Australian Orthopaedic Association National Joint Replacement Registry

Hip, Knee & Shoulder Arthroplasty
2022 ANNUAL REPORT

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

2022 Annual Report

Hip, Knee & Shoulder Arthroplasty

September 1999 – December 2021

Preface

It is my great pleasure to present the Australian Orthopaedic Association National Joint Replacement Registry (AOANJRR) Annual Report for 2022. This is the 23rd Annual Report produced by the AOANJRR. The Registry has information on joint replacement that goes back decades and significant changes in both the practice and outcomes of joint replacement surgery have occurred during this time. To ensure ongoing relevance for surgeons, patients and other stakeholders, this year's report has again focused on providing information on currently used prostheses.

For a second year, the AOANJRR provides an update of the impact of COVID-19 on the provision of joint replacement surgery in Australia during 2021 and compares this to 2020 and the pre-pandemic years of 2018 and 2019. This chapter shows us the significant impact that COVID-19 is having on the provision of healthcare, particularly elective surgery in the public system. The Registry reports that to date there are over 19,500 joint replacements that should have occurred, had the pre-pandemic trajectory continued. The AOA continues to remain extremely concerned about the consequences of this for our patients into the foreseeable future.

This year, the Registry has integrated the data on patient-reported outcomes within the hip, knee and shoulder chapters. This allows a clearer understanding of the influence that patient and prosthesis factors have on joint replacement and patient-reported outcomes after joint replacement.

The Annual Report is carefully reviewed prior to publication through an annual review by an independent group of surgeons with expertise in arthroplasty surgery as well as a separate review by the AOA Board. Both have assessed this report to be of the highest quality.

I would like to take the opportunity to acknowledge and thank the Registry staff for their hard work and dedication. The AOA Board is supportive of the ongoing and increasingly complex work of the Registry. Thanks to all of those at the Registry and at the South Australian Health and Medical Research Institute (SAHMRI) for the data collection, management, and analysis that has made this report possible.

I also thank the University of South Australia who provides additional statistical expertise and data linkage analysis support, the Federal Government who funds the Registry core activity through the legislated cost recovery program and has maintained and expanded the Registry's coverage under qualified privilege. In addition, the ongoing advice, support and involvement of the Therapeutics Goods Administration and the orthopaedic and healthcare industry who help the AOA achieve this work.

Finally, thanks to the patients, surgeons and hospitals that provide the Registry with high-quality data. Your support and commitment are helping us to achieve better joint replacement outcomes.

Annette Holian

President of the Australian Orthopaedic Association

AOANJRR Data Snapshot 2021

1,853,452
Total number of joint replacement procedures reported by the Registry at the end of 2021

Joint Replacement Procedures Reported in 2021

52,787 Hips

68,466 Knees

8,733 Shoulders

293 Ad Hoc Reports

81 Conference Presentations

2,249 Automated Industry Reporting System (AIRS)

42 Hospital Audit Reports

1,033 Individual Surgeon Reports

31 Journal Articles Published

COVID-19 Impact on Joint Replacement in Australia

In 2020-2021 there were **19,595** fewer procedures than expected had the 2008-2019 trend in joint replacement procedures continued.

Public Hospital joint replacement procedures decreased by **14.9%** in 2021 compared to 2019.

Private Hospital joint replacement procedures increased by **10.9%** in 2021 compared to 2019.

PROMs National Rollout
June 2022 Update

Participating Hospitals
217

Pre-Op PROMs
55,120

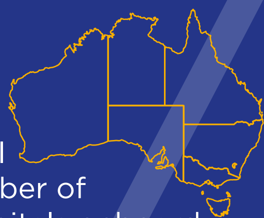
Post-Op PROMs
33,686

Pre-Op Completion Rate
77.5%

Post-Op Completion Rate
66.1%

% patient-reported change following hip, knee, or shoulder joint replacement as "much better"
84.7%

% patients very satisfied or satisfied following hip, knee, or shoulder joint replacement
85.9%



Total number of Hospitals onboard per state:

- ACT: **6**
- NSW: **60**
- NT: **3**
- QLD: **43**
- SA: **29**
- TAS: **7**
- VIC: **50**
- WA: **19**

733
Total number of surgeons participating

57,896
Patient participation through AOANJRR patient dashboards

Executive Summary

This summary provides a brief overview of some of the major findings from the 2022 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 2021. Again, historic data are still available in previous Annual Reports on the AOANJRR website.

This year, the Registry is providing an update on the impact of COVID-19 on joint replacement in Australia during 2021 and comparisons to 2020 and the pre-COVID years of 2018 and 2019.

The AOANJRR is providing information on patient reported outcome measures (PROMs) for a second year. However, this year PROMs information has been integrated within the relevant sections of the hip, knee and shoulder chapters to allow a more complete analysis of the influence of patient and prosthesis factors on joint replacement and patient-reported outcomes after joint replacement.

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-2022 from 1 October 2022. They include a Lay Summary of the main report and 14 additional reports on arthroplasty topics, as well as detailed analyses of all prostheses identified as having a higher than anticipated rate of revision.

Impact of COVID-19 in 2021

In 2021, hip, knee and shoulder joint replacement increased by 8,411 procedures (7%) compared to the previous year. However, the increase only occurred in the private hospital system particularly in the first half of the year.

When compared to the pre-pandemic year of 2019, in 2021 there have been 6,324 (14.9%) fewer procedures undertaken in the public system and 9,064 (10.9%) more procedures undertaken in the private system.

Over the last 2 years of the pandemic, there have been 19,595 fewer procedures than expected had the trend in joint replacement procedures observed between 2008 and 2019 continued.

In early 2021, most states were undertaking either similar or a larger number of procedures compared to pre-COVID years. In the later part of the year, a decrease in joint replacements was seen, with the greatest reductions in NSW and Victoria.

Patient Reported Outcome Measures

In 2021, the AOANJRR provided information on patient reported outcome measures (PROMs) for the first time. This formed the basis of a new chapter. This year, the PROMS information has been included within the relevant Hip, Knee and Shoulder chapters.

All classes of joint replacement demonstrated large improvements in quality of life and in joint-specific pain and function 6 months after joint replacement surgery. This varied very little by age and gender. In general, quality of life and the joint specific Oxford scores varied with ASA and BMI category. The pre-operative mean EQ-VAS and Oxford scores generally decreased with increasing ASA score and increasing BMI category.

Ten, Fifteen and Twenty Year Outcome

This section of the report provides 10 and 15 year benchmarks for prostheses used in >350 procedures in primary total conventional hip and primary total knee replacement undertaken for osteoarthritis. This chapter reports 20 year outcomes for a small number of prostheses that are still used.

Restricting analyses to modern prostheses reduces the 10 year benchmark standard to 4.4% for hips and 4.7% for knees. The same approach has been applied to the 15 year benchmarks. The calculated 15 year benchmark standard for hips is 6.3% and for knees is 6.4%. 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 and knee prosthesis combinations with a sufficient number of procedures and follow-up, 22% of hip and 16.7% of knee prosthesis combinations achieved a 10 year superiority benchmark. At 15 years, 20.0% of hip and 21.4% of knee prosthesis combinations still in use achieve a superiority benchmark.

Hip Replacement

In 2021, hip replacement increased by 5.5% compared to 2020. The revision burden in 2021 is 7.6% 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 increased by 7.0% in 2021 compared to 2020 and there has been a 125.2% 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 8.4%. Age does not have a major impact on the risk of revision, particularly in males. 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. With the analysis restricted to modern prostheses, 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, there is no difference in the rate of revision related to operative approach. 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. We also report on PROMs by surgical approach. The anterior approach had slightly higher pre- and post-operative mean EQ-VAS and OHS scores, but the change in score after surgery is similar for each approach. There was a similar proportion of patients who were very satisfied or satisfied when comparing the three surgical approaches.

Data on the outcomes of primary total conventional 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 9.4% at 15 years.

Knee Replacement

In 2021, knee replacement increased by 8.2% compared to the previous year. The revision burden decreased to 7.4%, but as was the case for hip replacement, the impact of COVID-19 makes the interpretation of this finding uncertain. There has been a small decrease in the use of partial knee replacement, and in 2021 it remains a small proportion (5.6%) 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, but its use is restricted to specific prostheses. Mobile bearings increase revision risk. There is no difference in revision risk between medial and lateral unicompartmental knee replacement.

Primary total knee replacement increased by 9.0% in 2021. The 20 year cumulative percent revision of total knee prostheses still used in 2021 for the management of osteoarthritis is 8.0%. The impact of patient and prosthesis factors on the outcome of total 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, but similar rates of satisfaction and post-operative improvement compared to when the patella is not resurfaced.

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. Patient satisfaction and patient-reported change are similar when stability groups are compared. 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 but later cementless fixation has the lowest rate. For medial pivot prostheses, the use of cement for tibial fixation is associated with a lower early rate of revision.

The use of computer navigation and robotic assistance to aid total knee replacement insertion reduces the rate of revision compared to when these forms of technology assistance are not used, but the effects of these techniques vary with age. Image derived instrumentation has a higher risk of revision overall and in the ≥65 years age group. There are similar rates of satisfaction and patient-reported change with the different insertion methods.

Shoulder Replacement Data

In 2021, shoulder replacement increased by 7.1%. The revision burden decreased to 7.3% which is the lowest reported. As with hip and knee replacement, due to the impact of COVID-19, the interpretation of this result remains uncertain. Summary data for partial shoulder procedures are provided in the Annual Report and a full analysis is provided in the Partial Shoulder Arthroplasty Supplementary Report.

There are three main types of total shoulder replacement: total reverse, total stemmed, and total mid head. The proportional use of both the total reverse and total mid head increased in 2021. However, total reverse shoulder replacement is by far the most common type of total shoulder replacement undertaken in Australia and accounts for 69.3% of all total shoulder procedures reported to the Registry. When the outcomes of these three different types of total shoulder are compared, total reverse and total mid head have lower rates of revision compared to total stemmed shoulders. There are similar improvements in the quality of life measure (EQ-VAS) and Oxford shoulder scores for total reverse and total mid head shoulder replacement.

The outcome of primary total stemmed shoulders is influenced in a major way by cement fixation of the glenoid and the use of XLPE, each of which are associated with a lower rate of revision in total stemmed shoulder replacement.

The rate of revision for total reverse shoulder replacement is the same when used for either osteoarthritis or rotator cuff arthropathy. Younger age and male gender 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, 3 total conventional hip and 1 total knee prosthesis have been newly identified.

Acknowledgements

The Registry continues to receive support and invaluable assistance from the Commonwealth 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 2022 Hip, Knee and Shoulder Arthroplasty Report is based on the analysis of 1,853,452 (796,686 hip, 980,419 knee and 76,347 shoulder) primary and revision procedures recorded by the Registry, with a procedure date up to and including 31 December 2021. Shoulder arthroplasty has been included in this report with hip and knee arthroplasty since 2017.

In addition, there are 15 supplementary reports that complete the AOANJRR Annual Report for 2022:

1. Lay Summary – Hip, Knee & Shoulder Replacement
2. Demographics of Hip, Knee & Shoulder Arthroplasty
3. Cement in Hip and Knee Arthroplasty
4. Mortality of Hip and Knee Arthroplasty
5. Revision of Hip and Knee Arthroplasty
6. Metal/Metal Bearing Surface in Total Conventional Hip Arthroplasty
7. Prosthesis Types with No or Minimal Use
8. Demographics and Outcome of Elbow and Wrist Arthroplasty
9. Demographics and Outcome of Ankle Arthroplasty
10. Demographics of Spinal Disc Arthroplasty
11. Analysis of State and Territory Health Data – All Arthroplasty 1993/1994 – 2020/2021
12. Partial Hip Arthroplasty
13. Patella/Trochlea Partial Knee Arthroplasty
14. Partial Shoulder Arthroplasty
15. Comparative Prosthesis Performance

In addition to the 15 supplementary reports, investigations of prostheses with higher than anticipated rates of revision are published online:
https://aoanjrr.sahmri.com/annual-reports-2022

All hospitals, public and private, undertaking joint replacement submit their data to the Registry. Currently, there are 320 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 Commonwealth Department of Health (DoH) funded the AOA to establish the Registry. The Department of Health 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.

The AOA contracts the South Australian Health and Medical Research Institute (SAHMRI) to provide data management and independent statistical 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.

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 (293 in 2021). 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 7.6% in 2021. The percentage of revision knee procedures has declined from a peak of 8.8% in 2004 to 7.4% in 2021. Revision shoulder arthroplasty peaked at 10.9% in 2012 and has declined to 7.3% in 2021.

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 is administered and chaired by the Department of Health. The purpose is 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 AOANJRR Committee to develop and manage AOANJRR policies. The Committee reports to the AOA Board. Members include the Chairperson, AOANJRR Director, three AOANJRR Deputy Directors and one Assistant Deputy Director. 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 AOANJRR Committee is provided in the acknowledgements section of this report.

The Director, Deputy Directors and Assistant Deputy Directors are appointed by the AOA Board and are responsible for providing strategic and clinical guidance. Additionally, the 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, Project Manager, Project Coordinators, Project Officers, PROMs Manager, PROMs Coordinators, PROMs Officer, Publications Manager, 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.

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 (99.2%) 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.

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.

The Registry is currently investigating the introduction of different analytical methods to cope with competing risks. 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.

[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.

REPORT REVIEW PRIOR TO PUBLICATION

Prior to publication there are two workshops held to review, comment, and provide advice on all sections of the report. Members of the AOA and Arthroplasty Society are invited to attend a two-day hip and knee surgeon workshop, to review all sections of the report other than the shoulder procedures section. This hybrid workshop was held in Adelaide on the weekend of the 6 and 7 August 2022.

In addition to AOANJRR and SAHMRI staff, and a representative of the AOA Executive, 22 AOA members with expertise in hip and knee arthroplasty attended the workshop. Of these, 13 members attended face-to-face and 9 members attended online.

The shoulder section was reviewed at a smaller online meeting held on 13 August 2022 and attended by the AOANJRR Director, the Registry Upper Limb Clinical Advisor, and the Registry Publications Manager.

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

Summary of the Impact of COVID-19 on Joint Replacement in Australia in 2021

Summary of the Impact of COVID-19 on Joint Replacement in Australia in 2021

INTRODUCTION

COVID-19 had a significant impact on the delivery of health services in Australia during both 2020 and 2021. The AOANJRR is in a unique position to assess the ongoing impact with respect to joint replacement surgery nationally, and by state and territory. The number of joint replacement procedures performed in 2021 has been compared to 2020, and to the pre-COVID years 2019 and 2018.

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, electives and trauma) as well as revision procedures.

ALL JOINT REPLACEMENT NATIONALLY

The Registry has recorded a total of 247,715 hip, knee and shoulder replacements performed in 2020 and 2021. This represents a deficit of 19,595 procedures compared to the number that would have been expected had the trend in joint replacement procedures from 2008 to 2019 continued (Figure C1).

Compared to last year, joint replacement has increased by 7.0% in 2021 (Figure C2). However, the increase only occurred in the private hospital system particularly in the first half of the year (Figure C3). The number of joint replacements in the public system was similar to pre-COVID years in the first few months but then continuously declined for the remainder of the year to be well below previous years (Figure C3).

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

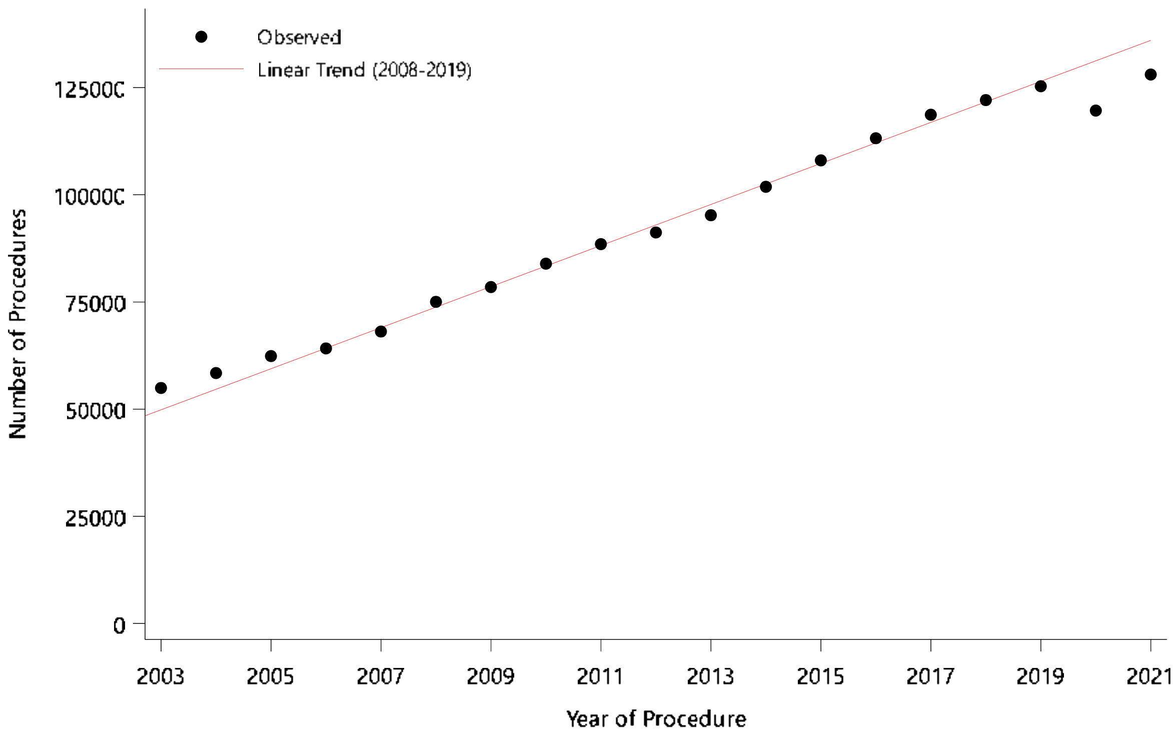


Figure C2 **All Joint Replacement Hip, Knee and Shoulder (Primary and Revision)**

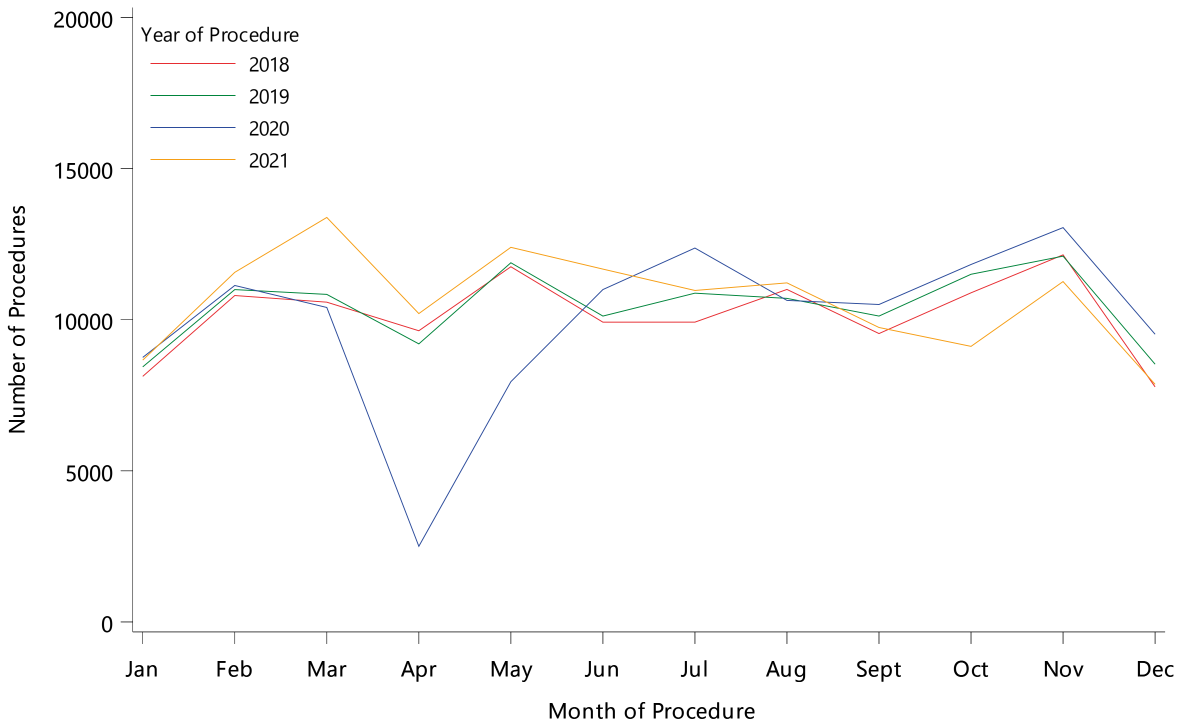
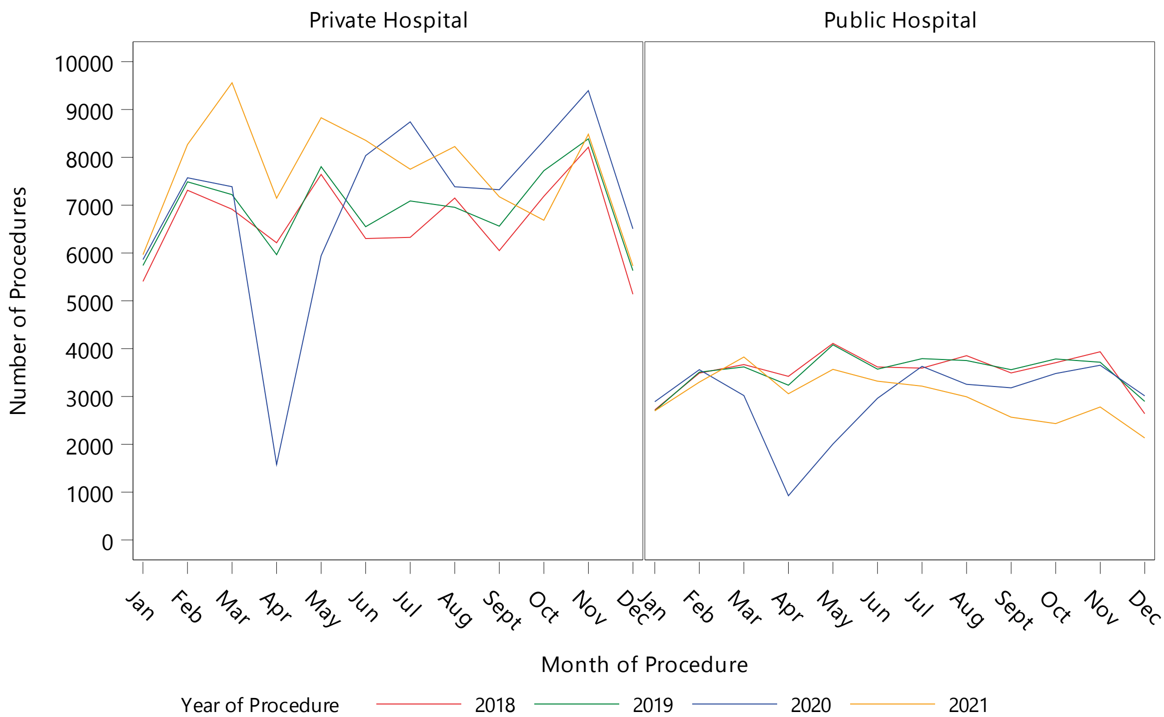


Figure C3 **Primary Joint Replacement - By Hospital Type**



ALL JOINT REPLACEMENT BY STATE AND TERRITORY

The impact of COVID-19 varied by state and territory. In early 2021, most states were undertaking either similar or a larger number of procedures compared to pre-COVID years. However, in the two biggest states (NSW and Victoria) there was a large reduction in the number of procedures undertaken in the later part of the year, while other states and the ACT continued to undertake a similar number of procedures to pre-COVID years (Figure C4 and Figure C5).

Figure C4 **All Joint Replacement – By State and Territory**

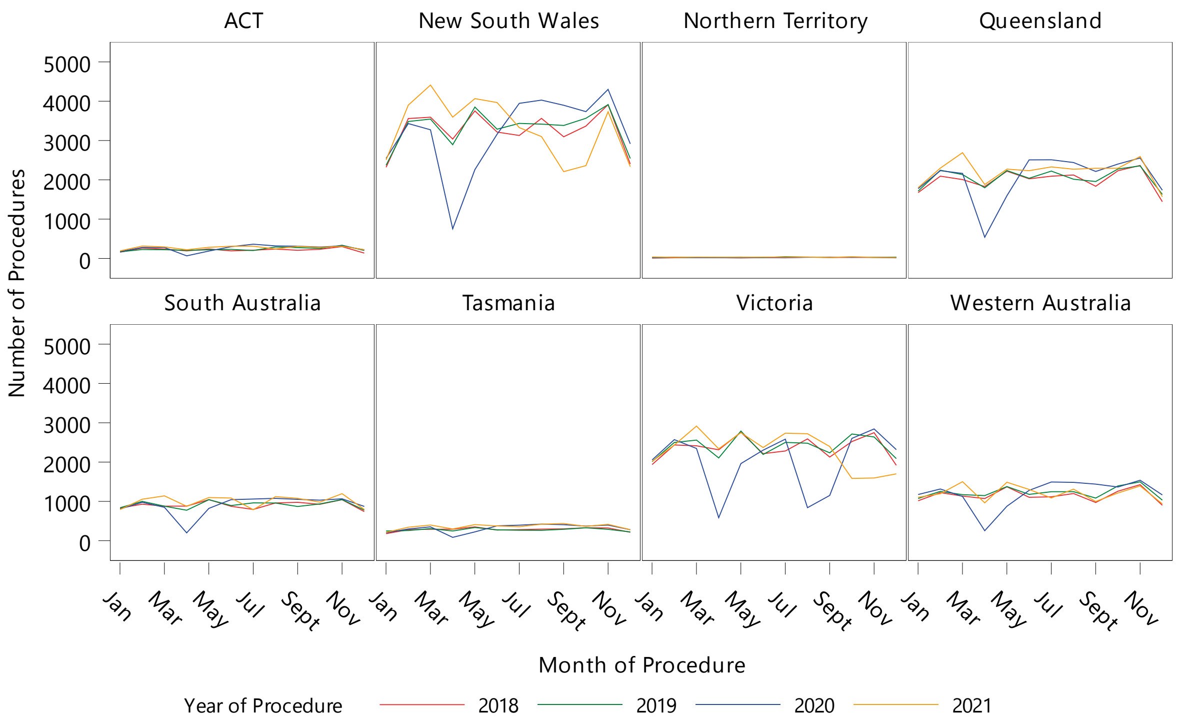
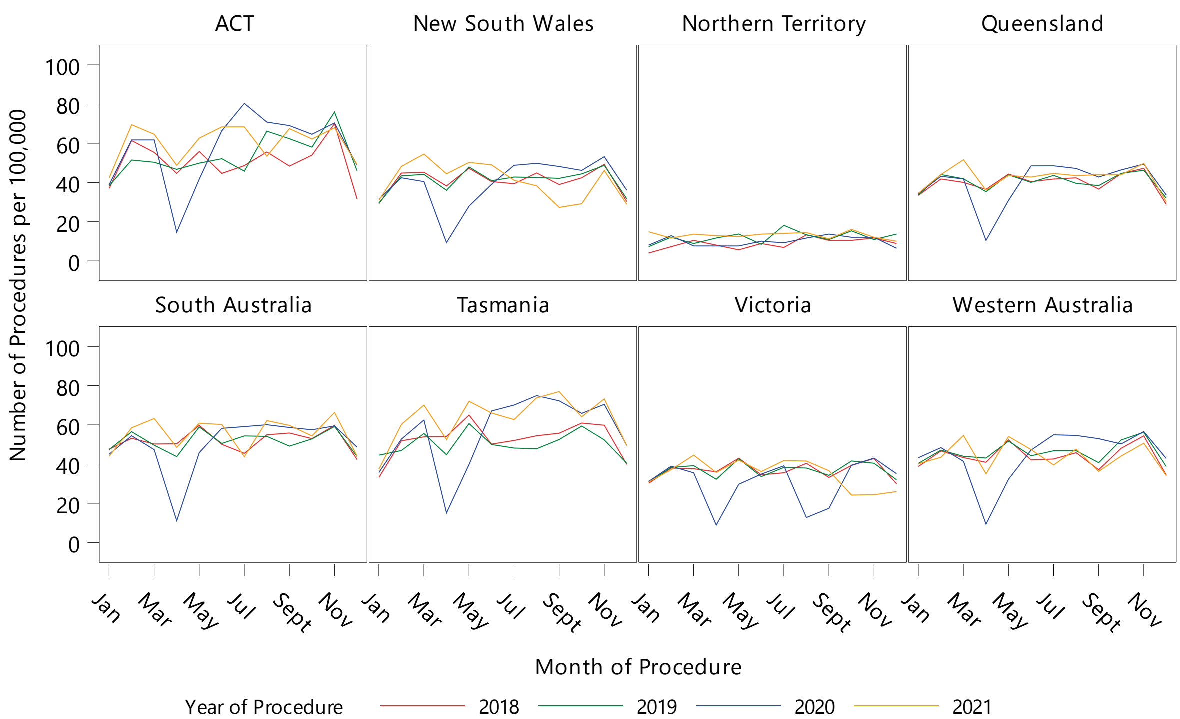


Figure C5 **All Joint Replacement per 100,000 Population – By State and Territory**



PROCEDURE TYPE AND INDICATION

In 2021, there was an increase in hip, knee and shoulder replacement in the first half of the year (Figure C6, Figure C7 and Figure C8).

The number of hip and shoulder replacements undertaken for the management of fracture in 2021 was similar to previous years (Figure C9 and Figure C10).

Revision procedures in 2021 declined in the last 3 months of the year (Figure C11).

Figure C6 **All Primary Hip Replacement (All Diagnoses)**

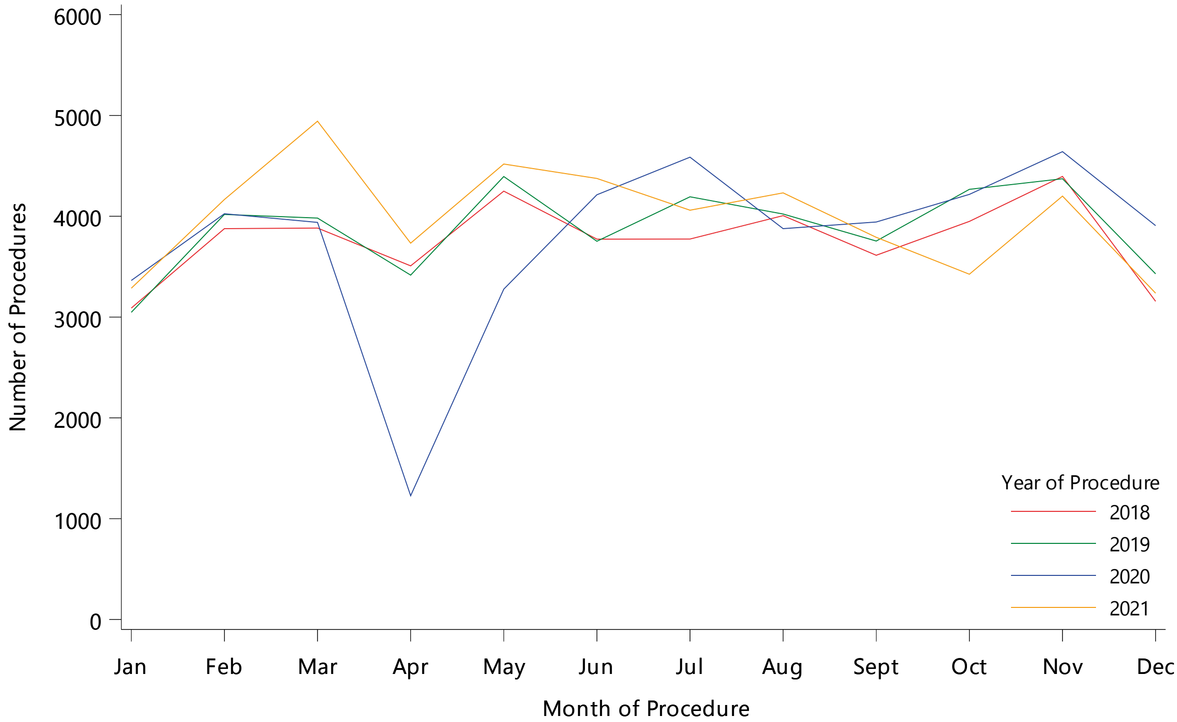


Figure C7 **All Primary Knee Replacement (All Diagnoses)**

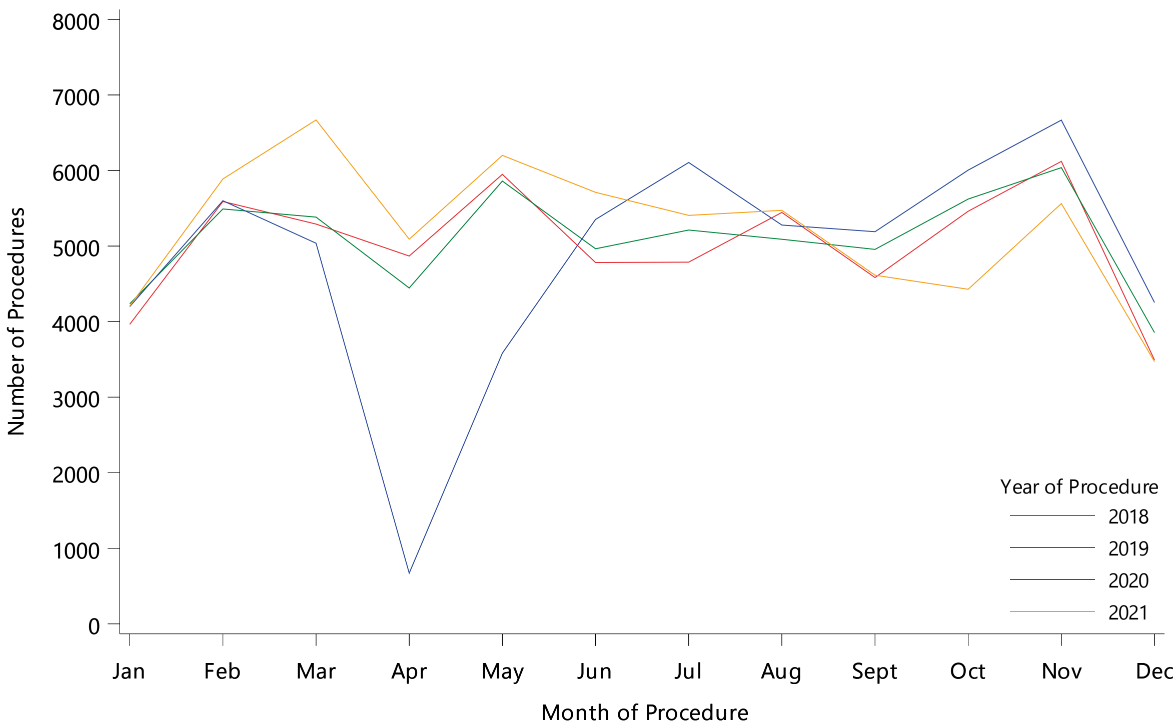


Figure C8 **All Primary Shoulder Replacement (All Diagnoses)**

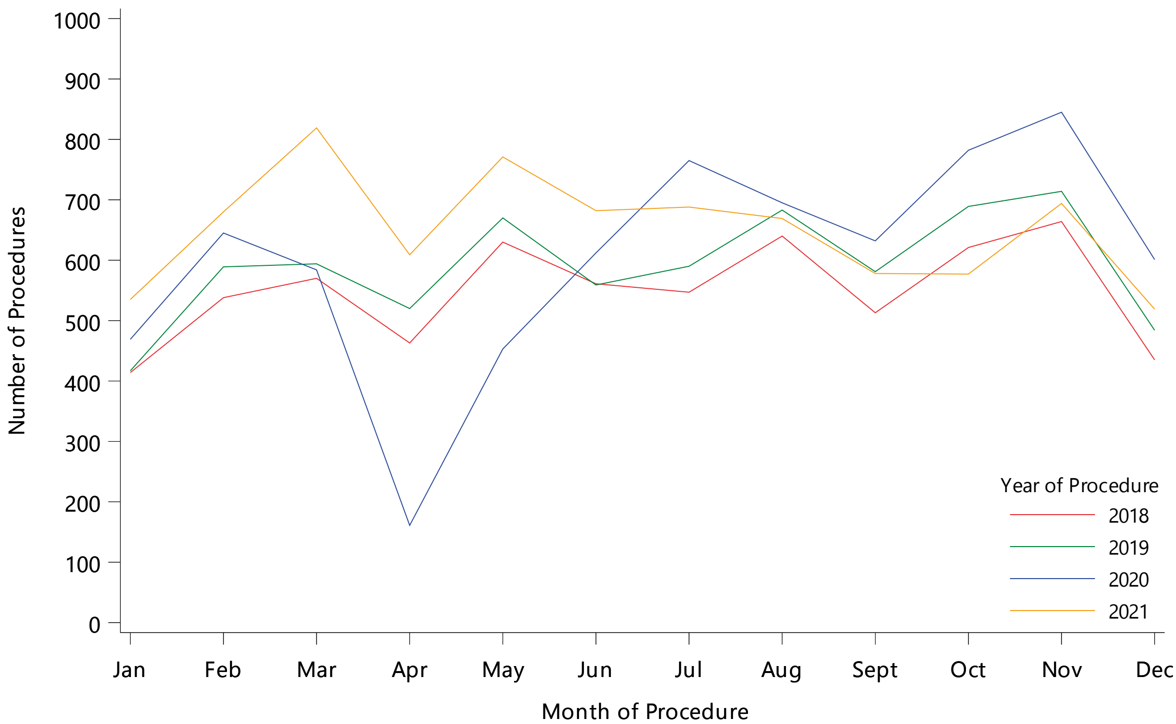


Figure C9 **Primary Hip Replacement (Primary Diagnosis Fractured Neck of Femur)**

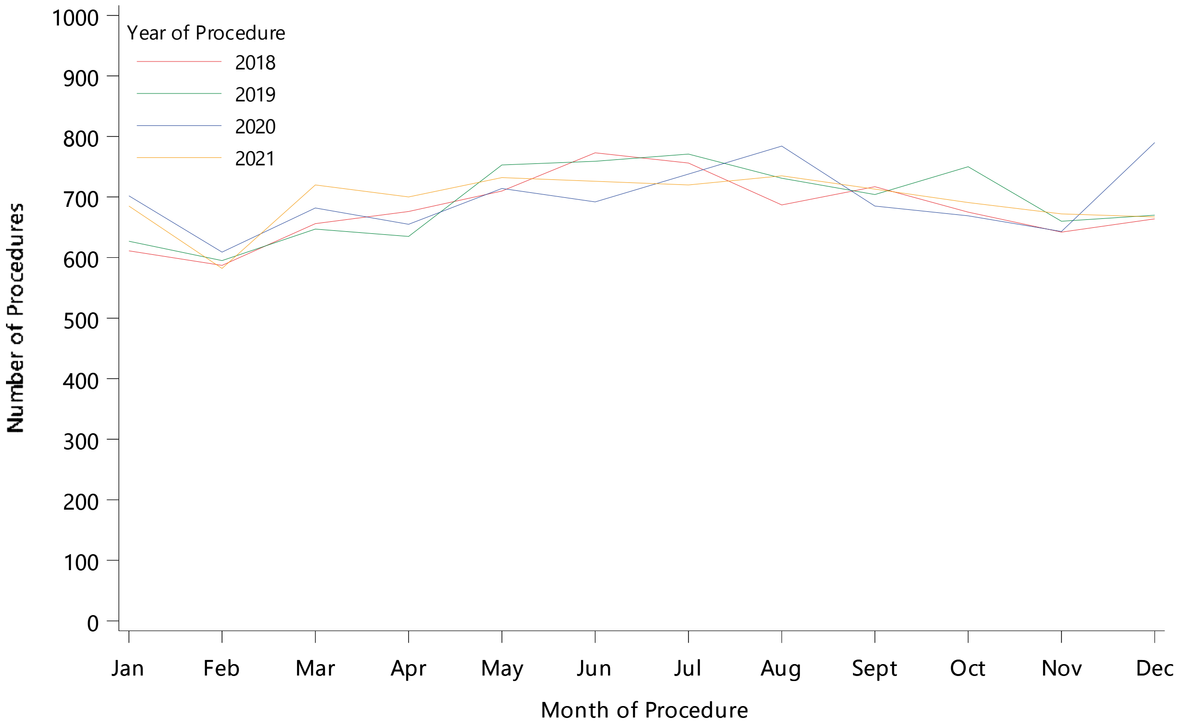


Figure C10 **Primary Shoulder Replacement (Primary Diagnosis Fracture)**

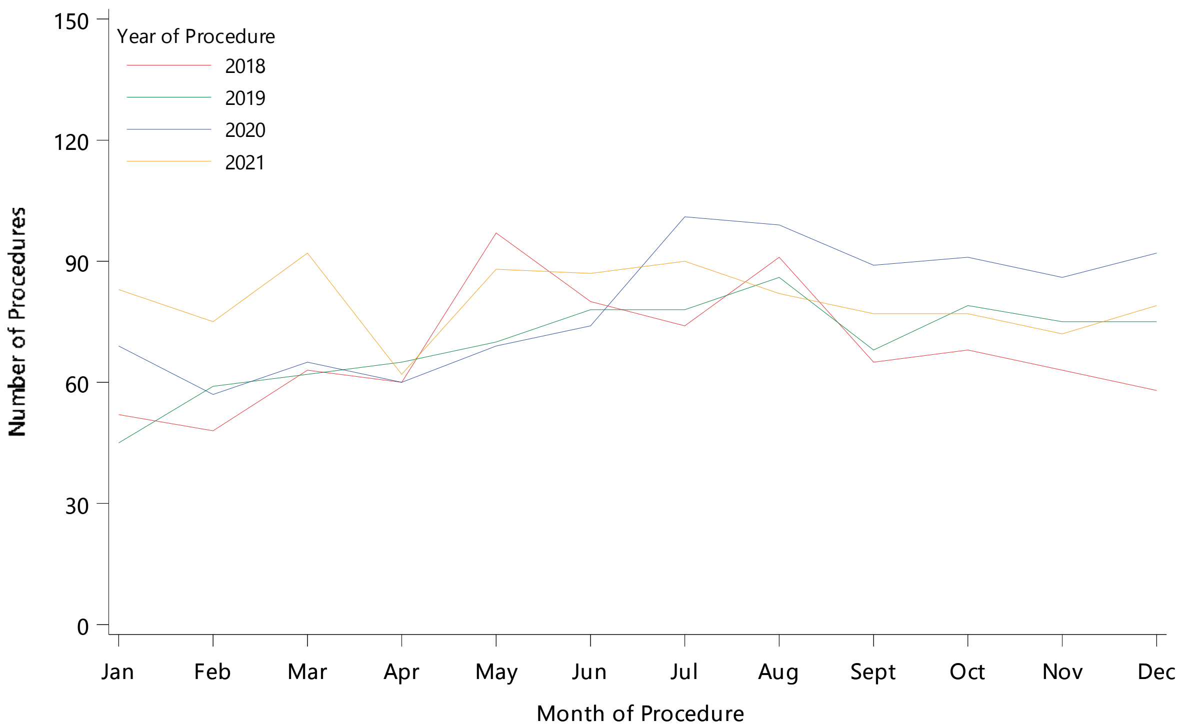
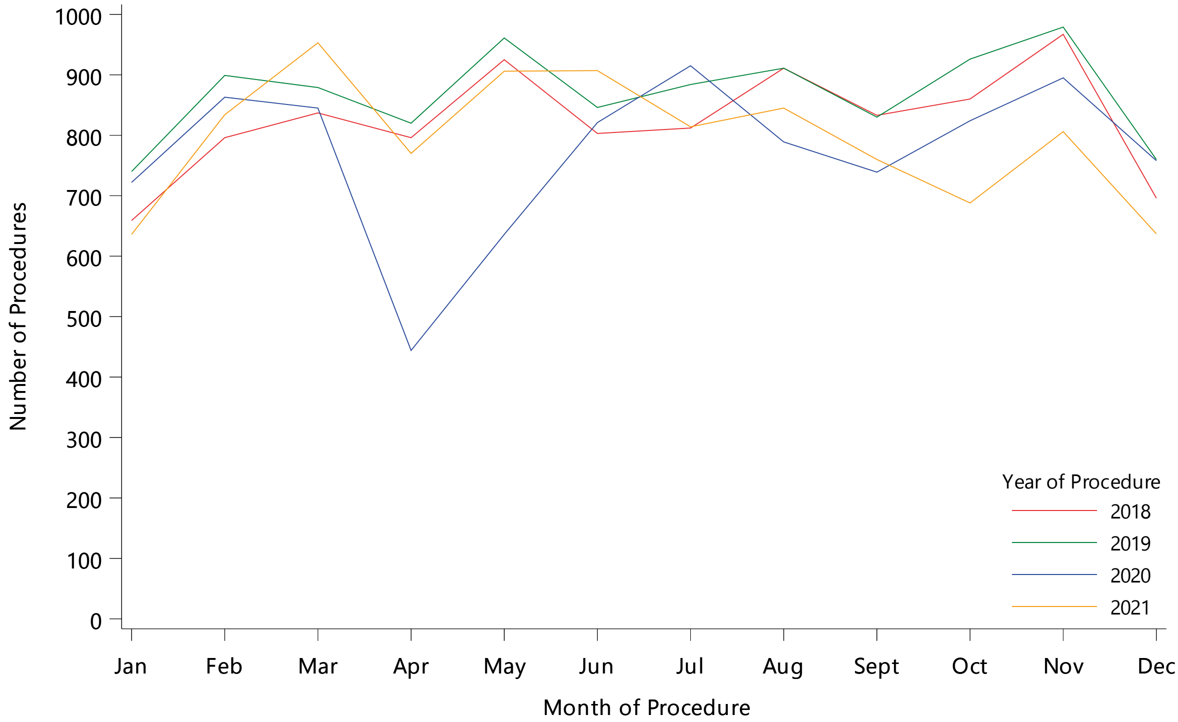


Figure C11 **Revision Hip, Knee and Shoulder Replacement**



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 2021 (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 prosthesis combinations reported. In addition, the Registry has excluded prostheses where a single surgeon performed more than 50% of procedures.

Detailed information on all prosthesis combinations is available in the supplementary report 'Comparative Prosthesis Performance' on the AOANJRR website: https://aoanjrr.sahmri.com/annual-reports-2022

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 41 femoral and acetabular combinations with 10 year outcome data. These prosthesis combinations have been used in 77.7% of all primary total conventional hip procedures performed for osteoarthritis.

The 10 year cumulative percent revision for the individual prosthesis combinations ranges from 2.8% to 8.8%. 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 4.4%.

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 4.4% at 10 years, then 9 (22.0%) hip prosthesis combinations qualify for the superiority benchmark. These are highlighted in green in Table TY1.

Non-inferiority approach: the permitted upper confidence interval level is 20% above the benchmark standard. For the benchmark standard of 4.4% at 10 years, the accepted upper confidence interval is 5.2% or less. Using this approach, an additional 6 prosthesis combinations can be benchmarked, i.e., 15 (36.6%) prosthesis combinations would receive either a superiority or non-inferiority benchmark. The additional 6 devices with a non-inferiority benchmark are highlighted in blue in Table TY1.

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 TY1 Cumulative Percent Revision of Primary Total Conventional Hip Replacement Prosthesis Combinations with 10 Year Data (Primary Diagnosis OA)

Femoral Component	Acetabular Component	N Revised	N Total	Type of Revision: THR	Femoral	Acetabular	Other	2 Yrs	5 Yrs	10 Yrs
Alloclassic	Allofit	147	3362	13	82	17	35	1.8 (1.4, 2.3)	2.6 (2.1, 3.2)	4.3 (3.6, 5.1)
Anthology	R3	229	7415	21	69	46	93	2.3 (2.0, 2.7)	2.7 (2.4, 3.2)	3.6 (3.2, 4.2)
Avenir	Continuum	59	1622	5	13	11	30	3.2 (2.4, 4.2)	3.6 (2.8, 4.7)	4.1 (3.1, 5.3)
C-Stem AMT	PINNACLE	114	4509	9	49	11	45	1.5 (1.2, 1.9)	2.8 (2.2, 3.4)	4.5 (3.4, 5.7)
CLS	Allofit	29	471	2	16	8	3	2.6 (1.5, 4.5)	4.3 (2.8, 6.6)	5.6 (3.8, 8.2)
CORAIL	PINNACLE	1910	53976	172	711	294	733	2.1 (2.0, 2.2)	3.0 (2.9, 3.2)	4.8 (4.5, 5.0)
CORAIL	Trident (Shell)	21	433	4	5	3	9	3.9 (2.3, 6.6)	5.8 (3.6, 9.3)	8.8 (5.4, 14.1)
CPCS	R3	195	6298	21	56	38	80	2.3 (1.9, 2.7)	3.1 (2.6, 3.6)	4.5 (3.8, 5.3)
CPCS	Reflection (Cup)	77	809	26	3	35	13	1.4 (0.8, 2.6)	2.8 (1.8, 4.3)	8.3 (6.2, 11.1)
CPCS	Reflection (Shell)	107	2754	14	46	14	33	1.0 (0.7, 1.4)	1.7 (1.2, 2.2)	3.4 (2.7, 4.3)
CPT	Allofit	46	1577	5	21	5	15	1.1 (0.7, 1.8)	2.7 (1.9, 3.8)	4.7 (3.4, 6.4)
CPT	Continuum	132	2777	8	46	19	59	3.1 (2.5, 3.9)	4.2 (3.5, 5.0)	6.5 (5.3, 7.9)
CPT	Trabecular Metal (Shell)	95	2012	8	41	18	28	2.6 (2.0, 3.4)	4.0 (3.1, 5.0)	6.0 (4.8, 7.6)
CPT	Trilogy	374	7724	37	142	41	154	2.3 (1.9, 2.6)	3.4 (3.0, 3.9)	5.3 (4.8, 5.9)
CPT	ZCA	39	859	13	9	10	7	1.1 (0.6, 2.1)	2.4 (1.5, 3.7)	4.7 (3.3, 6.7)
Exeter V40	Contemporary	292	4589	73	47	138	34	2.1 (1.8, 2.6)	3.2 (2.7, 3.8)	5.6 (4.9, 6.4)
Exeter V40	Exeter Contemporary	161	2933	53	33	53	22	1.9 (1.5, 2.5)	3.0 (2.5, 3.7)	4.7 (3.9, 5.6)
Exeter V40	Exeter X3 Rimfit	96	4031	23	28	24	21	1.7 (1.3, 2.2)	2.4 (2.0, 3.0)	3.0 (2.4, 3.7)
Exeter V40	PINNACLE	49	1990	2	19	11	17	1.5 (1.0, 2.2)	1.8 (1.3, 2.5)	3.8 (2.7, 5.3)
Exeter V40	Trabecular Metal (Shell)	21	449	2	3	2	14	3.0 (1.7, 5.1)	4.1 (2.6, 6.5)	5.3 (3.4, 8.1)
Exeter V40	Trident (Shell)	1962	69365	268	623	253	818	1.5 (1.4, 1.6)	2.3 (2.1, 2.4)	3.6 (3.4, 3.8)
Exeter V40	Trident/Tritanium (Shell)	110	4380	10	22	23	55	1.7 (1.4, 2.2)	2.6 (2.2, 3.2)	3.7 (2.9, 4.8)
H-Max	Delta-TT	64	1558	4	28	9	23	2.5 (1.8, 3.4)	3.9 (3.0, 5.1)	7.2 (4.5, 11.3)
M/L Taper	Allofit	23	690	1	13	3	6	1.8 (1.0, 3.1)	2.1 (1.2, 3.5)	4.3 (2.6, 7.1)
M/L Taper	Continuum	53	1476	6	17	7	23	2.8 (2.1, 3.8)	3.5 (2.7, 4.6)	4.1 (3.1, 5.5)
MS 30	Fitmore	16	547	0	2	8	6	1.3 (0.6, 2.8)	2.7 (1.5, 4.8)	3.9 (2.3, 6.6)
Metafix	Trinity	242	12334	28	66	53	95	1.8 (1.6, 2.1)	2.5 (2.2, 2.9)	3.8 (2.8, 5.3)
Omnifit	Trident (Shell)	160	3806	12	39	30	79	2.2 (1.8, 2.7)	3.0 (2.5, 3.6)	3.8 (3.2, 4.5)
Polarstem	R3	389	14545	25	126	52	186	2.3 (2.0, 2.5)	3.0 (2.7, 3.4)	4.2 (3.5, 5.1)
Quadra-H	Versafitcup CC	322	9340	33	142	61	86	2.2 (1.9, 2.5)	3.2 (2.8, 3.6)	6.2 (5.2, 7.5)
S-Rom	PINNACLE	148	2546	15	83	14	36	2.9 (2.3, 3.6)	4.5 (3.7, 5.4)	5.8 (4.9, 6.9)
SL-Plus	EP-Fit Plus	47	1112	3	20	9	15	2.0 (1.3, 3.0)	3.0 (2.1, 4.2)	4.2 (3.1, 5.6)
SL-Plus	R3	94	1650	4	26	22	42	3.2 (2.4, 4.2)	4.3 (3.4, 5.4)	6.2 (5.0, 7.6)
Secur-Fit	Trident (Shell)	457	9667	28	201	83	145	2.4 (2.1, 2.7)	3.5 (3.2, 3.9)	4.7 (4.2, 5.1)
Secur-Fit Plus	Trident (Shell)	223	5843	16	59	56	92	1.6 (1.3, 1.9)	2.3 (1.9, 2.7)	3.3 (2.9, 3.9)
Spectron EF	R3	85	2070	13	13	17	42	2.3 (1.8, 3.1)	3.8 (3.0, 4.8)	5.1 (4.1, 6.4)
Spectron EF	Reflection (Cup)	123	1403	47	12	55	9	1.3 (0.8, 2.0)	2.9 (2.1, 4.0)	7.2 (5.8, 8.9)
Summit	PINNACLE	162	5334	11	35	23	93	1.8 (1.5, 2.2)	2.3 (1.9, 2.8)	3.4 (2.9, 4.0)
Synergy	R3	149	4920	4	43	33	69	2.1 (1.7, 2.5)	2.6 (2.2, 3.1)	3.4 (2.9, 4.0)
Synergy	Reflection (Shell)	379	7278	33	85	120	141	2.0 (1.7, 2.3)	2.6 (2.2, 3.0)	3.8 (3.4, 4.3)
Tri-Lock	PINNACLE	24	1000	0	10	6	8	1.6 (1.0, 2.6)	2.4 (1.5, 3.6)	2.8 (1.8, 4.2)
TOTAL		**9425**	**271454**	**1072**	**3104**	**1735**	**3514**			

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 all prosthesis combinations is available in the supplementary report 'Comparative Prosthesis Performance' on the AOANJRR website: https://aoanjrr.sahmri.com/annual-reports-2022

There are 42 total knee replacement combinations with 10 year outcome data. These prosthesis combinations were used in 82.2% of all primary total knee replacement procedures performed for osteoarthritis reported to the Registry.

The 10 year cumulative percent revision ranges from 2.8% to 9.7%. 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 4.7%.

Applying the recommendations of the ISAR International Prosthesis Benchmarking Working Group, using the new benchmark of 4.7% at 10 years, then 7 (16.7%) knee prosthesis combinations qualify for the superiority benchmark. These are highlighted in green in Table TY2.

To assess non-inferiority, the permitted upper confidence interval level is 20% above the new benchmark standard which is 5.7% or less. An additional 12 knee prosthesis combinations can be benchmarked, i.e., 19 (45.2%) prosthesis combinations would receive either a superiority or a non-inferiority benchmark. The additional 12 devices with a non-inferiority benchmark are highlighted in blue (Table TY2).

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 TY2 Cumulative Percent Revision of Primary Total Knee Replacement Prosthesis Combinations with 10 Year Data (Primary Diagnosis OA)

Femoral Component	Tibial Component	N Revised	N Total	Type of Revision TKR	Femoral	Tibial	Other	2 Yrs	5 Yrs	10 Yrs
ACS	ACS Mobile	83	1847	32	8	4	39	3.1 (2.3, 4.0)	4.9 (3.9, 6.2)	6.2 (4.9, 7.8)
Active Knee	Active Knee	825	10289	239	29	42	515	2.5 (2.2, 2.8)	4.7 (4.3, 5.2)	8.2 (7.6, 8.8)
Advance	Advance II	108	1505	43	3	13	49	3.4 (2.6, 4.5)	5.0 (4.0, 6.3)	6.9 (5.7, 8.4)
BalanSys	BalanSys	105	4214	28	6	7	64	1.4 (1.1, 1.8)	2.3 (1.9, 2.9)	3.8 (3.0, 4.8)
Columbus	Columbus	165	5183	38	8	9	110	2.2 (1.8, 2.7)	4.4 (3.6, 5.3)	7.3 (6.0, 8.8)
E.Motion	E.Motion	66	991	18	9	4	35	4.4 (3.3, 5.9)	6.6 (5.2, 8.4)	7.3 (5.8, 9.2)
GMK Primary	GMK Primary	105	2959	32	2	15	56	2.6 (2.1, 3.3)	3.8 (3.1, 4.7)	4.8 (4.0, 5.9)
Genesis II CR	Genesis II	1154	25271	241	71	56	786	2.0 (1.8, 2.2)	3.5 (3.3, 3.7)	5.0 (4.7, 5.3)
Genesis II Oxinium CR (ctd)	Genesis II	553	10026	104	28	25	396	1.9 (1.6, 2.2)	3.5 (3.1, 3.9)	6.0 (5.5, 6.6)
Genesis II Oxinium PS (ctd)	Genesis II	1306	21367	182	33	168	923	2.8 (2.6, 3.0)	5.0 (4.7, 5.3)	7.3 (6.9, 7.7)
Genesis II PS	Genesis II	901	20378	161	32	58	650	2.1 (1.9, 2.3)	3.7 (3.4, 4.0)	5.1 (4.8, 5.5)
LCS CR	LCS	624	8335	255	24	90	255	2.5 (2.1, 2.8)	4.4 (4.0, 4.9)	6.4 (5.9, 7.0)
LCS CR	MBT	1393	32926	475	65	156	697	1.9 (1.8, 2.1)	3.5 (3.3, 3.7)	4.9 (4.6, 5.2)
LCS CR	MBT Duofix	850	15247	247	35	43	525	2.7 (2.4, 2.9)	4.1 (3.8, 4.4)	5.3 (5.0, 5.7)
Legion CR	Genesis II	228	7532	43	17	9	159	2.2 (1.9, 2.6)	3.7 (3.3, 4.3)	5.2 (4.4, 6.3)
Legion Oxinium CR	Genesis II	220	8804	53	17	5	145	1.7 (1.5, 2.1)	3.5 (3.1, 4.1)	4.5 (3.8, 5.2)
Legion Oxinium PS	Genesis II	644	16070	92	19	55	478	2.2 (2.0, 2.5)	4.1 (3.8, 4.4)	5.8 (5.3, 6.3)
Legion PS	Genesis II	186	5790	47	4	7	128	1.9 (1.6, 2.3)	3.2 (2.7, 3.7)	4.3 (3.7, 5.1)
MRK	MRK	27	742	7	1	0	19	1.9 (1.1, 3.3)	2.8 (1.8, 4.4)	4.4 (2.9, 6.6)
Natural Knee Flex	Natural Knee II	161	6180	45	8	8	100	1.5 (1.2, 1.9)	2.4 (2.0, 2.8)	3.3 (2.8, 3.9)
Nexgen CR	Nexgen	437	11565	140	22	32	243	1.2 (1.1, 1.5)	2.2 (1.9, 2.5)	3.1 (2.8, 3.5)
Nexgen CR	Nexgen TM CR	55	867	19	4	11	21	2.5 (1.6, 3.7)	5.5 (4.1, 7.3)	6.5 (4.9, 8.5)
Nexgen CR Flex	Nexgen	1543	60035	373	110	130	930	1.4 (1.3, 1.5)	2.3 (2.2, 2.4)	3.1 (3.0, 3.3)
Nexgen CR Flex	Nexgen TM CR	343	12235	112	23	29	179	1.2 (1.1, 1.5)	2.2 (2.0, 2.5)	3.2 (2.8, 3.6)
Nexgen LCCK	Nexgen	50	953	8	3	1	38	3.1 (2.2, 4.5)	4.9 (3.6, 6.6)	6.2 (4.6, 8.5)
Nexgen LPS	Nexgen	372	7021	98	21	33	220	1.9 (1.6, 2.3)	3.3 (2.9, 3.7)	4.9 (4.4, 5.5)
Nexgen LPS	Nexgen TM LPS	34	1476	11	3	6	14	1.0 (0.6, 1.6)	2.2 (1.5, 3.1)	2.8 (1.9, 4.0)
Nexgen LPS Flex	Nexgen	1624	37580	453	69	243	859	1.8 (1.6, 1.9)	3.1 (3.0, 3.3)	5.0 (4.8, 5.3)
Nexgen LPS Flex	Nexgen TM LPS	71	1576	34	4	6	27	2.0 (1.4, 2.8)	3.5 (2.7, 4.5)	4.5 (3.6, 5.8)
Nexgen RH	Nexgen	31	593	3	5	3	20	2.9 (1.8, 4.7)	5.1 (3.4, 7.6)	8.8 (6.0, 12.9)
PFC Sigma CR	MBT	331	6273	67	35	45	184	2.6 (2.3, 3.1)	3.9 (3.5, 4.4)	5.1 (4.5, 5.7)
PFC Sigma CR	PFC Sigma	883	24874	226	55	66	536	1.5 (1.3, 1.7)	2.5 (2.3, 2.7)	3.5 (3.3, 3.8)
PFC Sigma PS	MBT	357	6332	122	16	24	195	2.2 (1.9, 2.6)	3.9 (3.5, 4.4)	5.4 (4.8, 6.0)
PFC Sigma PS	PFC Sigma	378	8040	130	12	28	208	2.0 (1.7, 2.3)	3.3 (2.9, 3.7)	4.7 (4.2, 5.3)
RBK	RBK	561	11000	215	15	43	288	2.3 (2.0, 2.6)	3.9 (3.6, 4.3)	5.3 (4.9, 5.8)
Score	Score	362	5712	145	20	11	186	3.2 (2.8, 3.8)	6.2 (5.5, 6.9)	9.7 (8.6, 10.9)
Trekking	Trekking	62	1246	26	7	3	26	3.0 (2.2, 4.1)	4.7 (3.6, 6.1)	6.3 (4.8, 8.3)
Triathlon CR	Triathlon	2911	125118	533	117	136	2125	1.5 (1.4, 1.6)	2.5 (2.4, 2.6)	3.7 (3.6, 3.9)
Triathlon PS	Triathlon	588	13531	110	30	74	374	2.4 (2.1, 2.6)	3.9 (3.5, 4.2)	5.5 (5.1, 6.0)
Vanguard CR	Regenerex	88	1708	23	5	10	50	2.7 (2.0, 3.5)	4.0 (3.2, 5.1)	6.6 (5.2, 8.2)
Vanguard CR	Vanguard	1013	27014	231	38	71	673	1.7 (1.6, 1.9)	3.0 (2.8, 3.2)	4.9 (4.6, 5.3)
Vanguard PS	Vanguard	322	5216	80	7	58	177	3.4 (3.0, 4.0)	5.2 (4.6, 5.9)	7.3 (6.5, 8.2)
TOTAL		**22120**	**575621**	**5541**	**1040**	**1837**	**13702**			

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

FIFTEEN YEAR OUTCOMES

This year, the Registry is reporting 15 year outcomes for 20 hip and 28 knee prosthesis combinations. A combination is included if >350 procedures have been reported to the Registry, the follow-up period is 15 or more years, and the prosthesis is still available and still used.

Detailed information on all prosthesis combinations is available is available in the supplementary report 'Comparative Prosthesis Performance' on the AOANJRR website: https://aoanjrr.sahmri.com/annual-reports-2022

HIP REPLACEMENT

The 20 listed prosthesis combinations were used in 53.5% of all primary total conventional hip replacement procedures performed for osteoarthritis.

The 15 year cumulative percent revision ranges from 4.5% to 19.2%. The benchmark used to assess superiority and non-inferiority performance at 15 years was calculated based on modern prostheses. The 15 year benchmark is 6.3%. There are 4 (20.0%) hip prosthesis combinations which qualify for a superiority benchmark (highlighted in green).

An additional 4 prosthesis combinations qualify for a non-inferiority benchmark, i.e., 8 (40.0%) qualify for either a superiority or non-inferiority benchmark. Those prosthesis combinations that qualify for a non-inferiority benchmark are highlighted in blue (Table TY3).

KNEE REPLACEMENT

The listed 28 prosthesis combinations were used in 73.5% of all primary total knee replacement procedures performed for osteoarthritis.

The 15 year cumulative percent revision ranges from 3.4% to 11.8%. The benchmark used to assess superiority and non-inferiority at 15 years is 6.4%. There are 6 (21.4%) knee prosthesis combinations which qualify for a superiority benchmark (highlighted in green).

There are an additional 8 prosthesis combinations that qualify for a non-inferiority benchmark, i.e., 14 (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 TY4).

Table TY3 Cumulative Percent Revision of Primary Total Conventional Hip Replacement Prosthesis Combinations with 15 Year Data (Primary Diagnosis OA)

Femoral Component	Acetabular Component	N Revised	N Total	Type of Revision: THR	Type of Revision: Femoral	Type of Revision: Acetabular	Type of Revision: Other	5 Yrs	10 Yrs	15 Yrs
Alloclassic	Allofit	147	3362	13	82	17	35	2.6 (2.1, 3.2)	4.3 (3.6, 5.1)	6.2 (5.2, 7.4)
CLS	Allofit	29	471	2	16	8	3	4.3 (2.8, 6.6)	5.6 (3.8, 8.2)	7.7 (5.2, 11.2)
CORAIL	PINNACLE	1910	53976	172	711	294	733	3.0 (2.9, 3.2)	4.8 (4.5, 5.0)	8.1 (7.2, 9.1)
CPCS	Reflection (Cup)	77	809	26	3	35	13	2.8 (1.8, 4.3)	8.3 (6.2, 11.1)	19.2 (15.2, 24.0)
CPCS	Reflection (Shell)	107	2754	14	46	14	33	1.7 (1.2, 2.2)	3.4 (2.7, 4.3)	6.4 (5.1, 8.0)
CPT	Allofit	46	1577	5	21	5	15	2.7 (1.9, 3.8)	4.7 (3.4, 6.4)	5.2 (3.7, 7.3)
CPT	Trabecular Metal (Shell)	95	2012	8	41	18	28	4.0 (3.1, 5.0)	6.0 (4.8, 7.6)	9.6 (7.1, 12.8)
CPT	Trilogy	374	7724	37	142	41	154	3.4 (3.0, 3.9)	5.3 (4.8, 5.9)	6.8 (6.1, 7.7)
CPT	ZCA	39	859	13	9	10	7	2.4 (1.5, 3.7)	4.7 (3.3, 6.7)	6.4 (4.4, 9.2)
Exeter V40	Contemporary	292	4589	73	47	138	34	3.2 (2.7, 3.8)	5.6 (4.9, 6.4)	9.0 (7.9, 10.2)
Exeter V40	Exeter Contemporary	161	2933	53	33	53	22	3.0 (2.5, 3.7)	4.7 (3.9, 5.6)	7.9 (6.6, 9.4)
Exeter V40	Trident (Shell)	1962	69365	268	623	253	818	2.3 (2.1, 2.4)	3.6 (3.4, 3.8)	5.3 (5.0, 5.6)
MS 30	Fitmore	16	547	0	2	8	6	2.7 (1.5, 4.8)	3.9 (2.3, 6.6)	5.2 (2.8, 9.4)
Omnifit	Trident (Shell)	160	3806	12	39	30	79	3.0 (2.5, 3.6)	3.8 (3.2, 4.5)	5.1 (4.3, 6.0)
S-Rom	PINNACLE	148	2546	15	83	14	36	4.5 (3.7, 5.4)	5.8 (4.9, 6.9)	7.3 (6.1, 8.7)
Secur-Fit	Trident (Shell)	457	9667	28	201	83	145	3.5 (3.2, 3.9)	4.7 (4.2, 5.1)	6.1 (5.5, 6.7)
Secur-Fit Plus	Trident (Shell)	223	5843	16	59	56	92	2.3 (1.9, 2.7)	3.3 (2.9, 3.9)	4.5 (3.9, 5.2)
Spectron EF	Reflection (Cup)	123	1403	47	12	55	9	2.9 (2.1, 4.0)	7.2 (5.8, 8.9)	13.5 (11.2, 16.3)
Summit	PINNACLE	162	5334	11	35	23	93	2.3 (1.9, 2.8)	3.4 (2.9, 4.0)	5.4 (4.3, 6.8)
Synergy	Reflection (Shell)	379	7278	33	85	120	141	2.6 (2.2, 3.0)	3.8 (3.4, 4.3)	5.6 (5.0, 6.2)
TOTAL		**6907**	**186855**	**846**	**2290**	**1275**	**2496**			

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 TY4 Cumulative Percent Revision of Primary Total Knee Replacement Prosthesis Combinations with 15 Year Data (Primary Diagnosis OA)

Femoral Component	Tibial Component	N Revised	N Total	Type of Revision TKR	Femoral	Tibial	Other	5 Yrs	10 Yrs	15 Yrs
Active Knee	Active Knee	825	10289	239	29	42	515	4.7 (4.3, 5.2)	8.2 (7.6, 8.8)	11.8 (11.0, 12.8)
Advance	Advance II	108	1505	43	3	13	49	5.0 (4.0, 6.3)	6.9 (5.7, 8.4)	7.7 (6.3, 9.3)
BalanSys	BalanSys	105	4214	28	6	7	64	2.3 (1.9, 2.9)	3.8 (3.0, 4.8)	5.3 (3.5, 8.1)
Columbus	Columbus	165	5183	38	8	9	110	4.4 (3.6, 5.3)	7.3 (6.0, 8.8)	9.5 (7.3, 12.4)
Genesis II CR	Genesis II	1154	25271	241	71	56	786	3.5 (3.3, 3.7)	5.0 (4.7, 5.3)	6.2 (5.8, 6.6)
Genesis II Oxinium CR (ctd)	Genesis II	553	10026	104	28	25	396	3.5 (3.1, 3.9)	6.0 (5.5, 6.6)	8.6 (7.8, 9.4)
Genesis II Oxinium PS (ctd)	Genesis II	1306	21367	182	33	168	923	5.0 (4.7, 5.3)	7.3 (6.9, 7.7)	9.7 (9.0, 10.4)
Genesis II PS	Genesis II	901	20378	161	32	58	650	3.7 (3.4, 4.0)	5.1 (4.8, 5.5)	6.5 (5.9, 7.0)
LCS CR	LCS	624	8335	255	24	90	255	4.4 (4.0, 4.9)	6.4 (5.9, 7.0)	8.1 (7.5, 8.8)
LCS CR	MBT	1393	32926	475	65	156	697	3.5 (3.3, 3.7)	4.9 (4.6, 5.2)	6.1 (5.7, 6.5)
LCS CR	MBT Duofix	850	15247	247	35	43	525	4.1 (3.8, 4.4)	5.3 (5.0, 5.7)	7.3 (6.7, 7.8)
Nexgen CR	Nexgen	437	11565	140	22	32	243	2.2 (1.9, 2.5)	3.1 (2.8, 3.5)	4.5 (4.1, 5.0)
Nexgen CR	Nexgen TM CR	55	867	19	4	11	21	5.5 (4.1, 7.3)	6.5 (4.9, 8.5)	7.7 (5.8, 10.1)
Nexgen CR Flex	Nexgen	1543	60035	373	110	130	930	2.3 (2.2, 2.4)	3.1 (3.0, 3.3)	4.0 (3.7, 4.3)
Nexgen CR Flex	Nexgen TM CR	343	12235	112	23	29	179	2.2 (2.0, 2.5)	3.2 (2.8, 3.6)	4.6 (3.9, 5.3)
Nexgen LPS	Nexgen	372	7021	98	21	33	220	3.3 (2.9, 3.7)	4.9 (4.4, 5.5)	6.5 (5.8, 7.2)
Nexgen LPS	Nexgen TM LPS	34	1476	11	3	6	14	2.2 (1.5, 3.1)	2.8 (1.9, 4.0)	3.4 (2.3, 4.9)
Nexgen LPS Flex	Nexgen	1624	37580	453	69	243	859	3.1 (3.0, 3.3)	5.0 (4.8, 5.3)	6.8 (6.4, 7.2)
Nexgen LPS Flex	Nexgen TM LPS	71	1576	34	4	6	27	3.5 (2.7, 4.5)	4.5 (3.6, 5.8)	6.9 (4.7, 10.1)
PFC Sigma CR	MBT	331	6273	67	35	45	184	3.9 (3.5, 4.4)	5.1 (4.5, 5.7)	6.5 (5.8, 7.4)
PFC Sigma CR	PFC Sigma	883	24874	226	55	66	536	2.5 (2.3, 2.7)	3.5 (3.3, 3.8)	5.2 (4.8, 5.6)
PFC Sigma PS	MBT	357	6332	122	16	24	195	3.9 (3.5, 4.4)	5.4 (4.8, 6.0)	7.2 (6.4, 8.2)
PFC Sigma PS	PFC Sigma	378	8040	130	12	28	208	3.3 (2.9, 3.7)	4.7 (4.2, 5.3)	6.5 (5.7, 7.2)
RBK	RBK	561	11000	215	15	43	288	3.9 (3.6, 4.3)	5.3 (4.9, 5.8)	6.7 (6.1, 7.4)
Triathlon CR	Triathlon	2911	125118	533	117	136	2125	2.5 (2.4, 2.6)	3.7 (3.6, 3.9)	5.1 (4.6, 5.5)
Triathlon PS	Triathlon	588	13531	110	30	74	374	3.9 (3.5, 4.2)	5.5 (5.1, 6.0)	7.2 (6.3, 8.2)
Vanguard CR	Vanguard	1013	27014	231	38	71	673	3.0 (2.8, 3.2)	4.9 (4.6, 5.3)	7.4 (6.3, 8.7)
Vanguard PS	Vanguard	322	5216	80	7	58	177	5.2 (4.6, 5.9)	7.3 (6.5, 8.2)	7.7 (6.9, 8.7)
TOTAL		**19807**	**514494**	**4967**	**915**	**1702**	**12223**			

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

TWENTY YEAR OUTCOMES

The Registry is able to report 20 year outcomes for 8 hip and 9 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 all prosthesis combinations is available in the supplementary report 'Comparative Prosthesis Performance' on the AOANJRR website: https://aoanjrr.sahmri.com/annual-reports-2022

HIP REPLACEMENT

The 8 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 5.4% to 17.8% (Table TY5).

KNEE REPLACEMENT

The 9 listed prosthesis combinations were used in 18.4% of all primary total knee replacement procedures performed for osteoarthritis. All 9 combinations were used in 2021. The 20 year cumulative percent revision ranges from 6.0% to 10.5% (Table TY6).

Table TY5 Cumulative Percent Revision of Primary Total Conventional Hip Replacement Prosthesis Combinations with 20 Year Data (Primary Diagnosis OA)

Femoral Component	Acetabular Component	N Revised	N Total	Type of Revision: THR	Femoral	Acetabular	Other	10 Yrs	15 Yrs	20 Yrs
CPT	Trilogy	374	7724	37	142	41	154	5.3 (4.8, 5.9)	6.8 (6.1, 7.7)	7.8 (6.6, 9.1)
CPT	ZCA	39	859	13	9	10	7	4.7 (3.3, 6.7)	6.4 (4.4, 9.2)	9.6 (6.4, 14.4)
Exeter V40	Trident (Shell)	1962	69365	268	623	253	818	3.6 (3.4, 3.8)	5.3 (5.0, 5.6)	6.7 (6.0, 7.5)
Omnifit	Trident (Shell)	160	3806	12	39	30	79	3.8 (3.2, 4.5)	5.1 (4.3, 6.0)	6.5 (5.4, 7.9)
Secur-Fit	Trident (Shell)	457	9667	28	201	83	145	4.7 (4.2, 5.1)	6.1 (5.5, 6.7)	7.4 (6.4, 8.5)
Secur-Fit Plus	Trident (Shell)	223	5843	16	59	56	92	3.3 (2.9, 3.9)	4.5 (3.9, 5.2)	5.4 (4.7, 6.3)
Spectron EF	Reflection (Cup)	123	1403	47	12	55	9	7.2 (5.8, 8.9)	13.5 (11.2, 16.3)	17.8 (14.0, 22.6)
Synergy	Reflection (Shell)	379	7278	33	85	120	141	3.8 (3.4, 4.3)	5.6 (5.0, 6.2)	8.6 (7.4, 9.9)
TOTAL		**3717**	**105945**	**454**	**1170**	**648**	**1445**			

Note: Restricted to modern prostheses

Table TY6 Cumulative Percent Revision of Primary Total Knee Replacement Combinations with 20 Year Data (Primary Diagnosis OA)

Femoral Component	Tibial Component	N Revised	N Total	Type of Revision: TKR	Type of Revision: Femoral	Type of Revision: Tibial	Type of Revision: Other	10 Yrs	15 Yrs	20 Yrs
Genesis II CR	Genesis II	1154	25271	241	71	56	786	5.0 (4.7, 5.3)	6.2 (5.8, 6.6)	7.4 (6.7, 8.1)
Genesis II Oxinium CR (ctd)	Genesis II	553	10026	104	28	25	396	6.0 (5.5, 6.6)	8.6 (7.8, 9.4)	10.5 (9.2, 11.9)
Genesis II PS	Genesis II	901	20378	161	32	58	650	5.1 (4.8, 5.5)	6.5 (5.9, 7.0)	7.0 (6.4, 7.6)
LCS CR	LCS	624	8335	255	24	90	255	6.4 (5.9, 7.0)	8.1 (7.5, 8.8)	9.3 (8.6, 10.1)
LCS CR	MBT Duofix	850	15247	247	35	43	525	5.3 (5.0, 5.7)	7.3 (6.7, 7.8)	9.5 (8.3, 10.9)
Nexgen CR	Nexgen	437	11565	140	22	32	243	3.1 (2.8, 3.5)	4.5 (4.1, 5.0)	6.0 (5.3, 6.7)
Nexgen LPS	Nexgen	372	7021	98	21	33	220	4.9 (4.4, 5.5)	6.5 (5.8, 7.2)	8.5 (7.3, 9.9)
PFC Sigma CR	MBT	331	6273	67	35	45	184	5.1 (4.5, 5.7)	6.5 (5.8, 7.4)	8.4 (6.8, 10.3)
PFC Sigma CR	PFC Sigma	883	24874	226	55	66	536	3.5 (3.3, 3.8)	5.2 (4.8, 5.6)	6.7 (5.9, 7.6)
TOTAL		**6105**	**128990**	**1539**	**323**	**448**	**3795**			

Note: Restricted to modern prostheses

Hip Replacement

Hip Replacement

CATEGORIES OF HIP REPLACEMENT

The Registry groups hip replacement into three broad categories: primary partial, primary total and revision hip replacement.

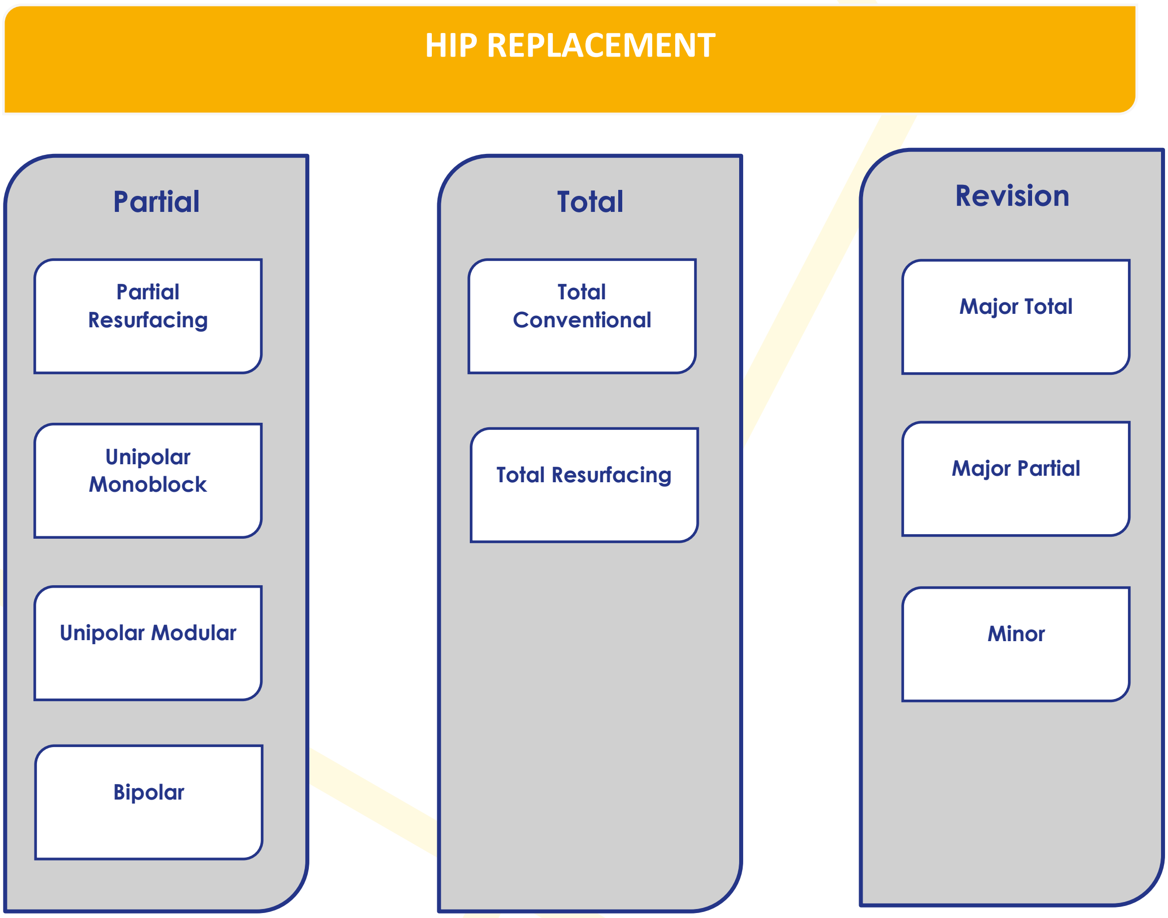
A primary replacement is an initial replacement procedure undertaken on a joint and involves replacing either part (partial) or all (total) of the articular surface.

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-2022



USE OF HIP REPLACEMENT

This report includes 796,686 hip replacements reported to the Registry with a procedure date up to and including 31 December 2021. This is an additional 52,787 hip procedures compared to the number reported last year. The relative frequency of each type of hip procedure is provided in Table H1.

Table H1 Number of Hip Replacements

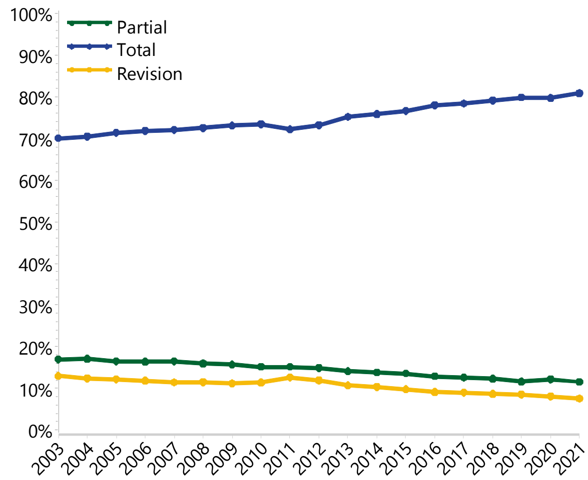
Hip Category	Number	Percent
Partial	113824	14.3
Total	599656	75.3
Revision	83206	10.4
TOTAL	**796686**	**100.0**

The number of hip replacement procedures undertaken in 2021 is 95.1% higher than the number undertaken in 2003. The corresponding increase in primary total hip replacement is 125.2%, for primary partial it is 32.6% and for revision hip replacement it is 14.0%.

The number of hip replacements undertaken has increased by 2,699 (5.5%) compared to 2020. During this time, the use of primary total hip replacement increased by 7.0%, accounting for 80.9% of all hip replacement procedures in 2021. Primary partial hip replacement increased by 0.1%, accounting for 11.6% of hip procedures in 2021.

The proportion of revision hip procedures has declined from a peak of 12.9% in 2003 to 7.6% in 2021. This equates to 2,791 fewer revision procedures in 2021 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 408,787 and BMI data on 298,880 hip replacement procedures. Since its initial collection, ASA score has been recorded for 96.2% of procedures. BMI has been recorded for 87.4% of procedures since collection commenced.

In 2021, ASA score is reported in 99.8% and BMI in 92.4% of hip replacement procedures. There is no variation in the reporting of ASA score based on procedure type. However, there is some variation in the reporting of BMI in 2021. The Registry recorded BMI for 62.2% of primary partial hip, 97.1% of primary total hip, and 88.1% of revision hip replacement procedures.

ASA SCORE

There are five ASA score classifications.[2]

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

There is a difference in ASA score depending on the class of hip replacement. Partial hip replacement procedures have a higher proportion of patients with ASA scores 3 and 4 compared to patients undergoing primary total hip replacement. Revision hip replacement procedures also have patients with higher ASA scores (Table H2).

BMI CATEGORY

BMI for adults is classified by the World Health Organisation into six main categories.[3]

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 are normal or pre-obese (Table H3).

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

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

Table H2 ASA Score for Hip Replacement

ASA Score	Partial		Total		Revision		TOTAL	
	N	Col%	N	Col%	N	Col%	N	Col%
ASA 1	163	0.3	29748	9.3	1444	4.0	31355	7.7
ASA 2	5447	10.6	169255	52.7	12529	34.3	187231	45.8
ASA 3	31008	60.6	115594	36.0	19498	53.4	166100	40.6
ASA 4	14371	28.1	6425	2.0	3041	8.3	23837	5.8
ASA 5	216	0.4	23	0.0	25	0.1	264	0.1
TOTAL	**51205**	**100.0**	**321045**	**100.0**	**36537**	**100.0**	**408787**	**100.0**

Table H3 BMI Category for Hip Replacement

BMI Category	Partial		Total		Revision		TOTAL	
	N	Col%	N	Col%	N	Col%	N	Col%
Underweight	2232	9.9	2650	1.1	424	1.7	5306	1.8
Normal	11182	49.5	55606	22.1	5846	23.8	72634	24.3
Pre Obese	6449	28.5	92377	36.7	8457	34.4	107283	35.9
Obese Class 1	1998	8.8	62183	24.7	5841	23.8	70022	23.4
Obese Class 2	534	2.4	26185	10.4	2527	10.3	29246	9.8
Obese Class 3	215	1.0	12702	5.0	1472	6.0	14389	4.8
TOTAL	**22610**	**100.0**	**251703**	**100.0**	**24567**	**100.0**	**298880**	**100.0**

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

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

The Registry identifies 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

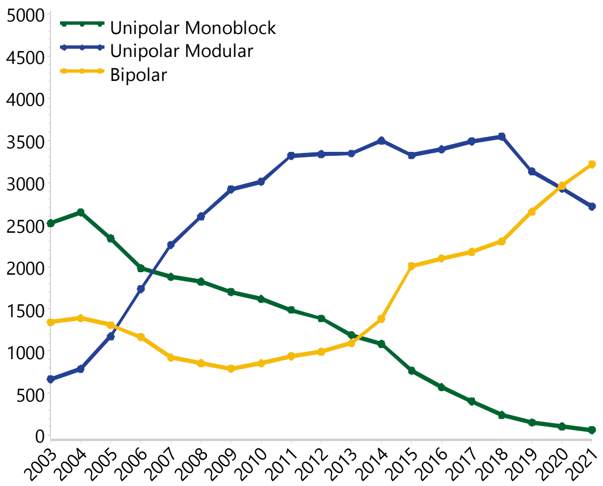
Hip Class	Number	Percent
Unipolar Monoblock	29189	25.6
Unipolar Modular	52059	45.7
Bipolar	32561	28.6
TOTAL	113809	100.0

Note: Excludes 15 partial resurfacing procedures not used since 2014

In 2021, 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-2022

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-2022

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

2003		2018		2019		2020		2021	
N	Model	N	Model	N	Model	N	Model	N	Model
1988	Austin-Moore Type	2851	Exeter V40	2979	Exeter V40	2924	Exeter V40	3050	Exeter V40
810	Exeter V40	811	CPCS	725	CPCS	852	CPT	845	CPT
526	Thompson Type	623	CPT	713	CPT	768	CPCS	713	CPCS
186	Alloclassic	459	C-Stem AMT	475	C-Stem AMT	477	C-Stem AMT	498	C-Stem AMT
127	Elite Plus	292	Absolut	175	Absolut	123	Short Exeter V40	130	CORAIL
105	CPT	166	CORAIL	141	CORAIL	108	CORAIL	128	Short Exeter V40
95	Spectron EF	164	ETS	124	ETS	92	ETS	92	Absolut
74	C-Stem	83	Quadra-C	96	Short Exeter V40	86	Taper Fit	72	Taper Fit
65	CPCS	83	Short Exeter V40	65	Spectron EF	78	twinSys (ctd)	68	Quadra-C
63	Omnifit	62	Austin-Moore Type	56	Quadra-C	60	Quadra-C	61	ETS
10 Most Used									
4039	(10) 89.3%	5594	(10) 92.0%	5549	(10) 93.5%	5568	(10) 92.9%	5657	(10) 94.3%
Remainder									
482	(52) 10.7%	489	(40) 8.0%	386	(36) 6.5%	425	(36) 7.1%	339	(37) 5.7%
TOTAL									
4521	(62) 100.0%	6083	(50) 100.0%	5935	(46) 100.0%	5993	(46) 100.0%	5996	(47) 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 2021 (described as modern prostheses) are included in the analyses, unless clearly specified.

Fractured neck of femur is the principal diagnosis for the three main classes of primary partial hip replacement: unipolar monoblock (97.7%), unipolar modular (96.2%) and bipolar (93.9%). A comparative analysis of partial hip replacement and total conventional hip replacement was undertaken for fractured neck of femur and is presented in the primary total hip replacement chapter of this report.

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

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

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	19377	21228	38.1 (37.5, 38.8)	61.8 (61.1, 62.4)	77.5 (77.0, 78.1)	86.7 (86.2, 87.2)	93.5 (93.1, 93.8)
Unipolar Modular	28189	41019	26.7 (26.3, 27.2)	47.9 (47.4, 48.4)	63.6 (63.1, 64.1)	74.9 (74.4, 75.4)	84.8 (84.3, 85.3)
Bipolar	14166	24421	24.5 (24.0, 25.1)	44.8 (44.1, 45.5)	60.3 (59.5, 61.0)	70.9 (70.2, 71.7)	81.9 (81.2, 82.7)
TOTAL	**61732**	**86668**					

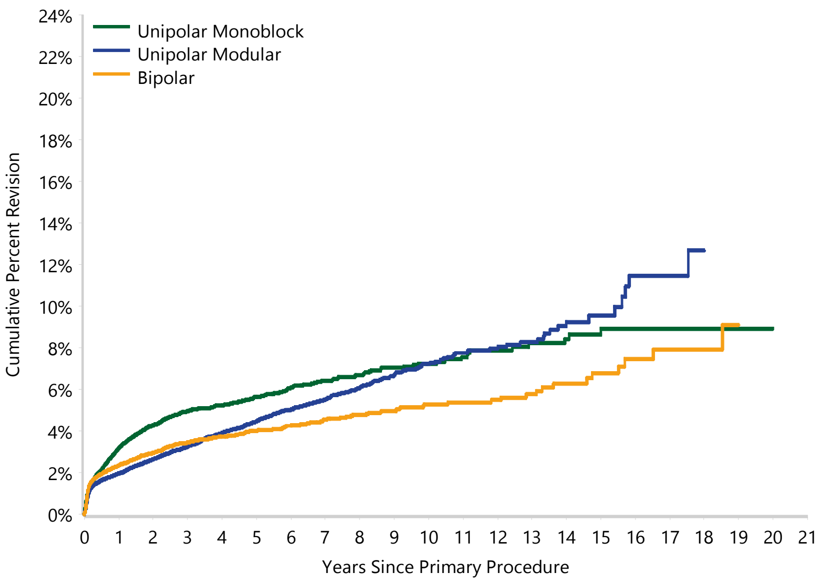
Note: Restricted to modern prostheses

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	839	21729	3.2 (2.9, 3.4)	4.3 (4.0, 4.6)	5.0 (4.6, 5.3)	5.6 (5.2, 6.1)	6.4 (5.9, 6.9)	7.3 (6.6, 7.9)
Unipolar Modular	1383	42436	2.0 (1.8, 2.1)	2.6 (2.5, 2.8)	3.3 (3.1, 3.5)	4.5 (4.2, 4.7)	5.5 (5.2, 5.9)	7.3 (6.7, 7.8)
Bipolar	741	25092	2.4 (2.2, 2.6)	3.0 (2.7, 3.2)	3.4 (3.2, 3.7)	4.0 (3.7, 4.4)	4.5 (4.2, 5.0)	5.3 (4.8, 5.9)
TOTAL	2963	89257						

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
- 0 - 1Yr: HR=1.71 (1.53, 1.91), p<0.001
- 1Yr - 3Yr: HR=1.60 (1.34, 1.92), p<0.001
- 3Yr - 5Yr: HR=0.62 (0.44, 0.87), p=0.005
- 5Yr+: HR=0.68 (0.50, 0.92), p=0.013

Unipolar Monoblock vs Bipolar
- 0 - 1Yr: HR=1.48 (1.31, 1.67), p<0.001
- 1Yr - 3Yr: HR=1.93 (1.56, 2.40), p<0.001
- 3Yr - 5Yr: HR=1.37 (0.89, 2.11), p=0.148
- 5Yr+: HR=1.57 (1.06, 2.32), p=0.024

Bipolar vs Unipolar Modular
- 0 - 1Yr: HR=1.15 (1.03, 1.29), p=0.012
- 1Yr - 3Yr: HR=0.83 (0.68, 1.01), p=0.066
- 3Yr - 5Yr: HR=0.45 (0.32, 0.63), p<0.001
- 5Yr+: HR=0.43 (0.31, 0.60), p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Monoblock	21729	12991	10064	7785	4422	2492	1096
Unipolar Modular	42436	28609	22460	17455	10173	5576	2179
Bipolar	25092	16228	12086	8989	4977	2654	1227

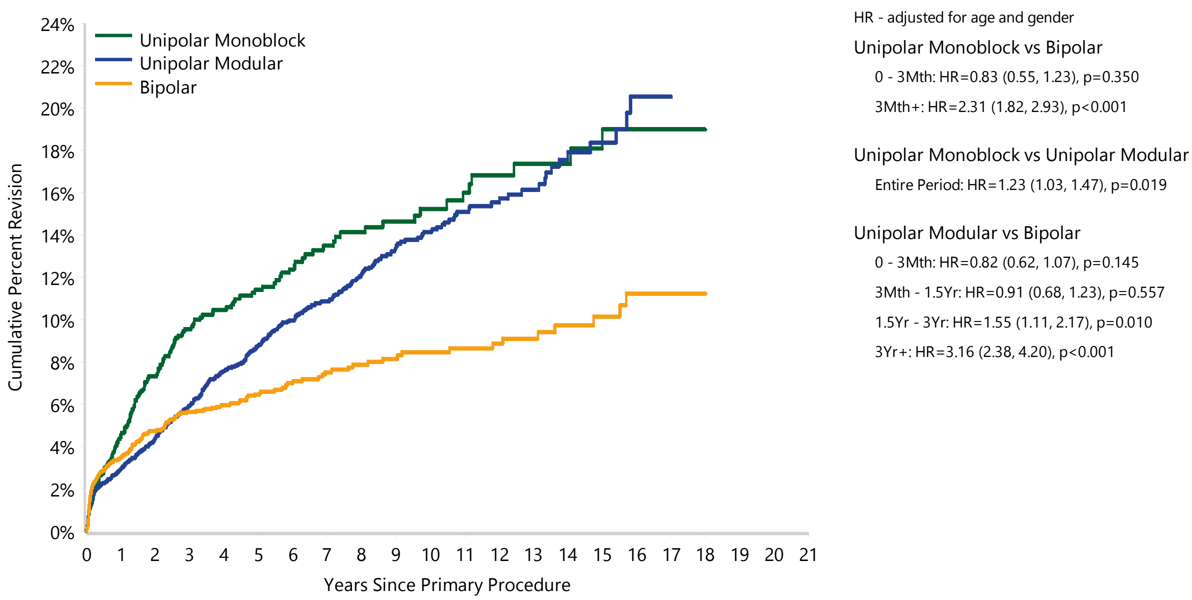
Note: Restricted to modern prostheses

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	166	1842	4.5 (3.6, 5.7)	7.3 (6.1, 8.8)	9.6 (8.1, 11.3)	11.4 (9.7, 13.4)	13.5 (11.5, 15.8)	15.2 (12.9, 17.9)
Unipolar Modular	486	6101	2.9 (2.5, 3.4)	4.4 (3.8, 5.0)	5.9 (5.3, 6.7)	8.8 (7.9, 9.7)	10.9 (9.8, 12.0)	14.2 (12.8, 15.6)
Bipolar	236	4345	3.5 (3.0, 4.1)	4.7 (4.1, 5.5)	5.6 (4.9, 6.5)	6.5 (5.6, 7.4)	7.5 (6.5, 8.7)	8.5 (7.3, 9.8)
TOTAL	888	12288						

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)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Monoblock	1842	1223	1010	853	593	424	251
Unipolar Modular	6101	4620	3866	3252	2269	1542	823
Bipolar	4345	3077	2421	1959	1317	838	528

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-2022

Primary Total Hip Replacement

CLASSES OF TOTAL HIP REPLACEMENT

A total hip procedure replaces both the femoral and acetabular articular surfaces. The Registry subcategorises primary total hip replacement 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-2022

USE OF TOTAL HIP REPLACEMENT

The Registry has recorded 599,398 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	580029	96.8
Total Resurfacing	19369	3.2
TOTAL	**599398**	**100.0**

Osteoarthritis is the principal diagnosis for primary total hip replacement (88.3%).

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	2036	19369	1.7 (1.5, 1.9)	3.1 (2.9, 3.4)	4.8 (4.5, 5.1)	9.0 (8.6, 9.5)	12.4 (11.9, 12.9)	14.9 (14.2, 15.7)
Total Conventional	27837	580029	1.8 (1.7, 1.8)	2.7 (2.7, 2.8)	3.6 (3.5, 3.6)	5.9 (5.9, 6.0)	8.8 (8.7, 9.0)	11.9 (11.6, 12.2)
TOTAL	**29873**	**599398**						

PRIMARY TOTAL CONVENTIONAL HIP REPLACEMENT

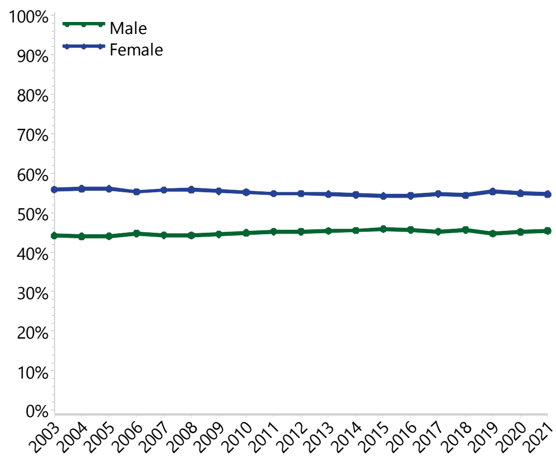
DEMOGRAPHICS

There have been 580,029 primary total conventional hip replacement procedures reported to the Registry. This is an additional 41,984 procedures compared to the previous report.

Primary total conventional hip replacement procedures increased by 7.2% in 2021 compared to the previous year. There has been a 142.6% increase since 2003.

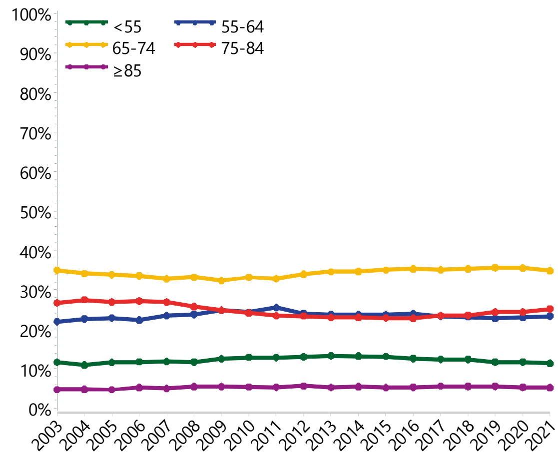
Primary total conventional hip replacement is more common in females. This proportion has remained stable since 2003 (Figure HT1).

Figure HT1 Primary Total Conventional Hip Replacement by Gender



The mean age of patients is 67.8 years (Table HT3). There has been minimal change in the proportion of patients aged 55-64 years (21.9% in 2003 to 23.4% in 2021) and for patients aged <55 years (11.7% in 2003 to 11.4% in 2021) (Figure HT2).

Figure HT2 Primary Total Conventional Hip Replacement by Age



The use of cementless fixation has increased from 51.3% in 2003 to 61.6% in 2021. Hybrid fixation has increased from 34.8% to 36.3% and cemented fixation has declined from 13.9% to 2.1% (Figure HT3).

Figure HT3 Primary Total Conventional Hip Replacement by Fixation

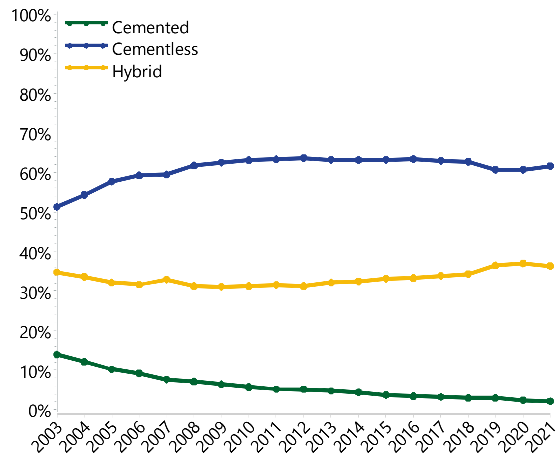


Table HT3 Age and Gender of Primary Total Conventional Hip Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	261420	45.1%	11	108	67	66.4	11.5
Female	318609	54.9%	11	101	70	69.0	11.3
TOTAL	**580029**	**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 2021, 67.8% of primary total conventional hip replacements used stems in the 10 most used femoral component list. Seven of these stems are cementless. The 10 most used cemented and cementless stems are listed in Table HT5 and Table HT6, respectively. The 10 most used cemented stems account for 93.9% of cemented stem procedures. The 10 most used cementless stems account for 78.4% of cementless stem procedures.

The Trident (Shell), Trinity and PINNACLE are the most frequently used acetabular prostheses for primary total conventional hip replacement. In 2021, 87.8% of primary total conventional hip procedures used acetabular components from the 10 most used list (Table HT7). All of the acetabular components in this list are cementless prostheses. The 10 most used cemented and cementless acetabular prostheses are listed separately in Table HT8 and Table HT9.

Table HT4 10 Most Used Femoral Components in Primary Total Conventional Hip Replacement

2003		2018		2019		2020		2021	
N	Model	N	Model	N	N	Model	N	Model	N
3901	Exeter V40	7368	Exeter V40	7844	Exeter V40	7142	Exeter V40	7479	Exeter V40
1029	ABGII	5322	CORAIL	4897	CORAIL	4549	CORAIL	4356	CORAIL
1000	Synergy	2243	Polarstem	2526	Metafix	2628	Accolade II	3576	Accolade II
819	Alloclassic	2133	Metafix	2401	Accolade II	2625	Metafix	2752	Polarstem
809	VerSys	2072	Quadra-H	2332	Polarstem	2472	Polarstem	2658	Metafix
780	Spectron EF	1996	Accolade II	2021	Quadra-H	1757	Quadra-H	1807	Quadra-H
713	Secur-Fit Plus	1185	Paragon	1287	Paragon	1339	CPT	1424	Paragon
618	Omnifit	1159	CPT	1275	CPT	1235	Paragon	1424	Quadra-C
565	C-Stem	945	Taperloc	1086	Taperloc	1142	Quadra-C	1358	CPT
485	S-Rom	905	CPCS	1061	C-Stem AMT	985	CPCS	1258	AMIStem H
10 Most Used									
10719	(10) 62.8%	25328	(10) 65.3%	26730	(10) 66.5%	25874	(10) 66.9%	28092	(10) 67.8%
Remainder									
6353	(73) 37.2%	13477	(88) 34.7%	13451	(90) 33.5%	12780	(80) 33.1%	13332	(79) 32.2%
TOTAL									
17072	(83) 100.0%	38805	(98) 100.0%	40181	(100) 100.0%	38654	(90) 100.0%	41424	(89) 100.0%

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

2003			2018			2019			2020			2021		
N	Model		N	Model		N	Model		N	Model		N	Model	
3901	Exeter V40		7368	Exeter V40		7844	Exeter V40		7142	Exeter V40		7479	Exeter V40	
780	Spectron EF		1159	CPT		1275	CPT		1339	CPT		1424	Quadra-C	
565	C-Stem		905	CPCS		1061	C-Stem AMT		1142	Quadra-C		1358	CPT	
477	CPT		885	C-Stem AMT		987	CPCS		985	CPCS		958	CPCS	
445	Elite Plus		727	Quadra-C		841	Quadra-C		788	Taper Fit		886	Short Exeter V40	
358	MS 30		681	Short Exeter V40		805	Short Exeter V40		785	Short Exeter V40		778	Taper Fit	
338	Omnifit		592	Taper Fit		790	Taper Fit		733	C-Stem AMT		691	C-Stem AMT	
321	Charnley		394	MS 30		383	Absolut		532	Evolve		619	Evolve	
245	CPCS		387	Evolve		358	Evolve		366	MS 30		361	MS 30	
122	Exeter		343	Absolut		324	MS 30		310	Absolut		320	X-Acta	
10 Most Used														
7552	(10)	91.7%	13441	(10)	93.3%	14668	(10)	93.3%	14122	(10)	93.2%	14874	(10)	93.9%
Remainder														
680	(26)	8.3%	966	(21)	6.7%	1058	(23)	6.7%	1025	(18)	6.8%	973	(18)	6.1%
TOTAL														
8232	(36)	100.0%	14407	(31)	100.0%	15726	(33)	100.0%	15147	(28)	100.0%	15847	(28)	100.0%

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

2003			2018			2019			2020			2021		
N	Model		N	Model		N	Model		N	Model		N	Model	
1029	ABGII		5322	CORAIL		4897	CORAIL		4549	CORAIL		4356	CORAIL	
980	Synergy		2243	Polarstem		2526	Metafix		2628	Accolade II		3576	Accolade II	
819	Alloclassic		2133	Metafix		2401	Accolade II		2625	Metafix		2658	Metafix	
739	VerSys		2072	Quadra-H		2329	Polarstem		2375	Polarstem		2536	Polarstem	
713	Secur-Fit Plus		1996	Accolade II		2021	Quadra-H		1757	Quadra-H		1807	Quadra-H	
485	S-Rom		1185	Paragon		1287	Paragon		1235	Paragon		1424	Paragon	
482	Secur-Fit		945	Taperloc		1086	Taperloc		931	AMIStem H		1258	AMIStem H	
376	CORAIL		860	AMIStem H		847	AMIStem H		885	Taperloc		943	Taperloc Microplasty	
334	Accolade I		580	Anthology		597	Taperloc Microplasty		784	Taperloc Microplasty		904	Taperloc	
334	Mallory-Head		549	Tri-Fit TS		482	Anthology		477	Optimys		582	Origin	
10 Most Used														
6291	(10)	71.2%	17885	(10)	73.3%	18473	(10)	75.5%	18246	(10)	77.6%	20044	(10)	78.4%
Remainder														
2549	(47)	28.8%	6513	(64)	26.7%	5982	(68)	24.5%	5261	(58)	22.4%	5533	(55)	21.6%
TOTAL														
8840	(57)	100.0%	24398	(74)	100.0%	24455	(78)	100.0%	23507	(68)	100.0%	25577	(65)	100.0%

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

2003		2018		2019		2020		2021	
N	Model	N	Model	N	Model	N	Model	N	Model
3986	Trident (Shell)	8563	Trident (Shell)	9262	Trident (Shell)	8866	Trident (Shell)	9667	Trident (Shell)
1748	Reflection (Shell)	6386	PINNACLE	6132	PINNACLE	5264	PINNACLE	5309	Trinity
1524	Trilogy	3873	R3	4388	Trinity	4846	Trinity	5048	PINNACLE
955	Vitalock	3687	Trinity	3828	R3	3936	R3	4121	R3
907	Duraloc	1914	Mpact	2307	Mpact	2928	G7	3522	G7
827	ABGII	1836	Versafitcup CC	2227	G7	2823	Mpact	3334	Mpact
793	Allofit	1494	G7	1724	Versafitcup CC	1371	Versafitcup CC	1742	Versafitcup CC
729	Mallory-Head	1445	Logical G	1474	Logical G	1353	Logical G	1523	Trident/Tritanium (Shell)
539	Contemporary	1321	Acetabular Shell (Global)	1214	Acetabular Shell (Global)	1153	Trident/Tritanium (Shell)	1301	Logical G
537	PINNACLE	1197	Continuum	1116	Trident/Tritanium (Shell)	719	RM Cup	785	RM Cup
10 Most Used									
12545	(10) 73.5%	31716	(10) 81.7%	33672	(10) 83.8%	33259	(10) 86.0%	36352	(10) 87.8%
Remainder									
4527	(69) 26.5%	7089	(62) 18.3%	6509	(63) 16.2%	5395	(61) 14.0%	5072	(61) 12.2%
TOTAL									
17072	(79) 100.0%	38805	(72) 100.0%	40181	(73) 100.0%	38654	(71) 100.0%	41424	(71) 100.0%

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

2003		2018		2019		2020		2021	
N	Model	N	Model	N	Model	N	Model	N	Model
539	Contemporary	532	Exeter X3 Rimfit	571	Exeter X3 Rimfit	509	Exeter X3 Rimfit	486	Exeter X3 Rimfit
256	Exeter	105	Contemporary	91	Marathon	52	Marathon	53	Avantage
251	Reflection (Cup)	82	Marathon	73	Contemporary	50	Reflection (Cup)	49	Marathon
227	Exeter Contemporary	81	ZCA	66	Novae E	42	Avantage	39	Reflection (Cup)
199	Charnley Ogee	53	Reflection (Cup)	50	Reflection (Cup)	40	Novae E	27	Apricot
149	Elite Plus LPW	52	Novae E	47	Avantage	40	ZCA	25	Contemporary
130	Low Profile Cup	41	Avantage	40	ZCA	24	Apricot	23	Muller
109	Elite Plus Ogee	34	Apricot	35	Apricot	24	Muller	22	Novae E
102	Charnley	32	Exeter Contemporary	34	Low Profile Cup	22	Contemporary	19	Exeter Contemporary
90	ZCA	24	Muller	33	Exeter Contemporary	21	Polarcup	19	ZCA
10 Most Used									
2052	(10) 85.4%	1036	(10) 89.7%	1040	(10) 88.7%	824	(10) 88.7%	762	(10) 87.5%
Remainder									
351	(16) 14.6%	119	(18) 10.3%	133	(20) 11.3%	105	(19) 11.3%	109	(18) 12.5%
TOTAL									
2403	(26) 100.0%	1155	(28) 100.0%	1173	(30) 100.0%	929	(29) 100.0%	871	(28) 100.0%

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

2003			2018			2019			2020			2021		
N	Model		N	Model		N	Model		N	Model		N	Model	
3986	Trident (Shell)		8563	Trident (Shell)		9262	Trident (Shell)		8866	Trident (Shell)		9666	Trident (Shell)	
1748	Reflection (Shell)		6385	PINNACLE		6131	PINNACLE		5263	PINNACLE		5309	Trinity	
1524	Trilogy		3873	R3		4388	Trinity		4846	Trinity		5047	PINNACLE	
955	Vitalock		3687	Trinity		3827	R3		3935	R3		4121	R3	
907	Duraloc		1913	Mpact		2307	Mpact		2928	G7		3522	G7	
827	ABGII		1836	Versafitcup CC		2227	G7		2823	Mpact		3334	Mpact	
793	Allofit		1494	G7		1724	Versafitcup CC		1371	Versafitcup CC		1742	Versafitcup CC	
729	Mallory-Head		1445	Logical G		1474	Logical G		1353	Logical G		1523	Trident/Tritanium (Shell)	
537	PINNACLE		1321	Acetabular Shell (Global)		1213	Acetabular Shell (Global)		1153	Trident/Tritanium (Shell)		1301	Logical G	
521	Fitmore		1196	Continuum		1116	Trident/Tritanium (Shell)		719	RM Cup		785	RM Cup	
10 Most Used														
12527	(10)	85.4%	31713	(10)	84.2%	33669	(10)	86.3%	33257	(10)	88.2%	36350	(10)	89.6%
Remainder														
2142	(43)	14.6%	5937	(43)	15.8%	5339	(44)	13.7%	4468	(39)	11.8%	4203	(41)	10.4%
TOTAL														
14669	(53)	100.0%	37650	(53)	100.0%	39008	(54)	100.0%	37725	(49)	100.0%	40553	(51)	100.0%

Note: In 2021, 2 shells in the cementless group were inserted with cement

OUTCOME FOR ALL DIAGNOSES

In 2014, the Registry excluded large head metal/metal bearing surfaces from many comparative analyses of primary total conventional hip replacement outcomes due to several factors: they are no longer used, account for an increasingly small proportion of procedures (currently 2.8%) and have a much higher rate of revision than other bearing surfaces (32.4% at 20 years). In addition, large head metal/metal bearings were preferentially used in younger patients with cementless fixation and with particular femoral stem and acetabular prosthesis combinations.

Consequently, in specific analyses metal/metal bearings have the potential to be a major confounding factor and are almost always excluded from general analyses. In prosthesis-specific analyses, prostheses with large head metal/metal bearings are identified separately. Where large head metal/metal bearings are excluded in any analysis this is clearly identified by the Registry.

Since 2019, the Registry has also excluded small head size (<32mm in diameter) metal/metal bearings from comparative analyses. Small head metal/metal bearings were not used in 2021 and form a small proportion of all primary total conventional hip replacement procedures (1.0%).

The Registry recognises that hip replacement prosthesis use and availability changes with time. In order to keep Registry data contemporaneous, only procedures using prostheses that have been available and used in 2021 (described as modern prostheses) are included in the analyses, unless clearly specified. This has resulted in 104,658 procedures being excluded from the analysis for the 2022 Annual Report (18.8%).

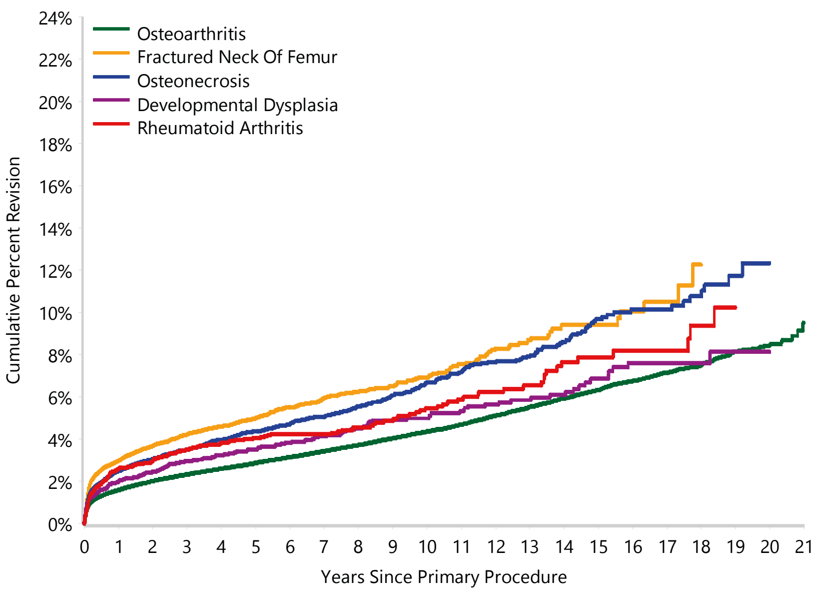
Osteoarthritis is the principal diagnosis, followed by fractured neck of femur, osteonecrosis, developmental dysplasia, rheumatoid arthritis, and tumour (Table HT10). Osteoarthritis has a lower rate of revision compared to fractured neck of femur and osteonecrosis. Osteoarthritis also has a lower rate of revision compared to developmental dysplasia. However, this difference is only evident in the first month and 2 to 2.5 years (Figure HT4).

Table HT10 Cumulative Percent Revision of Primary Total Conventional Hip 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	13098	397261	87.6%	1.6 (1.6, 1.6)	2.3 (2.3, 2.4)	2.9 (2.8, 2.9)	4.4 (4.3, 4.4)	6.3 (6.2, 6.5)	8.4 (8.1, 8.8)
Fractured Neck Of Femur	1163	24801	5.5%	3.0 (2.8, 3.2)	4.2 (4.0, 4.5)	5.0 (4.7, 5.3)	6.9 (6.5, 7.5)	9.4 (8.4, 10.5)	
Osteonecrosis	718	14583	3.2%	2.5 (2.3, 2.8)	3.5 (3.2, 3.8)	4.4 (4.0, 4.7)	6.7 (6.1, 7.3)	9.7 (8.7, 10.8)	12.3 (10.4, 14.6)
Developmental Dysplasia	239	5912	1.3%	2.0 (1.6, 2.4)	3.0 (2.5, 3.4)	3.5 (3.1, 4.1)	5.0 (4.3, 5.7)	6.9 (5.8, 8.1)	8.1 (6.6, 10.0)
Rheumatoid Arthritis	173	3573	0.8%	2.6 (2.1, 3.2)	3.5 (2.9, 4.2)	4.0 (3.4, 4.8)	5.5 (4.6, 6.5)	7.9 (6.5, 9.5)	
Tumour	137	2552	0.6%	4.7 (3.8, 5.7)	7.1 (5.9, 8.6)	8.4 (6.9, 10.2)	11.9 (9.2, 15.4)		
Other (5)	308	4582	1.0%	4.1 (3.5, 4.7)	5.7 (5.0, 6.5)	6.7 (6.0, 7.6)	8.9 (7.8, 10.1)	11.2 (9.5, 13.1)	
TOTAL	**15836**	**453264**	**100%**						

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=1.81 (1.70, 1.92), p<0.001

Osteonecrosis vs Osteoarthritis
Entire Period: HR=1.48 (1.37, 1.59), p<0.001

Developmental Dysplasia vs Osteoarthritis
0 - 1Mth: HR=1.40 (1.07, 1.83), p=0.013
1Mth - 3Mth: HR=0.75 (0.48, 1.17), p=0.201
3Mth - 2Yr: HR=1.24 (0.96, 1.59), p=0.093
2Yr - 2.5Yr: HR=2.14 (1.32, 3.47), p=0.002
2.5Yr+: HR=0.98 (0.79, 1.21), p=0.828

Rheumatoid Arthritis vs Osteoarthritis
Entire Period: HR=1.32 (1.13, 1.53), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Osteoarthritis	397261	352075	275373	204605	79576	21543	1383
Fractured Neck Of Femur	24801	20122	13747	8690	2286	352	14
Osteonecrosis	14583	12691	9757	7111	2827	895	74
Developmental Dysplasia	5912	5204	4063	3080	1441	550	47
Rheumatoid Arthritis	3573	3241	2654	2097	1016	344	35

Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded
Only primary diagnoses with >2,000 procedures have been listed

PROSTHESIS TYPES

There are 1,464 different stem and acetabular combinations for primary total conventional hip replacement recorded by the Registry. This is a decrease of 26 prosthesis combinations since the previous report and is due to the restriction in the analyses to modern prosthesis combinations.

The cumulative percent revision of the 102 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 92.4% 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 2021.

The 'Other' group consists of all prosthesis combinations with ≤500 procedures. This group accounts for 7.6% of all primary total conventional hip replacement procedures.

There are 7 cemented primary total conventional stem and acetabular combinations with >500 procedures. The CPT/ZCA has the lowest 15 year cumulative percent revision of 7.1% (Table HT11).

There are 63 cementless primary total conventional stem and acetabular combinations listed. The Alloclassic/Trilogy has the lowest 15 year cumulative percent revision of 2.7%. At 20 years, the Secur-Fit Plus/Trident has a cumulative percent revision of 5.9% (Table HT12).

There are 32 combinations of primary total hip replacement with hybrid fixation. The Exeter V40 /Trilogy has the lowest cumulative percent revision at 15 years of 3.9% (n=604) followed by the Omnifit/Trident with a cumulative percent revision of 4.7% (n=2,989) (Table HT13). The Exeter/Vitalock has previously been reported with the lowest cumulative percent revision for hybrid fixation but this combination was not used in 2021.

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	610	1.9 (1.1, 3.4)	2.5 (1.5, 4.2)	3.0 (1.9, 4.9)			
CPCS	Reflection (Cup)	98	1095	2.0 (1.3, 3.1)	3.1 (2.2, 4.4)	4.0 (2.9, 5.5)	8.7 (6.8, 11.3)	19.1 (15.4, 23.5)	
CPT	ZCA	51	1047	1.0 (0.5, 1.8)	2.3 (1.6, 3.5)	2.9 (2.0, 4.2)	5.1 (3.7, 6.9)	7.1 (5.1, 9.9)	12.2 (8.2, 17.7)
Exeter V40	Contemporary	374	5704	1.7 (1.4, 2.1)	2.9 (2.5, 3.4)	3.6 (3.1, 4.1)	6.2 (5.5, 7.0)	9.8 (8.7, 11.0)	
	Exeter Contemporary	195	3438	1.4 (1.1, 1.9)	2.4 (1.9, 2.9)	3.1 (2.6, 3.8)	4.8 (4.1, 5.7)	8.3 (7.0, 9.7)	
	Exeter X3 Rimfit	141	5237	1.5 (1.2, 1.9)	2.3 (1.9, 2.8)	2.9 (2.4, 3.4)	3.6 (3.0, 4.3)		
Spectron EF	Reflection (Cup)	137	1662	1.1 (0.7, 1.7)	1.8 (1.3, 2.6)	2.9 (2.2, 3.9)	7.2 (5.9, 8.8)	13.3 (11.1, 15.9)	18.4 (14.6, 23.0)
Other (263)		259	5523	2.7 (2.3, 3.2)	3.8 (3.3, 4.3)	4.4 (3.9, 5.1)	6.5 (5.6, 7.5)	10.8 (8.9, 13.0)	
TOTAL		**1273**	**24316**						

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
AMIStem H	Mpact	57	2443	2.0 (1.5, 2.7)	2.7 (2.1, 3.6)	3.4 (2.5, 4.7)			
	Versafitcup CC	75	3412	1.5 (1.1, 1.9)	2.0 (1.6, 2.6)	2.9 (2.3, 3.7)			
Accolade II	Trident (Shell)	275	11960	1.8 (1.6, 2.1)	2.5 (2.2, 2.8)	2.9 (2.5, 3.3)			
	Trident/Tritanium (Shell)	87	3183	2.2 (1.8, 2.8)	3.1 (2.5, 3.8)	3.5 (2.8, 4.4)			
Alloclassic	Allofit	188	3963	1.6 (1.2, 2.0)	2.3 (1.9, 2.9)	3.0 (2.5, 3.5)	4.8 (4.1, 5.6)	6.8 (5.8, 8.0)	
	Fitmore*	53	726	4.4 (3.1, 6.2)	5.4 (4.0, 7.3)	5.8 (4.4, 7.8)	7.8 (6.0, 10.3)	7.8 (6.0, 10.3)	
	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, 6.7)	5.9 (4.5, 7.8)	
	Trilogy*	21	945	0.6 (0.3, 1.4)	0.9 (0.4, 1.7)	1.1 (0.6, 2.0)	2.5 (1.6, 3.8)	2.7 (1.7, 4.2)	
Anthology	R3	257	8036	2.0 (1.7, 2.3)	2.6 (2.2, 2.9)	2.9 (2.5, 3.3)	3.7 (3.3, 4.2)		
	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)	3.9 (2.7, 5.6)	
Avenir	Continuum	62	1765	2.7 (2.0, 3.5)	3.0 (2.3, 4.0)	3.5 (2.7, 4.6)	3.9 (3.1, 5.1)		
	Trilogy*	12	626	1.0 (0.4, 2.1)	1.1 (0.5, 2.3)	1.3 (0.6, 2.6)	2.1 (1.1, 3.8)		
C2	Delta-TT	26	1022	1.3 (0.8, 2.2)	2.1 (1.4, 3.3)	2.6 (1.7, 3.9)	3.8 (2.3, 6.1)		
CLS	Allofit	29	501	1.8 (0.9, 3.4)	3.4 (2.2, 5.5)	4.1 (2.6, 6.2)	5.2 (3.6, 7.7)	7.2 (4.9, 10.5)	
	Fitmore	19	612	1.3 (0.7, 2.6)	2.3 (1.4, 4.0)	2.6 (1.6, 4.4)	4.3 (2.5, 7.3)	4.3 (2.5, 7.3)	
CORAIL	Fitmore*	14	513	2.2 (1.2, 3.8)	2.3 (1.3, 4.1)	2.3 (1.3, 4.1)	3.4 (1.9, 6.1)		
	G7	6	505	0.8 (0.3, 2.2)					
	PINNACLE	2167	59111	1.7 (1.6, 1.8)	2.6 (2.5, 2.7)	3.2 (3.1, 3.4)	4.9 (4.7, 5.2)	8.0 (7.2, 9.0)	
	PINNACLE*^{MoM}	133	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)	17.1 (14.3, 20.5)	
	Trinity	16	994	1.5 (0.9, 2.5)	1.8 (1.1, 2.9)	1.8 (1.1, 2.9)			
EVOK	Logical G	14	549	2.1 (1.2, 3.8)	3.3 (1.9, 5.9)				
H-Max	Delta-TT	75	1680	1.9 (1.4, 2.7)	3.5 (2.7, 4.5)	4.2 (3.3, 5.3)	7.7 (5.2, 11.5)		
HACTIV	Logical G	58	1309	3.9 (2.9, 5.1)	4.6 (3.6, 6.0)				
	Saturne	12	598	1.6 (0.9, 3.2)	2.4 (1.3, 4.5)	2.4 (1.3, 4.5)			
M/L Taper	Allofit	25	752	1.6 (0.9, 2.8)	1.9 (1.1, 3.2)	2.2 (1.3, 3.6)	4.2 (2.6, 6.7)		
	Continuum	63	1623	2.4 (1.8, 3.3)	3.4 (2.6, 4.4)	3.7 (2.9, 4.8)	4.6 (3.5, 6.0)		
	Trilogy	34	900	1.2 (0.7, 2.2)	1.6 (0.9, 2.6)	2.7 (1.8, 4.0)	4.0 (2.8, 5.7)	4.7 (3.3, 6.8)	
MasterLoc	Mpact	10	636	1.5 (0.8, 2.8)	1.5 (0.8, 2.8)				
	Versafitcup CC	5	596	0.9 (0.3, 2.3)	1.2 (0.5, 2.9)				
Metafix	Trinity	268	13339	1.5 (1.3, 1.7)	2.2 (1.9, 2.5)	2.5 (2.2, 2.9)	4.2 (3.0, 6.0)		
MiniHip	Trinity	39	1167	2.5 (1.8, 3.6)	3.2 (2.3, 4.4)	3.5 (2.5, 4.8)			
Omnifit	Trident (Shell)	88	1272	1.9 (1.3, 2.8)	3.2 (2.3, 4.3)	4.1 (3.1, 5.4)	5.6 (4.4, 7.0)	7.3 (5.8, 9.0)	9.1 (7.3, 11.3)
Optimys	RM Cup	35	2009	1.4 (0.9, 2.0)	1.8 (1.3, 2.6)	2.5 (1.7, 3.8)			
	seleXys	12	560	0.7 (0.3, 2.0)	1.9 (1.0, 3.6)	3.1 (1.7, 5.5)			
Origin	Logical G	73	2523	2.2 (1.7, 2.9)	3.1 (2.5, 4.0)	3.7 (2.8, 4.7)			
Paragon	Acetabular Shell (Global)	82	4153	1.5 (1.2, 2.0)	1.9 (1.5, 2.3)	2.3 (1.8, 3.0)			
	Novae	17	868	0.9 (0.5, 1.8)	1.9 (1.2, 3.2)	2.1 (1.3, 3.4)			
	Trinity	33	1879	1.8 (1.2, 2.5)	2.0 (1.4, 2.9)	2.0 (1.4, 2.9)			
Polarstem	EP-Fit Plus	11	2377	0.2 (0.1, 0.5)	0.5 (0.2, 0.9)	0.5 (0.3, 1.0)			
	R3	423	15314	2.0 (1.8, 2.3)	2.6 (2.3, 2.9)	3.1 (2.8, 3.4)	4.3 (3.6, 5.1)		
Profemur L	Dynasty	93	1889	3.6 (2.8, 4.5)	4.7 (3.8, 5.8)	5.3 (4.3, 6.6)			
	Procotyl L	22	1136	1.4 (0.8, 2.3)	2.2 (1.4, 3.4)	2.5 (1.6, 3.8)			
Quadra-H	Mpact	178	5390	2.1 (1.7, 2.5)	3.2 (2.8, 3.8)	4.5 (3.8, 5.4)			

Femoral Component	Acetabular Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
	Trident (Shell)	23	711	1.6 (0.9, 2.8)	2.8 (1.8, 4.3)	3.5 (2.3, 5.4)			
	Versafitcup CC	340	9848	1.8 (1.6, 2.1)	2.6 (2.3, 3.0)	3.2 (2.8, 3.6)	6.2 (5.2, 7.4)		
	Versafitcup DM	39	837	3.6 (2.5, 5.1)	5.2 (3.8, 7.1)	5.5 (4.0, 7.6)			
S-Rom	PINNACLE	222	3679	2.4 (2.0, 3.0)	4.0 (3.4, 4.7)	4.7 (4.0, 5.4)	6.2 (5.4, 7.1)	7.8 (6.7, 9.0)	
SL-Plus	EP-Fit Plus	48	1217	1.6 (1.0, 2.4)	2.1 (1.4, 3.1)	2.7 (1.9, 3.8)	3.8 (2.8, 5.1)		
	R3	107	1805	2.6 (1.9, 3.4)	4.0 (3.2, 5.0)	4.4 (3.5, 5.4)	6.6 (5.4, 8.0)		
Secur-Fit	Trident (Shell)	506	10447	1.9 (1.7, 2.2)	2.9 (2.6, 3.3)	3.6 (3.3, 4.0)	4.8 (4.3, 5.2)	6.2 (5.7, 6.9)	7.8 (6.7, 9.0)
Secur-Fit Plus	Trident (Shell)	256	6326	1.3 (1.0, 1.6)	2.0 (1.6, 2.3)	2.5 (2.1, 2.9)	3.5 (3.1, 4.1)	4.8 (4.2, 5.4)	5.9 (5.1, 6.9)
Summit	PINNACLE	178	5719	1.5 (1.2, 1.8)	2.1 (1.8, 2.6)	2.4 (2.0, 2.8)	3.5 (3.0, 4.1)	5.6 (4.5, 7.0)	
	PINNACLE*MoM	87	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)	11.4 (9.2, 14.1)	
Synergy	R3	177	5363	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)	422	7878	1.5 (1.3, 1.8)	2.3 (2.0, 2.7)	2.7 (2.3, 3.1)	4.0 (3.5, 4.4)	5.8 (5.2, 6.4)	8.8 (7.7, 10.1)
Taperloc	Continuum	17	778	1.7 (1.0, 2.9)	2.3 (1.4, 3.7)				
	G7	109	4194	2.2 (1.8, 2.7)	2.7 (2.2, 3.3)	2.9 (2.4, 3.6)			
Taperloc Microplasty	Continuum	18	571	2.8 (1.7, 4.5)	3.3 (2.1, 5.1)	3.3 (2.1, 5.1)			
	G7	36	3023	1.2 (0.9, 1.7)	1.3 (0.9, 1.8)	1.3 (0.9, 1.8)			
Tri-Fit TS	Trinity	96	4466	1.2 (0.9, 1.6)	2.0 (1.6, 2.5)	2.3 (1.8, 2.8)			
Tri-Lock	PINNACLE	32	1126	1.5 (1.0, 2.5)	2.4 (1.6, 3.5)	2.8 (1.9, 4.0)	3.3 (2.3, 4.8)		
VerSys	Trilogy*	266	4495	2.6 (2.2, 3.1)	3.4 (2.9, 4.0)	4.0 (3.5, 4.6)	5.3 (4.7, 6.1)	6.4 (5.7, 7.3)	7.2 (6.3, 8.1)
twinSys (cless)	RM Cup	50	1397	2.3 (1.6, 3.2)	3.1 (2.3, 4.2)	3.4 (2.6, 4.6)			
Other (576)		854	19102	2.6 (2.4, 2.9)	3.8 (3.5, 4.1)	4.4 (4.1, 4.7)	6.0 (5.6, 6.5)	7.6 (6.9, 8.5)	
TOTAL		**9134**	**259535**						

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 2021
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)	23	863	1.5 (0.9, 2.6)	2.3 (1.5, 3.6)	2.9 (1.8, 4.5)			
	Trinity	9	530	1.7 (0.9, 3.3)					
C-Stem AMT	PINNACLE	169	5952	1.5 (1.2, 1.9)	2.4 (2.0, 2.9)	3.3 (2.8, 3.8)	4.9 (4.0, 6.1)		
CPCS	R3	272	8043	2.1 (1.8, 2.5)	3.0 (2.6, 3.4)	3.4 (3.0, 3.9)	5.0 (4.3, 5.9)		
	Reflection (Shell)	130	3128	0.9 (0.6, 1.3)	1.3 (1.0, 1.8)	1.7 (1.3, 2.3)	3.7 (3.0, 4.5)	6.8 (5.6, 8.4)	
CPT	Allofit	60	1748	1.3 (0.9, 2.0)	1.9 (1.4, 2.7)	3.1 (2.3, 4.2)	5.2 (4.0, 6.9)	6.1 (4.5, 8.2)	
	Continuum	178	3362	2.9 (2.4, 3.5)	4.0 (3.4, 4.8)	4.7 (4.0, 5.5)	7.1 (5.9, 8.4)		
	G7	66	2249	3.0 (2.3, 3.9)	3.7 (2.8, 4.9)				
	Trabecular Metal (Shell)	126	2478	2.5 (1.9, 3.2)	3.5 (2.8, 4.3)	4.5 (3.7, 5.5)	6.5 (5.4, 7.9)	9.6 (7.4, 12.3)	
	Trilogy	442	8776	1.9 (1.6, 2.2)	2.8 (2.5, 3.2)	3.7 (3.3, 4.1)	5.6 (5.0, 6.1)	7.3 (6.5, 8.1)	8.1 (7.0, 9.3)
Evolve	Logical G	47	2167	1.6 (1.2, 2.3)	2.1 (1.5, 2.8)	2.5 (1.8, 3.4)			
Exeter V40	Fixa	29	810	2.1 (1.3, 3.4)	2.7 (1.8, 4.1)	3.0 (2.0, 4.5)			
	PINNACLE	70	2484	1.5 (1.1, 2.0)	2.0 (1.5, 2.7)	2.3 (1.7, 3.0)	4.2 (3.1, 5.5)		
	R3	98	2578	2.2 (1.7, 2.8)	3.0 (2.4, 3.8)	3.8 (3.1, 4.6)	4.4 (3.6, 5.4)		
	Trabecular Metal (Shell)	29	571	2.9 (1.8, 4.6)	3.5 (2.2, 5.4)	4.2 (2.8, 6.3)	6.0 (4.1, 8.6)		
	Trident (Shell)	2458	81158	1.3 (1.2, 1.4)	2.0 (1.9, 2.1)	2.5 (2.4, 2.7)	3.9 (3.7, 4.1)	5.6 (5.3, 5.9)	7.0 (6.3, 7.7)
	Trident/Tritanium (Shell)	183	5867	1.8 (1.5, 2.2)	2.6 (2.2, 3.1)	3.3 (2.8, 3.9)	4.6 (3.8, 5.6)		
	Trilogy*	20	604	1.7 (0.9, 3.1)	2.4 (1.4, 4.0)	2.6 (1.5, 4.2)	3.5 (2.2, 5.5)	3.9 (2.5, 6.0)	
MS 30	Allofit*	52	1336	1.1 (0.6, 1.8)	1.6 (1.0, 2.4)	2.2 (1.5, 3.1)	3.8 (2.8, 5.1)	6.5 (4.7, 9.0)	
	Continuum	19	933	1.6 (1.0, 2.7)	1.9 (1.2, 3.0)	2.1 (1.3, 3.4)			
	Fitmore	22	645	1.6 (0.9, 2.9)	2.1 (1.2, 3.6)	3.4 (2.1, 5.4)	4.4 (2.8, 6.8)	5.5 (3.2, 9.2)	
	G7	12	818	1.3 (0.7, 2.4)	2.0 (1.1, 3.8)				
Omnifit	Trident (Shell)	109	2989	1.8 (1.4, 2.3)	2.7 (2.2, 3.4)	3.0 (2.4, 3.7)	3.7 (3.0, 4.5)	4.7 (3.7, 5.8)	5.7 (4.3, 7.4)
Quadra-C	Mpact	52	3597	1.2 (0.9, 1.6)	1.7 (1.3, 2.3)	2.0 (1.4, 2.8)			
	Versafitcup CC	31	1619	1.6 (1.1, 2.3)	1.8 (1.2, 2.6)	2.0 (1.4, 3.0)			
Short Exeter V40	Trident (Shell)	55	3374	1.1 (0.8, 1.6)	1.8 (1.4, 2.4)	2.4 (1.8, 3.2)			
Spectron EF	R3	97	2334	1.7 (1.3, 2.4)	2.9 (2.2, 3.6)	3.7 (2.9, 4.6)	5.6 (4.5, 6.9)		
	Reflection (Shell)*	357	5203	1.1 (0.9, 1.5)	2.0 (1.6, 2.4)	2.8 (2.4, 3.3)	5.5 (4.8, 6.2)	9.4 (8.4, 10.6)	13.2 (11.4, 15.2)
Taper Fit	Trinity	77	3683	1.5 (1.2, 2.0)	2.4 (1.9, 3.1)	3.0 (2.3, 3.9)			
X-Acta	Mpact	12	637	1.7 (0.9, 3.1)	2.3 (1.3, 4.1)	2.3 (1.3, 4.1)			
	Versafitcup CC	9	671	0.9 (0.4, 2.1)	1.1 (0.5, 2.4)	1.7 (0.9, 3.3)			
twinSys (ctd)	RM Cup	13	561	2.0 (1.1, 3.6)	2.6 (1.5, 4.5)	2.6 (1.5, 4.5)			
Other (523)		384	9934	2.2 (1.9, 2.5)	3.2 (2.8, 3.6)	4.0 (3.6, 4.5)	6.0 (5.3, 6.8)	8.8 (7.4, 10.4)	
TOTAL		5710	171702						

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 2021
Only prostheses with >500 procedures have been listed

OUTCOME FOR OSTEOARTHRITIS - PATIENT CHARACTERISTICS

The following analyses have been undertaken excluding all procedures using metal/metal bearing surfaces. All other bearing surfaces are included in this analysis. Only procedures using prostheses that have been used in the past year have been included. The 20 year cumulative percent revision of primary total conventional hip replacement undertaken for osteoarthritis is 8.4% (Table HT14 and Figure HT5).

Reason for Revision

The Registry has decided to combine dislocation and instability together for the analyses as they both reflect a similar reason for revision. Periprosthetic joint infection is now the most common reason for revision of primary conventional hip replacement followed by dislocation/instability, fracture and loosening (Table HT15).

The most common reason for revision varies with time. In the first 11 years, dislocation/instability and infection are the most frequent reasons for revision. After 11 years, loosening is the predominant reason 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, patients 55-64 years after 6 months, and patients 65-74 years after 4 years (Table HT17 and Figure HT7).

Males have a higher rate of revision than females after 3 months. The cumulative percent revision at 20 years is 9.0% for males and 8.0% for females (Table HT18 and Figure HT8).
The Registry continues to report 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 compared to males aged 65-74 years in the first 4.5 years only. Compared to males aged <55 years, males aged ≥75 years do not have a significantly different rate of revision after the first 3 months (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 chapter. The Registry can now report on the outcome of 260,733 primary total conventional hip replacement procedures for osteoarthritis in relation to 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 HT19 and Figure HT13). The difference in revision rate for each ASA score is partially due to an increase in revision for infection with increasing ASA score (Figure HT14).

BMI data have been collected since 2015. The revision outcomes are reported for 214,613 primary total conventional hip replacement procedures for osteoarthritis. When compared to patients in the normal BMI class, there is no difference in the rate of revision for patients in the underweight or pre-obese classes. The rate of revision is increased for obese class 1 and obese class 3 compared to normal bodyweight, and for obese class 2 only for the first 18 months (Table HT20 and Figure HT15).

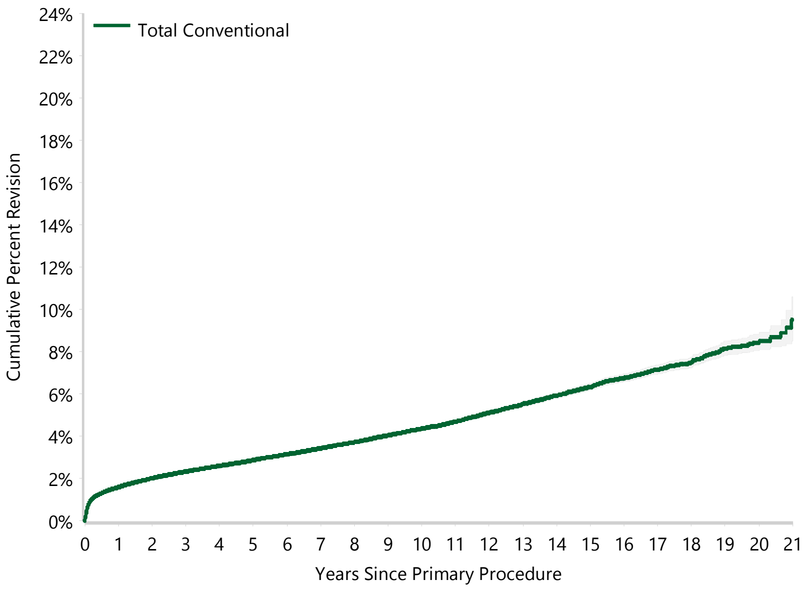
The most common reasons for revision are shown in Figure HT16. There is an increasing rate of revision for infection with increasing obesity classes. At 3 years, the cumulative incidence of infection is 2.1% for obese class 3 compared to 1.3% for obese class 2 and 0.8% for obese class 1. The cumulative incidence of infection for patients in obese class 3 is 6-fold compared to patients in the normal BMI class (Figure HT16).

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	13098	397261	1.6 (1.6, 1.6)	2.3 (2.3, 2.4)	2.9 (2.8, 2.9)	4.4 (4.3, 4.4)	6.3 (6.2, 6.5)	8.4 (8.1, 8.8)
TOTAL	13098	397261						

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	397261	352075	275373	204605	79576	21543	1383

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	2972	22.7
Prosthesis Dislocation/Instability	2879	22.0
Fracture	2856	21.8
Loosening	2753	21.0
Pain	255	1.9
Leg Length Discrepancy	229	1.7
Malposition	201	1.5
Lysis	164	1.3
Implant Breakage Stem	125	1.0
Implant Breakage Acetabular Insert	102	0.8
Incorrect Sizing	84	0.6
Wear Acetabular Insert	79	0.6
Metal Related Pathology	59	0.5
Implant Breakage Acetabular	46	0.4
Implant Breakage Head	23	0.2
Progression Of Disease	1	0.0
Other	270	2.1
TOTAL	13098	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	4330	33.1
Head/Insert	3203	24.5
Acetabular Component	2486	19.0
THR (Femoral/Acetabular)	1463	11.2
Head Only	652	5.0
Cement Spacer	506	3.9
Minor Components	228	1.7
Insert Only	131	1.0
Removal of Prostheses	70	0.5
Reinsertion of Components	19	0.1
Bipolar Head and Femoral	3	0.0
Bipolar Only	2	0.0
Total Femoral	2	0.0
Cement Only	1	0.0
Saddle	1	0.0
Head/Neck	1	0.0
TOTAL	13098	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)

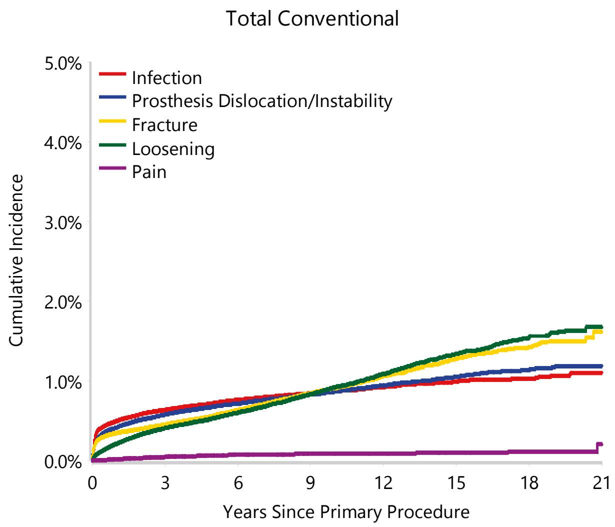
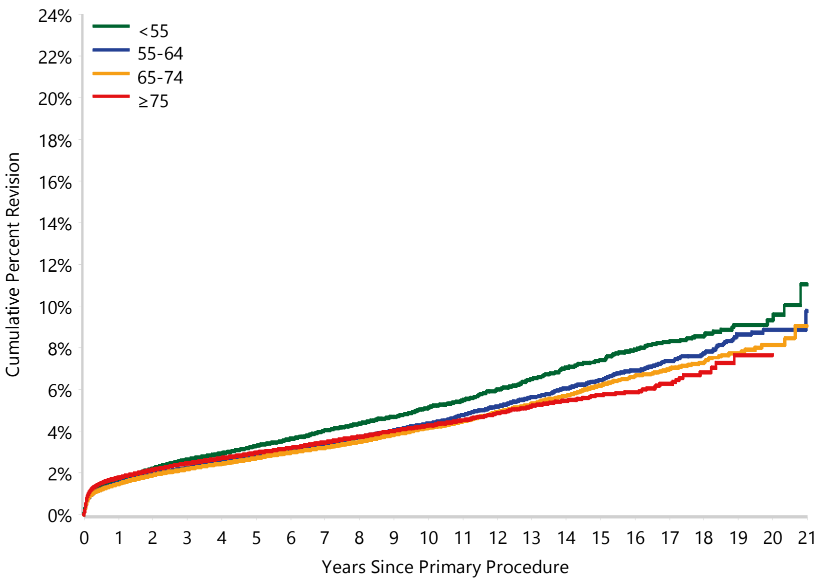


Table HT17 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Age (Primary Diagnosis OA)

Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
<55	1628	41405	1.6 (1.5, 1.8)	2.6 (2.5, 2.8)	3.3 (3.1, 3.5)	5.1 (4.8, 5.4)	7.4 (6.9, 7.9)	9.3 (8.5, 10.3)
55-64	3209	93581	1.5 (1.4, 1.6)	2.2 (2.1, 2.3)	2.8 (2.7, 2.9)	4.4 (4.2, 4.5)	6.4 (6.2, 6.8)	8.9 (8.2, 9.6)
65-74	4551	142728	1.5 (1.4, 1.5)	2.2 (2.1, 2.3)	2.7 (2.6, 2.8)	4.2 (4.0, 4.3)	6.2 (5.9, 6.5)	8.2 (7.6, 8.8)
≥75	3710	119547	1.8 (1.7, 1.8)	2.5 (2.4, 2.5)	3.0 (2.9, 3.1)	4.3 (4.1, 4.4)	5.7 (5.4, 6.1)	7.6 (6.6, 8.9)
TOTAL	13098	397261						

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 (0.90, 1.32), p=0.358
2Wk - 3Mth: HR=0.70 (0.62, 0.80), p<0.001
3Mth+: HR=1.33 (1.24, 1.43), p<0.001

55-64 vs ≥75
0 - 2Wk: HR=0.85 (0.73, 0.99), p=0.038
2Wk - 1Mth: HR=0.65 (0.57, 0.74), p<0.001
1Mth - 3Mth: HR=0.89 (0.78, 1.01), p=0.062
3Mth - 6Mth: HR=0.88 (0.74, 1.04), p=0.128
6Mth+: HR=1.13 (1.06, 1.20), p<0.001

65-74 vs ≥75
0 - 1Mth: HR=0.76 (0.69, 0.83), p<0.001
1Mth - 3Mth: HR=0.85 (0.76, 0.95), p=0.005
3Mth - 9Mth: HR=0.88 (0.79, 0.99), p=0.040
9Mth - 1.5Yr: HR=1.14 (1.01, 1.29), p=0.030
1.5Yr - 4Yr: HR=1.00 (0.92, 1.10), p=0.927
4Yr+: HR=1.08 (1.00, 1.17), p=0.039

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
<55	41405	36937	29415	22237	9052	3063	335
55-64	93581	83297	66263	50445	21935	6832	539
65-74	142728	127015	99676	74789	30549	8701	447
≥75	119547	104826	80019	57134	18040	2947	62

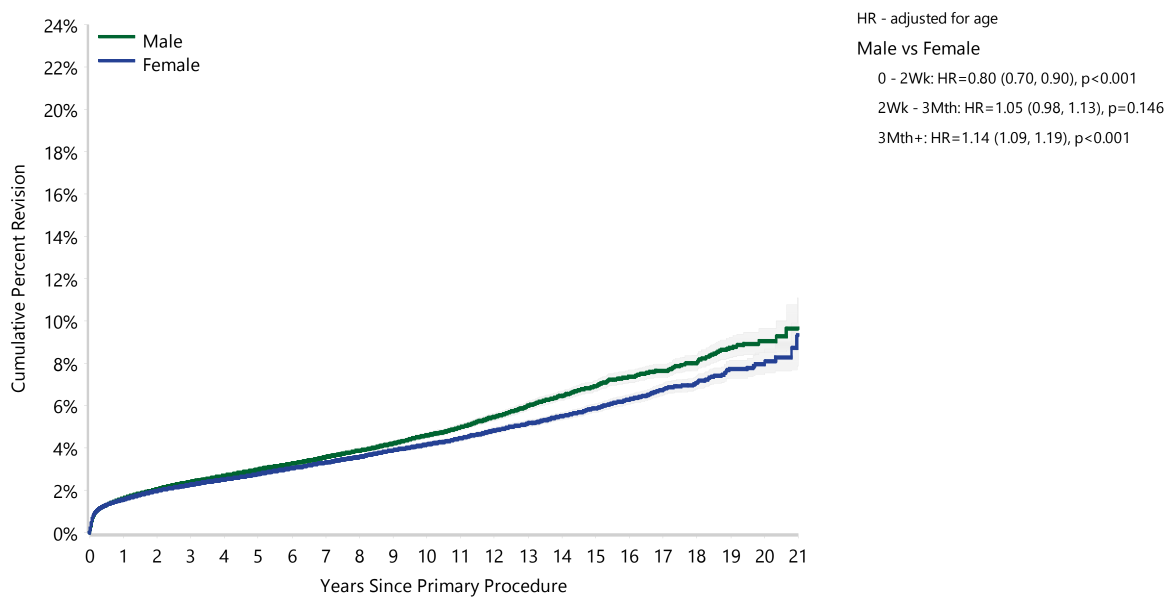
Note: Restricted to modern prostheses
All procedures using metal/metal prostheses have been excluded

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		**6204**	**182016**	**1.6 (1.6, 1.7)**	**2.4 (2.3, 2.5)**	**3.0 (2.9, 3.1)**	**4.6 (4.5, 4.7)**	**6.9 (6.7, 7.2)**	**9.0 (8.5, 9.6)**
	<55	868	23357	1.6 (1.4, 1.7)	2.5 (2.3, 2.8)	3.2 (2.9, 3.4)	4.9 (4.5, 5.3)	7.4 (6.7, 8.1)	9.3 (8.0, 10.7)
	55-64	1574	47203	1.5 (1.4, 1.6)	2.2 (2.1, 2.4)	2.7 (2.6, 2.9)	4.3 (4.0, 4.5)	6.7 (6.2, 7.1)	8.8 (7.9, 9.8)
	65-74	2118	64245	1.5 (1.4, 1.6)	2.2 (2.1, 2.3)	2.8 (2.7, 2.9)	4.4 (4.2, 4.6)	6.7 (6.3, 7.1)	9.0 (8.1, 10.0)
	≥75	1644	47211	1.9 (1.8, 2.1)	2.8 (2.6, 3.0)	3.4 (3.2, 3.6)	5.0 (4.8, 5.3)	7.2 (6.5, 7.8)	
Female		**6894**	**215245**	**1.6 (1.5, 1.6)**	**2.3 (2.2, 2.3)**	**2.8 (2.7, 2.8)**	**4.2 (4.1, 4.3)**	**5.9 (5.7, 6.1)**	**8.0 (7.5, 8.5)**
	<55	760	18048	1.8 (1.6, 2.0)	2.8 (2.5, 3.0)	3.5 (3.2, 3.8)	5.4 (4.9, 5.8)	7.5 (6.8, 8.3)	9.4 (8.3, 10.7)
	55-64	1635	46378	1.5 (1.4, 1.6)	2.3 (2.1, 2.4)	2.8 (2.7, 3.0)	4.5 (4.2, 4.7)	6.3 (5.9, 6.7)	9.0 (8.0, 10.0)
	65-74	2433	78483	1.5 (1.4, 1.5)	2.2 (2.1, 2.3)	2.6 (2.5, 2.8)	4.0 (3.8, 4.2)	5.8 (5.5, 6.1)	7.5 (6.8, 8.4)
	≥75	2066	72336	1.7 (1.6, 1.8)	2.2 (2.1, 2.4)	2.7 (2.5, 2.8)	3.8 (3.6, 4.0)	5.0 (4.6, 5.3)	6.9 (5.7, 8.5)
TOTAL		**13098**	**397261**						

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

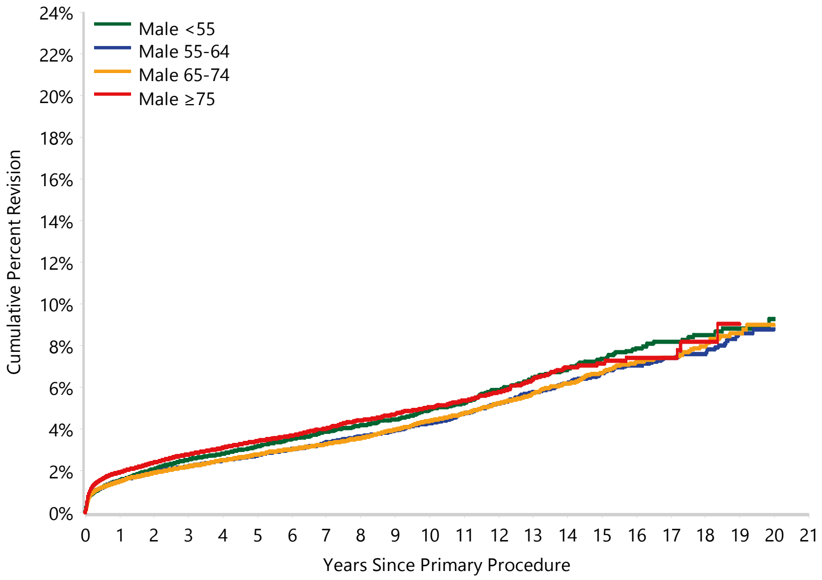
Figure HT8 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Gender (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Male	182016	160705	124724	91457	34075	9321	639
Female	215245	191370	150649	113148	45501	12222	744

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, 1.48), p=0.351
2Wk - 3Mth: HR=0.67 (0.56, 0.79), p<0.001
3Mth+: HR=1.02 (0.93, 1.12), p=0.721

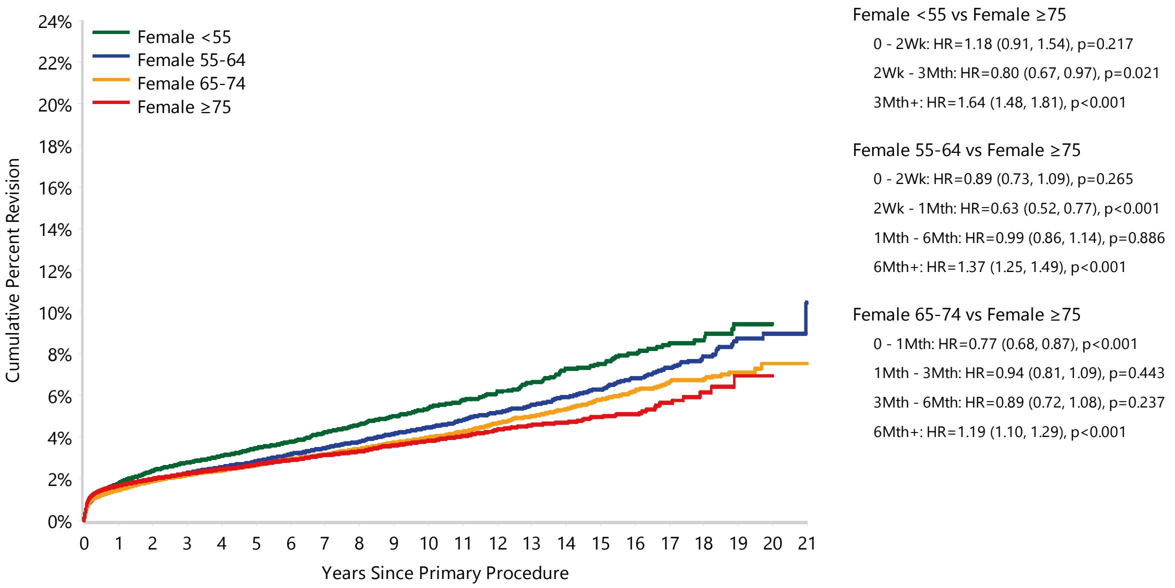
Male 55-64 vs Male ≥75
Entire Period: HR=0.83 (0.78, 0.89), p<0.001

Male 65-74 vs Male ≥75
0 - 1.5Yr: HR=0.81 (0.75, 0.88), p<0.001
1.5Yr - 4.5Yr: HR=0.81 (0.72, 0.92), p<0.001
4.5Yr+: HR=0.90 (0.81, 1.01), p=0.062

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Male	<55	23357	20788	16495	12242	4676	1585	177
	55-64	47203	41858	33004	24809	10273	3202	265
	65-74	64245	57116	44765	33426	13294	3686	178
	≥75	47211	40943	30460	20980	5832	848	19

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)



Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Female	<55	18048	16149	12920	9995	4376	1478	158
	55-64	46378	41439	33259	25636	11662	3630	274
	65-74	78483	69899	54911	41363	17255	5015	269
	≥75	72336	63883	49559	36154	12208	2099	43

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)

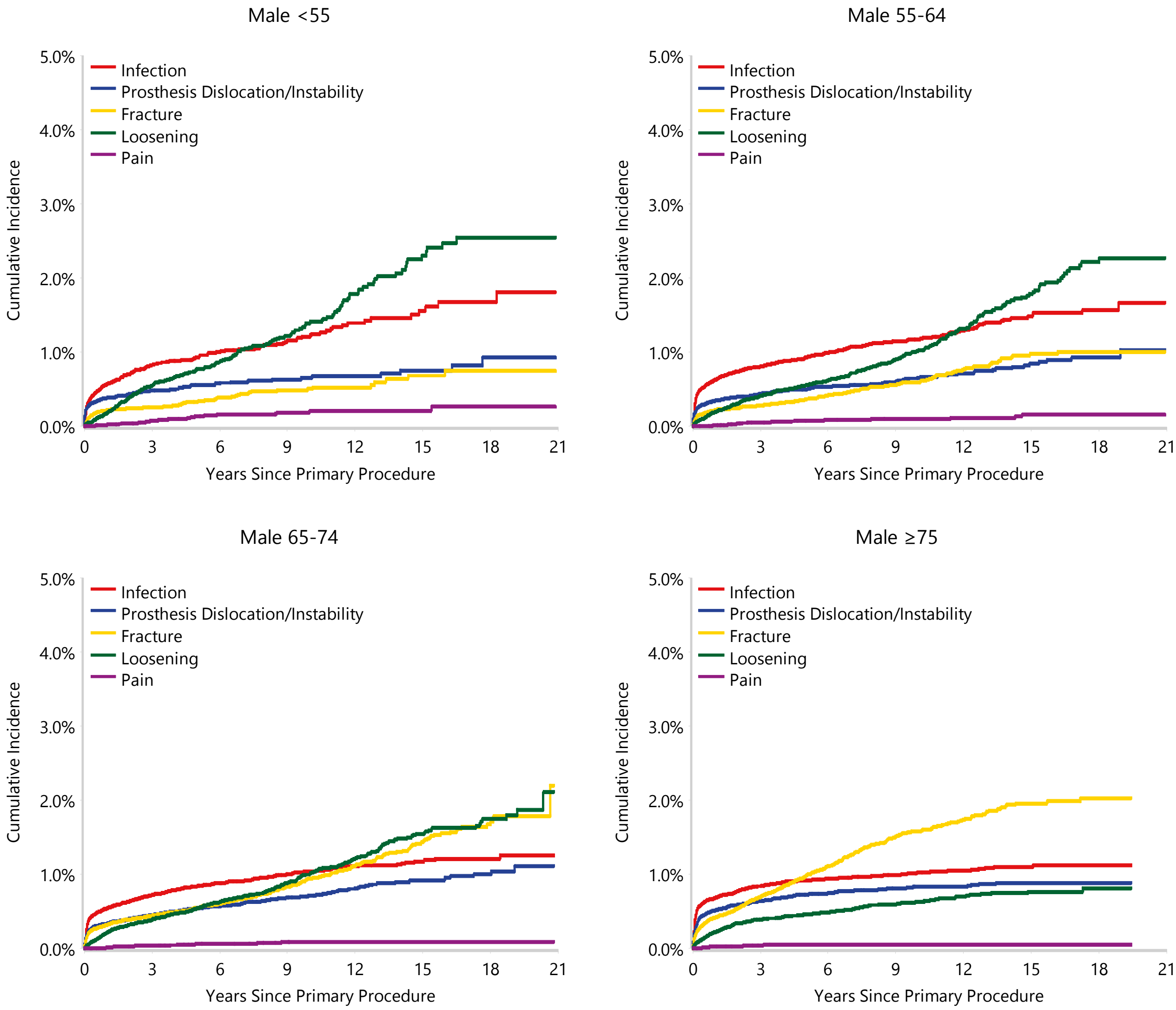
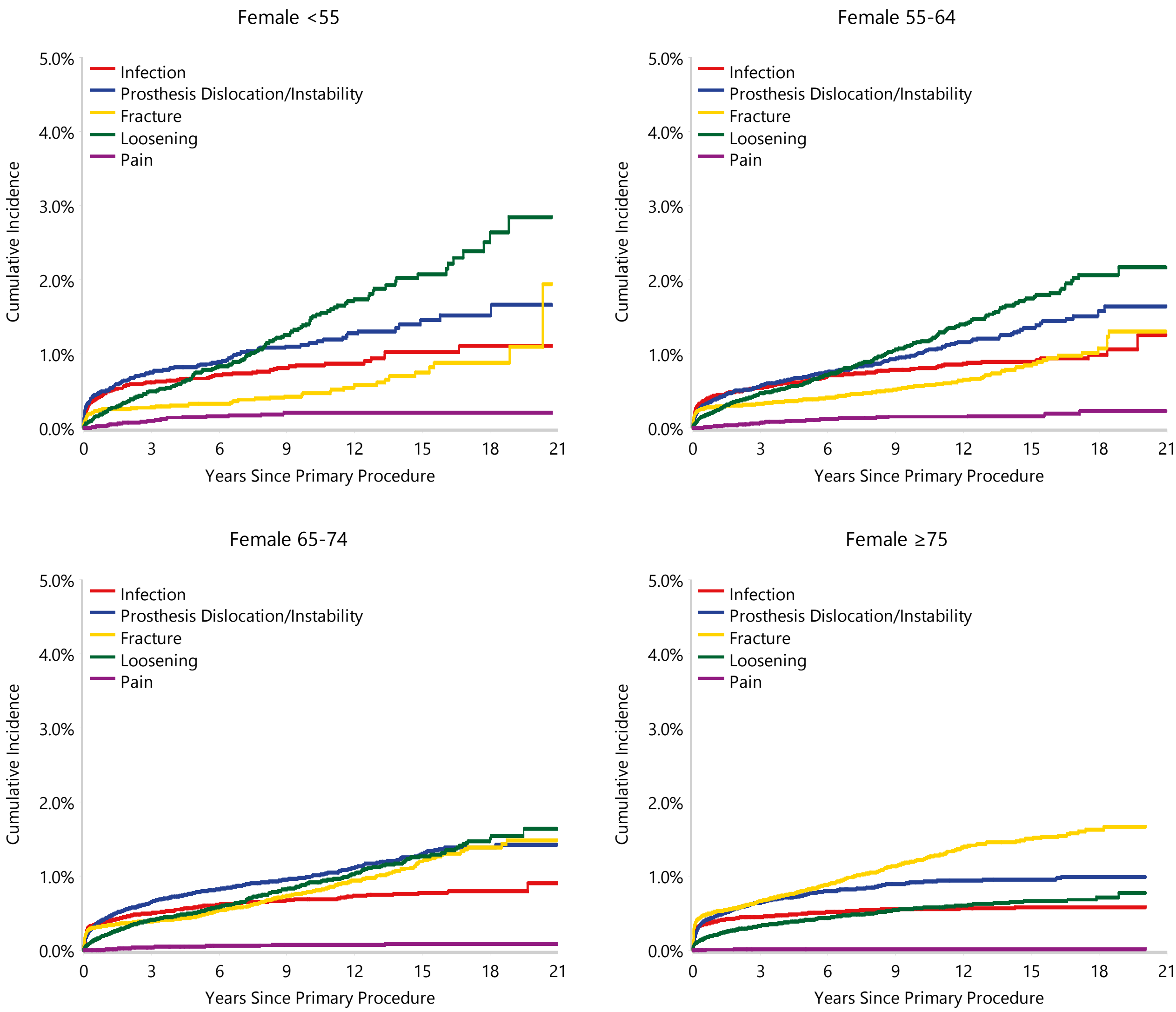


Figure HT12 Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement in Females by Age (Primary Diagnosis OA)



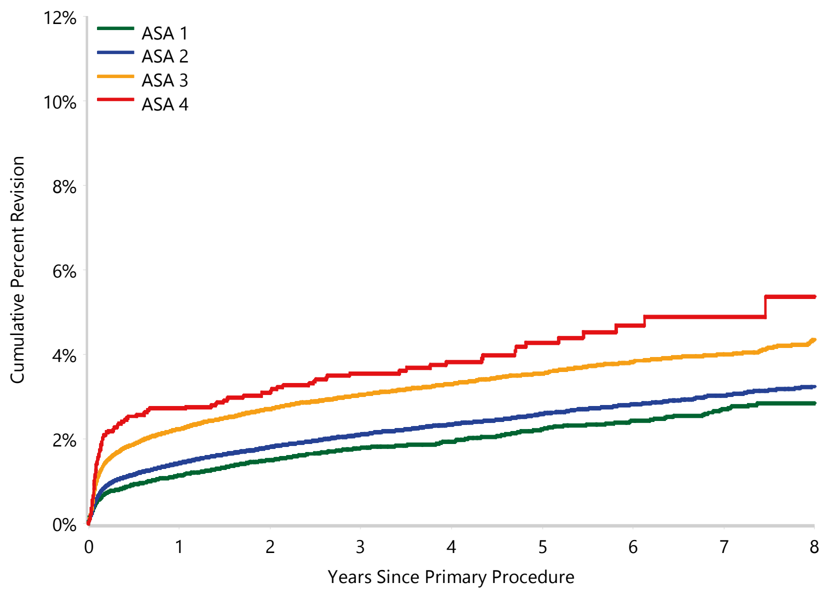
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

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	4 Yrs	6 Yrs	8 Yrs
ASA 1	462	23214	1.1 (1.0, 1.3)	1.5 (1.3, 1.7)	1.8 (1.6, 2.0)	1.9 (1.8, 2.1)	2.4 (2.2, 2.7)	2.8 (2.5, 3.2)
ASA 2	3195	142107	1.4 (1.4, 1.5)	1.8 (1.7, 1.9)	2.1 (2.0, 2.2)	2.3 (2.3, 2.4)	2.8 (2.7, 2.9)	3.2 (3.1, 3.4)
ASA 3	2808	91745	2.2 (2.1, 2.3)	2.7 (2.6, 2.8)	3.0 (2.9, 3.2)	3.3 (3.2, 3.4)	3.8 (3.7, 4.0)	4.3 (4.1, 4.6)
ASA 4	131	3655	2.7 (2.2, 3.3)	3.1 (2.6, 3.7)	3.6 (3.0, 4.3)	3.8 (3.2, 4.6)	4.7 (3.9, 5.7)	5.4 (4.2, 6.9)
ASA 5	1	12	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)	
TOTAL	6597	260733						

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

Figure HT13 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 (1.11, 1.36), p<0.001

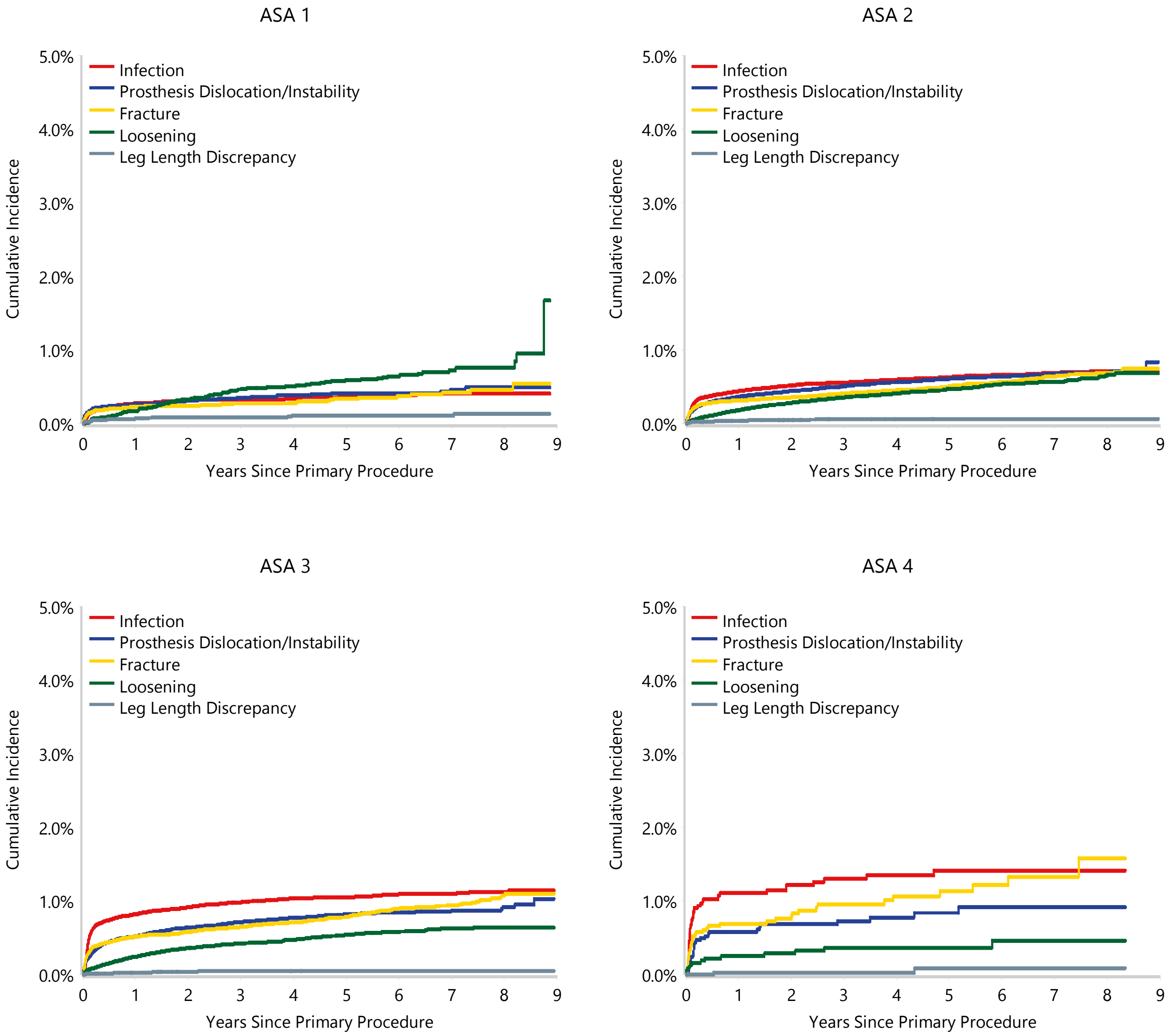
ASA 3 vs ASA 1
Entire Period: HR=1.81 (1.63, 2.00), p<0.001

ASA 4 vs ASA 1
Entire Period: HR=2.24 (1.84, 2.72), p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	6 Yrs	8 Yrs
ASA 1	23214	20319	17582	14759	11817	6142	1378
ASA 2	142107	120729	102077	83177	65438	32688	6741
ASA 3	91745	75056	61698	48126	35996	16276	3064
ASA 4	3655	2900	2361	1785	1295	531	97

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

Figure HT14 **Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement by ASA Score (Primary Diagnosis OA)**



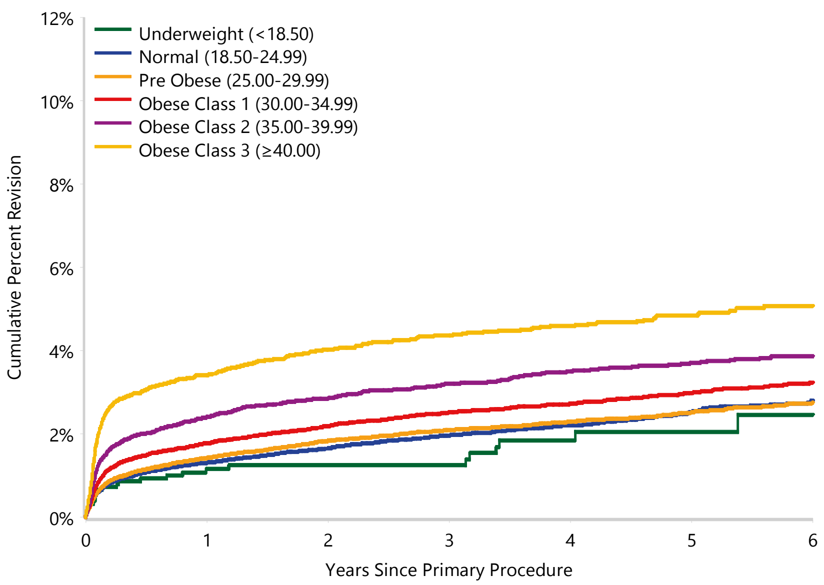
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

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	6 Yrs
Underweight (<18.50)	24	1539	1.2 (0.7, 1.9)	1.2 (0.8, 2.0)	1.2 (0.8, 2.0)	1.9 (1.2, 2.9)	2.1 (1.3, 3.2)	2.5 (1.5, 4.0)
Normal (18.50-24.99)	864	44311	1.3 (1.2, 1.4)	1.7 (1.5, 1.8)	2.0 (1.8, 2.1)	2.2 (2.1, 2.4)	2.5 (2.3, 2.7)	2.8 (2.6, 3.0)
Pre Obese (25.00-29.99)	1604	79070	1.4 (1.3, 1.5)	1.8 (1.7, 1.9)	2.1 (2.0, 2.2)	2.3 (2.2, 2.4)	2.5 (2.4, 2.7)	2.8 (2.6, 2.9)
Obese Class 1 (30.00-34.99)	1326	54930	1.8 (1.7, 1.9)	2.2 (2.1, 2.3)	2.5 (2.4, 2.7)	2.7 (2.6, 2.9)	3.0 (2.8, 3.2)	3.2 (3.0, 3.4)
Obese Class 2 (35.00-39.99)	724	23445	2.4 (2.2, 2.6)	2.9 (2.6, 3.1)	3.2 (3.0, 3.5)	3.5 (3.2, 3.8)	3.7 (3.4, 4.0)	3.9 (3.6, 4.2)
Obese Class 3 (≥40.00)	477	11318	3.4 (3.1, 3.8)	4.0 (3.7, 4.4)	4.4 (4.0, 4.8)	4.6 (4.2, 5.0)	4.8 (4.4, 5.3)	5.1 (4.6, 5.6)
TOTAL	**5019**	**214613**						

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 HT15 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=0.82 (0.55, 1.23), p=0.338

Pre Obese (25.00-29.99) vs Normal (18.50-24.99)
Entire Period: HR=1.03 (0.95, 1.12), p=0.498

Obese Class 1 (30.00-34.99) vs Normal (18.50-24.99)
0 - 3Mth: HR=1.38 (1.24, 1.54), p<0.001
3Mth+: HR=1.12 (1.01, 1.25), p=0.036

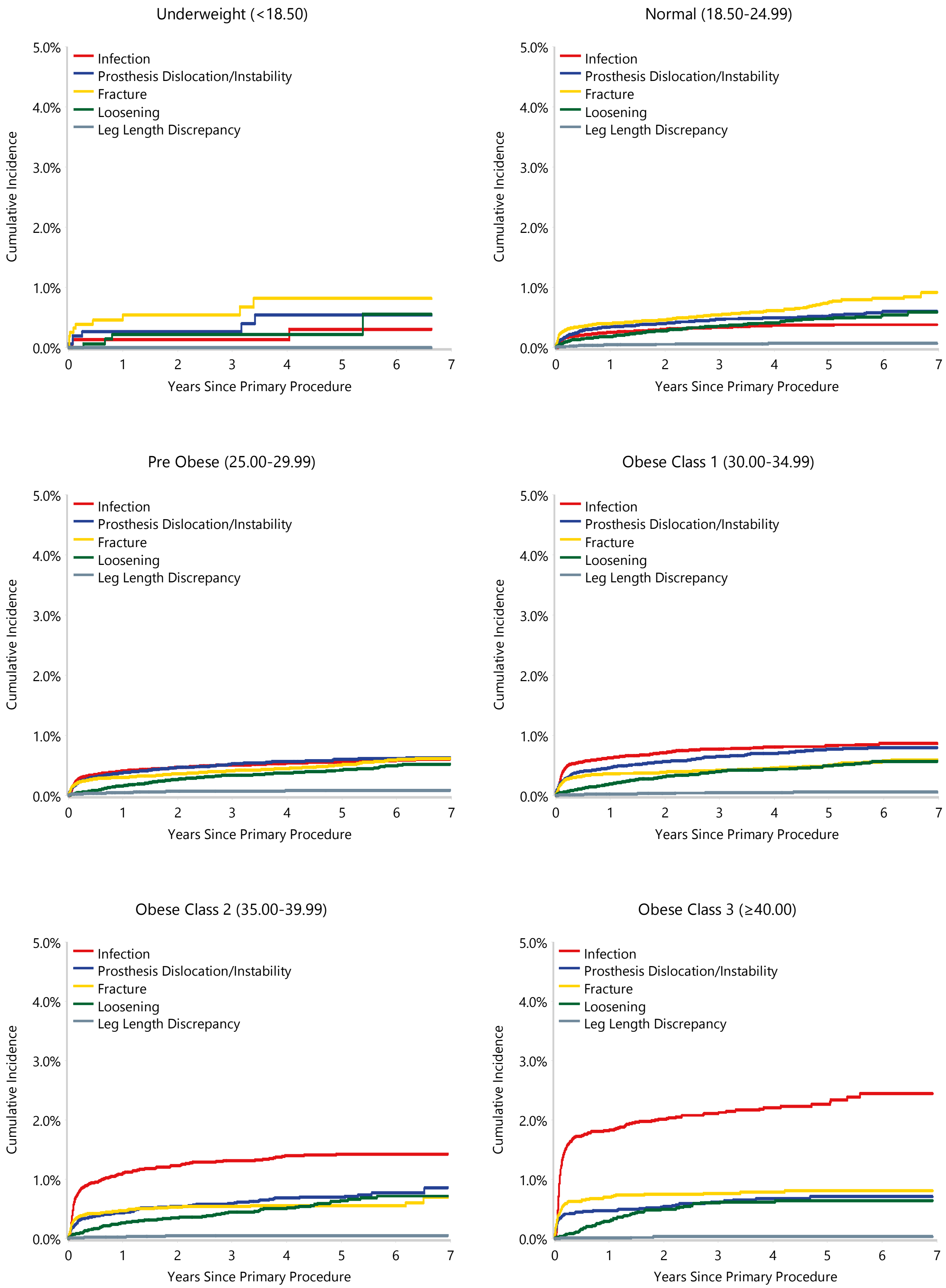
Obese Class 2 (35.00-39.99) vs Normal (18.50-24.99)
0 - 3Mth: HR=1.96 (1.73, 2.22), p<0.001
3Mth - 1.5Yr: HR=1.47 (1.25, 1.73), p<0.001
1.5Yr+: HR=1.12 (0.92, 1.37), p=0.253

Obese Class 3 (≥40.00) vs Normal (18.50-24.99)
0 - 3Mth: HR=3.16 (2.75, 3.62), p<0.001
3Mth+: HR=1.42 (1.19, 1.68), p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Underweight (<18.50)	1539	1223	987	713	504	303	135
Normal (18.50-24.99)	44311	36199	29072	21940	15439	9587	4331
Pre Obese (25.00-29.99)	79070	64796	52169	39486	27785	17235	7746
Obese Class 1 (30.00-34.99)	54930	44313	35610	26900	18825	11469	5103
Obese Class 2 (35.00-39.99)	23445	18873	15095	11304	7938	4840	2116
Obese Class 3 (≥40.00)	11318	9075	7343	5485	3852	2422	1086

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 HT16 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

PATIENT REPORTED OUTCOME MEASURES - PATIENT CHARACTERISTICS

EQ-VAS and EQ-5D-5L

Patient reported outcome measures (PROMs) are surveys that assess dimensions of health from the perspective of the patient.

In 2021, PROMs were introduced as a separate new chapter. This year, PROM information is included in the hip, knee and shoulder chapters to allow a more complete analysis of the influence of patient and prosthesis factors on joint replacement and patient-reported outcomes after joint replacement.

The EQ-VAS and EQ-5D-5L are measures of quality of life. EQ-VAS is a measure of patient reported health, and ranges from 0 (worst health imaginable) to 100 (best health imaginable). The mean EQ-VAS score increased by 14 points following total conventional hip replacement (Table HT21). The change in the distribution of EQ-VAS responses following surgery is shown in Figure HT17, and the change in each domain of the EQ-5D-5L is shown in Figure HT18.

Females aged <65 years have a slightly lower mean pre-operative EQ-VAS, but all groups have similar mean post-operative scores at 6 months after surgery (Table HT22 and Figure HT19).

The pre-operative mean EQ-VAS decreases with increasing ASA score, but the improvement in each group is similar (Table HT23 and Figure HT20).

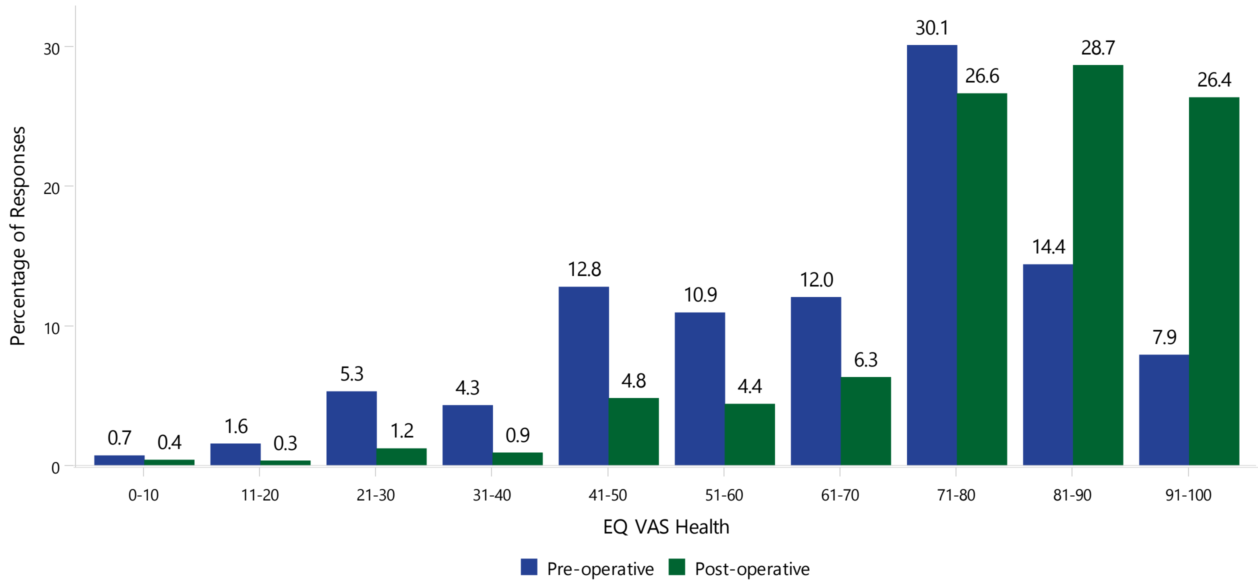
The mean pre-operative EQ-VAS assessment decreases with each increase in BMI category, apart from the underweight group where the number for assessment is small but post-operative improvements are similar (Table HT24 and Figure HT21).

Table HT21 Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Conventional Hip Replacement (Primary Diagnosis OA)

Class	Pre-operative			Post-operative		
	N	Mean±SD	Median (Q1, Q3)	N	Mean±SD	Median (Q1, Q3)
Total Conventional	13418	66.50±20.07	73.00 (51.00, 80.00)	8461	80.48±16.24	85.00 (75.00, 91.00)

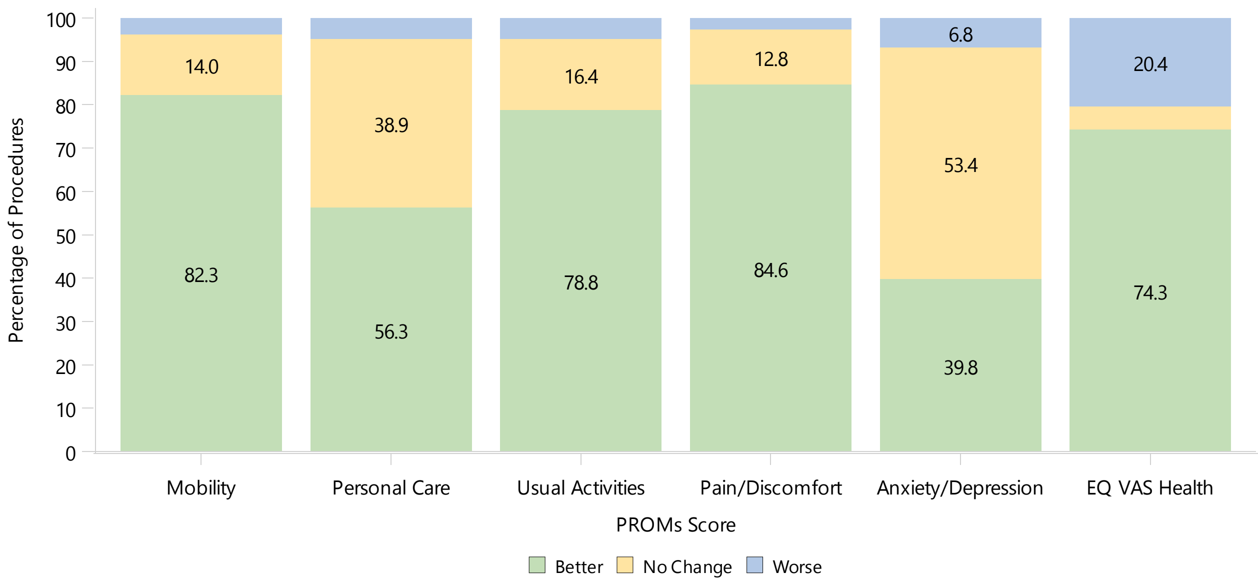
Note: Restricted to modern prostheses

Figure HT17 Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Conventional Hip Replacement (Primary Diagnosis OA)



Note: Restricted to modern prostheses

Figure HT18 Change in EQ-5D-5L Domain Score and EQ-VAS Health in Primary Total Conventional Hip Replacement (Primary Diagnosis OA)



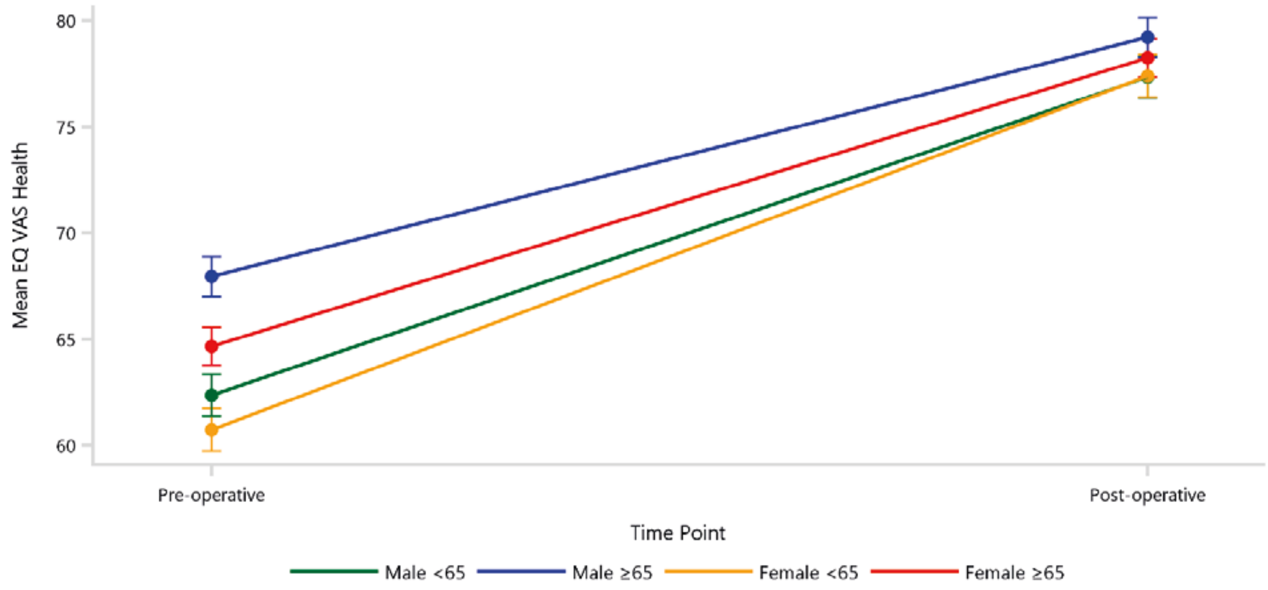
Note: Restricted to modern prostheses

Table HT22 Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Conventional Hip Replacement by Gender and Age (Primary Diagnosis OA)

Gender	Age	Pre-operative N	Pre-operative Mean (95% CI)	Post-operative N	Post-operative Mean (95% CI)	Change in Score
Male	<65	2866	62.37 (61.39, 63.34)	1750	77.34 (76.36, 78.33)	14.98 (14.07, 15.89)
Male	≥65	3403	67.94 (67.00, 68.88)	2167	79.21 (78.27, 80.15)	11.27 (10.44, 12.09)
Female	<65	2572	60.74 (59.73, 61.74)	1630	77.40 (76.39, 78.41)	16.66 (15.72, 17.61)
Female	≥65	4577	64.67 (63.78, 65.56)	2914	78.24 (77.35, 79.13)	13.57 (12.86, 14.28)

Note: Restricted to modern prostheses
Adjusted for ASA score and BMI category

Figure HT19 Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Conventional Hip Replacement by Gender and Age (Primary Diagnosis OA)



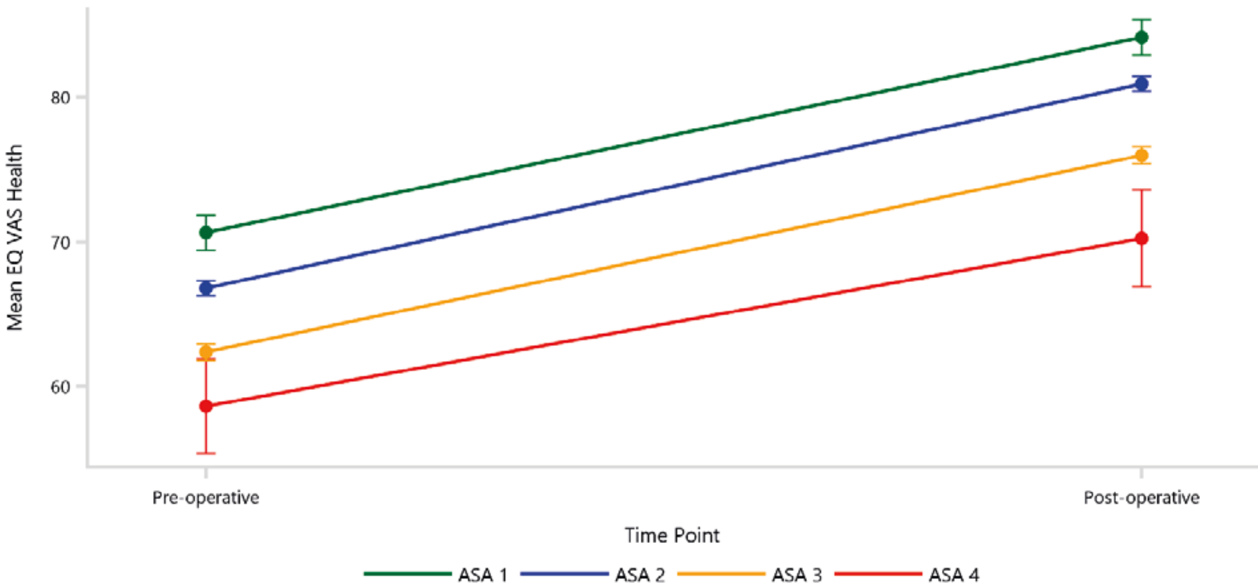
Note: Restricted to modern prostheses
Adjusted for ASA score and BMI category

Table HT23 Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Conventional Hip Replacement by ASA Score (Primary Diagnosis OA)

ASA Score	Pre-operative		Post-operative		
	N	Mean (95% CI)	N	Mean (95% CI)	Change in Score
ASA 1	1130	70.61 (69.39, 71.83)	684	84.11 (82.88, 85.35)	13.50 (12.05, 14.95)
ASA 2	7558	66.77 (66.26, 67.29)	4811	80.91 (80.39, 81.42)	14.13 (13.58, 14.69)
ASA 3	4579	62.35 (61.77, 62.93)	2877	75.96 (75.37, 76.54)	13.61 (12.89, 14.32)
ASA 4	139	58.62 (55.35, 61.89)	84	70.22 (66.86, 73.58)	11.60 (7.44, 15.76)

Note: Restricted to modern prostheses
Adjusted for age, gender and BMI category

Figure HT20 Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Conventional Hip Replacement by ASA Score (Primary Diagnosis OA)



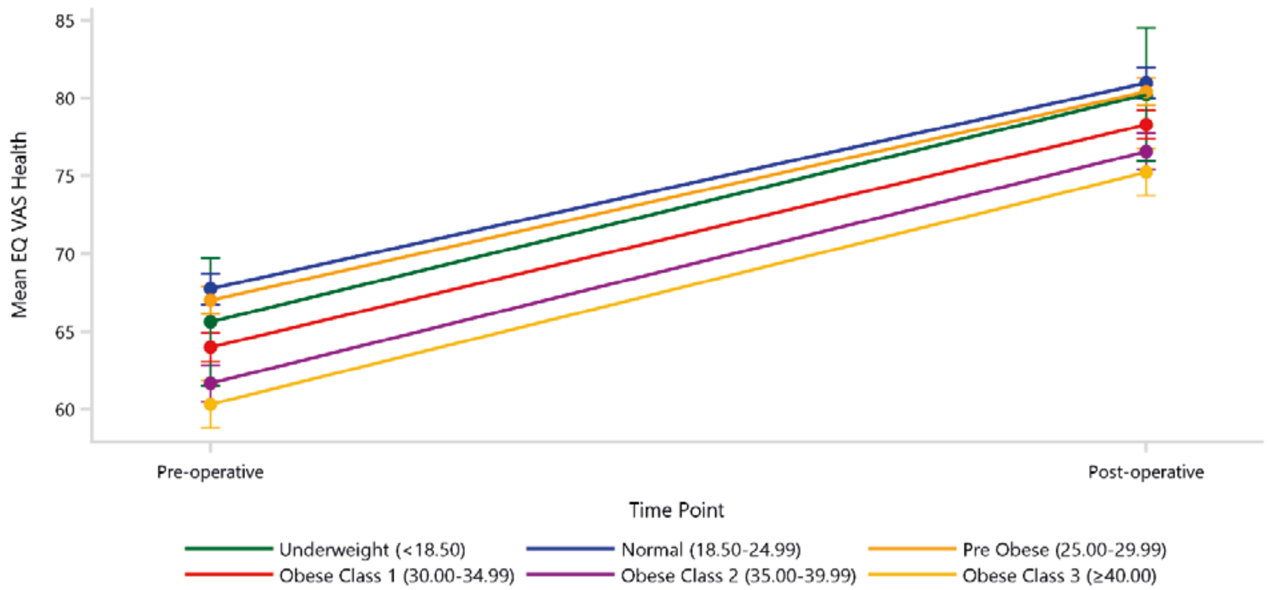
Note: Restricted to modern prostheses
Adjusted for age, gender and BMI category

Table HT24 Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Conventional Hip Replacement by BMI Category (Primary Diagnosis OA)

BMI Category	Pre-operative		Post-operative		
	N	Mean (95% CI)	N	Mean (95% CI)	Change in Score
Underweight (<18.50)	89	65.61 (61.51, 69.72)	52	80.22 (75.94, 84.49)	14.60 (9.39, 19.82)
Normal (18.50-24.99)	2619	67.72 (66.73, 68.72)	1702	80.97 (79.98, 81.97)	13.25 (12.32, 14.19)
Pre Obese (25.00-29.99)	4786	67.01 (66.15, 67.87)	2973	80.39 (79.52, 81.26)	13.38 (12.68, 14.08)
Obese Class 1 (30.00-34.99)	3521	63.98 (63.05, 64.90)	2193	78.29 (77.36, 79.22)	14.31 (13.50, 15.13)
Obese Class 2 (35.00-39.99)	1521	61.65 (60.46, 62.83)	983	76.56 (75.38, 77.74)	14.91 (13.69, 16.14)
Obese Class 3 (≥40.00)	765	60.32 (58.78, 61.85)	488	75.23 (73.70, 76.76)	14.91 (13.18, 16.65)

Note: Restricted to modern prostheses
Adjusted for age, gender and ASA score
BMI has not been presented for patients ≤19 years

Figure HT21 Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Conventional Hip Replacement by BMI Category (Primary Diagnosis OA)



Note: Restricted to modern prostheses
Adjusted for age, gender and ASA score
BMI has not been presented for patients ≤19 years

Oxford Scores

The Oxford Hip Score (OHS) is a joint specific assessment of pain and function. The OHS totals the responses from 12 questions, each on a 5-level scale of 0 (worst possible score) to 4 (best possible score). The mean pre-operative OHS is 20.7 and this improves to 41.2 post-operatively. The minimal clinically important change for the OHS is at least 5 points (Table HT25).

Similar to the EQ-VAS, females aged <65 years have the lowest pre-operative OHS but all groups have similar improvements with males having slightly higher scores (Table HT26 and Figure HT22).

The pre-operative mean OHS decreases with increasing ASA score, but the improvement in each group is similar (Table HT27 and Figure HT23).

The mean pre-operative OHS decreases with each increase in BMI category, apart from the underweight group where the number for assessment is small, but post-operative improvements are similar. Patients in obese class 3 have the largest change (Table HT28 and Figure HT24).

Table HT25 Mean Pre-operative and Post-operative Oxford Hip Score in Primary Total Conventional Hip Replacement (Primary Diagnosis OA)

Class	Pre-operative			Post-operative		
	N	Mean±SD	Median (Q1, Q3)	N	Mean±SD	Median (Q1, Q3)
Total Conventional	13409	20.69±8.92	21.00 (14.00, 27.00)	8484	41.24±7.44	44.00 (38.00, 47.00)

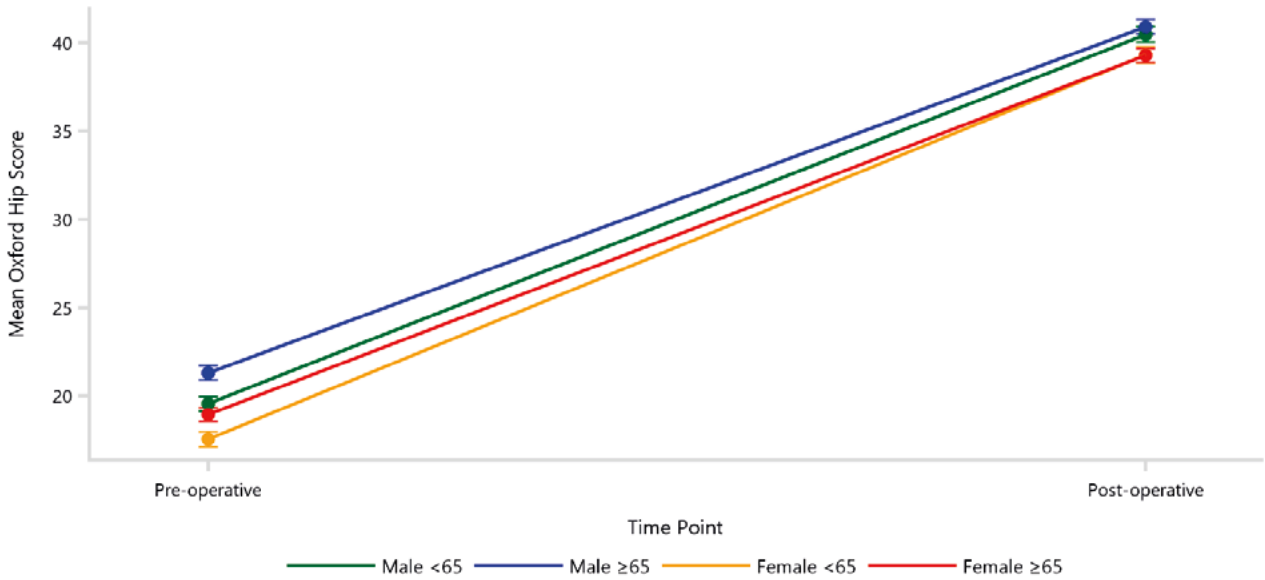
Note: Restricted to modern prostheses

Table HT26 Mean Pre-operative and Post-operative Oxford Hip Score in Primary Total Conventional Hip Replacement by Gender and Age (Primary Diagnosis OA)

		Pre-operative		Post-operative		
Gender	Age	N	Mean (95% CI)	N	Mean (95% CI)	Change in Score
Male	<65	2868	19.54 (19.12, 19.97)	1753	40.46 (40.02, 40.90)	20.91 (20.49, 21.33)
Male	≥65	3393	21.31 (20.90, 21.71)	2182	40.89 (40.48, 41.31)	19.59 (19.21, 19.97)
Female	<65	2571	17.55 (17.11, 17.99)	1628	39.31 (38.86, 39.76)	21.76 (21.32, 22.20)
Female	≥65	4577	18.94 (18.55, 19.33)	2921	39.27 (38.88, 39.67)	20.33 (20.00, 20.66)

Note: Restricted to modern prostheses
Adjusted for ASA score and BMI category

Figure HT22 Mean Pre-operative and Post-operative Oxford Hip Score in Primary Total Conventional Hip Replacement by Gender and Age (Primary Diagnosis OA)



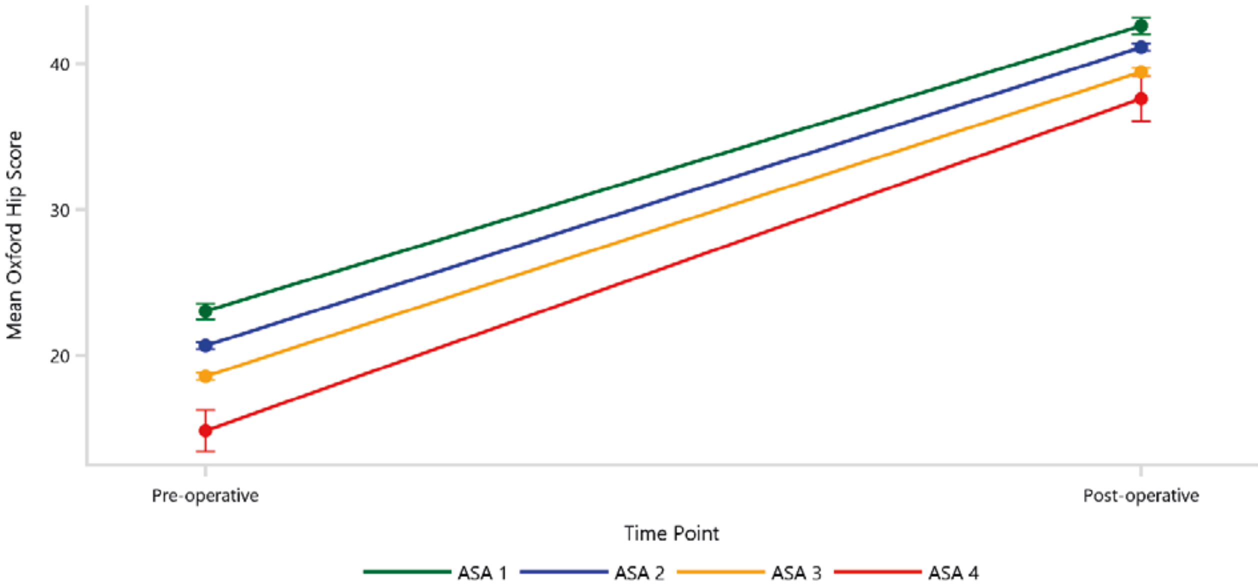
Note: Restricted to modern prostheses
Adjusted for ASA score and BMI category

Table HT27 Mean Pre-operative and Post-operative Oxford Hip Score in Primary Total Conventional Hip Replacement by ASA Score (Primary Diagnosis OA)

ASA Score	Pre-operative		Post-operative		
	N	Mean (95% CI)	N	Mean (95% CI)	Change in Score
ASA 1	1129	23.02 (22.49, 23.55)	687	42.58 (42.02, 43.14)	19.56 (18.89, 20.23)
ASA 2	7553	20.67 (20.44, 20.89)	4830	41.12 (40.89, 41.35)	20.45 (20.20, 20.71)
ASA 3	4575	18.58 (18.32, 18.83)	2879	39.44 (39.17, 39.71)	20.86 (20.53, 21.19)
ASA 4	140	14.85 (13.43, 16.27)	84	37.59 (36.05, 39.13)	22.73 (20.82, 24.65)

Note: Restricted to modern prostheses
Adjusted for age, gender and BMI category

Figure HT23 Mean Pre-operative and Post-operative Oxford Hip Score in Primary Total Conventional Hip Replacement by ASA Score (Primary Diagnosis OA)



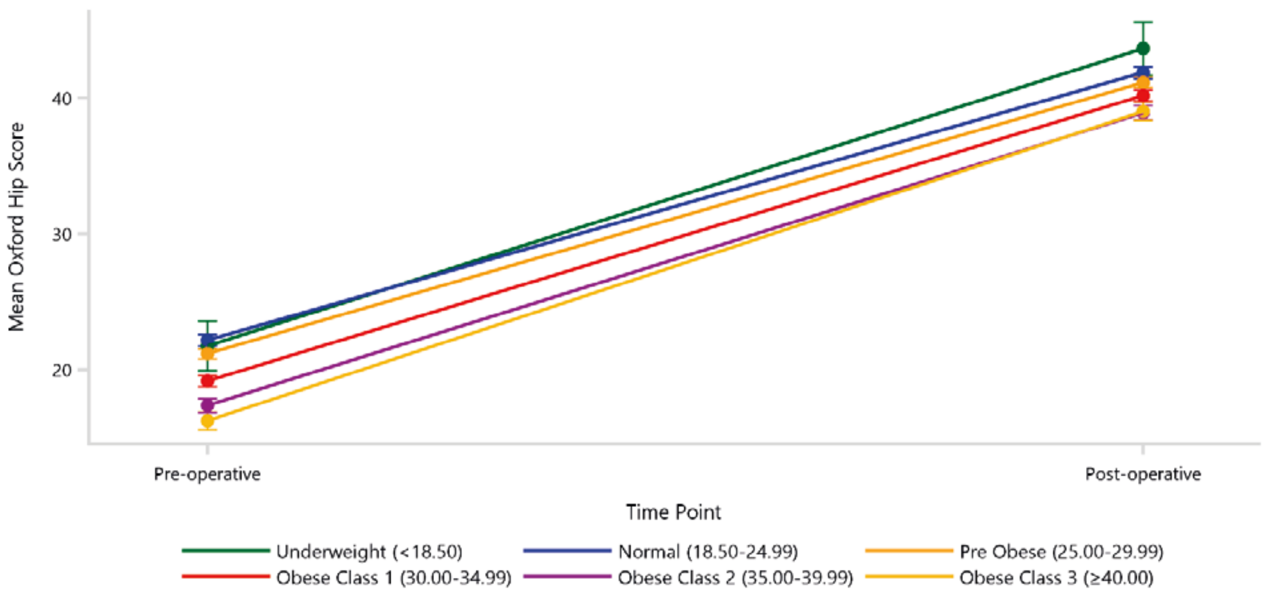
Note: Restricted to modern prostheses
Adjusted for age, gender and BMI category

Table HT28 **Mean Pre-operative and Post-operative Oxford Hip Score in Primary Total Conventional Hip Replacement by BMI Category (Primary Diagnosis OA)**

BMI Category	Pre-operative		Post-operative		
	N	Mean (95% CI)	N	Mean (95% CI)	Change in Score
Underweight (<18.50)	84	21.75 (19.92, 23.59)	52	43.62 (41.66, 45.57)	21.86 (19.42, 24.30)
Normal (18.50-24.99)	2618	22.16 (21.72, 22.59)	1713	41.86 (41.41, 42.30)	19.70 (19.27, 20.13)
Pre Obese (25.00-29.99)	4787	21.17 (20.80, 21.55)	2986	41.13 (40.75, 41.52)	19.96 (19.64, 20.28)
Obese Class 1 (30.00-34.99)	3517	19.15 (18.75, 19.55)	2196	40.15 (39.74, 40.57)	21.00 (20.63, 21.38)
Obese Class 2 (35.00-39.99)	1514	17.36 (16.84, 17.87)	981	38.91 (38.38, 39.44)	21.56 (20.99, 22.12)
Obese Class 3 (≥40.00)	771	16.22 (15.55, 16.88)	487	39.02 (38.32, 39.71)	22.80 (22.00, 23.60)

Note: Restricted to modern prostheses
Adjusted for age, gender and ASA score

Figure HT24 **Mean Pre-operative and Post-operative Oxford Hip Score in Primary Total Conventional Hip Replacement by BMI Category (Primary Diagnosis OA)**



Note: Restricted to modern prostheses
Adjusted for age, gender and ASA score

PROMs: Patient Satisfaction and Change

Patients were surveyed at 6 months post-operatively on how satisfied they were with their primary total conventional hip replacement, and on their perceived change in their hip after surgery. There are 89.2% of patients who are either very satisfied or satisfied (Table HT29 and Figure HT25).

Age and gender have minimal effect on the proportion of patients who are satisfied. However, in general there is a larger percentage of younger patients who are very satisfied (Table HT30 and Figure HT26).

There is a high percentage (96.4%) of patients who rate their hip as much better or a little better (Table HT31 and Figure HT27).

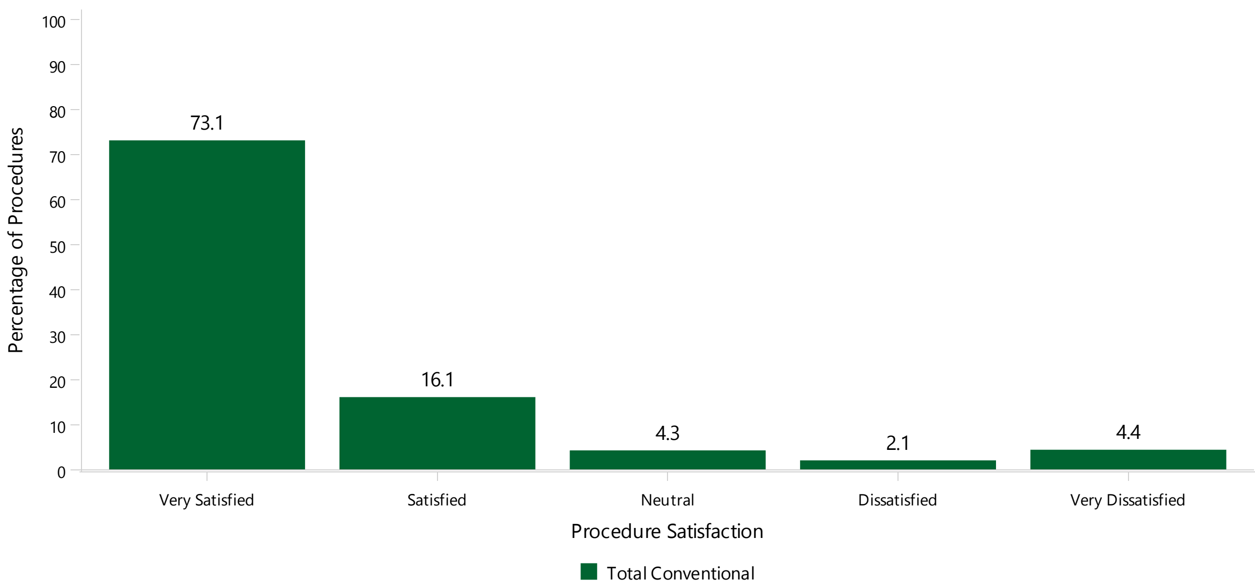
Patient-reported change by age and gender are presented in Table HT32 and Figure HT28.

Table HT29 Procedure Satisfaction in Primary Total Conventional Hip Replacement (Primary Diagnosis OA)

Class	Very Satisfied		Satisfied		Neutral		Dissatisfied		Very Dissatisfied		TOTAL	
	N	Row%	N	Row%	N	Row%	N	Row%	N	Row%	N	Row%
Total Conventional	6195	73.1	1365	16.1	361	4.3	175	2.1	375	4.4	8471	100.0

Note: Restricted to modern prostheses

Figure HT25 Procedure Satisfaction in Primary Total Conventional Hip Replacement (Primary Diagnosis OA)



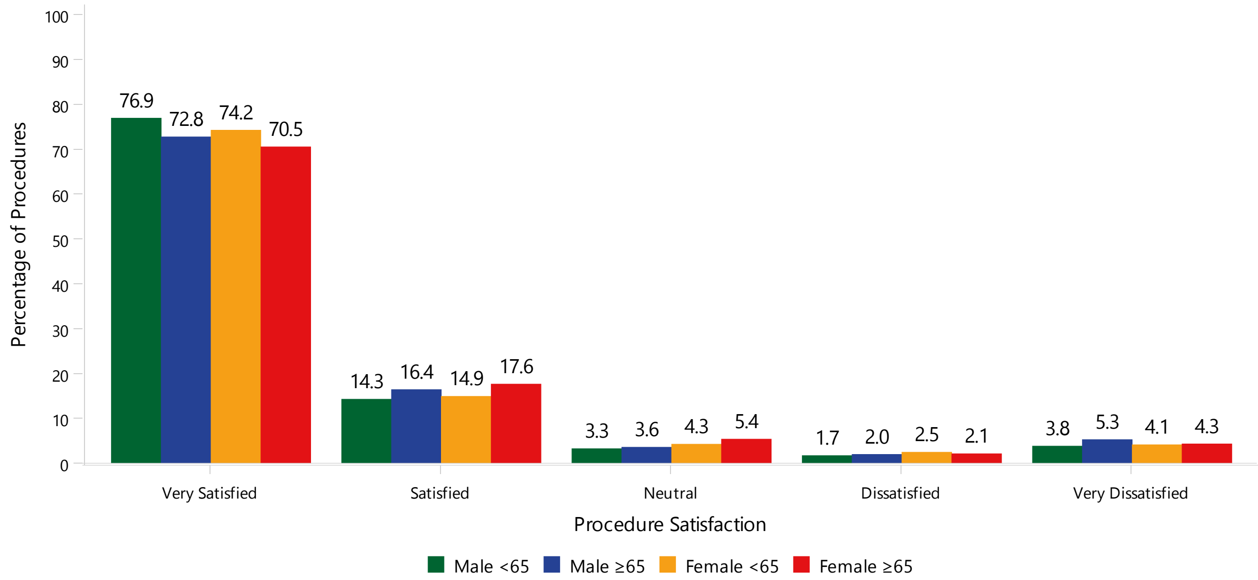
Note: Restricted to modern prostheses

Table HT30 Procedure Satisfaction in Primary Total Conventional Hip Replacement by Gender and Age (Primary Diagnosis OA)

		Very Satisfied			Satisfied			Neutral			Dissatisfied			Very Dissatisfied			TOTAL		
Gender	Age	N	Row %	Col%	N	Row %	Col%	N	Row %	Col%	N	Row %	Col%	N	Row %	Col%	N	Row %	Col%
Male	<65	1347	76.9	21.7	250	14.3	18.3	57	3.3	15.8	30	1.7	17.1	67	3.8	17.9	1751	100.0	20.7
	≥65	1586	72.8	25.6	358	16.4	26.2	78	3.6	21.6	43	2.0	24.6	115	5.3	30.7	2180	100.0	25.7
Female	<65	1204	74.2	19.4	242	14.9	17.7	69	4.3	19.1	40	2.5	22.9	67	4.1	17.9	1622	100.0	19.1
	≥65	2058	70.5	33.2	515	17.6	37.7	157	5.4	43.5	62	2.1	35.4	126	4.3	33.6	2918	100.0	34.4
TOTAL		**6195**	**73.1**	**100.0**	**1365**	**16.1**	**100.0**	**361**	**4.3**	**100.0**	**175**	**2.1**	**100.0**	**375**	**4.4**	**100.0**	**8471**	**100.0**	**100.0**

Note: Restricted to modern prostheses

Figure HT26 Procedure Satisfaction in Primary Total Conventional Hip Replacement by Gender and Age (Primary Diagnosis OA)



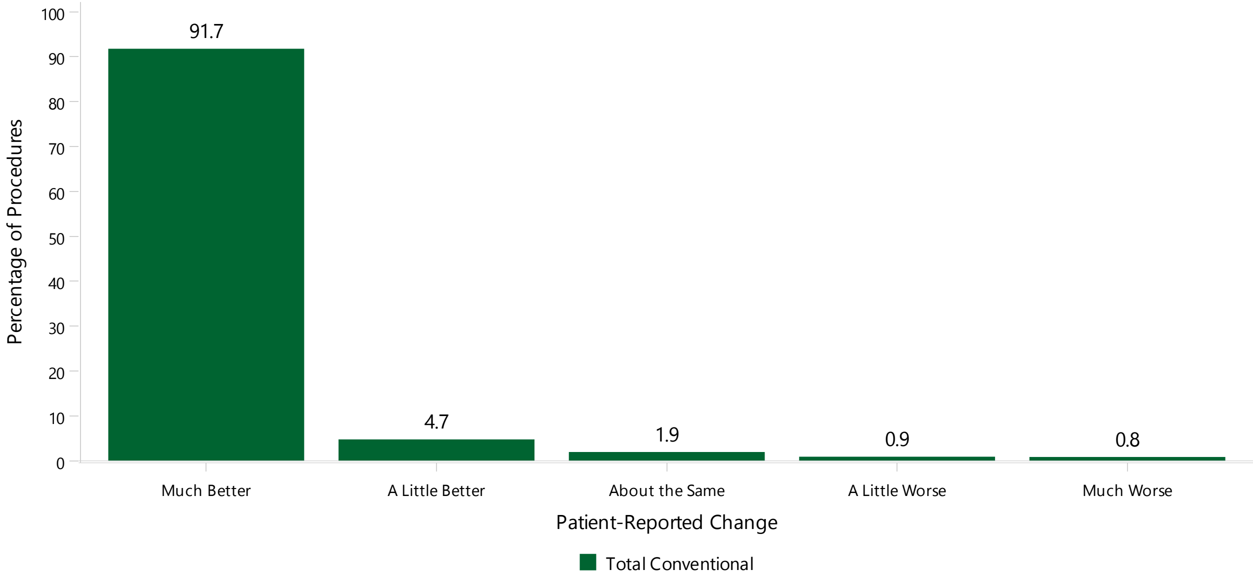
Note: Restricted to modern prostheses

Table HT31 Patient-Reported Change in Primary Total Conventional Hip Replacement (Primary Diagnosis OA)

Class	Much Better		A Little Better		About the Same		A Little Worse		Much Worse		TOTAL	
	N	Row%	N	Row%	N	Row%	N	Row%	N	Row%	N	Row%
Total Conventional	7768	91.7	400	4.7	161	1.9	73	0.9	68	0.8	8470	100.0

Note: Restricted to modern prostheses

Figure HT27 Patient-Reported Change in Primary Total Conventional Hip Replacement (Primary Diagnosis OA)



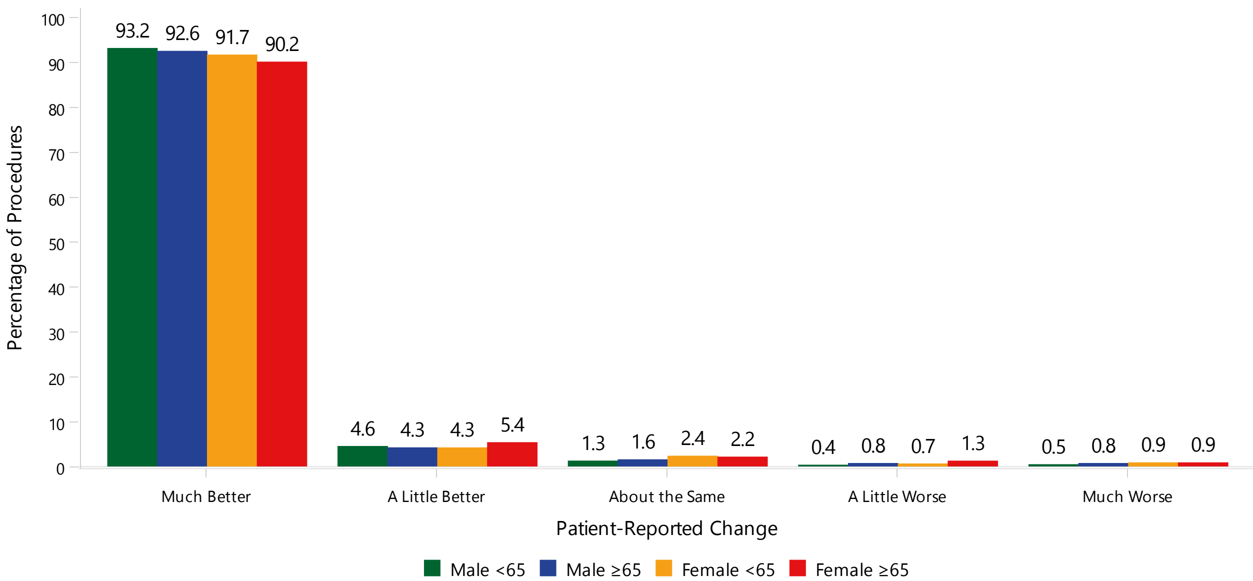
Note: Restricted to modern prostheses

Table HT32 Patient-Reported Change in Primary Total Conventional Hip Replacement by Gender and Age (Primary Diagnosis OA)

		Much Better			A Little Better			About the Same			A Little Worse			Much Worse			TOTAL		
Gender	Age	N	Row %	Col%	N	Row %	Col%	N	Row %	Col%	N	Row %	Col%	N	Row %	Col%	N	Row %	Col%
Male	<65	1632	93.2	21.0	80	4.6	20.0	23	1.3	14.3	7	0.4	9.6	9	0.5	13.2	1751	100.0	20.7
	≥65	2018	92.6	26.0	93	4.3	23.3	35	1.6	21.7	17	0.8	23.3	17	0.8	25.0	2180	100.0	25.7
Female	<65	1488	91.7	19.2	69	4.3	17.3	39	2.4	24.2	11	0.7	15.1	15	0.9	22.1	1622	100.0	19.1
	≥65	2630	90.2	33.9	158	5.4	39.5	64	2.2	39.8	38	1.3	52.1	27	0.9	39.7	2917	100.0	34.4
TOTAL		**7768**	**91.7**	**100.0**	**400**	**4.7**	**100.0**	**161**	**1.9**	**100.0**	**73**	**0.9**	**100.0**	**68**	**0.8**	**100.0**	**8470**	**100.0**	**100.0**

Note: Restricted to modern prostheses

Figure HT28 Patient-Reported Change in Primary Total Conventional Hip Replacement by Gender and Age (Primary Diagnosis OA)



Note: Restricted to modern prostheses

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 2021. These bearing surfaces include mixed ceramic/mixed ceramic and all femoral head materials used in conjunction with cross-linked polyethylene (XLPE). Modern bearing surfaces account for 96.8% of all primary total conventional hip procedures performed in 2021.

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 in the first 1.5 years 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 HT33 and Figure HT29).

The outcome with respect to fixation varies with age.

For patients aged <55 years, there is no difference in the rate of revision when comparing fixation methods. 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 in the first 1.5 years for patients aged 65-74 years when compared to hybrid fixation. 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 HT34 and Figure HT30 to Figure HT33).

PROMs and Femoral Fixation

PROMs have been analysed with respect to the method of femoral fixation when only cementless acetabular inserts were used. When patient age was assessed, there was a slightly lower change in EQ-VAS for cementless femoral fixation for patients aged ≥75 years but for patients aged <75 years there was no difference (Table HT35 and Figure HT34). There were no differences in the pre- to post-operative change in OHS scores with regards to age and femoral fixation (Table HT36 and Figure HT35). Satisfaction and patient-reported change were similar for both cemented and cementless femoral fixation irrespective of age (Table HT37, Figure HT36, Table HT38 and Figure HT37).

Mini Stems

The Registry defines a mini stem as a short cementless femoral stem where fixation is designed to be entirely metaphyseal. These stems may enable femoral neck sparing. There have been 7,528 procedures using a mini stem prosthesis undertaken for osteoarthritis. This represents <1.9% of all primary total conventional hip procedures. There were 1,504 procedures recorded in 2021 using a mini stem prosthesis. This is an increase of 10.9% compared to 2020. The 8 year cumulative percent revision for primary total conventional hip replacement using a mini stem is 2.8% compared to 3.7% for other femoral stems. Mini stems have a reduced rate of revision after 6 months (Table HT39 and Figure HT38). There is an increased cumulative incidence of fracture and loosening for procedures using a mini stem compared to other femoral stems at 1 year (0.6% compared to 0.3%, and 0.4% compared to 0.2%, respectively) (Figure HT39). The types of revision are presented in Table HT40.
The Registry has information on 6 different mini stem prostheses. Rates of revision vary depending on the type of prosthesis (Table HT41).

Femoral Stems with Exchangeable Necks

A femoral stem with an exchangeable neck has a separate neck that connects proximally to the stem. The Registry has only recorded 33 procedures reported in 2021 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'.

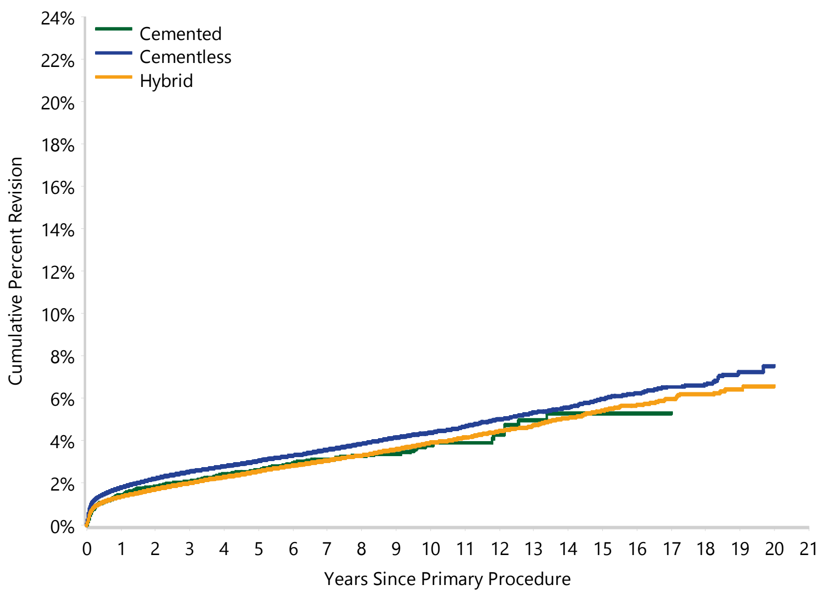
Detailed information on femoral stems with exchangeable necks is available in the supplementary report 'Prosthesis Types with No or Minimal Use' on the AOANJRR website: https://aoanjrr.sahmri.com/annual-reports-2022

Table HT33 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	206	7346	1.4 (1.2, 1.7)	2.1 (1.8, 2.4)	2.6 (2.3, 3.0)	3.8 (3.2, 4.5)	5.3 (4.1, 6.7)	
Cementless	7020	220214	1.8 (1.7, 1.8)	2.5 (2.5, 2.6)	3.0 (3.0, 3.1)	4.4 (4.3, 4.5)	6.0 (5.7, 6.2)	7.5 (6.8, 8.3)
Hybrid	3788	133701	1.3 (1.3, 1.4)	2.0 (1.9, 2.1)	2.5 (2.5, 2.6)	3.9 (3.8, 4.0)	5.4 (5.2, 5.7)	6.6 (6.0, 7.1)
TOTAL	**11014**	**361261**						

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

Figure HT29 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Fixation (Primary Diagnosis OA)



HR - adjusted for age and gender

Cemented vs Hybrid
Entire Period: HR=1.01 (0.88, 1.16), p=0.886

Cementless vs Hybrid
0 - 2Wk: HR=2.18 (1.87, 2.55), p<0.001
2Wk - 1Mth: HR=1.32 (1.18, 1.48), p<0.001
1Mth - 1.5Yr: HR=1.16 (1.08, 1.24), p<0.001
1.5Yr+: HR=1.03 (0.97, 1.09), p=0.374

Cementless vs Cemented
0 - 2Wk: HR=2.16 (1.77, 2.65), p<0.001
2Wk - 1Mth: HR=1.31 (1.10, 1.56), p=0.002
1Mth+: HR=1.07 (0.93, 1.24), p=0.324

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Cemented	7346	6683	5365	4063	960	184	0
Cementless	220214	192608	146865	104450	34489	7025	198
Hybrid	133701	118723	92380	68795	25731	6165	224

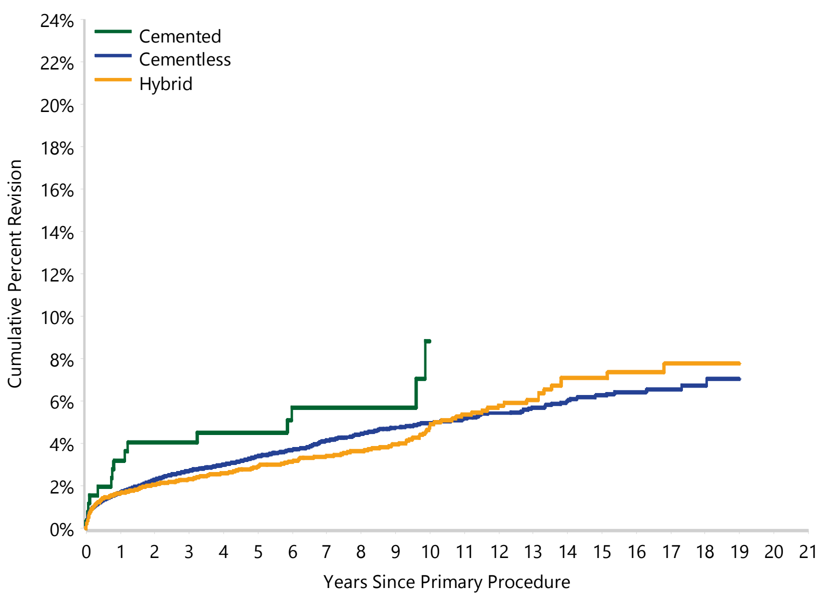
Note: Includes mixed ceramic/mixed ceramic and cross-linked polyethylene (XLPE) bearing surfaces
Restricted to modern prostheses

Table HT34 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		**1295**	**36766**	**1.7 (1.6, 1.8)**	**2.6 (2.5, 2.8)**	**3.3 (3.1, 3.5)**	**4.9 (4.6, 5.3)**	**6.5 (6.0, 7.1)**	**7.2 (6.5, 8.1)**
	Cemented	16	257	3.2 (1.6, 6.3)	4.0 (2.2, 7.4)	4.5 (2.5, 8.0)	8.8 (4.9, 15.8)		
	Cementless	1042	29549	1.7 (1.6, 1.9)	2.7 (2.5, 2.9)	3.4 (3.2, 3.6)	4.9 (4.6, 5.3)	6.3 (5.7, 6.9)	
	Hybrid	237	6960	1.7 (1.4, 2.0)	2.3 (2.0, 2.7)	2.9 (2.5, 3.4)	4.8 (4.1, 5.6)	7.1 (5.9, 8.5)	
55-64		**2623**	**84099**	**1.6 (1.5, 1.7)**	**2.3 (2.2, 2.4)**	**2.8 (2.7, 2.9)**	**4.2 (4.1, 4.4)**	**5.9 (5.6, 6.2)**	**7.5 (6.7, 8.3)**
	Cemented	28	763	1.9 (1.1, 3.1)	2.6 (1.6, 4.0)	2.9 (1.9, 4.4)	3.8 (2.6, 5.7)	6.4 (3.8, 10.7)	
	Cementless	1893	62350	1.6 (1.5, 1.7)	2.3 (2.2, 2.5)	2.8 (2.7, 3.0)	4.1 (3.9, 4.4)	5.7 (5.3, 6.1)	7.4 (6.4, 8.5)
	Hybrid	702	20986	1.4 (1.3, 1.6)	2.1 (1.9, 2.3)	2.7 (2.5, 3.0)	4.5 (4.1, 4.9)	6.2 (5.6, 6.9)	7.8 (6.8, 9.1)
65-74		**3797**	**130937**	**1.5 (1.4, 1.5)**	**2.2 (2.1, 2.2)**	**2.7 (2.6, 2.8)**	**3.9 (3.8, 4.1)**	**5.5 (5.2, 5.7)**	**6.8 (6.0, 7.6)**
	Cemented	67	2254	1.3 (0.9, 1.9)	1.9 (1.4, 2.6)	2.5 (1.9, 3.2)	4.1 (3.1, 5.4)	5.8 (3.9, 8.5)	
	Cementless	2388	81132	1.6 (1.6, 1.7)	2.3 (2.2, 2.5)	2.8 (2.7, 2.9)	4.0 (3.8, 4.2)	5.5 (5.2, 5.9)	7.1 (5.7, 8.8)
	Hybrid	1342	47551	1.2 (1.1, 1.3)	1.9 (1.7, 2.0)	2.4 (2.3, 2.6)	3.8 (3.5, 4.0)	5.3 (4.9, 5.7)	6.4 (5.6, 7.4)
≥75		**3299**	**109459**	**1.8 (1.7, 1.9)**	**2.4 (2.4, 2.5)**	**2.9 (2.8, 3.1)**	**4.2 (4.0, 4.3)**	**5.6 (5.3, 6.0)**	
	Cemented	95	4072	1.3 (1.0, 1.7)	1.9 (1.5, 2.4)	2.6 (2.1, 3.2)	3.0 (2.4, 3.7)		
	Cementless	1697	47183	2.3 (2.2, 2.4)	3.0 (2.9, 3.2)	3.5 (3.3, 3.7)	4.9 (4.6, 5.2)	7.1 (6.4, 7.8)	
	Hybrid	1507	58204	1.4 (1.3, 1.5)	2.0 (1.9, 2.1)	2.5 (2.4, 2.7)	3.7 (3.4, 3.9)	4.7 (4.4, 5.1)	
TOTAL		**11014**	**361261**						

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

Figure HT30 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=1.61 (0.97, 2.67), p=0.064

Cemented vs Cementless

Entire Period: HR=1.51 (0.92, 2.48), p=0.100

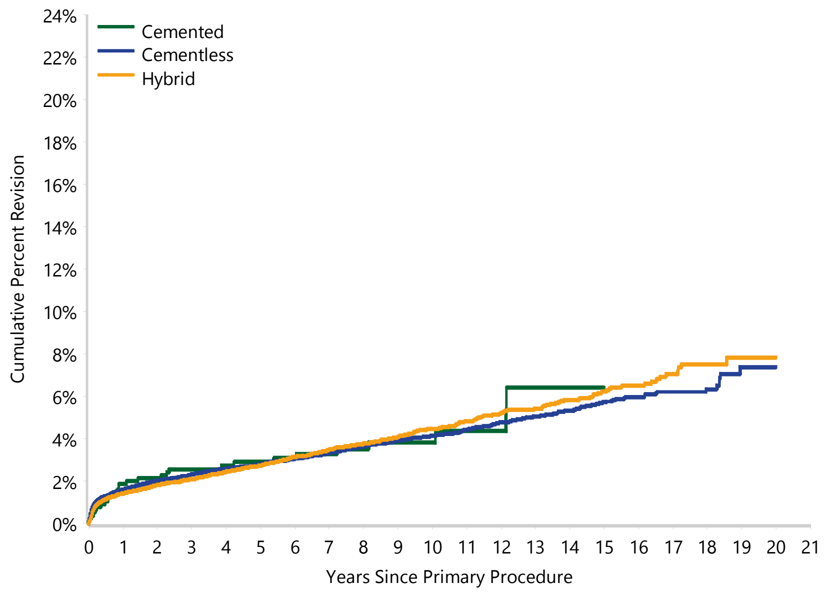
Cementless vs Hybrid

Entire Period: HR=1.07 (0.92, 1.23), p=0.380

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Cemented	257	232	210	176	50	13	0
Cementless	29549	26042	20201	14640	4957	1146	34
Hybrid	6960	6209	4869	3647	1275	367	28

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

Figure HT31 **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=1.00 (0.68, 1.46), p=0.995

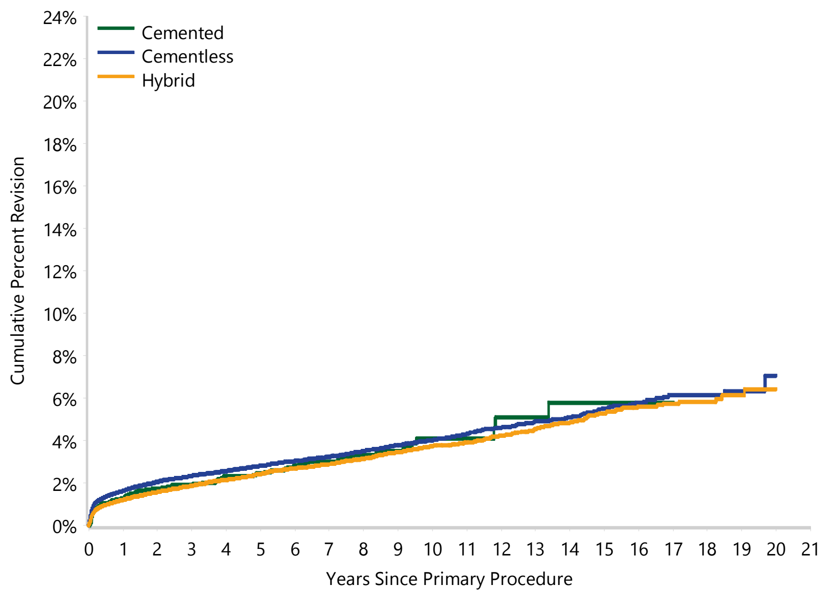
Cemented vs Cementless
Entire Period: HR=1.03 (0.71, 1.50), p=0.874

Cementless vs Hybrid
0 - 1Mth: HR=1.81 (1.43, 2.30), p<0.001
1Mth+: HR=0.87 (0.80, 0.96), p=0.005

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Cemented	763	725	633	541	181	49	0
Cementless	62350	54704	42217	30659	11001	2405	75
Hybrid	20986	18761	14918	11447	4800	1416	69

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

Figure HT32 **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=1.06 (0.83, 1.36), p=0.632

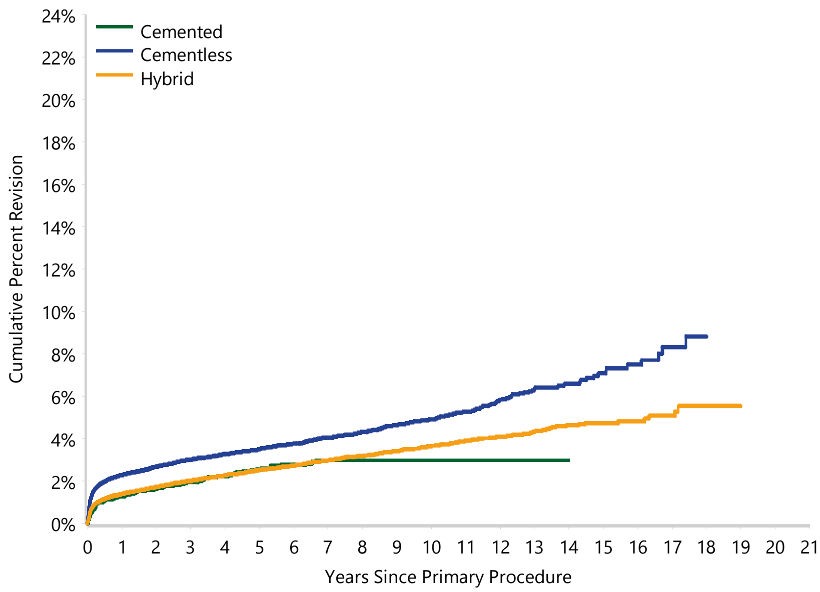
Cementless vs Hybrid
0 - 2Wk: HR=2.27 (1.72, 2.99), p<0.001
2Wk - 3Mth: HR=1.29 (1.13, 1.47), p<0.001
3Mth - 1.5Yr: HR=1.18 (1.02, 1.36), p=0.026
1.5Yr+: HR=0.95 (0.86, 1.04), p=0.270

Cementless vs Cemented
0 - 1Mth: HR=1.53 (1.15, 2.03), p=0.003
1Mth+: HR=0.99 (0.77, 1.26), p=0.933

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Cemented	2254	2074	1744	1400	373	86	0
Cementless	81132	71133	54085	38396	12838	2701	82
Hybrid	47551	42611	33667	25865	10979	3064	103

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

Figure HT33 **Cumulative Percent Revision of Primary Total Conventional Hip Replacement in Patients Aged ≥75 Years by Fixation (Primary Diagnosis OA)**



HR - adjusted for age and gender

Cemented vs Hybrid

Entire Period: HR=0.93 (0.75, 1.14), p=0.482

Cementless vs Hybrid

0 - 2Wk: HR=2.79 (2.19, 3.54), p<0.001

2Wk - 1Mth: HR=1.64 (1.38, 1.94), p<0.001

1Mth+: HR=1.27 (1.17, 1.38), p<0.001

Cementless vs Cemented

0 - 2Wk: HR=3.00 (2.20, 4.09), p<0.001

2Wk+: HR=1.44 (1.17, 1.77), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Cemented	4072	3652	2778	1946	356	36	0
Cementless	47183	40729	30362	20755	5693	773	7
Hybrid	58204	51142	38926	27836	8677	1318	24

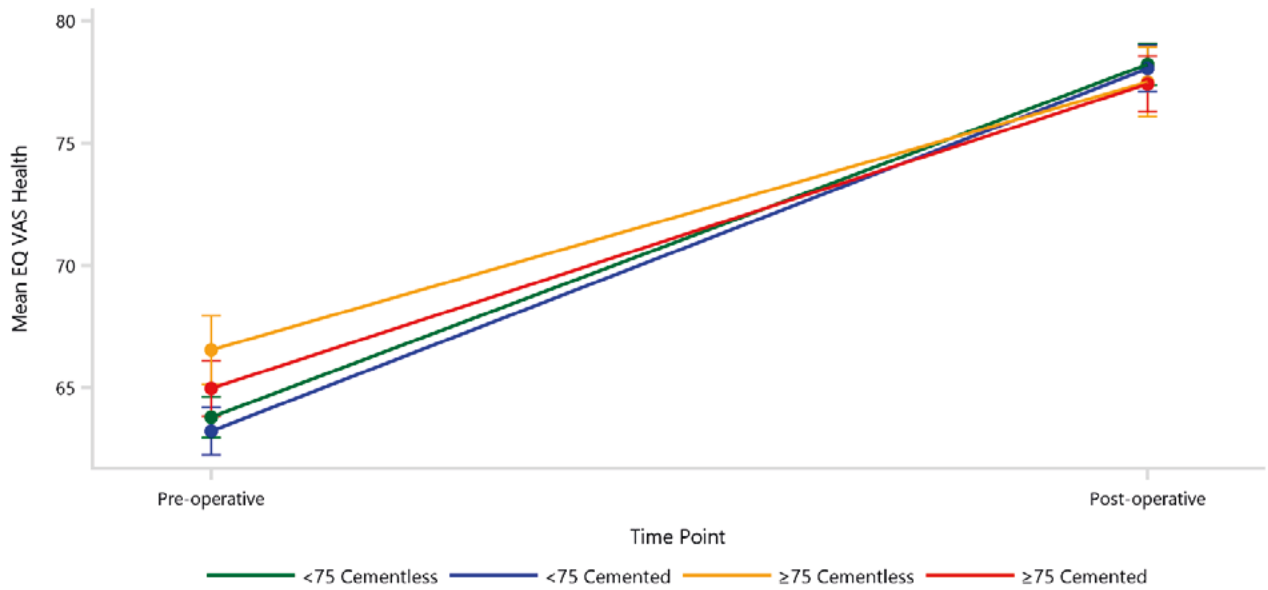
Note: Includes mixed ceramic/mixed ceramic and cross-linked polyethylene (XLPE) bearing surfaces
Restricted to modern prostheses

Table HT35 Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Conventional Hip Replacement with Cementless Acetabular Fixation by Age and Femoral Fixation (Primary Diagnosis OA)

		Pre-operative		Post-operative		
Age	Femoral Fixation	N	Mean (95% CI)	N	Mean (95% CI)	Change in Score
<75	Cementless	6706	63.79 (62.95, 64.64)	4019	78.22 (77.37, 79.07)	14.42 (13.83, 15.02)
	Cemented	3424	63.22 (62.26, 64.18)	2369	78.03 (77.09, 78.98)	14.81 (14.01, 15.62)
≥75	Cementless	1045	66.53 (65.13, 67.93)	623	77.50 (76.08, 78.91)	10.96 (9.44, 12.49)
	Cemented	1886	64.97 (63.83, 66.10)	1203	77.41 (76.28, 78.55)	12.45 (11.34, 13.56)

Note: Restricted to modern prostheses
Adjusted for gender, ASA score and BMI category

Figure HT34 Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Conventional Hip Replacement with Cementless Acetabular Fixation by Age and Femoral Fixation (Primary Diagnosis OA)



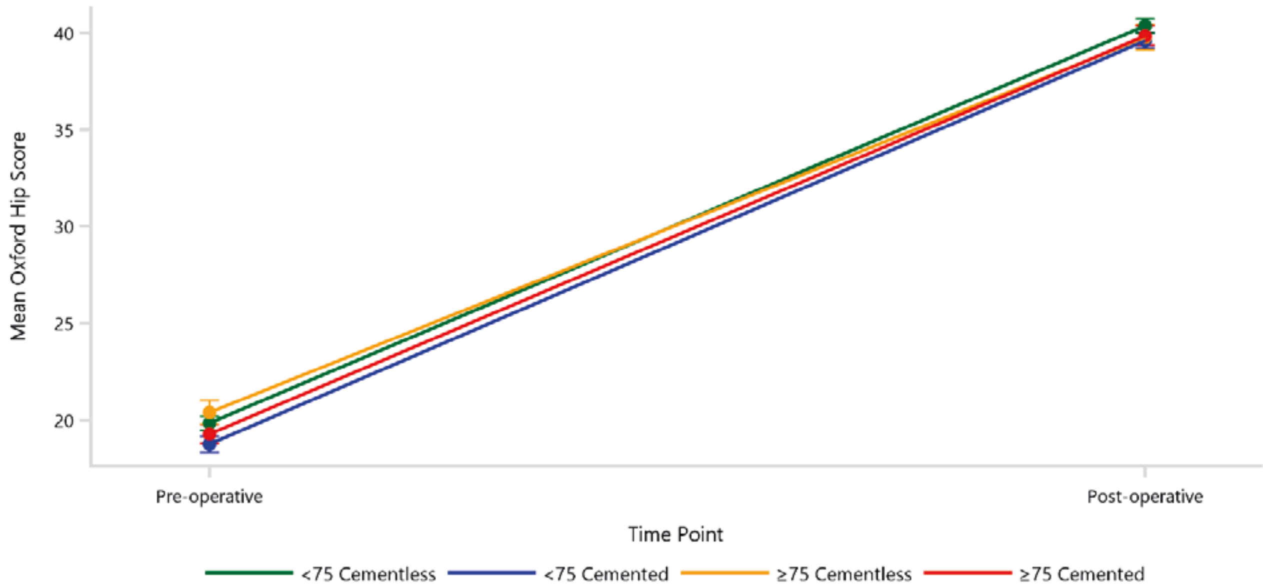
Note: Restricted to modern prostheses
Adjusted for gender, ASA score and BMI category

Table HT36 Mean Pre-operative and Post-operative Oxford Hip Score in Primary Total Conventional Hip Replacement with Cementless Acetabular Fixation by Age and Femoral Fixation (Primary Diagnosis OA)

		Pre-operative		Post-operative		
Age	Femoral Fixation	N	Mean (95% CI)	N	Mean (95% CI)	Change in Score
<75	Cementless	6697	19.83 (19.47, 20.20)	4031	40.38 (40.00, 40.75)	20.54 (20.27, 20.82)
	Cemented	3418	18.74 (18.32, 19.16)	2371	39.62 (39.20, 40.04)	20.88 (20.51, 21.25)
≥75	Cementless	1047	20.39 (19.79, 21.00)	620	39.78 (39.14, 40.42)	19.39 (18.68, 20.09)
	Cemented	1893	19.27 (18.78, 19.76)	1211	39.86 (39.35, 40.37)	20.59 (20.08, 21.11)

Note: Restricted to modern prostheses
Adjusted for gender, ASA score and BMI category

Figure HT35 Mean Pre-operative and Post-operative Oxford Hip Score in Primary Total Conventional Hip Replacement with Cementless Acetabular Fixation by Age and Femoral Fixation (Primary Diagnosis OA)



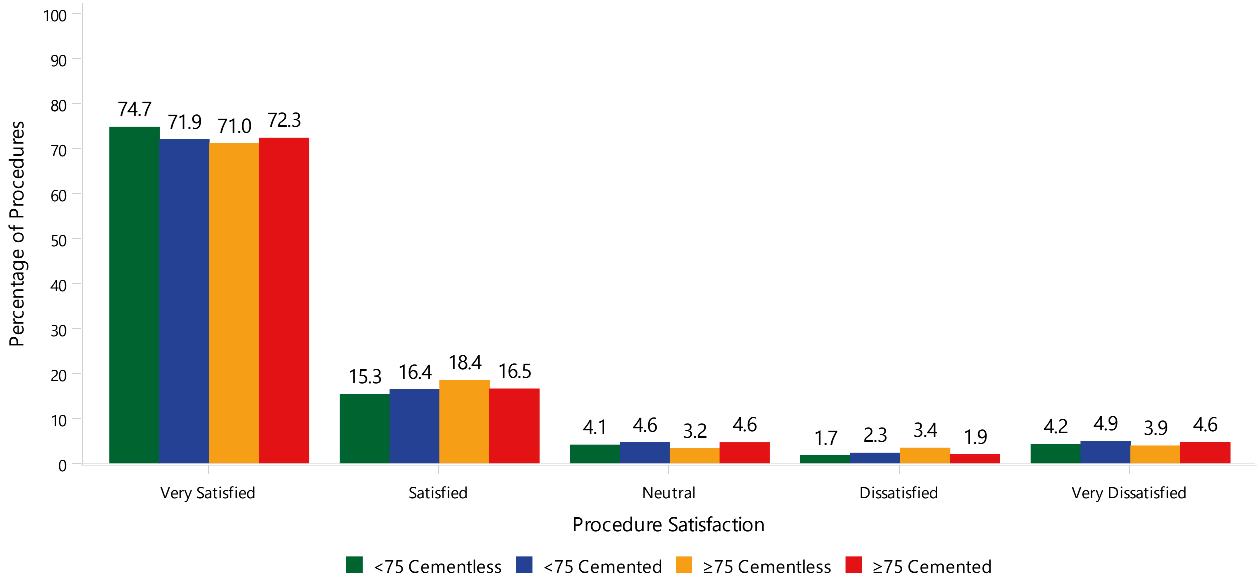
Note: Restricted to modern prostheses
Adjusted for gender, ASA score and BMI category

Table HT37 Procedure Satisfaction in Primary Total Conventional Hip Replacement with Cementless Acetabular Fixation by Age and Femoral Fixation (Primary Diagnosis OA)

Age	Femoral Fixation	Very Satisfied			Satisfied			Neutral			Dissatisfied			Very Dissatisfied			TOTAL		
		N	Row%	Col%	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%
<75	Cementless	3007	74.7	49.9	615	15.3	46.7	164	4.1	47.1	69	1.7	41.3	169	4.2	46.4	4024	100.0	49.0
	Cemented	1704	71.9	28.3	388	16.4	29.5	108	4.6	31.0	54	2.3	32.3	115	4.9	31.6	2369	100.0	28.8
≥75	Cementless	439	71.0	7.3	114	18.4	8.7	20	3.2	5.7	21	3.4	12.6	24	3.9	6.6	618	100.0	7.5
	Cemented	874	72.3	14.5	200	16.5	15.2	56	4.6	16.1	23	1.9	13.8	56	4.6	15.4	1209	100.0	14.7
TOTAL		6024	73.3	100.0	1317	16.0	100.0	348	4.2	100.0	167	2.0	100.0	364	4.4	100.0	8220	100.0	100.0

Note: Restricted to modern prostheses

Figure HT36 Procedure Satisfaction in Primary Total Conventional Hip Replacement with Cementless Acetabular Fixation by Age and Femoral Fixation (Primary Diagnosis OA)



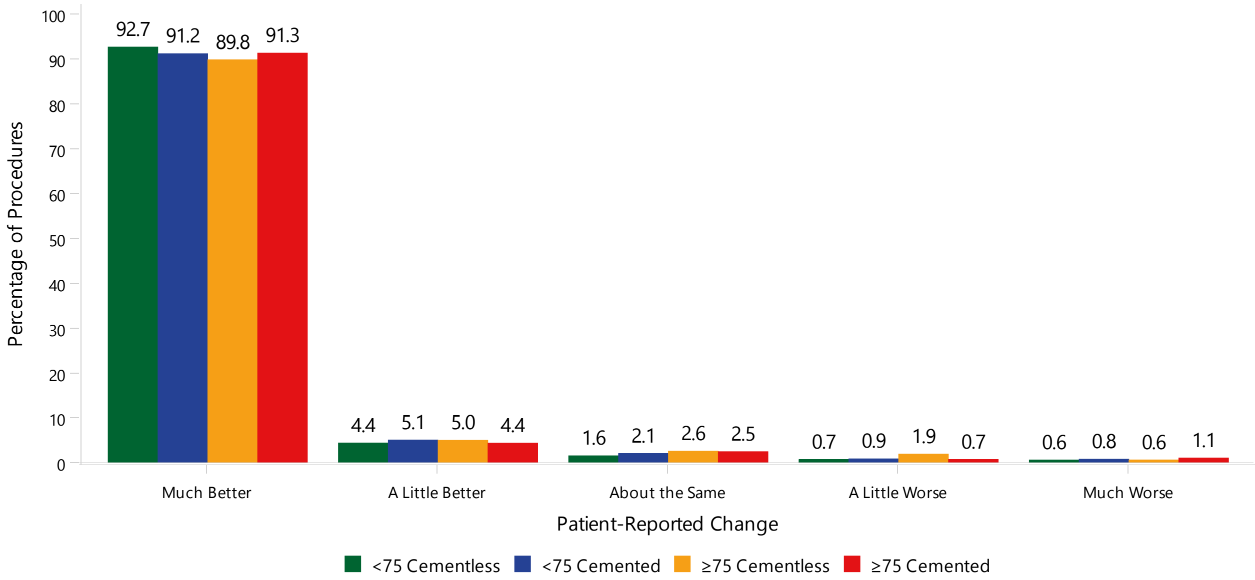
Note: Restricted to modern prostheses

Table HT38 Patient-Reported Change in Primary Total Conventional Hip Replacement with Cementless Acetabular Component by Age and Femoral Fixation (Primary Diagnosis OA)

Age	Femoral Fixation	Much Better N	Much Better Row%	Much Better Col%	A Little Better N	A Little Better Row%	A Little Better Col%	About the Same N	About the Same Row%	About the Same Col%	A Little Worse N	A Little Worse Row%	A Little Worse Col%	Much Worse N	Much Worse Row%	Much Worse Col%	TOTAL N	TOTAL Row%	TOTAL Col%
<75	Cementless	3728	92.7	49.4	178	4.4	46.6	63	1.6	39.9	29	0.7	40.8	25	0.6	41.0	4023	100.0	48.9
	Cemented	2160	91.2	28.6	120	5.1	31.4	49	2.1	31.0	21	0.9	29.6	19	0.8	31.1	2369	100.0	28.8
≥75	Cementless	555	89.8	7.4	31	5.0	8.1	16	2.6	10.1	12	1.9	16.9	4	0.6	6.6	618	100.0	7.5
	Cemented	1104	91.3	14.6	53	4.4	13.9	30	2.5	19.0	9	0.7	12.7	13	1.1	21.3	1209	100.0	14.7
TOTAL		**7547**	**91.8**	**100.0**	**382**	**4.6**	**100.0**	**158**	**1.9**	**100.0**	**71**	**0.9**	**100.0**	**61**	**0.7**	**100.0**	**8219**	**100.0**	**100.0**

Note: Restricted to modern prostheses

Figure HT37 Patient-Reported Change in Primary Total Conventional Hip Replacement with Cementless Acetabular Component by Age and Femoral Fixation (Primary Diagnosis OA)



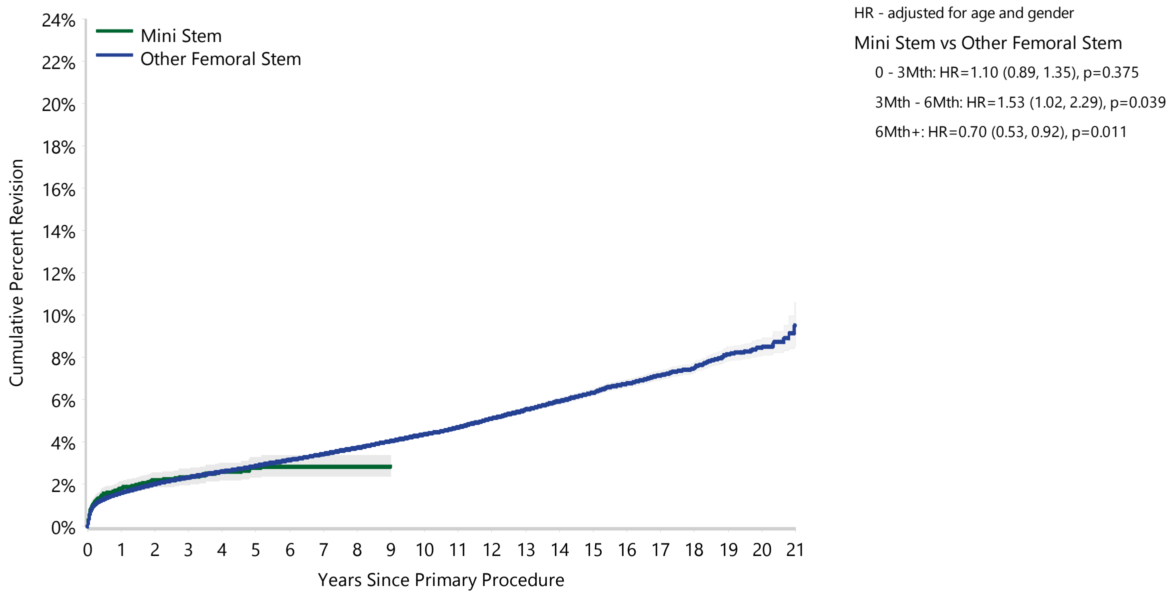
Note: Restricted to modern prostheses

Table HT39 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Stem Type (Primary Diagnosis OA)

Stem Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	8 Yrs	15 Yrs	20 Yrs
Mini Stem	166	7528	1.8 (1.5, 2.1)	2.3 (2.0, 2.7)	2.8 (2.3, 3.3)	2.8 (2.4, 3.4)		
Other Femoral Stem	12932	389733	1.6 (1.5, 1.6)	2.3 (2.3, 2.4)	2.9 (2.8, 2.9)	3.7 (3.6, 3.8)	6.3 (6.2, 6.5)	8.4 (8.1, 8.8)
TOTAL	**13098**	**397261**						

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

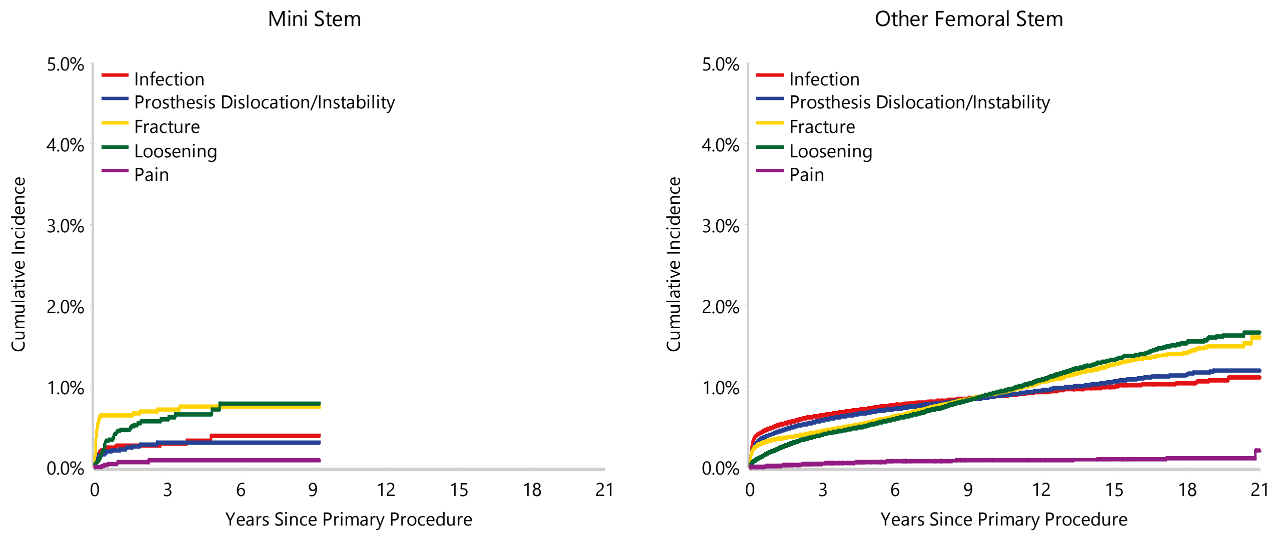
Figure HT38 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Stem Type (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	8 Yrs	15 Yrs	20 Yrs
Mini Stem	7528	5880	3309	1386	225	0	0
Other Femoral Stem	389733	346195	272064	203219	118096	21543	1383

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

Figure HT39 Cumulative Incidence Revision Diagnosis of 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 HT40 Primary Total Conventional Hip Replacement by Type of Revision and Stem Type (Primary Diagnosis OA)

Type of Revision	Mini Stem			Other Femoral Stem		
	Number	% Primaries Revised	% Revisions	Number	% Primaries Revised	% Revisions
Femoral Component	78	1.0	47.0	4252	1.1	32.9
Head/Insert	20	0.3	12.0	3183	0.8	24.6
Acetabular Component	32	0.4	19.3	2454	0.6	19.0
THR (Femoral/Acetabular)	14	0.2	8.4	1449	0.4	11.2
Head Only	15	0.2	9.0	637	0.2	4.9
Cement Spacer	4	0.1	2.4	502	0.1	3.9
Minor Components	1	0.0	0.6	227	0.1	1.8
Other	2	0.0	1.2	228	0.1	1.8
N Revision	166	2.2	100.0	12932	3.3	100.0
N Primary	7528			389733		

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

Table HT41 Cumulative Percent Revision of Primary Total Conventional Hip Replacement using a Mini Stem by Femoral Component (Primary Diagnosis OA)

Femoral Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
MiniHip	42	1271	2.4 (1.7, 3.4)	3.1 (2.2, 4.2)	3.6 (2.6, 4.8)			
MiniMax	21	379	4.5 (2.8, 7.2)	5.8 (3.8, 8.8)				
Optimys	45	2448	1.3 (0.9, 1.8)	1.9 (1.4, 2.6)	2.8 (2.0, 3.9)			
Taperloc Microplasty	56	3395	1.6 (1.2, 2.1)	1.8 (1.4, 2.4)	1.8 (1.4, 2.4)			
Other (2)	2	35	2.9 (0.4, 18.6)	5.9 (1.5, 21.6)	5.9 (1.5, 21.6)			
TOTAL	166	7528						

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. For this analysis, the Registry has identified 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 2021. XLPE is classified as ultra high molecular weight polyethylene that has been irradiated by high dose (≥50kGy) gamma or electron beam radiation.

Comparison of Bearing Surfaces

This year, the Registry is reporting on 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. As in previous years, the Registry urges caution in the interpretation of this result. 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 on the outcome, 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 1.5 years (Table HT42 and Figure HT40). The Registry acknowledges that there may be prosthesis-specific factors that are confounders in the analysis of bearing surface.

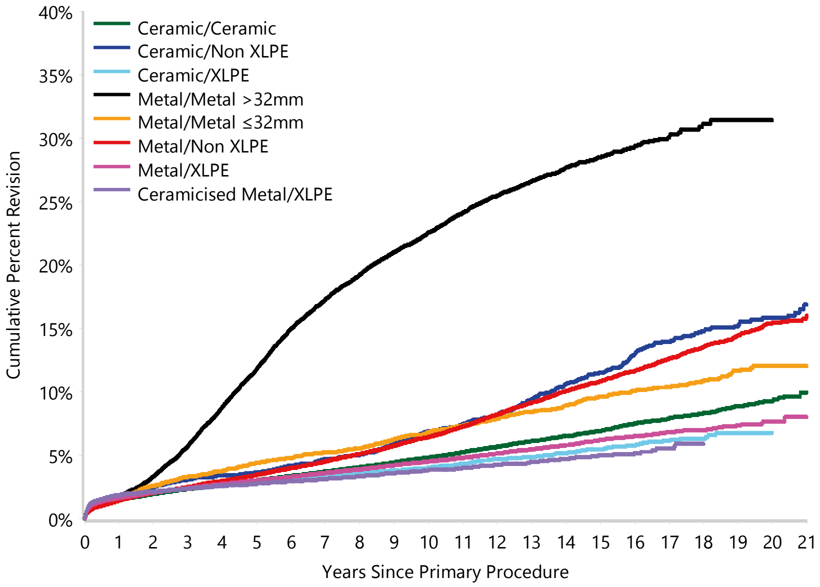
Detailed information on the analysis of metal/metal and metal/ceramic bearing surfaces are available in the supplementary reports 'Metal/Metal Bearing Surface in Total Conventional Hip Arthroplasty' and 'Prosthesis Types with No or Minimal Use' on the AOANJRR website: https://aoanjrr.sahmri.com/annual-reports-2022

Table HT42 **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	4552	103169	1.5 (1.4, 1.6)	2.4 (2.3, 2.4)	3.0 (2.9, 3.1)	4.8 (4.7, 5.0)	6.9 (6.7, 7.2)	9.3 (8.8, 9.8)
Ceramic/Non XLPE	661	9351	1.8 (1.6, 2.1)	3.1 (2.7, 3.5)	3.6 (3.3, 4.1)	6.9 (6.3, 7.6)	11.5 (10.6, 12.5)	15.8 (14.5, 17.3)
Ceramic/XLPE	3407	124435	1.7 (1.6, 1.8)	2.4 (2.3, 2.5)	2.9 (2.8, 3.0)	4.0 (3.9, 4.2)	5.5 (5.1, 5.9)	6.8 (6.0, 7.6)
Ceramic/Metal	28	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	3654	14422	1.7 (1.5, 1.9)	5.7 (5.3, 6.1)	11.8 (11.3, 12.3)	22.6 (21.9, 23.3)	28.5 (27.7, 29.3)	31.4 (30.1, 32.8)
Metal/Metal ≤32mm	467	5143	1.6 (1.3, 2.0)	3.3 (2.9, 3.8)	4.4 (3.9, 5.0)	6.8 (6.1, 7.6)	9.6 (8.8, 10.5)	12.1 (10.9, 13.3)
Metal/Non XLPE	3048	35581	1.4 (1.3, 1.5)	2.5 (2.3, 2.7)	3.5 (3.3, 3.7)	6.4 (6.2, 6.7)	10.8 (10.4, 11.3)	15.4 (14.8, 16.1)
Metal/XLPE	6850	186339	1.6 (1.6, 1.7)	2.4 (2.3, 2.5)	3.0 (2.9, 3.1)	4.5 (4.4, 4.6)	6.2 (6.0, 6.4)	7.7 (7.2, 8.2)
Ceramicised Metal/Non XLPE	57	304	1.6 (0.7, 3.9)	3.7 (2.1, 6.6)	4.1 (2.3, 7.0)	12.5 (9.0, 17.3)	21.8 (16.8, 28.1)	
Ceramicised Metal/XLPE	951	31411	1.9 (1.7, 2.0)	2.4 (2.2, 2.6)	2.8 (2.6, 3.0)	3.8 (3.6, 4.1)	5.0 (4.6, 5.5)	
TOTAL	**23675**	**510454**						

Note: Excludes 325 procedures with unknown bearing surfaces, 1 procedure with ceramicised metal/ceramic bearing surface, 8 procedures with metal/ceramic bearing surface

Figure HT40 **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=1.00 (0.96, 1.04), p=0.978

Ceramic/Non XLPE vs Metal/XLPE
0 - 3Mth: HR=1.01 (0.83, 1.24), p=0.900
3Mth - 2Yr: HR=1.41 (1.17, 1.69), p<0.001
2Yr+: HR=1.97 (1.78, 2.17), p<0.001

Ceramic/XLPE vs Metal/XLPE
0 - 2Wk: HR=1.08 (0.96, 1.23), p=0.192
2Wk - 1Mth: HR=1.04 (0.94, 1.15), p=0.470
1Mth - 1.5Yr: HR=1.02 (0.96, 1.09), p=0.539
1.5Yr+: HR=0.79 (0.74, 0.84), p<0.001

Metal/Metal ≤32mm vs Metal/XLPE — Entire Period: HR=1.40 (1.27, 1.54), p<0.001

Metal/Non XLPE vs Metal/XLPE
0 - 1Mth: HR=0.74 (0.63, 0.87), p<0.001
1Mth - 3Mth: HR=0.86 (0.72, 1.04), p=0.114
3Mth - 1.5Yr: HR=1.31 (1.17, 1.47), p<0.001
1.5Yr - 6.5Yr: HR=1.51 (1.40, 1.64), p<0.001
6.5Yr - 17.5: HR=2.27 (2.13, 2.41), p<0.001
17.5+: HR=2.42 (1.86, 3.14), p<0.001

Metal/Metal >32mm vs Metal/XLPE
0 - 2Wk: HR=1.29 (0.97, 1.71), p=0.080
2Wk - 3Mth: HR=0.64 (0.51, 0.80), p<0.001
3Mth - 9Mth: HR=1.14 (0.89, 1.46), p=0.297
9Mth - 1.5Yr: HR=2.71 (2.29, 3.21), p<0.001
1.5Yr - 2Yr: HR=4.21 (3.49, 5.06), p<0.001
2Yr - 3Yr: HR=6.59 (5.83, 7.44), p<0.001
3Yr - 6Yr: HR=10.36 (9.65, 11.11), p<0.001
6Yr - 9.5Yr: HR=6.98 (6.44, 7.58), p<0.001
9.5Yr - 10.5Yr: HR=6.03 (5.10, 7.13),
10.5Yr+: HR=3.55 (3.21, 3.92), p<0.001

Ceramicised Metal/XLPE vs Metal/XLPE
0 - 3Mth: HR=1.23 (1.11, 1.36), p<0.001
3Mth+: HR=0.71 (0.65, 0.77), p<0.001

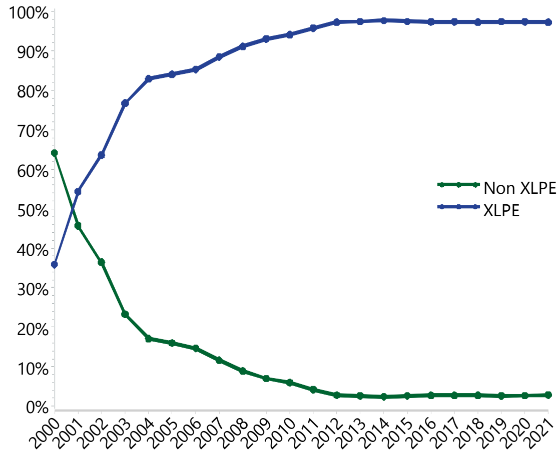
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Ceramic/Ceramic	103169	97040	86119	73169	36002	12218	1098
Ceramic/Non XLPE	9351	8401	6922	5591	3411	2044	543
Ceramic/XLPE	124435	104581	72045	45553	12319	2542	95
Metal/Metal >32mm	14422	14061	13215	11979	9280	2855	52
Metal/Metal ≤32mm	5143	5021	4840	4654	3902	2381	382
Metal/Non XLPE	35581	34223	31856	29125	20703	11024	1875
Metal/XLPE	186339	170870	143203	114213	48606	12591	457
Ceramicised Metal/XLPE	31411	27529	21695	16689	6590	1682	0

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

Cross-linked Polyethylene (XLPE)

XLPE has been used in 306,639 procedures reported to the Registry. This includes 32,329 procedures that have XLPE with the addition of an antioxidant. In 2021, when polyethylene was used as a bearing surface in primary total conventional hip procedures, the proportion of XLPE was 97.2% (Figure HT41).

Figure HT41 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 HT43 and Figure HT42). The difference increases with time and at 20 years the cumulative percent revision is 7.1% and 17.8%, respectively.

At 20 years, the cumulative percent revision of total conventional hip replacement with XLPE is 7.1% compared to 17.8% for non XLPE.

The cumulative incidence of loosening and prosthesis dislocation/instability at 20 years is 1.1% and 1.2% for XLPE, compared to 4.8% and 1.4% for non XLPE bearings, respectively (Figure HT43).

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 HT43 and Figure HT44). 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 82.8% of XLPE procedures and in only 20.9% of non XLPE procedures.

For XLPE, 32mm has a lower rate of revision than <32mm after 9 months. When compared to >32mm head size, 32mm has a lower rate of revision after 1 month (Figure HT45). The Registry has previously shown that this increased use of larger head sizes with XLPE is the reason for a reduction in revision for dislocation/instability (Figure HT46).

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 HT47).

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. Both have a reduced rate of revision when XLPE is used.

The Reflection (Cup) has a 16 year follow-up for both types of polyethylene. XLPE has been used in 55.6% of Reflection (Cup) primary total conventional hip procedures. After 2 years, XLPE has a lower rate of revision than non XLPE (Table HT44 and Figure HT48).

The Reflection (Shell) has a 19 year follow-up with an insert using both types of polyethylene. XLPE is used in 84.4% of Reflection (Shell) primary total conventional hip procedures. XLPE has a lower rate of revision after 3 months compared to non XLPE (Table HT44 and Figure HT49).

Prosthesis-Specific Analysis: Antioxidant

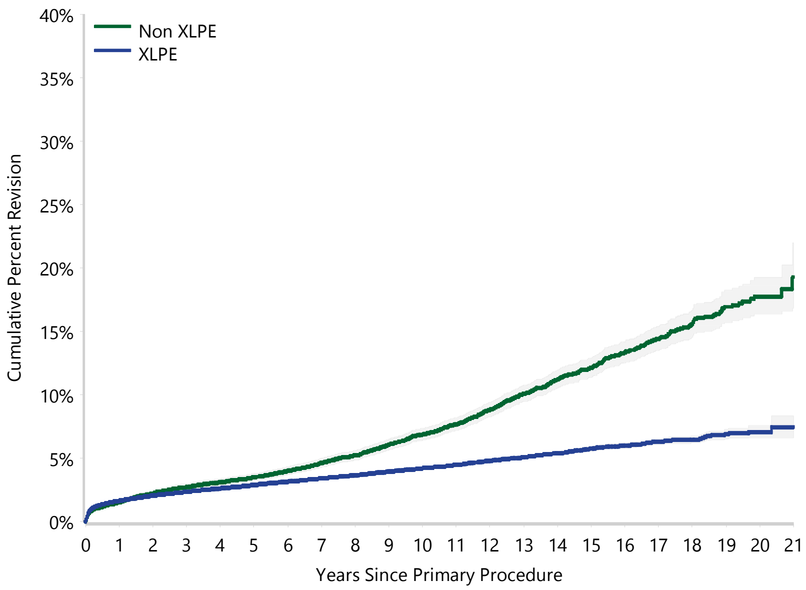
The Registry has performed a separate analysis of acetabular components that have both XLPE and XLPE with antioxidant. There has been a 20.3% increase in procedures using antioxidant compared to 2020. The Trinity is the only acetabular shell with both types of polyethylene and there was no difference when comparing the rate of revision between XLPE and XLPE with antioxidant within this prosthesis (Table HT45 and Figure HT50).

Table HT43 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		**1249**	**17797**	**1.5 (1.4, 1.7)**	**2.7 (2.5, 3.0)**	**3.5 (3.2, 3.8)**	**6.9 (6.4, 7.3)**	**12.1 (11.4, 12.9)**	**17.8 (16.4, 19.3)**
	<32mm	1059	14084	1.5 (1.3, 1.7)	2.7 (2.4, 3.0)	3.5 (3.2, 3.8)	7.0 (6.5, 7.5)	12.3 (11.5, 13.1)	18.0 (16.6, 19.6)
	32mm	187	3633	1.6 (1.2, 2.1)	2.7 (2.2, 3.3)	3.5 (2.9, 4.2)	6.3 (5.4, 7.4)	10.3 (8.5, 12.5)	
	>32mm	3	80	2.9 (0.7, 11.3)	4.6 (1.5, 13.6)	4.6 (1.5, 13.6)			
XLPE		**9430**	**306639**	**1.6 (1.6, 1.7)**	**2.4 (2.3, 2.4)**	**2.9 (2.8, 3.0)**	**4.2 (4.1, 4.3)**	**5.7 (5.6, 5.9)**	**7.1 (6.6, 7.6)**
	<32mm	2115	52780	1.6 (1.5, 1.7)	2.4 (2.3, 2.5)	3.0 (2.8, 3.2)	4.4 (4.2, 4.6)	6.0 (5.7, 6.2)	7.4 (6.8, 7.9)
	32mm	3649	126168	1.6 (1.5, 1.7)	2.3 (2.2, 2.4)	2.7 (2.6, 2.8)	3.9 (3.8, 4.1)	5.2 (4.9, 5.6)	
	>32mm	3666	127691	1.7 (1.6, 1.8)	2.4 (2.3, 2.5)	3.0 (2.9, 3.1)	4.4 (4.3, 4.6)	6.2 (5.7, 6.7)	
TOTAL		**10679**	**324436**						

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

Figure HT42 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Polyethylene Type (Primary Diagnosis OA)

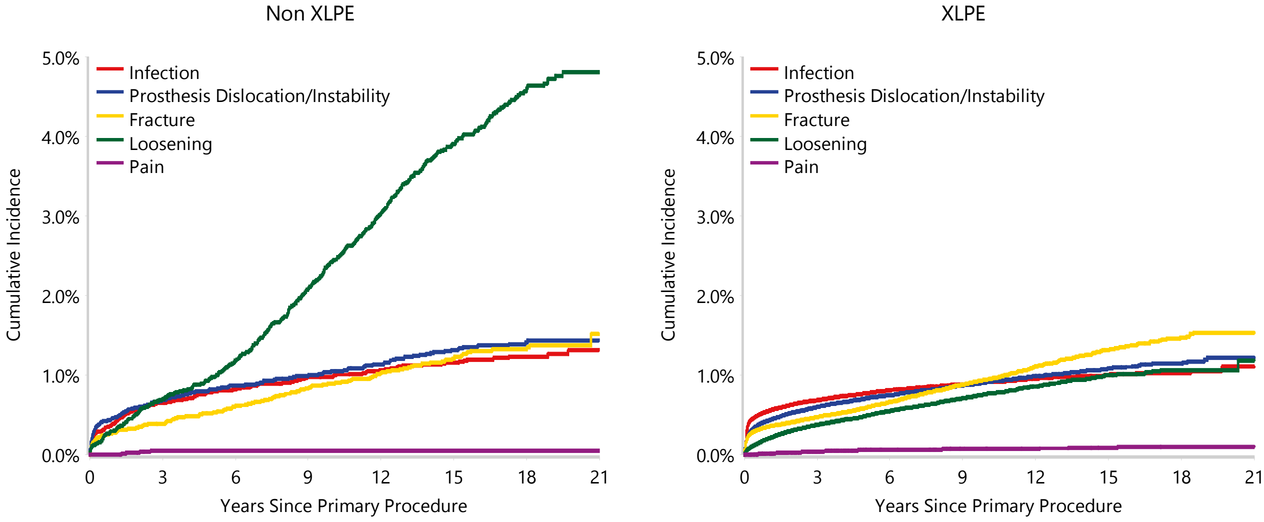


HR - adjusted for age and gender
Non XLPE vs XLPE
0 - 1Mth: HR=0.86 (0.70, 1.05), p=0.127
1Mth - 3Mth: HR=0.92 (0.72, 1.16), p=0.484
3Mth - 6Mth: HR=0.82 (0.57, 1.17), p=0.271
6Mth - 1Yr: HR=1.27 (0.98, 1.65), p=0.071
1Yr - 1.5Yr: HR=2.02 (1.57, 2.59), p<0.001
1.5Yr - 2Yr: HR=1.50 (1.10, 2.05), p=0.009
2Yr - 2.5Yr: HR=1.84 (1.35, 2.52), p<0.001
2.5Yr - 5.5Yr: HR=1.51 (1.28, 1.78), p<0.001
5.5Yr - 6.5Yr: HR=2.24 (1.70, 2.95), p<0.001
6.5Yr - 8.5Yr: HR=2.68 (2.20, 3.26), p<0.001
8.5Yr+: HR=3.70 (3.30, 4.15), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Non XLPE	17797	16325	13886	11604	6959	2894	328
XLPE	306639	268468	204188	147134	52606	12794	422

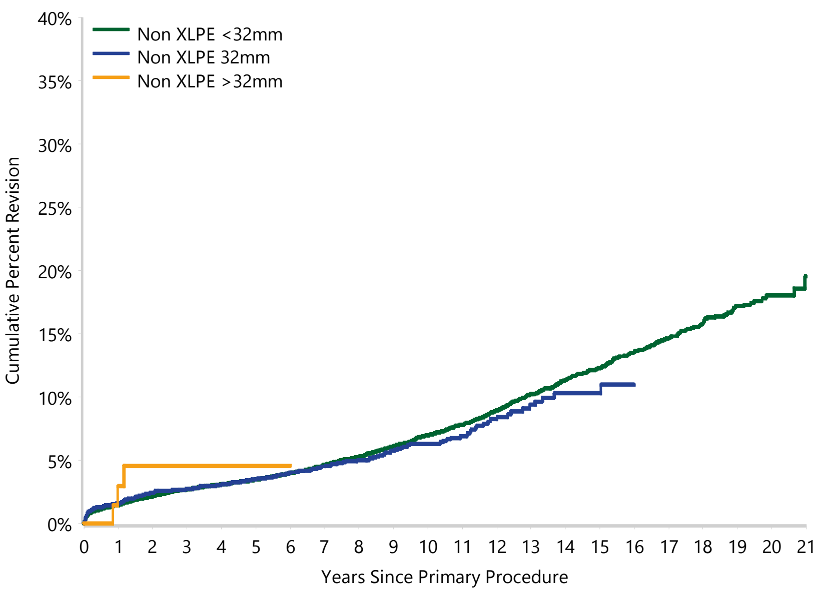
Note: Restricted to modern prostheses

Figure HT43 **Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement by Polyethylene Type (Primary Diagnosis OA)**



Note: Restricted to modern prostheses

Figure HT44 **Cumulative Percent Revision of Primary Total Conventional Hip Replacement using Non XLPE by Head Size (Primary Diagnosis OA)**



HR - adjusted for age and gender

Non XLPE 32mm vs Non XLPE <32mm

Entire Period: HR=1.02 (0.87, 1.19), p=0.835

Non XLPE >32mm vs Non XLPE <32mm

Entire Period: HR=1.01 (0.32, 3.13), p=0.991

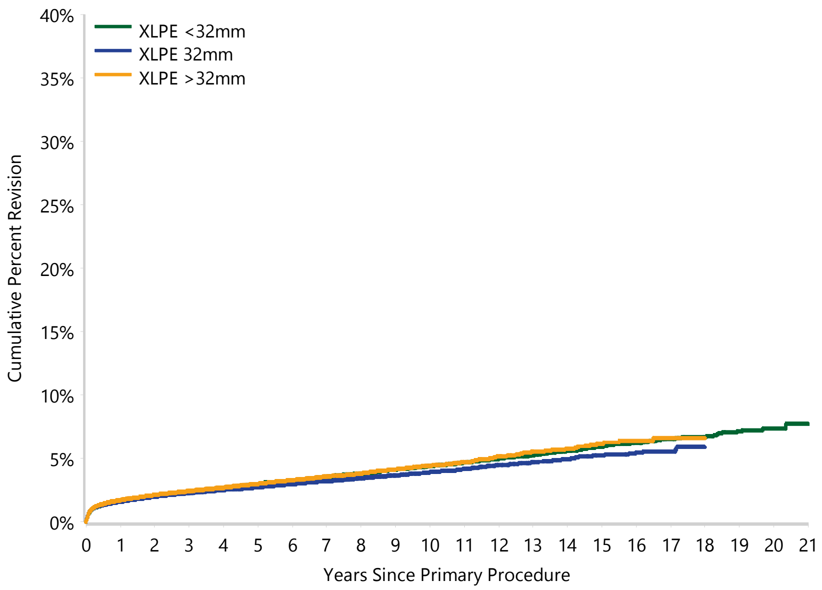
Non XLPE >32mm vs Non XLPE 32mm

Entire Period: HR=0.99 (0.32, 3.10), p=0.985

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Non XLPE	<32mm	14084	12871	10936	9198	5956	2759	327
	32mm	3633	3391	2915	2386	1000	135	1
	>32mm	80	63	35	20	3	0	0

Note: Restricted to modern prostheses

Figure HT45 **Cumulative Percent Revision of Primary Total Conventional Hip Replacement using XLPE by Head Size (Primary Diagnosis OA)**



HR - adjusted for age and gender

XLPE <32mm vs XLPE 32mm
0 - 1Mth: HR=0.96 (0.85, 1.09), p=0.520
1Mth - 9Mth: HR=1.05 (0.95, 1.17), p=0.349
9Mth+: HR=1.18 (1.10, 1.27), p<0.001

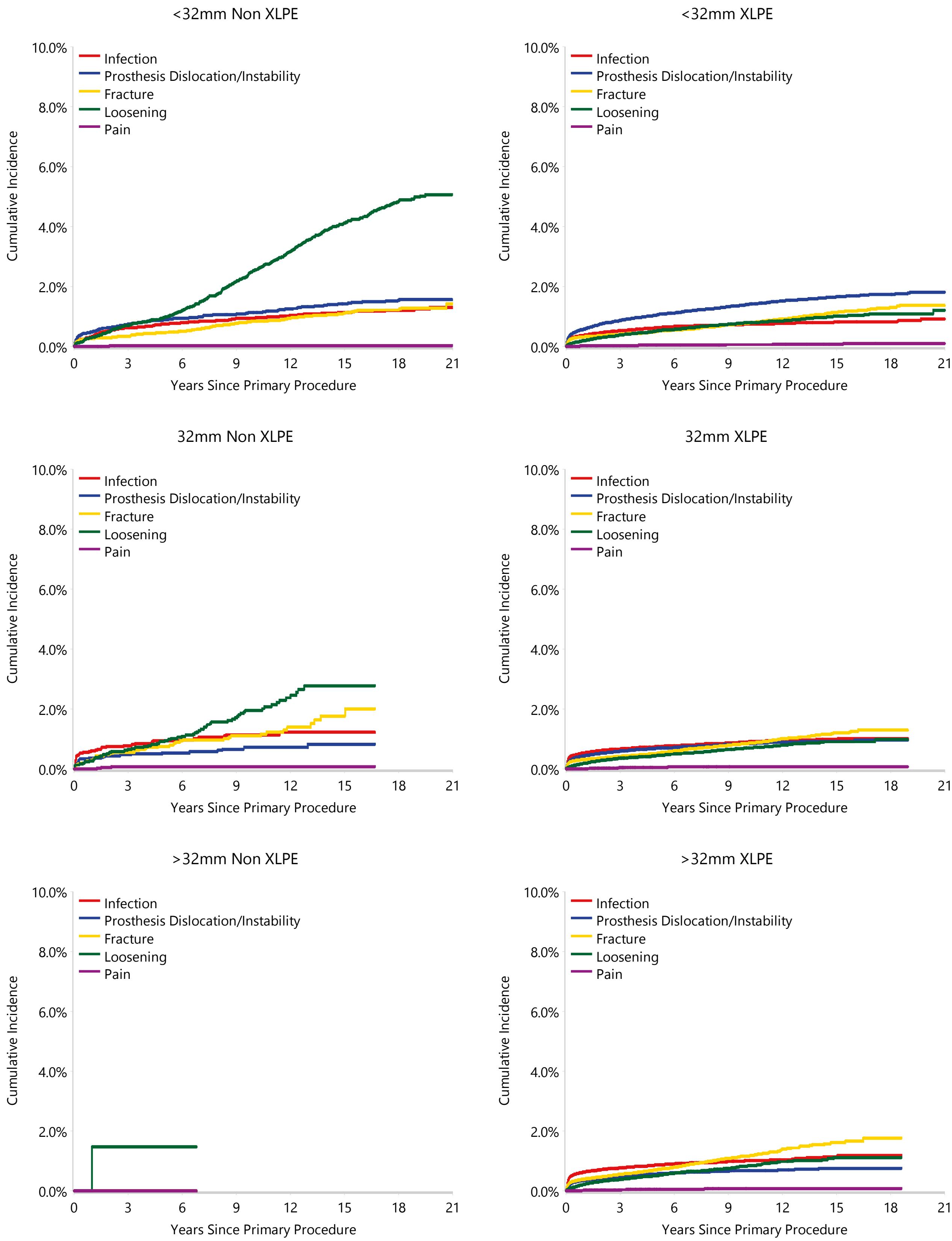
XLPE >32mm vs XLPE 32mm
0 - 1Mth: HR=0.96 (0.87, 1.05), p=0.347
1Mth+: HR=1.13 (1.07, 1.19), p<0.001

XLPE >32mm vs XLPE <32mm
Entire Period: HR=0.99 (0.94, 1.05), p=0.771

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
XLPE	<32mm	52780	47612	39801	34101	20785	9230	418
	32mm	126168	113473	89289	64078	18667	2471	1
	>32mm	127691	107383	75098	48955	13154	1093	3

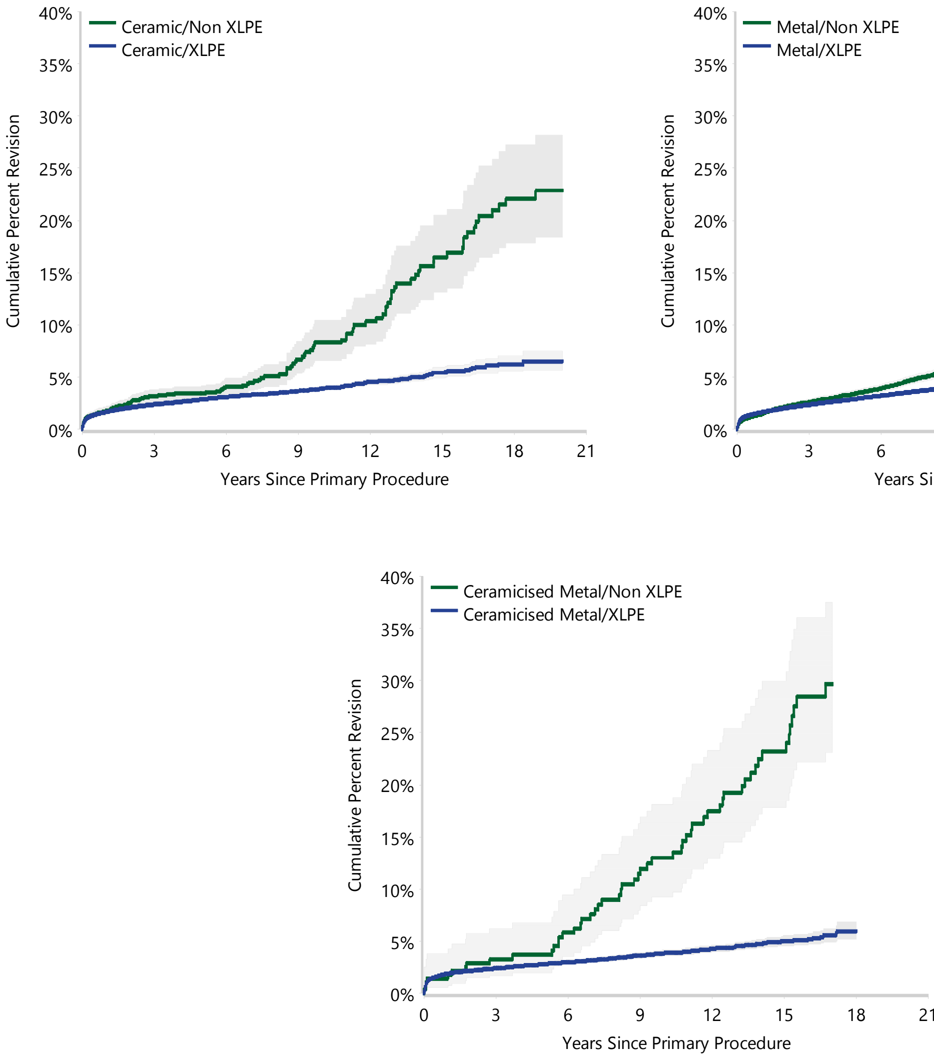
Note: Restricted to modern prostheses

Figure HT46 **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 HT47 **Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Head Surface and Polyethylene Type (Primary Diagnosis OA)**



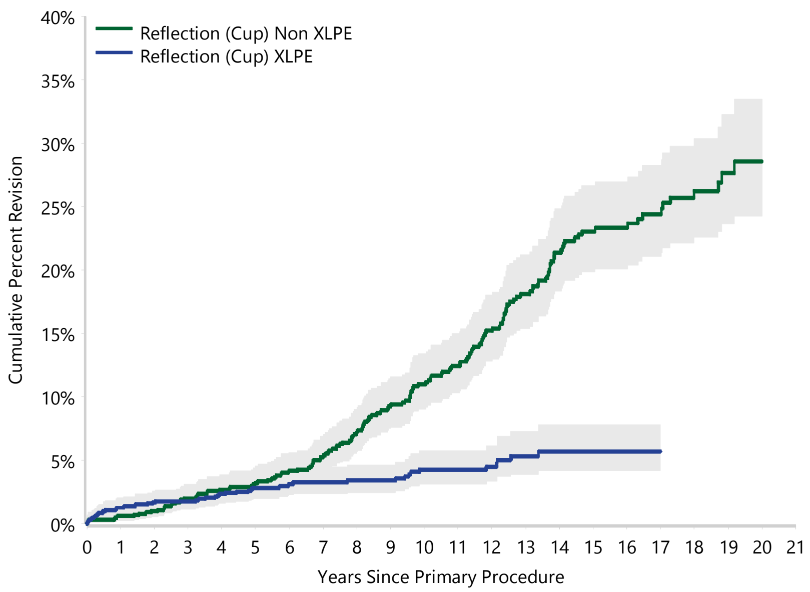
Note: Restricted to modern prostheses

Table HT44 **Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Prosthesis Type and Polyethylene Type (Primary Diagnosis OA)**

Prosthesis Type	Polyethylene Type	N Revised	N Total	5 Yrs	10 Yrs	12 Yrs	15 Yrs	17 Yrs
Reflection (Cup)		**211**	**2311**	**3.0 (2.4, 3.8)**	**7.7 (6.5, 9.1)**	**10.2 (8.7, 11.9)**	**15.6 (13.6, 18.0)**	**16.7 (14.4, 19.2)**
	Non XLPE	163	1027	3.2 (2.3, 4.6)	11.0 (9.0, 13.4)	15.2 (12.8, 18.1)	23.1 (19.9, 26.7)	24.4 (21.0, 28.2)
	XLPE	48	1284	2.8 (2.0, 4.0)	4.3 (3.1, 5.8)	4.5 (3.3, 6.1)	5.7 (4.2, 7.8)	5.7 (4.2, 7.8)
Reflection (Shell)		**770**	**14271**	**2.4 (2.2, 2.7)**	**4.3 (3.9, 4.7)**	**5.3 (4.9, 5.7)**	**6.9 (6.4, 7.4)**	**8.3 (7.6, 9.0)**
	Non XLPE	339	2225	4.4 (3.6, 5.4)	9.8 (8.6, 11.3)	13.2 (11.7, 14.9)	17.3 (15.5, 19.3)	20.4 (18.4, 22.7)
	XLPE	431	12046	2.1 (1.8, 2.3)	3.2 (2.9, 3.6)	3.6 (3.3, 4.0)	4.6 (4.1, 5.1)	5.3 (4.7, 5.9)
TOTAL		**981**	**16582**					

Note: Restricted to modern prostheses

Figure HT48 Cumulative Percent Revision of Reflection (Cup) Primary Total Conventional Hip Replacement by Polyethylene Type (Primary Diagnosis OA)



HR - adjusted for age and gender

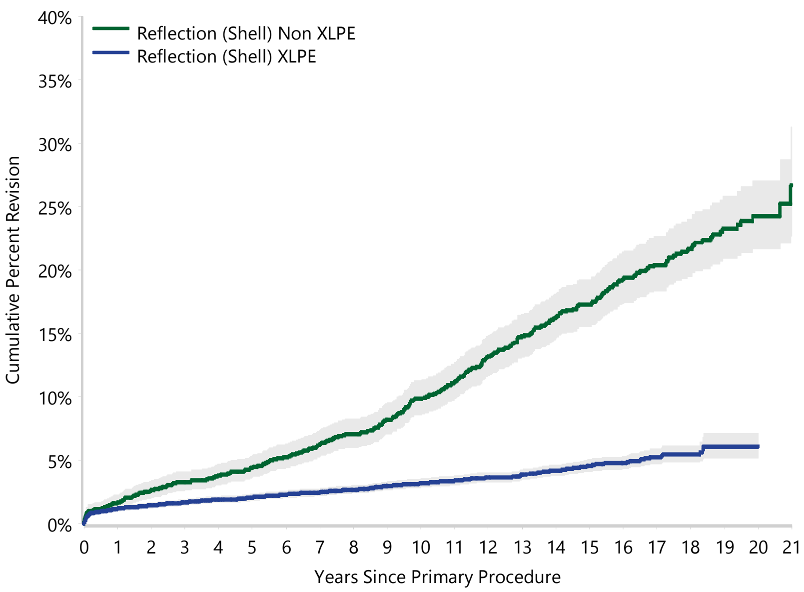
Reflection (Cup) Non XLPE vs
Reflection (Cup) XLPE

0 - 2Yr: HR=0.56 (0.26, 1.19), p=0.132
2Yr - 12Yr: HR=4.55 (2.90, 7.15), p<0.001
12Yr - 12.5Yr: HR=4.36 (0.97, 19.69), p=0.055
12.5Yr+: HR=10.67 (2.56, 44.49), p=0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Reflection (Cup)	Non XLPE	1027	1001	929	856	584	283	41
	XLPE	1284	1211	1094	948	518	154	0

Note: Restricted to modern prostheses

Figure HT49 **Cumulative Percent Revision of Reflection (Shell) Primary Total Conventional Hip Replacement by Polyethylene Type (Primary Diagnosis OA)**



HR - adjusted for age and gender

Reflection (Shell) Non XLPE vs

Reflection (Shell) XLPE

- 0 - 1Mth: HR=1.60 (0.96, 2.67), p=0.071
- 1Mth - 3Mth: HR=0.56 (0.20, 1.57), p=0.272
- 3Mth - 6.5Yr: HR=3.04 (2.37, 3.90), p<0.001
- 6.5Yr - 12Yr: HR=6.59 (5.03, 8.65), p<0.001
- 12Yr+: HR=5.51 (3.97, 7.65), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Reflection (Shell) Non XLPE	2225	2147	2028	1881	1408	855	168
XLPE	12046	11682	11040	10311	7023	2923	41

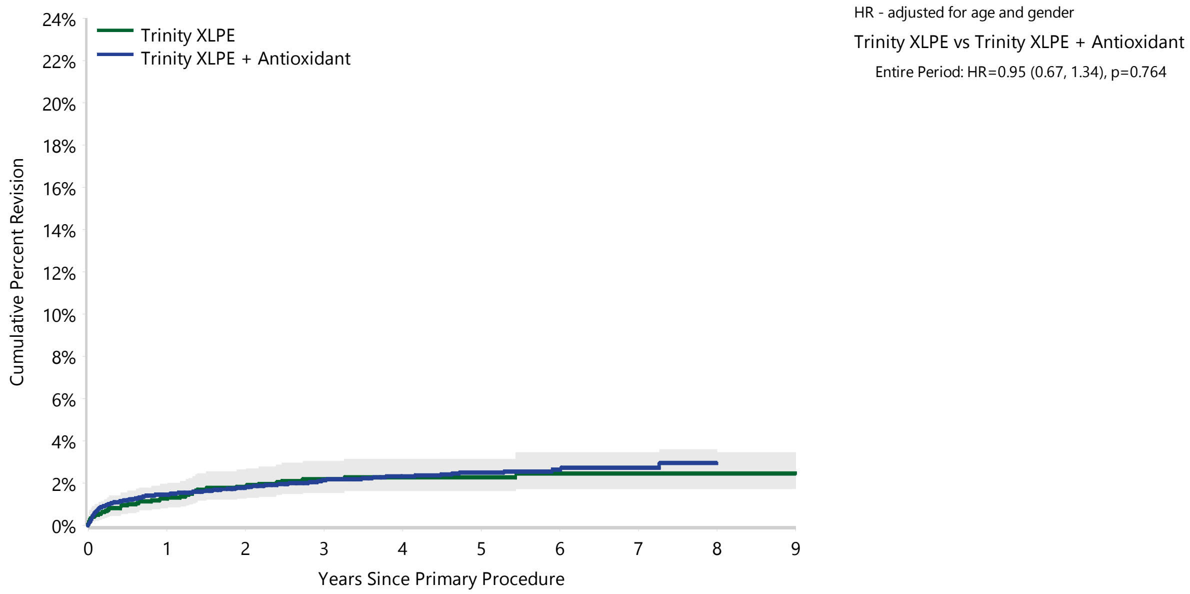
Note: Restricted to modern prostheses

Table HT45 **Cumulative Percent Revision of Trinity Primary Total Conventional Hip Replacement by XLPE Type (Primary Diagnosis OA)**

Prosthesis Type	Polyethylene Type	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Trinity		**346**	**18468**	**1.5 (1.3, 1.7)**	**1.8 (1.6, 2.0)**	**2.2 (1.9, 2.4)**	**2.4 (2.2, 2.7)**	**2.7 (2.3, 3.1)**	
	XLPE	36	1589	1.3 (0.8, 1.9)	1.8 (1.3, 2.6)	2.2 (1.6, 3.0)	2.3 (1.6, 3.1)	2.5 (1.8, 3.5)	
	XLPE + Antioxidant	310	16879	1.5 (1.3, 1.7)	1.8 (1.6, 2.0)	2.2 (1.9, 2.4)	2.5 (2.2, 2.8)	2.7 (2.3, 3.2)	
TOTAL		**346**	**18468**						

Note: Restricted to modern prostheses

Figure HT50 **Cumulative Percent Revision of Trinity Primary Total Conventional Hip Replacement by XLPE Type (Primary Diagnosis OA)**



Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Trinity	XLPE	1589	1560	1494	1218	632	164	30
	XLPE + Antioxidant	16879	12376	8629	5619	1859	589	0

Note: Restricted to modern prostheses

Ceramic/Ceramic Bearings

Ceramic/ceramic bearings have been used in 72,375 primary total conventional hip replacement procedures undertaken for osteoarthritis. This is the second most common bearing reported to the Registry.

This analysis has been restricted to procedures with mixed ceramic femoral head and mixed ceramic acetabular bearing surfaces. In 2021, mixed ceramic accounted for 99.9% of all procedures with a ceramic/ceramic bearing surface (Figure HT51).

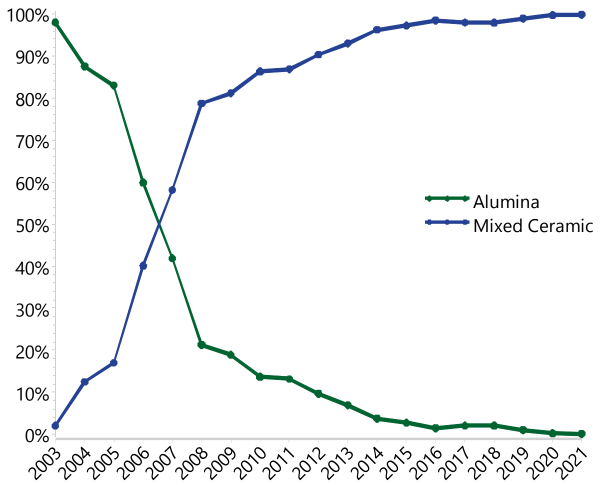
Head Size

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.

Mixed ceramic heads with head sizes ≤28mm have a higher rate of revision than 32mm heads in the first 3 months. 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 HT46 and Figure HT52).

At 1 year, the cumulative incidence of prosthesis dislocation/instability is 1.6% for head sizes ≤28mm compared to 0.3% for 32mm, 0.3% for 36-38mm, and 0.2% for head sizes ≥40mm (Figure HT53).

Figure HT51 Primary Total Conventional Hip Replacement with Ceramic Femoral Heads by Ceramic Type (Primary Diagnosis OA)



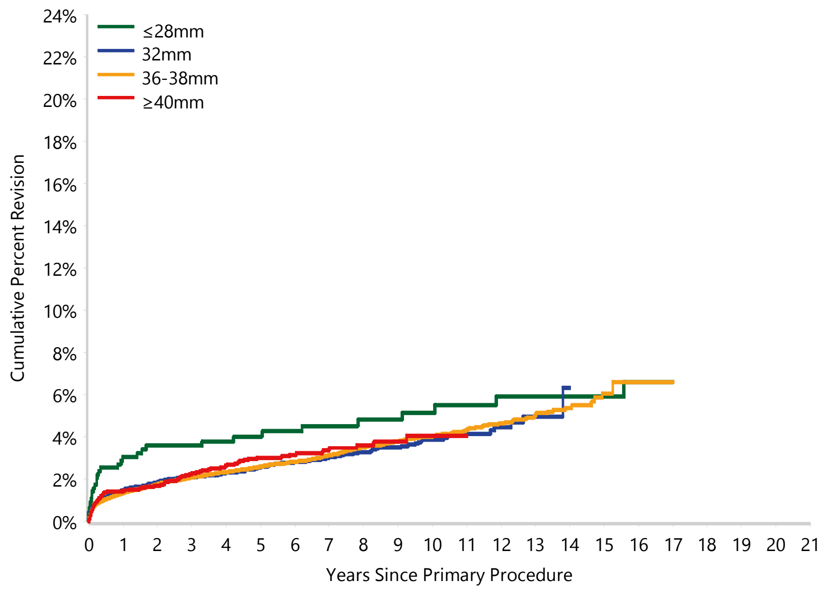
Note: Restricted to modern prostheses

Table HT46 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	633	3.1 (2.0, 4.7)	3.6 (2.4, 5.4)	4.0 (2.7, 6.0)	5.2 (3.5, 7.5)	5.9 (4.1, 8.5)	
32mm	267	9867	1.5 (1.3, 1.7)	2.1 (1.8, 2.4)	2.6 (2.3, 2.9)	3.9 (3.4, 4.5)		
36-38mm	1186	40310	1.4 (1.2, 1.5)	2.1 (2.0, 2.2)	2.6 (2.4, 2.8)	4.0 (3.8, 4.3)	6.1 (5.3, 7.0)	
≥40mm	100	3812	1.4 (1.1, 1.9)	2.2 (1.8, 2.8)	3.0 (2.4, 3.7)	4.0 (3.2, 5.2)		
TOTAL	1584	54622						

Note: Restricted to modern prostheses

Figure HT52 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=2.58 (1.50, 4.43), p<0.001

3Mth+: HR=0.89 (0.54, 1.47), p=0.661

36-38mm vs 32mm

Entire Period: HR=1.01 (0.87, 1.16), p=0.923

≥40mm vs 32mm

Entire Period: HR=1.06 (0.83, 1.35), p=0.647

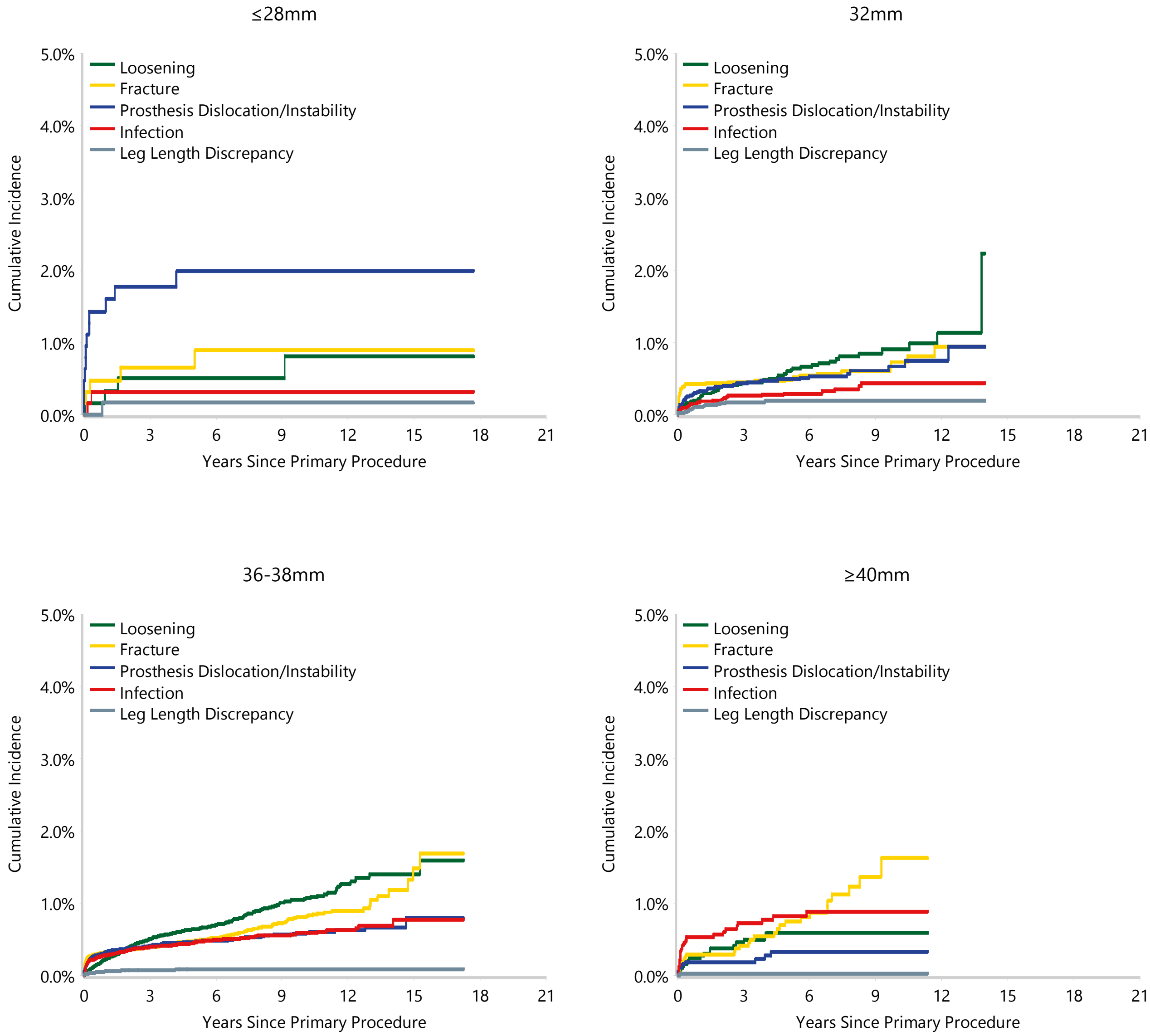
36-38mm vs ≥40mm

Entire Period: HR=0.95 (0.77, 1.17), p=0.633

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
≤28mm	633	568	467	401	267	157	0
32mm	9867	8839	7027	5066	1272	0	0
36-38mm	40310	36962	30626	23004	6814	423	0
≥40mm	3812	3177	2302	1703	221	0	0

Note: Restricted to modern prostheses

Figure HT53 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 884 procedures using constrained acetabular prostheses for primary total conventional hip replacement. Of these, 706 procedures were constrained acetabular inserts and 178 procedures were constrained cups. There were 79 procedures reported in 2021. This is a decrease of 17.7% compared to 2020. The most commonly used constrained prostheses are presented in Table HT47. 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 HT48).

When all diagnoses are included, and when used only for osteoarthritis, constrained acetabular prostheses have a higher rate of revision compared to other acetabular prostheses (Table HT49, Figure HT54, Table HT50, and Figure HT55). Gender and age <70 years and ≥70 years are not risk factors for revision (Table HT51, Figure HT56, Table HT52 and Figure HT57). 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 HT53 and Table HT54).

Table HT47 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	6	98	6.9 (3.2, 14.8)	6.9 (3.2, 14.8)				
PINNACLE/PINNACLE	7	126	3.3 (1.2, 8.5)	5.1 (2.3, 11.0)	5.1 (2.3, 11.0)			
Trabecular Metal (Shell)/Longevity	7	104	2.0 (0.5, 7.8)	5.5 (2.3, 12.8)	7.2 (3.2, 15.6)			
Trident (Cup)	8	144	5.6 (2.7, 11.4)	5.6 (2.7, 11.4)				
Trident (Shell)/Trident	16	215	5.1 (2.8, 9.2)	5.8 (3.2, 10.3)	7.5 (4.3, 12.8)			
Other Constrained Prosthesis	14	197	6.3 (3.5, 11.2)	7.1 (4.1, 12.1)	9.6 (5.6, 16.2)			
TOTAL	**58**	**884**						

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

Table HT48 Primary Total Conventional Hip Replacement by Primary Diagnosis and Acetabular Type

Primary Diagnosis	Constrained Prosthesis		Other Acetabular Prosthesis	
	N	Col%	N	Col%
Osteoarthritis	345	39.0	396916	87.7
Fractured Neck Of Femur	240	27.1	24561	5.4
Osteonecrosis	31	3.5	14552	3.2
Developmental Dysplasia	21	2.4	5891	1.3
Rheumatoid Arthritis	8	0.9	3565	0.8
Tumour	104	11.8	2448	0.5
Failed Internal Fixation	98	11.1	1814	0.4
Other Inflammatory Arthritis	6	0.7	1856	0.4
Fracture/Dislocation	23	2.6	603	0.1
Arthrodesis Takedown	4	0.5	87	0.0
Other	4	0.5	87	0.0
TOTAL	**884**	**100.0**	**452380**	**100.0**

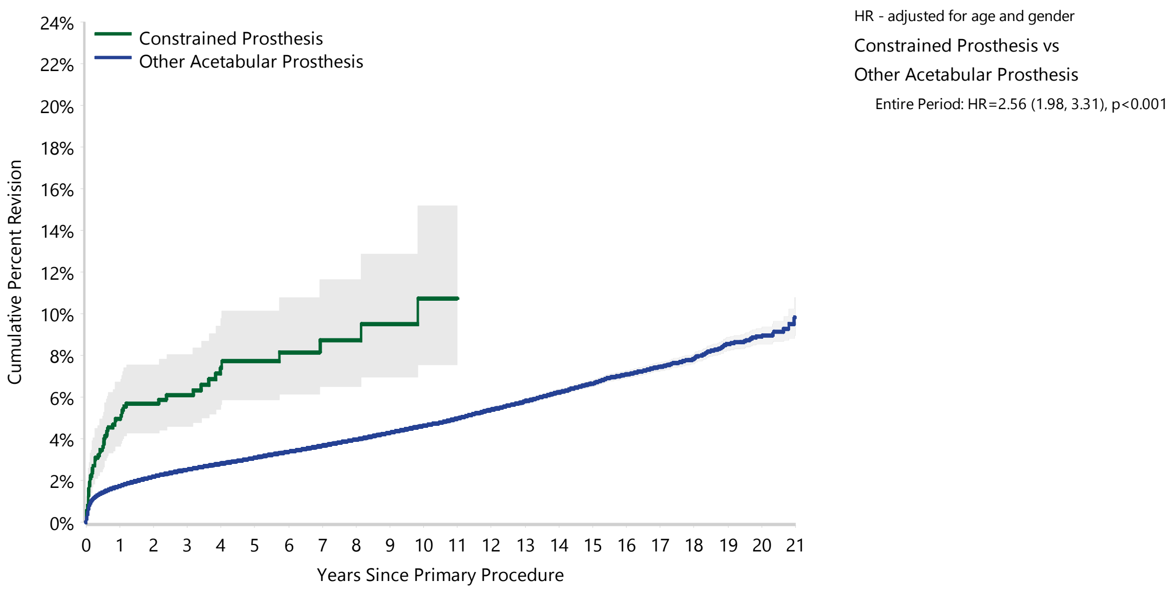
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT49 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	58	884	5.0 (3.7, 6.7)	6.1 (4.6, 8.1)	7.7 (5.9, 10.1)	10.7 (7.5, 15.2)		
Other Acetabular Prosthesis	15778	452380	1.7 (1.7, 1.8)	2.5 (2.5, 2.6)	3.1 (3.0, 3.1)	4.6 (4.5, 4.7)	6.7 (6.5, 6.8)	8.9 (8.5, 9.3)
TOTAL	**15836**	**453264**						

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

Figure HT54 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	884	655	402	251	66	13	0
Other Acetabular Prosthesis	452380	397843	308597	227636	87935	23924	1573

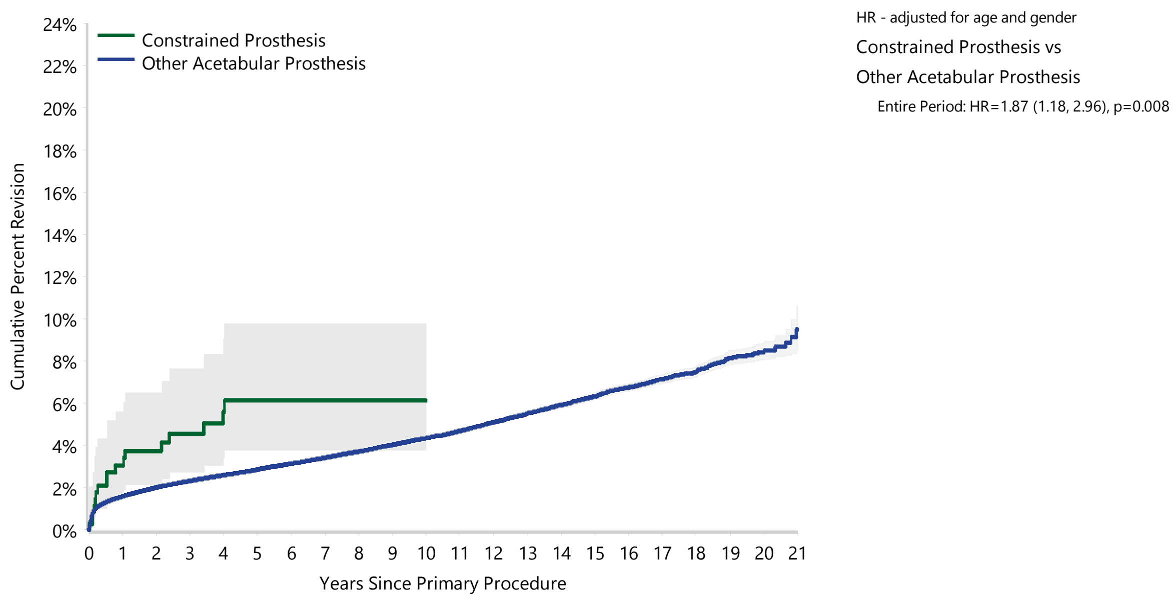
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT50 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Acetabular 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	345	3.1 (1.7, 5.6)	4.6 (2.7, 7.6)	6.1 (3.8, 9.8)	6.1 (3.8, 9.8)		
Other Acetabular Prosthesis	13080	396916	1.6 (1.6, 1.6)	2.3 (2.3, 2.4)	2.9 (2.8, 2.9)	4.4 (4.3, 4.4)	6.3 (6.2, 6.5)	8.4 (8.1, 8.8)
TOTAL	**13098**	**397261**						

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

Figure HT55 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Acetabular Type (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Constrained Prosthesis	345	284	203	142	41	10	0
Other Acetabular Prosthesis	396916	351791	275170	204463	79535	21533	1383

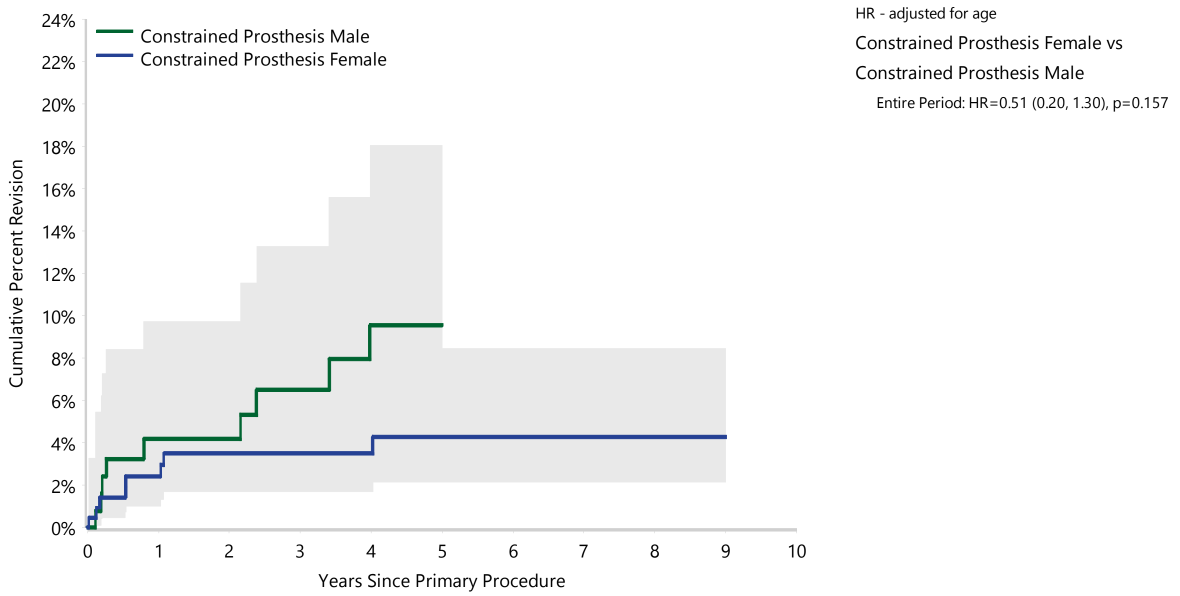
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT51 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	7 Yrs	10 Yrs
Constrained Prosthesis	Male	9	129	4.2 (1.8, 9.8)	6.5 (3.1, 13.3)	9.6 (5.0, 18.1)		
	Female	9	216	2.4 (1.0, 5.7)	3.5 (1.7, 7.2)	4.3 (2.1, 8.5)	4.3 (2.1, 8.5)	
TOTAL		18	345					

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

Figure HT56 Cumulative Percent Revision of Constrained Primary Total Conventional Hip Replacement by Gender (Primary Diagnosis OA)



Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Constrained Prosthesis	Male	129	100	68	43	21	8
	Female	216	184	135	99	75	33

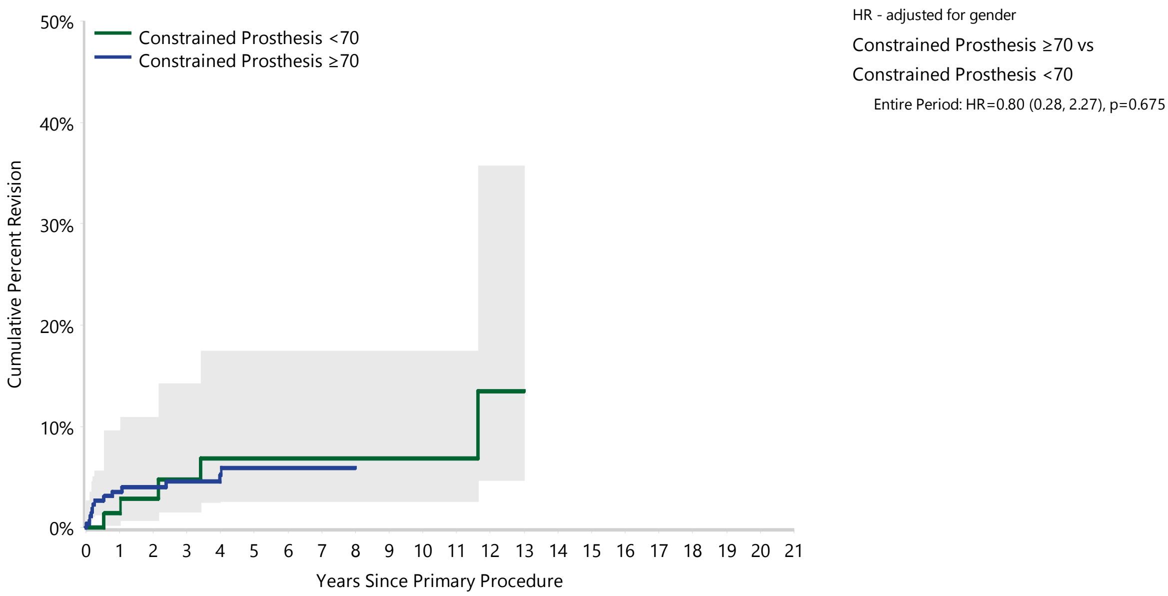
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT52 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	76	1.4 (0.2, 9.6)	4.8 (1.5, 14.2)	6.8 (2.6, 17.5)	6.8 (2.6, 17.5)		
	≥70	13	269	3.5 (1.9, 6.7)	4.5 (2.5, 8.1)	5.9 (3.4, 10.2)			
TOTAL		**18**	**345**						

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

Figure HT57 Cumulative Percent Revision of Constrained Primary Total Conventional Hip Replacement by Age (Primary Diagnosis OA)



Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Constrained Prosthesis	<70	76	68	48	39	16	6	0
	≥70	269	216	155	103	25	4	0

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

Table HT53 Cumulative Percent Revision of Constrained Primary Total Conventional Hip Replacement by Acetabular Fixation Irrespective of Femoral Fixation (Primary Diagnosis OA)

Acetabular Type	Acetabular Fixation	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Constrained Prosthesis	Cementless	18	302	3.5 (1.9, 6.4)	5.1 (3.1, 8.6)	6.8 (4.2, 10.8)	6.8 (4.2, 10.8)		
	Cemented	0	43	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)			
TOTAL		18	345						

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

Table HT54 Cumulative Percent Revision of Constrained Primary Total Conventional Hip Replacement with Cemented Femoral Fixation by Acetabular Fixation (Primary Diagnosis OA)

Acetabular Type	Acetabular Fixation	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Constrained Prosthesis	Cementless	6	195	2.1 (0.8, 5.6)	2.7 (1.1, 6.4)	3.5 (1.6, 7.8)			
	Cemented	0	39	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)			
TOTAL		6	234						

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.

The commonly used dual mobility prostheses are presented in Table HT55. There has been an increasing use of these prostheses for primary hip replacement. The Registry has recorded 21,198 primary total conventional hip replacement procedures using dual mobility prostheses; an increase of 22.3% since 2020. 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 HT56).

When all diagnoses are included, dual mobility prostheses have a higher rate of revision compared to other acetabular prostheses (Table HT57 and Figure HT58).

For the diagnosis of osteoarthritis, there is no difference in the overall rate of revision when dual mobility prostheses are used (Table HT58 and Figure HT59). Dual mobility prostheses have a lower rate of revision for dislocation/instability compared to all other acetabular prostheses (Table HT59 and Figure HT60).

Males have a higher risk of revision than females when used for a diagnosis of osteoarthritis, but age is not a risk factor for revision (Table HT60, Figure HT61, Table HT61 and Figure HT62).

The majority of dual mobility prostheses are inserted with cementless acetabular fixation. However, there is no difference in the rate of revision when acetabular fixation is compared (Table HT62 and Figure HT63). There are not enough dual mobility prostheses recorded with a cemented acetabular component to perform a comparative analysis with regards to the type of femoral fixation.

Table HT55 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	18	487	2.3 (1.3, 4.1)	4.0 (2.3, 6.9)	4.9 (2.8, 8.6)			
Active Articulation	89	4257	2.0 (1.6, 2.6)	2.7 (2.1, 3.4)				
Avantage	12	321	3.1 (1.6, 5.9)	3.6 (2.0, 6.7)	5.9 (3.0, 11.4)			
BI-MENTUM	3	102						
Custom Made (Signature)	1	104						
Dual Mobility Cup	3	95	1.1 (0.1, 7.2)	3.5 (1.1, 10.5)				
MDM (Dual Mobility)	67	2596	1.9 (1.4, 2.5)	2.7 (2.1, 3.5)	3.3 (2.5, 4.3)			
Novae E	32	1586	1.0 (0.6, 1.7)	2.2 (1.5, 3.2)	2.3 (1.6, 3.3)			
Polarcup	50	1028	2.9 (2.0, 4.1)	4.6 (3.4, 6.2)	5.6 (4.1, 7.6)	7.8 (5.4, 11.2)		
Restoration	158	5007	2.5 (2.1, 3.0)	3.3 (2.8, 3.9)	4.1 (3.4, 4.9)			
Saturne	27	1147	1.5 (0.9, 2.5)	2.6 (1.7, 3.9)	3.3 (2.1, 5.2)			
Trinity	42	2942	1.4 (1.0, 1.9)	1.7 (1.2, 2.4)				
Versafit	51	1477	2.7 (2.0, 3.7)	3.9 (3.0, 5.2)	4.2 (3.1, 5.5)			
Other (6)	1	49	2.3 (0.3, 15.4)					
TOTAL	**554**	**21198**						

Note: All procedures using metal/metal prostheses have been excluded
Only prostheses with >50 procedures have been listed
Restricted to modern prostheses

Table HT56 Primary Total Conventional Hip Replacement by Primary Diagnosis and Acetabular Mobility

	Dual Mobility Prosthesis		Other Acetabular Prosthesis	
Primary Diagnosis	N	Col%	N	Col%
Osteoarthritis	14620	69.0	382641	88.6
Fractured Neck Of Femur	4128	19.5	20673	4.8
Osteonecrosis	852	4.0	13731	3.2
Developmental Dysplasia	409	1.9	5503	1.3
Rheumatoid Arthritis	118	0.6	3455	0.8
Tumour	513	2.4	2039	0.5
Failed Internal Fixation	316	1.5	1596	0.4
Other Inflammatory Arthritis	98	0.5	1764	0.4
Fracture/Dislocation	113	0.5	513	0.1
Arthrodesis Takedown	14	0.1	77	0.0
Other	17	0.1	74	0.0
TOTAL	**21198**	**100.0**	**432066**	**100.0**

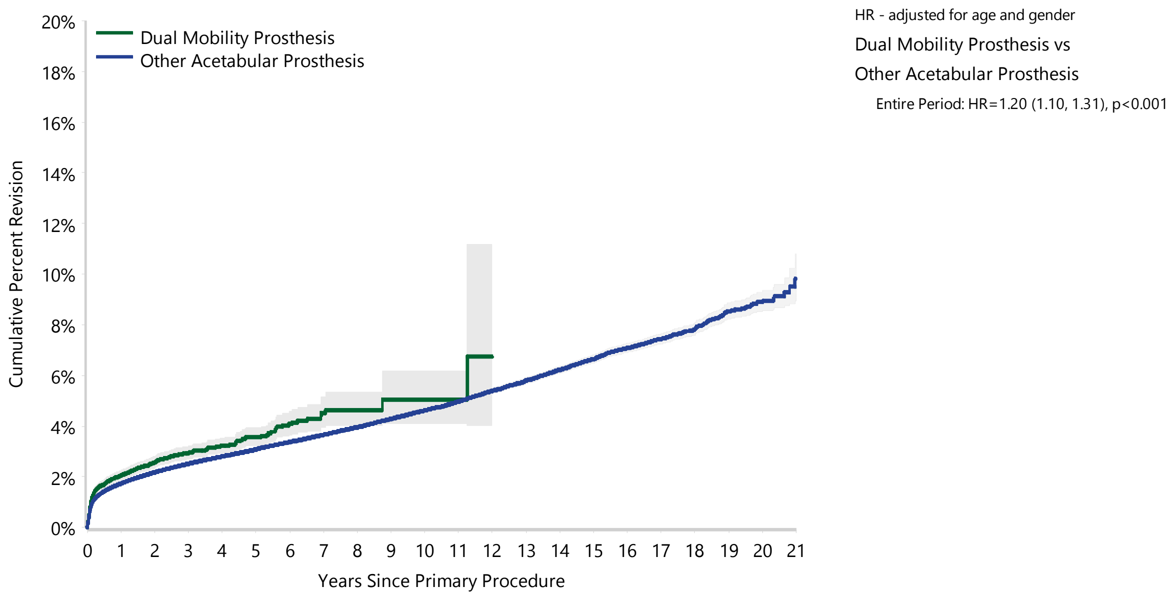
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT57 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	554	21198	2.1 (1.9, 2.3)	2.9 (2.7, 3.2)	3.6 (3.2, 3.9)	5.0 (4.1, 6.2)		
Other Acetabular Prosthesis	15282	432066	1.7 (1.7, 1.8)	2.5 (2.5, 2.6)	3.1 (3.0, 3.1)	4.6 (4.5, 4.7)	6.7 (6.5, 6.8)	8.9 (8.5, 9.3)
TOTAL	**15836**	**453264**						

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

Figure HT58 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	21198	14891	6672	2623	125	2	0
Other Acetabular Prosthesis	432066	383607	302327	225264	87876	23935	1573

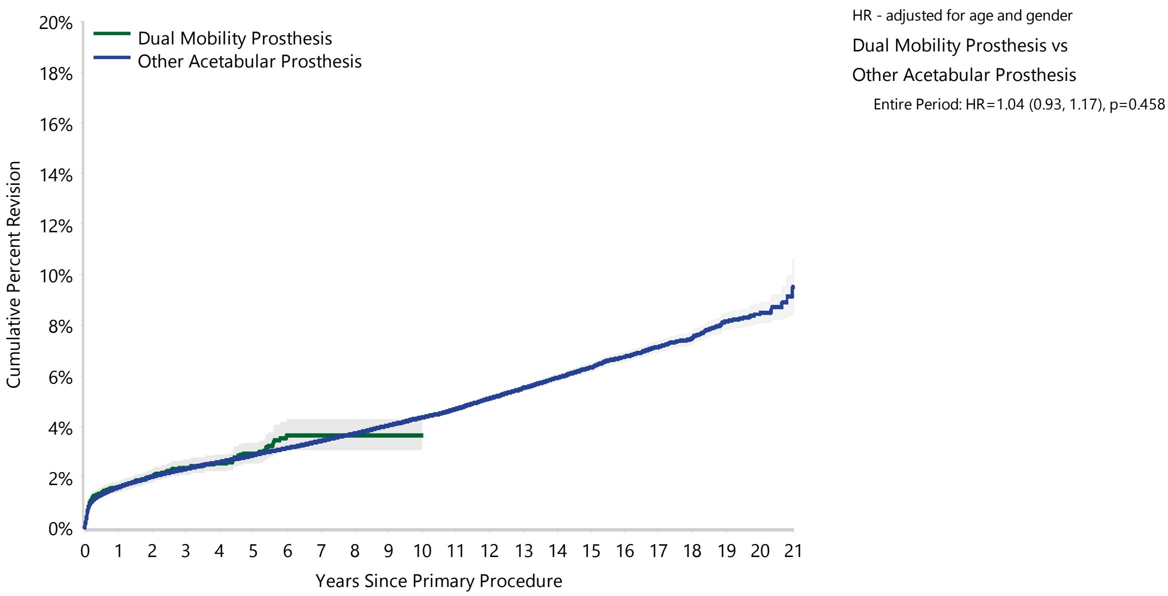
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT58 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	309	14620	1.6 (1.4, 1.8)	2.4 (2.1, 2.7)	2.9 (2.6, 3.4)	3.6 (3.1, 4.3)		
Other Acetabular Prosthesis	12789	382641	1.6 (1.6, 1.6)	2.3 (2.3, 2.4)	2.9 (2.8, 2.9)	4.4 (4.3, 4.4)	6.3 (6.2, 6.5)	8.4 (8.1, 8.8)
TOTAL	13098	397261						

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

Figure HT59 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Acetabular Mobility (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Dual Mobility Prosthesis	14620	10453	4604	1799	77	2	0
Other Acetabular Prosthesis	382641	341622	270769	202806	79499	21541	1383

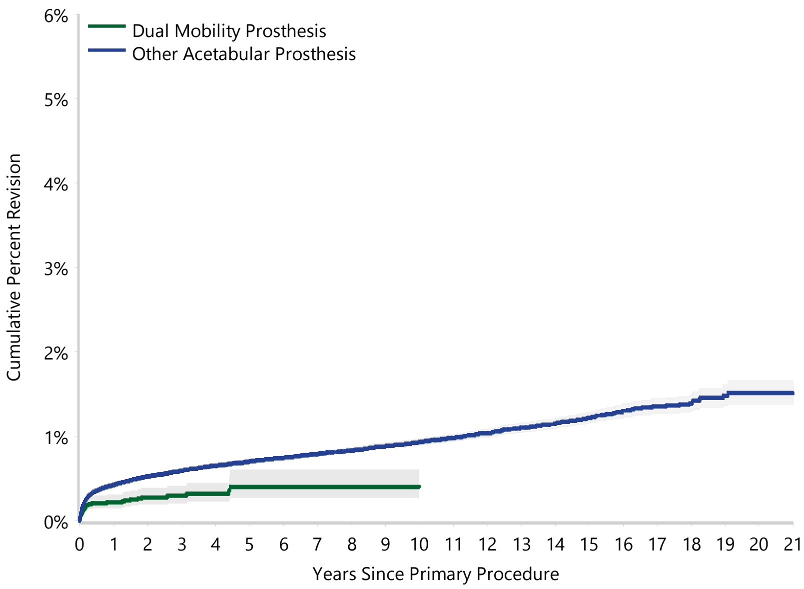
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT59 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	40	14620	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	2839	382641	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 (1.2, 1.3)	1.5 (1.4, 1.7)
TOTAL	2879	397261						

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

Figure HT60 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Acetabular Mobility (Primary Diagnosis OA, Revision for Prosthesis Dislocation/Instability)



HR - adjusted for age and gender
Dual Mobility Prosthesis vs
Other Acetabular Prosthesis
Entire Period: HR=0.51 (0.38, 0.70), p<0.001

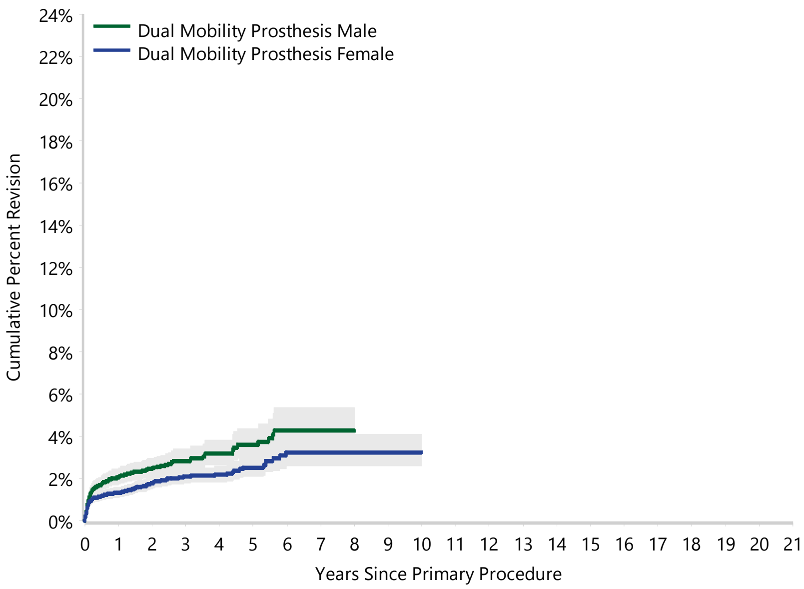
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Dual Mobility Prosthesis	14620	10453	4604	1799	77	2	0
Other Acetabular Prosthesis	382641	341622	270769	202806	79499	21541	1383

Table HT60 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	141	5429	2.1 (1.7, 2.5)	2.8 (2.4, 3.4)	3.6 (2.9, 4.4)			
	Female	168	9191	1.3 (1.1, 1.6)	2.1 (1.8, 2.5)	2.5 (2.1, 3.1)	3.2 (2.6, 4.1)		
TOTAL		309	14620						

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

Figure HT61 Cumulative Percent Revision of Dual Mobility Primary Total Conventional Hip Replacement by Gender (Primary Diagnosis OA)



HR - adjusted for age
Dual Mobility Prosthesis Female vs
Dual Mobility Prosthesis Male
Entire Period: HR=0.70 (0.56, 0.88), p=0.002

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Dual Mobility Prosthesis	Male	5429	3857	1714	715	21	1	0
	Female	9191	6596	2890	1084	56	1	0

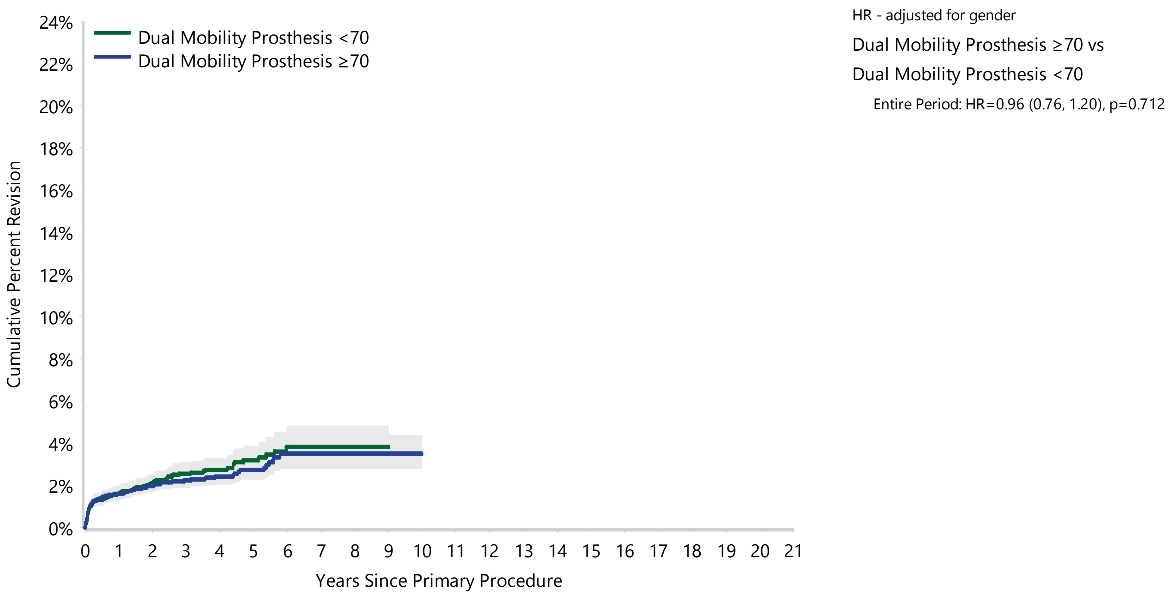
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT61 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	135	6000	1.6 (1.3, 2.0)	2.6 (2.1, 3.1)	3.2 (2.6, 3.9)			
	≥70	174	8620	1.6 (1.3, 1.9)	2.2 (1.9, 2.6)	2.7 (2.3, 3.3)	3.5 (2.8, 4.4)		
TOTAL		309	14620						

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

Figure HT62 Cumulative Percent Revision of Dual Mobility Primary Total Conventional Hip Replacement by Age (Primary Diagnosis OA)



Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Dual Mobility Prosthesis	<70	6000	4419	2055	816	29	0	0
	≥70	8620	6034	2549	983	48	2	0

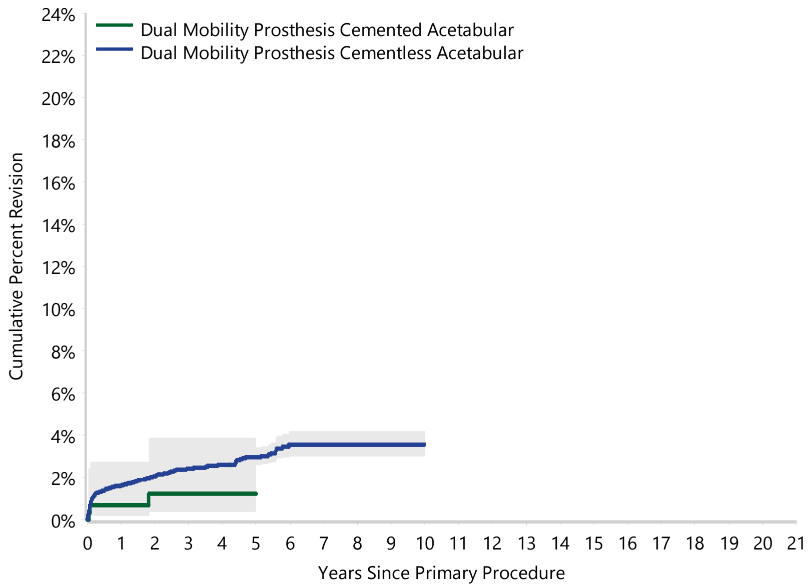
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT62 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	303	14327	1.6 (1.4, 1.9)	2.4 (2.1, 2.7)	3.0 (2.6, 3.4)	3.6 (3.0, 4.2)		
	Cemented	6	293	0.7 (0.2, 2.7)	1.2 (0.4, 3.9)	1.2 (0.4, 3.9)			
TOTAL		309	14620						

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

Figure HT63 Cumulative Percent Revision of Dual Mobility Primary Total Conventional Hip Replacement by Acetabular Fixation (Primary Diagnosis OA)



HR - adjusted for age and gender
Dual Mobility Prosthesis Cemented Acetabular vs
Dual Mobility Prosthesis Cementless Acetabular
Entire Period: HR=0.88 (0.39, 1.98), p=0.758

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Dual Mobility Prosthesis	Cemented Acetabular	293	227	127	56	4	0	0
	Cementless Acetabular	14327	10226	4477	1743	73	2	0

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

Surgical Approach

The Registry commenced collection of surgical approach in 2015 and can now report on the outcome of 62,420 anterior, 34,328 lateral, and 122,642 posterior total conventional hip replacement procedures for osteoarthritis. 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 HT63 to Table HT65).

The following analyses were performed with hazard ratios adjusted for age, gender, ASA score, BMI category, femoral fixation, and head size. There is no difference in the overall rate of revision when surgical approach is compared (Table HT66 and Figure HT64). However, there are differences in the types of revision and reasons for revision between the approaches.

There is a higher rate of major revisions with the anterior approach compared to other approaches. There is no difference between the posterior and lateral approaches (Table HT67 and Figure HT65). The most common reasons for revision of primary total hip replacement in the first 6 years include loosening, fracture, infection, and dislocation/instability (Figure HT66).

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 HT68 and Figure HT67).

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 (Table HT69 and Figure HT68). There is no difference when the posterior approach is compared to the lateral approach.

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 HT70 and Figure HT69).

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 HT71 and Figure HT70).

PROMs and Surgical Approach

Patient-reported outcomes for the three commonly performed surgical approaches for primary total conventional hip replacement were analysed. The anterior approach has slightly higher pre- and post-operative mean EQ-VAS scores, but the change in score after surgery is similar for each approach (Table HT72 and Figure HT71). There were similar findings for the OHS (Table HT73 and Figure HT72).

There is a similar proportion of patients who are very satisfied or satisfied when comparing the three surgical approaches (Table HT74 and Figure HT73).

The patient-reported change of "much better" is slightly higher for the anterior approach compared to the lateral approach (Table HT75 and Figure HT74).

Table HT63 Primary Total Conventional Hip Replacement by Age and Surgical Approach (Primary Diagnosis OA)

Age	Anterior		Lateral		Posterior	
	N	Col%	N	Col%	N	Col%
<55	7741	12.4	3491	10.2	12787	10.4
55-64	16260	26.0	7899	23.0	28693	23.4
65-74	22839	36.6	12540	36.5	44407	36.2
≥75	15580	25.0	10398	30.3	36755	30.0
TOTAL	**62420**	**100.0**	**34328**	**100.0**	**122642**	**100.0**

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

Table HT64 Primary Total Conventional Hip Replacement by BMI Category and Surgical Approach (Primary Diagnosis OA)

BMI Category	Anterior		Lateral		Posterior	
	N	Col%	N	Col%	N	Col%
Underweight (<18.50)	461	0.8	242	0.7	820	0.7
Normal (18.50-24.99)	14592	23.9	6339	19.4	22850	19.3
Pre Obese (25.00-29.99)	24222	39.7	11644	35.6	42161	35.7
Obese Class 1 (30.00-34.99)	14571	23.9	8726	26.7	30916	26.2
Obese Class 2 (35.00-39.99)	5131	8.4	3877	11.8	14111	11.9
Obese Class 3 (≥40.00)	1989	3.3	1900	5.8	7291	6.2
TOTAL	**60966**	**100.0**	**32728**	**100.0**	**118149**	**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 HT65 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	7204	11.6	2665	7.8	9243	7.5
ASA 2	35199	56.5	18078	52.8	65284	53.3
ASA 3	19304	31.0	12998	38.0	45994	37.6
ASA 4	620	1.0	497	1.5	1914	1.6
ASA 5	2	0.0	1	0.0	4	0.0
TOTAL	**62329**	**100.0**	**34239**	**100.0**	**122439**	**100.0**

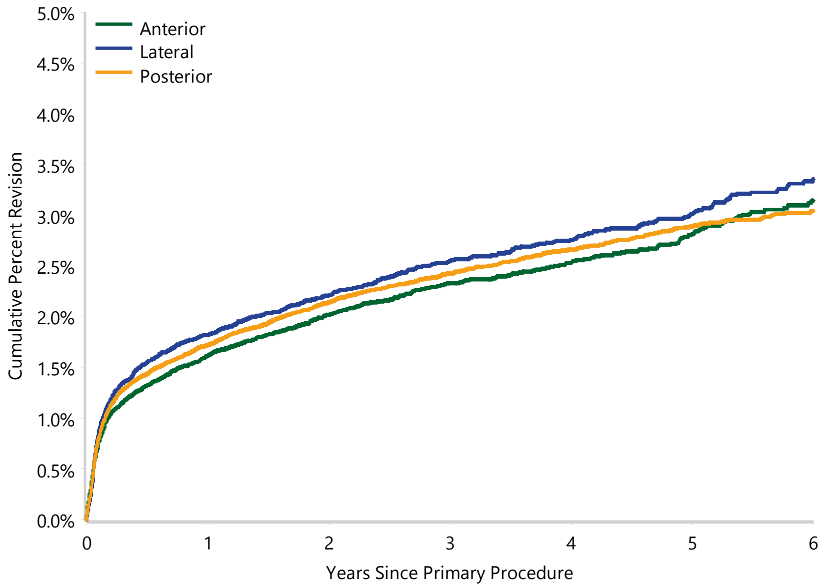
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT66 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Surgical Approach (Primary Diagnosis OA)

Surgical Approach	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Anterior	1351	60905	1.6 (1.5, 1.7)	2.0 (1.9, 2.1)	2.3 (2.2, 2.5)	2.5 (2.4, 2.7)	2.8 (2.7, 3.0)	3.1 (2.9, 3.4)
Lateral	857	32663	1.8 (1.7, 2.0)	2.2 (2.1, 2.4)	2.5 (2.4, 2.7)	2.8 (2.6, 3.0)	3.0 (2.8, 3.2)	3.4 (3.1, 3.6)
Posterior	2726	118017	1.7 (1.6, 1.8)	2.1 (2.1, 2.2)	2.4 (2.3, 2.5)	2.7 (2.6, 2.8)	2.9 (2.8, 3.0)	3.0 (2.9, 3.2)
TOTAL	4934	211585						

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 HT64 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Surgical Approach (Primary Diagnosis OA)



HR adjusted for age, gender, ASA score and BMI category, femoral fixation and head size

Lateral vs Anterior
Entire Period: HR=1.07 (0.98, 1.16),p=0.152

Posterior vs Anterior
Entire Period: HR=1.01 (0.95, 1.09),p=0.670

Posterior vs Lateral
Entire Period: HR=0.95 (0.88, 1.03),p=0.206

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Anterior	60905	48608	38434	28504	19407	11558	4929
Lateral	32663	28154	24010	19426	14623	9663	4483
Posterior	118017	94816	75079	55312	37899	22454	9710

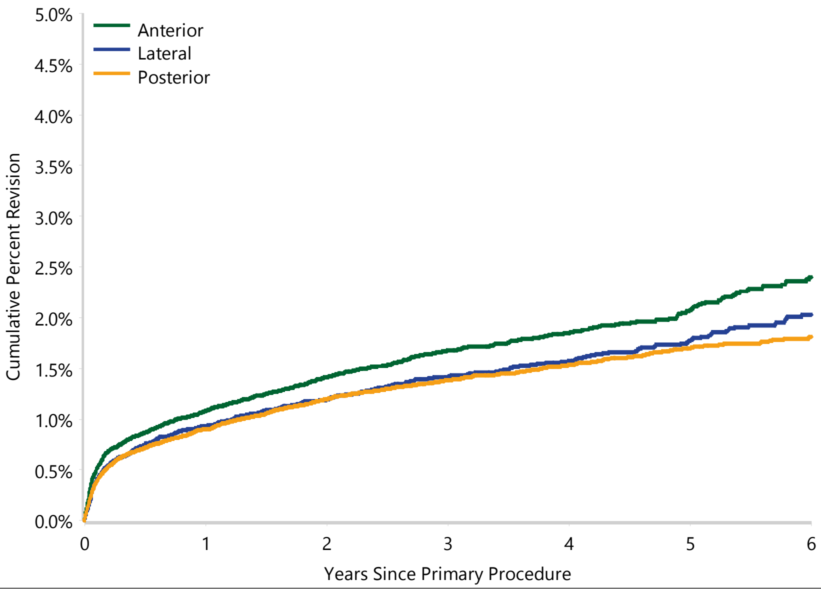
Note: All procedures using metal/metal prostheses have been excluded
Excludes procedures with unknown ASA score, BMI category or head size
Due to low numbers, ASA score 1-2 and 3-5 have been combined
Due to low numbers BMI category underweight and normal have been combined
Restricted to modern prostheses

Table HT67 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Surgical Approach (Primary Diagnosis OA, Major Revisions)

Surgical Approach	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Anterior	971	60905	1.1 (1.0, 1.2)	1.4 (1.3, 1.5)	1.7 (1.6, 1.8)	1.9 (1.7, 2.0)	2.1 (1.9, 2.2)	2.4 (2.2, 2.6)
Lateral	486	32663	0.9 (0.8, 1.0)	1.2 (1.1, 1.3)	1.4 (1.3, 1.6)	1.6 (1.4, 1.7)	1.8 (1.6, 1.9)	2.0 (1.8, 2.2)
Posterior	1536	118017	0.9 (0.8, 1.0)	1.2 (1.1, 1.3)	1.4 (1.3, 1.5)	1.5 (1.5, 1.6)	1.7 (1.6, 1.8)	1.8 (1.7, 1.9)
TOTAL	2993	211585						

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 HT65 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=0.85 (0.76, 0.95),p=0.004

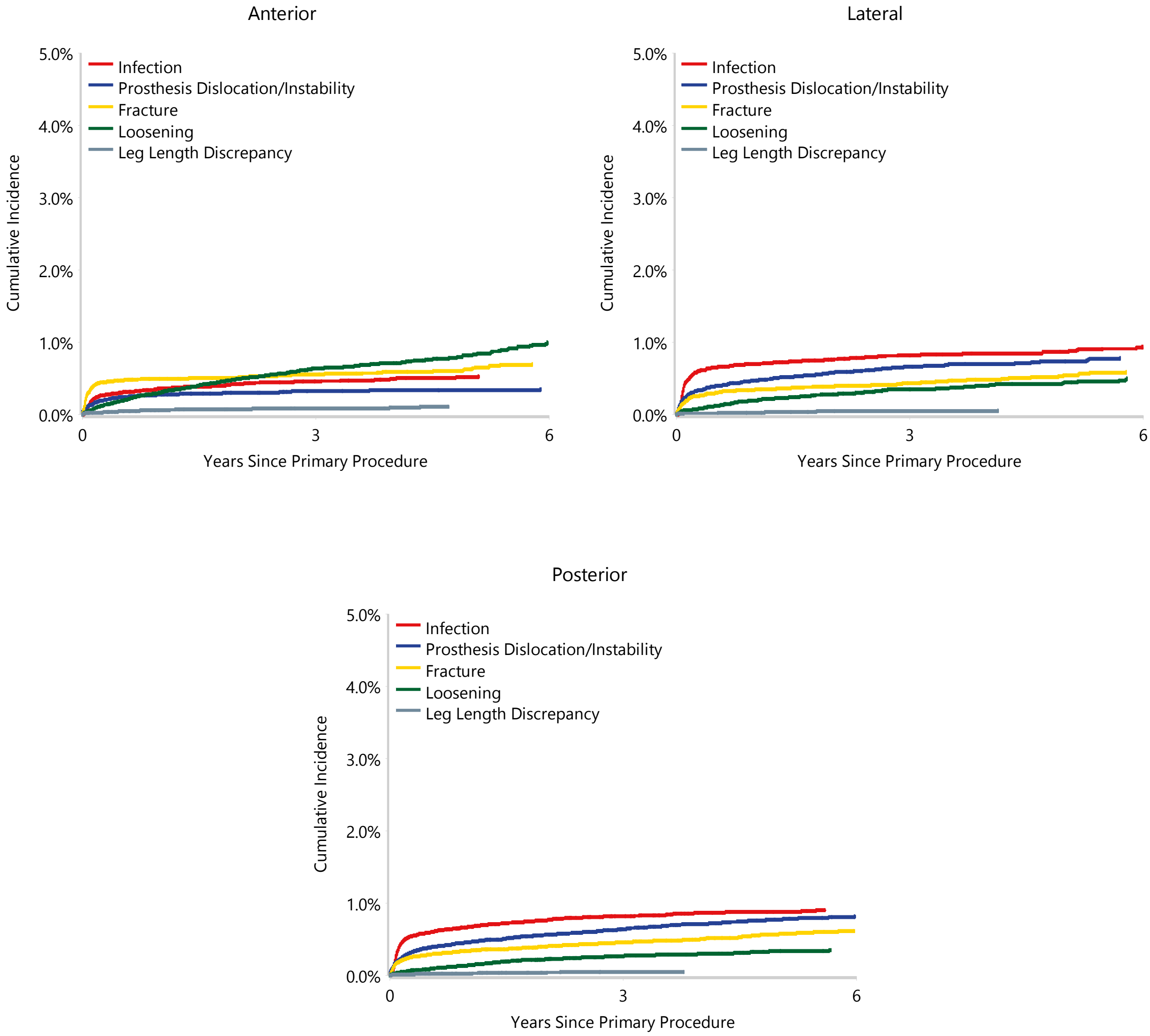
Posterior vs Anterior
Entire Period: HR=0.82 (0.75, 0.89),p<0.001

Posterior vs Lateral
Entire Period: HR=0.96 (0.87, 1.06),p=0.448

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Anterior	60905	48608	38434	28504	19407	11558	4929
Lateral	32663	28154	24010	19426	14623	9663	4483
Posterior	118017	94816	75079	55312	37899	22454	9710

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 HT66 Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement by Surgical Approach (Primary Diagnosis OA)



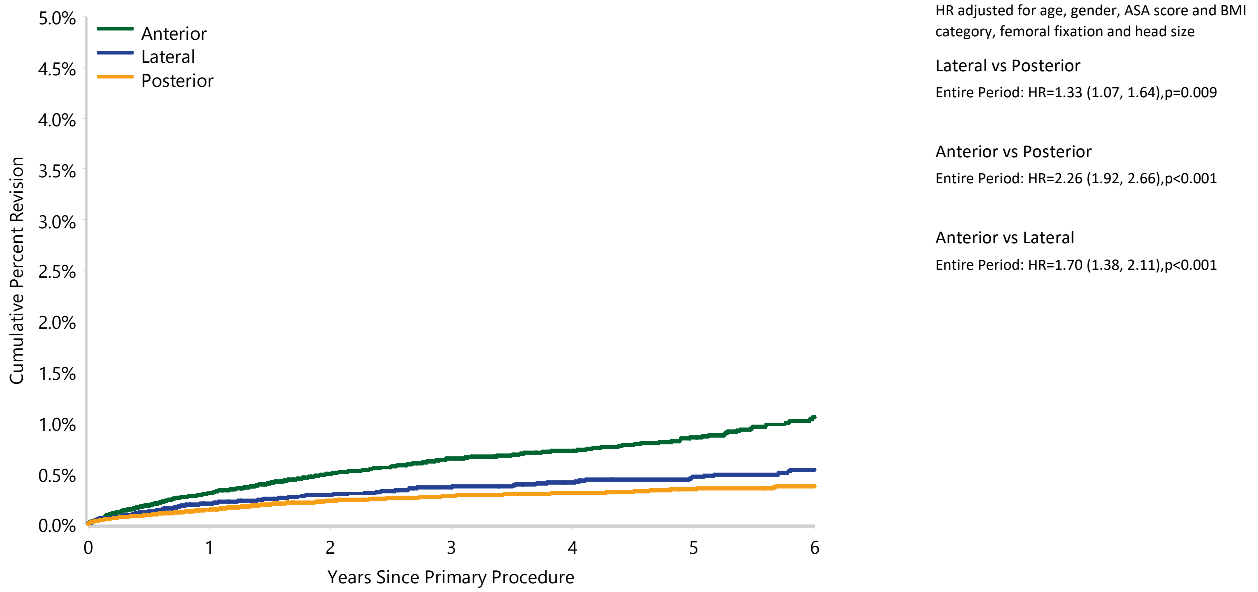
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT68 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	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Anterior	358	60905	0.3 (0.3, 0.4)	0.5 (0.4, 0.6)	0.6 (0.6, 0.7)	0.7 (0.6, 0.8)	0.8 (0.8, 1.0)	1.1 (0.9, 1.2)
Lateral	121	32663	0.2 (0.2, 0.3)	0.3 (0.2, 0.4)	0.4 (0.3, 0.4)	0.4 (0.3, 0.5)	0.5 (0.4, 0.6)	0.5 (0.4, 0.7)
Posterior	291	118017	0.1 (0.1, 0.2)	0.2 (0.2, 0.3)	0.3 (0.2, 0.3)	0.3 (0.3, 0.3)	0.3 (0.3, 0.4)	0.4 (0.3, 0.4)
TOTAL	770	211585						

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 HT67 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	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Anterior	60905	48608	38434	28504	19407	11558	4929
Lateral	32663	28154	24010	19426	14623	9663	4483
Posterior	118017	94816	75079	55312	37899	22454	9710

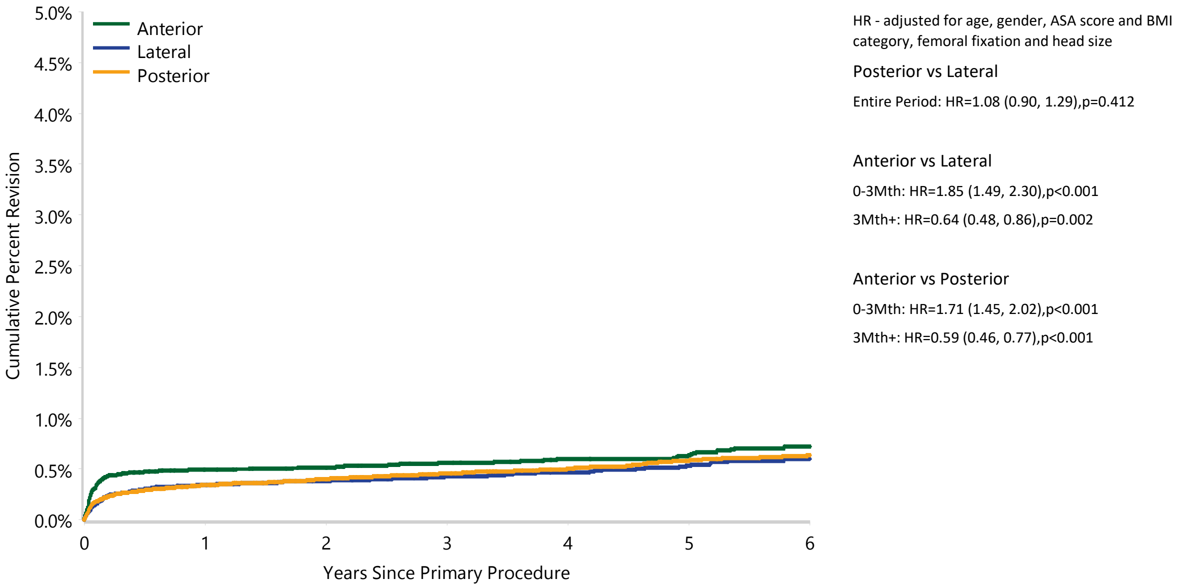
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses
Excludes procedures with unknown ASA score, BMI category or head size
Due to low numbers, ASA scores 1-2 and 3-5 have been combined
Due to low numbers, BMI categories underweight and normal have been combined

Table HT69 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	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Anterior	341	60905	0.5 (0.4, 0.6)	0.5 (0.5, 0.6)	0.6 (0.5, 0.6)	0.6 (0.5, 0.7)	0.6 (0.6, 0.7)	0.7 (0.6, 0.8)
Lateral	150	32663	0.3 (0.3, 0.4)	0.4 (0.3, 0.5)	0.4 (0.4, 0.5)	0.5 (0.4, 0.6)	0.5 (0.4, 0.6)	0.6 (0.5, 0.7)
Posterior	531	118017	0.3 (0.3, 0.4)	0.4 (0.4, 0.4)	0.5 (0.4, 0.5)	0.5 (0.5, 0.5)	0.6 (0.5, 0.6)	0.6 (0.6, 0.7)
TOTAL	1022	211585						

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 HT68 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Surgical Approach (Primary Diagnosis OA, Revision for Fracture)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Anterior	60905	48608	38434	28504	19407	11558	4929
Lateral	32663	28154	24010	19426	14623	9663	4483
Posterior	118017	94816	75079	55312	37899	22454	9710

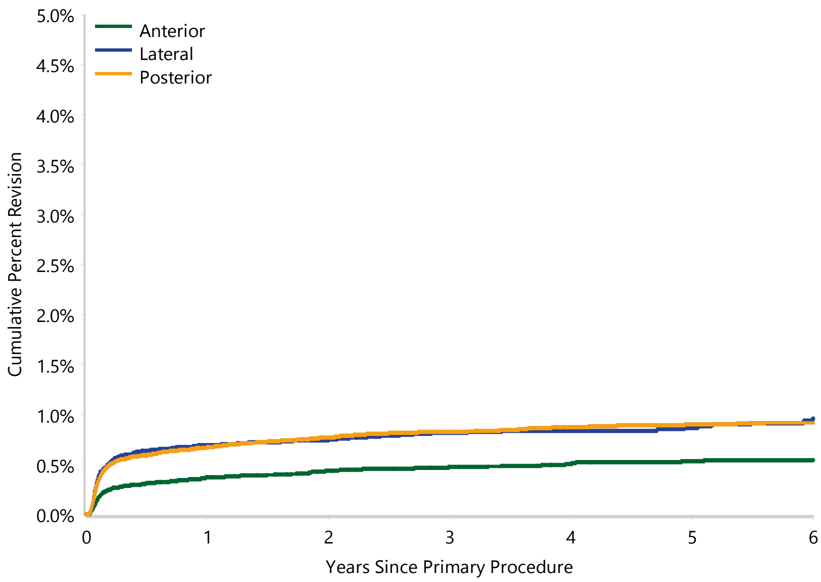
Note: All procedures using metal/metal prostheses have been excluded
Excludes procedures with unknown ASA score, BMI category or head size
Due to low numbers, ASA scores 1-2, and 3-5 have been combined
Due to low numbers, BMI categories underweight and normal have been combined
Restricted to modern prostheses

Table HT70 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	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Anterior	269	60905	0.4 (0.3, 0.4)	0.4 (0.4, 0.5)	0.5 (0.4, 0.5)	0.5 (0.4, 0.6)	0.5 (0.5, 0.6)	0.5 (0.5, 0.6)
Lateral	264	32663	0.7 (0.6, 0.8)	0.7 (0.7, 0.9)	0.8 (0.7, 0.9)	0.8 (0.7, 0.9)	0.9 (0.8, 1.0)	1.0 (0.8, 1.1)
Posterior	919	118017	0.7 (0.6, 0.7)	0.8 (0.7, 0.8)	0.8 (0.8, 0.9)	0.9 (0.8, 0.9)	0.9 (0.8, 1.0)	0.9 (0.9, 1.0)
TOTAL	1452	211585						

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 HT69 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=1.48 (1.24, 1.76),p<0.001

Posterior vs Anterior
Entire Period: HR=1.47 (1.28, 1.69),p<0.001

Posterior vs Lateral
Entire Period: HR=0.99 (0.87, 1.14),p=0.940

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Anterior	60905	48608	38434	28504	19407	11558	4929
Lateral	32663	28154	24010	19426	14623	9663	4483
Posterior	118017	94816	75079	55312	37899	22454	9710

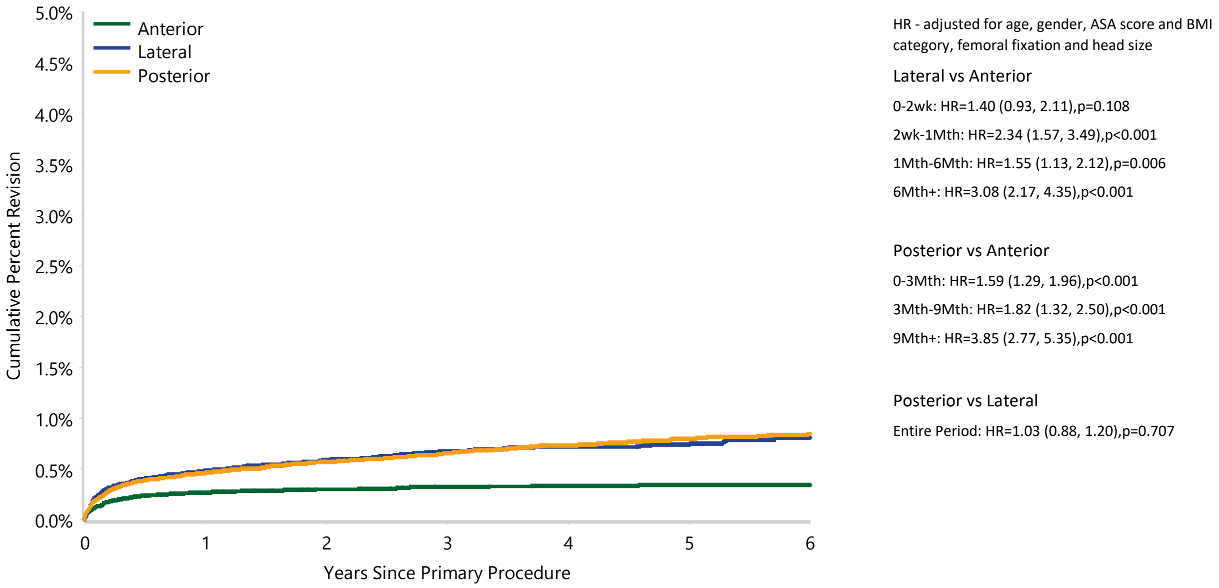
Note: All procedures using metal/metal prostheses have been excluded
Excludes procedures with unknown ASA score, BMI category or head size
Due to low numbers, ASA scores 1-2 and 3-5 were combined
Due to low numbers, BMI categories underweight and normal were combined
Restricted to modern prostheses

Table HT71 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	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Anterior	182	60905	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	215	32663	0.5 (0.4, 0.6)	0.6 (0.5, 0.7)	0.7 (0.6, 0.8)	0.7 (0.6, 0.8)	0.7 (0.6, 0.9)	0.8 (0.7, 0.9)
Posterior	735	118017	0.5 (0.4, 0.5)	0.6 (0.5, 0.6)	0.7 (0.6, 0.7)	0.7 (0.7, 0.8)	0.8 (0.7, 0.9)	0.8 (0.8, 0.9)
TOTAL	1132	211585						

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 HT70 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Surgical Approach (Primary Diagnosis OA, Revision for Dislocation/Instability)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Anterior	60905	48608	38434	28504	19407	11558	4929
Lateral	32663	28154	24010	19426	14623	9663	4483
Posterior	118017	94816	75079	55312	37899	22454	9710

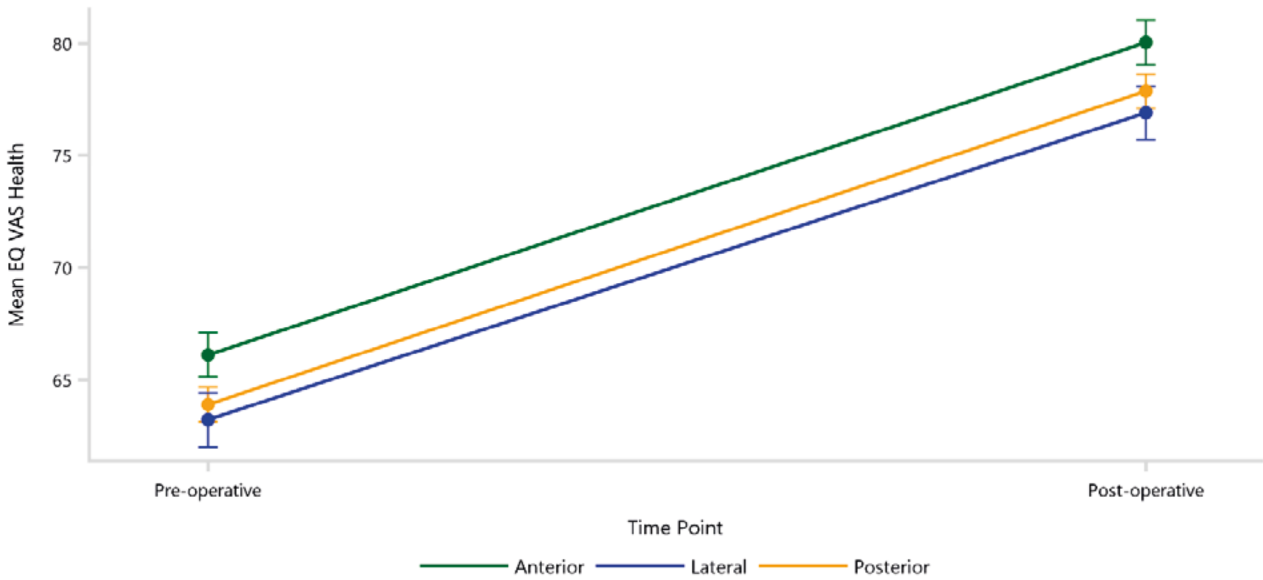
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses
Excludes procedures with unknown ASA score, BMI category or head size
Due to low numbers, ASA scores 1-2 and 3-5 have been combined
Due to low numbers, BMI categories underweight and normal have been combined

Table HT72 Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Conventional Hip Replacement by Surgical Approach (Primary Diagnosis OA)

Surgical Approach	Pre-operative		Post-operative		
	N	Mean (95% CI)	N	Mean (95% CI)	Change in Score
Anterior	3006	66.11 (65.13, 67.08)	1758	80.03 (79.03, 81.03)	13.92 (13.02, 14.82)
Lateral	1441	63.21 (62.00, 64.43)	993	76.89 (75.70, 78.08)	13.68 (12.43, 14.92)
Posterior	8956	63.90 (63.13, 64.67)	5704	77.86 (77.09, 78.63)	13.96 (13.45, 14.46)

Note: Restricted to modern prostheses
Adjusted for age, gender, ASA score and BMI category

Figure HT71 Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Conventional Hip Replacement by Surgical Approach (Primary Diagnosis OA)



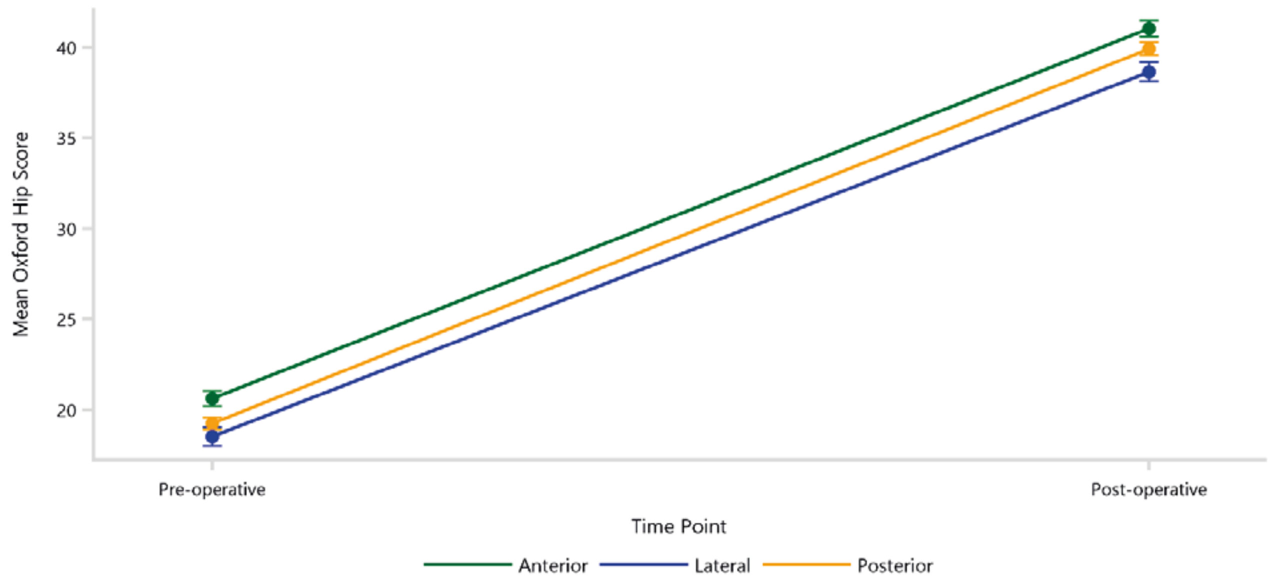
Note: Restricted to modern prostheses
Adjusted for age, gender, ASA score and BMI category

Table HT73 Mean Pre-operative and Post-operative Oxford Hip Score in Primary Total Conventional Hip Replacement by Surgical Approach (Primary Diagnosis OA)

Surgical Approach	Pre-operative		Post-operative		
	N	Mean (95% CI)	N	Mean (95% CI)	Change in Score
Anterior	2997	20.62 (20.20, 21.04)	1762	41.03 (40.58, 41.47)	20.41 (19.99, 20.83)
Lateral	1441	18.52 (17.99, 19.05)	990	38.65 (38.12, 39.19)	20.13 (19.56, 20.71)
Posterior	8956	19.24 (18.90, 19.57)	5726	39.93 (39.59, 40.27)	20.69 (20.46, 20.92)

Note: Restricted to modern prostheses
Adjusted for age, gender, ASA score and BMI category

Figure HT72 Mean Pre-operative and Post-operative Oxford Hip Score in Primary Total Conventional Hip Replacement by Surgical Approach (Primary Diagnosis OA)



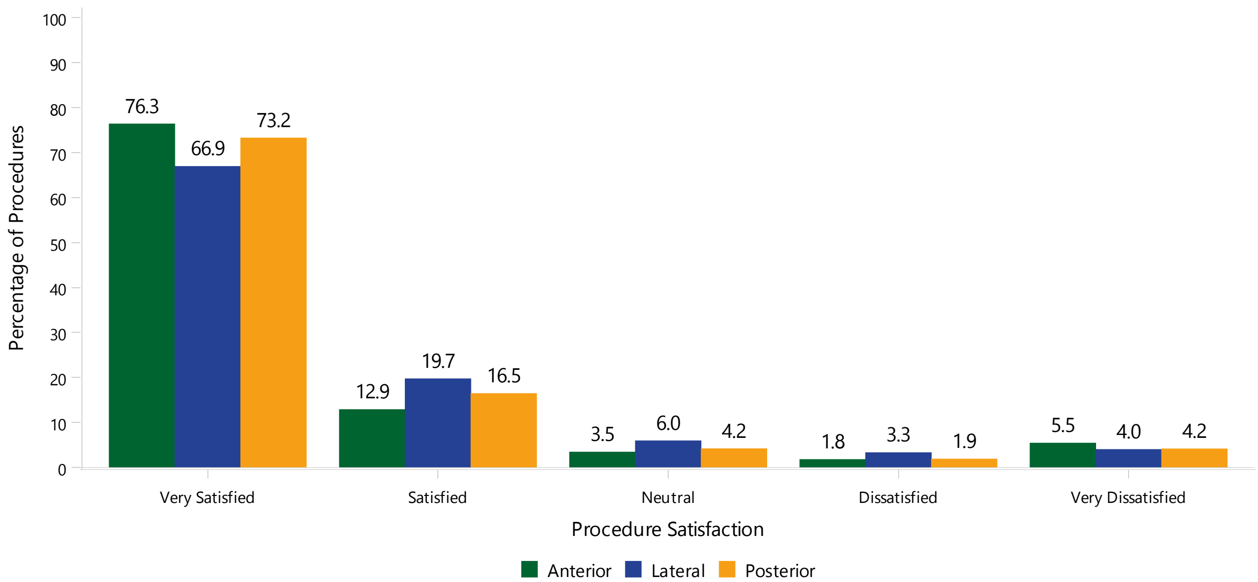
Note: Restricted to modern prostheses
Adjusted for age, gender, ASA score and BMI category

Table HT74 Procedure Satisfaction in Primary Total Conventional Hip Replacement by Surgical Approach (Primary Diagnosis OA)

Surgical Approach	Very Satisfied			Satisfied			Neutral			Dissatisfied			Very Dissatisfied			TOTAL		
	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%
Anterior	1342	76.3	21.7	227	12.9	16.6	61	3.5	16.9	32	1.8	18.3	96	5.5	25.6	1758	100.0	20.8
Lateral	661	66.9	10.7	195	19.7	14.3	59	6.0	16.3	33	3.3	18.9	40	4.0	10.7	988	100.0	11.7
Posterior	4187	73.2	67.6	942	16.5	69.1	241	4.2	66.8	110	1.9	62.9	239	4.2	63.7	5719	100.0	67.6
TOTAL	**6190**	**73.1**	**100.0**	**1364**	**16.1**	**100.0**	**361**	**4.3**	**100.0**	**175**	**2.1**	**100.0**	**375**	**4.4**	**100.0**	**8465**	**100.0**	**100.0**

Note: Restricted to modern prostheses

Figure HT73 Procedure Satisfaction in Primary Total Conventional Hip Replacement by Surgical Approach (Primary Diagnosis OA)



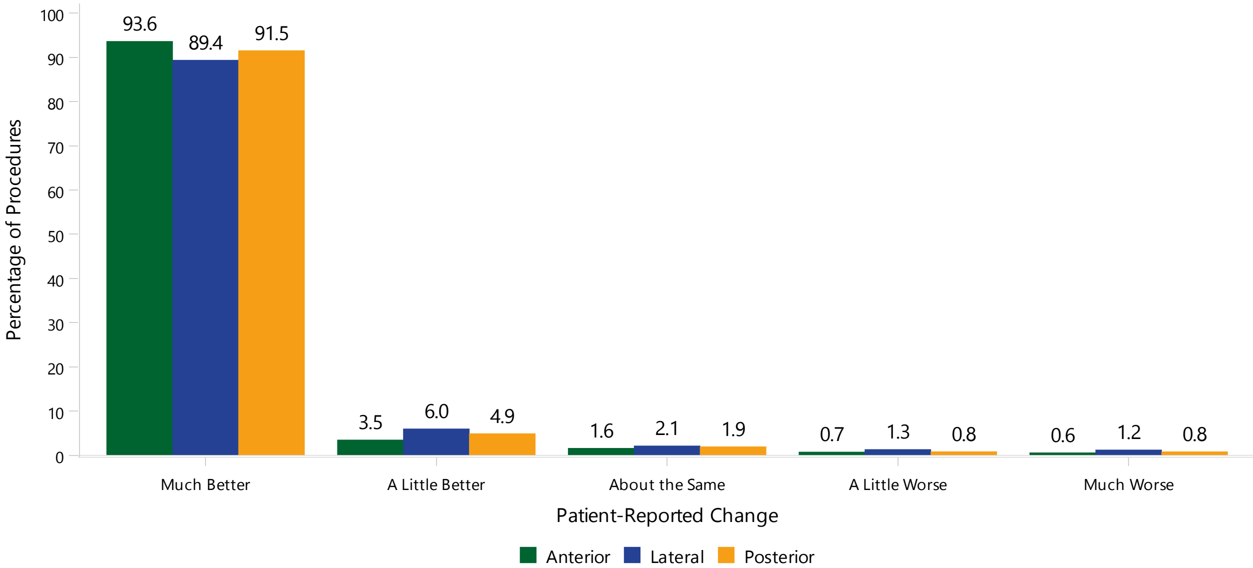
Note: Restricted to modern prostheses

Table HT75 Patient-Reported Change in Primary Total Conventional Hip Replacement by Surgical Approach (Primary Diagnosis OA)

Surgical Approach	Much Better			A Little Better			About the Same			A Little Worse			Much Worse			TOTAL		
	N	Row %	Col%	N	Row %	Col%	N	Row %	Col%	N	Row %	Col%	N	Row %	Col%	N	Row %	Col%
Anterior	1645	93.6	21.2	61	3.5	15.3	28	1.6	17.5	13	0.7	17.8	10	0.6	14.7	1757	100.0	20.8
Lateral	883	89.4	11.4	59	6.0	14.8	21	2.1	13.1	13	1.3	17.8	12	1.2	17.6	988	100.0	11.7
Posterior	5235	91.5	67.4	280	4.9	70.0	111	1.9	69.4	47	0.8	64.4	46	0.8	67.6	5719	100.0	67.6
TOTAL	7763	91.7	100.0	400	4.7	100.0	160	1.9	100.0	73	0.9	100.0	68	0.8	100.0	8464	100.0	100.0

Note: Restricted to modern prostheses

Figure HT74 Patient-Reported Change in Primary Total Conventional Hip Replacement by Surgical Approach (Primary Diagnosis OA)



Note: Restricted to modern prostheses

OUTCOME FOR FRACTURED NECK OF FEMUR

There have been 24,801 primary total conventional hip replacement procedures recorded by the Registry with a diagnosis of fractured neck of femur.

The cumulative percent revision of primary total conventional hip replacement for fractured neck of femur is 9.4% at 15 years (Table HT76 and Figure HT75).

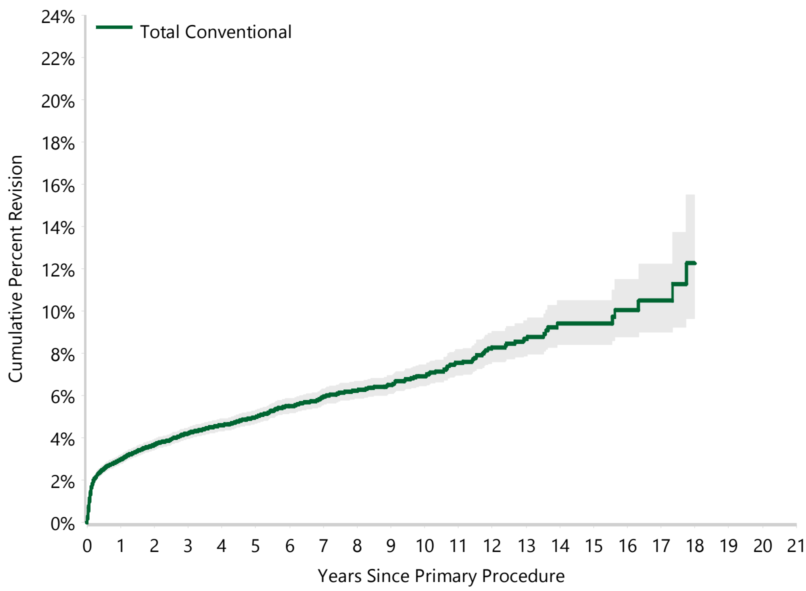
At 15 years, the cumulative percent survival of patients is 30.4% (Table HT77 and Figure HT76).

Table HT76 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	1163	24801	3.0 (2.8, 3.2)	4.2 (4.0, 4.5)	5.0 (4.7, 5.3)	6.9 (6.5, 7.5)	9.4 (8.4, 10.5)	
TOTAL	1163	24801						

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

Figure HT75 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	24801	20122	13747	8690	2286	352	14

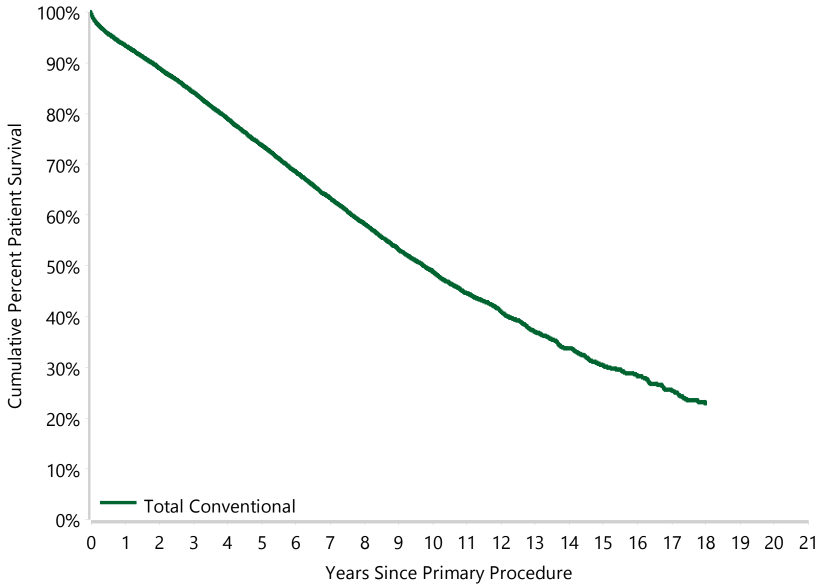
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT77 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	7263	24801	93.4 (93.1, 93.7)	84.2 (83.7, 84.7)	73.7 (73.1, 74.4)	48.9 (47.8, 49.9)	30.4 (28.8, 32.0)	
TOTAL	7263	24801						

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

Figure HT76 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	24801	20122	13747	8690	2286	352	14

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 HT78 and Figure HT77).

Type of Revision

Replacement of the femoral component only is the most common type of revision, followed by head and insert, acetabular only, and total hip replacement (femoral/acetabular) (Table HT79).

Table HT78 Primary Total Conventional Hip Replacement by Reason for Revision (Primary Diagnosis Fractured NOF)

Reason for Revision	Number	Percent
Prosthesis Dislocation/Instability	392	33.7
Fracture	329	28.3
Infection	212	18.2
Loosening	155	13.3
Leg Length Discrepancy	10	0.9
Pain	8	0.7
Malposition	8	0.7
Implant Breakage Acetabular	7	0.6
Implant Breakage Stem	7	0.6
Lysis	7	0.6
Implant Breakage Acetabular Insert	6	0.5
Tumour	4	0.3
Metal Related Pathology	3	0.3
Heterotopic Bone	1	0.1
Incorrect Sizing	1	0.1
Progression Of Disease	1	0.1
Wear Head	1	0.1
Other	11	0.9
TOTAL	**1163**	**100.0**

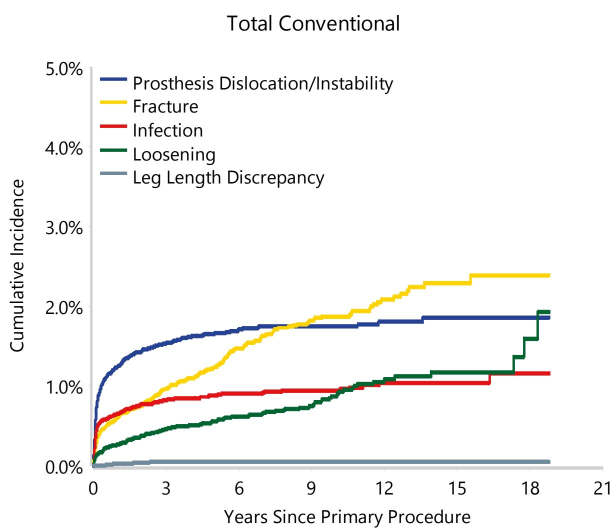
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT79 Primary Total Conventional Hip Replacement by Type of Revision (Primary Diagnosis Fractured NOF)

Type of Revision	Number	Percent
Femoral Component	409	35.2
Head/Insert	297	25.5
Acetabular Component	202	17.4
THR (Femoral/Acetabular)	120	10.3
Head Only	48	4.1
Cement Spacer	35	3.0
Minor Components	25	2.1
Insert Only	18	1.5
Removal of Prostheses	6	0.5
Total Femoral	2	0.2
Reinsertion of Components	1	0.1
TOTAL	**1163**	**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 HT77 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 chapter. The Registry can now report on the early outcome of 17,602 primary total conventional hip replacement procedures for fractured neck of femur in relation to these scores.

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 HT80 and Figure HT78). The most common reasons for revision for each ASA score are shown in Figure HT79. 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 above than patients with osteoarthritis (Table HT81).

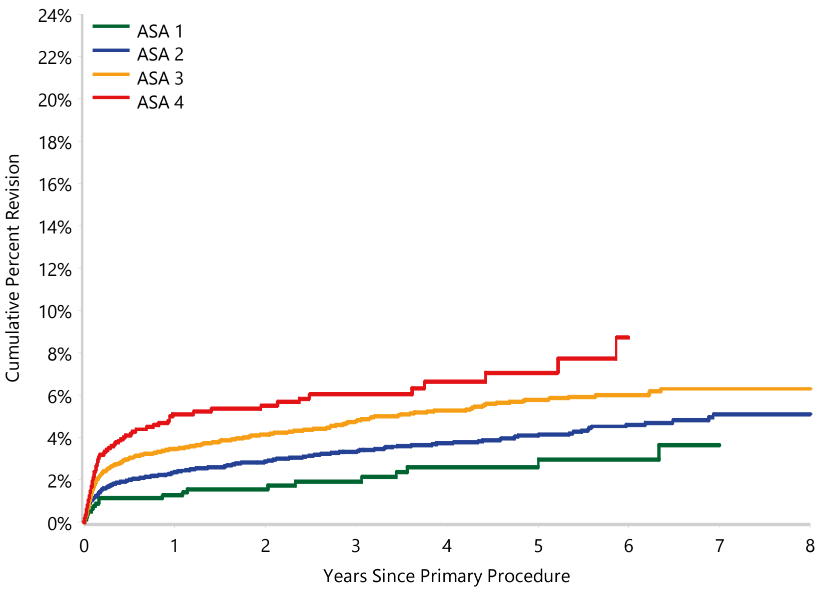
BMI data have been collected since 2015. The early revision outcomes are reported for 10,464 primary total conventional hip replacement procedures for fractured neck of femur. Patients in obese class 2 and obese class 3 have a higher rate of revision compared to patients in the normal BMI class (Table HT82 and Figure HT80). The most common reasons for revision are shown in Figure HT81.

Table HT80 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by ASA Score (Primary Diagnosis Fractured NOF)

ASA Score	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	7 Yrs
ASA 1	19	791	1.3 (0.7, 2.4)	1.6 (0.9, 2.8)	1.9 (1.1, 3.2)	2.6 (1.6, 4.2)	2.6 (1.6, 4.2)	3.6 (2.1, 6.2)
ASA 2	229	6522	2.4 (2.0, 2.8)	2.9 (2.5, 3.3)	3.3 (2.9, 3.9)	3.7 (3.3, 4.3)	4.1 (3.6, 4.7)	5.1 (4.3, 6.0)
ASA 3	397	8863	3.5 (3.1, 3.9)	4.1 (3.7, 4.6)	4.8 (4.3, 5.3)	5.3 (4.8, 5.8)	5.8 (5.2, 6.4)	6.3 (5.6, 7.1)
ASA 4	74	1417	5.1 (4.0, 6.5)	5.5 (4.3, 7.0)	6.0 (4.8, 7.7)	6.6 (5.2, 8.5)	7.1 (5.4, 9.2)	
ASA 5	0	9	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)				
TOTAL	719	17602						

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

Figure HT78 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=1.71 (1.07, 2.74), p=0.024

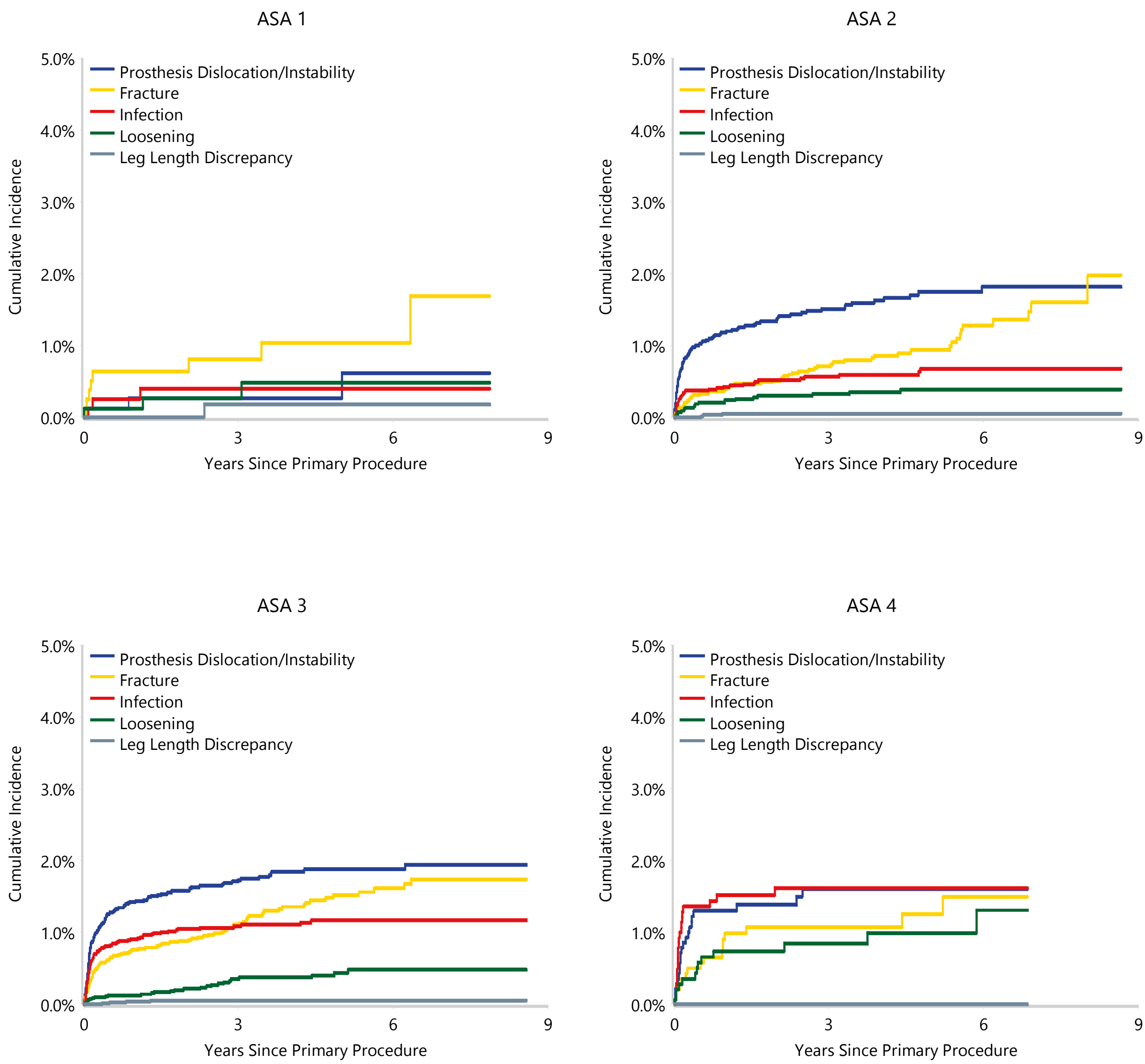
ASA 3 vs ASA 1
Entire Period: HR=2.46 (1.54, 3.91), p<0.001

ASA 4 vs ASA 1
Entire Period: HR=3.37 (2.02, 5.62), p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	7 Yrs
ASA 1	791	702	581	463	369	272	99
ASA 2	6522	5397	4515	3559	2664	1839	621
ASA 3	8863	6744	5161	3773	2636	1702	539
ASA 4	1417	883	607	414	274	159	37

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

Figure HT79 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 HT81 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	791	4.5	23214	8.9	24005	8.6
ASA 2	6522	37.1	142107	54.5	148629	53.4
ASA 3	8863	50.4	91745	35.2	100608	36.1
ASA 4	1417	8.1	3655	1.4	5072	1.8
ASA 5	9	0.1	12	0.0	21	0.0
TOTAL	17602	100.0	260733	100.0	278335	100.0

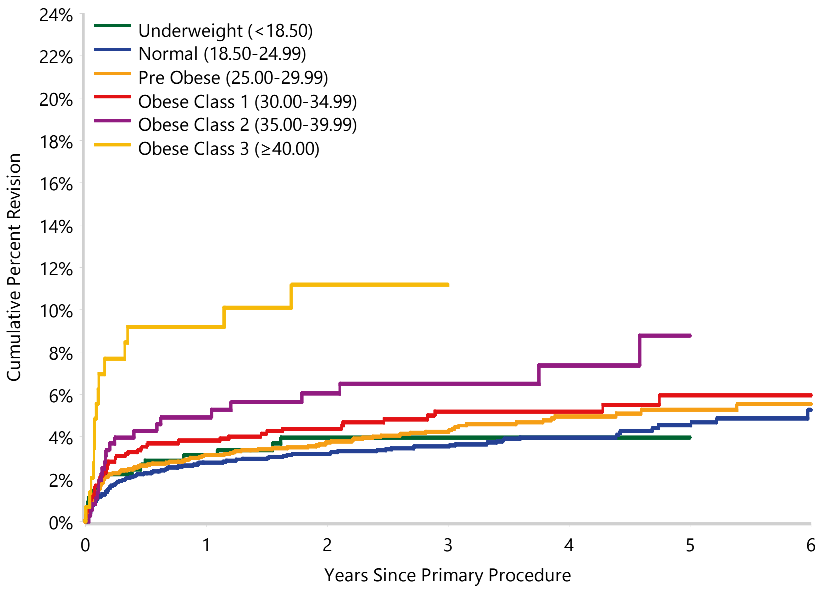
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT82 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by BMI Category (Primary Diagnosis Fractured NOF)

BMI Category	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Underweight (<18.50)	19	548	3.1 (1.9, 5.1)	4.0 (2.5, 6.2)	4.0 (2.5, 6.2)	4.0 (2.5, 6.2)	4.0 (2.5, 6.2)	
Normal (18.50-24.99)	155	4561	2.8 (2.3, 3.3)	3.2 (2.7, 3.8)	3.6 (3.0, 4.2)	4.0 (3.4, 4.7)	4.5 (3.8, 5.4)	5.3 (4.2, 6.6)
Pre Obese (25.00-29.99)	143	3585	3.2 (2.6, 3.8)	3.8 (3.1, 4.5)	4.3 (3.6, 5.1)	5.0 (4.2, 5.9)	5.3 (4.4, 6.3)	5.5 (4.5, 6.7)
Obese Class 1 (30.00-34.99)	58	1253	3.8 (2.9, 5.1)	4.4 (3.3, 5.7)	5.2 (4.0, 6.8)	5.2 (4.0, 6.8)	5.9 (4.5, 7.9)	5.9 (4.5, 7.9)
Obese Class 2 (35.00-39.99)	24	369	4.9 (3.1, 7.8)	6.0 (3.9, 9.2)	6.5 (4.3, 9.8)	7.4 (4.8, 11.3)	8.8 (5.4, 14.0)	
Obese Class 3 (≥40.00)	16	148	9.2 (5.4, 15.3)	11.2 (6.8, 17.9)	11.2 (6.8, 17.9)			
TOTAL	415	10464						

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 HT80 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=1.10 (0.68, 1.78), p=0.691

Pre Obese (25.00-29.99) vs Normal (18.50-24.99)
Entire Period: HR=1.14 (0.91, 1.44), p=0.248

Obese Class 1 (30.00-34.99) vs
Normal (18.50-24.99)
Entire Period: HR=1.31 (0.97, 1.78), p=0.078

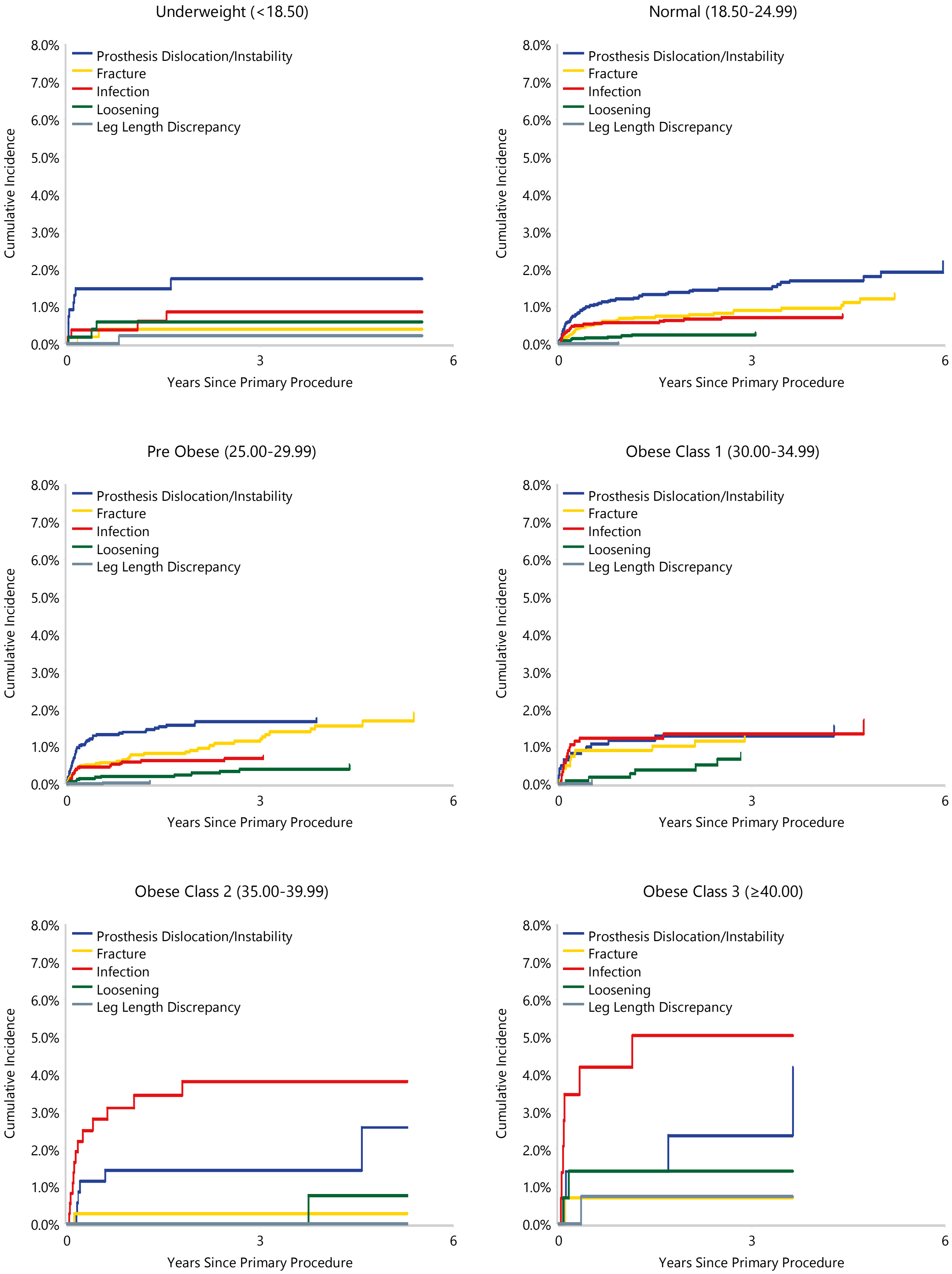
Obese Class 2 (35.00-39.99) vs
Normal (18.50-24.99)
Entire Period: HR=1.86 (1.21, 2.86), p=0.004

Obese Class 3 (≥40.00) vs Normal (18.50-24.99)
Entire Period: HR=3.34 (1.99, 5.61), p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Underweight (<18.50)	548	389	292	205	138	68	18
Normal (18.50-24.99)	4561	3441	2574	1809	1165	625	234
Pre Obese (25.00-29.99)	3585	2688	2006	1393	885	486	193
Obese Class 1 (30.00-34.99)	1253	933	689	489	342	187	76
Obese Class 2 (35.00-39.99)	369	274	215	155	97	52	24
Obese Class 3 (≥40.00)	148	103	76	53	28	11	3

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 HT81 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.

The Registry has recorded 1,448 procedures with cemented fixation, 6,084 with cementless fixation and 15,102 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 HT83 and Figure HT82).

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 (Table HT84 and Figure HT83).

For patients aged ≥70 years, there is almost twice the risk of revision for cementless implants compared to hybrid for the first 3 months.

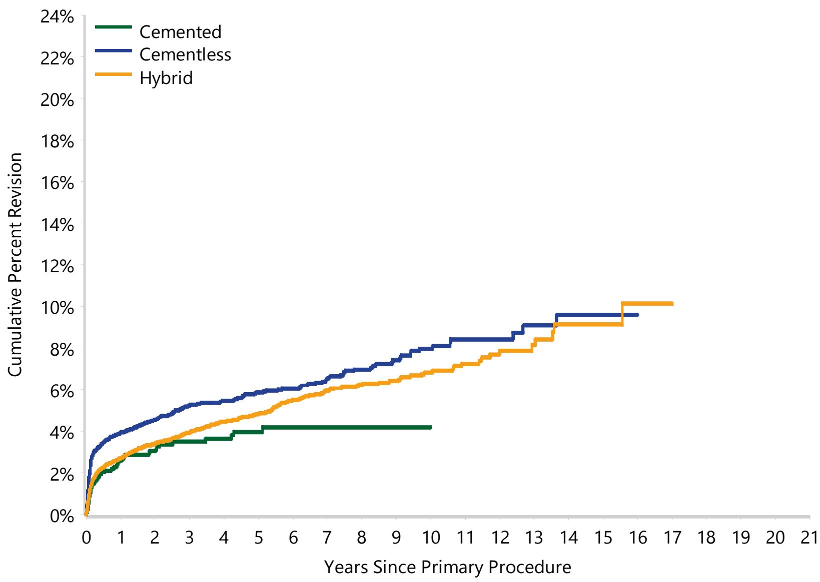
However, for patients aged ≥70 years, cementless fixation has a higher rate of revision than cemented fixation over the entire period, and for the first 3 months compared to hybrid fixation. There is no difference in the rate of revision when hybrid fixation is compared to cemented fixation (Table HT84 and Figure HT84).

Table HT83 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	48	1448	2.6 (1.9, 3.6)	3.1 (2.3, 4.2)	3.5 (2.6, 4.7)	4.0 (3.0, 5.3)	4.2 (3.1, 5.6)	4.2 (3.1, 5.6)
Cementless	347	6084	3.9 (3.5, 4.5)	4.5 (4.0, 5.1)	5.2 (4.7, 5.9)	5.9 (5.2, 6.5)	6.5 (5.8, 7.3)	8.0 (7.0, 9.1)
Hybrid	655	15102	2.7 (2.5, 3.0)	3.4 (3.1, 3.7)	3.9 (3.6, 4.3)	4.8 (4.5, 5.3)	6.0 (5.5, 6.5)	6.8 (6.2, 7.5)
TOTAL	1050	22634						

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

Figure HT82 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=1.44 (1.06, 1.96), p=0.018

Cementless vs Hybrid
0 - 3Mth: HR=1.64 (1.36, 1.98), p<0.001
3Mth+: HR=0.89 (0.74, 1.07), p=0.199

Hybrid vs Cemented
Entire Period: HR=1.22 (0.91, 1.64), p=0.180

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Cemented	1448	1149	945	768	450	238	48
Cementless	6084	5079	4353	3685	2454	1521	703
Hybrid	15102	12117	9980	7980	4850	2772	1070

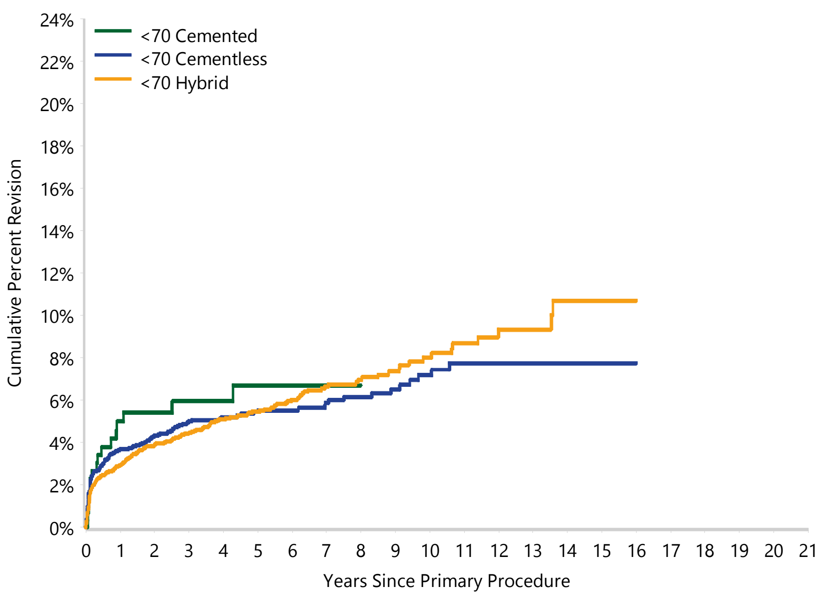
Note: Includes mixed ceramic/mixed ceramic and XLPE bearing surfaces
Restricted to modern prostheses

Table HT84 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		**389**	**7333**	**3.3 (2.9, 3.7)**	**4.1 (3.6, 4.6)**	**4.7 (4.2, 5.2)**	**5.5 (4.9, 6.1)**	**6.3 (5.7, 7.1)**	**7.6 (6.8, 8.6)**
	Cemented	17	310	5.0 (3.0, 8.3)	5.4 (3.3, 8.8)	5.9 (3.7, 9.6)	6.7 (4.1, 10.8)	6.7 (4.1, 10.8)	
	Cementless	132	2437	3.7 (3.0, 4.5)	4.3 (3.5, 5.2)	5.0 (4.2, 6.0)	5.4 (4.6, 6.5)	5.9 (4.9, 7.0)	7.2 (5.9, 8.7)
	Hybrid	240	4586	2.9 (2.5, 3.5)	3.9 (3.4, 4.5)	4.4 (3.8, 5.1)	5.5 (4.8, 6.3)	6.7 (5.8, 7.7)	8.0 (6.8, 9.4)
≥70		**661**	**15301**	**2.9 (2.7, 3.2)**	**3.5 (3.2, 3.8)**	**4.0 (3.7, 4.4)**	**4.8 (4.5, 5.3)**	**5.8 (5.3, 6.3)**	**6.6 (6.0, 7.3)**
	Cemented	31	1138	2.0 (1.3, 3.0)	2.5 (1.7, 3.6)	2.8 (2.0, 4.1)	3.2 (2.2, 4.7)	3.5 (2.4, 5.1)	
	Cementless	215	3647	4.1 (3.5, 4.8)	4.7 (4.0, 5.5)	5.4 (4.7, 6.2)	6.1 (5.3, 7.1)	7.0 (6.0, 8.1)	8.6 (7.3, 10.2)
	Hybrid	415	10516	2.6 (2.3, 2.9)	3.2 (2.9, 3.6)	3.7 (3.3, 4.1)	4.6 (4.1, 5.1)	5.6 (5.1, 6.3)	6.1 (5.4, 6.9)
TOTAL		**1050**	**22634**						

Note: Includes mixed ceramic/mixed ceramic and XLPE bearing surfaces
Restricted to modern prostheses

Figure HT83 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=1.18 (0.72, 1.93), p=0.513

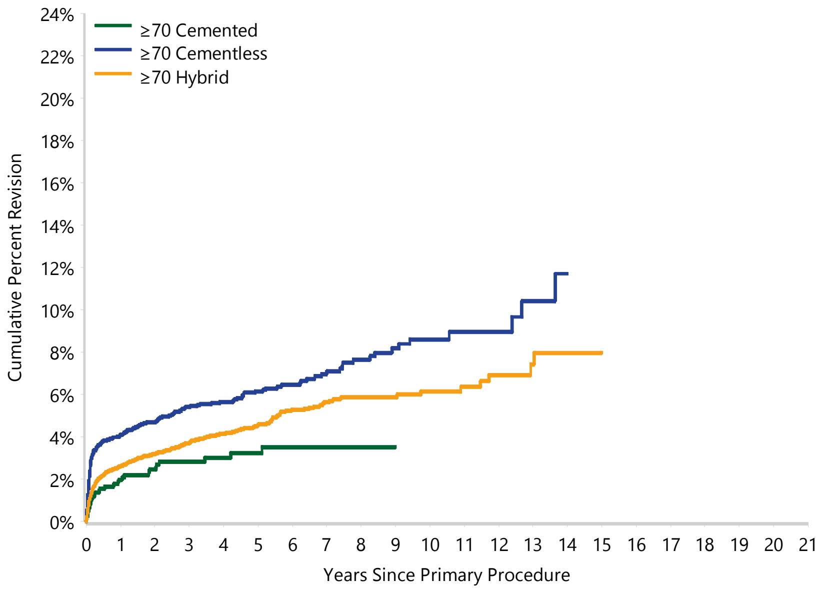
<70 Cemented vs <70 Cementless
Entire Period: HR=1.22 (0.74, 2.03), p=0.433

<70 Cementless vs <70 Hybrid
0 - 1Mth: HR=1.65 (1.08, 2.53), p=0.020
1Mth+: HR=0.79 (0.62, 1.02), p=0.068

Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<70	Cemented	310	230	188	165	103	59	13
	Cementless	2437	2118	1852	1592	1133	744	361
	Hybrid	4586	3772	3191	2614	1700	1042	468

Note: Includes mixed ceramic/mixed ceramic and XLPE bearing surfaces
Restricted to modern prostheses

Figure HT84 **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=1.95 (1.34, 2.85), p<0.001

≥70 Cementless vs ≥70 Hybrid
0 - 3Mth: HR=1.93 (1.53, 2.43), p<0.001
3Mth+: HR=1.01 (0.80, 1.28), p=0.941

≥70 Hybrid vs ≥70 Cemented
Entire Period: HR=1.41 (0.98, 2.03), p=0.064

Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
≥70	Cemented	1138	919	757	603	347	179	35
	Cementless	3647	2961	2501	2093	1321	777	342
	Hybrid	10516	8345	6789	5366	3150	1730	602

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 HT85 and Figure HT85). However, there is higher rate of revision for prosthesis dislocation/instability for head sizes <32mm and 32mm when compared to >32mm (Table HT86 and Figure HT86).

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 HT87 and Figure HT87).

Dual Mobility

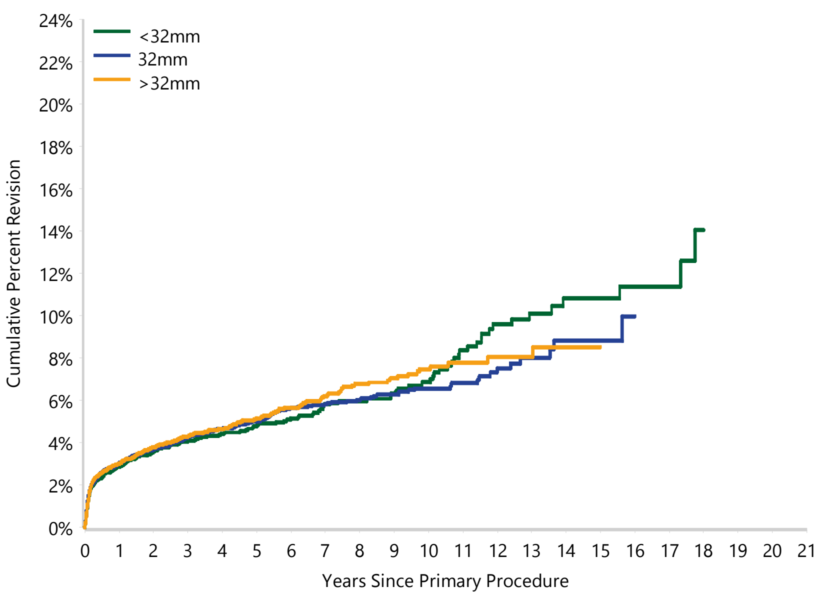
There is no difference in the rate of revision when dual mobility prostheses are used (Table HT88 and Figure HT88).

Table HT85 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	298	6707	2.9 (2.5, 3.3)	3.6 (3.1, 4.1)	4.1 (3.6, 4.6)	4.8 (4.2, 5.5)	5.8 (5.1, 6.7)	6.9 (5.9, 8.0)
32mm	469	9711	3.0 (2.7, 3.4)	3.7 (3.3, 4.1)	4.2 (3.8, 4.7)	5.0 (4.5, 5.5)	5.8 (5.3, 6.4)	6.6 (5.9, 7.3)
>32mm	396	8382	3.0 (2.7, 3.4)	3.8 (3.4, 4.2)	4.3 (3.8, 4.8)	5.1 (4.6, 5.7)	6.2 (5.5, 6.9)	7.5 (6.6, 8.5)
TOTAL	1163	24800						

Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses
Excludes 1 procedure with unknown head size

Figure HT85 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=1.01 (0.87, 1.16), p=0.935

>32mm vs <32mm
Entire Period: HR=0.95 (0.81, 1.10), p=0.482

>32mm vs 32mm
Entire Period: HR=0.94 (0.82, 1.08), p=0.388

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<32mm	6707	5065	4009	3156	1925	1207	615
32mm	9711	8287	7177	6074	3931	2359	976
>32mm	8382	6770	5630	4517	2834	1676	695

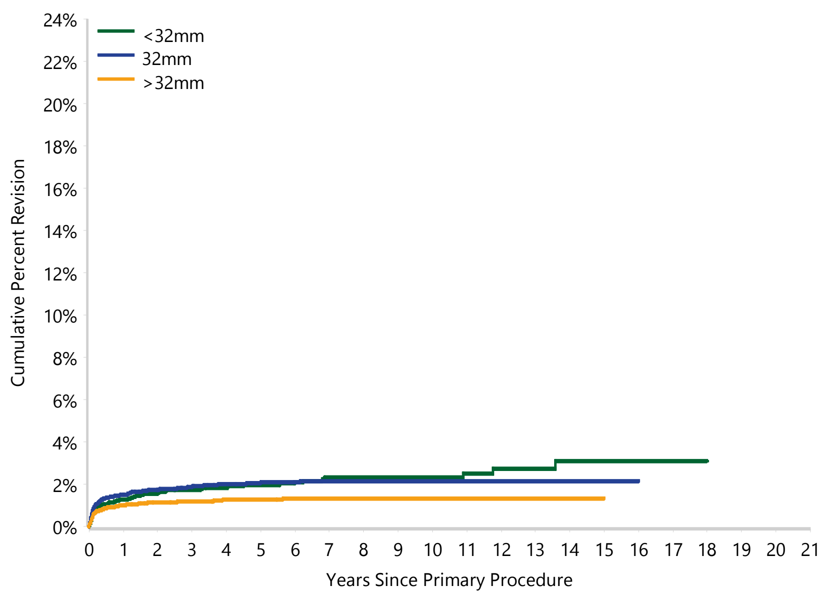
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT86 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	114	6707	1.3 (1.0, 1.6)	1.6 (1.3, 1.9)	1.7 (1.4, 2.1)	2.0 (1.6, 2.4)	2.3 (1.9, 2.9)	2.3 (1.9, 2.9)
32mm	182	9711	1.5 (1.3, 1.8)	1.7 (1.5, 2.0)	1.9 (1.6, 2.2)	2.1 (1.8, 2.4)	2.2 (1.9, 2.5)	2.2 (1.9, 2.5)
>32mm	96	8382	1.0 (0.8, 1.2)	1.1 (0.9, 1.4)	1.2 (1.0, 1.5)	1.3 (1.0, 1.6)	1.3 (1.1, 1.7)	1.3 (1.1, 1.7)
TOTAL	392	24800						

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

Figure HT86 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 - 2Yr: HR=1.40 (1.05, 1.87), p=0.023
2Yr+: HR=3.04 (1.67, 5.53), p<0.001

32mm vs >32mm
Entire Period: HR=1.60 (1.24, 2.06), p<0.001

32mm vs <32mm
0 - 3Mth: HR=1.23 (0.89, 1.70), p=0.211
3Mth - 6Mth: HR=1.36 (0.74, 2.48), p=0.322
6Mth+: HR=0.69 (0.47, 1.02), p=0.059

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<32mm	6707	5065	4009	3156	1925	1207	615
32mm	9711	8287	7177	6074	3931	2359	976
>32mm	8382	6770	5630	4517	2834	1676	695

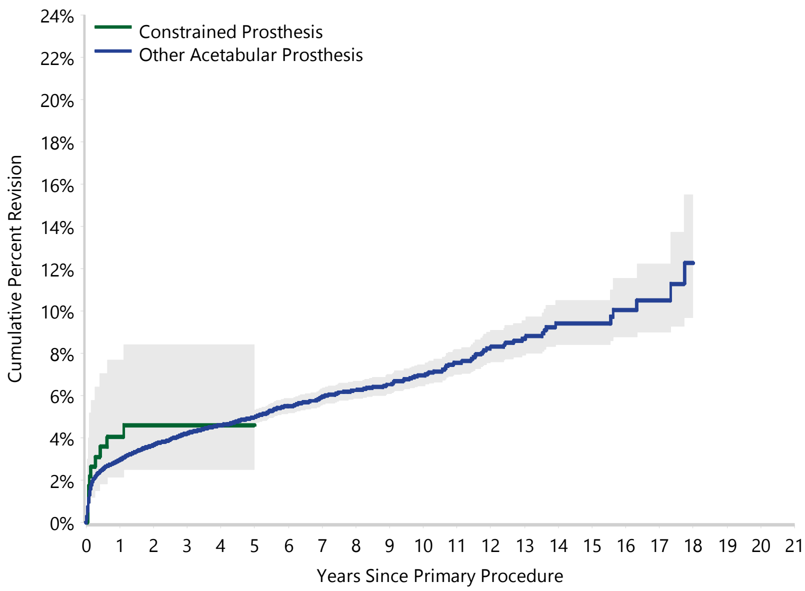
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT87 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	10	240	4.1 (2.1, 7.7)	4.6 (2.5, 8.4)	4.6 (2.5, 8.4)	4.6 (2.5, 8.4)		
Other Acetabular Prosthesis	1153	24561	3.0 (2.8, 3.2)	3.7 (3.4, 3.9)	4.2 (3.9, 4.5)	5.0 (4.7, 5.3)	5.9 (5.6, 6.3)	6.9 (6.5, 7.5)
TOTAL	**1163**	**24801**						

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

Figure HT87 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=1.09 (0.59, 2.04), p=0.781

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Constrained Prosthesis	240	181	135	89	51	32	11
Other Acetabular Prosthesis	24561	19941	16681	13658	8639	5210	2275

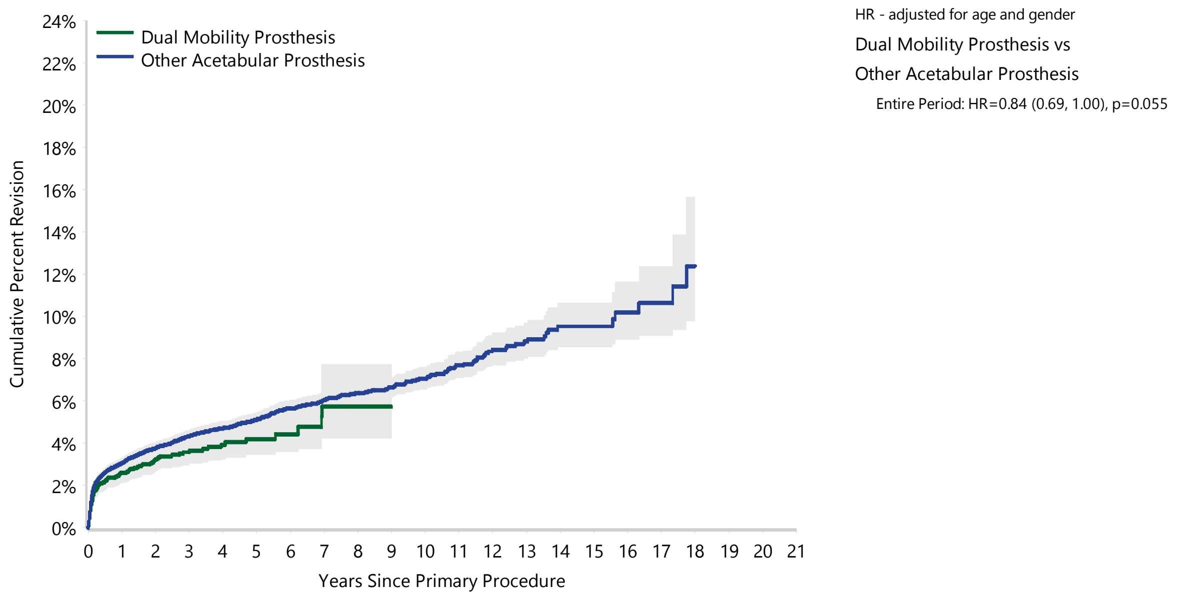
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT88 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	130	4128	2.6 (2.1, 3.1)	3.2 (2.7, 3.9)	3.6 (3.0, 4.3)	4.2 (3.5, 5.1)	5.7 (4.2, 7.7)	
Other Acetabular Prosthesis	1033	20673	3.1 (2.8, 3.3)	3.8 (3.5, 4.0)	4.3 (4.0, 4.6)	5.1 (4.8, 5.5)	6.0 (5.6, 6.4)	7.1 (6.6, 7.6)
TOTAL	1163	24801						

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

Figure HT88 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	4128	2841	2013	1352	548	189	27
Other Acetabular Prosthesis	20673	17281	14803	12395	8142	5053	2259

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 were compared. Unipolar monoblock hip replacement has a higher rate of revision than total conventional hip replacement after 3 months. Unipolar modular hip replacement has a lower rate of revision than total conventional hip replacement for the first month. From 1 month 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 HT89 and Figure HT89).

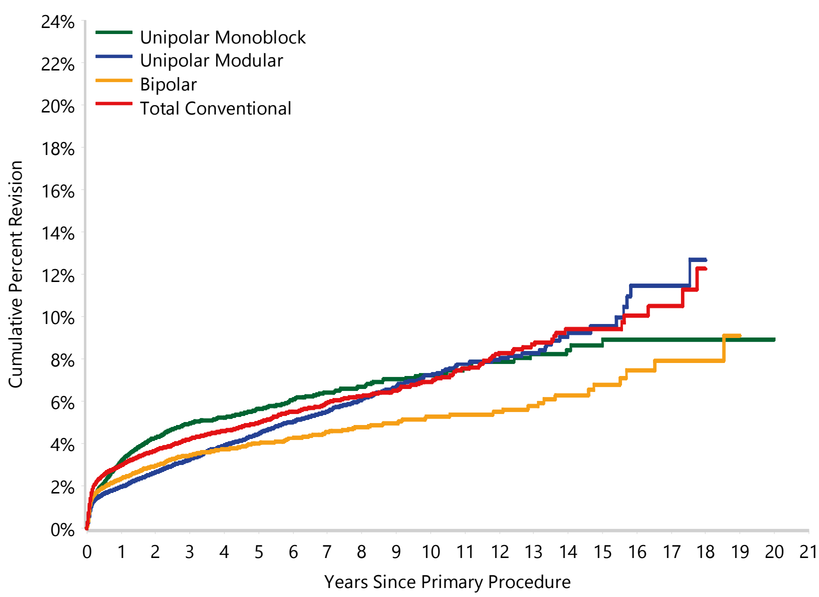
The rates of revision for each type of hip replacement for patients aged <70 years and ≥70 years are provided in Table HT90, Figure HT90 and Figure HT91. For patients aged ≥70 years, bipolar hip replacement has a lower rate of revision than total conventional hip replacement.

Table HT89 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	839	21729	3.2 (2.9, 3.4)	4.3 (4.0, 4.6)	5.0 (4.6, 5.3)	5.6 (5.2, 6.1)	6.4 (5.9, 6.9)	7.3 (6.6, 7.9)
Unipolar Modular	1383	42436	2.0 (1.8, 2.1)	2.6 (2.5, 2.8)	3.3 (3.1, 3.5)	4.5 (4.2, 4.7)	5.5 (5.2, 5.9)	7.3 (6.7, 7.8)
Bipolar	741	25092	2.4 (2.2, 2.6)	3.0 (2.7, 3.2)	3.4 (3.2, 3.7)	4.0 (3.7, 4.4)	4.5 (4.2, 5.0)	5.3 (4.8, 5.9)
Total Conventional	1163	24801	3.0 (2.8, 3.2)	3.7 (3.4, 3.9)	4.2 (4.0, 4.5)	5.0 (4.7, 5.3)	5.9 (5.6, 6.3)	6.9 (6.5, 7.5)
TOTAL	**4126**	**114058**						

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

Figure HT89 Cumulative Percent Revision of Primary Hip Replacement by Class (Primary Diagnosis Fractured NOF)



HR - adjusted for age and gender

Unipolar Monoblock vs Total Conventional
- 0 - 3Mth: HR=1.07 (0.92, 1.24), p=0.380
- 3Mth - 6Mth: HR=1.86 (1.42, 2.43), p<0.001
- 6Mth - 1Yr: HR=3.04 (2.42, 3.82), p<0.001
- 1Yr - 2.5Yr: HR=2.06 (1.70, 2.51), p<0.001
- 2.5Yr+: HR=1.21 (0.98, 1.50), p=0.071

Unipolar Modular vs Total Conventional
- 0 - 1Mth: HR=0.76 (0.64, 0.89), p<0.001
- 1Mth - 3Mth: HR=0.97 (0.82, 1.14), p=0.673
- 3Mth - 6Mth: HR=0.85 (0.65, 1.11), p=0.240
- 6Mth - 1Yr: HR=0.90 (0.70, 1.15), p=0.391
- 1Yr - 1.5Yr: HR=1.15 (0.89, 1.48), p=0.282
- 1.5Yr - 2Yr: HR=1.26 (0.94, 1.68), p=0.118
- 2Yr - 3Yr: HR=1.37 (1.08, 1.73), p=0.008
- 3Yr+: HR=1.87 (1.60, 2.19), p<0.001

Bipolar vs Total Conventional
- 0 - 3Mth: HR=1.00 (0.87, 1.14), p=0.969
- 3Mth+: HR=0.98 (0.86, 1.11), p=0.727

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Monoblock	21729	12991	10064	7785	4422	2492	1096
Unipolar Modular	42436	28609	22460	17455	10173	5576	2179
Bipolar	25092	16228	12086	8989	4977	2654	1227
Total Conventional	24801	20122	16816	13747	8690	5242	2286

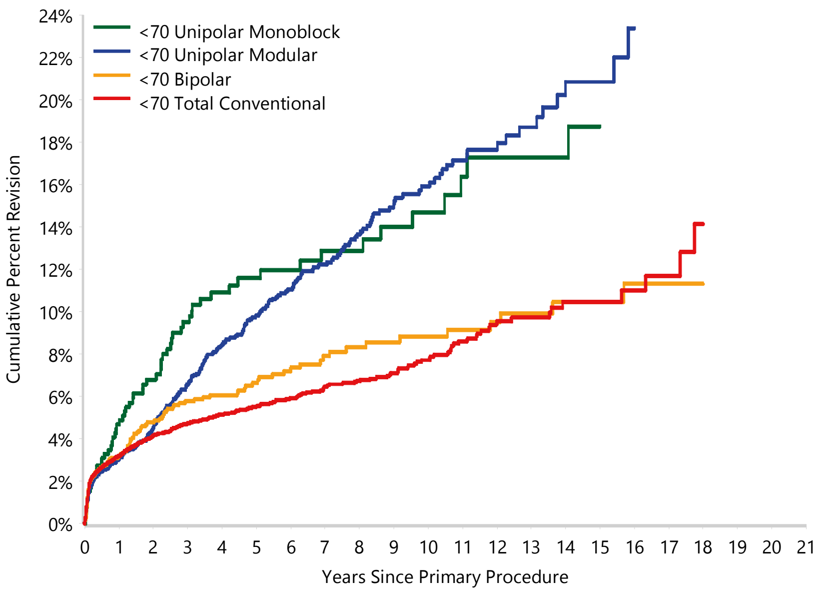
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

Table HT90 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		**909**	**13825**	**3.2 (2.9, 3.5)**	**4.4 (4.1, 4.8)**	**5.5 (5.1, 5.9)**	**6.8 (6.4, 7.4)**	**8.2 (7.6, 8.8)**	**10.0 (9.3, 10.8)**
	Unipolar Monoblock	66	701	4.7 (3.2, 6.8)	6.8 (5.0, 9.3)	9.5 (7.2, 12.5)	11.6 (8.9, 14.9)	12.9 (10.0, 16.6)	14.7 (11.3, 19.0)
	Unipolar Modular	273	2949	3.0 (2.5, 3.8)	4.5 (3.8, 5.4)	6.5 (5.6, 7.7)	9.8 (8.6, 11.2)	12.2 (10.7, 13.9)	15.9 (14.0, 18.1)
	Bipolar	129	2286	3.2 (2.5, 4.0)	4.8 (3.9, 5.9)	5.8 (4.8, 7.0)	6.6 (5.5, 8.0)	7.9 (6.5, 9.6)	8.8 (7.2, 10.8)
	Total Conventional	441	7889	3.2 (2.8, 3.6)	4.1 (3.7, 4.6)	4.7 (4.3, 5.3)	5.5 (5.0, 6.1)	6.4 (5.8, 7.1)	7.7 (6.9, 8.6)
≥70		**3217**	**100233**	**2.4 (2.3, 2.5)**	**3.1 (2.9, 3.2)**	**3.5 (3.4, 3.7)**	**4.3 (4.1, 4.5)**	**5.1 (4.9, 5.3)**	**6.0 (5.7, 6.3)**
	Unipolar Monoblock	773	21028	3.1 (2.9, 3.4)	4.2 (3.9, 4.5)	4.8 (4.4, 5.1)	5.4 (5.0, 5.8)	6.1 (5.6, 6.6)	6.8 (6.2, 7.5)
	Unipolar Modular	1110	39487	1.9 (1.7, 2.0)	2.5 (2.3, 2.7)	3.0 (2.8, 3.2)	3.9 (3.7, 4.2)	4.8 (4.4, 5.1)	6.1 (5.5, 6.6)
	Bipolar	612	22806	2.3 (2.1, 2.5)	2.7 (2.5, 3.0)	3.2 (2.9, 3.5)	3.7 (3.4, 4.0)	4.1 (3.7, 4.5)	4.8 (4.2, 5.4)
	Total Conventional	722	16912	2.9 (2.6, 3.1)	3.5 (3.2, 3.8)	4.0 (3.7, 4.3)	4.7 (4.4, 5.1)	5.7 (5.2, 6.2)	6.5 (5.9, 7.1)
TOTAL		**4126**	**114058**						

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

Figure HT90 Cumulative Percent Revision of Primary Hip Replacement in Patients Aged <70 Years by Class (Primary Diagnosis Fractured NOF)



HR - adjusted for gender

<70 Unipolar Monoblock vs <70 Total Conventional
0 - 3Mth: HR=1.01 (0.59, 1.74), p=0.967
3Mth+: HR=2.35 (1.75, 3.15), p<0.001

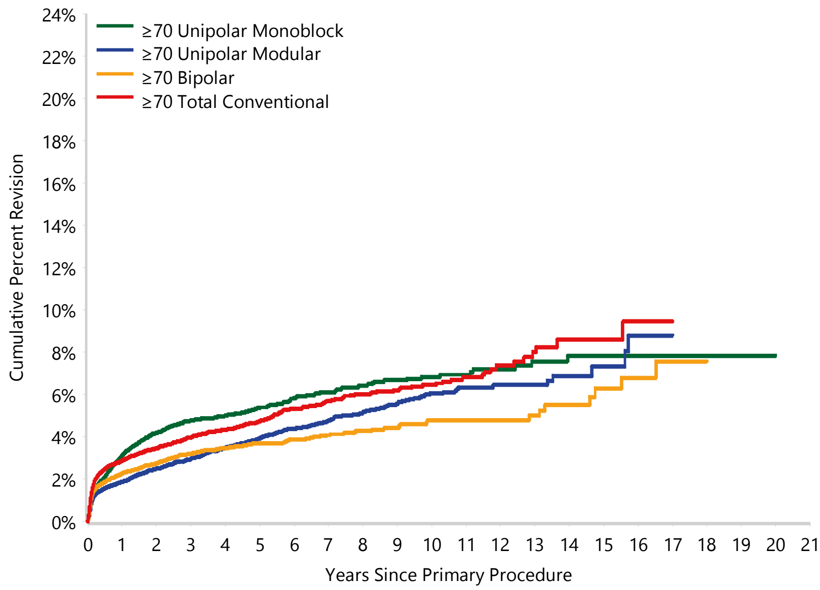
<70 Unipolar Modular vs <70 Total Conventional
0 - 2Yr: HR=1.05 (0.85, 1.30), p=0.667
2Yr+: HR=3.22 (2.59, 3.99), p<0.001

<70 Bipolar vs <70 Total Conventional
Entire Period: HR=1.11 (0.92, 1.36), p=0.280

	Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<70	Unipolar Monoblock	701	471	399	343	238	179	113
	Unipolar Modular	2949	2236	1880	1618	1160	799	443
	Bipolar	2286	1629	1286	1054	727	467	306
	Total Conventional	7889	6593	5654	4765	3260	2125	1059

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

Figure HT91 Cumulative Percent Revision of Primary Hip Replacement in Patients Aged ≥70 Years by Class (Primary Diagnosis Fractured NOF)



HR - adjusted for gender

≥70 Unipolar Monoblock vs ≥70 Total Conventional
- 0 - 2Wk: HR=1.15 (0.87, 1.51), p=0.340
- 2Wk - 3Mth: HR=0.69 (0.59, 0.82), p<0.001
- 3Mth - 6Mth: HR=1.34 (1.00, 1.78), p=0.047
- 6Mth - 1Yr: HR=2.24 (1.75, 2.86), p<0.001
- 1Yr - 2Yr: HR=1.84 (1.44, 2.35), p<0.001
- 2Yr+: HR=0.91 (0.74, 1.13), p=0.390

≥70 Unipolar Modular vs ≥70 Total Conventional
- 0 - 1Mth: HR=0.56 (0.48, 0.67), p<0.001
- 1Mth - 3Mth: HR=0.71 (0.60, 0.85), p<0.001
- 3Mth - 6Mth: HR=0.63 (0.47, 0.84), p=0.001
- 6Mth - 1Yr: HR=0.67 (0.51, 0.88), p=0.004
- 1Yr - 1.5Yr: HR=1.04 (0.78, 1.39), p=0.790
- 1.5Yr - 2Yr: HR=0.98 (0.70, 1.38), p=0.925
- 2Yr - 3Yr: HR=0.80 (0.61, 1.06), p=0.116
- 3Yr - 3.5Yr: HR=1.34 (0.88, 2.05), p=0.170
- 3.5Yr+: HR=1.23 (1.00, 1.51), p=0.053

≥70 Bipolar vs ≥70 Total Conventional
- Entire Period: HR=0.76 (0.68, 0.84), p<0.001

	Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
≥70	Unipolar Monoblock	21028	12520	9665	7442	4184	2313	983
	Unipolar Modular	39487	26373	20580	15837	9013	4777	1736
	Bipolar	22806	14599	10800	7935	4250	2187	921
	Total Conventional	16912	13529	11162	8982	5430	3117	1227

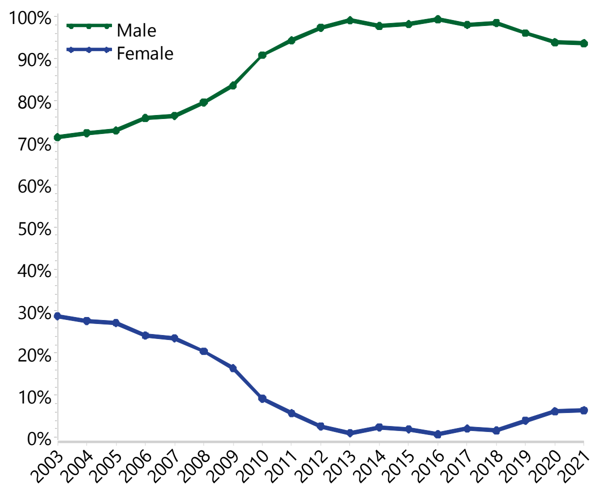
Note: All procedures using metal/metal prostheses have been excluded
Restricted to modern prostheses

PRIMARY TOTAL RESURFACING HIP REPLACEMENT

DEMOGRAPHICS

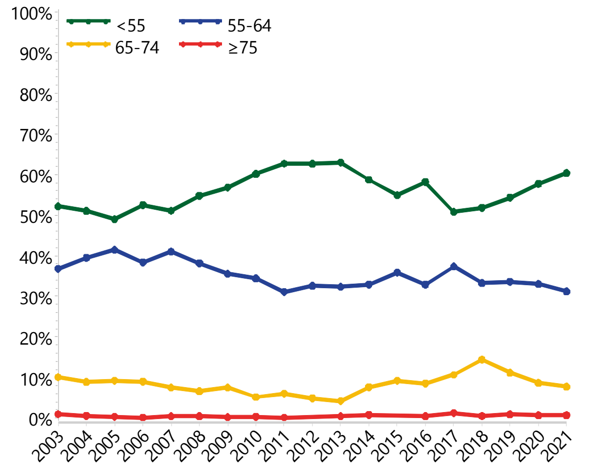
There have been 19,369 primary total resurfacing hip replacement procedures reported to the Registry. This is an additional 555 procedures compared to the last report. In 2021, the number of primary total resurfacing procedures is 3.9% less than in 2020, and 70.3% less than in 2005 when the use of hip resurfacing peaked. Primary total resurfacing hip replacement represents 1.1% of all hip replacements performed in 2021.
In 2021, 93.6% of primary total resurfacing hip replacements were undertaken in males (Table HT91 and Figure HT92).

Figure HT92 Primary Total Resurfacing Hip Replacement by Gender



The changes in usage of primary total resurfacing hip replacement for each age group in 2021 are provided in Figure HT93.

Figure HT93 Primary Total Resurfacing Hip Replacement by Age



There were only three types of resurfacing prostheses used in 2021, with the Adept the most commonly used. The ReCerf resurfacing head was used for the first time in 2018 (Table HT92).

Table HT91 Age and Gender of Primary Total Resurfacing Hip Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	15690	81.0%	13	82	54	53.3	9.1
Female	3679	19.0%	14	81	53	51.5	8.6
TOTAL	**19369**	**100.0%**	**13**	**82**	**54**	**53.0**	**9.1**

Table HT92 Most Used Resurfacing Heads in Primary Total Resurfacing Hip Replacement

2003		2018		2019		2020		2021	
N	Model	N	Model	N	Model	N	Model	N	Model
1359	BHR	247	Adept	301	Adept	318	Adept	314	Adept
58	Durom	132	BHR	145	BHR	156	BHR	121	ReCerf
43	ASR	3	ReCerf	81	ReCerf	93	ReCerf	110	BHR
42	Cormet								
38	Cormet 2000 HAP								
7	Conserve Plus								
Most Used									
1547	(6) 100.0%	382	(3) 100.0%	527	(3) 100.0%	567	(3) 100.0%	545	(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 (95.6%), followed by developmental dysplasia (2.0%), and osteonecrosis (1.6%).

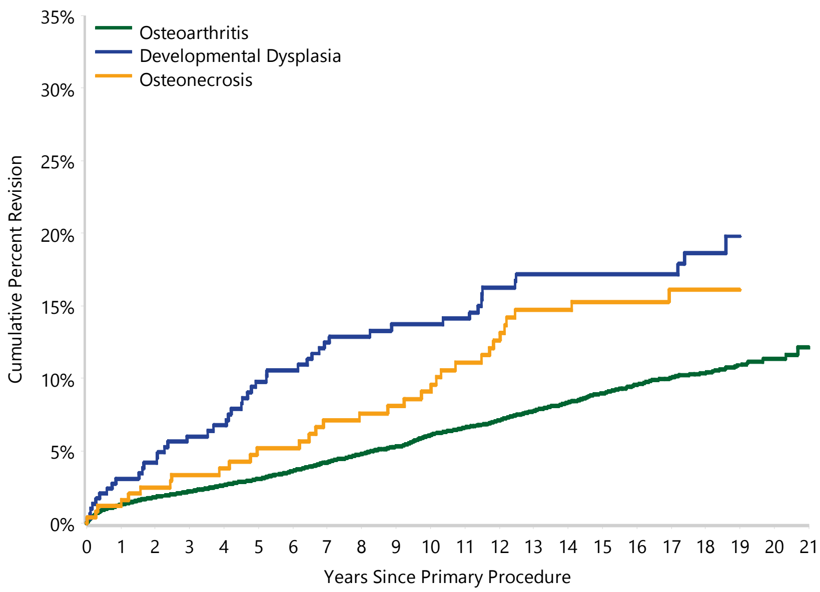
Primary total resurfacing hip replacement for osteoarthritis has a lower rate of revision compared to developmental dysplasia from 6 months up to 5 years. There is a higher rate of revision for osteonecrosis compared to osteoarthritis (Table HT93 and Figure HT94).

Table HT93 Cumulative Percent Revision of Primary Total Resurfacing Hip 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	1042	14348	95.6%	1.3 (1.1, 1.5)	2.2 (2.0, 2.5)	3.1 (2.8, 3.4)	6.1 (5.7, 6.5)	9.0 (8.4, 9.5)	11.3 (10.6, 12.2)
Developmental Dysplasia	48	294	2.0%	3.1 (1.6, 5.9)	6.0 (3.8, 9.5)	9.8 (6.8, 14.0)	13.7 (10.1, 18.4)	17.2 (13.1, 22.3)	
Osteonecrosis	34	247	1.6%	1.2 (0.4, 3.7)	3.3 (1.7, 6.6)	5.2 (3.0, 9.0)	9.1 (5.9, 13.7)	15.3 (11.0, 21.0)	
Other (6)	17	115	0.8%	2.6 (0.8, 7.9)	3.5 (1.3, 9.1)	6.5 (3.1, 13.1)	13.3 (7.9, 21.9)	15.9 (9.8, 25.2)	
TOTAL	**1141**	**15004**							

Note: Only primary diagnoses with >100 procedures have been listed
Restricted to modern prostheses

Figure HT94 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=1.31 (0.58, 2.97), p=0.521

6Mth - 5Yr: HR=2.28 (1.46, 3.58), p<0.001

5Yr+: HR=0.87 (0.56, 1.35), p=0.532

Developmental Dysplasia vs Osteonecrosis

Entire Period: HR=0.75 (0.48, 1.17), p=0.210

Osteonecrosis vs Osteoarthritis

Entire Period: HR=1.68 (1.18, 2.37), p=0.003

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Osteoarthritis	14348	13621	12400	11481	9051	5374	530
Developmental Dysplasia	294	278	251	237	209	151	16
Osteonecrosis	247	239	217	202	182	135	22

Note: Only primary diagnoses with >100 procedures have been listed
Restricted to modern prostheses

Prosthesis Types

The cumulative percent revision of the three different primary total resurfacing hip prosthesis combinations with >100 procedures is listed in Table HT94.

Table HT94 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	75	2654	1.1 (0.7, 1.5)	1.7 (1.2, 2.3)	2.4 (1.8, 3.1)	5.4 (4.1, 7.1)	7.4 (5.4, 10.0)	
BHR	BHR	1065	12051	1.4 (1.2, 1.6)	2.5 (2.2, 2.8)	3.4 (3.1, 3.8)	6.5 (6.1, 7.0)	9.5 (9.0, 10.1)	11.9 (11.1, 12.8)
ReCerf	ReCerf	1	298	0.3 (0.0, 2.5)					
Other (1)		0	1						
TOTAL		**1141**	**15004**						

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 11.3% (Table HT95 and Figure HT95).

Reasons for Revision

The main reasons for revision of primary total resurfacing hip replacement are loosening, metal related pathology, and fracture (Table HT96).

Loosening is the most common reason for revision after 7 years.

The five most common reasons for revision are shown in Figure HT96. 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 7 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 HT97).

Age and Gender

In the first 18 months, patients aged ≥65 years and 55-64 years have a higher rate of revision compared to patients aged <55 years (Table HT98 and Figure HT97).

Females have a higher rate of revision compared to males (Table HT99 and Figure HT98). 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 (Figure HT99). Age is not a risk factor for revision for female patients (Figure HT100).

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. Revision is also higher for head sizes 50-54mm compared to ≥55mm (Table HT100 and Figure HT101).

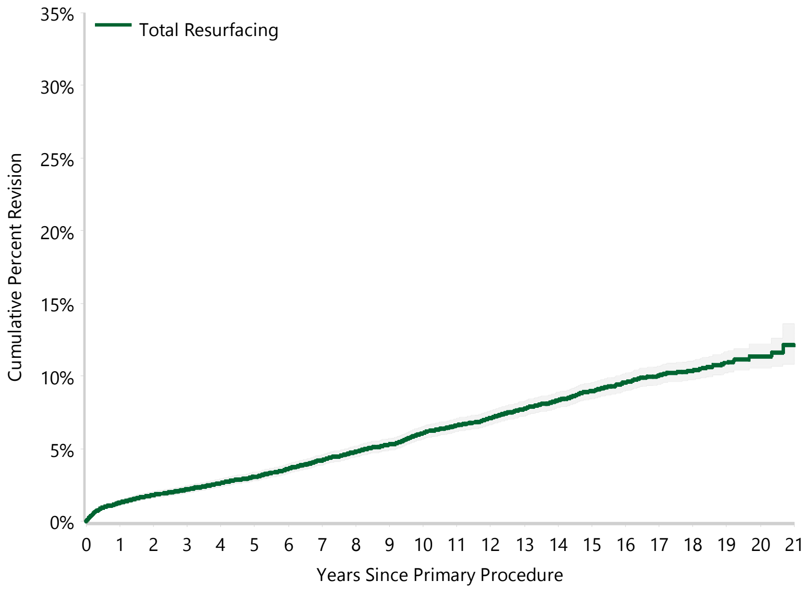
The reason for revision varies with head size. Head sizes <50mm have a higher cumulative incidence of metal related pathology, loosening, fracture, pain, and lysis compared to head sizes ≥50mm (Figure HT102). This effect of femoral component head size is evident in both males and females (Table HT101 and Figure HT103).

Table HT95 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	1042	14348	1.3 (1.1, 1.5)	2.2 (2.0, 2.5)	3.1 (2.8, 3.4)	6.1 (5.7, 6.5)	9.0 (8.4, 9.5)	11.3 (10.6, 12.2)
TOTAL	1042	14348						

Note: Restricted to modern prostheses

Figure HT95 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	14348	13621	12400	11481	9051	5374	530

Note: Restricted to modern prostheses

Table HT96 Primary Total Resurfacing Hip Replacement by Reason for Revision (Primary Diagnosis OA)

Reason for Revision	Number	Percent
Loosening	266	25.5
Metal Related Pathology	227	21.8
Fracture	205	19.7
Lysis	111	10.7
Infection	68	6.5
Pain	61	5.9
Prosthesis Dislocation/Instability	26	2.5
Osteonecrosis	25	2.4
Other (10)	53	5.1
TOTAL	**1042**	**100.0**

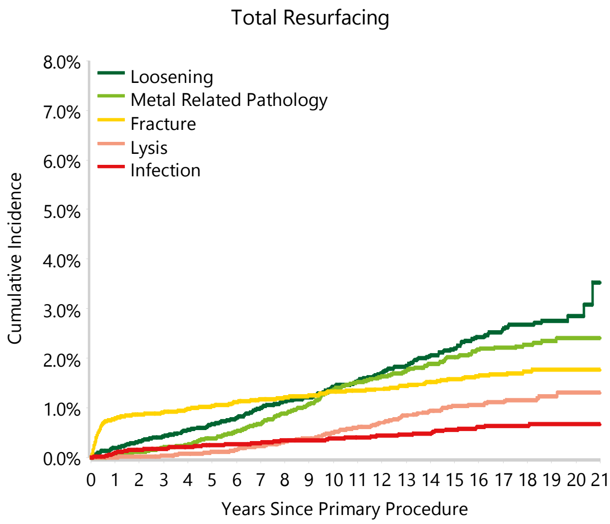
Note: Restricted to modern prostheses

Table HT97 Primary Total Resurfacing Hip Replacement by Type of Revision (Primary Diagnosis OA)

Type of Revision	Number	Percent
THR (Femoral/Acetabular)	723	69.4
Femoral Component	257	24.7
Acetabular Component	30	2.9
Cement Spacer	25	2.4
Removal of Prostheses	7	0.7
TOTAL	**1042**	**100.0**

Note: Restricted to modern prostheses

Figure HT96 Cumulative Incidence Revision Diagnosis of Primary Total Resurfacing Hip Replacement (Primary Diagnosis OA)



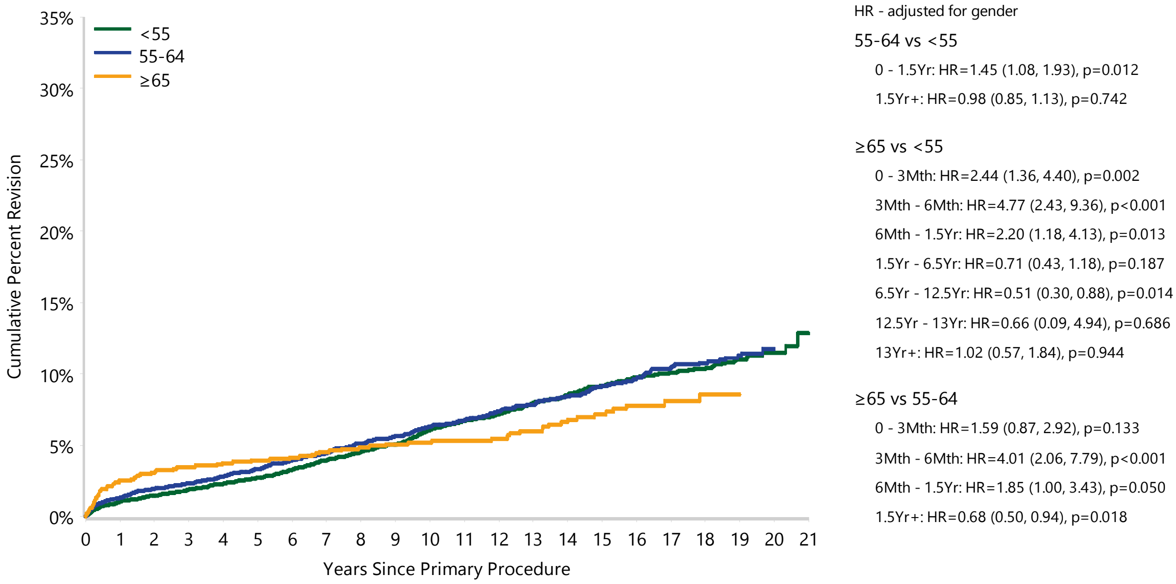
Note: Restricted to modern prostheses

Table HT98 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	549	7612	1.1 (0.8, 1.3)	1.9 (1.6, 2.2)	2.7 (2.4, 3.1)	6.1 (5.5, 6.7)	9.1 (8.4, 10.0)	11.5 (10.4, 12.7)
55-64	412	5374	1.3 (1.0, 1.7)	2.3 (2.0, 2.8)	3.3 (2.9, 3.9)	6.3 (5.6, 7.0)	9.1 (8.3, 10.1)	11.7 (10.5, 13.1)
≥65	81	1362	2.5 (1.8, 3.5)	3.5 (2.6, 4.6)	3.9 (3.0, 5.1)	5.2 (4.1, 6.6)	7.1 (5.7, 9.0)	
TOTAL	1042	14348						

Note: Restricted to modern prostheses

Figure HT97 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement by Age (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
<55	7612	7213	6563	6107	4748	2798	297
55-64	5374	5131	4695	4352	3506	2102	197
≥65	1362	1277	1142	1022	797	474	36

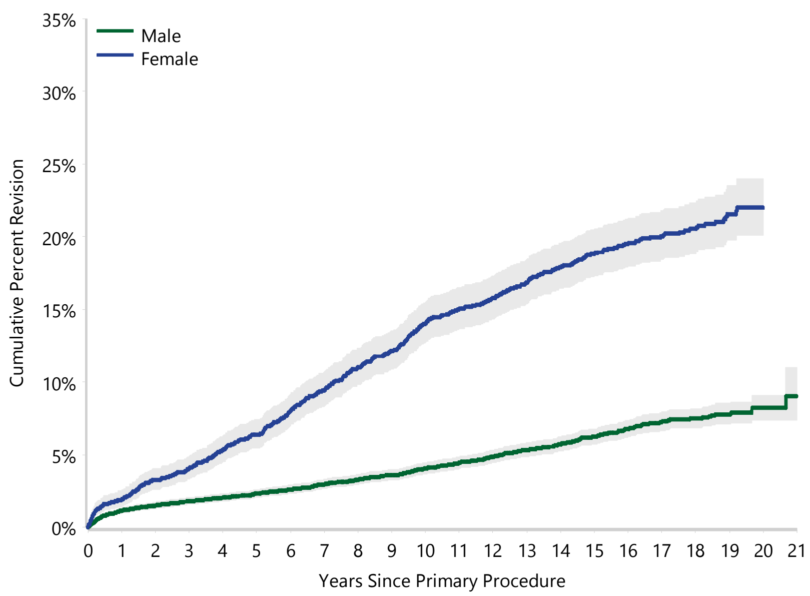
Note: Restricted to modern prostheses

Table HT99 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		**580**	**11892**	**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, 6.8)**	**8.2 (7.4, 9.1)**
	<55	288	6210	1.0 (0.7, 1.2)	1.5 (1.2, 1.9)	2.0 (1.6, 2.4)	3.8 (3.3, 4.4)	6.2 (5.5, 7.0)	8.1 (7.0, 9.4)
	55-64	224	4424	1.1 (0.8, 1.4)	1.8 (1.4, 2.2)	2.4 (2.0, 2.9)	4.2 (3.6, 4.9)	6.3 (5.5, 7.2)	8.4 (7.1, 10.0)
	≥65	68	1258	2.5 (1.8, 3.5)	3.4 (2.5, 4.5)	3.8 (2.8, 5.0)	4.8 (3.7, 6.3)	6.3 (4.9, 8.2)	
Female		**462**	**2456**	**1.9 (1.4, 2.5)**	**4.1 (3.3, 4.9)**	**6.4 (5.5, 7.4)**	**14.0 (12.7, 15.5)**	**18.8 (17.3, 20.5)**	**22.0 (20.1, 24.0)**
	<55	261	1402	1.5 (1.0, 2.3)	3.5 (2.7, 4.6)	5.8 (4.6, 7.1)	14.2 (12.4, 16.2)	18.9 (16.8, 21.1)	22.0 (19.5, 24.7)
	55-64	188	950	2.4 (1.6, 3.6)	4.8 (3.6, 6.4)	7.4 (5.9, 9.3)	14.3 (12.2, 16.8)	19.3 (16.8, 22.0)	22.8 (19.9, 26.1)
	≥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, 16.3)	13.8 (8.2, 22.7)	
TOTAL		**1042**	**14348**						

Note: Restricted to modern prostheses

Figure HT98 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement by Gender (Primary Diagnosis OA)



HR - adjusted for age

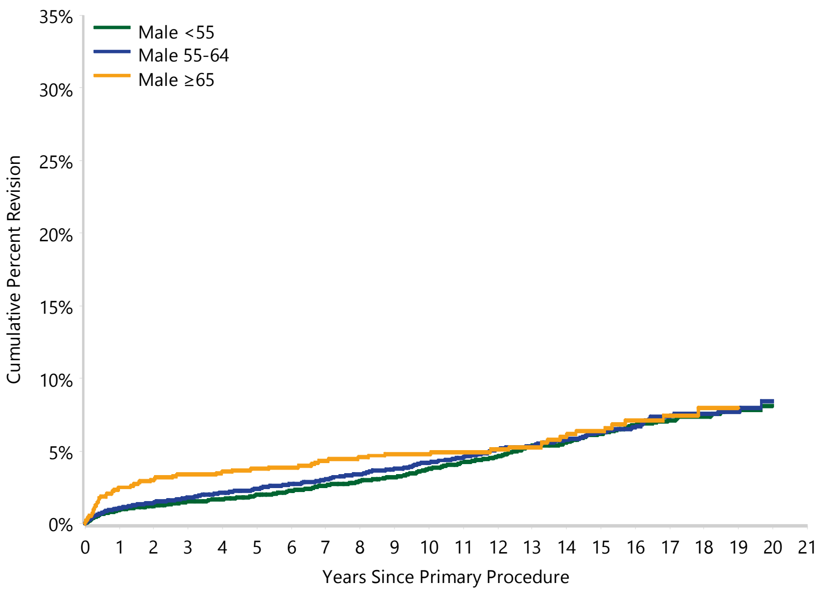
Female vs Male

Entire Period: HR=3.10 (2.74, 3.51), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Male	11892	11251	10133	9289	7096	3991	364
Female	2456	2370	2267	2192	1955	1383	166

Note: Restricted to modern prostheses

Figure HT99 **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, 1.26), p=0.551

Male ≥65 vs Male <55

0 - 3Mth: HR=2.12 (1.12, 4.00), p=0.020

3Mth - 6Mth: HR=3.83 (1.88, 7.81), p<0.001

6Mth - 1Yr: HR=2.25 (1.03, 4.92), p=0.041

1Yr - 13.5Yr: HR=0.80 (0.54, 1.17), p=0.248

13.5Yr+: HR=0.94 (0.45, 1.96), p=0.869

Male ≥65 vs Male 55-64

0 - 6Mth: HR=2.55 (1.58, 4.12), p<0.001

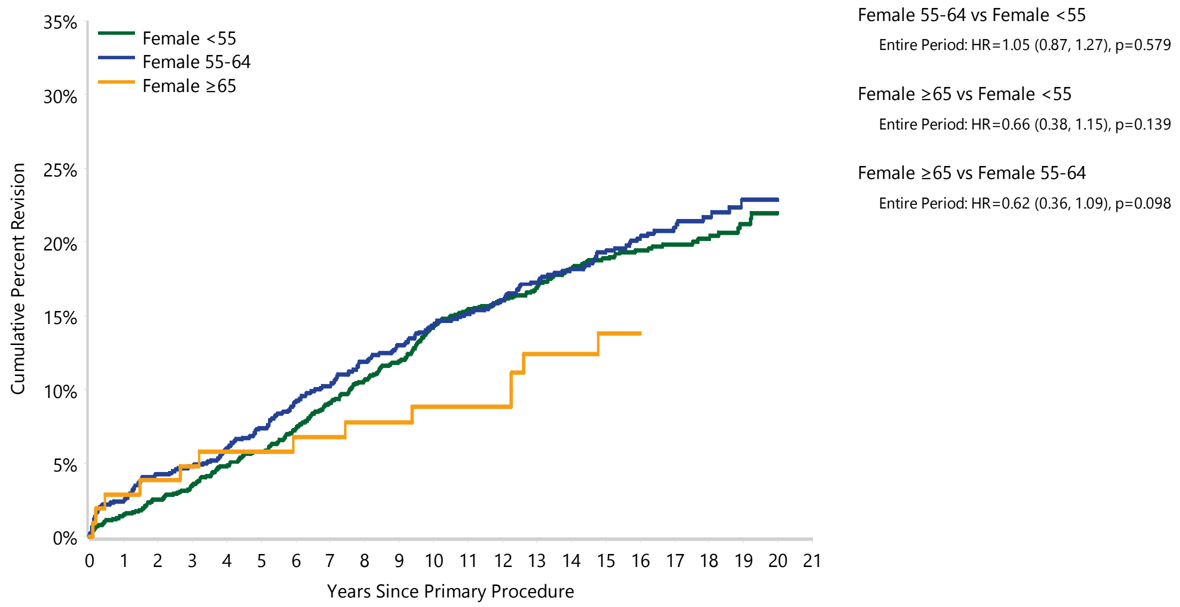
6Mth - 1Yr: HR=2.14 (0.98, 4.68), p=0.057

1Yr+: HR=0.78 (0.55, 1.11), p=0.166

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Male	<55	6210	5860	5274	4863	3642	2024	201
	55-64	4424	4215	3815	3500	2742	1553	134
	≥65	1258	1176	1044	926	712	414	29

Note: Restricted to modern prostheses

Figure HT100 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	1402	1353	1289	1244	1106	774	96
	55-64	950	916	880	852	764	549	63
	≥65	104	101	98	96	85	60	7

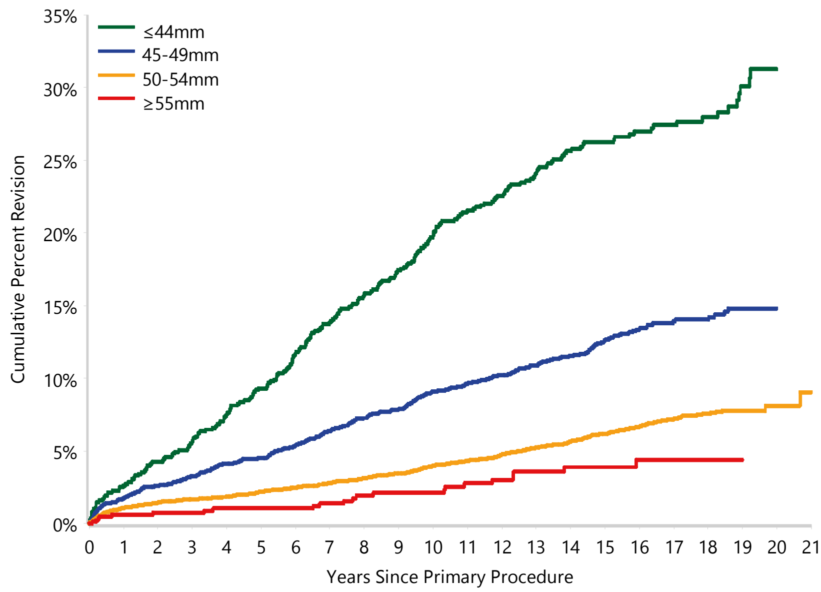
Note: Restricted to modern prostheses

Table HT100 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	233	882	2.6 (1.7, 3.9)	5.6 (4.3, 7.4)	9.3 (7.6, 11.5)	19.7 (17.2, 22.6)	26.3 (23.4, 29.4)	31.3 (27.6, 35.3)
45-49mm	304	2878	1.7 (1.3, 2.3)	3.3 (2.7, 4.0)	4.5 (3.8, 5.4)	9.1 (8.0, 10.3)	12.6 (11.2, 14.1)	14.8 (13.2, 16.6)
50-54mm	482	9762	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)	8.1 (7.3, 9.1)
≥55mm	23	826	0.6 (0.3, 1.5)	0.8 (0.3, 1.7)	1.0 (0.5, 2.1)	2.1 (1.2, 3.6)	3.9 (2.5, 6.0)	
TOTAL	1042	14348						

Note: Restricted to modern prostheses

Figure HT101 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement by Head Size (Primary Diagnosis OA)



HR - adjusted for age and gender

≤44mm vs ≥55mm

Entire Period: HR=4.50 (2.83, 7.16), p<0.001

45-49mm vs ≥55mm

Entire Period: HR=2.48 (1.60, 3.86), p<0.001

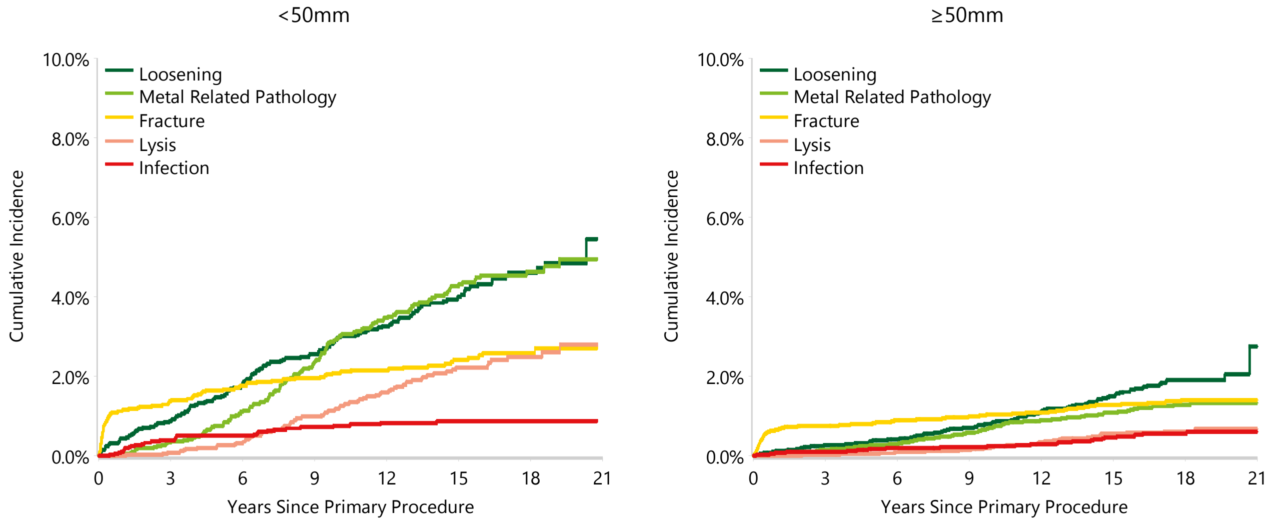
50-54mm vs ≥55mm

Entire Period: HR=1.59 (1.05, 2.42), p=0.029

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
≤44mm	882	848	799	765	662	426	61
45-49mm	2878	2735	2502	2352	1891	1098	130
50-54mm	9762	9267	8407	7726	6036	3605	314
≥55mm	826	771	692	638	462	245	25

Note: Restricted to modern prostheses

Figure HT102 Cumulative Incidence Revision Diagnosis of Primary Total Resurfacing Hip Replacement by Head Size (Primary Diagnosis OA)



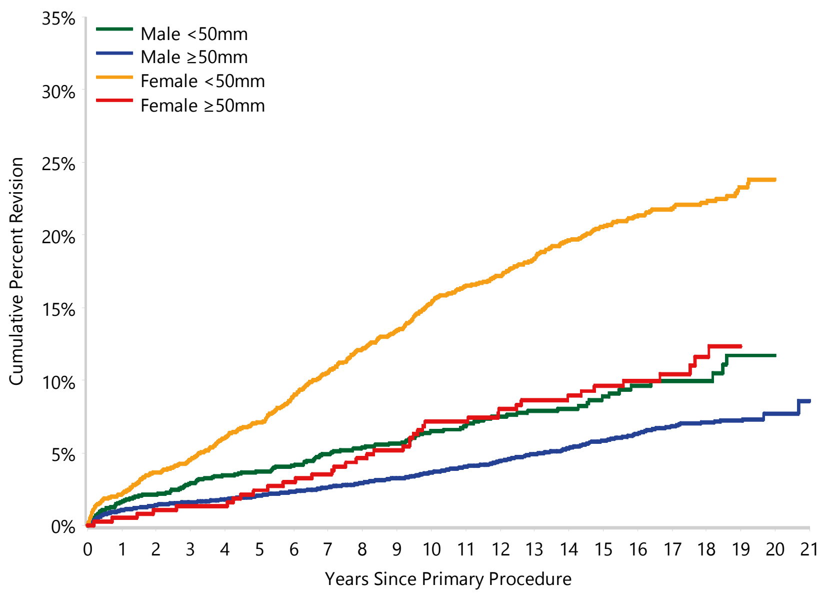
Note: Restricted to modern prostheses

Table HT101 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		**580**	**11892**	**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, 6.8)**	**8.2 (7.4, 9.1)**
	<50mm	114	1685	1.6 (1.1, 2.4)	3.0 (2.2, 3.9)	3.7 (2.9, 4.8)	6.5 (5.3, 8.0)	8.9 (7.3, 10.8)	11.7 (9.2, 14.8)
	≥50mm	466	10207	1.1 (0.9, 1.3)	1.6 (1.4, 1.9)	2.1 (1.8, 2.4)	3.7 (3.3, 4.1)	5.8 (5.3, 6.4)	7.7 (6.8, 8.7)
Female		**462**	**2456**	**1.9 (1.4, 2.5)**	**4.1 (3.3, 4.9)**	**6.4 (5.5, 7.4)**	**14.0 (12.7, 15.5)**	**18.8 (17.3, 20.5)**	**22.0 (20.1, 24.0)**
	<50mm	423	2075	2.2 (1.6, 2.9)	4.6 (3.7, 5.6)	7.1 (6.1, 8.3)	15.3 (13.8, 16.9)	20.5 (18.8, 22.4)	23.8 (21.7, 26.1)
	≥50mm	39	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)	9.6 (6.9, 13.2)	
TOTAL		**1042**	**14348**						

Note: Restricted to modern prostheses

Figure HT103 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=1.60 (1.31, 1.97), p<0.001

Male <50mm vs Female <50mm

Entire Period: HR=0.44 (0.35, 0.54), p<0.001

Male ≥50mm vs Female ≥50mm

Entire Period: HR=0.60 (0.43, 0.83), p=0.001

Female <50mm vs Female ≥50mm

Entire Period: HR=2.19 (1.58, 3.04), p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Male	<50mm	1685	1583	1398	1282	928	399	53
	≥50mm	10207	9668	8735	8007	6168	3592	311
Female	<50mm	2075	2000	1903	1835	1625	1125	138
	≥50mm	381	370	364	357	330	258	28

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 was compared using only modern prostheses.

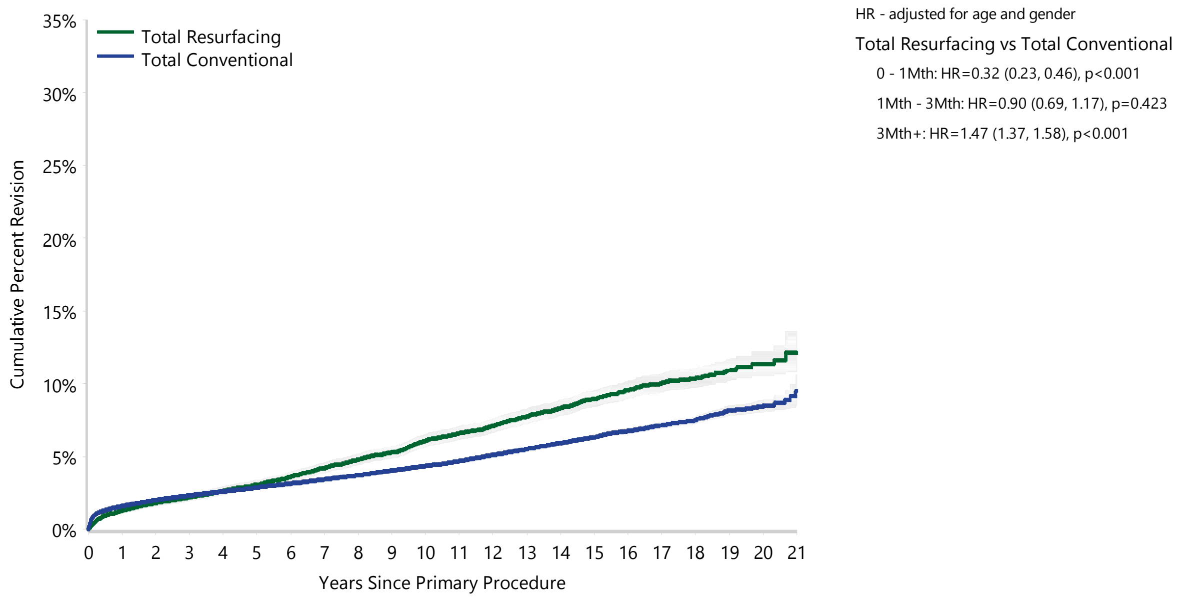
Primary total resurfacing has a lower rate of revision than primary total conventional hip replacement in the first month. After 3 months, primary total resurfacing has a higher rate of revision (Table HT102 and Figure HT104).

Table HT102 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	1042	14348	1.3 (1.1, 1.5)	2.2 (2.0, 2.5)	3.1 (2.8, 3.4)	6.1 (5.7, 6.5)	9.0 (8.4, 9.5)	11.3 (10.6, 12.2)
Total Conventional	13098	397261	1.6 (1.6, 1.6)	2.3 (2.3, 2.4)	2.9 (2.8, 2.9)	4.4 (4.3, 4.4)	6.3 (6.2, 6.5)	8.4 (8.1, 8.8)
TOTAL	**14140**	**411609**						

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

Figure HT104 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	14348	13621	12400	11481	9051	5374	530
Total Conventional	397261	352075	275373	204605	79576	21543	1383

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

Knee Replacement

Knee Replacement

CATEGORIES OF KNEE REPLACEMENT

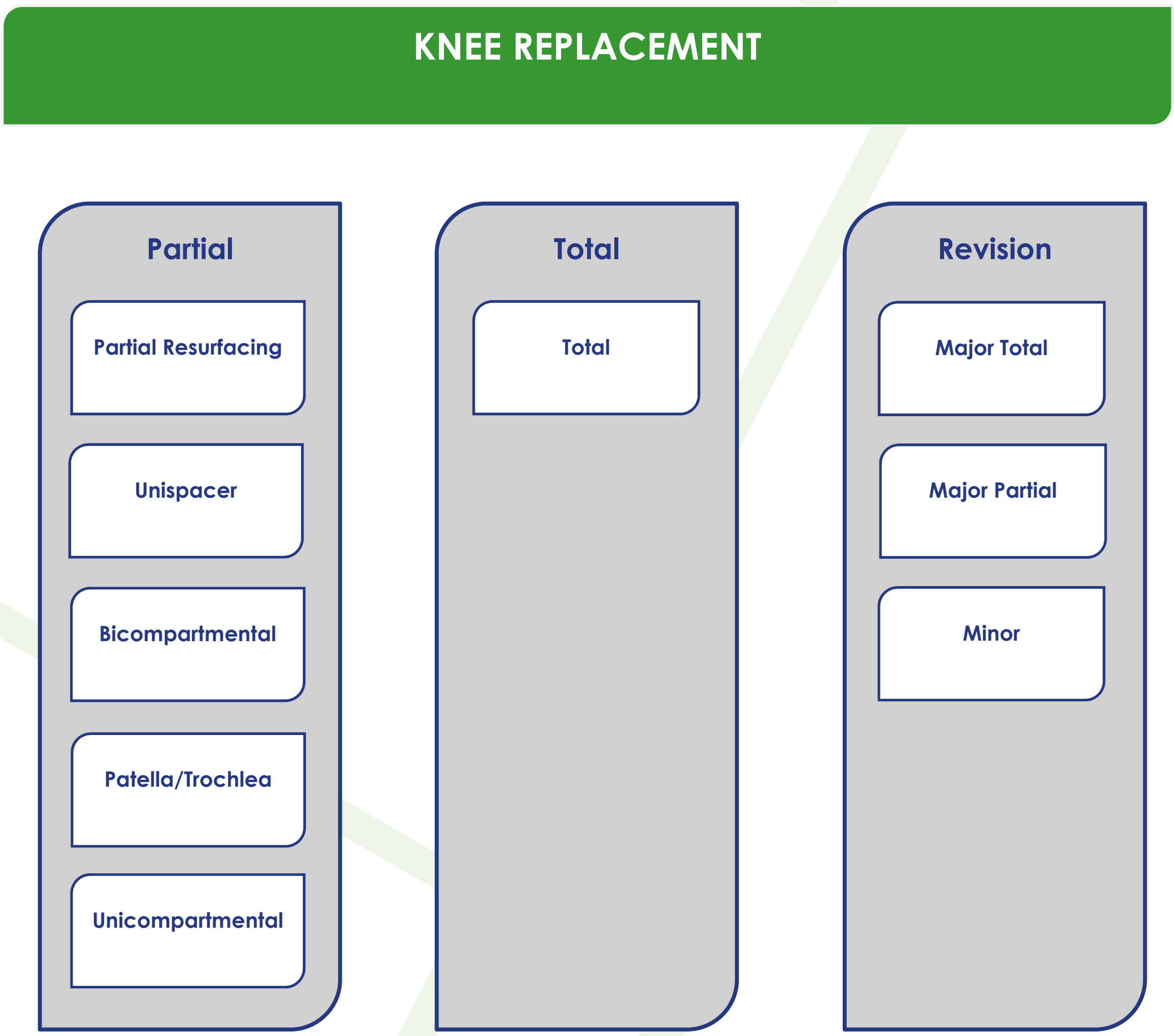
The Registry groups knee replacement into three broad categories: primary partial, primary total and revision knee replacement.

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.

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-2022



USE OF KNEE REPLACEMENT

This report analyses 980,419 knee replacements with a procedure date up to and including 31 December 2021. This is an additional 68,466 knee procedures compared to the number reported last year. The relative frequency of each category of knee replacement is provided in Table K1.

Table K1 Number of Knee Replacements

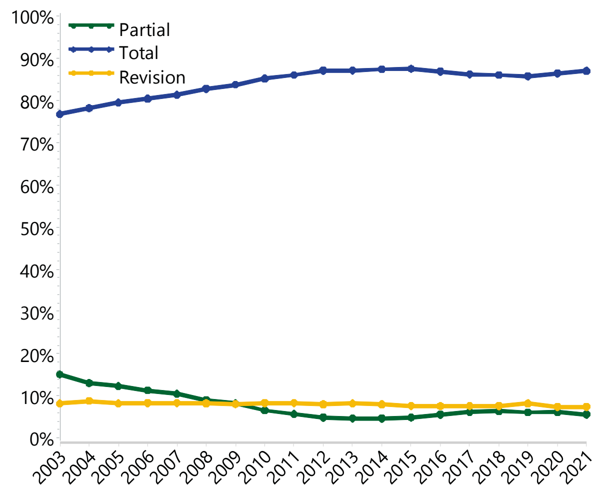
Knee Category	Number	Percent
Partial	72774	7.4
Total	829272	84.6
Revision	78373	8.0
TOTAL	980419	100.0

In 2021, the number of knee replacements undertaken has increased by 5,141 (8.2%) compared to 2020. During the last year, primary partial knee replacement decreased by 2.0% and primary total knee replacement increased by 9.0%. Revision knee replacement increased by 7.8%.

Primary partial knee replacement has decreased to 5.6%, and the proportion of revision knee procedures has declined to 7.4%.

In 2021, primary total knee replacement accounted for 87.0% of all knee replacement procedures. Primary partial knee replacement has decreased to 5.6%, and the proportion of revision knee procedures has declined to 7.4%. This equates to 951 fewer revision procedures in 2021 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 collection of ASA score in 2012 and BMI data in 2015.

There are ASA score data on 532,328 and BMI data on 422,252 knee replacement procedures. Since its initial collection, ASA score has been recorded for 96.7% of procedures. BMI has been recorded for 94.9% of procedures since collection commenced.

In 2021, ASA score is reported in 99.9% of knee replacement procedures and BMI data are reported in 98.9% of procedures. BMI data are reported for 99.3% of primary partial knees, 99.2% of primary total knees and 94.1% of revision knee replacement procedures.

ASA SCORE

There are five ASA score classifications.[4]

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 92.8% of procedures, patients have an ASA score of 2 or 3, 5.9% 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 a lower proportion 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.[5]

1.	Underweight	<18.50
2.	Normal	18.50 - 24.99
3.	Pre-obese	25.00 - 29.99
4.	Obese Class 1	30.00 - 34.99
5.	Obese Class 2	35.00 - 39.99
6.	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).

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

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

Table K2 ASA Score for Knee Replacement

ASA Score	Partial		Total		Revision		TOTAL	
	N	Col%	N	Col%	N	Col%	N	Col%
ASA 1	3721	12.3	26318	5.7	1444	3.5	31483	5.9
ASA 2	18420	61.1	251372	54.5	17180	42.1	286972	53.9
ASA 3	7855	26.1	178668	38.7	20488	50.2	207011	38.9
ASA 4	148	0.5	4975	1.1	1709	4.2	6832	1.3
ASA 5	1	0.0	14	0.0	15	0.0	30	0.0
TOTAL	30145	100.0	461347	100.0	40836	100.0	532328	100.0

Table K3 BMI Category for Knee Replacement

BMI Category	Partial		Total		Revision		TOTAL	
	N	Col%	N	Col%	N	Col%	N	Col%
Underweight	48	0.2	727	0.2	116	0.4	891	0.2
Normal	3711	14.8	38463	10.5	3354	11.0	45528	10.8
Pre Obese	10094	40.3	114379	31.2	9236	30.2	133709	31.7
Obese Class 1	7647	30.5	113071	30.8	9305	30.4	130023	30.8
Obese Class 2	2610	10.4	62100	16.9	5214	17.0	69924	16.6
Obese Class 3	948	3.8	37866	10.3	3363	11.0	42177	10.0
TOTAL	25058	100.0	366606	100.0	30588	100.0	422252	100.0

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

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

The Registry subcategorises partial knee replacement 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 (6.6%). 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	245	0.3
Unispacer	40	0.1
Bicompartmental	165	0.2
Patella/Trochlea	4827	6.6
Unicompartmental	67497	92.7
TOTAL	72774	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. Partial resurfacing has not been recorded in 2021. 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-2022

PATELLA/TROCHLEA

There have been 4,827 patella/trochlear knee replacement procedures undertaken for all diagnoses. This is an additional 298 procedures compared to the previous report. The principal diagnosis for patella/trochlea procedures is osteoarthritis. The mean age of patients is 58.4 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 2021 (described as modern prostheses) are included in the analyses, unless clearly specified.

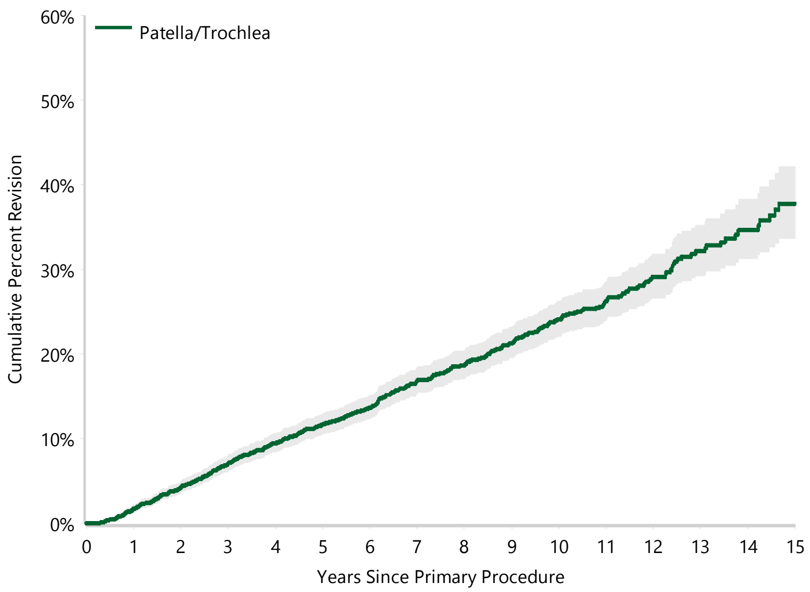
The Registry has recorded 557 revisions of 3,589 primary patella/trochlear knee replacement procedures for osteoarthritis. The cumulative percent revision of patella/trochlear replacement at 15 years is 37.8% (Table KP2 and Figure KP1). The most common reason for revision is progression of disease, with 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/Trochlea	557	3589	1.7 (1.3, 2.2)	7.0 (6.2, 8.0)	11.6 (10.5, 12.9)	16.8 (15.3, 18.4)	24.1 (22.1, 26.2)	37.8 (33.6, 42.2)
TOTAL	557	3589						

Note: Restricted to modern prostheses

Figure KP1 Cumulative Percent Revision of Primary Patella/Trochlea Knee Replacement (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	15 Yrs
Patella/Trochlea	3589	3231	2486	1806	1247	655	77

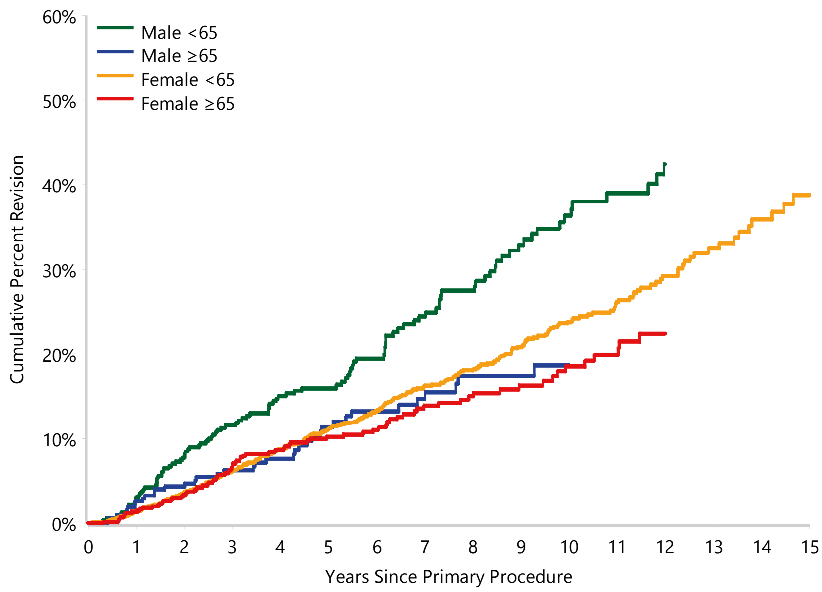
Note: Restricted to modern prostheses

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	15 Yrs
Male		152	814	2.9 (1.9, 4.3)	9.5 (7.5, 11.9)	14.2 (11.7, 17.1)	20.6 (17.4, 24.4)	29.7 (25.3, 34.7)	
	<65	113	490	3.0 (1.8, 5.1)	11.6 (8.9, 15.0)	16.0 (12.7, 20.0)	24.4 (20.0, 29.7)	36.4 (30.4, 43.1)	
	≥65	39	324	2.6 (1.3, 5.1)	6.3 (4.0, 9.8)	11.4 (8.0, 16.3)	14.7 (10.5, 20.4)	18.7 (13.4, 25.6)	
Female		405	2775	1.4 (1.0, 1.9)	6.3 (5.4, 7.4)	10.9 (9.6, 12.3)	15.7 (14.0, 17.5)	22.5 (20.3, 24.9)	37.0 (32.3, 42.1)
	<65	318	2085	1.4 (0.9, 2.0)	6.2 (5.2, 7.4)	11.1 (9.6, 12.8)	16.3 (14.4, 18.4)	23.8 (21.2, 26.7)	38.8 (33.5, 44.7)
	≥65	87	690	1.4 (0.7, 2.6)	6.7 (4.9, 9.0)	10.2 (8.0, 13.1)	13.9 (11.0, 17.4)	18.5 (14.8, 23.1)	
TOTAL		557	3589						

Note: Restricted to modern prostheses

Figure KP2 Cumulative Percent Revision of Primary Patella/Trochlea Knee Replacement by Gender and Age (Primary Diagnosis OA)



Male <65 vs Male ≥65
Entire Period: HR=1.91 (1.33, 2.75), p<0.001

Male <65 vs Female <65
Entire Period: HR=1.61 (1.30, 2.00), p<0.001

Male ≥65 vs Female ≥65
Entire Period: HR=1.04 (0.71, 1.51), p=0.845

Female <65 vs Female ≥65
Entire Period: HR=1.23 (0.97, 1.56), p=0.083

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	15 Yrs
Male	<65	490	435	330	232	155	82	11
	≥65	324	293	219	158	105	58	4
Female	<65	2085	1879	1455	1052	731	376	54
	≥65	690	624	482	364	256	139	8

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-2022

UNICOMPARTMENTAL

Demographics

This year, the Registry is reporting on 67,497 primary unicompartmental knee procedures. This is an additional 3,520 procedures compared to the last report.
The use of unicompartmental knee replacement decreased from 5.7% in 2020 to 5.2% of all knee procedures in 2021. Although the proportion of unicompartmental knee replacements had 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 (54.3%) (Table KP4). The proportion of males has increased to 60.8% in 2021 (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

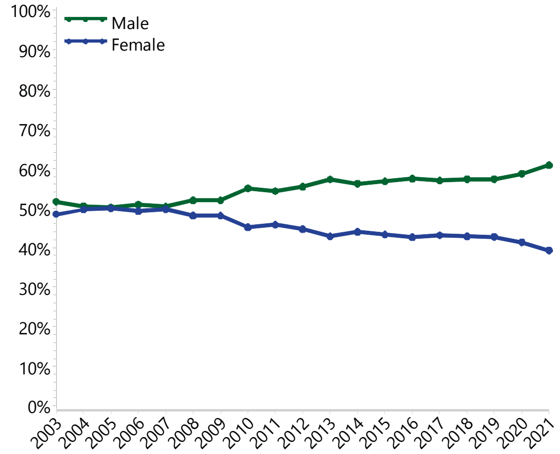
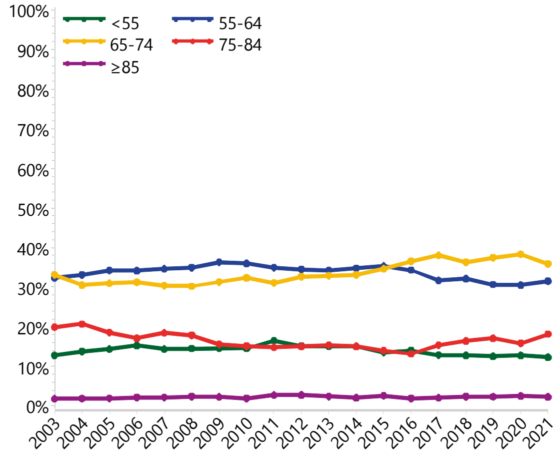


Figure KP4 Primary Unicompartmental Knee Replacement by Age



The proportion of unicompartmental knee replacements using robotic assistance increased to 36.4% in 2021 (Figure KP5).

In 2021, the 10 most used tibial prostheses account for 99.4% of all unicompartmental procedures. The Restoris MCK, Oxford (cementless) and Persona are the most used prostheses in 2021 (Table KP5).
The outcomes of unicompartmental knee prosthesis combinations with >200 procedures are presented in Table KP6.

Figure KP5 Primary Unicompartmental Knee Replacement by Robotic Assistance (Primary Diagnosis OA)

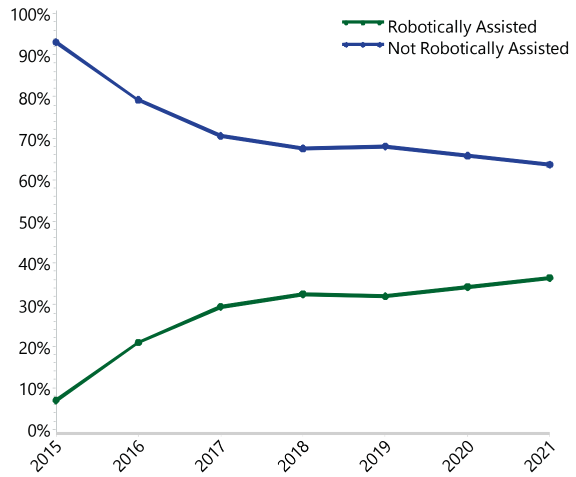


Table KP4 Age and Gender of Primary Unicompartmental Knee Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	36674	54.3%	24	98	66	65.8	9.6
Female	30823	45.7%	13	98	65	64.9	10.2
TOTAL	67497	100.0%	13	98	65	65.4	9.9

Table KP5 10 Most Used Tibial Prostheses in Primary Unicompartmental Knee Replacement

2003		2018		2019		2020		2021	
N	Model	N	Model	N	Model	N	Model	N	Model
1366	Oxford (ctd)	1148	Restoris MCK	1095	Restoris MCK	1146	Restoris MCK	1180	Restoris MCK
444	Repicci II	985	ZUK	897	ZUK	814	Oxford (cless)	770	Oxford (cless)
373	Preservation Fixed	804	Oxford (cless)	831	Oxford (cless)	712	ZUK	524	Persona
353	M/G	202	Journey Uni (v2)	208	BalanSys Uni Fixed	176	BalanSys Uni Fixed	275	ZUK
336	Allegretto Uni	196	Oxford (ctd)	196	Journey Uni (v2)	168	Sigma HP	173	Sigma HP
321	GRU	146	Sigma HP	168	Oxford (ctd)	153	Journey Uni (v2)	162	BalanSys Uni Fixed
275	Genesis	139	BalanSys Uni Fixed	162	Sigma HP	138	Oxford (ctd)	154	Journey Uni (v2)
260	Unix	46	Triathlon PKR	118	Genus	130	Genus	123	Oxford (ctd)
121	Preservation Mobile	36	Genus	24	Journey Uni All Poly	68	Persona	106	Genus
101	Endo-Model Sled	29	GMK-UNI	17	Endo-Model Sled	20	Endo-Model Sled	10	Journey Uni All Poly
10 Most Used									
3950	(10) 96.1%	3731	(10) 98.0%	3716	(10) 98.9%	3525	(10) 98.7%	3477	(10) 99.4%
Remainder									
159	(7) 3.9%	76	(7) 2.0%	40	(6) 1.1%	46	(6) 1.3%	22	(5) 0.6%
TOTAL									
4109	(17) 100.0%	3807	(17) 100.0%	3756	(16) 100.0%	3571	(16) 100.0%	3499	(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
Allegretto Uni	ZUK	23	283	0.7 (0.2, 2.8)	4.6 (2.6, 7.9)	7.2 (4.5, 11.4)			
BalanSys Uni	BalanSys Uni Fixed	52	1085	1.8 (1.1, 2.8)	3.6 (2.6, 5.1)	4.4 (3.1, 6.1)	7.9 (5.7, 11.0)	13.0 (8.9, 18.8)	
Endo-Model Sled	Endo-Model Sled	217	1330	1.3 (0.8, 2.1)	5.2 (4.1, 6.5)	8.0 (6.7, 9.7)	14.7 (12.7, 16.9)	22.2 (19.5, 25.3)	
Genus	Genus	14	395	3.0 (1.6, 5.4)	4.6 (2.7, 7.8)				
Journey Uni	Journey Uni (v2)	59	1205	2.3 (1.6, 3.3)	4.7 (3.6, 6.3)	6.0 (4.6, 7.9)			
	Journey Uni All Poly	40	340	1.5 (0.6, 3.6)	6.9 (4.6, 10.3)	9.2 (6.4, 13.0)	15.0 (11.0, 20.3)		
Oxford (cless)	Oxford (cless)	569	8274	2.7 (2.4, 3.1)	4.7 (4.2, 5.2)	6.0 (5.5, 6.6)	11.1 (10.0, 12.2)	20.4 (16.7, 24.7)	
	Oxford (ctd)	49	468	3.5 (2.1, 5.6)	6.4 (4.5, 9.1)	9.3 (6.9, 12.4)	15.3 (10.9, 21.3)		
Oxford (ctd)	Oxford (ctd)	2552	13545	2.2 (1.9, 2.4)	5.7 (5.3, 6.1)	8.2 (7.7, 8.6)	14.6 (14.0, 15.3)	22.2 (21.4, 23.1)	31.1 (29.7, 32.6)
Persona	Persona	6	593	2.2 (0.9, 5.2)					
Restoris MCK	Restoris MCK	172	6349	1.3 (1.0, 1.6)	3.2 (2.7, 3.7)	4.1 (3.5, 4.8)			
Sigma HP	Sigma HP	77	1643	1.0 (0.6, 1.6)	2.8 (2.0, 3.8)	4.8 (3.7, 6.2)	8.4 (6.4, 10.9)		
Triathlon PKR	Triathlon PKR	31	375	3.0 (1.7, 5.3)	6.4 (4.3, 9.5)	7.5 (5.1, 10.8)	12.2 (8.0, 18.5)		
ZUK	ZUK	577	9579	1.5 (1.3, 1.7)	3.4 (3.1, 3.8)	4.6 (4.2, 5.1)	7.9 (7.2, 8.7)	12.7 (11.2, 14.3)	
Other (5)		57	345	5.7 (3.7, 8.8)	12.5 (9.3, 16.7)	17.2 (13.4, 22.0)			
TOTAL		4495	45809						

Note: Restricted to modern prostheses
Only prostheses with >200 procedures have been listed

OUTCOME FOR OSTEOARTHRITIS

The Registry has recorded 4,449 revisions of primary unicompartmental knee replacements with an initial diagnosis of osteoarthritis.
In order to keep Registry data contemporaneous, only procedures using prostheses that have been available and used in 2021 (described as modern prostheses) are included in the analyses, unless clearly specified.

The cumulative percent revision for primary unicompartmental knee replacement undertaken for osteoarthritis is 12.0% at 10 years and 28.4% at 20 years (Table KP7 and Figure KP6).

The main reasons for revision are progression of disease, loosening and pain (Table KP8 and Figure KP7). The main type of revision is to a total knee replacement (Table KP9).

Patient Characteristics

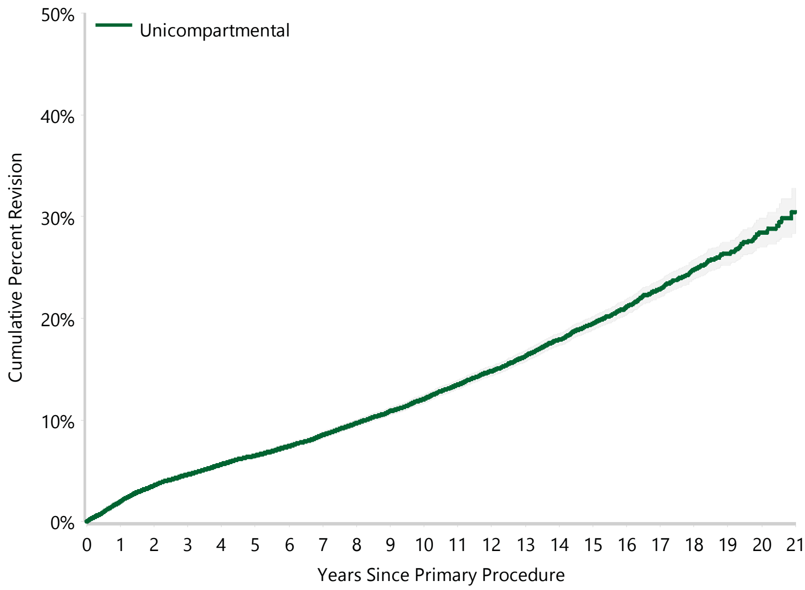
Age is a major factor affecting the outcome of primary unicompartmental knee replacement, with the rate of revision decreasing with increasing age (Table KP10 and Figure KP8).
Females have a higher rate of revision than males (Table KP11 and Figure KP9). The main reason for this difference is an increased cumulative incidence for progression of disease (Figure KP10). The effect of age on the rate of revision is evident in both males and females (Table KP11, Figure KP11 and Figure KP12).

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	4449	45423	2.0 (1.8, 2.1)	4.6 (4.4, 4.8)	6.5 (6.2, 6.7)	12.0 (11.6, 12.5)	19.5 (18.8, 20.1)	28.4 (27.0, 29.8)
TOTAL	4449	45423						

Note: Restricted to modern prostheses

Figure KP6 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	45423	40966	32394	24330	12358	4449	431

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	1602	36.0
Loosening	1443	32.4
Pain	342	7.7
Infection	232	5.2
Bearing Dislocation	166	3.7
Fracture	130	2.9
Instability	81	1.8
Lysis	81	1.8
Wear Tibial Insert	67	1.5
Malalignment	60	1.3
Other (14)	245	5.5
TOTAL	4449	100.0

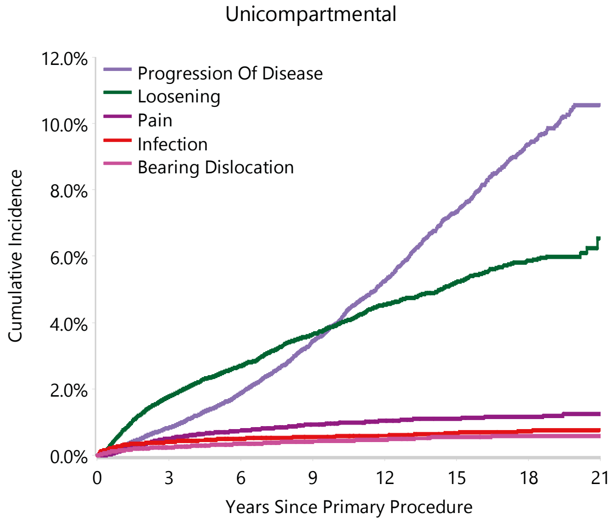
Note: Restricted to modern prostheses

Table KP9 Primary Unicompartmental Knee Replacement by Type of Revision (Primary Diagnosis OA)

Type of Revision	Number	Percent
TKR (Tibial/Femoral)	3744	84.2
Uni Insert Only	458	10.3
Uni Tibial Component	98	2.2
Uni Femoral Component	49	1.1
Cement Spacer	37	0.8
UKR (Uni Tibial/Uni Femoral)	33	0.7
Patella/Trochlear Resurfacing	15	0.3
Removal of Prostheses	5	0.1
Reinsertion of Components	4	0.1
Femoral Component*	3	0.1
Tibial Component	2	0.0
Patella Only	1	0.0
TOTAL	4449	100.0

Note: *Bicompartmental component
Restricted to modern prostheses

Figure KP7 Cumulative Incidence Revision Diagnosis of Primary Unicompartmental Knee Replacement (Primary Diagnosis OA)



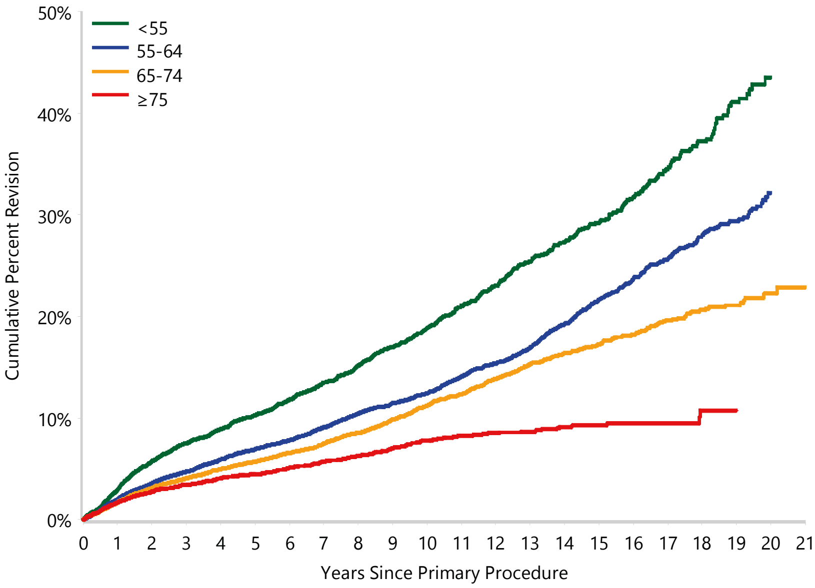
Note: Restricted to modern prostheses

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	966	5907	3.0 (2.6, 3.5)	7.5 (6.9, 8.3)	10.3 (9.4, 11.2)	18.8 (17.5, 20.2)	29.2 (27.2, 31.2)	43.5 (39.8, 47.4)
55-64	1693	14930	2.0 (1.8, 2.3)	4.7 (4.4, 5.1)	6.9 (6.5, 7.4)	12.4 (11.7, 13.1)	21.6 (20.5, 22.8)	32.1 (29.8, 34.6)
65-74	1340	15903	1.7 (1.5, 1.9)	4.1 (3.8, 4.4)	5.7 (5.3, 6.1)	11.2 (10.5, 11.9)	17.3 (16.2, 18.4)	22.2 (20.4, 24.2)
≥75	450	8683	1.7 (1.4, 2.0)	3.4 (3.0, 3.9)	4.5 (4.0, 5.0)	7.8 (7.0, 8.6)	9.3 (8.3, 10.4)	
TOTAL	4449	45423						

Note: Restricted to modern prostheses

Figure KP8 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement by Age (Primary Diagnosis OA)



HR - adjusted for gender

<55 vs ≥75
- 0 - 6Mth: HR=1.70 (1.29, 2.24), p<0.001
- 6Mth - 3Yr: HR=2.46 (2.11, 2.88), p<0.001
- 3Yr - 7Yr: HR=2.42 (2.00, 2.93), p<0.001
- 7Yr - 12Yr: HR=3.58 (2.72, 4.71), p<0.001
- 12Yr - 12.5Yr: HR=22.40 (8.62, 58.20), p<0.001
- 12.5Yr - 14Yr: HR=8.85 (4.29, 18.26), p<0.001
- 14Yr+: HR=11.38 (5.74, 22.55), p<0.001

55-64 vs ≥75
- 0 - 1.5Yr: HR=1.37 (1.18, 1.60), p<0.001
- 1.5Yr - 2Yr: HR=1.46 (1.11, 1.92), p=0.007
- 2Yr - 7Yr: HR=1.72 (1.49, 2.00), p<0.001
- 7Yr - 11Yr: HR=2.26 (1.73, 2.94), p<0.001
- 11Yr - 11.5Yr: HR=2.85 (1.74, 4.65), p<0.001
- 11.5Yr - 12Yr: HR=1.69 (0.97, 2.94), p=0.064
- 12Yr - 13Yr: HR=8.78 (3.73, 20.68), p<0.001
- 13Yr - 13.5Yr: HR=11.60 (5.26, 25.55), p<0.001
- 13.5Yr+: HR=8.53 (4.40, 16.53), p<0.001

65-74 vs ≥75
- 0 - 4Yr: HR=1.24 (1.09, 1.42), p<0.001
- 4Yr - 5.5Yr: HR=1.43 (1.11, 1.85), p=0.006
- 5.5Yr - 7Yr: HR=1.33 (1.02, 1.72), p=0.034
- 7Yr - 7.5Yr: HR=2.50 (1.61, 3.88), p<0.001
- 7.5Yr - 12Yr: HR=2.21 (1.69, 2.89), p<0.001
- 12Yr - 13Yr: HR=8.15 (3.43, 19.37), p<0.001
- 13Yr+: HR=3.90 (2.00, 7.63), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
<55	5907	5311	4179	3198	1666	654	75
55-64	14930	13542	10965	8463	4586	1758	178
65-74	15903	14368	11245	8313	4188	1542	159
≥75	8683	7745	6005	4356	1918	495	19

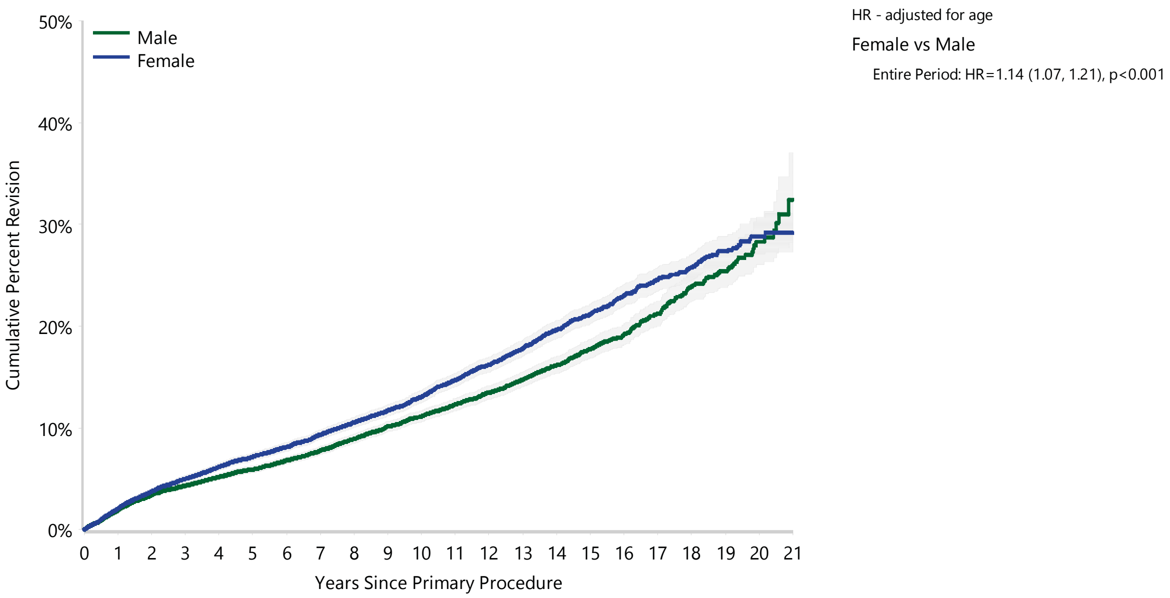
Note: Restricted to modern prostheses

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		**2123**	**24897**	**1.9 (1.7, 2.1)**	**4.3 (4.1, 4.6)**	**5.9 (5.6, 6.3)**	**11.1 (10.6, 11.7)**	**17.8 (16.9, 18.7)**	**28.3 (26.0, 30.7)**
	<55	407	2759	3.1 (2.5, 3.8)	7.1 (6.1, 8.2)	9.3 (8.2, 10.6)	18.4 (16.4, 20.5)	29.3 (26.2, 32.6)	
	55-64	851	8248	2.0 (1.7, 2.4)	4.6 (4.1, 5.1)	6.5 (6.0, 7.2)	12.1 (11.2, 13.1)	20.1 (18.6, 21.7)	32.2 (28.8, 35.9)
	65-74	652	9054	1.6 (1.3, 1.9)	3.8 (3.4, 4.2)	5.3 (4.8, 5.8)	9.9 (9.0, 10.8)	15.0 (13.7, 16.4)	21.3 (18.3, 24.6)
	≥75	213	4836	1.6 (1.3, 2.0)	3.2 (2.7, 3.8)	4.0 (3.4, 4.7)	6.9 (5.9, 8.0)	8.3 (6.9, 10.0)	
Female		**2326**	**20526**	**2.1 (1.9, 2.3)**	**5.0 (4.7, 5.3)**	**7.1 (6.8, 7.5)**	**13.0 (12.4, 13.6)**	**21.2 (20.2, 22.1)**	**28.8 (27.1, 30.6)**
	<55	559	3148	2.9 (2.3, 3.5)	7.9 (7.0, 8.9)	11.0 (9.9, 12.3)	19.2 (17.5, 21.0)	29.2 (26.8, 31.8)	41.9 (37.6, 46.6)
	55-64	842	6682	2.0 (1.7, 2.4)	4.9 (4.4, 5.5)	7.4 (6.7, 8.1)	12.7 (11.8, 13.8)	23.1 (21.5, 24.9)	32.1 (29.1, 35.4)
	65-74	688	6849	1.9 (1.6, 2.2)	4.4 (3.9, 5.0)	6.2 (5.6, 6.9)	12.7 (11.7, 13.8)	19.8 (18.3, 21.5)	23.6 (21.4, 26.0)
	≥75	237	3847	1.8 (1.4, 2.3)	3.7 (3.1, 4.3)	5.1 (4.4, 5.9)	8.7 (7.6, 10.0)	10.3 (8.9, 11.8)	
TOTAL		**4449**	**45423**						

Note: Restricted to modern prostheses

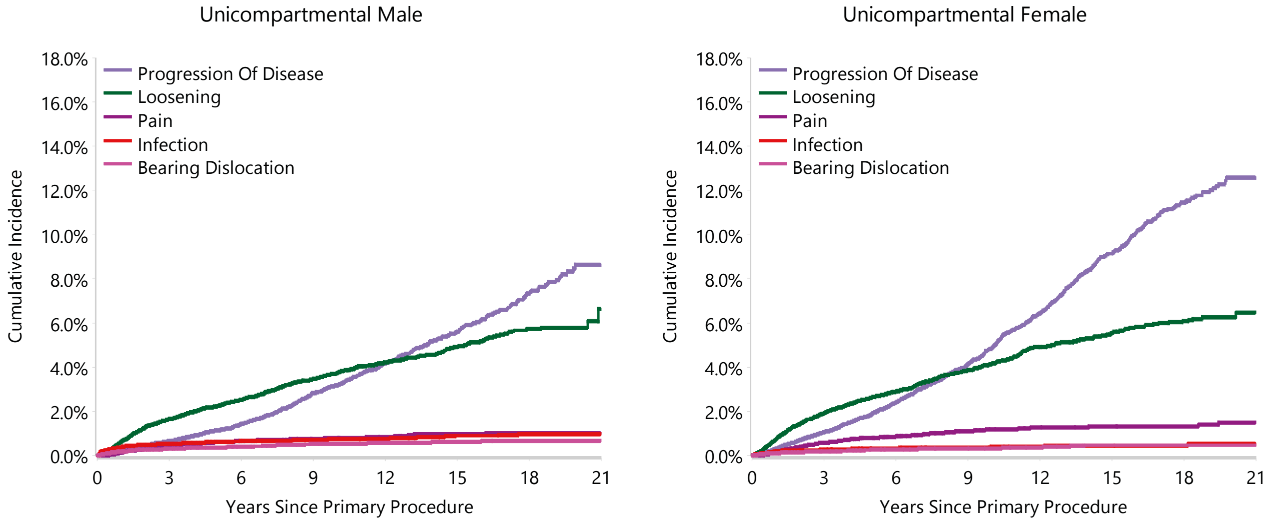
Figure KP9 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement by Gender (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Male	24897	22236	17313	12765	6053	2080	197
Female	20526	18730	15081	11565	6305	2369	234

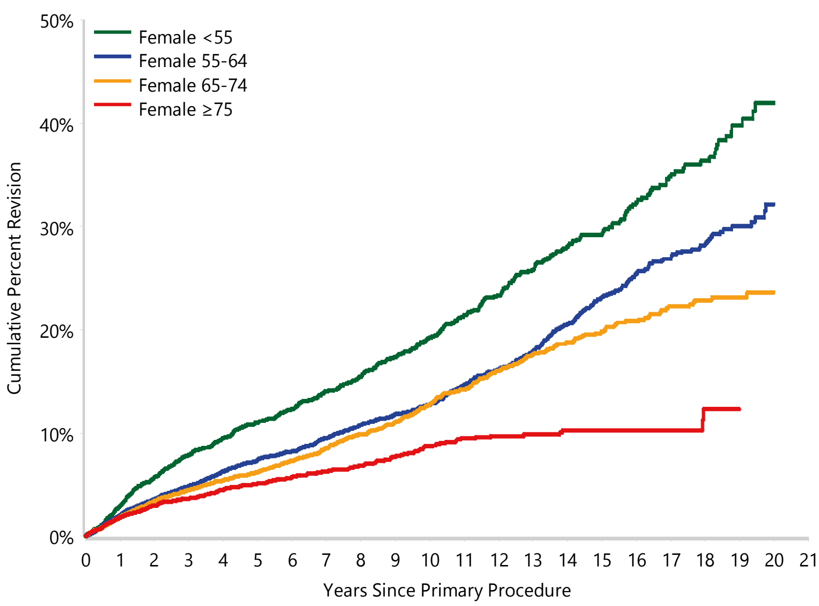
Note: Restricted to modern prostheses

Figure KP10 Cumulative Incidence Revision Diagnosis of Primary Unicompartmental Knee Replacement by Gender (Primary Diagnosis OA)



Note: Restricted to modern prostheses

Figure KP11 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement for Females by Age (Primary Diagnosis OA)



Female <55 vs Female ≥75
- 0 - 1.5Yr: HR=1.99 (1.52, 2.60), p<0.001
- 1.5Yr - 3Yr: HR=2.73 (2.05, 3.64), p<0.001
- 3Yr - 4Yr: HR=2.17 (1.47, 3.20), p<0.001
- 4Yr - 11Yr: HR=2.47 (1.97, 3.10), p<0.001
- 11Yr+: HR=12.58 (5.86, 26.98), p<0.001

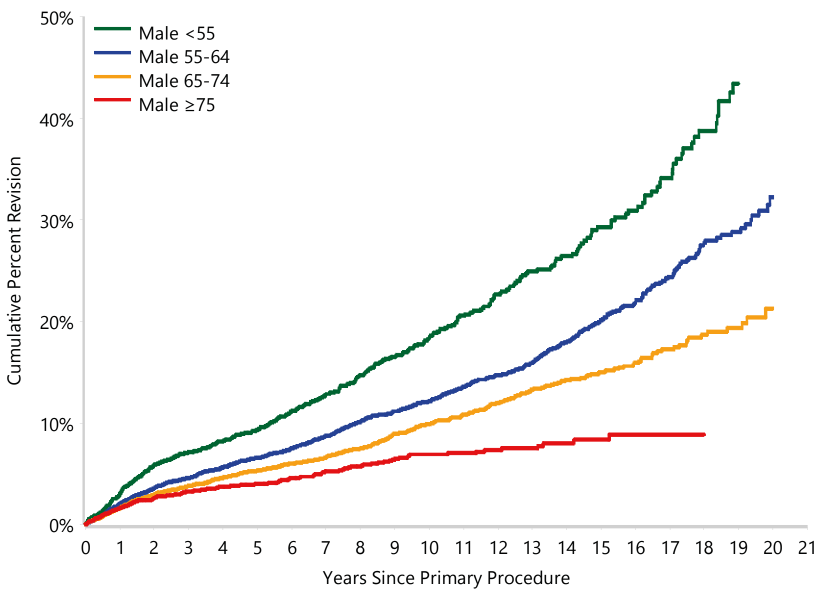
Female 55-64 vs Female ≥75
- 0 - 3Mth: HR=0.91 (0.56, 1.48), p=0.705
- 3Mth - 6Mth: HR=2.15 (1.38, 3.37), p<0.001
- 6Mth - 1.5Yr: HR=1.14 (0.86, 1.52), p=0.355
- 1.5Yr - 11Yr: HR=1.67 (1.38, 2.01), p<0.001
- 11Yr+: HR=10.05 (4.74, 21.34), p<0.001

Female 65-74 vs Female ≥75
- 0 - 1.5Yr: HR=1.12 (0.87, 1.46), p=0.374
- 1.5Yr - 7.5Yr: HR=1.52 (1.24, 1.86), p<0.001
- 7.5Yr - 11Yr: HR=1.76 (1.35, 2.30), p<0.001
- 11Yr - 11.5Yr: HR=11.58 (4.63, 29.01), p<0.001
- 11.5Yr+: HR=6.01 (2.79, 12.98), p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Female	<55	3148	2893	2312	1791	983	409	52
	55-64	6682	6121	5037	3972	2291	892	82
	65-74	6849	6219	4936	3732	1983	770	84
	≥75	3847	3497	2796	2070	1048	298	16

Note: Restricted to modern prostheses

Figure KP12 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement for Males by Age (Primary Diagnosis OA)



Male <55 vs Male ≥75
0 - 1.5Yr: HR=2.01 (1.54, 2.62), p<0.001
1.5Yr - 2Yr: HR=4.53 (2.88, 7.12), p<0.001
2Yr - 5.5Yr: HR=2.96 (2.19, 4.00), p<0.001
5.5Yr - 7Yr: HR=3.87 (2.55, 5.88), p<0.001
7Yr - 11Yr: HR=3.84 (2.77, 5.33), p<0.001
11Yr - 12Yr: HR=3.38 (1.75, 6.53), p<0.001
12Yr+: HR=5.49 (3.73, 8.08), p<0.001

Male 55-64 vs Male ≥75
0 - 1.5Yr: HR=1.26 (1.00, 1.60), p=0.049
1.5Yr - 7Yr: HR=2.36 (1.88, 2.96), p<0.001
7Yr - 7.5Yr: HR=2.78 (1.59, 4.87), p<0.001
7.5Yr - 11.5Yr: HR=2.23 (1.67, 2.99), p<0.001
11.5Yr - 12Yr: HR=1.02 (0.44, 2.38), p=0.964
12Yr+: HR=3.75 (2.67, 5.25), p<0.001

Male 65-74 vs Male ≥75
0 - 1.5Yr: HR=1.06 (0.84, 1.35), p=0.603
1.5Yr+: HR=1.78 (1.45, 2.20), p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Male	<55	2759	2418	1867	1407	683	245	23
	55-64	8248	7421	5928	4491	2295	866	96
	65-74	9054	8149	6309	4581	2205	772	75
	≥75	4836	4248	3209	2286	870	197	3

Note: Restricted to modern prostheses

OUTCOME BY PROSTHESIS CHARACTERISTICS

Bearing Mobility

Fixed bearings are used in 51.1% of unicompartmental knee replacements, while in the remainder the bearing insert is mobile. The number of prostheses using mobile bearings has reduced to two in 2021. Fixed bearing prostheses have a lower rate of revision compared to mobile bearing prostheses (Table KP12 and Figure KP13).

Robotic Assistance

There have been 6,751 robotically assisted unicompartmental knee replacement procedures recorded since 2015. In 2021, 36.4% of unicompartmental knee procedures used robotic assistance. There are only 6 unicompartmental combinations that can be used with robotic assistance.

Unicompartmental knee procedures using robotic assistance have a lower rate of revision compared to unicompartmental procedures without robotic assistance (Table KP13 and Figure KP14). However, there is no difference when this comparison is restricted to fixed bearing designs (Table KP14 and Figure KP15).
When using robotic assistance, there are fewer revisions for loosening, progression of disease and pain, but more revisions for infection (Table KP15 and Figure KP16).

Position

The Registry has recorded 1,189 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 KP16 and Figure KP17).
Fixed bearing prostheses have a lower rate of revision compared to mobile bearings used for lateral unicompartmental knee replacement (Table KP17 and Figure KP18).

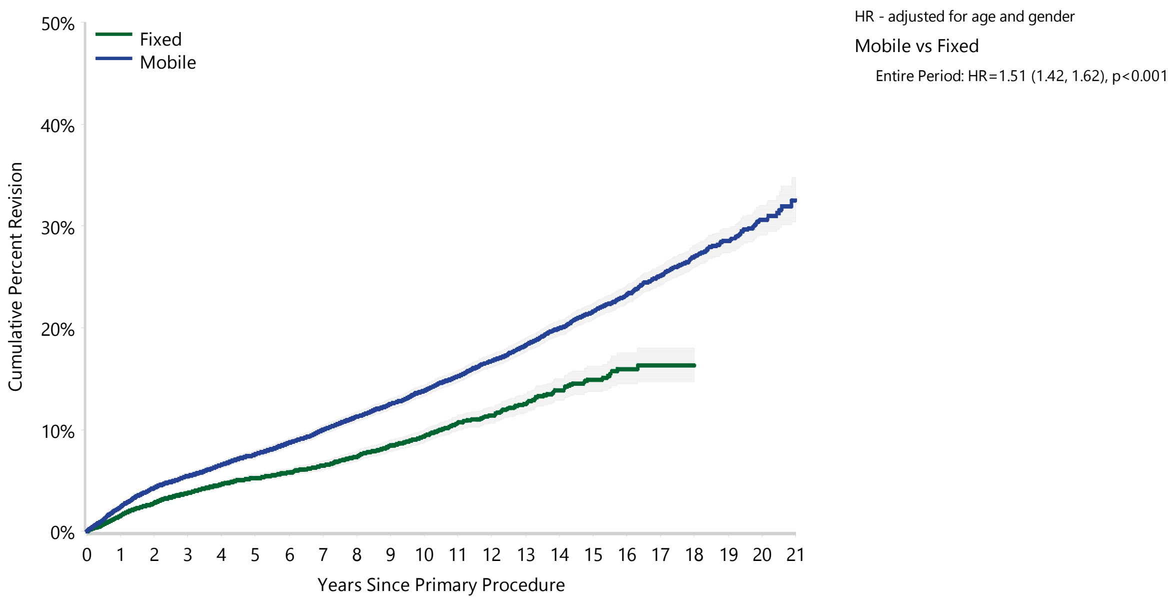
The most common reasons for revision of both lateral and medial unicompartmental knees are progression of disease and loosening (Table KP18 and Figure KP19).
The outcome of prosthesis combinations with >50 procedures used in lateral unicompartmental knee replacement is presented in Table KP19.

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	1291	23193	1.5 (1.4, 1.7)	3.8 (3.5, 4.0)	5.2 (4.9, 5.6)	9.3 (8.7, 9.9)	14.9 (13.7, 16.2)	
Mobile	3157	22229	2.4 (2.2, 2.6)	5.4 (5.1, 5.7)	7.6 (7.2, 8.0)	13.8 (13.3, 14.4)	21.6 (20.8, 22.4)	30.6 (29.1, 32.0)
TOTAL	4448	45422						

Note: Excludes 1 primary unicompartmental knee procedure with unknown/missing mobility
Restricted to modern prostheses

Figure KP13 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	23193	20222	14436	9171	3497	583	1
Mobile	22229	20744	17958	15159	8861	3866	430

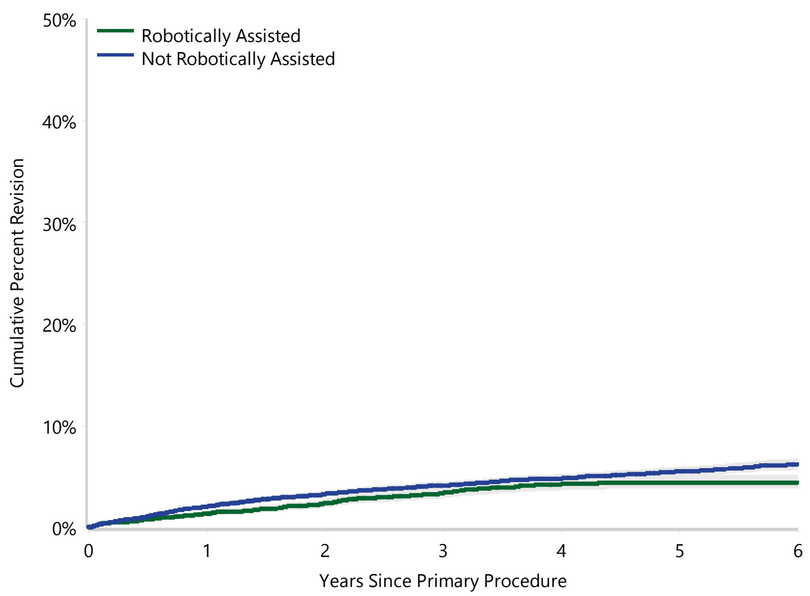
Note: Restricted to modern prostheses

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
Robotically Assisted	194	6751	1.3 (1.1, 1.6)	2.4 (2.0, 2.8)	3.4 (2.9, 3.9)	4.2 (3.6, 4.9)	4.4 (3.8, 5.1)	4.4 (3.8, 5.1)
Not Robotically Assisted	687	16468	2.0 (1.8, 2.3)	3.3 (3.0, 3.6)	4.1 (3.8, 4.5)	4.8 (4.4, 5.2)	5.5 (5.1, 5.9)	6.2 (5.7, 6.7)
TOTAL	881	23219						

Note: Restricted to modern prostheses

Figure KP14 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement Since 2015 by Robotic Assistance (Primary Diagnosis OA)



HR - adjusted for age and gender
Not Robotically Assisted vs
Robotically Assisted
Entire Period: HR=1.27 (1.08, 1.49), p=0.003

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Robotically Assisted	6751	5399	4127	2938	1752	730	138
Not Robotically Assisted	16468	13935	11449	8878	6391	3981	1885

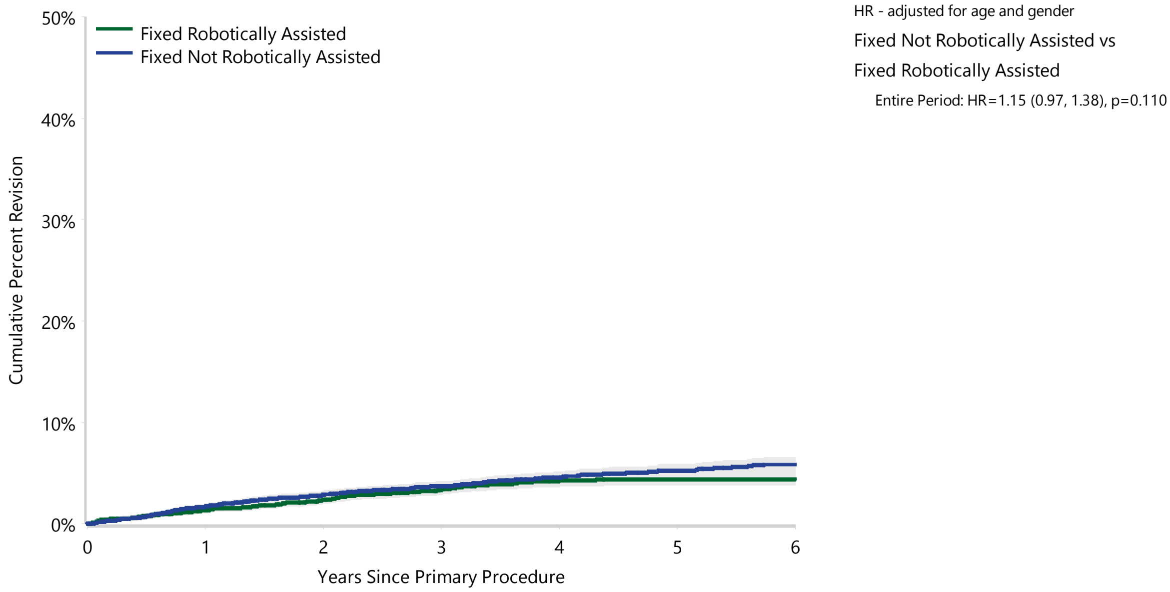
Note: Restricted to modern prostheses

Table KP14 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement with Fixed Bearings Since 2015 by Robotic Assistance (Primary Diagnosis OA)

Mobility	Robotic Assistance	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Fixed	Robotically Assisted	194	6747	1.3 (1.1, 1.6)	2.4 (2.0, 2.8)	3.4 (2.9, 3.9)	4.2 (3.6, 4.9)	4.4 (3.8, 5.1)	4.4 (3.8, 5.1)
	Not Robotically Assisted	345	9252	1.7 (1.4, 2.0)	2.8 (2.5, 3.2)	3.7 (3.3, 4.2)	4.6 (4.1, 5.1)	5.3 (4.7, 5.9)	5.8 (5.2, 6.6)
TOTAL		539	15999						

Note: Restricted to modern prostheses
Excludes 1 procedure with unknown mobility

Figure KP15 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement with Fixed Bearings 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
Fixed	Robotically Assisted	6747	5397	4126	2938	1752	730	138
	Not Robotically Assisted	9252	7774	6301	4749	3237	1963	922

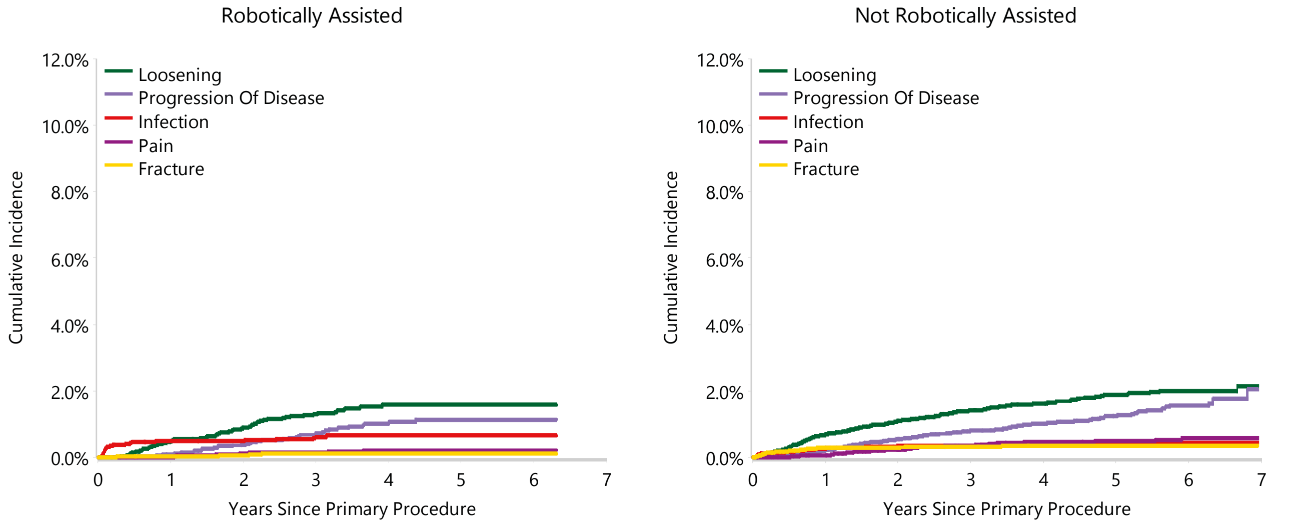
Note: Restricted to modern prostheses

Table KP15 Revision Diagnosis of Primary Unicompartmental Knee Replacement Since 2015 by Robotic Assistance (Primary Diagnosis OA)

Revision Diagnosis	Robotically Assisted			Not Robotically Assisted		
	Number	% Primaries Revised	% Revisions	Number	% Primaries Revised	% Revisions
Loosening	71	1.1	36.6	230	1.4	33.5
Progression of Disease	42	0.6	21.6	148	0.9	21.5
Pain	9	0.1	4.6	59	0.4	8.6
Infection	38	0.6	19.6	58	0.4	8.4
Bearing Dislocation				55	0.3	8.0
Fracture	6	0.1	3.1	53	0.3	7.7
Instability	5	0.1	2.6	26	0.2	3.8
Malalignment	5	0.1	2.6	14	0.1	2.0
Lysis	4	0.1	2.1	8	0.0	1.2
Prosthesis Dislocation	1	0.0	0.5	7	0.0	1.0
Incorrect Sizing				6	0.0	0.9
Arthrofibrosis				3	0.0	0.4
Implant Breakage Tibial				2	0.0	0.3
Osteonecrosis	2	0.0	1.0	2	0.0	0.3
Patella Erosion				2	0.0	0.3
Patellofemoral Pain	1	0.0	0.5	2	0.0	0.3
Wear Tibial Insert	1	0.0	0.5	2	0.0	0.3
Metal Related Pathology	1	0.0	0.5	1	0.0	0.1
Synovitis	1	0.0	0.5	1	0.0	0.1
Other	7	0.1	3.6	8	0.0	1.2
N Revision	**194**	**2.9**	**100.0**	**687**	**4.2**	**100.0**
N Primary	**6751**			**16468**		

Note: Restricted to modern prostheses

Figure KP16 Cumulative Incidence Revision Diagnosis of Primary Unicompartmental Knee Replacement Since 2015 by Robotic Assistance (Primary Diagnosis OA)



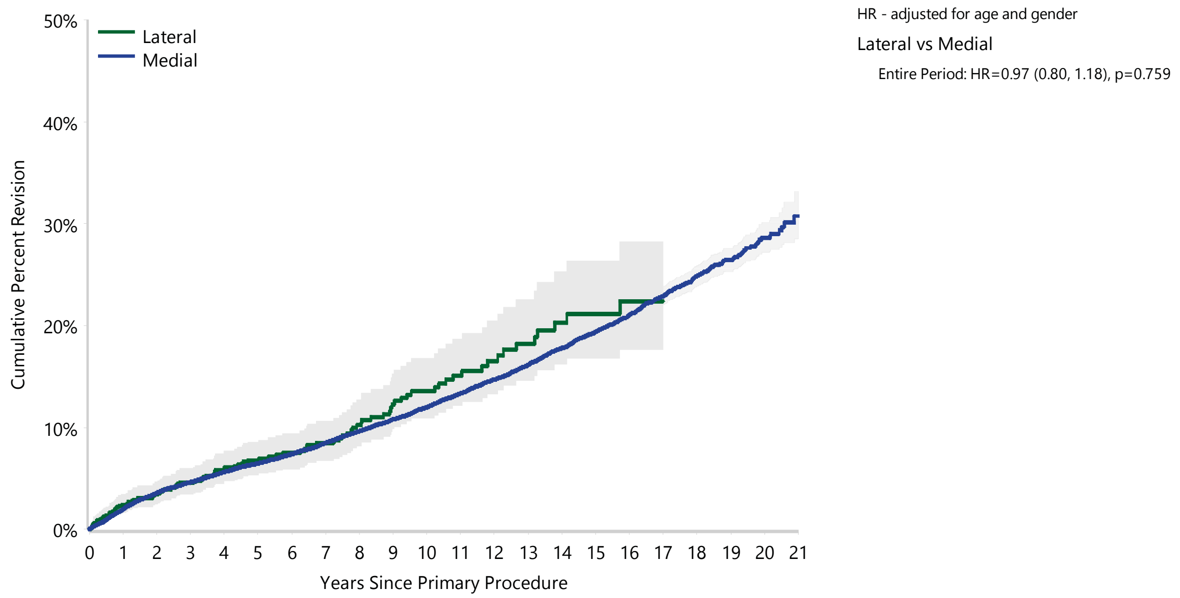
Note: Restricted to modern prostheses

Table KP16 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	108	1189	2.3 (1.6, 3.4)	4.5 (3.4, 6.0)	6.8 (5.3, 8.6)	13.5 (10.9, 16.8)	21.1 (16.8, 26.4)	
Medial	4274	43768	2.0 (1.8, 2.1)	4.6 (4.4, 4.8)	6.5 (6.2, 6.7)	11.9 (11.5, 12.4)	19.4 (18.7, 20.1)	28.6 (27.2, 30.1)
TOTAL	4382	44957						

Note: Excludes 466 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	1189	1074	833	575	240	75	14
Medial	43768	39473	31238	23493	11934	4280	416

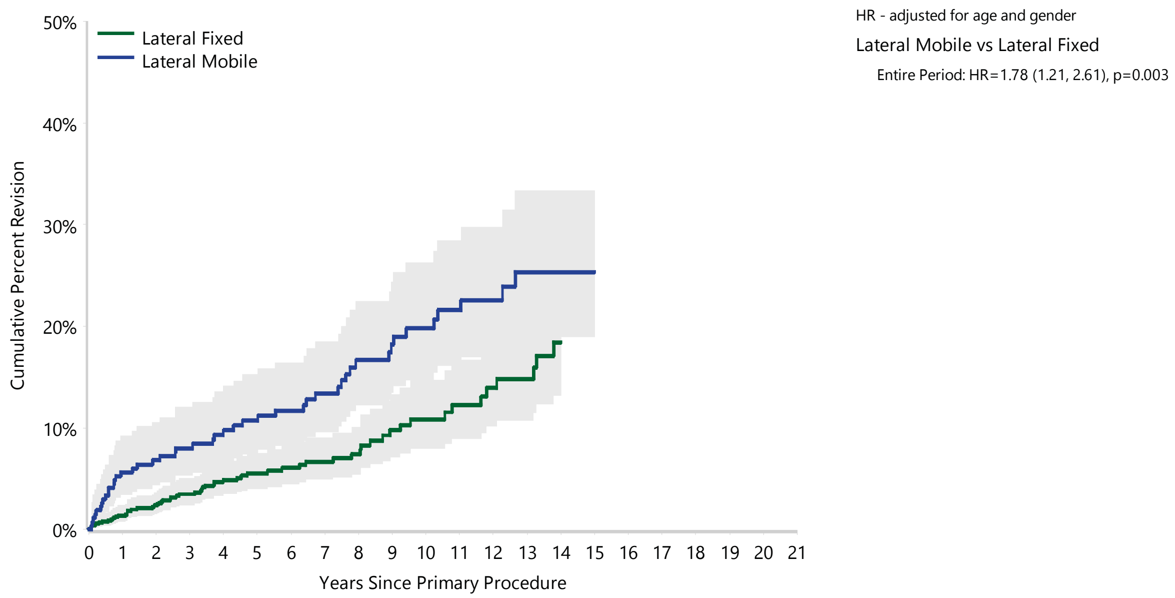
Note: Restricted to modern prostheses

Table KP17 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	20 Yrs
Lateral	Fixed	61	920	1.4 (0.8, 2.4)	3.5 (2.4, 5.0)	5.5 (4.0, 7.5)	10.8 (8.0, 14.7)		
	Mobile	47	269	5.6 (3.4, 9.2)	8.0 (5.3, 12.0)	10.7 (7.4, 15.2)	19.8 (14.7, 26.3)	25.3 (19.0, 33.4)	
TOTAL		108	1189						

Note: Excludes 467 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	920	825	612	394	148	35	0
	Mobile	269	249	221	181	92	40	14

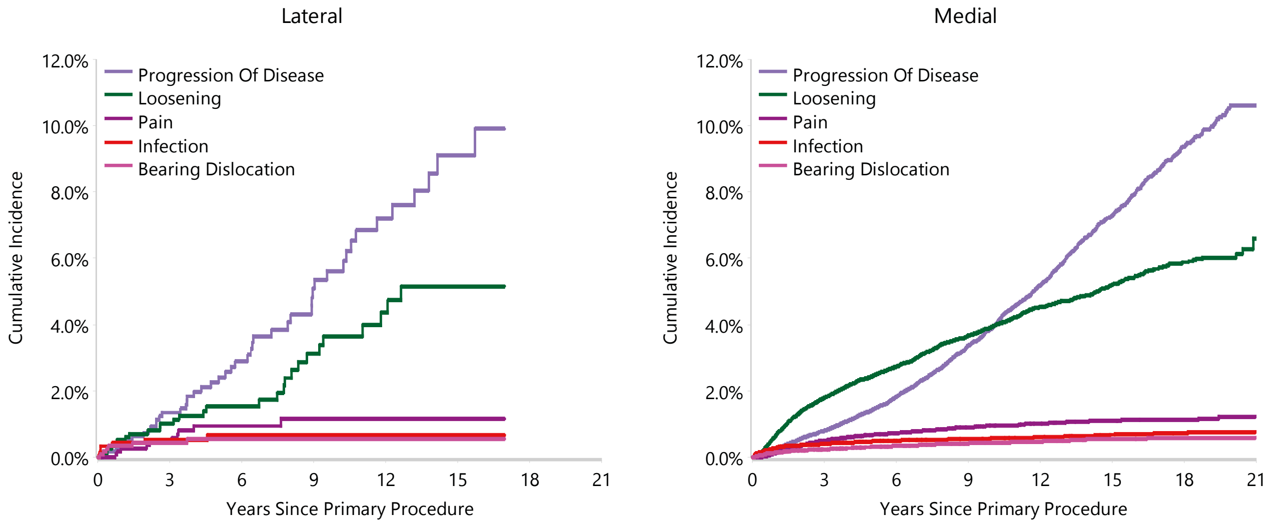
Note: Restricted to modern prostheses

Table KP18 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	47	4.0	43.5	1525	3.5	35.7
Loosening	28	2.4	25.9	1396	3.2	32.7
Pain	10	0.8	9.3	325	0.7	7.6
Infection	7	0.6	6.5	225	0.5	5.3
Bearing Dislocation	6	0.5	5.6	160	0.4	3.7
Fracture	2	0.2	1.9	126	0.3	2.9
Instability	2	0.2	1.9	79	0.2	1.8
Lysis				79	0.2	1.8
Wear Tibial Insert	2	0.2	1.9	63	0.1	1.5
Malalignment	2	0.2	1.9	57	0.1	1.3
Other	2	0.2	1.9	239	0.5	5.6
N Revision	**108**	**9.1**	**100.0**	**4274**	**9.8**	**100.0**
N Primary	**1189**			**43768**		

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

Table KP19 Cumulative Percent Revision of Lateral Primary Unicompartmental Knee Replacement by Prosthesis Combination (Primary Diagnosis OA)

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	2	53	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	3.7 (0.5, 23.5)		
Endo-Model Sled	Endo-Model Sled	23	156	0.0 (0.0, 0.0)	4.0 (1.8, 8.7)	6.9 (3.8, 12.5)	13.3 (8.2, 21.2)		
Oxford (cless)	Oxford (ctd)	7	84	3.7 (1.2, 10.9)	5.0 (1.9, 12.8)	5.0 (1.9, 12.8)	13.7 (6.2, 28.6)		
Oxford (ctd)	Oxford (ctd)	39	172	7.0 (4.0, 12.0)	10.0 (6.3, 15.5)	13.8 (9.4, 20.0)	22.2 (16.2, 30.1)	28.2 (20.9, 37.2)	
Restoris MCK	Restoris MCK	4	232	0.5 (0.1, 3.3)	2.3 (0.9, 6.2)				
Sigma HP	Sigma HP	4	62	1.8 (0.3, 12.2)	1.8 (0.3, 12.2)	7.2 (2.3, 21.1)	7.2 (2.3, 21.1)		
ZUK	ZUK	20	318	1.3 (0.5, 3.4)	3.0 (1.6, 5.8)	5.4 (3.2, 9.1)	12.2 (7.4, 19.8)		
Other (9)		9	112	5.5 (2.5, 11.8)	7.8 (4.0, 15.1)	7.8 (4.0, 15.1)			
TOTAL		108	1189						

Note: Only prostheses with >50 procedures have been listed
Restricted to modern prostheses

Primary Total Knee Replacement

CLASS OF TOTAL KNEE REPLACEMENT

The Registry defines a total knee replacement 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 Registry details the outcome of total knee replacement based on specific patient and prosthesis characteristics. 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, the Registry subdivides these systems 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. The Registry then undertakes a catalogue range-specific analysis to determine if the higher than anticipated rate of revision is associated with specific prosthesis attributes within that system.

To enable the Registry to undertake range-specific analyses 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 have been 829,272 primary total knee replacement procedures reported to the Registry. This is an additional 59,474 procedures compared to the last report.

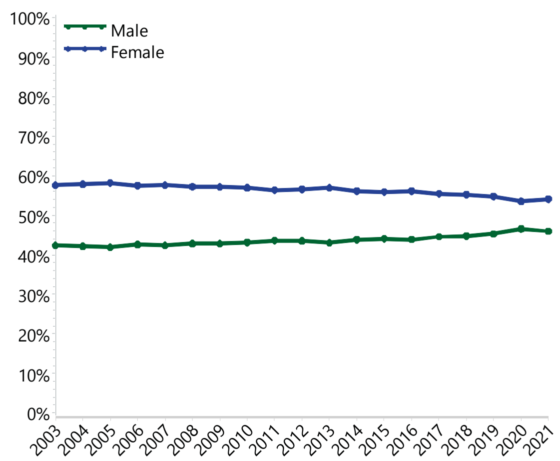
In 2021, there is an increase of 9.0% in primary total knee replacement procedures when compared to 2020. As a proportion of all knee replacement procedures, primary total knee replacement increased to 87.0% in 2021.

Osteoarthritis is the most common diagnosis for primary total knee replacement.

There have been 829,272 primary total knee replacement procedures reported to the Registry. This is an additional 59,474 procedures compared to the last report.

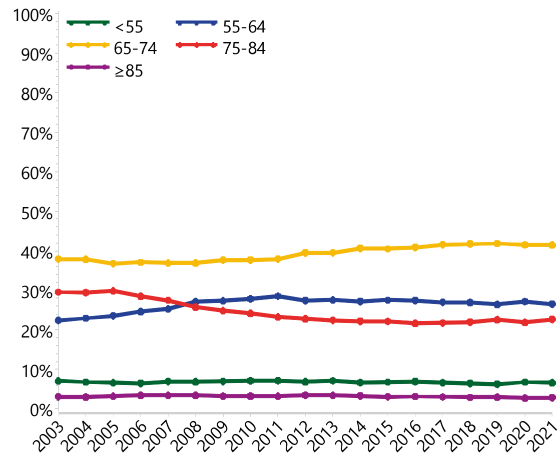
Primary total knee replacement remains more common in females (56.1%). This proportion has shown little change from 2003. The mean age of patients is 68.5 years (Table KT1 and Figure KT1).

Figure KT1 Primary Total Knee Replacement by Gender



There has been a 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



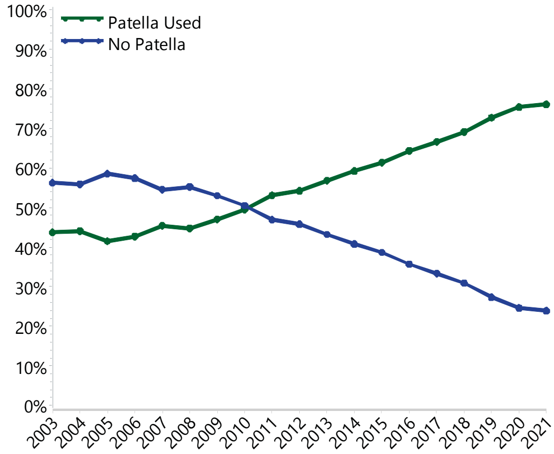
Detailed demographic information on primary total knee replacement is available in the supplementary report 'Demographics of Hip, Knee and Shoulder Arthroplasty' on the AOANJRR website: https://aoanjrr.sahmri.com/annual-reports-2022

Table KT1 Age and Gender of Primary Total Knee Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	364431	43.9%	8	101	68	68.1	9.1
Female	464841	56.1%	8	103	69	68.7	9.3
TOTAL	829272	100.0%	8	103	69	68.5	9.2

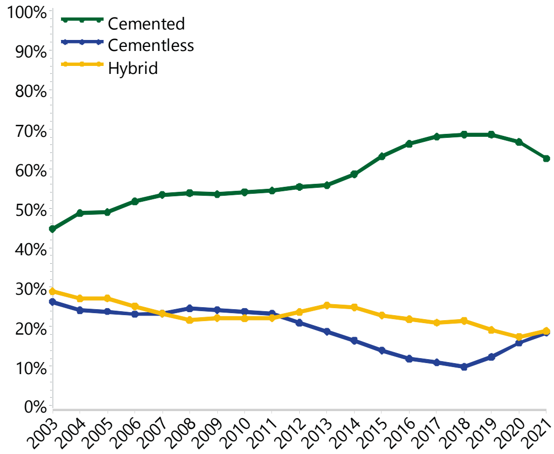
Patella resurfacing at the time of the primary total knee replacement has increased to 76.1% in 2021 (Figure KT3).

Figure KT3 Primary Total Knee Replacement by Patella Usage



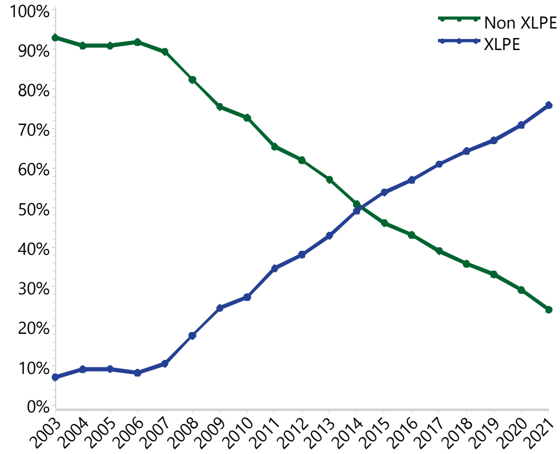
The most common method of fixation is cementing both femoral and tibial components. This accounts for 62.5% of procedures in 2021. The use of cementless fixation decreased to 9.8% of all primary total knee replacement in 2018 but has increased to 18.6% in 2021 (Figure KT4). Hybrid primary total knee replacement (femoral cementless) was used in 18.9% of procedures in 2021.

Figure KT4 Primary Total Knee Replacement by Fixation



The use of cross-linked polyethylene (XLPE) in primary total knee replacement increased to 75.8% in 2021 (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 2021, the most commonly used femoral prostheses were 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 2021 were the Triathlon, Persona and Genesis II (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		2018		2019		2020		2021	
N	Model	N	Model	N	Model	N	Model	N	Model
3183	LCS CR	12328	Triathlon CR	13405	Triathlon CR	13772	Triathlon CR	16268	Triathlon CR
2846	Duracon	5796	Nexgen CR Flex	5665	Persona CR	8439	Persona CR	11462	Persona CR
2150	Nexgen CR	3588	Persona CR	4305	Nexgen CR Flex	3250	GMK Sphere Primary	4135	Attune CR
1419	PFC Sigma CR	3246	Attune CR	3404	Attune CR	3149	Attune CR	3646	GMK Sphere Primary
1354	Scorpio CR	2190	Nexgen LPS Flex	2747	GMK Sphere Primary	2391	Nexgen CR Flex	2206	Attune PS
1059	Genesis II CR	2147	GMK Sphere Primary	1842	LCS CR	1781	Attune PS	1665	Nexgen CR Flex
1002	Natural Knee II	2090	LCS CR	1795	Attune PS	1608	Apex Knee CR	1601	Apex Knee CR
902	Nexgen LPS	1956	Vanguard CR	1567	Vanguard CR	1407	LCS CR	1587	Legion Oxinium CR
883	Profix	1660	Evolution	1541	Evolution	1364	Legion Oxinium CR	1206	Legion Oxinium PS
751	Scorpio PS	1408	Apex Knee CR	1477	Apex Knee CR	1218	Evolution	1099	Legion CR
10 Most Used									
15549	(10) 71.5%	36409	(10) 64.8%	37748	(10) 66.1%	38379	(10) 71.0%	44875	(10) 76.2%
Remainder									
6185	(47) 28.5%	19776	(74) 35.2%	19347	(67) 33.9%	15692	(65) 29.0%	14053	(65) 23.8%
TOTAL									
21734	(57) 100.0%	56185	(84) 100.0%	57095	(77) 100.0%	54071	(75) 100.0%	58928	(75) 100.0%

Table KT3 10 Most Used Cemented Femoral Prostheses in Primary Total Knee Replacement

2003		2018		2019		2020		2021	
N	Model	N	Model	N	Model	N	Model	N	Model
1222	Duracon	6673	Triathlon CR	6645	Triathlon CR	6247	Triathlon CR	7115	Triathlon CR
942	LCS CR	3158	Attune CR	3415	Persona CR	4920	Persona CR	6303	Persona CR
827	Nexgen LPS	2931	Nexgen CR Flex	3283	Attune CR	3250	GMK Sphere Primary	3646	GMK Sphere Primary
765	Nexgen CR	2363	Persona CR	2747	GMK Sphere Primary	2876	Attune CR	2275	Attune CR
693	Nexgen LPS Flex	2147	GMK Sphere Primary	2316	Nexgen CR Flex	1694	Attune PS	2107	Attune PS
645	Genesis II CR	1927	Nexgen LPS Flex	1777	Attune PS	1364	Legion Oxinium CR	1587	Legion Oxinium CR
515	PFC Sigma PS	1620	Evolution	1513	Evolution	1225	Nexgen CR Flex	1206	Legion Oxinium PS
497	Profix	1393	Legion Oxinium PS	1379	Legion Oxinium CR	1140	Evolution	1089	Columbus
479	Genesis II Oxinium CR	1365	Attune PS	1272	Legion Oxinium PS	1111	Columbus	989	Evolution
419	Genesis II PS	1344	Genesis II Oxinium PS	1268	Genesis II Oxinium PS	1074	Genesis II Oxinium PS	876	Genesis II Oxinium PS
10 Most Used									
7004	(10) 71.6%	24921	(10) 64.4%	25615	(10) 65.3%	24901	(10) 68.6%	27193	(10) 72.3%
Remainder									
2778	(38) 28.4%	13785	(71) 35.6%	13600	(66) 34.7%	11415	(63) 31.4%	10441	(63) 27.7%
TOTAL									
9782	(48) 100.0%	38706	(81) 100.0%	39215	(76) 100.0%	36316	(73) 100.0%	37634	(73) 100.0%

Table KT4 10 Most Used Cementless Femoral Prostheses in Primary Total Knee Replacement

2003		2018		2019		2020		2021	
N	Model	N	Model	N	Model	N	Model	N	Model
2241	LCS CR	5655	Triathlon CR	6760	Triathlon CR	7525	Triathlon CR	9153	Triathlon CR
1624	Duracon	2865	Nexgen CR Flex	2250	Persona CR	3519	Persona CR	5159	Persona CR
1385	Nexgen CR	1445	LCS CR	1989	Nexgen CR Flex	1166	Nexgen CR Flex	1860	Attune CR
1075	PFC Sigma CR	1225	Persona CR	1297	LCS CR	992	LCS CR	798	Nexgen CR Flex
1059	Scorpio CR	1042	Vanguard CR	797	Vanguard CR	773	Apex Knee CR	765	Apex Knee CR
746	Natural Knee II	648	Apex Knee CR	664	Apex Knee CR	449	PFC Sigma CR	583	LCS CR
633	Active Knee	566	Legion CR	549	PFC Sigma CR	413	Legion CR	510	Legion CR
425	Maxim	532	PFC Sigma CR	503	Legion CR	381	Vanguard CR	381	Score
414	Genesis II CR	367	BalanSys	390	BalanSys	365	Score	291	GMK Primary
386	Profix	367	Genesis II CR	356	Score	273	Attune CR	242	Genesis II CR
10 Most Used									
9988	(10) 83.6%	14712	(10) 84.2%	15555	(10) 87.0%	15856	(10) 89.3%	19742	(10) 92.7%
Remainder									
1964	(28) 16.4%	2767	(26) 15.8%	2325	(22) 13.0%	1899	(24) 10.7%	1552	(24) 7.3%
TOTAL									
11952	(38) 100.0%	17479	(36) 100.0%	17880	(32) 100.0%	17755	(34) 100.0%	21294	(34) 100.0%

Table KT5 10 Most Used Tibial Components in Primary Total Knee Replacement

2003		2018		2019		2020		2021	
N	Model	N	Model	N	Model	N	Model	N	Model
3755	Nexgen	13321	Triathlon	14348	Triathlon	14547	Triathlon	16955	Triathlon
2843	Duracon	7929	Nexgen	7456	Genesis II	9064	Persona	12024	Persona
2040	Genesis II	7698	Genesis II	6334	Persona	6325	Genesis II	6879	Genesis II
1364	MBT	4622	Attune	5646	Nexgen	4983	Attune	6387	Attune
1362	LCS	4040	Persona	5250	Attune	3144	Nexgen	3490	GMK Primary
1360	Series 7000	2123	Apex Knee	2556	GMK Primary	2951	GMK Primary	2319	Apex Knee
1168	PFC Sigma	2106	GMK Primary	2330	Apex Knee	2376	Apex Knee	2179	Nexgen
1060	MBT Duofix	2046	Vanguard	1740	Vanguard	1257	MBT	1089	Columbus
1002	Natural Knee II	1928	MBT	1670	MBT	1205	Evolution	996	Evolution
894	Profix	1660	Evolution	1537	Evolution	1111	Columbus	931	MBT
10 Most Used									
16848	(10) 77.5%	47473	(10) 84.5%	48867	(10) 85.6%	46963	(10) 86.9%	53249	(10) 90.4%
Remainder									
4886	(38) 22.5%	8712	(51) 15.5%	8228	(49) 14.4%	7108	(47) 13.1%	5679	(47) 9.6%
TOTAL									
21734	(48) 100.0%	56185	(61) 100.0%	57095	(59) 100.0%	54071	(57) 100.0%	58928	(57) 100.0%

Table KT6 10 Most Used Cemented Tibial Components in Primary Total Knee Replacement

2003		2018		2019		2020		2021	
N	Model	N	Model	N	Model	N	Model	N	Model
3010	Nexgen	11640	Triathlon	10825	Triathlon	9456	Triathlon	10614	Triathlon
2348	Duracon	7631	Genesis II	7404	Genesis II	7577	Persona	9893	Persona
1993	Genesis II	7125	Nexgen	5955	Persona	6305	Genesis II	6877	Genesis II
1168	PFC Sigma	4534	Attune	5168	Attune	4689	Attune	4458	Attune
1067	MBT	4028	Persona	5036	Nexgen	2860	Nexgen	3295	GMK Primary
1033	LCS	2094	Apex Knee	2419	GMK Primary	2844	GMK Primary	2297	Apex Knee
1007	Series 7000	2023	Vanguard	2277	Apex Knee	2369	Apex Knee	2052	Nexgen
719	Profix	1939	GMK Primary	1717	Vanguard	1205	Evolution	1089	Columbus
587	AGC	1660	Evolution	1537	Evolution	1111	Columbus	996	Evolution
478	Natural Knee II	1496	MBT	1267	MBT	1029	Vanguard	786	MBT
10 Most Used									
13410	(10) 84.9%	44170	(10) 87.8%	43605	(10) 87.4%	39445	(10) 87.6%	42357	(10) 90.3%
Remainder									
2382	(31) 15.1%	6152	(45) 12.2%	6267	(43) 12.6%	5592	(41) 12.4%	4533	(40) 9.7%
TOTAL									
15792	(41) 100.0%	50322	(55) 100.0%	49872	(53) 100.0%	45037	(51) 100.0%	46890	(50) 100.0%

Table KT7 10 Most Used Cementless Tibial Components in Primary Total Knee Replacement

2003		2018		2019		2020		2021	
N	Model	N	Model	N	Model	N	Model	N	Model
1060	MBT Duofix	1681	Triathlon	3523	Triathlon	5091	Triathlon	6341	Triathlon
745	Nexgen	804	Nexgen	625	Nexgen TM CR	1487	Persona	2131	Persona
524	Natural Knee II	797	MBT Duofix	610	Nexgen	430	MBT Duofix	1929	Attune
495	Duracon	724	Nexgen TM CR	570	MBT Duofix	418	Nexgen TM CR	362	Nexgen TM CR
487	Active Knee	432	MBT	403	MBT	304	MBT	288	Score
353	Series 7000	180	Score	379	Persona	294	Attune	195	GMK Primary
329	LCS	177	Regenerex	192	ACS Fixed	284	Nexgen	145	MBT
305	RBK	167	GMK Primary	137	GMK Primary	184	Score	127	Nexgen
297	MBT	145	RBK	131	Score	107	GMK Primary	95	Legion
242	Profix Mobile	130	Nexgen TM LPS	119	Nexgen TM LPS	100	RBK	86	Natural Knee II
10 Most Used									
4837	(10) 81.4%	5237	(10) 89.3%	6689	(10) 92.6%	8699	(10) 96.3%	11699	(10) 97.2%
Remainder									
1105	(18) 18.6%	626	(16) 10.7%	534	(14) 7.4%	335	(13) 3.7%	339	(14) 2.8%
TOTAL									
5942	(28) 100.0%	5863	(26) 100.0%	7223	(24) 100.0%	9034	(23) 100.0%	12038	(24) 100.0%

OUTCOME FOR ALL DIAGNOSES

Primary Diagnosis

The Registry recognises that the usage and availability of knee prostheses changes with time. In order to keep Registry data contemporaneous, only procedures using prostheses that have been available and used in 2021 (described as modern prostheses) are included in the analyses, unless clearly specified. This has resulted in 101,577 (12.2%) procedures being excluded from the analysis for the 2022 Annual Report.

The most common diagnosis for primary total knee replacement is osteoarthritis. Comparisons of revision rates for other primary diagnoses compared to osteoarthritis are shown in Table KT8 and Figure KT6.

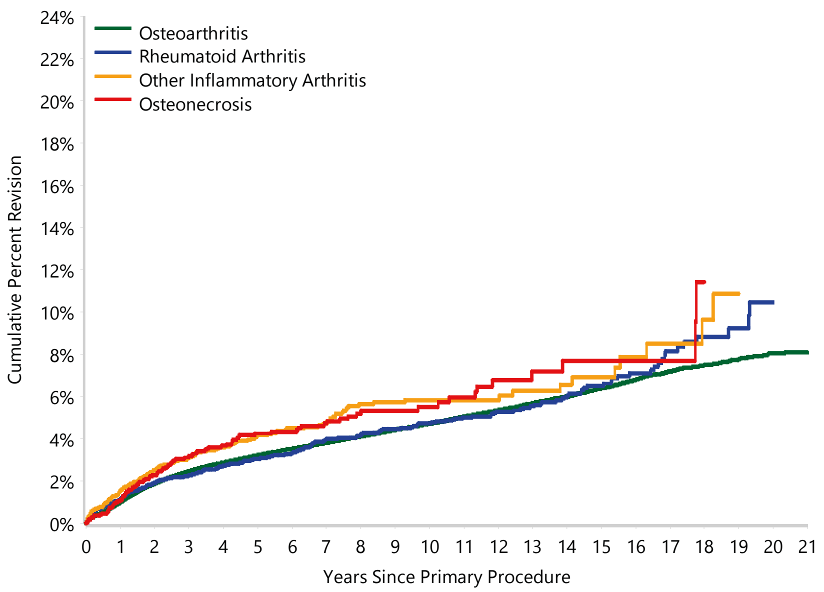
Rheumatoid arthritis has a lower rate of revision compared to osteoarthritis after 9 months.

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	25251	711978	97.8%	1.0 (1.0, 1.0)	2.5 (2.4, 2.5)	3.2 (3.2, 3.3)	4.7 (4.7, 4.8)	6.4 (6.3, 6.5)	8.0 (7.8, 8.3)
Rheumatoid Arthritis	331	8091	1.1%	1.1 (0.9, 1.4)	2.3 (2.0, 2.7)	3.0 (2.7, 3.5)	4.7 (4.2, 5.3)	6.5 (5.7, 7.5)	10.4 (8.3, 13.1)
Other Inflammatory Arthritis	161	3697	0.5%	1.6 (1.2, 2.0)	3.1 (2.6, 3.8)	4.2 (3.5, 5.0)	5.8 (4.9, 6.9)	6.9 (5.6, 8.5)	
Osteonecrosis	98	2185	0.3%	1.1 (0.7, 1.6)	3.2 (2.5, 4.1)	4.3 (3.4, 5.3)	5.5 (4.4, 6.8)	7.7 (5.9, 10.0)	
Other (4)	220	1744	0.2%	4.5 (3.6, 5.6)	9.7 (8.3, 11.4)	13.2 (11.4, 15.3)	21.0 (18.1, 24.3)	31.0 (25.5, 37.3)	
TOTAL	26061	727695	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=1.48 (1.11, 1.98), p=0.007
- 3Mth - 9Mth: HR=0.93 (0.66, 1.30), p=0.659
- 9Mth - 1.5Yr: HR=0.62 (0.45, 0.84), p=0.002
- 1.5Yr+: HR=0.84 (0.73, 0.96), p=0.011

Other Inflammatory Arthritis vs Osteoarthritis
- 0 - 1Yr: HR=1.46 (1.12, 1.91), p=0.005
- 1Yr - 1.5Yr: HR=0.79 (0.47, 1.33), p=0.377
- 1.5Yr+: HR=1.08 (0.88, 1.33), p=0.450

Osteonecrosis vs Osteoarthritis
- Entire Period: HR=1.29 (1.06, 1.57), p=0.012

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Osteoarthritis	711978	643368	515752	394801	159609	40379	2564
Rheumatoid Arthritis	8091	7495	6340	5112	2458	889	83
Other Inflammatory Arthritis	3697	3303	2607	1937	741	221	28
Osteonecrosis	2185	1990	1611	1242	474	128	10

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

PROSTHESIS TYPES

Overall, there are 296 femoral and tibial prosthesis combinations that meet the definition of a modern prosthesis in primary total knee replacement.

The cumulative percent revision of the 116 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 98.5% of all primary total knee replacement procedures. The ‘other’ group is the combined outcome of the remaining 180 prosthesis combinations with <400 procedures per combination.

There are 55 cemented femoral and tibial prosthesis combinations with >400 procedures (Table KT9).

There are 28 cementless femoral and tibial prosthesis combinations with >400 procedures (Table KT10).

There are 33 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	23	735	1.5 (0.9, 2.8)	2.8 (1.8, 4.3)	3.6 (2.4, 5.4)			
	ACS Mobile	30	1310	0.8 (0.4, 1.5)	1.9 (1.2, 2.9)	3.1 (2.1, 4.6)			
Active Knee	Active Knee	121	3280	0.9 (0.6, 1.3)	2.7 (2.2, 3.4)	3.7 (3.0, 4.5)	5.4 (4.5, 6.6)	7.9 (5.3, 11.6)	
Advance	Advance II	63	850	1.5 (0.9, 2.6)	4.3 (3.1, 5.9)	5.1 (3.8, 6.8)	7.1 (5.5, 9.1)	8.0 (6.2, 10.4)	
Anatomic	Anatomic	29	1263	1.2 (0.7, 1.9)	2.8 (1.9, 4.0)	2.8 (1.9, 4.0)			
Apex Knee CR	Apex Knee	56	4926	0.5 (0.4, 0.8)	1.2 (0.9, 1.6)	1.8 (1.3, 2.4)			
Apex Knee PS	Apex Knee	133	5548	0.8 (0.6, 1.0)	2.3 (1.9, 2.8)	3.1 (2.6, 3.8)			
Attune CR	Attune	473	20427	0.9 (0.8, 1.0)	2.3 (2.1, 2.5)	3.1 (2.8, 3.4)			
Attune PS	Attune	206	10431	0.9 (0.7, 1.1)	2.1 (1.8, 2.4)	2.6 (2.3, 3.0)			
BalanSys	BalanSys	61	2141	0.4 (0.2, 0.8)	1.6 (1.1, 2.2)	2.1 (1.5, 2.8)	3.7 (2.8, 4.9)	5.1 (3.5, 7.5)	
Columbus	Columbus	72	4460	0.9 (0.7, 1.3)	2.2 (1.7, 2.9)	2.4 (1.9, 3.1)	3.9 (2.3, 6.6)		
E.Motion	E.Motion	25	583	1.9 (1.1, 3.4)	3.7 (2.4, 5.6)	3.9 (2.6, 5.9)			
Evolis	Evolis	24	1104	0.4 (0.1, 1.0)	1.1 (0.6, 1.9)	1.7 (1.0, 2.7)	3.1 (2.0, 4.8)		
Evolution	Evolution	251	10085	0.8 (0.7, 1.0)	2.4 (2.1, 2.7)	3.1 (2.7, 3.5)			
GMK Primary	GMK Primary	26	738	1.1 (0.6, 2.2)	2.6 (1.7, 4.2)	3.3 (2.2, 5.0)	4.3 (2.9, 6.3)		
GMK Sphere Primary	GMK Primary	325	14314	1.3 (1.1, 1.5)	2.8 (2.5, 3.1)	3.2 (2.8, 3.6)			
	GMK Sphere Primary	64	2404	0.8 (0.5, 1.3)	2.8 (2.1, 3.7)	4.4 (3.3, 5.8)			
Genesis II CR	Genesis II	666	16521	0.9 (0.8, 1.1)	2.3 (2.1, 2.6)	3.0 (2.7, 3.3)	4.4 (4.1, 4.8)	5.6 (5.1, 6.1)	7.0 (6.1, 7.9)
Genesis II Oxinium CR	Genesis II	546	10108	1.1 (0.9, 1.3)	2.7 (2.4, 3.0)	3.4 (3.1, 3.8)	5.9 (5.4, 6.5)	8.5 (7.7, 9.3)	10.4 (9.1, 11.8)
Genesis II Oxinium PS	Genesis II	1321	21819	1.4 (1.3, 1.6)	3.6 (3.3, 3.8)	4.9 (4.6, 5.2)	7.2 (6.8, 7.7)	9.7 (9.0, 10.3)	
Genesis II PS	Genesis II	822	19825	1.1 (1.0, 1.3)	2.7 (2.5, 2.9)	3.6 (3.3, 3.9)	4.9 (4.5, 5.2)	6.0 (5.5, 6.5)	6.4 (5.8, 7.1)
LCS CR	LCS	335	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, 12.0)
	MBT	580	13293	0.8 (0.7, 1.0)	2.6 (2.3, 2.9)	3.6 (3.2, 3.9)	5.2 (4.8, 5.7)	6.1 (5.6, 6.8)	
Legion CR	Genesis II	93	3807	1.1 (0.8, 1.5)	2.3 (1.8, 2.9)	3.2 (2.6, 4.0)	4.3 (3.2, 5.9)		
Legion Oxinium CR	Genesis II	224	8902	0.8 (0.6, 1.0)	2.5 (2.1, 2.9)	3.6 (3.1, 4.1)	4.5 (3.9, 5.2)		
Legion Oxinium PS	Genesis II	648	16287	1.1 (0.9, 1.2)	3.0 (2.8, 3.3)	4.0 (3.7, 4.4)	5.7 (5.2, 6.3)		
Legion PS	Genesis II	189	5929	1.3 (1.0, 1.6)	2.5 (2.1, 2.9)	3.1 (2.7, 3.7)	4.3 (3.6, 5.0)		
MRK	MRK	21	659	0.8 (0.3, 1.9)	2.3 (1.3, 3.9)	2.5 (1.5, 4.2)	4.2 (2.6, 6.6)		
Natural Knee Flex	Natural Knee II	84	2595	1.2 (0.9, 1.8)	2.7 (2.1, 3.4)	3.1 (2.4, 3.9)	4.3 (3.4, 5.5)		
Nexgen CR	Nexgen	161	4174	0.7 (0.5, 1.0)	1.6 (1.3, 2.0)	2.1 (1.7, 2.6)	3.1 (2.6, 3.7)	5.0 (4.2, 5.9)	6.1 (5.1, 7.3)

Femoral Component	Tibial Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
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)	2.2 (1.3, 3.6)		
	Nexgen	689	30252	0.7 (0.6, 0.8)	1.6 (1.4, 1.7)	2.1 (1.9, 2.3)	2.9 (2.7, 3.2)	3.9 (3.5, 4.4)	
Nexgen LCCK	Nexgen	57	1086	2.1 (1.4, 3.1)	3.7 (2.7, 5.0)	5.0 (3.8, 6.7)	6.3 (4.7, 8.4)		
Nexgen LPS	Nexgen	320	6158	1.1 (0.9, 1.4)	2.4 (2.0, 2.8)	3.1 (2.7, 3.6)	4.7 (4.1, 5.3)	6.4 (5.7, 7.2)	8.8 (7.5, 10.4)
Nexgen LPS Flex	Nexgen	1574	36453	0.9 (0.8, 1.0)	2.3 (2.1, 2.4)	3.1 (2.9, 3.3)	5.0 (4.7, 5.3)	6.8 (6.4, 7.2)	
Nexgen RH	Nexgen	36	685	2.1 (1.3, 3.6)	4.2 (2.8, 6.1)	5.3 (3.7, 7.6)	8.4 (5.9, 11.9)		
Optetrak Logic CR	Optetrak Logic	18	705	0.9 (0.4, 2.0)	2.4 (1.4, 4.0)	2.9 (1.7, 4.7)			
Optetrak Logic PS	Optetrak Logic	24	635	1.9 (1.1, 3.3)	3.4 (2.2, 5.2)	4.4 (2.9, 6.7)			
	Optetrak Logic RBK	20	934	1.5 (0.9, 2.6)	2.4 (1.5, 3.8)	3.2 (1.9, 5.2)			
PFC Sigma CR	MBT	42	1190	0.8 (0.5, 1.6)	1.9 (1.2, 2.8)	2.3 (1.6, 3.3)	3.4 (2.5, 4.6)	3.8 (2.8, 5.3)	
	PFC Sigma	492	13507	0.8 (0.7, 1.0)	2.1 (1.8, 2.3)	2.6 (2.4, 2.9)	3.6 (3.3, 4.0)	5.2 (4.7, 5.8)	7.0 (5.8, 8.5)
PFC Sigma PS	MBT	346	6153	1.0 (0.8, 1.3)	2.9 (2.5, 3.4)	3.9 (3.4, 4.4)	5.4 (4.8, 6.0)	7.2 (6.4, 8.1)	
	PFC Sigma	393	8352	1.2 (1.0, 1.4)	2.6 (2.3, 2.9)	3.3 (2.9, 3.7)	4.7 (4.2, 5.2)	6.4 (5.8, 7.2)	
Persona CR	Nexgen	9	508	1.0 (0.4, 2.4)	1.9 (1.0, 3.7)				
	Persona	212	17927	0.8 (0.7, 1.0)	1.8 (1.6, 2.1)	2.3 (2.0, 2.8)			
Persona PS	Persona	67	4102	0.8 (0.6, 1.2)	1.8 (1.4, 2.3)	2.5 (1.9, 3.3)			
RBK	RBK	120	2665	1.0 (0.7, 1.4)	2.5 (2.0, 3.2)	3.3 (2.6, 4.0)	4.9 (4.1, 5.9)	6.1 (4.9, 7.5)	
SAIPH	SAIPH	77	4778	0.5 (0.3, 0.8)	1.7 (1.3, 2.2)	2.2 (1.7, 2.8)			
Score	Score	42	1048	1.7 (1.0, 2.7)	3.0 (2.1, 4.3)	4.2 (3.0, 5.7)	5.5 (3.9, 7.6)		
Triathlon CR	Triathlon	1497	63667	0.8 (0.7, 0.9)	1.9 (1.8, 2.0)	2.4 (2.3, 2.6)	3.7 (3.5, 4.0)	5.1 (4.5, 5.7)	
Triathlon FS	Triathlon	29	411	3.5 (2.1, 5.9)	6.6 (4.5, 9.7)	8.0 (5.5, 11.6)			
Triathlon PS	Triathlon	424	9799	1.5 (1.2, 1.7)	3.0 (2.7, 3.4)	3.8 (3.4, 4.3)	5.7 (5.2, 6.3)	7.8 (6.5, 9.2)	
Unity Knee	Unity Knee	2	613	0.3 (0.1, 1.3)	0.3 (0.1, 1.3)				
Vanguard CR	Vanguard	433	12293	0.8 (0.6, 0.9)	2.1 (1.9, 2.4)	2.7 (2.5, 3.1)	4.6 (4.1, 5.1)	8.3 (6.0, 11.3)	
Vanguard PS	Vanguard	299	4625	1.9 (1.6, 2.4)	4.4 (3.9, 5.1)	5.4 (4.8, 6.2)	7.7 (6.8, 8.6)	8.1 (7.2, 9.2)	
Other (80)		378	4895	3.1 (2.6, 3.6)	6.4 (5.7, 7.3)	8.6 (7.7, 9.7)	13.2 (11.7, 14.8)	20.2 (16.3, 24.7)	
TOTAL		**15288**	**446706**						

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 2021

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	52	1095	1.5 (0.9, 2.5)	4.0 (2.9, 5.4)	4.8 (3.6, 6.4)			
Active Knee	Active Knee	565	4899	1.3 (1.1, 1.7)	4.0 (3.4, 4.5)	5.6 (5.0, 6.3)	9.6 (8.8, 10.5)	13.3 (12.2, 14.4)	
Apex Knee CR	Apex Knee	27	468	2.4 (1.3, 4.3)	5.4 (3.7, 8.0)	5.7 (3.9, 8.3)			
Attune CR	Attune	10	1632	0.8 (0.4, 1.7)	1.2 (0.5, 2.8)				
Columbus	Columbus	66	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)		
GMK Primary	GMK Primary	52	1493	1.2 (0.7, 1.9)	3.2 (2.3, 4.3)	3.9 (2.9, 5.2)			
Genesis II CR	Genesis II	44	747	1.5 (0.8, 2.6)	3.9 (2.7, 5.5)	4.7 (3.3, 6.5)	7.1 (5.3, 9.6)		
Genesis II PS	Genesis II	31	420	1.7 (0.8, 3.5)	3.3 (2.0, 5.6)	4.1 (2.5, 6.5)	6.6 (4.5, 9.6)		
LCS CR	LCS	171	2379	1.4 (1.0, 2.0)	3.4 (2.7, 4.2)	4.3 (3.5, 5.2)	6.1 (5.2, 7.2)	7.3 (6.2, 8.5)	8.8 (7.6, 10.2)
	MBT	483	9391	1.1 (0.9, 1.3)	3.4 (3.0, 3.8)	4.1 (3.7, 4.6)	5.5 (5.0, 6.0)	7.8 (6.9, 8.8)	
	MBT Duofix	832	14555	1.3 (1.1, 1.5)	3.3 (3.0, 3.6)	4.1 (3.8, 4.5)	5.4 (5.0, 5.8)	7.4 (6.8, 8.0)	9.8 (8.6, 11.1)
Natural Knee Flex	Natural Knee II	42	1721	0.7 (0.4, 1.3)	1.6 (1.1, 2.4)	2.1 (1.5, 2.9)	3.0 (2.2, 4.1)		
Nexgen CR	Nexgen	130	3446	0.6 (0.4, 0.9)	1.7 (1.3, 2.2)	2.1 (1.7, 2.7)	3.0 (2.5, 3.7)	4.0 (3.3, 4.8)	5.7 (4.7, 7.1)
	Nexgen TM CR	50	746	1.4 (0.7, 2.5)	4.3 (3.0, 6.1)	6.1 (4.6, 8.2)	6.9 (5.2, 9.1)	8.1 (6.0, 10.8)	
Nexgen CR Flex	Nexgen	326	8681	1.1 (0.9, 1.4)	2.7 (2.4, 3.1)	3.3 (2.9, 3.7)	4.2 (3.7, 4.7)	5.0 (4.4, 5.7)	
	Nexgen TM CR	324	11400	0.5 (0.4, 0.7)	1.8 (1.5, 2.0)	2.3 (2.0, 2.6)	3.3 (2.9, 3.7)	4.6 (3.9, 5.5)	
Nexgen LPS	Nexgen TM LPS	34	1446	0.6 (0.3, 1.2)	1.2 (0.7, 1.9)	2.1 (1.4, 3.1)	2.7 (1.9, 3.9)	3.7 (2.5, 5.6)	
Nexgen LPS Flex	Nexgen	50	1196	2.6 (1.8, 3.7)	4.0 (3.0, 5.3)	4.1 (3.1, 5.5)			
	Nexgen TM LPS	51	1062	1.3 (0.8, 2.2)	3.1 (2.2, 4.3)	4.2 (3.2, 5.7)	5.3 (4.0, 7.0)		
PFC Sigma CR	MBT	70	995	2.3 (1.5, 3.5)	4.9 (3.7, 6.4)	5.6 (4.3, 7.2)	6.7 (5.3, 8.5)	8.5 (6.5, 11.0)	
	MBT Duofix*	165	3327	1.0 (0.7, 1.4)	2.7 (2.2, 3.3)	3.4 (2.9, 4.1)	4.8 (4.0, 5.7)	7.2 (6.0, 8.7)	
Persona CR	Persona	46	3436	1.3 (0.9, 1.8)	2.3 (1.7, 3.3)				
RBK	RBK	371	6907	1.3 (1.1, 1.6)	3.1 (2.7, 3.6)	4.2 (3.7, 4.7)	5.5 (5.0, 6.1)	6.8 (6.0, 7.6)	
Score	Score	223	2970	1.6 (1.2, 2.1)	5.0 (4.2, 6.0)	6.9 (5.9, 8.0)	11.1 (9.6, 12.7)		
Triathlon CR	Triathlon	789	30575	1.0 (0.9, 1.2)	2.3 (2.1, 2.5)	3.0 (2.7, 3.2)	4.3 (4.0, 4.6)	6.2 (5.2, 7.3)	
Triathlon PS	Triathlon	67	1343	1.9 (1.3, 2.8)	3.5 (2.6, 4.7)	4.6 (3.6, 6.0)	5.8 (4.6, 7.4)		
Vanguard CR	Regenerex	88	1697	1.2 (0.8, 1.8)	3.3 (2.6, 4.3)	4.0 (3.1, 5.0)	6.7 (5.3, 8.4)		
	Vanguard	107	1695	1.4 (1.0, 2.1)	4.1 (3.3, 5.2)	4.8 (3.9, 5.9)	6.5 (5.4, 7.9)		
Other (32)		207	2826	2.6 (2.1, 3.3)	6.1 (5.3, 7.1)	7.2 (6.3, 8.3)	8.8 (7.7, 10.1)	9.6 (8.3, 11.2)	
TOTAL		5473	123048						

Note: Only combinations with >400 procedures have been listed
Restricted to modern prostheses
* denotes prosthesis combinations that have not had any reported use in primary total knee procedures in 2021

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	66	1478	1.3 (0.8, 2.1)	4.1 (3.1, 5.3)	5.0 (3.8, 6.4)			
Active Knee	Active Knee	159	2323	0.7 (0.4, 1.1)	2.8 (2.2, 3.5)	3.8 (3.1, 4.7)	6.9 (5.8, 8.2)	10.7 (9.0, 12.8)	
Advance	Advance II	23	428	0.7 (0.2, 2.2)	2.4 (1.3, 4.4)	3.4 (2.0, 5.7)	5.4 (3.5, 8.3)	6.5 (4.2, 10.1)	
Apex Knee CR	Apex Knee	66	4208	0.9 (0.7, 1.3)	1.6 (1.2, 2.1)	2.2 (1.7, 2.8)			
Attune CR	Attune	6	778	1.1 (0.5, 2.5)					
Attune PS	Attune	5	601	1.0 (0.4, 2.6)					
BalanSys	BalanSys	47	2157	1.0 (0.7, 1.6)	2.1 (1.6, 2.9)	2.5 (1.9, 3.4)			
GMK Primary	GMK Primary	30	790	1.2 (0.6, 2.3)	3.8 (2.6, 5.5)	4.1 (2.9, 6.0)			
Genesis II CR	Genesis II	473	8615	1.0 (0.8, 1.2)	3.2 (2.9, 3.6)	4.3 (3.9, 4.8)	6.0 (5.5, 6.6)	7.2 (6.5, 7.9)	8.1 (7.2, 9.1)
Genesis II PS	Genesis II	68	707	1.7 (1.0, 3.0)	4.4 (3.1, 6.2)	5.6 (4.1, 7.6)	8.7 (6.8, 11.1)	10.7 (8.5, 13.6)	
LCS CR	LCS	152	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)	8.5 (7.1, 10.2)
	MBT	367	11061	0.7 (0.6, 0.9)	2.1 (1.9, 2.4)	2.8 (2.5, 3.1)	4.0 (3.6, 4.4)	4.5 (4.0, 5.1)	
	MBT Duofix	37	1000	1.3 (0.8, 2.2)	3.2 (2.3, 4.5)	3.3 (2.4, 4.7)	4.1 (3.0, 5.7)		
Legion CR	Genesis II	141	3810	1.4 (1.1, 1.8)	3.5 (2.9, 4.2)	4.3 (3.6, 5.1)	6.1 (5.0, 7.5)		
Natural Knee Flex	Natural Knee II	41	1971	0.4 (0.2, 0.8)	1.3 (0.8, 1.9)	1.8 (1.3, 2.5)	2.5 (1.8, 3.4)		
Nexgen CR	Nexgen	159	4361	0.6 (0.4, 0.9)	1.7 (1.4, 2.2)	2.2 (1.8, 2.7)	3.1 (2.6, 3.8)	4.4 (3.7, 5.2)	5.9 (4.9, 7.2)
Nexgen CR Flex	Nexgen	563	22072	0.7 (0.6, 0.8)	1.8 (1.6, 2.0)	2.3 (2.1, 2.5)	3.1 (2.8, 3.3)	3.8 (3.4, 4.4)	
	Nexgen TM CR	24	879	0.7 (0.3, 1.5)	1.5 (0.9, 2.6)	1.7 (1.0, 2.8)	2.4 (1.5, 3.7)	3.7 (2.4, 5.8)	
Nexgen LPS	Nexgen	57	1048	0.5 (0.2, 1.2)	2.7 (1.9, 3.9)	4.1 (3.0, 5.6)	5.4 (4.1, 7.0)	6.3 (4.8, 8.2)	
Nexgen LPS Flex	Nexgen	60	1065	2.1 (1.4, 3.1)	4.3 (3.3, 5.8)	5.5 (4.2, 7.1)	6.8 (5.1, 9.1)		
	Nexgen TM LPS	20	511	0.6 (0.2, 1.8)	1.8 (0.9, 3.4)	2.0 (1.1, 3.7)	3.1 (1.9, 5.1)	5.4 (3.2, 9.2)	
Optetrak Logic CR	Optetrak Logic	29	1067	1.1 (0.6, 2.0)	2.5 (1.7, 3.8)	4.0 (2.6, 6.1)			
PFC Sigma CR	MBT	224	4171	1.3 (1.0, 1.6)	3.1 (2.6, 3.7)	4.0 (3.4, 4.7)	5.1 (4.5, 5.9)	7.0 (6.0, 8.1)	9.0 (7.1, 11.3)
	PFC Sigma	410	11854	0.6 (0.5, 0.8)	1.9 (1.6, 2.1)	2.4 (2.1, 2.7)	3.4 (3.1, 3.8)	5.1 (4.5, 5.8)	6.3 (5.4, 7.4)
PFC Sigma PS	MBT Duofix*	178	2252	1.8 (1.3, 2.5)	4.4 (3.7, 5.4)	5.9 (5.0, 7.0)	7.9 (6.8, 9.2)	10.1 (8.6, 11.8)	
Persona CR	Persona	114	9113	1.0 (0.8, 1.3)	2.0 (1.6, 2.5)	2.2 (1.7, 2.9)			
RBK	RBK	76	1612	1.1 (0.7, 1.7)	2.9 (2.2, 3.9)	3.7 (2.9, 4.8)	4.9 (3.8, 6.2)	7.5 (5.5, 10.2)	
Score	Score	99	1724	1.5 (1.0, 2.2)	3.9 (3.1, 5.0)	6.3 (5.1, 7.7)			
Trekking	Trekking	20	560	1.1 (0.5, 2.4)	2.8 (1.7, 4.6)	3.5 (2.1, 5.7)			
Triathlon CR	Triathlon	687	33066	0.7 (0.6, 0.8)	1.6 (1.5, 1.8)	2.1 (2.0, 2.3)	3.2 (3.0, 3.6)	4.3 (3.5, 5.3)	
Triathlon PS	Triathlon	119	2970	1.7 (1.3, 2.3)	2.7 (2.2, 3.4)	3.6 (3.0, 4.4)	4.9 (4.1, 6.0)		
Vanguard CR	Vanguard	490	13404	0.8 (0.7, 1.0)	2.2 (2.0, 2.5)	3.0 (2.7, 3.3)	5.0 (4.5, 5.5)	6.4 (5.6, 7.3)	
Vanguard PS	Vanguard	34	709	1.4 (0.8, 2.6)	3.2 (2.1, 4.9)	4.2 (2.9, 6.0)	5.8 (4.1, 8.2)		
Other (68)		256	3212	2.9 (2.3, 3.5)	6.1 (5.3, 7.0)	7.3 (6.4, 8.3)	9.2 (8.1, 10.4)	11.6 (10.0, 13.6)	
TOTAL		**5300**	**157941**						

Note: Only combinations with >400 procedures have been listed
Restricted to modern prostheses
*denotes prosthesis combinations that has not had any reported use in primary total knee procedures in 2021

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 8.0% (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 6 months and this increases to more than 6 times after 9.5 years (Table KT15 and Figure KT9).

Males have a higher rate of revision which is largely due to an increased incidence of infection.

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 (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. The Registry reports on the outcome of 444,380 primary total knee replacement procedures for osteoarthritis in relation to 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. The early revision outcomes are reported for 355,846 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).

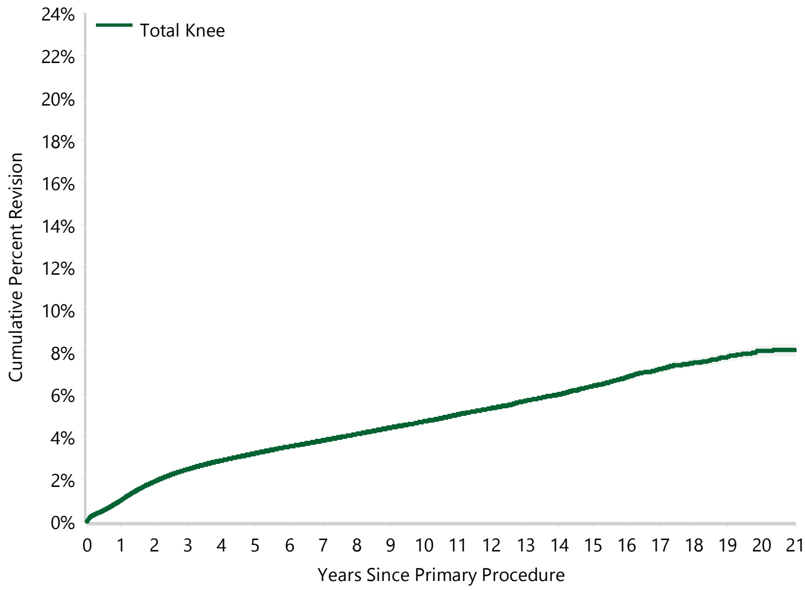
The most common reasons for revision are shown in Figure KT17. There is an increased rate of revision for infection for patients in obese classes 2 and 3 when compared to patients with a normal BMI (Table KT19 and Figure KT18).

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	25251	711978	1.0 (1.0, 1.0)	2.5 (2.4, 2.5)	3.2 (3.2, 3.3)	4.7 (4.7, 4.8)	6.4 (6.3, 6.5)	8.0 (7.8, 8.3)
TOTAL	25251	711978						

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	711978	643368	515752	394801	159609	40379	2564

Note: Restricted to modern prostheses

Table KT13 Primary Total Knee Replacement by Reason for Revision (Primary Diagnosis OA)

Reason for Revision	Number	Percent
Infection	6724	26.6
Loosening	5667	22.4
Instability	2427	9.6
Pain	2020	8.0
Patellofemoral Pain	1994	7.9
Patella Erosion	1655	6.6
Arthrofibrosis	989	3.9
Fracture	893	3.5
Malalignment	584	2.3
Wear Tibial Insert	351	1.4
Lysis	340	1.3
Incorrect Sizing	253	1.0
Metal Related Pathology	113	0.4
Other	1241	4.9
TOTAL	**25251**	**100.0**

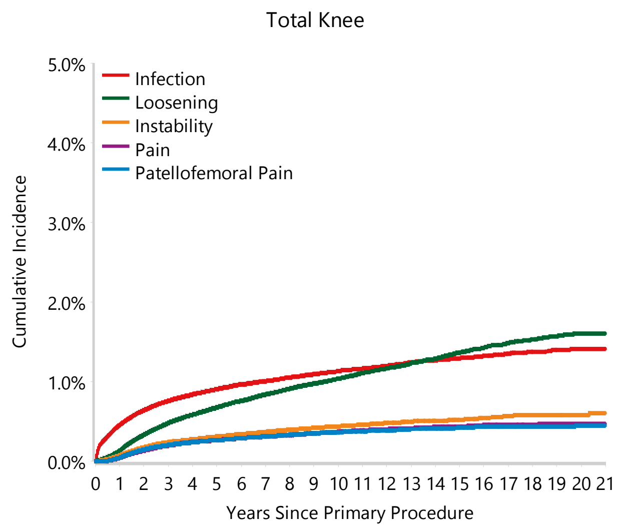
Note: Restricted to modern prostheses

Table KT14 Primary Total Knee Replacement by Type of Revision (Primary Diagnosis OA)

Type of Revision	Number	Percent
Insert Only	6901	27.3
TKR (Tibial/Femoral)	6226	24.7
Patella Only	4670	18.5
Insert/Patella	2651	10.5
Tibial Component	2040	8.1
Cement Spacer	1309	5.2
Femoral Component	1230	4.9
Removal of Prostheses	139	0.6
Minor Components	49	0.2
Total Femoral	13	0.1
Cement Only	12	0.0
Reinsertion of Components	11	0.0
TOTAL	**25251**	**100.0**

Note: Restricted to modern prostheses

Figure KT8 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement (Primary Diagnosis OA)



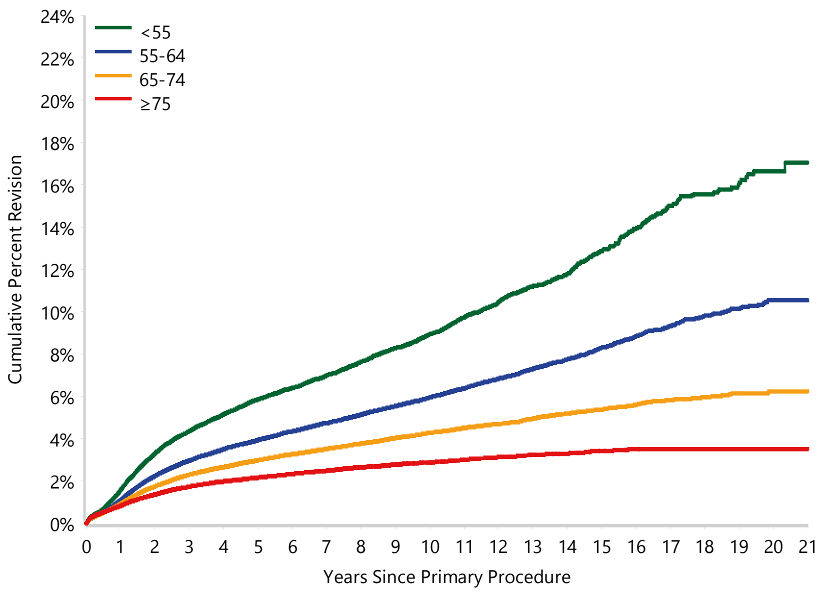
Note: Restricted to modern prostheses

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	3334	46794	1.6 (1.5, 1.7)	4.4 (4.2, 4.6)	5.9 (5.6, 6.1)	8.9 (8.6, 9.3)	12.9 (12.3, 13.4)	16.6 (15.6, 17.7)
55-64	8782	190748	1.1 (1.1, 1.2)	3.0 (2.9, 3.0)	3.9 (3.8, 4.0)	5.9 (5.8, 6.1)	8.3 (8.1, 8.5)	10.5 (10.1, 11.0)
65-74	9068	285504	0.9 (0.9, 1.0)	2.3 (2.2, 2.4)	3.0 (2.9, 3.0)	4.3 (4.2, 4.4)	5.4 (5.2, 5.5)	6.2 (6.0, 6.5)
≥75	4067	188932	0.8 (0.8, 0.9)	1.7 (1.7, 1.8)	2.2 (2.1, 2.2)	2.9 (2.8, 3.0)	3.4 (3.3, 3.6)	3.5 (3.3, 3.7)
TOTAL	25251	711978						

Note: Restricted to modern prostheses

Figure KT9 Cumulative Percent Revision of Primary Total Knee Replacement by Age (Primary Diagnosis OA)



HR - adjusted for gender

<55 vs ≥75
- 0 - 6Mth: HR=1.32 (1.17, 1.50), p<0.001
- 6Mth - 1.5Yr: HR=2.96 (2.70, 3.25), p<0.001
- 1.5Yr - 2Yr: HR=3.44 (2.96, 4.01), p<0.001
- 2Yr - 3.5Yr: HR=3.16 (2.85, 3.50), p<0.001
- 3.5Yr - 4Yr: HR=3.87 (3.18, 4.70), p<0.001
- 4Yr - 4.5Yr: HR=3.86 (3.13, 4.75), p<0.001
- 4.5Yr - 7.5Yr: HR=3.68 (3.29, 4.12), p<0.001
- 7.5Yr - 8.5Yr: HR=4.92 (4.05, 5.97), p<0.001
- 8.5Yr - 9.5Yr: HR=4.40 (3.49, 5.54), p<0.001
- 9.5Yr+: HR=6.16 (5.47, 6.95), p<0.001

55-64 vs ≥75
- 0 - 6Mth: HR=0.99 (0.91, 1.09), p=0.895
- 6Mth - 9Mth: HR=1.83 (1.63, 2.07), p<0.001
- 9Mth - 1.5Yr: HR=1.98 (1.83, 2.15), p<0.001
- 1.5Yr - 2Yr: HR=2.24 (1.98, 2.54), p<0.001
- 2Yr - 2.5Yr: HR=2.04 (1.84, 2.27), p<0.001
- 2.5Yr - 3.5Yr: HR=2.14 (1.95, 2.35), p<0.001
- 3.5Yr - 4.5Yr: HR=2.45 (2.20, 2.74), p<0.001
- 4.5Yr - 8Yr: HR=2.46 (2.26, 2.66), p<0.001
- 8Yr+: HR=3.28 (3.00, 3.59), p<0.001

65-74 vs ≥75
- 0 - 6Mth: HR=0.95 (0.87, 1.03), p=0.194
- 6Mth - 1.5Yr: HR=1.44 (1.34, 1.55), p<0.001
- 1.5Yr - 2Yr: HR=1.58 (1.40, 1.79), p<0.001
- 2Yr+: HR=1.62 (1.54, 1.72), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
<55	46794	42232	34198	26992	12360	3831	312
55-64	190748	173006	140178	109589	48427	13690	1000
65-74	285504	257819	206208	157554	64451	16921	1041
≥75	188932	170311	135168	100666	34371	5937	211

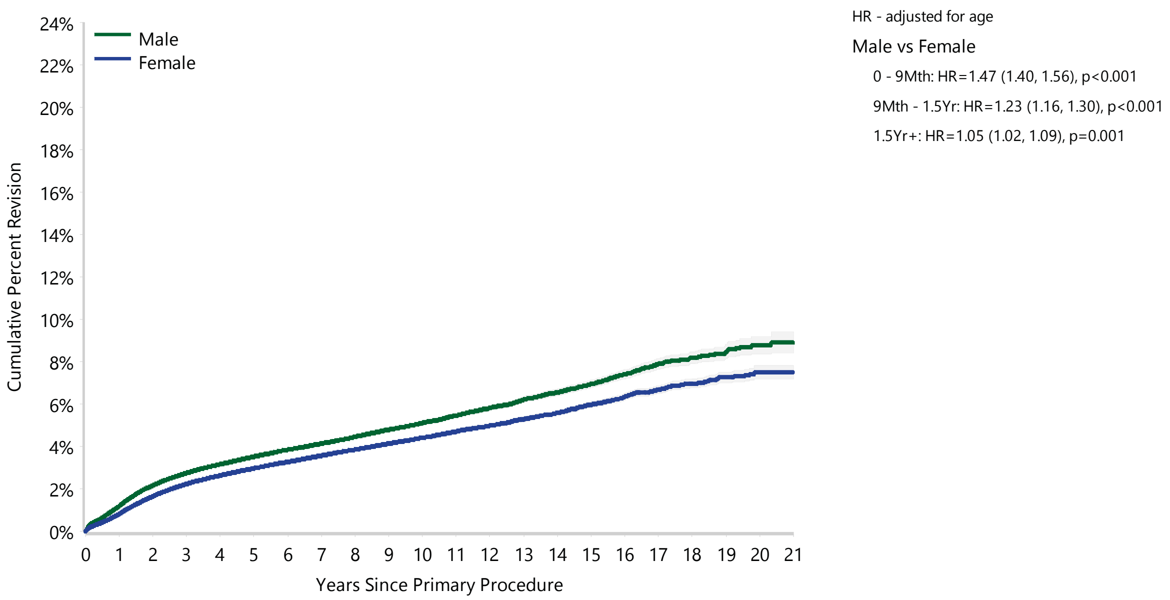
Note: Restricted to modern prostheses

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		12026	316008	1.2 (1.2, 1.2)	2.8 (2.7, 2.8)	3.5 (3.5, 3.6)	5.1 (5.0, 5.2)	7.0 (6.8, 7.1)	8.8 (8.4, 9.2)
	<55	1518	20206	1.9 (1.7, 2.1)	4.8 (4.5, 5.1)	6.2 (5.8, 6.6)	9.3 (8.8, 9.8)	13.6 (12.8, 14.5)	17.5 (16.0, 19.2)
	55-64	4277	89262	1.3 (1.2, 1.4)	3.2 (3.1, 3.4)	4.2 (4.1, 4.3)	6.3 (6.1, 6.5)	8.7 (8.4, 9.0)	11.0 (10.3, 11.8)
	65-74	4410	129197	1.1 (1.1, 1.2)	2.5 (2.4, 2.6)	3.3 (3.2, 3.4)	4.6 (4.5, 4.8)	5.8 (5.6, 6.1)	6.7 (6.3, 7.1)
	≥75	1821	77343	1.0 (0.9, 1.1)	2.0 (1.9, 2.1)	2.4 (2.3, 2.6)	3.2 (3.0, 3.3)	3.7 (3.5, 4.0)	3.8 (3.5, 4.1)
Female		13225	395970	0.8 (0.8, 0.9)	2.2 (2.2, 2.3)	3.0 (2.9, 3.0)	4.4 (4.3, 4.5)	6.0 (5.8, 6.1)	7.5 (7.2, 7.8)
	<55	1816	26588	1.3 (1.2, 1.5)	4.0 (3.8, 4.3)	5.6 (5.3, 5.9)	8.7 (8.2, 9.1)	12.3 (11.6, 13.0)	15.9 (14.6, 17.3)
	55-64	4505	101486	0.9 (0.9, 1.0)	2.7 (2.6, 2.8)	3.7 (3.6, 3.8)	5.7 (5.5, 5.9)	8.0 (7.7, 8.3)	10.1 (9.5, 10.8)
	65-74	4658	156307	0.7 (0.7, 0.8)	2.1 (2.0, 2.2)	2.8 (2.7, 2.8)	4.0 (3.9, 4.1)	5.0 (4.8, 5.2)	5.9 (5.5, 6.3)
	≥75	2246	111589	0.7 (0.7, 0.8)	1.6 (1.5, 1.6)	2.0 (1.9, 2.1)	2.7 (2.6, 2.8)	3.2 (3.0, 3.4)	3.3 (3.1, 3.6)
TOTAL		25251	711978						

Note: Restricted to modern prostheses

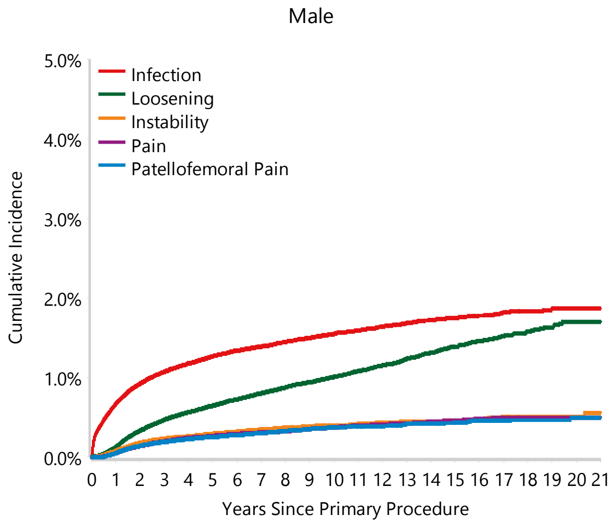
Figure KT10 Cumulative Percent Revision of Primary Total Knee Replacement by Gender (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Male	316008	283507	223871	168968	66108	15949	1000
Female	395970	359861	291881	225833	93501	24430	1564

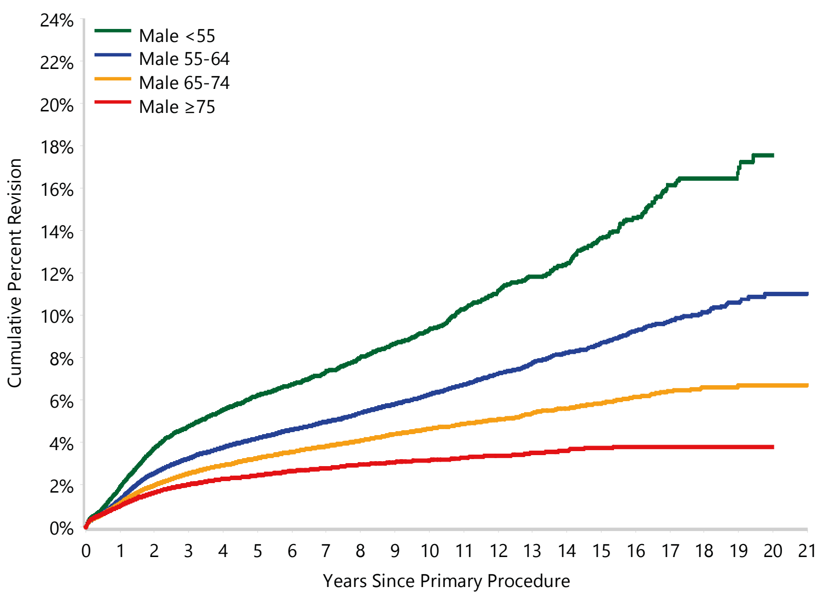
Note: Restricted to modern prostheses

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=1.53 (1.30, 1.82), p<0.001
6Mth - 9Mth: HR=2.45 (1.96, 3.07), p<0.001
9Mth - 3.5Yr: HR=2.89 (2.63, 3.18), p<0.001
3.5Yr - 7.5Yr: HR=3.50 (3.05, 4.02), p<0.001
7.5Yr+: HR=5.62 (4.84, 6.53), p<0.001

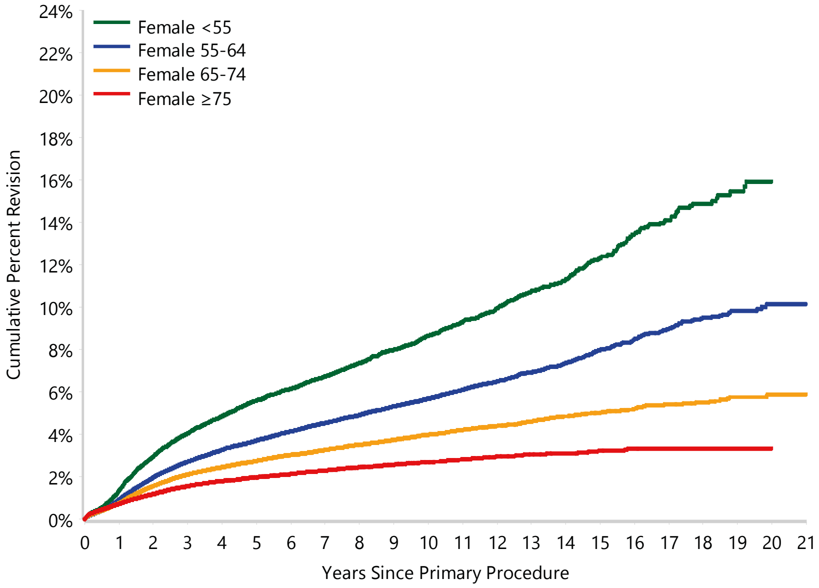
Male 55-64 vs Male ≥75
0 - 3Mth: HR=1.02 (0.89, 1.18), p=0.739
3Mth - 1Yr: HR=1.56 (1.41, 1.72), p<0.001
1Yr - 5.5Yr: HR=2.02 (1.88, 2.17), p<0.001
5.5Yr - 8.5Yr: HR=2.54 (2.23, 2.90), p<0.001
8.5Yr+: HR=3.31 (2.88, 3.80), p<0.001

Male 65-74 vs Male ≥75
0 - 6Mth: HR=1.05 (0.94, 1.17), p=0.400
6Mth - 2.5Yr: HR=1.35 (1.25, 1.45), p<0.001
2.5Yr+: HR=1.68 (1.55, 1.82), p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Male	<55	20206	18107	14527	11414	5295	1632	149
	55-64	89262	80375	64153	49540	21610	5858	427
	65-74	129197	115895	91617	69259	27167	6649	371
	≥75	77343	69130	53574	38755	12036	1810	53

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=1.21 (1.00, 1.46), p=0.046
6Mth - 3Yr: HR=3.25 (2.98, 3.55), p<0.001
3Yr - 7Yr: HR=3.78 (3.39, 4.23), p<0.001
7Yr - 14Yr: HR=5.19 (4.49, 5.99), p<0.001
14Yr+: HR=8.87 (6.54, 12.03), p<0.001

Female 55-64 vs Female ≥75
0 - 3Mth: HR=0.80 (0.69, 0.94), p=0.007
3Mth - 6Mth: HR=1.14 (0.95, 1.38), p=0.166
6Mth - 3.5Yr: HR=2.12 (1.99, 2.27), p<0.001
3.5Yr - 8Yr: HR=2.60 (2.38, 2.84), p<0.001
8Yr - 12Yr: HR=3.08 (2.67, 3.56), p<0.001
12Yr - 15Yr: HR=3.95 (3.18, 4.92), p<0.001
15Yr+: HR=4.88 (3.50, 6.80), p<0.001

Female 65-74 vs Female ≥75
0 - 6Mth: HR=0.90 (0.80, 1.02), p=0.093
6Mth - 5Yr: HR=1.56 (1.46, 1.66), p<0.001
5Yr+: HR=1.69 (1.52, 1.87), p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Female	<55	26588	24125	19671	15578	7065	2199	163
	55-64	101486	92631	76025	60049	26817	7832	573
	65-74	156307	141924	114591	88295	37284	10272	670
	≥75	111589	101181	81594	61911	22335	4127	158

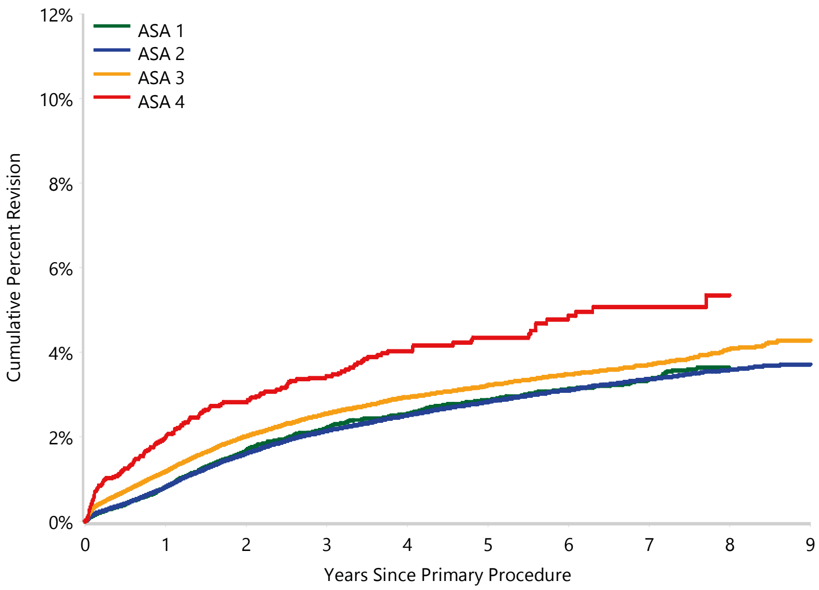
Note: Restricted to modern prostheses

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	621	25466	0.8 (0.7, 0.9)	1.7 (1.5, 1.9)	2.2 (2.0, 2.4)	2.9 (2.6, 3.1)	3.4 (3.1, 3.7)	
ASA 2	5612	242928	0.8 (0.8, 0.9)	1.6 (1.6, 1.7)	2.1 (2.1, 2.2)	2.8 (2.8, 2.9)	3.4 (3.3, 3.5)	3.7 (3.6, 3.9)
ASA 3	4403	171343	1.2 (1.1, 1.2)	2.0 (1.9, 2.1)	2.6 (2.5, 2.6)	3.2 (3.1, 3.3)	3.7 (3.6, 3.8)	4.3 (4.1, 4.5)
ASA 4	166	4630	2.0 (1.6, 2.4)	2.8 (2.4, 3.4)	3.4 (2.9, 4.1)	4.4 (3.7, 5.1)	5.1 (4.3, 6.0)	
ASA 5	1	13	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	12.5 (1.9, 61.3)		
TOTAL	10803	444380						

Note: Restricted to modern prostheses
267,598 procedures have 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=1.17 (1.07, 1.27), p<0.001

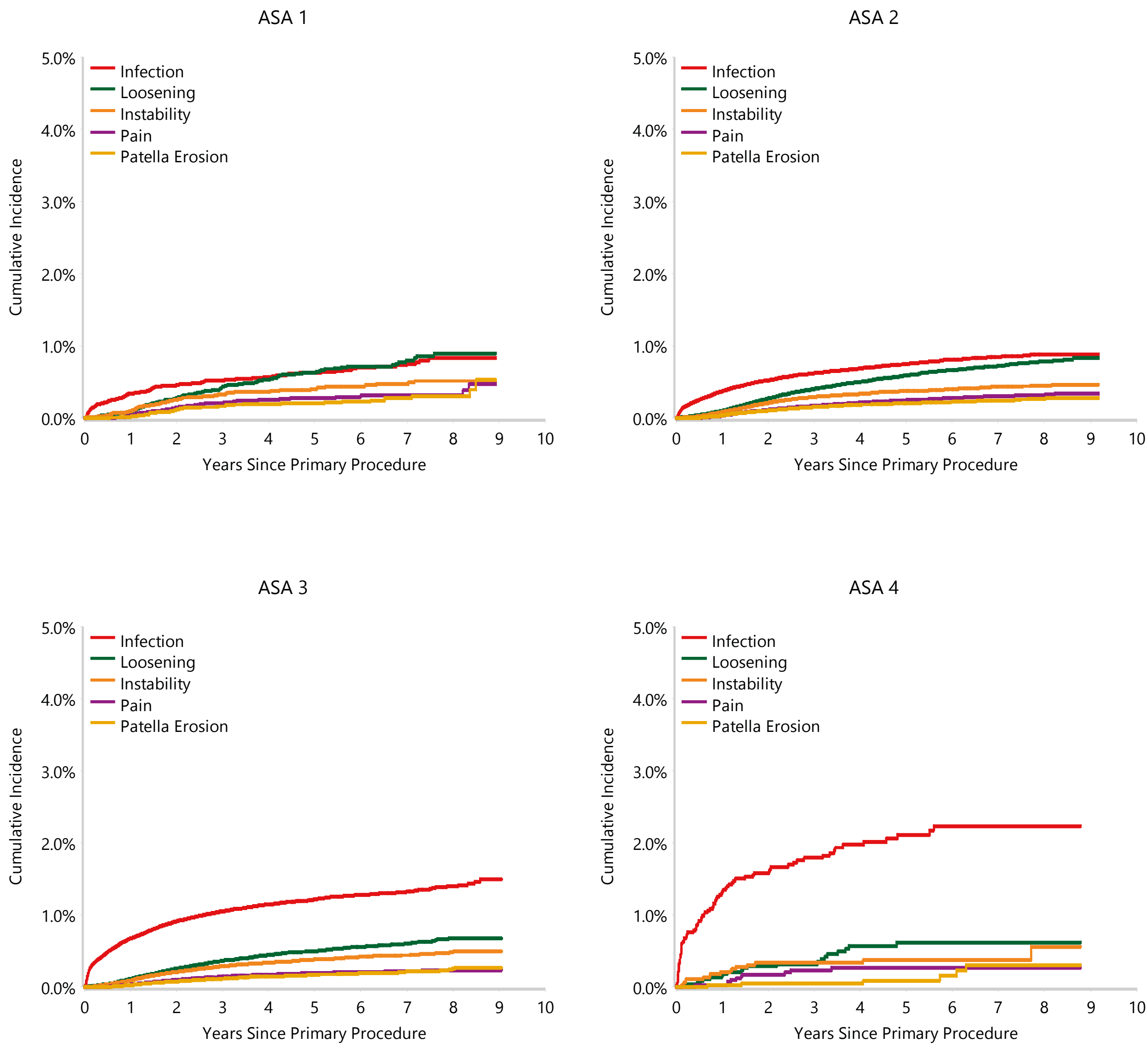
ASA 3 vs ASA 1
0 - 1Mth: HR=2.46 (2.09, 2.88), p<0.001
1Mth - 6Mth: HR=1.96 (1.73, 2.22), p<0.001
6Mth+: HR=1.32 (1.21, 1.44), p<0.001

ASA 4 vs ASA 1
0 - 1.5Yr: HR=2.86 (2.33, 3.50), p<0.001
1.5Yr+: HR=1.47 (1.11, 1.94), p=0.007

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	9 Yrs
ASA 1	25466	22410	19345	16251	10188	4450	19
ASA 2	242928	210004	179623	148792	89939	37405	125
ASA 3	171343	144423	120802	96608	53796	20314	56
ASA 4	4630	3861	3238	2558	1418	587	4

Note: Restricted to modern prostheses
267,598 procedures have unknown ASA score

Figure KT15 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by ASA Score (Primary Diagnosis OA)



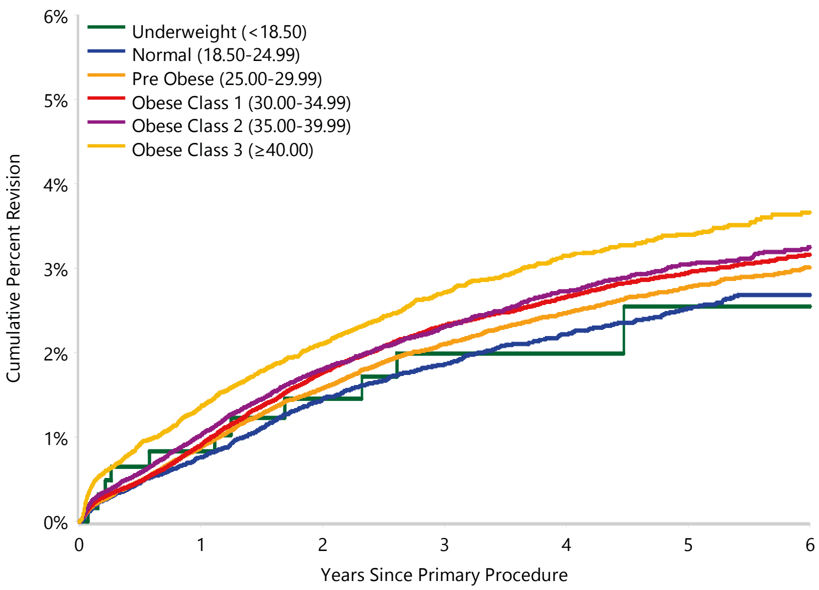
Note: Restricted to modern prostheses
267,598 procedures have unknown ASA score

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)	11	633	0.8 (0.3, 2.0)	1.5 (0.7, 2.9)	2.0 (1.1, 3.7)	2.0 (1.1, 3.7)	2.5 (1.3, 4.8)	2.5 (1.3, 4.8)
Normal (18.50-24.99)	649	36777	0.8 (0.7, 0.9)	1.5 (1.3, 1.6)	1.9 (1.7, 2.0)	2.2 (2.0, 2.4)	2.5 (2.3, 2.7)	2.7 (2.5, 2.9)
Pre Obese (25.00-29.99)	2190	110892	0.9 (0.8, 0.9)	1.6 (1.5, 1.7)	2.1 (2.0, 2.2)	2.5 (2.4, 2.6)	2.8 (2.7, 2.9)	3.0 (2.9, 3.2)
Obese Class 1 (30.00-34.99)	2330	110088	0.9 (0.9, 1.0)	1.8 (1.7, 1.9)	2.3 (2.2, 2.4)	2.7 (2.5, 2.8)	2.9 (2.8, 3.1)	3.2 (3.0, 3.3)
Obese Class 2 (35.00-39.99)	1321	60510	1.0 (0.9, 1.1)	1.8 (1.7, 1.9)	2.3 (2.2, 2.4)	2.7 (2.6, 2.9)	3.1 (2.9, 3.2)	3.2 (3.1, 3.5)
Obese Class 3 (≥40.00)	952	36946	1.4 (1.3, 1.5)	2.1 (2.0, 2.3)	2.7 (2.5, 2.9)	3.1 (2.9, 3.4)	3.4 (3.2, 3.6)	3.7 (3.4, 3.9)
TOTAL	7453	355846						

Note: Restricted to modern prostheses
356,132 procedures have unknown BMI
BMI has not been presented for patients aged ≤19 years

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=1.09 (0.60, 1.97), p=0.787

Pre Obese (25.00-29.99) vs Normal (18.50-24.99)
Entire Period: HR=1.03 (0.94, 1.12), p=0.515

Obese Class 1 (30.00-34.99) vs Normal (18.50-24.99)
Entire Period: HR=1.06 (0.97, 1.16), p=0.177

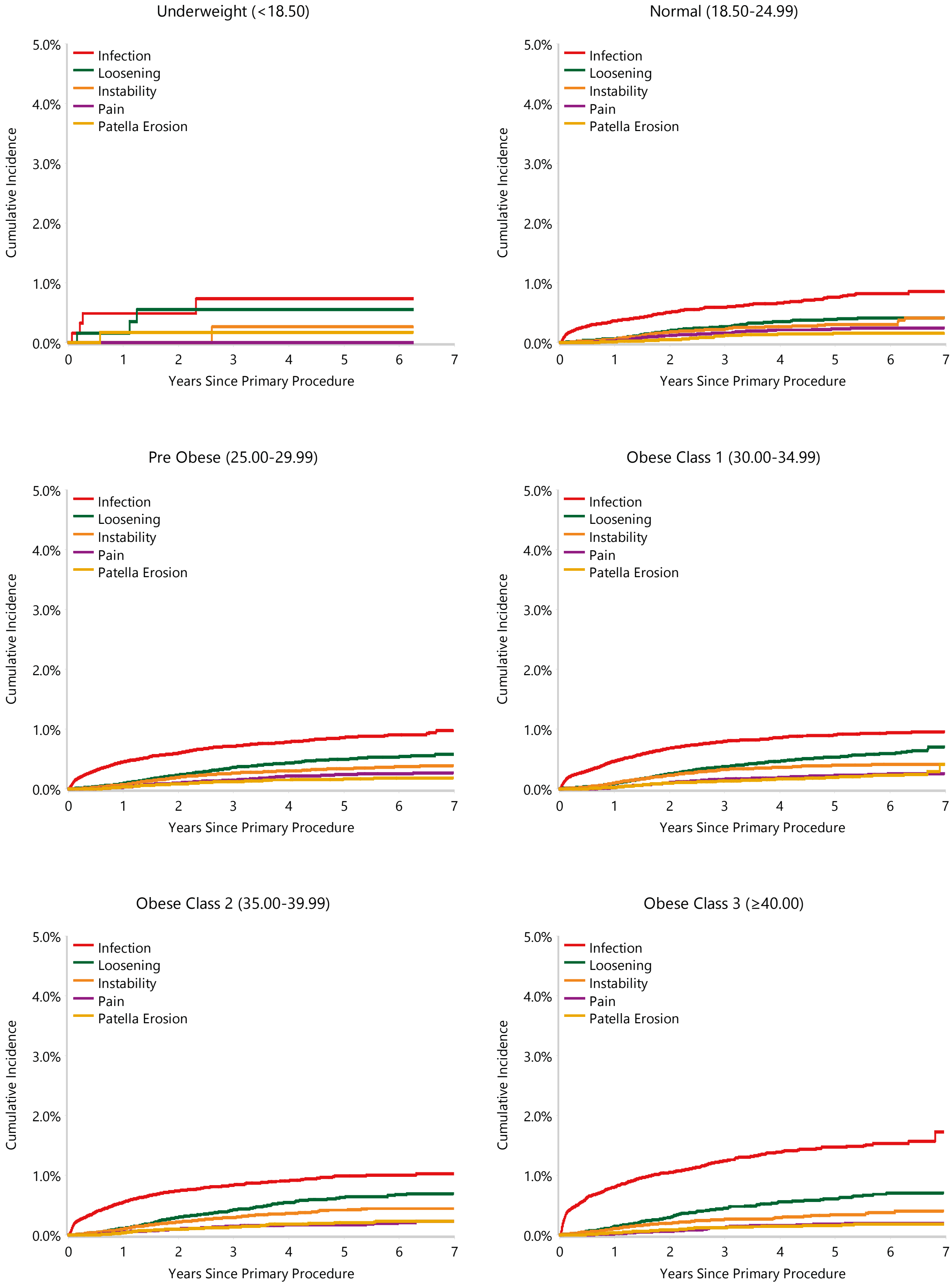
Obese Class 2 (35.00-39.99) vs Normal (18.50-24.99)
0 - 6Mth: HR=1.20 (1.04, 1.38), p=0.011
6Mth - 1.5Yr: HR=1.07 (0.94, 1.21), p=0.316
1.5Yr+: HR=1.00 (0.88, 1.12), p=0.953

Obese Class 3 (≥40.00) vs Normal (18.50-24.99)
0 - 1Mth: HR=2.28 (1.85, 2.80), p<0.001
1Mth - 6Mth: HR=1.65 (1.39, 1.96), p<0.001
6Mth - 1.5Yr: HR=1.02 (0.88, 1.19), p=0.762
1.5Yr - 2Yr: HR=0.89 (0.70, 1.12), p=0.323
2Yr+: HR=1.08 (0.93, 1.26), p=0.298

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Underweight (<18.50)	633	515	408	304	219	138	63
Normal (18.50-24.99)	36777	30291	24343	18440	13020	8128	3726
Pre Obese (25.00-29.99)	110892	91523	73951	56430	39988	24764	11197
Obese Class 1 (30.00-34.99)	110088	90882	73598	55954	39696	24507	11123
Obese Class 2 (35.00-39.99)	60510	50082	40703	31215	21827	13413	6070
Obese Class 3 (≥40.00)	36946	30689	25266	19361	13672	8416	3697

Note: Restricted to modern prostheses
356,132 procedures have unknown BMI
BMI has not been presented for patients aged ≤19 years

Figure KT17 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by BMI Category (Primary Diagnosis OA)



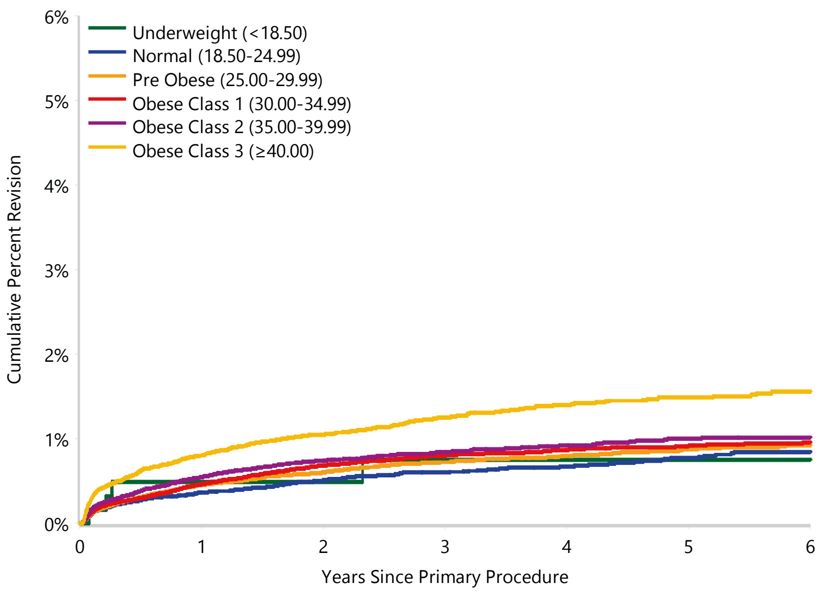
Note: Restricted to modern prostheses
BMI has not been presented for patients aged ≤19 years

Table KT19 Cumulative Percent Revision of Primary Total Knee Replacement by BMI Category (Primary Diagnosis OA, Revision for Infection)

BMI Category	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Underweight (<18.50)	4	633	0.5 (0.2, 1.5)	0.5 (0.2, 1.5)	0.8 (0.3, 2.0)	0.8 (0.3, 2.0)	0.8 (0.3, 2.0)	0.8 (0.3, 2.0)
Normal (18.50-24.99)	216	36777	0.4 (0.3, 0.4)	0.5 (0.4, 0.6)	0.6 (0.5, 0.7)	0.7 (0.6, 0.8)	0.8 (0.7, 0.9)	0.8 (0.7, 1.0)
Pre Obese (25.00-29.99)	755	110892	0.5 (0.4, 0.5)	0.6 (0.6, 0.7)	0.7 (0.7, 0.8)	0.8 (0.7, 0.9)	0.9 (0.8, 0.9)	0.9 (0.8, 1.0)
Obese Class 1 (30.00-34.99)	797	110088	0.5 (0.4, 0.5)	0.7 (0.6, 0.7)	0.8 (0.7, 0.9)	0.9 (0.8, 0.9)	0.9 (0.9, 1.0)	1.0 (0.9, 1.0)
Obese Class 2 (35.00-39.99)	479	60510	0.5 (0.5, 0.6)	0.7 (0.7, 0.8)	0.8 (0.8, 0.9)	0.9 (0.8, 1.0)	1.0 (0.9, 1.1)	1.0 (0.9, 1.1)
Obese Class 3 (≥40.00)	442	36946	0.8 (0.7, 0.9)	1.1 (0.9, 1.2)	1.3 (1.1, 1.4)	1.4 (1.3, 1.5)	1.5 (1.4, 1.6)	1.6 (1.4, 1.7)
TOTAL	2693	355846						

Note: Restricted to modern prostheses
356,132 procedures have unknown BMI
BMI has not been presented for patients aged ≤19 years

Figure KT18 Cumulative Percent Revision of Primary Total Knee Replacement by BMI Category (Primary Diagnosis OA, Revision for Infection)



HR - adjusted for age and gender

Underweight (<18.50) vs Normal (18.50-24.99)
Entire Period: HR=1.31 (0.49, 3.53), p=0.589

Pre Obese (25.00-29.99) vs Normal (18.50-24.99)
Entire Period: HR=1.03 (0.89, 1.20), p=0.665

Obese Class 1 (30.00-34.99) vs Normal (18.50-24.99)
Entire Period: HR=1.14 (0.98, 1.32), p=0.099

Obese Class 2 (35.00-39.99) vs Normal (18.50-24.99)
Entire Period: HR=1.34 (1.14, 1.58), p<0.001

Obese Class 3 (≥40.00) vs Normal (18.50-24.99)
0 - 1Mth: HR=3.16 (2.43, 4.09), p<0.001
1Mth - 1.5Yr: HR=2.03 (1.67, 2.46), p<0.001
1.5Yr+: HR=2.05 (1.61, 2.61), p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Underweight (<18.50)	633	515	408	304	219	138	63
Normal (18.50-24.99)	36777	30291	24343	18440	13020	8128	3726
Pre Obese (25.00-29.99)	110892	91523	73951	56430	39988	24764	11197
Obese Class 1 (30.00-34.99)	110088	90882	73598	55954	39696	24507	11123
Obese Class 2 (35.00-39.99)	60510	50082	40703	31215	21827	13413	6070
Obese Class 3 (≥40.00)	36946	30689	25266	19361	13672	8416	3697

Note: Restricted to modern prostheses
356,132 procedures have unknown BMI
BMI has not been presented for patients aged ≤19 years

PATIENT REPORTED OUTCOME MEASURES – PATIENT CHARACTERISTICS

EQ-VAS and EQ-5D-5L

Patient reported outcome measures (PROMs) are surveys that assess dimensions of health from the perspective of the patient.

In 2021, PROMs were introduced as a separate chapter. This year, PROM information is included in the hip, knee and shoulder chapters to allow a more complete analysis of the influence of patient and prosthesis factors on joint replacement and patient-reported outcomes after joint replacement.

The EQ-VAS and EQ-5D-5L are measures of quality of life. EQ-VAS is a measure of patient-reported health, and ranges from 0 (worst health imaginable) to 100 (best health imaginable).

The mean EQ-VAS increased by almost 10 points following knee replacement (Table KT20). Pre-operative and 6-month post-operative scores following total knee replacement are shown in Figure KT19. The percentage of patients who reported being better, worse or no different post-operatively compared to their pre-operative response for each of the EQ-5D domains and the EQ-VAS is shown in Figure KT20.

Age <65 years and female gender are associated with lower pre-operative EQ-VAS assessments. Change after surgery occurs in all subgroups, but the change is greater for patients aged <65 years, and for females (Table KT21 and Figure KT21).

Pre-operative mean EQ-VAS decreases with increasing ASA score, but the magnitude of change after surgery is similar in each group (Table KT22 and Figure KT22).

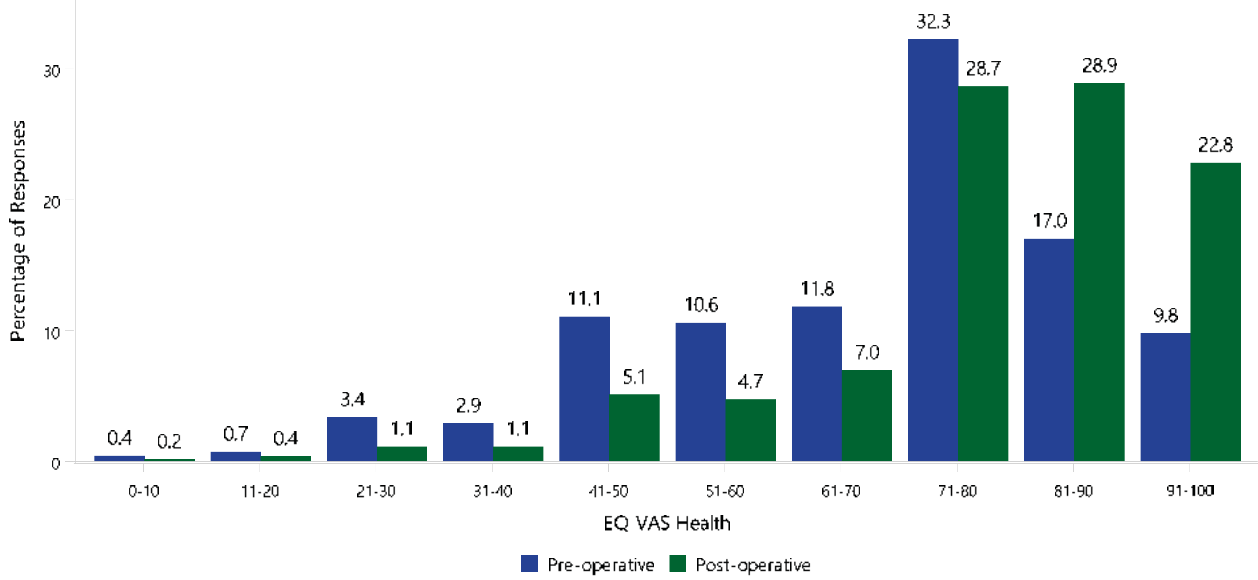
The mean EQ-VAS assessment before surgery decreases with each rise in BMI category, except in the underweight group where there are too few procedures for analysis. The magnitude of change increases with each BMI category (Table KT23 and Figure KT23).

Table KT20 Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Knee Replacement (Primary Diagnosis OA)

Class	Pre-operative			Post-operative		
	N	Mean±SD	Median (Q1, Q3)	N	Mean±SD	Median (Q1, Q3)
Total Knee	21087	69.82±18.46	75.00 (57.00, 82.00)	13321	79.59±15.80	82.00 (75.00, 90.00)

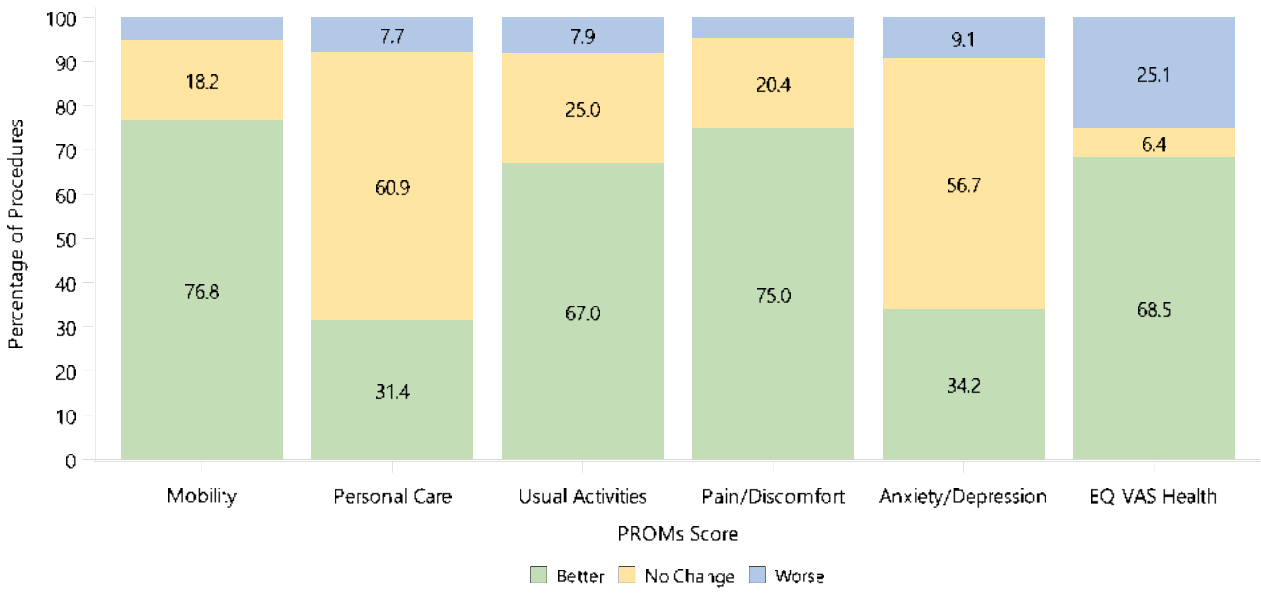
Note: Restricted to modern prostheses

Figure KT19 Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Knee Replacement (Primary Diagnosis OA)



Note: Restricted to modern prostheses

Figure KT20 Change in EQ-5D-5L Domain Score and EQ-VAS Health in Primary Total Knee Replacement (Primary Diagnosis OA)



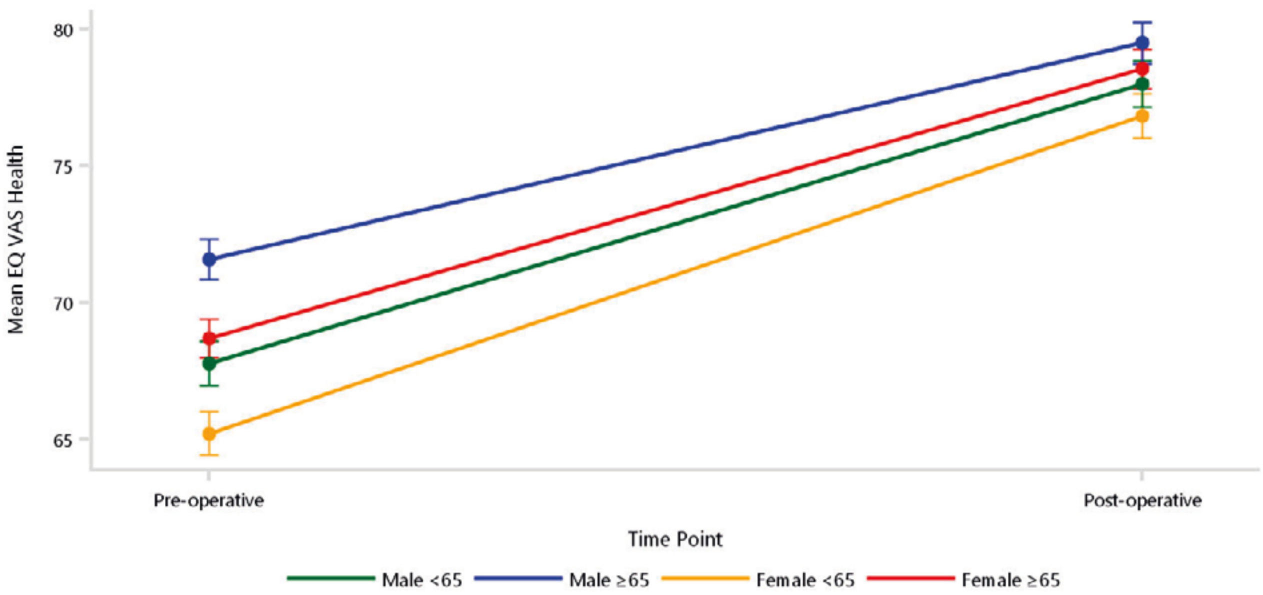
Note: Restricted to modern prostheses

Table KT21 Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Knee Replacement by Gender and Age (Primary Diagnosis OA)

		Pre-operative		Post-operative		
Gender	Age	N	Mean (95% CI)	N	Mean (95% CI)	Change in Score
Male	<65	3593	67.78 (66.97, 68.59)	2284	78.00 (77.17, 78.84)	10.22 (9.49, 10.96)
Male	≥65	5879	71.59 (70.86, 72.32)	3648	79.50 (78.74, 80.25)	7.91 (7.33, 8.49)
Female	<65	4101	65.23 (64.44, 66.02)	2582	76.83 (76.01, 77.64)	11.59 (10.90, 12.29)
Female	≥65	7514	68.71 (68.02, 69.41)	4807	78.55 (77.84, 79.26)	9.83 (9.32, 10.34)

Note: Restricted to modern prostheses
Adjusted for ASA score and BMI category

Figure KT21 Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Knee Replacement by Gender and Age (Primary Diagnosis OA)



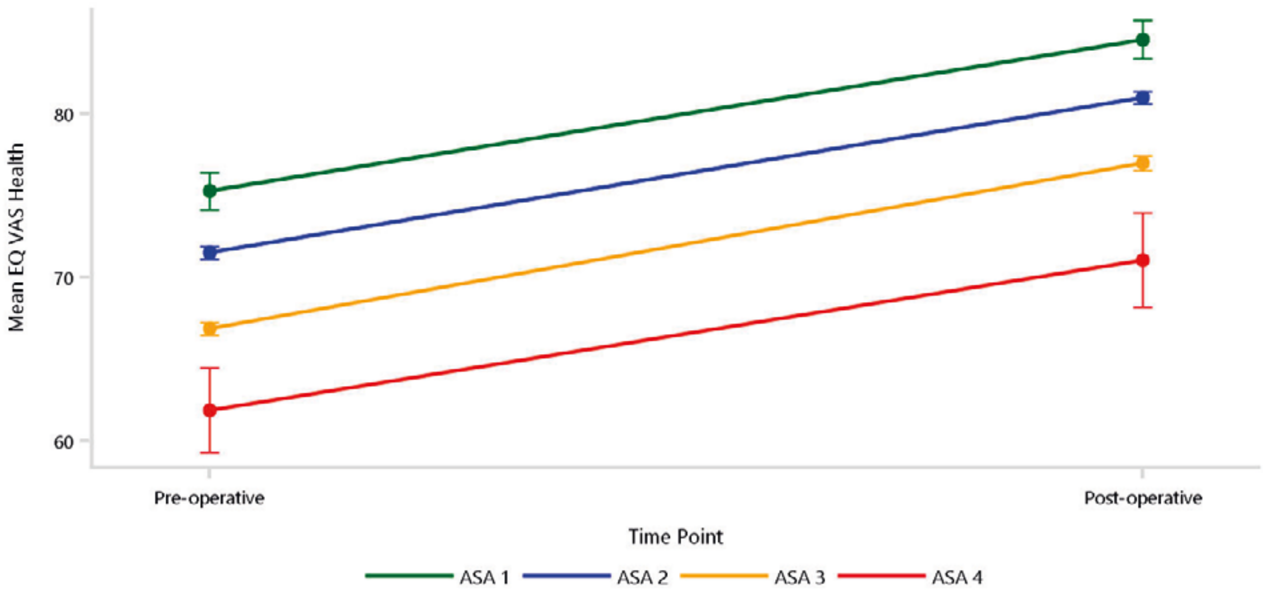
Note: Restricted to modern prostheses
Adjusted for ASA score and BMI category

Table KT22 Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Knee Replacement by ASA Score (Primary Diagnosis OA)

ASA Score	Pre-operative		Post-operative		
	N	Mean (95% CI)	N	Mean (95% CI)	Change in Score
ASA 1	1029	75.26 (74.14, 76.39)	684	84.52 (83.35, 85.69)	9.26 (7.90, 10.61)
ASA 2	11315	71.50 (71.14, 71.87)	7156	80.97 (80.59, 81.36)	9.47 (9.05, 9.89)
ASA 3	8515	66.86 (66.46, 67.26)	5336	76.97 (76.55, 77.40)	10.11 (9.63, 10.59)
ASA 4	186	61.87 (59.28, 64.46)	108	71.06 (68.20, 73.92)	9.18 (5.85, 12.52)

Note: Restricted to modern prostheses
Adjusted for age, gender and BMI category
Only ASA scores with >40 pre-operative and post-operative responses are listed

Figure KT22 Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Knee Replacement by ASA Score (Primary Diagnosis OA)



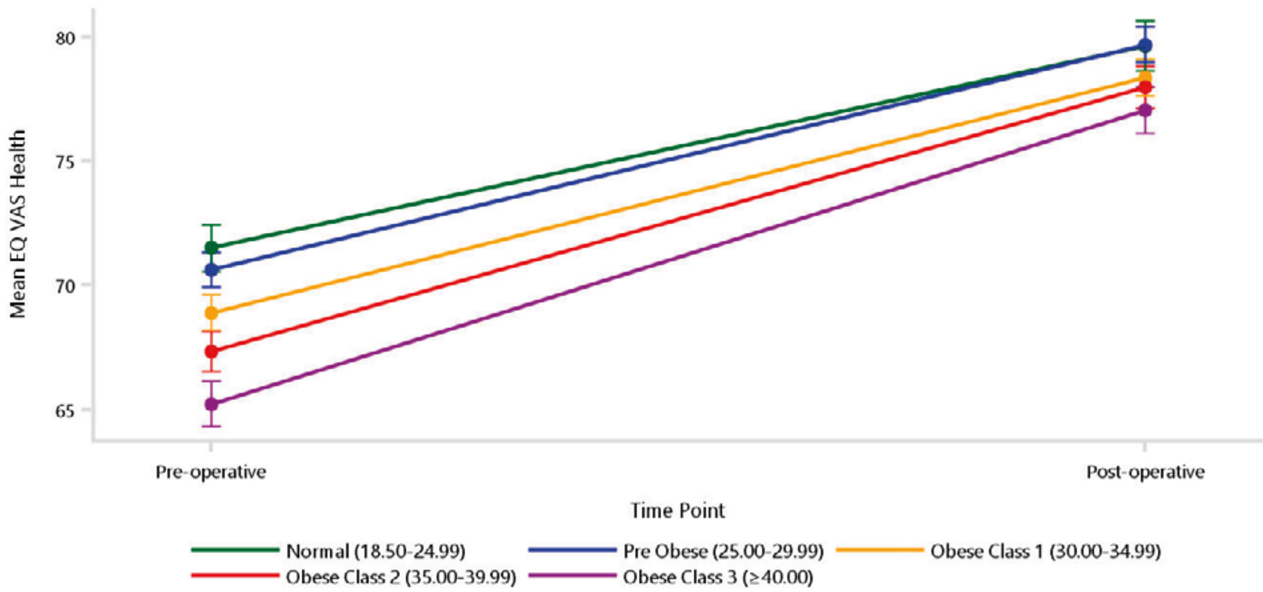
Note: Restricted to modern prostheses
Adjusted for age, gender and BMI category
Only ASA scores with >40 pre-operative and post-operative responses are listed

Table KT23 Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Knee Replacement by BMI Category (Primary Diagnosis OA)

BMI Category	Pre-operative		Post-operative		
	N	Mean (95% CI)	N	Mean (95% CI)	Change in Score
Normal (18.50-24.99)	2053	71.51 (70.56, 72.47)	1266	79.66 (78.65, 80.66)	8.14 (7.16, 9.12)
Pre Obese (25.00-29.99)	6329	70.64 (69.93, 71.35)	3973	79.71 (78.98, 80.44)	9.07 (8.52, 9.63)
Obese Class 1 (30.00-34.99)	6411	68.90 (68.18, 69.61)	4019	78.39 (77.65, 79.13)	9.49 (8.94, 10.04)
Obese Class 2 (35.00-39.99)	3622	67.35 (66.53, 68.16)	2310	77.99 (77.15, 78.83)	10.64 (9.91, 11.37)
Obese Class 3 (≥40.00)	2465	65.23 (64.32, 66.14)	1621	77.05 (76.11, 77.99)	11.82 (10.95, 12.70)

Note: Restricted to modern prostheses
Adjusted for age, gender and ASA score
BMI has not been presented for patients aged ≤19 years
Only BMI categories with >40 pre-operative and post-operative responses are listed

Figure KT23 Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Knee Replacement by BMI Category (Primary Diagnosis OA)



Note: Restricted to modern prostheses
Adjusted for age, gender and ASA score
BMI has not been presented for patients aged ≤19 years
Only BMI categories with >40 pre-operative and post-operative responses are listed

Oxford Scores

The Oxford Knee Score (OKS) provides a joint specific assessment of pain and function. The OKS totals the responses from 12 questions, each on a 5-level scale of 0 (worst possible score) to 4 (best possible score). The mean OKS was 22 pre-operatively and this increased to 38 post-surgery (Table KT24).

Similar to the EQ-VAS assessments, lower pre-operative mean OKS are associated with age <65 years and female gender (Table KT25 and Figure KT24).

Pre-operative mean Oxford scores decreases with each increase in ASA score and with each increase in BMI category, except for those in the underweight group, where there are too few procedures for analysis. Similar increases in Oxford score are seen post-operatively in all ASA scores and BMI categories (Table KT26, Figure KT25, Table KT27 and Figure KT26).

Table KT24 Mean Pre-operative and Post-operative Oxford Knee Score in Primary Total Knee Replacement (Primary Diagnosis OA)

Class	Pre-operative			Post-operative		
	N	Mean±SD	Median (Q1, Q3)	N	Mean±SD	Median (Q1, Q3)
Total Knee	21012	22.42±8.34	22.00 (16.00, 28.00)	13354	37.59±7.97	39.00 (34.00, 44.00)

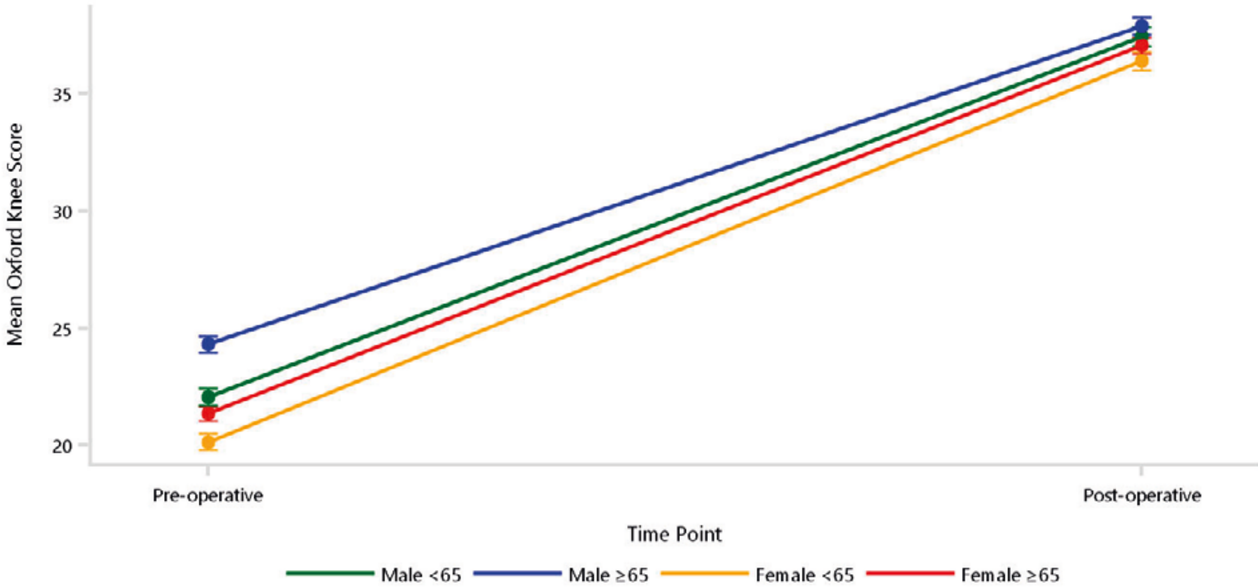
Note: Restricted to modern prostheses

Table KT25 Mean Pre-operative and Post-operative Oxford Knee Score in Primary Total Knee Replacement by Gender and Age (Primary Diagnosis OA)

		Pre-operative		Post-operative		
Gender	Age	N	Mean (95% CI)	N	Mean (95% CI)	Change in Score
Male	<65	3571	22.06 (21.69, 22.43)	2279	37.43 (37.02, 37.84)	15.37 (15.00, 15.73)
Male	≥65	5847	24.31 (23.98, 24.64)	3656	37.90 (37.53, 38.26)	13.59 (13.30, 13.88)
Female	<65	4090	20.16 (19.80, 20.51)	2596	36.40 (36.01, 36.80)	16.25 (15.91, 16.59)
Female	≥65	7504	21.35 (21.03, 21.67)	4823	37.05 (36.71, 37.39)	15.70 (15.45, 15.95)

Note: Restricted to modern prostheses
Adjusted for ASA score and BMI category

Figure KT24 Mean Pre-operative and Post-operative Oxford Knee Score in Primary Total Knee Replacement by Gender and Age (Primary Diagnosis OA)



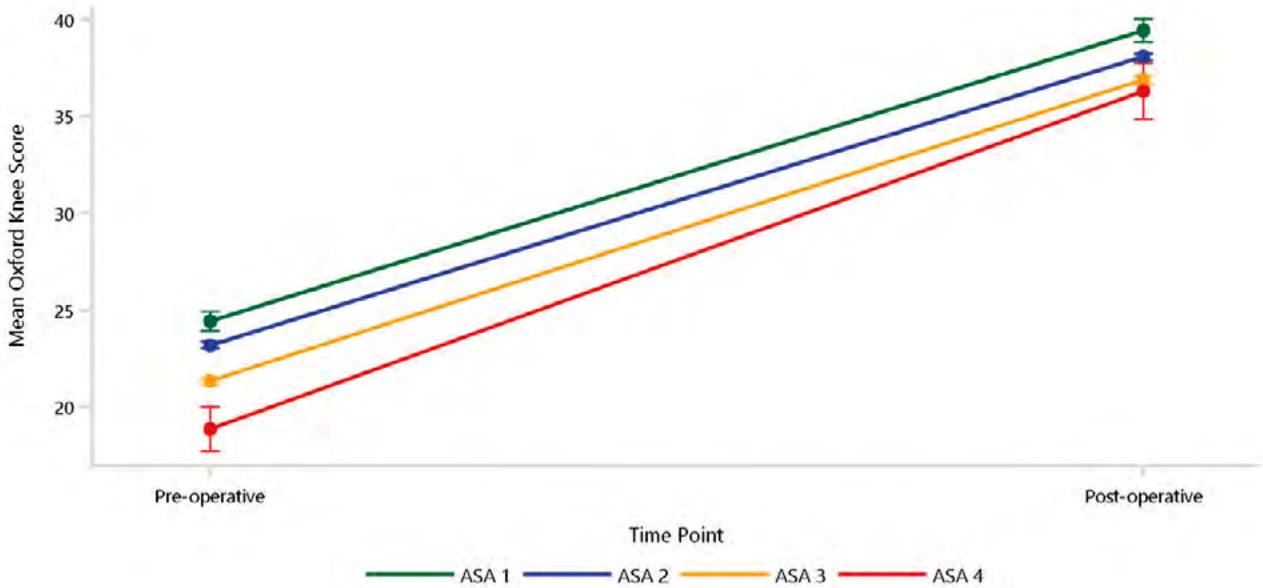
Note: Restricted to modern prostheses
Adjusted for ASA score and BMI category

Table KT26 Mean Pre-operative and Post-operative Oxford Knee Score in Primary Total Knee Replacement by ASA Score (Primary Diagnosis OA)

ASA Score	Pre-operative		Post-operative		
	N	Mean (95% CI)	N	Mean (95% CI)	Change in Score
ASA 1	1025	24.44 (23.94, 24.94)	690	39.45 (38.85, 40.04)	15.00 (14.34, 15.67)
ASA 2	11262	23.20 (23.04, 23.37)	7182	38.07 (37.88, 38.27)	14.87 (14.66, 15.08)
ASA 3	8500	21.34 (21.16, 21.52)	5337	36.88 (36.67, 37.10)	15.54 (15.30, 15.78)
ASA 4	183	18.87 (17.71, 20.03)	109	36.32 (34.86, 37.77)	17.45 (15.79, 19.10)

Note: Restricted to modern prostheses
Adjusted for age, gender and BMI category
Only ASA scores with >40 pre-operative and post-operative responses are listed

Figure KT25 Mean Pre-operative and Post-operative Oxford Knee Score in Primary Total Knee Replacement by ASA Score (Primary Diagnosis OA)



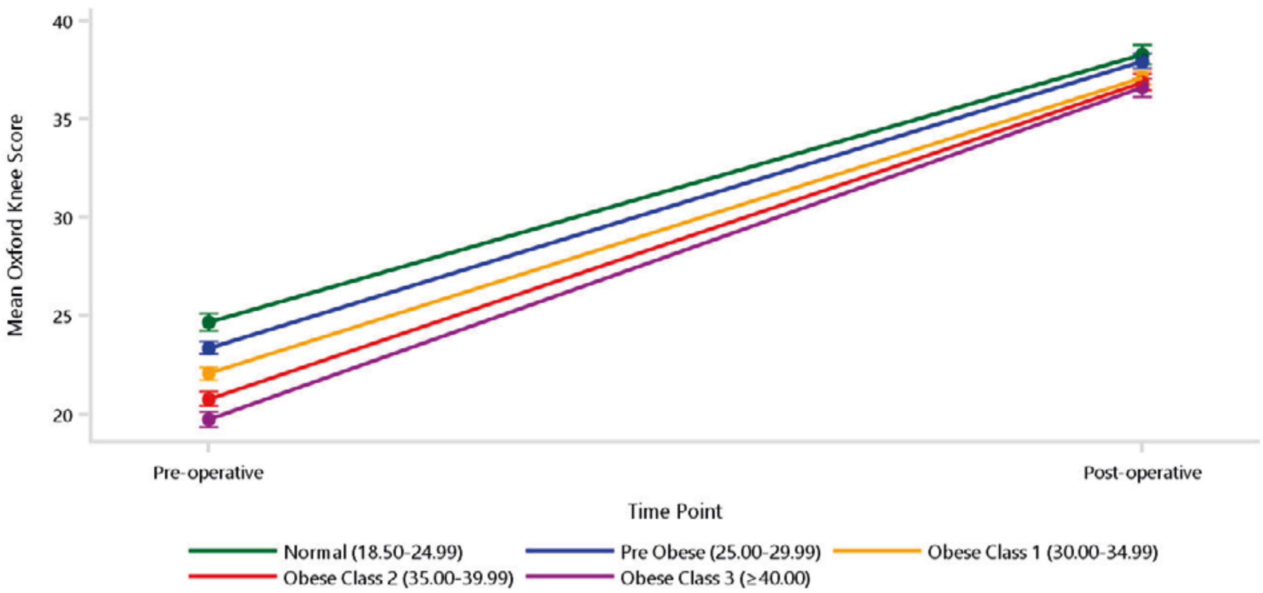
Note: Restricted to modern prostheses
Adjusted for age, gender and BMI category
Only ASA scores with >40 pre-operative and post-operative responses are listed

Table KT27 Mean Pre-operative and Post-operative Oxford Knee Score in Primary Total Knee Replacement by BMI Category (Primary Diagnosis OA)

BMI Category	Pre-operative		Post-operative		
	N	Mean (95% CI)	N	Mean (95% CI)	Change in Score
Normal (18.50-24.99)	2043	24.67 (24.24, 25.10)	1272	38.30 (37.80, 38.80)	13.63 (13.14, 14.11)
Pre Obese (25.00-29.99)	6300	23.38 (23.06, 23.71)	3979	37.96 (37.61, 38.31)	14.58 (14.30, 14.85)
Obese Class 1 (30.00-34.99)	6385	22.07 (21.75, 22.40)	4032	37.12 (36.76, 37.47)	15.04 (14.77, 15.32)
Obese Class 2 (35.00-39.99)	3619	20.79 (20.42, 21.16)	2315	36.88 (36.47, 37.29)	16.09 (15.73, 16.45)
Obese Class 3 (≥40.00)	2462	19.74 (19.33, 20.15)	1624	36.60 (36.14, 37.06)	16.86 (16.43, 17.29)

Note: Restricted to modern prostheses
Adjusted for age, gender and ASA score
BMI has not been presented for patients aged ≤19 years
Only BMI categories with >40 pre-operative and post-operative responses are listed

Figure KT26 Mean Pre-operative and Post-operative Oxford Knee Score in Primary Total Knee Replacement by BMI Category (Primary Diagnosis OA)



Note: Restricted to modern prostheses
Adjusted for age, gender and ASA score
BMI has not been presented for patients aged ≤19 years
Only BMI categories with >40 pre-operative and post-operative responses are listed

PROMs: Patient Satisfaction and Change

Patients were surveyed at 6 months post-operatively on how satisfied they were with their primary knee replacement, and on their perceived change in their knee after surgery. Satisfaction following knee replacement is shown in Table KT28.

After knee replacement, 83.7% of patients are satisfied or very satisfied (Figure KT27).

Procedure satisfaction by age and gender are presented in Table KT29 and Figure KT28.

There is a high percentage (92.3%) of patients who rate their knee as much better (Table KT30 and Figure KT29).

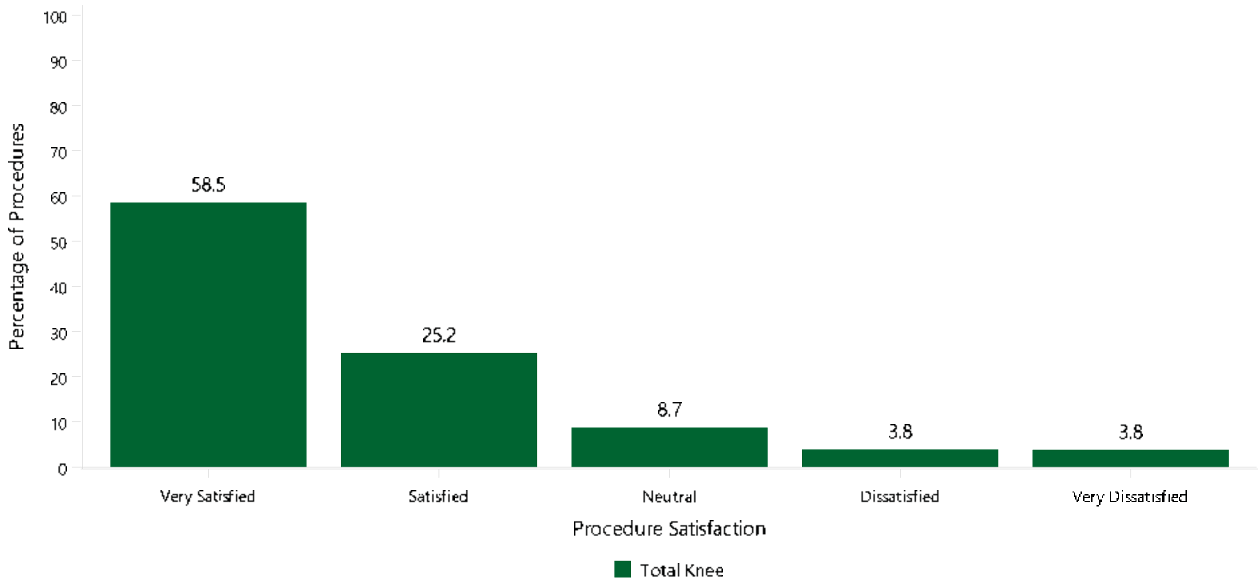
Patient-reported change by age and gender are presented in Table KT31 and Figure KT30.

Table KT28 Procedure Satisfaction in Primary Total Knee Replacement (Primary Diagnosis OA)

Class	Very Satisfied		Satisfied		Neutral		Dissatisfied		Very Dissatisfied		TOTAL	
	N	Row%	N	Row%	N	Row%	N	Row%	N	Row%	N	Row%
Total Knee	7795	58.5	3363	25.2	1158	8.7	512	3.8	504	3.8	13332	100.0

Note: Restricted to modern prostheses

Figure KT27 Procedure Satisfaction in Primary Total Knee Replacement (Primary Diagnosis OA)



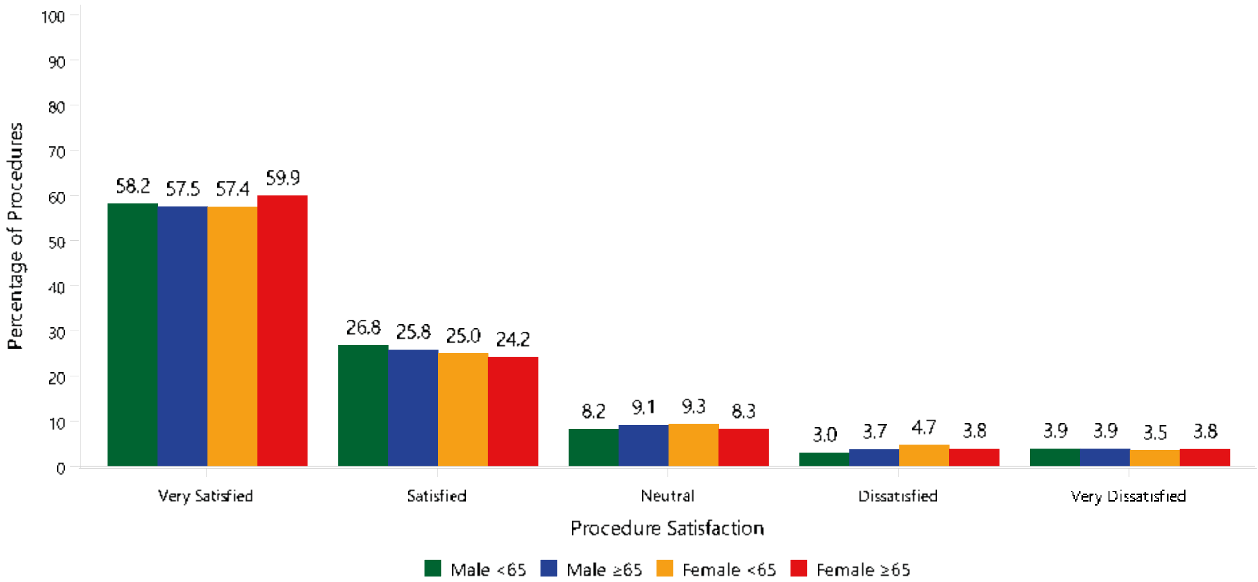
Note: Restricted to modern prostheses

Table KT29 Procedure Satisfaction in Primary Total Knee Replacement by Gender and Age (Primary Diagnosis OA)

Gender	Age	Very Satisfied N	Very Satisfied Row %	Very Satisfied Col %	Satisfied N	Satisfied Row %	Satisfied Col %	Neutral N	Neutral Row %	Neutral Col %	Dissatisfied N	Dissatisfied Row %	Dissatisfied Col %	Very Dissatisfied N	Very Dissatisfied Row %	Very Dissatisfied Col %	TOTAL N	TOTAL Row %	TOTAL Col %
Male	<65	1325	58.2	17.0	610	26.8	18.1	187	8.2	16.1	68	3.0	13.3	88	3.9	17.5	2278	100.0	17.1
	≥65	2098	57.5	26.9	942	25.8	28.0	332	9.1	28.7	136	3.7	26.6	142	3.9	28.2	3650	100.0	27.4
Female	<65	1490	57.4	19.1	648	25.0	19.3	242	9.3	20.9	123	4.7	24.0	91	3.5	18.1	2594	100.0	19.5
	≥65	2882	59.9	37.0	1163	24.2	34.6	397	8.3	34.3	185	3.8	36.1	183	3.8	36.3	4810	100.0	36.1
TOTAL		7795	58.5	100.0	3363	25.2	100.0	1158	8.7	100.0	512	3.8	100.0	504	3.8	100.0	13332	100.0	100.0

Note: Restricted to modern prostheses

Figure KT28 Procedure Satisfaction in Primary Total Knee Replacement by Gender and Age (Primary Diagnosis OA)



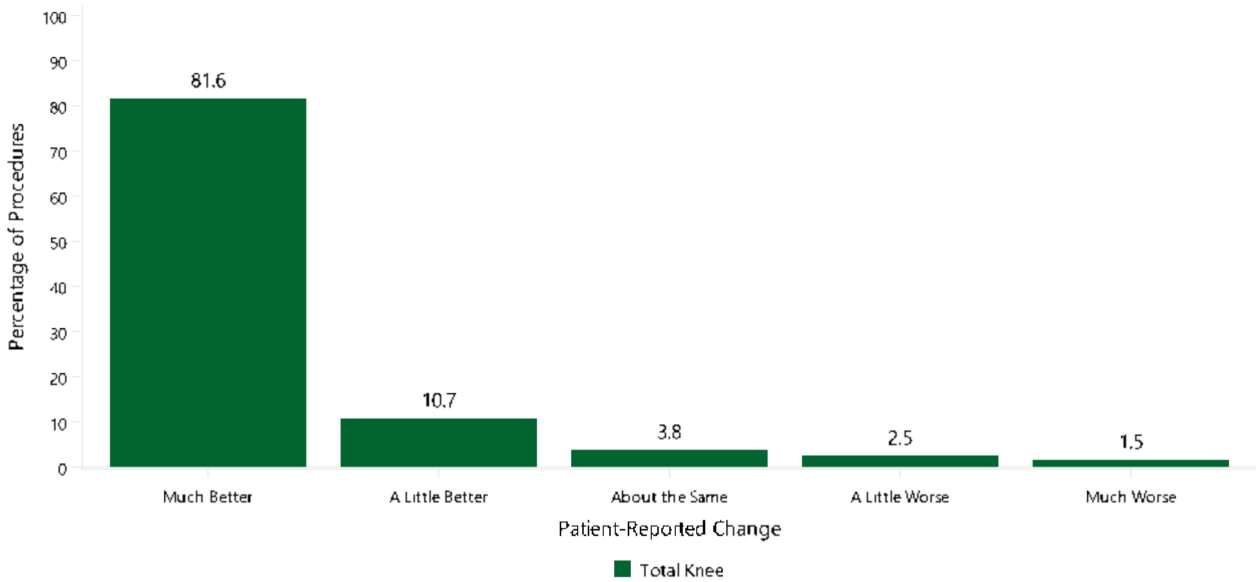
Note: Restricted to modern prostheses

Table KT30 Patient-Reported Change after Primary Total Knee Replacement (Primary Diagnosis OA)

	Much Better		A Little Better		About the Same		A Little Worse		Much Worse		TOTAL	
Class	N	Row%	N	Row%	N	Row%	N	Row%	N	Row%	N	Row%
Total Knee	10872	81.6	1424	10.7	500	3.8	329	2.5	205	1.5	13330	100.0

Note: Restricted to modern prostheses

Figure KT29 Patient-Reported Change after Primary Total Knee Replacement (Primary Diagnosis OA)



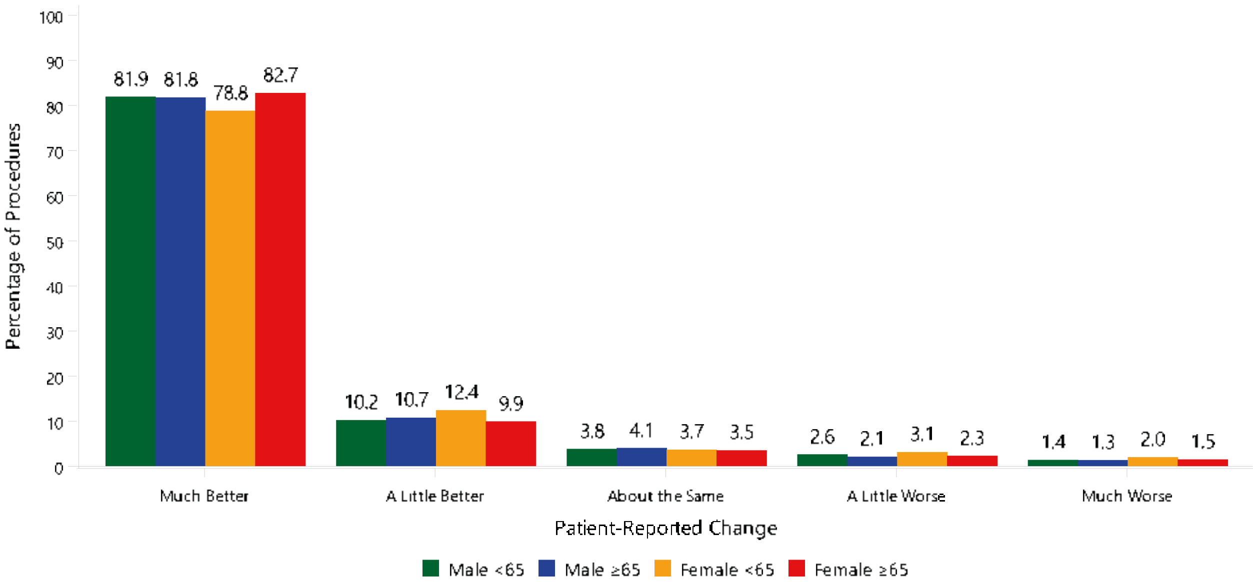
Note: Restricted to modern prostheses

Table KT31 Patient-Reported Change after Primary Total Knee Replacement by Age and Gender (Primary Diagnosis OA)

		Much Better			A Little Better			About the Same			A Little Worse			Much Worse			TOTAL		
Gender	Age	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%
Male	<65	1865	81.9	17.2	233	10.2	16.4	87	3.8	17.4	60	2.6	18.2	32	1.4	15.6	2277	100.0	17.1
	≥65	2984	81.8	27.4	392	10.7	27.5	148	4.1	29.6	77	2.1	23.4	49	1.3	23.9	3650	100.0	27.4
Female	<65	2044	78.8	18.8	322	12.4	22.6	95	3.7	19.0	81	3.1	24.6	52	2.0	25.4	2594	100.0	19.5
	≥65	3979	82.7	36.6	477	9.9	33.5	170	3.5	34.0	111	2.3	33.7	72	1.5	35.1	4809	100.0	36.1
TOTAL		10872	81.6	100.0	1424	10.7	100.0	500	3.8	100.0	329	2.5	100.0	205	1.5	100.0	13330	100.0	100.0

Note: Restricted to modern prostheses

Figure KT30 Patient-Reported Change after Primary Total Knee Replacement by Age and Gender (Primary Diagnosis OA)



Note: Restricted to modern prostheses

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.

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 bearings in the first 7 years (Table KT32 and Figure KT31).

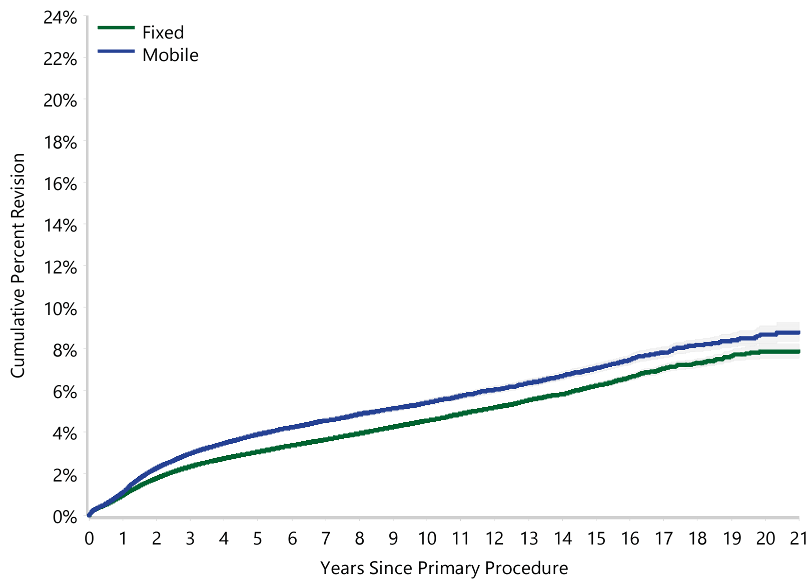
When types of fixed bearings are compared, moulded non-modular tibial prostheses have a lower rate of revision compared to fixed modular components. There is no difference when comparing all-polyethylene to fixed modular or fixed non-modular tibial prostheses. However, the moulded non-modular and the all-polyethylene groups only have a limited number of prosthesis types. There are only 4 moulded non-modular and 5 all polyethylene tibial prostheses (Table KT33 and Figure KT32).

Table KT32 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	19151	582551	1.0 (0.9, 1.0)	2.3 (2.3, 2.4)	3.1 (3.0, 3.1)	4.6 (4.5, 4.6)	6.2 (6.1, 6.4)	7.9 (7.6, 8.2)
Mobile	6094	129255	1.1 (1.1, 1.2)	3.0 (2.9, 3.1)	3.9 (3.8, 4.0)	5.4 (5.3, 5.6)	7.1 (6.9, 7.3)	8.7 (8.3, 9.1)
TOTAL	25245	711806						

Note: Restricted to modern prostheses
Excludes 172 procedures with unknown bearing mobility

Figure KT31 Cumulative Percent Revision of Primary Total Knee Replacement by Bearing Mobility (Primary Diagnosis OA)



HR - adjusted for age and gender
Mobile vs Fixed
0 - 1Yr: HR=1.15 (1.08, 1.22), p<0.001
1Yr - 1.5Yr: HR=1.45 (1.34, 1.57), p<0.001
1.5Yr - 2.5Yr: HR=1.23 (1.15, 1.33), p<0.001
2.5Yr - 3Yr: HR=1.38 (1.22, 1.55), p<0.001
3Yr - 5Yr: HR=1.29 (1.19, 1.39), p<0.001
5Yr - 7Yr: HR=1.12 (1.02, 1.24), p=0.022
7Yr+: HR=0.95 (0.88, 1.02), p=0.132

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Fixed	582551	522927	412961	309664	115767	25284	1343
Mobile	129255	120278	102655	85013	43766	15071	1218

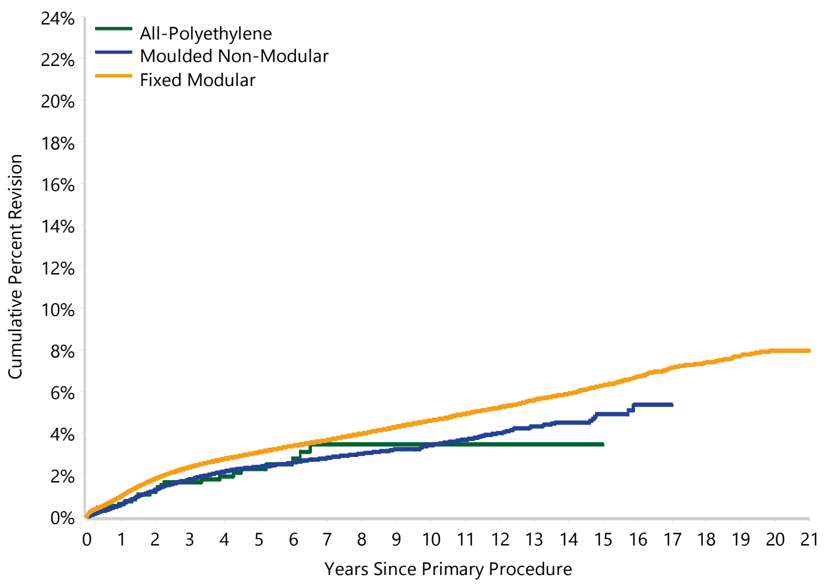
Note: Restricted to modern prostheses

Table KT33 Cumulative Percent Revision of Primary Total Knee Replacement by Fixed Bearing Type (Primary Diagnosis OA)

Fixed Bearing Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
All-Polyethylene	23	990	0.6 (0.3, 1.4)	1.6 (1.0, 2.7)	2.3 (1.4, 3.6)	3.5 (2.2, 5.4)	3.5 (2.2, 5.4)	
Moulded Non-Modular	576	18721	0.6 (0.5, 0.7)	1.8 (1.6, 2.0)	2.4 (2.2, 2.6)	3.4 (3.2, 3.8)	4.9 (4.3, 5.5)	
Fixed Modular	18552	562840	1.0 (0.9, 1.0)	2.4 (2.3, 2.4)	3.1 (3.0, 3.1)	4.6 (4.5, 4.7)	6.3 (6.2, 6.4)	8.0 (7.6, 8.3)
TOTAL	19151	582551						

Note: Restricted to modern prostheses

Figure KT32 Cumulative Percent Revision of Primary Total Knee Replacement by Fixed Bearing Type (Primary Diagnosis OA)



HR - adjusted for age and gender

All-Polyethylene vs Fixed Modular

Entire Period: HR=0.87 (0.58, 1.30), p=0.489

Moulded Non-Modular vs Fixed Modular

Entire Period: HR=0.72 (0.67, 0.79), p<0.001

Moulded Non-Modular vs All-Polyethylene

Entire Period: HR=0.84 (0.55, 1.27), p=0.402

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
All-Polyethylene	990	937	753	472	149	57	3
Moulded Non-Modular	18721	18086	16294	14054	6578	825	0
Fixed Modular	562840	503904	395914	295138	109040	24402	1340

Note: Restricted to modern prostheses

Stability

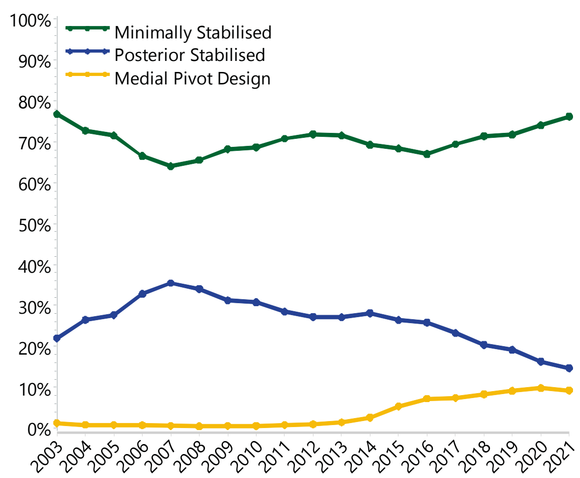
Stability refers to particular prosthetic features intended to substitute for the intrinsic stability of knee ligaments. In 2018, the Registry expanded the classification to include the medial pivot designs separately. The five categories are: minimally stabilised, medial pivot design, posterior stabilised, fully stabilised, and hinged prostheses.

The five major categories for stability are minimally stabilised, medial pivot design, posterior stabilised, fully stabilised, and hinged prostheses.

The Registry defines minimally stabilised prostheses 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 2021, these accounted for 76.1% of primary procedures. The use of posterior stabilised prostheses has declined to 14.7% in 2021. Medial pivot design prostheses have been used in small numbers since the Registry began collecting data. In 2021, medial pivot design prostheses accounted for 9.2% of primary procedures (Figure KT33).

Figure KT33 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 KT34 and Figure KT34).

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 KT35).

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’ or ‘anterior stabilised’ designs which are intended to provide additional anterior stability.

There are two knee prostheses with >500 procedures in each conformity category using a fixed bearing XLPE insert, with a follow-up of >3 years. The Triathlon prosthesis with the cruciate retaining polyethylene insert shows no difference when compared to the condylar stabilising polyethylene (Table KT35 and Figure KT36). The PFC Sigma knee shows no difference in revision rates when the cruciate retaining (curved) and curved plus inserts are compared (Table KT36 and Figure KT37).

An alternative approach is the ultra-congruent or ‘deep dish’ polyethylene shape that can add additional sagittal stability without the need for a peg and box design. There are two prostheses with >500 procedures in each category using a fixed bearing XLPE insert with a follow-up of >3 years. The Natural Knee and Persona have both cruciate retaining and ultra-congruent components. There is no difference in the rate of revision between the polyethylene insert styles for either design (Table KT37, Figure KT38, Table KT38, and Figure KT39).

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 0.4% 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 and fracture. Hinged prostheses are used proportionally more for tumour, fracture, and rheumatoid arthritis (Table KT39).

Fully stabilised prostheses have been used in 3,073 and hinged prostheses in 2,526 primary procedures. For these two knee designs, the cumulative percent revision for all diagnoses are shown in Table KT40 and Figure KT40.

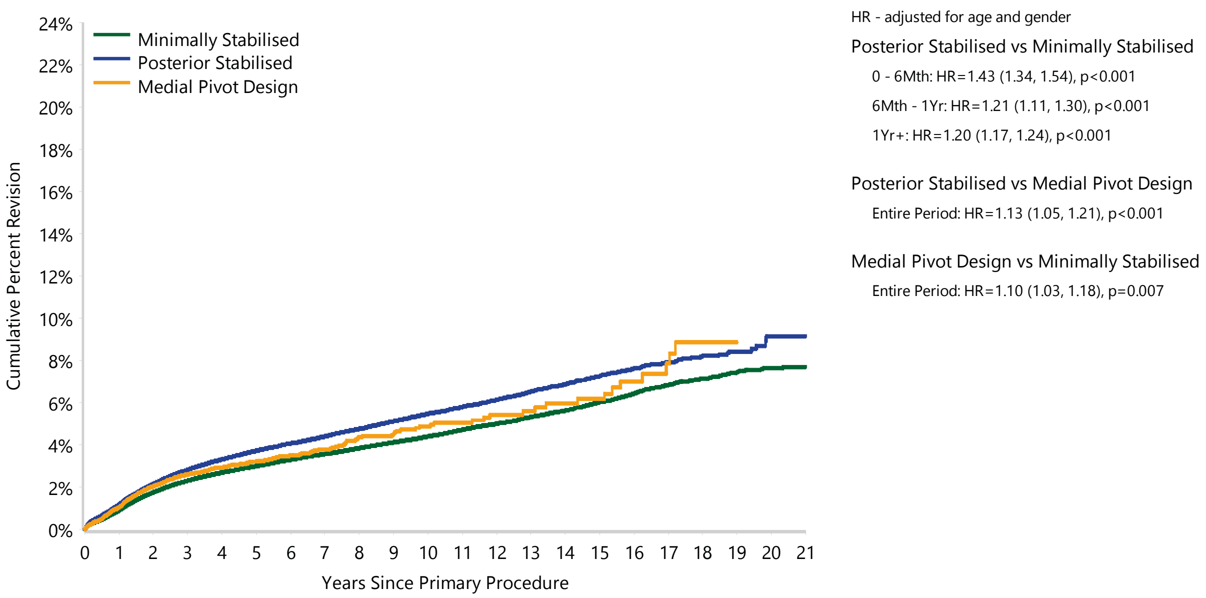
When the outcome for osteoarthritis is considered, fully stabilised and hinged knee prostheses both have higher rates of revision compared to minimally stabilised prostheses (Figure KT41). For both of these designs, infection is the most common reason for revision, followed by loosening for fully stabilised and fracture for hinged prostheses (Table KT41 and Figure KT42).

Table KT34 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	16521	500931	0.9 (0.9, 0.9)	2.3 (2.3, 2.4)	3.0 (2.9, 3.1)	4.4 (4.3, 4.5)	6.0 (5.9, 6.2)	7.6 (7.4, 7.9)
Posterior Stabilised	7603	172835	1.2 (1.1, 1.2)	2.8 (2.7, 2.9)	3.7 (3.6, 3.8)	5.5 (5.3, 5.6)	7.2 (7.0, 7.5)	9.2 (8.4, 10.0)
Medial Pivot Design	858	33823	1.0 (0.9, 1.2)	2.6 (2.4, 2.8)	3.2 (3.0, 3.5)	4.9 (4.4, 5.5)	6.2 (5.2, 7.3)	
Fully Stabilised	164	2786	2.7 (2.2, 3.4)	5.1 (4.3, 6.0)	6.4 (5.4, 7.5)	8.6 (7.2, 10.3)		
Hinged	99	1436	2.9 (2.2, 4.0)	6.2 (4.9, 7.7)	8.0 (6.4, 10.0)	12.1 (9.6, 15.2)		
TOTAL	25245	711811						

Note: Restricted to modern prostheses
Excludes 167 procedures with unknown stability

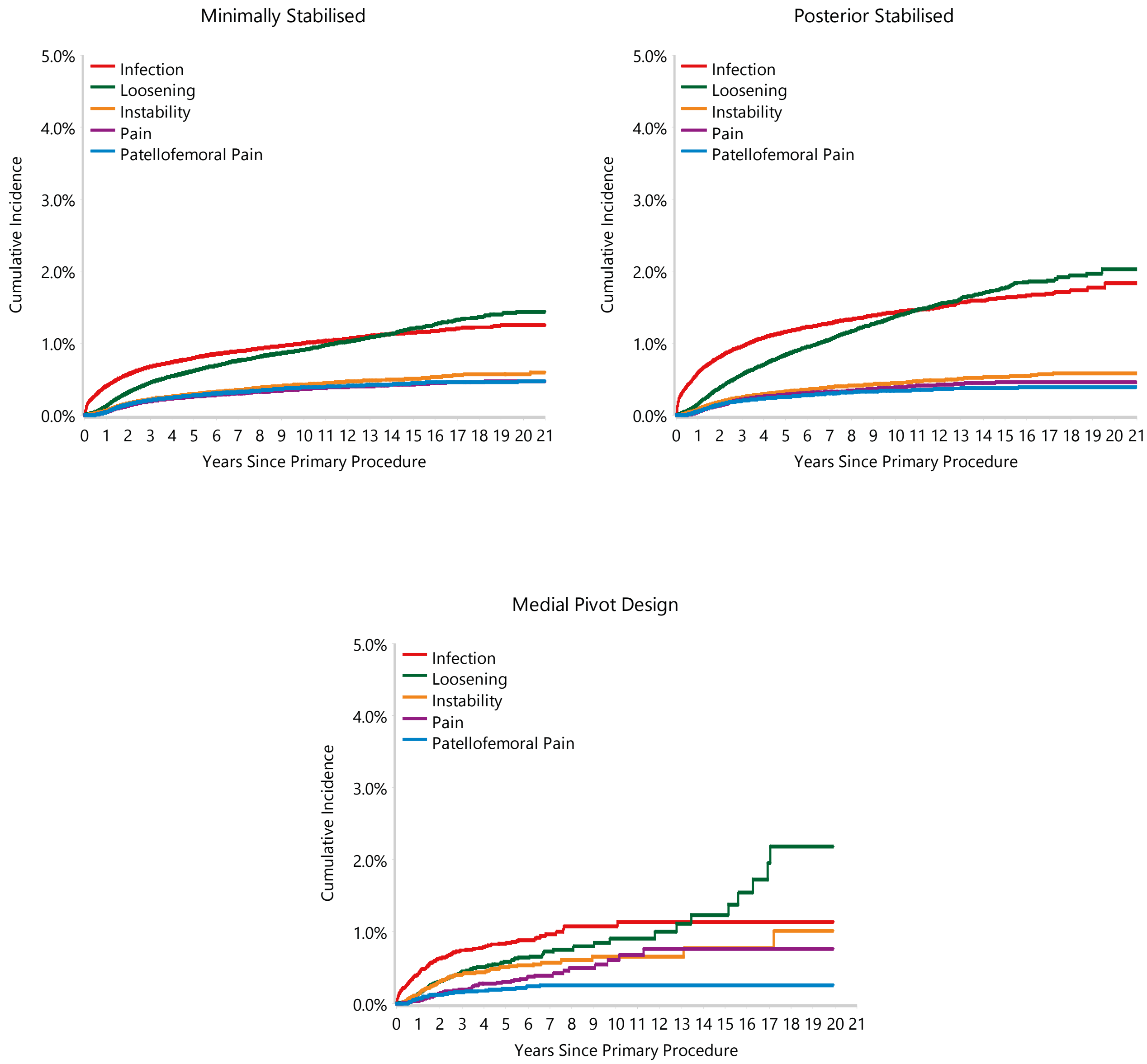
Figure KT34 Cumulative Percent Revision of Primary Total Knee Replacement by Stability (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Minimally Stabilised	500931	450179	358851	274538	111873	29931	2176
Posterior Stabilised	172835	161348	136885	109542	46125	10006	342
Medial Pivot Design	33823	28083	17405	9012	1149	373	39

Note: Restricted to modern prostheses

Figure KT35 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by Stability (Primary Diagnosis OA)



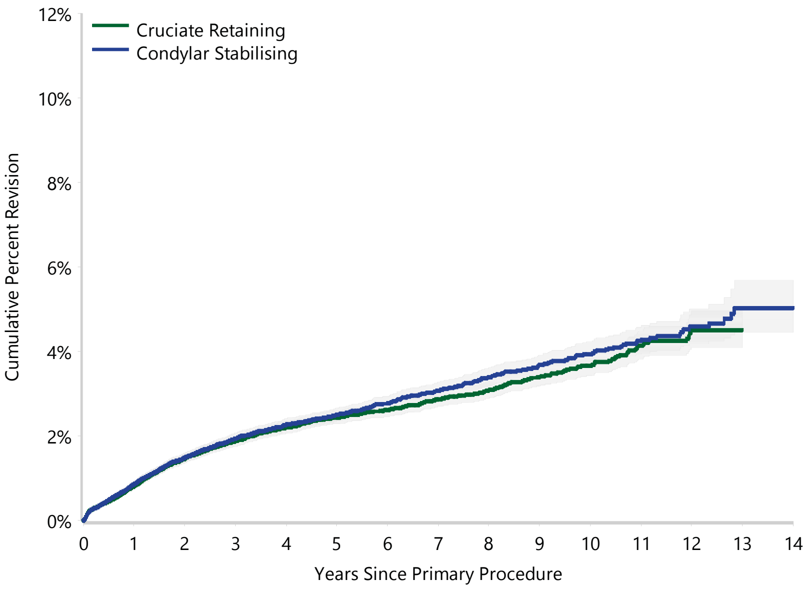
Note: Restricted to modern prostheses

Table KT35 Cumulative Percent Revision of Triathlon/Triathlon Primary Total Knee Replacement with XLPE by Polyethylene Insert Shape (Primary Diagnosis OA)

Polyethylene Insert Shape	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Cruciate Retaining	1223	54818	0.8 (0.7, 0.9)	1.9 (1.8, 2.0)	2.4 (2.3, 2.6)	2.9 (2.7, 3.1)	3.7 (3.4, 3.9)	
Condylar Stabilising	1316	58752	0.9 (0.8, 0.9)	1.9 (1.8, 2.1)	2.5 (2.4, 2.7)	3.1 (2.9, 3.3)	3.9 (3.7, 4.2)	5.0 (4.5, 5.7)
TOTAL	2539	113570						

Note: Restricted to modern prostheses

Figure KT36 Cumulative Percent Revision of Triathlon/Triathlon Primary Total Knee Replacement with XLPE by Polyethylene Insert Shape (Primary Diagnosis OA)



HR - adjusted for age and gender

Condylar Stabilising vs Cruciate Retaining

Entire Period: HR=1.05 (0.97, 1.14), p=0.200

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Cruciate Retaining	54818	47157	33775	23192	15329	5418	29
Condylar Stabilising	58752	49318	34801	22933	13690	4833	96

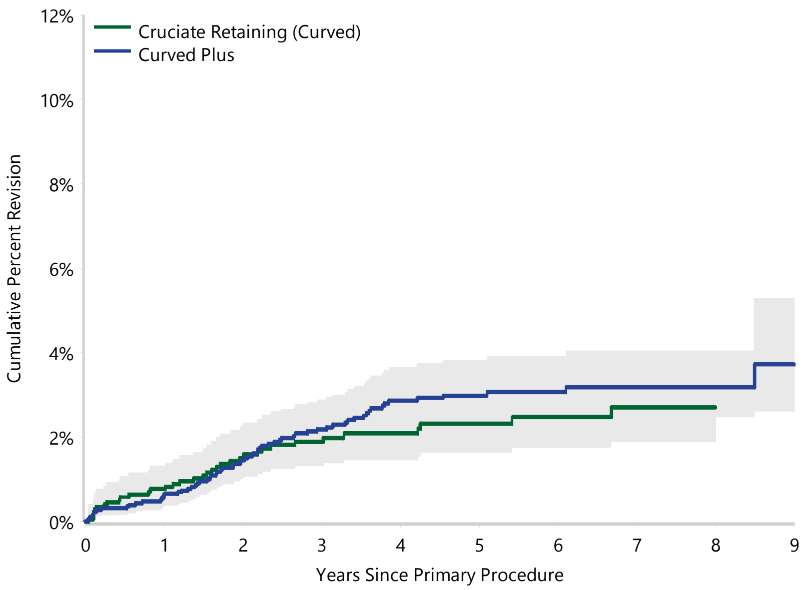
Note: Restricted to modern prostheses

Table KT36 Cumulative Percent Revision of PFC Sigma/PFC Sigma Primary Total Knee Replacement with XLPE by Polyethylene Insert Shape (Primary Diagnosis OA)

Polyethylene Insert Shape	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	9 Yrs
Cruciate Retaining (Curved)	35	1723	0.8 (0.4, 1.3)	1.5 (1.0, 2.3)	1.9 (1.3, 2.7)	2.3 (1.6, 3.3)	2.7 (1.9, 3.9)	
Curved Plus	66	2508	0.7 (0.4, 1.1)	1.5 (1.1, 2.0)	2.2 (1.7, 2.9)	3.0 (2.3, 3.8)	3.2 (2.5, 4.1)	3.7 (2.6, 5.3)
TOTAL	101	4231						

Note: Restricted to modern prostheses

Figure KT37 Cumulative Percent Revision of PFC Sigma/PFC Sigma Primary Total Knee Replacement with XLPE by Polyethylene Insert Shape (Primary Diagnosis OA)



HR - adjusted for age and gender

Curved Plus vs Cruciate Retaining (Curved)

Entire Period: HR=1.17 (0.77, 1.77), p=0.461

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	9 Yrs
Cruciate Retaining (Curved)	1723	1561	1358	1077	721	366	4
Curved Plus	2508	2337	2121	1886	1307	562	114

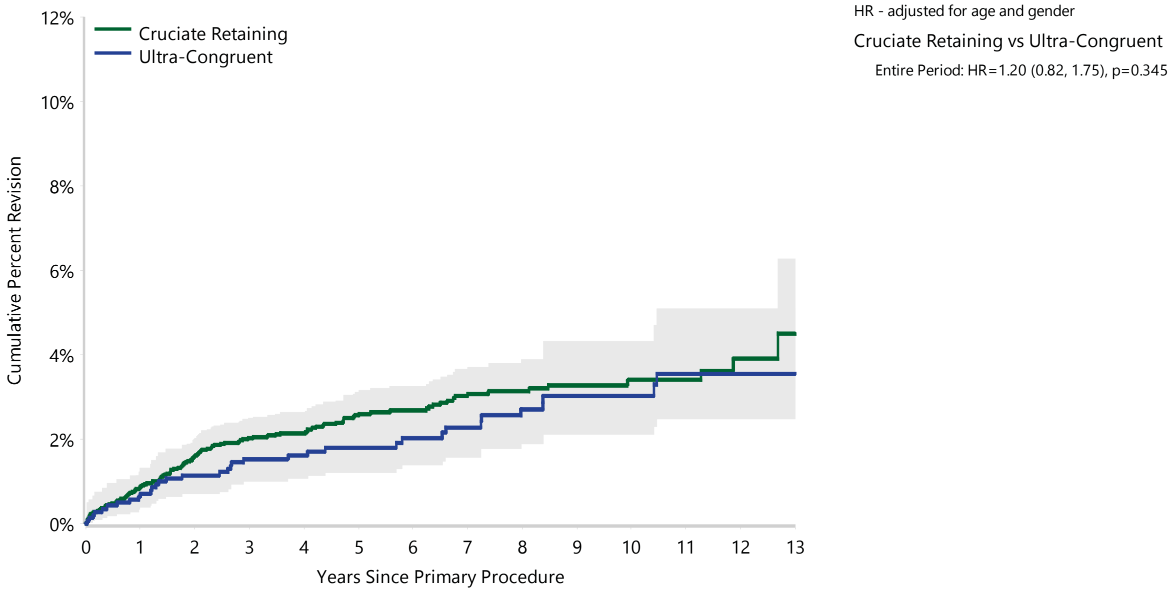
Note: Restricted to modern prostheses

Table KT37 Cumulative Percent Revision of Natural Knee/Natural Knee Primary Total Knee Replacement with XLPE by Polyethylene Insert Shape (Primary Diagnosis OA)

Polyethylene Insert Shape	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Cruciate Retaining	119	4457	0.9 (0.6, 1.2)	2.0 (1.6, 2.5)	2.6 (2.1, 3.1)	3.1 (2.5, 3.7)	3.4 (2.8, 4.1)	4.5 (3.2, 6.3)
Ultra-Congruent	35	1408	0.7 (0.4, 1.3)	1.5 (1.0, 2.3)	1.8 (1.2, 2.7)	2.3 (1.6, 3.3)	3.0 (2.1, 4.3)	3.6 (2.5, 5.1)
TOTAL	154	5865						

Note: Restricted to modern prostheses

Figure KT38 Cumulative Percent Revision of Natural Knee/Natural Knee Primary Total Knee Replacement with XLPE by Polyethylene Insert Shape (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Cruciate Retaining	4457	4179	3537	2712	1759	798	103
Ultra-Congruent	1408	1374	1255	965	727	432	67

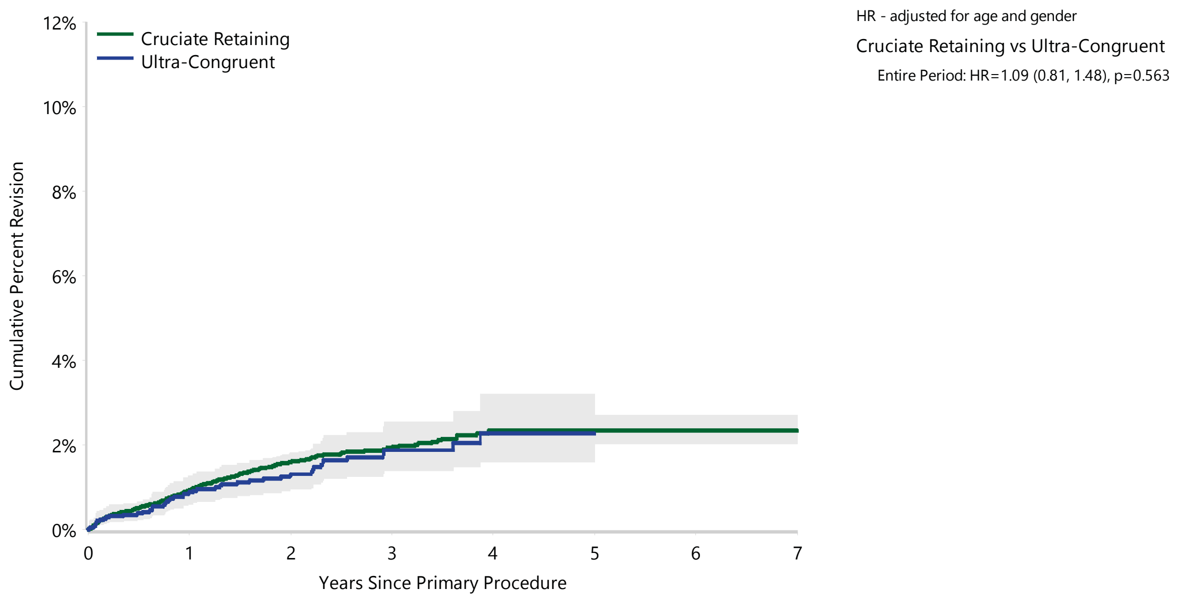
Note: Restricted to modern prostheses

Table KT38 Cumulative Percent Revision of Persona Primary Total Knee Replacement with XLPE by Polyethylene Insert Shape (Primary Diagnosis OA)

Polyethylene Insert Shape	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	7 Yrs
Cruciate Retaining	327	27154	0.9 (0.8, 1.1)	1.6 (1.4, 1.8)	1.9 (1.7, 2.2)	2.3 (2.0, 2.7)	2.3 (2.0, 2.7)	2.3 (2.0, 2.7)
Ultra-Congruent	48	3446	0.9 (0.6, 1.3)	1.3 (0.9, 1.8)	1.9 (1.4, 2.5)	2.3 (1.6, 3.2)	2.3 (1.6, 3.2)	
TOTAL	375	30600						

Note: Restricted to modern prostheses

Figure KT39 Cumulative Percent Revision of Persona Primary Total Knee Replacement with XLPE by Polyethylene Insert Shape (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	7 Yrs
Cruciate Retaining	27154	16478	8772	4213	1564	505	97
Ultra-Congruent	3446	2616	1994	1096	380	77	11

Note: Restricted to modern prostheses

Table KT39 Primary Total Knee Replacement by Primary Diagnosis and Stability

Primary Diagnosis	Fully Stabilised		Hinged		TOTAL	
	N	Col%	N	Col%	N	Col%
Osteoarthritis	2786	90.7	1436	56.8	4222	75.4
Tumour	11	0.4	645	25.5	656	11.7
Fracture	50	1.6	254	10.1	304	5.4
Rheumatoid Arthritis	136	4.4	72	2.9	208	3.7
Osteonecrosis	36	1.2	33	1.3	69	1.2
Other Inflammatory Arthritis	34	1.1	29	1.1	63	1.1
Other	20	0.7	57	2.3	77	1.4
TOTAL	3073	100.0	2526	100.0	5599	100.0

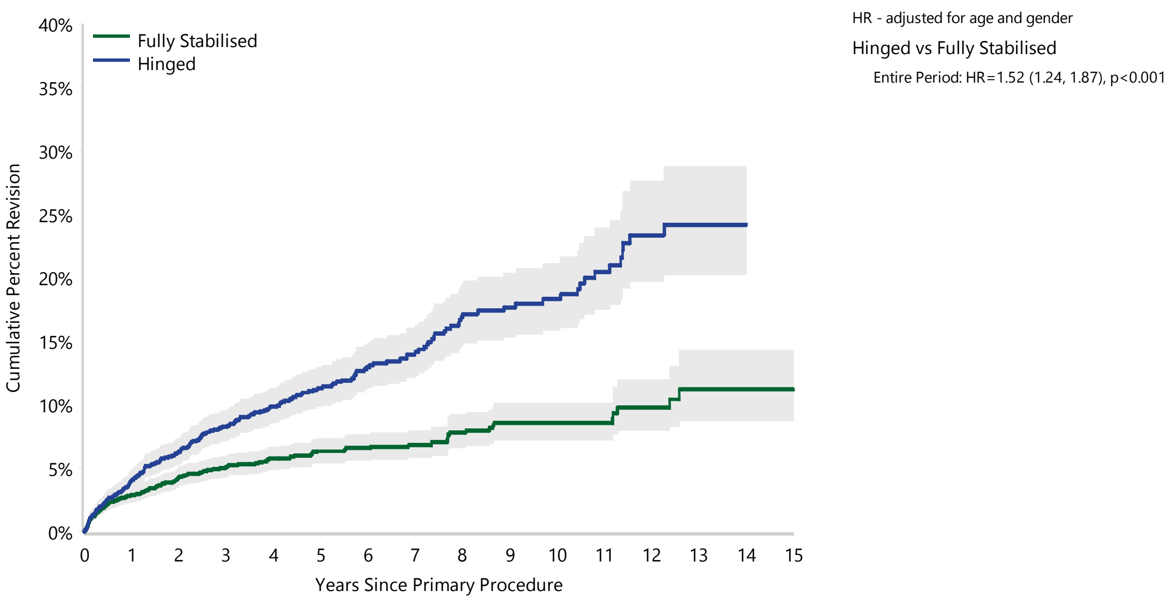
Note: Restricted to modern prostheses

Table KT40 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	181	3073	2.9 (2.3, 3.5)	5.1 (4.3, 6.0)	6.3 (5.4, 7.4)	6.8 (5.8, 7.9)	8.5 (7.2, 10.1)	11.2 (8.7, 14.3)
Hinged	251	2526	4.0 (3.3, 4.9)	8.3 (7.1, 9.6)	11.3 (9.8, 13.0)	14.2 (12.3, 16.3)	18.3 (15.8, 21.2)	
TOTAL	432	5599						

Note: Restricted to modern prostheses

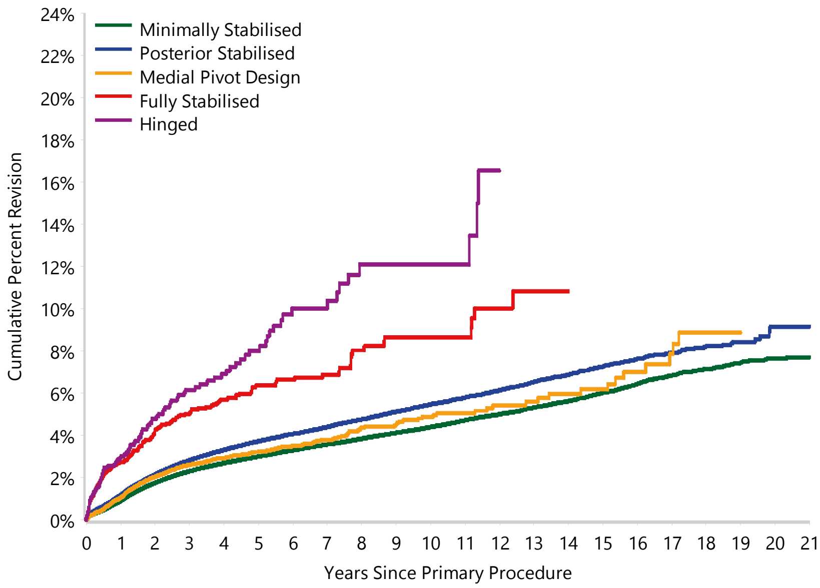
Figure KT40 Cumulative Percent Revision of Primary Total Knee Replacement by Stability (All Diagnoses)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	15 Yrs
Fully Stabilised	3073	2661	1928	1285	751	313	40
Hinged	2526	2005	1235	739	447	223	36

Note: Restricted to modern prostheses

Figure KT41 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=1.42 (1.33, 1.53), p<0.001
- 6Mth - 1Yr: HR=1.21 (1.12, 1.31), p<0.001
- 1Yr - 2Yr: HR=1.12 (1.05, 1.19), p<0.001
- 2Yr+: HR=1.24 (1.20, 1.29), p<0.001

Medial Pivot Design vs Minimally Stabilised
- Entire Period: HR=1.10 (1.02, 1.17), p=0.009

Fully Stabilised vs Minimally Stabilised
- 0 - 6Mth: HR=4.56 (3.50, 5.93), p<0.001
- 6Mth - 1.5Yr: HR=1.36 (0.95, 1.95), p=0.093
- 1.5Yr+: HR=1.88 (1.51, 2.36), p<0.001

Hinged vs Minimally Stabilised
- Entire Period: HR=2.92 (2.40, 3.56), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Minimally Stabilised	500931	450179	358851	274538	111873	29931	2176
Posterior Stabilised	172835	161348	136885	109542	46125	10006	342
Medial Pivot Design	33823	28083	17405	9012	1149	373	39
Fully Stabilised	2786	2423	1758	1168	278	31	4
Hinged	1436	1173	717	417	108	14	0

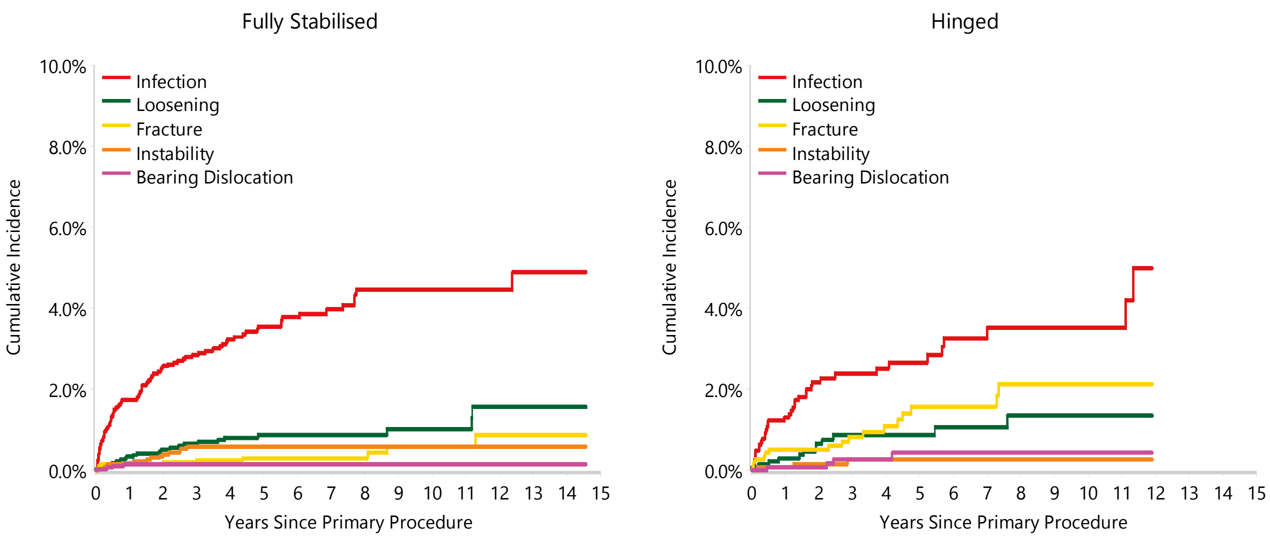
Note: Restricted to modern prostheses

Table KT41 Revision Diagnosis of Primary Total Knee Replacement by Stability (Primary Diagnosis OA)

Revision Diagnosis	Fully Stabilised Number	Fully Stabilised % Primaries Revised	Fully Stabilised % Revisions	Hinged Number	Hinged % Primaries Revised	Hinged % Revisions
Infection	95	3.4	57.9	38	2.6	38.4
Loosening	23	0.8	14.0	12	0.8	12.1
Fracture	10	0.4	6.1	17	1.2	17.2
Instability	14	0.5	8.5	3	0.2	3.0
Bearing Dislocation	4	0.1	2.4	4	0.3	4.0
Patella Erosion	4	0.1	2.4	4	0.3	4.0
Other	14	0.5	8.5	21	1.5	21.2
N Revision	164	5.9	100.0	99	6.9	100.0
N Primary	2786			1436		

Note: Restricted to modern prostheses

Figure KT42 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by Stability (Primary Diagnosis OA)



Note: Restricted to modern prostheses

PATIENT REPORTED OUTCOME MEASURES - PROSTHESIS CHARACTERISTICS

PROMs and Stability

PROMs are reported with respect to selected prosthesis characteristics. Patient satisfaction (the proportion of patients who are satisfied or very satisfied) following knee replacement ranges from 83% to 86% when prosthesis stability is considered (Table KT42 and Figure KT43).

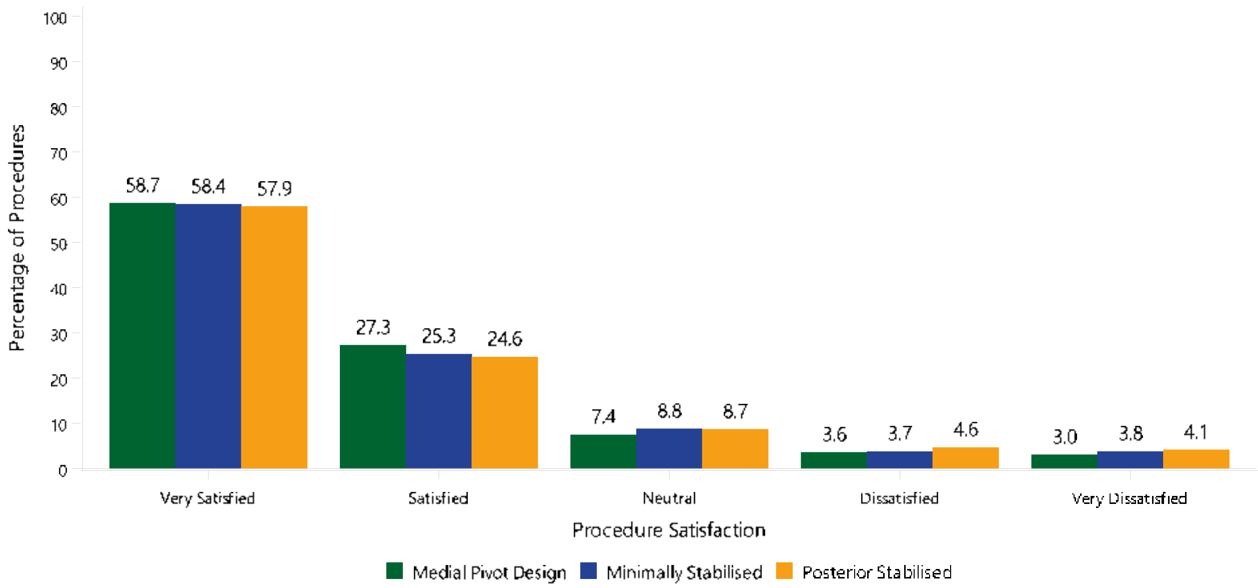
For all stability types, patient-reported change (the proportion of patients who are much better or a little better) is over 92% (Table KT43 and Figure KT44).

Table KT42 Procedure Satisfaction in Primary Total Knee Replacement by Stability (Primary Diagnosis OA)

	Very Satisfied			Satisfied			Neutral			Dissatisfied			Very Dissatisfied			TOTAL		
Stability	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%
Medial Pivot Design	426	58.7	5.5	198	27.3	5.9	54	7.4	4.7	26	3.6	5.1	22	3.0	4.4	726	100.0	5.5
Minimally Stabilised	6146	58.4	79.7	2661	25.3	79.6	925	8.8	80.5	393	3.7	77.1	396	3.8	79.4	10521	100.0	79.7
Posterior Stabilised	1136	57.9	14.7	483	24.6	14.5	170	8.7	14.8	91	4.6	17.8	81	4.1	16.2	1961	100.0	14.8
TOTAL	7708	58.4	100.0	3342	25.3	100.0	1149	8.7	100.0	510	3.9	100.0	499	3.8	100.0	13208	100.0	100.0

Note: Restricted to modern prostheses

Figure KT43 Procedure Satisfaction in Primary Total Knee Replacement by Stability (Primary Diagnosis OA)



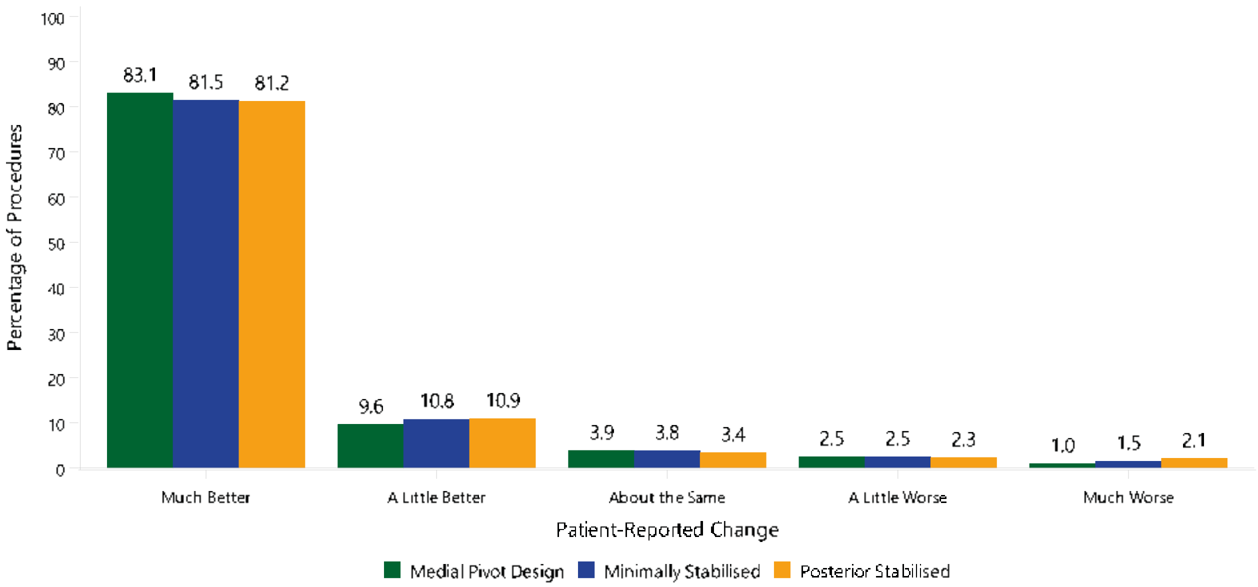
Note: Restricted to modern prostheses

Table KT43 Patient-Reported Change after Primary Total Knee Replacement by Stability (Primary Diagnosis OA)

	Much Better			A Little Better			About the Same			A Little Worse			Much Worse			TOTAL		
Stability	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%
Medial Pivot Design	603	83.1	5.6	70	9.6	4.9	28	3.9	5.6	18	2.5	5.6	7	1.0	3.4	726	100.0	5.5
Minimally Stabilised	8569	81.5	79.6	1132	10.8	79.9	404	3.8	81.0	260	2.5	80.5	155	1.5	76.0	10520	100.0	79.7
Posterior Stabilised	1592	81.2	14.8	214	10.9	15.1	67	3.4	13.4	45	2.3	13.9	42	2.1	20.6	1960	100.0	14.8
TOTAL	10764	81.5	100.0	1416	10.7	100.0	499	3.8	100.0	323	2.4	100.0	204	1.5	100.0	13206	100.0	100.0

Note: Restricted to modern prostheses

Figure KT44 Patient-Reported Change after Primary Total Knee Replacement by Stability (Primary Diagnosis OA)



Note: Restricted to modern prostheses

Patella Resurfacing

Primary total knee replacement procedures with patella resurfacing have a lower rate of revision compared to procedures without patella resurfacing. This is both overall and for each of the three common stability types (Table KT44 and Figure KT45).

When resurfacing the patella, the rate of revision is lower for minimally stabilised compared to posterior stabilised prostheses. Posterior stabilised without patella resurfacing has the highest rate of revision (Table KT45 and Figure KT46).

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 (Figure KT47).

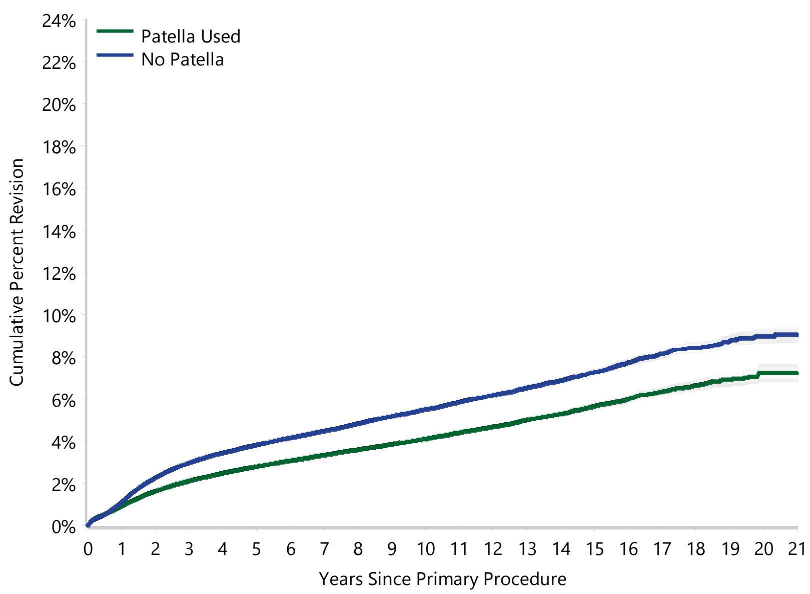
Outcomes related to the use of patella resurfacing vary depending on the type of prosthesis used.

Table KT44 Cumulative Percent Revision of Primary Total Knee Replacement by Patella Usage (Primary Diagnosis OA)

Patella Usage	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Patella Used	12294	430124	0.9 (0.9, 0.9)	2.1 (2.1, 2.2)	2.8 (2.7, 2.8)	4.1 (4.0, 4.2)	5.7 (5.5, 5.8)	7.2 (6.8, 7.6)
No Patella	12957	281854	1.1 (1.1, 1.1)	3.0 (2.9, 3.0)	3.8 (3.7, 3.9)	5.5 (5.4, 5.6)	7.3 (7.1, 7.4)	9.0 (8.6, 9.3)
TOTAL	25251	711978						

Note: Restricted to modern prostheses

Figure KT45 Cumulative Percent Revision of Primary Total Knee Replacement by Patella Usage (Primary Diagnosis OA)



HR - adjusted for age and gender
No Patella vs Patella Used
0 - 6Mth: HR=0.95 (0.89, 1.02), p=0.152
6Mth - 1Yr: HR=1.50 (1.39, 1.61), p<0.001
1Yr - 1.5Yr: HR=1.69 (1.58, 1.81), p<0.001
1.5Yr - 2Yr: HR=1.54 (1.42, 1.67), p<0.001
2Yr - 3.5Yr: HR=1.42 (1.33, 1.50), p<0.001
3.5Yr+: HR=1.21 (1.16, 1.27), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Patella Used	430124	380291	290646	211627	76202	17826	930
No Patella	281854	263077	225106	183174	83407	22553	1634

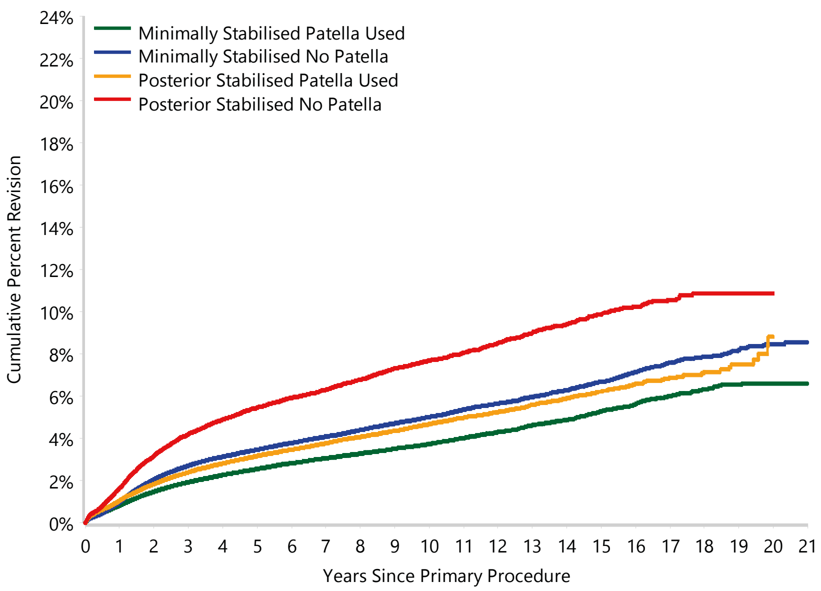
Note: Restricted to modern prostheses

Table KT45 Cumulative Percent Revision of Primary Total Knee Replacement by Stability and Patella Usage (Primary Diagnosis OA)

Stability	Patella Usage	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Minimally Stabilised	Patella Used	6925	271492	0.8 (0.8, 0.9)	1.9 (1.9, 2.0)	2.5 (2.5, 2.6)	3.7 (3.6, 3.8)	5.3 (5.1, 5.5)	6.6 (6.2, 7.0)
	No Patella	9596	229439	1.0 (0.9, 1.0)	2.7 (2.6, 2.8)	3.5 (3.4, 3.5)	5.0 (4.9, 5.1)	6.7 (6.5, 6.9)	8.5 (8.1, 8.8)
Posterior Stabilised	Patella Used	4800	133855	1.1 (1.0, 1.1)	2.4 (2.3, 2.5)	3.2 (3.1, 3.3)	4.7 (4.5, 4.8)	6.2 (6.0, 6.5)	8.8 (7.5, 10.4)
	No Patella	2803	38980	1.6 (1.5, 1.8)	4.2 (4.0, 4.4)	5.5 (5.2, 5.7)	7.7 (7.4, 8.0)	9.9 (9.5, 10.3)	10.9 (10.3, 11.5)
Medial Pivot Design	Patella Used	394	21593	0.9 (0.8, 1.0)	2.0 (1.8, 2.3)	2.5 (2.3, 2.8)	3.5 (2.9, 4.2)	6.1 (3.7, 10.0)	
	No Patella	464	12230	1.3 (1.1, 1.5)	3.5 (3.1, 3.8)	4.2 (3.8, 4.7)	6.3 (5.6, 7.2)	7.3 (6.3, 8.6)	
TOTAL		24982	707589						

Note: Restricted to modern prostheses

Figure KT46 Cumulative Percent Revision of Primary Total Knee Replacement by Stability and Patella Usage (Primary Diagnosis OA)



HR - adjusted for age and gender

Minimally Stabilised Patella Used vs Minimally Stabilised No Patella
0 - 3Mth: HR=1.10 (1.00, 1.21), p=0.041
3Mth - 6Mth: HR=0.93 (0.82, 1.05), p=0.244
6Mth - 1.5Yr: HR=0.64 (0.60, 0.68), p<0.001
1.5Yr - 3.5Yr: HR=0.70 (0.66, 0.74), 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=0.82 (0.79, 0.85), p<0.001

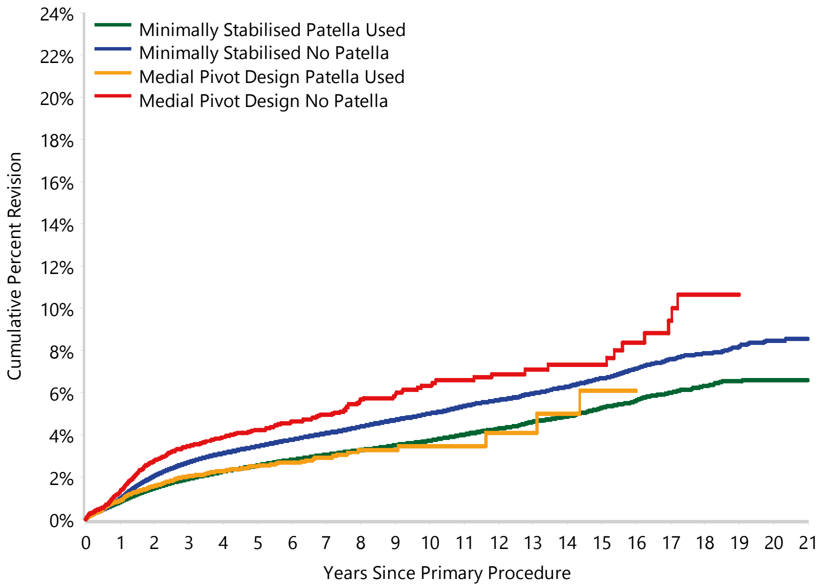
Minimally Stabilised No Patella vs Posterior Stabilised No Patella
0 - 1Yr: HR=0.60 (0.55, 0.66), p<0.001
1Yr - 2Yr: HR=0.68 (0.62, 0.74), p<0.001
2Yr - 3.5Yr: HR=0.62 (0.56, 0.68), p<0.001
3.5Yr - 5Yr: HR=0.59 (0.52, 0.67), p<0.001
5Yr+: HR=0.71 (0.66, 0.77), p<0.001

Posterior Stabilised Patella Used vs Posterior Stabilised No Patella
Entire Period: HR=0.61 (0.58, 0.64), p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Minimally Stabilised	Patella Used	271492	236294	176256	126232	45711	11399	734
	No Patella	229439	213885	182595	148306	66162	18532	1442
Posterior Stabilised	Patella Used	133855	123917	102798	79867	29884	6323	191
	No Patella	38980	37431	34087	29675	16241	3683	151

Note: Restricted to modern prostheses

Figure KT47 Cumulative Percent Revision of Primary Total Knee Replacement by Stability and Patella Usage (Primary Diagnosis OA)



HR - adjusted for age and gender

Minimally Stabilised Patella Used vs
Minimally Stabilised No Patella
0 - 3Mth: HR=1.13 (1.03, 1.25), p=0.012
3Mth - 6Mth: HR=0.92 (0.80, 1.05), p=0.224
6Mth - 1.5Yr: HR=0.63 (0.59, 0.67), p<0.001
1.5Yr - 3.5Yr: HR=0.68 (0.65, 0.73), p<0.001
3.5Yr+: HR=0.84 (0.80, 0.89), p<0.001

Minimally Stabilised Patella Used vs
Medial Pivot Design Patella Used
Entire Period: HR=1.00 (0.90, 1.11), p=0.982

Minimally Stabilised No Patella vs
Medial Pivot Design No Patella
Entire Period: HR=0.80 (0.73, 0.88), p<0.001

Medial Pivot Design Patella Used vs
Medial Pivot Design No Patella
Entire Period: HR=0.61 (0.53, 0.70), p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Minimally Stabilised	Patella Used	271492	236294	176256	126232	45711	11399	734
	No Patella	229439	213885	182595	148306	66162	18532	1442
Medial Pivot Design	Patella Used	21593	17411	9832	4444	360	78	2
	No Patella	12230	10672	7573	4568	789	295	37

Note: Restricted to modern prostheses

PATIENT REPORTED OUTCOME MEASURES – PROSTHESIS CHARACTERISTICS

PROMs and Patella Usage

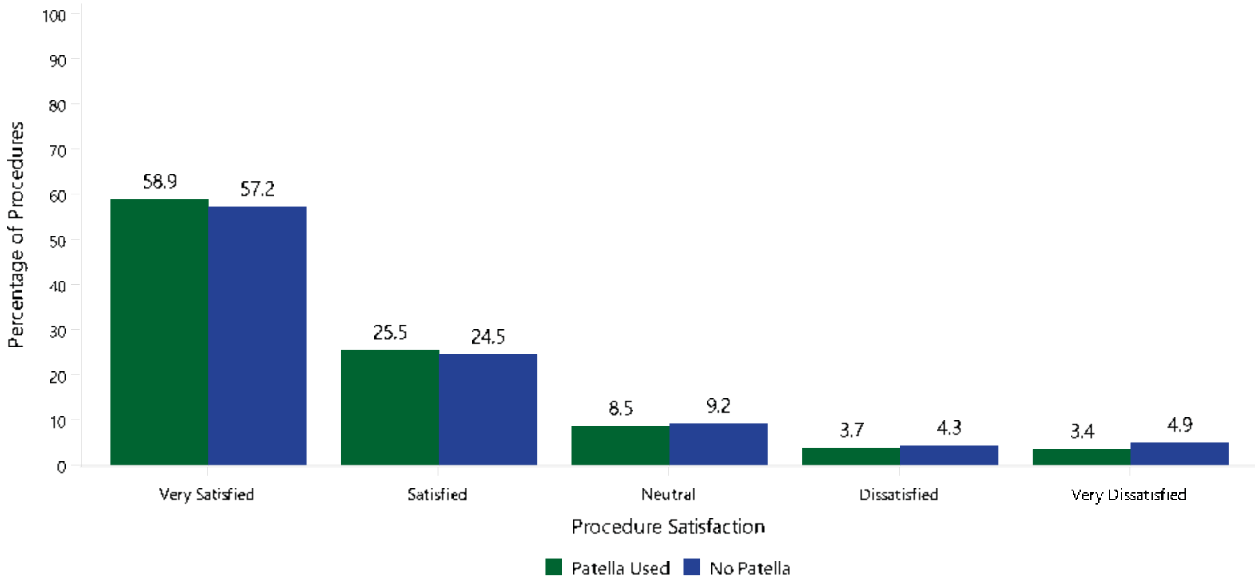
Post-operative satisfaction and patient-reported change are similar when analysed by patella component use (Table KT46, Figure KT48, Table KT47 and Figure KT49).

Table KT46 Procedure Satisfaction in Primary Total Knee Replacement by Patella Usage (Primary Diagnosis OA)

	Very Satisfied			Satisfied			Neutral			Dissatisfied			Very Dissatisfied			TOTAL		
Patella Usage	N	Row%	Col%	N	Row %	Col%	N	Row %	Col%	N	Row %	Col%	N	Row %	Col%	N	Row%	Col%
Patella Used	6046	58.9	77.6	2615	25.5	77.8	878	8.5	75.8	381	3.7	74.4	353	3.4	70.0	10273	100.0	77.1
No Patella	1749	57.2	22.4	748	24.5	22.2	280	9.2	24.2	131	4.3	25.6	151	4.9	30.0	3059	100.0	22.9
TOTAL	7795	58.5	100.0	3363	25.2	100.0	1158	8.7	100.0	512	3.8	100.0	504	3.8	100.0	13332	100.0	100.0

Note: Restricted to modern prostheses

Figure KT48 Procedure Satisfaction in Primary Total Knee Replacement by Patella Usage (Primary Diagnosis OA)



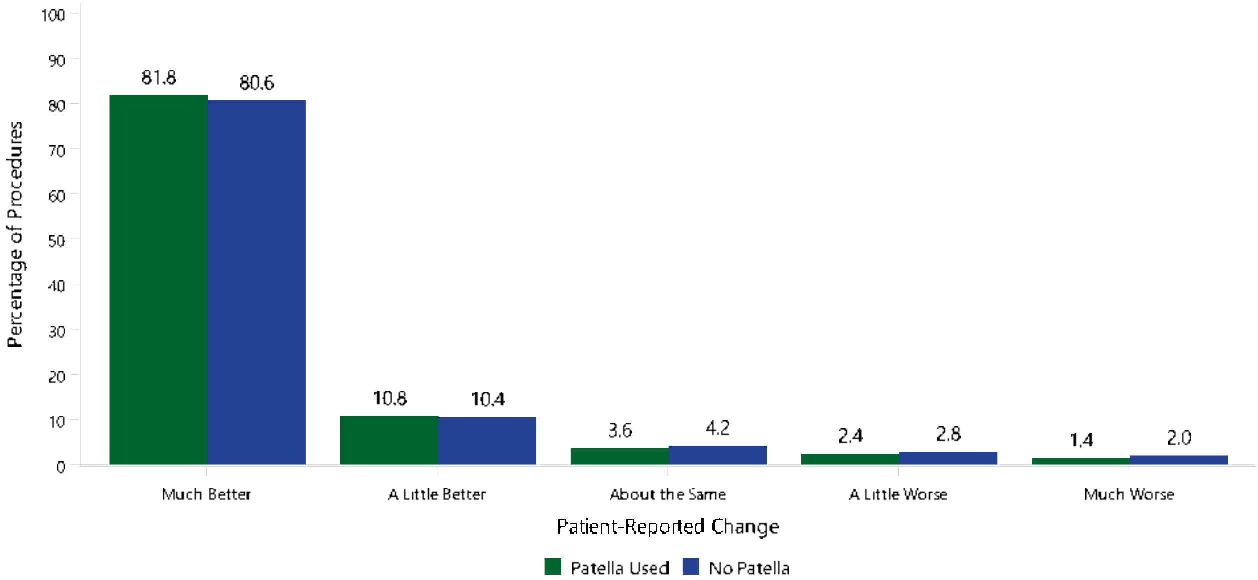
Note: Restricted to modern prostheses

Table KT47 Patient-Reported Change after Primary Total Knee Replacement by Patella Usage (Primary Diagnosis OA)

	Much Better			A Little Better			About the Same			A Little Worse			Much Worse			TOTAL		
Patella Usage	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%
Patella Used	8406	81.8	77.3	1105	10.8	77.6	373	3.6	74.6	243	2.4	73.9	144	1.4	70.2	10271	100.0	77.1
No Patella	2466	80.6	22.7	319	10.4	22.4	127	4.2	25.4	86	2.8	26.1	61	2.0	29.8	3059	100.0	22.9
TOTAL	10872	81.6	100.0	1424	10.7	100.0	500	3.8	100.0	329	2.5	100.0	205	1.5	100.0	13330	100.0	100.0

Note: Restricted to modern prostheses

Figure KT49 Patient-Reported Change after Primary Total Knee Replacement by Patella Usage (Primary Diagnosis OA)



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 cemented and cementless fixation. Cementless fixation has a higher rate of revision compared to cemented fixation (Table KT48 and Figure KT50).

When a posterior stabilised knee is used, cemented fixation has a lower initial rate of revision compared to hybrid and cementless fixation. After 1.5 years, cementless fixation has a lower rate of revision than cemented fixation. Cementless fixation has a lower rate of revision than hybrid fixation (Table KT49 and Figure KT51).

Cementing the tibial component gives the best outcome for minimally stabilised knee replacement.

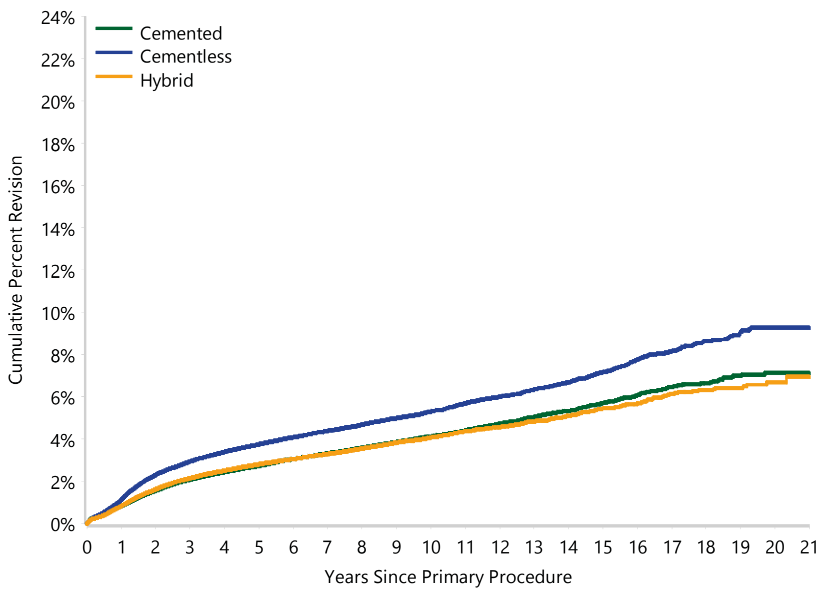
When a medial pivot design prosthesis is used, there is no difference in rate of revision between cemented and hybrid fixation. Cementless fixation has an early higher rate of revision compared to hybrid and cemented fixation, but this changes to a lower rate after 2 years and 3.5 years for these fixation methods, respectively (Table KT50 and Figure KT52).

Table KT48 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	6965	242582	0.8 (0.8, 0.9)	2.1 (2.0, 2.1)	2.7 (2.7, 2.8)	4.1 (4.0, 4.2)	5.7 (5.5, 5.9)	7.1 (6.7, 7.5)
Cementless	5027	114394	1.1 (1.1, 1.2)	2.9 (2.8, 3.0)	3.7 (3.6, 3.9)	5.3 (5.1, 5.5)	7.2 (6.9, 7.4)	9.3 (8.8, 9.8)
Hybrid	4483	143849	0.8 (0.8, 0.9)	2.2 (2.1, 2.2)	2.8 (2.7, 2.9)	4.1 (3.9, 4.2)	5.4 (5.2, 5.7)	6.7 (6.2, 7.2)
TOTAL	16475	500825						

Note: Restricted to modern prostheses
Excluding cementless Genesis Oxinium femoral prostheses

Figure KT50 Cumulative Percent Revision of Minimally Stabilised Primary Total Knee Replacement by Fixation (Primary Diagnosis OA)



HR - adjusted for age and gender

Cementless vs Cemented
0 - 6Mth: HR=1.11 (1.01, 1.22), p=0.028
6Mth - 1.5Yr: HR=1.47 (1.38, 1.57), p<0.001
1.5Yr+: HR=1.15 (1.10, 1.21), p<0.001

Cementless vs Hybrid
Entire Period: HR=1.26 (1.21, 1.32), p<0.001

Hybrid vs Cemented
Entire Period: HR=0.96 (0.93, 1.00), p=0.048

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Cemented	242582	216453	166129	118834	43924	11156	925
Cementless	114394	101990	84147	71578	35623	10413	647
Hybrid	143849	131644	108514	84066	32279	8328	604

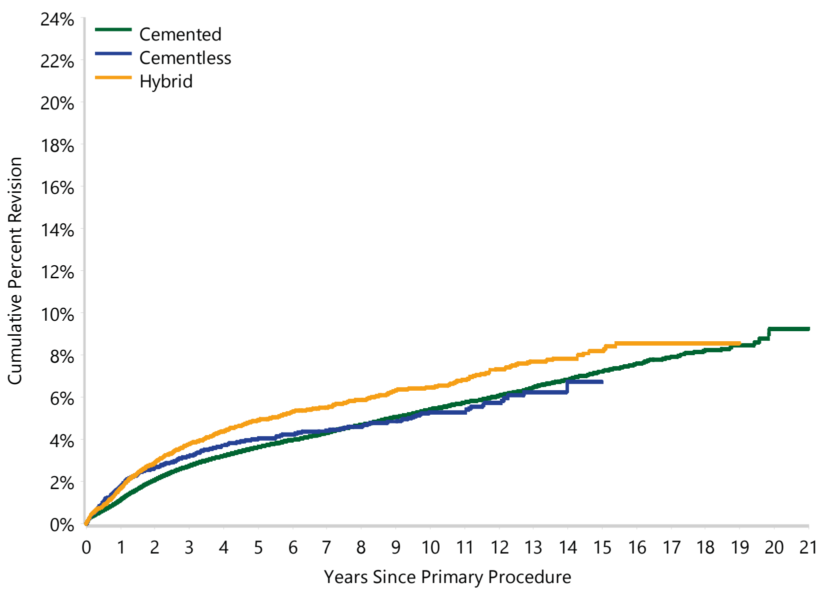
Note: Restricted to modern prostheses

Table KT49 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	6717	155992	1.1 (1.1, 1.2)	2.7 (2.7, 2.8)	3.6 (3.5, 3.7)	5.4 (5.3, 5.6)	7.2 (7.0, 7.4)	9.2 (8.4, 10.2)
Cementless	279	6202	1.8 (1.5, 2.2)	3.2 (2.8, 3.7)	4.0 (3.6, 4.6)	5.3 (4.7, 6.0)	6.7 (5.5, 8.1)	
Hybrid	607	10641	1.7 (1.5, 2.0)	3.8 (3.4, 4.2)	4.9 (4.5, 5.4)	6.4 (5.9, 7.0)	8.2 (7.4, 9.0)	
TOTAL	7603	172835						

Note: Restricted to modern prostheses

Figure KT51 Cumulative Percent Revision of Posterior Stabilised Primary Total Knee Replacement by Fixation (Primary Diagnosis OA)



HR - adjusted for age and gender

Cementless vs Cemented

0 - 1.5Yr: HR=1.31 (1.11, 1.56), p=0.001

1.5Yr+: HR=0.71 (0.60, 0.85), p<0.001

Hybrid vs Cemented

0 - 1.5Yr: HR=1.41 (1.23, 1.60), p<0.001

1.5Yr - 2.5Yr: HR=1.12 (0.91, 1.39), p=0.288

2.5Yr - 3Yr: HR=1.41 (1.01, 1.95), p=0.042

3Yr - 6Yr: HR=1.19 (0.99, 1.43), p=0.059

6Yr+: HR=0.84 (0.69, 1.03), p=0.091

Hybrid vs Cementless

Entire Period: HR=1.29 (1.12, 1.48), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Cemented	155992	145781	122984	98073	40528	9151	319
Cementless	6202	5847	5049	4143	1982	76	1
Hybrid	10641	9720	8852	7326	3615	779	22

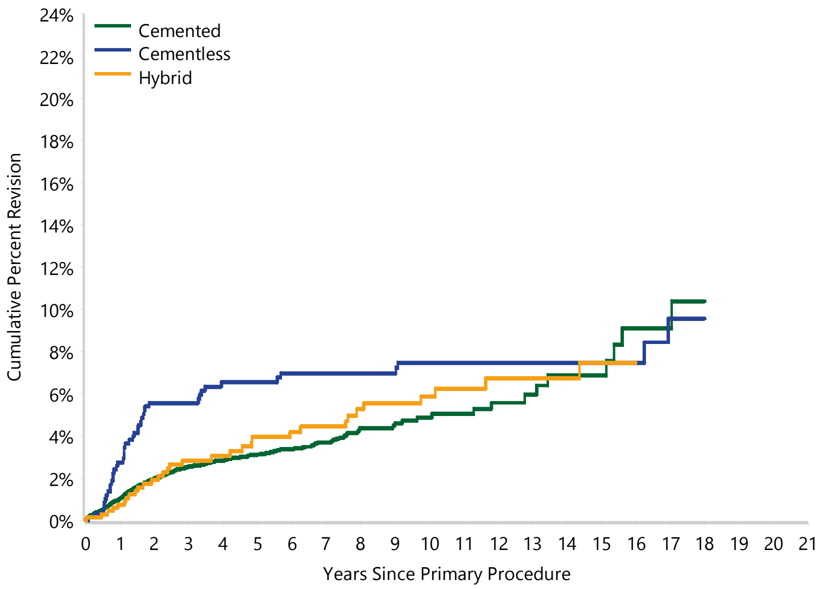
Note: Restricted to modern prostheses

Table KT50 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	782	32550	1.0 (0.9, 1.1)	2.5 (2.3, 2.7)	3.1 (2.9, 3.4)	4.9 (4.2, 5.6)	6.9 (5.3, 8.9)	
Cementless	43	594	2.8 (1.7, 4.5)	5.6 (4.0, 7.8)	6.5 (4.8, 8.9)	7.5 (5.5, 10.0)	7.5 (5.5, 10.0)	
Hybrid	33	679	0.8 (0.3, 1.8)	2.8 (1.8, 4.5)	3.9 (2.6, 6.0)	5.9 (4.1, 8.4)	7.5 (5.1, 10.8)	
TOTAL	858	33823						

Note: Restricted to modern prostheses

Figure KT52 Cumulative Percent Revision of Medial Pivot Design Primary Total Knee Replacement by Fixation (Primary Diagnosis OA)



HR - adjusted for age and gender

Cementless vs Cemented
0 - 1.5Yr: HR=2.59 (1.72, 3.91), p<0.001
1.5Yr - 3.5Yr: HR=2.00 (1.12, 3.58), p=0.019
3.5Yr+: HR=0.43 (0.19, 0.94), p=0.035

Hybrid vs Cemented
Entire Period: HR=1.14 (0.79, 1.64), p=0.480

Cementless vs Hybrid
0 - 9Mth: HR=1.83 (0.89, 3.78), p=0.102
9Mth - 2Yr: HR=2.87 (1.64, 5.02), p<0.001
2Yr+: HR=0.48 (0.24, 0.96), p=0.039

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Cemented	32550	26890	16396	8150	577	140	22
Cementless	594	556	503	443	309	126	16
Hybrid	679	637	506	419	263	107	1

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 338,604 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 KT51 and Figure KT53). The major reason for this difference is a reduced cumulative incidence of loosening (Figure KT54).

The difference between XLPE and non XLPE is more evident in younger patients. The 15 year cumulative percent revision rate for patients aged <65 years for XLPE is 7.0% and for non XLPE is 10.1%. For patients aged ≥65 years, the 15 year cumulative percent revision for XLPE is 3.8% and for non XLPE is 5.0% (Table KT52 and Figure KT55).

There are prosthesis-specific differences when XLPE is used. When considering the XLPE sub-types there is no difference when XLPE is compared to XLPE with antioxidant (Table KT53, Figure KT56 and Figure KT57).

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' 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.

There are 67,634 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 KT54 and Figure KT58). There are more revisions for loosening and for patella pain where an alternate surface femoral component is used (Figure KT59).

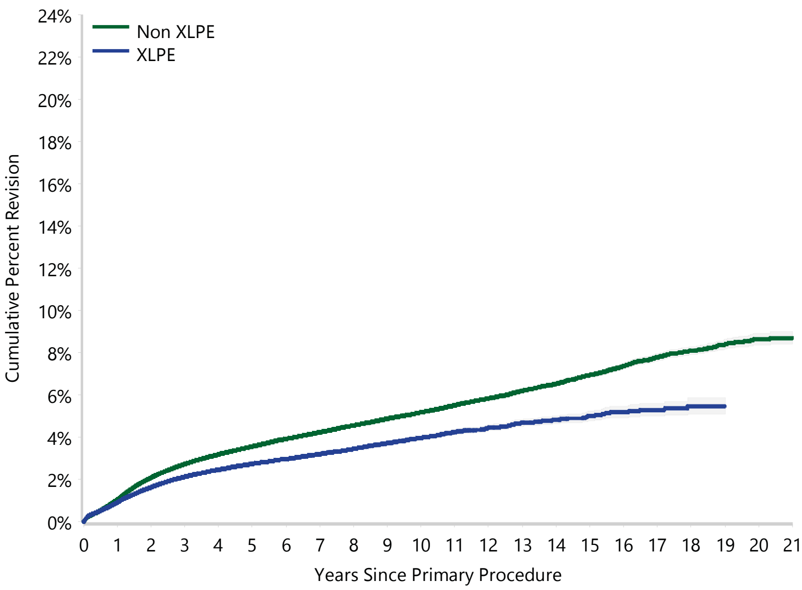
There is variation in the revision rate depending on the type of material used in the alternate surface. In 2021, there were 3 femoral prostheses used that used a zirconia-based alternate surface, 12 that used a TiN surface, and 6 with a ceramicised metal surface. Zirconia-based alternate surface femoral components had a lower rate of revision compared to those with a TiN surface and compared to ceramicised metal after 6 months. TiN alternate surface components had a higher rate of revision compared to ceramicised metal components (Table KT55 and Figure KT60).

Table KT51 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	16956	373040	1.0 (1.0, 1.1)	2.7 (2.7, 2.8)	3.6 (3.5, 3.6)	5.2 (5.1, 5.3)	6.9 (6.8, 7.1)	8.7 (8.4, 8.9)
XLPE	8288	338604	0.9 (0.9, 1.0)	2.1 (2.1, 2.2)	2.7 (2.7, 2.8)	4.0 (3.9, 4.1)	5.0 (4.8, 5.2)	
TOTAL	**25244**	**711644**						

Note: Restricted to modern prostheses
Includes 69,893 procedures using XLPE with antioxidant
Excludes 334 procedures with unknown polyethylene

Figure KT53 Cumulative Percent Revision of Primary Total Knee Replacement by Polyethylene Type (Primary Diagnosis OA)

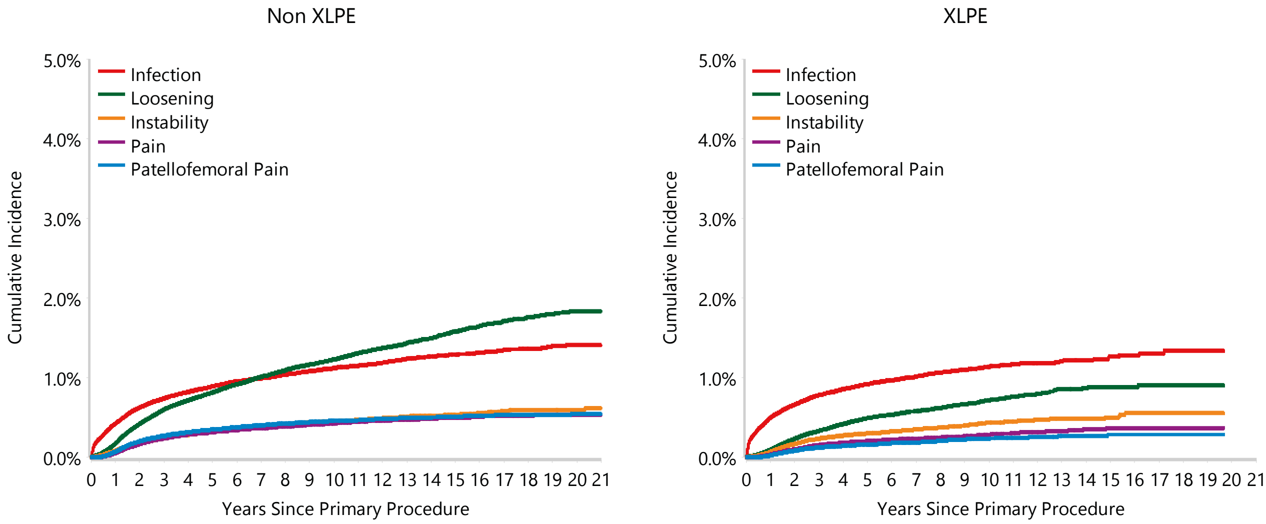


HR - adjusted for age and gender
Non XLPE vs XLPE
0 - 3Mth: HR=0.94 (0.87, 1.02), p=0.133
3Mth - 6Mth: HR=1.19 (1.06, 1.33), p=0.002
6Mth - 9Mth: HR=1.42 (1.28, 1.57), p<0.001
9Mth - 1Yr: HR=1.22 (1.10, 1.35), p<0.001
1Yr - 1.5Yr: HR=1.55 (1.44, 1.66), p<0.001
1.5Yr+: HR=1.38 (1.33, 1.43), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Non XLPE	373040	352792	306499	256081	127014	36436	2560
XLPE	338604	290289	209079	138596	32519	3919	1

Note: Restricted to modern prostheses

Figure KT54 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by Polyethylene Type (Primary Diagnosis OA)



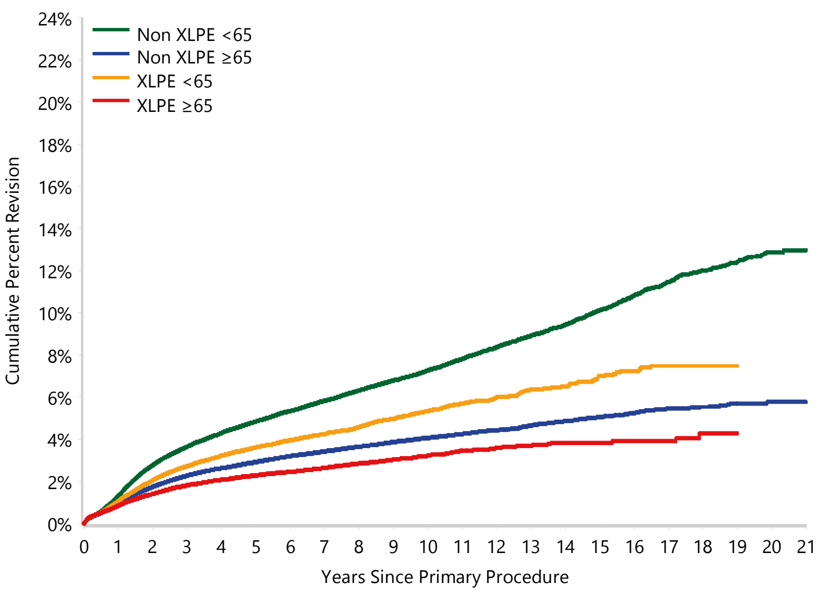
Note: Restricted to modern prostheses

Table KT52 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		**16956**	**373040**	**1.0 (1.0, 1.1)**	**2.7 (2.7, 2.8)**	**3.6 (3.5, 3.6)**	**5.2 (5.1, 5.3)**	**6.9 (6.8, 7.1)**	**8.7 (8.4, 8.9)**
	<65	8362	123543	1.3 (1.2, 1.4)	3.6 (3.5, 3.8)	4.8 (4.7, 5.0)	7.3 (7.1, 7.4)	10.1 (9.9, 10.4)	12.9 (12.4, 13.4)
	≥65	8594	249497	0.9 (0.9, 1.0)	2.3 (2.2, 2.3)	2.9 (2.9, 3.0)	4.1 (4.0, 4.2)	5.0 (4.9, 5.2)	5.8 (5.5, 6.0)
XLPE		**8288**	**338604**	**0.9 (0.9, 1.0)**	**2.1 (2.1, 2.2)**	**2.7 (2.7, 2.8)**	**4.0 (3.9, 4.1)**	**5.0 (4.8, 5.2)**	
	<65	3749	113851	1.1 (1.0, 1.1)	2.7 (2.6, 2.8)	3.6 (3.5, 3.7)	5.3 (5.1, 5.5)	7.0 (6.6, 7.5)	
	≥65	4539	224753	0.8 (0.8, 0.9)	1.8 (1.8, 1.9)	2.3 (2.2, 2.4)	3.2 (3.1, 3.3)	3.8 (3.6, 4.0)	
TOTAL		25244	711644						

Note: Restricted to modern prostheses
Includes 69,893 procedures using XLPE with antioxidant
Excludes 334 procedures with unknown polyethylene

Figure KT55 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=1.02 (0.91, 1.14), p=0.721
3Mth - 9Mth: HR=1.56 (1.43, 1.71), p<0.001
9Mth - 2Yr: HR=1.81 (1.71, 1.91), p<0.001
2Yr - 3.5Yr: HR=1.65 (1.54, 1.77), p<0.001
3.5Yr - 6Yr: HR=1.95 (1.82, 2.10), p<0.001
6Yr - 8.5Yr: HR=2.16 (1.98, 2.36), p<0.001
8.5Yr - 9.5Yr: HR=2.03 (1.73, 2.39), p<0.001
9.5Yr - 11.5Yr: HR=2.66 (2.34, 3.02), p<0.001
11.5Yr - 12.5Yr: HR=3.72 (2.92, 4.73), p<0.001
12.5Yr - 13Yr: HR=1.85 (1.37, 2.51), p<0.001
13Yr - 17: HR=3.38 (2.87, 3.98), p<0.001
17+: HR=5.55 (3.23, 9.53), p<0.001

Non XLPE <65 vs XLPE <65
0 - 3Mth: HR=0.90 (0.80, 1.01), p=0.066
3Mth - 1Yr: HR=1.41 (1.31, 1.53), p<0.001
1Yr - 1.5Yr: HR=1.59 (1.45, 1.73), p<0.001
1.5Yr - 2Yr: HR=1.39 (1.26, 1.53), p<0.001
2Yr - 2.5Yr: HR=1.22 (1.09, 1.36), p<0.001
2.5Yr - 5Yr: HR=1.36 (1.26, 1.47), p<0.001
5Yr - 8.5Yr: HR=1.49 (1.36, 1.63), p<0.001
8.5Yr - 13Yr: HR=1.66 (1.46, 1.89), p<0.001
13Yr - 16Yr: HR=2.12 (1.72, 2.62), p<0.001
16Yr+: HR=2.67 (1.87, 3.80), p<0.001

Non XLPE ≥65 vs XLPE ≥65
0 - 6Mth: HR=0.94 (0.88, 1.02), p=0.140
6Mth - 1Yr: HR=1.31 (1.20, 1.44), p<0.001
1Yr+: HR=1.37 (1.31, 1.44), p<0.001

XLPE <65 vs XLPE ≥65
0 - 6Mth: HR=1.07 (0.99, 1.16), p=0.097
6Mth - 1.5Yr: HR=1.59 (1.47, 1.71), p<0.001
1.5Yr+: HR=1.82 (1.71, 1.93), p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Non XLPE	<65	123543	117033	102630	87739	48117	15800	1310
	≥65	249497	235759	203869	168342	78897	20636	1250
XLPE	<65	113851	98084	71677	48804	12646	1712	1
	≥65	224753	192205	137402	89792	19873	2207	0

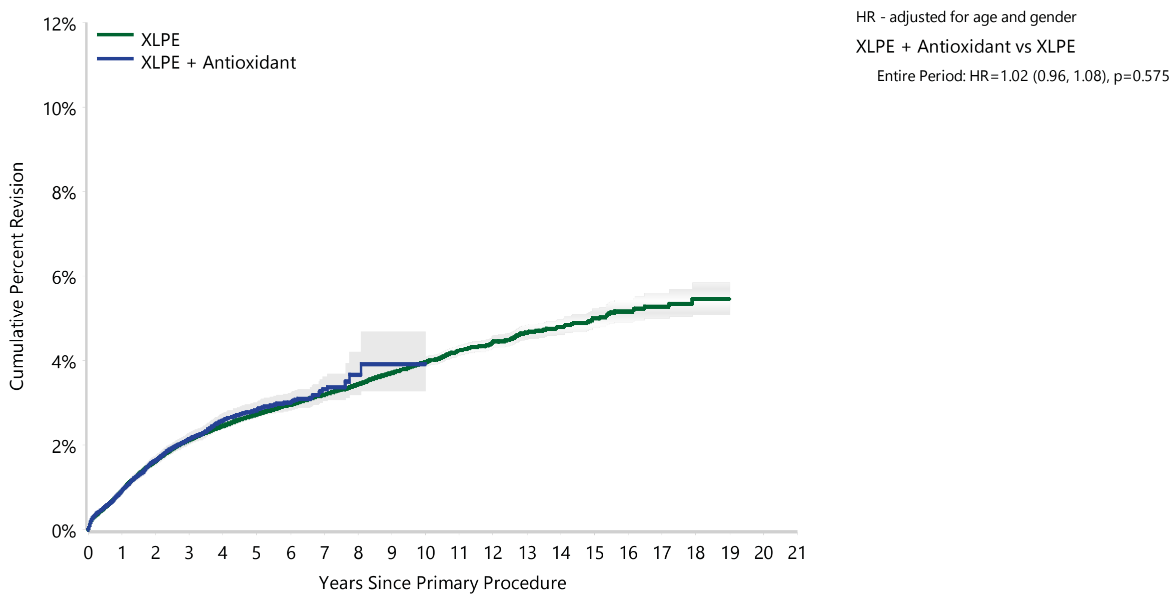
Note: Restricted to modern prostheses

Table KT53 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	7096	268711	0.9 (0.9, 1.0)	2.1 (2.1, 2.2)	2.7 (2.7, 2.8)	4.0 (3.9, 4.1)	5.0 (4.8, 5.2)	
XLPE + Antioxidant	1192	69893	0.9 (0.8, 1.0)	2.1 (2.0, 2.3)	2.8 (2.6, 3.0)	3.9 (3.3, 4.7)		
TOTAL	8288	338604						

Note: Restricted to modern prostheses

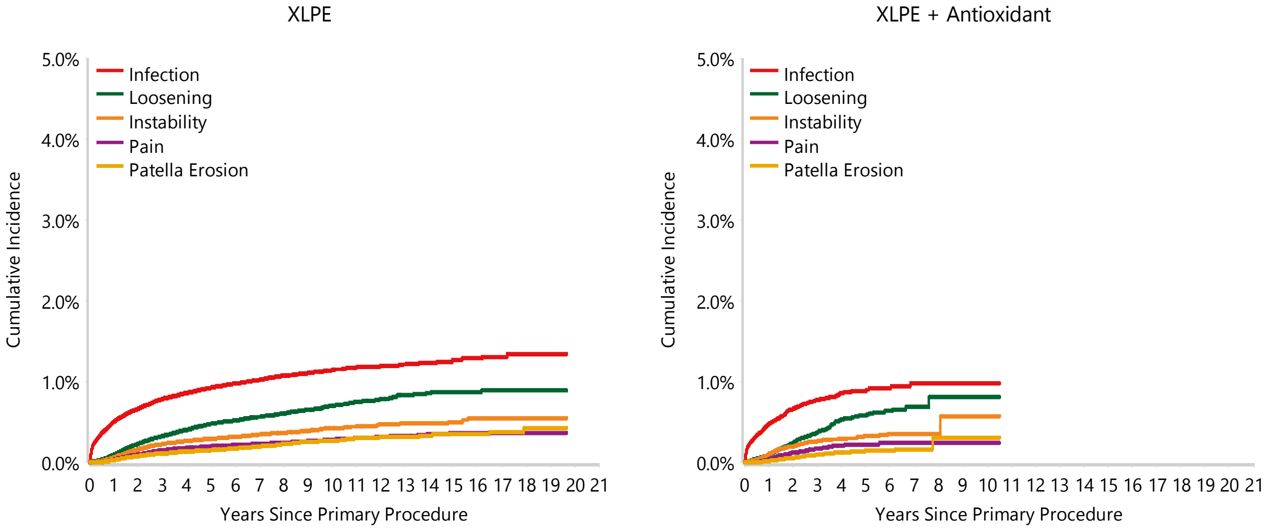
Figure KT56 Cumulative Percent Revision of XLPE Primary Total Knee Replacement by Polyethylene Type (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
XLPE	268711	239474	184657	129307	32430	3919	1
XLPE + Antioxidant	69893	50815	24422	9289	89	0	0

Note: Restricted to modern prostheses

Figure KT57 Cumulative Incidence Revision Diagnosis of XLPE Primary Total Knee Replacement by Polyethylene Type (Primary Diagnosis OA)



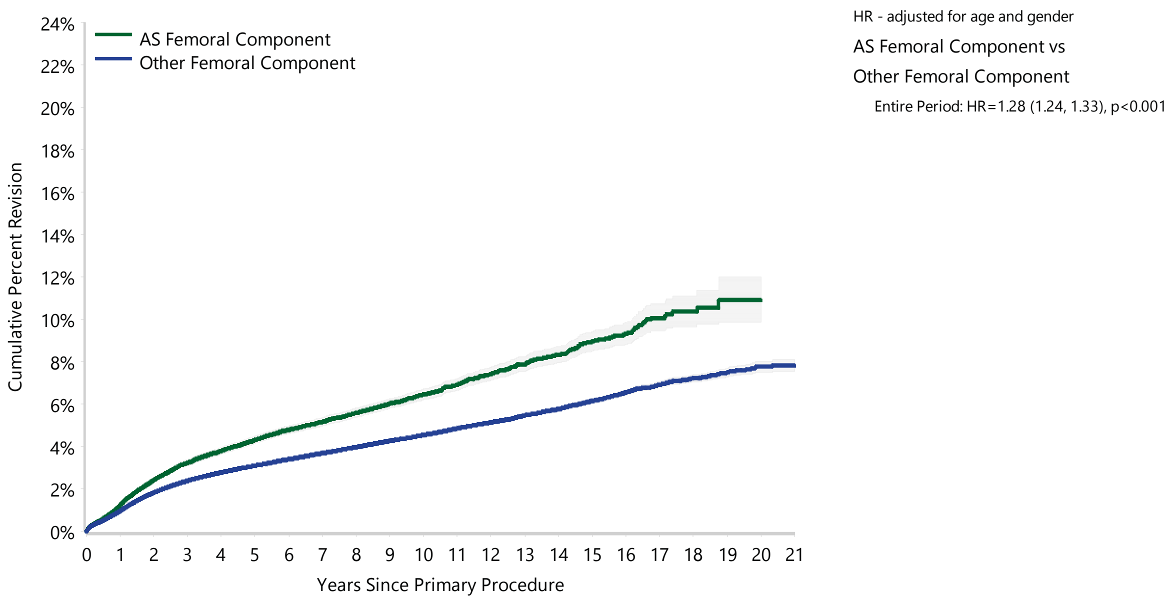
Note: Restricted to modern prostheses

Table KT54 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	3151	67634	1.2 (1.1, 1.3)	3.2 (3.1, 3.4)	4.3 (4.1, 4.5)	6.5 (6.2, 6.7)	9.0 (8.5, 9.4)	10.9 (9.9, 12.0)
Other Femoral Component	22100	644344	1.0 (0.9, 1.0)	2.4 (2.3, 2.4)	3.1 (3.1, 3.2)	4.5 (4.5, 4.6)	6.1 (6.0, 6.3)	7.8 (7.5, 8.0)
TOTAL	25251	711978						

Note: Restricted to modern prostheses

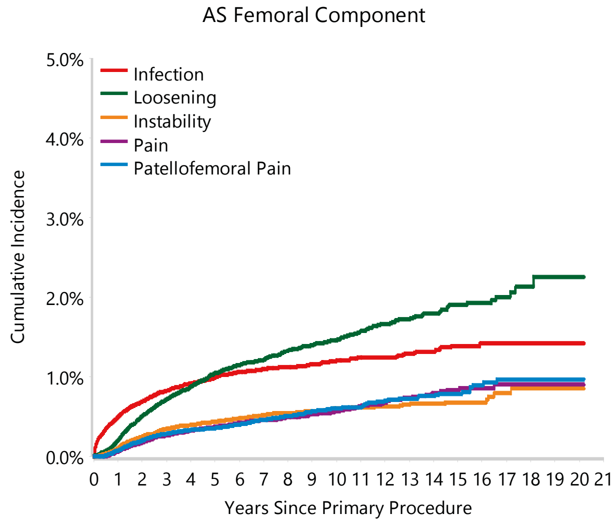
Figure KT58 Cumulative Percent Revision of Primary Total Knee Replacement by Femoral Bearing Surface (Primary Diagnosis OA)

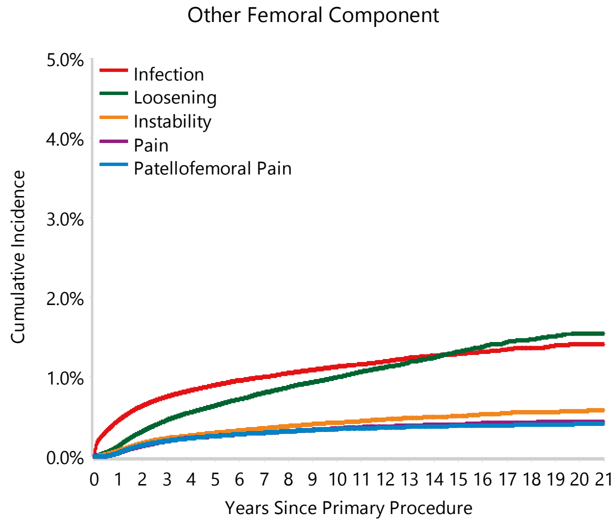


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
AS Femoral Component	67634	60874	47954	36126	12741	2970	61
Other Femoral Component	644344	582494	467798	358675	146868	37409	2503

Note: Restricted to modern prostheses

Figure KT59 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by Femoral Bearing Surface (Primary Diagnosis OA)





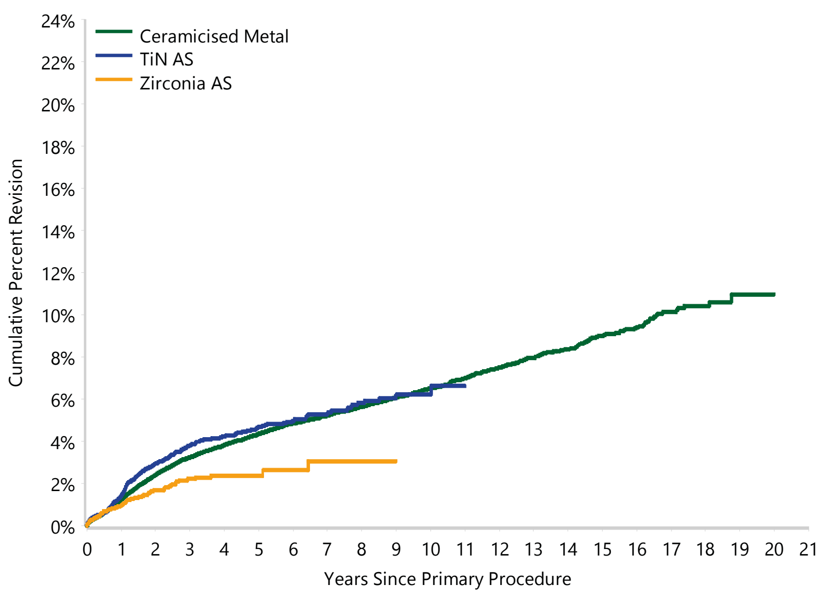
Note: Restricted to modern prostheses

Table KT55 Cumulative Percent Revision of Primary Total Knee Replacement by AS Femoral Material (Primary Diagnosis OA)

AS Femoral Material	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Ceramicised Metal	2825	57233	1.2 (1.1, 1.3)	3.2 (3.1, 3.4)	4.4 (4.2, 4.5)	6.5 (6.3, 6.8)	9.0 (8.6, 9.5)	11.0 (9.9, 12.1)
TiN AS	247	5617	1.4 (1.1, 1.8)	3.8 (3.3, 4.4)	4.7 (4.1, 5.4)	6.2 (5.4, 7.2)		
Zirconia AS	79	4784	1.0 (0.7, 1.3)	2.2 (1.8, 2.8)	2.4 (1.9, 3.0)			
TOTAL	3151	67634						

Note: Restricted to modern prostheses

Figure KT60 Cumulative Percent Revision of Primary Total Knee Replacement by AS Femoral Material (Primary Diagnosis OA)



HR - adjusted for age and gender

TiN AS vs Ceramicised Metal
Entire Period: HR=1.16 (1.02, 1.32), p=0.028

TiN AS vs Zirconia AS
Entire Period: HR=1.81 (1.40, 2.34), p<0.001

Zirconia AS vs Ceramicised Metal
0 - 6Mth: HR=1.17 (0.81, 1.69), p=0.393
6Mth+: HR=0.54 (0.41, 0.72), p<0.001

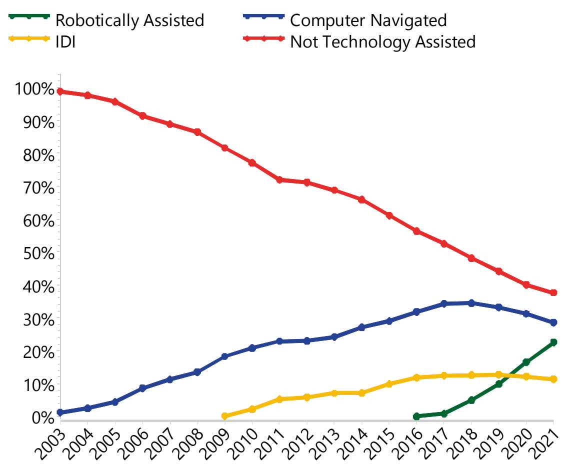
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Ceramicised Metal	57233	52181	42518	32972	12496	2970	61
TiN AS	5617	5074	3891	2733	220	0	0
Zirconia AS	4784	3619	1545	421	25	0	0

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 37.6% of primary knee procedures in 2021. The increase in use of individual technology assisted methods is shown in Figure KT61. 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.

Figure KT61 Primary Total Knee Replacement by Technology Assistance (Primary Diagnosis OA)



Note: Restricted to modern prostheses

Computer Navigation

There have been 177,448 primary total knee replacement procedures using computer navigation. In 2021, computer navigation was used in 28.5% of all primary total knee replacement procedures.

After 6 months, procedures using computer navigation have a lower rate of revision compared to non-navigated procedures (Table KT56, Figure KT62 and Figure KT63).

Patients aged <65 years have a lower rate of revision when computer navigation is used compared to when it is not used. This effect is also evident in patients aged ≥65 years after 6 months (Table KT57 and Figure KT64).

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 56,677 primary total knee replacement procedures undertaken using IDI since 2009. In 2021, IDI was used in 11.3% of all primary total knee replacement procedures.

IDI usage has a higher rate of revision compared to when IDI is not used (Table KT58 and Figure KT65). There is an increased proportion of revision for loosening when IDI is used (Figure KT66).

The effect of IDI on revision varies with age. In patients aged ≥65 years where IDI is used, there is a higher rate of revision after 3 months compared to when it is not used. There is no difference with IDI use for patients aged <65 years (Table KT59 and Figure KT67).

Robotic Assistance

Robotic assistance has been recorded for 30,469 total knee replacements since 2016, and in 2021 was used for 22.5% of procedures. There are 5 robotic systems that are used with a small number of prostheses. The use of robotic assistance is associated with a lower rate of revision compared to when it is not used (Table KT60 and Figure KT68). There are fewer revisions for loosening and instability using robotic assistance (Figure KT69).

For patients aged ≥65 years, the use of robotic assistance leads to a lower rate of revision compared to when it is not used, but there is no difference for patients aged <65 years (Table KT61 and Figure KT70).

Technology Assistance Compared

Total knee procedures since 2016 for osteoarthritis using XLPE with and without the use of assistive technology are compared in Table KT62 and Figure KT71. Procedures using robotic assistance have a lower rate of revision compared to computer navigated, IDI and those not technology assisted. IDI has a higher rate of revision compared to computer navigated procedures after 1.5 years, but there is no difference compared to when no technology assistance is used. Computer navigation shows no difference when compared to procedures without technology assistance.

Prosthesis-Specific Analysis

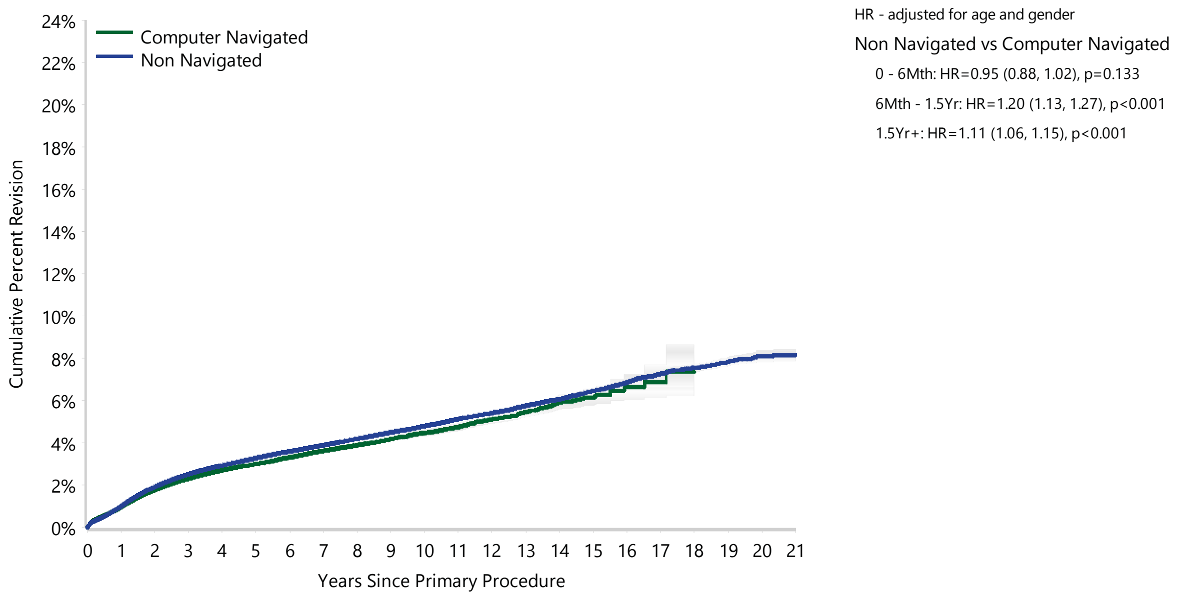
There is one prosthesis using XLPE that has been used both with and without robotic assistance that has over 10,000 procedures in each group. The Triathlon CR/Triathlon has a lower rate of revision when used with robotic assistance compared to when computer navigation is used, and when compared to procedures without technology assistance. There is no difference in rate of revision when comparing procedures using computer navigation and no technology assistance (Table KT63 and Figure KT72).

Table KT56 Cumulative Percent Revision of Primary Total Knee Replacement by Computer Navigation (Primary Diagnosis OA)

Navigation	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Computer Navigated	5172	177448	1.0 (0.9, 1.0)	2.3 (2.2, 2.4)	3.0 (2.9, 3.1)	4.5 (4.3, 4.6)	6.1 (5.8, 6.5)	
Non Navigated	20079	534530	1.0 (1.0, 1.0)	2.5 (2.5, 2.6)	3.3 (3.2, 3.3)	4.8 (4.7, 4.9)	6.5 (6.3, 6.6)	8.1 (7.8, 8.4)
TOTAL	25251	711978						

Note: Restricted to modern prostheses

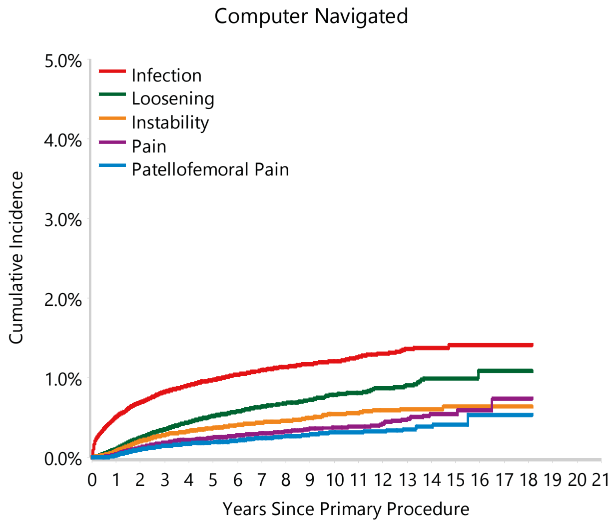
Figure KT62 Cumulative Percent Revision of Primary Total Knee Replacement by Computer Navigation (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Computer Navigated	177448	158369	119410	80777	21447	1485	0
Non Navigated	534530	484999	396342	314024	138162	38894	2564

Note: Restricted to modern prostheses

Figure KT63 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by Computer Navigation (Primary Diagnoses OA)



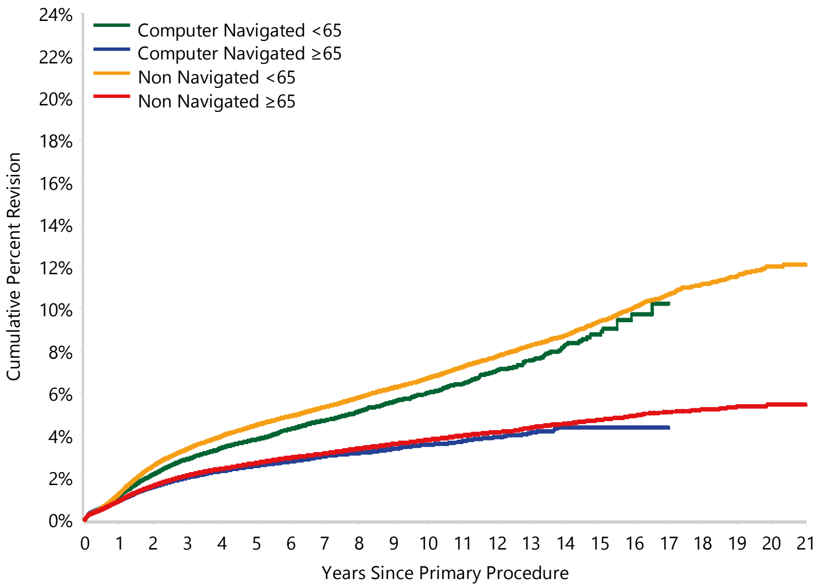
Note: Restricted to modern prostheses

Table KT57 Cumulative Percent Revision of Primary Total Knee Replacement by Computer Navigation and Age (Primary Diagnosis OA)

Navigation	Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Computer Navigated		**5172**	**177448**	**1.0 (0.9, 1.0)**	**2.3 (2.2, 2.4)**	**3.0 (2.9, 3.1)**	**4.5 (4.3, 4.6)**	**6.1 (5.8, 6.5)**	
	<65	2427	61711	1.1 (1.0, 1.2)	2.9 (2.7, 3.0)	3.8 (3.6, 4.0)	6.0 (5.7, 6.3)	8.8 (8.1, 9.5)	
	≥65	2745	115737	0.9 (0.8, 0.9)	2.0 (1.9, 2.1)	2.6 (2.5, 2.7)	3.6 (3.4, 3.7)	4.4 (4.1, 4.7)	
Non Navigated		**20079**	**534530**	**1.0 (1.0, 1.0)**	**2.5 (2.5, 2.6)**	**3.3 (3.2, 3.3)**	**4.8 (4.7, 4.9)**	**6.5 (6.3, 6.6)**	**8.1 (7.8, 8.4)**
	<65	9689	175831	1.2 (1.2, 1.3)	3.4 (3.3, 3.4)	4.5 (4.4, 4.6)	6.7 (6.6, 6.9)	9.4 (9.2, 9.6)	12.0 (11.5, 12.5)
	≥65	10390	358699	0.9 (0.9, 0.9)	2.1 (2.1, 2.2)	2.7 (2.6, 2.7)	3.8 (3.7, 3.9)	4.7 (4.6, 4.8)	5.4 (5.2, 5.7)
TOTAL		25251	711978						

Note: Restricted to modern prostheses

Figure KT64 Cumulative Percent Revision of Primary Total Knee Replacement by Computer Navigation and Age (Primary Diagnosis OA)



HR - adjusted for gender

Computer Navigated <65 vs Non Navigated <65

Entire Period: HR=0.88 (0.84, 0.92), p<0.001

Computer Navigated ≥65 vs Non Navigated ≥65

0 - 6Mth: HR=1.14 (1.04, 1.25), p=0.005

6Mth+: HR=0.90 (0.86, 0.95), p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Computer Navigated	<65	61711	55501	42627	29545	8822	698	0
	≥65	115737	102868	76783	51232	12625	787	0
Non Navigated	<65	175831	159737	131749	107036	51965	16823	1312
	≥65	358699	325262	264593	206988	86197	22071	1252

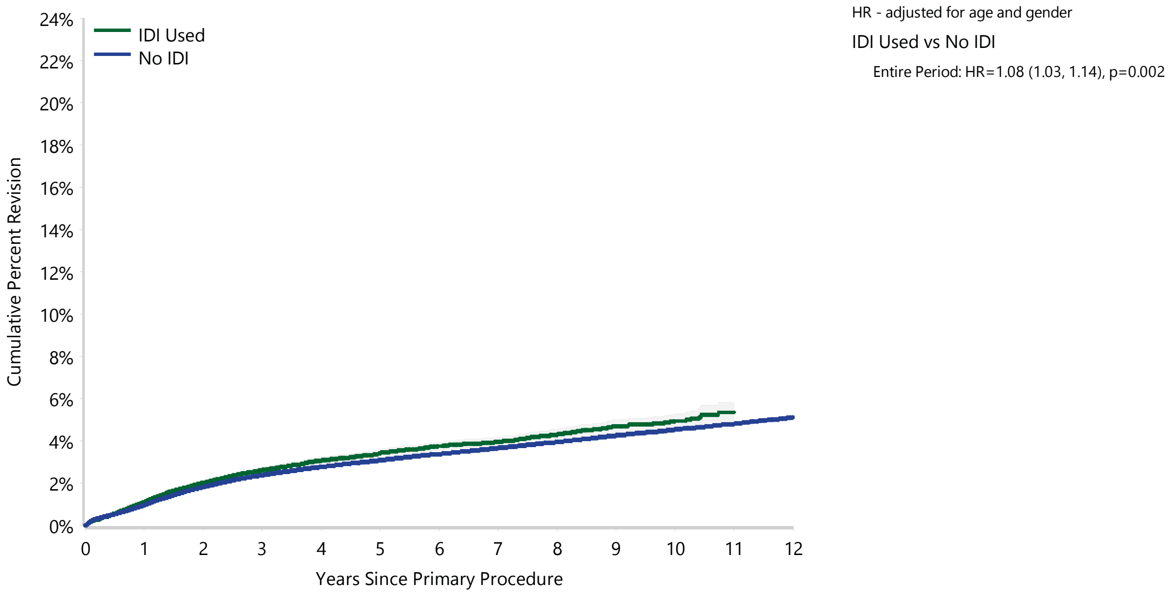
Note: Restricted to modern prostheses

Table KT58 Cumulative Percent Revision of Primary Total Knee Replacement since 2009 by IDI Usage (Primary Diagnosis OA)

IDI Usage	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
IDI Used	1631	56677	1.1 (1.0, 1.2)	2.6 (2.5, 2.8)	3.4 (3.3, 3.6)	4.0 (3.8, 4.2)	4.9 (4.6, 5.3)	
No IDI	16190	535044	1.0 (0.9, 1.0)	2.4 (2.3, 2.4)	3.1 (3.0, 3.1)	3.7 (3.6, 3.7)	4.5 (4.5, 4.6)	5.1 (5.0, 5.2)
TOTAL	17821	591721						

Note: Restricted to modern prostheses

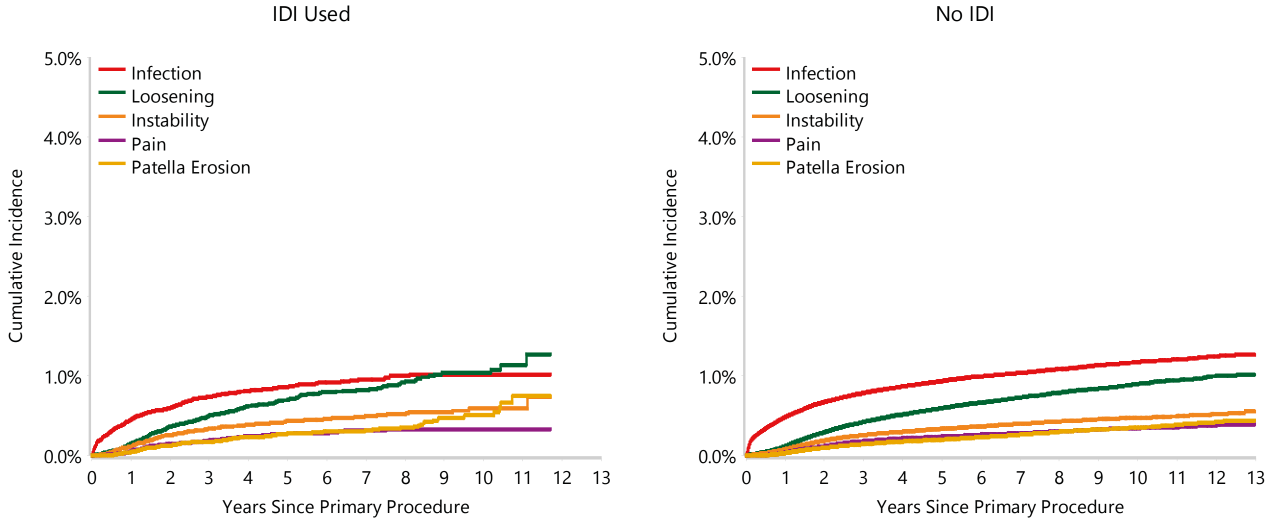
Figure KT65 Cumulative Percent Revision of Primary Total Knee Replacement since 2009 by IDI Usage (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
IDI Used	56677	49138	34160	20258	9765	2260	18
No IDI	535044	476327	368996	267803	177736	70119	18417

Note: Restricted to modern prostheses

Figure KT66 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement since 2009 by IDI Usage (Primary Diagnosis OA)



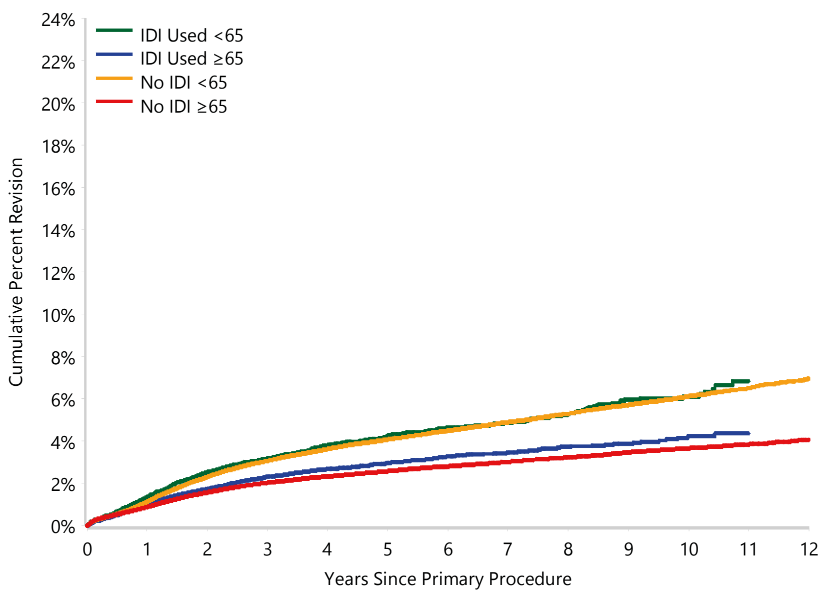
Note: Restricted to modern prostheses

Table KT59 Cumulative Percent Revision of Primary Total Knee Replacement since 2009 by IDI Usage and Age (Primary Diagnosis OA)

IDI Usage	Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
IDI Used		1631	56677	1.1 (1.0, 1.2)	2.6 (2.5, 2.8)	3.4 (3.3, 3.6)	4.0 (3.8, 4.2)	4.9 (4.6, 5.3)	
	<65	735	20064	1.4 (1.2, 1.5)	3.2 (2.9, 3.5)	4.3 (3.9, 4.6)	4.9 (4.5, 5.3)	6.1 (5.6, 6.7)	
	≥65	896	36613	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, 4.7)	
No IDI		16190	535044	1.0 (0.9, 1.0)	2.4 (2.3, 2.4)	3.1 (3.0, 3.1)	3.7 (3.6, 3.7)	4.5 (4.5, 4.6)	5.1 (5.0, 5.2)
	<65	7442	180284	1.1 (1.1, 1.2)	3.1 (3.0, 3.2)	4.1 (4.0, 4.2)	4.9 (4.8, 5.0)	6.1 (6.0, 6.3)	6.9 (6.7, 7.2)
	≥65	8748	354760	0.9 (0.9, 0.9)	2.0 (2.0, 2.1)	2.6 (2.5, 2.6)	3.0 (3.0, 3.1)	3.7 (3.6, 3.8)	4.1 (3.9, 4.2)
TOTAL		17821	591721						

Note: Restricted to modern prostheses

Figure KT67 Cumulative Percent Revision of Primary Total Knee Replacement since 2009 by IDI Usage and Age (Primary Diagnosis OA)



HR - adjusted for gender

IDI Used <65 vs No IDI <65

Entire Period: HR=1.04 (0.96, 1.12), p=0.344

IDI Used ≥65 vs No IDI ≥65

0 - 3Mth: HR=0.81 (0.72, 0.91), p<0.001

3Mth - 1.5Yr: HR=1.25 (1.15, 1.37), p<0.001

1.5Yr+: HR=1.17 (1.07, 1.28), p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
IDI Used	<65	20064	17512	12442	7723	3949	997	10
	≥65	36613	31626	21718	12535	5816	1263	8
No IDI	<65	180284	161177	126648	94514	64983	28013	7721
	≥65	354760	315150	242348	173289	112753	42106	10696

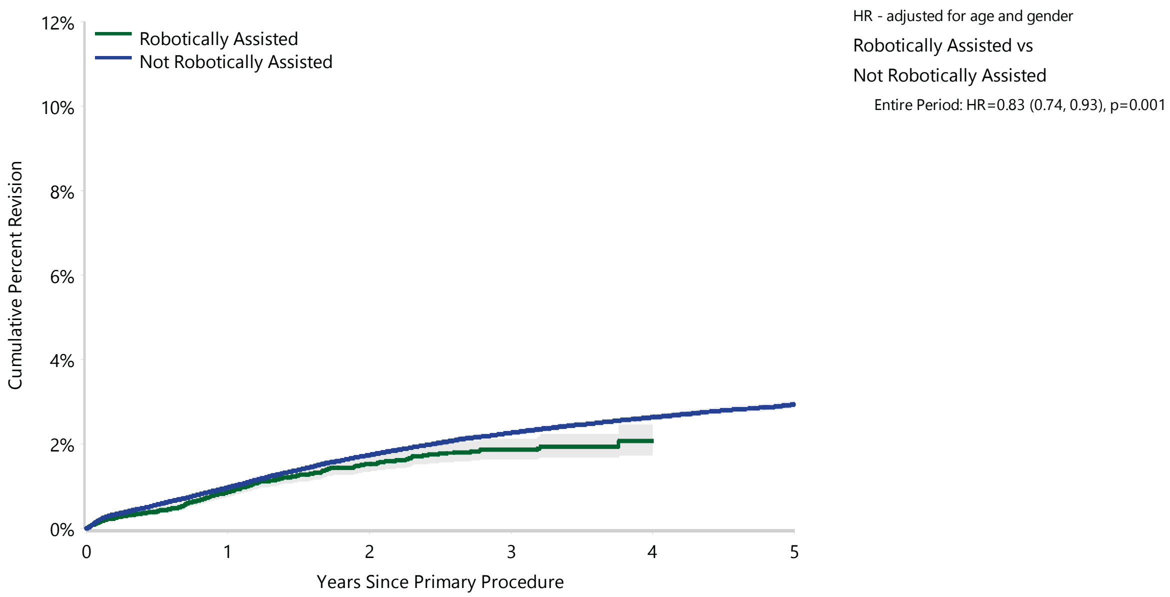
Note: Restricted to modern prostheses

Table KT60 Cumulative Percent Revision of Primary Total Knee Replacement since 2016 by Robotic Assistance (Primary Diagnosis OA)

Robotic Assistance	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
Robotically Assisted	317	30469	0.9 (0.8, 1.0)	1.5 (1.4, 1.7)	1.9 (1.6, 2.1)	2.1 (1.7, 2.5)	
Not Robotically Assisted	6095	294550	1.0 (0.9, 1.0)	1.7 (1.7, 1.8)	2.3 (2.2, 2.3)	2.6 (2.6, 2.7)	2.9 (2.9, 3.0)
TOTAL	6412	325019					

Note: Restricted to modern prostheses

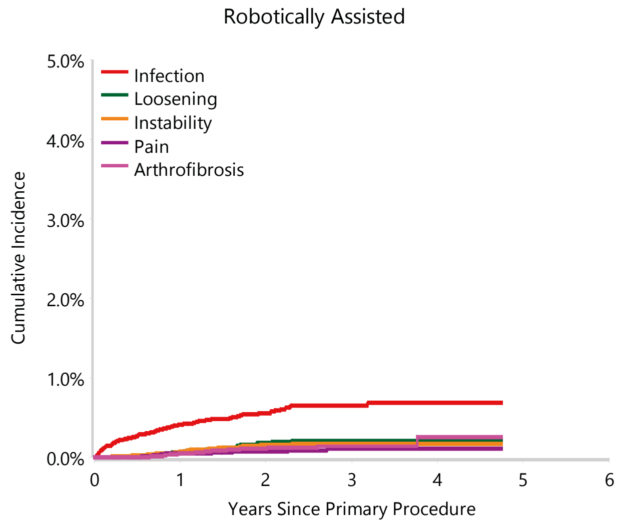
Figure KT68 Cumulative Percent Revision of Primary Total Knee Replacement since 2016 by Robotic Assistance (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
Robotically Assisted	30469	17198	8424	3016	406	8
Not Robotically Assisted	294550	245941	198957	147574	96161	46009

Note: Restricted to modern prostheses

Figure KT69 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement since 2016 by Robotic Assistance (Primary Diagnoses OA)



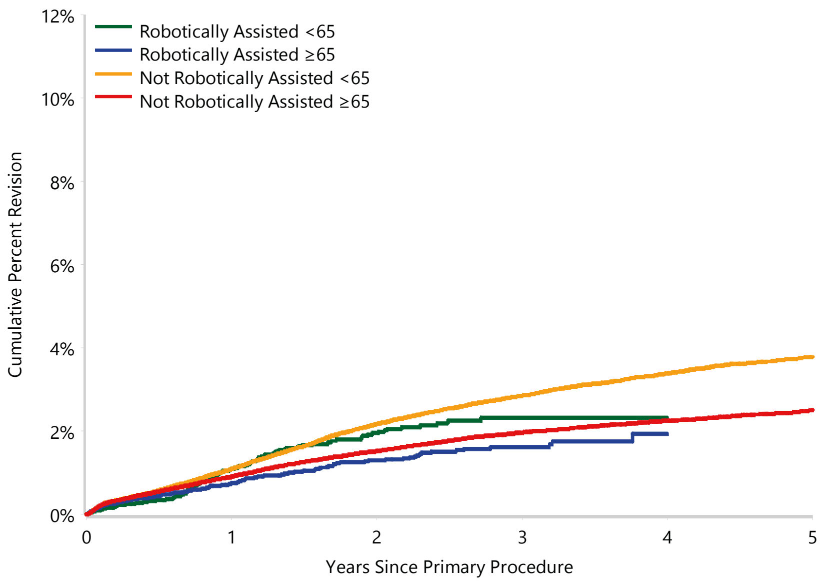
Note: Restricted to modern prostheses

Table KT61 Cumulative Percent Revision of Primary Total Knee Replacement since 2016 by Robotic Assistance and Age (Primary Diagnosis OA)

Robotic Assistance	Age	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
Robotically Assisted		317	30469	0.9 (0.8, 1.0)	1.5 (1.4, 1.7)	1.9 (1.6, 2.1)	2.1 (1.7, 2.5)	
	<65	133	10637	1.1 (0.9, 1.4)	2.0 (1.6, 2.4)	2.3 (1.9, 2.8)	2.3 (1.9, 2.8)	
	≥65	184	19832	0.8 (0.6, 0.9)	1.3 (1.1, 1.5)	1.6 (1.4, 1.9)	1.9 (1.5, 2.5)	
Not Robotically Assisted		6095	294550	1.0 (0.9, 1.0)	1.7 (1.7, 1.8)	2.3 (2.2, 2.3)	2.6 (2.6, 2.7)	2.9 (2.9, 3.0)
	<65	2583	97842	1.1 (1.0, 1.2)	2.2 (2.1, 2.3)	2.9 (2.7, 3.0)	3.4 (3.3, 3.5)	3.8 (3.6, 3.9)
	≥65	3512	196708	0.9 (0.9, 1.0)	1.5 (1.5, 1.6)	2.0 (1.9, 2.0)	2.2 (2.2, 2.3)	2.5 (2.4, 2.6)
TOTAL		6412	325019					

Note: Restricted to modern prostheses

Figure KT70 Cumulative Percent Revision of Primary Total Knee Replacement since 2016 by Robotic Assistance and Age (Primary Diagnosis OA)



HR - adjusted for gender
Robotically Assisted <65 vs
Not Robotically Assisted <65
Entire Period: HR=0.84 (0.71, 1.00), p=0.055

Robotically Assisted ≥65 vs
Not Robotically Assisted ≥65
Entire Period: HR=0.83 (0.72, 0.97), p=0.015

Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
Robotically Assisted	<65	10637	6059	2872	1087	156	5
	≥65	19832	11139	5552	1929	250	3
Not Robotically Assisted	<65	97842	82115	66553	50091	33105	16200
	≥65	196708	163826	132404	97483	63056	29809

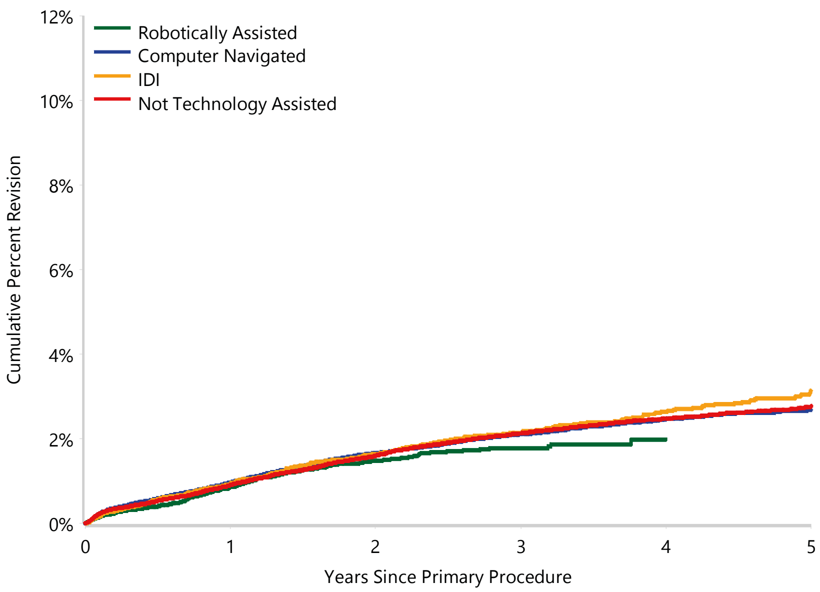
Note: Restricted to modern prostheses

Table KT62 Cumulative Percent Revision of Primary Total Knee Replacement using XLPE since 2016 by Technology Assistance (Primary Diagnosis OA)

Technology Assistance	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
Robotically Assisted	302	29876	0.9 (0.7, 1.0)	1.5 (1.3, 1.7)	1.8 (1.6, 2.0)	2.0 (1.7, 2.4)	
Computer Navigated	1567	83444	1.0 (0.9, 1.0)	1.7 (1.6, 1.8)	2.1 (2.0, 2.2)	2.5 (2.3, 2.6)	2.7 (2.5, 2.8)
IDI	315	15173	0.9 (0.8, 1.1)	1.6 (1.4, 1.9)	2.2 (1.9, 2.4)	2.6 (2.3, 3.0)	3.1 (2.8, 3.5)
Not Technology Assisted	1664	87050	0.9 (0.8, 1.0)	1.6 (1.5, 1.7)	2.1 (2.0, 2.2)	2.5 (2.4, 2.6)	2.8 (2.6, 2.9)
TOTAL	3848	215543					

Note: Restricted to modern prostheses

Figure KT71 Cumulative Percent Revision of Primary Total Knee Replacement using XLPE since 2016 by Technology Assistance (Primary Diagnosis OA)



HR - adjusted for age and gender

Robotically Assisted vs Computer Navigated
Entire Period: HR=0.86 (0.76, 0.98), p=0.018

Robotically Assisted vs IDI
Entire Period: HR=0.81 (0.69, 0.95), p=0.009

Robotically Assisted vs Not Technology Assisted
Entire Period: HR=0.84 (0.75, 0.96), p=0.007

IDI vs Computer Navigated
0 - 1.5Yr: HR=1.01 (0.88, 1.15), p=0.909
1.5Yr+: HR=1.16 (1.00, 1.35), p=0.044

IDI vs Not Technology Assisted
Entire Period: HR=1.04 (0.92, 1.18), p=0.495

Computer Navigated vs Not Technology Assisted
Entire Period: HR=0.98 (0.91, 1.05), p=0.566

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
Robotically Assisted	29876	16782	8144	2927	399	8
Computer Navigated	83444	68227	54038	38824	24147	10816
IDI	15173	12693	10275	7554	4895	2245
Not Technology Assisted	87050	71430	57496	42725	27830	13209

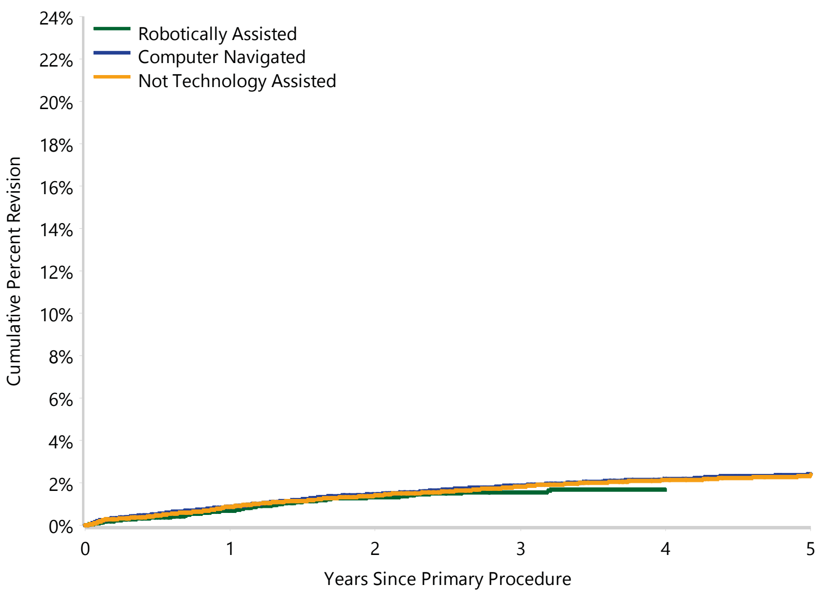
Note: Restricted to modern prostheses

Table KT63 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
Robotically Assisted	189	20254	0.7 (0.6, 0.8)	1.3 (1.1, 1.5)	1.6 (1.3, 1.8)	1.7 (1.4, 2.0)	
Computer Navigated	568	32946	0.9 (0.8, 1.0)	1.5 (1.3, 1.6)	1.9 (1.7, 2.1)	2.2 (2.0, 2.4)	2.4 (2.2, 2.6)
Not Technology Assisted	331	18903	0.9 (0.7, 1.0)	1.4 (1.3, 1.6)	1.8 (1.6, 2.1)	2.1 (1.9, 2.4)	2.4 (2.1, 2.7)
TOTAL	1088	72103					

Note: Restricted to modern prostheses
Excludes 37 procedures using IDI

Figure KT72 Cumulative Percent Revision of Triathlon CR/Triathlon Primary Total Knee Replacement using XLPE since 2016 by Technology Assistance (Primary Diagnosis OA)



HR - adjusted for age and gender

Robotically Assisted vs Computer Navigated
Entire Period: HR=0.83 (0.70, 0.98), p=0.028

Robotically Assisted vs Not Technology Assisted
Entire Period: HR=0.83 (0.69, 1.00), p=0.046

Computer Navigated vs Not Technology Assisted
Entire Period: HR=1.00 (0.88, 1.15), p=0.972

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
Robotically Assisted	20254	12063	6222	2267	339	7
Computer Navigated	32946	27282	22097	16451	10502	4848
Not Technology Assisted	18903	16259	13607	10294	6668	3303

Note: Restricted to modern prostheses
Excludes 37 procedures using IDI

PATIENT REPORTED OUTCOME MEASURES – TECHNOLOGY ASSISTANCE

PROMs are reported with respect to surgical technique. Satisfaction (patients who report they are satisfied or very satisfied) with and without technology assistance is over 80% for each surgical technique (Table KT64 and Figure KT73).

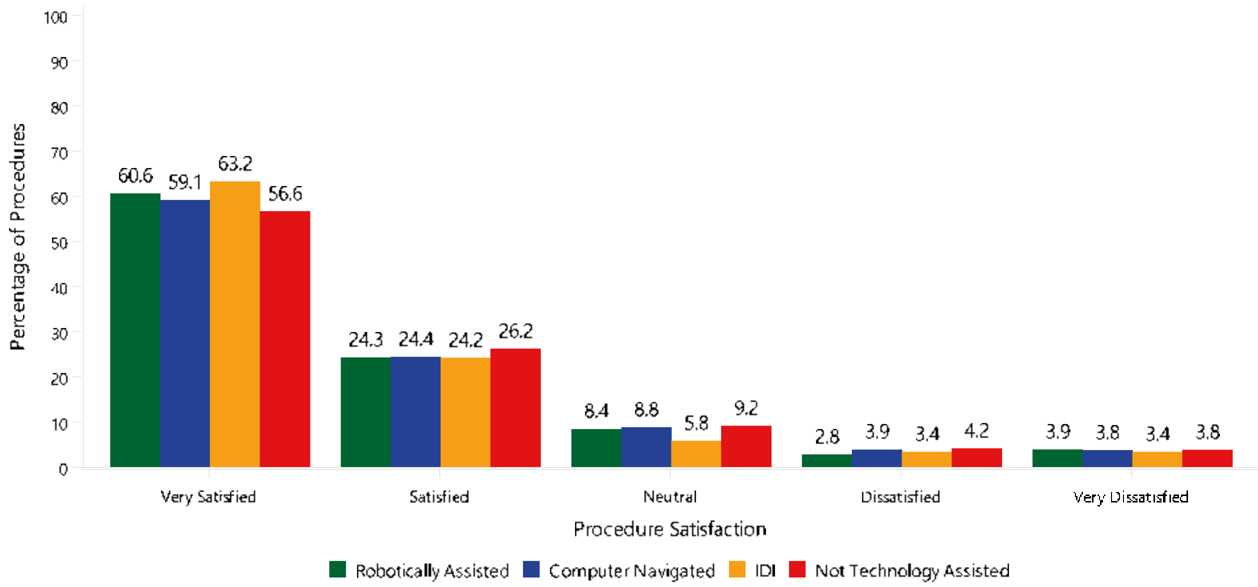
Change after surgery is reported as much better in over 80% of procedures with each surgical technique (Table KT65 and Figure KT74).

Table KT64 Procedure Satisfaction in Primary Total Knee Replacement by Technology Assistance (Primary Diagnosis OA)

	Very Satisfied			Satisfied			Neutral			Dissatisfied			Very Dissatisfied			TOTAL		
Technology Assistance	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%
Robotically Assisted	1050	60.6	13.5	421	24.3	12.5	146	8.4	12.6	49	2.8	9.6	68	3.9	13.5	1734	100.0	13.0
Computer Navigated	2465	59.1	31.6	1017	24.4	30.2	368	8.8	31.8	162	3.9	31.6	157	3.8	31.2	4169	100.0	31.3
IDI	695	63.2	8.9	266	24.2	7.9	64	5.8	5.5	37	3.4	7.2	37	3.4	7.3	1099	100.0	8.2
Not Technology Assisted	3585	56.6	46.0	1659	26.2	49.3	580	9.2	50.1	264	4.2	51.6	242	3.8	48.0	6330	100.0	47.5
TOTAL	7795	58.5	100.0	3363	25.2	100.0	1158	8.7	100.0	512	3.8	100.0	504	3.8	100.0	13332	100.0	100.0

Note: Restricted to modern prostheses

Figure KT73 Procedure Satisfaction in Primary Total Knee Replacement by Technology Assistance (Primary Diagnosis OA)



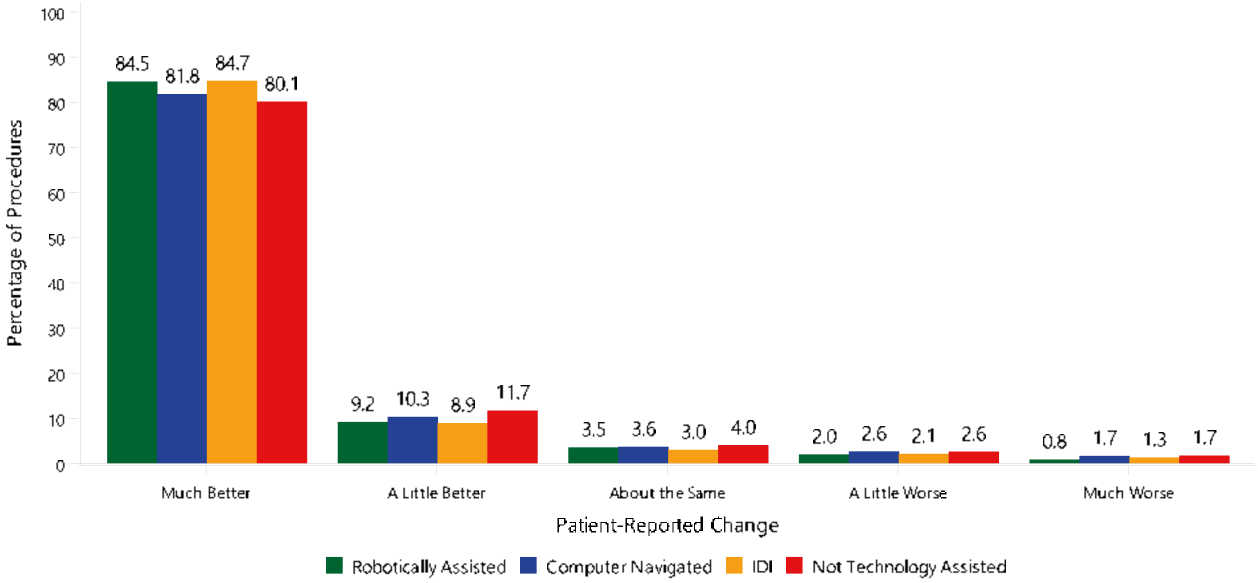
Note: Restricted to modern prostheses

Table KT65 Patient-Reported Change after Primary Total Knee Replacement by Technology Assistance (Primary Diagnosis OA)

	Much Better			A Little Better			About the Same			A Little Worse			Much Worse			TOTAL		
Technology Assistance	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%
Robotically Assisted	1466	84.5	13.5	159	9.2	11.2	61	3.5	12.2	34	2.0	10.3	14	0.8	6.8	1734	100.0	13.0
Computer Navigated	3408	81.8	31.3	429	10.3	30.1	152	3.6	30.4	110	2.6	33.4	69	1.7	33.7	4168	100.0	31.3
IDI	931	84.7	8.6	98	8.9	6.9	33	3.0	6.6	23	2.1	7.0	14	1.3	6.8	1099	100.0	8.2
Not Technology Assisted	5067	80.1	46.6	738	11.7	51.8	254	4.0	50.8	162	2.6	49.2	108	1.7	52.7	6329	100.0	47.5
TOTAL	10872	81.6	100.0	1424	10.7	100.0	500	3.8	100.0	329	2.5	100.0	205	1.5	100.0	13330	100.0	100.0

Note: Restricted to modern prostheses

Figure KT74 Patient-Reported Change after Primary Total Knee Replacement by Technology Assistance (Primary Diagnosis OA)



Note: Restricted to modern prostheses

Shoulder Replacement

Shoulder Replacement

CATEGORIES OF SHOULDER REPLACEMENT

The Registry groups shoulder replacement into three broad categories: primary partial, primary total, and revision shoulder replacement.

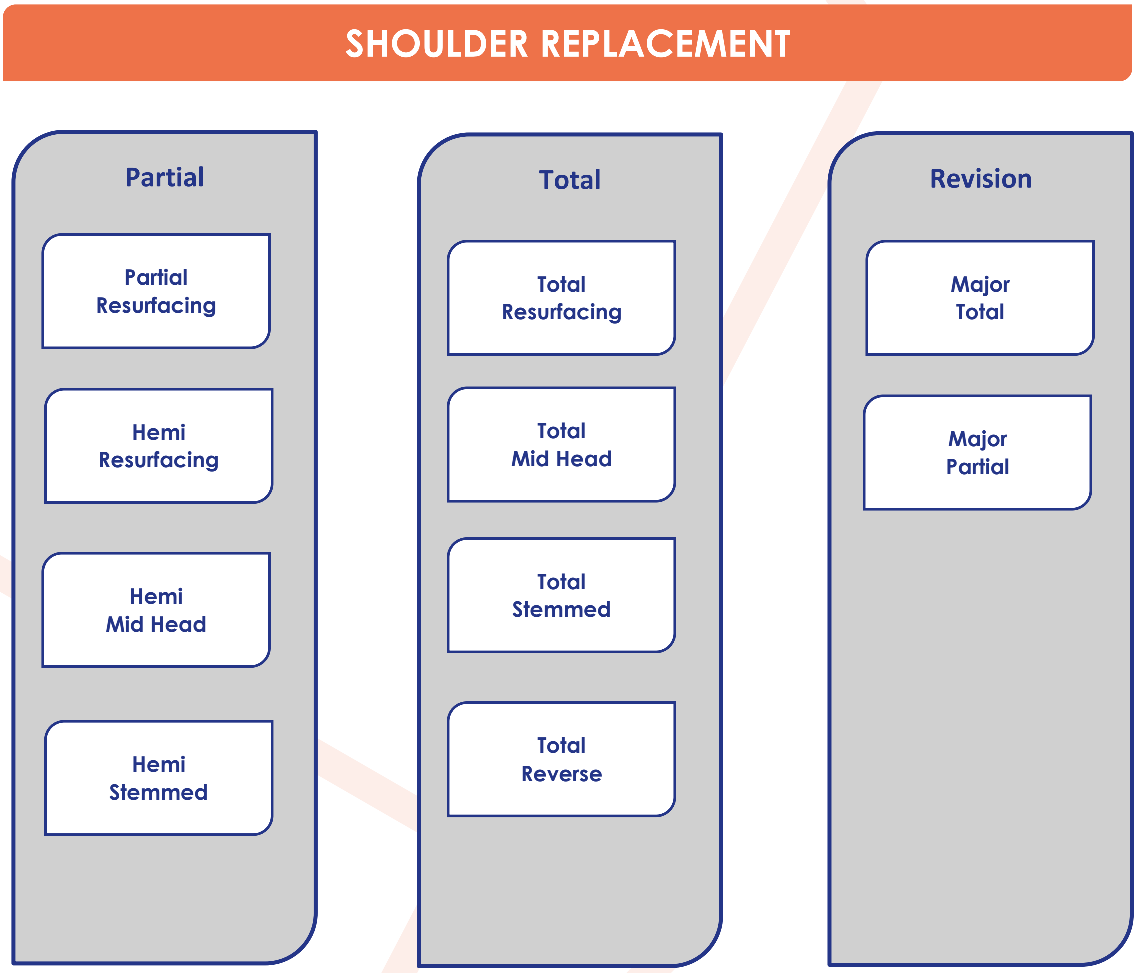
A primary replacement is an initial procedure undertaken on a joint and involves replacing either part (partial) or all (total) of the articular surface.

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, hemi resurfacing, hemi mid head and hemi stemmed replacement.

Total shoulder subclasses include total resurfacing, total mid head, total stemmed and total reverse shoulder replacement. 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-2022



USE OF SHOULDER REPLACEMENT

This report includes 76,347 shoulder replacements reported to the Registry with a procedure date up to and including 31 December 2021. This is an additional 8,733 shoulder procedures since the last 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 2021 increased by 562 (7.1%) compared to the previous year and has increased by 219.8% since 2008.

The number of shoulder replacements has increased compared to last year's decrease when elective surgery was cancelled during COVID-19 restrictions.

The proportion of total shoulder replacements has increased from 57.6% in 2008 to 89.6% in 2021.

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).

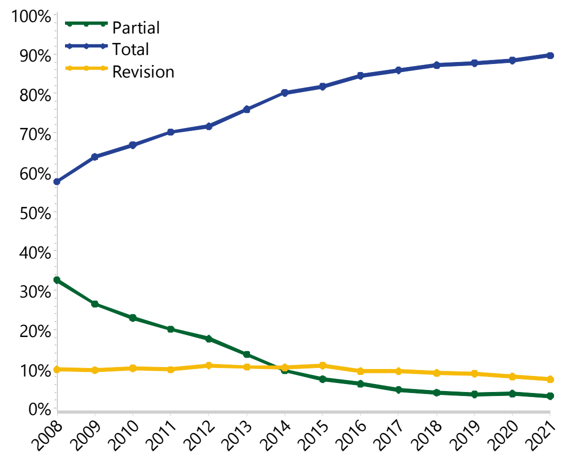
Table S1 Number of Shoulder Replacements

Shoulder Category	Number	Percent
Partial	7623	10.0
Total	61620	80.7
Revision	7104	9.3
TOTAL	**76347**	**100.0**

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).

In 2021, the proportion of revision procedures has declined to 7.3%, this equates to 302 less revisions compared to the peak of 10.9% in 2012.

Figure S1 Proportion of Shoulder Replacements



ASA SCORE 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 54,947 and BMI data on 44,031 shoulder replacement procedures. Since its initial collection, ASA score has been recorded for 94.8% of procedures. BMI has been recorded for 90.0% of procedures since collection commenced.

In 2021, ASA score is reported in 99.8% of shoulder replacement procedures and BMI is reported in 96.3% of procedures. The percentage of procedures with ASA score reported for primary partial shoulder is 99.6%, primary total shoulder is 99.8%, and for revision shoulder replacement is 99.7%.

BMI data are reported for 94.7% of primary partial shoulder, 96.6% of primary total shoulder, and 94.0% of revision shoulder replacements.

ASA SCORE

There are five ASA score classifications:[6]

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:[7]

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

For all shoulder replacements, the majority of procedures are undertaken in patients who are pre-obese or obese class 1 (61.4%). There is a slightly higher proportion of primary total shoulder replacement procedures where the patients are pre-obese or obese class 1 (61.6%), compared to partial shoulder replacement (59.5%), and revision shoulder replacement (60.3%) (Table S3).

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

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

Table S2 ASA Score for Shoulder Replacement

ASA Score	Partial		Total		Revision		TOTAL	
	N	Col%	N	Col%	N	Col%	N	Col%
ASA 1	329	11.6	1898	4.0	161	3.3	2388	4.3
ASA 2	1234	43.6	20855	44.2	1801	36.6	23890	43.5
ASA 3	1167	41.2	23139	49.0	2739	55.7	27045	49.2
ASA 4	101	3.6	1300	2.8	215	4.4	1616	2.9
ASA 5	.	.	8	0.0	.	.	8	0.0
TOTAL	**2831**	**100.0**	**47200**	**100.0**	**4916**	**100.0**	**54947**	**100.0**

Note: A further 21,400 procedures did not have ASA score recorded

Table S3 BMI Category for Shoulder Replacement

BMI Category	Partial		Total		Revision		TOTAL	
	N	Col%	N	Col%	N	Col%	N	Col%
Underweight	20	1.1	283	0.7	35	0.9	338	0.8
Normal	341	19.0	6354	16.5	674	17.9	7369	16.7
Pre Obese	614	34.3	13082	34.0	1211	32.2	14907	33.9
Obese Class 1	453	25.3	10617	27.6	1055	28.1	12125	27.5
Obese Class 2	223	12.4	5167	13.4	497	13.2	5887	13.4
Obese Class 3	141	7.9	2979	7.7	285	7.6	3405	7.7
TOTAL	**1792**	**100.0**	**38482**	**100.0**	**3757**	**100.0**	**44031**	**100.0**

Note: BMI has not been presented for patients aged ≤19 years
A further 32,316 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 68.1% 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:[8]

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).

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	595	46.6	22101	72.0	1060	36.2	23756	68.1
No	644	50.5	8142	26.5	1680	57.4	10466	30.0
Not Defined	.	.	1	0.0	.	.	1	0.0
Unknown	37	2.9	458	1.5	185	6.3	680	1.9
TOTAL	**1276**	**100.0**	**30702**	**100.0**	**2925**	**100.0**	**34903**	**100.0**

Note: A further 41,444 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	327	40.4	11562	44.3	368	37.4	12257	43.9
A2	145	17.9	5885	22.5	318	32.3	6348	22.8
B1	96	11.9	3908	15.0	89	9.1	4093	14.7
B2	169	20.9	3569	13.7	109	11.1	3847	13.8
C	72	8.9	1187	4.5	99	10.1	1358	4.9
TOTAL	**809**	**100.0**	**26111**	**100.0**	**983**	**100.0**	**27903**	**100.0**

Note: 86 procedures have been excluded where a glenoid morphology of B3 was recorded
A further 48,358 procedures did not have glenoid morphology recorded

[8] 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.

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

The Registry subcategorises primary partial shoulder replacement into four main classes. 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 shoulder joint.
Hemi resurfacing involves the use of a humeral prosthesis that replaces the humeral articular surface only, without resecting the head.
Hemi mid head involves resection of part of the humeral head and replacement with a humeral head and an epiphyseal fixation prosthesis.
Hemi stemmed 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 have been 7,623 primary partial shoulder replacements reported to the Registry up to 31 December 2021. This is an additional 277 procedures compared to the number reported last year. The most common class of primary partial shoulder replacement is hemi stemmed. This accounts for 72.7% of all partial shoulder replacements, followed by hemi resurfacing (23.5%), partial resurfacing (2.6%), and hemi mid head (1.2%) (Table SP1).

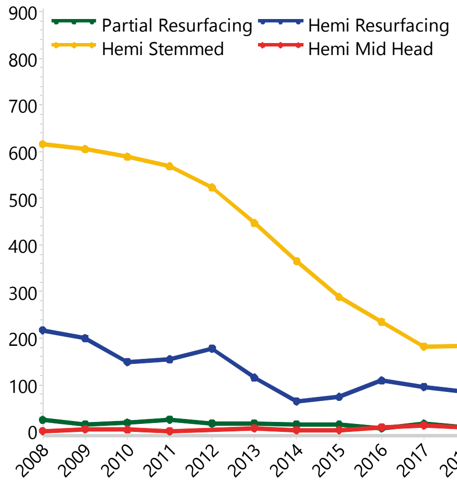
Table SP1 Primary Partial Shoulder Replacement by Class

Shoulder Class	Number	Percent
Partial Resurfacing	202	2.6
Hemi Resurfacing	1790	23.5
Hemi Stemmed	5542	72.7
Hemi Mid Head	89	1.2
TOTAL	**7623**	**100.0**

The use of the two main classes of primary partial shoulder replacement has declined over the last 8 years. The number of hemi resurfacing procedures decreased from 178 in 2012 to 51 in 2021. The number of hemi stemmed procedures decreased from 616 in 2008 to 198 in 2021 (Figure SP1).

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-2022

Figure SP1 Primary Partial Shoulder Replacement by Class

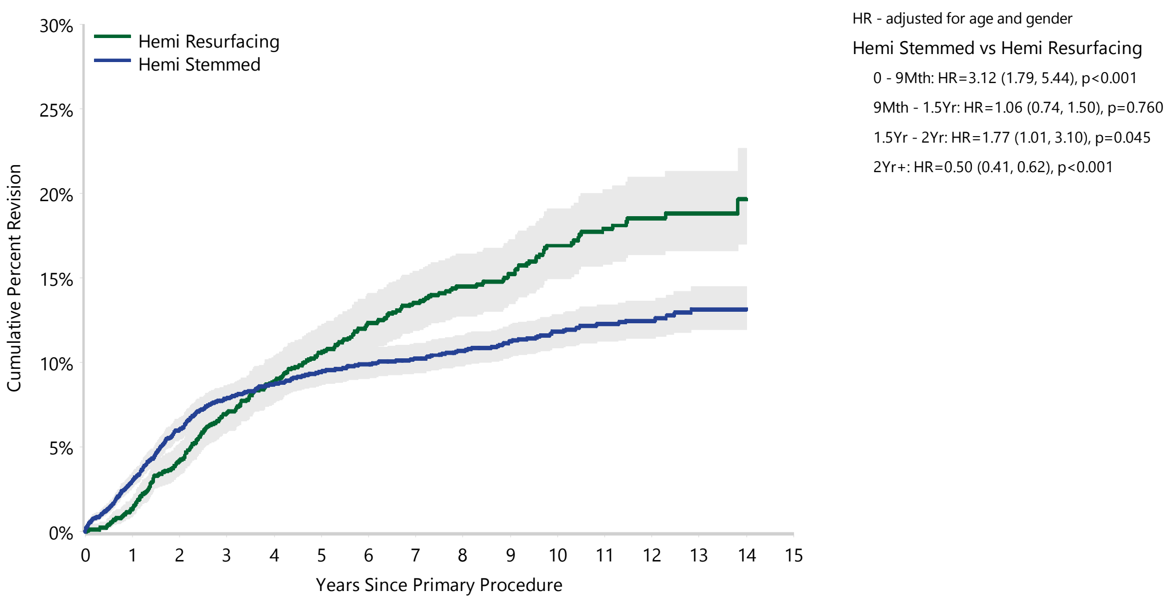


The cumulative percent revision varies depending on the shoulder class. Partial resurfacing and hemi mid head have only been used in small numbers (202 and 89 procedures, respectively). This makes the assessment of comparative performance difficult. However, there is a clear difference between the two more commonly used classes. Devices in these classes have a longer follow-up and the cumulative percent revision at 14 years for hemi resurfacing is higher than for hemi stemmed (19.6% compared to 13.2%, respectively) (Table SP2 and Figure SP2).

Table SP2 Cumulative Percent Revision of Primary Partial Shoulder Replacement by Class (All Diagnoses)

Shoulder Class	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Partial Resurfacing	13	202	0.5 (0.1, 3.5)	1.5 (0.5, 4.7)	2.7 (1.1, 6.5)	4.7 (2.4, 9.3)	5.6 (2.9, 10.6)	
Hemi Resurfacing	244	1790	1.4 (0.9, 2.0)	7.0 (5.9, 8.3)	10.6 (9.1, 12.2)	13.5 (11.9, 15.4)	16.9 (14.9, 19.1)	19.6 (17.0, 22.7)
Hemi Stemmed	528	5542	3.0 (2.6, 3.5)	7.9 (7.2, 8.7)	9.5 (8.7, 10.3)	10.2 (9.4, 11.1)	11.8 (10.8, 12.9)	13.2 (11.9, 14.5)
Hemi Mid Head	9	89	2.4 (0.6, 9.3)	10.3 (5.0, 20.8)	14.8 (7.8, 27.3)	14.8 (7.8, 27.3)		
TOTAL	794	7623						

Figure SP2 Cumulative Percent Revision of Primary Partial Shoulder Replacement by Class (All Diagnoses)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Hemi Resurfacing	1790	1707	1435	1166	926	571	88
Hemi Stemmed	5542	4963	4018	3297	2536	1322	135

PRIMARY PARTIAL RESURFACING SHOULDER REPLACEMENT

The Registry has recorded 202 partial resurfacing shoulder replacement procedures. This is an additional 6 procedures compared to the number reported last year. The principal diagnosis for partial resurfacing shoulder procedures is instability for males (56.1%) and osteoarthritis for females (44.7%). This procedure is undertaken more commonly in males (76.7%). The mean age for males is 38.6 years compared to 55.3 years for females.

The Registry has recorded 13 revisions of primary partial resurfacing shoulder replacement. The cumulative percent revision at 10 years is 5.6% (Table SP2). The most common reason for revision is glenoid erosion. All were revised to a total shoulder replacement (8 of which were total stemmed).

PRIMARY HEMI RESURFACING SHOULDER REPLACEMENT

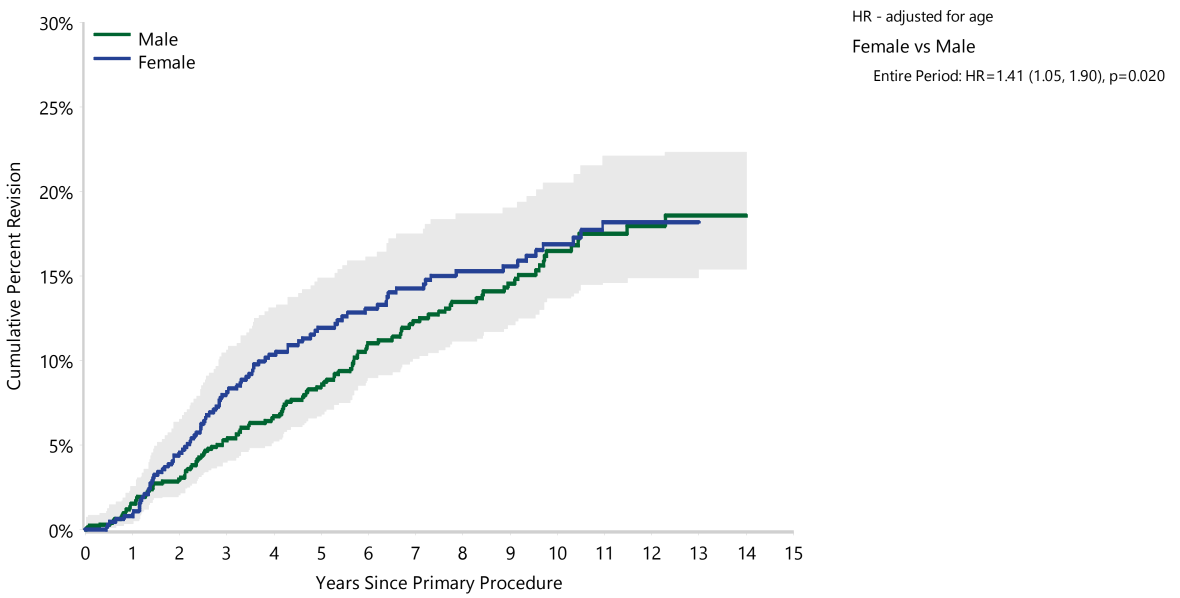
There have been 1,790 primary hemi resurfacing shoulder replacement procedures reported to the Registry. This is an additional 51 procedures compared to the previous report. The use of primary hemi resurfacing has declined by 55.8% since 2008. The procedure is more common in males (59.1%). The mean age is 59.9 years for males and 67.7 years for females. The principal diagnosis for primary hemi resurfacing shoulder replacement is osteoarthritis (88.4%).

The Registry has recorded 244 revisions of primary hemi resurfacing shoulder replacement (Table SP2 and Figure SP2). The most common reasons for revision are glenoid erosion, pain, rotator cuff insufficiency, and instability/dislocation. The most common type of revision is to a total shoulder replacement, the majority of which were total reverse (60.8%). Females have a higher rate of revision than males (Table SP3 and Figure SP3).

Table SP3 **Cumulative Percent Revision of Primary Hemi Resurfacing 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	115	943	1.5 (0.9, 2.6)	5.3 (4.0, 7.0)	8.4 (6.7, 10.6)	12.3 (10.1, 15.0)	16.5 (13.7, 19.7)	18.6 (15.4, 22.3)
Female	92	640	0.8 (0.3, 1.9)	8.2 (6.2, 10.7)	12.0 (9.6, 14.9)	14.3 (11.6, 17.5)	16.9 (13.8, 20.5)	
TOTAL	207	1583						

Figure SP3 **Cumulative Percent Revision of Primary Hemi Resurfacing 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	943	893	748	603	467	269	46
Female	640	617	522	420	340	225	34

PRIMARY HEMI MID HEAD SHOULDER REPLACEMENT

The Registry has recorded 89 primary hemi mid head shoulder replacement procedures. This is an additional 10 procedures compared to the number reported last year. The principal diagnosis is osteoarthritis (59.6%). This procedure is undertaken more commonly in males (64.0%). The mean age for males is 49.4 years and 64.6 years for females.

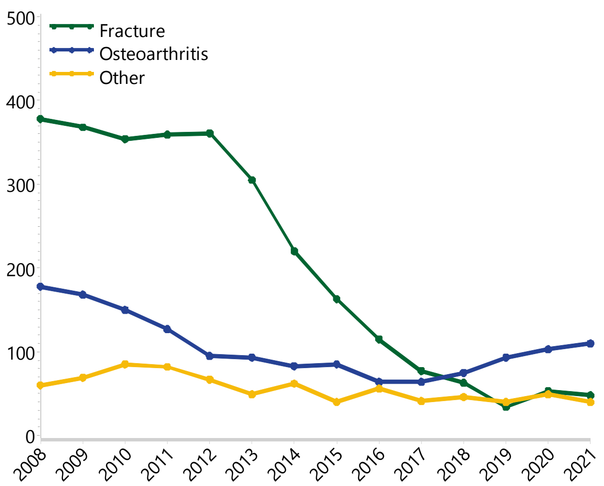
The Registry has recorded 9 revisions of primary hemi mid head shoulder replacement. The cumulative percent revision at 7 years is 14.8% (Table SP2). The most common reason for revision is glenoid erosion. The most common type of revision involves replacement of the humeral and glenoid components.

PRIMARY HEMI STEMMED SHOULDER REPLACEMENT

This year, the Registry is reporting on 5,542 primary hemi stemmed shoulder replacement procedures. This is an additional 210 procedures compared to the last report. This procedure is more commonly undertaken in females (68.5%). The mean age is 71.8 years for females and 63 years for males.

The most common primary diagnosis is fracture (55.9%), followed by osteoarthritis (29.0%). In 2021, the number of primary hemi stemmed shoulder replacements undertaken for fracture decreased by 87.3% compared to 2008. In 2021, the number of primary hemi stemmed shoulder replacements undertaken for osteoarthritis decreased by 38.2% compared to 2008 (Figure SP4).

Figure SP4 **Primary Hemi Stemmed Shoulder Replacement by Primary Diagnosis**



The cumulative percent revision at 14 years for primary hemi stemmed shoulder replacement procedures undertaken for both fracture and osteoarthritis is 13.0%. There is a higher rate of revision in the first 6 months when primary hemi stemmed shoulder replacement is performed for fracture compared to osteoarthritis. After this time, there is no difference (Table SP4 and Figure SP5).

The Registry has recorded 528 revisions of primary hemi stemmed shoulder replacement. Reasons for revision vary depending on the primary diagnosis. Rotator cuff insufficiency occurs more frequently in primary hemi stemmed shoulder replacement undertaken for fracture (26.4%), whereas glenoid erosion occurs more frequently in procedures undertaken for osteoarthritis (29.4%).

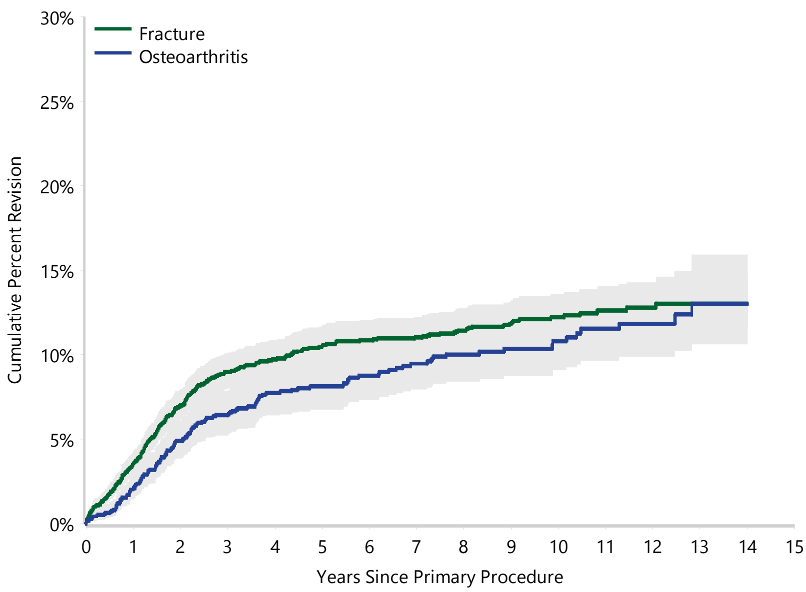
The most common type of revision is to a total shoulder replacement for both primary diagnoses (72.1% for fracture and 59.6% for osteoarthritis). Most were revised to a total reverse shoulder replacement (97.9% when used for fracture and 87.7% for osteoarthritis). Glenoid component only revision occurs more frequently in procedures undertaken for osteoarthritis (25.0% compared to 4.6% for fracture).

Table SP4 Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Primary Diagnosis

Primary Diagnosis	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Fracture	326	3097	3.6 (2.9, 4.3)	9.0 (8.0, 10.1)	10.5 (9.4, 11.7)	11.0 (9.9, 12.2)	12.2 (11.0, 13.6)	13.0 (11.6, 14.6)
Osteoarthritis	136	1607	2.1 (1.5, 3.0)	6.4 (5.3, 7.8)	8.1 (6.8, 9.7)	9.5 (8.0, 11.2)	10.8 (9.1, 12.8)	13.0 (10.6, 15.9)
Rotator Cuff Arthropathy	18	251	2.0 (0.8, 4.8)	5.2 (3.0, 9.0)	6.9 (4.2, 11.2)	6.9 (4.2, 11.2)	10.4 (6.3, 16.9)	
Osteonecrosis	17	206	2.0 (0.8, 5.3)	5.5 (3.0, 10.0)	7.8 (4.6, 13.3)	9.8 (5.9, 16.0)	12.7 (7.7, 20.4)	
Tumour	17	181	5.0 (2.4, 10.2)	11.9 (6.7, 20.8)				
Other (4)	14	200	3.1 (1.4, 6.8)	5.3 (2.9, 9.7)	5.3 (2.9, 9.7)	5.3 (2.9, 9.7)	11.0 (6.2, 19.0)	
TOTAL	**528**	**5542**						

Note: Only primary diagnoses with >100 procedures have been listed

Figure SP5 Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Primary Diagnosis



HR - adjusted for age and gender

Fracture vs Osteoarthritis

0 - 6Mth: HR=2.90 (1.48, 5.71), p=0.002

6Mth - 2.5Yr: HR=1.25 (0.96, 1.64), p=0.101

2.5Yr+: HR=0.79 (0.56, 1.12), p=0.191

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Fracture	3097	2821	2356	1956	1522	766	69
Osteoarthritis	1607	1439	1125	920	700	397	46

Note: Only primary diagnoses with >1,000 procedures have been listed

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-2022

Primary Total Shoulder Replacement

CLASSES OF TOTAL SHOULDER REPLACEMENT

The Registry subcategorises primary total shoulder replacement into four classes. These are defined by the type of prosthesis used.

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

Total mid head involves glenoid replacement combined with resection of part of the humeral head and replacement with a humeral head and an epiphyseal fixation prosthesis.

Total stemmed 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 reverse involves glenoid replacement with a glenosphere prosthesis combined with resection of the humeral head and replacement with humeral cup and humeral stem prostheses. A humeral stem prosthesis may have metaphyseal or diaphyseal fixation.

Detailed information on primary total resurfacing 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-2022

USE OF TOTAL SHOULDER REPLACEMENT

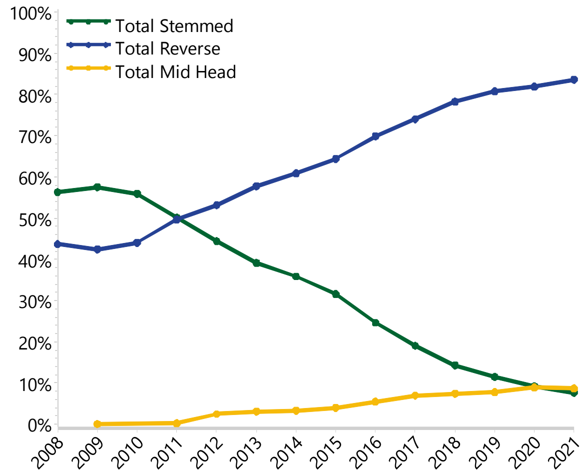
The Registry has recorded 61,385 primary total shoulder replacement procedures. Of these, total reverse is the most common, followed by total stemmed and total mid head (Table ST1).

The use of different prosthesis classes has changed over time with a major increase in the use of total reverse shoulder and a corresponding decline in the use of total stemmed shoulder replacement (Figure ST1).

Table ST1 Primary Total Shoulder Replacement by Class

Shoulder Class	Number	Percent
Total Stemmed	15463	25.2
Total Reverse	42513	69.3
Total Mid Head	3409	5.6
TOTAL	**61385**	**100.0**

Figure ST1 Primary Total Shoulder Replacement by Class



Primary total shoulder replacement is undertaken more often in females and this is irrespective of shoulder class (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 total reverse shoulders having the highest proportion (Table ST4).

Osteoarthritis is the most common primary diagnosis followed by rotator cuff arthropathy and fracture (Table ST5).

The cumulative percent revision varies by class with total reverse and total mid head having a lower cumulative percent revision than total stemmed shoulder replacement (Table ST6 and Figure ST2).

Primary total reverse shoulder replacement accounts for 69.3% of all primary total shoulder replacements.

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-2022

Table ST2 Primary Total Shoulder Replacement by Class and Gender

Shoulder Class	Male		Female		TOTAL	
	N	Row%	N	Row%	N	Row%
Total Stemmed	6622	42.8	8841	57.2	15463	100.0
Total Reverse	15872	37.3	26641	62.7	42513	100.0
Total Mid Head	1663	48.8	1746	51.2	3409	100.0
TOTAL	**24157**	**39.4**	**37228**	**60.6**	**61385**	**100.0**

Table ST3 Age and Gender of Primary Total Shoulder Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	24157	39.4%	14	96	71	70.2	9.0
Female	37228	60.6%	13	102	74	73.4	8.4
TOTAL	**61385**	**100.0%**	**13**	**102**	**73**	**72.2**	**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	872	5.6	3626	23.4	6859	44.4	4106	26.6	15463	100.0
Total Reverse	677	1.6	4502	10.6	16563	39.0	20771	48.9	42513	100.0
Total Mid Head	318	9.3	947	27.8	1501	44.0	643	18.9	3409	100.0
TOTAL	**1867**	**3.0**	**9075**	**14.8**	**24923**	**40.6**	**25520**	**41.6**	**61385**	**100.0**

Table ST5 Primary Total Shoulder Replacement by Primary Diagnosis and Gender

Primary Diagnosis	Male		Female		TOTAL	
	N	Col%	N	Col%	N	Col%
Osteoarthritis	15179	62.8	21230	57.0	36409	59.3
Rotator Cuff Arthropathy	7101	29.4	8438	22.7	15539	25.3
Fracture	1075	4.5	5496	14.8	6571	10.7
Rheumatoid Arthritis	228	0.9	791	2.1	1019	1.7
Osteonecrosis	175	0.7	618	1.7	793	1.3
Instability	187	0.8	307	0.8	494	0.8
Other Inflammatory Arthritis	83	0.3	225	0.6	308	0.5
Tumour	120	0.5	114	0.3	234	0.4
Other	9	0.0	9	0.0	18	0.0
TOTAL	**24157**	**100.0**	**37228**	**100.0**	**61385**	**100.0**

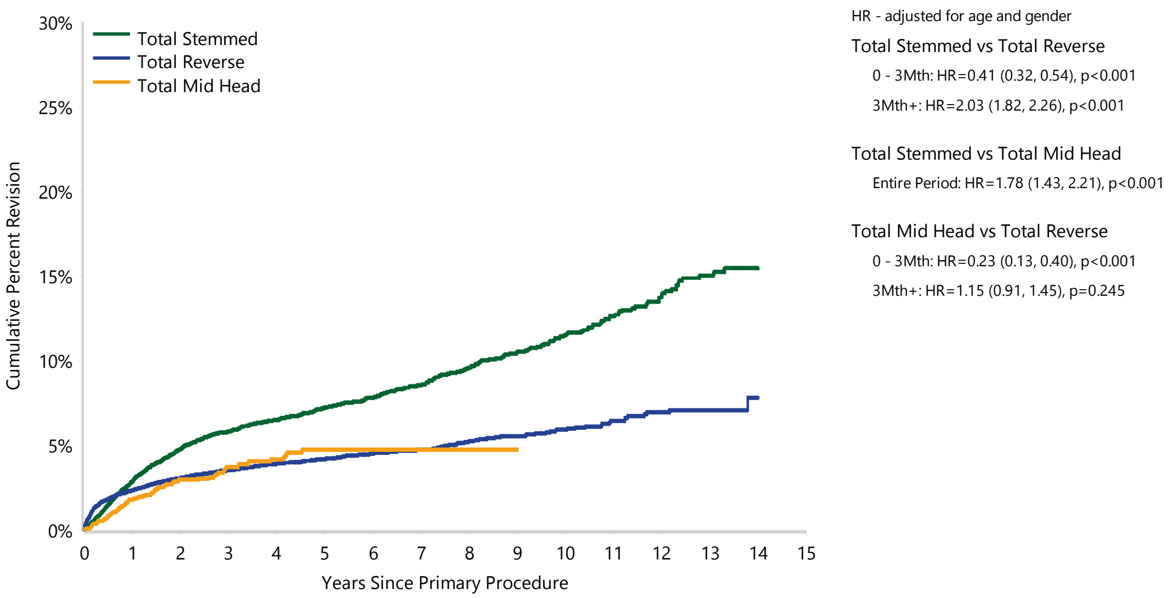
Note: Instability includes instability and dislocation

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	698	8757	2.9 (2.5, 3.2)	5.8 (5.3, 6.4)	7.2 (6.6, 7.8)	8.5 (7.9, 9.3)	11.5 (10.6, 12.5)	15.4 (13.9, 17.1)
Total Reverse	1456	40538	2.3 (2.2, 2.5)	3.5 (3.3, 3.7)	4.2 (3.9, 4.4)	4.7 (4.4, 5.0)	5.9 (5.5, 6.4)	7.8 (6.3, 9.6)
Total Mid Head	92	3079	1.8 (1.4, 2.4)	3.7 (3.0, 4.6)	4.7 (3.8, 5.9)	4.7 (3.8, 5.9)		
TOTAL	2246	52374						

Note: Restricted to modern prostheses

Figure ST2 **Cumulative Percent Revision of Primary Total Shoulder Replacement by Class (All Diagnoses)**



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Total Stemmed	8757	7882	6183	4493	2857	1267	193
Total Reverse	40538	32852	20674	11444	5909	1661	99
Total Mid Head	3079	2375	1207	463	137	1	0

Note: Restricted to modern prostheses

PATIENT REPORTED OUTCOME MEASURES – COMPARISON OF PRIMARY STEMMED AND PRIMARY REVERSE TOTAL SHOULDER REPLACEMENT

Patient reported outcome measures (PROMs) are surveys that assess dimensions of health from the perspective of the patient.

For the first time, the AOANJRR is reporting preliminary PROMs comparing primary stemmed and primary reverse total shoulder replacement. There are currently insufficient data to include separate reports on total mid head and stemmed total shoulder replacement.

More detailed analyses of the effect of patient factors on PROMs for reverse shoulder replacement used for the management of osteoarthritis and rotator cuff arthropathy are presented later in this report. However, similar detailed analyses for total stemmed and total mid head shoulder replacement are not yet available, due to limited data for these classes of prostheses.

The EQ-VAS and EQ-5D-5L are measures of quality of life. EQ-VAS is a measure of patient reported health, and ranges from 0 (worst health imaginable) to 100 (best health imaginable).

Total stemmed shoulder replacement has a higher pre-operative EQ-VAS. The EQ-VAS score increase following surgery is similar for both classes of shoulder replacement (Table ST7 and Figure ST3).

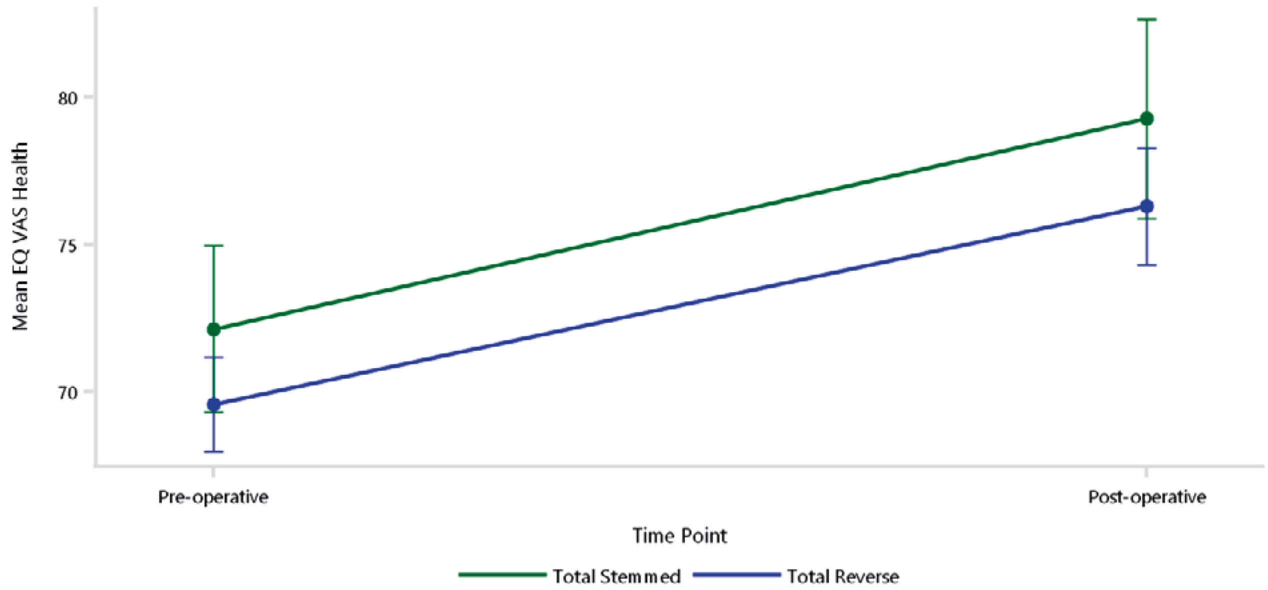
The percentage of total stemmed shoulder replacement patients who reported being better, worse or no different post-operatively compared to their pre-operative response for each of the EQ-5D domains and the EQ-VAS is shown in Figure ST4. The corresponding percentages for patients who underwent primary total reverse shoulder replacement are shown in Figure ST44.

Table ST7 Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Shoulder Replacement by Type of Primary (Primary Diagnosis OA)

Type of Primary	Pre-operative		Post-operative		
	N	Mean (95% CI)	N	Mean (95% CI)	Change in Score
Total Stemmed	178	72.14 (69.31, 74.97)	102	79.28 (75.89, 82.66)	7.14 (3.40, 10.87)
Total Reverse	549	69.57 (67.97, 71.17)	290	76.31 (74.33, 78.29)	6.74 (4.53, 8.95)

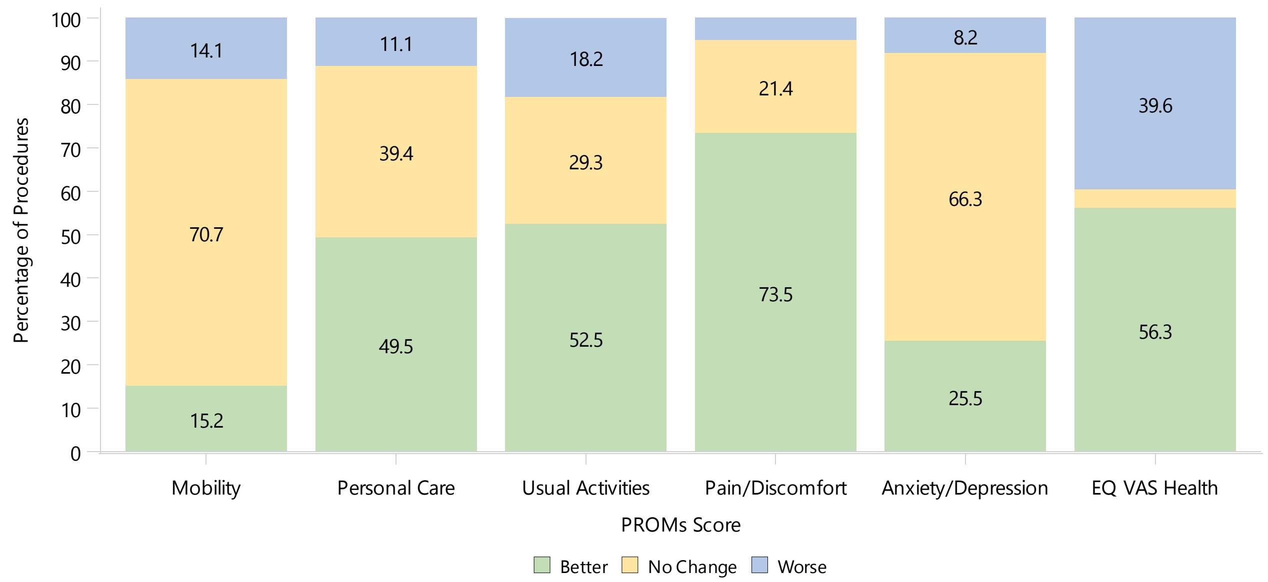
Note: Restricted to modern prostheses
Adjusted for age and gender

Figure ST3 Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Shoulder Replacement by Type of Primary (Primary Diagnosis OA)



Note: Restricted to modern prostheses
Adjusted for age and gender

Figure ST4 Change in EQ-5D-5L Domain Score and EQ-VAS Health in Primary Total Stemmed Shoulder Replacement (Primary Diagnosis OA)



Note: Restricted to modern prostheses

PROMs: Oxford Score

The Oxford Shoulder Score (OSS) provides a joint specific score of pain and function. The OSS totals the responses from 12 questions, each on a 5-level scale of 0 (worst possible score) to 4 (best possible score).

OSS scores before and 6 months after surgery for the two shoulder classes are provided in Table ST8 and shown graphically in Figure ST5.

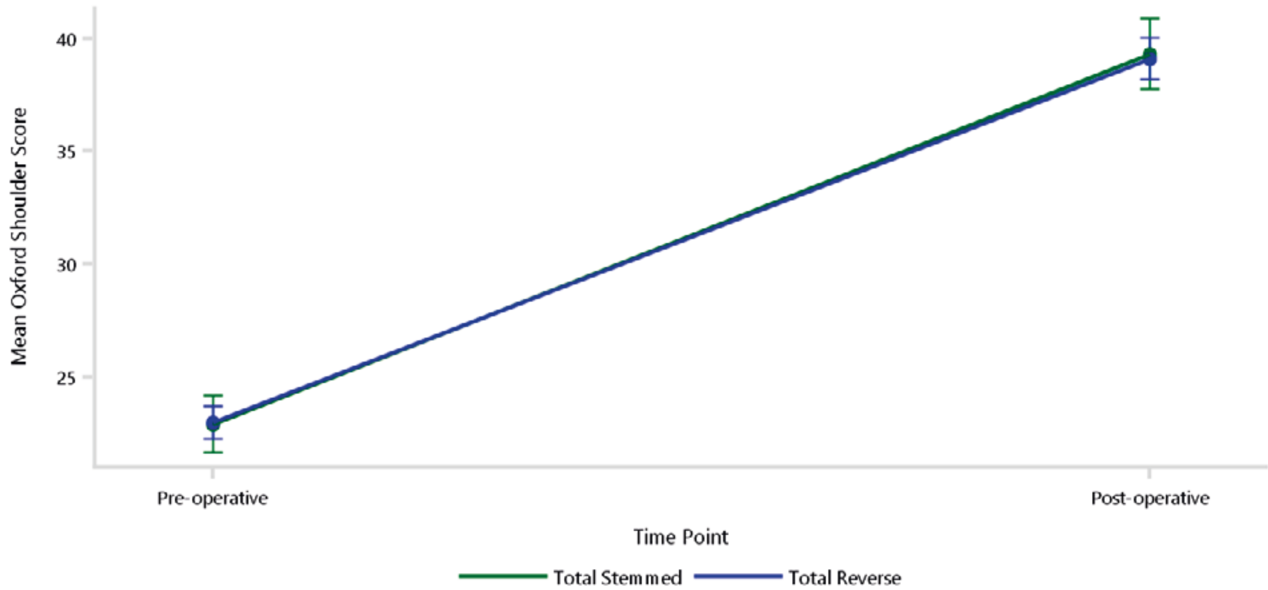
There is no difference in the pre- or post-operative score between shoulder classes and the mean change in score is just over 16 points.

Table ST8 Mean Pre-operative and Post-operative Oxford Shoulder Score in Primary Total Shoulder Replacement by Type of Primary (Primary Diagnosis OA)

Type of Primary	Pre-operative		Post-operative		
	N	Mean (95% CI)	N	Mean (95% CI)	Change in Score
Total Stemmed	176	22.93 (21.66, 24.20)	102	39.31 (37.74, 40.88)	16.38 (14.68, 18.08)
Total Reverse	545	22.99 (22.27, 23.71)	291	39.09 (38.18, 40.01)	16.11 (15.10, 17.11)

Note: Restricted to modern prostheses
Adjusted for age and gender

Figure ST5 Mean Pre-operative and Post-operative Oxford Shoulder Score in Primary Total Shoulder Replacement by Type of Primary (Primary Diagnosis OA)



Note: Restricted to modern prostheses
Adjusted for age and gender

PROMs: Patient Satisfaction and Change

Patients were surveyed at 6 months post-operatively on how satisfied they were with their primary shoulder replacement, and on their perceived change in their shoulder after surgery.

After total stemmed shoulder replacement, 90.2% of patients were either very satisfied or satisfied. After total reverse shoulder replacement, 85.5% of patients were either very satisfied or satisfied (Table ST9 and Figure ST6).

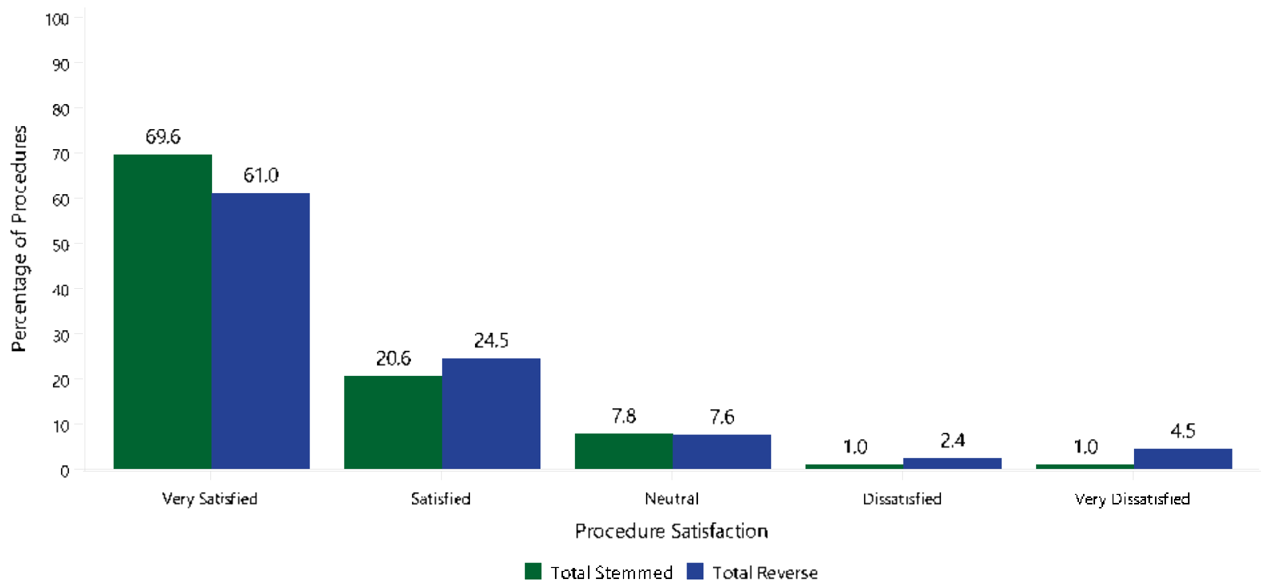
There was a high percentage (95.1%) of patients who rated their primary total stemmed shoulder replacement as much better or a little better. Patient-reported change after total reverse shoulder replacement was largely much better or a little better (94.5%) (Table ST10 and Figure ST7).

Table ST9 Procedure Satisfaction in Primary Total Shoulder Replacement by Type of Primary (Primary Diagnosis OA)

Type of Primary	Very Satisfied			Satisfied			Neutral			Dissatisfied			Very Dissatisfied			TOTAL		
	N	Row %	Col%	N	Row %	Col%	N	Row %	Col%	N	Row %	Col%	N	Row %	Col%	N	Row %	Col%
Total Stemmed	71	69.6	28.6	21	20.6	22.8	8	7.8	26.7	1	1.0	12.5	1	1.0	7.1	102	100.0	26.0
Total Reverse	177	61.0	71.4	71	24.5	77.2	22	7.6	73.3	7	2.4	87.5	13	4.5	92.9	290	100.0	74.0
TOTAL	**248**	**63.3**	**100.0**	**92**	**23.5**	**100.0**	**30**	**7.7**	**100.0**	**8**	**2.0**	**100.0**	**14**	**3.6**	**100.0**	**392**	**100.0**	**100.0**

Note: Restricted to modern prostheses

Figure ST6 Procedure Satisfaction in Primary Total Shoulder Replacement by Type of Primary (Primary Diagnosis OA



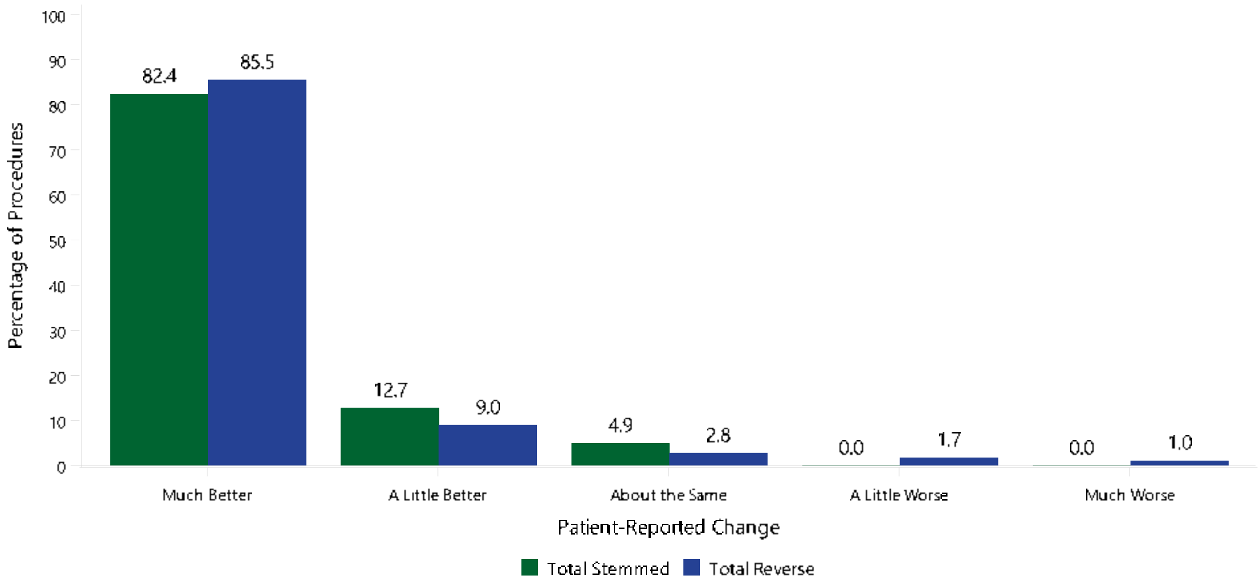
Note: Restricted to modern prostheses

Table ST10 Patient-Reported Change in Primary Total Shoulder Replacement by Type of Primary (Primary Diagnosis OA)

Type of Primary	Much Better			A Little Better			About the Same			A Little Worse			Much Worse			TOTAL		
	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%
Total Stemmed	84	82.4	25.3	13	12.7	33.3	5	4.9	38.5	.	.	.	.	.	.	102	100.0	26.0
Total Reverse	248	85.5	74.7	26	9.0	66.7	8	2.8	61.5	5	1.7	100.0	3	1.0	100.0	290	100.0	74.0
TOTAL	332	84.7	100.0	39	9.9	100.0	13	3.3	100.0	5	1.3	100.0	3	0.8	100.0	392	100.0	100.0

Note: Restricted to modern prostheses

Figure ST7 Patient-Reported Change in Primary Total Shoulder Replacement by Type of Primary (Primary Diagnosis OA)



Note: Restricted to modern prostheses

PRIMARY TOTAL MID HEAD SHOULDER REPLACEMENT

DEMOGRAPHICS AND OUTCOME

There have been 3,409 primary total mid head shoulder replacements reported to the Registry. This is an additional 681 procedures compared to the previous report.

The use of primary mid head shoulder replacement has increased by 825.4% since its first full year of use in 2012.

In order to keep Registry data contemporaneous, only procedures using prostheses that have been available and used in 2021 (described as modern prostheses) are included in the analyses, unless clearly specified.

Primary total mid head shoulder replacement is undertaken more often in females who have an older mean age than males (Table ST11).

Osteoarthritis is the most common primary diagnosis (Table ST12). The most used total mid head prostheses are listed in Table ST13 and Table ST14.

The main reasons for revision are instability/dislocation, rotator cuff insufficiency, loosening, and infection (Table ST15).

The most common types of revision involve replacement of both the humeral and glenoid components with 93.8% being revised to a total reverse shoulder replacement (Table ST16). The outcomes of the most commonly used prosthesis combinations are listed in Table ST17.

Table ST11 Age and Gender of Primary Total Mid Head Shoulder Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	1663	48.8%	31	95	65	64.5	9.3
Female	1746	51.2%	32	94	69	68.9	8.3
TOTAL	3409	100.0%	31	95	67	66.8	9.0

Table ST12 Primary Total Mid Head Shoulder Replacement by Primary Diagnosis and Gender

Primary Diagnosis	Male		Female		TOTAL	
	N	Col%	N	Col%	N	Col%
Osteoarthritis	1601	96.3	1640	93.9	3241	95.1
Osteonecrosis	14	0.8	42	2.4	56	1.6
Rotator Cuff Arthropathy	24	1.4	17	1.0	41	1.2
Rheumatoid Arthritis	5	0.3	20	1.1	25	0.7
Other Inflammatory Arthritis	4	0.2	16	0.9	20	0.6
Instability	14	0.8	6	0.3	20	0.6
Fracture	1	0.1	5	0.3	6	0.2
TOTAL	1663	100.0	1746	100.0	3409	100.0

Table ST13 Most Used Humeral Stem Prostheses in Primary Total Mid Head Shoulder Replacement

2011		2018		2019		2020		2021	
N	Model	N	Model	N	Model	N	Model	N	Model
2	Simpliciti	270	Affinis	311	Affinis	382	Affinis	362	Affinis
2	TESS	108	Simpliciti	119	Simpliciti	165	Simpliciti	197	Simpliciti
1	Affinis	39	Comprehensive	50	Comprehensive	35	Comprehensive	56	Comprehensive
		29	SMR	34	SMR	22	SMR	18	Global Icon
		13	Global Icon	17	Global Icon	13	Global Icon	18	SMR
		10	Sidus			2	Equinoxe	6	Equinoxe
						1	Sidus		
Most Used									
5	(3) 100.0%	469	(6) 100.0%	531	(5) 100.0%	620	(7) 100.0%	657	(6) 100.0%

Table ST14 Most Used Glenoid Prostheses in Primary Total Mid Head Shoulder Replacement

2011		2018		2019		2020		2021	
N	Model	N	Model	N	Model	N	Model	N	Model
2	Aequalis	257	Affinis	298	Affinis	355	Affinis	333	Affinis
1	Affinis	81	Perform	120	Perform	164	Perform	197	Perform
1	Comprehensive	38	Comprehensive	50	Comprehensive	41	Global	51	Comprehensive
1	TESS	27	Aequalis	29	Global	36	Comprehensive	47	Global
		27	Global	26	SMR L1	12	SMR L1	14	SMR L1
		15	SMR	8	SMR	9	SMR	6	Equinoxe
		14	SMR L1			2	Equinoxe	4	Alliance
		7	Anatomical Shoulder			1	Custom Made (Lima)	4	SMR
		1	Bigliani/Flatow					1	Custom Made (Comprehensive)
		1	Bigliani/Flatow TM						
10 Most Used									
5	(4) 100.0%	468	(10) 99.8%	531	(6) 100.0%	620	(8) 100.0%	657	(9) 100.0%
Remainder									
0	(0) 0%	1	(1) 0.2%	0	(0) 0%	0	(0) 0%	0	(0) 0%
TOTAL									
5	(4) 100.0%	469	(11) 100.0%	531	(6) 100.0%	620	(8) 100.0%	657	(9) 100.0%

Table ST15 Primary Total Mid Head Shoulder Replacement by Reason for Revision

Reason for Revision	Number	Percent
Instability/Dislocation	37	40.2
Rotator Cuff Insufficiency	21	22.8
Loosening	12	13.0
Infection	11	12.0
Pain	4	4.3
Malposition	1	1.1
Incorrect Sizing	1	1.1
Lysis	1	1.1
Implant Breakage Humeral	1	1.1
Arthrofibrosis	1	1.1
Fracture	1	1.1
Other	1	1.1
TOTAL	92	100.0

Note: Restricted to modern prostheses

Table ST16 Primary Total Mid Head Shoulder Replacement by Type of Revision

Type of Revision	Number	Percent
Humeral/Glenoid	65	70.7
Humeral Component	10	10.9
Head Only	7	7.6
Cement Spacer	6	6.5
Removal of Prostheses	2	2.2
Glenoid Component	1	1.1
Reoperation	1	1.1
TOTAL	92	100.0

Note: Restricted to modern prostheses

Table ST17 Cumulative Percent Revision of Primary Total Mid Head 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	64	1995	1.8 (1.2, 2.5)	3.8 (2.9, 4.9)	4.5 (3.5, 5.8)	4.5 (3.5, 5.8)		
	Global	1	81	1.6 (0.2, 10.7)	1.6 (0.2, 10.7)				
Comprehensive	Comprehensive	13	204	4.9 (2.6, 9.2)	7.4 (4.2, 13.1)				
Global Icon	Global	0	61	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)				
SMR	SMR	3	53	3.9 (1.0, 14.8)	6.1 (2.0, 17.8)				
	SMR L1	5	89	2.5 (0.6, 9.7)	6.6 (2.4, 17.7)				
Simpliciti	Perform	5	578	0.4 (0.1, 1.8)	1.2 (0.4, 3.3)				
Other (5)		1	18	14.3 (2.1, 66.6)					
TOTAL		92	3079						

Note: Only prostheses with >10 procedures have been listed
Restricted to modern prostheses

PRIMARY TOTAL STEMMED SHOULDER REPLACEMENT

DEMOGRAPHICS

There have been 15,463 total stemmed shoulder replacements reported to the Registry. This is an additional 591 procedures compared to the previous report.

Although the proportional use in males has increased since 2008, the majority of procedures are undertaken in females. The mean age of females is older than males (Figure ST8 and Table ST18).

Almost 50% of procedures are undertaken in the 65-74 year age group. The proportional use in older patients has declined (Figure ST9). Osteoarthritis (94.3%) is the most common primary diagnosis (Table ST19).

The use of total stemmed shoulder replacement, as in previous years, continues to decline.

Figure ST8 **Primary Total Stemmed Shoulder Replacement by Gender**

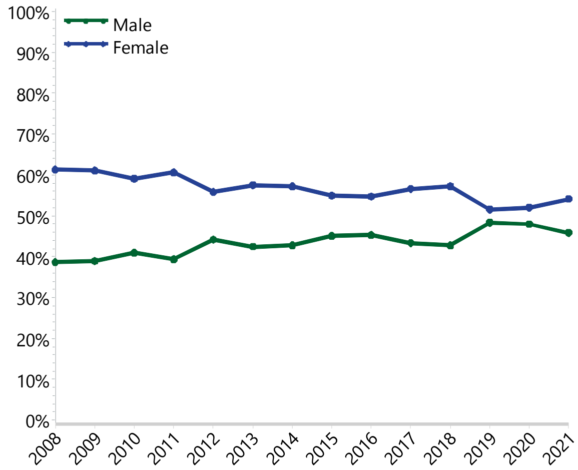


Figure ST9 **Primary Total Stemmed Shoulder Replacement by Age**

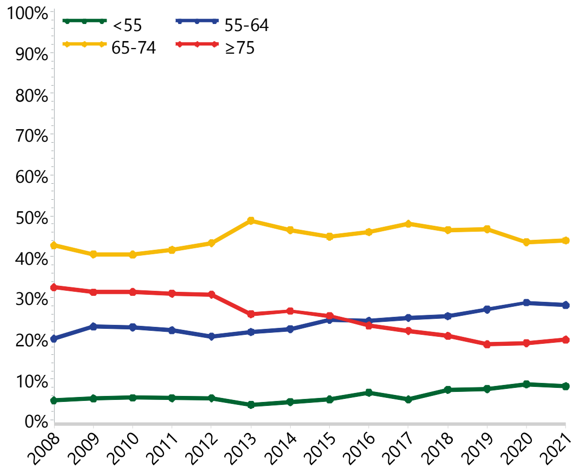


Table ST18 **Age and Gender of Primary Total Stemmed Shoulder Replacement**

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	6622	42.8%	21	93	67	66.8	9.0
Female	8841	57.2%	19	96	71	70.3	8.5
TOTAL	**15463**	**100.0%**	**19**	**96**	**69**	**68.8**	**8.9**

Table ST19 Primary Total Stemmed Shoulder Replacement by Primary Diagnosis and Gender

Primary Diagnosis	Male		Female		TOTAL	
	N	Col%	N	Col%	N	Col%
Osteoarthritis	6346	95.8	8240	93.2	14586	94.3
Rheumatoid Arthritis	64	1.0	195	2.2	259	1.7
Osteonecrosis	70	1.1	185	2.1	255	1.6
Fracture	35	0.5	93	1.1	128	0.8
Other Inflammatory Arthritis	30	0.5	60	0.7	90	0.6
Rotator Cuff Arthropathy	41	0.6	41	0.5	82	0.5
Instability	29	0.4	17	0.2	46	0.3
Tumour	4	0.1	7	0.1	11	0.1
Other	3	0.0	3	0.0	6	0.0
TOTAL	6622	100.0	8841	100.0	15463	100.0

Note: Instability includes dislocation

The most common type of fixation is hybrid fixation (cementless humerus and cemented glenoid) (Figure ST10).

Hybrid fixation with a cemented glenoid has increased from 55.8% in 2010 to 79.1% in 2021.

The 10 most used humeral stem and glenoid prostheses are listed in Table ST20 and Table ST21.

Figure ST10 Primary Total Stemmed Shoulder Replacement by Fixation

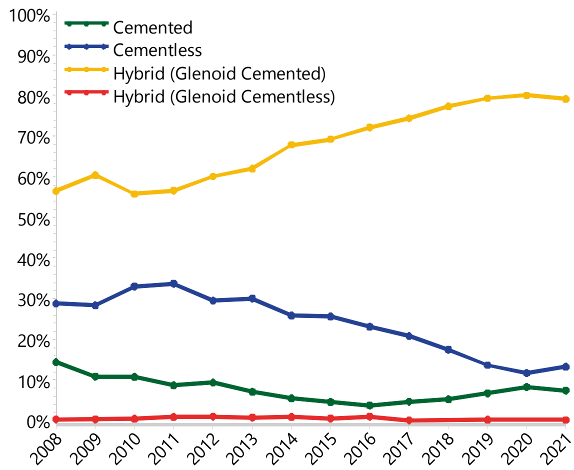


Table ST20 10 Most Used Humeral Stem Prostheses in Primary Total Stemmed Shoulder Replacement

2008		2018		2019		2020		2021	
N	Model	N	Model	N	Model	N	Model	N	Model
298	SMR	176	Ascend Flex	175	Ascend Flex	143	Ascend Flex	173	Ascend Flex
167	Aequalis	146	Comprehensive	128	Global Unite	111	Global Unite	91	Global Unite
117	Global Advantage	145	SMR	119	Comprehensive	94	Comprehensive	84	Comprehensive
91	Global AP	137	Global Unite	119	SMR	92	Equinoxe	83	Equinoxe
40	Bigliani/Flatow	135	Global AP	105	Equinoxe	88	SMR	83	SMR
37	Bigliani/Flatow TM	79	Equinoxe	81	Global AP	77	Global AP	57	Global AP
32	Solar	36	Bigliani/Flatow TM	29	Bigliani/Flatow TM	19	Global Advantage	4	Bigliani/Flatow TM
27	Affinis	16	Global Advantage	10	Global Advantage	9	Bigliani/Flatow TM	2	Delta Xtend
11	Univers 3D	14	Turon	6	MSS	5	Turon	2	Global Advantage
10	Cofield 2	11	Aequalis	5	Turon	2	Affinis	1	Affinis
10 Most Used									
830	(10) 97.9%	895	(10) 99.4%	777	(10) 99.2%	640	(10) 100.0%	580	(10) 100.0%
Remainder									
18	(7) 2.1%	5	(3) 0.6%	6	(2) 0.8%	0	(0) 0%	0	(0) 0%
TOTAL									
848	(17) 100.0%	900	(13) 100.0%	783	(12) 100.0%	640	(10) 100.0%	580	(10) 100.0%

Table ST21 10 Most Used Glenoid Prostheses in Primary Total Stemmed Shoulder Replacement

2008		2018		2019		2020		2021	
N	Model	N	Model	N	Model	N	Model	N	Model
237	SMR L1	288	Global	221	Global	207	Global	174	Perform
209	Global	153	Perform	179	Perform	143	Perform	151	Global
167	Aequalis	139	Comprehensive	114	Comprehensive	92	Equinoxe	83	Equinoxe
79	Bigliani/Flatow	128	SMR L1	105	Equinoxe	91	Comprehensive	71	Comprehensive
57	SMR	79	Equinoxe	98	SMR L1	72	SMR L1	70	SMR L1
32	Solar	34	Aequalis	23	Bigliani/Flatow	15	SMR	13	Alliance
27	Affinis	21	Bigliani/Flatow	18	SMR	8	Bigliani/Flatow	10	SMR
11	Univers 3D	16	Bigliani/Flatow TM	6	Bigliani/Flatow TM	5	Turon	3	Bigliani/Flatow
10	Cofield 2	14	SMR	6	MSS	2	Affinis	2	SMR Axioma
7	Promos	14	Turon	5	Custom Made (Comprehensive)	2	Alliance	1	Affinis
10 Most Used									
836	(10) 98.6%	886	(10) 98.4%	775	(10) 99.0%	637	(10) 99.5%	578	(10) 99.7%
Remainder									
12	(6) 1.4%	14	(5) 1.6%	8	(3) 1.0%	3	(3) 0.5%	2	(2) 0.3%
TOTAL									
848	(16) 100.0%	900	(15) 100.0%	783	(13) 100.0%	640	(13) 100.0%	580	(12) 100.0%

OUTCOME FOR ALL DIAGNOSES

Primary Diagnosis

The Registry recognises that the usage and availability of prostheses change with time. In order to keep Registry data contemporaneous, only procedures using prostheses that have been available and used in 2021 (described as modern prostheses) are included in the analyses, unless clearly specified. This change to the assessment of the overall cumulative percent revision has been made to ensure that it reflects the use of currently available prostheses.

At 14 years, the cumulative percent revision for primary total stemmed shoulder replacement undertaken for osteoarthritis is 15.3%.

There is no difference in the rate of revision when osteoarthritis is compared to other primary diagnoses. However, the number of procedures undertaken for other diagnoses is small (Table ST22 and Figure ST11).

Reason for Revision

The most common reason for revision is rotator cuff insufficiency followed by instability/ dislocation, and loosening (Table ST23 and Figure ST12).

Type of Revision

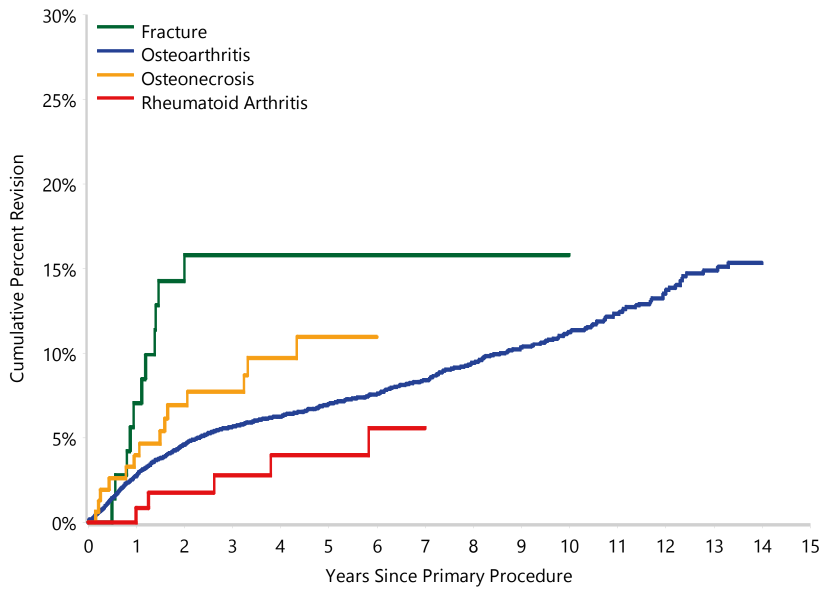
The most common type of revision is of the humeral component only. This may include the revision of a humeral component (epiphysis and/or humeral stem) and additional minor components, such as the humeral head/glenosphere and/or removal of the glenoid component (Table ST24). Almost all are revised to a total reverse shoulder replacement with retention of the original humeral stem on most occasions (87.4%).

Table ST22 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement by Primary Diagnosis

Primary Diagnosis	N Revised	N Total	Primary Percent	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Osteoarthritis	646	8269	94.4%	2.8 (2.4, 3.1)	5.7 (5.2, 6.2)	7.0 (6.4, 7.6)	8.4 (7.7, 9.1)	11.2 (10.3, 12.3)	15.3 (13.7, 17.1)
Osteonecrosis	14	157	1.8%	4.0 (1.8, 8.6)	7.7 (4.3, 13.5)	11.0 (6.5, 18.1)			
Rheumatoid Arthritis	9	118	1.3%	0.9 (0.1, 6.1)	2.8 (0.9, 8.4)	4.0 (1.5, 10.3)	5.6 (2.3, 13.3)		
Fracture	11	73	0.8%	7.1 (3.0, 16.1)	15.8 (9.1, 26.7)	15.8 (9.1, 26.7)	15.8 (9.1, 26.7)	15.8 (9.1, 26.7)	
Rotator Cuff Arthropathy	9	56	0.6%	7.1 (2.7, 17.9)	13.5 (6.6, 26.3)	16.0 (8.3, 29.7)	16.0 (8.3, 29.7)		
Other Inflammatory Arthritis	5	48	0.5%	6.6 (2.2, 19.0)	6.6 (2.2, 19.0)	9.2 (3.5, 22.7)	9.2 (3.5, 22.7)	16.2 (6.0, 39.3)	
Other (3)	4	36	0.4%	5.8 (1.5, 21.4)	9.9 (3.2, 28.2)	15.9 (5.9, 38.9)	15.9 (5.9, 38.9)		
TOTAL	**698**	**8757**	**100.0%**						

Note: Only primary diagnoses with >30 procedures have been listed
Restricted to modern prostheses

Figure ST11 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement by Primary Diagnosis



HR - adjusted for age and gender

Fracture vs Osteoarthritis
Entire Period: HR=1.77 (0.97, 3.21), p=0.060

Osteonecrosis vs Osteoarthritis
Entire Period: HR=1.01 (0.59, 1.73), p=0.970

Rheumatoid Arthritis vs Osteoarthritis
Entire Period: HR=0.69 (0.35, 1.33), p=0.266

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Fracture	73	65	49	41	32	12	1
Osteoarthritis	8269	7445	5848	4259	2703	1197	181
Osteonecrosis	157	140	103	59	37	16	4
Rheumatoid Arthritis	118	113	92	69	51	26	5

Note: Only primary diagnoses with >70 procedures have been listed
Restricted to modern prostheses

Table ST23 Primary Total Stemmed Shoulder Replacement by Reason for Revision

Reason for Revision	Number	Percent
Rotator Cuff Insufficiency	237	34.0
Instability/Dislocation	187	26.8
Loosening	112	16.0
Infection	44	6.3
Fracture	21	3.0
Pain	15	2.1
Arthrofibrosis	12	1.7
Wear Glenoid Insert	10	1.4
Malposition	9	1.3
Lysis	8	1.1
Incorrect Sizing	8	1.1
Implant Breakage Glenoid Insert	7	1.0
Implant Breakage Glenoid	7	1.0
Dissociation	6	0.9
Metal Related Pathology	6	0.9
Progression Of Disease	2	0.3
Other	7	1.0
TOTAL	698	100.0

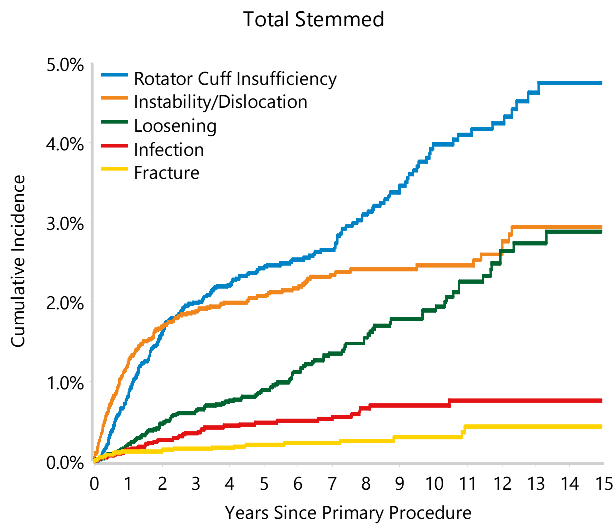
Note: Restricted to modern prostheses

Table ST24 Primary Total Stemmed Shoulder Replacement by Type of Revision

Type of Revision	Number	Percent
Humeral Component	380	54.4
Humeral/Glenoid	197	28.2
Head Only	53	7.6
Glenoid Component	28	4.0
Cement Spacer	22	3.2
Removal of Prostheses	6	0.9
Reoperation	5	0.7
Minor Components	3	0.4
Head/Insert	2	0.3
Reinsertion of Components	1	0.1
Cement Only	1	0.1
TOTAL	698	100.0

Note: Humeral heads are replaced when the humeral component is revised
Restricted to modern prostheses

Figure ST12 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Shoulder Replacement



Note: Restricted to modern prostheses

OUTCOME FOR OSTEOARTHRITIS - PATIENT CHARACTERISTICS

Age and Gender

Patients aged ≥65 years have a lower rate of revision compared to patients aged <55 years (Table ST25 and Figure ST13).

There is no difference in the rate of revision between males and females (Table ST26 and Figure ST14).

There is no difference in the rate of revision between males and females for osteoarthritis.

ASA and BMI

Most patients have an ASA score of 2 or 3. ASA score does not affect the rate of revision (Table ST27 and Figure ST15). The most common reasons for revision by ASA score are presented in Figure ST16.

The most common BMI categories are pre-obese and obese class 1. BMI is not a risk factor for revision (Table ST28 and Figure ST17). The most common reasons for revision by BMI category are shown in Figure ST18.

Glenoid Morphology

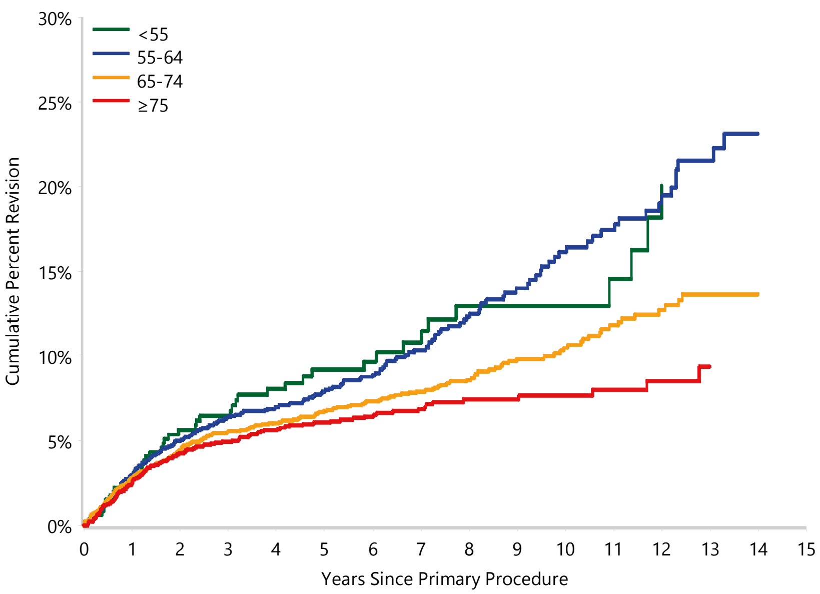
The Registry has information on the early outcome of 2,695 primary total stemmed shoulder replacement procedures for osteoarthritis by glenoid morphology category. The cumulative percent revision for the different morphology categories is presented in Table ST29. The category of glenoid morphology is not a risk factor for revision (Figure ST19).

Table ST25 Cumulative Percent Revision of Primary Total Stemmed 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	45	470	2.9 (1.7, 5.0)	6.5 (4.5, 9.3)	9.2 (6.6, 12.7)	10.8 (7.8, 14.8)	13.0 (9.4, 17.8)	
55-64	201	2035	3.0 (2.3, 3.8)	6.4 (5.4, 7.6)	7.9 (6.7, 9.3)	10.4 (8.9, 12.1)	16.2 (13.7, 19.0)	23.1 (19.1, 27.8)
65-74	274	3716	2.8 (2.3, 3.4)	5.6 (4.8, 6.4)	6.8 (6.0, 7.7)	7.9 (7.0, 9.0)	10.5 (9.1, 12.0)	13.7 (11.6, 16.0)
≥75	126	2048	2.5 (1.9, 3.3)	5.0 (4.1, 6.1)	6.1 (5.1, 7.3)	6.9 (5.8, 8.2)	7.7 (6.4, 9.2)	
TOTAL	**646**	**8269**						

Note: Restricted to modern prostheses

Figure ST13 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement by Age (Primary Diagnosis OA)



HR - adjusted for gender

55-64 vs <55

Entire Period: HR=0.99 (0.72, 1.37), p=0.964

65-74 vs <55

Entire Period: HR=0.71 (0.52, 0.98), p=0.037

≥75 vs <55

Entire Period: HR=0.57 (0.41, 0.81), p=0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
<55	470	414	310	226	132	68	15
55-64	2035	1814	1389	1008	620	288	48
65-74	3716	3357	2635	1894	1218	533	81
≥75	2048	1860	1514	1131	733	308	37

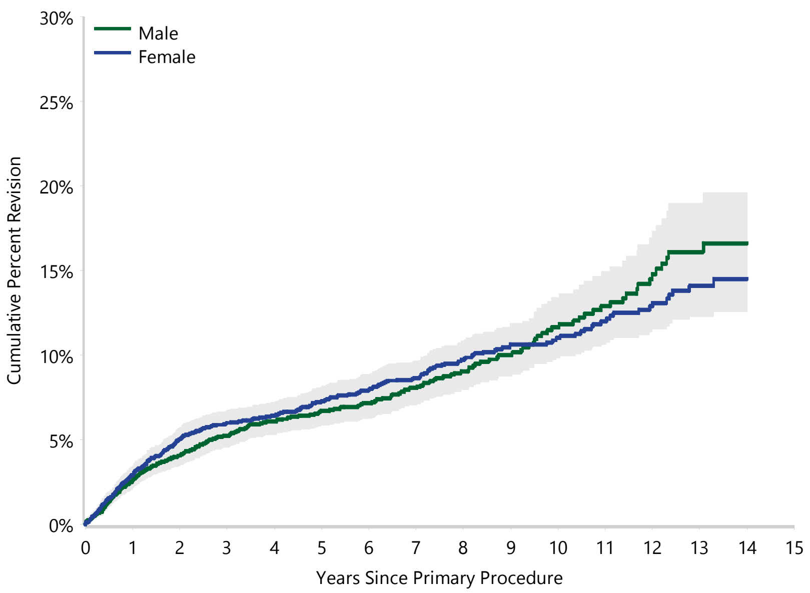
Note: Restricted to modern prostheses

Table ST26 Cumulative Percent Revision of Primary Total Stemmed 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	278	3693	2.6 (2.1, 3.2)	5.2 (4.5, 6.1)	6.7 (5.9, 7.7)	8.1 (7.1, 9.2)	11.6 (10.1, 13.4)	16.6 (14.0, 19.6)
Female	368	4576	2.9 (2.4, 3.4)	6.0 (5.3, 6.8)	7.3 (6.5, 8.1)	8.7 (7.8, 9.7)	11.0 (9.8, 12.3)	14.5 (12.6, 16.7)
TOTAL	**646**	**8269**						

Note: Restricted to modern prostheses

Figure ST14 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement by Gender (Primary Diagnosis OA)



HR - adjusted for age
Female vs Male
Entire Period: HR=1.13 (0.96, 1.32), p=0.135

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Male	3693	3322	2558	1857	1147	478	76
Female	4576	4123	3290	2402	1556	719	105

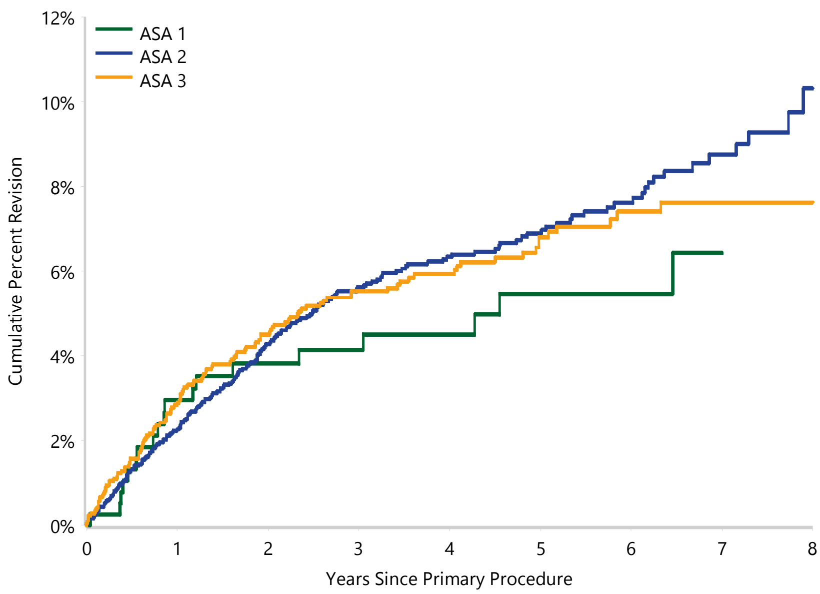
Note: Restricted to modern prostheses

Table ST27 **Cumulative Percent Revision of Primary Total Stemmed 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	19	386	3.0 (1.6, 5.3)	3.8 (2.3, 6.4)	4.1 (2.5, 6.8)	5.5 (3.4, 8.6)	6.4 (3.9, 10.4)	
ASA 2	197	3185	2.3 (1.8, 2.9)	4.3 (3.6, 5.1)	5.6 (4.8, 6.5)	6.9 (5.9, 8.0)	8.7 (7.5, 10.2)	10.3 (8.4, 12.6)
ASA 3	122	2138	2.9 (2.2, 3.7)	4.5 (3.7, 5.5)	5.5 (4.6, 6.7)	6.8 (5.7, 8.2)	7.6 (6.3, 9.2)	7.6 (6.3, 9.2)
ASA 4	1	58	1.9 (0.3, 12.4)	1.9 (0.3, 12.4)	1.9 (0.3, 12.4)	1.9 (0.3, 12.4)		
ASA 5	0	1						
TOTAL	339	5768						

Note: Restricted to modern prostheses

Figure ST15 **Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement by ASA Score (Primary Diagnosis OA)**



HR - adjusted for age and gender

ASA 2 vs ASA 1

Entire Period: HR=1.44 (0.89, 2.31), p=0.135

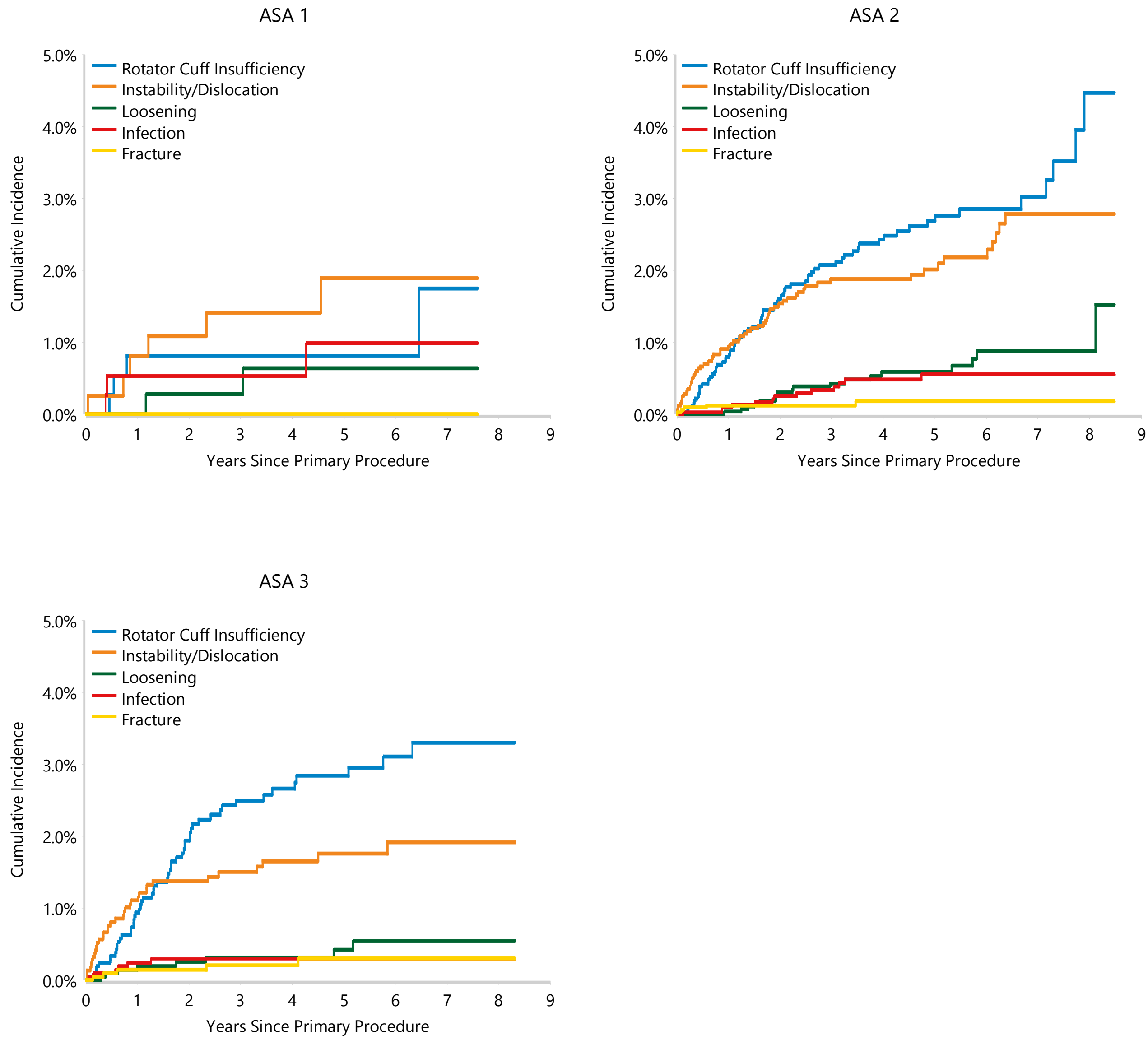
ASA 3 vs ASA 1

Entire Period: HR=1.42 (0.87, 2.32), p=0.165

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	8 Yrs
ASA 1	386	350	305	266	178	75	16
ASA 2	3185	2790	2402	1984	1168	423	139
ASA 3	2138	1856	1601	1300	762	249	82

Note: Restricted to modern prostheses

Figure ST16 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Shoulder Replacement by ASA Score (Primary Diagnosis OA)



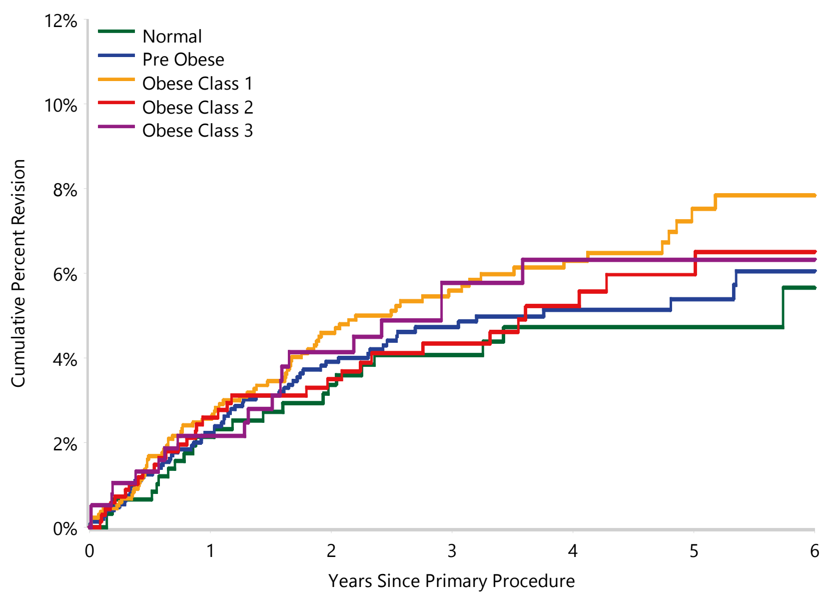
Note: Restricted to modern prostheses

Table ST28 Cumulative Percent Revision of Primary Total Stemmed 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	11	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)				
Normal	25	612	2.1 (1.2, 3.7)	3.4 (2.1, 5.3)	4.1 (2.7, 6.2)	4.7 (3.1, 7.1)	4.7 (3.1, 7.1)	5.7 (3.5, 9.0)
Pre Obese	66	1466	2.2 (1.6, 3.2)	3.9 (3.0, 5.1)	4.7 (3.7, 6.1)	5.1 (4.0, 6.6)	5.4 (4.2, 6.9)	6.1 (4.6, 7.9)
Obese Class 1	76	1345	2.6 (1.8, 3.6)	4.6 (3.5, 6.0)	5.6 (4.4, 7.1)	6.3 (5.0, 8.0)	7.5 (5.9, 9.6)	7.8 (6.1, 10.0)
Obese Class 2	32	693	2.6 (1.6, 4.2)	3.5 (2.3, 5.3)	4.3 (3.0, 6.4)	5.2 (3.6, 7.5)	6.0 (4.1, 8.6)	6.5 (4.5, 9.4)
Obese Class 3	19	385	2.2 (1.1, 4.3)	4.1 (2.5, 6.9)	5.8 (3.7, 9.1)	6.3 (4.0, 9.9)	6.3 (4.0, 9.9)	6.3 (4.0, 9.9)
TOTAL	218	4512						

Note: Restricted to modern prostheses
BMI has not been presented for patients aged ≤19 years

Figure ST17 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement by BMI Category (Primary Diagnosis OA)



HR - adjusted for age and gender
Pre Obese vs Normal
Entire Period: HR=1.13 (0.71, 1.79), p=0.617

Obese Class 1 vs Normal
Entire Period: HR=1.38 (0.88, 2.17), p=0.162

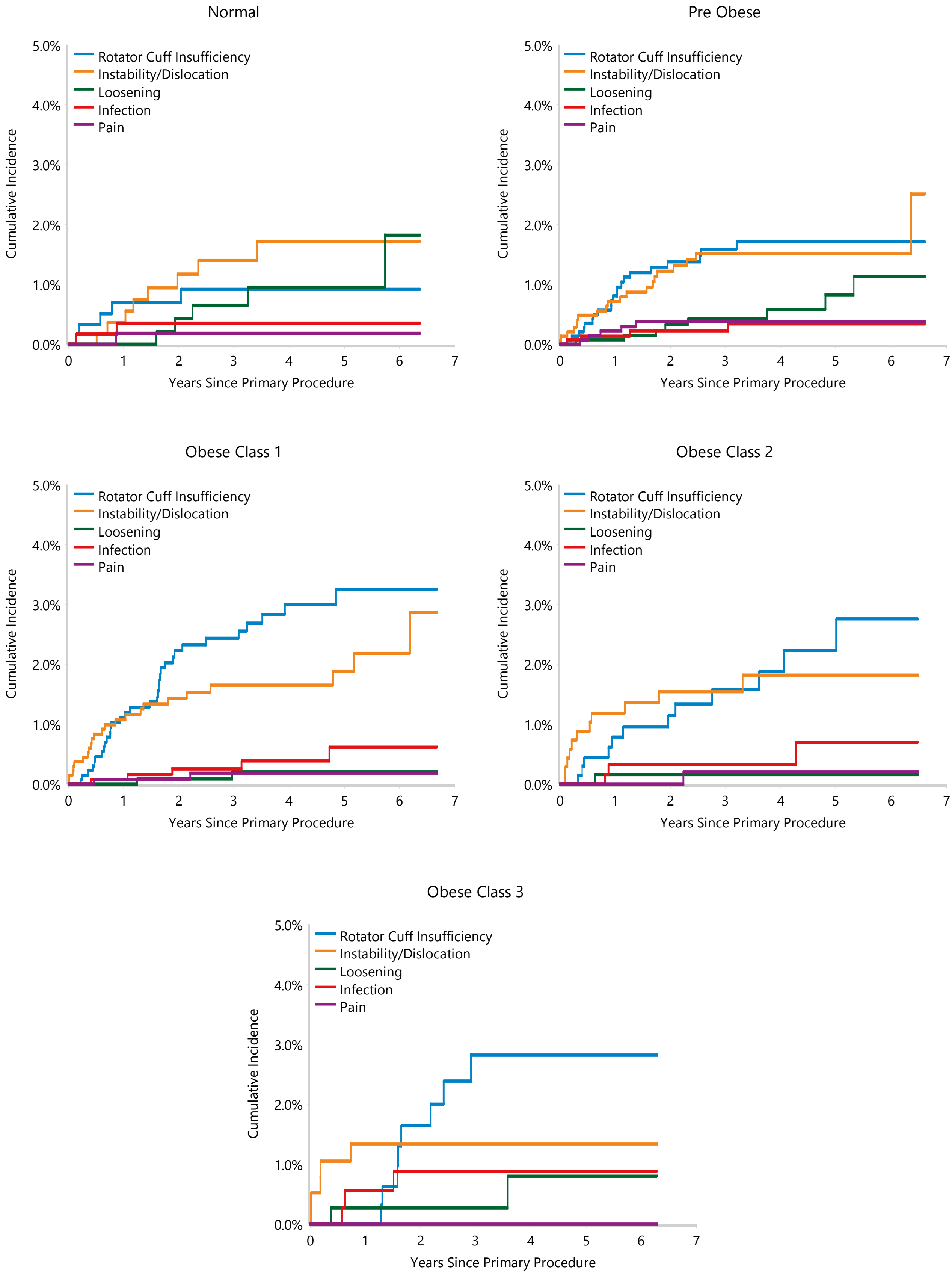
Obese Class 2 vs Normal
Entire Period: HR=1.10 (0.65, 1.86), p=0.726

Obese Class 3 vs Normal
Entire Period: HR=1.13 (0.62, 2.05), p=0.695

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Normal	612	507	431	340	236	157	79
Pre Obese	1466	1255	1039	789	548	343	154
Obese Class 1	1345	1162	961	746	536	323	151
Obese Class 2	693	586	491	379	268	173	71
Obese Class 3	385	329	265	210	151	105	50

Note: BMI has not been presented for patients aged ≤19 years
Restricted to modern prostheses

Figure ST18 **Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Shoulder Replacement by BMI Category (Primary Diagnosis OA)**



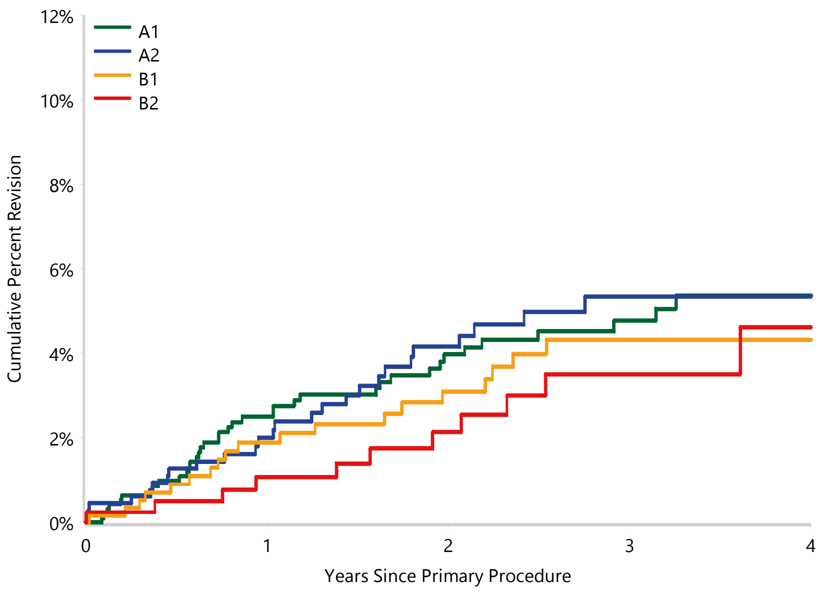
Note: BMI has not been presented for patients aged ≤19 years
Restricted to modern prostheses

Table ST29 **Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement by Glenoid Morphology (Primary Diagnosis OA)**

Glenoid Morphology	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs
A1	38	955	2.5 (1.7, 3.8)	4.0 (2.8, 5.6)	4.8 (3.4, 6.6)	5.4 (3.9, 7.4)
A2	26	661	2.0 (1.1, 3.5)	4.2 (2.7, 6.3)	5.3 (3.6, 7.8)	5.3 (3.6, 7.8)
B1	19	577	1.9 (1.0, 3.5)	3.1 (1.9, 5.1)	4.3 (2.7, 6.8)	4.3 (2.7, 6.8)
B2	11	411	1.1 (0.4, 2.8)	2.1 (1.0, 4.5)	3.5 (1.9, 6.5)	4.6 (2.4, 8.9)
C	2	91	2.4 (0.6, 9.3)	2.4 (0.6, 9.3)	2.4 (0.6, 9.3)	
TOTAL	96	2695				

Note: Restricted to modern prostheses
3 procedures have been excluded where a glenoid morphology of B3 was recorded

Figure ST19 **Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement by Glenoid Morphology (Primary Diagnosis OA)**



HR - adjusted for age and gender

A2 vs A1

Entire Period: HR=1.02 (0.62, 1.68), p=0.945

B1 vs A1

Entire Period: HR=0.79 (0.45, 1.37), p=0.396

B2 vs A1

Entire Period: HR=0.62 (0.31, 1.23), p=0.172

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs
A1	955	762	576	372	160
A2	661	513	381	239	93
B1	577	468	357	221	88
B2	411	339	247	141	58

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. There is no difference between cemented and hybrid (glenoid cemented) fixation (Table ST30 and Figure ST20).

Glenoid Type and Design

An analysis was undertaken to determine the impact of glenoid type. There are three broad glenoid types: modular metal backed, non modular metal backed and all-polyethylene. Cemented all-polyethylene glenoids are the most common type of glenoid used. These prostheses have a lower rate of revision compared to modular metal backed glenoids over the entire period and when compared to non modular metal backed glenoid prostheses in the first 1.5 years. Modular metal backed glenoids have a higher rate of revision compared to non modular metal backed glenoids (Table ST31 and Figure ST21). When a modular metal backed glenoid was revised, 92.8% retained the metal glenoid component (base plate) and replaced the modular insert with a glenosphere. The humeral stem was also revised in only a small number of revisions.

Pegged and keeled all-polyethylene glenoid prostheses were also compared. The majority of all-polyethylene glenoid prostheses are pegged. There is no difference in the rate of revision between these prostheses (Table ST32 and Figure ST22).

The most common type of polyethylene used is non XLPE. XLPE increased in use up to 2015 but has remained relatively constant since that time (Figure ST23).

Glenoid prostheses using XLPE have a lower rate of revision compared to non XLPE (Table ST33 and Figure ST24).

This is also the case when only cemented all-polyethylene glenoids using non XLPE and XLPE are compared (Table ST34 and Figure ST25). However, it remains uncertain if these differences are due to the XLPE or the prosthesis with which it is used.

XLPE glenoids have a lower rate of revision than non XLPE glenoids.

When the use of XLPE with cemented pegged and keeled prostheses was compared, pegged cemented glenoids have a higher rate of revision when non XLPE is used compared to when XLPE is used. There is no difference in the revision rate for keeled cemented prostheses or between the two different glenoid designs when the outcome for non XLPE and XLPE is assessed (Table ST35 and Figure ST26).

Humeral Heads

Humeral head sizes <44mm have the highest rate of revision. This rate of revision decreases with increasing humeral head size. Humeral heads >50mm have the lowest rate of revision (Table ST36 and Figure ST27). The cumulative incidence for the most common reasons for revision for the different head sizes is shown in Figure ST28.

Humeral head sizes <44mm have the highest rate of revision.

Prosthesis Types

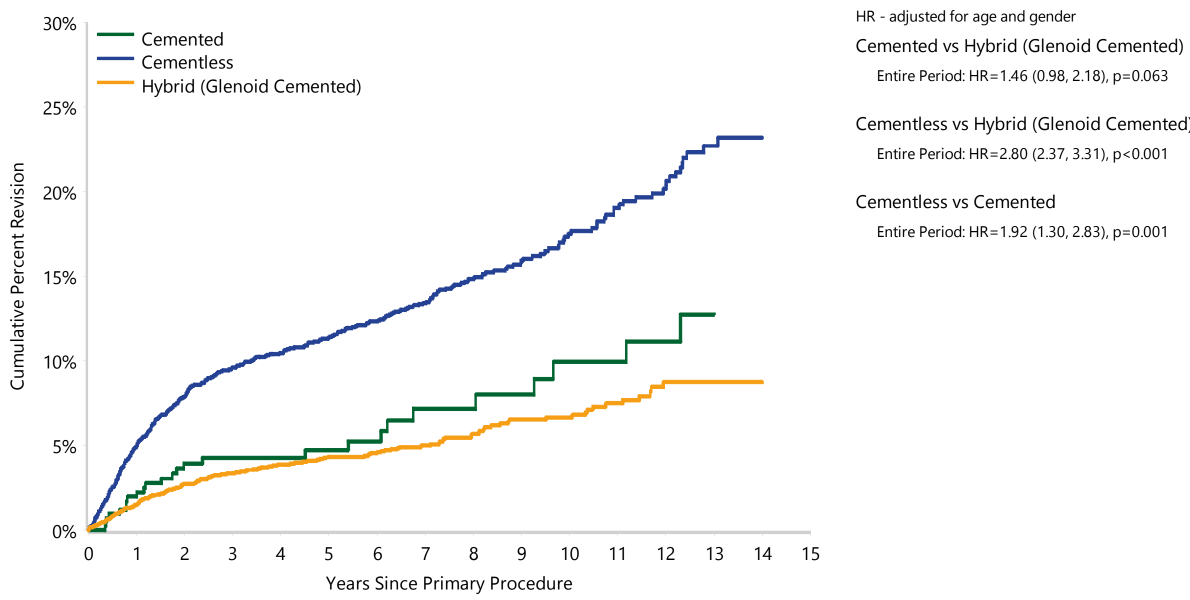
The outcomes of the most commonly used prosthesis combinations are listed in Table ST37. The most commonly used cementless prosthesis combinations are listed in Table ST38. The most commonly used prosthesis combinations with hybrid (glenoid cemented) fixation are listed in Table ST39.

Table ST30 Cumulative Percent Revision of Primary Total Stemmed 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	27	429	2.0 (1.0, 3.9)	4.3 (2.6, 6.9)	4.7 (2.9, 7.6)	7.2 (4.6, 11.2)	9.9 (6.4, 15.4)	
Cementless	398	2793	5.0 (4.2, 5.9)	9.6 (8.5, 10.8)	11.4 (10.2, 12.7)	13.4 (12.1, 14.8)	17.5 (15.7, 19.4)	23.2 (20.4, 26.3)
Hybrid (Glenoid Cemented)	214	4995	1.5 (1.2, 1.9)	3.4 (2.9, 4.0)	4.3 (3.7, 5.0)	5.0 (4.3, 5.8)	6.7 (5.7, 7.8)	8.7 (7.2, 10.6)
Hybrid (Glenoid Cementless)	7	52	5.8 (1.9, 16.9)	7.9 (3.0, 19.7)	14.5 (7.2, 28.2)	14.5 (7.2, 28.2)	14.5 (7.2, 28.2)	
TOTAL	**646**	**8269**						

Note: Restricted to modern prostheses

Figure ST20 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement by Fixation (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Cemented	429	377	265	186	127	87	17
Cementless	2793	2564	2233	1853	1272	481	56
Hybrid (Glenoid Cemented)	4995	4457	3306	2182	1280	621	107

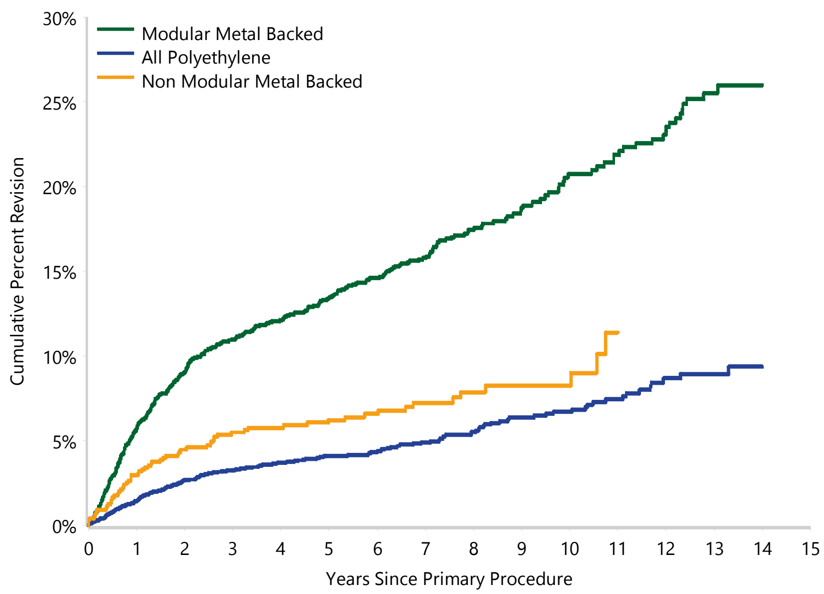
Note: Only fixations with >100 procedures have been listed
Restricted to modern prostheses

Table ST31 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement by Glenoid Type (Primary Diagnosis OA)

Glenoid Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Modular Metal Backed	360	2178	5.7 (4.8, 6.8)	11.0 (9.7, 12.4)	13.4 (12.0, 15.0)	15.8 (14.2, 17.5)	20.7 (18.6, 23.1)	26.0 (23.0, 29.3)
All Polyethylene	221	5125	1.4 (1.1, 1.8)	3.3 (2.8, 3.8)	4.1 (3.5, 4.8)	4.9 (4.2, 5.7)	6.7 (5.7, 7.9)	9.4 (7.7, 11.4)
Non Modular Metal Backed	65	966	3.0 (2.1, 4.3)	5.5 (4.2, 7.2)	6.2 (4.8, 8.1)	7.2 (5.6, 9.3)	8.2 (6.4, 10.7)	
TOTAL	646	8269						

Note: Restricted to modern prostheses

Figure ST21 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement by Glenoid Type (Primary Diagnosis OA)



HR - adjusted for age and gender

Modular Metal Backed vs All Polyethylene
Entire Period: HR=3.30 (2.79, 3.91), p<0.001

Modular Metal Backed vs
Non Modular Metal Backed
Entire Period: HR=2.26 (1.74, 2.95), p<0.001

Non Modular Metal Backed vs All Polyethylene
0 - 1.5Yr: HR=1.72 (1.20, 2.47), p=0.003
1.5Yr - 2.5Yr: HR=0.92 (0.42, 1.99), p=0.827
2.5Yr+: HR=1.38 (0.88, 2.18), p=0.161

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Modular Metal Backed	2178	1973	1680	1368	947	371	57
All Polyethylene	5125	4595	3461	2314	1390	706	124
Non Modular Metal Backed	966	877	707	577	366	120	0

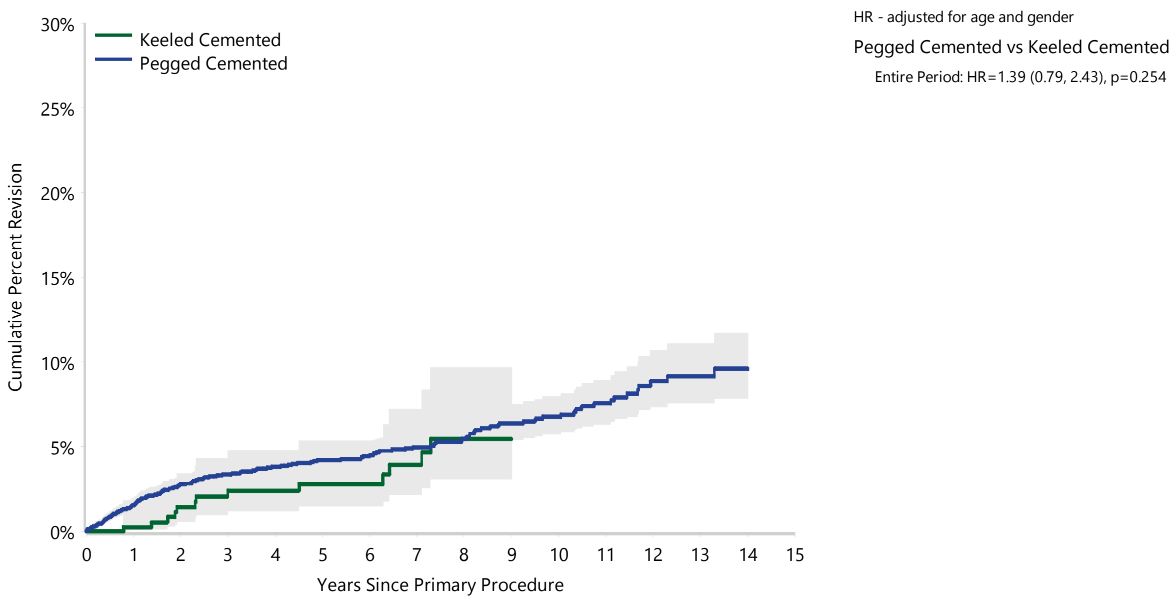
Note: Restricted to modern prostheses

Table ST32 Cumulative Percent Revision of All-Polyethylene Cemented Primary Total Stemmed Shoulder Replacement by Glenoid Design (Primary Diagnosis OA)

Glenoid Design	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Keeled Cemented	13	424	0.3 (0.0, 1.9)	2.4 (1.2, 4.8)	2.8 (1.5, 5.4)	4.0 (2.2, 7.2)		
Pegged Cemented	208	4698	1.5 (1.2, 2.0)	3.4 (2.8, 3.9)	4.2 (3.6, 4.9)	5.0 (4.3, 5.8)	6.8 (5.7, 8.0)	9.6 (7.8, 11.7)
TOTAL	221	5122						

Note: Restricted to modern prostheses

Figure ST22 Cumulative Percent Revision of All-Polyethylene Cemented Primary Total Stemmed Shoulder Replacement by Glenoid Design (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Keeled Cemented	424	371	287	230	140	39	13
Pegged Cemented	4698	4221	3172	2083	1249	667	111

Note: Restricted to modern prostheses

Figure ST23 Primary Total Stemmed Shoulder Replacement by Polyethylene Type (Primary Diagnosis OA)

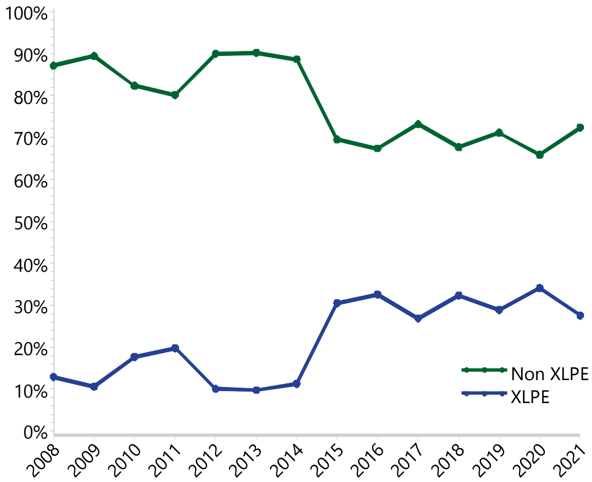
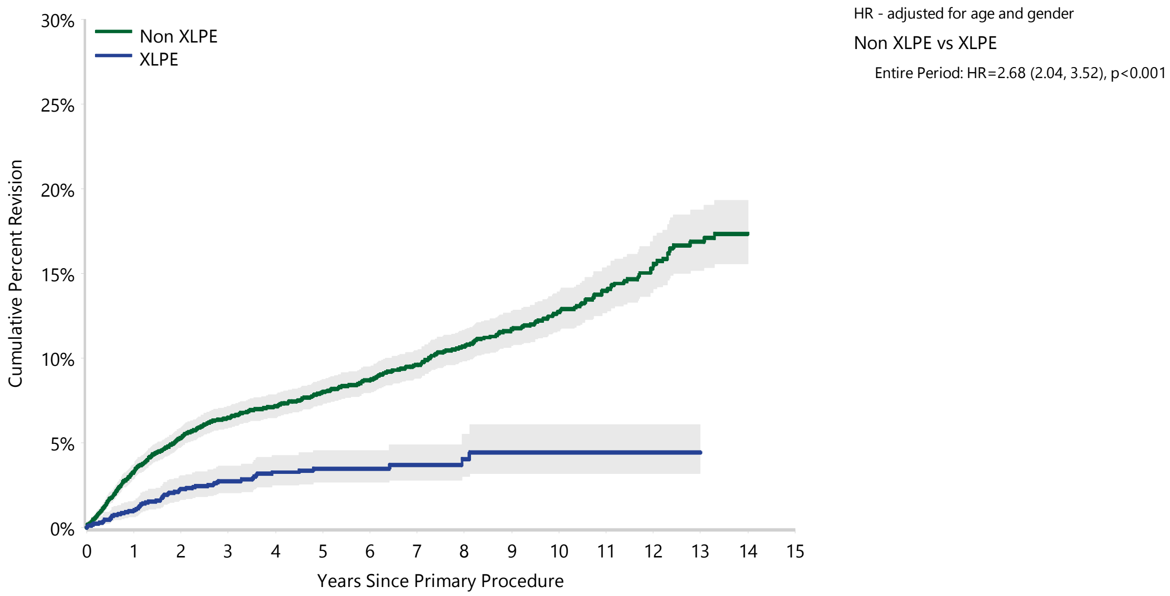


Table ST33 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement using All Types of Glenoids by Polyethylene Type (Primary Diagnosis OA)

Polyethylene Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Non XLPE	589	6368	3.3 (2.9, 3.8)	6.5 (5.9, 7.2)	8.0 (7.3, 8.7)	9.6 (8.8, 10.5)	12.7 (11.6, 13.9)	17.4 (15.6, 19.3)
XLPE	57	1899	1.0 (0.7, 1.6)	2.8 (2.1, 3.7)	3.5 (2.7, 4.6)	3.7 (2.8, 4.9)	4.4 (3.2, 6.1)	
TOTAL	**646**	**8267**						

Note: Restricted to modern prostheses
Excludes 2 procedures with unknown polyethylene

Figure ST24 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement using All Types of Glenoids by Polyethylene Type (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Non XLPE	6368	5723	4583	3458	2360	1025	162
XLPE	1899	1721	1264	801	343	172	19

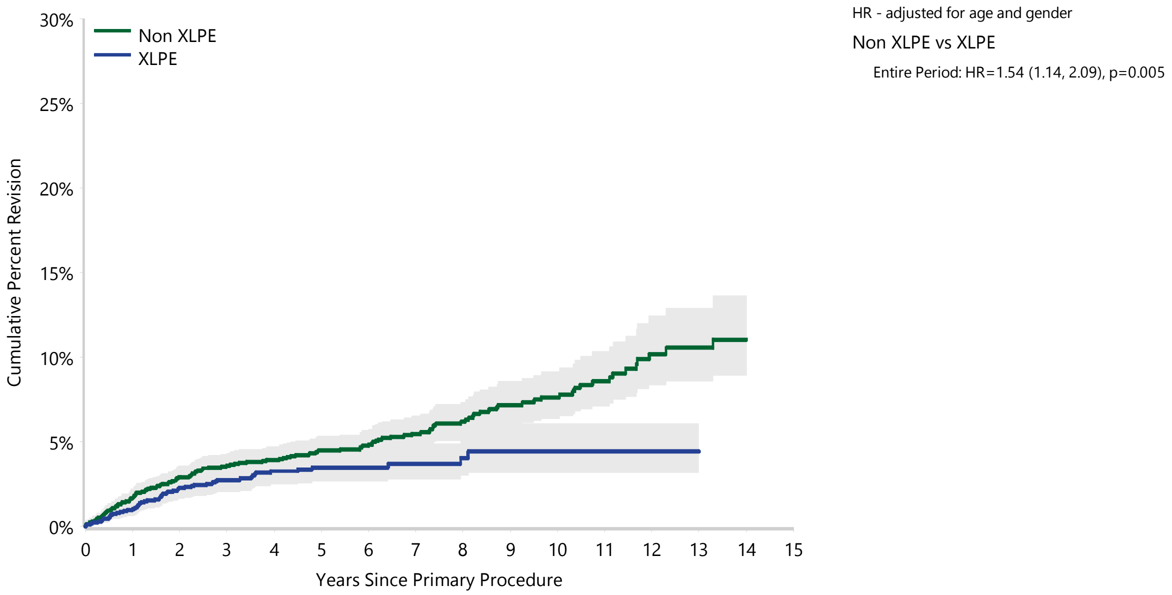
Note: Restricted to modern prostheses

Table ST34 **Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement Using Cemented All-Polyethylene Glenoids by Polyethylene Type (Primary Diagnosis OA)**

Polyethylene Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Non XLPE	164	3226	1.7 (1.3, 2.2)	3.6 (3.0, 4.3)	4.5 (3.7, 5.3)	5.5 (4.6, 6.5)	7.6 (6.4, 9.1)	11.0 (8.9, 13.6)
XLPE	57	1899	1.0 (0.7, 1.6)	2.8 (2.1, 3.7)	3.5 (2.7, 4.6)	3.7 (2.8, 4.9)	4.4 (3.2, 6.1)	
TOTAL	221	5125						

Note: Restricted to modern prostheses

Figure ST25 **Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement Using Cemented All-Polyethylene Glenoids by Polyethylene Type (Primary Diagnosis OA)**



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Non XLPE	3226	2874	2197	1513	1047	534	105
XLPE	1899	1721	1264	801	343	172	19

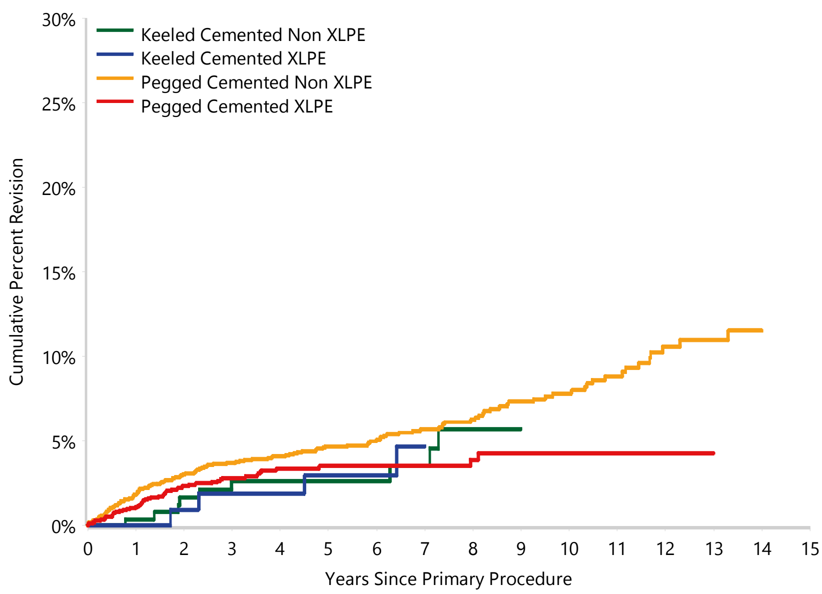
Note: Restricted to modern prostheses

Table ST35 **Cumulative Percent Revision of All Polyethylene Cemented Primary Total Stemmed Shoulder Replacement by Glenoid Design and Polyethylene Type (Primary Diagnosis OA)**

Glenoid Design	Polyethylene Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Keeled Cemented	Non XLPE	9	315	0.4 (0.1, 2.6)	2.7 (1.2, 5.8)	2.7 (1.2, 5.8)	3.5 (1.6, 7.5)		
	XLPE	4	109	0.0 (0.0, 0.0)	1.9 (0.5, 7.4)	2.9 (1.0, 8.9)	4.7 (1.7, 12.5)		
Pegged Cemented	Non XLPE	155	2909	1.8 (1.4, 2.4)	3.7 (3.0, 4.5)	4.7 (3.9, 5.6)	5.7 (4.7, 6.8)	7.8 (6.5, 9.4)	11.5 (9.3, 14.3)
	XLPE	53	1789	1.1 (0.7, 1.7)	2.8 (2.1, 3.8)	3.5 (2.7, 4.6)	3.5 (2.7, 4.6)	4.3 (3.1, 6.0)	
TOTAL		221	5122						

Note: Restricted to modern prostheses

Figure ST26 **Cumulative Percent Revision of All Polyethylene Cemented Primary Total Stemmed Shoulder Replacement by Glenoid Design and Polyethylene Type (Primary Diagnosis OA)**



HR - adjusted for age and gender

Keeled Cemented Non XLPE vs
Keeled Cemented XLPE
Entire Period: HR=0.84 (0.26, 2.72), p=0.767

Keeled Cemented Non XLPE vs
Pegged Cemented Non XLPE
Entire Period: HR=0.59 (0.30, 1.16), p=0.127

Keeled Cemented XLPE vs Pegged Cemented XLPE
Entire Period: HR=1.14 (0.41, 3.17), p=0.797

Pegged Cemented Non XLPE vs
Pegged Cemented XLPE
Entire Period: HR=1.61 (1.18, 2.21), p=0.002

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Keeled Cemented	Non XLPE	315	263	186	141	96	38	13
	XLPE	109	108	101	89	44	1	0
Pegged Cemented	Non XLPE	2909	2609	2010	1371	950	496	92
	XLPE	1789	1612	1162	712	299	171	19

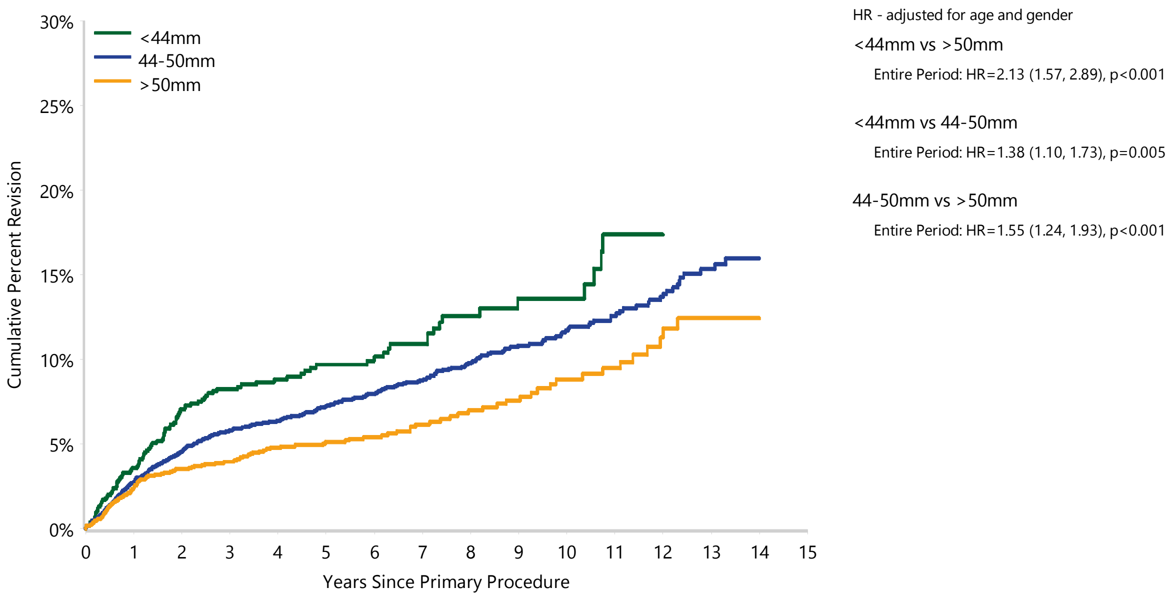
Note: Restricted to modern prostheses

Table ST36 Cumulative Percent Revision of Primary Total Stemmed 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	104	1075	3.6 (2.6, 4.9)	8.3 (6.7, 10.2)	9.7 (7.9, 11.9)	10.9 (8.9, 13.3)	13.6 (10.9, 16.9)	
44-50mm	419	5095	2.8 (2.3, 3.3)	5.8 (5.2, 6.5)	7.2 (6.5, 8.0)	8.8 (7.9, 9.7)	11.7 (10.5, 13.0)	16.0 (14.0, 18.2)
>50mm	123	2097	2.4 (1.8, 3.1)	4.0 (3.2, 4.9)	5.1 (4.2, 6.3)	6.2 (5.1, 7.5)	8.8 (7.1, 10.9)	12.4 (9.7, 15.9)
TOTAL	646	8267						

Note: Excludes 2 procedure with unknown head sizes
Restricted to modern prostheses

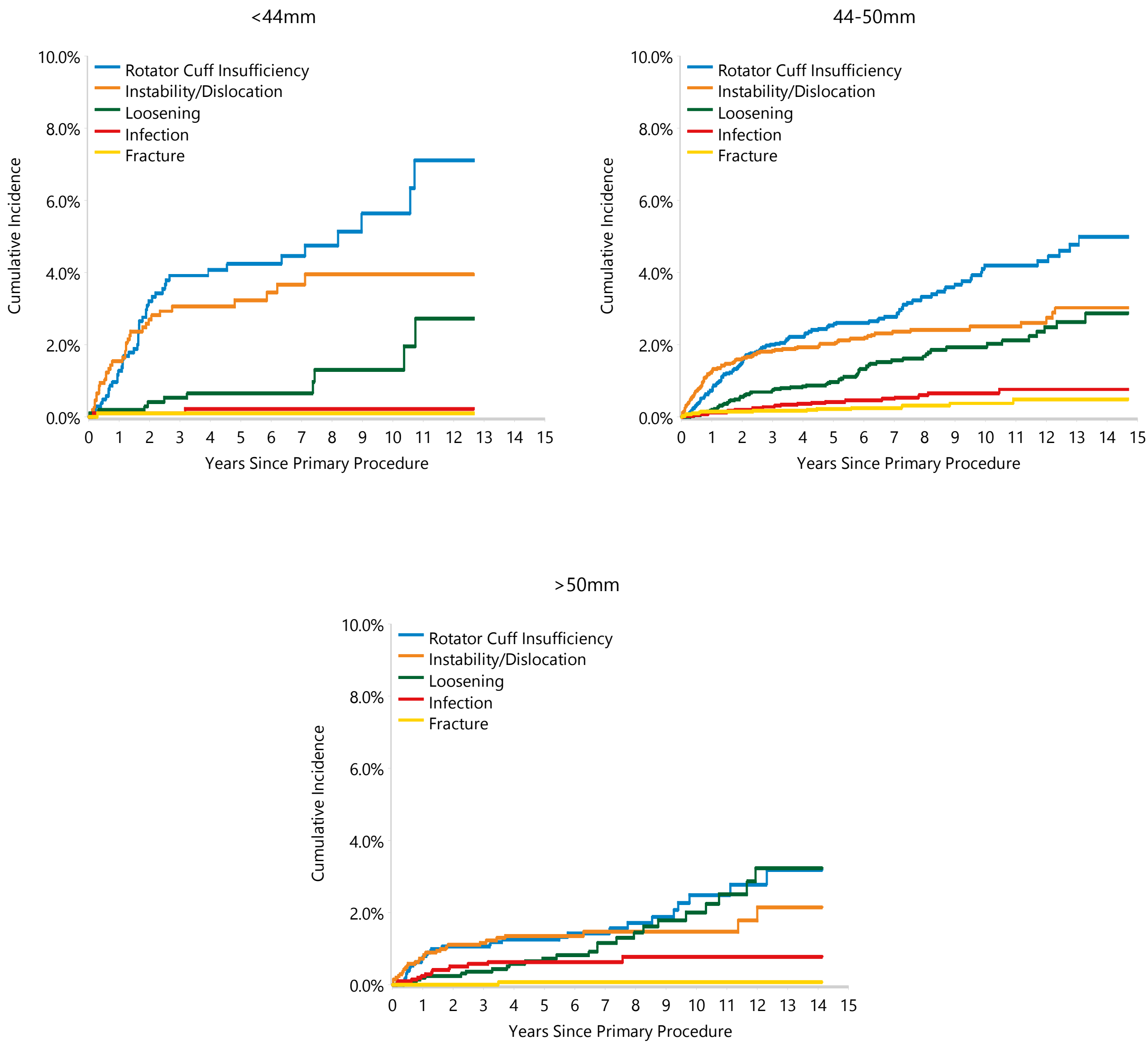
Figure ST27 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement by Humeral Head Size (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
<44mm	1075	946	695	468	296	114	11
44-50mm	5095	4601	3670	2719	1742	764	120
>50mm	2097	1898	1483	1072	665	319	50

Note: Restricted to modern prostheses

Figure ST28 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Shoulder Replacement by Humeral Head Size (Primary Diagnosis OA)



Note: Restricted to modern prostheses

Table ST37 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement by Prosthesis Combination (Primary Diagnosis OA)

Humeral Stem	Glenoid	N Revised	N Total	1 Yr	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Affinis	Affinis	17	183	0.0 (0.0, 0.0)	5.2 (2.7, 9.7)	5.8 (3.2, 10.5)	8.5 (5.1, 14.0)	
Ascend Flex	Perform	14	942	0.6 (0.2, 1.4)	1.9 (1.1, 3.3)	1.9 (1.1, 3.3)		
Bigliani/Flatow TM	Bigliani/Flatow	30	452	1.8 (0.9, 3.5)	5.1 (3.4, 7.6)	6.1 (4.1, 8.9)	7.5 (5.1, 10.8)	
	Bigliani/Flatow TM	42	643	2.3 (1.4, 3.8)	5.1 (3.6, 7.1)	6.0 (4.3, 8.2)	7.0 (5.1, 9.6)	
Comprehensive	Comprehensive	39	758	3.6 (2.4, 5.2)	5.4 (4.0, 7.5)	5.4 (4.0, 7.5)		
Equinoxe	Equinoxe	42	567	3.3 (2.0, 5.2)	10.2 (7.3, 14.2)	13.1 (9.2, 18.6)		
Global AP*	Global	10	327	1.3 (0.5, 3.3)				
Global Advantage	Global	49	725	1.2 (0.7, 2.4)	3.9 (2.7, 5.6)	5.2 (3.7, 7.2)	7.1 (5.2, 9.6)	10.5 (7.8, 14.2)
Global Unite	Global	18	994	0.6 (0.3, 1.4)	2.5 (1.5, 3.9)			
SMR	SMR	25	480	1.9 (1.0, 3.6)	4.8 (3.2, 7.2)	5.1 (3.4, 7.6)	5.8 (3.9, 8.6)	
	SMR L1	356	2153	5.7 (4.8, 6.7)	13.4 (12.0, 15.0)	15.8 (14.2, 17.5)	20.7 (18.6, 23.1)	26.0 (23.0, 29.3)
Other (7)		4	45	4.7 (1.2, 17.5)	12.4 (4.7, 30.5)	12.4 (4.7, 30.5)		
TOTAL		**646**	**8269**					

Note: Only combinations with >50 procedures have been listed
Restricted to modern prostheses
*Used with Global Unite heads

Table ST38 Cumulative Percent Revision of Cementless Primary Total Stemmed 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
Bigliani/ Flatow TM	Bigliani/ Flatow TM	40	616	2.1 (1.2, 3.6)	4.6 (3.2, 6.6)	5.0 (3.5, 7.0)	5.9 (4.2, 8.2)	7.0 (5.0, 9.6)	
Equinoxe	Equinoxe	5	40	10.5 (4.1, 25.7)	13.4 (5.8, 29.4)	13.4 (5.8, 29.4)	13.4 (5.8, 29.4)		
SMR	SMR L1	350	2121	5.7 (4.7, 6.7)	10.9 (9.7, 12.4)	13.2 (11.8, 14.8)	15.7 (14.1, 17.4)	20.7 (18.5, 23.1)	26.0 (23.0, 29.3)
Other (5)		3	16	12.5 (3.3, 41.4)	19.8 (6.8, 49.9)	19.8 (6.8, 49.9)			
TOTAL		**398**	**2793**						

Note: Only prostheses with >10 procedures have been listed
Restricted to modern prostheses

Table ST39 Cumulative Percent Revision of Hybrid (Glenoid Cemented) Primary Total Stemmed 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	16	178	0.0 (0.0, 0.0)	1.7 (0.6, 5.2)	4.7 (2.4, 9.3)	5.4 (2.8, 10.1)	8.2 (4.8, 13.7)	
Ascend Flex	Perform	14	835	0.7 (0.3, 1.6)	1.9 (1.1, 3.3)	2.1 (1.2, 3.6)	2.1 (1.2, 3.6)		
Bigliani/Flatow TM	Bigliani/Flatow	23	421	1.2 (0.5, 2.8)	3.4 (2.0, 5.7)	4.2 (2.6, 6.7)	5.0 (3.2, 7.7)	6.0 (3.9, 9.2)	
Comprehensive	Comprehensive	39	749	3.6 (2.5, 5.2)	5.0 (3.6, 6.9)	5.5 (4.0, 7.6)	5.5 (4.0, 7.6)		
Equinoxe	Equinoxe	35	502	2.6 (1.5, 4.6)	6.0 (4.0, 8.9)	10.2 (7.0, 14.9)	13.8 (9.2, 20.2)		
Global AP	Global	10	315	1.3 (0.5, 3.4)	4.4 (2.3, 8.1)				
Global Advantage	Global	37	601	1.2 (0.6, 2.4)	3.6 (2.4, 5.5)	4.0 (2.7, 6.0)	4.9 (3.4, 7.1)	6.6 (4.6, 9.3)	9.3 (6.5, 13.1)
Global Unite	Global	16	897	0.6 (0.2, 1.4)	1.4 (0.8, 2.6)	2.4 (1.5, 4.0)			
SMR	SMR	23	463	2.0 (1.0, 3.8)	4.0 (2.5, 6.3)	4.5 (2.9, 6.9)	4.8 (3.2, 7.3)	5.6 (3.7, 8.4)	
Other (6)		1	34	0.0 (0.0, 0.0)	5.9 (0.9, 35.0)	5.9 (0.9, 35.0)	5.9 (0.9, 35.0)		
TOTAL		**214**	**4995**						

Note: Only combinations with >50 procedures have been listed
Restricted to modern prostheses

PRIMARY TOTAL REVERSE SHOULDER REPLACEMENT

DEMOGRAPHICS

There have been 42,513 primary total reverse shoulder replacement procedures reported to the Registry. This is an increase of 6,533 procedures compared to the previous report.

Osteoarthritis is the most common diagnosis for primary total reverse shoulder replacement followed by rotator cuff arthropathy, and fracture (Table ST40 and Figure ST29).

Primary total reverse shoulder replacement is more commonly undertaken in females. However, there has been an increase in usage in males from 33.9% in 2008 to 40.7% in 2021 (Figure ST30).

The most common primary diagnoses are osteoarthritis, rotator cuff arthropathy, and fracture.

Figure ST29 Primary Total Reverse Shoulder Replacement by Primary Diagnosis

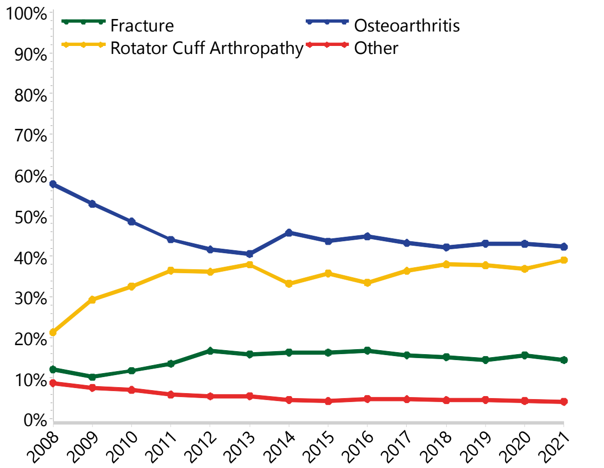
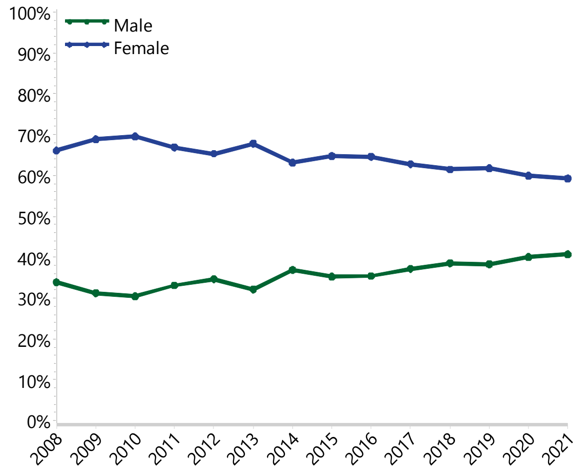


Figure ST30 Primary Total Reverse Shoulder Replacement by Gender



Females are on average older (Table ST41). The proportional use in patients aged ≥75 years has declined in recent years and is now very similar to the proportional use in the 65-74 year age group (Figure ST31).

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 ST32).

The most commonly used humeral stems are listed in Table ST42. The most used glenoid prostheses are listed in Table ST43.

Table ST40 Primary Total Reverse Shoulder Replacement by Primary Diagnosis and Gender

Primary Diagnosis	Male		Female		TOTAL	
	N	Col%	N	Col%	N	Col%
Osteoarthritis	7232	45.6	11350	42.6	18582	43.7
Rotator Cuff Arthropathy	7036	44.3	8380	31.5	15416	36.3
Fracture	1039	6.5	5398	20.3	6437	15.1
Rheumatoid Arthritis	159	1.0	576	2.2	735	1.7
Osteonecrosis	91	0.6	391	1.5	482	1.1
Instability	144	0.9	284	1.1	428	1.0
Tumour	116	0.7	107	0.4	223	0.5
Other Inflammatory Arthritis	49	0.3	149	0.6	198	0.5
Other	6	0.0	6	0.0	12	0.0
TOTAL	**15872**	**100.0**	**26641**	**100.0**	**42513**	**100.0**

Table ST41 Age and Gender of Primary Total Reverse Shoulder Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	15872	37.3%	14	96	73	72.2	8.2
Female	26641	62.7%	13	102	75	74.8	8.0
TOTAL	**42513**	**100.0%**	**13**	**102**	**74**	**73.8**	**8.2**

Figure ST31 Primary Total Reverse Shoulder Replacement by Age

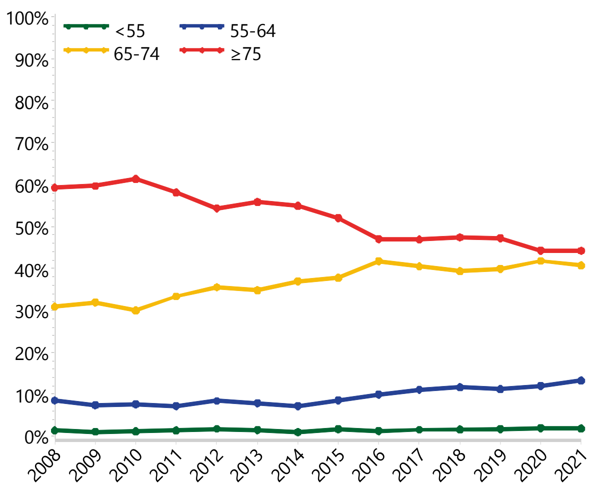


Figure ST32 Primary Total Reverse Shoulder Replacement by Fixation

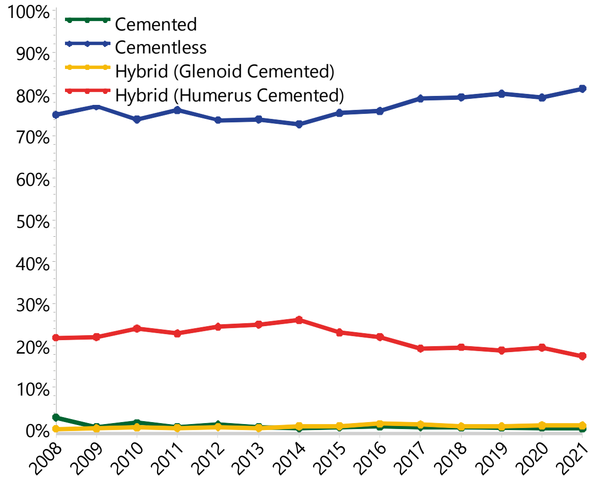


Table ST42 10 Most Used Humeral Stem Prostheses in Primary Total Reverse Shoulder Replacement

2008		2018		2019		2020		2021	
N	Model	N	Model	N	Model	N	Model	N	Model
263	SMR	1073	SMR	1107	SMR	1056	SMR	1182	SMR
252	Delta Xtend	1066	Delta Xtend	978	Delta Xtend	853	Equinoxe	1017	Comprehensive
76	Aequalis	496	Comprehensive	675	Equinoxe	798	Comprehensive	916	Equinoxe
42	Trabecular Metal	495	Equinoxe	647	Comprehensive	777	Delta Xtend	731	Ascend Flex
21	Delta CTA	420	RSP	484	Ascend Flex	578	Ascend Flex	694	Delta Xtend
2	Custom Made (Lima)	376	Ascend Flex	405	RSP	359	Aequalis	515	AltiVate Reverse
1	Generic Humeral Stem	357	Aequalis	380	Aequalis	332	Affinis	326	Aequalis
1	Promos	324	Affinis	346	Affinis	278	RSP	287	Affinis
		183	Trabecular Metal	180	Trabecular Metal	253	AltiVate Reverse	240	Global Unite
		95	Global Unite	160	Global Unite	190	Global Unite	166	RSP
10 Most Used									
658	(8) 100.0%	4885	(10) 99.1%	5362	(10) 97.5%	5474	(10) 96.1%	6074	(10) 96.2%
Remainder									
0	(0) 0%	44	(6) 0.9%	137	(5) 2.5%	221	(7) 3.9%	243	(7) 3.8%
TOTAL									
658	(8) 100.0%	4929	(16) 100.0%	5499	(15) 100.0%	5695	(17) 100.0%	6317	(17) 100.0%

Table ST43 10 Most Used Glenoid Prostheses in Primary Total Reverse Shoulder Replacement

2008		2018		2019		2020		2021	
N	Model	N	Model	N	Model	N	Model	N	Model
264	SMR L1	1159	Delta Xtend	1137	Delta Xtend	1007	SMR L1	1140	SMR L1
252	Delta Xtend	1045	SMR L1	1055	SMR L1	965	Delta Xtend	1063	Comprehensive Reverse
76	Aequalis	702	Aequalis	763	Aequalis	853	Equinoxe	933	Delta Xtend
42	Trabecular Metal	519	Comprehensive Reverse	690	Comprehensive Reverse	819	Comprehensive Reverse	913	Equinoxe
21	Delta CTA	495	Equinoxe	675	Equinoxe	794	Aequalis	881	Aequalis
1	Generic Metaglene	431	RSP	484	RSP	532	RSP	702	RSP
1	Promos	323	Affinis	346	Affinis	332	Affinis	286	Affinis
1	SMR	154	Trabecular Metal	136	Trabecular Metal	145	Perform Reversed	190	Perform Reversed
		31	Perform Reversed	101	Perform Reversed	142	Trabecular Metal	112	Trabecular Metal
		19	Custom Made (Comprehensive)	34	SMR Axioma	37	MSS	31	SMR Axioma
10 Most Used									
658	(8) 100.0%	4878	(10) 99.0%	5421	(10) 98.6%	5626	(10) 98.8%	6251	(10) 99.0%
Remainder									
0	(0) 0%	51	(7) 1.0%	78	(6) 1.4%	69	(7) 1.2%	66	(8) 1.0%
TOTAL									
658	(8) 100.0%	4929	(17) 100.0%	5499	(16) 100.0%	5695	(17) 100.0%	6317	(18) 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 2021 (described as modern prostheses) are included in the analyses, unless clearly specified. As with primary total stemmed total shoulder replacement, all outcome analyses have been confined to total reverse shoulder prostheses used in 2021, irrespective of primary diagnoses.

Procedures undertaken for instability and rheumatoid arthritis 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 ST44 and Figure ST33).

Reason for Revision

Instability/dislocation is the most common reason for revision followed by infection, loosening, and fracture (Table ST45 and Figure ST34).

Type of Revision

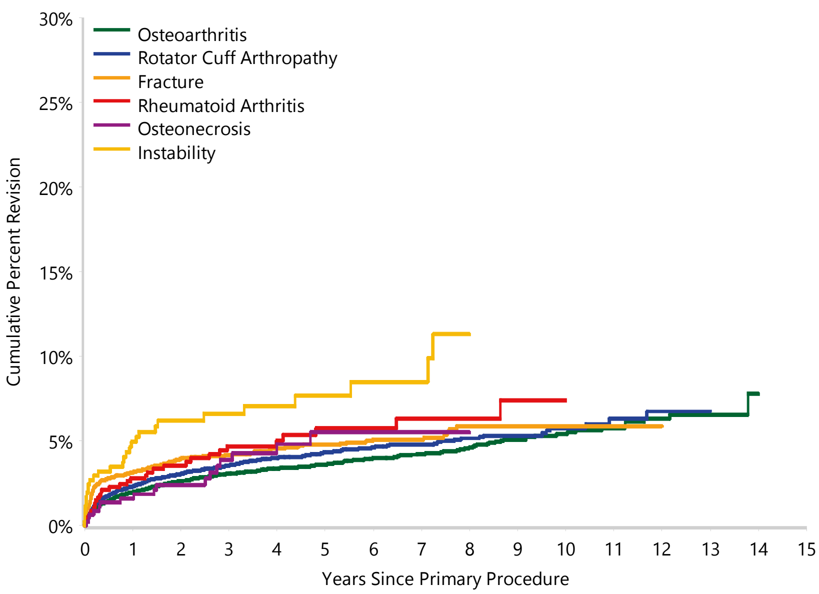
The most common types of revision are humeral component only, replacement of both cup (liner) and glenosphere, and cup only revisions (Table ST46). When only the humeral component is revised, this may be associated with exchange of the epiphysis and/or humeral stem and additional minor components such as the liner.

Table ST44 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Primary Diagnosis

Primary Diagnosis	N Revised	N Total	Primary Percent	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Osteoarthritis	566	17700	43.7%	2.0 (1.8, 2.2)	3.1 (2.8, 3.4)	3.6 (3.3, 3.9)	4.2 (3.8, 4.6)	5.4 (4.8, 6.1)	7.8 (5.6, 10.8)
Rotator Cuff Arthropathy	525	14755	36.4%	2.3 (2.1, 2.6)	3.6 (3.2, 3.9)	4.3 (3.9, 4.7)	4.8 (4.3, 5.2)	5.8 (5.0, 6.6)	
Fracture	253	6119	15.1%	3.2 (2.7, 3.6)	4.2 (3.7, 4.7)	4.8 (4.2, 5.4)	5.1 (4.4, 5.8)	5.9 (5.0, 6.9)	
Rheumatoid Arthritis	34	676	1.7%	2.8 (1.8, 4.4)	4.7 (3.2, 6.8)	5.8 (4.0, 8.3)	6.3 (4.3, 9.2)	7.4 (4.8, 11.2)	
Osteonecrosis	17	457	1.1%	1.6 (0.8, 3.3)	3.9 (2.3, 6.6)	5.5 (3.3, 9.0)	5.5 (3.3, 9.0)		
Instability	30	410	1.0%	4.9 (3.2, 7.6)	6.6 (4.4, 9.7)	7.7 (5.2, 11.2)	8.5 (5.7, 12.5)		
Other (3)	31	421	1.0%	3.5 (2.0, 6.0)	8.2 (5.4, 12.4)	9.7 (6.4, 14.4)	11.3 (7.2, 17.4)		
TOTAL	1456	40538	100.0%						

Note: Only primary diagnoses with >300 procedures have been listed
Restricted to modern prostheses

Figure ST33 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Primary Diagnosis



HR - adjusted for age and gender

Rotator Cuff Arthropathy vs Osteoarthritis
Entire Period: HR=1.12 (0.99, 1.26), p=0.070

Fracture vs Osteoarthritis
0 - 3Mth: HR=2.64 (2.16, 3.23), p<0.001
3Mth+: HR=1.08 (0.87, 1.33), p=0.488

Rheumatoid Arthritis vs Osteoarthritis
Entire Period: HR=1.47 (1.04, 2.09), p=0.029

Osteonecrosis vs Osteoarthritis
Entire Period: HR=1.20 (0.74, 1.95), p=0.455

Instability vs Osteoarthritis
Entire Period: HR=2.25 (1.56, 3.25), p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Osteoarthritis	17700	14553	9356	5364	2795	872	59
Rotator Cuff Arthropathy	14755	11866	7359	3914	2022	511	23
Fracture	6119	4878	2991	1596	762	166	13
Rheumatoid Arthritis	676	564	370	232	149	52	2
Osteonecrosis	457	382	242	126	60	19	2
Instability	410	321	215	135	73	25	0

Note: Only primary diagnoses with >300 procedures have been listed
Restricted to modern prostheses

Table ST45 Primary Total Reverse Shoulder Replacement by Reason for Revision

Reason for Revision	Number	Percent
Instability/Dislocation	478	32.8
Infection	353	24.2
Loosening	247	17.0
Fracture	160	11.0
Dissociation	52	3.6
Pain	30	2.1
Lysis	18	1.2
Malposition	18	1.2
Arthrofibrosis	15	1.0
Metal Related Pathology	12	0.8
Incorrect Sizing	11	0.8
Implant Breakage Glenoid	10	0.7
Rotator Cuff Insufficiency	6	0.4
Wear Humeral Cup	5	0.3
Tumour	3	0.2
Heterotopic Bone	3	0.2
Implant Breakage Humeral	2	0.1
Wear Glenoid Insert	1	0.1
Implant Breakage Glenoid Insert	1	0.1
Other	31	2.1
TOTAL	**1456**	**100.0**

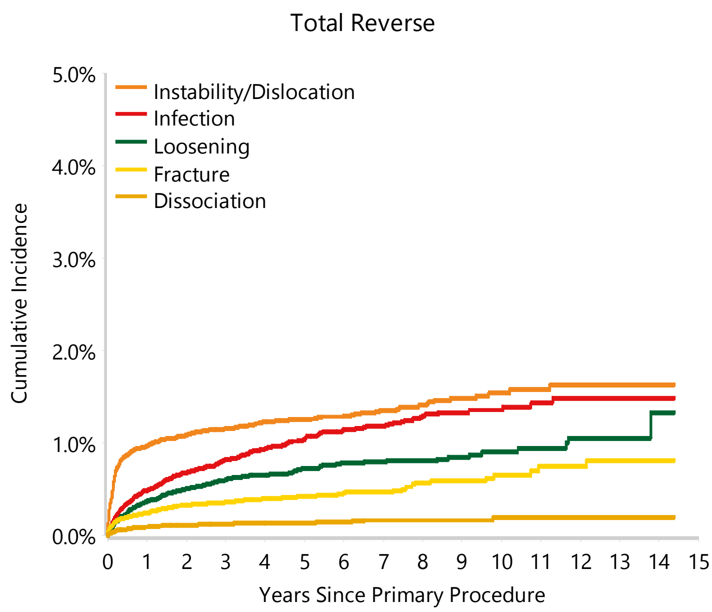
Note: Restricted to modern prostheses

Table ST46 Primary Total Reverse Shoulder Replacement by Type of Revision

Type of Revision	Number	Percent
Humeral Component	331	22.7
Cup/Head	299	20.5
Cup Only	264	18.1
Humeral Head Only	147	10.1
Cement Spacer	128	8.8
Humeral/Glenoid	112	7.7
Glenoid Component	109	7.5
Removal of Prostheses	25	1.7
Minor Components	11	0.8
Reoperation	10	0.7
Glenosphere Only	9	0.6
Cement Only	6	0.4
Reinsertion of Components	3	0.2
Head/Insert	2	0.1
TOTAL	**1456**	**100.0**

Note: Restricted to modern prostheses

Figure ST34 Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement



Note: Restricted to modern prostheses

OUTCOME FOR OSTEOARTHRITIS – PATIENT CHARACTERISTICS

Age and Gender

Primary total reverse shoulder replacement, when used for the management of osteoarthritis, is most commonly used in patients aged ≥75 years. Older patients have a lower rate of revision (Table ST47 and Figure ST35).

Males have a higher rate of revision compared to females (Table ST48 and Figure ST36). The increase in the rate of revision is due to a higher cumulative incidence of instability/dislocation and infection (Figure ST37).

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 instability/dislocation and infection.

ASA and BMI

Patients with ASA scores 3 and 4 have higher rates of revision compared to patients with an ASA 1 score (Table ST49 and Figure ST38). The most common reasons for revision for the different ASA scores are presented in Figure ST39. 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 (Table ST50 and Figure ST40). 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. The most common reasons for revision for the different BMI categories are shown in Figure ST41.

Glenoid Morphology

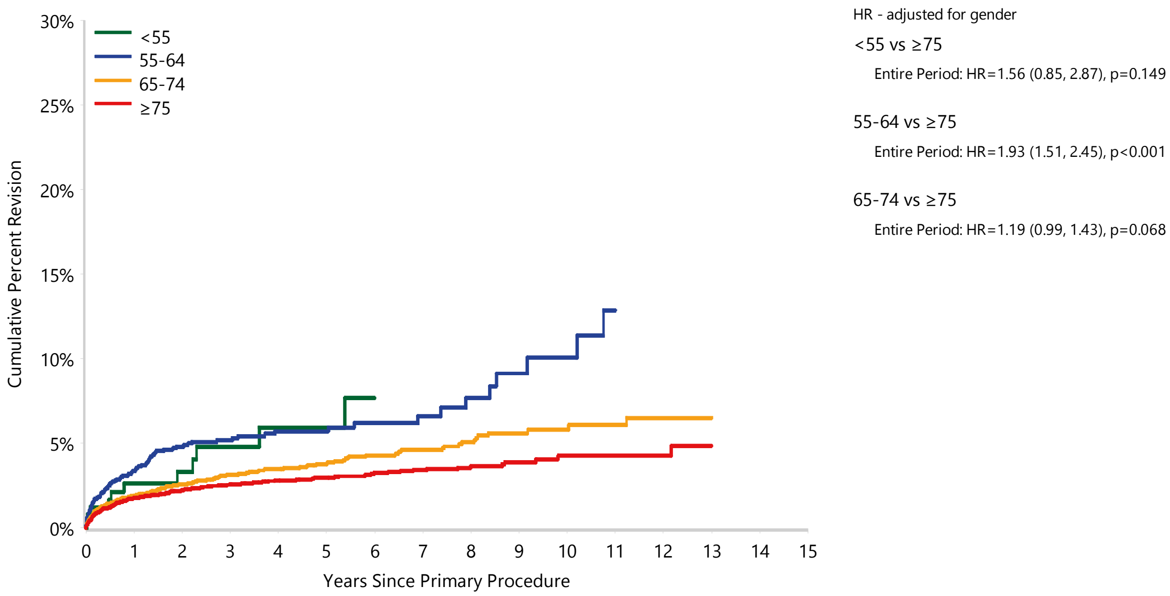
The Registry has glenoid morphology data on 8,378 primary total reverse shoulder replacements undertaken for osteoarthritis. The cumulative percent revision for the different morphology categories is presented in Table ST51. The category of glenoid morphology is not a risk factor for revision (Figure ST42).

Table ST47 Cumulative Percent Revision of Primary Total 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	11	248	2.6 (1.2, 5.8)	4.8 (2.5, 9.2)	5.9 (3.1, 11.2)			
55-64	96	1780	3.3 (2.6, 4.3)	5.2 (4.2, 6.4)	5.7 (4.6, 7.1)	6.6 (5.2, 8.4)	10.1 (7.1, 14.1)	
65-74	229	6961	1.9 (1.6, 2.2)	3.1 (2.7, 3.6)	3.8 (3.3, 4.3)	4.6 (4.0, 5.3)	5.8 (4.8, 7.0)	
≥75	230	8711	1.7 (1.5, 2.1)	2.6 (2.2, 2.9)	2.9 (2.6, 3.4)	3.4 (2.9, 3.9)	4.3 (3.5, 5.2)	
TOTAL	**566**	**17700**						

Note: Restricted to modern prostheses

Figure ST35 Cumulative Percent Revision of Primary Total 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	248	178	103	58	32	11	2
55-64	1780	1369	832	436	218	73	5
65-74	6961	5711	3632	2088	1048	336	29
≥75	8711	7295	4789	2782	1497	452	23

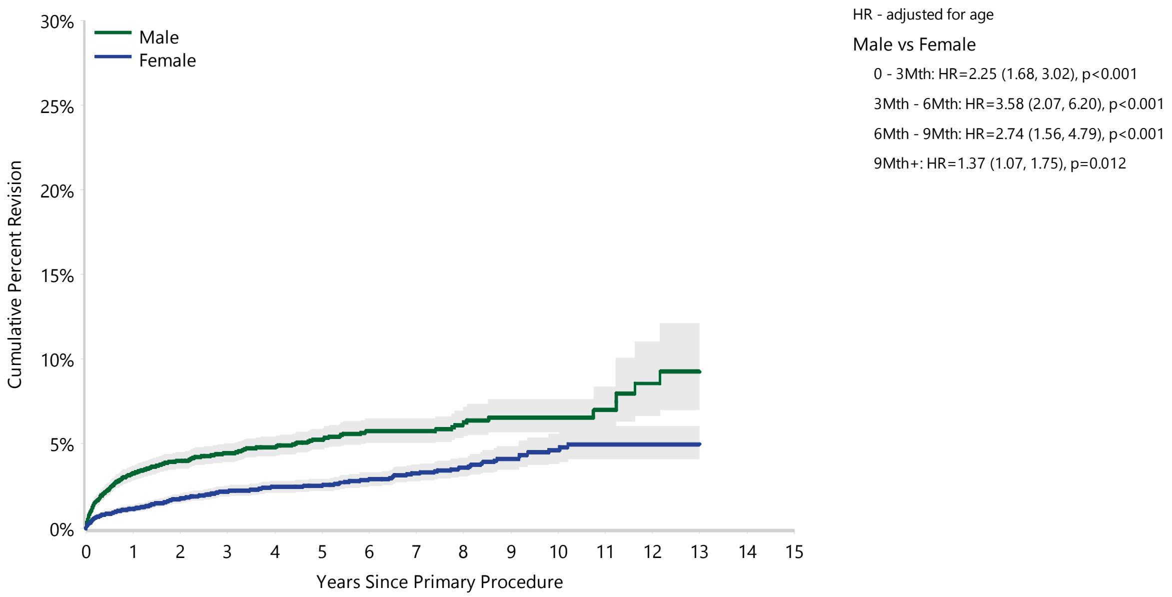
Note: Restricted to modern prostheses

Table ST48 **Cumulative Percent Revision of Primary Total 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	315	6938	3.2 (2.8, 3.7)	4.4 (3.9, 5.0)	5.2 (4.6, 5.9)	5.7 (5.1, 6.5)	6.6 (5.7, 7.6)	
Female	251	10762	1.2 (1.0, 1.4)	2.2 (1.9, 2.5)	2.5 (2.2, 2.9)	3.3 (2.8, 3.8)	4.6 (3.8, 5.6)	
TOTAL	566	17700						

Note: Restricted to modern prostheses

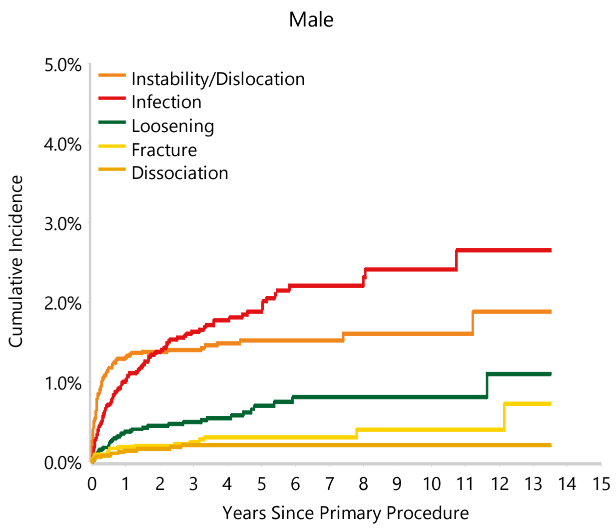
Figure ST36 **Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Gender (Primary Diagnosis OA)**

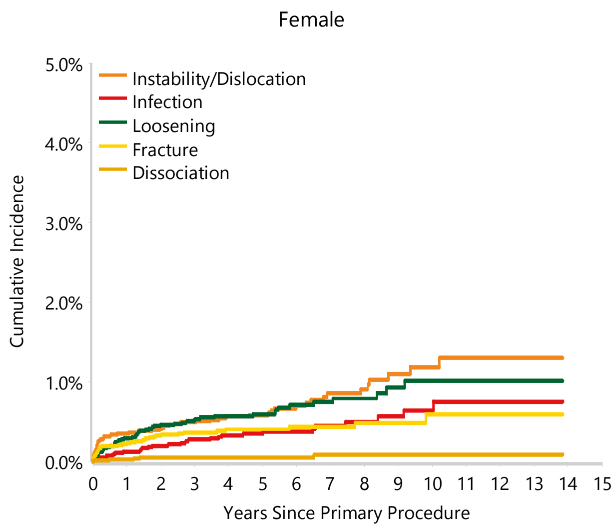


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Male	6938	5573	3472	1926	976	288	22
Female	10762	8980	5884	3438	1819	584	37

Note: Restricted to modern prostheses

Figure ST37 **Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement by Gender (Primary Diagnosis OA)**





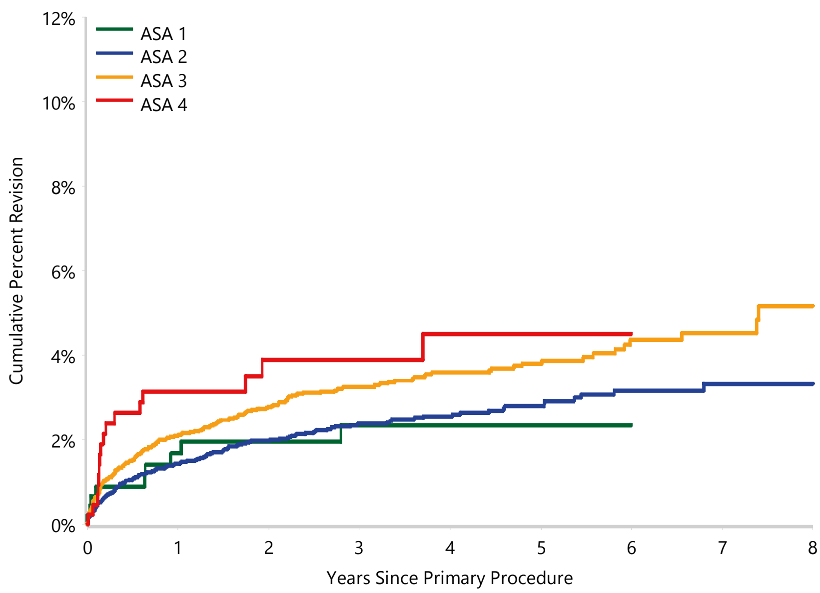
Note: Restricted to modern prostheses

Table ST49 Cumulative Percent Revision of Primary Total 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	9	449	1.7 (0.8, 3.5)	2.0 (1.0, 3.9)	2.4 (1.2, 4.5)	2.4 (1.2, 4.5)	2.4 (1.2, 4.5)	
ASA 2	145	6410	1.4 (1.2, 1.8)	2.0 (1.7, 2.4)	2.4 (2.0, 2.8)	2.6 (2.2, 3.0)	2.8 (2.3, 3.3)	3.3 (2.7, 4.1)
ASA 3	235	7749	2.1 (1.8, 2.5)	2.8 (2.4, 3.2)	3.2 (2.8, 3.7)	3.6 (3.1, 4.1)	3.8 (3.3, 4.4)	5.2 (4.1, 6.5)
ASA 4	16	430	3.1 (1.8, 5.4)	3.9 (2.3, 6.4)	3.9 (2.3, 6.4)	4.5 (2.7, 7.5)	4.5 (2.7, 7.5)	
ASA 5	0	1						
TOTAL	405	15039						

Note: Restricted to modern prostheses

Figure ST38 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by ASA Score (Primary Diagnosis OA)



HR - adjusted for age and gender

ASA 2 vs ASA 1

Entire Period: HR=1.40 (0.71, 2.74), p=0.333

ASA 3 vs ASA 1

Entire Period: HR=2.12 (1.08, 4.14), p=0.028

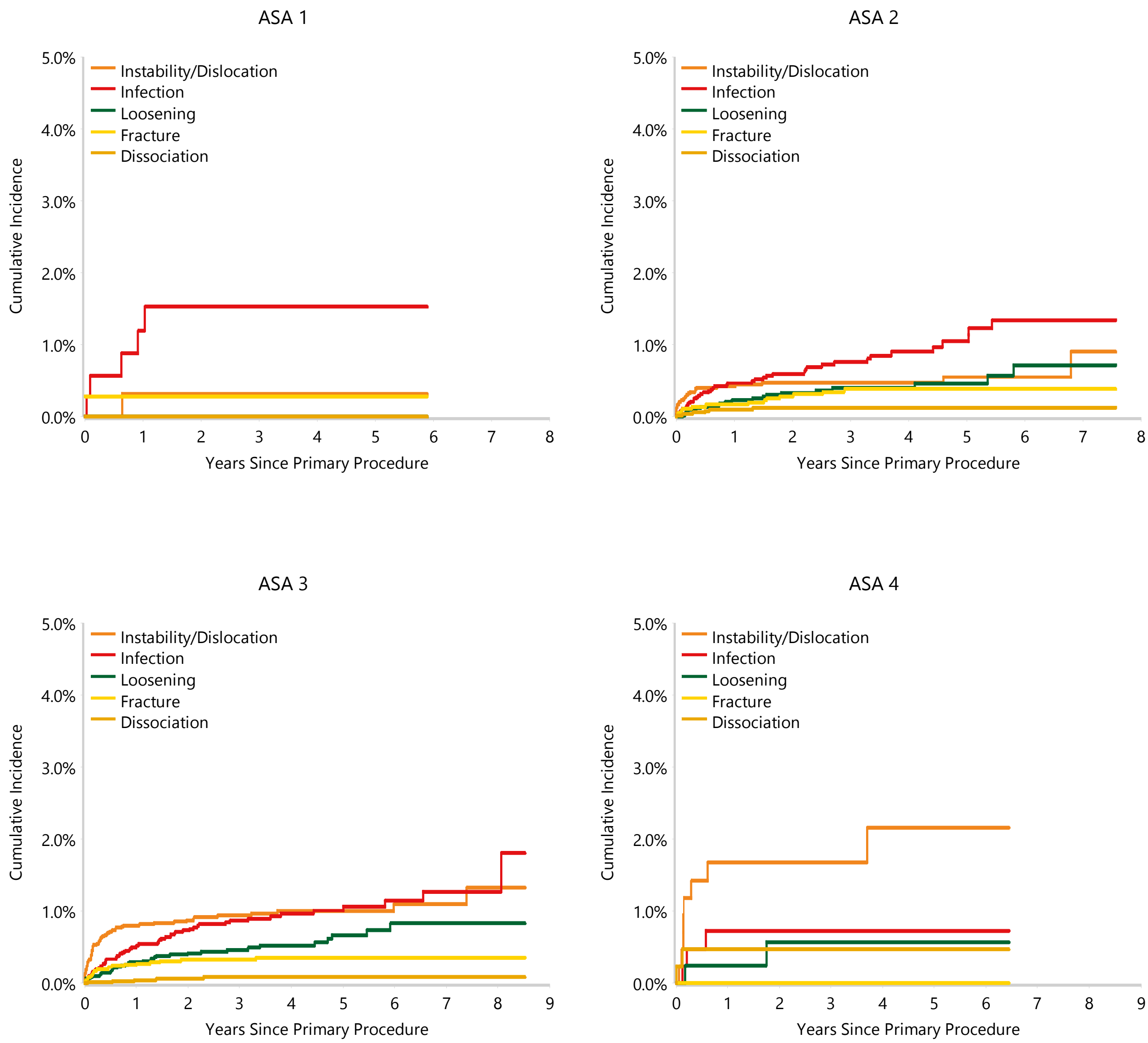
ASA 4 vs ASA 1

Entire Period: HR=2.68 (1.18, 6.09), p=0.018

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	8 Yrs
ASA 1	449	355	300	237	165	112	12
ASA 2	6410	5244	4212	3215	2356	1554	176
ASA 3	7749	6080	4676	3359	2295	1485	131
ASA 4	430	338	249	189	136	86	13

Note: Restricted to modern prostheses

Figure ST39 **Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement by ASA Score (Primary Diagnosis OA)**



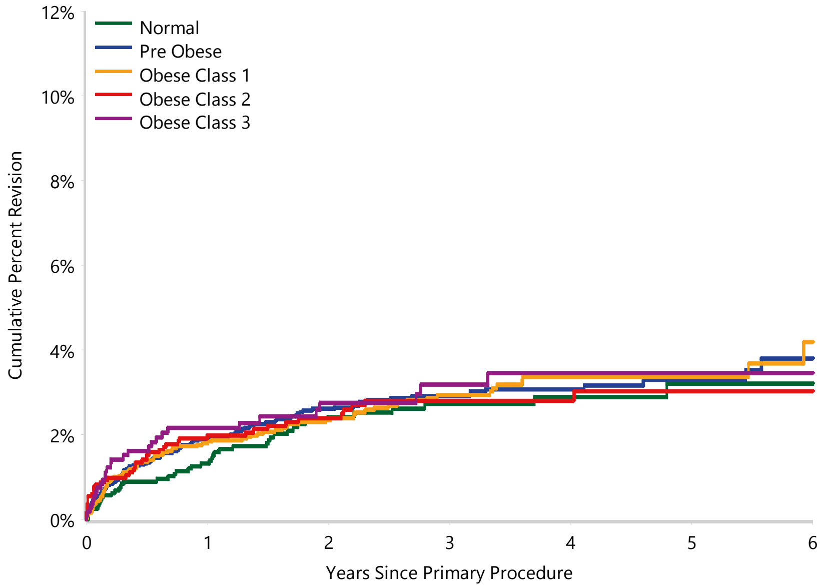
Note: Restricted to modern prostheses

Table ST50 Cumulative Percent Revision of Primary Total 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	73	2.8 (0.7, 10.6)	4.6 (1.5, 13.7)	7.8 (2.8, 20.8)	7.8 (2.8, 20.8)	7.8 (2.8, 20.8)	
Normal	44	1943	1.3 (0.9, 2.0)	2.4 (1.8, 3.3)	2.7 (2.0, 3.7)	2.9 (2.1, 3.9)	3.2 (2.3, 4.5)	3.2 (2.3, 4.5)
Pre Obese	114	4405	1.9 (1.5, 2.4)	2.6 (2.1, 3.2)	2.9 (2.4, 3.5)	3.1 (2.5, 3.7)	3.3 (2.7, 4.0)	3.8 (2.9, 4.9)
Obese Class 1	91	3536	1.8 (1.4, 2.3)	2.3 (1.9, 2.9)	2.9 (2.4, 3.7)	3.4 (2.7, 4.2)	3.4 (2.7, 4.2)	4.2 (3.0, 5.8)
Obese Class 2	44	1824	2.0 (1.4, 2.8)	2.4 (1.7, 3.3)	2.8 (2.1, 3.8)	2.8 (2.1, 3.8)	3.0 (2.2, 4.1)	3.0 (2.2, 4.1)
Obese Class 3	29	1073	2.2 (1.4, 3.3)	2.7 (1.9, 4.0)	3.2 (2.2, 4.7)	3.5 (2.4, 5.1)	3.5 (2.4, 5.1)	3.5 (2.4, 5.1)
TOTAL	326	12854						

Note: BMI has not been presented for patients aged ≤19 years
Restricted to modern prostheses

Figure ST40 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by BMI Category (Primary Diagnosis OA)



HR - adjusted for age and gender

Pre Obese vs Normal
Entire Period: HR=0.98 (0.69, 1.39), p=0.926

Obese Class 1 vs Normal
Entire Period: HR=0.99 (0.69, 1.42), p=0.957

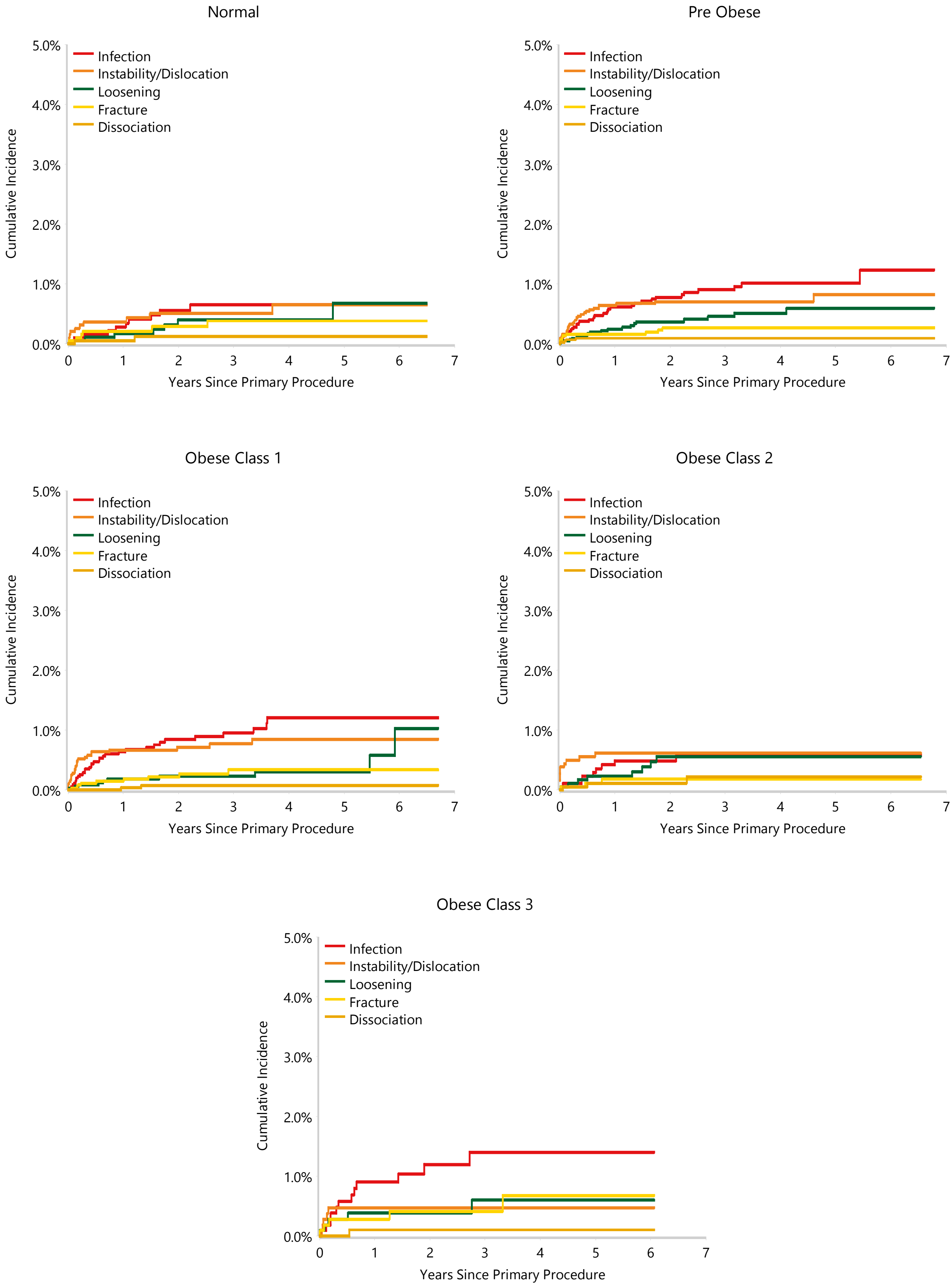
Obese Class 2 vs Normal
0 - 2Wk: HR=2.37 (1.09, 5.16), p=0.029
2Wk+: HR=0.88 (0.56, 1.38), p=0.571

Obese Class 3 vs Normal
Entire Period: HR=1.19 (0.74, 1.92), p=0.464

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Normal	1943	1519	1137	815	532	260	102
Pre Obese	4405	3415	2590	1803	1146	605	224
Obese Class 1	3536	2726	2079	1408	847	471	178
Obese Class 2	1824	1411	1004	690	443	235	87
Obese Class 3	1073	813	592	397	243	127	44

Note: BMI has not been presented for patients aged ≤19 years
Restricted to modern prostheses

Figure ST41 **Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement by BMI Category (Primary Diagnosis OA)**



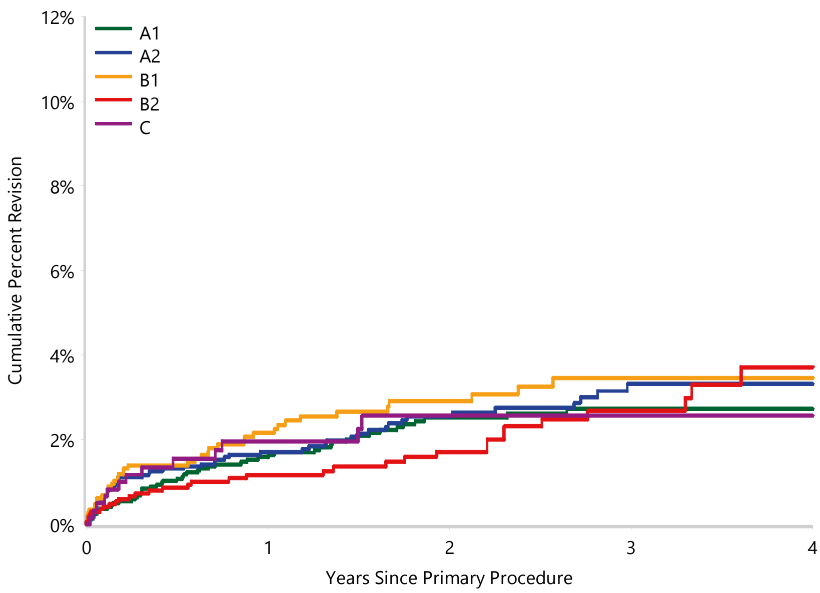
Note: BMI has not been presented for patients aged ≤19 years
Restricted to modern prostheses

Table ST51 **Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Glenoid Morphology (Primary Diagnosis OA)**

Glenoid Morphology	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs
A1	51	2426	1.6 (1.1, 2.2)	2.5 (1.9, 3.3)	2.7 (2.1, 3.6)	2.7 (2.1, 3.6)
A2	52	2194	1.7 (1.2, 2.4)	2.6 (1.9, 3.4)	3.3 (2.5, 4.4)	3.3 (2.5, 4.4)
B1	39	1468	2.2 (1.5, 3.1)	2.9 (2.1, 4.1)	3.5 (2.5, 4.8)	3.5 (2.5, 4.8)
B2	32	1680	1.2 (0.7, 1.9)	1.7 (1.1, 2.6)	2.7 (1.8, 4.0)	3.7 (2.4, 5.7)
C	13	610	2.0 (1.1, 3.5)	2.6 (1.5, 4.4)	2.6 (1.5, 4.4)	2.6 (1.5, 4.4)
TOTAL	187	8378				

Note: Restricted to modern prostheses
48 procedures have been excluded where a glenoid morphology of B3 was recorded

Figure ST42 **Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Glenoid Morphology (Primary Diagnosis OA)**



HR - adjusted for age and gender

A2 vs A1
Entire Period: HR=1.17 (0.80, 1.73), p=0.417

B1 vs A1
Entire Period: HR=1.25 (0.83, 1.90), p=0.286

B2 vs A1
Entire Period: HR=0.79 (0.51, 1.23), p=0.297

C vs A1
Entire Period: HR=0.86 (0.47, 1.59), p=0.632

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs
A1	2426	1764	1229	709	288
A2	2194	1572	1070	590	231
B1	1468	1036	664	371	149
B2	1680	1163	775	417	143
C	610	423	272	153	60

Note: Restricted to modern prostheses

PATIENT REPORTED OUTCOME MEASURES – PATIENT CHARACTERISTICS

EQ-VAS and EQ-5D-5L

The mean EQ-VAS score increased by 7.3 points following total reverse shoulder replacement for osteoarthritis (Table ST52). The percentage change following surgery is shown in Figure ST43, and the change in each domain of the EQ-5D-5L is shown in Figure ST44.

Age <65 years and female gender are associated with lower pre-operative EQ-VAS assessments. Improvement after surgery is also greater for patients aged <65 years, and for females (Table ST53, Figure ST45, Table ST54 and Figure ST46).

EQ-VAS for ASA scores 2 and 3 are reported. The pre-operative mean EQ-VAS is lower for ASA score 3 as is the post-operative improvement (Table ST55 and Figure ST47).

Compared to pre-obese patients, patients with increasing obesity have lower mean pre- and post-operative EQ-VAS, but larger improvements (Table ST56 and Figure ST48).

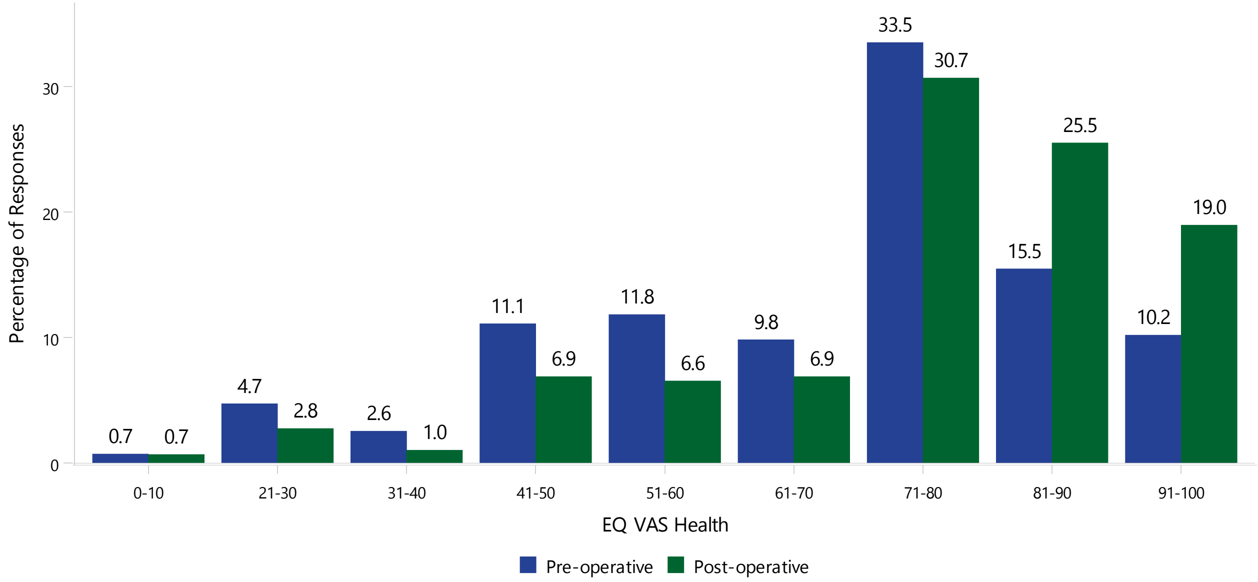
Glenoid morphology does not appear to impact the pre-operative mean EQ-VAS. The mean change in score is greatest for the B1 category (Table ST57 and Figure ST49).

Table ST52 Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Reverse Shoulder Replacement (Primary Diagnosis OA)

Class	Pre-operative			Post-operative		
	N	Mean±SD	Median (Q1, Q3)	N	Mean±SD	Median (Q1, Q3)
Total Reverse	549	69.17±18.85	75.00 (54.00, 82.00)	290	76.42±17.85	78.00 (71.00, 90.00)

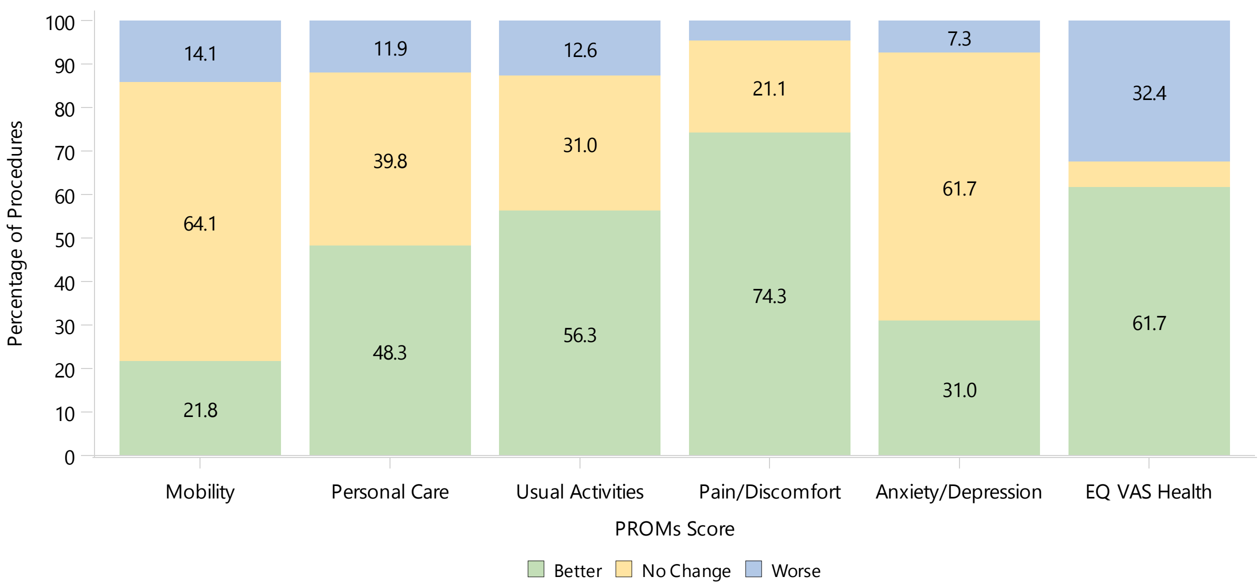
Note: Restricted to modern prostheses

Figure ST43 Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Reverse Shoulder Replacement (Primary Diagnosis OA)



Note: Restricted to modern prostheses

Figure ST44 Change in EQ-5D-5L Domain Score and EQ-VAS Health in Primary Total Reverse Shoulder Replacement (Primary Diagnosis OA)



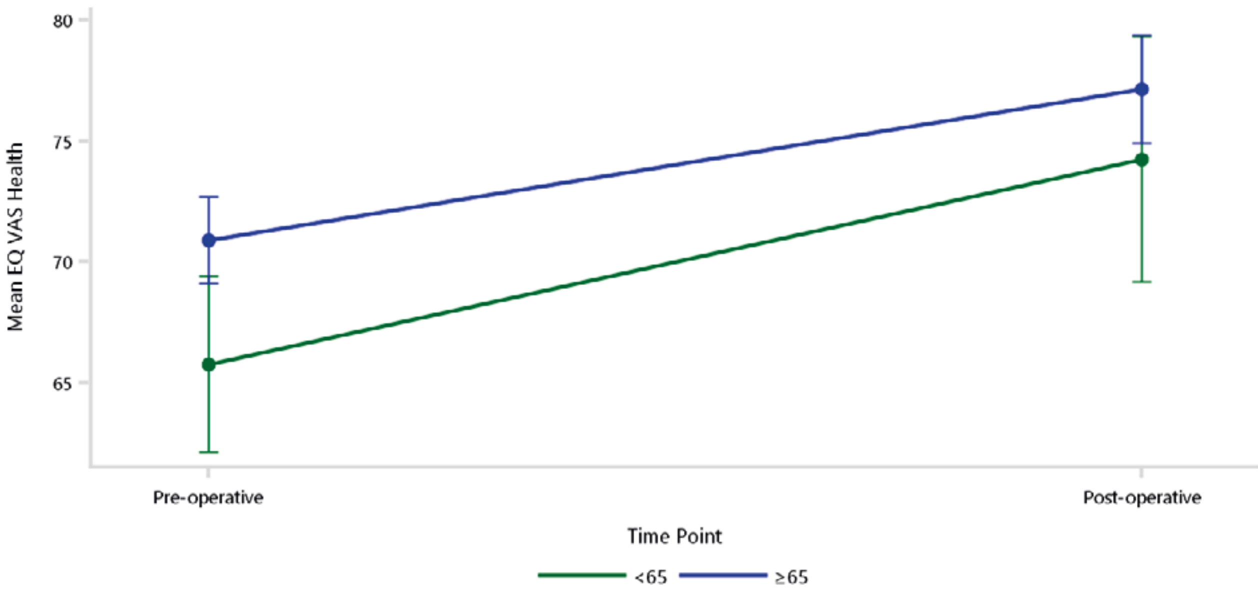
Note: Restricted to modern prostheses

Table ST53 Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Reverse Shoulder Replacement by Age (Primary Diagnosis OA)

Age	Pre-operative		Post-operative		
	N	Mean (95% CI)	N	Mean (95% CI)	Change in Score
<65	100	65.76 (62.11, 69.40)	45	74.24 (69.18, 79.31)	8.49 (3.02, 13.95)
≥65	449	70.89 (69.11, 72.67)	245	77.14 (74.91, 79.37)	6.25 (3.82, 8.68)

Note: Restricted to modern prostheses
Adjusted for gender

Figure ST45 Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Reverse Shoulder Replacement by Age (Primary Diagnosis OA)



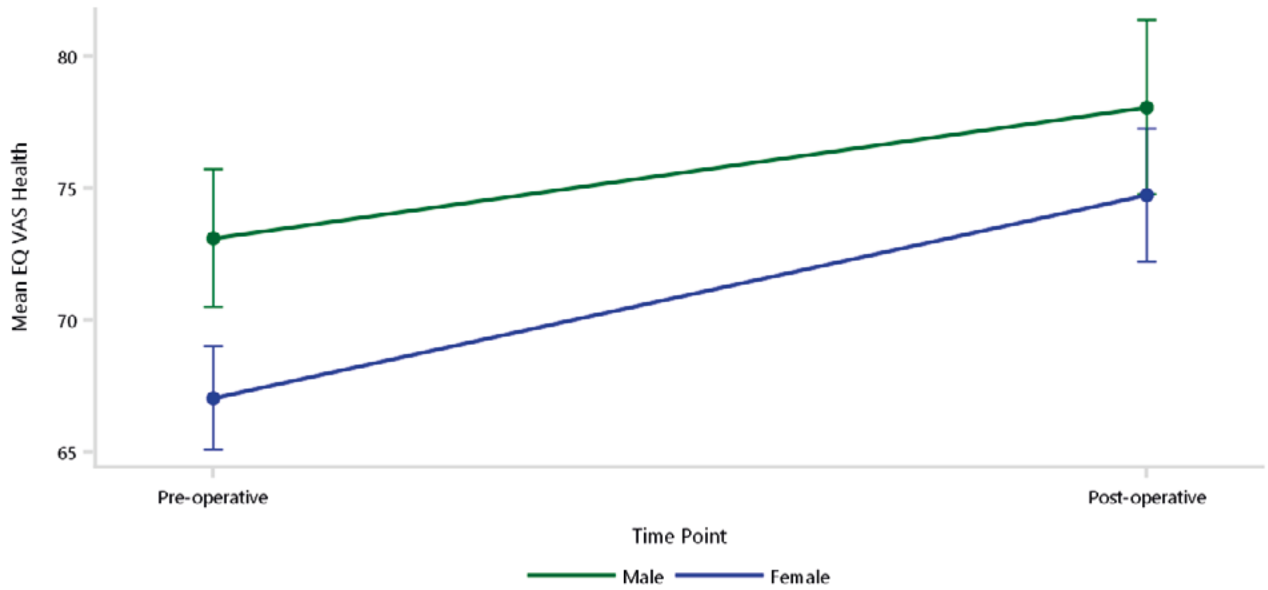
Note: Restricted to modern prostheses
Adjusted for gender

Table ST54 Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Reverse Shoulder Replacement by Gender (Primary Diagnosis OA)

Gender	Pre-operative		Post-operative		
	N	Mean (95% CI)	N	Mean (95% CI)	Change in Score
Male	198	73.12 (70.51, 75.74)	107	78.09 (74.78, 81.40)	4.96 (1.32, 8.61)
Female	351	67.07 (65.11, 69.02)	183	74.75 (72.22, 77.28)	7.69 (4.90, 10.47)

Note: Restricted to modern prostheses
Adjusted for age

Figure ST46 Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Reverse Shoulder Replacement by Gender (Primary Diagnosis OA)



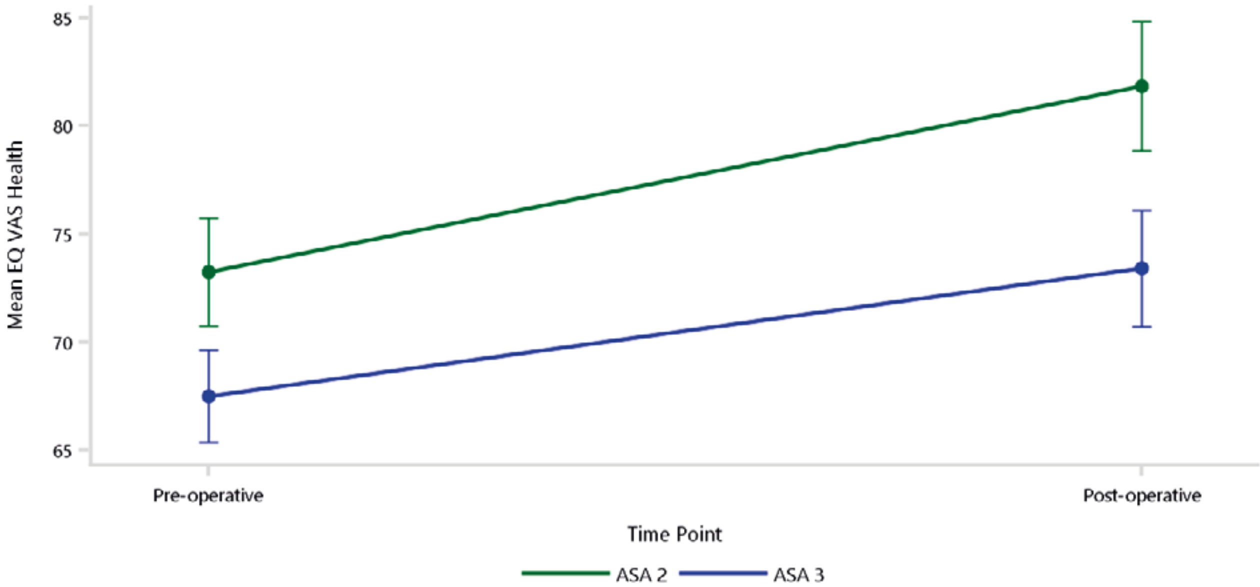
Note: Restricted to modern prostheses
Adjusted for age

Table ST55 Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Reverse Shoulder Replacement by ASA Score (Primary Diagnosis OA)

ASA Score	Pre-operative		Post-operative		
	N	Mean (95% CI)	N	Mean (95% CI)	Change in Score
ASA 2	223	73.24 (70.75, 75.72)	124	81.83 (78.85, 84.81)	8.59 (5.28, 11.91)
ASA 3	299	67.50 (65.36, 69.64)	151	73.40 (70.70, 76.10)	5.90 (2.92, 8.88)

Note: Restricted to modern prostheses
Adjusted for age and gender
Only ASA categories with >40 pre-operative and post-operative responses have been included

Figure ST47 Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Reverse Shoulder Replacement by ASA Score (Primary Diagnosis OA)



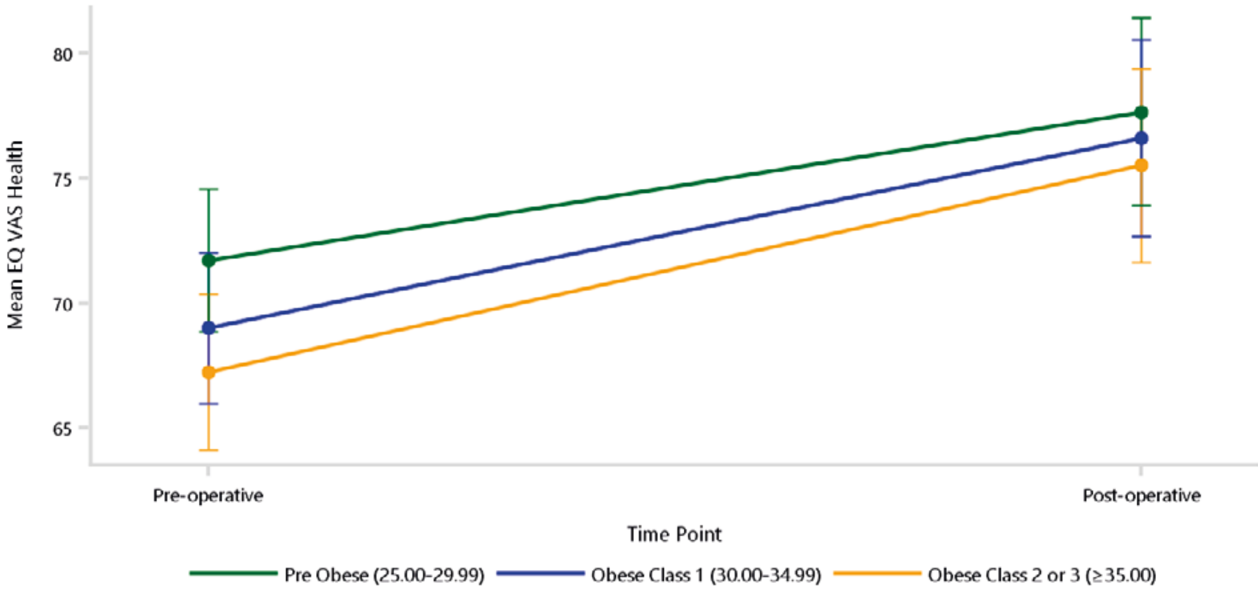
Note: Restricted to modern prostheses
Adjusted for age and gender
Only ASA categories with >40 pre-operative and post-operative responses have been included

Table ST56 Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Reverse Shoulder Replacement by BMI Category (Primary Diagnosis OA)

BMI Category	Pre-operative		Post-operative		
	N	Mean (95% CI)	N	Mean (95% CI)	Change in Score
Pre Obese (25.00-29.99)	170	71.74 (68.89, 74.60)	86	77.67 (73.91, 81.44)	5.93 (1.78, 10.08)
Obese Class 1 (30.00-34.99)	152	69.02 (66.00, 72.04)	79	76.61 (72.67, 80.56)	7.60 (3.19, 12.00)
Obese Class 2 or 3 (≥35.00)	152	67.24 (64.12, 70.36)	85	75.53 (71.64, 79.41)	8.28 (4.02, 12.55)

Note: Restricted to modern prostheses
Adjusted for age and gender
Due to a small number of procedures, the BMI categories obese class 2 and obese class 3 have been combined
Only BMI categories with >40 pre-operative and post-operative responses have been included

Figure ST48 Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Reverse Shoulder Replacement by BMI Category (Primary Diagnosis OA)



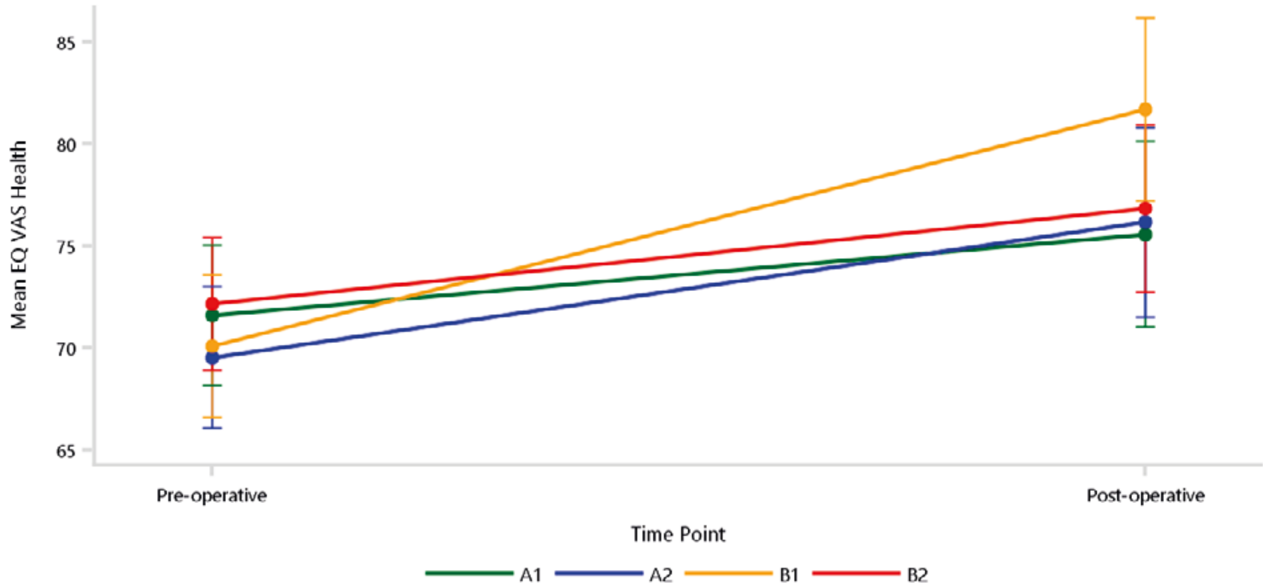
Note: Restricted to modern prostheses
Adjusted for age and gender
Due to a small number of procedures, the BMI categories obese class 2 and obese class 3 have been combined
Only BMI categories with >40 pre-operative and post-operative responses have been included

Table ST57 Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Reverse Shoulder Replacement by Glenoid Morphology (Primary Diagnosis OA)

Glenoid Morphology	Pre-operative		Post-operative		
	N	Mean (95% CI)	N	Mean (95% CI)	Change in Score
A1	109	71.59 (68.15, 75.04)	57	75.58 (71.03, 80.12)	3.98 (-0.98, 8.94)
A2	108	69.55 (66.10, 73.00)	54	76.16 (71.52, 80.79)	6.61 (1.57, 11.64)
B1	105	70.09 (66.62, 73.57)	57	81.69 (77.20, 86.17)	11.59 (6.64, 16.55)
B2	119	72.16 (68.92, 75.41)	68	76.83 (72.73, 80.94)	4.67 (0.11, 9.23)

Note: Restricted to modern prostheses
Adjusted for age and gender
Only glenoid morphologies with >40 pre-operative and post-operative responses have been included

Figure ST49 Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Reverse Shoulder Replacement by Glenoid Morphology (Primary Diagnosis OA)



Note: Restricted to modern prostheses
Adjusted for age and gender
Only glenoid morphologies with >40 pre-operative and post-operative responses have been included

PROMS: Oxford Score

The Oxford Shoulder Score (OSS) before and 6 months after surgery are provided in Table ST58.

Lower pre-operative mean OSS are associated with age <65 years and female gender. Higher post-operative scores occur in all subgroups, but the amount of change is greater for females and older patients aged ≥65 years (Table ST59, Figure ST50, Table ST60 and Figure ST51).

OSS for ASA score 2 and ASA score 3 are presented. Pre-operative mean Oxford scores are lower for ASA score 3 and mean improvement after surgery is similar (Table ST61 and Figure ST52).

The pre-operative mean Oxford score is similar for the different BMI categories. The largest change in mean Oxford score is in obese class 2 and obese class 3 (Table ST62 and Figure ST53).

The pre- and post-operative OSS is not affected by glenoid morphology (Table ST63 and Figure ST54).

Table ST58 Mean Pre-operative and Post-operative Oxford Shoulder Score in Primary Total Reverse Shoulder Replacement (Primary Diagnosis OA)

Class	Pre-operative			Post-operative		
	N	Mean±SD	Median (Q1, Q3)	N	Mean±SD	Median (Q1, Q3)
Total Reverse	545	22.41±8.66	23.00 (17.00, 29.00)	291	38.74±7.83	41.00 (35.00, 45.00)

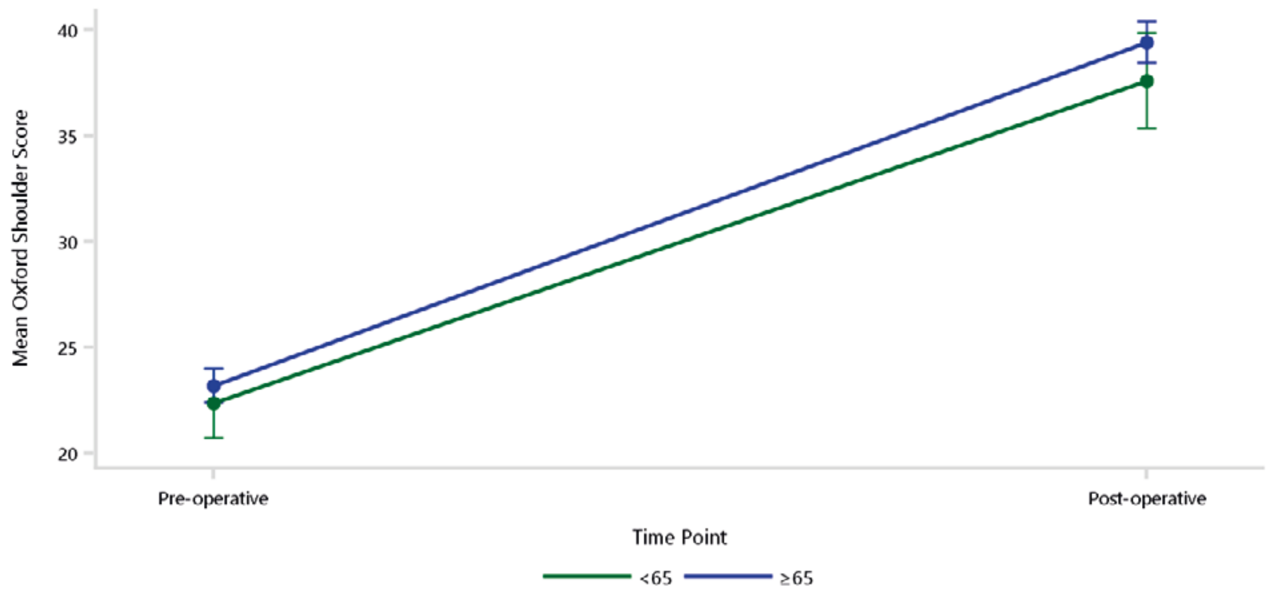
Note: Restricted to modern prostheses

Table ST59 Mean Pre-operative and Post-operative Oxford Shoulder Score in Primary Total Reverse Shoulder Replacement by Age (Primary Diagnosis OA)

Age	Pre-operative		Post-operative		
	N	Mean (95% CI)	N	Mean (95% CI)	Change in Score
<65	98	22.38 (20.75, 24.01)	45	37.62 (35.37, 39.87)	15.24 (12.82, 17.66)
≥65	447	23.20 (22.41, 23.99)	246	39.43 (38.44, 40.42)	16.23 (15.16, 17.31)

Note: Restricted to modern prostheses
Adjusted for gender

Figure ST50 Mean Pre-operative and Post-operative Oxford Shoulder Score in Primary Total Reverse Shoulder Replacement by Age (Primary Diagnosis OA)



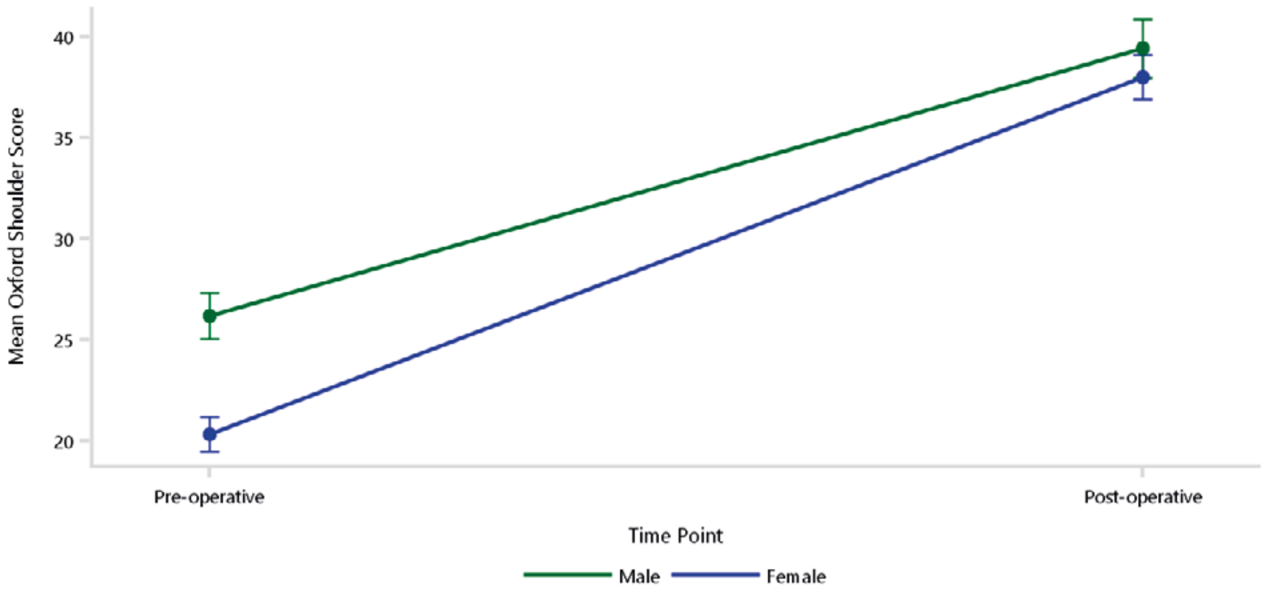
Note: Restricted to modern prostheses
Adjusted for gender

Table ST60 **Mean Pre-operative and Post-operative Oxford Shoulder Score in Primary Total Reverse Shoulder Replacement by Gender (Primary Diagnosis OA)**

Gender	Pre-operative		Post-operative		
	N	Mean (95% CI)	N	Mean (95% CI)	Change in Score
Male	197	26.18 (25.02, 27.33)	107	39.43 (37.99, 40.88)	13.26 (11.69, 14.83)
Female	348	20.31 (19.45, 21.17)	184	38.03 (36.93, 39.13)	17.72 (16.52, 18.93)

Note: Restricted to modern prostheses
Adjusted for age

Figure ST51 **Mean Pre-operative and Post-operative Oxford Shoulder Score in Primary Total Reverse Shoulder Replacement by Gender (Primary Diagnosis OA)**



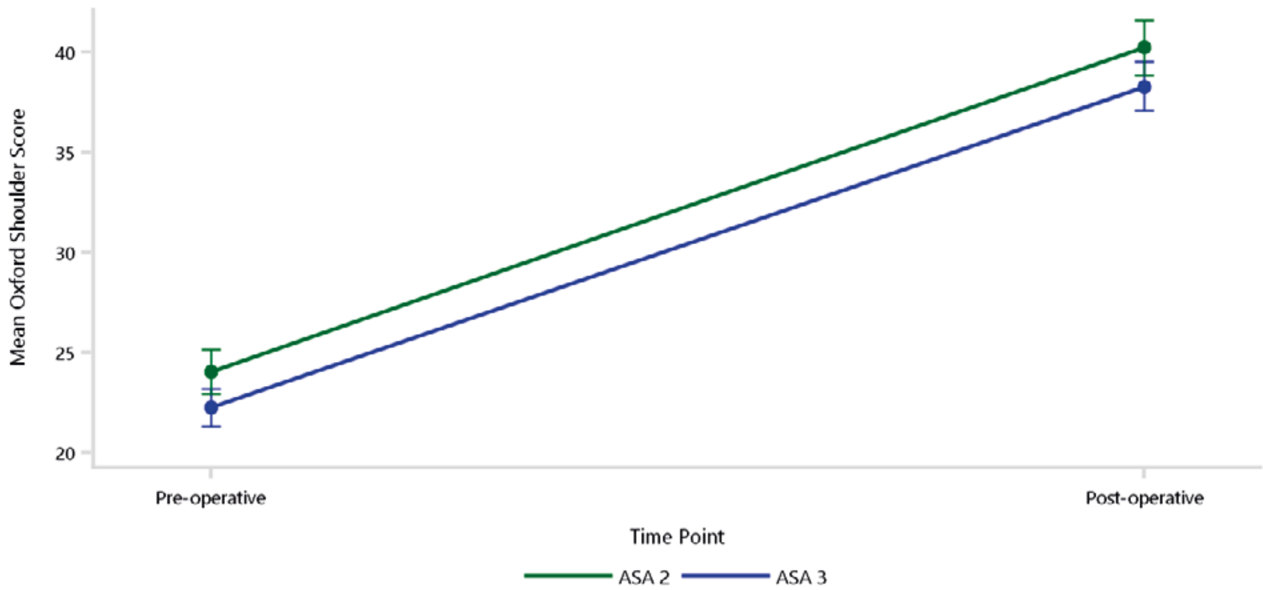
Note: Restricted to modern prostheses
Adjusted for age

Table ST61 Mean Pre-operative and Post-operative Oxford Shoulder Score in Primary Total Reverse Shoulder Replacement by ASA Score (Primary Diagnosis OA)

ASA Score	Pre-operative		Post-operative		
	N	Mean (95% CI)	N	Mean (95% CI)	Change in Score
ASA 2	222	24.05 (22.96, 25.14)	124	40.22 (38.85, 41.59)	16.17 (14.65, 17.68)
ASA 3	298	22.25 (21.31, 23.19)	152	38.28 (37.05, 39.52)	16.03 (14.68, 17.39)

Note: Restricted to modern prostheses
Adjusted for age and gender
Only ASA categories with >40 pre-operative and post-operative responses have been included

Figure ST52 Mean Pre-operative and Post-operative Oxford Shoulder Score in Primary Total Reverse Shoulder Replacement by ASA Score (Primary Diagnosis OA)



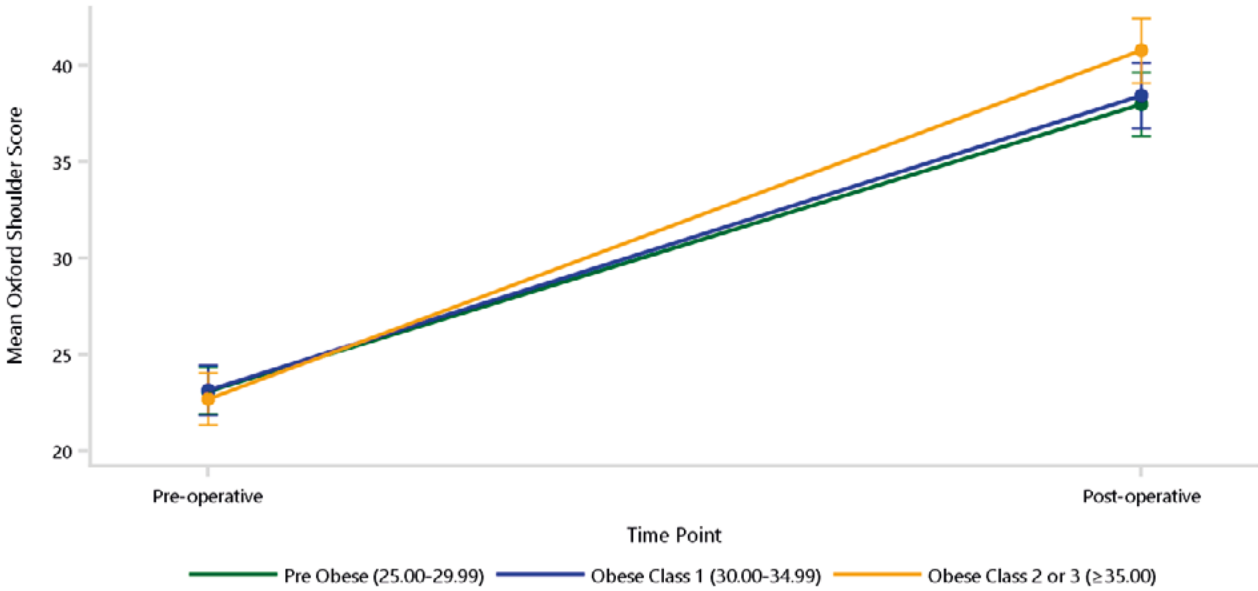
Note: Restricted to modern prostheses
Adjusted for age and gender
Only ASA categories with >40 pre-operative and post-operative responses have been included

Table ST62 Mean Pre-operative and Post-operative Oxford Shoulder Score in Primary Total Reverse Shoulder Replacement by BMI Category (Primary Diagnosis OA)

BMI Category	Pre-operative		Post-operative		
	N	Mean (95% CI)	N	Mean (95% CI)	Change in Score
Pre Obese (25.00-29.99)	169	23.13 (21.90, 24.35)	85	38.01 (36.37, 39.65)	14.89 (13.09, 16.69)
Obese Class 1 (30.00-34.99)	150	23.17 (21.87, 24.46)	79	38.47 (36.76, 40.17)	15.30 (13.40, 17.20)
Obese Class 2 or 3 (≥35.00)	152	22.71 (21.38, 24.04)	86	40.78 (39.11, 42.46)	18.08 (16.25, 19.90)

Note: Restricted to modern prostheses
Adjusted for age and gender
Only BMI categories with >40 pre-operative and post-operative responses have been included
Due to a small number of procedures, the BMI categories obese class 2 and obese class 3 have been combined

Figure ST53 Mean Pre-operative and Post-operative Oxford Shoulder Score in Primary Total Reverse Shoulder Replacement by BMI Category (Primary Diagnosis OA)



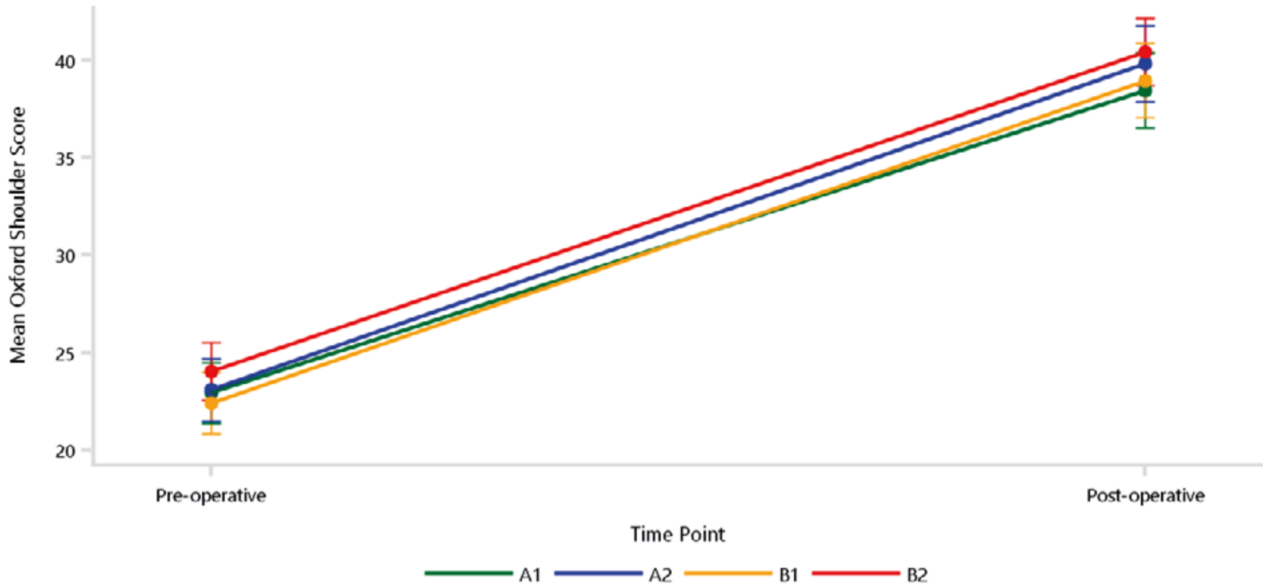
Note: Restricted to modern prostheses
Adjusted for age and gender
Only BMI categories with >40 pre-operative and post-operative responses have been included
Due to a small number of procedures, the BMI categories obese class 2 and obese class 3 have been combined

Table ST63 **Mean Pre-operative and Post-operative Oxford Shoulder Score in Primary Total Reverse Shoulder Replacement by Glenoid Morphology (Primary Diagnosis OA)**

Glenoid Morphology	Pre-operative		Post-operative		
	N	Mean (95% CI)	N	Mean (95% CI)	Change in Score
A1	109	22.96 (21.40, 24.52)	57	38.47 (36.55, 40.39)	15.51 (13.28, 17.74)
A2	105	23.10 (21.51, 24.68)	54	39.82 (37.86, 41.78)	16.72 (14.44, 19.00)
B1	105	22.45 (20.87, 24.02)	56	38.96 (37.05, 40.86)	16.51 (14.26, 18.76)
B2	119	24.04 (22.57, 25.52)	68	40.43 (38.70, 42.15)	16.38 (14.33, 18.44)

Note: Restricted to modern prostheses
Adjusted for age and gender
Only glenoid morphologies with >40 pre-operative and post-operative responses have been included

Figure ST54 **Mean Pre-operative and Post-operative Oxford Shoulder Score in Primary Total Reverse Shoulder Replacement by Glenoid Morphology (Primary Diagnosis OA)**



Note: Restricted to modern prostheses
Adjusted for age and gender
Only glenoid morphologies with >40 pre-operative and post-operative responses have been included

PROMs: Satisfaction and Change

Patients were surveyed at 6 months post-operatively on how satisfied they were with their total reverse shoulder replacement for osteoarthritis, and on their perceived change in their shoulder after surgery.

After total reverse shoulder replacement, 85.5% of patients are very satisfied or satisfied (Table ST64 and Figure ST55).

Procedure satisfaction by age and gender are presented in Table ST65, Figure ST56, Table ST66 and Figure ST57.

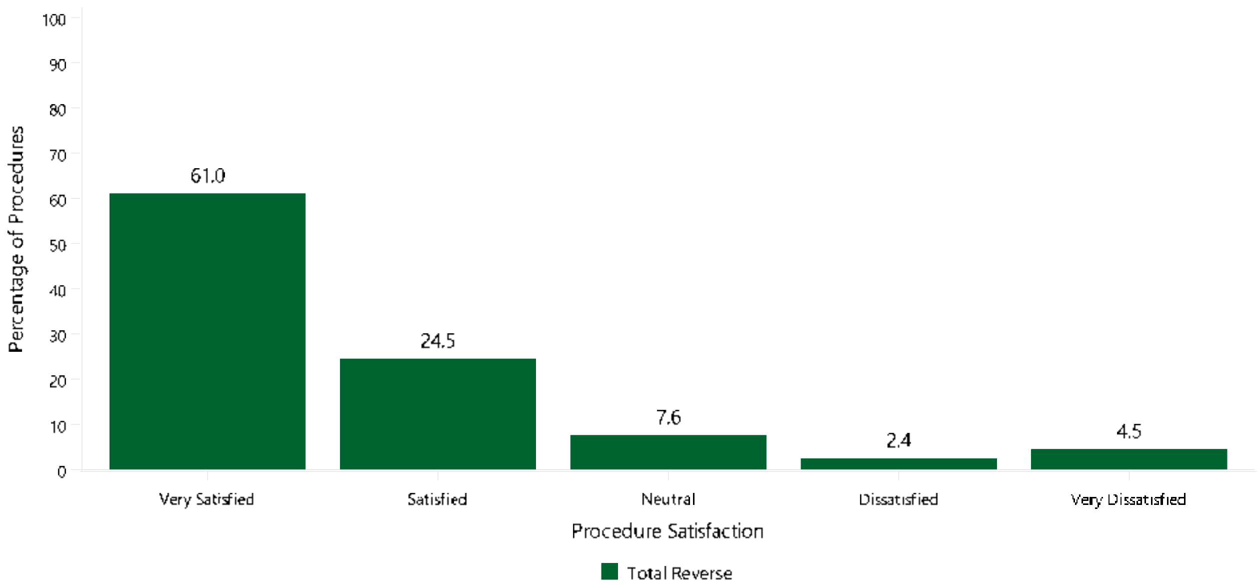
Patient-reported change is much better in 85.5% of total reverse shoulders (Table ST67 and Figure ST58). Patient-reported change by age and gender are presented in Table ST68, Figure ST59, Table ST69 and Figure ST60.

Table ST64 Procedure Satisfaction in Primary Total Reverse Shoulder Replacement (Primary Diagnosis OA)

Class	Very Satisfied		Satisfied		Neutral		Dissatisfied		Very Dissatisfied		TOTAL	
	N	Row%	N	Row%	N	Row%	N	Row%	N	Row%	N	Row%
Total Reverse	177	61.0	71	24.5	22	7.6	7	2.4	13	4.5	290	100.0

Note: Restricted to modern prostheses

Figure ST55 Procedure Satisfaction in Primary Total Reverse Shoulder Replacement (Primary Diagnosis OA)



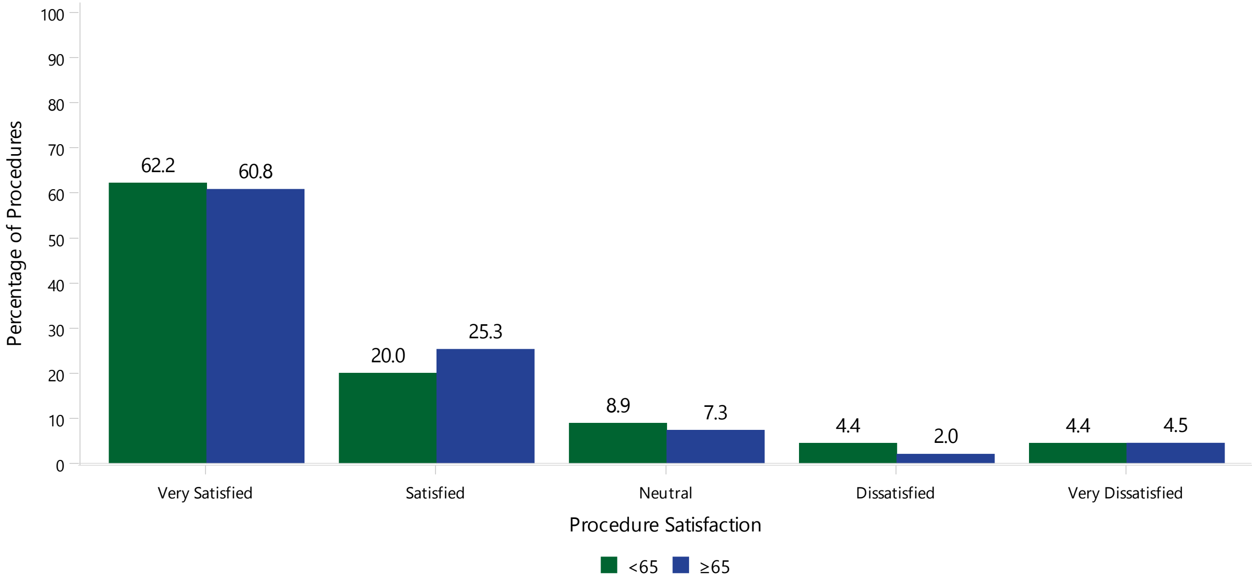
Note: Restricted to modern prostheses

Table ST65 Procedure Satisfaction in Primary Total Reverse Shoulder Replacement by Age (Primary Diagnosis OA)

Age	Very Satisfied			Satisfied			Neutral			Dissatisfied			Very Dissatisfied			TOTAL		
	N	Row %	Col%	N	Row %	Col%	N	Row %	Col%	N	Row %	Col%	N	Row %	Col%	N	Row %	Col%
<65	28	62.2	15.8	9	20.0	12.7	4	8.9	18.2	2	4.4	28.6	2	4.4	15.4	45	100.0	15.5
≥65	149	60.8	84.2	62	25.3	87.3	18	7.3	81.8	5	2.0	71.4	11	4.5	84.6	245	100.0	84.5
TOTAL	**177**	**61.0**	**100.0**	**71**	**24.5**	**100.0**	**22**	**7.6**	**100.0**	**7**	**2.4**	**100.0**	**13**	**4.5**	**100.0**	**290**	**100.0**	**100.0**

Note: Restricted to modern prostheses

Figure ST56 Procedure Satisfaction in Primary Total Reverse Shoulder Replacement by Age (Primary Diagnosis OA)



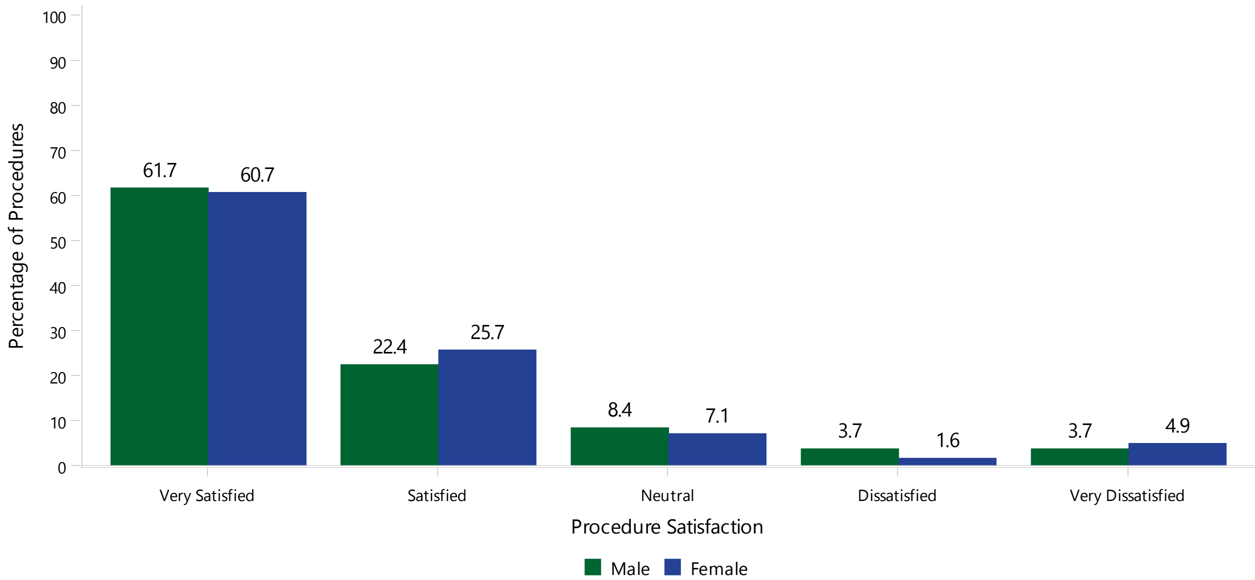
Note: Restricted to modern prostheses

Table ST66 Procedure Satisfaction in Primary Total Reverse Shoulder Replacement by Gender (Primary Diagnosis OA)

Gender	Very Satisfied			Satisfied			Neutral			Dissatisfied			Very Dissatisfied			TOTAL		
	N	Row %	Col%	N	Row %	Col%	N	Row %	Col%	N	Row %	Col%	N	Row %	Col%	N	Row %	Col%
Male	66	61.7	37.3	24	22.4	33.8	9	8.4	40.9	4	3.7	57.1	4	3.7	30.8	107	100.0	36.9
Female	111	60.7	62.7	47	25.7	66.2	13	7.1	59.1	3	1.6	42.9	9	4.9	69.2	183	100.0	63.1
TOTAL	177	61.0	100.0	71	24.5	100.0	22	7.6	100.0	7	2.4	100.0	13	4.5	100.0	290	100.0	100.0

Note: Restricted to modern prostheses

Figure ST57 Procedure Satisfaction in Primary Total Reverse Shoulder Replacement by Gender (Primary Diagnosis OA)



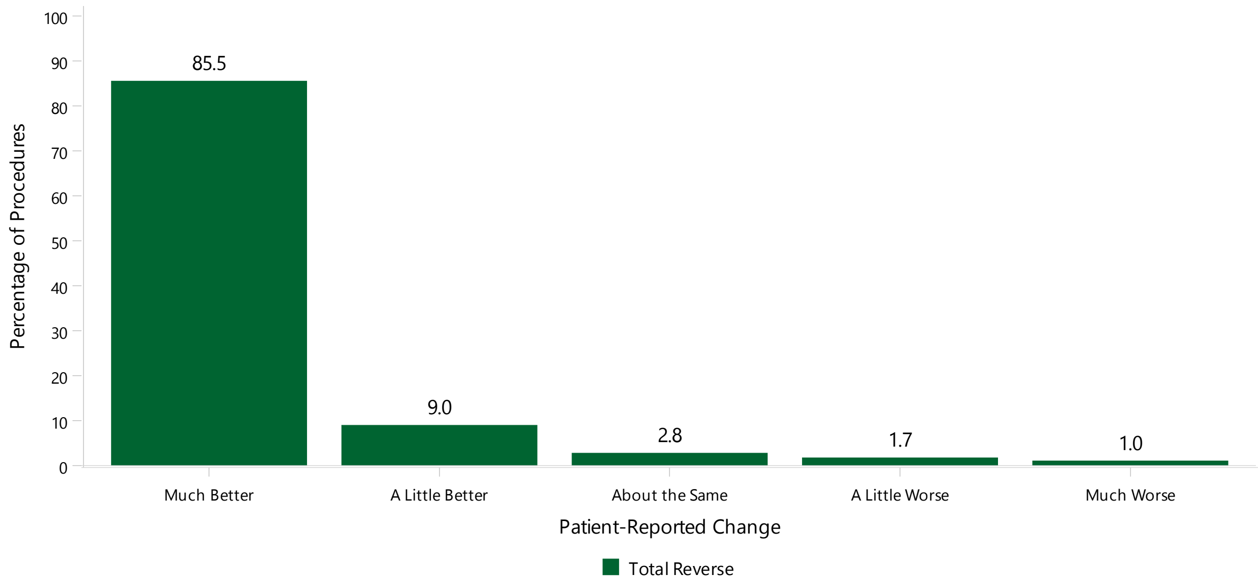
Note: Restricted to modern prostheses

Table ST67 Patient-Reported Change in Primary Total Reverse Shoulder Replacement (Primary Diagnosis OA)

Class	Much Better		A Little Better		About the Same		A Little Worse		Much Worse		TOTAL	
	N	Row%	N	Row%	N	Row%	N	Row%	N	Row%	N	Row%
Total Reverse	248	85.5	26	9.0	8	2.8	5	1.7	3	1.0	290	100.0

Note: Restricted to modern prostheses

Figure ST58 Patient-Reported Change in Primary Total Reverse Shoulder Replacement (Primary Diagnosis OA)



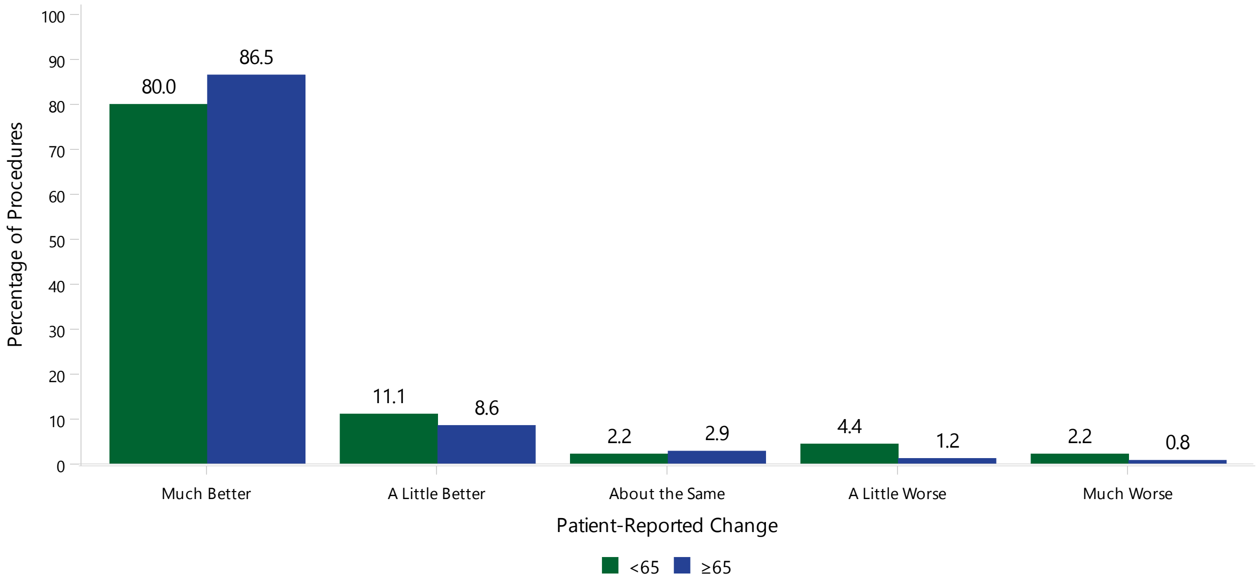
Note: Restricted to modern prostheses

Table ST68 Patient-Reported Change in Primary Total Reverse Shoulder Replacement by Age (Primary Diagnosis OA)

Age	Much Better			A Little Better			About the Same			A Little Worse			Much Worse			TOTAL		
	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%
<65	36	80.0	14.5	5	11.1	19.2	1	2.2	12.5	2	4.4	40.0	1	2.2	33.3	45	100.0	15.5
≥65	212	86.5	85.5	21	8.6	80.8	7	2.9	87.5	3	1.2	60.0	2	0.8	66.7	245	100.0	84.5
TOTAL	248	85.5	100.0	26	9.0	100.0	8	2.8	100.0	5	1.7	100.0	3	1.0	100.0	290	100.0	100.0

Note: Restricted to modern prostheses

Figure ST59 Patient-Reported Change in Primary Total Reverse Shoulder Replacement by Age (Primary Diagnosis OA)



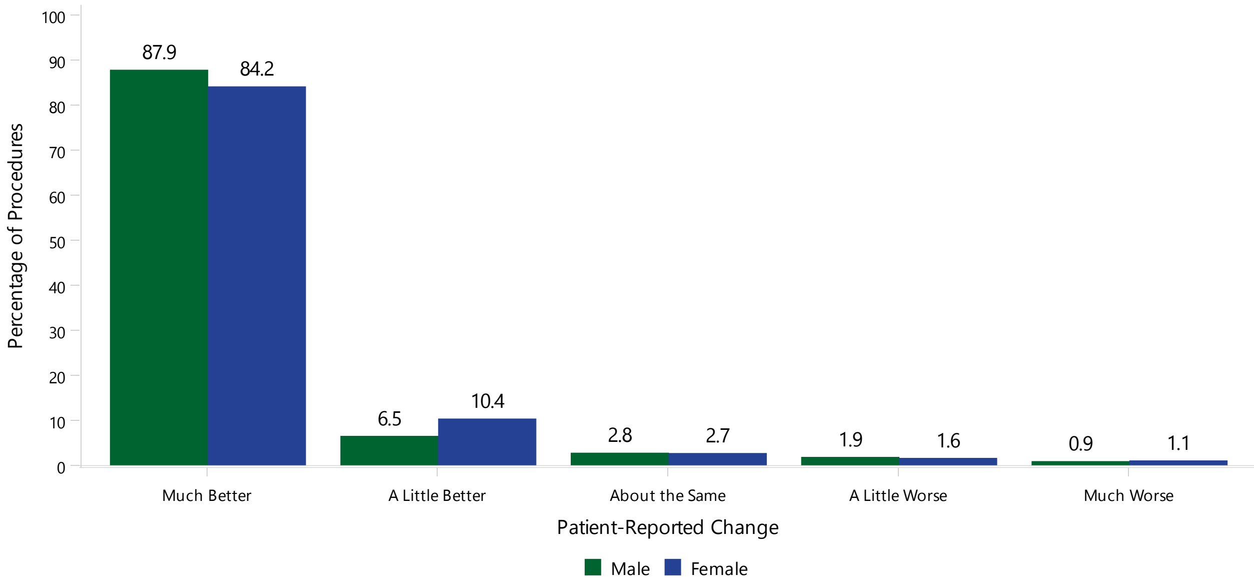
Note: Restricted to modern prostheses

Table ST69 Patient-Reported Change in Primary Total Reverse Shoulder Replacement by Gender (Primary Diagnosis OA)

Gender	Much Better			A Little Better			About the Same			A Little Worse			Much Worse			TOTAL		
	N	Row %	Col%	N	Row %	Col%	N	Row %	Col%	N	Row %	Col%	N	Row %	Col%	N	Row %	Col%
Male	94	87.9	37.9	7	6.5	26.9	3	2.8	37.5	2	1.9	40.0	1	0.9	33.3	107	100.0	36.9
Female	154	84.2	62.1	19	10.4	73.1	5	2.7	62.5	3	1.6	60.0	2	1.1	66.7	183	100.0	63.1
TOTAL	248	85.5	100.0	26	9.0	100.0	8	2.8	100.0	5	1.7	100.0	3	1.0	100.0	290	100.0	100.0

Note: Restricted to modern prostheses

Figure ST60 Patient-Reported Change in Primary Total Reverse Shoulder Replacement by Gender (Primary Diagnosis OA)



Note: Restricted to modern prostheses

OUTCOME FOR OSTEOARTHRITIS – PROSTHESIS CHARACTERISTICS

Fixation

Fixation is not a risk factor for revision of primary total reverse shoulder replacement. There is no difference between hybrid (humerus cemented) and cementless humeral stems (Table ST70 and Figure ST61).

Type of Polyethylene

Non XLPE is the most common type of polyethylene used in primary total reverse shoulder replacement for the management of osteoarthritis. There is no difference in the cumulative percent revision when the different types of polyethylene are compared (Table ST71 and Figure ST62). The reasons for revision for the different polyethylene types are presented in Figure ST63.

Glenosphere Size

Glenosphere sizes <38mm have a higher rate of revision compared to 38-40mm and >40mm sizes (Table ST72 and Figure ST64). The cumulative incidence for the most common reasons for revision for the three different glenosphere sizes is presented in Figure ST65.

Glenosphere sizes <38mm have a higher rate of revision.

Prosthesis Types

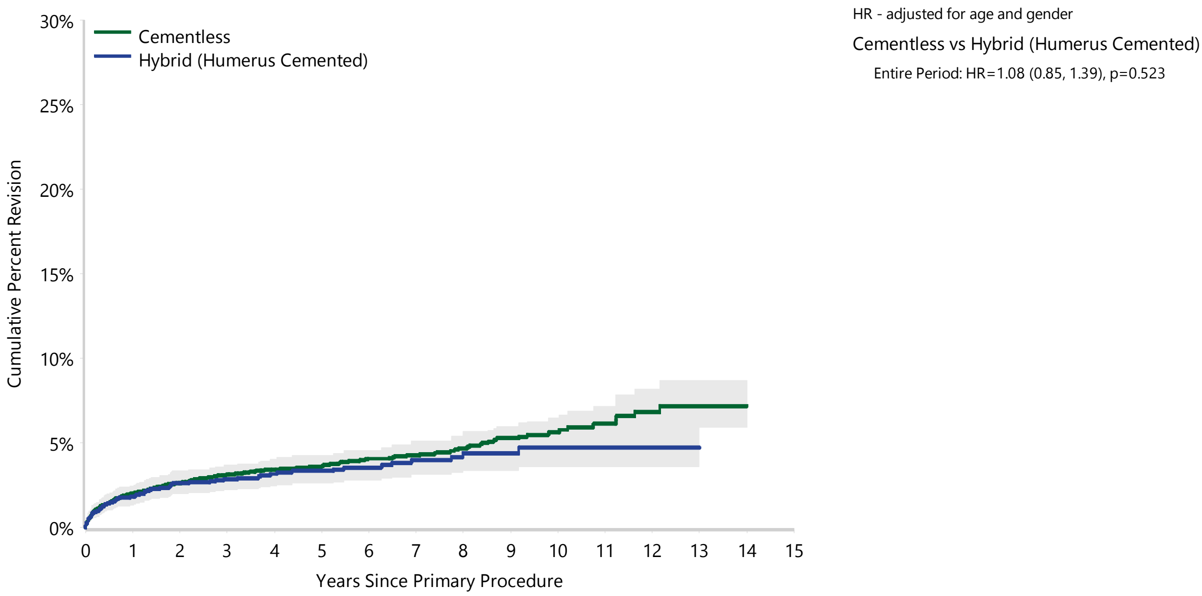
The outcomes of the most commonly used primary total reverse shoulder prostheses are listed in Table ST73. The outcomes for the most used prosthesis combinations using cementless fixation are listed in Table ST74. The most commonly used prosthesis combinations using hybrid (humerus cemented) fixation are listed in Table ST75.

Table ST70 Cumulative Percent Revision of Primary Total 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	93	0.0 (0.0, 0.0)	1.2 (0.2, 8.4)	3.0 (0.7, 11.9)	3.0 (0.7, 11.9)	3.0 (0.7, 11.9)	
Cementless	488	15257	2.0 (1.8, 2.3)	3.1 (2.8, 3.4)	3.6 (3.3, 4.0)	4.3 (3.8, 4.7)	5.6 (4.9, 6.5)	7.2 (5.9, 8.7)
Hybrid (Glenoid Cemented)	2	79	1.3 (0.2, 8.6)	3.1 (0.8, 12.1)	3.1 (0.8, 12.1)	3.1 (0.8, 12.1)		
Hybrid (Humerus Cemented)	73	2271	1.8 (1.3, 2.5)	2.9 (2.2, 3.7)	3.3 (2.6, 4.3)	4.0 (3.1, 5.1)	4.7 (3.6, 6.2)	
TOTAL	**566**	**17700**						

Note: Restricted to modern prostheses

Figure ST61 Cumulative Percent Revision of Primary Total 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	15257	12418	7805	4343	2141	638	41
Hybrid (Humerus Cemented)	2271	1984	1442	954	607	207	14

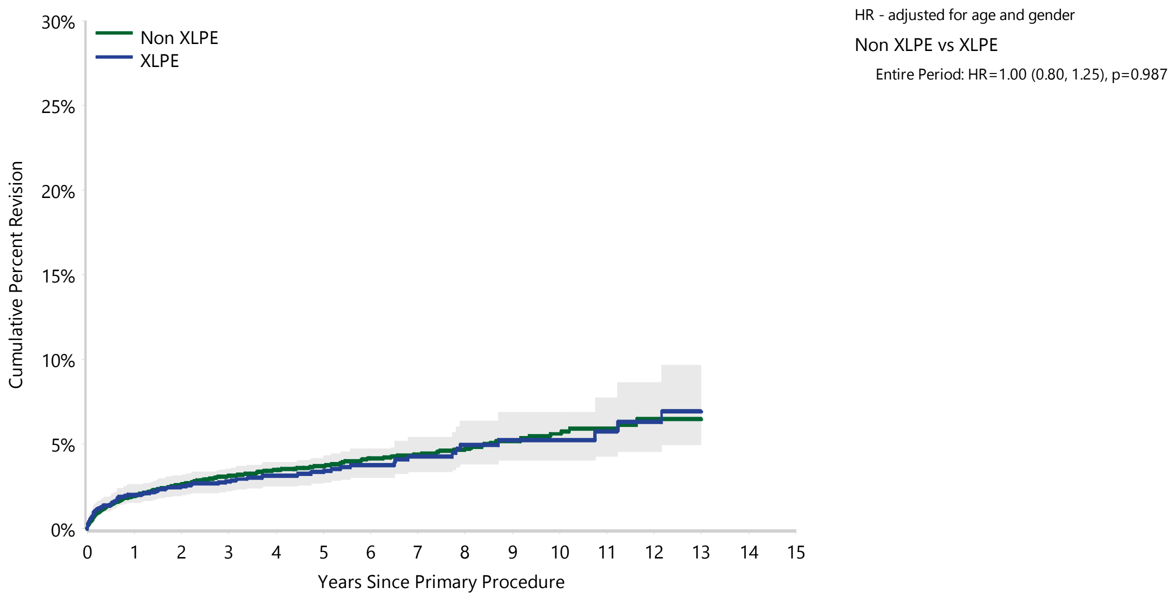
Note: Only fixations with >100 procedures have been listed
Restricted to modern prostheses

Table ST71 **Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Polyethylene Type (Primary Diagnosis OA)**

Polyethylene Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Non XLPE	370	11005	2.0 (1.7, 2.2)	3.1 (2.8, 3.5)	3.7 (3.3, 4.1)	4.4 (3.9, 4.9)	5.6 (4.9, 6.5)	
XLPE	96	3085	2.0 (1.6, 2.6)	2.8 (2.2, 3.5)	3.3 (2.7, 4.2)	4.3 (3.4, 5.4)	5.3 (4.0, 6.9)	
TOTAL	466	14090						

Note: Restricted to modern prostheses

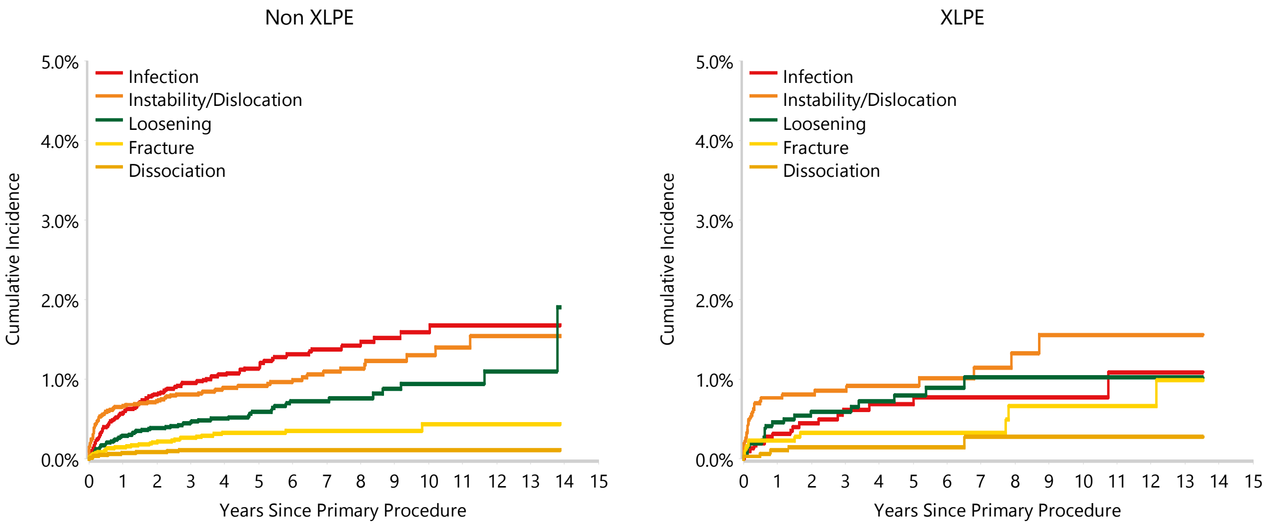
Figure ST62 **Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Polyethylene Type (Primary Diagnosis OA)**



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Non XLPE	11005	9244	6116	3651	2019	665	36
XLPE	3085	2415	1523	954	532	201	22

Note: Restricted to modern prostheses

Figure ST63 Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement by Polyethylene Type (Primary Diagnosis OA)



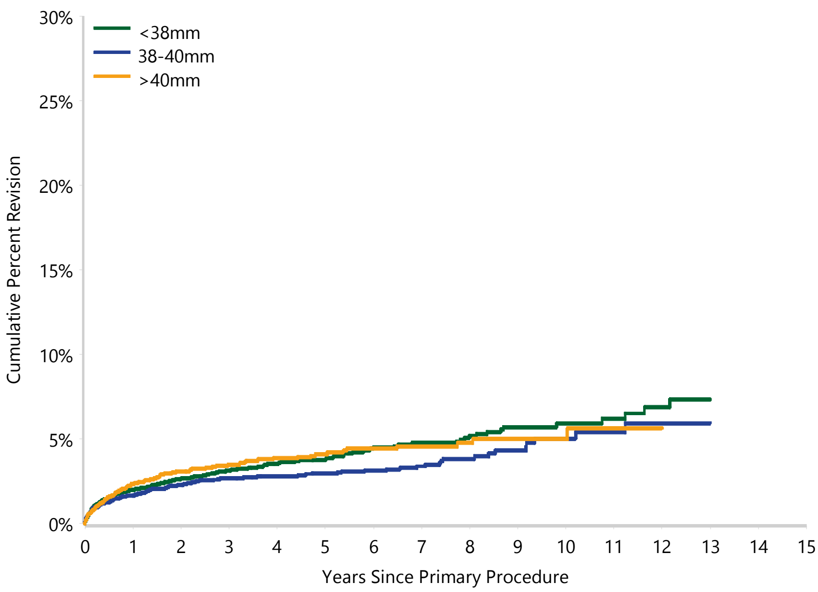
Note: Restricted to modern prostheses

Table ST72 **Cumulative Percent Revision of Primary Total 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	215	6072	2.0 (1.7, 2.4)	3.1 (2.7, 3.6)	3.8 (3.3, 4.4)	4.8 (4.1, 5.5)	5.9 (5.0, 7.1)	
38-40mm	188	6877	1.7 (1.4, 2.0)	2.7 (2.3, 3.1)	3.0 (2.6, 3.5)	3.4 (2.9, 4.0)	5.0 (4.0, 6.4)	
>40mm	150	4306	2.4 (1.9, 2.9)	3.5 (2.9, 4.1)	4.1 (3.4, 4.8)	4.6 (3.8, 5.4)	5.0 (4.1, 6.1)	
TOTAL	553	17255						

Note: Excludes 445 procedures with unknown glenosphere sizes
Restricted to modern prostheses

Figure ST64 **Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Glenosphere Size (Primary Diagnosis OA)**



HR - adjusted for age and gender

<38mm vs 38-40mm

Entire Period: HR=1.26 (1.04, 1.54), p=0.019

>40mm vs 38-40mm

0 - 3Mth: HR=0.73 (0.51, 1.05), p=0.090

3Mth - 9Mth: HR=1.21 (0.80, 1.81), p=0.368

9Mth+: HR=0.87 (0.64, 1.18), p=0.360

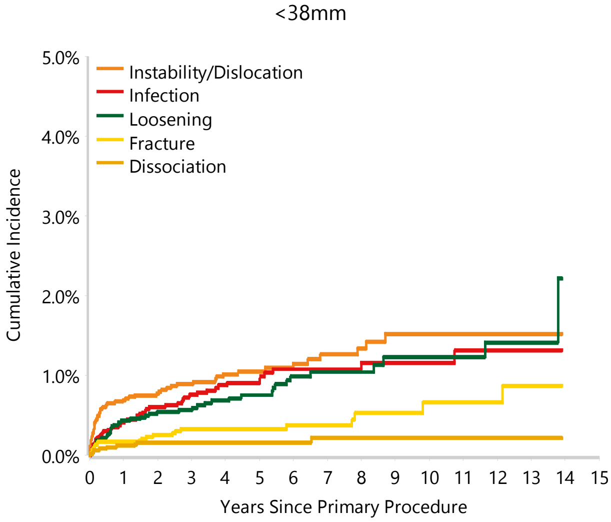
>40mm vs <38mm

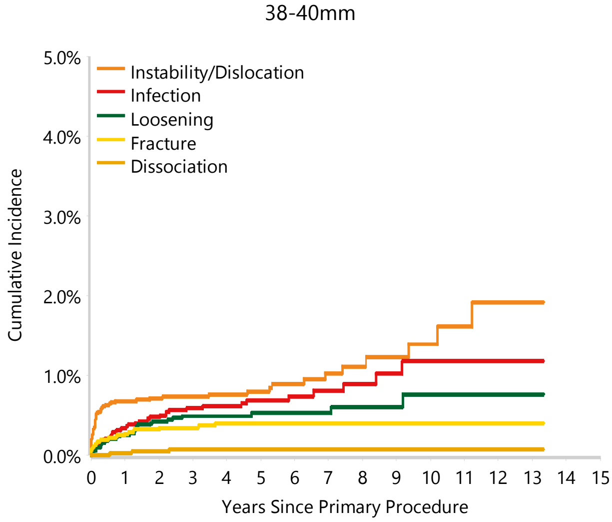
Entire Period: HR=0.70 (0.56, 0.87), p=0.001

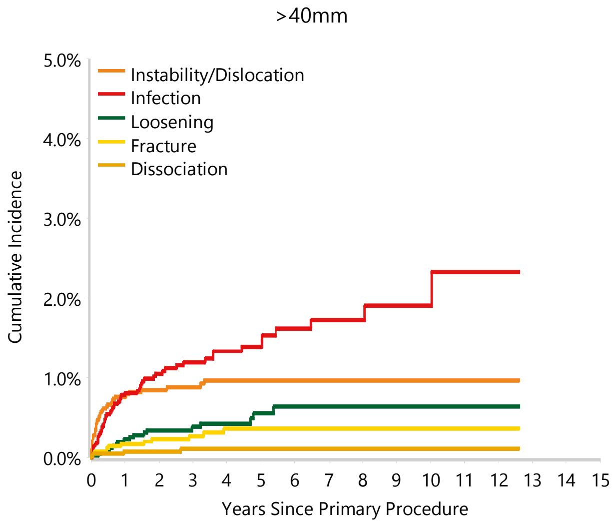
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
<38mm	6072	5030	3349	2049	1184	431	37
38-40mm	6877	5748	3699	2078	1019	294	13
>40mm	4306	3561	2262	1237	592	147	9

Note: Restricted to modern prostheses

Figure ST65 **Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement by Glenosphere Size (Primary Diagnosis OA)**







Note: Restricted to modern prostheses

Table ST73 Cumulative Percent Revision of Primary Total 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
Aequalis	Aequalis	65	1406	2.0 (1.3, 2.8)	3.3 (2.4, 4.4)	4.0 (3.0, 5.2)	5.4 (4.2, 7.0)	6.7 (5.0, 8.9)
	Perform Reversed	0	59	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)			
Affinis	Affinis	18	674	1.4 (0.7, 2.7)	3.0 (1.8, 4.9)	3.4 (2.1, 5.5)		
AltiVate Reverse	RSP	4	321	1.7 (0.6, 4.5)				
Ascend Flex	Aequalis	32	1086	2.2 (1.5, 3.3)	4.0 (2.7, 5.8)	4.4 (3.0, 6.4)		
	Perform Reversed	4	126	2.9 (1.0, 8.9)				
Comprehensive	Comprehensive Reverse	23	1640	1.0 (0.6, 1.7)	1.6 (1.0, 2.5)	2.1 (1.3, 3.3)	2.1 (1.3, 3.3)	
	Custom Made (Comprehensive)	0	39	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)		
	Trabecular Metal	1	28	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	16.7 (2.5, 72.7)		
Delta Xtend	Delta Xtend	152	4463	1.8 (1.5, 2.3)	2.8 (2.4, 3.4)	3.2 (2.7, 3.9)	3.8 (3.2, 4.5)	5.0 (4.1, 6.2)
Equinoxe	Equinoxe	46	1866	1.9 (1.3, 2.6)	2.9 (2.1, 4.0)	3.5 (2.5, 4.9)		
Global Unite	Delta Xtend	8	339	0.6 (0.2, 2.6)	3.4 (1.7, 6.7)	3.4 (1.7, 6.7)		
MSS	MSS	0	55	0.0 (0.0, 0.0)				
RSP	RSP	22	666	2.5 (1.5, 4.0)	3.4 (2.2, 5.2)			
SMR	Custom Made (Lima)	3	32	10.1 (3.4, 28.3)	10.1 (3.4, 28.3)			
	SMR Axioma	4	83	2.6 (0.7, 10.1)	6.3 (2.4, 16.2)			
	SMR L1	146	3987	2.5 (2.0, 3.0)	3.5 (2.9, 4.1)	3.8 (3.2, 4.5)	4.4 (3.7, 5.3)	5.3 (4.2, 6.6)
Trabecular Metal	Comprehensive Reverse	2	94	1.1 (0.2, 7.4)	4.4 (0.9, 19.2)			
	Trabecular Metal	28	696	1.8 (1.0, 3.1)	3.0 (1.9, 4.7)	4.3 (2.9, 6.4)	4.7 (3.2, 6.8)	5.4 (3.5, 8.3)
Other (13)		8	40	25.3 (13.1, 45.3)	25.3 (13.1, 45.3)			
TOTAL		**566**	**17700**					

Note: Only combinations with >25 procedures have been listed
Restricted to modern prostheses

Table ST74 Cumulative Percent Revision of Cementless Primary Total 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
Aequalis	Aequalis	55	1074	2.1 (1.4, 3.1)	3.7 (2.7, 5.0)	4.3 (3.2, 5.8)	6.0 (4.5, 7.9)	7.4 (5.4, 10.2)
	Perform Reversed	0	49	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)			
Affinis	Affinis	13	399	1.3 (0.6, 3.2)	3.6 (2.0, 6.5)	4.2 (2.4, 7.5)		
AltiVate Reverse	RSP	4	286	1.8 (0.7, 5.0)				
Ascend Flex	Aequalis	28	973	2.0 (1.3, 3.2)	4.0 (2.6, 5.9)	4.4 (2.9, 6.6)		
	Perform Reversed	4	112	3.3 (1.1, 9.9)				
Comprehensive	Comprehensive Reverse	22	1571	1.1 (0.7, 1.8)	1.7 (1.1, 2.6)	1.9 (1.2, 3.1)	1.9 (1.2, 3.1)	
	Custom Made (Comprehensive)	0	38	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)		
	Trabecular Metal	1	27	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	16.7 (2.5, 72.7)		
Delta Xtend	Delta Xtend	117	3265	2.0 (1.6, 2.5)	3.1 (2.5, 3.7)	3.5 (2.9, 4.3)	3.9 (3.2, 4.7)	5.6 (4.4, 7.1)
Equinoxe	Equinoxe	43	1792	1.8 (1.3, 2.6)	2.8 (2.0, 3.9)	3.5 (2.5, 4.9)		
Global Unite	Delta Xtend	6	297	0.7 (0.2, 2.9)	2.8 (1.3, 6.3)	2.8 (1.3, 6.3)		
MSS	MSS	0	54	0.0 (0.0, 0.0)				
RSP	RSP	18	567	2.6 (1.5, 4.3)	3.2 (2.0, 5.1)			
SMR	Custom Made (Lima)	3	32	10.1 (3.4, 28.3)	10.1 (3.4, 28.3)			
	SMR Axioma	3	81	2.7 (0.7, 10.4)	4.5 (1.4, 13.5)			
	SMR L1	140	3885	2.4 (2.0, 3.0)	3.4 (2.8, 4.1)	3.7 (3.1, 4.4)	4.4 (3.6, 5.3)	5.3 (4.2, 6.6)
Trabecular Metal	Comprehensive Reverse	2	90	1.1 (0.2, 7.7)	4.4 (1.0, 19.2)			
	Trabecular Metal	23	632	1.8 (1.0, 3.2)	2.8 (1.7, 4.5)	3.9 (2.6, 6.0)	4.3 (2.8, 6.6)	5.2 (3.2, 8.4)
Other (11)		6	33	23.4 (10.8, 46.3)	23.4 (10.8, 46.3)			
TOTAL		**488**	**15257**					

Note: Only combinations with >25 procedures have been listed
Restricted to modern prostheses

Table ST75 Cumulative Percent Revision of Hybrid (Humerus Cemented) Primary Total 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
Aequalis	Aequalis	10	310	1.6 (0.7, 3.9)	2.1 (0.9, 4.6)	3.1 (1.5, 6.1)	3.7 (1.9, 7.1)	
Affinis	Affinis	4	255	1.6 (0.6, 4.1)	1.6 (0.6, 4.1)			
AltiVate Reverse	RSP	0	34	0.0 (0.0, 0.0)				
Ascend Flex	Aequalis	4	102	4.4 (1.7, 11.5)				
Comprehensive	Comprehensive Reverse	1	63	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	4.5 (0.7, 28.1)		
Delta Xtend	Delta Xtend	34	1137	1.5 (0.9, 2.4)	2.4 (1.6, 3.4)	2.6 (1.8, 3.7)	3.4 (2.4, 4.8)	4.1 (2.8, 6.0)
Equinoxe	Equinoxe	3	72	2.9 (0.7, 11.0)	4.9 (1.6, 14.8)	4.9 (1.6, 14.8)		
Global Unite	Delta Xtend	2	39	0.0 (0.0, 0.0)	8.2 (2.1, 29.1)	8.2 (2.1, 29.1)		
RSP	RSP	4	94	2.2 (0.5, 8.4)	4.6 (1.8, 11.8)			
SMR	SMR L1	5	71	4.3 (1.4, 12.7)	7.6 (3.2, 17.3)	7.6 (3.2, 17.3)	7.6 (3.2, 17.3)	
Trabecular Metal	Trabecular Metal	4	55	2.0 (0.3, 13.1)	6.6 (2.2, 19.2)	9.3 (3.6, 23.2)	9.3 (3.6, 23.2)	9.3 (3.6, 23.2)
Other (12)		2	39	6.2 (1.5, 23.0)	6.2 (1.5, 23.0)			
TOTAL		**73**	**2271**					

Note: Only combinations with >25 procedures have been listed
Restricted to modern prostheses

OUTCOME FOR ROTATOR CUFF ARTHROPATHY – PATIENT CHARACTERISTICS

Age and Gender

For the diagnosis of rotator cuff arthropathy, age is not a risk factor for revision (Table ST76 and Figure ST66).

Males have a higher rate of revision compared to females (Table ST77 and Figure ST67). The increase in the rate of revision is due to a higher cumulative incidence of instability/dislocation and infection (Figure ST68).

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 ST69). The most common reasons for revision for the different ASA scores are presented in Figure ST70.

There is no difference in the rate of revision when patients in pre-obese and obese categories 1, 2, and 3 are compared to patients with a normal BMI (Table ST79 and Figure ST71).

The rate of instability/dislocation increases with increasing BMI category.

The most common reasons for revision for the different BMI categories are shown in Figure ST72. The rate of revision for instability/ dislocation increases with increasing BMI class.

Glenoid Morphology

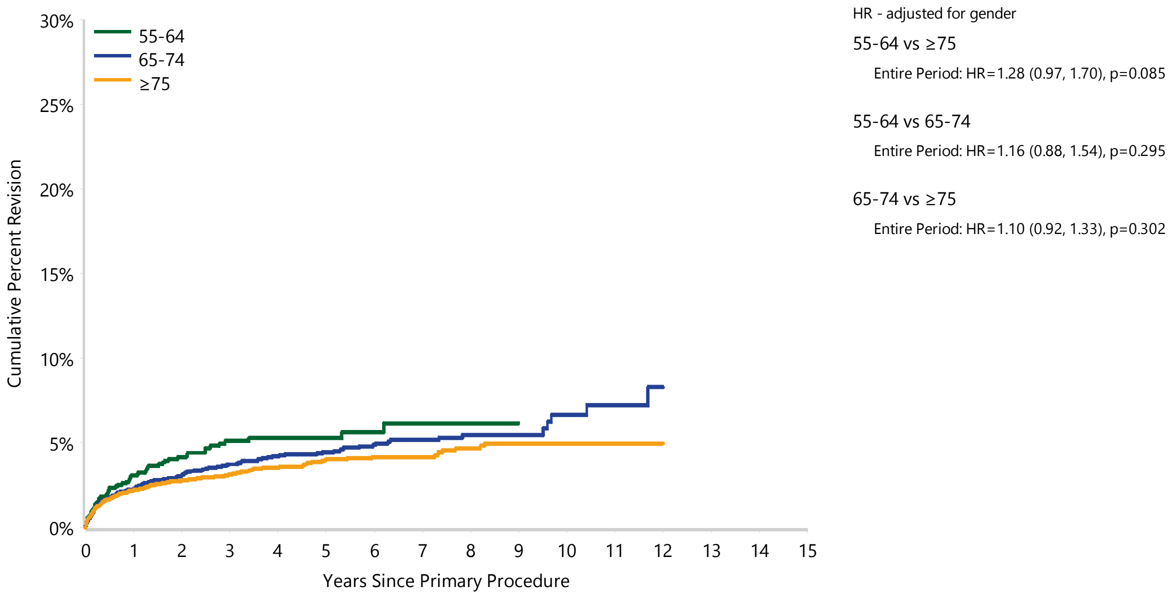
The Registry has glenoid morphology data on 8,417 primary total reverse shoulder replacements undertaken for rotator cuff arthropathy. The cumulative percent revision for the different morphology categories is presented in Table ST80. The category of glenoid morphology is not a risk factor for revision (Figure ST73).

Table ST76 Cumulative Percent Revision of Primary Total 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	7	141	2.9 (1.1, 7.4)	4.9 (2.2, 10.7)				
55-64	62	1401	3.1 (2.3, 4.2)	5.1 (3.9, 6.6)	5.3 (4.1, 6.8)	6.2 (4.6, 8.3)		
65-74	220	5946	2.3 (1.9, 2.7)	3.7 (3.2, 4.3)	4.5 (3.9, 5.1)	5.2 (4.4, 6.0)	6.7 (5.2, 8.4)	
≥75	236	7267	2.2 (1.9, 2.6)	3.1 (2.7, 3.6)	4.0 (3.5, 4.6)	4.2 (3.6, 4.8)	5.0 (4.2, 5.9)	
TOTAL	**525**	**14755**						

Note: Restricted to modern prostheses

Figure ST66 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Age (Primary Diagnosis Rotator Cuff Arthropathy)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
55-64	1401	1069	629	291	133	32	2
65-74	5946	4748	2857	1537	798	206	15
≥75	7267	5937	3815	2060	1081	270	6

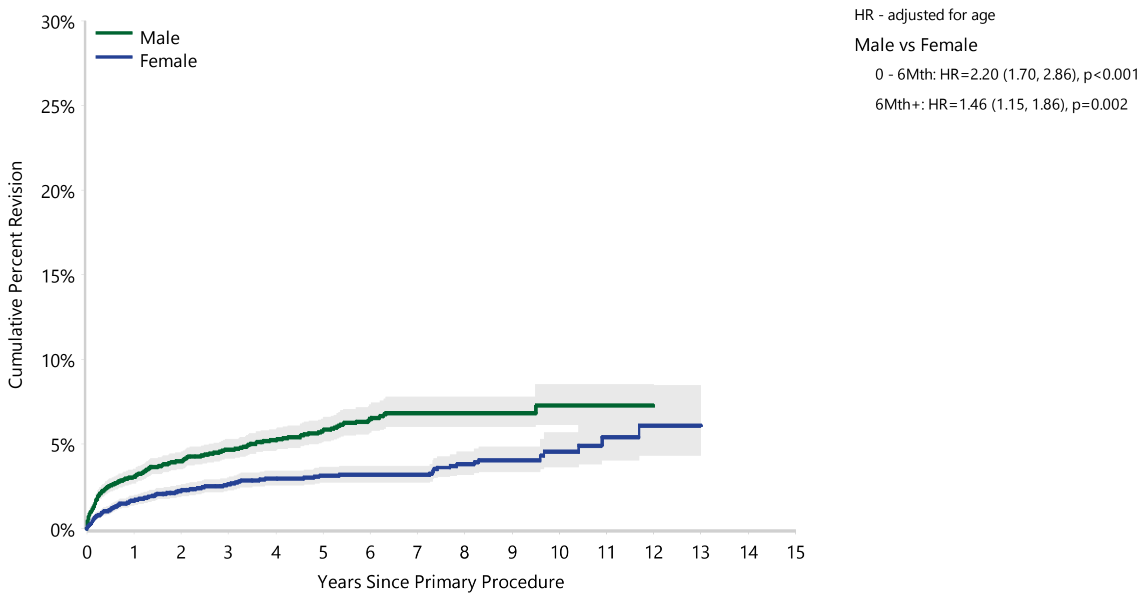
Note: Restricted to modern prostheses
Restricted to age groups with >150 procedures

Table ST77 Cumulative Percent Revision of Primary Total 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	312	6771	3.1 (2.7, 3.5)	4.7 (4.2, 5.3)	5.8 (5.1, 6.5)	6.8 (6.0, 7.8)	7.3 (6.1, 8.6)	
Female	213	7984	1.7 (1.4, 2.0)	2.6 (2.3, 3.0)	3.1 (2.7, 3.6)	3.2 (2.8, 3.7)	4.6 (3.7, 5.7)	
TOTAL	525	14755						

Note: Restricted to modern prostheses

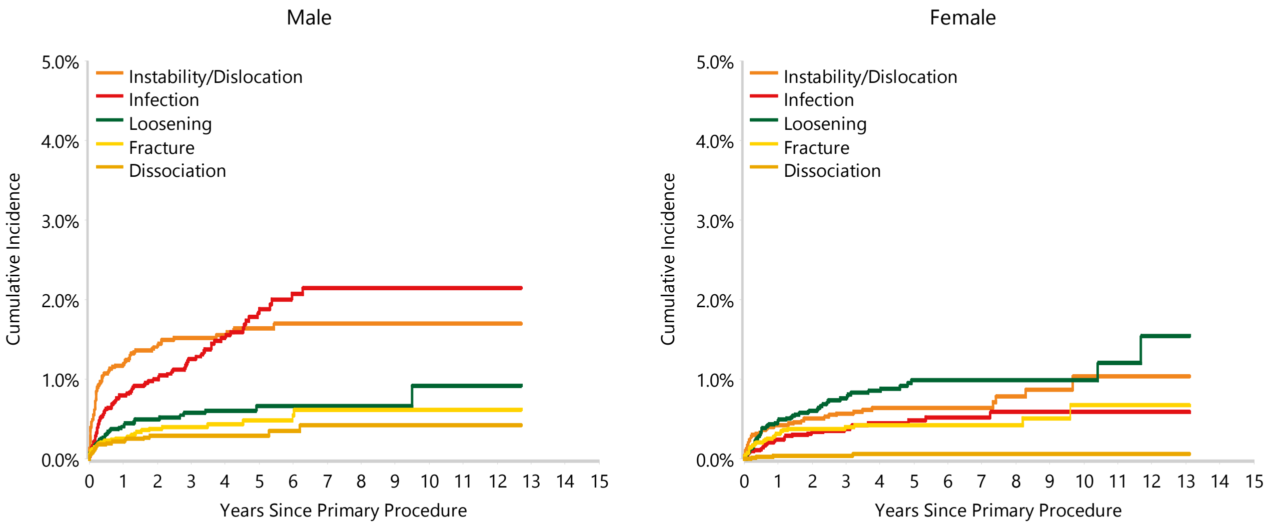
Figure ST67 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Gender (Primary Diagnosis Rotator Cuff Arthropathy)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Male	6771	5281	3144	1557	779	175	13
Female	7984	6585	4215	2357	1243	336	10

Note: Restricted to modern prostheses

Figure ST68 Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement by Gender (Primary Diagnosis Rotator Cuff Arthropathy)



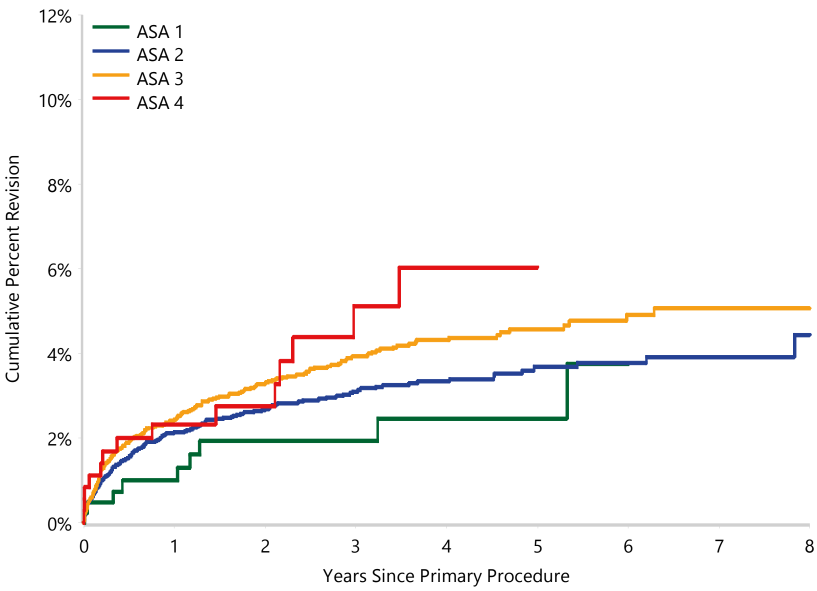
Note: Restricted to modern prostheses

Table ST78 **Cumulative Percent Revision of Primary Total 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	9	418	1.0 (0.4, 2.6)	1.9 (0.9, 4.0)	1.9 (0.9, 4.0)	2.5 (1.2, 5.0)	2.5 (1.2, 5.0)	
ASA 2	161	5500	2.1 (1.8, 2.6)	2.7 (2.3, 3.2)	3.1 (2.6, 3.6)	3.3 (2.8, 3.9)	3.7 (3.1, 4.3)	4.4 (3.4, 5.9)
ASA 3	234	6709	2.4 (2.1, 2.9)	3.3 (2.9, 3.8)	3.9 (3.4, 4.5)	4.3 (3.8, 4.9)	4.6 (4.0, 5.3)	5.1 (4.3, 5.9)
ASA 4	15	359	2.3 (1.2, 4.6)	2.8 (1.4, 5.3)	5.1 (2.9, 9.0)	6.0 (3.4, 10.5)	6.0 (3.4, 10.5)	
ASA 5	0	1						
TOTAL	419	12987						

Note: Restricted to modern prostheses

Figure ST69 **Cumulative Percent Revision of Primary Total 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=1.54 (0.79, 3.02), p=0.207

ASA 3 vs ASA 1

Entire Period: HR=2.01 (1.03, 3.92), p=0.041

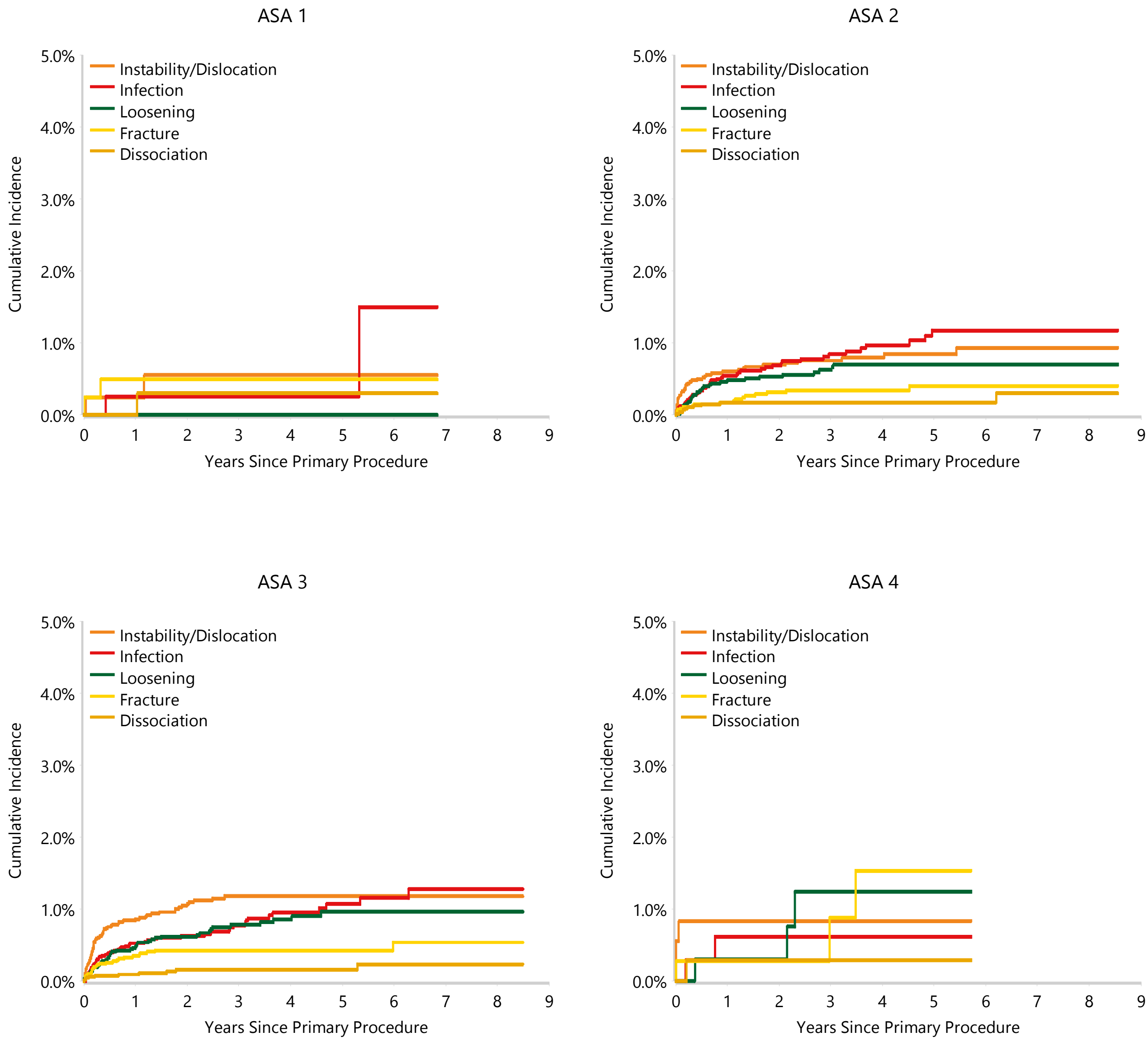
ASA 4 vs ASA 1

Entire Period: HR=2.48 (1.08, 5.69), p=0.031

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	8 Yrs
ASA 1	418	330	258	202	133	85	16
ASA 2	5500	4415	3509	2645	1851	1200	154
ASA 3	6709	5161	3958	2809	1862	1165	128
ASA 4	359	265	194	128	75	54	7

Note: Restricted to modern prostheses

Figure ST70 **Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement by ASA Score (Primary Diagnosis Rotator Cuff Arthropathy)**



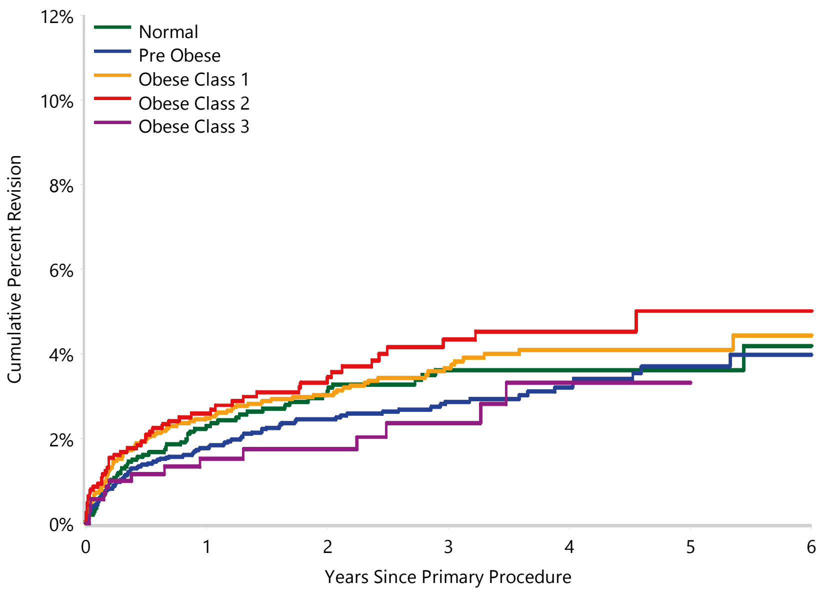
Note: Restricted to modern prostheses

Table ST79 **Cumulative Percent Revision of Primary Total 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	1	75	1.4 (0.2, 9.6)	1.4 (0.2, 9.6)	1.4 (0.2, 9.6)	1.4 (0.2, 9.6)	1.4 (0.2, 9.6)	
Normal	59	1989	2.3 (1.7, 3.1)	3.1 (2.4, 4.1)	3.6 (2.8, 4.7)	3.6 (2.8, 4.7)	3.6 (2.8, 4.7)	4.2 (3.0, 5.9)
Pre Obese	102	3972	1.8 (1.4, 2.3)	2.5 (2.0, 3.0)	2.9 (2.3, 3.5)	3.2 (2.6, 4.0)	3.7 (3.0, 4.6)	4.0 (3.1, 5.1)
Obese Class 1	102	3149	2.5 (2.0, 3.1)	3.0 (2.5, 3.7)	3.7 (3.0, 4.5)	4.1 (3.3, 5.0)	4.1 (3.3, 5.0)	4.4 (3.5, 5.6)
Obese Class 2	50	1387	2.6 (1.9, 3.6)	3.5 (2.6, 4.7)	4.3 (3.2, 5.8)	4.5 (3.4, 6.0)	5.0 (3.6, 6.9)	5.0 (3.6, 6.9)
Obese Class 3	15	707	1.5 (0.8, 2.8)	1.7 (1.0, 3.2)	2.4 (1.3, 4.2)	3.3 (1.9, 5.8)	3.3 (1.9, 5.8)	
TOTAL	329	11279						

Note: BMI has not been presented for patients aged ≤19 years
Restricted to modern prostheses

Figure ST71 **Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by BMI Category (Primary Diagnosis Rotator Cuff Arthropathy)**



HR - adjusted for age and gender
Pre Obese vs Normal
Entire Period: HR=0.80 (0.58, 1.11), p=0.177

Obese Class 1 vs Normal
Entire Period: HR=1.01 (0.73, 1.40), p=0.929

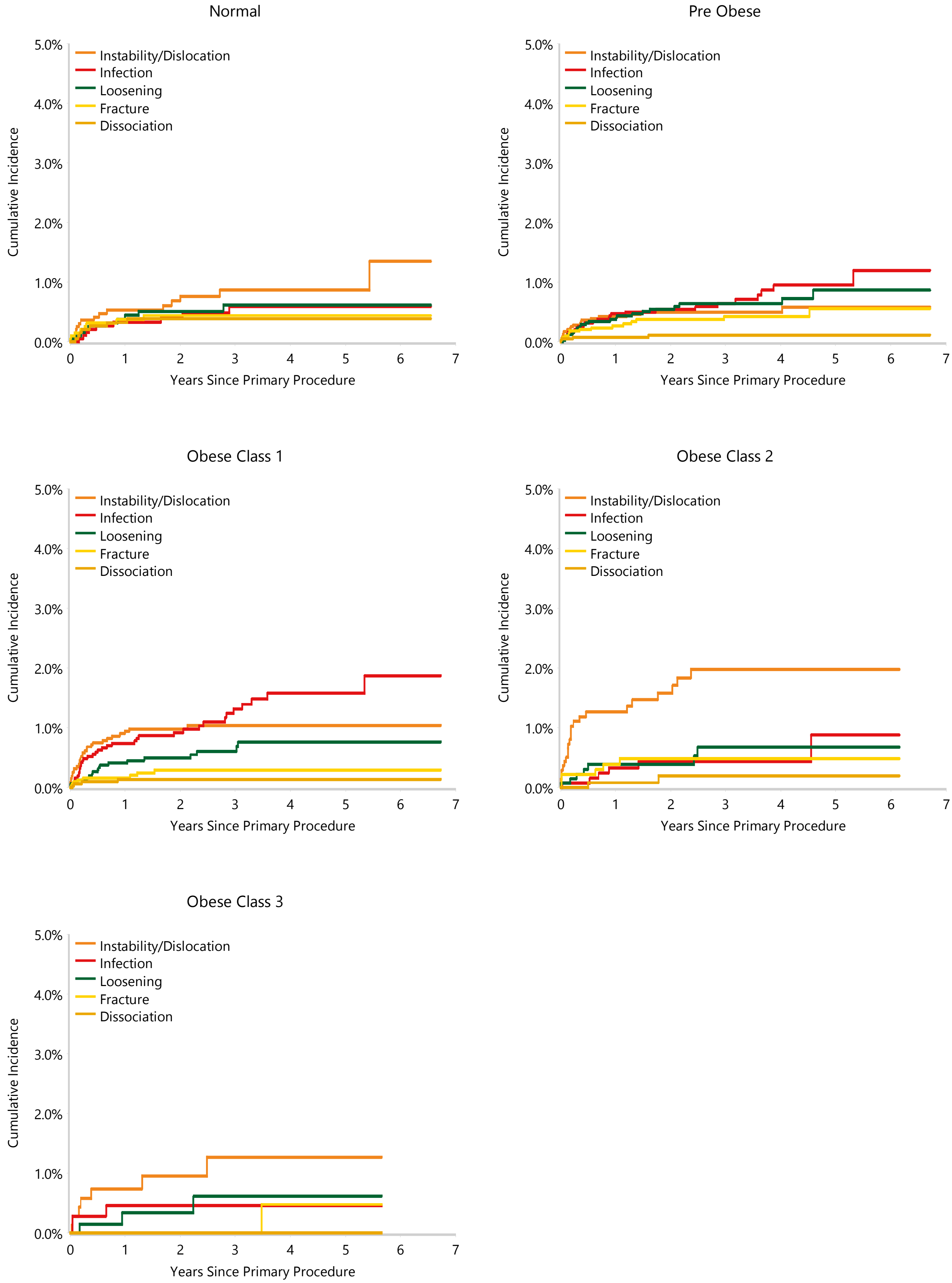
Obese Class 2 vs Normal
Entire Period: HR=1.17 (0.80, 1.72), p=0.416

Obese Class 3 vs Normal
Entire Period: HR=0.75 (0.42, 1.32), p=0.316

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Normal	1989	1506	1154	802	470	252	97
Pre Obese	3972	3045	2279	1545	955	459	197
Obese Class 1	3149	2408	1777	1227	718	382	159
Obese Class 2	1387	1050	770	517	306	143	46
Obese Class 3	707	504	375	244	147	77	30

Note: BMI has not been presented for patients aged ≤19 years
Restricted to modern prostheses

Figure ST72 Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement by BMI Category (Primary Diagnosis Rotator Cuff Arthropathy)



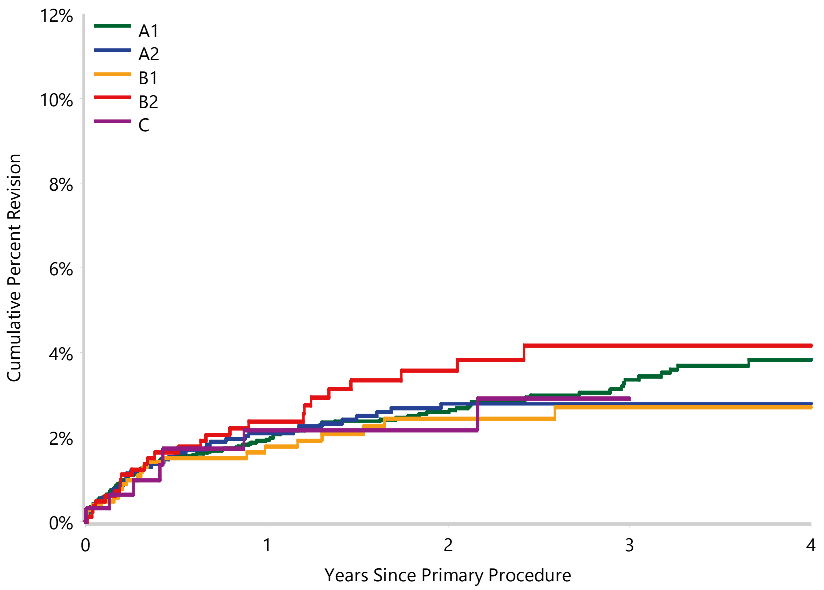
Note: BMI has not been presented for patients aged ≤19 years
Restricted to modern prostheses

Table ST80 Cumulative Percent Revision of Primary Total 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	112	4253	1.9 (1.6, 2.4)	2.6 (2.1, 3.2)	3.4 (2.7, 4.1)	3.8 (3.1, 4.7)
A2	46	1981	2.1 (1.5, 2.9)	2.8 (2.1, 3.7)	2.8 (2.1, 3.7)	2.8 (2.1, 3.7)
B1	23	1040	1.8 (1.1, 2.9)	2.4 (1.6, 3.7)	2.7 (1.7, 4.2)	2.7 (1.7, 4.2)
B2	26	825	2.4 (1.5, 3.7)	3.6 (2.4, 5.3)	4.2 (2.8, 6.2)	4.2 (2.8, 6.2)
C	7	318	2.2 (1.0, 4.8)	2.2 (1.0, 4.8)	2.9 (1.3, 6.2)	
TOTAL	214	8417				

Note: Restricted to modern prostheses
14 procedures have been excluded where a glenoid morphology of B3 was recorded

Figure ST73 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Glenoid Morphology (Primary Diagnosis Rotator Cuff Arthropathy)



HR - adjusted for age and gender
A2 vs A1
Entire Period: HR=0.94 (0.67, 1.33), p=0.743

B1 vs A1
Entire Period: HR=0.86 (0.55, 1.35), p=0.513

B2 vs A1
Entire Period: HR=1.27 (0.83, 1.94), p=0.277

C vs A1
Entire Period: HR=0.90 (0.42, 1.93), p=0.781

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs
A1	4253	3088	2135	1267	470
A2	1981	1376	939	529	204
B1	1040	725	470	278	114
B2	825	579	374	198	74
C	318	209	139	74	31

Note: Restricted to modern prostheses

PATIENT REPORTED OUTCOME MEASURES – PATIENT CHARACTERISTICS

EQ-VAS and EQ-5D-5L

The mean EQ-VAS score increased by just over 5 points following total reverse shoulder replacement for rotator cuff arthropathy (Table ST81). Scores before and 6 months after surgery are shown in Figure ST74. The percentage of patients who reported being better, worse or no different post-operatively compared to their pre-operative response for each of the EQ-5D domains and the EQ-VAS is shown in Figure ST75.

The EQ-VAS score for gender is shown in Table ST82 and Figure ST76. There are currently too few procedures undertaken in patients aged <65 years to analyse EQ-VAS scores by age.

Pre-operative mean EQ-VAS decreases with increasing ASA score. Patients with an ASA score of 3 have a lower change in score (Table ST83 and Figure ST77).

The mean EQ-VAS assessment before surgery is lower in obese class 2 and 3 patients compared to pre-obese and obese class 1 patients. Obese class 2 and 3 patients also have a small change following surgery (Table ST84 and Figure ST78).

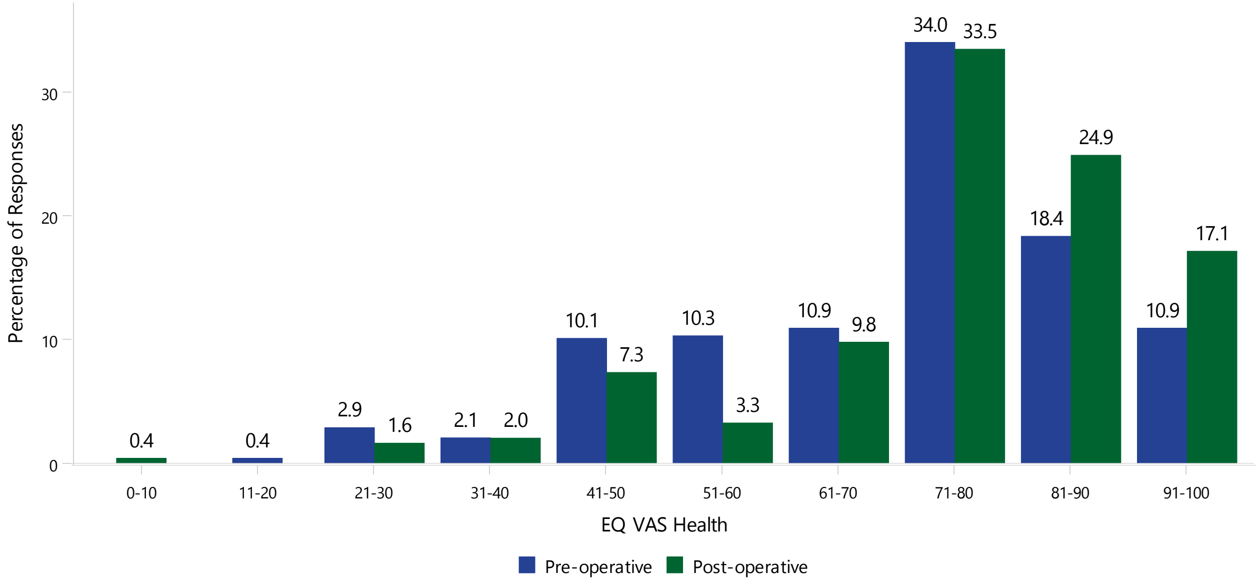
Glenoid morphology does not impact on pre- or post-operative EQ-VAS (Table ST85 and Figure ST79).

Table ST81 Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Reverse Shoulder Replacement (Primary Diagnosis Rotator Cuff Arthropathy)

Class	Pre-operative			Post-operative		
	N	Mean±SD	Median (Q1, Q3)	N	Mean±SD	Median (Q1, Q3)
Total Reverse	485	71.46±17.48	75.00 (60.00, 84.00)	245	76.58±16.31	77.00 (72.00, 89.00)

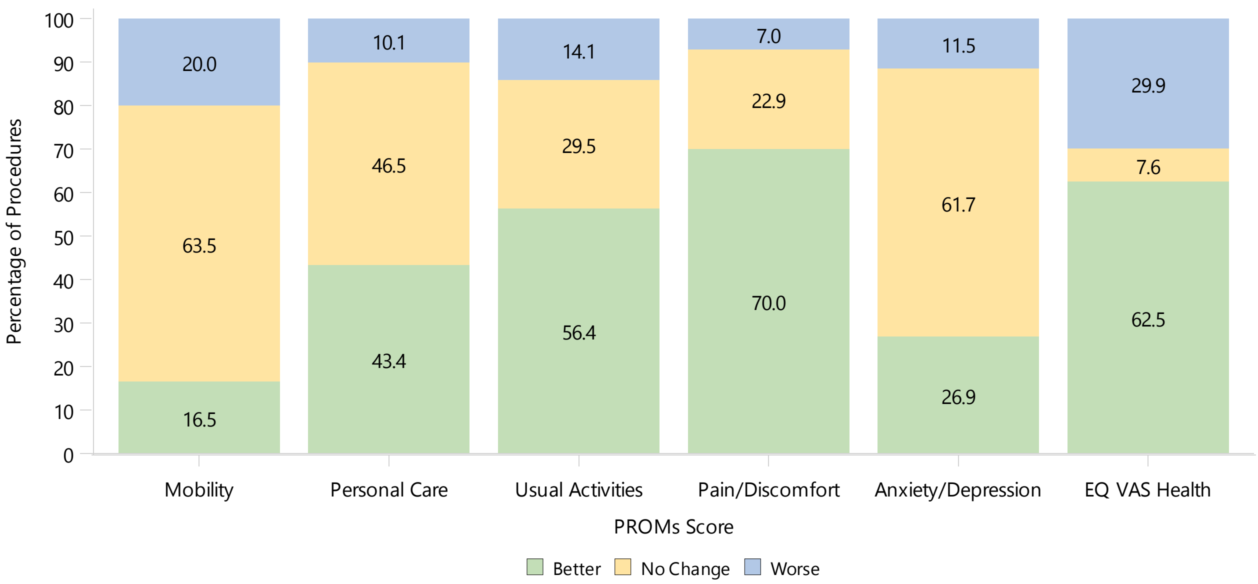
Note: Restricted to modern prostheses

Figure ST74 Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Reverse Shoulder Replacement (Primary Diagnosis Rotator Cuff Arthropathy)



Note: Restricted to modern prostheses

Figure ST75 Change in EQ-5D-5L Domain Score and EQ-VAS Health in Primary Total Reverse Shoulder Replacement (Primary Diagnosis Rotator Cuff Arthropathy)



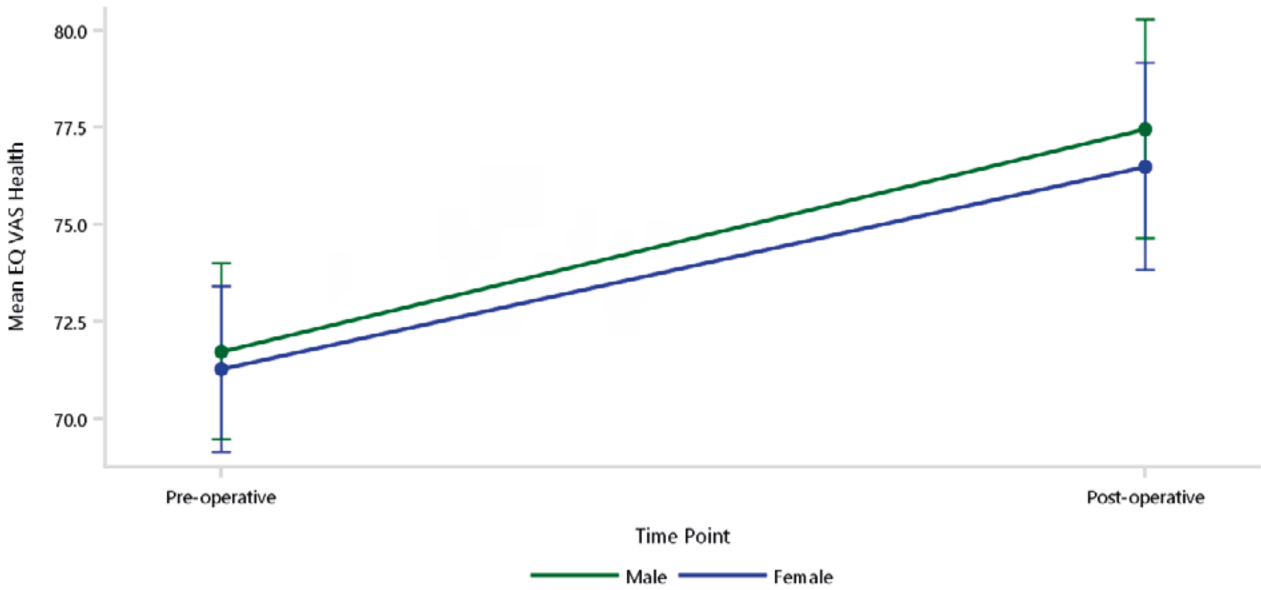
Note: Restricted to modern prostheses

Table ST82 **Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Reverse Shoulder Replacement by Gender (Primary Diagnosis Rotator Cuff Arthropathy)**

Gender	Pre-operative		Post-operative		
	N	Mean (95% CI)	N	Mean (95% CI)	Change in Score
Male	226	71.74 (69.46, 74.02)	116	77.47 (74.66, 80.29)	5.74 (2.74, 8.73)
Female	259	71.28 (69.14, 73.41)	129	76.50 (73.83, 79.17)	5.22 (2.41, 8.04)

Note: Restricted to modern prostheses
Adjusted for age

Figure ST76 **Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Reverse Shoulder Replacement by Gender (Primary Diagnosis Rotator Cuff Arthropathy)**



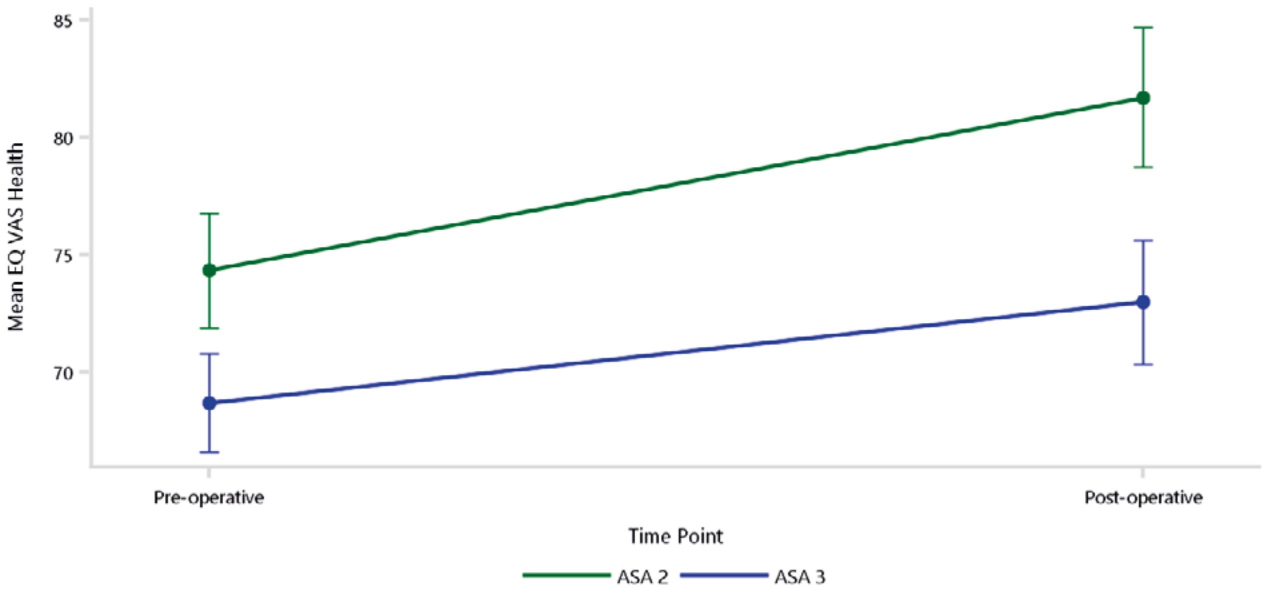
Note: Restricted to modern prostheses
Adjusted for age

Table ST83 Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Reverse Shoulder Replacement by ASA Score (Primary Diagnosis Rotator Cuff Arthropathy)

ASA Score	Pre-operative		Post-operative		
	N	Mean (95% CI)	N	Mean (95% CI)	Change in Score
ASA 2	194	74.33 (71.91, 76.76)	103	81.70 (78.75, 84.65)	7.37 (4.18, 10.55)
ASA 3	262	68.69 (66.60, 70.78)	126	72.98 (70.33, 75.64)	4.29 (1.44, 7.14)

Note: Restricted to modern prostheses
Adjusted for age and gender
Only ASA categories with >40 pre-operative and post-operative responses have been included

Figure ST77 Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Reverse Shoulder Replacement by ASA Score (Primary Diagnosis Rotator Cuff Arthropathy)



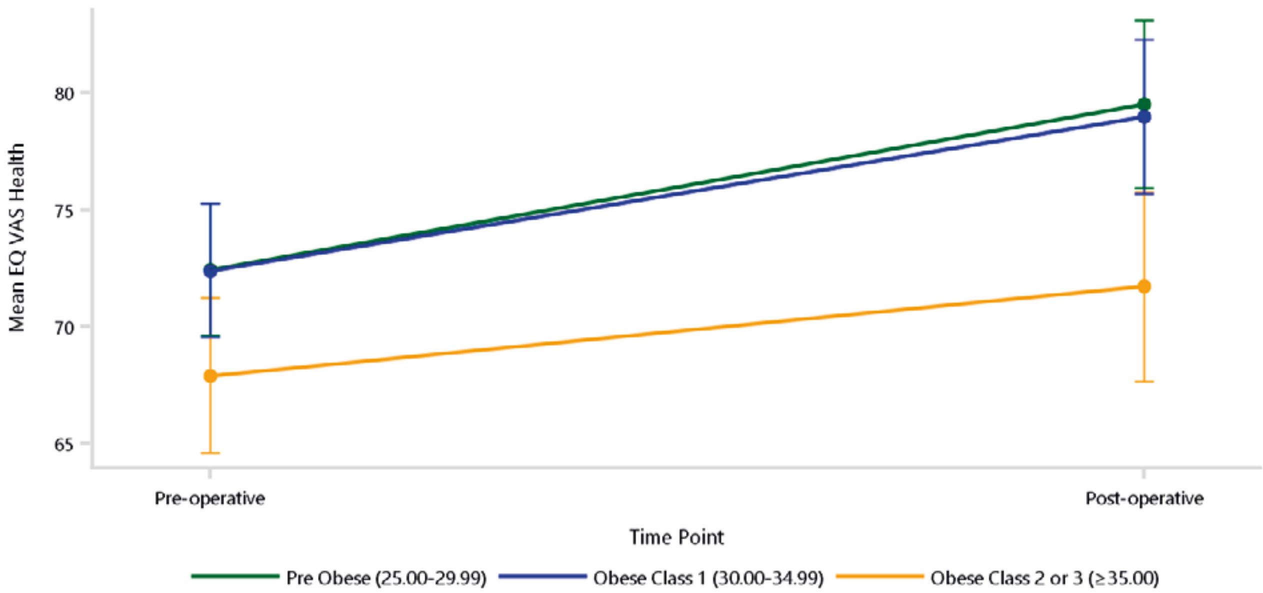
Note: Restricted to modern prostheses
Adjusted for age and gender
Only ASA categories with >40 pre-operative and post-operative responses have been included

Table ST84 Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Reverse Shoulder Replacement by BMI Category (Primary Diagnosis Rotator Cuff Arthropathy)

BMI Category	Pre-operative		Post-operative		
	N	Mean (95% CI)	N	Mean (95% CI)	Change in Score
Pre Obese (25.00-29.99)	147	72.45 (69.64, 75.27)	69	79.54 (75.96, 83.11)	7.08 (3.25, 10.92)
Obese Class 1 (30.00-34.99)	140	72.41 (69.55, 75.27)	82	79.00 (75.70, 82.31)	6.59 (3.01, 10.18)
Obese Class 2 or 3 (≥35.00)	110	67.92 (64.59, 71.25)	56	71.73 (67.67, 75.79)	3.81 (-0.47, 8.09)

Note: Restricted to modern prostheses
Adjusted for age and gender
Due to a small number of procedures, the BMI categories obese class 2 and obese class 3 have been combined
Only BMI categories with >40 pre-operative and post-operative responses have been included

Figure ST78 Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Reverse Shoulder Replacement by BMI Category (Primary Diagnosis Rotator Cuff Arthropathy)



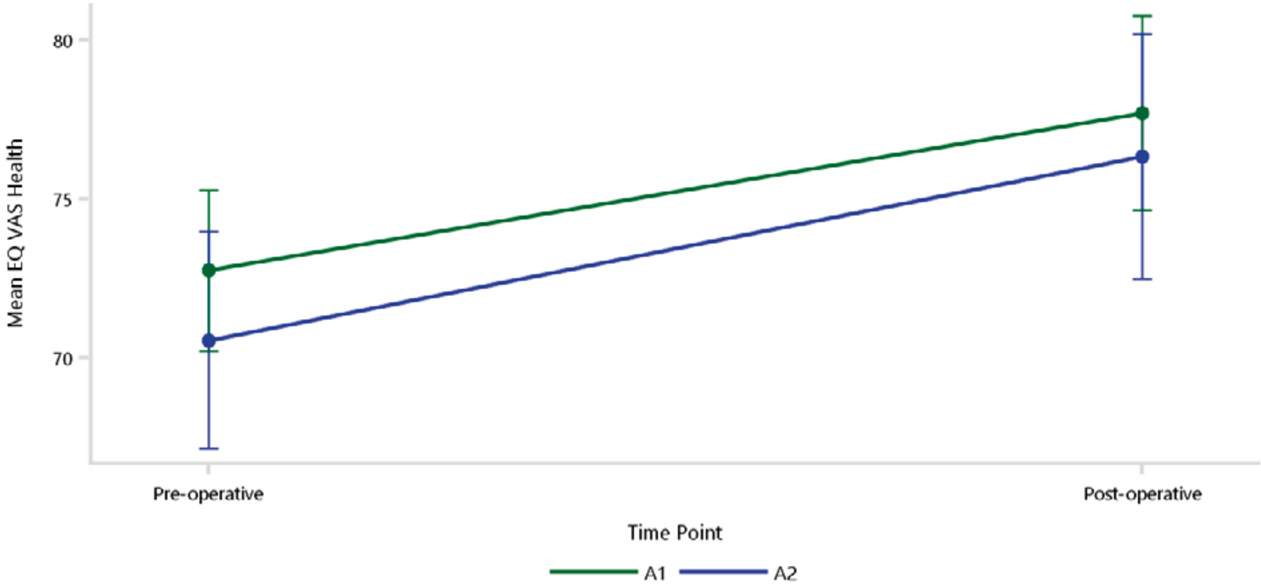
Note: Restricted to modern prostheses
Adjusted for age and gender
Due to a small number of procedures, the BMI categories obese class 2 and obese class 3 have been combined
Only BMI categories with >40 pre-operative and post-operative responses have been included

Table ST85 Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Reverse Shoulder Replacement by Glenoid Morphology (Primary Diagnosis Rotator Cuff Arthropathy)

Glenoid Morphology	Pre-operative		Post-operative		
	N	Mean (95% CI)	N	Mean (95% CI)	Change in Score
A1	195	72.75 (70.21, 75.28)	94	77.71 (74.65, 80.77)	4.97 (1.69, 8.24)
A2	107	70.54 (67.12, 73.96)	60	76.33 (72.48, 80.18)	5.79 (1.56, 10.02)

Note: Restricted to modern prostheses
Adjusted for age and gender
Only glenoid morphologies with >40 pre-operative and post-operative responses have been included

Figure ST79 Mean Pre-operative and Post-operative EQ-VAS Health in Primary Total Reverse Shoulder Replacement by Glenoid Morphology (Primary Diagnosis Rotator Cuff Arthropathy)



Note: Restricted to modern prostheses
Adjusted for age and gender
Only glenoid morphologies with >40 pre-operative and post-operative responses have been included

PROMs: Oxford Score

The Oxford shoulder scores (OSS) before and after total reverse shoulder replacement undertaken for rotator cuff arthropathy are provided in Table ST86.

The mean pre-operative and post-operative OSS by gender is shown in Table ST87 and Figure ST80. There are currently too few procedure numbers to analyse Oxford scores by patient age subgroups.

Pre-operative mean Oxford scores decrease with each increase in ASA score. Post-operative improvement is similar (Table ST88 and Figure ST81).

Pre-operative mean Oxford score decreases with increasing BMI category. Pre-obese and obese patients have similar changes in score post-operatively (Table ST89 and Figure ST82).

Glenoid morphology does not affect the pre-operative OSS, although currently there are too few procedures with glenoid morphologies B1, B2 and C for analysis. The post-operative improvement is similar for A1 and A2 glenoid morphologies (Table ST90 and Figure ST83).

Table ST86 Mean Pre-operative and Post-operative Oxford Shoulder Score in Primary Total Reverse Shoulder Replacement (Primary Diagnosis Rotator Cuff Arthropathy)

Class	Pre-operative			Post-operative		
	N	Mean±SD	Median (Q1, Q3)	N	Mean±SD	Median (Q1, Q3)
Total Reverse	482	23.32±8.64	24.00 (17.00, 29.00)	245	36.84±9.03	39.00 (33.00, 43.00)

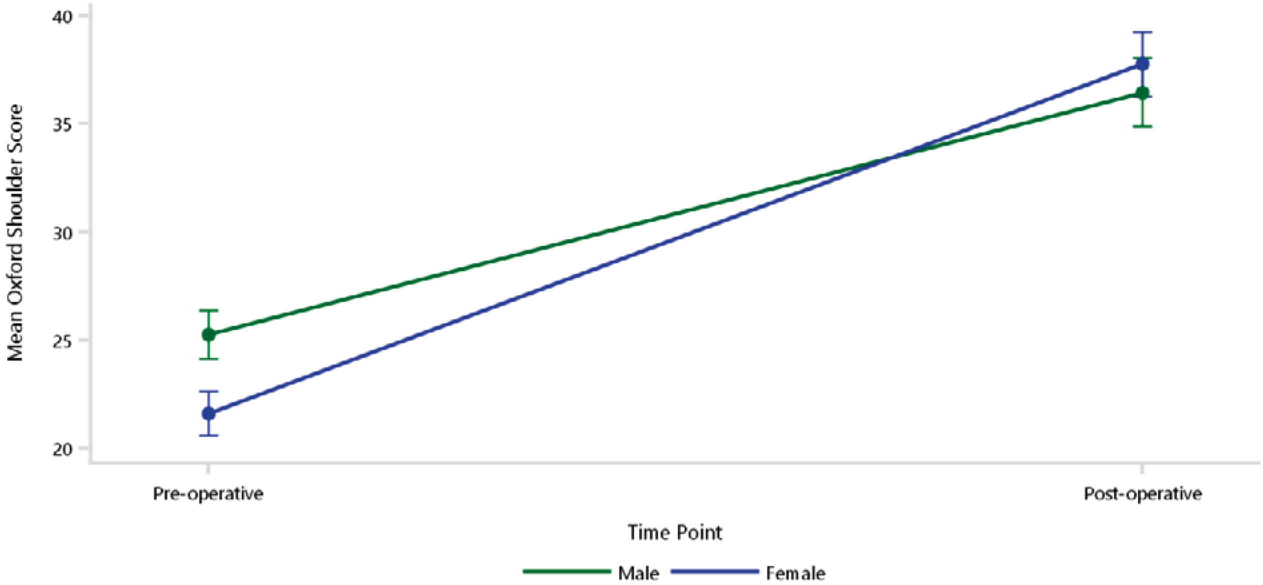
Note: Restricted to modern prostheses

Table ST87 Mean Pre-operative and Post-operative Oxford Shoulder Score in Primary Total Reverse Shoulder Replacement by Gender (Primary Diagnosis Rotator Cuff Arthropathy)

Gender	Pre-operative		Post-operative		
	N	Mean (95% CI)	N	Mean (95% CI)	Change in Score
Male	224	25.25 (24.14, 26.36)	116	36.45 (34.86, 38.04)	11.20 (9.54, 12.86)
Female	258	21.61 (20.57, 22.65)	129	37.76 (36.25, 39.26)	16.15 (14.59, 17.71)

Note: Restricted to modern prostheses
Adjusted for age

Figure ST80 Mean Pre-operative and Post-operative Oxford Shoulder Score in Primary Total Reverse Shoulder Replacement by Gender (Primary Diagnosis Rotator Cuff Arthropathy)



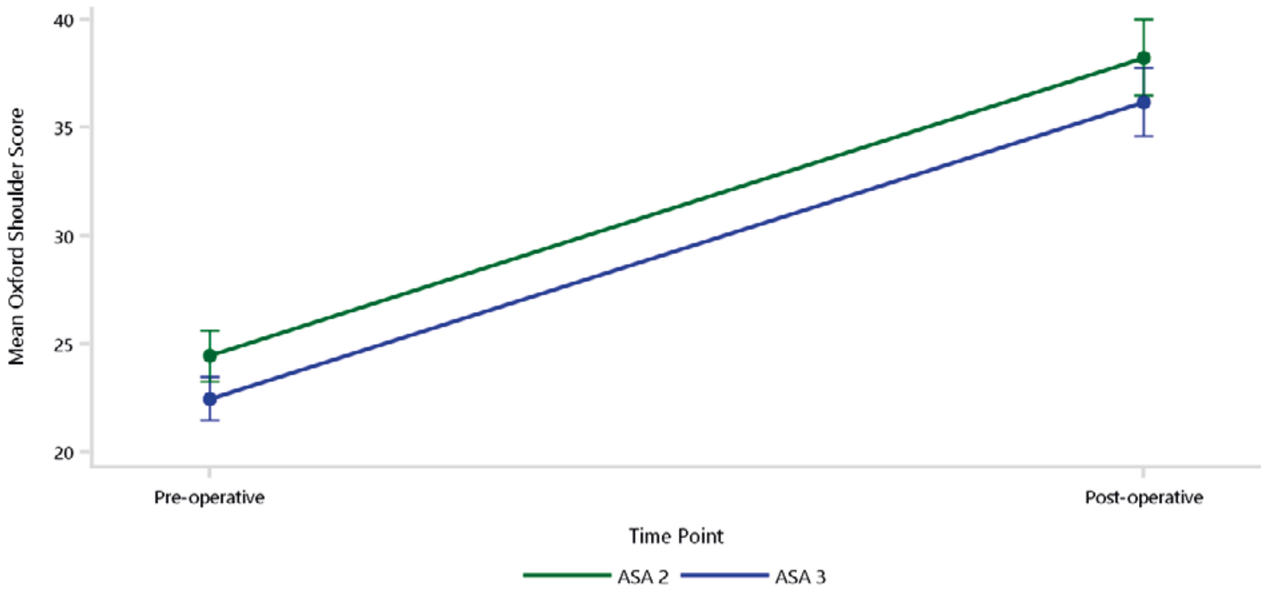
Note: Restricted to modern prostheses
Adjusted for age

Table ST88 **Mean Pre-operative and Post-operative Oxford Shoulder Score in Primary Total Reverse Shoulder Replacement by ASA Score (Primary Diagnosis Rotator Cuff Arthropathy)**

ASA Score	Pre-operative		Post-operative		
	N	Mean (95% CI)	N	Mean (95% CI)	Change in Score
ASA 2	193	24.45 (23.28, 25.61)	102	38.24 (36.48, 40.00)	13.79 (11.97, 15.62)
ASA 3	259	22.48 (21.47, 23.49)	127	36.18 (34.61, 37.75)	13.70 (12.07, 15.34)

Note: Restricted to modern prostheses
Adjusted for age and gender
Only ASA categories with >40 pre-operative and post-operative responses have been included

Figure ST81 **Mean Pre-operative and Post-operative Oxford Shoulder Score in Primary Total Reverse Shoulder Replacement by ASA Score (Primary Diagnosis Rotator Cuff Arthropathy)**



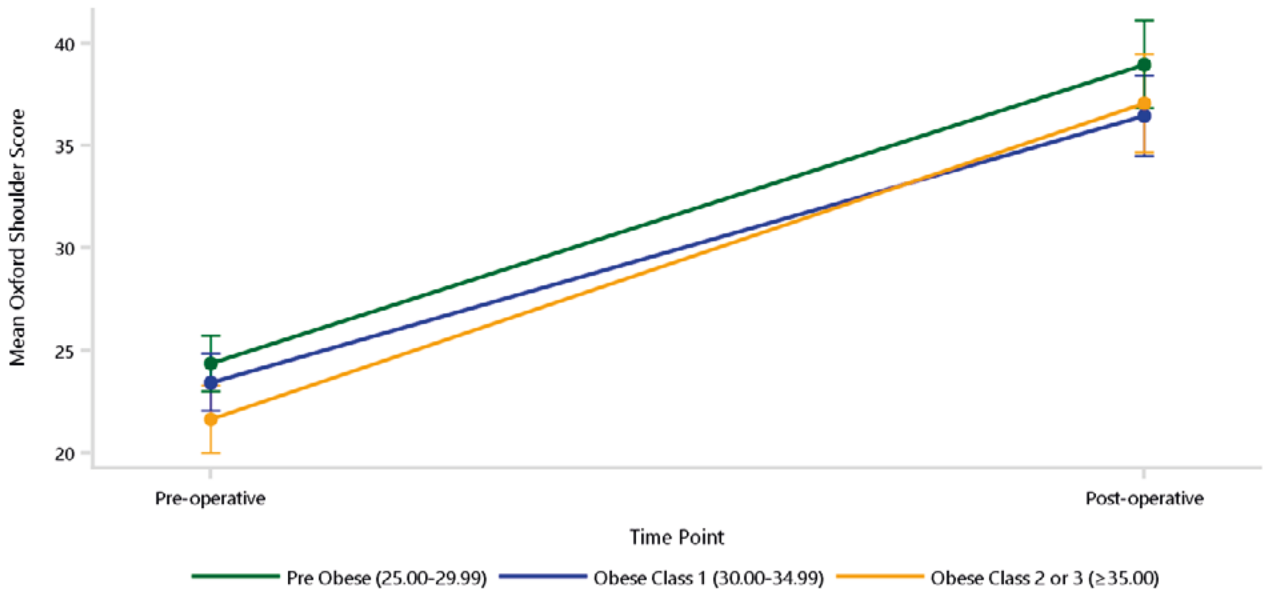
Note: Restricted to modern prostheses
Adjusted for age and gender
Only ASA categories with >40 pre-operative and post-operative responses have been included

Table ST89 **Mean Pre-operative and Post-operative Oxford Shoulder Score in Primary Total Reverse Shoulder Replacement by BMI Category (Primary Diagnosis Rotator Cuff Arthropathy)**

BMI Category	Pre-operative		Post-operative		
	N	Mean (95% CI)	N	Mean (95% CI)	Change in Score
Pre Obese (25.00-29.99)	147	24.38 (23.02, 25.74)	69	38.96 (36.82, 41.11)	14.59 (12.36, 16.81)
Obese Class 1 (30.00-34.99)	140	23.45 (22.07, 24.84)	81	36.46 (34.47, 38.45)	13.00 (10.93, 15.07)
Obese Class 2 or 3 (≥35.00)	106	21.63 (19.99, 23.27)	57	37.06 (34.66, 39.47)	15.43 (12.94, 17.92)

Note: Restricted to modern prostheses
Adjusted for age and gender
Due to a small number of procedures, the BMI categories obese class 2 and obese class 3 have been combined
Only BMI categories with >40 pre-operative and post-operative responses have been included

Figure ST82 **Mean Pre-operative and Post-operative Oxford Shoulder Score in Primary Total Reverse Shoulder Replacement by BMI Category (Primary Diagnosis Rotator Cuff Arthropathy)**



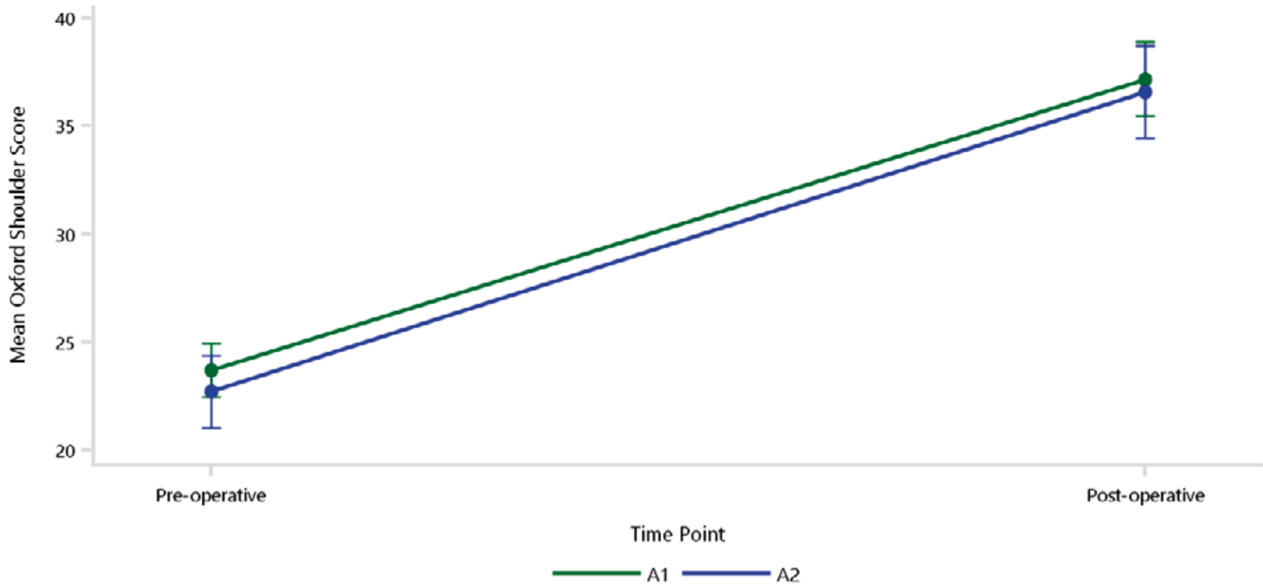
Note: Restricted to modern prostheses
Adjusted for age and gender
Due to a small number of procedures, the BMI categories obese class 2 and obese class 3 have been combined
Only BMI categories with >40 pre-operative and post-operative responses have been included

Table ST90 Mean Pre-operative and Post-operative Oxford Shoulder Score in Primary Total Reverse Shoulder Replacement by Glenoid Morphology (Primary Diagnosis Rotator Cuff Arthropathy)

Glenoid Morphology	Pre-operative		Post-operative		
	N	Mean (95% CI)	N	Mean (95% CI)	Change in Score
A1	193	23.69 (22.45, 24.93)	93	37.16 (35.45, 38.86)	13.47 (11.64, 15.30)
A2	106	22.72 (21.05, 24.39)	60	36.56 (34.43, 38.69)	13.84 (11.50, 16.19)

Note: Restricted to modern prostheses
Adjusted for age and gender
Only glenoid morphologies with >40 pre-operative and post-operative responses have been included

Figure ST83 Mean Pre-operative and Post-operative Oxford Shoulder Score in Primary Total Reverse Shoulder Replacement by Glenoid Morphology (Primary Diagnosis Rotator Cuff Arthropathy)



Note: Restricted to modern prostheses
Adjusted for age and gender
Only glenoid morphologies with >40 pre-operative and post-operative responses have been included

PROMs: Patient Satisfaction and Change

Patients were surveyed at 6 months post-operatively on how satisfied they were with their primary total reverse shoulder replacement for rotator cuff arthropathy, and on their perceived change in their shoulder after surgery.

After this procedure, 55.5% of patients are very satisfied and a further 28.2% are satisfied (Table ST91 and Figure ST84).

Procedure satisfaction by age and gender are presented in Table ST92, Figure ST85, Table ST93 and Figure ST86.

There was a high percentage (89.4%) of patients who rated their shoulder as much better and a little better (Table ST94 and Figure ST87).

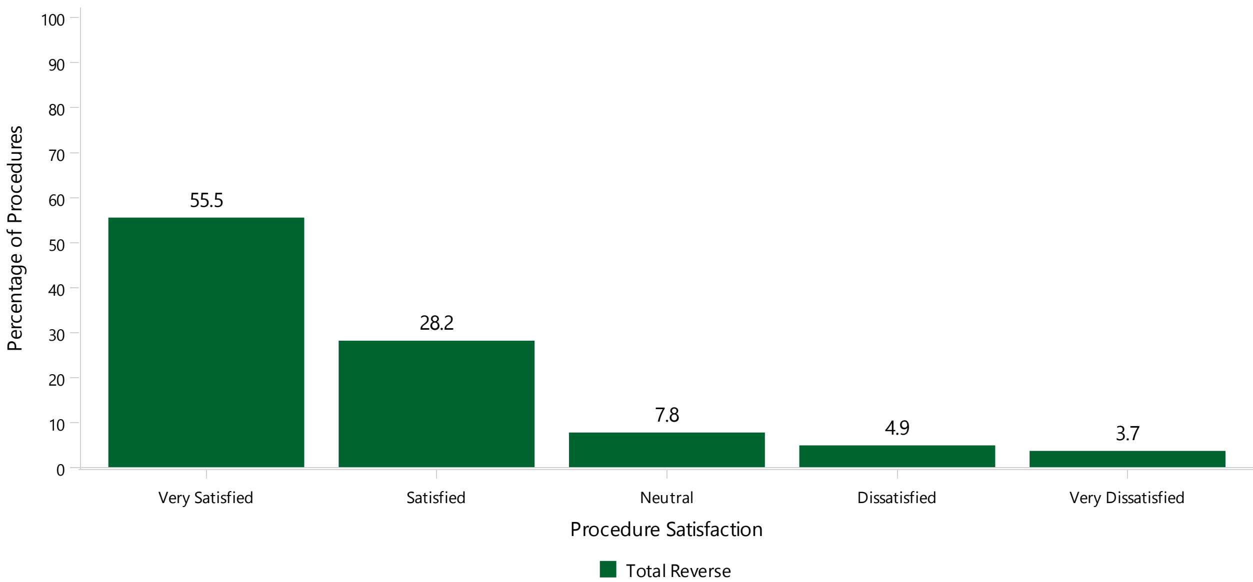
Patient-reported change by age and gender are presented in Table ST95, Figure ST88, Table ST96 and Figure ST89.

Table ST91 Procedure Satisfaction in Primary Total Reverse Shoulder Replacement (Primary Diagnosis Rotator Cuff Arthropathy)

Class	Very Satisfied		Satisfied		Neutral		Dissatisfied		Very Dissatisfied		TOTAL	
	N	Row%	N	Row%	N	Row%	N	Row%	N	Row%	N	Row%
Total Reverse	136	55.5	69	28.2	19	7.8	12	4.9	9	3.7	245	100.0

Note: Restricted to modern prostheses

Figure ST84 Procedure Satisfaction in Primary Total Reverse Shoulder Replacement (Primary Diagnosis Rotator Cuff Arthropathy)



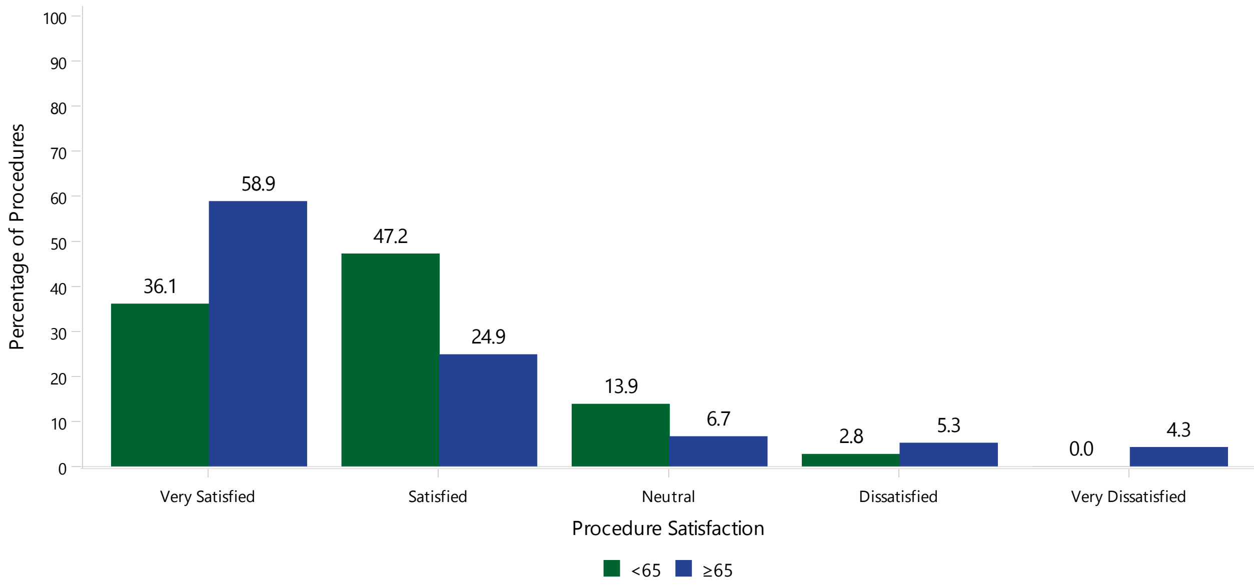
Note: Restricted to modern prostheses

Table ST92 Procedure Satisfaction in Primary Total Reverse Shoulder Replacement by Age (Primary Diagnosis Rotator Cuff Arthropathy)

Age	Very Satisfied			Satisfied			Neutral			Dissatisfied			Very Dissatisfied			TOTAL		
	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%
<65	13	36.1	9.6	17	47.2	24.6	5	13.9	26.3	1	2.8	8.3	.	.	.	36	100.0	14.7
≥65	123	58.9	90.4	52	24.9	75.4	14	6.7	73.7	11	5.3	91.7	9	4.3	100.0	209	100.0	85.3
TOTAL	**136**	**55.5**	**100.0**	**69**	**28.2**	**100.0**	**19**	**7.8**	**100.0**	**12**	**4.9**	**100.0**	**9**	**3.7**	**100.0**	**245**	**100.0**	**100.0**

Note: Restricted to modern prostheses

Figure ST85 Procedure Satisfaction in Primary Total Reverse Shoulder Replacement by Age (Primary Diagnosis Rotator Cuff Arthropathy)



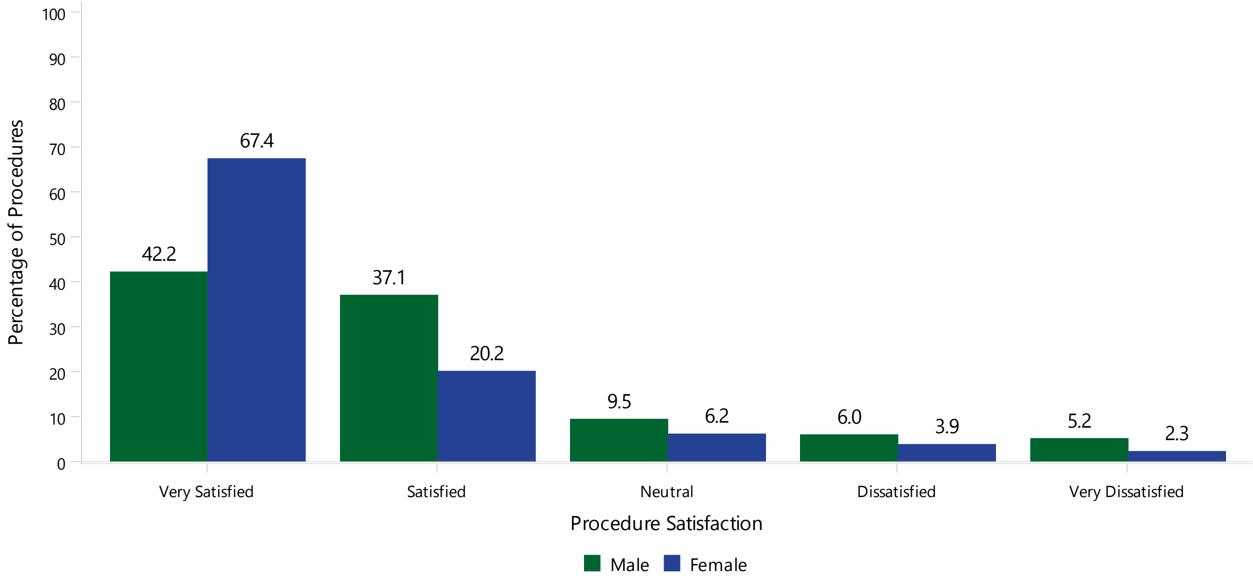
Note: Restricted to modern prostheses

Table ST93 Procedure Satisfaction in Primary Total Reverse Shoulder Replacement by Gender (Primary Diagnosis Rotator Cuff Arthropathy)

Gender	Very Satisfied			Satisfied			Neutral			Dissatisfied			Very Dissatisfied			TOTAL		
	N	Row %	Col%	N	Row %	Col%	N	Row %	Col%	N	Row %	Col%	N	Row %	Col%	N	Row %	Col%
Male	49	42.2	36.0	43	37.1	62.3	11	9.5	57.9	7	6.0	58.3	6	5.2	66.7	116	100.0	47.3
Female	87	67.4	64.0	26	20.2	37.7	8	6.2	42.1	5	3.9	41.7	3	2.3	33.3	129	100.0	52.7
TOTAL	136	55.5	100.0	69	28.2	100.0	19	7.8	100.0	12	4.9	100.0	9	3.7	100.0	245	100.0	100.0

Note: Restricted to modern prostheses

Figure ST86 Procedure Satisfaction in Primary Total Reverse Shoulder Replacement by Gender (Primary Diagnosis Rotator Cuff Arthropathy)



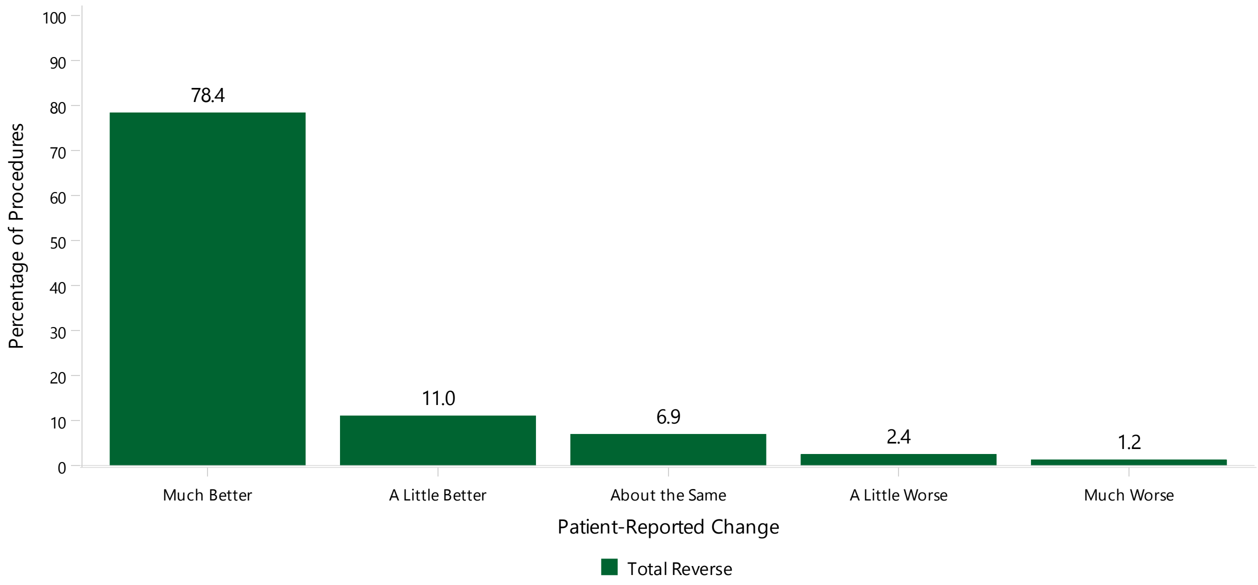
Note: Restricted to modern prostheses

Table ST94 Patient-Reported Change in Primary Total Reverse Shoulder Replacement (Primary Diagnosis Rotator Cuff Arthropathy)

Class	Much Better		A Little Better		About the Same		A Little Worse		Much Worse		TOTAL	
	N	Row%	N	Row%	N	Row%	N	Row%	N	Row%	N	Row%
Total Reverse	192	78.4	27	11.0	17	6.9	6	2.4	3	1.2	245	100.0

Note: Restricted to modern prostheses

Figure ST87 Patient-Reported Change in Primary Total Reverse Shoulder Replacement (Primary Diagnosis Rotator Cuff Arthropathy)



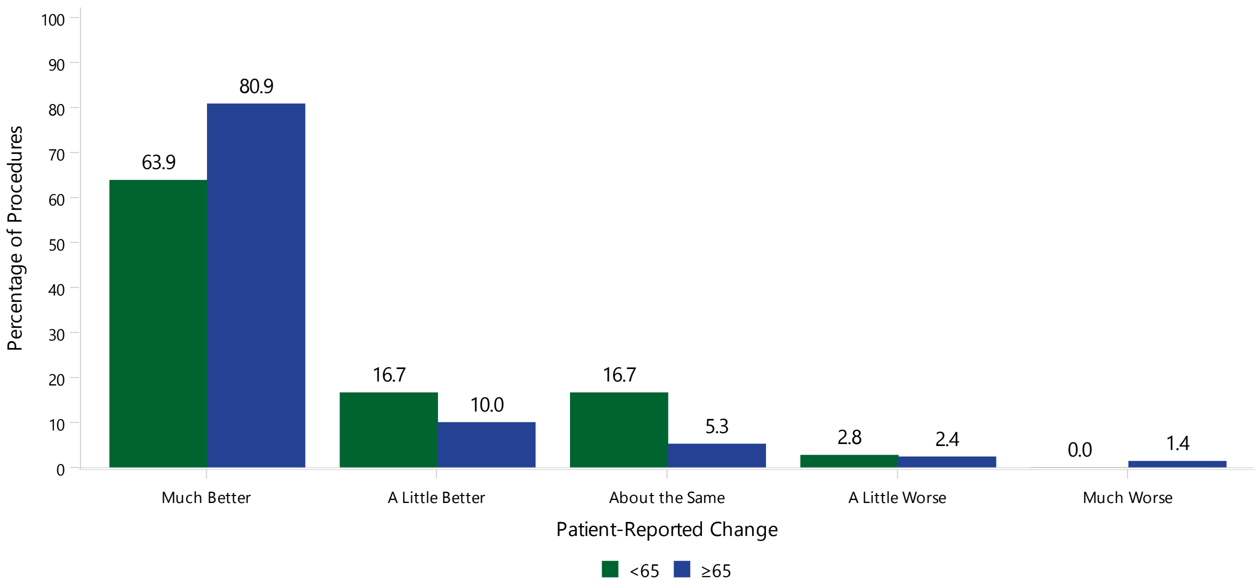
Note: Restricted to modern prostheses

Table ST95 Patient-Reported Change in Primary Total Reverse Shoulder Replacement by Age (Primary Diagnosis Rotator Cuff Arthropathy)

Age	Much Better			A Little Better			About the Same			A Little Worse			Much Worse			TOTAL		
	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%
<65	23	63.9	12.0	6	16.7	22.2	6	16.7	35.3	1	2.8	16.7	.	.	.	36	100.0	14.7
≥65	169	80.9	88.0	21	10.0	77.8	11	5.3	64.7	5	2.4	83.3	3	1.4	100.0	209	100.0	85.3
TOTAL	**192**	**78.4**	**100.0**	**27**	**11.0**	**100.0**	**17**	**6.9**	**100.0**	**6**	**2.4**	**100.0**	**3**	**1.2**	**100.0**	**245**	**100.0**	**100.0**

Note: Restricted to modern prostheses

Figure ST88 Patient-Reported Change in Primary Total Reverse Shoulder Replacement by Age (Primary Diagnosis Rotator Cuff Arthropathy)



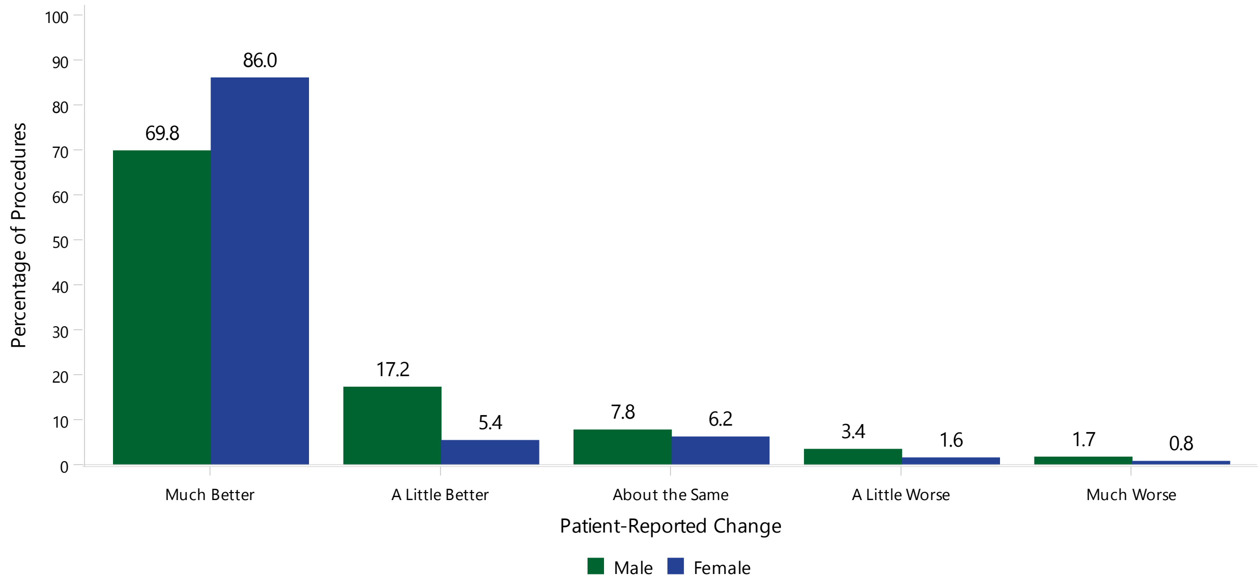
Note: Restricted to modern prostheses

Table ST96 Patient-Reported Change in Primary Total Reverse Shoulder Replacement by Gender (Primary Diagnosis Rotator Cuff Arthropathy)

Gender	Much Better			A Little Better			About the Same			A Little Worse			Much Worse			TOTAL		
	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%	N	Row%	Col%
Male	81	69.8	42.2	20	17.2	74.1	9	7.8	52.9	4	3.4	66.7	2	1.7	66.7	116	100.0	47.3
Female	111	86.0	57.8	7	5.4	25.9	8	6.2	47.1	2	1.6	33.3	1	0.8	33.3	129	100.0	52.7
TOTAL	**192**	**78.4**	**100.0**	**27**	**11.0**	**100.0**	**17**	**6.9**	**100.0**	**6**	**2.4**	**100.0**	**3**	**1.2**	**100.0**	**245**	**100.0**	**100.0**

Note: Restricted to modern prostheses

Figure ST89 Patient-Reported Change in Primary Total Reverse Shoulder Replacement by Gender (Primary Diagnosis Rotator Cuff Arthropathy)



Note: Restricted to modern prostheses

OUTCOME FOR ROTATOR CUFF ARTHROPATHY – PROSTHESIS CHARACTERISTICS

Fixation

Fixation is not a risk factor for revision (Table ST97 and Figure ST90).

Type of Polyethylene

Non XLPE is the most common type of polyethylene used in primary total reverse shoulder replacement for the management of rotator cuff arthropathy. There is no difference in the cumulative percent revision when the different types of polyethylene are compared (Table ST98 and Figure ST91). The reasons for revision for the different polyethylene types are presented in Figure ST92.

Glenosphere Size

Glenosphere size does not affect the risk of revision when total reverse shoulder replacement is used for the management of rotator cuff arthropathy (Table ST99 and Figure ST93). The cumulative incidence of the most common reasons for revision for the different glenosphere sizes is presented in Figure ST94.

Prosthesis Types

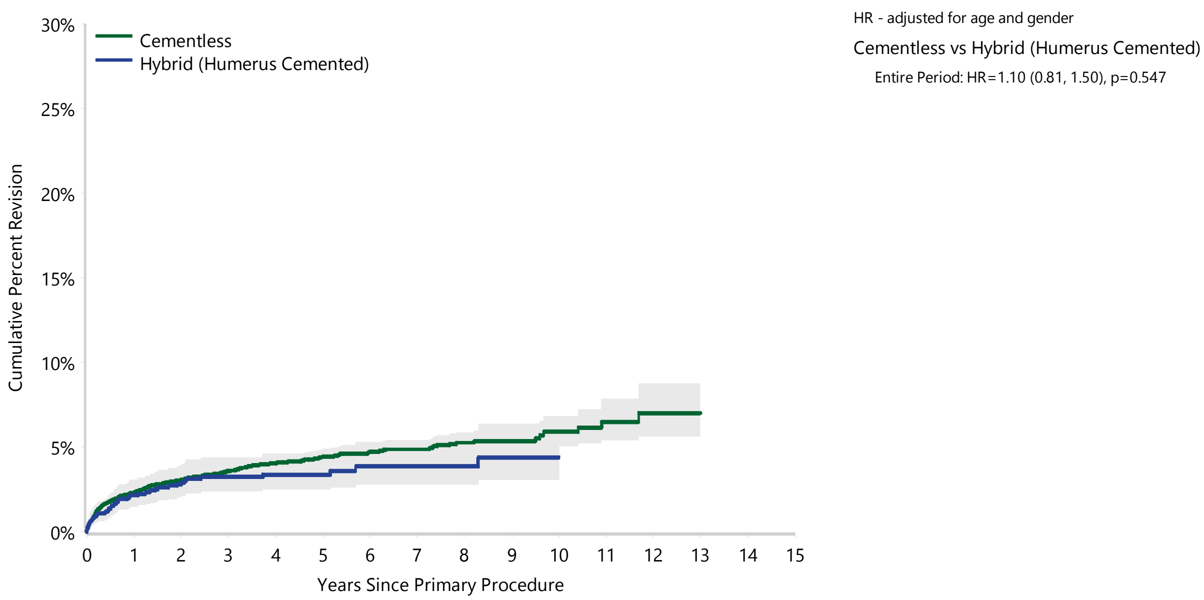
The outcomes of the most commonly used prosthesis combinations are listed in Table ST100. The most commonly used prosthesis combinations using cementless fixation for rotator cuff arthropathy are listed in Table ST101. The most commonly used prosthesis combinations using hybrid (humerus cemented) fixation for rotator cuff arthropathy are listed in Table ST102.

Table ST97 Cumulative Percent Revision of Primary Total 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	23	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	475	13221	2.3 (2.1, 2.6)	3.6 (3.3, 4.0)	4.4 (4.0, 4.9)	4.9 (4.4, 5.4)	5.9 (5.1, 6.8)	
Hybrid (Glenoid Cemented)	5	99	5.3 (2.2, 12.2)	5.3 (2.2, 12.2)	5.3 (2.2, 12.2)			
Hybrid (Humerus Cemented)	44	1412	2.2 (1.5, 3.1)	3.2 (2.4, 4.4)	3.4 (2.5, 4.6)	3.9 (2.8, 5.3)	4.4 (3.1, 6.4)	
TOTAL	**525**	**14755**						

Note: Restricted to modern prostheses

Figure ST90 Cumulative Percent Revision of Primary Total 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	13221	10602	6556	3449	1724	440	21
Hybrid (Humerus Cemented)	1412	1165	745	441	288	69	2

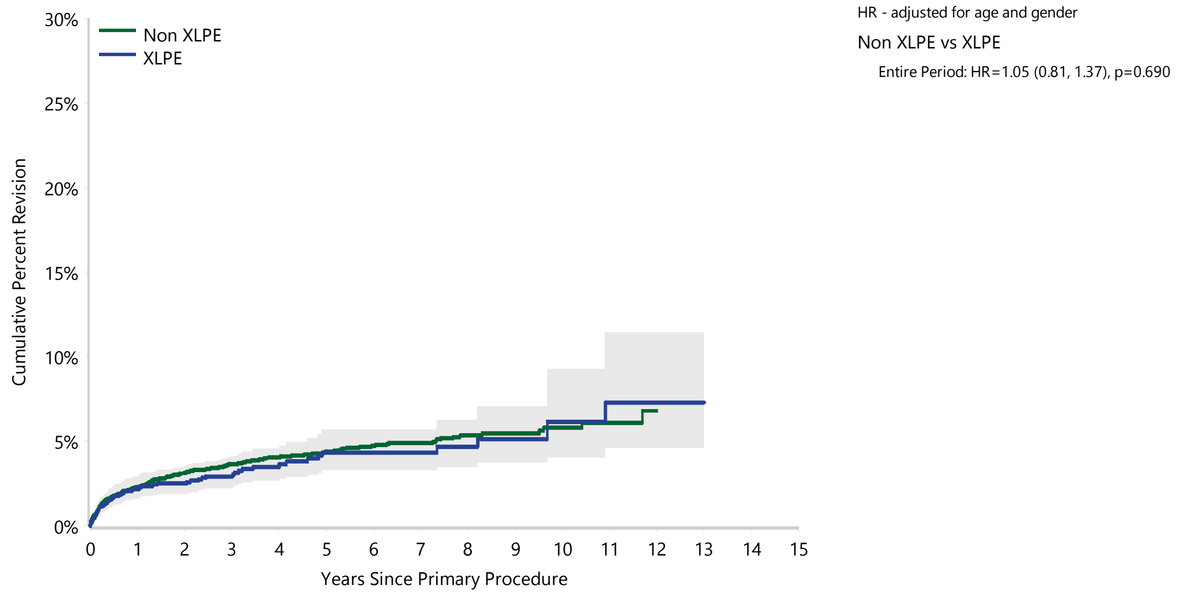
Note: Only fixations with >100 procedures have been listed
Restricted to modern prostheses

Table ST98 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Polyethylene Type (Primary Diagnosis Rotator Cuff Arthropathy)

Polyethylene Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Non XLPE	352	9466	2.3 (2.0, 2.6)	3.7 (3.3, 4.1)	4.4 (3.9, 4.9)	4.9 (4.4, 5.5)	5.8 (5.0, 6.7)	
XLPE	68	2196	2.2 (1.6, 2.9)	2.9 (2.2, 3.8)	4.3 (3.3, 5.7)	4.3 (3.3, 5.7)	6.1 (4.1, 9.3)	
TOTAL	**420**	**11662**						

Note: Restricted to modern prostheses

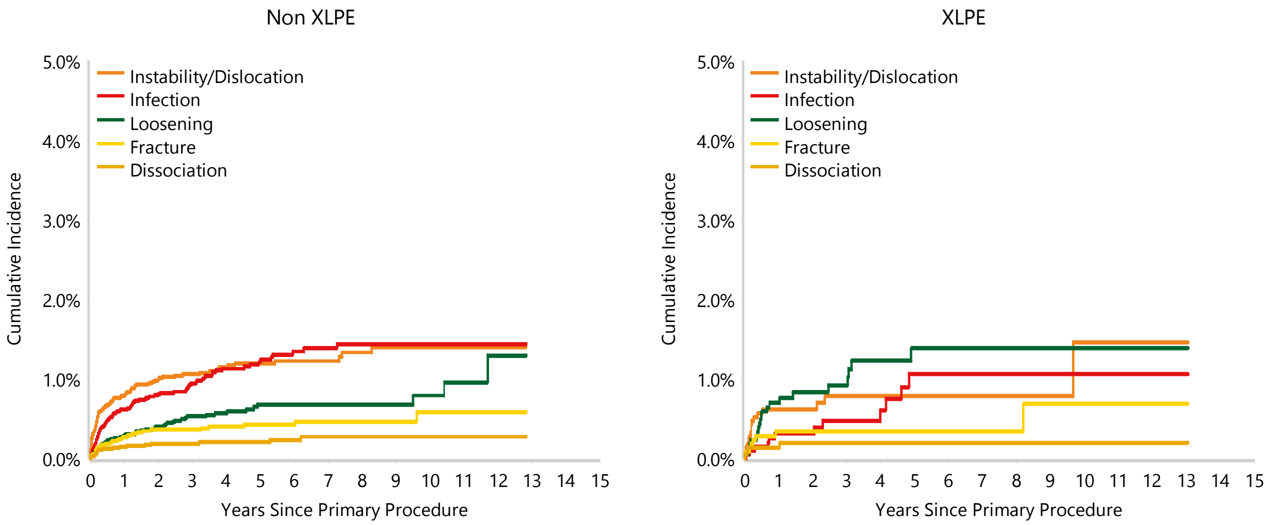
Figure ST91 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Polyethylene Type (Primary Diagnosis Rotator Cuff Arthropathy)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Non XLPE	9466	7780	4995	2781	1514	418	10
XLPE	2196	1594	912	514	303	89	13

Note: Restricted to modern prostheses

Figure ST92 Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement by Polyethylene Type (Primary Diagnosis Rotator Cuff Arthropathy)



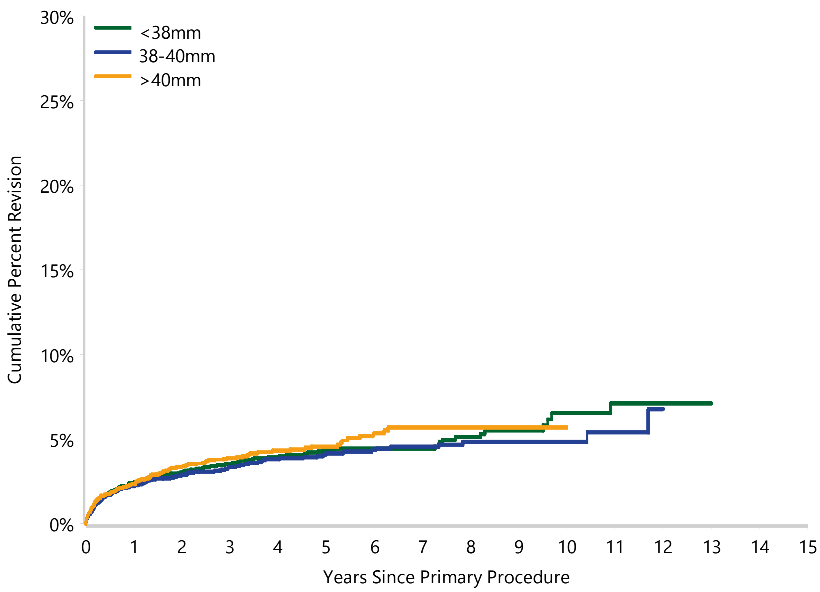
Note: Restricted to modern prostheses

Table ST99 Cumulative Percent Revision of Primary Total 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	177	4871	2.5 (2.0, 2.9)	3.5 (3.0, 4.1)	4.4 (3.7, 5.1)	4.4 (3.8, 5.2)	6.5 (5.1, 8.3)	
38-40mm	194	5639	2.2 (1.9, 2.7)	3.4 (2.9, 3.9)	4.1 (3.5, 4.8)	4.5 (3.9, 5.3)	4.8 (4.1, 5.7)	
>40mm	147	3904	2.3 (1.9, 2.9)	3.9 (3.3, 4.6)	4.6 (3.8, 5.4)	5.7 (4.7, 6.9)	5.7 (4.7, 6.9)	
TOTAL	**518**	**14414**						

Note: Excludes 341 procedures with unknown glenosphere sizes
Restricted to modern prostheses

Figure ST93 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Glenosphere Size (Primary Diagnosis Rotator Cuff Arthropathy)



HR - adjusted for age and gender
<38mm vs 38-40mm
Entire Period: HR=1.08 (0.88, 1.32), p=0.471

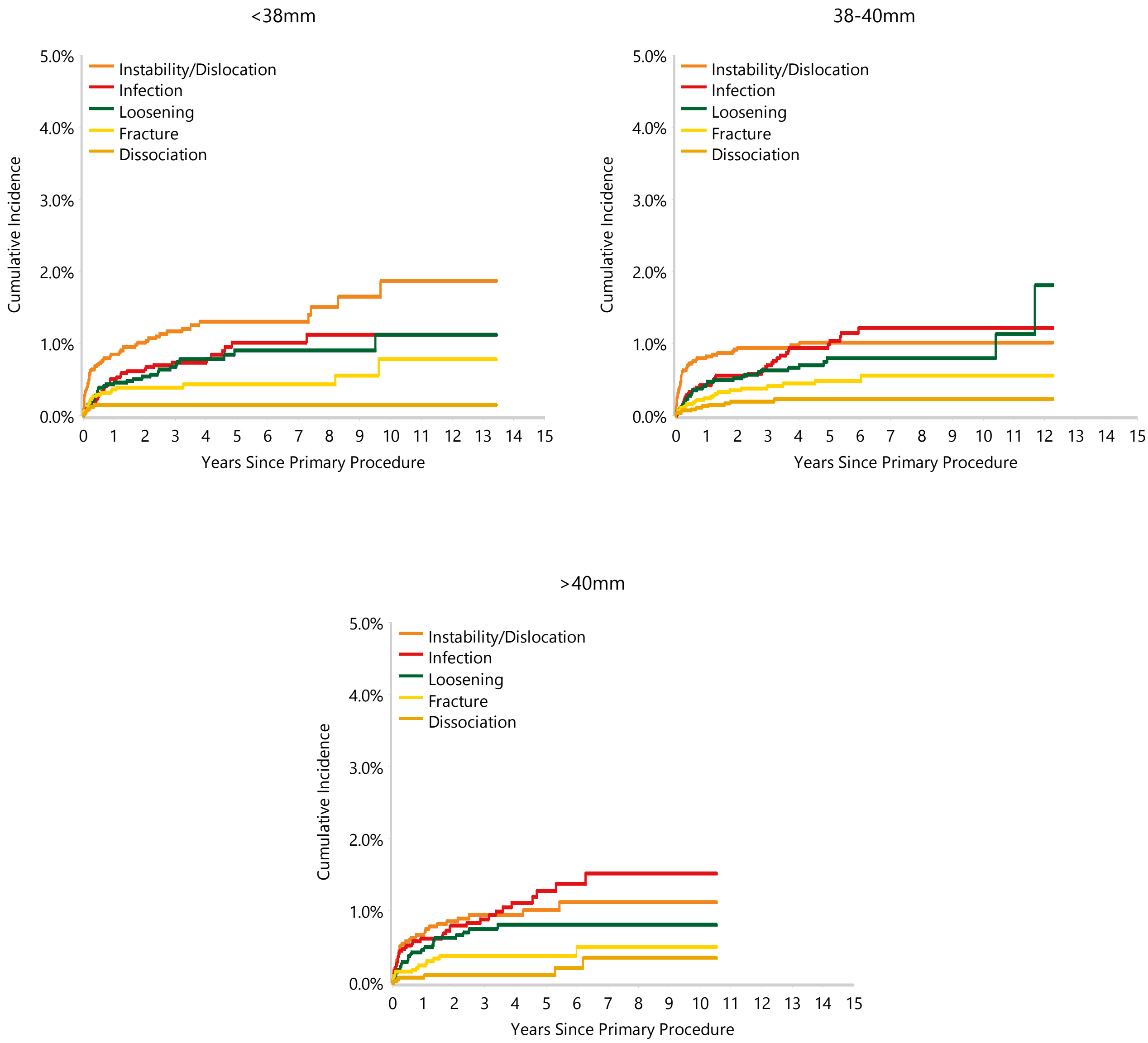
>40mm vs 38-40mm
Entire Period: HR=0.86 (0.69, 1.08), p=0.206

>40mm vs <38mm
Entire Period: HR=0.80 (0.64, 1.01), p=0.061

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
<38mm	4871	3896	2454	1326	778	244	17
38-40mm	5639	4647	3030	1669	820	210	5
>40mm	3904	3145	1841	919	424	57	1

Note: Restricted to modern prostheses

Figure ST94 **Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement by Glenosphere Size (Primary Diagnosis Rotator Cuff Arthropathy)**



Note: Restricted to modern prostheses

Table ST100 Cumulative Percent Revision of Primary Total 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
Aequalis	Aequalis	52	1140	2.3 (1.5, 3.3)	3.8 (2.8, 5.1)	4.7 (3.5, 6.3)	4.9 (3.7, 6.5)	7.0 (5.0, 9.8)
	Perform Reversed	0	61	0.0 (0.0, 0.0)				
Affinis	Affinis	18	643	1.8 (1.0, 3.2)	3.1 (1.9, 5.1)			
AltiVate Reverse	RSP	9	401	2.4 (1.2, 4.8)				
Ascend Flex	Aequalis	32	996	2.5 (1.6, 3.8)	4.3 (3.0, 6.2)	4.3 (3.0, 6.2)		
	Perform Reversed	3	169	2.2 (0.7, 6.6)				
Comprehensive	Comprehensive Reverse	22	1265	1.3 (0.8, 2.1)	1.9 (1.2, 2.9)	3.5 (1.8, 6.8)		
	Trabecular Metal	1	35	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)			
Delta Xtend	Delta Xtend	140	3809	2.0 (1.6, 2.5)	3.2 (2.6, 3.8)	3.8 (3.2, 4.5)	4.6 (3.8, 5.4)	4.8 (4.0, 5.8)
Equinoxe	Equinoxe	33	1285	1.8 (1.2, 2.7)	3.0 (2.1, 4.2)	4.0 (2.7, 5.9)		
Global Unite	Delta Xtend	11	323	1.6 (0.7, 3.9)	3.8 (1.9, 7.3)	5.2 (2.8, 9.5)		
MSS	MSS	1	30	0.0 (0.0, 0.0)				
RSP	RSP	25	678	2.9 (1.8, 4.5)	4.1 (2.7, 6.0)			
SMR	SMR Axioma	2	31	6.9 (1.8, 25.0)	6.9 (1.8, 25.0)			
	SMR L1	127	3082	3.0 (2.4, 3.6)	4.0 (3.4, 4.8)	4.7 (3.9, 5.6)	4.9 (4.1, 5.9)	6.5 (4.6, 9.2)
Trabecular Metal	Comprehensive Reverse	7	93	5.9 (2.5, 13.7)	10.3 (4.7, 21.5)			
	Trabecular Metal	41	666	3.9 (2.7, 5.7)	5.5 (3.9, 7.5)	6.1 (4.5, 8.3)	6.4 (4.7, 8.7)	8.3 (5.4, 12.4)
Other (9)		1	48	2.9 (0.4, 19.1)	2.9 (0.4, 19.1)			
TOTAL		**525**	**14755**					

Note: Only combinations with >25 procedures have been listed
Restricted to modern prostheses

Table ST101 Cumulative Percent Revision of Cementless Primary Total 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
Aequalis	Aequalis	41	948	2.1 (1.3, 3.2)	3.5 (2.5, 5.0)	4.7 (3.4, 6.5)	4.7 (3.4, 6.5)	6.8 (4.6, 10.0)
	Perform Reversed	0	48	0.0 (0.0, 0.0)				
Affinis	Affinis	12	362	1.7 (0.8, 3.8)	3.4 (1.8, 6.2)			
AltiVate Reverse	RSP	8	370	2.3 (1.1, 4.9)				
Ascend Flex	Aequalis	31	891	2.7 (1.7, 4.1)	4.7 (3.3, 6.7)	4.7 (3.3, 6.7)		
	Perform Reversed	3	157	2.3 (0.7, 7.1)				
Comprehensive	Comprehensive Reverse	21	1227	1.2 (0.7, 2.1)	1.8 (1.1, 2.9)	3.4 (1.7, 6.8)		
	Trabecular Metal	1	35	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)			
Delta Xtend	Delta Xtend	123	3217	2.1 (1.6, 2.6)	3.3 (2.7, 4.0)	4.0 (3.3, 4.8)	4.8 (4.0, 5.8)	5.0 (4.1, 6.1)
Equinoxe	Equinoxe	33	1246	1.8 (1.2, 2.8)	3.0 (2.1, 4.4)	4.1 (2.8, 6.1)		
Global Unite	Delta Xtend	10	299	1.8 (0.7, 4.2)	3.5 (1.7, 7.1)	5.1 (2.7, 9.6)		
MSS	MSS	1	30	0.0 (0.0, 0.0)				
RSP	RSP	22	622	2.6 (1.6, 4.3)	4.0 (2.6, 6.0)			
SMR	SMR Axioma	2	31	6.9 (1.8, 25.0)	6.9 (1.8, 25.0)			
	SMR L1	120	2982	2.9 (2.3, 3.5)	3.9 (3.2, 4.7)	4.6 (3.8, 5.5)	4.8 (4.0, 5.8)	6.5 (4.5, 9.3)
Trabecular Metal	Comprehensive Reverse	7	92	6.0 (2.5, 13.8)	10.4 (4.8, 21.7)			
	Trabecular Metal	40	620	4.1 (2.8, 6.0)	5.7 (4.1, 7.9)	6.4 (4.7, 8.7)	6.7 (4.9, 9.2)	8.7 (5.7, 13.2)
Other (8)		0	44	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)			
TOTAL		**475**	**13221**					

Note: Only combinations with >25 procedures have been listed
Restricted to modern prostheses

Table ST102 Cumulative Percent Revision of Hybrid (Humerus Cemented) Primary Total 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
Aequalis	Aequalis	11	188	3.2 (1.5, 7.0)	4.9 (2.6, 9.3)	4.9 (2.6, 9.3)	5.9 (3.2, 10.9)	
Affinis	Affinis	6	258	2.1 (0.9, 5.0)	3.0 (1.3, 6.9)			
AltiVate Reverse	RSP	0	27	0.0 (0.0, 0.0)				
Ascend Flex	Aequalis	0	101	0.0 (0.0, 0.0)				
Comprehensive	Comprehensive Reverse	1	37	3.2 (0.5, 20.8)				
Delta Xtend	Delta Xtend	16	575	1.6 (0.8, 3.0)	2.6 (1.6, 4.4)	2.9 (1.8, 4.8)	3.3 (2.0, 5.5)	3.3 (2.0, 5.5)
Equinoxe	Equinoxe	0	37	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)			
RSP	RSP	3	53	5.9 (1.9, 17.1)	5.9 (1.9, 17.1)			
SMR	SMR L1	4	41	7.7 (2.5, 22.0)	10.4 (4.0, 25.4)	10.4 (4.0, 25.4)	10.4 (4.0, 25.4)	
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 (7)		2	54	2.2 (0.3, 14.7)	5.3 (1.3, 19.8)	5.3 (1.3, 19.8)		
TOTAL		**44**	**1412**					

Note: Only combinations with >25 procedures have been listed
Restricted to modern prostheses

OUTCOME FOR FRACTURE – PATIENT CHARACTERISTICS

Age and Gender

For the diagnosis of fracture, patients aged <75 years have a higher risk of revision than patients aged ≥75 years (Table ST103 and Figure ST95).

Males have a higher rate of revision than females in the first 3 months (Table ST104 and Figure ST96). The higher rate of revision for males is due to an increased incidence of revision for instability/dislocation (Figure ST97).

ASA and BMI

There is no difference in the rate of revision when comparing patients with ASA scores of 2, 3 or 4 to patients with an ASA score of 1 (Table ST105 and Figure ST98). The most common reasons for revision for the different ASA scores are presented in Figure ST99.

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 ST106 and Figure ST100). Patients in obese class 3 have a higher rate of revision than patients with a normal BMI. The most common reasons for revision for the different BMI categories are shown in Figure ST101.

Glenoid Morphology

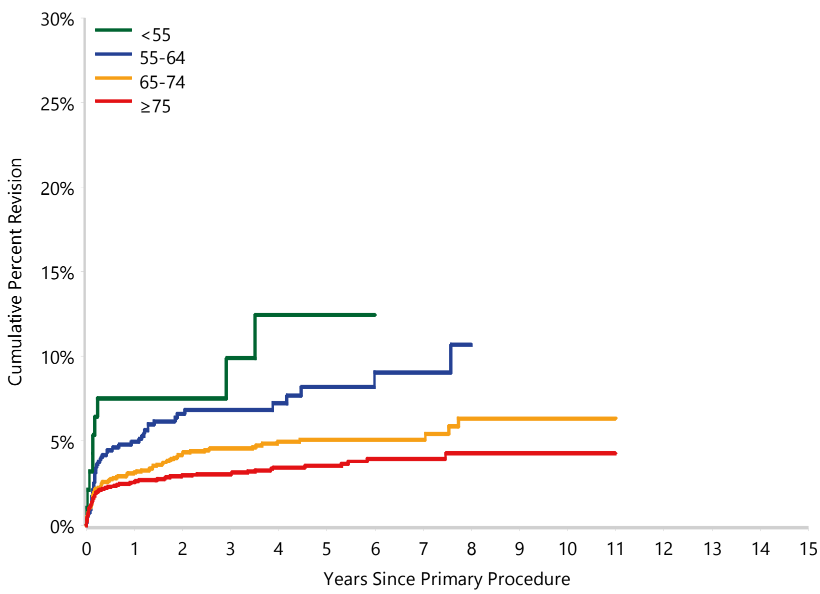
The Registry has glenoid morphology data on 2,840 primary total reverse shoulder replacements undertaken for fracture. The distribution of the different morphology categories is presented in Table ST107. Almost all are in the A1 category, so it is not possible at this time to make a meaningful comparison of outcomes based on the different types of glenoid morphology.

Table ST103 Cumulative Percent Revision of Primary Total 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	9	95	7.5 (3.7, 15.1)	9.9 (4.8, 19.6)	12.5 (6.3, 23.9)			
55-64	51	761	4.9 (3.6, 6.8)	6.8 (5.1, 9.0)	8.2 (6.0, 11.0)	9.1 (6.5, 12.5)		
65-74	97	2203	3.1 (2.5, 4.0)	4.5 (3.7, 5.6)	5.1 (4.1, 6.2)	5.1 (4.1, 6.2)	6.3 (4.8, 8.3)	
≥75	96	3060	2.6 (2.1, 3.2)	3.0 (2.5, 3.8)	3.5 (2.9, 4.4)	4.0 (3.2, 4.9)	4.2 (3.3, 5.4)	
TOTAL	253	6119						

Note: Restricted to modern prostheses

Figure ST95 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Age (Primary Diagnosis Fracture)



HR - adjusted for gender
<55 vs ≥75
Entire Period: HR=2.45 (1.23, 4.88), p=0.010

55-64 vs ≥75
0 - 1Mth: HR=0.75 (0.32, 1.75), p=0.499
1Mth+: HR=2.60 (1.80, 3.75), p<0.001

65-74 vs ≥75
Entire Period: HR=1.32 (1.00, 1.76), p=0.051

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
<55	95	68	38	15	6	2	0
55-64	761	573	320	150	71	22	1
65-74	2203	1802	1129	598	281	58	5
≥75	3060	2435	1504	833	404	84	7

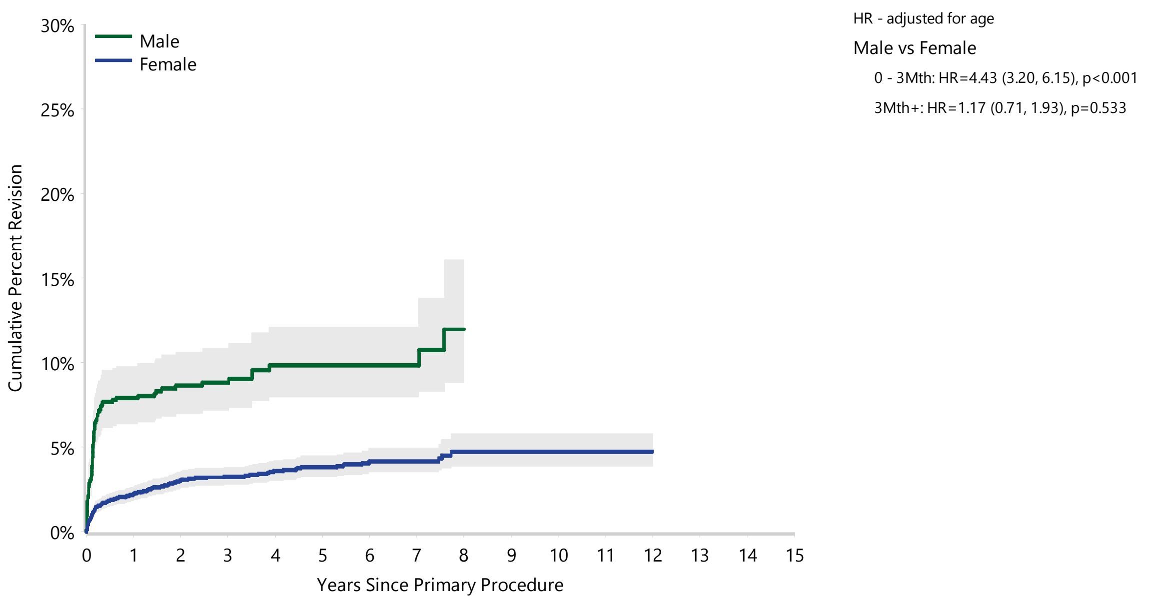
Note: Restricted to modern prostheses

Table ST104 Cumulative Percent Revision of Primary Total 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	88	990	7.9 (6.4, 9.8)	8.8 (7.1, 10.9)	9.8 (7.9, 12.1)	9.8 (7.9, 12.1)		
Female	165	5129	2.2 (1.9, 2.7)	3.3 (2.8, 3.8)	3.8 (3.2, 4.5)	4.2 (3.5, 4.9)	4.7 (3.9, 5.8)	
TOTAL	253	6119						

Note: Restricted to modern prostheses

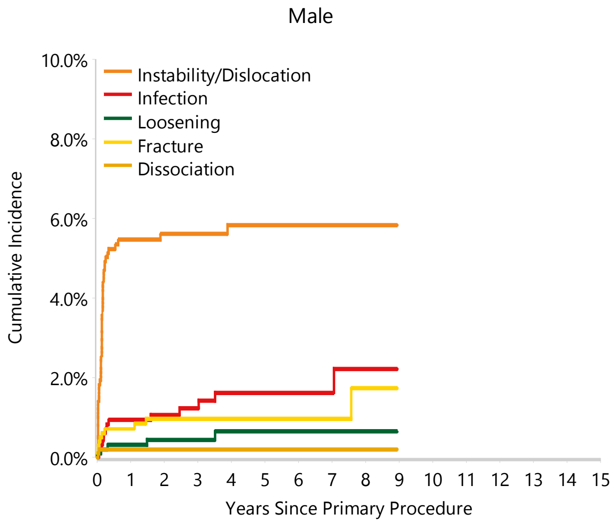
Figure ST96 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Gender (Primary Diagnosis Fracture)

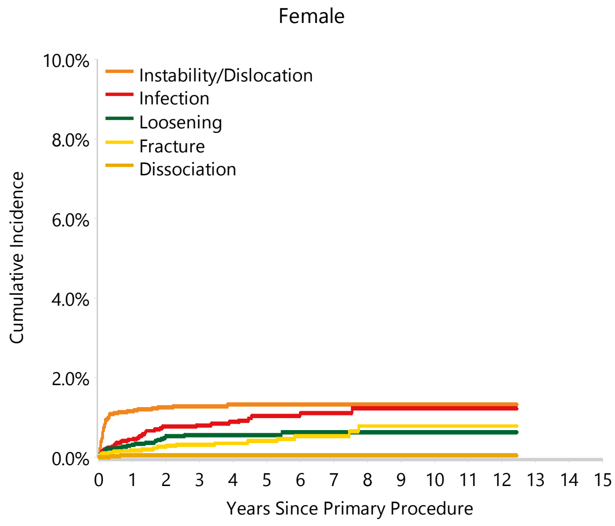


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Male	990	732	418	205	98	17	3
Female	5129	4146	2573	1391	664	149	10

Note: Restricted to modern prostheses

Figure ST97 Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement by Gender (Primary Diagnosis Fracture)





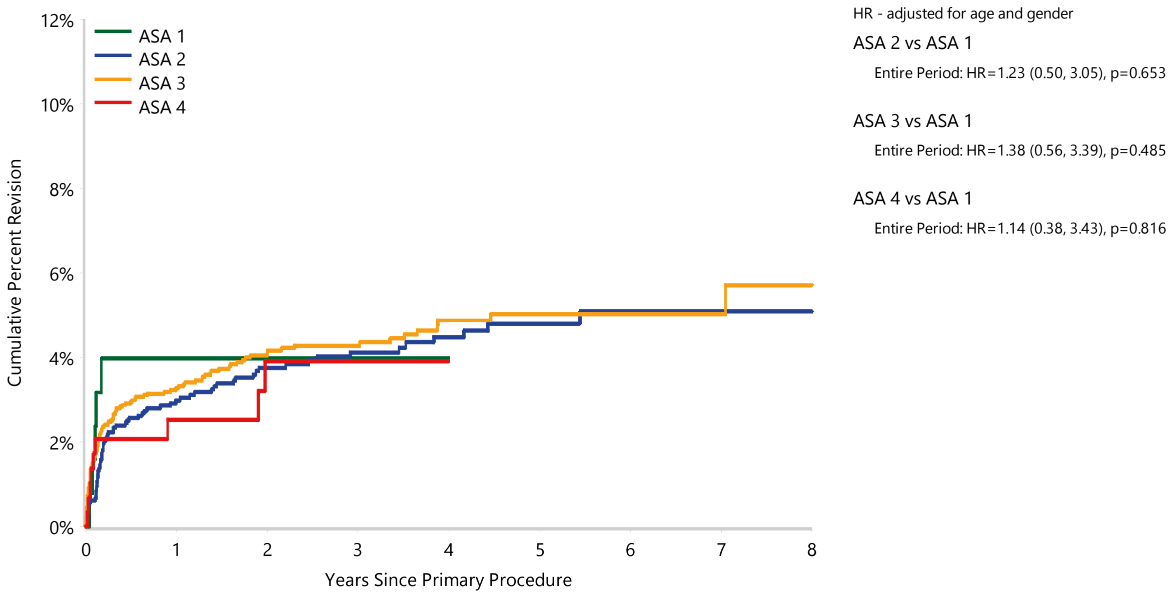
Note: Restricted to modern prostheses

Table ST105 Cumulative Percent Revision of Primary Total 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	5	126	4.0 (1.7, 9.3)	4.0 (1.7, 9.3)	4.0 (1.7, 9.3)	4.0 (1.7, 9.3)		
ASA 2	76	1916	3.0 (2.3, 3.9)	3.8 (3.0, 4.8)	4.1 (3.3, 5.2)	4.5 (3.6, 5.7)	4.8 (3.8, 6.1)	5.1 (4.0, 6.5)
ASA 3	121	2959	3.3 (2.7, 4.0)	4.1 (3.4, 4.9)	4.3 (3.6, 5.1)	4.9 (4.0, 5.9)	5.0 (4.1, 6.1)	5.7 (4.3, 7.6)
ASA 4	9	294	2.5 (1.2, 5.3)	3.9 (2.0, 7.6)	3.9 (2.0, 7.6)	3.9 (2.0, 7.6)		
ASA 5	0	1						
TOTAL	211	5296						

Note: Restricted to modern prostheses

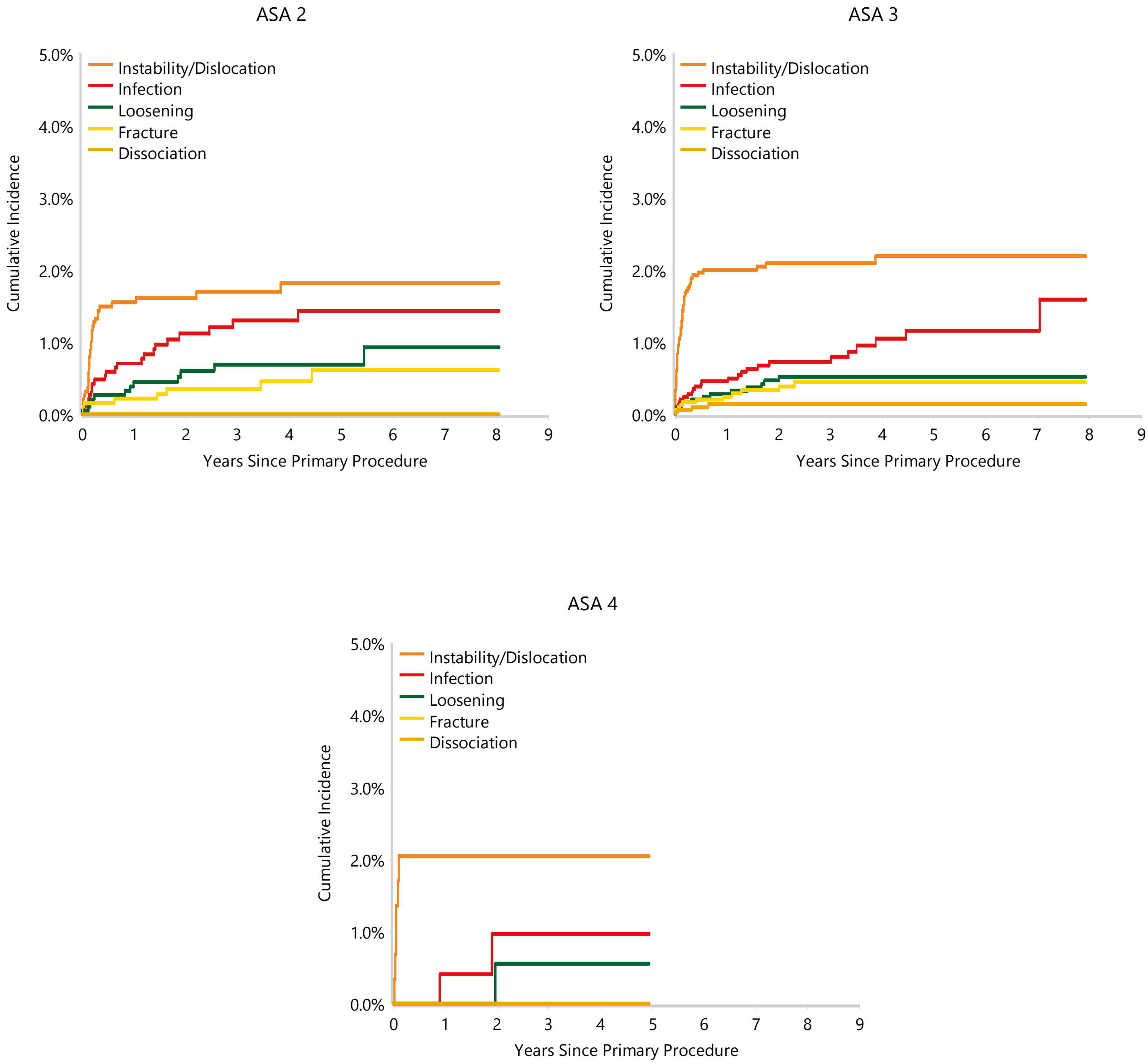
Figure ST98 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by ASA Score (Primary Diagnosis Fracture)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	8 Yrs
ASA 1	126	102	81	60	47	25	4
ASA 2	1916	1553	1221	939	687	428	45
ASA 3	2959	2254	1708	1225	806	524	40
ASA 4	294	209	135	95	62	39	2

Note: Restricted to modern prostheses

Figure ST99 **Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement by ASA Score (Primary Diagnosis Fracture)**



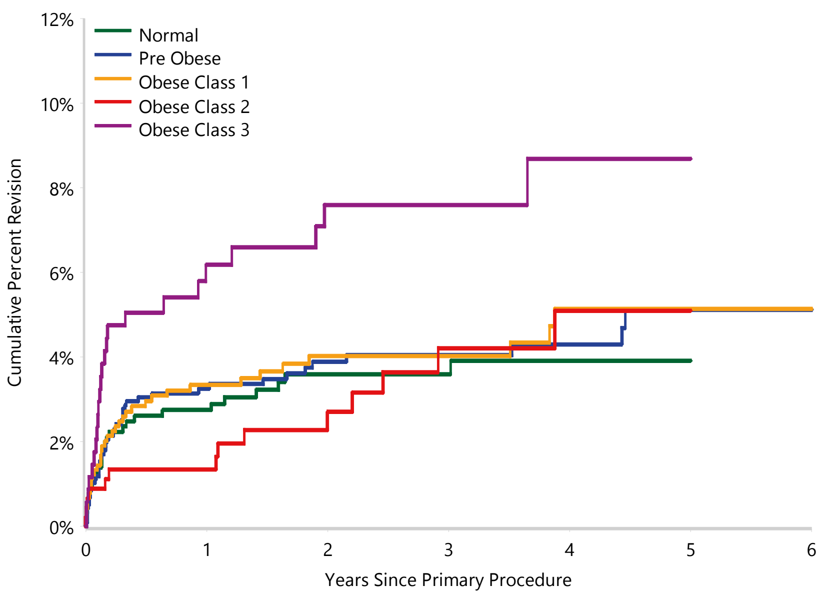
Note: Restricted to modern prostheses
Due to a small number of revisions, procedures with ASA 1 are not shown

Table ST106 Cumulative Percent Revision of Primary Total 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	77	1.3 (0.2, 9.0)	1.3 (0.2, 9.0)	1.3 (0.2, 9.0)	1.3 (0.2, 9.0)		
Normal	29	866	2.7 (1.8, 4.1)	3.6 (2.5, 5.2)	3.6 (2.5, 5.2)	3.9 (2.7, 5.7)	3.9 (2.7, 5.7)	
Pre Obese	46	1184	3.3 (2.4, 4.5)	3.9 (2.9, 5.2)	4.0 (3.0, 5.4)	4.3 (3.2, 5.8)	5.1 (3.7, 7.1)	5.1 (3.7, 7.1)
Obese Class 1	36	903	3.3 (2.3, 4.8)	4.0 (2.9, 5.6)	4.0 (2.9, 5.6)	5.1 (3.6, 7.3)	5.1 (3.6, 7.3)	5.1 (3.6, 7.3)
Obese Class 2	14	451	1.3 (0.6, 3.0)	2.7 (1.4, 5.1)	4.2 (2.4, 7.4)	5.1 (2.9, 9.0)	5.1 (2.9, 9.0)	
Obese Class 3	24	342	6.2 (4.0, 9.4)	7.6 (5.1, 11.3)	7.6 (5.1, 11.3)	8.7 (5.7, 13.2)	8.7 (5.7, 13.2)	
TOTAL	150	3823						

Note: BMI has not been presented for patients aged ≤19 years
Restricted to modern prostheses

Figure ST100 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by BMI Category (Primary Diagnosis Fracture)



HR - adjusted for age and gender

Pre Obese vs Normal
Entire Period: HR=1.07 (0.67, 1.71), p=0.773

Obese Class 1 vs Normal
Entire Period: HR=1.06 (0.65, 1.74), p=0.809

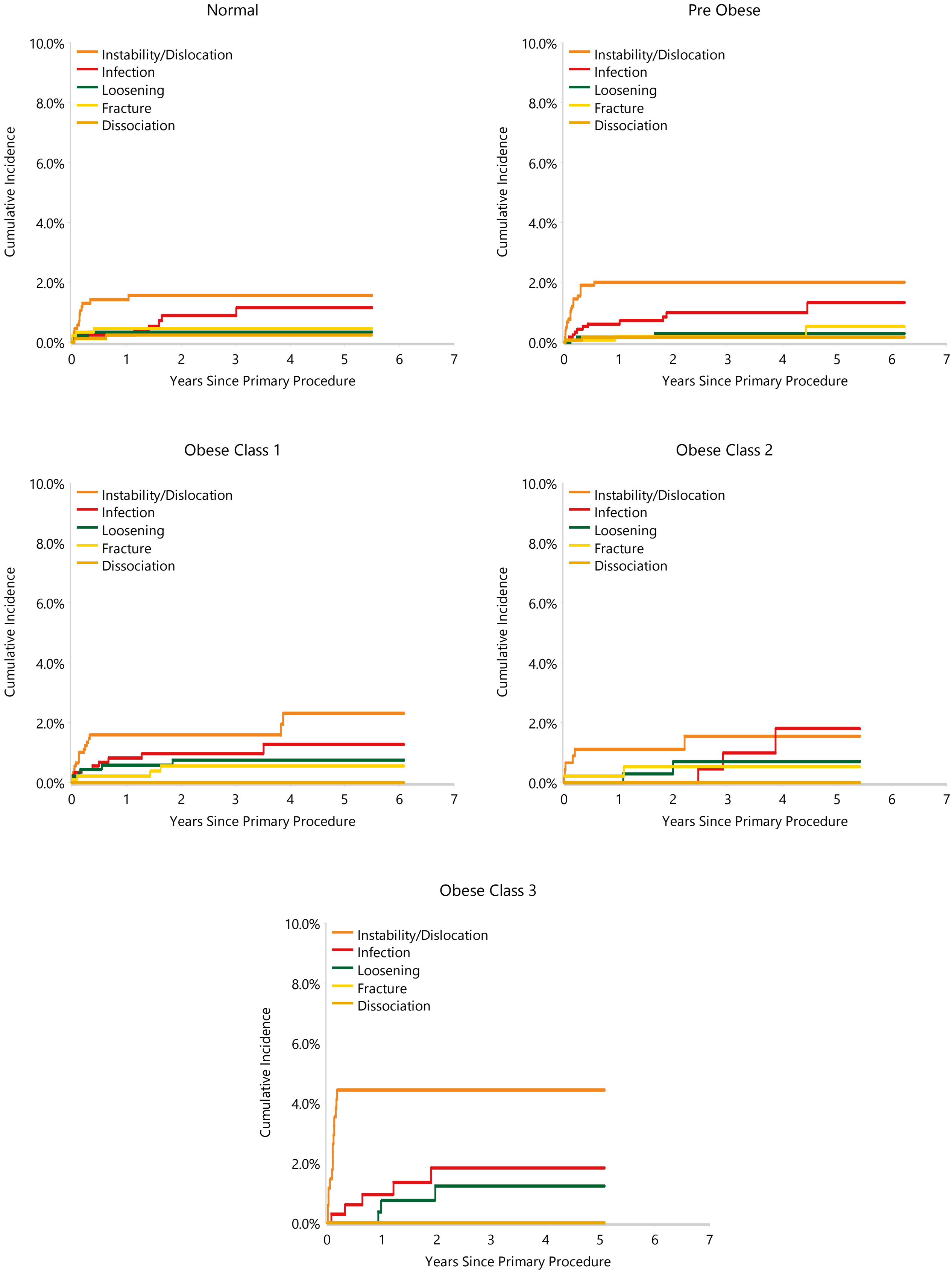
Obese Class 2 vs Normal
Entire Period: HR=0.85 (0.44, 1.61), p=0.609

Obese Class 3 vs Normal
Entire Period: HR=1.80 (1.03, 3.13), p=0.039

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Normal	866	648	454	312	173	76	23
Pre Obese	1184	903	673	457	305	144	53
Obese Class 1	903	693	505	364	216	116	50
Obese Class 2	451	329	230	166	104	59	26
Obese Class 3	342	243	179	119	73	43	13

Note: BMI has not been presented for patients aged ≤19 years
Restricted to modern prostheses

Figure ST101 Cumulative Incidence Revision Diagnosis of Primary Total 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 ST107 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Glenoid Morphology (Primary Diagnosis Fracture)

Glenoid Morphology	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs
A1	79	2401	2.9 (2.3, 3.7)	3.5 (2.8, 4.4)	3.7 (3.0, 4.6)	3.9 (3.1, 4.9)
A2	11	235	3.5 (1.8, 6.9)	5.3 (2.8, 10.0)	5.3 (2.8, 10.0)	
B1	3	107	2.1 (0.5, 8.1)	3.9 (1.2, 12.1)		
B2	2	70	1.4 (0.2, 9.7)	3.7 (0.9, 14.6)	3.7 (0.9, 14.6)	
C	0	27	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	
TOTAL	95	2840				

Note: Restricted to modern prostheses

OUTCOME FOR FRACTURE – PROSTHESIS CHARACTERISTICS

Fixation

When total reverse shoulder replacement is used for the management of fracture there is no difference in the cumulative percent revision when cementless fixation is compared to hybrid fixation (humerus cemented) (Table ST108 and Figure ST102).

There is no difference in the rate of revision when cementless and hybrid fixation are compared.

Type of Polyethylene

Non XLPE is the most common type of polyethylene used in primary total reverse shoulder replacement for the management of fracture. There is no difference in the cumulative percent revision when the different types of polyethylene are compared (Table ST109 and Figure ST103).

The reasons for revision for the different polyethylene types are presented in Figure ST104.

Glenosphere Size

Glenosphere size is not a risk factor for revision for fracture (Table ST110 and Figure ST105). The reasons for revision of the different glenosphere sizes are presented in Figure ST106.

Glenosphere size is not a risk factor for revision.

Prosthesis Types

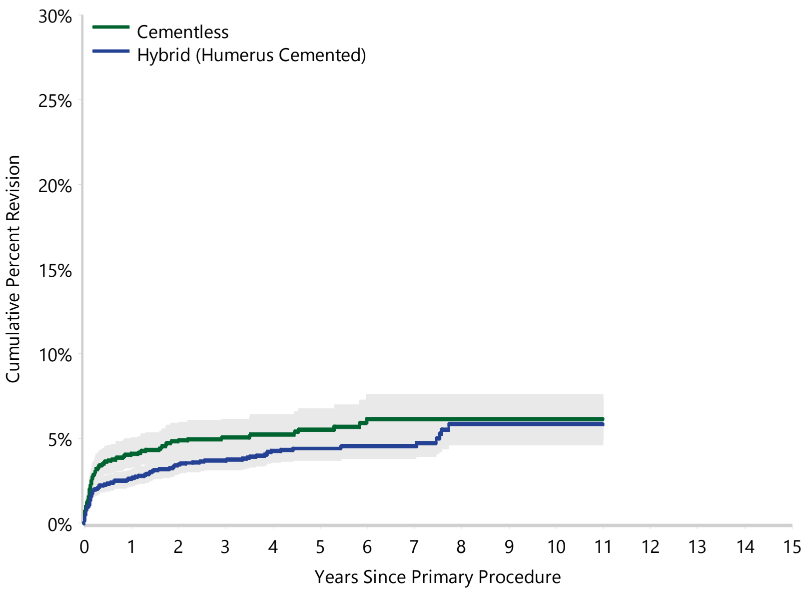
The outcomes of the most commonly used prosthesis combinations used in total reverse shoulder replacement for fracture are listed in Table ST111. The cementless prosthesis combinations are listed in Table ST112. The hybrid (humerus cemented) prosthesis combinations are listed in Table ST113.

Table ST108 Cumulative Percent Revision of Primary Total 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	77	4.1 (1.3, 12.1)	4.1 (1.3, 12.1)	4.1 (1.3, 12.1)	4.1 (1.3, 12.1)		
Cementless	99	1974	4.1 (3.3, 5.1)	5.0 (4.1, 6.2)	5.5 (4.5, 6.8)	6.2 (5.0, 7.6)	6.2 (5.0, 7.6)	
Hybrid (Glenoid Cemented)	4	89	4.8 (1.8, 12.2)	4.8 (1.8, 12.2)	4.8 (1.8, 12.2)			
Hybrid (Humerus Cemented)	147	3979	2.6 (2.2, 3.2)	3.7 (3.1, 4.4)	4.4 (3.7, 5.2)	4.5 (3.8, 5.4)	5.8 (4.6, 7.4)	
TOTAL	**253**	**6119**						

Note: Restricted to modern prostheses

Figure ST102 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Fixation (Primary Diagnosis Fracture)



HR - adjusted for age and gender

Cementless vs Hybrid (Humerus Cemented)

Entire Period: HR=1.23 (0.96, 1.59), p=0.106

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Cementless	1974	1603	1069	593	289	58	7
Hybrid (Humerus Cemented)	3979	3154	1852	969	457	103	5

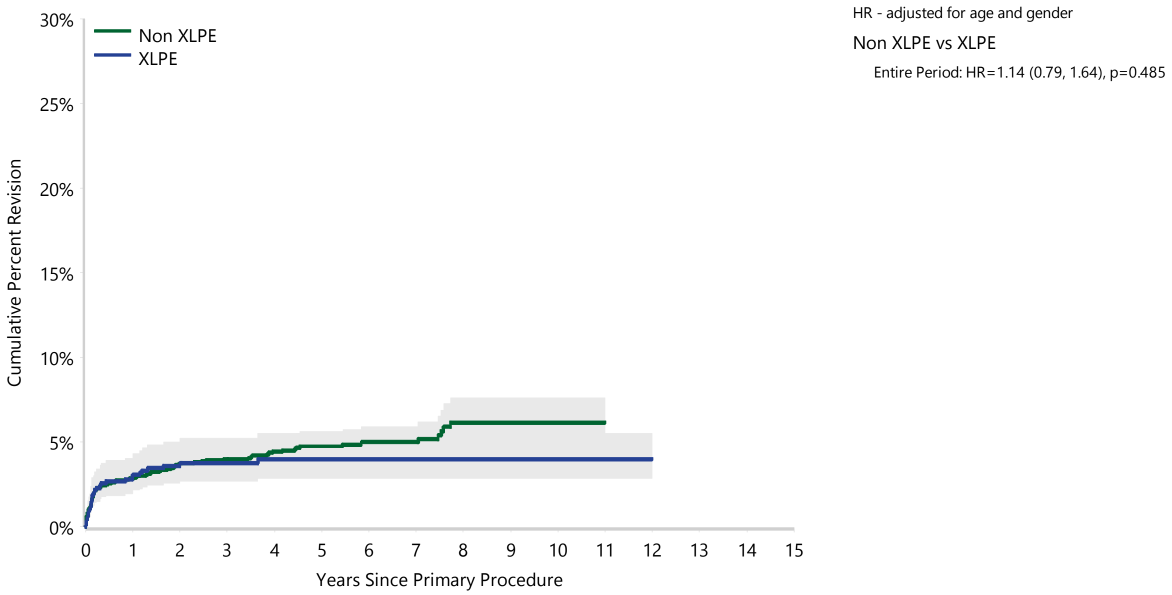
Note: Restricted to modern prostheses

Table ST109 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Polyethylene Type (Primary Diagnosis Fracture)

Polyethylene Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Non XLPE	151	3712	2.9 (2.4, 3.5)	4.0 (3.3, 4.7)	4.8 (4.0, 5.6)	5.0 (4.2, 5.9)	6.2 (5.0, 7.6)	
XLPE	36	1039	3.1 (2.1, 4.4)	3.8 (2.7, 5.2)	4.0 (2.9, 5.5)	4.0 (2.9, 5.5)	4.0 (2.9, 5.5)	
TOTAL	187	4751						

Note: Restricted to modern prostheses

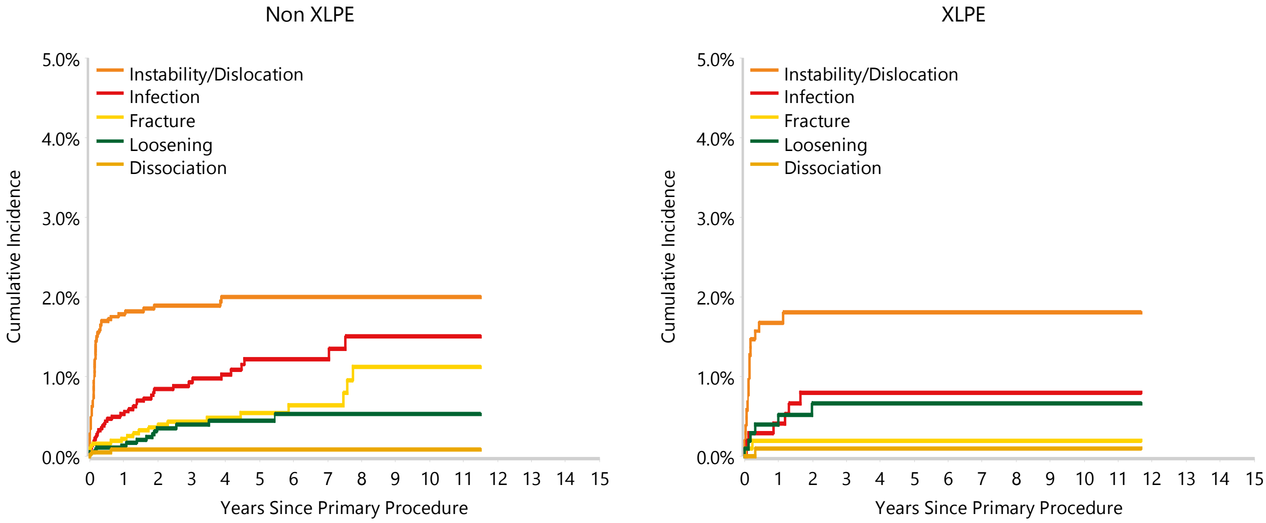
Figure ST103 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Polyethylene Type (Primary Diagnosis Fracture)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
Non XLPE	3712	3005	1865	1039	505	112	5
XLPE	1039	789	490	305	178	53	7

Note: Restricted to modern prostheses

Figure ST104 Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement by Polyethylene Type (Primary Diagnosis Fracture)



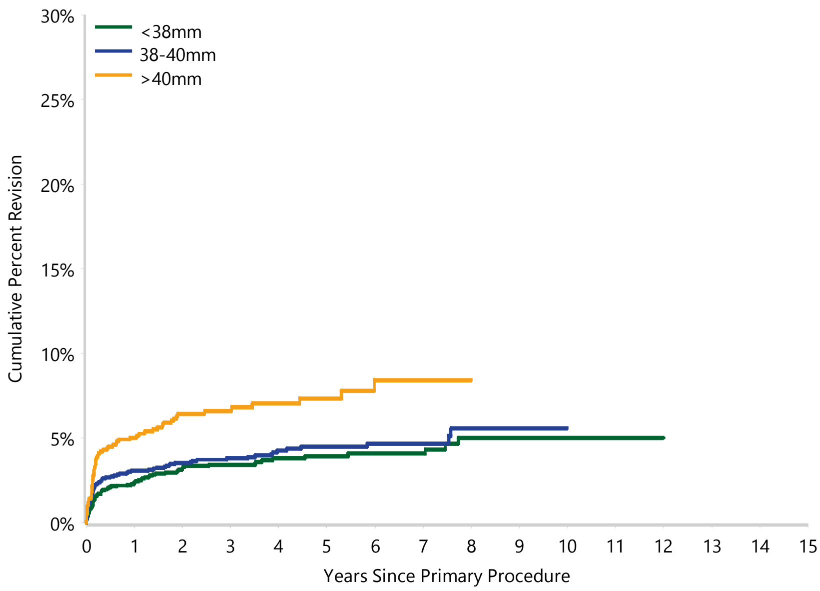
Note: Restricted to modern prostheses

Table ST110 Cumulative Percent Revision of Primary Total 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	83	2444	2.4 (1.8, 3.1)	3.4 (2.7, 4.3)	3.9 (3.1, 4.9)	4.1 (3.2, 5.1)	5.0 (3.8, 6.6)	
38-40mm	99	2554	3.1 (2.5, 3.8)	3.8 (3.1, 4.7)	4.5 (3.7, 5.5)	4.7 (3.8, 5.8)	5.6 (4.2, 7.4)	
>40mm	69	1064	5.0 (3.9, 6.6)	6.6 (5.2, 8.4)	7.4 (5.8, 9.4)	8.4 (6.4, 11.1)		
TOTAL	251	6062						

Note: Excludes 57 procedures with unknown glenosphere sizes
Restricted to modern prostheses

Figure ST105 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Glenosphere Size (Primary Diagnosis Fracture)



HR - adjusted for age and gender

38-40mm vs <38mm
Entire Period: HR=1.15 (0.86, 1.54), p=0.336

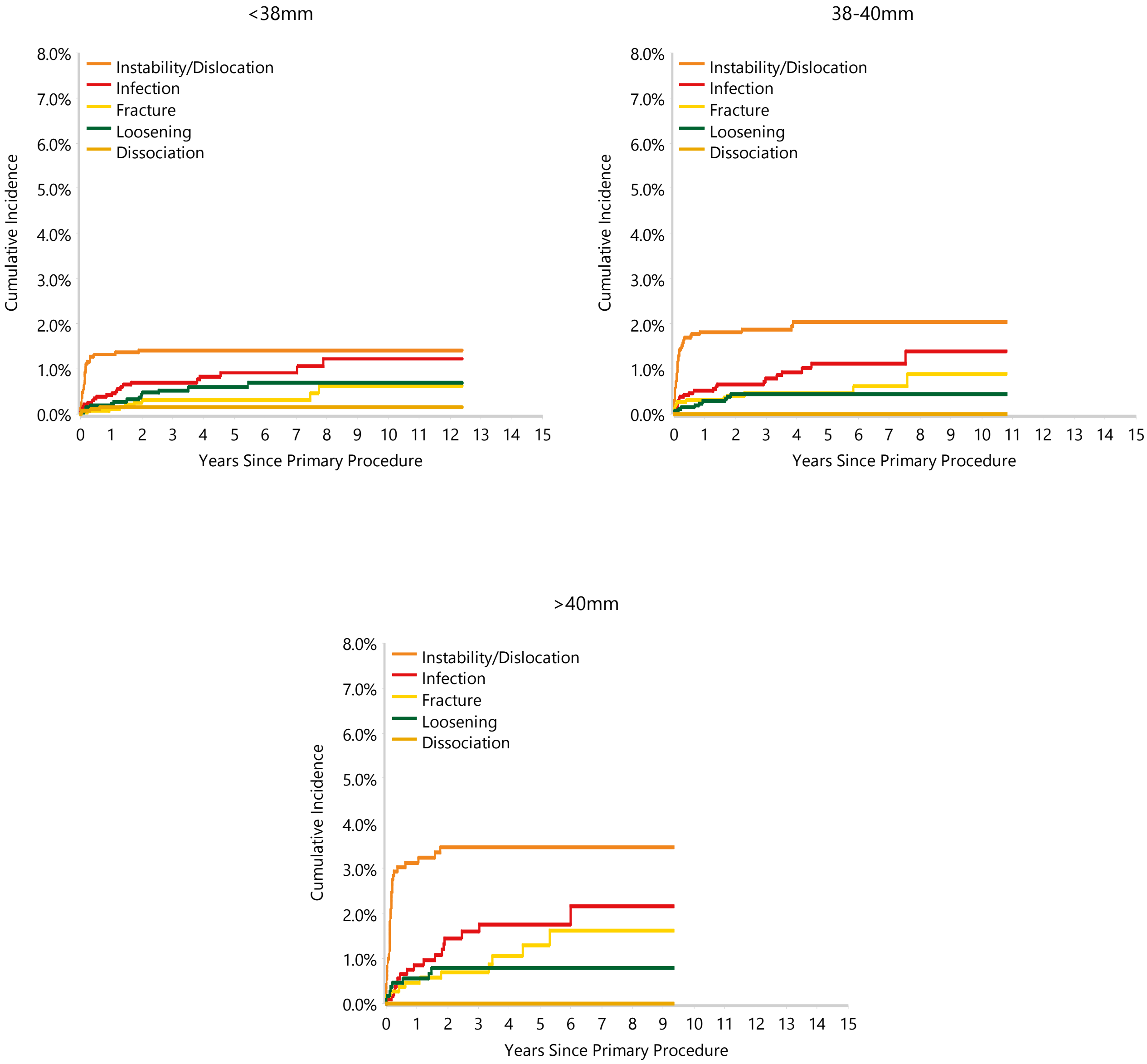
>40mm vs <38mm
Entire Period: HR=1.33 (0.94, 1.86), p=0.103

>40mm vs 38-40mm
Entire Period: HR=1.15 (0.83, 1.60), p=0.410

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	14 Yrs
<38mm	2444	1942	1225	694	367	95	8
38-40mm	2554	2089	1282	677	298	59	2
>40mm	1064	836	481	224	96	11	3

Note: Restricted to modern prostheses

Figure ST106 Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement by Glenosphere Size (Primary Diagnosis Fracture)



Note: Restricted to modern prostheses

Table ST111 Cumulative Percent Revision of Primary Total 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	35	1027	1.9 (1.2, 3.0)	2.8 (1.9, 4.1)	3.9 (2.7, 5.6)	4.3 (2.9, 6.2)		
Affinis	Affinis	9	332	1.8 (0.8, 4.1)	2.7 (1.3, 5.3)				
AltiVate Reverse	RSP	3	105	2.9 (1.0, 8.9)					
Ascend Flex	Aequalis	1	54	1.9 (0.3, 12.9)	1.9 (0.3, 12.9)	1.9 (0.3, 12.9)			
Comprehensive	Comprehensive Reverse	12	542	2.0 (1.1, 3.7)	2.4 (1.3, 4.4)	3.2 (1.6, 6.2)			
Delta Xtend	Delta Xtend	70	1347	3.8 (2.9, 5.0)	4.9 (3.8, 6.2)	5.5 (4.4, 7.0)	5.7 (4.5, 7.3)	6.6 (5.0, 8.7)	
Equinoxe	Equinoxe	13	329	2.6 (1.3, 5.2)	4.9 (2.7, 8.7)				
Global Unite	Delta Xtend	7	336	1.5 (0.6, 3.7)	2.0 (0.9, 4.3)				
RSP	RSP	11	199	3.1 (1.4, 6.8)	6.9 (3.8, 12.4)				
SMR	SMR L1	81	1471	4.7 (3.7, 6.0)	5.7 (4.6, 7.1)	5.8 (4.7, 7.2)	6.3 (5.0, 7.9)	6.3 (5.0, 7.9)	
Trabecular Metal	Comprehensive Reverse	2	58	3.5 (0.9, 13.4)	3.5 (0.9, 13.4)				
	Trabecular Metal	7	257	2.4 (1.1, 5.3)	2.9 (1.4, 5.9)	2.9 (1.4, 5.9)	2.9 (1.4, 5.9)		
Other (11)		2	62	3.8 (0.9, 14.3)	3.8 (0.9, 14.3)				
TOTAL		253	6119						

Note: Only combinations with >50 procedures have been listed
Restricted to modern prostheses

Table ST112 Cumulative Percent Revision of Cementless Primary Total 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	4	60	3.4 (0.9, 12.9)	3.4 (0.9, 12.9)	9.4 (3.5, 24.3)	9.4 (3.5, 24.3)		
Comprehensive	Comprehensive Reverse	3	113	1.8 (0.5, 7.1)					
Delta Xtend	Delta Xtend	8	202	2.0 (0.8, 5.2)	3.7 (1.8, 7.7)	3.7 (1.8, 7.7)	5.1 (2.4, 10.6)		
Equinoxe	Equinoxe	3	66	3.0 (0.8, 11.6)	5.5 (1.7, 16.7)				
Global Unite	Delta Xtend	3	87	2.3 (0.6, 9.0)	2.3 (0.6, 9.0)	7.5 (1.8, 27.7)			
SMR	SMR L1	73	1276	5.0 (3.9, 6.3)	5.9 (4.7, 7.4)	6.0 (4.8, 7.5)	6.6 (5.2, 8.4)		
Trabecular Metal	Trabecular Metal	2	58	3.4 (0.9, 13.1)	3.4 (0.9, 13.1)	3.4 (0.9, 13.1)	3.4 (0.9, 13.1)	3.4 (0.9, 13.1)	
Other (11)		3	112	2.9 (0.9, 8.8)					
TOTAL		99	1974						

Note: Only combinations with >50 procedures have been listed
Restricted to modern prostheses

Table ST113 Cumulative Percent Revision of Hybrid (Humerus Cemented) Primary Total 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	31	954	1.8 (1.1, 2.9)	2.8 (1.9, 4.2)	3.5 (2.4, 5.1)	3.9 (2.6, 5.8)		
Affinis	Affinis	8	313	1.6 (0.7, 3.9)	2.5 (1.2, 5.2)				
AltiVate Reverse	RSP	2	86	2.4 (0.6, 9.1)					
Comprehensive	Comprehensive Reverse	9	401	2.2 (1.1, 4.4)	2.2 (1.1, 4.4)	3.3 (1.5, 7.4)			
Delta Xtend	Delta Xtend	59	1123	4.0 (3.0, 5.3)	4.9 (3.7, 6.3)	5.7 (4.4, 7.4)	5.7 (4.4, 7.4)	6.7 (5.0, 9.1)	
Equinoxe	Equinoxe	9	245	2.3 (1.0, 5.6)	4.7 (2.3, 9.4)				
Global Unite	Delta Xtend	4	233	1.4 (0.4, 4.1)					
RSP	RSP	11	163	3.8 (1.7, 8.3)	8.4 (4.7, 15.0)				
SMR	SMR L1	5	179	1.7 (0.6, 5.3)	3.4 (1.4, 8.0)	3.4 (1.4, 8.0)			
Trabecular Metal	Trabecular Metal	5	185	2.3 (0.9, 5.9)	2.9 (1.2, 6.9)	2.9 (1.2, 6.9)			
Other (9)		4	97	4.2 (1.6, 10.9)	4.2 (1.6, 10.9)				
TOTAL		**147**	**3979**						

Note: Only combinations with >50 procedures have been listed
Restricted to modern prostheses

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 2021 (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 or 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 Director and Deputy 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 Australian Society of Arthroplasty surgeons. The panel meets with Registry staff at a joint specific workshop to review the Stage 2 analysis and determine which prostheses will be identified inthe 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 which 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, there are two workshops held to review, comment, and provide advice on all sections of the report. Members of the AOA and Arthroplasty Society are invited to attend a two-day hip and knee surgeon workshop, to review all sections of the report other than the shoulder procedures section. This hybrid workshop was held in Adelaide on the weekend of the 6 and 7 August 2022.

In addition to AOANJRR and SAHMRI staff, and a representative of the AOA Executive, 22 AOA members with expertise in hip and knee arthroplasty attended the workshop. Of these, 13 members attended face-to-face and 9 members attended online.

The shoulder section was reviewed at a smaller online meeting held on 13 August 2022 and attended by the AOANJRR Director, the Registry Upper Limb Clinical Advisor, and the Registry Publications Manager. There are no additional shoulder prostheses identified this year.

Only prostheses identified for the first time or prostheses that are not re-identified are discussed in the following text.

Investigations of prostheses identified as having a higher than anticipated rate of revision are available on the Registry website: https://www.aoanjrr.sahmri.com/annual-reports-2022

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	514	2.14	Entire Period: HR=2.11 (1.17, 3.82), p=0.013

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	≤2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
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
Re-Identified and Still Used	.	.	.	.	
**Quadra-H	7	84	207	3.39	Entire Period: HR=3.28 (1.56, 6.90), p=0.001
Identified and no longer used	.	.	.	.	
UHR/ABGII	23	177	997	2.31	0 - 2Wk: HR=4.92 (1.20, 20.15), p=0.026
	.	.	.	.	2Wk - 9Mth: HR=0.89 (0.29, 2.78), p=0.846
	.	.	.	.	9Mth - 3.5Yr: HR=1.94 (0.72, 5.21), p=0.189
	.	.	.	.	3.5Yr+: HR=8.60 (4.88, 15.17), p<0.001
UHR/Omnifit (cless)	8	40	268	2.98	Entire Period: HR=3.83 (1.90, 7.70), p<0.001
**Basis	18	156	813	2.21	0 - 1Yr: HR=0.50 (0.12, 1.99), p=0.323
	.	.	.	.	1Yr - 2.5Yr: HR=6.95 (3.54, 13.66), p<0.001
	.	.	.	.	2.5Yr+: HR=3.78 (1.76, 8.12), p<0.001
**Synergy	9	55	431	2.09	Entire Period: HR=2.67 (1.38, 5.16), p=0.003

Note: Components have been compared to all other modern bipolar hip components
**Femoral Stem Component

Table IP5 Cumulative Percent Revision of Bipolar Hip Prostheses Identified as Having a Higher than Anticipated Rate of Revision

CPR	1 Yr	3 Yrs	5 Yrs	10 Yrs	20 Yrs
Re-Identified and Still Used					
**Quadra-H	6.3 (2.4, 16.1)	11.3 (5.1, 24.0)	15.3 (7.1, 31.2)		
Identified and No Longer Used					
UHR/ABGII	4.3 (2.1, 8.9)	5.1 (2.6, 10.0)	10.8 (6.5, 17.9)		
UHR/Omnifit (cless)	18.3 (9.1, 34.6)	18.3 (9.1, 34.6)	18.3 (9.1, 34.6)	18.3 (9.1, 34.6)	
**Basis	1.5 (0.4, 5.8)	10.1 (5.9, 17.2)	12.6 (7.6, 20.6)		
**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

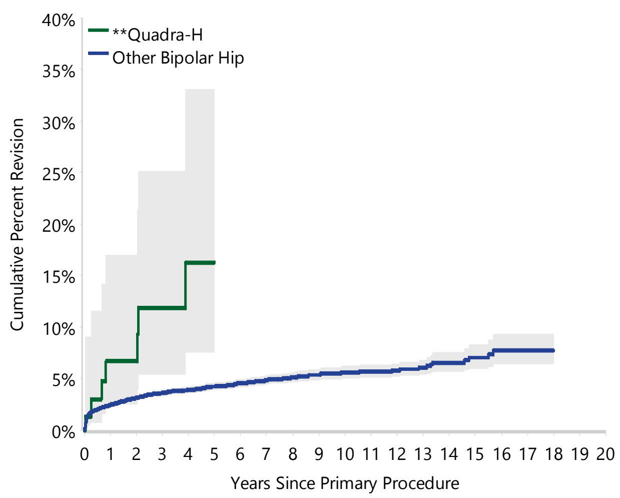
Table IP6 Yearly Usage of Bipolar Hip Prostheses Identified as Having a Higher than Anticipated Rate of Revision

Year of Implant	≤2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Re-Identified and Still Used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
**Quadra-H	.	.	.	.	11	7	5	6	4	11	9	7	4	7	5	7	1
Identified and No Longer Used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
UHR/ABGII	120	10	15	20	7	5	.	.	.	.	.	.	.	.	.	.	.
UHR/Omnifit (cless)	33	4	1	2	.	.	.	.	.	.	.	.	.	.	.	.	.
**Basis	52	13	9	11	4	7	8	21	24	6	1	.	.	.	.	.	.
**Synergy	44	3	2	1	1	.	1	.	2	.	.	.	1	.	.	.	.

Note: **Femoral Stem Component

Figure IP1 Cumulative Percent Revision of Re-Identified and Still Used Bipolar Hip Prostheses

Re-Identified and Still Used



PRIMARY TOTAL HIP REPLACEMENT

TOTAL CONVENTIONAL

Large head (>32mm) metal/metal bearings have been removed from the comparator group for all primary total conventional hip investigations.

There are three newly identified total conventional hip prostheses.
The CORAIL/Trident (Shell) combination has been used in 494 procedures, 25 of which have been revised. The cumulative percent revision at 10 years is 8.4%. Of the 25 revisions, 20 were major. There were 11 revisions for loosening and 8 for infection.

This year the Registry identified the G7 acetabular cup in combination with five femoral stems in Stage 1. As per our approach to identifying prostheses with higher than anticipated rates of revision, an additional analysis was performed on the individual cup. Upon further investigation, only one range, within the G7 portfolio, the G7 Multihole acetabular component, was identified.

The G7 Multihole acetabular component has been used in 686 procedures since 2017, 42 of which have been revised. The cumulative percent revision at 3 years is 8.2%. Of the 42 revisions, 20 were major, 12 of which involved the acetabulum. There were 16 revisions for prosthesis dislocation/instability, 14 for infection, and 7 for fracture.

While the registry acknowledges that the G7 Multihole cup may be used in more difficult cases, it has a higher rate of revision than the solid and the cluster shells and has been implanted in over 100 hospitals.

As the G7 Multihole is now identified individually, the Taperloc/G7 combination is no longer listed.

The HACTIV femoral stem has been used in 2407 procedures since 2010, 86 of which have been revised. The cumulative percent revision at 8 years is 4.8%. Of the 86 revisions, 70 were major, 35 of which involved the femoral stem. There have been 23 revisions for prosthesis dislocation/instability, 23 for infection, and 21 for fracture.

As the HACTIV femoral stem is now identified individually, the HACTIV/Logical G combination is no longer listed.

The M-Cor/Equator+ Cup and Meridian/ABGII combinations are identified for the first time and are no longer used. M-Cor/Equator+ Cup combination has been identified to highlight a potential stem breakage issue - there have been 6 revisions for implant breakage of the stem which have occurred from 4.7 years to 9.6 years after the primary procedure was performed.

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	.	.	.	.	
CORAIL/Trident (Shell)	25	494	2087	1.20	Entire Period: HR=1.80 (1.22, 2.67), p=0.003
*HACTIV	86	2407	7586	1.13	0 - 1Mth: HR=1.59 (1.09, 2.33), p=0.015
	.	.	.	.	1Mth - 2Yr: HR=1.76 (1.35, 2.30), p<0.001
	.	.	.	.	2Yr+: HR=0.34 (0.13, 0.89), p=0.029
**G7 Multihole	42	686	987	4.26	Entire Period: HR=3.34 (2.47, 4.52), p<0.001
Re-Identified and Still Used	.	.	.	.	
Accolade II/Trident Tritanium (Shell)	87	3187	8147	1.07	0 - 1Mth: HR=1.72 (1.26, 2.36), p<0.001
	.	.	.	.	1Mth+: HR=0.94 (0.71, 1.25), p=0.673
Avenir/Fitmore	17	298	845	2.01	0 - 1Mth: HR=4.84 (2.61, 9.00), p<0.001
	.	.	.	.	1Mth+: HR=1.40 (0.67, 2.95), p=0.369
CPT/Fitmore	20	286	1697	1.18	Entire Period: HR=2.11 (1.36, 3.27), p<0.001
CPT/Low Profile Cup	16	204	1098	1.46	Entire Period: HR=2.53 (1.55, 4.13), p<0.001
*Furlong Evolution	36	516	1587	2.27	Entire Period: HR=2.80 (2.02, 3.88), p<0.001
*MiniMax	21	410	1144	1.84	0 - 2Wk: HR=6.05 (2.88, 12.70), p<0.001
	.	.	.	.	2Wk+: HR=1.56 (0.92, 2.63), p=0.097
*Novation	80	1402	8117	0.99	0 - 3Mth: HR=2.31 (1.68, 3.17), p<0.001
	.	.	.	.	3Mth+: HR=1.37 (1.01, 1.85), p=0.043
*Profemur L	117	3115	11745	1.00	0 - 3Mth: HR=1.62 (1.26, 2.09), p<0.001
	.	.	.	.	3Mth+: HR=1.18 (0.91, 1.54), p=0.205
*Taper Fit	133	4181	13595	0.98	0 - 6Mth: HR=0.82 (0.62, 1.10), p=0.187
	.	.	.	.	6Mth - 2Yr: HR=1.15 (0.78, 1.67), p=0.480
	.	.	.	.	2Yr+: HR=2.58 (1.99, 3.33), p<0.001
**Atlas (Shell)	53	489	4072	1.30	Entire Period: HR=2.48 (1.90, 3.25), p<0.001
**Continuum	589	13684	84229	0.70	0 - 1Mth: HR=1.84 (1.58, 2.14), p<0.001
	.	.	.	.	1Mth - 3Mth: HR=1.44 (1.17, 1.78), p<0.001
	.	.	.	.	3Mth - 1.5Yr: HR=1.16 (0.97, 1.38), p=0.115
	.	.	.	.	1.5Yr - 2Yr: HR=1.40 (1.00, 1.96), p=0.048
	.	.	.	.	2Yr+: HR=0.86 (0.74, 1.01), p=0.062
**Delta-One-TT	11	175	793	1.39	Entire Period: HR=2.10 (1.16, 3.79), p=0.013
**Dynasty	106	2078	8916	1.19	Entire Period: HR=1.75 (1.44, 2.12), p<0.001
**Fin II	161	2298	19598	0.82	Entire Period: HR=1.61 (1.38, 1.88), p<0.001
**Furlong	64	941	5784	1.11	Entire Period: HR=1.93 (1.51, 2.46), p<0.001
**Versafitcup DM	54	1392	4365	1.24	Entire Period: HR=1.56 (1.20, 2.04), p=0.001
Identified and No Longer Used	.	.	.	.	
+M-Cor/Equator+ Cup	11	77	854	1.29	0 - 2Yr: HR=0.58 (0.08, 4.11), p=0.585
	.	.	.	.	2Yr+: HR=4.14 (2.22, 7.69), p<0.001
+Meridian/ABGII	21	143	1767	1.19	Entire Period: HR=2.44 (1.59, 3.74), p<0.001
Anatomic II/Duraloc Option	10	60	692	1.45	Entire Period: HR=2.94 (1.58, 5.47), p<0.001
Anca-Fit/PINNACLE	16	101	1025	1.56	Entire Period: HR=3.19 (1.96, 5.21), p<0.001
CORAIL/Trabecular Metal (Shell)	11	98	715	1.54	Entire Period: HR=2.88 (1.59, 5.20), p<0.001
F2L/Delta-PF	19	107	1246	1.52	Entire Period: HR=3.13 (2.00, 4.91), p<0.001
Friendly Hip/Cup (Exactech)	14	97	1067	1.31	Entire Period: HR=2.73 (1.62, 4.62), p<0.001
Friendly Hip/Delta-TT	6	74	445	1.35	Entire Period: HR=2.47 (1.11, 5.48), p=0.026
MBA (exch neck)/PINNACLE	27	225	1959	1.38	Entire Period: HR=2.74 (1.88, 4.00), p<0.001
Secur-Fit Plus/PINNACLE	14	246	1371	1.02	Entire Period: HR=1.75 (1.03, 2.95), p=0.036

Femoral Stem/Acetabular	N Revised	N Total	Obs. Years	Revisions/ 100 Obs. Yrs	Hazard Ratio, P Value
Secur-Fit Plus/Secur-Fit	30	197	2597	1.16	Entire Period: HR=2.39 (1.67, 3.42), p<0.001
Taperloc/M2a^{MoM}	73	515	6494	1.12	Entire Period: HR=2.34 (1.86, 2.95), p<0.001
*ABGII (exch neck)	100	246	2009	4.98	0 - 1Mth: HR=4.09 (1.95, 8.58), p<0.001
	.	.	.	.	1Mth - 1.5Yr: HR=2.64 (1.32, 5.27), p=0.006
	.	.	.	.	1.5Yr - 2.5Yr: HR=7.96 (3.79, 16.71), p<0.001
	.	.	.	.	2.5Yr - 4Yr: HR=13.63 (7.90, 23.54), p<0.001
	.	.	.	.	4Yr - 4.5Yr: HR=40.72 (22.35, 74.18), p<0.001
	.	.	.	.	4.5Yr+: HR=15.85 (12.11, 20.73), p<0.001
*Adapter (cless)	154	744	7003	2.20	0 - 2Wk: HR=3.85 (1.92, 7.72), p<0.001
	.	.	.	.	2Wk - 1Mth: HR=1.59 (0.66, 3.82), p=0.302
	.	.	.	.	1Mth - 6Mth: HR=0.75 (0.28, 1.99), p=0.557
	.	.	.	.	6Mth - 3Yr: HR=4.22 (3.00, 5.94), p<0.001
	.	.	.	.	3Yr - 3.5Yr: HR=12.13 (6.84, 21.52), p<0.001
	.	.	.	.	3.5Yr - 4Yr: HR=6.79 (3.03, 15.21), p<0.001
	.	.	.	.	4Yr - 6.5Yr: HR=7.94 (5.65, 11.15), p<0.001
	.	.	.	.	6.5Yr - 7Yr: HR=11.23 (5.77, 21.83), p<0.001
	.	.	.	.	7Yr+: HR=4.43 (3.28, 5.99), p<0.001
*Adapter (ctd)	33	148	1250	2.64	0 - 6Mth: HR=1.94 (0.73, 5.16), p=0.186
	.	.	.	.	6Mth+: HR=6.83 (4.74, 9.83), p<0.001
*Apex	183	2591	22858	0.80	0 - 2Wk: HR=0.68 (0.28, 1.64), p=0.389
	.	.	.	.	2Wk+: HR=1.62 (1.40, 1.88), p<0.001
*BMHR VST	35	260	2597	1.35	0 - 3Mth: HR=0.89 (0.29, 2.75), p=0.834
	.	.	.	.	3Mth+: HR=3.14 (2.22, 4.45), p<0.001
*CBH Stem	42	274	2492	1.69	Entire Period: HR=3.37 (2.49, 4.56), p<0.001
*Edinburgh	19	138	1067	1.78	Entire Period: HR=3.53 (2.25, 5.53), p<0.001
*Elite Plus	272	2841	32138	0.85	0 - 1Mth: HR=0.26 (0.11, 0.62), p=0.002
	.	.	.	.	1Mth - 3Mth: HR=0.75 (0.40, 1.39), p=0.356
	.	.	.	.	3Mth+: HR=2.11 (1.87, 2.40), p<0.001
*Emperion	56	507	4437	1.26	Entire Period: HR=2.42 (1.86, 3.14), p<0.001
*Excia (cless)	28	426	2761	1.01	Entire Period: HR=1.82 (1.26, 2.64), p=0.001
*GHE	13	114	855	1.52	Entire Period: HR=2.93 (1.70, 5.05), p<0.001
*K2	85	601	5777	1.47	Entire Period: HR=2.99 (2.41, 3.70), p<0.001
*LYDERIC II	16	164	1470	1.09	Entire Period: HR=2.20 (1.35, 3.59), p=0.001
*Linear	19	290	1687	1.13	Entire Period: HR=1.93 (1.23, 3.03), p=0.004
*ML Taper Kinectiv	194	3532	29001	0.67	Entire Period: HR=1.31 (1.13, 1.50), p<0.001
*MSA	41	224	1948	2.10	Entire Period: HR=4.01 (2.95, 5.45), p<0.001
*Margron	121	688	8827	1.37	Entire Period: HR=2.81 (2.35, 3.36), p<0.001
*Mayo	19	168	1939	0.98	Entire Period: HR=2.04 (1.30, 3.19), p=0.002
*Metha (exch neck)	14	88	852	1.64	Entire Period: HR=3.28 (1.94, 5.53), p<0.001
*Profemur Z	30	186	2065	1.45	Entire Period: HR=2.96 (2.07, 4.23), p<0.001
*Trabecular Metal	122	1904	16457	0.74	0 - 1Mth: HR=2.57 (1.84, 3.58), p<0.001
	.	.	.	.	1Mth - 3Mth: HR=1.84 (1.14, 2.97), p=0.012
	.	.	.	.	3Mth - 1.5Yr: HR=1.59 (1.06, 2.37), p=0.024
	.	.	.	.	1.5Yr - 3.5Yr: HR=1.25 (0.76, 2.04), p=0.376
	.	.	.	.	3.5Yr - 4Yr: HR=2.02 (0.84, 4.88), p=0.118
	.	.	.	.	4Yr - 7Yr: HR=1.26 (0.79, 2.00), p=0.331
	.	.	.	.	7Yr+: HR=0.42 (0.20, 0.89), p=0.022

Femoral Stem/Acetabular	N Revised	N Total	Obs. Years	Revisions/ 100 Obs. Yrs	Hazard Ratio, P Value
*UniSyn	61	466	4636	1.32	Entire Period: HR=2.61 (2.03, 3.36), p<0.001
**2000 Plus	20	135	1287	1.55	Entire Period: HR=3.12 (2.01, 4.84), p<0.001
**ASR	2042	4421	39381	5.19	0 - 2Wk: HR=1.26 (0.77, 2.07), p=0.354
	.	.	.	.	2Wk - 1Mth: HR=0.21 (0.08, 0.55), p=0.001
	.	.	.	.	1Mth - 3Mth: HR=0.78 (0.48, 1.25), p=0.301
	.	.	.	.	3Mth - 9Mth: HR=1.30 (0.88, 1.94), p=0.186
	.	.	.	.	9Mth - 1.5Yr: HR=4.11 (3.23, 5.23), p<0.001
	.	.	.	.	1.5Yr - 2Yr: HR=7.14 (5.53, 9.21), p<0.001
	.	.	.	.	2Yr - 2.5Yr: HR=13.12 (10.64, 16.17), p<0.001
	.	.	.	.	2.5Yr - 3Yr: HR=18.08 (14.82, 22.07), p<0.001
	.	.	.	.	3Yr - 5Yr: HR=30.17 (27.49, 33.10), p<0.001
	.	.	.	.	5Yr - 6Yr: HR=34.92 (30.50, 39.97), p<0.001
	.	.	.	.	6Yr - 7Yr: HR=23.21 (19.62, 27.45), p<0.001
	.	.	.	.	7Yr - 8Yr: HR=18.41 (15.19, 22.29), p<0.001
	.	.	.	.	8Yr - 8.5Yr: HR=14.36 (10.70, 19.28), p<0.001
	.	.	.	.	8.5Yr - 10Yr: HR=10.58 (8.66, 12.92), p<0.001
	.	.	.	.	10Yr - 10.5Yr: HR=8.84 (5.80, 13.49), p<0.001
	.	.	.	.	10.5Yr - 11Yr: HR=5.55 (3.59, 8.59), p<0.001
	.	.	.	.	11Yr - 12Yr: HR=6.86 (5.14, 9.16), p<0.001
	.	.	.	.	12Yr+: HR=4.66 (3.72, 5.83), p<0.001
**Adept	21	121	1259	1.67	Entire Period: HR=3.28 (2.14, 5.02), p<0.001
**Artek	72	179	2367	3.04	0 - 1Yr: HR=1.55 (0.64, 3.72), p=0.329
	.	.	.	.	1Yr - 1.5Yr: HR=4.58 (1.14, 18.34), p=0.031
	.	.	.	.	1.5Yr - 2.5Yr: HR=5.89 (2.21, 15.70), p<0.001
	.	.	.	.	2.5Yr - 4Yr: HR=14.63 (8.08, 26.48), p<0.001
	.	.	.	.	4Yr - 4.5Yr: HR=4.56 (0.64, 32.46), p=0.129
	.	.	.	.	4.5Yr - 6Yr: HR=18.27 (10.34, 32.29), p<0.001
	.	.	.	.	6Yr+: HR=6.21 (4.47, 8.62), p<0.001
**BHR	527	2988	33425	1.58	0 - 2Wk: HR=0.81 (0.39, 1.71), p=0.586
	.	.	.	.	2Wk - 1Mth: HR=0.15 (0.04, 0.61), p=0.007
	.	.	.	.	1Mth - 3Mth: HR=1.08 (0.66, 1.77), p=0.761
	.	.	.	.	3Mth - 1Yr: HR=0.53 (0.27, 1.01), p=0.055
	.	.	.	.	1Yr - 1.5Yr: HR=1.63 (0.92, 2.87), p=0.094
	.	.	.	.	1.5Yr+: HR=4.60 (4.19, 5.05), p<0.001
**Bionik	153	608	5721	2.67	0 - 2Wk: HR=2.95 (1.23, 7.10), p=0.015
	.	.	.	.	2Wk - 3Mth: HR=1.09 (0.49, 2.44), p=0.826
	.	.	.	.	3Mth+: HR=6.60 (5.59, 7.79), p<0.001
**Conserve Plus	21	135	1626	1.29	0 - 1Yr: HR=0.83 (0.21, 3.31), p=0.789
	.	.	.	.	1Yr+: HR=3.45 (2.20, 5.40), p<0.001
**Cormet	145	803	9041	1.60	0 - 1.5Yr: HR=1.10 (0.69, 1.75), p=0.685
	.	.	.	.	1.5Yr - 2Yr: HR=0.60 (0.08, 4.28), p=0.612
	.	.	.	.	2Yr+: HR=4.75 (3.98, 5.67), p<0.001
**DeltaLox	29	222	1742	1.66	Entire Period: HR=3.29 (2.29, 4.73), p<0.001
**Duraloc	634	5354	63503	1.00	0 - 3Mth: HR=0.78 (0.59, 1.03), p=0.083
	.	.	.	.	3Mth - 9Mth: HR=1.35 (0.94, 1.93), p=0.104
	.	.	.	.	9Mth - 2Yr: HR=1.84 (1.41, 2.40), p<0.001
	.	.	.	.	2Yr - 2.5Yr: HR=0.87 (0.43, 1.75), p=0.697

Femoral Stem/Acetabular	N Revised	N Total	Obs. Years	Revisions/ 100 Obs. Yrs	Hazard Ratio, P Value
	.	.	.	.	2.5Yr - 3Yr: HR=2.16 (1.33, 3.49), p=0.001
	.	.	.	.	3Yr - 5.5Yr: HR=1.82 (1.42, 2.35), p<0.001
	.	.	.	.	5.5Yr+: HR=2.98 (2.69, 3.31), p<0.001
**Durom	206	1245	14909	1.38	0 - 1.5Yr: HR=0.74 (0.47, 1.16), p=0.193
	.	.	.	.	1.5Yr+: HR=3.89 (3.36, 4.50), p<0.001
**ExpanSys	13	71	818	1.59	Entire Period: HR=3.29 (1.91, 5.66), p<0.001
**Hedrocel	13	46	582	2.23	Entire Period: HR=4.48 (2.60, 7.71), p<0.001
**Icon	104	401	4055	2.56	0 - 2.5Yr: HR=2.53 (1.70, 3.78), p<0.001
	.	.	.	.	2.5Yr+: HR=7.21 (5.78, 8.99), p<0.001
**Inter-Op	9	33	370	2.43	Entire Period: HR=4.96 (2.58, 9.52), p<0.001
**MBA	18	124	1111	1.62	Entire Period: HR=3.27 (2.06, 5.19), p<0.001
**Mitch TRH	153	731	7866	1.95	0 - 3Mth: HR=0.56 (0.23, 1.35), p=0.199
	.	.	.	.	3Mth - 2Yr: HR=2.43 (1.53, 3.86), p<0.001
	.	.	.	.	2Yr+: HR=5.77 (4.85, 6.87), p<0.001
**Mueller	12	58	517	2.32	Entire Period: HR=4.50 (2.55, 7.92), p<0.001
**Plasmacup	36	482	4225	0.85	Entire Period: HR=1.69 (1.22, 2.34), p=0.001
**SPH-Blind	129	952	12728	1.01	Entire Period: HR=2.10 (1.76, 2.50), p<0.001
**seleXys (excluding seleXys PC)	51	391	3419	1.49	Entire Period: HR=2.94 (2.23, 3.87), p<0.001

Note: Components have been compared to all other modern total conventional hip components
*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					
CORAIL/Trident (Shell)	2.9 (1.7, 4.9)	4.8 (3.1, 7.5)	5.8 (3.7, 8.9)	8.4 (5.3, 13.2)	
*HACTIV	3.0 (2.4, 3.8)	3.8 (3.1, 4.7)	3.8 (3.1, 4.7)		
**G7 Multihole	6.1 (4.5, 8.2)	8.2 (5.4, 12.2)			
Re-Identified and Still Used					
Accolade II/Trident Tritanium (Shell)	2.2 (1.8, 2.8)	3.1 (2.5, 3.8)	3.5 (2.8, 4.4)		
Avenir/Fitmore	5.2 (3.2, 8.5)	5.6 (3.5, 9.1)	6.4 (4.0, 10.3)		
CPT/Fitmore	3.9 (2.2, 6.9)	5.9 (3.7, 9.5)	6.5 (4.1, 10.4)	8.2 (5.1, 13.0)	
CPT/Low Profile Cup	5.5 (3.1, 9.6)	6.6 (3.9, 11.1)	9.2 (5.7, 14.9)		
*Furlong Evolution	5.1 (3.4, 7.4)	7.9 (5.7, 11.0)	8.7 (6.2, 12.1)		
*MiniMax	4.2 (2.6, 6.6)	5.4 (3.5, 8.2)			
*Novation	3.7 (2.9, 4.9)	4.5 (3.5, 5.7)	5.3 (4.3, 6.7)	7.2 (5.6, 9.2)	
*Profemur L	2.8 (2.2, 3.4)	3.8 (3.1, 4.6)	4.3 (3.6, 5.2)		
*Taper Fit	1.5 (1.2, 1.9)	2.6 (2.1, 3.2)	4.1 (3.2, 5.1)	8.8 (6.6, 11.7)	
**Atlas (Shell)	3.3 (2.0, 5.3)	4.2 (2.8, 6.5)	5.1 (3.4, 7.6)	10.2 (7.3, 14.1)	
**Continuum	2.7 (2.4, 2.9)	3.5 (3.2, 3.8)	3.9 (3.6, 4.3)	5.4 (4.9, 5.9)	
**Delta-One-TT	3.5 (1.6, 7.5)	5.5 (2.9, 10.3)	6.5 (3.5, 12.0)		
**Dynasty	3.4 (2.7, 4.3)	4.6 (3.8, 5.7)	5.4 (4.4, 6.5)		
**Fin II	2.6 (2.0, 3.4)	3.5 (2.8, 4.3)	4.6 (3.8, 5.6)	7.6 (6.5, 8.9)	
**Furlong	4.1 (3.0, 5.6)	6.3 (4.8, 8.1)	6.6 (5.1, 8.5)	7.6 (5.9, 9.8)	
**Versafitcup DM	3.0 (2.2, 4.1)	4.3 (3.3, 5.6)	4.8 (3.6, 6.3)		
Identified and No Longer Used					
+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)	
+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)	
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, 20.7)	12.0 (6.8, 20.7)	
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)		
MBA (exch neck)/PINNACLE	2.2 (0.9, 5.3)	3.6 (1.8, 7.1)	7.6 (4.7, 12.1)	13.5 (9.3, 19.3)	
Secur-Fit Plus/PINNACLE	3.3 (1.6, 6.4)	4.5 (2.5, 8.0)	5.0 (2.8, 8.6)		
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)	
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)	
*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)	17.0 (11.6, 24.5)	23.6 (17.0, 32.2)	
*Apex	2.2 (1.7, 2.9)	3.2 (2.6, 4.0)	4.6 (3.8, 5.5)	7.4 (6.4, 8.6)	
*BMHR VST	1.9 (0.8, 4.6)	4.6 (2.7, 8.0)	7.0 (4.5, 10.8)	12.4 (8.8, 17.1)	
*CBH Stem	4.0 (2.3, 7.2)	7.4 (4.9, 11.3)	9.8 (6.8, 14.1)	15.1 (11.2, 20.2)	
*Edinburgh	6.0 (3.1, 11.7)	9.6 (5.6, 16.4)	12.5 (7.7, 20.0)	16.7 (10.7, 25.7)	
*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)	15.8 (13.7, 18.1)
*Emperion	4.8 (3.2, 7.0)	6.0 (4.2, 8.4)	7.2 (5.3, 9.9)	11.8 (9.1, 15.4)	
*Excia (cless)	4.2 (2.7, 6.6)	5.2 (3.4, 7.8)	5.8 (3.9, 8.5)	7.4 (5.0, 11.0)	
*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)	

CPR	1 Yr	3 Yrs	5 Yrs	10 Yrs	20 Yrs
*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, 9.4)	6.7 (4.3, 10.3)		
*ML Taper Kinectiv	2.4 (2.0, 3.0)	3.5 (3.0, 4.2)	4.3 (3.7, 5.1)	6.0 (5.2, 6.9)	
*MSA	5.8 (3.4, 9.8)	9.5 (6.3, 14.1)	11.3 (7.8, 16.3)	18.4 (13.7, 24.5)	
*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)	
*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 (5.7, 8.0)	
*UniSyn	3.2 (2.0, 5.3)	5.9 (4.1, 8.5)	6.6 (4.7, 9.3)	12.0 (9.2, 15.7)	
**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)	44.0 (36.6, 52.2)
**BHR	1.1 (0.8, 1.6)	3.2 (2.6, 3.9)	6.1 (5.3, 7.0)	14.3 (13.0, 15.7)	
**Bionik	3.6 (2.4, 5.5)	7.7 (5.8, 10.2)	14.5 (11.9, 17.6)	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)	14.5 (10.2, 20.3)	
**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 (18.0, 21.6)
**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)	
**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)	
**Mueller	1.8 (0.2, 11.8)	12.2 (5.7, 25.3)	14.5 (7.1, 28.1)	23.6 (13.2, 40.1)	
**Plasmacup	4.4 (2.9, 6.6)	5.6 (3.9, 8.1)	5.8 (4.1, 8.3)	7.6 (5.5, 10.4)	
**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)	16.8 (14.0, 20.1)
**seleXys (excluding seleXys PC)	4.6 (2.9, 7.2)	7.8 (5.5, 11.0)	10.6 (7.9, 14.1)	13.5 (10.3, 17.5)	

Note: *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	≤2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Newly Identified	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
CORAIL/Trident (Shell)	7	4	22	10	13	16	25	26	24	14	13	11	32	37	47	66	127
*HACTIV	.	.	.	.	.	2	19	63	61	117	146	96	240	452	388	418	405
**G7 Multihole	.	.	.	.	.	.	.	.	.	.	.	.	15	49	169	222	231
Re-Identified and Still Used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Accolade II/Trident Tritanium (Shell)	.	.	.	.	.	.	.	1	1	30	119	258	484	402	510	583	799
Avenir/Fitmore	.	.	.	.	.	.	.	.	2	7	5	46	44	42	56	42	54
CPT/Fitmore	25	6	4	16	12	15	24	14	30	30	22	18	16	20	25	8	1
CPT/Low Profile Cup	24	8	7	7	6	9	16	26	20	6	5	2	3	15	31	11	8
*Furlong Evolution	.	.	.	.	.	.	.	.	29	25	32	11	54	102	106	83	74
*MiniMax	.	.	.	.	.	.	.	.	.	.	.	4	43	170	133	41	19
*Novation	.	.	.	.	4	32	53	130	137	226	266	148	90	101	145	51	19
*Profemur L	.	.	.	.	.	.	.	2	47	288	383	406	405	439	426	389	330
*Taper Fit	179	66	26	18	6	8	17	55	45	110	161	227	315	592	790	788	778
**Atlas (Shell)	109	79	46	16	13	6	7	4	8	28	23	13	27	26	26	35	23
**Continuum	.	.	.	.	175	1117	1245	1333	1502	1492	1359	1327	1293	1197	850	513	281
**Delta-One-TT	.	.	.	.	.	4	7	7	15	37	13	12	14	14	23	15	14
**Dynasty	.	.	.	.	.	.	40	31	49	178	298	317	306	307	272	242	38
**Fin II	39	128	175	251	269	318	286	205	247	101	6	.	.	9	76	94	94
**Furlong	31	.	4	7	61	90	85	73	76	64	66	12	55	100	82	65	70
**Versafitcup DM	.	.	.	.	.	.	10	12	4	19	139	184	196	182	185	229	232
Identified and No Longer Used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
+M-Cor/Equator+ Cup	.	.	6	70	1	.	.	.	.	.	.	.	.	.	.	.	.
+Meridian/ABGII	143	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Anatomic II/Duraloc Option	4	33	23	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Anca-Fit/PINNACLE	.	30	55	16	.	.	.	.	.	.	.	.	.	.	.	.	.
CORAIL/Trabecular Metal (Shell)	.	.	5	10	17	21	8	8	8	6	1	6	2	4	1	1	.
F2L/Delta-PF	69	28	10	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Friendly Hip/Cup (Exactech)	58	19	12	2	6	.	.	.	.	.	.	.	.	.	.	.	.
Friendly Hip/Delta-TT	.	.	.	.	.	.	14	12	13	13	9	6	4	2	1	.	.
MBA (exch neck)/PINNACLE	.	.	24	45	9	43	46	14	44	.	.	.	.	.	.	.	.
Secur-Fit Plus/PINNACLE	4	.	.	.	.	.	.	.	42	42	53	25	33	31	16	.	.
Secur-Fit Plus/Secur-Fit	175	22	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Taperloc/M2a^{MoM}	284	38	43	76	49	23	2	.	.	.	.	.	.	.	.	.	.
*ABGII (exch neck)	.	.	10	39	69	58	63	7	.	.	.	.	.	.	.	.	.
*Adapter (cless)	19	140	131	122	158	115	58	.	1	.	.	.	.	.	.	.	.
*Adapter (ctd)	7	41	52	33	8	7	.	.	.	.	.	.	.	.	.	.	.
*Apex	75	247	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	19	14	37	28	27	45	53	43	7	.	1	.	.	.	.	.	.
*Edinburgh	20	37	29	18	23	10	1	.	.	.	.	.	.	.	.	.	.
*Elite Plus	2656	112	46	26	.	.	1	.	.	.	.	.	.	.	.	.	.
*Emperion	1	13	21	26	65	87	72	44	53	38	41	34	12	.	.	.	.
*Excia (cless)	.	.	.	6	34	8	47	58	38	17	42	35	65	66	10	.	.
*GHE	.	.	.	.	.	9	4	47	28	14	12	.	.	.	.	.	.
*K2	.	1	22	80	172	204	122	.	.	.	.	.	.	.	.	.	.

Year of Implant	≤2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
*LYDERIC II	136	12	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	58	76	46	21	7	.	.	.	.	.	.	.
*Margron	573	85	28	2	.	.	.	.	.	.	.	.	.	.	.	.	.
*Mayo	58	24	25	29	30	2	.	.	.	.	.	.	.	.	.	.	.
*Metha (exch neck)	.	.	.	.	20	53	15	.	.	.	.	.	.	.	.	.	.
*Profemur Z	120	56	6	1	2	1	.	.	.	.	.	.	.	.	.	.	.
*Trabecular Metal	.	6	101	148	198	242	272	276	186	220	112	106	32	5	.	.	.
*UniSyn	130	33	37	46	48	36	22	19	23	27	23	17	5	.	.	.	.
**2000 Plus	11	23	42	14	18	25	2	.	.	.	.	.	.	.	.	.	.
**ASR	668	958	1185	1180	430	.	.	.	.	.	.	.	.	.	.	.	.
**Adept	.	19	20	29	30	11	12	.	.	.	.	.	.	.	.	.	.
**Artek	179	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
**BHR	520	550	581	477	404	276	134	27	13	5	1	.	.	.	.	.	.
**Bionik	11	147	136	138	134	38	4	.	.	.	.	.	.	.	.	.	.
**Conserve Plus	35	46	24	15	14	1	.	.	.	.	.	.	.	.	.	.	.
**Cormet	239	114	73	129	124	93	26	4	1	.	.	.	.	.	.	.	.
**DeltaLox	.	.	.	.	.	34	84	72	24	8	.	.	.	.	.	.	.
**Duraloc	4133	301	253	293	187	82	84	18	3	.	.	.	.	.	.	.	.
**Durom	349	322	257	218	85	13	1	.	.	.	.	.	.	.	.	.	.
**ExpanSys	32	30	8	1	.	.	.	.	.	.	.	.	.	.	.	.	.
**Hedrocel	46	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
**Icon	43	80	84	68	78	37	11	.	.	.	.	.	.	.	.	.	.
**Inter-Op	33	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
**MBA	108	9	5	2	.	.	.	.	.	.	.	.	.	.	.	.	.
**Mitch TRH	.	45	273	164	130	82	37	.	.	.	.	.	.	.	.	.	.
**Mueller	47	.	1	2	.	.	.	1	.	1	1	.	1	1	3	.	.
**Plasmacup	10	16	13	7	54	60	59	77	70	44	51	21	.	.	.	.	.
**SPH-Blind	884	49	19	.	.	.	.	.	.	.	.	.	.	.	.	.	.
**seleXys (excluding seleXys PC)	.	35	33	20	21	53	70	89	57	13	.	.	.	.	.	.	.

Note: *Femoral Stem Component
**Acetabular Component
+ Newly identified and no longer used

Figure IP2 Cumulative Percent Revision of Newly Identified Total Conventional Hip Prostheses

Newly Identified

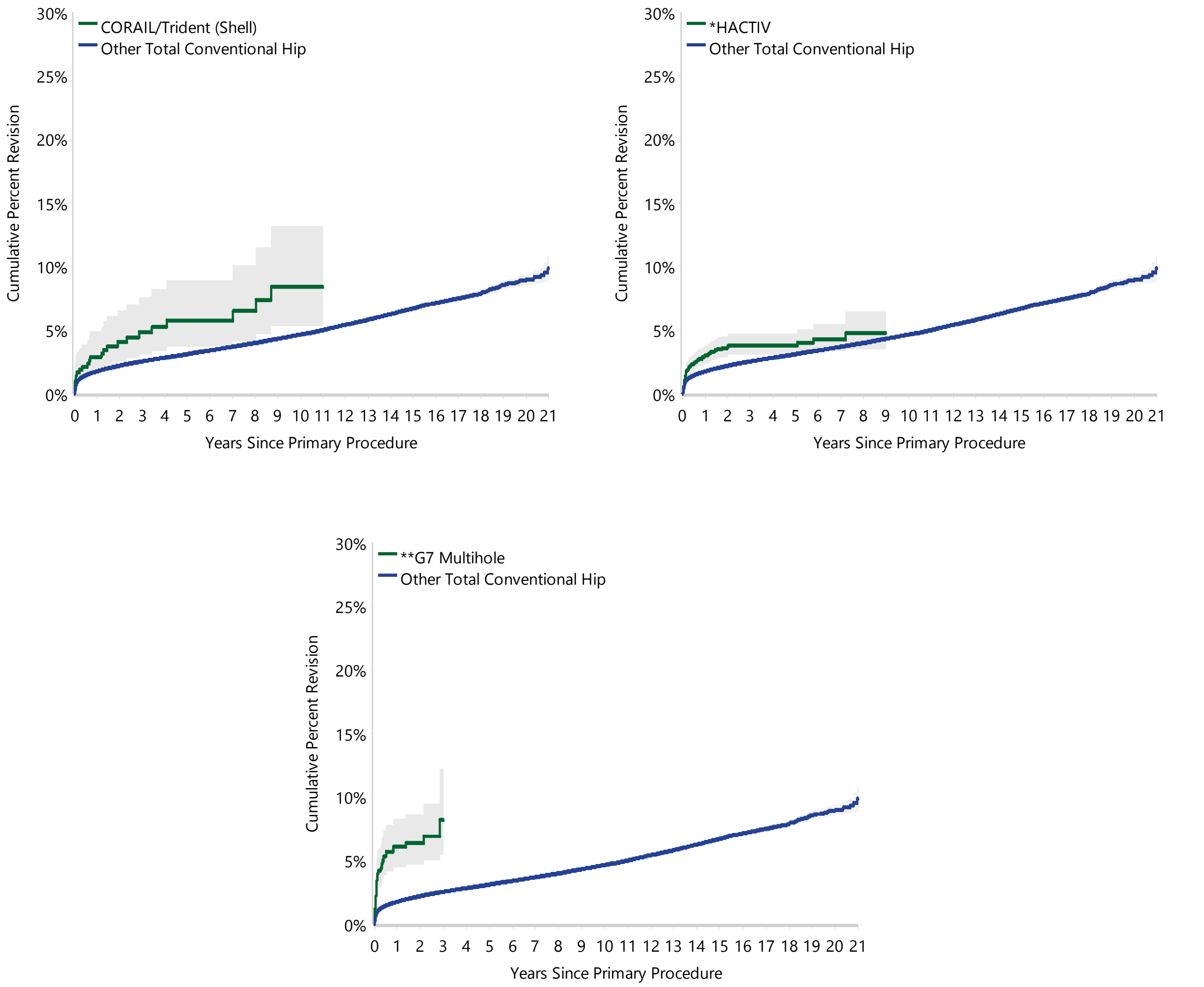
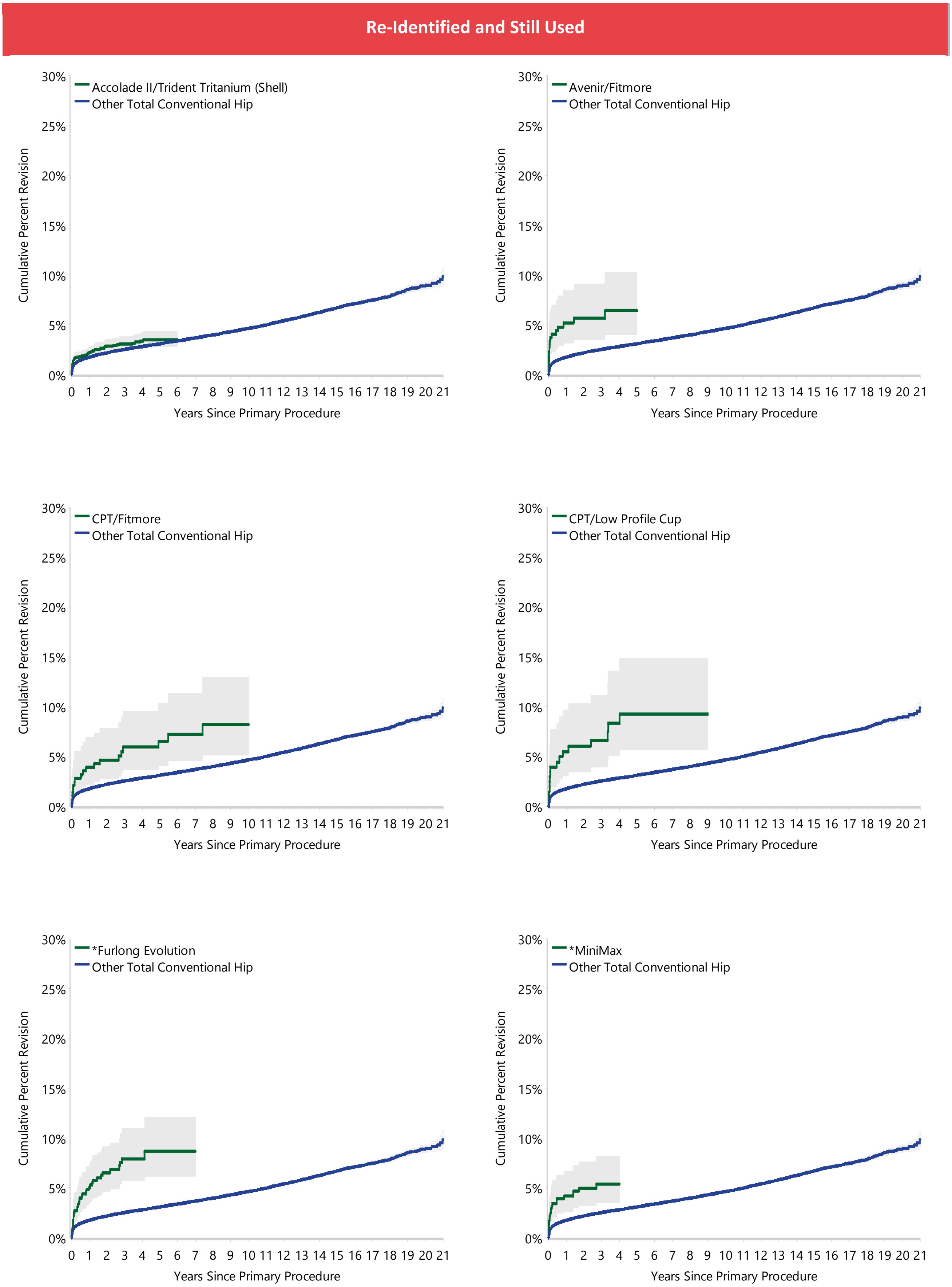
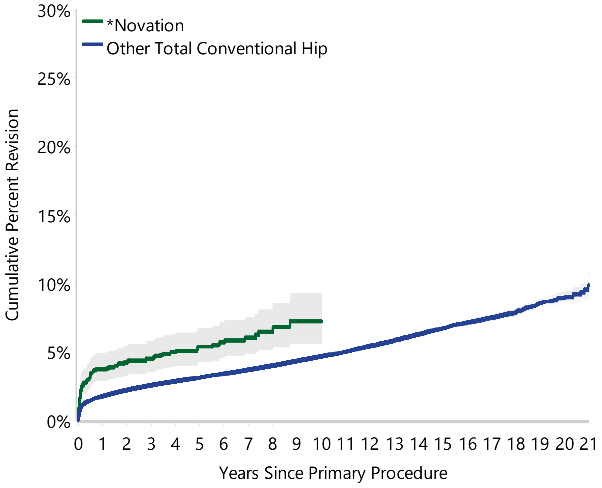
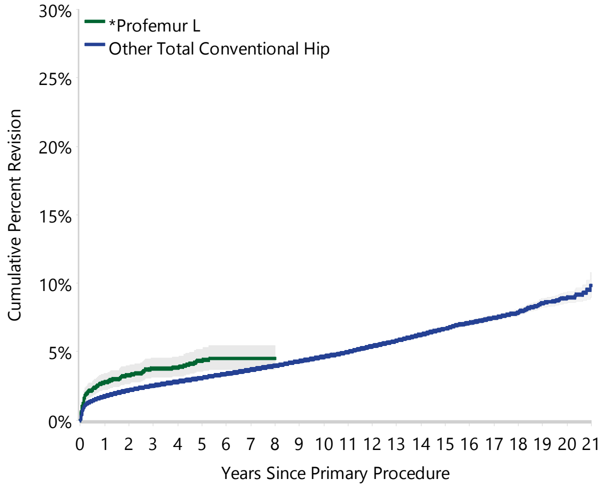
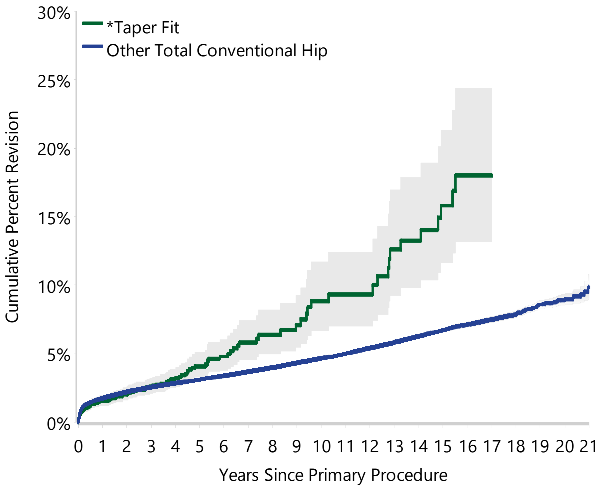


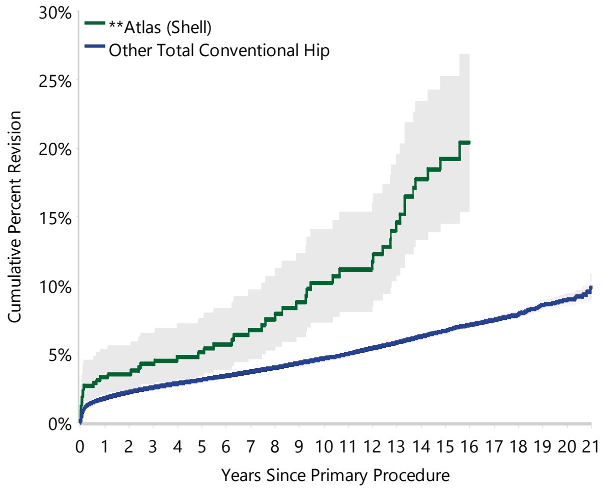
Figure IP3 Cumulative Percent Revision of Re-Identified and Still Used Total Conventional Hip Prostheses

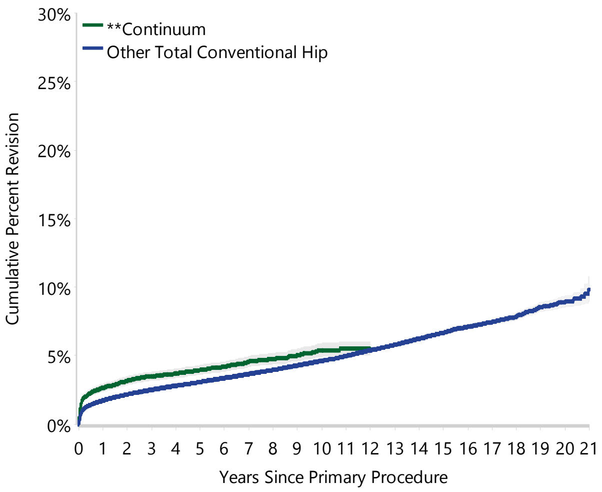


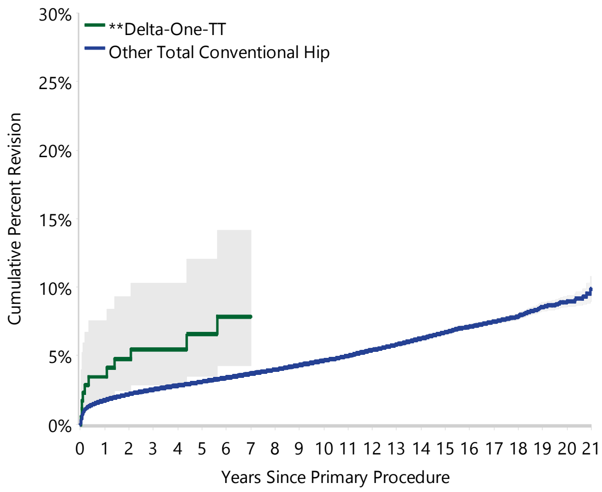

*Novation
Other Total Conventional Hip
Cumulative Percent Revision
30%
25%
20%
15%
10%
5%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
Years Since Primary Procedure

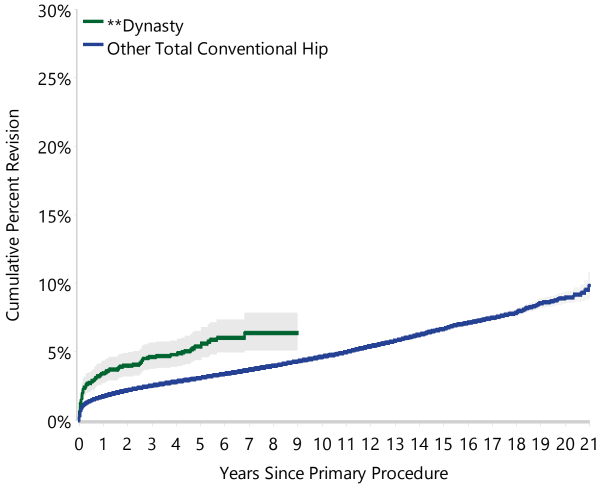

*Profemur L
Other Total Conventional Hip
Cumulative Percent Revision
30%
25%
20%
15%
10%
5%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
Years Since Primary Procedure

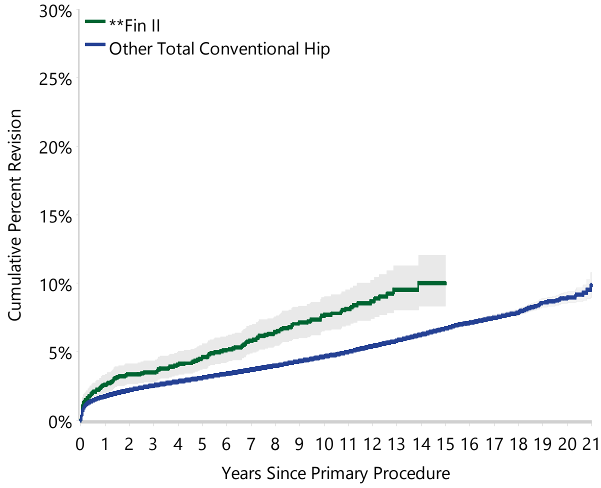

*Taper Fit
Other Total Conventional Hip
Cumulative Percent Revision
30%
25%
20%
15%
10%
5%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
Years Since Primary Procedure

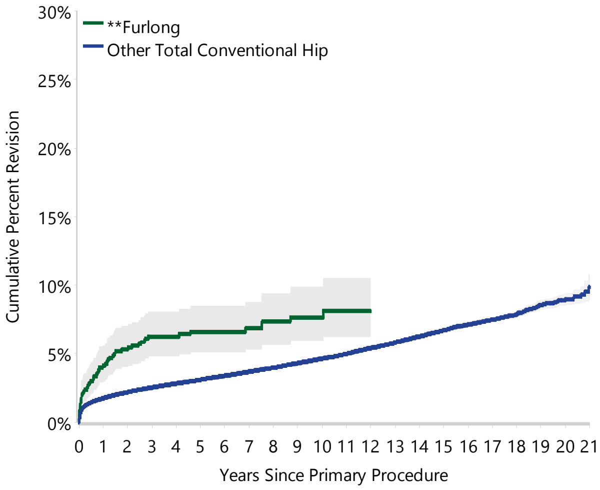

**Atlas (Shell)
Other Total Conventional Hip
Cumulative Percent Revision
30%
25%
20%
15%
10%
5%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
Years Since Primary Procedure

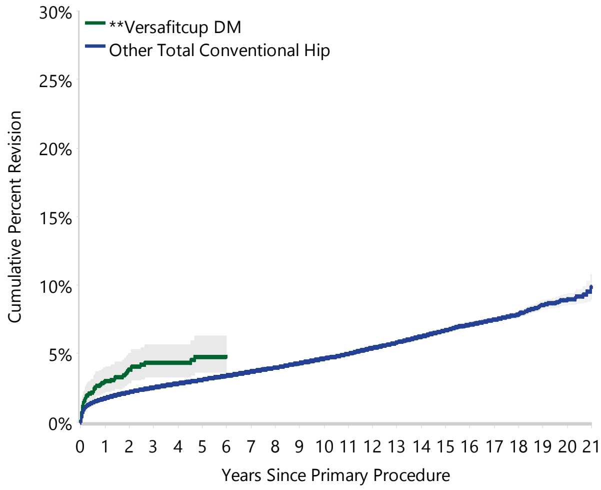

**Continuum
Other Total Conventional Hip
Cumulative Percent Revision
30%
25%
20%
15%
10%
5%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
Years Since Primary Procedure


**Delta-One-TT
Other Total Conventional Hip
Cumulative Percent Revision
30%
25%
20%
15%
10%
5%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
Years Since Primary Procedure


**Dynasty
Other Total Conventional Hip
Cumulative Percent Revision
30%
25%
20%
15%
10%
5%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
Years Since Primary Procedure


**Fin II
Other Total Conventional Hip
Cumulative Percent Revision
30%
25%
20%
15%
10%
5%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
Years Since Primary Procedure


**Furlong
Other Total Conventional Hip
Cumulative Percent Revision
30%
25%
20%
15%
10%
5%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
Years Since Primary Procedure


**Versafitcup DM
Other Total Conventional Hip
Cumulative Percent Revision
30%
25%
20%
15%
10%
5%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
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	409	1168	13805	2.96	0 - 3Yr: HR=2.74 (2.15, 3.48), p<0.001
	.	.	.	.	3Yr - 4.5Yr: HR=7.57 (5.50, 10.42), p<0.001
	.	.	.	.	4.5Yr - 5Yr: HR=11.41 (6.96, 18.71), p<0.001
	.	.	.	.	5Yr - 6Yr: HR=7.94 (5.45, 11.57), p<0.001
	.	.	.	.	6Yr - 7.5Yr: HR=6.98 (5.10, 9.55), p<0.001
	.	.	.	.	7.5Yr - 9Yr: HR=4.87 (3.31, 7.16), p<0.001
	.	.	.	.	9Yr+: HR=2.73 (2.16, 3.45), p<0.001
Bionik/Bionik	63	200	2150	2.93	Entire Period: HR=4.67 (3.62, 6.03), p<0.001
Conserve Plus/Conserve Plus	16	63	889	1.80	Entire Period: HR=2.30 (1.40, 3.77), p<0.001
Cormet/Cormet	138	626	7867	1.75	Entire Period: HR=2.52 (2.11, 3.00), p<0.001
Durom/Durom	116	847	11650	1.00	0 - 4.5Yr: HR=2.51 (1.92, 3.27), p<0.001
	.	.	.	.	4.5Yr+: HR=1.10 (0.83, 1.46), p=0.501
Recap/Recap	30	196	2377	1.26	0 - 6Mth: HR=2.98 (1.32, 6.73), p=0.008
	.	.	.	.	6Mth - 1.5Yr: HR=6.60 (3.21, 13.61), p<0.001
	.	.	.	.	1.5Yr+: HR=1.32 (0.81, 2.17), p=0.267
*Cormet 2000 HAP	28	95	1377	2.03	Entire Period: HR=3.42 (2.35, 4.97), 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)	5.6 (4.1, 7.7)	9.7 (7.6, 12.3)	17.1 (14.4, 20.4)	
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	≤2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Identified and No Longer Used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
ASR/ASR	510	258	176	133	91	.	.	.	.	.	.	.	.	.	.	.	.
Bionik/Bionik	12	33	33	46	54	20	2	.	.	.	.	.	.	.	.	.	.
Conserve Plus/Conserve Plus	48	11	3	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Cormet/Cormet	239	74	76	94	75	50	10	4	4	.	.	.	.	.	.	.	.
Durom/Durom	431	143	105	88	46	24	10	.	.	.	.	.	.	.	.	.	.
Recap/Recap	41	10	42	46	38	16	3	.	.	.	.	.	.	.	.	.	.
*Cormet 2000 HAP	95	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Note: *Head Component

PRIMARY PARTIAL KNEE REPLACEMENT

PATELLA/TROCHLEA

There are no newly identified currently used patella/trochlear knee prostheses.

The Lubinus/Lubinus combination is identified for the first time and is no longer used.

Table IP13 Revision Rate of Patella-Trochlear Knee Prostheses Identified as Having a Higher than Anticipated Rate of Revision

Patella/Trochlear	N Revised	N Total	Obs. Years	Revisions/ 100 Obs. Yrs	Hazard Ratio, P Value
Identified and No Longer Used	.	.	.	.	
+Lubinus/Lubinus	22	39	400	5.50	Entire Period: HR=1.77 (1.12, 2.80), p=0.014
**LCS	217	413	4106	5.29	Entire Period: HR=1.81 (1.54, 2.13), 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					
+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	≤2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Identified and No Longer Used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
+Lubinus/Lubinus	36	1	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.
**LCS	197	65	64	60	27	.	.	.	.	.	.	.	.	.	.	.	.

Note: **Trochlear Component
+ Newly identified and no longer used

UNICOMPARTMENTAL

There are no newly identified currently used unicompartmental knee prostheses.

The Eius/Eius combination is identified and is no longer used.

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	40	167	887	4.51	Entire Period: HR=2.94 (2.15, 4.01), p<0.001
Identified and No Longer Used	.	.	.	.	
+Eius/Eius	51	142	1698	3.00	Entire Period: HR=1.62 (1.23, 2.14), p<0.001
Advance/Advance	16	37	331	4.83	Entire Period: HR=3.51 (2.15, 5.72), p<0.001
BalanSys Uni/BalanSys Uni Mobile	58	199	2340	2.48	0 - 6Mth: HR=4.02 (2.00, 8.10), p<0.001
	.	.	.	.	6Mth - 2Yr: HR=2.66 (1.57, 4.50), p<0.001
	.	.	.	.	2Yr+: HR=1.25 (0.90, 1.74), p=0.176
Freedom PKR Active/Freedom PKR Active	467	1505	15150	3.08	0 - 9Mth: HR=0.65 (0.39, 1.08), p=0.093
	.	.	.	.	9Mth - 1Yr: HR=1.31 (0.70, 2.48), p=0.401
	.	.	.	.	1Yr - 1.5Yr: HR=2.40 (1.69, 3.41), p<0.001
	.	.	.	.	1.5Yr+: HR=2.42 (2.18, 2.68), p<0.001
Uniglide/Uniglide	181	756	8287	2.18	0 - 1.5Yr: HR=2.25 (1.70, 2.97), p<0.001
	.	.	.	.	1.5Yr - 2Yr: HR=1.57 (0.78, 3.17), p=0.209
	.	.	.	.	2Yr - 3Yr: HR=2.43 (1.55, 3.81), p<0.001
	.	.	.	.	3Yr+: HR=1.11 (0.91, 1.35), p=0.322
**Preservation Mobile	156	400	5009	3.11	0 - 1.5Yr: HR=2.58 (1.85, 3.62), p<0.001
	.	.	.	.	1.5Yr - 3Yr: HR=3.55 (2.41, 5.21), p<0.001
	.	.	.	.	3Yr+: HR=1.41 (1.15, 1.73), 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	6.7 (3.7, 11.7)	18.1 (12.9, 25.0)	24.2 (18.1, 31.9)		
Identified and No Longer Used					
+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)	
Advance/Advance	10.8 (4.2, 26.3)	27.0 (15.6, 44.4)	32.9 (20.2, 50.6)	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)	
Freedom PKR Active/Freedom PKR Active	1.7 (1.1, 2.5)	7.9 (6.6, 9.4)	13.7 (12.1, 15.6)	27.6 (25.3, 30.1)	
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)	

Note: **Tibial Component
+ Newly identified and no longer used

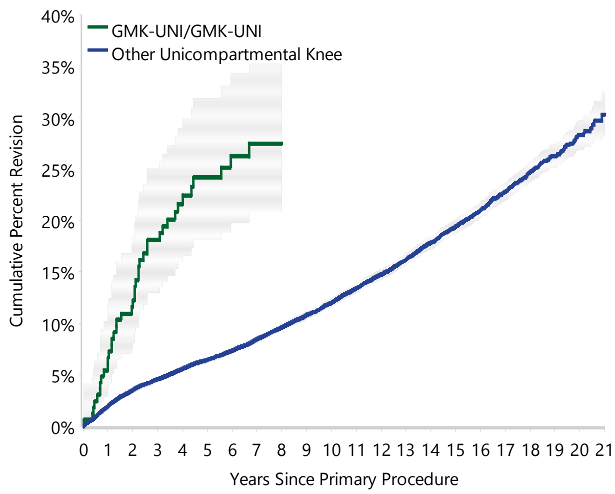
Table IP18 Yearly Usage of Unicompartmental Knee Prostheses Identified as Having a Higher than Anticipated Rate of Revision

Year of Implant	≤2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Re-Identified and Still Used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
GMK-UNI/GMK-UNI	.	.	.	5	10	2	.	21	22	16	19	17	12	29	3	8	3
Identified and No Longer Used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
+Eius/Eius	95	21	9	8	7	2	.	.	.	.	.	.	.	.	.	.	.
Advance/Advance	31	2	3	1	.	.	.	.	.	.	.	.	.	.	.	.	.
BalanSys Uni/BalanSys Uni Mobile	88	63	33	9	2	4	.	.	.	.	.	.	.	.	.	.	.
Freedom PKR Active/Freedom PKR Active	242	281	264	162	149	102	75	68	63	51	31	12	5	.	.	.	.
Uniglide/Uniglide	269	84	107	93	61	30	38	25	22	9	5	8	3	.	1	1	.
**Preservation Mobile	370	17	13	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Note: **Tibial Component
+ Newly identified and no longer used

Figure IP4 Cumulative Percent Revision of Re-Identified and Still Used Unicompartmental Knee Prostheses

Re-Identified and Still Used



PRIMARY TOTAL KNEE REPLACEMENT

There is one newly identified total knee prosthesis.

The Legion Oxinium FS femoral component has been used in 435 procedures, 36 of which have been revised. The cumulative percent revision at 10 years is 11.3%. Of the 36 revisions, 9 were major and 19 were insert only. There were 13 revisions for infection, 7 for loosening, 3 for bearing dislocation, and 3 for pain. As fully stabilised components are selectively used for difficult or unusual primary procedures, further analysis compared Legion Oxinium FS femoral components to other fully stabilised primary total knee replacement procedures. This analysis also demonstrated a significantly higher rate of revision. When used for revision procedures, bearing dislocation was found to occur more often with the Legion Oxinium FS femoral component compared to similar designs.

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					
*Legion Oxinium FS	36	435	2249	1.60	0 - 6Mth: HR=7.14 (4.44, 11.49), p<0.001
					6Mth – 1.5Yr: HR=1.57 (0.70, 3.49), p=0.271
					1.5Yr+: HR=1.62 (0.94, 2.79), p=0.083
Re-Identified and Still Used					
ACS (cless)/ACS Fixed	118	2570	12297	0.96	Entire Period: HR=1.46 (1.22, 1.75), p<0.001
Active Knee (cless)/Active Knee	721	7214	77613	0.93	0 - 1Yr: HR=1.05 (0.84, 1.31), p=0.660
					1Yr - 2.5Yr: HR=1.63 (1.39, 1.92), p<0.001
					2.5Yr - 3Yr: HR=1.15 (0.76, 1.76), p=0.507
					3Yr+: HR=2.28 (2.08, 2.50), p<0.001
Advance/Advance	70	1004	7216	0.97	Entire Period: HR=1.69 (1.34, 2.13), p<0.001
Apex Knee CR (cless)/Apex Knee (cless)	27	471	2825	0.96	Entire Period: HR=1.63 (1.12, 2.37), p=0.010
Columbus/Columbus	168	5251	18863	0.89	Entire Period: HR=1.34 (1.15, 1.56), p<0.001
E.Motion/E.Motion	66	998	6577	1.00	0 - 1.5Yr: HR=2.49 (1.81, 3.42), p<0.001
					1.5Yr+: HR=1.21 (0.84, 1.76), p=0.310
Nexgen LPS Flex (cless)/Nexgen	107	2110	11975	0.89	0 - 1.5Yr: HR=1.95 (1.52, 2.51), p<0.001
					1.5Yr - 2Yr: HR=1.66 (0.96, 2.86), p=0.069
					2Yr+: HR=1.00 (0.71, 1.40), p=0.982
Score (cless)/Score (cless)	226	3007	17759	1.27	0 - 6Mth: HR=0.98 (0.61, 1.59), p=0.948
					6Mth - 1.5Yr: HR=2.10 (1.62, 2.71), p<0.001
					1.5Yr+: HR=2.31 (1.96, 2.71), p<0.001
Score (cless)/Score (ctd)	96	1679	7987	1.20	Entire Period: HR=1.79 (1.46, 2.19), p<0.001
Trekking/Trekking	65	1263	7104	0.91	0 - 1Yr: HR=2.29 (1.59, 3.29), p<0.001
					1Yr - 3Yr: HR=0.96 (0.60, 1.55), p=0.867
					3Yr+: HR=1.39 (0.89, 2.19), p=0.147
Vanguard PS/Vanguard	334	5347	40187	0.83	0 - 1.5Yr: HR=1.94 (1.66, 2.28), p<0.001
					1.5Yr+: HR=1.31 (1.13, 1.52), p<0.001
**Legion Revision Tibial Baseplate	63	1017	4738	1.33	0 - 6Mth: HR=4.73 (3.26, 6.86), p<0.001
					6Mth - 1.5Yr: HR=0.88 (0.44, 1.76), p=0.719
					1.5Yr+: HR=1.53 (1.05, 2.23), p=0.027
Identified and No Longer Used					
ACS/ACS Mobile PC (cless)	30	131	905	3.31	Entire Period: HR=5.70 (3.99, 8.16), p<0.001

Femoral/Tibial	N Revised	N Total	Obs. Years	Revisions/ 100 Obs. Yrs	Hazard Ratio, P Value
AMK/AMK	26	203	2517	1.03	Entire Period: HR=2.35 (1.60, 3.45), p<0.001
Buechel-Pappas/Buechel-Pappas	53	479	5018	1.06	Entire Period: HR=2.10 (1.60, 2.74), p<0.001
Eska RP/Eska RP	9	40	371	2.43	Entire Period: HR=5.40 (2.82, 10.33), p<0.001
Evolis (cless)/Evolis (cless)	10	87	787	1.27	Entire Period: HR=2.34 (1.26, 4.34), p=0.006
Gemini MK II/Gemini MK II	8	21	217	3.69	Entire Period: HR=7.30 (3.65, 14.60), p<0.001
Genesis (ctd)/Genesis (ctd)	11	62	696	1.58	Entire Period: HR=3.70 (2.05, 6.67), p<0.001
Genesis II CR (cless)/Profix Mobile (ctd)	36	241	2870	1.25	Entire Period: HR=2.81 (2.02, 3.89), p<0.001
Genesis II Oxinium CR (cless)/Genesis II	47	110	1000	4.70	0 - 1.5Yr: HR=13.78 (9.24, 20.55), p<0.001
	.	.	.	.	1.5Yr - 2.5Yr: HR=24.02 (14.47, 39.88), p<0.001
	.	.	.	.	2.5Yr+: HR=2.66 (1.33, 5.31), p=0.005
Genesis II Oxinium CR (cless)/Profix Mobile	57	88	624	9.13	0 - 6Mth: HR=7.24 (2.72, 19.30), p<0.001
	.	.	.	.	6Mth - 9Mth: HR=52.36 (28.94, 94.75), p<0.001
	.	.	.	.	9Mth - 1.5Yr: HR=38.15 (24.85, 58.57), p<0.001
	.	.	.	.	1.5Yr - 2Yr: HR=31.53 (15.02, 66.22), p<0.001
	.	.	.	.	2Yr+: HR=6.69 (3.96, 11.30), p<0.001
Genesis II Oxinium PS (ctd)/Genesis II (cless)	17	56	467	3.64	0 - 1Yr: HR=17.01 (9.41, 30.72), p<0.001
	.	.	.	.	1Yr - 1.5Yr: HR=7.37 (1.84, 29.50), p=0.004
	.	.	.	.	1.5Yr+: HR=2.22 (0.83, 5.91), p=0.111
Genesis II Oxinium PS (ctd)/Genesis II (keel)	69	269	2924	2.36	Entire Period: HR=4.84 (3.82, 6.13), p<0.001
HLS Noetos/HLS Noetos	42	294	2923	1.44	Entire Period: HR=2.88 (2.13, 3.90), p<0.001
IB II/IB II	39	199	2568	1.52	0 - 2Yr: HR=0.89 (0.29, 2.75), p=0.834
	.	.	.	.	2Yr - 2.5Yr: HR=5.21 (1.68, 16.13), p=0.004
	.	.	.	.	2.5Yr+: HR=5.26 (3.74, 7.41), p<0.001
Interax/Interax	11	52	522	2.11	0 - 3Yr: HR=0.86 (0.12, 6.12), p=0.881
	.	.	.	.	3Yr+: HR=9.01 (4.84, 16.75), p<0.001
Journey Oxinium/Journey	362	3033	30214	1.20	0 - 3Mth: HR=0.27 (0.09, 0.85), p=0.025
	.	.	.	.	3Mth - 1.5Yr: HR=2.17 (1.74, 2.72), p<0.001
	.	.	.	.	1.5Yr - 2Yr: HR=1.76 (1.14, 2.70), p=0.010
	.	.	.	.	2Yr - 2.5Yr: HR=2.31 (1.53, 3.48), p<0.001
	.	.	.	.	2.5Yr - 3Yr: HR=1.56 (0.89, 2.76), p=0.123
	.	.	.	.	3Yr+: HR=3.00 (2.63, 3.42), p<0.001
Maxim (cless)/Vanguard (ctd)	69	413	5330	1.29	0 - 2Yr: HR=1.51 (0.86, 2.66), p=0.152
	.	.	.	.	2Yr - 3Yr: HR=1.25 (0.40, 3.87), p=0.700
	.	.	.	.	3Yr - 4.5Yr: HR=3.40 (1.70, 6.81), p<0.001
	.	.	.	.	4.5Yr - 6Yr: HR=1.09 (0.27, 4.35), p=0.907
	.	.	.	.	6Yr - 9.5Yr: HR=2.19 (1.09, 4.38), p=0.026
	.	.	.	.	9.5Yr+: HR=5.06 (3.64, 7.04), p<0.001
Optetrak-CR (ctd)/Optetrak (ctd)	11	92	858	1.28	Entire Period: HR=2.76 (1.53, 4.97), p<0.001
Optetrak-PS/Optetrak	297	2410	25418	1.17	0 - 1Mth: HR=0.23 (0.03, 1.65), p=0.144
	.	.	.	.	1Mth - 1.5Yr: HR=1.79 (1.38, 2.33), p<0.001
	.	.	.	.	1.5Yr+: HR=2.76 (2.43, 3.14), p<0.001
Optetrak-PS/Optetrak RBK	94	1127	9709	0.97	Entire Period: HR=1.92 (1.57, 2.35), p<0.001
Optetrak-PS/Optetrak-PS	14	55	546	2.56	Entire Period: HR=5.77 (3.42, 9.74), p<0.001
PFC Sigma PS (ctd)/MBT (cless)	25	316	2717	0.92	Entire Period: HR=1.65 (1.11, 2.44), p=0.012
Profix Oxinium (cless)/Profix	33	75	724	4.56	0 - 9Mth: HR=5.96 (2.24, 15.87), p<0.001
	.	.	.	.	9Mth - 2Yr: HR=26.47 (17.25, 40.62), p<0.001
	.	.	.	.	2Yr+: HR=3.31 (1.66, 6.62), p<0.001

Femoral/Tibial	N Revised	N Total	Obs. Years	Revisions/ 100 Obs. Yrs	Hazard Ratio, P Value
Profix Oxinium (cless)/Profix Mobile	71	158	1362	5.21	0 - 9Mth: HR=3.14 (1.18, 8.35), p=0.021
	.	.	.	.	9Mth - 1.5Yr: HR=26.24 (18.22, 37.80), p<0.001
	.	.	.	.	1.5Yr - 2Yr: HR=17.97 (9.34, 34.58), p<0.001
	.	.	.	.	2Yr - 2.5Yr: HR=37.24 (22.09, 62.77), p<0.001
	.	.	.	.	2.5Yr - 3Yr: HR=23.26 (10.43, 51.87), p<0.001
	.	.	.	.	3Yr+: HR=2.56 (1.33, 4.93), p=0.004
Profix Oxinium (ctd)/Profix (cless)	14	100	1246	1.12	Entire Period: HR=2.07 (1.23, 3.49), p=0.006
Profix Oxinium (ctd)/Profix Mobile	29	228	3096	0.94	Entire Period: HR=1.78 (1.24, 2.57), p=0.001
Profix/Profix Mobile	114	1005	12504	0.91	0 - 2.5Yr: HR=2.83 (2.20, 3.64), p<0.001
	.	.	.	.	2.5Yr+: HR=1.45 (1.11, 1.90), p=0.007
Rotaglide Plus/Rotaglide Plus	83	631	7743	1.07	0 - 1.5Yr: HR=1.30 (0.74, 2.29), p=0.360
	.	.	.	.	1.5Yr - 2Yr: HR=3.43 (1.71, 6.85), p<0.001
	.	.	.	.	2Yr+: HR=2.59 (2.02, 3.32), p<0.001
SAL/SAL	15	56	740	2.03	0 - 8.5Yr: HR=1.62 (0.61, 4.32), p=0.333
	.	.	.	.	8.5Yr+: HR=10.51 (5.81, 19.01), p<0.001
Scorpio NRG PS (cless)/Series 7000 (cless)	84	1172	10491	0.80	Entire Period: HR=1.35 (1.09, 1.67), p=0.006
TC-Plus (cless)/TC-Plus (ctd)	8	63	702	1.14	Entire Period: HR=2.64 (1.32, 5.26), p=0.005
Trac/Trac	27	138	1670	1.62	Entire Period: HR=3.38 (2.32, 4.92), p<0.001
Vanguard PS/Regenerex	38	465	3202	1.19	0 - 1.5Yr: HR=2.43 (1.53, 3.85), p<0.001
	.	.	.	.	1.5Yr - 2Yr: HR=2.61 (1.09, 6.28), p=0.032
	.	.	.	.	2Yr+: HR=1.51 (0.91, 2.51), p=0.108
*LCS Duofix	664	4866	53539	1.24	Entire Period: HR=2.58 (2.39, 2.79), p<0.001
*LCS PS	70	638	5721	1.22	Entire Period: HR=2.48 (1.97, 3.14), p<0.001
*Renasys	18	121	1453	1.24	Entire Period: HR=2.71 (1.71, 4.30), p<0.001

Note: Components have been compared to all other 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					
*Legion Oxinium FS	4.8 (3.1, 7.3)	7.1 (5.0, 10.2)	8.7 (6.2, 12.2)	11.3 (8.0, 15.7)	
Re-Identified and Still Used					
ACS (cless)/ACS Fixed	1.4 (1.0, 2.0)	4.0 (3.3, 4.9)	4.9 (4.1, 5.9)		
Active Knee (cless)/Active Knee	1.1 (0.9, 1.4)	3.6 (3.2, 4.0)	5.0 (4.6, 5.6)	8.8 (8.2, 9.6)	
Advance/Advance	2.0 (1.3, 3.1)	5.5 (4.2, 7.1)	6.4 (5.0, 8.2)	8.1 (6.4, 10.2)	
Apex Knee CR (cless)/Apex Knee (cless)	2.4 (1.3, 4.3)	5.4 (3.6, 7.9)	5.6 (3.8, 8.2)		
Columbus/Columbus	1.2 (0.9, 1.5)	3.3 (2.8, 4.0)	4.4 (3.7, 5.3)	7.3 (6.0, 8.8)	
E.Motion/E.Motion	2.5 (1.7, 3.7)	5.7 (4.4, 7.3)	6.5 (5.1, 8.3)	7.3 (5.7, 9.2)	
Nexgen LPS Flex (cless)/Nexgen	2.4 (1.9, 3.2)	4.4 (3.6, 5.4)	5.0 (4.2, 6.1)	6.9 (5.1, 9.2)	
Score (cless)/Score (cless)	1.6 (1.2, 2.1)	5.0 (4.2, 6.0)	6.9 (5.9, 8.0)	11.1 (9.7, 12.8)	
Score (cless)/Score (ctd)	1.5 (1.0, 2.2)	3.9 (3.0, 5.0)	6.2 (5.0, 7.6)		
Trekking/Trekking	2.3 (1.6, 3.3)	3.8 (2.8, 5.0)	4.9 (3.7, 6.3)	6.5 (5.0, 8.5)	
Vanguard PS/Vanguard	1.9 (1.5, 2.3)	4.3 (3.8, 4.9)	5.3 (4.7, 5.9)	7.4 (6.7, 8.3)	
**Legion Revision Tibial Baseplate	3.3 (2.3, 4.6)	5.2 (3.9, 6.9)	6.3 (4.8, 8.3)	9.9 (7.5, 13.0)	
Identified and No Longer Used					
ACS/ACS Mobile PC (cless)	7.7 (4.2, 13.8)	19.3 (13.5, 27.2)	20.1 (14.2, 28.2)		
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 (cless)/Evolis (cless)	2.3 (0.6, 8.9)	8.0 (3.9, 16.1)	10.3 (5.5, 18.9)	11.5 (6.4, 20.4)	
Gemini MK II/Gemini MK II	9.5 (2.5, 33.0)	14.3 (4.8, 38.0)	23.8 (10.7, 48.1)	23.8 (10.7, 48.1)	
Genesis (ctd)/Genesis (ctd)	0.0 (0.0, 0.0)	6.7 (2.6, 16.8)	10.0 (4.6, 20.9)	16.1 (8.6, 28.9)	
Genesis II CR (cless)/Profix Mobile (ctd)	2.9 (1.4, 6.1)	7.7 (4.9, 11.9)	9.4 (6.3, 14.0)	14.5 (10.4, 19.9)	
Genesis II Oxinium CR (cless)/Genesis II	11.8 (7.0, 19.5)	38.9 (30.4, 48.7)	39.8 (31.3, 49.7)	42.8 (34.0, 52.7)	
Genesis II Oxinium CR (cless)/Profix Mobile	24.0 (16.3, 34.4)	52.8 (42.8, 63.5)	57.4 (47.4, 67.9)	61.1 (51.0, 71.3)	
Genesis II Oxinium PS (ctd)/Genesis II (cless)	19.6 (11.4, 32.7)	26.8 (17.1, 40.4)	30.4 (20.1, 44.2)	30.4 (20.1, 44.2)	
Genesis II Oxinium PS (ctd)/Genesis II (keel)	4.5 (2.6, 7.7)	14.9 (11.1, 19.7)	19.0 (14.8, 24.3)	22.6 (18.0, 28.2)	
HLS Noetos/HLS Noetos	3.4 (1.8, 6.2)	8.6 (5.9, 12.4)	10.7 (7.7, 14.9)	13.5 (10.0, 18.1)	
IB II/IB II	0.0 (0.0, 0.0)	3.5 (1.7, 7.3)	7.8 (4.8, 12.6)	15.8 (11.3, 22.0)	
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)	11.0 (9.9, 12.2)	
Maxim (cless)/Vanguard (ctd)	1.2 (0.5, 2.9)	3.7 (2.2, 6.0)	6.0 (4.0, 8.8)	9.4 (6.9, 12.8)	
Optetrak-CR (ctd)/Optetrak (ctd)	0.0 (0.0, 0.0)	6.6 (3.0, 14.0)	10.1 (5.4, 18.5)	11.4 (6.3, 20.2)	
Optetrak-PS/Optetrak	1.5 (1.1, 2.0)	4.8 (4.0, 5.7)	6.4 (5.4, 7.4)	11.7 (10.4, 13.1)	
Optetrak-PS/Optetrak RBK	1.8 (1.2, 2.7)	4.6 (3.5, 6.0)	5.9 (4.6, 7.5)	8.5 (6.8, 10.5)	
Optetrak-PS/Optetrak-PS	1.8 (0.3, 12.2)	16.4 (8.9, 29.1)	20.0 (11.6, 33.3)	24.4 (14.9, 38.5)	
PFC Sigma PS (ctd)/MBT (cless)	2.2 (1.1, 4.6)	5.4 (3.4, 8.6)	7.1 (4.7, 10.5)	7.4 (5.0, 11.0)	
Profix Oxinium (cless)/Profix	13.3 (7.4, 23.4)	36.1 (26.4, 48.1)	37.5 (27.6, 49.5)	42.0 (31.7, 54.2)	
Profix Oxinium (cless)/Profix Mobile	9.0 (5.4, 14.6)	40.2 (32.9, 48.3)	41.5 (34.2, 49.7)	46.0 (38.4, 54.3)	
Profix Oxinium (ctd)/Profix (cless)	4.0 (1.5, 10.3)	8.0 (4.1, 15.4)	9.0 (4.8, 16.6)	11.2 (6.4, 19.4)	
Profix Oxinium (ctd)/Profix Mobile	2.2 (0.9, 5.2)	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)	
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)	
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)	40.0 (24.7, 60.1)
Scorpio NRG PS (cless)/Series 7000 (cless)	1.2 (0.7, 2.0)	4.9 (3.8, 6.3)	6.1 (4.9, 7.7)	7.4 (6.0, 9.2)	

CPR	1 Yr	3 Yrs	5 Yrs	10 Yrs	20 Yrs
TC-Plus (cless)/TC-Plus (ctd)	1.6 (0.2, 10.7)	8.4 (3.6, 19.1)	8.4 (3.6, 19.1)	14.4 (7.4, 26.9)	
Trac/Trac	2.2 (0.7, 6.6)	5.9 (3.0, 11.4)	9.0 (5.2, 15.2)	15.1 (9.9, 22.7)	
Vanguard PS/Regenerex	3.2 (2.0, 5.3)	7.1 (5.1, 9.9)	7.4 (5.3, 10.2)	8.9 (6.4, 12.4)	
*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)	11.6 (9.2, 14.5)	
*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	≤2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Newly Identified	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
*Legion Oxinium FS	.	7	22	19	28	28	24	31	30	18	23	25	24	37	30	37	52
Re-Identified and Still Used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
ACS (cless)/ACS Fixed	.	.	.	.	.	.	41	119	283	337	331	238	266	259	319	209	168
Active Knee (cless)/Active Knee	2317	466	510	483	412	479	601	500	427	319	336	176	91	35	21	24	17
Advance/Advance	73	16	2	5	43	115	138	74	7	92	92	100	90	69	58	17	13
Apex Knee CR (cless)/Apex Knee (cless)	.	.	.	.	.	.	.	69	83	118	78	11	3	29	53	6	21
Columbus/Columbus	49	91	90	148	156	134	136	108	69	36	60	118	358	670	828	1111	1089
E.Motion/E.Motion	.	.	.	.	12	87	114	129	171	71	93	87	101	64	45	11	13
Nexgen LPS Flex (cless)/Nexgen	.	.	.	.	.	73	78	149	312	238	280	225	252	221	188	82	12
Score (cless)/Score (cless)	1	.	11	135	212	187	204	196	238	273	263	170	160	214	151	252	340
Score (cless)/Score (ctd)	3	.	3	3	3	.	5	15	90	181	324	300	267	122	205	114	44
Trekking/Trekking	.	.	.	.	.	35	102	133	107	108	106	129	216	143	99	65	20
Vanguard PS/Vanguard	22	81	145	321	430	478	607	561	451	523	445	331	310	205	186	136	115
**Legion Revision Tibial Baseplate	.	16	33	48	40	56	47	63	54	47	38	50	50	87	93	129	166
Identified and No Longer Used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
ACS/ACS Mobile PC (cless)	.	.	.	.	.	.	20	37	57	17	.	.	.	.	.	.	.
AMK/AMK	203	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Buechel-Pappas/Buechel-Pappas	1	39	51	84	100	148	44	4	.	7	1	.	.	.	.	.	.
Eska RP/Eska RP	9	24	5	.	2	.	.	.	.	.	.	.	.	.	.	.	.
Evolis (cless)/Evolis (cless)	.	.	.	17	5	11	9	20	7	11	7	.	.	.	.	.	.
Gemini MK II/Gemini MK II	21	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Genesis (ctd)/Genesis (ctd)	62	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Genesis II CR (cless)/Profix Mobile (ctd)	166	2	5	12	6	9	17	2	22	.	.	.	.	.	.	.	.
Genesis II Oxinium CR (cless)/Genesis II	110	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Genesis II Oxinium CR (cless)/Profix Mobile	88	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Genesis II Oxinium PS (ctd)/Genesis II (cless)	.	.	4	4	11	35	1	1	.	.	.	.	.	.	.	.	.
Genesis II Oxinium PS (ctd)/Genesis II (keel)	19	123	127	.	.	.	.	.	.	.	.	.	.	.	.	.	.
HLS Noetos/HLS Noetos	4	47	45	45	56	48	28	20	1	.	.	.	.	.	.	.	.
IB II/IB II	199	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Interax/Interax	52	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Journey Oxinium/Journey	.	134	337	541	555	464	334	343	325	.	.	.	.	.	.	.	.
Maxim (cless)/Vanguard (ctd)	350	23	30	10	.	.	.	.	.	.	.	.	.	.	.	.	.
Optetrak-CR (ctd)/Optetrak (ctd)	22	9	7	7	4	.	5	6	8	24	.	.	.	.	.	.	.
Optetrak-PS/Optetrak	663	253	216	168	202	198	202	200	151	115	30	3	5	3	1	.	.
Optetrak-PS/Optetrak RBK	1	81	173	166	119	82	40	37	50	100	56	46	88	75	13	.	.
Optetrak-PS/Optetrak-PS	22	18	15	.	.	.	.	.	.	.	.	.	.	.	.	.	.
PFC Sigma PS (ctd)/MBT (cless)	47	2	.	.	.	.	25	89	110	42	.	1	.	.	.	.	.
Profix Oxinium (cless)/Profix	75	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Profix Oxinium (cless)/Profix Mobile	158	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Profix Oxinium (ctd)/Profix (cless)	56	15	8	10	8	2	.	1	.	.	.	.	.	.	.	.	.
Profix Oxinium (ctd)/Profix Mobile	218	3	4	1	2	.	.	.	.	.	.	.	.	.	.	.	.

Year of Implant	≤2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Profix/Profix Mobile	873	51	56	11	12	2	.	.	.	.	.	.	.	.	.	.	.
Rotaglide Plus/Rotaglide Plus	543	43	30	15	.	.	.	.	.	.	.	.	.	.	.	.	.
SAL/SAL	56	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Scorpio NRG PS (cless)/Series 7000 (cless)	.	.	76	185	171	166	114	67	71	76	72	77	69	28	.	.	.
TC-Plus (cless)/TC-Plus (ctd)	55	5	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	51	53	3	14	.	.	.	.	.	.	.	.	.	.	.	.	.

Note: *Femoral Component
**Tibial Component

Figure IP5 Cumulative Percent Revision of Newly Identified Total Knee Prostheses

Newly Identified

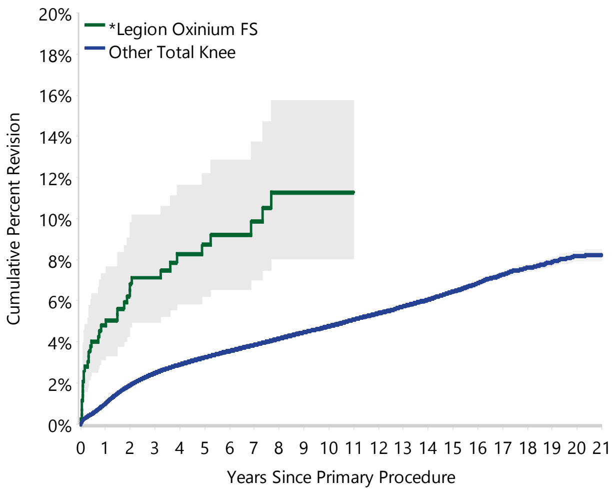
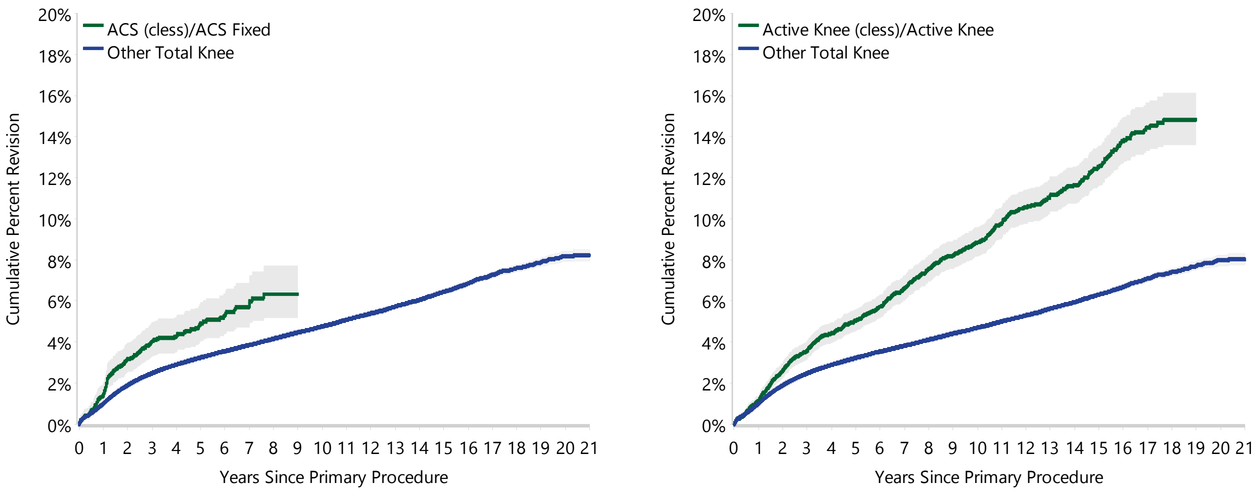
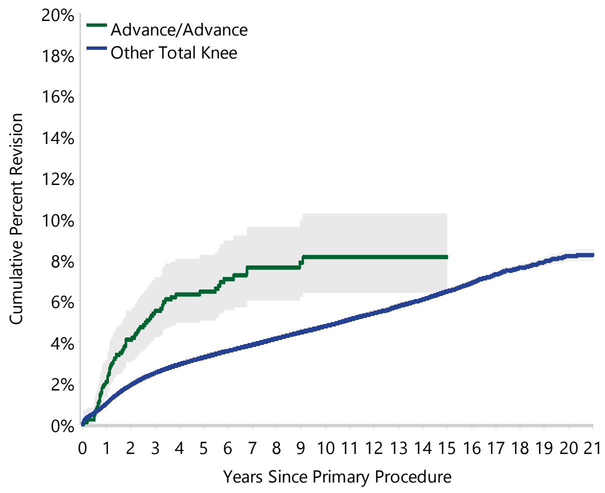
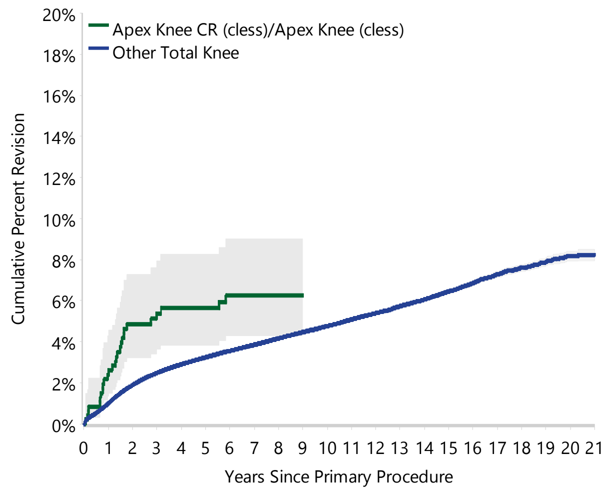


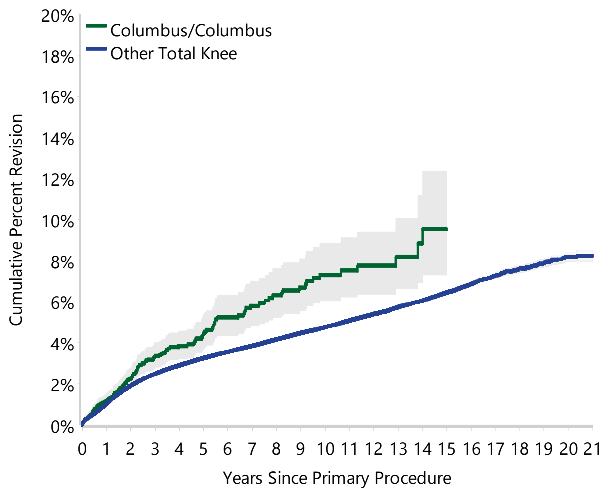
Figure IP6 Cumulative Percent Revision of Re-Identified and Still Used Total Knee Prostheses

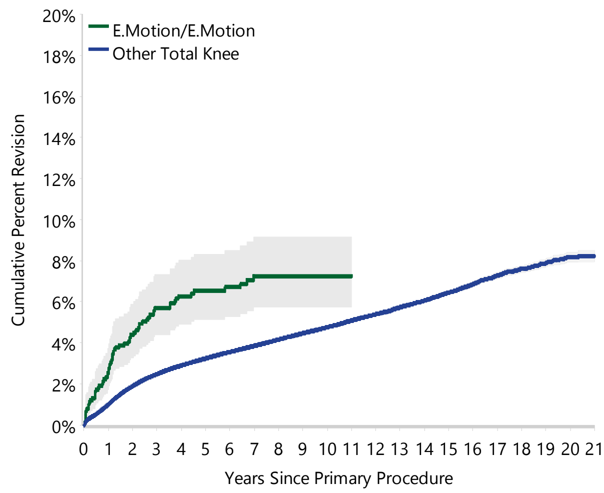
Re-Identified and Still Used

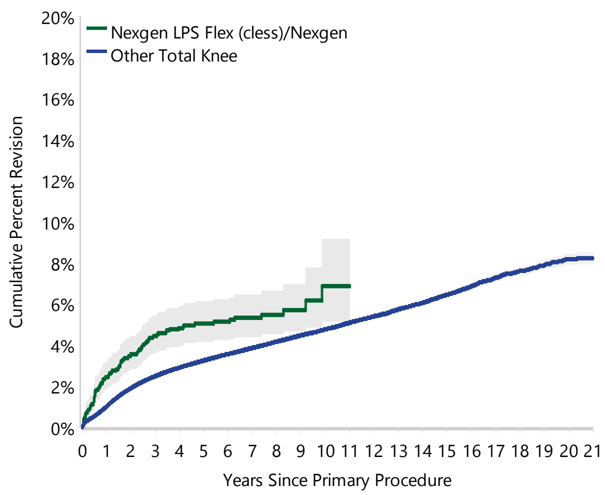


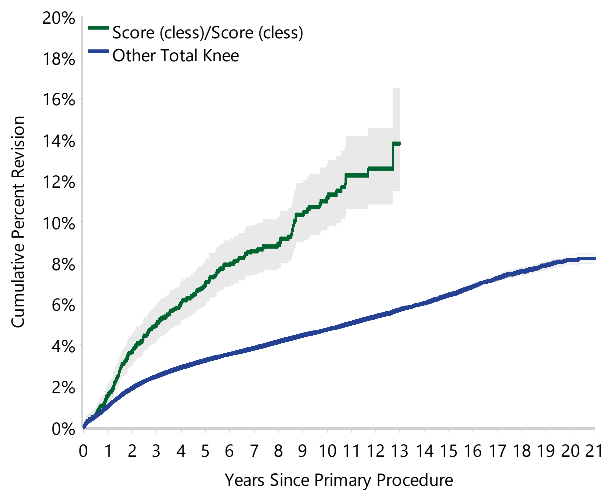

Advance/Advance
Other Total Knee
Cumulative Percent Revision
0% 2% 4% 6% 8% 10% 12% 14% 16% 18% 20%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
Years Since Primary Procedure

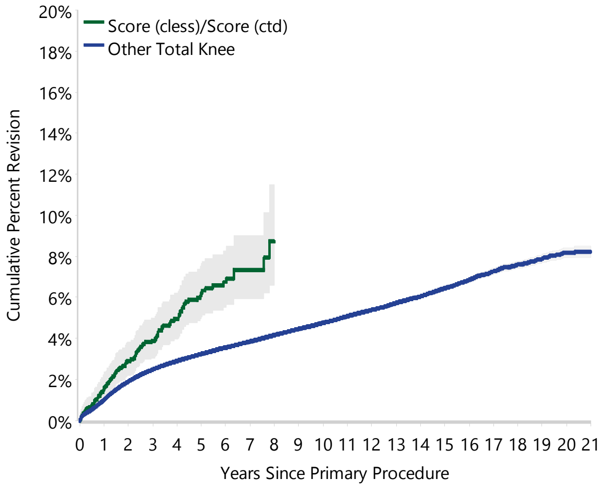

Apex Knee CR (cless)/Apex Knee (cless)
Other Total Knee
Cumulative Percent Revision
0% 2% 4% 6% 8% 10% 12% 14% 16% 18% 20%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
Years Since Primary Procedure

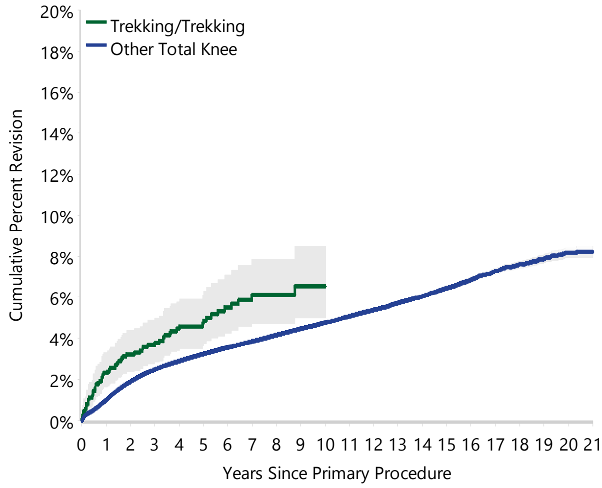

Columbus/Columbus
Other Total Knee
Cumulative Percent Revision
0% 2% 4% 6% 8% 10% 12% 14% 16% 18% 20%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
Years Since Primary Procedure

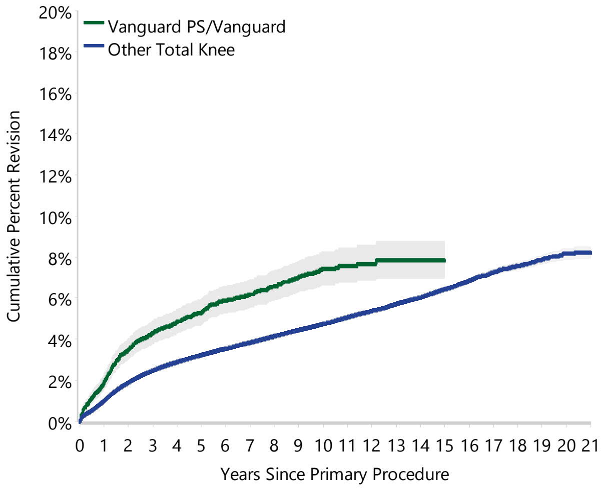

E.Motion/E.Motion
Other Total Knee
Cumulative Percent Revision
0% 2% 4% 6% 8% 10% 12% 14% 16% 18% 20%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
Years Since Primary Procedure

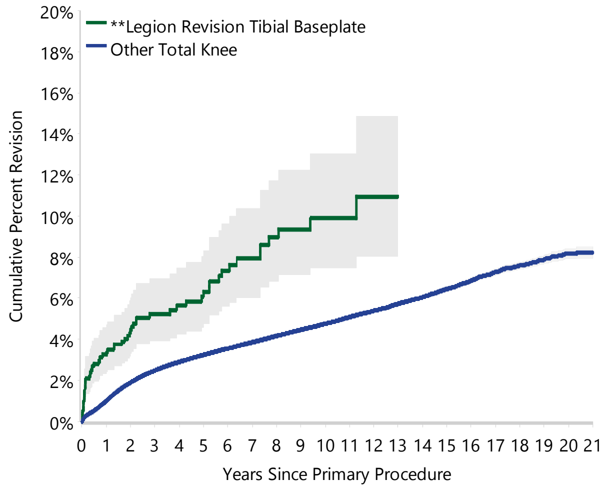

Nexgen LPS Flex (cless)/Nexgen
Other Total Knee
Cumulative Percent Revision
0% 2% 4% 6% 8% 10% 12% 14% 16% 18% 20%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
Years Since Primary Procedure


Score (cless)/Score (cless)
Other Total Knee
Cumulative Percent Revision
0% 2% 4% 6% 8% 10% 12% 14% 16% 18% 20%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
Years Since Primary Procedure


Score (cless)/Score (ctd)
Other Total Knee
Cumulative Percent Revision
0% 2% 4% 6% 8% 10% 12% 14% 16% 18% 20%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
Years Since Primary Procedure


Trekking/Trekking
Other Total Knee
Cumulative Percent Revision
0% 2% 4% 6% 8% 10% 12% 14% 16% 18% 20%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
Years Since Primary Procedure


Vanguard PS/Vanguard
Other Total Knee
Cumulative Percent Revision
0% 2% 4% 6% 8% 10% 12% 14% 16% 18% 20%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
Years Since Primary Procedure


**Legion Revision Tibial Baseplate
Other Total Knee
Cumulative Percent Revision
0% 2% 4% 6% 8% 10% 12% 14% 16% 18% 20%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
Years Since Primary Procedure

PRIMARY PARTIAL SHOULDER REPLACEMENT

HEMI STEMMED

There are no newly identified hemi stemmed shoulder prostheses.

Table IP22 Revision Rate of Hemi Stemmed 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	.	.	.	.	
Global Unite/Global Unite	36	206	966	3.73	Entire Period: HR=1.87 (1.33, 2.62), p<0.001
Identified and No Longer Used	.	.	.	.	
Delta Xtend/Delta Xtend	14	75	431	3.25	Entire Period: HR=2.36 (1.38, 4.01), p=0.001

Note: Components have been compared to all other hemi stemmed shoulder components

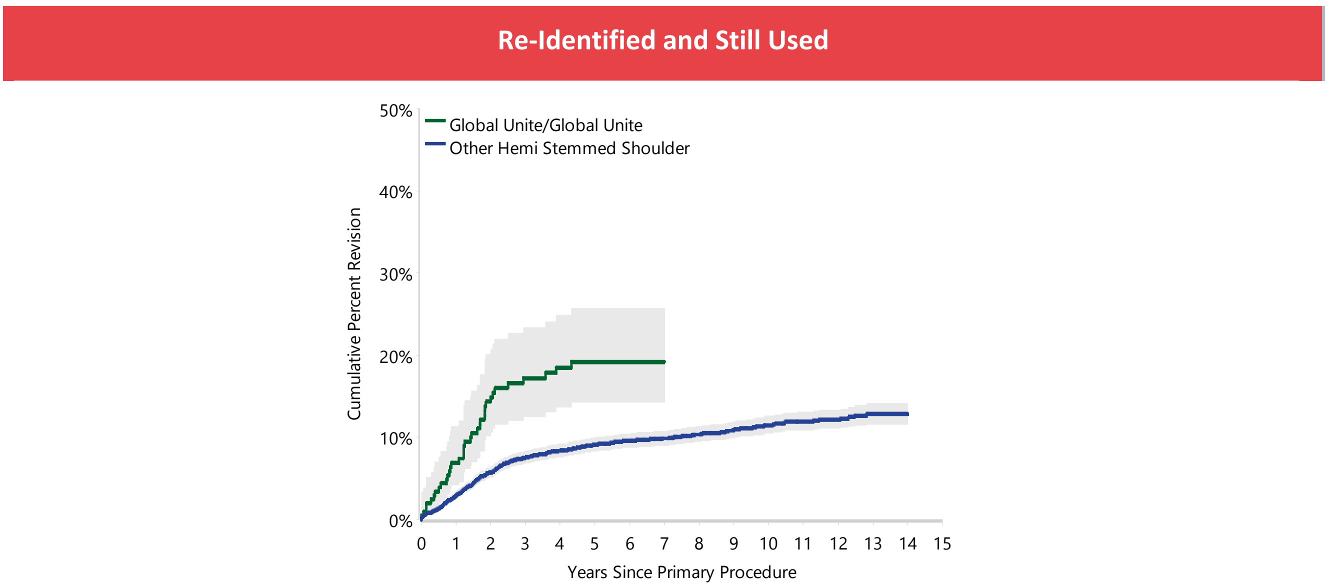
Table IP23 Cumulative Percent Revision of Hemi Stemmed Shoulder Prostheses Identified as Having a Higher than Anticipated Rate of Revision

CPR	1 Yr	3 Yrs	5 Yrs	7 Yrs	13 Yrs
Re-Identified and Still Used					
Global Unite/Global Unite	6.9 (4.1, 11.3)	17.2 (12.5, 23.4)	19.2 (14.2, 25.6)	19.2 (14.2, 25.6)	
Identified and No Longer Used					
Delta Xtend/Delta Xtend	6.7 (2.8, 15.4)	16.6 (9.8, 27.4)	16.6 (9.8, 27.4)	19.0 (11.3, 30.8)	

Table IP24 Yearly Usage of Hemi Stemmed 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
Re-Identified and Still Used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Global Unite/Global Unite	.	.	.	.	.	15	37	25	38	37	14	12	11	12	5
Identified and No Longer Used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Delta Xtend/Delta Xtend	2	5	9	9	5	10	7	6	5	4	3	6	3	1	.

Figure IP7 Cumulative Percent Revision of Re-Identified and Still Used Hemi Stemmed Shoulder Prostheses



PRIMARY TOTAL SHOULDER REPLACEMENT

TOTAL STEMMED

There are no newly identified total stemmed shoulder prostheses.

Table IP25 Revision Rate of Total Stemmed 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	388	2309	14786	2.62	Entire Period: HR=3.07 (2.64, 3.56), p<0.001
Identified and No Longer Used	.	.	.	.	
Comprehensive/Custom Made (Comprehensive)	6	18	42	14.1	Entire Period: HR=6.28 (2.80, 14.06), p<0.001
SMR/SMR L2	317	856	6116	5.18	Entire Period: HR=4.17 (3.65, 4.77), p<0.001
Univers 3D/Univers 3D	16	34	289	5.54	Entire Period: HR=4.56 (2.77, 7.50), p<0.001
Vaios/Vaios	19	36	204	9.32	Entire Period: HR=6.75 (4.28, 10.66), p<0.001

Note: Components have been compared to all other modern total stemmed shoulder components

Table IP26 Cumulative Percent Revision of Total Stemmed Shoulder Prostheses Identified as Having a Higher than Anticipated Rate of Revision

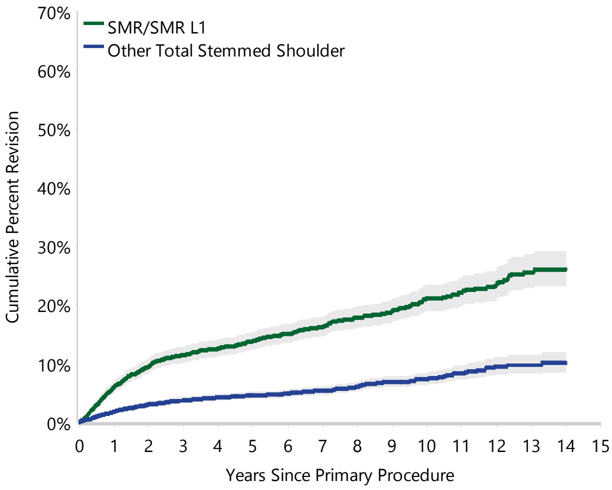
CPR	1 Yr	3 Yrs	5 Yrs	7 Yrs	13 Yrs
Re-Identified and Still Used					
SMR/SMR L1	6.0 (5.1, 7.0)	11.4 (10.2, 12.8)	13.8 (12.4, 15.4)	16.2 (14.6, 17.9)	25.6 (22.8, 28.6)
Identified and No Longer Used					
Comprehensive/Custom Made (Comprehensive)	16.7 (5.7, 43.2)	28.2 (12.8, 55.1)			
SMR/SMR L2	9.5 (7.7, 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 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
Re-Identified and Still Used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
SMR/SMR L1	135	237	247	.	.	157	301	255	242	195	172	128	98	72	70
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 IP8 Cumulative Percent Revision of Re-Identified and Still Used Total Stemmed Shoulder Prostheses

Re-Identified and Still Used



TOTAL REVERSE

There are no newly identified currently used total reverse shoulder prostheses.

The SMR/SMR Axioma combination is no longer identified as it no longer has a significantly higher rate of revision.

Table IP28 Revision Rate of Total Reverse Shoulder Prostheses Identified as Having a Higher than Anticipated Rate of Revision

Humeral Stem/Glenoid	N Revised	N Total	Obs. Years	Revisions/ 100 Obs. Yrs	Hazard Ratio, P Value
Re-Identified and Still Used	.	.	.	.	
SMR/SMR L1	378	8945	36685	1.03	0 - 3Mth: HR=1.57 (1.31, 1.88), p<0.001
	.	.	.	.	3Mth - 9Mth: HR=1.30 (0.99, 1.70), p=0.055
	.	.	.	.	9Mth+: HR=0.82 (0.68, 1.00), p=0.049

Note: Components have been compared to all other modern total reverse shoulder components

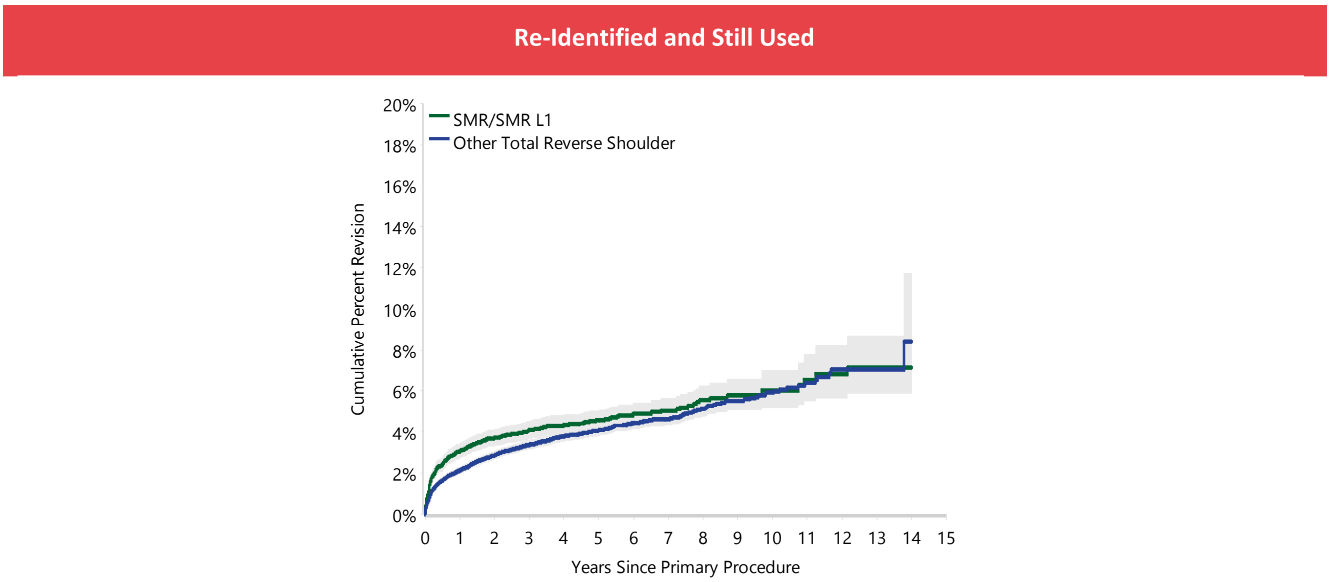
Table IP29 Cumulative Percent Revision of Total Reverse Shoulder Prostheses Identified as Having a Higher than Anticipated Rate of Revision

CPR	1 Yr	3 Yrs	5 Yrs	7 Yrs	13 Yrs
Re-Identified and Still Used					
SMR/SMR L1	3.0 (2.7, 3.4)	4.1 (3.7, 4.5)	4.6 (4.1, 5.1)	5.0 (4.5, 5.6)	7.1 (5.9, 8.7)

Table IP30 Yearly Usage of Total 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
Re-Identified and Still Used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
SMR/SMR L1	145	262	271	.	.	249	562	633	732	914	930	1045	1055	1007	1140

Figure IP9 Cumulative Percent Revision of Re-Identified and Still Used Total Reverse Shoulder Prostheses



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	11	49	324	3.40	Entire Period: HR=2.06 (1.13, 3.75), p=0.019

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)	22.3 (12.6, 37.8)	

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
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 & COORDINATORS

VICTORIA

PUBLIC HOSPITALS		PRIVATE HOSPITALS	
Austin Health	R Kentish/ B Murray	Ballarat Day Procedure Centre	Amy Ingram
Bairnsdale Regional Health Service	S Guns	Beleura Private Hospital	Jean Leyland
Ballarat Health Service	M Nicholson/ B Anderson	Bellbird Private Hospital	Belinda Van Denberg
Bass Coast Health	Fanella King	Cabrini Private Hospital, Brighton	T Colliver/ M Speak
Bendigo Health Care Group	S Sharp/ C Jensen	Cabrini Private Hospital, Malvern	T Colliver/ M Speak
Box Hill Hospital	L Bingham	Epping Private Hospital	J Jose
Broadmeadows Hospital	R Paul/ B Wilson	Epworth Eastern Hospital	Linda Dennehy
Central Gippsland Health	M Pusmucans/ J Hunt	Epworth Freemasons	Claudia Nozzolillo
Cohuna District Hospital	K Storm	Epworth Geelong	Natalie Cuttiford
Colac Area Health	A Tout	Epworth Richmond	Lynne Moyes
Dandenong Hospital	K Ferguson/ M Murray	Essendon Private Hospital	Elaine Jordan
East Grampians Health Service	J Sargent/ K Carr	Frankston Private Hospital	Naomi Larner
Echuca Regional Health	Heather Lias	Glenferrie Private Hospital	S Jones/ M Westley
Echuca Regional Health	Kerryn Giorgianni	Holmesglen Private Hospital	Nicole Groves
Footscray Hospital	Anna Dijak	John Fawkner Hospital	Belinda Emmett
Frankston Hospital	Donna Anderson	Knox Private Hospital	J Assauw/ E George/ H McCarty
Goulburn Valley Health	Andrea Stevens	Linacre Private Hospital	D Tyler/ M Dillon
Hamilton Base Hospital	Rosalie Broadfoot	Maryvale Private Hospital	F Van Dyke/ K Collier
Kyabram District Health Service	L Walker/ L Fleming	Masada Private Hospital	D MacKenzie/ S Howell
Latrobe Regional Hospital	Simone Lovison	Melbourne Private Hospital	Tracey Perkins
Maroondah Hospital	Georgia Whitemore	Mildura Private Hospital	Sue Malcolm
Mildura Base Hospital	Kaylene Mailes	Mitcham Private Hospital	J Lonthyil/ J Nankivell
Monash Medical Centre Clayton Campus	Jessica Cranston	Mulgrave Private Hospital	Anthony Puzon
Moorabbin Hospital	C Jackson/ L Mason	Northpark Private Hospital	Kath Morris
Northeast Health Wangaratta	Debbie Reidy	Peninsula Private Hospital	Kerri Jones
Portland Hospital	Michael Ashby	Ringwood Private Hospital	Carol Burns
Sandringham Hospital	L Scopel/ G Jack	Shepparton Private Hospital	Niki Miller
South West Health Care Warrnambool Campus	Tony Kelly	St John of God Ballarat Hospital	Gitty Mathachan
St Vincents Public Hospital	A Lynskey/ S Osman	St John of God Bendigo Hospital	Alanna Sheehan
Stawell Regional Health	S Campigli/ Cy Ellen	St John of God Berwick Hospital	Rebecca Jamieson
Sunshine Hospital	Anna Dijak	St John of God Geelong Hospital	Colin Hay
Swan Hill District Health	Donna Hartland	St John of God Warrnambool Hospital	G Wheaton /L McPherson
The Alfred	Megan Crofts	St Vincent's Private East Melbourne	Brandi Lyon
The Northern Hospital	Siew Perry	St Vincent's Private Fitzroy	D Dellevirgini/ N Carter
The Royal Children's Hospital	Sonia Mouat	St Vincent's Private Kew	J Miller/ H Xing
The Royal Melbourne Hospital	Abigail Ryburn	St Vincent's Private Werribee	D Sanchez/ C Ipio
University Hospital Geelong Barwon Health	D Barber/ M Quinn	The Avenue Hospital	Justine Walsh
West Gippsland Healthcare Group	B Norman/ S Backman	The Bays Hospital	S Burton/ L Kerr
West Wimmera Health Service	Michelle Borain	The Melbourne Eastern Private Hospital	Jay Phillpotts
Western Health Bacchus Marsh Hospital	C Clifford/ J Dehnert	Vermont Private Hospital	Dianne Cooper
Williamstown Hospital	A Chircop/ J Bonganay	Wangaratta Private Hospital	Janet McKie
Wimmera Health Care Group	A Ampt/ M Markby	Warringal Private Hospital	M Dey/ M Bhagat
		Waverley Private Hospital	Napoleon Dator
		Werribee Mercy Hospital	Jamil Anwar
		Western Private Hospital	Daniela Cringasu

NEW SOUTH WALES

PUBLIC HOSPITALS		PRIVATE HOSPITALS	
Albury Base Hospital	Laurel Rhodes	Albury Wodonga Private Hospital	Dom Mahaffey
Armidale Hospital	A Sutherland/ A Prater	Armidale Private Hospital	Katherine Latter
Auburn Health Service	Sarah Sisson	Baringa Private Hospital	K Henderson/ E Ford/ F Howson
Bankstown/Lidcombe Hospital	Karen Och	Bathurst Private Hospital	Diane Carter
Bathurst Base Hospital	Kylie Peers	Brisbane Waters Private Hospital	Adele Ryan
Belmont Hospital	J Jones/ J Osland	Calvary Health Care Riverina	Sarah Jones
Blacktown Hospital	June Tsang	Campbelltown Private Hospital	Sarah Clancy
Bowral and District Hospital	R Roberts/ B Allan	Delmar Private Hospital	Cathy Byrne
Broken Hill Health Service	Sue Beahl	Dubbo Private Hospital	K Troth/ S Cross
Campbelltown Hospital	Susan Birch	Dudley Private Hospital	Pam Fullgrabe
Canterbury Hospital	Jenny Cubitt	East Sydney Private Hospital	Thea Woodgate
Chris O'Brien Lifehouse	Shauna Harnedy	Forster Private Hospital	Deb Conway
Coffs Harbour Health Campus	Robbie Bentley	Gosford Private Hospital	Amy Maguire
Concord Repatriation Hospital	David Debello	Hawkesbury District Health Service	E Jones/ S Garden
Dubbo Base Hospital	Kathy Chapman	Holroyd Private Hospital	Mynard Brosas
Fairfield Hospital	Caroline Youkhana	Hunter Valley Private Hospital	Renae Pridue
Gosford Hospital	T Hoad/ K Brown/ M Farthing	Hurstville Private Hospital	Simelibuhle (Simmy) Masuku
Goulburn Base Hospital	L Phelan/ K Goode	Insight Clinic Private Hospital	Debbie van de Stadt
Grafton Base Hospital	Freya Hickey	Kareena Private Hospital	Anita Burazer
Hornsby Ku-Ring-Gai Hospital	J Colville/ B Chu	Kogarah Private Hospital	E Naidoo/ K Gardner
Institute of Rheumatology and Orthopaedic Surgery	Maria Hatziandreou	Lake Macquarie Private Hospital	Vanessa Jones
John Hunter Hospital	Felicia Bristow	Lakeview Private Hospital	Hailey MacAllister
Lismore Base Hospital	Glen Nettle	Lingard Private Hospital	A Dagg/ A Flaherty
Liverpool Health Service	John Murphy	Macquarie University Hospital	Julie Guthrie
Maitland Hospital	Katie Peattie	Maitland Private Hospital	J Chalmers/ M Mead
Manning Rural Referral Hospital	Grahame Cooke	Mayo Private Hospital	Hannah Evenden
Mount Druitt Hospital	Charmaine Boyd	Nepean Private Hospital	Jacintha Vimalraj
Murwillumbah District Hospital	Glenda Jacklin	Newcastle Private Hospital	D Fogarty/ J Kelly
Nepean Hospital	R Steward/ D Dobbs	North Shore Private Hospital	Ann Bloxham
Orange Health Service	Deb Campbell	Northern Beaches Hospital	Shermaine Maristela
Port Macquarie Base Hospital	J Atkins/ F Cheney	Norwest Private Hospital	R Shepherd/ J Woodward
Royal Newcastle Centre	Graham Cutler	Nowra Private Hospital	Leasha Kingston
Royal North Shore Hospital	Darren Krusi	Orange Private Hospital	Kristin Burton
Royal Prince Alfred Hospital	Jennifer Wilkie	Port Macquarie Private Hospital	Tresna Bell
Ryde Hospital	K Jones/ H Nowlan	Shellharbour Private Hospital	Mel Stevens
Shoalhaven District Memorial Hospital	Luke Royston	Southern Highlands Hospital	Lynne Byrne
South East Regional Hospital	Leanne Williams	St George Private Hospital	Susy Tanevska
St George Hospital	D Gray/ D Elliott	St George Private Hospital	Lee Mayo
St Vincents Public Hospital	M Ellis/ A Baker/ M Theresa Butler	St Lukes Care	Mynard Brosas
		St Vincent's Private Community Hospital Griffith	Margaret Blackman
Sutherland Hospital	Claire Kirgan		
Tamworth Base Hospital	Molly Lebrocq	St Vincents Private Hospital Darlinghurst	Hannah George
The Children's Hospital Westmead	Ariella Galstaun	St Vincents Private Hospital Lismore	Janelle Hospers
The Prince of Wales Hospital	Elena Katz	Strathfield Private Hospital	John Mati
Tweed Hospital	A Budd/ N Prestage	Sydney Adventist Private Hospital	Jill Parker
Wagga Wagga Base Hospital	A Meek/ M O'Reilly	Sydney Adventist Private Hospital	Melissa Ng
Westmead Public Hospital	Dee Martic	Sydney Private Hospital	Margaret Haughton
Wollongong Hospital	Carol Jackson	Sydney South West Private Hospital	Hong Tran
Wyong Hospital	M Randall/ T Clancy	Tamara Private Hospital	Kris Wall
		The Mater Hospital	Namor Guerrero

NEW SOUTH WALES continued

PUBLIC HOSPITALS		PRIVATE HOSPITALS	
		Toronto Private Hospital	Stephanie Keys
		Tuggerah Lakes Private Hospital	Jane Hanneghan
		Waratah Private Hospital	Kim Graham
		Warners Bay Private Hospital	Annette Harrison
		Westmead Private Hospital	Katarina Teren
		Wollongong Private Hospital	Kathy Jankulovski

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/ L Van Niekerk/ E Walker	Buderim Private Hospital	Phil Hall
Gold Coast Hospital, Robina Campus	A Brooks/ R Kapera	Caboolture Private Hospital	Rachel Condon
Gold Coast University Hospital	Karen Morton	Cairns Private Hospital	Louisa Smit
Hervey Bay Hospital	Sarah Dane Smith	Friendly Societys Hospital Bundaberg	K Smith/ M Alcorn
Ipswich Hospital	Jannah O'Sullivan	Gold Coast Private Hospital	Kathryn Schott
Logan Hospital	Janelle Lindsay	Greenslopes Private Hospital	K Williams/R Griffin
Mackay Base Hospital	Chantal Ruthenberg	Hervey Bay Surgical Centre	Michelle Pracy
Maryborough Hospital	Y Howlett/ D Carroll	Hillcrest Private Hospital, Rockhampton	Judy Hope
Mater Hospital Brisbane	A Roeun/ C Steains	John Flynn Hospital, Tugun	Lynda Wise
Nambour General Hospital	Renee Hutchison	Mater Private Hospital Brisbane	J Windsor/ M Baltais/ SPfeffer
Prince Charles Hospital	L Tuppin/ R Seddon	Mater Private Hospital Bundaberg	J Zillmann/ L Zunker/ M Mooney
Princess Alexandra Hospital	Jo-Anne DePlater	Mater Private Hospital Mackay	Hazel Douglas
Queen Elizabeth II Jubilee Hospital	Donna 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	R Kitchin/ G van Fleet	Mater Private Hospital Springfield	C James/ C Cullen
Redland Public Hospital	Sara Mackenzie	Mater Private Hospital Townsville	Joanne Humphreys
Rockhampton Base Hospital	Simone Platzke	Nambour Selangor Private Hospital	T Dempsey/ S Pfeiffer
Royal Brisbane and Women's Hospital	G McPhee/A Dowe/ B Ballantyne	Noosa Hospital	Judy Andersson
Sunshine Coast University Hospital	F Tognolini/ C Jones	North West Private Hospital	D Campbell/ T Auckland
Surgical, Treatment and Rehabilitation Service	Emily Daniels	Peninsula Private Hospital	Anne Moutrey
Toowoomba Hospital	F Chadwick/A Lostroh	Pindara Private Hospital	Esther Moire
		St Andrews Hospital, Toowoomba	Ashleigh Shannon
		St Andrews Private Hospital, Ipswich	Mel Grant
		St Andrews War Memorial Hospital, Spring Hill	Stephanie Flood
		St Stephen's Private Hospital	Karen McLaughlan
		St Vincent's Private Hospital Northside	D Ravn/L Shannon
		St Vincent's Private Hospital Toowoomba	Amanda Fitzgerald
		Sunnybank Private Hospital	Francina Robinston
		Sunshine Coast University Private Hospital	Tanya Prothero
		Wesley Hospital	K Patel/C Gregory
		Westside Private Hospital	Mark Esdale

WESTERN AUSTRALIA

PUBLIC HOSPITALS		PRIVATE HOSPITALS	
Albany Regional Hospital	Paula Karra	Bethesda Hospital	H Hanekom/ H Collis/ J Fitzroy
Armadale Health Service	E Griffiths/D Carkeek	Hollywood Private Hospital	Michelle Connor
Bunbury Regional Hospital	Anthea Amonini	Joondalup Health Campus	J Holmes/D Crowley
Busselton Health Campus	Gemma Moyes	Mount Hospital	M Gontran/M Huyser
Fiona Stanley Hospital	Jarrod Duncan	Peel Health Campus	Geraldine Keogh
Fremantle Hospital	Elsy Jiji	South Perth Hospital	Deb Waters
Geraldton Hospital	Vicki Richards	St John of God Bunbury Hospital	Tersia Steyn
Kalgoorlie Health Campus	Nicole Hintz	St John of God Geraldton Hospital	Kristie Hutton
Osborne Park Hospital	Jenny Misiewicz	St John of God Midland Hospital	Stuart Blinman
Rockingham General Hospital	Carol Beaney	St John of God Mt Lawley Hospital	Francisco Campos
Royal Perth Hospital	Leonie Daly	St John of God Murdoch Hospital	Christopher Sheen
Sir Charles Gairdner Hospital	A Burke/ T Lemmey	St John of God Subiaco Hospital	Philip Emrose
		Waikiki Private Hospital	Bill Muir

SOUTH AUSTRALIA

PUBLIC HOSPITALS		PRIVATE HOSPITALS	
Clare Hospital and Health Services	Melissa Bradley	Ashford Community Hospital	Lisa Kowalik
Flinders Medical Centre	J Platten/A Ware	Burnside War Memorial Hospital	Laura Johnson
Gawler Health Services	Tina Sayce	Calvary Adelaide Hospital	I Snowball/T Heinrich
Lyell McEwin Hospital	L Wills/L Chapman	Calvary Central Districts Hospital	Linda Keech
Modbury Public Hospital	Brenda Foster	Calvary North Adelaide Hospital	Elizabeth Rennison
Mount Barker District Soldiers Memorial Hospital	Emma Crowder	Glenelg Community Hospital	N Russell Higgins/V Lawrence/R English
Mount Gambier Hospital	Kylie Duncan	North Eastern Community Hospital	Laura Shaw
Murray Bridge Soldiers Memorial Hospital	Janine Colwell	Sportsmed SA	F Penning/ S Williams/ K Stapleton/ S Chong
Naracoorte Health Service	Trina Berry	St Andrews Private Hospital	C McAllister/ L White
Noarlunga Hospital	Kylie Thomson	Stirling District Hospital	L White / C McAllister
Port Augusta Hospital	P Williams/J Haynes	The Memorial Hospital	J Emery/J Ohlson
Port Lincoln Hospital	Christine Weber	Western Hospital	A Scheepers
Port Pirie Regional Health Service	Sarah Zanker		
Queen Elizabeth Hospital	Andrea Hunter		
Riverland General Hospital	Michiela 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	Margaret Betterman		

TASMANIA

PUBLIC HOSPITALS		PRIVATE HOSPITALS	
Launceston General Hospital	M Postmus/E Davidson	Calvary Health Care St Lukes	G Stratton/T Morice
North West Regional Hospital, Burnie Campus	B Kerr/R Dicker	Calvary Health Care, St Johns	Cate Farrell
Royal Hobart Hospital	S Kirkham/C Michelle	Calvary Hospital	E Hey/K Harrex/ B Stephensen/A Copping
		Hobart Private Hospital	Janine Dohnt
		North-West Private Hospital	Danielle Jenner

AUSTRALIAN CAPITAL TERRITORY

PUBLIC HOSPITALS		PRIVATE HOSPITALS	
The Canberra Hospital	H Boyd/T Schild	Calvary Bruce Private Hospital	Carlene Morris
Calvary Public Hospital	Jennifer Cain	Calvary John James Memorial Hospital	Samjith Sreesan
		Canberra Private Hospital	M Gower/S Phillips/M Rogina/L Tuohy
		The National Capital Private	R Barancewicz/G Palada/I Coronado

NORTHERN TERRITORY

PUBLIC HOSPITALS		PRIVATE HOSPITALS	
Alice Springs Hospital	Debra Mullan	Darwin Private Hospital	B Hinchcliffe/V Frewin
Royal Darwin Hospital	Wendy 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 Test (χ2) 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.

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

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 off 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 & CONFIDENTIALITY

The South Australian Health and Medical Research Institute (SAHMRI) undertakes data entry, validation and analysis and provides secure data storage.

The list of personnel with access to identified Registry information is as follows:

Director, Professor Stephen Graves
Deputy Director, Professor Richard de Steiger
Deputy Director, Mr Peter Lewis
Deputy Director, Professor Ian Harris
Assistant Deputy Director, Mr James Stoney
Registry Executive Manager, Ms Kathy Hill
Publications Manager, Dr Sophia Corfield
SAHMRI staff including the project manager, data managers, data assistants, statisticians, and programmers.

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 and for a further five years in August 2018. 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 numberof 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 relevantto your operation.

Your Involvement - *the information we need*

The information we require includes your name, date of birth, address, Medicare number, hospital identity number, the name of the hospital and the reason you are having a joint replacement or knee osteotomy. This information is necessary to accurately link you to the medical device inserted as well as linking any following joint surgery you may have, to your previous records. We will also record the day of the operation, which joint was operated on and the type of medical device used. No other personal information is recorded. Government Departments also provide information so that the Registry can check the accuracy of the data and update records to reflect if someone has died.

Information - *how we will keep your information confidential*

Your personal information is confidential and safety measures are in place to protect this information. Your personal information is protected by an Act of Parliament. This means you cannot be identified in any reports produced by the Registry. On occasion, your data may be linked to other government health datasets to further enhance the Registry's ability to improve patient outcomes. Your de-identified data may be used for other research projects and may be shared with national and international collaborators.

How we will collect the information

Although we are asking to record your operation details in the Registry you are not required to do anything. Your surgeon and/or theatre staff will complete the form that contains your personal details at the time of your operation and send it to us. The information will be entered into the secure Registry database which is stored in the South Australian Health & Medical Research Institute, Adelaide, South Australia.

Risks and Benefits - *to you*

There are no risks to you by having your details in the Registry. The Registry produces general reports on a variety of factors that influence the success of joint operations. The results of joint operations have greatly improved because of this information.

What to do if you don't want to be in the Registry

We understand that not everyone is comfortable about having his or her personal details documented in a registry. If you feel this way and do not want your details recorded, please contact the Manager on 1800 068 419 (freecall) as well as making your decision known to hospital staff. A decision on whether or not you wish to be involved in the Registry does not affect your treatment in any way. If you have any questions, concerns, or require further information on the National Joint Replacement Registry please do not hesitate to contact the Registry.

Concerns or complaints related to the data collection process may be directed to the AOANJRR on 1800 068 419 (freecall) or alternatively the Australian Government, Office of the Privacy Commissioner on 1300 363 992

APPENDIX 6 – IMPLEMENTATION TIMELINE

Implementation of National Joint Replacement Registry for Hip, Knee & 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

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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