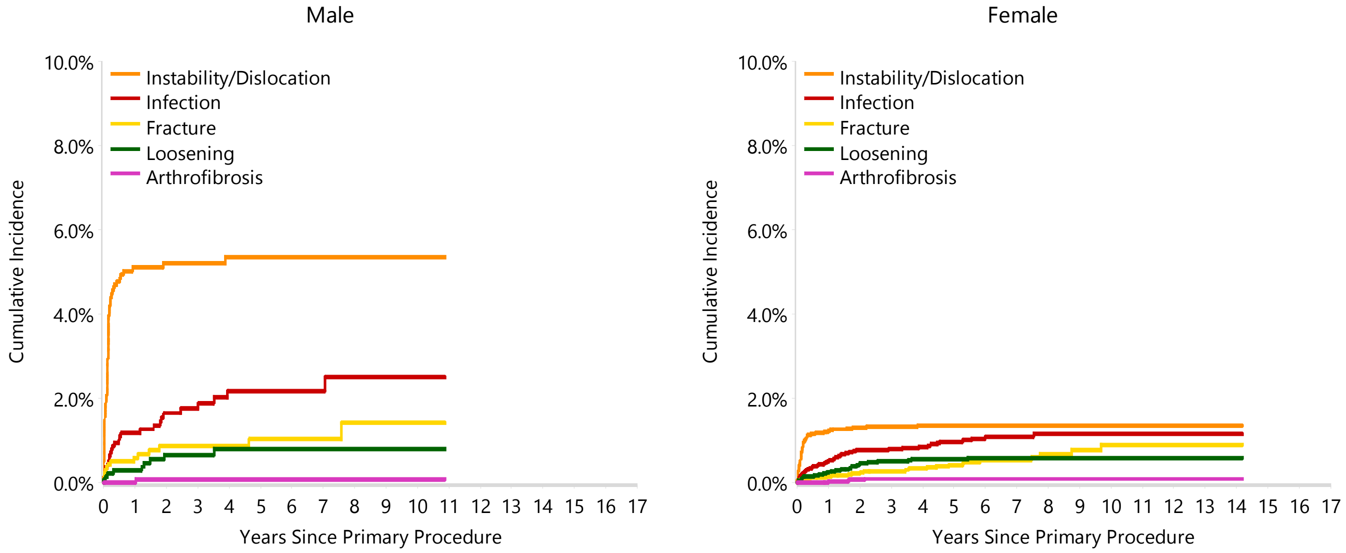


HR - adjusted for age
Male vs Female
0 - 3Mth: HR=3.90 (2.93, 5.20), p<0.001
3Mth+: HR=1.62 (1.13, 2.32), p=0.008

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Male	1401	1044	642	368	183	55	10
Female	6935	5746	3799	2306	1196	350	47

Note: Restricted to modern prostheses

Figure ST119 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Reverse Shoulder Replacement by Gender (Primary Diagnosis Fracture)



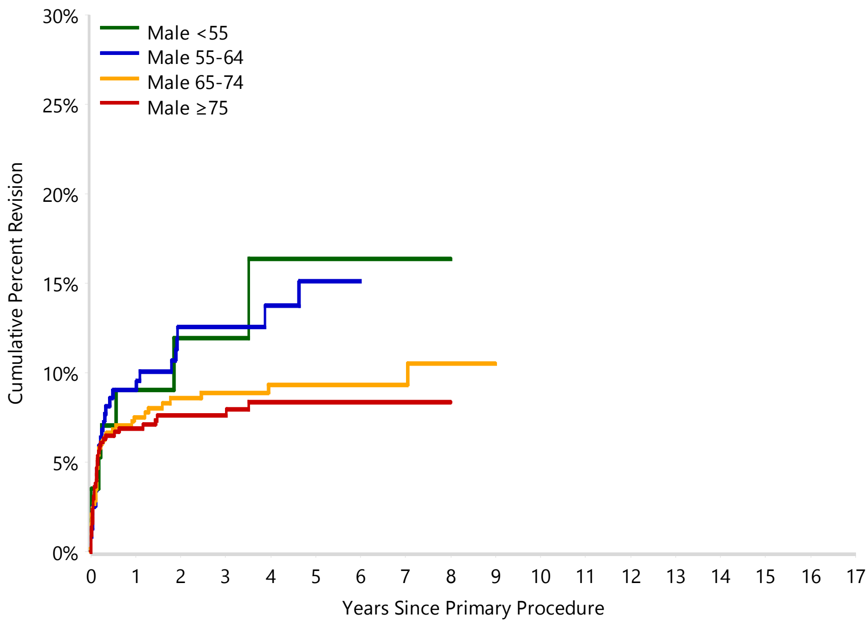
Note: Restricted to modern prostheses

Table ST119 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Gender and Age (Primary Diagnosis Fracture)

Gender	Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Male		**126**	**1401**	**7.6 (6.3, 9.1)**	**9.1 (7.7, 10.8)**	**10.2 (8.5, 12.1)**	**10.2 (8.5, 12.1)**	**11.3 (9.2, 13.9)**	
	<55	7	57	9.0 (3.9, 20.3)	12.0 (5.4, 25.2)	16.4 (7.6, 33.2)	16.4 (7.6, 33.2)		
	55-64	30	237	9.0 (6.0, 13.5)	12.5 (8.7, 17.9)	15.1 (10.4, 21.7)			
	65-74	45	522	7.5 (5.5, 10.2)	8.9 (6.6, 11.8)	9.3 (7.0, 12.4)	9.3 (7.0, 12.4)		
	≥75	44	585	6.9 (5.1, 9.3)	7.6 (5.7, 10.2)	8.4 (6.2, 11.2)	8.4 (6.2, 11.2)		
Female		**231**	**6935**	**2.3 (1.9, 2.6)**	**3.2 (2.8, 3.7)**	**3.8 (3.3, 4.3)**	**4.2 (3.6, 4.8)**	**4.9 (4.1, 5.9)**	**4.9 (4.1, 5.9)**
	<55	6	93	5.5 (2.3, 12.7)	7.9 (3.4, 17.5)	7.9 (3.4, 17.5)			
	55-64	50	836	3.6 (2.5, 5.1)	5.6 (4.2, 7.6)	7.1 (5.3, 9.4)	8.1 (5.9, 11.0)		
	65-74	92	2527	2.3 (1.7, 2.9)	3.6 (2.9, 4.5)	4.3 (3.5, 5.3)	4.5 (3.6, 5.5)	5.0 (3.9, 6.3)	
	≥75	83	3479	1.8 (1.4, 2.3)	2.3 (1.8, 2.8)	2.5 (2.0, 3.2)	3.0 (2.4, 3.8)	3.5 (2.6, 4.7)	
TOTAL		357	8336						

Note: Restricted to modern prostheses

Figure ST120 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement in Males by Age (Primary Diagnosis Fracture)



Male 55-64 vs Male <55
Entire Period: HR=1.01 (0.45, 2.31), p=0.972

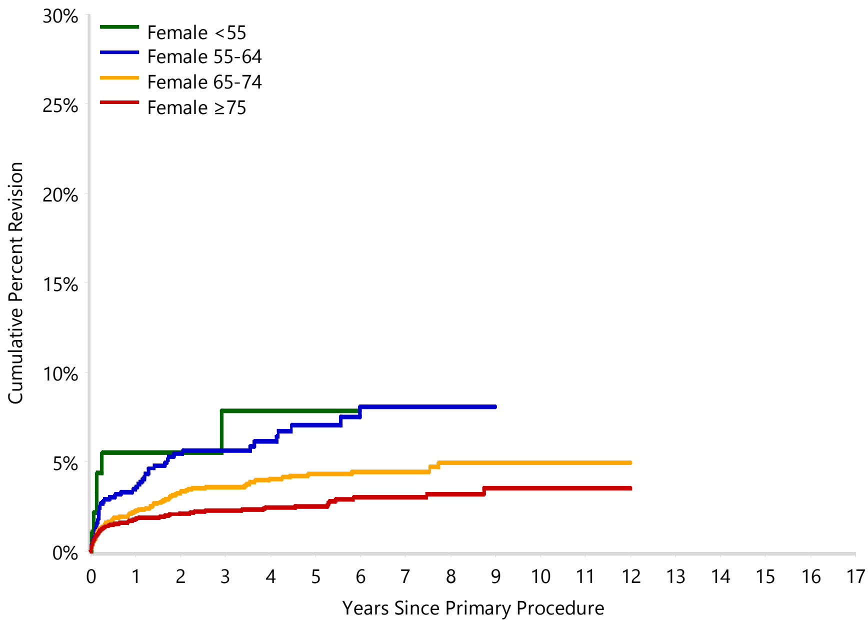
Male 65-74 vs Male <55
Entire Period: HR=0.69 (0.31, 1.52), p=0.353

Male ≥75 vs Male <55
Entire Period: HR=0.61 (0.28, 1.36), p=0.231

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Male	<55	57	40	23	10	7	3	1
	55-64	237	178	99	56	33	11	3
	65-74	522	391	259	162	79	22	4
	≥75	585	435	261	140	64	19	2

Note: Restricted to modern prostheses

Figure ST121 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement in Females by Age (Primary Diagnosis Fracture)



Female 55-64 vs Female <55
Entire Period: HR=0.88 (0.38, 2.05), p=0.764

Female 65-74 vs Female <55
Entire Period: HR=0.51 (0.22, 1.17), p=0.112

Female ≥75 vs Female <55
Entire Period: HR=0.34 (0.15, 0.78), p=0.010

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Female	**<55**	93	71	38	24	8	1	1
	55-64	836	673	432	246	106	35	10
	65-74	2527	2104	1438	902	475	139	18
	≥75	3479	2898	1891	1134	607	175	18

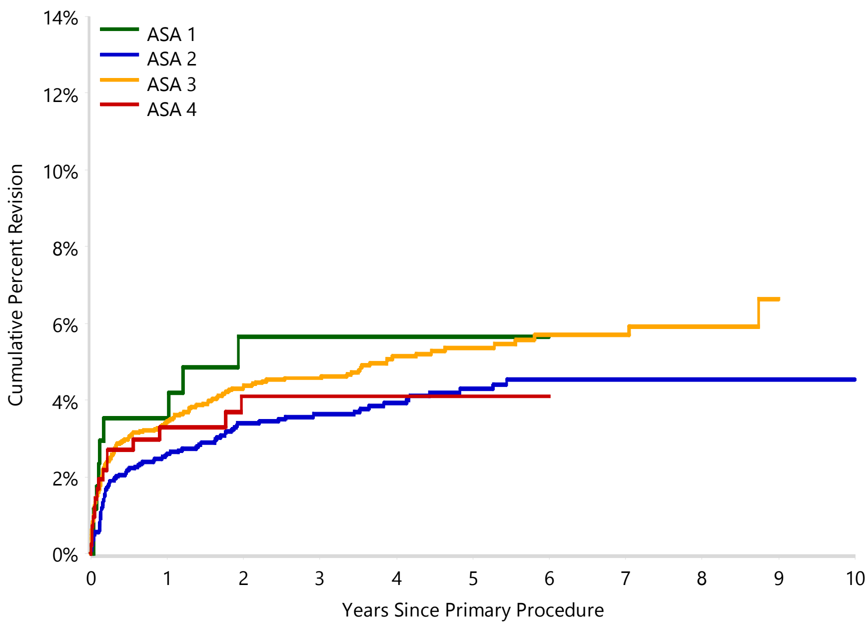
Note: Restricted to modern prostheses

Table ST120 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by ASA Score (Primary Diagnosis Fracture)

ASA Score	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	8 Yrs
ASA 1	9	171	3.5 (1.6, 7.7)	5.7 (3.0, 10.6)	5.7 (3.0, 10.6)	5.7 (3.0, 10.6)	5.7 (3.0, 10.6)	
ASA 2	97	2665	2.6 (2.1, 3.3)	3.4 (2.7, 4.2)	3.6 (2.9, 4.5)	3.9 (3.2, 4.8)	4.3 (3.5, 5.3)	4.5 (3.7, 5.6)
ASA 3	193	4243	3.5 (2.9, 4.1)	4.3 (3.7, 5.0)	4.6 (4.0, 5.3)	5.1 (4.4, 6.0)	5.4 (4.6, 6.2)	5.9 (5.0, 7.0)
ASA 4	15	419	3.3 (1.9, 5.6)	4.1 (2.5, 6.8)	4.1 (2.5, 6.8)	4.1 (2.5, 6.8)	4.1 (2.5, 6.8)	
ASA 5	0	1						
TOTAL	314	7499						

Note: Restricted to modern prostheses

Figure ST122 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by ASA Score (Primary Diagnosis Fracture)



HR - adjusted for age and gender

ASA 2 vs ASA 1

Entire Period: HR=0.85 (0.43, 1.68), p=0.630

ASA 3 vs ASA 1

Entire Period: HR=1.15 (0.59, 2.26), p=0.680

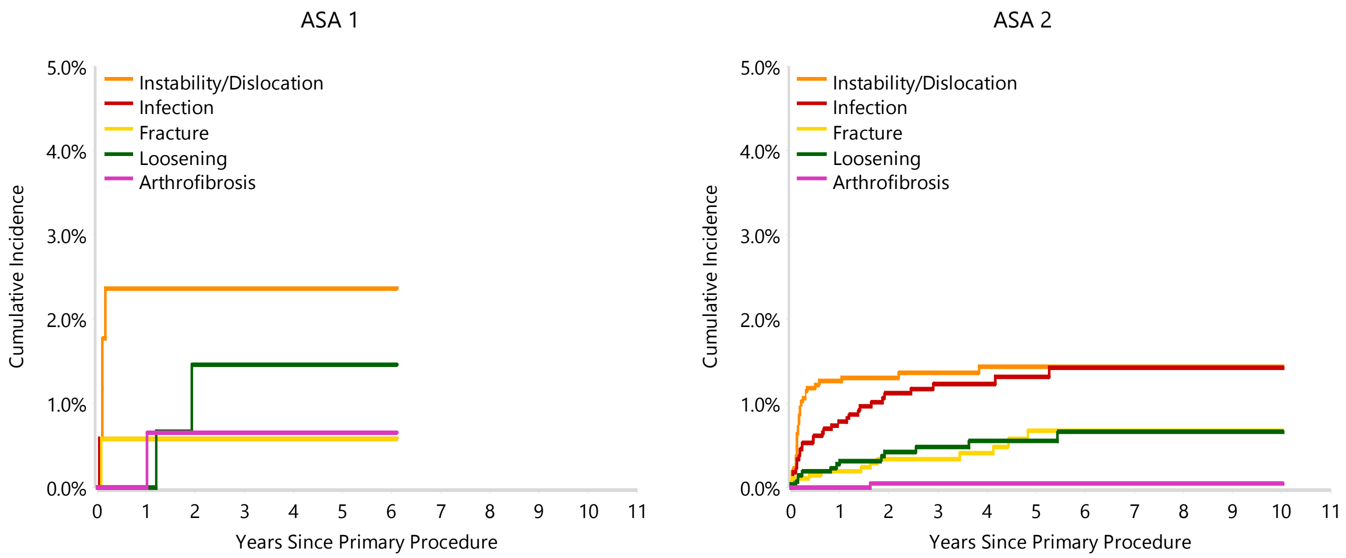
ASA 4 vs ASA 1

Entire Period: HR=1.00 (0.43, 2.29), p=0.997

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	8 Yrs
ASA 1	171	148	119	100	78	58	18
ASA 2	2665	2197	1824	1502	1164	881	235
ASA 3	4243	3370	2649	1996	1504	1074	236
ASA 4	419	304	226	153	96	67	14

Note: Restricted to modern prostheses

Figure ST123 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Reverse Shoulder Replacement by ASA Score (Primary Diagnosis Fracture)



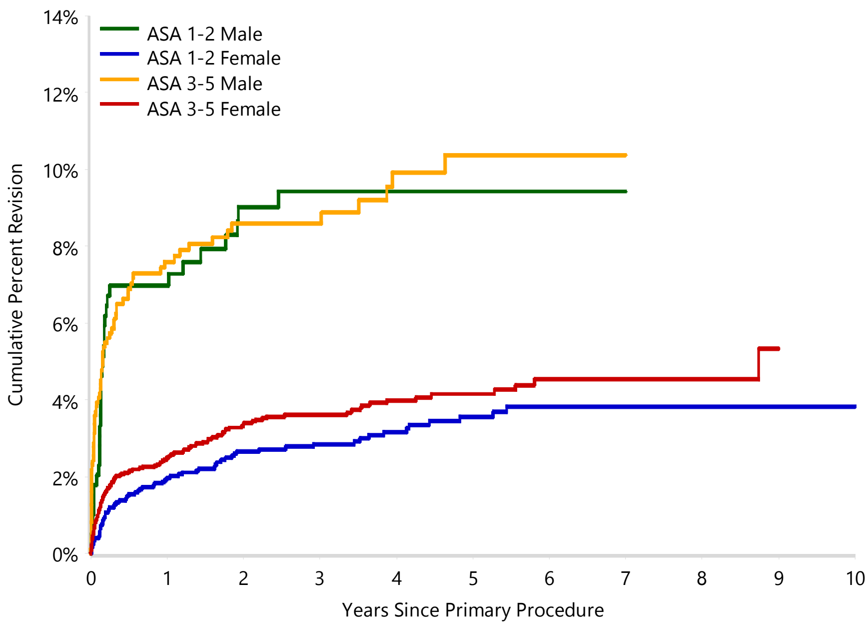
Note: Restricted to modern prostheses

Table ST121 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by ASA Score and Gender (Primary Diagnosis Fracture)

ASA Score	Gender	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	8 Yrs
ASA 1	Male	8	35	14.6 (6.3, 31.5)	24.6 (13.1, 43.4)	24.6 (13.1, 43.4)	24.6 (13.1, 43.4)		
	Female	1	136	0.7 (0.1, 5.1)	0.7 (0.1, 5.1)	0.7 (0.1, 5.1)	0.7 (0.1, 5.1)		
ASA 2	Male	26	358	6.2 (4.2, 9.3)	7.4 (5.1, 10.8)	7.9 (5.4, 11.4)	7.9 (5.4, 11.4)	7.9 (5.4, 11.4)	
	Female	71	2307	2.0 (1.5, 2.7)	2.8 (2.1, 3.6)	3.0 (2.3, 3.8)	3.7 (2.9, 4.8)	4.0 (3.1, 5.1)	4.0 (3.1, 5.1)
ASA 3	Male	72	780	8.0 (6.3, 10.2)	9.1 (7.2, 11.5)	9.1 (7.2, 11.5)	11.0 (8.6, 14.0)	11.0 (8.6, 14.0)	
	Female	121	3463	2.4 (2.0, 3.0)	3.3 (2.7, 4.0)	3.6 (3.0, 4.3)	4.1 (3.4, 5.0)	4.5 (3.7, 5.5)	4.5 (3.7, 5.5)
ASA 4 or 5	Male	3	88	3.8 (1.2, 11.3)	3.8 (1.2, 11.3)	3.8 (1.2, 11.3)			
	Female	12	332	3.2 (1.7, 5.8)	4.2 (2.3, 7.3)	4.2 (2.3, 7.3)	4.2 (2.3, 7.3)		
TOTAL		314	7499						

Note: Restricted to modern prostheses

Figure ST124 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by ASA Score and Gender (Primary Diagnosis Fracture)



HR - adjusted for age

ASA 1-2 Male vs ASA 1-2 Female
0 - 2Yr: HR=3.27 (2.15, 4.96), p<0.001
2Yr+: HR=0.57 (0.08, 4.22), p=0.584

ASA 1-2 Male vs ASA 3-5 Male
Entire Period: HR=0.84 (0.56, 1.26), p=0.400

ASA 1-2 Female vs ASA 3-5 Female
Entire Period: HR=0.71 (0.53, 0.95), p=0.021

ASA 3-5 Male vs ASA 3-5 Female
0 - 3Mth: HR=3.33 (2.34, 4.74), p<0.001
3Mth+: HR=1.54 (0.99, 2.38), p=0.054

Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	8 Yrs
ASA 1-2	Male	393	304	243	199	113	48	28
	Female	2443	2041	1700	1403	826	367	225
ASA 3-5	Male	868	619	468	341	173	65	36
	Female	3795	3056	2408	1808	968	399	214

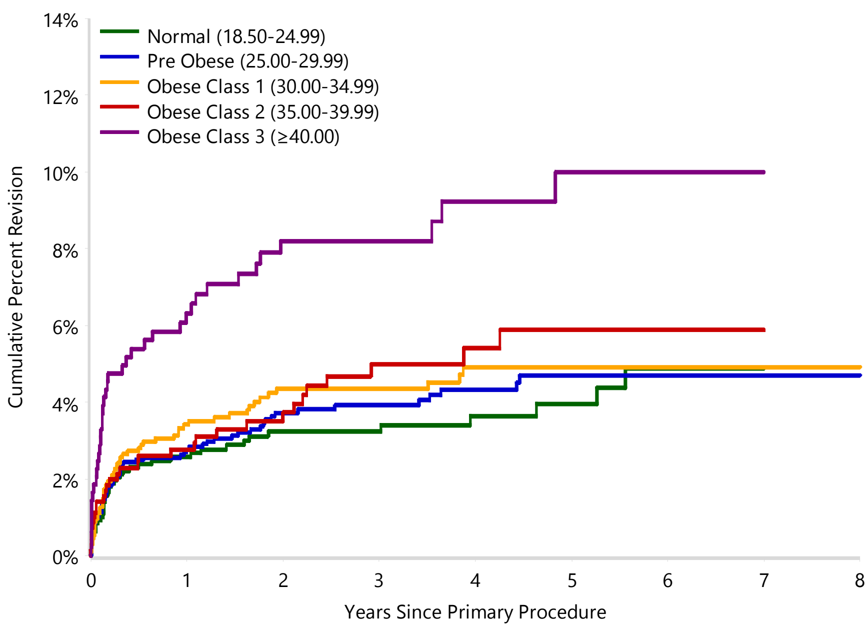
Note: Restricted to modern prostheses

Table ST122 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by BMI Category (Primary Diagnosis Fracture)

BMI Category	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Underweight (<18.50)	3	120	2.7 (0.9, 8.2)	2.7 (0.9, 8.2)	2.7 (0.9, 8.2)			
Normal (18.50-24.99)	43	1296	2.6 (1.8, 3.6)	3.2 (2.4, 4.4)	3.2 (2.4, 4.4)	3.6 (2.6, 5.0)	4.0 (2.8, 5.5)	4.9 (3.4, 7.1)
Pre Obese (25.00-29.99)	66	1765	2.8 (2.1, 3.7)	3.7 (2.9, 4.8)	3.9 (3.1, 5.0)	4.3 (3.4, 5.6)	4.7 (3.6, 6.0)	4.7 (3.6, 6.0)
Obese Class 1 (30.00-34.99)	56	1354	3.4 (2.6, 4.6)	4.3 (3.3, 5.7)	4.3 (3.3, 5.7)	4.9 (3.8, 6.4)	4.9 (3.8, 6.4)	4.9 (3.8, 6.4)
Obese Class 2 (35.00-39.99)	31	711	2.8 (1.8, 4.3)	3.7 (2.5, 5.5)	5.0 (3.4, 7.2)	5.4 (3.7, 7.8)	5.9 (4.0, 8.5)	5.9 (4.0, 8.5)
Obese Class 3 (≥40.00)	40	487	6.3 (4.5, 8.9)	8.2 (6.0, 11.2)	8.2 (6.0, 11.2)	9.2 (6.7, 12.6)	10.0 (7.2, 13.8)	10.0 (7.2, 13.8)
TOTAL	239	5733						

Note: BMI has not been presented for patients aged ≤19 years
Restricted to modern prostheses

Figure ST125 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by BMI Category (Primary Diagnosis Fracture)



HR - adjusted for age and gender

Pre Obese (25.00-29.99) vs Normal (18.50-24.99)
Entire Period: HR=1.04 (0.71, 1.53), p=0.823

Obese Class 1 (30.00-34.99) vs Normal (18.50-24.99)
Entire Period: HR=1.13 (0.76, 1.69), p=0.534

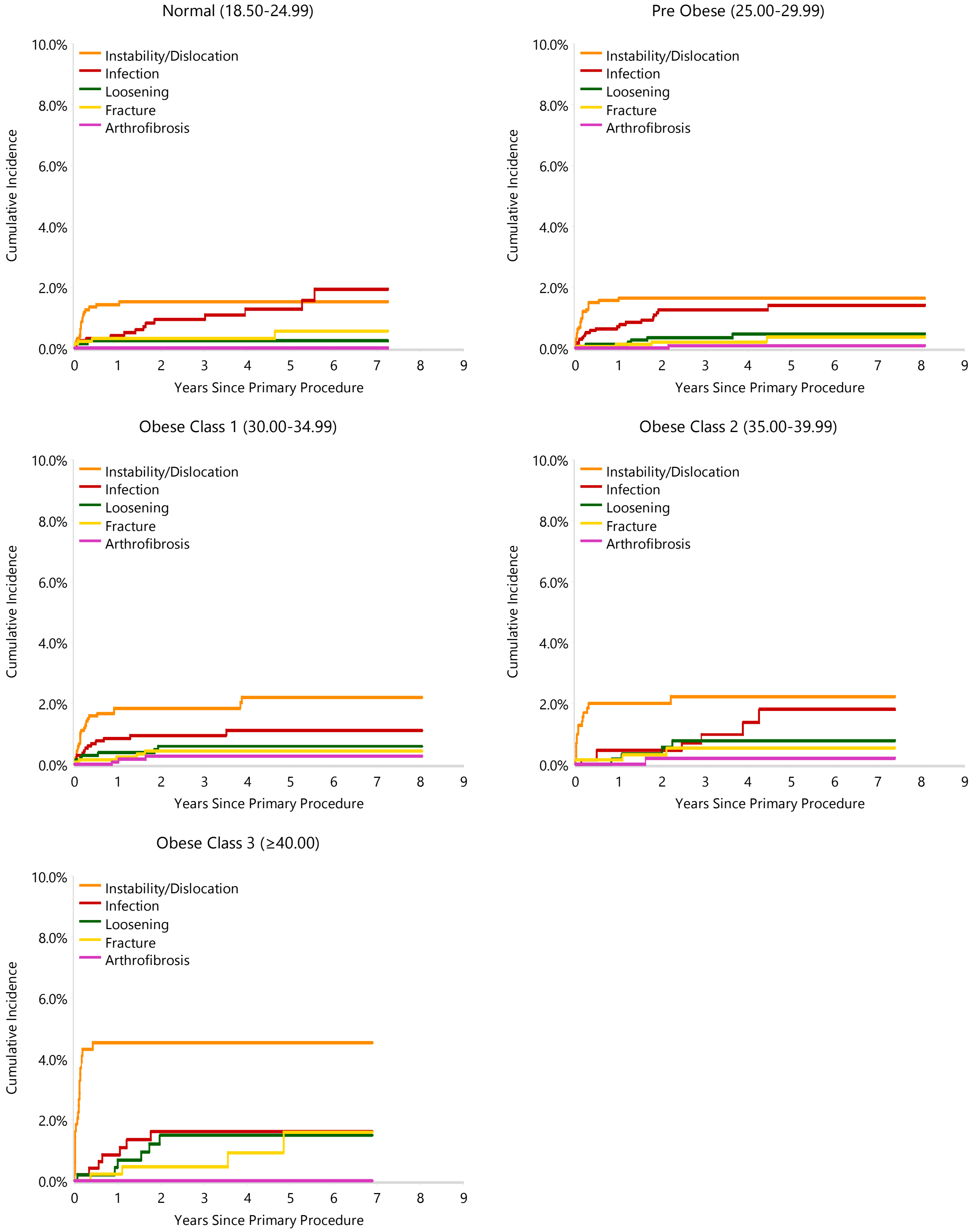
Obese Class 2 (35.00-39.99) vs Normal (18.50-24.99)
Entire Period: HR=1.25 (0.78, 1.99), p=0.347

Obese Class 3 (≥40.00) vs Normal (18.50-24.99)
Entire Period: HR=2.17 (1.39, 3.37), p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Normal (18.50-24.99)	1296	996	759	581	403	265	140
Pre Obese (25.00-29.99)	1765	1401	1080	822	618	413	268
Obese Class 1 (30.00-34.99)	1354	1055	848	662	467	333	200
Obese Class 2 (35.00-39.99)	711	564	429	302	213	159	96
Obese Class 3 (≥40.00)	487	386	307	225	166	112	68

Note: BMI has not been presented for patients aged ≤19 years
Restricted to modern prostheses

Figure ST126 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Reverse Shoulder Replacement by BMI Category (Primary Diagnosis Fracture)



Note: BMI has not been presented for patients aged ≤19 years
Restricted to modern prostheses

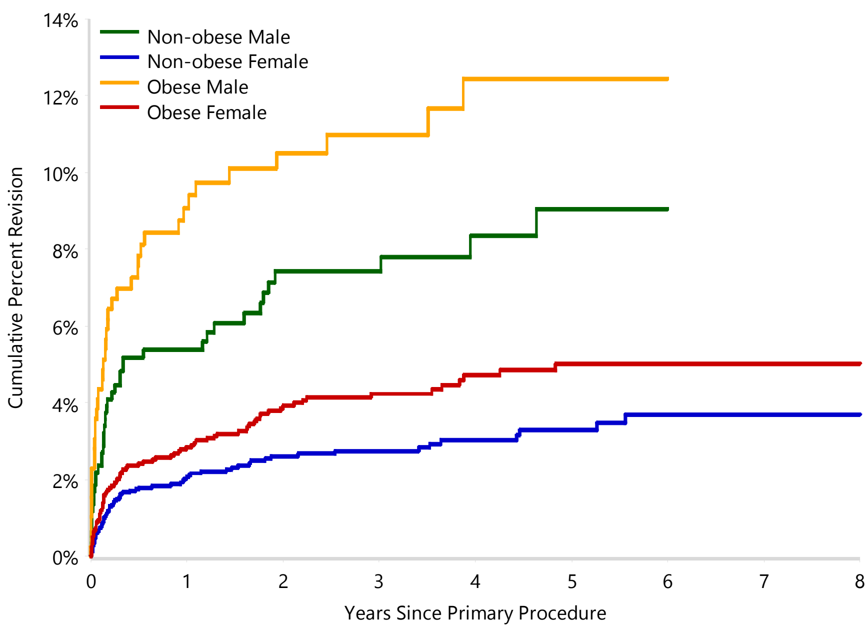
Primary Total Shoulder Replacement

Table ST123 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by BMI Category and Gender (Primary Diagnosis Fracture)

BMI Category	Gender	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Non-obese	Male	42	597	5.4 (3.8, 7.6)	7.4 (5.4, 10.1)	7.4 (5.4, 10.1)	8.3 (6.1, 11.4)	9.1 (6.5, 12.5)	9.1 (6.5, 12.5)
	Female	70	2584	2.1 (1.6, 2.7)	2.6 (2.0, 3.3)	2.7 (2.1, 3.5)	3.0 (2.4, 3.9)	3.3 (2.6, 4.2)	3.7 (2.8, 4.8)
Obese	Male	41	392	9.1 (6.6, 12.5)	10.5 (7.7, 14.2)	11.0 (8.1, 14.8)	12.4 (9.1, 16.9)	12.4 (9.1, 16.9)	12.4 (9.1, 16.9)
	Female	86	2160	2.8 (2.2, 3.7)	3.9 (3.1, 4.9)	4.2 (3.4, 5.3)	4.7 (3.8, 5.9)	5.0 (4.0, 6.3)	5.0 (4.0, 6.3)
TOTAL		239	5733						

Note: BMI has not been presented for patients ≤19 years
Restricted to modern prostheses

Figure ST127 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by BMI Category and Gender (Primary Diagnosis Fracture)



HR - adjusted for age

Non-obese Male vs Non-obese Female
Entire Period: HR=2.51 (1.71, 3.69), p<0.001

Non-obese Male vs Obese Male
Entire Period: HR=0.73 (0.47, 1.12), p=0.153

Non-obese Female vs Obese Female
Entire Period: HR=0.77 (0.56, 1.06), p=0.107

Obese Male vs Obese Female
0 - 1.5Yr: HR=2.86 (1.92, 4.26), p<0.001
1.5Yr - 2Yr: HR=1.51 (0.62, 3.67), p=0.367
2Yr+: HR=2.33 (0.98, 5.50), p=0.054

Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Non-obese	Male	597	441	325	245	167	113	73
	Female	2584	2052	1579	1202	886	590	353
Obese	Male	392	275	212	154	105	77	46
	Female	2160	1730	1372	1035	741	527	318

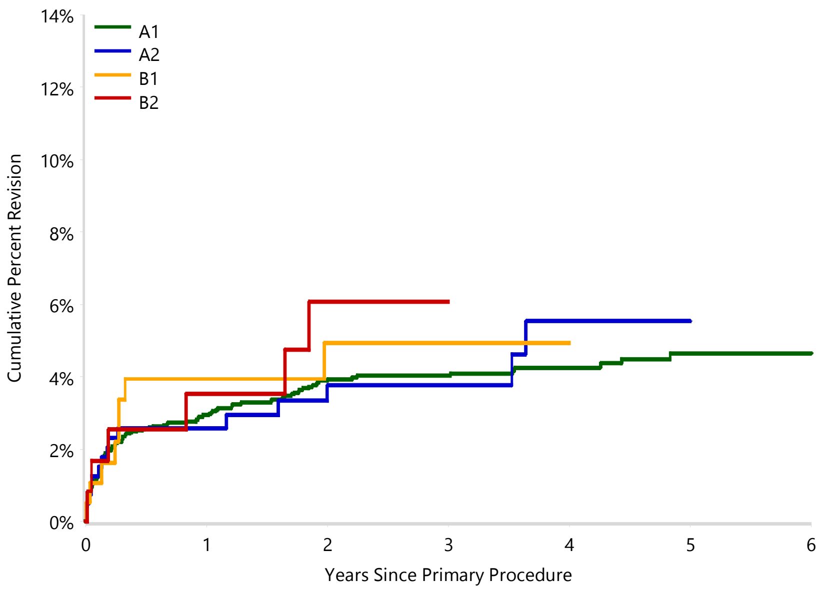
Note: BMI has not been presented for patients ≤19 years
Restricted to modern prostheses

Table ST124 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Glenoid Morphology (Primary Diagnosis Fracture)

Glenoid Morphology	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs
A1	144	3909	2.9 (2.5, 3.5)	3.9 (3.3, 4.6)	4.0 (3.4, 4.8)	4.3 (3.6, 5.0)
A2	15	400	2.6 (1.4, 4.7)	3.8 (2.2, 6.5)	3.8 (2.2, 6.5)	5.5 (3.1, 9.7)
B1	8	188	3.9 (1.9, 8.1)	4.9 (2.4, 9.8)	4.9 (2.4, 9.8)	4.9 (2.4, 9.8)
B2	7	119	3.5 (1.3, 9.1)	6.1 (2.7, 13.2)	6.1 (2.7, 13.2)	
C	1	45	2.3 (0.3, 15.4)	2.3 (0.3, 15.4)	2.3 (0.3, 15.4)	2.3 (0.3, 15.4)
TOTAL	175	4661				

Note: Restricted to modern prostheses

Figure ST128 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Glenoid Morphology (Primary Diagnosis Fracture)



HR - adjusted for age and gender

A1 vs A2

Entire Period: HR=0.90 (0.53, 1.53), p=0.698

B1 vs A2

Entire Period: HR=1.08 (0.46, 2.54), p=0.864

B2 vs A2

Entire Period: HR=1.35 (0.55, 3.32), p=0.510

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs
A1	3909	2988	2192	1546	980
A2	400	287	218	148	91
B1	188	127	96	70	47
B2	119	93	68	46	38

Note: Restricted to modern prostheses

OUTCOME FOR FRACTURE – PROSTHESIS CHARACTERISTICS

Glenoid Baseplate
A glenoid baseplate is categorised as augmented if the backside has been modified for glenoid deformity (eg wedged, stepped, angulated, or lateralised). Augmented and non-augmented glenoid baseplates revision rates did not differ for glenoid morphology category A (Table ST125 and Figure ST129). There are insufficient revisions to analyse glenoid morphology B or C categories.

Humeral Fixation, Stem Type and Stem Length
When total stemmed reverse shoulder replacement is used for the management of fracture, there is no difference when cementless fixation is used compared to hybrid fixation (humerus cemented) (Table ST126 and Figure ST130).

There is an increased rate of revision for non-fracture humeral stems compared to fracture humeral stems (Table ST127 and Figure ST131). When compared by fixation, a cemented fracture stem has a lower rate of revision than a cemented non fracture stem. There was no difference in the rate of revision when cementless fixation stems are used (Table ST128, Figure ST132 and Figure ST133).

There was no difference between a conventional length and a short humeral stem (Table ST129 and Figure ST134).

Polyethylene Type and Bearing Surface
Non XLPE is the most common polyethylene type used in primary total stemmed reverse shoulder replacement for the management of fracture. Both metal/XLPE and metal/non-XLPE after the first 3 months have a higher rate of revision than XLPE/metal (Table ST130 and Figure ST135).

The cumulative incidence for the most common reasons for revision of the different types of bearing surface are presented in Figure ST136.

Glenosphere Size and Lateralisation
Glenosphere sizes >40mm have a higher rate of revision compared to glenosphere sizes <38mm (Table ST131 and Figure ST137). The cumulative incidence for the most common reasons for revision of the different glenosphere sizes are presented in Figure ST138.

If the radius of curvature of the articular surface of the glenosphere is displaced laterally by design, it is categorised as a lateralised glenosphere. There is no difference in the rate of revision when lateralised and standard glenospheres are compared (Table ST132 and Figure ST139).

Glenosphere sizes >40mm have a higher rate of revision compared to <38mm sizes.

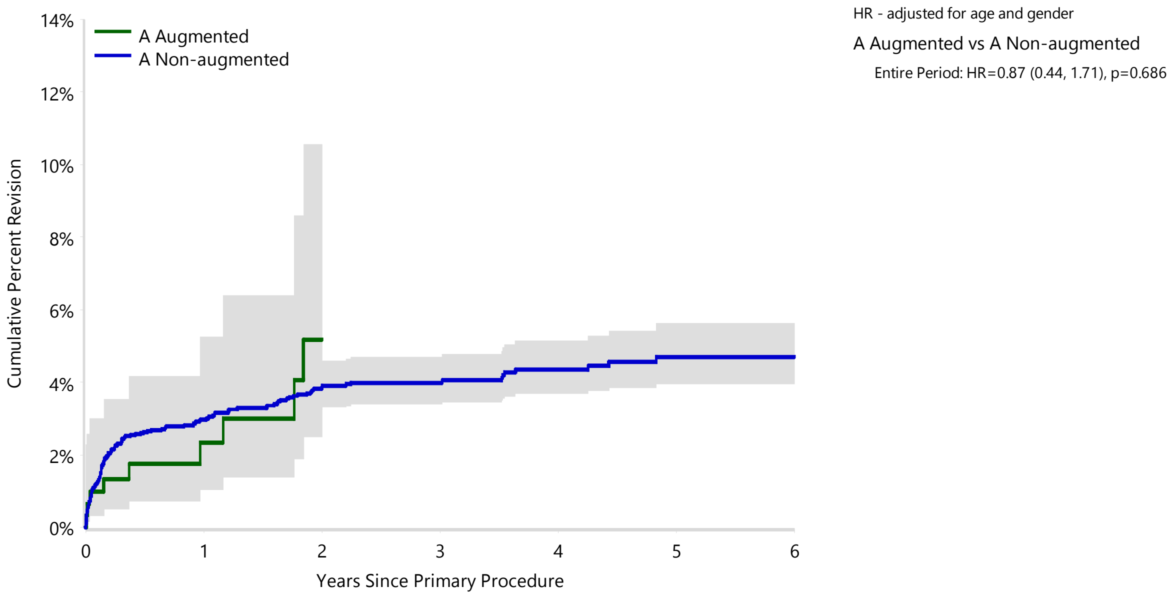
The outcomes of the most commonly used prosthesis combinations are listed in Table ST133. The most commonly used cementless prosthesis combinations are listed in Table ST134. The most commonly used hybrid (humerus cemented) prosthesis combinations are listed in Table ST135.

Table ST125 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Glenoid Morphology and Glenoid Augmentation (Primary Diagnosis Fracture)

Glenoid Morphology	Glenoid Augmentation	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
A	Augmented	9	306	2.3 (1.0, 5.3)	5.2 (2.5, 10.6)			
	Non-augmented	150	4003	3.0 (2.5, 3.6)	3.9 (3.3, 4.6)	4.0 (3.4, 4.7)	4.4 (3.7, 5.1)	4.7 (3.9, 5.6)
B	Augmented	2	66	3.3 (0.8, 12.5)	3.3 (0.8, 12.5)	3.3 (0.8, 12.5)		
	Non-augmented	13	241	3.9 (2.1, 7.4)	5.8 (3.3, 10.0)	5.8 (3.3, 10.0)	6.8 (3.9, 11.6)	6.8 (3.9, 11.6)
C	Augmented	0	11	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)			
	Non-augmented	1	34	3.0 (0.4, 19.6)	3.0 (0.4, 19.6)	3.0 (0.4, 19.6)	3.0 (0.4, 19.6)	3.0 (0.4, 19.6)
TOTAL		175	4661					

Note: Excludes 3,675 procedures with unknown glenoid augmentation or glenoid morphology. Restricted to modern prostheses

Figure ST129 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement with Glenoid Morphology A by Glenoid Augmentation (Primary Diagnosis Fracture)



Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
A	Augmented	306	165	77	31	16	6
	Non-augmented	4003	3110	2333	1663	1055	603

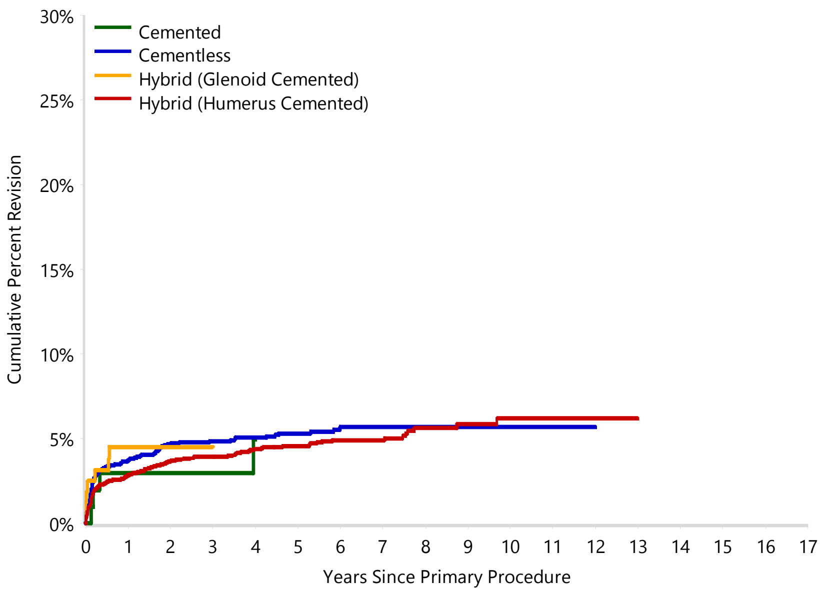
Note: Restricted to modern prostheses

Table ST126 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Fixation (Primary Diagnosis Fracture)

Fixation	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Cemented	5	108	3.0 (1.0, 8.9)	3.0 (1.0, 8.9)				
Cementless	124	2574	3.7 (3.0, 4.5)	4.8 (4.0, 5.8)	5.3 (4.4, 6.3)	5.7 (4.7, 6.8)	5.7 (4.7, 6.8)	
Hybrid (Glenoid Cemented)	7	161	4.5 (2.2, 9.3)	4.5 (2.2, 9.3)				
Hybrid (Humerus Cemented)	221	5493	2.8 (2.4, 3.3)	3.9 (3.4, 4.5)	4.6 (4.0, 5.3)	4.9 (4.3, 5.7)	6.2 (5.1, 7.5)	
TOTAL	357	8336						

Note: Restricted to modern prostheses

Figure ST130 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Fixation (Primary Diagnosis Fracture)



HR - adjusted for age and gender

Cemented vs Hybrid (Humerus Cemented)
Entire Period: HR=1.11 (0.46, 2.70), p=0.814

Cementless vs Hybrid (Humerus Cemented)
0 - 3Mth: HR=1.33 (0.99, 1.78), p=0.055
3Mth+: HR=0.86 (0.61, 1.19), p=0.360

Hybrid (Glenoid Cemented) vs
Hybrid (Humerus Cemented)
Entire Period: HR=1.21 (0.57, 2.57), p=0.615

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Cemented	108	88	61	37	17	10	2
Cementless	2574	2106	1466	973	521	159	32
Hybrid (Glenoid Cemented)	161	119	55	28	14	1	1
Hybrid (Humerus Cemented)	5493	4477	2859	1636	827	235	22

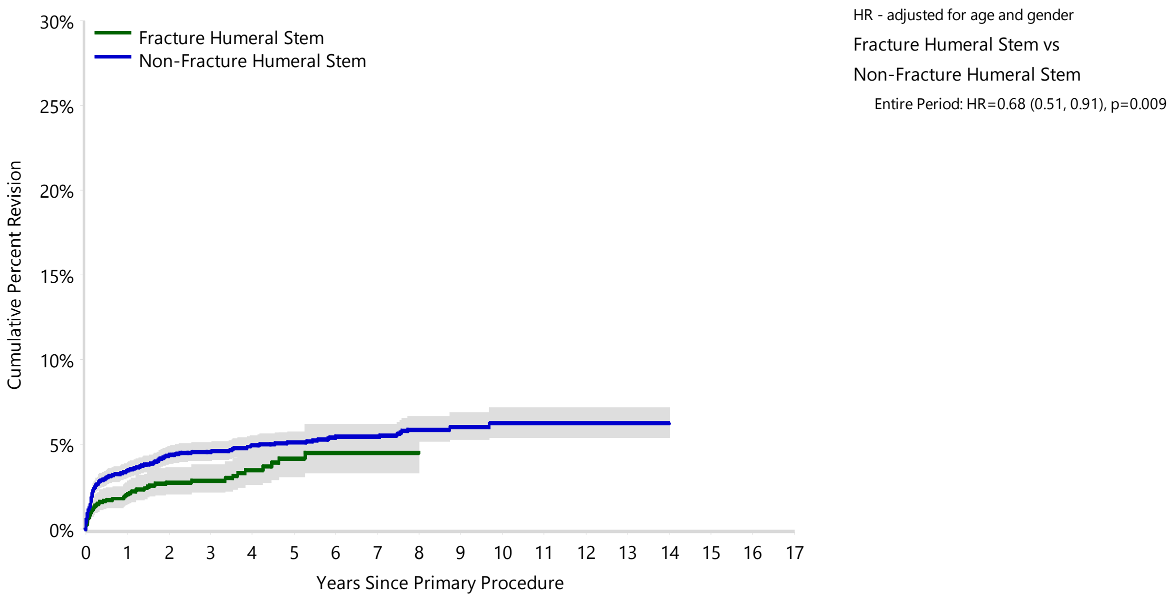
Note: Restricted to modern prostheses

Table ST127 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Stem Type (Primary Diagnosis Fracture)

Stem Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Fracture Humeral Stem	55	1896	2.1 (1.5, 2.8)	2.9 (2.1, 3.8)	4.2 (3.1, 5.7)	4.5 (3.3, 6.2)		
Non-Fracture Humeral Stem	302	6440	3.5 (3.0, 3.9)	4.6 (4.1, 5.1)	5.1 (4.6, 5.7)	5.4 (4.8, 6.1)	6.2 (5.4, 7.2)	6.2 (5.4, 7.2)
TOTAL	357	8336						

Note: Restricted to modern prostheses

Figure ST131 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Stem Type (Primary Diagnosis Fracture)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Fracture Humeral Stem	1896	1449	782	328	108	6	0
Non-Fracture Humeral Stem	6440	5341	3659	2346	1271	399	57

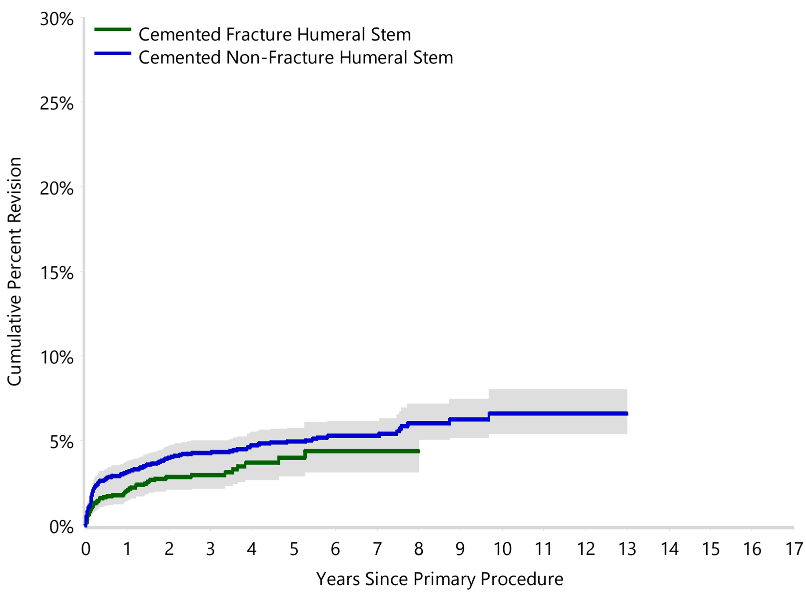
Note: Restricted to modern prostheses

Table ST128 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Humeral Fixation and Stem Type (Primary Diagnosis Fracture)

Humeral Fixation	Stem Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Cementless	Fracture Humeral Stem	6	205	2.0 (0.7, 5.2)	2.0 (0.7, 5.2)				
	Non-Fracture Humeral Stem	125	2530	3.9 (3.2, 4.8)	5.1 (4.2, 6.0)	5.4 (4.5, 6.4)	5.7 (4.8, 6.8)	5.7 (4.8, 6.8)	
Cemented	Fracture Humeral Stem	49	1691	2.1 (1.5, 2.9)	3.0 (2.2, 4.0)	4.0 (2.9, 5.5)	4.4 (3.1, 6.1)		
	Non-Fracture Humeral Stem	177	3910	3.2 (2.7, 3.8)	4.3 (3.6, 5.0)	5.0 (4.2, 5.8)	5.3 (4.5, 6.2)	6.6 (5.4, 8.0)	
TOTAL		357	8336						

Note: Restricted to modern prostheses

Figure ST132 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement with Cemented Humeral Fixation by Stem Type (Primary Diagnosis Fracture)

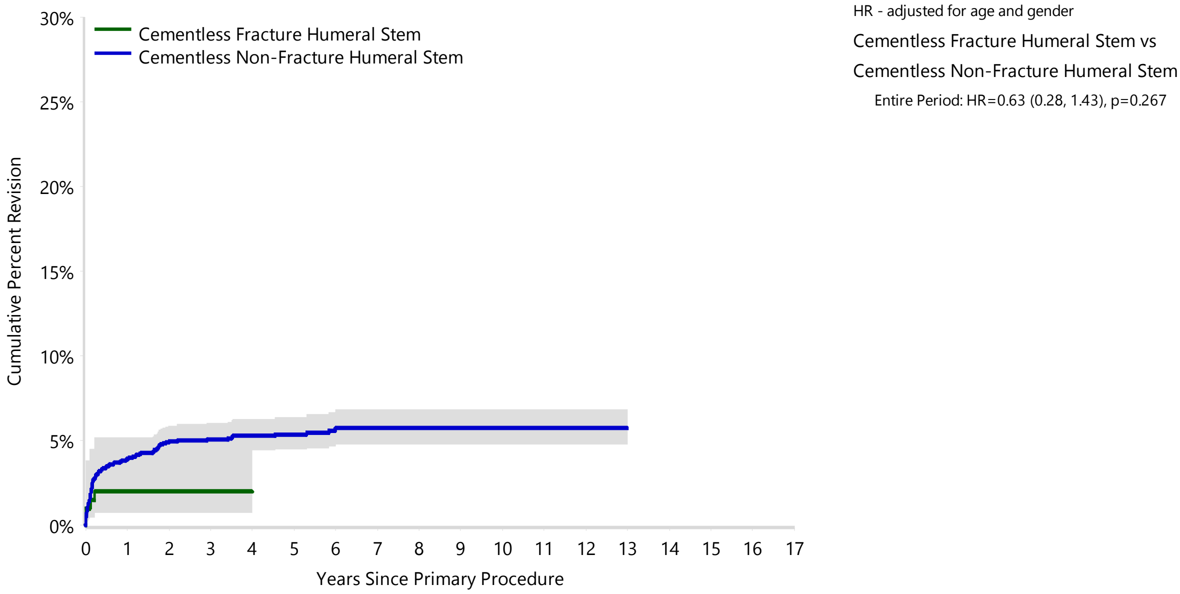


HR - adjusted for age and gender
Cemented Fracture Humeral Stem vs
Cemented Non-Fracture Humeral Stem
Entire Period: HR=0.70 (0.51, 0.96), p=0.029

	Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Cemented	Fracture Humeral Stem	1691	1296	694	290	93	5	0
	Non-Fracture Humeral Stem	3910	3269	2226	1383	751	240	24

Note: Restricted to modern prostheses

Figure ST133 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement with Cementless Humeral Fixation by Stem Type (Primary Diagnosis Fracture)



	Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Cementless	**Fracture Humeral Stem**	205	153	88	38	15	1	0
	Non-Fracture Humeral Stem	2530	2072	1433	963	520	159	33

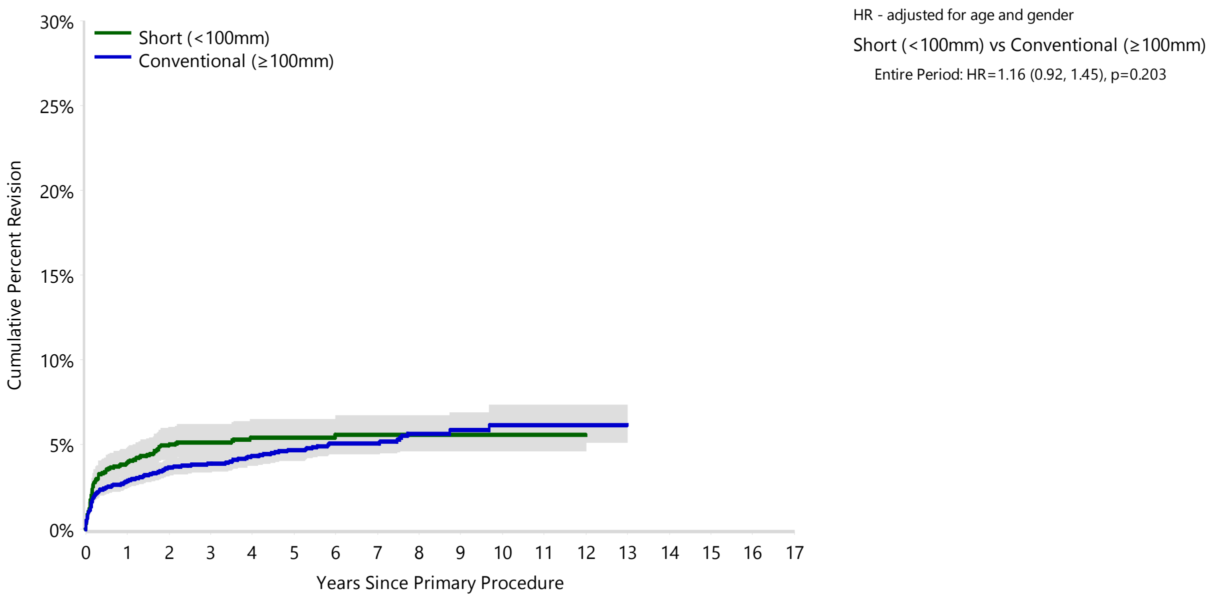
Note: Restricted to modern prostheses

Table ST129 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Humeral Stem Length (Primary Diagnosis Fracture)

Humeral Stem Length	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Short (<100mm)	110	2271	3.9 (3.2, 4.8)	5.1 (4.3, 6.2)	5.4 (4.5, 6.5)	5.6 (4.6, 6.7)	5.6 (4.6, 6.7)	
Conventional (≥100mm)	247	6062	2.9 (2.5, 3.3)	3.9 (3.4, 4.4)	4.6 (4.1, 5.3)	5.1 (4.4, 5.8)	6.2 (5.1, 7.4)	
TOTAL	357	8333						

Note: Excludes 3 procedures with unknown humeral stem length
Restricted to modern prostheses

Figure ST134 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Humeral Stem Length (Primary Diagnosis Fracture)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Short (<100mm)	2271	1798	1180	757	414	138	33
Conventional (≥100mm)	6062	4991	3261	1917	965	267	24

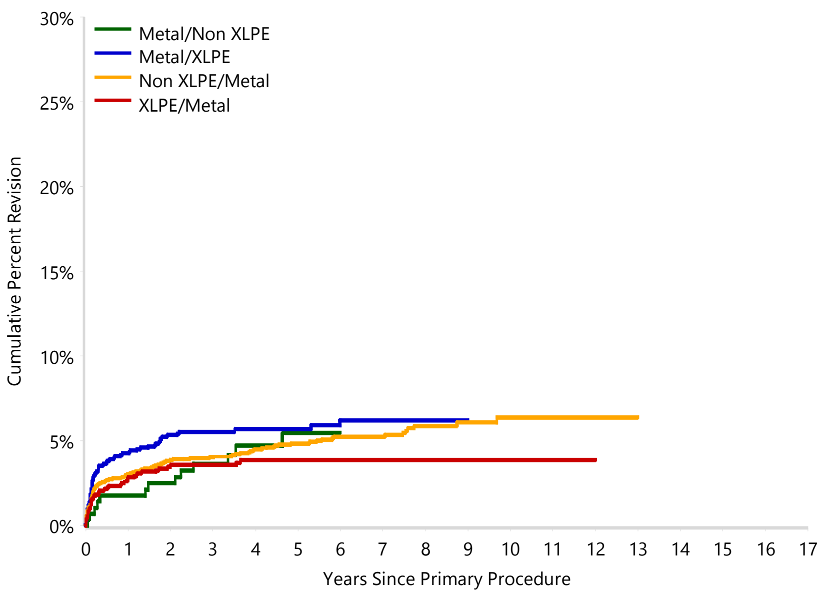
Note: Restricted to modern prostheses

Table ST130 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Bearing Surface (Primary Diagnosis Fracture)

Bearing Surface	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Ceramic/XLPE	0	4	0.0 (0.0, 0.0)					
Metal/Non XLPE	13	286	1.8 (0.7, 4.2)	3.7 (2.0, 6.7)	5.5 (3.1, 9.4)			
Metal/XLPE	77	1445	4.3 (3.3, 5.5)	5.5 (4.4, 6.9)	5.7 (4.5, 7.1)	6.2 (4.9, 7.9)		
Non XLPE/Metal	214	4952	3.0 (2.6, 3.5)	4.0 (3.5, 4.7)	4.8 (4.2, 5.6)	5.2 (4.5, 6.0)	6.4 (5.3, 7.7)	
XLPE/Metal	53	1629	2.8 (2.1, 3.8)	3.6 (2.7, 4.7)	3.9 (3.0, 5.1)	3.9 (3.0, 5.1)	3.9 (3.0, 5.1)	
TOTAL	357	8316						

Note: Restricted to modern prostheses, reported humeral cup/glenosphere
Excludes 20 procedures with unknown bearing surface

Figure ST135 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Bearing Surface (Primary Diagnosis Fracture)



HR - adjusted for age and gender

Metal/Non XLPE vs XLPE/Metal
0 - 3Mth: HR=0.57 (0.18, 1.83), p=0.346
3Mth+: HR=2.07 (1.04, 4.11), p=0.038

Metal/XLPE vs XLPE/Metal
Entire Period: HR=1.45 (1.02, 2.06), p=0.037

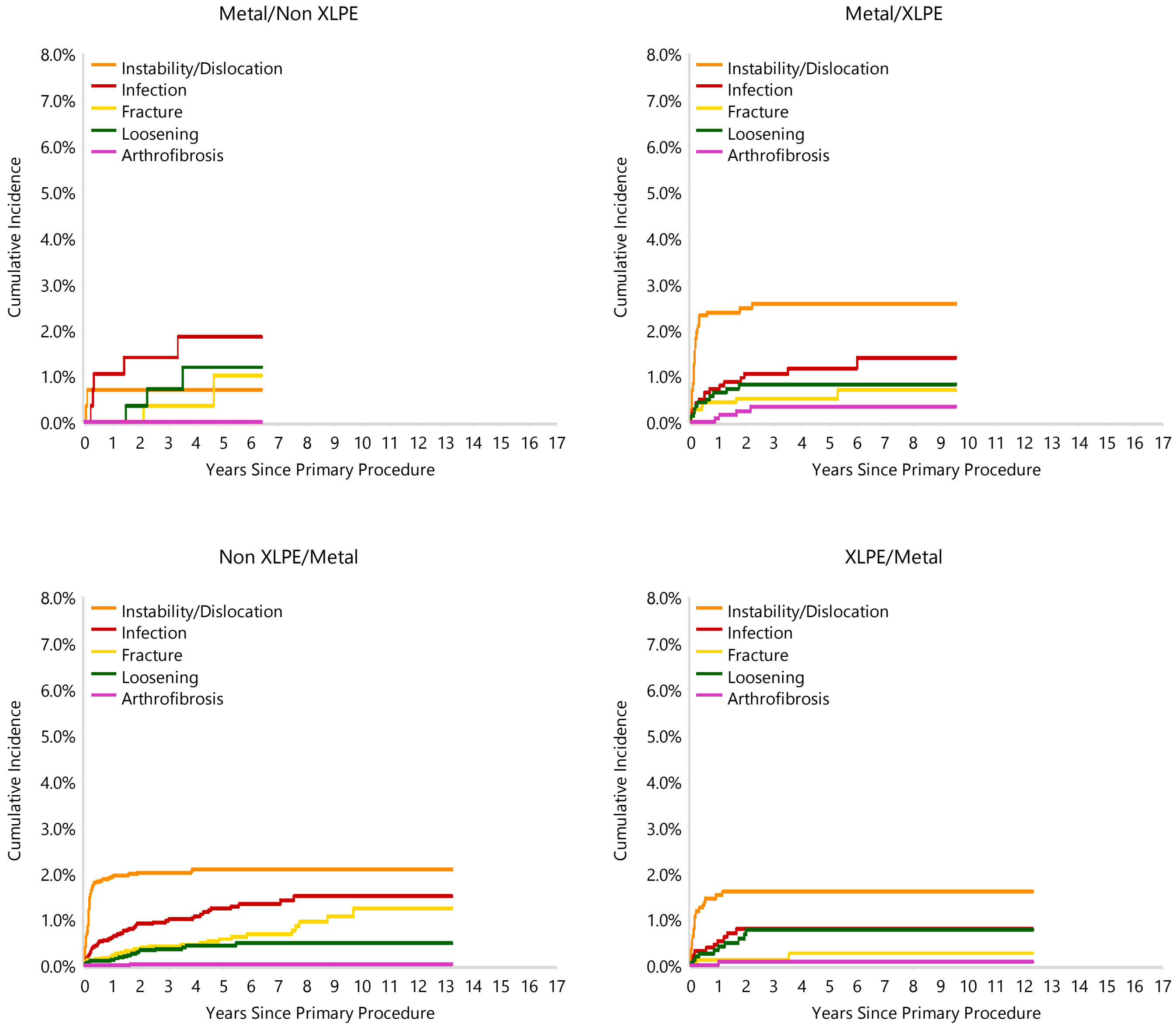
Non XLPE/Metal vs XLPE/Metal
Entire Period: HR=1.26 (0.93, 1.71), p=0.130

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Metal/Non XLPE	286	271	215	113	23	0	0
Metal/XLPE	1445	1185	777	447	192	29	1
Non XLPE/Metal	4952	4095	2723	1661	885	259	24
XLPE/Metal	1629	1217	713	442	269	116	32

Note: Restricted to modern prostheses, reported humeral cup/glenosphere

Primary Total Shoulder Replacement

Figure ST136 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Reverse Shoulder Replacement by Bearing Surface (Primary Diagnosis Fracture)



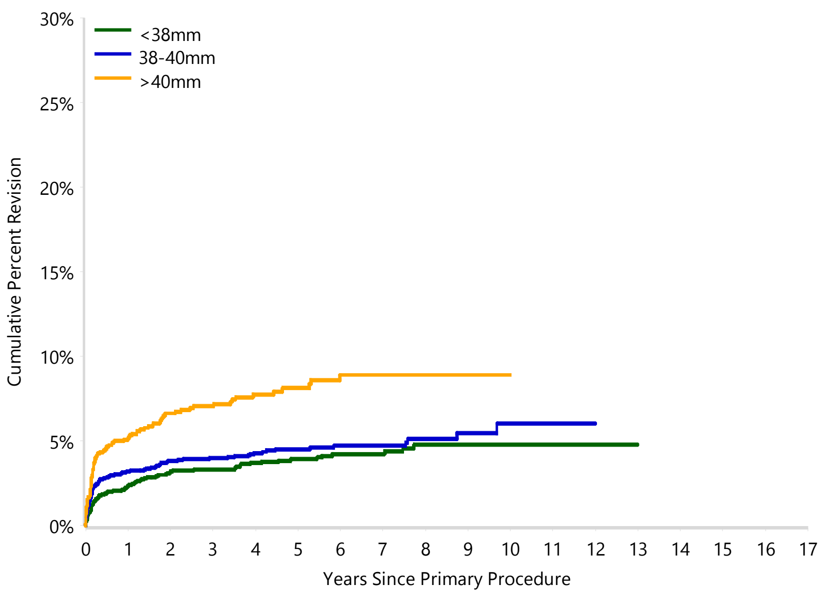
Note: Restricted to modern prostheses

Table ST131 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Glenosphere Size (Primary Diagnosis Fracture)

Glenosphere Size	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
<38mm	116	3442	2.4 (1.9, 2.9)	3.3 (2.7, 4.0)	3.9 (3.2, 4.8)	4.2 (3.5, 5.2)	4.8 (3.9, 5.9)	
38-40mm	137	3308	3.2 (2.6, 3.9)	4.0 (3.4, 4.8)	4.5 (3.8, 5.3)	4.7 (3.9, 5.6)	6.0 (4.6, 7.9)	
>40mm	97	1327	5.2 (4.1, 6.5)	7.1 (5.7, 8.6)	8.1 (6.6, 9.9)	8.9 (7.2, 10.9)	8.9 (7.2, 10.9)	
TOTAL	350	8077						

Note: Excludes 259 procedures with unknown glenosphere sizes
Restricted to modern prostheses

Figure ST137 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Glenosphere Size (Primary Diagnosis Fracture)



HR - adjusted for age and gender

38-40mm vs <38mm
Entire Period: HR=1.17 (0.92, 1.50), p=0.202

>40mm vs <38mm
Entire Period: HR=1.42 (1.06, 1.90), p=0.018

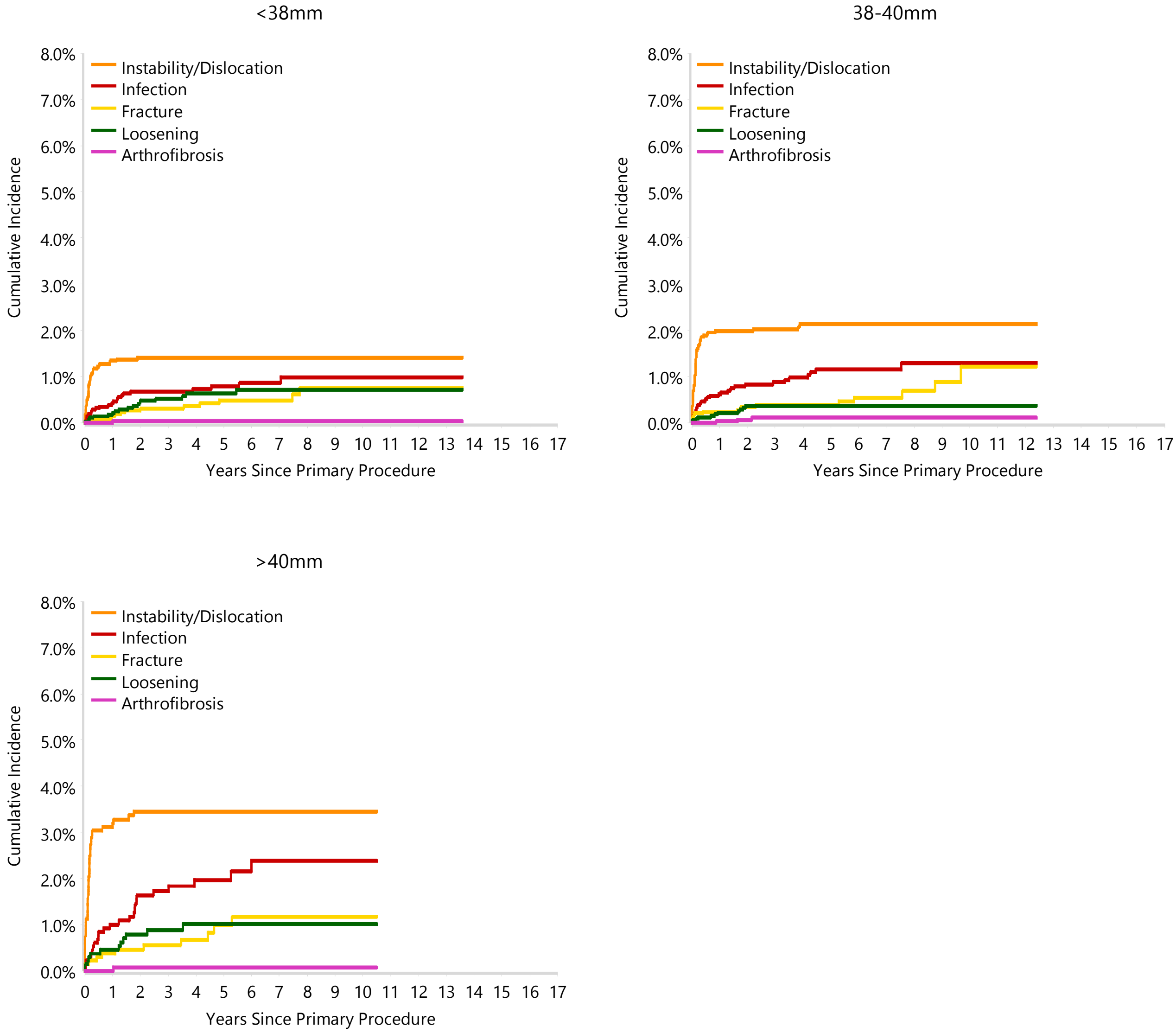
>40mm vs 38-40mm
0 - 3Mth: HR=1.27 (0.90, 1.81), p=0.178
3Mth+: HR=1.14 (0.78, 1.66), p=0.511

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
<38mm	3442	2754	1759	1097	604	213	39
38-40mm	3308	2773	1913	1145	584	137	15
>40mm	1327	1121	755	427	187	53	3

Note: Restricted to modern prostheses

Primary Total Shoulder Replacement

Figure ST138 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Reverse Shoulder Replacement by Glenosphere Size (Primary Diagnosis Fracture)



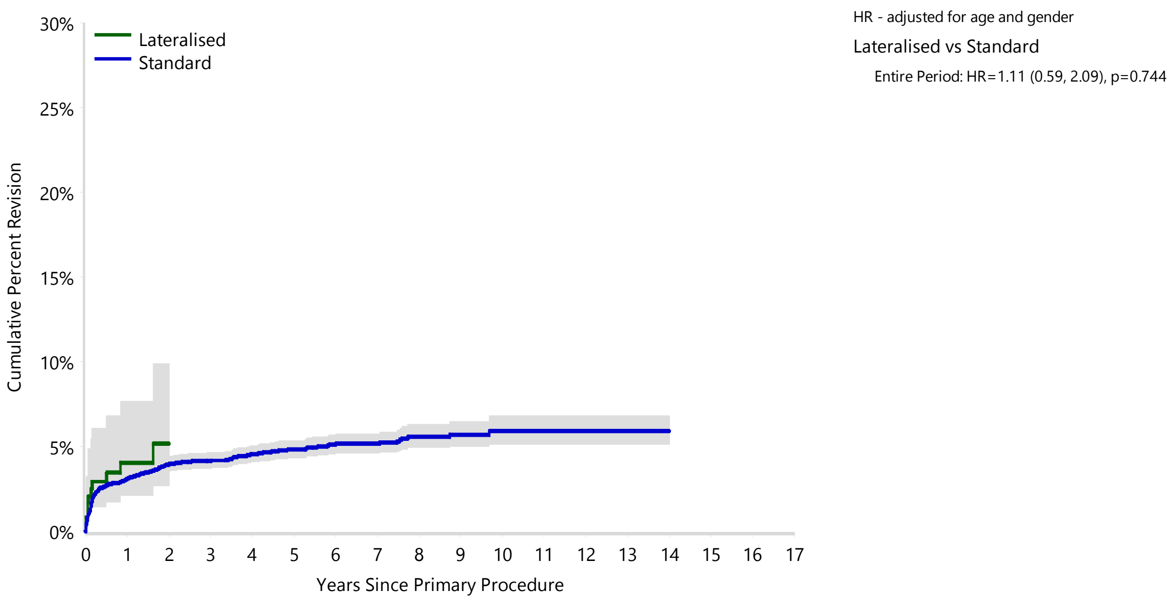
Note: Restricted to modern prostheses

Table ST132 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Glenosphere Lateralisation (Primary Diagnosis Fracture)

Glenoid Lateralisation	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Lateralised	10	243	4.0 (2.1, 7.7)					
Standard	346	8086	3.1 (2.7, 3.5)	4.2 (3.7, 4.7)	4.8 (4.3, 5.4)	5.2 (4.6, 5.8)	5.9 (5.1, 6.8)	5.9 (5.1, 6.8)
TOTAL	356	8329						

Note: Excludes 7 procedures with unknown lateralisation
Restricted to modern prostheses

Figure ST139 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Glenosphere Lateralisation (Primary Diagnosis Fracture)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Lateralised	243	143	25	7	3	0	0
Standard	8086	6643	4414	2666	1375	404	57

Note: Restricted to modern prostheses

Primary Total Shoulder Replacement

Table ST133 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Prosthesis Combination (Primary Diagnosis Fracture)

Humeral Stem	Glenoid Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Aequalis	Aequalis	48	1304	2.2 (1.5, 3.2)	2.9 (2.1, 4.0)	4.1 (3.0, 5.5)	4.5 (3.3, 6.2)	5.9 (4.1, 8.3)	
	Perform Reversed	3	82	4.0 (1.0, 15.6)					
Affinis	Affinis	16	368	2.2 (1.1, 4.4)	3.8 (2.2, 6.5)	5.4 (3.3, 8.9)			
AltiVate Reverse	RSP	7	250	2.8 (1.3, 6.1)					
Ascend Flex	Aequalis	3	77	2.8 (0.7, 10.8)	4.7 (1.5, 14.0)	4.7 (1.5, 14.0)			
Comprehensive	Comprehensive Reverse	23	983	2.0 (1.3, 3.2)	2.6 (1.7, 4.0)	3.3 (2.1, 5.1)	3.3 (2.1, 5.1)		
Delta Xtend	Delta Xtend	81	1473	4.0 (3.1, 5.1)	4.9 (3.9, 6.2)	5.4 (4.3, 6.8)	5.7 (4.6, 7.1)	7.1 (5.4, 9.2)	
Equinoxe	Equinoxe	30	645	3.3 (2.1, 5.0)	5.4 (3.7, 7.8)	6.7 (4.5, 10.1)			
Global Unite	Delta Xtend	15	529	2.2 (1.2, 3.9)	2.4 (1.4, 4.2)	4.3 (2.2, 8.3)			
RSP	RSP	13	217	3.3 (1.6, 6.7)	5.9 (3.4, 10.2)	6.8 (4.0, 11.7)			
SMR	SMR L1	101	1835	4.5 (3.6, 5.5)	5.7 (4.7, 6.9)	5.8 (4.8, 7.0)	6.1 (5.0, 7.4)	6.1 (5.0, 7.4)	
Trabecular Metal	Comprehensive Reverse	3	115	2.6 (0.9, 8.0)					
	Trabecular Metal	9	292	2.1 (0.9, 4.6)	2.9 (1.5, 5.8)	2.9 (1.5, 5.8)	3.7 (1.9, 7.2)		
Other (16)		5	166	2.7 (1.0, 7.0)					
TOTAL		357	8336						

Note Restricted to modern prostheses
Only prostheses with >50 procedures have been listed

Table ST134 Cumulative Percent Revision of Cementless Primary Total Stemmed Reverse Shoulder Replacement by Prosthesis Combination (Primary Diagnosis Fracture)

Humeral Stem	Glenoid Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Aequalis	Aequalis	5	62	3.2 (0.8, 12.3)	3.2 (0.8, 12.3)	9.6 (4.1, 21.7)	9.6 (4.1, 21.7)		
Comprehensive	Comprehensive Reverse	5	219	2.1 (0.8, 5.7)	3.1 (1.2, 7.5)				
Delta Xtend	Delta Xtend	8	217	1.8 (0.7, 4.9)	3.4 (1.6, 7.0)	3.4 (1.6, 7.0)	4.2 (2.1, 8.5)		
Equinoxe	Equinoxe	5	110	3.7 (1.4, 9.5)	5.2 (2.1, 12.4)				
Global Unite	Delta Xtend	4	123	1.6 (0.4, 6.4)	1.6 (0.4, 6.4)				
SMR	SMR L1	89	1565	4.6 (3.6, 5.7)	5.8 (4.7, 7.1)	5.9 (4.8, 7.3)	6.3 (5.1, 7.7)	6.3 (5.1, 7.7)	
Trabecular Metal	Trabecular Metal	2	59	3.4 (0.9, 12.9)	3.4 (0.9, 12.9)	3.4 (0.9, 12.9)	3.4 (0.9, 12.9)	3.4 (0.9, 12.9)	
Other (15)		6	219	2.5 (1.0, 5.9)	3.3 (1.5, 7.4)				
TOTAL		124	2574						

Note Restricted to modern prostheses
Only prostheses with >50 procedures have been listed

Table ST135 Cumulative Percent Revision of Hybrid (Humerus Cemented) Primary Total Stemmed Reverse Shoulder Replacement by Prosthesis Combination (Primary Diagnosis Fracture)

Humeral Stem	Glenoid Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Aequalis	Aequalis	42	1222	2.2 (1.5, 3.2)	2.9 (2.1, 4.0)	3.5 (2.5, 4.8)	4.0 (2.9, 5.6)	5.5 (3.7, 8.1)	
	Perform Reversed	3	80	4.0 (1.0, 15.7)					
Affinis	Affinis	15	345	2.1 (1.0, 4.3)	3.8 (2.2, 6.6)	5.5 (3.2, 9.1)			
AltiVate Reverse	RSP	6	204	2.9 (1.2, 6.9)					
Comprehensive	Comprehensive Reverse	17	715	2.0 (1.2, 3.4)	2.5 (1.5, 4.1)	3.5 (2.0, 5.9)			
Delta Xtend	Delta Xtend	70	1233	4.2 (3.2, 5.5)	5.0 (3.9, 6.4)	5.6 (4.4, 7.2)	5.8 (4.6, 7.3)	7.5 (5.6, 10.0)	
Equinoxe	Equinoxe	22	508	2.9 (1.7, 4.9)	5.3 (3.4, 8.2)	6.3 (3.9, 10.0)			
Global Unite	Delta Xtend	10	372	2.3 (1.1, 4.5)	2.6 (1.4, 5.0)				
RSP	RSP	13	172	4.1 (2.0, 8.5)	7.4 (4.3, 12.8)	8.6 (5.0, 14.5)			
SMR	SMR L1	9	240	3.0 (1.4, 6.2)	4.2 (2.2, 7.9)	4.2 (2.2, 7.9)	4.2 (2.2, 7.9)		
Trabecular Metal	Comprehensive Reverse	3	97	3.1 (1.0, 9.4)	3.1 (1.0, 9.4)				
	Trabecular Metal	7	217	1.9 (0.7, 5.0)	3.0 (1.4, 6.7)	3.0 (1.4, 6.7)	4.2 (1.9, 9.2)		
Other (12)		4	88	3.6 (1.2, 10.8)	5.8 (2.1, 15.4)	5.8 (2.1, 15.4)			
TOTAL		221	5493						

Note Restricted to modern prostheses
Only prostheses with >50 procedures have been listed

Special Clinical Assessment – Shoulder Osteoarthritis

The purpose of the following analysis is to inform surgeons about the outcome of specific clinical options across several shoulder prosthesis categories. This special clinical analysis evaluates glenohumeral osteoarthritis and the following prosthesis class choices for its surgical management: hemi stemmed anatomic with a pyrocarbon humeral head, total stemmed anatomic with a polyethylene glenoid, total stemless anatomic with a polyethylene glenoid, total stemmed reverse with a lateralised glenosphere and a total stemmed reverse with a standard glenosphere procedures (Table ST136 and Figure ST140). A polyethylene glenoid excludes modular metal backed glenoids in total shoulder anatomic procedures.

It is important to recognise that there are patient and prosthesis factors that may further confound the results beyond that which are presented here.

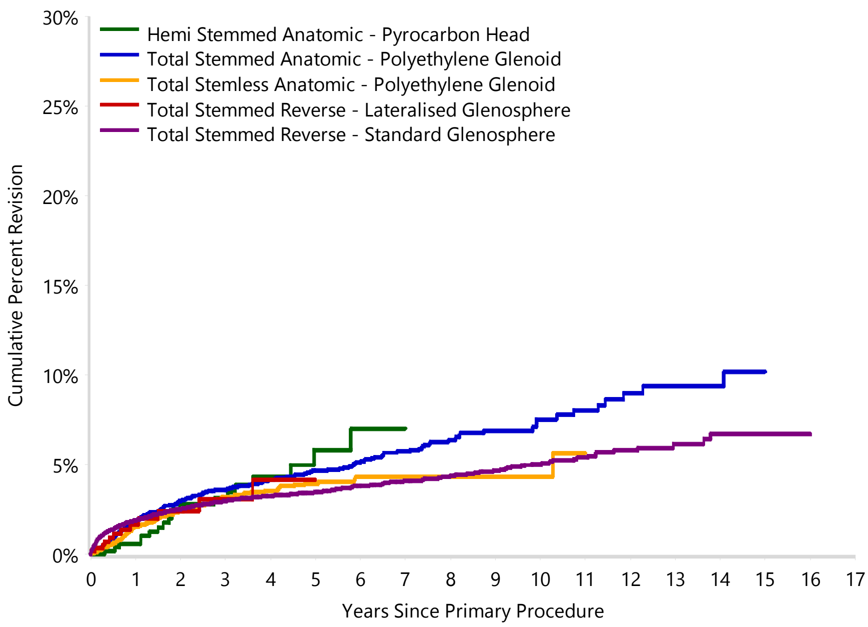
Primary Total Shoulder Replacement

Table ST136 Cumulative Percent Revision of Primary Shoulder Replacement by Class (Primary Diagnosis OA)

Shoulder Class	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Hemi Stemmed Anatomic - Pyrocarbon Head	19	563	0.6 (0.2, 1.8)	3.1 (1.8, 5.3)	5.8 (3.5, 9.7)	7.0 (4.1, 11.9)		
Total Stemmed Anatomic - Polyethylene Glenoid	245	5153	1.8 (1.5, 2.2)	3.6 (3.1, 4.2)	4.7 (4.1, 5.4)	5.7 (5.0, 6.6)	7.5 (6.4, 8.9)	9.4 (7.6, 11.5)
Total Stemless Anatomic - Polyethylene Glenoid	124	4383	1.5 (1.2, 2.0)	3.2 (2.7, 3.9)	4.0 (3.3, 4.8)	4.3 (3.5, 5.2)	4.3 (3.5, 5.2)	
Total Stemmed Reverse - Lateralised Glenosphere	12	598	1.7 (0.8, 3.4)	3.1 (1.6, 5.8)	4.2 (2.1, 8.3)			
Total Stemmed Reverse - Standard Glenosphere	754	23299	1.9 (1.7, 2.1)	3.0 (2.8, 3.2)	3.5 (3.2, 3.7)	4.1 (3.8, 4.4)	5.0 (4.6, 5.5)	6.7 (5.6, 7.9)
TOTAL	1154	33996						

Note: Restricted to modern prostheses

Figure ST140 Cumulative Percent Revision of Primary Shoulder Replacement by Class (Primary Diagnosis OA)



HR - adjusted for age and gender

Hemi Stemmed Anatomic - Pyrocarbon Head vs
Total Stemmed Reverse - Standard Glenosphere
0 - 6Mth: HR=0.07 (0.01, 0.50), p=0.007
6Mth - 1.5Yr: HR=0.74 (0.32, 1.67), p=0.465
1.5Yr+: HR=1.38 (0.76, 2.50), p=0.285

Total Stemmed Anatomic - Polyethylene Glenoid vs
Total Stemmed Reverse - Standard Glenosphere
0 - 3Mth: HR=0.31 (0.20, 0.49), p<0.001
3Mth+: HR=1.43 (1.21, 1.68), p<0.001

Total Stemless Anatomic - Polyethylene Glenoid vs
Total Stemmed Reverse - Standard Glenosphere
0 - 3Mth: HR=0.22 (0.13, 0.39), p<0.001
3Mth+: HR=1.06 (0.86, 1.31), p=0.599

Total Stemmed Reverse - Lateralised Glenosphere vs
Total Stemmed Reverse - Standard Glenosphere
Entire Period: HR=0.87 (0.49, 1.54), p=0.637

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Hemi Stemmed Anatomic - Pyrocarbon Head	563	459	269	111	46	0	0
Total Stemmed Anatomic - Polyethylene Glenoid	5153	4657	3588	2441	1396	417	116
Total Stemless Anatomic - Polyethylene Glenoid	4383	3511	2133	1074	423	85	0
Total Stemmed Reverse - Lateralised Glenosphere	598	321	112	43	12	3	0
Total Stemmed Reverse - Standard Glenosphere	23299	19632	13712	8653	4751	1627	308

Note: Restricted to modern prostheses

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Prostheses with Higher than Anticipated Rates of Revision

Prostheses with Higher than Anticipated Rates of Revision

Introduction

A unique and important function of registries is that they are able to provide population based data on the comparative outcome of individual prostheses in a community. Outcome data are necessary to enable an evidence-based approach to prosthesis selection. For many prostheses, the only source of outcome data are Registry reports.

It is evident from Registry data that most prostheses have similar outcomes. However, a number have a rate of revision that is statistically higher than other prostheses in the same class. The Registry identifies these as 'prostheses with a higher than anticipated rate of revision'.

The Registry has developed a standardised three-stage approach to identify prostheses that are outliers with respect to rate of revision. In order to keep Registry data contemporaneous, only procedures using prostheses that have been available and used in 2023 (described as modern prostheses) are included as the comparator within the class. This is a more pragmatic approach than comparing to a select group of prostheses with the lowest rate of revision.

STAGE 1

The first stage is a screening test to identify prostheses that differ significantly from the combined revisions per 100 observed component years of all other modern prostheses in the same class. The analysis is automated and identifies prostheses based on set criteria. These include:

1. The revision rate (per 100 component years) exceeds twice that for the group,
   and
2. The Poisson probability of observing that number of revisions, given the rate of the group is significant ($p<0.05$),
   and either:
3. There are at least 10 primary procedures for that component,
   or
4. The proportion revised is at least 75% and there have been at least two revisions.

The Registry has the capacity to assess the outcome of individual prostheses or combinations of prostheses used in a procedure. It is apparent from previous reports that individual prostheses that perform well in one combination, may not perform well in another. Therefore, the outcome of an individual prosthesis is partly dependent on the combination of the different prostheses used.

Consequently, the Registry undertakes two different analyses in Stage 1. The first assesses the outcome of all combinations. The second assesses all individual prostheses regardless of the combination. Both analyses are reviewed to determine if a higher revision rate is identified with a single combination, multiple combinations, or uniformly with all combinations. If prostheses are identified in a single combination, that combination progresses to Stage 2. An individual prosthesis progresses to Stage 2 if it is identified in multiple combinations or uniformly across all combinations.

If a prosthesis is identified in more than two combinations with 10 or more procedures in Stage 1, an additional analysis of the individual prosthesis is undertaken for review at Stage 2, regardless of whether the individual prosthesis was identified in Stage 1. The purpose of this is to simplify the reporting of an individual prosthesis and to avoid identifying the same prosthesis in multiple combinations when it may be more appropriate to identify it individually.

A prosthesis or combination may also be brought to the attention of the Registry by the Therapeutic Goods Administration (TGA) or a member of the AOA. A further investigation may then be undertaken as outlined in Stage 2.

It has been apparent that the revision rates for total stemmed anatomic shoulder replacements have been confounded by the higher than anticipated rate of revision of modular metal backed glenoid prostheses in this class. The Clinical Directors have decided to re-analyse Stage 1 for total stemmed anatomic combinations in comparison to the total stemmed anatomic class excluding modular metal backed glenoids. The new comparator only applied to Newly Identified prostheses. Re-identified and Still Used and Identified and no longer used are compared to all other procedures in this class. The new comparator will apply to all sections in subsequent reports.

STAGE 2

In Stage 2, the AOANJRR Clinical Director, Deputy Clinical Directors, and Assistant Deputy Clinical Directors in conjunction with SAHMRI staff, review the identified prostheses and undertake further investigation. This includes examining the impact of confounders and calculating age and gender adjusted hazard ratios. In addition, all prostheses identified in previous reports are re-analysed as part of the Stage 2 analysis. This is not dependent on re-identification in Stage 1. If there is a significant difference compared to the combined hazard rate of all other modern prostheses in the same class, then the prosthesis or prosthesis combination progresses to Stage 3. The possible exception to this is the presence of confounding factors, such as use in complex primary procedures.

STAGE 3

The final stage involves review by a panel of independent orthopaedic surgeons from the AOA and the Arthroplasty Society of Australia or the Shoulder and Elbow Society. The panel meets with Registry staff at joint specific workshops to review the Stage 2 analysis and determine which prostheses will be identified in the Annual Report.

Identified Prostheses

Identified prostheses are listed in one of three groups. The first group 'Newly Identified', lists prostheses that are identified for the first time and are still used.

The second group is 'Re-Identified and Still Used'. This listing identifies prostheses that continue to have a higher than anticipated rate of revision and provides information on their continued use. Most identified or re-identified prostheses decline in use. This is usually evident only after the first year because almost a full year of use has occurred prior to identification in the Annual Report.

Prostheses that have a higher rate of revision but are no longer used in Australia make up the third group: 'Identified and No Longer Used'. These are listed to provide ongoing information on the rate of revision. This also enables comparison of other prostheses to the discontinued group. This group may include prostheses that are no longer used in Australia that are identified for the first time.

The Registry does not make a recommendation or otherwise on the continued use of identified prostheses. Identification is made to ensure that prostheses with a higher rate of revision, compared to others in the same class, are highlighted.

On occasion, a prosthesis previously identified no longer meets the criteria for inclusion. In this situation, the prosthesis is not subsequently re-identified. The Registry monitors the continual real-time performance of prostheses within a community and the Annual Report provides the outcome at a particular time. It is necessary to appreciate that outcomes are continually changing and that many factors may influence that change, including identification in the Annual Report.

Primary Partial Hip Replacement

UNIPOLAR MODULAR

There is one newly identified unipolar modular hip prosthesis.

The Avenir cementless femoral stem has been used since 2011 in 67 procedures of which 8 have been revised. The cumulative percent revision is 17.3% at 6 years. All revisions were major revisions, with 3 for fracture.

The current approach used by the Registry is most effective at identifying the relative performance of recently introduced prostheses. As the Registry's follow-up period increases, it is becoming evident that prostheses with a delayed onset of higher rates of revision are not as readily identified by this approach. The Registry will develop further strategies in the future to identify these prostheses.

Prior to publication, three workshops were held to review, comment, and provide advice on all sections of the report. Members of the AOA, Arthroplasty Society of Australia, and Shoulder and Elbow Society are invited to attend these surgeon workshops.

The hip, knee and shoulder surgeon workshops were held in Adelaide on the weekend of the 3 and 4 August 2024. In addition to AOANJRR and SAHMRI staff, 17 hip, 16 knee and 4 shoulder arthroplasty specialists from the AOA membership attended the workshops.

Investigations of prostheses identified as having a higher than anticipated rate of revision are available on the Registry website: https://aoanjrr.sahmri.com/annual-reports-2024

Table IP1 Revision Rate of Unipolar Modular Hip Prostheses Identified as Having a Higher than Anticipated Rate of Revision

Head/Femoral Stem	N Revised	N Total	Obs. Years	Revisions/ 100 Obs. Yrs	Hazard Ratio, P Value
Newly Identified					
**Avenir	8	67	227	3.52	Entire Period: HR=3.03 (1.51, 6.07), p=0.001
Identified and No Longer Used					
Unipolar Head (JRI)/Furlong LOL	11	132	542	2.03	Entire Period: HR=2.09 (1.16, 3.79), p=0.014

Note: Components have been compared to all other modern unipolar modular hip components. Note: **Femoral Stem Component

Prostheses with Higher than Anticipated Rates of Revision

Table IP2 Cumulative Percent Revision of Unipolar Modular Hip Prostheses Identified as Having a Higher than Anticipated Rate of Revision

CPR	1 Yr	3 Yrs	5 Yrs	10 Yrs	20 Yrs
Newly Identified					
**Avenir	7.7 (3.3, 17.6)	10.0 (4.6, 21.2)	13.2 (6.2, 26.8)		
Identified and No Longer Used					
Unipolar Head (JRI)/Furlong LOL	6.4 (3.1, 13.0)	9.8 (5.3, 17.5)	11.2 (6.3, 19.6)		

Note: **Femoral Stem Component

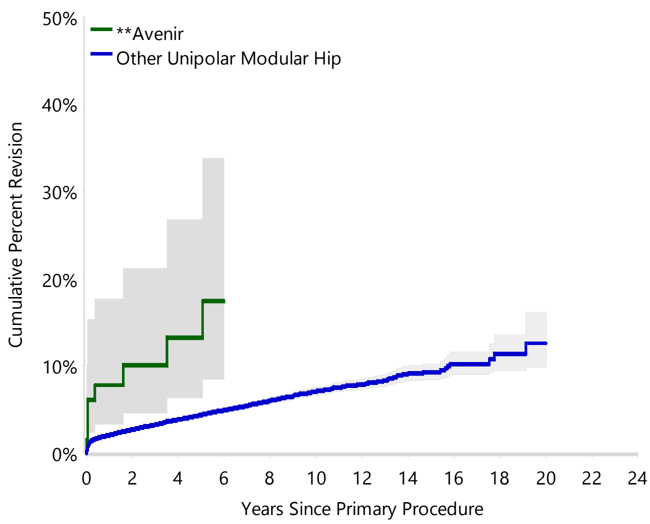
Table IP3 Yearly Usage of Unipolar Modular Hip Prostheses Identified as Having a Higher than Anticipated Rate of Revision

Year of Implant	≤2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Newly Identified																		
**Avenir	.	.	.	.	.	8	8	5	7	3	6	8	10	.	1	3	3	5
Identified and No Longer Used																		
Unipolar Head (JRI)/Furlong LOL	.	12	18	10	13	10	8	7	34	16	4	.	.	.	.	.	.	.

Note: **Femoral Stem Component

Figure IP1 Cumulative Percent Revision of Newly Identified Unipolar Modular Hip Prostheses

Newly Identified



BIPOLAR

There are no newly identified bipolar hip prostheses.

Table IP4 Revision Rate of Bipolar Hip Prostheses Identified as Having a Higher than Anticipated Rate of Revision

Bipolar/Femoral Stem	N Revised	N Total	Obs. Years	Revisions/ 100 Obs. Yrs	Hazard Ratio, P Value
Identified and No Longer Used					
UHR/ABGII	23	177	1012	2.27	0 - 2Wk: HR=4.64 (1.14, 18.86), p=0.032
	.	.	.	.	2Wk - 9Mth: HR=0.86 (0.28, 2.67), p=0.790
	.	.	.	.	9Mth - 3.5Yr: HR=2.12 (0.79, 5.68), p=0.137
	.	.	.	.	3.5Yr+: HR=8.68 (4.95, 15.22), p<0.001
UHR/Omnifit (cless)	8	40	280	2.85	Entire Period: HR=3.81 (1.90, 7.66), p<0.001
**Basis	18	156	857	2.10	0 - 1Yr: HR=0.48 (0.12, 1.92), p=0.297
	.	.	.	.	1Yr+: HR=5.16 (3.11, 8.57), p<0.001
**Quadra-H	7	84	236	2.97	Entire Period: HR=3.13 (1.49, 6.59), p=0.002
**Synergy	9	55	451	1.99	Entire Period: HR=2.67 (1.38, 5.16), p=0.003

Note: Components have been compared to all other modern bipolar hip components
**Femoral Stem Component

Table IP5 Cumulative Percent Revision of Bipolar Hip Prostheses Identified as Having a Higher than Anticipated Rate of Revision

CPR	1 Yr	3 Yrs	5 Yrs	10 Yrs	20 Yrs
Identified and No Longer Used					
UHR/ABGII	4.3 (2.1, 8.9)	5.1 (2.6, 10.0)	10.8 (6.5, 17.9)		
UHR/Omnifit (cless)	18.3 (9.1, 34.6)	18.3 (9.1, 34.6)	18.3 (9.1, 34.6)	18.3 (9.1, 34.6)	
**Basis	1.5 (0.4, 5.8)	10.1 (5.9, 17.2)	12.6 (7.6, 20.6)		
**Quadra-H	6.3 (2.4, 16.1)	10.7 (4.9, 22.5)	13.9 (6.6, 27.8)		
**Synergy	7.3 (2.8, 18.4)	9.5 (4.1, 21.4)	12.2 (5.6, 25.4)	18.0 (9.2, 33.4)	

Note: **Femoral Stem Component

Table IP6 Yearly Usage of Bipolar Hip Prostheses Identified as Having a Higher than Anticipated Rate of Revision

Year of Implant	≤2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Identified and No Longer Used																		
UHR/ABGII	130	15	20	7	5	.	.	.	.	.	.	.	.	.	.	.	.	.
UHR/Omnifit (cless)	37	1	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
**Basis	65	9	11	4	7	8	21	24	6	1	.	.	.	.	.	.	.	.
**Quadra-H	.	.	.	11	7	5	6	4	11	9	7	4	7	5	7	1	.	.
**Synergy	47	2	1	1	.	1	.	2	.	.	.	1	.	.	.	.	.	.

Note: **Femoral Stem Component

Prostheses with Higher than Anticipated Rates of Revision

Primary Total Hip Replacement

TOTAL CONVENTIONAL

There is one newly identified total conventional hip replacement.

The CPT femoral stem has previously been identified in combination with the G7, Fitmore and Low Profile Cup acetabular components. This year the CPT stem was identified in combination with 3 more acetabular prostheses. Therefore, additional analysis was carried out for the CPT stem alone. The CPT stem has been used in 24509 procedures of which 1235 have been revised. The cumulative percent revision is 6.2% at 10 years. Of the 1235 revisions 817 (66%) were major revisions and over 600 of these required a femoral component revision. There were 381 revisions for fracture, 337 for dislocation/instability, 277 for infection and 161 for loosening.

As this stem has been used for diagnoses other than osteoarthritis in 24% of primaries, further analysis was performed. The CPT stem was compared to all other total conventional hip replacements for the primary diagnosis of osteoarthritis. There were 19328 primary hip replacement procedures using the CPT stem, of which 936 had been revised. In this comparison the CPT stem still had a higher rate of revision.

This year there are 5 total conventional hip prostheses or prostheses combinations identified for the first time and are no longer used. These are the ESOP/Delta PF combination (not used since 2007), the Omnifit/Vitalock combination (not used since 2006), the Evolve/Acetabular shell (Global) combination (not used since 2022), the Proxima femoral stem (not used since 2008) and the Universal acetabular component (not used since 2011).

The Profemur L femoral stem (first identified in 2012) is no longer identified.

Table IP7 Revision Rate of Total Conventional Hip Prostheses Identified as Having a Higher than Anticipated Rate of Revision

Femoral Stem/Acetabular	N Revised	N Total	Obs. Years	Revisions/ 100 Obs. Yrs	Hazard Ratio, P Value
Newly Identified					
*CPT	1235	24509	174502	0.71	Entire Period: HR=1.37 (1.29, 1.45), p<0.001
Re-Identified and Still Used					
Accolade II/Trident Tritanium (Shell)	141	4213	15344	0.92	Entire Period: HR=1.25 (1.06, 1.47), p=0.009
Avenir/Fitmore	21	372	1443	1.46	0 - 1Mth: HR=5.04 (2.93, 8.68), p<0.001
	.	.	.	.	1Mth+: HR=1.08 (0.54, 2.15), p=0.837
CORAIL/Trident (Shell)	30	680	3097	0.97	Entire Period: HR=1.51 (1.05, 2.16), p=0.024
*Excia (cless)	28	450	3482	0.80	0 - 3Mth: HR=2.62 (1.55, 4.43), p<0.001
	.	.	.	.	3Mth+: HR=1.12 (0.66, 1.90), p=0.665
*HACTIV	113	2827	12352	0.91	Entire Period: HR=1.40 (1.16, 1.68), p<0.001
*Revision Hip	10	116	598	1.67	Entire Period: HR=2.76 (1.49, 5.13), p=0.001
*Taper Fit	190	6234	22344	0.85	0 - 6Mth: HR=0.89 (0.71, 1.11), p=0.298
	.	.	.	.	6Mth - 9Mth: HR=1.58 (0.93, 2.68), p=0.089
	.	.	.	.	9Mth - 2Yr: HR=0.90 (0.60, 1.36), p=0.633
	.	.	.	.	2Yr - 5.5Yr: HR=1.73 (1.29, 2.31), p<0.001
	.	.	.	.	5.5Yr - 9Yr: HR=1.81 (1.03, 3.19), p=0.040
	.	.	.	.	9Yr+: HR=3.65 (2.36, 5.66), p<0.001
**Atlas (Shell)	58	545	4707	1.23	Entire Period: HR=2.43 (1.88, 3.14), p<0.001
**Continuum	650	14030	106391	0.61	0 - 1Mth: HR=1.82 (1.57, 2.11), p<0.001
	.	.	.	.	1Mth - 3Mth: HR=1.43 (1.17, 1.75), p<0.001
	.	.	.	.	3Mth - 1.5Yr: HR=1.20 (1.00, 1.43), p=0.045
	.	.	.	.	1.5Yr - 2Yr: HR=1.45 (1.05, 2.00), p=0.025
	.	.	.	.	2Yr+: HR=0.83 (0.73, 0.96), p=0.009
**Delta-One-TT	14	199	1088	1.29	Entire Period: HR=2.17 (1.28, 3.66), p=0.003
**Dynasty	115	2127	12578	0.91	0 - 3Mth: HR=1.93 (1.45, 2.55), p<0.001
	.	.	.	.	3Mth+: HR=1.42 (1.11, 1.81), p=0.004
**Fin II	179	2482	22784	0.79	Entire Period: HR=1.59 (1.37, 1.84), p<0.001
**Fixa	72	1468	8401	0.86	0 - 3Mth: HR=1.73 (1.21, 2.48), p=0.002

Femoral Stem/Acetabular	N Revised	N Total	Obs. Years	Revisions/ 100 Obs. Yrs	Hazard Ratio, P Value
	.	.	.	.	3Mth - 2Yr: HR=1.81 (1.20, 2.73), p=0.004
	.	.	.	.	2Yr+: HR=1.05 (0.67, 1.65), p=0.829
**Furlong	70	970	7279	0.96	0 - 3Mth: HR=1.98 (1.32, 2.99), p=0.001
	.	.	.	.	3Mth - 1.5Yr: HR=3.57 (2.43, 5.24), p<0.001
	.	.	.	.	1.5Yr+: HR=1.08 (0.71, 1.66), p=0.717
**G7 Multihole	65	1256	2629	2.47	Entire Period: HR=2.52 (1.98, 3.22), p<0.001
**Mueller	12	62	537	2.24	Entire Period: HR=4.42 (2.51, 7.78), p<0.001
**Versafitcup DM	71	2090	7634	0.93	Entire Period: HR=1.31 (1.04, 1.65), p=0.023
Identified and No Longer Used					
+**Universal	22	167	1935	1.14	Entire Period: HR=2.44 (1.61, 3.71), p<0.001
+*Proxima	13	51	891	1.46	Entire Period: HR=3.00 (1.74, 5.17), p<0.001
+Esop/Delta-PF	10	59	767	1.30	Entire Period: HR=2.75 (1.48, 5.12), p=0.001
+Evolve/Acetabular Shell (Global)	9	139	732	1.23	Entire Period: HR=2.14 (1.12, 4.12), p=0.022
+Omnifit/Vitalock	15	66	884	1.70	Entire Period: HR=3.59 (2.17, 5.94), p<0.001
Anatomic II/Duraloc Option	11	60	758	1.45	Entire Period: HR=3.08 (1.70, 5.55), p<0.001
Anca-Fit/PINNACLE	16	101	1086	1.47	Entire Period: HR=3.11 (1.90, 5.07), p<0.001
CORAIL/Trabecular Metal (Shell)	11	98	817	1.35	Entire Period: HR=2.67 (1.48, 4.82), p=0.001
CPCS/Reflection (Non XLPE Cup)	76	407	4687	1.62	0 - 2Yr: HR=0.70 (0.32, 1.57), p=0.389
	.	.	.	.	2Yr - 3Yr: HR=4.08 (1.69, 9.81), p=0.001
	.	.	.	.	3Yr - 7Yr: HR=1.86 (0.89, 3.90), p=0.101
	.	.	.	.	7Yr+: HR=7.02 (5.41, 9.10), p<0.001
F2L/Delta-PF	20	107	1340	1.49	Entire Period: HR=3.17 (2.05, 4.92), p<0.001
Friendly Hip/Cup (Exactech)	16	97	1128	1.42	Entire Period: HR=3.05 (1.87, 4.98), p<0.001
Friendly Hip/Delta-TT	6	74	525	1.14	Entire Period: HR=2.27 (1.02, 5.04), p=0.044
M-Cor/Equator+ Cup	11	77	937	1.17	Entire Period: HR=2.52 (1.40, 4.55), p=0.002
MBA (exch neck)/PINNACLE	29	225	2196	1.32	Entire Period: HR=2.75 (1.91, 3.96), p<0.001
Meridian/ABGII	22	143	1806	1.22	Entire Period: HR=2.55 (1.68, 3.87), p<0.001
Secur-Fit Plus/Secur-Fit	31	197	2727	1.14	Entire Period: HR=2.44 (1.72, 3.46), p<0.001
Taperloc/M2a^{MoM}	75	515	7047	1.06	Entire Period: HR=2.29 (1.83, 2.88), p<0.001
*ABGII (exch neck)	107	246	2183	4.90	0 - 1Mth: HR=4.09 (1.95, 8.59), p<0.001
	.	.	.	.	1Mth - 1.5Yr: HR=2.68 (1.34, 5.36), p=0.005
	.	.	.	.	1.5Yr - 2.5Yr: HR=8.15 (3.88, 17.10), p<0.001
	.	.	.	.	2.5Yr - 4Yr: HR=13.76 (7.97, 23.75), p<0.001
	.	.	.	.	4Yr - 4.5Yr: HR=42.37 (23.29, 77.07), p<0.001
	.	.	.	.	4.5Yr+: HR=15.28 (11.87, 19.67), p<0.001
*Adapter (cless)	157	744	7578	2.07	0 - 2Wk: HR=3.92 (1.96, 7.86), p<0.001
	.	.	.	.	2Wk - 1Mth: HR=1.57 (0.65, 3.78), p=0.313
	.	.	.	.	1Mth - 6Mth: HR=0.75 (0.28, 2.00), p=0.563
	.	.	.	.	6Mth - 3Yr: HR=4.35 (3.09, 6.12), p<0.001
	.	.	.	.	3Yr - 3.5Yr: HR=12.02 (6.79, 21.29), p<0.001
	.	.	.	.	3.5Yr - 6.5Yr: HR=7.92 (5.79, 10.82), p<0.001
	.	.	.	.	6.5Yr - 7Yr: HR=12.02 (6.19, 23.31), p<0.001
	.	.	.	.	7Yr - 8Yr: HR=8.17 (4.61, 14.48), p<0.001
	.	.	.	.	8Yr - 9.5Yr: HR=4.41 (2.36, 8.23), p<0.001
	.	.	.	.	9.5Yr - 10Yr: HR=1.46 (0.20, 10.38), p=0.707
	.	.	.	.	10Yr - 12.5Yr: HR=5.26 (3.34, 8.28), p<0.001
	.	.	.	.	12.5Yr+: HR=1.10 (0.41, 2.94), p=0.849
*Adapter (ctd)	33	148	1327	2.49	0 - 6Mth: HR=1.94 (0.73, 5.17), p=0.185
	.	.	.	.	6Mth+: HR=6.56 (4.56, 9.45), p<0.001

Prostheses with Higher than Anticipated Rates of Revision

Femoral Stem/Acetabular	N Revised	N Total	Obs. Years	Revisions/ 100 Obs. Yrs	Hazard Ratio, P Value
*Apex	196	2591	26456	0.74	Entire Period: HR=1.53 (1.33, 1.77), p<0.001
*BMHR VST	38	260	3024	1.26	Entire Period: HR=2.52 (1.83, 3.47), p<0.001
*CBH Stem	43	274	2767	1.55	Entire Period: HR=3.24 (2.40, 4.36), p<0.001
*Edinburgh	19	138	1115	1.70	Entire Period: HR=3.48 (2.22, 5.45), p<0.001
*Elite Plus	277	2841	33232	0.83	0 - 3Mth: HR=0.45 (0.27, 0.75), p=0.002
	.	.	.	.	3Mth+: HR=2.16 (1.91, 2.44), p<0.001
*Emperion	59	507	5219	1.13	Entire Period: HR=2.32 (1.79, 2.99), p<0.001
*Furlong Evolution	41	521	2509	1.63	Entire Period: HR=2.56 (1.89, 3.48), p<0.001
*GHE	13	114	990	1.31	Entire Period: HR=2.70 (1.57, 4.65), p<0.001
*K2	88	601	6512	1.35	Entire Period: HR=2.86 (2.32, 3.52), p<0.001
*LYDERIC II	16	164	1511	1.06	Entire Period: HR=2.20 (1.35, 3.59), p=0.001
*Linear	20	290	2165	0.92	Entire Period: HR=1.79 (1.16, 2.78), p=0.009
*ML Taper Kinectiv	211	3532	34244	0.62	Entire Period: HR=1.28 (1.12, 1.47), p<0.001
*MSA	43	224	2254	1.91	Entire Period: HR=3.83 (2.84, 5.17), p<0.001
*Margron	126	688	9429	1.34	Entire Period: HR=2.83 (2.37, 3.38), p<0.001
*Mayo	19	168	2093	0.91	Entire Period: HR=1.95 (1.24, 3.06), p=0.003
*Metha (exch neck)	15	88	983	1.53	Entire Period: HR=3.17 (1.91, 5.26), p<0.001
*MiniMax	23	415	1908	1.21	0 - 2Wk: HR=6.06 (2.88, 12.72), p<0.001
	.	.	.	.	2Wk+: HR=1.41 (0.87, 2.31), p=0.165
*Novation	88	1423	10477	0.84	0 - 3Mth: HR=2.31 (1.69, 3.17), p<0.001
	.	.	.	.	3Mth+: HR=1.31 (0.99, 1.73), p=0.061
*Profemur Z	32	186	2198	1.46	Entire Period: HR=3.06 (2.17, 4.34), p<0.001
*Trabecular Metal	130	1904	19245	0.68	0 - 1Mth: HR=2.57 (1.84, 3.59), p<0.001
	.	.	.	.	1Mth - 3Mth: HR=1.82 (1.13, 2.93), p=0.013
	.	.	.	.	3Mth - 1.5Yr: HR=1.65 (1.10, 2.46), p=0.014
	.	.	.	.	1.5Yr - 3.5Yr: HR=1.27 (0.78, 2.08), p=0.338
	.	.	.	.	3.5Yr - 4Yr: HR=2.04 (0.85, 4.93), p=0.112
	.	.	.	.	4Yr - 7Yr: HR=1.31 (0.83, 2.05), p=0.245
	.	.	.	.	7Yr+: HR=0.55 (0.32, 0.93), p=0.024
*UniSyn	70	466	5168	1.35	Entire Period: HR=2.81 (2.22, 3.56), p<0.001
**2000 Plus	20	135	1371	1.46	Entire Period: HR=3.03 (1.95, 4.69), p<0.001
**ASR	2082	4421	41963	4.96	0 - 2Wk: HR=1.29 (0.79, 2.11), p=0.315
	.	.	.	.	2Wk - 1Mth: HR=0.21 (0.08, 0.55), p=0.001
	.	.	.	.	1Mth - 3Mth: HR=0.77 (0.48, 1.24), p=0.278
	.	.	.	.	3Mth - 6Mth: HR=1.03 (0.57, 1.86), p=0.933
	.	.	.	.	6Mth - 9Mth: HR=1.82 (1.08, 3.09), p=0.025
	.	.	.	.	9Mth - 1.5Yr: HR=4.24 (3.34, 5.40), p<0.001
	.	.	.	.	1.5Yr - 2Yr: HR=7.37 (5.72, 9.50), p<0.001
	.	.	.	.	2Yr - 2.5Yr: HR=13.33 (10.84, 16.39), p<0.001
	.	.	.	.	2.5Yr - 3Yr: HR=18.58 (15.27, 22.61), p<0.001
	.	.	.	.	3Yr - 6Yr: HR=32.20 (29.89, 34.69), p<0.001
	.	.	.	.	6Yr - 7Yr: HR=24.40 (20.73, 28.74), p<0.001
	.	.	.	.	7Yr - 8Yr: HR=19.28 (15.99, 23.24), p<0.001
	.	.	.	.	8Yr - 8.5Yr: HR=14.97 (11.23, 19.95), p<0.001
	.	.	.	.	8.5Yr - 10Yr: HR=11.20 (9.20, 13.62), p<0.001
	.	.	.	.	10Yr - 10.5Yr: HR=8.77 (5.80, 13.25), p<0.001
	.	.	.	.	10.5Yr - 12Yr: HR=6.74 (5.32, 8.54), p<0.001
	.	.	.	.	12Yr - 12.5Yr: HR=4.14 (2.39, 7.16), p<0.001
	.	.	.	.	12.5Yr - 13.5Yr: HR=7.07 (5.14, 9.72), p<0.001

Femoral Stem/Acetabular	N Revised	N Total	Obs. Years	Revisions/ 100 Obs. Yrs	Hazard Ratio, P Value
	.	.	.	.	13.5Yr+: HR=3.49 (2.71, 4.49), p<0.001
**Adept	24	121	1400	1.71	Entire Period: HR=3.48 (2.33, 5.20), p<0.001
**Artek	73	179	2465	2.96	0 - 1Yr: HR=1.56 (0.65, 3.75), p=0.319
	.	.	.	.	1Yr - 1.5Yr: HR=4.74 (1.18, 18.97), p=0.027
	.	.	.	.	1.5Yr - 2.5Yr: HR=6.05 (2.27, 16.14), p<0.001
	.	.	.	.	2.5Yr - 4Yr: HR=14.87 (8.22, 26.91), p<0.001
	.	.	.	.	4Yr - 4.5Yr: HR=4.78 (0.67, 34.00), p=0.118
	.	.	.	.	4.5Yr - 6Yr: HR=18.81 (10.65, 33.22), p<0.001
	.	.	.	.	6Yr+: HR=6.20 (4.49, 8.57), p<0.001
**BHR	574	2988	36476	1.57	0 - 2Wk: HR=0.83 (0.39, 1.74), p=0.622
	.	.	.	.	2Wk - 1Mth: HR=0.15 (0.04, 0.61), p=0.007
	.	.	.	.	1Mth - 3Mth: HR=1.07 (0.65, 1.74), p=0.798
	.	.	.	.	3Mth - 1Yr: HR=0.55 (0.28, 1.05), p=0.071
	.	.	.	.	1Yr - 1.5Yr: HR=1.68 (0.95, 2.97), p=0.073
	.	.	.	.	1.5Yr+: HR=4.64 (4.25, 5.07), p<0.001
**Bionik	155	608	6158	2.52	0 - 2Wk: HR=3.01 (1.25, 7.23), p=0.013
	.	.	.	.	2Wk - 3Mth: HR=1.08 (0.49, 2.41), p=0.849
	.	.	.	.	3Mth+: HR=6.37 (5.41, 7.51), p<0.001
**Conserve Plus	23	135	1768	1.30	0 - 1Yr: HR=0.84 (0.21, 3.34), p=0.799
	.	.	.	.	1Yr+: HR=3.56 (2.32, 5.45), p<0.001
**Cormet	155	803	9849	1.57	0 - 3Mth: HR=0.61 (0.27, 1.36), p=0.227
	.	.	.	.	3Mth - 1.5Yr: HR=1.89 (1.07, 3.34), p=0.027
	.	.	.	.	1.5Yr+: HR=4.46 (3.76, 5.28), p<0.001
**DeltaLox	30	222	1974	1.52	Entire Period: HR=3.15 (2.20, 4.50), p<0.001
**Duraloc	669	5354	66578	1.00	0 - 3Mth: HR=0.78 (0.59, 1.03), p=0.077
	.	.	.	.	3Mth - 9Mth: HR=1.40 (0.98, 2.01), p=0.066
	.	.	.	.	9Mth - 2Yr: HR=1.89 (1.45, 2.47), p<0.001
	.	.	.	.	2Yr - 2.5Yr: HR=0.88 (0.44, 1.77), p=0.726
	.	.	.	.	2.5Yr - 5.5Yr: HR=1.91 (1.53, 2.39), p<0.001
	.	.	.	.	5.5Yr+: HR=3.09 (2.80, 3.41), p<0.001
**Durom	221	1245	16260	1.36	0 - 1.5Yr: HR=0.75 (0.48, 1.18), p=0.211
	.	.	.	.	1.5Yr+: HR=3.87 (3.36, 4.45), p<0.001
**ExpanSys	15	71	865	1.73	Entire Period: HR=3.74 (2.26, 6.18), p<0.001
**Hedrocel	13	46	615	2.12	Entire Period: HR=4.39 (2.55, 7.57), p<0.001
**Icon	113	401	4417	2.56	0 - 2.5Yr: HR=2.56 (1.72, 3.82), p<0.001
	.	.	.	.	2.5Yr - 3Yr: HR=10.46 (4.69, 23.31), p<0.001
	.	.	.	.	3Yr+: HR=7.10 (5.71, 8.82), p<0.001
**Inter-Op	9	33	380	2.37	Entire Period: HR=4.98 (2.59, 9.56), p<0.001
**MBA	18	124	1137	1.58	Entire Period: HR=3.28 (2.07, 5.21), p<0.001
**Mitch TRH	176	731	8604	2.05	0 - 3Mth: HR=0.56 (0.23, 1.35), p=0.196
	.	.	.	.	3Mth - 2Yr: HR=2.52 (1.58, 4.00), p<0.001
	.	.	.	.	2Yr+: HR=6.14 (5.23, 7.21), p<0.001
**Plasmacup	40	482	4971	0.80	Entire Period: HR=1.70 (1.24, 2.31), p<0.001
**SPH-Blind	132	952	13457	0.98	Entire Period: HR=2.10 (1.77, 2.50), p<0.001
**seleXys (excluding seleXys PC)	52	391	3884	1.34	Entire Period: HR=2.77 (2.11, 3.64), p<0.001

Note: Components have been compared to all other modern total conventional hip components
Large head (>32mm) metal/metal bearings have been removed from the comparator group for all primary total conventional hip investigations
*Femoral Stem Component
**Acetabular Component
+ Newly identified and no longer used

Prostheses with Higher than Anticipated Rates of Revision

Table IP8 Cumulative Percent Revision of Total Conventional Hip Prostheses Identified as Having a Higher than Anticipated Rate of Revision

CPR	1 Yr	3 Yrs	5 Yrs	10 Yrs	20 Yrs
Newly Identified					
*CPT	2.3 (2.1, 2.5)	3.3 (3.1, 3.5)	4.2 (4.0, 4.5)	6.2 (5.9, 6.6)	9.6 (8.6, 10.6)
Re-Identified and Still Used					
Accolade II/Trident Tritanium (Shell)	2.2 (1.8, 2.7)	3.2 (2.7, 3.8)	3.9 (3.3, 4.6)		
Avenir/Fitmore	5.1 (3.3, 7.9)	5.5 (3.6, 8.3)	5.9 (3.9, 9.0)		
CORAIL/Trident (Shell)	2.7 (1.7, 4.3)	4.0 (2.7, 5.9)	4.6 (3.1, 6.8)	6.8 (4.4, 10.6)	
*Excia (cless)	4.0 (2.5, 6.3)	5.0 (3.3, 7.4)	5.4 (3.7, 8.0)	6.7 (4.6, 9.9)	
*HACTIV	2.7 (2.2, 3.4)	3.7 (3.0, 4.4)	3.9 (3.2, 4.8)	6.5 (4.6, 9.0)	
*Revision Hip	2.9 (0.9, 8.8)	8.3 (4.0, 16.9)	12.0 (6.3, 22.4)		
*Taper Fit	1.6 (1.3, 1.9)	2.4 (2.0, 2.9)	3.4 (2.9, 4.1)	7.3 (5.6, 9.4)	
**Atlas (Shell)	3.3 (2.1, 5.3)	4.2 (2.8, 6.3)	4.9 (3.3, 7.2)	9.5 (6.8, 13.0)	
**Continuum	2.6 (2.4, 2.9)	3.5 (3.2, 3.8)	4.0 (3.6, 4.3)	5.2 (4.8, 5.6)	
**Delta-One-TT	3.5 (1.7, 7.3)	5.9 (3.3, 10.4)	6.7 (3.8, 11.6)		
**Dynasty	3.3 (2.7, 4.2)	4.5 (3.7, 5.4)	5.1 (4.2, 6.1)	6.0 (5.0, 7.2)	
**Fin II	2.5 (1.9, 3.2)	3.3 (2.7, 4.1)	4.4 (3.6, 5.3)	7.6 (6.5, 8.9)	
**Fixa	3.2 (2.4, 4.2)	4.3 (3.3, 5.5)	4.7 (3.7, 6.0)	6.5 (5.0, 8.3)	
**Furlong	4.2 (3.1, 5.7)	6.2 (4.8, 7.9)	6.7 (5.3, 8.5)	7.5 (5.9, 9.6)	
**G7 Multihole	5.2 (4.0, 6.6)	5.9 (4.6, 7.6)	6.2 (4.8, 8.0)		
**Mueller	1.7 (0.2, 11.6)	12.1 (5.6, 25.0)	14.2 (7.0, 27.6)	23.4 (13.1, 39.8)	
**Versafitcup DM	2.4 (1.8, 3.2)	3.5 (2.7, 4.5)	4.1 (3.2, 5.2)		
Identified and No Longer Used					
+**Universal	4.8 (2.4, 9.4)	4.8 (2.4, 9.4)	5.4 (2.9, 10.2)	11.6 (7.3, 18.2)	
+*Proxima	3.9 (1.0, 14.8)	3.9 (1.0, 14.8)	3.9 (1.0, 14.8)	12.0 (5.6, 24.7)	23.2 (13.5, 38.2)
+Esop/Delta-PF	0.0 (0.0, 0.0)	1.8 (0.3, 12.0)	5.6 (1.8, 16.3)	7.8 (3.0, 19.4)	
+Evolve/Acetabular Shell (Global)	2.9 (1.1, 7.5)	3.7 (1.6, 8.7)	5.7 (2.7, 11.6)		
+Omnifit/Vitalock	1.5 (0.2, 10.3)	6.2 (2.4, 15.8)	6.2 (2.4, 15.8)	14.8 (8.0, 26.7)	28.6 (18.0, 43.6)
Anatomic II/Duraloc Option	1.7 (0.2, 11.2)	6.7 (2.6, 16.8)	10.1 (4.7, 21.1)	14.2 (7.3, 26.5)	
Anca-Fit/PINNACLE	6.0 (2.7, 12.8)	8.0 (4.1, 15.4)	11.1 (6.3, 19.2)	16.4 (10.1, 25.8)	
CORAIL/Trabecular Metal (Shell)	6.2 (2.8, 13.2)	9.5 (5.1, 17.5)	11.9 (6.8, 20.5)	11.9 (6.8, 20.5)	
CPCS/Reflection (Non XLPE Cup)	1.0 (0.4, 2.7)	2.9 (1.6, 5.1)	3.4 (2.0, 5.8)	10.0 (7.2, 13.8)	
F2L/Delta-PF	5.6 (2.6, 12.1)	10.3 (5.9, 17.9)	12.3 (7.3, 20.2)	16.5 (10.6, 25.3)	
Friendly Hip/Cup (Exactech)	2.1 (0.5, 8.0)	3.2 (1.0, 9.5)	6.5 (3.0, 14.0)	14.1 (8.2, 23.6)	
Friendly Hip/Delta-TT	5.5 (2.1, 14.0)	8.3 (3.8, 17.6)	8.3 (3.8, 17.6)	8.3 (3.8, 17.6)	
M-Cor/Equator+ Cup	0.0 (0.0, 0.0)	2.7 (0.7, 10.4)	4.1 (1.3, 12.1)	11.6 (6.0, 21.9)	
MBA (exch neck)/PINNACLE	2.2 (0.9, 5.3)	3.6 (1.8, 7.1)	7.6 (4.7, 12.1)	13.9 (9.7, 19.6)	
Meridian/ABGII	2.1 (0.7, 6.4)	5.0 (2.4, 10.1)	6.4 (3.4, 12.0)	8.3 (4.6, 14.5)	
Secur-Fit Plus/Secur-Fit	3.1 (1.4, 6.7)	7.3 (4.4, 11.9)	7.8 (4.8, 12.6)	10.1 (6.5, 15.3)	19.5 (14.0, 26.9)
Taperloc/M2a^{MoM}	1.8 (0.9, 3.3)	4.3 (2.9, 6.5)	7.4 (5.4, 10.0)	12.4 (9.7, 15.6)	17.9 (13.7, 23.1)
*ABGII (exch neck)	4.5 (2.5, 8.0)	11.1 (7.8, 15.8)	20.5 (15.9, 26.2)	37.2 (31.2, 43.9)	
*Adapter (cless)	3.2 (2.2, 4.8)	6.9 (5.2, 8.9)	11.7 (9.5, 14.3)	20.1 (17.2, 23.3)	
*Adapter (ctd)	4.1 (1.9, 8.9)	9.1 (5.4, 15.2)	16.2 (11.0, 23.6)	23.6 (17.0, 32.2)	
*Apex	2.2 (1.7, 2.9)	3.3 (2.7, 4.0)	4.6 (3.8, 5.4)	7.3 (6.3, 8.5)	
*BMHR VST	1.9 (0.8, 4.6)	4.6 (2.7, 8.0)	7.0 (4.5, 10.8)	12.2 (8.7, 16.8)	
*CBH Stem	4.0 (2.3, 7.2)	7.4 (4.9, 11.3)	9.8 (6.8, 14.1)	15.0 (11.1, 20.1)	
*Edinburgh	6.0 (3.1, 11.7)	9.6 (5.6, 16.4)	12.5 (7.7, 20.0)	16.8 (10.7, 25.8)	
*Elite Plus	1.5 (1.1, 2.0)	2.8 (2.3, 3.5)	4.2 (3.5, 5.1)	7.8 (6.8, 9.0)	15.6 (13.7, 17.6)
*Emperion	4.8 (3.2, 7.0)	6.0 (4.2, 8.4)	7.2 (5.2, 9.8)	11.0 (8.5, 14.2)	
*Furlong Evolution	5.2 (3.6, 7.5)	7.4 (5.4, 10.0)	8.3 (6.1, 11.1)		

CPR	1 Yr	3 Yrs	5 Yrs	10 Yrs	20 Yrs
*GHE	2.6 (0.9, 8.0)	5.3 (2.4, 11.5)	8.2 (4.3, 15.2)	12.7 (7.5, 20.9)	
*K2	5.2 (3.7, 7.3)	7.5 (5.7, 10.0)	9.8 (7.7, 12.6)	13.8 (11.2, 17.0)	
*LYDERIC II	3.1 (1.3, 7.2)	5.7 (3.0, 10.6)	7.1 (4.0, 12.5)	12.2 (7.2, 20.1)	
*Linear	2.8 (1.4, 5.4)	5.9 (3.7, 9.3)	7.0 (4.6, 10.6)	7.0 (4.6, 10.6)	
*ML Taper Kinectiv	2.4 (2.0, 3.0)	3.5 (3.0, 4.2)	4.3 (3.7, 5.0)	6.0 (5.2, 6.9)	
*MSA	5.8 (3.4, 9.8)	9.5 (6.3, 14.1)	11.3 (7.8, 16.3)	17.8 (13.3, 23.6)	
*Margron	5.8 (4.3, 7.9)	8.6 (6.7, 10.9)	10.6 (8.5, 13.1)	15.7 (13.1, 18.8)	20.7 (17.6, 24.3)
*Mayo	3.0 (1.3, 7.0)	6.6 (3.7, 11.6)	6.6 (3.7, 11.6)	8.6 (5.2, 14.2)	
*Metha (exch neck)	12.5 (7.1, 21.4)	13.6 (8.0, 22.8)	13.6 (8.0, 22.8)	16.0 (9.8, 25.5)	
*MiniMax	4.6 (2.9, 7.1)	5.6 (3.7, 8.3)	5.6 (3.7, 8.3)		
*Novation	3.7 (2.9, 4.9)	4.5 (3.5, 5.7)	5.2 (4.1, 6.5)	6.9 (5.6, 8.6)	
*Profemur Z	6.0 (3.4, 10.5)	10.4 (6.8, 15.8)	11.0 (7.2, 16.5)	12.2 (8.2, 18.0)	
*Trabecular Metal	3.5 (2.7, 4.4)	4.8 (3.9, 5.8)	5.4 (4.5, 6.6)	6.8 (5.7, 8.0)	
*UniSyn	3.2 (2.0, 5.3)	5.9 (4.1, 8.5)	6.6 (4.7, 9.3)	12.4 (9.6, 16.0)	
**2000 Plus	3.0 (1.1, 7.8)	6.8 (3.6, 12.7)	9.2 (5.3, 15.7)	14.1 (9.0, 21.8)	
**ASR	1.9 (1.5, 2.3)	9.6 (8.8, 10.5)	24.5 (23.3, 25.8)	45.1 (43.6, 46.6)	
**Adept	4.1 (1.7, 9.6)	8.4 (4.6, 15.0)	9.3 (5.3, 16.2)	15.9 (10.3, 24.0)	
**Artek	2.8 (1.2, 6.7)	8.0 (4.8, 13.1)	16.1 (11.4, 22.5)	27.1 (21.0, 34.4)	44.2 (36.8, 52.4)
**BHR	1.1 (0.8, 1.6)	3.2 (2.6, 3.9)	6.1 (5.3, 7.0)	14.3 (13.0, 15.7)	
**Bionik	3.6 (2.4, 5.5)	7.7 (5.8, 10.2)	14.3 (11.7, 17.4)	24.3 (20.9, 28.1)	
**Conserve Plus	1.5 (0.4, 5.8)	3.0 (1.1, 7.8)	3.8 (1.6, 8.8)	11.6 (7.0, 18.8)	
**Cormet	1.5 (0.9, 2.6)	3.5 (2.4, 5.1)	5.2 (3.9, 7.0)	13.7 (11.4, 16.5)	
**DeltaLox	5.9 (3.5, 9.9)	8.7 (5.6, 13.3)	10.1 (6.8, 15.0)	14.2 (10.1, 19.9)	
**Duraloc	1.8 (1.5, 2.2)	3.0 (2.6, 3.5)	4.1 (3.6, 4.7)	8.4 (7.6, 9.2)	19.7 (18.2, 21.3)
**Durom	1.1 (0.7, 1.9)	3.6 (2.7, 4.8)	5.5 (4.3, 6.9)	13.6 (11.7, 15.7)	
**ExpanSys	2.8 (0.7, 10.8)	5.7 (2.2, 14.5)	10.3 (5.0, 20.3)	16.8 (9.7, 28.4)	
**Hedrocel	4.3 (1.1, 16.3)	6.6 (2.2, 19.2)	6.6 (2.2, 19.2)	23.4 (12.8, 40.4)	36.3 (22.6, 54.7)
**Icon	3.0 (1.7, 5.3)	7.8 (5.5, 10.9)	12.7 (9.7, 16.5)	24.2 (20.1, 29.1)	
**Inter-Op	12.1 (4.7, 29.1)	15.2 (6.6, 32.6)	21.4 (10.8, 39.8)	28.3 (15.8, 47.4)	28.3 (15.8, 47.4)
**MBA	4.0 (1.7, 9.4)	8.2 (4.5, 14.8)	10.2 (5.9, 17.2)	16.0 (9.9, 25.5)	
**Mitch TRH	1.5 (0.8, 2.7)	4.6 (3.3, 6.4)	7.7 (6.0, 10.0)	15.6 (13.1, 18.6)	
**Plasmacup	4.4 (2.9, 6.6)	5.6 (3.9, 8.1)	5.8 (4.1, 8.3)	8.0 (5.8, 10.9)	
**SPH-Blind	3.8 (2.8, 5.2)	5.8 (4.5, 7.5)	7.3 (5.8, 9.2)	10.4 (8.6, 12.6)	16.5 (14.0, 19.4)
**seleXys (excluding seleXys PC)	4.6 (2.9, 7.2)	7.8 (5.5, 11.0)	10.6 (7.9, 14.1)	13.3 (10.2, 17.2)	

Note: Large head (>32mm) metal/metal bearings have been removed from the comparator group for all primary total conventional hip investigations
Components have been compared to all other modern total conventional hip components
*Femoral Stem Component
**Acetabular Component
+ Newly identified and no longer used

Prostheses with Higher than Anticipated Rates of Revision

Table IP9 Yearly Usage of Total Conventional Hip Prostheses Identified as Having a Higher than Anticipated Rate of Revision

Year of Implant	≤2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Newly Identified																		
*CPT	3073	739	1070	1049	1196	1241	1295	1462	1566	1303	1233	1240	1159	1275	1339	1409	1328	1532
Re-Identified and Still Used																		
Accolade II/Trident Tritanium (Shell)	.	.	.	.	.	.	1	1	30	119	258	484	402	510	584	810	669	345
Avenir/Fitmore	.	.	.	.	.	.	.	2	7	5	46	44	42	56	41	55	41	33
CORAIL/Trident (Shell)	11	22	10	13	16	25	26	24	14	13	11	32	37	47	65	128	99	87
*Excia (cless)	.	.	6	34	8	47	58	38	17	42	35	65	66	10	.	.	18	6
*HACTIV	.	.	.	.	2	19	63	61	117	146	96	240	452	388	418	406	194	225
*Revision Hip	21	2	1	3	3	3	7	6	13	6	5	10	4	5	2	2	11	12
*Taper Fit	245	26	18	6	8	17	55	45	110	161	227	315	592	790	789	798	853	1179
**Atlas (Shell)	188	46	16	13	6	7	4	8	28	23	13	27	26	26	35	23	27	29
**Continuum	.	.	.	175	1117	1245	1331	1504	1492	1359	1327	1293	1197	850	513	294	182	151
**Delta-One-TT	.	.	.	.	4	7	7	15	37	13	12	14	14	23	15	14	13	11
**Dynasty	.	.	.	.	.	40	31	49	178	298	317	306	307	272	241	39	32	17
**Fin II	167	175	251	269	318	286	205	247	101	6	.	.	9	76	94	96	88	94
**Fixa	.	.	.	.	.	44	161	153	99	134	100	91	78	84	95	134	162	133
**Furlong	31	4	7	61	90	85	73	76	64	66	12	55	100	82	65	71	21	7
**G7 Multihole	.	.	.	.	.	.	.	.	.	.	.	15	49	169	222	243	234	324
**Mueller	47	1	2	.	.	.	1	.	1	1	.	1	1	3	.	.	1	3
**Versafitcup DM	.	.	.	.	.	10	12	4	19	146	193	199	194	188	229	249	269	378
Identified and No Longer Used																		
+**Universal	128	11	11	6	7	4	.	.	.	.	.	.	.	.	.	.	.	.
+*Proxima	46	4	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
+Esop/Delta-PF	30	29	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
+Evolve/Acetabular Shell (Global)	.	.	.	.	.	.	.	.	1	13	43	32	15	11	10	12	2	.
+Omnifit/Vitalock	66	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Anatomic II/Duraloc Option	37	23	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Anca-Fit/PINNACLE	30	55	16	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
CORAIL/Trabecular Metal (Shell)	.	5	10	17	20	9	8	8	6	1	6	2	4	1	1	.	.	.
CPCS/Reflection (Non XLPE Cup)	337	36	19	13	.	2	.	.	.	.	.	.	.	.	.	.	.	.
F2L/Delta-PF	97	10	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Friendly Hip/Cup (Exactech)	77	12	2	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Friendly Hip/Delta-TT	.	.	.	.	.	14	12	13	13	9	6	4	2	1	.	.	.	.
M-Cor/Equator+ Cup	.	6	70	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
MBA (exch neck)/PINNACLE	.	24	45	9	43	46	14	44	.	.	.	.	.	.	.	.	.	.
Meridian/ABGII	143	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Secur-Fit Plus/Secur-Fit	197	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Taperloc/M2a^{MoM}	322	43	76	49	23	2	.	.	.	.	.	.	.	.	.	.	.	.
*ABGII (exch neck)	.	10	39	69	58	63	7	.	.	.	.	.	.	.	.	.	.	.
*Adapter (cless)	159	131	122	158	115	58	.	1	.	.	.	.	.	.	.	.	.	.
*Adapter (ctd)	48	52	33	8	7	.	.	.	.	.	.	.	.	.	.	.	.	.
*Apex	322	223	265	197	169	190	219	246	188	193	168	88	61	44	18	.	.	.
*BMHR VST	.	.	2	65	81	71	22	13	5	1	.	.	.	.	.	.	.	.
*CBH Stem	33	37	28	27	45	53	43	7	.	1	.	.	.	.	.	.	.	.
*Edinburgh	57	29	18	23	10	1	.	.	.	.	.	.	.	.	.	.	.	.
*Elite Plus	2768	46	26	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.

Year of Implant	≤2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
*Emperion	14	21	26	65	87	72	44	53	38	41	34	12	.	.	.	.	.	.
*Furlong Evolution	.	.	.	.	.	.	.	29	25	32	11	54	102	106	83	75	4	.
*GHE	.	.	.	.	9	4	47	28	14	12	.	.	.	.	.	.	.	.
*K2	1	22	80	172	204	122	.	.	.	.	.	.	.	.	.	.	.	.
*LYDERIC II	148	8	8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
*Linear	.	.	.	.	.	.	23	31	31	88	70	27	12	5	3	.	.	.
*ML Taper Kinectiv	.	.	36	341	647	576	515	384	345	256	199	159	74	.	.	.	.	.
*MSA	.	2	3	11	57	77	46	21	7	.	.	.	.	.	.	.	.	.
*Margron	658	28	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
*Mayo	82	25	29	30	2	.	.	.	.	.	.	.	.	.	.	.	.	.
*Metha (exch neck)	.	.	.	20	53	15	.	.	.	.	.	.	.	.	.	.	.	.
*MiniMax	.	.	.	.	.	.	.	.	.	.	4	43	170	133	41	19	5	.
*Novation	.	.	.	4	32	53	130	137	226	266	148	90	101	145	51	19	21	.
*Profemur Z	176	6	1	2	1	.	.	.	.	.	.	.	.	.	.	.	.	.
*Trabecular Metal	6	101	148	198	242	272	276	186	220	112	106	32	5	.	.	.	.	.
*UniSyn	163	37	46	48	36	22	19	23	27	23	17	5	.	.	.	.	.	.
**2000 Plus	34	42	14	18	25	2	.	.	.	.	.	.	.	.	.	.	.	.
**ASR	1626	1185	1180	430	.	.	.	.	.	.	.	.	.	.	.	.	.	.
**Adept	19	20	29	30	11	12	.	.	.	.	.	.	.	.	.	.	.	.
**Artek	179	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
**BHR	1070	581	477	404	276	134	27	13	5	1	.	.	.	.	.	.	.	.
**Bionik	158	136	138	134	38	4	.	.	.	.	.	.	.	.	.	.	.	.
**Conserve Plus	81	24	15	14	1	.	.	.	.	.	.	.	.	.	.	.	.	.
**Cormet	353	73	129	124	93	26	4	1	.	.	.	.	.	.	.	.	.	.
**DeltaLox	.	.	.	.	34	84	72	24	8	.	.	.	.	.	.	.	.	.
**Duraloc	4434	253	293	187	82	84	18	3	.	.	.	.	.	.	.	.	.	.
**Durom	671	257	218	85	13	1	.	.	.	.	.	.	.	.	.	.	.	.
**ExpanSys	62	8	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
**Hedrocel	46	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
**Icon	123	84	68	78	37	11	.	.	.	.	.	.	.	.	.	.	.	.
**Inter-Op	33	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
**MBA	117	5	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
**Mitch TRH	45	273	164	130	82	37	.	.	.	.	.	.	.	.	.	.	.	.
**Plasmacup	26	13	7	54	60	59	77	70	44	51	21	.	.	.	.	.	.	.
**SPH-Blind	933	19	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
**seleXys (excluding seleXys PC)	35	33	20	21	53	70	89	57	13	.	.	.	.	.	.	.	.	.

Note: Large head (>32mm) metal/metal bearings have been removed from the comparator group for all primary total conventional hip investigations
Components have been compared to all other modern total conventional hip components
*Femoral Stem Component
**Acetabular Component
+ Newly identified and no longer used

Figure IP2 Cumulative Percent Revision of Newly Identified Total Conventional Hip Prostheses

Newly Identified

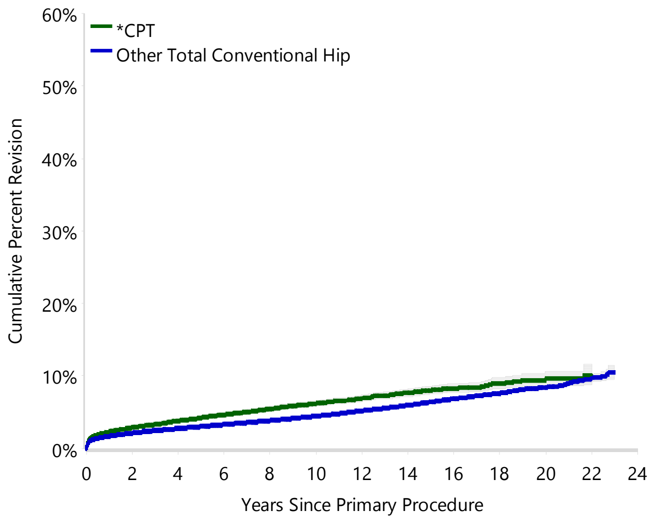
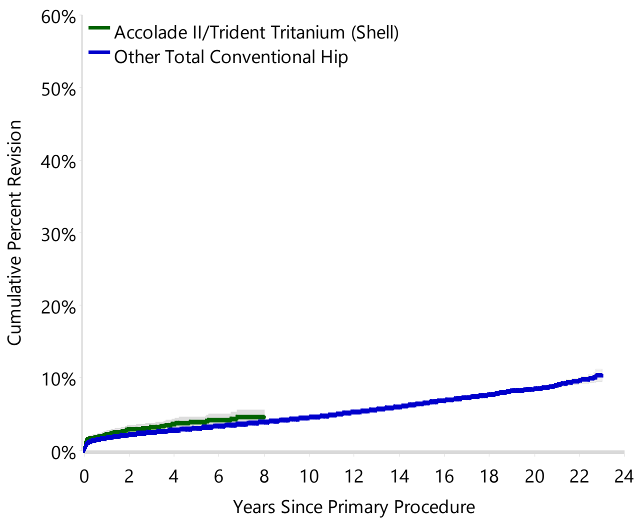
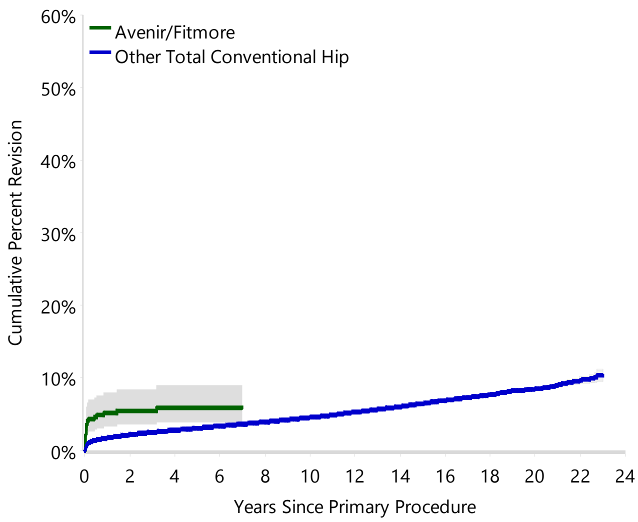
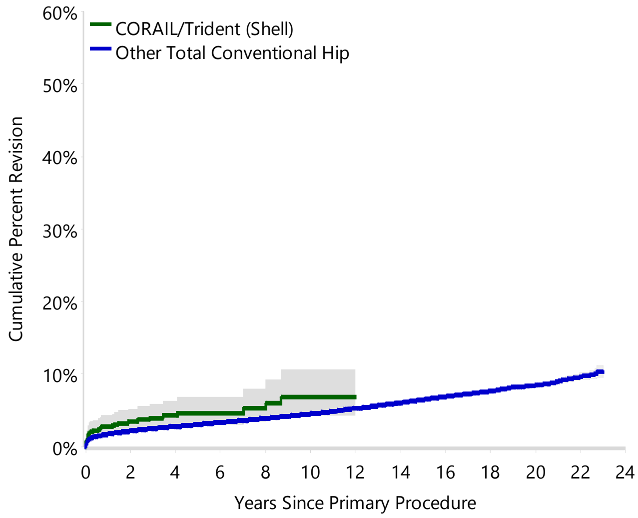


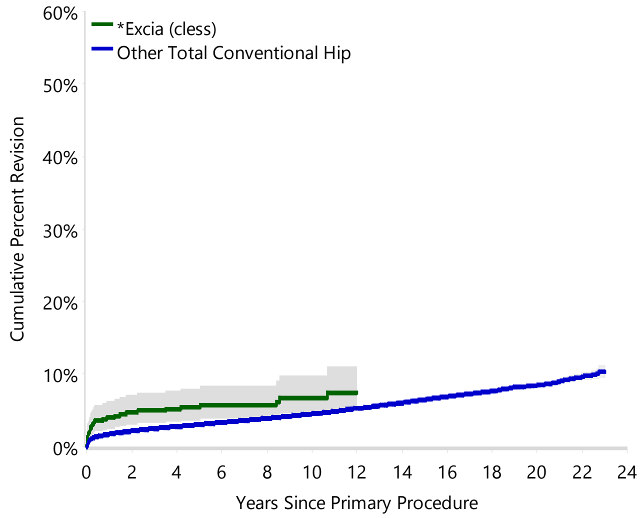
Figure IP3 Cumulative Percent Revision of Re-Identified and Still Used Total Conventional Hip Prostheses

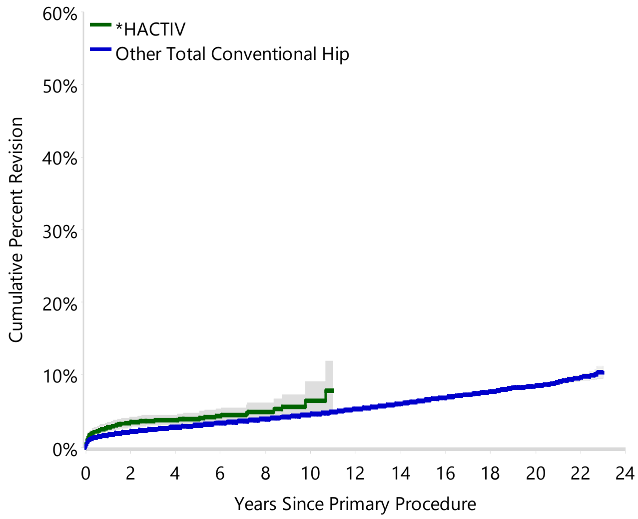
Re-Identified and Still Used

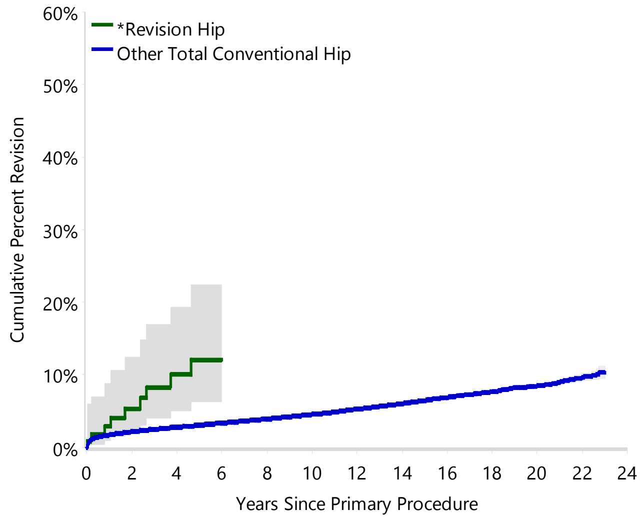


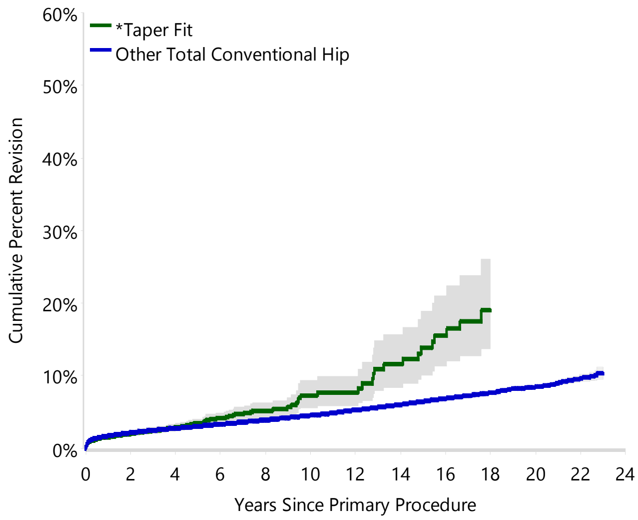


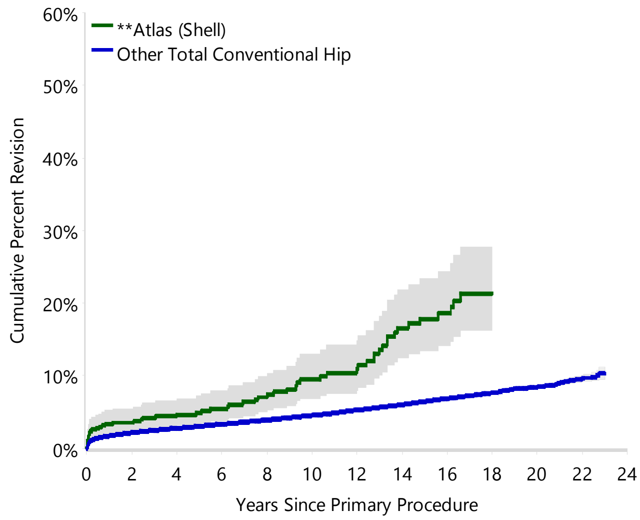

CORAIL/Trident (Shell)
Other Total Conventional Hip
Cumulative Percent Revision
60%
50%
40%
30%
20%
10%
0%
0 2 4 6 8 10 12 14 16 18 20 22 24
Years Since Primary Procedure


*Excia (cless)
Other Total Conventional Hip
Cumulative Percent Revision
60%
50%
40%
30%
20%
10%
0%
0 2 4 6 8 10 12 14 16 18 20 22 24
Years Since Primary Procedure

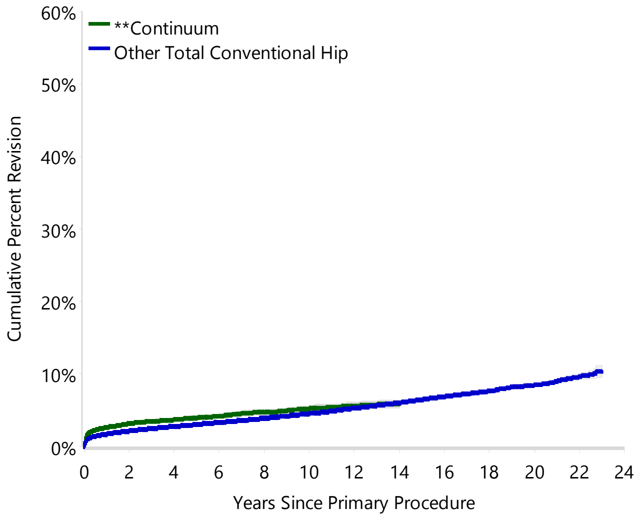

*HACTIV
Other Total Conventional Hip
Cumulative Percent Revision
60%
50%
40%
30%
20%
10%
0%
0 2 4 6 8 10 12 14 16 18 20 22 24
Years Since Primary Procedure

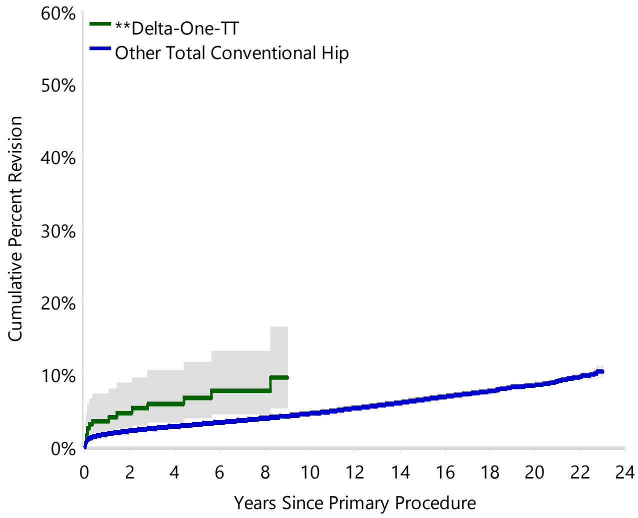

*Revision Hip
Other Total Conventional Hip
Cumulative Percent Revision
60%
50%
40%
30%
20%
10%
0%
0 2 4 6 8 10 12 14 16 18 20 22 24
Years Since Primary Procedure

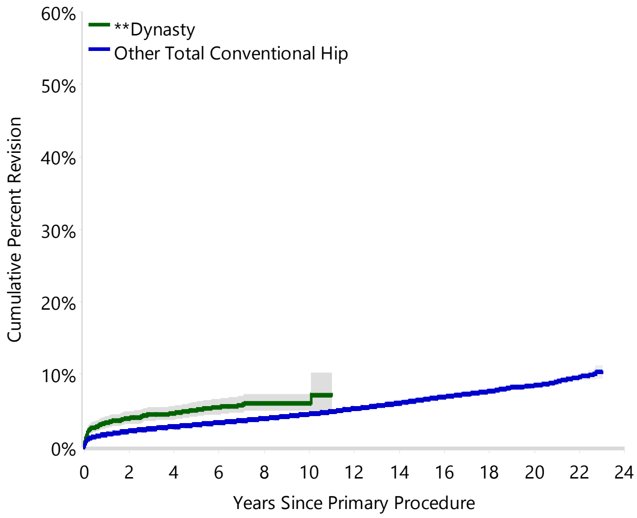

*Taper Fit
Other Total Conventional Hip
Cumulative Percent Revision
60%
50%
40%
30%
20%
10%
0%
0 2 4 6 8 10 12 14 16 18 20 22 24
Years Since Primary Procedure

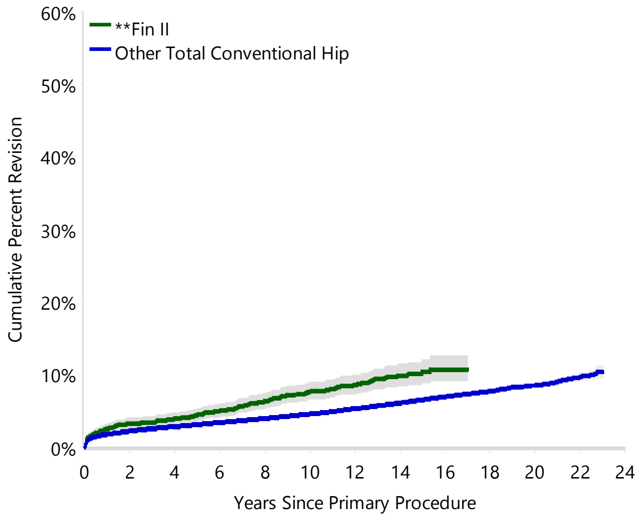

**Atlas (Shell)
Other Total Conventional Hip
Cumulative Percent Revision
60%
50%
40%
30%
20%
10%
0%
0 2 4 6 8 10 12 14 16 18 20 22 24
Years Since Primary Procedure

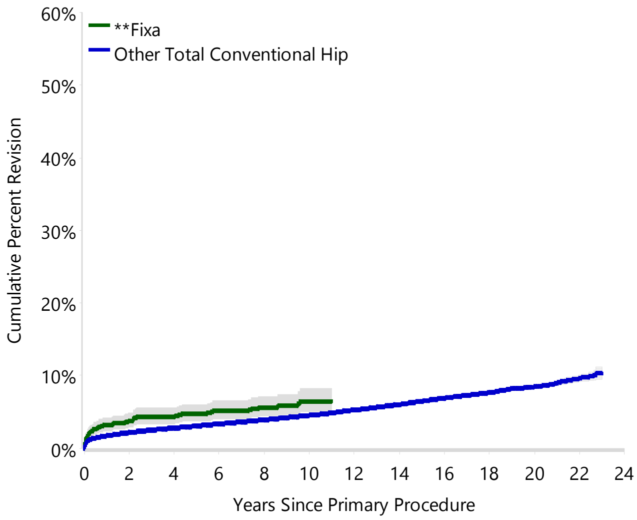
Prostheses with Higher than Anticipated Rates of Revision

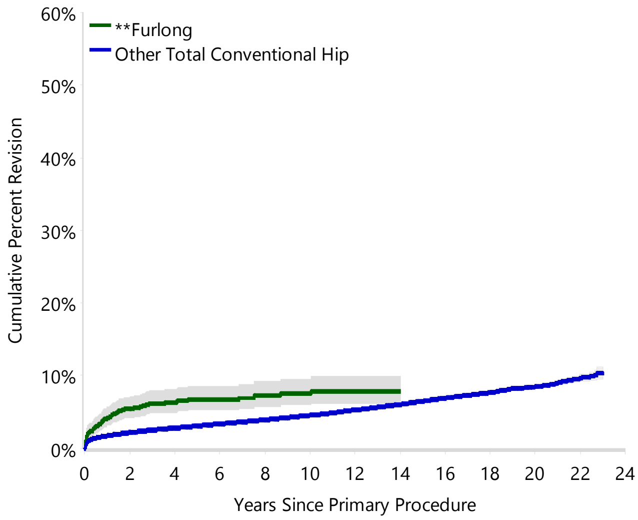


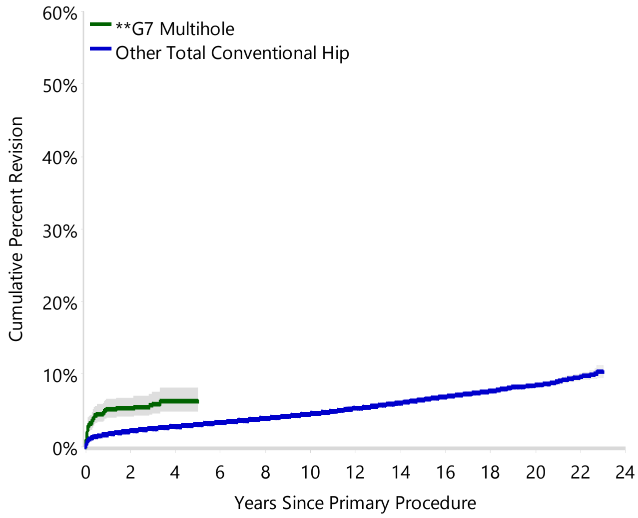


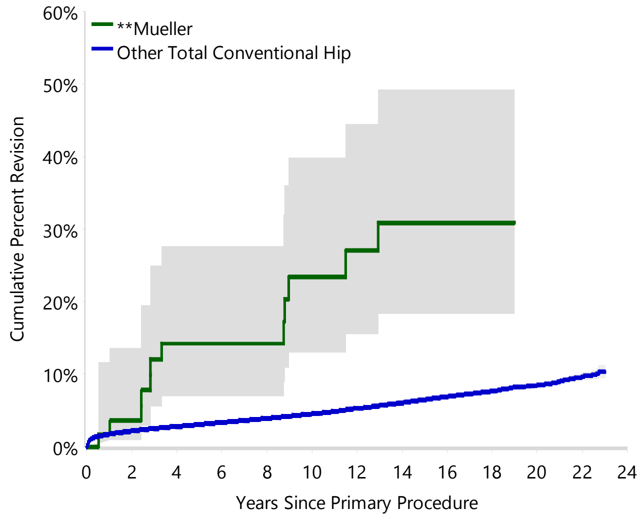


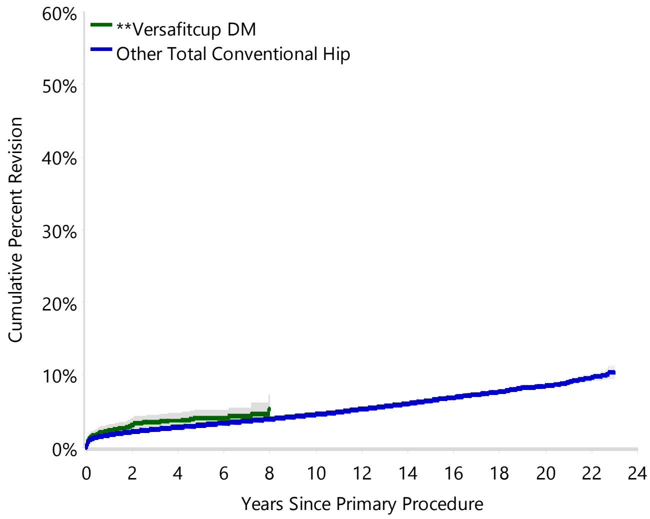







**G7 Multihole
Other Total Conventional Hip
Cumulative Percent Revision
60%
50%
40%
30%
20%
10%
0%
0
2
4
6
8
10
12
14
16
18
20
22
24
Years Since Primary Procedure


**Mueller
Other Total Conventional Hip
Cumulative Percent Revision
60%
50%
40%
30%
20%
10%
0%
0
2
4
6
8
10
12
14
16
18
20
22
24
Years Since Primary Procedure


**Versafitcup DM
Other Total Conventional Hip
Cumulative Percent Revision
60%
50%
40%
30%
20%
10%
0%
0
2
4
6
8
10
12
14
16
18
20
22
24
Years Since Primary Procedure

Prostheses with Higher than Anticipated Rates of Revision

TOTAL RESURFACING

There are no newly identified total resurfacing hip prostheses.

Table IP10 Revision Rate of Total Resurfacing Hip Prostheses Identified as having a Higher than Anticipated Rate of Revision

Head/Acetabular	N Revised	N Total	Obs. Years	Revisions/ 100 Obs. Yrs	Hazard Ratio, P Value
Identified and No Longer Used					
ASR/ASR	419	1168	15149	2.77	Entire Period: HR=4.18 (3.74, 4.67), p<0.001
Bionik/Bionik	64	200	2402	2.66	Entire Period: HR=4.38 (3.41, 5.64), p<0.001
Conserve Plus/Conserve Plus	17	63	972	1.75	Entire Period: HR=2.35 (1.46, 3.80), p<0.001
Cormet/Cormet	148	626	8702	1.70	Entire Period: HR=2.54 (2.14, 3.01), p<0.001
Durom/Durom	121	847	12919	0.94	0 - 4.5Yr: HR=2.51 (1.92, 3.26), p<0.001
	.	.	.	.	4.5Yr+: HR=1.10 (0.84, 1.44), p=0.485
Recap/Recap	31	196	2671	1.16	0 - 6Mth: HR=2.89 (1.28, 6.52), p=0.010
	.	.	.	.	6Mth - 1.5Yr: HR=6.73 (3.27, 13.86), p<0.001
	.	.	.	.	1.5Yr+: HR=1.27 (0.79, 2.06), p=0.324
*Cormet 2000 HAP	31	95	1485	2.09	Entire Period: HR=3.65 (2.55, 5.21), p<0.001

Note: Components have been compared to all other total resurfacing hip components
*Head Component

Table IP11 Cumulative Percent Revision of Total Resurfacing Hip Prostheses Identified as having a Higher than Anticipated Rate of Revision

CPR	1 Yr	3 Yrs	5 Yrs	10 Yrs	20 Yrs
Identified and No Longer Used					
ASR/ASR	3.4 (2.5, 4.6)	7.2 (5.9, 8.8)	15.5 (13.5, 17.7)	29.9 (27.4, 32.7)	
Bionik/Bionik	3.5 (1.7, 7.2)	12.5 (8.7, 18.0)	18.6 (13.8, 24.7)	27.8 (22.1, 34.6)	
Conserve Plus/Conserve Plus	4.8 (1.6, 14.0)	6.4 (2.4, 16.1)	9.6 (4.4, 20.1)	14.4 (7.8, 25.9)	28.0 (18.4, 41.1)
Cormet/Cormet	2.1 (1.2, 3.6)	5.8 (4.2, 7.9)	9.8 (7.7, 12.5)	17.3 (14.5, 20.5)	27.2 (23.1, 31.9)
Durom/Durom	3.3 (2.3, 4.8)	5.6 (4.2, 7.3)	7.7 (6.1, 9.7)	11.0 (9.0, 13.3)	
Recap/Recap	5.1 (2.8, 9.3)	8.7 (5.5, 13.6)	10.2 (6.7, 15.4)	14.5 (10.2, 20.3)	
*Cormet 2000 HAP	6.3 (2.9, 13.5)	8.4 (4.3, 16.1)	9.5 (5.0, 17.4)	21.1 (14.2, 30.7)	32.6 (24.0, 43.2)

Note: Components have been compared to all other total resurfacing hip components
*Head Component

Table IP12 Yearly Usage of Total Resurfacing Hip Prostheses Identified as having a Higher than Anticipated Rate of Revision

Year of Implant	≤2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Identified and No Longer Used																		
ASR/ASR	768	176	133	91	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bionik/Bionik	45	33	46	54	20	2	.	.	.	.	.	.	.	.	.	.	.	.
Conserve Plus/Conserve Plus	59	3	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cormet/Cormet	313	76	94	75	50	10	4	4	.	.	.	.	.	.	.	.	.	.
Durom/Durom	574	105	88	46	24	10	.	.	.	.	.	.	.	.	.	.	.	.
Recap/Recap	51	42	46	38	16	3	.	.	.	.	.	.	.	.	.	.	.	.
*Cormet 2000 HAP	95	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Note: Components have been compared to all other total resurfacing hip components
*Head Component

Primary Partial Knee Replacement

PATELLA/TROCHLEA

There are no newly identified patella/trochlea prostheses.

Table IP13 Revision Rate of Patella-Trochlear Knee Prostheses Identified as Having a Higher than Anticipated Rate of Revision

Patella/Trochlear	N Revised	N Total	Obs. Years	Revisions/ 100 Obs. Yrs	Hazard Ratio, P Value
Identified and No Longer Used					
Lubinus/Lubinus	23	39	411	5.60	Entire Period: HR=2.11 (1.37, 3.25), p<0.001
PFC Sigma/Sigma HP	48	117	953	5.04	Entire Period: HR=1.98 (1.48, 2.67), p<0.001
**LCS	228	413	4323	5.27	Entire Period: HR=1.94 (1.65, 2.28), p<0.001

Note: Components have been compared to all other modern patella-trochlear knee components
**Trochlear Component

Table IP14 Cumulative Percent Revision of Patella-Trochlear Knee Prostheses Identified as Having a Higher than Anticipated Rate of Revision

CPR	1 Yr	3 Yrs	5 Yrs	10 Yrs	20 Yrs
Identified and No Longer Used					
Lubinus/Lubinus	5.1 (1.3, 19.0)	18.1 (9.1, 34.3)	20.9 (11.0, 37.6)	35.0 (22.0, 52.7)	
PFC Sigma/Sigma HP	4.3 (1.8, 10.0)	14.7 (9.4, 22.6)	20.9 (14.5, 29.6)	39.1 (30.4, 49.2)	
**LCS	3.9 (2.4, 6.2)	11.9 (9.1, 15.4)	20.7 (17.1, 25.0)	40.9 (36.2, 46.0)	

Note: **Trochlear Component

Table IP15 Yearly Usage of Patella-Trochlear Knee Prostheses Identified as Having a Higher than Anticipated Rate of Revision

Year of Implant	≤2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Identified and No Longer Used																		
Lubinus/Lubinus	37	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.
PFC Sigma/Sigma HP	.	14	6	5	16	15	12	20	7	7	7	8	.	.	.	.	.	.
**LCS	262	64	60	27	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Note: **Trochlear Component

Prostheses with Higher than Anticipated Rates of Revision

UNICOMPARTMENTAL

There are no newly identified unicompartmental prostheses.

Table IP16 Revision Rate of Unicompartmental Knee Prostheses Identified as Having a Higher than Anticipated Rate of Revision

Femoral/Tibial	N Revised	N Total	Obs. Years	Revisions/ 100 Obs. Yrs	Hazard Ratio, P Value
Identified and No Longer Used					
Advance/Advance	16	37	348	4.60	0 - 2Yr: HR=6.03 (2.88, 12.66), p<0.001
	.	.	.	.	2Yr - 4.5Yr: HR=6.55 (2.46, 17.42), p<0.001
	.	.	.	.	4.5Yr – 7Yr: HR=6.46 (2.08, 20.06), p=0.001
					7Yr+: HR=0.82 (0.21,3.30), P=0.784
BalanSys Uni/BalanSys Uni Convex	18	54	595	3.03	Entire Period: HR=2.00 (1.26, 3.18), p=0.003
BalanSys Uni/BalanSys Uni Mobile	67	199	2530	2.65	0 - 2Yr: HR=3.14 (2.07, 4.79), p<0.001
	.	.	.	.	2Yr+: HR=1.46 (1.09, 1.97), p=0.011
Eius/Eius	54	142	1834	2.94	Entire Period: HR=1.63 (1.25, 2.14), p<0.001
Freedom PKR Active/Freedom PKR Active	509	1505	16570	3.07	0 - 6Mth: HR=0.48 (0.23, 1.01), p=0.054
	.	.	.	.	6Mth - 9Mth: HR=1.10 (0.57, 2.14), p=0.780
	.	.	.	.	9Mth - 1Yr: HR=1.68 (0.94, 3.00), p=0.080
	.	.	.	.	1Yr - 1.5Yr: HR=2.46 (1.71, 3.52), p<0.001
	.	.	.	.	1.5Yr - 2Yr: HR=1.66 (1.02, 2.71), p=0.041
	.	.	.	.	2Yr - 3.5Yr: HR=2.49 (1.88, 3.29), p<0.001
	.	.	.	.	3.5Yr - 4Yr: HR=3.82 (2.51, 5.81), p<0.001
	.	.	.	.	4Yr - 5Yr: HR=4.47 (3.29, 6.06), p<0.001
	.	.	.	.	5Yr - 7Yr: HR=2.91 (2.28, 3.73), p<0.001
	.	.	.	.	7Yr - 8.5Yr: HR=2.15 (1.56, 2.96), p<0.001
	.	.	.	.	8.5Yr - 9Yr: HR=4.51 (2.99, 6.79), p<0.001
	.	.	.	.	9Yr - 10Yr: HR=3.35 (2.39, 4.71), p<0.001
	.	.	.	.	10Yr+: HR=1.72 (1.43, 2.08), p<0.001
GMK-UNI/GMK-UNI	45	168	1125	4.00	Entire Period: HR=2.78 (2.07, 3.72), p<0.001
Uniglide/Uniglide	199	756	9084	2.19	0 - 2Yr: HR=2.20 (1.70, 2.84), p<0.001
	.	.	.	.	2Yr - 2.5Yr: HR=3.26 (1.86, 5.69), p<0.001
	.	.	.	.	2.5Yr+: HR=1.20 (1.01, 1.44), p=0.041
**Preservation Mobile	163	400	5310	3.07	0 - 6Mth: HR=1.12 (0.46, 2.70), p=0.804
	.	.	.	.	6Mth - 1.5Yr: HR=3.55 (2.46, 5.11), p<0.001
	.	.	.	.	1.5Yr - 3Yr: HR=3.73 (2.54, 5.47), p<0.001
	.	.	.	.	3Yr+: HR=1.44 (1.18, 1.76), p<0.001

Note: Components have been compared to all other modern unicompartmental knee components
**Tibial Component

Table IP17 Cumulative Percent Revision of Unicompartmental Knee Prostheses Identified as Having a Higher than Anticipated Rate of Revision

CPR	1 Yr	3 Yrs	5 Yrs	10 Yrs	20 Yrs
Identified and No Longer Used					
Advance/Advance	10.8 (4.2, 26.3)	27.0 (15.6, 44.4)	35.8 (22.5, 53.6)	41.6 (27.5, 59.4)	
BalanSys Uni/BalanSys Uni Convex	1.9 (0.3, 12.4)	7.4 (2.8, 18.5)	7.4 (2.8, 18.5)	25.1 (15.4, 39.4)	
BalanSys Uni/BalanSys Uni Mobile	7.0 (4.2, 11.6)	13.1 (9.1, 18.6)	14.6 (10.4, 20.4)	21.7 (16.5, 28.2)	
Eius/Eius	4.9 (2.4, 10.1)	12.8 (8.3, 19.5)	17.8 (12.4, 25.2)	22.3 (16.3, 30.2)	
Freedom PKR Active/Freedom PKR Active	1.9 (1.3, 2.7)	8.0 (6.7, 9.5)	13.8 (12.1, 15.6)	27.3 (25.0, 29.7)	
GMK-UNI/GMK-UNI	6.5 (3.7, 11.5)	17.4 (12.4, 24.1)	24.5 (18.6, 31.8)		
Uniglide/Uniglide	4.8 (3.5, 6.6)	10.8 (8.8, 13.3)	13.0 (10.8, 15.6)	19.8 (17.1, 22.9)	
**Preservation Mobile	5.3 (3.5, 7.9)	15.5 (12.3, 19.5)	19.1 (15.6, 23.3)	27.2 (23.1, 31.9)	44.1 (39.0, 49.6)

Note: **Tibial Component

Table IP18 Yearly Usage of Unicompartmental Knee Prostheses Identified as Having a Higher than Anticipated Rate of Revision

Year of Implant	≤2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Identified and No Longer Used																		
Advance/Advance	33	3	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
BalanSys Uni/BalanSys Uni Convex	.	12	10	4	7	9	1	3	3	5	.	.	.	.	.	.	.	.
BalanSys Uni/BalanSys Uni Mobile	151	33	9	2	4	.	.	.	.	.	.	.	.	.	.	.	.	.
Eius/Eius	116	9	8	7	2	.	.	.	.	.	.	.	.	.	.	.	.	.
Freedom PKR Active/Freedom PKR Active	523	264	162	149	102	75	68	63	51	31	12	5	.	.	.	.	.	.
GMK-UNI/GMK-UNI	.	.	5	10	2	.	21	22	16	19	17	12	29	3	8	3	1	.
Uniglide/Uniglide	353	107	93	61	30	38	25	22	9	5	8	3	.	1	1	.	.	.
**Preservation Mobile	387	13	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Note: **Tibial Component

Prostheses with Higher than Anticipated Rates of Revision

Primary Total Knee Replacement

There is one newly identified total knee replacement.

Since 2007, seven different combinations of the Optetrak total knee replacement have been identified. This year the Optetrak Logic CR/Optetrak Logic is identified (which includes both cemented and cementless femoral components). The Optetrak Logic CR/Optetrak Logic has been used in 1,884 procedures since 2014 with 155 revised. The cumulative percent revision at 8 years is 13.6%. There have been 68 major revisions and 87 minor revisions, of which the tibial insert was exchanged in 81. There have been 32 revisions for wear of the tibial insert, 32 for loosening, 21 for infection, 17 for lysis, and 14 for both instability and breakage of the tibial insert. The tibial inserts were the subject of a Hazard Alert from the TGA (Therapeutic Goods Administration) in 2023 and all are non-XLPE.

Table IP19 Revision Rate of Total Knee Prostheses Identified as Having a Higher than Anticipated Rate of Revision

Femoral/Tibial	N Revised	N Total	Obs. Years	Revisions/ 100 Obs. Yrs	Hazard Ratio, P Value
Newly Identified					
Optetrak Logic CR/Optetrak Logic	155	1884	9445	1.64	0 - 1.5Yr: HR=1.11 (0.77, 1.61), p=0.581
	.	.	.	.	1.5Yr - 3.5Yr: HR=3.03 (2.32, 3.96), p<0.001
	.	.	.	.	3.5Yr+: HR=6.84 (5.43, 8.61), p<0.001
Re-Identified and Still Used					
ACS (cless)/ACS Fixed	132	2873	17103	0.77	Entire Period: HR=1.34 (1.13, 1.59), p<0.001
Active Knee (cless)/Active Knee	772	7250	86573	0.89	0 - 1Yr: HR=1.08 (0.87, 1.35), p=0.480
	.	.	.	.	1Yr - 2.5Yr: HR=1.75 (1.49, 2.05), p<0.001
	.	.	.	.	2.5Yr - 3Yr: HR=1.21 (0.79, 1.84), p=0.378
	.	.	.	.	3Yr+: HR=2.30 (2.10, 2.51), p<0.001
Apex Knee CR (cless)/Apex Knee (cless)	30	527	3702	0.81	Entire Period: HR=1.51 (1.06, 2.16), p=0.022
Attune PS (ctd)/Attune (cless)	28	992	1889	1.48	Entire Period: HR=1.71 (1.18, 2.47), p=0.004
Columbus/Columbus	231	7427	30220	0.76	Entire Period: HR=1.21 (1.06, 1.37), p=0.004
E.Motion/E.Motion	74	1027	8182	0.90	0 - 1.5Yr: HR=2.60 (1.90, 3.56), p<0.001
	.	.	.	.	1.5Yr+: HR=1.26 (0.90, 1.75), p=0.175
Mutars/Mutars	69	436	1100	6.27	Entire Period: HR=4.59 (3.61, 5.82), p<0.001
Trekking/Trekking	75	1291	9291	0.81	0 - 6Mth: HR=2.59 (1.63, 4.11), p<0.001
	.	.	.	.	6Mth - 2Yr: HR=1.42 (0.94, 2.13), p=0.095
	.	.	.	.	2Yr+: HR=1.26 (0.90, 1.76), p=0.181
*Legion Oxinium FS	45	515	2904	1.55	0 - 9Mth: HR=6.15 (4.12, 9.18), p<0.001
	.	.	.	.	9Mth - 1.5Yr: HR=1.24 (0.47, 3.31), p=0.666
	.	.	.	.	1.5Yr+: HR=1.70 (1.06, 2.73), p=0.029
**Legion Revision Tibial Baseplate	80	1308	6520	1.23	0 - 6Mth: HR=4.13 (2.90, 5.88), p<0.001
	.	.	.	.	6Mth+: HR=1.39 (1.05, 1.85), p=0.020
Identified and No Longer Used					
ACS/ACS Mobile PC (cless)	31	131	1073	2.89	Entire Period: HR=5.57 (3.92, 7.91), p<0.001
AMK/AMK	26	203	2567	1.01	Entire Period: HR=2.44 (1.66, 3.59), p<0.001
Advance/Advance	81	1009	8675	0.93	Entire Period: HR=1.80 (1.45, 2.24), p<0.001
Buechel-Pappas/Buechel-Pappas	58	479	5613	1.03	Entire Period: HR=2.19 (1.69, 2.84), p<0.001
Eska RP/Eska RP	9	40	401	2.25	Entire Period: HR=5.21 (2.72, 9.97), p<0.001
Evolis (cless)/Evolis (cless)	10	87	909	1.10	Entire Period: HR=2.19 (1.18, 4.07), p=0.012
Gemini MK II/Gemini MK II	8	21	223	3.59	Entire Period: HR=7.56 (3.78, 15.10), p<0.001
Genesis (ctd)/Genesis (ctd)	11	62	721	1.53	Entire Period: HR=3.77 (2.09, 6.80), p<0.001
Genesis II CR (cless)/Profix Mobile (ctd)	38	241	3064	1.24	Entire Period: HR=2.97 (2.16, 4.08), p<0.001
Genesis II Oxinium CR (cless)/Genesis II	48	110	1046	4.59	0 - 6Mth: HR=5.85 (2.20, 15.59), p<0.001
	.	.	.	.	6Mth - 9Mth: HR=19.99 (8.31, 48.11), p<0.001
	.	.	.	.	9Mth - 1Yr: HR=16.01 (6.00, 42.71), p<0.001

Femoral/Tibial	N Revised	N Total	Obs. Years	Revisions/ 100 Obs. Yrs	Hazard Ratio, P Value
	.	.	.	.	1Yr - 1.5Yr: HR=23.51 (13.01, 42.50), p<0.001
	.	.	.	.	1.5Yr - 2.5Yr: HR=25.47 (15.34, 42.28), p<0.001
	.	.	.	.	2.5Yr - 5Yr: HR=5.77 (2.17, 15.37), p<0.001
					5Yr+: HR=2.16 (0.90, 5.19), p=0.085
Genesis II Oxinium CR (cless)/Profix Mobile	57	88	650	8.77	0 - 6Mth: HR=7.32 (2.74, 19.50), p<0.001
	.	.	.	.	6Mth - 1.5Yr: HR=45.61 (32.22, 64.56), p<0.001
	.	.	.	.	1.5Yr - 2Yr: HR=34.03 (16.21, 71.42), p<0.001
	.	.	.	.	2Yr+: HR=6.76 (4.00, 11.42), p<0.001
Genesis II Oxinium PS (ctd)/Genesis II (cless)	17	56	535	3.18	0 - 1Yr: HR=17.70 (9.80, 31.97), p<0.001
	.	.	.	.	1Yr - 1.5Yr: HR=8.17 (2.04, 32.66), p=0.003
	.	.	.	.	1.5Yr+: HR=2.02 (0.76, 5.37), p=0.160
Genesis II Oxinium PS (ctd)/Genesis II (keel)	69	269	3158	2.18	Entire Period: HR=4.72 (3.73, 5.98), p<0.001
HLS Noetos/HLS Noetos	43	294	3225	1.33	Entire Period: HR=2.83 (2.10, 3.82), p<0.001
IB II/IB II	40	199	2634	1.52	0 - 2Yr: HR=0.93 (0.30, 2.88), p=0.897
	.	.	.	.	2Yr - 2.5Yr: HR=5.33 (1.72, 16.47), p=0.003
	.	.	.	.	2.5Yr+: HR=5.51 (3.93, 7.71), p<0.001
Interax/Interax	12	52	529	2.27	0 - 3Yr: HR=0.90 (0.13, 6.37), p=0.913
	.	.	.	.	3Yr+: HR=10.04 (5.56, 18.14), p<0.001
Journey Oxinium/Journey	410	3033	33978	1.21	0 - 3Mth: HR=0.27 (0.09, 0.85), p=0.024
	.	.	.	.	3Mth - 1.5Yr: HR=2.33 (1.86, 2.91), p<0.001
	.	.	.	.	1.5Yr - 2.5Yr: HR=2.11 (1.57, 2.84), p<0.001
	.	.	.	.	2.5Yr - 3Yr: HR=1.64 (0.93, 2.90), p=0.086
	.	.	.	.	3Yr - 3.5Yr: HR=2.39 (1.44, 3.98), p<0.001
	.	.	.	.	3.5Yr+: HR=3.22 (2.85, 3.65), p<0.001
Maxim (cless)/Vanguard (ctd)	75	413	5635	1.33	0 - 2Yr: HR=1.60 (0.91, 2.81), p=0.105
	.	.	.	.	2Yr - 3Yr: HR=1.30 (0.42, 4.02), p=0.652
	.	.	.	.	3Yr - 4.5Yr: HR=3.53 (1.76, 7.06), p<0.001
	.	.	.	.	4.5Yr - 6Yr: HR=1.11 (0.28, 4.44), p=0.881
	.	.	.	.	6Yr - 9.5Yr: HR=2.20 (1.10, 4.41), p=0.025
	.	.	.	.	9.5Yr+: HR=5.58 (4.10, 7.58), p<0.001
Nexgen LPS Flex (cless)/Nexgen	119	2114	15485	0.77	0 - 1.5Yr: HR=2.03 (1.58, 2.61), p<0.001
	.	.	.	.	1.5Yr+: HR=1.12 (0.87, 1.46), p=0.371
Optetrak-CR (ctd)/Optetrak (ctd)	12	92	944	1.27	Entire Period: HR=2.90 (1.65, 5.11), p<0.001
Optetrak-PS/Optetrak	353	2410	27976	1.26	0 - 1Mth: HR=0.23 (0.03, 1.63), p=0.140
	.	.	.	.	1Mth - 1.5Yr: HR=1.90 (1.46, 2.46), p<0.001
	.	.	.	.	1.5Yr - 2.5Yr: HR=2.80 (2.08, 3.75), p<0.001
	.	.	.	.	2.5Yr - 3Yr: HR=1.96 (1.08, 3.54), p=0.026
	.	.	.	.	3Yr+: HR=3.41 (3.00, 3.88), p<0.001
Optetrak-PS/Optetrak RBK	102	1127	11235	0.91	Entire Period: HR=1.95 (1.60, 2.36), p<0.001
Optetrak-PS/Optetrak-PS	14	55	572	2.45	Entire Period: HR=5.77 (3.41, 9.74), p<0.001
PFC Sigma PS (ctd)/MBT (cless)	25	316	3176	0.79	Entire Period: HR=1.55 (1.05, 2.30), p=0.028
Profix Oxinium (cless)/Profix	33	75	763	4.33	0 - 9Mth: HR=6.10 (2.29, 16.26), p<0.001
	.	.	.	.	9Mth - 2Yr: HR=28.95 (18.86, 44.43), p<0.001
	.	.	.	.	2Yr+: HR=3.34 (1.67, 6.68), p<0.001
Profix Oxinium (cless)/Profix Mobile	71	158	1425	4.98	0 - 9Mth: HR=3.18 (1.19, 8.47), p=0.020
	.	.	.	.	9Mth - 1.5Yr: HR=28.74 (19.95, 41.41), p<0.001
	.	.	.	.	1.5Yr - 2Yr: HR=19.33 (10.05, 37.21), p<0.001
	.	.	.	.	2Yr - 2.5Yr: HR=37.94 (22.43, 64.18), p<0.001

Prostheses with Higher than Anticipated Rates of Revision

Femoral/Tibial	N Revised	N Total	Obs. Years	Revisions/ 100 Obs. Yrs	Hazard Ratio, P Value
	.	.	.	.	2.5Yr - 3Yr: HR=24.55 (11.01, 54.75), p<0.001
	.	.	.	.	3Yr+: HR=2.55 (1.32, 4.90), p=0.005
Profix Oxinium (ctd)/Profix (cless)	14	100	1352	1.04	Entire Period: HR=2.06 (1.22, 3.47), p=0.006
Profix Oxinium (ctd)/Profix Mobile	30	228	3285	0.91	Entire Period: HR=1.88 (1.32, 2.69), p<0.001
Profix/Profix Mobile	114	1005	13298	0.86	0 - 1.5Yr: HR=2.85 (2.09, 3.88), p<0.001
	.	.	.	.	1.5Yr - 2.5Yr: HR=3.25 (2.12, 4.99), p<0.001
	.	.	.	.	2.5Yr - 3Yr: HR=1.33 (0.43, 4.13), p=0.621
	.	.	.	.	3Yr - 6.5Yr: HR=2.10 (1.38, 3.19), p<0.001
	.	.	.	.	6.5Yr+: HR=1.14 (0.78, 1.65), p=0.503
Rotaglide Plus/Rotaglide Plus	88	631	8147	1.08	0 - 1.5Yr: HR=1.36 (0.77, 2.40), p=0.281
	.	.	.	.	1.5Yr - 2Yr: HR=3.67 (1.84, 7.33), p<0.001
	.	.	.	.	2Yr+: HR=2.77 (2.18, 3.52), p<0.001
SAL/SAL	15	56	762	1.97	0 - 8.5Yr: HR=1.69 (0.63, 4.50), p=0.295
	.	.	.	.	8.5Yr+: HR=10.64 (5.88, 19.26), p<0.001
Score (cless)/Score (cless)	254	3026	22701	1.12	0 - 6Mth: HR=0.97 (0.60, 1.56), p=0.896
	.	.	.	.	6Mth - 1.5Yr: HR=2.12 (1.65, 2.72), p<0.001
	.	.	.	.	1.5Yr+: HR=2.15 (1.85, 2.50), p<0.001
Score (cless)/Score (ctd)	119	1679	10859	1.10	Entire Period: HR=1.92 (1.60, 2.30), p<0.001
Scorpio NRG PS (cless)/Series 7000 (cless)	91	1172	12290	0.74	Entire Period: HR=1.37 (1.11, 1.68), p=0.002
TC-Plus (cless)/TC-Plus (ctd)	8	63	745	1.07	Entire Period: HR=2.62 (1.31, 5.23), p=0.006
Trac/Trac	27	138	1709	1.58	Entire Period: HR=3.51 (2.41, 5.12), p<0.001
Vanguard PS/Regenerex	45	465	3914	1.15	0 - 1.5Yr: HR=2.55 (1.61, 4.05), p<0.001
	.	.	.	.	1.5Yr+: HR=1.95 (1.34, 2.84), p<0.001
Vanguard PS/Vanguard	370	5405	48313	0.77	0 - 1.5Yr: HR=1.97 (1.68, 2.31), p<0.001
	.	.	.	.	1.5Yr+: HR=1.34 (1.17, 1.54), p<0.001
*LCS Duofix	697	4866	58489	1.19	Entire Period: HR=2.62 (2.43, 2.82), p<0.001
*LCS PS	78	638	6527	1.20	Entire Period: HR=2.63 (2.10, 3.28), p<0.001
*Renasys	20	121	1557	1.28	Entire Period: HR=2.96 (1.91, 4.58), p<0.001

Note: Components have been compared to all other modern total knee components
*Femoral Component
**Tibial Component

Table IP20 Cumulative Percent Revision of Total Knee Prostheses Identified as Having a Higher than Anticipated Rate of Revision

CPR	1 Yr	3 Yrs	5 Yrs	10 Yrs	20 Yrs
Newly Identified					
Optetrak Logic CR/Optetrak Logic	1.1 (0.7, 1.6)	4.2 (3.3, 5.2)	7.8 (6.6, 9.3)		
Re-Identified and Still Used					
ACS (cless)/ACS Fixed	1.3 (1.0, 1.8)	3.7 (3.0, 4.5)	4.5 (3.7, 5.4)	5.8 (4.9, 7.0)	
Active Knee (cless)/Active Knee	1.1 (0.9, 1.4)	3.6 (3.1, 4.0)	5.0 (4.5, 5.6)	8.7 (8.1, 9.4)	14.9 (13.8, 16.1)
Apex Knee CR (cless)/Apex Knee (cless)	2.5 (1.4, 4.2)	5.2 (3.5, 7.5)	5.6 (3.9, 8.0)	6.2 (4.4, 8.8)	
Attune PS (ctd)/Attune (cless)	1.9 (1.2, 3.0)				
Columbus/Columbus	1.1 (0.9, 1.4)	2.7 (2.4, 3.2)	3.8 (3.3, 4.4)	6.3 (5.3, 7.5)	
E.Motion/E.Motion	2.6 (1.7, 3.7)	5.7 (4.4, 7.3)	6.6 (5.2, 8.3)	8.2 (6.5, 10.2)	
Mutars/Mutars	7.0 (4.8, 10.0)	17.2 (13.3, 22.2)	25.5 (19.7, 32.5)		
Trekking/Trekking	2.3 (1.6, 3.2)	3.9 (3.0, 5.2)	4.9 (3.8, 6.2)	6.4 (5.1, 8.1)	
*Legion Oxinium FS	5.0 (3.4, 7.3)	7.1 (5.1, 9.8)	8.8 (6.4, 11.9)	11.2 (8.2, 15.1)	
**Legion Revision Tibial Baseplate	3.0 (2.2, 4.1)	4.7 (3.6, 6.1)	6.0 (4.7, 7.8)	9.1 (7.0, 11.6)	
Identified and No Longer Used					
ACS/ACS Mobile PC (cless)	7.7 (4.2, 13.8)	19.3 (13.5, 27.2)	20.1 (14.2, 28.2)	24.5 (17.9, 33.1)	
AMK/AMK	1.0 (0.2, 3.9)	5.0 (2.7, 9.1)	6.6 (3.9, 11.1)	11.4 (7.5, 16.9)	18.3 (12.1, 27.1)
Advance/Advance	2.0 (1.3, 3.1)	5.4 (4.1, 6.9)	6.4 (5.1, 8.1)	8.6 (6.9, 10.7)	
Buechel-Pappas/Buechel-Pappas	1.9 (1.0, 3.6)	5.7 (3.9, 8.2)	7.9 (5.8, 10.7)	10.5 (8.0, 13.7)	
Eska RP/Eska RP	7.5 (2.5, 21.5)	12.7 (5.5, 27.9)	18.2 (9.1, 34.5)	21.1 (11.1, 37.9)	
Evolis (cless)/Evolis (cless)	2.3 (0.6, 8.9)	8.0 (3.9, 16.1)	10.3 (5.5, 18.9)	11.5 (6.4, 20.4)	
Gemini MK II/Gemini MK II	9.5 (2.5, 33.0)	14.3 (4.8, 38.0)	23.8 (10.7, 48.1)	23.8 (10.7, 48.1)	
Genesis (ctd)/Genesis (ctd)	0.0 (0.0, 0.0)	6.7 (2.6, 16.8)	10.0 (4.6, 20.9)	16.1 (8.6, 28.9)	
Genesis II CR (cless)/Profix Mobile (ctd)	2.9 (1.4, 6.1)	7.7 (4.9, 11.9)	9.4 (6.3, 14.0)	14.7 (10.7, 20.1)	17.6 (13.0, 23.6)
Genesis II Oxinium CR (cless)/Genesis II	11.8 (7.0, 19.5)	38.9 (30.4, 48.7)	39.8 (31.3, 49.7)	42.8 (34.0, 52.7)	
Genesis II Oxinium CR (cless)/Profix Mobile	24.0 (16.3, 34.4)	52.8 (42.8, 63.5)	57.4 (47.4, 67.9)	61.1 (51.0, 71.3)	67.1 (56.7, 77.1)
Genesis II Oxinium PS (ctd)/Genesis II (cless)	19.6 (11.4, 32.7)	26.8 (17.1, 40.4)	30.4 (20.1, 44.2)	30.4 (20.1, 44.2)	
Genesis II Oxinium PS (ctd)/Genesis II (keel)	4.5 (2.6, 7.7)	14.9 (11.1, 19.7)	19.0 (14.8, 24.3)	22.6 (18.0, 28.2)	
HLS Noetos/HLS Noetos	3.4 (1.8, 6.2)	8.6 (5.9, 12.4)	10.7 (7.7, 14.9)	13.5 (10.0, 18.1)	
IB II/IB II	0.0 (0.0, 0.0)	3.6 (1.7, 7.3)	7.8 (4.8, 12.7)	15.9 (11.3, 22.1)	25.7 (19.0, 34.2)
Interax/Interax	0.0 (0.0, 0.0)	2.0 (0.3, 13.4)	8.3 (3.2, 20.7)	13.0 (6.0, 26.8)	
Journey Oxinium/Journey	1.4 (1.0, 1.9)	4.6 (3.9, 5.4)	6.5 (5.6, 7.4)	11.2 (10.1, 12.4)	
Maxim (cless)/Vanguard (ctd)	1.2 (0.5, 2.9)	3.7 (2.2, 6.0)	6.0 (4.0, 8.8)	9.4 (6.9, 12.8)	25.1 (20.2, 31.0)
Nexgen LPS Flex (cless)/Nexgen	2.4 (1.8, 3.2)	4.3 (3.6, 5.3)	5.0 (4.2, 6.0)	6.5 (5.3, 7.9)	
Optetrak-CR (ctd)/Optetrak (ctd)	0.0 (0.0, 0.0)	6.6 (3.0, 14.0)	10.1 (5.4, 18.5)	12.8 (7.3, 22.0)	
Optetrak-PS/Optetrak	1.5 (1.1, 2.0)	4.8 (4.0, 5.7)	6.4 (5.5, 7.5)	12.1 (10.8, 13.6)	19.8 (17.4, 22.4)
Optetrak-PS/Optetrak RBK	1.8 (1.2, 2.7)	4.6 (3.5, 6.0)	6.0 (4.7, 7.5)	8.3 (6.8, 10.2)	
Optetrak-PS/Optetrak-PS	1.8 (0.3, 12.2)	16.4 (8.9, 29.1)	20.0 (11.6, 33.3)	24.4 (14.9, 38.5)	
PFC Sigma PS (ctd)/MBT (cless)	2.2 (1.1, 4.6)	5.4 (3.4, 8.6)	7.1 (4.7, 10.5)	7.4 (5.0, 10.9)	
Profix Oxinium (cless)/Profix	13.3 (7.4, 23.4)	36.1 (26.4, 48.1)	37.5 (27.6, 49.5)	42.0 (31.7, 54.2)	46.0 (35.1, 58.5)
Profix Oxinium (cless)/Profix Mobile	9.0 (5.4, 14.6)	40.2 (32.9, 48.3)	41.5 (34.2, 49.7)	46.0 (38.4, 54.3)	
Profix Oxinium (ctd)/Profix (cless)	4.0 (1.5, 10.3)	8.0 (4.1, 15.4)	9.0 (4.8, 16.6)	11.2 (6.4, 19.4)	
Profix Oxinium (ctd)/Profix Mobile	2.2 (0.9, 5.2)	7.2 (4.4, 11.4)	9.4 (6.3, 14.1)	11.8 (8.2, 16.8)	14.4 (10.2, 20.1)
Profix/Profix Mobile	2.3 (1.5, 3.4)	6.5 (5.1, 8.2)	8.2 (6.6, 10.1)	10.0 (8.3, 12.1)	13.0 (10.9, 15.5)
Rotaglide Plus/Rotaglide Plus	0.8 (0.3, 1.9)	4.1 (2.8, 6.0)	5.8 (4.2, 8.0)	11.1 (8.8, 14.0)	18.5 (15.0, 22.6)
SAL/SAL	0.0 (0.0, 0.0)	1.9 (0.3, 12.6)	1.9 (0.3, 12.6)	14.8 (7.3, 28.6)	37.5 (24.0, 55.2)
Score (cless)/Score (cless)	1.5 (1.1, 2.0)	4.7 (4.0, 5.5)	6.4 (5.6, 7.4)	10.4 (9.1, 11.8)	
Score (cless)/Score (ctd)	1.5 (1.0, 2.2)	3.8 (3.0, 4.9)	5.8 (4.7, 7.0)	8.9 (7.3, 10.9)	
Scorpio NRG PS (cless)/Series 7000 (cless)	1.2 (0.7, 2.0)	4.9 (3.8, 6.3)	6.2 (4.9, 7.7)	7.4 (6.0, 9.1)	

Prostheses with Higher than Anticipated Rates of Revision

CPR	1 Yr	3 Yrs	5 Yrs	10 Yrs	20 Yrs
TC-Plus (cless)/TC-Plus (ctd)	1.6 (0.2, 10.7)	8.4 (3.6, 19.1)	8.4 (3.6, 19.1)	14.4 (7.4, 26.9)	
Trac/Trac	2.2 (0.7, 6.6)	5.9 (3.0, 11.4)	9.0 (5.2, 15.2)	15.1 (9.9, 22.8)	
Vanguard PS/Regenerex	3.2 (2.0, 5.3)	7.1 (5.1, 9.9)	7.8 (5.7, 10.6)	9.9 (7.3, 13.3)	
Vanguard PS/Vanguard	1.8 (1.5, 2.2)	4.2 (3.7, 4.8)	5.2 (4.6, 5.8)	7.3 (6.6, 8.1)	
*LCS Duofix	1.5 (1.2, 1.9)	5.9 (5.3, 6.6)	9.7 (8.9, 10.6)	13.0 (12.1, 14.1)	
*LCS PS	2.1 (1.2, 3.5)	6.7 (5.0, 9.0)	8.5 (6.6, 11.0)	12.0 (9.6, 14.8)	
*Renasys	2.5 (0.8, 7.5)	4.2 (1.8, 9.8)	8.5 (4.6, 15.1)	11.2 (6.7, 18.5)	

Note: *Femoral Component
**Tibial Component

Table IP21 Yearly Usage of Total Knee Prostheses Identified as Having a Higher than Anticipated Rate of Revision

Year of Implant	≤2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Newly Identified																		
Optetrak Logic CR/Optetrak Logic	.	.	.	.	.	.	.	.	21	171	234	321	339	286	195	226	81	10
Re-Identified and Still Used																		
ACS (cless)/ACS Fixed	.	.	.	.	.	41	118	284	337	331	238	266	259	319	209	169	125	177
Active Knee (cless)/Active Knee	2783	510	483	412	479	601	500	427	319	336	176	91	35	21	24	17	1	35
Apex Knee CR (cless)/Apex Knee (cless)	.	.	.	.	.	.	69	83	118	78	11	3	29	53	6	23	47	7
Attune PS (ctd)/Attune (cless)	.	.	.	.	.	.	.	.	.	.	.	.	.	1	38	530	287	136
Columbus/Columbus	140	90	148	156	135	135	108	69	36	60	118	358	670	828	1115	1104	1080	1077
E.Motion/E.Motion	.	.	.	12	87	114	129	171	71	93	87	101	64	45	12	15	14	12
Mutars/Mutars	.	.	.	.	.	.	2	12	8	15	14	26	32	63	56	63	70	75
Trekking/Trekking	.	.	.	.	35	102	133	107	108	106	129	216	143	99	65	20	18	10
*Legion Oxinium FS	7	22	19	28	28	24	31	30	18	23	25	24	37	30	37	53	38	41
**Legion Revision Tibial Baseplate	16	33	48	40	56	47	63	54	47	38	50	50	87	93	129	173	138	146
Identified and No Longer Used																		
ACS/ACS Mobile PC (cless)	.	.	.	.	.	20	37	57	17	.	.	.	.	.	.	.	.	.
AMK/AMK	203	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Advance/Advance	89	2	5	43	115	138	74	7	92	92	100	90	69	58	17	13	5	.
Buechel-Pappas/Buechel-Pappas	40	51	84	100	148	44	4	.	7	1	.	.	.	.	.	.	.	.
Eska RP/Eska RP	33	5	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Evolis (cless)/Evolis (cless)	.	.	17	5	11	9	20	7	11	7	.	.	.	.	.	.	.	.
Gemini MK II/Gemini MK II	21	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Genesis (ctd)/Genesis (ctd)	62	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Genesis II CR (cless)/Profix Mobile (ctd)	168	5	12	6	9	17	2	22	.	.	.	.	.	.	.	.	.	.
Genesis II Oxinium CR (cless)/Genesis II	110	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Genesis II Oxinium CR (cless)/Profix Mobile	88	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Genesis II Oxinium PS (ctd)/Genesis II (cless)	.	4	4	11	35	1	1	.	.	.	.	.	.	.	.	.	.	.
Genesis II Oxinium PS (ctd)/Genesis II (keel)	142	127	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
HLS Noetos/HLS Noetos	51	45	45	56	48	28	20	1	.	.	.	.	.	.	.	.	.	.
IB II/IB II	199	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Interax/Interax	52	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Journey Oxinium/Journey	134	337	541	555	464	334	343	325	.	.	.	.	.	.	.	.	.	.
Maxim (cless)/Vanguard (ctd)	373	30	10	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Nexgen LPS Flex (cless)/Nexgen	.	.	.	.	73	78	149	312	238	280	225	252	221	188	82	12	4	.
Optetrak-CR (ctd)/Optetrak (ctd)	31	7	7	4	.	5	6	8	24	.	.	.	.	.	.	.	.	.
Optetrak-PS/Optetrak	916	216	168	202	198	202	200	151	115	30	3	5	3	1	.	.	.	.
Optetrak-PS/Optetrak RBK	82	173	166	119	82	40	37	50	100	56	46	88	75	13	.	.	.	.
Optetrak-PS/Optetrak-PS	40	15	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
PFC Sigma PS (ctd)/MBT (cless)	49	.	.	.	.	25	89	110	42	.	1	.	.	.	.	.	.	.
Profix Oxinium (cless)/Profix	75	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Profix Oxinium (cless)/Profix Mobile	158	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Profix Oxinium (ctd)/Profix (cless)	71	8	10	8	2	.	1	.	.	.	.	.	.	.	.	.	.	.
Profix Oxinium (ctd)/Profix Mobile	221	4	1	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Profix/Profix Mobile	924	56	11	12	2	.	.	.	.	.	.	.	.	.	.	.	.	.

Year of Implant	≤2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Rotaglide Plus/Rotaglide Plus	586	30	15	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
SAL/SAL	56	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Score (cless)/Score (cless)	1	11	135	212	187	204	195	239	273	263	170	160	214	151	252	354	5	.
Score (cless)/Score (ctd)	3	3	3	3	.	5	15	90	181	324	300	267	122	205	114	44	.	.
Scorpio NRG PS (cless)/Series 7000 (cless)	.	76	185	171	166	114	67	71	76	72	77	69	28	.	.	.	.	.
TC-Plus (cless)/TC-Plus (ctd)	60	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Trac/Trac	138	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Vanguard PS/Regenerex	.	.	.	4	121	54	27	15	21	18	76	59	56	14	.	.	.	.
Vanguard PS/Vanguard	103	145	321	430	478	607	561	451	523	445	331	310	205	186	136	117	56	.
*LCS Duofix	844	1636	1532	854	.	.	.	.	.	.	.	.	.	.	.	.	.	.
*LCS PS	.	.	8	157	203	109	51	69	39	2	.	.	.	.	.	.	.	.
*Renasys	104	3	14	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Note: *Femoral Component
**Tibial Component

Figure IP4 Cumulative Percent Revision of Newly Identified Total Knee Prostheses

Newly Identified

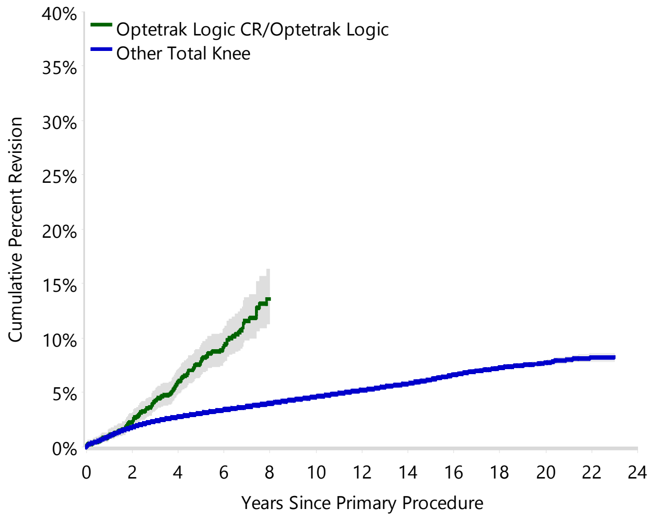
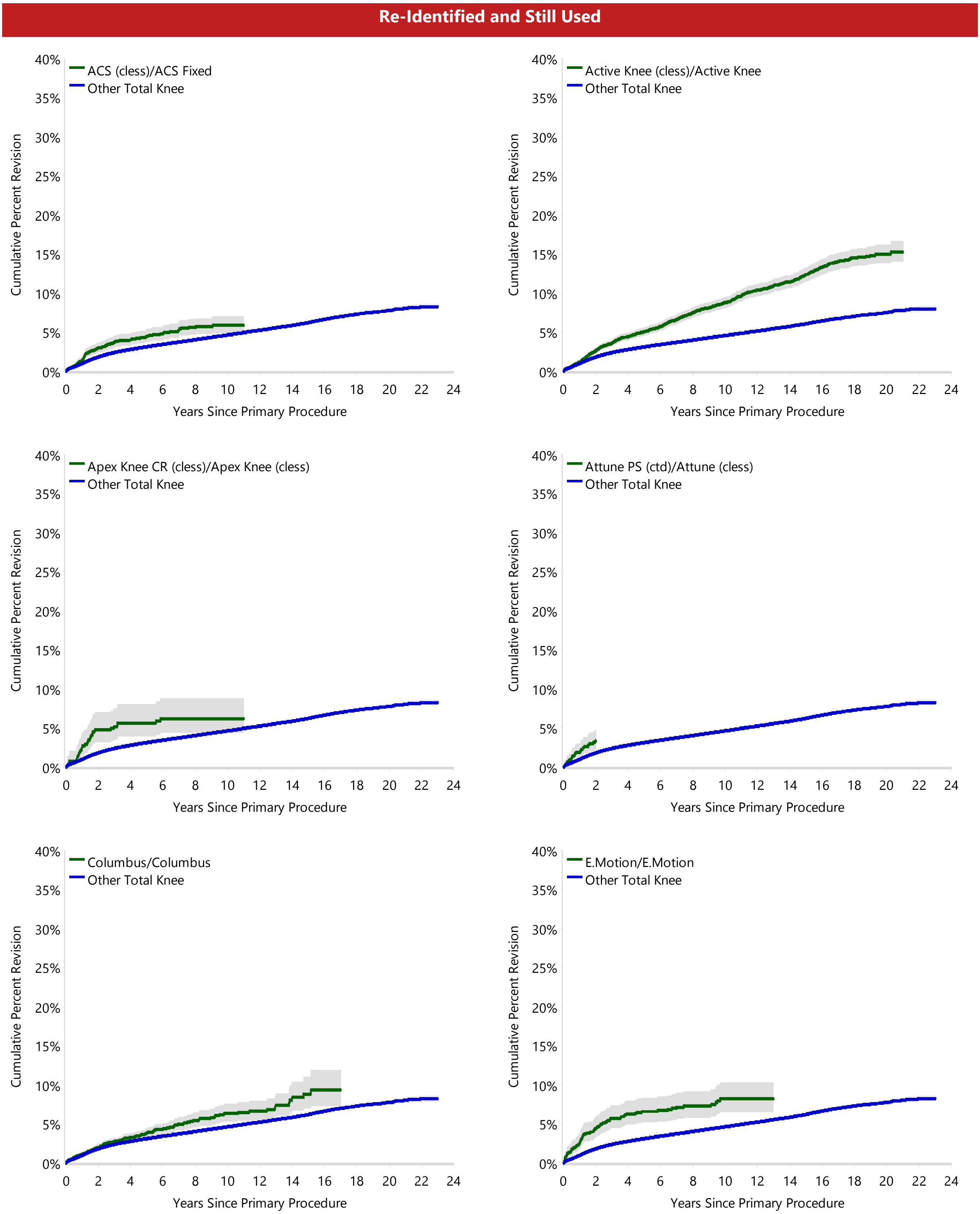
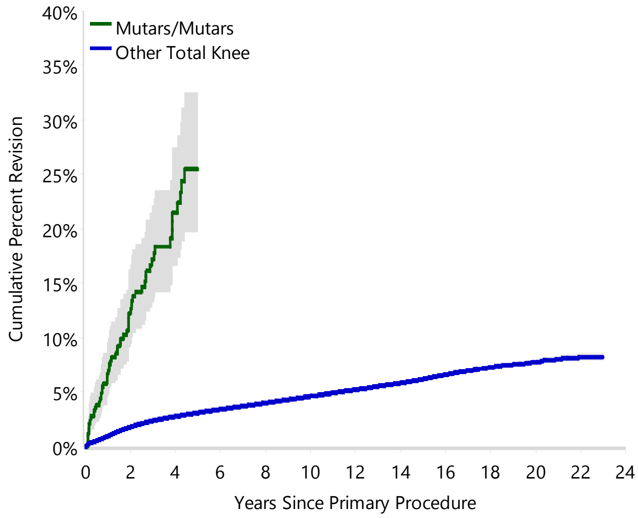
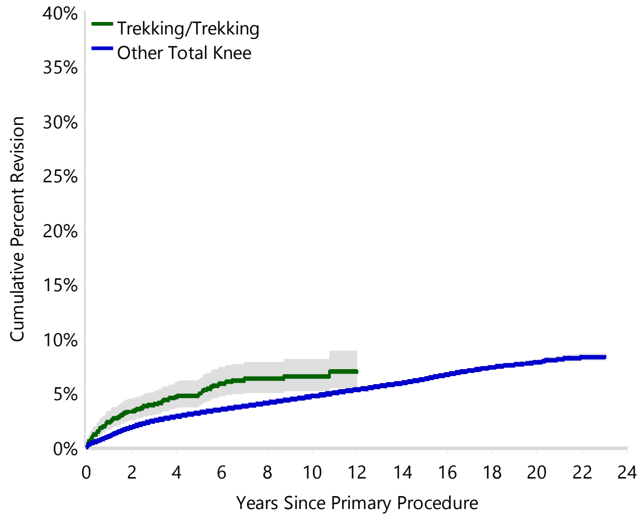


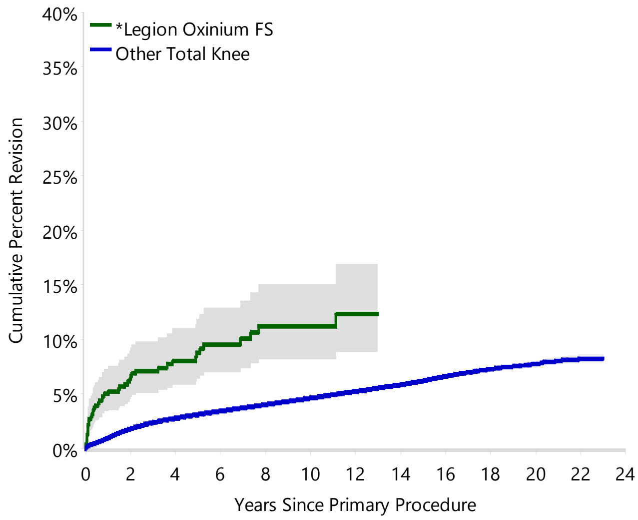
Figure IP5 Cumulative Percent Revision of Re-Identified and Still Used Total Knee Prostheses

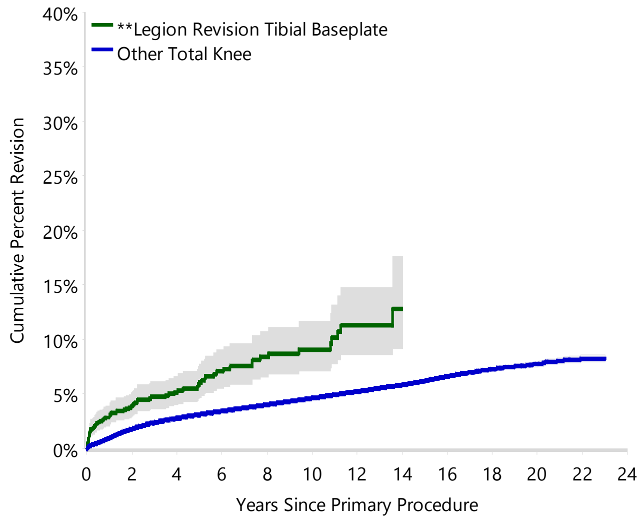


Prostheses with Higher than Anticipated Rates of Revision









Primary Partial Shoulder Replacement

HEMI STEMMED ANATOMIC

There are no newly identified hemi stemmed anatomic shoulder prostheses.

Table IP22 Revision Rate of Hemi Stemmed Anatomic Shoulder Prostheses Identified as Having a Higher than Anticipated Rate of Revision

Humeral Stem/Head	N Revised	N Total	Obs. Years	Revisions/ 100 Obs. Yrs	Hazard Ratio, P Value
Re-Identified and Still Used					
Delta Xtend/Delta Xtend	14	78	494	2.83	Entire Period: HR=1.88 (1.10, 3.20), p=0.021
Global Unite/Global Unite	42	216	1237	3.40	Entire Period: HR=1.80 (1.31, 2.48), p<0.001

Note: Components have been compared to all other modern hemi stemmed anatomic shoulder components

Table IP23 Cumulative Percent Revision of Hemi Stemmed Anatomic Shoulder Prostheses Identified as Having a Higher than Anticipated Rate of Revision

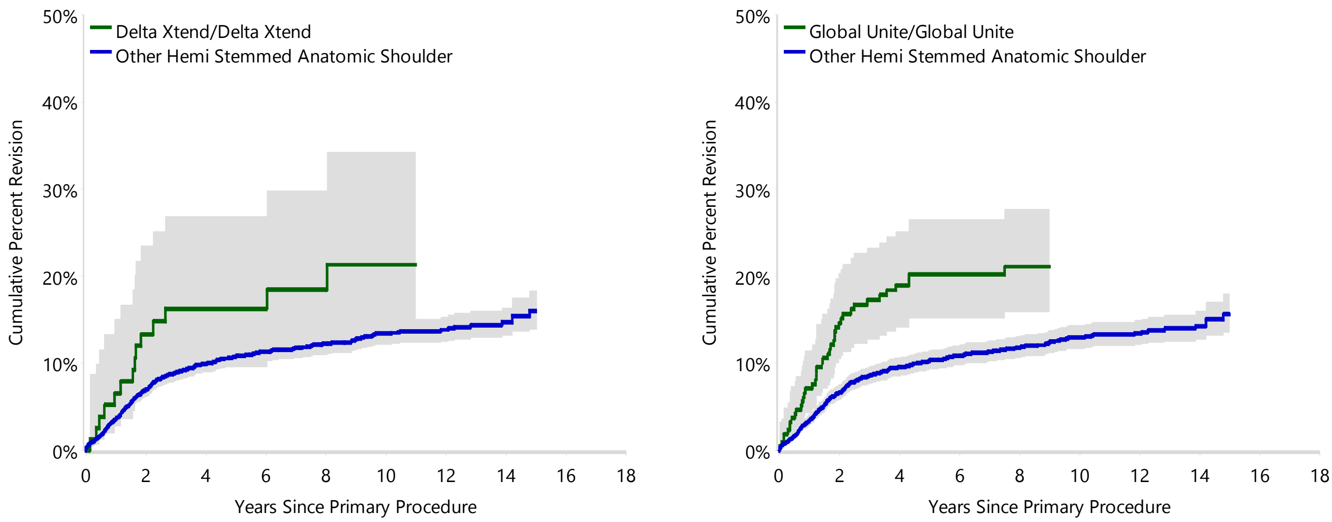
CPR	1 Yr	3 Yrs	5 Yrs	7 Yrs	13 Yrs
Re-Identified and Still Used					
Delta Xtend/Delta Xtend	6.5 (2.8, 15.0)	16.2 (9.6, 26.9)	16.2 (9.6, 26.9)	18.4 (11.0, 29.8)	
Global Unite/Global Unite	7.1 (4.3, 11.5)	17.3 (12.7, 23.2)	20.2 (15.2, 26.5)	20.2 (15.2, 26.5)	

Table IP24 Yearly Usage of Hemi Stemmed Anatomic Shoulder Prostheses Identified as Having a Higher than Anticipated Rate of Revision

Year of Implant	≤2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Re-Identified and Still Used																	
Delta Xtend/Delta Xtend	2	5	9	9	5	10	7	6	5	4	3	6	3	1	.	1	2
Global Unite/Global Unite	.	.	.	.	.	15	37	25	38	37	14	12	11	12	6	2	7

Figure IP6 Cumulative Percent Revision of Re-Identified and Still Used Hemi Stemmed Anatomic Shoulder Prostheses

Re-Identified and Still Used



Prostheses with Higher than Anticipated Rates of Revision

Primary Total Shoulder Replacement

TOTAL STEMMED ANATOMIC

There are two newly identified total stemmed anatomic shoulder prosthesis combinations.

After an enquiry initiated by the TGA (Therapeutic Goods Administration) an analysis of the Equinoxe stemmed anatomic shoulder was carried out. The Equinoxe/Equinoxe polyethylene glenoid was first used in 2011 and is categorised as total stemmed anatomic with an all polyethylene glenoid. There have been 303 procedures of which 93.5% were for osteoarthritis. The cumulative percent revision at 9 years is 14.1%. Of the 31 revisions, 14 have been for loosening and 7 for rotator cuff insufficiency. The majority (29/31) have been major revisions. The bearing surface of this implant combination is (humeral/glenoid) metal/non-XLPE.

The Equinoxe/Equinoxe cage glenoid combination utilises the same Equinoxe stem, but the cage glenoid is a non-modular metal backed glenoid. There have been 431 prostheses of which 97.4% were for osteoarthritis. The cumulative percent revision at 8 years is 16.4%. Of the 39 revisions, 10 revisions were for loosening, 5 for rotator cuff insufficiency and 4 for glenoid implant breakage. The majority (31/39) were major revisions. The Equinoxe cage glenoid component is non-XLPE.

Table IP25 Revision Rate of Total Stemmed Anatomic Shoulder Prostheses Identified as Having a Higher than Anticipated Rate of Revision

Humeral Stem/Glenoid	N Revised	N Total	Obs. Years	Revisions/ 100 Obs. Yrs	Hazard Ratio, P Value
Newly Identified					
Equinoxe/Equinoxe (All Poly)	31	303	1499	2.07	0 - 2Yr: HR=1.98 (1.16, 3.38), p=0.012
	.	.	.	.	2Yr+: HR=3.45 (2.02, 5.88), p<0.001
Equinoxe/Equinoxe (Cage)	39	431	1701	2.29	Entire Period: HR=2.27 (1.60, 3.21), p<0.001
Re-Identified and Still Used					
SMR/SMR L1	447	2438	17975	2.49	Entire Period: HR=3.07 (2.63, 3.58), p<0.001
Identified and No Longer Used					
Comprehensive/Custom Made (Comprehensive)	6	18	64	9.32	Entire Period: HR=4.91 (2.19, 11.00), p<0.001
SMR/SMR L2	324	856	6796	4.77	Entire Period: HR=3.71 (3.24, 4.25), p<0.001
Univers 3D/Univers 3D	17	34	300	5.67	Entire Period: HR=4.27 (2.63, 6.92), p<0.001
Vaios/Vaios	19	36	220	8.64	Entire Period: HR=5.85 (3.70, 9.23), p<0.001

Note: Components have been compared to all other modern total stemmed anatomic shoulder components

Table IP26 Cumulative Percent Revision of Total Stemmed Anatomic Shoulder Prostheses Identified as Having a Higher than Anticipated Rate of Revision

CPR	1 Yr	3 Yrs	5 Yrs	7 Yrs	13 Yrs
Newly Identified					
Equinoxe/Equinoxe (All Poly)	2.1 (0.9, 4.5)	6.7 (4.3, 10.4)	9.3 (6.2, 13.7)	12.7 (8.6, 18.4)	
Equinoxe/Equinoxe (Cage)	3.6 (2.2, 5.9)	6.8 (4.7, 9.9)	11.4 (8.1, 16.0)	14.8 (10.3, 21.0)	
Re-Identified and Still Used					
SMR/SMR L1	5.9 (5.0, 6.9)	11.4 (10.2, 12.7)	13.8 (12.4, 15.2)	16.1 (14.6, 17.7)	25.7 (23.2, 28.5)
Identified and No Longer Used					
Comprehensive/Custom Made (Comprehensive)	16.7 (5.7, 43.2)	27.8 (12.6, 54.4)	34.3 (17.0, 61.3)		
SMR/SMR L2	9.5 (7.7, 11.7)	22.2 (19.6, 25.2)	29.8 (26.9, 33.1)	34.1 (31.0, 37.4)	40.2 (36.8, 43.8)
Univers 3D/Univers 3D	5.9 (1.5, 21.5)	14.7 (6.4, 31.8)	21.2 (10.7, 39.4)	31.0 (18.0, 50.1)	48.9 (32.7, 68.0)
Vaios/Vaios	13.9 (6.0, 30.2)	27.8 (16.0, 45.5)	39.1 (25.3, 57.0)	48.7 (33.6, 66.4)	

Table IP27 Yearly Usage of Total Stemmed Anatomic Shoulder Prostheses Identified as Having a Higher than Anticipated Rate of Revision

Year of Implant	≤2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Newly Identified																	
Equinoxe/Equinoxe (All Poly)	.	.	.	.	6	10	26	18	8	23	36	45	37	18	28	24	24
Equinoxe/Equinoxe (Cage)	.	.	.	.	.	.	.	14	38	19	35	34	68	74	64	62	23
Re-Identified and Still Used																	
SMR/SMR L1	135	237	247	.	.	156	302	255	242	195	172	128	98	72	70	65	64
Identified and No Longer Used																	
Comprehensive/Custom Made (Comprehensive)	.	.	.	.	.	.	.	.	.	1	4	7	5	1	.	.	.
SMR/SMR L2	.	.	43	343	336	134	.	.	.	.	.	.	.	.	.	.	.
Univers 3D/Univers 3D	23	11	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Vaios/Vaios	.	.	.	.	16	17	2	1	.	.	.	.	.	.	.	.	.

Figure IP7 Cumulative Percent Revision of Newly Identified Total Stemmed Anatomic Shoulder Prostheses

Newly Identified

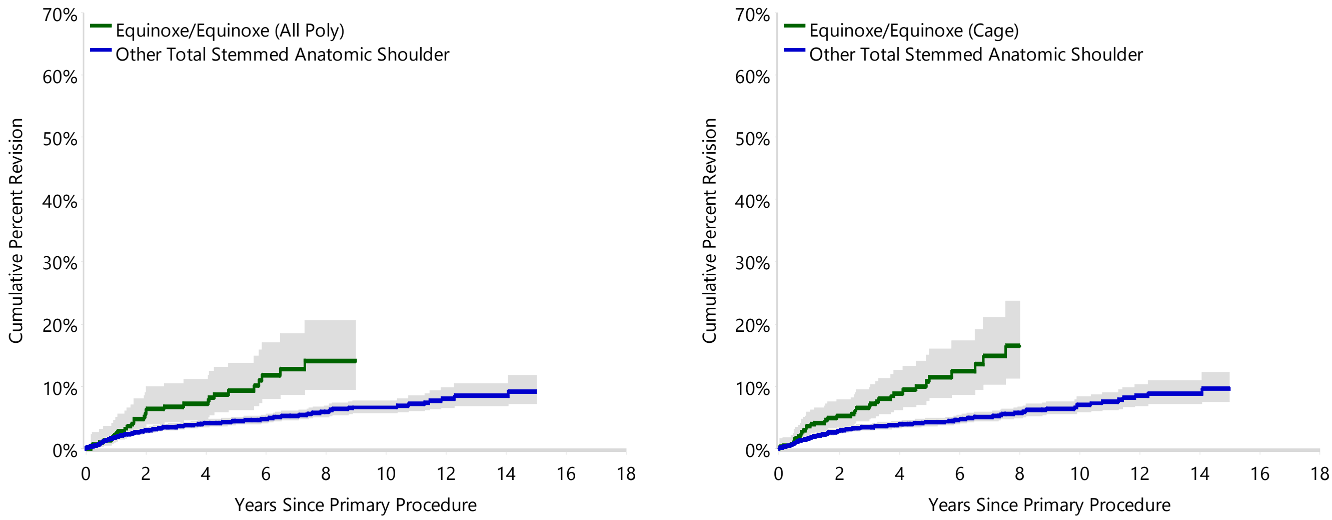
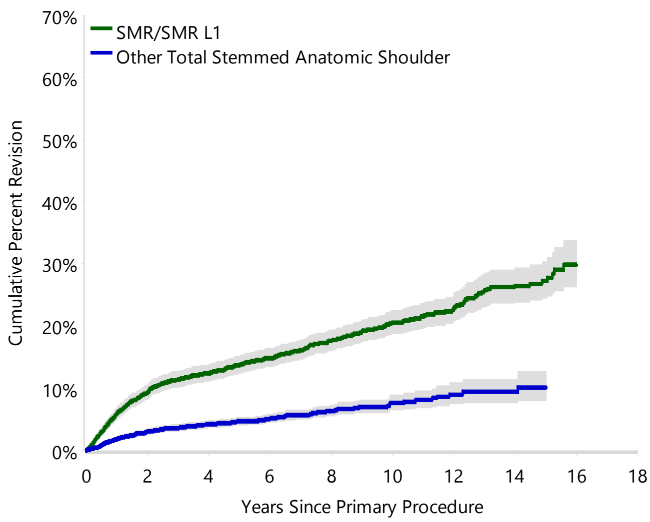


Figure IP8 Cumulative Percent Revision of Re-Identified and Still Used Total Stemmed Anatomic Shoulder Prostheses

Re-Identified and Still Used

Prostheses with Higher than Anticipated Rates of Revision



TOTAL STEMMED REVERSE

There are no newly identified total stemmed reverse shoulder prostheses.

The previously identified Trabecular Metal/Comprehensive combination no longer fulfils the criteria for identification in 2024.

Table IP28 Revision Rate of Total Stemmed Reverse Shoulder Prostheses Identified as Having a Higher than Anticipated Rate of Revision

Humeral Stem/Glenoid	N Revised	N Total	Obs. Years	Revisions/ 100 Obs. Yrs	Hazard Ratio, P Value
Re-Identified and Still Used					
SMR/SMR L1	459	10943	52698	0.87	0 - 3Mth: HR=1.53 (1.30, 1.79), p<0.001
	.	.	.	.	3Mth - 6Mth: HR=1.19 (0.87, 1.64), p=0.275
	.	.	.	.	6Mth - 2Yr: HR=1.03 (0.84, 1.25), p=0.803
	.	.	.	.	2Yr+: HR=0.60 (0.47, 0.77), p<0.001
Verso/Verso	6	38	76	7.90	Entire Period: HR=4.97 (2.23, 11.09), p<0.001

Note: Components have been compared to all other modern total stemmed reverse shoulder components
The SMR/SMR L1 combination has a higher than expected rate of revision in the first 3 months only. After 2 years it has a lower rate of revision.
This combination is one of two that have reached the 'non-inferior' 10 year performance benchmark (for further information refer to the 10, 15, 20 Year Prosthesis Outcomes chapter in this report).

Table IP29 Cumulative Percent Revision of Total Stemmed Reverse Shoulder Prostheses Identified as Having a Higher than Anticipated Rate of Revision

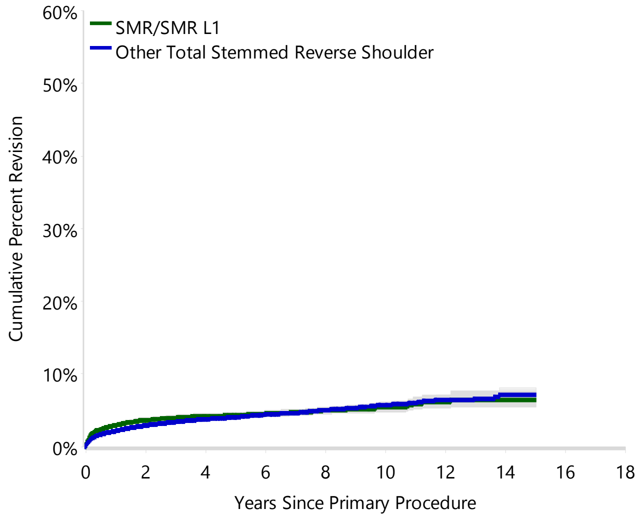
CPR	1 Yr	3 Yrs	5 Yrs	7 Yrs	13 Yrs
Re-Identified and Still Used					
SMR/SMR L1	2.9 (2.6, 3.3)	4.0 (3.6, 4.4)	4.3 (3.9, 4.7)	4.7 (4.3, 5.2)	6.5 (5.4, 7.7)
Verso/Verso	19.2 (8.9, 38.4)	19.2 (8.9, 38.4)			

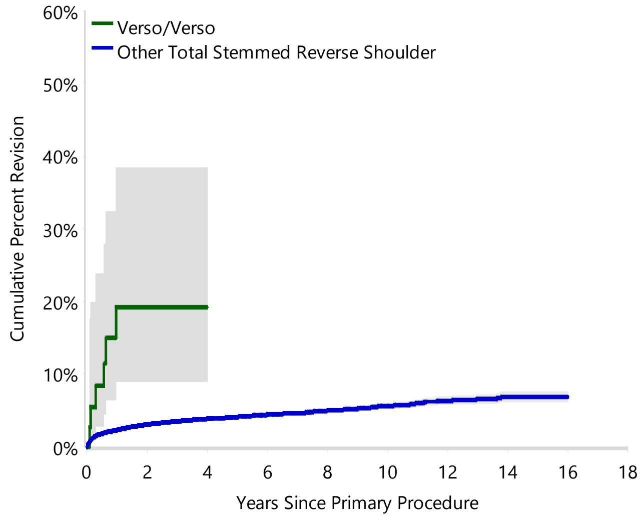
Table IP30 Yearly Usage of Total Stemmed Reverse Shoulder Prostheses Identified as Having a Higher than Anticipated Rate of Revision

Year of Implant	≤2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Re-Identified and Still Used																	
SMR/SMR L1	145	262	271	.	.	248	563	633	732	914	930	1046	1055	1009	1189	1028	918
Verso/Verso	.	.	.	.	.	.	.	.	.	.	.	5	8	1	6	5	13

Figure IP9 **Cumulative Percent Revision of Re-Identified and Still Used Total Stemmed Reverse Shoulder Prostheses**

Re-Identified and Still Used





Prostheses with Higher than Anticipated Rates of Revision

Primary Total Ankle Replacement

There is one newly identified total ankle replacement this year.

The Hintermann Series H3/Hintermann Series H3 total ankle replacement has been the subject of a Hazard Alert by the Therapeutic Goods Administration (TGA) this year. As a result, further investigation of this prosthesis was carried out. The Hintermann Series H3/Hintermann Series H3 total ankle replacement has been used since 2007 in 558 procedures of which 99 have been revised. At 14 years the cumulative percent revision is 25.4%. There have been 33 major revisions and 66 minor revisions, of which the polyethylene insert was exchanged in 52. The have been 24 revisions for loosening, 17 for breakage of the insert, 11 for instability and 10 for infection. There have been further revisions related to the insert (lysis, prosthesis dissociation and insert wear) in another 13.

Table IP31 Revision Rate of Total Ankle Prostheses Identified as Having a Higher than Anticipated Rate of Revision

Talar/Tibial Tray	N Revised	N Total	Obs. Years	Revisions/ 100 Obs. Yrs	Hazard Ratio, P Value
Newly Identified					
Hintermann Series H3/Hintermann Series H3	99	558	4352	2.28	Entire Period: HR=1.78 (1.41, 2.24), p<0.001
Identified and No Longer Used					
S.T.A.R/S.T.A.R	13	49	385	3.37	Entire Period: HR=2.28 (1.31, 3.97), p=0.003

Note: Components have been compared to all other total ankle components

Table IP32 Cumulative Percent Revision of Total Ankle Prostheses Identified as Having a Higher than Anticipated Rate of Revision

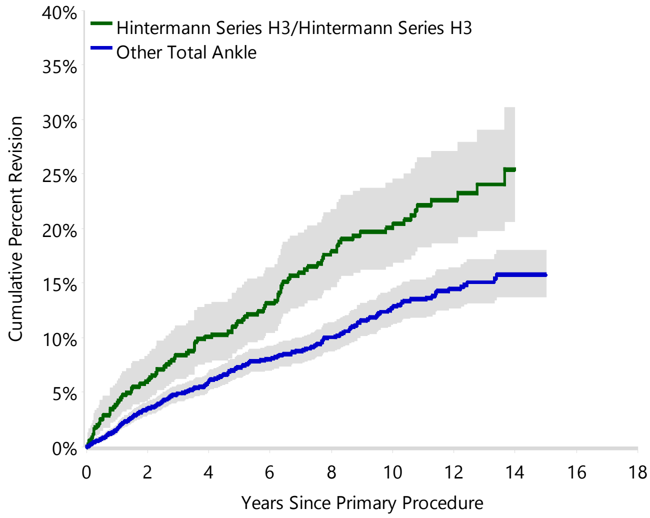
CPR	1 Yr	3 Yrs	5 Yrs	7 Yrs	13 Yrs
Newly Identified					
Hintermann Series H3/Hintermann Series H3	4.0 (2.7, 6.0)	8.4 (6.3, 11.1)	11.4 (9.0, 14.6)	15.9 (12.9, 19.6)	24.1 (19.8, 29.0)
Identified and No Longer Used					
S.T.A.R/S.T.A.R	4.1 (1.0, 15.5)	12.6 (5.8, 25.8)	14.7 (7.3, 28.4)	21.4 (12.1, 36.1)	

Table IP33 Yearly Usage of Total Ankle Prostheses Identified as Having a Higher than Anticipated Rate of Revision

Year of Implant	≤2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Newly Identified																	
Hintermann Series H3/Hintermann Series H3	6	34	45	63	56	67	48	40	34	12	25	30	13	20	24	21	20
Identified and No Longer Used																	
S.T.A.R/S.T.A.R	1	.	3	3	4	2	15	12	4	4	.	1	.	.	.	.	.

Figure IP10 Cumulative Percent Revision of Newly Identified Total Ankle Prostheses

Newly Identified



Appendices

Appendices

APPENDIX 1 – Participating Hospitals and Coordinators

VICTORIA			
Public Hospitals		**Private Hospitals**	
Austin Health	R Kentish / B Murray	Ballarat Day Procedure Centre	A Ingram
Bairnsdale Regional Health Service	S Guns	Beleura Private Hospital	J Leyland
Bass Coast Health	F King / L Mckenzie / P Dewar	Bellbird Private Hospital	B Van Denberg
Bendigo Health	S Sharp / C Jensen	Cabrini Brighton	D Heng
Box Hill Hospital	L Bingham	Cabrini Malvern	D Heng
Broadmeadows Hospital	R Paul / B Wilson	Epping Private Hospital	J Jose
Central Gippsland Health	J Hunt / M Pusmucans	Epworth Eastern	K Longley
Cohuna District Hospital	K Storm	Epworth Freemasons	C Nozzolillo
Colac Area Health	A Tout	Epworth Geelong	N Cuttiford
Dandenong Hospital	K Ferguson / M Murray	Epworth Richmond	A Condon / L Moyes
East Grampians Health Service	J Sargent / K Carr	Essendon Private Hospital	E Jordan
Echuca Regional Health	K Giorgianni / H Lias	Glenferrie Private Hospital	S Jones / M Westley
Footscray Hospital	L Carbone / A Dijak	Holmesglen Private Hospital	N Malovic
Frankston Hospital	J Harry	John Fawkner Private Hospital	B Emmett
Frankston Public Surgical Centre	N Larner / S Reeves	Knox Private Hospital	J Assauw / E George / H McCarty
Goulburn Valley Health	A Stevens	La Trobe Private Hospital	J Telfer
Grampians Health Ballarat	M Nicholson / B Anderson	Linacre Private Hospital	M Kortwaar / D Tyler / M Dillon
Grampians Health Horsham	M Markby / A Ampt	Maryvale Private Hospital	F Van Dyke / K Collier
Grampians Health Stawell	C Ellen / S Hamilton	Masada Private Hospital	D MacKenzie / S Howell
Hamilton Base Hospital	R Broadfoot	Melbourne Private Hospital	T Perkins
Kyabram District Health Service	B Harrison / L Walker	Mildura Health Private Hospital	S Malcolm
Latrobe Regional Hospital	S Lovison	Mitcham Private Hospital	J Lonthyil / J Nankivell
Maroondah Hospital	B Connelly / G Whitemore	Mulgrave Private Hospital	B Gurung / A Chandrakumar
Mildura Base Public Hospital	K Mailes	Northpark Private Hospital	K Morris
Monash Medical Centre	J Cranston	Peninsula Private Hospital	K Jones
Moorabbin Hospital	C Jackson / L Mason	Ringwood Private Hospital	C Burns
Northeast Health Wangaratta	D Reidy	Shepparton Private Hospital	A Lam / N Miller
Northern Hospital Epping	S Perry	St John of God Ballarat Hospital	G Mathachan
Portland District Health	M Ashby	St John of God Bendigo Hospital	A Sheehan
Sandringham Hospital	G Jack / L Scopel / S Kurup	St John of God Berwick Hospital	R Jamieson
St Vincent's Hospital Melbourne	D Thangavel / A Lynskey / S Osman	St John of God Geelong Hospital	C Hay
Sunshine Hospital	A Dijak	St John of God Warrnambool Hospital	G Wheaton / L McPherson
Swan Hill District Health	D Hartland	St Vincent's Private East Melbourne	S Francis
The Alfred	M Crofts / T Krohman	St Vincent's Private Fitzroy	D Dellevirgini / N Carter
The Royal Children's Hospital	S Lauletta	St Vincent's Private Hospital Kew	J Miller / S Vohra / H Xing
The Royal Melbourne Hospital	H Eggleston	St Vincent's Private Hospital Werribee	D Sanchez / M Ipio / C Ipio
University Hospital Geelong	M Quinn / D Barber	The Avenue Hospital	T Kilpi
Warrnambool Base Hospital	T Kelly	The Bays Hospital	L Kerr / S Burton
West Gippsland Healthcare Group	B Norman / S Backman	The Melbourne Eastern Private Hospital	J Phillpotts
West Wimmera Health Service	T Heinrich	Vermont Private Hospital	V Howell / D Cooper
Western Health Bacchus Marsh Hospital	C Clifford / J Dehnert	Wangaratta Private Hospital	J McKie
Williamstown Hospital	J Bonganay / A Chircop	Waringal Private Hospital	M Dey / M Bhagat
		Waverley Private Hospital	N Dator / E Fernandez / N Smith
		Werribee Mercy Hospital	J Anwar
		Western Private Hospital	D Cringasu

NEW SOUTH WALES			
Public Hospitals		**Private Hospitals**	
Albury Wodonga Health	L Rhodes	Albury Wodonga Private Hospital	D Mahaffey / R Daggett / D Bonnie
Armidale Hospital	A Sutherland / A Prater	Armidale Private Hospital	K Latter
Auburn Health Service	A Balangue	Baringa Private Hospital	E Ford / K Henderson / F Howson
Bankstown/Lidcombe Hospital	N Bassett / K Och	Bathurst Private Hospital	D Carter / K Quinton
Bathurst Base Hospital	B Hodges / R MacCabe	Brisbane Waters Private Hospital	A Ryan
Belmont Hospital	J Osland / J Jones	Calvary Health Care Riverina	B Das / F Oxley / L Pennier
Blacktown Hospital	J Tsang	Campbelltown Private Hospital	J Blanch / C Macdonald
Bowral and District Hospital	R Roberts / B Allan	Delmar Private Hospital	C Byrne
Broken Hill Base Hospital	S Beahl	Dubbo Private Hospital	S Cross / K Troth
Campbelltown Hospital	S Birch	Dudley Private Hospital	P Fullgrabe
Canterbury Hospital	J Cubitt	East Sydney Private Hospital	T Woodgate
Chris O'Brien Lifehouse	S Harnedy	Forster Private Hospital	D Conway
Coffs Harbour Health Campus	J Bellenger	Gosford Private Hospital	A Maguire
Concord Repatriation General Hospital	D Debello	Hawkesbury District Health Service	E Jones / S Garden
Dubbo Hospital	K Chapman / R Willis	Holroyd Private Hospital	M Brosas
Fairfield Hospital	C Youkhana	Hunter Valley Private Hospital	R Pridue
Gosford Hospital	M Farthing / K Brown / T Hoad	Hurstville Private Hospital	T Ross / J Mati
Goulburn Base Hospital	K Goode / L Phelan	Insight Private Hospital	J Furness
Grafton Base Hospital	F Hickey / K Shaw / G Snook	Kareena Private Hospital	A Burazer
Hornsby Ku-Ring-Gai Hospital	J Colville / B Chu	Kogarah Private Hospital	R Duag / M McDonnell
Institute of Rheumatology and	M Hatziandreou	Lake Macquarie Private Hospital	V Jones
John Hunter Hospital	F Bristow	Lakeview Private Hospital	H MacAllister
Lismore Base Hospital	G Nettle	Lingard Private Hospital	A Dagg / A Flaherty
Liverpool Hospital	S Seap	Macquarie University Hospital	J Guthrie
Maitland Hospital	B Game	Maitland Private Hospital	J Hayward / J Chalmers / M Mead
Manning Hospital	G Cooke	Mater Hospital North Sydney	N Guerrero
Mount Druitt Hospital	C Boyd	Mayo Private Hospital	K Boucher
Murwillumbah District Hospital	G Jacklin	Nepean Private Hospital	J Vimalraj
Nepean Hospital	R Steward / D Dobbs	Newcastle Private Hospital	D Fogarty / J Kelly
Orange Health Service	R Jones / D Campbell / J Allenby	North Shore Private Hospital	A Bloxham
Port Macquarie Base Hospital	F Cheney / J Atkins	Northern Beaches Hospital	S Maristela
Prince of Wales Hospital	E Katz	Norwest Private Hospital	J Woodward / R Shepherd
Royal Newcastle Centre	G Cutler	Nowra Private Hospital	D Maslen / G Hutton
Royal North Shore Hospital	D Krusi / H Celep	Orange Private Hospital	A McClelland / K Burton
Royal Prince Alfred Hospital	J Wilkie	Port Macquarie Private Hospital	T Bell
Ryde Hospital	K Jones / H Nowlan	Prince of Wales Private Hospital	R Gengania / E Perez / F Sarmiento
Shoalhaven District Memorial Hospital	L Royston	Shellharbour Private Hospital	M Stevens / J Wilkinson
South East Regional Hospital	L Williams	Southern Highlands Private Hospital	L Byrne
St George Hospital	D Gray / D Elliott	St George Private Hospital	L Mayo
St Vincent's Hospital Sydney	A Baker / L Hatton	St Lukes Care	D Papadopoulos
Sutherland Hospital	C Kirgan	St Vincent’s Private Community Hospital	M Blackman
Tamworth Hospital	M Lebrocq	St Vincent’s Private Hospital Sydney	H George / M Bancroft / M McGlynn
The Children's Hospital at Westmead	A Galstaun	St Vincent's Lismore	J Hospers
Tweed Hospital	A Budd / N Prestage	Strathfield Private Hospital	J Mati
Wagga Wagga Base Hospital	A Meek / M O'Reilly	Sydney Adventist Hospital	J Parker / A Hickey
Westmead Hospital	D Martic	Sydney Private Hospital	M Haughton / R Cabading / P Gyawali

Appendices

NEW SOUTH WALES			
Public Hospitals		**Private Hospitals**	
Wollongong Hospital	C Jackson	Sydney South West Private Hospital	H Tran
Wyong Hospital	T Clancy / M Randall	Tamara Private Hospital	R Moody
		Toronto Private Hospital	S Keys
		Tuggerah Lakes Private Hospital	J Hanneghan
		Waratah Private Hospital	K Graham
		Warners Bay Private Hospital	A Harrison
		Westmead Private Hospital	K Teren
		Wollongong Private Hospital	C Gillespie / J Burns

QUEENSLAND			
Public Hospitals		**Private Hospitals**	
Bundaberg Base Hospital	J Larsen / J Anderson / D Norman	Brisbane Private Hospital	L Drabble / J Oddy
Cairns Hospital	C McCall / L Borzi / H Campbell / E	Buderim Private Hospital	P Hall / S Newbury
Gold Coast University Hospital	M Armstrong	Caboolture Private Hospital	L King
Hervey Bay Hospital	S Dane Smith / M Elsworth	Cairns Private Hospital	L Rush
Ipswich Hospital	S Wilkinson	Friendly Society Private Hospital	M Alcorn / K Smith
Logan Hospital	M Harrison / S Childs	Gold Coast Private Hospital	V French
Mackay Base Hospital	C Ruthenberg	Greenslopes Private Hospital	K Williams / R Griffin
Maryborough Hospital	Y Howlett / S Hose	Hervey Bay Surgical Hospital	M Pracy
Mater Hospital Brisbane	M Colbeck / A Roeun / C Steains	Hillcrest Rockhampton Private Hospital	J Smith
Nambour General Hospital	R Hutchison	John Flynn Private Hospital	L Sarquis / L Wise
Princess Alexandra Hospital	S Reed	Mater Private Hospital Brisbane	J Windsor / M Baltais / S Pfeffer
Queen Elizabeth II Jubilee Hospital	D Cal	Mater Private Hospital Bundaberg	J Zillmann / L Zunker / M Mooney
Queensland Children's Hospital	F Wright / M Cullen	Mater Private Hospital Mackay	H Douglas
Redcliffe Hospital	S Ovchinnikoff / G van Fleet	Mater Private Hospital Redland	J Golding / J Garnsey
Redland Hospital	S Mackenzie / M McGahey	Mater Private Hospital Rockhampton	T Harkin / M Havik
Robina Hospital	L Thompson / R Alfredson	Mater Private Hospital Springfield	C Cullen / C James
Rockhampton Hospital	M Todd / S Platzke	Mater Private Hospital Townsville	J Humphreys
Royal Brisbane and Women's Hospital	G McPhee / A Dowe / B Ballantyne	Nambour Selangor Private Hospital	S Pfeiffer / T Dempsey
Sunshine Coast University Hospital	F Tognolini / C Jones	Noosa Hospital	J Andersson
Surgical, Treatment & Rehabilitation	E Daniels	North West Private Hospital	D Campbell / T Auckland
The Prince Charles Hospital	L Tuppin / R Seddon	Peninsula Private Hospital	A Moutrey
Toowoomba Hospital	F Chadwick / A Lostroh	Pindara Private Hospital	E Moire
Townsville Hospital & Health Service	T Cudmore	St Andrews Ipswich Private Hospital	M Grant
		St Andrews Toowoomba Hospital	A Shannon
		St Andrews War Memorial Hospital	S Flood
		St Stephen's Hospital	K McLaughlan / S Costello
		St Vincent's Private Hospital Northside	D Ravn / L Shannon
		St Vincent's Private Hospital Toowoomba	A Fitzgerald / R Butler
		Sunnybank Private Hospital	F Robinston
		Sunshine Coast University Private	T Prothero
		The Wesley Hospital	K Patel / C Gregory
		Westside Private Hospital	M Esdale

WESTERN AUSTRALIA			
Public Hospitals		**Private Hospitals**	
Albany Health Campus	P Karra	Bethesda Health Care	H Hanekom / J Fitzroy
Armadale Health Service	L Bennett / E Griffiths / D Carkeek	Hollywood Private Hospital	M Connor
Bunbury Regional Hospital	L Watterson-Stutley	Joondalup Health Campus	J Holmes / D Crowley / D Jenkins
Busselton Health Campus	G Moyes	Mount Hospital	M Gontran / M Huyser
Fiona Stanley Hospital	J Duncan	Peel Health Campus	G Keogh
Fremantle Hospital	E Jiji	South Perth Hospital	D Waters
Geraldton Hospital	V Richards / J Joseph	St John of God Bunbury Hospital	I Du Plessis / T Steyn
Kalgoorlie Health Campus	N Hintz	St John of God Geraldton Hospital	L Culallad / R Caporn / K Hutton
Osborne Park Hospital	J Misiewicz / T Hughes / K Zhang	St John of God Midland Hospital	S Blinman
Perth Children's Hospital	K Theedom	St John of God Mt Lawley Hospital	F Campos
Rockingham General Hospital	C Beaney	St John of God Murdoch Hospital	C Sheen
Royal Perth Hospital	L Daly	St John of God Subiaco Hospital	P Emrose
Sir Charles Gairdner Hospital	T Lemmey / M Requilme	Waikiki Private Hospital	B Muir

SOUTH AUSTRALIA			
Public Hospitals		**Private Hospitals**	
Clare Hospital	M Green	Ashford Hospital	L Kowalik
Flinders Medical Centre	A Olson / S McAndrew	Burnside War Memorial Hospital	L Johnson / T Behrendt
Gawler Health Service	T Sayce	Calvary Adelaide Hospital	D Jocey-Prior / T Heinrich
Lyell McEwin Hospital	L Wills	Calvary Central Districts Hospital	L Keech
Modbury Hospital	J Harris / B Foster	Calvary North Adelaide Hospital	E Rennison / A Labang
Mount Barker District Soldiers Memorial	E Crowder	Flinders Private Hospital	M Ender
Mount Gambier and Districts Health	K Duncan	Glenelg Community Hospital	R English / V Lawrence / N Russell-
Murray Bridge Soldiers Memorial	J Colwell	North Eastern Community Hospital	L Shaw
Naracoorte Health Service	T Berry	Sportsmed SA	S Chong / S Williams / K Stapleton / F
Noarlunga Hospital	C Roper / K Thomson	St Andrew's Hospital	C McAllister / L White
Port Augusta Hospital	P Williams / J Haynes / L Turner	Stirling Hospital	S Kemp
Port Lincoln Hospital	C Weber	The Memorial Hospital	J Ohlson / J Emery
Port Pirie Regional Health Service	L Cutler	Western Hospital	A Scheepers / R Dalziell
Riverland General Hospital	M Gardner / N Romeo		
Royal Adelaide Hospital	A Wilson / R Woodfine / L Davies		
South Coast District Hospital	J Hunt / A Price		
The Queen Elizabeth Hospital	A Hunter		
Whyalla Hospital and Health Service	E Windhouwer / M Prunty		
Women's and Children's Hospital	M Betterman		

Appendices

TASMANIA			
Public Hospitals		**Private Hospitals**	
Launceston General Hospital	M Postmus / E Davidson	Calvary Lenah Valley Hospital	A Copping / B Stephensen / E Hey / K
North West Regional Hospital	B Kerr / R Dicker / T Gorrie	Calvary St John's Hospital	C Farrell
Royal Hobart Hospital	M Chandler / S Kirkham	Calvary St Luke's Hospital	G Stratton / T Morice
		Hobart Private Hospital	J Dohnt
		North-West Private Hospital	P Purva

NORTHERN TERRITORY			
Public Hospitals		**Private Hospitals**	
Alice Springs Hospital	S Ryan / C Wooding / L Mathieson	Darwin Private Hospital	S Delaney / A Thomas / P Lacsina / V
Royal Darwin Hospital	W Rogers		

AUSTRALIAN CAPITAL TERRITORY			
Public Hospitals		**Private Hospitals**	
Canberra Hospital	T Schild / H Boyd	Calvary Bruce Private Hospital	C Morris
North Canberra Hospital	J Cain / R Kathage / T Pula	Calvary John James Hospital	S Sreesan
		Canberra Private Hospital	S Phillips / M Rogina / M Gower / L
		The National Capital Private Hospital	G Palada / R Barancewicz / I Coronado

APPENDIX 2 - Glossary

STATISTICAL TERMS

Adjustment: The process of re-estimating a crude measure, such as a rate or rate ratio, to minimise the effects of a difference in the distribution of a characteristic, such as age, between groups being compared on that measure. Adjustment may be carried out in the context of a modelling procedure, for example, linear or proportional hazards regression models, or by standardising the data set against a reference population with a known age distribution, for example, the World Standard Population or the Australian population defined by the Australian Bureau of Statistics Census in a specified year.

Censoring: When the outcome of interest is the time to a defined event, for example, revision of a prosthesis, the event may not occur during the available period of observation. For example, the Registry analyses its data on prosthesis revision for the period ending 31 December each year, and many prostheses will not have been revised by that time. Unless the prosthesis was revised prior to 31 December the outcome is unknown. For the majority, we only know that up until 31 December they had not yet been revised. The times to revision for these prostheses are said to have been censored at 31 December. Statistical methods exist to ensure that censored data are not ignored in analysis, rather information on survival up until the time of censoring is used to give the best possible estimates of survival or revision probabilities.

Chi-Square (X^2 Test: Any test whose statistic has a chi-square distribution under the null hypothesis is called a chi-square test. A common example is a test for association between two categorical variables whose data are arrayed in a cross-classification table of counts (Pearson's chi-square test). This can be generalised to many situations where the distribution of observed data is being compared to an expected theoretical distribution.

Closure of the Database: Closure of the database occurs in April of the report year for procedures up to 31 December of the preceding year. Due to delays in receipt of the procedure form, some procedures are not included until the following annual report.

Competing Risk: Any event that changes the probability of occurrence of another event is known as a competing risk for the other event. For example, death is a competing risk for revision because the probability of revision after death cannot be assumed to be the same as the probability of revision before death. Another example is that if interest centres on specific causes of revision, then each cause (infection, loosening etc) is a competing risk for each other cause. Treating a competing risk event as a right censoring will bias the estimation of the risk of the event of interest.

Confidence Interval: A set of values for a summary measure, such as a rate or rate ratio, constructed so the set has a specified probability of including the true value of the measure. The specified probability is called the confidence interval, the end points are called lower and upper confidence limits; 95% confidence intervals are most common.

Cox Model or Proportional Hazards Model: A statistical model that relates the hazard for an individual at any time *t* to an (unspecified) baseline hazard and a set of predictor variables, such as treatment type, age, gender etc. The Cox model produces hazard ratios that allow comparisons between groups of the rate of the event of interest. The main assumption of a Cox model is that the ratio of hazards between groups that we wish to compare does not vary over time. If the hazard for prosthesis Model A is twice that of prosthesis Model B at three years, it will also be twice at four years, and so on. This is referred to as the 'proportional hazards assumption'. If the hazard ratio is not proportional over the entire time of observation, then a time varying model is used, which estimates a separate hazard ratio within each pre-defined time period. Within each time period, the hazards are proportional. The Registry uses a set algorithm which iteratively chooses time points until the assumption of proportional hazards is met for each time period. The time points are selected based on where the greatest change in hazard occurs between the two comparison groups, weighted by the number of events in that time period.

Cumulative Incidence Function: An estimator of the actual probability of revision in the presence of a competing risk. In these circumstances, the Kaplan-Meier estimate, which treats competing risks as censored, overestimates the true probability. In the competing risks paradigm, patients who have already had a revision or who have died are excluded from the set at risk of being revised. Under Kaplan-Meier, only patients who have already been revised are excluded from the risk set; dead patients are analysed as though they are still at risk of revision.

Cumulative Percent Revision: Otherwise known as the 'cumulative failure rate'. This is defined as 100 x [1- S(t)] where S(t) is the survivorship probability estimated by the Kaplan-Meier method (see survival curve, below). The cumulative percent revision gives the percent of procedures revised up until time t, and allows for right censoring due to death (but see Cumulative Incidence Function above) or closure of the database for analysis.

Hazard Ratio: A hazard is an estimate of the instantaneous risk of occurrence of an event, for example revision, at a point in time, t. A hazard ratio results from dividing one group's hazard by another's to give a comparative measure of the instantaneous risk of experiencing the event of interest. In this report, hazard ratios are adjusted for age and gender as appropriate. Hazard ratios are either for the entire survivorship period (if proportional; see 'Cox Model or Proportional Hazards Model' section above) or for specific time periods (if the hazard for the entire survivorship period is not proportional).

For example, a comparison of Primary Total Conventional Hip Replacement for a Primary Diagnosis of Avascular Necrosis

(AVN), Developmental Dysplasia of the Hip (DDH) and Osteoarthritis (OA):

Avascular Necrosis vs Osteoarthritis.

Entire Period: HR=1.34 (1.16, 1.54), p<0.001

The hazard ratio for this comparison is proportional over the entire time of observation. AVN has a significantly higher rate of event (in this case, revision) compared to OA over the entire time of observation (p<0.001). The hazard is 1.34 times higher for AVN compared to OA and, with 95% confidence, the true hazard for AVN will lie between 1.16 times higher and 1.54 times higher than the hazard for OA.

Developmental Dysplasia vs Osteoarthritis

0-3Mth: HR=1.75 (1.21, 2.52), p=0.002

3Mth+: HR=1.07 (0.78, 1.45), p=0.683

The hazard ratio is not proportional over the entire time of observation, so the hazard ratio has been divided into two periods; the time from primary arthroplasty to three months following the primary and three months following the primary to the end of observation. DDH has a significantly higher revision rate compared to OA in the first three months following the primary (p=0.002). The hazard for revision in the first three months is 1.75 times higher for DDH than for OA and with 95% confidence, the true hazard for DDH will lie between 1.21 and 2.52 times higher. From three months following the primary to the end of observation, there is no significant difference in the revision rate between DDH and OA (p=0.683).

Incidence Rate: The number of new occurrences of an event divided by a measure of the population at risk of that event over a specified time period. The population at risk is often given in terms of person-time: for example, if 6 persons are each at risk over 4 months, they contribute 6 x 1/3 = 2 person-years to the denominator of the incidence rate. The incidence rate ratio (IRR) is commonly used to compare the incidence rates of two groups. If the two groups incidence rates are the same, the result is an IRR of 1.

Log Rank Test: A family of statistical tests that compares the survival experience of two or more groups over the entire time of observation (contrast with comparison of survival at a defined time, e.g. five-year survival).

Observed Component Years: For each procedure, component time is the time during which it is at risk of being revised. This is calculated as the number of days from the date of the primary procedure until either the date of revision, date of death or end of study (31/12/2019) whichever happens first. This is then divided by 365.25 to obtain the number of component years. Each primary procedure then contributes this calculated number of component years to the overall total component years for a particular category of prosthesis.

For example: A primary total hip procedure performed on 1/1/2019 was revised on 1/7/2019. Therefore, the number of days that this procedure is at risk of being revised is 183 days. This prosthesis then contributes 0.5 (183/365.25) component years to the overall number of observed component years for the total hip procedure category.

A patient with a primary procedure on 1/1/2019 died without being revised on 1/4/2019. This procedure contributes 0.25 component years.

A primary procedure occurs on 1/1/2019 and has not been revised. This procedure contributes 1 component year (as observation time is censored at 31/12/2019).

Survival Curve: A plot of the proportion of subjects who have not yet experienced a defined event (for example, death or revision of prosthesis) versus time. The Kaplan-Meier method is the one most commonly used. The curve takes account of subjects whose ultimate survival time is not known, a phenomenon called 'censoring'. The survival estimate at each time is accompanied by a confidence interval based on the method of Greenwood. An interval is interpretable only at the time for which it was estimated and the sequence of intervals (depicted as shading on the Kaplan-Meier curve) cannot be used to judge the significance of any perceived difference over the entire time of observation. Often, for convenience, the curve is presented to show the proportion revised by a certain time, rather than the proportion not being revised ('surviving'). In the Registry, we call this cumulative percent revision (CPR). The Kaplan-Meier method is biassed in the presence of a competing risk and will overestimate the risk of revision. In such circumstances, use of the cumulative incidence function for all competing risks, rather than the Kaplan-Meier estimate, is advised. The cumulative incidence of all competing risks must be assessed simultaneously to avoid bias in interpretation.

APPENDIX 3 – Diagnosis Hierarchy

DIAGNOSIS HIERARCHY FOR REVISION HIP REPLACEMENT

Rank	Diagnosis	Category
1	Tumour	Dominant diagnosis independent of prosthesis/surgery
2	Infection	
3	Leg Length Discrepancy	Surgical procedure
4	Incorrect Sizing	
5	Malposition	
6	Metal Related Pathology	Reaction to prosthesis
7	Loosening	
8	Lysis	
9	Wear Hip Insert	Wear and implant breakage
10	Wear Acetabular Cup/Shell	
11	Wear Head	
12	Implant Breakage Head	
13	Implant Breakage Stem	
14	Implant Breakage Hip Insert	
15	Implant Breakage Acetabular Cup/Shell	
16	Prosthesis Dislocation	Stability of prosthesis
17	Instability	
18	Fracture (Femur/Acetabular/Neck/Periprosthetic)	Fracture of bone
19	Chondrolysis/Acetabular Erosion	Progression of disease on non-operated part of joint
20	Progression of Disease	
21	Synovitis	New diseases occurring in association with joint replacement
22	Osteonecrosis/AVN	
23	Heterotopic Bone	
24	Pain	Pain
25	Other	Remaining diagnoses

Appendices

DIAGNOSIS HIERARCHY FOR REVISION KNEE REPLACEMENT

Rank	Diagnosis	Category
1	Tumour	Dominant diagnosis independent of prosthesis/surgery
2	Infection	
3	Incorrect Side	Surgical procedure
4	Incorrect Sizing	
5	Malalignment	
6	Metal Related Pathology	Reaction to prosthesis
7	Loosening	
8	Lysis	
9	Wear Knee Insert	Wear and implant breakage
10	Wear Tibial Tray	
11	Wear Femoral	
12	Wear Patella	
13	Implant Breakage Femoral	
14	Implant Breakage Knee Insert	
15	Implant Breakage Tibial Tray	
16	Implant Breakage Patella	
17	Bearing Dislocation	Stability of prosthesis/knee
18	Patellar Dislocation	
19	Prosthesis Dislocation	
20	Instability	
21	Patellar Maltracking	
22	Fracture (Femur/Tibia/Patella/Periprosthetic)	Fracture of bone
23	Progression of Disease	Progression of disease on non-operated part of join
24	Patellar Erosion	
25	Synovitis	New diseases occurring in association with joint replacement
26	Arthrofibrosis	
27	Osteonecrosis/AVN	
28	Heterotopic Bone	
29	Patellofemoral Pain	Pain
30	Pain	
31	Other	Remaining diagnoses

DIAGNOSIS HIERARCHY FOR REVISION SHOULDER REPLACEMENT

Rank	Diagnosis	Category
1	Tumour	Dominant diagnosis independent of prosthesis/surgery
2	Infection	
3	Incorrect Side	Surgical procedure
4	Incorrect Sizing	
5	Malalignment	
6	Metal Related Pathology	Reaction to prosthesis
7	Loosening	
8	Lysis	
9	Wear Glenoid Insert	Wear and implant breakage
10	Wear Glenoid	
11	Wear Humeral	
12	Implant Breakage Glenoid Insert	
13	Implant Breakage Glenoid	
14	Implant Breakage Humeral	
15	Implant Breakage Head	
16	Instability/ Dislocation	Stability of prosthesis
17	Rotator Cuff Insufficiency	
18	Dissociation	
19	Fracture (Glenoid/Humeral/Periprosthetic)	Fracture of bone
20	Progression of Disease	Progression of disease on non-operated part of join
21	Glenoid Erosion	
22	Synovitis	New diseases occurring in association with joint replacement
23	Arthrofibrosis	
24	Osteonecrosis/AVN	
25	Heterotopic Bone	
26	Pain	Pain
27	Other	Remaining diagnoses

APPENDIX 4 – Patient Consent and Confidentiality Guidelines

PATIENT CONSENT

The Australian Orthopaedic Association National Joint Replacement Registry (AOANJRR) obtains consent to include information from individuals undergoing joint replacement by using the 'opt off' approach. The implementation of the new Commonwealth Legislation at the end of 2001 resulted in the Registry meeting with the Privacy Commission to ensure that the system used for patient consent is within the privacy guidelines.

Using this approach, patients are provided with a Patient Information Sheet. This explains what information is required, how it is collected and the avenues to take should an individual not want their information included in the Registry. The information is provided to patients by surgeons and hospitals prior to surgery. To accommodate patients that may have questions, wish to opt out or discuss any issues, a freecall number is available to contact the Registry.

PATIENT CONFIDENTIALITY

Joint replacement patients will not be contacted directly by the Registry. No individual patient will be identified during analysis or in reports and publications produced by the Registry. Patient operative and prostheses data is managed in accordance with the Guidelines for the Protection of Privacy in the Conduct of Medical Research. Personal data collected are for use by the AOA National Joint Replacement Registry only. The Registry has been listed as a Federal Quality Assurance Activity and all information is protected (refer to section below).

DATA MANAGEMENT AND CONFIDENTIALITY

The South Australian Health and Medical Research Institute (SAHMRI) undertakes data entry, validation and analysis and provides secure data storage. Only a small number of identified positions have access to patient information.

Declaration of the project as a Quality Assurance Activity ensures that Registry and SAHMRI staff are bound to maintain confidentiality. Confidentiality not only applies to individual patients but also includes surgeons and hospitals.

SAHMRI has security systems to restrict access to SAHMRI and Registry staff only. There are policies and procedures in place as well as software barriers to protect personal information. These include the use of codes, passwords, and encryption.

The proforma used for data collection are stored in a secure locked room at SAHMRI. Forms are scanned and electronically stored. After data entry and data cleaning, all data are securely stored and retained in accordance with good scientific practice.

SURGEON CONFIDENTIALITY

Surgeon confidentiality is assured. The purpose of the Registry is to provide demographic and outcome information relevant to joint replacement surgery. Surgeon name is not recorded in the Registry database.

It is an important Registry function to provide a service to surgeons that allows them to monitor and audit their own performance. For this reason, surgeons have a choice to identify themselves by code, which can be linked to their procedures. This is optional and there is no requirement to provide the surgeon code. These codes are provided to surgeons by AOA.

Surgeons are provided with access to their own information through a secure online facility. It is important to emphasise that surgeons have the choice of using their code and that surgeon name is not recorded in the database.

FEDERAL QUALITY ASSURANCE ACTIVITY

The AOANJRR was initially declared a Federal Quality Assurance Activity in March 1999, by the then Federal Minister for Health and Aged Care, Dr Wooldridge. This was renewed in 2001, 2006, 2011, 2016 and for a further five years in July 2022. An amendment was approved in 2018 to add collection of Knee Osteotomy procedures. This declaration ensures freedom from subpoena and absolute confidentiality of information held by the Registry.

The Quality Assurance legislation is part of the Health Insurance Act of 1973. This act was amended in 1992 to include quality assurance confidentiality. The Act operates on the underlying assumption that quality assurance activities are in the public interest.

A declaration as a Quality Assurance Activity by the Commonwealth Minister of Health prohibits the disclosure of information, which identifies individual patients or health care providers that is known solely as a result of the declared quality assurance activity. It is not possible to provide identifying information to any individual or organisation including the government.

The protection provided by the declaration assures surgeons, hospitals and government that information supplied to the Registry remains confidential and secure. The act also protects persons engaging in those activities in good faith from civil liability in respect of those activities.

APPENDIX 5 - Patient Information Sheet

INTRODUCTION – ABOUT THE REGISTRY

You are about to have an operation on one of your joints. More than 100,000 people have a joint replacement or knee osteotomy operation each year in Australia. Most of these operations are very successful. However, a number of people who have a joint operation may at some time require another operation on that joint. This may occur due to a variety of reasons. For instance, if you have had a joint replacement the most common cause is that the joint replacement has worn out. How quickly this occurs depends on which of the many different types of artificial joints have been used. For those patients having a knee osteotomy the aim is to delay or prevent the need for having a joint replacement.

In order to improve the success of these operations, the Australian Orthopaedic Association set up the National Joint Replacement Registry in 1999. The purpose is to monitor and report on the results of these operations. This information helps everyone working in the health system to ensure patients get the best treatment possible both now and in the future. Another important Registry role is that it assists hospitals and doctors to locate people in the uncommon event a problem with any medical device used is identified.

To do this it is important for the Registry to record a small amount of information on as many people having these operations as possible. It is also important to record if any subsequent operations have occurred. By analysing this information, it is possible to identify which of the medical devices are working best and the best type of operation for each patient. We are asking you to participate in the Registry, by allowing us to document information relevant to your operation.

YOUR INVOLVEMENT – THE INFORMATION WE NEED

The information we require includes your name, date of birth, address, Medicare number, hospital identity number, the name of the hospital and the reason you are having a joint replacement or knee osteotomy. This information is necessary to accurately link you to the medical device inserted as well as linking any following joint surgery you may have, to your previous records. We will also record the day of the operation, which joint was operated on and the type of medical device used. No other personal information is recorded. Government Departments also provide information so that the Registry can check the accuracy of the data and update records to reflect if someone has died.

INFORMATION – HOW WE WILL KEEP YOUR INFORMATION CONFIDENTIAL

Your personal information is confidential and safety measures are in place to protect this information. Your personal information is protected by an Act of Parliament. This means you cannot be identified in any reports produced by the Registry. On occasion, your data may be linked to other government health datasets to further enhance the Registry's ability to improve patient outcomes. Your de-identified data may be used for other research projects and may be shared with national and international collaborators.

HOW WE WILL COLLECT THE INFORMATION

Although we are asking to record your operation details in the Registry you are not required to do anything. Your surgeon and/or theatre staff will complete the form that contains your personal details at the time of your operation and send it to us. The information will be entered into the secure Registry database which is stored in the South Australian Health & Medical Research Institute, Adelaide, South Australia.

RISKS AND BENEFITS – TO YOU

There are no risks to you by having your details in the Registry. The Registry produces general reports on a variety of factors that influence the success of joint operations. The results of joint operations have greatly improved because of this information.

WHAT TO DO IF YOU DON'T WANT TO BE IN THE REGISTRY

We understand that not everyone is comfortable about having his or her personal details documented in a registry. If you feel this way and do not want your details recorded, please contact the Manager on 1800 068 419 (freecall) as well as making your decision known to hospital staff. A decision on whether or not you wish to be involved in the Registry does not affect your treatment in any way. If you have any questions, concerns, or require further information on the National Joint Replacement Registry please do not hesitate to contact the Registry.

Concerns or complaints related to the data collection process may be directed to the AOANJRR on 1800 068 419 (freecall) or alternatively the Australian Government, Office of the Privacy Commissioner on 1300 363 992

Appendices

APPENDIX 6 - Implementation Timeline

IMPLEMENTATION OF NATIONAL JOINT REPLACEMENT REGISTRY FOR HIP, KNEE AND SHOULDER REPLACEMENT

The Registry was implemented in a staged manner on a state-by-state basis. The table below shows the commencement date for each state or territory. Implementation was completed nationally by mid 2002, therefore 2003 was the first year of complete national data.

National data collection on shoulder replacement commenced in November 2007. Knee osteotomy data collection commenced in early 2018.

State/Territory	Commencement Date
South Australia	September 1999
Queensland	April 2000
Western Australia	April 2000
Victoria	July 2000
Tasmania	September 2000
Northern Territory	October 2000
Australian Capital Territory	May 2001
New South Wales	June 2001

APPENDIX 7 - ICD - 10-AM Codes

ICD-10-AM CODES – v11 (2019 Edition) State Health Department Separation Data	
HIP	
Partial Hip Replacement	
49315-00	Partial arthroplasty (excludes Austin Moore)
47522-00	Hemiarthroplasty of femur (Austin Moore)
Primary Total Hip Replacement	
49318-00	Total arthroplasty of hip unilateral
49319-00	Total arthroplasty of hip bilateral
90607-00 [1489]	Resurfacing of hip, unilateral
90607-01 [1489]	Resurfacing of hip, bilateral
Revision Hip Replacement	
49312-00	Excision arthroplasty of hip (removal of prosthesis without replacement)
49324-00	Revision of total arthroplasty of hip
49327-00	Revision of total arthroplasty with bone graft to acetabulum
49330-00	Revision of total arthroplasty with bone graft to femur
49333-00	Revision of total arthroplasty with bone graft to acetabulum and femur
49339-00	Revision of total arthroplasty with anatomic specific allograft to acetabulum
49342-00	Revision of total arthroplasty of hip with anatomic specific allograft to femur
49345-00	Revision of total arthroplasty with anatomic specific allograft to acetabulum and femur
49346-00	Revision of partial arthroplasty hip replacement

ICD-10-AM CODES – v11 (2019 Edition) State Health Department Separation Data	
KNEE	
Partial Knee Replacement	
Patellofemoral Knee Replacement	
49534-01	Total replacement arthroplasty of patellofemoral joint of knee
Unicompartmental Knee Replacement	
49517-00	Hemi arthroplasty of knee
Primary Total Knee Replacement	
49518-00	Total arthroplasty of knee unilateral
49519-00	Total arthroplasty of knee bilateral
49521-00	Total arthroplasty of knee with bone graft to femur unilateral
49521-01	Total arthroplasty of knee with bone graft to femur bilateral
49521-02	Total arthroplasty of knee with bone graft to tibia unilateral
49521-03	Total arthroplasty of knee with bone graft to tibia bilateral
49524-00	Total arthroplasty of knee with bone graft to femur and tibia unilateral
49524-01	Total arthroplasty of knee with bone graft to femur and tibia bilateral
Revision Knee Replacement	
49512-00	Arthrodesis with removal of prosthesis
49515-00	Removal-prostheses from knee
49527-00	Revision of total arthroplasty of knee excluding patella resurfacing
49530-00	Revision of total arthroplasty of knee with bone graft to femur
49530-01	Revision of total arthroplasty of knee with bone graft to tibia
49533-00	Revision of total arthroplasty of knee with bone graft to femur and tibia
49554-00	Revision of total arthroplasty of knee with anatomic specific allograft
90562-00	Patella resurfacing

SHOULDER	
Partial Shoulder Replacement	
48915-00	Hemiarthroplasty of shoulder
Total Shoulder Replacement	
48918-00	Total arthroplasty of shoulder
Revision Shoulder Replacement	
48921-00	Revision of total joint replacement of shoulder
48924-00	Revision of total joint replacement of shoulder with bone graft
48927-00	Removal of shoulder prosthesis
48942-00	Arthrodesis and removal of shoulder prosthesis

Australian
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