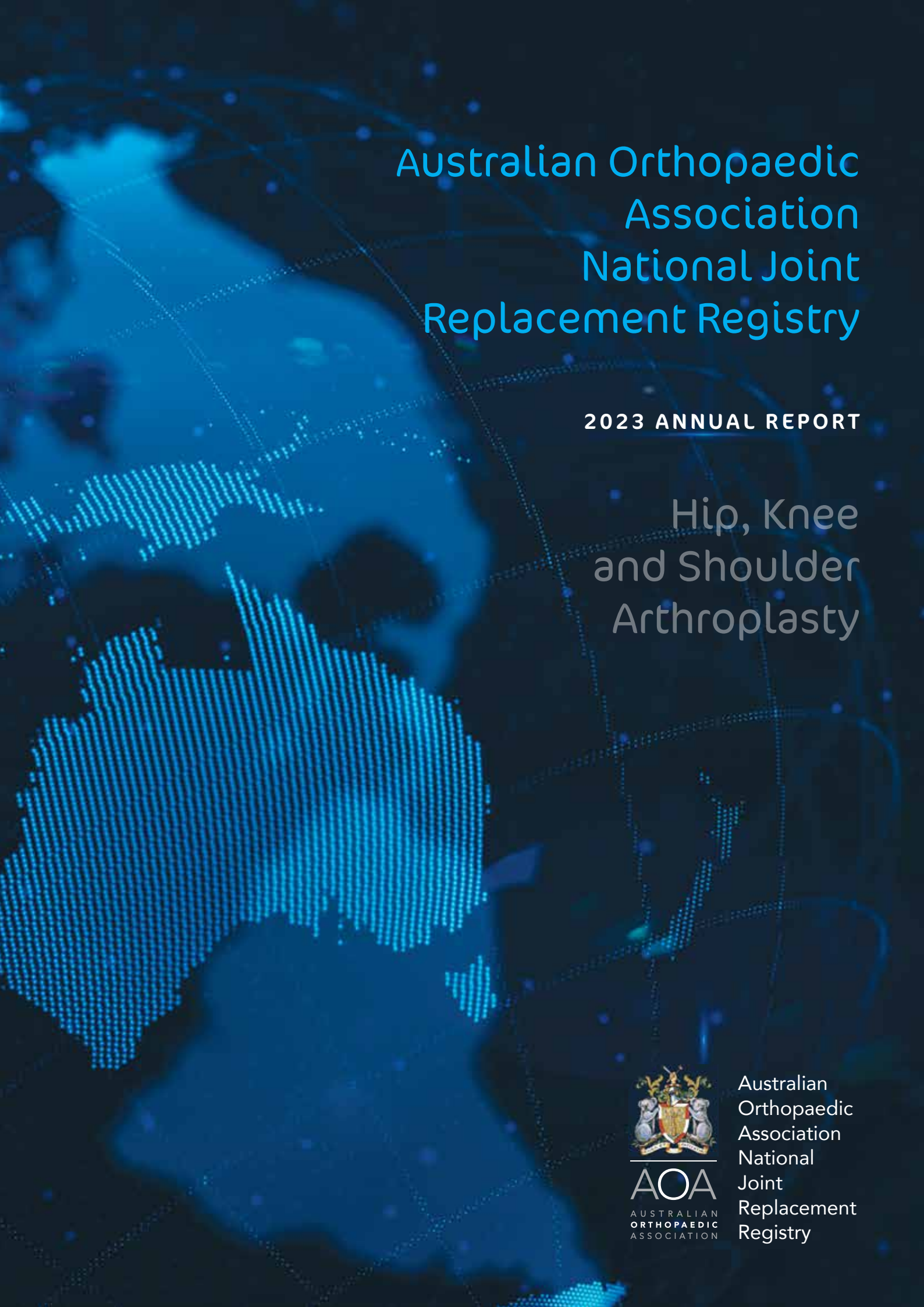
Australian Orthopaedic Association National Joint Replacement Registry

2023 ANNUAL REPORT

Hip, Knee and Shoulder Arthroplasty



AOA
AUSTRALIAN ORTHOPAEDIC ASSOCIATION

Australian Orthopaedic Association National Joint Replacement Registry

Australian Orthopaedic Association National Joint Replacement Registry



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Australian Orthopaedic Association National Joint Replacement Registry

2023 ANNUAL REPORT

Data Period 1 September 1999 – 31 December 2022

Hip, Knee and Shoulder Arthroplasty

Preface

As President of the AOA, it is a great pleasure to write the preface for our 2023 Australian Orthopaedic Association National Joint Replacement Registry (AOANJRR) Annual Report.

The Registry has data that has been collected for over 20 years. This has allowed AOA surgeons and indeed surgeons from all around the world to make decisions that will directly benefit their patients as a result of this data. The Registry should be congratulated on producing its 24th Report.

There have tumultuous times over the past 2 years in the Registry. As a result of these changes and Covid, the report had been reduced in its scope and size. This year sees a return to a full report and 16 supplementary chapters. This is due to the incredible work of the Registry team led by Paul Smith, deputy directors Peter Lewis, Chris Vertullo and Michael McAuliffe and assistant deputy directors Catherine McDougall, Chris Wall, James Stoney, and David Gill. They have been supported by Kathy Hill and her team of Registry staff – their enthusiasm for their jobs and growing confidence and expertise is reflected in this report. Neil Bergman has also led the Registry committee strongly over this period with the support and expertise of all on the committee.

Highlights of the year have included reaching just short of 2 million joint replacements, the Registry strategy day, and the Registry workshop (with thanks to all who gave up their time to attend) to ensure that this report is an accurate reflection of the data presented.

This year, the report includes a separate chapter on infection, currently the most common reason for revision surgery and a PROMs section in a dedicated supplementary chapter.

Our funding for core activities comes from a legislated cost recovery program. This data remains protected under qualified privilege. Other sources of funding are currently being sought through both state and federal governments for the PROMs program. The South Australian Health and Medical Research Institute (SAHMRI) provides invaluable assistance for data collection, management and analysis and we thank them for this. The University of South Australia is also acknowledged for the support they provide in additional statistical expertise and data linkage analysis support.

This Registry is your Registry and without the support of AOA surgeons and members, there would be no data. Your support and that of your hospitals and patients allows the AOANJRR to produce high-quality data that is envied around the world and benefits both our patients and those in other countries as well.

Enjoy sitting back perhaps enjoying a quiet beverage and reading this year's report.

Chris Morrey
President,
Australian Orthopaedic Association

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AOANJRR Data Snapshot 2022

Infection has now become the No.1 reason for prosthesis revision

1,982,200
Total number of joint replacement procedures reported by the Registry at the end of 2022

124
Ad Hoc Reports

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

Joint Replacement Procedures Performed in 2022

52,863
Hips

64,846
Knees

8,636
Shoulders

2,939
Automated Industry Reporting System (AIRS)

12
Hospital Audit Reports

1,622
Individual Surgeon Reports

25
Conference Presentations

46
Journal Articles Published

COVID-19 Impact on Joint Replacement in Australia

In 2022 there were
14,513
fewer procedures than expected had the 2008–2019 trend in joint replacement procedures continued

Public Hospital joint replacement procedures decreased by
22.2%
in 2022 compared to 2019

Private Hospital joint replacement procedures increased by
12.5%
in 2022 compared to 2019

PROMs National Rollout

JUNE 2023 UPDATE

Participating Hospitals
239

Pre-Op PROMs
86,573

Post-Op PROMs
55,991

Pre-Op Completion Rate
73.5%

Post-Op Completion Rate
62.3%

% patient-reported change following hip, knee, or shoulder joint replacement as "much better"
85%

% patients very satisfied or satisfied following hip, knee, or shoulder joint replacement
86.9%

Total number of Hospitals onboard per state:

- ACT: **6**
- NSW: **66**
- NT: **3**
- QLD: **45**
- SA: **29**
- TAS: **7**
- VIC: **61**
- WA: **22**

765
Total number of surgeons participating

94,356
Patient participation through AOANJRR patient dashboards

Executive Summary

This summary provides a brief overview of some of the major findings from the 2023 Annual Report. 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 2022. Again, historic data are still available in previous Annual Reports on the AOANJRR website.

This year, the Registry is again providing an update on the impact of COVID-19 on joint replacement in Australia during 2022 and comparisons to 2020 and 2021, and to the pre-COVID year 2019.

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-2023 from 1 October 2023. They include a Lay Summary of the main report and 15 additional reports on arthroplasty topics, as well as detailed analyses of all prostheses identified as having a higher than anticipated rate of revision. This year, information on patient reported outcome measures (PROMs) is available as a dedicated supplementary report.

Impact of COVID-19 in 2022

In 2022, hip, knee and shoulder joint replacement decreased 3.0% compared to the previous year. The decrease was most notable in January. However, in the public system the decrease continued until later in the year.

In early 2022, the states of NSW, Victoria and SA had the largest reduction in the number of procedures compared to the other states. A smaller reduction was seen in Queensland. From March onwards, all states were undertaking either a similar or a larger number of procedures compared to pre-COVID years.

When compared to the pre-pandemic year of 2019, in 2022 there were 33,332 fewer procedures performed in the public sector, assuming the number of procedures had continued to increase at the same rate observed between 2008 and 2019. The number of joint replacements performed in the private sector in 2022 approximates the pre-pandemic trend.

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. For the first time, 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 7.6% for total stemmed anatomic and 5.6% for total stemmed reverse. The calculated 15 year benchmark standard for hips is 6.2% 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, 20% of hip and 21.1% 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, 21.7% of hip and 22.7% of knee prosthesis combinations still in use achieve a superiority benchmark.

Special Chapter: Infection in Joint Replacement

The 2023 Annual Report includes a new chapter detailing the outcome of revision for infection in primary hip, knee and shoulder replacement. Infection following joint replacement surgery is a devastating complication that has a major impact on patients' quality of life and carries an enormous cost penalty to the health system.

In contrast to revision for aseptic reasons, revisions for infection in hip, knee and shoulder replacements have shown a steady increase since the commencement of data collection by the AOANJRR. In 2022, there were 1,173 (2.2%) hip, 1,535 (2.4%) knee and 191 (2.2%) shoulder replacement revision procedures performed due to infection.

The tendency for revision for infection to occur more commonly in males is observed in hip, knee and shoulder replacements. Irrespective of ASA score, males have a higher proportion of revisions for infection than females. While obesity is a significant risk factor for infection in arthroplasty, revisions for infection occur disproportionately more frequently in males in all BMI grades.

Consistent with the international literature, the Registry has defined an early revision for infection as one which is undertaken within 3 months of the primary procedure. Early revision for infection occurs in 51% of 1st revision procedures for hips, 23.9% of 1st revisions for knees, and 21.9% of 1st revision shoulder replacement procedures.

Revision for infection of a primary hip, knee or shoulder replacement carries a high risk of requiring a 2nd revision for any reason.

The effect of the timing of a debridement, antibiotics and implant retention (DAIR) procedure differs for hips, knees and shoulders. For hips, an early DAIR (performed within 3 months of the primary procedure) has a lower rate of 2nd revision when compared to a DAIR procedure after 3 months (late DAIR). For knees, DAIR procedures performed within 4 weeks of the primary procedure have a lower rate of 2nd revision compared to DAIR procedures performed after this time. However, for shoulders, there is no difference in the rate of 2nd revision related to timing of the DAIR procedure.

The risk of a 3rd revision of a primary hip or primary knee replacement revised for infection in a two-stage process is highest if the second stage is performed within 1 month of the first stage. For shoulders, the risk of a 3rd revision for infection in a two-stage process is highest if the second stage revision is performed after 6 months from the first stage.

Hip Replacement

There has been minimal change in the number of hip replacements undertaken in 2022 compared to 2021. The revision burden in 2022 is 7.3% which is the lowest burden yet reported by the Registry. However, the impact of COVID-19 makes the interpretation of this finding uncertain. Only summary data for partial hip replacement are provided in this year's report. A full report on partial hip replacement is available as a supplementary report. The summary information reports that 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.

Primary total hip replacement decreased by 201 procedures in 2022 compared to 2021 and there has been a 128.1% 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 approach, but there are no other differences between approaches. However, there are 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.

Knee Replacement

In 2022, knee replacement decreased by 5.5% compared to the previous year. The revision burden decreased 7.2%. There has been a decrease in the use of partial knee replacement, and in 2022 it remains a small proportion (7.3%) of all knee replacement procedures. Younger age and female gender are associated with higher rates of revision for unicompartmental knee replacement. Robotic assistance is associated with a reduced revision risk for unicompartmental knee replacement, but its use is restricted to specific prostheses. Mobile bearings increase revision risk, but its use is restricted to only three prostheses. There is no difference in revision risk between medial and lateral unicompartmental knee replacement.

Primary total knee replacement decreased by 5.3% in 2022. The 20 year cumulative percent revision of knee prostheses still used in 2022 for the management of osteoarthritis is 7.7%. 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.

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. Medial pivot designs have a higher rate of revision compared to minimally stabilised prostheses. However, there is no difference if the patella is resurfaced. Medial pivot designs have a lower rate of revision compared to posterior stabilised prostheses. There is no difference in revision rate when the congruency types of minimally stabilised inserts are compared.

The effect of fixation varies depending on prosthesis stability and often with time. For minimally stabilised prostheses, hybrid fixation has the lowest rate 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.

Executive Summary

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.

Shoulder Replacement Data

In 2022, shoulder replacement decreased by 1.4% compared to the previous year. The revision burden increased to 7.9% following the lowest reported revision burden of 7.3% last year. Summary data for partial shoulder anatomic procedures are provided in the Annual Report and a full analysis is provided 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 70.9% 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. Total stemmed anatomic with modified central peg polyethylene glenoid and total stemless anatomic, along with total stemmed reverse shoulder replacements have the lowest rates of revision.

The outcome of primary total stemmed anatomic shoulders is influenced by glenoid fixation, polyethylene type, humeral head size, age and gender. By contrast, total stemless anatomic revision is lower for males but is not influenced by other prosthetic factors or age.

The rate of revision for total reverse shoulder replacement is the same when used for either osteoarthritis or rotator cuff arthropathy. Younger age, male gender, and primary diagnosis fracture are associated with an increased risk of revision. It is becoming evident that higher ASA scores increase revision risk, but the evidence for BMI categories impacting revision rates remains unclear. The method of fixation is not a risk factor for revision.

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.

Prostheses with Higher than Anticipated Rates of Revision

Each year, the AOANJRR identifies prostheses with higher than anticipated rates of revision. This year, 4 total conventional hip, 3 total knee prostheses and 2 total stemmed reverse shoulder prostheses 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 2023 Hip, Knee and Shoulder Arthroplasty Report is based on the analysis of 1,982,200 (850,603 hip, 1,046,247 knee and 85,350 shoulder) primary and revision procedures recorded by the Registry, with a procedure date up to and including 31 December 2022. Shoulder arthroplasty has been included in this report with hip and knee arthroplasty since 2017.

In addition, there are 16 supplementary reports that complete the AOANJRR Annual Report for 2023:

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 Hip Arthroplasty
14. Partial Knee Arthroplasty
15. Partial Shoulder Arthroplasty
16. Comparative Prosthesis Performance

In addition to the 16 supplementary reports, investigations of prostheses with higher than anticipated rates of revision are published on https://aoanjrr.sahmri.com/annual-reports-2023

All hospitals, public and private, undertaking joint replacement submit their data to the Registry. Currently, there are 318 participating hospitals. However, this may vary from time to time due to hospital closures, new hospitals, or changes to services within hospitals.

Background

Joint replacement is a commonly performed major surgical procedure that has considerable success in alleviating pain and disability.

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 ad hoc reports. These ad hoc 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 7.3% in 2022. The percentage of revision knee procedures has declined from a peak of 8.8% in 2004 to 7.2% in 2022. Revision shoulder arthroplasty peaked at 10.9% in 2012 and has declined to 7.9% in 2022.

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) and knees (2013).
- The benefit of computer assisted surgery for knee replacement.
- 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, recommend AOANJRR policies to the Board. The Committee reports to the AOA Board. Members include the Chairperson, AOANJRR Clinical Director with the three AOANJRR Deputy Clinical Directors and four Assistant Deputy 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 Clinical Director, Deputy Clinical Directors and Assistant Deputy Clinical Directors are appointed by the AOA Board and are responsible for providing strategic and clinical guidance. Additionally, the 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, Ad Hoc 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 Quality

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.

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 (99.0%) 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 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 (CPR) 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 and knee surgeon workshops were held in Adelaide on the weekend of the 5 and 6 August 2023. In addition to AOANJRR and SAHMRI staff, 24 hip and 21 knee arthroplasty specialists from the AOA membership attended the workshops.

The shoulder surgeon workshop was held on 12 August 2023. In addition to AOANJRR and SAHMRI staff, 6 AOA members with expertise in shoulder arthroplasty attended the workshop.

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.

Impact of COVID-19

Summary of the Impact of COVID-19 on Joint Replacement in Australia in 2022

Introduction

COVID-19 continued to have a significant impact on the delivery of health services in Australia in 2022. The AOANJRR is in a unique position to assess the ongoing impact on joint replacement surgery nationally, and by state and territory. The number of joint replacement procedures performed in 2022 has been compared to 2020 and 2021, and to the pre-COVID year of 2019.

The information is presented for all procedures nationally, by state and territory, as well as by public and private hospitals. The information is also presented by joint replacement type (hip, knee, and shoulder) for primary procedures (overall, elective, and trauma) as well as revision procedures.

All Joint Replacement Nationally

The Registry has recorded 376,411 hip, knee and shoulder replacements performed in the years between 2020 and 2022. The number of joint replacements performed in the private sector in 2022 approximates the pre-pandemic trend (Figure C1). Between 2020 and 2022, there were 33,332 fewer joint replacements performed in the public sector, assuming the number of procedures had continued to increase at the same rate observed from 2008 to 2019 (Figure C1).

Compared to 2021, joint replacement decreased by 3.0% in 2022 (Figure C2). The decrease was most noticeable in January. However, in the public hospital system, the decrease continued until later in the year (Figure C3).

Figure C1 Observed and Predicted Hip, Knee and Shoulder Replacement Procedures by Year and Hospital Type

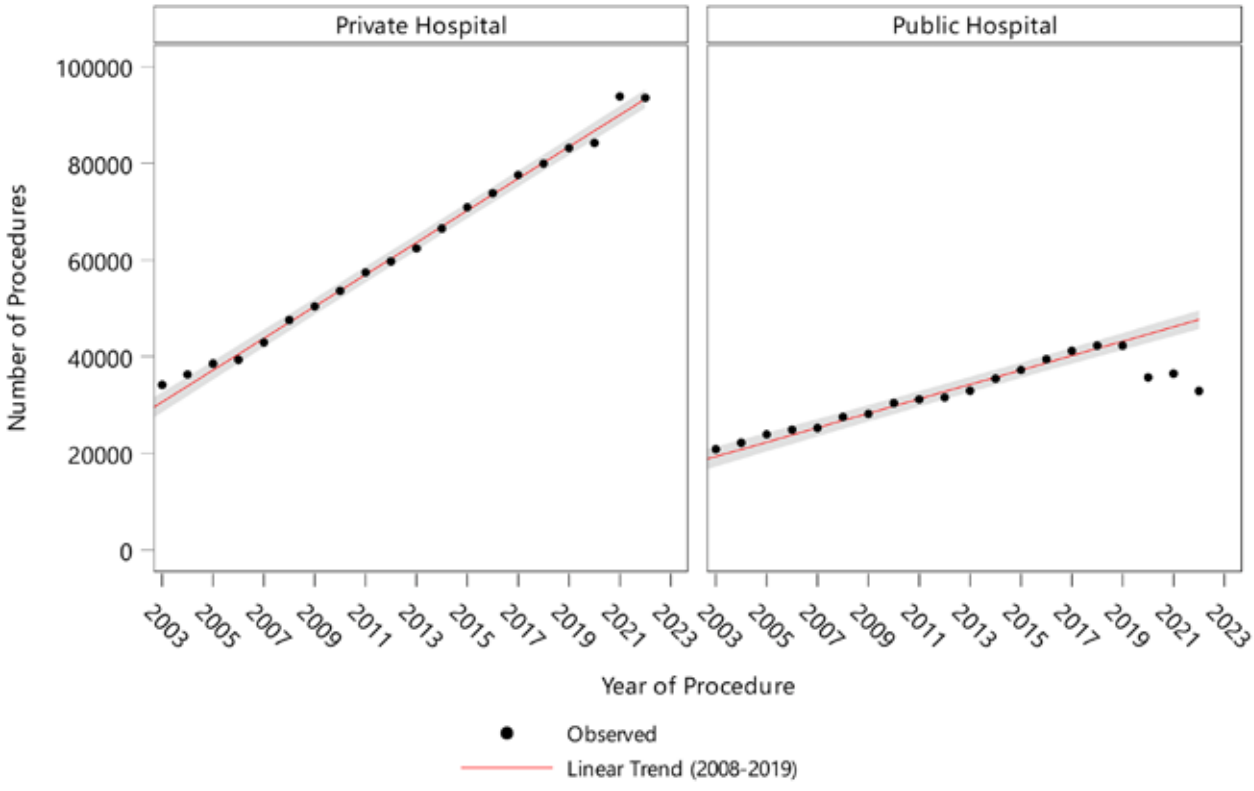


Figure C2 **All Joint Replacement Hip, Knee and Shoulder (Primary and Revision)**

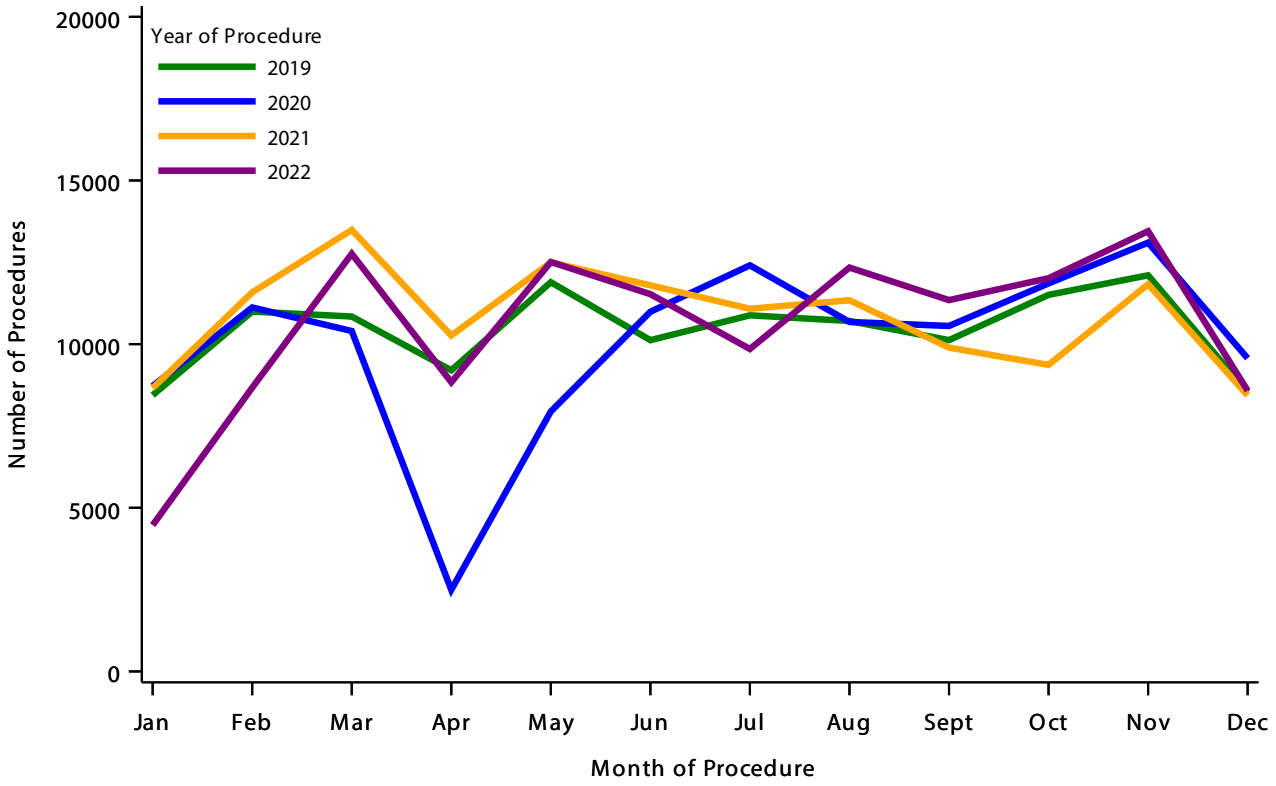
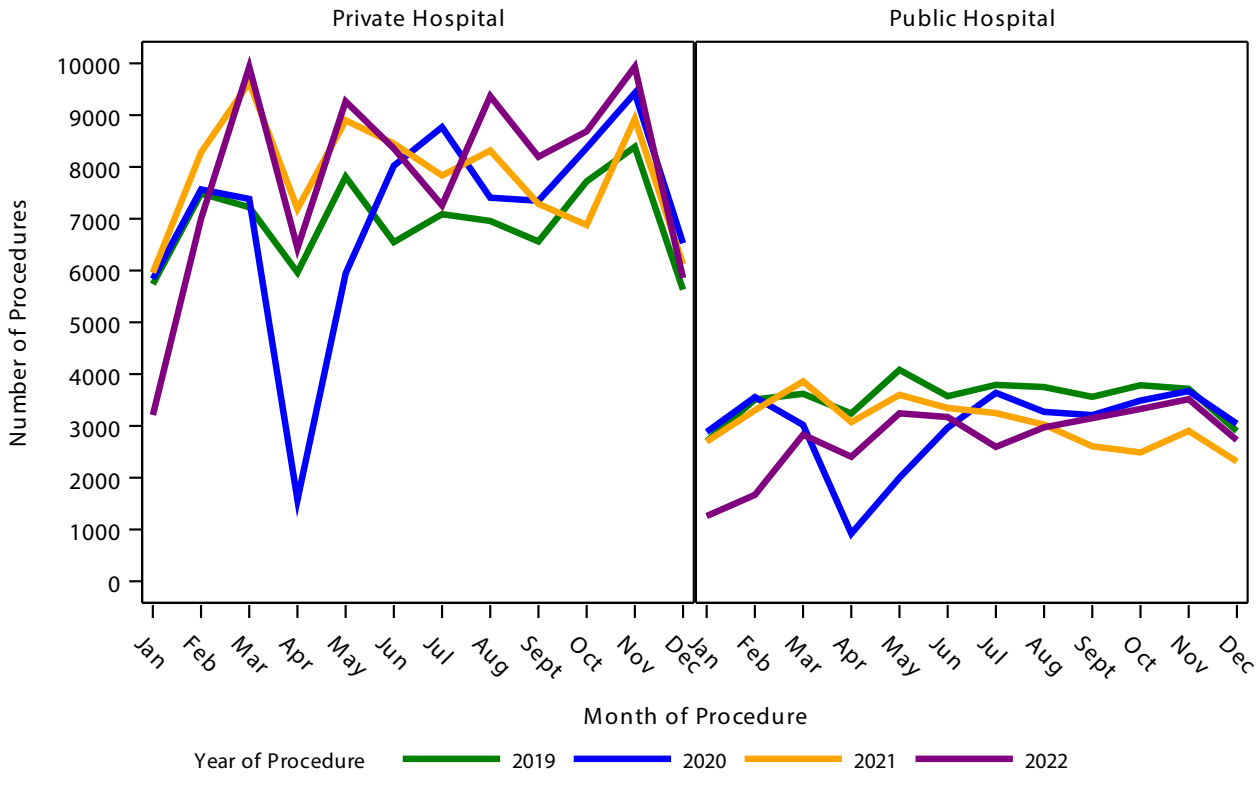


Figure C3 **Primary Joint Replacement - By Hospital Type**



All Joint Replacement by State and Territory

The impact of COVID-19 varied by state and territory. In January 2022, the states of NSW, Victoria and SA had a large reduction in the number of procedures. A smaller reduction was seen in Queensland. From March onward, all states were undertaking either a similar or a larger number of procedures compared to 2019 (Figure C4 and Figure C5).

Figure C4 All Joint Replacement – By State and Territory

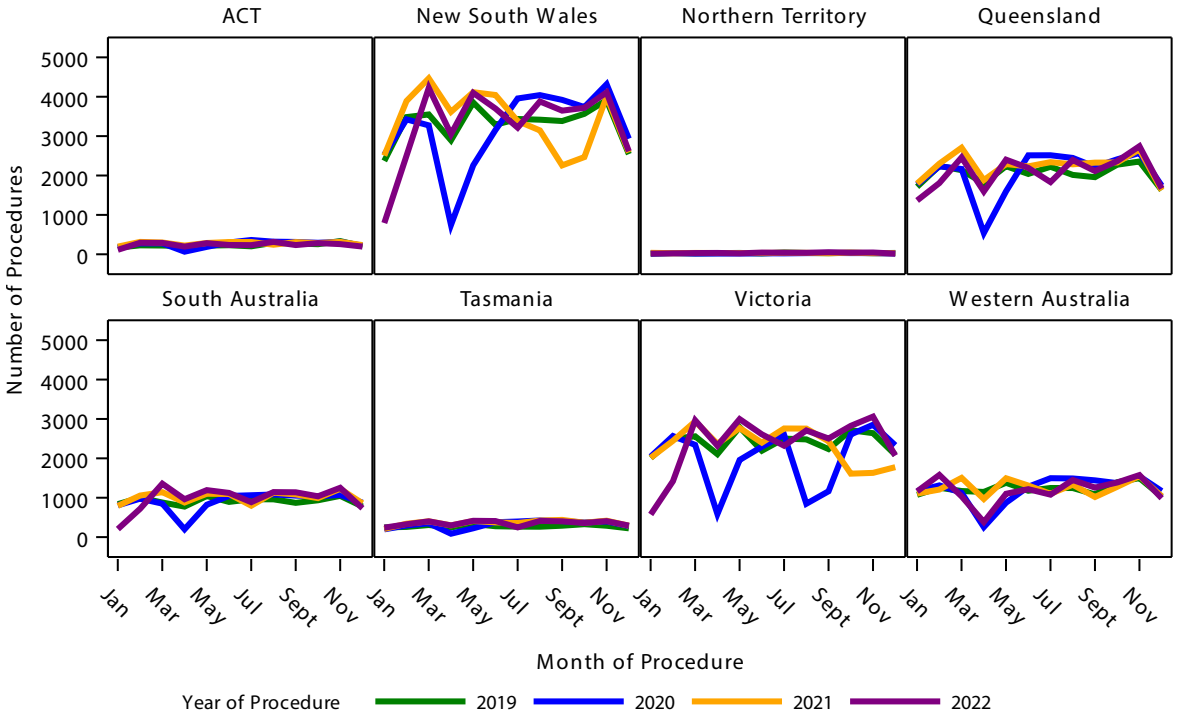
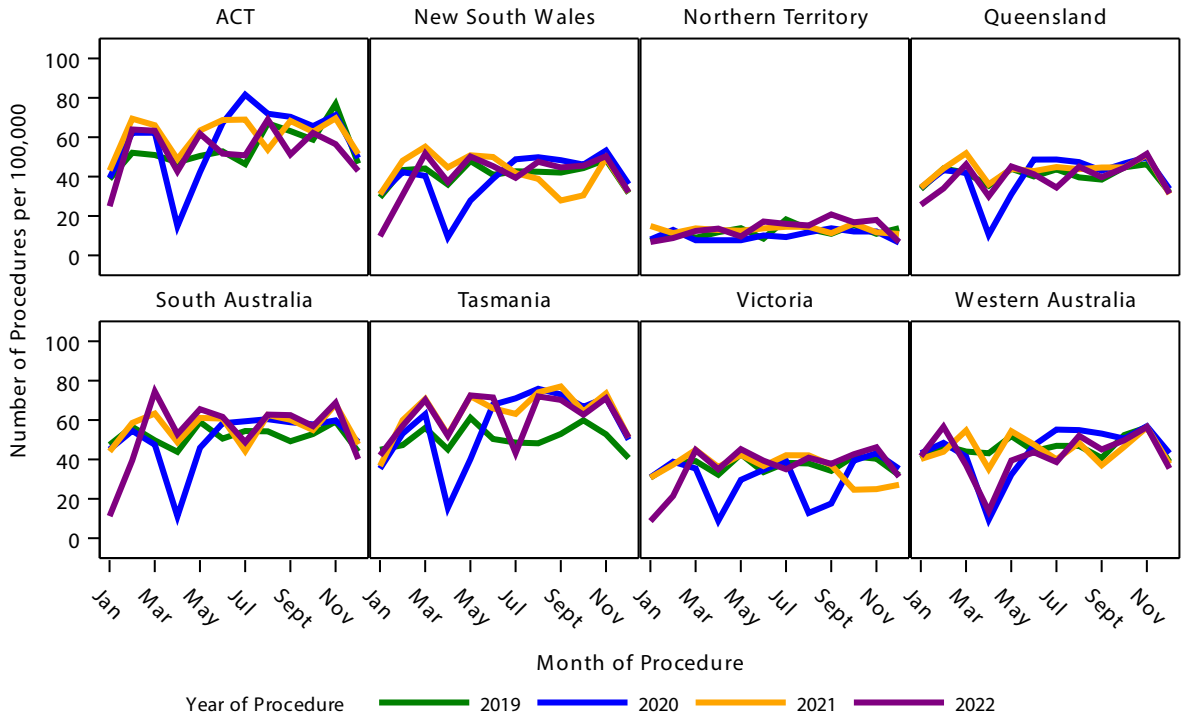


Figure C5 All Joint Replacement per 100,000 Population – By State and Territory



Procedure Type and Indication

In 2022, there was a decrease in hip, knee and shoulder replacement in January (Figure C6, Figure C7 and Figure C8).

The number of hip and shoulder replacements undertaken for the management of fractures in 2022 was similar to previous years (Figure C9 and Figure C10).

There were fewer revision procedures performed in the first 2 months of 2022 (Figure C11).

Figure C6 All Primary Hip Replacement (All Diagnoses)

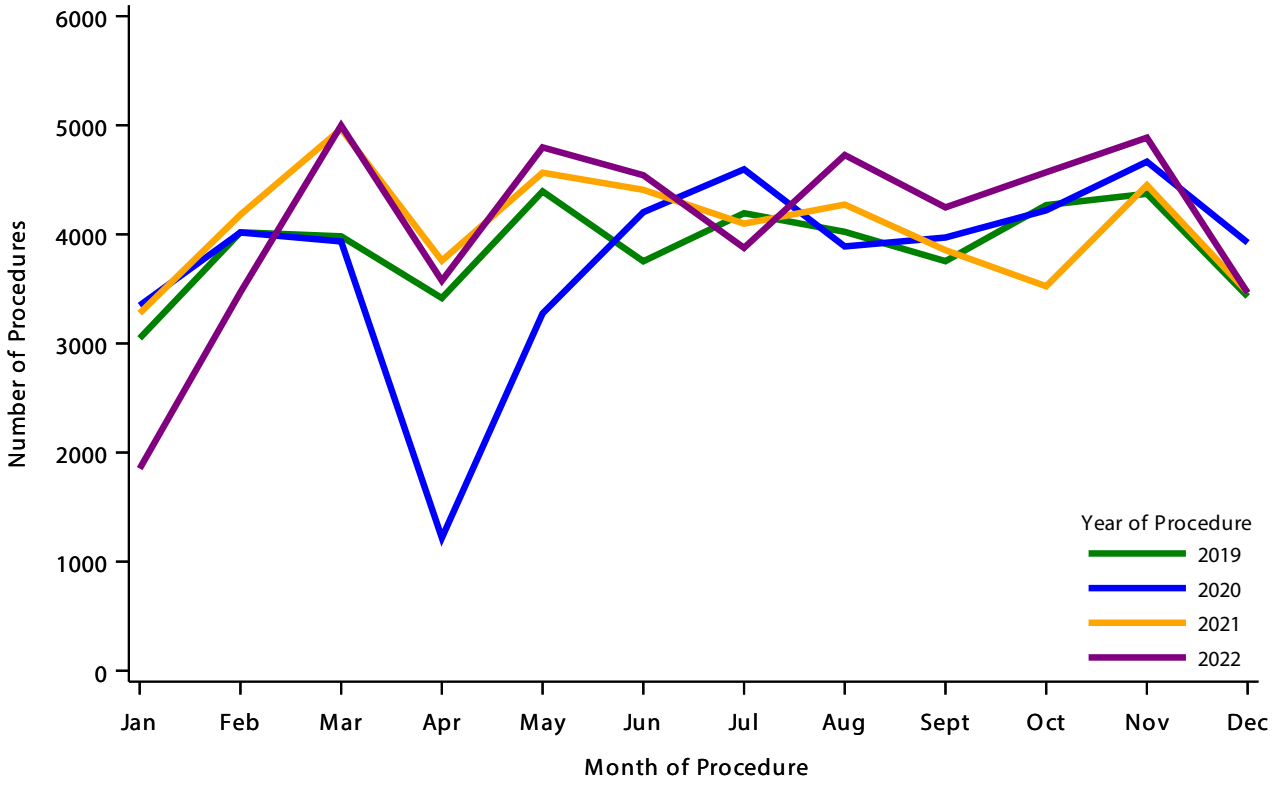


Figure C7 All Primary Knee Replacement (All Diagnoses)

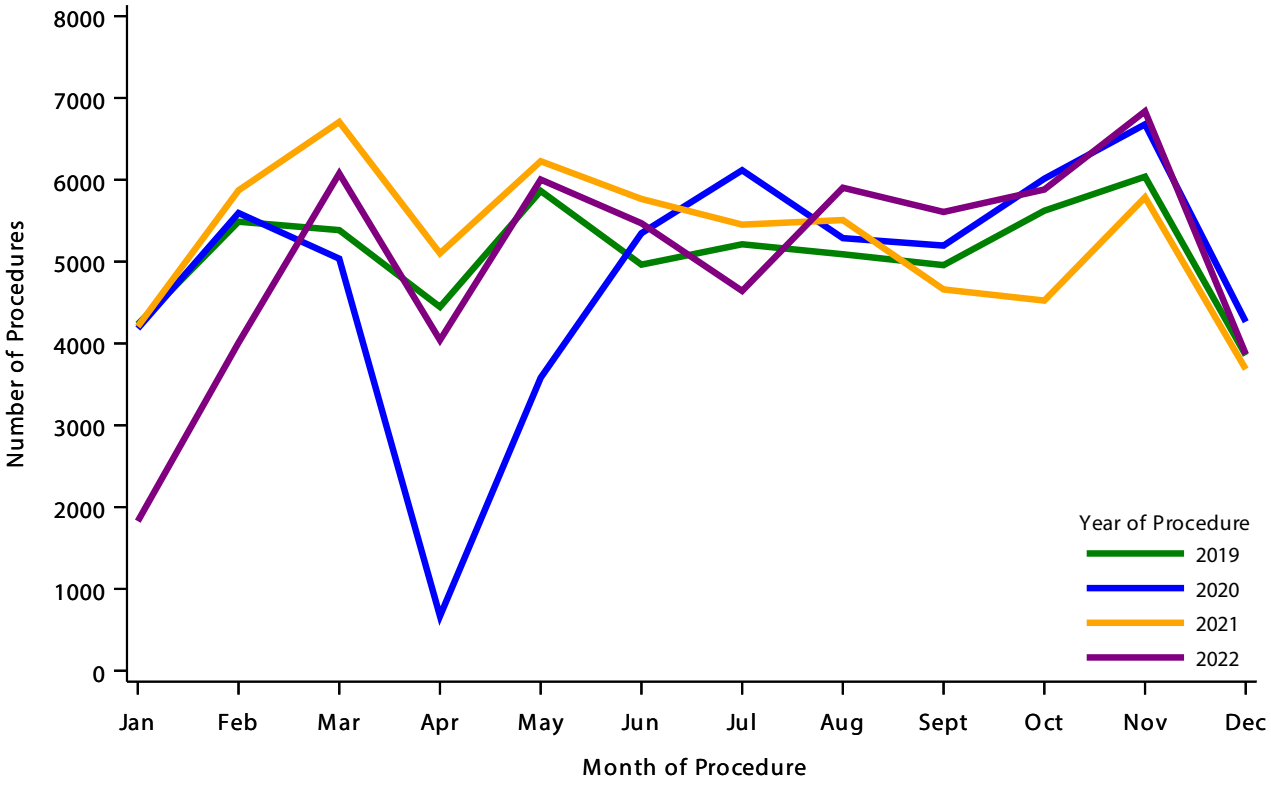


Figure C8 All Primary Shoulder Replacement (All Diagnoses)

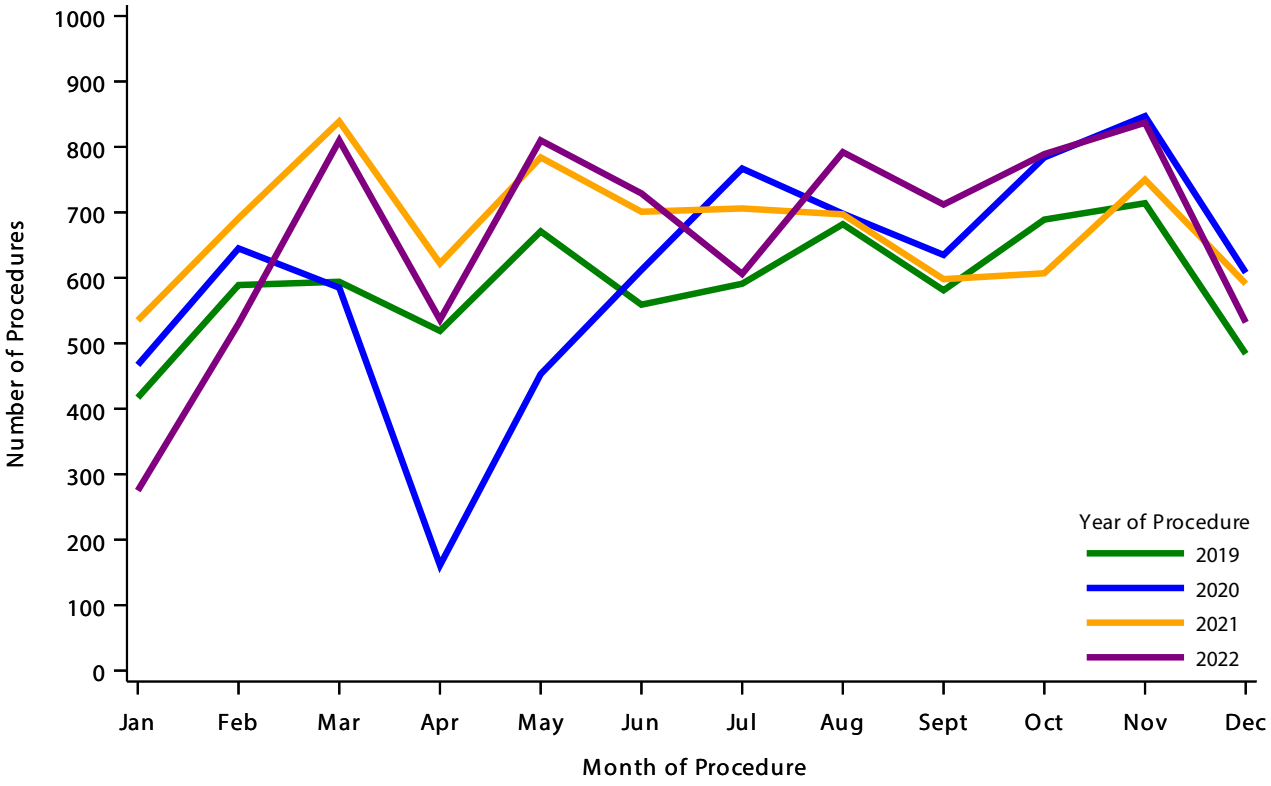


Figure C9 Primary Hip Replacement (Primary Diagnosis Fractured Neck of Femur)

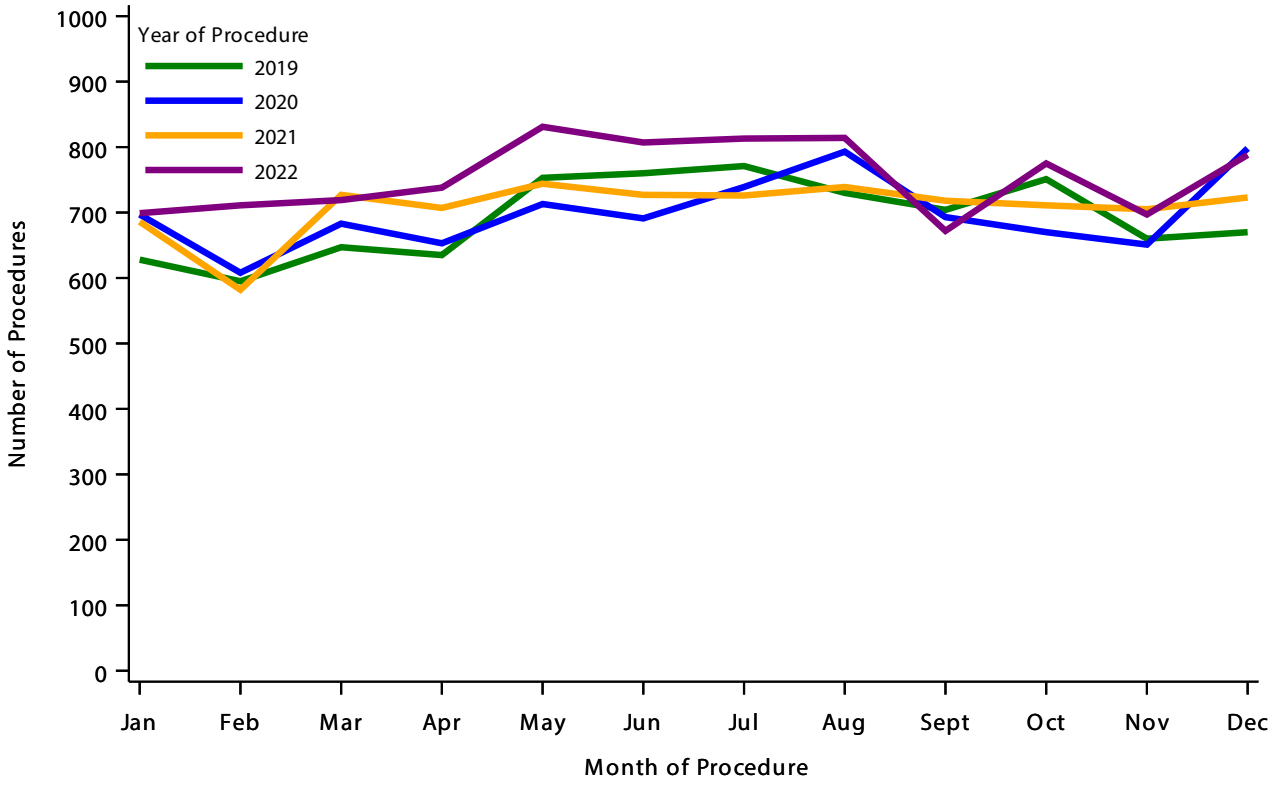


Figure C10 Primary Shoulder Replacement (Primary Diagnosis Fracture)

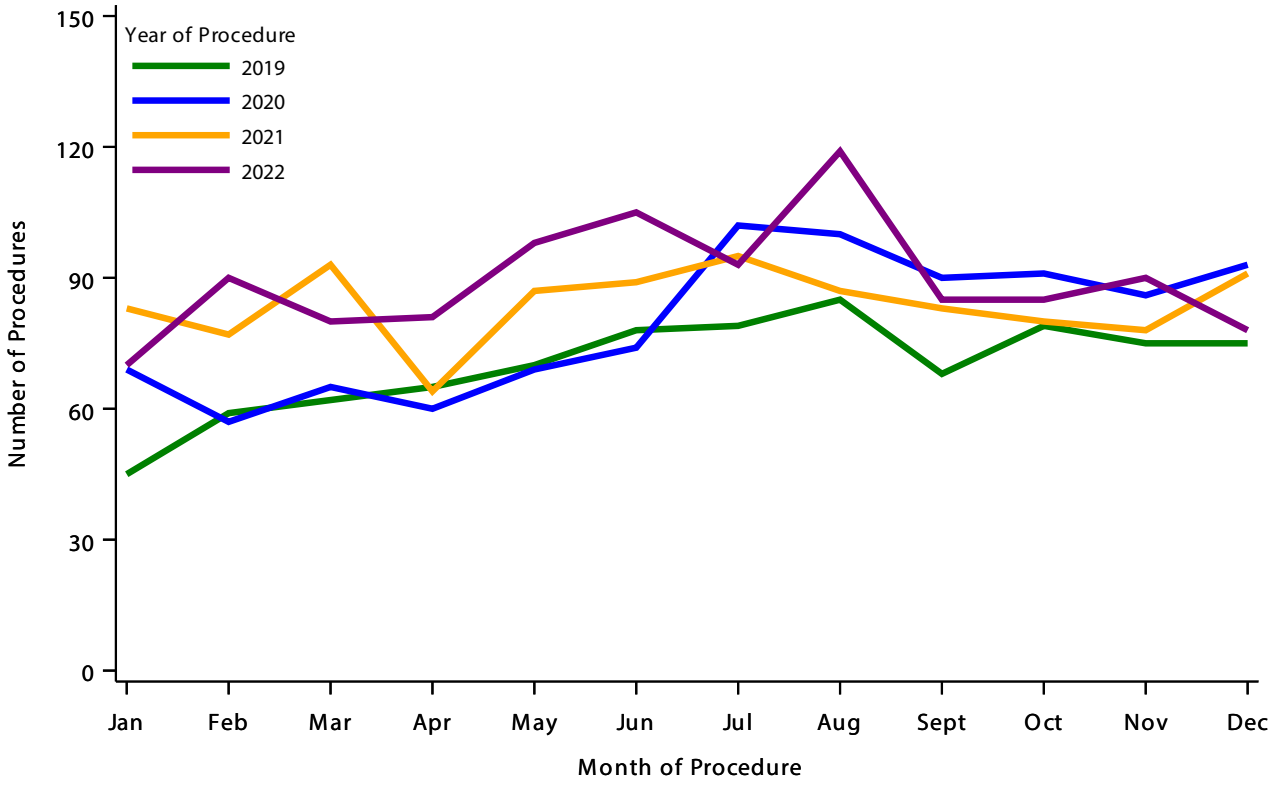
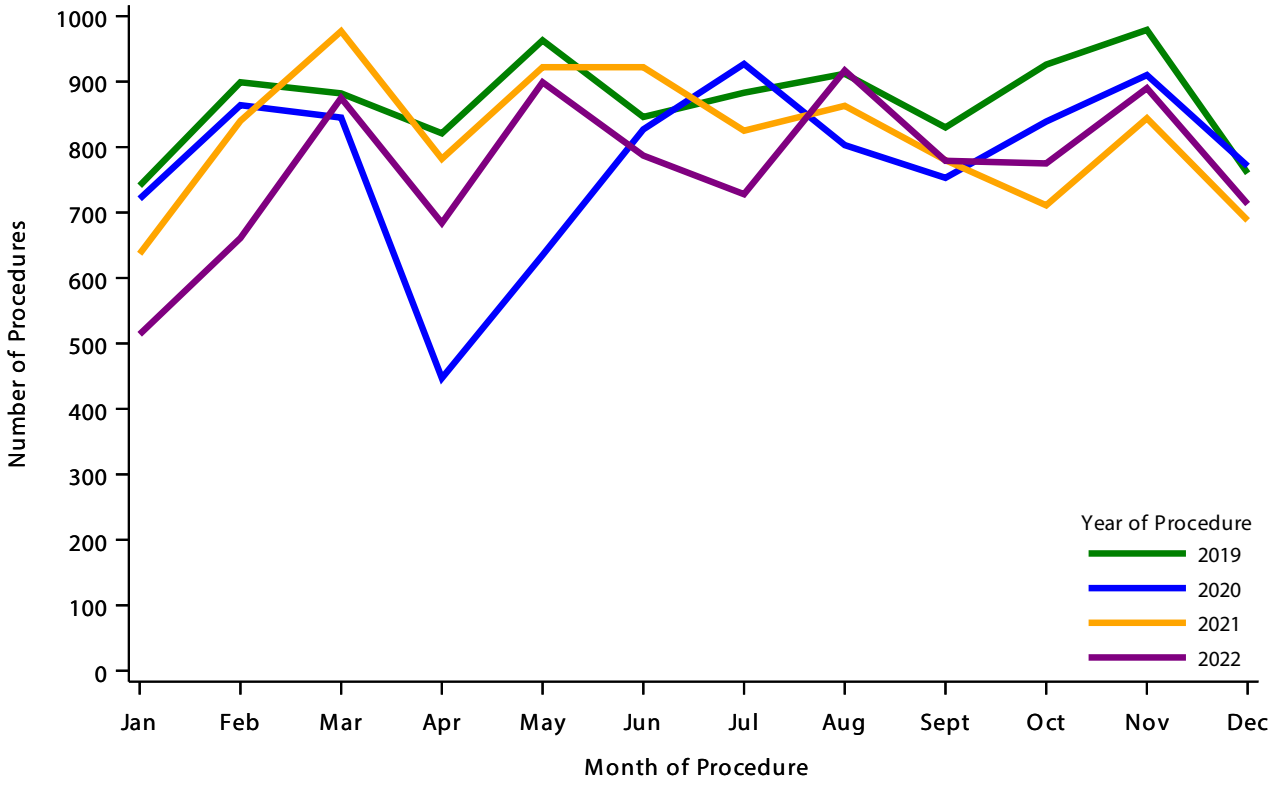


Figure C11 Revision Hip, Knee and Shoulder Replacement



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 2022 (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-2023

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 77.6% of all primary total conventional hip procedures performed for osteoarthritis.

The 10 year cumulative percent revision for the individual prosthesis combinations ranges from 2.4% to 8.3%. 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. 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. To identify better performing prosthesis combinations, the following two recommended approaches have been used:

Superiority approach: the upper confidence interval is less than, or equal to, the benchmark standard. Using the new benchmark of 4.3% at 10 years, then 9 (20.0%) 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 10 prosthesis combinations can be benchmarked, i.e., 19 (42.2%) 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.

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				2 Yrs	5 Yrs	10 Yrs
				THR	Femoral	Acetabular	Other			
Alloclassic	Allofit	151	3366	14	84	17	36	1.8 (1.4, 2.3)	2.6 (2.1, 3.2)	4.3 (3.6, 5.1)
Anthology	R3	246	7731	25	71	49	101	2.3 (2.0, 2.7)	2.8 (2.4, 3.2)	3.7 (3.2, 4.2)
Avenir	Continuum	57	1314	5	11	12	29	3.7 (2.8, 4.9)	4.4 (3.4, 5.7)	4.7 (3.6, 6.1)
C-Stem AMT	Marathon	9	481	2	2	3	2	0.9 (0.3, 2.3)	1.6 (0.8, 3.3)	2.4 (1.2, 4.7)
C-Stem AMT	PINNACLE	131	4803	12	54	15	50	1.6 (1.3, 2.0)	2.7 (2.2, 3.3)	4.4 (3.5, 5.5)
CORAIL	PINNACLE	2095	56919	193	798	314	790	2.1 (1.9, 2.2)	3.0 (2.8, 3.1)	4.6 (4.4, 4.9)
CORAIL	Trident (Shell)	22	516	4	5	3	10	3.3 (2.0, 5.5)	4.9 (3.1, 7.8)	7.6 (4.6, 12.2)

Femoral Component	Acetabular Component	N Revised	N Total	Type of Revision				2 Yrs	5 Yrs	10 Yrs
				THR	Femoral	Acetabular	Other			
CPCS	R3	221	6872	22	62	45	92	2.3 (2.0, 2.7)	3.1 (2.7, 3.6)	4.4 (3.8, 5.1)
CPCS	Reflection (Cup)	82	831	27	4	38	13	1.5 (0.9, 2.6)	2.8 (1.8, 4.3)	8.3 (6.2, 11.0)
CPCS	Reflection (Shell)	108	2787	14	47	14	33	0.9 (0.6, 1.4)	1.7 (1.2, 2.2)	3.3 (2.6, 4.1)
CPT	Allofit	52	1662	7	22	5	18	1.3 (0.9, 2.0)	2.8 (2.1, 3.9)	4.6 (3.4, 6.1)
CPT	Continuum	129	2558	9	45	18	57	3.3 (2.6, 4.0)	4.4 (3.6, 5.3)	6.2 (5.1, 7.5)
CPT	Trabecular Metal (Shell)	104	2070	8	44	18	34	2.6 (2.0, 3.4)	3.9 (3.1, 4.9)	6.1 (4.9, 7.6)
CPT	Trilogy	394	7815	43	149	42	160	2.3 (2.0, 2.7)	3.5 (3.1, 4.0)	5.3 (4.8, 5.9)
CPT	ZCA	40	865	14	9	10	7	1.2 (0.6, 2.2)	2.4 (1.6, 3.8)	4.7 (3.3, 6.6)
Exeter V40	Contemporary	304	4605	81	47	142	34	2.1 (1.8, 2.6)	3.2 (2.7, 3.7)	5.6 (4.9, 6.4)
Exeter V40	Exeter Contemporary	166	2949	55	34	54	23	1.9 (1.5, 2.5)	3.0 (2.4, 3.7)	4.6 (3.9, 5.5)
Exeter V40	Exeter X3 Rimfit	108	4288	27	32	26	23	1.7 (1.3, 2.1)	2.4 (2.0, 3.0)	3.4 (2.7, 4.2)
Exeter V40	PINNACLE	52	2111	2	19	11	20	1.5 (1.0, 2.1)	1.7 (1.2, 2.4)	3.6 (2.6, 4.9)
Exeter V40	Trabecular Metal (Shell)	21	477	2	3	2	14	2.8 (1.6, 4.8)	3.9 (2.4, 6.2)	5.0 (3.2, 7.7)
Exeter V40	Trident (Shell)	2141	73962	288	685	275	893	1.5 (1.4, 1.6)	2.3 (2.2, 2.4)	3.5 (3.4, 3.7)
Exeter V40	Trident/Tritanium (Shell)	132	4799	13	29	25	65	1.8 (1.4, 2.2)	2.8 (2.3, 3.3)	3.8 (3.1, 4.7)
H-Max	Delta-TT	71	1619	5	33	10	23	2.5 (1.8, 3.4)	3.9 (3.0, 5.0)	6.6 (4.9, 8.8)
M/L Taper	Continuum	46	1289	5	15	6	20	2.6 (1.9, 3.6)	3.4 (2.5, 4.6)	3.9 (2.9, 5.3)
MS 30	Fitmore	16	575	0	2	8	6	1.3 (0.6, 2.6)	2.6 (1.4, 4.5)	3.6 (2.1, 6.0)
MS 30	Low Profile Cup	15	410	6	1	6	2	0.7 (0.2, 2.3)	1.3 (0.6, 3.2)	2.9 (1.5, 5.5)
Metafix	Trinity	320	15313	38	82	68	132	1.9 (1.6, 2.1)	2.6 (2.3, 2.9)	3.8 (3.1, 4.7)
MiniHip	Trinity	37	1200	1	19	10	7	2.7 (2.0, 3.9)	3.2 (2.3, 4.4)	3.3 (2.4, 4.6)
Omnifit	Trident (Shell)	164	3811	12	40	30	82	2.2 (1.8, 2.7)	3.0 (2.5, 3.6)	3.9 (3.3, 4.6)
Polarstem	R3	451	16898	28	150	63	210	2.2 (2.0, 2.4)	2.9 (2.6, 3.2)	4.0 (3.5, 4.5)
Quadra-C	Versafitcup CC	28	1643	4	7	7	10	1.5 (1.0, 2.3)	1.8 (1.2, 2.7)	3.0 (1.5, 6.2)
Quadra-H	Versafitcup CC	349	9986	36	156	64	93	2.2 (1.9, 2.5)	3.1 (2.7, 3.5)	5.5 (4.7, 6.5)
S-Rom	PINNACLE	153	2589	15	86	15	37	2.9 (2.3, 3.6)	4.5 (3.7, 5.4)	5.8 (4.9, 6.8)
SL-Plus	EP-Fit Plus	47	1116	3	20	9	15	2.0 (1.3, 3.0)	2.9 (2.1, 4.1)	4.2 (3.1, 5.6)
SL-Plus	R3	100	1669	5	27	24	44	3.1 (2.4, 4.1)	4.3 (3.4, 5.4)	6.2 (5.0, 7.6)
Secur-Fit	Trident (Shell)	496	9775	33	220	90	153	2.4 (2.1, 2.8)	3.6 (3.2, 3.9)	4.8 (4.4, 5.3)
Secur-Fit Plus	Trident (Shell)	237	5919	16	64	59	98	1.6 (1.3, 2.0)	2.4 (2.0, 2.8)	3.4 (2.9, 3.9)
Spectron EF	R3	97	2132	17	17	19	44	2.4 (1.9, 3.2)	3.9 (3.1, 4.9)	5.1 (4.1, 6.4)
Spectron EF	Reflection (Cup)	124	1404	47	12	56	9	1.3 (0.8, 2.0)	2.9 (2.1, 4.0)	7.1 (5.7, 8.8)
Summit	PINNACLE	176	5561	13	36	30	97	1.8 (1.5, 2.2)	2.3 (2.0, 2.8)	3.5 (2.9, 4.1)
Synergy	R3	163	5066	5	45	40	73	2.1 (1.7, 2.5)	2.7 (2.2, 3.2)	3.4 (2.9, 4.0)
Synergy	Reflection (Shell)	390	7299	33	85	127	145	1.9 (1.7, 2.3)	2.6 (2.2, 2.9)	3.8 (3.4, 4.3)
Tri-Fit TS	Trinity	104	4619	11	49	15	29	1.7 (1.4, 2.1)	2.3 (1.9, 2.8)	2.9 (2.3, 3.6)
Tri-Lock	PINNACLE	26	1052	0	10	8	8	1.5 (0.9, 2.4)	2.2 (1.4, 3.4)	3.5 (2.2, 5.5)
twinSys (cless)	RM Cup	45	1389	3	9	5	28	2.4 (1.7, 3.4)	3.2 (2.4, 4.3)	3.9 (2.9, 5.3)
TOTAL		**10420**	**296115**	**1203**	**3441**	**1907**	**3869**			

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-2023

There are 38 total knee replacement combinations with 10 year outcome data. These prosthesis combinations were used in 81.4% of all primary total knee replacement procedures performed for osteoarthritis.

The 10 year cumulative percent revision ranges from 2.8% to 9.6%. 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 is 4.6%.

Applying the recommendations of the ISAR International Prosthesis Benchmarking Working Group, using the new benchmark of 4.6% at 10 years, then 8 (21.1%) 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 (44.7%) 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, 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				2 Yrs	5 Yrs	10 Yrs
				TKR	Femoral	Tibial	Other			
ACS	ACS Fixed	146	3423	36	9	21	80	2.9 (2.3, 3.5)	4.3 (3.7, 5.1)	5.4 (4.6, 6.4)
ACS	ACS Mobile	96	2029	36	8	4	48	3.1 (2.4, 3.9)	5.0 (4.0, 6.1)	6.2 (5.0, 7.6)
Active Knee	Active Knee	864	10522	255	29	42	538	2.4 (2.2, 2.8)	4.6 (4.2, 5.1)	8.0 (7.5, 8.6)
Advance	Advance II	114	1504	47	3	13	51	3.4 (2.6, 4.5)	5.0 (4.0, 6.3)	6.8 (5.6, 8.3)
Apex Knee CR	Apex Knee	187	11013	44	15	12	116	1.3 (1.1, 1.6)	2.2 (1.9, 2.6)	3.3 (2.5, 4.3)
BalanSys	BalanSys	125	4474	38	6	7	74	1.4 (1.0, 1.7)	2.4 (1.9, 2.9)	3.9 (3.2, 4.8)
Columbus	Columbus	192	6253	48	8	9	127	2.1 (1.7, 2.5)	3.9 (3.3, 4.6)	6.5 (5.4, 7.9)
E.Motion	E.Motion	71	1007	19	9	4	39	4.4 (3.3, 5.8)	6.4 (5.0, 8.2)	8.3 (6.5, 10.5)
GMK Primary	GMK Primary	114	3282	35	3	15	61	2.4 (1.9, 3.1)	3.7 (3.0, 4.5)	4.7 (3.9, 5.7)
Genesis II CR	Genesis II	1203	25772	254	75	56	818	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	594	10540	115	31	26	422	1.9 (1.6, 2.2)	3.5 (3.1, 3.9)	6.0 (5.5, 6.5)
Genesis II Oxinium PS (ctd)	Genesis II	1390	21861	199	34	170	987	2.8 (2.6, 3.0)	4.9 (4.6, 5.2)	7.1 (6.8, 7.5)
Genesis II PS	Genesis II	940	20602	174	33	59	674	2.0 (1.8, 2.2)	3.6 (3.4, 3.9)	5.0 (4.7, 5.4)
LCS CR	LCS	630	8339	258	24	90	258	2.5 (2.1, 2.8)	4.5 (4.0, 4.9)	6.4 (5.9, 7.0)
LCS CR	MBT	1469	32992	504	70	160	735	1.9 (1.8, 2.1)	3.5 (3.3, 3.7)	4.9 (4.6, 5.1)
Legion CR	Genesis II	273	8416	52	19	13	189	2.2 (1.9, 2.5)	3.6 (3.2, 4.1)	5.9 (5.0, 6.9)

Femoral Component	Tibial Component	N Revised	N Total	Type of Revision				2 Yrs	5 Yrs	10 Yrs
				TKR	Femoral	Tibial	Other			
Legion Oxinium CR	Genesis II	261	10012	67	19	7	168	1.7 (1.4, 1.9)	3.3 (2.9, 3.8)	4.3 (3.7, 4.9)
Legion Oxinium PS	Genesis II	701	17145	105	20	60	516	2.2 (2.0, 2.4)	3.9 (3.6, 4.3)	5.5 (5.1, 6.0)
Legion PS	Genesis II	201	6018	51	4	7	139	1.9 (1.6, 2.3)	3.1 (2.7, 3.6)	4.2 (3.6, 4.9)
MRK	MRK	29	808	7	1	0	21	1.9 (1.1, 3.2)	2.7 (1.7, 4.2)	4.5 (3.0, 6.6)
Natural Knee Flex	Natural Knee II	178	6263	48	8	9	113	1.5 (1.2, 1.9)	2.4 (2.0, 2.8)	3.3 (2.8, 3.9)
Nexgen CR	Nexgen	447	11575	144	22	33	248	1.3 (1.1, 1.5)	2.2 (1.9, 2.5)	3.1 (2.8, 3.5)
Nexgen CR Flex	Nexgen	1646	60411	416	112	135	983	1.4 (1.3, 1.5)	2.3 (2.2, 2.4)	3.1 (3.0, 3.3)
Nexgen CR Flex	Nexgen TM CR	364	12303	125	23	29	187	1.2 (1.1, 1.5)	2.2 (2.0, 2.5)	3.1 (2.8, 3.5)
Nexgen LCCK	Nexgen	53	970	8	3	1	41	3.1 (2.2, 4.4)	4.7 (3.5, 6.3)	6.2 (4.6, 8.3)
Nexgen LPS	Nexgen	379	7020	101	22	33	223	1.9 (1.6, 2.3)	3.3 (2.9, 3.7)	4.8 (4.3, 5.4)
Nexgen LPS Flex	Nexgen	1703	37798	486	70	247	900	1.8 (1.6, 1.9)	3.1 (3.0, 3.3)	5.0 (4.7, 5.2)
Nexgen RH	Nexgen	33	669	3	5	3	22	2.8 (1.7, 4.4)	4.9 (3.3, 7.2)	8.1 (5.6, 11.6)
PFC Sigma CR	PFC Sigma	918	24908	236	56	70	556	1.5 (1.4, 1.7)	2.5 (2.3, 2.7)	3.5 (3.3, 3.8)
PFC Sigma PS	MBT	378	6327	130	16	25	207	2.2 (1.9, 2.6)	4.0 (3.5, 4.5)	5.4 (4.9, 6.1)
RBK	RBK	589	11017	231	16	43	299	2.3 (2.1, 2.6)	3.9 (3.6, 4.3)	5.3 (4.9, 5.8)
SAIPH	SAIPH	86	5364	24	2	0	60	1.0 (0.7, 1.3)	2.1 (1.7, 2.6)	2.8 (1.9, 4.1)
Score	Score	398	5993	160	20	12	206	3.1 (2.7, 3.6)	5.9 (5.3, 6.6)	9.6 (8.6, 10.8)
Trekking	Trekking	68	1264	31	7	3	27	3.0 (2.2, 4.1)	4.7 (3.6, 6.1)	6.3 (5.0, 8.1)
Triathlon CR	Triathlon	3305	141966	610	130	154	2411	1.4 (1.4, 1.5)	2.4 (2.3, 2.5)	3.6 (3.5, 3.8)
Triathlon PS	Triathlon	633	14195	116	32	77	408	2.4 (2.1, 2.6)	3.8 (3.5, 4.2)	5.4 (5.0, 5.9)
Vanguard CR	Vanguard	1086	27167	262	40	72	712	1.7 (1.6, 1.9)	3.0 (2.8, 3.2)	4.8 (4.5, 5.1)
Vanguard PS	Vanguard	343	5269	89	7	60	187	3.4 (2.9, 3.9)	5.2 (4.6, 5.9)	7.3 (6.6, 8.2)
TOTAL		**22207**	**586491**	**5564**	**1011**	**1781**	**13851**			

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

SHOULDER REPLACEMENT

For the first time, 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-2023

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 45.2% of all primary total stemmed anatomic shoulder replacement procedures performed for osteoarthritis.

The 10 year cumulative percent revision ranges from 6.1% to 20.1%. 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 7.6%.

Using the benchmark of 7.6% 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 9.1% 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 4 total stemmed reverse shoulder replacement combinations undertaken for all diagnoses with 10 year outcomes.

These prosthesis combinations were used in 56.8% of primary total stemmed reverse shoulder replacement procedures performed for any diagnosis reported to the Registry.

The 10 year cumulative percent revision ranges from 5.1% to 6.5%. The cumulative percent revision benchmark at 10 years, calculated this year based on the aggregate performance of modern prostheses with cementless fixation is 5.6%.

Applying a benchmark of 5.6% 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 6.7% 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				2 Yrs	5 Yrs	10 Yrs
				TSR	Humeral	Glenoid	Other			
Affinis	Affinis	19	187	6	1	7	5	1.1 (0.3, 4.4)	5.1 (2.7, 9.6)	9.1 (5.6, 14.6)
Bigliani/Flatow TM	Bigliani/Flatow	35	453	23	1	4	7	3.6 (2.2, 5.8)	5.5 (3.7, 8.1)	8.8 (6.2, 12.3)
SMR	SMR	28	490	22	1	0	5	4.2 (2.7, 6.4)	5.1 (3.4, 7.5)	6.1 (4.2, 8.8)
SMR	SMR L1	378	2210	7	354	1	16	8.9 (7.7, 10.1)	13.3 (11.9, 14.9)	20.1 (18.1, 22.3)
TOTAL		**460**	**3340**	**58**	**357**	**12**	**33**			

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	178	4077	10	32	12	124	2.8 (2.3, 3.3)	4.3 (3.7, 5.0)	6.5 (5.5, 7.7)
Delta Xtend	Delta Xtend	414	10745	21	60	26	307	2.8 (2.5, 3.1)	3.8 (3.4, 4.2)	5.1 (4.6, 5.7)
SMR	SMR L1	422	9984	27	93	28	274	3.7 (3.4, 4.1)	4.4 (4.0, 4.9)	5.6 (4.9, 6.3)
Trabecular Metal	Trabecular Metal	93	1827	2	8	32	51	3.7 (2.9, 4.7)	5.2 (4.2, 6.4)	6.2 (4.9, 7.8)
TOTAL		**1107**	**26633**	**60**	**193**	**98**	**756**			

Note: Only prostheses with >50 procedures have been listed. Green: prostheis 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 1.5 years, and a lower rate of revision from 1.5 years onwards after the primary procedure

Fifteen Year Outcomes

This year, the Registry is reporting 15 year outcomes for 23 hip and 22 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-2023

HIP REPLACEMENT

The 23 listed prosthesis combinations were used in 53.2% of all primary total conventional hip replacement procedures performed for osteoarthritis.

The 15 year cumulative percent revision ranges from 4.6% to 18.5%. The benchmark used to assess superiority and non-inferiority performance at 15 years was calculated based on modern prostheses. The 15 year benchmark is 6.2%. There are 5 (21.7%) hip prosthesis combinations that qualify for a superiority benchmark and these are highlighted in green (Table BM5).

An additional 6 prosthesis combinations qualify for a non-inferiority benchmark, i.e., 11 (47.8%) 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 22 prosthesis combinations were used in 69.8% of all primary total knee replacement procedures performed for osteoarthritis.

The 15 year cumulative percent revision ranges from 4.0% to 11.7%. The benchmark used to assess superiority and non-inferiority at 15 years is 6.2%. There are 5 (22.7%) knee prosthesis combinations that qualify for a superiority benchmark and these are highlighted in green (Table BM6).

There are an additional 6 prosthesis combinations that qualify for a non-inferiority benchmark, i.e., 11 (50.0%) qualify for either a superiority or non-inferiority benchmark. Those prostheses that qualify for a non-inferiority benchmark are highlighted in blue (Table BM6).

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				5 Yrs	10 Yrs	15 Yrs
				THR	Femoral	Acetabular	Other			
Alloclassic	Allofit	151	3366	14	84	17	36	2.6 (2.1, 3.2)	4.3 (3.6, 5.1)	6.0 (5.0, 7.1)
C-Stem AMT	PINNACLE	131	4803	12	54	15	50	2.7 (2.2, 3.3)	4.4 (3.5, 5.5)	9.3 (5.1, 16.9)
CORAIL	PINNACLE	2095	56919	193	798	314	790	3.0 (2.8, 3.1)	4.6 (4.4, 4.9)	7.6 (7.0, 8.3)
CPCS	Reflection (Cup)	82	831	27	4	38	13	2.8 (1.8, 4.3)	8.3 (6.2, 11.0)	18.5 (14.7, 23.2)
CPCS	Reflection (Shell)	108	2787	14	47	14	33	1.7 (1.2, 2.2)	3.3 (2.6, 4.1)	5.9 (4.7, 7.3)
CPT	Allofit	52	1662	7	22	5	18	2.8 (2.1, 3.9)	4.6 (3.4, 6.1)	5.3 (3.9, 7.3)
CPT	Trabecular Metal (Shell)	104	2070	8	44	18	34	3.9 (3.1, 4.9)	6.1 (4.9, 7.6)	9.1 (7.1, 11.7)
CPT	Trilogy	394	7815	43	149	42	160	3.5 (3.1, 4.0)	5.3 (4.8, 5.9)	6.8 (6.1, 7.6)
CPT	ZCA	40	865	14	9	10	7	2.4 (1.6, 3.8)	4.7 (3.3, 6.6)	6.2 (4.3, 8.8)
Exeter V40	Contemporary	304	4605	81	47	142	34	3.2 (2.7, 3.7)	5.6 (4.9, 6.4)	8.8 (7.8, 10.0)
Exeter V40	Exeter Contemporary	166	2949	55	34	54	23	3.0 (2.4, 3.7)	4.6 (3.9, 5.5)	7.8 (6.6, 9.3)
Exeter V40	PINNACLE	52	2111	2	19	11	20	1.7 (1.2, 2.4)	3.6 (2.6, 4.9)	4.7 (3.3, 6.6)
Exeter V40	Trident (Shell)	2141	73962	288	685	275	893	2.3 (2.2, 2.4)	3.5 (3.4, 3.7)	5.1 (4.8, 5.4)
MS 30	Fitmore	16	575	0	2	8	6	2.6 (1.4, 4.5)	3.6 (2.1, 6.0)	4.8 (2.6, 9.0)
MS 30	Low Profile Cup	15	410	6	1	6	2	1.3 (0.6, 3.2)	2.9 (1.5, 5.5)	6.0 (3.3, 10.9)
Omnifit	Trident (Shell)	164	3811	12	40	30	82	3.0 (2.5, 3.6)	3.9 (3.3, 4.6)	5.1 (4.3, 6.0)
S-Rom	PINNACLE	153	2589	15	86	15	37	4.5 (3.7, 5.4)	5.8 (4.9, 6.8)	7.2 (6.1, 8.5)
SL-Plus	EP-Fit Plus	47	1116	3	20	9	15	2.9 (2.1, 4.1)	4.2 (3.1, 5.6)	4.7 (3.5, 6.2)
Secur-Fit	Trident (Shell)	496	9775	33	220	90	153	3.6 (3.2, 3.9)	4.8 (4.4, 5.3)	6.3 (5.8, 7.0)
Secur-Fit Plus	Trident (Shell)	237	5919	16	64	59	98	2.4 (2.0, 2.8)	3.4 (2.9, 3.9)	4.6 (4.0, 5.2)
Spectron EF	Reflection (Cup)	124	1404	47	12	56	9	2.9 (2.1, 4.0)	7.1 (5.7, 8.8)	13.1 (10.9, 15.7)
Summit	PINNACLE	176	5561	13	36	30	97	2.3 (2.0, 2.8)	3.5 (2.9, 4.1)	5.1 (4.2, 6.3)
Synergy	Reflection (Shell)	390	7299	33	85	127	145	2.6 (2.2, 2.9)	3.8 (3.4, 4.3)	5.5 (4.9, 6.1)
TOTAL		**7638**	**203204**	**936**	**2562**	**1385**	**2755**			

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				5 Yrs	10 Yrs	15 Yrs
				TKR	Femoral	Tibial	Other			
Active Knee	Active Knee	864	10522	255	29	42	538	4.6 (4.2, 5.1)	8.0 (7.5, 8.6)	11.7 (10.9, 12.6)
Advance	Advance II	114	1504	47	3	13	51	5.0 (4.0, 6.3)	6.8 (5.6, 8.3)	8.2 (6.8, 10.0)
BalanSys	BalanSys	125	4474	38	6	7	74	2.4 (1.9, 2.9)	3.9 (3.2, 4.8)	6.0 (4.1, 8.6)
Columbus	Columbus	192	6253	48	8	9	127	3.9 (3.3, 4.6)	6.5 (5.4, 7.9)	8.7 (6.8, 11.0)
Genesis II CR	Genesis II	1203	25772	254	75	56	818	3.5 (3.2, 3.7)	5.0 (4.7, 5.3)	6.1 (5.7, 6.5)
Genesis II Oxinium CR (ctd)	Genesis II	594	10540	115	31	26	422	3.5 (3.1, 3.9)	6.0 (5.5, 6.5)	8.4 (7.7, 9.2)
Genesis II Oxinium PS (ctd)	Genesis II	1390	21861	199	34	170	987	4.9 (4.6, 5.2)	7.1 (6.8, 7.5)	9.4 (8.9, 10.0)
Genesis II PS	Genesis II	940	20602	174	33	59	674	3.6 (3.4, 3.9)	5.0 (4.7, 5.4)	6.4 (5.9, 6.9)
LCS CR	LCS	630	8339	258	24	90	258	4.5 (4.0, 4.9)	6.4 (5.9, 7.0)	8.1 (7.5, 8.8)
LCS CR	MBT	1469	32992	504	70	160	735	3.5 (3.3, 3.7)	4.9 (4.6, 5.1)	6.0 (5.6, 6.4)
Nexgen CR	Nexgen	447	11575	144	22	33	248	2.2 (1.9, 2.5)	3.1 (2.8, 3.5)	4.5 (4.1, 5.0)
Nexgen CR Flex	Nexgen	1646	60411	416	112	135	983	2.3 (2.2, 2.4)	3.1 (3.0, 3.3)	4.0 (3.8, 4.3)
Nexgen CR Flex	Nexgen TM CR	364	12303	125	23	29	187	2.2 (2.0, 2.5)	3.1 (2.8, 3.5)	4.3 (3.8, 4.9)
Nexgen LPS	Nexgen	379	7020	101	22	33	223	3.3 (2.9, 3.7)	4.8 (4.3, 5.4)	6.4 (5.8, 7.1)
Nexgen LPS Flex	Nexgen	1703	37798	486	70	247	900	3.1 (3.0, 3.3)	5.0 (4.7, 5.2)	6.6 (6.2, 7.0)
PFC Sigma CR	PFC Sigma	918	24908	236	56	70	556	2.5 (2.3, 2.7)	3.5 (3.3, 3.8)	5.0 (4.7, 5.4)
PFC Sigma PS	MBT	378	6327	130	16	25	207	4.0 (3.5, 4.5)	5.4 (4.9, 6.1)	7.4 (6.6, 8.3)
RBK	RBK	589	11017	231	16	43	299	3.9 (3.6, 4.3)	5.3 (4.9, 5.8)	6.6 (6.0, 7.2)
Triathlon CR	Triathlon	3305	141966	610	130	154	2411	2.4 (2.3, 2.5)	3.6 (3.5, 3.8)	4.8 (4.5, 5.1)
Triathlon PS	Triathlon	633	14195	116	32	77	408	3.8 (3.5, 4.2)	5.4 (5.0, 5.9)	7.1 (6.3, 8.0)
Vanguard CR	Vanguard	1086	27167	262	40	72	712	3.0 (2.8, 3.2)	4.8 (4.5, 5.1)	7.0 (6.3, 7.8)
Vanguard PS	Vanguard	343	5269	89	7	60	187	5.2 (4.6, 5.9)	7.3 (6.6, 8.2)	8.6 (7.4, 10.1)
TOTAL		**19312**	**502815**	**4838**	**859**	**1610**	**12005**			

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

Twenty Year Outcomes

The Registry is able to report 20 year outcomes for 9 hip and 13 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-2023

HIP REPLACEMENT

The 9 listed prosthesis combinations have been used in 30.3% of all primary total conventional hip replacement procedures performed for osteoarthritis. The 20 year cumulative percent revision ranges from 5.6% to 16.8% (Table BM7).

KNEE REPLACEMENT

The 13 listed prosthesis combinations were used in 29.0% of all primary total knee replacement procedures performed for osteoarthritis. The 20 year cumulative percent revision ranges from 5.9% to 14.3% (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				10 Yrs	15 Yrs	20 Yrs
				THR	Femoral	Acetabular	Other			
CPT	Trilogy	394	7815	43	149	42	160	5.3 (4.8, 5.9)	6.8 (6.1, 7.6)	8.0 (6.7, 9.5)
CPT	ZCA	40	865	14	9	10	7	4.7 (3.3, 6.6)	6.2 (4.3, 8.8)	9.1 (6.1, 13.3)
Exeter V40	Contemporary	304	4605	81	47	142	34	5.6 (4.9, 6.4)	8.8 (7.8, 10.0)	14.4 (12.2, 17.0)
Exeter V40	Trident (Shell)	2141	73962	288	685	275	893	3.5 (3.4, 3.7)	5.1 (4.8, 5.4)	6.7 (6.0, 7.4)
Omnifit	Trident (Shell)	164	3811	12	40	30	82	3.9 (3.3, 4.6)	5.1 (4.3, 6.0)	6.3 (5.3, 7.6)
Secur-Fit	Trident (Shell)	496	9775	33	220	90	153	4.8 (4.4, 5.3)	6.3 (5.8, 7.0)	7.6 (6.8, 8.6)
Secur-Fit Plus	Trident (Shell)	237	5919	16	64	59	98	3.4 (2.9, 3.9)	4.6 (4.0, 5.2)	5.6 (4.8, 6.4)
Spectron EF	Reflection (Cup)	124	1404	47	12	56	9	7.1 (5.7, 8.8)	13.1 (10.9, 15.7)	16.8 (13.4, 21.0)
Synergy	Reflection (Shell)	390	7299	33	85	127	145	3.8 (3.4, 4.3)	5.5 (4.9, 6.1)	7.9 (7.0, 8.8)
TOTAL		**4290**	**115455**	**567**	**1311**	**831**	**1581**			

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				10 Yrs	15 Yrs	20 Yrs
				TKR	Femoral	Tibial	Other			
Active Knee	Active Knee	864	10522	255	29	42	538	8.0 (7.5, 8.6)	11.7 (10.9, 12.6)	14.3 (13.1, 15.6)
Advance	Advance II	114	1504	47	3	13	51	6.8 (5.6, 8.3)	8.2 (6.8, 10.0)	10.4 (8.5, 12.8)
Genesis II CR	Genesis II	1203	25772	254	75	56	818	5.0 (4.7, 5.3)	6.1 (5.7, 6.5)	7.3 (6.7, 7.9)
Genesis II Oxinium CR (ctd)	Genesis II	594	10540	115	31	26	422	6.0 (5.5, 6.5)	8.4 (7.7, 9.2)	10.5 (9.3, 11.7)
Genesis II PS	Genesis II	940	20602	174	33	59	674	5.0 (4.7, 5.4)	6.4 (5.9, 6.9)	7.3 (6.6, 8.1)
LCS CR	LCS	630	8339	258	24	90	258	6.4 (5.9, 7.0)	8.1 (7.5, 8.8)	9.3 (8.6, 10.0)
LCS CR	MBT	1469	32992	504	70	160	735	4.9 (4.6, 5.1)	6.0 (5.6, 6.4)	7.8 (7.0, 8.6)
Nexgen CR	Nexgen	447	11575	144	22	33	248	3.1 (2.8, 3.5)	4.5 (4.1, 5.0)	5.9 (5.3, 6.6)
Nexgen LPS	Nexgen	379	7020	101	22	33	223	4.8 (4.3, 5.4)	6.4 (5.8, 7.1)	8.1 (7.2, 9.2)
Nexgen LPS Flex	Nexgen	1703	37798	486	70	247	900	5.0 (4.7, 5.2)	6.6 (6.2, 7.0)	7.5 (6.9, 8.2)
PFC Sigma CR	PFC Sigma	918	24908	236	56	70	556	3.5 (3.3, 3.8)	5.0 (4.7, 5.4)	6.5 (5.8, 7.2)
PFC Sigma PS	MBT	378	6327	130	16	25	207	5.4 (4.9, 6.1)	7.4 (6.6, 8.3)	10.3 (7.6, 13.8)
RBK	RBK	589	11017	231	16	43	299	5.3 (4.9, 5.8)	6.6 (6.0, 7.2)	9.0 (7.6, 10.6)
TOTAL		**10228**	**208916**	**2935**	**467**	**897**	**5929**			

Note: Restricted to modern prostheses


Infection

Infection in Joint Replacement

Introduction

This year, the Registry is providing a comprehensive analysis of primary hip, knee and shoulder replacement surgery for infection. Infections after hip, knee, and shoulder replacement surgeries are challenging complications with a profound impact on patients' quality of life, morbidity, and healthcare costs. The aim of this chapter is to provide information on revision procedures for infection.

The Registry defines the reason for revision by what is recorded at the time of surgery on the joint replacement recording form. In the case of infection, this is the surgeon's opinion of the presence of infection, but this is not corroborated by microbiological results. Therefore, this will include a small number where infection is not later proven, but also will exclude another small number of cases where an alternate diagnosis, such as loosening is recorded, but the true reason is later found to be a septic process.

The Registry defines a revision as a re-operation of a previous joint replacement where one or more of the prosthetic components are replaced, removed, or one or more components are added. The following analyses, by definition, do not include infected joint replacements treated by a wound or joint washout alone, or those treated by antibiotic suppression where there was no prosthetic revision.

The Registry has a linking process that is run monthly and automatically links a primary procedure to any subsequent revisions on the same side. The key to determining the order of revisions is knowledge of the primary procedure.

TERMINOLOGY

Reporting the outcome of revision procedures has the potential to be confusing. This is in part related to a lack of agreed terminology. The Registry has endeavoured to standardise the sequence of revisions and uses a numerical approach to describe revision procedures.

AOANJRR TERMINOLOGY FOR NUMERICAL SEQUENCE OF REVISION

Sequence of Procedures	Primary Procedure	1st Revision Procedure	2nd Revision Procedure
What this Means		Revision of Primary Procedure	Revision of 1st Revision Procedure
Outcome Measure		Cumulative Percent Revision	Cumulative Percent 2nd Revision

The 1st revision is the revision of a primary procedure. The 2nd revision is the revision of the 1st revision, and so on. Non-specific terminology such as 're-revision' has been avoided. This numerical sequence becomes increasingly important as registries have longer follow-up of known primary procedures that have multiple revisions.

When reporting the cumulative percent revision, the specific numerical terminology is used to correctly report the revision sequence. We have defined the term cumulative percent 2nd revision as the percent of 1st revision procedures revised up until time *t* allowing for right censoring due to death and 'closure' of the database at the time of the analysis.

In this chapter, the numerical terminology has been applied to the classification of revisions for infection.

AOANJRR TERMINOLOGY FOR CLASSIFYING REVISIONS FOR INFECTION

Terminology Used	Planned Two Stage Revision	Single Stage Revision	DAIR
What this Means	The Surgeon's Intention to Perform a 2nd Revision was Recorded **OR** A Cement Spacer was used or the Prosthesis was removed in the 1st Revision **OR** For Hip Revisions a Fully Cemented Major Revision was Performed in the 1st Revision	Any Major Revision that is not a planned Two-stage Revision	A Minor Revision involving only Modular Components
Outcome Measure	Cumulative Percent 3rd Revision*	Cumulative Percent 2nd Revision	Cumulative Percent 2nd Revision

* For planned two-stage revisions that have had the second stage revision for infection completed

Infection in Hip, Knee and Shoulder Joint Replacement

Where appropriate, the following analyses include primary procedures performed for osteoarthritis and using prostheses that have been available and used in 2022 (described as modern prostheses).

Revision as a proportion of all hip, knee and shoulder replacement procedures has declined over the last 20 years (Figure IF1). As revisions for osteolysis and loosening have decreased after primary joint replacement, infection has become a more common reason for revision (Figure IF2).

The number of revisions of hip replacements for reasons other than infection has declined from a peak of 4,081 (10.8%) procedures in 2011 to 2,690 (5.1%) in 2022. Revisions of knee replacements for reasons other than infection reached a peak of 3,701 (5.6%) in 2019 and have declined to 3,146 (4.9%) in 2022. Revision of shoulder replacements for reasons other than infection have plateaued since 2018 (Table IF1 and Figure IF3).

In contrast to revision for aseptic reasons, revisions for infection in hip, knee and shoulder replacements have shown a steady increase since the commencement of data collection by the AOANJRR. In 2022, 1,173 (2.2%) hip replacements, 1,535 (2.4%) knee replacements and 191 (2.2%) shoulder replacements were revision procedures performed due to infection (Table IF2 and Figure IF4).

While the absolute number of revisions for infection has continued to grow over time, the individual risk of a joint replacement being revised for infection has concerningly shown no decline. The cumulative percentage revision for infection of a primary hip replacement has steadily increased over the time period since registry data collection began in 1999 (Table IF3 and Figure IF5). The cumulative percentage revision for infection of a primary knee replacement increased in the period 1999 to 2013 but appears to have plateaued since that time (Table IF4 and Figure IF6). The cumulative percentage revision for infection of a primary shoulder replacement has not significantly changed over the period 2008 to 2022 (Table IF5 and Figure IF7).

Figure IF1 Revision Procedures as a Percentage of All Procedures by Joint

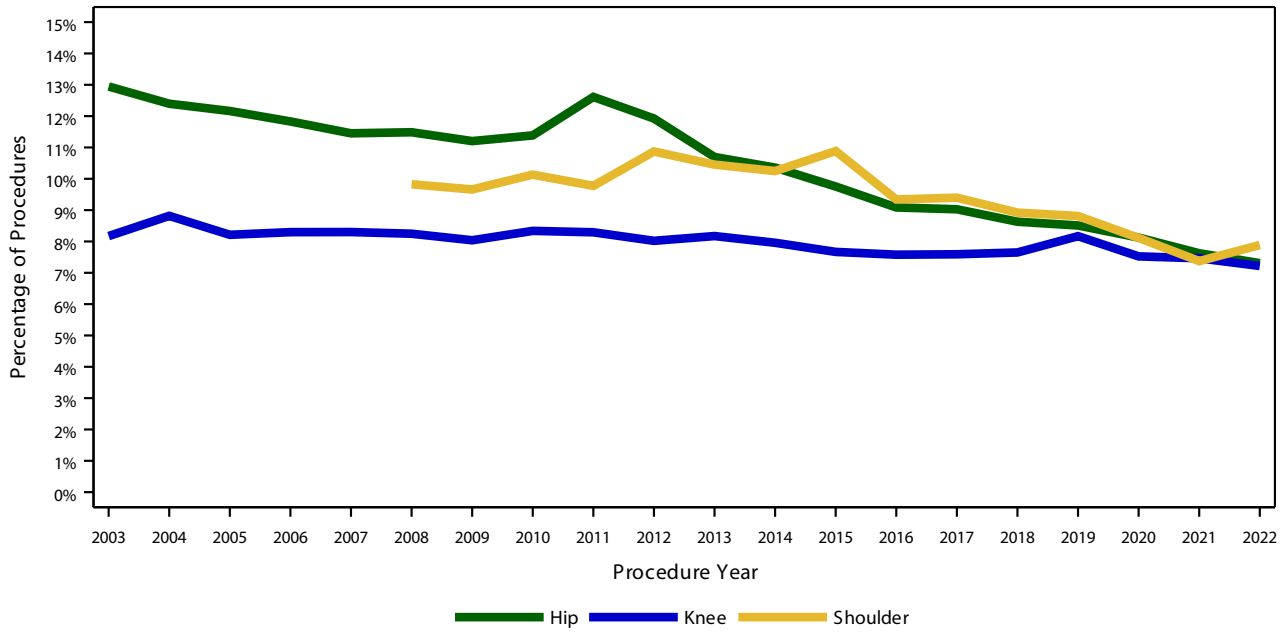


Figure IF2 Revision Procedures as a Percentage of All Hip, Knee and Shoulder Replacement Procedures by Revision Diagnosis

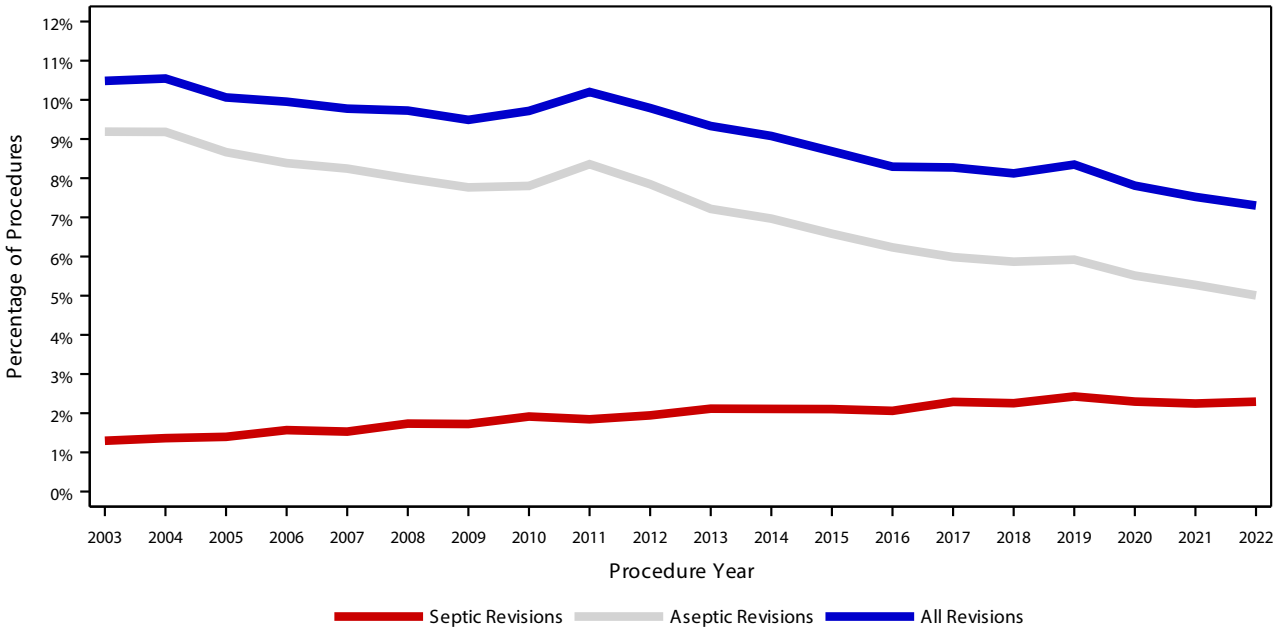


Table IF1 All Revision Hip, Knee and Shoulder Replacement for Reasons Other than Infection by Joint

Procedure Year	Hip		Knee		Shoulder	
	N	% Procedures for Joint	N	% Procedures for Joint	N	% Procedures for Joint
≤2002	5808	12.1%	3689	7.7%	.	.
2003	3111	11.7%	1935	6.8%	.	.
2004	3156	11.2%	2207	7.3%	.	.
2005	3170	10.9%	2234	6.7%	.	.
2006	3069	10.3%	2286	6.7%	.	.
2007*	3039	9.9%	2435	6.8%	165	10.1%
2008	3209	9.7%	2562	6.5%	224	8.5%
2009	3228	9.4%	2593	6.3%	272	8.7%
2010	3402	9.4%	2846	6.4%	300	9.0%
2011	4081	10.8%	3002	6.4%	313	8.4%
2012	3790	9.9%	2978	6.1%	387	9.5%
2013	3433	8.6%	3048	6.0%	392	9.1%
2014	3569	8.3%	3126	5.8%	403	8.6%
2015	3451	7.7%	3221	5.6%	440	8.5%
2016	3266	7.0%	3344	5.5%	446	7.7%
2017	3241	6.7%	3391	5.3%	472	7.2%
2018	3201	6.5%	3474	5.3%	492	6.8%
2019	3215	6.3%	3701	5.6%	505	6.5%
2020	2922	5.9%	3226	5.1%	459	5.8%
2021	2877	5.4%	3517	5.1%	476	5.4%
2022	2690	5.1%	3146	4.9%	490	5.7%
TOTAL	**70928**	**8.3%**	**61961**	**5.9%**	**6236**	**7.3%**

* The first full year of national data collection for shoulders was 2008. Shoulder procedure counts reported for 2007 include all procedures prior to 2008.

Figure IF3 All Revision Hip, Knee and Shoulder Replacement for Reasons Other than Infection by Joint

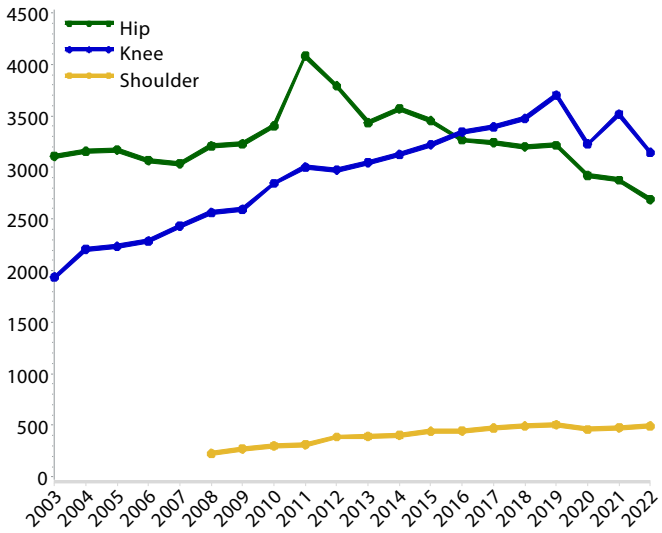


Table IF2 All Revision Hip, Knee and Shoulder Replacement for Infection by Joint

Procedure Year	Hip		Knee		Shoulder	
	N	% Procedures for Joint	N	% Procedures for Joint	N	% Procedures for Joint
≤2002	538	1.1%	626	1.3%	.	.
2003	333	1.3%	379	1.3%	.	.
2004	340	1.2%	456	1.5%	.	.
2005	383	1.3%	487	1.5%	.	.
2006	462	1.5%	540	1.6%	.	.
2007*	475	1.5%	558	1.5%	14	0.9%
2008	578	1.8%	688	1.7%	35	1.3%
2009	623	1.8%	701	1.7%	29	0.9%
2010	702	1.9%	869	2.0%	36	1.1%
2011	689	1.8%	891	1.9%	52	1.4%
2012	785	2.0%	931	1.9%	57	1.4%
2013	831	2.1%	1127	2.2%	57	1.3%
2014	890	2.1%	1181	2.2%	78	1.7%
2015	925	2.1%	1228	2.1%	121	2.3%
2016	996	2.1%	1238	2.0%	98	1.7%
2017	1110	2.3%	1463	2.3%	144	2.2%
2018	1076	2.2%	1524	2.3%	154	2.1%
2019	1124	2.2%	1739	2.6%	180	2.3%
2020	1080	2.2%	1490	2.4%	182	2.3%
2021	1152	2.2%	1604	2.3%	170	1.9%
2022	1173	2.2%	1535	2.4%	191	2.2%
TOTAL	**16265**	**1.9%**	**21255**	**2.0%**	**1598**	**1.9%**

* The first full year of national data collection for shoulders was 2008. Shoulder procedure counts reported for 2007 include all procedures prior to 2008.

Figure IF4 All Revision Hip, Knee and Shoulder Replacement for Infection by Joint

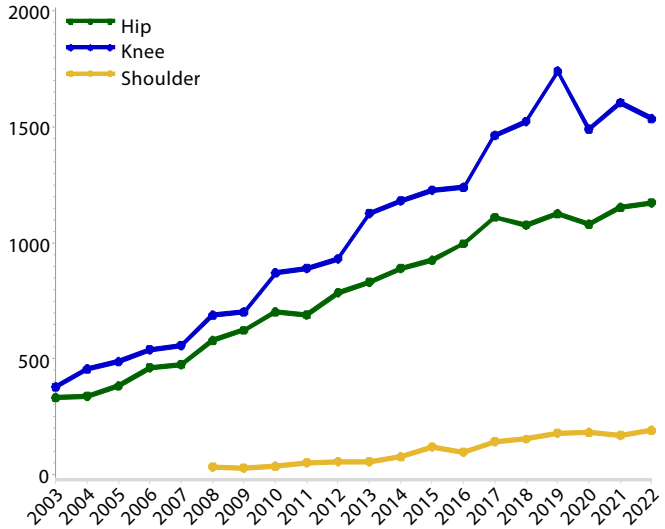
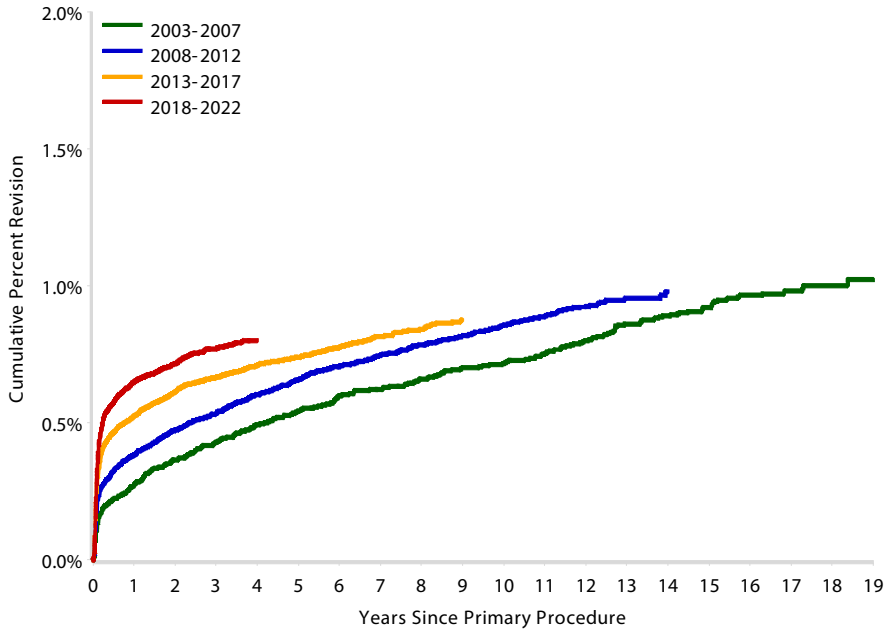


Table IF3 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Year of Implant (Primary Diagnosis OA, Revision for Infection)

Year of Implant	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
2003–2007	354	43077	0.3 (0.2, 0.3)	0.4 (0.4, 0.5)	0.5 (0.5, 0.6)	0.7 (0.6, 0.8)	0.9 (0.8, 1.0)	
2008–2012	650	76098	0.4 (0.3, 0.4)	0.5 (0.5, 0.6)	0.7 (0.6, 0.7)	0.9 (0.8, 0.9)		
2013–2017	1036	130333	0.5 (0.5, 0.6)	0.7 (0.6, 0.7)	0.7 (0.7, 0.8)			
2018–2022	1224	173884	0.6 (0.6, 0.7)	0.8 (0.7, 0.8)				
TOTAL	**3264**	**423392**						

Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded
Procedures prior to full national data collection in 2003 have been excluded

Figure IF5 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Year of Implant (Primary Diagnosis OA, Revision for Infection)



HR - adjusted for age and gender

2003-2007 vs 2018-2022

0 - 3Mth: HR=0.39 (0.31, 0.48), p<0.001
3Mth - 1Yr: HR=0.66 (0.46, 0.93), p=0.018
1Yr - 1.5Yr: HR=1.40 (0.92, 2.13), p=0.120
1.5Yr+: HR=1.12 (0.92, 1.37), p=0.245

2008-2012 vs 2018-2022

0 - 1Mth: HR=0.65 (0.54, 0.79), p<0.001
1Mth - 3Mth: HR=0.46 (0.37, 0.58), p<0.001
3Mth - 2Yr: HR=0.93 (0.77, 1.12), p=0.447
2Yr - 2.5Yr: HR=0.96 (0.62, 1.49), p=0.848
2.5Yr - 3.5Yr: HR=1.38 (0.97, 1.97), p=0.076
3.5Yr+: HR=1.14 (0.93, 1.42), p=0.212

2013-2017 vs 2018-2022

Entire Period: HR=0.86 (0.79, 0.93), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
2003–2007	43077	41917	40074	37832	30254	21945	0
2008–2012	76098	74330	71453	67857	55924	0	0
2013–2017	130333	127064	122814	117575	0	0	0
2018–2022	173884	134010	63503	0	0	0	0

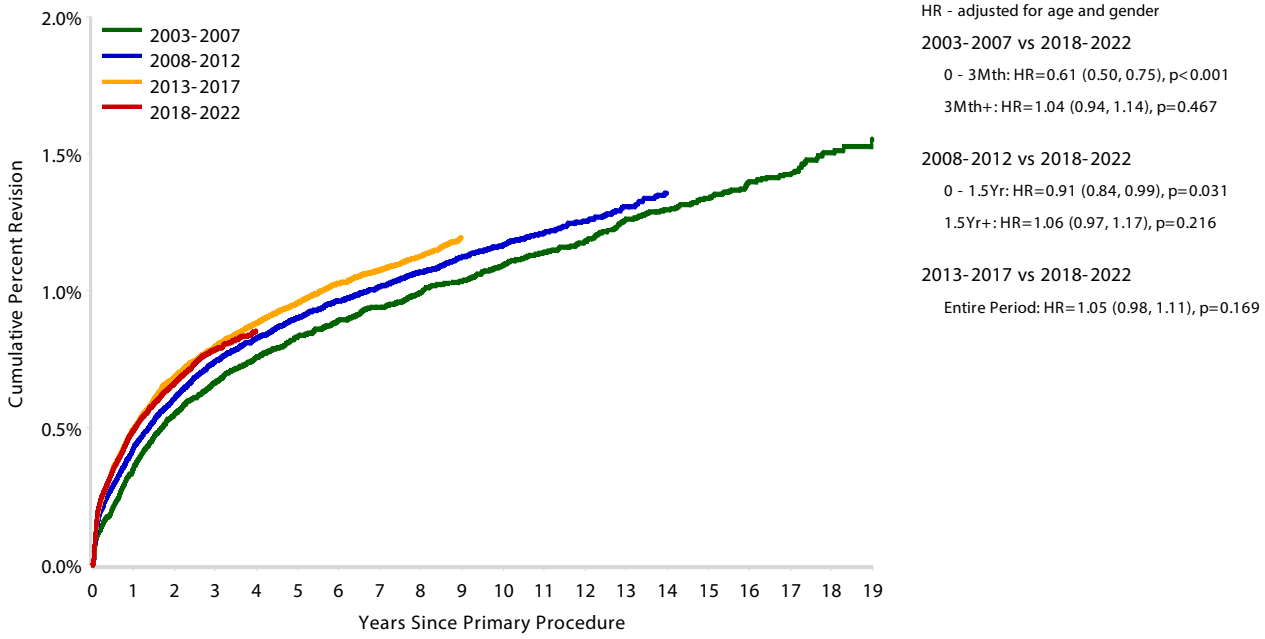
Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded
Procedures prior to full national data collection in 2003 have been excluded

Table IF4 Cumulative Percent Revision of Primary Total Knee Replacement by Year of Implant (Primary Diagnosis OA, Revision for Infection)

Year of Implant	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
2003–2007	888	72183	0.4 (0.3, 0.4)	0.7 (0.6, 0.7)	0.8 (0.8, 0.9)	1.1 (1.0, 1.2)	1.3 (1.2, 1.4)	
2008–2012	1736	147489	0.4 (0.4, 0.5)	0.7 (0.7, 0.8)	0.9 (0.9, 1.0)	1.2 (1.1, 1.2)		
2013–2017	2447	229423	0.5 (0.5, 0.5)	0.8 (0.8, 0.8)	1.0 (0.9, 1.0)			
2018–2022	1810	275544	0.5 (0.5, 0.5)	0.8 (0.7, 0.8)				
TOTAL	**6881**	**724639**						

Note: Restricted to modern prostheses
Procedures prior to full national data collection in 2003 have been excluded

Figure IF6 Cumulative Percent Revision of Primary Total Knee Replacement by Year of Implant (Primary Diagnosis OA, Revision for Infection)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
2003–2007	72183	70861	67672	64108	52200	38172	0
2008–2012	147489	144919	139193	133049	112094	0	0
2013–2017	229423	225862	218131	209618	0	0	0
2018–2022	275544	216822	103902	0	0	0	0

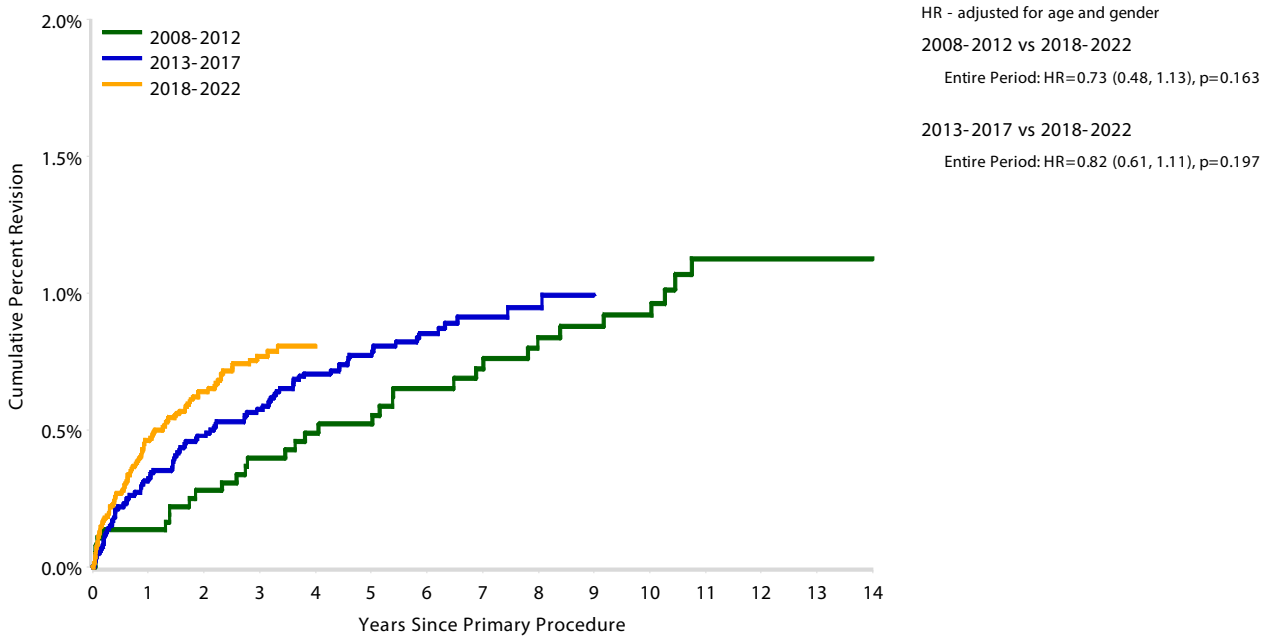
Note Restricted to modern prostheses
Procedures prior to full national data collection in 2003 have been excluded

Table IF5 Cumulative Percent Revision of Primary Shoulder Replacement by Year of Implant (Primary Diagnosis OA, Revision for Infection)

Year of Implant	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
2008–2012	33	3708	0.1 (0.1, 0.3)	0.4 (0.2, 0.7)	0.5 (0.3, 0.8)	0.7 (0.5, 1.1)	0.9 (0.6, 1.3)	1.1 (0.8, 1.6)
2013–2017	85	10021	0.3 (0.2, 0.5)	0.6 (0.4, 0.7)	0.8 (0.6, 1.0)	0.9 (0.7, 1.1)		
2018–2022	115	18704	0.5 (0.4, 0.6)	0.8 (0.6, 0.9)				
TOTAL	**233**	**32433**						

Note: Restricted to modern prostheses
Procedures prior to full national data collection in 2008 have been excluded

Figure IF7 Cumulative Percent Revision of Primary Shoulder Replacement by Year of Implant (Primary Diagnosis OA, Revision for Infection)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
2008–2012	3708	3541	3316	3056	2728	2237	318
2013–2017	10021	9691	9201	8661	3734	0	0
2018–2022	18704	14390	6443	0	0	0	0

Note: Restricted to modern prostheses
Procedures prior to full national data collection in 2008 have been excluded

DEMOGRAPHICS

There is a marked gender difference in the risk of revision with respect to infection. Revision for reasons other than infection are more commonly performed in females in almost all age groups (Figure IF8). By contrast, revisions for infection are more common in males in all age groups (Figure IF8). The tendency for revision for infection to occur more commonly in males is observed in hip, knee and shoulder replacements (Figure IF9 to Figure IF11).

Figure IF8 All Revisions of Hip, Knee and Shoulder Replacement by Age and Gender

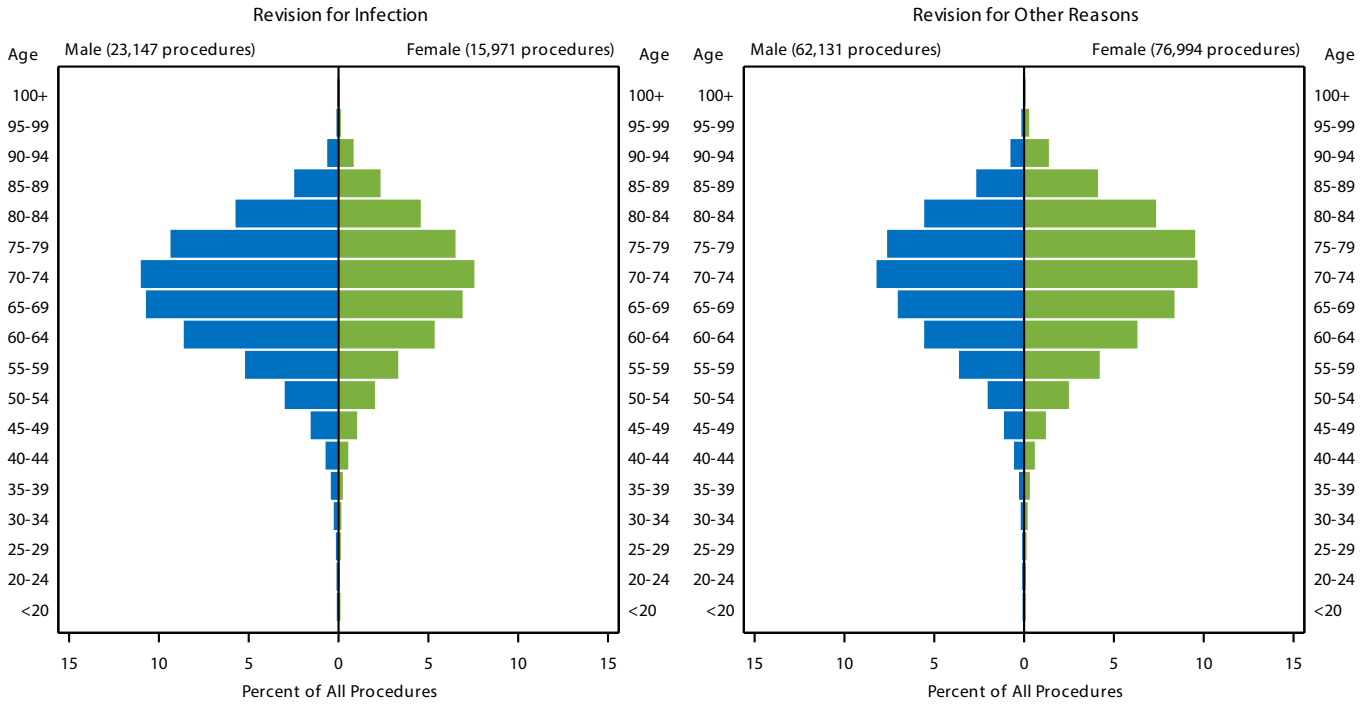


Figure IF9 All Revisions of Hip Replacement by Age and Gender

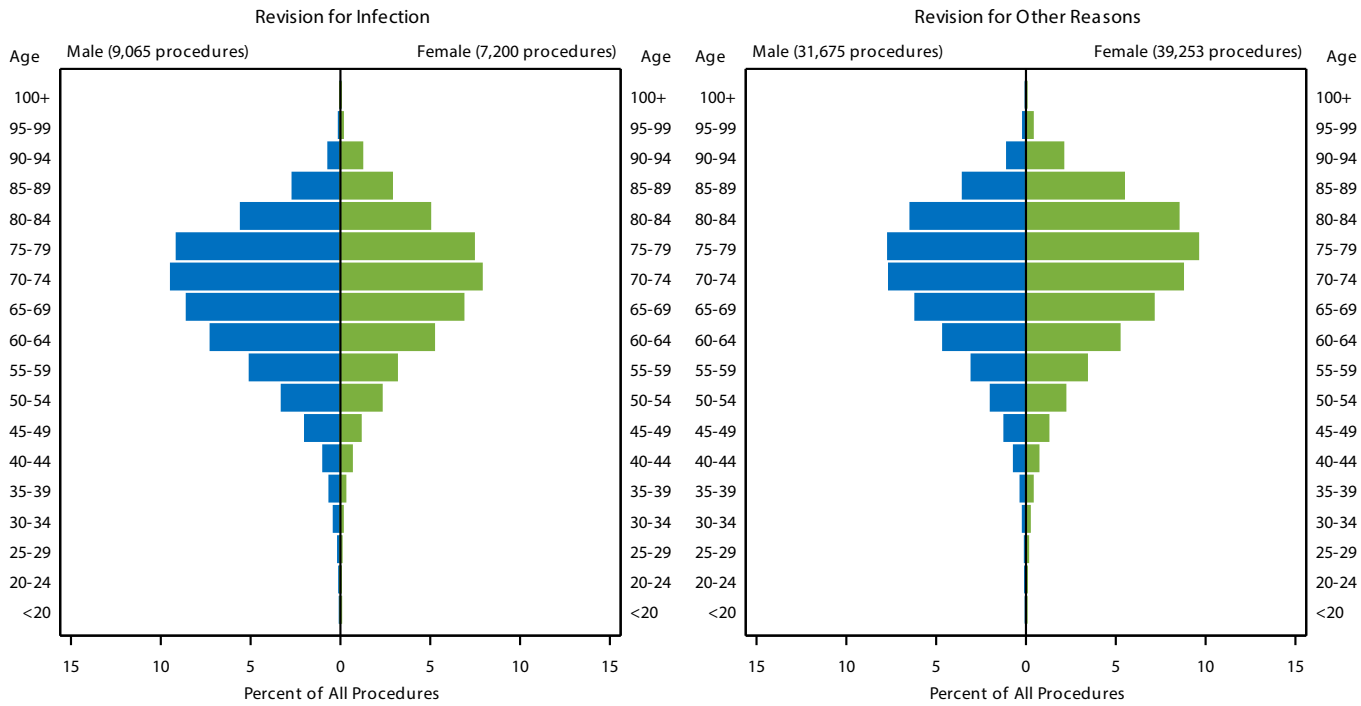


Figure IF10 All Revisions of Knee Replacement by Age and Gender

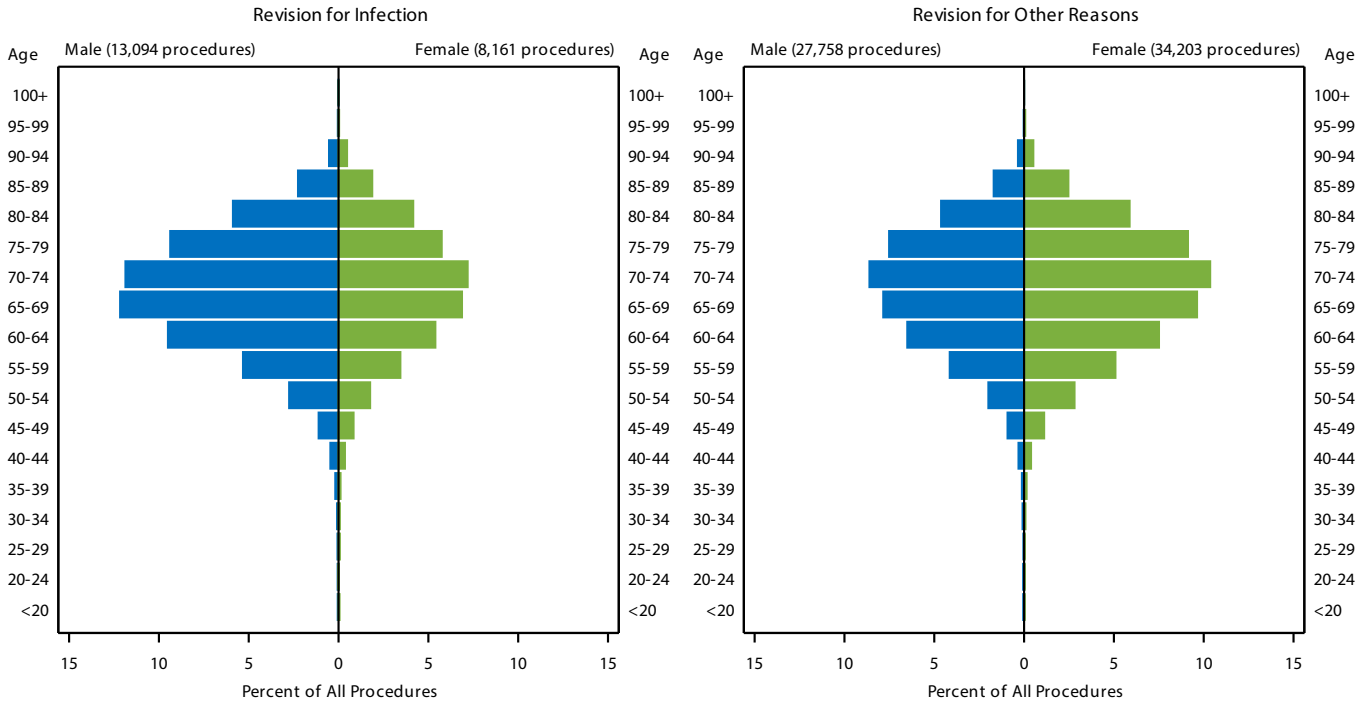
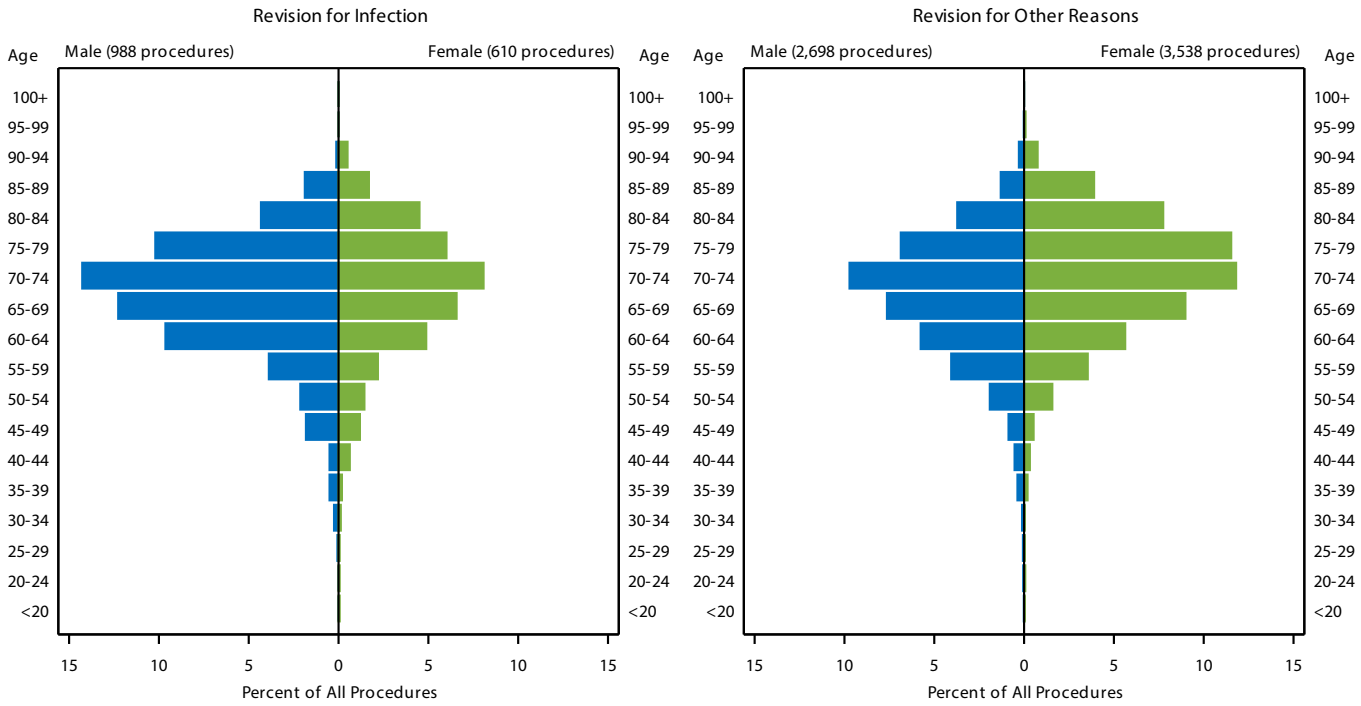


Figure IF11 All Revisions of Shoulder Replacement by Age and Gender



Primary Total Conventional Hip Replacement – Revision for Infection

The following analyses include primary conventional total hip procedures performed for osteoarthritis and using prostheses that have been available and used in 2022 (described as modern prostheses). All procedures using a metal/metal bearing surface have been excluded.

DEMOGRAPHICS

The demographics of 1st revision of known primary total conventional hip replacement for both infection and aseptic reasons are shown in Table IF6. The mean time to 1st revision for infection is shorter than the mean time to 1st revision for aseptic reasons (1.8 ±3.1 years versus 3.7 ±4.4 years post primary procedure).

Males account for a larger proportion of revisions for infection than females, across all age groups, and are overrepresented when compared to the proportion of primary procedures that are undertaken in males (Figure IF12).

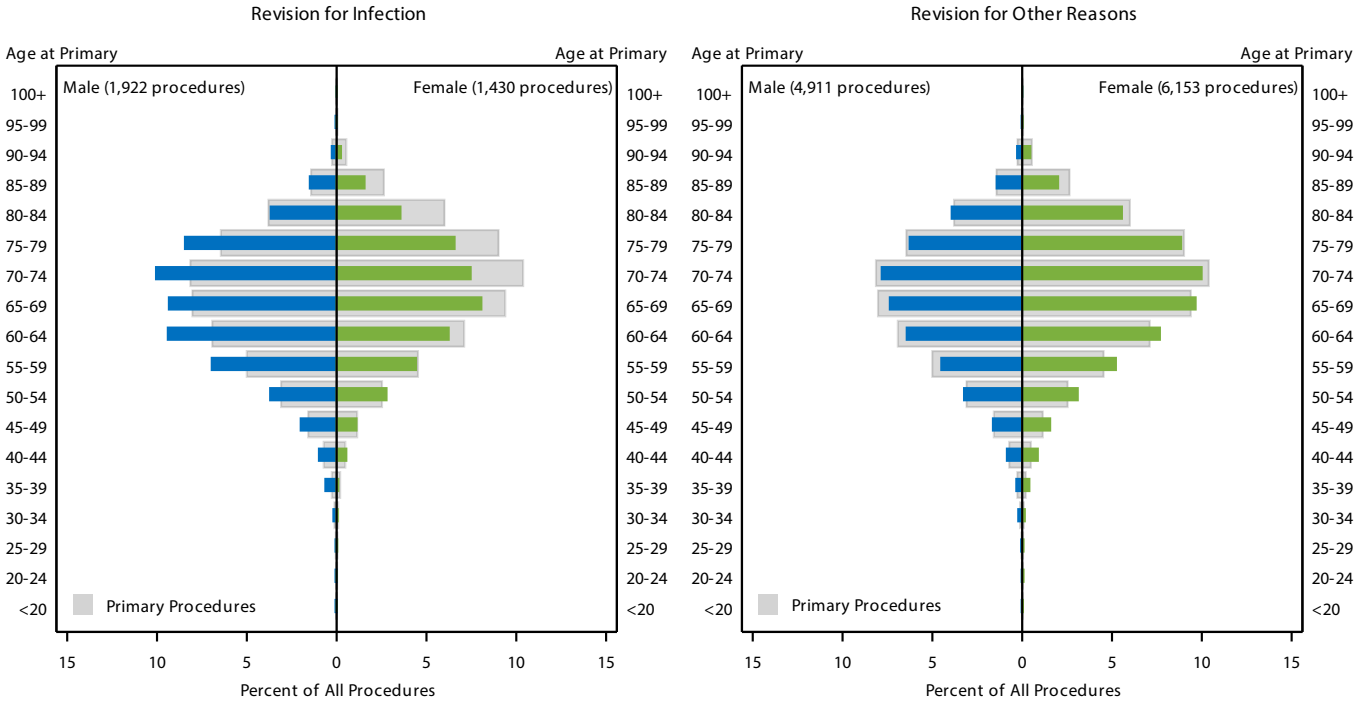
Table IF6 Summary of Known Primary Total Conventional Hip Replacement (Primary Diagnosis OA)

Variable	Primary	1st Revision for Infection	1st Revision for Other Reasons	TOTAL
Follow-Up Years (Primary to 1st Revision)				
Mean ± SD	6.4 ± 4.8	1.8 ± 3.1	3.7 ± 4.4	6.3 ± 4.8
Median (IQR)	5.4 (2.5, 9.2)	0.2 (0.1, 2.1)	1.8 (0.2, 5.9)	5.3 (2.4, 9.1)
Minimum	0	0	0	0
Maximum	22.9	21	22.1	22.9
Follow-Up Years (1st Revision to 2nd Revision)				
Mean ± SD		2.9 ± 3.6	4.7 ± 4.1	4.3 ± 4.1
Median (IQR)		1.4 (0.2, 4.6)	3.8 (1.4, 6.9)	3.3 (0.9, 6.5)
Minimum		0	0	0
Maximum		20.8	22.1	22.1
Age at Primary				
Mean ± SD	68.3 ± 10.7	66.9 ± 10.8	67.5 ± 11.1	68.3 ± 10.7
Median (IQR)	69 (61, 76)	68 (60, 75)	68 (61, 76)	69 (61, 76)
Primary Hospital Calendar Year Volume				
Mean ± SD	205.8 ± 169.6	183 ± 150.7	204.3 ± 170.6	205.5 ± 169.5
Median (IQR)	151 (81.3, 247.3)	134.2 (81, 232)	151 (80.2, 245.9)	151 (81.3, 247.3)
Gender at Primary				
Male	198,551 (45.9%)	1,922 (57.3%)	4,911 (44.4%)	205,384 (45.9%)
Female	234,123 (54.1%)	1,430 (42.7%)	6,153 (55.6%)	241,706 (54.1%)
ASA Score at Primary[1]				
ASA 1	25,581 (8.6%)	96 (4.4%)	431 (7.8%)	26,108 (8.6%)
ASA 2	160,409 (54.1%)	957 (43.6%)	2,722 (49.4%)	164,088 (53.9%)
ASA 3	106,324 (35.9%)	1,088 (49.6%)	2,261 (41%)	109,673 (36.1%)
ASA 4 or 5	4,142 (1.4%)	54 (2.5%)	101 (1.8%)	4,297 (1.4%)
ASA Score at 1st Revision[2]				
ASA 1		48 (1.9%)	412 (5%)	460 (4.2%)
ASA 2		851 (32.9%)	3,195 (38.4%)	4,046 (37.1%)
ASA 3		1,526 (58.9%)	4,179 (50.2%)	5,705 (52.3%)
ASA 4 or 5		164 (6.3%)	532 (6.4%)	696 (6.4%)
BMI Category at Primary[3]				
Underweight (<18.50)	1,826 (0.7%)	3 (0.2%)	21 (0.5%)	1,850 (0.7%)
Normal (18.50-24.99)	51,633 (20.6%)	170 (9.3%)	864 (20.4%)	52,667 (20.5%)

Variable		Primary	1st Revision for Infection	1st Revision for Other Reasons	TOTAL
	Pre Obese (25.00-29.99)	92,176 (36.8%)	486 (26.7%)	1,437 (34%)	94,099 (36.7%)
	Obese Class 1 (30.00-34.99)	64,237 (25.6%)	497 (27.3%)	1,116 (26.4%)	65,850 (25.7%)
	Obese Class 2 (35.00-39.99)	27,354 (10.9%)	367 (20.2%)	495 (11.7%)	28,216 (11%)
	Obese Class 3 (≥40.00)	13,297 (5.3%)	296 (16.3%)	292 (6.9%)	13,885 (5.4%)
BMI Category at 1st Revision[4]					
	Underweight (<18.50)		6 (0.3%)	55 (0.9%)	61 (0.7%)
	Normal (18.50-24.99)		242 (12.6%)	1,397 (21.8%)	1,639 (19.7%)
	Pre Obese (25.00-29.99)		560 (29.1%)	2,312 (36.1%)	2,872 (34.4%)
	Obese Class 1 (30.00-34.99)		507 (26.3%)	1,578 (24.6%)	2,085 (25%)
	Obese Class 2 (35.00-39.99)		341 (17.7%)	683 (10.7%)	1,024 (12.3%)
	Obese Class 3 (≥40.00)		271 (14.1%)	388 (6.1%)	659 (7.9%)
Bearing Surface in Primary[5]					
	Ceramic/Ceramic	74,267 (17.2%)	422 (12.6%)	2,065 (18.7%)	76,754 (17.2%)
	Ceramic/Non XLPE	4,996 (1.2%)	31 (0.9%)	178 (1.6%)	5,205 (1.2%)
	Ceramic/XLPE	129,971 (30%)	968 (28.9%)	2,387 (21.6%)	133,326 (29.8%)
	Ceramic/Metal	297 (0.1%)	4 (0.1%)	26 (0.2%)	327 (0.1%)
	Metal/Non XLPE	13,238 (3.1%)	158 (4.7%)	887 (8%)	14,283 (3.2%)
	Metal/XLPE	175,341 (40.5%)	1,515 (45.2%)	4,684 (42.4%)	181,540 (40.6%)
	Metal/Ceramic	5 (0%)			5 (0%)
	Ceramicised Metal/Non XLPE	286 (0.1%)	4 (0.1%)	51 (0.5%)	341 (0.1%)
	Ceramicised Metal/XLPE	34,143 (7.9%)	248 (7.4%)	781 (7.1%)	35,172 (7.9%)
	Ceramicised Metal/Ceramic	2 (0%)			2 (0%)
Approach in Primary[6]					
	Anterior	73,754 (28.9%)	336 (17.9%)	1,303 (30.1%)	75,393 (28.8%)
	Lateral	37,942 (14.8%)	338 (18%)	732 (16.9%)	39,012 (14.9%)
	Posterior	143,835 (56.3%)	1,204 (64.1%)	2,301 (53.1%)	147,340 (56.3%)
Primary Hospital Type					
	Public Hospital	134,130 (31%)	1,270 (37.9%)	3,340 (30.2%)	138,740 (31%)
	Private Hospital	298,544 (69%)	2,082 (62.1%)	7,724 (69.8%)	308,350 (69%)
Primary Hospital Location[7]					
	Urban	328,913 (76.2%)	2,512 (75.2%)	8,418 (76.4%)	339,843 (76.2%)
	Rural	102,658 (23.8%)	828 (24.8%)	2,596 (23.6%)	106,082 (23.8%)
Primary Hospital Calendar Year Volume					
	1st Quartile	24,351 (5.6%)	188 (5.6%)	731 (6.6%)	25,270 (5.7%)
	2nd Quartile	74,348 (17.2%)	578 (17.2%)	1,932 (17.5%)	76,858 (17.2%)
	3rd Quartile	119,922 (27.7%)	1,104 (32.9%)	2,989 (27%)	124,015 (27.7%)
	4th Quartile	214,053 (49.5%)	1,482 (44.2%)	5,412 (48.9%)	220,947 (49.4%)
TOTAL		**432,674**	**3,352**	**11,064**	**447,090**

Note: Restricted to modern prostheses. All procedures using metal/metal prostheses have been excluded
Abbreviations: SD – standard deviation, IQR – interquartile range, ASA – American Society of Anesthesiologists, BMI – Body Mass Index (kg/m^2)
[1] Excludes 142,924 procedures with unknown ASA score at primary
[2] Excludes 3,509 procedures with unknown ASA score at 1st revision
[3] Excludes 190,523 procedures with unknown BMI category at primary
[4] Excludes 6,076 procedures with unknown BMI category at 1st revision
[5] Excludes 135 procedures with unknown bearing surface in primary
[6] Excludes 185,345 procedures with unknown approach in primary
[7] Excludes 1,165 procedures with unknown primary hospital location

Figure IF12 1st Revision of Known Primary Total Conventional Hip Replacement by Age and Gender (Primary Diagnosis OA)

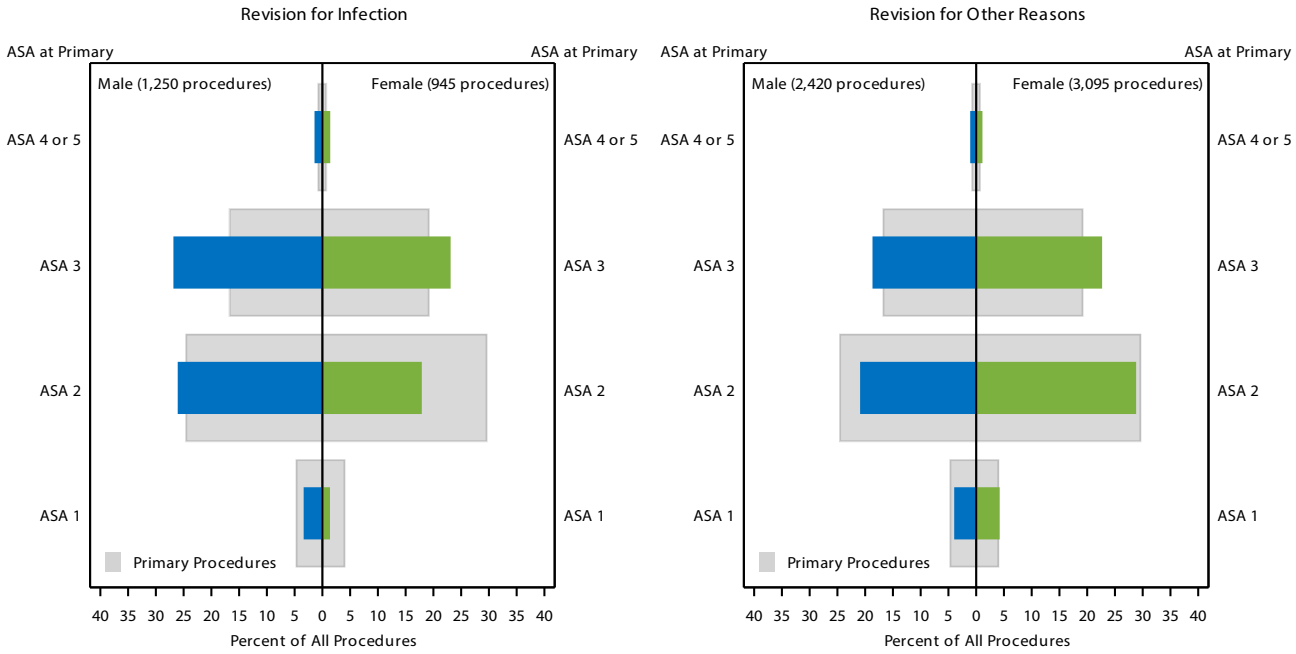


Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded

ASA Score and BMI Category

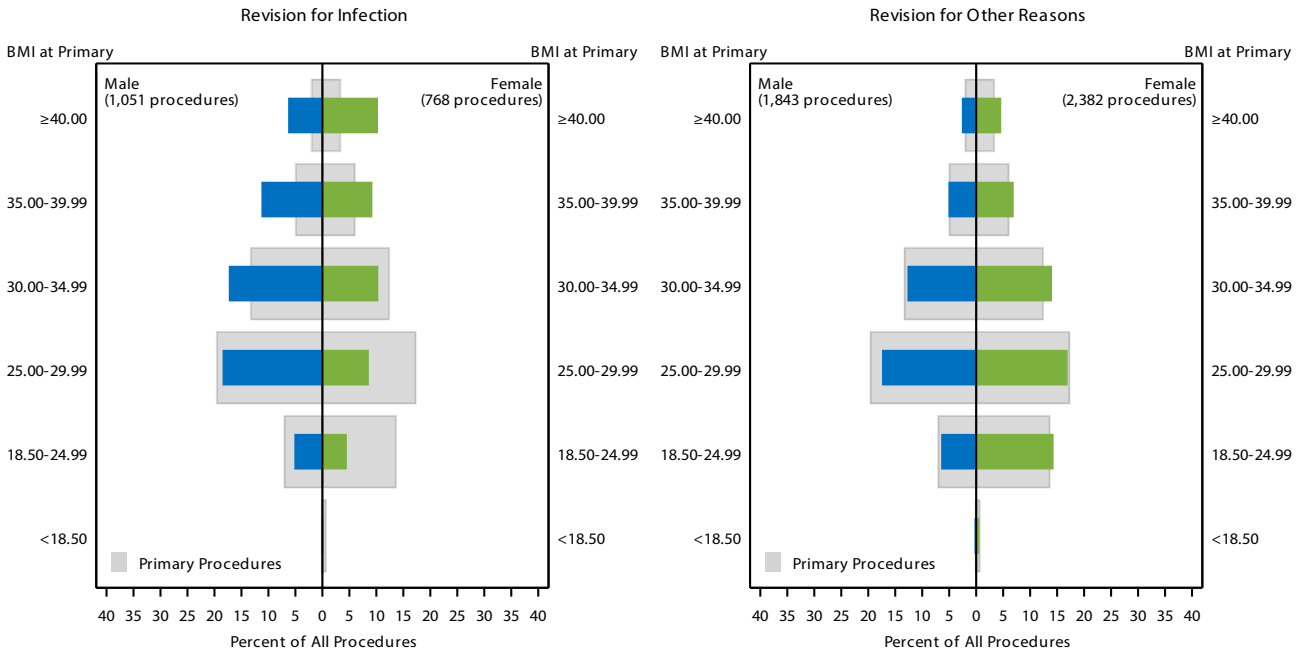
Irrespective of ASA score, males have a higher proportion of revisions for infection than females. When compared to the number of primary procedures in each ASA score, males with an ASA score of ≥2 and females with an ASA score of 3, have a larger proportion of revisions for infection. In contrast, a larger proportion of revisions for aseptic reasons are undertaken in female patients with an ASA score of ≤2 (Figure IF13). Compared to revisions for aseptic reasons, revisions for infection occur disproportionately more frequently in males in obese classes ≥1, and in females in obese classes ≥2 (Figure IF14).

Figure IF13 1st Revision of Known Primary Total Conventional Hip Replacement by ASA Score at Primary and Gender (Primary Diagnosis OA)



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

Figure IF14 1st Revision of Known Primary Total Conventional Hip Replacement by BMI Category at Primary and Gender (Primary Diagnosis OA)



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

TIMING OF REVISION FOR INFECTION

An early revision for infection is defined by the Registry as a revision within 3 months of the primary procedure.

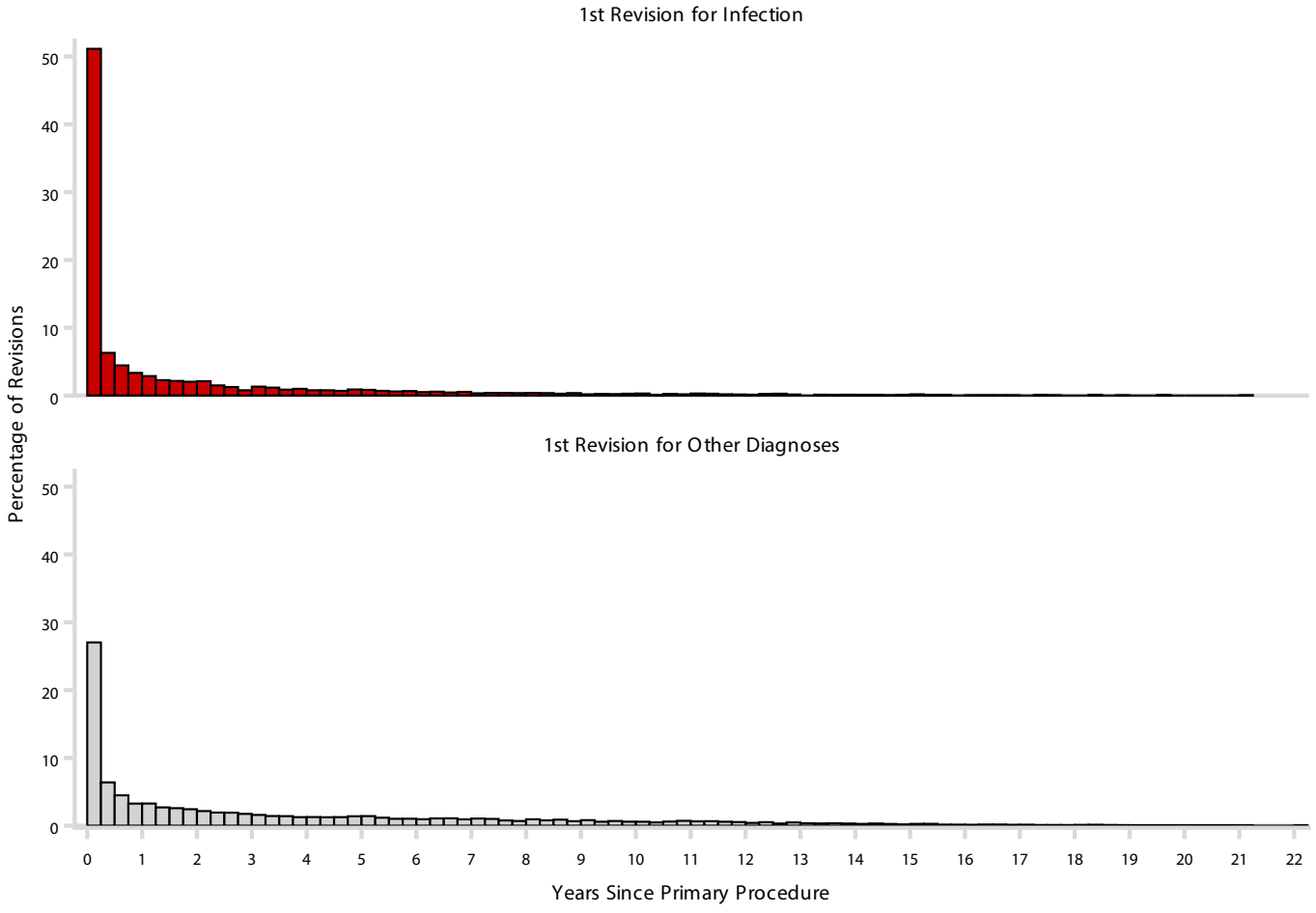
When primary hip replacements are revised for infection, 51.1% are early revisions (Table IF7 and Figure IF15).

Table IF7 Time to 1st Revision in Primary Total Conventional Hip Replacement by 1st Revision Diagnosis (Primary Diagnosis OA)

Time to 1st Revision	1st Revision for Infection			1st Revision for Other Diagnoses			TOTAL		
	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%
≤7 Days	16	2.2	0.5	702	97.8	6.3	718	100.0	5.0
>7 Days to ≤4 Weeks	807	40.8	24.1	1172	59.2	10.6	1979	100.0	13.7
>4 Weeks to ≤3 Months	891	44.4	26.6	1116	55.6	10.1	2007	100.0	13.9
>3 Months to ≤1 Year	472	23.2	14.1	1561	76.8	14.1	2033	100.0	14.1
>1 Year to ≤2 Years	312	20.5	9.3	1212	79.5	11.0	1524	100.0	10.6
>2 Years	854	13.9	25.5	5301	86.1	47.9	6155	100.0	42.7
TOTAL	**3352**	**23.3**	**100.0**	**11064**	**76.7**	**100.0**	**14416**	**100.0**	**100.0**

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

Figure IF15 Time to 1st Revision in Primary Total Conventional Hip Replacement by 1st Revision Diagnosis (Primary Diagnosis OA)



Note: Restricted to modern prostheses. All procedures using metal/metal prostheses have been excluded. Bins are 0 to <3 months, 3 months to <6 months, etc.

REVISION PROCEDURES

Revision for infection of primary hip replacements with exchange of modular components only, corresponding to a debridement, antibiotics and implant retention (DAIR) procedure, is most commonly performed early, with 74.3% of procedures occurring within 3 months of the primary procedure. Other revisions for infection more commonly occur later, with 75.8% being performed more than 3 months after the primary procedure (Table IF8).

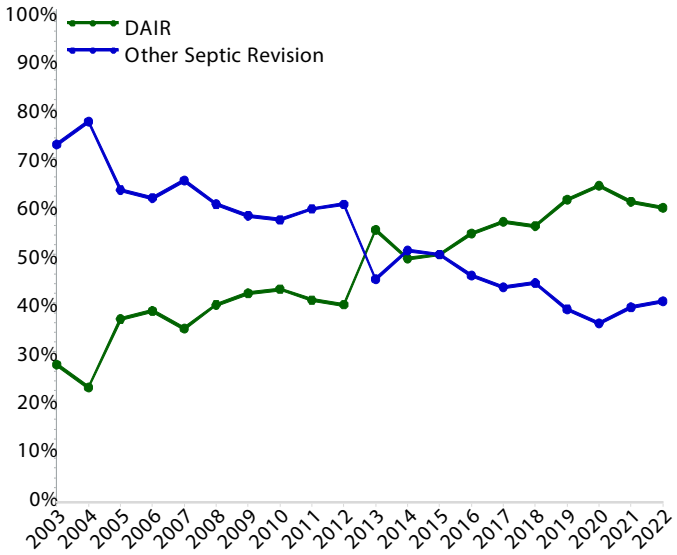
In 2022, DAIR procedures (minor revisions) are the most common 1st revision procedure of a primary hip replacement for infection. The proportion of DAIR procedures as the 1st revision procedure has risen from 27.3% in 2003 to 59.6% in 2022 (Figure IF16).

Table IF8 Time to 1st Revision in Primary Total Conventional Hip Replacement by 1st Revision Diagnosis (Primary Diagnosis OA)

Time to 1st Revision	DAIR			Other Septic Revision			Other Revision			TOTAL		
	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%
≤7 Days	13	1.8	0.7	3	0.4	0.2	702	97.8	6.3	718	100.0	5.0
>7 Days to ≤4 Weeks	673	34.0	37.4	134	6.8	8.6	1172	59.2	10.6	1979	100.0	13.7
>4 Weeks to ≤3 Months	652	32.5	36.2	239	11.9	15.4	1116	55.6	10.1	2007	100.0	13.9
>3 Months to ≤1 Year	186	9.1	10.3	286	14.1	18.4	1561	76.8	14.1	2033	100.0	14.1
>1 Year to ≤2 Years	61	4.0	3.4	251	16.5	16.2	1212	79.5	11.0	1524	100.0	10.6
>2 Years	216	3.5	12.0	638	10.4	41.1	5301	86.1	47.9	6155	100.0	42.7
TOTAL	**1801**	**12.5**	**100.0**	**1551**	**10.8**	**100.0**	**11064**	**76.7**	**100.0**	**14416**	**100.0**	**100.0**

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

Figure IF16 1st Revision of Known Primary Total Conventional Hip Replacement by Management Strategy (Primary Diagnosis OA, 1st Revision for Infection)



Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded
By revision procedure year

REVISION RISK OVER TIME

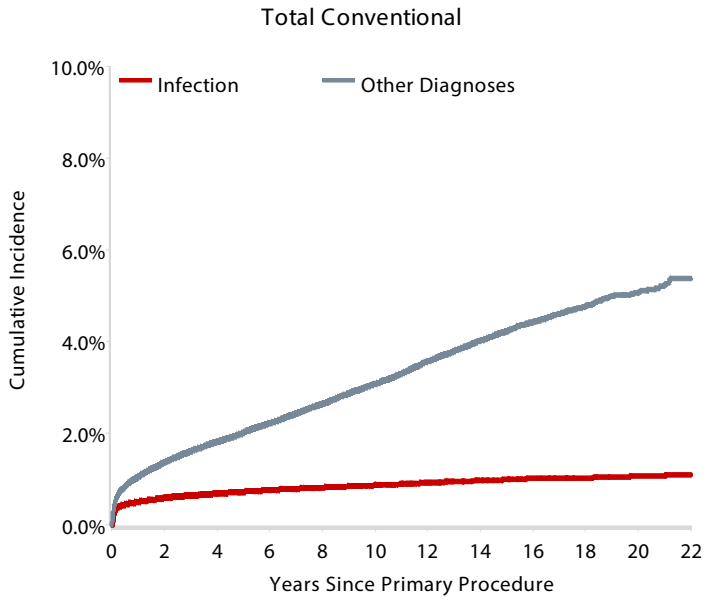
The cumulative incidence of revision for infection steadily increases with time. The cumulative incidence of revision for infection of a primary conventional hip replacement is 0.5% at 1 year and slowly increases to 1.1% at 20 years after the primary procedure (Table IF9 and Figure IF17).

Table IF9 Cumulative Incidence Revision Diagnosis in Primary Total Conventional Hip Replacement (Primary Diagnosis OA)

Type of Primary	Event	N Events	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Total Conventional	Infection	3352	0.5 (0.5, 0.5)	0.7 (0.6, 0.7)	0.7 (0.7, 0.8)	0.9 (0.9, 0.9)	1.0 (1.0, 1.0)	1.1 (1.0, 1.1)
Total Conventional	Other Diagnoses	11064	1.1 (1.0, 1.1)	1.6 (1.6, 1.7)	2.1 (2.0, 2.1)	3.1 (3.1, 3.2)	4.3 (4.2, 4.4)	5.1 (5.0, 5.3)
Total Conventional	Deceased	71305	0.9 (0.8, 0.9)	3.6 (3.5, 3.6)	7.5 (7.4, 7.6)	22.2 (22.0, 22.4)	40.3 (40.0, 40.6)	56.6 (56.1, 57.1)
Total Conventional	All Revision	14416	1.6 (1.6, 1.6)	2.3 (2.3, 2.3)	2.8 (2.7, 2.8)	4.0 (3.9, 4.1)	5.3 (5.2, 5.4)	6.2 (6.1, 6.4)

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

Figure IF17 Cumulative Incidence Revision Diagnosis in Primary Total Conventional Hip Replacement (Primary Diagnosis OA)



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

RISKS OF REVISION BY PRIMARY DIAGNOSIS

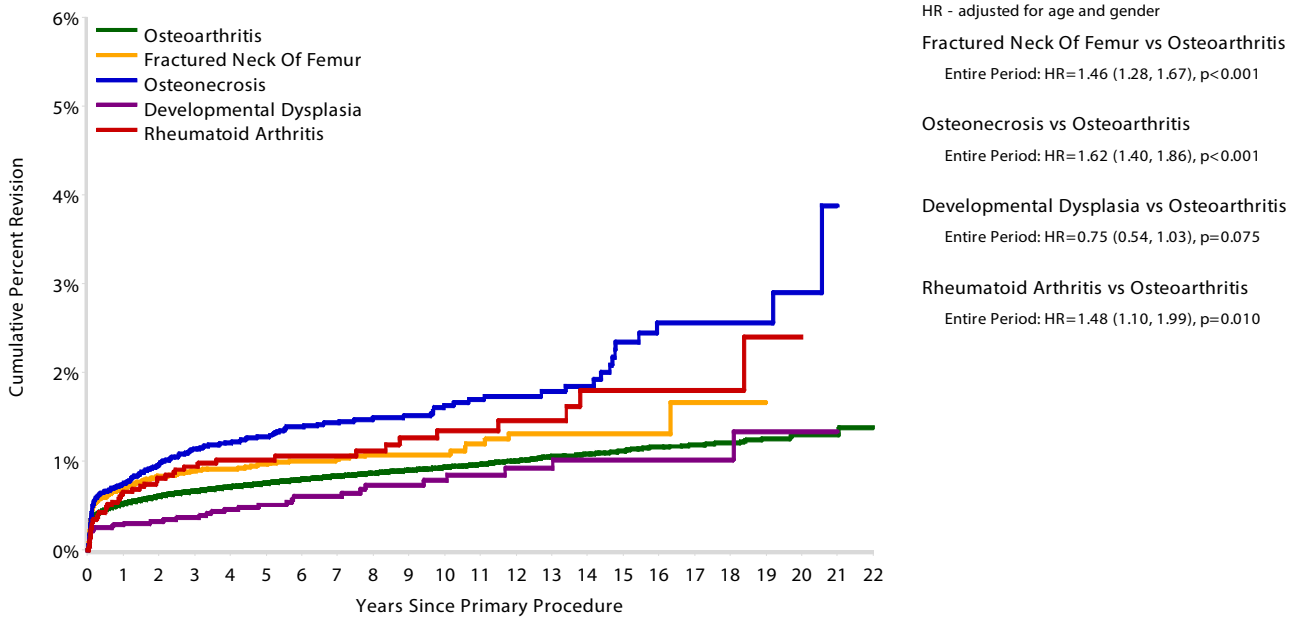
When compared to primary procedures undertaken for osteoarthritis, procedures performed for osteonecrosis, rheumatoid arthritis and fractured neck of femur all have a higher rate of revision for infection (Table IF10 and Figure IF18).

Table IF10 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Primary Diagnosis (Revision for Infection)

Primary Diagnosis	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Osteoarthritis	3352	432674	0.5 (0.5, 0.5)	0.7 (0.6, 0.7)	0.8 (0.7, 0.8)	0.9 (0.9, 1.0)	1.1 (1.1, 1.2)	1.3 (1.2, 1.4)
Fractured Neck Of Femur	244	27539	0.7 (0.6, 0.8)	0.9 (0.8, 1.0)	1.0 (0.8, 1.1)	1.1 (0.9, 1.2)	1.3 (1.1, 1.6)	
Osteonecrosis	211	15813	0.7 (0.6, 0.9)	1.1 (1.0, 1.3)	1.3 (1.1, 1.5)	1.6 (1.4, 1.9)	2.3 (1.9, 2.9)	2.9 (2.1, 3.9)
Developmental Dysplasia	39	6452	0.3 (0.2, 0.5)	0.4 (0.2, 0.6)	0.5 (0.3, 0.7)	0.8 (0.5, 1.1)	1.0 (0.7, 1.5)	1.3 (0.8, 2.3)
Rheumatoid Arthritis	44	3806	0.7 (0.4, 1.0)	0.9 (0.7, 1.3)	1.0 (0.7, 1.4)	1.3 (1.0, 1.9)	1.8 (1.2, 2.6)	2.4 (1.4, 4.2)
Tumour	32	2750	0.8 (0.5, 1.3)	1.3 (0.8, 2.0)	1.8 (1.1, 2.8)	4.3 (2.5, 7.4)		
Failed Internal Fixation	50	2034	1.8 (1.3, 2.5)	2.4 (1.8, 3.3)	2.6 (2.0, 3.5)	3.2 (2.2, 4.5)	5.0 (2.9, 8.5)	
Other (4)	37	2885	0.6 (0.4, 1.0)	1.1 (0.7, 1.5)	1.3 (0.9, 1.8)	1.6 (1.1, 2.3)	1.6 (1.1, 2.3)	4.6 (2.1, 10.0)
TOTAL	**4009**	**493953**						

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 IF18 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Primary Diagnosis (Revision for Infection)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Osteoarthritis	432674	386337	306450	231396	92710	26702	3298
Fractured Neck Of Femur	27539	22422	15738	10219	2751	472	34
Osteonecrosis	15813	13858	10682	7961	3233	1070	171
Developmental Dysplasia	6452	5743	4579	3486	1672	654	112
Rheumatoid Arthritis	3806	3417	2854	2250	1134	415	66

Note: Restricted to modern prostheses. Only primary diagnoses with >3,000 procedures have been listed
All procedures using metal/metal prostheses have been excluded

OUTCOME OF 1ST REVISION

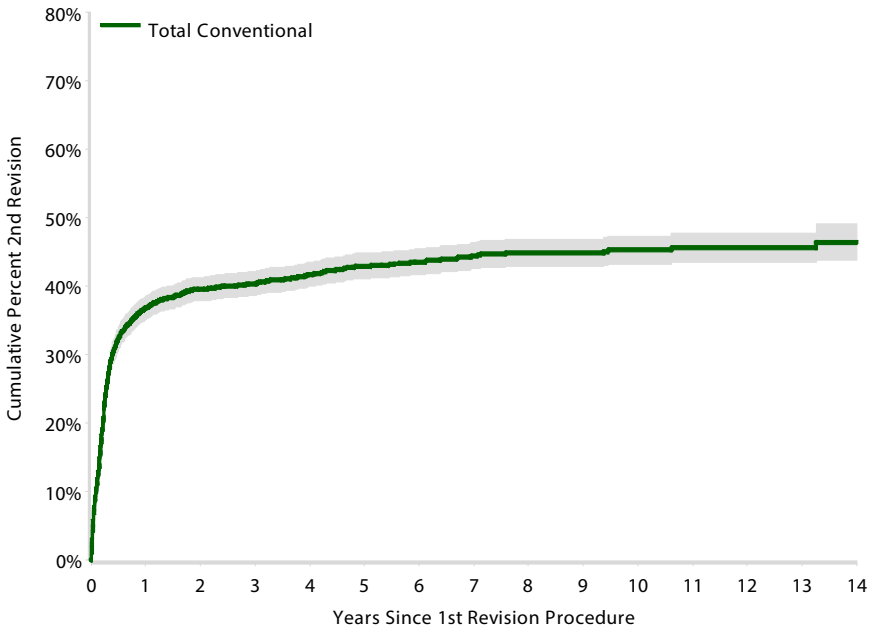
Revision of a primary hip replacement for infection carries a high risk of requiring a 2nd revision for any reason, with a 10 year cumulative percent 2nd revision of 45.3% (Table IF11 and Figure IF19). This includes 623 revision procedures where a 2nd major revision occurred within 6 months of the 1st revision for infection, which are likely to be intended two stage revisions.

Table IF11 Cumulative Percent 2nd Revision of Known Primary Total Conventional Hip Replacement (Primary Diagnosis OA, 1st Revision for Infection)

Type of Primary	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Total Conventional	1338	3352	36.8 (35.2, 38.5)	40.3 (38.6, 42.1)	43.0 (41.2, 44.8)	44.4 (42.5, 46.4)	45.3 (43.3, 47.3)	45.6 (43.5, 47.8)
TOTAL	**1338**	**3352**						

Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded
Includes all septic 1st revisions (i.e. including two stage)

Figure IF19 Cumulative Percent 2nd Revision of Known Primary Total Conventional Hip Replacement (Primary Diagnosis OA, 1st Revision for Infection)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Total Conventional	3352	1798	1232	773	444	200	114

Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded
Includes all septic 1st revisions (i.e. including two stage)

OUTCOME OF DAIR PROCEDURES

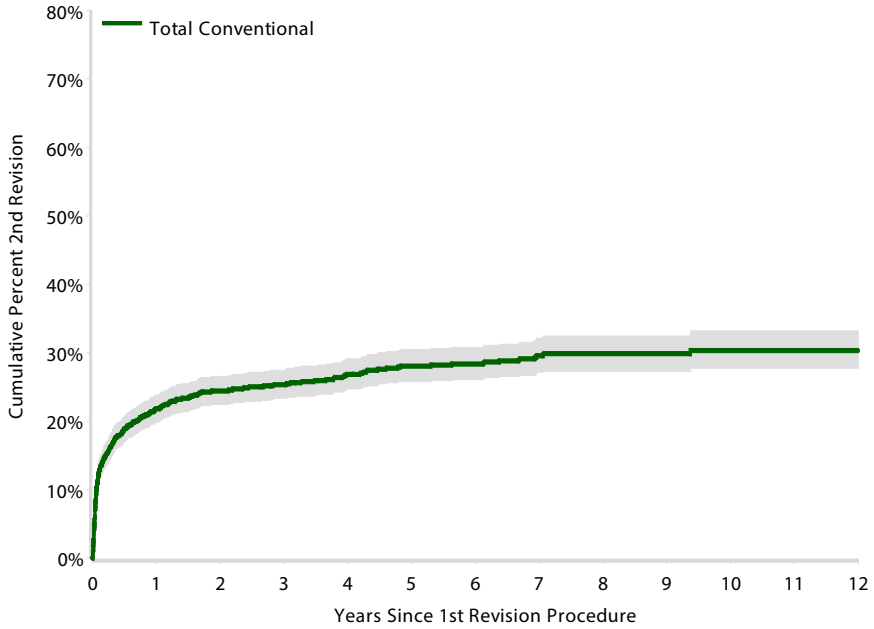
A DAIR procedure undertaken as the 1st revision procedure of a primary conventional hip replacement has a 10 year cumulative percent 2nd revision of 30.3% (Table IF12 and Figure IF20). Timing of the DAIR procedure affects the risk of a 2nd revision. An early DAIR (performed within 3 months of the primary procedure) has a lower rate of 2nd revision when compared to a DAIR procedure after 3 months (late DAIR) from one month following the 1st revision procedure. In the first month only after the 1st revision, early DAIR has a higher rate of 2nd revision (Table IF13 and Figure IF21). In the first 2 weeks following the 1st revision, DAIR procedures performed within 4 weeks of the primary procedure have a higher rate of revision than DAIR procedures performed between 4 weeks and 3 months after the primary procedure. After this time there is no difference (Table IF14 and Figure IF22).

Table IF12 Cumulative Percent 2nd Revision of Known Primary Total Conventional Hip Replacement (Primary Diagnosis OA, DAIR 1st Revision for Infection)

Type of Primary	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Total Conventional	459	1801	21.8 (19.9, 23.9)	25.3 (23.3, 27.5)	28.1 (25.8, 30.4)	29.6 (27.1, 32.1)	30.3 (27.7, 33.1)	30.3 (27.7, 33.1)
TOTAL	**459**	**1801**						

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

Figure IF20 Cumulative Percent 2nd Revision of Known Primary Total Conventional Hip Replacement (Primary Diagnosis OA, DAIR 1st Revision for Infection)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Total Conventional	1801	1186	808	490	271	105	61

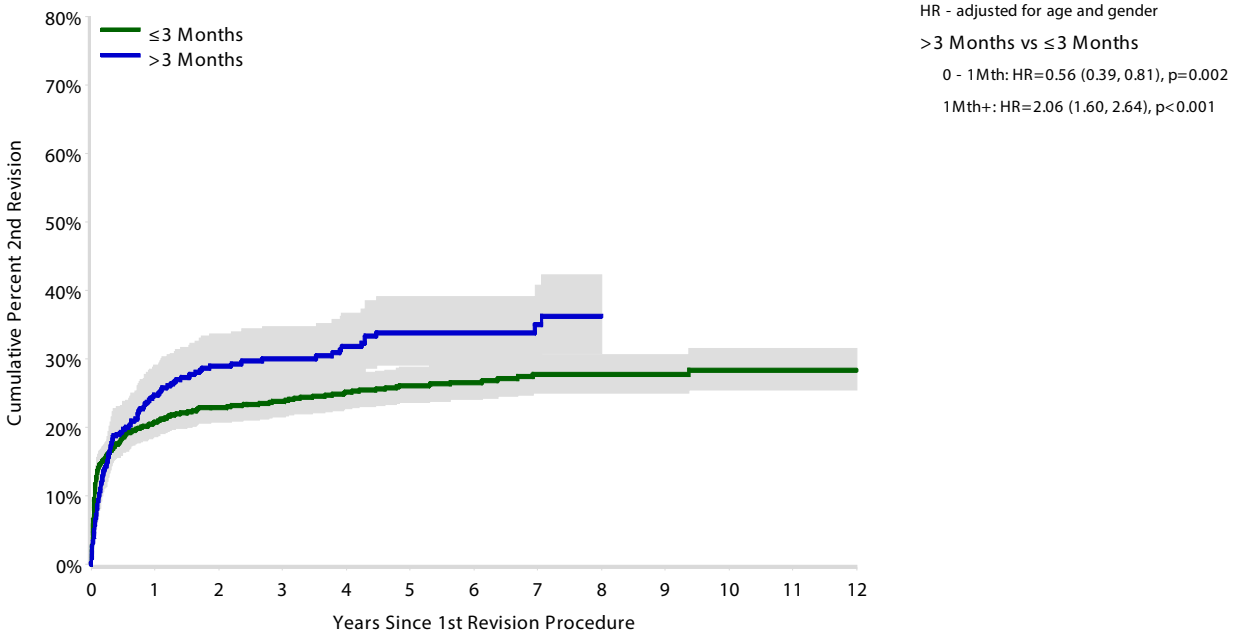
Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded

Table IF13 Cumulative Percent 2nd Revision of Known Primary Total Conventional Hip Replacement by Time to 1st Revision (Primary Diagnosis OA, DAIR 1st Revision for Infection)

Time to 1st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
≤3 Months	323	1338	20.8 (18.7, 23.2)	23.8 (21.5, 26.2)	26.2 (23.7, 28.8)	27.7 (25.0, 30.7)	28.3 (25.4, 31.5)	28.3 (25.4, 31.5)
>3 Months	136	463	24.8 (21.0, 29.1)	30.0 (25.8, 34.7)	33.9 (29.2, 39.1)	35.1 (30.0, 40.7)		
TOTAL	**459**	**1801**						

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

Figure IF21 Cumulative Percent 2nd Revision of Known Primary Total Conventional Hip Replacement by Time to 1st Revision (Primary Diagnosis OA, DAIR 1st Revision for Infection)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
≤3 Months	1338	900	617	384	217	92	51
>3 Months	463	286	191	106	54	13	10

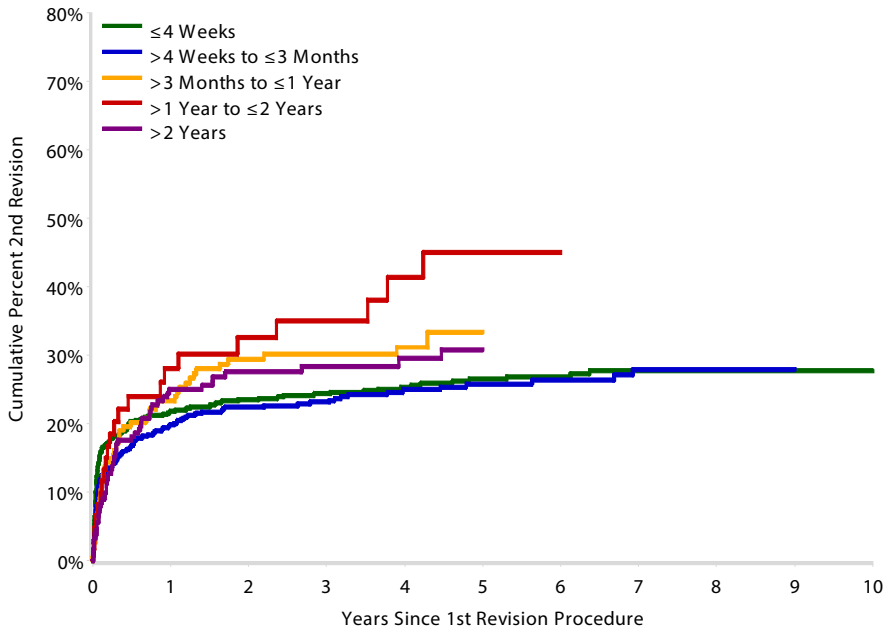
Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded

Table IF14 Cumulative Percent 2nd Revision of Known Primary Total Conventional Hip Replacement by Time to 1st Revision (Primary Diagnosis OA, DAIR 1st Revision for Infection)

Time to 1st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
≤4 Weeks	171	686	21.8 (18.8, 25.1)	24.4 (21.2, 27.9)	26.5 (23.2, 30.3)	27.7 (24.2, 31.7)	27.7 (24.2, 31.7)	
>4 Weeks to ≤3 Months	152	652	19.9 (16.9, 23.2)	23.1 (19.9, 26.8)	25.8 (22.3, 29.8)	28.0 (23.8, 32.6)		
>3 Months to ≤1 Year	54	186	23.3 (17.7, 30.4)	30.2 (23.8, 37.8)	33.4 (26.5, 41.6)			
>1 Year to ≤2 Years	23	61	28.1 (18.2, 41.9)	35.0 (23.7, 49.6)	45.0 (31.4, 61.3)			
>2 Years	59	216	25.0 (19.6, 31.6)	28.4 (22.5, 35.4)	30.9 (24.4, 38.5)			
TOTAL	**459**	**1801**						

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

Figure IF22 Cumulative Percent 2nd Revision of Known Primary Total Conventional Hip Replacement by Time to 1st Revision (Primary Diagnosis OA, DAIR 1st Revision for Infection)



HR - adjusted for age and gender

>4 Weeks to ≤3 Months vs ≤4 Weeks
0 - 2Wk: HR=0.62 (0.41, 0.94), p=0.025
2Wk+: HR=1.09 (0.84, 1.40), p=0.512

>3 Months to ≤1 Year vs ≤4 Weeks
0 - 1Mth: HR=0.53 (0.31, 0.91), p=0.021
1Mth+: HR=1.89 (1.30, 2.75), p<0.001

>1 Year to ≤2 Years vs ≤4 Weeks
0 - 1Mth: HR=0.58 (0.24, 1.43), p=0.237
1Mth+: HR=3.12 (1.88, 5.17), p<0.001

>2 Years vs ≤4 Weeks
0 - 1Mth: HR=0.47 (0.27, 0.83), p=0.008
1Mth+: HR=2.13 (1.49, 3.04), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
≤4 Weeks	686	466	340	221	135	55	29
>4 Weeks to ≤3 Months	652	434	277	163	82	37	22
>3 Months to ≤1 Year	186	119	85	49	22	5	4
>1 Year to ≤2 Years	61	34	24	11	7	2	2
>2 Years	216	133	82	46	25	6	4

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

COMPARATIVE OUTCOMES OF REVISION PROCEDURES

A single stage 1st revision for infection involves revision of the major components of the hip replacement. For the purposes of this analysis, the Registry defines a single stage revision of a primary hip replacement as a major revision for infection that is not classified as a two stage revision. The single stage revision group may include a small number of patients who have died before a planned second stage or those who have chosen not to have a further procedure.

In the following analysis, potential two stage revisions have been identified as 1st revision procedures where either:
i) the 1st revision was for infection and the type of revision recorded was removal of prostheses or a cement spacer; or
ii) a planned second stage was noted on the data collection form, and where a 2nd major revision was performed for infection. Revisions that were initially planned as two stage procedures but did not result in a second revision for infection, have been classified as incomplete two stage procedures.

The Registry has made the assumption that in the majority of cases, a fully cemented major component revision for infection is likely to represent a prosthesis combination designed to act as a highly functional spacer until a definitive prosthesis is subsequently inserted. This form of revision is therefore also classified as a two stage procedure in terms of an analysis by intention to treat. This group is included in the two stage revision analysis.

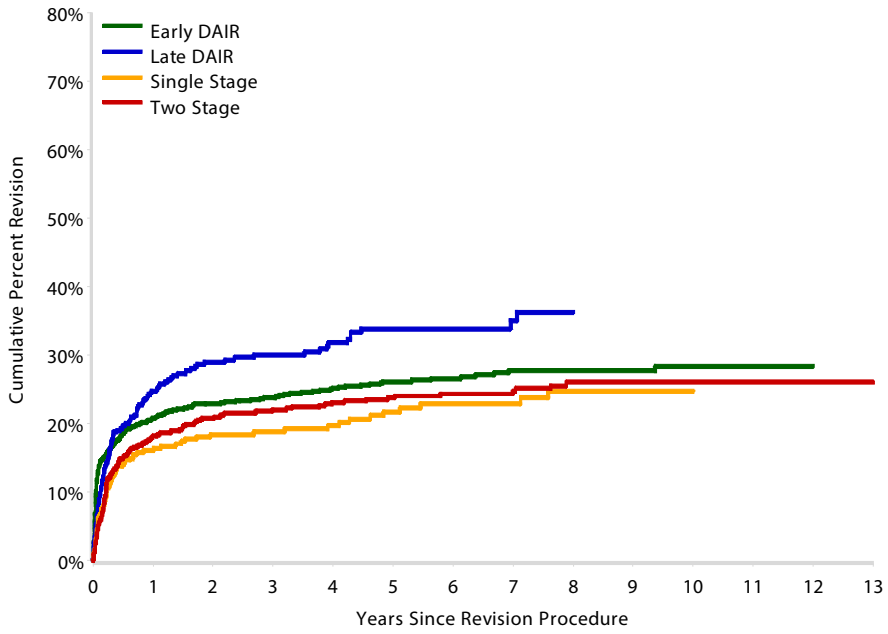
After one month, late DAIR procedures have a higher rate of further revision compared to early DAIR procedures. Compared to single and two stage revision procedures, late DAIR procedures have a higher rate of revision at all follow-up times. Early DAIR procedures have a higher rate of revision than single stage procedures in the first 2 weeks only. After this time, there is no difference. There is no difference in the rate of subsequent revision between single and two stage revision procedures (Table IF15 and Figure IF23).

Table IF15 Cumulative Percent Revision of Known Primary Total Conventional Hip Replacement by Management Strategy (Primary Diagnosis OA, 1st Revision for Infection)

Management Strategy	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Early DAIR	323	1338	20.8 (18.7, 23.2)	23.8 (21.5, 26.2)	26.2 (23.7, 28.8)	27.7 (25.0, 30.7)	28.3 (25.4, 31.5)	28.3 (25.4, 31.5)
Late DAIR	136	463	24.8 (21.0, 29.1)	30.0 (25.8, 34.7)	33.9 (29.2, 39.1)	35.1 (30.0, 40.7)		
Single Stage	77	371	16.1 (12.7, 20.4)	18.8 (15.1, 23.4)	21.7 (17.5, 26.7)	22.9 (18.5, 28.1)	24.7 (19.9, 30.5)	
Two Stage	162	699	18.1 (15.4, 21.2)	22.0 (19.1, 25.4)	23.8 (20.7, 27.3)	24.7 (21.5, 28.4)	26.0 (22.5, 29.9)	26.0 (22.5, 29.9)
TOTAL	**698**	**2871**						

Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded
For DAIR and single stage revisions, time to revision is reported as time to 2nd revision
For two stage revisions, time to revision is reported as time to 3rd revision
Excludes incomplete two stage procedures

Figure IF23 Cumulative Percent Revision of Known Primary Total Conventional Hip Replacement by Management Strategy (Primary Diagnosis OA, 1st Revision for Infection)



HR - adjusted for age and gender

Early DAIR vs Late DAIR

0 - 1Mth: HR=1.71 (1.29, 2.28), p<0.001

1Mth+: HR=0.49 (0.39, 0.63), p<0.001

Single Stage vs Late DAIR

Entire Period: HR=0.60 (0.46, 0.80), p<0.001

Two Stage vs Late DAIR

Entire Period: HR=0.65 (0.52, 0.82), p<0.001

Early DAIR vs Single Stage

0 - 2Wk: HR=3.85 (2.49, 5.97), p<0.001

2Wk+: HR=1.03 (0.80, 1.34), p=0.813

Two Stage vs Single Stage

Entire Period: HR=1.08 (0.82, 1.42), p=0.574

Early DAIR vs Two Stage

0 - 2Wk: HR=3.58 (2.38, 5.38), p<0.001

2Wk - 1Mth: HR=2.01 (1.39, 2.90), p<0.001

1Mth+: HR=0.76 (0.60, 0.95), p=0.016

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Early DAIR	1338	900	617	384	217	92	51
Late DAIR	463	286	191	106	54	13	10
Single Stage	371	272	198	144	90	49	29
Two Stage	699	521	404	302	198	97	56

Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded
Adjustment for age is for age at 1st revision
For DAIR and single stage revisions, time to revision is reported as time to 2nd revision
For two stage revisions, time to revision is reported as time to 3rd revision
Excludes incomplete two stage procedures

COMPARATIVE OUTCOMES OF TIMING OF TWO STAGE REVISION PROCEDURES

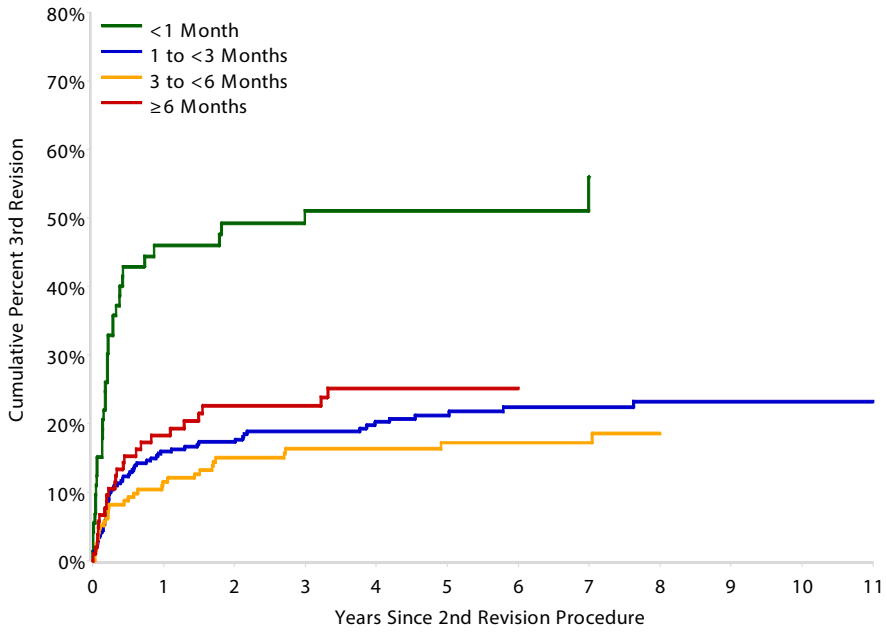
The risk of a 3rd revision of a primary hip replacement revised for infection in a two stage process is highest if the second stage is performed within 1 month of the first stage. For two stage revisions where the second stage was more than one month after the first stage, there is no difference in the rate of 3rd revision when the timing of the second stage is considered (Table IF16 and Figure IF24).

Table IF16 Cumulative Percent 3rd Revision of Known Primary Total Conventional Hip Replacement by Time Between 1st and 2nd Revision Procedure (Primary Diagnosis OA, 1st Revision for Infection)

Time Between 1st and 2nd Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
<1 Month	37	73	45.9 (35.2, 58.1)	51.0 (39.9, 63.3)	51.0 (39.9, 63.3)	55.9 (42.6, 70.1)		
1 to <3 Months	67	323	15.9 (12.3, 20.4)	18.8 (14.9, 23.7)	21.2 (16.9, 26.4)	22.4 (17.9, 27.8)	23.2 (18.5, 28.9)	
3 to <6 Months	32	198	11.5 (7.7, 16.9)	16.3 (11.6, 22.5)	17.2 (12.3, 23.6)	17.2 (12.3, 23.6)		
≥6 Months	26	105	18.3 (12.1, 27.1)	22.5 (15.6, 32.0)	25.1 (17.6, 35.0)			
TOTAL	**162**	**699**						

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

Figure IF24 Cumulative Percent 3rd Revision of Known Primary Total Conventional Hip Replacement by Time Between 1st and 2nd Revision Procedure (Primary Diagnosis OA, 1st Revision for Infection)



HR - adjusted for age and gender

<1 Month vs 3 to <6 Months
Entire Period: HR=4.63 (2.87, 7.47), p<0.001

1 to <3 Months vs 3 to <6 Months
Entire Period: HR=1.29 (0.85, 1.97), p=0.232

≥6 Months vs 3 to <6 Months
Entire Period: HR=1.53 (0.91, 2.57), p=0.107

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
<1 Month	73	35	27	16	9	6	5
1 to <3 Months	323	250	188	147	101	52	31
3 to <6 Months	198	155	128	91	62	26	13
≥6 Months	105	81	61	48	26	13	7

Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded
Adjustment for age is for age at 1st revision

OUTCOMES OF REVISION FOR INFECTION OVER TIME

The cumulative percent 2nd revision of a known primary hip replacement following 1st revision for infection has reduced over successive 5 year intervals since inception of data collection by the Registry. The 3 year cumulative percent 2nd revision of a primary hip replacement revised for infection has fallen from 47.3% in 2003–2007 to 37.2% in 2018–2022 (Table IF17 and Figure IF25).

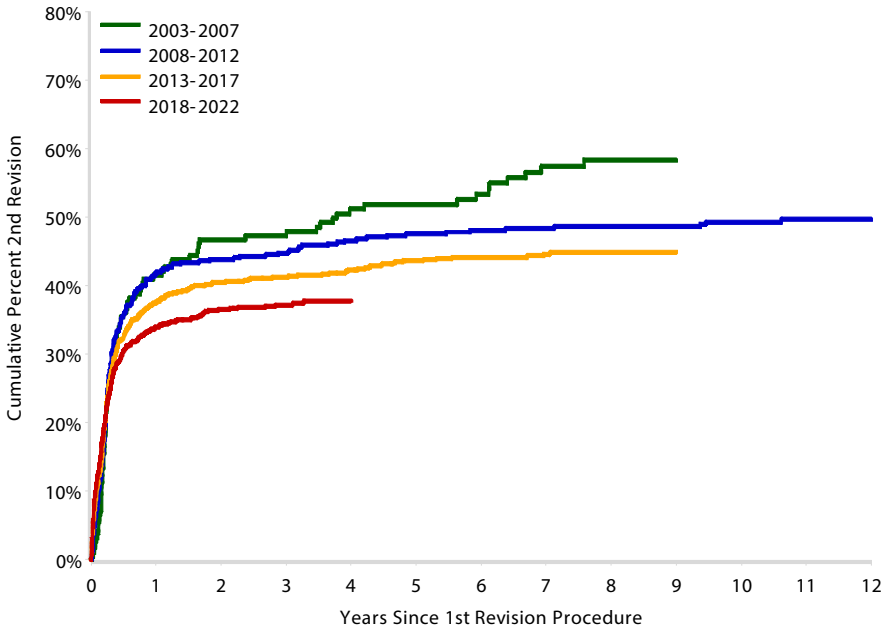
The cumulative percent 2nd revision of a primary hip replacement for infection via a DAIR procedure or a single stage revision has remained static comparing the time periods pre-2013 to 2013–2022. The 7 year cumulative percent 3rd revision of a primary hip replacement for infection via a two stage procedure has increased from 18.5% pre-2013 to 27% in 2013–2022 (Table IF18, Figure IF26 and Figure IF27).

Table IF17 Cumulative Percent 2nd Revision of Known Primary Total Conventional Hip Replacement by Year of 1st Revision (Primary Diagnosis OA, 1st Revision for Infection)

Year of 1st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
2003–2007	104	189	41.5 (34.8, 49.0)	47.3 (40.4, 54.8)	51.8 (44.7, 59.4)	57.4 (50.0, 65.0)		
2008–2012	224	466	41.8 (37.5, 46.5)	44.7 (40.3, 49.4)	47.6 (43.1, 52.3)	48.3 (43.8, 53.1)	49.3 (44.7, 54.0)	49.7 (45.1, 54.5)
2013–2017	442	1027	37.6 (34.7, 40.7)	41.2 (38.2, 44.4)	43.7 (40.7, 46.9)	44.6 (41.5, 47.8)		
2018–2022	557	1644	34.0 (31.6, 36.4)	37.2 (34.7, 39.8)				
TOTAL	**1327**	**3326**						

Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded
Procedures prior to full national data collection in 2003 have been excluded

Figure IF25 Cumulative Percent 2nd Revision of Known Primary Total Conventional Hip Replacement by Year of 1st Revision (Primary Diagnosis OA, 1st Revision for Infection)



HR - adjusted for age and gender

2003-2007 vs 2018-2022
- 0 - 1Mth: HR=0.28 (0.12, 0.62), p=0.001
- 1Mth - 3Mth: HR=1.77 (1.26, 2.49), p<0.001
- 3Mth - 6Mth: HR=1.67 (1.07, 2.60), p=0.023
- 6Mth+: HR=2.60 (1.74, 3.87), p<0.001

2008-2012 vs 2018-2022
- 0 - 2Wk: HR=0.34 (0.18, 0.66), p=0.001
- 2Wk - 1Mth: HR=0.91 (0.58, 1.43), p=0.682
- 1Mth - 6Mth: HR=1.52 (1.23, 1.86), p<0.001
- 6Mth+: HR=1.51 (1.07, 2.13), p=0.019

2013-2017 vs 2018-2022
- 0 - 1Mth: HR=0.88 (0.69, 1.12), p=0.309
- 1Mth - 6Mth: HR=1.19 (1.00, 1.42), p=0.049
- 6Mth+: HR=1.36 (1.02, 1.82), p=0.038

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
2003–2007	189	103	84	69	51	37	34
2008–2012	466	263	241	212	184	153	72
2013–2017	1027	610	538	480	197	0	0
2018–2022	1644	808	356	0	0	0	0

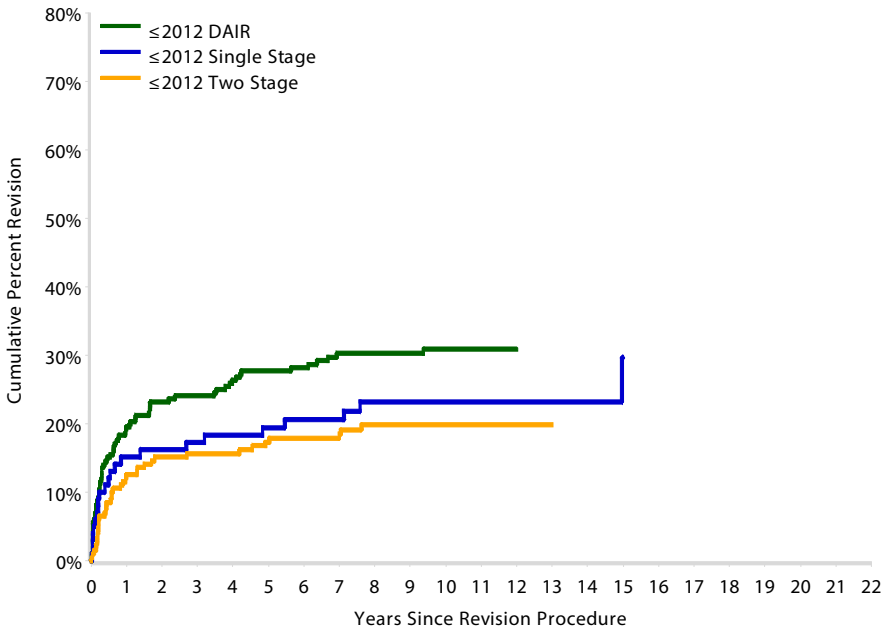
Note: Restricted to modern prostheses. All procedures using metal/metal prostheses have been excluded
Procedures prior to full national data collection in 2003 have been excluded

Table IF18 Cumulative Percent Revision of Known Primary Total Conventional Hip Replacement by Year of 1st Revision and Management Strategy (Primary Diagnosis OA, 1st Revision for Infection)

Year of 1st Revision	Management Strategy	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
≤2012	DAIR	75	260	19.6 (15.2, 25.0)	24.1 (19.3, 29.9)	27.7 (22.6, 33.8)	30.3 (24.9, 36.5)	30.9 (25.4, 37.2)	30.9 (25.4, 37.2)
	Single Stage	23	100	15.2 (9.4, 23.9)	17.3 (11.1, 26.3)	19.5 (12.9, 28.8)	20.6 (13.8, 30.1)	23.3 (15.9, 33.2)	23.3 (15.9, 33.2)
	Two Stage	39	200	12.6 (8.7, 18.1)	15.7 (11.3, 21.5)	17.3 (12.7, 23.4)	18.5 (13.7, 24.8)	19.8 (14.8, 26.3)	19.8 (14.8, 26.3)
2013–2022	DAIR	384	1541	22.2 (20.1, 24.4)	25.5 (23.3, 27.8)	28.0 (25.5, 30.6)	28.7 (26.1, 31.5)		
	Single Stage	54	271	16.5 (12.5, 21.5)	19.4 (15.0, 24.9)	22.9 (17.7, 29.3)			
	Two Stage	123	499	20.3 (17.0, 24.2)	24.7 (21.0, 28.9)	26.4 (22.5, 30.8)	27.0 (23.0, 31.6)		
TOTAL		**698**	**2871**						

Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded
Adjustment for age is for age at 1st revision
For DAIR and single stage revisions, time to revision is reported as time to 2nd revision
For two stage revisions, time to revision is reported as time to 3rd revision

Figure IF26 Cumulative Percent Revision of Known Primary Total Conventional Hip Replacement by Management Strategy (Primary Diagnosis OA, 1st Revision for Infection, 1st Revisions Performed in ≤2012)



HR - adjusted for age and gender

≤2012 DAIR vs ≤2012 Two Stage

Entire Period: HR=1.81 (1.22, 2.69), p=0.003

≤2012 DAIR vs ≤2012 Single Stage

Entire Period: HR=1.46 (0.91, 2.35), p=0.113

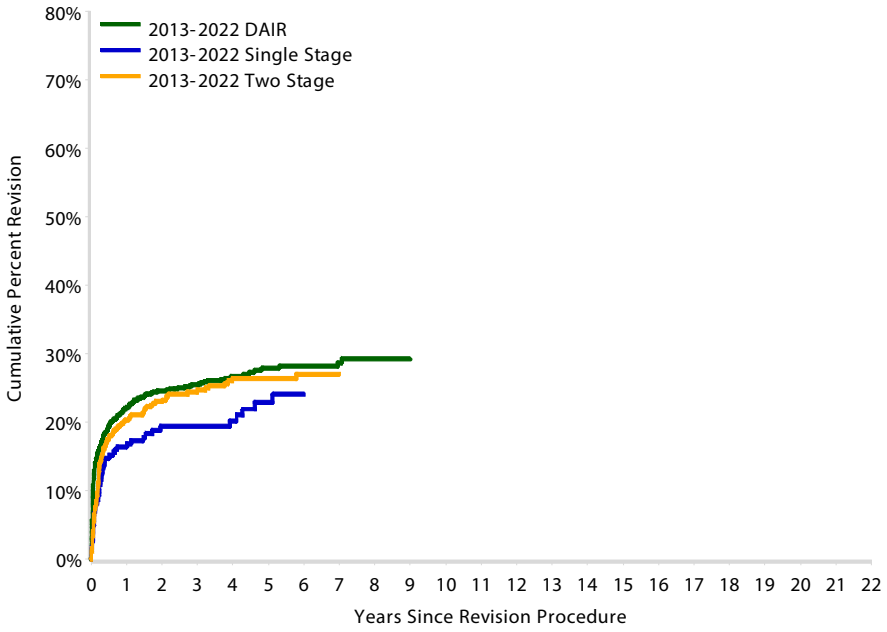
≤2012 Single Stage vs ≤2012 Two Stage

Entire Period: HR=1.24 (0.74, 2.08), p=0.415

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
≤2012	DAIR	260	199	177	153	133	105	61
	Single Stage	100	82	77	71	61	49	29
	Two Stage	200	173	159	146	128	97	56

Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded
Adjustment for age is for age at 1st revision
For DAIR and single stage revisions, time to revision is reported as time to 2nd revision
For two stage revisions, time to revision is reported as time to 3rd revision

Figure IF27 Cumulative Percent Revision of Known Primary Total Conventional Hip Replacement by Management Strategy (Primary Diagnosis OA, 1st Revision for Infection, 1st Revisions Performed in 2013–2022)



HR - adjusted for age and gender

2013-2022 DAIR vs 2013-2022 Single Stage

0 - 2Wk: HR=3.88 (2.19, 6.87), p<0.001

2Wk+: HR=1.10 (0.82, 1.47), p=0.536

2013-2022 DAIR vs 2013-2022 Two Stage

0 - 2Wk: HR=3.20 (1.88, 5.47), p<0.001

2Wk+: HR=0.91 (0.73, 1.13), p=0.369

2013-2022 Two Stage vs 2013-2022 Single Stage

Entire Period: HR=1.21 (0.88, 1.67), p=0.238

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
2013–2022	DAIR	1541	987	631	337	138	0	0
	Single Stage	271	190	121	73	29	0	0
	Two Stage	499	348	245	156	70	0	0

Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded
Adjustment for age is for age at 1st revision
For DAIR and single stage revisions, time to revision is reported as time to 2nd revision
For two stage revisions, time to revision is reported as time to 3rd revision

MORTALITY FOLLOWING REVISION FOR INFECTION

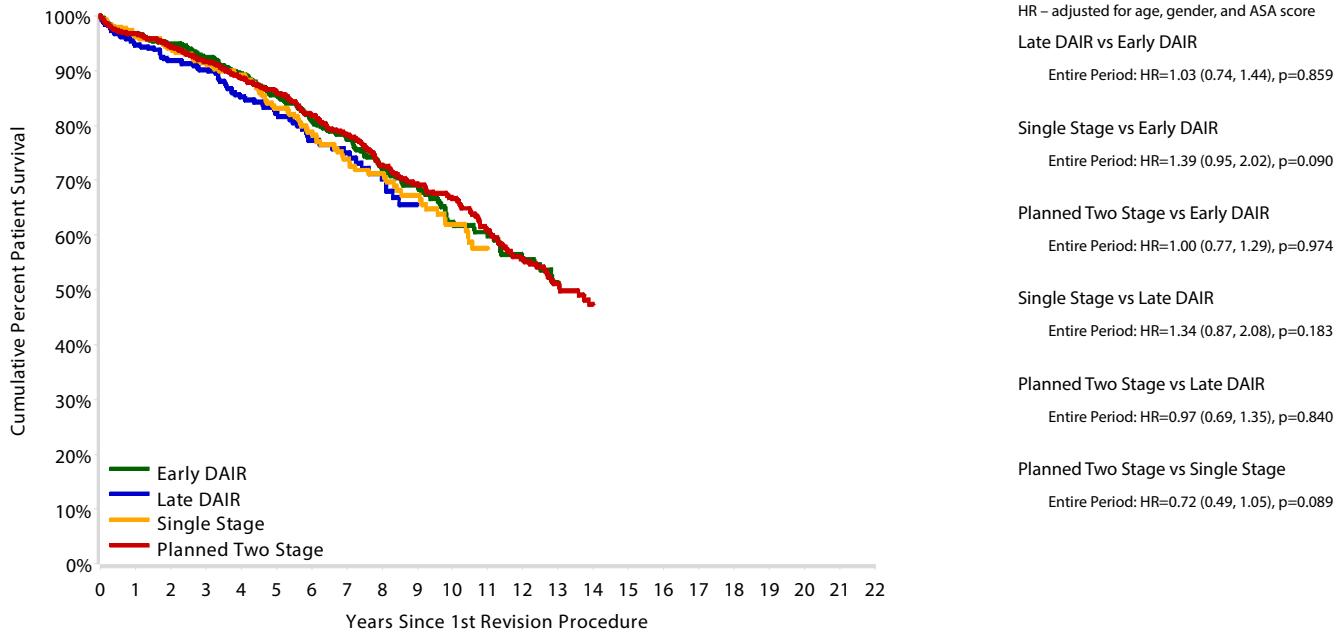
There is no difference in mortality when revision for infection using DAIR procedures, single stage or two stage revision procedures are compared (Table IF19 and Figure IF28). There is a higher rate of mortality within the first 3 months for revision for infection compared to revision for other diagnoses. Revision for fracture has a higher rate of mortality compared to revision for infection and revision for other diagnoses in the first 4.5 years following the revision procedure (Table IF20 and Figure IF29).

Table IF19 Cumulative Percent Survival of Patients with Known Primary Total Conventional Hip Replacement Since 1st Revised by Intended Treatment Strategy (Primary Diagnosis OA)

Intended Treatment Strategy	N Deceased	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Early DAIR	234	1325	96.7 (95.6, 97.6)	92.4 (90.7, 93.9)	85.6 (83.0, 87.8)	77.5 (74.0, 80.5)	62.2 (57.1, 67.0)	55.6 (49.4, 61.3)
Late DAIR	87	456	94.6 (92.1, 96.4)	90.2 (86.8, 92.8)	82.2 (77.3, 86.2)	75.0 (68.6, 80.2)		
Single Stage	91	360	96.5 (93.9, 98.0)	91.6 (87.8, 94.2)	83.1 (77.9, 87.2)	73.9 (67.4, 79.3)	61.9 (54.0, 68.9)	
Planned Two Stage	274	1127	96.7 (95.5, 97.6)	91.7 (89.7, 93.2)	86.3 (83.8, 88.4)	78.3 (75.1, 81.2)	66.6 (62.4, 70.5)	55.7 (50.5, 60.5)
TOTAL	**686**	**3268**						

Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded
Excludes 16 procedures with unknown intended treatment strategy or missing first stage
Restricted to the first revision hip procedure recorded for each patient

Figure IF28 Cumulative Percent Survival of Patients with Known Primary Total Conventional Hip Replacement Since 1st Revised by Intended Treatment Strategy (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Early DAIR	1325	1129	807	511	301	120	67
Late DAIR	456	377	258	154	86	29	21
Single Stage	360	311	237	173	112	60	38
Planned Two Stage	1127	986	779	569	384	204	119

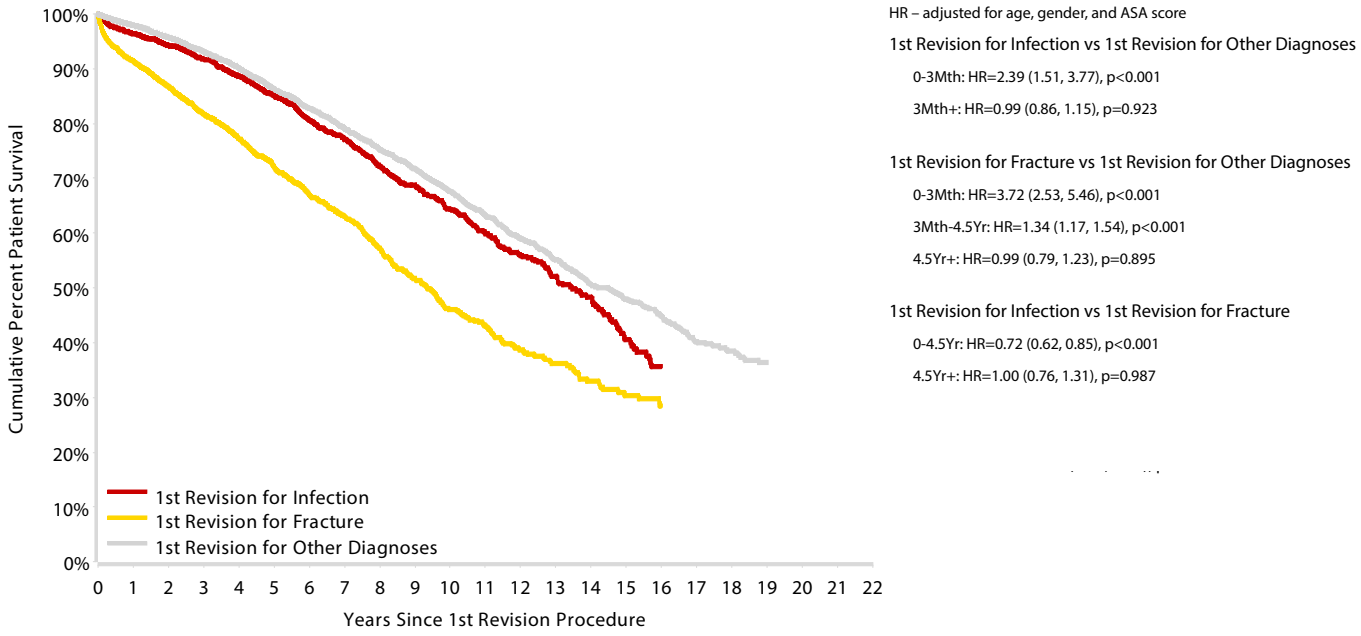
Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded
Restricted to the first revision hip procedure recorded for each patient

Table IF20 Cumulative Percent Survival of Patients with Known Primary Total Conventional Hip Replacement Since 1st Revised by Reason for 1st Revision (Primary Diagnosis OA)

Reason for 1st Revision	N Deceased	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
1st Revision for Infection	691	3284	96.4 (95.7, 97.0)	91.8 (90.7, 92.8)	85.2 (83.6, 86.6)	77.1 (75.1, 78.9)	64.3 (61.5, 67.0)	55.9 (52.6, 59.1)
1st Revision for Fracture	1002	3098	91.4 (90.4, 92.4)	81.8 (80.3, 83.2)	72.2 (70.3, 74.0)	63.0 (60.7, 65.2)	46.1 (43.1, 49.1)	38.7 (35.3, 42.1)
1st Revision for Other Diagnoses	1658	7671	97.9 (97.5, 98.2)	93.1 (92.5, 93.7)	86.3 (85.4, 87.2)	79.1 (77.9, 80.2)	67.6 (65.9, 69.2)	59.0 (57.0, 60.9)
TOTAL	**3351**	**14053**						

Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded
Restricted to the first revision hip procedure recorded for each patient

Figure IF29 Cumulative Percent Survival of Patients with Known Primary Total Conventional Hip Replacement Since 1st Revised by Reason for 1st Revision (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
1st Revision for Infection	3284	2817	2093	1418	892	421	250
1st Revision for Fracture	3098	2551	1813	1167	680	262	139
1st Revision for Other Diagnoses	7671	6901	5387	3779	2525	1285	785

Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded
Restricted to the first revision hip procedure recorded for each patient

Primary Total Knee Replacement – Revision for Infection

The following analyses include primary total knee replacement procedures performed for osteoarthritis and using prostheses that have been available and used in 2022 (described as modern prostheses).

DEMOGRAPHICS

The demographics of 1st revision of known primary total knee replacement for both infection and aseptic reasons are shown in Table IF21. The mean time to 1st revision for infection is shorter than the mean time to 1st revision for aseptic reasons (2.4 ± 3.2 years versus 4.0 ± 3.8 years post primary procedure).

Males account for a higher proportion of revisions for infection than females, at all ages (Figure IF30).

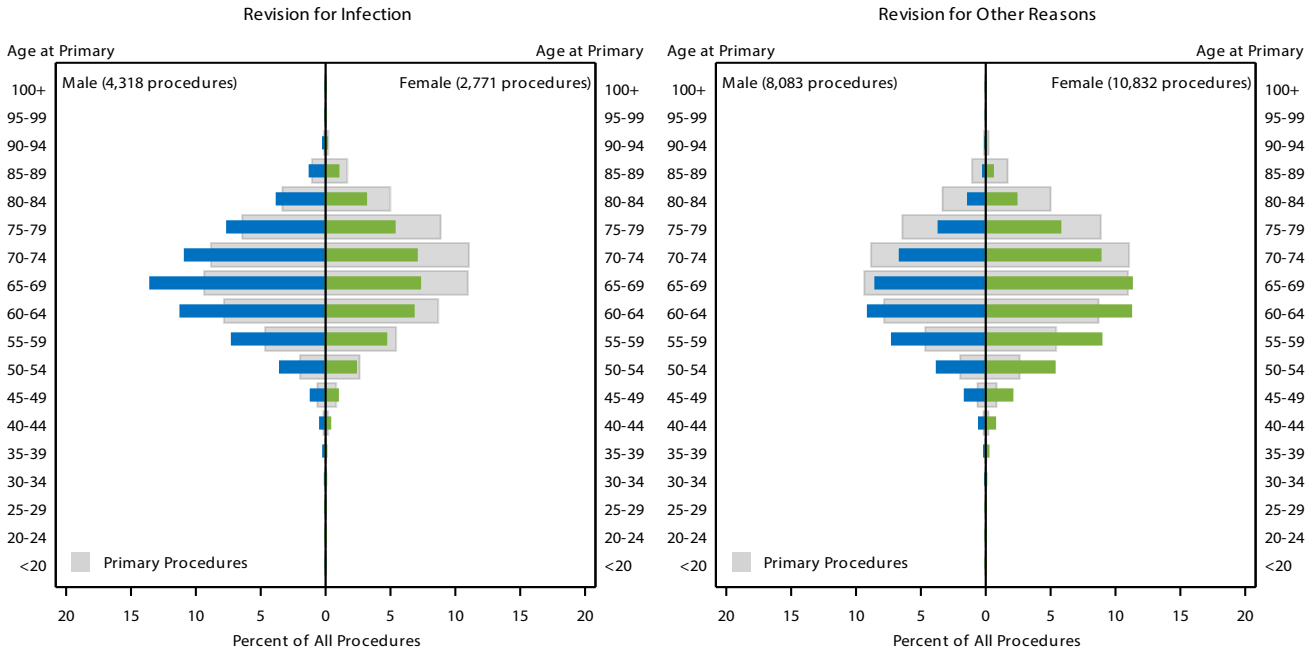
Table IF21 Summary of Known Primary Total Knee Replacement (Primary Diagnosis OA)

Variable	Primary	1st Revision for Infection	1st Revision for Other Reasons	TOTAL
Follow-Up Years (Primary to 1st Revision)				
Mean ± SD	6.7 ± 4.7	2.4 ± 3.2	4 ± 3.8	6.6 ± 4.7
Median (IQR)	5.9 (2.8, 9.8)	1.2 (0.3, 3.2)	2.5 (1.2, 5.6)	5.8 (2.6, 9.6)
Minimum	0	0	0	0
Maximum	23.2	21.3	21.1	23.2
Follow-Up Years (1st Revision to 2nd Revision)				
Mean ± SD		3.3 ± 3.9	5.5 ± 4.3	4.9 ± 4.3
Median (IQR)		1.6 (0.3, 5.1)	4.5 (1.9, 8.1)	3.8 (1.3, 7.5)
Minimum	.	0	0	0
Maximum	.	21.3	21.9	21.9
Age at Primary				
Mean ± SD	68.5 ± 9.1	67 ± 9.4	64.3 ± 9.2	68.4 ± 9.1
Median (IQR)	69 (62, 75)	67 (61, 74)	64 (58, 71)	69 (62, 75)
Primary Hospital Calendar Year Volume				
Mean ± SD	285 ± 234	271.9 ± 229.8	296.8 ± 251	285.2 ± 234.4
Median (IQR)	217.2 (117.5, 369.3)	207.4 (115.9, 353.2)	219.7 (117.4, 400.6)	217.2 (117.5, 393.5)
Gender at Primary				
Male	329,680 (44.4%)	4,318 (60.9%)	8,083 (42.7%)	342,081 (44.6%)
Female	412,167 (55.6%)	2,771 (39.1%)	10,832 (57.3%)	425,770 (55.4%)
ASA Score at Primary[1]				
ASA 1	27,557 (5.6%)	176 (4.3%)	541 (6.6%)	28,274 (5.6%)
ASA 2	266,765 (54.3%)	1,781 (43.4%)	4,539 (55.7%)	273,085 (54.2%)
ASA 3	191,845 (39%)	2,047 (49.9%)	2,988 (36.6%)	196,880 (39.1%)
ASA 4 or 5	5,117 (1%)	96 (2.3%)	86 (1.1%)	5,299 (1.1%)
ASA Score at 1st Revision[2]				
ASA 1		97 (1.8%)	558 (4.1%)	655 (3.5%)
ASA 2		1,636 (31.2%)	6,410 (47.2%)	8,046 (42.7%)
ASA 3		3,073 (58.6%)	6,313 (46.4%)	9,386 (49.8%)
ASA 4 or 5		440 (8.4%)	313 (2.3%)	753 (4%)
BMI Category at Primary[3]				
Underweight (<18.50)	736 (0.2%)	4 (0.1%)	10 (0.2%)	750 (0.2%)
Normal (18.50-24.99)	42,319 (10.4%)	267 (8.4%)	534 (9.4%)	43,120 (10.4%)
Pre Obese (25.00-29.99)	126,749 (31.3%)	887 (28%)	1,723 (30.3%)	129,359 (31.2%)
Obese Class 1 (30.00-34.99)	125,421 (30.9%)	936 (29.5%)	1,829 (32.1%)	128,186 (31%)
Obese Class 2 (35.00-39.99)	68,501 (16.9%)	553 (17.5%)	1,007 (17.7%)	70,061 (16.9%)
Obese Class 3 (≥40.00)	41,547 (10.3%)	522 (16.5%)	589 (10.3%)	42,658 (10.3%)

Variable	Primary	1st Revision for Infection	1st Revision for Other Reasons	TOTAL
BMI Category at 1st Revision[4]				
Underweight (<18.50)		15 (0.4%)	27 (0.2%)	42 (0.3%)
Normal (18.50-24.99)		452 (12.3%)	1,066 (9.6%)	1,518 (10.3%)
Pre Obese (25.00-29.99)		1,080 (29.3%)	3,240 (29.2%)	4,320 (29.2%)
Obese Class 1 (30.00-34.99)		1,040 (28.2%)	3,506 (31.6%)	4,546 (30.7%)
Obese Class 2 (35.00-39.99)		609 (16.5%)	1,987 (17.9%)	2,596 (17.6%)
Obese Class 3 (≥40.00)		487 (13.2%)	1,280 (11.5%)	1,767 (11.9%)
Bearing Surface in Primary[5]				
Non XLPE	358,667 (48.4%)	3,842 (54.2%)	12,661 (66.9%)	375,170 (48.9%)
XLPE	382,778 (51.6%)	3,246 (45.8%)	6,251 (33.1%)	392,275 (51.1%)
Primary Hospital Type				
Public Hospital	219,123 (29.5%)	2,488 (35.1%)	4,891 (25.9%)	226,502 (29.5%)
Private Hospital	522,724 (70.5%)	4,601 (64.9%)	14,024 (74.1%)	541,349 (70.5%)
Primary Hospital Location[6]				
Urban	554,164 (75%)	5,250 (74.3%)	14,394 (76.5%)	573,808 (75%)
Rural	185,136 (25%)	1,819 (25.7%)	4,413 (23.5%)	191,368 (25%)
Primary Hospital Calendar Year Volume				
1st Quartile	30,379 (4.1%)	304 (4.3%)	906 (4.8%)	31,589 (4.1%)
2nd Quartile	130,293 (17.6%)	1,316 (18.6%)	3,311 (17.5%)	134,920 (17.6%)
3rd Quartile	194,703 (26.2%)	2,034 (28.7%)	4,855 (25.7%)	201,592 (26.3%)
4th Quartile	386,472 (52.1%)	3,435 (48.5%)	9,843 (52%)	399,750 (52.1%)
TOTAL	**741,847**	**7,089**	**18,915**	**767,851**

Note: Restricted to modern prostheses
Abbreviations: SD – standard deviation, IQR – interquartile range, ASA – American Society of Anesthesiologists, BMI – Body Mass Index (kg/m^2)
[1] Excludes 264,313 procedures with unknown ASA score at primary
[2] Excludes 7,164 procedures with unknown ASA score at 1st revision
[3] Excludes 353,717 procedures with unknown BMI Category at Primary
[4] Excludes 11,215 procedures with unknown BMI category at 1st revision
[5] Excludes 406 procedures with unknown bearing surface in primary
[6] Excludes 2,675 procedures with unknown primary hospital location

Figure IF30 1st Revision of Known Primary Total Knee Replacement by Age and Gender (Primary Diagnosis OA)



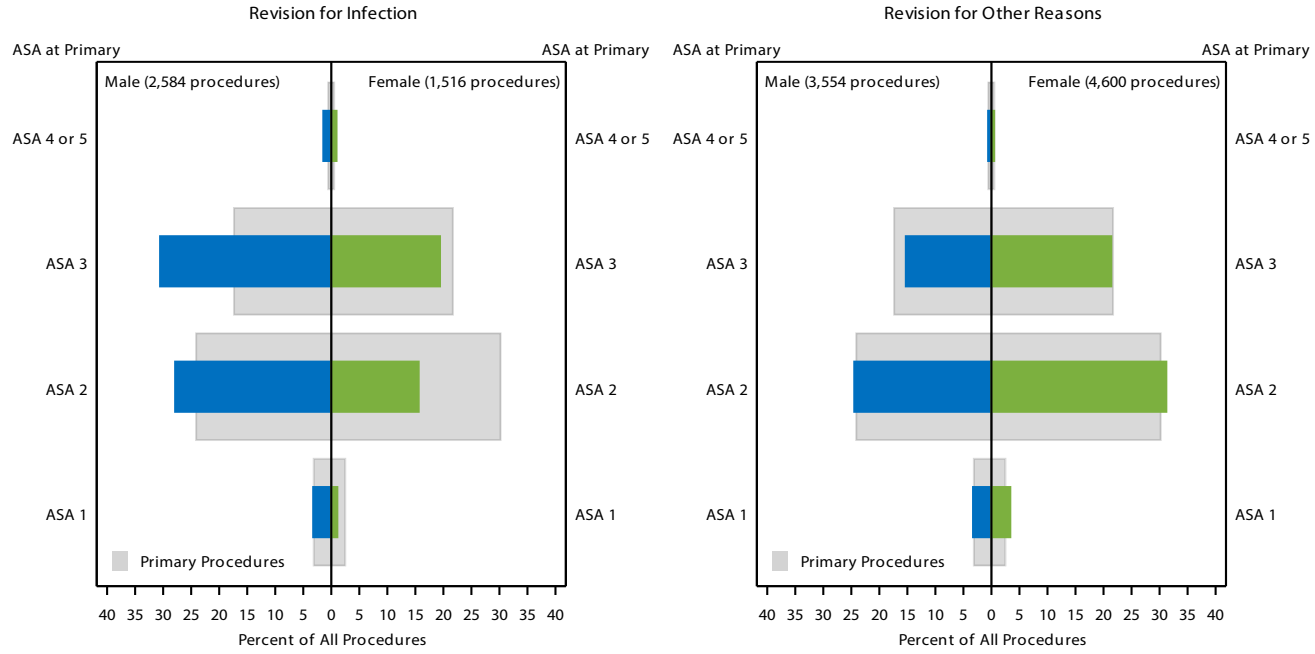
Note: Restricted to modern prostheses

ASA Score and BMI Category

Males with an ASA score of ≥2 have a relatively higher risk of revision for infection than females. In contrast, the proportions of males and females having revisions for aseptic reasons are similar to those of primary total knee replacements (Figure IF31).

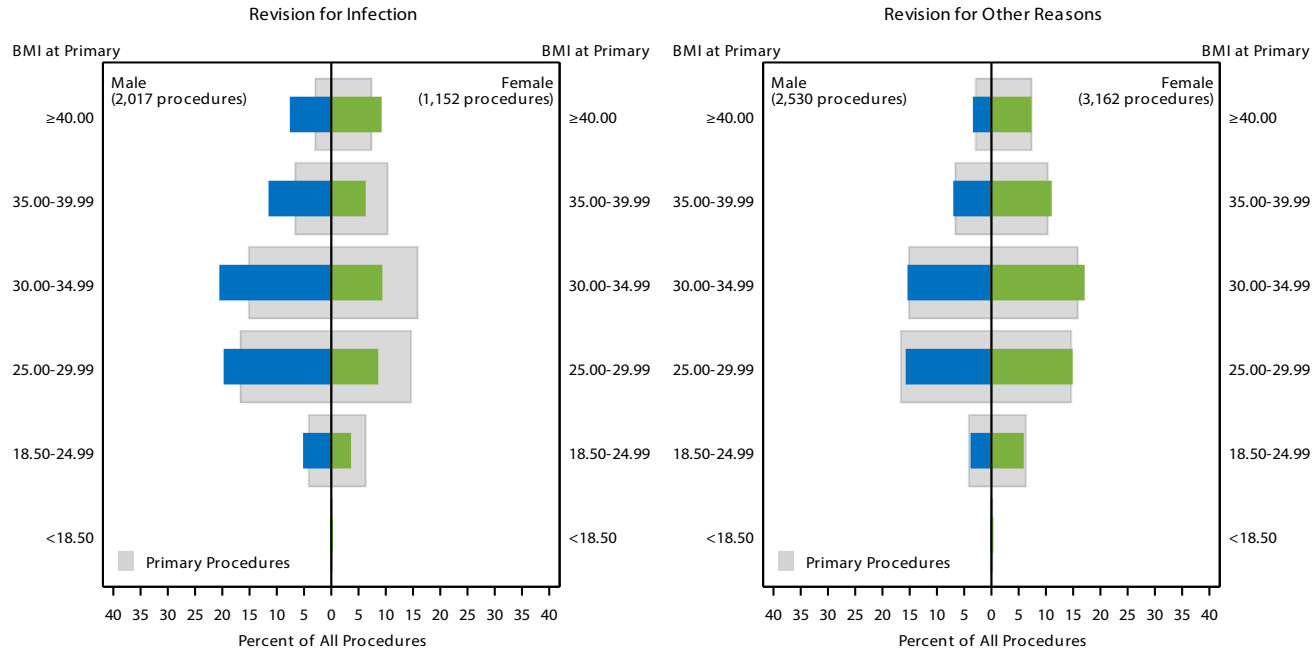
Compared to revisions for aseptic reasons, revisions for infection occur disproportionately more frequently in males irrespective of BMI category, and in females in obese class 3 (Figure IF32).

Figure IF31 1st Revision of Known Primary Total Knee Replacement by ASA Score at Primary and Gender (Primary Diagnosis OA)



Note: Restricted to modern prostheses

Figure IF32 1st Revision of Known Primary Total Knee Replacement by BMI Category at Primary and Gender (Primary Diagnosis OA)



Note: Restricted to modern prostheses

TIMING OF REVISION FOR INFECTION

An early revision for infection is defined by the Registry as a revision within 3 months of the primary procedure.

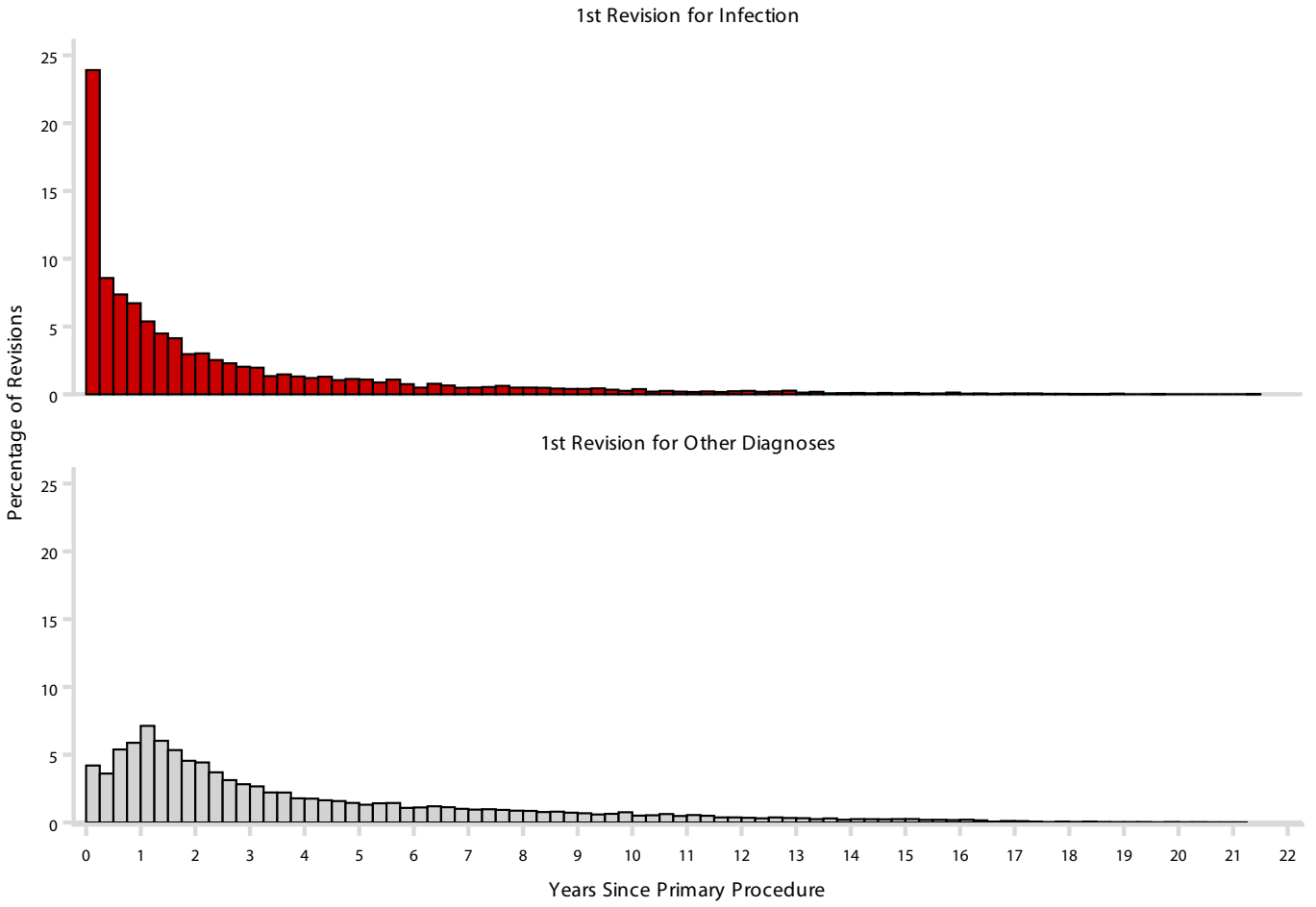
When primary knee replacements are revised for infection, 23.9% are early revisions (Table IF22 and Figure IF33).

Table IF22 Time to 1st Revision in Primary Total Knee Replacement by 1st Revision Diagnosis (Primary Diagnosis OA)

Time to 1st Revision	1st Revision for Infection			1st Revision for Other Diagnoses			TOTAL		
	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%
≤7 Days	64	29.4	0.9	154	70.6	0.8	218	100.0	0.8
>7 Days to ≤4 Weeks	742	74.3	10.5	257	25.7	1.4	999	100.0	3.8
>4 Weeks to ≤3 Months	889	69.8	12.5	384	30.2	2.0	1273	100.0	4.9
>3 Months to ≤1 Year	1606	36.3	22.7	2814	63.7	14.9	4420	100.0	17.0
>1 Year to ≤2 Years	1202	21.6	17.0	4359	78.4	23.0	5561	100.0	21.4
>2 Years	2586	19.1	36.5	10947	80.9	57.9	13533	100.0	52.0
TOTAL	**7089**	**27.3**	**100.0**	**18915**	**72.7**	**100.0**	**26004**	**100.0**	**100.0**

Note: Restricted to modern prostheses

Figure IF33 Time to 1st Revision in Primary Total Knee Replacement by 1st Revision Diagnosis (Primary Diagnosis OA)



Note: Restricted to modern prostheses
Bins are 0 to <3 months, 3 months to <6 months, etc.

REVISION PROCEDURES

Revision for infection of primary knee replacements with exchange of the tibial bearing insert, corresponding to a debridement, antibiotics and implant retention (DAIR) procedure, account for 89.9% of early revisions for infection. Conversely, major revisions for infection more commonly occur later, with 93.7% being performed after 3 months from the primary procedure (Table IF23).

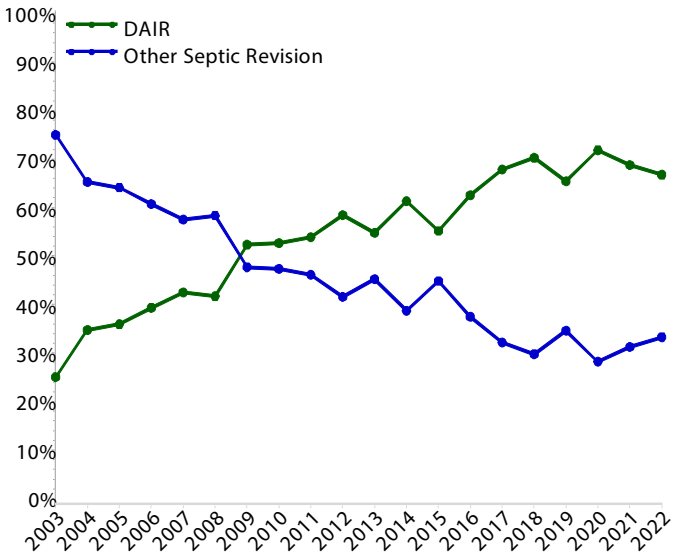
In 2022, DAIR procedures are the most common 1st revision procedure of a primary knee replacement for infection. The proportion of DAIR procedures as the 1st revision procedure has risen from 25.0% in 2003 to 66.7% in 2022 (Figure IF34).

Table IF23 Time to 1st Revision in Primary Total Knee Replacement by 1st Revision Diagnosis (Primary Diagnosis OA)

Time to 1st Revision	DAIR			Other Septic Revision			Other Revision			TOTAL		
	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%
>7 Days to ≤4 Weeks	703	70.4	16.2	39	3.9	1.4	257	25.7	1.4	999	100.0	3.8
≤7 Days	58	26.6	1.3	6	2.8	0.2	154	70.6	0.8	218	100.0	0.8
>4 Weeks to ≤3 Months	762	59.9	17.5	127	10.0	4.6	384	30.2	2.0	1273	100.0	4.9
>3 Months to ≤1 Year	925	20.9	21.3	681	15.4	24.9	2814	63.7	14.9	4420	100.0	17.0
>1 Year to ≤2 Years	575	10.3	13.2	627	11.3	22.9	4359	78.4	23.0	5561	100.0	21.4
>2 Years	1329	9.8	30.5	1257	9.3	45.9	10947	80.9	57.9	13533	100.0	52.0
TOTAL	**4352**	**16.7**	**100.0**	**2737**	**10.5**	**100.0**	**18915**	**72.7**	**100.0**	**26004**	**100.0**	**100.0**

Note: Restricted to modern prostheses

Figure IF34 1st Revision of Known Primary Total Knee Replacement by Management Strategy (Primary Diagnosis OA, 1st Revision for Infection)



Note: Restricted to modern prostheses
By year of revision procedure

REVISION RISK OVER TIME

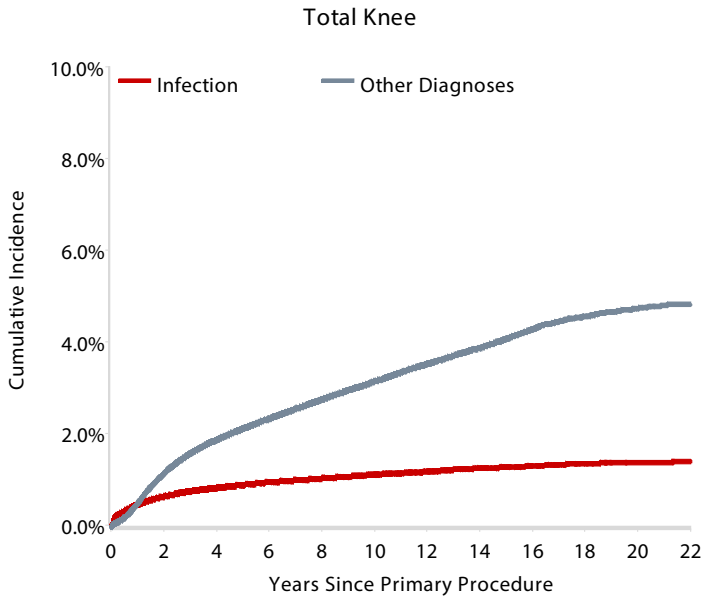
The cumulative incidence of revision for infection of a primary knee replacement steadily increases with time. The risk of revision for infection of a primary total knee replacement is 0.5% at 1 year and slowly increases to 1.4% at 20 years after the primary procedure (Table IF24 and Figure IF35).

Table IF24 Cumulative Incidence Revision Diagnosis in Primary Total Knee Replacement (Primary Diagnosis OA)

Type of Primary	Event	N Events	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Total Knee	Infection	7089	0.5 (0.4, 0.5)	0.8 (0.7, 0.8)	0.9 (0.9, 0.9)	1.1 (1.1, 1.2)	1.3 (1.3, 1.3)	1.4 (1.4, 1.5)
Total Knee	Other Diagnoses	18915	0.5 (0.5, 0.5)	1.6 (1.6, 1.6)	2.2 (2.1, 2.2)	3.2 (3.2, 3.3)	4.2 (4.1, 4.2)	4.8 (4.7, 4.9)
Total Knee	Deceased	116875	0.6 (0.6, 0.6)	2.8 (2.7, 2.8)	6.1 (6.1, 6.2)	19.6 (19.5, 19.8)	38.5 (38.3, 38.7)	57.8 (57.3, 58.2)
Total Knee	All Revision	26004	1.0 (0.9, 1.0)	2.4 (2.3, 2.4)	3.1 (3.0, 3.1)	4.4 (4.3, 4.4)	5.5 (5.4, 5.5)	6.2 (6.1, 6.3)

Note: Restricted to modern prostheses

Figure IF35 Cumulative Incidence Revision Diagnosis in Primary Total Knee Replacement (Primary Diagnosis OA)



Note: Restricted to modern prostheses

RISKS OF REVISION BY PRIMARY DIAGNOSIS

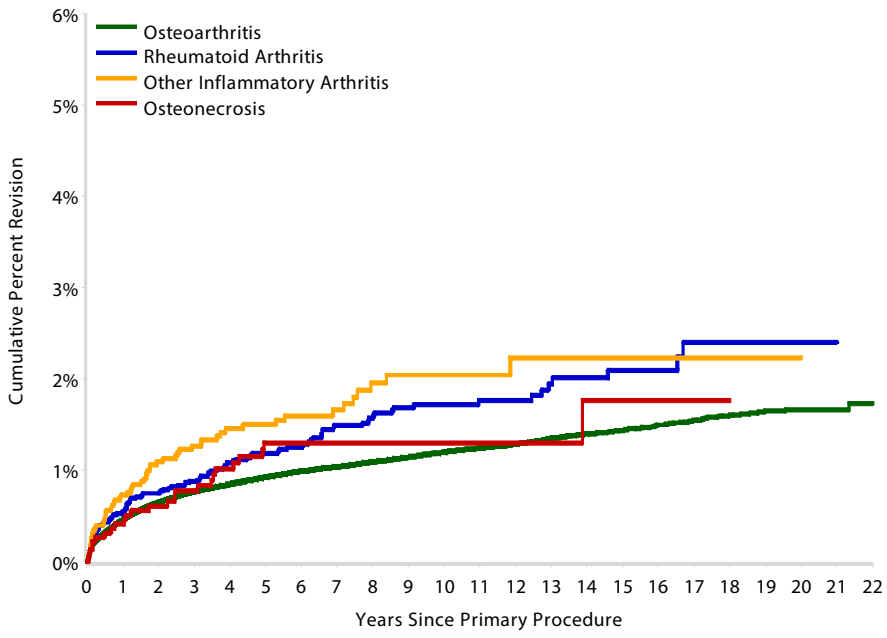
When compared to primary knee replacement procedures undertaken for osteoarthritis, procedures performed for rheumatoid arthritis and other inflammatory arthritis have a higher rate of revision for infection (Table IF25 and Figure IF36).

Table IF25 Cumulative Percent Revision of Primary Total Knee Replacement by Primary Diagnosis (Revision for Infection)

Primary Diagnosis	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Osteoarthritis	7089	741847	0.5 (0.4, 0.5)	0.8 (0.7, 0.8)	0.9 (0.9, 0.9)	1.2 (1.2, 1.2)	1.4 (1.4, 1.5)	1.7 (1.6, 1.7)
Rheumatoid Arthritis	117	8189	0.5 (0.4, 0.7)	0.9 (0.7, 1.1)	1.2 (1.0, 1.5)	1.7 (1.4, 2.1)	2.1 (1.7, 2.6)	2.4 (1.9, 3.1)
Other Inflammatory Arthritis	59	3836	0.7 (0.5, 1.1)	1.3 (0.9, 1.7)	1.5 (1.1, 2.0)	2.0 (1.5, 2.7)	2.2 (1.6, 3.0)	2.2 (1.6, 3.0)
Osteonecrosis	25	2258	0.4 (0.2, 0.8)	0.8 (0.5, 1.3)	1.3 (0.9, 1.9)	1.3 (0.9, 1.9)	1.8 (1.0, 3.2)	
Other (4)	66	1819	2.1 (1.5, 2.9)	3.2 (2.4, 4.2)	4.1 (3.2, 5.3)	5.3 (4.1, 7.0)	7.2 (4.9, 10.4)	
TOTAL	**7356**	**757949**						

Note: Restricted to modern prostheses
Only primary diagnoses with >2,000 procedures have been listed

Figure IF36 Cumulative Percent Revision of Primary Total Knee Replacement by Primary Diagnosis (Revision for Infection)



HR - adjusted for age and gender

Rheumatoid Arthritis vs Osteoarthritis
Entire Period: HR=1.49 (1.24, 1.79), p<0.001

Other Inflammatory Arthritis vs Osteoarthritis
Entire Period: HR=1.62 (1.25, 2.09), p<0.001

Osteonecrosis vs Osteoarthritis
Entire Period: HR=1.27 (0.86, 1.89), p=0.227

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Osteoarthritis	741847	675256	544838	421804	176167	46509	5258
Rheumatoid Arthritis	8189	7636	6542	5281	2656	1020	156
Other Inflammatory Arthritis	3836	3475	2775	2066	806	251	45
Osteonecrosis	2258	2068	1688	1314	530	158	24

Note: Restricted to modern prostheses
Only primary diagnoses with >2,000 procedures have been listed

OUTCOME OF 1ST REVISION

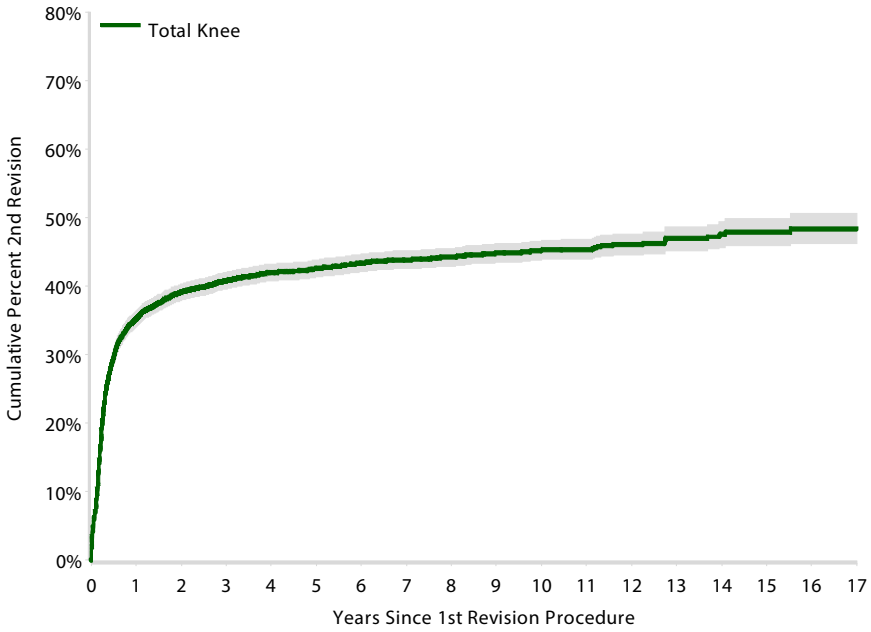
Revision of a primary knee replacement for infection carries a high risk of requiring a 2nd revision procedure for any reason, with a 3 year cumulative percent 2nd revision of 40.8%, rising to 46.1% at 12 years (Table IF26 and Figure IF37). This includes 1,215 revision procedures where a 2nd major revision occurred within 6 months of the 1st revision for infection, which are likely to be intended two stage revisions.

Table IF26 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement (Primary Diagnosis OA, 1st Revision for Infection)

Type of Primary	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Total Knee	2831	7089	35.2 (34.1, 36.4)	40.8 (39.6, 42.0)	42.5 (41.3, 43.8)	43.9 (42.6, 45.1)	45.3 (43.9, 46.7)	46.1 (44.6, 47.6)
TOTAL	**2831**	**7089**						

Note: Restricted to modern prostheses
Includes all septic 1st revisions (i.e. including two stage)

Figure IF37 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement (Primary Diagnosis OA, 1st Revision for Infection)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Total Knee	7089	3990	2717	1827	1171	561	304

Note: Restricted to modern prostheses
Includes all septic 1st revisions (i.e. including two stage)

OUTCOME OF DAIR PROCEDURES

A DAIR procedure undertaken as the 1st revision procedure of a primary conventional knee replacement has a 10 year cumulative percent 2nd revision of 32.3% (Table IF27 and Figure IF38).

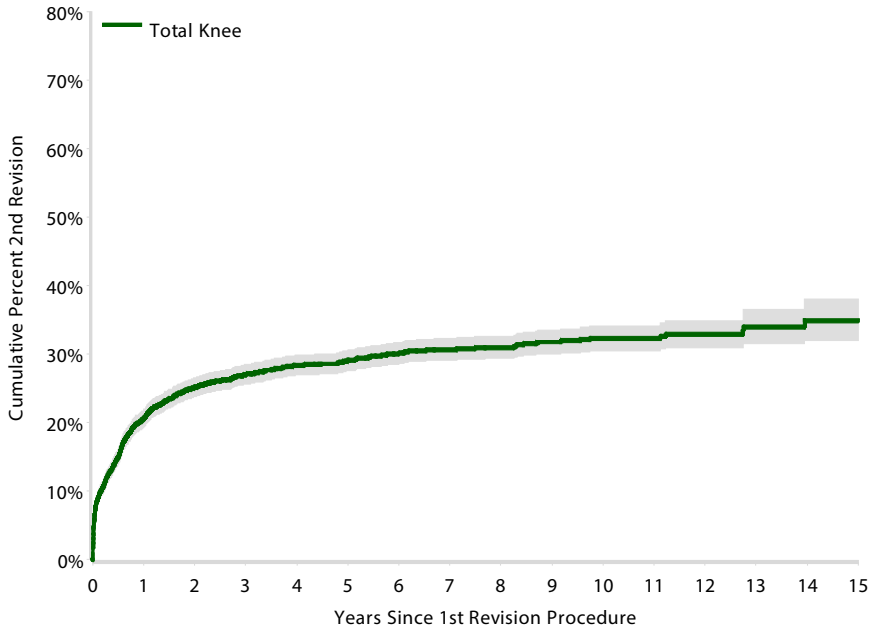
After 3 months, early DAIR revisions (performed within 3 months of the primary procedure) have a lower rate of 2nd revision compared to late DAIR procedures (performed more than 3 months after the primary) (Table IF28 and Figure IF39). A DAIR procedure undertaken within 4 weeks of the primary knee replacement procedure has a lower risk of further revision than a DAIR procedure performed between 4 weeks and 3 months of the primary procedure (Table IF29 and Figure IF40).

Table IF27 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement (Primary Diagnosis OA, DAIR 1st Revision for Infection)

Type of Primary	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Total Knee	1152	4352	20.6 (19.4, 21.8)	27.0 (25.7, 28.5)	29.0 (27.6, 30.5)	30.7 (29.1, 32.3)	32.3 (30.5, 34.1)	32.9 (31.0, 34.9)
TOTAL	**1152**	**4352**						

Note: Restricted to modern prostheses

Figure IF38 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement (Primary Diagnosis OA, DAIR 1st Revision for Infection)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Total Knee	4352	2956	1969	1275	757	332	163

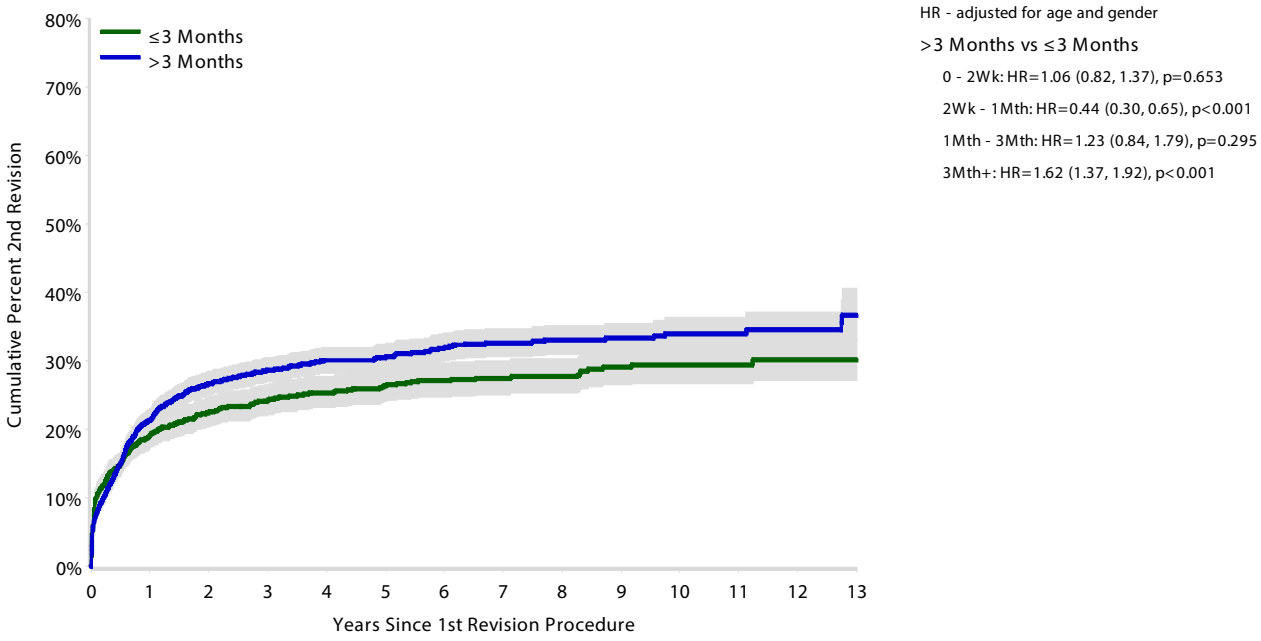
Note: Restricted to modern prostheses

Table IF28 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by Time to 1st Revision (Primary Diagnosis OA, DAIR 1st Revision for Infection)

Time to 1st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
≤3 Months	381	1523	19.2 (17.3, 21.3)	24.3 (22.1, 26.6)	26.4 (24.1, 28.9)	27.5 (25.1, 30.1)	29.5 (26.8, 32.4)	30.1 (27.2, 33.3)
>3 Months	771	2829	21.4 (19.8, 23.0)	28.7 (26.9, 30.5)	30.5 (28.7, 32.5)	32.7 (30.6, 34.8)	34.0 (31.7, 36.4)	34.5 (32.0, 37.2)
TOTAL	**1152**	**4352**						

Note: Restricted to modern prostheses

Figure IF39 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by Time to 1st Revision (Primary Diagnosis OA, DAIR 1st Revision for Infection)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
≤3 Months	1523	1110	788	544	340	162	82
>3 Months	2829	1846	1181	731	417	170	81

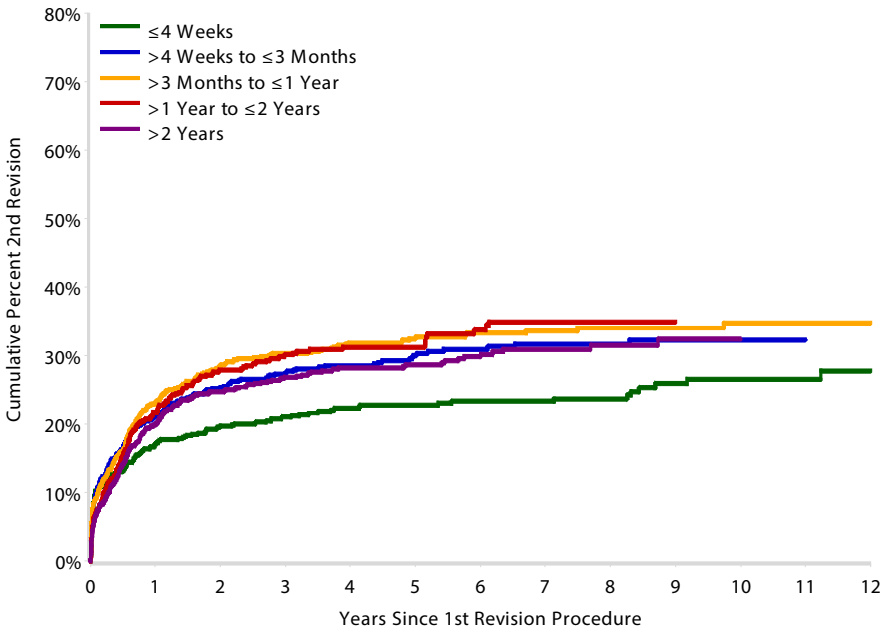
Note: Restricted to modern prostheses

Table IF29 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by Time to 1st Revision (Primary Diagnosis OA, DAIR 1st Revision for Infection)

Time to 1st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
≤4 Weeks	167	761	17.1 (14.6, 20.0)	21.0 (18.2, 24.2)	22.7 (19.7, 26.1)	23.3 (20.2, 26.8)	26.5 (22.7, 30.8)	27.8 (23.4, 32.8)
>4 Weeks to ≤3 Months	214	762	21.3 (18.5, 24.4)	27.5 (24.3, 31.0)	30.1 (26.7, 33.8)	31.7 (28.1, 35.6)	32.3 (28.6, 36.4)	
>3 Months to ≤1 Year	281	925	23.1 (20.5, 26.0)	30.3 (27.3, 33.5)	32.5 (29.4, 35.9)	33.6 (30.4, 37.2)	34.7 (31.2, 38.6)	34.7 (31.2, 38.6)
>1 Year to ≤2 Years	169	575	21.7 (18.5, 25.5)	30.1 (26.3, 34.3)	31.3 (27.4, 35.6)	34.9 (30.5, 39.9)		
>2 Years	321	1329	20.0 (17.8, 22.4)	26.8 (24.3, 29.6)	28.7 (25.9, 31.6)	31.0 (27.9, 34.3)	32.4 (28.8, 36.2)	
TOTAL	**1152**	**4352**						

Note: Restricted to modern prostheses

Figure IF40 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by Time to 1st Revision (Primary Diagnosis OA, DAIR 1st Revision for Infection)



HR - adjusted for age and gender

>4 Weeks to ≤3 Months vs ≤4 Weeks

Entire Period: HR=1.34 (1.09, 1.63), p=0.005

>3 Months to ≤1 Year vs ≤4 Weeks

0 - 2Wk: HR=1.51 (1.10, 2.07), p=0.010

2Wk - 1Mth: HR=0.50 (0.27, 0.91), p=0.023

1Mth - 9Mth: HR=1.75 (1.34, 2.29), p<0.001

9Mth+: HR=1.59 (1.20, 2.11), p=0.001

>1 Year to ≤2 Years vs ≤4 Weeks

0 - 2Wk: HR=1.17 (0.78, 1.74), p=0.446

2Wk - 1Mth: HR=0.37 (0.16, 0.87), p=0.021

1Mth+: HR=1.87 (1.47, 2.38), p<0.001

>2 Years vs ≤4 Weeks

0 - 3Mth: HR=1.02 (0.79, 1.31), p=0.885

3Mth - 6Mth: HR=2.44 (1.68, 3.55), p<0.001

6Mth+: HR=1.68 (1.32, 2.15), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
≤4 Weeks	761	567	414	291	185	87	48
>4 Weeks to ≤3 Months	762	543	374	253	155	75	34
>3 Months to ≤1 Year	925	627	446	295	177	84	41
>1 Year to ≤2 Years	575	386	257	153	84	38	21
>2 Years	1329	833	478	283	156	48	19

Note: Restricted to modern prostheses

COMPARATIVE OUTCOMES OF REVISION PROCEDURES

A single stage 1st revision involves revision of the major components of the knee replacement for infection. For the purposes of this analysis, the Registry defines a single stage revision of a primary knee replacement as a major revision for infection that is not classified as a two stage revision. The single stage revision group may include a small number of patients who have died before a planned second stage or those who have chosen not to have a further procedure.

In the following analysis, potential two stage revisions have been identified as 1st revision procedures where either:

i) the 1st revision was for infection and the type of revision recorded was removal of prostheses or a cement spacer; or
ii) a planned second stage was noted on the data collection form, and where a 2nd major revision was performed for infection. Revisions that were initially planned as two stage procedures, but did not result in a second revision for infection, have been classified as incomplete two stage procedures.

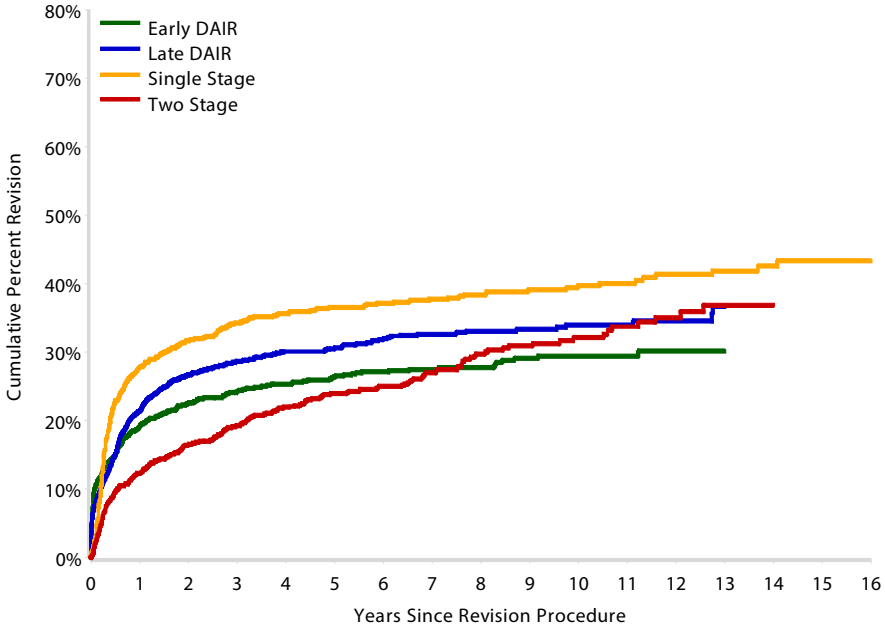
Compared to two stage procedures, single stage revisions have a higher further revision rate between 1 and 9 months but there is no difference outside of this time period (Table IF30 and Figure IF41).

Table IF30 Cumulative Percent Revision of Known Primary Total Knee Replacement by Management Strategy (Primary Diagnosis OA, 1st Revision for Infection)

Management Strategy	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Early DAIR	381	1523	19.2 (17.3, 21.3)	24.3 (22.1, 26.6)	26.4 (24.1, 28.9)	27.5 (25.1, 30.1)	29.5 (26.8, 32.4)	30.1 (27.2, 33.3)
Late DAIR	771	2829	21.4 (19.8, 23.0)	28.7 (26.9, 30.5)	30.5 (28.7, 32.5)	32.7 (30.6, 34.8)	34.0 (31.7, 36.4)	34.5 (32.0, 37.2)
Single Stage	421	1183	27.8 (25.3, 30.5)	34.2 (31.5, 37.2)	36.5 (33.7, 39.5)	37.7 (34.8, 40.8)	39.7 (36.6, 43.0)	41.3 (37.9, 44.9)
Two Stage	275	1109	12.3 (10.5, 14.4)	19.3 (17.0, 21.8)	24.0 (21.3, 26.8)	27.0 (24.1, 30.1)	32.1 (28.6, 35.9)	35.0 (30.9, 39.5)
TOTAL	**1848**	**6644**						

Note: Restricted to modern prostheses
For DAIR and single stage revisions, time to revision is reported as time to 2nd revision
For two stage revisions, time to revision is reported as time to 3rd revision
Excludes incomplete two stage procedures

Figure IF41 Cumulative Percent Revision of Known Primary Total Knee Replacement by Management Strategy (Primary Diagnosis OA, 1st Revision for Infection)



HR - adjusted for age and gender

Early DAIR vs Late DAIR

- 0 - 2Wk: HR=0.95 (0.73, 1.22), p=0.666
- 2Wk - 1Mth: HR=2.35 (1.64, 3.38), p<0.001
- 1Mth+: HR=0.64 (0.55, 0.75), p<0.001

Single Stage vs Late DAIR

- 0 - 2Wk: HR=0.12 (0.06, 0.23), p<0.001
- 2Wk - 1Mth: HR=0.97 (0.59, 1.62), p=0.921
- 1Mth - 3Mth: HR=2.88 (2.26, 3.68), p<0.001
- 3Mth - 6Mth: HR=2.58 (2.02, 3.30), p<0.001
- 6Mth+: HR=0.89 (0.74, 1.08), p=0.234

Two Stage vs Late DAIR

- 0 - 2Wk: HR=0.04 (0.01, 0.13), p<0.001
- 2Wk - 6Mth: HR=0.92 (0.74, 1.16), p=0.492
- 6Mth - 9Mth: HR=0.27 (0.15, 0.47), p<0.001
- 9Mth - 1.5Yr: HR=0.59 (0.41, 0.84), p=0.003
- 1.5Yr - 2.5Yr: HR=0.83 (0.54, 1.27), p=0.383
- 2.5Yr+: HR=1.62 (1.25, 2.10), p<0.001

Early DAIR vs Single Stage

- 0 - 2Wk: HR=7.91 (3.99, 15.69), p<0.001
- 2Wk - 1Mth: HR=1.40 (0.98, 2.01), p=0.067
- 1Mth - 3Mth: HR=0.29 (0.20, 0.41), p<0.001
- 3Mth - 6Mth: HR=0.21 (0.15, 0.31), p<0.001
- 6Mth+: HR=0.73 (0.58, 0.90), p=0.004

Early DAIR vs Two Stage

- 0 - 2Wk: HR=13.03 (6.75, 25.12), p<0.001
- 2Wk - 1Mth: HR=2.69 (1.82, 3.97), p<0.001
- 1Mth - 6Mth: HR=0.70 (0.52, 0.95), p=0.023
- 6Mth - 9Mth: HR=2.44 (1.30, 4.56), p=0.005
- 9Mth - 1.5Yr: HR=0.93 (0.62, 1.39), p=0.732
- 1.5Yr - 2Yr: HR=0.77 (0.44, 1.37), p=0.378
- 2Yr+: HR=0.49 (0.35, 0.67), p<0.001

Single Stage vs Two Stage

- 0 - 1Mth: HR=1.24 (0.78, 1.98), p=0.369
- 1Mth - 3Mth: HR=3.17 (2.37, 4.24), p<0.001
- 3Mth - 6Mth: HR=2.84 (2.12, 3.80), p<0.001
- 6Mth - 9Mth: HR=2.83 (1.48, 5.39), p=0.001
- 9Mth - 1Yr: HR=1.70 (1.00, 2.91), p=0.051
- 1Yr - 3Yr: HR=1.04 (0.76, 1.42), p=0.808
- 3Yr+: HR=0.61 (0.42, 0.89), p=0.009

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Early DAIR	1523	1110	788	544	340	162	82
Late DAIR	2829	1846	1181	731	417	170	81
Single Stage	1183	768	573	426	322	184	120
Two Stage	1109	897	669	498	335	154	77

Note: Restricted to modern prostheses
Adjustment for age is for age at 1st revision
For DAIR and single stage revisions, time to revision is reported as time to 2nd revision
For two stage revisions, time to revision is reported as time to 3rd revision
Excludes incomplete two stage procedures

COMPARATIVE OUTCOMES OF TIMING OF TWO STAGE REVISION PROCEDURES

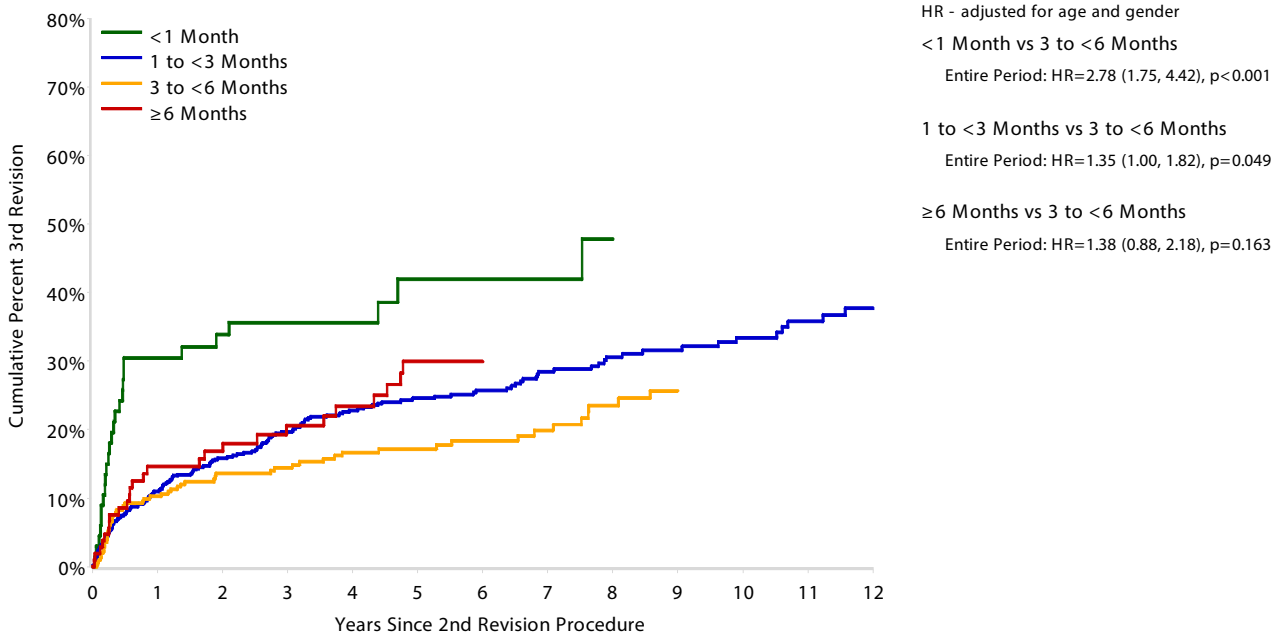
The 10 year cumulative percent 3rd revision of a primary knee replacement revised for infection in a two stage process is highest if the second stage revision is performed within 1 month of the first stage. The risk of a 3rd revision is lower when the second stage procedure is performed after 3 months from the first stage (Table IF31 and Figure IF42).

Table IF31 Cumulative Percent 3rd Revision of Known Primary Total Knee Replacement by Time Between 1st and 2nd Revision Procedure (Primary Diagnosis OA, 1st Revision for Infection)

Time Between 1st and 2nd Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
<1 Month	26	67	30.4 (20.8, 43.1)	35.6 (25.2, 48.7)	42.0 (29.9, 56.6)	42.0 (29.9, 56.6)		
1 to <3 Months	163	627	11.0 (8.8, 13.8)	19.7 (16.6, 23.2)	24.5 (21.1, 28.5)	28.4 (24.6, 32.8)	33.4 (28.8, 38.5)	37.7 (32.1, 43.8)
3 to <6 Months	59	309	10.2 (7.3, 14.2)	14.4 (10.8, 19.0)	17.2 (13.2, 22.2)	19.9 (15.3, 25.5)		
≥6 Months	27	106	14.6 (9.0, 23.0)	20.5 (13.7, 30.1)	29.9 (21.1, 41.3)			
TOTAL	**275**	**1109**						

Note: Restricted to modern prostheses

Figure IF42 Cumulative Percent 3rd Revision of Known Primary Total Knee Replacement by Time Between 1st and 2nd Revision Procedure (Primary Diagnosis OA, 1st Revision for Infection)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
<1 Month	67	42	34	16	11	6	4
1 to <3 Months	627	516	376	288	195	101	48
3 to <6 Months	309	258	200	153	99	39	22
≥6 Months	106	81	59	41	30	8	3

Note: Restricted to modern prostheses
Adjustment for age is for age at 1st revision

OUTCOMES OF REVISION FOR INFECTION OVER TIME

The 3 year cumulative percent 2nd revision of a known primary knee replacement following 1st revision for infection increased following the 5 year interval 2003–2007. The cumulative percent 2nd revision of a known primary knee replacement remained constant in the two 5 year intervals 2008–2012 and 2013–2017 but has decreased in the period 2018–2022 (Table IF32 and Figure IF43).

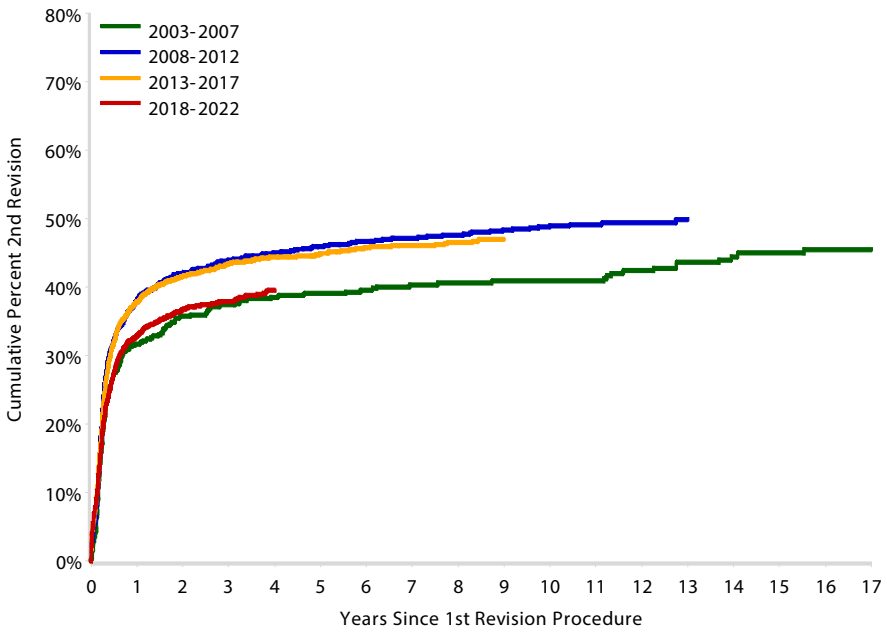
The cumulative percent 2nd revision of a primary knee replacement for infection via a DAIR procedure has remained static comparing the time periods pre-2013 to 2013–2022. The 7 year cumulative percent 2nd revision of a primary knee replacement for infection via a single stage procedure has increased from 27.9% pre-2013 to 42.3% in the period 2013–2022. The 7 year cumulative percent 3rd revision of a primary knee replacement for infection via a two stage procedure has reduced from 29.9% pre-2013 to 25.2% in the period 2013–2022 (Table IF33, Figure IF44 and Figure IF45).

Table IF32 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by Year of 1st Revision (Primary Diagnosis OA, 1st Revision for Infection)

Year of 1st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
2003–2007	198	475	31.8 (27.7, 36.2)	37.4 (33.1, 42.0)	39.0 (34.7, 43.7)	40.4 (36.0, 45.0)	40.9 (36.6, 45.6)	42.4 (37.9, 47.2)
2008–2012	527	1113	38.0 (35.2, 41.0)	43.9 (41.0, 46.9)	46.0 (43.0, 49.0)	47.2 (44.2, 50.2)	49.0 (46.0, 52.1)	49.4 (46.4, 52.5)
2013–2017	1021	2280	37.9 (35.9, 40.0)	43.4 (41.4, 45.5)	44.8 (42.8, 46.9)	46.1 (44.0, 48.2)		
2018–2022	1073	3182	32.9 (31.2, 34.7)	37.9 (36.1, 39.8)				
TOTAL	**2819**	**7050**						

Note: Restricted to modern prostheses. Procedures prior to full national data collection in 2003 have been excluded

Figure IF43 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by Year of 1st Revision (Primary Diagnosis OA, 1st Revision for Infection)



HR - adjusted for age and gender

2003-2007 vs 2018-2022

0 - 2Wk: HR=0.33 (0.15, 0.69), p=0.003

2Wk - 3Mth: HR=1.11 (0.88, 1.41), p=0.363

3Mth+: HR=0.97 (0.79, 1.19), p=0.786

2008-2012 vs 2018-2022

0 - 1Mth: HR=0.78 (0.59, 1.02), p=0.064

1Mth - 3Mth: HR=1.38 (1.16, 1.63), p<0.001

3Mth+: HR=1.20 (1.04, 1.38), p=0.013

2013-2017 vs 2018-2022

Entire Period: HR=1.15 (1.05, 1.25), p=0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
2003–2007	475	312	268	246	218	180	149
2008–2012	1113	666	569	509	442	369	144
2013–2017	2280	1370	1154	1051	491	0	0
2018–2022	3182	1608	702	0	0	0	0

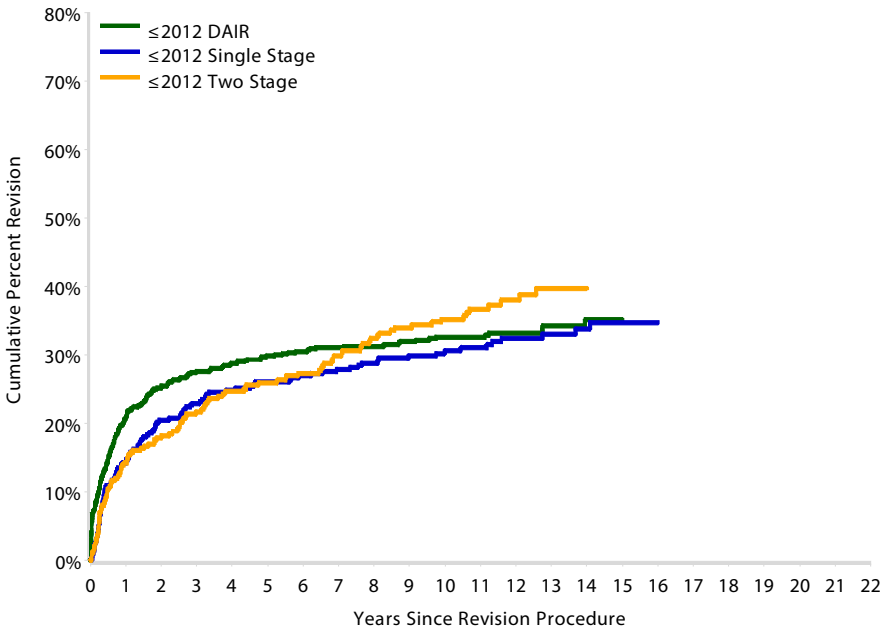
Note: Restricted to modern prostheses. Procedures prior to full national data collection in 2003 have been excluded

Table IF33 Cumulative Percent Revision of Known Primary Total Knee Replacement by Year of 1st Revision and Management Strategy (Primary Diagnosis OA, 1st Revision for Infection)

Year of 1st Revision	Management Strategy	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
≤2012	DAIR	246	783	20.8 (18.1, 23.8)	27.6 (24.5, 30.9)	29.8 (26.7, 33.2)	31.1 (27.9, 34.5)	32.6 (29.3, 36.1)	33.2 (29.8, 36.8)
	Single Stage	121	394	14.5 (11.4, 18.4)	23.0 (19.1, 27.5)	26.0 (21.9, 30.7)	27.9 (23.6, 32.7)	30.6 (26.2, 35.6)	32.4 (27.8, 37.7)
	Two Stage	116	324	14.2 (10.8, 18.5)	21.8 (17.6, 26.7)	26.0 (21.5, 31.2)	29.9 (25.1, 35.3)	35.2 (30.1, 40.9)	38.0 (32.6, 44.0)
2013–2022	DAIR	906	3569	20.5 (19.2, 21.9)	26.9 (25.3, 28.5)	28.7 (27.1, 30.4)	30.6 (28.8, 32.5)		
	Single Stage	300	789	34.8 (31.5, 38.3)	40.2 (36.6, 43.9)	41.9 (38.3, 45.8)	42.3 (38.6, 46.2)		
	Two Stage	159	785	11.4 (9.4, 13.9)	18.1 (15.4, 21.2)	23.1 (20.0, 26.8)	25.2 (21.6, 29.1)		
TOTAL		**1848**	**6644**						

Note: Restricted to modern prostheses
Adjustment for age is for age at 1st revision
For DAIR and single stage revisions, time to revision is reported as time to 2nd revision
For two stage revisions, time to revision is reported as time to 3rd revision

Figure IF44 Cumulative Percent Revision of Known Primary Total Knee Replacement by Management Strategy (Primary Diagnosis OA, 1st Revision for Infection, 1st Revisions Performed in ≤2012)



HR - adjusted for age and gender

≤2012 DAIR vs ≤2012 Two Stage
- 0 - 2Wk: HR=16.22 (3.88, 67.82), p<0.001
- 2Wk - 1Mth: HR=3.39 (1.36, 8.49), p=0.009
- 1Mth - 6Mth: HR=0.81 (0.56, 1.18), p=0.277
- 6Mth - 9Mth: HR=2.08 (1.08, 3.98), p=0.027
- 9Mth - 2Yr: HR=1.09 (0.72, 1.66), p=0.678
- 2Yr+: HR=0.57 (0.40, 0.81), p=0.001

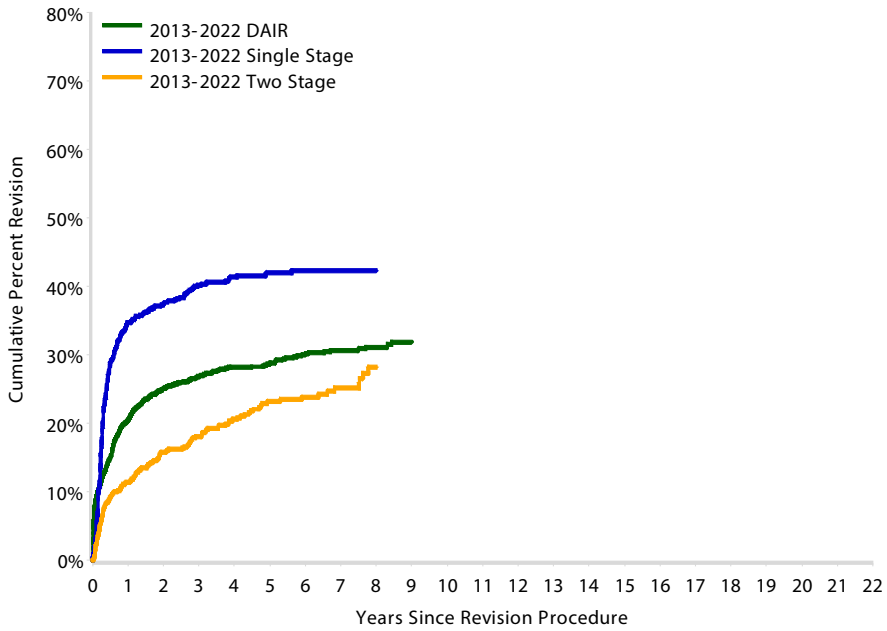
≤2012 DAIR vs ≤2012 Single Stage
- 0 - 2Wk: HR=17.88 (4.28, 74.69), p<0.001
- 2Wk - 1Mth: HR=3.74 (1.50, 9.34), p=0.004
- 1Mth - 6Mth: HR=0.90 (0.62, 1.30), p=0.559
- 6Mth - 2Yr: HR=1.46 (1.02, 2.08), p=0.039
- 2Yr+: HR=0.62 (0.44, 0.89), p=0.009

≤2012 Single Stage vs ≤2012 Two Stage
- Entire Period: HR=0.91 (0.70, 1.17), p=0.457

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
≤2012	DAIR	783	592	512	460	404	332	163
	Single Stage	394	333	282	254	223	184	120
	Two Stage	324	277	243	222	194	154	77

Note: Restricted to modern prostheses
Adjustment for age is for age at 1st revision
For DAIR and single stage revisions, time to revision is reported as time to 2nd revision
For two stage revisions, time to revision is reported as time to 3rd revision

Figure IF45 Cumulative Percent Revision of Known Primary Total Knee Replacement by Management Strategy (Primary Diagnosis OA, 1st Revision for Infection, 1st Revisions Performed in 2013–2022)



HR - adjusted for age and gender

2013-2022 DAIR vs 2013-2022 Two Stage

0 - 2Wk: HR=11.46 (5.79, 22.69), p<0.001

2Wk+: HR=1.16 (0.98, 1.38), p=0.087

2013-2022 Single Stage vs 2013-2022 Two Stage

0 - 1Mth: HR=1.21 (0.76, 1.93), p=0.429

1Mth - 3Mth: HR=5.12 (3.81, 6.88), p<0.001

3Mth - 6Mth: HR=4.61 (3.40, 6.23), p<0.001

6Mth+: HR=1.24 (0.94, 1.63), p=0.127

2013-2022 Single Stage vs 2013-2022 DAIR

0 - 1Mth: HR=0.35 (0.23, 0.53), p<0.001

1Mth - 6Mth: HR=4.18 (3.46, 5.05), p<0.001

6Mth+: HR=1.07 (0.84, 1.36), p=0.601

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
2013–2022	DAIR	3569	2364	1457	815	353	0	0
	Single Stage	789	435	291	172	99	0	0
	Two Stage	785	620	426	276	141	0	0

Note: Restricted to modern prostheses
Adjustment for age is for age at 1st revision
For DAIR and single stage revisions, time to revision is reported as time to 2nd revision
For two stage revisions, time to revision is reported as time to 3rd revision

MORTALITY FOLLOWING REVISION FOR INFECTION

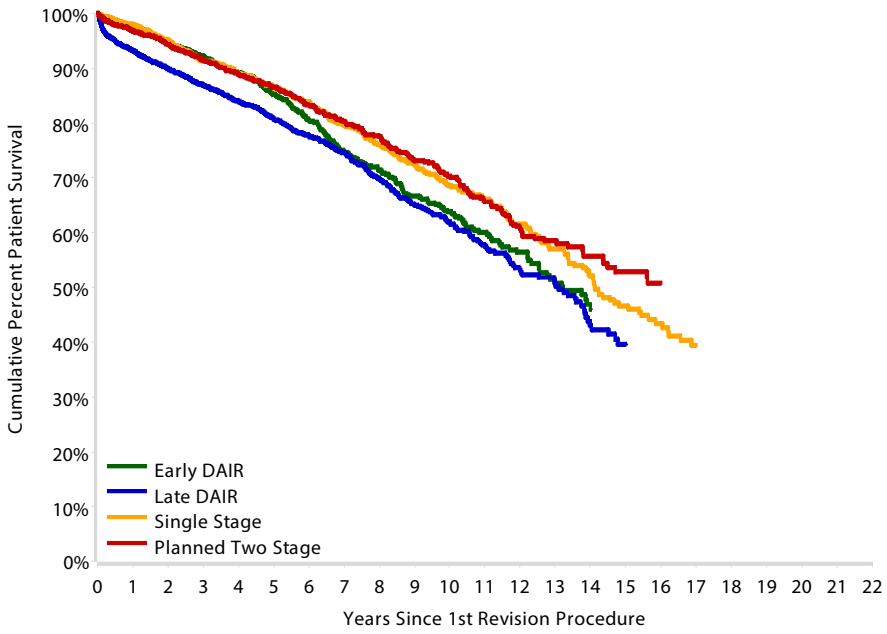
Late DAIR has a higher rate of mortality in the first 3 months compared to all three other treatment strategies (Table IF34 and Figure IF46). Revision for infection has a higher rate of mortality than revision for other diagnoses. There is no difference in mortality when revision for infection and revision for fracture are compared (Table IF35 and Figure IF47).

Table IF34 Cumulative Percent Survival of Patients with Known Primary Total Knee Replacement Since 1st Revised by Intended Treatment Strategy (Primary Diagnosis OA)

Intended Treatment Strategy	N Deceased	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Early DAIR	344	1487	97.4 (96.5, 98.1)	92.2 (90.6, 93.5)	85.3 (83.1, 87.3)	74.9 (71.9, 77.7)	63.8 (60.0, 67.4)	56.4 (51.8, 60.8)
Late DAIR	618	2729	93.2 (92.2, 94.1)	86.9 (85.4, 88.2)	80.9 (79.1, 82.5)	74.6 (72.3, 76.7)	62.0 (58.7, 65.0)	53.1 (49.0, 57.1)
Single Stage	287	1140	98.1 (97.1, 98.7)	91.3 (89.4, 92.9)	86.4 (84.0, 88.6)	79.5 (76.4, 82.2)	68.6 (64.7, 72.2)	61.5 (57.0, 65.7)
Planned Two Stage	313	1326	96.8 (95.7, 97.7)	91.5 (89.8, 92.9)	86.5 (84.4, 88.4)	80.3 (77.7, 82.7)	70.4 (66.9, 73.6)	60.8 (56.4, 64.8)
TOTAL	**1562**	**6682**						

Note: Restricted to modern prostheses
Excludes 183 procedures with unknown intended treatment strategy or missing first stage
Restricted to the first revision knee procedure recorded for each patient

Figure IF46 Cumulative Percent Survival of Patients with Known Primary Total Knee Replacement Since 1st Revised by Intended Treatment Strategy (Primary Diagnosis OA)



HR - adjusted for age, gender, and ASA score

Late DAIR vs Early DAIR
0-3Mth: HR=2.69 (1.72, 4.19), p<0.001
3Mth+: HR=0.96 (0.79, 1.18), p=0.730

Single Stage vs Early DAIR
Entire Period: HR=0.98 (0.75, 1.28), p=0.885

Planned Two Stage vs Early DAIR
Entire Period: HR=0.91 (0.72, 1.16), p=0.448

Single Stage vs Late DAIR
0-3Mth: HR=0.36 (0.17, 0.77), p=0.009
3Mth-3Yr: HR=1.11 (0.82, 1.52), p=0.497
3Yr+: HR=0.91 (0.63, 1.31), p=0.601

Planned Two Stage vs Late DAIR
0-3Mth: HR=0.32 (0.15, 0.66), p=0.002
3Mth+: HR=0.95 (0.77, 1.18), p=0.658

Planned Two Stage vs Single Stage
Entire Period: HR=0.93 (0.71, 1.22), p=0.596

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Early DAIR	1487	1339	1019	719	463	226	119
Late DAIR	2729	2268	1613	1044	626	255	129
Single Stage	1140	1015	795	588	446	264	177
Planned Two Stage	1326	1211	997	782	564	284	169

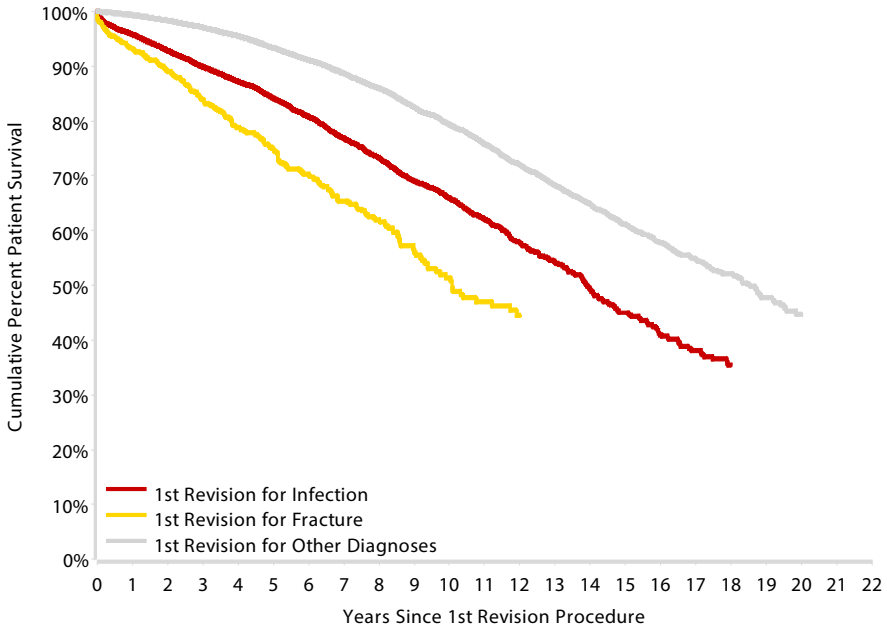
Note: Restricted to modern prostheses
Restricted to the first revision knee procedure recorded for each patient

Table IF35 Cumulative Percent Survival of Patients with Known Primary Total Knee Replacement Since 1st Revised by Reason for 1st Revision (Primary Diagnosis OA)

Reason for 1st Revision	N Deceased	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
1st Revision for Infection	1591	6865	95.8 (95.3, 96.2)	89.8 (89.0, 90.6)	84.2 (83.1, 85.1)	76.9 (75.6, 78.1)	66.0 (64.3, 67.6)	57.8 (55.7, 59.8)
1st Revision for Fracture	272	943	93.3 (91.4, 94.7)	83.9 (81.1, 86.3)	74.9 (71.4, 78.1)	65.4 (61.2, 69.3)	51.4 (46.0, 56.5)	44.5 (38.3, 50.5)
1st Revision for Other Diagnoses	2460	17066	99.3 (99.2, 99.4)	97.1 (96.8, 97.3)	93.4 (92.9, 93.8)	88.7 (88.1, 89.3)	79.3 (78.4, 80.2)	72.0 (70.8, 73.2)
TOTAL	**4323**	**24874**						

Note: Restricted to modern prostheses
Restricted to the first revision knee procedure recorded for each patient

Figure IF47 Cumulative Percent Survival of Patients with Known Primary Total Knee Replacement Since 1st Revised by Reason for 1st Revision (Primary Diagnosis OA)



HR - adjusted for age, gender, and ASA score

1st Revision for Infection vs 1st Revision for Other Diagnoses

- 0-3Mth: HR=8.95 (5.62, 14.26), p<0.001
- 3Mth-2Yr: HR=2.70 (2.20, 3.30), p<0.001
- 2Yr-3Yr: HR=1.81 (1.40, 2.35), p<0.001
- 3Yr+: HR=1.28 (1.11, 1.48), p<0.001

1st Revision for Fracture vs 1st Revision for Other Diagnoses

- 0-2Wk: HR=16.88 (7.67, 37.15), p<0.001
- 2Wk-3Mth: HR=6.93 (3.49, 13.75), p<0.001
- 3Mth-2.5Yr: HR=2.78 (2.08, 3.71), p<0.001
- 2.5Yr-3Yr: HR=2.72 (1.51, 4.92), p<0.001
- 3Yr-3.5Yr: HR=1.23 (0.54, 2.81), p=0.624
- 3.5Yr-4Yr: HR=2.91 (1.54, 5.48), p<0.001
- 4Yr-5.5Yr: HR=1.74 (1.11, 2.72), p=0.016
- 5.5Yr+: HR=1.10 (0.63, 1.92), p=0.741

1st Revision for Infection vs 1st Revision for Fracture

- Entire Period: HR=0.86 (0.71, 1.03), p=0.098

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
1st Revision for Infection	6865	5994	4547	3228	2169	1062	610
1st Revision for Fracture	943	775	528	359	222	85	49
1st Revision for Other Diagnoses	17066	15677	12642	9513	6867	3647	2155

Note: Restricted to modern prostheses
Restricted to the first revision knee procedure recorded for each patient

Primary Total Shoulder Replacement – Revision for Infection

The following analyses include primary shoulder replacement procedures performed for osteoarthritis and using prostheses that have been available and used in 2022 (described as modern prostheses). This includes partial and total shoulder replacements.

DEMOGRAPHICS

The demographics of 1st revision of known shoulder replacement for both infection and aseptic reasons are shown in Table IF36. The mean time to 1st revision for infection is shorter than the mean time to 1st revision for aseptic reasons. Similarly, following a 1st revision for infection, the mean time to a 2nd revision is shorter than for revision for aseptic reasons.

Males account for a greater proportion of 1st revisions for infection than females at all ages (Figure IF48).

Table IF36 Summary of Known Primary Shoulder Replacement (Primary Diagnosis OA)

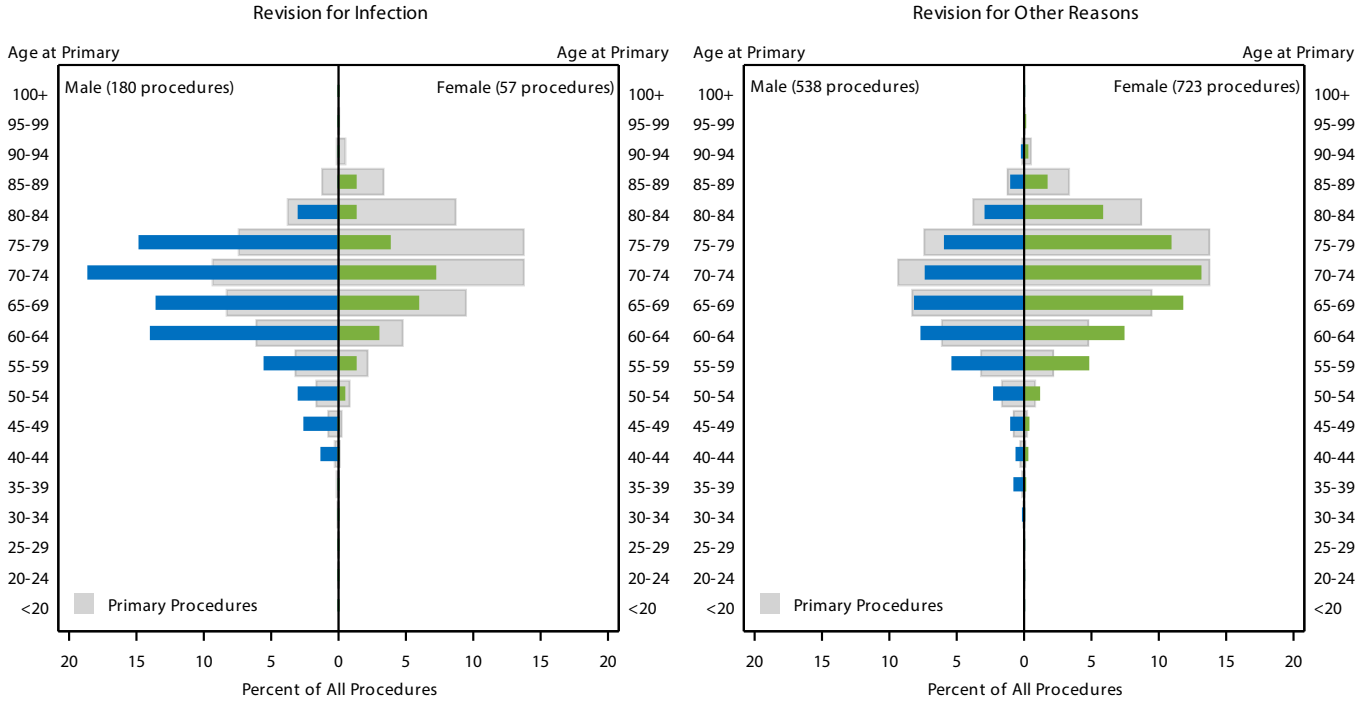
Variable	Primary	1st Revision for Infection	1st Revision for Other Reasons	TOTAL
Follow-Up Years (Primary to 1st Revision)				
Mean ± SD	4.4 ± 3.4	1.9 ± 2.3	2.4 ± 2.9	4.3 ± 3.4
Median (IQR)	3.7 (1.7, 6.4)	1 (0.3, 2.8)	1.3 (0.4, 3.2)	3.6 (1.6, 6.3)
Minimum	0	0	0	0
Maximum	16.9	10.8	14.5	16.9
Follow-Up Years (1st Revision to 2nd Revision)				
Mean ± SD		2.1 ± 2.7	4.1 ± 3.4	3.8 ± 3.4
Median (IQR)		0.8 (0.3, 2.9)	3.3 (1.2, 6.1)	2.9 (0.9, 5.8)
Minimum		0	0	0
Maximum		12.6	15.3	15.3
Age at Primary				
Mean ± SD	71.4 ± 8.9	68.2 ± 8.6	68.6 ± 9.4	71.3 ± 8.9
Median (IQR)	72 (66, 78)	69 (63, 74)	69 (62, 75)	72 (66, 77)
Primary Hospital Calendar Year Volume				
Mean ± SD	21.3 ± 20.6	22.1 ± 19	17.3 ± 19.2	21.1 ± 20.6
Median (IQR)	14.1 (6.5, 28.7)	17.1 (8.6, 29.3)	10.2 (4.3, 22.6)	14.1 (6.4, 28.7)
Gender at Primary				
Male	13,922 (42.4%)	180 (75.9%)	538 (42.7%)	14,640 (42.6%)
Female	18,915 (57.6%)	57 (24.1%)	723 (57.3%)	19,695 (57.4%)
ASA Score at Primary[1]				
ASA 1	1,245 (4.5%)	12 (6.2%)	31 (3.8%)	1,288 (4.5%)
ASA 2	12,691 (45.7%)	88 (45.1%)	357 (44.3%)	13,136 (45.7%)
ASA 3	13,198 (47.6%)	90 (46.2%)	397 (49.3%)	13,685 (47.6%)
ASA 4 or 5	614 (2.2%)	5 (2.6%)	21 (2.6%)	640 (2.2%)
ASA Score at 1st Revision[2]				
ASA 1		5 (2.3%)	24 (2.3%)	29 (2.3%)
ASA 2		71 (33.3%)	376 (36.6%)	447 (36%)
ASA 3		127 (59.6%)	594 (57.8%)	721 (58.1%)
ASA 4 or 5		10 (4.7%)	33 (3.2%)	43 (3.5%)

Note: Restricted to modern prostheses
Abbreviations: SD – standard deviation, IQR – interquartile range, ASA – American Society of Anesthesiologists, BMI – Body Mass Index (kg/m2)

Variable	Primary	1st Revision for Infection	1st Revision for Other Reasons	TOTAL
BMI Category at Primary[3]				
Underweight (<18.50)	109 (0.4%)		4 (0.6%)	113 (0.5%)
Normal (18.50-24.99)	3,532 (14.6%)	15 (9.2%)	83 (13.3%)	3,630 (14.5%)
Pre Obese (25.00-29.99)	8,206 (33.8%)	58 (35.6%)	200 (32.2%)	8,464 (33.8%)
Obese Class 1 (30.00-34.99)	6,875 (28.3%)	52 (31.9%)	182 (29.3%)	7,109 (28.4%)
Obese Class 2 (35.00-39.99)	3,528 (14.5%)	20 (12.3%)	101 (16.2%)	3,649 (14.6%)
Obese Class 3 (≥40.00)	2,005 (8.3%)	18 (11%)	52 (8.4%)	2,075 (8.3%)
BMI Category at 1st Revision[4]				
Underweight (<18.50)			9 (1%)	9 (0.9%)
Normal (18.50-24.99)		23 (12.7%)	133 (15.3%)	156 (14.9%)
Pre Obese (25.00-29.99)		63 (34.8%)	266 (30.6%)	329 (31.3%)
Obese Class 1 (30.00-34.99)		54 (29.8%)	266 (30.6%)	320 (30.5%)
Obese Class 2 (35.00-39.99)		26 (14.4%)	125 (14.4%)	151 (14.4%)
Obese Class 3 (≥40.00)		15 (8.3%)	70 (8.1%)	85 (8.1%)
Type of Primary				
Hemi Stemmed Anatomic	1,349 (4.1%)	10 (4.2%)	102 (8.1%)	1,461 (4.3%)
Total Stemmed Anatomic	7,409 (22.6%)	29 (12.2%)	590 (46.8%)	8,028 (23.4%)
Total Stemmed Reverse	20,450 (62.3%)	181 (76.4%)	479 (38%)	21,110 (61.5%)
Total Stemless Anatomic	3,596 (11%)	17 (7.2%)	88 (7%)	3,701 (10.8%)
Total Stemless Reverse	33 (0.1%)		2 (0.2%)	35 (0.1%)
Bearing Surface in Primary[5]				
Ceramic/Non XLPE	525 (1.7%)	6 (2.6%)	19 (1.6%)	550 (1.7%)
Ceramic/XLPE	1,907 (6.1%)	8 (3.5%)	41 (3.5%)	1,956 (6%)
Metal/Non XLPE	7,120 (22.6%)	36 (15.9%)	566 (48.8%)	7,722 (23.5%)
Metal/XLPE	5,604 (17.8%)	19 (8.4%)	152 (13.1%)	5,775 (17.6%)
Non XLPE/Metal	12,487 (39.7%)	137 (60.4%)	291 (25.1%)	12,915 (39.3%)
XLPE/Metal	3,835 (12.2%)	21 (9.3%)	90 (7.8%)	3,946 (12%)
Hospital Type				
Public Hospital	7,832 (23.9%)	49 (20.7%)	281 (22.3%)	8,162 (23.8%)
Private Hospital	25,005 (76.1%)	188 (79.3%)	980 (77.7%)	26,173 (76.2%)
Primary Hospital Location[6]				
Urban	25,809 (78.6%)	200 (84.4%)	975 (77.4%)	26,984 (78.6%)
Rural	7,013 (21.4%)	37 (15.6%)	284 (22.6%)	7,334 (21.4%)
Primary Hospital Calendar Year Volume				
1st Quartile	1,410 (4.3%)	12 (5.1%)	63 (5%)	1,485 (4.3%)
2nd Quartile	4,460 (13.6%)	30 (12.7%)	152 (12.1%)	4,642 (13.5%)
3rd Quartile	7,031 (21.4%)	54 (22.8%)	252 (20%)	7,337 (21.4%)
4th Quartile	19,936 (60.7%)	141 (59.5%)	794 (63%)	20,871 (60.8%)
TOTAL	**32,837**	**237**	**1,261**	**34,335**

[1] Excludes 5,586 procedures with unknown ASA score at primary
[2] Excludes 258 procedures with unknown ASA score at 1st revision
[3] Excludes 9,295 procedures with unknown BMI category at primary
[4] Excludes 448 procedures with unknown BMI category at 1st revision
[5] Excludes 1,471 procedures with unknown bearing surface in primary
[6] Excludes 17 procedures with unknown primary hospital location

Figure IF48 1st Revision for Infection of Known Primary Shoulder Replacement by Age and Gender (Primary Diagnosis OA)



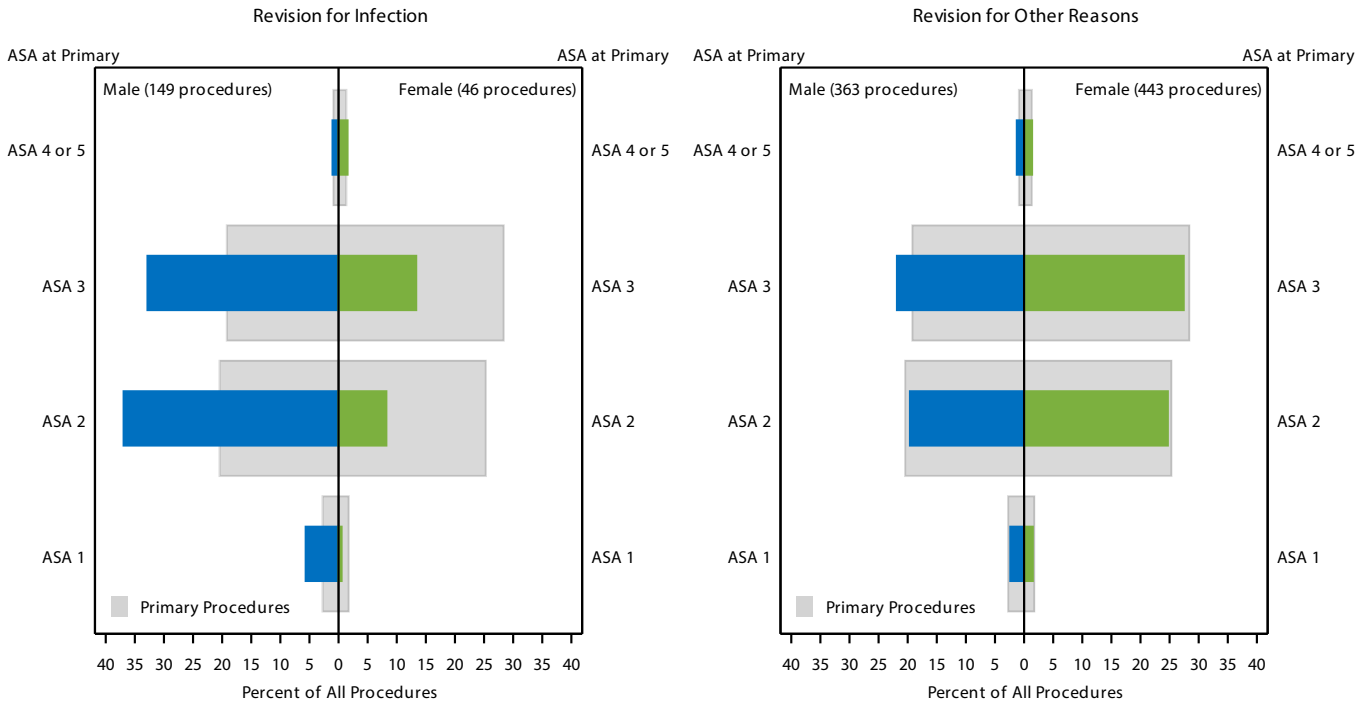
Note: Restricted to modern prostheses

ASA Score and BMI Category

In all ASA grades, males account for a larger proportion of revisions for infection than would be expected based on the distribution of primary procedures. This contrasts with aseptic reasons for revision of primary shoulder replacement, where males and females in each ASA grade are represented in similar proportions to those found in primary procedures (Figure IF49).

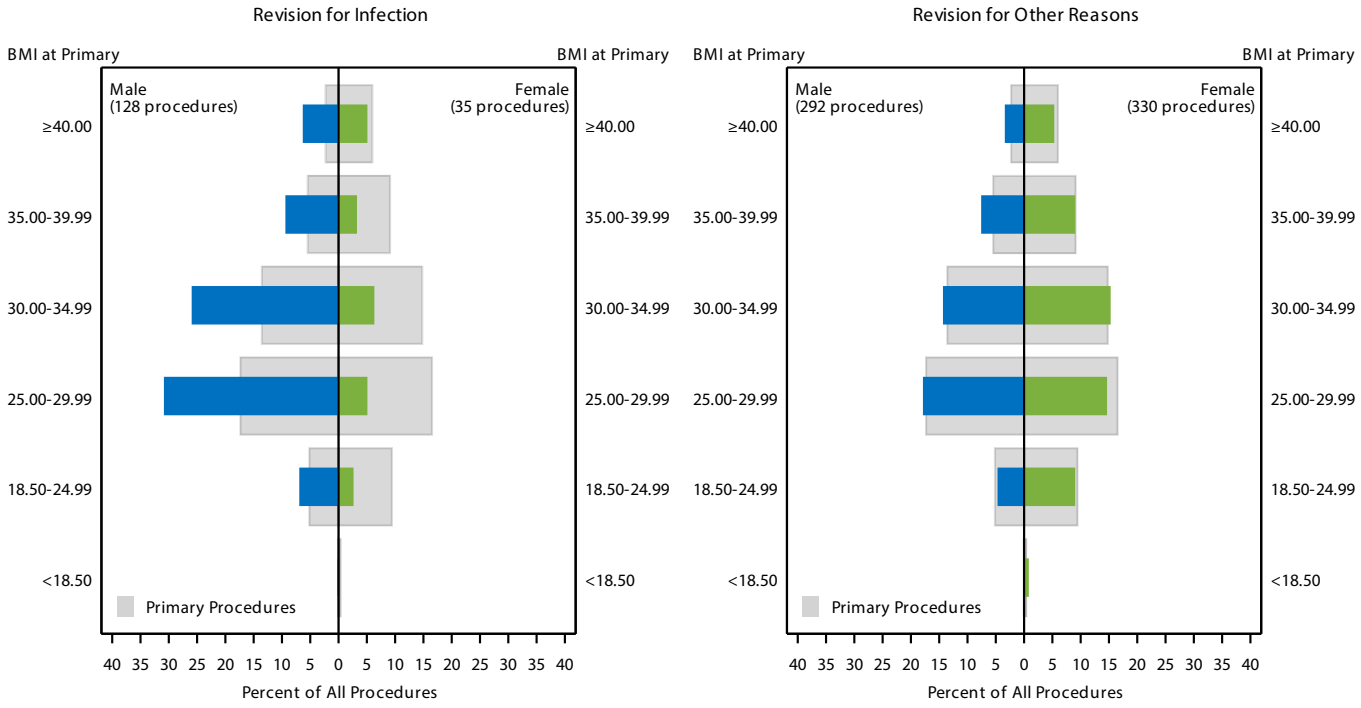
Compared to revisions for aseptic reasons, revisions for infection occur disproportionately more frequently in males with a BMI above 18.5. Females tend to account for a much smaller proportion of these revisions (Figure IF50).

Figure IF49 1st Revision of Known Primary Shoulder Replacement by ASA Score at Primary and Gender (Primary Diagnosis OA)



Note: Restricted to modern prostheses

Figure IF50 1st Revision of Known Primary Shoulder Replacement by BMI Category at Primary and Gender (Primary Diagnosis OA)



Note: Restricted to modern prostheses

TIMING OF REVISION FOR INFECTION

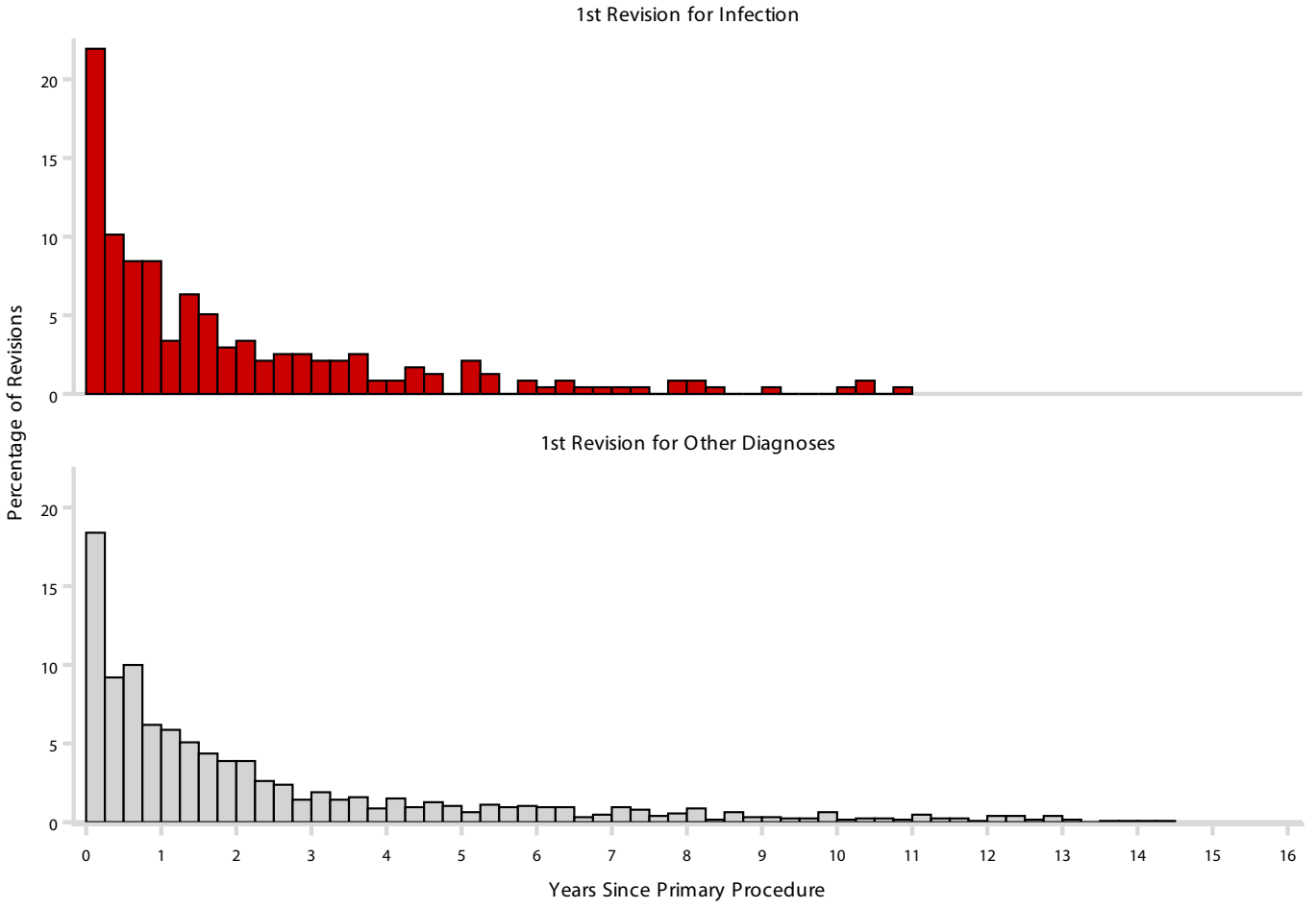
An early revision for infection is defined by the Registry as revision within 3 months of the primary procedure. When shoulder replacements are revised for infection, 21.9% are early revisions (Table IF37 and Figure IF51).

Table IF37 Time to 1st Revision in Primary Shoulder Replacement by 1st Revision Diagnosis (Primary Diagnosis OA)

Time to 1st Revision	1st Revision for Infection			1st Revision for Other Diagnoses			TOTAL		
	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%
≤7 Days	.	.	.	60	100.0	4.8	60	100.0	4.0
>7 Days to ≤4 Weeks	24	35.3	10.1	44	64.7	3.5	68	100.0	4.5
>4 Weeks to ≤3 Months	28	17.9	11.8	128	82.1	10.2	156	100.0	10.4
>3 Months to ≤1 Year	64	16.7	27.0	320	83.3	25.4	384	100.0	25.6
>1 Year to ≤2 Years	42	14.8	17.7	242	85.2	19.2	284	100.0	19.0
>2 Years	79	14.5	33.3	467	85.5	37.0	546	100.0	36.4
TOTAL	**237**	**15.8**	**100.0**	**1261**	**84.2**	**100.0**	**1498**	**100.0**	**100.0**

Note: Restricted to modern prostheses

Figure IF51 Time to 1st Revision in Primary Shoulder Replacement by 1st Revision Diagnosis (Primary Diagnosis OA)



Note: Restricted to modern prostheses
Bins are 0 to <3 months, 3 months to <6 months, etc.

REVISION PROCEDURES

Revision for infection of primary shoulder replacements, with exchange of modular components only corresponding to a DAIR procedure, occurs within 3 months of the primary procedure in 40.8% of cases. Major revisions for infection more often occur after 3 months from the primary procedure (Table IF38).

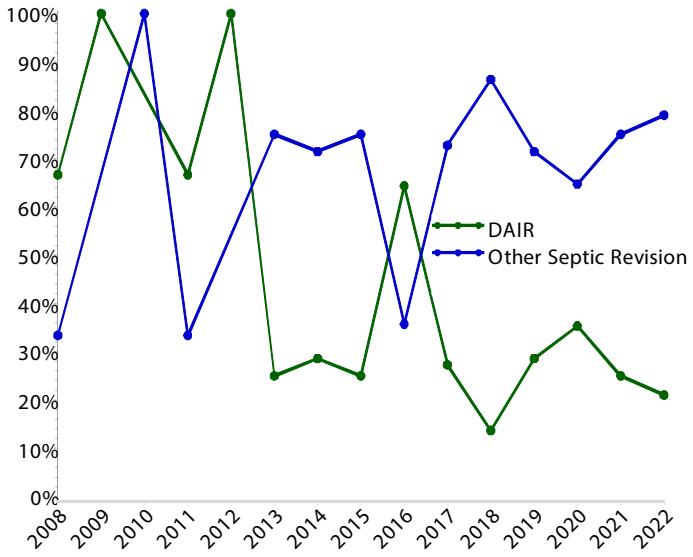
In 2022, compared to major revisions, DAIR procedures are less common 1st revision procedures of primary shoulder replacement for infection. The proportion of DAIR procedures as the 1st revision procedure is 21.1% in 2022 (Figure IF52).

Table IF38 Primary Shoulder Replacement by Time to 1st Revision and Type of Revision (Primary Diagnosis OA)

Time to 1st Revision	DAIR			Other Septic Revision			Other Revision			TOTAL		
	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%
≤7 Days	.	.	.	.	.	.	60	100.0	4.8	60	100.0	4.0
>7 Days to ≤4 Weeks	15	22.1	21.1	9	13.2	5.4	44	64.7	3.5	68	100.0	4.5
>4 Weeks to ≤3 Months	14	9.0	19.7	14	9.0	8.4	128	82.1	10.2	156	100.0	10.4
>3 Months to ≤1 Year	18	4.7	25.4	46	12.0	27.7	320	83.3	25.4	384	100.0	25.6
>1 Year to ≤2 Years	10	3.5	14.1	32	11.3	19.3	242	85.2	19.2	284	100.0	19.0
>2 Years	14	2.6	19.7	65	11.9	39.2	467	85.5	37.0	546	100.0	36.4
TOTAL	**71**	**4.7**	**100.0**	**166**	**11.1**	**100.0**	**1261**	**84.2**	**100.0**	**1498**	**100.0**	**100.0**

Note: Restricted to modern prostheses

Figure IF52 1st Revision of Known Primary Shoulder Replacement by Management Strategy (Primary Diagnosis OA, 1st Revision for Infection)



Note: Restricted to modern prostheses
By year of revision procedure

REVISION RISK OVER TIME

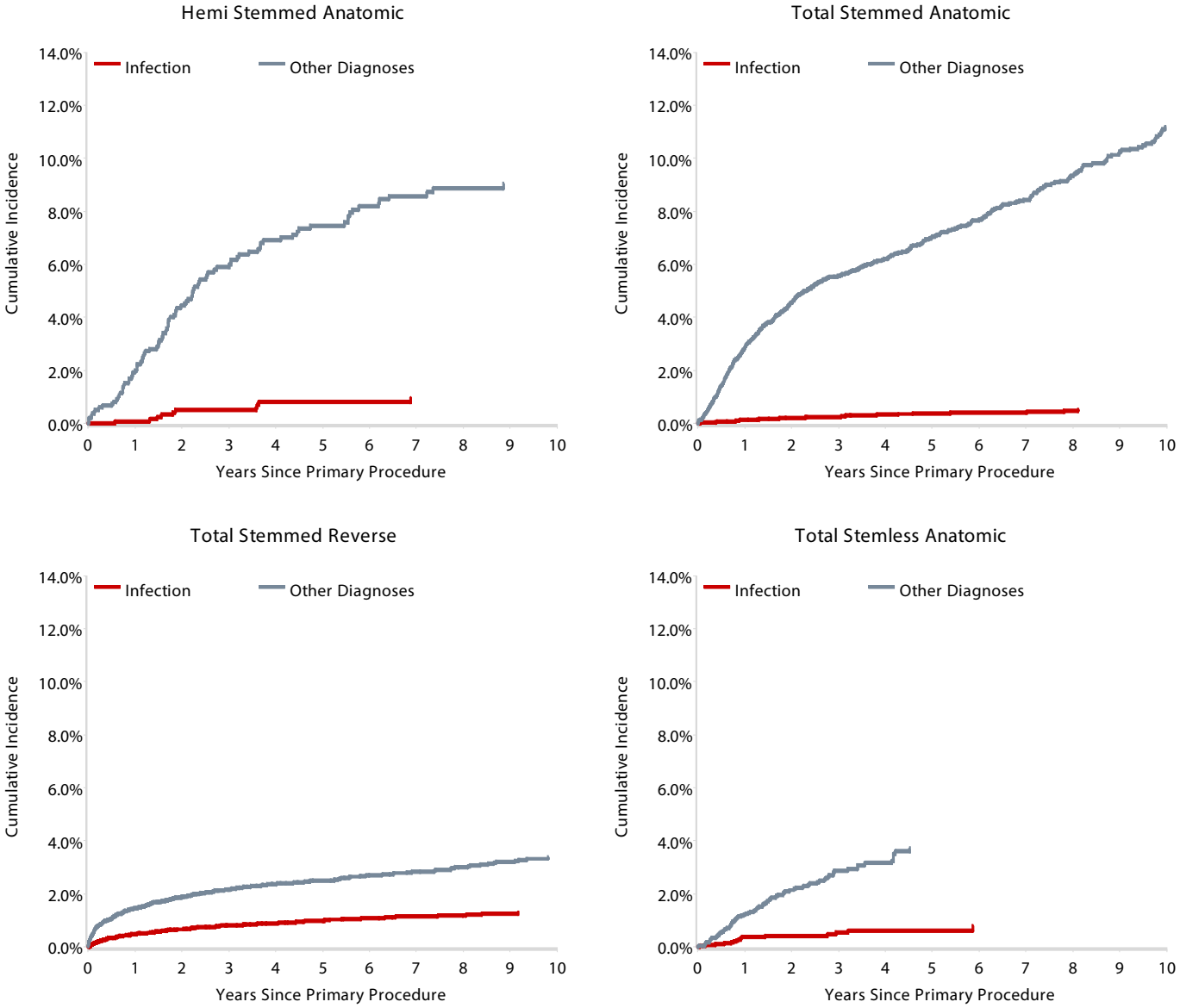
The cumulative incidence of revision for infection steadily increases with time and varies with the type of shoulder procedure. The risk of revision for infection at 1 year is 0.1% for primary hemi stemmed anatomic shoulder replacement, 0.1% for total stemmed anatomic, 0.4% for total stemless anatomic, and 0.5% for total stemmed reverse. This slowly increases to 0.9% for hemi stemmed anatomic at 14 years, 0.6% for total stemmed anatomic at 14 years, 1.5% for total stemmed reverse at 14 years, and 0.8% for total stemless anatomic replacement at 10 years after the primary procedure (Table IF39 and Figure IF53).

Table IF39 Cumulative Incidence Revision Diagnosis in Primary Shoulder Replacement (Primary Diagnosis OA)

Type of Primary	Event	N sEvents	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Hemi Stemmed Anatomic	Infection	10	0.1 (0.0, 0.4)	0.5 (0.2, 1.1)	0.8 (0.4, 1.5)	0.9 (0.5, 1.7)	0.9 (0.5, 1.7)	0.9 (0.5, 1.7)
Hemi Stemmed Anatomic	Other Diagnoses	102	2.0 (1.3, 2.9)	5.9 (4.7, 7.3)	7.5 (6.0, 9.1)	8.6 (7.0, 10.4)	9.0 (7.4, 10.9)	9.8 (8.0, 11.9)
Hemi Stemmed Anatomic	Deceased	319	1.5 (1.0, 2.3)	6.1 (4.8, 7.5)	11.2 (9.3, 13.2)	19.2 (16.7, 21.8)	32.5 (29.2, 35.9)	46.6 (42.0, 51.2)
Hemi Stemmed Anatomic	All Revision	112	2.1 (1.4, 3.0)	6.4 (5.1, 7.9)	8.3 (6.8, 10.0)	9.5 (7.9, 11.4)	10.0 (8.2, 11.9)	10.8 (8.8, 12.9)
Total Stemmed Anatomic	Infection	29	0.1 (0.1, 0.2)	0.2 (0.2, 0.4)	0.4 (0.3, 0.6)	0.4 (0.3, 0.6)	0.5 (0.3, 0.8)	0.6 (0.4, 0.9)
Total Stemmed Anatomic	Other Diagnoses	590	2.8 (2.5, 3.2)	5.6 (5.0, 6.1)	7.0 (6.4, 7.7)	8.4 (7.7, 9.2)	11.2 (10.2, 12.2)	14.4 (12.9, 15.9)
Total Stemmed Anatomic	Deceased	775	0.5 (0.4, 0.7)	2.4 (2.0, 2.7)	5.3 (4.7, 5.9)	9.7 (8.8, 10.6)	18.1 (16.6, 19.6)	32.8 (30.3, 35.3)
Total Stemmed Anatomic	All Revision	619	3.0 (2.6, 3.4)	5.8 (5.3, 6.4)	7.4 (6.8, 8.1)	8.8 (8.1, 9.6)	11.7 (10.7, 12.8)	15.0 (13.5, 16.5)
Total Stemmed Reverse	Infection	181	0.5 (0.4, 0.6)	0.8 (0.7, 1.0)	1.0 (0.8, 1.1)	1.1 (1.0, 1.3)	1.3 (1.1, 1.5)	1.5 (1.2, 1.8)
Total Stemmed Reverse	Other Diagnoses	479	1.4 (1.3, 1.6)	2.2 (2.0, 2.4)	2.5 (2.3, 2.7)	2.8 (2.6, 3.1)	3.4 (3.0, 3.8)	4.3 (3.6, 5.1)
Total Stemmed Reverse	Deceased	2674	1.1 (0.9, 1.2)	4.8 (4.5, 5.2)	10.8 (10.3, 11.4)	19.9 (19.0, 20.8)	34.5 (33.0, 35.9)	57.9 (55.3, 60.4)
Total Stemmed Reverse	All Revision	660	1.9 (1.7, 2.1)	3.0 (2.7, 3.2)	3.5 (3.2, 3.8)	4.0 (3.7, 4.3)	4.7 (4.2, 5.1)	5.8 (5.0, 6.6)
Total Stemless Anatomic	Infection	17	0.4 (0.2, 0.7)	0.5 (0.3, 0.9)	0.6 (0.4, 1.0)	0.8 (0.4, 1.4)	0.8 (0.4, 1.4)	
Total Stemless Anatomic	Other Diagnoses	88	1.2 (0.9, 1.7)	2.9 (2.3, 3.6)	3.7 (2.9, 4.6)	3.7 (2.9, 4.6)	3.7 (2.9, 4.6)	
Total Stemless Anatomic	Deceased	92	0.4 (0.2, 0.7)	1.8 (1.3, 2.4)	4.3 (3.3, 5.5)	7.1 (5.4, 9.1)	11.6 (8.0, 15.9)	
Total Stemless Anatomic	All Revision	105	1.6 (1.2, 2.1)	3.4 (2.8, 4.2)	4.3 (3.5, 5.2)	4.5 (3.6, 5.5)	4.5 (3.6, 5.5)	

Note: Restricted to modern prostheses

Figure IF53 Cumulative Incidence Revision Diagnosis in Primary Shoulder Replacement (Primary Diagnosis OA)



Note: Restricted to modern prostheses
Due to a small number of revisions, total stemless reverse procedures have been excluded

RISKS OF REVISION BY PRIMARY DIAGNOSIS

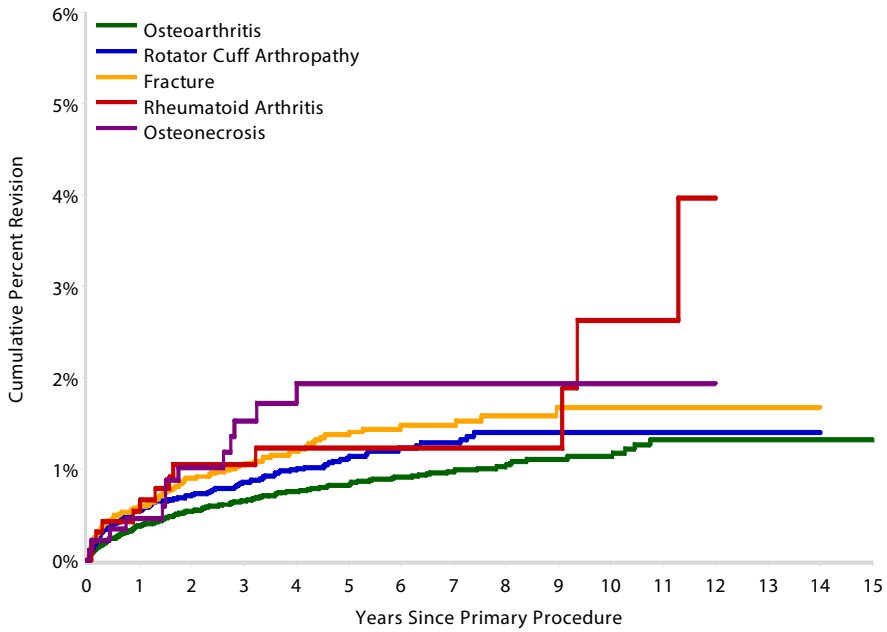
When compared to primary procedures undertaken for osteoarthritis, procedures performed for rotator cuff arthropathy, rheumatoid arthritis, and fracture have a higher rate of revision for infection (Table IF40 and Figure IF54).

Table IF40 Cumulative Percent Revision of Primary Shoulder Replacement by Primary Diagnosis (Revision for Infection)

Primary Diagnosis	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Osteoarthritis	237	32837	0.4 (0.3, 0.5)	0.7 (0.6, 0.8)	0.8 (0.7, 0.9)	1.0 (0.8, 1.1)	1.1 (1.0, 1.3)	1.3 (1.1, 1.6)
Rotator Cuff Arthropathy	157	17628	0.6 (0.5, 0.7)	0.8 (0.7, 1.0)	1.1 (0.9, 1.3)	1.3 (1.1, 1.5)	1.4 (1.2, 1.7)	1.4 (1.2, 1.7)
Fracture	100	9128	0.6 (0.4, 0.8)	1.0 (0.8, 1.3)	1.4 (1.1, 1.7)	1.5 (1.2, 1.8)	1.7 (1.3, 2.1)	1.7 (1.3, 2.1)
Rheumatoid Arthritis	13	985	0.5 (0.2, 1.3)	1.0 (0.5, 2.0)	1.2 (0.7, 2.3)	1.2 (0.7, 2.3)	2.6 (1.2, 5.8)	
Osteonecrosis	13	910	0.5 (0.2, 1.2)	1.5 (0.8, 2.8)	1.9 (1.1, 3.4)	1.9 (1.1, 3.4)	1.9 (1.1, 3.4)	
Other (4)	15	1279	0.6 (0.3, 1.3)	1.0 (0.5, 1.9)	1.2 (0.6, 2.2)	1.2 (0.6, 2.2)	3.5 (1.8, 6.7)	
TOTAL	**535**	**62767**						

Note: Restricted to modern prostheses
Only primary diagnoses with >750 procedures have been listed

Figure IF54 Cumulative Percent Revision of Primary Shoulder Replacement by Primary Diagnosis (Revision for Infection)



HR - adjusted for age and gender

Rotator Cuff Arthropathy vs Osteoarthritis
Entire Period: HR=1.41 (1.15, 1.73), p=0.001

Fracture vs Osteoarthritis
Entire Period: HR=2.19 (1.73, 2.79), p<0.001

Rheumatoid Arthritis vs Osteoarthritis
Entire Period: HR=2.10 (1.20, 3.69), p=0.009

Osteonecrosis vs Osteoarthritis
Entire Period: HR=1.65 (0.93, 2.92), p=0.086

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Osteoarthritis	32837	28011	19327	12064	6777	2486	489
Rotator Cuff Arthropathy	17628	14607	9469	5327	2799	828	70
Fracture	9128	7525	5066	3259	1954	758	118
Rheumatoid Arthritis	985	824	593	378	248	104	17
Osteonecrosis	910	784	555	337	181	83	22

Note: Restricted to modern prostheses
Only primary diagnoses with >750 procedures have been listed

OUTCOME OF 1ST REVISION

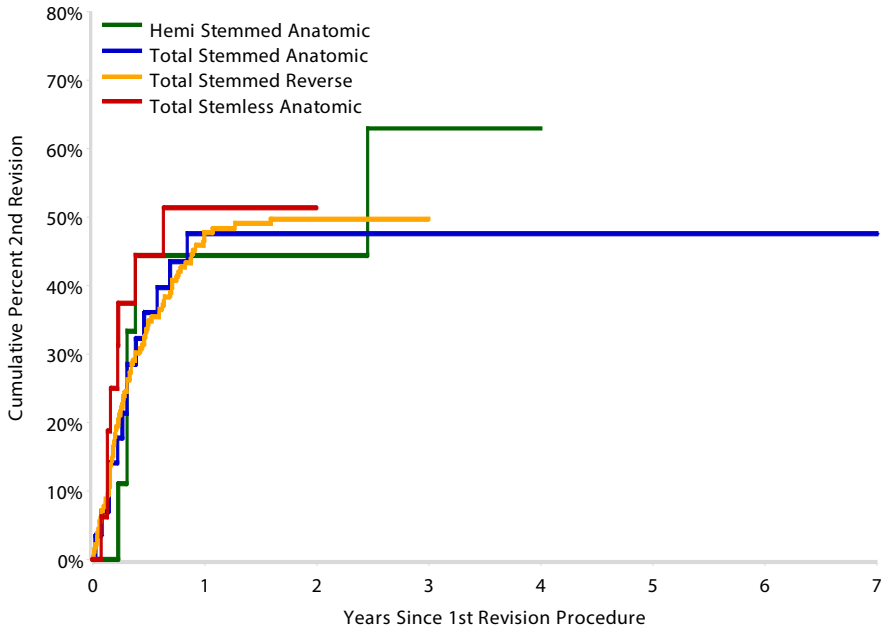
Revision of primary shoulder replacement for infection carries a high risk of a 2nd revision surgery for any reason, with a 3 year cumulative percent 2nd revision of 63% for hemi stemmed anatomic, 47.6% for total stemmed anatomic at 5 years, 49.8% for total stemmed reverse at 2 years, and 51.4% total stemless anatomic at 1 year (Table IF41 and Figure IF55). This includes 59 revision procedures where a 2nd major revision for infection occurred within 6 months of the 1st revision for infection, which are likely to be intended two stage revisions.

Table IF41 Cumulative Percent 2nd Revision of Known Primary Shoulder Replacement (Primary Diagnosis OA, 1st Revision for Infection)

Type of Primary	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	7 Yrs
Hemi Stemmed Anatomic	5	10	44.4 (19.5, 79.6)	44.4 (19.5, 79.6)	63.0 (30.7, 93.2)	63.0 (30.7, 93.2)		
Total Stemmed Anatomic	13	29	47.6 (30.9, 67.6)	47.6 (30.9, 67.6)	47.6 (30.9, 67.6)	47.6 (30.9, 67.6)	47.6 (30.9, 67.6)	47.6 (30.9, 67.6)
Total Stemmed Reverse	87	181	47.8 (40.6, 55.5)	49.8 (42.5, 57.5)	49.8 (42.5, 57.5)			
Total Stemless Anatomic	8	17	51.4 (29.7, 77.1)	51.4 (29.7, 77.1)				
TOTAL	**113**	**237**						

Note: Restricted to modern prostheses. Includes all septic 1st revisions (i.e. including two stage)

Figure IF55 Cumulative Percent 2nd Revision of Known Primary Shoulder Replacement (Primary Diagnosis OA, 1st Revision for Infection)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	7 Yrs
Hemi Stemmed Anatomic	10	5	4	2	2	1	0
Total Stemmed Anatomic	29	13	11	11	9	8	4
Total Stemmed Reverse	181	82	68	43	29	25	11
Total Stemless Anatomic	17	4	3	2	2	1	1

Note: Restricted to modern prostheses. Includes all septic 1st revisions (i.e. including two stage)

OUTCOME OF DAIR PROCEDURES

A DAIR procedure undertaken as the 1st revision procedure of a total stemmed reverse shoulder replacement has a cumulative percent 2nd revision of 27.8% at 7 years (Table IF42 and Figure IF56). There are insufficient numbers to report on DAIR procedures for other types of shoulder replacement.

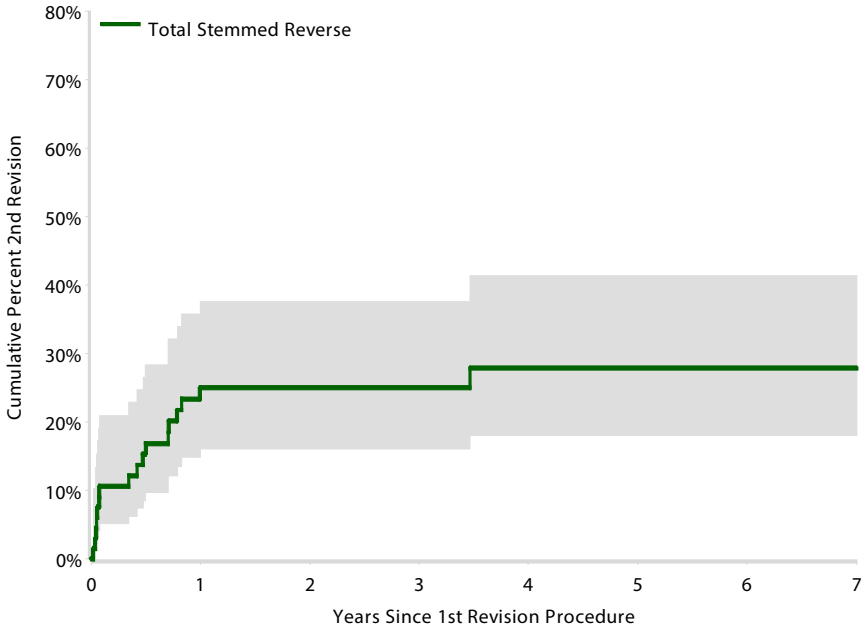
There is no difference in rate of 2nd revision related to timing of the DAIR procedure (Table IF43, Figure IF57 and Table IF44).

Table IF42 Cumulative Percent 2nd Revision of Known Primary Shoulder Replacement (Primary Diagnosis OA, DAIR 1st Revision for Infection)

Type of Primary	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	7 Yrs
Total Stemmed Anatomic	0	1						
Total Stemmed Reverse	17	66	25.1 (16.2, 37.7)	25.1 (16.2, 37.7)	25.1 (16.2, 37.7)	27.8 (18.1, 41.3)	27.8 (18.1, 41.3)	27.8 (18.1, 41.3)
Total Stemless Anatomic	0	4	0.0 (0.0, 0.0)					
TOTAL	**17**	**71**						

Note: Restricted to modern prostheses

Figure IF56 Cumulative Percent 2nd Revision of Known Primary Total Stemmed Reverse Shoulder Replacement (Primary Diagnosis OA, DAIR 1st Revision for Infection)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	7 Yrs
Total Stemmed Reverse	66	45	41	30	21	18	8

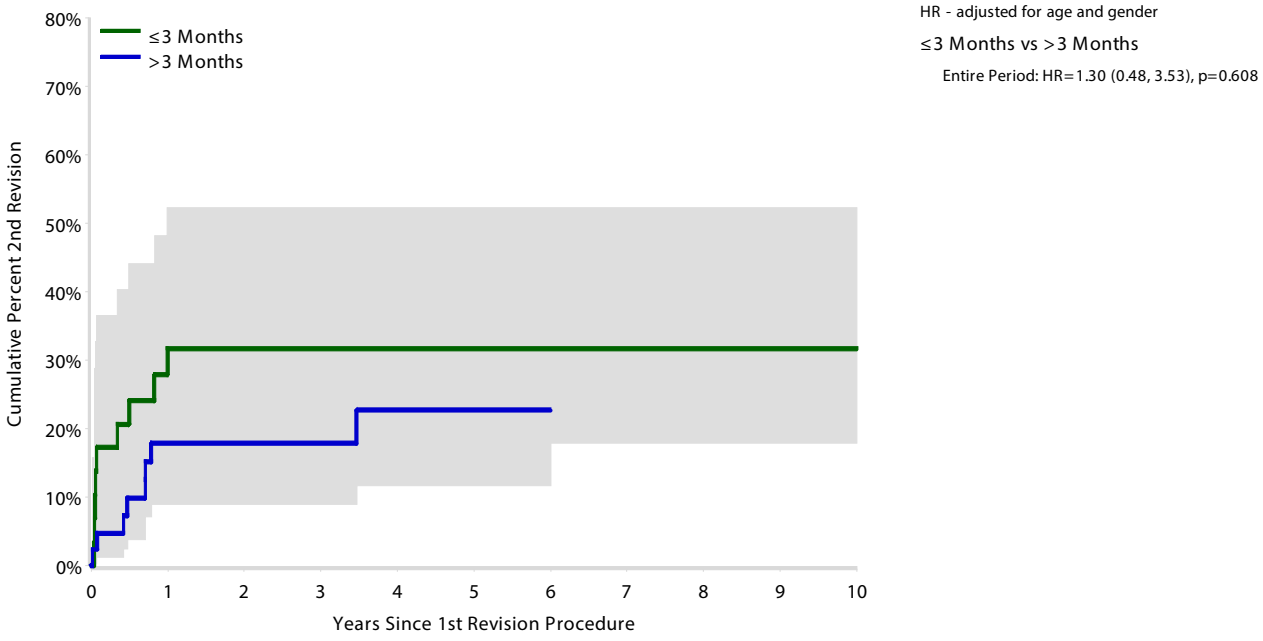
Note: Restricted to modern prostheses

Table IF43 Cumulative Percent 2nd Revision of Known Primary Shoulder Replacement by Time to 1st Revision (Primary Diagnosis OA, DAIR 1st Revision for Infection)

Time to 1st Revision	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	7 Yrs
≤3 Months	9	29	31.7 (17.9, 52.2)	31.7 (17.9, 52.2)	31.7 (17.9, 52.2)	31.7 (17.9, 52.2)	31.7 (17.9, 52.2)	31.7 (17.9, 52.2)
>3 Months	8	42	17.9 (8.9, 33.9)	17.9 (8.9, 33.9)	17.9 (8.9, 33.9)	22.7 (11.6, 41.5)	22.7 (11.6, 41.5)	
TOTAL	**17**	**71**						

Note: Restricted to modern prostheses

Figure IF57 Cumulative Percent 2nd Revision of Known Primary Shoulder Replacement by Time to 1st Revision (Primary Diagnosis OA, DAIR 1st Revision for Infection)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	7 Yrs
≤3 Months	29	18	18	13	10	8	5
>3 Months	42	30	25	19	13	12	4

Note: Restricted to modern prostheses

Table IF44 Cumulative Percent 2nd Revision of Known Primary Shoulder Replacement by Time to 1st Revision (Primary Diagnosis OA, DAIR 1st Revision for Infection)

Time to 1st Revision	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	7 Yrs
≤4 Weeks	3	15	22.2 (7.7, 54.5)	22.2 (7.7, 54.5)	22.2 (7.7, 54.5)	22.2 (7.7, 54.5)	22.2 (7.7, 54.5)	22.2 (7.7, 54.5)
>4 Weeks to ≤3 Months	6	14	42.9 (22.0, 71.6)	42.9 (22.0, 71.6)	42.9 (22.0, 71.6)	42.9 (22.0, 71.6)		
>3 Months to ≤1 Year	3	18	18.1 (6.2, 46.5)	18.1 (6.2, 46.5)	18.1 (6.2, 46.5)	18.1 (6.2, 46.5)	18.1 (6.2, 46.5)	
>1 Year to ≤2 Years	2	10	22.2 (6.1, 63.5)	22.2 (6.1, 63.5)	22.2 (6.1, 63.5)	22.2 (6.1, 63.5)	22.2 (6.1, 63.5)	22.2 (6.1, 63.5)
>2 Years	3	14	14.9 (3.9, 47.7)	14.9 (3.9, 47.7)	14.9 (3.9, 47.7)	29.1 (9.6, 69.1)	29.1 (9.6, 69.1)	
TOTAL	**17**	**71**						

Note: Restricted to modern prostheses. Estimated HRs not presented due to a small number of revisions

COMPARATIVE OUTCOMES OF REVISION PROCEDURES

A single stage 1st revision involves revision of the major components of the shoulder replacement for infection. For the purposes of this analysis, the Registry defines a single stage revision of a primary shoulder replacement as a major revision for infection that is not classified as a two stage revision. The single stage revision group may include a small number of patients who have died before a planned second stage or those who have chosen not to have a further procedure.

In the following analysis, potential two stage revisions have been identified as 1st revision procedures where either:

i) the 1st revision was for infection and the type of revision recorded was removal of prostheses or a cement spacer; or
ii) a planned second stage was noted on the data collection form, and where a 2nd major revision was performed for infection. Revisions that were initially planned as two stage procedures, but did not result in a second revision for infection, have been classified as incomplete two stage procedures.

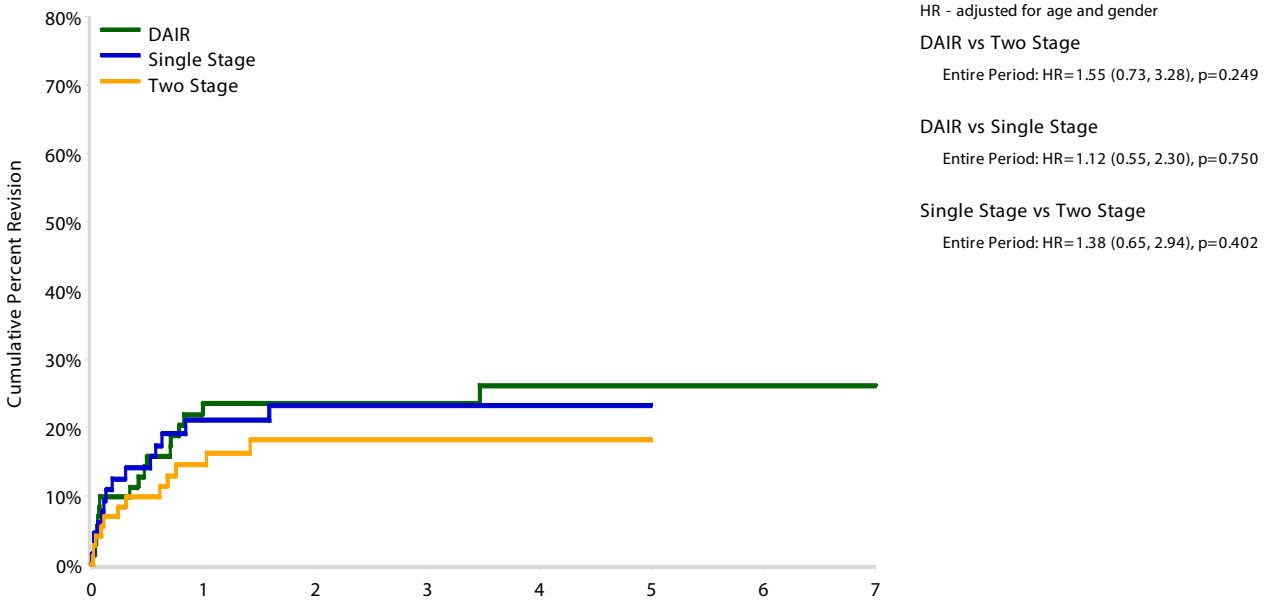
There is no significant difference in rates of subsequent revision of primary shoulder replacements between DAIR procedures, single or two stage procedures (Table IF45 and Figure IF58).

Table IF45 Cumulative Percent Revision of Known Primary Shoulder Replacement by Management Strategy (Primary Diagnosis OA, 1st Revision for Infection)

Management Strategy	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	7 Yrs
DAIR	17	71	23.5 (15.1, 35.5)	23.5 (15.1, 35.5)	23.5 (15.1, 35.5)	26.1 (16.9, 39.1)	26.1 (16.9, 39.1)	26.1 (16.9, 39.1)
Single Stage	14	66	21.0 (12.7, 33.5)	23.3 (14.4, 36.3)	23.3 (14.4, 36.3)	23.3 (14.4, 36.3)	23.3 (14.4, 36.3)	
Two Stage	14	72	14.5 (8.1, 25.4)	18.1 (10.7, 29.8)	18.1 (10.7, 29.8)	18.1 (10.7, 29.8)	18.1 (10.7, 29.8)	
TOTAL	**45**	**209**						

Note: Restricted to modern prostheses. For DAIR and single stage revisions, time to revision is reported as time to 2nd revision
For two stage revisions, time to revision is reported as time to 3rd revision. Excludes incomplete two stage procedures

Figure IF58 Cumulative Percent Revision of Known Primary Shoulder Replacement by Management Strategy (Primary Diagnosis OA, 1st Revision for Infection)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	7 Yrs
DAIR	71	48	43	32	23	20	9
Single Stage	66	40	30	18	12	9	4
Two Stage	72	50	39	32	17	11	7

Note: Restricted to modern prostheses. Adjustment for age is for age at 1st revision. For DAIR and single stage revisions, time to revision is reported as time to 2nd revision. For two stage revisions, time to revision is reported as time to 3rd revision. Excludes incomplete two stage procedures

COMPARATIVE OUTCOMES OF TIMING OF TWO STAGE REVISION PROCEDURES

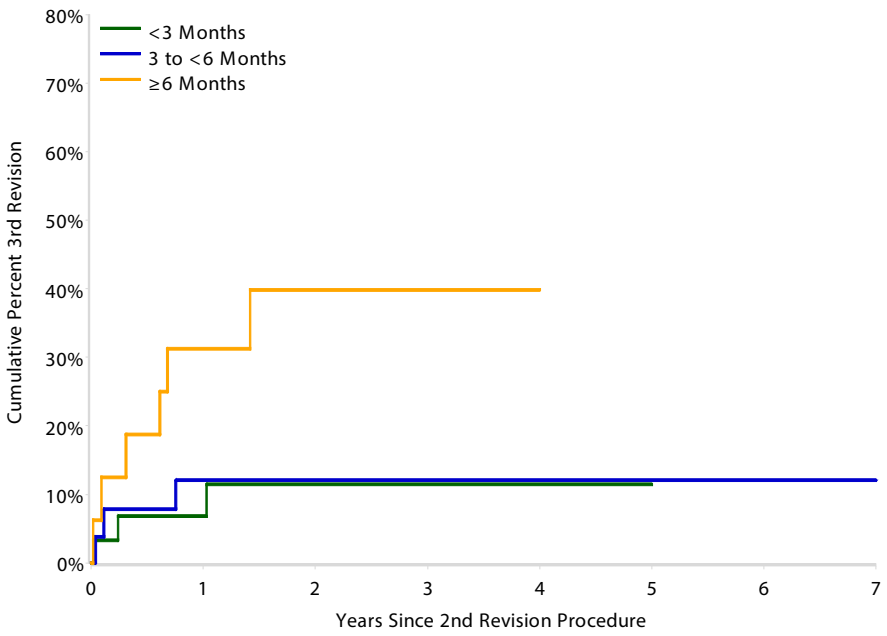
The 5 year cumulative percent 3rd revision of a known primary shoulder replacement revised for infection in a two stage process is highest if the second stage revision is performed after 6 months from the first stage. There is no difference in the rate of 3rd revision if the second stage is undertaken within 3 months or between 3 and 6 months of the first stage (Table IF46 and Figure IF59).

Table IF46 Cumulative Percent 3rd Revision of Known Primary Shoulder Replacement by Time Between 1st and 2nd Revision Procedure (Primary Diagnosis OA, 1st Revision for Infection)

Time Between 1st and 2nd Revision	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	7 Yrs
<3 Months	4	30	6.8 (1.7, 24.5)	11.4 (3.8, 31.9)	11.4 (3.8, 31.9)	11.4 (3.8, 31.9)	11.4 (3.8, 31.9)	
3 to <6 Months	4	26	12.0 (4.0, 32.9)	12.0 (4.0, 32.9)	12.0 (4.0, 32.9)	12.0 (4.0, 32.9)	12.0 (4.0, 32.9)	12.0 (4.0, 32.9)
≥6 Months	6	16	31.3 (14.4, 59.5)	39.8 (19.9, 68.8)	39.8 (19.9, 68.8)	39.8 (19.9, 68.8)		
TOTAL	**14**	**72**						

Note: Restricted to modern prostheses

Figure IF59 Cumulative Percent 3rd Revision of Known Primary Shoulder Replacement by Time Between 1st and 2nd Revision Procedure (Primary Diagnosis OA, 1st Revision for Infection)



HR - adjusted for age and gender

3 to <6 Months vs <3 Months

Entire Period: HR=0.74 (0.17, 3.29), p=0.694

≥6 Months vs <3 Months

Entire Period: HR=3.13 (0.85, 11.51), p=0.086

≥6 Months vs 3 to <6 Months

Entire Period: HR=4.21 (0.97, 18.29), p=0.054

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	7 Yrs
<3 Months	30	20	15	12	5	4	2
3 to <6 Months	26	21	17	14	9	5	4
≥6 Months	16	9	7	6	3	2	1

Note: Restricted to modern prostheses
Adjustment for age is for age at 1st revision

MORTALITY FOLLOWING REVISION FOR INFECTION

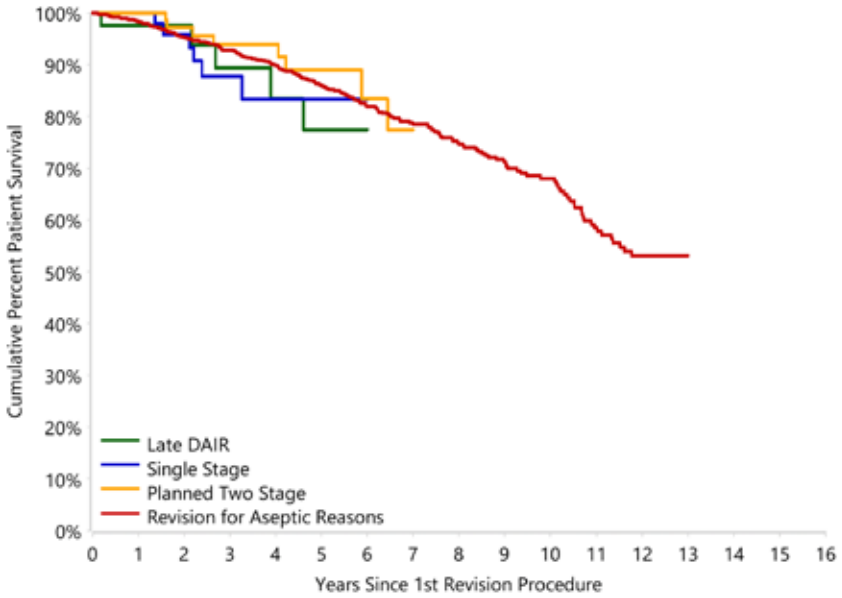
There is no significant difference in mortality when comparing the revision of a primary shoulder replacement for aseptic reasons with DAIR procedures, single stage, and two stage procedures (Table IF47 and Figure IF60).

Table IF47 Cumulative Percent Survival of Patients with Known Primary Shoulder Replacement Since 1st Revised by Intended Treatment Strategy (Primary Diagnosis OA)

Intended Treatment Strategy	N Deceased	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	7 Yrs
Early DAIR	1	29	100.0 (100.0, 100.0)	100.0 (100.0, 100.0)	100.0 (100.0, 100.0)	100.0 (100.0, 100.0)	100.0 (100.0, 100.0)	100.0 (100.0, 100.0)
Late DAIR	6	41	97.6 (83.9, 99.7)	97.6 (83.9, 99.7)	89.3 (69.5, 96.6)	83.4 (59.8, 93.8)	77.4 (52.2, 90.4)	
Single Stage	7	66	100.0 (100.0, 100.0)	95.7 (84.0, 98.9)	87.7 (72.6, 94.7)	83.3 (65.4, 92.4)	83.3 (65.4, 92.4)	
Planned Two Stage	8	95	100.0 (100.0, 100.0)	97.1 (89.0, 99.3)	93.9 (84.5, 97.7)	93.9 (84.5, 97.7)	88.9 (76.4, 95.0)	77.4 (55.2, 89.6)
Revision for Aseptic Reasons	209	1231	98.3 (97.4, 98.9)	95.3 (93.8, 96.4)	92.8 (91.0, 94.2)	89.8 (87.7, 91.6)	86.0 (83.4, 88.2)	78.5 (75.0, 81.5)
TOTAL	**231**	**1462**						

Note: Restricted to modern prostheses. Excludes 3 procedures with unknown intended treatment strategy or missing first stage
Restricted to the first revision shoulder procedure recorded for each patient

Figure IF60 Cumulative Percent Survival of Patients with Known Primary Shoulder Replacement Since 1st Revised by Intended Treatment Strategy (Primary Diagnosis OA)



HR – adjusted for age, gender and ASA score

Late DAIR vs Revision for Aseptic Reasons
Entire Period: HR=1.03 (0.42, 2.53), p=0.951

Single Stage vs Revision for Aseptic Reasons
Entire Period: HR=0.96 (0.39, 2.35), p=0.921

Planned Two Stage vs Revision for Aseptic Reasons
Entire Period: HR=0.89 (0.39, 2.04), p=0.778

Single Stage vs Late DAIR
Entire Period: HR=0.93 (0.27, 3.23), p=0.908

Planned Two Stage vs Late DAIR
Entire Period: HR=0.86 (0.26, 2.87), p=0.809

Planned Two Stage vs Single Stage
Entire Period: HR=0.93 (0.28, 3.07), p=0.903

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	7 Yrs
Late DAIR	41	34	27	19	14	13	5
Single Stage	66	52	40	25	17	13	7
Planned Two Stage	95	79	63	52	40	26	13
Revision for Aseptic Reasons	1231	1062	899	768	636	514	307

Note: Restricted to modern prostheses. Due to a small number of deaths, early DAIR procedures have been excluded
Restricted to the first revision shoulder procedure recorded for each patient

Hip Replacement

Hip Replacement

Categories of Hip Replacement

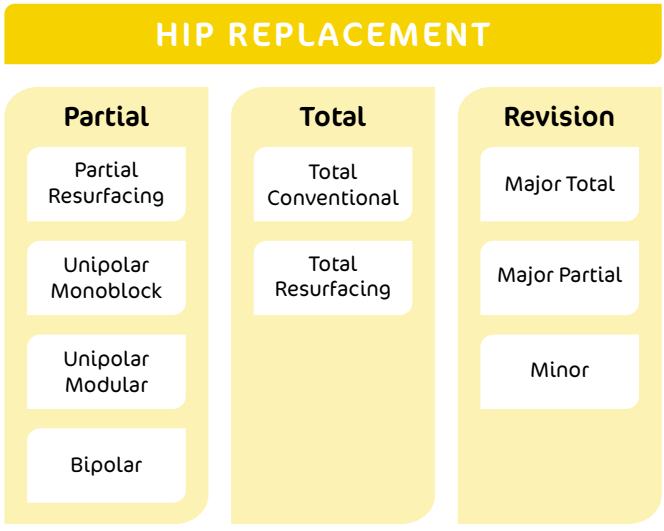
Hip replacement is grouped into three broad categories: primary partial, primary total and revision hip replacement.

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-2023



Use of Hip Replacement

There are 850,603 hip replacements with a procedure date up to and including 31 December 2022. This is an additional 53,917 hip procedures compared to the number reported last year. The relative frequency of each type of hip procedure is provided in Table H1.

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

Table H1 Number of Hip Replacements

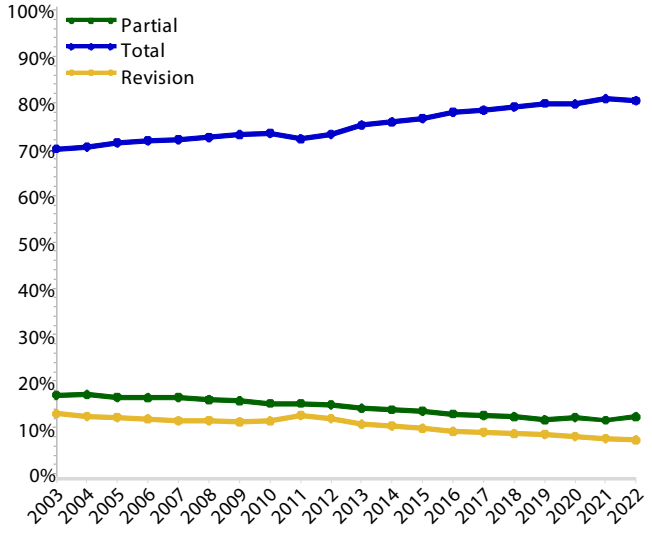
Hip Category	Number	Percent
Partial	120448	14.2
Total	642962	75.6
Revision	87193	10.3
TOTAL	**850603**	**100.0**

The number of hip replacement procedures undertaken in 2022 is 98.7% higher than the number undertaken in 2003. The corresponding increase in primary total hip replacement is 128.1%, for primary partial it is 43.5% and for revision hip replacement it is 12.2%.

There have been 10 more hip replacement procedures undertaken in 2022 compared to the previous year. During this time, the use of primary total hip replacement decreased by 0.5%, accounting for 75.6% of all hip replacement procedures in 2022. Primary partial hip replacement increased by 6.2%, accounting for 14.2% of hip procedures in 2022.

The proportion of revision hip procedures has declined from a peak of 12.9% in 2003 to 7.3% in 2022. This equates to 2,980 fewer revision procedures in 2022 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 462,567 and BMI data on 348,440 hip replacement procedures. Since its initial collection, ASA score has been recorded for 96.6% of procedures. BMI has been recorded for 88.0% 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

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 or revision total hip replacement. Total hip replacement procedures have more patients with ASA scores 1 and 2 (Table H2).

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

The majority of hip replacement procedures are undertaken in patients who have a normal BMI or are pre-obese (Table H3).

Table H2 ASA Score for Hip Replacement

ASA Score	Partial		Total		Revision		TOTAL	
	N	Col%	N	Col%	N	Col%	N	Col%
ASA 1	172	0.3	32615	9.0	1529	3.8	34316	7.4
ASA 2	5901	10.2	190825	52.4	13610	33.6	210336	45.5
ASA 3	34977	60.5	133511	36.7	21851	53.9	190339	41.1
ASA 4	16510	28.6	7283	2.0	3487	8.6	27280	5.9
ASA 5	240	0.4	29	0.0	27	0.1	296	0.1
TOTAL	**57800**	**100.0**	**364263**	**100.0**	**40504**	**100.0**	**462567**	**100.0**

Table H3 BMI Category for Hip Replacement

BMI Category	Partial		Total		Revision		TOTAL	
	N	Col%	N	Col%	N	Col%	N	Col%
Underweight	2622	9.8	3142	1.1	485	1.7	6249	1.8
Normal	13162	49.3	64861	22.1	6669	23.8	84692	24.3
Pre Obese	7640	28.6	107601	36.6	9625	34.4	124866	35.8
Obese Class 1	2366	8.9	72738	24.8	6612	23.6	81716	23.5
Obese Class 2	651	2.4	30531	10.4	2907	10.4	34089	9.8
Obese Class 3	253	0.9	14875	5.1	1700	6.1	16828	4.8
TOTAL	**26694**	**100.0**	**293748**	**100.0**	**27998**	**100.0**	**348440**	**100.0**

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

1 https://www.asahq.org/resources/clinical-information/asa-physical-status-classification-system

2 http://www.euro.who.int/en/health-topics/disease-prevention/nutrition/a-healthy-lifestyle/body-mass-index-bmi

Primary Partial Hip Replacement Summary

Introduction

This section provides summary information on partial hip replacement. Detailed information on partial hips is available on the AOANJRR website as a separate supplementary report.

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

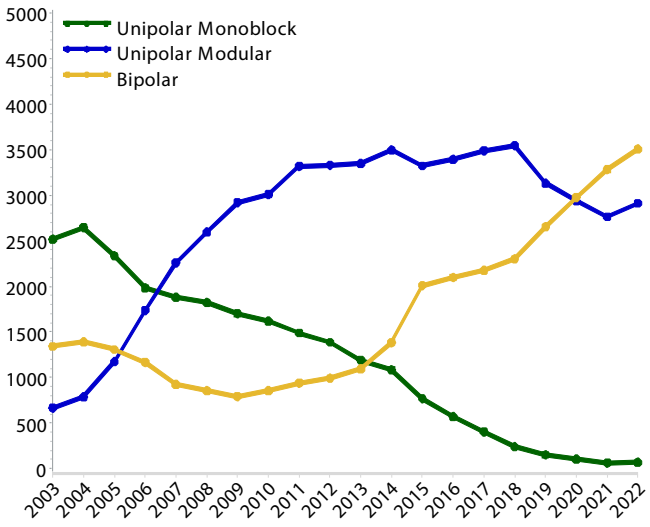
Hip Class	Number	Percent
Unipolar Monoblock	29257	24.3
Unipolar Modular	55028	45.7
Bipolar	36148	30.0
TOTAL	**120433**	**100.0**

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

In 2022, bipolar hip replacement was more commonly used than unipolar modular. The use of unipolar monoblock continues to decline (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-2023

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-2023

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

2003		2019		2020		2021		2022	
N	Model	N	Model	N	Model	N	Model	N	Model
1988	Austin-Moore Type	2980	Exeter V40	2935	Exeter V40	3097	Exeter V40	3400	Exeter V40
810	Exeter V40	725	CPCS	860	CPT	873	CPT	836	CPT
526	Thompson Type	713	CPT	769	CPCS	724	CPCS	721	CPCS
186	Alloclassic	475	C-Stem AMT	477	C-Stem AMT	499	C-Stem AMT	484	C-Stem AMT
127	Elite Plus	175	Absolut	123	Short Exeter V40	132	CORAIL	204	Short Exeter V40
105	CPT	141	CORAIL	108	CORAIL	130	Short Exeter V40	183	CORAIL
95	Spectron EF	124	ETS	92	ETS	93	Absolut	99	Quadra-C
74	C-Stem	96	Short Exeter V40	86	Taper Fit	74	Taper Fit	81	Taper Fit
65	CPCS	65	Spectron EF	77	twinSys (ctd)	72	Quadra-C	67	ETS
63	Omnifit	56	Quadra-C	61	Quadra-C	62	ETS	58	Polarstem
10 Most Used									
4039	(10) 89.3%	5550	(10) 93.5%	5588	(10) 92.9%	5756	(10) 94.2%	6133	(10) 94.6%
Remainder									
482	(52) 10.7%	386	(36) 6.5%	428	(36) 7.1%	353	(38) 5.8%	353	(39) 5.4%
TOTAL									
4521	(62) 100.0%	5936	(46) 100.0%	6016	(46) 100.0%	6109	(48) 100.0%	6486	(49) 100.0%

Note: Excludes partial resurfacing

Outcome for Fractured Neck of Femur

In order to keep Registry data contemporaneous, only procedures using prostheses that have been available and used in 2022 (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 (98.0%), unipolar modular (96.2%) and bipolar (94.0%). A comparative analysis of partial hip replacement and total conventional hip replacement has been undertaken for fractured neck of femur and is presented in the primary total hip replacement 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, unipolar monoblock has the lowest cumulative percent revision for fractured neck of femur, followed by bipolar, and unipolar modular (Table HP4 and Figure HP2). The difference in outcome between classes is most apparent in patients aged <75 years (Table HP5 and Figure HP3).

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

Hip Class	N Deceased	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Monoblock	3106	3624	33.6 (32.1, 35.2)	56.1 (54.5, 57.8)	72.3 (70.8, 73.8)	82.3 (81.0, 83.6)	90.5 (89.4, 91.6)
Unipolar Modular	31356	44025	27.1 (26.7, 27.5)	48.6 (48.1, 49.1)	64.7 (64.2, 65.2)	75.9 (75.4, 76.3)	85.7 (85.2, 86.1)
Bipolar	16309	27609	24.9 (24.3, 25.4)	45.4 (44.7, 46.0)	60.9 (60.2, 61.6)	71.8 (71.1, 72.5)	82.7 (82.0, 83.4)
TOTAL	**50771**	**75258**					

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

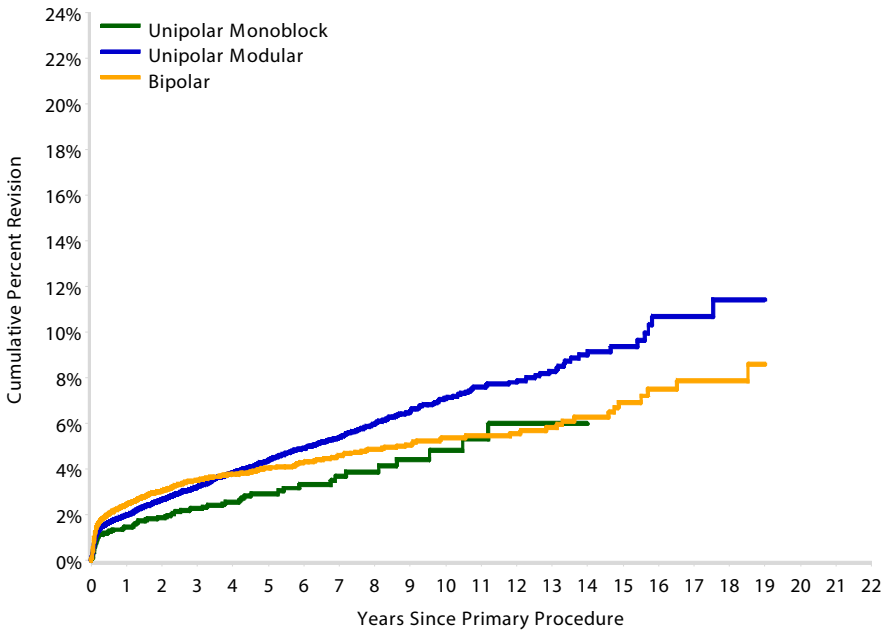
The rate of revision for fractured neck of femur in primary total conventional hip replacement compared to primary partial hip replacement can be found later in this chapter in the following section: **Outcome of Total Conventional Compared to Partial Hip Replacement.**

Table 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	81	3707	1.5 (1.1, 2.0)	1.9 (1.4, 2.4)	2.3 (1.8, 2.9)	2.9 (2.3, 3.8)	3.7 (2.8, 4.8)	4.8 (3.5, 6.6)
Unipolar Modular	1478	45559	2.0 (1.9, 2.1)	2.7 (2.5, 2.8)	3.2 (3.0, 3.4)	4.4 (4.1, 4.6)	5.4 (5.1, 5.7)	7.1 (6.6, 7.6)
Bipolar	858	28395	2.5 (2.3, 2.7)	3.1 (2.8, 3.3)	3.5 (3.3, 3.8)	4.0 (3.8, 4.4)	4.6 (4.2, 5.0)	5.4 (4.9, 5.9)
TOTAL	**2417**	**77661**						

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=0.73 (0.58, 0.91), p=0.005

Bipolar vs Unipolar Modular

0 - 1Mth: HR=1.32 (1.11, 1.56), p=0.001

1Mth - 3Mth: HR=1.04 (0.87, 1.25), p=0.630

3Mth - 2.5Yr: HR=1.02 (0.88, 1.18), p=0.785

2.5Yr+: HR=0.48 (0.39, 0.58), p<0.001

Bipolar vs Unipolar Monoblock

0 - 3Mth: HR=1.62 (1.27, 2.07), p<0.001

3Mth - 6Mth: HR=1.61 (1.11, 2.33), p=0.012

6Mth - 1.5Yr: HR=1.45 (1.08, 1.96), p=0.014

1.5Yr - 2Yr: HR=1.21 (0.79, 1.86), p=0.379

2Yr+: HR=0.74 (0.56, 0.98), p=0.032

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Monoblock	3707	2383	1908	1512	888	493	213
Unipolar Modular	45559	30505	24058	18753	11049	6237	2534
Bipolar	28395	18355	13675	10211	5633	3086	1309

Note: Restricted to modern prostheses

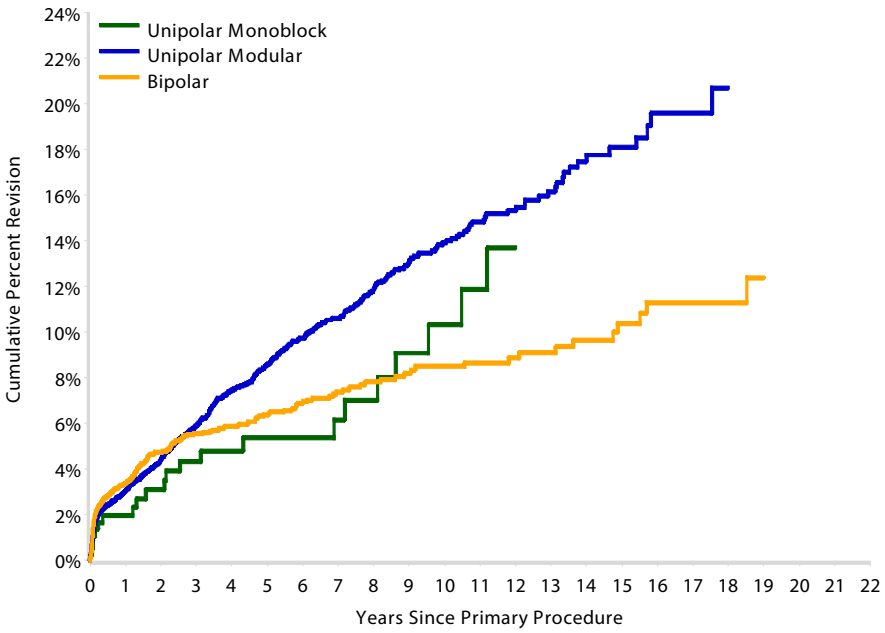
Primary Partial Hip Replacement Summary

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	22	395	2.0 (0.9, 4.1)	3.1 (1.7, 5.7)	4.3 (2.5, 7.4)	5.4 (3.2, 8.9)	6.2 (3.7, 10.2)	10.3 (6.3, 16.6)
Unipolar Modular	514	6445	3.0 (2.6, 3.5)	4.4 (3.9, 5.0)	5.9 (5.3, 6.6)	8.6 (7.8, 9.5)	10.6 (9.6, 11.6)	13.9 (12.6, 15.3)
Bipolar	263	4888	3.4 (2.9, 4.0)	4.7 (4.1, 5.4)	5.6 (4.9, 6.4)	6.4 (5.6, 7.3)	7.4 (6.4, 8.4)	8.5 (7.3, 9.8)
TOTAL	**799**	**11728**						

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 Bipolar

Entire Period: HR=1.00 (0.65, 1.54), p=0.992

Unipolar Modular vs Bipolar

0 - 1Mth: HR=0.81 (0.57, 1.16), p=0.251

1Mth - 3Yr: HR=1.11 (0.91, 1.36), p=0.300

3Yr+: HR=2.69 (2.00, 3.62), p<0.001

Unipolar Modular vs Unipolar Monoblock

Entire Period: HR=1.41 (0.92, 2.15), p=0.118

Number at Risk	0 Yr	1 Yr	2 Yr	3 Yr	5 Yr	7 Yr	10 Yr
Unipolar Monoblock	395	278	239	215	155	112	66
Unipolar Modular	6445	4845	4092	3438	2440	1688	943
Bipolar	4888	3439	2720	2206	1482	987	560

Note: Restricted to modern prostheses

More information regarding partial hip procedures is available in the 'Partial Hip Supplementary Report' available on the AOANJRR website: https://aoanjrr.sahmri.com/annual-reports-2023

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-2023

Use of Total Hip Replacement

There are 642,704 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	622952	96.9
Total Resurfacing	19752	3.1
TOTAL	**642704**	**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	2113	19752	1.7 (1.5, 1.9)	3.1 (2.9, 3.3)	4.7 (4.4, 5.1)	8.9 (8.5, 9.4)	12.2 (11.7, 12.7)	14.6 (14.0, 15.3)
Total Conventional	29945	622952	1.8 (1.7, 1.8)	2.7 (2.7, 2.7)	3.5 (3.5, 3.6)	5.8 (5.7, 5.8)	8.5 (8.4, 8.7)	11.5 (11.2, 11.7)
TOTAL	**32058**	**642704**						

Primary Total Conventional Hip Replacement

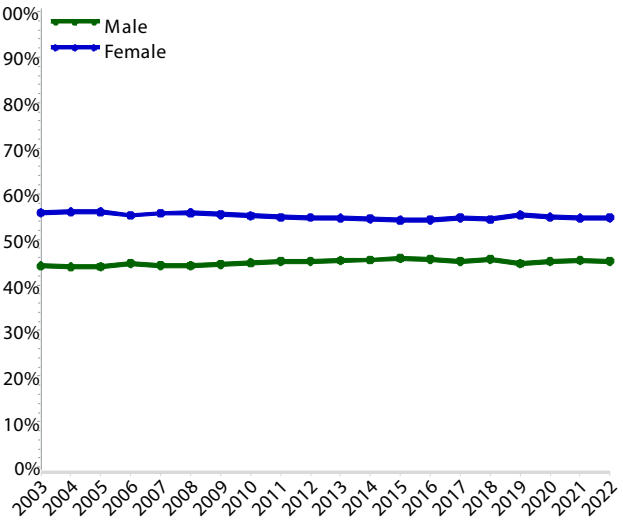
DEMOGRAPHICS

There are 622,952 primary total conventional hip replacement procedures. This is an additional 42,923 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



Primary Total Hip Replacement

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 2022) and for patients aged <55 years (11.7% in 2003 to 11.4% in 2022) (Table HT3 and Figure HT2).

Primary total conventional hip replacement decreased by 5 procedures in 2022 compared to the previous year. There has been a 146.9% increase since 2003.

The use of cementless fixation has increased from 51.3% in 2003 to 61.9% in 2022. Hybrid fixation has increased from 34.8% to 36.2% and cemented fixation has declined from 13.9% to 1.9% (Figure HT3).

Figure HT2 Primary Total Conventional Hip Replacement by Age

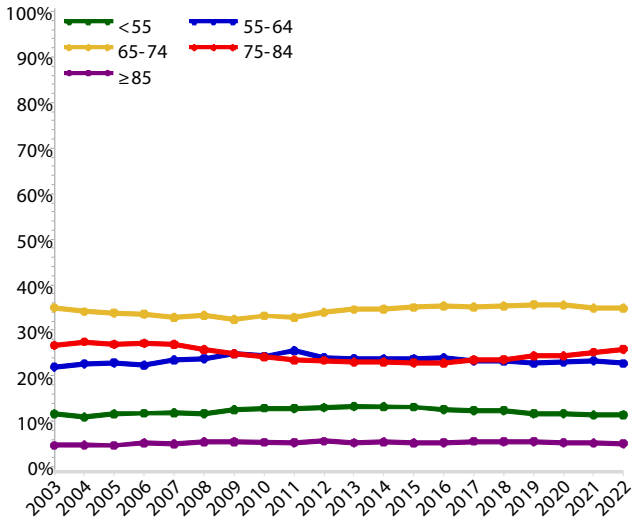


Figure HT3 Primary Total Conventional Hip Replacement by Fixation

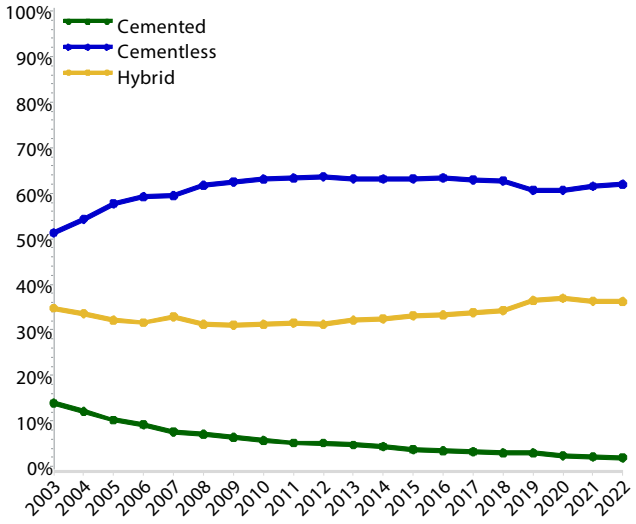


Table HT3 Age and Gender of Primary Total Conventional Hip Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	280830	45.1%	11	108	67	66.4	11.5
Female	342122	54.9%	11	103	70	69.0	11.3
TOTAL	**622952**	**100.0%**	**11**	**108**	**69**	**67.8**	**11.5**

The Exeter V40, CORAIL, and Accolade II are the most used femoral stems for primary total conventional hip replacement (Table HT4). In 2022, 68.1% 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 93.5% of cemented stem procedures. The 10 most used cementless stems account for 78.8% of cementless stem procedures.

The Trident (Shell), Trinity and PINNACLE are the most frequently used acetabular prostheses for primary total conventional hip replacement. In 2022, 86.5% 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		2019		2020		2021		2022	
N	Model	N	Model	N	Model	N	Model	N	Model
3901	Exeter V40	7844	Exeter V40	7144	Exeter V40	7599	Exeter V40	7732	Exeter V40
1029	ABGII	4898	CORAIL	4550	CORAIL	4442	CORAIL	3881	CORAIL
1000	Synergy	2526	Metafix	2630	Accolade II	3621	Accolade II	3750	Accolade II
819	Alloclassic	2401	Accolade II	2630	Metafix	2790	Polarstem	3265	Metafix
809	VerSys	2334	Polarstem	2473	Polarstem	2689	Metafix	2806	Polarstem
780	Spectron EF	2021	Quadra-H	1763	Quadra-H	1818	Quadra-H	1543	Quadra-H
713	Secur-Fit Plus	1287	Paragon	1339	CPT	1455	Paragon	1496	Paragon
618	Omnifit	1275	CPT	1236	Paragon	1444	Quadra-C	1480	Quadra-C
565	C-Stem	1086	Taperloc	1147	Quadra-C	1409	CPT	1440	AMIStem H
485	S-Rom	1061	C-Stem AMT	983	CPCS	1274	AMIStem H	1289	CPT
10 Most Used									
10719	(10) 62.8%	26733	(10) 66.5%	25895	(10) 67.0%	28541	(10) 67.7%	28682	(10) 68.1%
Remainder									
6353	(73) 37.2%	13452	(90) 33.5%	12782	(80) 33.0%	13612	(81) 32.3%	13466	(77) 31.9%
TOTAL									
17072	(83) 100.0%	40185	(100) 100.0%	38677	(90) 100.0%	42153	(91) 100.0%	42148	(87) 100.0%

Table HT5 10 Most Used Cemented Femoral Components in Primary Total Conventional Hip Replacement

2003		2019		2020		2021		2022	
N	Model	N	Model	N	Model	N	Model	N	Model
3901	Exeter V40	7844	Exeter V40	7144	Exeter V40	7599	Exeter V40	7732	Exeter V40
780	Spectron EF	1275	CPT	1339	CPT	1444	Quadra-C	1480	Quadra-C
565	C-Stem	1061	C-Stem AMT	1147	Quadra-C	1409	CPT	1289	CPT
477	CPT	987	CPCS	983	CPCS	975	CPCS	908	Short Exeter V40
445	Elite Plus	841	Quadra-C	788	Taper Fit	897	Short Exeter V40	888	CPCS
358	MS 30	805	Short Exeter V40	785	Short Exeter V40	797	Taper Fit	834	Taper Fit
338	Omnifit	790	Taper Fit	734	C-Stem AMT	705	C-Stem AMT	581	Evolve
321	Charnley	383	Absolut	532	Evolve	635	Evolve	542	C-Stem AMT
245	CPCS	358	Evolve	367	MS 30	368	MS 30	357	X-Acta
122	Exeter	324	MS 30	310	Absolut	322	X-Acta	351	MS 30
10 Most Used									
7552	(10) 91.7%	14668	(10) 93.3%	14129	(10) 93.2%	15151	(10) 93.8%	14962	(10) 93.5%
Remainder									
680	(26) 8.3%	1058	(23) 6.7%	1025	(18) 6.8%	1009	(19) 6.2%	1036	(20) 6.5%
TOTAL									
8232	(36) 100.0%	15726	(33) 100.0%	15154	(28) 100.0%	16160	(29) 100.0%	15998	(30) 100.0%

Table HT6 10 Most Used Cementless Femoral Components in Primary Total Conventional Hip Replacement

2003		2019		2020		2021		2022	
N	Model	N	Model	N	Model	N	Model	N	Model
1029	ABGII	4898	CORAIL	4550	CORAIL	4442	CORAIL	3842	CORAIL
980	Synergy	2526	Metafix	2630	Accolade II	3621	Accolade II	3750	Accolade II
819	Alloclassic	2401	Accolade II	2630	Metafix	2689	Metafix	3265	Metafix
739	VerSys	2331	Polarstem	2376	Polarstem	2571	Polarstem	2569	Polarstem
713	Secur-Fit Plus	2021	Quadra-H	1763	Quadra-H	1818	Quadra-H	1543	Quadra-H
485	S-Rom	1287	Paragon	1236	Paragon	1455	Paragon	1496	Paragon
482	Secur-Fit	1086	Taperloc	933	AMIStem H	1274	AMIStem H	1440	AMIStem H
376	CORAIL	848	AMIStem H	885	Taperloc	949	Taperloc Microplasty	994	Taperloc
334	Accolade I	597	Taperloc Microplasty	784	Taperloc Microplasty	913	Taperloc	856	Taperloc Microplasty
334	Mallory-Head	482	Anthology	477	Optimys	588	Origin	839	Origin
10 Most Used									
6291	(10) 71.2%	18477	(10) 75.5%	18264	(10) 77.6%	20320	(10) 78.2%	20594	(10) 78.8%
Remainder									
2549	(47) 28.8%	5982	(68) 24.5%	5259	(58) 22.4%	5673	(57) 21.8%	5556	(53) 21.2%
TOTAL									
8840	(57) 100.0%	24459	(78) 100.0%	23523	(68) 100.0%	25993	(67) 100.0%	26150	(63) 100.0%

Table HT7 10 Most Used Acetabular Components in Primary Total Conventional Hip Replacement

2003		2019		2020		2021		2022	
N	Model	N	Model	N	Model	N	Model	N	Model
3986	Trident (Shell)	9262	Trident (Shell)	8863	Trident (Shell)	9829	Trident (Shell)	9359	Trident (Shell)
1748	Reflection (Shell)	6133	PINNACLE	5268	PINNACLE	5406	Trinity	6121	Trinity
1524	Trilogy	4388	Trinity	4853	Trinity	5148	PINNACLE	4585	PINNACLE
955	Vitalock	3830	R3	3935	R3	4193	R3	3919	R3
907	Duraloc	2308	Mpact	2927	G7	3605	G7	3820	G7
827	ABGII	2227	G7	2831	Mpact	3377	Mpact	3497	Mpact
793	Allofit	1721	Versafitcup CC	1375	Versafitcup CC	1736	Versafitcup CC	1628	Versafitcup CC
729	Mallory-Head	1474	Logical G	1353	Logical G	1552	Trident/Tritanium (Shell)	1378	Logical G
539	Contemporary	1214	Acetabular Shell (Global)	1155	Trident/ Tritanium (Shell)	1325	Logical G	1371	Trident/ Tritanium (Shell)
537	PINNACLE	1116	Trident/Tritanium (Shell)	719	RM Cup	801	RM Cup	777	Trident II/ Tritanium (Shell)
10 Most Used									
12545	(10) 73.5%	33673	(10) 83.8%	33279	(10) 86.0%	36972	(10) 87.7%	36455	(10) 86.5%
Remainder									
4527	(69) 26.5%	6512	(63) 16.2%	5398	(61) 14.0%	5181	(62) 12.3%	5693	(62) 13.5%
TOTAL									
17072	(79) 100.0%	40185	(73) 100.0%	38677	(71) 100.0%	42153	(72) 100.0%	42148	(72) 100.0%

Table HT8 10 Most Used Cemented Acetabular Components in Primary Total Conventional Hip Replacement

2003		2019		2020		2021		2022	
N	Model	N	Model	N	Model	N	Model	N	Model
539	Contemporary	571	Exeter X3 Rimfit	512	Exeter X3 Rimfit	487	Exeter X3 Rimfit	424	Exeter X3 Rimfit
256	Exeter	91	Marathon	52	Marathon	57	Avantage	76	Avantage
251	Reflection (Cup)	73	Contemporary	50	Reflection (Cup)	50	Marathon	40	Reflection (Cup)
227	Exeter Contemporary	66	Novae E	42	Avantage	40	Reflection (Cup)	38	Marathon
199	Charnley Ogee	50	Reflection (Cup)	40	ZCA	27	Apricot	29	Muller
149	Elite Plus LPW	47	Avantage	39	Novae E	26	Contemporary	25	Apricot
130	Low Profile Cup	40	ZCA	24	Apricot	25	Novae E	17	Exeter Contemporary
109	Elite Plus Ogee	35	Apricot	24	Muller	23	Muller	15	Trident (Cup)
102	Charnley	34	Low Profile Cup	22	Contemporary	19	Exeter Contemporary	15	ZCA
90	ZCA	33	Exeter Contemporary	21	Polarcup	19	ZCA	14	BI-MENTUM
10 Most Used									
2052	(10) 85.4%	1040	(10) 88.7%	826	(10) 88.6%	773	(10) 86.9%	693	(10) 85.8%
Remainder									
351	(16) 14.6%	133	(20) 11.3%	106	(19) 11.4%	117	(18) 13.1%	115	(19) 14.2%
TOTAL									
2403	(26) 100.0%	1173	(30) 100.0%	932	(29) 100.0%	890	(28) 100.0%	808	(29) 100.0%

Table HT9 10 Most Used Cementless Acetabular Components in Primary Total Conventional Hip Replacement

2003		2019		2020		2021		2022	
N	Model	N	Model	N	Model	N	Model	N	Model
3986	Trident (Shell)	9262	Trident (Shell)	8863	Trident (Shell)	9828	Trident (Shell)	9358	Trident (Shell)
1748	Reflection (Shell)	6132	PINNACLE	5267	PINNACLE	5406	Trinity	6121	Trinity
1524	Trilogy	4388	Trinity	4853	Trinity	5147	PINNACLE	4585	PINNACLE
955	Vitalock	3829	R3	3934	R3	4193	R3	3919	R3
907	Duraloc	2308	Mpact	2927	G7	3605	G7	3820	G7
827	ABGII	2227	G7	2831	Mpact	3377	Mpact	3497	Mpact
793	Allofit	1721	Versafitcup CC	1375	Versafitcup CC	1736	Versafitcup CC	1628	Versafitcup CC
729	Mallory-Head	1474	Logical G	1353	Logical G	1552	Trident/ Tritanium (Shell)	1378	Logical G
537	PINNACLE	1213	Acetabular Shell (Global)	1155	Trident/ Tritanium (Shell)	1325	Logical G	1371	Trident/ Tritanium (Shell)
521	Fitmore	1116	Trident/ Tritanium (Shell)	719	RM Cup	801	RM Cup	777	Trident II/ Tritanium (Shell)
10 Most Used									
12527	(10) 85.4%	33670	(10) 86.3%	33277	(10) 88.2%	36970	(10) 89.6%	36454	(10) 88.2%
Remainder									
2142	(43) 14.6%	5342	(44) 13.7%	4468	(39) 11.8%	4293	(42) 10.4%	4886	(40) 11.8%
TOTAL									
14669	(53) 100.0%	39012	(54) 100.0%	37745	(49) 100.0%	41263	(52) 100.0%	41340	(50) 100.0%

Note: In 2022, 1 shell in the cementless group was 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 2022 (described as modern prostheses) are included in the analyses, unless clearly specified. This has resulted in 106,892 (17.86%) hip procedures being excluded from the analysis for the 2023 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-2023

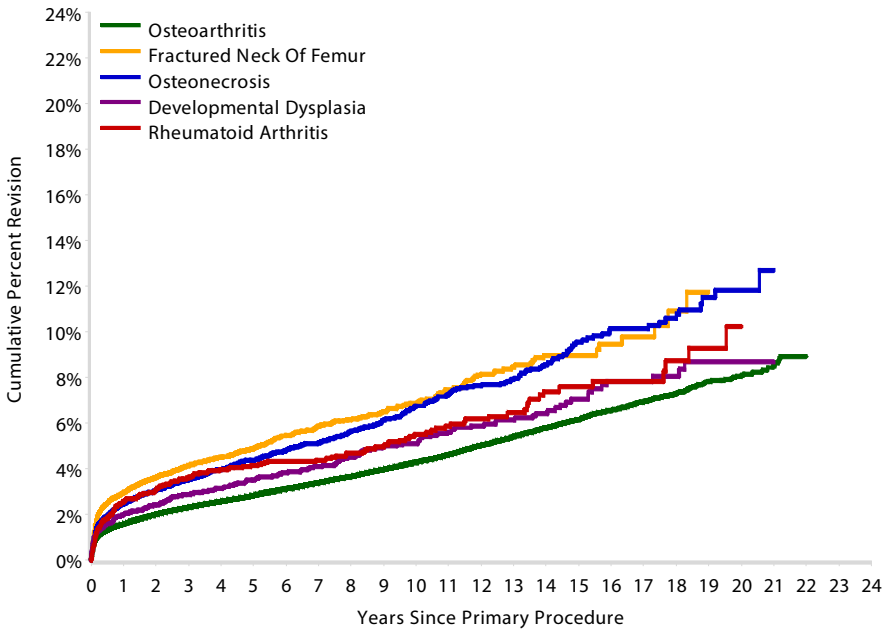
Osteoarthritis is the principal diagnosis for primary total conventional hip replacement, followed by fractured neck of femur, osteonecrosis, developmental dysplasia, rheumatoid arthritis, and tumour (Table HT10). Osteoarthritis has a lower rate of revision compared to fractured neck of femur, rheumatoid arthritis and osteonecrosis. Osteoarthritis also has a lower rate of revision compared to developmental dysplasia. However, this difference is only evident in the first month and after 3 months (Figure HT4).

Table HT10 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Primary Diagnosis

Total Hip Class	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Osteoarthritis	14416	432674	1.6 (1.6, 1.6)	2.3 (2.3, 2.4)	2.8 (2.8, 2.9)	4.3 (4.2, 4.4)	6.2 (6.0, 6.3)	8.1 (7.8, 8.4)
Fractured Neck of Femur	1290	27539	3.0 (2.8, 3.2)	4.1 (3.9, 4.4)	4.9 (4.6, 5.2)	6.9 (6.4, 7.4)	9.0 (8.2, 9.9)	
Osteonecrosis	797	15813	2.5 (2.2, 2.7)	3.5 (3.2, 3.8)	4.4 (4.0, 4.8)	6.8 (6.2, 7.3)	9.6 (8.7, 10.5)	11.8 (10.3, 13.5)
Developmental Dysplasia	271	6452	2.0 (1.7, 2.4)	2.9 (2.5, 3.3)	3.5 (3.1, 4.1)	5.1 (4.5, 5.9)	7.1 (6.1, 8.2)	8.7 (7.2, 10.4)
Rheumatoid Arthritis	186	3806	2.6 (2.1, 3.1)	3.6 (3.0, 4.3)	4.2 (3.5, 4.9)	5.5 (4.7, 6.5)	7.6 (6.3, 9.1)	10.2 (7.7, 13.5)
Tumour	145	2750	4.5 (3.7, 5.4)	6.8 (5.6, 8.2)	7.9 (6.6, 9.6)	12.9 (10.0, 16.5)		
Failed Internal Fixation	147	2034	4.8 (4.0, 5.9)	6.7 (5.7, 8.0)	7.9 (6.7, 9.4)	9.4 (7.8, 11.2)	11.9 (9.2, 15.3)	
Other (4)	175	2885	3.2 (2.6, 3.9)	4.7 (4.0, 5.6)	5.5 (4.7, 6.5)	7.9 (6.7, 9.3)	9.8 (8.1, 11.9)	13.8 (10.0, 19.0)
TOTAL	**17427**	**493953**						

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=1.79 (1.69, 1.89), p<0.001

Osteonecrosis vs Osteoarthritis

Entire Period: HR=1.50 (1.40, 1.61), p<0.001

Developmental Dysplasia vs Osteoarthritis

0 - 1Mth: HR=1.45 (1.13, 1.87), p=0.004

1Mth - 3Mth: HR=0.74 (0.49, 1.13), p=0.160

3Mth+: HR=1.17 (1.01, 1.35), p=0.039

Rheumatoid Arthritis vs Osteoarthritis

Entire Period: HR=1.33 (1.15, 1.53), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yr	5Yr	10 Yr	15 Yr	20 Yr
Osteoarthritis	432674	386337	306450	231396	92710	26702	3298
Fractured Neck Of Femur	27539	22422	15738	10219	2751	472	34
Osteonecrosis	15813	13858	10682	7961	3233	1070	171
Developmental Dysplasia	6452	5743	4579	3486	1672	654	112
Rheumatoid Arthritis	3806	3417	2854	2250	1134	415	66

Note: Restricted to modern prostheses
Only primary diagnoses with >1,000 procedures have been listed

PROSTHESIS TYPES

There are 1,519 different stem and acetabular combinations for primary total conventional hip replacement. This is an increase of 55 prosthesis combinations since the previous report.

The cumulative percent revision of the 107 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 92.6% 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 2022.

The 'Other' group consists of all prosthesis combinations with ≤500 procedures. This group accounts for 7.4% of all primary total conventional hip replacement procedures.

There are 8 cemented primary total conventional stem and acetabular combinations with >500 procedures. The CPT/ZCA has the lowest 15 year cumulative percent revision of 7.4% (n=1,057) (Table HT11).

There are 66 cementless primary total conventional stem and acetabular combinations listed. The Alloclassic/Trilogy has the lowest 15 year cumulative percent revision of 2.6% (n=945). At 20 years, the Secur-Fit Plus/Trident (shell) has a cumulative percent revision of 5.9% (n=6,408) (Table HT12).

There are 33 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 Omnifit/Trident with a cumulative percent revision of 4.7% (n=2,995) (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	18	636	1.8 (1.0, 3.3)	2.4 (1.4, 4.0)	2.9 (1.8, 4.6)	3.6 (2.2, 5.8)		
CPCS	Reflection (Cup)	103	1132	2.0 (1.3, 3.1)	3.1 (2.2, 4.4)	4.0 (2.9, 5.4)	8.7 (6.7, 11.1)	18.3 (14.8, 22.5)	
CPT	ZCA	53	1057	1.1 (0.6, 1.9)	2.4 (1.6, 3.6)	3.0 (2.1, 4.3)	5.0 (3.7, 6.8)	7.4 (5.3, 10.2)	11.6 (8.1, 16.5)
Exeter V40	Contemporary	388	5721	1.7 (1.4, 2.1)	2.9 (2.5, 3.4)	3.5 (3.1, 4.1)	6.1 (5.5, 6.9)	9.6 (8.5, 10.7)	15.5 (13.4, 18.0)
	Exeter Contemporary	201	3456	1.4 (1.1, 1.9)	2.3 (1.9, 2.9)	3.1 (2.6, 3.8)	4.8 (4.1, 5.6)	8.2 (7.0, 9.5)	11.0 (8.4, 14.4)
	Exeter X3 Rimfit	158	5600	1.5 (1.3, 1.9)	2.4 (2.0, 2.8)	2.9 (2.4, 3.4)	3.8 (3.2, 4.6)		
Short Exeter V40	Exeter X3 Rimfit	14	516	1.4 (0.7, 2.9)	2.7 (1.5, 4.7)	3.4 (2.0, 5.9)			
Spectron EF	Reflection (Cup)	138	1666	1.1 (0.7, 1.7)	1.8 (1.3, 2.6)	2.9 (2.1, 3.8)	7.1 (5.8, 8.7)	12.9 (10.8, 15.4)	17.2 (13.8, 21.3)
Other (284)		276	5341	2.9 (2.5, 3.4)	4.1 (3.6, 4.7)	4.8 (4.2, 5.4)	7.1 (6.2, 8.2)	11.0 (9.3, 13.1)	12.9 (10.5, 15.7)
TOTAL		**1349**	**25125**						

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	9	674	1.8 (0.9, 3.5)					
AMIStem H	Mpact	74	3353	1.8 (1.4, 2.4)	2.6 (2.0, 3.3)	3.1 (2.4, 4.1)			
	Versafitcup CC	86	3770	1.4 (1.1, 1.9)	1.9 (1.5, 2.4)	2.8 (2.2, 3.5)			
Accolade II	Trident (Shell)	350	14616	1.9 (1.6, 2.1)	2.5 (2.2, 2.8)	2.8 (2.5, 3.2)			
	Trident/ Tritanium (Shell)	109	3857	2.2 (1.8, 2.7)	2.9 (2.4, 3.5)	3.5 (2.8, 4.2)			
Alloclassic	Allofit	194	3967	1.6 (1.2, 2.0)	2.3 (1.9, 2.9)	2.9 (2.4, 3.5)	4.9 (4.2, 5.7)	6.6 (5.7, 7.7)	
	Fitmore*	54	727	4.4 (3.1, 6.2)	5.4 (4.0, 7.3)	5.8 (4.3, 7.8)	7.6 (5.8, 10.0)	8.2 (6.2, 10.9)	
	Trabecular Metal (Shell)*	53	1060	2.3 (1.5, 3.4)	2.9 (2.0, 4.1)	4.0 (3.0, 5.4)	5.1 (3.9, 6.6)	5.7 (4.4, 7.5)	
	Trilogy*	21	945	0.6 (0.3, 1.4)	0.9 (0.4, 1.7)	1.1 (0.6, 2.0)	2.4 (1.5, 3.7)	2.6 (1.7, 4.0)	
Anthology	R3	278	8379	2.0 (1.7, 2.3)	2.6 (2.2, 2.9)	2.9 (2.6, 3.3)	3.8 (3.4, 4.3)		
	Reflection (Shell)*	31	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, 5.5)	
Avenir	Continuum	60	1441	3.1 (2.3, 4.1)	3.5 (2.7, 4.6)	4.2 (3.3, 5.5)	4.5 (3.5, 5.8)		
	Trilogy*	13	626	1.0 (0.4, 2.1)	1.1 (0.5, 2.3)	1.3 (0.6, 2.6)	2.3 (1.3, 4.0)		
C2	Delta-TT	28	1138	1.3 (0.8, 2.1)	2.0 (1.3, 3.1)	2.4 (1.6, 3.6)	3.3 (2.1, 5.0)		
CLS	Allofit*	29	501	1.8 (0.9, 3.4)	3.4 (2.1, 5.5)	4.1 (2.6, 6.2)	5.2 (3.5, 7.6)	6.8 (4.7, 9.9)	
	Fitmore	22	674	1.4 (0.7, 2.6)	2.6 (1.6, 4.3)	2.9 (1.8, 4.7)	4.3 (2.6, 6.9)	4.3 (2.6, 6.9)	
CORAIL	Fitmore*	14	514	2.1 (1.2, 3.8)	2.3 (1.3, 4.1)	2.3 (1.3, 4.1)	3.2 (1.8, 5.6)		
	G7	8	621	0.8 (0.3, 2.0)	1.5 (0.7, 3.0)				
	PINNACLE	2377	62363	1.7 (1.6, 1.8)	2.6 (2.4, 2.7)	3.1 (3.0, 3.3)	4.8 (4.6, 5.0)	7.7 (7.1, 8.3)	
	PINNACLE^MoM	143	966	2.2 (1.4, 3.3)	3.7 (2.6, 5.1)	5.9 (4.6, 7.6)	12.3 (10.3, 14.6)	17.6 (15.0, 20.6)	
	Trident (Shell)	25	588	2.5 (1.5, 4.2)	4.1 (2.6, 6.3)	4.9 (3.2, 7.5)	7.3 (4.6, 11.6)		
	Trinity	19	1226	1.5 (0.9, 2.4)	1.7 (1.1, 2.7)	1.7 (1.1, 2.7)			
EVOK	Logical G	25	732	2.6 (1.6, 4.0)	4.5 (2.9, 6.7)				
H-Max	Delta-TT	83	1740	1.9 (1.4, 2.7)	3.4 (2.7, 4.4)	4.1 (3.3, 5.2)	7.1 (5.4, 9.2)		
HACTIV	Logical G	63	1322	3.9 (3.0, 5.1)	4.8 (3.7, 6.1)	5.0 (3.9, 6.4)			
	Saturne	12	764	1.2 (0.6, 2.3)	1.7 (0.9, 3.2)	1.7 (0.9, 3.2)			
M/L Taper	Allofit*	26	752	1.6 (0.9, 2.8)	1.9 (1.1, 3.2)	2.2 (1.3, 3.5)	3.8 (2.4, 5.9)		
	Continuum	55	1411	2.3 (1.6, 3.2)	3.4 (2.5, 4.5)	3.6 (2.7, 4.8)	4.4 (3.3, 5.8)		
	Trilogy	34	913	1.2 (0.7, 2.2)	1.6 (0.9, 2.6)	2.6 (1.8, 3.9)	3.8 (2.7, 5.4)	4.4 (3.1, 6.2)	
MasterLoc	Mpact	13	883	1.5 (0.8, 2.6)	1.5 (0.8, 2.6)	1.9 (1.0, 3.4)			
	Versafitcup CC	7	826	0.8 (0.4, 1.9)	1.0 (0.5, 2.2)				
Metafix	Trinity	356	16533	1.5 (1.3, 1.7)	2.3 (2.0, 2.5)	2.6 (2.4, 3.0)	4.0 (3.2, 5.0)		
MiniHip	Trinity	41	1228	2.6 (1.8, 3.6)	3.2 (2.3, 4.4)	3.4 (2.5, 4.7)	3.6 (2.6, 4.9)		
Nanos	R3	10	663	0.9 (0.4, 2.0)	1.2 (0.6, 2.4)	1.2 (0.6, 2.4)	1.5 (0.8, 2.8)		
Omnifit	Trident (Shell)	89	1272	1.9 (1.3, 2.8)	3.2 (2.3, 4.3)	4.2 (3.2, 5.5)	5.6 (4.5, 7.1)	7.3 (5.9, 9.0)	8.9 (7.2, 11.0)
Optimys	RM Cup	50	2482	1.7 (1.2, 2.3)	2.1 (1.6, 2.8)	2.5 (1.8, 3.4)			

Table HT12 ***Continued***

Femoral Component	Acetabular Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
	seleXys	13	628	0.7 (0.2, 1.8)	1.7 (0.9, 3.2)	2.8 (1.6, 4.9)			
Origin	Logical G	100	3290	2.3 (1.8, 2.9)	3.3 (2.7, 4.1)	3.7 (3.0, 4.6)			
Paragon	Acetabular Shell (Global)	99	4391	1.6 (1.2, 2.0)	1.9 (1.5, 2.4)	2.4 (1.9, 2.9)			
	Novae	22	870	0.9 (0.5, 1.8)	2.0 (1.3, 3.2)	2.4 (1.5, 3.7)			
	Trinity	59	3056	1.9 (1.5, 2.5)	2.1 (1.6, 2.7)	2.1 (1.6, 2.7)			
Polarstem	EP-Fit Plus	12	2582	0.2 (0.1, 0.5)	0.4 (0.2, 0.8)	0.6 (0.3, 1.0)	0.6 (0.3, 1.0)		
	R3	486	17640	2.0 (1.8, 2.2)	2.5 (2.3, 2.7)	3.0 (2.7, 3.2)	4.1 (3.6, 4.7)		
Profemur L	Dynasty	99	1907	3.5 (2.8, 4.5)	4.6 (3.8, 5.7)	5.2 (4.3, 6.3)			
	Procotyl L	26	1490	1.2 (0.7, 1.9)	1.8 (1.2, 2.8)	2.2 (1.4, 3.3)			
Quadra-H	Mpact	215	6068	2.1 (1.7, 2.5)	3.1 (2.7, 3.7)	4.4 (3.8, 5.1)			
	Trident (Shell)	24	712	1.5 (0.9, 2.8)	2.7 (1.7, 4.2)	3.3 (2.2, 5.0)			
	Versafitcup CC	369	10542	1.8 (1.6, 2.1)	2.6 (2.3, 2.9)	3.1 (2.8, 3.5)	5.5 (4.7, 6.5)		
	Versafitcup DM	42	1011	3.1 (2.2, 4.4)	4.5 (3.3, 6.1)	4.8 (3.5, 6.5)			
S-Rom	PINNACLE	236	3749	2.4 (2.0, 3.0)	4.1 (3.5, 4.8)	4.8 (4.2, 5.6)	6.3 (5.5, 7.2)	7.7 (6.7, 8.9)	
SL-Plus	EP-Fit Plus	48	1221	1.6 (1.0, 2.4)	2.1 (1.4, 3.0)	2.7 (1.9, 3.8)	3.8 (2.8, 5.1)	4.4 (3.3, 5.8)	
	R3	116	1824	2.5 (1.9, 3.4)	4.0 (3.2, 5.0)	4.4 (3.5, 5.4)	6.5 (5.4, 7.8)		
Secur-Fit	Trident (Shell)	550	10564	1.9 (1.7, 2.2)	3.0 (2.6, 3.3)	3.7 (3.3, 4.0)	4.9 (4.5, 5.4)	6.5 (5.9, 7.1)	8.1 (7.1, 9.1)
Secur-Fit Plus	Trident (Shell)	270	6408	1.3 (1.1, 1.6)	2.0 (1.7, 2.4)	2.5 (2.1, 2.9)	3.6 (3.1, 4.1)	4.8 (4.2, 5.5)	5.9 (5.1, 6.8)
Summit	PINNACLE	196	5968	1.5 (1.2, 1.8)	2.2 (1.8, 2.6)	2.4 (2.1, 2.9)	3.6 (3.1, 4.2)	5.3 (4.4, 6.5)	
	PINNACLE*MoM	91	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)	11.3 (9.1, 13.9)	
Synergy	R3	192	5521	1.8 (1.5, 2.2)	2.4 (2.0, 2.9)	2.8 (2.4, 3.3)	3.8 (3.3, 4.4)		
	Reflection (Shell)	434	7899	1.5 (1.3, 1.8)	2.3 (2.0, 2.7)	2.7 (2.3, 3.0)	3.9 (3.5, 4.4)	5.7 (5.1, 6.3)	8.0 (7.2, 9.0)
Taperloc	Continuum	15	701	1.6 (0.9, 2.8)	2.2 (1.3, 3.6)	2.2 (1.3, 3.6)			
	G7	126	4941	2.2 (1.8, 2.6)	2.7 (2.2, 3.2)	2.8 (2.3, 3.4)			
Taperloc Microplasty	Continuum	18	574	2.8 (1.7, 4.6)	3.2 (2.0, 5.1)	3.2 (2.0, 5.1)			
	G7	52	3778	1.2 (0.9, 1.6)	1.6 (1.2, 2.1)	1.6 (1.2, 2.1)			
Tri-Fit TS	Trinity	112	4808	1.3 (1.0, 1.6)	2.1 (1.7, 2.6)	2.4 (2.0, 2.9)	3.0 (2.4, 3.7)		
Tri-Lock	PINNACLE	34	1182	1.5 (0.9, 2.3)	2.2 (1.5, 3.3)	2.6 (1.8, 3.7)	3.9 (2.6, 5.9)		
VerSys	Trilogy*	275	4497	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)	7.4 (6.5, 8.3)
twinSys (cless)	RM Cup	53	1487	2.3 (1.7, 3.2)	3.0 (2.2, 4.0)	3.4 (2.6, 4.5)	4.3 (3.3, 5.7)		
Other (586)		838	20135	2.5 (2.3, 2.7)	3.6 (3.3, 3.9)	4.1 (3.8, 4.4)	5.7 (5.2, 6.1)	7.3 (6.6, 8.1)	9.1 (7.7, 10.6)
TOTAL		**10083**	**284662**						

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 2022
Only prostheses with >500 procedures have been listed

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)*	25	865	1.5 (0.9, 2.6)	2.2 (1.4, 3.5)	2.9 (1.9, 4.4)			
	Trinity	18	814	2.2 (1.4, 3.6)	2.5 (1.5, 3.9)				
C-Stem AMT	PINNACLE	197	6368	1.6 (1.3, 2.0)	2.5 (2.1, 2.9)	3.3 (2.8, 3.8)	5.0 (4.1, 6.0)	9.4 (5.5, 16.0)	
CPCS	R3	309	8773	2.2 (1.9, 2.5)	3.0 (2.6, 3.4)	3.4 (3.0, 3.9)	4.9 (4.3, 5.6)		
	Reflection (Shell)	131	3162	0.9 (0.6, 1.3)	1.3 (1.0, 1.8)	1.7 (1.3, 2.3)	3.6 (2.9, 4.4)	6.3 (5.2, 7.7)	
CPT	Allofit	67	1838	1.4 (1.0, 2.1)	2.1 (1.5, 2.9)	3.3 (2.5, 4.3)	5.1 (3.9, 6.6)	6.1 (4.6, 8.0)	
	Continuum	170	3113	3.1 (2.5, 3.7)	4.1 (3.5, 4.9)	4.8 (4.1, 5.7)	6.6 (5.6, 7.8)		
	G7	84	3162	2.5 (2.0, 3.2)	3.3 (2.6, 4.1)	3.4 (2.7, 4.3)			
	Trabecular Metal (Shell)	135	2542	2.4 (1.9, 3.1)	3.4 (2.8, 4.2)	4.4 (3.6, 5.4)	6.5 (5.4, 7.8)	9.1 (7.3, 11.3)	
	Trilogy	464	8896	1.9 (1.7, 2.3)	2.9 (2.5, 3.2)	3.7 (3.3, 4.1)	5.6 (5.1, 6.2)	7.2 (6.5, 8.0)	8.2 (7.1, 9.6)
Evolve	Logical G	58	2446	1.7 (1.3, 2.4)	2.2 (1.7, 2.9)	2.6 (2.0, 3.4)			
Exeter V40	Fixa	34	854	2.4 (1.5, 3.7)	3.0 (2.1, 4.5)	3.3 (2.3, 4.8)	5.3 (3.7, 7.7)		
	PINNACLE	74	2633	1.5 (1.1, 2.0)	2.0 (1.5, 2.6)	2.2 (1.7, 2.9)	4.0 (3.0, 5.2)	4.9 (3.6, 6.6)	
	R3	107	2702	2.1 (1.6, 2.7)	3.0 (2.4, 3.8)	3.8 (3.1, 4.6)	4.4 (3.6, 5.4)		
	Trabecular Metal (Shell)	30	608	2.7 (1.7, 4.4)	3.3 (2.1, 5.1)	4.0 (2.6, 6.0)	5.6 (3.9, 8.2)		
	Trident (Shell)	2693	86923	1.3 (1.3, 1.4)	2.0 (1.9, 2.1)	2.5 (2.4, 2.7)	3.9 (3.7, 4.0)	5.5 (5.2, 5.8)	6.9 (6.3, 7.6)
	Trident/ Tritanium (Shell)	213	6480	1.8 (1.5, 2.2)	2.7 (2.3, 3.1)	3.4 (2.9, 3.9)	4.7 (4.0, 5.6)		
	Trilogy*	20	606	1.7 (0.9, 3.1)	2.4 (1.4, 3.9)	2.5 (1.5, 4.2)	3.5 (2.2, 5.5)	3.8 (2.5, 5.9)	
MS 30	Allofit*	52	1337	1.1 (0.6, 1.8)	1.6 (1.0, 2.4)	2.2 (1.5, 3.1)	3.6 (2.7, 4.9)	6.0 (4.4, 8.2)	
	Continuum	19	924	1.6 (1.0, 2.7)	1.9 (1.2, 3.0)	2.1 (1.3, 3.3)			
	Fitmore	24	677	1.5 (0.8, 2.8)	2.0 (1.2, 3.4)	3.2 (2.0, 5.0)	4.3 (2.8, 6.6)	6.1 (3.7, 10.1)	
	G7	18	1090	1.5 (0.9, 2.4)	2.1 (1.3, 3.3)	2.1 (1.3, 3.3)			
Omnifit	Trident (Shell)	112	2995	1.8 (1.4, 2.3)	2.7 (2.2, 3.3)	3.0 (2.4, 3.6)	3.8 (3.1, 4.6)	4.7 (3.8, 5.8)	5.5 (4.3, 7.1)
Polarstem	R3	13	538	1.9 (1.0, 3.7)	5.2 (2.2, 12.1)				
Quadra-C	Mpact	75	4764	1.1 (0.9, 1.5)	1.9 (1.5, 2.5)	2.0 (1.6, 2.6)			
	Versafitcup CC	34	1831	1.5 (1.0, 2.1)	1.7 (1.2, 2.4)	2.0 (1.4, 2.9)	3.2 (1.7, 6.2)		
Short Exeter V40	Trident (Shell)	74	4087	1.2 (0.9, 1.6)	1.9 (1.4, 2.4)	2.5 (2.0, 3.3)			
Spectron EF	R3	109	2408	1.8 (1.4, 2.5)	2.9 (2.3, 3.7)	3.7 (3.0, 4.6)	5.5 (4.5, 6.7)		
	Reflection (Shell)*	370	5205	1.1 (0.9, 1.5)	2.0 (1.6, 2.4)	2.8 (2.4, 3.3)	5.5 (4.9, 6.2)	9.3 (8.3, 10.4)	12.9 (11.3, 14.7)
Taper Fit	Trinity	104	4472	1.6 (1.3, 2.0)	2.4 (2.0, 3.0)	3.1 (2.5, 3.9)			
X-Acta	Mpact	15	889	1.3 (0.7, 2.4)	2.0 (1.1, 3.4)	2.4 (1.4, 4.2)			
	Versafitcup CC	10	745	0.8 (0.4, 1.9)	1.0 (0.5, 2.2)	1.5 (0.8, 2.9)			
twinSys (ctd)	RM Cup	15	663	2.0 (1.2, 3.4)	2.4 (1.5, 4.0)	2.4 (1.5, 4.0)			
Other (542)		419	11046	2.2 (1.9, 2.5)	3.2 (2.8, 3.5)	4.0 (3.6, 4.5)	6.1 (5.4, 6.9)	9.0 (7.7, 10.5)	13.9 (10.7, 18.0)
TOTAL		**6292**	**186456**						

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 2022
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 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. Overall, patients aged ≥75 years have a lower rate of revision than patients aged <55 years after 3 months and patients 55–64 years after 6 months. Patients aged ≥75 years have a similar revision outcome to patients 65–74 years after 9 months (Table HT17 and Figure HT7).

Females have a higher rate of revision in the first 2 weeks compared to males. From 2 weeks onwards, females have a lower rate of revision than males. The cumulative percent revision at 20 years is 8.6% for males and 7.7% 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 males aged 55–64 years and when compared to males aged 65–74 years. Compared to males aged <55 years, males aged ≥75 years have a higher rate of revision between 2 weeks and 3 months only (Table HT18 and Figure HT9).

For females, the rate of revision decreases with increasing age. Females aged <55 years have a higher rate of revision compared to females aged ≥75 years after 3 months (Table HT18 and Figure HT10).

For both males and females <75 years of age, loosening is the most common reason for revision. For patients aged ≥75 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 296,456 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 250,477 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 only for the first 18 months (Table HT20 and Figure HT17).

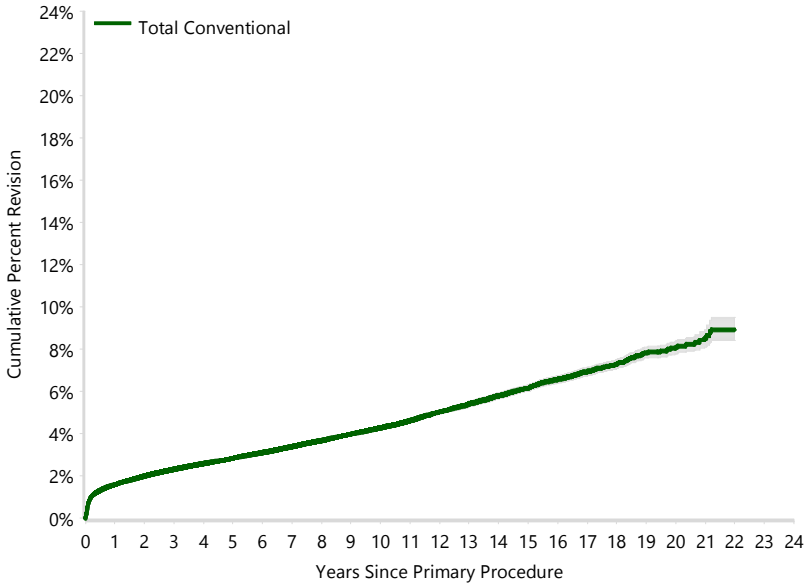
The most common reasons for revision are shown in Figure HT18. There is an increasing rate of revision for infection with increasing obesity class. At 3 years, the cumulative incidence of revision for infection is 0.8% for obese class 1, 1.4% for obese class 2, and 2.2% for obese class 3. The cumulative incidence of infection for patients in obese class 3 is 6-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	14416	432674	1.6 (1.6, 1.6)	2.3 (2.3, 2.4)	2.8 (2.8, 2.9)	4.3 (4.2, 4.4)	6.2 (6.0, 6.3)	8.1 (7.8, 8.4)
TOTAL	**14416**	**432674**						

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	432674	386337	306450	231396	92710	26702	3298

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	3352	23.3
Fracture	3170	22.0
Prosthesis Dislocation/Instability	3124	21.7
Loosening	2999	20.8
Pain	276	1.9
Leg Length Discrepancy	236	1.6
Malposition	217	1.5
Lysis	176	1.2
Implant Breakage Stem	139	1.0
Implant Breakage Acetabular Insert	107	0.7
Incorrect Sizing	90	0.6
Wear Acetabular Insert	88	0.6
Metal Related Pathology	65	0.5
Implant Breakage Acetabular	50	0.3
Implant Breakage Head	25	0.2
Progression Of Disease	1	0.0
Other	301	2.1
TOTAL	**14416**	**100.0**

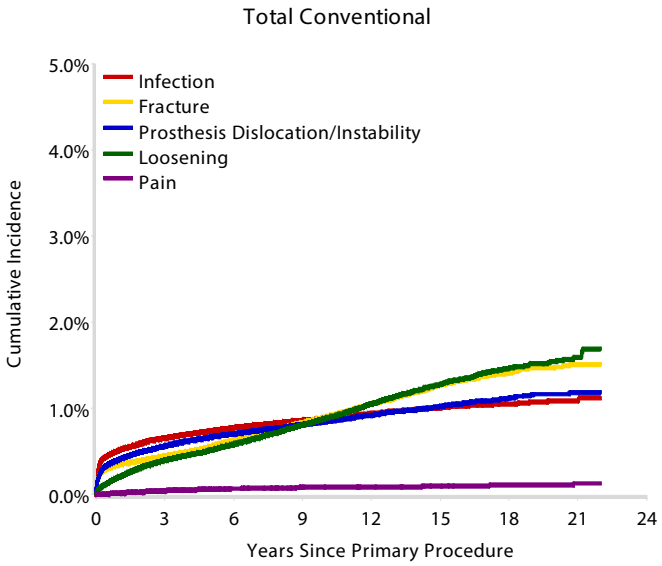
Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded

Table HT16 Primary Total Conventional Hip Replacement by Type of Revision (Primary Diagnosis OA)

Type of Revision	Number	Percent
Femoral Component	4779	33.2
Head/Insert	3583	24.9
Acetabular Component	2691	18.7
THR (Femoral/Acetabular)	1638	11.4
Head Only	707	4.9
Cement Spacer	526	3.6
Minor Components	249	1.7
Insert Only	140	1.0
Removal of Prostheses	69	0.5
Reinsertion of Components	21	0.1
Bipolar Head and Femoral	4	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	**14416**	**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)



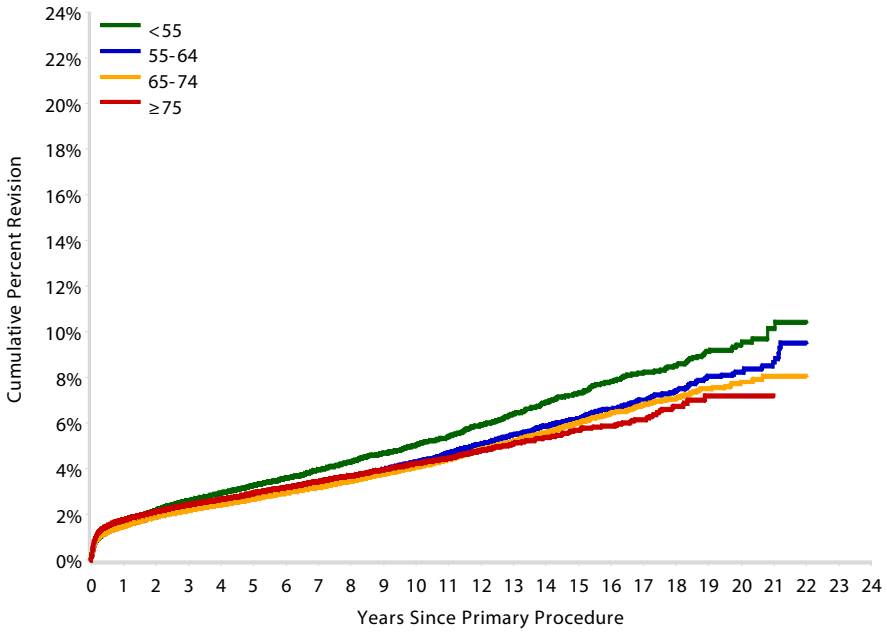
Note: Restricted to modern prostheses

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	1805	44868	1.6 (1.5, 1.8)	2.6 (2.5, 2.8)	3.3 (3.1, 3.4)	5.0 (4.8, 5.3)	7.3 (6.9, 7.8)	9.4 (8.7, 10.2)
55–64	3539	101893	1.5 (1.5, 1.6)	2.2 (2.2, 2.3)	2.8 (2.7, 2.9)	4.3 (4.1, 4.5)	6.2 (5.9, 6.5)	8.2 (7.7, 8.7)
65–74	5023	155457	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 (7.3, 8.3)
≥75	4049	130456	1.8 (1.7, 1.8)	2.4 (2.3, 2.5)	2.9 (2.8, 3.0)	4.2 (4.1, 4.4)	5.7 (5.4, 6.0)	7.2 (6.4, 8.0)
TOTAL	**14416**	**432674**						

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=1.09 (0.91, 1.31), p=0.360

2Wk - 3Mth: HR=0.70 (0.62, 0.79), p<0.001

3Mth+: HR=1.35 (1.26, 1.44), p<0.001

55-64 vs ≥75

0 - 2Wk: HR=0.83 (0.72, 0.97), p=0.016

2Wk - 1Mth: HR=0.68 (0.60, 0.77), p<0.001

1Mth - 6Mth: HR=0.91 (0.82, 1.00), p=0.044

6Mth+: HR=1.11 (1.05, 1.18), p<0.001

65-74 vs ≥75

0 - 1Mth: HR=0.78 (0.71, 0.85), p<0.001

1Mth - 9Mth: HR=0.89 (0.82, 0.96), p=0.002

9Mth - 1.5Yr: HR=1.10 (0.98, 1.24), p=0.101

1.5Yr+: HR=1.04 (0.98, 1.11), p=0.179

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
<55	44868	40277	32486	25196	10694	3706	758
55–64	101893	91571	73685	57156	25521	8523	1249
65–74	155457	139452	111347	84783	35644	10757	1126
≥75	130456	115037	88932	64261	20851	3716	165

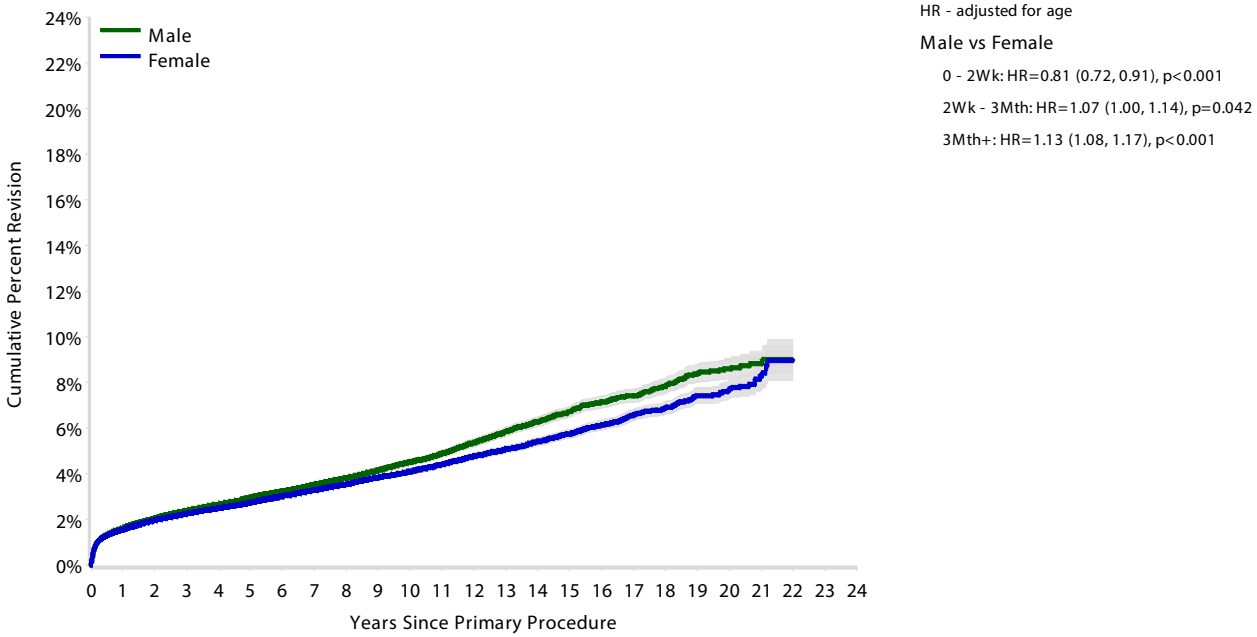
Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded

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		**6833**	**198551**	**1.6 (1.6, 1.7)**	**2.4 (2.3, 2.5)**	**3.0 (2.9, 3.0)**	**4.5 (4.4, 4.6)**	**6.7 (6.5, 6.9)**	**8.6 (8.2, 9.0)**
	<55	961	25373	1.5 (1.4, 1.7)	2.5 (2.3, 2.7)	3.1 (2.9, 3.3)	4.8 (4.4, 5.1)	7.2 (6.6, 7.9)	9.5 (8.4, 10.6)
	55–64	1757	51596	1.5 (1.4, 1.7)	2.2 (2.1, 2.4)	2.7 (2.6, 2.9)	4.2 (4.0, 4.5)	6.5 (6.1, 6.9)	8.3 (7.6, 9.0)
	65–74	2330	69941	1.5 (1.4, 1.6)	2.2 (2.1, 2.3)	2.8 (2.6, 2.9)	4.3 (4.1, 4.5)	6.5 (6.1, 6.8)	
	≥75	1785	51641	1.9 (1.8, 2.0)	2.7 (2.6, 2.9)	3.4 (3.2, 3.5)	5.0 (4.7, 5.2)	7.0 (6.5, 7.7)	8.7 (7.3, 10.4)
Female		**7583**	**234123**	**1.6 (1.5, 1.6)**	**2.3 (2.2, 2.3)**	**2.7 (2.7, 2.8)**	**4.1 (4.0, 4.2)**	**5.7 (5.6, 5.9)**	**7.7 (7.3, 8.1)**
	<55	844	19495	1.7 (1.6, 1.9)	2.8 (2.5, 3.0)	3.5 (3.2, 3.8)	5.3 (4.9, 5.8)	7.4 (6.8, 8.1)	9.4 (8.4, 10.6)
	55–64	1782	50297	1.5 (1.4, 1.6)	2.3 (2.1, 2.4)	2.8 (2.6, 2.9)	4.4 (4.1, 4.6)	6.0 (5.7, 6.4)	8.2 (7.5, 9.0)
	65–74	2693	85516	1.5 (1.4, 1.5)	2.2 (2.1, 2.3)	2.6 (2.5, 2.7)	3.9 (3.7, 4.1)	5.7 (5.4, 6.0)	7.5 (6.8, 8.1)
	≥75	2264	78815	1.7 (1.6, 1.8)	2.2 (2.1, 2.3)	2.7 (2.5, 2.8)	3.8 (3.6, 4.0)	5.0 (4.6, 5.3)	6.4 (5.6, 7.4)
TOTAL		**14416**	**432674**						

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

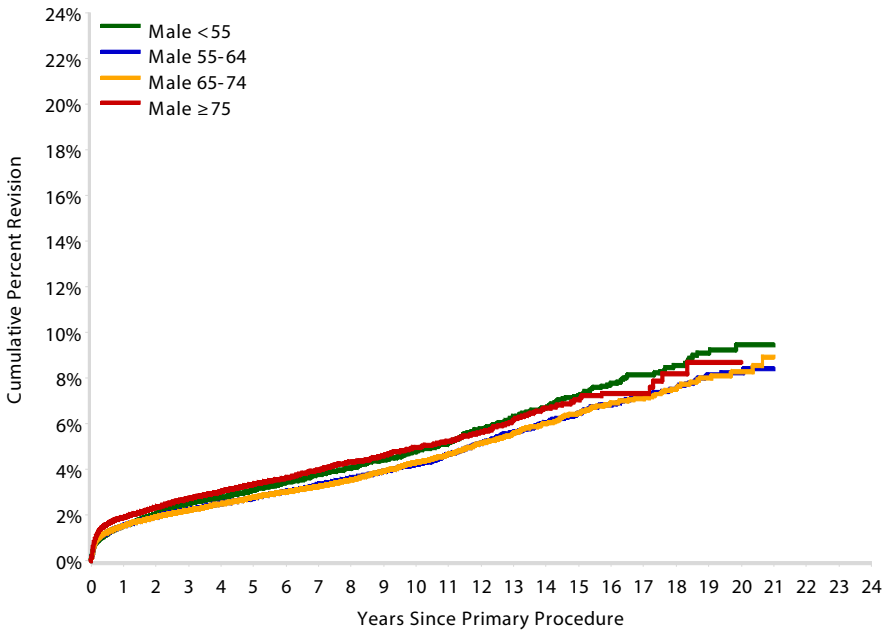
Figure HT8 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Gender (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Male	198551	176716	139034	103848	39938	11354	1511
Female	234123	209621	167416	127548	52772	15348	1787

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

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=1.13 (0.87, 1.46), p=0.350

2Wk - 3Mth: HR=0.63 (0.54, 0.75), p<0.001

3Mth+: HR=1.05 (0.96, 1.15), p=0.293

Male 55-64 vs Male ≥75

Entire Period: HR=0.85 (0.79, 0.91), p<0.001

Male 65-74 vs Male ≥75

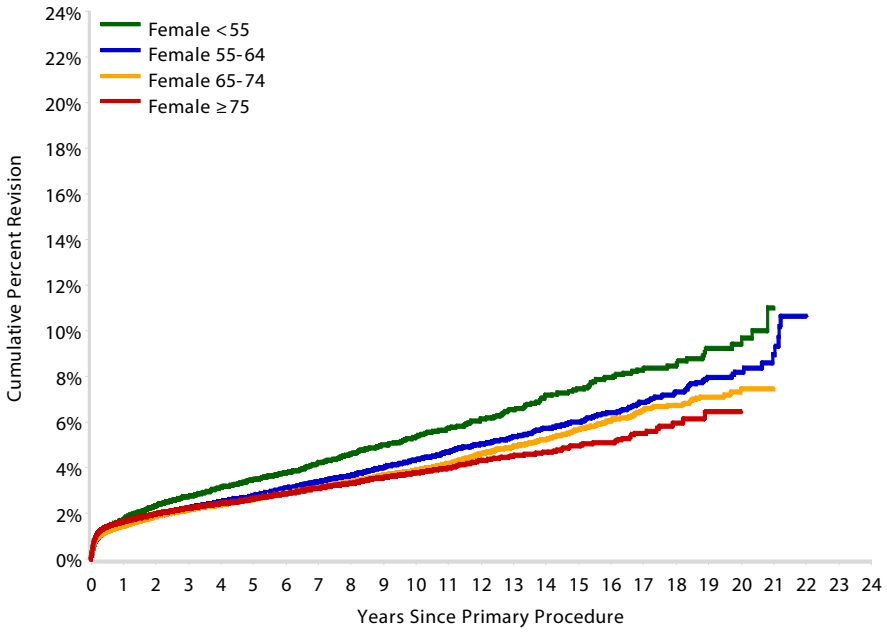
0 - 3Mth: HR=0.81 (0.73, 0.89), p<0.001

3Mth+: HR=0.86 (0.80, 0.93), p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Male	<55	25373	22756	18297	14035	5614	1888	403
	55–64	51596	46174	36836	28280	12050	3918	615
	65–74	69941	62677	49904	37777	15493	4485	444
	≥75	51641	45109	33997	23756	6781	1063	49

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=1.23 (0.94, 1.61), p=0.127

2Wk - 3Mth: HR=0.79 (0.66, 0.95), p=0.011

3Mth+: HR=1.65 (1.50, 1.81), p<0.001

Female 55-64 vs Female ≥75

0 - 2Wk: HR=0.92 (0.74, 1.14), p=0.437

2Wk - 1Mth: HR=0.65 (0.54, 0.78), p<0.001

1Mth - 6Mth: HR=0.99 (0.86, 1.13), p=0.856

6Mth+: HR=1.32 (1.22, 1.43), p<0.001

Female 65-74 vs Female ≥75

0 - 2Wk: HR=0.88 (0.73, 1.06), p=0.179

2Wk - 1Mth: HR=0.74 (0.64, 0.86), p<0.001

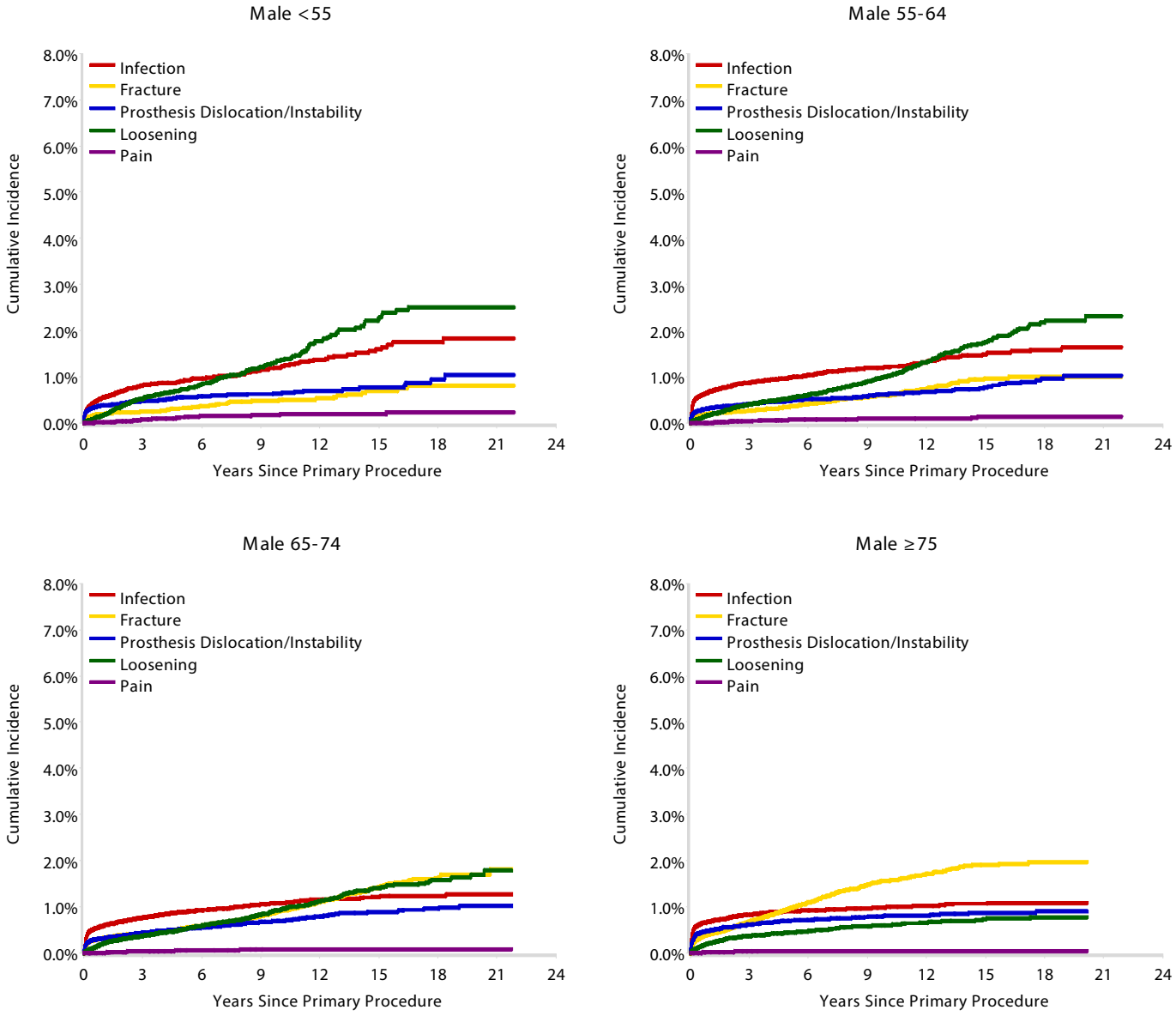
1Mth - 6Mth: HR=0.92 (0.82, 1.04), p=0.178

6Mth+: HR=1.17 (1.09, 1.26), p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Female	<55	19495	17521	14189	11161	5080	1818	355
	55–64	50297	45397	36849	28876	13471	4605	634
	65–74	85516	76775	61443	47006	20151	6272	682
	≥75	78815	69928	54935	40505	14070	2653	116

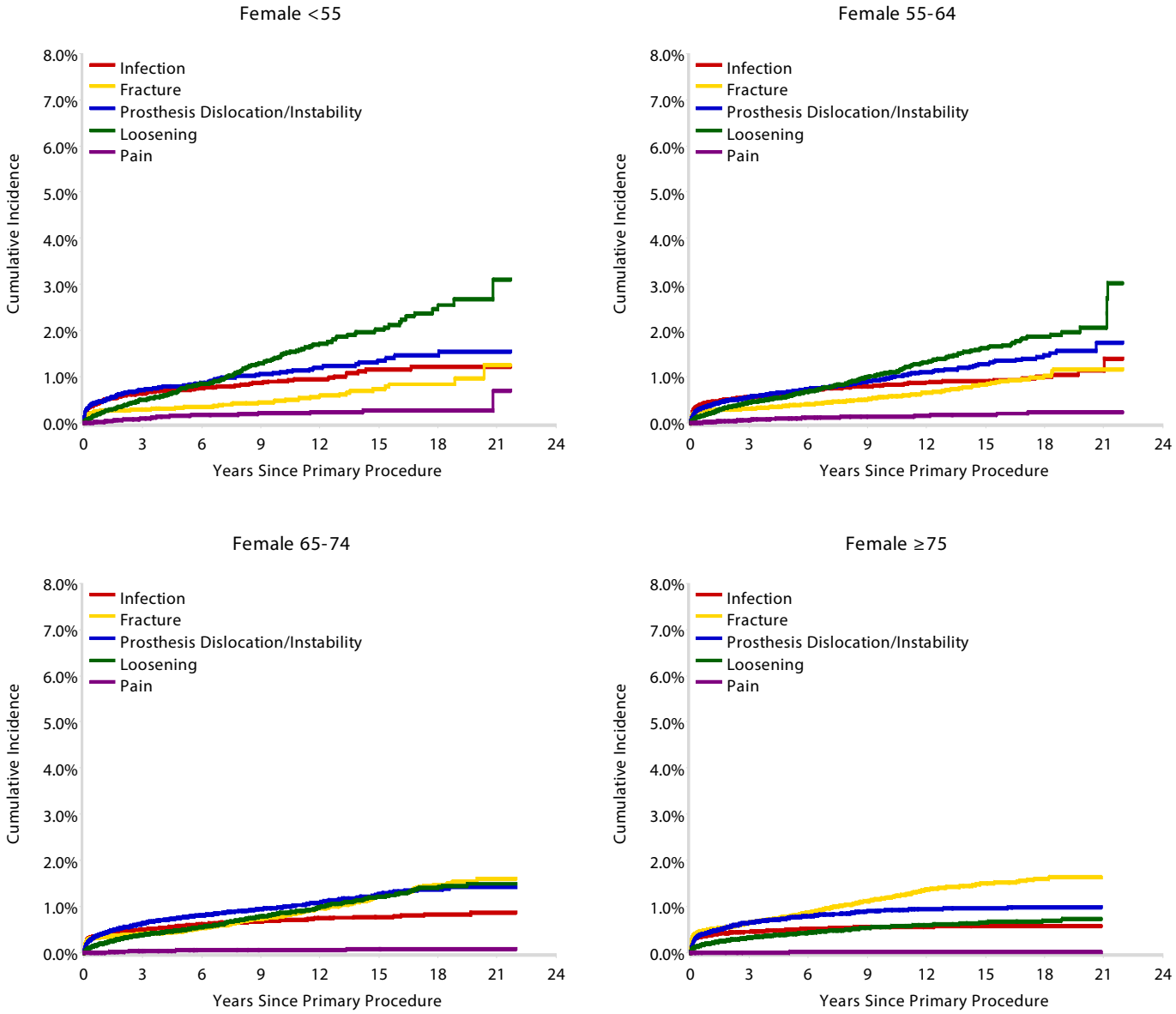
Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded

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)

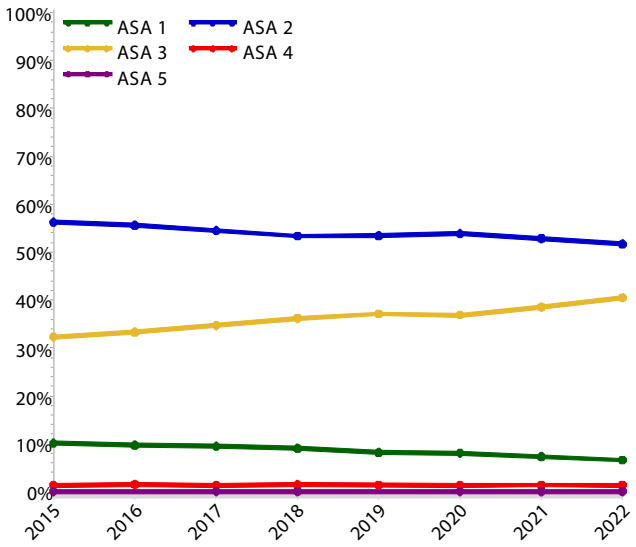
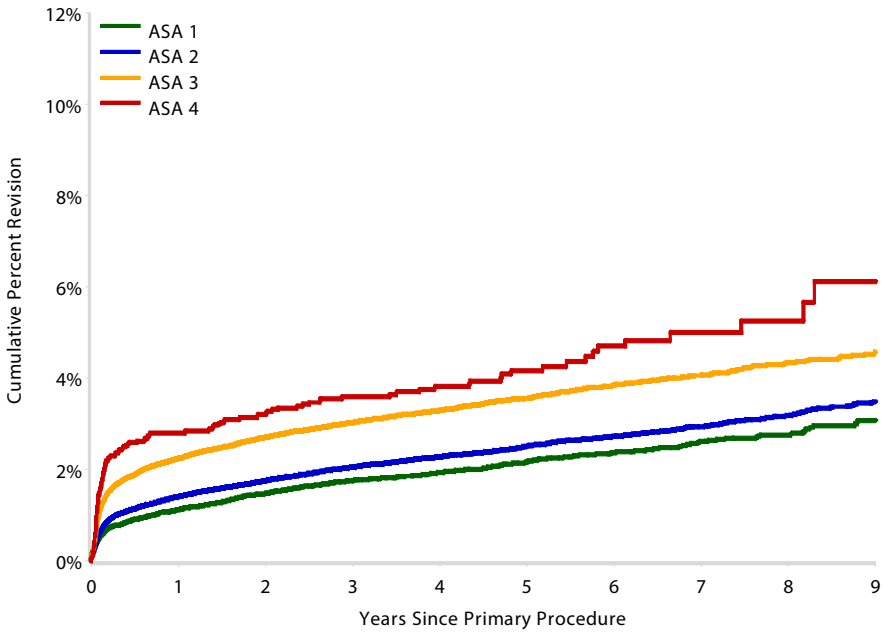


Table HT19 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by ASA Score (Primary Diagnosis OA)

ASA Score	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	9 Yrs
ASA 1	527	25581	1.1 (1.0, 1.3)	1.5 (1.3, 1.6)	1.8 (1.6, 1.9)	2.2 (2.0, 2.4)	2.6 (2.4, 2.9)	3.1 (2.7, 3.4)
ASA 2	3679	160409	1.4 (1.3, 1.5)	1.8 (1.7, 1.8)	2.1 (2.0, 2.1)	2.5 (2.4, 2.6)	2.9 (2.8, 3.1)	3.5 (3.3, 3.6)
ASA 3	3349	106324	2.2 (2.2, 2.3)	2.7 (2.6, 2.8)	3.0 (2.9, 3.1)	3.6 (3.4, 3.7)	4.1 (3.9, 4.2)	4.6 (4.3, 4.8)
ASA 4	154	4126	2.8 (2.3, 3.4)	3.2 (2.7, 3.8)	3.6 (3.0, 4.3)	4.2 (3.5, 4.9)	5.0 (4.1, 6.0)	6.1 (4.7, 7.9)
ASA 5	1	16	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	20.0 (3.1, 79.6)	
TOTAL	**7710**	**296456**						

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=1.23 (1.12, 1.35), p<0.001

ASA 3 vs ASA 1

0 - 2Wk: HR=1.81 (1.54, 2.13), p<0.001

2Wk - 1Mth: HR=2.41 (2.10, 2.77), p<0.001

1Mth - 3Mth: HR=2.11 (1.84, 2.41), p<0.001

3Mth - 1.5Yr: HR=1.81 (1.60, 2.05), p<0.001

1.5Yr+: HR=1.48 (1.31, 1.67), p<0.001

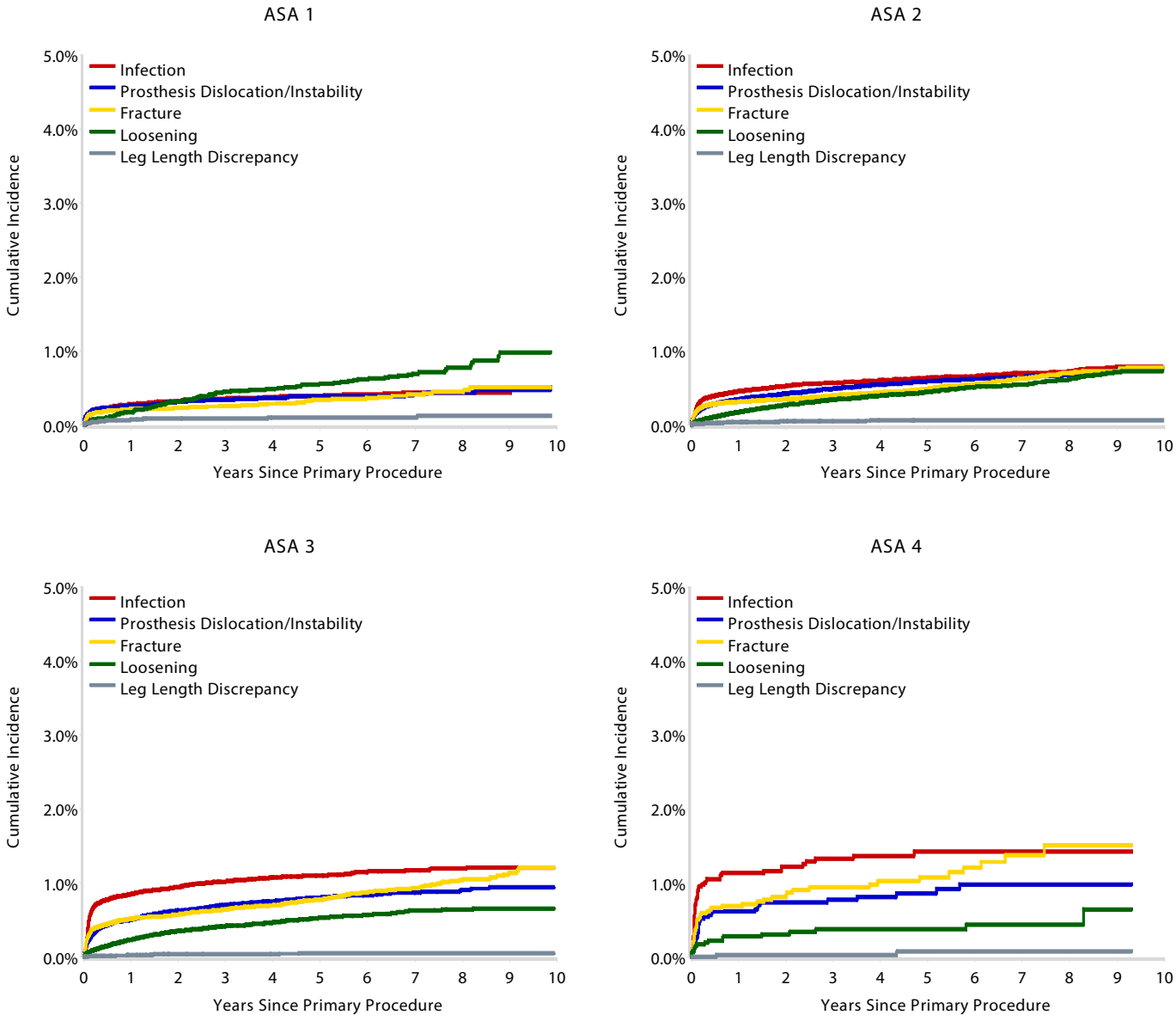
ASA 4 vs ASA 1

Entire Period: HR=2.34 (1.95, 2.81), p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	9 Yrs
ASA 1	25581	22885	20125	17411	11668	6057	1356
ASA 2	160409	139010	118720	100138	63798	31594	6442
ASA 3	106324	88320	72939	59517	34298	15300	2854
ASA 4	4126	3352	2713	2139	1149	472	85

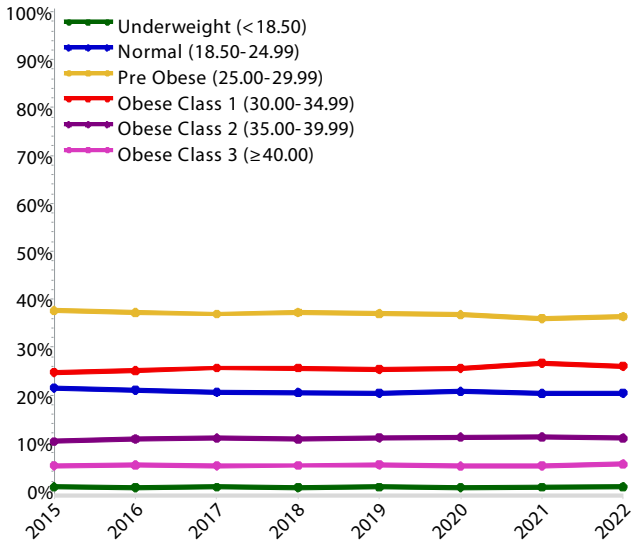
Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded

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)



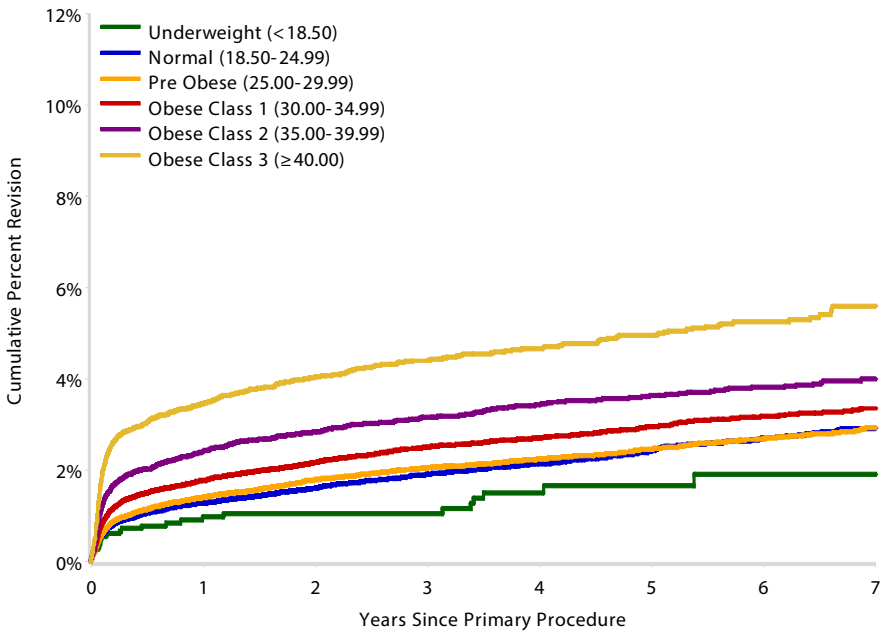
Note: BMI has not been presented for patients aged ≤19 years

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)	24	1821	1.0 (0.6, 1.6)	1.0 (0.7, 1.7)	1.0 (0.7, 1.7)	1.5 (1.0, 2.3)	1.7 (1.1, 2.6)	1.9 (1.2, 3.0)
Normal (18.50–24.99)	1033	51615	1.3 (1.2, 1.4)	1.6 (1.5, 1.7)	1.9 (1.8, 2.0)	2.1 (2.0, 2.3)	2.4 (2.3, 2.6)	2.9 (2.7, 3.1)
Pre Obese (25.00–29.99)	1922	92166	1.4 (1.3, 1.5)	1.8 (1.7, 1.9)	2.1 (2.0, 2.2)	2.2 (2.1, 2.4)	2.5 (2.3, 2.6)	2.9 (2.8, 3.1)
Obese Class 1 (30.00–34.99)	1612	64228	1.8 (1.7, 1.9)	2.2 (2.1, 2.3)	2.5 (2.4, 2.6)	2.7 (2.6, 2.9)	3.0 (2.8, 3.1)	3.4 (3.2, 3.6)
Obese Class 2 (35.00–39.99)	861	27352	2.4 (2.2, 2.6)	2.8 (2.6, 3.0)	3.2 (2.9, 3.4)	3.4 (3.2, 3.7)	3.6 (3.4, 3.9)	4.0 (3.7, 4.3)
Obese Class 3 (≥40.00)	588	13295	3.5 (3.2, 3.8)	4.0 (3.7, 4.4)	4.4 (4.0, 4.8)	4.7 (4.3, 5.1)	5.0 (4.6, 5.4)	5.6 (5.1, 6.1)
TOTAL	**6040**	**250477**						

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=0.68 (0.46, 1.02), p=0.064

Pre Obese (25.00-29.99) vs Normal (18.50-24.99)
Entire Period: HR=1.03 (0.95, 1.11), p=0.446

Obese Class 1 (30.00-34.99) vs Normal (18.50-24.99)
0 - 3Mth: HR=1.41 (1.27, 1.56), p<0.001
3Mth+: HR=1.14 (1.03, 1.25), p=0.011

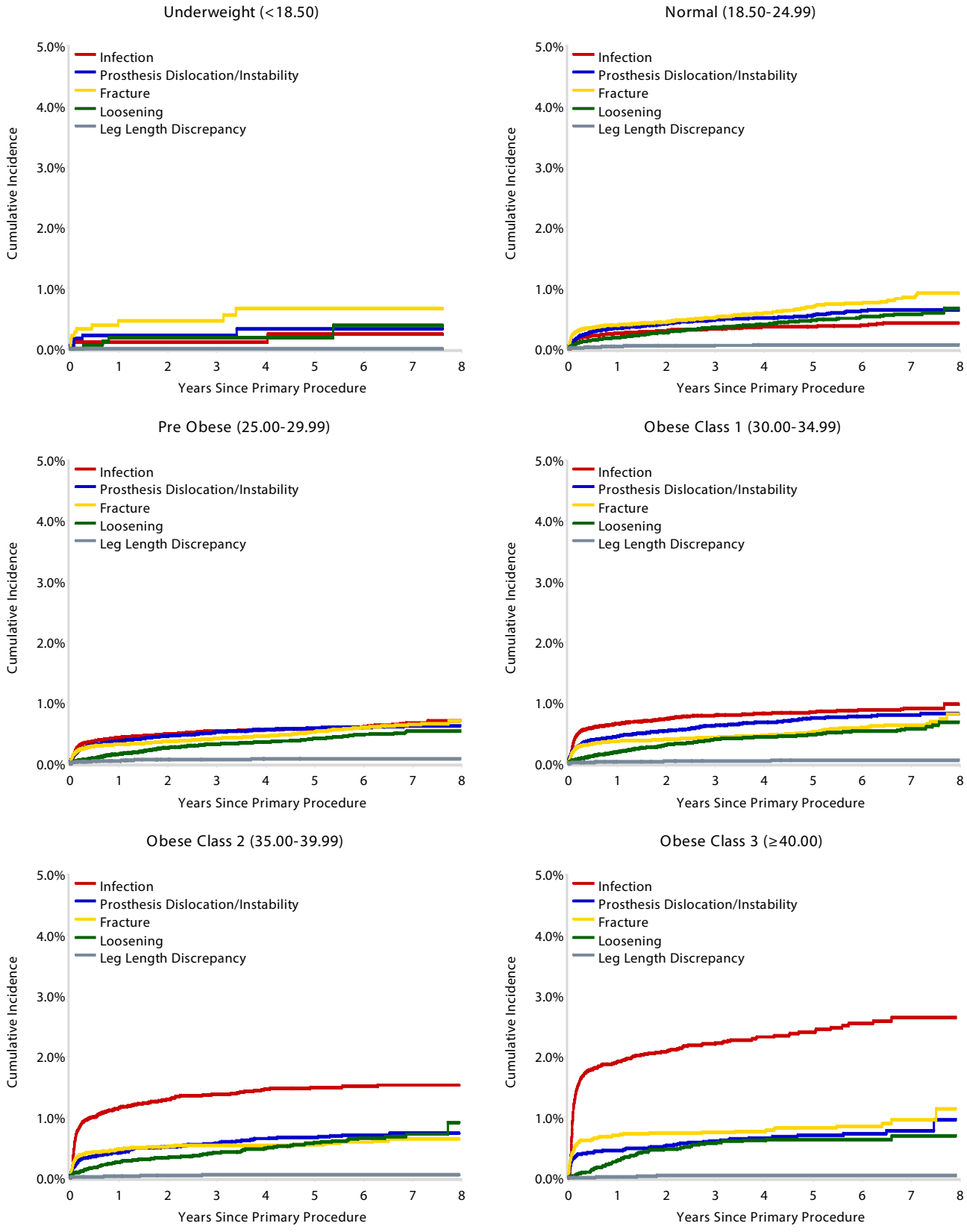
Obese Class 2 (35.00-39.99) vs Normal (18.50-24.99)
0 - 3Mth: HR=2.01 (1.79, 2.25), p<0.001
3Mth - 1.5Yr: HR=1.45 (1.24, 1.69), p<0.001
1.5Yr+: HR=1.08 (0.91, 1.28), p=0.407

Obese Class 3 (≥40.00) vs Normal (18.50-24.99)
0 - 3Mth: HR=3.15 (2.78, 3.58), p<0.001
3Mth+: HR=1.57 (1.35, 1.82), p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	7 Yrs
Underweight (<18.50)	1821	1474	1185	939	677	474	124
Normal (18.50–24.99)	51615	43248	35441	28284	21291	14902	4135
Pre Obese (25.00–29.99)	92166	77332	63589	51106	38569	27001	7478
Obese Class 1 (30.00–34.99)	64228	53546	43513	34841	26256	18252	4937
Obese Class 2 (35.00–39.99)	27352	22702	18509	14763	11038	7729	2040
Obese Class 3 (≥40.00)	13295	10817	8899	7173	5344	3754	1043

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 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 2022. 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 97.3% of all primary total conventional hip procedures performed in 2022.

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 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 has a higher rate of revision 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).

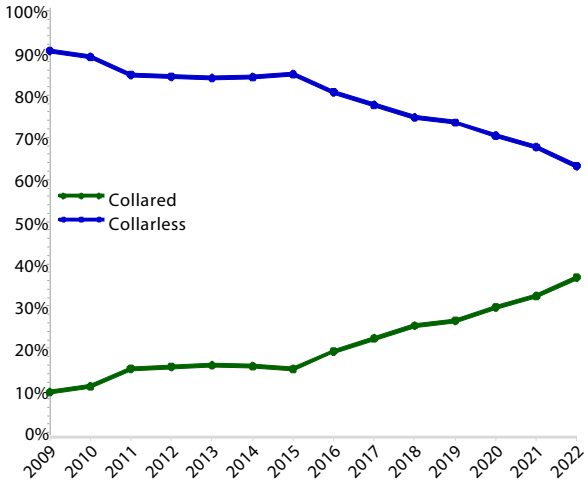
Collared and Collarless Cementless Stems

A new 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 5.3% 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 anterior and posterior approaches, collarless stems have a higher rate of revision for the first 3 months, with no difference after this time (Table HT25 and Table HT26). For the lateral 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 9,459 procedures using a mini stem prosthesis undertaken for osteoarthritis. This represents 3.7% of all primary total conventional hip procedures. There are 1,358 procedures recorded in 2022 using a mini stem prosthesis. This is a decrease of 10.5% compared to 2021. The 9 year cumulative percent revision for primary total conventional hip replacement using a mini stem is 2.7% compared to 4.1% for other cementless femoral stems. Mini stems have a reduced rate of revision after 2 years (Table HT29 and Figure HT27).

The reasons for revision and type of revision are shown in Figure HT28 and Table HT30. Mini stems have a higher rate of revision for loosening in the first 6 months and from 9 to 12 months. However, from 1.5 years onwards mini stems have a lower rate of revision for loosening than other cementless femoral stems (Table HT31 and Figure HT29).

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 HT32 and Figure HT30).

There were 6 different mini stem prostheses used in 2022. Rates of revision vary depending on the type of prosthesis used (Table HT33).

Femoral Stems with Exchangeable Necks

A femoral stem with an exchangeable neck has a separate neck that connects proximally to the stem. There were 29 procedures reported in 2022 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'.

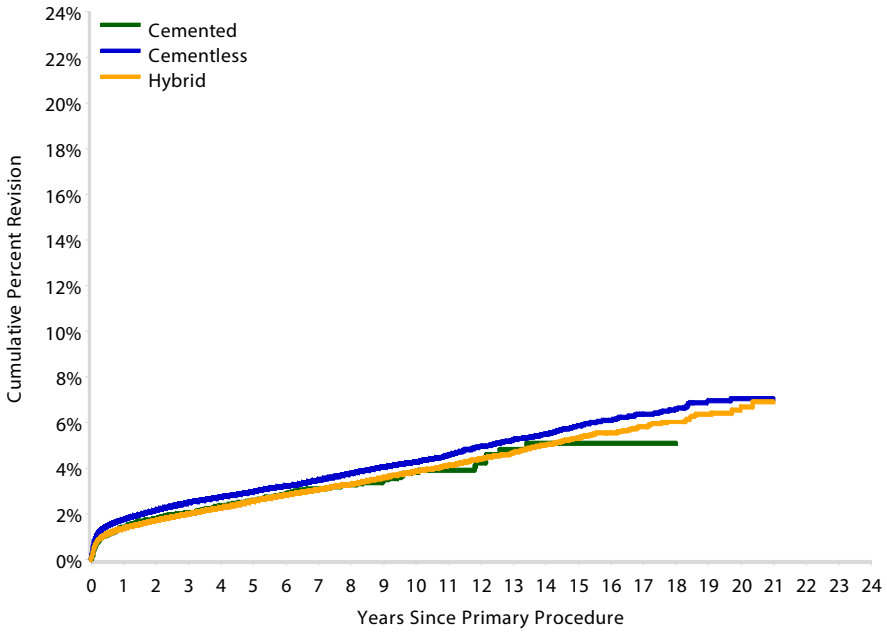
Detailed information on femoral stems with exchangeable necks is available in the supplementary report 'Prosthesis Types with No or Minimal Use' on the AOANJRR website: https://aoanjrr.sahmri.com/annual-reports-2023

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	223	7771	1.4 (1.2, 1.7)	2.1 (1.8, 2.4)	2.6 (2.2, 3.0)	3.8 (3.3, 4.5)	5.1 (4.1, 6.3)	
Cementless	7813	243075	1.8 (1.7, 1.8)	2.5 (2.4, 2.6)	3.0 (2.9, 3.1)	4.3 (4.2, 4.4)	5.9 (5.7, 6.1)	7.0 (6.6, 7.5)
Hybrid	4198	145090	1.4 (1.3, 1.4)	2.0 (1.9, 2.1)	2.6 (2.5, 2.7)	3.9 (3.7, 4.0)	5.3 (5.1, 5.6)	6.7 (6.2, 7.3)
TOTAL	**12234**	**395936**						

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=1.00 (0.87, 1.14), p=0.957

Cementless vs Hybrid

0 - 2Wk: HR=2.08 (1.80, 2.41), p<0.001
2Wk - 1Mth: HR=1.31 (1.18, 1.46), p<0.001
1Mth - 6Mth: HR=1.09 (1.00, 1.18), p=0.041
6Mth - 3Yr: HR=1.16 (1.08, 1.25), p<0.001
3Yr - 3.5Yr: HR=0.74 (0.60, 0.91), p=0.004
3.5Yr+: HR=1.00 (0.93, 1.07), p=0.997

Cementless vs Cemented

0 - 2Wk: HR=2.09 (1.72, 2.54), p<0.001
2Wk - 1Mth: HR=1.32 (1.12, 1.56), p=0.001
1Mth+: HR=1.07 (0.93, 1.22), p=0.356

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Cemented	7771	7127	5875	4515	1351	234	4
Cementless	243075	214443	166394	121758	42115	9002	688
Hybrid	145090	129785	102462	76818	29914	7904	638

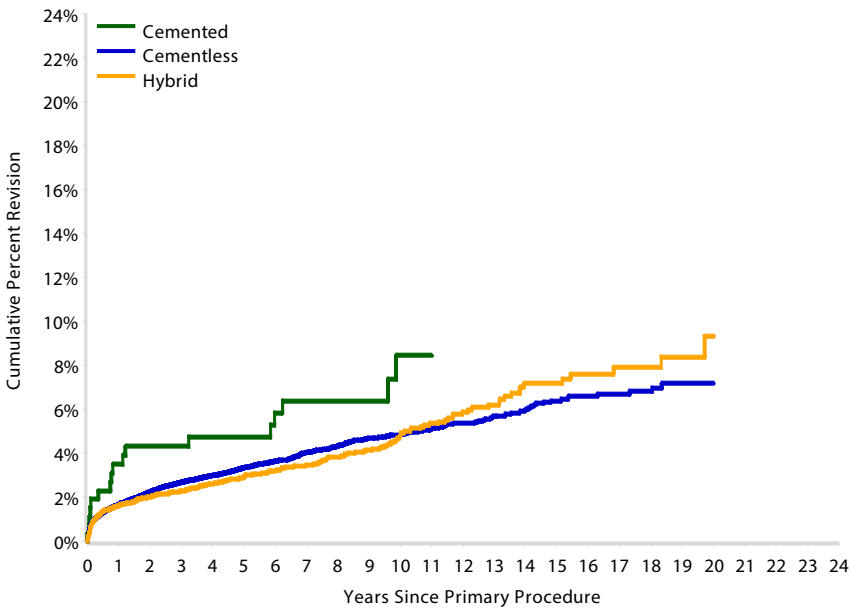
Note: Includes mixed ceramic/mixed ceramic and cross-linked polyethylene (XLPE) bearing surfaces
Restricted to modern prostheses

Table HT22 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Age and Fixation (Primary Diagnosis OA)

Age	Fixation	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
<55		**1449**	**40176**	**1.7 (1.6, 1.8)**	**2.6 (2.5, 2.8)**	**3.3 (3.1, 3.5)**	**4.9 (4.6, 5.2)**	**6.6 (6.1, 7.1)**	**7.8 (6.9, 8.9)**
	Cemented	18	265	3.5 (1.8, 6.6)	4.3 (2.4, 7.6)	4.7 (2.7, 8.2)	8.4 (5.1, 13.8)		
	Cementless	1162	32447	1.7 (1.5, 1.8)	2.7 (2.5, 2.9)	3.3 (3.1, 3.6)	4.8 (4.5, 5.2)	6.4 (5.9, 7.0)	7.2 (6.4, 8.1)
	Hybrid	269	7464	1.6 (1.4, 1.9)	2.3 (2.0, 2.7)	2.9 (2.5, 3.4)	4.8 (4.2, 5.5)	7.2 (6.1, 8.5)	9.3 (7.1, 12.2)
55–64		**2920**	**92267**	**1.6 (1.5, 1.7)**	**2.3 (2.2, 2.4)**	**2.8 (2.7, 2.9)**	**4.2 (4.0, 4.3)**	**5.7 (5.4, 6.0)**	**7.1 (6.5, 7.7)**
	Cemented	30	790	1.9 (1.2, 3.2)	2.6 (1.7, 4.0)	3.1 (2.1, 4.6)	3.9 (2.7, 5.7)	6.2 (3.8, 10.2)	
	Cementless	2103	68756	1.6 (1.5, 1.7)	2.3 (2.2, 2.4)	2.8 (2.6, 2.9)	4.0 (3.9, 4.2)	5.5 (5.2, 5.9)	6.8 (6.1, 7.5)
	Hybrid	787	22721	1.5 (1.3, 1.7)	2.1 (2.0, 2.3)	2.8 (2.6, 3.0)	4.5 (4.1, 4.8)	6.1 (5.6, 6.7)	7.8 (6.8, 8.9)
65–74		**4243**	**143407**	**1.5 (1.4, 1.6)**	**2.2 (2.1, 2.2)**	**2.7 (2.6, 2.7)**	**3.9 (3.7, 4.0)**	**5.4 (5.2, 5.6)**	**6.5 (6.0, 7.1)**
	Cemented	72	2355	1.4 (1.0, 1.9)	1.9 (1.4, 2.6)	2.5 (1.9, 3.2)	4.0 (3.1, 5.1)	5.4 (3.8, 7.6)	
	Cementless	2689	89660	1.7 (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)	6.5 (5.8, 7.3)
	Hybrid	1482	51392	1.2 (1.1, 1.3)	1.9 (1.8, 2.0)	2.4 (2.3, 2.6)	3.7 (3.5, 3.9)	5.2 (4.9, 5.6)	6.4 (5.6, 7.4)
≥75		**3622**	**120086**	**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)**	**6.8 (6.1, 7.6)**
	Cemented	103	4361	1.2 (0.9, 1.6)	1.9 (1.5, 2.4)	2.4 (2.0, 3.0)	3.3 (2.7, 4.2)	3.3 (2.7, 4.2)	
	Cementless	1859	52212	2.2 (2.1, 2.4)	2.9 (2.8, 3.1)	3.4 (3.2, 3.6)	4.8 (4.6, 5.1)	6.8 (6.3, 7.5)	
	Hybrid	1660	63513	1.4 (1.3, 1.5)	2.0 (1.9, 2.1)	2.5 (2.4, 2.7)	3.6 (3.4, 3.8)	4.7 (4.3, 5.0)	5.4 (4.7, 6.0)
TOTAL		**12234**	**395936**						

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 Hybrid

Entire Period: HR=1.64 (1.02, 2.65), p=0.041

Cemented vs Cementless

Entire Period: HR=1.60 (1.00, 2.54), p=0.049

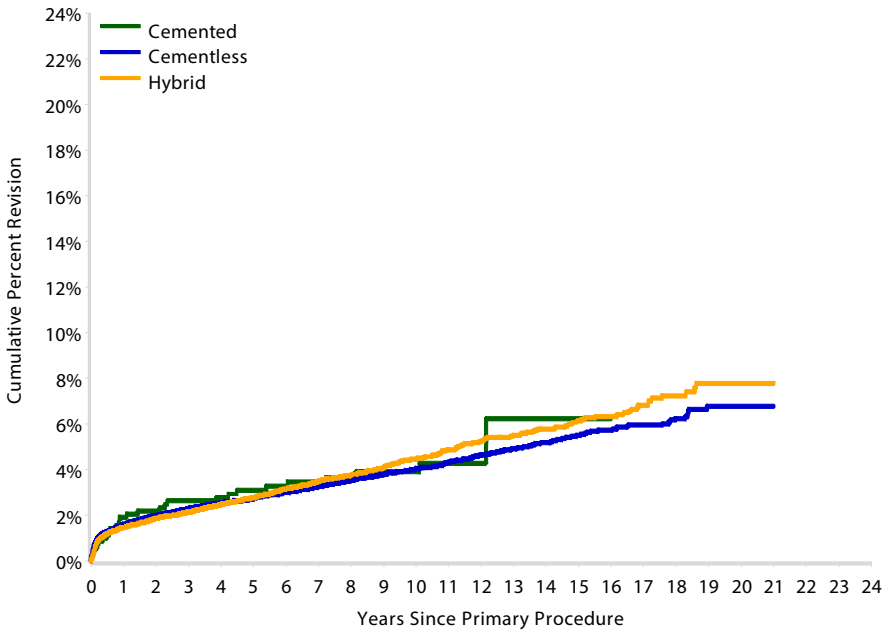
Cementless vs Hybrid

Entire Period: HR=1.03 (0.90, 1.17), p=0.679

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Cemented	265	239	223	187	82	16	1
Cementless	32447	28757	22612	16972	6137	1440	142
Hybrid	7464	6725	5407	4104	1550	480	77

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=0.98 (0.68, 1.41), p=0.915

Cemented vs Cementless

Entire Period: HR=1.05 (0.73, 1.51), p=0.792

Cementless vs Hybrid

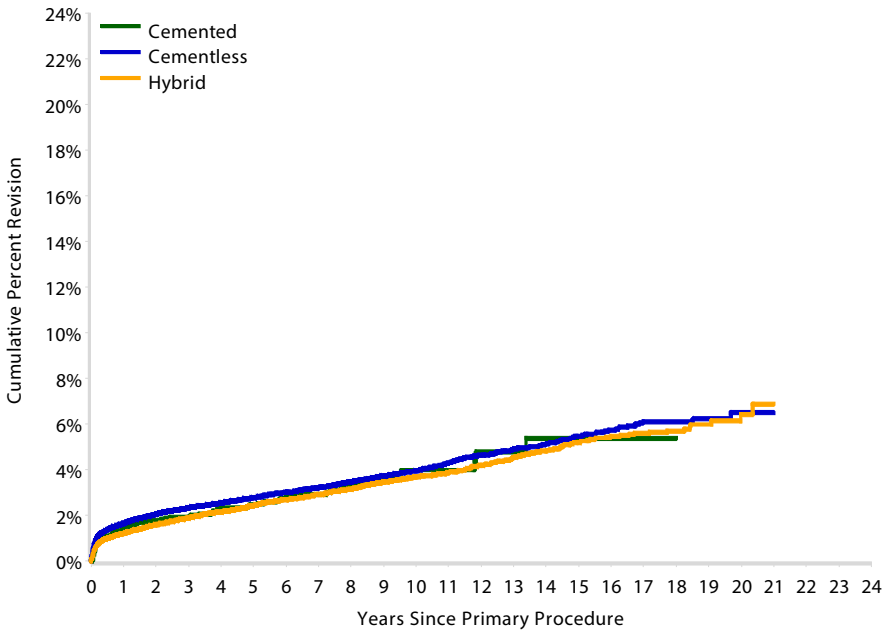
0 - 1Mth: HR=1.69 (1.35, 2.12), p<0.001

1Mth+: HR=0.85 (0.78, 0.93), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Cemented	790	742	671	586	249	63	0
Cementless	68756	61038	47809	35720	13381	3127	273
Hybrid	22721	20470	16490	12790	5637	1831	189

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=1.05 (0.83, 1.32), p=0.712

Cementless vs Hybrid

0 - 2Wk: HR=2.16 (1.67, 2.80), p<0.001

2Wk - 3Mth: HR=1.31 (1.16, 1.49), p<0.001

3Mth+: HR=1.00 (0.92, 1.08), p=0.980

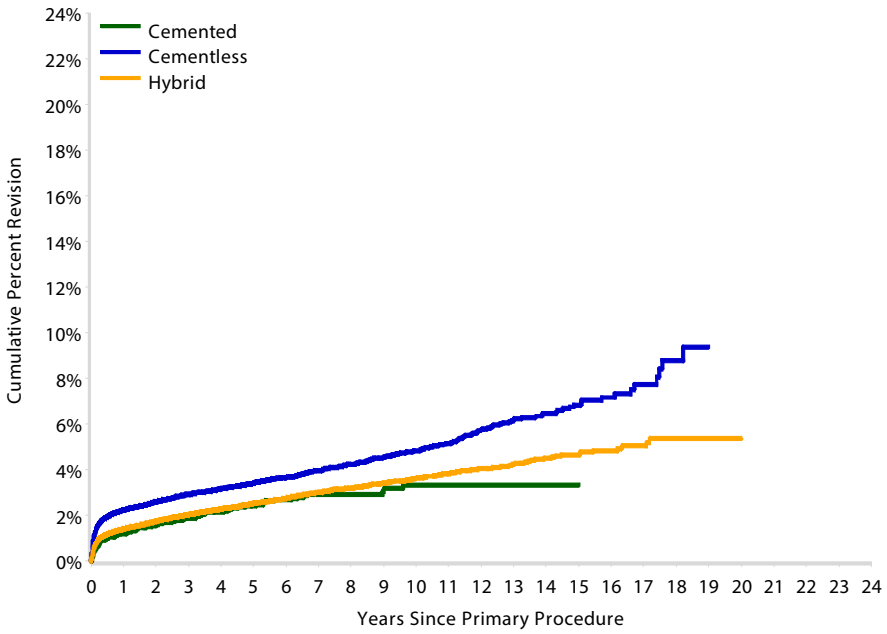
Cementless vs Cemented

Entire Period: HR=1.08 (0.85, 1.37), p=0.517

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Cemented	2355	2203	1881	1541	527	107	3
Cementless	89660	79274	61575	44962	15704	3445	245
Hybrid	51392	46508	37381	28826	12749	3893	307

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=0.91 (0.75, 1.12), p=0.379

Cementless vs Hybrid

0 - 2Wk: HR=2.66 (2.11, 3.35), p<0.001

2Wk - 1Mth: HR=1.61 (1.37, 1.90), p<0.001

1Mth+: HR=1.25 (1.16, 1.35), p<0.001

Cementless vs Cemented

0 - 2Wk: HR=2.90 (2.16, 3.91), p<0.001

2Wk - 1Mth: HR=1.76 (1.37, 2.26), p<0.001

1Mth+: HR=1.37 (1.11, 1.67), p=0.002

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Cemented	4361	3943	3100	2201	493	48	0
Cementless	52212	45374	34398	24104	6893	990	28
Hybrid	63513	56082	43184	31098	9978	1700	65

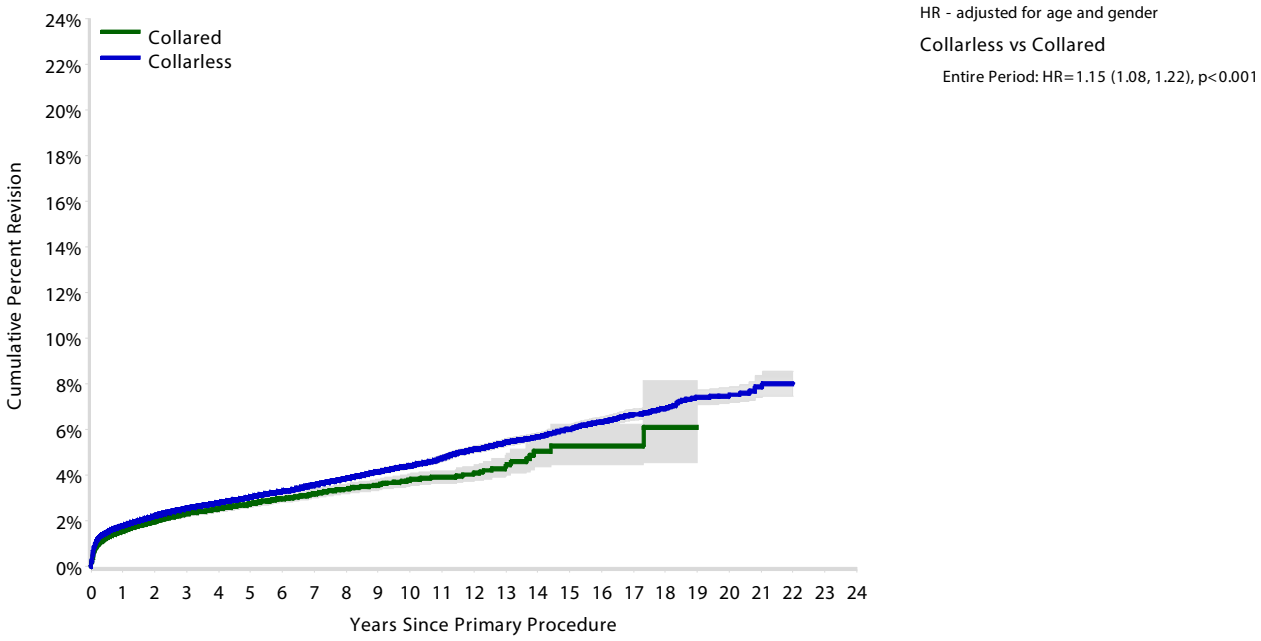
Note: Includes mixed ceramic/mixed ceramic and cross-linked polyethylene (XLPE) bearing surfaces
Restricted to modern prostheses

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	1331	54341	1.6 (1.5, 1.7)	2.3 (2.2, 2.5)	2.7 (2.6, 2.9)	3.6 (3.3, 3.8)	5.3 (4.5, 6.2)	
Collarless	7254	204058	1.8 (1.7, 1.9)	2.5 (2.5, 2.6)	3.0 (3.0, 3.1)	4.2 (4.0, 4.3)	6.0 (5.8, 6.2)	7.5 (7.1, 7.8)
TOTAL	**8585**	**258399**						

Note: Restricted to modern prostheses

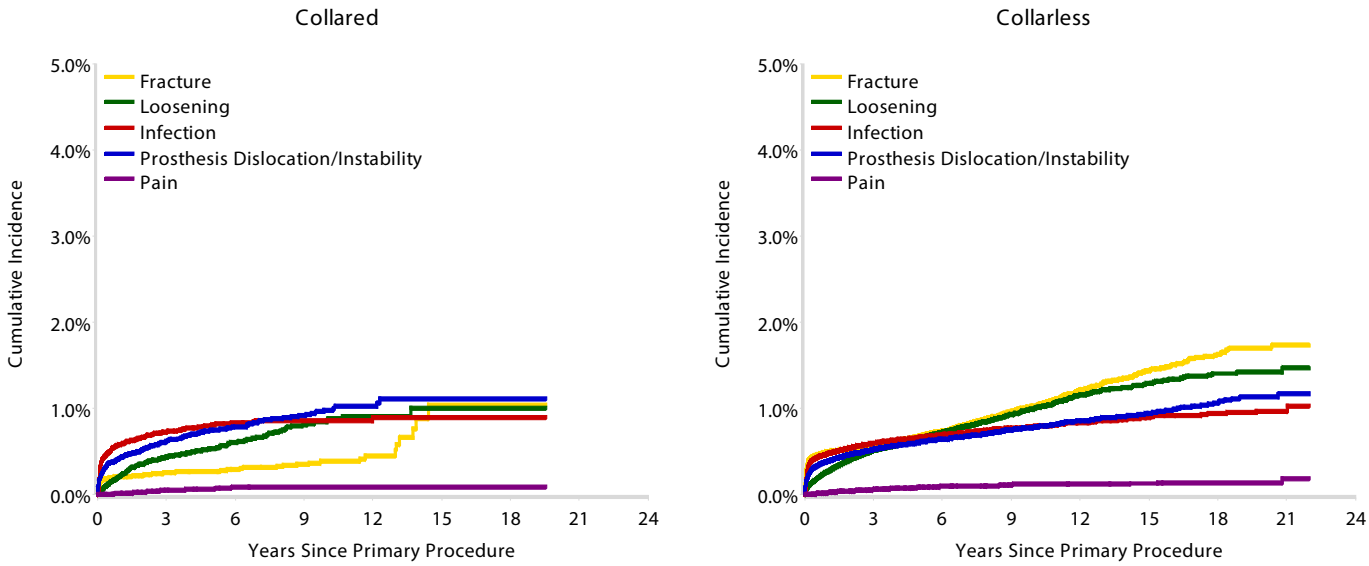
Figure HT25 Cumulative Percent Revision of Cementless Primary Total Conventional Hip Replacement by Stem Collar Use (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	9 Yrs	15 Yrs	20 Yrs
Collared	54341	44481	29786	18274	5760	267	32
Collarless	204058	184415	149565	114903	55525	13717	1876

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	315	0.6	23.7	2758	1.4	38.0
Head/Insert	469	0.9	35.2	1658	0.8	22.9
Acetabular Component	243	0.4	18.3	1327	0.7	18.3
THR (Femoral/Acetabular)	152	0.3	11.4	580	0.3	8.0
Head Only	60	0.1	4.5	426	0.2	5.9
Cement Spacer	48	0.1	3.6	261	0.1	3.6
Minor Components	17	0.0	1.3	128	0.1	1.8
Insert Only	19	0.0	1.4	67	0.0	0.9
Removal of Prostheses	5	0.0	0.4	31	0.0	0.4
Reinsertion of Components	1	0.0	0.1	10	0.0	0.1
Total Femoral				3	0.0	0.0
Bipolar Head and Femoral	2	0.0	0.2	2	0.0	0.0
Bipolar Only				2	0.0	0.0
Head/Neck				1	0.0	0.0
N Revision	**1331**	**2.4**	**100.0**	**7254**	**3.6**	**100.0**
N Primary	**54341**			**204058**		

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	211	13064	1.2 (1.0, 1.4)	1.9 (1.6, 2.2)	2.1 (1.8, 2.5)	2.4 (2.0, 2.8)	2.8 (2.2, 3.7)
	Collarless	1203	47108	1.8 (1.7, 1.9)	2.5 (2.3, 2.6)	2.9 (2.8, 3.1)	3.2 (3.0, 3.4)	3.4 (3.1, 3.6)
Lateral	Collared	133	5385	1.5 (1.2, 1.9)	2.3 (2.0, 2.8)	2.9 (2.4, 3.5)	3.2 (2.7, 3.8)	3.2 (2.7, 3.8)
	Collarless	514	16365	2.1 (1.9, 2.4)	2.9 (2.7, 3.2)	3.3 (3.0, 3.6)	3.6 (3.3, 3.9)	3.8 (3.5, 4.2)
Posterior	Collared	594	25910	1.7 (1.6, 1.9)	2.5 (2.3, 2.7)	2.8 (2.6, 3.0)	2.9 (2.7, 3.2)	3.1 (2.8, 3.5)
	Collarless	1557	57573	2.0 (1.8, 2.1)	2.7 (2.6, 2.8)	3.1 (3.0, 3.3)	3.3 (3.2, 3.5)	3.5 (3.3, 3.7)
TOTAL		**4212**	**165405**					

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	0 – 3Mth: HR=1.73 (1.40, 2.15), p<0.001
	3Mth+: HR=1.07 (0.88, 1.31), p=0.499
Lateral Collarless vs Lateral Collared	Entire Period: HR=1.22 (1.00, 1.47), p=0.044
Posterior Collarless vs Posterior Collared	0 – 3Mth: HR=1.29 (1.13, 1.47), p<0.001
	3Mth+: HR=0.98 (0.86, 1.12), p=0.767

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 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	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
AMIStem H	Collared	20	1361	1.4 (0.9, 2.3)	1.8 (1.1, 2.9)				
	Collarless	136	5983	1.5 (1.2, 1.9)	2.1 (1.7, 2.5)	2.9 (2.4, 3.5)			
CORAIL	Collared	1001	37140	1.5 (1.4, 1.7)	2.3 (2.1, 2.5)	2.7 (2.6, 2.9)	3.8 (3.5, 4.1)	5.6 (4.5, 6.9)	
	Collarless	1200	23768	1.7 (1.5, 1.9)	2.6 (2.4, 2.8)	3.3 (3.1, 3.5)	5.3 (5.0, 5.6)	8.4 (7.7, 9.1)	
HACTIV	Collared	50	1189	3.5 (2.5, 4.7)	4.3 (3.3, 5.7)	5.0 (3.7, 6.8)			
	Collarless	38	1229	2.2 (1.5, 3.2)	3.0 (2.1, 4.1)	3.0 (2.1, 4.1)	3.7 (2.6, 5.2)		
Metafix	Collared	130	8921	1.2 (1.0, 1.4)	1.8 (1.5, 2.1)	2.1 (1.7, 2.6)			
	Collarless	194	6654	1.8 (1.5, 2.2)	2.6 (2.3, 3.1)	3.1 (2.7, 3.6)	4.5 (3.6, 5.4)		
Origin	Collared	10	740	1.3 (0.7, 2.6)					
	Collarless	86	2459	2.5 (1.9, 3.2)	3.5 (2.8, 4.4)	3.9 (3.2, 4.9)			
Paragon	Collared	35	1900	1.7 (1.2, 2.4)	2.1 (1.5, 3.0)				
	Collarless	137	6204	1.6 (1.3, 1.9)	2.0 (1.7, 2.4)	2.4 (2.0, 2.8)			
Polarstem	Collared	17	1098	1.7 (1.1, 2.8)	1.9 (1.2, 3.1)				
	Collarless	453	18499	1.7 (1.6, 1.9)	2.2 (2.0, 2.4)	2.6 (2.3, 2.8)	3.5 (3.1, 4.0)		
TOTAL		**3507**	**117145**						

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 Collared vs AMIStem H Collarless	Entire Period: HR=1.00 (0.62, 1.62), p=0.997
CORAIL Collared vs CORAIL Collarless	0 – 6Mth: HR=0.97 (0.84, 1.12), p=0.669
	6Mth – 1.5Yr: HR=0.81 (0.66, 1.00), p=0.051
	1.5Yr – 2Yr: HR=0.69 (0.47, 1.00), p=0.051
	2Yr – 2.5Yr: HR=0.95 (0.64, 1.42), p=0.817
	2.5Yr – 5.5Yr: HR=0.65 (0.53, 0.80), p<0.001
	5.5Yr+: HR=0.51 (0.41, 0.63), p<0.001
HACTIV Collared vs HACTIV Collarless	Entire Period: HR=1.59 (1.03, 2.45), p=0.034
Metafix Collared vs Metafix Collarless	Entire Period: HR=0.63 (0.50, 0.79), p<0.001
Origin Collared vs Origin Collarless	Entire Period: HR=0.52 (0.27, 1.01), p=0.055
Paragon Collared vs Paragon Collarless	Entire Period: HR=1.08 (0.74, 1.58), p=0.681
Polarstem Collared vs Polarstem Collarless	Entire Period: HR=0.87 (0.53, 1.42), p=0.575

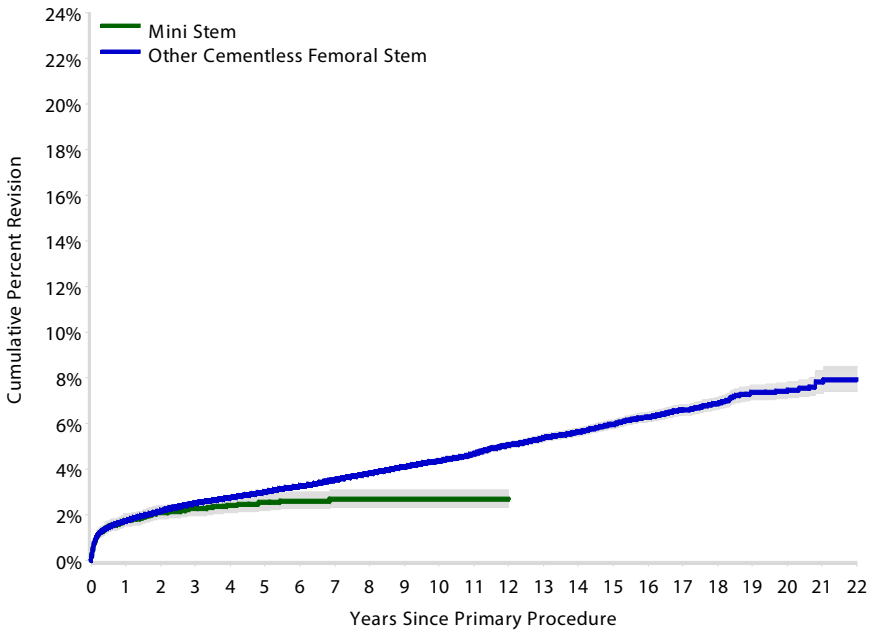
Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded
Only prostheses with >500 procedures each have been included

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	208	9459	1.7 (1.5, 2.0)	2.3 (2.0, 2.6)	2.5 (2.2, 2.9)	2.7 (2.3, 3.1)		
Other Cementless Femoral Stem	8424	249545	1.7 (1.7, 1.8)	2.5 (2.4, 2.6)	3.0 (2.9, 3.1)	4.1 (4.0, 4.2)	6.0 (5.8, 6.2)	7.4 (7.1, 7.8)
TOTAL	**8632**	**259004**						

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=0.95 (0.74, 1.21), p=0.668

1Mth - 3Mth: HR=1.07 (0.79, 1.44), p=0.669

3Mth - 6Mth: HR=1.24 (0.83, 1.86), p=0.287

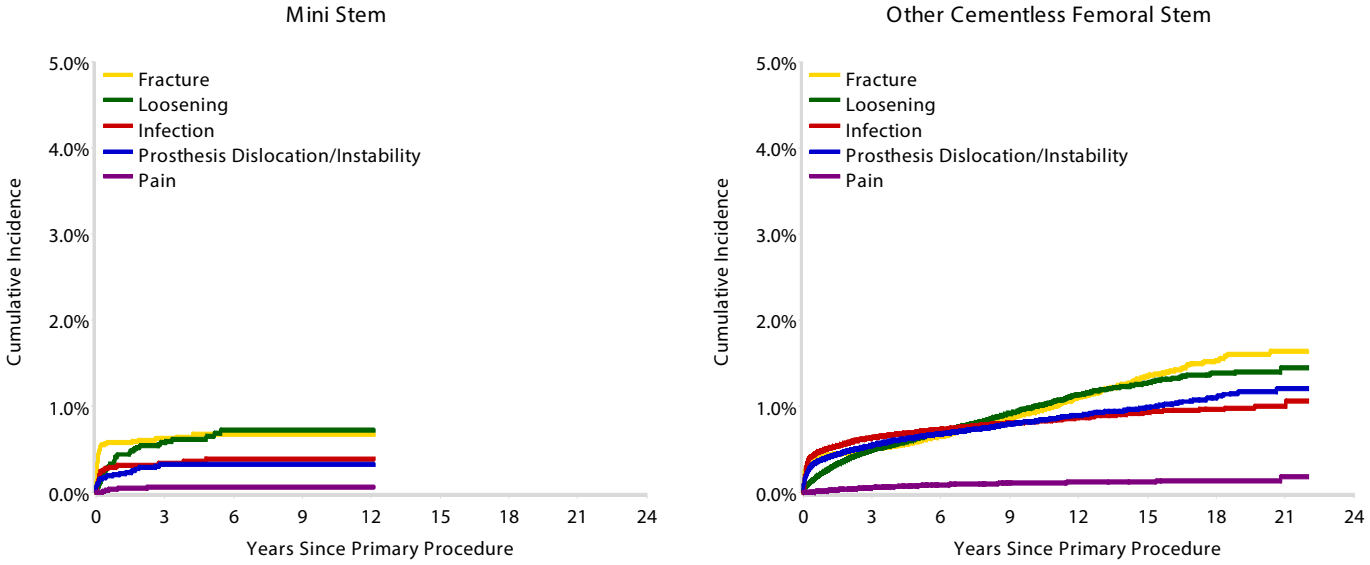
6Mth - 2Yr: HR=0.84 (0.63, 1.12), p=0.230

2Yr+: HR=0.39 (0.26, 0.59), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	9 Yrs	15 Yrs	20 Yrs
Mini Stem	9459	7926	5026	2764	673	0	0
Other Cementless Femoral Stem	249545	221520	174768	130732	60754	14007	1917

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

Figure HT28 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 HT30 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	90	1.0	43.3	2998	1.2	35.6
Head/Insert	29	0.3	13.9	2103	0.8	25.0
Acetabular Component	38	0.4	18.3	1550	0.6	18.4
THR (Femoral/ Acetabular)	21	0.2	10.1	716	0.3	8.5
Head Only	22	0.2	10.6	466	0.2	5.5
Cement Spacer	5	0.1	2.4	305	0.1	3.6
Minor Components	1	0.0	0.5	145	0.1	1.7
Other	2	0.0	1.0	141	0.1	1.7
N Revision	**208**	**2.2**	**100.0**	**8424**	**3.4**	**100.0**
N Primary	**9459**			**249545**		

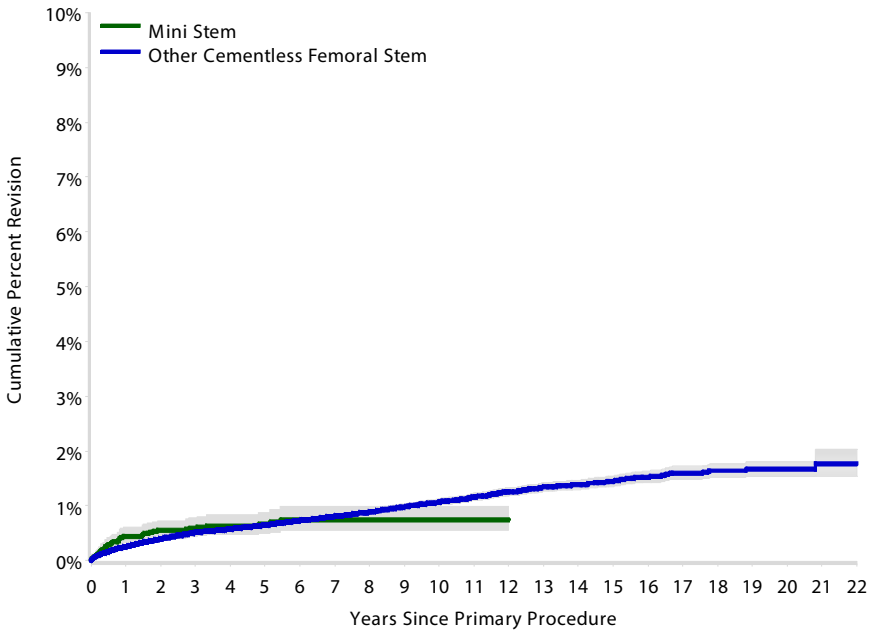
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT31 Cumulative Percent Revision of Cementless Primary Total Conventional Hip Replacement by Stem Type (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	53	9459	0.4 (0.3, 0.6)	0.6 (0.4, 0.8)	0.7 (0.5, 0.9)	0.7 (0.6, 1.0)		
Other Cementless Femoral Stem	1825	249545	0.3 (0.2, 0.3)	0.5 (0.5, 0.5)	0.7 (0.6, 0.7)	1.1 (1.0, 1.1)	1.4 (1.4, 1.5)	1.7 (1.5, 1.8)
TOTAL	**1878**	**259004**						

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 (Primary Diagnosis OA, Revision for Loosening)



HR - adjusted for age and gender

Mini Stem vs Other Cementless Femoral Stem

0 - 6Mth: HR=1.70 (1.15, 2.53), p=0.008

6Mth - 9Mth: HR=1.05 (0.43, 2.57), p=0.911

9Mth - 1Yr: HR=2.59 (1.25, 5.34), p=0.010

1Yr - 1.5Yr: HR=0.32 (0.08, 1.28), p=0.106

1.5Yr+: HR=0.53 (0.30, 0.94), p=0.030

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Mini Stem	9459	7926	5026	2764	385	0	0
Other Cementless Femoral Stem	249545	221520	174768	130732	49930	14007	1917

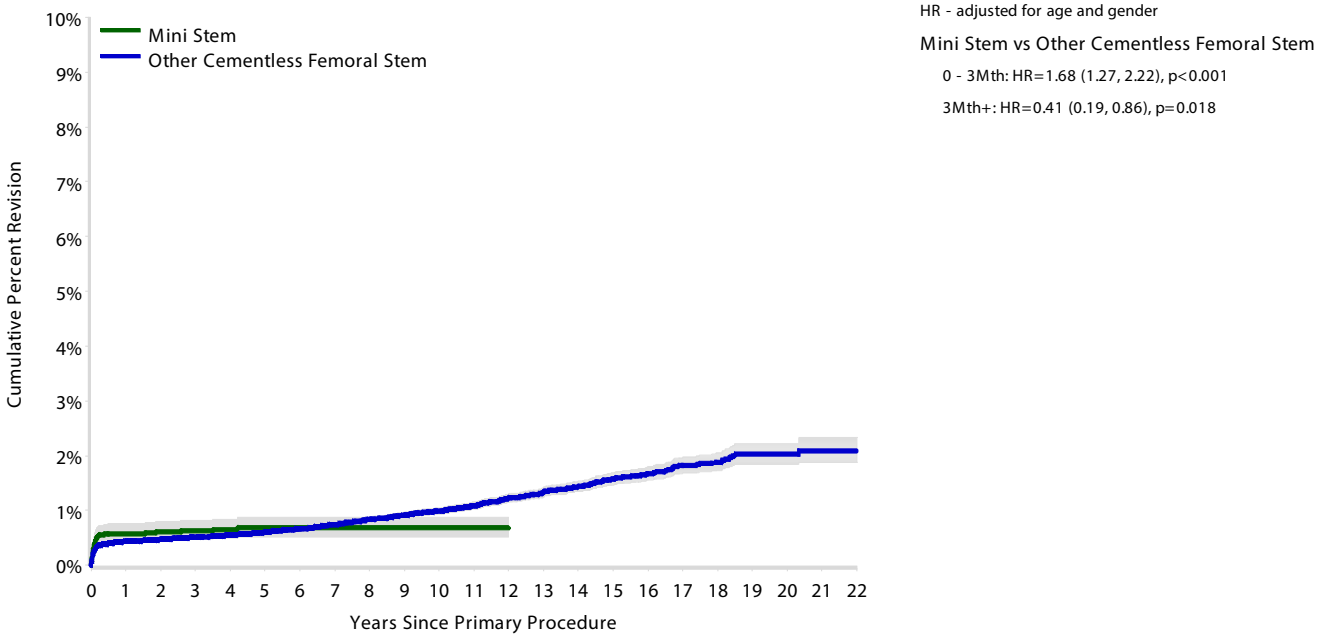
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT32 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	59	9459	0.6 (0.4, 0.8)	0.6 (0.5, 0.8)	0.7 (0.5, 0.9)	0.7 (0.5, 0.9)		
Other Cementless Femoral Stem	1891	249545	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)	2.0 (1.8, 2.2)
TOTAL	**1950**	**259004**						

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

Figure HT30 Cumulative Percent Revision of Cementless Primary Total Conventional Hip Replacement by Stem Type (Primary Diagnosis OA, Revision for Fracture)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Mini Stem	9459	7926	5026	2764	385	0	0
Other Cementless Femoral Stem	249545	221520	174768	130732	49930	14007	1917

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 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	45	1328	2.5 (1.7, 3.5)	3.1 (2.3, 4.2)	3.6 (2.7, 4.8)	3.7 (2.8, 4.9)		
MiniMax	23	384	5.0 (3.2, 7.7)	6.1 (4.1, 9.0)				
Nanos	10	674	0.9 (0.4, 2.0)	1.2 (0.6, 2.4)	1.2 (0.6, 2.4)	1.5 (0.8, 2.8)		
Optimys	59	2966	1.4 (1.1, 2.0)	2.0 (1.5, 2.6)	2.7 (2.0, 3.5)			
Taperloc Microplasty	71	4102	1.5 (1.2, 2.0)	2.0 (1.5, 2.5)	2.0 (1.5, 2.5)			
Other (1)	0	5	0.0 (0.0, 0.0)					
TOTAL	**208**	**9459**						

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 2022. 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 HT31.

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 5 years (Table HT34 and Figure HT32).

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-2023

Figure HT31 Proportion of Primary Total Conventional Hip Replacement by Bearing Surface (Primary Diagnosis OA)

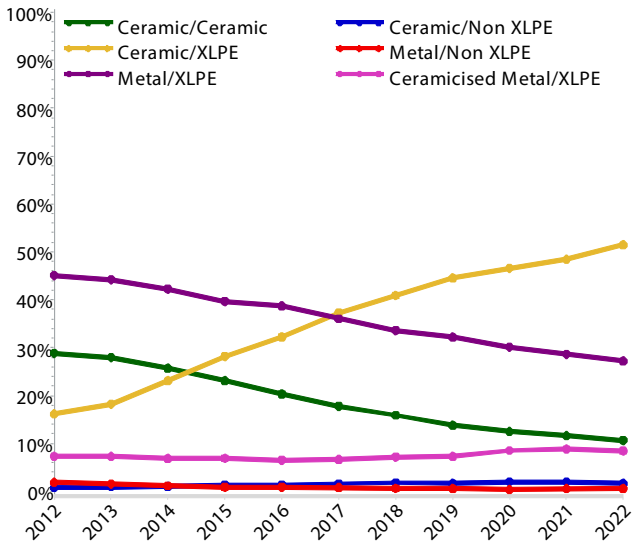
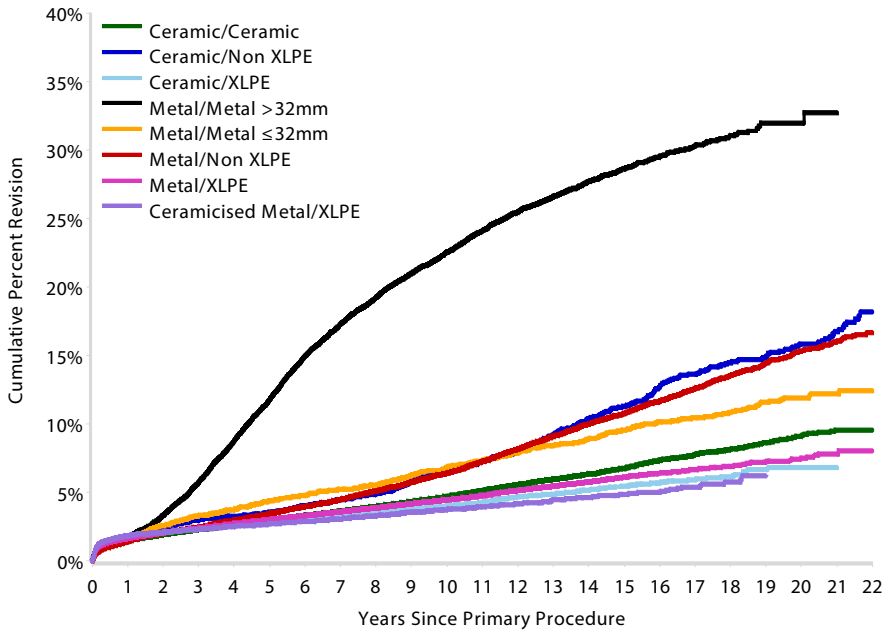


Table HT34 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Bearing Surface (Primary Diagnosis OA)

Bearing Surface	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Ceramic/Ceramic	4853	107126	1.5 (1.4, 1.5)	2.3 (2.2, 2.4)	3.0 (2.9, 3.1)	4.7 (4.6, 4.9)	6.8 (6.5, 7.0)	9.1 (8.7, 9.6)
Ceramic/Non XLPE	697	9962	1.7 (1.5, 2.0)	3.0 (2.7, 3.4)	3.5 (3.2, 4.0)	6.7 (6.1, 7.4)	11.3 (10.4, 12.3)	15.8 (14.5, 17.2)
Ceramic/XLPE	3986	143653	1.7 (1.6, 1.7)	2.4 (2.3, 2.5)	2.9 (2.8, 3.0)	4.0 (3.9, 4.2)	5.5 (5.2, 5.8)	6.8 (6.1, 7.6)
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)		
Metal/Metal >32mm	3756	14424	1.7 (1.5, 1.9)	5.7 (5.3, 6.1)	11.8 (11.2, 12.3)	22.6 (21.9, 23.3)	28.6 (27.8, 29.4)	32.0 (30.8, 33.2)
Metal/Metal ≤32mm	482	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 (8.7, 10.5)	11.9 (10.9, 13.1)
Metal/Non XLPE	3151	35807	1.4 (1.3, 1.5)	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 (14.7, 15.9)
Metal/XLPE	7398	196515	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, 7.9)
Ceramicised Metal/Non XLPE	57	310	1.6 (0.7, 3.9)	3.7 (2.0, 6.5)	4.0 (2.3, 6.9)	12.4 (8.9, 17.1)	21.5 (16.6, 27.6)	
Ceramicised Metal/XLPE	1050	34564	1.8 (1.7, 2.0)	2.3 (2.2, 2.5)	2.7 (2.5, 2.9)	3.8 (3.5, 4.0)	4.9 (4.5, 5.3)	
TOTAL	**25460**	**547803**						

Note: Excludes 248 procedures with unknown bearing surfaces, 2 procedures with ceramicised metal/ceramic bearing surface, 8 procedures with metal/ceramic bearing surface

Figure HT32 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=0.99 (0.96, 1.03), p=0.770

Ceramic/Non XLPE vs Metal/XLPE
- 0 - 2Yr: HR=1.16 (1.01, 1.32), p=0.029
- 2Yr - 3.5Yr: HR=1.48 (1.15, 1.91), p=0.002
- 3.5Yr - 5Yr: HR=0.85 (0.58, 1.24), p=0.388
- 5Yr - 8Yr: HR=1.50 (1.18, 1.89), p<0.001
- 8Yr+: HR=2.67 (2.37, 3.01), p<0.001

Ceramic/XLPE vs Metal/XLPE
- 0 - 2Yr: HR=1.01 (0.97, 1.06), p=0.562
- 2Yr+: HR=0.77 (0.72, 0.82), p<0.001

Metal/Metal >32mm vs Metal/XLPE
- 0 - 2Wk: HR=1.27 (0.96, 1.68), p=0.092
- 2Wk - 1Mth: HR=0.46 (0.31, 0.67), p<0.001
- 1Mth - 9Mth: HR=0.96 (0.79, 1.15), p=0.636
- 9Mth - 1.5Yr: HR=2.81 (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 (5.72, 7.29), p<0.001
- 3Yr - 8Yr: HR=9.45 (8.90, 10.02), p<0.001
- 8Yr - 10Yr: HR=5.92 (5.28, 6.63), p<0.001
- 10Yr - 12Yr: HR=4.86 (4.29, 5.51), p<0.001
- 12Yr+: HR=3.35 (2.97, 3.77), p<0.001

Metal/Metal ≤32mm vs Metal/XLPE
- Entire Period: HR=1.42 (1.30, 1.56), p<0.001

Metal/Non XLPE vs Metal/XLPE
- 0 - 1Mth: HR=0.73 (0.62, 0.85), p<0.001
- 1Mth - 6Mth: HR=0.89 (0.77, 1.03), p=0.120
- 6Mth - 3.5Yr: HR=1.41 (1.30, 1.54), p<0.001
- 3.5Yr - 5Yr: HR=1.57 (1.36, 1.80), p<0.001
- 5Yr - 7Yr: HR=1.73 (1.53, 1.96), p<0.001
- 7Yr - 10Yr: HR=2.13 (1.93, 2.37), p<0.001
- 10Yr+: HR=2.56 (2.38, 2.76), p<0.001

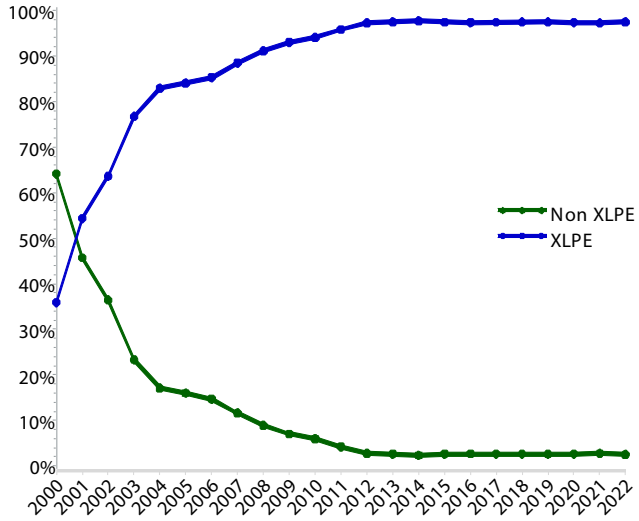
Ceramicised Metal/XLPE vs Metal/XLPE
- 0 - 6Mth: HR=1.16 (1.06, 1.27), p=0.001
- 6Mth - 1Yr: HR=1.04 (0.85, 1.28), p=0.694
- 1Yr+: HR=0.62 (0.56, 0.69), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Ceramic/Ceramic	107126	101283	90732	78607	41948	14629	2623
Ceramic/Non XLPE	9962	9108	7463	6050	3541	2150	784
Ceramic/XLPE	143653	122064	86968	56755	15458	3377	286
Metal/Metal >32mm	14424	14063	13216	11981	9306	4165	100
Metal/Metal ≤32mm	5143	5021	4840	4654	3954	2651	787
Metal/Non XLPE	35807	34413	32041	29306	20949	11722	3369
Metal/XLPE	196515	181105	153647	124529	56134	15691	1385
Ceramicised Metal/XLPE	34564	30720	24139	18672	8012	2230	0

Note: Only bearing surfaces with >5,000 procedures have been listed

Cross-linked Polyethylene (XLPE)
XLPE has been used in 339,455 procedures. This includes 41,316 procedures that have XLPE with the addition of an antioxidant. In 2022, when polyethylene was used as a bearing surface in primary total conventional hip procedures, the proportion of XLPE was 97.5% (Figure HT33).

Figure HT33 Primary Total Conventional Hip Replacement by Polyethylene Type (Primary Diagnosis OA)



XLPE has a lower rate of revision compared to non XLPE after 1 year (Table HT35 and Figure HT34). The difference increases with time and at 20 years the cumulative percent revision is 6.9% and 17.2%, respectively.

At 20 years the cumulative percent revision of total conventional hip replacement with XLPE is 6.9% compared to 17.2% 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 HT35).

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 HT35 and Figure HT36). 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 83.2% of XLPE procedures and in only 20.4% 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 HT35 and Figure HT37). 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 HT38).

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 HT39).

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 HT36 and Table HT37).

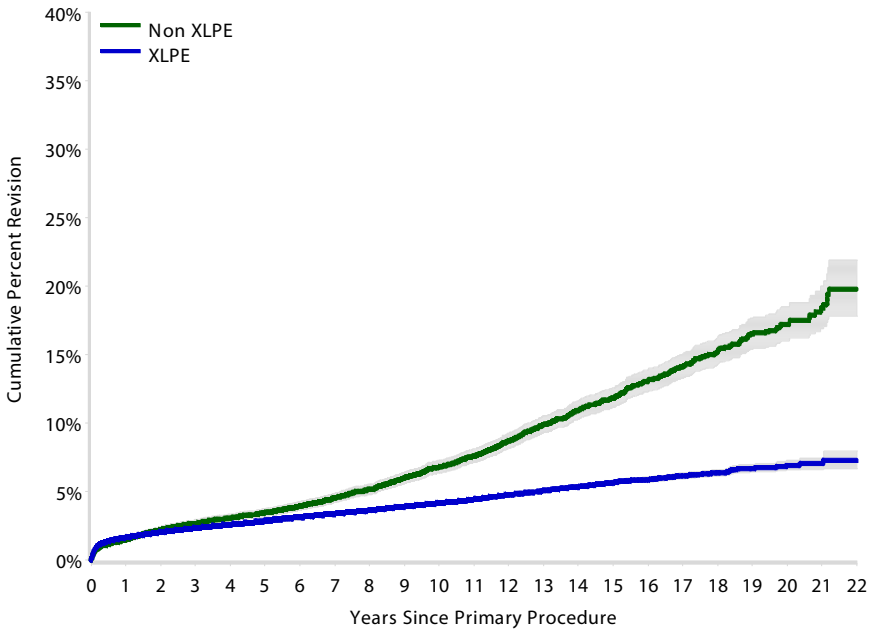
XLPE + Antioxidant
Acetabular components that have both XLPE and XLPE with antioxidant have been compared. There has been a 11.4% increase in procedures using antioxidant compared to 2021. Non XLPE has a higher rate of revision compared to XLPE + antioxidant after 9 months. XLPE has a higher rate of revision compared to XLPE + antioxidant after 3 years (Table HT38 and Figure HT40). The reasons for revision are shown in Table HT39 and Figure HT41.

Table HT35 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		**1309**	**18520**	**1.5 (1.3, 1.7)**	**2.7 (2.5, 3.0)**	**3.5 (3.2, 3.8)**	**6.8 (6.3, 7.3)**	**11.8 (11.1, 12.6)**	**17.2 (16.0, 18.5)**
	<32mm	1105	14750	1.4 (1.3, 1.7)	2.7 (2.4, 2.9)	3.4 (3.1, 3.8)	6.9 (6.4, 7.4)	12.1 (11.3, 12.9)	17.5 (16.3, 18.8)
	32mm	201	3685	1.7 (1.3, 2.1)	2.9 (2.4, 3.5)	3.6 (3.0, 4.3)	6.3 (5.4, 7.4)	9.7 (8.1, 11.5)	
	>32mm	3	85	2.5 (0.6, 9.5)	3.8 (1.2, 11.3)	3.8 (1.2, 11.3)			
XLPE		**10583**	**339455**	**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, 7.3)**
	<32mm	2269	56916	1.6 (1.5, 1.7)	2.4 (2.3, 2.5)	3.0 (2.8, 3.1)	4.4 (4.2, 4.6)	5.9 (5.7, 6.2)	7.3 (6.9, 7.8)
	32mm	4038	135340	1.6 (1.5, 1.7)	2.3 (2.2, 2.4)	2.7 (2.6, 2.8)	3.9 (3.8, 4.0)	5.1 (4.9, 5.4)	
	>32mm	4276	147191	1.7 (1.7, 1.8)	2.4 (2.3, 2.5)	3.0 (2.9, 3.1)	4.4 (4.2, 4.5)	5.9 (5.6, 6.3)	
TOTAL		**11892**	**357975**						

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

Figure HT34 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Polyethylene Type (Primary Diagnosis OA)



HR - adjusted for age and gender

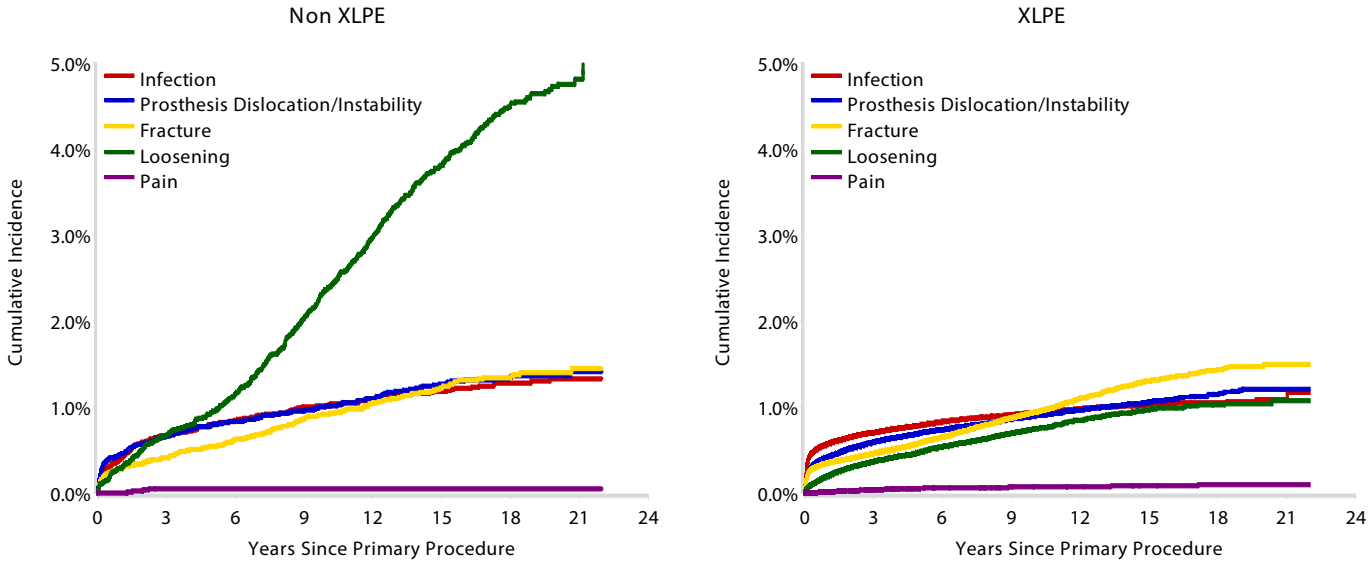
Non XLPE vs XLPE

0 - 1Mth: HR=0.84 (0.69, 1.02), p=0.077
1Mth - 3Mth: HR=0.89 (0.71, 1.12), p=0.333
3Mth - 6Mth: HR=0.80 (0.56, 1.14), p=0.218
6Mth - 1Yr: HR=1.26 (0.98, 1.64), p=0.076
1Yr - 1.5Yr: HR=2.10 (1.65, 2.68), p<0.001
1.5Yr - 5.5Yr: HR=1.57 (1.38, 1.79), p<0.001
5.5Yr - 6.5Yr: HR=2.19 (1.67, 2.87), p<0.001
6.5Yr - 8.5Yr: HR=2.66 (2.20, 3.22), p<0.001
8.5Yr - 11.5Yr: HR=3.15 (2.68, 3.71), p<0.001
11.5Yr+: HR=4.35 (3.75, 5.04), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Non XLPE	18520	17106	14511	12154	7180	3260	672
XLPE	339455	299650	232009	169881	62656	16133	1330

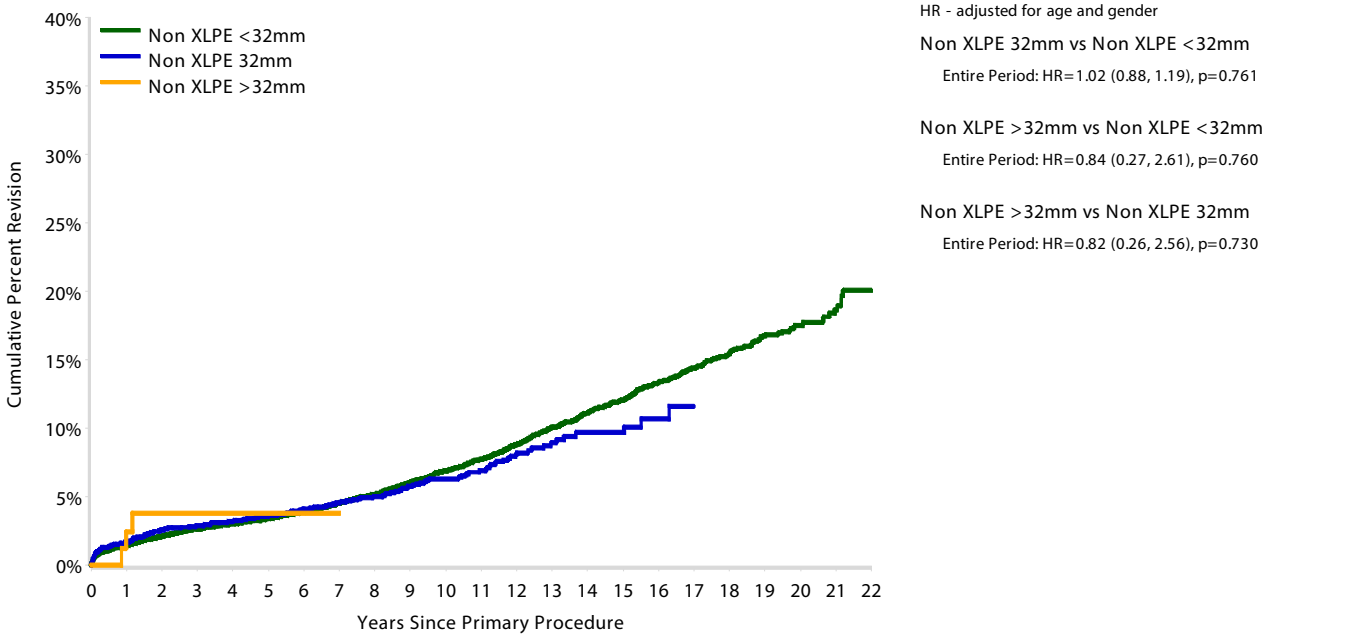
Note: Restricted to modern prostheses

Figure HT35 Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement by Polyethylene Type (Primary Diagnosis OA)



Note: Restricted to modern prostheses

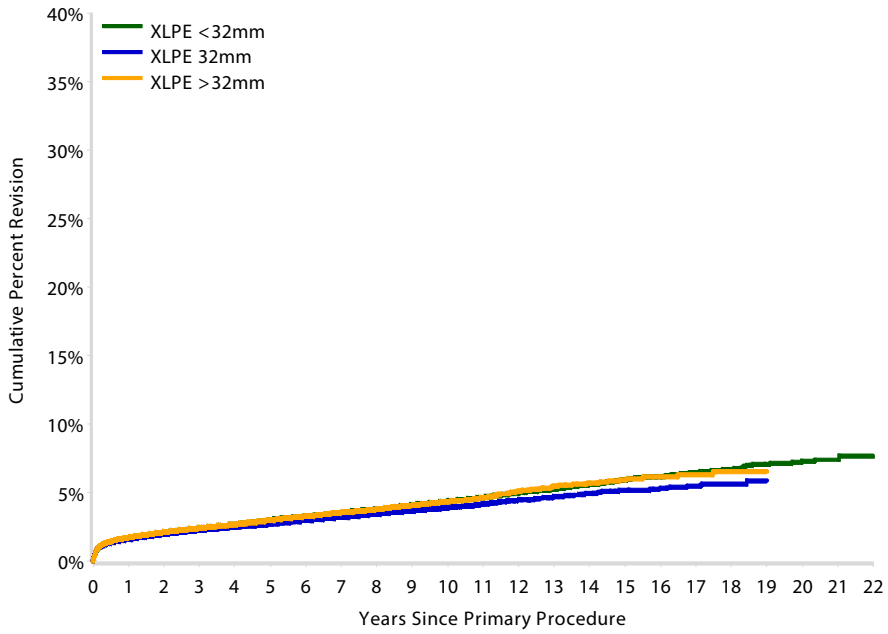
Figure HT36 Cumulative Percent Revision of Primary Total Conventional Hip Replacement using Non XLPE by Head Size (Primary Diagnosis OA)



Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Non XLPE	<32mm	14750	13550	11410	9617	6046	3042	667
	32mm	3685	3477	3051	2515	1131	217	5
	>32mm	85	79	50	22	3	1	0

Note: Restricted to modern prostheses

Figure HT37 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=0.97 (0.86, 1.09), p=0.615

1Mth - 1.5Yr: HR=1.08 (0.99, 1.18), p=0.100

1.5Yr+: HR=1.20 (1.11, 1.28), p<0.001

XLPE >32mm vs XLPE 32mm

0 - 1Mth: HR=0.95 (0.86, 1.03), p=0.223

1Mth+: HR=1.13 (1.07, 1.19), p<0.001

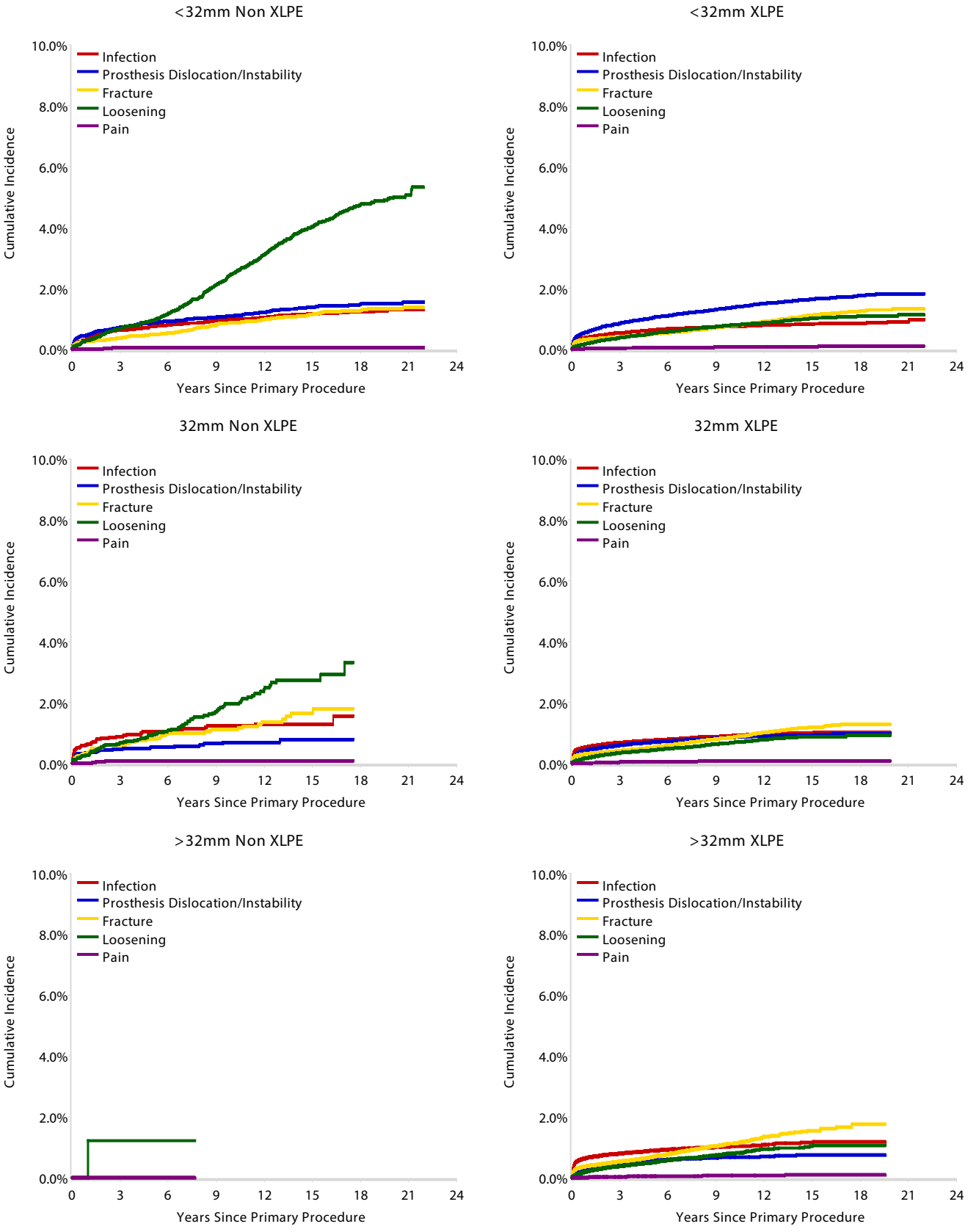
XLPE >32mm vs XLPE <32mm

Entire Period: HR=0.98 (0.93, 1.04), p=0.496

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
XLPE	<32mm	56916	51241	42396	35586	22306	10547	1269
	32mm	135340	123313	100141	74587	23467	3765	37
	>32mm	147191	125096	89472	59708	16883	1821	24

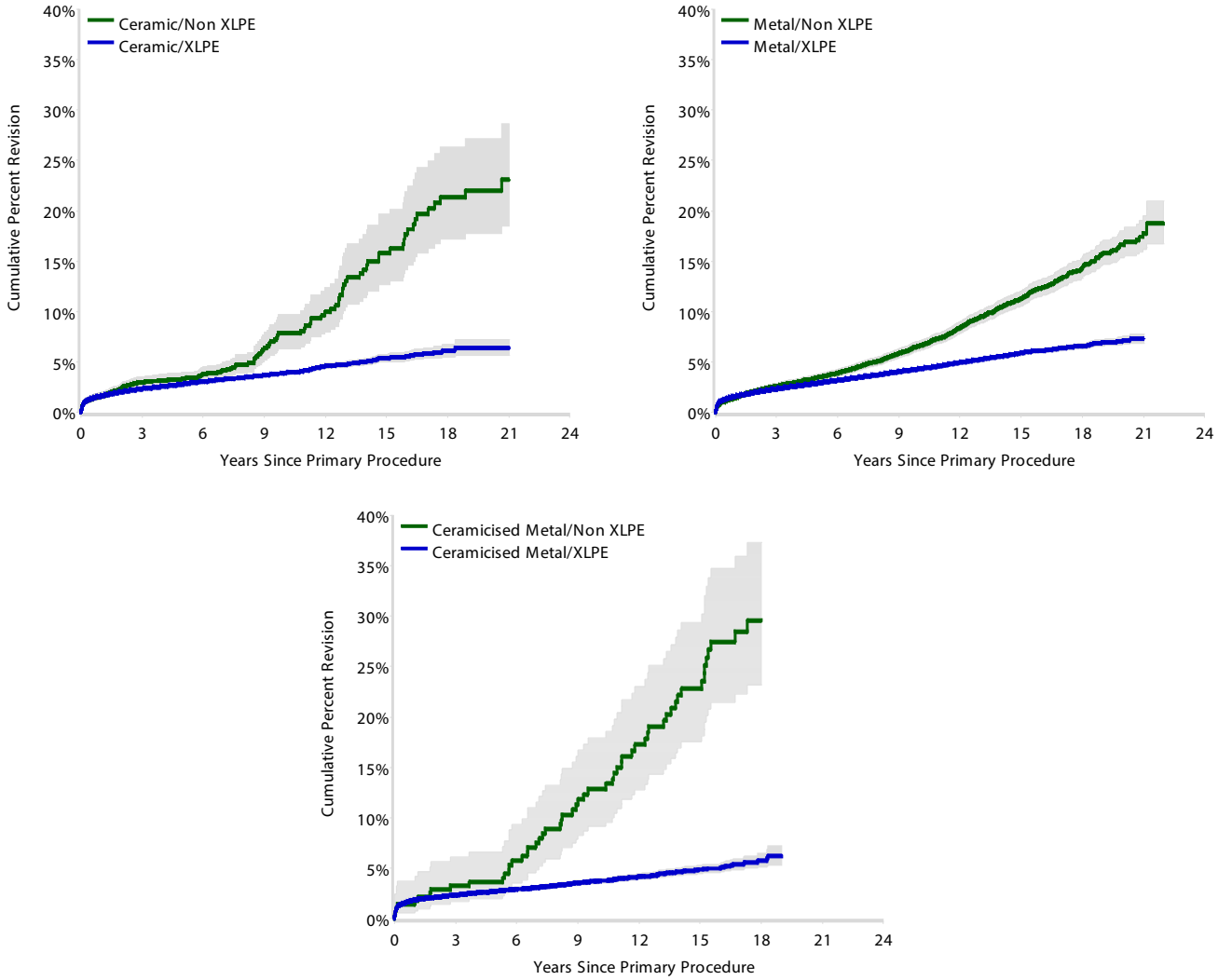
Note: Restricted to modern prostheses

Figure HT38 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 HT39 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Head Surface and Polyethylene Type (Primary Diagnosis OA)



Note: Restricted to modern prostheses

Table HT36 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)		**217**	**2334**	**1.0 (0.7, 1.5)**	**1.9 (1.4, 2.6)**	**3.0 (2.3, 3.8)**	**7.7 (6.5, 9.1)**	**15.2 (13.2, 17.4)**	**20.0 (16.8, 23.6)**
	Non XLPE	167	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, 26.5)	28.7 (24.6, 33.3)
	XLPE	50	1306	1.3 (0.8, 2.1)	1.8 (1.2, 2.7)	2.8 (2.0, 3.9)	4.4 (3.2, 5.9)	5.7 (4.2, 7.6)	
Reflection (Shell)		**795**	**14326**	**1.3 (1.1, 1.5)**	**1.9 (1.7, 2.2)**	**2.4 (2.2, 2.7)**	**4.3 (3.9, 4.6)**	**6.7 (6.2, 7.2)**	**10.0 (9.1, 11.1)**
	Non XLPE	350	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)	17.2 (15.5, 19.2)	24.0 (21.6, 26.7)
	XLPE	445	12099	1.2 (1.0, 1.4)	1.7 (1.5, 1.9)	2.1 (1.8, 2.3)	3.2 (2.9, 3.5)	4.5 (4.1, 5.0)	5.8 (5.2, 6.6)
TOTAL		**1012**	**16660**						

Note: Restricted to modern prostheses

Table HT37 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 – 5Yr: HR=1.10 (0.67, 1.80), p=0.704
	5Yr – 9Yr: HR=7.15 (3.23, 15.81), p<0.001
	9Yr – 12.5Yr: HR=5.61 (2.65, 11.86), p<0.001
	12.5Yr+: HR=13.61 (3.28, 56.46), p<0.001
Reflection (Shell) Non XLPE vs Reflection (Shell) XLPE	0 – 1Mth: HR=1.61 (0.96, 2.68), p=0.068
	1Mth – 3Mth: HR=0.56 (0.20, 1.58), p=0.276
	3Mth – 3.5Yr: HR=2.52 (1.81, 3.51), p<0.001
	3.5Yr – 6.5Yr: HR=3.99 (2.72, 5.85), p<0.001
	6.5Yr – 12Yr: HR=6.58 (5.03, 8.61), p<0.001
	12Yr+: HR=5.91 (4.35, 8.05), p<0.001

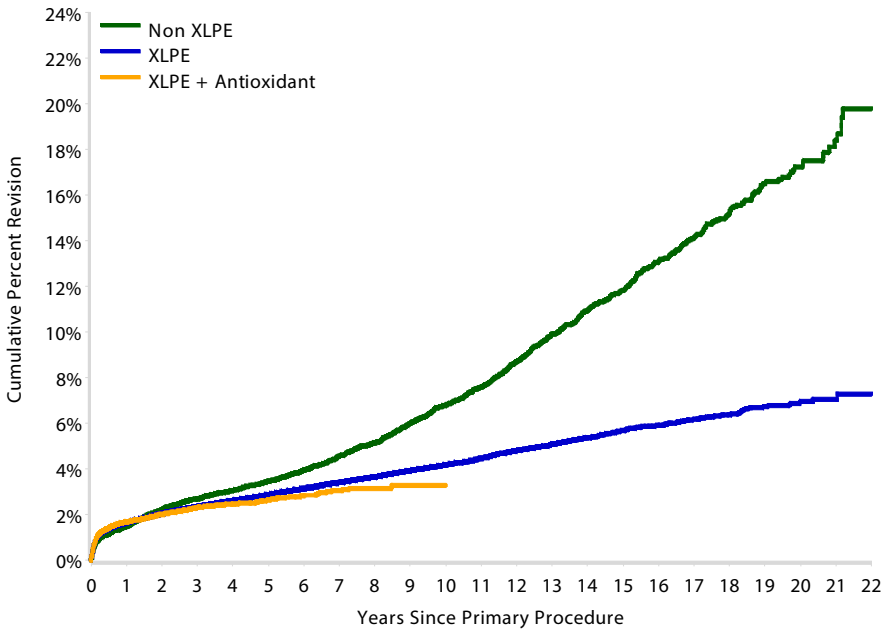
Note: Restricted to modern prostheses

Table HT38 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	1309	18520	1.5 (1.3, 1.7)	2.7 (2.5, 3.0)	3.5 (3.2, 3.8)	6.8 (6.3, 7.3)	11.8 (11.1, 12.6)	17.2 (16.0, 18.5)
XLPE	9714	298139	1.7 (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, 7.3)
XLPE + Antioxidant	869	41316	1.7 (1.6, 1.8)	2.3 (2.2, 2.5)	2.6 (2.5, 2.9)	3.3 (2.9, 3.7)		
TOTAL	**11892**	**357975**						

Note: Restricted to modern prostheses

Figure HT40 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=0.91 (0.79, 1.05), p=0.185

9Mth - 6Yr: HR=1.89 (1.65, 2.15), p<0.001

6Yr+: HR=4.27 (3.53, 5.16), p<0.001

XLPE vs XLPE + Antioxidant

0 - 3Yr: HR=1.03 (0.96, 1.11), p=0.429

3Yr+: HR=1.29 (1.09, 1.53), p=0.002

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Non XLPE	18520	17106	14511	12154	7180	3260	672
XLPE	298139	268097	215660	163196	62540	16133	1330
XLPE + Antioxidant	41316	31553	16349	6685	116	0	0

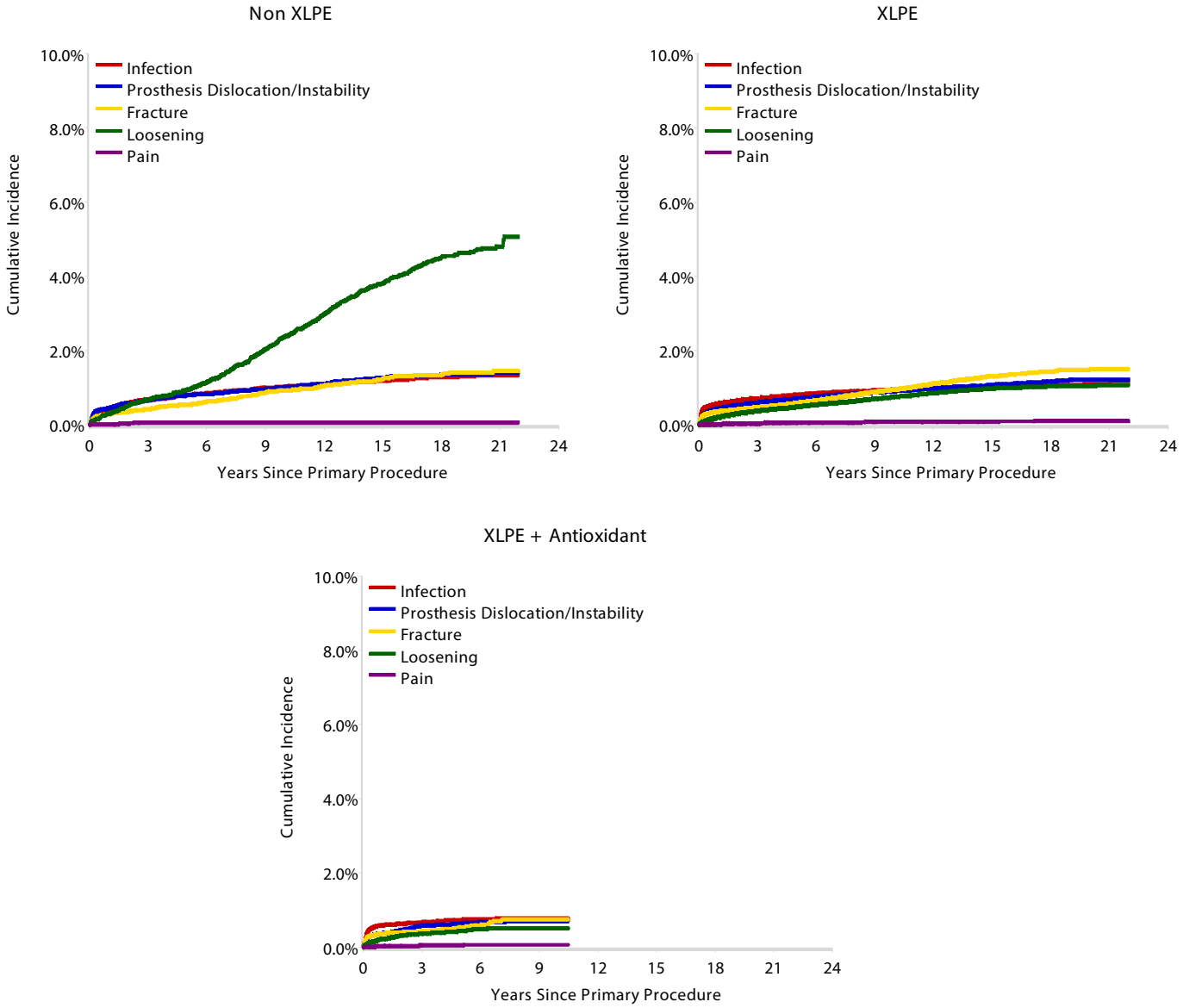
Note: Restricted to modern prostheses

Table HT39 Revision Diagnosis of Primary Total Conventional Hip Replacement by Polyethylene Type (Primary Diagnosis OA, Follow-up Limited to 11.8 Years)

Revision Diagnosis	Non XLPE			XLPE			XLPE + Antioxidant		
	Number	% Primaries Revised	% Revisions	Number	% Primaries Revised	% Revisions	Number	% Primaries Revised	% Revisions
Infection	174	0.9	17.2	2433	0.8	26.0	262	0.6	30.1
Prosthesis Dislocation/ Instability	176	1.0	17.4	2216	0.7	23.7	206	0.5	23.7
Fracture	152	0.8	15.0	2140	0.7	22.9	181	0.4	20.8
Loosening	399	2.2	39.5	1663	0.6	17.8	132	0.3	15.2
Pain	9	0.0	0.9	159	0.1	1.7	16	0.0	1.8
Leg Length Discrepancy	10	0.1	1.0	140	0.0	1.5	20	0.0	2.3
Malposition	8	0.0	0.8	126	0.0	1.3	22	0.1	2.5
Implant Breakage Stem	10	0.1	1.0	69	0.0	0.7			
Lysis	35	0.2	3.5	62	0.0	0.7	1	0.0	0.1
Incorrect Sizing	3	0.0	0.3	54	0.0	0.6	6	0.0	0.7
Implant Breakage Acetabular Insert	4	0.0	0.4	37	0.0	0.4	2	0.0	0.2
Metal Related Pathology	1	0.0	0.1	32	0.0	0.3	2	0.0	0.2
Wear Acetabular Insert	17	0.1	1.7	26	0.0	0.3			
Implant Breakage Acetabular	1	0.0	0.1	19	0.0	0.2	2	0.0	0.2
Heterotopic Bone	2	0.0	0.2	16	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				3	0.0	0.0			
Wear Acetabulum	2	0.0	0.2	3	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	7	0.0	0.7	134	0.0	1.4	14	0.0	1.6
N Revision	**1011**	**5.5**	**100.0**	**9349**	**3.1**	**100.0**	**869**	**2.1**	**100.0**
N Primary	**18520**			**298139**			**41316**		

Note: Restricted to modern prostheses
Restricted to revisions within 11.8 years for all groups to allow a time-matched comparison of revisions

Figure HT41 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 74,265 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 2022, mixed ceramic accounted for 99.9% of all procedures with a ceramic/ceramic bearing surface (Figure HT42).

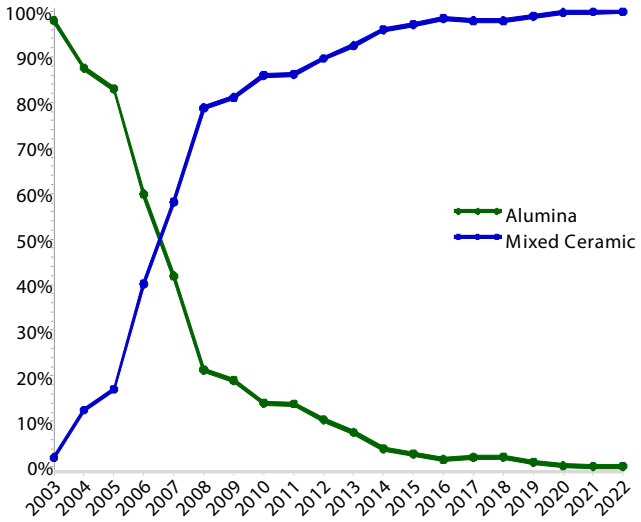
Head Size

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 HT43.

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 HT40 and Figure HT44).

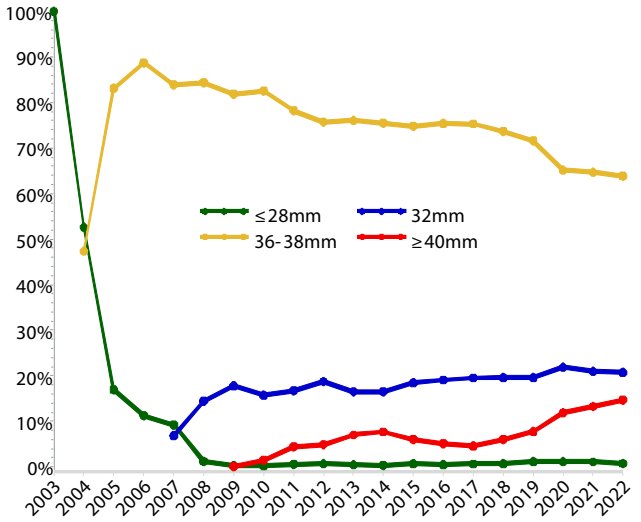
At 1 year, the cumulative incidence of prosthesis dislocation/instability is 1.5% for head sizes ≤28mm compared to 0.3% for 32mm, 0.3% for 36–38mm, and 0.2% for head sizes ≥40mm (Figure HT45).

Figure HT42 Primary Total Conventional Hip Replacement with Ceramic Femoral Heads by Ceramic Type (Primary Diagnosis OA)



Note: Restricted to modern prostheses

Figure HT43 Mixed Ceramic/Mixed Ceramic Primary Total Conventional Hip Replacement by Head Size (Primary Diagnosis OA)



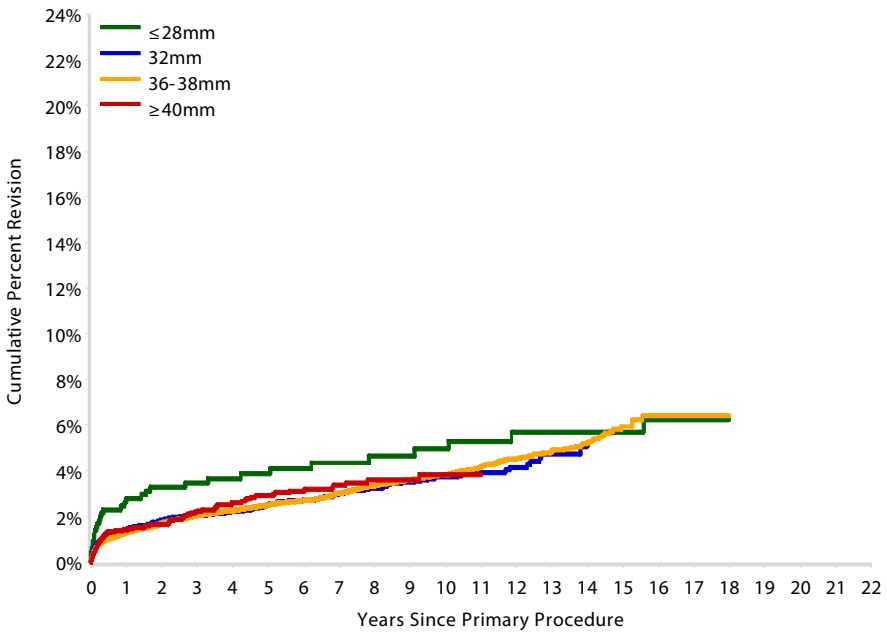
Note: Restricted to modern prostheses

Table HT40 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	31	656	2.8 (1.8, 4.4)	3.5 (2.3, 5.2)	3.9 (2.6, 5.7)	5.0 (3.4, 7.2)	5.7 (3.9, 8.2)	
32mm	284	10385	1.4 (1.2, 1.7)	2.0 (1.8, 2.3)	2.5 (2.2, 2.9)	3.7 (3.3, 4.3)		
36–38mm	1241	41596	1.3 (1.2, 1.4)	2.0 (1.9, 2.2)	2.5 (2.4, 2.7)	3.8 (3.6, 4.1)	5.9 (5.3, 6.6)	
≥40mm	95	3844	1.4 (1.1, 1.8)	2.2 (1.8, 2.8)	2.9 (2.3, 3.6)	3.8 (3.0, 4.9)		
TOTAL	**1651**	**56481**						

Note: Restricted to modern prostheses

Figure HT44 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=2.38 (1.36, 4.17), p=0.002

3Mth+: HR=0.91 (0.56, 1.48), p=0.715

36-38mm vs 32mm

Entire Period: HR=1.01 (0.88, 1.16), p=0.898

≥40mm vs 32mm

Entire Period: HR=1.06 (0.83, 1.36), p=0.632

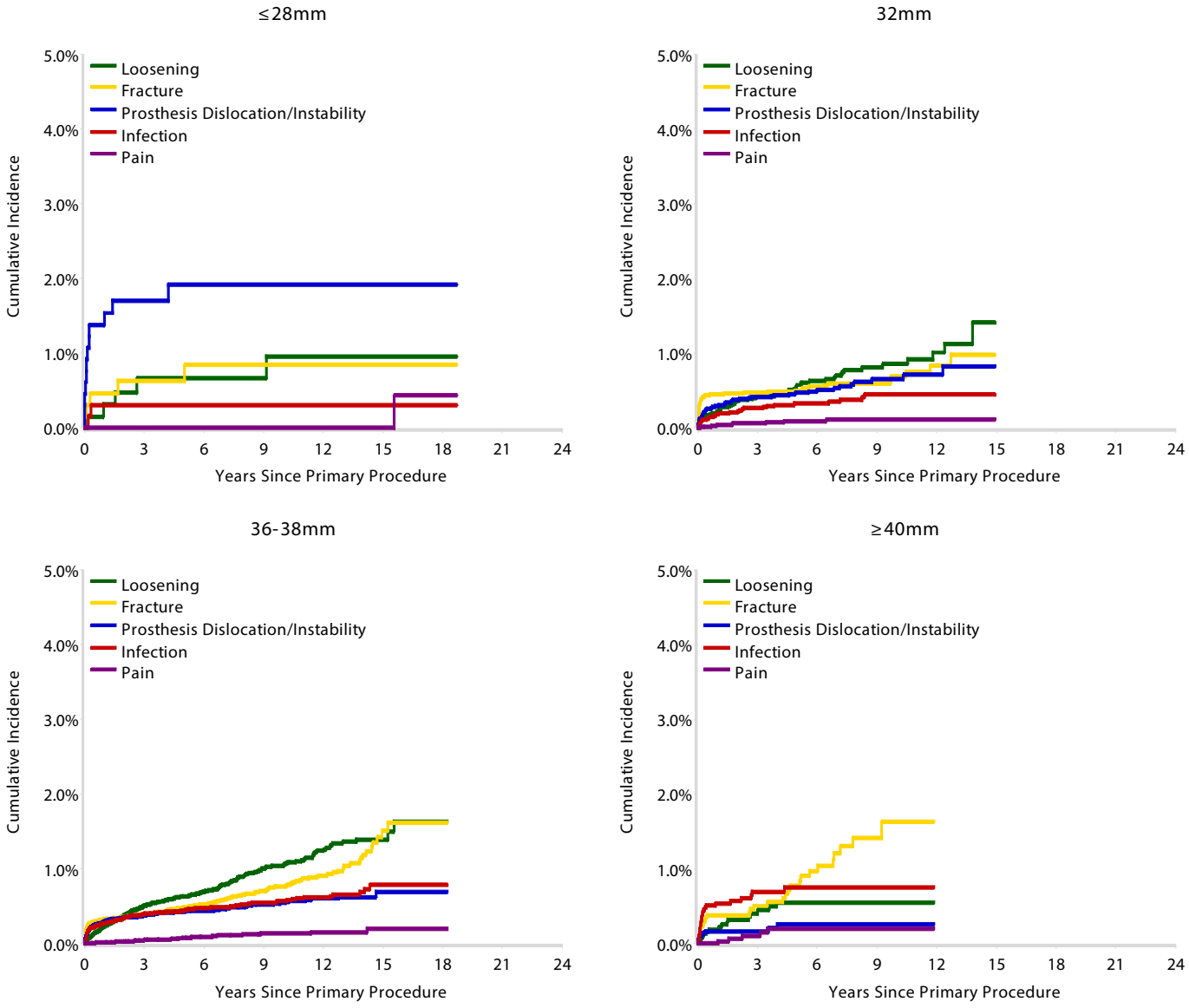
36-38mm vs ≥40mm

Entire Period: HR=0.95 (0.77, 1.17), p=0.634

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
≤28mm	656	608	509	424	283	202	0
32mm	10385	9427	7583	5740	1687	36	0
36–38mm	41596	38465	32495	25542	8517	769	0
≥40mm	3844	3205	2135	1504	237	0	0

Note: Restricted to modern prostheses

Figure HT45 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 960 procedures using constrained acetabular prostheses for primary total conventional hip replacement. Of these, 762 procedures were constrained acetabular inserts and 198 procedures were constrained cups. There were 75 procedures reported in 2022. This is a decrease of 5.1% compared to 2021. The most commonly used constrained prostheses are presented in Table HT41.

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 HT42).

When all diagnoses are included (Table HT43 and Figure HT46), and when used only for osteoarthritis (Table HT44), constrained acetabular prostheses have a higher rate of revision compared to other acetabular prostheses (Table HT47). Gender and age <70 years and ≥70 years are not risk factors for revision (Table HT45 to Table HT47). 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 HT41 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	8	127	6.3 (3.1, 12.9)					
PINNACLE/PINNACLE	7	131	2.5 (0.8, 7.4)	4.3 (1.8, 10.0)	5.9 (2.6, 13.1)			
Trabecular Metal (Shell)/Longevity	7	108	1.9 (0.5, 7.5)	5.3 (2.2, 12.4)	6.9 (3.1, 15.1)			
Trident (Cup)	9	159	5.6 (2.8, 11.0)	5.6 (2.8, 11.0)				
Trident (Shell)/Trident	17	221	5.3 (3.0, 9.5)	6.0 (3.4, 10.4)	7.7 (4.6, 12.9)			
Other Constrained Prosthesis	14	214	5.7 (3.2, 10.0)	6.3 (3.6, 10.8)	8.5 (5.0, 14.4)			
TOTAL	**62**	**960**						

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

Table HT42 Primary Total Conventional Hip Replacement by Primary Diagnosis and Acetabular Type

Primary Diagnosis	Constrained Prosthesis		Other Acetabular Prosthesis	
	N	Col%	N	Col%
Osteoarthritis	375	39.1	432299	87.7
Fractured Neck Of Femur	256	26.7	27283	5.5
Osteonecrosis	37	3.9	15776	3.2
Developmental Dysplasia	23	2.4	6429	1.3
Rheumatoid Arthritis	8	0.8	3798	0.8
Tumour	116	12.1	2634	0.5
Failed Internal Fixation	106	11.0	1928	0.4
Other Inflammatory Arthritis	6	0.6	1993	0.4
Fracture/Dislocation	25	2.6	677	0.1
Arthrodesis Takedown	4	0.4	86	0.0
Other	4	0.4	90	0.0
TOTAL	**960**	**100.0**	**492993**	**100.0**

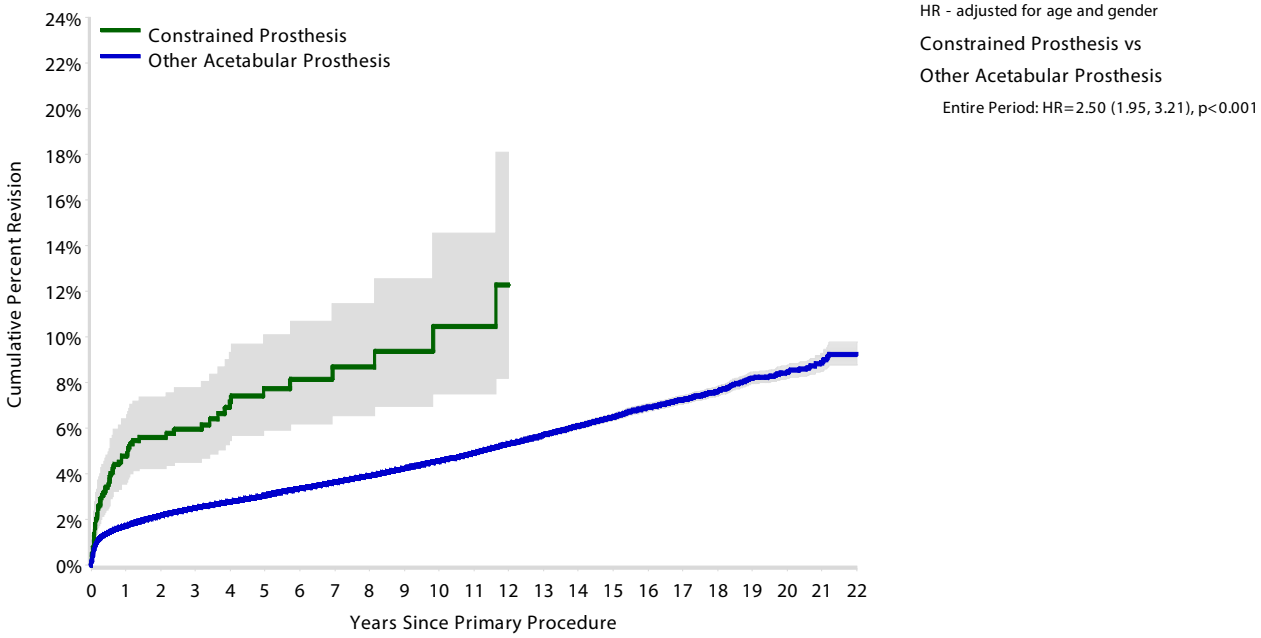
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT43 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	62	960	4.8 (3.6, 6.4)	5.9 (4.5, 7.8)	7.7 (5.9, 10.1)	10.5 (7.5, 14.5)		
Other Acetabular Prosthesis	17365	492993	1.7 (1.7, 1.8)	2.5 (2.5, 2.6)	3.1 (3.0, 3.1)	4.6 (4.5, 4.6)	6.5 (6.4, 6.6)	8.5 (8.2, 8.7)
TOTAL	**17427**	**493953**						

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

Figure HT46 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	960	720	445	279	76	14	2
Other Acetabular Prosthesis	492993	436594	343596	257611	102401	29614	3730

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

Table HT44 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	18	375	2.8 (1.5, 5.2)	4.2 (2.5, 7.0)	5.7 (3.5, 9.1)	5.7 (3.5, 9.1)		
Other Acetabular Prosthesis	14398	432299	1.6 (1.6, 1.6)	2.3 (2.3, 2.4)	2.8 (2.8, 2.9)	4.3 (4.2, 4.4)	6.2 (6.0, 6.3)	8.1 (7.8, 8.4)
TOTAL	**14416**	**432674**						

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

Table HT45 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	9	139	3.8 (1.6, 9.0)	6.1 (2.9, 12.4)	9.0 (4.6, 17.0)			
	Female	9	236	2.2 (0.9, 5.2)	3.2 (1.5, 6.6)	3.9 (2.0, 7.8)			
TOTAL		**18**	**375**						

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

Table HT46 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	5	79	1.3 (0.2, 9.1)	4.3 (1.4, 12.7)	6.2 (2.4, 16.0)	6.2 (2.4, 16.0)		
	≥70	13	296	3.2 (1.7, 6.1)	4.1 (2.3, 7.4)	5.5 (3.1, 9.4)			
TOTAL		**18**	**375**						

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

Table HT47 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=1.73 (1.09, 2.75), p=0.020
Constrained Prosthesis Female vs Constrained Prosthesis Male	Entire Period: HR=0.51 (0.20, 1.31), p=0.162
Constrained Prosthesis ≥70 vs Constrained Prosthesis <70	Entire Period: HR=0.78 (0.28, 2.20), p=0.640

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 26,752 primary total conventional hip replacement procedures using dual mobility prostheses. This is an increase of 7.6% (n=5,917) since 2021 (Figure HT47). The commonly used dual mobility prostheses are presented in Table HT48. 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 HT49).

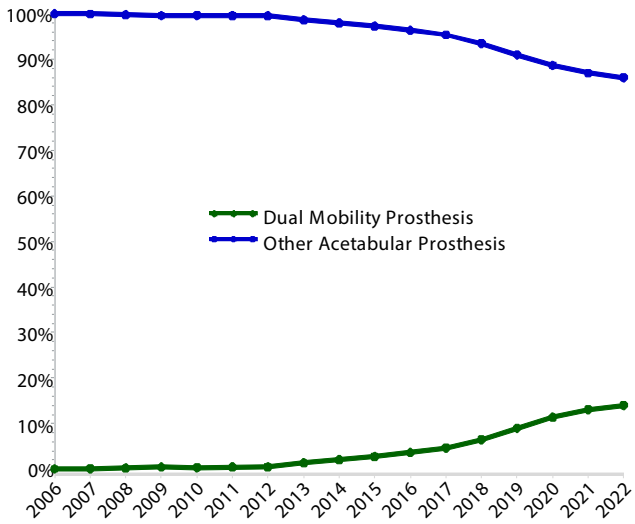
When all diagnoses are included, dual mobility prostheses have a higher rate of revision compared to other acetabular prostheses (Table HT50, Figure HT48 and Table HT56).

For the diagnosis of osteoarthritis, there is no difference in the overall rate of revision when dual mobility prostheses are used (Table HT51 and Table HT56). Dual mobility prostheses have a lower rate of revision for dislocation/instability compared to all other acetabular prostheses (Table HT52 and Table HT56).

Males have a higher risk of revision than females when dual mobility prostheses are used for a diagnosis of osteoarthritis, but age is not a risk factor for revision (Table HT53, Table HT54 and Table HT56).

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 HT55 and Table HT56).

Figure HT47 Primary Total Conventional Hip Replacement by Dual Mobility (All Diagnoses)



Note: Restricted to modern prostheses

Table HT48 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	22	505	2.2 (1.2, 3.9)	4.2 (2.6, 6.6)	4.9 (3.0, 7.9)			
Active Articulation	129	5774	2.1 (1.8, 2.5)	2.8 (2.3, 3.3)	2.8 (2.4, 3.4)			
Avantage	12	372	2.7 (1.4, 5.2)	3.2 (1.7, 6.0)	4.9 (2.6, 9.2)			
BI-MENTUM	10	401	2.9 (1.5, 5.3)					
MDM (Dual Mobility)	86	3753	1.7 (1.4, 2.2)	2.4 (1.9, 3.1)	3.2 (2.5, 4.1)			
MobiliT CUP	0	61						
Novae E	38	1710	1.0 (0.6, 1.6)	2.0 (1.4, 2.9)	2.3 (1.6, 3.2)			
Polarcup	53	1149	2.6 (1.8, 3.8)	4.2 (3.1, 5.7)	5.0 (3.7, 6.8)	7.3 (5.2, 10.4)		
Restoration	188	5438	2.6 (2.2, 3.0)	3.3 (2.9, 3.9)	4.4 (3.8, 5.2)			
Saturne	32	1353	1.2 (0.8, 2.0)	2.3 (1.6, 3.5)	3.1 (2.0, 4.6)			
SignaSure	5	350	1.1 (0.4, 3.0)					
Trinity	68	4067	1.5 (1.1, 1.9)	1.9 (1.5, 2.5)				
Versafit	54	1755	2.3 (1.7, 3.2)	3.4 (2.6, 4.5)	3.6 (2.7, 4.7)			
Other (4)	1	64	1.6 (0.2, 10.7)					
TOTAL	**698**	**26752**						

Note: All procedures using metal/metal prostheses have been excluded
Only prostheses with >50 procedures have been listed
Restricted to modern prostheses

Table HT49 Primary Total Conventional Hip Replacement by Primary Diagnosis and Acetabular Mobility

Primary Diagnosis	Dual Mobility Prosthesis		Other Acetabular Prosthesis	
	N	Col%	N	Col%
Osteoarthritis	18440	68.9	414234	88.7
Fractured Neck Of Femur	5277	19.7	22262	4.8
Osteonecrosis	1087	4.1	14726	3.2
Developmental Dysplasia	526	2.0	5926	1.3
Rheumatoid Arthritis	144	0.5	3662	0.8
Tumour	611	2.3	2139	0.5
Failed Internal Fixation	387	1.4	1647	0.4
Other Inflammatory Arthritis	105	0.4	1894	0.4
Fracture/Dislocation	148	0.6	554	0.1
Arthrodesis Takedown	12	0.0	78	0.0
Other	15	0.1	79	0.0
TOTAL	**26752**	**100.0**	**467201**	**100.0**

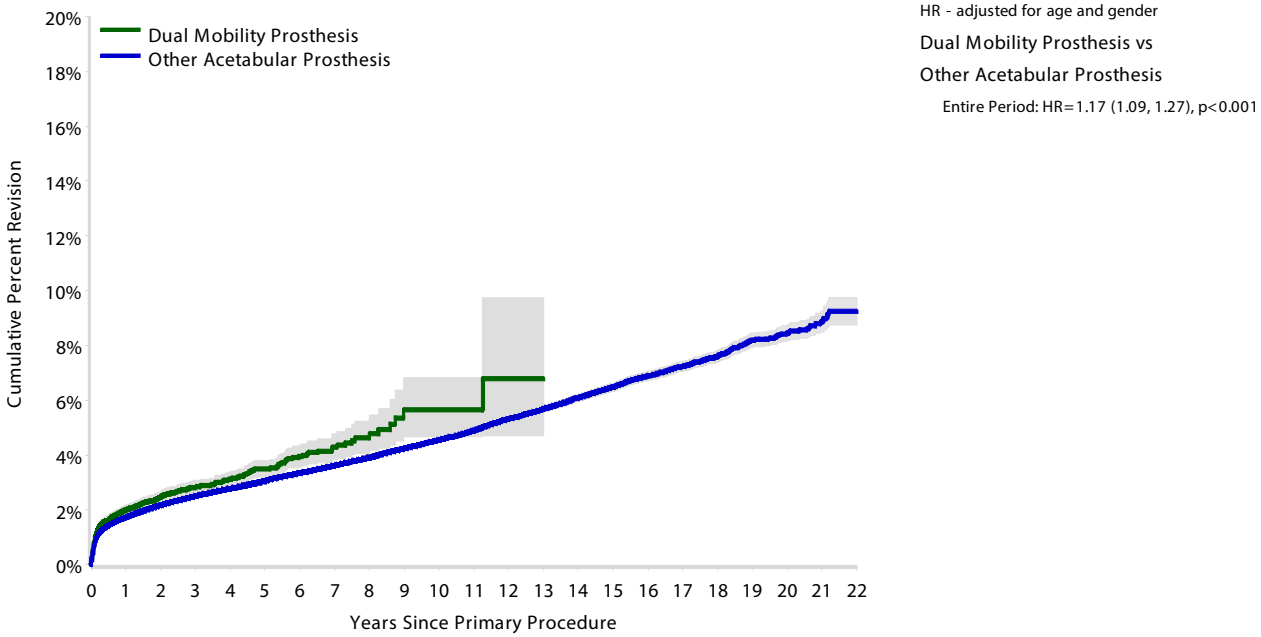
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT50 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	698	26752	2.0 (1.8, 2.2)	2.8 (2.6, 3.1)	3.5 (3.2, 3.8)	5.6 (4.7, 6.8)		
Other Acetabular Prosthesis	16729	467201	1.7 (1.7, 1.8)	2.5 (2.5, 2.5)	3.1 (3.0, 3.1)	4.6 (4.5, 4.6)	6.5 (6.3, 6.6)	8.4 (8.2, 8.7)
TOTAL	**17427**	**493953**						

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 Mobility (All Diagnoses)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Dual Mobility Prosthesis	26752	19705	9520	3785	146	4	0
Other Acetabular Prosthesis	467201	417609	334521	254105	102331	29624	3732

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

Table HT51 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	390	18440	1.5 (1.4, 1.7)	2.3 (2.0, 2.5)	2.8 (2.5, 3.2)	4.8 (3.6, 6.4)		
Other Acetabular Prosthesis	14026	414234	1.6 (1.6, 1.6)	2.3 (2.3, 2.4)	2.8 (2.8, 2.9)	4.3 (4.2, 4.4)	6.2 (6.0, 6.3)	8.1 (7.8, 8.4)
TOTAL	**14416**	**432674**						

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 (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	54	18440	0.2 (0.2, 0.3)	0.3 (0.2, 0.4)	0.4 (0.3, 0.6)	0.4 (0.3, 0.6)		
Other Acetabular Prosthesis	3070	414234	0.4 (0.4, 0.4)	0.6 (0.6, 0.6)	0.7 (0.7, 0.7)	0.9 (0.9, 1.0)	1.2 (1.1, 1.2)	1.5 (1.4, 1.6)
TOTAL	**3124**	**432674**						

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

Table HT53 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	15 Yrs	20 Yrs
Dual Mobility Prosthesis	Male	173	6907	1.8 (1.5, 2.2)	2.6 (2.2, 3.1)	3.3 (2.8, 4.0)			
	Female	217	11533	1.4 (1.2, 1.6)	2.1 (1.8, 2.4)	2.5 (2.2, 3.0)	3.3 (2.6, 4.1)		
TOTAL		**390**	**18440**						

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

Table HT54 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	173	7461	1.6 (1.3, 1.9)	2.5 (2.1, 2.9)	3.1 (2.6, 3.7)			
	≥70	217	10979	1.5 (1.3, 1.8)	2.1 (1.8, 2.5)	2.6 (2.2, 3.1)	5.2 (3.3, 8.1)		
TOTAL		**390**	**18440**						

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

Table HT55 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	383	18107	1.6 (1.4, 1.8)	2.3 (2.1, 2.6)	2.9 (2.5, 3.2)	4.8 (3.5, 6.4)		
	Cemented	7	333	0.6 (0.2, 2.4)	1.1 (0.3, 3.4)	1.1 (0.3, 3.4)			
TOTAL		390	18440						

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

Table HT56 Comparisons of Revision Rates of Primary Total Conventional Hip Replacement by Acetabular Mobility (Primary Diagnosis OA)

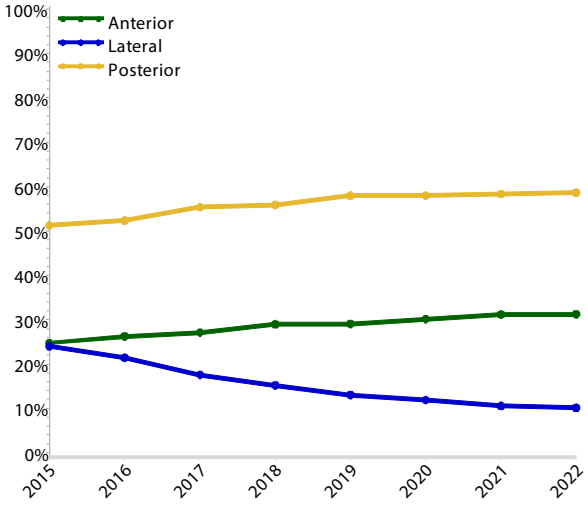
Outcome	Comparison	Hazard Ratio – adjusted for age and gender
All Cause Revision	Dual Mobility Prosthesis vs Other Acetabular Prosthesis	Entire Period: HR=1.01 (0.92, 1.12), p=0.783
Revision for Prosthesis Dislocation/Instability	Dual Mobility Prosthesis vs Other Acetabular Prosthesis	Entire Period: HR=0.54 (0.41, 0.71), p<0.001
All Cause Revision	Dual Mobility Prosthesis Female vs Dual Mobility Prosthesis Male	Entire Period: HR=0.75 (0.61, 0.92), p=0.005
	Dual Mobility Prosthesis ≥70 vs Dual Mobility Prosthesis <70	Entire Period: HR=0.92 (0.75, 1.13), p=0.423
	Dual Mobility Prosthesis Cemented Acetabular vs Dual Mobility Prosthesis Cementless Acetabular	0 – 1Mth: HR=0.47 (0.07, 3.37), p=0.452
		1Mth+: HR=1.10 (0.49, 2.48), p=0.814

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 73,754 anterior, 37,942 lateral, and 143,835 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 HT49.

Figure HT49 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 HT57 to Table HT59).

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 approach has a higher rate of revision. There are no other differences in the overall rate of revision when the posterior approach is compared to either the anterior or lateral approaches (Table HT60 and Figure HT50). However, there are differences in the types of revision and reasons for revision between the approaches.

Major Revisions

There is a higher rate of major revisions with the anterior approach compared to the posterior approach. There is no difference between the posterior and lateral approaches, or between the lateral and anterior approaches (Table HT61 and Figure HT51).

Reasons for Revision

The most common reasons for revision of primary total hip replacement in the first 7 years include loosening, fracture, infection, and dislocation/instability (Figure HT52).

Revision for Loosening
There is a higher rate of revision for loosening with the anterior approach compared to both the posterior and lateral approaches. The posterior approach has a lower rate of revision compared to the lateral approach (Table HT62 and Figure HT53).

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 HT63 and Figure HT54).

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 HT64 and Figure HT55).

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 HT65 and Figure HT56).

Table HT57 Primary Total Conventional Hip Replacement by Age and Surgical Approach (Primary Diagnosis OA)

Age	Anterior		Lateral		Posterior	
	N	Col%	N	Col%	N	Col%
<55	9167	12.4	3788	10.0	14732	10.2
55–64	19083	25.9	8698	22.9	33636	23.4
65–74	26831	36.4	13876	36.6	51986	36.1
≥75	18673	25.3	11580	30.5	43481	30.2
TOTAL	**73754**	**100.0**	**37942**	**100.0**	**143835**	**100.0**

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

Table HT58 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)	559	0.8	265	0.7	982	0.7
Normal (18.50–24.99)	17254	23.9	7031	19.4	26794	19.3
Pre Obese (25.00–29.99)	28672	39.7	12899	35.5	49549	35.6
Obese Class 1 (30.00–34.99)	17266	23.9	9656	26.6	36582	26.3
Obese Class 2 (35.00–39.99)	6098	8.4	4321	11.9	16598	11.9
Obese Class 3 (≥40.00)	2376	3.3	2138	5.9	8644	6.2
TOTAL	**72225**	**100.0**	**36310**	**100.0**	**139149**	**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 HT59 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	8166	11.1	2875	7.6	10454	7.3
ASA 2	41435	56.3	19823	52.4	75889	52.8
ASA 3	23319	31.7	14586	38.5	55048	38.3
ASA 4	730	1.0	562	1.5	2211	1.5
ASA 5	2	0.0	2	0.0	8	0.0
TOTAL	**73652**	**100.0**	**37848**	**100.0**	**143610**	**100.0**

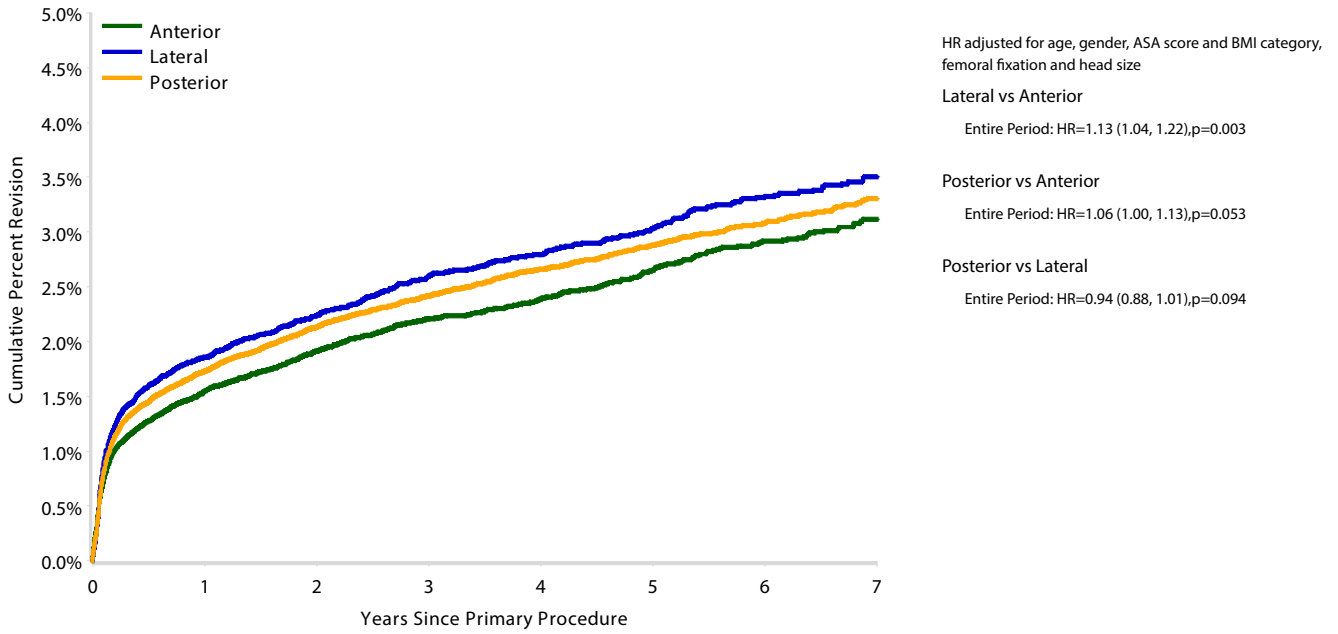
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT60 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	4 Yrs	5 Yrs	6 Yrs	7 Yrs
Anterior	1639	73754	1.6 (1.5, 1.7)	2.2 (2.1, 2.3)	2.4 (2.3, 2.5)	2.7 (2.5, 2.8)	2.9 (2.8, 3.1)	3.1 (3.0, 3.3)
Lateral	1070	37942	1.9 (1.7, 2.0)	2.6 (2.5, 2.8)	2.8 (2.7, 3.0)	3.1 (2.9, 3.3)	3.4 (3.2, 3.6)	3.5 (3.3, 3.8)
Posterior	3505	143835	1.7 (1.7, 1.8)	2.4 (2.3, 2.5)	2.7 (2.6, 2.8)	2.9 (2.8, 3.0)	3.1 (3.0, 3.2)	3.3 (3.2, 3.4)
TOTAL	**6214**	**255531**						

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 HT50 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Surgical Approach (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs
Anterior	72150	59546	37714	27937	18908	11252	4762
Lateral	36240	31691	23430	18910	14158	9261	4303
Posterior	138978	114900	73261	53803	36725	21717	9353

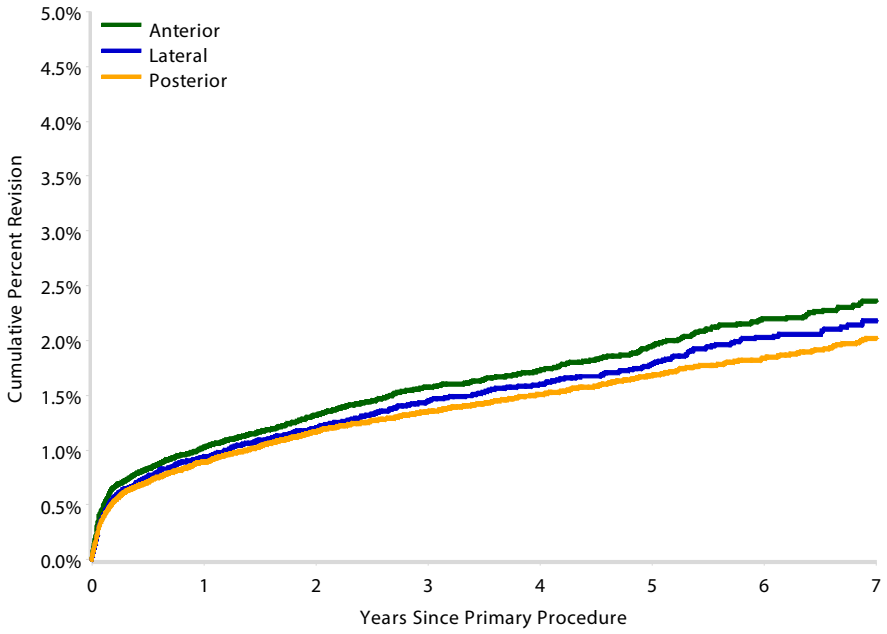
Note: All procedures using metal/metal prostheses have been excluded
Excludes procedures with unknown ASA score, BMI category or head size
Due to low numbers, ASA score 1–2 and 3–5 have been combined
Due to low numbers BMI category underweight and normal have been combined
Restricted to modern prostheses

Table HT61 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	4 Yrs	5 Yrs	6 Yrs	7 Yrs
Anterior	1137	72150	1.0 (0.9, 1.1)	1.6 (1.5, 1.7)	1.7 (1.6, 1.8)	1.9 (1.8, 2.1)	2.2 (2.1, 2.3)	2.4 (2.2, 2.5)
Lateral	580	36240	0.9 (0.8, 1.0)	1.4 (1.3, 1.6)	1.6 (1.5, 1.7)	1.8 (1.6, 1.9)	2.0 (1.9, 2.2)	2.2 (2.0, 2.4)
Posterior	1889	138978	0.9 (0.8, 0.9)	1.4 (1.3, 1.4)	1.5 (1.4, 1.6)	1.7 (1.6, 1.8)	1.8 (1.7, 1.9)	2.0 (1.9, 2.1)
TOTAL	**3606**	**247368**						

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 HT51 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=0.91 (0.82, 1.01),p=0.082

Posterior vs Anterior

Entire Period: HR=0.85 (0.79, 0.92),p<0.001

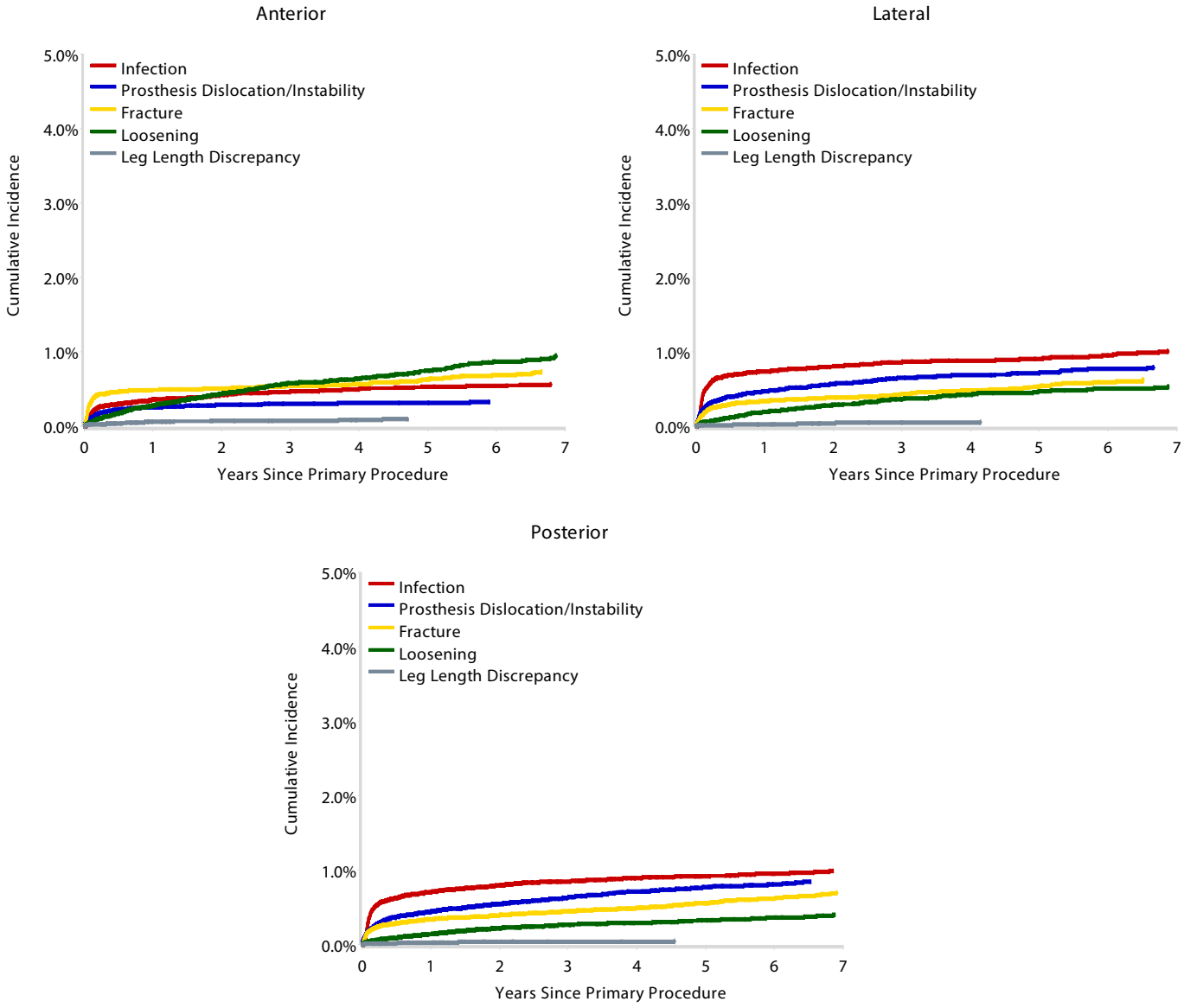
Posterior vs Lateral

Entire Period: HR=0.94 (0.85, 1.03),p=0.164

Number at Risk	0 Yr	1 Yr	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs
Anterior	72150	59546	37714	27937	18908	11252	4762
Lateral	36240	31691	23430	18910	14158	9261	4303
Posterior	138978	114900	73261	53803	36725	21717	9353

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 HT52 Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement by Surgical Approach (Primary Diagnosis OA)



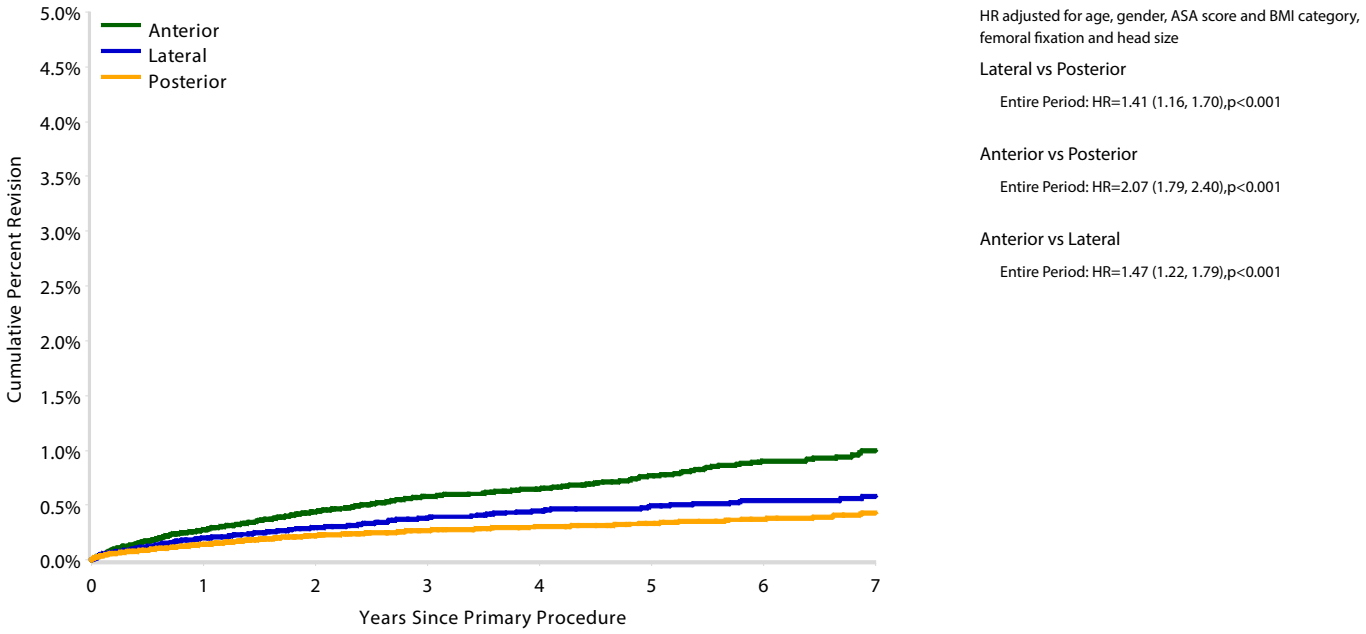
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT62 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	4 Yrs	5 Yrs	6 Yrs	7 Yrs
Anterior	412	72150	0.3 (0.2, 0.3)	0.6 (0.5, 0.7)	0.6 (0.6, 0.7)	0.8 (0.7, 0.9)	0.9 (0.8, 1.0)	1.0 (0.9, 1.1)
Lateral	150	36240	0.2 (0.2, 0.3)	0.4 (0.3, 0.5)	0.4 (0.4, 0.5)	0.5 (0.4, 0.6)	0.5 (0.5, 0.6)	0.6 (0.5, 0.7)
Posterior	363	138978	0.1 (0.1, 0.2)	0.3 (0.2, 0.3)	0.3 (0.3, 0.3)	0.3 (0.3, 0.4)	0.4 (0.3, 0.4)	0.4 (0.4, 0.5)
TOTAL	**925**	**247368**						

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 HT53 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	4 Yrs	5 Yrs	6 Yrs	7 Yrs
Anterior	72150	59546	37714	27937	18908	11252	4762
Lateral	36240	31691	23430	18910	14158	9261	4303
Posterior	138978	114900	73261	53803	36725	21717	9353

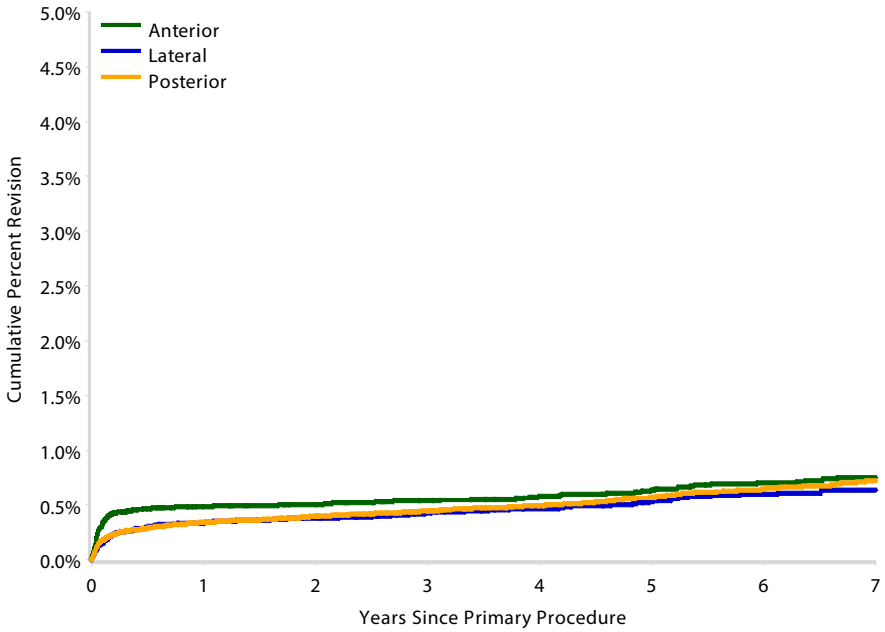
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses
Excludes procedures with unknown ASA score, BMI category or head size
Due to low numbers, ASA scores 1–2 and 3–5 have been combined
Due to low numbers, BMI categories underweight and normal have been combined

Table HT63 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	4 Yrs	5 Yrs	6 Yrs	7 Yrs
Anterior	412	72150	0.5 (0.4, 0.5)	0.5 (0.5, 0.6)	0.6 (0.5, 0.6)	0.6 (0.6, 0.7)	0.7 (0.6, 0.8)	0.8 (0.7, 0.9)
Lateral	175	36240	0.3 (0.3, 0.4)	0.4 (0.4, 0.5)	0.5 (0.4, 0.6)	0.5 (0.5, 0.6)	0.6 (0.5, 0.7)	0.6 (0.5, 0.8)
Posterior	658	138978	0.3 (0.3, 0.4)	0.4 (0.4, 0.5)	0.5 (0.5, 0.5)	0.6 (0.5, 0.6)	0.6 (0.6, 0.7)	0.7 (0.7, 0.8)
TOTAL	**1245**	**247368**						

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, Revision for Fracture)



HR - adjusted for age, gender, ASA score and BMI category, femoral fixation and head size

Posterior vs Lateral

Entire Period: HR=1.09 (0.92, 1.29),p=0.325

Anterior vs Lateral

0-3Mth: HR=1.83 (1.49, 2.24),p<0.001

3Mth+: HR=0.68 (0.53, 0.88),p=0.003

Anterior vs Posterior

0-3Mth: HR=1.68 (1.44, 1.96),p<0.001

3Mth+: HR=0.63 (0.50, 0.78),p=<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs
Anterior	72150	59546	37714	27937	18908	11252	4762
Lateral	36240	31691	23430	18910	14158	9261	4303
Posterior	138978	114900	73261	53803	36725	21717	9353

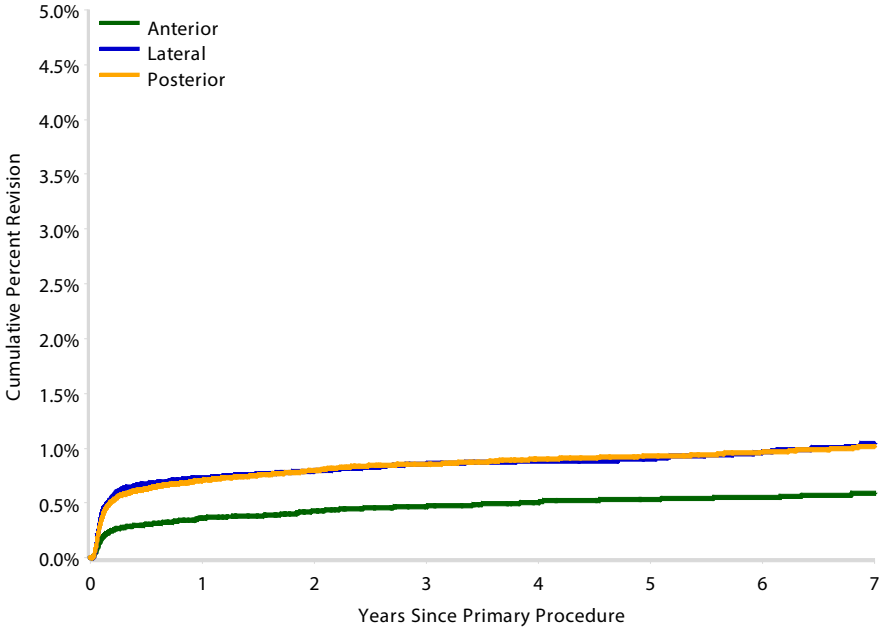
Note: All procedures using metal/metal prostheses have been excluded
Excludes procedures with unknown ASA score, BMI category or head size
Due to low numbers, ASA scores 1–2, and 3–5 have been combined
Due to low numbers, BMI categories underweight and normal have been combined
Restricted to modern prostheses

Table HT64 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	4 Yrs	5 Yrs	6 Yrs	7 Yrs
Anterior	327	72150	0.4 (0.3, 0.4)	0.5 (0.4, 0.5)	0.5 (0.5, 0.6)	0.5 (0.5, 0.6)	0.5 (0.5, 0.6)	0.6 (0.5, 0.7)
Lateral	316	36240	0.7 (0.6, 0.8)	0.9 (0.8, 1.0)	0.9 (0.8, 1.0)	0.9 (0.8, 1.0)	1.0 (0.9, 1.1)	1.0 (0.9, 1.2)
Posterior	1153	138978	0.7 (0.7, 0.8)	0.9 (0.8, 0.9)	0.9 (0.9, 1.0)	0.9 (0.9, 1.0)	1.0 (0.9, 1.0)	1.0 (0.9, 1.1)
TOTAL	**1796**	**247368**						

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 HT55 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=1.56 (1.33, 1.83),p<0.001

Posterior vs Anterior

Entire Period: HR=1.54 (1.35, 1.74),p<0.001

Posterior vs Lateral

Entire Period: HR=0.99 (0.87, 1.12),p=0.829

Number at Risk	0 Yr	1 Yr	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs
Anterior	72150	59546	37714	27937	18908	11252	4762
Lateral	36240	31691	23430	18910	14158	9261	4303
Posterior	138978	114900	73261	53803	36725	21717	9353

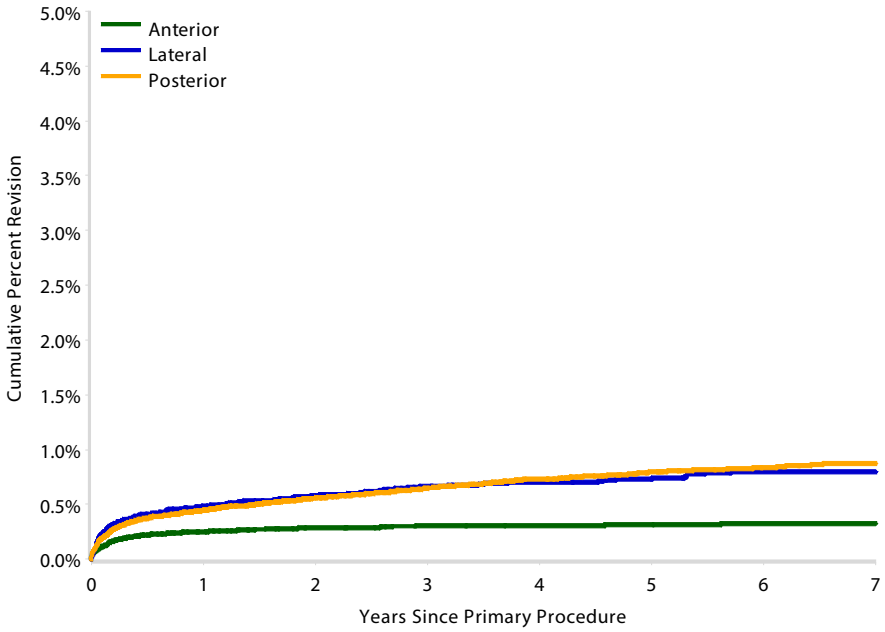
Note: All procedures using metal/metal prostheses have been excluded
Excludes procedures with unknown ASA score, BMI category or head size
Due to low numbers, ASA scores 1–2 and 3–5 were combined
Due to low numbers, BMI categories underweight and normal were combined
Restricted to modern prostheses

Table HT65 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	4 Yrs	5 Yrs	6 Yrs	7 Yrs
Anterior	205	72150	0.3 (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)	0.3 (0.3, 0.4)
Lateral	241	36240	0.5 (0.4, 0.6)	0.7 (0.6, 0.8)	0.7 (0.6, 0.8)	0.7 (0.6, 0.8)	0.8 (0.7, 0.9)	0.8 (0.7, 0.9)
Posterior	886	138978	0.4 (0.4, 0.5)	0.6 (0.6, 0.7)	0.7 (0.7, 0.8)	0.8 (0.7, 0.9)	0.8 (0.8, 0.9)	0.9 (0.8, 0.9)
TOTAL	**1332**	**247368**						

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 HT56 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=1.52 (1.03, 2.24),p=0.034

2wk-1Mth: HR=2.55 (1.75, 3.71),p<0.001

1Mth-6Mth: HR=1.65 (1.23, 2.23),p<0.001

6Mth+: HR=3.10 (2.24, 4.29),p<0.001

Posterior vs Anterior

0-3Mth: HR=1.61 (1.33, 1.96),p<0.001

3Mth-9Mth: HR=1.94 (1.43, 2.63),p<0.001

9Mth+: HR=4.29 (3.18, 5.80),p<0.001

Posterior vs Lateral

Entire Period: HR=1.05 (0.91, 1.21),p=0.542

Number at Risk	0 Yr	1 Yr	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs
Anterior	72150	59546	37714	27937	18908	11252	4762
Lateral	36240	31691	23430	18910	14158	9261	4303
Posterior	138978	114900	73261	53803	36725	21717	9353

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 scores 1–2 and 3–5 have been combined
Due to low numbers, BMI categories underweight and normal have been combined

OUTCOME FOR FRACTURED NECK OF FEMUR

There have been 27,539 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 9.0% at 15 years (Table HT66 and Figure HT57).

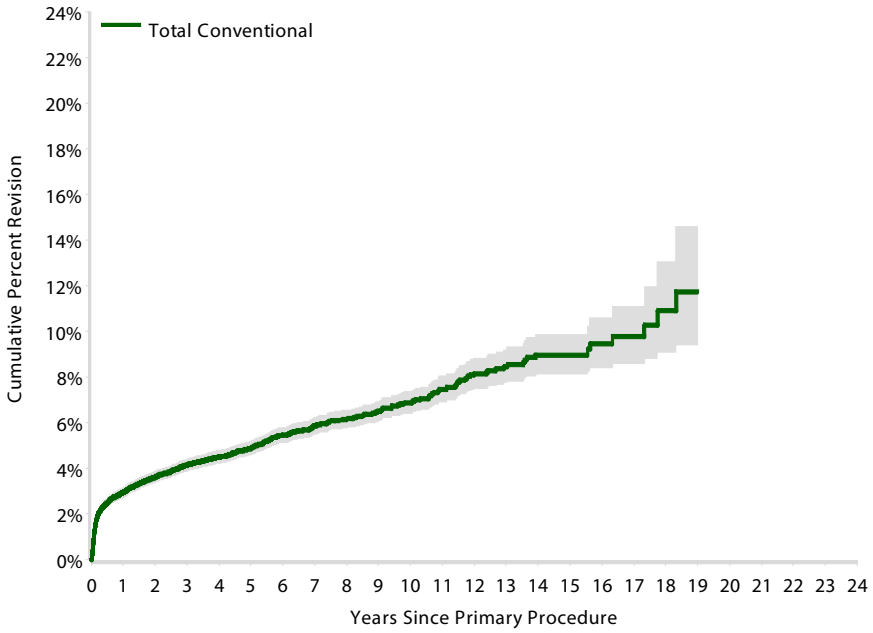
At 15 years, the cumulative percent survival of patients is 31.0% (Table HT67 and Figure HT58).

Table HT66 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	1290	27539	3.0 (2.8, 3.2)	4.1 (3.9, 4.4)	4.9 (4.6, 5.2)	6.9 (6.4, 7.4)	9.0 (8.2, 9.9)	
TOTAL	**1290**	**27539**						

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

Figure HT57 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	27539	22422	15738	10219	2751	472	34

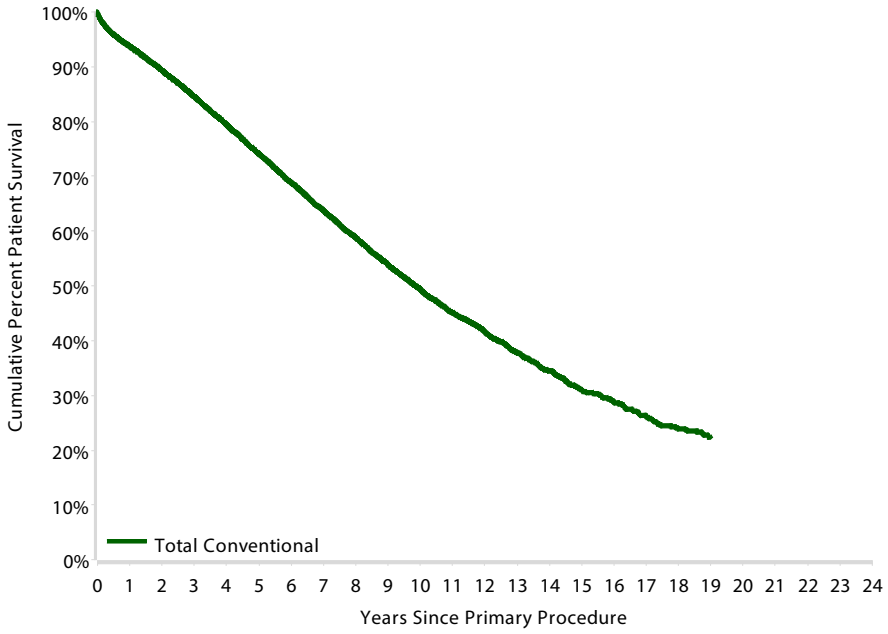
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT67 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	8253	27539	93.7 (93.4, 94.0)	84.5 (84.1, 85.0)	74.1 (73.5, 74.7)	49.3 (48.4, 50.3)	31.0 (29.6, 32.4)	
TOTAL	**8253**	**27539**						

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

Figure HT58 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	27539	22422	15738	10219	2751	472	34

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 HT68 and Figure HT59).

Type of Revision

Femoral component only is the most common type of revision, followed by head and insert, acetabular only, and total hip replacement (femoral/acetabular) (Table HT69).

Table HT68 Primary Total Conventional Hip Replacement by Reason for Revision (Primary Diagnosis Fractured NOF)

Reason for Revision	Number	Percent
Prosthesis Dislocation/Instability	423	32.8
Fracture	371	28.8
Infection	244	18.9
Loosening	171	13.3
Leg Length Discrepancy	11	0.9
Pain	9	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	7	0.5
Tumour	4	0.3
Metal Related Pathology	3	0.2
Incorrect Sizing	2	0.2
Heterotopic Bone	1	0.1
Progression Of Disease	1	0.1
Wear Head	1	0.1
Other	13	1.0
TOTAL	**1290**	**100.0**

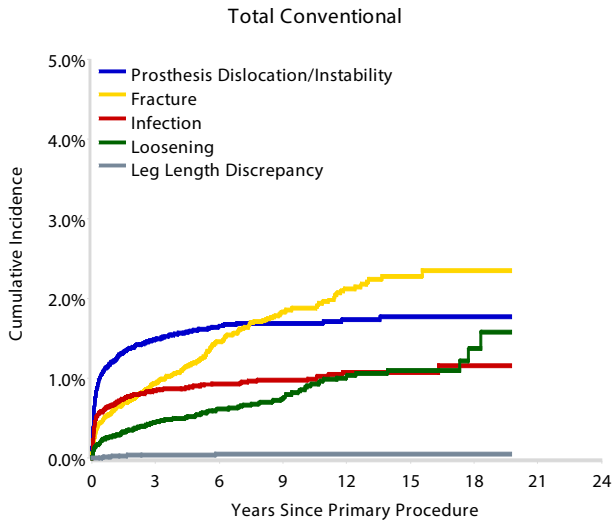
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT69 Primary Total Conventional Hip Replacement by Type of Revision (Primary Diagnosis Fractured NOF)

Type of Revision	Number	Percent
Femoral Component	455	35.3
Head/Insert	335	26.0
Acetabular Component	218	16.9
THR (Femoral/Acetabular)	134	10.4
Head Only	55	4.3
Cement Spacer	39	3.0
Minor Components	27	2.1
Insert Only	19	1.5
Removal of Prostheses	5	0.4
Total Femoral	2	0.2
Reinsertion of Components	1	0.1
TOTAL	**1290**	**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 HT59 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

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 20,333 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 HT60).

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 HT70 and Figure HT62). The most common reasons for revision for each ASA score are shown in Figure HT63. 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 HT71).

BMI data have been collected since 2015. The revision outcomes are reported for 12,586 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 HT61).

Patients in obese class 1, 2 and 3 have a higher rate of revision compared to patients in the normal BMI class (Table HT72 and Figure HT64). The most common reasons for revision are shown in Figure HT65.

Figure HT60 Primary Total Conventional Hip Replacement by ASA Score (Primary Diagnosis Fractured NOF)

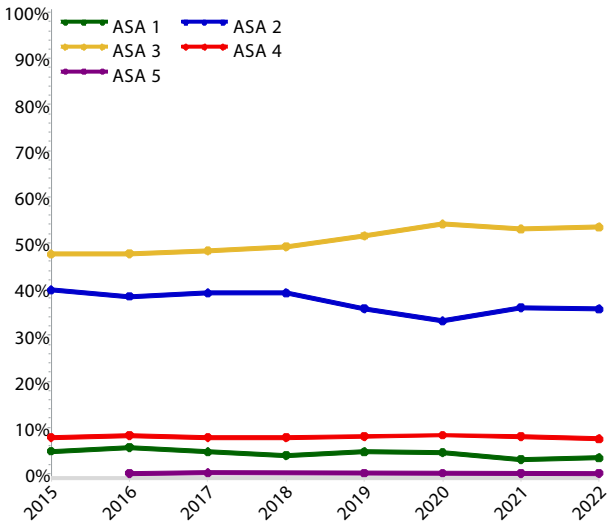


Figure HT61 Primary Total Conventional Hip Replacement by BMI Category (Primary Diagnosis Fractured NOF)

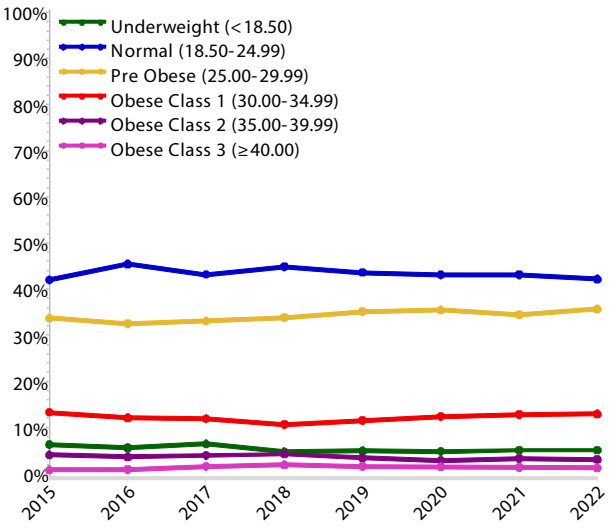
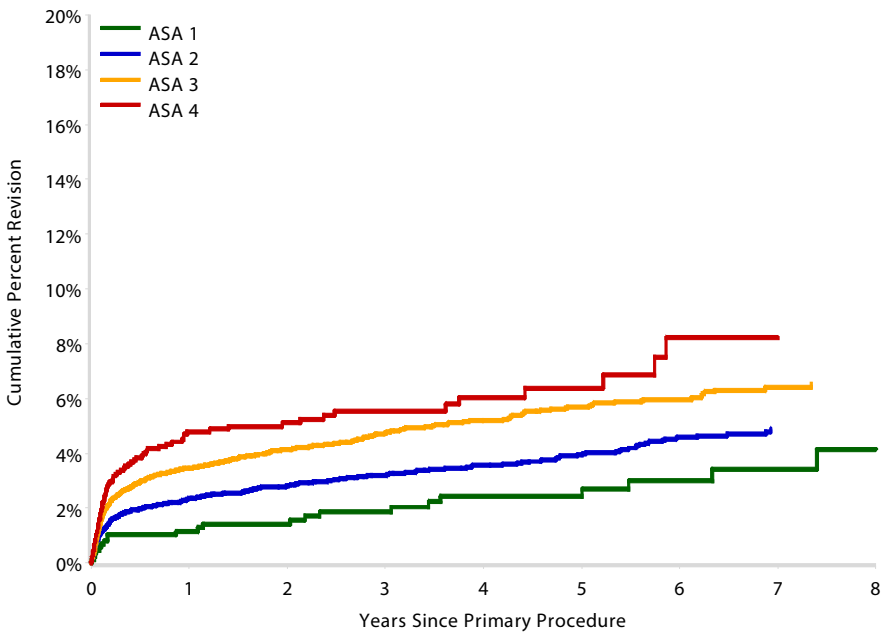


Table HT70 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by ASA Score (Primary Diagnosis Fractured NOF)

ASA Score	N Revised	N Total	1 Yr	2 Yrs	4 Yrs	6 Yrs	7 Yrs	8 Yrs
ASA 1	22	881	1.2 (0.6, 2.1)	1.4 (0.8, 2.5)	2.4 (1.5, 3.9)	3.0 (1.9, 4.7)	3.4 (2.1, 5.4)	4.2 (2.5, 6.9)
ASA 2	264	7518	2.3 (2.0, 2.7)	2.8 (2.4, 3.2)	3.5 (3.1, 4.0)	4.6 (4.0, 5.2)	4.9 (4.2, 5.6)	4.9 (4.2, 5.6)
ASA 3	474	10309	3.5 (3.1, 3.8)	4.1 (3.7, 4.6)	5.2 (4.7, 5.7)	6.0 (5.4, 6.6)	6.4 (5.8, 7.1)	6.5 (5.8, 7.3)
ASA 4	80	1615	4.8 (3.8, 6.0)	5.1 (4.1, 6.4)	6.0 (4.8, 7.7)	8.2 (6.0, 11.2)	8.2 (6.0, 11.2)	
ASA 5	0	10	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)				
TOTAL	**840**	**20333**						

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

Figure HT62 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by ASA Score (Primary Diagnosis Fractured NOF)



HR - adjusted for age and gender

ASA 2 vs ASA 1

Entire Period: HR=1.67 (1.08, 2.58), p=0.022

ASA 3 vs ASA 1

Entire Period: HR=2.46 (1.59, 3.79), p<0.001

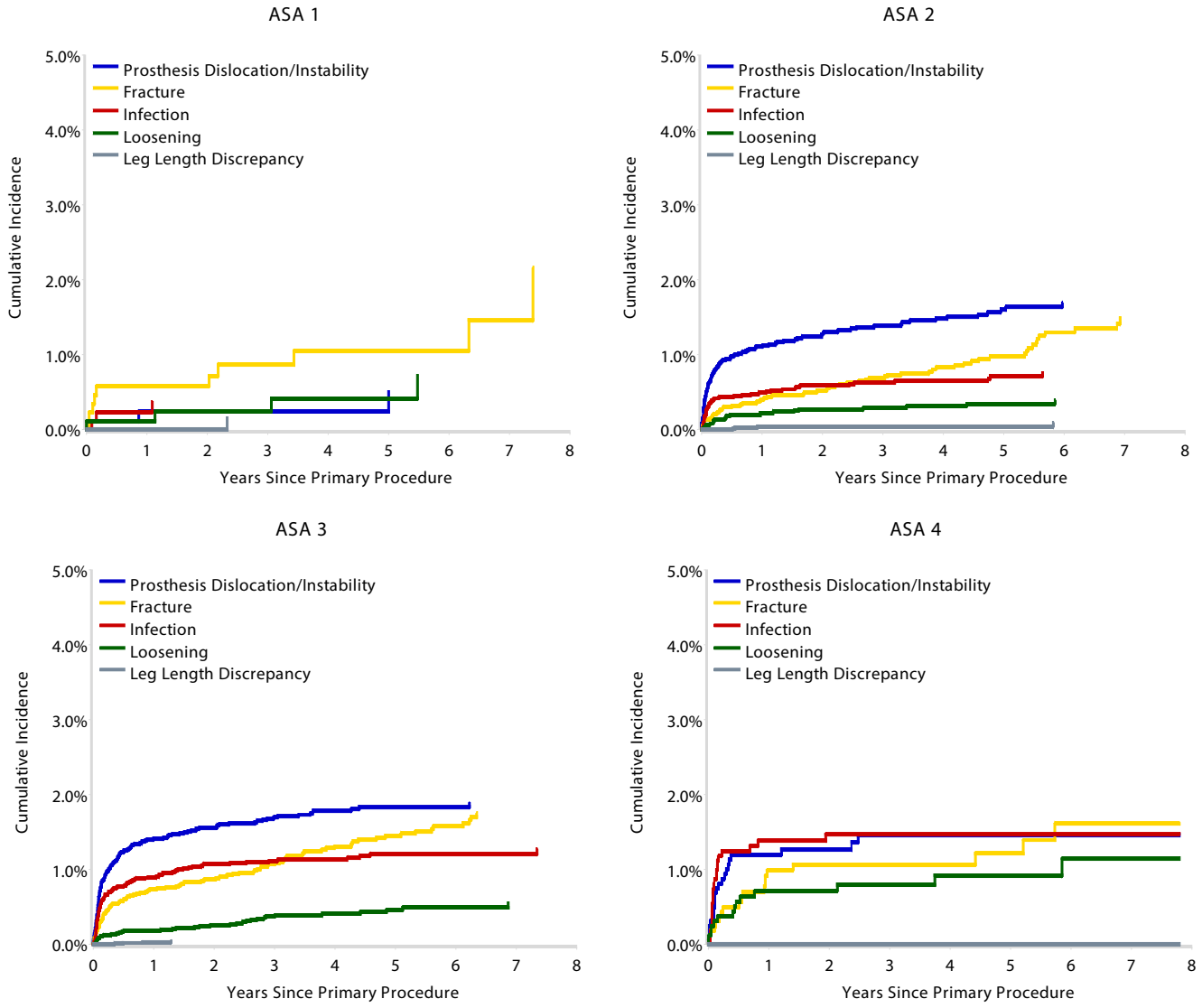
ASA 4 vs ASA 1

Entire Period: HR=3.09 (1.91, 5.00), p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	7 Yrs
ASA 1	881	775	689	573	455	367	167
ASA 2	7518	6274	5282	4381	3444	2552	1102
ASA 3	10309	7944	6270	4745	3412	2367	932
ASA 4	1615	1033	733	505	340	219	67

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

Figure HT63 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 HT71 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	881	4.3	25581	8.6	26462	8.4
ASA 2	7518	37.0	160409	54.1	167927	53.0
ASA 3	10309	50.7	106324	35.9	116633	36.8
ASA 4	1615	7.9	4126	1.4	5741	1.8
ASA 5	10	0.0	16	0.0	26	0.0
TOTAL	**20333**	**100.0**	**296456**	**100.0**	**316789**	**100.0**

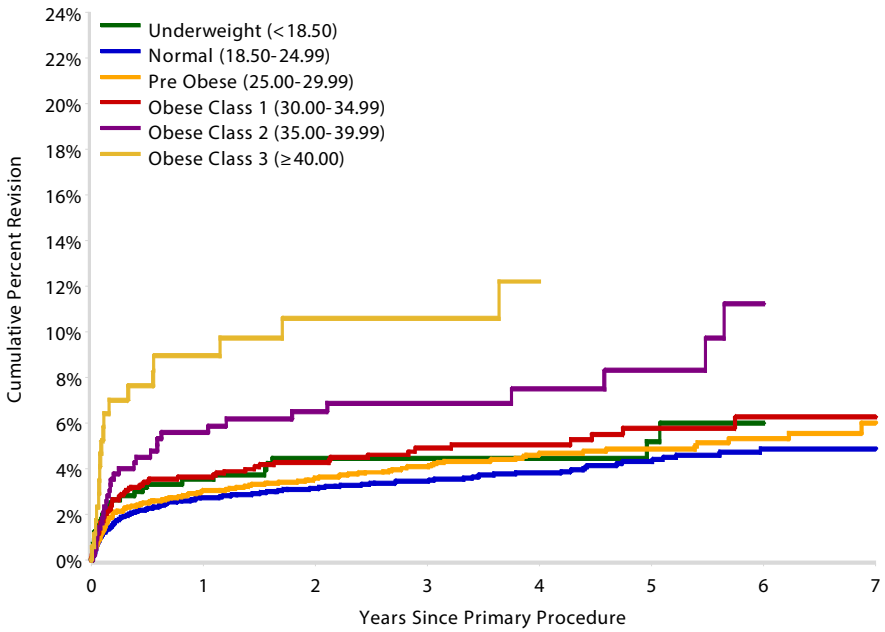
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT72 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by BMI Category (Primary Diagnosis Fractured NOF)

BMI Category	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	6 Yrs	7 Yrs
Underweight (<18.50)	28	657	3.5 (2.3, 5.3)	4.5 (3.0, 6.5)	4.5 (3.0, 6.5)	4.5 (3.0, 6.5)	6.0 (3.8, 9.4)	
Normal (18.50–24.99)	186	5458	2.7 (2.3, 3.2)	3.1 (2.7, 3.7)	3.5 (3.0, 4.0)	3.8 (3.3, 4.5)	4.9 (4.1, 5.8)	4.9 (4.1, 5.8)
Pre Obese (25.00–29.99)	170	4335	3.0 (2.6, 3.6)	3.6 (3.1, 4.2)	4.1 (3.5, 4.8)	4.7 (4.0, 5.5)	5.3 (4.5, 6.3)	6.0 (4.8, 7.6)
Obese Class 1 (30.00–34.99)	72	1530	3.6 (2.8, 4.7)	4.3 (3.3, 5.5)	4.9 (3.8, 6.2)	5.1 (4.0, 6.4)	6.3 (4.7, 8.2)	6.3 (4.7, 8.2)
Obese Class 2 (35.00–39.99)	32	433	5.6 (3.7, 8.3)	6.5 (4.5, 9.5)	6.9 (4.8, 9.9)	7.5 (5.2, 10.8)	11.2 (7.1, 17.4)	
Obese Class 3 (≥40.00)	18	173	8.9 (5.5, 14.4)	10.6 (6.7, 16.6)	10.6 (6.7, 16.6)	12.2 (7.6, 19.3)		
TOTAL	**506**	**12586**						

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 HT64 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=1.36 (0.91, 2.03), p=0.128

Pre Obese (25.00-29.99) vs Normal (18.50-24.99)
Entire Period: HR=1.12 (0.91, 1.38), p=0.272

Obese Class 1 (30.00-34.99) vs Normal (18.50-24.99)
Entire Period: HR=1.33 (1.01, 1.75), p=0.039

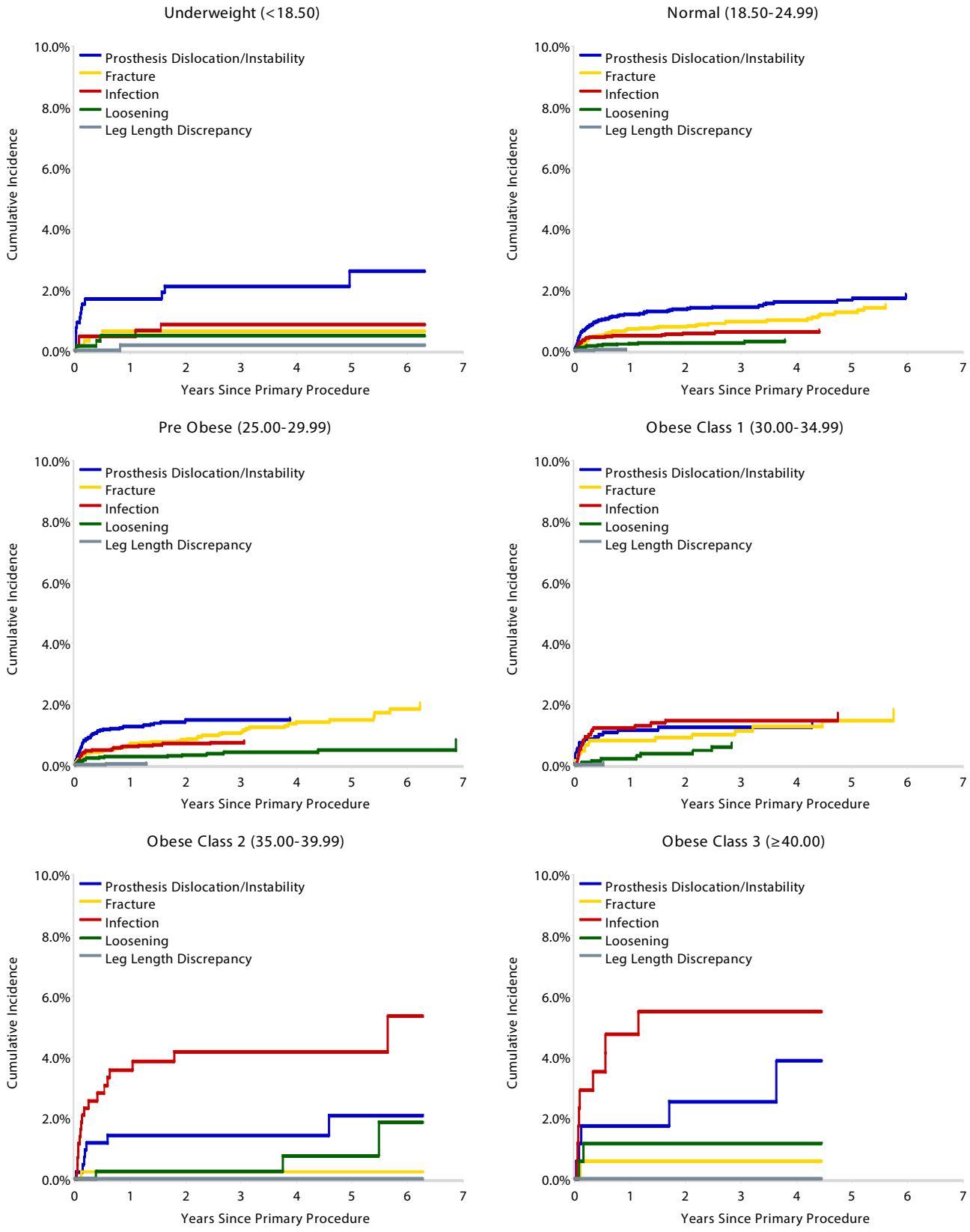
Obese Class 2 (35.00-39.99) vs Normal (18.50-24.99)
Entire Period: HR=2.10 (1.44, 3.06), p<0.001

Obese Class 3 (≥40.00) vs Normal (18.50-24.99)
Entire Period: HR=3.16 (1.94, 5.13), p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	6 Yrs	7 Yrs
Underweight (<18.50)	657	480	360	272	181	57	15
Normal (18.50–24.99)	5458	4179	3259	2422	1695	572	214
Pre Obese (25.00–29.99)	4335	3293	2558	1897	1305	460	179
Obese Class 1 (30.00–34.99)	1530	1156	885	652	465	173	71
Obese Class 2 (35.00–39.99)	433	333	261	207	143	48	23
Obese Class 3 (≥40.00)	173	124	98	71	48	10	2

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 HT65 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 1,546 procedures with cemented fixation, 6,523 with cementless fixation and 17,132 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 HT73 and Figure HT66).

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 only, 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 HT74 and Figure HT67).

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.

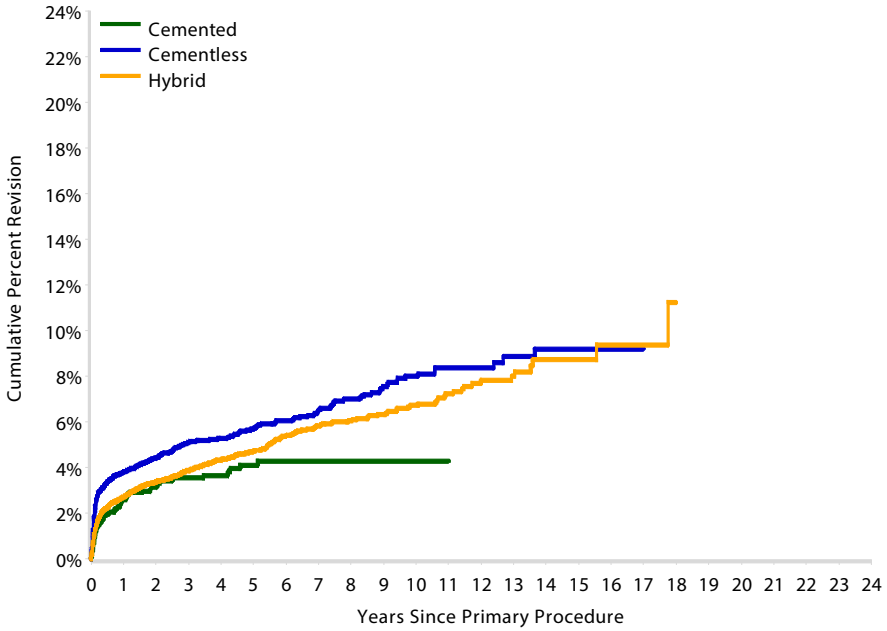
However, for patients aged ≥70 years, cementless fixation has a higher rate of revision than cemented fixation over the entire period, and for the first 3 months compared to hybrid fixation. There is no difference in the rate of revision when hybrid fixation is compared to cemented fixation (Table HT74 and Figure HT68).

Table HT73 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	53	1546	2.6 (1.9, 3.5)	3.2 (2.4, 4.2)	3.5 (2.7, 4.7)	4.1 (3.1, 5.4)	4.3 (3.3, 5.6)	4.3 (3.3, 5.6)
Cementless	373	6523	3.8 (3.4, 4.3)	4.4 (3.9, 5.0)	5.1 (4.6, 5.7)	5.7 (5.1, 6.3)	6.5 (5.8, 7.2)	8.0 (7.1, 9.0)
Hybrid	742	17132	2.7 (2.5, 3.0)	3.4 (3.1, 3.7)	3.9 (3.6, 4.2)	4.7 (4.4, 5.1)	5.8 (5.4, 6.3)	6.7 (6.1, 7.4)
TOTAL	**1168**	**25201**						

Note: Includes mixed ceramic/mixed ceramic and XLPE bearing surfaces
Restricted to modern prostheses

Figure HT66 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=1.41 (1.06, 1.89), p=0.019

Cementless vs Hybrid

0 - 3Mth: HR=1.57 (1.31, 1.88), p<0.001

3Mth+: HR=0.92 (0.77, 1.09), p=0.350

Hybrid vs Cemented

Entire Period: HR=1.20 (0.91, 1.59), p=0.196

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Cemented	1546	1246	1060	882	549	296	82
Cementless	6523	5497	4789	4097	2842	1801	856
Hybrid	17132	13812	11443	9352	5817	3379	1322

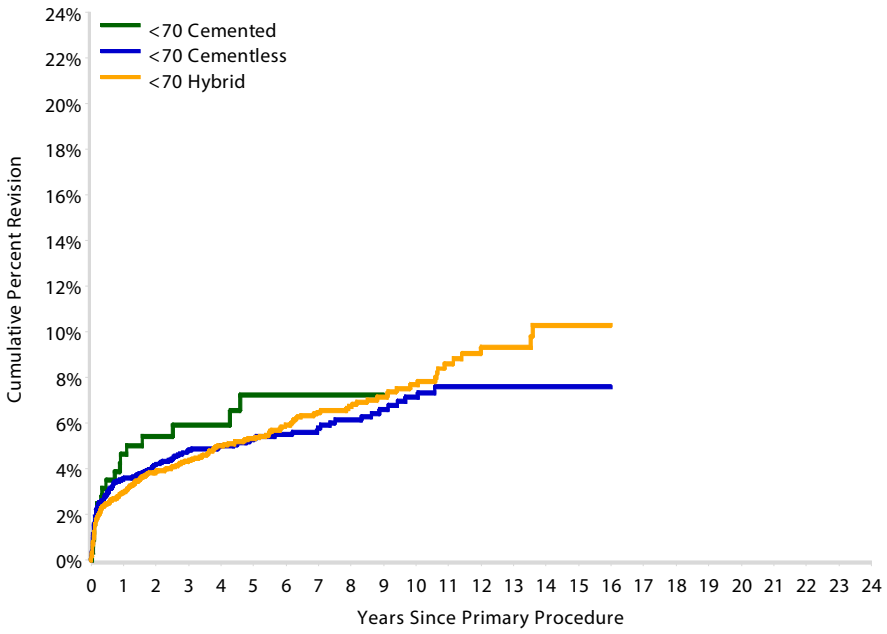
Note: Includes mixed ceramic/mixed ceramic and XLPE bearing surfaces
Restricted to modern prostheses

Table HT74 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		**433**	**8185**	**3.2 (2.9, 3.6)**	**4.0 (3.6, 4.5)**	**4.6 (4.1, 5.1)**	**5.4 (4.8, 5.9)**	**6.2 (5.6, 6.9)**	**7.4 (6.7, 8.3)**
	Cemented	19	335	4.6 (2.8, 7.7)	5.4 (3.3, 8.7)	5.9 (3.7, 9.4)	7.2 (4.6, 11.3)	7.2 (4.6, 11.3)	
	Cementless	142	2632	3.6 (2.9, 4.4)	4.2 (3.5, 5.0)	4.8 (4.0, 5.8)	5.3 (4.4, 6.3)	5.8 (4.9, 6.9)	7.1 (5.9, 8.6)
	Hybrid	272	5218	3.0 (2.5, 3.5)	3.9 (3.4, 4.5)	4.3 (3.8, 5.0)	5.3 (4.7, 6.1)	6.5 (5.7, 7.4)	7.7 (6.6, 8.9)
≥70		**735**	**17016**	**2.9 (2.6, 3.2)**	**3.4 (3.2, 3.7)**	**4.0 (3.7, 4.3)**	**4.7 (4.4, 5.1)**	**5.7 (5.3, 6.2)**	**6.7 (6.1, 7.3)**
	Cemented	34	1211	2.0 (1.4, 3.0)	2.6 (1.8, 3.7)	2.9 (2.0, 4.1)	3.2 (2.3, 4.6)	3.5 (2.5, 4.9)	3.5 (2.5, 4.9)
	Cementless	231	3891	4.0 (3.4, 4.7)	4.6 (3.9, 5.3)	5.3 (4.6, 6.1)	6.0 (5.2, 6.9)	7.0 (6.1, 8.1)	8.7 (7.4, 10.2)
	Hybrid	470	11914	2.6 (2.3, 2.9)	3.2 (2.8, 3.5)	3.6 (3.3, 4.0)	4.4 (4.0, 4.9)	5.5 (5.0, 6.1)	6.2 (5.5, 7.0)
TOTAL		**1168**	**25201**						

Note: Includes mixed ceramic/mixed ceramic and XLPE bearing surfaces
Restricted to modern prostheses

Figure HT67 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=1.20 (0.76, 1.92), p=0.434

<70 Cemented vs <70 Cementless

Entire Period: HR=1.28 (0.79, 2.06), p=0.318

<70 Cementless vs <70 Hybrid

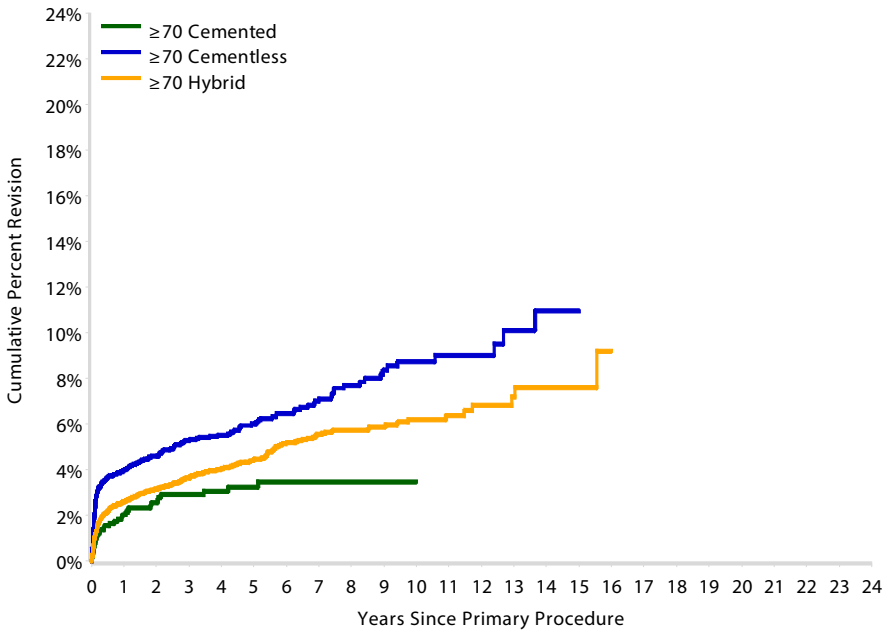
0 - 1Mth: HR=1.58 (1.05, 2.38), p=0.027

1Mth+: HR=0.79 (0.62, 1.00), p=0.048

Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<70	Cemented	335	250	212	184	126	73	27
	Cementless	2632	2287	2047	1790	1305	888	459
	Hybrid	5218	4282	3629	3063	2047	1283	586

Note: Includes mixed ceramic/mixed ceramic and XLPE bearing surfaces
Restricted to modern prostheses

Figure HT68 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=1.92 (1.34, 2.75), p<0.001

≥70 Cementless vs ≥70 Hybrid

0 - 3Mth: HR=1.84 (1.47, 2.30), p<0.001

3Mth+: HR=1.06 (0.85, 1.33), p=0.589

≥70 Hybrid vs ≥70 Cemented

Entire Period: HR=1.39 (0.98, 1.97), p=0.064

Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
≥70	Cemented	1211	996	848	698	423	223	55
	Cementless	3891	3210	2742	2307	1537	913	397
	Hybrid	11914	9530	7814	6289	3770	2096	736

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 HT75 and Figure HT69). However, there is higher rate of revision for prosthesis dislocation/instability for head sizes <32mm after 3 months and 32mm when compared to >32mm head sizes (Table HT76 and Figure HT70).

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 HT77 and Figure HT71). However, constrained prostheses are used in less than 1% of procedures.

Dual Mobility

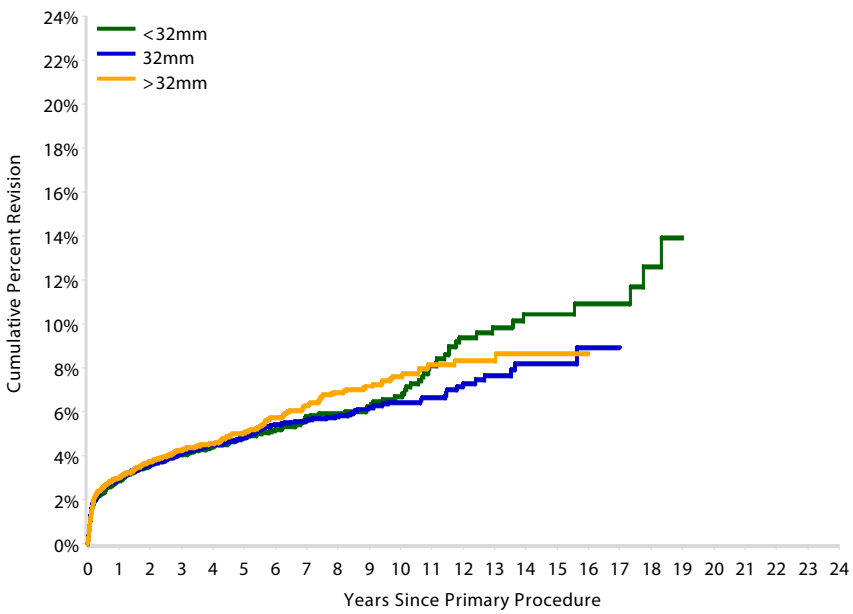
There is no difference in the rate of revision when dual mobility prostheses are used compared to other acetabular components (Table HT78 and Figure HT72).

Table HT75 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	346	7910	2.9 (2.5, 3.3)	3.6 (3.2, 4.1)	4.0 (3.6, 4.6)	4.9 (4.3, 5.5)	5.8 (5.1, 6.5)	6.7 (5.8, 7.7)
32mm	495	10290	3.0 (2.7, 3.3)	3.6 (3.2, 4.0)	4.1 (3.7, 4.5)	4.8 (4.4, 5.3)	5.6 (5.1, 6.1)	6.4 (5.8, 7.1)
>32mm	448	9312	3.0 (2.7, 3.4)	3.7 (3.3, 4.1)	4.2 (3.8, 4.7)	5.0 (4.6, 5.6)	6.3 (5.7, 7.0)	7.6 (6.8, 8.5)
TOTAL	**1289**	**27512**						

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses
Excludes 27 procedures with unknown head size

Figure HT69 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Head Size (Primary Diagnosis Fractured NOF)



HR - adjusted for age and gender

32mm vs <32mm

Entire Period: HR=0.98 (0.86, 1.13), p=0.812

>32mm vs <32mm

Entire Period: HR=0.95 (0.82, 1.10), p=0.483

>32mm vs 32mm

Entire Period: HR=0.97 (0.85, 1.10), p=0.611

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<32mm	7910	6009	4707	3712	2210	1380	673
32mm	10290	8883	7852	6787	4664	2848	1201
>32mm	9312	7510	6351	5223	3330	1984	875

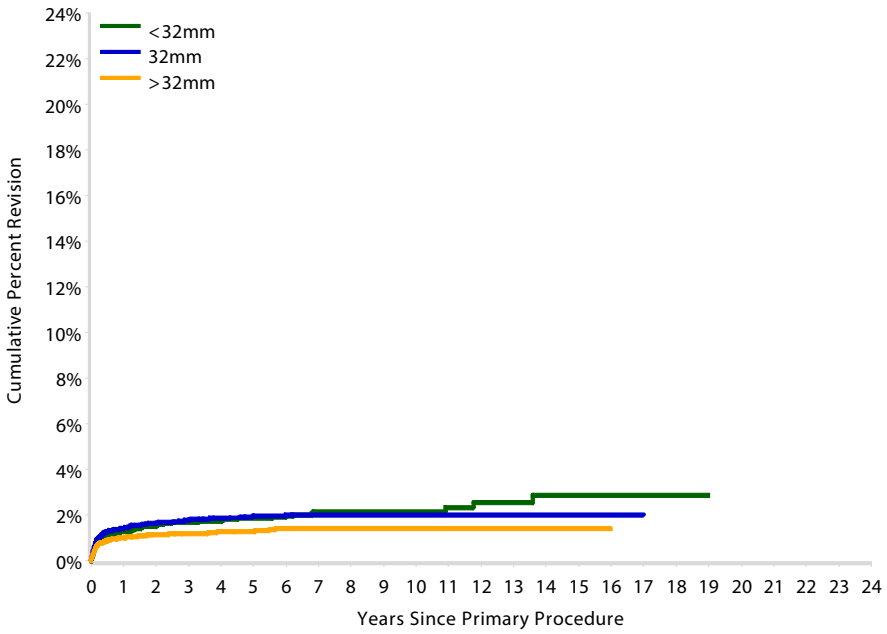
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT76 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	128	7910	1.3 (1.0, 1.5)	1.5 (1.3, 1.9)	1.7 (1.4, 2.0)	1.9 (1.5, 2.2)	2.2 (1.8, 2.6)	2.2 (1.8, 2.6)
32mm	184	10290	1.4 (1.2, 1.7)	1.6 (1.4, 1.9)	1.8 (1.5, 2.1)	2.0 (1.7, 2.3)	2.0 (1.8, 2.4)	2.0 (1.8, 2.4)
>32mm	110	9312	1.0 (0.8, 1.2)	1.2 (1.0, 1.4)	1.2 (1.0, 1.5)	1.3 (1.1, 1.6)	1.4 (1.2, 1.7)	1.4 (1.2, 1.7)
TOTAL	**422**	**27512**						

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 Head Size (Primary Diagnosis Fractured NOF, Revision for Prosthesis Dislocation/Instability)



HR - adjusted for age and gender

<32mm vs >32mm

0 - 3Mth: HR=1.23 (0.89, 1.69), p=0.205

3Mth - 2Yr: HR=1.51 (1.01, 2.26), p=0.047

2Yr+: HR=2.49 (1.39, 4.45), p=0.002

32mm vs >32mm

Entire Period: HR=1.45 (1.14, 1.86), p=0.002

32mm vs <32mm

0 - 3Mth: HR=1.15 (0.84, 1.56), p=0.384

3Mth - 6Mth: HR=1.42 (0.79, 2.55), p=0.245

6Mth+: HR=0.72 (0.49, 1.06), p=0.095

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<32mm	7910	6009	4707	3712	2210	1380	673
32mm	10290	8883	7852	6787	4664	2848	1201
>32mm	9312	7510	6351	5223	3330	1984	875

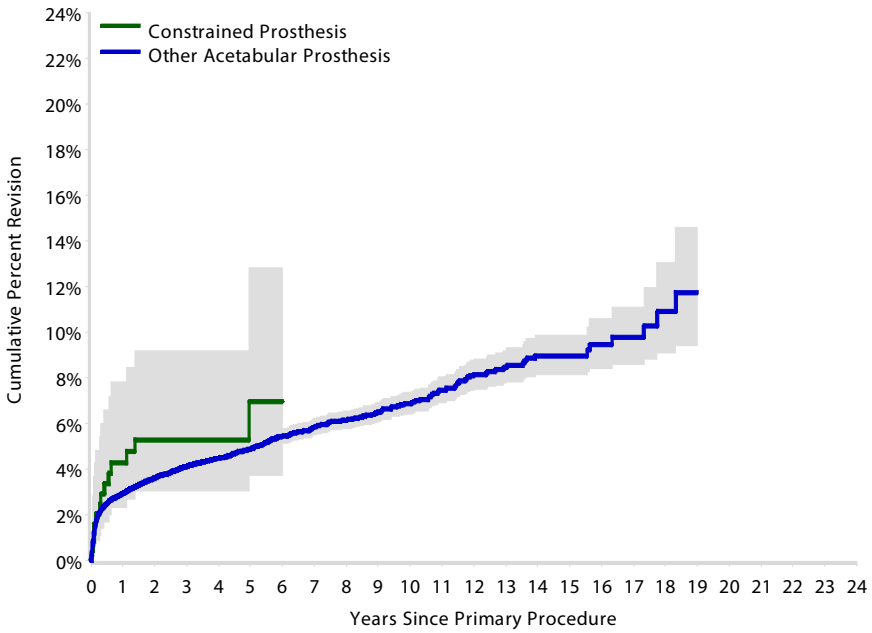
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT77 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	13	256	4.3 (2.3, 7.8)	5.3 (3.0, 9.2)	5.3 (3.0, 9.2)	7.0 (3.7, 12.8)		
Other Acetabular Prosthesis	1277	27283	2.9 (2.7, 3.2)	3.6 (3.4, 3.9)	4.1 (3.9, 4.4)	4.9 (4.6, 5.2)	5.8 (5.5, 6.2)	6.9 (6.4, 7.4)
TOTAL	**1290**	**27539**						

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

Figure HT71 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Acetabular Type (Primary Diagnosis Fractured NOF)



HR - adjusted for age and gender
Constrained Prosthesis vs
Other Acetabular Prosthesis
Entire Period: HR=1.32 (0.76, 2.27), p=0.325

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Constrained Prosthesis	256	191	156	108	56	35	13
Other Acetabular Prosthesis	27283	22231	18773	15630	10163	6187	2738

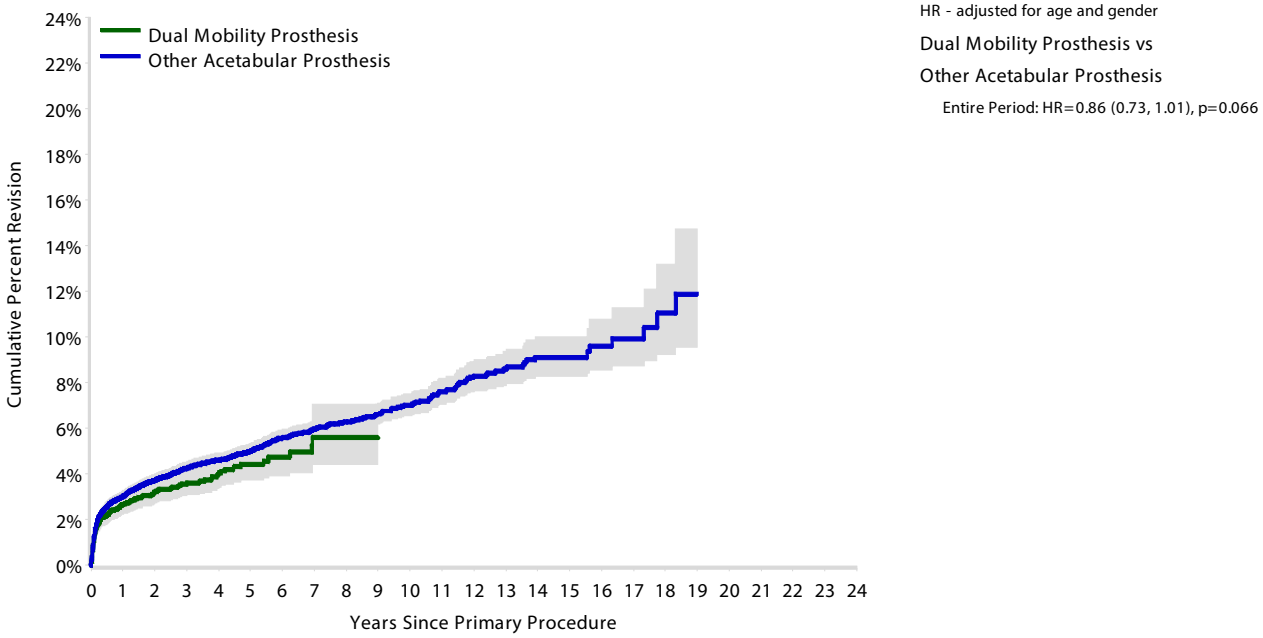
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT78 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Acetabular Mobility (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	172	5277	2.7 (2.2, 3.2)	3.2 (2.7, 3.8)	3.6 (3.0, 4.2)	4.4 (3.7, 5.2)	5.6 (4.4, 7.0)	
Other Acetabular Prosthesis	1118	22262	3.0 (2.8, 3.3)	3.7 (3.5, 4.0)	4.2 (4.0, 4.5)	5.0 (4.7, 5.3)	6.0 (5.6, 6.3)	7.0 (6.5, 7.5)
TOTAL	**1290**	**27539**						

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

Figure HT72 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	5277	3730	2643	1841	750	285	37
Other Acetabular Prosthesis	22262	18692	16286	13897	9469	5937	2714

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 hip replacement procedures are compared. These comparisons have not taken into account the competing risk of death, which increases with age.

Unipolar monoblock hip replacement has a lower rate of revision than total conventional hip replacement within the first month and from 3 months to 2 years. After this time there is no difference.

Unipolar modular hip replacement has a lower rate of revision than total conventional hip replacement for the first 3 months. From 3 months to 2 years there is no difference, but after this time unipolar modular has a higher rate of revision. There is no difference in the rate of revision when comparing bipolar to total conventional hip replacement (Table HT79 and Figure HT73).

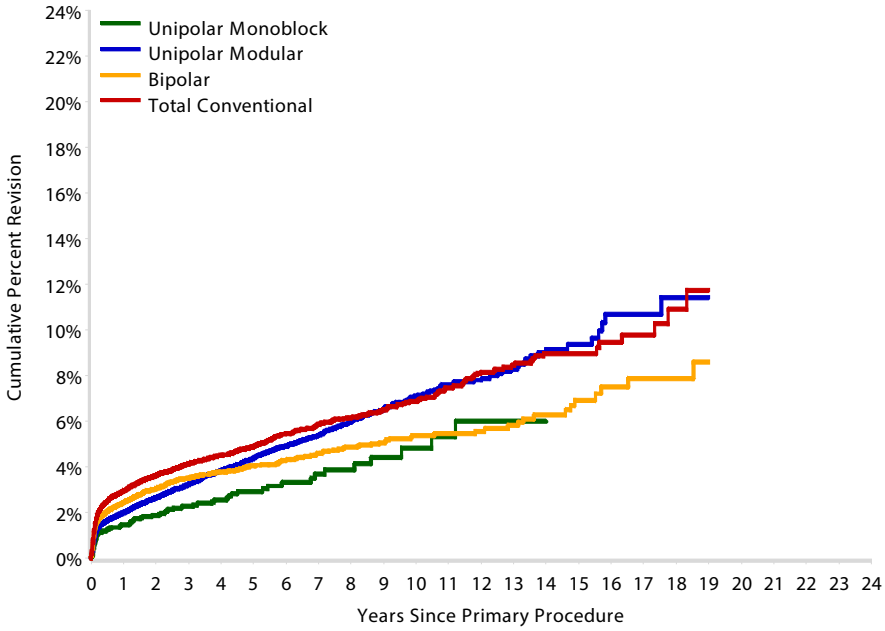
The rates of revision for each type of hip replacement for patients aged <70 years and ≥70 years are provided in Table HT80, Figure HT74 and Figure HT75. For patients aged <70 years, unipolar modular has a higher rate of revision compared to total conventional hip replacement after 2 years. For patients aged ≥70 years, bipolar and unipolar monoblock hip replacement have a lower rate of revision than conventional hip replacement. Unipolar modular has a lower rate of revision compared to total conventional hip replacement for the first 9 months, with no difference after this time.

Table HT79 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	81	3707	1.5 (1.1, 2.0)	1.9 (1.4, 2.4)	2.3 (1.8, 2.9)	2.9 (2.3, 3.8)	3.7 (2.8, 4.8)	4.8 (3.5, 6.6)
Unipolar Modular	1478	45559	2.0 (1.9, 2.1)	2.7 (2.5, 2.8)	3.2 (3.0, 3.4)	4.4 (4.1, 4.6)	5.4 (5.1, 5.7)	7.1 (6.6, 7.6)
Bipolar	858	28395	2.5 (2.3, 2.7)	3.1 (2.8, 3.3)	3.5 (3.3, 3.8)	4.0 (3.8, 4.4)	4.6 (4.2, 5.0)	5.4 (4.9, 5.9)
Total Conventional	1290	27539	3.0 (2.8, 3.2)	3.6 (3.4, 3.9)	4.1 (3.9, 4.4)	4.9 (4.6, 5.2)	5.9 (5.5, 6.2)	6.9 (6.4, 7.4)
TOTAL	**3707**	**105200**						

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

Figure HT73 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 - 1Mth: HR=0.55 (0.34, 0.91), p=0.019
1Mth - 3Mth: HR=0.85 (0.55, 1.31), p=0.457
3Mth - 2Yr: HR=0.59 (0.37, 0.95), p=0.030
2Yr+: HR=1.11 (0.75, 1.65), p=0.600

Unipolar Modular vs Total Conventional

0 - 3Mth: HR=0.84 (0.75, 0.95), p=0.003
3Mth - 9Mth: HR=0.85 (0.69, 1.04), p=0.109
9Mth - 1.5Yr: HR=1.04 (0.85, 1.29), p=0.683
1.5Yr - 2Yr: HR=1.24 (0.92, 1.66), p=0.150
2Yr - 3Yr: HR=1.37 (1.08, 1.74), p=0.010
3Yr+: HR=1.79 (1.54, 2.07), p<0.001

Bipolar vs Total Conventional

Entire Period: HR=1.00 (0.91, 1.09), p=0.998

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Monoblock	3707	2383	1908	1512	888	493	213
Unipolar Modular	45559	30505	24058	18753	11049	6237	2534
Bipolar	28395	18355	13675	10211	5633	3086	1309
Total Conventional	27539	22422	18929	15738	10219	6222	2751

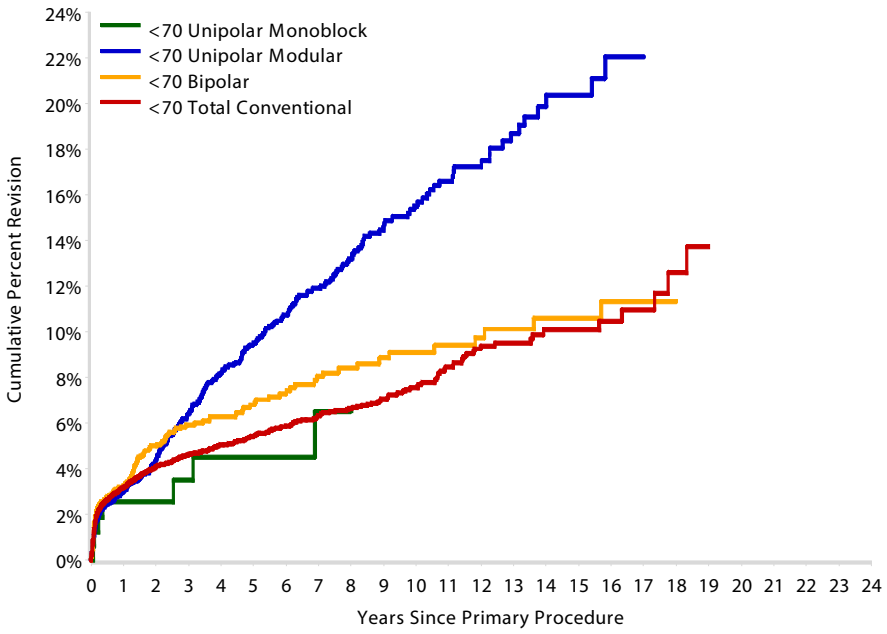
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT80 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		**934**	**14639**	**3.2 (2.9, 3.5)**	**4.3 (3.9, 4.6)**	**5.2 (4.8, 5.6)**	**6.5 (6.0, 6.9)**	**7.8 (7.2, 8.3)**	**9.6 (8.9, 10.3)**
	Unipolar Monoblock	11	173	2.5 (1.0, 6.6)	2.5 (1.0, 6.6)	3.5 (1.4, 8.3)	4.5 (2.0, 10.0)	6.5 (2.9, 14.4)	
	Unipolar Modular	284	3105	3.0 (2.4, 3.7)	4.4 (3.7, 5.3)	6.4 (5.5, 7.5)	9.5 (8.3, 10.9)	11.9 (10.5, 13.5)	15.5 (13.7, 17.6)
	Bipolar	149	2564	3.3 (2.6, 4.1)	5.0 (4.1, 6.0)	5.9 (5.0, 7.1)	6.8 (5.7, 8.1)	8.0 (6.7, 9.6)	9.1 (7.5, 10.9)
	Total Conventional	490	8797	3.2 (2.8, 3.6)	4.1 (3.7, 4.5)	4.6 (4.2, 5.1)	5.4 (4.9, 6.0)	6.3 (5.8, 7.0)	7.5 (6.8, 8.4)
≥70		**2773**	**90561**	**2.2 (2.1, 2.3)**	**2.8 (2.7, 2.9)**	**3.2 (3.1, 3.4)**	**4.0 (3.8, 4.1)**	**4.7 (4.5, 4.9)**	**5.7 (5.4, 6.1)**
	Unipolar Monoblock	70	3534	1.4 (1.0, 1.9)	1.8 (1.4, 2.4)	2.2 (1.7, 2.9)	2.8 (2.2, 3.7)	3.4 (2.6, 4.5)	3.7 (2.8, 4.9)
	Unipolar Modular	1194	42454	1.9 (1.8, 2.1)	2.5 (2.4, 2.7)	2.9 (2.8, 3.1)	3.9 (3.6, 4.1)	4.7 (4.4, 5.0)	6.0 (5.5, 6.5)
	Bipolar	709	25831	2.4 (2.2, 2.6)	2.8 (2.6, 3.1)	3.2 (3.0, 3.5)	3.7 (3.4, 4.0)	4.1 (3.8, 4.5)	4.8 (4.3, 5.4)
	Total Conventional	800	18742	2.8 (2.6, 3.1)	3.4 (3.1, 3.7)	3.9 (3.6, 4.2)	4.6 (4.3, 5.0)	5.6 (5.2, 6.1)	6.5 (5.9, 7.1)
TOTAL		**3707**	**105200**						

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

Figure HT74 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

Entire Period: HR=1.22 (0.67, 2.22), p=0.512

<70 Unipolar Modular vs <70 Total Conventional

0 - 2Yr: HR=1.04 (0.84, 1.28), p=0.724

2Yr+: HR=3.17 (2.57, 3.90), p<0.001

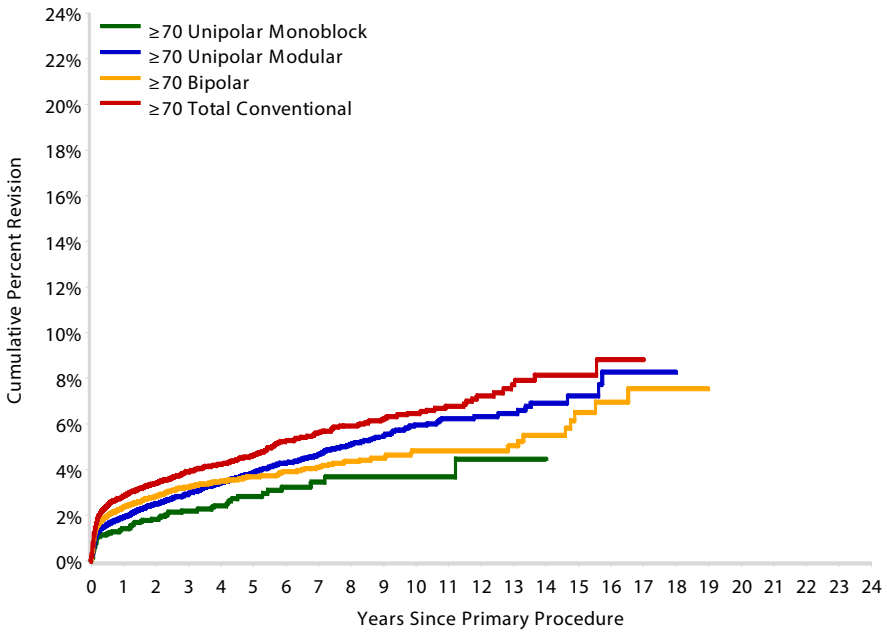
<70 Bipolar vs <70 Total Conventional

Entire Period: HR=1.16 (0.97, 1.40), p=0.106

Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<70	Unipolar Monoblock	173	122	108	96	66	46	29
	Unipolar Modular	3105	2325	1985	1689	1251	878	503
	Bipolar	2564	1835	1437	1184	834	552	329
	Total Conventional	8797	7323	6339	5454	3828	2539	1299

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

Figure HT75 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

Entire Period: HR=0.56 (0.44, 0.71), p<0.001

≥70 Unipolar Modular vs ≥70 Total Conventional

0 - 3Mth: HR=0.65 (0.58, 0.74), p<0.001

3Mth - 9Mth: HR=0.66 (0.53, 0.82), p<0.001

9Mth - 2Yr: HR=0.91 (0.75, 1.11), p=0.363

2Yr - 3.5Yr: HR=0.94 (0.74, 1.20), p=0.621

3.5Yr+: HR=1.18 (0.97, 1.45), p=0.098

≥70 Bipolar vs ≥70 Total Conventional

Entire Period: HR=0.79 (0.71, 0.87), p<0.001

Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
≥70	Unipolar Monoblock	3534	2261	1800	1416	822	447	184
	Unipolar Modular	42454	28180	22073	17064	9798	5359	2031
	Bipolar	25831	16520	12238	9027	4799	2534	980
	Total Conventional	18742	15099	12590	10284	6391	3683	1452

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

Primary Total Resurfacing Hip Replacement

DEMOGRAPHICS

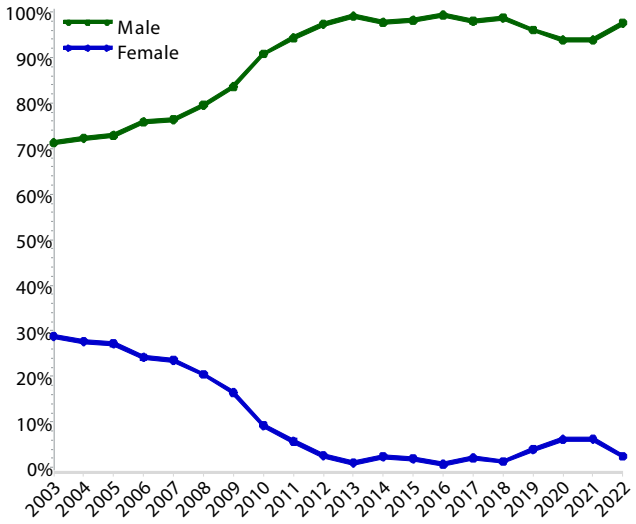
There have been 19,752 primary total resurfacing hip replacement procedures. This is an additional 383 procedures compared to the previous report.

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

In 2022, the number of primary total resurfacing procedures is 34.9% less than in 2021, and 80.1% less than in 2005 when the use of hip resurfacing peaked. Primary total resurfacing hip replacement represents 0.7% of all hip replacements performed in 2022.

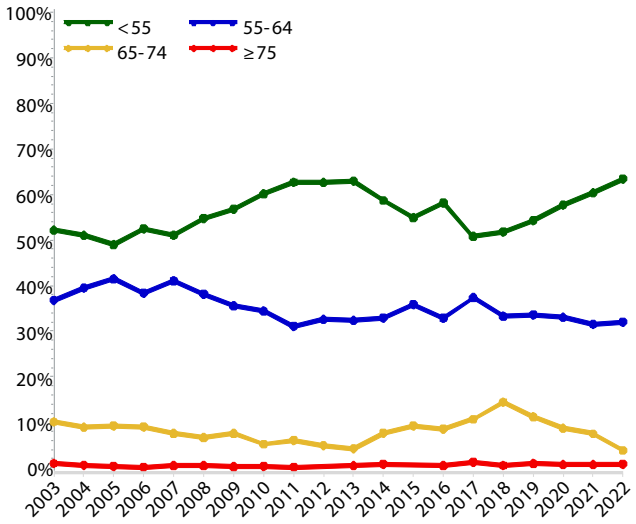
In 2022, 97.5% of primary total resurfacing hip replacements were undertaken in males (Table HT81 and Figure HT76).

Figure HT76 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 HT77.

Figure HT77 Primary Total Resurfacing Hip Replacement by Age



There were only three types of resurfacing prostheses used in 2022, with the Adept the most commonly used. The ReCerf resurfacing head was used for the first time in 2018 (Table HT82).

Table HT81 Age and Gender of Primary Total Resurfacing Hip Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	16065	81.3%	13	84	54	53.3	9.1
Female	3687	18.7%	14	81	53	51.5	8.6
TOTAL	**19752**	**100.0%**	**13**	**84**	**54**	**53.0**	**9.1**

Table HT82 Most Used Resurfacing Heads in Primary Total Resurfacing Hip Replacement

2003		2019		2020		2021		2022	
N	Model	N	Model	N	Model	N	Model	N	Model
1359	BHR	301	Adept	318	Adept	321	Adept	231	Adept
58	Durom	145	BHR	156	BHR	127	ReCerf	93	BHR
43	ASR	81	ReCerf	93	ReCerf	114	BHR	42	ReCerf
42	Cormet								
38	Cormet 2000 HAP								
7	Conserve Plus								
Most Used									
1547	(6) 100.0%	527	(3) 100.0%	567	(3) 100.0%	562	(3) 100.0%	366	(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 (1.9%), 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 HT83 and Figure HT78).

Prosthesis Types

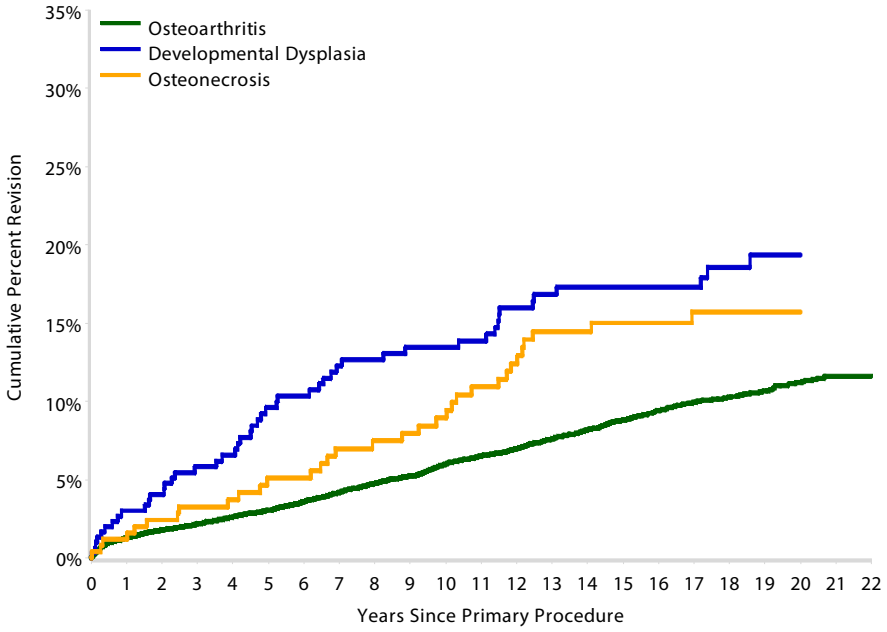
The cumulative percent revision of the three different primary total resurfacing hip prosthesis combinations with >100 procedures is listed in Table HT84.

Table HT83 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	1098	14723	1.3 (1.1, 1.5)	2.2 (2.0, 2.5)	3.1 (2.8, 3.4)	6.0 (5.6, 6.4)	8.8 (8.3, 9.4)	11.2 (10.5, 11.9)
Developmental Dysplasia	49	299	3.0 (1.6, 5.7)	5.8 (3.7, 9.2)	9.6 (6.7, 13.7)	13.5 (9.9, 18.1)	17.3 (13.2, 22.4)	19.4 (14.9, 25.0)
Osteonecrosis	34	248	1.2 (0.4, 3.7)	3.3 (1.7, 6.5)	5.1 (2.9, 8.8)	8.9 (5.9, 13.5)	15.0 (10.8, 20.6)	15.7 (11.4, 21.4)
Other (6)	17	117	2.6 (0.8, 7.9)	3.5 (1.3, 9.1)	6.3 (3.1, 12.8)	13.0 (7.7, 21.4)	15.5 (9.6, 24.5)	
TOTAL	**1198**	**15387**						

Note: Only primary diagnoses with >100 procedures have been listed
Restricted to modern prostheses

Figure HT78 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=1.27 (0.56, 2.89), p=0.564

6Mth - 5Yr: HR=2.26 (1.44, 3.55), p<0.001

5Yr+: HR=0.87 (0.56, 1.33), p=0.509

Developmental Dysplasia vs Osteonecrosis

Entire Period: HR=0.77 (0.49, 1.19), p=0.241

Osteonecrosis vs Osteoarthritis

Entire Period: HR=1.62 (1.14, 2.29), p=0.006

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Osteoarthritis	14723	14163	12901	11853	9453	6164	1415
Developmental Dysplasia	299	286	259	239	209	168	55
Osteonecrosis	248	243	225	208	184	146	50

Note: Only primary diagnoses with >100 procedures have been listed
Restricted to modern prostheses

Table HT84 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	85	2892	1.1 (0.8, 1.6)	1.6 (1.2, 2.2)	2.3 (1.8, 3.0)	4.9 (3.8, 6.4)	6.5 (4.8, 8.7)	
BHR	BHR	1112	12148	1.4 (1.2, 1.6)	2.5 (2.2, 2.8)	3.5 (3.1, 3.8)	6.5 (6.1, 7.0)	9.5 (8.9, 10.0)	11.8 (11.1, 12.5)
ReCerf	ReCerf	1	346	0.3 (0.0, 2.1)	0.3 (0.0, 2.1)				
Other (1)		0	1						
TOTAL		**1198**	**15387**						

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 11.2% (Table HT85 and Figure HT79).

Reasons for Revision

The main reasons for revision of primary total resurfacing hip replacement are loosening, metal related pathology, and fracture (Table HT86).

Loosening is the most common reason for revision after 12 years.

The five most common reasons for revision are shown in Figure HT80. 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 continues to increase and becomes 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 HT87).

Age and Gender

In the first 18 months, patients aged ≥65 years have a higher rate of revision compared to patients aged <55 years. Patients aged ≥65 years then have a lower rate of revision compared to patients aged <55 years from 6.5 years to 12.5 years (Table HT88 and Figure HT81).

Females have a higher rate of revision compared to males (Table HT89 and Figure HT82). Males aged ≥65 years have a higher rate of revision compared to males aged 55–64 years for the first 6 months only, and for the first 1 year compared to males aged <55 years. After this time, there is no difference (Table HT89 and Figure HT83). Age is not a risk factor for revision for female patients (Table HT89 and Figure HT84).

Head Size

The rate of revision decreases as the femoral component head size increases. Femoral head sizes ≤44mm and 45–49mm, have over twice the rate of revision compared to head sizes ≥55mm at 10 years. Revision is also higher for head sizes 50–54mm compared to ≥55mm (Table HT90 and Figure HT85).

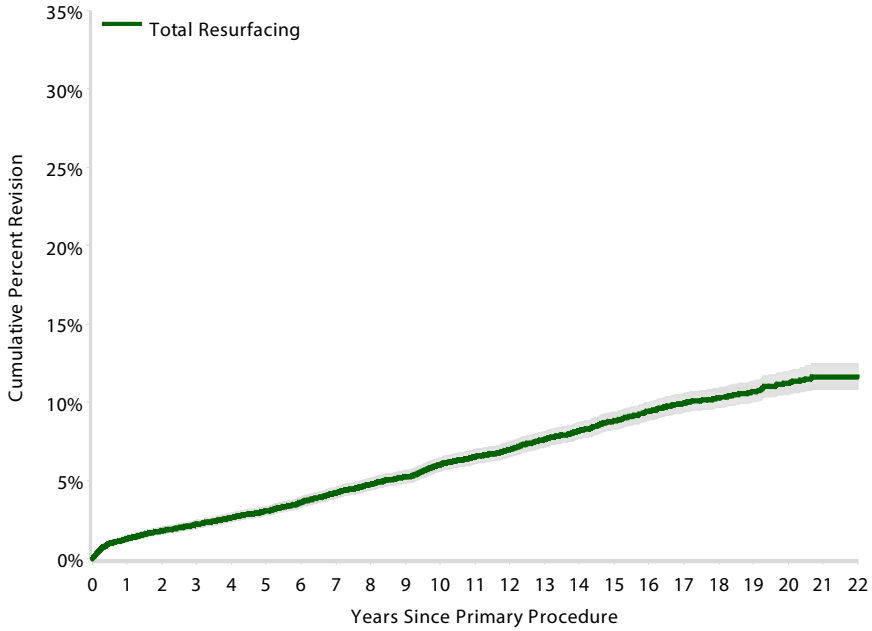
The reason for revision varies with head size. Head sizes <50mm have a higher cumulative incidence of metal related pathology, loosening, fracture, infection, and lysis compared to head sizes ≥50mm (Figure HT86). This effect of femoral component head size is evident in both males and females (Table HT91 and Figure HT87).

Table HT85 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	1098	14723	1.3 (1.1, 1.5)	2.2 (2.0, 2.5)	3.1 (2.8, 3.4)	6.0 (5.6, 6.4)	8.8 (8.3, 9.4)	11.2 (10.5, 11.9)
TOTAL	**1098**	**14723**						

Note: Restricted to modern prostheses

Figure HT79 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	14723	14163	12901	11853	9453	6164	1415

Note: Restricted to modern prostheses

Table HT86 Primary Total Resurfacing Hip Replacement by Reason for Revision (Primary Diagnosis OA)

Reason for Revision	Number	Percent
Loosening	278	25.3
Metal Related Pathology	240	21.9
Fracture	218	19.9
Lysis	117	10.7
Infection	70	6.4
Pain	66	6.0
Prosthesis Dislocation/Instability	29	2.6
Osteonecrosis	27	2.5
Other (11)	53	4.8
TOTAL	**1098**	**100.0**

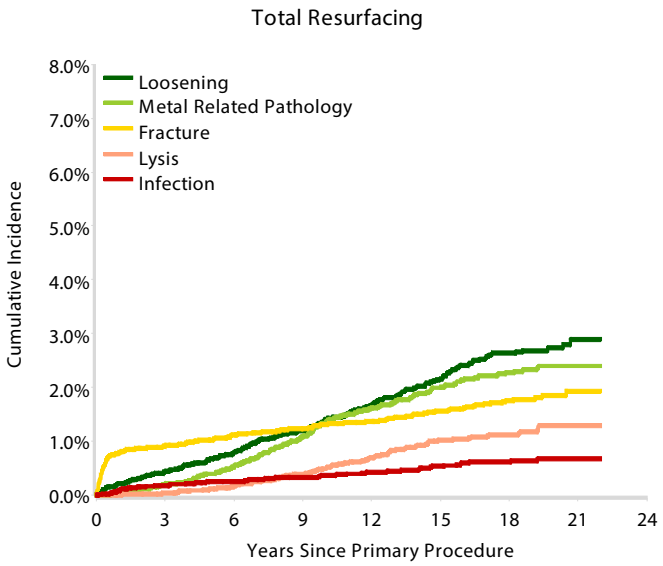
Note: Restricted to modern prostheses

Table HT87 Primary Total Resurfacing Hip Replacement by Type of Revision (Primary Diagnosis OA)

Type of Revision	Number	Percent
THR (Femoral/Acetabular)	756	68.9
Femoral Component	277	25.2
Acetabular Component	30	2.7
Cement Spacer	26	2.4
Removal of Prostheses	7	0.6
Head/Insert	1	0.1
Minor Components	1	0.1
TOTAL	**1098**	**100.0**

Note: Restricted to modern prostheses

Figure HT80 Cumulative Incidence Revision Diagnosis of Primary Total Resurfacing Hip Replacement (Primary Diagnosis OA)



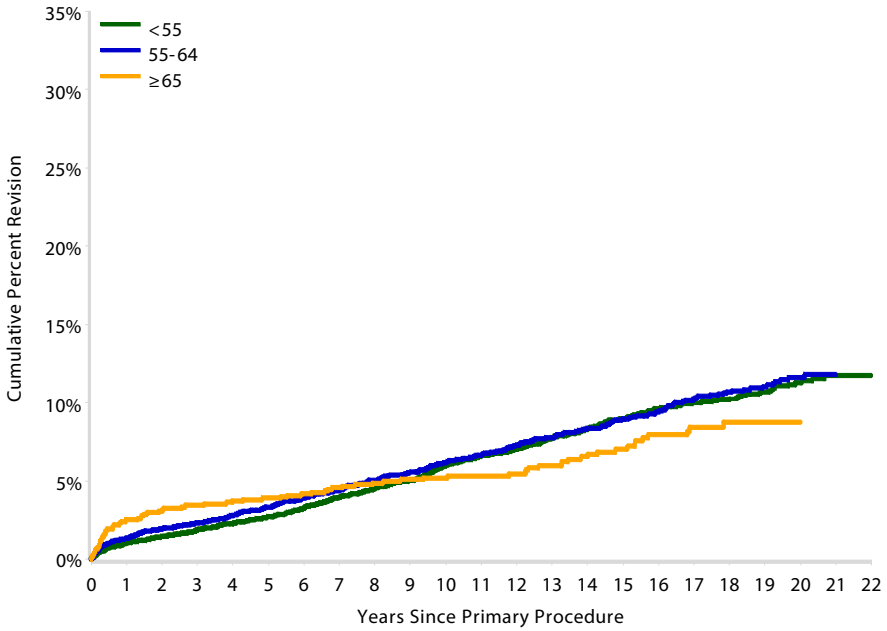
Note: Restricted to modern prostheses

Table HT88 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	578	7846	1.0 (0.8, 1.3)	1.9 (1.6, 2.2)	2.7 (2.4, 3.1)	6.0 (5.4, 6.6)	9.0 (8.3, 9.8)	11.3 (10.3, 12.3)
55–64	433	5498	1.3 (1.1, 1.7)	2.3 (1.9, 2.8)	3.3 (2.9, 3.9)	6.2 (5.5, 6.9)	8.9 (8.1, 9.9)	11.6 (10.5, 12.8)
≥65	87	1379	2.6 (1.8, 3.5)	3.5 (2.6, 4.6)	3.9 (3.0, 5.1)	5.2 (4.1, 6.6)	7.0 (5.6, 8.8)	8.8 (7.0, 11.0)
TOTAL	**1098**	**14723**						

Note: Restricted to modern prostheses

Figure HT81 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement by Age (Primary Diagnosis OA)



HR - adjusted for gender

55-64 vs <55

Entire Period: HR=1.06 (0.94, 1.20), p=0.366

≥65 vs <55

0 - 3Mth: HR=2.23 (1.28, 3.88), p=0.004

3Mth - 6Mth: HR=3.82 (1.99, 7.34), p<0.001

6Mth - 1.5Yr: HR=1.91 (1.04, 3.52), p=0.038

1.5Yr - 6.5Yr: HR=0.75 (0.46, 1.22), p=0.246

6.5Yr - 12.5Yr: HR=0.53 (0.31, 0.90), p=0.019

12.5Yr - 13Yr: HR=0.65 (0.09, 4.84), p=0.673

13Yr+: HR=1.19 (0.71, 2.00), p=0.498

≥65 vs 55-64

0 - 3Mth: HR=2.10 (1.21, 3.67), p=0.008

3Mth - 6Mth: HR=3.60 (1.87, 6.94), p<0.001

6Mth+: HR=0.80 (0.61, 1.05), p=0.112

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
<55	7846	7539	6831	6295	4996	3214	793
55–64	5498	5303	4867	4491	3640	2420	517
≥65	1379	1321	1203	1067	817	530	105

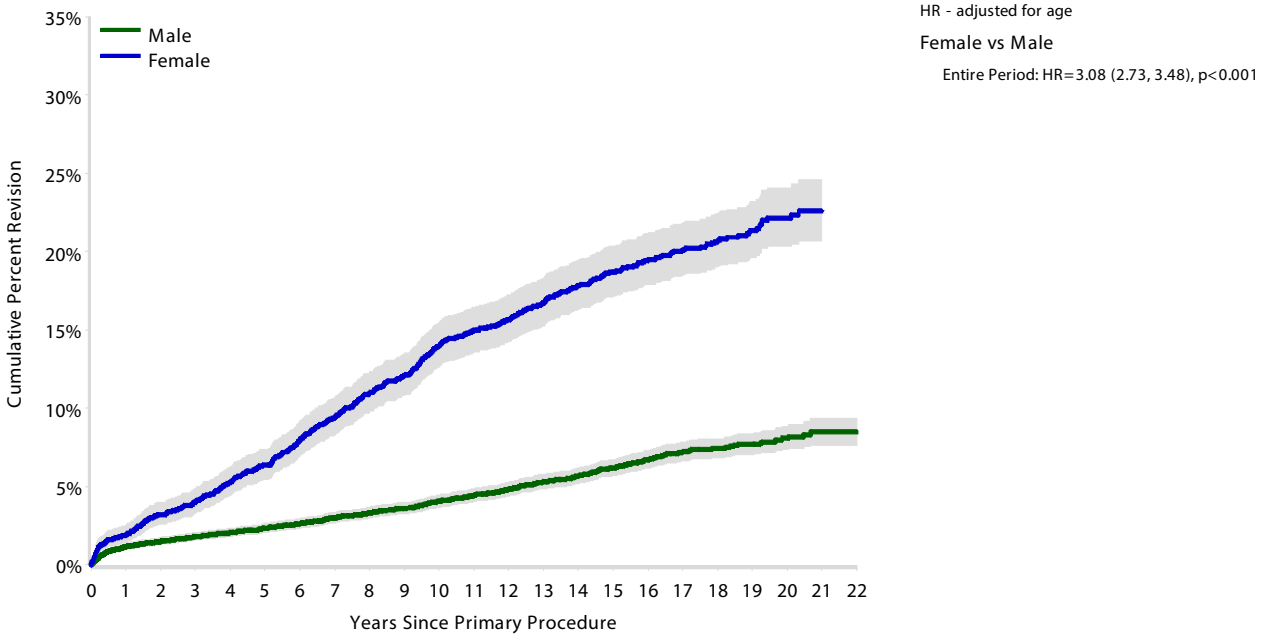
Note: Restricted to modern prostheses

Table HT89 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		**620**	**12259**	**1.2 (1.0, 1.4)**	**1.8 (1.6, 2.1)**	**2.3 (2.1, 2.6)**	**4.1 (3.7, 4.5)**	**6.2 (5.7, 6.7)**	**8.1 (7.4, 8.8)**
	<55	309	6441	0.9 (0.7, 1.2)	1.5 (1.3, 1.9)	2.0 (1.7, 2.4)	3.8 (3.3, 4.4)	6.1 (5.5, 6.9)	8.0 (7.0, 9.1)
	55–64	237	4543	1.1 (0.8, 1.5)	1.8 (1.4, 2.2)	2.4 (2.0, 2.9)	4.2 (3.6, 4.9)	6.2 (5.5, 7.1)	8.1 (7.0, 9.4)
	≥65	74	1275	2.5 (1.8, 3.6)	3.4 (2.5, 4.5)	3.7 (2.8, 5.0)	4.8 (3.7, 6.3)	6.3 (4.9, 8.0)	8.3 (6.4, 10.6)
Female		**478**	**2464**	**1.9 (1.4, 2.5)**	**4.0 (3.3, 4.9)**	**6.4 (5.4, 7.4)**	**14.0 (12.6, 15.4)**	**18.7 (17.1, 20.3)**	**22.1 (20.3, 24.1)**
	<55	269	1405	1.5 (1.0, 2.3)	3.5 (2.6, 4.6)	5.7 (4.6, 7.1)	14.1 (12.4, 16.1)	18.8 (16.8, 21.0)	22.0 (19.6, 24.5)
	55–64	196	955	2.4 (1.6, 3.6)	4.7 (3.6, 6.3)	7.3 (5.9, 9.2)	14.3 (12.2, 16.7)	19.1 (16.6, 21.8)	23.3 (20.4, 26.5)
	≥65	13	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)	13.5 (8.1, 22.3)	
TOTAL		**1098**	**14723**						

Note: Restricted to modern prostheses

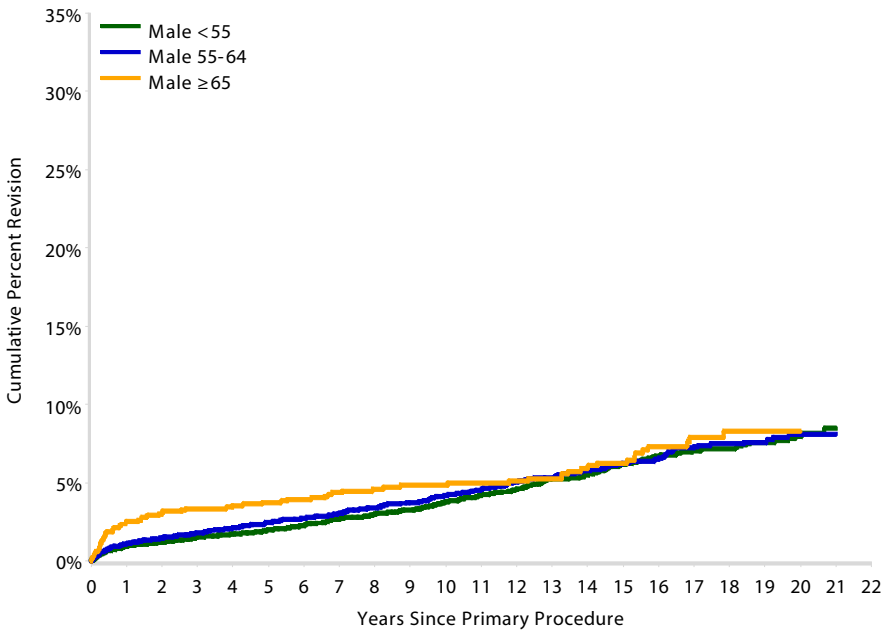
Figure HT82 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement by Gender (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Male	12259	11759	10618	9655	7488	4608	1002
Female	2464	2404	2283	2198	1965	1556	413

Note: Restricted to modern prostheses

Figure HT83 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=1.05 (0.89, 1.24), p=0.581

Male ≥65 vs Male <55

0 - 3Mth: HR=2.24 (1.21, 4.14), p=0.009

3Mth - 6Mth: HR=3.46 (1.72, 6.98), p<0.001

6Mth - 1Yr: HR=2.27 (1.04, 4.96), p=0.039

1Yr+: HR=0.88 (0.64, 1.22), p=0.450

Male ≥65 vs Male 55-64

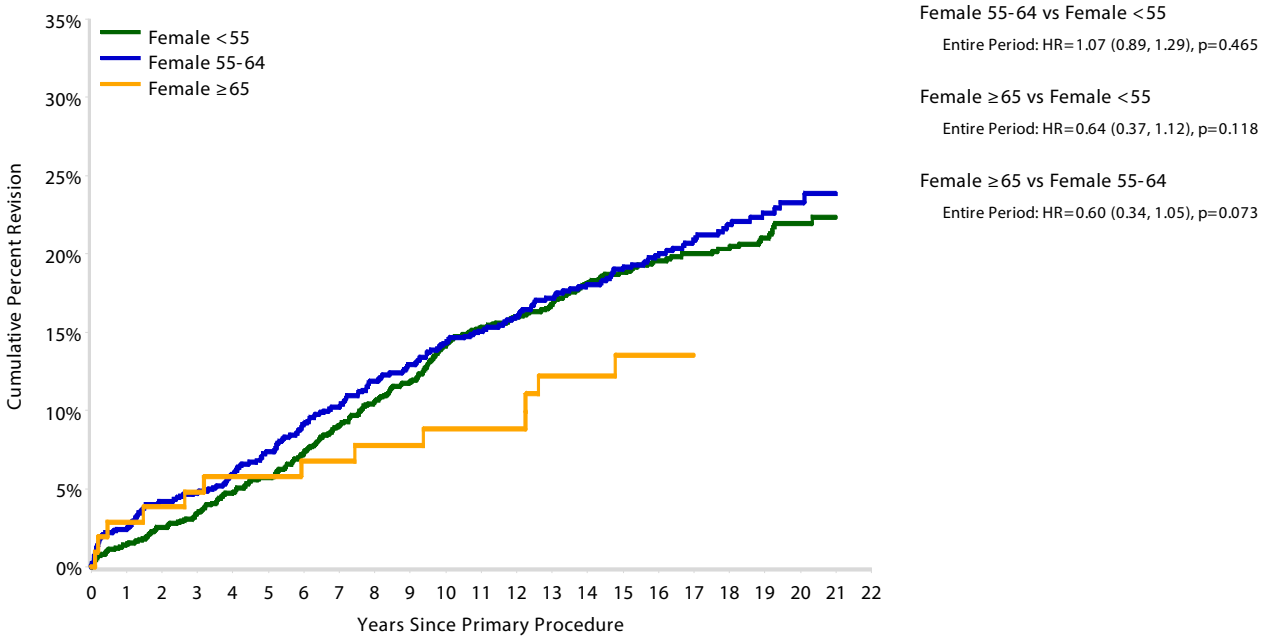
0 - 6Mth: HR=2.55 (1.60, 4.07), p<0.001

6Mth+: HR=0.93 (0.69, 1.27), p=0.652

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Male	<55	6441	6161	5532	5046	3883	2329	550
	55-64	4543	4378	3981	3638	2873	1812	364
	≥65	1275	1220	1105	971	732	467	88

Note: Restricted to modern prostheses

Figure HT84 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement in Females by Age (Primary Diagnosis OA)



Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Female	<55	1405	1378	1299	1249	1113	885	243
	55-64	955	925	886	853	767	608	153
	≥65	104	101	98	96	85	63	17

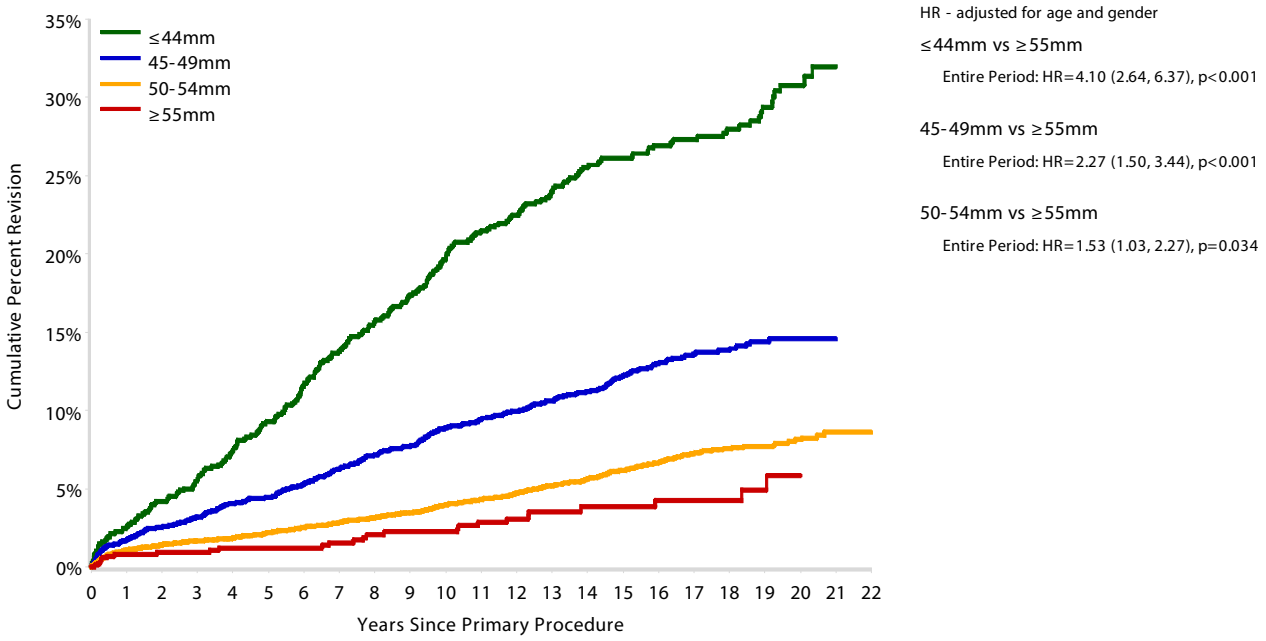
Note: Restricted to modern prostheses

Table HT90 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	239	884	2.6 (1.7, 3.9)	5.6 (4.3, 7.3)	9.3 (7.5, 11.4)	19.7 (17.1, 22.5)	26.1 (23.3, 29.2)	30.8 (27.4, 34.5)
45–49mm	314	2936	1.7 (1.3, 2.3)	3.2 (2.6, 3.9)	4.5 (3.7, 5.3)	8.9 (7.9, 10.1)	12.2 (10.9, 13.6)	14.6 (13.0, 16.3)
50–54mm	519	10046	1.1 (0.9, 1.3)	1.7 (1.5, 2.0)	2.2 (1.9, 2.5)	4.0 (3.6, 4.4)	6.2 (5.6, 6.8)	8.2 (7.4, 9.0)
≥55mm	26	857	0.8 (0.4, 1.7)	1.0 (0.5, 1.9)	1.2 (0.7, 2.3)	2.2 (1.4, 3.6)	3.8 (2.5, 5.8)	5.8 (3.6, 9.4)
TOTAL	**1098**	**14723**						

Note: Restricted to modern prostheses

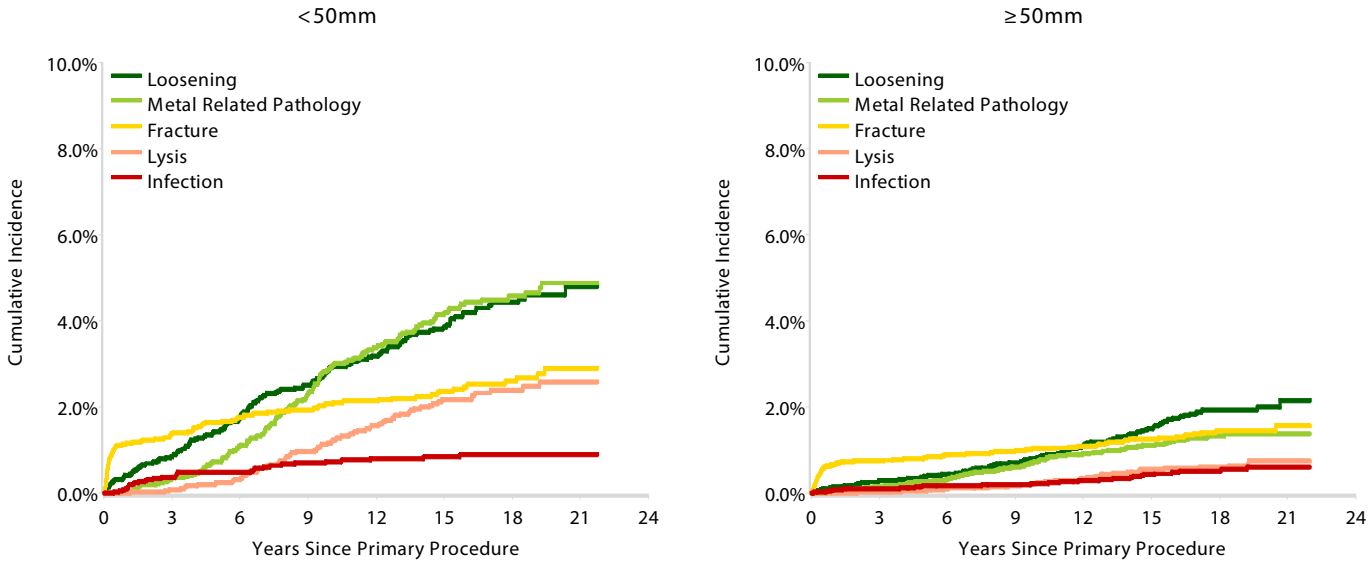
Figure HT85 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement by Head Size (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
≤44mm	884	857	805	765	664	497	136
45–49mm	2936	2827	2593	2409	1972	1290	314
50–54mm	10046	9656	8772	8014	6324	4097	892
≥55mm	857	823	731	665	493	280	73

Note: Restricted to modern prostheses

Figure HT86 Cumulative Incidence Revision Diagnosis of Primary Total Resurfacing Hip Replacement by Head Size (Primary Diagnosis OA)



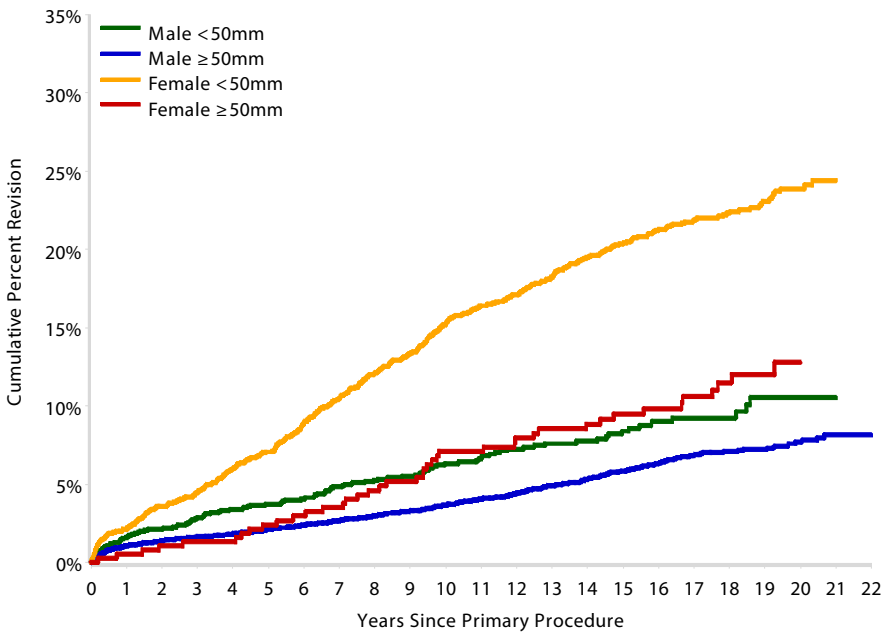
Note: Restricted to modern prostheses

Table HT91 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		**620**	**12259**	**1.2 (1.0, 1.4)**	**1.8 (1.6, 2.1)**	**2.3 (2.1, 2.6)**	**4.1 (3.7, 4.5)**	**6.2 (5.7, 6.7)**	**8.1 (7.4, 8.8)**
	<50mm	116	1737	1.6 (1.1, 2.4)	2.9 (2.2, 3.8)	3.7 (2.9, 4.8)	6.3 (5.2, 7.7)	8.4 (6.9, 10.1)	10.5 (8.5, 13.0)
	≥50mm	504	10522	1.1 (0.9, 1.3)	1.7 (1.4, 1.9)	2.1 (1.8, 2.4)	3.7 (3.3, 4.1)	5.8 (5.3, 6.4)	7.7 (7.0, 8.5)
Female		**478**	**2464**	**1.9 (1.4, 2.5)**	**4.0 (3.3, 4.9)**	**6.4 (5.4, 7.4)**	**14.0 (12.6, 15.4)**	**18.7 (17.1, 20.3)**	**22.1 (20.3, 24.1)**
	<50mm	437	2083	2.2 (1.6, 2.9)	4.5 (3.7, 5.5)	7.1 (6.0, 8.3)	15.2 (13.7, 16.9)	20.4 (18.6, 22.2)	23.9 (21.9, 26.0)
	≥50mm	41	381	0.5 (0.1, 2.1)	1.3 (0.6, 3.2)	2.4 (1.3, 4.6)	7.1 (4.9, 10.3)	9.5 (6.9, 13.0)	12.8 (9.4, 17.2)
TOTAL		**1098**	**14723**						

Note: Restricted to modern prostheses

Figure HT87 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=1.50 (1.22, 1.83), p<0.001

Male <50mm vs Female <50mm

Entire Period: HR=0.41 (0.34, 0.51), p<0.001

Male ≥50mm vs Female ≥50mm

Entire Period: HR=0.60 (0.43, 0.82), p=0.001

Female <50mm vs Female ≥50mm

Entire Period: HR=2.16 (1.57, 2.97), p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Male	<50mm	1737	1658	1480	1333	1004	510	116
	≥50mm	10522	10101	9138	8322	6484	4098	886
Female	<50mm	2083	2026	1918	1841	1632	1277	334
	≥50mm	381	378	365	357	333	279	79

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.

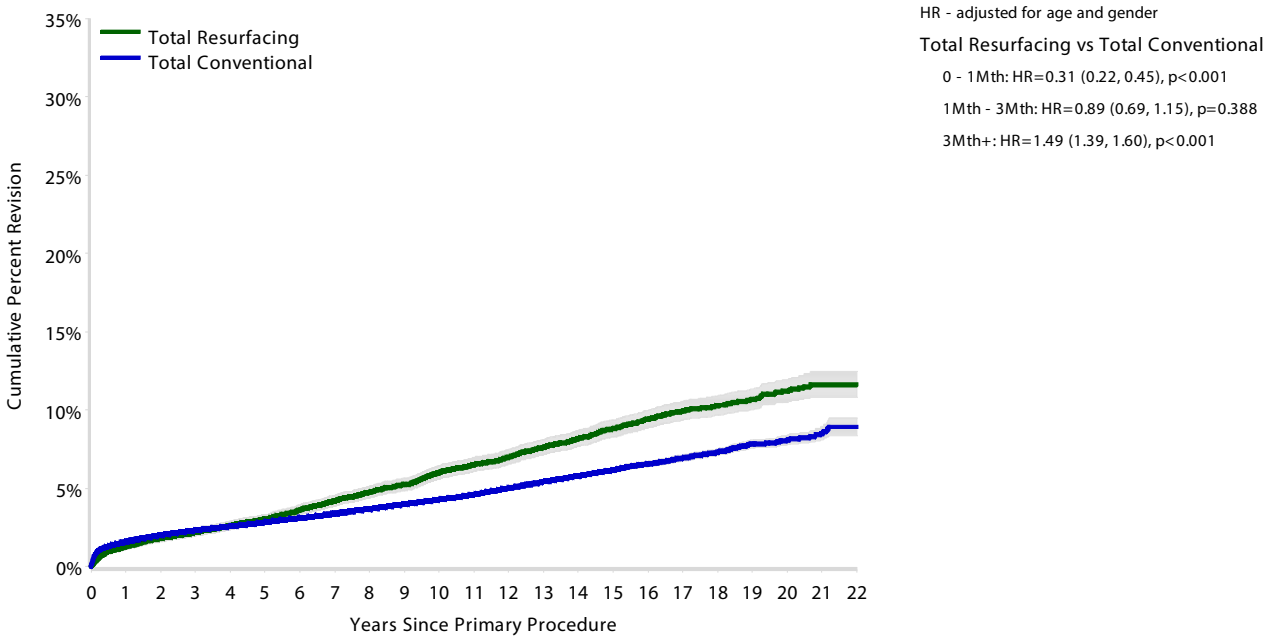
After 3 months, primary total resurfacing has a higher rate of revision (Table HT92 and Figure HT88). When analysed by gender, females with hip resurfacing have a higher rate of revision. Males with hip resurfacing have a lower rate of revision compared to males with a total conventional hip replacement for the first 3 months, with no difference after this time (Table HT93 and Figure HT89).

Table HT92 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	1098	14723	1.3 (1.1, 1.5)	2.2 (2.0, 2.5)	3.1 (2.8, 3.4)	6.0 (5.6, 6.4)	8.8 (8.3, 9.4)	11.2 (10.5, 11.9)
Total Conventional	14416	432674	1.6 (1.6, 1.6)	2.3 (2.3, 2.4)	2.8 (2.8, 2.9)	4.3 (4.2, 4.4)	6.2 (6.0, 6.3)	8.1 (7.8, 8.4)
TOTAL	**15514**	**447397**						

Note: All primary total conventional procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Figure HT88 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	14723	14163	12901	11853	9453	6164	1415
Total Conventional	432674	386337	306450	231396	92710	26702	3298

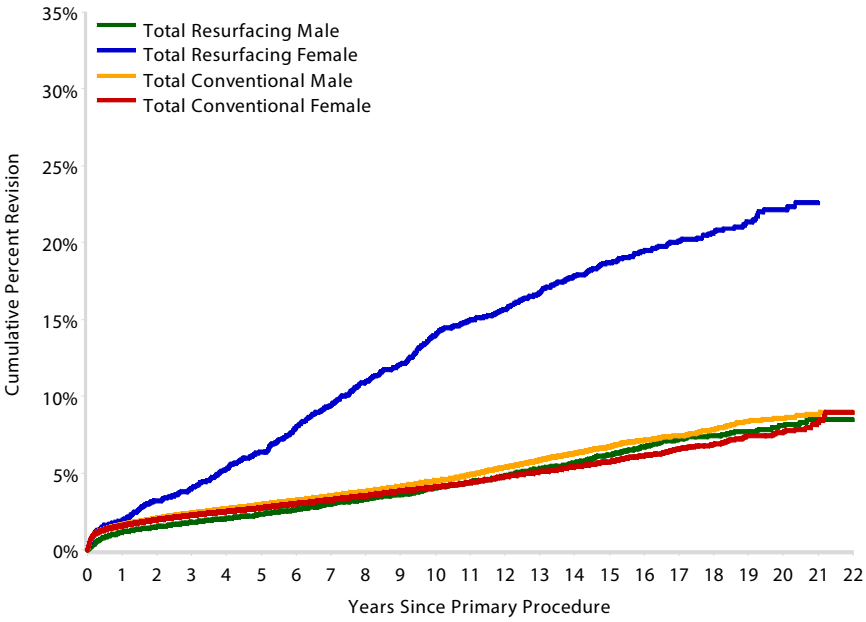
Note: All primary total conventional procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT93 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	Male	620	12259	1.2 (1.0, 1.4)	1.8 (1.6, 2.1)	2.3 (2.1, 2.6)	4.1 (3.7, 4.5)	6.2 (5.7, 6.7)	8.1 (7.4, 8.8)
	Female	478	2464	1.9 (1.4, 2.5)	4.0 (3.3, 4.9)	6.4 (5.4, 7.4)	14.0 (12.6, 15.4)	18.7 (17.1, 20.3)	22.1 (20.3, 24.1)
Total Conventional	Male	6833	198551	1.6 (1.6, 1.7)	2.4 (2.3, 2.5)	3.0 (2.9, 3.0)	4.5 (4.4, 4.6)	6.7 (6.5, 6.9)	8.6 (8.2, 9.0)
	Female	7583	234123	1.6 (1.5, 1.6)	2.3 (2.2, 2.3)	2.7 (2.7, 2.8)	4.1 (4.0, 4.2)	5.7 (5.6, 5.9)	7.7 (7.3, 8.1)
TOTAL		**15514**	**447397**						

Note: Restricted to modern prostheses
All primary total conventional procedures using metal/metal prostheses have been excluded

Figure HT89 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=0.26 (0.17, 0.39), p<0.001

1Mth - 3Mth: HR=0.73 (0.54, 0.99), p=0.040

3Mth+: HR=0.99 (0.90, 1.08), p=0.801

Total Resurfacing Female vs Total Conventional Female

0 - 1Mth: HR=0.70 (0.49, 1.00), p=0.053

1Mth - 3Mth: HR=2.16 (1.65, 2.82), p<0.001

3Mth - 6Mth: HR=3.28 (2.42, 4.44), p<0.001

6Mth+: HR=3.46 (3.13, 3.83), p<0.001

Total Conventional Male vs Total Conventional Female

0 - 2Wk: HR=0.82 (0.72, 0.92), p<0.001

2Wk - 3Mth: HR=1.07 (1.00, 1.14), p=0.046

3Mth+: HR=1.13 (1.08, 1.17), p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Total Resurfacing	Male	12259	11759	10618	9655	7488	4608	1002
	Female	2464	2404	2283	2198	1965	1556	413
Total Conventional	Male	198551	176716	139034	103848	39938	11354	1511
	Female	234123	209621	167416	127548	52772	15348	1787

Note: Restricted to modern prostheses
All primary total conventional procedures using metal/metal prostheses have been excluded

Knee Replacement

Knee Replacement

Categories of Knee Replacement

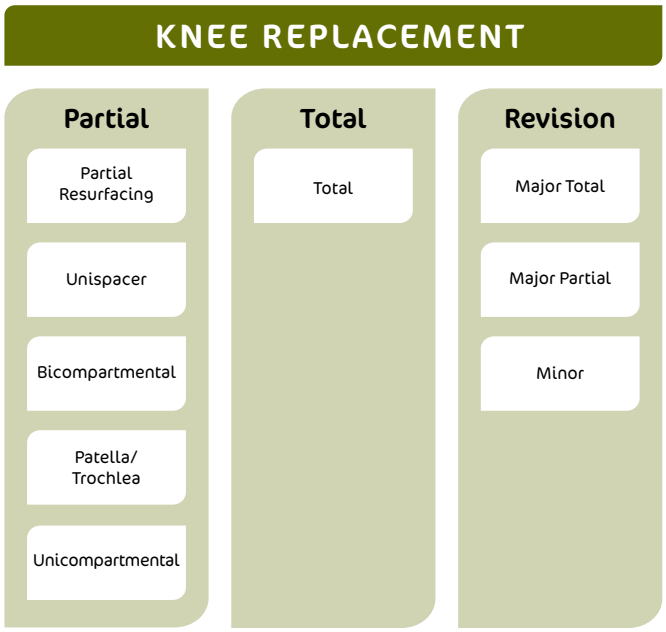
Knee replacement is grouped into three broad categories: primary partial, primary total and revision knee replacement.

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-2023



Use of Knee Replacement

This report analyses 1,046,247 knee replacements with a procedure date up to and including 31 December 2022. This is an additional 65,828 knee procedures since the last report. The relative frequency of each category of knee replacement is provided in Table K1.

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

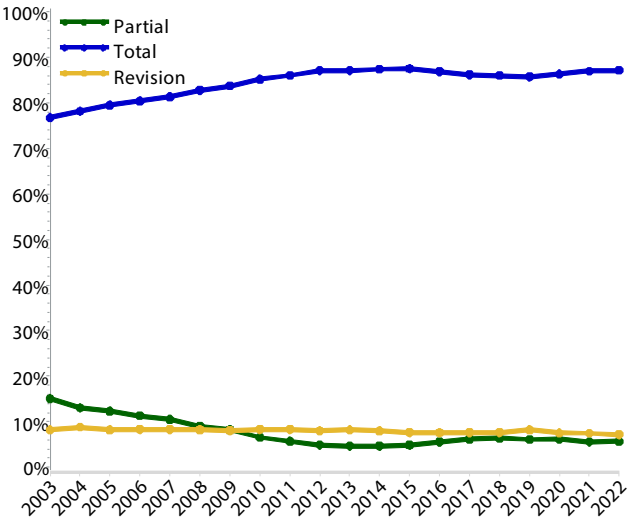
Table K1 Number of Knee Replacements

Knee Category	Number	Percent
Partial	76495	7.3
Total	886536	84.7
Revision	83216	8.0
TOTAL	**1046247**	**100.0**

In 2022, the number of knee replacements undertaken has decreased by 3,770 (5.5%) compared to 2021. During the last year, primary partial knee replacement decreased by 4.9% and primary total knee replacement decreased by 5.3%. Revision knee replacement decreased by 8.6%.

In 2022, primary total knee replacement accounted for 87.1% of all knee replacement procedures, primary partial knee replacement accounted for 5.7%, and the proportion of revision knee procedures was 7.2%. This equates to 1,036 fewer revision procedures in 2022 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 598,047 and BMI data on 487,285 knee replacement procedures. Since its initial collection, ASA score has been recorded for 97.1% of procedures. BMI has been recorded for 95.4% 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 92.9% of knee replacement procedures, patients have an ASA score of 2 or 3, 5.8% 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 K2).

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 K3).

Table K2 ASA Score for Knee Replacement

ASA Score	Partial		Total		Revision		TOTAL	
	N	Col%	N	Col%	N	Col%	N	Col%
ASA 1	4088	12.1	28948	5.6	1575	3.5	34611	5.8
ASA 2	20645	61.0	280706	54.1	18879	41.4	320230	53.5
ASA 3	8973	26.5	203310	39.2	23219	50.9	235502	39.4
ASA 4	160	0.5	5564	1.1	1946	4.3	7670	1.3
ASA 5	.	.	16	0.0	18	0.0	34	0.0
TOTAL	**33866**	**100.0**	**518544**	**100.0**	**45637**	**100.0**	**598047**	**100.0**

Note: A further 448,200 procedures did not have ASA score recorded

Table K3 BMI Category for Knee Replacement

BMI Category	Partial		Total		Revision		TOTAL	
	N	Col%	N	Col%	N	Col%	N	Col%
Underweight	58	0.2	847	0.2	132	0.4	1037	0.2
Normal	4293	14.9	44715	10.6	3890	11.1	52898	10.9
Pre Obese	11596	40.3	132462	31.3	10579	30.1	154637	31.7
Obese Class 1	8760	30.5	130606	30.8	10670	30.4	150036	30.8
Obese Class 2	2984	10.4	71449	16.9	5993	17.1	80426	16.5
Obese Class 3	1061	3.7	43359	10.2	3831	10.9	48251	9.9
TOTAL	**28752**	**100.0**	**423438**	**100.0**	**35095**	**100.0**	**487285**	**100.0**

Note: BMI has not been presented for patients aged ≤19 years. A further 558,962 procedures did not have BMI recorded or the patient is aged ≤19 years

1 https://www.asahq.org/resources/clinical-information/asa-physical-status-classification-system
2 http://www.euro.who.int/en/health-topics/disease-prevention/nutrition/a-healthy-lifestyle/body-mass-index-bmi

Primary Partial Knee Replacement Summary

Introduction

This section provides summary information on partial knee replacement. Detailed information on patella/trochlea partial knees is available on the AOANJRR website as a separate supplementary report.

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	5119	6.7
Unicompartmental	70925	92.7
TOTAL	**76495**	**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 was one partial resurfacing procedure undertaken in 2022. 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-2023

Patella/Trochlea

There have been 5,119 patella/trochlear knee replacement procedures undertaken for all diagnoses. This is an additional 292 procedures compared to the previous report.

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

The principal diagnosis for patella/trochlea procedures is osteoarthritis. The mean age of patients is 58.5 years, with this procedure undertaken more frequently in females.

In order to keep Registry data contemporaneous, only procedures using prostheses that have been available and used in 2022 (described as modern prostheses) are included in the analyses, unless clearly specified.

There are 463 revisions of 3,326 primary patella/trochlear knee replacement procedures for osteoarthritis. The cumulative percent revision for patella/trochlear replacement at 15 years is 35.6% (Table KP2 and Figure KP1).

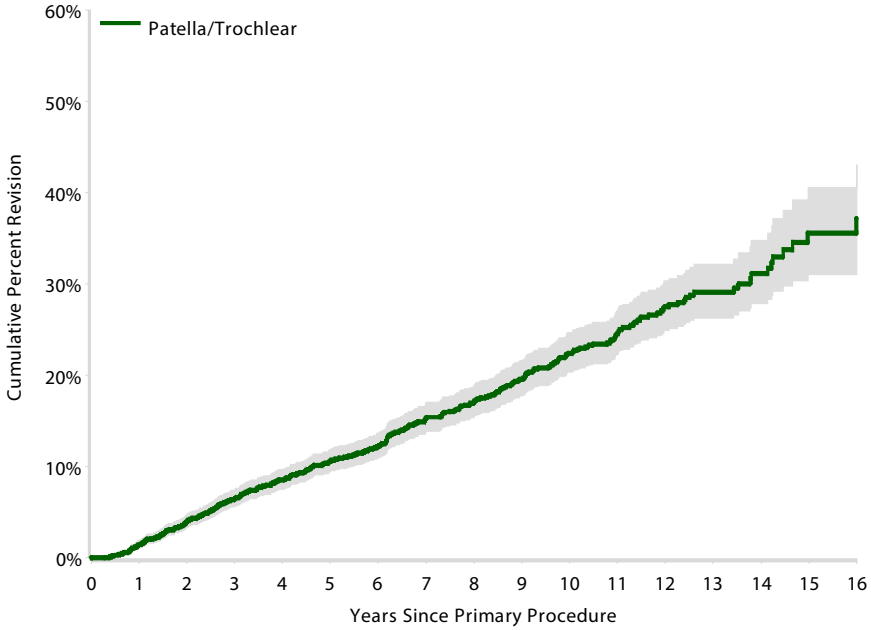
The most common reason for revision of a primary patella/trochlear knee replacement is progression of disease, with most revised to a total knee replacement. Both age and gender are risk factors for revision with patients aged <65 years and males having a higher rate of revision (Table KP3 and Figure KP2).

Table KP2 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	463	3326	1.4 (1.1, 1.9)	6.5 (5.7, 7.5)	10.6 (9.4, 11.8)	15.3 (13.8, 16.9)	22.4 (20.4, 24.7)	35.6 (31.0, 40.6)
TOTAL	**463**	**3326**						

Note: Restricted to modern prostheses

Figure KP1 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	3326	2990	2273	1648	1104	590	63

Note: Restricted to modern prostheses

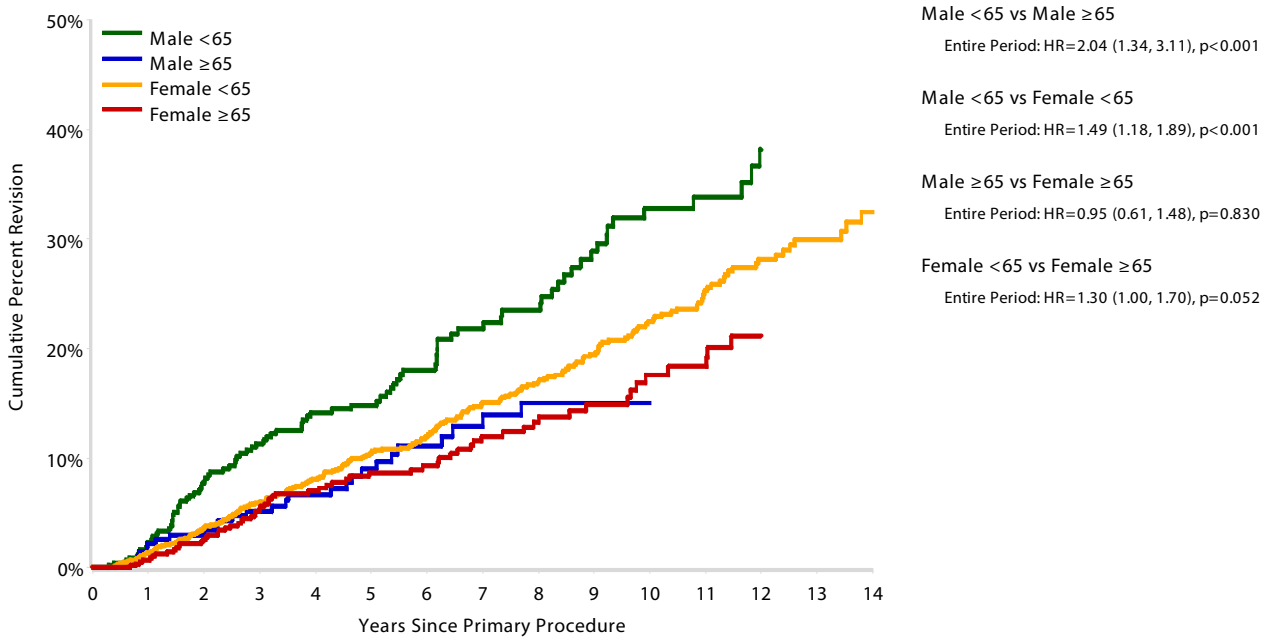
Primary Partial Knee Replacement Summary

Table KP3 Cumulative Percent Revision of Primary Patella/Trochlea 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
Male	<65	93	472	2.3 (1.3, 4.3)	11.3 (8.5, 14.9)	14.8 (11.6, 18.9)	21.8 (17.5, 27.0)	32.8 (26.8, 39.7)
	≥65	28	299	2.2 (1.0, 4.9)	5.2 (3.0, 8.8)	9.0 (5.8, 13.7)	12.9 (8.7, 18.8)	15.0 (10.2, 21.8)
Female	<65	275	1928	1.4 (0.9, 2.0)	6.0 (4.9, 7.2)	10.4 (8.9, 12.1)	15.1 (13.2, 17.3)	22.5 (19.8, 25.4)
	≥65	67	627	0.7 (0.3, 1.9)	5.4 (3.7, 7.8)	8.6 (6.4, 11.6)	12.0 (9.1, 15.7)	17.6 (13.5, 22.8)
TOTAL		**463**	**3326**					

Note: Restricted to modern prostheses

Figure KP2 Cumulative Percent Revision of Primary Patella/Trochlea Knee Replacement by Gender and Age (Primary Diagnosis OA)



Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Male	<65	472	407	298	229	145	77
	≥65	299	258	203	139	84	46
Female	<65	1928	1771	1354	966	658	349
	≥65	627	554	418	314	217	118

Note: Restricted to modern prostheses

More information regarding patella/trochlea procedures is available in the 'Patella/Trochlea Partial Knee Arthroplasty Supplementary Report' on the AOANJRR website: https://aoanjrr.sahmri.com/annual-reports-2023

Unicompartmental

DEMOGRAPHICS

There are now 70,925 primary unicompartmental knee procedures recorded. This is an additional 3,428 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 was 5.2% of all knee procedures in 2022 – the same as 2021. 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 (54.7%) (Table KP4). The proportion of males has increased to 61.3% in 2022 (Figure KP3). Unicompartmental knee replacement is most frequently undertaken in patients aged 55–74 years. The age distribution has remained relatively stable since 2003 (Figure KP4). The mean age of patients is 65.4 years (Table KP4).

Figure KP3 Primary Unicompartmental Knee Replacement by Gender

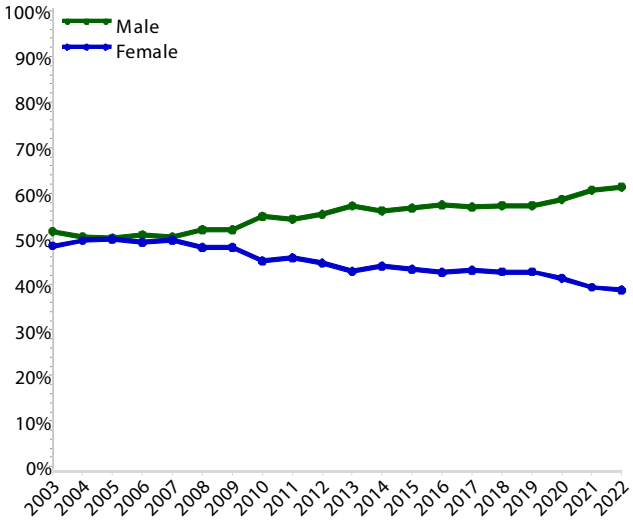
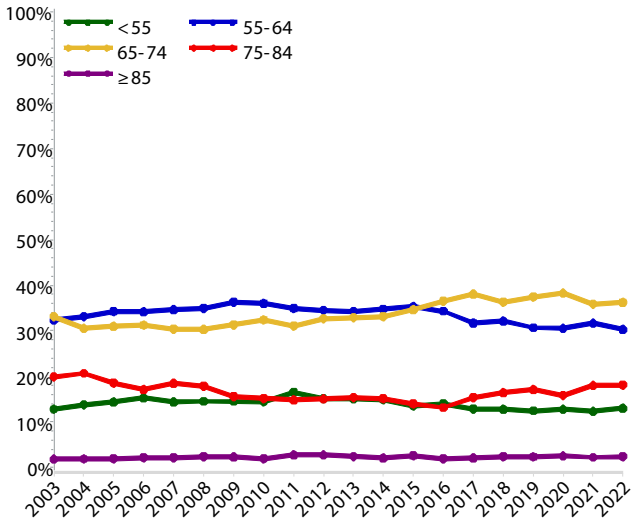


Figure KP4 Primary Unicompartmental Knee Replacement by Age



The use of mobile unicompartmental knee replacement has declined over time (Figure KP5). The proportion of unicompartmental knee replacements using robotic assistance increased to 40.7% in 2022 (Figure KP6).

In 2022, the 10 most used tibial prostheses account for 99.6% of all unicompartmental procedures. The Restoris MCK, Oxford (cementless) and Persona are the most used prostheses in 2022 (Table KP5).

The outcomes of unicompartmental knee prosthesis combinations with >200 procedures are presented in Table KP6.

Figure KP5 Primary Unicompartmental Knee Replacement by Mobility

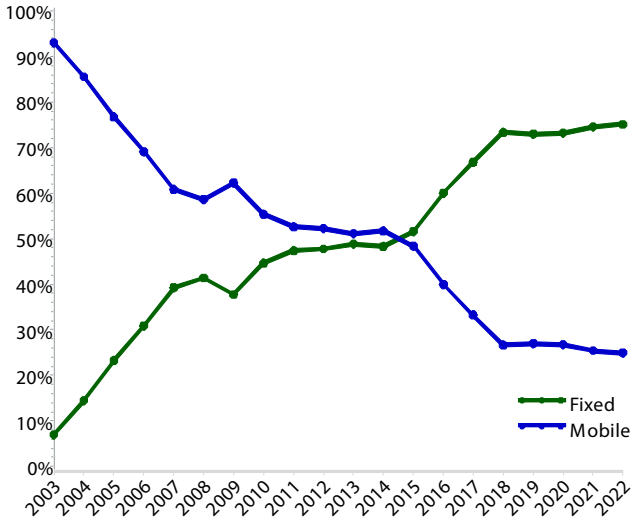


Figure KP6 Primary Unicompartmental Knee Replacement by Robotic Assistance (Primary Diagnosis OA)

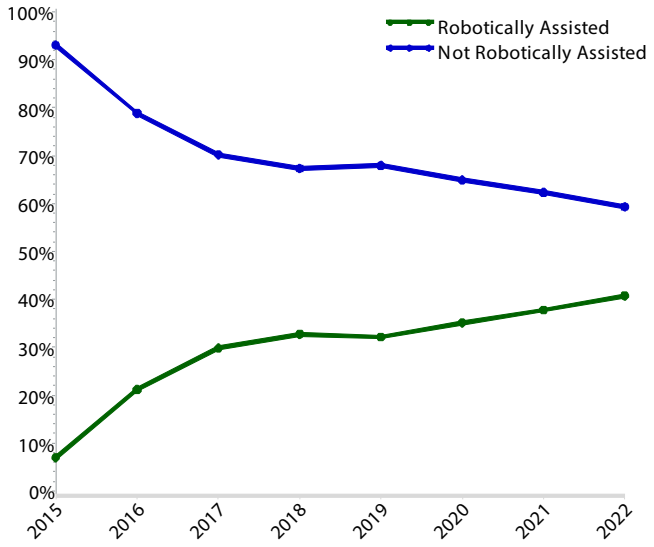


Table KP4 Age and Gender of Primary Unicompartmental Knee Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	38774	54.7%	24	98	66	65.8	9.6
Female	32151	45.3%	13	98	65	65.0	10.2
TOTAL	**70925**	**100.0%**	**13**	**98**	**65**	**65.4**	**9.9**

Table KP5 10 Most Used Tibial Prostheses in Primary Unicompartmental Knee Replacement

2003		2019		2020		2021		2022	
N	Model	N	Model	N	Model	N	Model	N	Model
1365	Oxford (ctd)	1094	Restoris MCK	1147	Restoris MCK	1199	Restoris MCK	1266	Restoris MCK
444	Repicci II	897	ZUK	813	Oxford (cless)	775	Oxford (cless)	739	Oxford (cless)
373	Preservation Fixed	831	Oxford (cless)	712	ZUK	532	Persona	694	Persona
353	M/G	208	BalanSys Uni Fixed	176	BalanSys Uni Fixed	281	ZUK	144	Journey Uni (v2)
336	Allegretto Uni	196	Journey Uni (v2)	168	Sigma HP	177	Sigma HP	134	Sigma HP
321	GRU	168	Oxford (ctd)	153	Journey Uni (v2)	163	BalanSys Uni Fixed	125	BalanSys Uni Fixed
275	Genesis	162	Sigma HP	138	Oxford (ctd)	157	Journey Uni (v2)	111	Genus
260	Unix	118	Genus	130	Genus	124	Oxford (ctd)	103	Oxford (ctd)
121	Preservation Mobile	24	Journey Uni All Poly	68	Persona	107	Genus	31	ZUK
101	Endo-Model Sled	17	Endo-Model Sled	20	Endo-Model Sled	10	Journey Uni All Poly	17	Moto
10 Most Used									
3949	(10) 96.2%	3715	(10) 98.9%	3525	(10) 98.7%	3525	(10) 99.3%	3364	(10) 99.6%
Remainder									
158	(7) 3.8%	40	(6) 1.1%	46	(6) 1.3%	24	(5) 0.7%	13	(5) 0.4%
TOTAL									
4107	(17) 100.0%	3755	(16) 100.0%	3571	(16) 100.0%	3549	(15) 100.0%	3377	(15) 100.0%

Table KP6 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	61	1211	1.9 (1.3, 2.9)	3.8 (2.8, 5.1)	4.4 (3.2, 5.9)	8.0 (5.9, 10.9)	12.4 (8.8, 17.5)	
Endo-Model Sled	Endo-Model Sled	229	1334	1.3 (0.8, 2.1)	5.2 (4.1, 6.5)	8.1 (6.7, 9.7)	14.7 (12.8, 16.9)	22.1 (19.5, 25.0)	
Genus	Genus	20	507	3.0 (1.7, 5.1)	4.7 (3.0, 7.3)				
Journey Uni	Journey Uni (v2)	71	1352	2.3 (1.6, 3.3)	4.7 (3.6, 6.1)	6.1 (4.8, 7.8)			
	Journey Uni All Poly	46	343	1.5 (0.6, 3.5)	6.6 (4.4, 9.9)	9.1 (6.4, 12.8)	15.9 (11.9, 21.1)		
Oxford (cless)	Oxford (cless)	642	9002	2.6 (2.3, 3.0)	4.6 (4.2, 5.1)	5.9 (5.4, 6.4)	10.7 (9.8, 11.7)	19.1 (16.1, 22.6)	
	Oxford (ctd)	52	486	3.2 (1.9, 5.2)	6.2 (4.4, 8.9)	8.9 (6.6, 11.9)	14.3 (10.4, 19.3)		
Oxford (ctd)	Oxford (ctd)	2666	13631	2.2 (1.9, 2.4)	5.7 (5.3, 6.1)	8.1 (7.7, 8.6)	14.5 (13.9, 15.2)	22.0 (21.2, 22.9)	30.9 (29.6, 32.2)
Persona	Persona	15	1294	1.4 (0.8, 2.4)					
Restoris MCK	Restoris MCK	228	7634	1.2 (1.0, 1.5)	3.3 (2.8, 3.8)	4.3 (3.8, 5.0)			
Sigma HP	Sigma HP	90	1781	0.9 (0.6, 1.5)	2.8 (2.1, 3.8)	4.5 (3.6, 5.8)	8.0 (6.3, 10.2)		
Triathlon PKR	Triathlon PKR	36	380	3.2 (1.8, 5.5)	6.8 (4.6, 9.8)	8.3 (5.9, 11.6)	12.3 (8.5, 17.4)		
ZUK	ZUK	643	9613	1.5 (1.3, 1.7)	3.4 (3.1, 3.8)	4.6 (4.1, 5.0)	7.9 (7.3, 8.7)	12.3 (11.1, 13.6)	
Other (6)		61	382	5.6 (3.6, 8.5)	12.0 (9.0, 16.0)	16.9 (13.2, 21.5)	20.1 (15.9, 25.3)		
TOTAL		**4860**	**48950**						

Note: Restricted to modern prostheses
Only prostheses with >200 procedures have been listed

Primary Partial Knee Replacement Summary

OUTCOME FOR OSTEOARTHRITIS

In order to keep Registry data contemporaneous, only procedures using prostheses that have been available and used in 2022 (described as modern prostheses) are included in the analyses, unless clearly specified.

There are 4,813 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 11.7% at 10 years and 27.8% at 20 years (Table KP7 and Figure KP7).

The main reasons for revision of unicompartmental knee replacement are progression of disease, loosening and pain (Table KP8 and Figure KP8). The main type of revision is to a total knee replacement (Table KP9).

Patient Characteristics

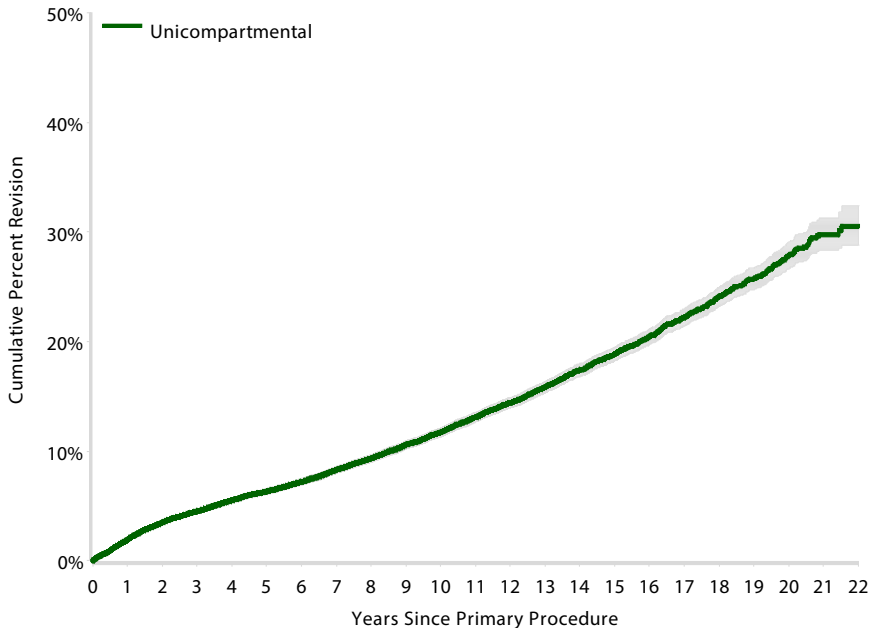
Age is a major factor affecting the outcome of primary unicompartmental knee replacement, with the rate of revision decreasing with increasing age (Table KP10 and Figure KP9). Females have a higher rate of revision than males (Table KP11 and Figure KP10). The main reason for this difference is an increased cumulative incidence for progression of disease (Figure KP11). The effect of age on the rate of revision is evident in both males and females (Table KP11, Figure KP12 and Figure KP13).

Table KP7 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	4813	48544	1.9 (1.8, 2.1)	4.5 (4.3, 4.7)	6.3 (6.1, 6.6)	11.7 (11.3, 12.1)	18.8 (18.2, 19.5)	27.8 (26.7, 29.0)
TOTAL	**4813**	**48544**						

Note: Restricted to modern prostheses

Figure KP7 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	48544	44145	35682	27450	13558	5338	906

Note: Restricted to modern prostheses

Table KP8 Primary Unicompartmental Knee Replacement by Reason for Revision (Primary Diagnosis OA)

Reason for Revision	Number	Percent
Progression Of Disease	1776	36.9
Loosening	1527	31.7
Pain	359	7.5
Infection	251	5.2
Bearing Dislocation	179	3.7
Fracture	141	2.9
Instability	89	1.8
Lysis	88	1.8
Wear Tibial Insert	76	1.6
Malalignment	60	1.2
Other (14)	267	5.5
TOTAL	**4813**	**100.0**

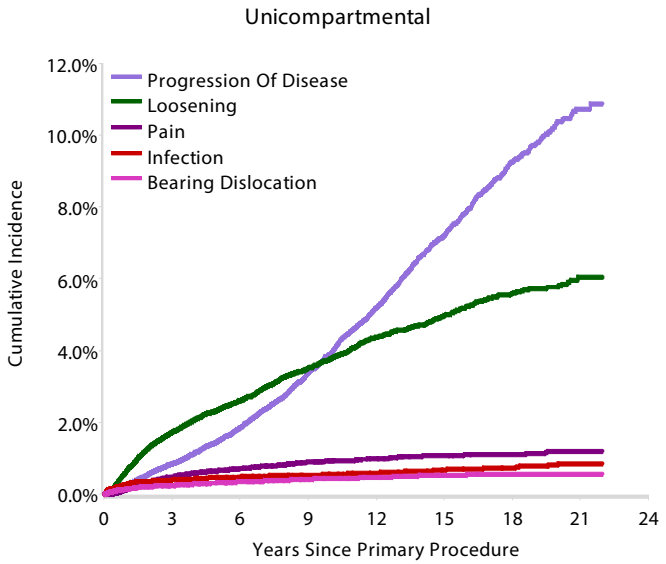
Note: Restricted to modern prostheses

Table KP9 Primary Unicompartmental Knee Replacement by Type of Revision (Primary Diagnosis OA)

Type of Revision	Number	Percent
TKR (Tibial/Femoral)	4061	84.4
Uni Insert Only	497	10.3
Uni Tibial Component	99	2.1
Uni Femoral Component	50	1.0
Cement Spacer	39	0.8
UKR (Uni Tibial/Uni Femoral)	34	0.7
Patella/Trochlear Resurfacing	17	0.4
Removal of Prostheses	5	0.1
Reinsertion of Components	4	0.1
Femoral Component*	4	0.1
Tibial Component	2	0.0
Patella Only	1	0.0
TOTAL	**4813**	**100.0**

Note: Restricted to modern prostheses. *Bicompartmental component

Figure KP8 Cumulative Incidence Revision Diagnosis of Primary Unicompartmental Knee Replacement (Primary Diagnosis OA)



Note: Restricted to modern prostheses

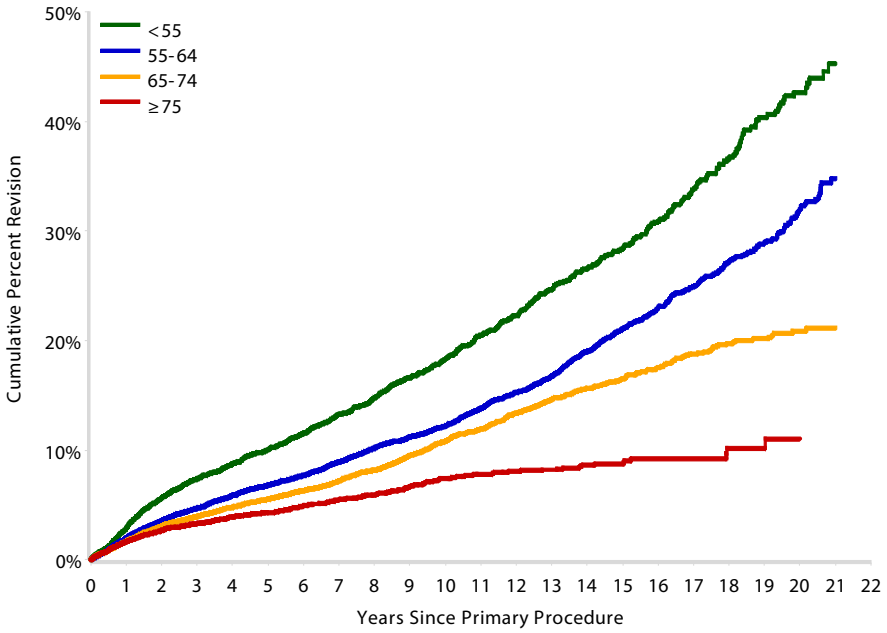
Primary Partial Knee Replacement Summary

Table KP10 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	1056	6333	2.9 (2.5, 3.3)	7.4 (6.8, 8.1)	10.1 (9.3, 10.9)	18.3 (17.1, 19.6)	28.4 (26.6, 30.2)	42.6 (39.5, 45.9)
55-64	1865	15882	2.0 (1.8, 2.2)	4.7 (4.4, 5.1)	6.8 (6.4, 7.2)	12.2 (11.6, 12.9)	21.1 (20.0, 22.1)	32.0 (30.0, 34.0)
65-74	1424	17024	1.7 (1.5, 1.9)	3.9 (3.6, 4.3)	5.5 (5.1, 5.9)	10.8 (10.2, 11.4)	16.5 (15.6, 17.5)	20.9 (19.4, 22.4)
≥75	468	9305	1.6 (1.4, 1.9)	3.3 (2.9, 3.7)	4.3 (3.9, 4.8)	7.4 (6.7, 8.2)	8.7 (7.8, 9.7)	11.0 (8.9, 13.7)
TOTAL	**4813**	**48544**						

Note: Restricted to modern prostheses

Figure KP9 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement by Age (Primary Diagnosis OA)



HR – adjusted for gender

<55 vs ≥75

- 0 – 9Mth: HR=1.75 (1.38, 2.20), p<0.001
- 9Mth – 3Yr: HR=2.69 (2.29, 3.16), p<0.001
- 3Yr – 6Yr: HR=2.65 (2.16, 3.25), p<0.001
- 6Yr – 12Yr: HR=3.50 (2.88, 4.25), p<0.001
- 12Yr – 12.5Yr: HR=8.19 (4.78, 14.05), p<0.001
- 12.5Yr – 13Yr: HR=4.84 (2.61, 8.98), p<0.001
- 13Yr – 14Yr: HR=4.26 (2.62, 6.92), p<0.001
- 14Yr+: HR=8.05 (5.80, 11.18), p<0.001

55-64 vs ≥75

- 0 – 1Mth: HR=0.73 (0.44, 1.21), p=0.225
- 1Mth – 6Mth: HR=1.44 (1.12, 1.85), p=0.004
- 6Mth – 9Mth: HR=1.29 (0.96, 1.72), p=0.088
- 9Mth – 1.5Yr: HR=1.39 (1.14, 1.70), p=0.001
- 1.5Yr – 7Yr: HR=1.91 (1.66, 2.20), p<0.001
- 7Yr – 11Yr: HR=2.34 (1.89, 2.90), p<0.001
- 11Yr – 11.5Yr: HR=3.44 (2.22, 5.34), p<0.001
- 11.5Yr – 12Yr: HR=2.07 (1.27, 3.38), p=0.003
- 12Yr – 14Yr: HR=4.16 (3.02, 5.74), p<0.001
- 14Yr+: HR=5.90 (4.35, 7.99), p<0.001

65-74 vs ≥75

- 0 – 1.5Yr: HR=1.14 (0.97, 1.35), p=0.101
- 1.5Yr – 7Yr: HR=1.48 (1.28, 1.71), p<0.001
- 7Yr+: HR=2.36 (1.94, 2.88), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
<55	6333	5723	4608	3599	1845	791	150
55-64	15882	14550	11978	9450	5040	2126	391
65-74	17024	15491	12471	9518	4597	1824	315
≥75	9305	8381	6625	4883	2076	597	50

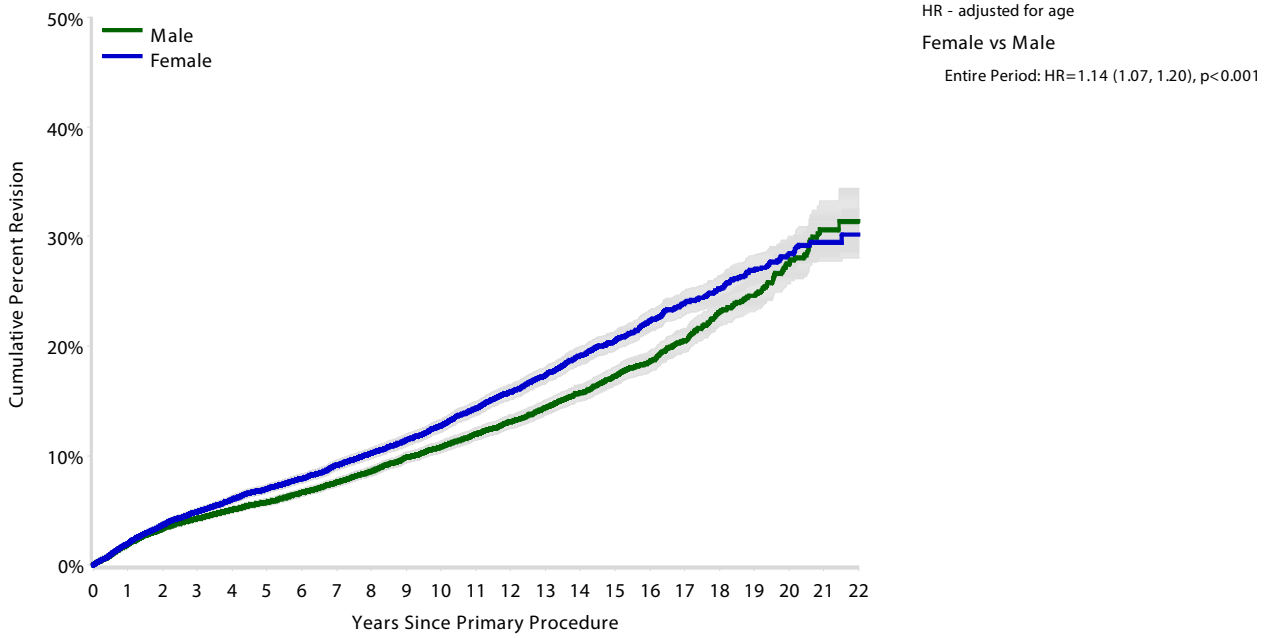
Note: Restricted to modern prostheses

Table KP11 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		2314	26821	1.9 (1.7, 2.0)	4.2 (4.0, 4.5)	5.8 (5.5, 6.1)	10.8 (10.3, 11.3)	17.2 (16.4, 18.1)	27.5 (25.7, 29.4)
	<55	455	3017	3.0 (2.4, 3.7)	7.1 (6.2, 8.1)	9.2 (8.1, 10.4)	17.9 (16.1, 19.8)	28.4 (25.6, 31.4)	46.2 (40.8, 52.0)
	55-64	938	8863	2.0 (1.7, 2.3)	4.6 (4.2, 5.1)	6.4 (5.9, 7.0)	11.9 (11.0, 12.8)	19.6 (18.2, 21.1)	31.6 (28.7, 34.7)
	65-74	702	9755	1.6 (1.4, 1.9)	3.7 (3.3, 4.1)	5.1 (4.7, 5.6)	9.6 (8.8, 10.5)	14.6 (13.3, 15.9)	19.5 (17.2, 21.9)
	≥75	219	5186	1.5 (1.2, 1.9)	3.0 (2.5, 3.5)	3.8 (3.2, 4.4)	6.3 (5.5, 7.4)	7.6 (6.4, 9.1)	
Female		2499	21723	2.0 (1.8, 2.2)	4.9 (4.6, 5.2)	6.9 (6.6, 7.3)	12.7 (12.1, 13.3)	20.5 (19.6, 21.4)	28.4 (26.9, 30.0)
	<55	601	3316	2.8 (2.3, 3.4)	7.7 (6.8, 8.7)	10.8 (9.7, 12.0)	18.7 (17.1, 20.4)	28.4 (26.2, 30.8)	40.5 (36.9, 44.4)
	55-64	927	7019	2.0 (1.7, 2.3)	4.9 (4.4, 5.4)	7.3 (6.6, 7.9)	12.6 (11.7, 13.6)	22.5 (21.0, 24.1)	32.5 (29.8, 35.3)
	65-74	722	7269	1.8 (1.5, 2.1)	4.3 (3.8, 4.8)	5.9 (5.4, 6.6)	12.2 (11.2, 13.3)	18.8 (17.3, 20.3)	22.6 (20.7, 24.7)
	≥75	249	4119	1.8 (1.4, 2.2)	3.6 (3.1, 4.3)	4.9 (4.3, 5.7)	8.4 (7.4, 9.7)	9.9 (8.6, 11.4)	
TOTAL		4813	48544						

Note: Restricted to modern prostheses

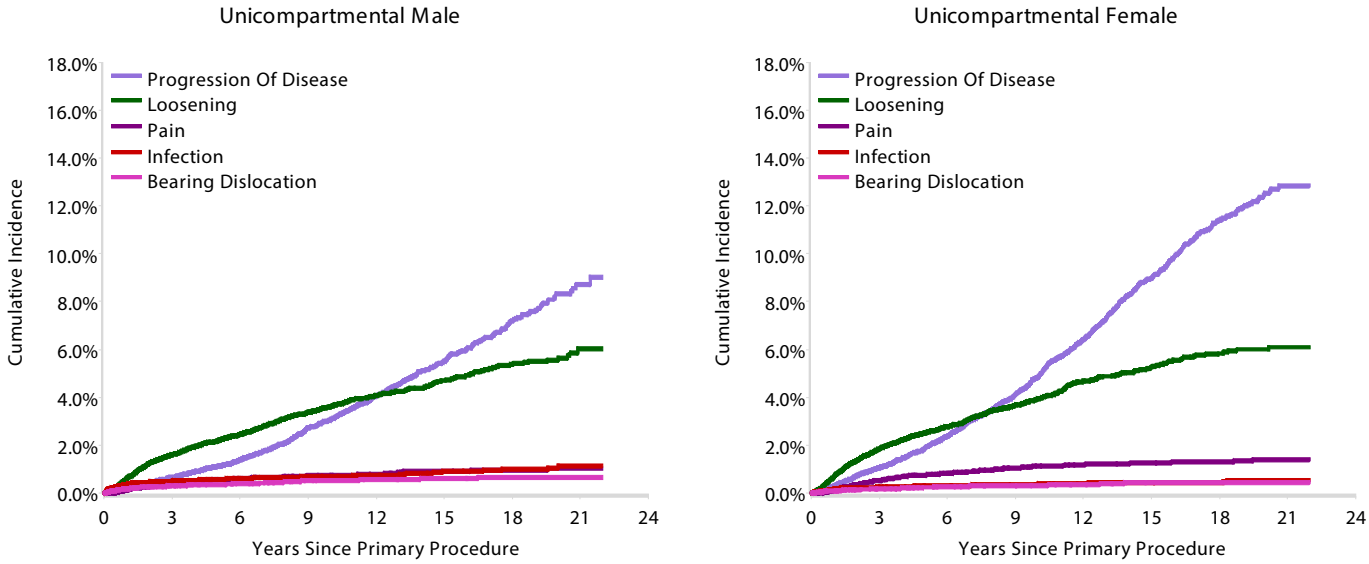
Figure KP10 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement by Gender (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Male	26821	24174	19175	14516	6696	2496	401
Female	21723	19971	16507	12934	6862	2842	505

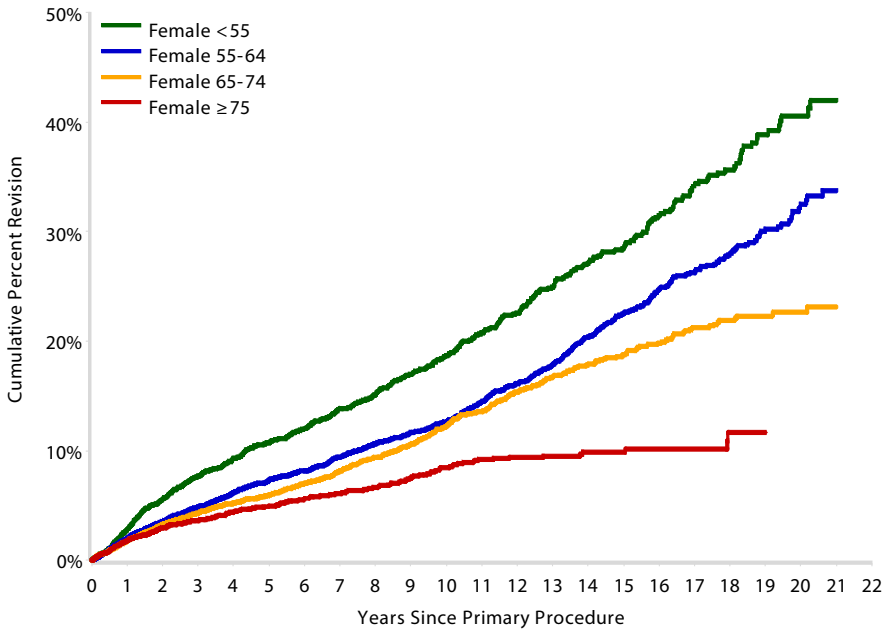
Note: Restricted to modern prostheses

Figure KP11 Cumulative Incidence Revision Diagnosis of Primary Unicompartmental Knee Replacement by Gender (Primary Diagnosis OA)



Note: Restricted to modern prostheses

Figure KP12 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement for Females by Age (Primary Diagnosis OA)



Female <55 vs Female ≥75
- 0 - 1.5Yr: HR=2.24 (1.75, 2.86), p<0.001
- 1.5Yr - 2Yr: HR=1.95 (1.27, 2.99), p=0.002
- 2Yr - 4Yr: HR=2.56 (1.98, 3.32), p<0.001
- 4Yr - 4.5Yr: HR=3.14 (1.91, 5.17), p<0.001
- 4.5Yr - 11Yr: HR=2.52 (2.02, 3.15), p<0.001
- 11Yr - 11.5Yr: HR=3.09 (1.39, 6.86), p=0.005
- 11.5Yr+: HR=5.99 (3.91, 9.17), p<0.001

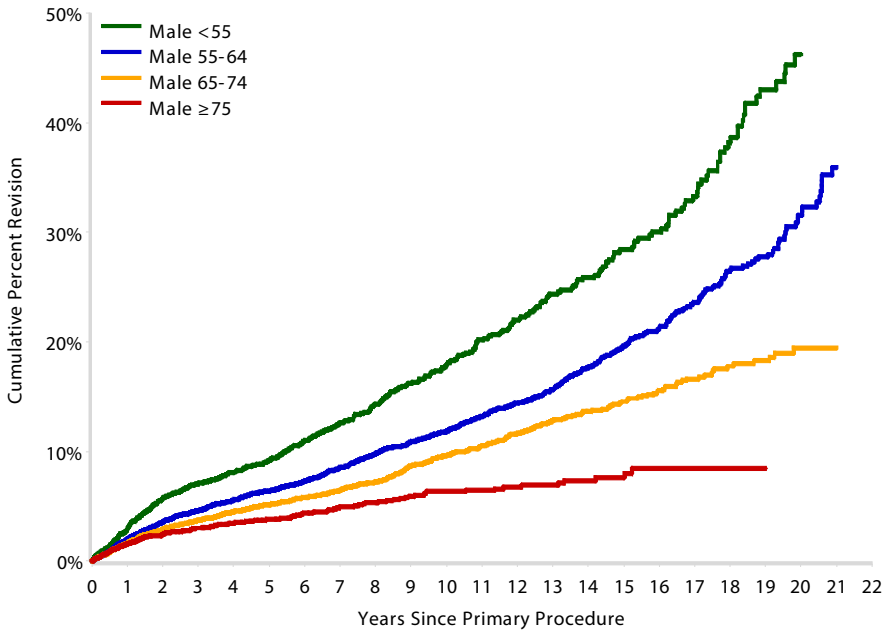
Female 55-64 vs Female ≥75
- 0 - 3Mth: HR=1.06 (0.67, 1.69), p=0.802
- 3Mth - 6Mth: HR=2.40 (1.53, 3.75), p<0.001
- 6Mth - 1.5Yr: HR=1.27 (0.98, 1.65), p=0.071
- 1.5Yr - 11Yr: HR=1.72 (1.45, 2.03), p<0.001
- 11Yr - 11.5Yr: HR=3.13 (1.62, 6.06), p<0.001
- 11.5Yr+: HR=4.82 (3.20, 7.24), p<0.001

Female 65-74 vs Female ≥75
- 0 - 9Mth: HR=1.28 (0.94, 1.74), p=0.113
- 9Mth - 3.5Yr: HR=1.31 (1.07, 1.59), p=0.008
- 3.5Yr - 6.5Yr: HR=1.37 (1.06, 1.77), p=0.015
- 6.5Yr - 7.5Yr: HR=2.04 (1.40, 2.99), p<0.001
- 7.5Yr - 10.5Yr: HR=1.96 (1.50, 2.55), p<0.001
- 10.5Yr+: HR=2.49 (1.69, 3.67), p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Female	<55	3316	3054	2523	1992	1089	491	95
	55-64	7019	6514	5485	4409	2500	1085	205
	65-74	7269	6674	5435	4225	2158	907	167
	≥75	4119	3729	3064	2308	1115	359	38

Note: Restricted to modern prostheses

Figure KP13 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement for Males by Age (Primary Diagnosis OA)



Male <55 vs Male ≥75
- 0 - 1.5Yr: HR=2.05 (1.58, 2.65), p<0.001
- 1.5Yr - 2Yr: HR=4.93 (3.21, 7.58), p<0.001
- 2Yr - 5.5Yr: HR=3.21 (2.40, 4.29), p<0.001
- 5.5Yr - 6Yr: HR=4.54 (2.44, 8.46), p<0.001
- 6Yr - 7Yr: HR=3.81 (2.33, 6.22), p<0.001
- 7Yr - 11Yr: HR=4.04 (2.94, 5.56), p<0.001
- 11Yr - 12Yr: HR=3.32 (1.76, 6.27), p<0.001
- 12Yr+: HR=6.30 (4.39, 9.03), p<0.001

Male 55-64 vs Male ≥75
- 0 - 1.5Yr: HR=1.30 (1.03, 1.64), p=0.024
- 1.5Yr - 7Yr: HR=2.49 (2.00, 3.11), p<0.001
- 7Yr - 7.5Yr: HR=2.71 (1.56, 4.71), p<0.001
- 7.5Yr - 8.5Yr: HR=2.73 (1.78, 4.18), p<0.001
- 8.5Yr - 11.5Yr: HR=2.24 (1.63, 3.08), p<0.001
- 11.5Yr - 12Yr: HR=1.37 (0.64, 2.93), p=0.415
- 12Yr+: HR=4.11 (2.98, 5.67), p<0.001

Male 65-74 vs Male ≥75
- 0 - 1.5Yr: HR=1.09 (0.87, 1.38), p=0.447
- 1.5Yr+: HR=1.86 (1.52, 2.29), p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Male	<55	3017	2669	2085	1607	756	300	55
	55-64	8863	8036	6493	5041	2540	1041	186
	65-74	9755	8817	7036	5293	2439	917	148
	≥75	5186	4652	3561	2575	961	238	12

Note: Restricted to modern prostheses

OUTCOME BY PROSTHESIS CHARACTERISTICS

Bearing Mobility

Fixed bearings are used in 52.5% of unicompartmental knee replacements, while in the remainder the bearing insert is mobile.

There are three prostheses using mobile bearings in 2022. Fixed bearing prostheses have a lower rate of revision compared to mobile bearing prostheses (Table KP12 and Figure KP14).

Robotic Assistance

There are 8,246 robotically assisted unicompartmental knee replacement procedures undertaken for osteoarthritis recorded since 2015. In 2022, 40.7% of unicompartmental knee procedures use robotic assistance. There are only four unicompartmental combinations that can be used with robotic assistance.

When adjusted for age, gender, ASA, BMI, and mobility, unicompartmental knee procedures using robotic assistance have a lower rate of revision compared to unicompartmental procedures without robotic assistance (Table KP13 and Figure KP15). When using robotic assistance, there are fewer revisions for loosening, progression of disease and pain, but more revisions for infection (Table KP14 and Figure KP16).

Position

There are 1,255 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 KP15 and Figure KP17). Fixed bearing prostheses have a lower rate of revision compared to mobile bearings used for lateral unicompartmental knee replacement (Table KP16 and Figure KP18).

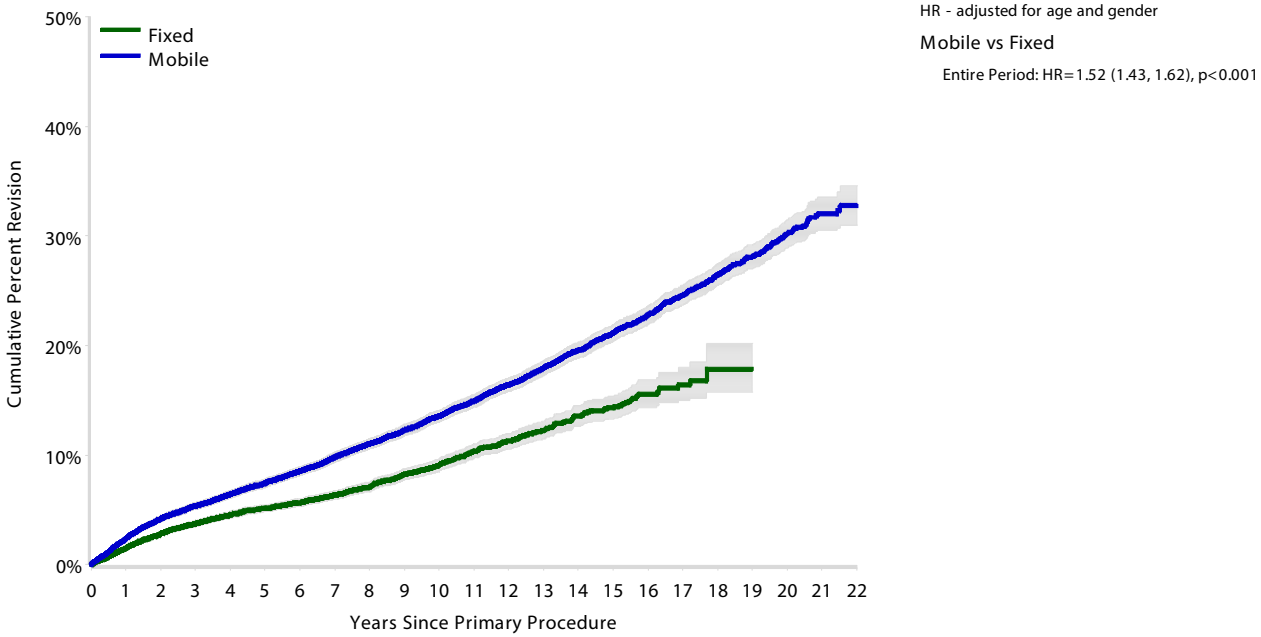
The most common reasons for revision of both lateral and medial unicompartmental knees are progression of disease and loosening (Table KP17 and Figure KP19).

Table KP12 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	1464	25469	1.5 (1.4, 1.7)	3.7 (3.5, 4.0)	5.1 (4.8, 5.4)	9.1 (8.5, 9.6)	14.3 (13.3, 15.4)	
Mobile	3348	23071	2.4 (2.2, 2.6)	5.3 (5.0, 5.6)	7.4 (7.1, 7.8)	13.5 (13.0, 14.1)	21.1 (20.4, 21.9)	30.2 (28.9, 31.5)
TOTAL	**4812**	**48540**						

Note: Excludes 4 primary unicompartmental knee procedures with unknown/missing mobility
Restricted to modern prostheses

Figure KP14 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	25469	22528	16774	11210	4084	958	9
Mobile	23071	21616	18907	16240	9474	4380	897

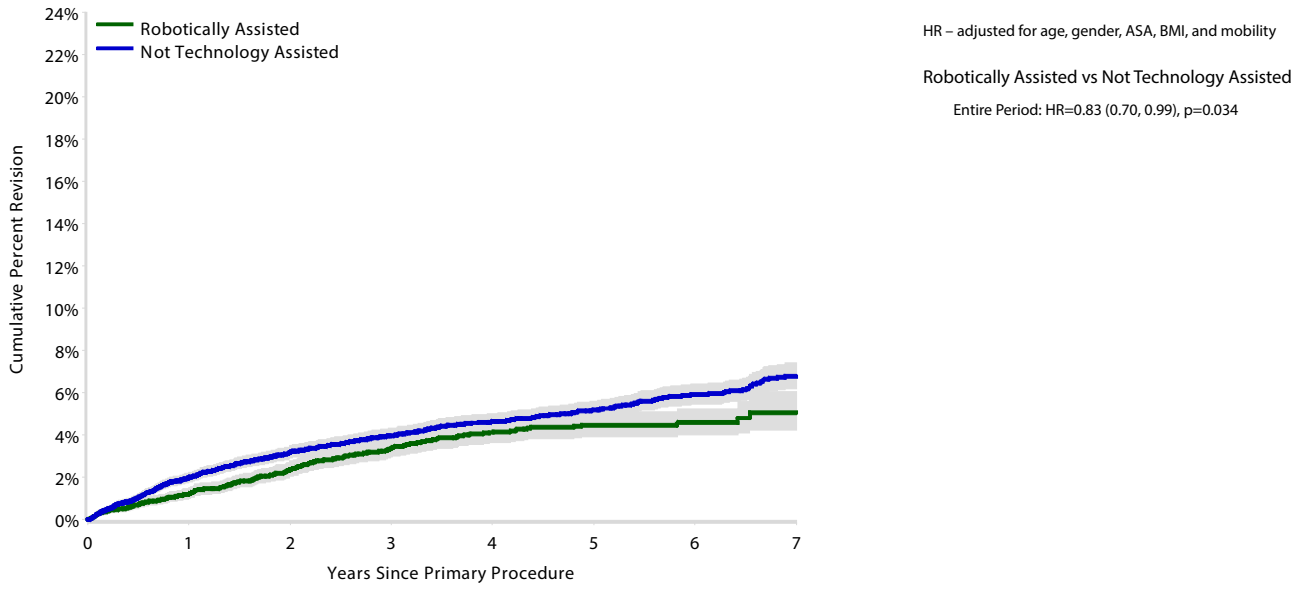
Note: Restricted to modern prostheses

Table KP13 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
Robotically Assisted	253	8246	1.2 (1.0, 1.5)	2.4 (2.0, 2.8)	3.4 (2.9, 3.9)	4.1 (3.6, 4.7)	4.5 (3.9, 5.1)	4.6 (4.0, 5.2)	5.1 (4.2, 6.1)
Not Technology Assisted	679	15386	2.0 (1.8, 2.2)	3.2 (2.9, 3.5)	4.0 (3.7, 4.3)	4.6 (4.3, 5.0)	5.2 (4.8, 5.6)	5.9 (5.5, 6.4)	6.8 (6.2, 7.4)
TOTAL	**932**	**23632**							

Note: Restricted to modern prostheses

Figure KP15 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
Robotically Assisted	8246	6779	5373	4096	2916	1747	721	135
Not Technology Assisted	15386	13398	11414	9460	7263	5200	3273	1544

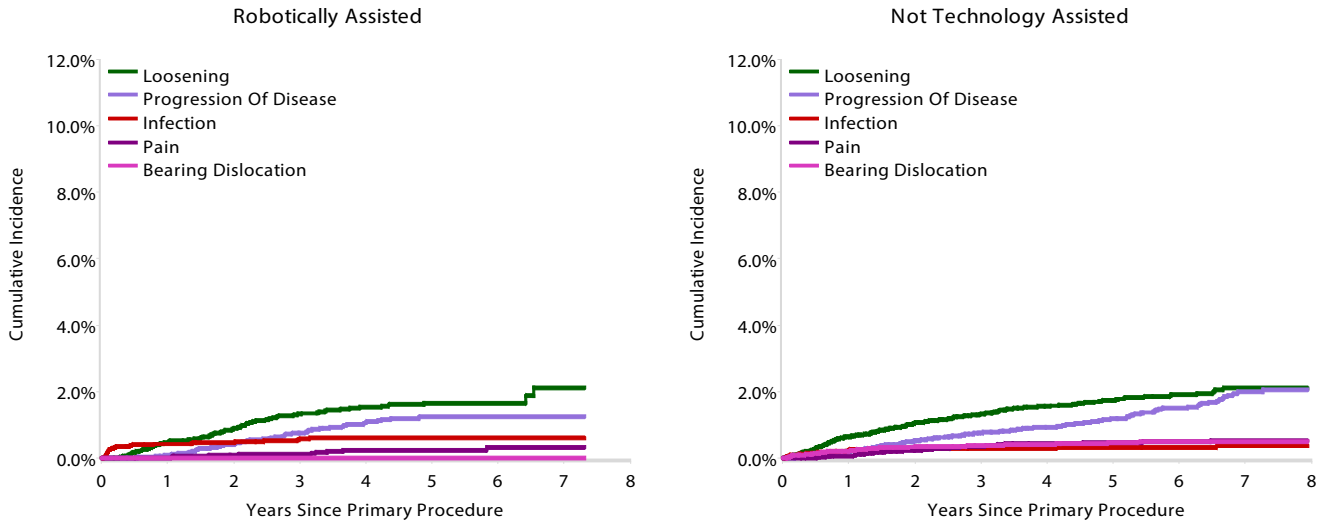
Note: Restricted to modern prostheses

Table KP14 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	95	1.2	37.5	222	1.4	32.7
Progression Of Disease	60	0.7	23.7	157	1.0	23.1
Bearing Dislocation				61	0.4	9.0
Pain	13	0.2	5.1	57	0.4	8.4
Fracture	7	0.1	2.8	51	0.3	7.5
Infection	43	0.5	17.0	46	0.3	6.8
Instability	7	0.1	2.8	28	0.2	4.1
Malalignment	5	0.1	2.0	13	0.1	1.9
Prosthesis Dislocation	1	0.0	0.4	8	0.1	1.2
Lysis	4	0.0	1.6	6	0.0	0.9
Incorrect Sizing				4	0.0	0.6
Implant Breakage Tibial	3	0.0	1.2	1	0.0	0.1
Implant Breakage Tibial Insert	1	0.0	0.4	2	0.0	0.3
Metal Related Pathology	1	0.0	0.4	2	0.0	0.3
Osteonecrosis	2	0.0	0.8	2	0.0	0.3
Patella Erosion				2	0.0	0.3
Patellofemoral Pain	1	0.0	0.4	2	0.0	0.3
Synovitis	1	0.0	0.4	2	0.0	0.3
Wear Tibial Insert	1	0.0	0.4	2	0.0	0.3
Arthrofibrosis	1	0.0	0.4	1	0.0	0.1
Wear Femoral				1	0.0	0.1
Other	7	0.1	2.8	9	0.1	1.3
N Revision	**253**	**3.1**	**100.0**	**679**	**4.4**	**100.0**
N Primary	**8246**			**15386**		

Note: Restricted to modern prostheses

Figure KP16 Cumulative Incidence Revision Diagnosis of Primary Unicompartmental Knee Replacement Since 2015 by Robotic Assistance (Primary Diagnosis OA)



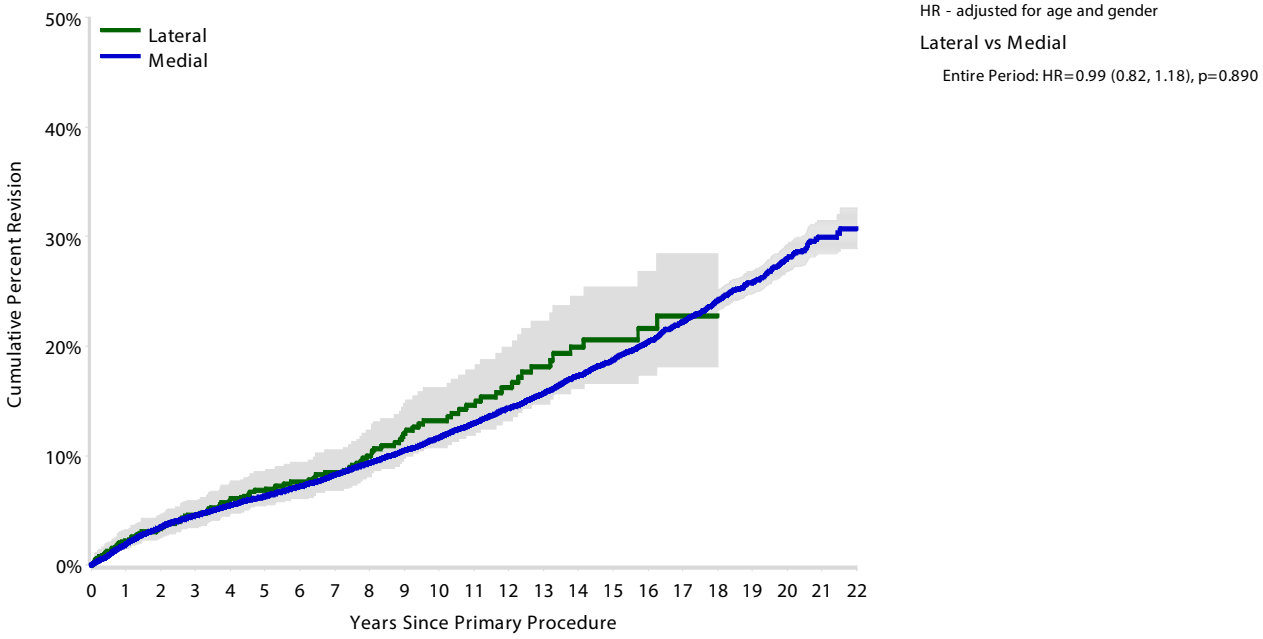
Note: Restricted to modern prostheses

Table KP15 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	120	1255	2.2 (1.5, 3.2)	4.5 (3.5, 5.9)	6.8 (5.4, 8.5)	13.2 (10.7, 16.2)	20.6 (16.6, 25.4)	
Medial	4622	46788	1.9 (1.8, 2.1)	4.5 (4.3, 4.7)	6.3 (6.0, 6.5)	11.6 (11.2, 12.0)	18.7 (18.1, 19.4)	28.0 (26.8, 29.2)
TOTAL	**4742**	**48043**						

Note: Excludes 501 primary unicompartmental knee procedures with unknown/missing position
Restricted to modern prostheses

Figure KP17 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	1255	1148	941	674	265	93	22
Medial	46788	42545	34385	26491	13100	5142	875

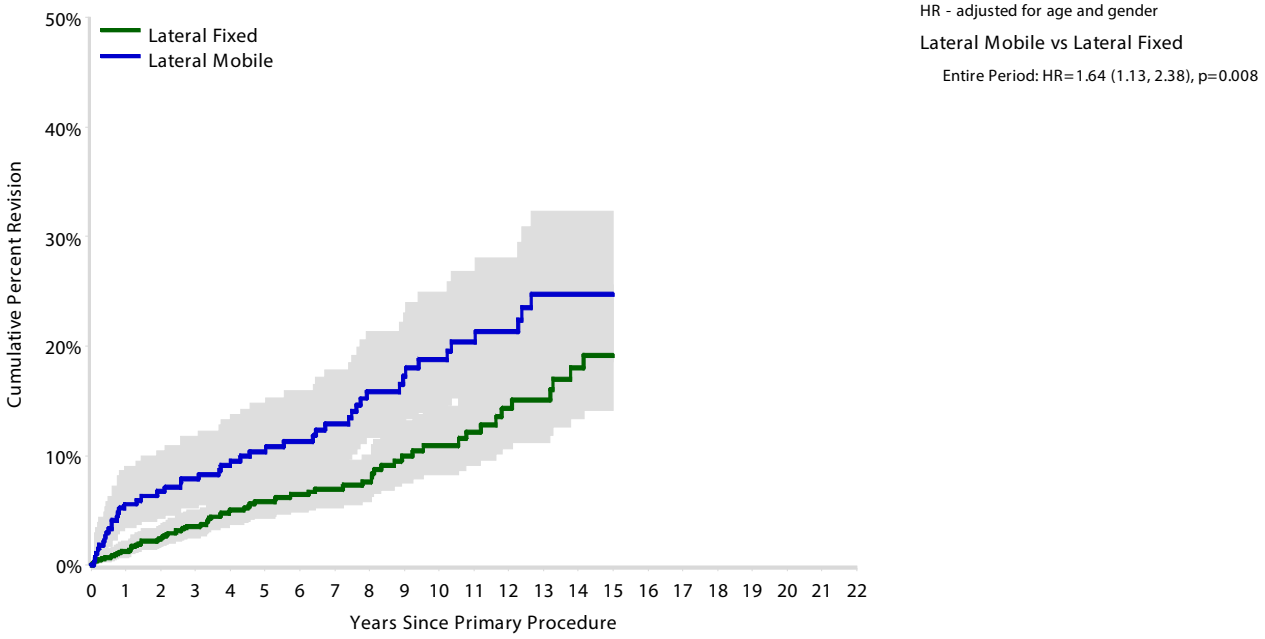
Note: Restricted to modern prostheses

Table KP16 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	71	983	1.3 (0.7, 2.2)	3.6 (2.5, 5.0)	5.8 (4.3, 7.7)	11.0 (8.2, 14.5)	19.1 (14.1, 25.6)
	Mobile	49	271	5.6 (3.4, 9.0)	7.9 (5.2, 11.8)	10.4 (7.2, 14.8)	18.7 (14.0, 24.9)	24.7 (18.6, 32.3)
TOTAL		**120**	**1254**					

Note: Excludes 505 primary unicompartmental knee procedures with unknown/missing position or mobility
Restricted to modern prostheses

Figure KP18 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	983	895	707	478	165	51	0
	Mobile	271	253	234	196	100	42	22

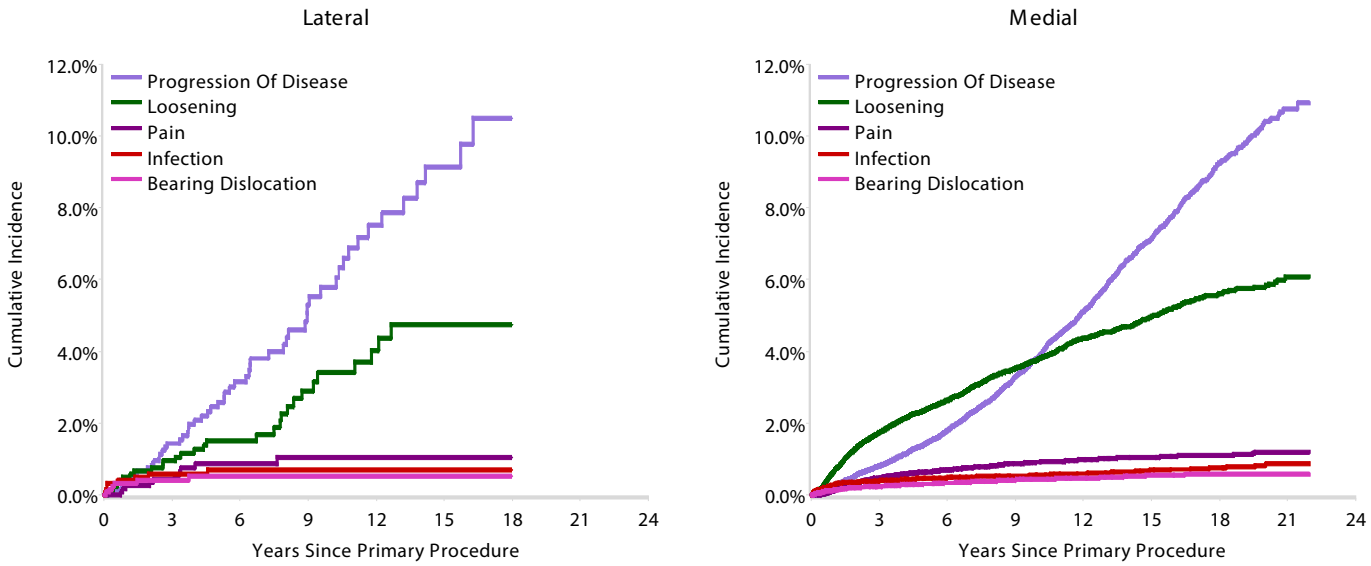
Note: Restricted to modern prostheses

Table KP17 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	56	4.5	46.7	1689	3.6	36.5
Loosening	29	2.3	24.2	1478	3.2	32.0
Pain	10	0.8	8.3	341	0.7	7.4
Infection	8	0.6	6.7	243	0.5	5.3
Bearing Dislocation	6	0.5	5.0	173	0.4	3.7
Fracture	2	0.2	1.7	137	0.3	3.0
Instability	2	0.2	1.7	87	0.2	1.9
Lysis				86	0.2	1.9
Wear Tibial Insert	2	0.2	1.7	71	0.2	1.5
Malalignment	3	0.2	2.5	56	0.1	1.2
Other	2	0.2	1.7	261	0.6	5.6
N Revision	**120**	**9.6**	**100.0**	**4622**	**9.9**	**100.0**
N Primary	**1255**			**46788**		

Note: Restricted to modern prostheses

Figure KP19 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 886,536 primary total knee replacement procedures recorded. This is an additional 57,264 procedures compared to the last report.

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

In 2022, there is a decrease of 5.3% in primary total knee replacement procedures when compared to 2021. As a proportion of all knee replacement procedures, primary total knee replacement increased to 87.1% in 2022.

Osteoarthritis is the most common diagnosis for primary total knee replacement.

Primary total knee replacement remains more common in females (55.8%). This proportion has shown little change from 2003. The mean age of patients is 68.4 years (Table KT1 and Figure KT1).

Figure KT1 Primary Total Knee Replacement by Gender

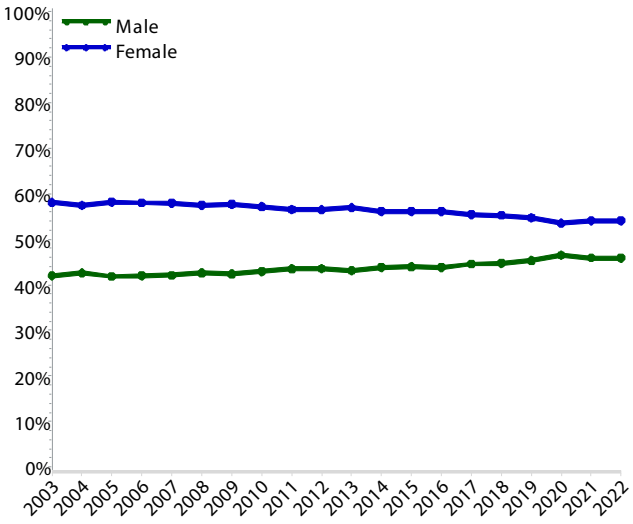


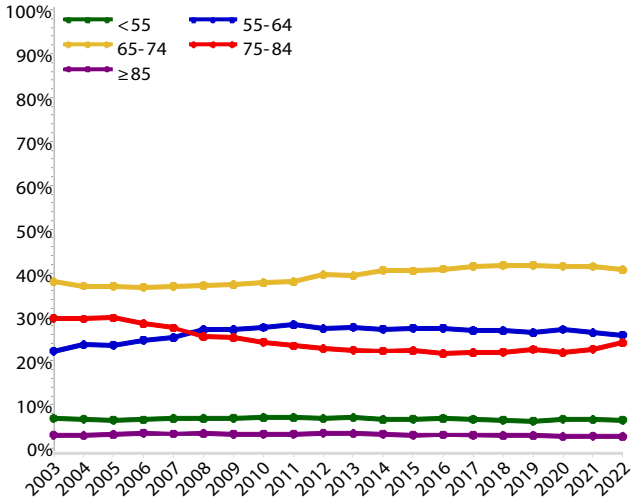
Table KT1 Age and Gender of Primary Total Knee Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	334954	44.2%	11	101	68	68.0	9.0
Female	422995	55.8%	10	100	69	68.7	9.3
TOTAL	**757949**	**100.0%**	**10**	**101**	**69**	**68.4**	**9.2**

There are 886,536 primary total knee replacement procedures.
This is an increase of 57,264 procedures compared to the last report.

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).

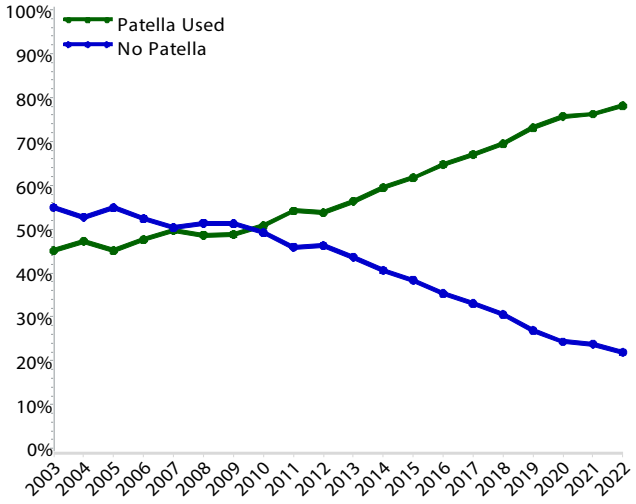
Figure KT2 Primary Total Knee Replacement by Age



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-2023

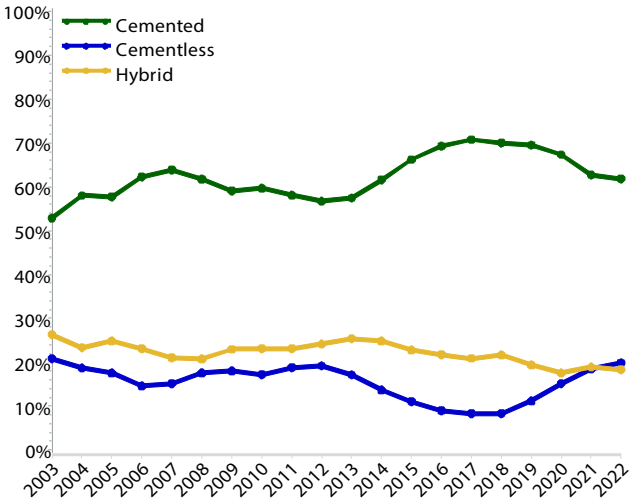
Patella resurfacing at the time of the primary total knee replacement has increased to 78.1% in 2022 (Figure KT3).

Figure KT3 Primary Total Knee Replacement by Patella Component Usage



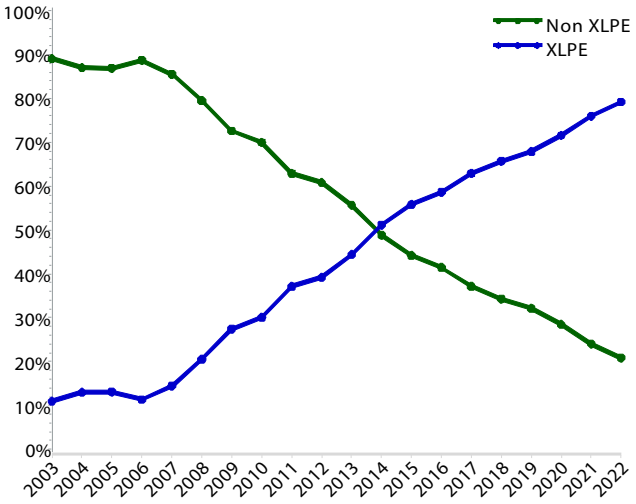
The most common method of fixation is cementing both femoral and tibial components. This accounts for 61.8% of procedures in 2022. The use of cementless fixation decreased to 8.3% of all primary total knee replacement in 2018 but has increased to 19.9% in 2022 (Figure KT4). Hybrid fixation for primary total knee replacement (femoral cementless) was used in 18.3% of procedures in 2022.

Figure KT4 Primary Total Knee Replacement by Fixation



The use of cross-linked polyethylene (XLPE) in primary total knee replacement increased to 79.2% in 2022 (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 2022, 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 2022 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		2019		2020		2021		2022	
N	Model	N	Model	N	Model	N	Model	N	Model
2251	LCS CR	13408	Triathlon CR	13772	Triathlon CR	16429	Triathlon CR	16933	Triathlon CR
2150	Nexgen CR	5666	Persona CR	8441	Persona CR	11578	Persona CR	12883	Persona CR
1158	PFC Sigma CR	4305	Nexgen CR Flex	3256	GMK Sphere Primary	4210	Attune CR	4329	Attune CR
965	Genesis II CR	3403	Attune CR	3150	Attune CR	3671	GMK Sphere Primary	3753	GMK Sphere Primary
901	Nexgen LPS	2747	GMK Sphere Primary	2390	Nexgen CR Flex	2235	Attune PS	2029	Attune PS
693	Nexgen LPS Flex	1795	Attune PS	1783	Attune PS	1690	Nexgen CR Flex	1499	Apex Knee CR
622	Active Knee	1550	Vanguard CR	1606	Apex Knee CR	1624	Apex Knee CR	1242	Legion Oxinium CR
536	Genesis II Oxinium CR	1541	Evolution	1367	Legion Oxinium CR	1598	Legion Oxinium CR	1085	Legion Oxinium PS
470	PFC Sigma PS	1477	Apex Knee CR	1218	Evolution	1226	Legion Oxinium PS	1066	Columbus
456	Genesis II PS	1466	LCS CR	1114	Columbus	1113	Legion CR	1046	Evolution
10 Most Used									
10202	(10) 93.2%	37358	(10) 66.4%	38097	(10) 71.1%	45374	(10) 76.3%	45865	(10) 81.2%
Remainder									
746	(10) 6.8%	18924	(57) 33.6%	15454	(60) 28.9%	14116	(63) 23.7%	10638	(66) 18.8%
TOTAL									
10948	(20) 100.0%	56282	(67) 100.0%	53551	(70) 100.0%	59490	(73) 100.0%	56503	(76) 100.0%

Table KT3 10 Most Used Cemented Femoral Prostheses in Primary Total Knee Replacement

2003		2019		2020		2021		2022	
N	Model	N	Model	N	Model	N	Model	N	Model
933	LCS CR	6648	Triathlon CR	6247	Triathlon CR	7171	Triathlon CR	7112	Triathlon CR
826	Nexgen LPS	3415	Persona CR	4920	Persona CR	6361	Persona CR	6634	Persona CR
765	Nexgen CR	3282	Attune CR	3256	GMK Sphere Primary	3671	GMK Sphere Primary	3753	GMK Sphere Primary
693	Nexgen LPS Flex	2747	GMK Sphere Primary	2876	Attune CR	2321	Attune CR	2283	Attune CR
622	Genesis II CR	2316	Nexgen CR Flex	1696	Attune PS	2132	Attune PS	1902	Attune PS
470	PFC Sigma PS	1777	Attune PS	1367	Legion Oxinium CR	1598	Legion Oxinium CR	1242	Legion Oxinium CR
430	Genesis II Oxinium CR	1513	Evolution	1225	Nexgen CR Flex	1226	Legion Oxinium PS	1085	Legion Oxinium PS
419	Genesis II PS	1379	Legion Oxinium CR	1140	Evolution	1103	Columbus	1066	Columbus
340	PFC Sigma CR	1271	Legion Oxinium PS	1114	Columbus	1008	Evolution	1006	Evolution
74	Genesis II Oxinium PS	1267	Genesis II Oxinium PS	1076	Genesis II Oxinium PS	882	Genesis II Oxinium PS	865	Apex Knee CR
10 Most Used									
5572	(10) 96.2%	25615	(10) 65.5%	24917	(10) 68.7%	27473	(10) 72.2%	26948	(10) 76.0%
Remainder									
219	(10) 3.8%	13503	(56) 34.5%	11366	(58) 31.3%	10573	(61) 27.8%	8511	(61) 24.0%
TOTAL									
5791	(20) 100.0%	39118	(66) 100.0%	36283	(68) 100.0%	38046	(71) 100.0%	35459	(71) 100.0%

Table KT4 10 Most Used Cementless Femoral Prostheses in Primary Total Knee Replacement

2003		2019		2020		2021		2022	
N	Model	N	Model	N	Model	N	Model	N	Model
1385	Nexgen CR	6760	Triathlon CR	7525	Triathlon CR	9258	Triathlon CR	9821	Triathlon CR
1318	LCS CR	2251	Persona CR	3521	Persona CR	5217	Persona CR	6249	Persona CR
818	PFC Sigma CR	1989	Nexgen CR Flex	1165	Nexgen CR Flex	1889	Attune CR	2046	Attune CR
613	Active Knee	947	LCS CR	771	Apex Knee CR	808	Nexgen CR Flex	634	Apex Knee CR
348	RBK	780	Vanguard CR	726	LCS CR	782	Apex Knee CR	492	Legion CR
343	Genesis II CR	664	Apex Knee CR	413	Legion CR	521	LCS CR	294	GMK Primary
110	Advance	503	Legion CR	380	Vanguard CR	513	Legion CR	276	Nexgen CR Flex
106	Genesis II Oxinium CR	390	BalanSys	365	Score	392	Score	188	Genesis II CR
75	Nexgen LPS	356	Score	312	PFC Sigma CR	291	GMK Primary	181	Triathlon PS
37	Genesis II PS	355	PFC Sigma CR	274	Attune CR	245	Genesis II CR	142	BalanSys
10 Most Used									
5153	(10) 99.9%	14995	(10) 87.4%	15452	(10) 89.5%	19916	(10) 92.9%	20323	(10) 96.6%
Remainder									
4	(1) 0.1%	2169	(22) 12.6%	1816	(24) 10.5%	1528	(24) 7.1%	721	(26) 3.4%
TOTAL									
5157	(11) 100.0%	17164	(32) 100.0%	17268	(34) 100.0%	21444	(34) 100.0%	21044	(36) 100.0%

Table KT5 10 Most Used Tibial Components in Primary Total Knee Replacement

2003		2019		2020		2021		2022	
N	Model	N	Model	N	Model	N	Model	N	Model
3693	Nexgen	14351	Triathlon	14548	Triathlon	17127	Triathlon	17666	Triathlon
2031	Genesis II	7455	Genesis II	9064	Persona	12155	Persona	13624	Persona
1362	LCS	6334	Persona	6329	Genesis II	6949	Genesis II	6444	Attune
1362	MBT	5643	Nexgen	4987	Attune	6494	Attune	5172	Genesis II
1155	PFC Sigma	5248	Attune	3143	Nexgen	3514	GMK Primary	3617	GMK Primary
622	Active Knee	2556	GMK Primary	2958	GMK Primary	2359	Apex Knee	2086	Apex Knee
416	RBK	2330	Apex Knee	2374	Apex Knee	2216	Nexgen	1066	Columbus
151	Advance II	1740	Vanguard	1250	MBT	1103	Columbus	1015	Evolution
73	Nexgen TM CR	1656	MBT	1205	Evolution	1016	Evolution	767	Journey
68	BalanSys	1537	Evolution	1114	Columbus	933	MBT	739	Nexgen
10 Most Used									
10933	(10) 99.9%	48850	(10) 86.8%	46972	(10) 87.7%	53866	(10) 90.5%	52196	(10) 92.4%
Remainder									
15	(4) 0.1%	7432	(37) 13.2%	6579	(39) 12.3%	5624	(42) 9.5%	4307	(44) 7.6%
TOTAL									
10948	(14) 100.0%	56282	(47) 100.0%	53551	(49) 100.0%	59490	(52) 100.0%	56503	(54) 100.0%

Table KT6 10 Most Used Cemented Tibial Components in Primary Total Knee Replacement

2003		2019		2020		2021		2022	
N	Model	N	Model	N	Model	N	Model	N	Model
2948	Nexgen	10828	Triathlon	9457	Triathlon	10715	Triathlon	10990	Persona
1984	Genesis II	7403	Genesis II	7576	Persona	10000	Persona	10737	Triathlon
1155	PFC Sigma	5955	Persona	6309	Genesis II	6947	Genesis II	5171	Genesis II
1065	MBT	5166	Attune	4693	Attune	4536	Attune	4589	Attune
1033	LCS	5033	Nexgen	2859	Nexgen	3319	GMK Primary	3400	GMK Primary
154	Active Knee	2419	GMK Primary	2851	GMK Primary	2337	Apex Knee	2044	Apex Knee
111	RBK	2277	Apex Knee	2367	Apex Knee	2086	Nexgen	1066	Columbus
84	Advance II	1717	Vanguard	1205	Evolution	1103	Columbus	1015	Evolution
68	BalanSys	1537	Evolution	1114	Columbus	1016	Evolution	767	Journey
7	MRH	1254	MBT	1029	Vanguard	788	MBT	663	Nexgen
10 Most Used									
8609	(10) 99.9%	43589	(10) 87.5%	39460	(10) 87.6%	42847	(10) 90.3%	40442	(10) 91.3%
Remainder									
8	(3) 0.1%	6228	(34) 12.5%	5574	(36) 12.4%	4590	(39) 9.7%	3860	(41) 8.7%
TOTAL									
8617	(13) 100.0%	49817	(44) 100.0%	45034	(46) 100.0%	47437	(49) 100.0%	44302	(51) 100.0%

Table KT7 10 Most Used Cementless Tibial Components in Primary Total Knee Replacement

2003		2019		2020		2021		2022	
N	Model	N	Model	N	Model	N	Model	N	Model
745	Nexgen	3523	Triathlon	5091	Triathlon	6412	Triathlon	6929	Triathlon
468	Active Knee	625	Nexgen TM CR	1488	Persona	2155	Persona	2634	Persona
329	LCS	610	Nexgen	418	Nexgen TM CR	1958	Attune	1855	Attune
305	RBK	402	MBT	304	MBT	362	Nexgen TM CR	217	GMK Primary
297	MBT	379	Persona	294	Attune	295	Score	123	Nexgen TM CR
73	Nexgen TM CR	192	ACS Fixed	284	Nexgen	195	GMK Primary	90	Score
67	Advance II	137	GMK Primary	184	Score	145	MBT	82	Legion
47	Genesis II	131	Score	107	GMK Primary	130	Nexgen	77	ACS Fixed
		90	Natural Knee II	100	RBK	97	Legion	76	Nexgen
		82	Attune	71	Natural Knee II	90	RBK	47	Natural Knee II
10 Most Used									
2331	(8) 100.0%	6171	(10) 95.5%	8341	(10) 97.9%	11839	(10) 98.2%	12130	(10) 99.4%
Remainder									
0	(0) 0%	294	(10) 4.5%	176	(10) 2.1%	214	(10) 1.8%	71	(10) 0.6%
TOTAL									
2331	(8) 100.0%	6465	(20) 100.0%	8517	(20) 100.0%	12053	(20) 100.0%	12201	(20) 100.0%

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 2022 (described as modern prostheses) are included in the analyses, unless clearly specified. This has resulted in 128,587 (14.5%) procedures being excluded from the analysis for the 2023 Annual Report.

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-2023

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.

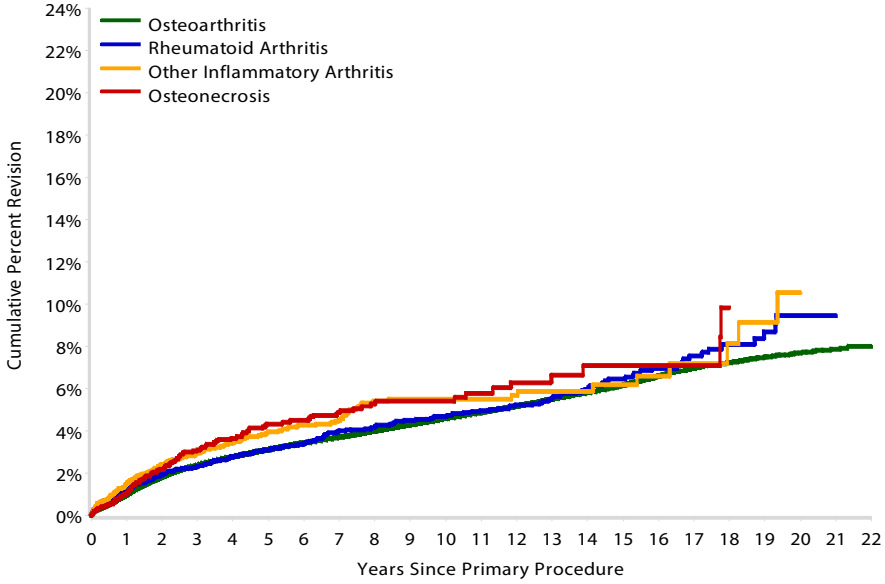
Rheumatoid arthritis has a lower rate of revision compared to osteoarthritis after 9 months.

Table KT8 Cumulative Percent Revision of Primary Total Knee Replacement by Primary Diagnosis

Primary Diagnosis	N Revised	N Total	Primary Percent	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Osteoarthritis	26004	741847	97.9%	1.0 (0.9, 1.0)	2.4 (2.4, 2.4)	3.1 (3.1, 3.2)	4.6 (4.5, 4.7)	6.2 (6.1, 6.3)	7.7 (7.5, 7.9)
Rheumatoid Arthritis	342	8189	1.1%	1.1 (0.9, 1.4)	2.3 (2.0, 2.7)	3.1 (2.7, 3.5)	4.7 (4.2, 5.3)	6.5 (5.7, 7.4)	9.4 (7.8, 11.4)
Other Inflammatory Arthritis	160	3836	0.5%	1.5 (1.2, 2.0)	2.9 (2.4, 3.6)	4.0 (3.3, 4.7)	5.5 (4.7, 6.5)	6.2 (5.1, 7.5)	10.5 (7.1, 15.6)
Osteonecrosis	101	2258	0.3%	1.1 (0.7, 1.6)	3.1 (2.4, 4.0)	4.3 (3.5, 5.4)	5.4 (4.4, 6.6)	7.1 (5.5, 9.1)	
Other (4)	229	1819	0.2%	4.4 (3.5, 5.5)	9.5 (8.1, 11.1)	13.1 (11.3, 15.1)	20.4 (17.7, 23.4)	28.9 (24.2, 34.4)	
TOTAL	**26836**	**757949**	**100.0%**						

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=1.49 (1.11, 1.98), p=0.007

3Mth - 9Mth: HR=0.96 (0.69, 1.34), p=0.817

9Mth - 1.5Yr: HR=0.67 (0.50, 0.91), p=0.010

1.5Yr+: HR=0.86 (0.76, 0.99), p=0.032

Other Inflammatory Arthritis vs Osteoarthritis

0 - 1.5Yr: HR=1.27 (1.00, 1.60), p=0.048

1.5Yr+: HR=1.02 (0.83, 1.25), p=0.863

Osteonecrosis vs Osteoarthritis

Entire Period: HR=1.29 (1.06, 1.57), p=0.011

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Osteoarthritis	741847	675256	544838	421804	176167	46509	5258
Rheumatoid Arthritis	8189	7636	6542	5281	2656	1020	156
Other Inflammatory Arthritis	3836	3475	2775	2066	806	251	45
Osteonecrosis	2258	2068	1688	1314	530	158	24

Note: Only primary diagnoses with >1,000 procedures have been listed; Restricted to modern prostheses

PROSTHESIS TYPES

Overall, there are 257 femoral and tibial prosthesis combinations that meet the definition of a modern prosthesis in primary total knee replacement.

The cumulative percent revision of the 110 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 98.6% of all primary total knee replacement procedures. The 'other' group is the combined outcome of the remaining 147 prosthesis combinations with ≤400 procedures per combination.

There are 57 cemented femoral and tibial prosthesis combinations with >400 procedures (Table KT9).

There are 23 cementless femoral and tibial prosthesis combinations with >400 procedures (Table KT10).

There are 30 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	24	769	1.6 (0.9, 2.8)	2.8 (1.8, 4.3)	3.4 (2.3, 5.1)			
	ACS Mobile	43	1492	1.0 (0.6, 1.7)	2.1 (1.4, 3.1)	3.4 (2.5, 4.8)	4.3 (3.1, 5.9)		
Active Knee	Active Knee	131	3516	0.9 (0.6, 1.3)	2.6 (2.1, 3.2)	3.5 (2.9, 4.3)	5.4 (4.4, 6.4)	7.4 (5.1, 10.7)	
Advance	Advance II	65	849	1.5 (0.9, 2.6)	4.3 (3.1, 5.9)	5.1 (3.8, 6.8)	7.0 (5.4, 9.0)	8.3 (6.4, 10.7)	10.4 (7.8, 13.7)
Anatomic	Anatomic	35	1425	1.2 (0.7, 1.9)	2.9 (2.1, 4.0)	2.9 (2.1, 4.0)			
Apex Knee CR	Apex Knee	73	5800	0.6 (0.4, 0.8)	1.3 (1.0, 1.7)	1.9 (1.4, 2.4)	2.2 (1.6, 3.1)		
Apex Knee PS	Apex Knee	160	6150	0.8 (0.6, 1.0)	2.2 (1.9, 2.7)	3.1 (2.6, 3.7)			
Attune CR	Attune	547	22707	0.9 (0.8, 1.0)	2.2 (2.0, 2.4)	2.9 (2.7, 3.2)			
Attune PS	Attune	247	12069	0.8 (0.7, 1.0)	2.0 (1.7, 2.3)	2.5 (2.2, 2.9)			
BalanSys	BalanSys	68	2258	0.4 (0.2, 0.8)	1.5 (1.1, 2.2)	2.0 (1.5, 2.7)	3.7 (2.8, 4.7)	5.6 (3.8, 8.1)	
Columbus	Columbus	98	5543	0.9 (0.7, 1.2)	2.2 (1.8, 2.7)	2.5 (2.0, 3.1)	3.6 (2.3, 5.6)		
E.Motion	E.Motion	29	599	1.9 (1.0, 3.3)	3.6 (2.4, 5.5)	3.8 (2.5, 5.7)	6.8 (4.5, 10.0)		
Evolis	Evolis	28	1160	0.4 (0.1, 0.9)	1.1 (0.6, 2.0)	1.8 (1.1, 2.8)	3.3 (2.2, 4.9)		
Evolution	Evolution	291	11085	0.8 (0.7, 1.0)	2.3 (2.0, 2.6)	3.0 (2.6, 3.4)			
GMK Primary	GMK Primary	27	768	1.1 (0.5, 2.1)	2.7 (1.7, 4.2)	3.3 (2.2, 5.0)	4.2 (2.9, 6.1)		
GMK Sphere Primary	GMK Primary	410	17636	1.3 (1.1, 1.5)	2.7 (2.4, 3.0)	3.1 (2.8, 3.5)			
	GMK Sphere Primary	77	2858	0.8 (0.5, 1.3)	2.7 (2.1, 3.5)	4.0 (3.1, 5.1)			
Genesis II CR	Genesis II	690	16877	0.9 (0.8, 1.1)	2.3 (2.1, 2.5)	3.0 (2.7, 3.2)	4.4 (4.0, 4.7)	5.5 (5.1, 6.0)	6.6 (5.9, 7.4)
Genesis II Oxinium CR	Genesis II	588	10632	1.1 (0.9, 1.3)	2.7 (2.4, 3.0)	3.4 (3.1, 3.8)	5.9 (5.4, 6.4)	8.3 (7.6, 9.1)	10.4 (9.2, 11.6)
Genesis II Oxinium PS	Genesis II	1405	22333	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 (8.8, 10.0)	
Genesis II PS	Genesis II	858	20056	1.1 (1.0, 1.3)	2.6 (2.4, 2.9)	3.5 (3.3, 3.8)	4.8 (4.5, 5.1)	6.0 (5.5, 6.5)	6.5 (5.9, 7.2)
Journey II Oxinium	Journey	12	970	0.4 (0.2, 1.1)	3.9 (1.8, 8.4)	6.1 (3.2, 11.4)			
LCS CR	LCS	337	3941	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	612	13323	0.9 (0.7, 1.0)	2.6 (2.3, 2.9)	3.5 (3.2, 3.9)	5.2 (4.8, 5.7)	6.1 (5.6, 6.7)	7.5 (6.2, 8.9)
Legion CR	Genesis II	109	4217	1.0 (0.8, 1.4)	2.3 (1.8, 2.8)	3.1 (2.5, 3.8)	4.1 (3.1, 5.2)		
Legion Oxinium CR	Genesis II	266	10118	0.8 (0.6, 1.0)	2.4 (2.1, 2.8)	3.3 (2.9, 3.8)	4.3 (3.8, 5.0)		
Legion Oxinium PS	Genesis II	706	17376	1.1 (0.9, 1.2)	3.0 (2.7, 3.2)	3.9 (3.6, 4.3)	5.5 (5.1, 6.0)		

Femoral Component	Tibial Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Legion PS	Genesis II	204	6162	1.3 (1.1, 1.7)	2.5 (2.1, 2.9)	3.1 (2.7, 3.6)	4.1 (3.6, 4.8)		
MRK	MRK	23	726	0.9 (0.4, 1.9)	2.2 (1.3, 3.7)	2.4 (1.4, 4.0)	4.3 (2.8, 6.7)		
Natural Knee Flex	Natural Knee II	90	2606	1.2 (0.9, 1.7)	2.7 (2.1, 3.4)	3.1 (2.5, 3.9)	4.2 (3.3, 5.2)		
Nexgen CR	Nexgen	166	4181	0.7 (0.5, 1.0)	1.6 (1.3, 2.0)	2.1 (1.7, 2.6)	3.2 (2.7, 3.8)	5.0 (4.3, 5.9)	6.1 (5.2, 7.2)
Nexgen CR Flex	Natural Knee II*	16	806	0.4 (0.1, 1.2)	1.0 (0.5, 2.0)	1.3 (0.7, 2.4)	2.1 (1.3, 3.5)		
	Nexgen	740	30414	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	62	1108	2.1 (1.4, 3.1)	3.8 (2.8, 5.1)	5.0 (3.8, 6.6)	6.4 (4.9, 8.4)		
Nexgen LPS	Nexgen	327	6155	1.1 (0.9, 1.4)	2.4 (2.0, 2.8)	3.1 (2.7, 3.5)	4.6 (4.1, 5.2)	6.3 (5.6, 7.1)	8.3 (7.3, 9.6)
Nexgen LPS Flex	Nexgen	1652	36675	0.9 (0.8, 1.0)	2.3 (2.1, 2.4)	3.1 (2.9, 3.3)	4.9 (4.7, 5.2)	6.5 (6.2, 6.9)	8.0 (6.9, 9.3)
Nexgen RH	Nexgen	38	771	1.9 (1.1, 3.2)	4.1 (2.8, 5.9)	5.0 (3.5, 7.1)	7.7 (5.4, 10.8)		
Optetrak Logic CR	Optetrak Logic	28	735	0.8 (0.4, 1.8)	2.6 (1.6, 4.1)	4.4 (2.9, 6.5)			
Optetrak Logic PS	Optetrak Logic	29	649	1.9 (1.1, 3.3)	3.5 (2.3, 5.3)	4.3 (2.9, 6.3)			
	Optetrak Logic RBK	30	1051	1.5 (0.9, 2.5)	2.9 (2.0, 4.3)	4.1 (2.8, 6.0)			
PFC Sigma CR	MBT*	45	1189	0.8 (0.5, 1.6)	1.9 (1.2, 2.8)	2.3 (1.6, 3.3)	3.3 (2.4, 4.6)	4.2 (3.1, 5.7)	
	PFC Sigma	510	13504	0.8 (0.7, 1.0)	2.1 (1.8, 2.3)	2.6 (2.4, 2.9)	3.6 (3.3, 4.0)	5.1 (4.6, 5.6)	6.6 (5.6, 7.6)
PFC Sigma PS	MBT	367	6148	1.0 (0.8, 1.3)	2.9 (2.5, 3.4)	3.9 (3.4, 4.4)	5.4 (4.9, 6.1)	7.3 (6.6, 8.2)	10.2 (7.6, 13.6)
	PFC Sigma*	403	8336	1.2 (1.0, 1.4)	2.6 (2.3, 2.9)	3.3 (2.9, 3.7)	4.7 (4.2, 5.2)	6.2 (5.6, 7.0)	8.7 (7.1, 10.5)
Persona CR	Nexgen	10	509	1.0 (0.4, 2.4)	1.8 (0.9, 3.5)	2.2 (1.2, 4.0)			
	Persona	315	24612	0.8 (0.7, 0.9)	1.8 (1.6, 2.0)	2.1 (1.9, 2.4)			
Persona PS	Persona	99	4852	1.1 (0.8, 1.4)	2.2 (1.7, 2.7)	2.7 (2.2, 3.3)			
RBK	RBK	130	2667	1.0 (0.7, 1.4)	2.5 (2.0, 3.2)	3.3 (2.7, 4.1)	5.0 (4.2, 6.0)	6.1 (5.1, 7.4)	
SAIPH	SAIPH	88	5429	0.5 (0.3, 0.7)	1.6 (1.2, 2.0)	2.1 (1.7, 2.7)	2.8 (2.0, 4.1)		
Score	Score	47	1190	1.7 (1.1, 2.6)	2.9 (2.1, 4.2)	4.0 (2.9, 5.4)	5.6 (4.1, 7.6)		
Trekking	Trekking	28	406	2.5 (1.3, 4.6)	4.3 (2.7, 6.9)	6.1 (4.1, 9.1)	8.1 (5.6, 11.7)		
Triathlon CR	Triathlon	1664	70813	0.8 (0.7, 0.8)	1.8 (1.7, 1.9)	2.4 (2.2, 2.5)	3.6 (3.4, 3.8)	4.7 (4.3, 5.1)	
Triathlon FS	Triathlon	30	457	3.2 (1.9, 5.4)	6.3 (4.3, 9.2)	7.5 (5.2, 10.7)			
Triathlon PS	Triathlon	453	10308	1.4 (1.2, 1.7)	3.0 (2.7, 3.4)	3.8 (3.4, 4.2)	5.5 (5.0, 6.1)	7.2 (6.3, 8.2)	
Unity Knee	Unity Knee	3	772	0.3 (0.1, 1.0)	0.3 (0.1, 1.0)				
Vanguard CR	Vanguard	473	12376	0.7 (0.6, 0.9)	2.1 (1.9, 2.4)	2.7 (2.4, 3.0)	4.6 (4.2, 5.1)	7.6 (6.3, 9.0)	
Vanguard PS	Vanguard	318	4675	1.9 (1.6, 2.4)	4.4 (3.8, 5.0)	5.4 (4.8, 6.1)	7.7 (6.9, 8.6)	9.1 (7.8, 10.7)	
Other (61)		363	4793	3.2 (2.7, 3.7)	6.8 (6.0, 7.7)	9.2 (8.2, 10.4)	14.0 (12.4, 15.8)	21.2 (17.4, 25.7)	
TOTAL		**16687**	**481602**						

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 2022

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	55	1171	1.6 (1.0, 2.5)	3.9 (2.9, 5.2)	4.6 (3.5, 6.1)	6.0 (4.6, 7.9)		
Active Knee	Active Knee	588	4896	1.4 (1.1, 1.7)	4.0 (3.4, 4.5)	5.6 (5.0, 6.3)	9.6 (8.8, 10.5)	13.4 (12.3, 14.5)	16.3 (14.8, 17.9)
Apex Knee CR	Apex Knee	28	508	2.3 (1.3, 4.1)	5.2 (3.5, 7.6)	5.6 (3.9, 8.2)	6.2 (4.3, 8.9)		
Attune CR	Attune	25	3072	0.9 (0.6, 1.4)	1.1 (0.7, 1.7)				
Columbus	Columbus	68	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)	14.9 (11.8, 18.8)	
GMK Primary	GMK Primary	58	1709	1.2 (0.7, 1.8)	3.0 (2.2, 4.1)	3.8 (2.9, 5.0)	5.0 (3.8, 6.6)		
Genesis II CR	Genesis II	46	748	1.5 (0.8, 2.6)	3.8 (2.6, 5.4)	4.5 (3.2, 6.3)	6.9 (5.1, 9.2)		
Genesis II PS	Genesis II	32	420	1.7 (0.8, 3.5)	3.3 (2.0, 5.6)	4.1 (2.5, 6.5)	6.5 (4.5, 9.4)		
LCS CR	LCS	173	2382	1.4 (1.0, 2.0)	3.4 (2.8, 4.3)	4.4 (3.6, 5.3)	6.2 (5.2, 7.3)	7.4 (6.3, 8.6)	8.8 (7.6, 10.2)
	MBT	506	9389	1.1 (0.9, 1.3)	3.4 (3.1, 3.8)	4.2 (3.8, 4.6)	5.4 (4.9, 5.9)	7.5 (6.7, 8.5)	10.5 (8.9, 12.3)
Natural Knee Flex	Natural Knee II	52	1768	0.7 (0.4, 1.2)	1.7 (1.2, 2.4)	2.2 (1.6, 3.1)	3.4 (2.5, 4.5)		
Nexgen CR	Nexgen	134	3446	0.6 (0.4, 0.9)	1.7 (1.3, 2.2)	2.2 (1.7, 2.7)	3.0 (2.5, 3.7)	4.0 (3.3, 4.8)	5.8 (4.8, 7.1)
	Nexgen TM CR*	51	746	1.3 (0.7, 2.5)	4.3 (3.0, 6.0)	6.0 (4.5, 8.0)	6.8 (5.1, 8.9)	7.9 (5.9, 10.5)	
Nexgen CR Flex	Nexgen	344	8754	1.1 (0.9, 1.4)	2.7 (2.4, 3.1)	3.3 (2.9, 3.7)	4.2 (3.8, 4.7)	5.0 (4.4, 5.7)	
	Nexgen TM CR	342	11466	0.5 (0.4, 0.7)	1.8 (1.5, 2.0)	2.3 (2.0, 2.6)	3.2 (2.9, 3.6)	4.4 (3.8, 5.0)	
Nexgen LPS Flex	Nexgen	51	1199	2.6 (1.8, 3.7)	4.0 (3.0, 5.2)	4.1 (3.2, 5.5)	5.0 (3.6, 6.9)		
PFC Sigma CR	MBT*	72	995	2.3 (1.5, 3.5)	4.9 (3.7, 6.4)	5.6 (4.3, 7.2)	6.6 (5.2, 8.4)	8.6 (6.6, 11.0)	
Persona CR	Persona	88	5668	1.2 (1.0, 1.6)	2.6 (2.0, 3.3)				
RBK	RBK	386	6919	1.3 (1.1, 1.6)	3.1 (2.8, 3.6)	4.2 (3.7, 4.7)	5.5 (4.9, 6.1)	6.6 (5.9, 7.4)	9.1 (7.4, 11.1)
Score	Score	241	2989	1.5 (1.1, 2.0)	4.8 (4.1, 5.7)	6.6 (5.7, 7.6)	10.9 (9.5, 12.4)		
Triathlon CR	Triathlon	937	37387	1.0 (0.9, 1.2)	2.2 (2.0, 2.4)	2.9 (2.7, 3.1)	4.2 (3.9, 4.5)	5.6 (5.0, 6.3)	
Triathlon PS	Triathlon	72	1439	1.9 (1.3, 2.7)	3.5 (2.6, 4.6)	4.5 (3.5, 5.8)	5.6 (4.4, 7.1)	7.9 (5.5, 11.3)	
Vanguard CR	Vanguard	109	1695	1.4 (1.0, 2.1)	4.1 (3.3, 5.2)	4.8 (3.8, 5.9)	6.5 (5.3, 7.8)		
Other (28)		195	2760	2.3 (1.8, 3.0)	5.8 (5.0, 6.8)	7.0 (6.1, 8.1)	8.5 (7.4, 9.9)	9.7 (8.2, 11.5)	
TOTAL		**4653**	**112026**						

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 2022

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	68	1528	1.3 (0.8, 2.0)	3.8 (2.9, 4.9)	4.5 (3.5, 5.8)			
Active Knee	Active Knee	165	2324	0.6 (0.4, 1.1)	2.8 (2.2, 3.5)	3.8 (3.1, 4.7)	6.8 (5.7, 8.0)	10.4 (8.8, 12.4)	
Advance	Advance II	24	428	0.7 (0.2, 2.2)	2.4 (1.3, 4.4)	3.4 (2.0, 5.7)	5.3 (3.4, 8.1)	6.8 (4.5, 10.3)	
Apex Knee CR	Apex Knee	87	4813	0.9 (0.7, 1.2)	1.7 (1.3, 2.1)	2.2 (1.8, 2.8)			
Attune CR	Attune	12	1462	0.8 (0.4, 1.6)	1.2 (0.7, 2.2)				
Attune PS	Attune	21	921	1.6 (1.0, 2.8)					
BalanSys	BalanSys	60	2301	1.0 (0.6, 1.5)	2.2 (1.6, 2.9)	2.8 (2.1, 3.6)			
GMK Primary	GMK Primary	32	868	1.1 (0.6, 2.1)	3.4 (2.3, 5.0)	3.7 (2.6, 5.4)			
Genesis II CR	Genesis II	496	8762	1.0 (0.8, 1.2)	3.2 (2.9, 3.6)	4.3 (3.9, 4.8)	5.9 (5.4, 6.5)	7.1 (6.4, 7.8)	8.3 (7.4, 9.3)
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)	10.9 (8.6, 13.7)	
LCS CR	LCS	155	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)	8.3 (7.0, 9.8)
	MBT	388	11100	0.7 (0.6, 0.9)	2.2 (1.9, 2.4)	2.8 (2.5, 3.1)	4.0 (3.6, 4.4)	4.5 (4.0, 5.0)	5.4 (4.6, 6.2)
Legion CR	Genesis II	170	4295	1.4 (1.1, 1.8)	3.4 (2.8, 4.0)	4.2 (3.6, 5.0)	7.6 (6.1, 9.4)		
Natural Knee Flex	Natural Knee II	43	1996	0.4 (0.2, 0.8)	1.2 (0.8, 1.9)	1.8 (1.3, 2.5)	2.4 (1.8, 3.3)		
Nexgen CR	Nexgen	161	4366	0.6 (0.4, 0.9)	1.7 (1.4, 2.2)	2.2 (1.8, 2.7)	3.1 (2.6, 3.7)	4.3 (3.7, 5.1)	5.6 (4.7, 6.7)
Nexgen CR Flex	Nexgen	598	22216	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 (3.5, 4.5)	
	Nexgen TM CR	27	881	0.7 (0.3, 1.5)	1.5 (0.9, 2.6)	1.8 (1.1, 2.9)	2.5 (1.6, 3.8)	3.5 (2.3, 5.2)	
Nexgen LPS	Nexgen	58	1050	0.5 (0.2, 1.2)	2.7 (1.8, 3.9)	4.1 (3.0, 5.5)	5.3 (4.0, 7.0)	6.4 (4.9, 8.3)	
Nexgen LPS Flex	Nexgen	62	1063	2.1 (1.4, 3.1)	4.3 (3.2, 5.7)	5.4 (4.2, 7.0)	6.8 (5.2, 9.0)		
Optetrak Logic CR	Optetrak Logic	50	1117	1.2 (0.7, 2.0)	3.8 (2.7, 5.2)	5.6 (4.2, 7.5)			
PFC Sigma CR	MBT*	229	4168	1.3 (1.0, 1.6)	3.0 (2.6, 3.6)	3.9 (3.4, 4.6)	5.1 (4.4, 5.8)	6.7 (5.8, 7.7)	8.6 (7.1, 10.4)
	PFC Sigma	427	11892	0.6 (0.5, 0.8)	1.9 (1.6, 2.1)	2.4 (2.1, 2.7)	3.4 (3.1, 3.8)	5.0 (4.4, 5.6)	6.3 (5.4, 7.2)
Persona CR	Persona	178	13144	1.0 (0.9, 1.2)	1.9 (1.7, 2.3)	2.2 (1.8, 2.6)			
RBK	RBK	79	1615	1.1 (0.7, 1.7)	2.9 (2.2, 3.9)	3.7 (2.8, 4.7)	5.0 (3.9, 6.2)	7.0 (5.3, 9.3)	
Score	Score	112	1844	1.4 (0.9, 2.1)	3.8 (3.0, 4.9)	5.9 (4.9, 7.3)			
Trekking	Trekking	22	564	1.1 (0.5, 2.4)	2.9 (1.8, 4.7)	3.4 (2.1, 5.3)			
Triathlon CR	Triathlon	769	36200	0.7 (0.6, 0.8)	1.6 (1.4, 1.7)	2.1 (1.9, 2.3)	3.2 (2.9, 3.4)	4.4 (3.8, 5.1)	
Triathlon PS	Triathlon	130	3064	1.7 (1.3, 2.2)	2.7 (2.2, 3.4)	3.6 (3.0, 4.4)	5.1 (4.3, 6.1)	5.8 (4.7, 7.0)	
Vanguard CR	Vanguard	521	13478	0.8 (0.6, 0.9)	2.2 (2.0, 2.5)	2.9 (2.7, 3.2)	4.8 (4.4, 5.3)	6.4 (5.7, 7.3)	
Vanguard PS	Vanguard	37	713	1.4 (0.8, 2.6)	3.3 (2.2, 4.9)	4.2 (3.0, 6.1)	5.7 (4.1, 7.9)		
Other (57)		243	3077	2.8 (2.3, 3.5)	5.9 (5.1, 6.8)	7.1 (6.2, 8.1)	9.0 (7.9, 10.2)	11.2 (9.6, 13.0)	
TOTAL		**5496**	**164321**						

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 2022

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 7.7% (Table KT12 and Figure KT7).

Reasons for Revision

Infection is the most common reason for revision followed by loosening, instability, pain, and patellofemoral pain (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 9 months and this increases to nearly 6 times after 7.5 years (Table KT15 and Figure KT9).

Males have a higher rate of revision compared to females (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).

Age-related differences in the rate of revision are evident for both males and females (Table KT16, Figure KT12 and Figure KT13).

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 491,284 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 KT17 and Figure KT14). 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 KT15).

BMI data have been collected since 2015. There are revision outcomes for 405,270 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 KT18 and Figure KT16).

The most common reasons for revision are shown in Figure KT17.

There is an increased rate of revision for obese male patients compared to obese female patients in the first 2 years with no difference after this time (Table KT19 and Figure KT18).

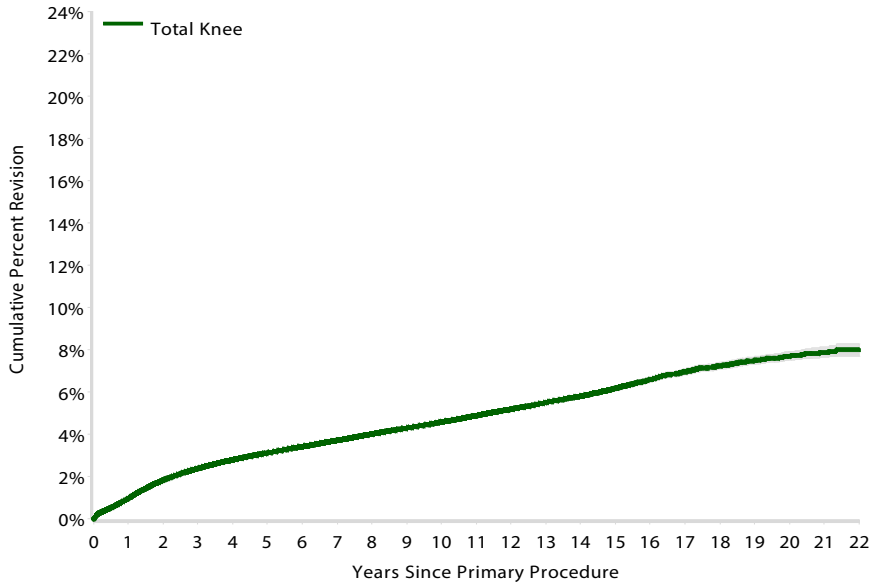
Males have a higher rate of revision which is largely due to an increased incidence of infection.

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	26004	741847	1.0 (0.9, 1.0)	2.4 (2.4, 2.4)	3.1 (3.1, 3.2)	4.6 (4.5, 4.7)	6.2 (6.1, 6.3)	7.7 (7.5, 7.9)
TOTAL	**26004**	**741847**						

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	741847	675256	544838	421804	176167	46509	5258

Note: Restricted to modern prostheses

Table KT13 Primary Total Knee Replacement by Reason for Revision (Primary Diagnosis OA)

Reason for Revision	Number	Percent
Infection	7089	27.3
Loosening	5844	22.5
Instability	2543	9.8
Pain	1995	7.7
Patellofemoral Pain	1878	7.2
Patella Erosion	1745	6.7
Arthrofibrosis	1027	3.9
Fracture	973	3.7
Malalignment	582	2.2
Wear Tibial Insert	355	1.4
Lysis	324	1.2
Incorrect Sizing	255	1.0
Metal Related Pathology	104	0.4
Other	1290	5.0
TOTAL	**26004**	**100.0**

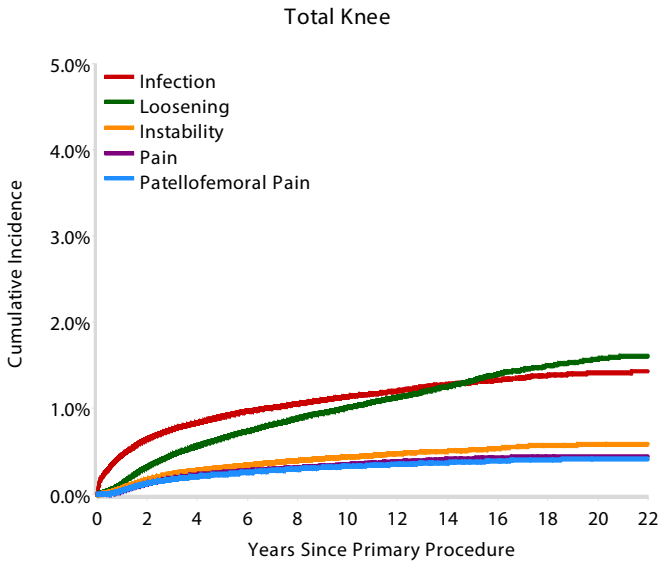
Note: Restricted to modern prostheses

Table KT14 Primary Total Knee Replacement by Type of Revision (Primary Diagnosis OA)

Type of Revision	Number	Percent
Insert Only	7350	28.3
TKR (Tibial/Femoral)	6464	24.9
Patella Only	4614	17.7
Insert/Patella	2714	10.4
Tibial Component	2075	8.0
Cement Spacer	1312	5.0
Femoral Component	1234	4.7
Removal of Prostheses	143	0.5
Minor Components	54	0.2
Total Femoral	16	0.1
Cement Only	15	0.1
Reinsertion of Components	13	0.0
TOTAL	**26004**	**100.0**

Note: Restricted to modern prostheses

Figure KT8 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement (Primary Diagnosis OA)



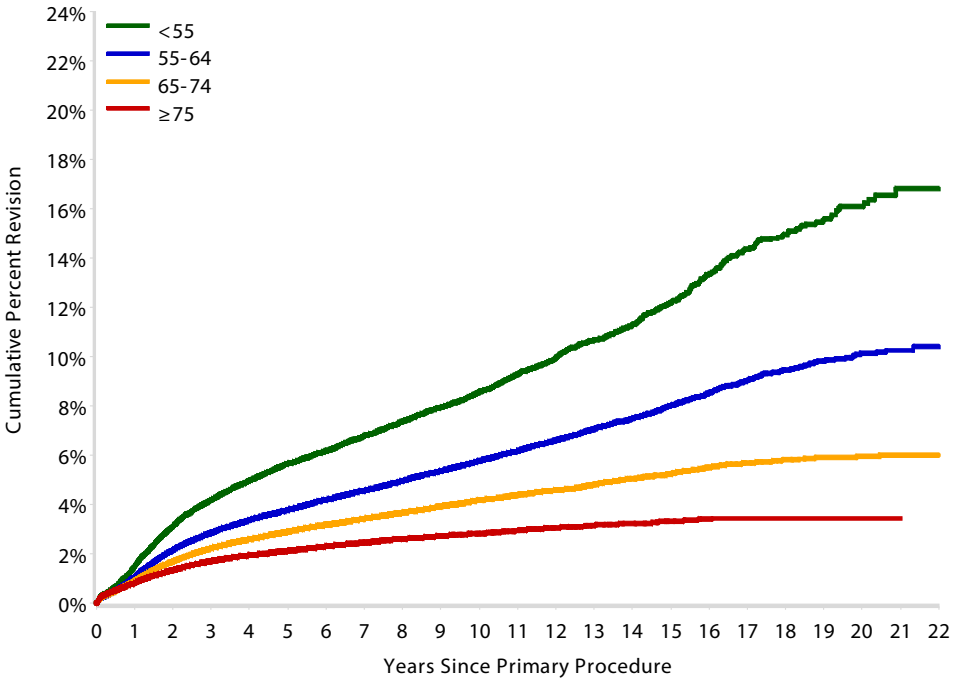
Note: Restricted to modern prostheses

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	3373	48208	1.5 (1.4, 1.6)	4.2 (4.0, 4.4)	5.7 (5.4, 5.9)	8.6 (8.3, 8.9)	12.2 (11.7, 12.7)	16.1 (15.2, 17.1)
55-64	9007	197384	1.1 (1.0, 1.1)	2.9 (2.8, 2.9)	3.8 (3.7, 3.9)	5.8 (5.6, 5.9)	8.0 (7.8, 8.2)	10.1 (9.7, 10.5)
65-74	9406	298210	0.9 (0.9, 0.9)	2.2 (2.2, 2.3)	2.9 (2.8, 3.0)	4.2 (4.1, 4.3)	5.2 (5.1, 5.4)	5.9 (5.7, 6.2)
≥75	4218	198045	0.8 (0.8, 0.9)	1.7 (1.6, 1.8)	2.1 (2.1, 2.2)	2.8 (2.7, 2.9)	3.3 (3.2, 3.5)	3.4 (3.3, 3.6)
TOTAL	**26004**	**741847**						

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 - 9Mth: HR=1.59 (1.44, 1.76), p<0.001
9Mth - 1.5Yr: HR=2.82 (2.55, 3.12), p<0.001
1.5Yr - 2Yr: HR=3.45 (2.96, 4.01), p<0.001
2Yr - 3.5Yr: HR=3.15 (2.84, 3.48), p<0.001
3.5Yr - 4Yr: HR=3.84 (3.16, 4.66), p<0.001
4Yr - 4.5Yr: HR=3.84 (3.12, 4.73), p<0.001
4.5Yr - 5Yr: HR=3.97 (3.20, 4.92), p<0.001
5Yr - 7.5Yr: HR=3.62 (3.20, 4.10), p<0.001
7.5Yr+: HR=5.59 (5.05, 6.18), p<0.001

55-64 vs ≥75

0 - 6Mth: HR=1.03 (0.94, 1.12), p=0.504
6Mth - 9Mth: HR=1.61 (1.43, 1.81), p<0.001
9Mth - 1.5Yr: HR=1.89 (1.75, 2.05), p<0.001
1.5Yr - 2Yr: HR=2.23 (1.97, 2.52), p<0.001
2Yr - 2.5Yr: HR=1.85 (1.64, 2.09), p<0.001
2.5Yr - 3.5Yr: HR=2.12 (1.93, 2.33), p<0.001
3.5Yr - 4.5Yr: HR=2.39 (2.14, 2.67), p<0.001
4.5Yr - 7.5Yr: HR=2.45 (2.25, 2.67), p<0.001
7.5Yr+: HR=3.32 (3.05, 3.61), p<0.001

65-74 vs ≥75

0 - 6Mth: HR=0.99 (0.92, 1.07), p=0.853
6Mth - 1.5Yr: HR=1.35 (1.26, 1.45), p<0.001
1.5Yr - 2Yr: HR=1.55 (1.37, 1.76), p<0.001
2Yr - 2.5Yr: HR=1.40 (1.24, 1.57), p<0.001
2.5Yr+: HR=1.67 (1.58, 1.78), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
<55	48208	43876	35507	28423	13351	4277	655
55-64	197384	180584	147073	116463	53303	15777	2108
65-74	298210	271749	219209	169662	71809	19554	2091
≥75	198045	179047	143049	107256	37704	6901	404

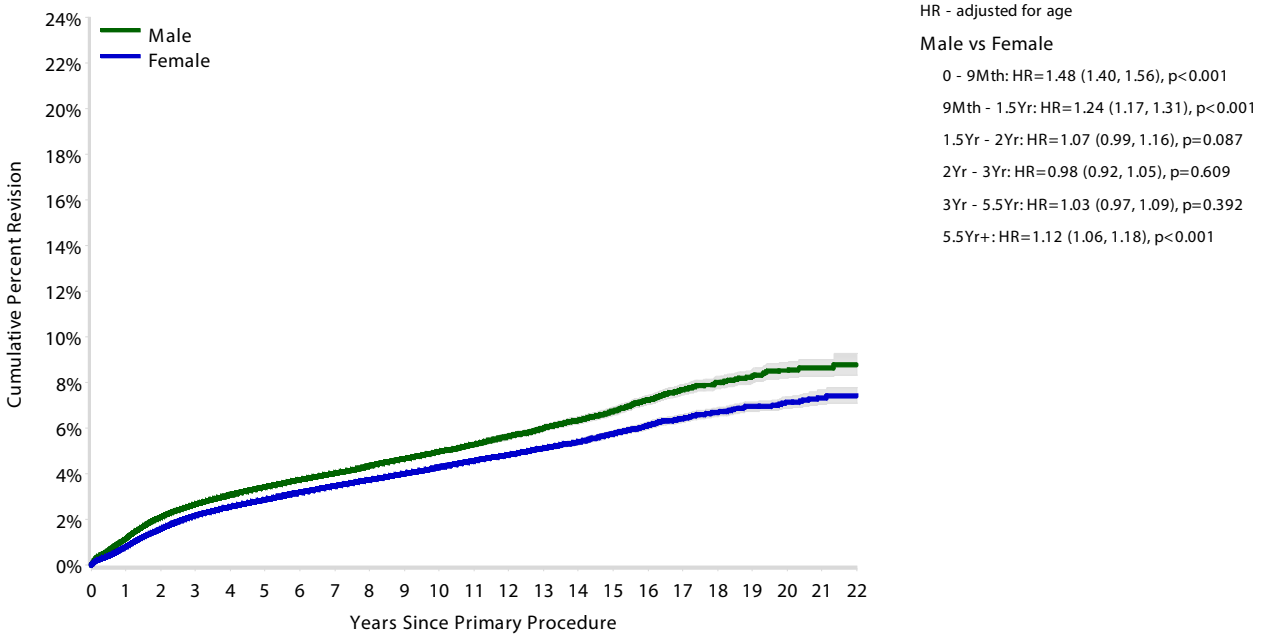
Note: Restricted to modern prostheses

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		12401	329680	1.2 (1.1, 1.2)	2.7 (2.6, 2.7)	3.4 (3.4, 3.5)	5.0 (4.9, 5.1)	6.7 (6.6, 6.9)	8.5 (8.2, 8.9)
	<55	1526	20848	1.8 (1.6, 2.0)	4.5 (4.2, 4.8)	5.9 (5.6, 6.3)	8.9 (8.4, 9.4)	12.8 (12.0, 13.6)	17.3 (15.8, 18.8)
	55-64	4390	92680	1.3 (1.2, 1.3)	3.1 (3.0, 3.2)	4.0 (3.9, 4.2)	6.1 (5.9, 6.3)	8.4 (8.1, 8.8)	10.7 (10.1, 11.3)
	65-74	4589	134992	1.1 (1.1, 1.2)	2.5 (2.4, 2.6)	3.2 (3.1, 3.3)	4.5 (4.4, 4.7)	5.7 (5.5, 6.0)	6.5 (6.2, 6.8)
	≥75	1896	81160	1.0 (0.9, 1.0)	2.0 (1.9, 2.1)	2.4 (2.3, 2.5)	3.1 (3.0, 3.3)	3.6 (3.4, 3.9)	3.7 (3.5, 4.0)
Female		13603	412167	0.8 (0.8, 0.8)	2.2 (2.1, 2.2)	2.9 (2.8, 2.9)	4.3 (4.2, 4.4)	5.7 (5.6, 5.9)	7.1 (6.9, 7.4)
	<55	1847	27360	1.3 (1.2, 1.4)	3.9 (3.7, 4.2)	5.4 (5.2, 5.8)	8.3 (7.9, 8.7)	11.7 (11.1, 12.4)	15.2 (14.1, 16.4)
	55-64	4617	104704	0.9 (0.9, 1.0)	2.6 (2.5, 2.7)	3.6 (3.4, 3.7)	5.5 (5.4, 5.7)	7.7 (7.4, 8.0)	9.7 (9.2, 10.2)
	65-74	4817	163218	0.7 (0.7, 0.8)	2.0 (2.0, 2.1)	2.7 (2.6, 2.8)	3.9 (3.8, 4.0)	4.9 (4.7, 5.0)	5.5 (5.3, 5.8)
	≥75	2322	116885	0.7 (0.7, 0.8)	1.5 (1.5, 1.6)	1.9 (1.8, 2.0)	2.6 (2.5, 2.7)	3.1 (3.0, 3.3)	3.2 (3.0, 3.4)
TOTAL		26004	741847						

Note: Restricted to modern prostheses

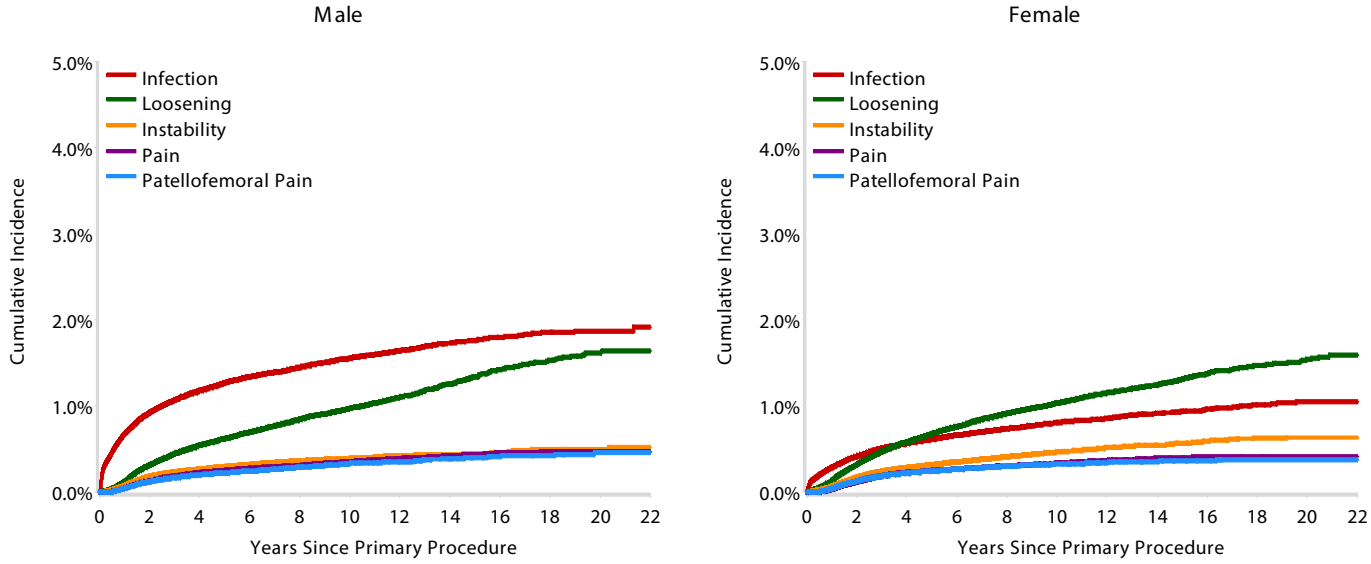
Figure KT10 Cumulative Percent Revision of Primary Total Knee Replacement by Gender (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Male	329680	298067	236753	180480	72567	18272	2033
Female	412167	377189	308085	241324	103600	28237	3225

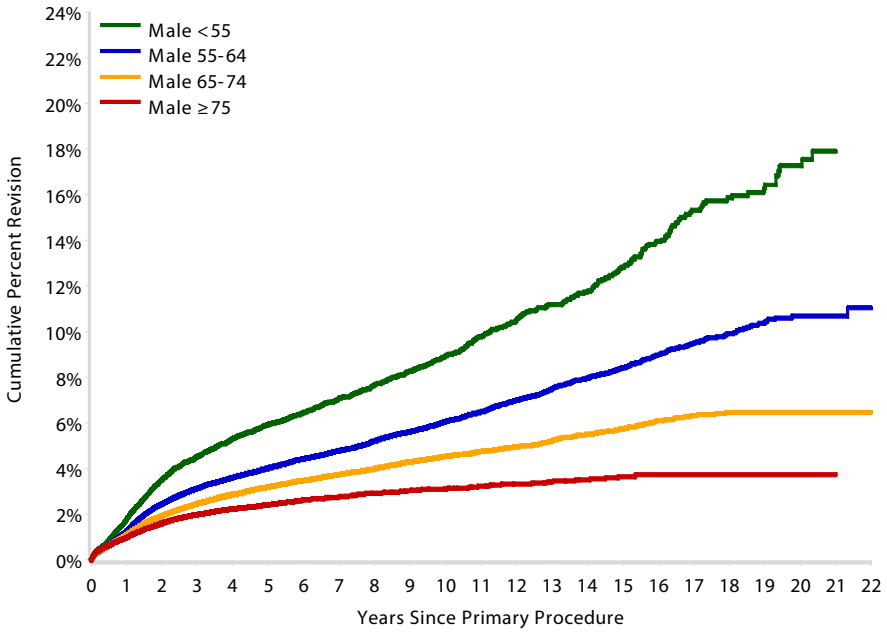
Note: Restricted to modern prostheses

Figure KT11 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by Gender (Primary Diagnosis OA)



Note: Restricted to modern prostheses

Figure KT12 Cumulative Percent Revision of Primary Total Knee Replacement in Males by Age (Primary Diagnosis OA)



Male <55 vs Male ≥75

- 0 - 6Mth: HR=1.45 (1.22, 1.72), p<0.001
- 6Mth - 9Mth: HR=2.40 (1.92, 3.00), p<0.001
- 9Mth - 3.5Yr: HR=2.83 (2.57, 3.11), p<0.001
- 3.5Yr - 7.5Yr: HR=3.40 (2.97, 3.90), p<0.001
- 7.5Yr+: HR=5.44 (4.70, 6.30), p<0.001

Male 55-64 vs Male ≥75

- 0 - 3Mth: HR=0.98 (0.86, 1.13), p=0.805
- 3Mth - 1Yr: HR=1.55 (1.41, 1.71), p<0.001
- 1Yr - 5.5Yr: HR=1.96 (1.83, 2.10), p<0.001
- 5.5Yr - 8.5Yr: HR=2.57 (2.26, 2.93), p<0.001
- 8.5Yr+: HR=3.29 (2.88, 3.76), p<0.001

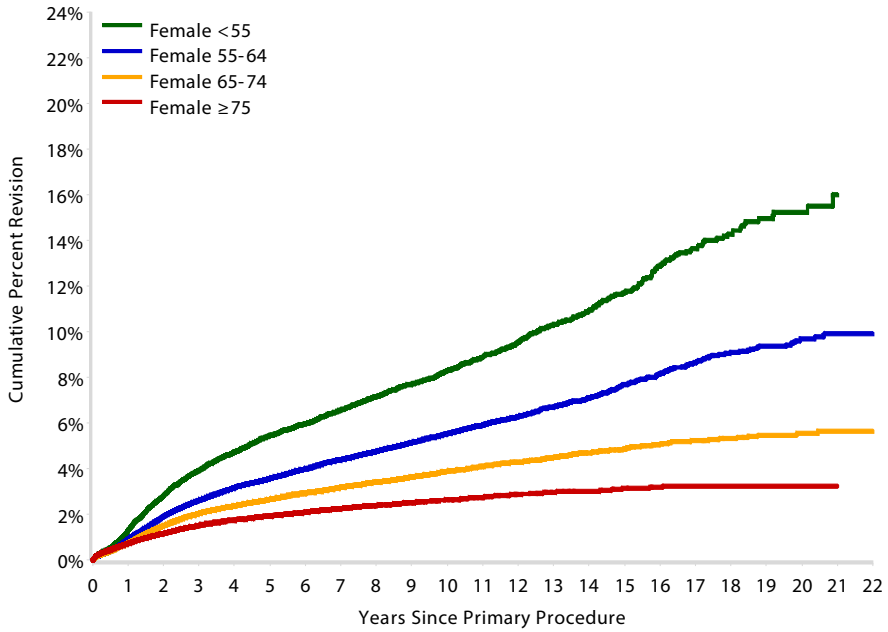
Male 65-74 vs Male ≥75

- 0 - 6Mth: HR=1.04 (0.94, 1.16), p=0.463
- 6Mth - 2.5Yr: HR=1.34 (1.25, 1.44), p<0.001
- 2.5Yr+: HR=1.66 (1.54, 1.80), p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Male	<55	20848	18846	15152	12018	5674	1790	287
	55-64	92680	84241	67600	52705	23624	6756	876
	65-74	134992	122300	97304	74456	30167	7650	758
	≥75	81160	72680	56697	41301	13102	2076	112

Note: Restricted to modern prostheses

Figure KT13 Cumulative Percent Revision of Primary Total Knee Replacement in Females by Age (Primary Diagnosis OA)



Female <55 vs Female ≥75

- 0 - 6Mth: HR=1.19 (0.99, 1.43), p=0.071
- 6Mth - 3Yr: HR=3.24 (2.97, 3.53), p<0.001
- 3Yr - 7Yr: HR=3.77 (3.38, 4.20), p<0.001
- 7Yr - 14Yr: HR=4.97 (4.31, 5.73), p<0.001
- 14Yr+: HR=8.66 (6.49, 11.55), p<0.001

Female 55-64 vs Female ≥75

- 0 - 3Mth: HR=0.80 (0.68, 0.94), p=0.005
- 3Mth - 6Mth: HR=1.11 (0.92, 1.35), p=0.262
- 6Mth - 3.5Yr: HR=2.11 (1.98, 2.26), p<0.001
- 3.5Yr - 8Yr: HR=2.55 (2.34, 2.79), p<0.001
- 8Yr - 12Yr: HR=3.04 (2.64, 3.49), p<0.001
- 12Yr - 15Yr: HR=3.97 (3.22, 4.90), p<0.001
- 15Yr+: HR=4.58 (3.38, 6.20), p<0.001

Female 65-74 vs Female ≥75

- 0 - 6Mth: HR=0.89 (0.79, 1.00), p=0.044
- 6Mth - 5Yr: HR=1.55 (1.46, 1.65), p<0.001
- 5Yr+: HR=1.66 (1.51, 1.83), p<0.001

Numbers at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Female	<55	27360	25030	20355	16405	7677	2487	368
	55-64	104704	96343	79473	63758	29679	9021	1232
	65-74	163218	149449	121905	95206	41642	11904	1333
	≥75	116885	106367	86352	65955	24602	4825	292

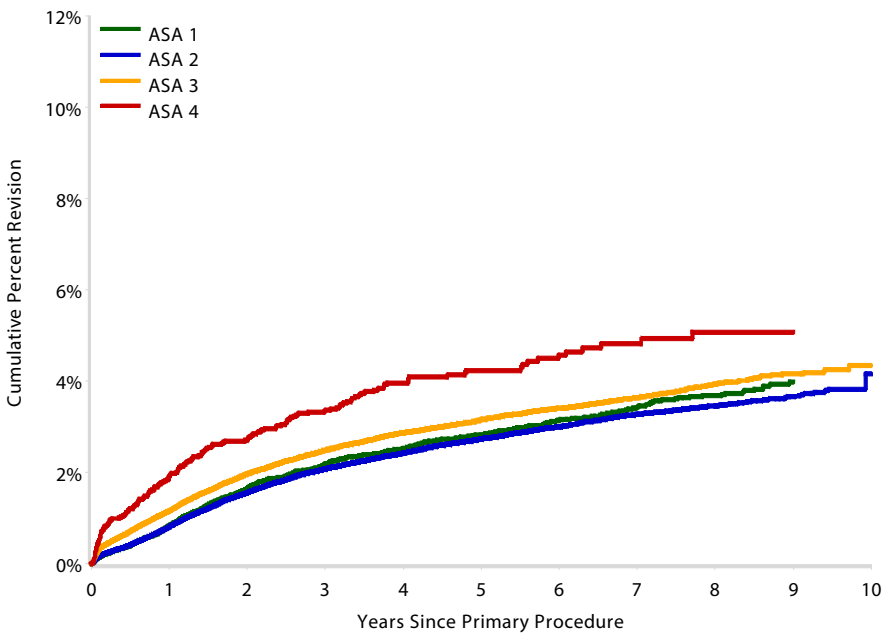
Note: Restricted to modern prostheses

Table KT17 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	717	27557	0.8 (0.7, 0.9)	1.7 (1.5, 1.8)	2.2 (2.0, 2.4)	2.8 (2.6, 3.1)	3.4 (3.2, 3.7)	4.0 (3.6, 4.4)
ASA 2	6320	266765	0.8 (0.8, 0.8)	1.6 (1.5, 1.6)	2.1 (2.0, 2.1)	2.7 (2.7, 2.8)	3.3 (3.2, 3.4)	3.7 (3.6, 3.8)
ASA 3	5035	191845	1.2 (1.1, 1.2)	2.0 (1.9, 2.0)	2.5 (2.4, 2.6)	3.2 (3.1, 3.3)	3.6 (3.5, 3.8)	4.2 (4.0, 4.3)
ASA 4	181	5102	1.9 (1.6, 2.3)	2.7 (2.3, 3.2)	3.4 (2.9, 3.9)	4.2 (3.6, 4.9)	4.8 (4.1, 5.6)	5.1 (4.3, 6.0)
ASA 5	1	15	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	**12254**	**491284**						

Note: Restricted to modern prostheses
Excludes 250,563 procedures with unknown ASA score

Figure KT14 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=1.12 (1.04, 1.22), p=0.003

ASA 3 vs ASA 1

0 - 6Mth: HR=2.09 (1.88, 2.32), p<0.001

6Mth+: HR=1.28 (1.18, 1.39), p<0.001

ASA 4 vs ASA 1

0 - 3Mth: HR=4.53 (3.36, 6.10), p<0.001

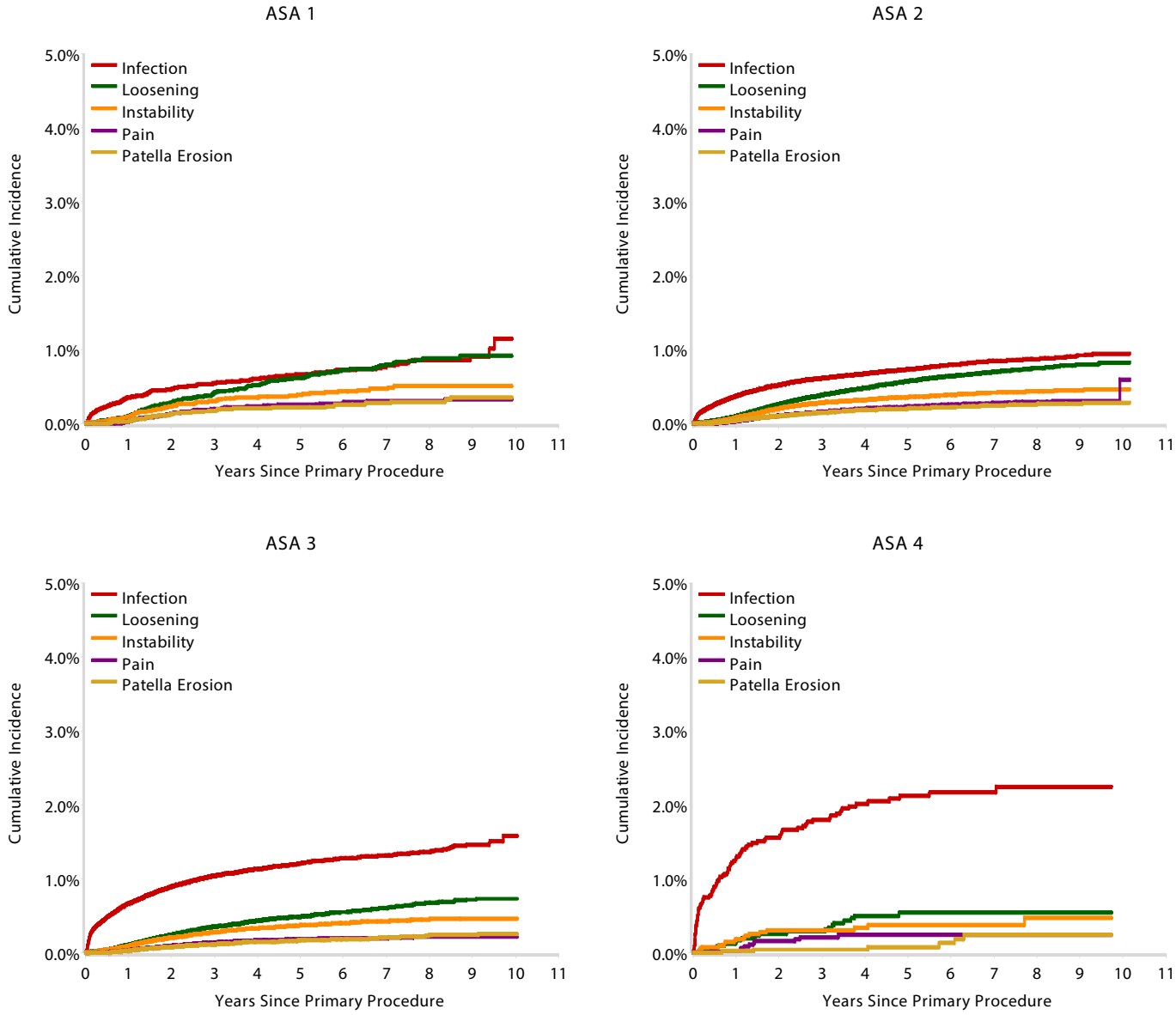
3Mth - 1.5Yr: HR=2.14 (1.68, 2.74), p<0.001

1.5Yr+: HR=1.40 (1.08, 1.82), p=0.011

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	9 Yrs
ASA 1	27557	24755	21665	18710	12766	7018	1782
ASA 2	266765	235447	202428	172730	113491	59869	13960
ASA 3	191845	164745	138035	114851	69516	33003	6922
ASA 4	5102	4318	3604	2985	1756	889	202

Note: Restricted to modern prostheses
Excludes 250,563 procedures with unknown ASA score

Figure KT15 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by ASA Score (Primary Diagnosis OA)



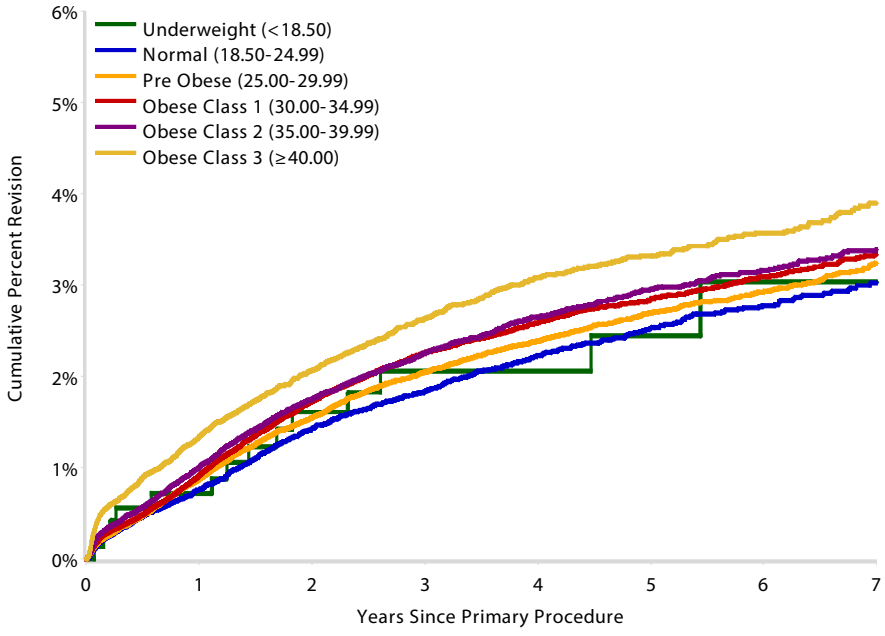
Note: Restricted to modern prostheses
Excludes 250,563 procedures with unknown ASA score

Table KT18 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)	14	736	0.7 (0.3, 1.7)	1.6 (0.9, 3.0)	2.1 (1.2, 3.6)	2.1 (1.2, 3.6)	2.4 (1.4, 4.3)	3.0 (1.7, 5.5)
Normal (18.50-24.99)	801	42319	0.8 (0.7, 0.8)	1.4 (1.3, 1.6)	1.8 (1.7, 2.0)	2.2 (2.1, 2.4)	2.5 (2.3, 2.7)	2.8 (2.6, 3.0)
Pre Obese (25.00-29.99)	2610	126749	0.9 (0.8, 0.9)	1.5 (1.5, 1.6)	2.0 (2.0, 2.1)	2.4 (2.3, 2.5)	2.7 (2.6, 2.8)	2.9 (2.8, 3.1)
Obese Class 1 (30.00-34.99)	2765	125418	0.9 (0.9, 1.0)	1.7 (1.7, 1.8)	2.3 (2.2, 2.3)	2.6 (2.5, 2.7)	2.8 (2.7, 3.0)	3.1 (3.0, 3.2)
Obese Class 2 (35.00-39.99)	1560	68501	1.0 (0.9, 1.1)	1.7 (1.6, 1.9)	2.3 (2.1, 2.4)	2.6 (2.5, 2.8)	3.0 (2.8, 3.1)	3.2 (3.0, 3.3)
Obese Class 3 (≥40.00)	1111	41547	1.3 (1.2, 1.5)	2.1 (1.9, 2.2)	2.6 (2.5, 2.8)	3.1 (2.9, 3.3)	3.3 (3.1, 3.5)	3.6 (3.4, 3.8)
TOTAL	**8861**	**405270**						

Note: Restricted to modern prostheses
BMI has not been presented for patients aged ≤19 years
Excludes 336,577 procedures with an unknown BMI

Figure KT16 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=1.12 (0.66, 1.89), p=0.682

Pre Obese (25.00-29.99) vs Normal (18.50-24.99)
Entire Period: HR=1.00 (0.92, 1.08), p=0.985

Obese Class 1 (30.00-34.99) vs Normal (18.50-24.99)
Entire Period: HR=1.03 (0.95, 1.11), p=0.516

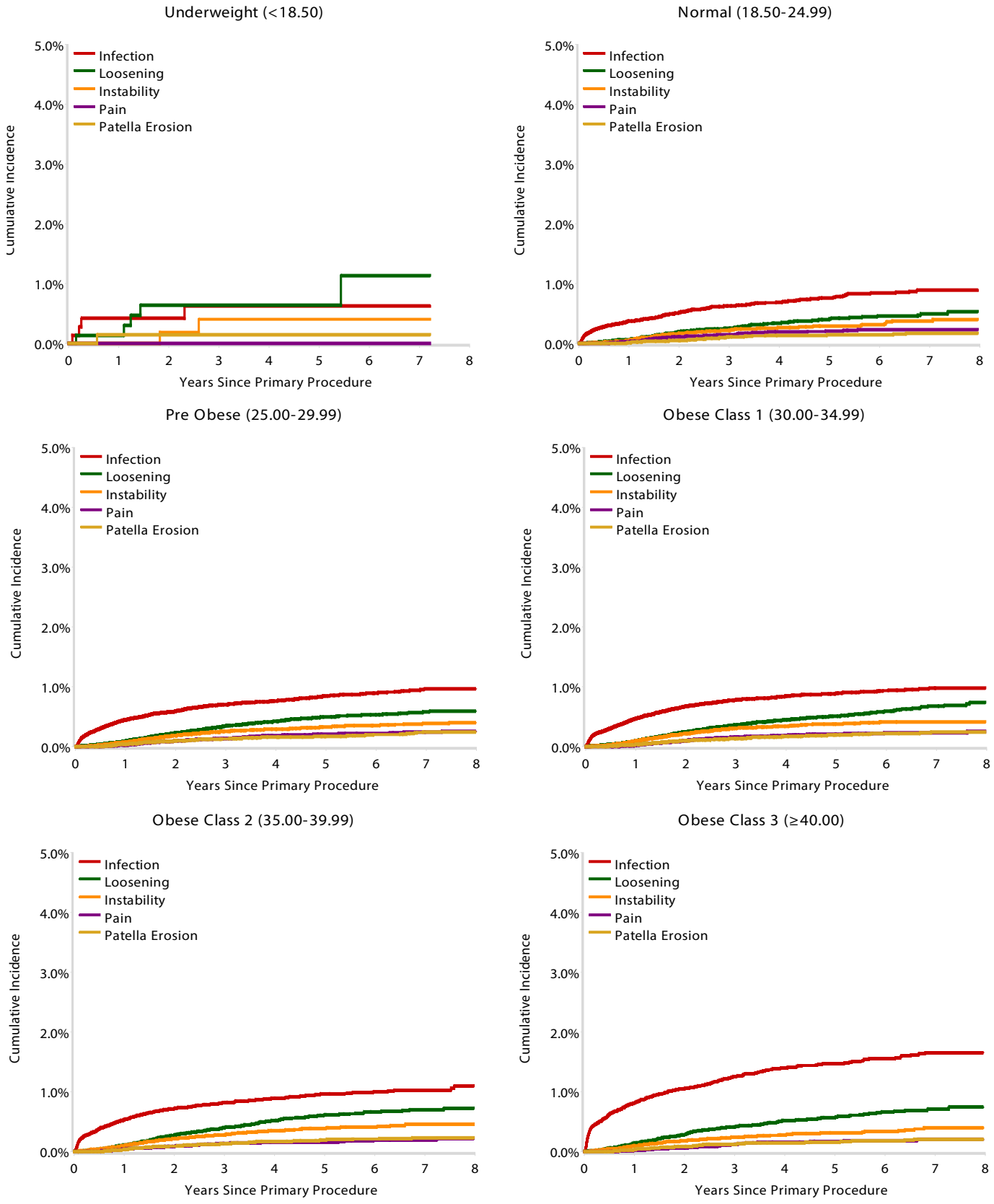
Obese Class 2 (35.00-39.99) vs Normal (18.50-24.99)
0 - 1Mth: HR=1.30 (1.07, 1.60), p=0.009
1Mth - 6Mth: HR=1.07 (0.91, 1.25), p=0.405
6Mth - 1.5Yr: HR=1.03 (0.91, 1.16), p=0.651
1.5Yr+: HR=0.98 (0.88, 1.09), p=0.704

Obese Class 3 (≥40.00) vs Normal (18.50-24.99)
0 - 1Mth: HR=2.23 (1.83, 2.72), p<0.001
1Mth - 6Mth: HR=1.53 (1.30, 1.80), p<0.001
6Mth - 1Yr: HR=1.03 (0.87, 1.23), p=0.706
1Yr - 2Yr: HR=0.93 (0.80, 1.08), p=0.336
2Yr+: HR=1.05 (0.92, 1.20), p=0.437

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Underweight (<18.50)	736	604	488	384	290	202	125
Normal (18.50-24.99)	42319	35759	29224	23341	17564	12304	7631
Pre Obese (25.00-29.99)	126749	107685	88298	71056	53954	38056	23478
Obese Class 1 (30.00-34.99)	125418	106856	87648	70733	53601	37878	23268
Obese Class 2 (35.00-39.99)	68501	58533	48177	39035	29784	20699	12731
Obese Class 3 (≥40.00)	41547	35523	29480	24200	18465	13006	7954

Note: Restricted to modern prostheses
BMI has not been presented for patients aged ≤19 years
Excludes 336,577 procedures with an unknown BMI

Figure KT17 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by BMI Category (Primary Diagnosis OA)



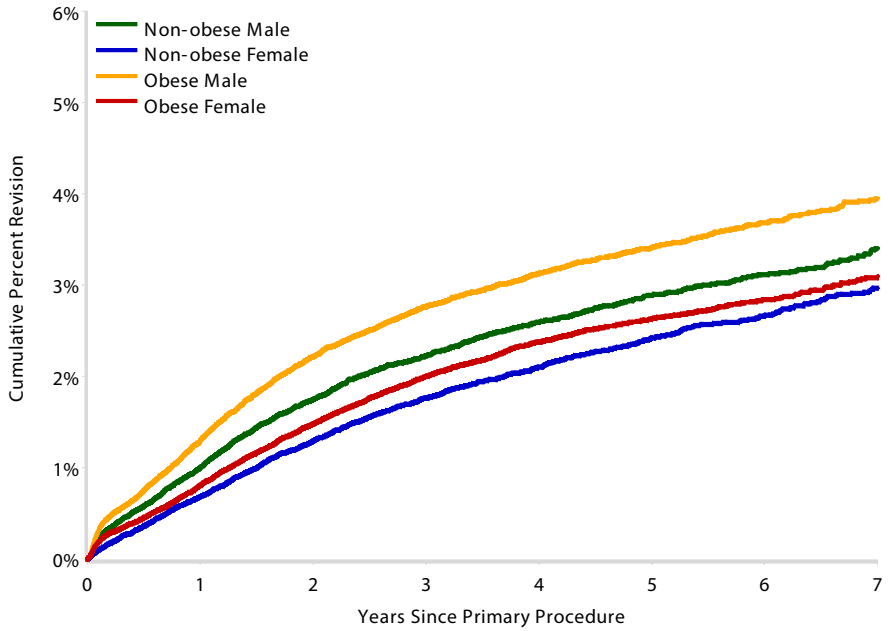
Note: Restricted to modern prostheses. BMI has not been presented for patients aged ≤19 years. Excludes 336,577 procedures with an unknown BMI

Table KT19 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	1871	84319	1.0 (0.9, 1.1)	1.7 (1.7, 1.8)	2.2 (2.1, 2.3)	2.6 (2.5, 2.7)	2.9 (2.8, 3.0)	3.1 (3.0, 3.3)
	Female	1554	85485	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, 2.6)	2.7 (2.5, 2.8)
Obese	Male	2676	99726	1.3 (1.2, 1.4)	2.2 (2.1, 2.3)	2.8 (2.7, 2.9)	3.1 (3.0, 3.3)	3.4 (3.3, 3.5)	3.7 (3.5, 3.8)
	Female	2760	135740	0.8 (0.8, 0.9)	1.5 (1.4, 1.6)	2.0 (1.9, 2.1)	2.4 (2.3, 2.5)	2.6 (2.5, 2.7)	2.8 (2.7, 3.0)
TOTAL		**8861**	**405270**						

Note: Restricted to modern prostheses
BMI has not been presented for patients aged ≤19 years
Excludes 336,577 procedures with an unknown BMI
Non-obese group includes underweight, normal and pre-obese
Obese group includes obese class 1, 2 and 3

Figure KT18 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=1.86 (1.54, 2.23), p<0.001
- 3Mth - 1.5Yr: HR=1.27 (1.14, 1.42), p<0.001
- 1.5Yr+: HR=0.99 (0.90, 1.09), p=0.832

Non-obese Male vs Obese Male
- 0 - 2Yr: HR=0.86 (0.80, 0.92), p<0.001
- 2Yr+: HR=1.01 (0.91, 1.13), p=0.797

Non-obese Female vs Obese Female
- 0 - 1Mth: HR=0.64 (0.51, 0.80), p<0.001
- 1Mth - 3Mth: HR=0.81 (0.65, 1.01), p=0.065
- 3Mth - 9Mth: HR=1.16 (1.01, 1.33), p=0.036
- 9Mth - 1.5Yr: HR=0.97 (0.87, 1.10), p=0.664
- 1.5Yr+: HR=1.08 (0.99, 1.18), p=0.083

Obese Male vs Obese Female
- 0 - 2Yr: HR=1.50 (1.40, 1.60), p<0.001
- 2Yr+: HR=1.06 (0.96, 1.16), p=0.258

Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Non-obese	Male	84319	71422	58384	46469	35066	24648	15138
	Female	85485	72626	59626	48312	36742	25914	16096
Obese	Male	99726	84288	68670	54950	41288	28699	17338
	Female	135740	116624	96635	79018	60562	42884	26615

Note: Restricted to modern prostheses
BMI has not been presented for patients aged ≤19 years
Excludes 336,577 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 2022, few all-polyethylene and non-modular tibial components were used.

Fixed bearings include non-modular tibial prostheses, as well as those with fixed inserts that do not move relative to the baseplate.

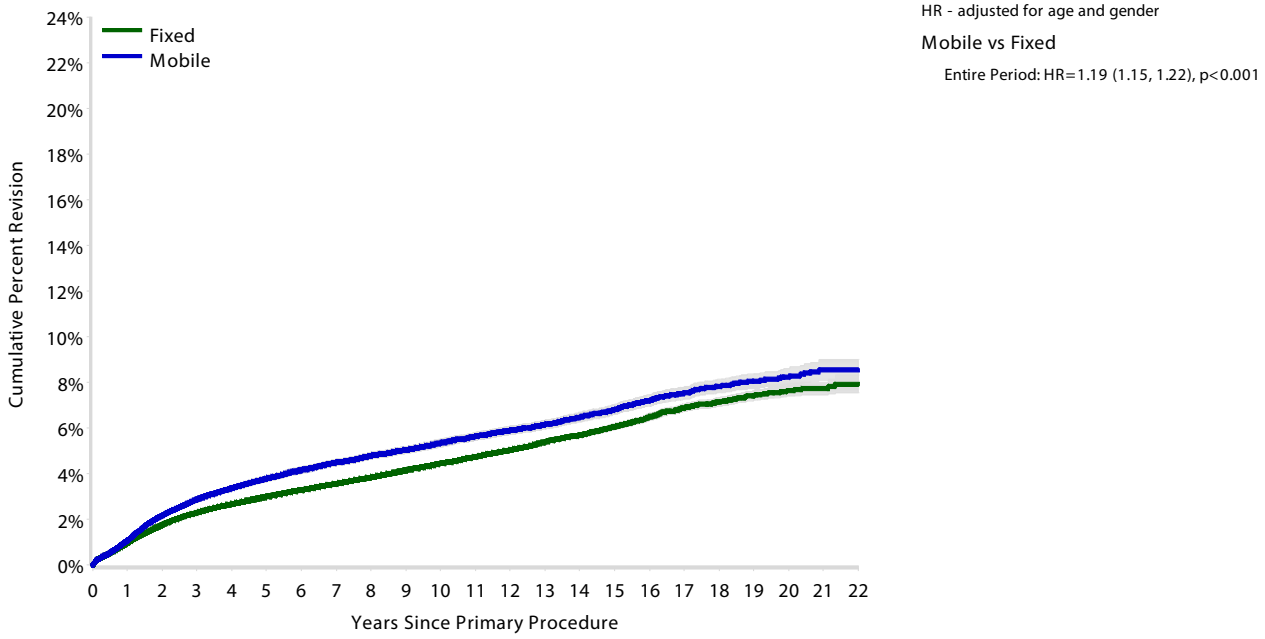
Fixed bearing prostheses have a lower rate of revision compared to mobile bearing prostheses (Table KT20 and Figure KT19).

Table KT20 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	20771	627861	0.9 (0.9, 1.0)	2.3 (2.3, 2.3)	3.0 (2.9, 3.0)	4.4 (4.4, 4.5)	6.1 (5.9, 6.2)	7.6 (7.4, 7.9)
Mobile	5232	113979	1.1 (1.0, 1.1)	2.9 (2.8, 3.0)	3.8 (3.7, 3.9)	5.3 (5.2, 5.5)	6.8 (6.6, 7.0)	8.3 (7.9, 8.6)
TOTAL	**26003**	**741840**						

Note: Excludes 7 procedures with unknown bearing mobility
Restricted to modern prostheses

Figure KT19 Cumulative Percent Revision of Primary Total Knee Replacement by Bearing Mobility (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Fixed	627861	568741	454880	347133	137666	32774	3103
Mobile	113979	106513	89958	74671	38501	13735	2155

Note: Excludes 7 procedures with unknown bearing mobility
Restricted to modern prostheses

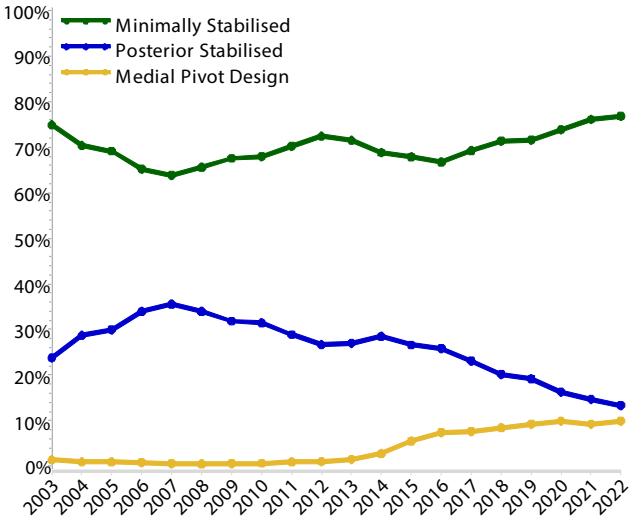
Stability
Stability refers to particular prosthetic features intended to substitute for the intrinsic stability of knee ligaments. In 2018, the classification of stability was expanded to include medial pivot design. The five categories are: minimally stabilised, medial pivot design, posterior stabilised, 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 2022, these accounted for 76.8% of primary procedures. The use of posterior stabilised prostheses has declined to 13.3% in 2022. The use of medial pivot design prostheses has increased since 2013. In 2022, medial pivot design prostheses accounted for 9.9% of primary procedures (Figure KT20).

Figure KT20 Primary Total Knee Replacement by Stability (Primary Diagnosis OA)



Note: Restricted to modern prostheses

Posterior stabilised and medial pivot design 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 (Table KT21 and Figure KT21).

The cumulative incidence for the different reasons for revision varies depending on stability. Posterior stabilised prostheses have a higher cumulative incidence of infection compared to minimally stabilised and medial pivot design prostheses. Posterior stabilised also have a higher cumulative incidence of loosening compared to minimally stabilised prostheses. Medial pivot design prostheses have a higher cumulative incidence of revision for pain and instability compared to minimally stabilised prostheses (Figure KT22).

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', 'deep dish' or 'ultra-congruent' designs which are intended to provide additional stability.

High polyethylene conformity has an increased rate of revision compared to low polyethylene conformity (Table KT22 and Figure KT23).

The outcome of total knee replacement with XLPE by prosthesis combination and polyethylene insert shape is presented in Table KT23 and Table KT24.

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 0.6% 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, and other inflammatory arthritis (Table KT25).

Fully stabilised prostheses have been used in 3,075 and hinged prostheses in 2,833 primary procedures. For these two knee designs, the cumulative percent revision for all diagnoses are shown in Table KT26 and Figure KT24.

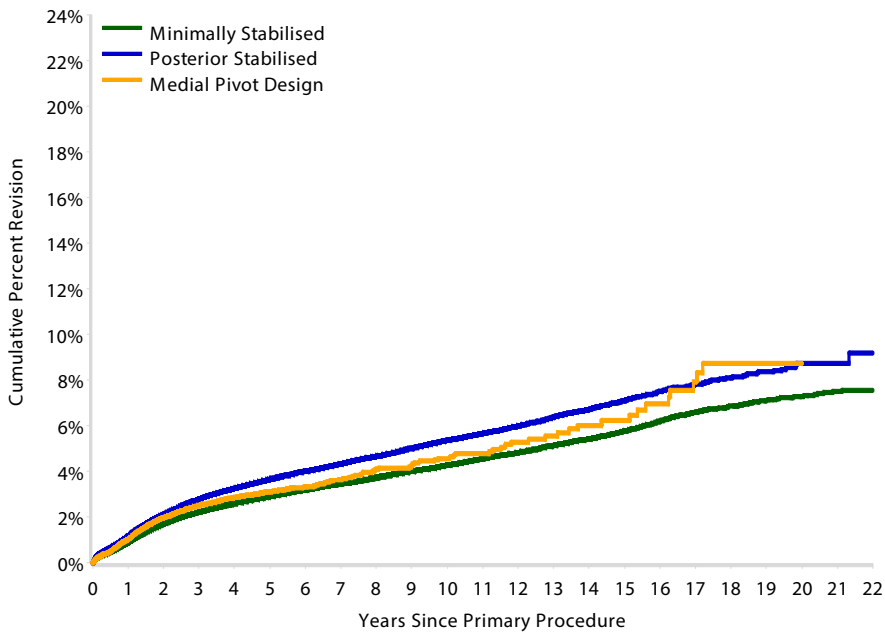
When the outcome for osteoarthritis is considered, fully stabilised and hinged knee prostheses both have higher rates of revision compared to minimally stabilised prostheses (Figure KT25). For both of these designs, infection is the most common reason for revision, followed by loosening and fracture (Table KT27 and Figure KT26).

Table KT21 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	16903	523470	0.9 (0.9, 0.9)	2.2 (2.2, 2.3)	2.9 (2.8, 2.9)	4.3 (4.2, 4.3)	5.8 (5.7, 5.9)	7.3 (7.1, 7.5)
Posterior Stabilised	7810	174579	1.2 (1.1, 1.2)	2.8 (2.7, 2.9)	3.7 (3.6, 3.8)	5.4 (5.2, 5.5)	7.1 (6.9, 7.3)	8.7 (8.3, 9.2)
Medial Pivot Design	1014	39327	1.0 (0.9, 1.1)	2.5 (2.3, 2.7)	3.1 (2.9, 3.3)	4.6 (4.1, 5.0)	6.2 (5.3, 7.3)	8.7 (6.9, 11.0)
Fully Stabilised	160	2795	2.7 (2.1, 3.4)	4.9 (4.1, 5.8)	6.1 (5.2, 7.2)	8.0 (6.7, 9.6)		
Hinged	116	1646	2.8 (2.1, 3.7)	6.3 (5.1, 7.7)	8.2 (6.7, 10.0)	11.9 (9.7, 14.7)		
TOTAL	**26003**	**741817**						

Note: Excludes 30 procedures with unknown stability
Restricted to modern prostheses

Figure KT21 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 - 6Mth: HR=1.45 (1.35, 1.56), p<0.001

6Mth - 1.5Yr: HR=1.18 (1.11, 1.24), p<0.001

1.5Yr+: HR=1.24 (1.20, 1.28), p<0.001

Posterior Stabilised vs Medial Pivot Design

Entire Period: HR=1.15 (1.08, 1.23), p<0.001

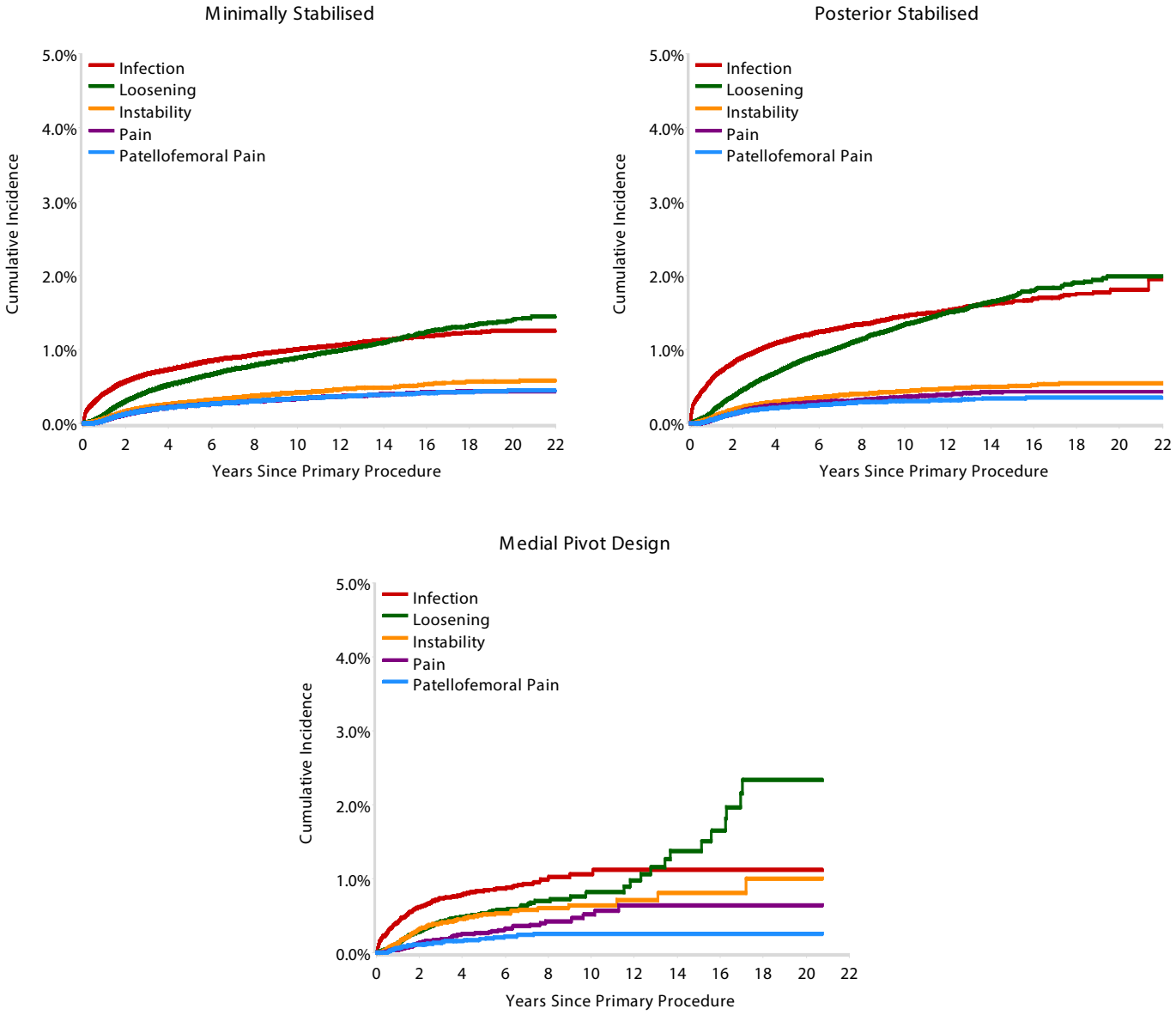
Medial Pivot Design vs Minimally Stabilised

Entire Period: HR=1.09 (1.02, 1.16), p=0.011

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Minimally Stabilised	523470	473934	378223	291412	122977	32958	4309
Posterior Stabilised	174579	164116	141697	116013	51306	13082	874
Medial Pivot Design	39327	33393	22241	12622	1443	422	70

Note: Restricted to modern prostheses

Figure KT22 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by Stability (Primary Diagnosis OA)



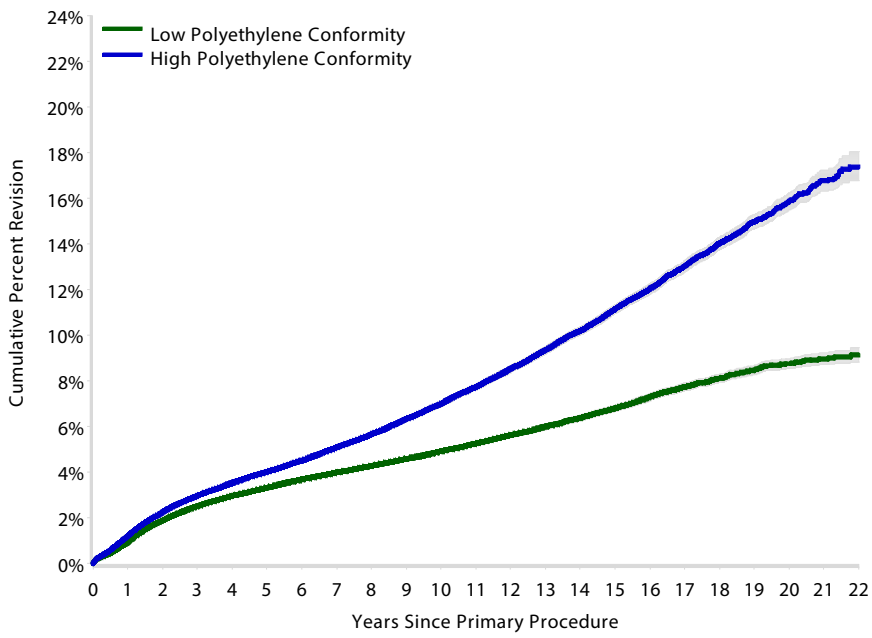
Note: Restricted to modern prostheses

Table KT22 Cumulative Percent Revision of Primary Total Knee Replacement with XLPE by Polyethylene Conformity (Primary Diagnosis OA)

Polyethylene Shape	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Low Polyethylene Conformity	10166	296325	0.9 (0.8, 0.9)	2.3 (2.2, 2.4)	3.0 (3.0, 3.1)	4.4 (4.4, 4.5)	6.1 (5.9, 6.2)	7.7 (7.5, 8.0)
High Polyethylene Conformity	13967	334662	1.1 (1.1, 1.1)	2.7 (2.6, 2.7)	3.5 (3.5, 3.6)	5.8 (5.7, 5.9)	8.9 (8.7, 9.1)	13.4 (12.9, 14.0)
TOTAL	**24133**	**630987**						

Note: Restricted to modern prostheses

Figure KT23 Cumulative Percent Revision of Primary Total Knee Replacement with XLPE by Polyethylene Conformity (Primary Diagnosis OA)



HR - adjusted for age and gender

High Polyethylene Conformity vs Low Polyethylene Conformity

- 0 - 1.5Yr: HR=1.16 (1.12, 1.20), p<0.001
- 1.5Yr - 2Yr: HR=1.06 (0.99, 1.14), p=0.103
- 2Yr - 2.5Yr: HR=1.11 (1.02, 1.21), p=0.012
- 2.5Yr - 5.5Yr: HR=1.20 (1.15, 1.25), p<0.001
- 5.5Yr - 6Yr: HR=1.53 (1.34, 1.75), p<0.001
- 6Yr - 8.5Yr: HR=1.83 (1.71, 1.95), p<0.001
- 8.5Yr - 10Yr: HR=2.10 (1.92, 2.31), p<0.001
- 10Yr - 10.5Yr: HR=2.36 (1.99, 2.80), p<0.001
- 10.5Yr - 11Yr: HR=1.74 (1.47, 2.08), p<0.001
- 11Yr - 13.5Yr: HR=2.19 (2.01, 2.39), p<0.001
- 13.5Yr - 16Yr: HR=2.01 (1.81, 2.23), p<0.001
- 16Yr - 18.5: HR=2.34 (2.03, 2.71), p<0.001
- 18.5+: HR=3.64 (2.74, 4.82), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Low Polyethylene Conformity	296325	266886	211619	166413	77611	22163	3477
High Polyethylene Conformity	334662	302036	238017	175034	64381	17761	2007

Note: Restricted to modern prostheses

Table KT23 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	14 Yrs
Triathlon/Triathlon	Condylar Stabilising	1508	68454	0.8 (0.8, 0.9)	1.9 (1.8, 2.0)	2.4 (2.3, 2.6)	3.0 (2.8, 3.2)	3.8 (3.5, 4.0)	4.6 (4.2, 5.1)
	Cruciate Retaining	1411	61785	0.8 (0.7, 0.9)	1.8 (1.7, 2.0)	2.4 (2.3, 2.6)	2.8 (2.7, 3.0)	3.6 (3.4, 3.8)	4.7 (4.2, 5.2)
PFC Sigma/PFC Sigma	Curved Plus	70	2524	0.6 (0.4, 1.0)	2.1 (1.6, 2.8)	2.9 (2.2, 3.6)	3.1 (2.4, 3.9)	3.4 (2.7, 4.5)	
	Cruciate Retaining (Curved)	42	1750	0.9 (0.5, 1.4)	1.9 (1.4, 2.7)	2.5 (1.8, 3.4)	2.9 (2.1, 4.0)		
Genesis II/Genesis II	Deep Dish	10	647	1.3 (0.6, 2.6)	1.9 (1.0, 3.6)				
	CR High Flex	196	7712	1.0 (0.8, 1.3)	2.3 (1.9, 2.7)	2.8 (2.4, 3.2)	3.4 (2.9, 3.9)	4.5 (3.7, 5.5)	
Natural Knee/Natural Knee	Ultra-Congruent	37	1415	0.7 (0.4, 1.3)	1.5 (1.0, 2.3)	1.8 (1.2, 2.6)	2.2 (1.5, 3.2)	3.0 (2.1, 4.2)	3.7 (2.6, 5.3)
	Cruciate Retaining	134	4534	0.8 (0.6, 1.2)	2.0 (1.7, 2.5)	2.6 (2.2, 3.2)	3.1 (2.6, 3.7)	3.5 (2.9, 4.2)	5.5 (3.9, 7.6)
Persona	Ultra-Congruent	65	4334	1.0 (0.7, 1.3)	1.8 (1.4, 2.4)	2.1 (1.6, 2.8)			
	Cruciate Retaining	520	39108	0.9 (0.8, 1.0)	1.9 (1.7, 2.1)	2.3 (2.0, 2.5)	2.3 (2.0, 2.5)		
Legion/Genesis II	Ultra-Congruent	20	826	1.8 (1.1, 3.2)	4.3 (2.5, 7.3)				
	Cruciate Retaining	140	5244	1.1 (0.8, 1.4)	2.5 (2.1, 3.1)	3.4 (2.9, 4.1)	4.1 (3.4, 4.9)	4.3 (3.5, 5.2)	
Legion Oxinium/ Genesis II	Ultra-Congruent	11	702	1.0 (0.5, 2.3)	2.4 (1.3, 4.4)				
	Cruciate Retaining	176	7195	0.8 (0.6, 1.0)	2.4 (2.0, 2.9)	3.5 (2.9, 4.1)	4.3 (3.6, 5.1)	5.0 (4.1, 6.2)	

Note: Restricted to modern prostheses

Table KT24 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
Triathlon/Triathlon	Condylar Stabilising vs Cruciate Retaining	Entire Period: HR=1.03 (0.96, 1.11), p=0.458
PFC Sigma/PFC Sigma	Curved Plus vs Cruciate Retaining (Curved)	Entire Period: HR=1.10 (0.75, 1.61), p=0.642
Genesis II/Genesis	Deep Dish vs CR High Flex	0 - 2Wk: HR=12.67 (3.17, 50.68), p<0.001 2Wk+: HR=0.67 (0.30, 1.53), p=0.345
Natural Knee/Natural Knee	Ultra-Congruent vs Cruciate Retaining	Entire Period: HR=0.80 (0.55, 1.15), p=0.220
Persona	Ultra-Congruent vs Cruciate Retaining	Entire Period: HR=0.95 (0.73, 1.22), p=0.671
Legion/Genesis II	Ultra-Congruent vs Cruciate Retaining	Entire Period: HR=1.43 (0.89, 2.31), p=0.140
Legion/Oxinium	Ultra-Congruent vs Cruciate Retaining	Entire Period: HR=1.06 (0.57, 1.97), p=0.843

Note: Restricted to modern prostheses

Table KT25 Primary Total Knee Replacement by Primary Diagnosis and Stability

Primary Diagnosis	Fully Stabilised		Hinged		TOTAL	
	N	Col%	N	Col%	N	Col%
Osteoarthritis	2795	90.9	1646	58.1	4441	75.2
Tumour	12	0.4	674	23.8	686	11.6
Fracture	50	1.6	295	10.4	345	5.8
Rheumatoid Arthritis	131	4.3	81	2.9	212	3.6
Other Inflammatory Arthritis	35	1.1	41	1.4	76	1.3
Osteonecrosis	36	1.2	38	1.3	74	1.3
Other	16	0.5	58	2.0	74	1.3
TOTAL	**3075**	**100.0**	**2833**	**100.0**	**5908**	**100.0**

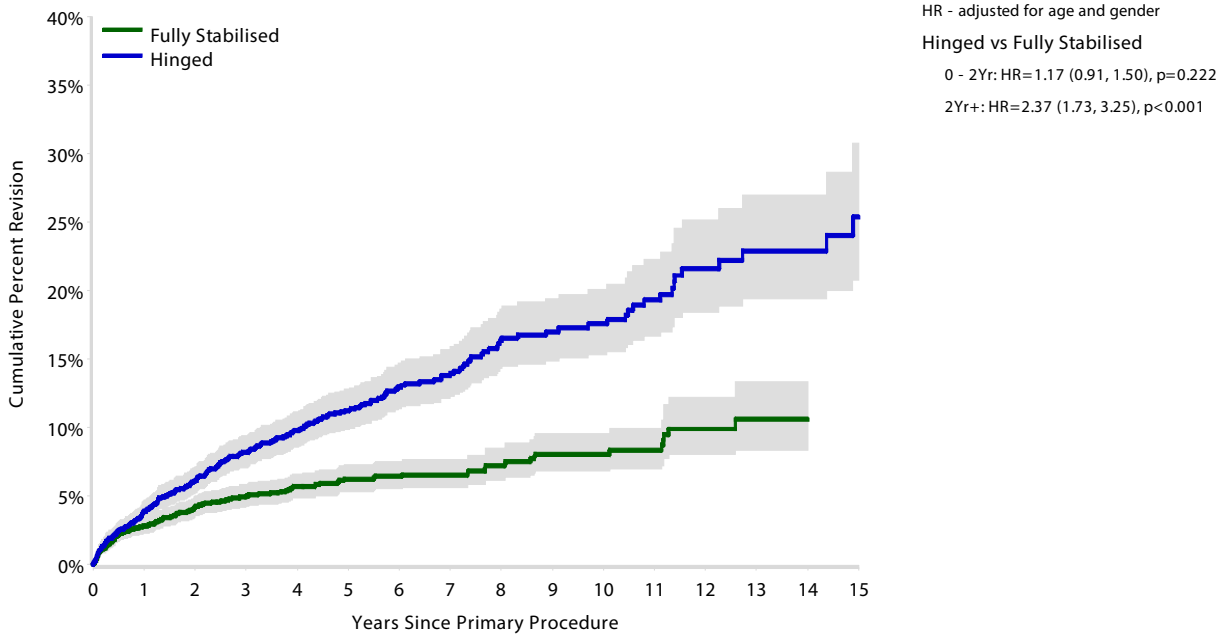
Note: Restricted to modern prostheses

Table KT26 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	179	3075	2.8 (2.3, 3.5)	5.0 (4.2, 5.9)	6.2 (5.3, 7.3)	6.6 (5.6, 7.7)	8.1 (6.8, 9.6)	
Hinged	281	2833	3.9 (3.2, 4.7)	8.2 (7.1, 9.4)	11.3 (9.9, 12.8)	14.0 (12.3, 15.9)	17.6 (15.3, 20.1)	25.4 (20.8, 30.7)
TOTAL	**460**	**5908**						

Note: Restricted to modern prostheses

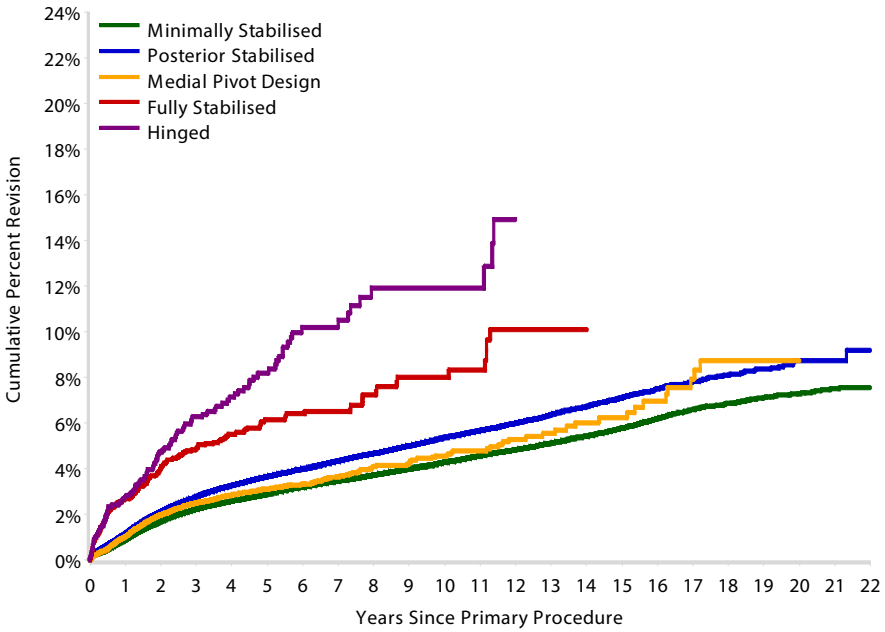
Figure KT24 Cumulative Percent Revision of Primary Total Knee Replacement by Stability (All Diagnoses)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	15 Yrs
Fully Stabilised	3075	2679	1977	1348	827	346	39
Hinged	2833	2267	1466	898	531	269	55

Note: Restricted to modern prostheses

Figure KT25 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 - 6Mth: HR=1.44 (1.35, 1.55), p<0.001

6Mth - 1.5Yr: HR=1.18 (1.12, 1.25), p<0.001

1.5Yr+: HR=1.24 (1.20, 1.28), p<0.001

Medial Pivot Design vs Minimally Stabilised

Entire Period: HR=1.09 (1.02, 1.16), p=0.011

Fully Stabilised vs Minimally Stabilised

0 - 6Mth: HR=4.53 (3.48, 5.90), p<0.001

6Mth - 1.5Yr: HR=1.40 (0.98, 2.01), p=0.063

1.5Yr+: HR=1.80 (1.43, 2.26), p<0.001

Hinged vs Minimally Stabilised

Entire Period: HR=2.99 (2.49, 3.59), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Minimally Stabilised	523470	473934	378223	291412	122977	32958	4309
Posterior Stabilised	174579	164116	141697	116013	51306	13082	874
Medial Pivot Design	39327	33393	22241	12622	1443	422	70
Fully Stabilised	2795	2445	1808	1234	305	29	4
Hinged	1646	1366	869	523	136	18	1

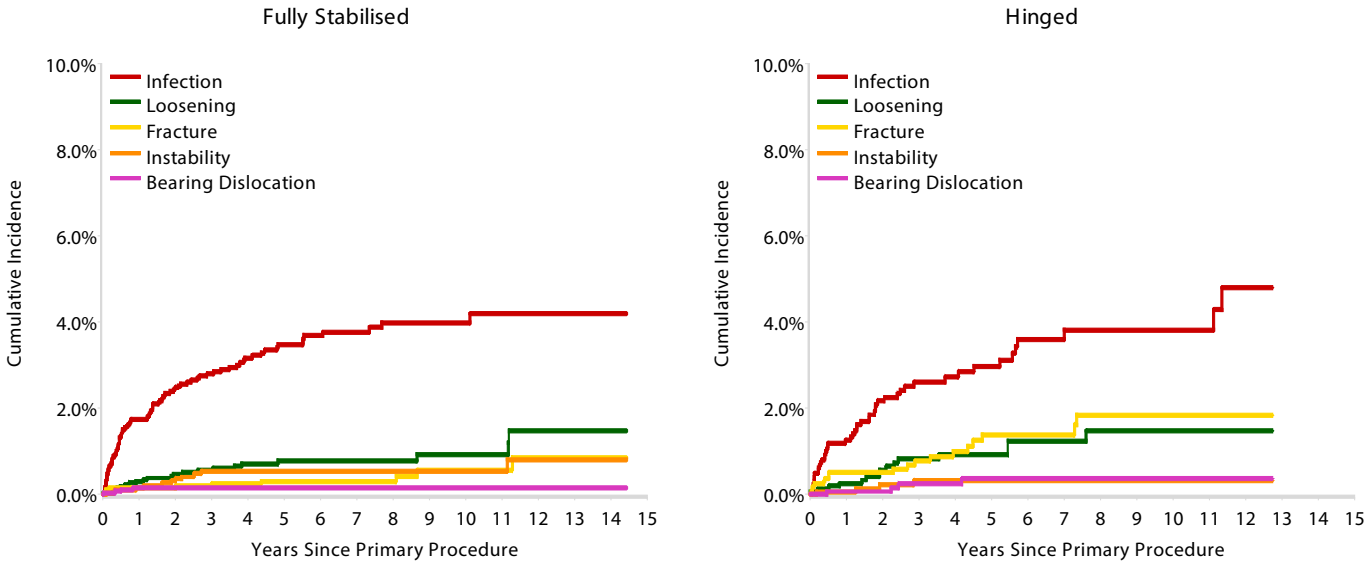
Note: Restricted to modern prostheses

Table KT27 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	91	3.3	56.9	47	2.9	40.5
Loosening	21	0.8	13.1	15	0.9	12.9
Fracture	10	0.4	6.3	18	1.1	15.5
Instability	14	0.5	8.8	4	0.2	3.4
Bearing Dislocation	4	0.1	2.5	4	0.2	3.4
Patella Erosion	4	0.1	2.5	4	0.2	3.4
Other	16	0.6	10.0	24	1.5	20.7
N Revision	**160**	**5.7**	**100.0**	**116**	**7.0**	**100.0**
N Primary	**2795**			**1646**		

Note: Restricted to modern prostheses

Figure KT26 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. This is both overall and for each of the three common stability types (Table KT28 and Figure KT27).

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 KT29 and Figure KT28).

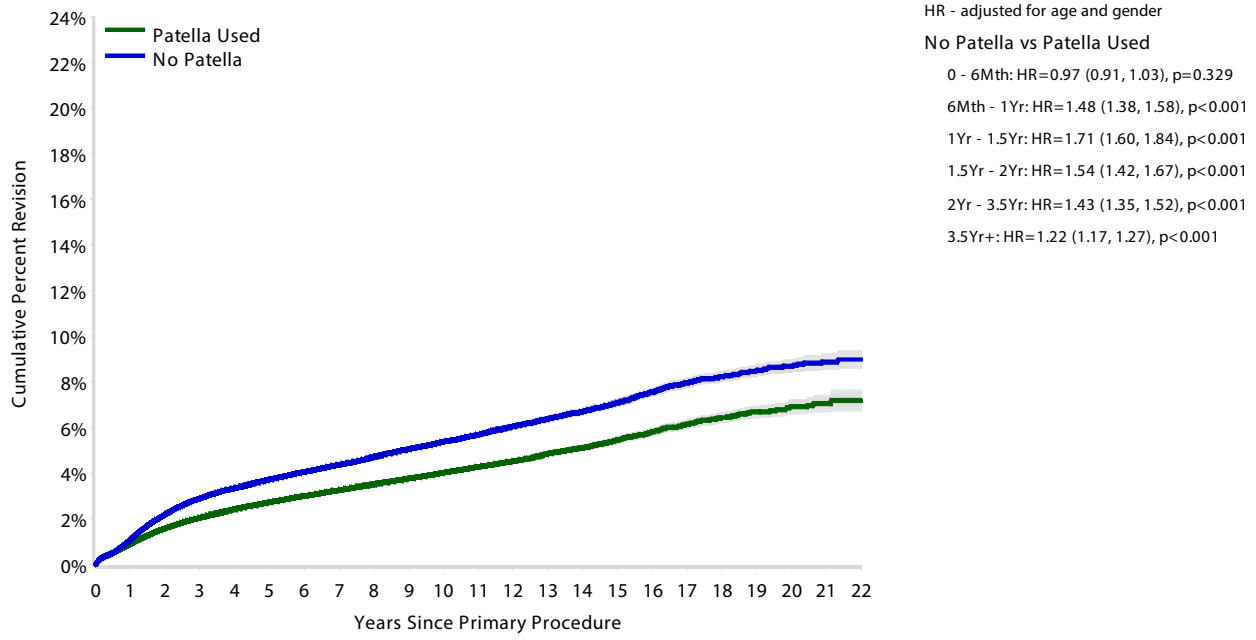
When the patella is resurfaced, there is no difference in the rate of revision for medial pivot design prostheses compared to minimally stabilised prostheses. When the patella is not resurfaced, medial pivot design prostheses have a higher rate of revision than minimally stabilised knee prostheses (Table KT29 and Figure KT29).

Table KT28 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	13247	464349	0.9 (0.9, 0.9)	2.1 (2.0, 2.1)	2.7 (2.7, 2.8)	4.0 (3.9, 4.1)	5.5 (5.3, 5.6)	6.9 (6.6, 7.2)
No Patella	12757	277498	1.1 (1.0, 1.1)	2.9 (2.8, 3.0)	3.7 (3.6, 3.8)	5.4 (5.3, 5.5)	7.1 (6.9, 7.2)	8.7 (8.4, 9.0)
TOTAL	**26004**	**741847**						

Note: Restricted to modern prostheses

Figure KT27 Cumulative Percent Revision of Primary Total Knee Replacement by Patella Component Usage (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Patella Used	464349	414713	320546	236233	88152	21774	2176
No Patella	277498	260543	224292	185571	88015	24735	3082

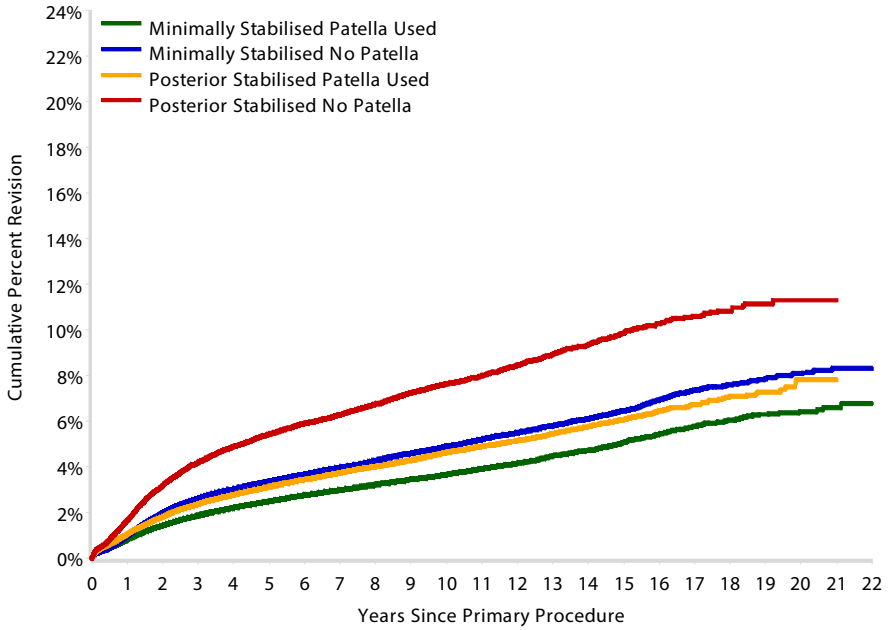
Note: Restricted to modern prostheses

Table KT29 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	7534	297925	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 (4.9, 5.3)	6.4 (6.1, 6.8)
	No Patella	9369	225545	1.0 (0.9, 1.0)	2.6 (2.6, 2.7)	3.4 (3.3, 3.4)	4.9 (4.8, 5.0)	6.5 (6.3, 6.6)	8.1 (7.8, 8.4)
Posterior Stabilised	Patella Used	5048	137446	1.0 (1.0, 1.1)	2.4 (2.3, 2.5)	3.1 (3.0, 3.2)	4.6 (4.5, 4.8)	6.1 (5.8, 6.3)	7.8 (7.2, 8.5)
	No Patella	2762	37133	1.7 (1.5, 1.8)	4.2 (4.0, 4.4)	5.4 (5.2, 5.7)	7.7 (7.4, 8.0)	9.8 (9.4, 10.3)	11.3 (10.6, 12.0)
Medial Pivot Design	Patella Used	485	25627	0.9 (0.8, 1.0)	2.0 (1.8, 2.2)	2.5 (2.2, 2.7)	3.3 (2.8, 3.8)	6.0 (3.8, 9.5)	
	No Patella	529	13700	1.3 (1.1, 1.5)	3.4 (3.1, 3.7)	4.2 (3.8, 4.6)	6.1 (5.4, 6.8)	7.4 (6.4, 8.7)	10.2 (8.1, 12.7)
TOTAL		**25727**	**737376**						

Note: Restricted to modern prostheses

Figure KT28 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=1.08 (0.99, 1.19), p=0.092
3Mth - 6Mth: HR=0.93 (0.82, 1.06), p=0.286
6Mth - 1Yr: HR=0.71 (0.65, 0.77), p<0.001
1Yr - 1.5Yr: HR=0.60 (0.55, 0.65), p<0.001
1.5Yr - 3.5Yr: HR=0.69 (0.65, 0.73), p<0.001
3.5Yr+: HR=0.83 (0.79, 0.87), p<0.001

Minimally Stabilised Patella Used
vs Posterior Stabilised Patella Used

Entire Period: HR=0.80 (0.78, 0.83), p<0.001

Minimally Stabilised No Patella
vs Posterior Stabilised No Patella

0 - 1Yr: HR=0.58 (0.53, 0.63), p<0.001
1Yr+: HR=0.66 (0.62, 0.69), p<0.001

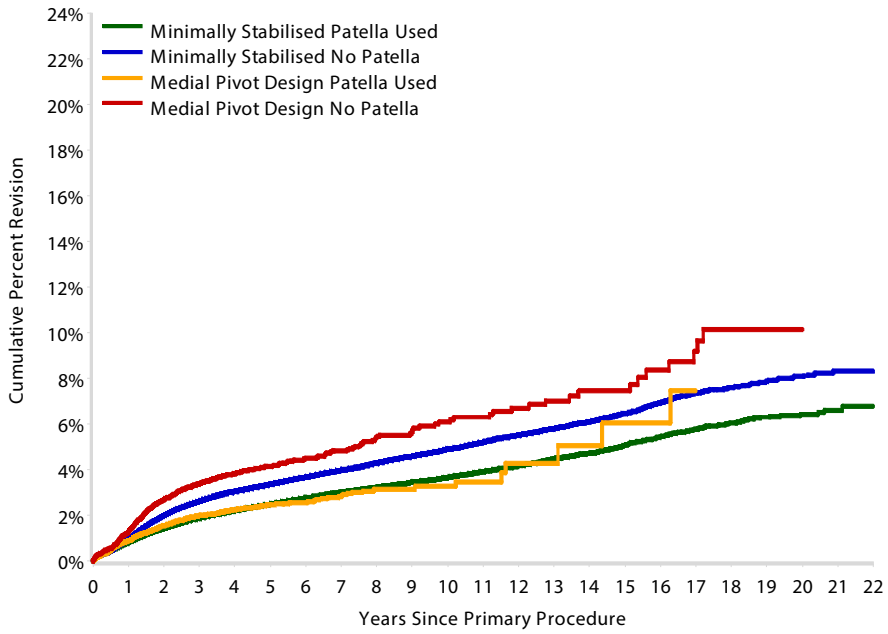
Posterior Stabilised Patella Used
vs Posterior Stabilised No Patella

Entire Period: HR=0.60 (0.58, 0.63), p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Minimally Stabilised	Patella Used	297925	262188	196565	141637	53011	13368	1619
	No Patella	225545	211746	181658	149775	69966	19590	2690
Posterior Stabilised	Patella Used	137446	128349	108873	86656	34401	8299	540
	No Patella	37133	35767	32824	29357	16905	4783	334

Note: Restricted to modern prostheses

Figure KT29 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=1.11 (1.01, 1.22), p=0.038

3Mth - 6Mth: HR=0.91 (0.80, 1.05), p=0.187

6Mth - 1Yr: HR=0.69 (0.63, 0.75), p<0.001

1Yr - 1.5Yr: HR=0.59 (0.54, 0.64), p<0.001

1.5Yr - 3.5Yr: HR=0.68 (0.64, 0.72), p<0.001

3.5Yr+: HR=0.84 (0.80, 0.88), p<0.001

Minimally Stabilised Patella Used vs Medial Pivot Design Patella Used

Entire Period: HR=1.00 (0.91, 1.10), p=0.946

Minimally Stabilised No Patella vs Medial Pivot Design No Patella

Entire Period: HR=0.80 (0.74, 0.88), p<0.001

Medial Pivot Design Patella Used vs Medial Pivot Design No Patella

Entire Period: HR=0.60 (0.53, 0.68), p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Minimally Stabilised	Patella Used	297925	262188	196565	141637	53011	13368	1619
	No Patella	225545	211746	181658	149775	69966	19590	2690
Medial Pivot Design	Patella Used	25627	21366	13228	6764	493	86	16
	No Patella	13700	12027	9013	5858	950	336	54

Note: Restricted to modern prostheses

FIXATION

The effect of fixation varies depending on prosthesis stability.

For minimally stabilised prostheses, hybrid fixation has a lower rate of revision compared to cementless fixation but no difference when compared to cemented fixation. Cementless fixation has a higher rate of revision compared to cemented fixation (Table KT30 and Figure KT30).

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 KT31 and Figure KT31).

Cementing the tibial component gives the best outcome for minimally stabilised knee replacement.

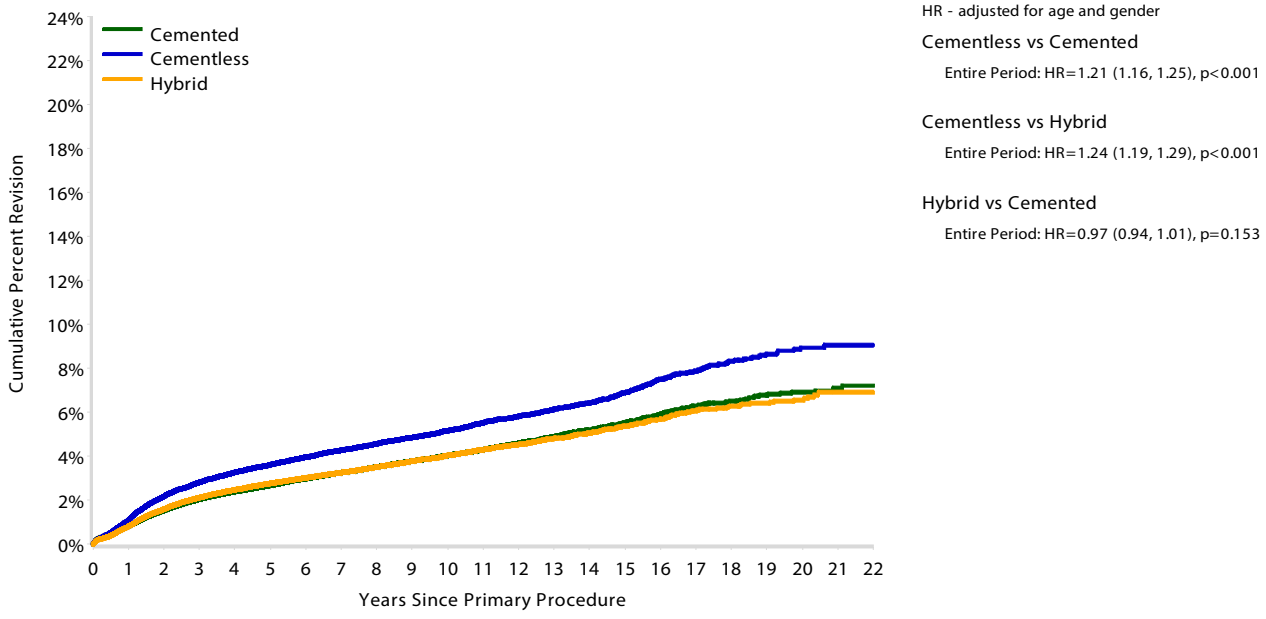
When a medial pivot design prosthesis is used, there is no difference in rate of revision between cemented and hybrid fixation. Cementless fixation has a higher rate of revision compared to cemented fixation for the entire period. Cementless fixation also has a higher rate of revision compared to hybrid fixation from 9 months to 1.5 years only, with no difference between the two fixation types either side of this time period (Table KT32 and Figure KT32).

Table KT30 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	7683	264453	0.8 (0.8, 0.9)	2.0 (2.0, 2.1)	2.7 (2.6, 2.7)	4.0 (3.9, 4.1)	5.5 (5.3, 5.7)	6.9 (6.6, 7.3)
Cementless	4324	106233	1.1 (1.0, 1.2)	2.8 (2.7, 2.9)	3.6 (3.5, 3.7)	5.2 (5.0, 5.3)	6.9 (6.6, 7.2)	8.9 (8.4, 9.5)
Hybrid	4850	152678	0.8 (0.8, 0.9)	2.1 (2.0, 2.2)	2.8 (2.7, 2.9)	4.0 (3.9, 4.2)	5.4 (5.2, 5.6)	6.6 (6.2, 6.9)
TOTAL	**16857**	**523364**						

Note: Excluding cementless Genesis Oxinium femoral prostheses. Restricted to modern prostheses

Figure KT30 Cumulative Percent Revision of Minimally Stabilised Primary Total Knee Replacement by Fixation (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Cemented	264453	239246	187863	138024	52641	14013	1787
Cementless	106233	93713	72726	60532	31705	8692	1233
Hybrid	152678	140883	117573	92796	38584	10219	1288

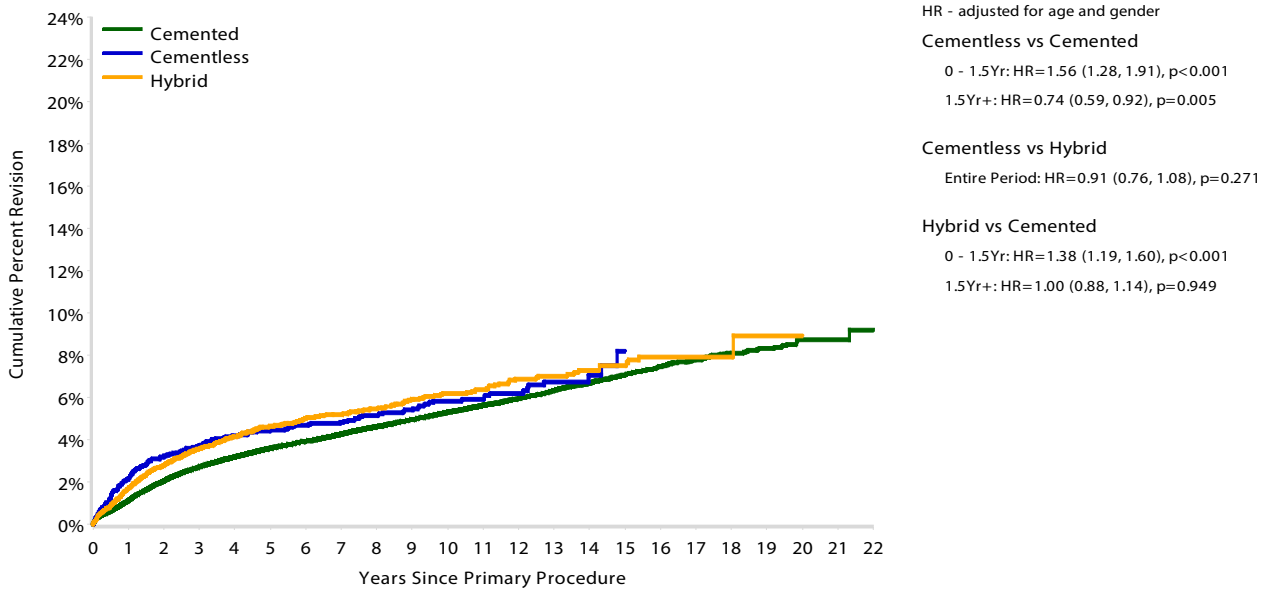
Note: Restricted to modern prostheses

Table KT31 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	7199	162793	1.1 (1.1, 1.2)	2.7 (2.6, 2.8)	3.6 (3.5, 3.7)	5.3 (5.2, 5.5)	7.1 (6.9, 7.3)	8.7 (8.2, 9.3)
Cementless	184	3657	2.2 (1.7, 2.7)	3.7 (3.1, 4.4)	4.5 (3.8, 5.2)	5.8 (5.0, 6.8)	8.2 (6.4, 10.5)	
Hybrid	427	8129	1.7 (1.5, 2.0)	3.6 (3.2, 4.0)	4.6 (4.2, 5.2)	6.2 (5.6, 6.8)	7.5 (6.7, 8.4)	8.9 (7.4, 10.8)
TOTAL	**7810**	**174579**						

Note: Restricted to modern prostheses

Figure KT31 Cumulative Percent Revision of Posterior Stabilised Primary Total Knee Replacement by Fixation (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Cemented	162793	153237	132451	108208	47540	12282	818
Cementless	3657	3365	2872	2333	1173	101	2
Hybrid	8129	7514	6374	5472	2593	699	54

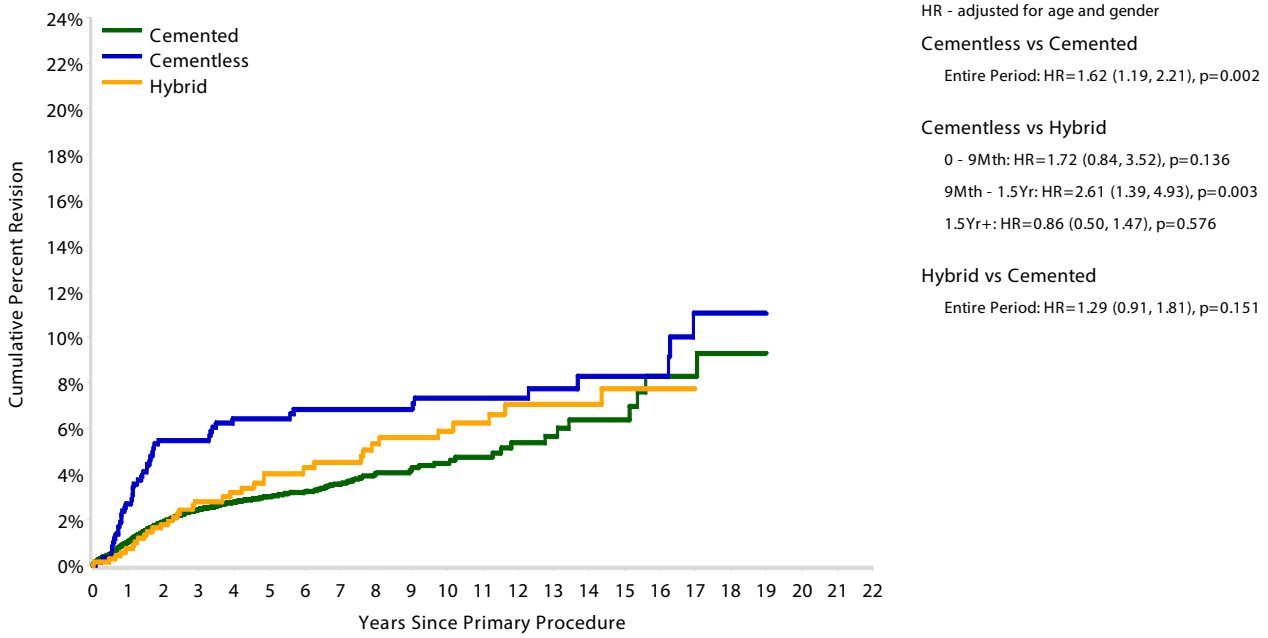
Note: Restricted to modern prostheses

Table KT32 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	20 Yrs
Cemented	932	38008	1.0 (0.9, 1.1)	2.4 (2.3, 2.6)	3.0 (2.8, 3.2)	4.5 (4.0, 5.0)	6.4 (5.1, 8.0)	
Cementless	46	599	2.7 (1.7, 4.4)	5.5 (3.9, 7.7)	6.4 (4.7, 8.7)	7.3 (5.4, 9.8)	8.3 (6.1, 11.2)	
Hybrid	36	720	0.7 (0.3, 1.7)	2.8 (1.8, 4.4)	4.0 (2.7, 6.0)	5.9 (4.1, 8.4)	7.7 (5.4, 11.0)	
TOTAL	**1014**	**39327**						

Note: Restricted to modern prostheses

Figure KT32 Cumulative Percent Revision of Medial Pivot Design Primary Total Knee Replacement by Fixation (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Cemented	38008	32153	21188	11740	790	169	34
Cementless	599	569	521	452	360	132	29
Hybrid	720	671	532	430	293	121	7

Note: Restricted to modern prostheses

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.

There are 382,778 primary total knee procedures that have used XLPE. After 3 months, the XLPE group has a lower rate of revision compared to the non XLPE group (Table KT33 and Figure KT34). The major reason for this difference is a reduced cumulative incidence of loosening (Figure KT35).

Primary total knee procedures that use non XLPE have a higher rate of revision for loosening than procedures that use XLPE (Table KT34 and Figure KT36). 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 KT35 and Figure KT37).

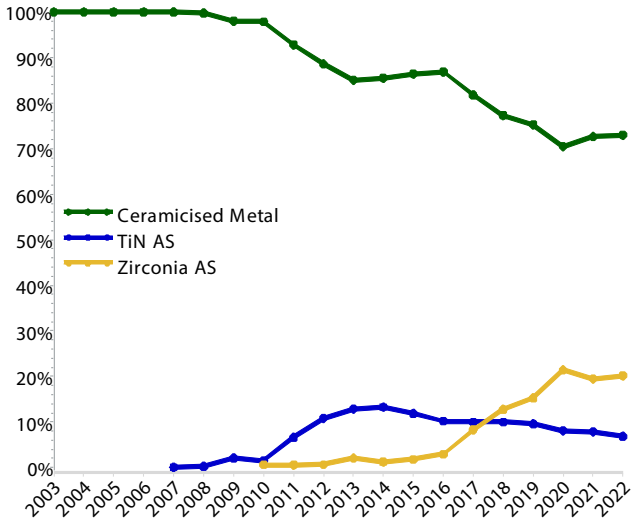
The difference between XLPE and non XLPE is more evident in younger patients. The 20 year cumulative percent revision rate for patients aged <65 years for XLPE is 8.2% and for non XLPE is 12.6%. For patients aged ≥65 years, the 20 year cumulative percent revision for XLPE is 4.1% and for non XLPE is 5.6% (Table KT36 and Figure KT38).

When considering the XLPE sub-types there is no difference when XLPE is compared to XLPE with antioxidant (Table KT37 and Figure KT39). The most common reasons for revision of XLPE and XLPE with antioxidant are shown in Figure KT40.

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 alternate surface femoral component is shown in Figure KT33.

Figure KT33 Primary Total Knee Replacement by AS Femoral Material



Note: TiN (titanium nitride) surface

There are 73,305 procedures with an alternate surface femoral component. Procedures using an alternate surface femoral component have a higher rate of revision compared to when these are not used (Table KT38 and Figure KT41). There are more revisions for loosening and for patella pain where an alternate surface femoral component is used (Figure KT42).

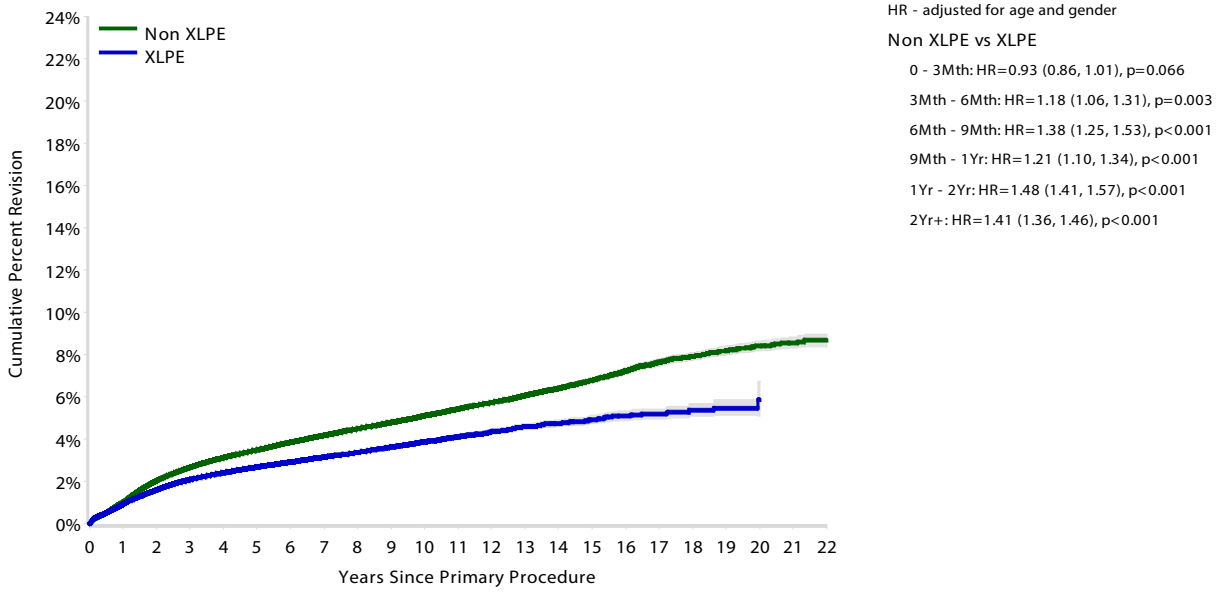
There is variation in the revision rate depending on the type of material used in the alternate surface. In 2022, there were 3 femoral prostheses used that used a zirconia-based alternate surface, 12 that used a TiN (titanium nitride) surface, and 6 with a ceramicised metal surface. Zirconia-based alternate surface femoral components have a lower rate of revision compared to those with a TiN surface and compared to ceramicised metal after 6 months. TiN alternate surface components have a higher rate of revision compared to ceramicised metal components for the first 1.5 years with no difference after that time. Ceramicised metal and TiN AS have a higher rate of revision compared to other femoral components. Zirconia AS has a lower rate of revision compared to other femoral components from 6 months onwards, with no difference prior to this time (Table KT39 and Figure KT43). The types of revision are shown in Figure KT44.

Table KT33 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	16503	358667	1.0 (1.0, 1.1)	2.7 (2.6, 2.7)	3.5 (3.4, 3.6)	5.1 (5.0, 5.2)	6.8 (6.7, 6.9)	8.4 (8.2, 8.6)
XLPE	9497	382778	0.9 (0.9, 0.9)	2.1 (2.0, 2.1)	2.7 (2.6, 2.7)	3.9 (3.8, 4.0)	4.9 (4.8, 5.1)	5.9 (5.1, 6.7)
TOTAL	**26000**	**741445**						

Note: Restricted to modern prostheses. Includes 90,027 procedures using cross-linked polyethylene with antioxidant
Excludes 402 procedures with unknown polyethylene

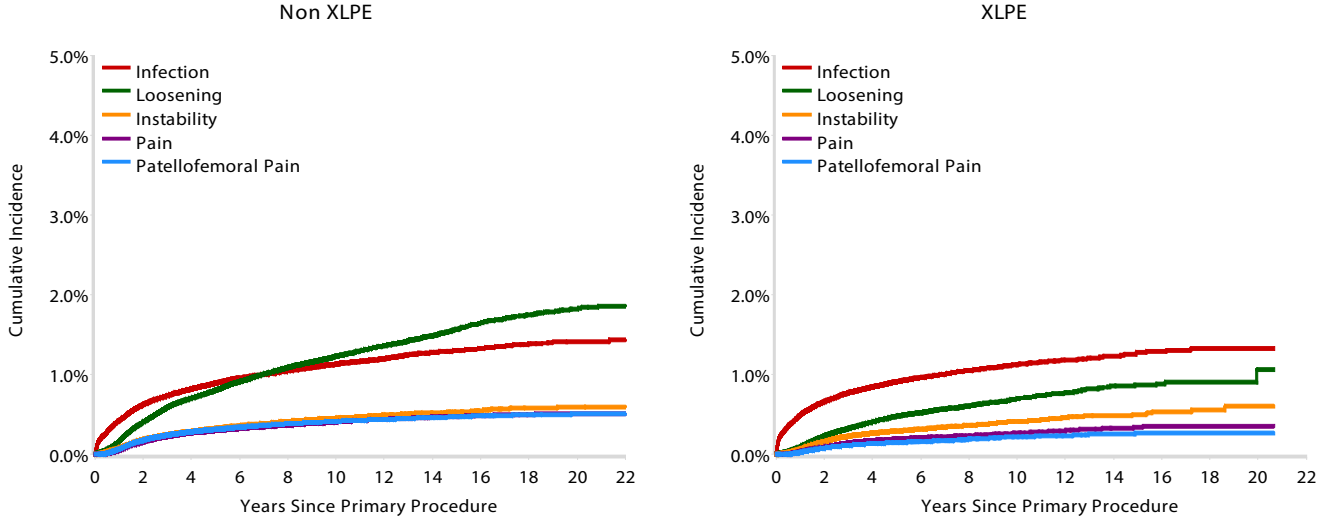
Figure KT34 Cumulative Percent Revision of Primary Total Knee Replacement by Polyethylene Type (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Non XLPE	358667	341230	300081	253623	132338	41130	5014
XLPE	382778	333863	244665	168181	43829	5379	244

Note: Restricted to modern prostheses

Figure KT35 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by Polyethylene Type (Primary Diagnosis OA)



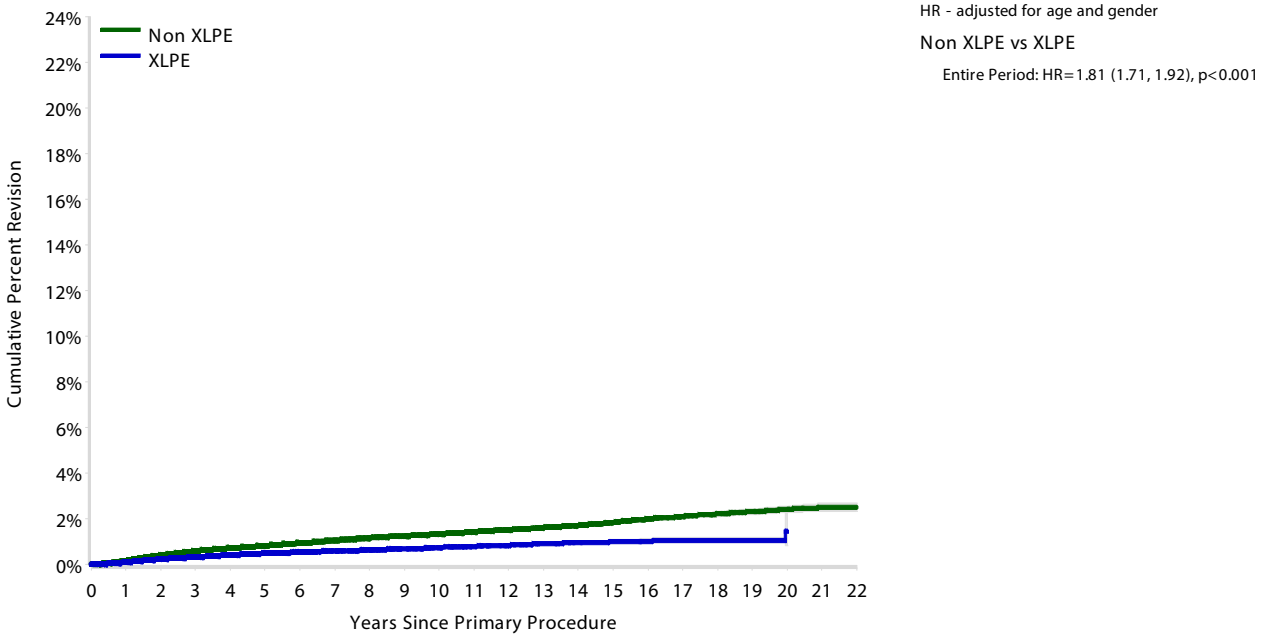
Note: Restricted to modern prostheses

Table KT34 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	4176	358667	0.2 (0.2, 0.2)	0.6 (0.6, 0.6)	0.8 (0.8, 0.9)	1.3 (1.3, 1.4)	1.8 (1.8, 1.9)	2.4 (2.3, 2.5)
XLPE	1666	382778	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)	1.4 (0.8, 2.5)
TOTAL	**5842**	**741445**						

Note: Restricted to modern prostheses
Includes 90,027 procedures using cross-linked polyethylene with antioxidant
Excludes 402 procedures with unknown polyethylene

Figure KT36 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	358667	341230	300081	253623	132338	41130	5014
XLPE	382778	333863	244665	168181	43829	5379	244

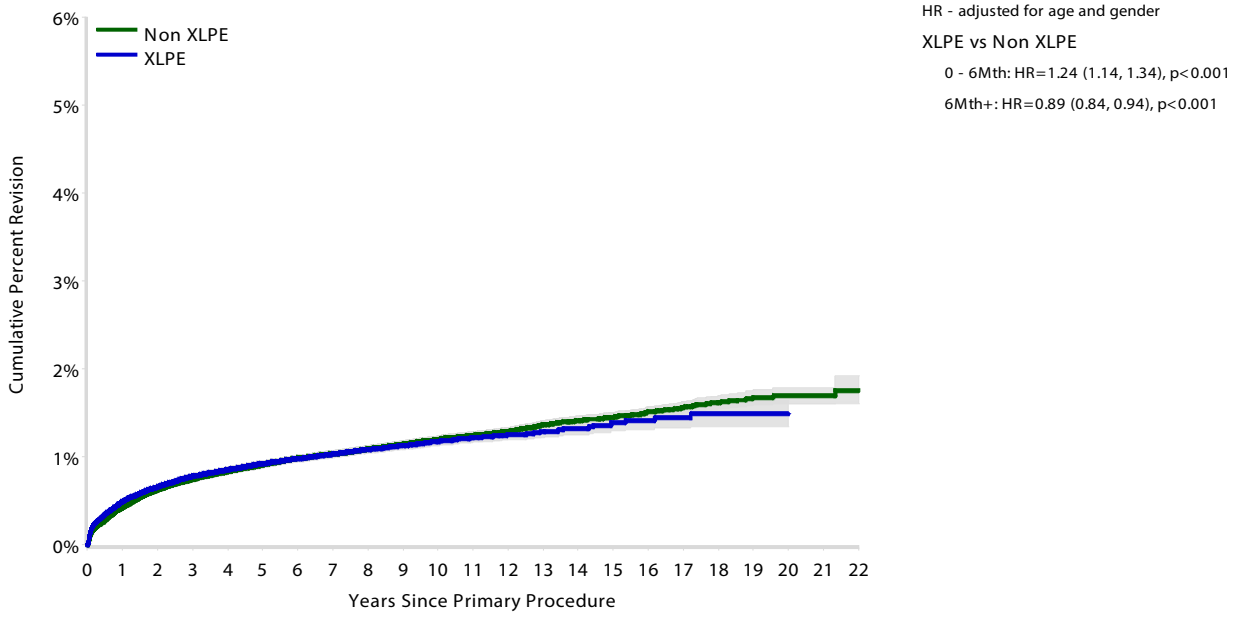
Note: Restricted to modern prostheses
Includes 90,027 procedures using cross-linked polyethylene with antioxidant
Excludes 402 procedures with unknown polyethylene

Table KT35 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	3842	358667	0.4 (0.4, 0.4)	0.7 (0.7, 0.8)	0.9 (0.9, 0.9)	1.2 (1.2, 1.2)	1.5 (1.4, 1.5)	1.7 (1.6, 1.8)
XLPE	3246	382778	0.5 (0.5, 0.5)	0.8 (0.8, 0.8)	0.9 (0.9, 1.0)	1.2 (1.1, 1.2)	1.4 (1.3, 1.5)	1.5 (1.3, 1.6)
TOTAL	**7088**	**741445**						

Note: Restricted to modern prostheses. Includes 90,027 procedures using cross-linked polyethylene with antioxidant. Excludes 402 procedures with unknown polyethylene

Figure KT37 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	358667	341230	300081	253623	132338	41130	5014
XLPE	382778	333863	244665	168181	43829	5379	244

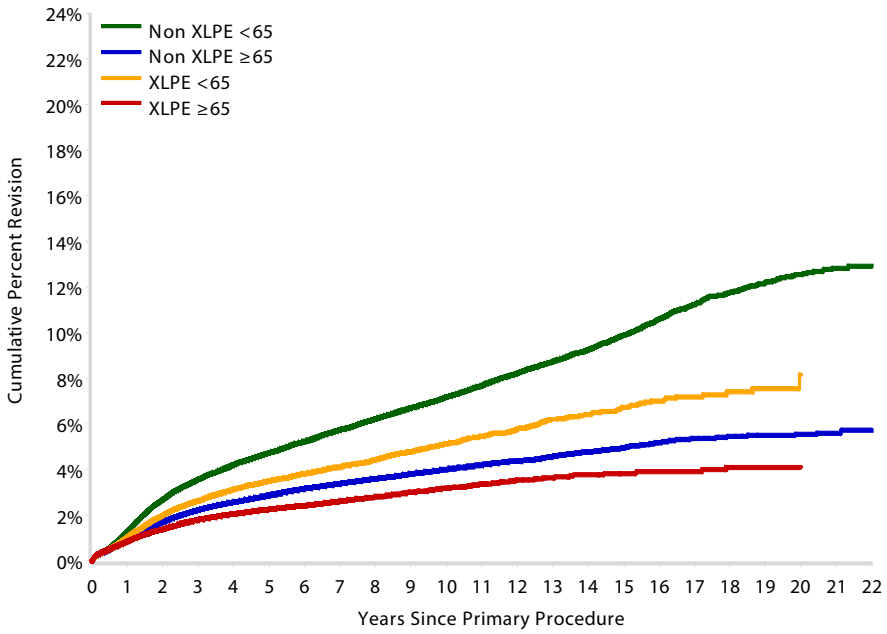
Note: Restricted to modern prostheses. Includes 90,027 procedures using cross-linked polyethylene with antioxidant. Excludes 402 procedures with unknown polyethylene

Table KT36 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		16503	358667	1.0 (1.0, 1.1)	2.7 (2.6, 2.7)	3.5 (3.4, 3.6)	5.1 (5.0, 5.2)	6.8 (6.7, 6.9)	8.4 (8.2, 8.6)
	<65	8117	117304	1.3 (1.2, 1.3)	3.6 (3.5, 3.7)	4.7 (4.6, 4.9)	7.2 (7.0, 7.4)	9.9 (9.7, 10.1)	12.6 (12.2, 13.0)
	≥65	8386	241363	0.9 (0.9, 0.9)	2.2 (2.2, 2.3)	2.9 (2.8, 3.0)	4.0 (3.9, 4.1)	5.0 (4.8, 5.1)	5.6 (5.4, 5.8)
XLPE		9497	382778	0.9 (0.9, 0.9)	2.1 (2.0, 2.1)	2.7 (2.6, 2.7)	3.9 (3.8, 4.0)	4.9 (4.8, 5.1)	5.9 (5.1, 6.7)
	<65	4260	128074	1.1 (1.0, 1.1)	2.6 (2.5, 2.7)	3.5 (3.4, 3.6)	5.1 (5.0, 5.3)	6.7 (6.4, 7.1)	8.2 (6.9, 9.6)
	≥65	5237	254704	0.8 (0.8, 0.9)	1.8 (1.7, 1.9)	2.3 (2.2, 2.3)	3.2 (3.1, 3.3)	3.8 (3.7, 4.0)	4.1 (3.8, 4.5)
TOTAL		**26000**	**741445**						

Note: Restricted to modern prostheses. Includes 90,027 procedures using cross-linked polyethylene with antioxidant. Excludes 402 procedures with unknown polyethylene

Figure KT38 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=1.05 (0.94, 1.18), p=0.394
- 3Mth - 9Mth: HR=1.49 (1.36, 1.64), p<0.001
- 9Mth - 1.5Yr: HR=1.77 (1.66, 1.89), p<0.001
- 1.5Yr - 2Yr: HR=1.87 (1.70, 2.05), p<0.001
- 2Yr - 3.5Yr: HR=1.66 (1.55, 1.77), p<0.001
- 3.5Yr - 6Yr: HR=1.91 (1.78, 2.05), p<0.001
- 6Yr - 8.5Yr: HR=2.19 (2.00, 2.39), p<0.001
- 8.5Yr - 10Yr: HR=2.23 (1.95, 2.54), p<0.001
- 10Yr - 12.5Yr: HR=2.91 (2.57, 3.30), p<0.001
- 12.5Yr - 13Yr: HR=1.98 (1.46, 2.68), p<0.001
- 13Yr - 17: HR=3.38 (2.89, 3.94), p<0.001
- 17 - 17.5: HR=9.89 (3.88, 25.24), p<0.001
- 17.5+: HR=4.56 (2.67, 7.78), p<0.001

Non XLPE <65 vs XLPE <65

- 0 - 3Mth: HR=0.92 (0.82, 1.04), p=0.200
- 3Mth - 6Mth: HR=1.25 (1.08, 1.45), p=0.002
- 6Mth - 1Yr: HR=1.45 (1.32, 1.58), p<0.001
- 1Yr - 1.5Yr: HR=1.55 (1.42, 1.70), p<0.001
- 1.5Yr - 2Yr: HR=1.45 (1.31, 1.60), p<0.001
- 2Yr - 2.5Yr: HR=1.26 (1.13, 1.41), p<0.001
- 2.5Yr - 3Yr: HR=1.35 (1.19, 1.55), p<0.001
- 3Yr - 5Yr: HR=1.38 (1.27, 1.50), p<0.001
- 5Yr - 5.5Yr: HR=1.78 (1.46, 2.16), p<0.001
- 5.5Yr - 8.5Yr: HR=1.50 (1.38, 1.64), p<0.001
- 8.5Yr - 13Yr: HR=1.71 (1.54, 1.89), p<0.001
- 13Yr - 15.5Yr: HR=2.11 (1.75, 2.54), p<0.001
- 15.5Yr+: HR=3.23 (2.47, 4.22), p<0.001

Non XLPE ≥65 vs XLPE ≥65

- 0 - 3Mth: HR=0.86 (0.79, 0.94), p<0.001
- 3Mth - 1Yr: HR=1.23 (1.14, 1.32), p<0.001
- 1Yr+: HR=1.38 (1.32, 1.44), p<0.001

XLPE <65 vs XLPE ≥65

- 0 - 3Mth: HR=0.98 (0.89, 1.07), p=0.634
- 3Mth - 6Mth: HR=1.24 (1.09, 1.42), p=0.001
- 6Mth - 1.5Yr: HR=1.55 (1.44, 1.66), p<0.001
- 1.5Yr+: HR=1.80 (1.70, 1.90), p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Non XLPE	<65	117304	111954	99143	85823	49461	17679	2611
	≥65	241363	229276	200938	167800	82877	23451	2403
XLPE	<65	128074	112410	83382	59063	17193	2375	152
	≥65	254704	221453	161283	109118	26636	3004	92

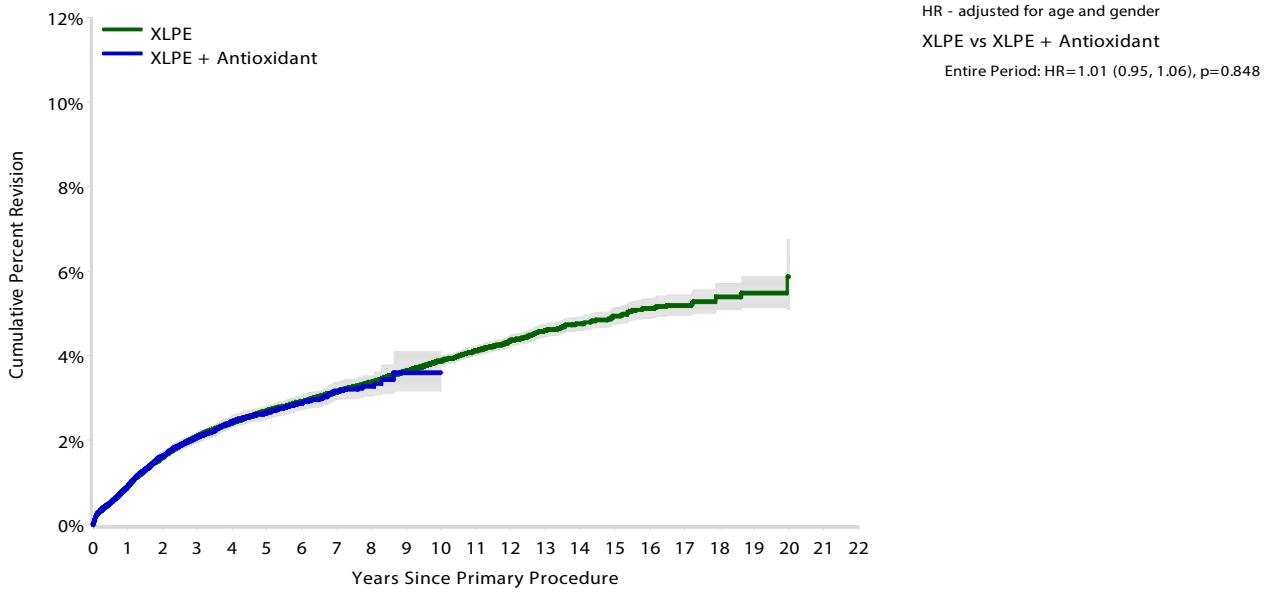
Note: Restricted to modern prostheses

Table KT37 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	20 Yrs
XLPE	7926	292751	0.9 (0.9, 0.9)	2.1 (2.0, 2.1)	2.7 (2.6, 2.8)	3.9 (3.8, 4.0)	4.9 (4.8, 5.1)	5.9 (5.1, 6.7)
XLPE + Antioxidant	1571	90027	0.9 (0.9, 1.0)	2.1 (2.0, 2.2)	2.7 (2.5, 2.8)	3.6 (3.2, 4.1)		
TOTAL	**9497**	**382778**						

Note: Restricted to modern prostheses

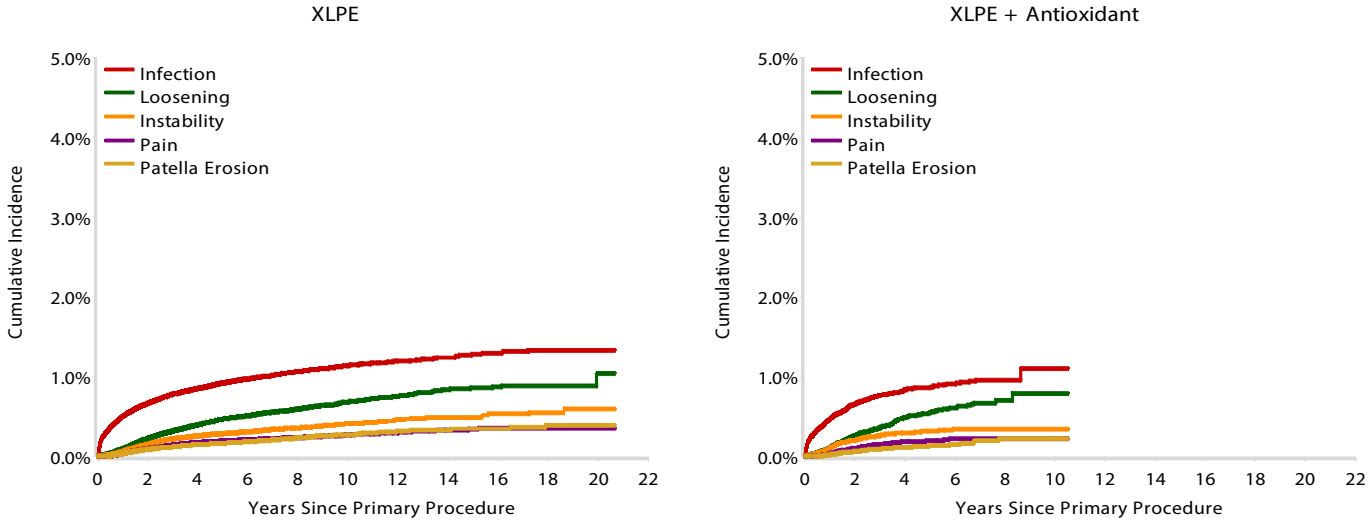
Figure KT39 Cumulative Percent Revision of XLPE Primary Total Knee Replacement by Polyethylene Type (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
XLPE	292751	264939	209261	152915	43764	5378	243
XLPE + Antioxidant	90027	68924	35404	15266	65	1	1

Note: Restricted to modern prostheses

Figure KT40 Cumulative Incidence Revision Diagnosis of XLPE Primary Total Knee Replacement by Polyethylene Type (Primary Diagnosis OA)



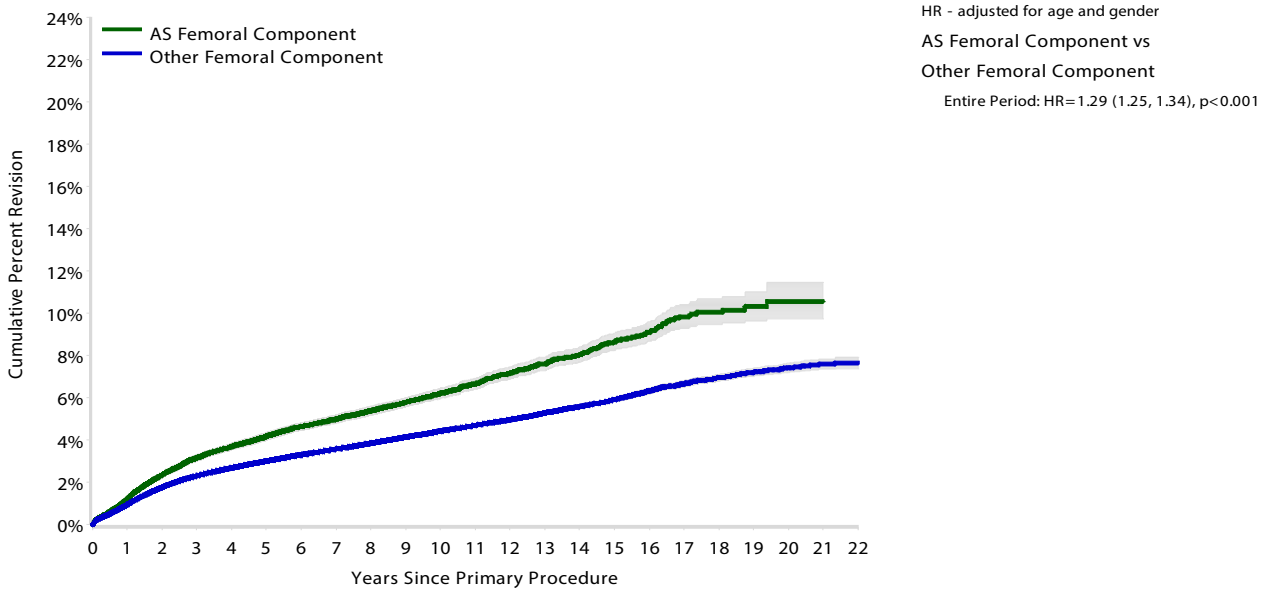
Note: Restricted to modern prostheses

Table KT38 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	3434	73305	1.2 (1.1, 1.3)	3.2 (3.0, 3.3)	4.2 (4.0, 4.3)	6.2 (6.0, 6.4)	8.6 (8.2, 9.0)	10.6 (9.7, 11.5)
Other Femoral Component	22570	668542	0.9 (0.9, 1.0)	2.3 (2.3, 2.3)	3.0 (3.0, 3.1)	4.4 (4.4, 4.5)	5.9 (5.8, 6.0)	7.4 (7.2, 7.6)
TOTAL	**26004**	**741847**						

Note: Restricted to modern prostheses

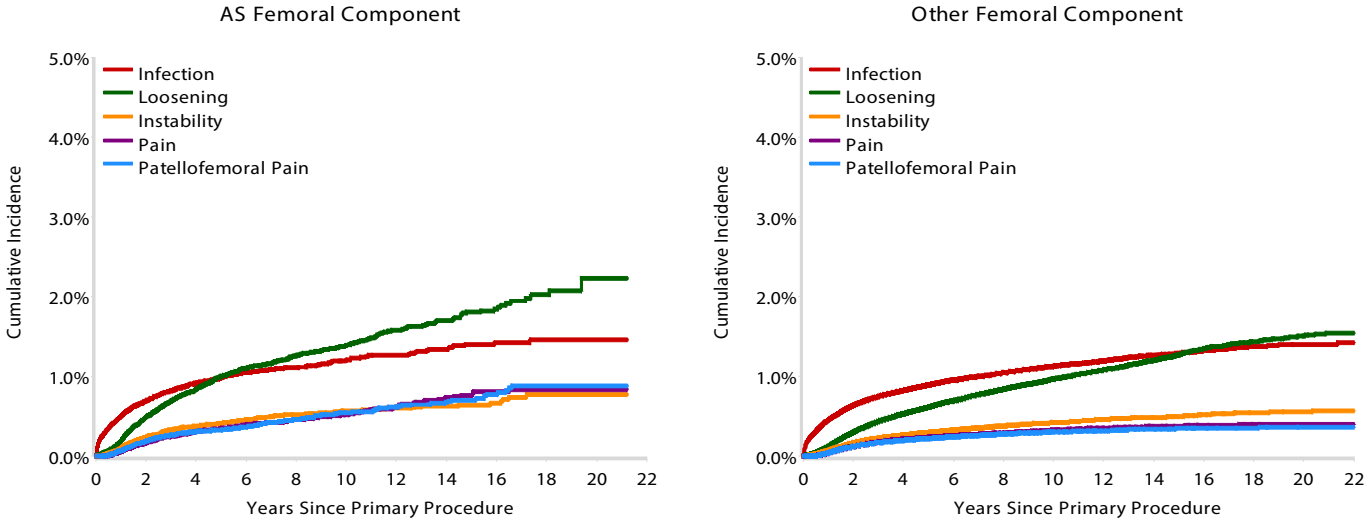
Figure KT41 Cumulative Percent Revision of Primary Total Knee Replacement by Femoral Bearing Surface (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
AS Femoral Component	73305	66591	53458	41065	15934	4071	187
Other Femoral Component	668542	608665	491380	380739	160233	42438	5071

Note: Restricted to modern prostheses

Figure KT42 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by Femoral Bearing Surface (Primary Diagnosis OA)



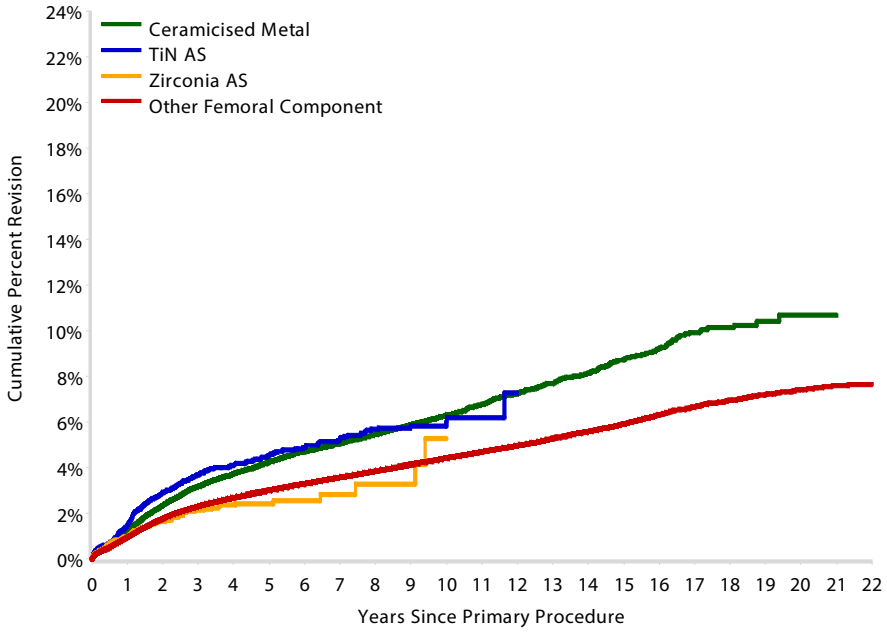
Note: Restricted to modern prostheses

Table KT39 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	3057	61362	1.2 (1.1, 1.3)	3.2 (3.0, 3.3)	4.2 (4.1, 4.4)	6.3 (6.1, 6.6)	8.7 (8.3, 9.2)	10.7 (9.8, 11.6)
TiN AS	269	6008	1.5 (1.2, 1.8)	3.7 (3.2, 4.2)	4.6 (4.0, 5.2)	5.8 (5.1, 6.6)		
Zirconia AS	108	5935	1.0 (0.8, 1.3)	2.2 (1.8, 2.6)	2.4 (2.0, 3.0)	5.3 (3.0, 9.2)		
Other Femoral Component	22570	668542	0.9 (0.9, 1.0)	2.3 (2.3, 2.3)	3.0 (3.0, 3.1)	4.4 (4.4, 4.5)	5.9 (5.8, 6.0)	7.4 (7.2, 7.6)
TOTAL	**26004**	**741847**						

Note: Restricted to modern prostheses

Figure KT43 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

Entire Period: HR=1.30 (1.25, 1.35), p<0.001

TiN AS vs Other Femoral Component

Entire Period: HR=1.46 (1.29, 1.64), p<0.001

Zirconia AS vs Other Femoral Component

0 - 6Mth: HR=1.31 (0.96, 1.80), p=0.091

6Mth+: HR=0.74 (0.58, 0.93), p=0.011

TiN AS vs Ceramicised Metal

0 - 1.5Yr: HR=1.31 (1.10, 1.56), p=0.002

1.5Yr+: HR=0.98 (0.82, 1.16), p=0.802

Zirconia AS vs Ceramicised Metal

0 - 6Mth: HR=1.01 (0.74, 1.39), p=0.935

6Mth+: HR=0.57 (0.45, 0.72), p<0.001

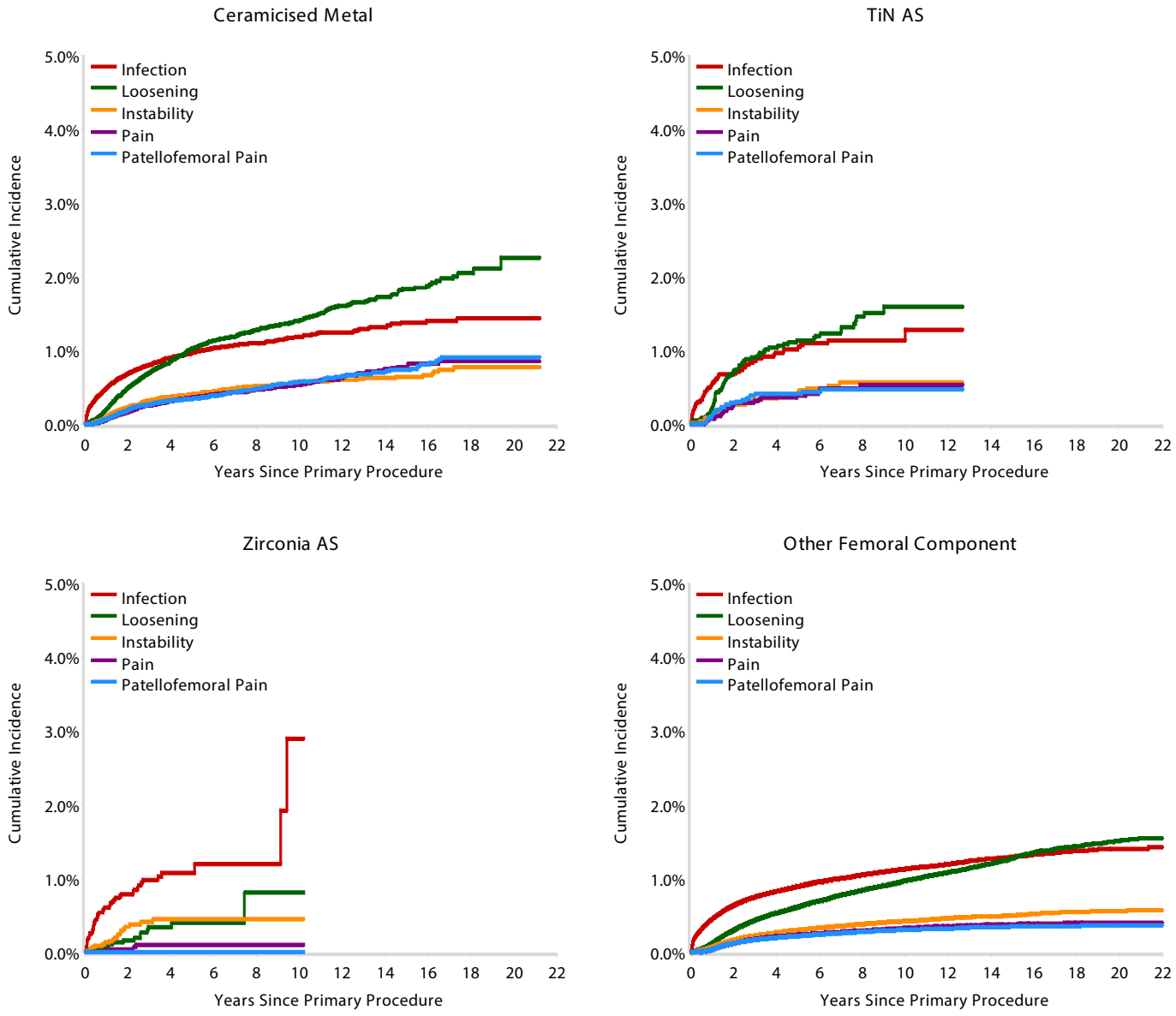
TiN AS vs Zirconia AS

Entire Period: HR=1.76 (1.40, 2.21), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Ceramicised Metal	61362	56333	46655	37027	15358	4071	187
TiN AS	6008	5520	4413	3212	532	0	0
Zirconia AS	5935	4738	2390	826	44	0	0
Other Femoral Component	668542	608665	491380	380739	160233	42438	5071

Note: Restricted to modern prostheses

Figure KT44 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by Femoral Material (Primary Diagnosis OA)

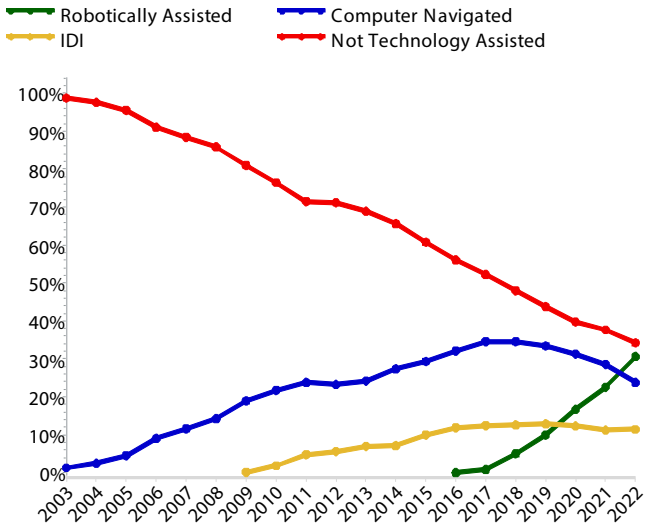


Note: Restricted to modern prostheses

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 34.2% of primary knee procedures in 2022. The increase in use of individual technology assisted methods is shown in Figure KT45. 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. This year, revision outcomes are analysed using each of these methods compared to where no assistive technology has been used.

Figure KT45 Primary Total Knee Replacement by Technology Assistance (Primary Diagnosis OA)



Note: Restricted to modern prostheses

Computer Navigation

There have been 187,386 primary total knee replacement procedures using computer navigation. In 2022, computer navigation was used in 23.8% 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 KT40, Figure KT46 and Figure KT47).

Using the same adjustments, there is no difference in the rate of revision for patients aged <65 or for patients aged ≥65 years when computer navigation is used compared to when no technology assistance is used (Table KT41 and Figure KT48).

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 60,135 primary total knee replacement procedures undertaken using IDI since 2009. In 2022, 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 KT42 and Figure KT49). There is an increased proportion of revision for loosening when IDI is used (Figure KT50).

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 after 3 months compared to when no technology assistance is used. There is no difference with IDI use for patients aged <65 years (Table KT43 and Figure KT51).

Robotic Assistance

Robotic assistance has been recorded for 47,594 total knee replacements since 2016. In 2022, robotic assistance was used in 30.6% 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 KT44 and Figure KT52). There are fewer revisions for loosening and instability using robotic assistance (Figure KT53).

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 KT45 and Figure KT54).

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 KT46 and Figure KT55. Procedures using IDI have a higher rate of revision compared to procedures with no technology assistance and when compared to computer navigated procedures after 2 years. There is no difference in the rate of revision when procedures using robotic assistance, computer navigation or 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 age, gender, ASA, BMI and tibial fixation adjusted analyses have been undertaken stratified by patella resurfacing.

There is no difference in the rate of revision when the Persona CR/Persona is used with robotic assistance compared to when computer navigation is used, and when compared to procedures without technology assistance (Table KT47 and Figure KT56).

There is no difference in the rate of revision for the Persona CR/Persona when the patella is not resurfaced or when patellar resurfacing is used for procedures with robotic assistance, computer navigation or without technology assistance (Table KT48 and Figure KT57, Table KT49 and Figure KT58).

The Triathlon CR/Triathlon has no difference in the rate of revision when computer navigation is compared with no technology assistance, and also where robotic assistance is compared to procedures without technology assistance. Procedures using robotic assistance have a lower rate of revision when compared to those using computer navigation (Table KT50 and Figure KT59).

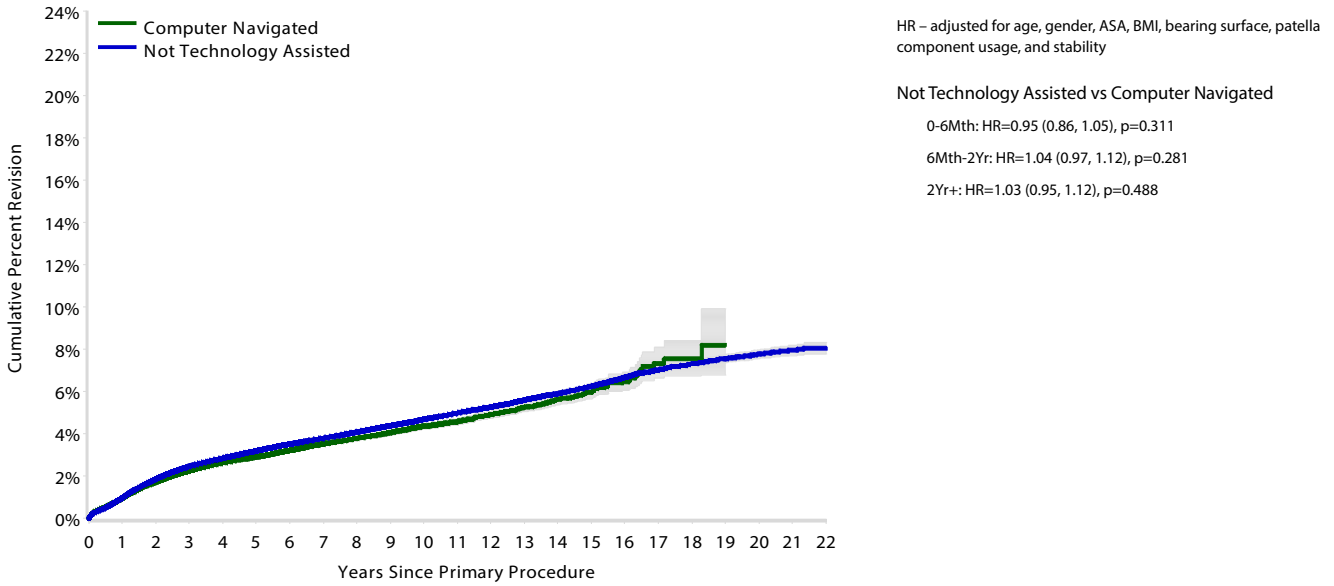
The rate of revision of the Triathlon CR/Triathlon, when using robotic assistance, is dependent on patellar resurfacing. When robotic assistance is used without patellar resurfacing, the rate of revision is higher than when using computer navigation (Table KT51 and Figure KT60). In this situation, there is an increased rate of revision due to patellar erosion (Figure KT61). When robotic assistance is used with patellar resurfacing, the rate of revision is lower than when either computer navigation or no technology assistance is used (Table KT52 and Figure KT62).

Table KT40 Cumulative Percent Revision of Primary Total Knee Replacement by Computer Navigation (Primary Diagnosis OA)

Technology Assistance	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Computer Navigated	5622	187386	0.9 (0.9, 1.0)	2.2 (2.2, 2.3)	2.9 (2.8, 3.0)	4.4 (4.2, 4.5)	6.0 (5.7, 6.3)	
Not Technology Assisted	18030	446732	1.0 (0.9, 1.0)	2.5 (2.4, 2.5)	3.2 (3.1, 3.3)	4.7 (4.6, 4.8)	6.3 (6.1, 6.4)	7.8 (7.6, 8.0)
TOTAL	**23652**	**634118**						

Note: Restricted to modern prostheses

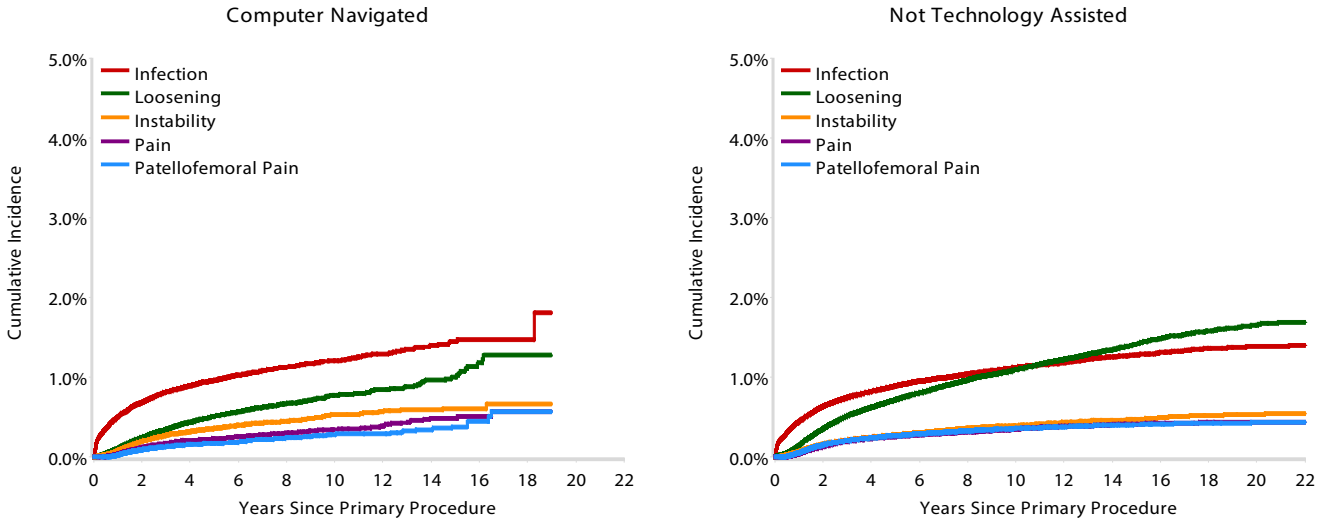
Figure KT46 Cumulative Percent Revision of Primary Total Knee Replacement by Computer Navigation (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Computer Navigated	187386	171585	134213	95101	27508	2571	1
Not Technology Assisted	446732	420478	363400	301508	145221	43938	5257

Note: Restricted to modern prostheses

Figure KT47 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by Computer Navigation (Primary Diagnoses OA)



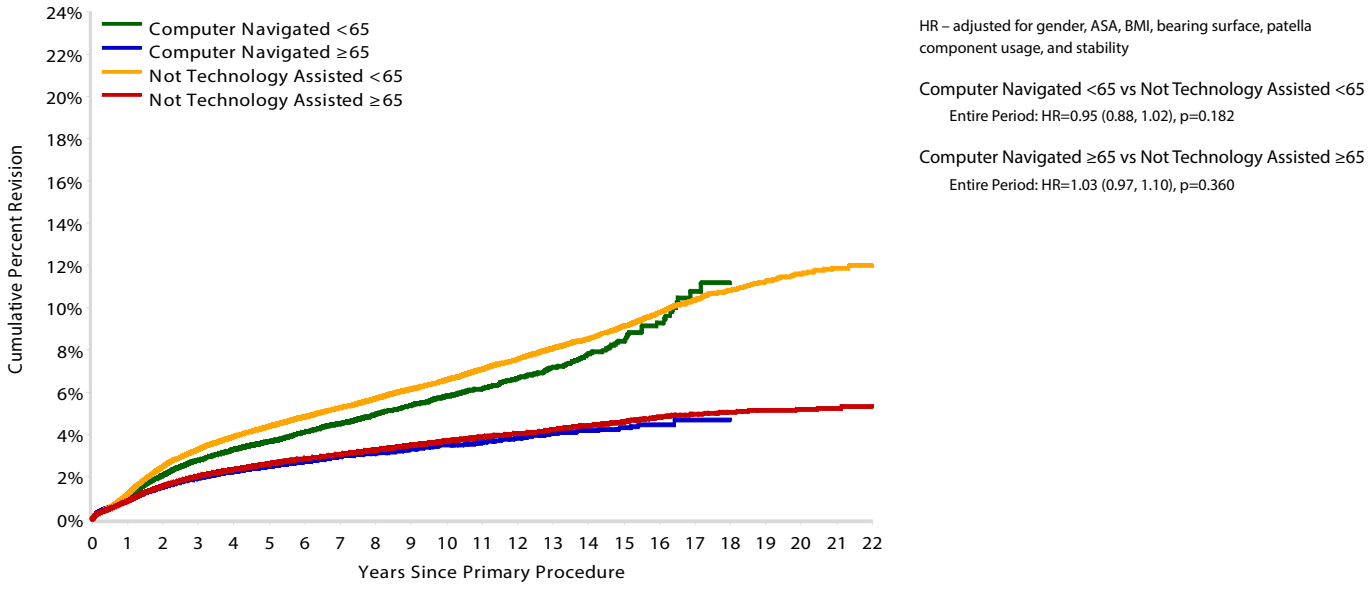
Note: Restricted to modern prostheses

Table KT41 Cumulative Percent Revision of Primary Total Knee Replacement by Computer Navigation and Age (Primary Diagnosis OA)

Technology Assistance	Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Computer Navigated	<65	2625	64720	1.1 (1.0, 1.2)	2.8 (2.7, 2.9)	3.7 (3.5, 3.8)	5.8 (5.6, 6.1)	8.4 (7.8, 9.1)	
	≥65	2997	122666	0.9 (0.8, 0.9)	2.0 (1.9, 2.0)	2.5 (2.4, 2.6)	3.5 (3.4, 3.6)	4.3 (4.0, 4.6)	
Not Technology Assisted	<65	8732	143416	1.2 (1.1, 1.3)	3.3 (3.2, 3.4)	4.4 (4.3, 4.5)	6.6 (6.5, 6.8)	9.1 (8.9, 9.4)	11.6 (11.2, 12.0)
	≥65	9298	303316	0.9 (0.8, 0.9)	2.0 (2.0, 2.1)	2.6 (2.6, 2.7)	3.7 (3.6, 3.8)	4.6 (4.5, 4.7)	5.2 (5.0, 5.4)
TOTAL		**23652**	**634118**						

Note: Restricted to modern prostheses

Figure KT48 Cumulative Percent Revision of Primary Total Knee Replacement by Computer Navigation and Age (Primary Diagnosis OA)



Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Computer Navigated	<65	64720	59687	47560	34649	11187	1173	0
	≥65	122666	111898	86653	60452	16321	1398	1
Not Technology Assisted	<65	143416	135515	118229	100886	53995	18881	2763
	≥65	303316	284963	245171	200622	91226	25057	2494

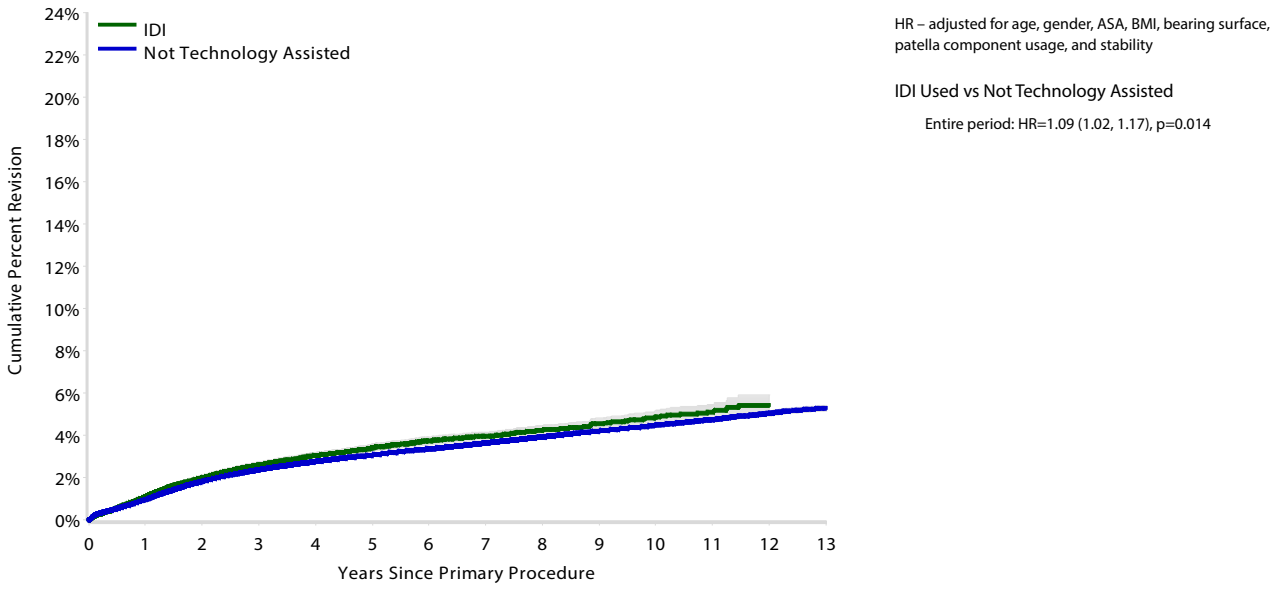
Note: Restricted to modern prostheses

Table KT42 Cumulative Percent Revision of Primary Total Knee Replacement Since 2009 by IDI Usage (Primary Diagnosis OA)

Technology Assistance	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
IDI	1800	60135	1.1 (1.0, 1.2)	2.6 (2.5, 2.7)	3.4 (3.3, 3.6)	4.0 (3.8, 4.2)	4.9 (4.6, 5.2)	
Not Technology Assisted	11588	343361	1.0 (0.9, 1.0)	2.4 (2.3, 2.4)	3.1 (3.0, 3.1)	3.6 (3.6, 3.7)	4.5 (4.4, 4.6)	5.3 (5.2, 5.4)
TOTAL	**13388**	**403496**						

Note: Restricted to modern prostheses

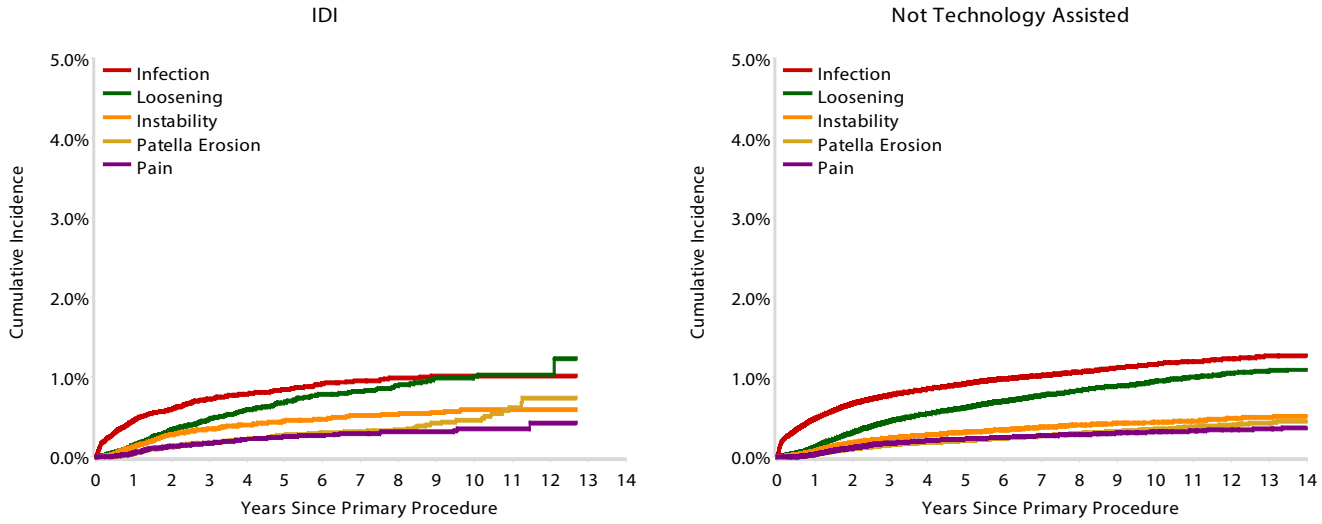
Figure KT49 Cumulative Percent Revision of Primary Total Knee Replacement Since 2009 by IDI Usage (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
IDI	60135	52976	38889	24794	12950	3438	16
Not Technology Assisted	343361	319137	266661	209878	151548	70686	12918

Note: Restricted to modern prostheses

Figure KT50 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement Since 2009 by IDI Usage (Primary Diagnosis OA)



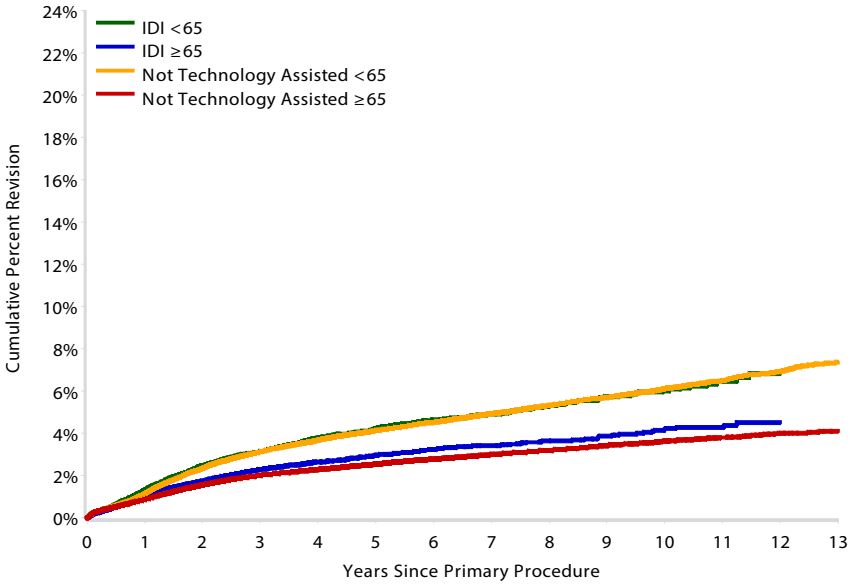
Note: Restricted to modern prostheses

Table KT43 Cumulative Percent Revision of Primary Total Knee Replacement Since 2009 by IDI Usage and Age (Primary Diagnosis OA)

Technology Assistance	Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
IDI	<65	803	20980	1.3 (1.2, 1.5)	3.1 (2.9, 3.4)	4.2 (3.9, 4.6)	4.9 (4.6, 5.3)	6.0 (5.5, 6.6)	
	≥65	997	39155	1.0 (0.9, 1.1)	2.3 (2.1, 2.5)	3.0 (2.8, 3.2)	3.4 (3.2, 3.7)	4.2 (3.8, 4.6)	
Not Technology Assisted	<65	5336	112241	1.2 (1.1, 1.2)	3.1 (3.0, 3.2)	4.1 (4.0, 4.3)	4.9 (4.8, 5.1)	6.1 (5.9, 6.3)	7.4 (7.1, 7.6)
	≥65	6252	231120	0.9 (0.8, 0.9)	2.0 (2.0, 2.1)	2.5 (2.5, 2.6)	3.0 (2.9, 3.1)	3.6 (3.5, 3.7)	4.1 (4.0, 4.3)
TOTAL		**13388**	**403496**						

Note: Restricted to modern prostheses

Figure KT51 Cumulative Percent Revision of Primary Total Knee Replacement Since 2009 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=1.03 (1.14, 0.94), p=0.504

IDI ≥65 vs Not Technology Assisted ≥65

0-3Mth: HR=0.90 (1.06, 0.77), p=0.220

3Mth-1.5Yr: HR=1.26 (1.42, 1.12), p<0.001

1.5Yr+: HR=1.15 (1.29, 1.02), p=0.024

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
IDI	<65	20980	18696	13936	9197	5128	1472	9
	≥65	39155	34280	24953	15597	7822	1966	7
Not Technology Assisted	<65	112241	104877	88646	72105	54201	27418	5540
	≥65	231120	214260	178015	137773	97347	43268	7378

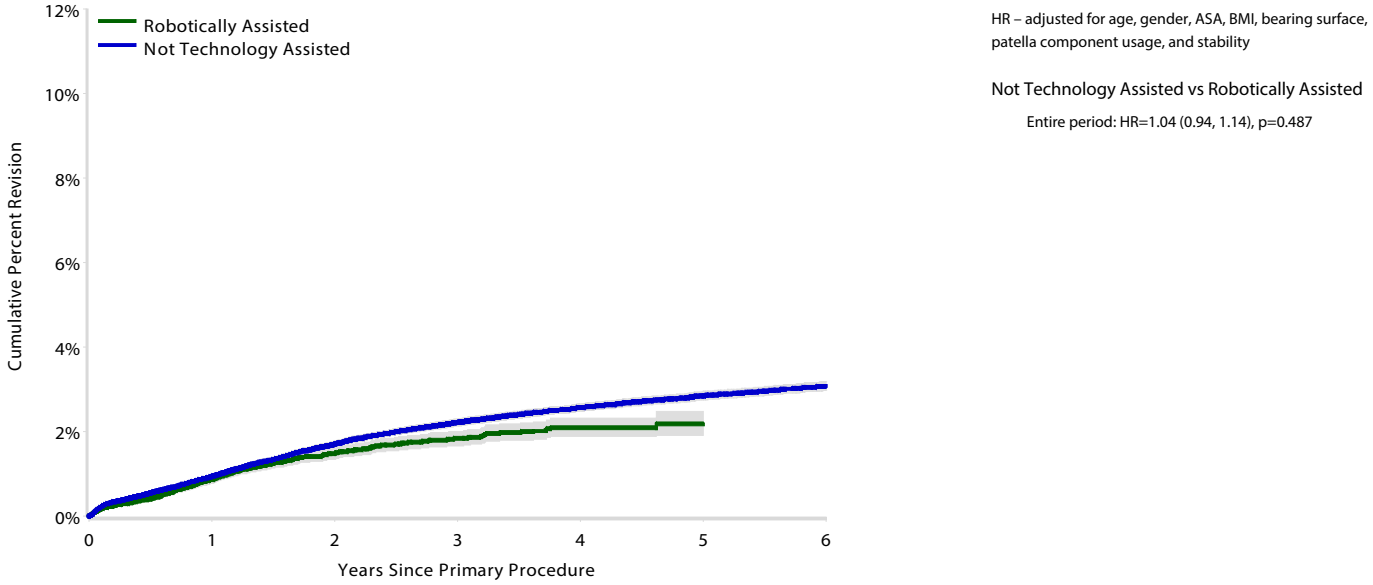
Note: Restricted to modern prostheses

Table KT44 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	552	47594	0.9 (0.8, 1.0)	1.5 (1.3, 1.6)	1.8 (1.7, 2.0)	2.1 (1.9, 2.3)	2.2 (1.9, 2.5)	
Not Technology Assisted	3717	166021	0.9 (0.9, 1.0)	1.7 (1.6, 1.8)	2.2 (2.1, 2.3)	2.6 (2.5, 2.7)	2.9 (2.8, 2.9)	3.1 (3.0, 3.2)
TOTAL	**4269**	**213615**						

Note: Restricted to modern prostheses

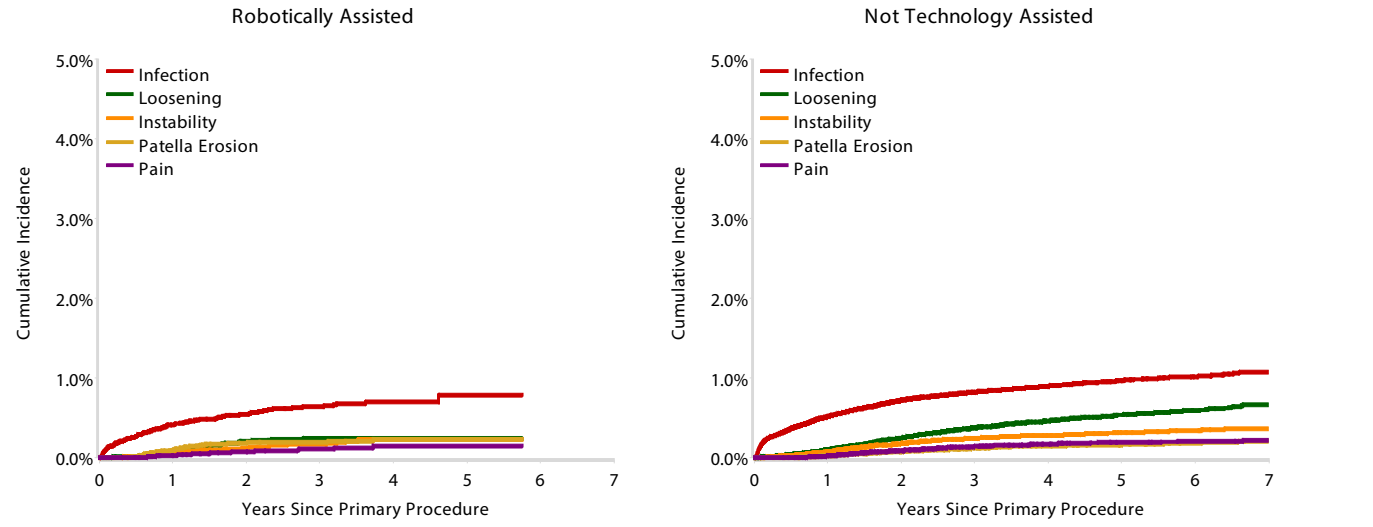
Figure KT52 Cumulative Percent Revision of Primary Total Knee Replacement Since 2016 by Robotic Assistance (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Robotically Assisted	47594	30217	17003	8336	2968	401	8
Not Technology Assisted	166021	144756	121046	98966	74584	49474	24302

Note: Restricted to modern prostheses

Figure KT53 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement Since 2016 by Robotic Assistance (Primary Diagnoses OA)



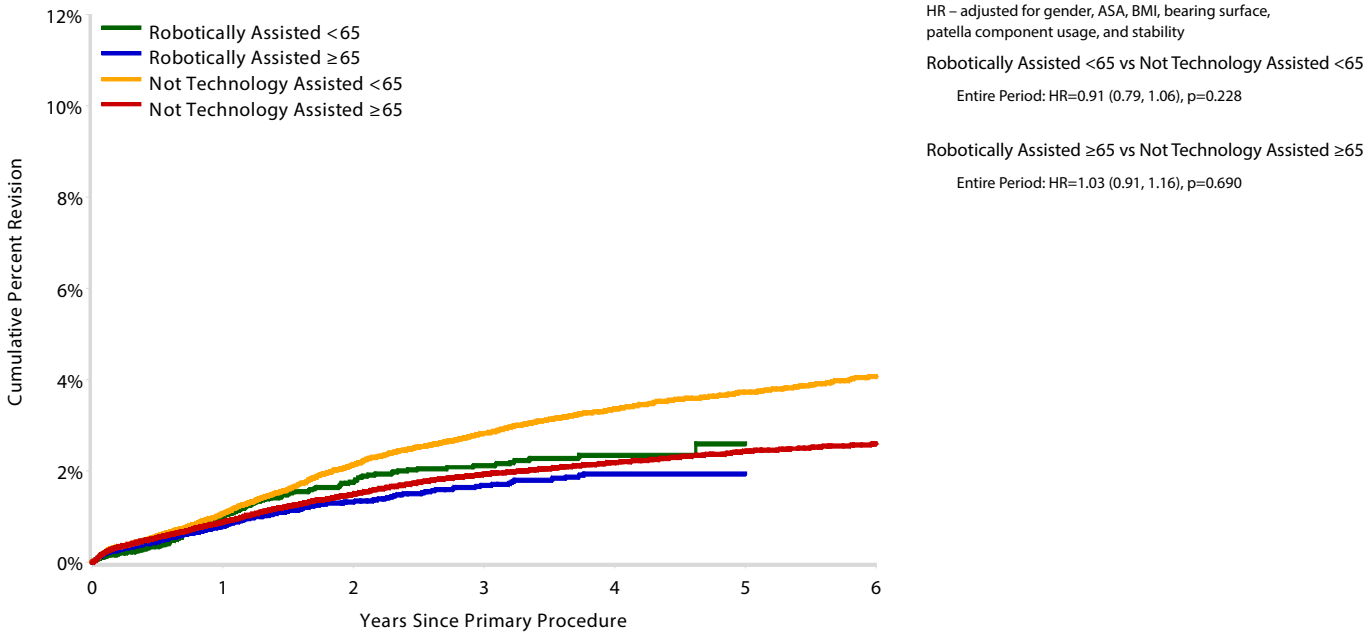
Note: Restricted to modern prostheses

Table KT45 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	220	16476	1.0 (0.9, 1.2)	1.8 (1.5, 2.0)	2.1 (1.8, 2.4)	2.4 (2.0, 2.8)	2.6 (2.1, 3.3)	
	≥65	332	31118	0.8 (0.7, 0.9)	1.3 (1.2, 1.5)	1.7 (1.5, 1.9)	1.9 (1.7, 2.2)	1.9 (1.7, 2.2)	
Not Technology Assisted	<65	1549	52909	1.1 (1.0, 1.2)	2.1 (2.0, 2.3)	2.8 (2.7, 3.0)	3.4 (3.2, 3.5)	3.7 (3.5, 3.9)	4.1 (3.9, 4.3)
	≥65	2168	113112	0.9 (0.8, 0.9)	1.5 (1.4, 1.6)	1.9 (1.8, 2.0)	2.2 (2.1, 2.3)	2.4 (2.3, 2.5)	2.6 (2.5, 2.7)
TOTAL		**4269**	**213615**						

Note: Restricted to modern prostheses

Figure KT54 Cumulative Percent Revision of Primary Total Knee Replacement Since 2016 by Robotic Assistance and Age (Primary Diagnosis OA)



Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Robotically Assisted	<65	16476	10562	6004	2855	1082	154	5
	≥65	31118	19655	10999	5481	1886	247	3
Not Technology Assisted	<65	52909	46424	38928	31943	24529	16637	8425
	≥65	113112	98332	82118	67023	50055	32837	15877

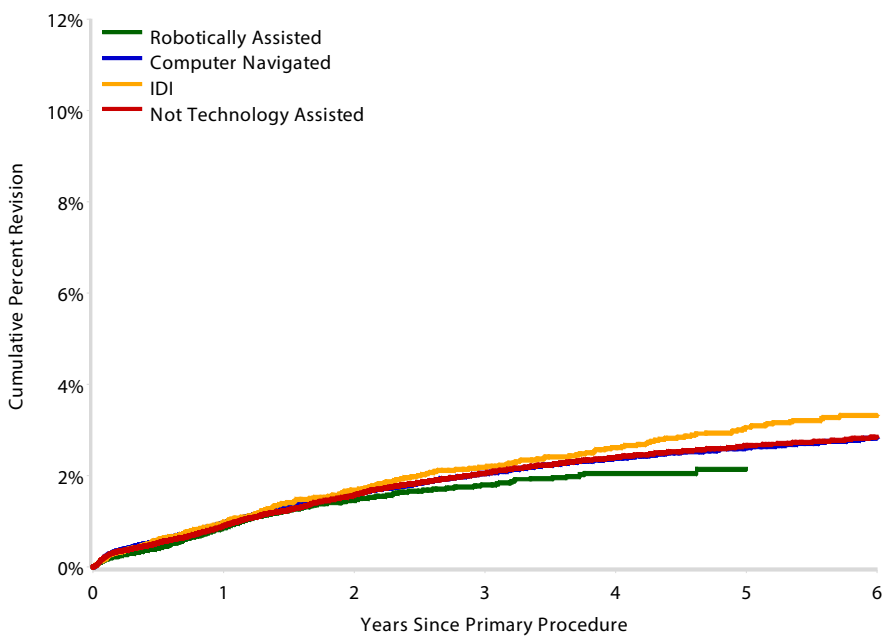
Note: Restricted to modern prostheses

Table KT46 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
Robotically Assisted	534	46890	0.9 (0.8, 1.0)	1.5 (1.3, 1.6)	1.8 (1.6, 2.0)	2.1 (1.9, 2.3)	2.2 (1.9, 2.5)	
Computer Navigated	1912	95004	1.0 (0.9, 1.0)	1.6 (1.5, 1.7)	2.1 (2.0, 2.2)	2.4 (2.3, 2.5)	2.6 (2.5, 2.7)	2.8 (2.7, 3.0)
IDI	399	17356	1.0 (0.8, 1.1)	1.7 (1.5, 1.9)	2.2 (2.0, 2.4)	2.6 (2.4, 2.9)	3.1 (2.8, 3.4)	3.3 (3.0, 3.7)
Not Technology Assisted	2024	100595	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)
TOTAL	**4869**	**259845**						

Note: Restricted to modern prostheses

Figure KT55 Cumulative Percent Revision of 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 stability

Robotically Assisted vs Not Technology Assisted

Entire Period: HR=0.98 (0.89, 1.08), p=0.675

Computer Navigated vs Not Technology Assisted

Entire Period: HR=1.03 (0.97, 1.10), p=0.330

IDI vs Not Technologay Assisted

Entire Period: HR=1.12 (1.00, 1.25), p=0.041

Robotically Assisted vs Computer Navigated

Entire Period: HR=0.95 (0.86, 1.04), p=0.267

IDI vs Computer Navigated

0-1.5Yr: HR=1.05 (0.91, 1.21), p=0.507

1.5-2Yr: HR=0.89 (0.63, 1.25), p=0.499

2Yr+ HR=1.23 (1.02, 1.47), p=0.027

Robotically Assisted vs IDI

Entire Period: HR=0.88 (0.77, 1.00), p=0.057

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Robotically Assisted	46890	29635	16597	8060	2879	394	8
Computer Navigated	95004	82350	67258	53185	38135	23689	10555
IDI	17356	14968	12506	10120	7433	4782	2210
Not Technology Assisted	100595	85881	70180	56382	41838	27134	12841

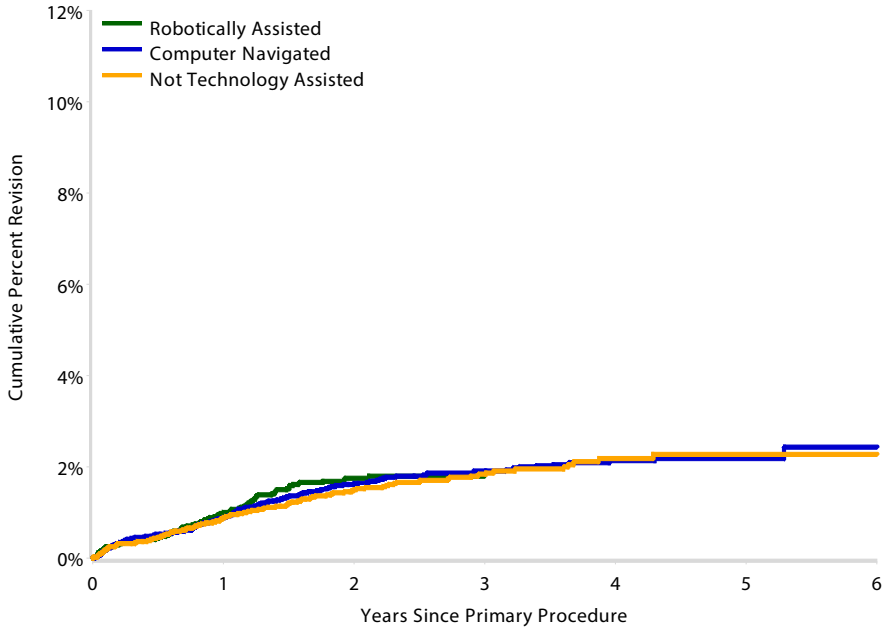
Note: Restricted to modern prostheses

Table KT47 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
Robotically Assisted	108	10583	1.0 (0.8, 1.2)	1.7 (1.4, 2.1)	1.8 (1.5, 2.2)			
Computer Navigated	200	12334	0.9 (0.7, 1.1)	1.6 (1.4, 1.9)	1.9 (1.6, 2.2)	2.1 (1.8, 2.5)	2.2 (1.9, 2.6)	2.4 (1.9, 3.1)
Not Technology Assisted	171	13965	0.9 (0.7, 1.1)	1.5 (1.3, 1.8)	1.8 (1.6, 2.2)	2.2 (1.8, 2.6)	2.3 (1.9, 2.8)	2.3 (1.9, 2.8)
TOTAL	**479**	**36882**						

Note: Restricted to modern prostheses
Posterior stabilised procedures have been excluded due to small numbers

Figure KT56 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, BMI, ASA, patella component usage and tibial fixation

Robotically Assisted vs Not Technology Assisted

Entire Period: HR=1.06 (0.83, 1.37), p=0.627

Computer Navigated vs Not Technology Assisted

Entire Period: HR=1.06 (0.86, 1.31), p=0.583

Robotically Assisted vs Computer Navigated

Entire Period: HR=1.37 (0.86, 2.20), p=0.190

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Robotically Assisted	10583	5216	1788	146	1	0	0
Computer Navigated	12334	10383	7573	4672	2105	623	85
Not Technology Assisted	13965	9340	5359	2779	1294	505	159

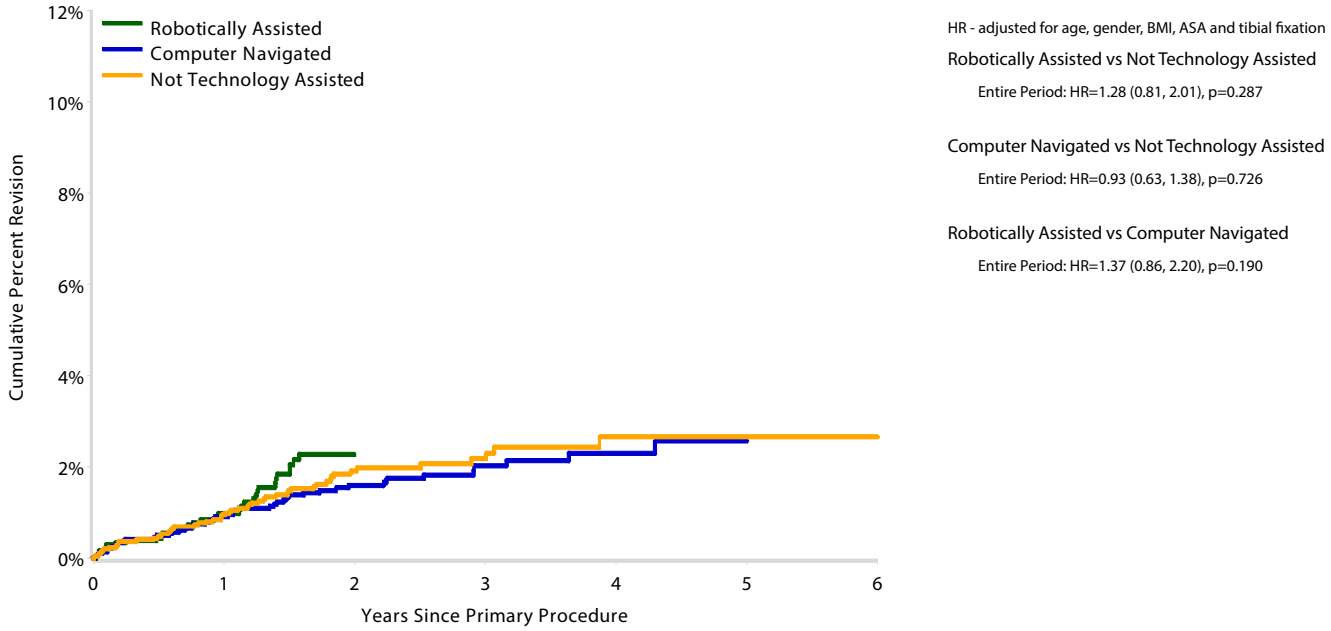
Note: Restricted to modern prostheses

Table KT48 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
Robotically Assisted	34	2402	1.0 (0.6, 1.6)	2.3 (1.6, 3.2)				
Computer Navigated	46	2666	0.9 (0.6, 1.4)	1.6 (1.2, 2.2)	2.0 (1.5, 2.8)	2.3 (1.7, 3.2)	2.6 (1.8, 3.7)	
Not Technology Assisted	59	4037	0.9 (0.7, 1.3)	1.9 (1.5, 2.5)	2.2 (1.6, 2.9)	2.7 (1.9, 3.6)	2.7 (1.9, 3.6)	2.7 (1.9, 3.6)
TOTAL	**139**	**9105**						

Note: Restricted to modern prostheses

Figure KT57 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)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Robotically Assisted	2402	1399	477	5	0	0	0
Computer Navigated	2666	2293	1625	941	465	147	24
Not Technology Assisted	4037	2697	1566	819	395	186	58

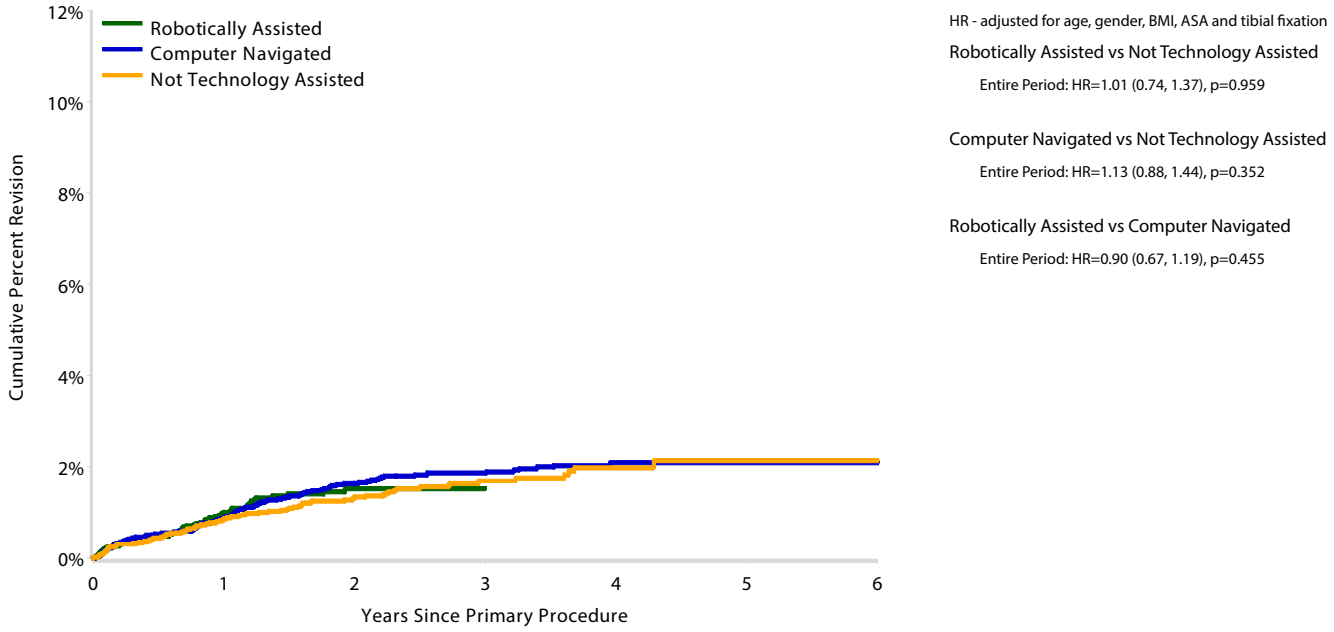
Note: Restricted to modern prostheses

Table KT49 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
Robotically Assisted	74	8181	1.0 (0.8, 1.3)	1.5 (1.2, 2.0)	1.5 (1.2, 2.0)			
Computer Navigated	154	9668	0.9 (0.7, 1.1)	1.6 (1.4, 2.0)	1.9 (1.6, 2.2)	2.1 (1.8, 2.5)	2.1 (1.8, 2.5)	2.1 (1.8, 2.5)
Not Technology Assisted	112	9928	0.9 (0.7, 1.1)	1.3 (1.1, 1.6)	1.7 (1.4, 2.1)	2.0 (1.6, 2.5)	2.1 (1.7, 2.7)	2.1 (1.7, 2.7)
TOTAL	**340**	**27777**						

Note: Restricted to modern prostheses
Posterior stabilised procedures have been excluded due to small numbers

Figure KT58 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)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Robotically Assisted	8181	3817	1311	141	1	0	0
Computer Navigated	9668	8090	5948	3731	1640	476	61
Not Technology Assisted	9928	6643	3793	1960	899	319	101

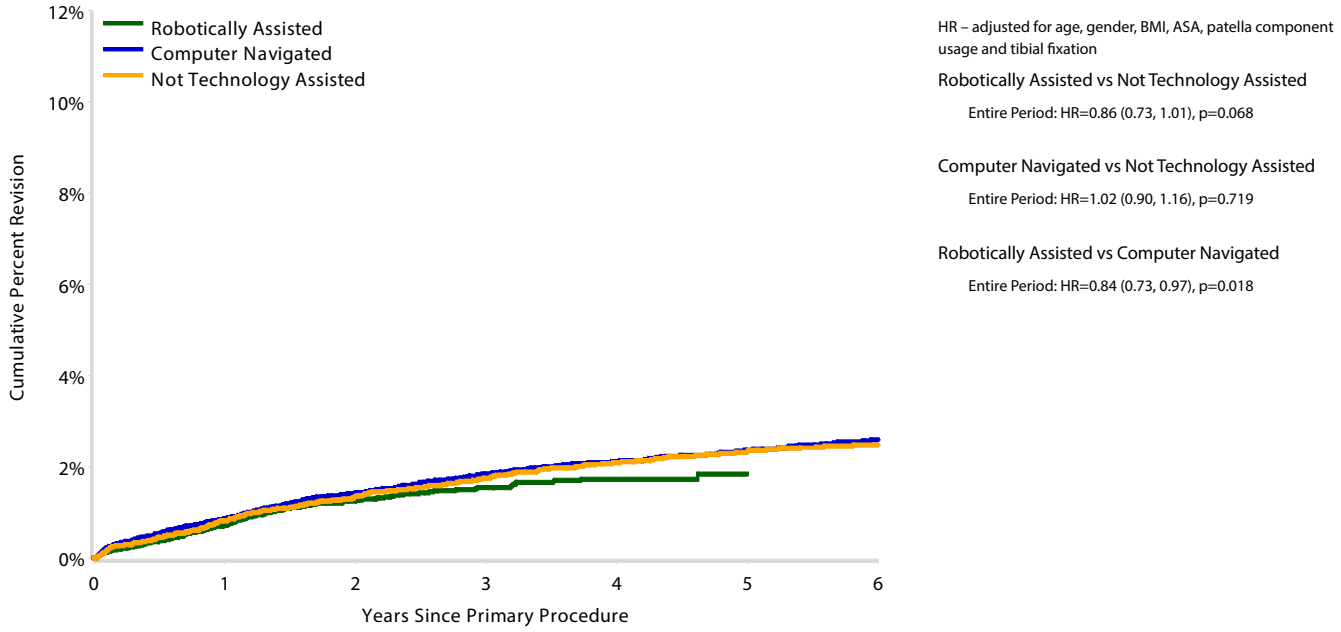
Note: Restricted to modern prostheses
Posterior stabilised procedures have been excluded due to small numbers

Table KT50 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
Robotically Assisted	310	29691	0.7 (0.6, 0.8)	1.3 (1.1, 1.4)	1.5 (1.4, 1.7)	1.7 (1.5, 2.0)	1.8 (1.6, 2.2)	
Computer Navigated	696	37899	0.9 (0.8, 1.0)	1.4 (1.3, 1.6)	1.8 (1.7, 2.0)	2.1 (2.0, 2.3)	2.4 (2.2, 2.6)	2.6 (2.4, 2.8)
Not Technology Assisted	393	21178	0.8 (0.7, 1.0)	1.4 (1.2, 1.5)	1.8 (1.6, 2.0)	2.1 (1.9, 2.3)	2.4 (2.1, 2.6)	2.5 (2.2, 2.8)
TOTAL	**1399**	**88768**						

Note: Restricted to modern prostheses
Posterior stabilised procedures have been excluded due to small numbers

Figure KT59 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
Robotically Assisted	29691	20099	11929	6161	2227	334	7
Computer Navigated	37899	32512	26902	21750	16168	10296	4742
Not Technology Assisted	21178	18672	16007	13396	10123	6517	3231

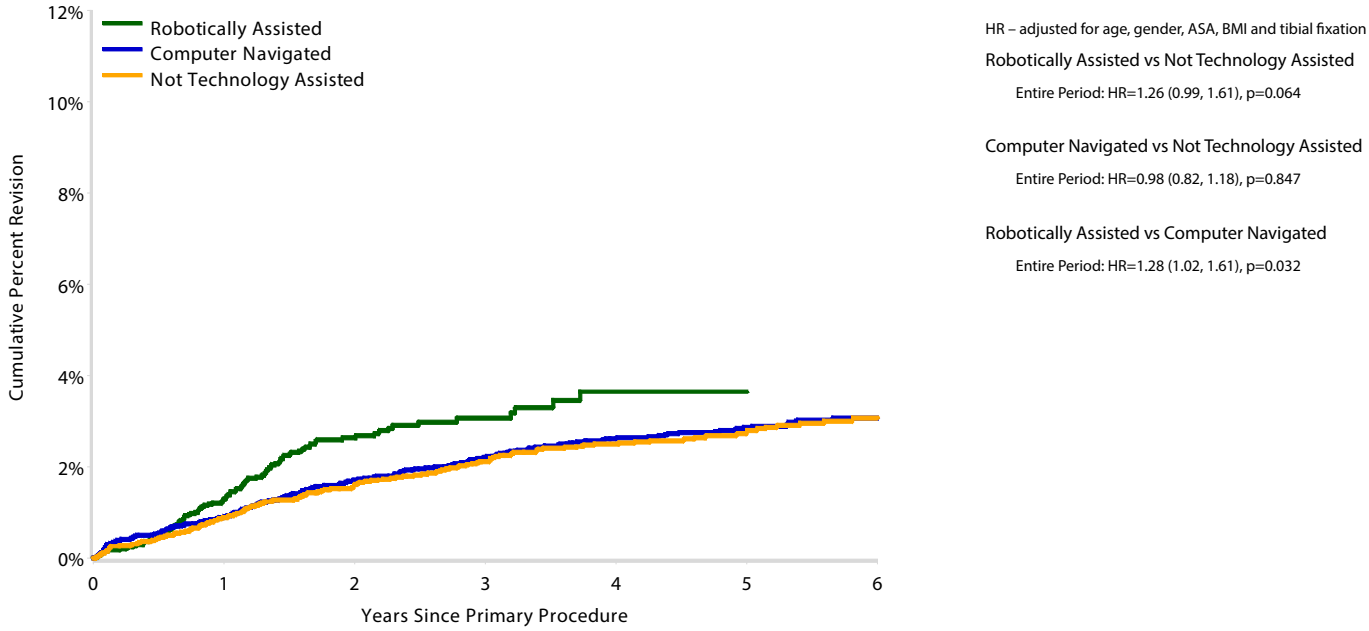
Note: Restricted to modern prostheses

Table KT51 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
Robotically Assisted	109	5314	1.3 (1.0, 1.7)	2.6 (2.2, 3.2)	3.1 (2.5, 3.8)	3.7 (2.9, 4.6)	3.7 (2.9, 4.6)	
Computer Navigated	309	13501	0.9 (0.8, 1.1)	1.7 (1.5, 2.0)	2.2 (2.0, 2.5)	2.6 (2.3, 3.0)	2.9 (2.5, 3.2)	3.1 (2.7, 3.5)
Not Technology Assisted	205	9075	0.9 (0.7, 1.1)	1.6 (1.4, 1.9)	2.1 (1.8, 2.5)	2.5 (2.2, 2.9)	2.8 (2.4, 3.2)	3.1 (2.6, 3.6)
TOTAL	**623**	**27890**						

Note: Restricted to modern prostheses

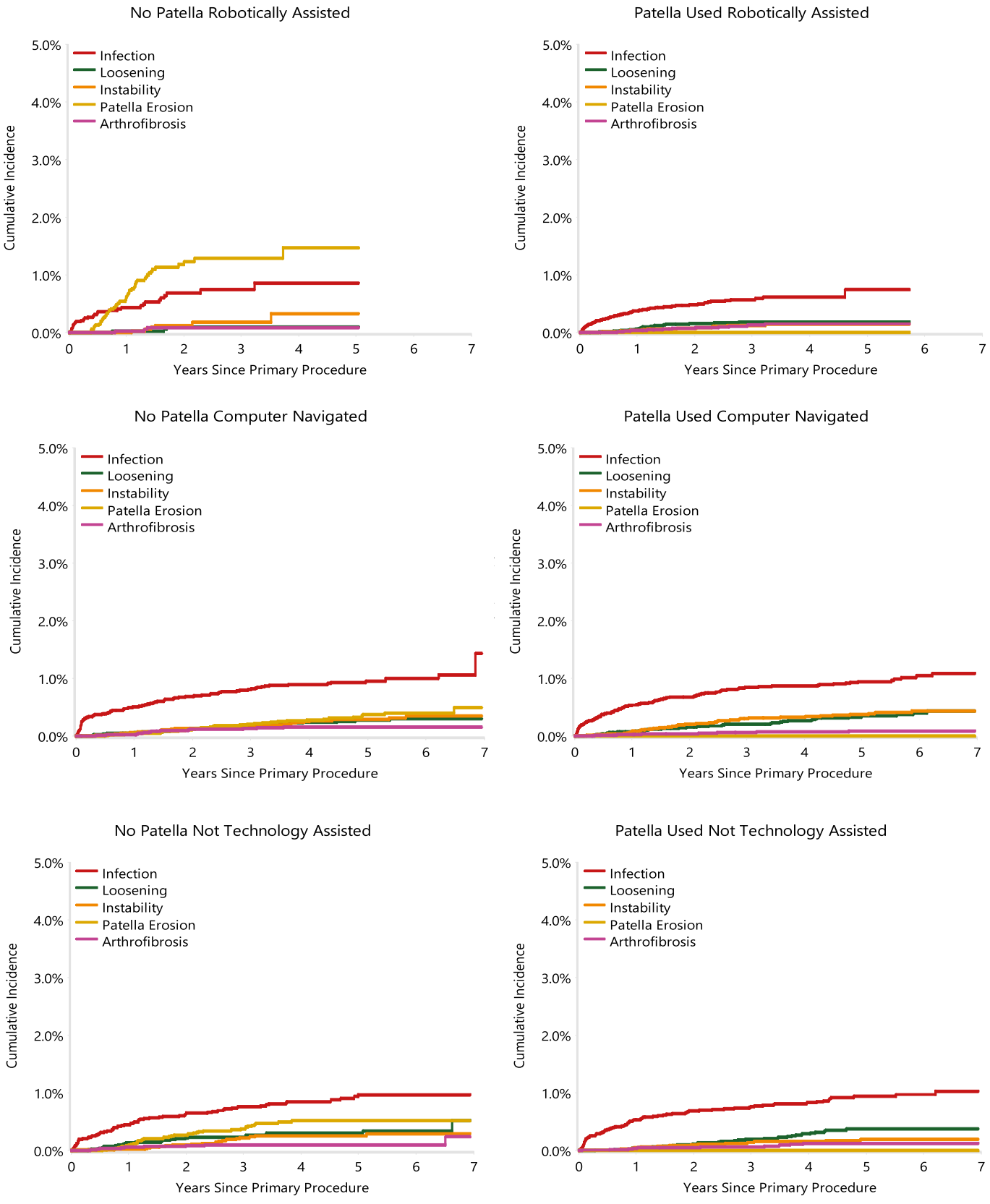
Figure KT60 Cumulative Percent Revision of Triathlon CR/Triathlon Primary Total Knee Replacement Using XLPE without a Patella Component Since 2016 by Technology Assistance (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Robotically Assisted	5314	3599	1996	966	367	44	0
Computer Navigated	13501	11925	10069	8265	6219	4029	1922
Not Technology Assisted	9075	8097	6990	5856	4322	2706	1304

Note: Restricted to modern prostheses

Figure KT61 Cumulative Incidence Revision Diagnosis of Triathlon CR/Triathlon Primary Total Knee Replacement Using XLPE Since 2016 by Patella Component Usage and Technology Assistance (Primary Diagnosis OA)



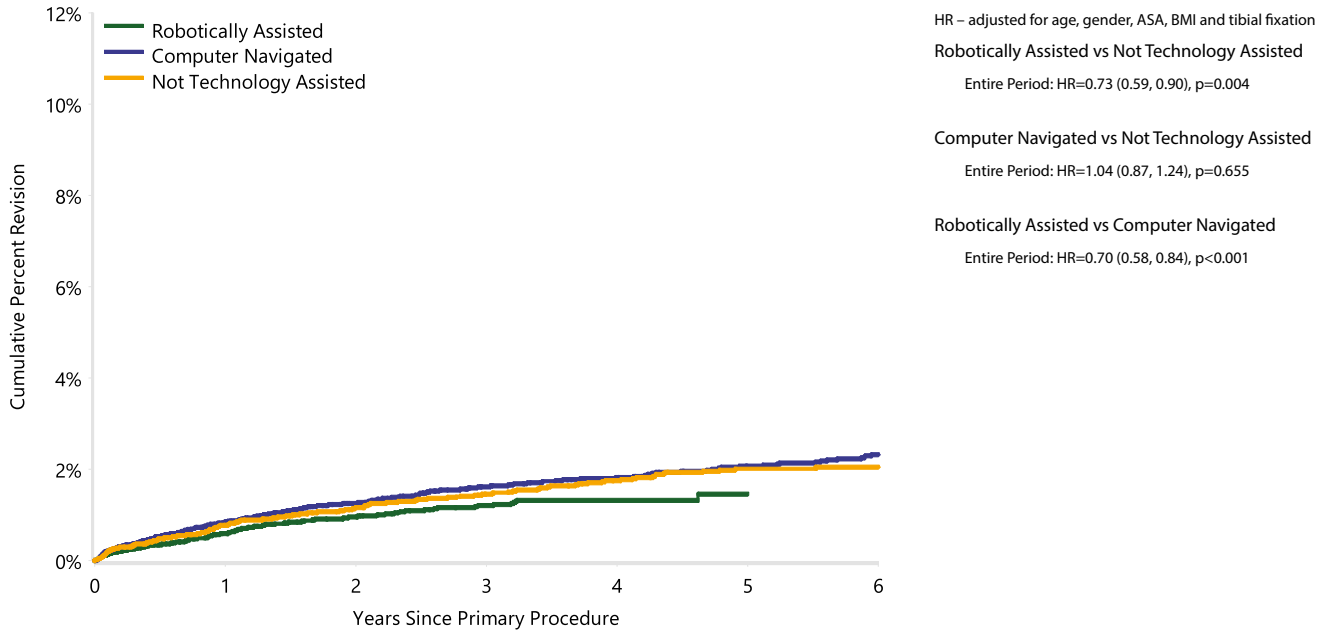
Note: Restricted to modern prostheses

Table KT52 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
Robotically Assisted	201	24377	0.6 (0.5, 0.7)	1.0 (0.8, 1.1)	1.2 (1.0, 1.4)	1.3 (1.1, 1.5)	1.5 (1.2, 1.8)	
Computer Navigated	387	24398	0.8 (0.7, 1.0)	1.3 (1.1, 1.4)	1.6 (1.5, 1.8)	1.8 (1.6, 2.0)	2.1 (1.9, 2.3)	2.3 (2.1, 2.6)
Not Technology Assisted	188	12103	0.8 (0.6, 1.0)	1.2 (1.0, 1.4)	1.5 (1.3, 1.7)	1.8 (1.5, 2.0)	2.0 (1.7, 2.3)	2.1 (1.8, 2.4)
TOTAL	**776**	**60878**						

Note: Restricted to modern prostheses
Posterior stabilised procedures have been excluded due to small numbers

Figure KT62 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
Robotically Assisted	24377	16500	9933	5195	1860	290	7
Computer Navigated	24398	20587	16833	13485	9949	6267	2820
Not Technology Assisted	12103	10575	9017	7540	5801	3811	1927

Note: Restricted to modern prostheses
Posterior stabilised procedures have been excluded due to small numbers

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.

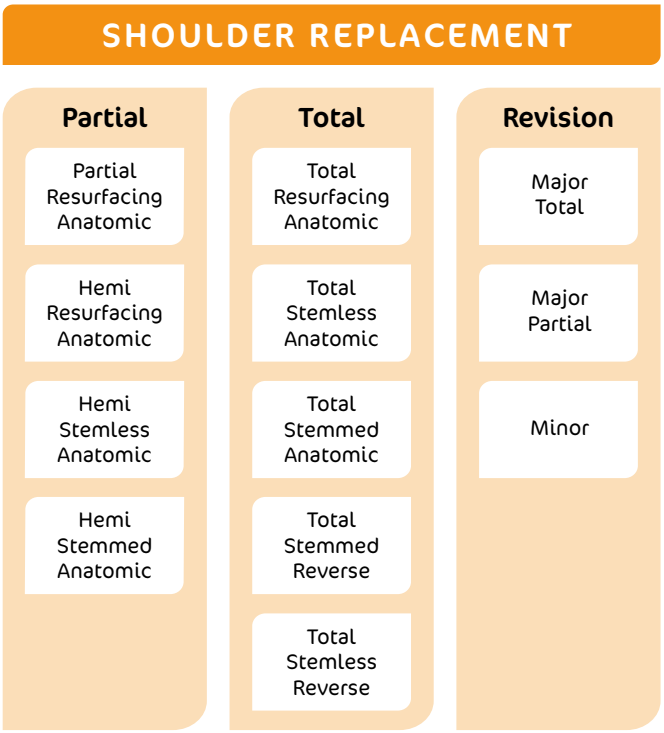
Primary partial and primary total shoulder replacements are further categorised into subclasses depending on the type of prosthesis used. Partial shoulder subclasses include partial resurfacing anatomic, hemi resurfacing anatomic, hemi stemless anatomic and hemi stemmed anatomic.

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-2023



Use of Shoulder Replacement

There are 85,350 shoulder replacements with a procedure date up to and including 31 December 2022. This is an additional 9,003 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 2022 decreased by 125 (1.4%) compared to the previous year and has increased by 227.6% 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 S1).

Table S1 Number of Shoulder Replacements

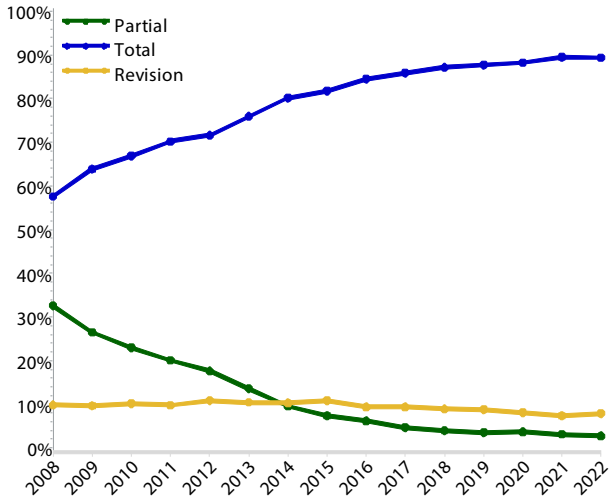
Shoulder Category	Number	Percent
Partial	7876	9.2
Total	69640	81.6
Revision	7834	9.2
TOTAL	**85350**	**100.0**

In 2022, the proportion of revision procedures has declined to 7.9%, this equates to 258 fewer revisions compared to the peak of 10.9% in 2012.

Since 2008, there has been a proportional increase in the use of total shoulder replacement, a major 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 89.4% in 2022

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 63,923 and BMI data on 52,735 shoulder replacement procedures. Since its initial collection, ASA score has been recorded for 95.5% of procedures. BMI has been recorded for 91.1% 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

Differences in ASA scores by procedure category are presented in Table S2.

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 shoulder replacements, the majority of procedures are undertaken in patients who are pre-obese or obese class 1 (61.5%) (Table S3).

Table S2 ASA Score for Shoulder Replacement

ASA Score	Partial		Total		Revision		TOTAL	
	N	Col%	N	Col%	N	Col%	N	Col%
ASA 1	366	11.9	2157	3.9	173	3.1	2696	4.2
ASA 2	1357	44.0	23981	43.4	2027	35.9	27365	42.8
ASA 3	1253	40.7	27534	49.9	3188	56.5	31975	50.0
ASA 4	106	3.4	1521	2.8	253	4.5	1880	2.9
ASA 5	.	.	7	0.0	.	.	7	0.0
TOTAL	**3082**	**100.0**	**55200**	**100.0**	**5641**	**100.0**	**63923**	**100.0**

Note: A further 21,427 procedures did not have ASA score recorded

1 https://www.asahq.org/resources/clinical-information/asa-physical-status-classification-system
2 http://www.euro.who.int/en/health-topics/disease-prevention/nutrition/a-healthy-lifestyle/body-mass-index-bmi

Table S3 BMI Category for Shoulder Replacement

BMI Category	Partial		Total		Revision		TOTAL	
	N	Col%	N	Col%	N	Col%	N	Col%
Underweight	22	1.1	337	0.7	44	1.0	403	0.8
Normal	389	19.1	7601	16.4	782	17.6	8772	16.6
Pre Obese	702	34.5	15791	34.1	1433	32.2	17926	34.0
Obese Class 1	511	25.1	12707	27.5	1271	28.6	14489	27.5
Obese Class 2	248	12.2	6274	13.6	587	13.2	7109	13.5
Obese Class 3	160	7.9	3545	7.7	331	7.4	4036	7.7
TOTAL	**2032**	**100.0**	**46255**	**100.0**	**4448**	**100.0**	**52735**	**100.0**

Note: BMI has not been presented for patients aged ≤19 years
A further 32,615 procedures did not have BMI recorded or the patient is aged ≤19 years

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 S4 and Table S5.

Overall, a CT scan was undertaken in 70.1% of shoulder replacements.

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.

GLENOID MORPHOLOGY

There are 5 glenoid morphology categories based on the Walch classification:[3]

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 and B2 for partial shoulder replacement (Table S5).

3 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.

Table S4 Usage of CT Scan for Shoulder Replacement

CT Scan Usage	Partial		Total		Revision		TOTAL	
	N	Col%	N	Col%	N	Col%	N	Col%
Yes	748	49.0	28601	74.1	1344	37.0	30693	70.1
No	733	48.1	9449	24.5	2057	56.6	12239	28.0
Unknown	44	2.9	546	1.4	232	6.4	822	1.9
TOTAL	**1525**	**100.0**	**38596**	**100.0**	**3633**	**100.0**	**43754**	**100.0**

Note: A further 41,596 procedures did not have CT scan usage recorded

Table S5 Glenoid Morphology for Shoulder Replacement

Glenoid Morphology	Partial		Total		Revision		TOTAL	
	N	Col%	N	Col%	N	Col%	N	Col%
A1	380	38.5	14652	44.0	469	37.7	15501	43.7
A2	198	20.1	7484	22.5	391	31.5	8073	22.7
B1	126	12.8	5004	15.0	125	10.1	5255	14.8
B2	203	20.6	4612	13.9	134	10.8	4949	13.9
C	79	8.0	1529	4.6	124	10.0	1732	4.9
TOTAL	**986**	**100.0**	**33281**	**100.0**	**1243**	**100.0**	**35510**	**100.0**

Note: 114 procedures have been excluded where a glenoid morphology of B3 was recorded
A further 49,726 procedures did not have glenoid morphology recorded

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 7,876 primary partial shoulder replacement procedures. This is an additional 253 procedures compared to the number reported last year.

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

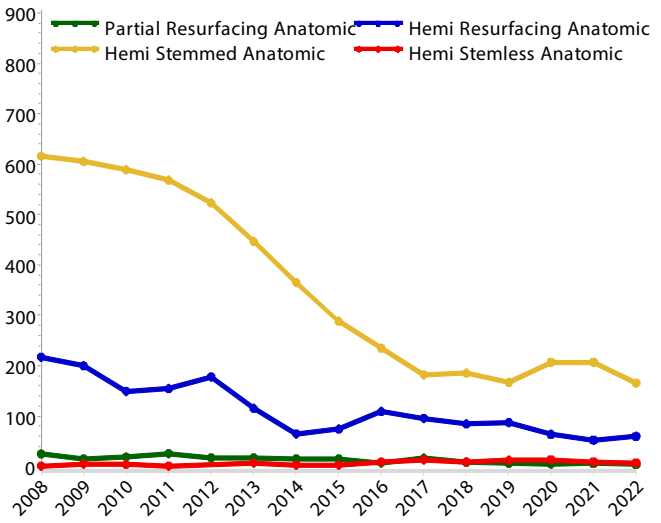
The most common class of primary partial shoulder replacement is hemi stemmed anatomic. This accounts for 72.6% of all partial shoulder replacements, followed by hemi resurfacing anatomic (23.5%), partial resurfacing anatomic (2.7%), and hemi stemless anatomic (1.2%) (Table SP1).

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 60 in 2022. The number of hemi stemmed anatomic procedures decreased from 616 in 2008 to 166 in 2022 (Figure SP1).

Table SP1 Primary Partial Shoulder Replacement by Class

Shoulder Class	Number	Percent
Partial Resurfacing Anatomic	209	2.7
Hemi Resurfacing Anatomic	1851	23.5
Hemi Stemmed Anatomic	5720	72.6
Hemi Stemless Anatomic	96	1.2
TOTAL	**7876**	**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-2023

Primary Hemi Stemmed Anatomic Shoulder Replacement

There are 5,720 primary hemi stemmed anatomic shoulder replacement procedures. This is an additional 178 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 71.7 years for females and 62.7 years for males (Table SP2).

The most common primary diagnosis is fracture (54.9%), followed by osteoarthritis (29.9%). In 2022, the number of primary hemi stemmed anatomic shoulder replacements undertaken for fracture decreased by 89.4% compared to 2008. In 2022, the number of primary hemi stemmed anatomic shoulder replacements undertaken for osteoarthritis decreased by 46.1% compared to 2008 (Figure SP2).

In order to keep Registry data contemporaneous, only procedures using prostheses that have been available and used in 2022 (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 17% and osteoarthritis is 12.1%. 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 405 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 (28%), whereas revision for glenoid erosion occurs more frequently in procedures undertaken for osteoarthritis (25%).

The most common type of revision is to a total shoulder replacement for both primary diagnoses (71.1% for fracture and 64.3% for osteoarthritis). Most were revised to a total reverse shoulder replacement (97.6% when used for fracture and 88.9% for osteoarthritis). Glenoid component only revision occurs more frequently in procedures undertaken for osteoarthritis (18.8% compared to 3.3% for fracture).

The outcomes of 14 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	1848	32.3%	14	94	63	62.7	13.6
Female	3872	67.7%	13	101	73	71.7	11.5
TOTAL	**5720**	**100.0%**	**13**	**101**	**70**	**68.8**	**13.0**

Figure SP2 Primary Hemi Stemmed Anatomic Shoulder Replacement by Primary Diagnosis

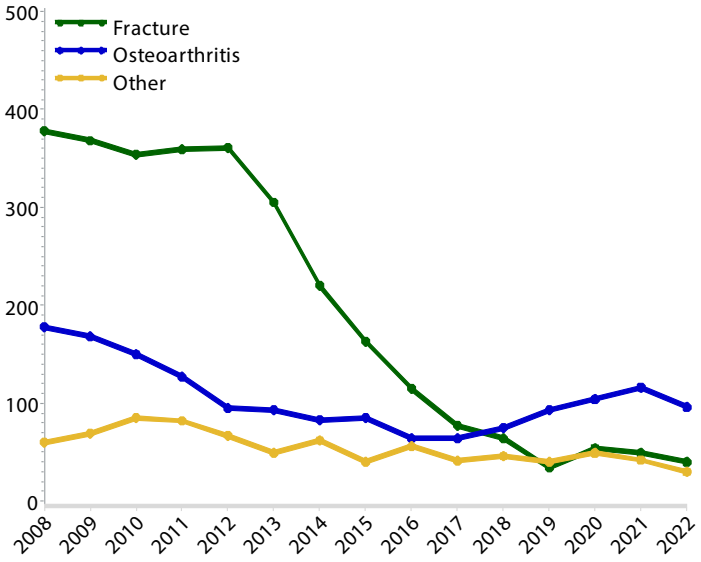
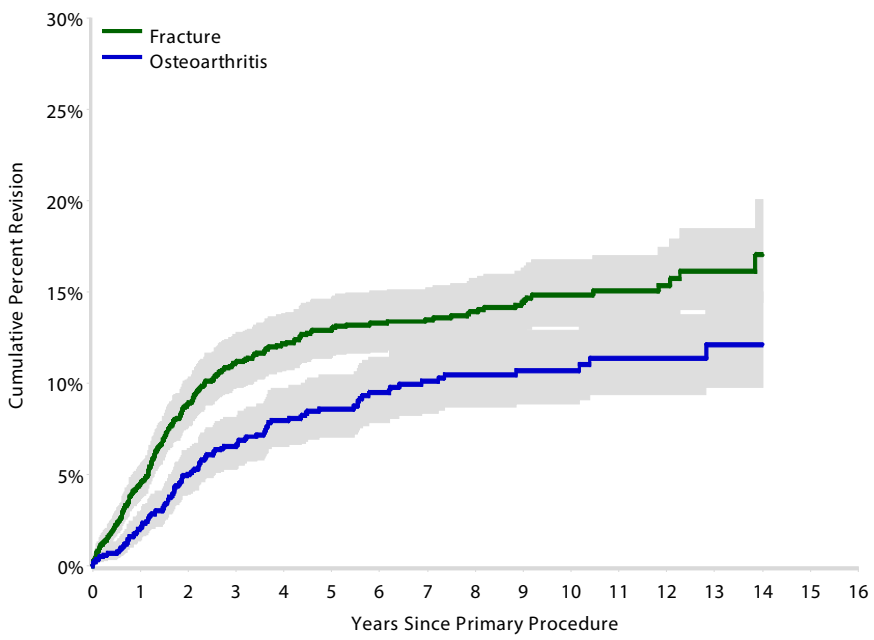


Table SP3 Cumulative Percent Revision of Primary Hemi Stemmed Anatomic Shoulder Replacement by Primary Diagnosis

Primary Diagnosis	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Fracture	239	1850	4.5 (3.6, 5.6)	11.2 (9.8, 12.8)	13.0 (11.4, 14.7)	13.5 (11.9, 15.3)	14.8 (13.1, 16.8)	17.0 (14.4, 20.1)
Osteoarthritis	112	1349	2.1 (1.4, 3.1)	6.6 (5.3, 8.1)	8.6 (7.1, 10.4)	10.1 (8.4, 12.2)	10.7 (8.9, 12.9)	12.1 (9.8, 15.0)
Rotator Cuff Arthropathy	17	194	2.6 (1.1, 6.2)	6.3 (3.5, 11.0)	8.5 (5.1, 14.1)	8.5 (5.1, 14.1)	13.0 (7.8, 21.1)	
Osteonecrosis	18	177	2.9 (1.2, 6.8)	6.8 (3.8, 12.0)	9.4 (5.6, 15.5)	10.6 (6.4, 17.2)	14.0 (8.5, 22.7)	
Tumour	6	126	2.3 (0.6, 9.0)	6.4 (2.3, 16.8)				
Other (4)	13	146	4.2 (1.9, 9.1)	8.0 (4.5, 14.0)	8.0 (4.5, 14.0)	8.0 (4.5, 14.0)		
TOTAL	**405**	**3842**						

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=3.41 (1.65, 7.03), p<0.001

6Mth - 1.5Yr: HR=1.87 (1.24, 2.81), p=0.002

1.5Yr+: HR=1.09 (0.81, 1.48), p=0.567

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Fracture	1850	1661	1328	1112	883	483	83
Osteoarthritis	1349	1207	901	692	526	286	58

Note: Only primary diagnoses with >1,000 procedures have been listed
Restricted to modern prostheses

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	52	668	2.3 (1.4, 3.8)	6.3 (4.7, 8.5)	7.0 (5.3, 9.3)	7.9 (6.0, 10.4)	8.5 (6.4, 11.1)	9.6 (7.2, 12.8)
Affinis	Affinis	9	60	8.5 (3.6, 19.3)	12.1 (6.0, 23.8)	17.2 (9.2, 30.9)	17.2 (9.2, 30.9)	17.2 (9.2, 30.9)	
Ascend Flex	Ascend Flex	3	43	5.1 (1.3, 19.1)	5.1 (1.3, 19.1)	9.5 (3.0, 27.6)	9.5 (3.0, 27.6)		
Ascend Flex PyC	Ascend Flex	24	589	1.3 (0.6, 2.6)	4.8 (3.1, 7.5)	6.9 (4.5, 10.5)	6.9 (4.5, 10.5)		
Comprehensive	Comprehensive	14	143	4.4 (2.0, 9.6)	10.8 (6.4, 18.0)	10.8 (6.4, 18.0)			
Delta Xtend	Delta Xtend	14	76	6.7 (2.8, 15.3)	16.4 (9.7, 27.2)	16.4 (9.7, 27.2)	18.6 (11.1, 30.1)	21.6 (13.0, 34.6)	
Equinoxe	Equinoxe	6	89	2.5 (0.6, 9.6)	9.0 (4.1, 19.2)	9.0 (4.1, 19.2)			
Global AP	Global AP	17	224	0.5 (0.1, 3.2)	5.1 (2.8, 8.9)	7.5 (4.7, 12.0)	8.1 (5.1, 12.7)	8.1 (5.1, 12.7)	
Global AP CTA	Global AP	10	102	2.0 (0.5, 7.6)	9.2 (4.9, 16.9)	10.3 (5.7, 18.4)	10.3 (5.7, 18.4)		
Global Unite	Global AP	1	21	0.0 (0.0, 0.0)	5.9 (0.9, 35.0)				
	Global Unite	40	208	7.3 (4.4, 11.7)	17.6 (13.0, 23.7)	20.1 (15.1, 26.5)	20.1 (15.1, 26.5)		
Mutars	Mutars	1	56	0.0 (0.0, 0.0)	4.0 (0.6, 25.2)	4.0 (0.6, 25.2)			
SMR	SMR	183	1281	4.0 (3.1, 5.3)	10.2 (8.6, 12.0)	12.7 (10.9, 14.7)	13.7 (11.9, 15.9)	16.1 (14.0, 18.5)	18.6 (15.7, 22.0)
SMR CTA	SMR	26	259	4.8 (2.8, 8.3)	9.0 (6.0, 13.5)	10.7 (7.3, 15.6)	10.7 (7.3, 15.6)	13.3 (8.9, 19.8)	
Other (6)		5	23	20.7 (8.2, 46.8)					
TOTAL		**405**	**3842**						

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-2023

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-2023

Use of Total Shoulder Replacement

There are 69,405 primary total shoulder replacement procedures. Of these, total stemmed reverse is the most common, followed by total stemmed anatomic and total stemless anatomic.

Primary total stemmed reverse shoulder replacement accounts for 70.9% of all primary total shoulder replacements.

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 (Figure ST1). Total stemless reverse replacements have been undertaken in Australia since 2016 (Table ST1).

Figure ST1 Primary Total Shoulder Replacement by Class

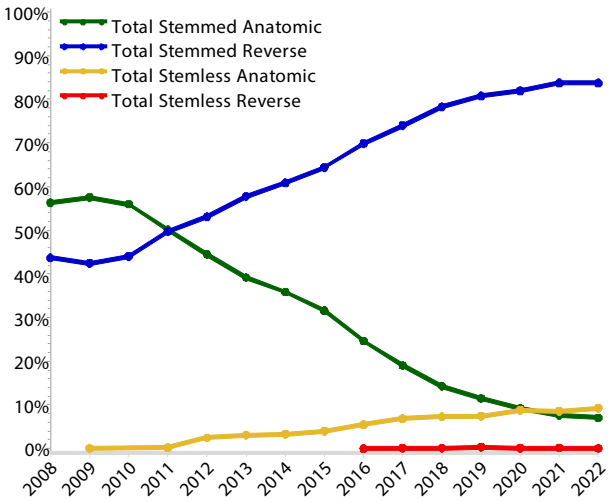


Table ST1 Primary Total Shoulder Replacement by Class

Class	Number	Percent
Total Stemmed Anatomic	16024	23.1
Total Stemmed Reverse	49230	70.9
Total Stemless Anatomic	4087	5.9
Total Stemless Reverse	64	0.1
TOTAL	**69405**	**100.0**

Primary total shoulder replacement is undertaken more often in females, and this is true of all classes with the exception of total stemless reverse, although numbers in this class are small (Table ST2). 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).

In order to keep Registry data contemporaneous, only procedures using prostheses that have been available and used in 2022 (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 ST2).

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-2023

Table ST2 Primary Total Shoulder Replacement by Class and Gender

Shoulder Class	Male		Female		TOTAL	
	N	Row%	N	Row%	N	Row%
Total Stemmed Anatomic	6882	42.9	9142	57.1	16024	100.0
Total Stemmed Reverse	18589	37.8	30641	62.2	49230	100.0
Total Stemless Anatomic	2023	49.5	2064	50.5	4087	100.0
Total Stemless Reverse	45	70.3	19	29.7	64	100.0
TOTAL	**27539**	**39.7**	**41866**	**60.3**	**69405**	**100.0**

Table ST3 Age and Gender of Primary Total Shoulder Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	27539	39.7%	14	96	71	70.2	9.0
Female	41866	60.3%	13	102	74	73.4	8.4
TOTAL	**69405**	**100.0%**	**13**	**102**	**73**	**72.1**	**8.8**

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	914	5.7	3788	23.6	7088	44.2	4234	26.4	16024	100.0
Total Stemmed Reverse	811	1.6	5367	10.9	19294	39.2	23758	48.3	49230	100.0
Total Stemless Anatomic	421	10.3	1114	27.3	1788	43.7	764	18.7	4087	100.0
Total Stemless Reverse	.	.	9	14.1	45	70.3	10	15.6	64	100.0
TOTAL	**2146**	**3.1**	**10278**	**14.8**	**28215**	**40.7**	**28766**	**41.4**	**69405**	**100.0**

Table ST5 Primary Total Shoulder Replacement by Primary Diagnosis

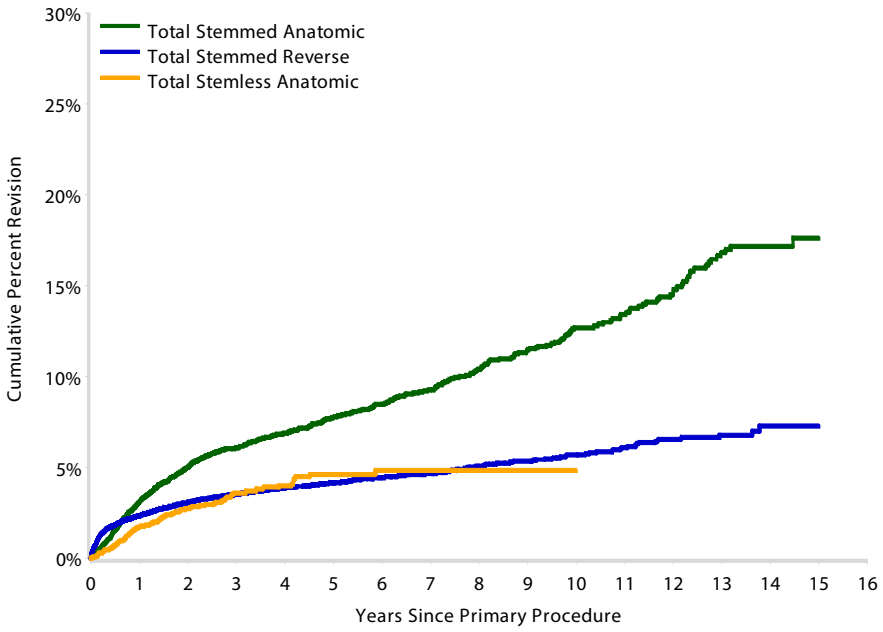
Primary Diagnosis	Number	Percent
Osteoarthritis	40404	58.2
Rotator Cuff Arthropathy	18124	26.1
Fracture	7648	11.0
Rheumatoid Arthritis	1146	1.7
Osteonecrosis	885	1.3
Instability	569	0.8
Other Inflammatory Arthritis	352	0.5
Tumour	259	0.4
Other	18	0.0
TOTAL	**69405**	**100.0**

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	672	7857	3.1 (2.7, 3.5)	6.1 (5.5, 6.7)	7.8 (7.1, 8.4)	9.3 (8.5, 10.0)	12.7 (11.6, 13.9)	17.2 (15.4, 19.1)
Total Stemmed Reverse	1728	47251	2.4 (2.2, 2.5)	3.5 (3.4, 3.7)	4.1 (3.9, 4.4)	4.7 (4.4, 4.9)	5.7 (5.3, 6.1)	7.3 (6.4, 8.3)
Total Stemless Anatomic	116	3753	1.7 (1.3, 2.2)	3.6 (2.9, 4.4)	4.6 (3.8, 5.6)	4.8 (3.9, 5.9)	4.8 (3.9, 5.9)	
Total Stemless Reverse	2	64	1.7 (0.2, 11.2)	3.5 (0.9, 13.3)				
TOTAL	**2518**	**58925**						

Note: Restricted to modern prostheses

Figure ST2 Cumulative Percent Revision of Primary Total Shoulder Replacement by Class (All Diagnoses)



HR - adjusted for age and gender

Total Stemmed Anatomic vs Total Stemmed Reverse

0 - 1Mth: HR=0.24 (0.14, 0.40), p<0.001

1Mth - 3Mth: HR=0.56 (0.40, 0.78), p<0.001

3Mth+: HR=2.24 (2.02, 2.49), p<0.001

Total Stemmed Anatomic vs Total Stemless Anatomic

Entire Period: HR=1.99 (1.63, 2.42), p<0.001

Total Stemless Anatomic vs Total Stemmed Reverse

0 - 3Mth: HR=0.19 (0.11, 0.34), p<0.001

3Mth+: HR=1.14 (0.93, 1.40), p=0.217

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Total Stemmed Anatomic	7857	7043	5568	3936	2539	1028	274
Total Stemmed Reverse	47251	39228	25693	14922	7772	2375	294
Total Stemless Anatomic	3753	2976	1675	757	233	43	0

Note: Restricted to modern prostheses

Primary Total Stemless Anatomic Shoulder Replacement

DEMOGRAPHICS

There have been 4,087 primary total stemless anatomic shoulder replacements. This is an additional 738 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 825.4% since its first full year of use in 2012.

Primary total stemless anatomic shoulder replacement is more commonly performed in patients aged 65–74 years of age (Figure ST3). Primary total stemless anatomic shoulder replacement is undertaken more often in females who are older on average than males (Table ST7).

Osteoarthritis is the most common primary diagnosis. The most used total stemless anatomic prostheses are listed in Table ST8 and Table ST9.

Figure ST3 Primary Total Stemless Anatomic Shoulder Replacement by Age Group

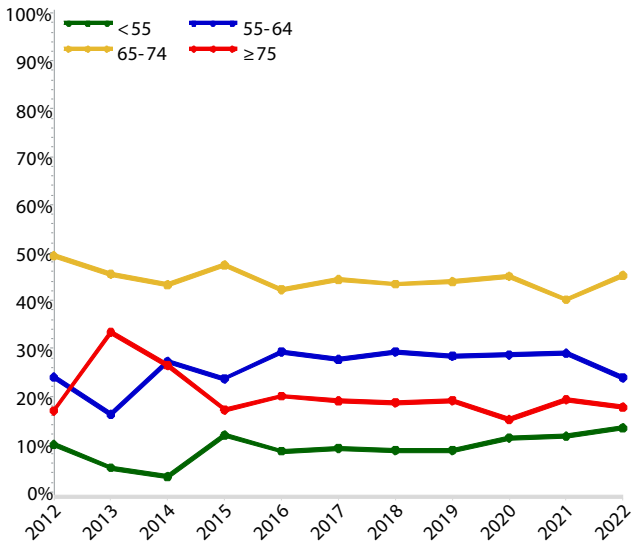


Table ST7 Age and Gender of Primary Total Stemless Anatomic Shoulder Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	2023	49.5%	31	95	65	64.3	9.5
Female	2064	50.5%	32	94	69	68.8	8.3
TOTAL	**4087**	**100.0%**	**31**	**95**	**67**	**66.6**	**9.2**

Table ST8 Most Used Humeral Stem Prostheses in Primary Total Stemless Anatomic Shoulder Replacement

2011		2019		2020		2021		2022	
N	Model	N	Model	N	Model	N	Model	N	Model
2	Simpliciti	311	Affinis	382	Affinis	378	Affinis	394	Affinis
2	TESS	119	Simpliciti	165	Simpliciti	201	Simpliciti	213	Simpliciti
1	Affinis	50	Comprehensive	35	Comprehensive	58	Comprehensive	46	Comprehensive
		17	Global Icon	13	Global Icon	21	Global Icon	35	Global Icon
		11	SMR	13	SMR	6	Equinoxe	19	Equinoxe
				2	Equinoxe	6	SMR	6	SMR
				1	Sidus				
Most Used									
5	(3) 100.0%	508	(5) 100.0%	611	(7) 100.0%	670	(6) 100.0%	713	(6) 100.0%

Table ST9 Most Used Glenoid Prostheses in Primary Total Stemless Anatomic Shoulder Replacement

2011		2019		2020		2021		2022	
N	Model	N	Model	N	Model	N	Model	N	Model
2	Aequalis	298	Affinis	355	Affinis	349	Affinis	359	Affinis
1	Affinis	120	Perform	164	Perform	201	Perform	213	Perform
1	Comprehensive	50	Comprehensive	41	Global	51	Comprehensive	70	Global
1	TESS	29	Global	36	Comprehensive	50	Global	35	Comprehensive
		8	SMR	9	SMR	6	Alliance	19	Equinoxe
		3	SMR L1	3	SMR L1	6	Equinoxe	11	Alliance
				2	Equinoxe	4	SMR	4	SMR L1
				1	Custom Made (Lima)	2	SMR L1	2	SMR
						1	Custom Made (Comprehensive)		
Most Used									
5	(4) 100.0%	508	(6) 100.0%	611	(8) 100.0%	670	(9) 100.0%	713	(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 2022 (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 4.6%.

The most common diagnosis for primary total stemless shoulder replacement is osteoarthritis. Osteonecrosis has a higher rate of revision compared to osteoarthritis. The number of procedures undertaken for other diagnoses is small (Table ST10 and Figure ST4).

Reason for Revision

The main reasons for revision are instability/dislocation, rotator cuff insufficiency, infection, and loosening (Table ST11 and Figure ST5).

Type of Revision

The most common types of revision involve replacement of both the humeral and glenoid components (Table ST12). Of these, 95.3% were revised to a total reverse shoulder replacement.

Prosthesis Types

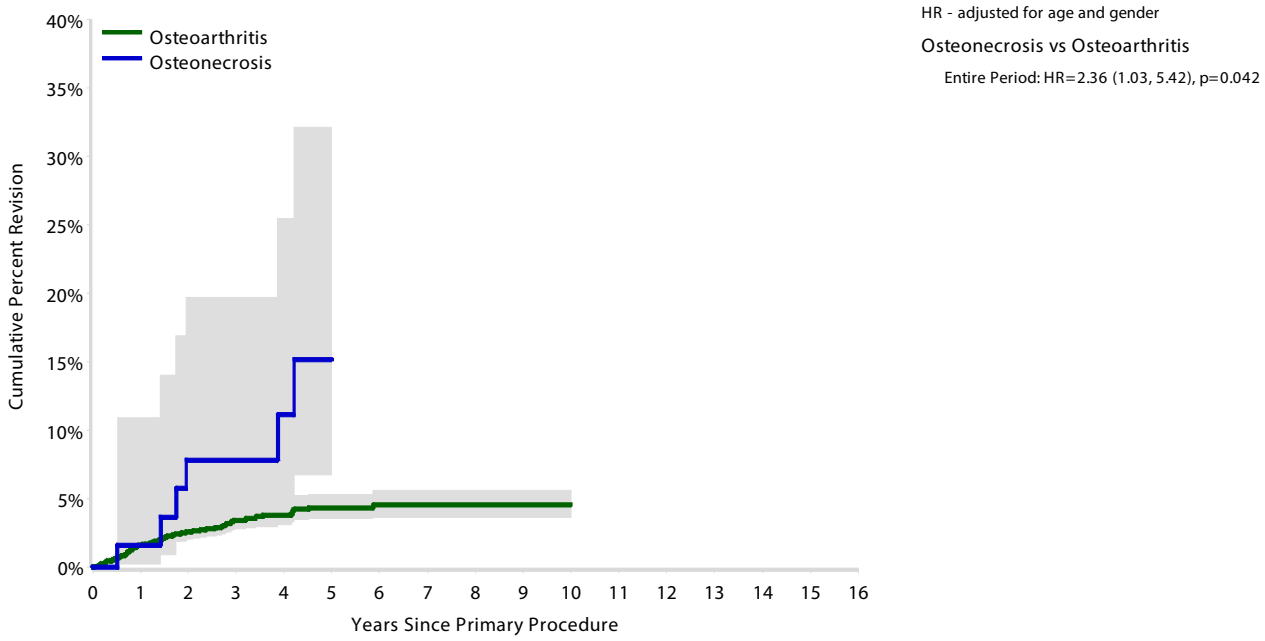
The outcomes of 7 humeral stem and glenoid prosthesis combinations with >29 procedures used in primary total stemless anatomic shoulder replacement are listed in Table ST13.

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	105	3596	1.6 (1.2, 2.1)	3.4 (2.8, 4.2)	4.4 (3.5, 5.3)	4.6 (3.7, 5.6)	4.6 (3.7, 5.6)	
Osteonecrosis	6	66	1.6 (0.2, 10.9)	7.9 (3.0, 19.7)	15.2 (6.7, 32.2)			
Other (5)	5	91	5.9 (2.5, 13.7)	5.9 (2.5, 13.7)	5.9 (2.5, 13.7)			
TOTAL	**116**	**3753**						

Note: Restricted to modern prostheses
Only primary diagnoses with >50 procedures have been listed

Figure ST4 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	3596	2851	1598	727	220	41	0
Osteonecrosis	66	53	35	12	6	1	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	42	36.2
Rotator Cuff Insufficiency	28	24.1
Infection	18	15.5
Loosening	16	13.8
Pain	6	5.2
Malposition	1	0.9
Lysis	1	0.9
Implant Breakage Humeral	1	0.9
Arthrofibrosis	1	0.9
Fracture	1	0.9
Other	1	0.9
TOTAL	**116**	**100.0**

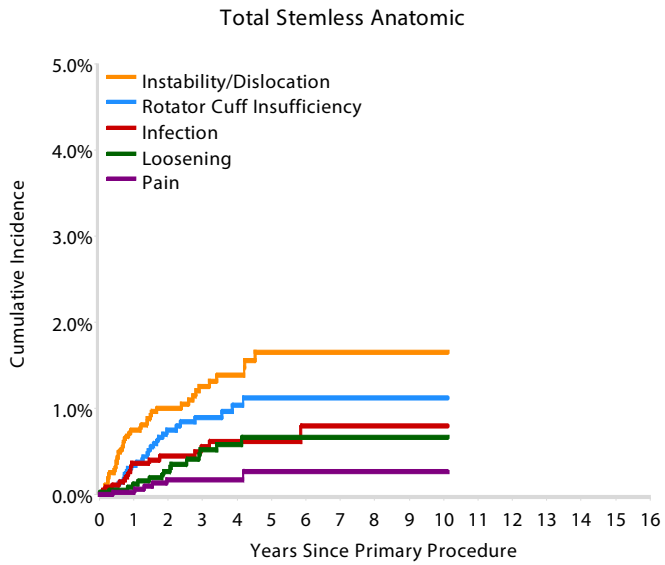
Note: Restricted to modern prostheses

Table ST12 Primary Total Stemless Anatomic Shoulder Replacement by Type of Revision (All Diagnoses)

Type of Revision	Number	Percent
Humeral/Glenoid	86	74.1
Head Only	9	7.8
Cement Spacer	9	7.8
Humeral Component	8	6.9
Removal of Prostheses	2	1.7
Glenoid Component	1	0.9
Reoperation	1	0.9
TOTAL	**116**	**100.0**

Note: Restricted to modern prostheses

Figure ST5 Cumulative Incidence Revision Diagnosis of Primary Total Stemless Anatomic Shoulder Replacement (All Diagnoses)



Note: Restricted to modern prostheses

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	80	2370	1.7 (1.2, 2.3)	3.7 (3.0, 4.7)	4.5 (3.6, 5.7)	4.7 (3.7, 6.0)	4.7 (3.7, 6.0)	
	Global	1	116	1.2 (0.2, 8.1)					
Comprehensive	Comprehensive	16	239	4.9 (2.7, 8.6)	7.4 (4.5, 12.2)				
Global Icon	Global	0	99	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)				
SMR	SMR	4	55	3.7 (0.9, 14.1)	7.6 (2.9, 19.0)	7.6 (2.9, 19.0)			
	SMR L1	3	33	3.2 (0.5, 20.8)	7.6 (1.9, 27.7)	12.8 (4.2, 35.3)			
Simpliciti	Perform	12	795	1.0 (0.4, 2.1)	1.7 (0.9, 3.2)				
Other (4)		0	46	0.0 (0.0, 0.0)					
TOTAL		**116**	**3753**						

Note: Restricted to modern prostheses.
Only prostheses with >29 procedures have been listed

OUTCOME FOR OSTEOARTHRITIS – PATIENT CHARACTERISTICS

There are 3,596 (95.8%) 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 4.6% (Table ST14).

The main reasons for revision are instability/dislocation (35.2%), rotator cuff insufficiency (23.8%), infection (16.2%) and loosening (15.2%) (Table ST15 and Figure ST6). The most common types of revision involve replacement of both the humeral and glenoid component with 94.9% being revised to a total stemmed reverse shoulder replacement (Table ST16).

Age and Gender

Patient age is not a risk factor for revision (Table ST17 and Figure ST7). Females have a higher rate of revision compared to males (Table ST18 and Figure ST8).

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 4.7% for ASA 2 and 5.5% for ASA 3 (Table ST19).

The most common BMI categories are pre-obese and obese class 1. BMI is not a risk factor for revision (Table ST20 and Figure ST9). The most common reasons for revision by BMI category are shown in Figure ST10.

Glenoid Morphology

Glenoid morphology category A2 has a higher rate of revision compared to A1 (Table ST21 and Figure ST11).

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	105	3596	1.6 (1.2, 2.1)	3.4 (2.8, 4.2)	4.4 (3.5, 5.3)	4.6 (3.7, 5.6)	4.6 (3.7, 5.6)	
TOTAL	**105**	**3596**						

Note: Restricted to modern prostheses

Table ST15 Primary Total Stemless Anatomic Shoulder Replacement by Reason for Revision (Primary Diagnosis OA)

Reason for Revision	Number	Percent
Instability/Dislocation	37	35.2
Rotator Cuff Insufficiency	25	23.8
Infection	17	16.2
Loosening	16	15.2
Pain	5	4.8
Malposition	1	1.0
Lysis	1	1.0
Implant Breakage Humeral	1	1.0
Arthrofibrosis	1	1.0
Fracture	1	1.0
TOTAL	**105**	**100.0**

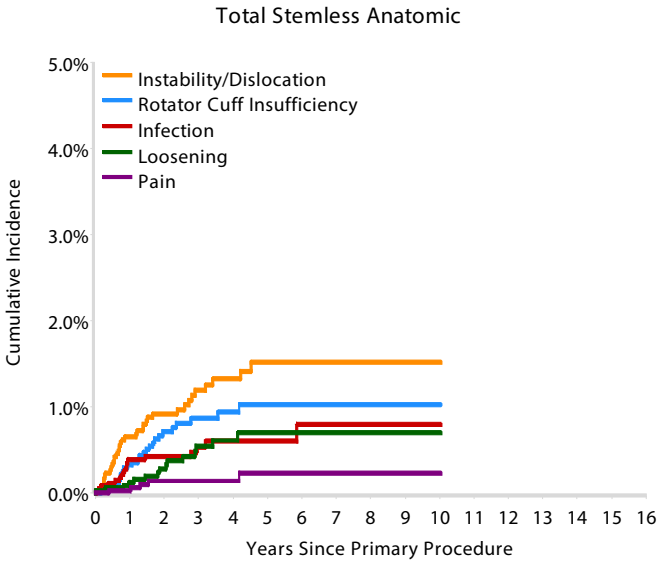
Note: Restricted to modern prostheses

Table ST16 Primary Total Stemless Anatomic Shoulder Replacement by Type of Revision (Primary Diagnosis OA)

Type of Revision	Number	Percent
Humeral/Glenoid	78	74.3
Head Only	9	8.6
Cement Spacer	8	7.6
Humeral Component	8	7.6
Removal of Prostheses	1	1.0
Glenoid Component	1	1.0
TOTAL	**105**	**100.0**

Note: Restricted to modern prostheses

Figure ST6 Cumulative Incidence Revision Diagnosis of Primary Total Stemless Anatomic Shoulder Replacement (Primary Diagnosis OA)



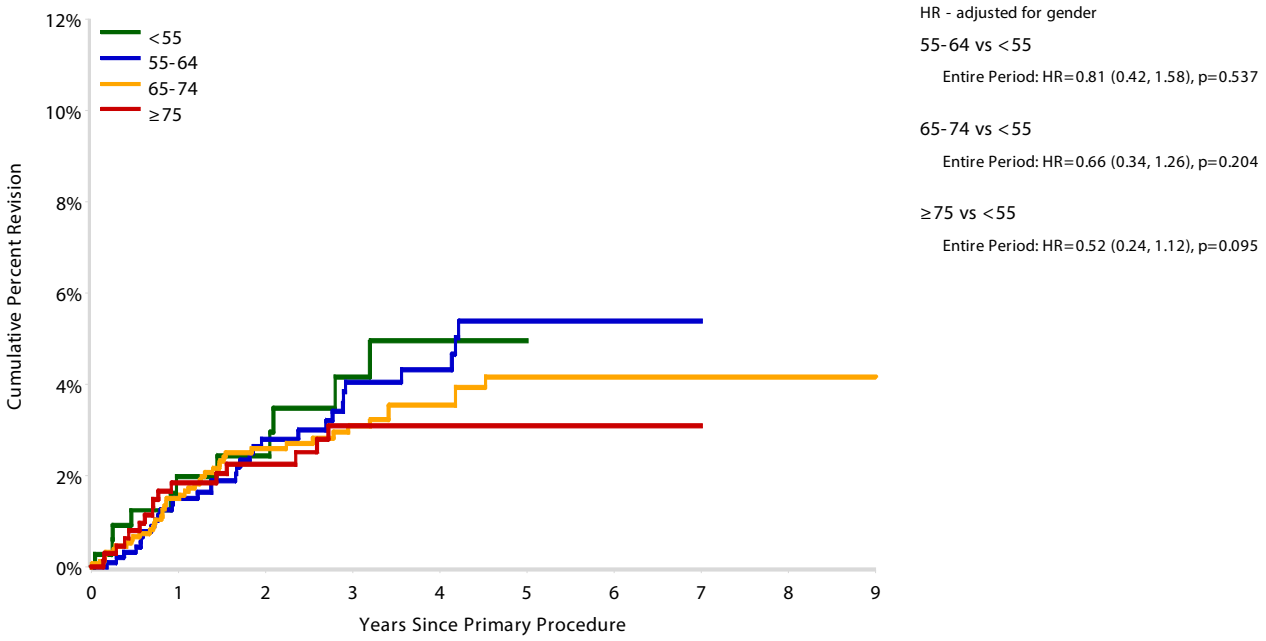
Note: Restricted to modern prostheses

Table ST17 Cumulative Percent Revision of Primary Total Stemless 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	12	353	2.0 (0.9, 4.4)	4.2 (2.2, 7.8)	5.0 (2.7, 9.1)			
55–64	32	978	1.5 (0.9, 2.6)	4.1 (2.8, 5.9)	5.4 (3.7, 7.8)	5.4 (3.7, 7.8)		
65–74	45	1588	1.5 (1.0, 2.3)	3.1 (2.2, 4.2)	4.2 (3.0, 5.7)	4.2 (3.0, 5.7)		
≥75	16	677	1.8 (1.0, 3.3)	3.1 (1.9, 5.1)	3.1 (1.9, 5.1)	3.1 (1.9, 5.1)		
TOTAL	**105**	**3596**						

Note: Restricted to modern prostheses

Figure ST7 Cumulative Percent Revision of Primary Total Stemless Anatomic Shoulder Replacement by Age (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
<55	353	261	131	62	17	4	0
55–64	978	799	435	187	43	10	0
65–74	1588	1253	714	336	113	21	0
≥75	677	538	318	142	47	6	0

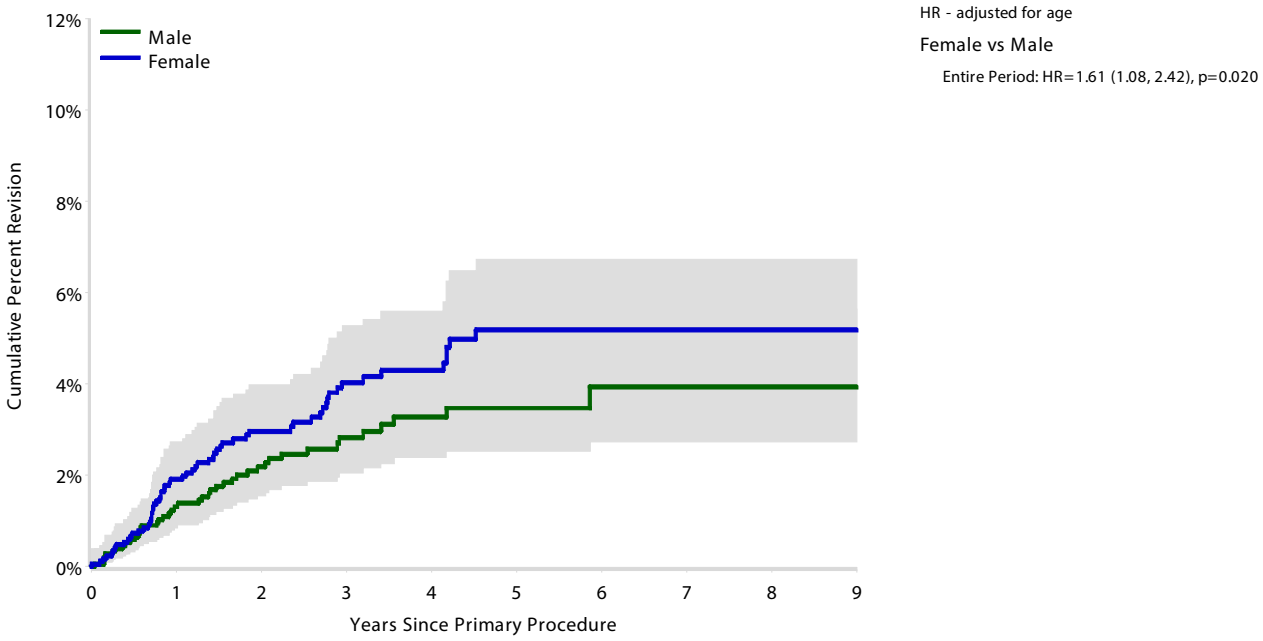
Note: Restricted to modern prostheses

Table ST18 Cumulative Percent Revision of Primary Total Stemless Anatomic Shoulder Replacement by Gender (Primary Diagnosis OA)

Gender	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Male	43	1823	1.3 (0.9, 2.0)	2.8 (2.0, 3.9)	3.5 (2.5, 4.8)	3.9 (2.7, 5.6)		
Female	62	1773	1.9 (1.3, 2.7)	4.0 (3.1, 5.3)	5.2 (4.0, 6.7)	5.2 (4.0, 6.7)		
TOTAL	**105**	**3596**						

Note: Restricted to modern prostheses

Figure ST8 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	1823	1423	756	331	86	23	0
Female	1773	1428	842	396	134	18	0

Note: Restricted to modern prostheses

Table ST19 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	3	266	0.8 (0.2, 3.3)	1.4 (0.4, 4.2)	1.4 (0.4, 4.2)	1.4 (0.4, 4.2)		
ASA 2	48	1709	1.4 (0.9, 2.1)	2.6 (1.8, 3.6)	3.4 (2.5, 4.5)	4.2 (3.1, 5.7)	4.7 (3.3, 6.6)	
ASA 3	50	1487	1.9 (1.3, 2.9)	2.9 (2.1, 4.0)	4.1 (3.1, 5.6)	5.5 (4.0, 7.3)	5.5 (4.0, 7.3)	
ASA 4	2	38	5.6 (1.4, 20.6)	5.6 (1.4, 20.6)	5.6 (1.4, 20.6)	5.6 (1.4, 20.6)		
TOTAL	**103**	**3500**						

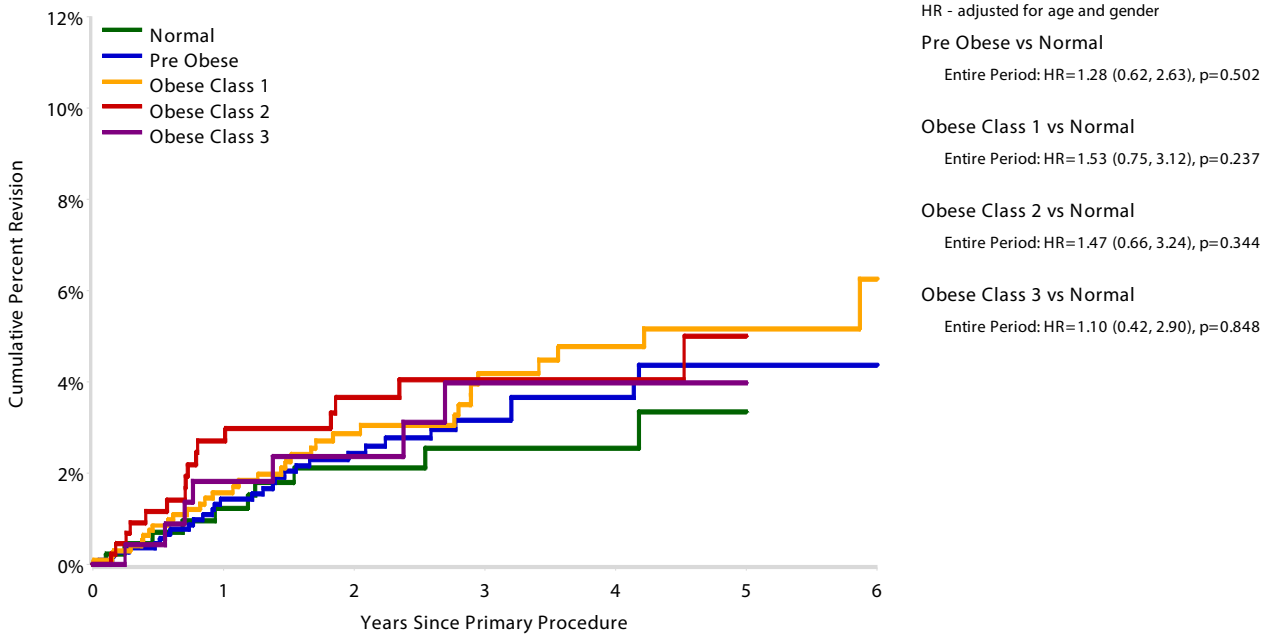
Note: Restricted to modern prostheses

Table ST20 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	0	9	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	10	458	1.2 (0.5, 2.9)	2.1 (1.1, 4.2)	2.5 (1.3, 4.9)	2.5 (1.3, 4.9)	3.4 (1.7, 6.6)	
Pre Obese	30	1132	1.4 (0.8, 2.4)	2.4 (1.6, 3.7)	3.2 (2.1, 4.7)	3.7 (2.5, 5.4)	4.4 (3.0, 6.5)	4.4 (3.0, 6.5)
Obese Class 1	33	1012	1.6 (0.9, 2.7)	2.9 (1.9, 4.3)	4.2 (2.9, 6.1)	4.8 (3.3, 6.9)	5.2 (3.6, 7.4)	6.3 (4.0, 9.8)
Obese Class 2	16	472	2.7 (1.5, 4.9)	3.7 (2.2, 6.1)	4.0 (2.4, 6.7)	4.0 (2.4, 6.7)	5.0 (2.9, 8.6)	
Obese Class 3	7	245	1.8 (0.7, 4.8)	2.4 (1.0, 5.6)	4.0 (1.9, 8.4)	4.0 (1.9, 8.4)	4.0 (1.9, 8.4)	
TOTAL	**96**	**3328**						

Note: Restricted to modern prostheses
BMI has not been presented for patients aged ≤19 years

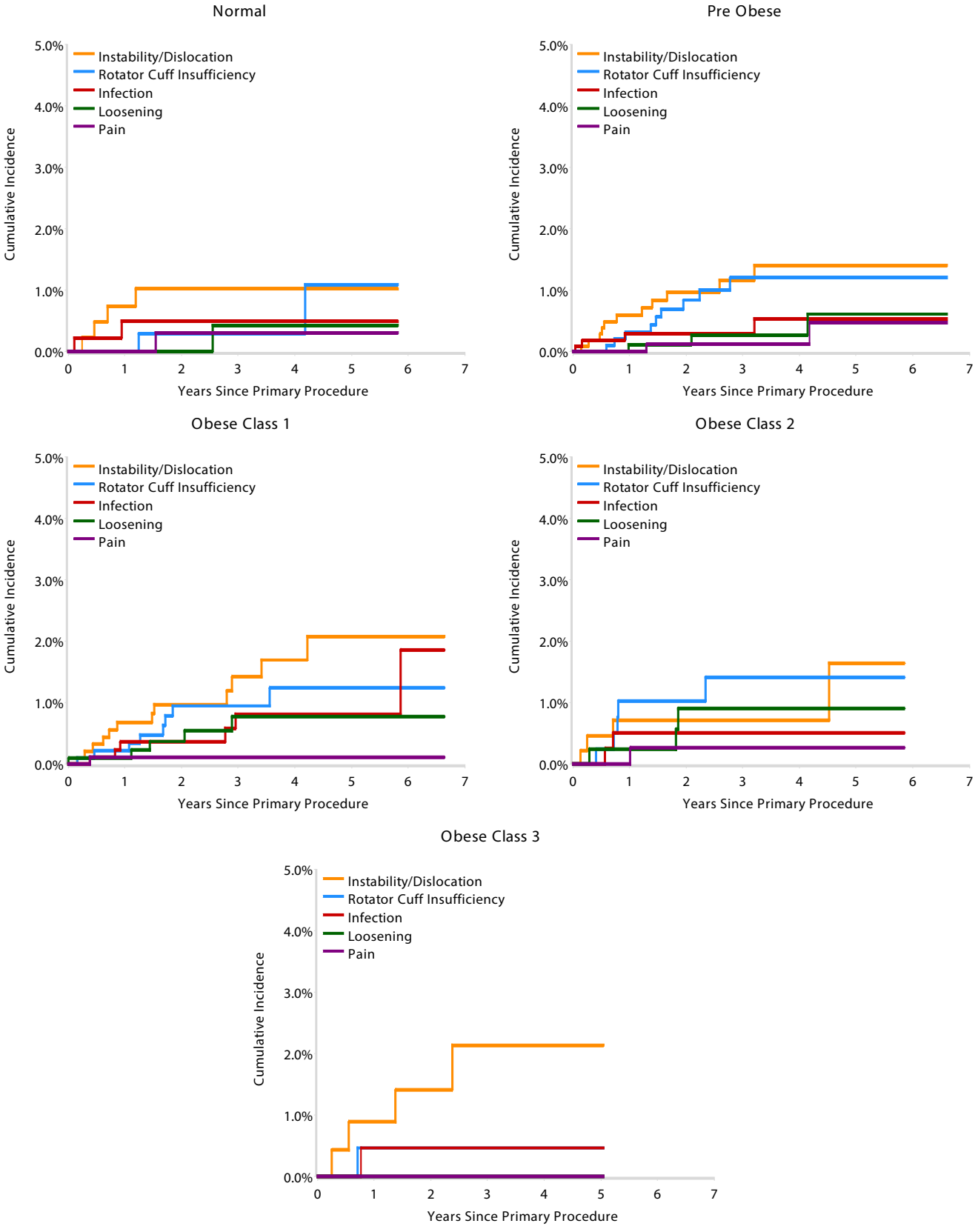
Figure ST9 Cumulative Percent Revision of Primary Total Stemless Anatomic Shoulder Replacement by BMI Category (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Normal	458	361	277	205	130	72	33
Pre Obese	1132	882	655	435	294	178	84
Obese Class 1	1012	778	570	401	265	160	80
Obese Class 2	472	362	274	208	124	72	36
Obese Class 3	245	198	155	100	75	41	18

Note: Restricted to modern prostheses
BMI has not been presented for patients aged ≤19 years

Figure ST10 Cumulative Incidence Revision Diagnosis of Primary Total Stemless Anatomic Shoulder Replacement by BMI Category (Primary Diagnosis OA)



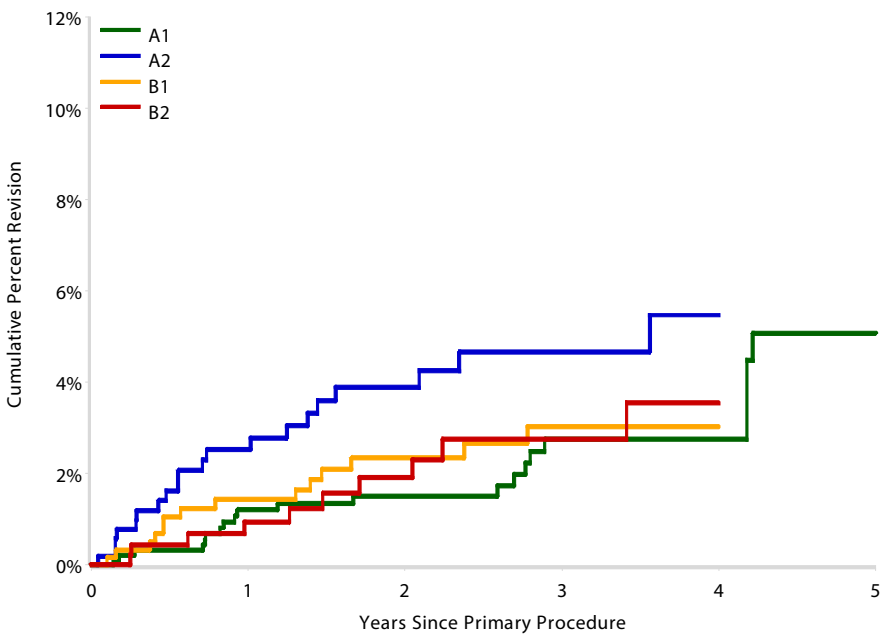
Note: Restricted to modern prostheses
BMI has not been presented for patients aged ≤19 years

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	21	1021	1.2 (0.6, 2.2)	1.5 (0.8, 2.6)	2.8 (1.7, 4.5)	2.8 (1.7, 4.5)	5.1 (3.0, 8.5)
A2	21	531	2.5 (1.4, 4.4)	3.9 (2.4, 6.2)	4.7 (3.0, 7.3)	5.5 (3.4, 8.8)	
B1	14	622	1.4 (0.7, 2.8)	2.3 (1.3, 4.1)	3.0 (1.8, 5.2)	3.0 (1.8, 5.2)	
B2	10	514	0.9 (0.4, 2.5)	1.9 (0.9, 4.0)	2.7 (1.4, 5.3)	3.5 (1.8, 6.9)	
C	1	71	1.7 (0.2, 11.2)	1.7 (0.2, 11.2)	1.7 (0.2, 11.2)	1.7 (0.2, 11.2)	
TOTAL	**67**	**2759**					

Note: Restricted to modern prostheses
Excludes 13 procedures where a glenoid morphology of B3 was recorded

Figure ST11 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=1.97 (1.07, 3.60), p=0.028

B1 vs A1

Entire Period: HR=1.05 (0.53, 2.09), p=0.878

B2 vs A1

Entire Period: HR=1.00 (0.46, 2.16), p=0.995

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
A1	1021	756	548	353	195	82
A2	531	393	274	171	91	37
B1	622	485	360	242	132	35
B2	514	368	255	150	83	30

Note: Restricted to modern prostheses

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 (Table ST22).

Bearing Surface

There is no difference in the rate of revision when ceramic/non XLPE, ceramic/XLPE and metal/non XLPE bearing surfaces (humeral head/glenoid) are compared (Table ST23 and Figure ST12).

Humeral Heads

Humeral head size is not a risk factor for revision of primary total stemless anatomic shoulder replacement (Table ST24 and Figure ST13).

Humeral head size is not a risk factor for revision of primary total stemless anatomic shoulder replacement.

The outcome of the most used primary total stemless anatomic prosthesis combinations are listed in Table ST25.

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	25	13.0 (4.4, 35.2)	17.9 (7.1, 41.0)	17.9 (7.1, 41.0)	17.9 (7.1, 41.0)		
Cementless	6	226	2.1 (0.7, 6.4)					
Hybrid (Glenoid Cemented)	95	3345	1.5 (1.1, 2.0)	3.2 (2.6, 4.0)	4.1 (3.3, 5.1)	4.3 (3.4, 5.4)	4.3 (3.4, 5.4)	
TOTAL	**105**	**3596**						

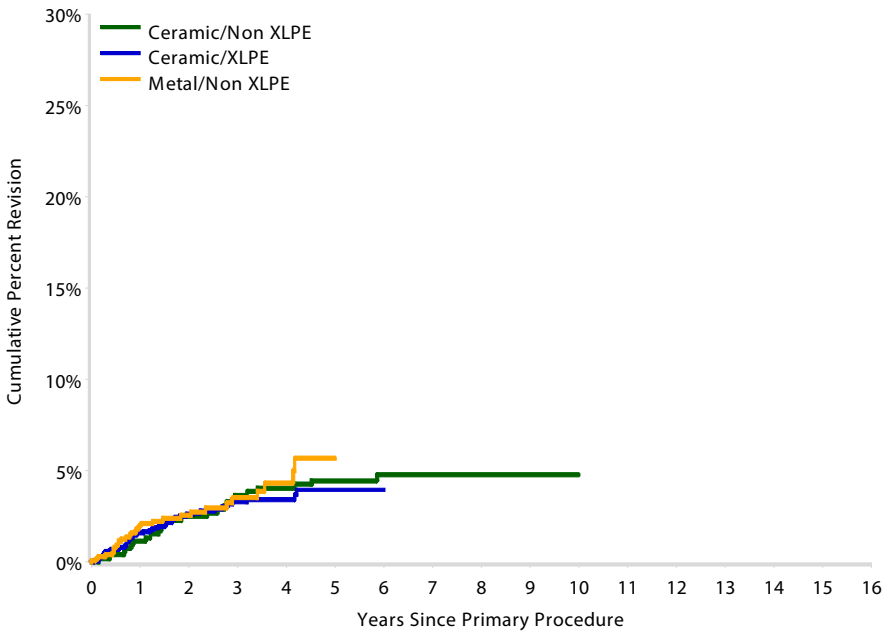
Note: Restricted to modern prostheses

Table ST23 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	25	520	1.2 (0.5, 2.6)	3.7 (2.4, 5.7)	4.5 (3.0, 6.7)	4.8 (3.2, 7.1)	4.8 (3.2, 7.1)	
Ceramic/XLPE	48	1858	1.6 (1.1, 2.3)	3.3 (2.4, 4.4)	4.0 (2.9, 5.4)			
Metal/Non XLPE	30	1083	2.0 (1.2, 3.1)	3.5 (2.3, 5.2)	5.7 (3.6, 8.9)			
Metal/XLPE	2	135	0.9 (0.1, 6.4)	2.0 (0.5, 7.7)				
TOTAL	**105**	**3596**						

Note: Restricted to modern prostheses

Figure ST12 Cumulative Percent Revision of Primary Total Stemless Anatomic Shoulder Replacement by Bearing Surface (Primary Diagnosis OA)



HR - adjusted for age and gender

Ceramic/Non XLPE vs Ceramic/XLPE

Entire Period: HR=1.10 (0.66, 1.81), p=0.721

Ceramic/Non XLPE vs Metal/Non XLPE

Entire Period: HR=0.93 (0.54, 1.62), p=0.804

Metal/Non XLPE vs Ceramic/XLPE

Entire Period: HR=1.18 (0.74, 1.86), p=0.489

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Ceramic/Non XLPE	520	514	493	401	201	41	0
Ceramic/XLPE	1858	1446	718	258	16	0	0
Metal/Non XLPE	1083	790	326	53	3	0	0

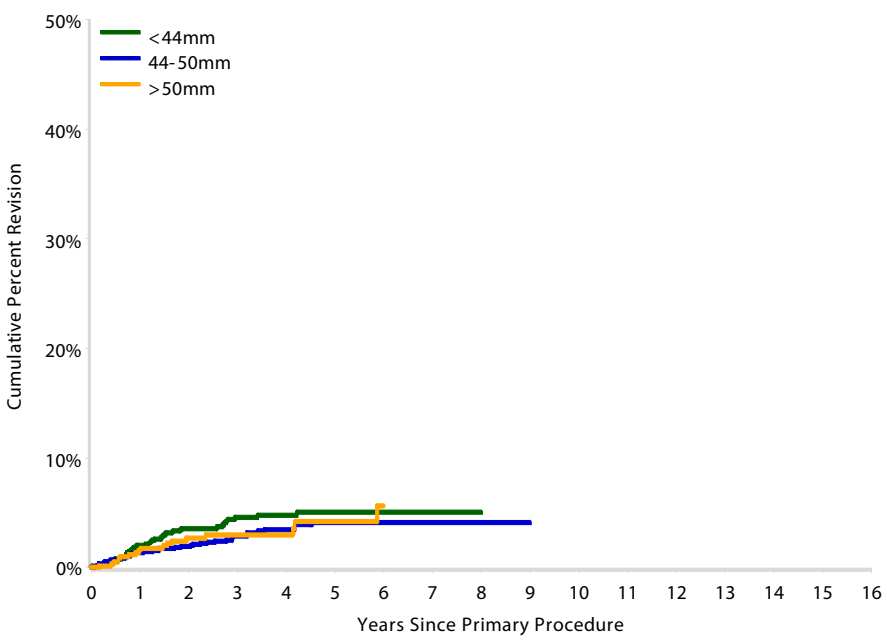
Note: Restricted to modern prostheses

Table ST24 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	42	1122	2.0 (1.3, 3.1)	4.6 (3.3, 6.2)	5.0 (3.7, 6.8)	5.0 (3.7, 6.8)		
44–50mm	45	1813	1.4 (0.9, 2.1)	2.9 (2.1, 4.0)	4.1 (3.0, 5.6)	4.1 (3.0, 5.6)		
>50mm	18	660	1.6 (0.8, 3.0)	3.0 (1.8, 4.9)	4.2 (2.4, 7.1)			
TOTAL	**105**	**3595**						

Note: Restricted to modern prostheses
Excludes 1 procedures with unknown head size.

Figure ST13 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 (0.76, 2.04), p=0.377

<44mm vs >50mm

Entire Period: HR=1.04 (0.52, 2.11), p=0.908

>50mm vs 44-50mm

Entire Period: HR=1.20 (0.67, 2.13), p=0.538

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
<44mm	1122	905	557	292	102	14	0
44–50mm	1813	1422	768	334	89	18	0
>50mm	660	524	273	101	29	9	0

Note: Restricted to modern prostheses

Table ST25 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	72	2265	1.5 (1.1, 2.1)	3.6 (2.8, 4.5)	4.3 (3.4, 5.4)	4.5 (3.5, 5.7)	4.5 (3.5, 5.7)	
	Global	1	113	1.2 (0.2, 8.2)					
Comprehensive	Comprehensive	16	232	5.0 (2.8, 8.9)	7.7 (4.7, 12.6)				
Global Icon	Global	0	95	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)				
SMR	SMR	3	54	3.8 (1.0, 14.4)	5.8 (1.9, 16.8)	5.8 (1.9, 16.8)			
	SMR L1	3	30	3.4 (0.5, 22.1)	7.8 (2.0, 28.2)	13.0 (4.3, 35.6)			
Simpliciti	Perform	10	763	0.9 (0.4, 2.1)	1.6 (0.8, 3.2)				
Other (4)		0	44	0.0 (0.0, 0.0)					
TOTAL		**105**	**3596**						

Note: Restricted to modern prostheses
Only prostheses with >29 procedures have been listed.

Primary Total Stemmed Anatomic Shoulder Replacement

DEMOGRAPHICS

There are 16,024 total stemmed anatomic shoulder replacement procedures. This is an additional 561 procedures compared to the previous report.

The majority of procedures are undertaken in females. The mean age of females is older than males (Table ST26).

The majority of procedures are undertaken in the 65–74 year age group. The proportional use in patients aged ≥75 years was declining, but increased in 2022 (Figure ST14).

The most common type of fixation is hybrid fixation (cementless humerus and cemented glenoid) (Figure ST15).

The 10 most used humeral stem and glenoid prostheses are listed in Table ST27 and Table ST28.

Hybrid fixation with a cemented glenoid has increased from 55.8% in 2010 to 76.8% in 2022.

Table ST26 Age and Gender of Primary Total Stemmed Anatomic Shoulder Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	6882	42.9%	21	93	67	66.7	9.0
Female	9142	57.1%	19	96	71	70.3	8.5
TOTAL	**16024**	**100.0%**	**19**	**96**	**69**	**68.7**	**8.9**

Figure ST14 Primary Total Stemmed Anatomic Shoulder Replacement by Age

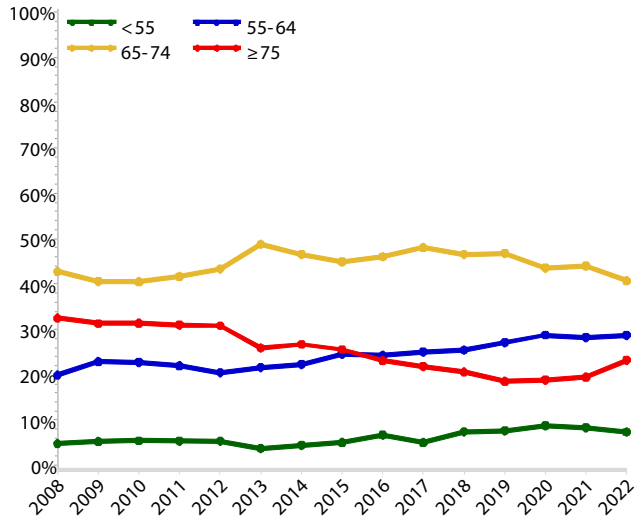


Figure ST15 Primary Total Stemmed Anatomic Shoulder Replacement by Fixation

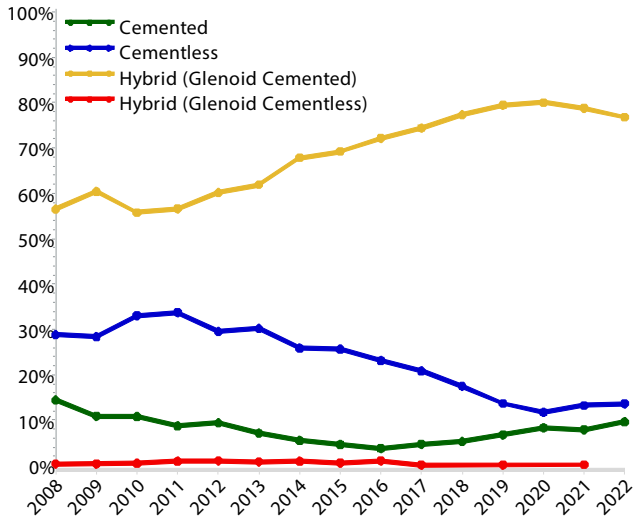


Table ST27 10 Most Used Humeral Stem Prostheses in Primary Total Stemmed Anatomic Shoulder Replacement

2008		2019		2020		2021		2022	
N	Model	N	Model	N	Model	N	Model	N	Model
298	SMR	175	Ascend Flex	143	Ascend Flex	179	Ascend Flex	181	Ascend Flex
167	Aequalis	128	Global Unite	111	Global Unite	92	Global Unite	102	Global Unite
117	Global Advantage	119	Comprehensive	94	Comprehensive	91	Equinoxe	85	Equinoxe
91	Global AP	119	SMR	92	Equinoxe	86	Comprehensive	74	SMR
40	Bigliani/Flatow	105	Equinoxe	88	SMR	83	SMR	66	Comprehensive
37	Bigliani/Flatow TM	81	Global AP	77	Global AP	57	Global AP	28	Global AP
32	Solar	29	Bigliani/Flatow TM	19	Global Advantage	4	Bigliani/Flatow TM	4	Affinis
27	Affinis	10	Global Advantage	9	Bigliani/Flatow TM	3	Delta Xtend	2	Delta Xtend
11	Univers 3D	6	MSS	5	Turon	2	Global Advantage	1	Bigliani/Flatow TM
10	Cofield 2	5	Turon	2	Affinis	1	Affinis		
10 Most Used									
830	(10) 97.9%	777	(10) 99.2%	640	(10) 100.0%	598	(10) 100.0%	543	(9) 100.0%
Remainder									
18	(7) 2.1%	6	(2) 0.8%	0	(0) 0%	0	(0) 0%	0	(0) 0%
TOTAL									
848	(17) 100.0%	783	(12) 100.0%	640	(10) 100.0%	598	(10) 100.0%	543	(9) 100.0%

Table ST28 10 Most Used Glenoid Prostheses in Primary Total Stemmed Anatomic Shoulder Replacement

2008		2019		2020		2021		2022	
N	Model	N	Model	N	Model	N	Model	N	Model
237	SMR L1	221	Global	207	Global	180	Perform	180	Perform
209	Global	179	Perform	143	Perform	152	Global	132	Global
167	Aequalis	114	Comprehensive	92	Equinoxe	91	Equinoxe	85	Equinoxe
79	Bigliani/Flatow	105	Equinoxe	91	Comprehensive	73	Comprehensive	63	SMR L1
57	SMR	98	SMR L1	72	SMR L1	70	SMR L1	56	Comprehensive
32	Solar	23	Bigliani/Flatow	15	SMR	13	Alliance	11	SMR
27	Affinis	18	SMR	8	Bigliani/Flatow	10	SMR	10	Alliance
11	Univers 3D	6	Bigliani/Flatow TM	5	Turon	3	Bigliani/Flatow	5	Affinis
10	Cofield 2	6	MSS	2	Affinis	2	SMR Axioma	1	Bigliani/Flatow
7	Promos	5	Custom Made (Comprehensive)	2	Alliance	1	Affinis		
10 Most Used									
836	(10) 98.6%	775	(10) 99.0%	637	(10) 99.5%	595	(10) 99.5%	543	(9) 100.0%
Remainder									
12	(6) 1.4%	8	(3) 1.0%	3	(3) 0.5%	3	(3) 0.5%	0	(0) 0%
TOTAL									
848	(16) 100.0%	783	(13) 100.0%	640	(13) 100.0%	598	(13) 100.0%	543	(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 when osteoarthritis is compared to osteonecrosis and rheumatoid arthritis (Table ST29 and Figure ST16).

Reason for Revision

The main reasons for revision are rotator cuff insufficiency, instability/dislocation, and loosening (Table ST30 and Figure ST17).

Type of Revision

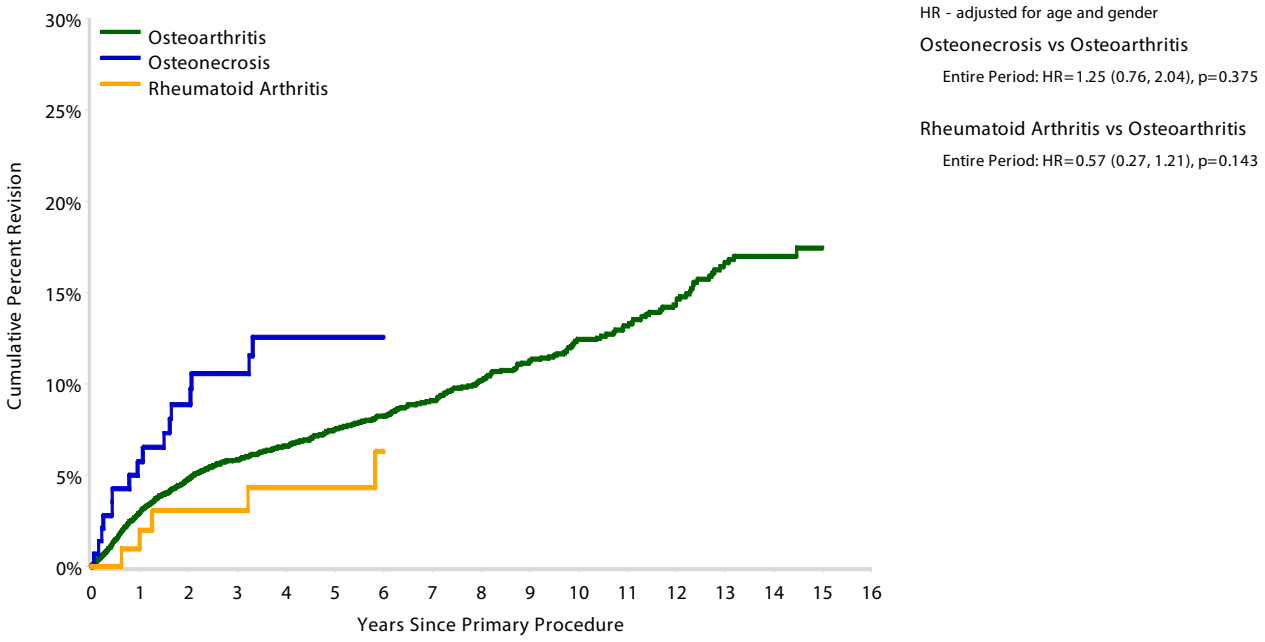
The most common type of revision involves replacement of the humeral component (58.9%) (Table ST31).

Table ST29 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	619	7409	3.0 (2.6, 3.4)	5.9 (5.3, 6.4)	7.5 (6.9, 8.2)	9.1 (8.3, 9.9)	12.4 (11.3, 13.6)	17.0 (15.2, 19.0)
Osteonecrosis	17	145	5.8 (2.9, 11.2)	10.6 (6.4, 17.2)	12.6 (7.9, 19.8)			
Rheumatoid Arthritis	7	108	2.0 (0.5, 7.8)	3.1 (1.0, 9.2)	4.3 (1.6, 11.2)			
Fracture	12	67	9.2 (4.2, 19.3)	18.8 (11.1, 30.8)	18.8 (11.1, 30.8)	18.8 (11.1, 30.8)	18.8 (11.1, 30.8)	
Rotator Cuff Arthropathy	7	50	4.1 (1.0, 15.3)	10.7 (4.6, 23.8)	13.2 (6.1, 27.2)	13.2 (6.1, 27.2)		
Other Inflammatory Arthritis	5	45	7.0 (2.3, 20.1)	7.0 (2.3, 20.1)	9.9 (3.8, 24.4)	9.9 (3.8, 24.4)	21.1 (7.0, 54.0)	
Other (3)	5	33	3.0 (0.4, 19.6)	11.0 (3.6, 30.5)	16.9 (6.4, 40.3)	16.9 (6.4, 40.3)		
TOTAL	**672**	**7857**						

Note: Only primary diagnoses with >30 procedures have been listed
Restricted to modern prostheses

Figure ST16 Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement by Primary Diagnosis



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Osteoarthritis	7409	6654	5264	3726	2405	974	264
Osteonecrosis	145	124	92	55	31	14	4
Rheumatoid Arthritis	108	95	78	58	38	16	3

Note: Restricted to modern prostheses
Only primary diagnoses with >70 procedures have been listed

Table ST30 Primary Total Stemmed Anatomic Shoulder Replacement by Reason for Revision (All Diagnoses)

Reason for Revision	Number	Percent
Rotator Cuff Insufficiency	245	36.5
Instability/Dislocation	183	27.2
Loosening	95	14.1
Infection	33	4.9
Fracture	18	2.7
Pain	17	2.5
Arthrofibrosis	12	1.8
Wear Glenoid Insert	11	1.6
Lysis	10	1.5
Implant Breakage Glenoid Insert	10	1.5
Implant Breakage Glenoid	7	1.0
Metal Related Pathology	7	1.0
Malposition	6	0.9
Dissociation	6	0.9
Incorrect Sizing	5	0.7
Progression Of Disease	2	0.3
Other	5	0.7
TOTAL	**672**	**100.0**

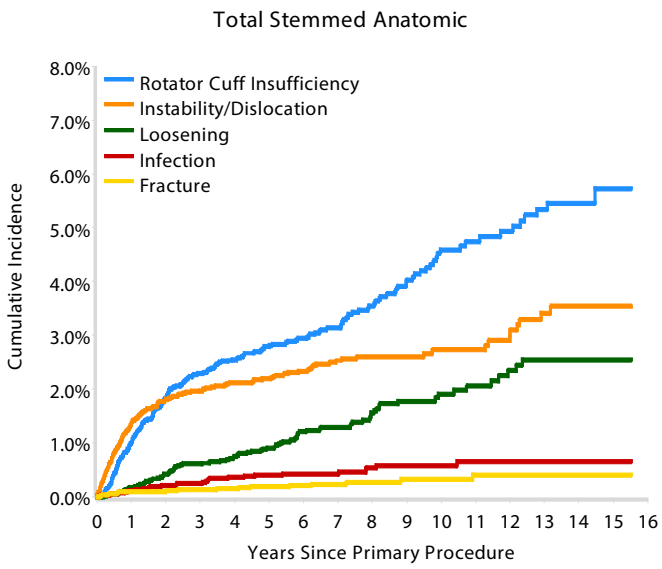
Note: Restricted to modern prostheses

Table ST31 Primary Total Stemmed Anatomic Shoulder Replacement by Type of Revision (All Diagnoses)

Type of Revision	Number	Percent
Humeral Component	396	58.9
Humeral/Glenoid	194	28.9
Head Only	39	5.8
Glenoid Component	17	2.5
Cement Spacer	14	2.1
Removal of Prostheses	4	0.6
Reoperation	3	0.4
Minor Components	2	0.3
Head/Insert	2	0.3
Reinsertion of Components	1	0.1
TOTAL	**672**	**100.0**

Note: Restricted to modern prostheses
Humeral heads are replaced when the humeral component is revised

Figure ST17 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Anatomic Shoulder Replacement (All Diagnoses)



Note: Restricted to modern prostheses

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 ST32.

The most commonly used cementless prosthesis combinations are listed in Table ST33. The most commonly used prosthesis combinations with hybrid (glenoid cemented) fixation are listed in Table ST34.

Table ST32 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	20	197	0.0 (0.0, 0.0)	2.6 (1.1, 6.2)	5.4 (2.9, 9.8)	6.6 (3.8, 11.4)	9.2 (5.7, 14.7)	
Ascend Flex	Perform	27	1182	0.8 (0.4, 1.6)	2.2 (1.5, 3.4)	2.7 (1.8, 4.1)	3.2 (2.0, 4.9)		
Bigliani/Flatow TM	Bigliani/Flatow	41	481	1.9 (1.0, 3.6)	4.2 (2.7, 6.5)	5.8 (4.0, 8.4)	7.0 (4.9, 9.8)	9.8 (7.1, 13.4)	
Comprehensive	Comprehensive	45	869	3.6 (2.5, 5.1)	4.9 (3.6, 6.6)	5.5 (4.1, 7.3)	5.5 (4.1, 7.3)		
Equinoxe	Equinoxe	55	685	3.2 (2.0, 4.9)	6.2 (4.5, 8.5)	9.9 (7.3, 13.2)	13.2 (9.7, 17.9)		
Global AP	Global	15	372	1.1 (0.4, 2.9)	3.9 (2.2, 6.7)				
Global Unite	Global	26	1158	1.0 (0.6, 1.8)	1.7 (1.1, 2.8)	2.5 (1.6, 3.7)	3.2 (2.1, 4.7)		
SMR	SMR	29	512	2.0 (1.1, 3.7)	4.5 (3.0, 6.7)	4.9 (3.3, 7.2)	5.2 (3.5, 7.6)	6.1 (4.2, 8.8)	7.0 (4.7, 10.3)
	SMR L1	413	2366	6.0 (5.1, 7.0)	11.4 (10.2, 12.8)	13.8 (12.5, 15.4)	16.1 (14.6, 17.7)	20.5 (18.6, 22.6)	26.3 (23.6, 29.3)
Other (5)		1	35	3.4 (0.5, 22.1)					
TOTAL		**672**	**7857**						

Note: Restricted to modern prostheses
Only prostheses with >50 procedures have been listed

Table ST33 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	6	51	8.4 (3.2, 21.0)	11.1 (4.7, 24.9)	14.2 (6.5, 29.3)	14.2 (6.5, 29.3)		
SMR	SMR L1	405	2322	5.9 (5.0, 7.0)	11.4 (10.1, 12.8)	13.7 (12.3, 15.3)	16.0 (14.5, 17.7)	20.5 (18.6, 22.6)	26.4 (23.6, 29.4)
Other (2)		0	3						
TOTAL		**411**	**2376**						

Note: Restricted to modern prostheses
Only prostheses with >10 procedures have been listed

Table ST34 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	18	187	0.0 (0.0, 0.0)	1.7 (0.5, 5.1)	4.5 (2.3, 8.9)	5.8 (3.1, 10.5)	8.4 (5.1, 13.8)	
Ascend Flex	Perform	23	1031	0.7 (0.4, 1.6)	2.2 (1.4, 3.5)	2.8 (1.8, 4.3)	3.2 (2.0, 5.1)		
Bigliani/Flatow TM	Bigliani/Flatow	34	447	1.3 (0.6, 3.0)	3.4 (2.1, 5.6)	5.1 (3.4, 7.7)	6.0 (4.1, 8.8)	8.6 (6.1, 12.3)	
Comprehensive	Comprehensive	45	855	3.6 (2.5, 5.1)	4.9 (3.6, 6.7)	5.5 (4.1, 7.4)	5.5 (4.1, 7.4)		
Equinoxe	Equinoxe	46	606	2.7 (1.6, 4.4)	5.5 (3.8, 7.9)	9.4 (6.7, 13.0)	13.6 (9.6, 19.1)		
Global AP	Global	15	359	1.1 (0.4, 3.0)	4.0 (2.3, 7.0)				
Global Unite	Global	21	1038	0.7 (0.3, 1.5)	1.4 (0.8, 2.4)	2.2 (1.4, 3.5)	2.9 (1.9, 4.6)		
SMR	SMR	27	491	2.1 (1.1, 3.8)	4.2 (2.7, 6.5)	4.7 (3.1, 7.0)	5.0 (3.3, 7.4)	6.0 (4.1, 8.7)	6.8 (4.5, 10.3)
Other (6)		1	35	3.4 (0.5, 22.1)					
TOTAL		**230**	**5049**						

Note: Restricted to modern prostheses
Only prostheses with >50 procedures have been listed

OUTCOME FOR OSTEOARTHRITIS – PATIENT CHARACTERISTICS

There are 7,409 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% (Table ST35).

The most common reasons for revision are rotator cuff insufficiency (37.3%), instability/dislocation (27%), and loosening (14.4%) (Table ST36 and Figure ST18). The most common type of revision is of the humeral component (58.8%) (Table ST37). 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 with retention of the original stem on most occasions (89.3%).

Age and Gender

Patients aged ≥65 years have a lower rate of revision compared to patients aged <55 years (Table ST38 and Figure ST19). Females have a higher rate of revision than males (Table ST39 and Figure ST20).

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 ST40 and Figure ST21). The most common reasons for revision by ASA score are presented in Figure ST22.

The most common BMI categories are pre-obese and obese class 1. BMI is not a risk factor for revision (Table ST41 and Figure ST23). The most common reasons for revision by BMI category are shown in Figure ST24.

Glenoid Morphology

The category of glenoid morphology is not a risk factor for revision (Table ST42 and Figure ST25).

Table ST35 Cumulative Percent Revision of Primary Total Stemmed 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 Stemmed Anatomic	619	7409	3.0 (2.6, 3.4)	5.9 (5.3, 6.4)	7.5 (6.9, 8.2)	9.1 (8.3, 9.9)	12.4 (11.3, 13.6)	17.0 (15.2, 19.0)
TOTAL	**619**	**7409**						

Note: Restricted to modern prostheses

Table ST36 Primary Total Stemmed Anatomic Shoulder Replacement by Reason for Revision (Primary Diagnosis OA)

Reason for Revision	Number	Percent
Rotator Cuff Insufficiency	231	37.3
Instability/Dislocation	167	27.0
Loosening	89	14.4
Infection	29	4.7
Pain	16	2.6
Fracture	15	2.4
Implant Breakage Glenoid Insert	10	1.6
Arthrofibrosis	9	1.5
Lysis	9	1.5
Wear Glenoid Insert	9	1.5
Implant Breakage Glenoid	7	1.1
Malposition	6	1.0
Metal Related Pathology	6	1.0
Incorrect Sizing	5	0.8
Dissociation	5	0.8
Progression Of Disease	1	0.2
Other	5	0.8
TOTAL	**619**	**100.0**

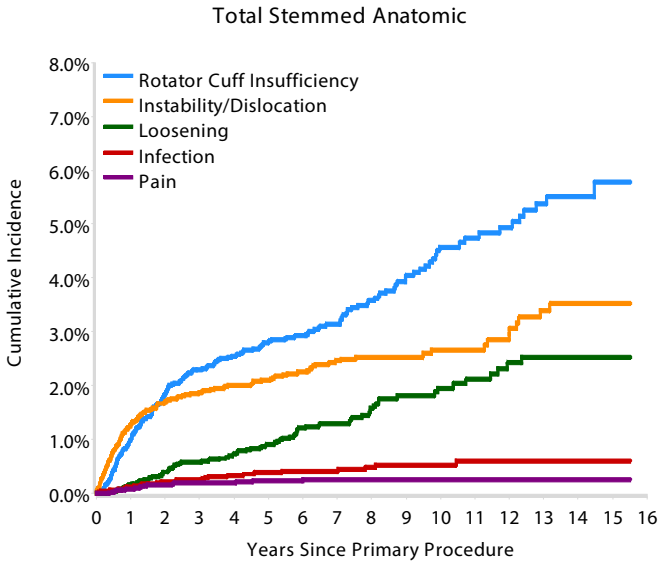
Note: Restricted to modern prostheses

Table ST37 Primary Total Stemmed Anatomic Shoulder Replacement by Type of Revision (Primary Diagnosis OA)

Type of Revision	Number	Percent
Humeral Component	364	58.8
Humeral/Glenoid	180	29.1
Head Only	36	5.8
Glenoid Component	15	2.4
Cement Spacer	14	2.3
Reoperation	3	0.5
Removal of Prostheses	3	0.5
Minor Components	2	0.3
Head/Insert	2	0.3
TOTAL	**619**	**100.0**

Note: Restricted to modern prostheses
Humeral heads are replaced when the humeral component is revised

Figure ST18 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Anatomic Shoulder Replacement (Primary Diagnosis OA)



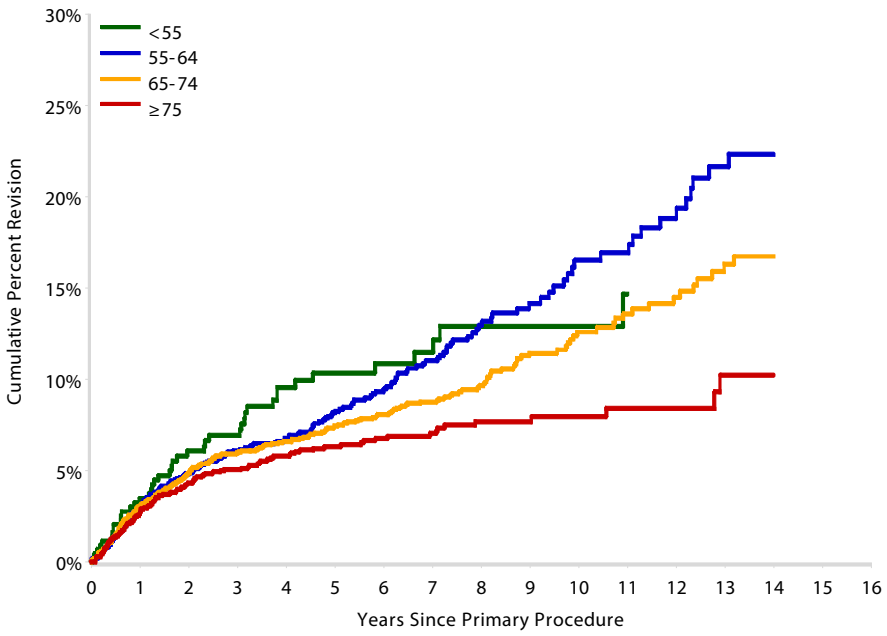
Note: Restricted to modern prostheses

Table ST38 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	47	446	3.5 (2.1, 5.7)	6.9 (4.8, 9.9)	10.4 (7.6, 14.1)	11.5 (8.4, 15.5)	12.9 (9.5, 17.5)	
55–64	187	1892	3.0 (2.3, 3.9)	6.1 (5.1, 7.3)	8.2 (6.9, 9.7)	11.0 (9.4, 12.9)	16.5 (13.9, 19.6)	22.3 (18.4, 26.9)
65–74	274	3298	3.0 (2.5, 3.7)	6.0 (5.2, 6.9)	7.4 (6.5, 8.5)	8.8 (7.7, 10.0)	12.6 (10.9, 14.5)	16.7 (14.1, 19.8)
≥75	111	1773	2.7 (2.0, 3.5)	5.1 (4.1, 6.3)	6.3 (5.2, 7.7)	7.0 (5.8, 8.5)	8.0 (6.5, 9.7)	10.2 (7.6, 13.8)
TOTAL	**619**	**7409**						

Note: Restricted to modern prostheses

Figure ST19 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=0.90 (0.65, 1.24), p=0.509

65-74 vs <55

Entire Period: HR=0.72 (0.52, 0.98), p=0.036

≥75 vs <55

Entire Period: HR=0.53 (0.37, 0.75), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
<55	446	396	299	199	127	60	25
55–64	1892	1689	1309	926	593	224	69
65–74	3298	2987	2377	1668	1073	432	119
≥75	1773	1582	1279	933	612	258	51

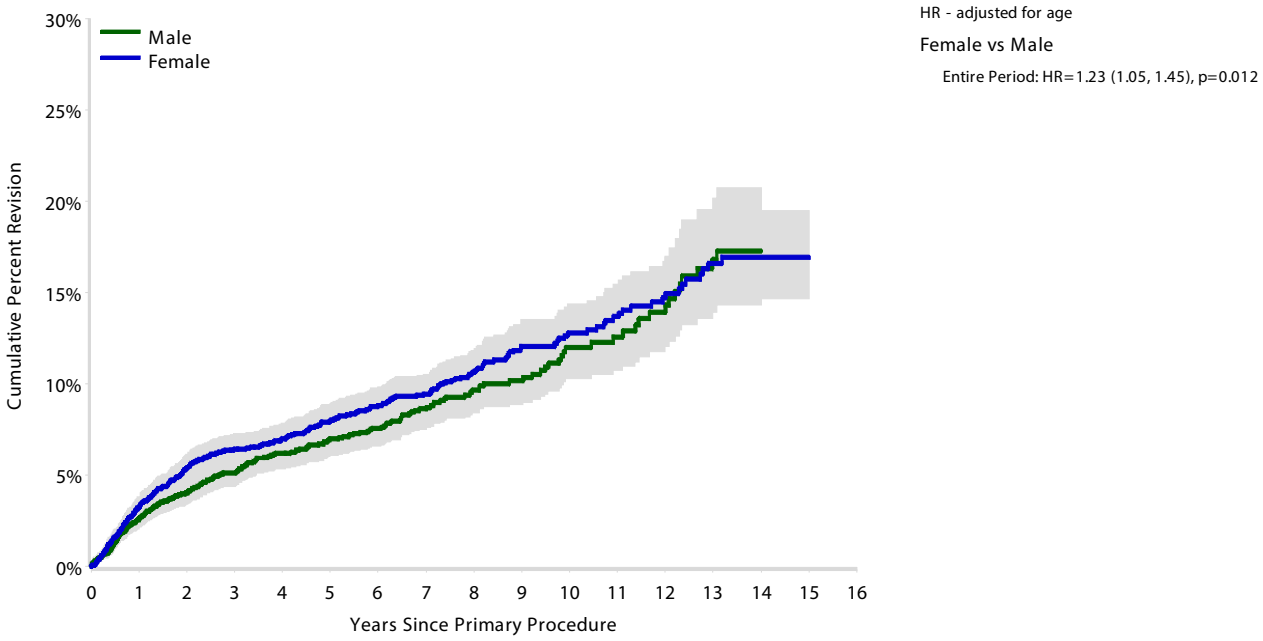
Note: Restricted to modern prostheses

Table ST39 Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement by Gender (Primary Diagnosis OA)

Gender	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Male	254	3309	2.6 (2.1, 3.3)	5.1 (4.4, 6.0)	7.0 (6.1, 8.0)	8.6 (7.5, 9.9)	12.0 (10.3, 13.9)	17.3 (14.3, 20.8)
Female	365	4100	3.2 (2.7, 3.8)	6.4 (5.7, 7.3)	8.0 (7.1, 8.9)	9.4 (8.5, 10.5)	12.8 (11.4, 14.4)	16.9 (14.7, 19.5)
TOTAL	**619**	**7409**						

Note: Restricted to modern prostheses

Figure ST20 Cumulative Percent Revision of Primary Total Stemmed 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	3309	2969	2315	1615	1012	382	100
Female	4100	3685	2949	2111	1393	592	164

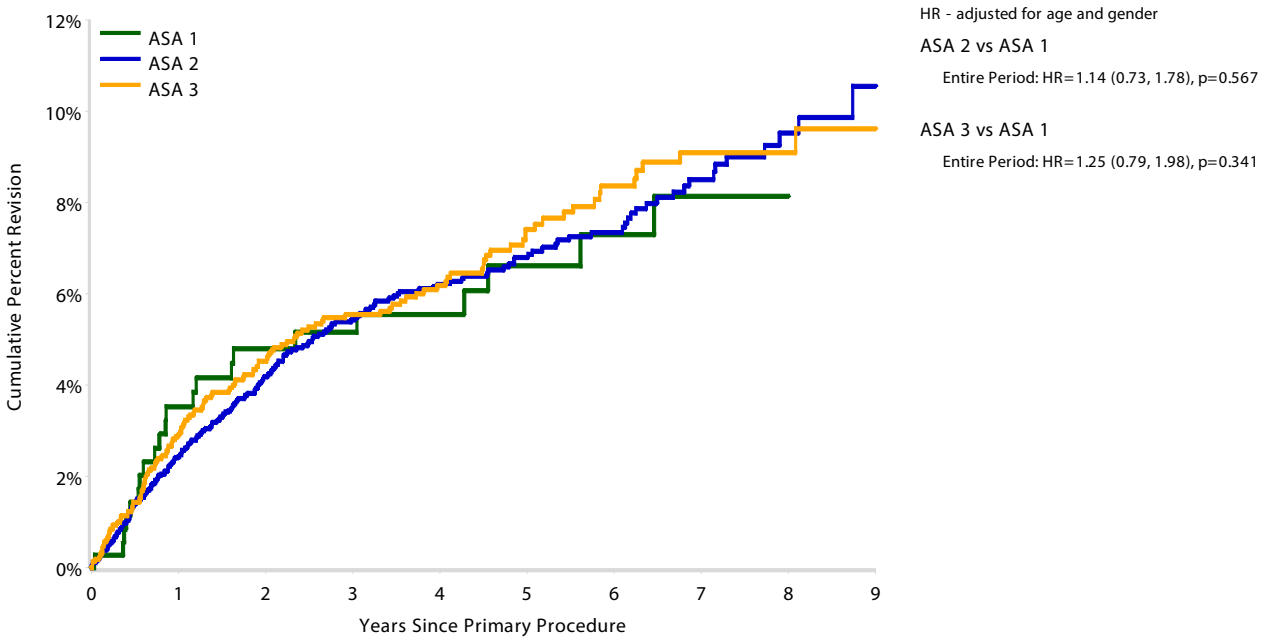
Note: Restricted to modern prostheses

Table ST40 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	22	360	3.5 (2.0, 6.1)	4.8 (3.0, 7.7)	5.2 (3.2, 8.2)	6.6 (4.3, 10.2)	8.1 (5.3, 12.5)	8.1 (5.3, 12.5)
ASA 2	199	3120	2.4 (1.9, 3.1)	4.2 (3.5, 5.0)	5.4 (4.6, 6.4)	6.8 (5.9, 7.9)	8.5 (7.3, 9.9)	9.5 (8.1, 11.2)
ASA 3	136	2139	2.9 (2.3, 3.8)	4.5 (3.7, 5.6)	5.5 (4.6, 6.7)	7.4 (6.2, 8.8)	9.1 (7.6, 10.9)	9.1 (7.6, 10.9)
ASA 4	2	51	4.0 (1.0, 15.1)	4.0 (1.0, 15.1)	4.0 (1.0, 15.1)	4.0 (1.0, 15.1)		
ASA 5	0	1						
TOTAL	**359**	**5671**						

Note: Restricted to modern prostheses

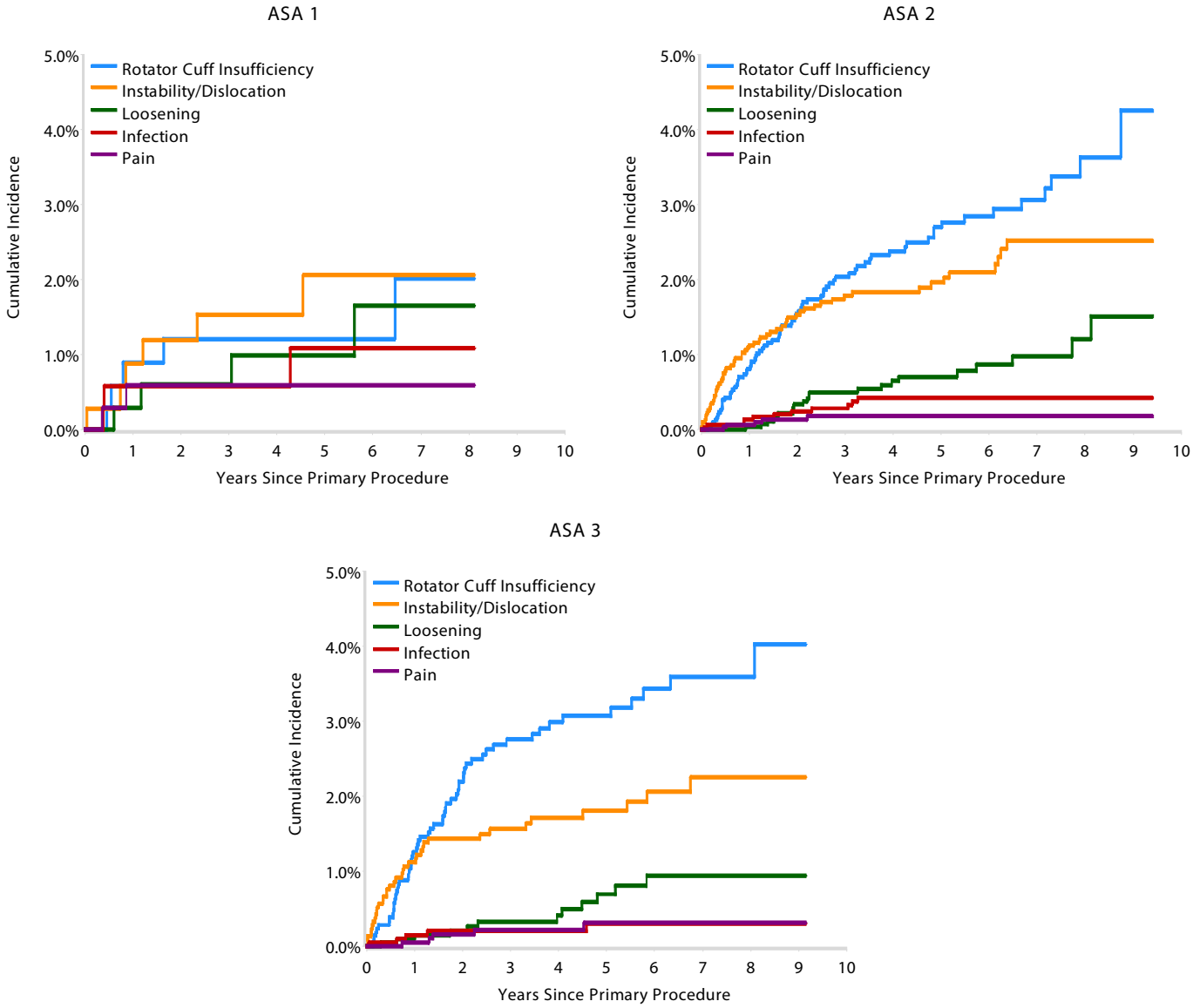
Figure ST21 Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement by ASA Score (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	8 Yrs
ASA 1	360	315	283	243	153	78	43
ASA 2	3120	2792	2424	2073	1297	613	305
ASA 3	2139	1843	1591	1359	796	370	182

Note: Restricted to modern prostheses

Figure ST22 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Anatomic Shoulder Replacement by ASA Score (Primary Diagnosis OA)



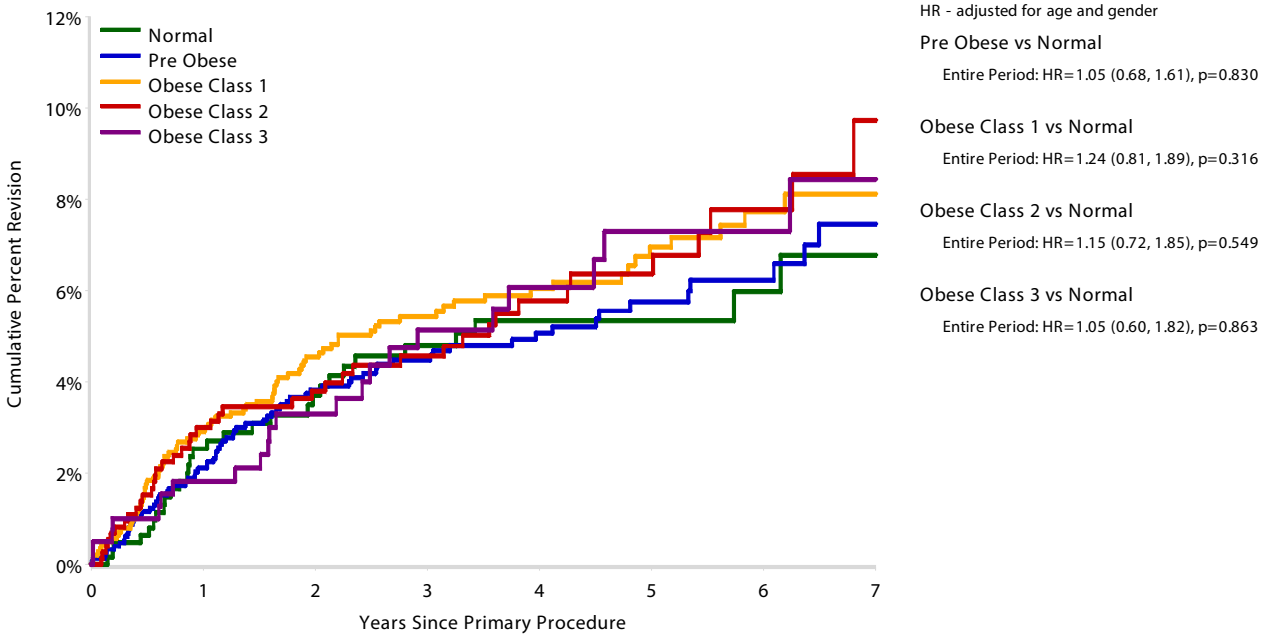
Note: Restricted to modern prostheses

Table ST41 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	0	14	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)			
Normal	30	642	2.5 (1.5, 4.2)	3.7 (2.4, 5.6)	4.8 (3.3, 7.0)	5.4 (3.7, 7.7)	5.4 (3.7, 7.7)	6.0 (4.1, 8.8)
Pre Obese	73	1506	2.1 (1.5, 3.0)	3.8 (2.9, 5.0)	4.5 (3.5, 5.8)	5.1 (4.0, 6.5)	5.8 (4.5, 7.3)	6.2 (4.9, 8.0)
Obese Class 1	82	1403	2.9 (2.1, 4.0)	4.5 (3.5, 5.8)	5.4 (4.3, 6.9)	6.0 (4.8, 7.6)	7.0 (5.5, 8.7)	7.7 (6.1, 9.7)
Obese Class 2	42	745	3.0 (2.0, 4.6)	3.8 (2.6, 5.5)	4.6 (3.2, 6.5)	5.8 (4.1, 8.0)	6.4 (4.6, 8.8)	7.8 (5.6, 10.8)
Obese Class 3	22	398	1.8 (0.9, 3.8)	3.3 (1.9, 5.8)	5.1 (3.2, 8.2)	6.1 (3.9, 9.5)	7.3 (4.7, 11.2)	7.3 (4.7, 11.2)
TOTAL	**249**	**4708**						

Note: Restricted to modern prostheses
BMI has not been presented for patients aged ≤19 years

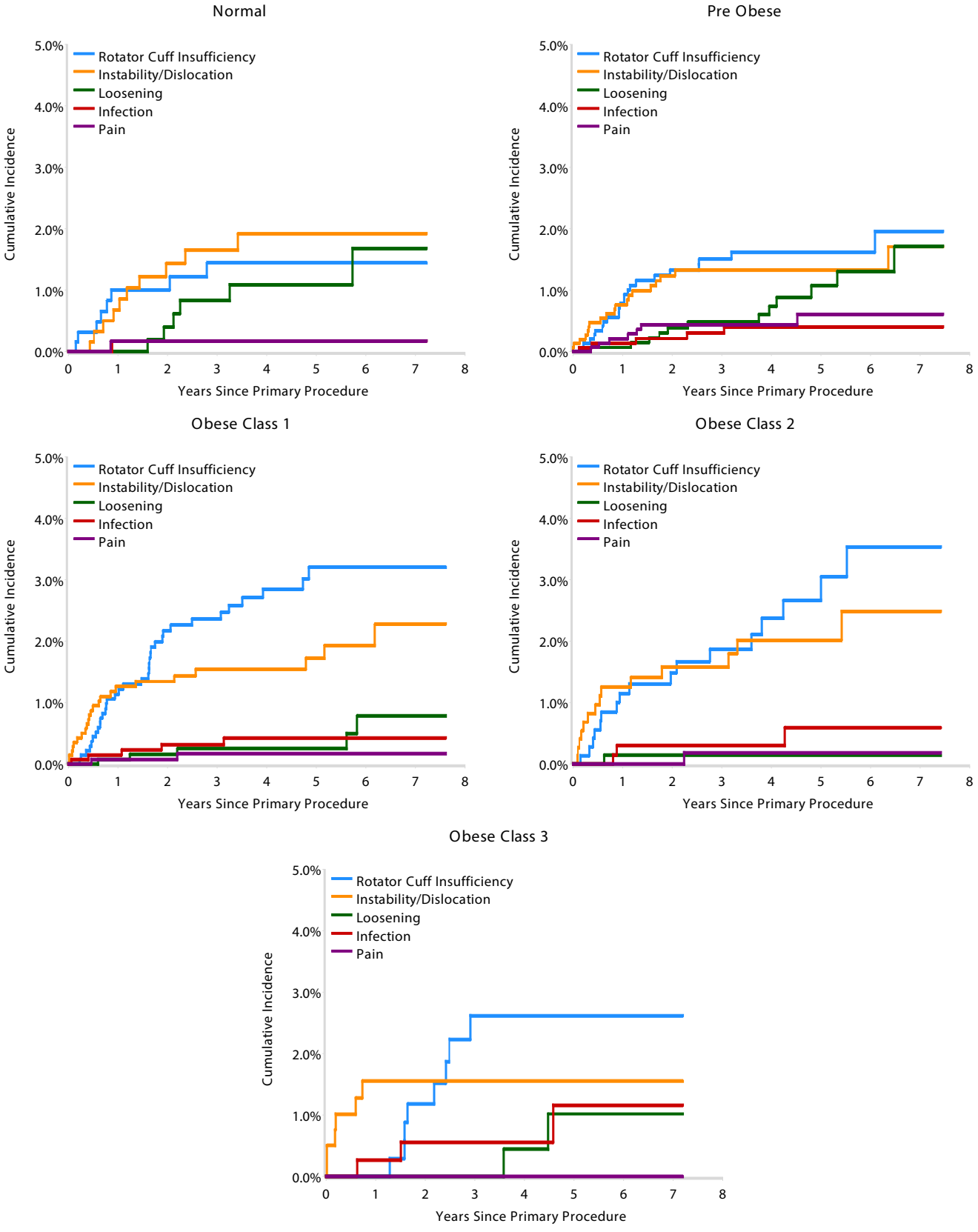
Figure ST23 Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement by BMI Category (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Normal	642	547	453	382	292	200	130
Pre Obese	1506	1318	1118	923	679	457	276
Obese Class 1	1403	1214	1042	858	661	458	270
Obese Class 2	745	637	541	448	339	233	139
Obese Class 3	398	350	297	238	185	131	89

Note: Restricted to modern prostheses
BMI has not been presented for patients aged ≤19 years

Figure ST24 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Anatomic Shoulder Replacement by BMI Category (Primary Diagnosis OA)



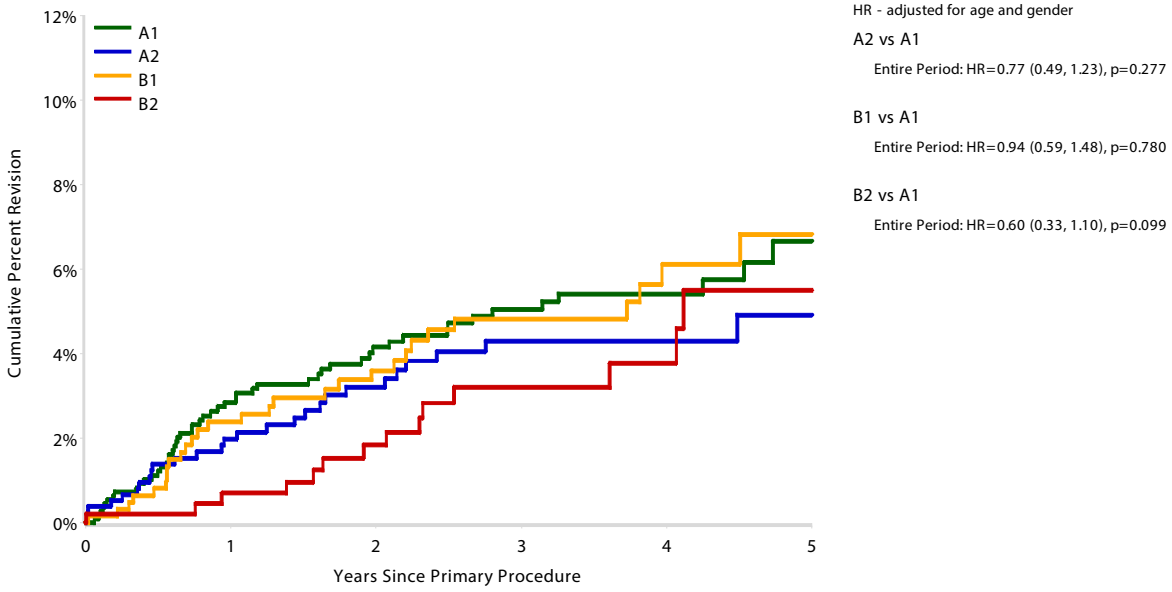
Note: Restricted to modern prostheses
BMI has not been presented for patients aged ≤19 years

Table ST42 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
A1	53	1108	2.9 (2.0, 4.1)	4.2 (3.1, 5.6)	5.1 (3.8, 6.7)	5.4 (4.1, 7.2)
A2	27	756	2.0 (1.2, 3.3)	3.2 (2.1, 4.9)	4.3 (2.9, 6.3)	4.3 (2.9, 6.3)
B1	29	644	2.4 (1.4, 4.0)	3.6 (2.3, 5.5)	4.8 (3.3, 7.1)	6.1 (4.2, 9.0)
B2	14	477	0.7 (0.2, 2.2)	1.8 (0.9, 3.8)	3.2 (1.8, 5.8)	3.8 (2.1, 6.7)
C	3	101	2.1 (0.5, 8.2)	2.1 (0.5, 8.2)	2.1 (0.5, 8.2)	
TOTAL	**126**	**3086**				

Note: Restricted to modern prostheses
Excludes 3 procedures with a recorded glenoid morphology of B3

Figure ST25 Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement by Glenoid Morphology (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs
A1	1108	910	724	547	352
A2	756	627	485	358	223
B1	644	530	426	327	200
B2	477	392	319	228	125

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 ST43 and Figure ST26).

A cemented polyethylene glenoid with a modified central peg has a lower revision rate than other glenoid types.

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.

Cemented all polyethylene glenoids are the most common type of glenoid used. These prostheses have a higher rate of revision compared to modified central peg glenoids. Modified central peg glenoids have a lower rate of revision compared to non-modular metal backed glenoids. Modular metal backed glenoids have a higher rate of revision compared to modified central peg glenoids. (Table ST44 and Figure ST27).

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 ST45 and Figure ST28).

Metal/XLPE bearing surface has a lower rate of revision than metal/non XLPE.

Humeral Heads

Humeral heads >50mm have a lower rate of revision compared to both <44mm and 44–50mm (Table ST46 and Figure ST29). The cumulative incidence revision diagnosis for the most common reasons for humeral head size revision is shown in Figure ST30.

The outcome of the most used prosthesis combinations are listed in Table ST47. The most commonly used cementless prosthesis combinations are listed in Table ST48. The most commonly used prosthesis combinations with hybrid (glenoid cemented) fixation are listed in Table ST49.

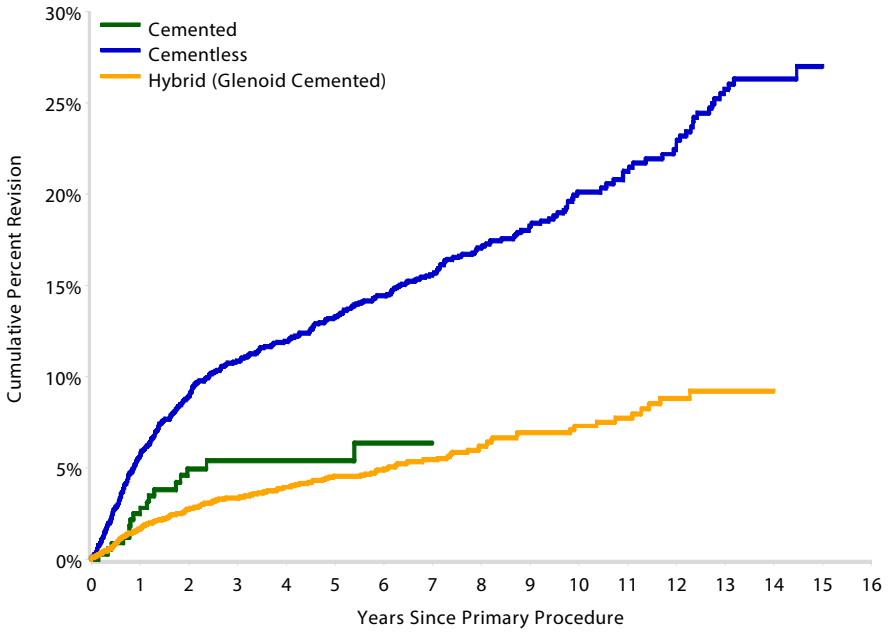
Humeral head sizes <44mm have the highest rate of revision compared to ≥44mm head sizes.

Table ST43 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	19	348	2.5 (1.3, 4.9)	5.4 (3.3, 8.7)	5.4 (3.3, 8.7)	6.4 (3.9, 10.5)		
Cementless	379	2233	5.7 (4.8, 6.7)	10.9 (9.6, 12.3)	13.3 (11.9, 14.8)	15.6 (14.1, 17.3)	20.1 (18.1, 22.3)	26.3 (23.4, 29.5)
Hybrid (Glenoid Cemented)	216	4799	1.7 (1.3, 2.1)	3.4 (2.9, 3.9)	4.6 (3.9, 5.3)	5.4 (4.7, 6.3)	7.3 (6.2, 8.6)	9.2 (7.5, 11.3)
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	**619**	**7409**						

Note: Restricted to modern prostheses

Figure ST26 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=1.51 (0.94, 2.41), p=0.087

Cementless vs Hybrid (Glenoid Cemented)

Entire Period: HR=3.08 (2.60, 3.64), p<0.001

Cementless vs Cemented

Entire Period: HR=2.04 (1.29, 3.25), p=0.002

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Cemented	348	298	194	109	55	18	3
Cementless	2233	2024	1748	1484	1112	453	154
Hybrid (Glenoid Cemented)	4799	4306	3298	2112	1223	495	106

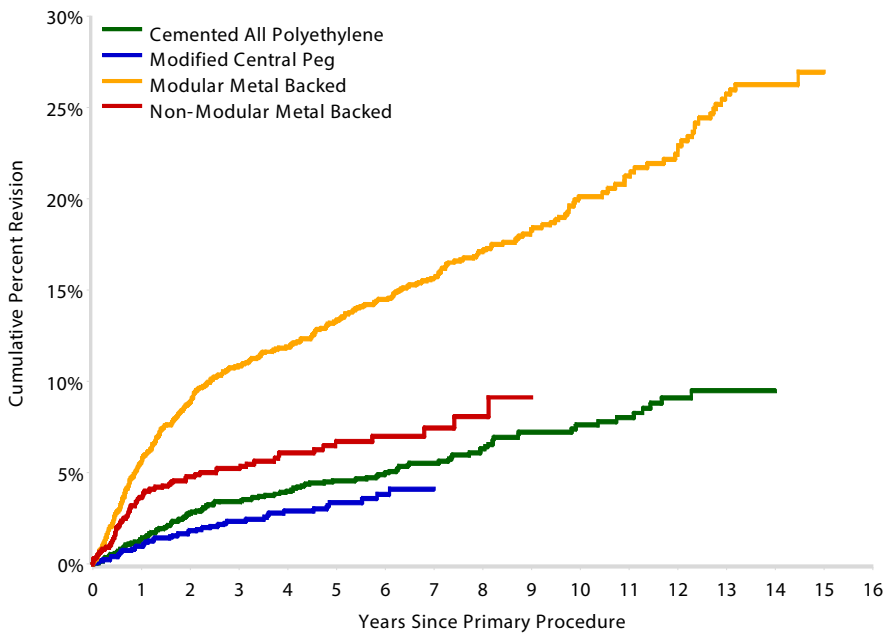
Note: Restricted to modern prostheses

Table ST44 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 Polyethylene	127	2443	1.4 (1.0, 1.9)	3.4 (2.8, 4.3)	4.6 (3.7, 5.6)	5.5 (4.6, 6.7)	7.6 (6.3, 9.2)	9.5 (7.7, 11.7)
Modified Central Peg	42	1516	1.0 (0.6, 1.6)	2.3 (1.7, 3.3)	3.4 (2.4, 4.7)	4.1 (3.0, 5.7)		
Modular Metal Backed	378	2210	5.6 (4.7, 6.7)	10.8 (9.6, 12.3)	13.3 (11.9, 14.9)	15.7 (14.1, 17.4)	20.1 (18.1, 22.3)	26.3 (23.4, 29.4)
Non-Modular Metal Backed	72	1240	3.7 (2.7, 4.9)	5.2 (4.1, 6.7)	6.7 (5.3, 8.5)	7.4 (5.7, 9.6)		
TOTAL	**619**	**7409**						

Note: Restricted to modern prostheses

Figure ST27 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=1.50 (1.06, 2.13), p=0.023

Modular Metal Backed vs Modified Central Peg

Entire Period: HR=4.40 (3.19, 6.08), p<0.001

Non-Modular Metal Backed vs Modified Central Peg

0 - 6Mth: HR=3.26 (1.91, 5.58), p<0.001

6Mth+: HR=1.73 (1.14, 2.63), p=0.009

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Cemented All Polyethylene	2443	2206	1780	1273	926	485	109
Modified Central Peg	1516	1363	992	544	183	0	0
Modular Metal Backed	2210	2013	1742	1478	1111	461	155
Non-Modular Metal Backed	1240	1072	750	431	185	28	0

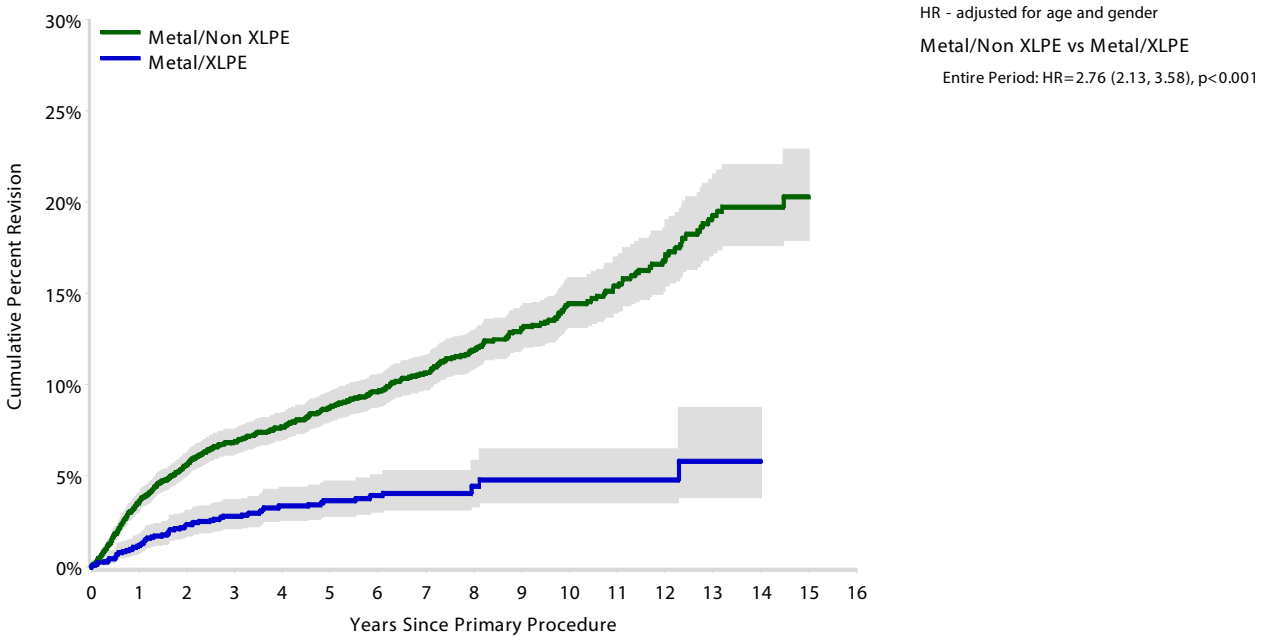
Note: Restricted to modern prostheses

Table ST45 Cumulative Percent Revision of Primary Total Stemmed 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/XLPE	1	1						
Metal/Non XLPE	555	5537	3.5 (3.1, 4.1)	6.9 (6.2, 7.6)	8.8 (8.0, 9.6)	10.6 (9.7, 11.6)	14.5 (13.1, 15.9)	19.7 (17.6, 22.1)
Metal/XLPE	63	1871	1.2 (0.8, 1.9)	2.8 (2.1, 3.7)	3.7 (2.8, 4.7)	4.1 (3.1, 5.3)	4.8 (3.5, 6.5)	5.8 (3.8, 8.8)
TOTAL	**619**	**7409**						

Note: Restricted to modern prostheses

Figure ST28 Cumulative Percent Revision of Primary Total Stemmed Anatomic Shoulder Replacement by Bearing Surface (Primary Diagnosis OA)



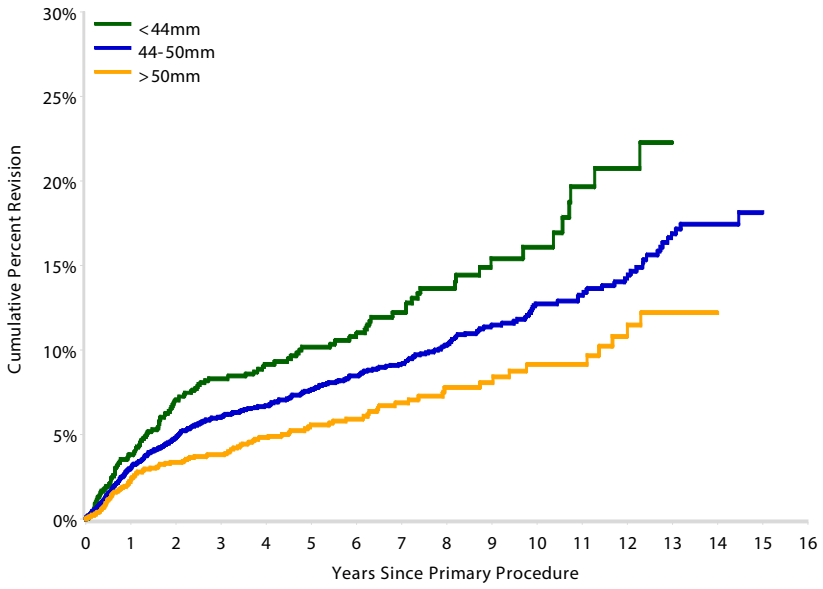
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Metal/Non XLPE	5537	4948	3934	2867	1946	794	207
Metal/XLPE	1871	1705	1330	859	459	180	57

Note: Restricted to modern prostheses

Table ST46 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	118	1090	3.8 (2.8, 5.2)	8.3 (6.7, 10.2)	10.2 (8.4, 12.4)	12.2 (10.1, 14.8)	16.1 (13.0, 19.8)	
44–50mm	399	4584	3.0 (2.6, 3.6)	6.0 (5.4, 6.8)	7.7 (6.9, 8.5)	9.2 (8.3, 10.2)	12.7 (11.4, 14.3)	17.5 (15.2, 20.0)
>50mm	102	1734	2.2 (1.6, 3.1)	3.8 (3.0, 4.9)	5.6 (4.5, 6.9)	6.9 (5.5, 8.5)	9.2 (7.2, 11.6)	12.2 (9.2, 16.0)
TOTAL	**619**	**7408**						

Figure ST29 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=2.11 (1.55, 2.88), p<0.001

<44mm vs 44-50mm

Entire Period: HR=1.39 (1.12, 1.73), p=0.003

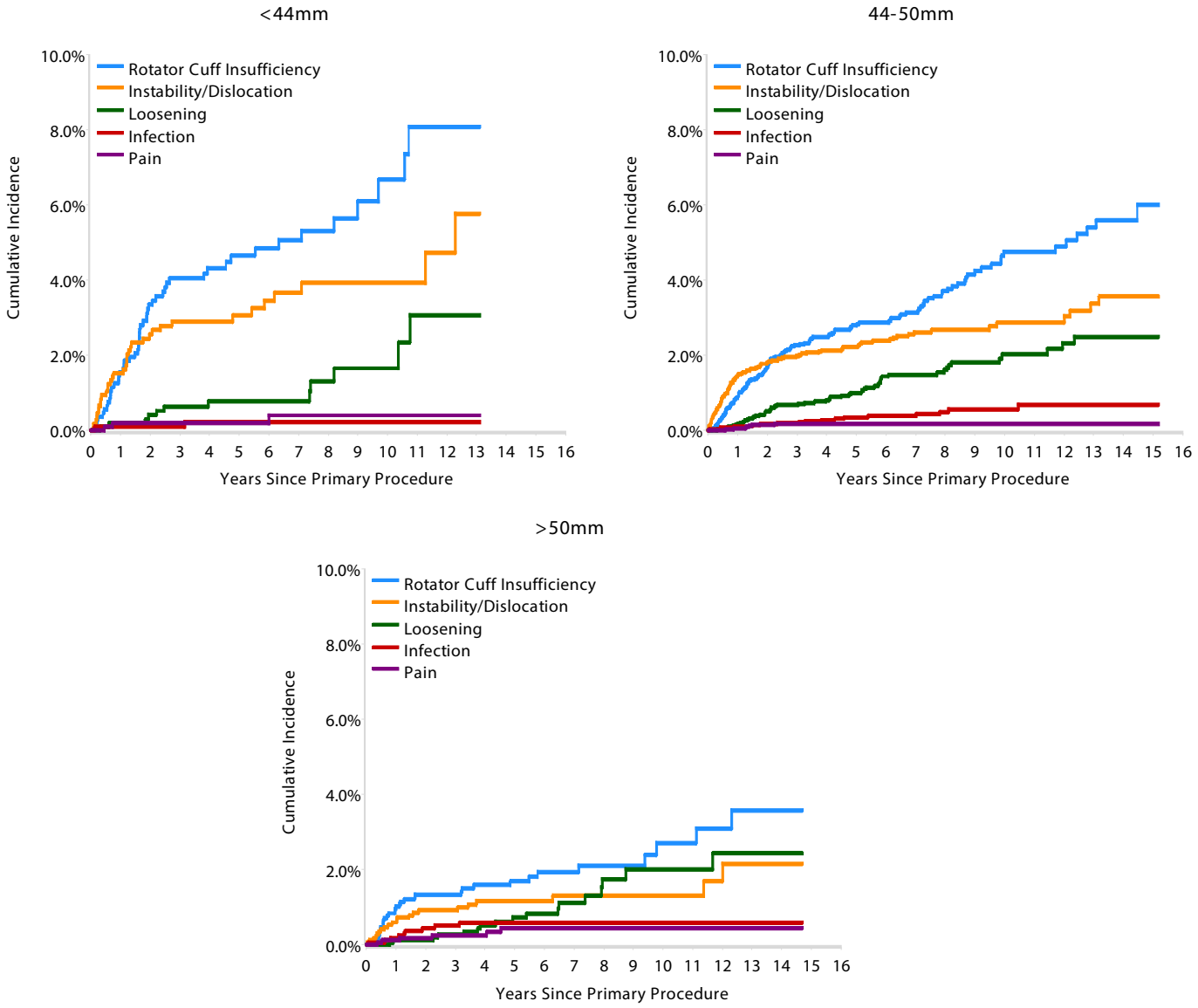
44-50mm vs >50mm

Entire Period: HR=1.52 (1.20, 1.92), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
<44mm	1090	952	726	495	320	110	25
44–50mm	4584	4132	3324	2403	1583	639	177
>50mm	1734	1569	1214	828	502	225	62

Note: Restricted to modern prostheses

Figure ST30 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Anatomic Shoulder Replacement by Humeral Head Size (Primary Diagnosis OA)



Note: Restricted to modern prostheses

Table ST47 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	19	187	0.0 (0.0, 0.0)	2.2 (0.8, 5.8)	5.1 (2.7, 9.6)	6.4 (3.6, 11.2)	9.1 (5.6, 14.6)	
Ascend Flex	Perform	24	1113	0.9 (0.5, 1.7)	2.1 (1.4, 3.3)	2.5 (1.6, 3.9)	3.0 (1.8, 4.7)		
Bigliani/Flatow TM	Bigliani/Flatow	35	453	1.8 (0.9, 3.5)	4.3 (2.7, 6.6)	5.5 (3.7, 8.1)	6.7 (4.7, 9.6)	8.8 (6.2, 12.3)	
Comprehensive	Comprehensive	44	826	3.6 (2.5, 5.2)	5.0 (3.7, 6.8)	5.6 (4.2, 7.6)	5.6 (4.2, 7.6)		
Equinoxe	Equinoxe	52	656	3.3 (2.1, 5.1)	6.1 (4.4, 8.5)	9.6 (7.1, 13.0)	13.1 (9.5, 17.9)		
Global AP	Global	15	352	1.2 (0.4, 3.1)	4.1 (2.3, 7.1)				
Global Unite	Global	23	1090	0.8 (0.4, 1.6)	1.6 (0.9, 2.6)	2.3 (1.5, 3.6)	3.1 (2.0, 4.7)		
SMR	SMR	28	490	2.1 (1.1, 3.8)	4.6 (3.1, 7.0)	5.1 (3.4, 7.5)	5.4 (3.7, 7.9)	6.1 (4.2, 8.8)	7.0 (4.6, 10.5)
	SMR L1	378	2210	5.6 (4.7, 6.7)	10.8 (9.6, 12.3)	13.3 (11.9, 14.9)	15.7 (14.1, 17.4)	20.1 (18.1, 22.3)	26.3 (23.4, 29.4)
Other (5)		1	32	3.7 (0.5, 23.5)					
TOTAL		**619**	**7409**						

Note: Restricted to modern prostheses
Only prostheses with >50 procedures have been listed

Table ST48 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	6	50	8.6 (3.3, 21.4)	11.4 (4.9, 25.4)	14.5 (6.7, 30.0)	14.5 (6.7, 30.0)		
SMR	SMR L1	373	2180	5.6 (4.7, 6.7)	10.9 (9.6, 12.3)	13.2 (11.8, 14.8)	15.6 (14.1, 17.3)	20.1 (18.2, 22.3)	26.4 (23.5, 29.5)
Other (2)		0	3						
TOTAL		**379**	**2233**						

Note: Restricted to modern prostheses
Only prostheses with >10 procedures have been listed

Table ST49 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	18	180	0.0 (0.0, 0.0)	1.7 (0.6, 5.2)	4.7 (2.4, 9.2)	6.0 (3.3, 10.8)	8.7 (5.2, 14.3)	
Ascend Flex	Perform	20	977	0.8 (0.4, 1.6)	2.1 (1.3, 3.4)	2.5 (1.5, 4.0)	2.9 (1.8, 4.9)		
Bigliani/Flatow TM	Bigliani/Flatow	28	422	1.2 (0.5, 2.8)	3.4 (2.0, 5.6)	4.7 (3.0, 7.3)	5.7 (3.8, 8.5)	7.5 (5.1, 11.0)	
Comprehensive	Comprehensive	44	816	3.7 (2.6, 5.2)	5.1 (3.7, 6.9)	5.7 (4.2, 7.7)	5.7 (4.2, 7.7)		
Equinoxe	Equinoxe	44	579	2.8 (1.7, 4.6)	5.5 (3.8, 8.0)	9.3 (6.6, 13.0)	13.6 (9.5, 19.2)		
Global AP	Global	15	340	1.2 (0.5, 3.2)	4.2 (2.4, 7.4)				
Global Unite	Global	20	981	0.6 (0.3, 1.4)	1.4 (0.8, 2.4)	2.2 (1.4, 3.5)	3.0 (1.9, 4.7)		
SMR	SMR	26	473	2.1 (1.2, 4.0)	4.4 (2.8, 6.7)	4.9 (3.2, 7.3)	5.1 (3.4, 7.7)	5.9 (4.0, 8.6)	6.8 (4.4, 10.4)
Other (5)		1	31	3.8 (0.6, 24.3)					
TOTAL		**216**	**4799**						

Note: Restricted to modern prostheses
Only prostheses with >50 procedures have been listed

Primary Total Stemmed Reverse Shoulder Replacement

DEMOGRAPHICS

There are 49,230 primary total stemmed reverse shoulder replacement procedures. This is an increase of 6,717 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 ST31).

Primary total stemmed reverse shoulder replacement is more commonly undertaken in females, with females older on average than males (Table ST50).

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 ST32).

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 ST33).

The most commonly used humeral stems are listed in Table ST51. The most used glenoid prostheses are listed in Table ST52.

The most common primary diagnoses are osteoarthritis, rotator cuff arthropathy, and fracture.

Figure ST31 Primary Total Stemmed Reverse Shoulder Replacement by Primary Diagnosis

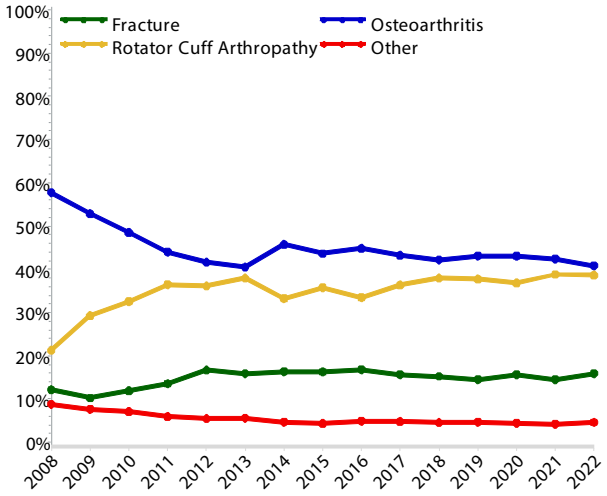


Table ST50 Age and Gender of Primary Total Stemmed Reverse Shoulder Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	18589	37.8%	14	96	73	72.1	8.3
Female	30641	62.2%	13	102	75	74.6	8.0
TOTAL	**49230**	**100.0%**	**13**	**102**	**74**	**73.7**	**8.2**

Figure ST32 Primary Total Stemmed Reverse Shoulder Replacement by Age

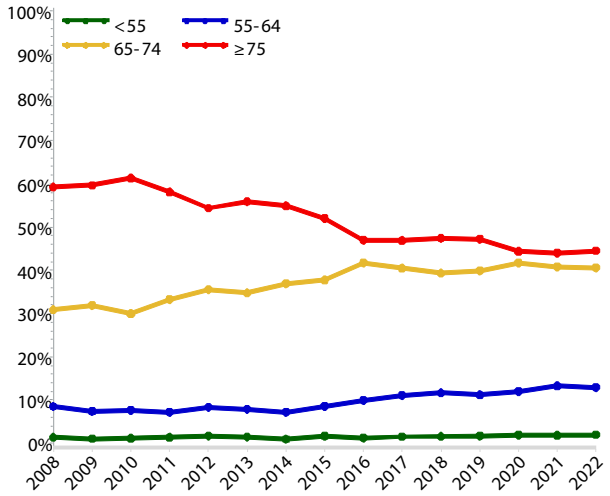


Figure ST33 Total Stemmed Reverse Shoulder Replacement by Fixation

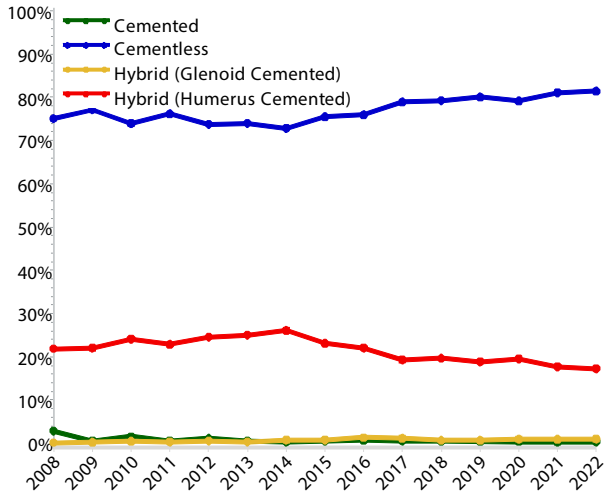


Table ST51 10 Most Used Humeral Stem Prostheses in Primary Total Stemmed Reverse Shoulder Replacement

2008		2019		2020		2021		2022	
N	Model	N	Model	N	Model	N	Model	N	Model
263	SMR	1107	SMR	1058	SMR	1229	SMR	1227	Comprehensive
252	Delta Xtend	978	Delta Xtend	855	Equinoxe	1066	Comprehensive	1079	SMR
76	Aequalis	675	Equinoxe	798	Comprehensive	953	Equinoxe	1017	Equinoxe
42	Trabecular Metal	647	Comprehensive	778	Delta Xtend	759	Ascend Flex	875	Ascend Flex
21	Delta CTA	484	Ascend Flex	581	Ascend Flex	711	Delta Xtend	668	Delta Xtend
2	Custom Made (Lima)	405	RSP	361	Aequalis	536	AltiVate Reverse	535	AltiVate Reverse
1	Generic Humeral Stem	380	Aequalis	333	Affinis	342	Aequalis	375	Aequalis
1	Promos	346	Affinis	280	RSP	293	Affinis	182	Global Unite
		180	Trabecular Metal	255	AltiVate Reverse	246	Global Unite	144	Trabecular Metal
		160	Global Unite	190	Global Unite	174	RSP	141	Affinis
10 Most Used									
658	(8) 100.0%	5362	(10) 97.5%	5489	(10) 96.1%	6309	(10) 96.2%	6243	(10) 96.7%
Remainder									
0	(0) 0%	137	(5) 2.5%	221	(7) 3.9%	252	(8) 3.8%	215	(7) 3.3%
TOTAL									
658	(8) 100.0%	5499	(15) 100.0%	5710	(17) 100.0%	6561	(18) 100.0%	6458	(17) 100.0%

Table ST52 10 Most Used Glenoid Prostheses in Primary Total Stemmed Reverse Shoulder Replacement

2008		2019		2020		2021		2022	
N	Model	N	Model	N	Model	N	Model	N	Model
264	SMR L1	1137	Delta Xtend	1009	SMR L1	1186	SMR L1	1269	Comprehensive Reverse
252	Delta Xtend	1055	SMR L1	966	Delta Xtend	1112	Comprehensive Reverse	1016	Equinoxe
76	Aequalis	763	Aequalis	855	Equinoxe	956	Delta Xtend	996	SMR L1
42	Trabecular Metal	690	Comprehensive Reverse	819	Comprehensive Reverse	951	Equinoxe	893	Aequalis
21	Delta CTA	675	Equinoxe	799	Aequalis	916	Aequalis	851	Delta Xtend
1	Generic Metaglene	484	RSP	536	RSP	733	RSP	671	RSP
1	Promos	346	Affinis	333	Affinis	292	Affinis	378	Perform Reversed
1	SMR	136	Trabecular Metal	145	Perform Reversed	199	Perform Reversed	140	Affinis
		101	Perform Reversed	142	Trabecular Metal	114	Trabecular Metal	95	Trabecular Metal
		34	SMR Axioma	37	MSS	32	SMR Axioma	42	MSS
10 Most Used									
658	(8) 100.0%	5421	(10) 98.6%	5641	(10) 98.8%	6491	(10) 98.9%	6351	(10) 98.3%
Remainder									
0	(0) 0%	78	(6) 1.4%	69	(7) 1.2%	70	(8) 1.1%	107	(7) 1.7%
TOTAL									
658	(8) 100.0%	5499	(16) 100.0%	5710	(17) 100.0%	6561	(18) 100.0%	6458	(17) 100.0%

OUTCOME FOR ALL DIAGNOSES

Primary Diagnosis

In order to keep Registry data contemporaneous, only procedures using prostheses that have been available and used in 2022 (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 ST53 and Figure ST34).

Reason for Revision

The main reasons for revision are instability/dislocation, infection, loosening, and fracture (Table ST54 and Figure ST35).

Type of Revision

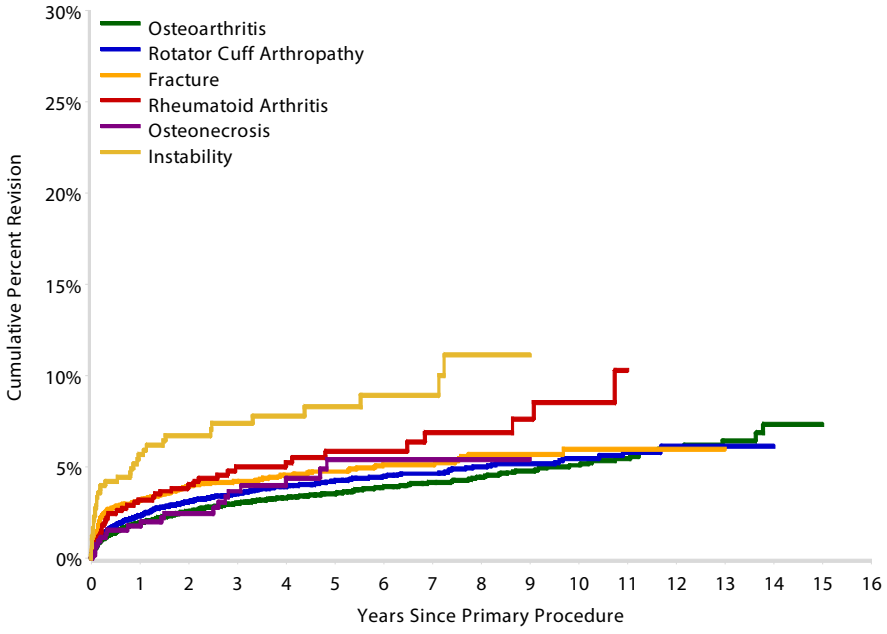
The most common types of revision involve replacement of the humeral component, replacement of the cup/head, cup only, and replacement of the humeral head only (Table ST55).

Table ST53 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	660	20450	1.9 (1.7, 2.1)	3.0 (2.8, 3.3)	3.5 (3.3, 3.8)	4.1 (3.8, 4.5)	5.1 (4.6, 5.7)	7.3 (5.9, 9.1)
Rotator Cuff Arthropathy	626	17343	2.3 (2.1, 2.6)	3.6 (3.3, 3.9)	4.2 (3.9, 4.6)	4.6 (4.3, 5.1)	5.5 (4.9, 6.1)	6.1 (5.2, 7.2)
Fracture	304	7204	3.2 (2.8, 3.6)	4.2 (3.7, 4.7)	4.8 (4.2, 5.3)	5.1 (4.6, 5.8)	6.0 (5.1, 7.1)	
Rheumatoid Arthritis	43	788	3.2 (2.2, 4.7)	5.0 (3.6, 7.0)	5.9 (4.2, 8.1)	6.9 (4.9, 9.6)	8.6 (5.8, 12.5)	
Osteonecrosis	20	522	1.8 (0.9, 3.4)	3.7 (2.2, 6.0)	5.4 (3.4, 8.5)	5.4 (3.4, 8.5)		
Instability	38	479	5.7 (3.9, 8.2)	7.4 (5.3, 10.4)	8.3 (5.9, 11.5)	8.9 (6.4, 12.5)		
Other (3)	37	465	4.0 (2.5, 6.4)	8.1 (5.6, 11.7)	9.9 (6.9, 14.2)	11.3 (7.6, 16.6)		
TOTAL	**1728**	**47251**						

Note: Only primary diagnoses with >300 procedures have been listed
Restricted to modern prostheses

Figure ST34 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 (1.00, 1.25), p=0.047

Fracture vs Osteoarthritis
0 - 3Mth: HR=2.70 (2.24, 3.25), p<0.001
3Mth+: HR=1.11 (0.91, 1.35), p=0.300

Rheumatoid Arthritis vs Osteoarthritis
Entire Period: HR=1.66 (1.22, 2.27), p=0.001

Osteonecrosis vs Osteoarthritis
Entire Period: HR=1.22 (0.78, 1.91), p=0.374

Instability vs Osteoarthritis
0 - 3Mth: HR=3.50 (2.20, 5.56), p<0.001
3Mth+: HR=1.86 (1.18, 2.94), p=0.007

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Osteoarthritis	20450	17270	11544	6912	3626	1185	167
Rotator Cuff Arthropathy	17343	14350	9276	5197	2704	782	66
Fracture	7204	5801	3688	2107	1042	265	35
Rheumatoid Arthritis	788	647	447	271	176	67	11
Osteonecrosis	522	444	307	178	81	26	8
Instability	479	374	252	156	88	32	5

Note: Only primary diagnoses with >300 procedures have been listed
Restricted to modern prostheses

Table ST54 Primary Total Stemmed Reverse Shoulder Replacement by Reason for Revision (All Diagnoses)

Reason for Revision	Number	Percent
Instability/Dislocation	564	32.6
Infection	436	25.2
Loosening	279	16.1
Fracture	191	11.1
Dissociation	61	3.5
Pain	35	2.0
Lysis	22	1.3
Malposition	20	1.2
Arthrofibrosis	18	1.0
Implant Breakage Glenoid	13	0.8
Incorrect Sizing	12	0.7
Metal Related Pathology	12	0.7
Rotator Cuff Insufficiency	6	0.3
Heterotopic Bone	6	0.3
Wear Humeral Cup	5	0.3
Tumour	4	0.2
Implant Breakage Humeral	3	0.2
Implant Breakage Glenoid Insert	2	0.1
Wear Glenoid Insert	1	0.1
Glenoid Erosion	1	0.1
Other	37	2.1
TOTAL	**1728**	**100.0**

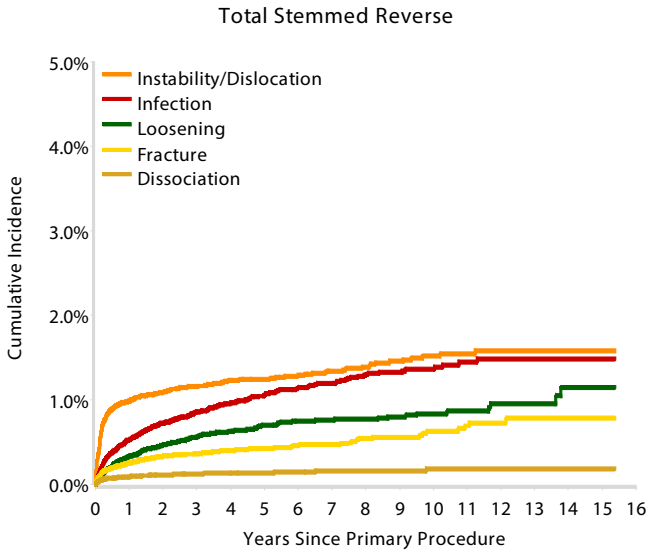
Note: Restricted to modern prostheses

Table ST55 Primary Total Stemmed Reverse Shoulder Replacement by Type of Revision (All Diagnoses)

Type of Revision	Number	Percent
Humeral Component	422	24.4
Cup/Head	337	19.5
Cup Only	303	17.5
Humeral Head Only	165	9.5
Humeral/Glenoid	146	8.4
Cement Spacer	146	8.4
Glenoid Component	128	7.4
Removal of Prostheses	31	1.8
Minor Components	12	0.7
Glenosphere Only	11	0.6
Reoperation	11	0.6
Cement Only	11	0.6
Reinsertion of Components	3	0.2
Head/Insert	2	0.1
TOTAL	**1728**	**100.0**

Note: Restricted to modern prostheses

Figure ST35 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Reverse Shoulder Replacement (All Diagnoses)



Note: Restricted to modern prostheses

PROSTHESIS TYPES

The outcomes of humeral stem and glenoid prosthesis combinations used in primary total stemmed reverse shoulder replacement 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 (humerus cemented) fixation are listed in Table ST58.

Table ST56 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	178	4077	2.1 (1.7, 2.6)	3.4 (2.9, 4.0)	4.3 (3.7, 5.0)	5.0 (4.2, 5.8)	6.5 (5.5, 7.7)	
	Perform Reversed	1	209	0.0 (0.0, 0.0)	0.7 (0.1, 5.1)				
Affinis	Affinis	62	1868	1.8 (1.3, 2.5)	3.5 (2.7, 4.6)	4.0 (3.1, 5.2)	5.0 (3.2, 7.6)		
AltiVate	RSP	1	56	1.8 (0.3, 12.0)					
AltiVate Reverse	RSP	33	1410	2.1 (1.5, 3.1)	3.2 (2.1, 4.7)				
Ascend Flex	Aequalis	95	2840	2.4 (1.9, 3.1)	4.1 (3.3, 5.0)	4.7 (3.7, 5.9)	4.7 (3.7, 5.9)		
	Perform Reversed	14	620	2.5 (1.4, 4.4)	3.1 (1.8, 5.3)				
Comprehensive	Comprehensive Reverse	88	4902	1.3 (1.0, 1.7)	2.0 (1.6, 2.5)	2.6 (2.0, 3.3)	3.0 (2.1, 4.1)		
	Custom Made (Comprehensive)	5	67	6.1 (2.3, 15.5)	6.1 (2.3, 15.5)	8.5 (3.5, 19.5)			
	Trabecular Metal	2	80	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	7.9 (2.0, 28.1)			
Delta Xtend	Delta Xtend	414	10745	2.2 (1.9, 2.5)	3.2 (2.9, 3.6)	3.8 (3.4, 4.2)	4.3 (3.8, 4.7)	5.1 (4.6, 5.7)	7.0 (5.5, 8.9)
Equinoxe	Equinoxe	152	4649	2.2 (1.8, 2.7)	3.6 (3.0, 4.2)	4.5 (3.8, 5.4)	5.8 (4.4, 7.5)		
Global Unite	Delta Xtend	34	1230	1.4 (0.8, 2.2)	2.8 (1.9, 4.0)	3.5 (2.4, 5.0)	4.2 (2.8, 6.3)		
MSS	MSS	3	134	1.1 (0.2, 7.5)					
Mets	Mets	22	131	11.6 (7.0, 18.9)	17.0 (10.9, 26.1)				
RSP	RSP	69	1735	2.8 (2.1, 3.7)	4.0 (3.1, 5.0)	4.5 (3.5, 5.7)			
SMR	Custom Made (Lima)	5	67	4.7 (1.5, 14.1)	6.9 (2.6, 17.6)				
	SMR Axioma	11	178	4.1 (2.0, 8.5)	8.2 (4.5, 14.9)				
	SMR L1	422	9984	3.0 (2.7, 3.4)	4.1 (3.7, 4.5)	4.4 (4.0, 4.9)	4.9 (4.4, 5.4)	5.6 (4.9, 6.3)	6.7 (5.5, 8.1)
Trabecular Metal	Comprehensive Reverse	16	313	4.3 (2.5, 7.3)	6.1 (3.7, 10.0)				
	Trabecular Metal	93	1827	2.8 (2.1, 3.6)	4.4 (3.5, 5.5)	5.2 (4.2, 6.4)	5.5 (4.5, 6.7)	6.2 (4.9, 7.8)	
Other (17)		8	129	7.5 (3.6, 15.4)					
TOTAL		**1728**	**47251**						

Note: Restricted to modern prostheses
Only prostheses with >50 procedures have been listed

Table ST57 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	118	2344	2.1 (1.6, 2.8)	3.8 (3.0, 4.7)	4.7 (3.9, 5.8)	5.5 (4.5, 6.7)	7.1 (5.7, 8.7)	
	Perform Reversed	0	136	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)				
Affinis	Affinis	33	896	1.6 (1.0, 2.7)	3.7 (2.6, 5.4)	4.4 (3.1, 6.3)			
AltiVate	RSP	1	52	1.9 (0.3, 12.9)					
AltiVate Reverse	RSP	26	1145	2.1 (1.3, 3.2)	3.0 (1.9, 4.7)				
Ascend Flex	Aequalis	87	2489	2.4 (1.8, 3.1)	4.3 (3.4, 5.3)	5.0 (3.9, 6.3)	5.0 (3.9, 6.3)		
	Perform Reversed	11	550	2.3 (1.2, 4.3)	2.7 (1.5, 4.8)				
Comprehensive	Comprehensive Reverse	69	4143	1.2 (0.9, 1.6)	1.9 (1.5, 2.5)	2.3 (1.8, 3.1)	2.8 (1.9, 4.2)		
	Custom Made (Comprehensive)	3	61	3.3 (0.8, 12.6)	3.3 (0.8, 12.6)	5.9 (1.9, 17.5)			
	Trabecular Metal	2	67	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	9.4 (2.4, 32.7)			
Delta Xtend	Delta Xtend	285	7529	2.0 (1.7, 2.4)	3.1 (2.8, 3.6)	3.7 (3.3, 4.2)	4.2 (3.7, 4.8)	5.2 (4.5, 5.9)	8.2 (5.7, 11.7)
Equinoxe	Equinoxe	124	4053	2.1 (1.7, 2.6)	3.2 (2.7, 3.9)	4.2 (3.4, 5.1)	5.7 (4.2, 7.7)		
Global Unite	Delta Xtend	23	818	1.3 (0.7, 2.3)	2.6 (1.6, 4.2)	3.5 (2.2, 5.4)	4.0 (2.5, 6.3)		
MSS	MSS	3	130	1.1 (0.2, 7.7)					
RSP	RSP	47	1361	2.6 (1.8, 3.6)	3.4 (2.5, 4.6)	3.8 (2.9, 5.1)			
SMR	Custom Made (Lima)	5	65	4.8 (1.6, 14.3)	7.0 (2.7, 17.8)				
	SMR Axioma	9	173	3.7 (1.7, 8.0)	7.0 (3.5, 13.5)				
	SMR L1	393	9481	2.9 (2.6, 3.3)	3.9 (3.6, 4.4)	4.3 (3.9, 4.8)	4.8 (4.3, 5.3)	5.5 (4.9, 6.3)	6.7 (5.5, 8.3)
Trabecular Metal	Comprehensive Reverse	12	234	4.0 (2.1, 7.5)	6.1 (3.4, 10.7)				
	Trabecular Metal	77	1467	3.0 (2.2, 4.0)	4.5 (3.5, 5.7)	5.3 (4.2, 6.6)	5.5 (4.4, 6.9)	6.4 (5.0, 8.2)	
Other (15)		8	115	8.5 (4.0, 17.4)					
TOTAL		**1336**	**37309**						

Note: Restricted to modern prostheses
Only prostheses with >50 procedures have been listed

Table ST58 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	60	1689	2.0 (1.4, 2.8)	2.9 (2.2, 3.9)	3.7 (2.8, 4.9)	4.2 (3.2, 5.5)	5.7 (4.2, 7.8)	
	Perform Reversed	1	73	0.0 (0.0, 0.0)	2.9 (0.4, 19.1)				
Affinis	Affinis	27	915	2.0 (1.3, 3.2)	3.3 (2.2, 4.8)	3.5 (2.4, 5.1)			
AltiVate Reverse	RSP	6	238	2.3 (1.0, 5.6)					
Ascend Flex	Aequalis	7	330	2.3 (1.1, 4.7)	2.3 (1.1, 4.7)				
	Perform Reversed	2	67	2.7 (0.4, 17.7)	5.8 (1.5, 21.5)				
Comprehensive	Comprehensive Reverse	18	709	2.1 (1.2, 3.5)	2.6 (1.6, 4.3)	3.8 (2.2, 6.4)			
Delta Xtend	Delta Xtend	124	3110	2.6 (2.1, 3.3)	3.4 (2.8, 4.1)	3.9 (3.2, 4.6)	4.3 (3.6, 5.2)	5.0 (4.1, 6.1)	5.5 (4.3, 7.0)
Equinoxe	Equinoxe	27	560	3.4 (2.1, 5.5)	6.2 (4.2, 9.1)	7.1 (4.7, 10.8)			
Global Unite	Delta Xtend	10	380	1.4 (0.6, 3.2)	2.9 (1.5, 5.6)	2.9 (1.5, 5.6)			
Mets	Mets	21	125	12.1 (7.4, 19.7)	17.9 (11.4, 27.5)				
RSP	RSP	22	345	4.1 (2.5, 6.8)	6.5 (4.3, 9.8)	7.2 (4.7, 10.9)			
SMR	SMR L1	18	364	3.8 (2.2, 6.5)	5.7 (3.6, 8.9)	5.7 (3.6, 8.9)	5.7 (3.6, 8.9)		
Trabecular Metal	Comprehensive Reverse	4	74	5.5 (2.1, 14.1)	5.5 (2.1, 14.1)				
	Trabecular Metal	14	328	1.9 (0.9, 4.2)	3.9 (2.1, 6.9)	4.9 (2.8, 8.4)	5.7 (3.3, 9.6)		
Other (13)		3	39	8.9 (2.9, 25.2)	8.9 (2.9, 25.2)				
TOTAL		**364**	**9346**						

Note: Restricted to modern prostheses
Only prostheses with >50 procedures have been listed

OUTCOME FOR OSTEOARTHRITIS – PATIENT CHARACTERISTICS

There are 20,450 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 7.3% (Table ST59).

The most common reasons for revision are instability/dislocation (28.9%), infection (27.4%) and loosening (17.6%) (Table ST60 and Figure ST36). The most common types of revision are humeral component only (22.4%), replacement of both cup (liner) and glenosphere (20.6%), and cup only revisions (15.9%) (Table ST61). 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.

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 55–64 and 65–74 years (Table ST62 and Figure ST37).

Males have a higher rate of revision compared to females (Table ST63 and Figure ST38). The increase in the rate of revision is due to a higher cumulative incidence of infection and instability/dislocation (Figure ST39).

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 instability/dislocation.

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 ST64 and Figure ST40). The most common reasons for revision of the different ASA scores are presented in Figure ST41. The rate of revision for instability/dislocation increases with increasing ASA score.

There is no difference in the rate of revision when pre-obese and obese class 1 and 3 patients are compared to patients with a normal BMI. Obese class 2 patients have a significantly higher rate of revision in the first 2 weeks compared to patients with a normal BMI, after which time there is no difference (Table ST65 and Figure ST42). The most common reasons for revision for the different BMI categories are shown in Figure ST43.

Glenoid Morphology

The outcome of the different morphology categories is presented in Table ST66. The category of glenoid morphology is not a risk factor for revision (Figure ST44).

Table ST59 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	660	20450	1.9 (1.7, 2.1)	3.0 (2.8, 3.3)	3.5 (3.3, 3.8)	4.1 (3.8, 4.5)	5.1 (4.6, 5.7)	7.3 (5.9, 9.1)
TOTAL	**660**	**20450**						

Note: Restricted to modern prostheses

Table ST60 Primary Total Stemmed Reverse Shoulder Replacement by Reason for Revision (Primary Diagnosis OA)

Reason for Revision	Number	Percent
Instability/Dislocation	191	28.9
Infection	181	27.4
Loosening	116	17.6
Fracture	67	10.2
Dissociation	22	3.3
Pain	15	2.3
Lysis	10	1.5
Arthrofibrosis	9	1.4
Implant Breakage Glenoid	7	1.1
Malposition	7	1.1
Metal Related Pathology	5	0.8
Incorrect Sizing	4	0.6
Wear Humeral Cup	3	0.5
Heterotopic Bone	3	0.5
Rotator Cuff Insufficiency	2	0.3
Other	18	2.7
TOTAL	**660**	**100.0**

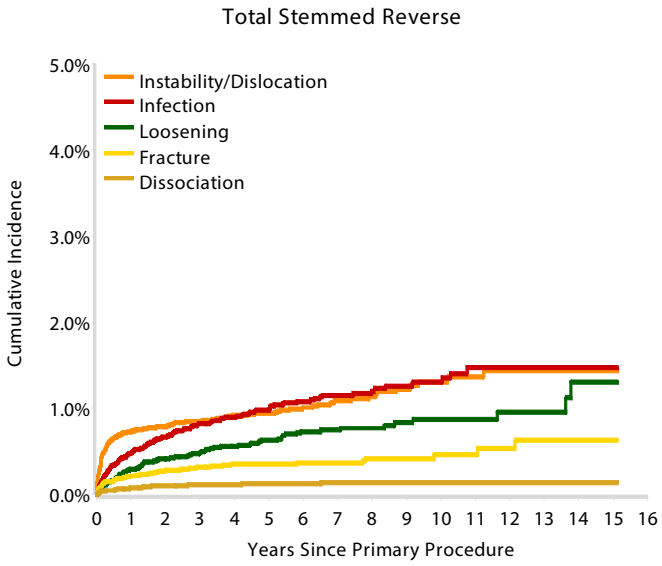
Note: Restricted to modern prostheses

Table ST61 Primary Total Stemmed Reverse Shoulder Replacement by Type of Revision (Primary Diagnosis OA)

Type of Revision	Number	Percent
Humeral Component	148	22.4
Cup/Head	136	20.6
Cup Only	105	15.9
Humeral Head Only	75	11.4
Cement Spacer	68	10.3
Humeral/Glenoid	56	8.5
Glenoid Component	49	7.4
Removal of Prostheses	10	1.5
Cement Only	6	0.9
Minor Components	3	0.5
Glenosphere Only	2	0.3
Reoperation	2	0.3
TOTAL	**660**	**100.0**

Note: Restricted to modern prostheses

Figure ST36 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Reverse Shoulder Replacement (Primary Diagnosis OA)



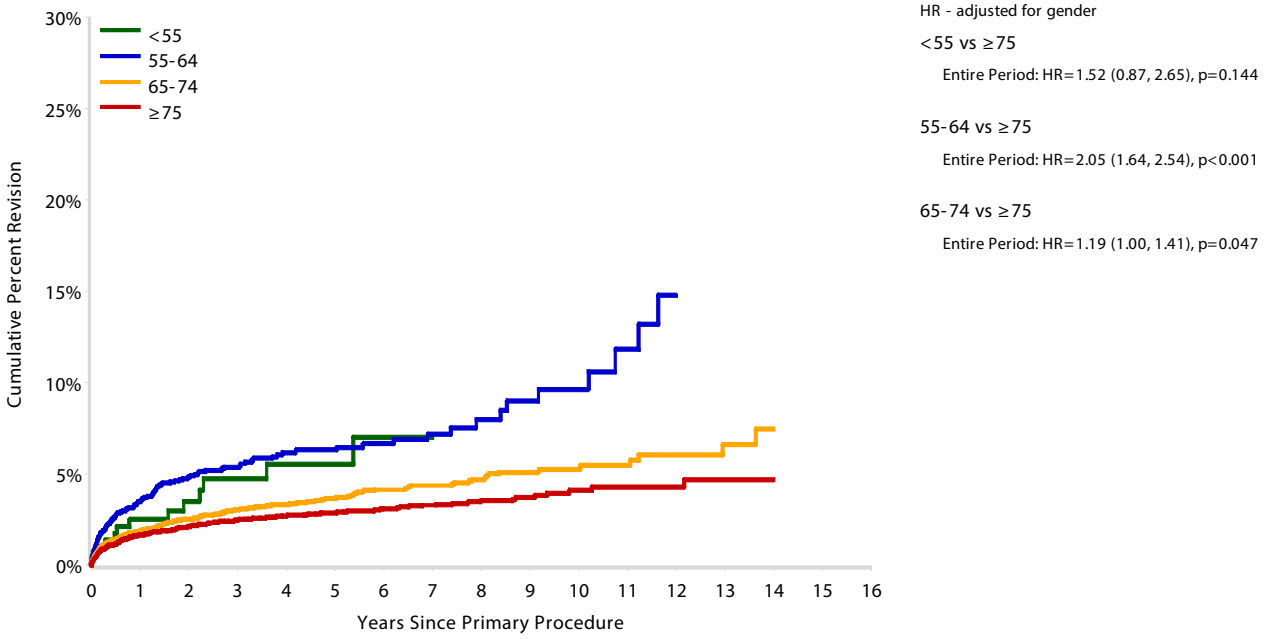
Note: Restricted to modern prostheses

Table ST62 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	13	296	2.5 (1.2, 5.2)	4.7 (2.6, 8.5)	5.5 (3.1, 9.8)	7.0 (3.8, 12.7)		
55–64	122	2118	3.5 (2.8, 4.4)	5.4 (4.4, 6.5)	6.3 (5.2, 7.6)	7.2 (5.8, 8.8)	9.6 (7.3, 12.6)	
65–74	267	8138	1.9 (1.6, 2.2)	3.0 (2.7, 3.5)	3.6 (3.2, 4.1)	4.4 (3.8, 5.0)	5.2 (4.5, 6.1)	7.4 (5.4, 10.1)
≥75	258	9898	1.6 (1.4, 1.9)	2.5 (2.2, 2.8)	2.9 (2.5, 3.3)	3.3 (2.9, 3.8)	4.1 (3.4, 4.9)	4.7 (3.7, 6.0)
TOTAL	**660**	**20450**						

Note: Restricted to modern prostheses

Figure ST37 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Age (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
<55	296	242	134	79	40	16	4
55–64	2118	1721	1056	591	299	101	19
65–74	8138	6836	4533	2752	1395	475	79
≥75	9898	8471	5821	3490	1892	593	65

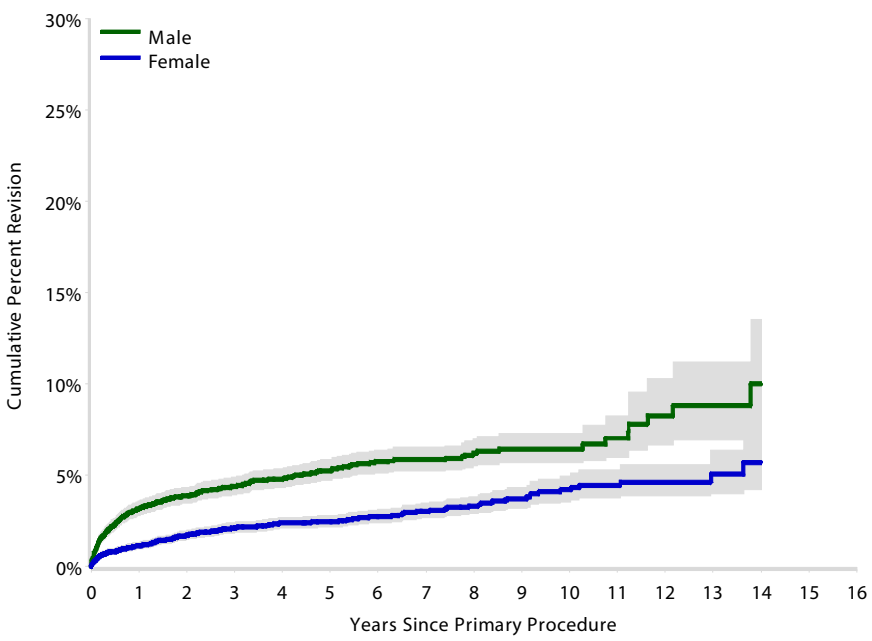
Note: Restricted to modern prostheses

Table ST63 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Gender (Primary Diagnosis OA)

Gender	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Male	373	8082	3.2 (2.8, 3.6)	4.4 (3.9, 4.9)	5.3 (4.7, 5.8)	5.8 (5.2, 6.5)	6.4 (5.7, 7.3)	10.0 (7.3, 13.5)
Female	287	12368	1.1 (1.0, 1.3)	2.1 (1.9, 2.4)	2.5 (2.2, 2.8)	3.0 (2.7, 3.5)	4.2 (3.6, 5.0)	5.7 (4.2, 7.8)
TOTAL	**660**	**20450**						

Note: Restricted to modern prostheses

Figure ST38 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=2.31 (1.75, 3.05), p<0.001

3Mth - 6Mth: HR=3.69 (2.17, 6.26), p<0.001

6Mth - 1.5Yr: HR=2.01 (1.46, 2.77), p<0.001

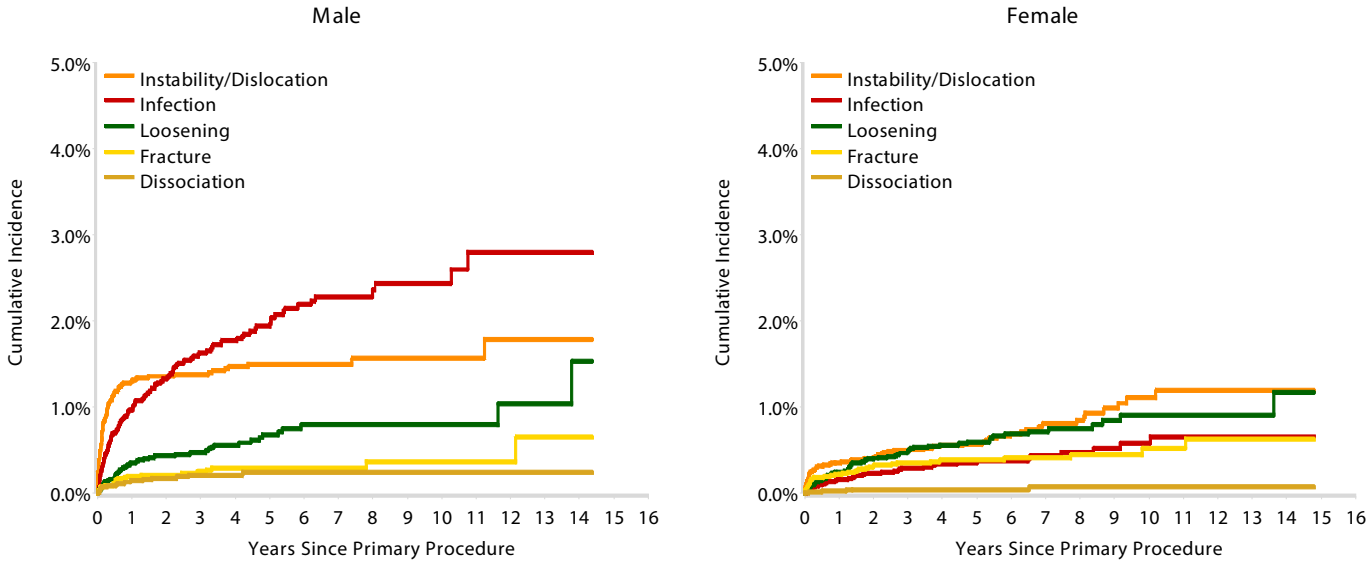
1.5Yr - 3Yr: HR=1.09 (0.74, 1.62), p=0.660

3Yr+: HR=1.51 (1.05, 2.17), p=0.024

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Male	8082	6688	4342	2506	1271	407	62
Female	12368	10582	7202	4406	2355	778	105

Note: Restricted to modern prostheses

Figure ST39 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Reverse Shoulder Replacement by Gender (Primary Diagnosis OA)



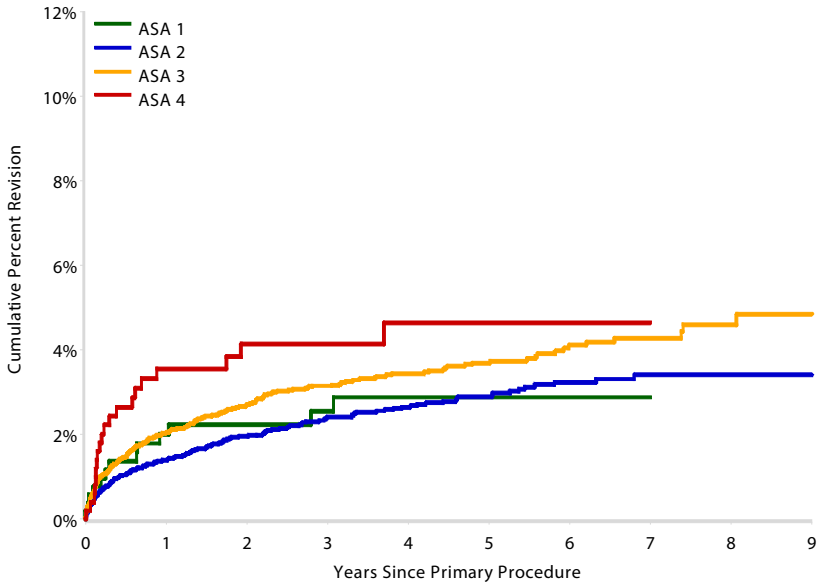
Note: Restricted to modern prostheses

Table ST64 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	13	523	2.0 (1.1, 3.7)	2.2 (1.2, 4.0)	2.5 (1.4, 4.5)	2.9 (1.7, 5.0)	2.9 (1.7, 5.0)	
ASA 2	180	7492	1.4 (1.1, 1.7)	2.0 (1.6, 2.3)	2.4 (2.1, 2.8)	2.6 (2.3, 3.1)	2.9 (2.5, 3.4)	3.4 (2.9, 4.0)
ASA 3	281	9259	2.0 (1.8, 2.4)	2.7 (2.4, 3.1)	3.2 (2.8, 3.6)	3.4 (3.0, 3.9)	3.7 (3.3, 4.2)	4.6 (3.9, 5.4)
ASA 4	20	506	3.6 (2.2, 5.7)	4.1 (2.7, 6.4)	4.1 (2.7, 6.4)	4.6 (3.0, 7.2)	4.6 (3.0, 7.2)	
ASA 5	0	1						
TOTAL	**494**	**17781**						

Note: Restricted to modern prostheses

Figure ST40 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=1.23 (0.70, 2.17), p=0.470

ASA 3 vs ASA 1

Entire Period: HR=1.78 (1.02, 3.12), p=0.042

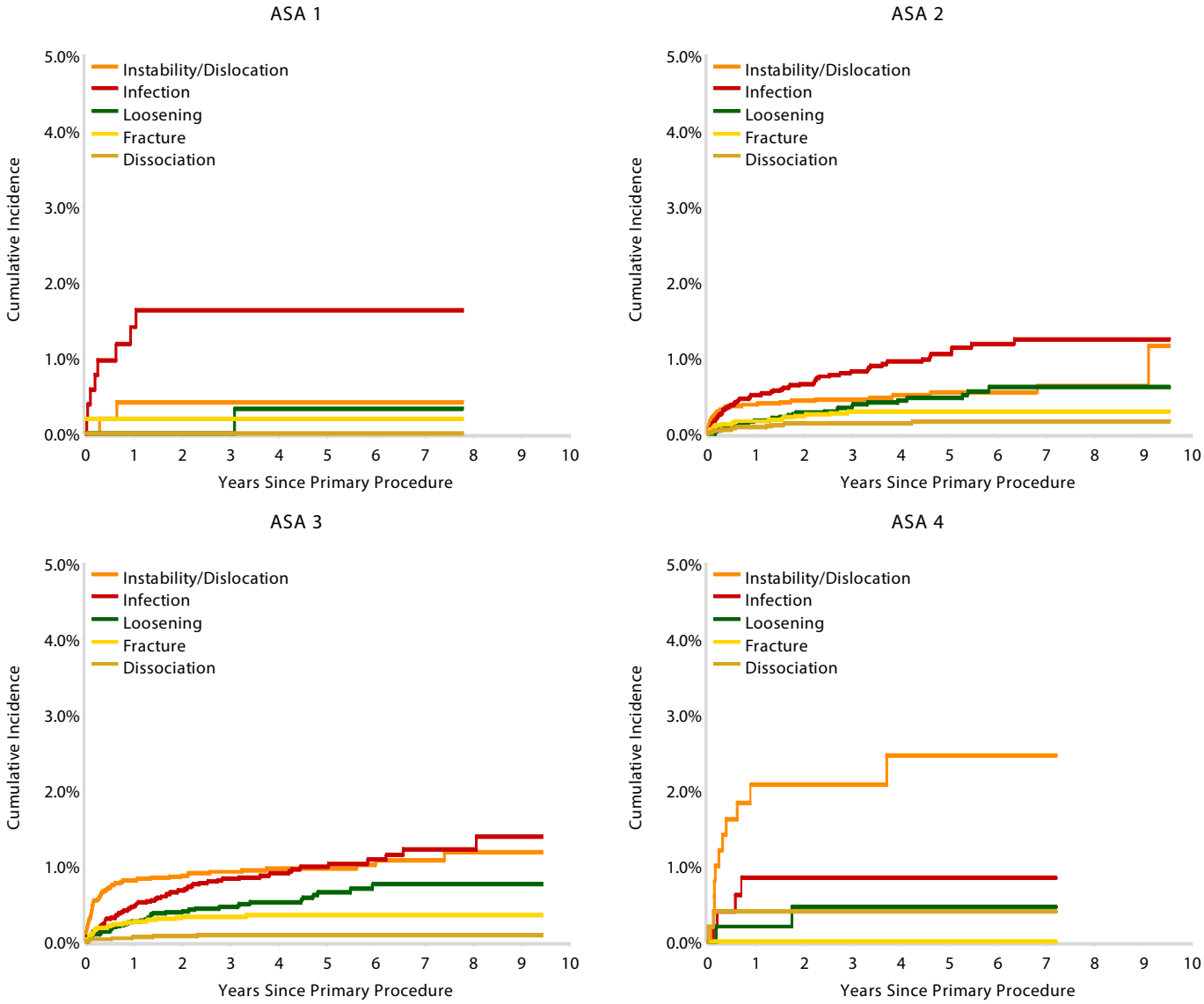
ASA 4 vs ASA 1

Entire Period: HR=2.45 (1.21, 4.95), p=0.012

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	8 Yrs
ASA 1	523	444	355	297	235	159	35
ASA 2	7492	6329	5173	4133	3149	2300	485
ASA 3	9259	7551	5918	4512	3231	2185	391
ASA 4	506	400	311	225	179	120	25

Note: Restricted to modern prostheses

Figure ST41 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Reverse Shoulder Replacement by ASA Score (Primary Diagnosis OA)



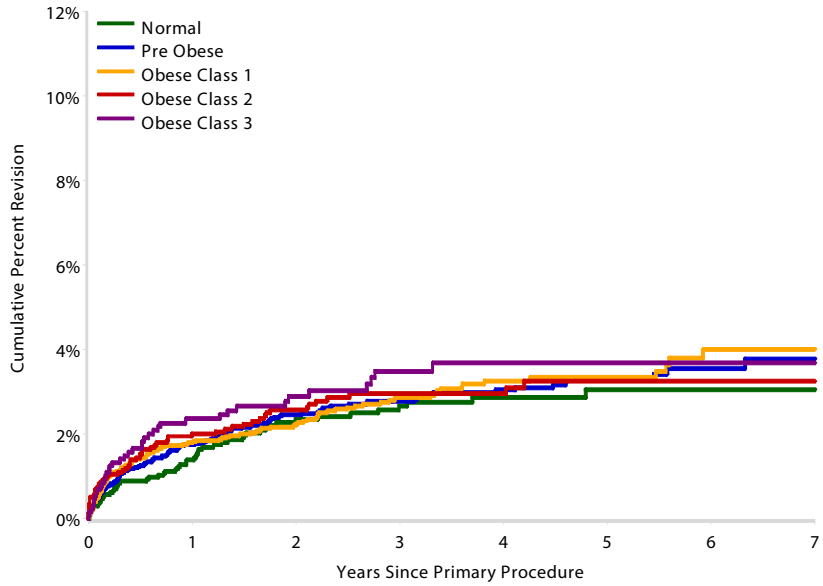
Note: Restricted to modern prostheses

Table ST65 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	4	82	2.5 (0.6, 9.5)	3.9 (1.3, 11.7)	6.2 (2.3, 16.3)	6.2 (2.3, 16.3)	6.2 (2.3, 16.3)	
Normal	54	2327	1.4 (1.0, 2.0)	2.3 (1.8, 3.1)	2.7 (2.0, 3.5)	2.9 (2.2, 3.8)	3.0 (2.3, 4.0)	3.0 (2.3, 4.0)
Pre Obese	139	5346	1.7 (1.4, 2.2)	2.5 (2.0, 2.9)	2.8 (2.3, 3.3)	3.0 (2.6, 3.6)	3.3 (2.8, 4.0)	3.5 (2.9, 4.3)
Obese Class 1	114	4287	1.8 (1.4, 2.3)	2.2 (1.8, 2.8)	2.9 (2.3, 3.5)	3.3 (2.7, 4.0)	3.3 (2.7, 4.1)	4.0 (3.2, 5.1)
Obese Class 2	58	2217	2.0 (1.5, 2.7)	2.6 (1.9, 3.4)	2.9 (2.3, 3.8)	2.9 (2.3, 3.8)	3.2 (2.5, 4.2)	3.2 (2.5, 4.2)
Obese Class 3	39	1301	2.4 (1.6, 3.4)	2.9 (2.1, 4.0)	3.5 (2.5, 4.8)	3.7 (2.7, 5.1)	3.7 (2.7, 5.1)	3.7 (2.7, 5.1)
TOTAL	**408**	**15560**						

Note: BMI has not been presented for patients aged ≤19 years
Restricted to modern prostheses

Figure ST42 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by BMI Category (Primary Diagnosis OA)



HR - adjusted for age and gender

Pre Obese vs Normal
Entire Period: HR=0.95 (0.70, 1.31), p=0.771

Obese Class 1 vs Normal
Entire Period: HR=0.98 (0.71, 1.36), p=0.920

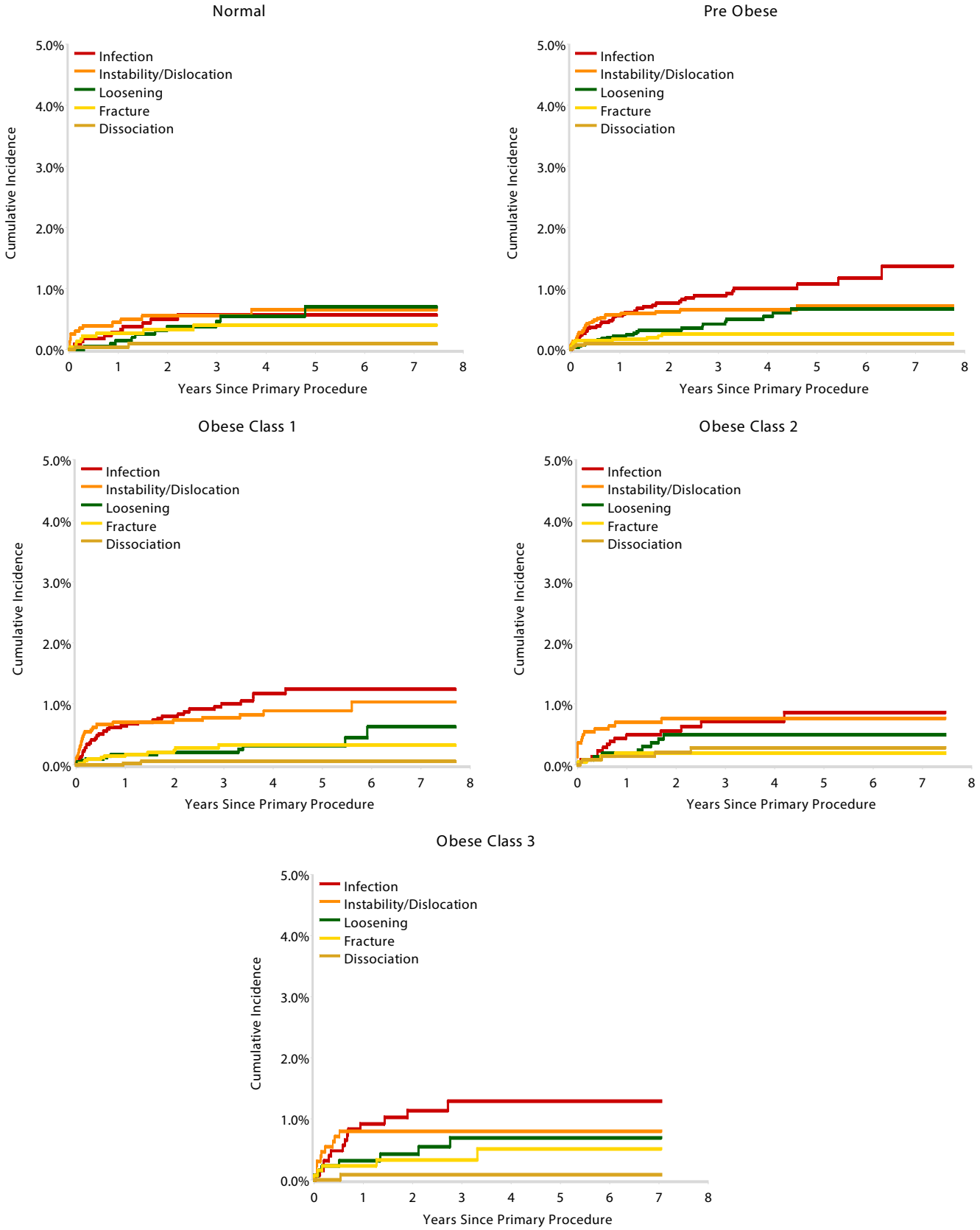
Obese Class 2 vs Normal
0 - 2Wk: HR=2.39 (1.14, 4.99), p=0.020
2Wk - 1Mth: HR=1.02 (0.38, 2.70), p=0.973
1Mth - 3Mth: HR=0.68 (0.30, 1.54), p=0.354
3Mth - 2Yr: HR=1.11 (0.69, 1.78), p=0.666
2Yr+: HR=0.73 (0.32, 1.67), p=0.461

Obese Class 3 vs Normal
Entire Period: HR=1.25 (0.82, 1.90), p=0.291

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Normal	2327	1906	1464	1093	781	503	251
Pre Obese	5346	4317	3359	2532	1751	1119	571
Obese Class 1	4287	3479	2679	2021	1373	819	456
Obese Class 2	2217	1790	1379	978	681	430	220
Obese Class 3	1301	1044	795	574	388	240	120

Note: BMI has not been presented for patients aged ≤19 years
Restricted to modern prostheses

Figure ST43 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Reverse Shoulder Replacement by BMI Category (Primary Diagnosis OA)



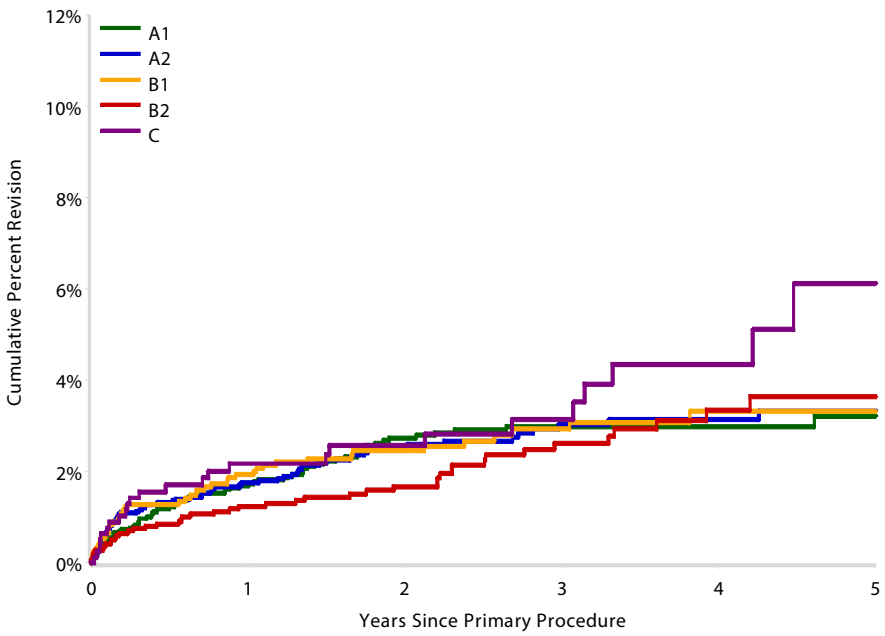
Note: BMI has not been presented for patients aged ≤19 years
Restricted to modern prostheses

Table ST66 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
A1	75	3066	1.7 (1.3, 2.2)	2.7 (2.2, 3.5)	3.0 (2.4, 3.8)	3.0 (2.4, 3.8)
A2	70	2807	1.8 (1.3, 2.3)	2.5 (2.0, 3.3)	3.0 (2.4, 3.9)	3.1 (2.4, 4.0)
B1	47	1907	1.9 (1.4, 2.7)	2.5 (1.8, 3.3)	2.9 (2.2, 4.0)	3.3 (2.4, 4.5)
B2	45	2185	1.2 (0.8, 1.8)	1.7 (1.2, 2.4)	2.6 (1.9, 3.6)	3.3 (2.4, 4.7)
C	25	789	2.2 (1.3, 3.5)	2.6 (1.6, 4.1)	3.1 (2.0, 4.9)	4.4 (2.8, 6.8)
TOTAL	**262**	**10754**				

Note: Restricted to modern prostheses
Excludes 64 procedures with a recorded glenoid morphology of B3

Figure ST44 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=1.06 (0.76, 1.47), p=0.736

B1 vs A1
Entire Period: HR=1.00 (0.69, 1.44), p=0.998

B2 vs A1
Entire Period: HR=0.73 (0.50, 1.06), p=0.097

C vs A1
Entire Period: HR=1.08 (0.69, 1.71), p=0.735

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs
A1	3066	2385	1721	1206	689
A2	2807	2143	1530	1028	573
B1	1907	1438	1010	648	357
B2	2185	1663	1144	749	402
C	789	591	414	266	151

Note: Restricted to modern prostheses

OUTCOME FOR OSTEOARTHRITIS – PROSTHESIS CHARACTERISTICS

Fixation

There is no difference between hybrid (humerus cemented) and cementless humeral stems (Table ST67 and Figure ST45).

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 ST68 and Figure ST46). The reasons for revision for the different types of bearing surface are presented in Figure ST47.

Glenosphere Size

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 ST69 and Figure ST48). The most common reasons for revision for the three different glenosphere size groups are presented in Figure ST49.

Glenosphere sizes <38mm have a higher rate of revision compared to sizes >40mm.

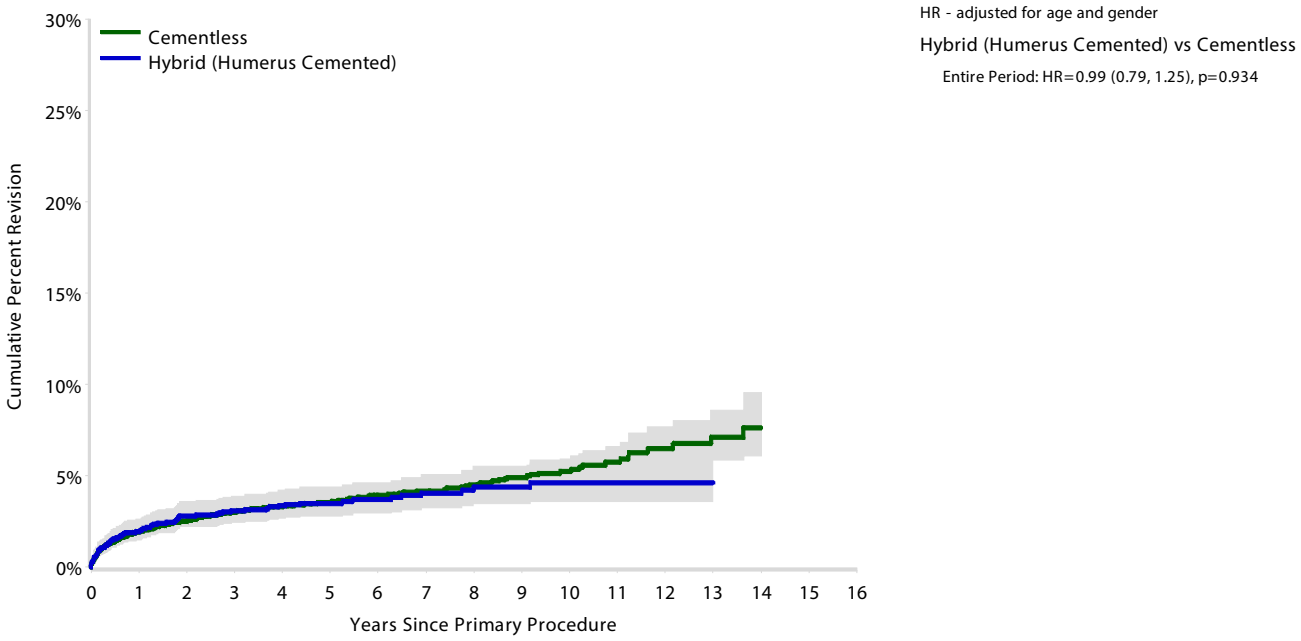
The outcomes of the most commonly used prosthesis combinations are listed in Table ST70. The most commonly used cementless prosthesis combinations are listed in Table ST71. The most commonly used hybrid (humerus cemented) prosthesis combinations are listed in Table ST72.

Table ST67 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	3	98	0.0 (0.0, 0.0)	1.2 (0.2, 8.1)	2.7 (0.7, 10.6)	2.7 (0.7, 10.6)	2.7 (0.7, 10.6)	
Cementless	570	17804	1.9 (1.7, 2.2)	3.0 (2.8, 3.3)	3.5 (3.2, 3.9)	4.2 (3.8, 4.6)	5.3 (4.7, 5.9)	7.6 (6.1, 9.5)
Hybrid (Glenoid Cemented)	3	94	1.1 (0.2, 7.3)	2.4 (0.6, 9.3)	5.0 (1.5, 15.9)			
Hybrid (Humerus Cemented)	84	2454	2.0 (1.5, 2.6)	3.1 (2.4, 3.9)	3.5 (2.8, 4.4)	4.0 (3.2, 5.1)	4.6 (3.6, 5.9)	
TOTAL	**660**	**20450**						

Note: Restricted to modern prostheses

Figure ST45 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Fixation (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Cementless	17804	14892	9766	5695	2865	872	126
Hybrid (Humerus Cemented)	2454	2204	1651	1127	712	281	33

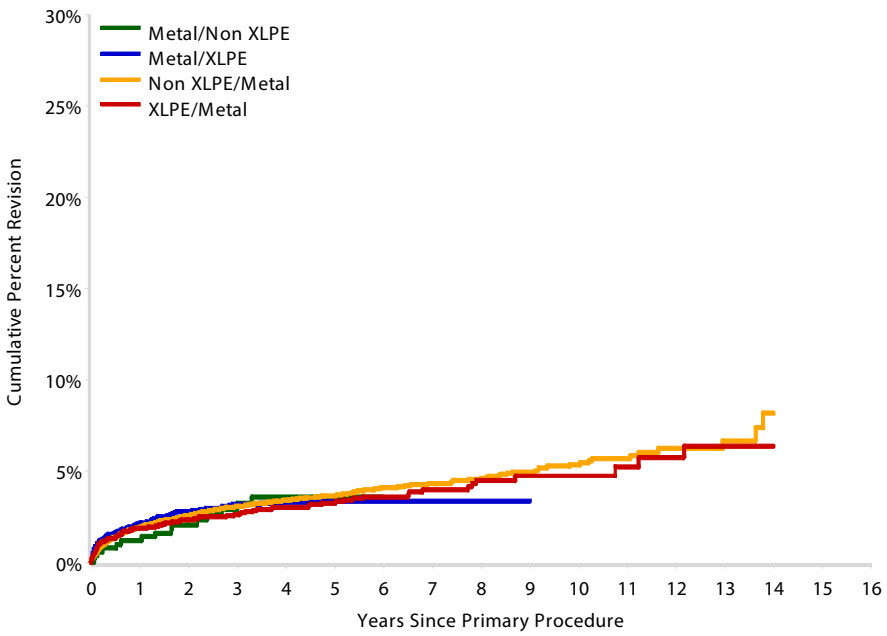
Note: Only fixations with >100 procedures have been listed
Restricted to modern prostheses

Table ST68 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	0	48	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)				
Metal/Non XLPE	17	500	1.2 (0.5, 2.7)	3.2 (1.9, 5.4)	3.6 (2.1, 5.9)			
Metal/XLPE	104	3565	2.1 (1.7, 2.7)	3.2 (2.6, 3.9)	3.4 (2.8, 4.1)	3.4 (2.8, 4.1)		
Non XLPE/Metal	428	12487	1.9 (1.7, 2.2)	3.1 (2.8, 3.4)	3.7 (3.3, 4.1)	4.3 (3.9, 4.8)	5.4 (4.7, 6.1)	8.2 (6.1, 11.0)
XLPE/Metal	111	3835	1.9 (1.5, 2.4)	2.6 (2.1, 3.3)	3.3 (2.6, 4.0)	4.0 (3.2, 5.0)	4.8 (3.7, 6.0)	6.4 (4.5, 8.9)
TOTAL	**660**	**20440**						

Note: Restricted to modern prostheses

Figure ST46 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=1.14 (0.68, 1.90), p=0.614

Metal/XLPE vs XLPE/Metal

Entire Period: HR=0.92 (0.70, 1.20), p=0.529

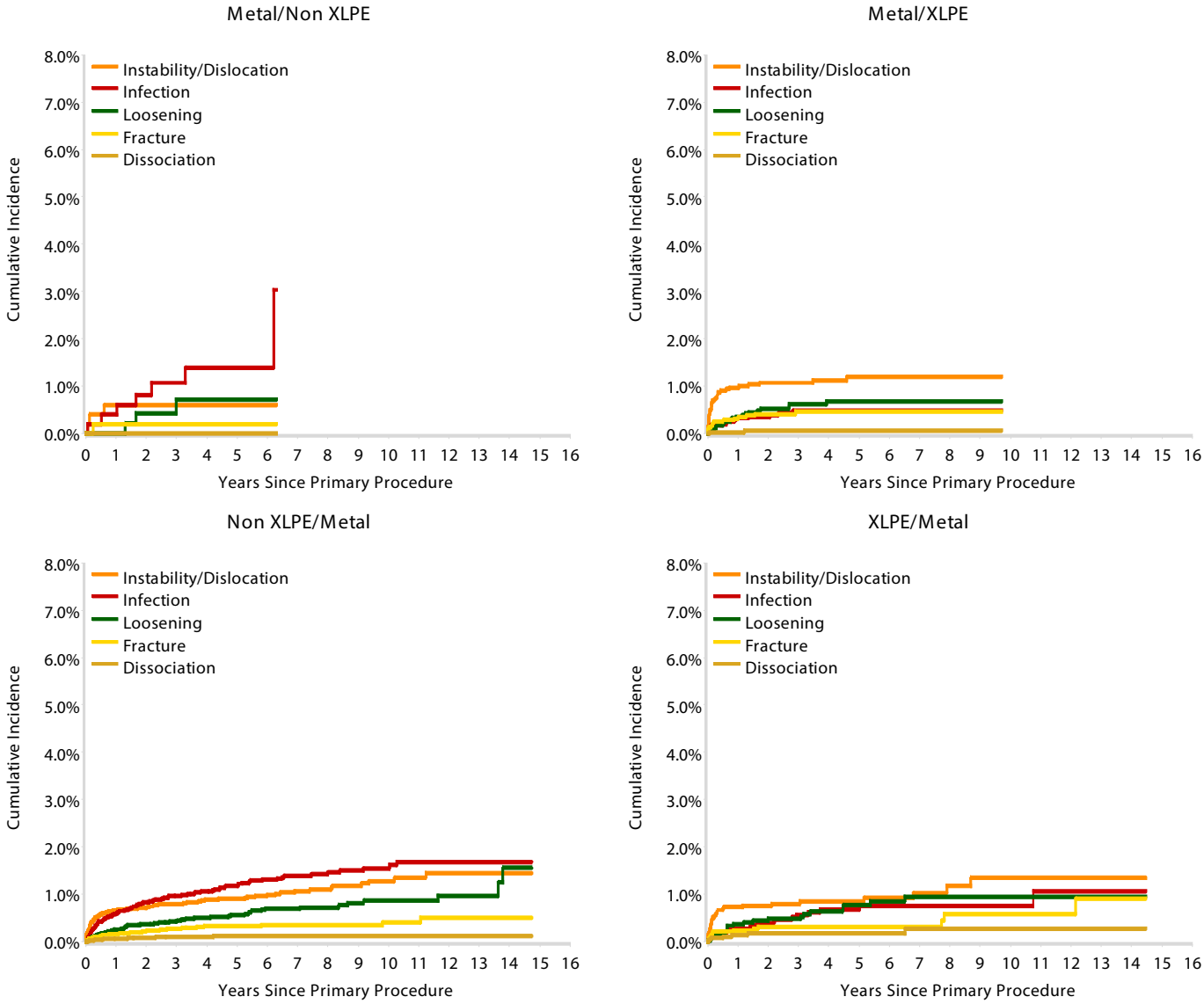
Non XLPE/Metal vs XLPE/Metal

Entire Period: HR=1.06 (0.86, 1.31), p=0.591

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Metal/Non XLPE	500	475	306	156	27	0	0
Metal/XLPE	3565	3024	1955	972	389	24	1
Non XLPE/Metal	12487	10721	7404	4595	2538	919	97
XLPE/Metal	3835	3010	1865	1182	669	241	69

Note: Restricted to modern prostheses

Figure ST47 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Reverse Shoulder Replacement by Bearing Surface (Primary Diagnosis OA)



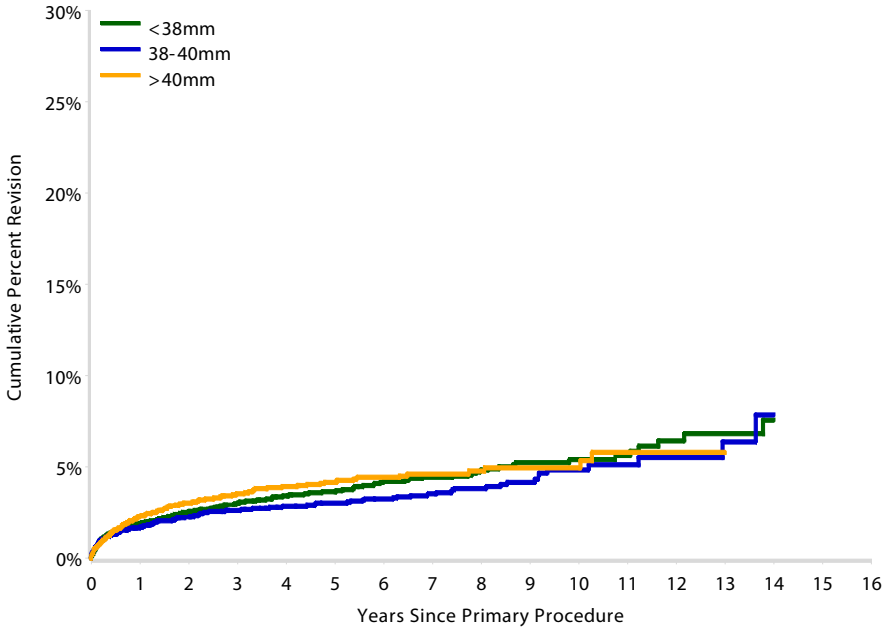
Note: Restricted to modern prostheses

Table ST69 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	240	7055	1.9 (1.6, 2.3)	3.0 (2.6, 3.5)	3.6 (3.2, 4.2)	4.4 (3.8, 5.1)	5.4 (4.6, 6.3)	7.6 (5.7, 10.0)
38–40mm	225	7851	1.7 (1.4, 2.0)	2.7 (2.3, 3.1)	3.0 (2.6, 3.5)	3.5 (3.0, 4.1)	4.9 (4.0, 5.9)	7.9 (5.0, 12.3)
>40mm	177	4842	2.3 (1.9, 2.8)	3.5 (3.0, 4.1)	4.2 (3.6, 4.9)	4.6 (3.9, 5.4)	4.9 (4.1, 5.9)	
TOTAL	**642**	**19748**						

Note: Excludes 702 procedures with unknown glenosphere sizes
Restricted to modern prostheses

Figure ST48 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=1.20 (1.00, 1.44), p=0.051

>40mm vs 38-40mm

0 - 3Mth: HR=0.68 (0.48, 0.95), p=0.025

3Mth+: HR=0.98 (0.78, 1.25), p=0.884

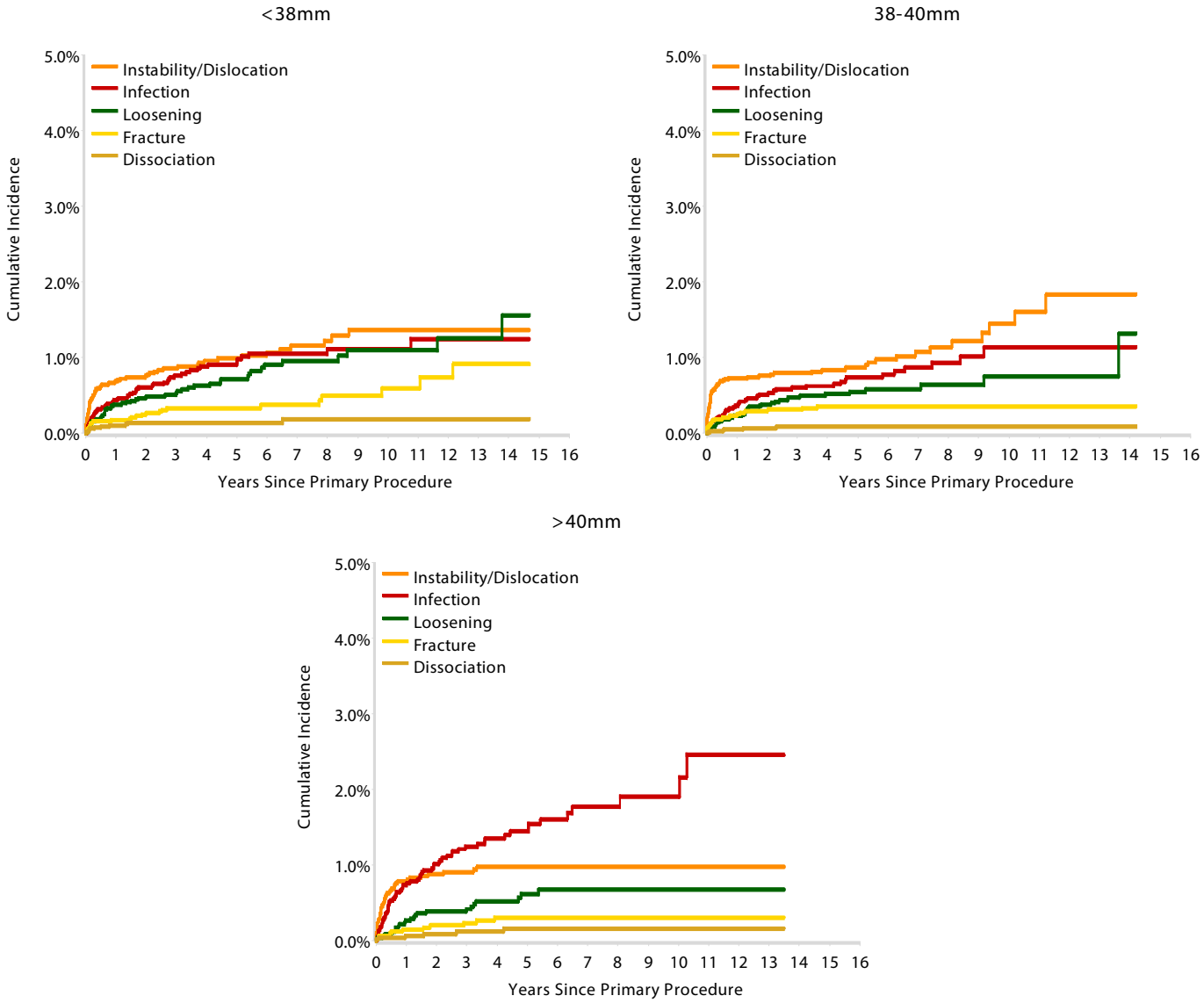
>40mm vs <38mm

Entire Period: HR=0.73 (0.59, 0.90), p=0.003

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
<38mm	7055	5913	4026	2557	1450	553	97
38–40mm	7851	6741	4565	2728	1375	390	47
>40mm	4842	4186	2845	1624	799	241	23

Note: Restricted to modern prostheses

Figure ST49 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Reverse Shoulder Replacement by Glenosphere Size (Primary Diagnosis OA)



Note: Restricted to modern prostheses

Table ST70 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	70	1480	2.0 (1.4, 2.9)	3.3 (2.5, 4.4)	3.9 (3.0, 5.1)	5.2 (4.0, 6.6)	6.2 (4.8, 8.1)	
	Perform Reversed	1	79	0.0 (0.0, 0.0)	1.8 (0.3, 12.0)				
Affinis	Affinis	23	739	1.4 (0.8, 2.6)	3.3 (2.1, 5.1)	3.5 (2.3, 5.4)			
AltiVate Reverse	RSP	7	549	1.3 (0.6, 2.8)					
Ascend Flex	Aequalis	43	1376	2.2 (1.6, 3.2)	3.8 (2.7, 5.2)	4.4 (3.1, 6.1)	4.4 (3.1, 6.1)		
	Perform Reversed	7	242	3.5 (1.6, 7.7)					
Comprehensive	Comprehensive Reverse	29	2164	1.0 (0.6, 1.5)	1.6 (1.1, 2.3)	1.9 (1.3, 2.8)	1.9 (1.3, 2.8)		
	Custom Made (Comprehensive)	2	41	2.4 (0.3, 16.1)	2.4 (0.3, 16.1)	5.8 (1.5, 21.7)			
	Trabecular Metal	1	28	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	12.5 (1.9, 61.3)			
Delta Xtend	Delta Xtend	162	4722	1.8 (1.5, 2.2)	2.8 (2.3, 3.3)	3.2 (2.7, 3.8)	3.6 (3.1, 4.3)	4.7 (3.9, 5.7)	7.0 (4.8, 10.0)
Equinoxe	Equinoxe	67	2345	1.8 (1.3, 2.4)	3.0 (2.3, 3.9)	4.0 (3.0, 5.2)	6.2 (4.1, 9.4)		
Global Unite	Delta Xtend	9	393	0.5 (0.1, 2.1)	2.6 (1.3, 5.1)	2.6 (1.3, 5.1)	3.6 (1.7, 7.5)		
MSS	MSS	1	75	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)				
RSP	RSP	25	730	2.5 (1.6, 4.0)	3.3 (2.2, 4.9)	3.8 (2.5, 5.5)			
SMR	Custom Made (Lima)	4	40	8.0 (2.6, 22.8)	8.0 (2.6, 22.8)				
	SMR Axioma	5	102	2.1 (0.5, 8.1)					
	SMR L1	162	4418	2.5 (2.1, 3.0)	3.4 (2.9, 4.1)	3.7 (3.2, 4.4)	4.2 (3.6, 5.0)	4.8 (4.0, 5.8)	6.4 (4.7, 8.8)
Trabecular Metal	Comprehensive Reverse	3	112	1.9 (0.5, 7.3)	3.7 (1.1, 11.9)				
	Trabecular Metal	31	742	1.8 (1.0, 3.1)	3.2 (2.1, 4.9)	4.4 (3.1, 6.4)	4.7 (3.3, 6.8)	5.3 (3.6, 7.8)	
Other (16)		8	73	14.6 (7.4, 27.8)	14.6 (7.4, 27.8)				
TOTAL		**660**	**20450**						

Note: Restricted to modern prostheses
Only prostheses with >25 procedures have been listed

Table ST71 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	59	1125	2.1 (1.4, 3.1)	3.7 (2.7, 5.0)	4.3 (3.2, 5.7)	5.7 (4.3, 7.5)	6.8 (5.1, 9.1)	
	Perform Reversed	0	67	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)				
Affinis	Affinis	16	450	1.2 (0.5, 2.8)	3.6 (2.1, 6.2)	4.1 (2.4, 6.9)			
AltiVate Reverse	RSP	5	496	1.2 (0.5, 2.9)					
Ascend Flex	Aequalis	39	1239	2.2 (1.5, 3.2)	3.8 (2.7, 5.3)	4.4 (3.1, 6.3)			
	Perform Reversed	6	215	3.1 (1.3, 7.5)					
Comprehensive	Comprehensive Reverse	28	2072	1.0 (0.7, 1.6)	1.6 (1.1, 2.4)	1.8 (1.2, 2.7)	1.8 (1.2, 2.7)		
	Custom Made (Comprehensive)	2	40	2.5 (0.4, 16.5)	2.5 (0.4, 16.5)	6.0 (1.5, 22.3)			
	Trabecular Metal	1	27	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	12.5 (1.9, 61.3)			
Delta Xtend	Delta Xtend	126	3501	1.9 (1.5, 2.4)	3.0 (2.4, 3.6)	3.4 (2.8, 4.1)	3.7 (3.1, 4.5)	5.2 (4.1, 6.5)	
Equinoxe	Equinoxe	62	2242	1.7 (1.2, 2.4)	2.8 (2.1, 3.7)	3.9 (2.9, 5.2)	6.3 (4.1, 9.6)		
Global Unite	Delta Xtend	7	341	0.6 (0.2, 2.4)	2.2 (1.0, 4.8)	2.2 (1.0, 4.8)			
MSS	MSS	1	74	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)				
RSP	RSP	21	629	2.6 (1.6, 4.2)	3.2 (2.0, 4.9)	3.7 (2.4, 5.7)			
SMR	Custom Made (Lima)	4	39	8.1 (2.7, 23.1)	8.1 (2.7, 23.1)				
	SMR Axioma	4	100	2.1 (0.5, 8.3)	5.6 (2.0, 15.0)				
	SMR L1	155	4304	2.5 (2.0, 3.0)	3.4 (2.9, 4.0)	3.6 (3.1, 4.3)	4.2 (3.5, 4.9)	4.8 (3.9, 5.8)	6.4 (4.7, 8.9)
Trabecular Metal	Comprehensive Reverse	2	105	1.0 (0.1, 6.8)	2.9 (0.7, 11.8)				
	Trabecular Metal	26	672	1.8 (1.0, 3.2)	3.0 (1.9, 4.7)	4.1 (2.8, 6.1)	4.4 (3.0, 6.5)	5.1 (3.3, 7.8)	
Other (15)		6	66	12.2 (5.4, 26.2)	12.2 (5.4, 26.2)				
TOTAL		**570**	**17804**						

Note: Restricted to modern prostheses
Only prostheses with >25 procedures have been listed

Table ST72 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	11	332	1.8 (0.8, 4.1)	2.2 (1.1, 4.6)	3.1 (1.6, 6.0)	3.7 (2.0, 6.9)	4.6 (2.5, 8.7)	
Affinis	Affinis	6	268	1.9 (0.8, 4.5)	2.5 (1.1, 5.6)	2.5 (1.1, 5.6)			
AltiVate Reverse	RSP	2	48	2.1 (0.3, 13.9)					
Ascend Flex	Aequalis	4	124	3.4 (1.3, 8.9)					
	Perform Reversed	1	26	6.7 (1.0, 38.7)	6.7 (1.0, 38.7)				
Comprehensive	Comprehensive Reverse	1	85	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	4.3 (0.6, 27.1)			
Delta Xtend	Delta Xtend	35	1160	1.6 (1.0, 2.5)	2.4 (1.6, 3.5)	2.6 (1.8, 3.7)	3.3 (2.3, 4.6)	3.8 (2.7, 5.5)	
Equinoxe	Equinoxe	5	99	3.2 (1.1, 9.7)	6.3 (2.6, 14.7)	6.3 (2.6, 14.7)			
Global Unite	Delta Xtend	2	49	0.0 (0.0, 0.0)	6.3 (1.6, 23.0)	6.3 (1.6, 23.0)			
RSP	RSP	4	95	2.1 (0.5, 8.2)	4.3 (1.6, 11.1)	4.3 (1.6, 11.1)			
SMR	SMR L1	5	79	3.9 (1.3, 11.6)	7.0 (2.9, 16.0)	7.0 (2.9, 16.0)	7.0 (2.9, 16.0)		
Trabecular Metal	Trabecular Metal	4	60	1.7 (0.2, 11.6)	6.3 (2.0, 18.3)	9.0 (3.4, 22.6)	9.0 (3.4, 22.6)	9.0 (3.4, 22.6)	
Other (9)		4	29	11.3 (3.8, 31.2)	15.7 (6.2, 36.9)				
TOTAL		**84**	**2454**						

Note: Restricted to modern prostheses
Only prostheses with >25 procedures have been listed

OUTCOME FOR ROTATOR CUFF ARTHROPATHY – PATIENT CHARACTERISTICS

There are 17,343 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 ST73).

The most common reasons for revision are instability/dislocation (28.4%), infection (24.8%), and loosening (17.1%) (Table ST74 and Figure ST50). The most common types of revision are of the humeral component (20.3%), cup/head (20%) and cup only (16.8%) (Table ST75 and Figure ST50).

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 (Table ST76 and Figure ST51). Males have a higher rate of revision compared to females (Table ST77 and Figure ST52). The increase in the rate of revision is due to a higher cumulative incidence of infection and instability/dislocation (Figure ST53).

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 3 and 4 have a higher risk of revision than those with an ASA score of 1 (Table ST78 and Figure ST54). The most common reasons for revision for the different ASA scores are presented in Figure ST55.

BMI category is not a risk factor for revision (Table ST79 and Figure ST56). The most common reasons for revision for the different BMI categories are shown in Figure ST57.

Glenoid Morphology

The cumulative percent revision for the different morphology categories is presented in Table ST80. The category of glenoid morphology is not a risk factor for revision (Figure ST58).

Table ST73 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	626	17343	2.3 (2.1, 2.6)	3.6 (3.3, 3.9)	4.2 (3.9, 4.6)	4.6 (4.3, 5.1)	5.5 (4.9, 6.1)	6.1 (5.2, 7.2)
TOTAL	**626**	**17343**						

Note: Restricted to modern prostheses

Table ST74 Primary Total Stemmed Reverse Shoulder Replacement by Reason for Revision (Primary Diagnosis Rotator Cuff Arthropathy)

Reason for Revision	Number	Percent
Instability/Dislocation	178	28.4
Infection	155	24.8
Loosening	107	17.1
Fracture	73	11.7
Dissociation	27	4.3
Pain	18	2.9
Malposition	10	1.6
Lysis	8	1.3
Incorrect Sizing	8	1.3
Metal Related Pathology	7	1.1
Rotator Cuff Insufficiency	4	0.6
Implant Breakage Glenoid	4	0.6
Arthrofibrosis	3	0.5
Implant Breakage Humeral	2	0.3
Wear Humeral Cup	2	0.3
Implant Breakage Glenoid Insert	1	0.2
Glenoid Erosion	1	0.2
Heterotopic Bone	1	0.2
Other	17	2.7
TOTAL	**626**	**100.0**

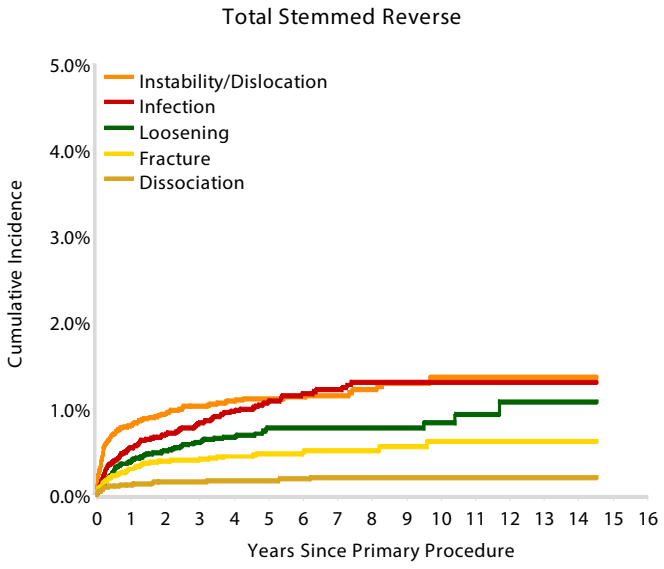
Note: Restricted to modern prostheses

Table ST75 Primary Total Stemmed Reverse Shoulder Replacement by Type of Revision (Primary Diagnosis Rotator Cuff Arthropathy)

Type of Revision	Number	Percent
Humeral Component	127	20.3
Cup/Head	125	20.0
Cup Only	105	16.8
Humeral Head Only	67	10.7
Glenoid Component	64	10.2
Humeral/Glenoid	61	9.7
Cement Spacer	45	7.2
Removal of Prostheses	9	1.4
Glenosphere Only	8	1.3
Reoperation	5	0.8
Cement Only	4	0.6
Minor Components	3	0.5
Reinsertion of Components	2	0.3
Head/Insert	1	0.2
TOTAL	**626**	**100.0**

Note: Restricted to modern prostheses

Figure ST50 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Reverse Shoulder Replacement (Primary Diagnosis Rotator Cuff Arthropathy)



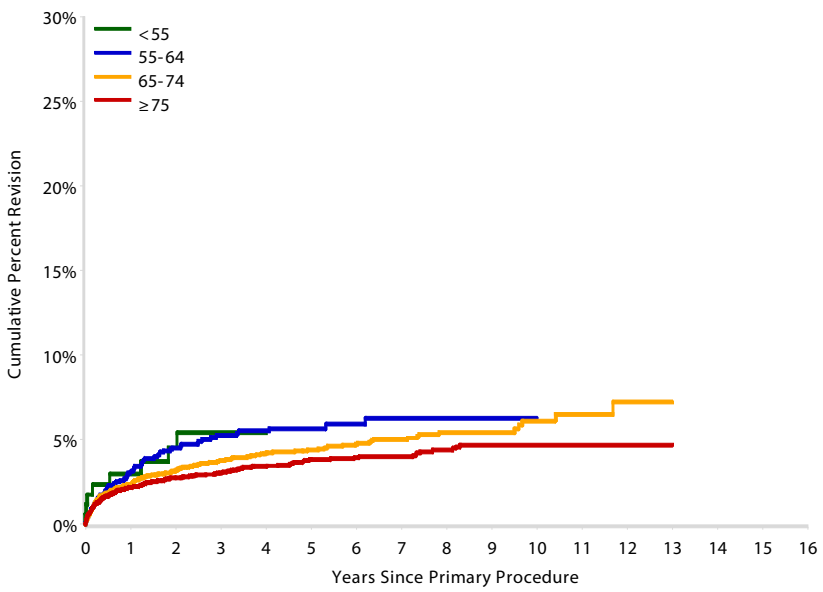
Note: Restricted to modern prostheses

Table ST76 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	9	172	3.0 (1.2, 7.0)	5.4 (2.7, 10.6)				
55–64	81	1737	3.1 (2.4, 4.1)	5.3 (4.2, 6.6)	5.7 (4.5, 7.1)	6.3 (4.9, 8.0)	6.3 (4.9, 8.0)	
65–74	266	6980	2.4 (2.0, 2.8)	3.7 (3.3, 4.3)	4.4 (3.9, 5.0)	5.0 (4.4, 5.7)	6.1 (5.1, 7.3)	
≥75	270	8454	2.2 (1.9, 2.5)	3.0 (2.7, 3.5)	3.8 (3.4, 4.3)	4.0 (3.5, 4.5)	4.7 (4.0, 5.5)	
TOTAL	**626**	**17343**						

Note: Restricted to modern prostheses

Figure ST51 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=1.47 (0.76, 2.87), p=0.253

55-64 vs ≥75

Entire Period: HR=1.36 (1.06, 1.75), p=0.015

65-74 vs ≥75

Entire Period: HR=1.14 (0.96, 1.35), p=0.130

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
<55	172	136	80	38	17	5	1
55–64	1737	1361	817	437	194	55	9
65–74	6980	5809	3673	2076	1083	330	32
≥75	8454	7044	4706	2646	1410	392	24

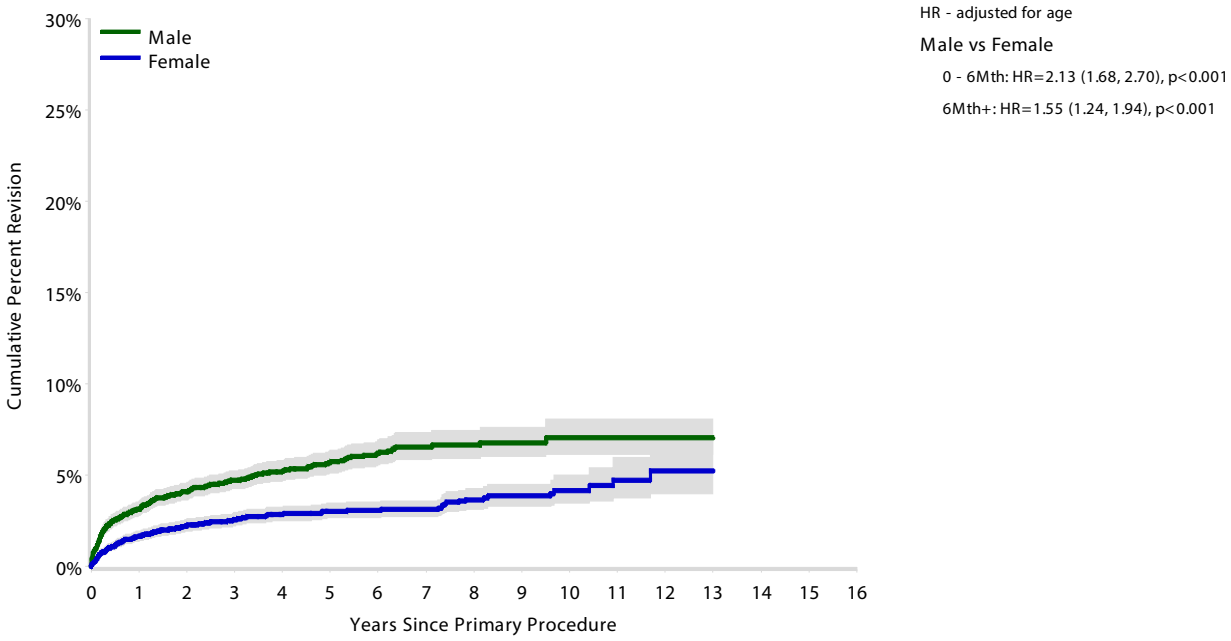
Note: Restricted to modern prostheses

Table ST77 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Gender (Primary Diagnosis Rotator Cuff Arthropathy)

Gender	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Male	380	8049	3.2 (2.8, 3.6)	4.7 (4.2, 5.3)	5.7 (5.1, 6.3)	6.6 (5.8, 7.3)	7.0 (6.1, 8.1)	
Female	246	9294	1.7 (1.4, 1.9)	2.6 (2.2, 2.9)	3.0 (2.7, 3.5)	3.1 (2.7, 3.6)	4.2 (3.5, 5.0)	
TOTAL	**626**	**17343**						

Note: Restricted to modern prostheses

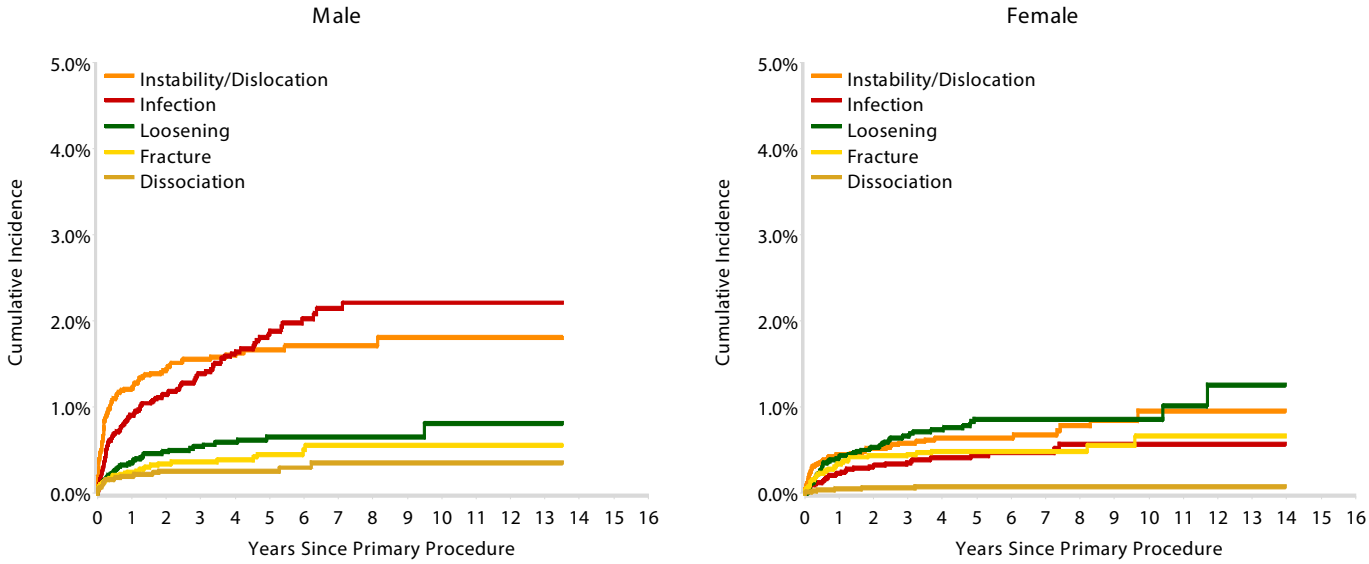
Figure ST52 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Gender (Primary Diagnosis Rotator Cuff Arthropathy)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Male	8049	6525	4003	2128	1054	289	27
Female	9294	7825	5273	3069	1650	493	39

Note: Restricted to modern prostheses

Figure ST53 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Reverse Shoulder Replacement by Gender (Primary Diagnosis Rotator Cuff Arthropathy)



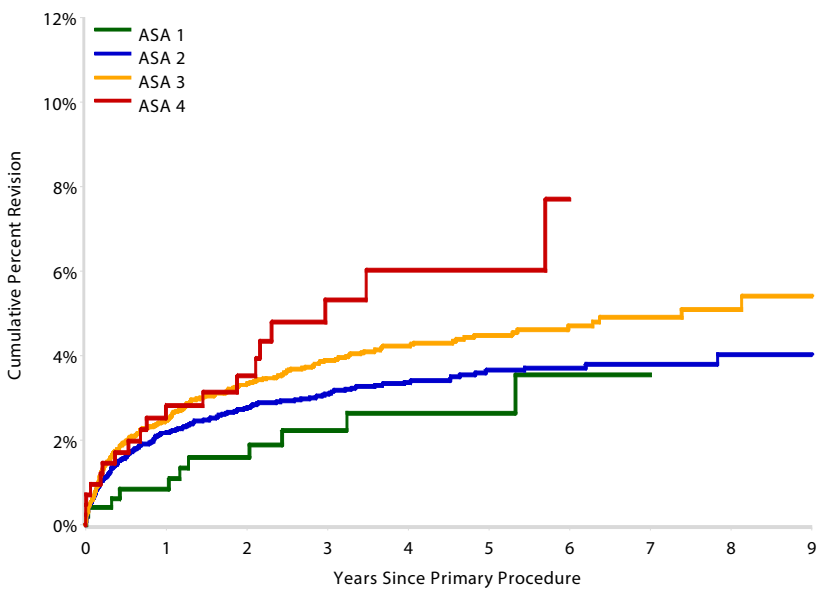
Note: Restricted to modern prostheses

Table ST78 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	11	485	0.8 (0.3, 2.2)	1.6 (0.8, 3.3)	2.2 (1.2, 4.3)	2.6 (1.4, 4.9)	2.6 (1.4, 4.9)	
ASA 2	195	6485	2.2 (1.9, 2.6)	2.8 (2.4, 3.2)	3.1 (2.7, 3.6)	3.4 (2.9, 3.9)	3.7 (3.2, 4.2)	4.0 (3.4, 4.8)
ASA 3	293	8173	2.5 (2.2, 2.8)	3.3 (2.9, 3.8)	3.9 (3.4, 4.4)	4.2 (3.8, 4.8)	4.5 (4.0, 5.1)	5.1 (4.4, 5.9)
ASA 4	20	419	2.8 (1.6, 5.0)	3.5 (2.0, 6.0)	5.3 (3.3, 8.6)	6.0 (3.7, 9.7)	6.0 (3.7, 9.7)	
ASA 5	0	1						
TOTAL	**519**	**15563**						

Note: Restricted to modern prostheses

Figure ST54 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=1.55 (0.84, 2.84), p=0.160

ASA 3 vs ASA 1

Entire Period: HR=2.03 (1.11, 3.73), p=0.021

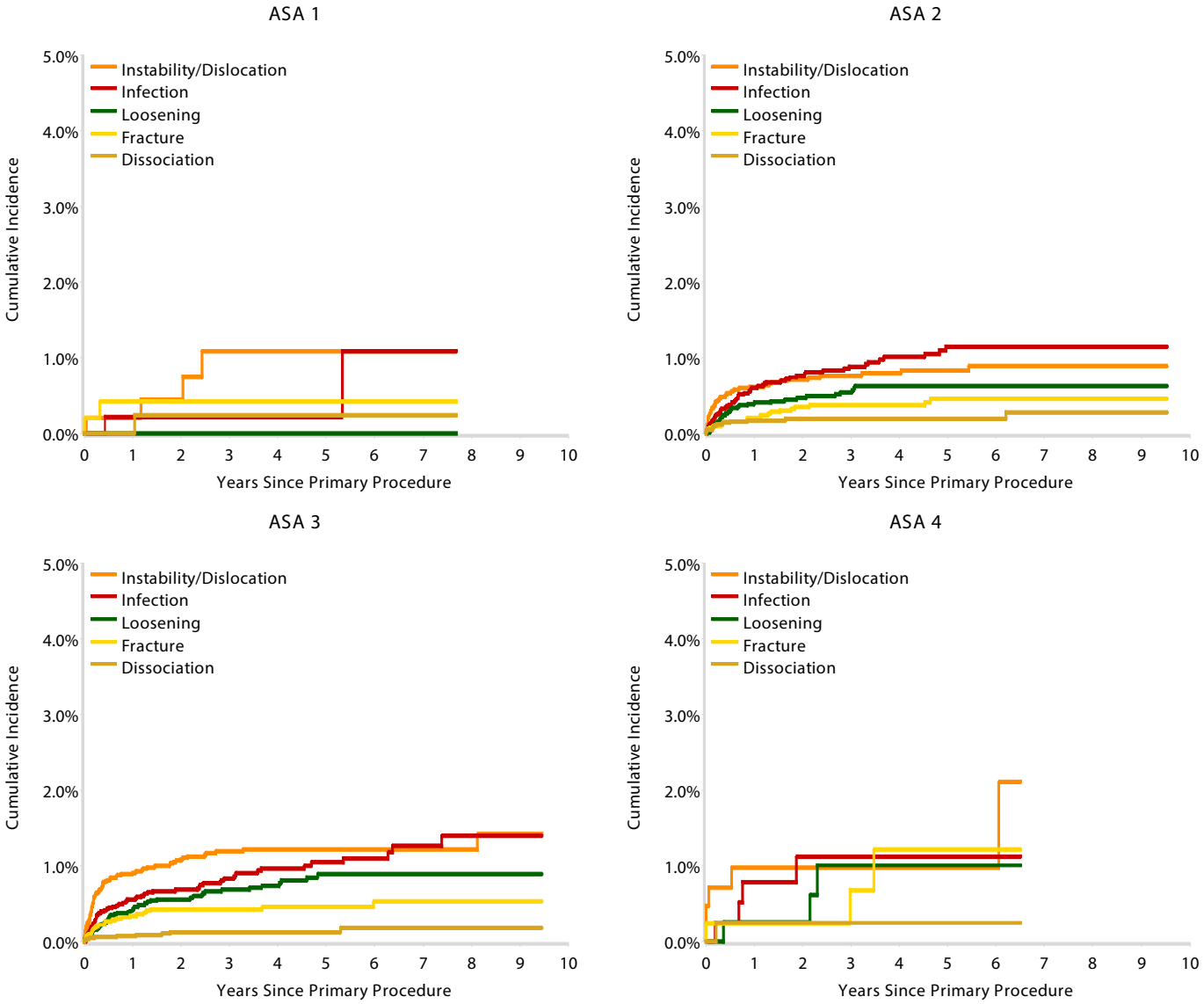
ASA 4 vs ASA 1

Entire Period: HR=2.77 (1.32, 5.80), p=0.006

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	8 Yrs
ASA 1	485	414	324	254	199	133	36
ASA 2	6485	5378	4348	3450	2596	1798	369
ASA 3	8173	6515	5012	3803	2680	1771	325
ASA 4	419	337	242	175	105	67	18

Note: Restricted to modern prostheses

Figure ST55 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Reverse Shoulder Replacement by ASA Score (Primary Diagnosis Rotator Cuff Arthropathy)



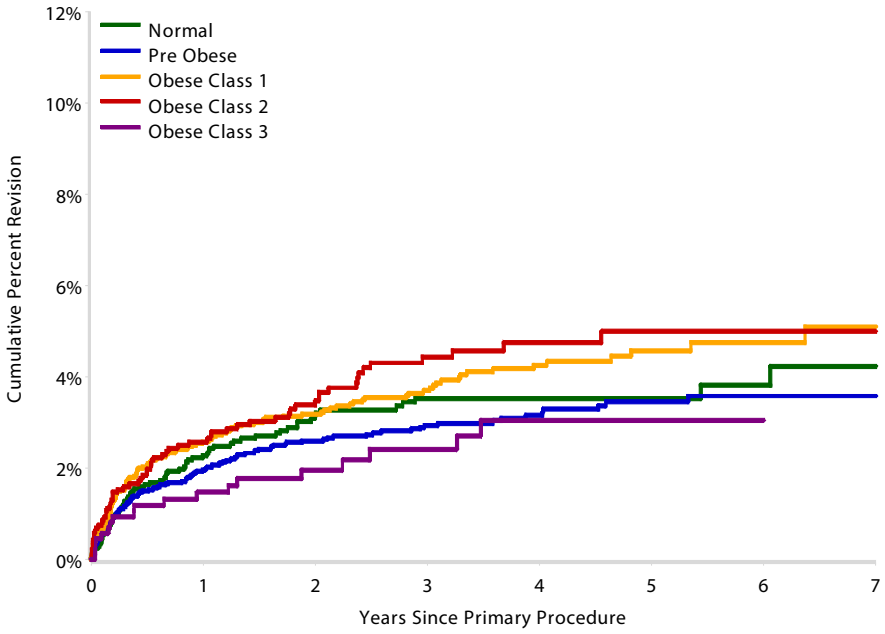
Note: Restricted to modern prostheses

Table ST79 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	2	87	1.2 (0.2, 8.2)	2.7 (0.7, 10.3)	2.7 (0.7, 10.3)	2.7 (0.7, 10.3)	2.7 (0.7, 10.3)	
Normal	73	2398	2.3 (1.7, 3.0)	3.2 (2.5, 4.0)	3.5 (2.8, 4.5)	3.5 (2.8, 4.5)	3.5 (2.8, 4.5)	3.8 (2.9, 4.9)
Pre Obese	133	4940	2.0 (1.6, 2.4)	2.6 (2.2, 3.1)	2.9 (2.5, 3.5)	3.2 (2.6, 3.8)	3.5 (2.9, 4.2)	3.6 (3.0, 4.3)
Obese Class 1	136	3821	2.6 (2.1, 3.1)	3.2 (2.7, 3.8)	3.7 (3.1, 4.4)	4.3 (3.6, 5.1)	4.6 (3.8, 5.5)	4.8 (3.9, 5.7)
Obese Class 2	65	1722	2.6 (1.9, 3.5)	3.5 (2.7, 4.5)	4.4 (3.5, 5.7)	4.7 (3.7, 6.1)	5.0 (3.9, 6.5)	5.0 (3.9, 6.5)
Obese Class 3	19	861	1.5 (0.8, 2.6)	2.0 (1.2, 3.3)	2.4 (1.5, 3.9)	3.1 (1.9, 4.9)	3.1 (1.9, 4.9)	3.1 (1.9, 4.9)
TOTAL	**428**	**13829**						

Note: BMI has not been presented for patients aged ≤19 years
Restricted to modern prostheses

Figure ST56 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 vs Normal
Entire Period: HR=0.82 (0.62, 1.09), p=0.172

Obese Class 1 vs Normal
Entire Period: HR=1.07 (0.80, 1.43), p=0.636

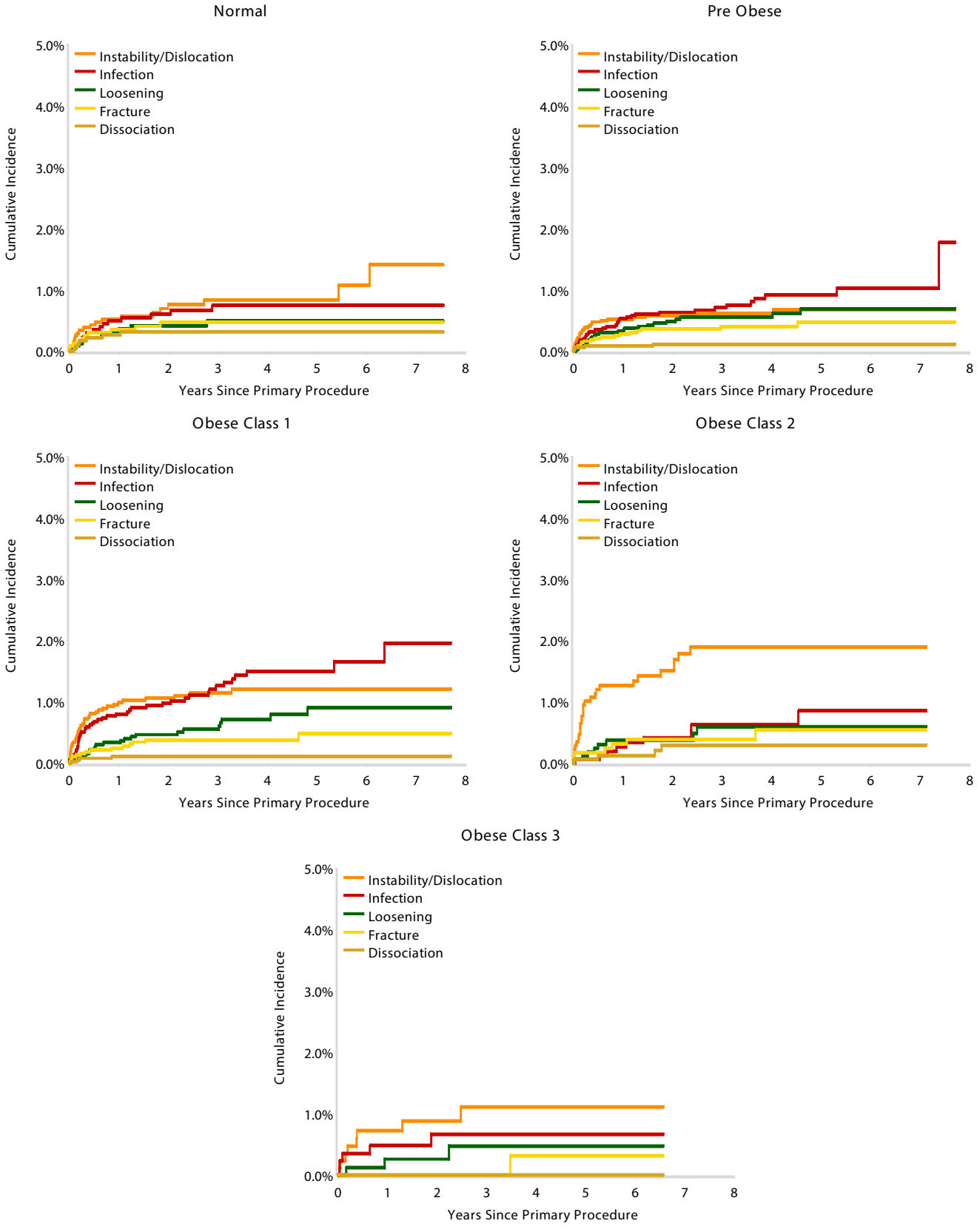
Obese Class 2 vs Normal
Entire Period: HR=1.17 (0.84, 1.65), p=0.355

Obese Class 3 vs Normal
Entire Period: HR=0.73 (0.44, 1.21), p=0.223

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Normal	2398	1922	1460	1113	771	453	241
Pre Obese	4940	3901	2972	2220	1501	925	446
Obese Class 1	3821	3070	2364	1744	1177	695	365
Obese Class 2	1722	1354	1025	743	500	295	137
Obese Class 3	861	691	500	367	234	143	72

Note: BMI has not been presented for patients aged ≤19 years
Restricted to modern prostheses

Figure ST57 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Reverse Shoulder Replacement by BMI Category (Primary Diagnosis Rotator Cuff Arthropathy)



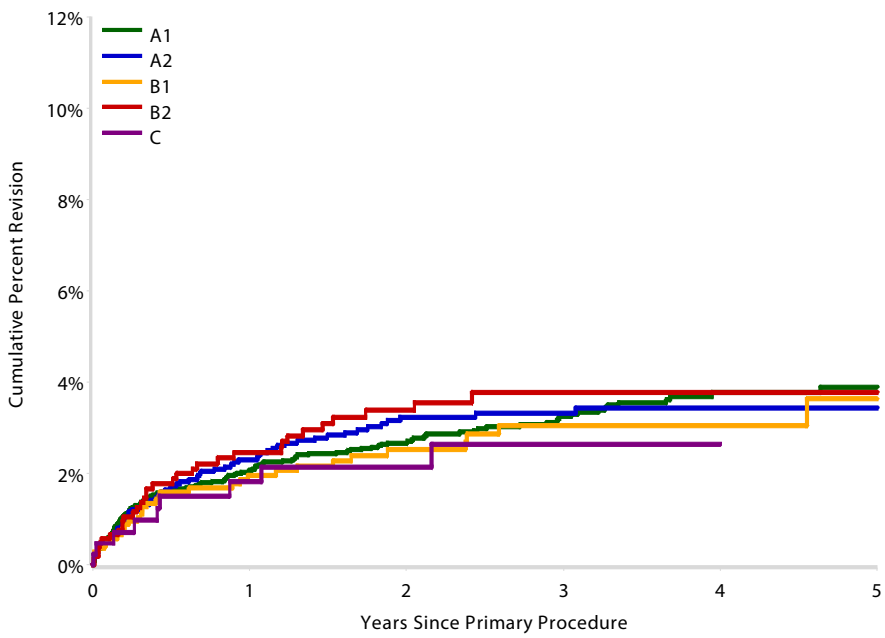
Note: BMI has not been presented for patients aged ≤19 years
Restricted to modern prostheses

Table ST80 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	152	5387	2.1 (1.7, 2.5)	2.7 (2.2, 3.2)	3.2 (2.7, 3.8)	3.8 (3.2, 4.5)
A2	72	2558	2.3 (1.8, 3.0)	3.2 (2.6, 4.1)	3.3 (2.6, 4.2)	3.4 (2.7, 4.3)
B1	34	1391	2.0 (1.3, 2.9)	2.5 (1.8, 3.6)	3.0 (2.1, 4.3)	3.0 (2.1, 4.3)
B2	33	1062	2.5 (1.6, 3.6)	3.4 (2.4, 4.8)	3.8 (2.7, 5.3)	3.8 (2.7, 5.3)
C	10	425	1.8 (0.9, 3.8)	2.1 (1.1, 4.3)	2.6 (1.4, 5.1)	2.6 (1.4, 5.1)
TOTAL	**301**	**10823**				

Note: Restricted to modern prostheses
Excludes 18 procedures with a recorded glenoid morphology of B3

Figure ST58 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=1.08 (0.81, 1.43), p=0.609

B1 vs A1

Entire Period: HR=0.89 (0.62, 1.29), p=0.548

B2 vs A1

Entire Period: HR=1.17 (0.80, 1.71), p=0.411

C vs A1

Entire Period: HR=0.90 (0.48, 1.71), p=0.753

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs
A1	5387	4159	3030	2078	1227
A2	2558	1930	1340	921	509
B1	1391	1025	704	459	269
B2	1062	813	565	358	194
C	425	310	207	136	69

Note: Restricted to modern prostheses

OUTCOME FOR ROTATOR CUFF ARTHROPATHY – PROSTHESIS CHARACTERISTICS

Fixation

Fixation is not a risk factor for revision (Table ST81 and Figure ST59).

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 ST82 and Figure ST60). The reasons for revision for the different bearing surfaces are presented in Figure ST61.

Glenosphere Size

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 ST83 and Figure ST62). The cumulative incidence of the most common reasons for revision for the different glenosphere sizes is presented in Figure ST63.

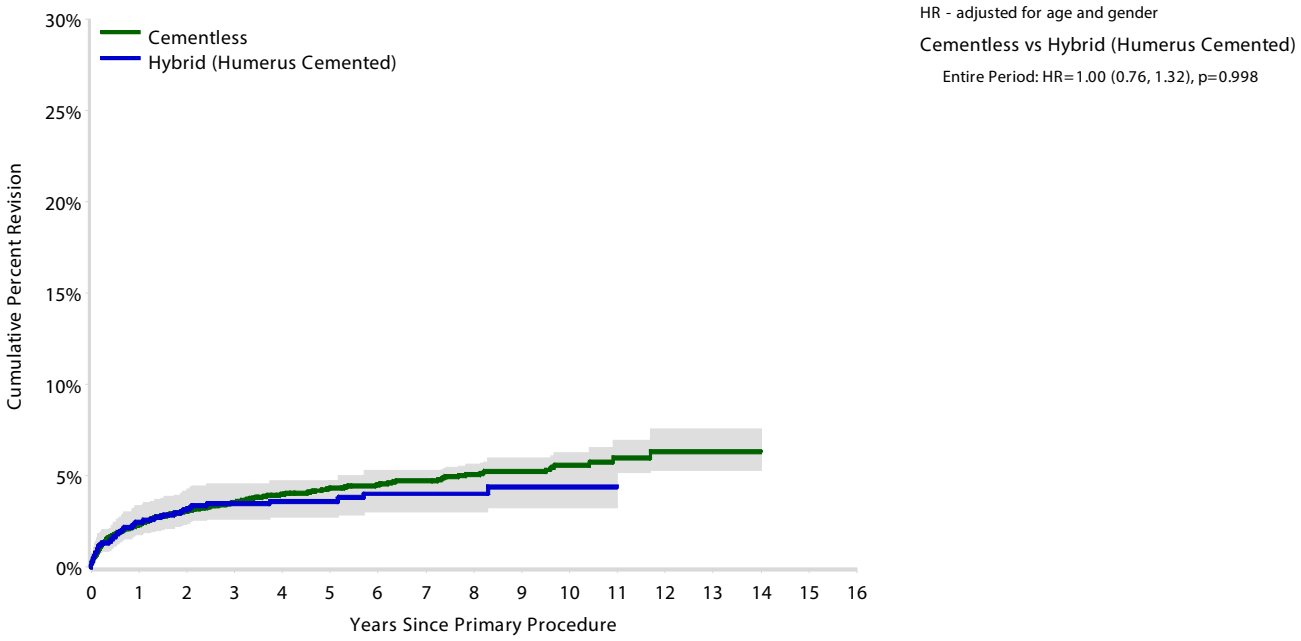
The outcomes of the most commonly used prosthesis combinations are listed in Table ST84. The most commonly used cementless prosthesis combinations are listed in Table ST85. The most commonly used hybrid (humerus cemented) prosthesis combinations are listed in Table ST86.

Table ST81 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	25	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	564	15630	2.3 (2.1, 2.6)	3.6 (3.2, 3.9)	4.3 (3.9, 4.7)	4.7 (4.3, 5.2)	5.6 (4.9, 6.3)	6.3 (5.3, 7.6)
Hybrid (Glenoid Cemented)	7	110	6.5 (3.1, 13.1)	6.5 (3.1, 13.1)				
Hybrid (Humerus Cemented)	54	1578	2.4 (1.8, 3.3)	3.5 (2.6, 4.6)	3.6 (2.7, 4.7)	4.0 (3.0, 5.3)	4.4 (3.2, 6.0)	
TOTAL	**626**	**17343**						

Note: Restricted to modern prostheses

Figure ST59 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	15630	12867	8267	4634	2355	669	57
Hybrid (Humerus Cemented)	1578	1369	933	525	336	108	7

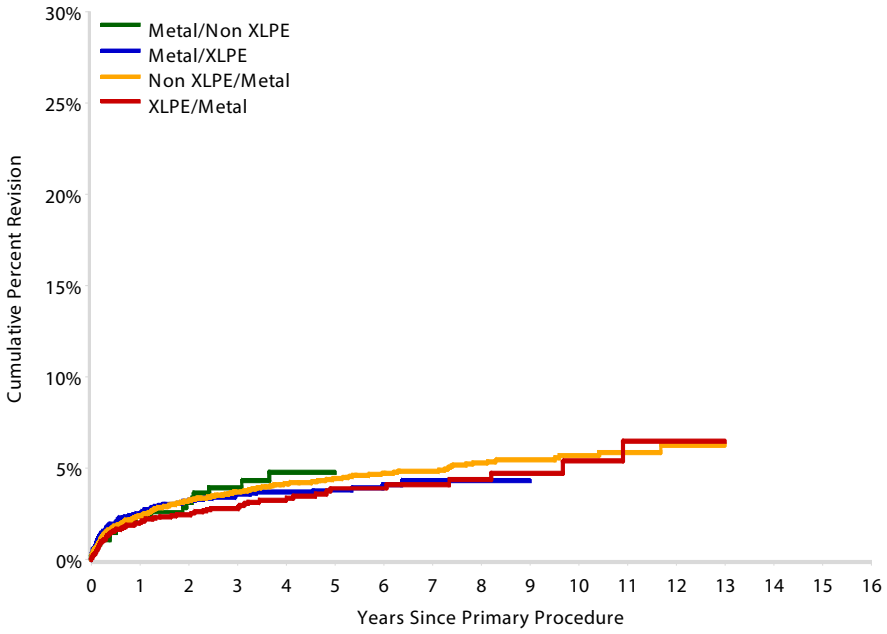
Note: Only fixations with >120 procedures have been listed
Restricted to modern prostheses

Table ST82 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	60	0.0 (0.0, 0.0)	2.3 (0.3, 15.1)				
Metal/Non XLPE	19	467	2.4 (1.3, 4.2)	3.9 (2.5, 6.3)	4.8 (3.0, 7.5)			
Metal/XLPE	102	2999	2.5 (2.0, 3.2)	3.6 (2.9, 4.3)	3.8 (3.1, 4.6)	4.3 (3.4, 5.4)		
Non XLPE/Metal	421	10893	2.4 (2.1, 2.7)	3.7 (3.4, 4.1)	4.4 (4.0, 4.9)	4.9 (4.4, 5.4)	5.7 (5.0, 6.4)	
XLPE/Metal	83	2905	2.0 (1.6, 2.6)	2.8 (2.2, 3.6)	3.9 (3.1, 5.0)	4.1 (3.2, 5.3)	5.4 (3.8, 7.6)	
TOTAL	**626**	**17334**						

Note: Restricted to modern prostheses
Excludes 9 procedures with unknown bearing surface

Figure ST60 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=1.26 (0.77, 2.08), p=0.356

Metal/XLPE vs XLPE/Metal

0 - 2Wk: HR=1.92 (1.06, 3.46), p=0.030

2Wk+: HR=0.94 (0.69, 1.27), p=0.689

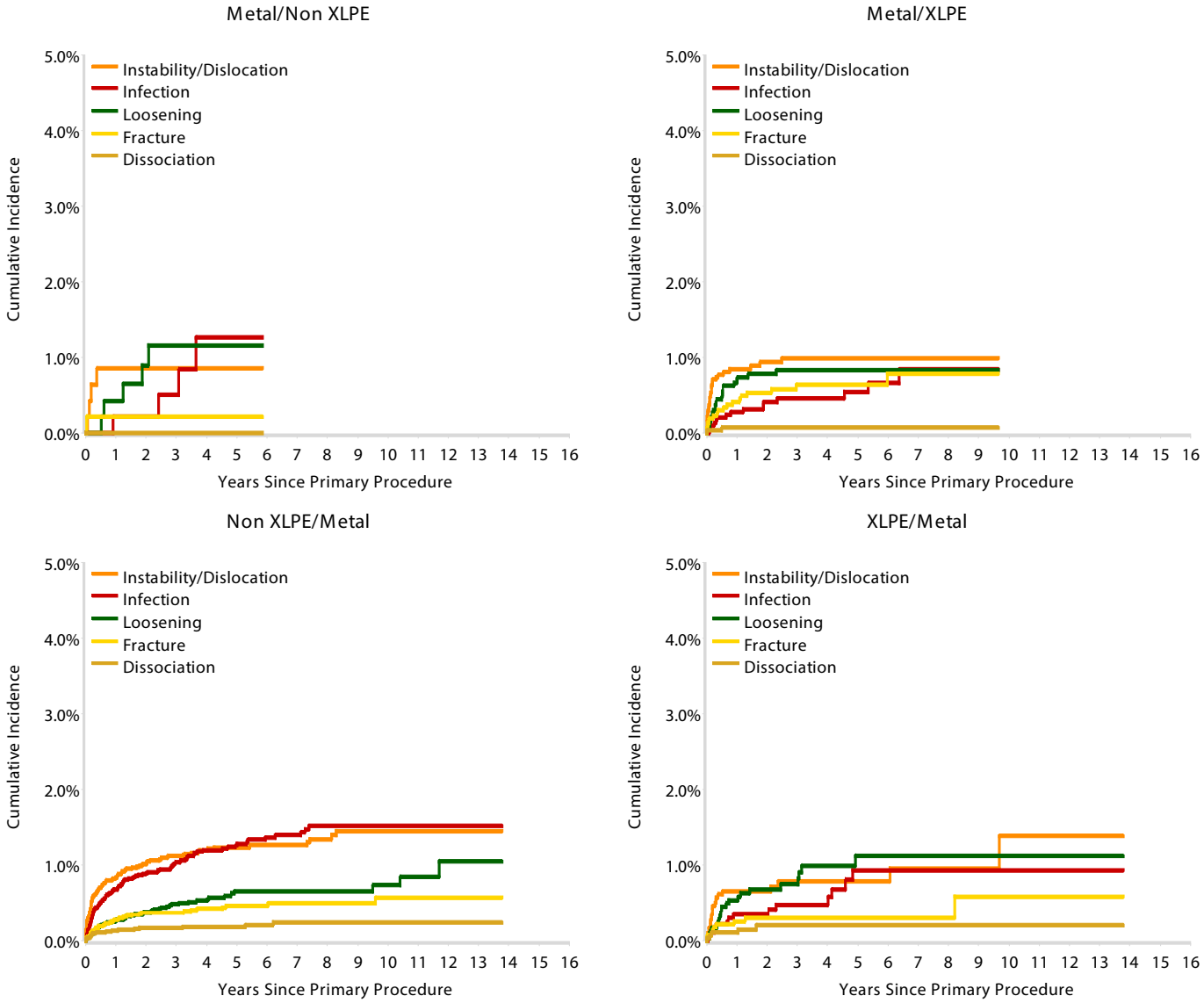
Non XLPE/Metal vs XLPE/Metal

Entire Period: HR=1.16 (0.92, 1.47), p=0.205

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Metal/Non XLPE	467	439	278	80	13	1	0
Metal/XLPE	2999	2512	1600	860	325	23	1
Non XLPE/Metal	10893	9179	6195	3601	1967	635	29
XLPE/Metal	2905	2155	1176	646	394	122	35

Note: Restricted to modern prostheses

Figure ST61 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Reverse Shoulder Replacement by Bearing Surface (Primary Diagnosis Rotator Cuff Arthropathy)



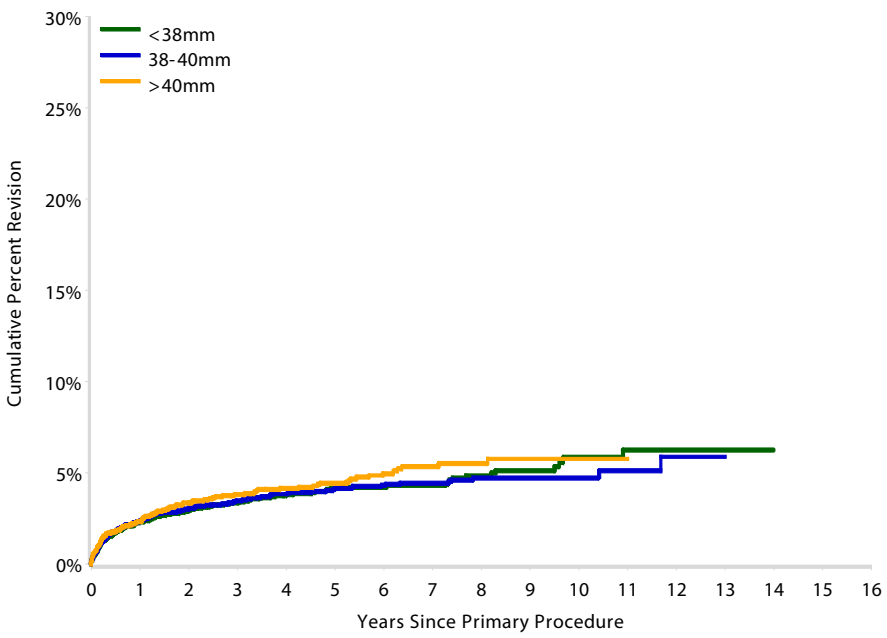
Note: Restricted to modern prostheses

Table ST83 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	203	5811	2.3 (1.9, 2.8)	3.4 (2.9, 3.9)	4.2 (3.6, 4.8)	4.3 (3.7, 5.0)	5.8 (4.8, 7.2)	6.3 (5.0, 7.9)
38–40mm	232	6490	2.4 (2.0, 2.8)	3.5 (3.1, 4.0)	4.1 (3.6, 4.7)	4.4 (3.9, 5.1)	4.7 (4.1, 5.5)	
>40mm	174	4509	2.3 (1.9, 2.8)	3.8 (3.3, 4.5)	4.4 (3.8, 5.2)	5.4 (4.5, 6.4)	5.8 (4.8, 7.0)	
TOTAL	**609**	**16810**						

Note: Excludes 341 procedures with unknown glenosphere sizes
Restricted to modern prostheses

Figure ST62 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=0.98 (0.81, 1.19), p=0.859

>40mm vs <38mm

Entire Period: HR=0.81 (0.65, 1.00), p=0.052

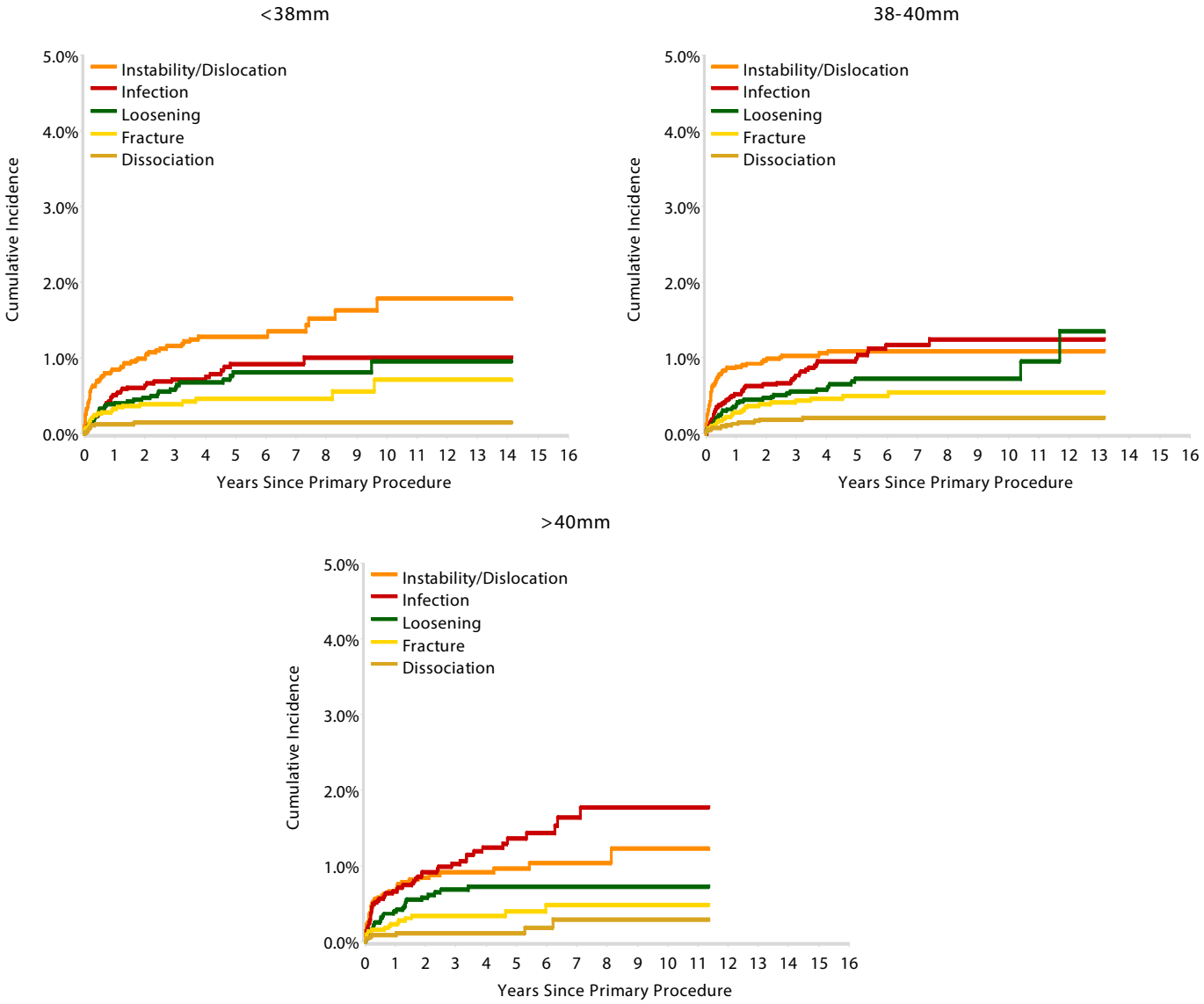
>40mm vs 38-40mm

Entire Period: HR=0.82 (0.67, 1.01), p=0.066

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
<38mm	5811	4738	3073	1753	986	335	45
38–40mm	6490	5481	3722	2185	1130	325	15
>40mm	4509	3795	2392	1257	586	121	5

Note: Restricted to modern prostheses

Figure ST63 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 ST84 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	53	1228	2.1 (1.4, 3.1)	3.6 (2.6, 4.8)	4.4 (3.3, 5.9)	4.6 (3.5, 6.1)	6.3 (4.6, 8.5)	
	Perform Reversed	0	76	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)				
Affinis	Affinis	20	699	1.6 (0.9, 2.9)	3.0 (1.9, 4.7)	3.6 (2.3, 5.7)			
AltiVate	RSP	0	28	0.0 (0.0, 0.0)					
AltiVate Reverse	RSP	20	637	2.6 (1.5, 4.3)	4.3 (2.6, 7.1)				
Ascend Flex	Aequalis	47	1275	2.6 (1.8, 3.7)	4.6 (3.4, 6.2)	5.4 (3.8, 7.6)	5.4 (3.8, 7.6)		
	Perform Reversed	6	330	1.7 (0.7, 4.2)					
Comprehensive	Comprehensive Reverse	34	1768	1.5 (1.0, 2.2)	2.2 (1.5, 3.1)	3.0 (1.9, 4.7)	3.0 (1.9, 4.7)		
	Trabecular Metal	1	36	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)				
Delta Xtend	Delta Xtend	155	4118	2.1 (1.7, 2.5)	3.2 (2.7, 3.8)	3.8 (3.2, 4.5)	4.4 (3.8, 5.2)	4.8 (4.1, 5.7)	
Equinoxe	Equinoxe	51	1665	2.2 (1.6, 3.1)	3.3 (2.5, 4.4)	4.2 (3.1, 5.7)			
Global Unite	Delta Xtend	12	368	1.7 (0.8, 3.7)	3.3 (1.7, 6.1)	4.5 (2.5, 8.0)			
MSS	MSS	2	49	3.3 (0.5, 21.4)	6.7 (1.7, 24.1)				
RSP	RSP	27	711	2.9 (1.9, 4.4)	3.8 (2.6, 5.6)	4.2 (2.8, 6.1)			
SMR	SMR Axioma	3	47	6.5 (2.2, 18.9)	6.5 (2.2, 18.9)				
	SMR L1	142	3463	2.9 (2.4, 3.5)	3.9 (3.3, 4.7)	4.4 (3.7, 5.3)	4.8 (4.1, 5.8)	5.8 (4.5, 7.4)	
Trabecular Metal	Comprehensive Reverse	10	101	8.1 (4.1, 15.5)	10.9 (5.9, 19.6)				
	Trabecular Metal	42	683	4.0 (2.7, 5.7)	5.4 (3.9, 7.4)	6.0 (4.4, 8.1)	6.2 (4.6, 8.4)	7.6 (5.3, 10.8)	
Other (12)		1	61	2.0 (0.3, 13.1)	2.0 (0.3, 13.1)	2.0 (0.3, 13.1)			
TOTAL		**626**	**17343**						

Note: Restricted to modern prostheses
Only prostheses with >25 procedures have been listed

Table ST85 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	42	1028	1.9 (1.2, 3.0)	3.4 (2.4, 4.7)	4.4 (3.2, 6.1)	4.4 (3.2, 6.1)	6.1 (4.2, 8.6)	
	Perform Reversed	0	58	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)				
Affinis	Affinis	13	406	1.5 (0.7, 3.3)	3.1 (1.7, 5.6)	4.2 (2.4, 7.2)			
AltiVate	RSP	0	28	0.0 (0.0, 0.0)					
AltiVate Reverse	RSP	19	592	2.6 (1.5, 4.5)					
Ascend Flex	Aequalis	44	1130	2.6 (1.8, 3.8)	4.9 (3.6, 6.6)	5.7 (4.0, 8.1)			
	Perform Reversed	5	309	1.9 (0.8, 4.5)					
Comprehensive	Comprehensive Reverse	32	1717	1.4 (0.9, 2.1)	2.1 (1.4, 3.0)	3.0 (1.9, 4.7)	3.0 (1.9, 4.7)		
	Trabecular Metal	1	36	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)				
Delta Xtend	Delta Xtend	135	3486	2.1 (1.6, 2.6)	3.3 (2.7, 3.9)	4.0 (3.3, 4.7)	4.6 (3.9, 5.5)	5.0 (4.2, 6.0)	
Equinoxe	Equinoxe	50	1613	2.2 (1.5, 3.1)	3.4 (2.5, 4.5)	4.3 (3.1, 5.8)			
Global Unite	Delta Xtend	11	336	1.8 (0.8, 4.0)	3.2 (1.6, 6.2)	4.5 (2.4, 8.2)			
MSS	MSS	2	49	3.3 (0.5, 21.4)	6.7 (1.7, 24.1)				
RSP	RSP	24	650	2.7 (1.7, 4.2)	3.7 (2.5, 5.6)	4.1 (2.7, 6.1)			
SMR	SMR Axioma	2	46	4.5 (1.1, 16.8)	4.5 (1.1, 16.8)				
	SMR L1	133	3356	2.7 (2.2, 3.4)	3.8 (3.2, 4.5)	4.3 (3.6, 5.1)	4.7 (3.9, 5.7)	5.7 (4.4, 7.4)	
Trabecular Metal	Comprehensive Reverse	10	99	8.2 (4.2, 15.7)	11.1 (6.0, 19.9)				
	Trabecular Metal	41	637	4.1 (2.8, 6.0)	5.6 (4.1, 7.8)	6.3 (4.6, 8.5)	6.5 (4.8, 8.9)	7.9 (5.5, 11.4)	
Other (9)		0	54	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)			
TOTAL		**564**	**15630**						

Note: Restricted to modern prostheses
Only prostheses with >25 procedures have been listed

Table ST86 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	196	3.1 (1.4, 6.8)	4.8 (2.5, 9.0)	4.8 (2.5, 9.0)	5.6 (3.0, 10.3)		
Affinis	Affinis	7	270	1.9 (0.8, 4.5)	3.0 (1.4, 6.3)				
AltiVate Reverse	RSP	0	40	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)				
Ascend Flex	Aequalis	2	141	1.5 (0.4, 5.8)	1.5 (0.4, 5.8)				
Comprehensive	Comprehensive Reverse	2	50	4.1 (1.0, 15.3)	4.1 (1.0, 15.3)				
Delta Xtend	Delta Xtend	19	614	2.0 (1.1, 3.5)	2.9 (1.8, 4.7)	3.2 (2.0, 5.0)	3.5 (2.2, 5.6)	3.5 (2.2, 5.6)	
Equinoxe	Equinoxe	1	47	2.6 (0.4, 17.2)	2.6 (0.4, 17.2)				
Global Unite	Delta Xtend	1	31	0.0 (0.0, 0.0)	4.5 (0.7, 28.1)	4.5 (0.7, 28.1)	4.5 (0.7, 28.1)		
RSP	RSP	3	58	5.3 (1.7, 15.5)	5.3 (1.7, 15.5)	5.3 (1.7, 15.5)			
SMR	SMR L1	4	43	7.3 (2.4, 21.0)	10.0 (3.9, 24.6)	10.0 (3.9, 24.6)	10.0 (3.9, 24.6)		
Trabecular Metal	Trabecular Metal	1	41	2.4 (0.3, 16.1)	2.4 (0.3, 16.1)	2.4 (0.3, 16.1)	2.4 (0.3, 16.1)		
Other (9)		3	47	4.7 (1.2, 17.6)	8.1 (2.6, 23.6)				
TOTAL		**54**	**1578**						

Note: Restricted to modern prostheses
Only prostheses with >25 procedures have been listed

OUTCOME FOR FRACTURE – PATIENT CHARACTERISTICS

There are 7,204 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 6.0% (Table ST87).

The most common reasons for revision are instability/dislocation (46.4%), infection (23.4%), fracture (11.8%) and loosening (11.5%) (Table ST88 and Figure ST64). The most common types of revision are of the humeral component (33.9%) and cup only (23.7%) (Table ST89).

Age and Gender

For the diagnosis of fracture, patients aged <75 years have a higher risk of revision than patients aged ≥75 years (Table ST90 and Figure ST65).

Males have a higher rate of revision than females in the first 3 months (Table ST91 and Figure ST66). The higher rate of revision for males is due to an increased incidence of revision for instability/dislocation (Figure ST67).

At 1 year, the cumulative incidence of revision for instability/dislocation in males is 5.5% compared to 1.2% for females.

ASA and BMI

ASA score is not a risk factor for revision (Table ST92 and Figure ST68). The cumulative incidence for the most common reasons for revision of the different ASA scores are presented in Figure ST69.

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 ST93 and Figure ST70). 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 ST71.

Glenoid Morphology

The cumulative percent revision for the different morphology categories is presented in Table ST94. The category of glenoid morphology is not a risk factor for revision (Figure ST72).

Table ST87 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	304	7204	3.2 (2.8, 3.6)	4.2 (3.7, 4.7)	4.8 (4.2, 5.3)	5.1 (4.6, 5.8)	6.0 (5.1, 7.1)	
TOTAL	**304**	**7204**						

Note: Restricted to modern prostheses

Table ST88 Primary Total Stemmed Reverse Shoulder Replacement by Reason for Revision (Primary Diagnosis Fracture)

Reason for Revision	Number	Percent
Instability/Dislocation	141	46.4
Infection	71	23.4
Fracture	36	11.8
Loosening	35	11.5
Arthrofibrosis	5	1.6
Dissociation	4	1.3
Implant Breakage Glenoid	2	0.7
Malposition	2	0.7
Heterotopic Bone	2	0.7
Lysis	2	0.7
Pain	1	0.3
Tumour	1	0.3
Implant Breakage Glenoid Insert	1	0.3
Other	1	0.3
TOTAL	**304**	**100.0**

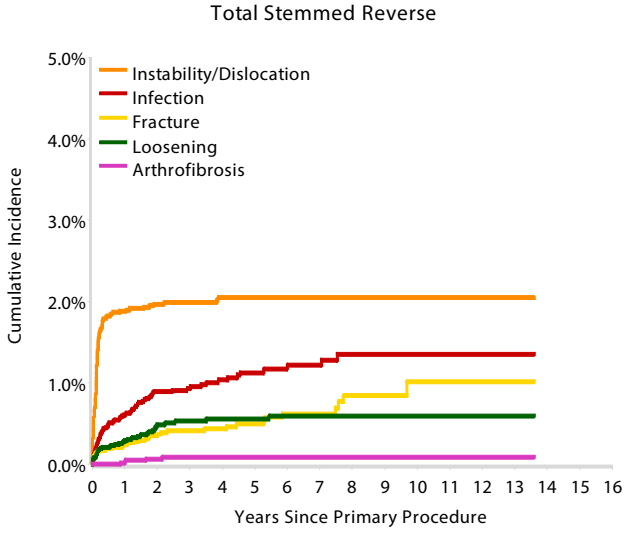
Note: Restricted to modern prostheses

Table ST89 Primary Total Stemmed Reverse Shoulder Replacement by Type of Revision (Primary Diagnosis Fracture)

Type of Revision	Number	Percent
Humeral Component	103	33.9
Cup Only	72	23.7
Cup/Head	56	18.4
Cement Spacer	21	6.9
Humeral/Glenoid	20	6.6
Removal of Prostheses	8	2.6
Glenoid Component	8	2.6
Humeral Head Only	7	2.3
Minor Components	4	1.3
Reoperation	2	0.7
Head/Insert	1	0.3
Glenosphere Only	1	0.3
Cement Only	1	0.3
TOTAL	**304**	**100.0**

Note: Restricted to modern prostheses

Figure ST64 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Reverse Shoulder Replacement (Primary Diagnosis Fracture)



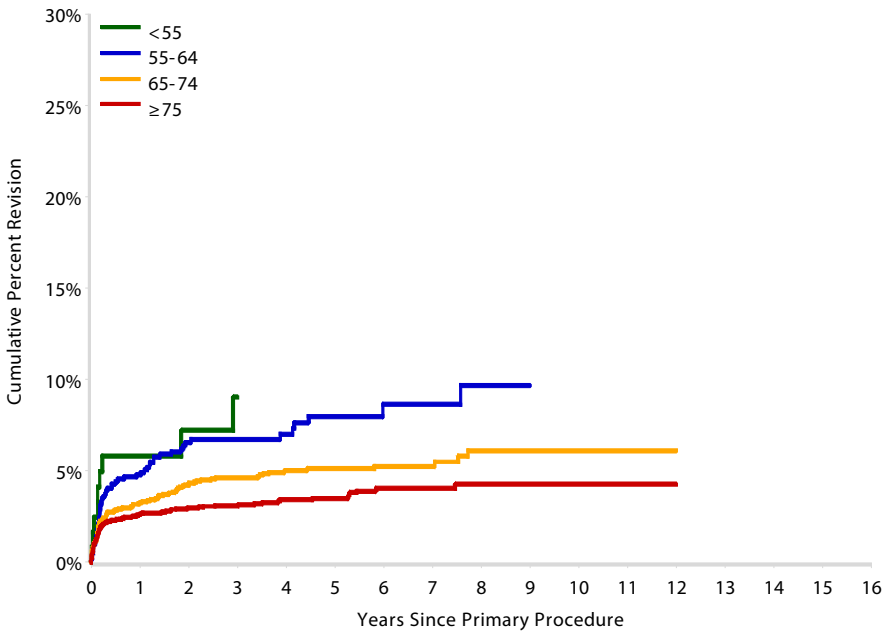
Note: Restricted to modern prostheses

Table ST90 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	10	122	5.8 (2.8, 11.8)	9.0 (4.6, 17.3)				
55–64	62	910	4.8 (3.6, 6.4)	6.7 (5.2, 8.7)	8.0 (6.1, 10.4)	8.6 (6.5, 11.4)		
65–74	118	2606	3.3 (2.6, 4.0)	4.6 (3.8, 5.6)	5.1 (4.2, 6.1)	5.3 (4.4, 6.3)	6.1 (4.9, 7.6)	
≥75	114	3566	2.6 (2.1, 3.2)	3.1 (2.6, 3.8)	3.5 (2.9, 4.2)	4.0 (3.3, 4.9)	4.2 (3.4, 5.3)	
TOTAL	**304**	**7204**						

Note: Restricted to modern prostheses

Figure ST65 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=2.04 (1.06, 3.91), p=0.031

55-64 vs ≥75

0 - 1Mth: HR=0.93 (0.46, 1.89), p=0.843

1Mth - 3Mth: HR=2.40 (1.47, 3.91), p<0.001

3Mth+: HR=2.40 (1.56, 3.69), p<0.001

65-74 vs ≥75

Entire Period: HR=1.34 (1.03, 1.73), p=0.027

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
<55	122	86	49	25	12	2	2
55–64	910	716	413	216	99	36	8
65–74	2606	2124	1402	830	411	98	15
≥75	3566	2875	1824	1036	520	129	10

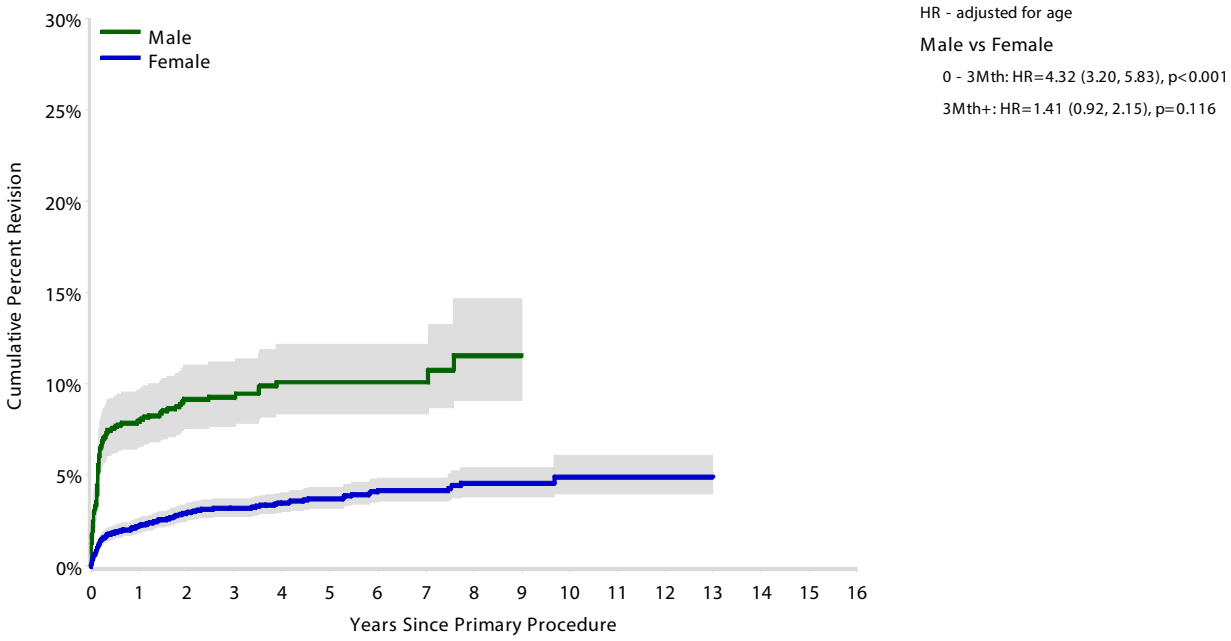
Note: Restricted to modern prostheses

Table ST91 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	109	1192	8.0 (6.5, 9.7)	9.3 (7.7, 11.2)	10.1 (8.4, 12.2)	10.1 (8.4, 12.2)		
Female	195	6012	2.2 (1.9, 2.7)	3.2 (2.8, 3.7)	3.7 (3.2, 4.3)	4.2 (3.6, 4.9)	4.9 (4.0, 6.1)	
TOTAL	**304**	**7204**						

Note: Restricted to modern prostheses

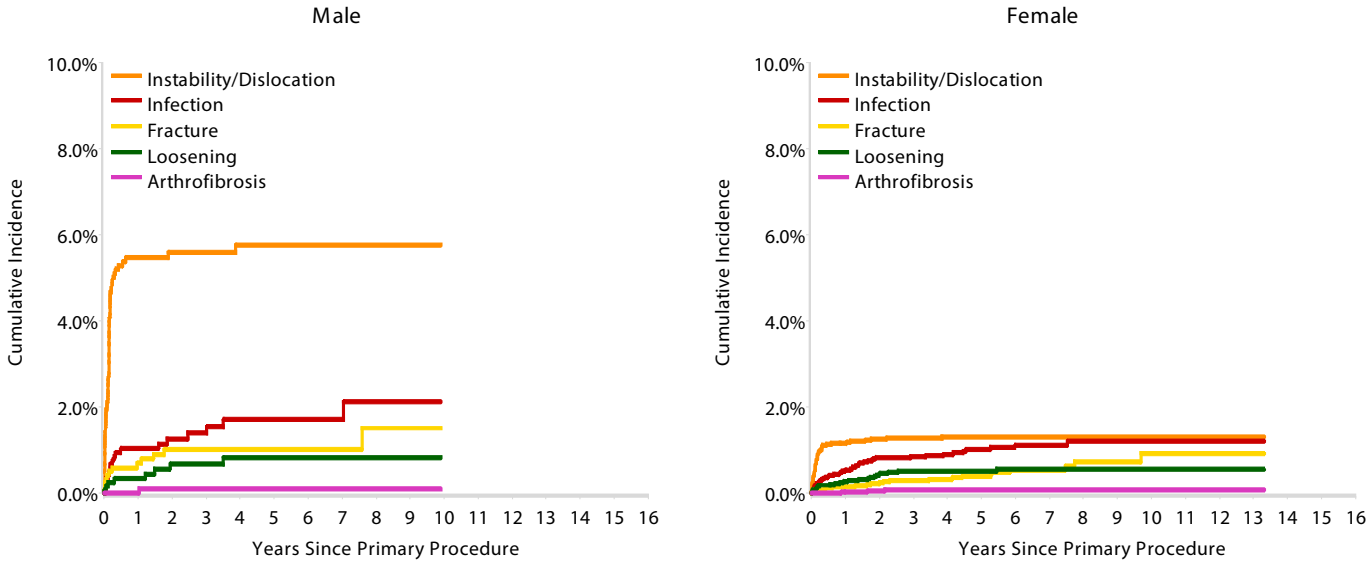
Figure ST66 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Gender (Primary Diagnosis Fracture)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Male	1192	882	512	293	136	37	8
Female	6012	4919	3176	1814	906	228	27

Note: Restricted to modern prostheses

Figure ST67 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Reverse Shoulder Replacement by Gender (Primary Diagnosis Fracture)



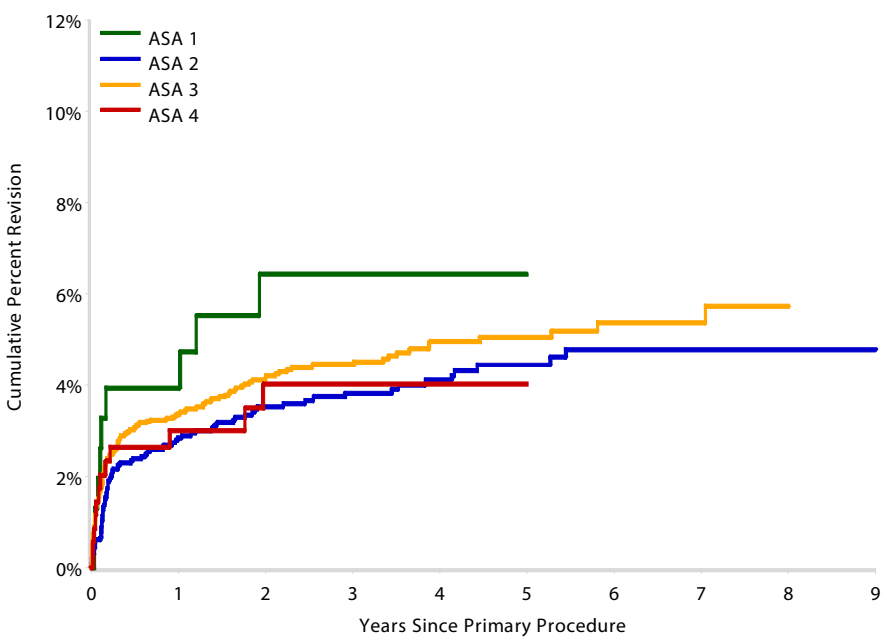
Note: Restricted to modern prostheses

Table ST92 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	153	3.9 (1.8, 8.6)	6.4 (3.4, 12.1)	6.4 (3.4, 12.1)	6.4 (3.4, 12.1)	6.4 (3.4, 12.1)	
ASA 2	86	2272	2.8 (2.2, 3.6)	3.5 (2.8, 4.4)	3.8 (3.1, 4.8)	4.1 (3.3, 5.1)	4.4 (3.6, 5.5)	4.8 (3.8, 6.0)
ASA 3	154	3597	3.4 (2.8, 4.0)	4.2 (3.5, 4.9)	4.4 (3.8, 5.2)	4.9 (4.2, 5.8)	5.0 (4.3, 6.0)	5.7 (4.7, 7.0)
ASA 4	12	351	3.0 (1.6, 5.5)	4.0 (2.3, 7.1)	4.0 (2.3, 7.1)	4.0 (2.3, 7.1)	4.0 (2.3, 7.1)	
ASA 5	0	1						
TOTAL	**261**	**6374**						

Note: Restricted to modern prostheses

Figure ST68 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=0.77 (0.39, 1.53), p=0.457

ASA 3 vs ASA 1

Entire Period: HR=0.93 (0.47, 1.84), p=0.841

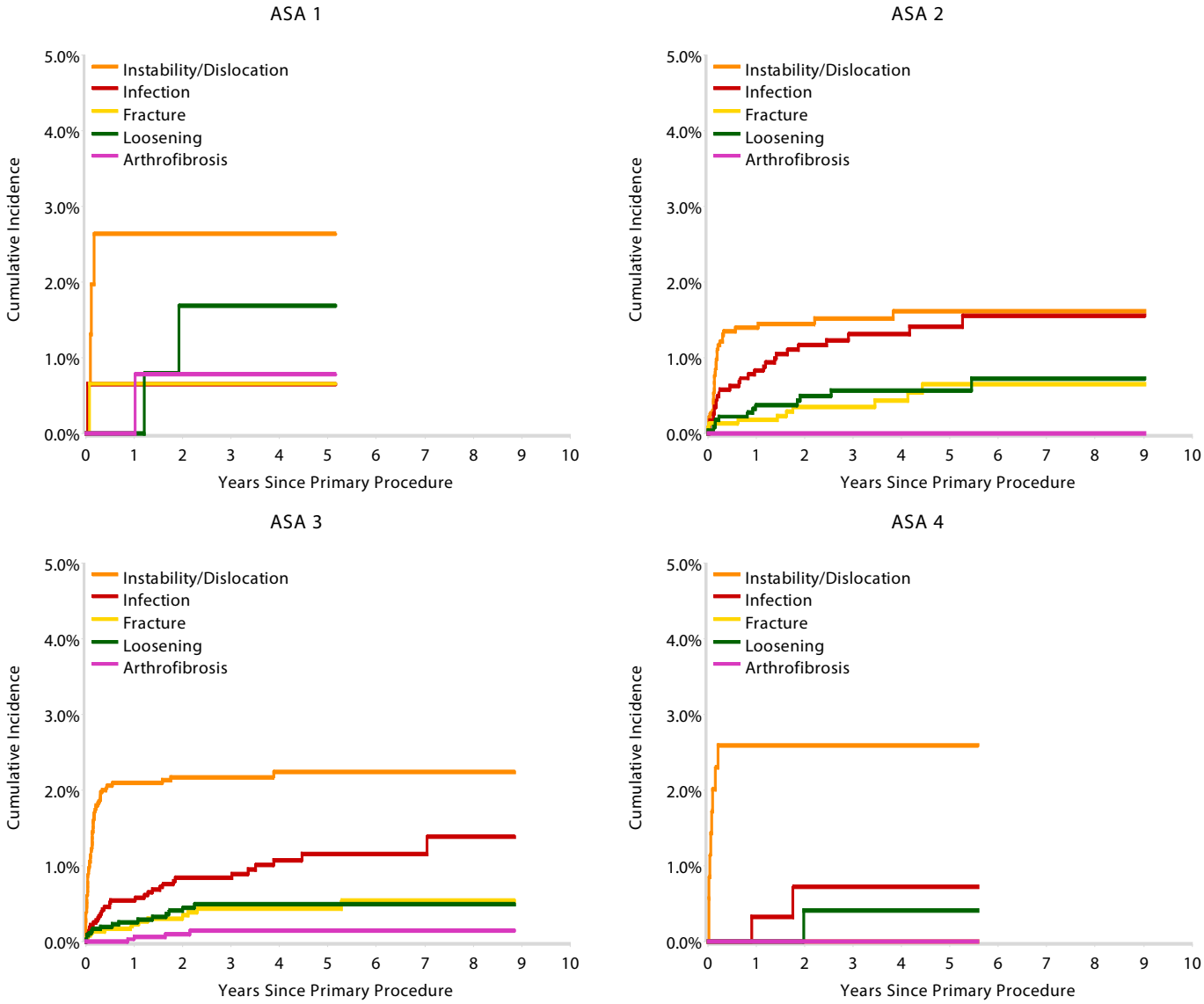
ASA 4 vs ASA 1

Entire Period: HR=0.81 (0.34, 1.94), p=0.634

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	8 Yrs
ASA 1	153	123	102	79	59	47	6
ASA 2	2272	1856	1529	1201	914	664	130
ASA 3	3597	2799	2130	1611	1158	754	126
ASA 4	351	257	179	112	81	52	6

Note: Restricted to modern prostheses

Figure ST69 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Reverse Shoulder Replacement by ASA Score (Primary Diagnosis Fracture)



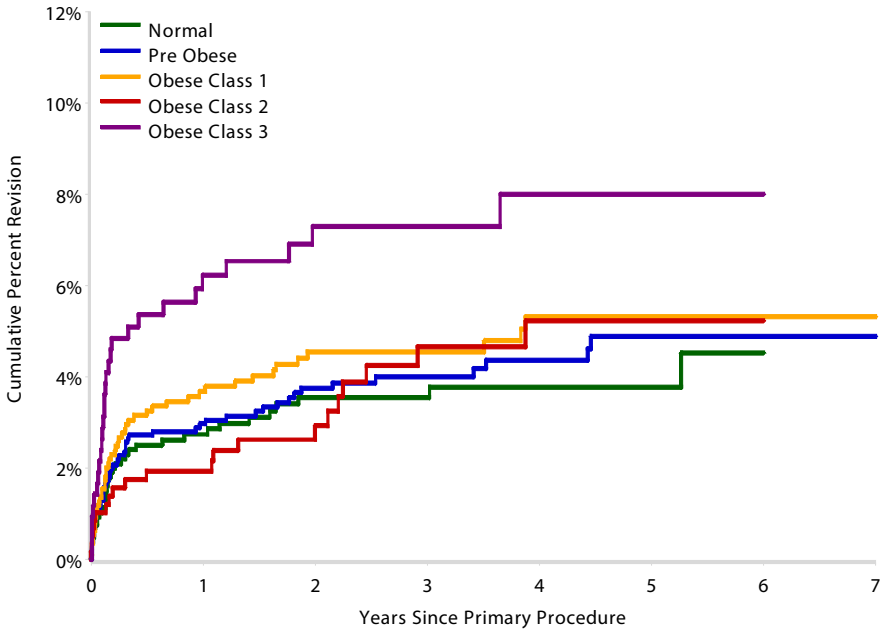
Note: Restricted to modern prostheses

Table ST93 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	1	100	1.0 (0.1, 7.1)	1.0 (0.1, 7.1)	1.0 (0.1, 7.1)	1.0 (0.1, 7.1)	1.0 (0.1, 7.1)	
Normal	36	1066	2.7 (1.9, 3.9)	3.6 (2.5, 5.0)	3.6 (2.5, 5.0)	3.8 (2.7, 5.3)	3.8 (2.7, 5.3)	4.5 (3.0, 6.9)
Pre Obese	56	1468	3.0 (2.2, 4.0)	3.8 (2.9, 4.9)	4.0 (3.1, 5.3)	4.4 (3.3, 5.7)	4.9 (3.7, 6.5)	4.9 (3.7, 6.5)
Obese Class 1	49	1106	3.7 (2.7, 5.0)	4.6 (3.4, 6.1)	4.6 (3.4, 6.1)	5.3 (4.0, 7.1)	5.3 (4.0, 7.1)	5.3 (4.0, 7.1)
Obese Class 2	21	584	1.9 (1.1, 3.5)	2.9 (1.8, 4.9)	4.7 (3.0, 7.3)	5.2 (3.3, 8.2)	5.2 (3.3, 8.2)	5.2 (3.3, 8.2)
Obese Class 3	29	420	6.2 (4.2, 9.1)	7.3 (5.1, 10.4)	7.3 (5.1, 10.4)	8.0 (5.5, 11.5)	8.0 (5.5, 11.5)	8.0 (5.5, 11.5)
TOTAL	**192**	**4744**						

Note: BMI has not been presented for patients aged ≤19 years
Restricted to modern prostheses

Figure ST70 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by BMI Category (Primary Diagnosis Fracture)



HR - adjusted for age and gender

Pre Obese vs Normal
Entire Period: HR=1.07 (0.70, 1.62), p=0.763

Obese Class 1 vs Normal
Entire Period: HR=1.21 (0.79, 1.87), p=0.384

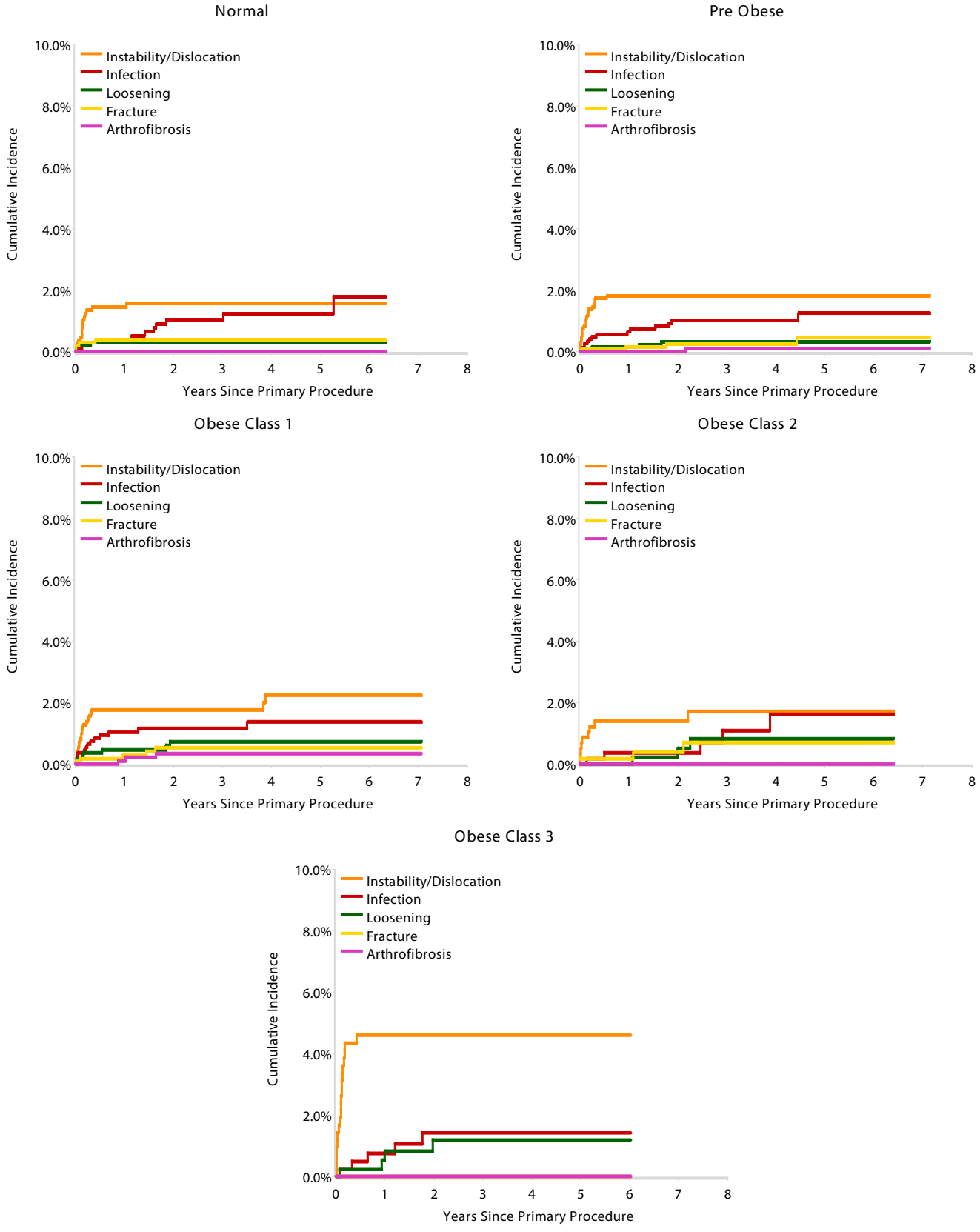
Obese Class 2 vs Normal
Entire Period: HR=1.03 (0.60, 1.78), p=0.908

Obese Class 3 vs Normal
Entire Period: HR=1.87 (1.13, 3.09), p=0.014

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Normal	1066	806	610	436	294	161	66
Pre Obese	1468	1131	860	645	439	284	136
Obese Class 1	1106	870	676	495	345	209	111
Obese Class 2	584	442	319	220	162	102	54
Obese Class 3	420	316	234	170	116	71	41

Note: BMI has not been presented for patients aged ≤19 years
Restricted to modern prostheses

Figure ST71 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Reverse Shoulder Replacement by BMI Category (Primary Diagnosis Fracture)



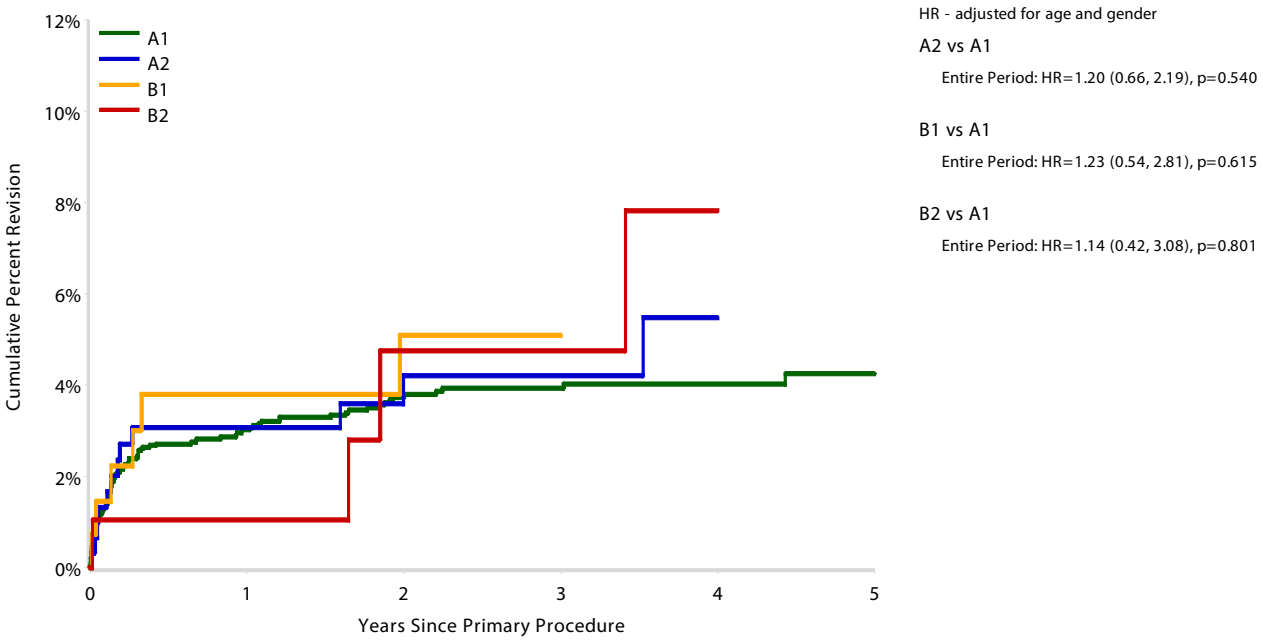
Note: BMI has not been presented for patients aged ≤19 years
Restricted to modern prostheses

Table ST94 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	110	3151	3.0 (2.5, 3.7)	3.7 (3.1, 4.5)	3.9 (3.2, 4.7)	4.0 (3.3, 4.9)
A2	12	305	3.1 (1.6, 5.8)	4.2 (2.3, 7.6)	4.2 (2.3, 7.6)	5.5 (2.9, 10.3)
B1	6	138	3.8 (1.6, 8.9)	5.1 (2.3, 11.2)	5.1 (2.3, 11.2)	
B2	4	96	1.0 (0.1, 7.2)	4.8 (1.5, 14.5)	4.8 (1.5, 14.5)	7.8 (2.8, 20.8)
C	1	36	2.9 (0.4, 19.1)	2.9 (0.4, 19.1)	2.9 (0.4, 19.1)	2.9 (0.4, 19.1)
TOTAL	**133**	**3726**				

Note: Restricted to modern prostheses

Figure ST72 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Glenoid Morphology (Primary Diagnosis Fracture)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs
A1	3151	2297	1609	1042	586
A2	305	224	152	96	59
B1	138	101	73	51	26
B2	96	72	48	39	22

Note: Restricted to modern prostheses

OUTCOME FOR FRACTURE – PROSTHESIS CHARACTERISTICS

Fixation

When total stemmed reverse shoulder replacement is used for the management of fracture, cementless fixation has a higher rate of revision compared to hybrid fixation (humerus cemented) in the first 3 months only (Table ST95 and Figure ST73).

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. Metal/XLPE has a higher rate of revision than XLPE/metal (Table ST96 and Figure ST74).

The cumulative incidence for the most common reasons for revision of the different types of bearing surface are presented in Figure ST75.

Glenosphere Size

Glenosphere sizes >40mm have a higher rate of revision compared to glenosphere sizes <38mm (Table ST97 and Figure ST76). The cumulative incidence for the most common reasons for revision of the different glenosphere sizes are presented in Figure ST77.

Glenosphere sizes >40mm have a higher rate of revision compared to <38mm sizes.

Stem Types

There is an increased rate of revision for non fracture humeral stems compared to fracture humeral stems (Table ST98 and Figure ST78).

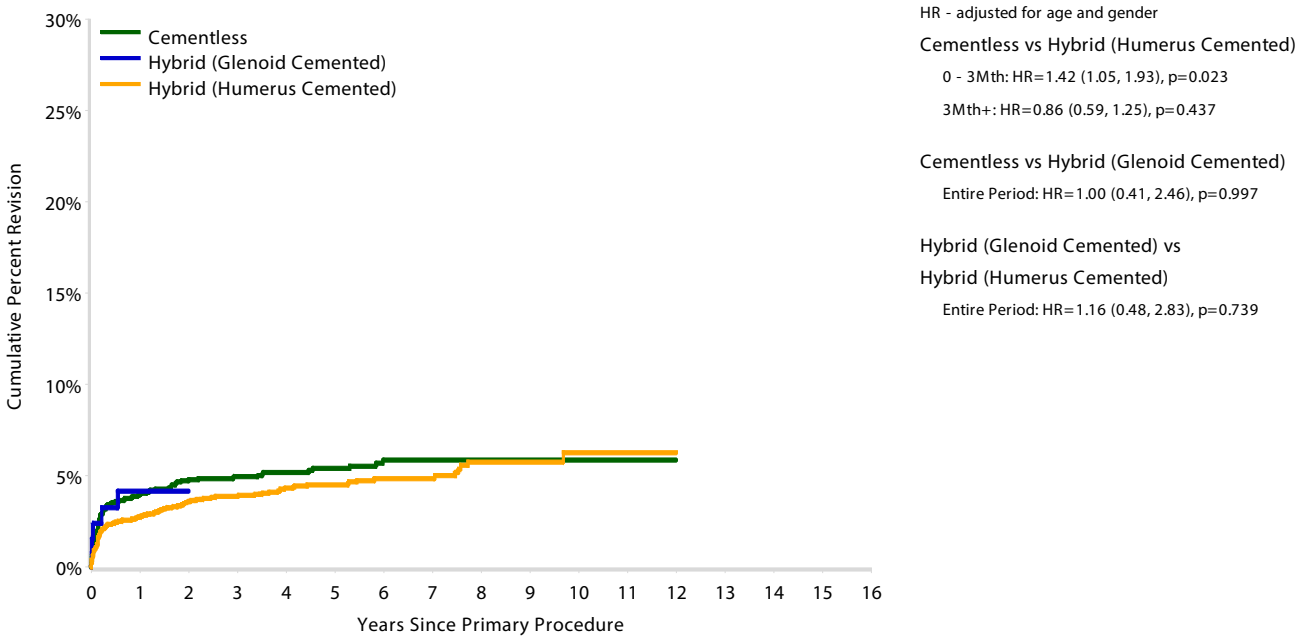
The outcomes of the most commonly used prosthesis combinations are listed in Table ST99. The most commonly used cementless prosthesis combinations are listed in Table ST100. The most commonly used hybrid (humerus cemented) prosthesis combinations are listed in Table ST101.

Table ST95 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	3	95	3.4 (1.1, 10.1)	3.4 (1.1, 10.1)	3.4 (1.1, 10.1)	3.4 (1.1, 10.1)		
Cementless	111	2240	4.0 (3.3, 4.9)	4.9 (4.1, 6.0)	5.4 (4.5, 6.5)	5.9 (4.8, 7.1)	5.9 (4.8, 7.1)	
Hybrid (Glenoid Cemented)	5	126	4.2 (1.7, 9.7)					
Hybrid (Humerus Cemented)	185	4743	2.8 (2.3, 3.3)	3.9 (3.3, 4.5)	4.5 (3.9, 5.2)	4.8 (4.1, 5.7)	6.3 (5.0, 8.0)	
TOTAL	**304**	**7204**						

Note: Restricted to modern prostheses

Figure ST73 Cumulative Percent Revision of Primary Total Stemmed Reverse Shoulder Replacement by Fixation (Primary Diagnosis Fracture)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Cementless	2240	1856	1278	776	386	100	18
Hybrid (Glenoid Cemented)	126	86	38	25	9	1	1
Hybrid (Humerus Cemented)	4743	3786	2322	1276	632	156	15

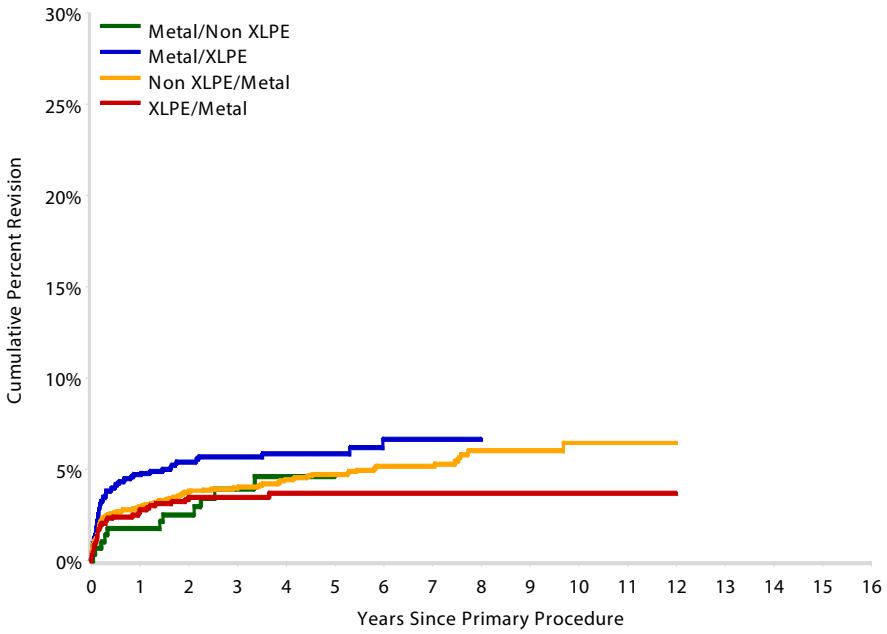
Note: Restricted to modern prostheses

Table ST96 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						
Metal/Non XLPE	11	285	1.8 (0.7, 4.2)	4.0 (2.1, 7.3)	4.6 (2.5, 8.3)			
Metal/XLPE	70	1280	4.7 (3.7, 6.0)	5.7 (4.5, 7.2)	5.8 (4.6, 7.4)	6.6 (5.1, 8.6)		
Non XLPE/Metal	182	4331	3.0 (2.5, 3.5)	4.0 (3.4, 4.7)	4.7 (4.1, 5.5)	5.2 (4.4, 6.0)	6.5 (5.2, 8.0)	
XLPE/Metal	41	1288	2.8 (2.0, 3.9)	3.5 (2.6, 4.7)	3.7 (2.7, 5.0)	3.7 (2.7, 5.0)	3.7 (2.7, 5.0)	
TOTAL	**304**	**7188**						

Note: Restricted to modern prostheses
Excludes 16 procedures with unknown bearing surface

Figure ST74 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 (0.17, 1.83), p=0.341

3Mth+: HR=2.03 (0.94, 4.39), p=0.073

Metal/XLPE vs XLPE/Metal

Entire Period: HR=1.58 (1.07, 2.33), p=0.020

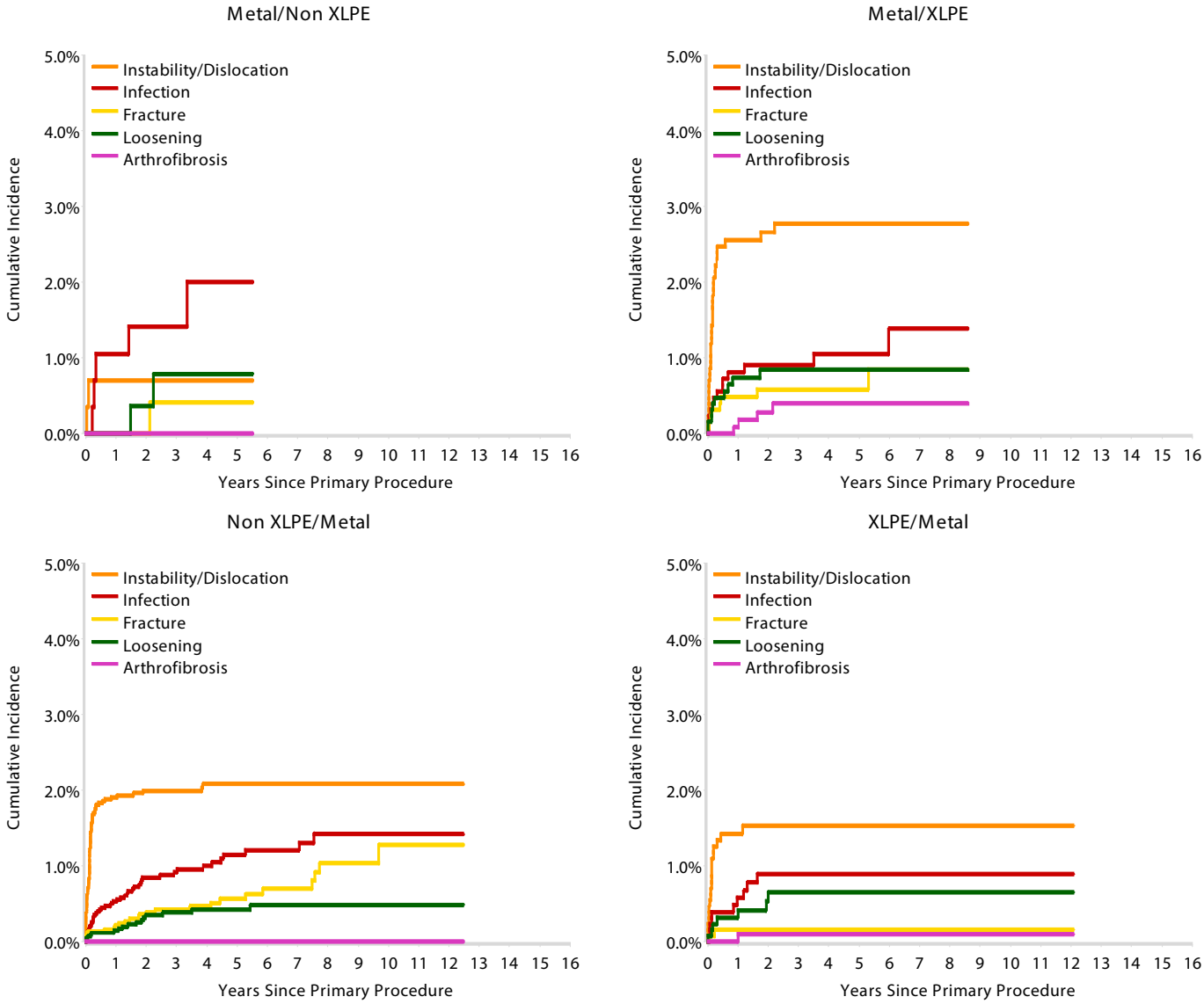
Non XLPE/Metal vs XLPE/Metal

Entire Period: HR=1.26 (0.90, 1.78), p=0.176

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Metal/Non XLPE	285	269	172	65	4	0	0
Metal/XLPE	1280	1009	647	327	125	17	1
Non XLPE/Metal	4331	3530	2274	1337	686	173	15
XLPE/Metal	1288	978	583	367	217	75	19

Note: Restricted to modern prostheses

Figure ST75 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Reverse Shoulder Replacement by Bearing Surface (Primary Diagnosis Fracture)



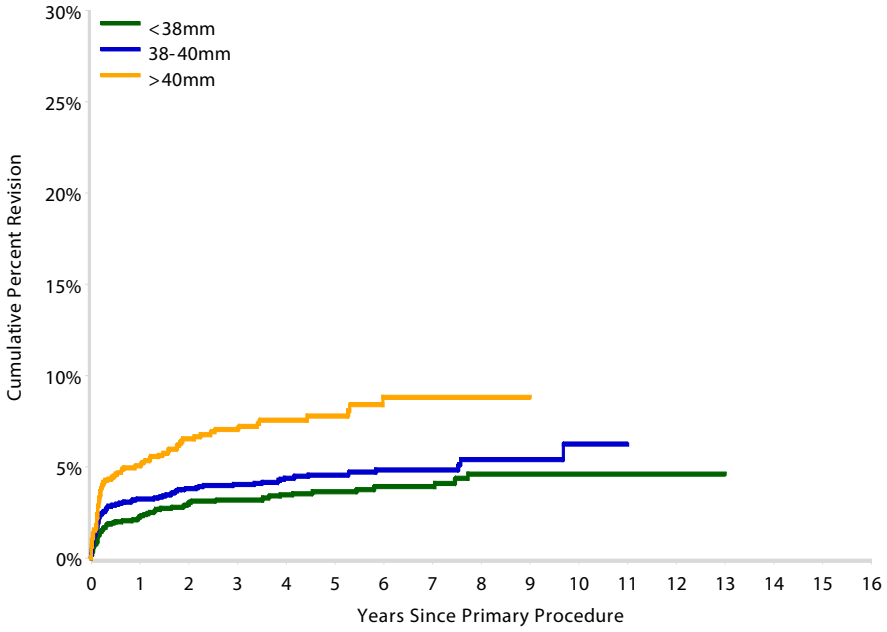
Note: Restricted to modern prostheses

Table ST97 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	93	2893	2.3 (1.8, 2.9)	3.2 (2.6, 3.9)	3.7 (2.9, 4.5)	3.9 (3.1, 4.9)	4.6 (3.6, 6.0)	
38–40mm	122	2943	3.3 (2.7, 4.0)	4.0 (3.4, 4.9)	4.6 (3.8, 5.5)	4.8 (4.0, 5.9)	6.2 (4.5, 8.6)	
>40mm	85	1221	5.1 (4.0, 6.5)	7.0 (5.7, 8.7)	7.8 (6.3, 9.6)	8.8 (7.0, 11.1)		
TOTAL	**300**	**7057**						

Note: Excludes 147 procedures with unknown glenosphere sizes
Restricted to modern prostheses

Figure ST76 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=1.28 (0.98, 1.67), p=0.074

>40mm vs <38mm

Entire Period: HR=1.47 (1.07, 2.01), p=0.016

>40mm vs 38-40mm

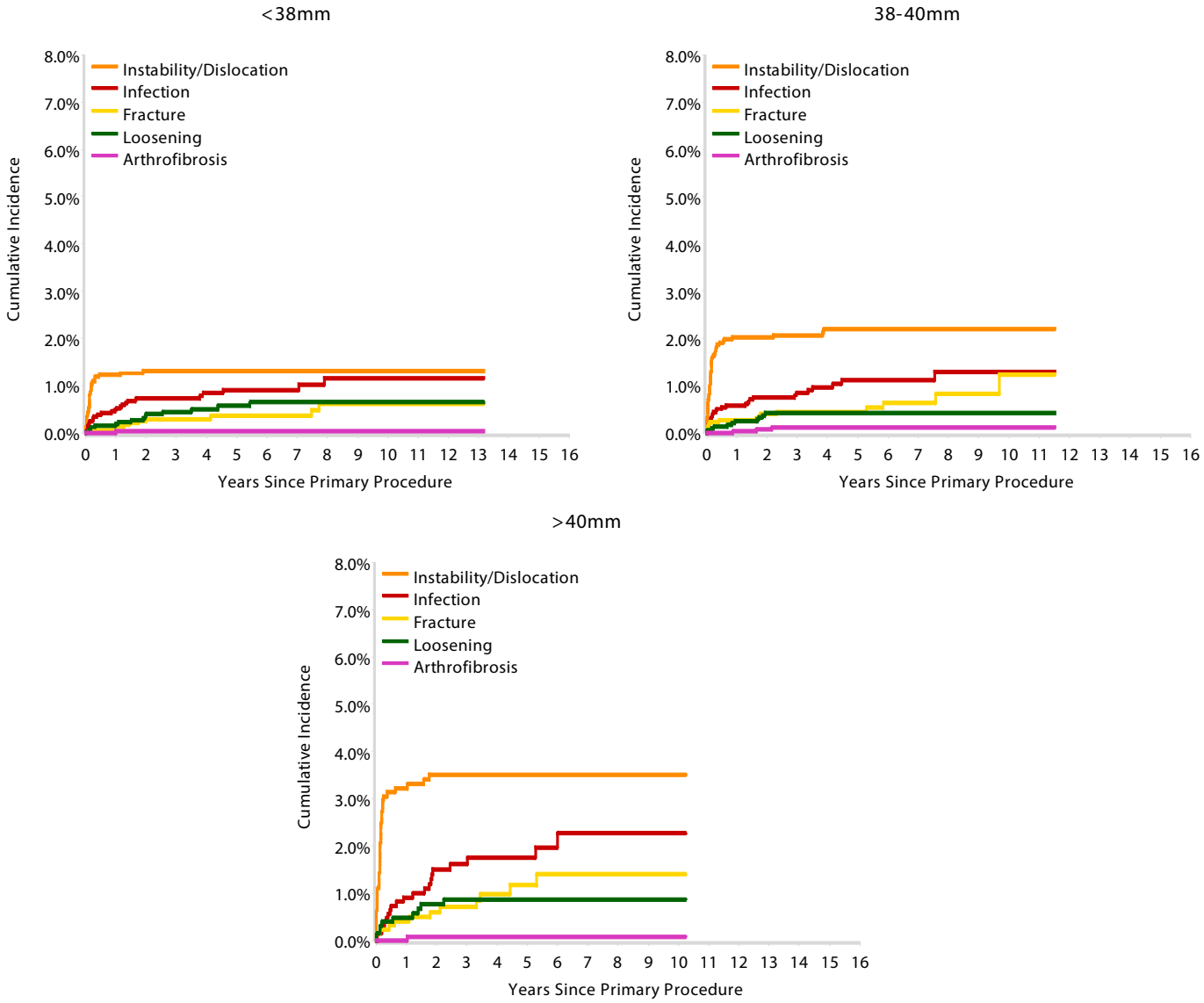
0 - 3Mth: HR=1.17 (0.81, 1.68), p=0.409

3Mth+: HR=1.12 (0.74, 1.70), p=0.595

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
<38mm	2893	2333	1467	889	473	140	24
38–40mm	2943	2423	1592	886	428	92	8
>40mm	1221	986	619	328	137	32	3

Note: Restricted to modern prostheses

Figure ST77 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Reverse Shoulder Replacement by Glenosphere Size (Primary Diagnosis Fracture)



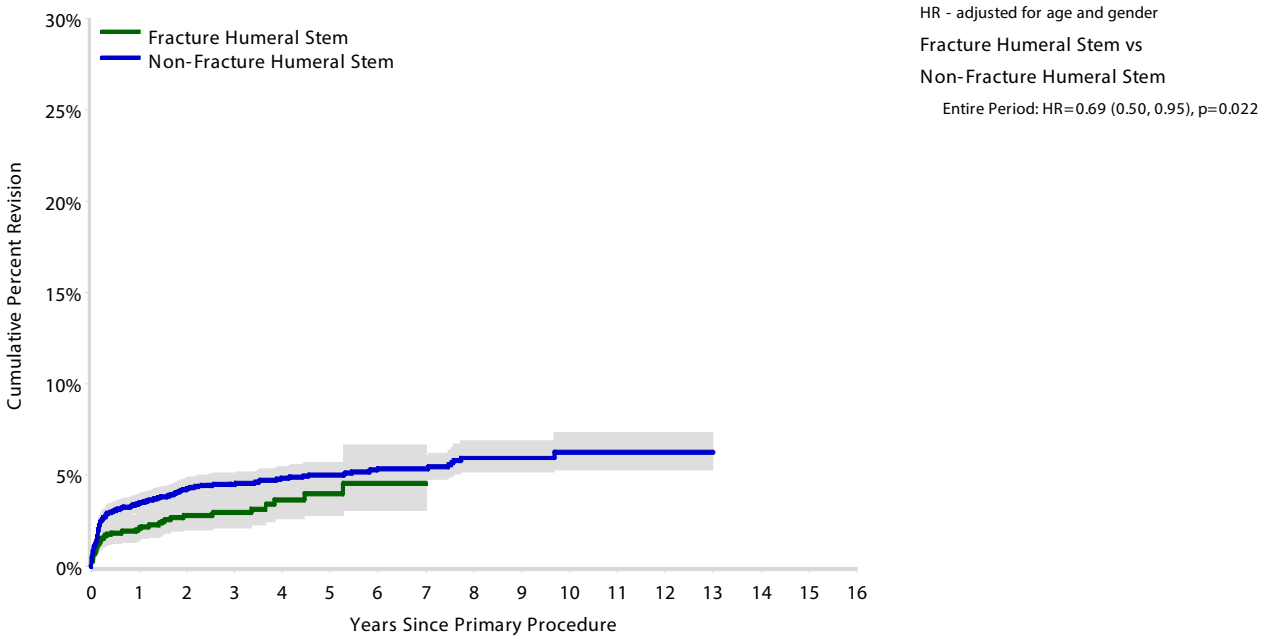
Note: Restricted to modern prostheses

Table ST98 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	43	1519	2.1 (1.5, 3.0)	2.9 (2.1, 4.1)	4.0 (2.8, 5.7)	4.5 (3.1, 6.7)		
Non-Fracture Humeral Stem	261	5685	3.5 (3.0, 4.0)	4.5 (4.0, 5.1)	5.0 (4.4, 5.7)	5.4 (4.7, 6.1)	6.2 (5.3, 7.4)	
TOTAL	**304**	**7204**						

Note: Restricted to modern prostheses

Figure ST78 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	1519	1144	563	211	56	2	0
Non-Fracture Humeral Stem	5685	4657	3125	1896	986	263	35

Note: Restricted to modern prostheses

Table ST99 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	39	1182	1.9 (1.3, 2.9)	2.7 (1.9, 3.8)	3.7 (2.6, 5.2)	4.0 (2.8, 5.7)	5.8 (3.8, 8.7)	
Affinis	Affinis	13	351	2.0 (1.0, 4.2)	3.9 (2.2, 6.9)	4.5 (2.6, 7.8)			
AltiVate Reverse	RSP	4	175	2.7 (1.0, 7.1)					
Ascend Flex	Aequalis	1	63	1.6 (0.2, 10.9)	1.6 (0.2, 10.9)	1.6 (0.2, 10.9)			
Comprehensive	Comprehensive Reverse	16	722	2.0 (1.1, 3.4)	2.5 (1.5, 4.2)	3.0 (1.7, 5.1)			
Delta Xtend	Delta Xtend	77	1425	4.0 (3.1, 5.2)	4.9 (3.9, 6.2)	5.5 (4.4, 6.9)	5.8 (4.6, 7.3)	7.1 (5.3, 9.6)	
Equinoxe	Equinoxe	23	487	3.3 (2.0, 5.5)	5.9 (3.9, 9.1)	7.0 (4.4, 11.1)			
Global Unite	Delta Xtend	11	420	2.0 (1.0, 3.9)	2.3 (1.2, 4.4)	3.8 (1.6, 8.9)			
RSP	RSP	13	213	3.4 (1.6, 6.9)	6.4 (3.6, 11.0)				
SMR	SMR L1	93	1675	4.7 (3.8, 5.9)	5.7 (4.7, 7.0)	5.9 (4.8, 7.2)	6.2 (5.1, 7.7)	6.2 (5.1, 7.7)	
Trabecular Metal	Comprehensive Reverse	3	81	3.7 (1.2, 11.0)	3.7 (1.2, 11.0)				
	Trabecular Metal	9	282	2.2 (1.0, 4.9)	3.1 (1.5, 6.1)	3.1 (1.5, 6.1)	4.0 (2.0, 7.8)		
Other (13)		2	128	1.7 (0.4, 6.7)					
TOTAL		**304**	**7204**						

Note: Restricted to modern prostheses
Only prostheses with >50 procedures have been listed

Table ST100 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	60	3.3 (0.8, 12.7)	3.3 (0.8, 12.7)	10.4 (4.4, 23.7)	10.4 (4.4, 23.7)		
Comprehensive	Comprehensive Reverse	4	148	2.3 (0.7, 7.0)	3.5 (1.3, 9.4)				
Delta Xtend	Delta Xtend	8	213	1.9 (0.7, 5.0)	3.5 (1.7, 7.3)	3.5 (1.7, 7.3)	4.6 (2.2, 9.2)		
Equinoxe	Equinoxe	4	82	3.7 (1.2, 10.9)	5.6 (2.1, 14.6)	5.6 (2.1, 14.6)			
Global Unite	Delta Xtend	3	97	2.1 (0.5, 8.2)	2.1 (0.5, 8.2)	5.3 (1.5, 18.1)			
SMR	SMR L1	82	1434	4.9 (3.9, 6.2)	5.8 (4.7, 7.2)	6.0 (4.8, 7.4)	6.4 (5.1, 8.0)	6.4 (5.1, 8.0)	
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 (11)		3	147	2.1 (0.7, 6.4)	2.1 (0.7, 6.4)				
TOTAL		**111**	**2240**						

Note: Restricted to modern prostheses
Only prostheses with >50 procedures have been listed

Table ST101 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	34	1107	1.9 (1.2, 2.9)	2.7 (1.8, 3.9)	3.2 (2.2, 4.6)	3.5 (2.4, 5.2)		
Affinis	Affinis	12	330	1.9 (0.8, 4.1)	3.9 (2.1, 7.0)	4.5 (2.5, 7.9)			
AltiVate Reverse	RSP	3	142	2.6 (0.8, 8.0)					
Comprehensive	Comprehensive Reverse	12	536	2.0 (1.1, 3.7)	2.4 (1.3, 4.3)	3.1 (1.6, 5.8)			
Delta Xtend	Delta Xtend	66	1190	4.2 (3.2, 5.5)	5.0 (3.9, 6.4)	5.7 (4.4, 7.2)	5.9 (4.6, 7.5)	7.5 (5.4, 10.4)	
Equinoxe	Equinoxe	18	380	3.2 (1.8, 5.8)	6.2 (3.8, 10.1)				
Global Unite	Delta Xtend	7	295	1.8 (0.7, 4.2)	2.2 (1.0, 4.9)				
RSP	RSP	13	171	4.2 (2.0, 8.6)	7.9 (4.5, 13.5)				
SMR	SMR L1	8	217	2.9 (1.3, 6.4)	4.3 (2.1, 8.5)	4.3 (2.1, 8.5)	4.3 (2.1, 8.5)		
Trabecular Metal	Comprehensive Reverse	3	66	4.5 (1.5, 13.4)	4.5 (1.5, 13.4)				
	Trabecular Metal	7	208	2.0 (0.8, 5.3)	3.3 (1.5, 7.2)	3.3 (1.5, 7.2)	4.7 (2.1, 10.4)		
Other (11)		2	101	2.2 (0.5, 8.3)					
TOTAL		**185**	**4743**						

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, total stemmed anatomic with a cemented polyethylene glenoid, total stemmed anatomic with a modified central peg, total stemmed anatomic with a modular metal backed glenoid, total stemmed anatomic with a non-modular metal backed glenoid, total stemless anatomic excluding modular metal backed glenoids, and total stemmed reverse procedures (Table ST102 and Figure ST79). The definitions of polyethylene glenoid types can be found on page 338.

It is important to recognise that there are patient and prosthesis factors that may further confound the results beyond that which are presented here.

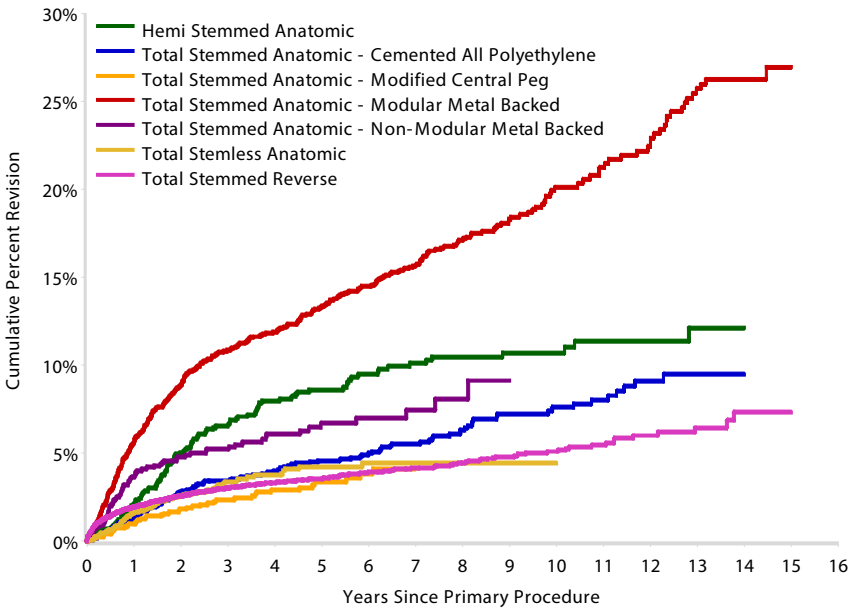
Peer reviewed journal articles that are based on AOANJRR shoulder replacement data and published over the last 8 years are available on the AOANJRR website: https://aoanjrr.sahmri.com/publications-2023

Table ST102 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	112	1349	2.1 (1.4, 3.1)	6.6 (5.3, 8.1)	8.6 (7.1, 10.4)	10.1 (8.4, 12.2)	10.7 (8.9, 12.9)	12.1 (9.8, 15.0)
Total Stemmed Anatomic – Cemented All Polyethylene	127	2443	1.4 (1.0, 1.9)	3.4 (2.8, 4.3)	4.6 (3.7, 5.6)	5.5 (4.6, 6.7)	7.6 (6.3, 9.2)	9.5 (7.7, 11.7)
Total Stemmed Anatomic – Modified Central Peg	42	1516	1.0 (0.6, 1.6)	2.3 (1.7, 3.3)	3.4 (2.4, 4.7)	4.1 (3.0, 5.7)		
Total Stemmed Anatomic – Modular Metal Backed	378	2210	5.6 (4.7, 6.7)	10.8 (9.6, 12.3)	13.3 (11.9, 14.9)	15.7 (14.1, 17.4)	20.1 (18.1, 22.3)	26.3 (23.4, 29.4)
Total Stemmed Anatomic – Non-Modular Metal Backed	72	1240	3.7 (2.7, 4.9)	5.2 (4.1, 6.7)	6.7 (5.3, 8.5)	7.4 (5.7, 9.6)		
Total Stemless Anatomic	102	3566	1.6 (1.2, 2.1)	3.4 (2.7, 4.2)	4.2 (3.4, 5.2)	4.4 (3.6, 5.5)	4.4 (3.6, 5.5)	
Total Stemmed Reverse	660	20450	1.9 (1.7, 2.1)	3.0 (2.8, 3.3)	3.5 (3.3, 3.8)	4.1 (3.8, 4.5)	5.1 (4.6, 5.7)	7.3 (5.9, 9.1)
TOTAL	**1493**	**32774**						

Note: Restricted to modern prostheses
Modular metal backed glenoids have been excluded from the total stemless anatomic group

Figure ST79 Cumulative Percent Revision of Primary Shoulder Replacement by Class (Primary Diagnosis OA)



HR - adjusted for age and gender

Hemi Stemmed Anatomic
vs Total Stemmed Anatomic - Modified Central Peg
Entire Period: HR=2.30 (1.61, 3.28), p<0.001

Total Stemmed Anatomic - Cemented All Polyethylene vs
Total Stemmed Anatomic - Modified Central Peg
Entire Period: HR=1.54 (1.08, 2.18), p=0.015

Total Stemmed Anatomic - Modular Metal Backed
vs Total Stemmed Anatomic - Modified Central Peg
Entire Period: HR=4.46 (3.23, 6.14), p<0.001

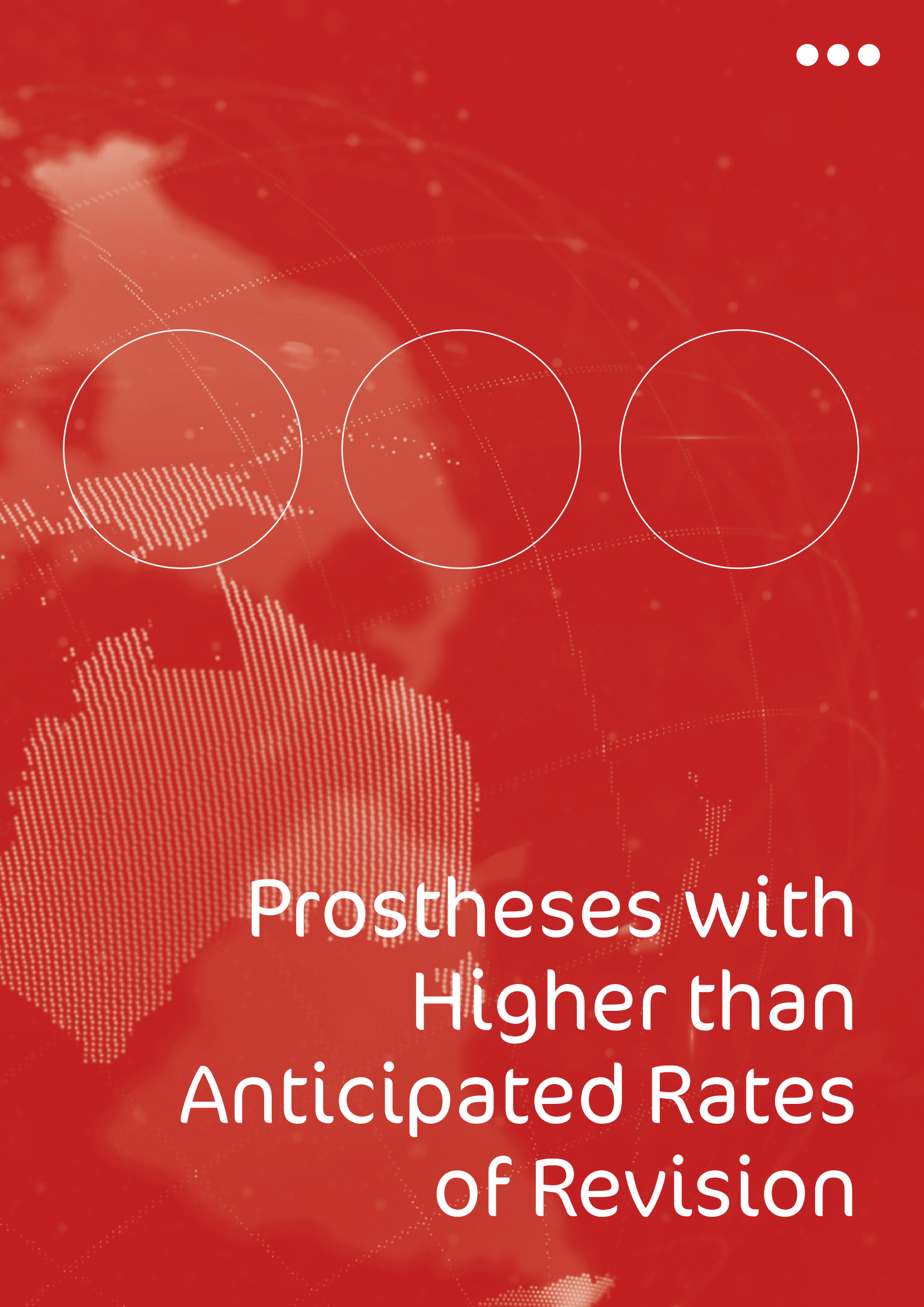
Total Stemmed Anatomic - Non-Modular Metal Backed vs
Total Stemmed Anatomic - Modified Central Peg
0 - 1Yr: HR=2.98 (1.93, 4.58), p<0.001
1Yr+: HR=1.41 (0.88, 2.27), p=0.157

Total Stemless Anatomic
vs Total Stemmed Anatomic - Modified Central Peg
Entire Period: HR=1.22 (0.85, 1.75), p=0.273

Total Stemmed Reverse
vs Total Stemmed Anatomic - Modified Central Peg
0 - 1Mth: HR=8.39 (4.79, 14.72), p<0.001
1Mth - 3Mth: HR=3.40 (2.16, 5.35), p<0.001
3Mth+: HR=1.03 (0.75, 1.42), p=0.857

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Hemi Stemmed Anatomic	1349	1207	901	692	526	286	58
Total Stemmed Anatomic – Cemented All Polyethylene	2443	2206	1780	1273	926	485	109
Total Stemmed Anatomic – Modified Central Peg	1516	1363	992	544	183	0	0
Total Stemmed Anatomic – Modular Metal Backed	2210	2013	1742	1478	1111	461	155
Total Stemmed Anatomic – Non-Modular Metal Backed	1240	1072	750	431	185	28	0
Total Stemless Anatomic	3566	2825	1577	715	218	41	0
Total Stemmed Reverse	20450	17270	11544	6912	3626	1185	167

Note: Restricted to modern prostheses
Modular metal backed glenoids have been excluded from the total stemless anatomic group



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 2022 (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.

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.

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 and knee surgeon workshops were held in Adelaide on the weekend of the 5 and 6 August 2023. In addition to AOANJRR and SAHMRI staff, 24 hip and 21 knee arthroplasty specialists from the AOA membership attended the workshops.

The shoulder surgeon workshop was held on 12 August 2023. In addition to AOANJRR and SAHMRI staff, 6 AOA members with expertise in shoulder arthroplasty attended the workshop.

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-2023

Primary Partial Hip Replacement

UNIPOLAR MODULAR

There are no newly identified unipolar modular hip prostheses.

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
Identified and No Longer Used					
Unipolar Head (JRI)/Furlong LOL	11	132	533	2.06	Entire Period: HR=2.09 (1.16, 3.78), p=0.014

Note: Components have been compared to all other modern unipolar modular hip components

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
Identified and No Longer Used					
Unipolar Head (JRI)/Furlong LOL	6.4 (3.1, 13.0)	9.7 (5.3, 17.4)	11.1 (6.3, 19.4)		

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
Identified and No Longer Used																	
Unipolar Head (JRI)/Furlong LOL	.	12	18	10	13	10	8	7	34	16	4	.	.	.	.	.	.

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	1007	2.28	0 - 2Wk: HR=4.68 (1.15, 19.08), p=0.031
	.	.	.	.	2Wk - 9Mth: HR=0.85 (0.27, 2.66), p=0.784
	.	.	.	.	9Mth - 3.5Yr: HR=2.01 (0.75, 5.41), p=0.165
	.	.	.	.	3.5Yr+: HR=8.61 (4.90, 15.12), p<0.001
UHR/Omnifit (class)	8	40	274	2.92	Entire Period: HR=3.80 (1.89, 7.63), p<0.001
**Basis	18	156	837	2.15	0 - 1Yr: HR=0.48 (0.12, 1.92), p=0.299
	.	.	.	.	1Yr - 1.5Yr: HR=5.98 (1.88, 19.05), p=0.002
	.	.	.	.	1.5Yr+: HR=4.96 (2.82, 8.70), p<0.001
**Quadra-H	7	84	223	3.14	Entire Period: HR=3.10 (1.47, 6.52), p=0.002
**Synergy	9	55	442	2.04	Entire Period: HR=2.66 (1.37, 5.14), 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 (class)	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)	10.8 (4.9, 22.8)	14.3 (6.8, 29.0)		
**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
Identified and No Longer Used																	
UHR/ABGII	130	15	20	7	5	.	.	.	.	.	.	.	.	.	.	.	.
UHR/Omnifit (class)	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

Primary Total Hip Replacement

TOTAL CONVENTIONAL

There are four newly identified total conventional hip prostheses.

The Fixa acetabular component, although not individually identified in Stage 1, was identified with 3 different femoral stems (the Corae, Hydra and Short Exeter V40), and therefore underwent further individual analysis. The Corae/Fixa combination has been previously identified in 2019. There have been 1,335 procedures with the Fixa acetabular component since 2011, with 62 of these procedures revised. The cumulative percent revision is 6.7% at 10 years. Of the 62 revisions, 47 were major. There were 21 revisions for infection, 14 for fracture and 12 for dislocation/instability.

Since 2016, the CPT/G7 combination has been used in 3,172 procedures and 85 of these have been revised. It has been used in 140 hospitals. The cumulative percent revision at 5 years is 3.4%. There have been 29 revisions for fracture, 29 for dislocation/instability and 18 for infection, mostly occurring before 2 years. Of the 85 revisions, 51 have been major.

As this combination has been used for a larger proportion of diagnoses other than osteoarthritis (which may be considered as complex or difficult primary procedures) further analysis was carried out. There have been 1,950 primary procedures with 50 revisions where the CPT/G7 combination was used just for osteoarthritis. This combination has a higher rate of revision compared to other total conventional hips used for osteoarthritis. The 5 year cumulative percent revision is 3.3%. There have been 16 revisions for dislocation/instability, 15 for fracture and 13 for infection.

The G7 Multihole acetabular component range has been previously identified in 2022, so supplementary analysis of the CPT/G7 combination was carried out with and without this particular range. In both of these further analyses, the CPT/G7 combination had a higher rate of revision than other total hips. The CPT stem has been identified in the past, associated with the Low Profile Cup (since 2011) and the Fitmore acetabular component (since 2014).

The Revision Hip is a modular cementless femoral component that has been used since 2002 in 104 primary procedures with 10 revised. The cumulative percent revision is 12.7% at 5 years. Of the 10 revisions, 9 were major revisions, and in 8 of these the femoral component was revised. There were 4 revisions for loosening and 3 for fracture. This stem also has been used for potentially complex primary cases, so additional analysis was carried out just for the primary diagnosis of osteoarthritis. This also showed the Revision Hip femoral component to have a higher rate of revision than other total hip prostheses.

The CPCS/Reflection (Cup) combination has been used since 2001 in 1,132 primary procedures and 103 of these have been revised. The cumulative percent revision is 23.6% at 18 years with a higher rate of revision after 6.5 years. Loosening was the revision diagnosis in 52, dislocation/instability in 18, infection in 17 and fracture in 14. Major revisions were performed in 90, with the acetabular component revised in 82. A catalogue range breakdown showed that the majority of those revised used non-XLPE cups. Extra analyses revealed that the CPCS/Reflection (Cup) combination with XLPE cups did not have a higher rate of revision and confirmed that higher rate of revision was seen only with the non-XLPE cups. The non-XLPE ranges have not been used since 2011, and therefore this sub-set is included in the identified but no longer used category.

The Secur-fit Plus/PINNACLE combination 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/G7	85	3172	5872	1.45	Entire Period: HR=1.37 (1.11, 1.70), p=0.003
*Revision Hip	10	104	547	1.83	Entire Period: HR=3.04 (1.64, 5.65), p<0.001
**Fixa	62	1335	7193	0.86	Entire Period: HR=1.47 (1.15, 1.88), p=0.002
Re-Identified and Still Used					
Accolade II/Trident Tritanium (Shell)	109	3861	11529	0.95	0 - 3Mth: HR=1.36 (1.06, 1.74), p=0.015
	.	.	.	.	3Mth+: HR=0.94 (0.70, 1.26), p=0.683
Avenir/Fitmore	18	339	1125	1.60	0 - 1Mth: HR=4.24 (2.28, 7.89), p<0.001
	.	.	.	.	1Mth+: HR=1.30 (0.65, 2.59), p=0.464
CORAIL/Trident (Shell)	26	592	2550	1.02	Entire Period: HR=1.55 (1.06, 2.27), p=0.025
CPT/Fitmore	21	290	1840	1.14	Entire Period: HR=2.13 (1.39, 3.27), p<0.001
CPT/Low Profile Cup	16	213	1202	1.33	Entire Period: HR=2.38 (1.46, 3.88), p<0.001
*Excia (cless)	28	441	3117	0.90	0 - 3Mth: HR=2.68 (1.59, 4.53), p<0.001
	.	.	.	.	3Mth+: HR=1.24 (0.73, 2.09), p=0.424
*Furlong Evolution	39	521	2052	1.90	Entire Period: HR=2.67 (1.95, 3.66), p<0.001
*HACTIV	94	2598	9895	0.95	0 - 1Mth: HR=1.53 (1.06, 2.23), p=0.024
	.	.	.	.	1Mth - 1.5Yr: HR=1.66 (1.26, 2.18), p<0.001
	.	.	.	.	1.5Yr+: HR=0.67 (0.40, 1.14), p=0.138
*MiniMax	23	415	1528	1.51	0 - 2Wk: HR=6.02 (2.87, 12.65), p<0.001
	.	.	.	.	2Wk+: HR=1.57 (0.96, 2.56), p=0.072
*Novation	81	1423	9320	0.87	0 - 3Mth: HR=2.32 (1.69, 3.17), p<0.001
	.	.	.	.	3Mth+: HR=1.23 (0.91, 1.67), p=0.177
*Profemur L	127	3514	14768	0.86	Entire Period: HR=1.27 (1.07, 1.52), p=0.006
*Taper Fit	163	5034	17555	0.93	0 - 1Mth: HR=0.82 (0.56, 1.19), p=0.287
	.	.	.	.	1Mth - 6Mth: HR=0.96 (0.68, 1.36), p=0.829
	.	.	.	.	6Mth - 9Mth: HR=1.60 (0.90, 2.83), p=0.106
	.	.	.	.	9Mth - 2Yr: HR=1.09 (0.72, 1.64), p=0.692
	.	.	.	.	2Yr - 5Yr: HR=1.92 (1.38, 2.68), p<0.001
	.	.	.	.	5Yr - 5.5Yr: HR=4.20 (1.88, 9.41), p<0.001
	.	.	.	.	5.5Yr+: HR=2.60 (1.77, 3.83), p<0.001
**Atlas (Shell)	55	516	4387	1.25	Entire Period: HR=2.45 (1.88, 3.19), p<0.001
**Continuum	623	13870	95437	0.65	0 - 1Mth: HR=1.82 (1.57, 2.12), p<0.001
	.	.	.	.	1Mth - 3Mth: HR=1.43 (1.16, 1.75), p<0.001
	.	.	.	.	3Mth - 1.5Yr: HR=1.18 (0.99, 1.41), p=0.068
	.	.	.	.	1.5Yr - 2Yr: HR=1.41 (1.01, 1.95), p=0.042
	.	.	.	.	2Yr+: HR=0.86 (0.75, 1.00), p=0.049
**Delta-One-TT	13	187	938	1.39	Entire Period: HR=2.23 (1.30, 3.84), p=0.003
**Dynasty	112	2109	10762	1.04	Entire Period: HR=1.68 (1.40, 2.03), p<0.001
**Fin II	171	2387	21193	0.81	Entire Period: HR=1.61 (1.39, 1.87), p<0.001
**Furlong	68	963	6539	1.04	Entire Period: HR=1.90 (1.50, 2.41), p<0.001
**G7 Multihole	50	926	1690	2.96	Entire Period: HR=2.74 (2.07, 3.61), p<0.001

Femoral Stem/Acetabular	N Revised	N Total	Obs. Years	Revisions/ 100 Obs. Yrs	Hazard Ratio, P Value
**Mueller	12	59	529	2.27	Entire Period: HR=4.53 (2.57, 7.98), p<0.001
**Versafitcup DM	58	1706	5932	0.98	Entire Period: HR=1.33 (1.02, 1.72), p=0.031
Identified and No Longer Used					
+CPCS/Reflection (Non XLPE Cup)	72	407	4598	1.57	0 - 2Yr: HR=0.70 (0.31, 1.56), p=0.381
	.	.	.	.	2Yr - 3Yr: HR=4.04 (1.68, 9.71), p=0.001
	.	.	.	.	3Yr - 7Yr: HR=1.85 (0.88, 3.89), p=0.103
	.	.	.	.	7Yr+: HR=6.85 (5.23, 8.97), p<0.001
Anatomic II/Duraloc Option	10	60	725	1.38	Entire Period: HR=2.89 (1.55, 5.37), p<0.001
Anca-Fit/PINNACLE	16	101	1066	1.50	Entire Period: HR=3.14 (1.92, 5.13), p<0.001
CORAIL/Trabecular Metal (Shell)	11	98	766	1.44	Entire Period: HR=2.77 (1.54, 5.01), p<0.001
F2L/Delta-PF	19	107	1295	1.47	Entire Period: HR=3.10 (1.98, 4.86), p<0.001
Friendly Hip/Cup (Exactech)	16	97	1099	1.46	Entire Period: HR=3.12 (1.91, 5.09), p<0.001
Friendly Hip/Delta-TT	6	74	487	1.23	Entire Period: HR=2.37 (1.06, 5.26), p=0.034
M-Cor/Equator+ Cup	11	77	897	1.23	Entire Period: HR=2.62 (1.46, 4.71), p=0.001
MBA (exch neck)/PINNACLE	27	225	2081	1.30	Entire Period: HR=2.65 (1.82, 3.87), p<0.001
Meridian/ABGII	21	143	1806	1.16	Entire Period: HR=2.47 (1.61, 3.78), p<0.001
Secur-Fit Plus/Secur-Fit	31	197	2673	1.16	Entire Period: HR=2.47 (1.74, 3.52), p<0.001
Taperloc/M2a^{MoM}	73	515	6778	1.08	Entire Period: HR=2.30 (1.83, 2.90), p<0.001
*ABGII (exch neck)	106	246	2100	5.05	0 - 1Mth: HR=4.10 (1.95, 8.61), p<0.001
	.	.	.	.	1Mth - 1.5Yr: HR=2.66 (1.33, 5.31), p=0.005
	.	.	.	.	1.5Yr - 2.5Yr: HR=8.05 (3.83, 16.90), p<0.001
	.	.	.	.	2.5Yr - 4Yr: HR=13.93 (8.07, 24.05), p<0.001
	.	.	.	.	4Yr - 4.5Yr: HR=42.26 (23.21, 76.93), p<0.001
	.	.	.	.	4.5Yr+: HR=16.15 (12.52, 20.84), p<0.001
*Adapter (cless)	156	744	7313	2.13	0 - 2Wk: HR=3.89 (1.94, 7.79), p<0.001
	.	.	.	.	2Wk - 1Mth: HR=1.58 (0.66, 3.81), p=0.304
	.	.	.	.	1Mth - 6Mth: HR=0.74 (0.28, 1.98), p=0.551
	.	.	.	.	6Mth - 3Yr: HR=4.29 (3.05, 6.05), p<0.001
	.	.	.	.	3Yr - 3.5Yr: HR=12.46 (7.03, 22.09), p<0.001
	.	.	.	.	3.5Yr - 4Yr: HR=6.99 (3.12, 15.64), p<0.001
	.	.	.	.	4Yr - 6.5Yr: HR=8.06 (5.74, 11.32), p<0.001
	.	.	.	.	6.5Yr - 7Yr: HR=11.55 (5.95, 22.42), p<0.001
	.	.	.	.	7Yr - 8Yr: HR=7.97 (4.50, 14.13), p<0.001
	.	.	.	.	8Yr+: HR=3.59 (2.55, 5.06), p<0.001
*Adapter (ctd)	33	148	1288	2.56	0 - 6Mth: HR=1.94 (0.73, 5.16), p=0.186
	.	.	.	.	6Mth+: HR=6.75 (4.69, 9.73), p<0.001
*Apex	188	2591	24719	0.76	Entire Period: HR=1.54 (1.33, 1.77), p<0.001
*BMHR VST	36	260	2812	1.28	Entire Period: HR=2.50 (1.80, 3.47), p<0.001
*CBH Stem	42	274	2634	1.59	Entire Period: HR=3.27 (2.41, 4.42), p<0.001
*Edinburgh	19	138	1090	1.74	Entire Period: HR=3.53 (2.25, 5.53), p<0.001
*Elite Plus	273	2841	32763	0.83	0 - 3Mth: HR=0.45 (0.27, 0.75), p=0.002
	.	.	.	.	3Mth+: HR=2.16 (1.91, 2.45), p<0.001
*Emperion	56	507	4832	1.16	Entire Period: HR=2.31 (1.78, 3.00), p<0.001

HTARR Hips

Femoral Stem/Acetabular	N Revised	N Total	Obs. Years	Revisions/ 100 Obs. Yrs	Hazard Ratio, P Value
*GHE	13	114	925	1.41	Entire Period: HR=2.82 (1.63, 4.85), p<0.001
*K2	88	601	6163	1.43	Entire Period: HR=2.97 (2.41, 3.66), p<0.001
*LYDERIC II	16	164	1491	1.07	Entire Period: HR=2.22 (1.36, 3.62), p=0.001
*Linear	20	290	1927	1.04	Entire Period: HR=1.91 (1.23, 2.96), p=0.003
*ML Taper Kinectiv	205	3532	31690	0.65	Entire Period: HR=1.31 (1.14, 1.50), p<0.001
*MSA	42	224	2101	2.00	Entire Period: HR=3.91 (2.89, 5.30), p<0.001
*Margron	123	688	9151	1.34	Entire Period: HR=2.85 (2.38, 3.40), p<0.001
*Mayo	19	168	2020	0.94	Entire Period: HR=2.01 (1.28, 3.14), p=0.002
*Metha (exch neck)	15	88	923	1.63	Entire Period: HR=3.32 (2.01, 5.51), p<0.001
*Profemur Z	31	186	2134	1.45	Entire Period: HR=3.04 (2.14, 4.33), p<0.001
*Trabecular Metal	126	1904	17895	0.70	0 - 1Mth: HR=2.57 (1.84, 3.59), p<0.001
	.	.	.	.	1Mth - 3Mth: HR=1.81 (1.12, 2.92), p=0.014
	.	.	.	.	3Mth - 1.5Yr: HR=1.62 (1.09, 2.42), p=0.018
	.	.	.	.	1.5Yr - 3.5Yr: HR=1.27 (0.77, 2.07), p=0.347
	.	.	.	.	3.5Yr - 4Yr: HR=2.07 (0.86, 5.01), p=0.104
	.	.	.	.	4Yr - 7Yr: HR=1.23 (0.78, 1.96), p=0.374
	.	.	.	.	7Yr+: HR=0.52 (0.29, 0.95), p=0.032
*UniSyn	68	466	4910	1.39	Entire Period: HR=2.83 (2.23, 3.60), p<0.001
**2000 Plus	20	135	1332	1.50	Entire Period: HR=3.08 (1.99, 4.78), p<0.001
**ASR	2063	4421	40749	5.06	0 - 2Wk: HR=1.27 (0.78, 2.09), p=0.335
	.	.	.	.	2Wk - 1Mth: HR=0.21 (0.08, 0.55), p=0.001
	.	.	.	.	1Mth - 3Mth: HR=0.76 (0.47, 1.23), p=0.267
	.	.	.	.	3Mth - 9Mth: HR=1.33 (0.89, 1.97), p=0.160
	.	.	.	.	9Mth - 1.5Yr: HR=4.23 (3.32, 5.38), p<0.001
	.	.	.	.	1.5Yr - 2Yr: HR=7.25 (5.62, 9.35), p<0.001
	.	.	.	.	2Yr - 2.5Yr: HR=13.20 (10.72, 16.25), p<0.001
	.	.	.	.	2.5Yr - 3Yr: HR=18.29 (15.01, 22.29), p<0.001
	.	.	.	.	3Yr - 5Yr: HR=30.91 (28.20, 33.88), p<0.001
	.	.	.	.	5Yr - 6Yr: HR=35.03 (30.68, 40.00), p<0.001
	.	.	.	.	6Yr - 7Yr: HR=23.86 (20.22, 28.16), p<0.001
	.	.	.	.	7Yr - 8Yr: HR=18.75 (15.52, 22.65), p<0.001
	.	.	.	.	8Yr - 8.5Yr: HR=14.29 (10.69, 19.09), p<0.001
	.	.	.	.	8.5Yr - 10Yr: HR=11.05 (9.06, 13.47), p<0.001
	.	.	.	.	10Yr - 10.5Yr: HR=8.49 (5.60, 12.86), p<0.001
	.	.	.	.	10.5Yr - 12Yr: HR=6.56 (5.17, 8.33), p<0.001
	.	.	.	.	12Yr - 12.5Yr: HR=4.14 (2.38, 7.20), p<0.001
	.	.	.	.	12.5Yr - 13.5Yr: HR=6.94 (5.03, 9.58), p<0.001
	.	.	.	.	13.5Yr+: HR=3.69 (2.75, 4.96), p<0.001
**Adept	23	121	1331	1.73	Entire Period: HR=3.45 (2.29, 5.20), p<0.001
**Artek	73	179	2427	3.01	0 - 1Yr: HR=1.55 (0.64, 3.72), p=0.329
	.	.	.	.	1Yr - 1.5Yr: HR=4.73 (1.18, 18.93), p=0.028
	.	.	.	.	1.5Yr - 2.5Yr: HR=5.95 (2.23, 15.86), p<0.001
	.	.	.	.	2.5Yr - 4Yr: HR=14.93 (8.25, 27.02), p<0.001

Femoral Stem/Acetabular	N Revised	N Total	Obs. Years	Revisions/ 100 Obs. Yrs	Hazard Ratio, P Value
	.	.	.	.	4Yr - 4.5Yr: HR=4.73 (0.66, 33.62), p=0.120
	.	.	.	.	4.5Yr - 6Yr: HR=18.33 (10.38, 32.38), p<0.001
	.	.	.	.	6Yr+: HR=6.53 (4.72, 9.02), p<0.001
**BHR	551	2988	35033	1.57	0 - 2Wk: HR=0.82 (0.39, 1.73), p=0.603
	.	.	.	.	2Wk - 1Mth: HR=0.15 (0.04, 0.61), p=0.007
	.	.	.	.	1Mth - 3Mth: HR=1.06 (0.65, 1.73), p=0.819
	.	.	.	.	3Mth - 1Yr: HR=0.54 (0.28, 1.03), p=0.062
	.	.	.	.	1Yr - 1.5Yr: HR=1.68 (0.95, 2.97), p=0.074
	.	.	.	.	1.5Yr+: HR=4.65 (4.25, 5.10), p<0.001
**Bionik	155	608	5956	2.60	0 - 2Wk: HR=2.98 (1.24, 7.17), p=0.014
	.	.	.	.	2Wk - 3Mth: HR=1.08 (0.49, 2.41), p=0.846
	.	.	.	.	3Mth+: HR=6.56 (5.56, 7.73), p<0.001
**Conserve Plus	21	135	1698	1.24	0 - 1Yr: HR=0.83 (0.21, 3.31), p=0.789
	.	.	.	.	1Yr+: HR=3.35 (2.14, 5.26), p<0.001
**Cormet	150	803	9476	1.58	0 - 3Mth: HR=0.61 (0.27, 1.36), p=0.225
	.	.	.	.	3Mth - 1.5Yr: HR=1.86 (1.06, 3.29), p=0.031
	.	.	.	.	1.5Yr - 2Yr: HR=0.61 (0.09, 4.34), p=0.622
	.	.	.	.	2Yr+: HR=4.74 (3.98, 5.63), p<0.001
**DeltaLox	29	222	1866	1.55	Entire Period: HR=3.16 (2.19, 4.54), p<0.001
**Duraloc	653	5354	65189	1.00	0 - 3Mth: HR=0.78 (0.59, 1.03), p=0.077
	.	.	.	.	3Mth - 9Mth: HR=1.37 (0.96, 1.97), p=0.085
	.	.	.	.	9Mth - 2Yr: HR=1.88 (1.44, 2.46), p<0.001
	.	.	.	.	2Yr - 2.5Yr: HR=0.88 (0.44, 1.76), p=0.712
	.	.	.	.	2.5Yr - 5.5Yr: HR=1.92 (1.54, 2.40), p<0.001
	.	.	.	.	5.5Yr+: HR=3.10 (2.80, 3.43), p<0.001
**Durom	215	1245	15611	1.38	0 - 1.5Yr: HR=0.74 (0.47, 1.17), p=0.199
	.	.	.	.	1.5Yr+: HR=3.94 (3.42, 4.55), p<0.001
**ExpanSys	14	71	850	1.65	Entire Period: HR=3.52 (2.09, 5.94), p<0.001
**Hedrocel	13	46	599	2.17	Entire Period: HR=4.55 (2.64, 7.84), p<0.001
**Icon	110	401	4253	2.59	0 - 2.5Yr: HR=2.54 (1.70, 3.80), p<0.001
	.	.	.	.	2.5Yr+: HR=7.41 (5.99, 9.17), p<0.001
**Inter-Op	9	33	376	2.39	Entire Period: HR=5.06 (2.64, 9.71), p<0.001
**MBA	18	124	1124	1.60	Entire Period: HR=3.31 (2.09, 5.26), p<0.001
**Mitch TRH	166	731	8254	2.01	0 - 3Mth: HR=0.56 (0.23, 1.34), p=0.194
	.	.	.	.	3Mth - 2Yr: HR=2.48 (1.56, 3.94), p<0.001
	.	.	.	.	2Yr+: HR=6.04 (5.12, 7.13), p<0.001
**Plasmacup	38	482	4600	0.83	Entire Period: HR=1.70 (1.23, 2.33), p=0.001
**SPH-Blind	130	952	13114	0.99	Entire Period: HR=2.12 (1.78, 2.52), p<0.001
**seleXys (excluding seleXys PC)	51	391	3657	1.39	Entire Period: HR=2.83 (2.15, 3.73), 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

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/G7	2.6 (2.0, 3.2)	3.3 (2.6, 4.1)	3.4 (2.7, 4.4)		
*Revision Hip	3.2 (1.0, 9.7)	8.9 (4.3, 17.9)	12.7 (6.7, 23.6)		
**Fixa	3.0 (2.2, 4.1)	4.0 (3.0, 5.2)	4.5 (3.4, 5.8)	6.7 (5.0, 8.9)	
Re-Identified and Still Used					
Accolade II/Trident Tritanium (Shell)	2.2 (1.7, 2.7)	2.9 (2.4, 3.5)	3.5 (2.8, 4.2)		
Avenir/Fitmore	4.8 (3.0, 7.7)	5.2 (3.3, 8.2)	5.7 (3.6, 9.1)		
CORAIL/Trident (Shell)	2.5 (1.5, 4.1)	4.1 (2.6, 6.3)	4.9 (3.1, 7.4)	7.2 (4.5, 11.4)	
CPT/Fitmore	4.2 (2.4, 7.2)	6.1 (3.8, 9.6)	6.7 (4.2, 10.4)	8.2 (5.2, 12.7)	
CPT/Low Profile Cup	5.2 (2.9, 9.2)	6.3 (3.7, 10.6)	8.4 (5.2, 13.6)	8.4 (5.2, 13.6)	
*Excia (cless)	4.1 (2.6, 6.5)	5.1 (3.4, 7.6)	5.6 (3.8, 8.2)	7.0 (4.8, 10.3)	
*Furlong Evolution	5.0 (3.4, 7.2)	7.5 (5.5, 10.2)	8.3 (6.1, 11.2)		
*HACTIV	2.8 (2.2, 3.5)	3.6 (2.9, 4.4)	3.8 (3.1, 4.6)	4.4 (3.5, 5.6)	
*MiniMax	4.6 (2.9, 7.1)	5.6 (3.8, 8.3)	5.6 (3.8, 8.3)		
*Novation	3.7 (2.9, 4.9)	4.5 (3.5, 5.7)	5.3 (4.2, 6.6)	6.5 (5.2, 8.2)	
*Profemur L	2.5 (2.0, 3.1)	3.5 (2.9, 4.2)	4.0 (3.3, 4.7)		
*Taper Fit	1.6 (1.3, 2.0)	2.6 (2.1, 3.1)	3.9 (3.2, 4.7)	8.0 (6.1, 10.4)	
**Atlas (Shell)	3.3 (2.1, 5.3)	4.2 (2.8, 6.4)	5.0 (3.4, 7.4)	9.8 (7.1, 13.6)	
**Continuum	2.7 (2.4, 2.9)	3.5 (3.2, 3.8)	3.9 (3.6, 4.3)	5.2 (4.8, 5.7)	
**Delta-One-TT	3.2 (1.5, 7.1)	5.8 (3.1, 10.5)	6.7 (3.7, 12.0)		
**Dynasty	3.4 (2.7, 4.2)	4.6 (3.7, 5.6)	5.2 (4.3, 6.3)	6.3 (5.2, 7.7)	
**Fin II	2.5 (2.0, 3.2)	3.4 (2.7, 4.2)	4.5 (3.7, 5.4)	7.6 (6.5, 8.8)	
**Furlong	4.2 (3.1, 5.7)	6.2 (4.9, 8.0)	6.7 (5.2, 8.5)	7.6 (5.9, 9.7)	
**G7 Multihole	5.3 (4.0, 7.1)	6.7 (4.9, 9.1)			
**Mueller	1.8 (0.2, 11.8)	12.1 (5.6, 25.1)	14.3 (7.0, 27.7)	23.4 (13.1, 39.9)	
**Versafitcup DM	2.5 (1.9, 3.4)	3.7 (2.9, 4.8)	4.1 (3.1, 5.3)		
Identified and No Longer Used					
+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)	
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, 15.3)	11.0 (6.3, 19.1)	16.2 (10.0, 25.6)	
CORAIL/Trabecular Metal (Shell)	6.2 (2.8, 13.2)	9.5 (5.1, 17.5)	12.0 (6.8, 20.6)	12.0 (6.8, 20.6)	
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)	13.4 (9.3, 19.2)	
Meridian/ABGII	2.1 (0.7, 6.4)	5.0 (2.4, 10.1)	6.4 (3.4, 12.0)	8.2 (4.6, 14.4)	
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)	19.7 (14.1, 27.2)
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)	
*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)	

CPR	1 Yr	3 Yrs	5 Yrs	10 Yrs	20 Yrs
*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)	23.7 (17.1, 32.3)	
*Apex	2.2 (1.7, 2.9)	3.3 (2.7, 4.0)	4.6 (3.8, 5.5)	7.2 (6.2, 8.4)	
*BMHR VST	1.9 (0.8, 4.6)	4.6 (2.7, 8.0)	7.0 (4.5, 10.8)	12.2 (8.7, 16.9)	
*CBH Stem	4.0 (2.3, 7.2)	7.4 (4.9, 11.3)	9.8 (6.8, 14.1)	15.0 (11.2, 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)	15.3 (13.5, 17.3)
*Emperion	4.8 (3.2, 7.0)	6.0 (4.2, 8.4)	7.2 (5.2, 9.8)	11.3 (8.7, 14.7)	
*GHE	2.6 (0.9, 8.0)	5.3 (2.4, 11.5)	8.2 (4.3, 15.2)		
*K2	5.2 (3.7, 7.3)	7.5 (5.7, 10.0)	9.8 (7.7, 12.6)	13.8 (11.2, 16.9)	
*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)		
*ML Taper Kinectiv	2.4 (2.0, 3.0)	3.5 (3.0, 4.2)	4.3 (3.7, 5.0)	6.1 (5.3, 7.0)	
*MSA	5.8 (3.4, 9.8)	9.5 (6.3, 14.1)	11.3 (7.8, 16.3)	18.0 (13.4, 23.9)	
*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)	20.2 (17.0, 23.8)
*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)	
*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)	6.7 (5.6, 8.0)	
*UniSyn	3.2 (2.0, 5.3)	5.9 (4.1, 8.5)	6.6 (4.7, 9.3)	12.3 (9.5, 15.9)	
**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 (23.2, 25.8)	45.1 (43.5, 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, 22.4)	26.9 (20.9, 34.3)	43.9 (36.6, 52.1)
**BHR	1.1 (0.8, 1.6)	3.2 (2.6, 3.9)	6.1 (5.3, 7.0)	14.3 (13.0, 15.6)	
**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, 16.4)	
**DeltaLox	5.9 (3.5, 9.9)	8.7 (5.6, 13.3)	10.1 (6.8, 15.0)	14.3 (10.1, 20.0)	
**Duraloc	1.8 (1.5, 2.2)	3.0 (2.6, 3.5)	4.1 (3.6, 4.7)	8.3 (7.6, 9.2)	19.7 (18.2, 21.4)
**Durom	1.1 (0.7, 1.9)	3.6 (2.7, 4.8)	5.5 (4.3, 6.9)	13.5 (11.7, 15.7)	
**ExpanSys	2.8 (0.7, 10.8)	5.7 (2.2, 14.4)	10.2 (5.0, 20.2)	16.6 (9.6, 28.1)	
**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, 16.4)	24.2 (20.1, 29.0)	
**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, 18.5)	
**Plasmacup	4.4 (2.9, 6.6)	5.6 (3.9, 8.1)	5.8 (4.1, 8.3)	7.7 (5.6, 10.6)	
**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, 19.5)
**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, 17.3)	

Note: 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

Table IP9 Yearly Usage of Total Conventional Hip Prostheses Identified as Having a Higher than Anticipated Rate of Revision

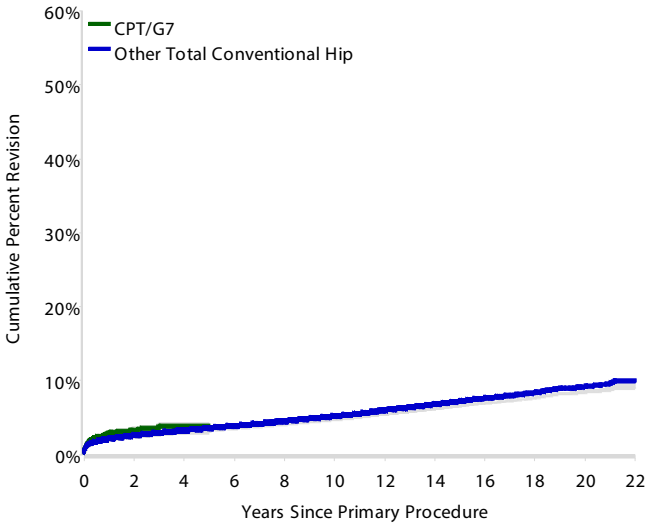
Year of Implant	≤2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Newly Identified																	
CPT/G7	.	.	.	.	.	.	.	.	.	.	30	101	217	384	676	883	881
*Revision Hip	21	2	1	3	3	3	7	6	13	6	5	10	4	5	2	2	11
**Fixa	.	.	.	.	.	44	161	153	99	134	100	91	78	84	95	134	162
Re-Identified and Still Used																	
Accolade II/Trident Tritanium (Shell)	.	.	.	.	.	.	1	1	30	119	258	484	402	510	584	810	662
Avenir/Fitmore	.	.	.	.	.	.	.	2	7	5	46	44	42	56	41	55	41
CORAIL/Trident (Shell)	11	22	10	13	16	25	26	24	14	13	11	32	37	47	65	128	98
CPT/Fitmore	31	4	16	12	15	24	14	30	30	22	18	16	20	25	8	1	4
CPT/Low Profile Cup	32	7	7	6	9	16	26	20	6	5	2	3	15	31	11	8	9
*Excia (cless)	.	.	6	34	8	47	58	38	17	42	35	65	66	10	.	.	15
*Furlong Evolution	.	.	.	.	.	.	.	29	25	32	11	54	102	106	83	75	4
*HACTIV	.	.	.	.	2	19	63	61	117	146	96	240	452	388	418	406	190
*MiniMax	.	.	.	.	.	.	.	.	.	.	4	43	170	133	41	19	5
*Novation	.	.	.	4	32	53	130	137	226	266	148	90	101	145	51	19	21
*Profemur L	.	.	.	.	.	.	2	47	288	384	406	405	439	426	388	340	389
*Taper Fit	245	26	18	6	8	17	55	45	110	161	227	315	592	790	788	797	834
**Atlas (Shell)	188	46	16	13	6	7	4	8	28	23	13	27	26	26	35	23	27
**Continuum	.	.	.	175	1117	1245	1331	1504	1492	1359	1327	1293	1197	850	513	289	178
**Delta-One-TT	.	.	.	.	4	7	7	15	37	13	12	14	14	23	15	14	12
**Dynasty	.	.	.	.	.	40	31	49	178	298	317	306	307	272	241	39	31
**Fin II	167	175	251	269	318	286	205	247	101	6	.	.	9	76	94	96	87
**Furlong	31	4	7	61	90	85	73	76	64	66	12	55	100	82	65	71	21
**G7 Multihole	.	.	.	.	.	.	.	.	.	.	.	15	49	169	222	242	229
**Mueller	47	1	2	.	.	.	1	.	1	1	.	1	1	3	.	.	1
**Versafitcup DM	.	.	.	.	.	10	12	4	19	146	193	199	194	188	229	250	262
Identified and No Longer Used																	
+CPCS/Reflection (Non XLPE Cup)	337	36	19	13	.	2	.	.	.	.	.	.	.	.	.	.	.
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	.	.
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	.	.	.	.	.	.	.	.	.	.	.

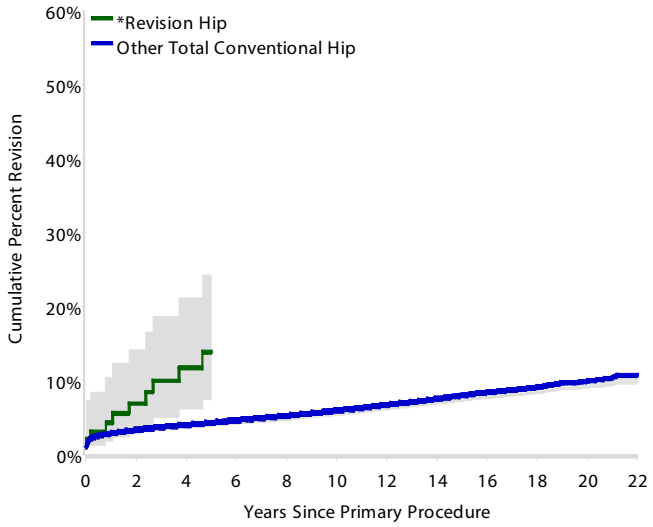
Year of Implant	≤2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
*ABGII (exch neck)	.	10	39	69	58	63	7	.	.	.	.	.	.	.	.	.	.
*Adapter (cless)	159	131	122	158	115	58	.	1	.	.	.	.	.	.	.	.	.
*Adapter (ctd)	48	52	33	8	7	.	.	.	.	.	.	.	.	.	.	.	.
*Apex	322	223	265	197	169	190	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	.	.	.	.	.	.	.	.	.	.	.
*Emperion	14	21	26	65	87	72	44	53	38	41	34	12	.	.	.	.	.
*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	.	.	.	.	.	.	.	.	.	.	.
*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
*Femoral Stem Component **Acetabular Component + Newly identified and no longer used

Figure IP1 Cumulative Percent Revision of Newly Identified Total Conventional Hip Prostheses

Newly Identified





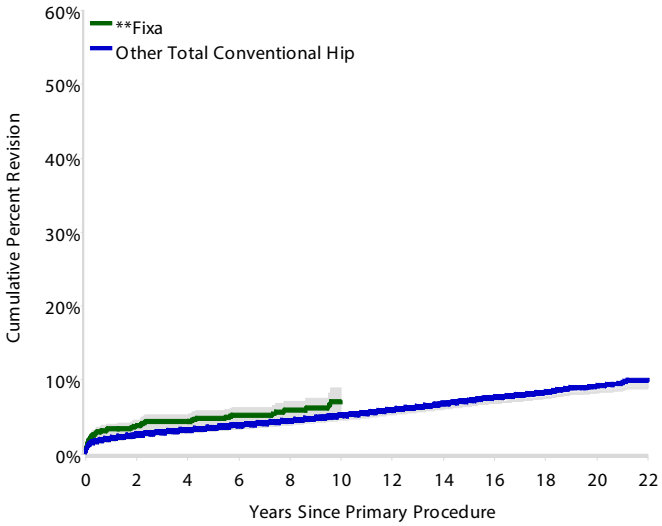
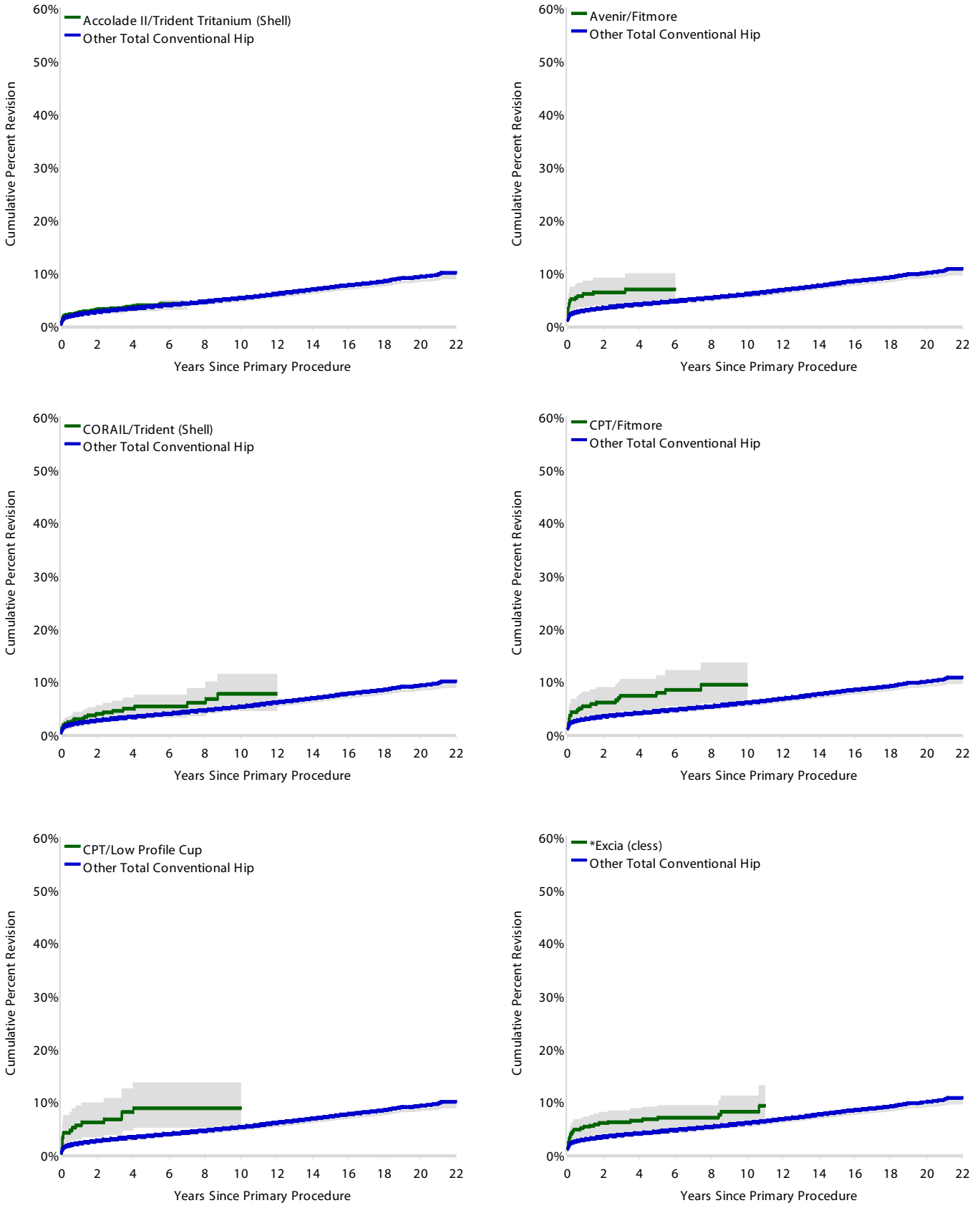
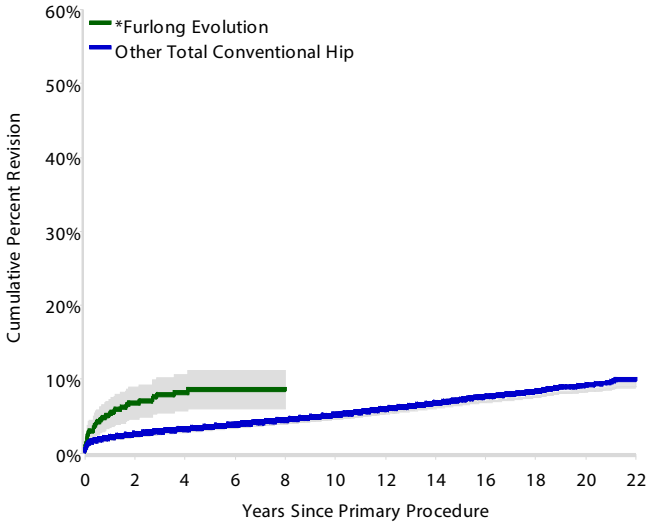


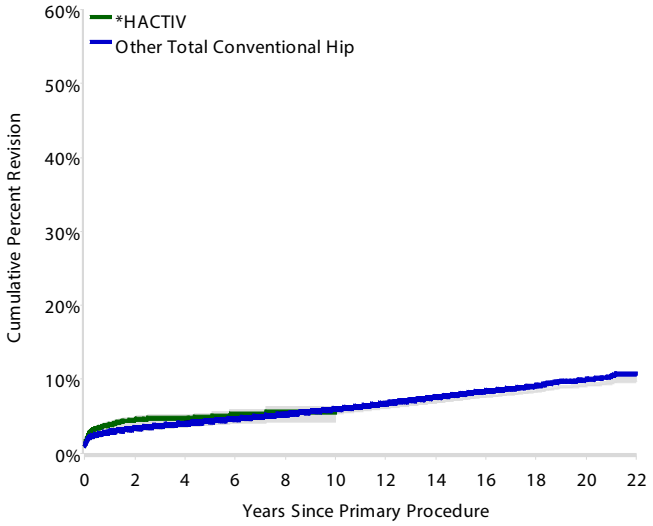
Figure IP2 Cumulative Percent Revision of Re-Identified and Still Used Total Conventional Hip Prostheses

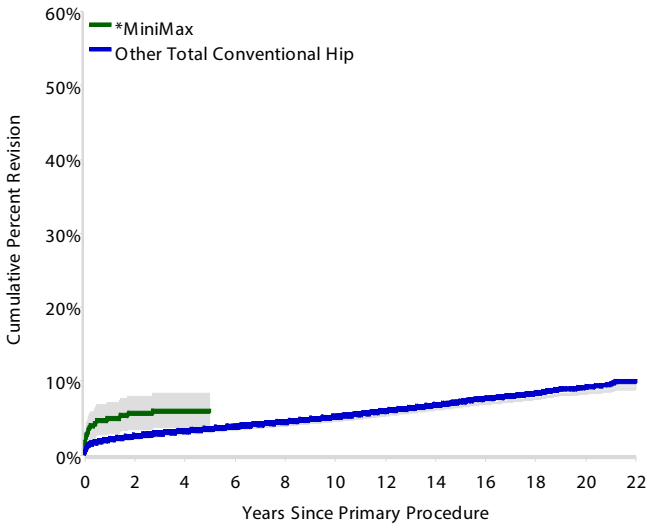
Re-Identified and Still Used

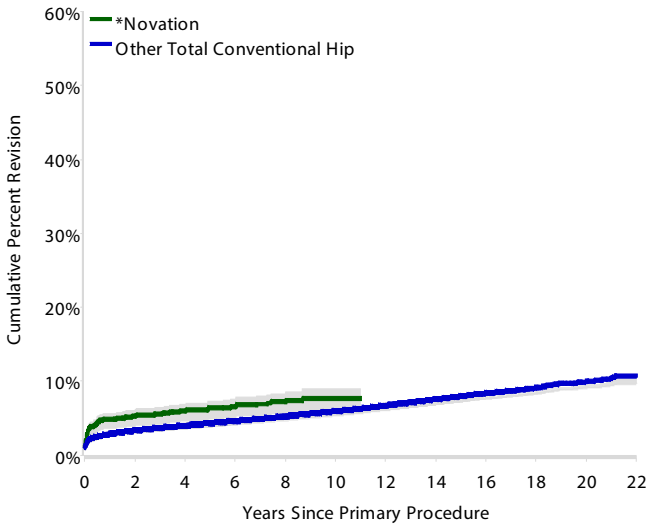


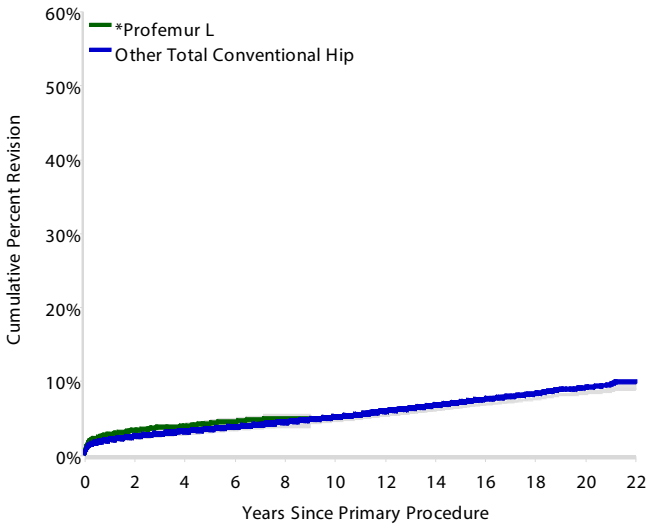
HTARR Hips

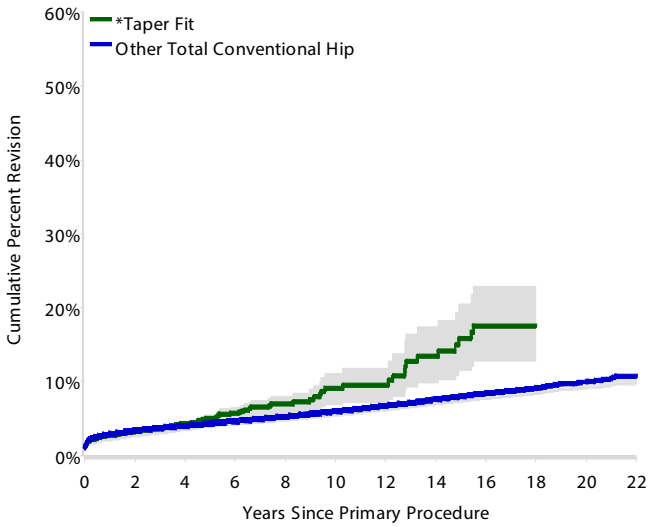

*Furlong Evolution
Other Total Conventional Hip
Cumulative Percent Revision
60%
50%
40%
30%
20%
10%
0%
0 2 4 6 8 10 12 14 16 18 20 22
Years Since Primary Procedure

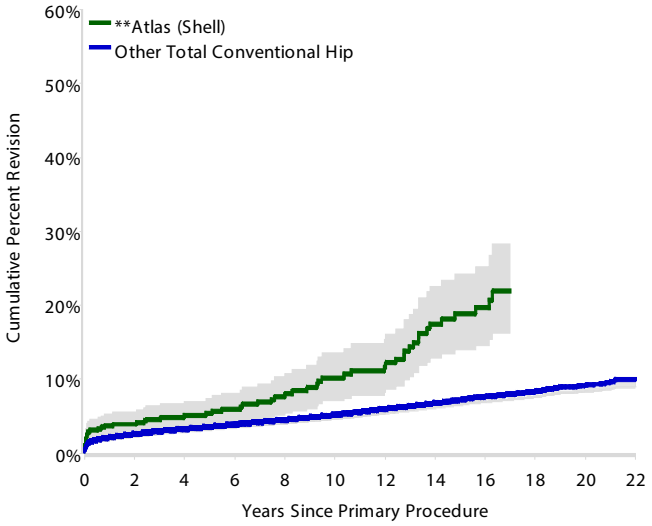

*HACTIV
Other Total Conventional Hip
Cumulative Percent Revision
60%
50%
40%
30%
20%
10%
0%
0 2 4 6 8 10 12 14 16 18 20 22
Years Since Primary Procedure

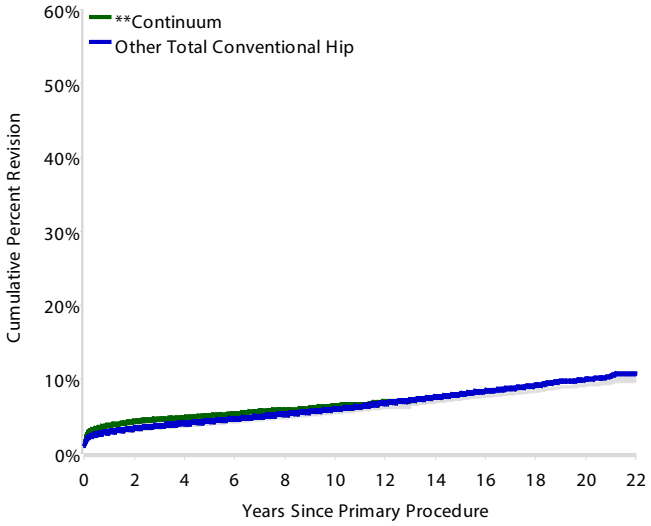

*MiniMax
Other Total Conventional Hip
Cumulative Percent Revision
60%
50%
40%
30%
20%
10%
0%
0 2 4 6 8 10 12 14 16 18 20 22
Years Since Primary Procedure

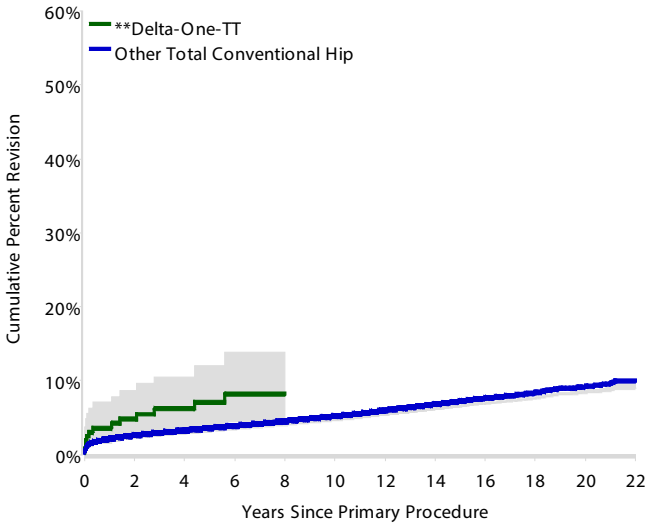

*Novation
Other Total Conventional Hip
Cumulative Percent Revision
60%
50%
40%
30%
20%
10%
0%
0 2 4 6 8 10 12 14 16 18 20 22
Years Since Primary Procedure

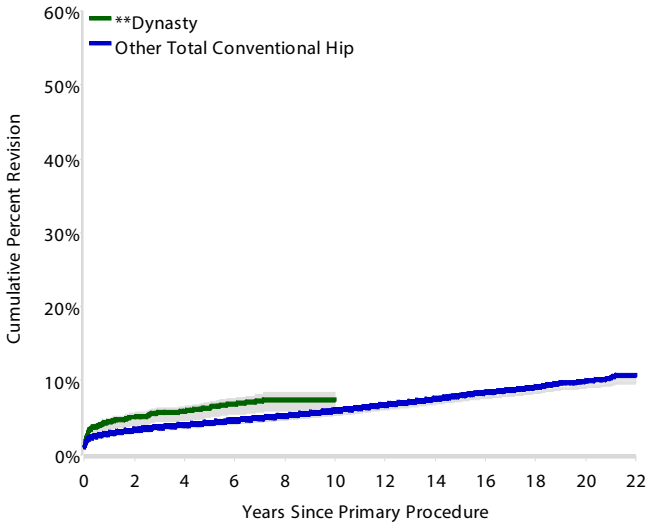

*Profemur L
Other Total Conventional Hip
Cumulative Percent Revision
60%
50%
40%
30%
20%
10%
0%
0 2 4 6 8 10 12 14 16 18 20 22
Years Since Primary Procedure

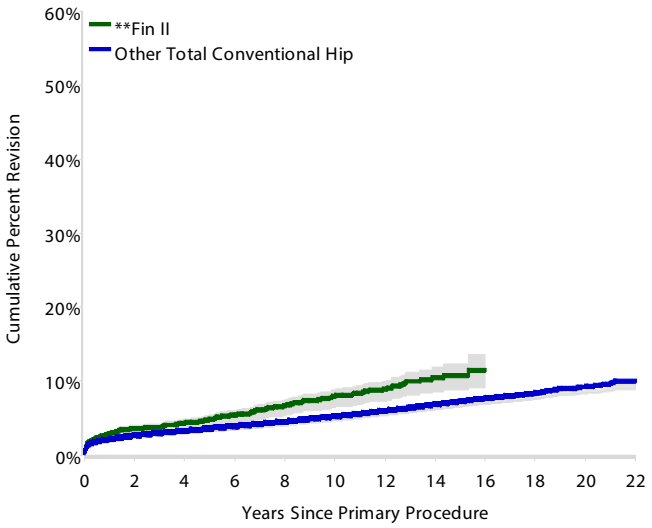

*Taper Fit
Other Total Conventional Hip
Cumulative Percent Revision
60%
50%
40%
30%
20%
10%
0%
0 2 4 6 8 10 12 14 16 18 20 22
Years Since Primary Procedure

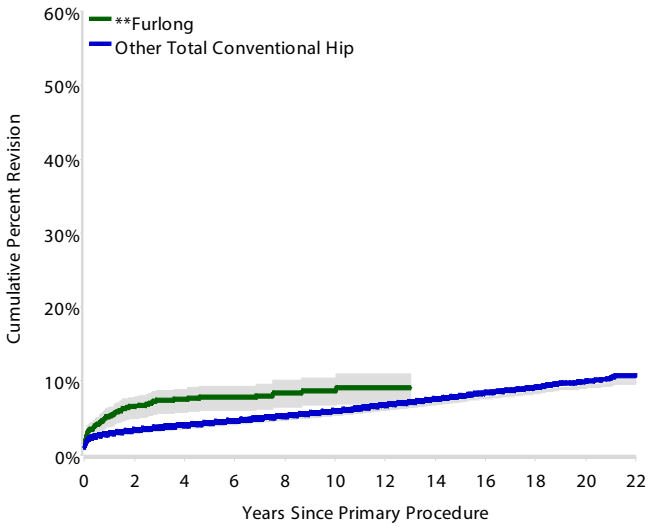

**Atlas (Shell)
Other Total Conventional Hip
Cumulative Percent Revision
60%
50%
40%
30%
20%
10%
0%
0 2 4 6 8 10 12 14 16 18 20 22
Years Since Primary Procedure


**Continuum
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
Years Since Primary Procedure

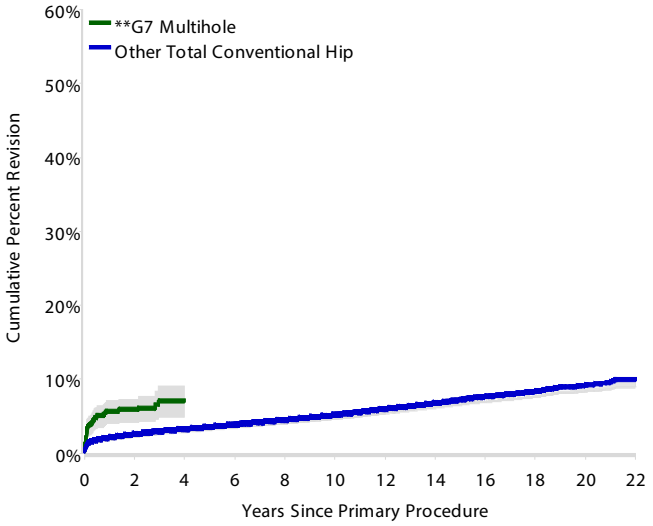

**Delta-One-TT
Other Total Conventional Hip
Cumulative Percent Revision
60%
50%
40%
30%
20%
10%
0%
0 2 4 6 8 10 12 14 16 18 20 22
Years Since Primary Procedure

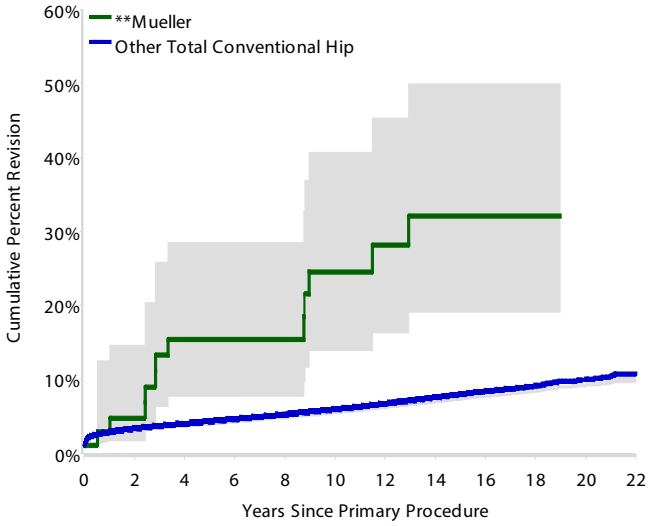

**Dynasty
Other Total Conventional Hip
Cumulative Percent Revision
60%
50%
40%
30%
20%
10%
0%
0 2 4 6 8 10 12 14 16 18 20 22
Years Since Primary Procedure

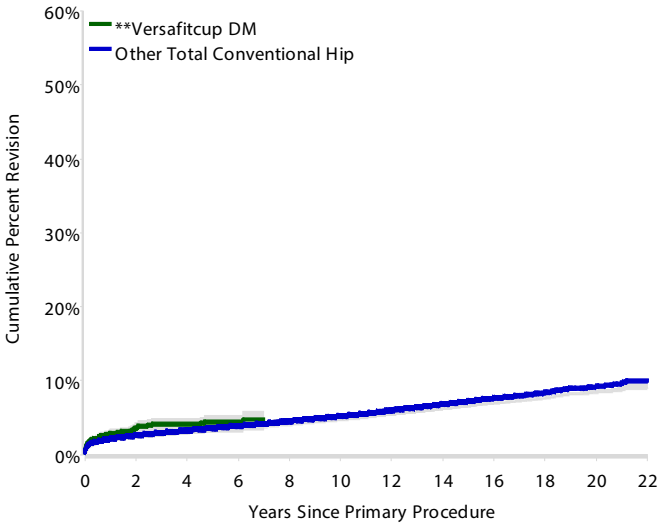

**Fin II
Other Total Conventional Hip
Cumulative Percent Revision
60%
50%
40%
30%
20%
10%
0%
0 2 4 6 8 10 12 14 16 18 20 22
Years Since Primary Procedure


**Furlong
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
Years Since Primary Procedure

HTARR Hips


**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
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
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
Years Since Primary Procedure

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	415	1168	14489	2.86	0 - 3Yr: HR=2.74 (2.16, 3.49), p<0.001
	.	.	.	.	3Yr - 5Yr: HR=8.54 (6.54, 11.14), p<0.001
	.	.	.	.	5Yr - 6Yr: HR=7.91 (5.44, 11.50), p<0.001
	.	.	.	.	6Yr - 7.5Yr: HR=6.95 (5.09, 9.50), p<0.001
	.	.	.	.	7.5Yr - 9Yr: HR=4.99 (3.39, 7.34), p<0.001
	.	.	.	.	9Yr - 10.5Yr: HR=3.60 (2.44, 5.30), p<0.001
	.	.	.	.	10.5Yr - 12.5Yr: HR=2.87 (1.89, 4.36), p<0.001
	.	.	.	.	12.5Yr+: HR=1.98 (1.36, 2.89), p<0.001
Bionik/Bionik	64	200	2276	2.81	Entire Period: HR=4.54 (3.53, 5.84), p<0.001
Conserve Plus/Conserve Plus	17	63	931	1.83	Entire Period: HR=2.38 (1.47, 3.85), p<0.001
Cormet/Cormet	143	626	8285	1.73	Entire Period: HR=2.51 (2.11, 2.99), p<0.001
Durom/Durom	117	847	12298	0.95	0 - 4.5Yr: HR=2.50 (1.92, 3.26), p<0.001
	.	.	.	.	4.5Yr+: HR=1.06 (0.81, 1.40), p=0.670
Recap/Recap	31	196	2527	1.23	0 - 6Mth: HR=2.92 (1.29, 6.61), p=0.009
	.	.	.	.	6Mth - 1.5Yr: HR=6.81 (3.31, 14.03), p<0.001
	.	.	.	.	1.5Yr+: HR=1.33 (0.82, 2.15), p=0.246
*Cormet 2000 HAP	30	95	1433	2.09	Entire Period: HR=3.58 (2.49, 5.15), p<0.001

Note: Components have been compared to all other modern 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)	
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)	
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)	

Note: *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
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: *Head Component

Primary Partial Knee Replacement

PATELLA/TROCHLEA

The PFC Sigma/Sigma HP combination is identified but no longer used. It has been previously identified between 2011 and 2015.

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					
+PFC Sigma/Sigma HP	45	117	894	5.03	Entire Period: HR=2.03 (1.49, 2.76), p<0.001
Lubinus/Lubinus	22	39	406	5.42	Entire Period: HR=2.03 (1.29, 3.20), p=0.002
**LCS	222	413	4228	5.25	Entire Period: HR=1.98 (1.67, 2.34), p<0.001

Note: Components have been compared to all other modern patella-trochlear knee components **Trochlear Component + Newly identified and no longer used

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					
+PFC Sigma/Sigma HP	4.3 (1.8, 10.0)	14.7 (9.4, 22.6)	20.9 (14.5, 29.6)		
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)	
**LCS	3.9 (2.4, 6.2)	11.9 (9.1, 15.4)	20.7 (17.1, 25.0)	40.9 (36.1, 45.9)	

Note: **Trochlear Component + Newly identified and no longer used

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
Identified and No Longer Used																	
+PFC Sigma/Sigma HP	.	14	6	5	16	15	12	20	7	7	7	8	.	.	.	.	.
Lubinus/Lubinus	37	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.
**LCS	262	64	60	27	.	.	.	.	.	.	.	.	.	.	.	.	.

Note: **Trochlear Component + Newly identified and no longer used

UNICOMPARTMENTAL

The BalanSys Uni/BalanSys Uni Convex is identified for the first time and is no longer used. A similar combination, the BalanSys Uni/BalanSys Uni mobile has been identified since 2009. The BalanSys Uni/BalanSys Uni Convex is mentioned to highlight a potential problem of breakage of the tibial insert. This has accounted for 8 of the 17 revisions from 54 primary procedures and occurs after 5 years.

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
Re-Identified and Still Used					
GMK-UNI/GMK-UNI	42	168	1008	4.16	Entire Period: HR=2.79 (2.06, 3.78), p<0.001
Identified and No Longer Used					
+BalanSys Uni/BalanSys Uni Convex	17	54	562	3.03	Entire Period: HR=1.96 (1.21, 3.15), p=0.005
Advance/Advance	16	37	339	4.72	Entire Period: HR=3.49 (2.14, 5.69), p<0.001
BalanSys Uni/BalanSys Uni Mobile	61	199	2440	2.50	0 - 6Mth: HR=4.04 (2.01, 8.12), p<0.001
	.	.	.	.	6Mth - 2Yr: HR=2.70 (1.60, 4.58), p<0.001
	.	.	.	.	2Yr+: HR=1.31 (0.95, 1.79), p=0.097
Eius/Eius	51	142	1768	2.88	Entire Period: HR=1.57 (1.19, 2.06), p=0.001
Freedom PKR Active/Freedom PKR Active	491	1505	15889	3.09	0 - 9Mth: HR=0.65 (0.39, 1.09), p=0.103
	.	.	.	.	9Mth - 1.5Yr: HR=2.09 (1.54, 2.84), p<0.001
	.	.	.	.	1.5Yr - 2Yr: HR=1.66 (1.02, 2.71), p=0.042
	.	.	.	.	2Yr - 3.5Yr: HR=2.32 (1.75, 3.07), p<0.001
	.	.	.	.	3.5Yr - 5Yr: HR=3.99 (3.12, 5.11), p<0.001
	.	.	.	.	5Yr - 8.5Yr: HR=2.49 (2.05, 3.02), p<0.001
	.	.	.	.	8.5Yr - 9Yr: HR=4.30 (2.85, 6.48), p<0.001
	.	.	.	.	9Yr - 10Yr: HR=3.41 (2.42, 4.80), p<0.001
	.	.	.	.	10Yr+: HR=1.73 (1.42, 2.12), p<0.001
Uniglide/Uniglide	187	756	8702	2.15	0 - 1.5Yr: HR=2.29 (1.74, 3.03), p<0.001
	.	.	.	.	1.5Yr - 2Yr: HR=1.53 (0.76, 3.10), p=0.232
	.	.	.	.	2Yr - 3Yr: HR=2.47 (1.58, 3.88), p<0.001
	.	.	.	.	3Yr+: HR=1.11 (0.91, 1.34), p=0.300
**Preservation Mobile	160	400	5166	3.10	0 - 1.5Yr: HR=2.63 (1.88, 3.68), p<0.001
	.	.	.	.	1.5Yr - 3Yr: HR=3.55 (2.41, 5.21), p<0.001
	.	.	.	.	3Yr+: HR=1.42 (1.16, 1.74), p<0.001

Note: Components have been compared to all other modern unicompartmental knee components
**Tibial Component
+ Newly identified and no longer used

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
Re-Identified and Still Used					
GMK-UNI/GMK-UNI	6.6 (3.7, 11.5)	17.6 (12.6, 24.3)	24.3 (18.4, 31.7)		
Identified and No Longer Used					
+BalanSys Uni/BalanSys Uni Convex	1.9 (0.3, 12.4)	7.4 (2.8, 18.5)	7.4 (2.8, 18.5)	25.7 (15.7, 40.3)	
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 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	1.8 (1.2, 2.6)	7.9 (6.6, 9.4)	13.7 (12.0, 15.6)	27.5 (25.2, 29.9)	
Uniglide/Uniglide	4.8 (3.5, 6.6)	10.7 (8.7, 13.1)	12.9 (10.7, 15.5)	19.8 (17.0, 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)	45.0 (39.7, 50.8)

Note: **Tibial Component
+ Newly identified and no longer used

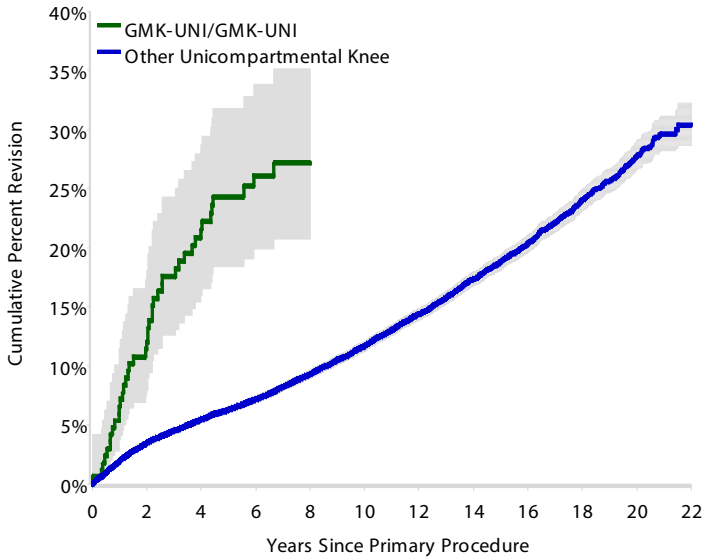
Table IP18 Yearly Usage of Unicompartmental Knee Prostheses Identified as Having a Higher than Anticipated Rate of Revision

Year of Implant	≤2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Re-Identified and Still Used																	
GMK-UNI/GMK-UNI	.	.	5	10	2	.	21	22	16	19	17	12	29	3	8	3	1
Identified and No Longer Used																	
+BalanSys Uni/BalanSys Uni Convex	.	12	10	4	7	9	1	3	3	5	.	.	.	.	.	.	.
Advance/Advance	33	3	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
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	.	.	.	.	.
Uniglide/Uniglide	353	107	93	61	30	38	25	22	9	5	8	3	.	1	1	.	.
**Preservation Mobile	387	13	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Note: **Tibial Component
+ Newly identified and no longer used

Figure IP3 Cumulative Percent Revision of Re-Identified and Still Used Unicompartmental Knee Prostheses

Re-Identified and Still Used



Primary Total Knee Replacement

There are three newly identified total knee prostheses.

The Attune PS (cemented)/Attune (cementless) is a 'reverse hybrid' combination with 854 primary procedures since 2019. There have been 21 revisions with a cumulative percent revision of 1.8% at 1 year. There have been 12 revisions for loosening and 6 for infection. Fourteen of the revisions are major revisions and all of these involved a tibial component revision. If both components of the Attune PS/Attune are cemented, a higher rate of revision is not evident.

The Optetrak Logic CR (cementless)/Optetrak Logic (cemented) combination has been used since 2014 and 51 of the 1,130 procedures have been revised. The cumulative percent revision is 7.2% at 7 years. Revisions have been for infection in 10, loosening in 8, instability in 8, insert wear in 7, insert breakage in 3, with synovitis and lysis occurring more often than expected. Insert exchange has been performed in 31 of the 35 minor revisions. All of the tibial inserts are non-XLPE.

Further analysis revealed the Optetrak Logic CR/Optetrak Logic combination also has a higher rate of revision when compared to other CR total knee procedures using non-XLPE. The tibial inserts have recently been the subject of a Hazard Notice from the TGA (Therapeutic Goods Administration). Since 2007, 6 different Optetrak total knee combinations have been identified.

The Mutars/Mutars knee prosthesis has been used since 2012 in 357 primary procedures with 51 revised. A hinged articulation was used in 36 of these. The cumulative percent revision is 21.9% at 4 years. There have been 17 revisions for infection, 13 for loosening, with 6 for femoral implant breakages and 3 for metal related pathology. Major revisions have been used in 38 of the 51 revisions, with 32 of these revisions involving exchange of the femoral component.

As this prosthesis is often used for complex primary procedures including tumour, more detailed analyses were carried out. When the hinged Mutars prosthesis is compared to other hinged total knee replacements used for all diagnoses in primary procedures there is a higher rate of revision. When restricting the comparison to procedures just for osteoarthritis, the hinged Mutars prosthesis also has a higher rate of revision.

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					
Attune PS (ctd)/Attune (class)	21	854	1012	2.08	Entire Period: HR=2.13 (1.39, 3.27), p<0.001
Mutars/Mutars	51	357	828	6.16	Entire Period: HR=4.00 (3.03, 5.27), p<0.001
Optetrak Logic CR (class)/Optetrak Logic (ctd)	51	1130	4551	1.12	Entire Period: HR=1.72 (1.30, 2.26), p<0.001
Re-Identified and Still Used					
ACS (class)/ACS Fixed	123	2695	14638	0.84	Entire Period: HR=1.38 (1.15, 1.64), p<0.001
Active Knee (class)/Active Knee	750	7215	82231	0.91	0 - 1Yr: HR=1.07 (0.86, 1.33), p=0.558
	.	.	.	.	1Yr - 2.5Yr: HR=1.70 (1.44, 1.99), p<0.001
	.	.	.	.	2.5Yr - 3Yr: HR=1.18 (0.78, 1.80), p=0.438
	.	.	.	.	3Yr+: HR=2.32 (2.12, 2.54), p<0.001
Advance/Advance	75	1009	7970	0.94	Entire Period: HR=1.74 (1.39, 2.18), p<0.001
Apex Knee CR (class)/Apex Knee (class)	28	513	3253	0.86	Entire Period: HR=1.56 (1.08, 2.25), p=0.019
Columbus/Columbus	197	6334	24048	0.82	Entire Period: HR=1.26 (1.09, 1.45), p=0.001
E.Motion/E.Motion	71	1014	7388	0.96	0 - 1.5Yr: HR=2.51 (1.83, 3.46), p<0.001
	.	.	.	.	1.5Yr+: HR=1.31 (0.93, 1.84), p=0.123
Nexgen LPS Flex (class)/Nexgen	111	2114	13765	0.81	0 - 1.5Yr: HR=1.99 (1.55, 2.56), p<0.001
	.	.	.	.	1.5Yr - 2Yr: HR=1.68 (0.97, 2.90), p=0.062
	.	.	.	.	2Yr+: HR=0.96 (0.70, 1.33), p=0.826
Score (class)/Score (class)	244	3026	20270	1.20	0 - 6Mth: HR=0.97 (0.60, 1.57), p=0.911
	.	.	.	.	6Mth - 1.5Yr: HR=2.05 (1.60, 2.64), p<0.001
	.	.	.	.	1.5Yr+: HR=2.29 (1.97, 2.67), p<0.001
Trekking/Trekking	71	1281	8209	0.86	0 - 1Yr: HR=2.30 (1.60, 3.30), p<0.001
	.	.	.	.	1Yr - 2Yr: HR=1.02 (0.56, 1.84), p=0.948
	.	.	.	.	2Yr+: HR=1.32 (0.93, 1.88), p=0.124
Vanguard PS/Vanguard	356	5403	44335	0.80	0 - 1.5Yr: HR=1.95 (1.67, 2.29), p<0.001
	.	.	.	.	1.5Yr+: HR=1.37 (1.20, 1.58), p<0.001
*Legion Oxinium FS	39	472	2568	1.52	0 - 6Mth: HR=6.98 (4.40, 11.08), p<0.001
	.	.	.	.	6Mth - 1.5Yr: HR=1.70 (0.81, 3.56), p=0.161
	.	.	.	.	1.5Yr+: HR=1.57 (0.93, 2.66), p=0.089
**Legion Revision Tibial Baseplate	69	1155	5577	1.24	0 - 6Mth: HR=4.36 (3.03, 6.29), p<0.001
	.	.	.	.	6Mth - 1.5Yr: HR=0.76 (0.38, 1.52), p=0.439
	.	.	.	.	1.5Yr+: HR=1.58 (1.12, 2.24), p=0.009
Identified and No Longer Used					
ACS/ACS Mobile PC (class)	30	131	990	3.03	Entire Period: HR=5.62 (3.93, 8.02), p<0.001
AMK/AMK	26	203	2553	1.02	Entire Period: HR=2.41 (1.64, 3.54), p<0.001
Buechel-Pappas/Buechel-Pappas	55	479	5330	1.03	Entire Period: HR=2.14 (1.65, 2.79), p<0.001
Eska RP/Eska RP	9	40	386	2.33	Entire Period: HR=5.35 (2.80, 10.23), p<0.001
Evolis (class)/Evolis (class)	10	87	850	1.18	Entire Period: HR=2.29 (1.23, 4.24), p=0.008
Gemini MK II/Gemini MK II	8	21	220	3.64	Entire Period: HR=7.50 (3.75, 14.99), p<0.001
Genesis (ctd)/Genesis (ctd)	11	62	709	1.55	Entire Period: HR=3.77 (2.09, 6.81), p<0.001

Femoral/Tibial	N Revised	N Total	Obs. Years	Revisions/ 100 Obs. Yrs	Hazard Ratio, P Value
Genesis II CR (class)/Profix Mobile (ctd)	37	241	2971	1.25	Entire Period: HR=2.92 (2.12, 4.03), p<0.001
Genesis II Oxinium CR (class)/Genesis II	47	110	1025	4.59	0 - 1.5Yr: HR=14.15 (9.48, 21.11), p<0.001
	.	.	.	.	1.5Yr - 2.5Yr: HR=24.86 (14.98, 41.28), p<0.001
	.	.	.	.	2.5Yr+: HR=2.69 (1.35, 5.37), p=0.005
Genesis II Oxinium CR (class)/Profix Mobile	57	88	636	8.96	0 - 6Mth: HR=7.33 (2.75, 19.53), p<0.001
	.	.	.	.	6Mth - 9Mth: HR=52.73 (29.14, 95.40), p<0.001
	.	.	.	.	9Mth - 1.5Yr: HR=39.96 (26.03, 61.35), p<0.001
	.	.	.	.	1.5Yr - 2Yr: HR=33.01 (15.73, 69.28), p<0.001
	.	.	.	.	2Yr+: HR=6.81 (4.03, 11.50), p<0.001
Genesis II Oxinium PS (ctd)/Genesis II (class)	17	56	501	3.39	0 - 1Yr: HR=17.32 (9.59, 31.29), p<0.001
	.	.	.	.	1Yr - 1.5Yr: HR=7.76 (1.94, 31.05), p=0.003
	.	.	.	.	1.5Yr+: HR=2.14 (0.80, 5.69), p=0.129
Genesis II Oxinium PS (ctd)/Genesis II (keel)	69	269	3049	2.26	Entire Period: HR=4.81 (3.80, 6.09), p<0.001
HLS Noetos/HLS Noetos	43	294	3076	1.40	Entire Period: HR=2.92 (2.16, 3.94), p<0.001
IB II/IB II	40	199	2614	1.53	0 - 2Yr: HR=0.91 (0.29, 2.83), p=0.873
	.	.	.	.	2Yr - 2.5Yr: HR=5.32 (1.72, 16.44), p=0.003
	.	.	.	.	2.5Yr+: HR=5.54 (3.96, 7.75), p<0.001
Interax/Interax	12	52	526	2.28	0 - 3Yr: HR=0.89 (0.12, 6.28), p=0.902
	.	.	.	.	3Yr+: HR=10.15 (5.62, 18.32), p<0.001
Journey Oxinium/Journey	385	3033	32176	1.20	0 - 3Mth: HR=0.28 (0.09, 0.86), p=0.025
	.	.	.	.	3Mth - 1.5Yr: HR=2.25 (1.80, 2.81), p<0.001
	.	.	.	.	1.5Yr - 2Yr: HR=1.84 (1.20, 2.82), p=0.005
	.	.	.	.	2Yr - 2.5Yr: HR=2.36 (1.56, 3.56), p<0.001
	.	.	.	.	2.5Yr - 3Yr: HR=1.61 (0.91, 2.83), p=0.102
	.	.	.	.	3Yr+: HR=3.12 (2.75, 3.54), p<0.001
Maxim (cless)/Vanguard (ctd)	70	413	5492	1.27	0 - 2Yr: HR=1.56 (0.89, 2.75), p=0.124
	.	.	.	.	2Yr - 3Yr: HR=1.28 (0.41, 3.96), p=0.671
	.	.	.	.	3Yr - 4.5Yr: HR=3.50 (1.75, 7.00), p<0.001
	.	.	.	.	4.5Yr - 6Yr: HR=1.11 (0.28, 4.43), p=0.885
	.	.	.	.	6Yr+: HR=4.15 (3.10, 5.57), p<0.001
Optetrak-CR (ctd)/Optetrak (ctd)	12	92	906	1.32	Entire Period: HR=2.97 (1.68, 5.23), p<0.001
Optetrak-PS/Optetrak	328	2410	26745	1.23	0 - 1Mth: HR=0.23 (0.03, 1.65), p=0.144
	.	.	.	.	1Mth - 1.5Yr: HR=1.85 (1.42, 2.40), p<0.001
	.	.	.	.	1.5Yr+: HR=3.06 (2.71, 3.45), p<0.001
Optetrak-PS/Optetrak RBK	96	1127	10497	0.91	Entire Period: HR=1.91 (1.56, 2.33), p<0.001
Optetrak-PS/Optetrak-PS	14	55	561	2.50	Entire Period: HR=5.81 (3.44, 9.81), p<0.001
PFC Sigma PS (ctd)/MBT (class)	25	316	2952	0.85	Entire Period: HR=1.61 (1.09, 2.38), p=0.017
Profix Oxinium (class)/Profix	33	75	745	4.43	0 - 9Mth: HR=6.03 (2.26, 16.05), p<0.001
	.	.	.	.	9Mth - 2Yr: HR=27.72 (18.06, 42.55), p<0.001
	.	.	.	.	2Yr+: HR=3.36 (1.68, 6.72), p<0.001

HTARR Knees

Femoral/Tibial	N Revised	N Total	Obs. Years	Revisions/ 100 Obs. Yrs	Hazard Ratio, P Value
Profix Oxinium (class)/Profix Mobile	71	158	1395	5.09	0 - 9Mth: HR=3.15 (1.18, 8.40), p=0.021
	.	.	.	.	9Mth - 1.5Yr: HR=27.48 (19.08, 39.59), p<0.001
	.	.	.	.	1.5Yr - 2Yr: HR=18.78 (9.76, 36.13), p<0.001
	.	.	.	.	2Yr - 2.5Yr: HR=37.51 (22.18, 63.45), p<0.001
	.	.	.	.	2.5Yr - 3Yr: HR=23.91 (10.72, 53.31), p<0.001
	.	.	.	.	3Yr+: HR=2.59 (1.35, 4.98), p=0.004
Profix Oxinium (ctd)/Profix (class)	14	100	1300	1.08	Entire Period: HR=2.08 (1.23, 3.50), p=0.006
Profix Oxinium (ctd)/Profix Mobile	29	228	3203	0.91	Entire Period: HR=1.81 (1.26, 2.61), p=0.001
Profix/Profix Mobile	114	1005	12924	0.88	0 - 1.5Yr: HR=2.79 (2.04, 3.80), p<0.001
	.	.	.	.	1.5Yr - 2.5Yr: HR=3.20 (2.08, 4.91), p<0.001
	.	.	.	.	2.5Yr - 3Yr: HR=1.30 (0.42, 4.04), p=0.649
	.	.	.	.	3Yr - 3.5Yr: HR=2.54 (1.05, 6.10), p=0.037
	.	.	.	.	3.5Yr - 6.5Yr: HR=1.99 (1.24, 3.21), p=0.004
	.	.	.	.	6.5Yr+: HR=1.17 (0.81, 1.70), p=0.395
Rotaglide Plus/Rotaglide Plus	86	631	7966	1.08	0 - 1.5Yr: HR=1.34 (0.76, 2.36), p=0.313
	.	.	.	.	1.5Yr - 2Yr: HR=3.58 (1.79, 7.16), p<0.001
	.	.	.	.	2Yr+: HR=2.73 (2.14, 3.48), p<0.001
SAL/SAL	15	56	752	1.99	0 - 8.5Yr: HR=1.67 (0.63, 4.44), p=0.307
	.	.	.	.	8.5Yr+: HR=10.76 (5.95, 19.45), p<0.001
Score (class)/Score (ctd)	109	1679	9441	1.15	0 - 2Yr: HR=1.48 (1.11, 1.97), p=0.007
	.	.	.	.	2Yr+: HR=2.36 (1.84, 3.04), p<0.001
Scorpio NRG PS (class)/Series 7000 (class)	89	1172	11403	0.78	Entire Period: HR=1.39 (1.13, 1.71), p=0.001
TC-Plus (class)/TC-Plus (ctd)	8	63	724	1.10	Entire Period: HR=2.66 (1.33, 5.30), p=0.005
Trac/Trac	27	138	1698	1.59	Entire Period: HR=3.47 (2.38, 5.06), p<0.001
Vanguard PS/Regenerex	42	465	3567	1.18	0 - 1.5Yr: HR=2.49 (1.57, 3.96), p<0.001
	.	.	.	.	1.5Yr+: HR=1.88 (1.26, 2.81), p=0.002
*LCS Duofix	681	4866	56126	1.21	Entire Period: HR=2.62 (2.43, 2.83), p<0.001
*LCS PS	75	638	6138	1.22	Entire Period: HR=2.62 (2.08, 3.28), p<0.001
*Renasys	19	121	1507	1.26	Entire Period: HR=2.86 (1.82, 4.48), 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					
Attune PS (ctd)/Attune (class)	1.8 (1.0, 3.0)				
Mutars/Mutars	6.5 (4.2, 9.9)	17.2 (12.8, 23.0)			
Optetrak Logic CR (class)/Optetrak Logic (ctd)	1.3 (0.7, 2.1)	3.8 (2.8, 5.2)	5.6 (4.2, 7.5)		
Re-Identified and Still Used					
ACS (class)/ACS Fixed	1.4 (1.0, 1.9)	3.8 (3.1, 4.6)	4.5 (3.8, 5.5)	5.9 (4.9, 7.1)	
Active Knee (class)/Active Knee	1.1 (0.9, 1.4)	3.6 (3.2, 4.0)	5.0 (4.6, 5.6)	8.8 (8.1, 9.5)	15.1 (13.9, 16.5)
Advance/Advance	2.0 (1.3, 3.1)	5.4 (4.1, 7.0)	6.4 (5.0, 8.1)	8.3 (6.7, 10.5)	
Apex Knee CR (class)/Apex Knee (class)	2.3 (1.3, 4.0)	5.1 (3.5, 7.5)	5.6 (3.8, 8.1)	6.2 (4.3, 8.8)	
Columbus/Columbus	1.1 (0.9, 1.4)	3.0 (2.6, 3.6)	4.0 (3.4, 4.7)	6.6 (5.5, 7.9)	
E.Motion/E.Motion	2.5 (1.7, 3.7)	5.6 (4.3, 7.2)	6.4 (5.0, 8.1)	8.3 (6.5, 10.5)	
Nexgen LPS Flex (class)/Nexgen	2.4 (1.8, 3.2)	4.4 (3.6, 5.3)	5.0 (4.2, 6.1)	6.5 (5.1, 8.1)	
Score (class)/Score (class)	1.5 (1.1, 2.0)	4.8 (4.1, 5.6)	6.6 (5.7, 7.6)	10.9 (9.6, 12.5)	
Trekking/Trekking	2.3 (1.6, 3.3)	3.9 (3.0, 5.1)	4.9 (3.8, 6.2)	6.5 (5.1, 8.3)	
Vanguard PS/Vanguard	1.8 (1.5, 2.2)	4.2 (3.7, 4.8)	5.3 (4.7, 5.9)	7.4 (6.7, 8.2)	
*Legion Oxinium FS	4.8 (3.2, 7.2)	6.9 (4.9, 9.7)	8.3 (6.0, 11.5)	10.6 (7.6, 14.7)	
**Legion Revision Tibial Baseplate	3.0 (2.1, 4.1)	4.8 (3.6, 6.3)	6.1 (4.6, 7.9)	9.2 (7.1, 12.0)	
Identified and No Longer Used					
ACS/ACS Mobile PC (class)	7.7 (4.2, 13.8)	19.3 (13.5, 27.2)	20.1 (14.2, 28.2)		
AMK/AMK	1.0 (0.2, 3.9)	5.0 (2.7, 9.1)	6.6 (3.9, 11.1)	11.3 (7.5, 16.9)	18.1 (12.0, 26.9)
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 (class)/Evolis (class)	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 (class)/Profix Mobile (ctd)	2.9 (1.4, 6.1)	7.7 (4.9, 11.9)	9.4 (6.3, 14.0)	14.8 (10.7, 20.2)	17.8 (13.1, 23.9)
Genesis II Oxinium CR (class)/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 (class)/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)	
Genesis II Oxinium PS (ctd)/Genesis II (class)	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)	3.5 (1.7, 7.3)	7.8 (4.8, 12.6)	15.8 (11.3, 22.0)	25.5 (18.8, 33.9)
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)	11.1 (10.0, 12.3)	
Maxim (class)/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)	
Optetrak-CR (ctd)/Optetrak (ctd)	0.0 (0.0, 0.0)	6.6 (3.0, 14.0)	10.1 (5.4, 18.5)	13.2 (7.4, 22.7)	
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, 13.5)	19.4 (16.3, 23.0)
Optetrak-PS/Optetrak RBK	1.8 (1.2, 2.7)	4.6 (3.5, 6.0)	5.9 (4.6, 7.5)	8.2 (6.7, 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 (class)	2.2 (1.1, 4.6)	5.4 (3.4, 8.6)	7.1 (4.7, 10.5)	7.4 (5.0, 10.9)	

HTARR Knees

CPR	1 Yr	3 Yrs	5 Yrs	10 Yrs	20 Yrs
Profix Oxinium (class)/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)	
Profix Oxinium (class)/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 (class)	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)	6.7 (4.1, 10.9)	9.0 (5.9, 13.6)	11.3 (7.8, 16.3)	
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)	13.3 (11.0, 15.9)
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)	18.2 (14.7, 22.3)
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 (class)/Score (ctd)	1.5 (1.0, 2.2)	3.8 (3.0, 4.9)	5.9 (4.9, 7.3)		
Scorpio NRG PS (class)/Series 7000 (class)	1.2 (0.7, 2.0)	4.9 (3.8, 6.3)	6.2 (4.9, 7.7)	7.5 (6.1, 9.2)	
TC-Plus (class)/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, 22.7)	
Vanguard PS/Regenerex	3.2 (2.0, 5.3)	7.1 (5.1, 9.9)	7.6 (5.5, 10.4)	9.6 (7.0, 13.0)	
*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 (9.7, 15.0)	
*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
Newly Identified																	
Attune PS (ctd)/Attune (class)	.	.	.	.	.	.	.	.	.	.	.	.	.	1	38	529	286
Mutars/Mutars	.	.	.	.	.	.	2	12	8	15	14	26	32	63	56	63	66
Optetrak Logic CR (class)/ Optetrak Logic (ctd)	.	.	.	.	.	.	.	.	2	102	117	190	205	196	125	143	50
Re-Identified and Still Used																	
ACS (class)/ACS Fixed	.	.	.	.	.	41	118	284	337	331	238	266	259	319	209	168	125
Active Knee (class)/Active Knee	2783	510	483	412	479	601	500	427	319	336	176	91	35	21	24	17	1
Advance/Advance	89	2	5	43	115	138	74	7	92	92	100	90	69	58	17	13	5
Apex Knee CR (class)/Apex Knee (class)	.	.	.	.	.	.	69	83	118	78	11	3	29	53	6	21	42
Columbus/Columbus	140	90	148	156	135	135	108	69	36	60	118	358	670	828	1114	1103	1066
E.Motion/E.Motion	.	.	.	12	87	114	129	171	71	93	87	101	64	45	12	15	13
Nexgen LPS Flex (class)/Nexgen	.	.	.	.	73	78	149	312	238	280	225	252	221	188	82	12	4
Score (class)/Score (class)	1	11	135	212	187	204	195	239	273	263	170	160	214	151	252	354	5
Trekking/Trekking	.	.	.	.	35	102	133	107	108	106	129	216	143	99	65	20	18
Vanguard PS/Vanguard	103	145	321	430	478	607	561	451	523	445	331	310	205	186	136	117	54
*Legion Oxinium FS	7	22	19	28	28	24	31	30	18	23	25	24	37	30	37	53	36
**Legion Revision Tibial Baseplate	16	33	48	40	56	47	63	54	47	38	50	50	87	93	129	172	132
Identified and No Longer Used																	
ACS/ACS Mobile PC (class)	.	.	.	.	.	20	37	57	17	.	.	.	.	.	.	.	.
AMK/AMK	203	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Year of Implant	≤2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Buechel-Pappas/Buechel-Pappas	40	51	84	100	148	44	4	.	7	1	.	.	.	.	.	.	.
Eska RP/Eska RP	33	5	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.
Evolis (class)/Evolis (class)	.	.	17	5	11	9	20	7	11	7	.	.	.	.	.	.	.
Gemini MK II/Gemini MK II	21	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Genesis (ctd)/Genesis (ctd)	62	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Genesis II CR (class)/Profix Mobile (ctd)	168	5	12	6	9	17	2	22	.	.	.	.	.	.	.	.	.
Genesis II Oxinium CR (class)/ Genesis II	110	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Genesis II Oxinium CR (class)/ Profix Mobile	88	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Genesis II Oxinium PS (ctd)/ Genesis II (class)	.	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 (class)/Vanguard (ctd)	373	30	10	.	.	.	.	.	.	.	.	.	.	.	.	.	.
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 (class)	49	.	.	.	.	25	89	110	42	.	1	.	.	.	.	.	.
Profix Oxinium (class)/Profix	75	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Profix Oxinium (class)/Profix Mobile	158	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Profix Oxinium (ctd)/Profix (class)	71	8	10	8	2	.	1	.	.	.	.	.	.	.	.	.	.
Profix Oxinium (ctd)/Profix Mobile	221	4	1	2	.	.	.	.	.	.	.	.	.	.	.	.	.
Profix/Profix Mobile	924	56	11	12	2	.	.	.	.	.	.	.	.	.	.	.	.
Rotaglide Plus/Rotaglide Plus	586	30	15	.	.	.	.	.	.	.	.	.	.	.	.	.	.
SAL/SAL	56	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Score (class)/Score (ctd)	3	3	3	3	.	5	15	90	181	324	300	267	122	205	114	44	.
Scorpio NRG PS (class)/Series 7000 (class)	.	76	185	171	166	114	67	71	76	72	77	69	28	.	.	.	.
TC-Plus (class)/TC-Plus (ctd)	60	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Trac/Trac	138	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Vanguard PS/Regenerex	.	.	.	4	121	54	27	15	21	18	76	59	56	14	.	.	.
*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

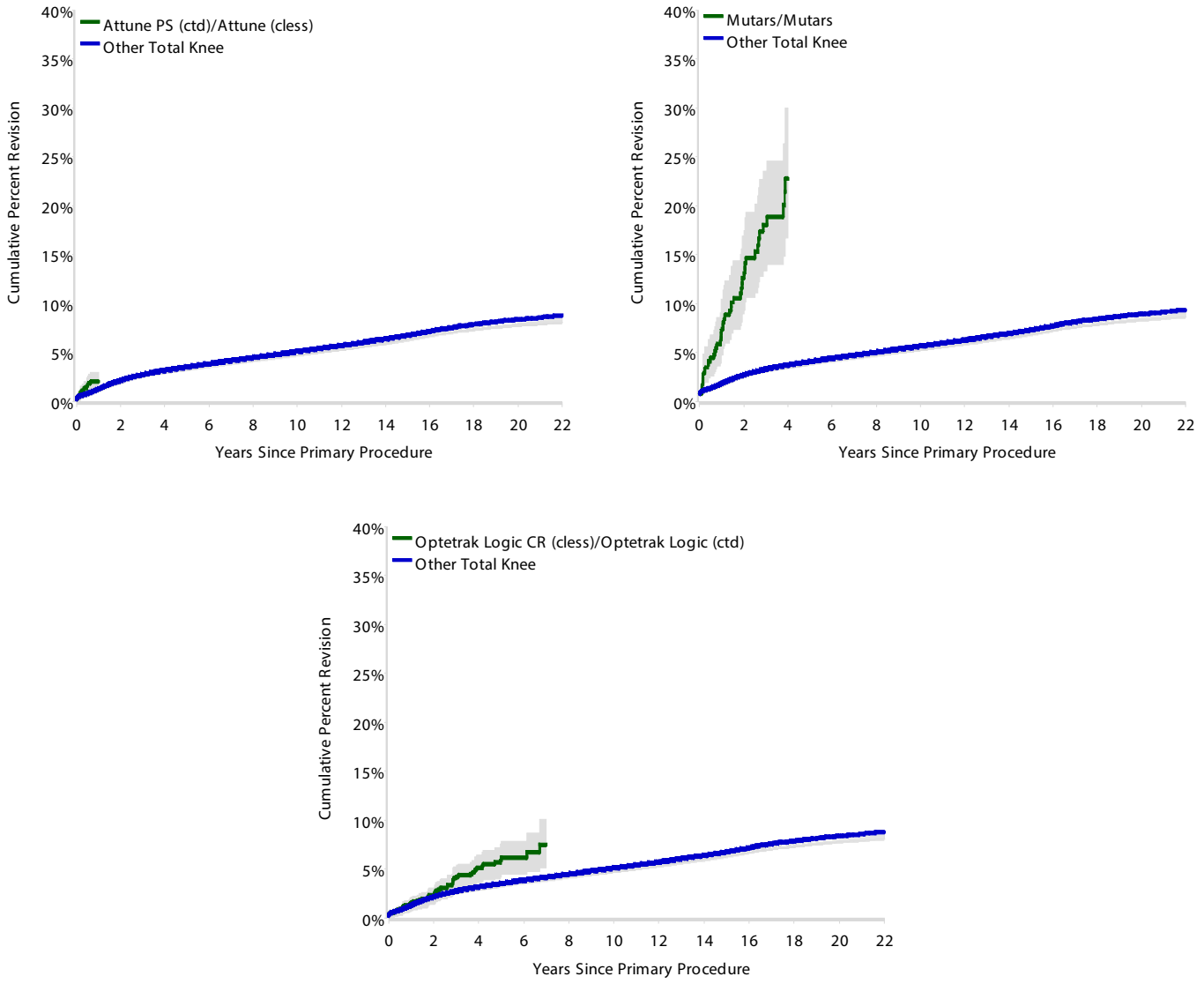
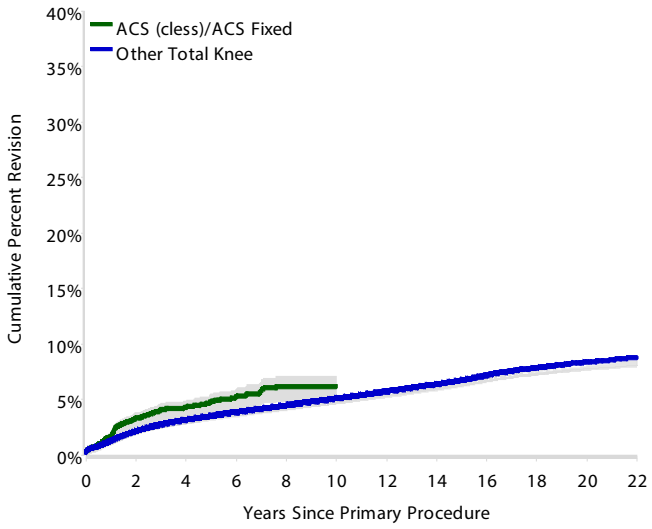
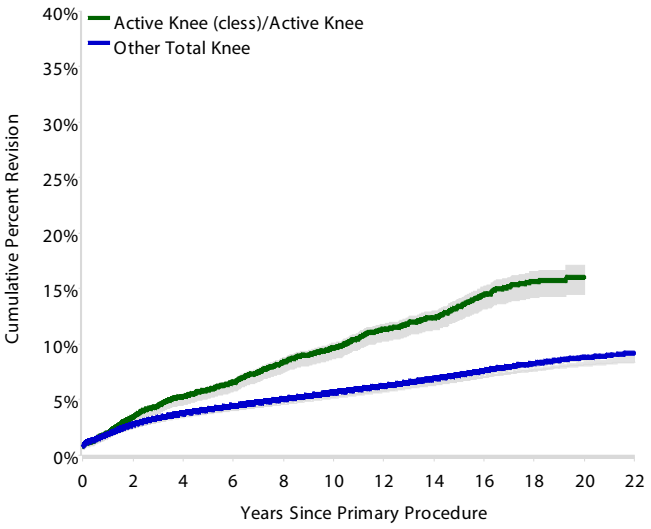
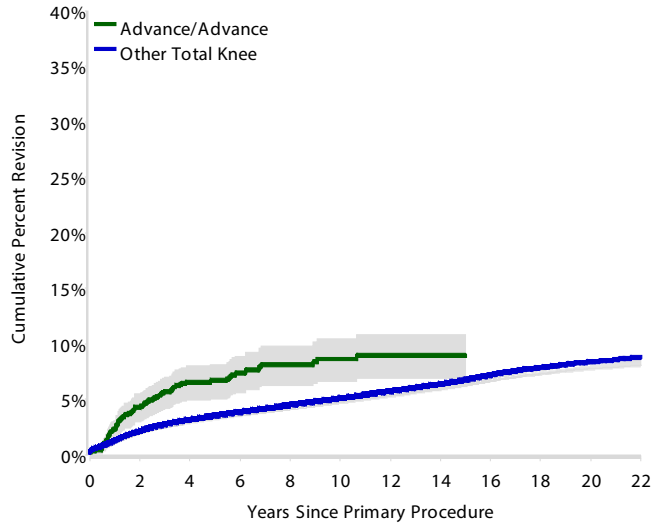


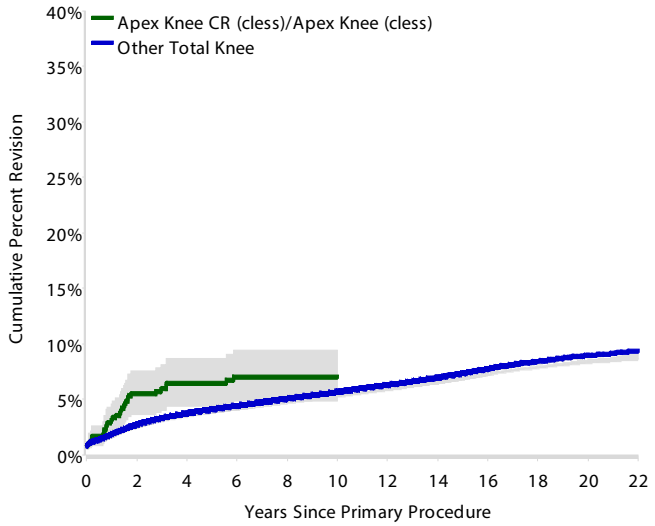
Figure IP5 Cumulative Percent Revision of Re-Identified and Still Used Total Knee Prostheses

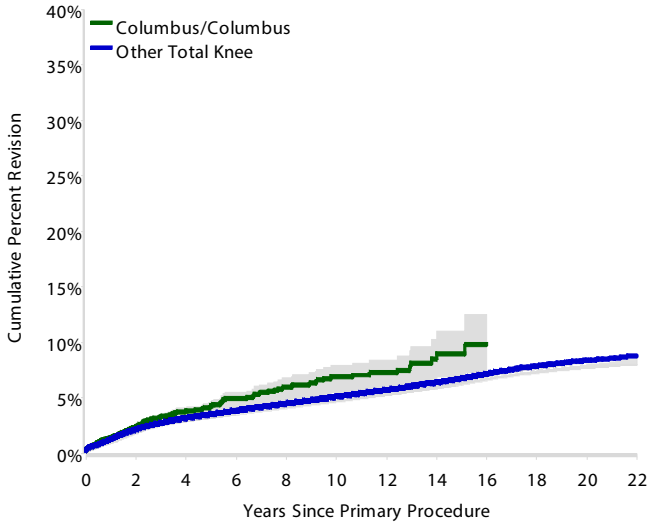
Re-Identified and Still Used

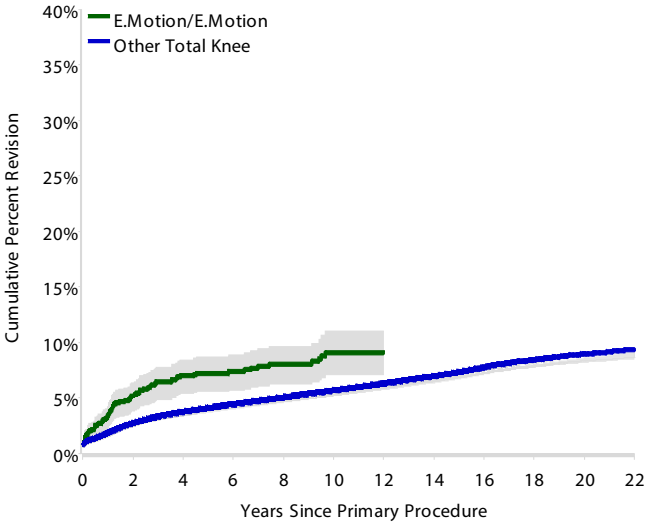




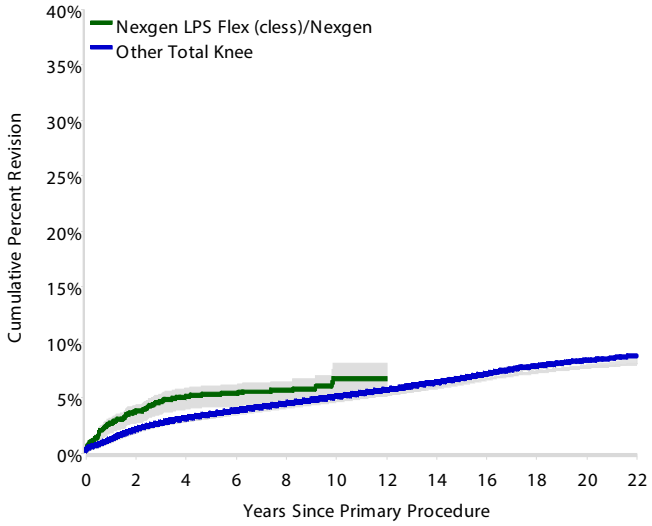


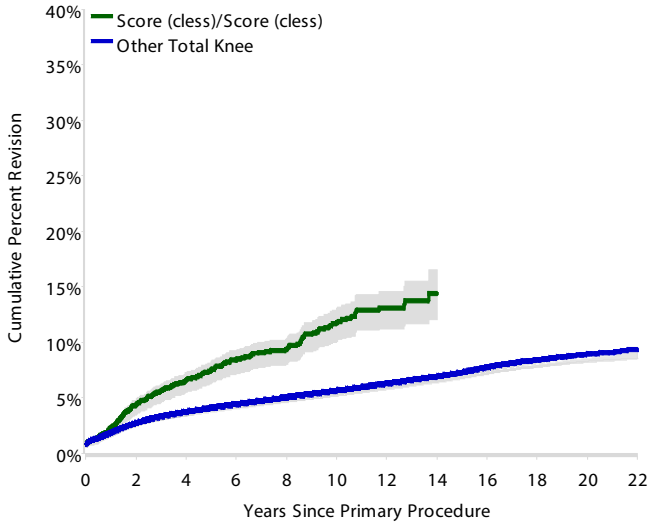


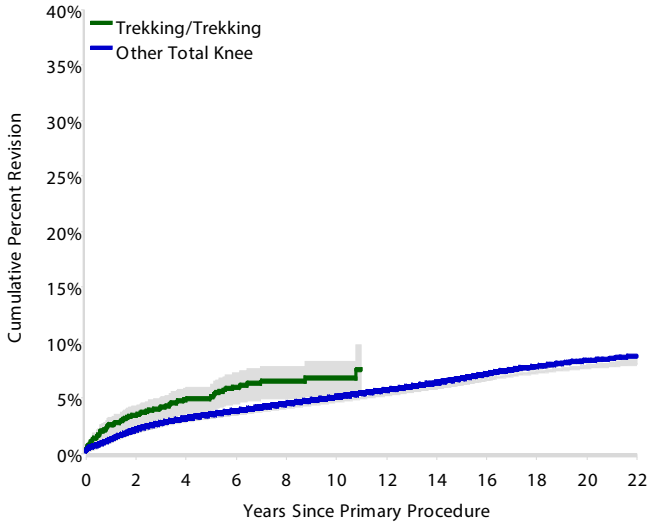


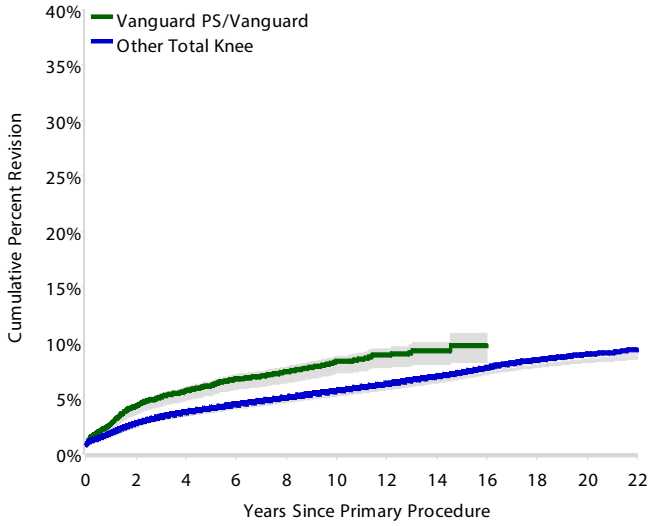


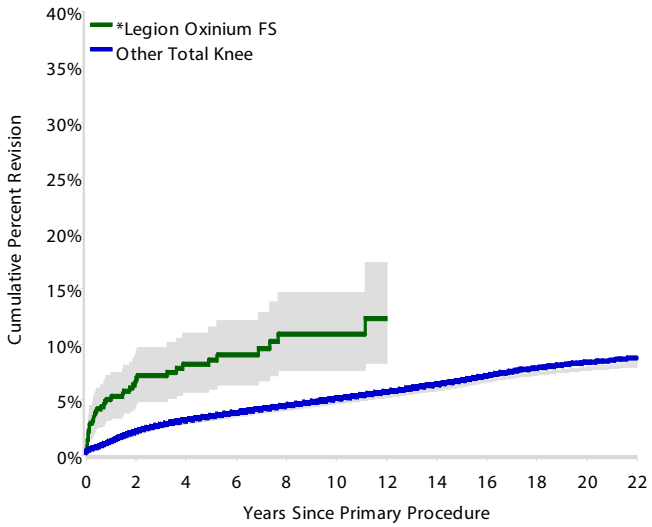
HTARR Knees

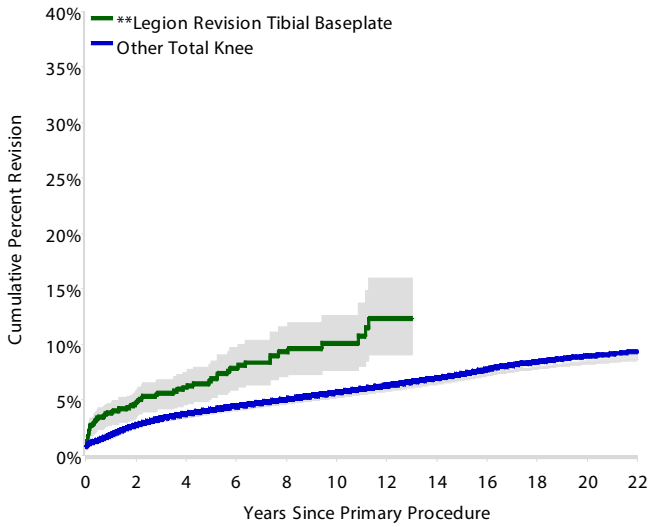

Nexgen LPS Flex (class)/Nexgen
Other Total Knee
Cumulative Percent Revision
Years Since Primary Procedure


Score (class)/Score (class)
Other Total Knee
Cumulative Percent Revision
Years Since Primary Procedure


Trekking/Trekking
Other Total Knee
Cumulative Percent Revision
Years Since Primary Procedure


Vanguard PS/Vanguard
Other Total Knee
Cumulative Percent Revision
Years Since Primary Procedure


*Legion Oxinium FS
Other Total Knee
Cumulative Percent Revision
Years Since Primary Procedure


**Legion Revision Tibial Baseplate
Other Total Knee
Cumulative Percent Revision
Years Since Primary Procedure

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	76	463	3.02	Entire Period: HR=1.95 (1.14, 3.33), p=0.014
Global Unite/Global Unite	40	208	1103	3.63	Entire Period: HR=1.83 (1.32, 2.54), 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

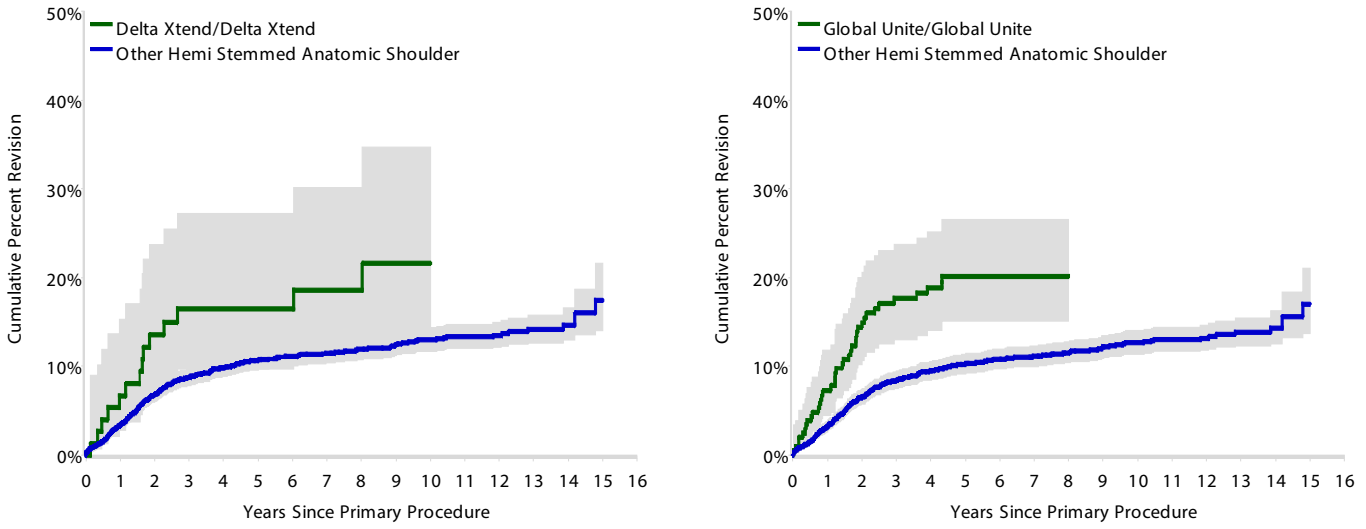
CPR	1 Yr	3 Yrs	5 Yrs	7 Yrs	13 Yrs
Re-Identified and Still Used					
Delta Xtend/Delta Xtend	6.7 (2.8, 15.3)	16.4 (9.7, 27.2)	16.4 (9.7, 27.2)	18.6 (11.1, 30.1)	
Global Unite/Global Unite	7.3 (4.4, 11.7)	17.6 (13.0, 23.7)	20.1 (15.1, 26.5)	20.1 (15.1, 26.5)	

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
Re-Identified and Still Used																
Delta Xtend/Delta Xtend	2	5	9	9	5	10	7	6	5	4	3	6	3	1	.	1
Global Unite/Global Unite	.	.	.	.	.	15	37	25	38	37	14	12	11	12	6	1

Figure IP6 Cumulative Percent Revision of Re-Identified and Still Used Hemi Stemmed Anatomic Shoulder Prostheses

Re-Identified and Still Used



Primary Total Shoulder Replacement

TOTAL STEMMED ANATOMIC

There are no newly identified total stemmed anatomic shoulder prostheses.

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
Re-Identified and Still Used					
SMR/SMR L1	415	2372	16387	2.53	Entire Period: HR=3.01 (2.57, 3.52), p<0.001
Identified and No Longer Used					
Comprehensive/Custom Made (Comprehensive)	6	18	53	11.23	Entire Period: HR=5.36 (2.39, 12.02), p<0.001
SMR/SMR L2	320	856	6478	4.94	Entire Period: HR=3.79 (3.31, 4.34), p<0.001
Univers 3D/Univers 3D	17	34	295	5.76	Entire Period: HR=4.41 (2.72, 7.16), p<0.001
Vaios/Vaios	19	36	212	8.97	Entire Period: HR=6.09 (3.85, 9.61), 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

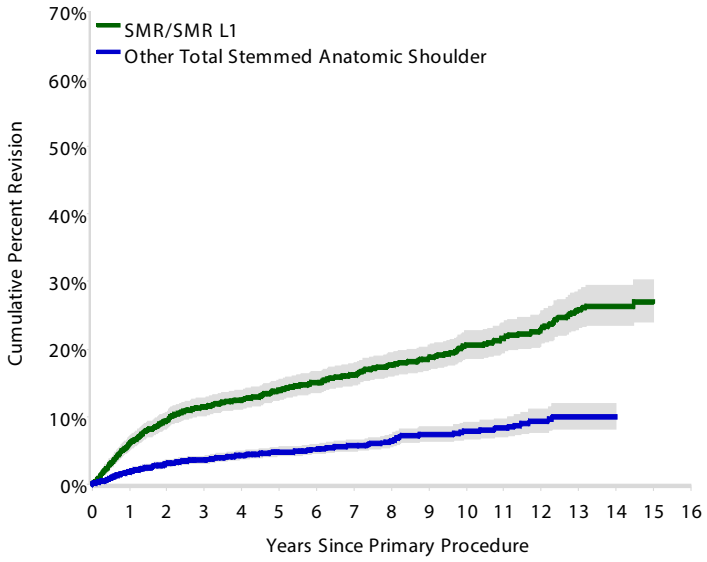
CPR	1 Yr	3 Yrs	5 Yrs	7 Yrs	13 Yrs
Re-Identified and Still Used					
SMR/SMR L1	6.0 (5.1, 7.0)	11.4 (10.2, 12.8)	13.9 (12.5, 15.4)	16.2 (14.7, 17.8)	25.8 (23.1, 28.8)
Identified and No Longer Used					
Comprehensive/Custom Made (Comprehensive)	16.7 (5.7, 43.2)	27.8 (12.6, 54.4)			
SMR/SMR L2	9.5 (7.7, 11.7)	22.2 (19.6, 25.2)	29.7 (26.8, 33.0)	34.0 (30.8, 37.3)	
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
Re-Identified and Still Used																
SMR/SMR L1	135	237	247	.	.	156	302	255	242	195	172	128	98	72	70	63
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 Re-Identified and Still Used Total Stemmed Anatomic Shoulder Prostheses

Re-Identified and Still Used



TOTAL STEMMED REVERSE

There are two newly identified total stemmed reverse shoulder prostheses.

The Trabecular Metal/Comprehensive Reverse combination has been used in 313 procedures since 2017. The 3 year cumulative percent revision is 6.1%. Of the 16 revisions, 7 were for instability/dislocation and 4 were for dissociation. There were 11 major revisions including 7 glenoid component only revisions and 5 minor revisions, all of which involved the humeral cup only. Twelve of the revised procedures had used cementless fixation, while in the remaining 4 the humeral component was cemented.

The Verso/Verso combination has been used in 23 procedures since 2018. The 3 year cumulative percent revision is 22.7%. Three of the 5 revisions were for dissociation. The remaining revisions were for instability/dislocation and loosening. There have been two major revisions, both of which involved the humeral component only. The 3 minor revisions included 2 revisions of the cup/head and one of the cup only. All of the revised procedures used cementless fixation.

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
Newly Identified					
Trabecular Metal/ Comprehensive Reverse	16	313	789	2.03	Entire Period: HR=1.79 (1.09, 2.93), p=0.020
Verso/Verso	5	23	50	9.91	Entire Period: HR=6.12 (2.54, 14.72), p<0.001
Re-Identified and Still Used					
SMR/SMR L1	423	9990	44399	0.95	0 - 3Mth: HR=1.54 (1.30, 1.82), p<0.001
	.	.	.	.	3Mth - 1.5Yr: HR=1.15 (0.95, 1.40), p=0.148
	.	.	.	.	1.5Yr+: HR=0.69 (0.55, 0.86), 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 1.5 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
Newly Identified					
Trabecular Metal/ Comprehensive Reverse	4.3 (2.5, 7.3)	6.1 (3.7, 10.0)			
Verso/Verso	22.7 (10.1, 46.2)	22.7 (10.1, 46.2)			
Re-Identified and Still Used					
SMR/SMR L1	3.0 (2.7, 3.4)	4.1 (3.7, 4.5)	4.5 (4.0, 4.9)	4.9 (4.4, 5.4)	6.7 (5.5, 8.1)

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
Newly Identified	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Trabecular Metal/ Comprehensive Reverse	.	.	.	.	.	.	.	.	.	.	24	43	68	56	73	49
Verso/Verso	.	.	.	.	.	.	.	.	.	.	.	5	8	1	6	3
Re-Identified and Still Used																
SMR/SMR L1	145	262	271	.	.	248	563	633	732	914	930	1046	1055	1009	1186	996

Figure IP8 Cumulative Percent Revision of Newly Identified Total Stemmed Reverse Shoulder Prostheses

Newly Identified

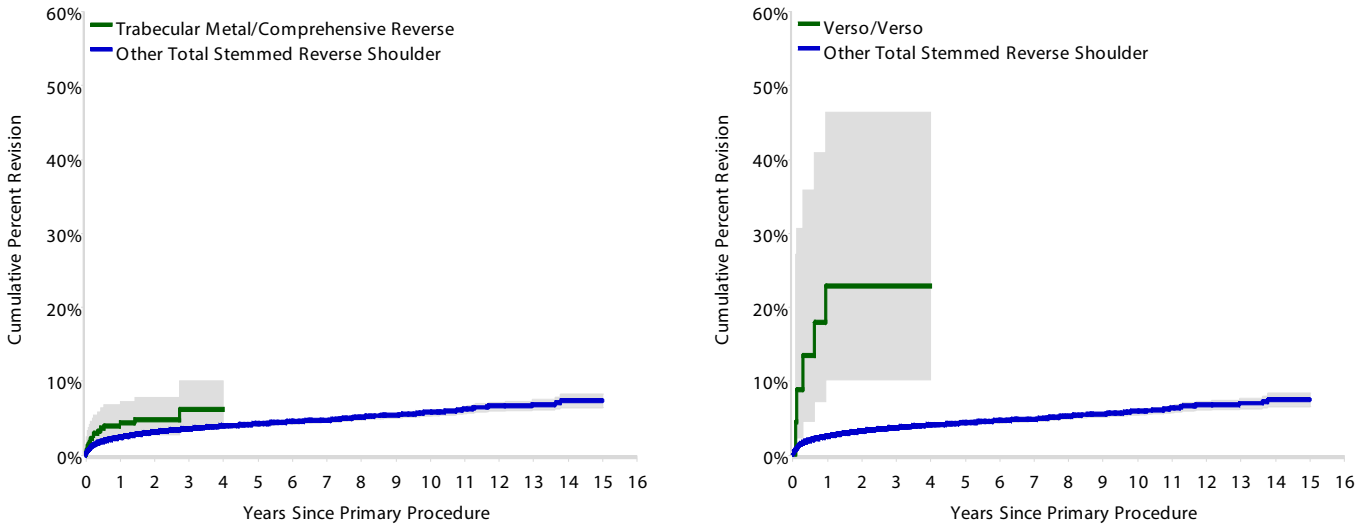
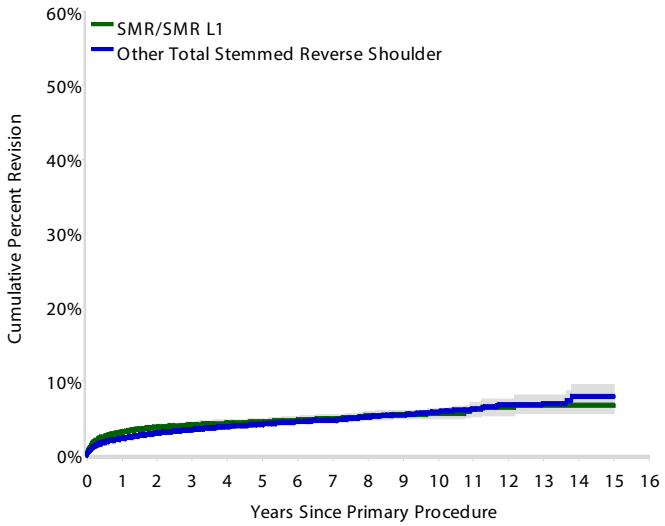


Figure IP9 Cumulative Percent Revision of Re-Identified and Still Used Total Stemmed Reverse Shoulder Prostheses

Re-Identified and Still Used



Primary Total Ankle Replacement

There are no newly identified total ankle prostheses.

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
Identified and No Longer Used					
S.T.A.R/S.T.A.R	12	49	356	3.37	Entire Period: HR=2.17 (1.22, 3.86), p=0.008

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
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)	21.6 (12.2, 36.6)	

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
Identified and No Longer Used																
S.T.A.R/S.T.A.R	1	.	3	3	4	2	15	12	4	4	.	1	.	.	.	.

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	Bellbird Private Hospital	B Van Denberg
Bendigo Health Care Group	S Sharp/ C Jensen	Cabrini Private Hospital, Brighton	D Heng
Box Hill Hospital	L Bingham	Cabrini Private Hospital, Malvern	D Heng
Broadmeadows Hospital	R Paul/ B Wilson	Epping Private Hospital	J Jose
Central Gippsland Health	M Pusmucans/ J Hunt	Epworth Eastern Hospital	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	L Moyes
East Grampians Health Service	J Sargent/ K Carr	Essendon Private Hospital	E Jordan
Echuca Regional Health	H Lias/ K Giorgianni	Frankston Private Hospital	N Larner
Footscray Hospital	A Dijak	Glenferrie Private Hospital	S Jones/M Westley
Frankston Hospital	J Harry	Holmesglen Private Hospital	N Malovic
Frankston Public Surgical Centre	N Larner/ S Reeves	John Fawkner Hospital	B Emmett
Goulburn Valley Health	A Stevens	Knox Private Hospital	J Assauw/E George/ H McCarty
Grampians Health Ballarat	M Nicholson/ B Anderson	Linacre Private Hospital	D Tyler/ M Dillon
Grampians Health Stawell	S Hamilton/ C Ellen	Maryvale Private Hospital	F Van Dyke/ K Collier
Hamilton Base Hospital	R Broadfoot	Masada Private Hospital	D MacKenzie/ S Howell
Kyabram District Health Service	L Walker/ B Harrison	Melbourne Private Hospital	T Perkins
Latrobe Regional Hospital	S Lovison	Mildura Health Private Hospital	S Malcolm
Maroondah Hospital	G Whitemore	Mitcham Private Hospital	J Lonthyil/ J Nankivell
Mildura Base Hospital	K Mailes	Mulgrave Private Hospital	B Gurung
Monash Medical Centre Clayton Campus	J Cranston	Northpark Private Hospital	K Morris
Moorabbin Hospital	C Jackson/ L Mason	Peninsula Private Hospital	K Jones
Northeast Health Wangaratta	D Reidy	Ringwood Private Hospital	C Burns
Portland District Health	M Ashby	Shepparton Private Hospital	N Miller
Sandringham Hospital	L Scopel/ G Jack/ S Kurup	St John of God Ballarat Hospital	G Mathachan
South West Health Care Warrnambool Campus	T Kelly	St John of God Bendigo Hospital	A Sheehan
St Vincents Public Hospital	A Lynskey/ S Osman	St John of God Berwick Hospital	R Jamieson
Sunshine Hospital	A Dijak	St John of God Geelong Hospital	C Hay
Swan Hill District Health	D Hartland	St John of God Warrnambool Hospital	G Wheaton/L McPherson
The Alfred	M Crofts	St Vincent's Private East Melbourne	S Francis
The Northern Hospital	S Perry	St Vincent's Private Fitzroy	D Dellevirgini/ N Carter
The Royal Children's Hospital	S Lauletta	St Vincent's Private Kew	J Miller/ H Xing
The Royal Melbourne Hospital	H Eggleston	St Vincent's Private Werribee	D Sanchez/ C Ipio
University Hospital Geelong Barwon Health	D Barber/ M Quinn	The Avenue Hospital	T Kilpi
West Gippsland Healthcare Group	B Norman/ S Backman	The Bays Hospital	S Burton/ L Kerr
West Wimmera Health Service	T Heinrich	The Melbourne Eastern Private Hospital	J Phillpotts
Western Health Bacchus Marsh Hospital	C Clifford/ J Dehnert	Vermont Private Hospital	D Cooper/ V Howell
Williamstown Hospital	A Chircop/ J Bonganay	Wangaratta Private Hospital	J McKie
Wimmera Health Care Group	A Ampt/ M Markby	Warringal Private Hospital	M Dey/ M Bhagat
		Waverley Private Hospital	N Dator
		Werribee Mercy Hospital	J Anwar
		Western Private Hospital	D Cringasu

NEW SOUTH WALES			
Public Hospitals		Private Hospitals	
Albury Base Hospital	L Rhodes	Albury Wodonga Private Hospital	D Mahaffey
Armidale Hospital	A Sutherland/ A Prater	Armidale Private Hospital	K Latter
Auburn Health Service	A Balangue	Baringa Private Hospital	K Henderson/ E Ford/ F Howson
Bankstown/Lidcombe Hospital	K Och	Bathurst Private Hospital	K Quinton/ D Carter
Bathurst Base Hospital	K Peers	Brisbane Waters Private Hospital	A Ryan
Belmont Hospital	J Jones/ J Osland	Calvary Health Care Riverina	B Das
Blacktown Hospital	J Tsang	Campbelltown Private Hospital	S Clancy
Bowral and District Hospital	R Roberts/ B Allan	Delmar Private Hospital	C Byrne
Broken Hill Base Hospital	S Beahl	Dubbo Private Hospital	K Troth/ S Cross
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 Base Hospital	K Chapman	Holroyd Private Hospital	M Brosas
Fairfield Hospital	C Youkhana	Hunter Valley Private Hospital	R Pridue
Gosford Hospital	T Hoad/ K Brown/ M Farthing	Hurstville Private Hospital	T Ross
Goulburn Base Hospital	L Phelan/ K Goode	Insight Clinic Private Hospital	J Furness
Grafton Base Hospital	F Hickey	Kareena Private Hospital	A Burazer
Hornsby Ku-Ring-Gai Hospital	J Colville/ B Chu	Kogarah Private Hospital	E Naidoo/ K Gardner
Institute of Rheumatology and Orthopaedic Surgery	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 Health Service	S Seap	Macquarie University Hospital	J Guthrie
Maitland Hospital	B Game	Maitland Private Hospital	J Chalmers/ M Mead
Manning Rural Referral Hospital	G Cooke	Mayo Private Hospital	K Boucher
Mount Druitt Hospital	C Boyd	Nepean Private Hospital	J Vimalraj
Murwillumbah District Hospital	G Jacklin	Newcastle Private Hospital	D Fogarty/ J Kelly
Nepean Hospital	R Steward/ D Dobbs	North Shore Private Hospital	A Bloxham
Orange Health Service	D Campbell/ R Jones	Northern Beaches Hospital	S Maristela
Port Macquarie Base Hospital	J Atkins/ F Cheney	Norwest Private Hospital	R Shepherd/ J Woodward
Royal Newcastle Centre	G Cutler	Nowra Private Hospital	D Maslen/ G Hutton
Royal North Shore Hospital	D Krusi	Orange Private Hospital	K Burton
Royal Prince Alfred Hospital	J Wilkie	Port Macquarie Private Hospital	T Bell
Ryde Hospital	K Jones/ H Nowlan	Shellharbour Private Hospital	M Stevens
Shoalhaven District Memorial Hospital	L Royston	Southern Highlands Hospital	L Byrne
South East Regional Hospital	L Williams	St George Private Hospital	L Mayo
St George Hospital	D Gray/ D Elliott	St Lukes Care	D Papadopoulos
St Vincents Public Hospital	A Baker/ L Hatton	St Vincent's Private Community Hospital Griffith	M Blackman
Sutherland Hospital	C Kirgan	St Vincents Private Hospital Darlinghurst	H George/ M Bancroft
Tamworth Base Hospital	M Lebrocq	St Vincents Private Hospital Lismore	J Hospers
The Children's Hospital Westmead	A Galstaun	Strathfield Private Hospital	J Mati
The Prince of Wales Hospital	E Katz	Sydney Adventist Private Hospital	J Parker/ M Ng
Tweed Hospital	A Budd/ N Prestage	Sydney Private Hospital	M Haughton/ P Gyawali

Appendices

NEW SOUTH WALES			
Public Hospitals		**Private Hospitals**	
Wagga Wagga Base Hospital	A Meek/ M O'Reilly	Sydney South West Private Hospital	H Tran
Westmead Public Hospital	D Martic	Tamara Private Hospital	K Wall
Wollongong Hospital	C Jackson	The Mater Hospital	N Guerrero
Wyong Hospital	M Randall/ T Clancy	The Prince of Wales Private Hospital	E Perez/ R Gengania
		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

QUEENSLAND			
Public Hospitals		**Private Hospitals**	
Bundaberg Base Hospital	J Anderson/ D Norman/ J Larsen	Brisbane Private Hospital	L Drabble/ J Oddy
Cairns Base Hospital	H Campbell/C McCall / E Walker/L Borzi	Buderim Private Hospital	P Hall
Gold Coast Hospital, Robina Campus	R Alfredson	Caboolture Private Hospital	L King
Gold Coast University Hospital	M Armstrong	Cairns Private Hospital	L Smit
Hervey Bay Hospital	S Dane Smith	Friendly Societys Hospital Bundaberg	K Smith/ M Alcorn
Ipswich Hospital	S Wilkinson	Gold Coast Private Hospital	V French
Logan Hospital	S Childs	Greenslopes Private Hospital	K Williams/ R Griffin
Mackay Base Hospital	C Ruthenberg	Hervey Bay Surgical Centre	M Pracy
Maryborough Hospital	Y Howlett/ S Hose	Hillcrest Private Hospital, Rockhampton	J Smith
Mater Hospital Brisbane	A Roeun/ S Steains	John Flynn Hospital, Tugun	L Wise
Nambour General Hospital	R Hutchison	Mater Private Hospital Brisbane	J Windsor/ M Baltais/ S Pfeffer
Prince Charles Hospital	L Tuppin/ R Seddon	Mater Private Hospital Bundaberg	J Zillmann/ L Zunker/ M Mooney
Princess Alexandra Hospital	S Reed	Mater Private Hospital Mackay	H Douglas
Queen Elizabeth II Jubilee Hospital	D Cal	Mater Private Hospital Redland	J Golding/ J Garnsey
Queensland Children's Hospital	F Wright/ M Cullen	Mater Private Hospital Rockhampton	T Harkin/ M Havik
Redcliffe Hospital	G van Fleet/ S Ovchinnikoff	Mater Private Hospital Springfield	C James/ C Cullen
Redland Public Hospital	S Mackenzie	Mater Private Hospital Townsville	J Humphreys
Rockhampton Base Hospital	S Platzke	Nambour Selangor Private Hospital	T Dempsey/ S Pfeiffer
Royal Brisbane and Women's Hospital	G McPhee/ A Dowe/ B Ballantyne	Noosa Hospital	J Andersson
Sunshine Coast University Hospital	F Tognolini/ C Jones	North West Private Hospital	D Campbell/ T Auckland
Surgical, Treatment & Rehabilitation Service	E Daniels	Peninsula Private Hospital	A Moutrey
Toowoomba Hospital	F Chadwick/ A Lostroh	Pindara Private Hospital	E Moire
Townsville Hospital & Health Service	T Cudmore	St Andrews Hospital, Toowoomba	A Shannon
		St Andrews Private Hospital, Ipswich	M Grant
		St Andrews War Memorial Hospital, Spring Hill	S Flood
		St Stephen's Private Hospital	K McLaughlan
		St Vincent's Private Hospital Northside	D Ravn/ L Shannon
		St Vincent's Private Hospital Toowoomba	A Fitzgerald
		Sunnybank Private Hospital	F Robinston
		Sunshine Coast University Private Hospital	T Bryant
		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	E Griffiths/ D Carkeek	Hollywood Private Hospital	M Connor
Bunbury Regional Hospital	L Watterson-Stutley	Joondalup Health Campus	J Holmes/ D Crowley
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 Regional Hospital	V Richards	St John of God Bunbury Hospital	T Steyn
Kalgoorlie Health Campus	N Hintz	St John of God Geraldton Hospital	L Culallad/ K Hutton
Osborne Park Hospital	J Misiewicz/ K Zhang	St John of God Midland Hospital	S Blinman
Rockingham General Hospital	C Beaney	St John of God Mt Lawley Hospital	F Campos
Royal Perth Hospital	L Daly	St John of God Murdoch Hospital	C Sheen
Sir Charles Gairdner Hospital	T Lemmey	St John of God Subiaco Hospital	P Emrose
		Waikiki Private Hospital	B Muir

SOUTH AUSTRALIA			
Public Hospitals		**Private Hospitals**	
Clare Hospital and Health Services	M Bradley	Ashford Community Hospital	L Kowalik
Flinders Medical Centre	A Olson	Burnside War Memorial Hospital	L Johnson
Gawler Health Services	T Sayce	Calvary Adelaide Hospital	D Jocey-Prior/ T Heinrich
Lyell McEwin Hospital	L Wills	Calvary Central Districts Hospital	L Keech
Modbury Public Hospital	B Foster	Calvary North Adelaide Hospital	E Rennison
Mount Barker District Soldiers Memorial Hospital	E Crowder	Flinders Private Hospital	M Ender
Mount Gambier Hospital	K Duncan	Glenelg Community Hospital	N Russell-Higgins/ V Lawrence/ R English
Murray Bridge Soldiers Memorial Hospital	J Colwell	North Eastern Community Hospital	L Shaw
Naracoorte Health Service	T Berry	Sportsmed SA	F Penning/ S Williams/ K Stapleton/ S Chong
Noarlunga Hospital	K Thomson	St Andrews Private Hospital	C McAllister/ L White
Port Augusta Hospital	P Williams/ J Haynes	Stirling District Hospital	S Kemp
Port Lincoln Hospital	C Weber	The Memorial Hospital	J Emery/ J Ohlson
Port Pirie Regional Health Service	L Cutler	Western Hospital	A Scheepers
Queen Elizabeth Hospital	A Hunter		
Riverland General Hospital	M Gardner		
Royal Adelaide Hospital	A Wilson/ R Woodfine/ L Davies		
South Coast District Hospital	A Price/ J Hunt		
Whyalla Hospital and Health Service	M Prunty/ E Windhouwer		
Women's and Children's Hospital	M Betterman		

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TASMANIA			
Public Hospitals		**Private Hospitals**	
Launceston General Hospital	M Postmus/ E Davidson	Calvary Health Care, St Johns	C Farrell
North West Regional Hospital, Burnie Campus	B Kerr/ R Dicker	Calvary Health Care St Lukes	G Stratton/ T Morice
Royal Hobart Hospital	S Kirkham/ M Chandler	Calvary Lenah Valley Hospital	E Hey/ K Harrex/ B Stephensen/ A Copping
		Hobart Private Hospital	J Dohnt
		North-West Private Hospital	P Purva

AUSTRALIAN CAPITAL TERRITORY			
PUBLIC HOSPITALS	**PRIVATE HOSPITALS**		
Calvary Public Hospital Bruce	J Cain	Calvary Bruce Private Hospital	C Morris
The Canberra Hospital	H Boyd/ T Schild	Calvary John James Memorial Hospital	S Sreesan
		Canberra Private Hospital	M Gower/ S Phillips/ M Rogina/ L Tuohy
		The National Capital Private Hospital	R Barancewicz/ G Palada/ I Coronado

NORTHERN TERRITORY			
PUBLIC HOSPITALS	**PRIVATE HOSPITALS**		
Alice Springs Hospital	S Ryan	Darwin Private Hospital	P Lacsina/ V Frewin
Royal Darwin Hospital	W Rogers		

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

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 joint
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 joint
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 PrivacyCommissioner on 1300 363 992

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 & 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

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