Australian Orthopaedic Association National Joint Replacement Registry

AUSTRALIAN ORTHOPAEDIC ASSOCIATION

Hip, Knee & Shoulder Arthroplasty

ANNUAL REPORT 2020

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Australian Orthopaedic Association
National Joint Replacement Registry

2020 Annual Report

Hip, Knee & Shoulder Arthroplasty

September 1999 – December 2019

Preface

It is my great pleasure to present the Australian Orthopaedic Association National Joint Replacement Registry (AOANJRR) Annual Report for 2020. This important document reflects the Australian Orthopaedic Association's (AOA) commitment to ongoing improvement in orthopaedic care. A critically important prerequisite to achieve this is the provision of quality data that can be used to inform beneficial change. Encouraged by the membership, the AOA established the AOANJRR over 20 years ago for this very purpose. This is the Registry's 21st Annual Report.

The AOANJRR's core activity is the routine collection, analysis, and reporting of procedure data on the ever-increasing number of joint replacements undertaken each year in Australia. The Annual Report which currently has over 30,000 downloads per year provides an up-to-date overview of current practice and results. This information has changed practice and improved outcomes not only in Australia but also internationally.

Prior to its release, the report is always reviewed by an independent group of surgeons with expertise in arthroplasty surgery. Normally this is undertaken at an in-person conference held over several days. This year, because of COVID-19, the review was held virtually over two consecutive weekends. The process went well, and the new format enabled an increased number of surgeons to participate.

Each year, the AOANJRR continues to expand its activities and the last 12 months can rightfully be regarded as the busiest and most successful the Registry has experienced. The rate of publications in peer-reviewed journals continues to increase with a publication currently being accepted each one to two weeks. In addition to its core activities, the Registry has completed and reported on the PROMs Pilot Study as well as obtained funding from all governments (state, territory and Federal) to roll this program out nationally. The Registry has also expanded its data linkage activities with other registries and to federal administrative data sets. The Registry has also recently received permissions to link to state health department data sets which it will be progressing in the near future. It has continued to develop its clinical trials capacity and now is in the process of undertaking or finalising 10 clinical trials. The AOA partners with the South Australian Health and Medical Research Institute (SAHMRI) and the University of South Australia (UniSA) to manage and deliver the Registry outputs. None of this could have been achieved without their expertise and ongoing commitment and support.

It is important to acknowledge that this has not been an easy year. There were the widespread devastating bushfires in the Australian summer that caused extensive damage to property, the environment, destroyed livelihoods, and resulted in extensive loss of life. This was quickly followed by COVID-19 and the consequent tragic global pandemic that we are all still dealing with. Health systems have been under strain and the capacity to provide routine health care has been reduced. During this difficult time, AOANJRR staff and staff at SAHMRI and UniSA have continued to work tirelessly to maintain Registry activities and develop and implement improvement strategies.

I would like to take this opportunity to thank all those involved with the ongoing management of the Registry and the production of this report. The Staff, Director, and Deputy Directors are congratulated for the quality of work and for their dedication to the Registry and its outputs. The AOA is also very grateful for the continued support of the Commonwealth Government which not only provides funding for core activities through its legislated cost recovery program but also provides ongoing support and advice in many other ways. It is also important to acknowledge the many other stakeholders supporting the Registry including state and territory governments, the Therapeutic Goods Administration, and industry particularly orthopaedic manufacturers. Finally, as always, a special thank you to all the hospitals, hospital coordinators, surgeons, and patients for contributing their data and their continued ongoing support. Without this support, the work of the Registry would not be possible.

Andrew Ellis

Andrew Ellis

President of the Australian Orthopaedic Association

AOANJRR Data Snapshot 2019

1,603,846
Total number of joint replacement procedures reported in the Registry at the end of 2019

Joint Replacement Procedures Reported in 2019

51,163
Hips Reported

66,729
Knees Reported

7,735
Shoulders Reported

246
Ad Hoc Reports Produced in 2019

26
Journal Articles Published in 2019

1,374
CPD Certificates Produced in 2019

924
Individual Surgeon Reports

70
Conference Presentations

Accessing Data from the AOANJRR

Publicly available documents on the website:
- Annual Report
- Supplementary Reports
- Prothesis Investigations

http://aoanjrr.sahmri.com

Ad Hoc Reports by request

Annual individual surgeon reports via the surgeon portal

Stakeholder specific web portals

The online Automated Industry Report System (AIRS)

AOANJRR Update 2019

Patient Reported Outcome Measures (PROMs)

The AOANJRR has developed an automated platform for integrated data capture known as RAPID with dashboard facilities for the delivery of real-time data including trial recruitment, PROMs and outcome data.

The PROMs pilot is now completed and has shown that RAPID is a very effective data collection and reporting platform.

The final report of the pilot study is available on the AOANJRR website **https://aoanjrr.sahmri.com/proms-pilot-report**

RAPID

When patients are registered and consented in RAPID, 97.8% complete pre-op data entry and 79% complete data entry 6 months after their joint replacement surgery.

Registry Nested Clinical Trials (RNCTs)

The AOANJRR has designed and developed a clinical trials platform which has been purpose-built in parallel with, and complements, the PROMs and AOANJRR data linkage programs. By developing the clinical trials platform simultaneously with the PROMs program, the infrastructure has been established to undertake large, efficient, cost effective registry-nested trials within Australia.

Other Registries within the AOANJRR

The Knee Osteotomy Registry is currently being rolled out nationally and is now in 59 hospitals and 528 procedures have been collected.

Work to deliver a Temporomandibular Joint Registry (TMJ) across Australia and New Zealand is well underway.

Executive Summary

This summary provides a brief overview of some of the major findings from the 2020 Annual Report. The design and structure of the Annual Report are similar to last year. Previously reported analyses on the outcome of primary hip, knee and shoulder replacement have been updated and extended. The analysis was undertaken on 1,603,846 joint replacement procedures (694,730 hips, 849,329 knees, and 59,787 shoulders) reported to the AOANJRR up to the end of 2019. As with previous annual reports, a number of new topics have been selected for more detailed analysis. The outcomes of revision hip and knee replacement are the new topics included in this year's report.

As in previous years, in addition to the main report, the Registry is also publishing supplementary reports. These supplementary reports are listed in the introductory chapter and will be available on the AOANJRR website https://aoanjrr.sahmri.com/annual-reports-2020 from 1 October 2020. They include a Lay Summary of the main report,12 different reports on arthroplasty topics, as well as detailed analyses of all prostheses identified as having a higher than anticipated rate of revision.

Outcomes of Revision Hip and Knee Replacement

The Registry analysed the outcome of 1st revision procedures by assessing the rate of a 2nd (subsequent) revision and mortality. When a 1st revision hip replacement is undertaken, almost 20% of procedures undergo a 2nd revision within 10 years. ASA does not greatly impact the revision risk but increasing BMI is associated with an increased 2nd revision rate. The reason for the 1st revision also affects the subsequent risk of revision, with dislocation being associated with a higher rate of 2nd revision compared to other diagnoses. When revising for loosening, the use of cementless femoral fixation is associated with a lower risk of a 2nd revision. When revising for dislocation, the risk of a 2nd revision is reduced if a dual mobility prosthesis or a femoral head size of >32mm is used. Mortality following the 1st hip revision varies depending on the reason for revision. This is both in the short term (30 and 90 days) and the long term. Revision for fracture has the highest risk of mortality which is almost 5% at 90 days and over 50% at 10 years. The outcome of 1st hip revision surgery has improved with time.

The outcomes of the 1st revision of a resurfacing hip replacement were also assessed. There is a lower rate of 2nd revision compared to the 1st revision of conventional total hip in the first 1.5 years but after this time there is no difference. At 10 years, the risk of a 2nd revision of a resurfacing hip is just over 20%. Mortality is much lower following the 1st revision of a resurfacing hip compared to the 1st revision of a total conventional hip. This is most likely due to the much younger age and lower comorbidity of these patients.

When a 1st revision knee replacement is undertaken, just over 20% of procedures undergo a 2nd revision within 10 years. This is similar to the rate of 2nd revision of a total hip replacement. When a 1st revision knee replacement is undertaken, age and gender have a significant effect, with younger patients and males at higher risk of 2nd revision. Patients with an ASA score of 1 and patients in increasing BMI categories are associated with a higher risk of a 2nd revision. The reason for the 1st revision also affects the subsequent risk of revision, with arthrofibrosis and loosening having higher rates of 2nd revision. When revising for loosening, revising both the femoral and tibial components and using a stem extension is associated with a lower rate of 2nd revision. Mortality following the 1st knee revision varies depending on the reason for revision. This is both in the short term (30 and 90 days) and the long term. Revision for fracture has the highest risk of mortality and this is very similar to 1st hip revisions for fracture with just under 4% at 90 days and just under 50% at 10 years.

Ten and Fifteen Year Outcome Data

The Registry continues to highlight the 10 and 15 year cumulative percent revision of prosthesis combinations used in primary total hip and primary total knee replacement. These are important milestones to benchmark comparative prosthesis performance. In recent years, the AOANJRR has applied the benchmarking approach recommended by an International Working Group to identify those devices that have superior and non-inferior performance at 10 years. These benchmarks reflect proven long-term success. The approach used is explained and the prostheses achieving these benchmarks are highlighted. Of those hip and knee prostheses combinations with a sufficient number of procedures and follow-up, 16.2% of hip and 12.7% of knee prosthesis combinations achieved a 10 year superiority benchmark. Currently, there is insufficient follow-up to enable adequate comparative 10 year data to be reported for primary shoulder replacement but it is expected that the Registry will report this data for the first time next year.

Hip Replacement Data

In 2019, hip replacement increased by 1.9% compared to 2018. The revision burden in 2019 is 8.4% which is the same as 2018 and is the equal lowest burden reported by the Registry. The use of primary partial hip replacement, as a class of hip prostheses, continues to decline but within this group, the use of bipolar prostheses continues to increase. Partial hips are used principally for the management of fractured neck of femur. Cement fixation of the femoral component and the use of bipolar prostheses continues to be associated with the lowest rate of revision for the management of this diagnosis.

Primary total hip continues to increase in use. In recent years, the Registry has reported on the effect of ASA score, BMI, and operative approach. Updated information relevant to each of these factors is again provided. Revision rates increase with increasing ASA score and increasing BMI category. This is largely due to an increased rate of revision for infection. Overall, there is no difference in revision related to operative approach although there are differences in the types and reasons for revision. To reflect contemporary practice, analyses of the effect of prosthesis factors on the cumulative percent revision following primary total hip replacement are largely limited to procedures using modern bearings (XLPE with metal, ceramic or ceramicised metal heads and ceramic on ceramic bearings using mixed ceramic). These bearings have lower rates of revision particularly in the long-term compared to other previously used bearings and there remains little difference between these types of modern bearings.

Knee Replacement Data

In 2019, knee replacement increased by 1.3% and the revision burden was 8.0%. The small increase in proportional use of unicompartmental knee replacement reported in the two previous years has not continued in 2019. The impact of patient and prosthesis factors on the outcome of knee replacement surgery is similar to previous reports. There are higher revision rates in younger patients and males and there is increased risk of revision for infection associated with increasing ASA score and BMI. There is a reduced rate of revision when patella resurfacing and cement fixation, particularly of the tibial component, are used. With respect to bearing surface, the use of XLPE continues to increase. Its impact on the revision rate varies depending on the prosthesis but it is never detrimental and often associated with a reduced revision rate.

Shoulder Replacement Data

In 2019, shoulder replacement increased by 4.9%. The outcome of these procedures continues to improve with the revision burden declining from a peak of 10.9% in 2012 to its lowest level of 8.5% in 2019. Partial shoulder replacement is being used less often and in 2019 accounted for only 3.5% of all shoulder procedures. The two main types of shoulder replacement are reverse and total stemmed shoulder replacement. Reverse shoulder replacement continues to increase in use and in 2019 accounted for 80.4% of all total shoulder replacements. After 3 months, reverse shoulder replacement has a lower rate of revision compared to total stemmed shoulder replacement. The use of cement fixation of the glenoid component and XLPE in total stemmed shoulder replacement reduces the rate of revision to levels that are comparable to reverse shoulder replacement. The impact of increasing ASA score and BMI on shoulder replacement is not the same as for hip and knee replacement in that the difference in the outcome is not as great, and there is no evidence of increased revision for infection.

Prostheses with Higher than Anticipated Rates of Revision

Each year, the AOANJRR identifies prostheses with higher than anticipated rates of revision. This year, 4 new hip prostheses and prostheses combinations have been identified. There is also 1 new knee prosthesis identified. There are no new shoulder prostheses identified this year.

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 would also like to acknowledge 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. It is their contribution that allows ongoing improvements in arthroplasty outcomes to be achieved.

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Contents

Introduction

The 2020 Hip, Knee and Shoulder Arthroplasty Annual Report is based on the analysis of 1,603,846 (694,730 hip, 849,329 knee and 59,787 shoulder) primary and revision procedures recorded by the Registry, with a procedure date up to and including 31 December 2019. Shoulder arthroplasty has been included in this report with hip and knee arthroplasty since 2017.

In addition, there are 13 supplementary reports that complete the AOANJRR Annual Report for 2020:

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 No Longer Used
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 – 2018/2019
12. Partial Hip Arthroplasty
13. Partial Knee Arthroplasty

In addition to the 13 supplementary reports, investigations of prostheses with higher than anticipated rates of revision are published on https://aoanjrr.sahmri.com/annual-reports-2020

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

BACKGROUND

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 (Appendix 6).

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

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

PURPOSE

The purpose of the Registry is to define, improve and maintain the quality of care for individuals receiving joint replacement surgery. This is achieved by collecting a defined minimum data set that enables outcomes to be determined based on patient characteristics, prosthesis type and features, method of prosthesis fixation and surgical technique used. The principal outcome measure is time to first revision surgery. This is an unambiguous measure of the need for further intervention. Combined with a careful analysis of potential confounding factors, this can be used as an accurate measure of the success, or otherwise, of a procedure. The Registry also monitors mortality of patients, which is critical when determining the rate of revision.

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 (245 in 2019). 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 8.4% in 2019, equating to 2,283 fewer hip revisions in 2019. The percentage of revision knee procedures has declined from a peak of 8.8% in 2004 to 8% in 2019, equating to 515 fewer knee revisions in 2019. Revision shoulder arthroplasty peaked at 10.9% in 2012 and has declined to 8.5% in 2019.

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 two Assistant Deputy Directors. 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 Manager, Project Manager, Project Officers, Administration Officer, and Research 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.

In the 2018/19 financial year, the Registry received 1373 more hip, knee and shoulder procedures than were provided in the various health department data files.

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.

The Registry is able to obtain over 97.8% of joint replacement procedures undertaken in Australia. On initial submission of forms from participating hospitals, the Registry's capture rate is 95.9%. 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 relating to hip, knee and shoulder replacement in Australia.

OUTCOME ASSESSMENT

The Registry describes the time to 1st 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 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.

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 combinations 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.

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. This year, due to COVID-19 restrictions, workshops were held online rather than face-to-face. The workshop format was modified to accommodate the online delivery. This enabled a larger than usual number of surgeons to attend.

In addition to AOANJRR and SAHMRI staff, and the AOA Executive, 31 AOA members with expertise in hip and knee arthroplasty attended the workshop. This workshop was online on the weekend of 1 and 2 August 2020.

[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.

Members of the AOA with expertise in shoulder surgery were invited to attend a separate workshop to review this section of the report. In addition to AOANJRR and SAHMRI staff, and the AOA Executive, 15 AOA members with expertise in shoulder arthroplasty attended the workshop. This workshop was held online on 8 August 2020.

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

2020

Revision Joint Replacement

INTRODUCTION

This year, the Registry is providing a comprehensive analysis of the outcome of revision hip and knee replacement surgery. The aim of this chapter is to provide information on revisions for specific reasons, and the outcomes of major total, partial and minor revisions. The Registry also examines mortality after the 1st revision.

The Registry defines a revision as a re-operation of a previous joint replacement where one or more of the prosthetic components are replaced, removed, or one or more components are added. To fully understand the outcome of an initial revision procedure, it is necessary to know the details of the primary procedure. Without this information the Registry is unaware if the revision is the 1st revision or a subsequent revision. The Registry has a linking process which is run monthly and automatically links a primary procedure to any subsequent revisions on the same side. The key to determining the order of revisions is knowledge of the primary procedure.

TERMINOLOGY

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

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

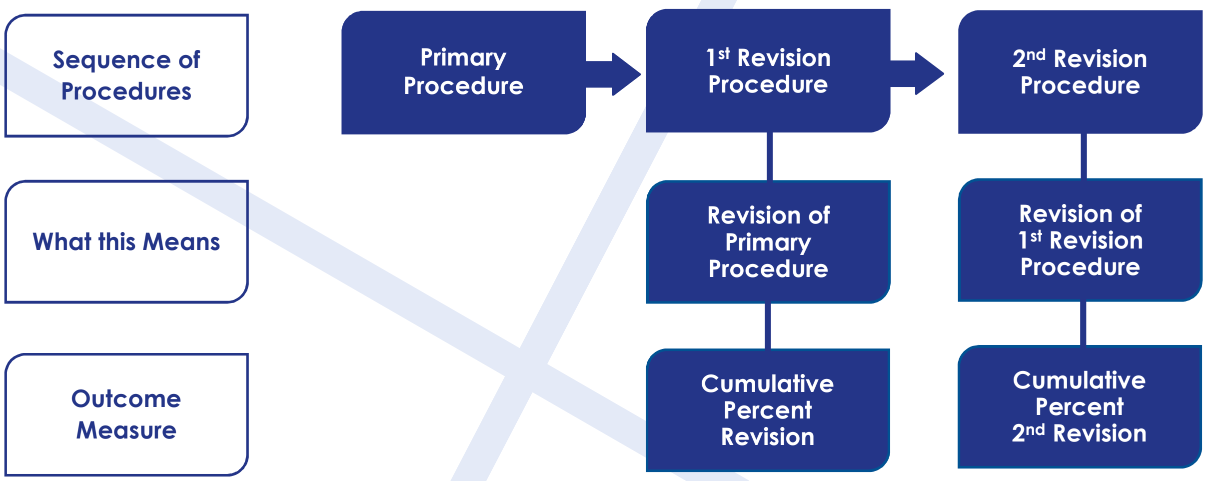
When reporting the cumulative percent revision, the specific numerical terminology is used to correctly report the revision sequence. We have defined the term cumulative percent 2nd revision as the percent of 1st revision procedures revised up until time *t* allowing for right censoring due to death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

APPROACH TO ANALYSIS

The analyses are only performed for procedures with a primary diagnosis of osteoarthritis. The reason for this is because there are known differences in outcomes based on the primary diagnosis.

Due to the complexities involved in the analysis of revisions for sepsis, 1st revision procedures undertaken for infection have been excluded from all analyses. However, 2nd revisions for infection are reported. In the future, the Annual Report will provide the outcomes of revision for infection separately from aseptic revisions.

AOANJRR Terminology for the Numerical Sequence of Revision Procedures



Revision of Total Conventional Hip Replacement

For the analysis of the 1st revision of primary total conventional hip replacement (THR), primary procedures involving metal/metal bearing surfaces and exchangeable necks have been excluded. Metal/metal bearing surfaces may have major issues associated with revisions, such as extensive soft tissue destruction which are not seen with conventional bearings making comparative analysis of the 1st revision more complicated. Metal/metal bearing surfaces also have not been used since 2017. Exchangeable necks are also seldom used, have an additional revision option (isolated head/neck exchange), and the reasons for revision vary from conventional THR.

We have defined the term cumulative percent 2nd revision as the percent of 1st procedures revised up until time *t* allowing for right censoring due to death and 'closure' of the database at the time of the analysis.

The Registry has information on 15,547 1st revision THR procedures where the primary diagnosis was osteoarthritis. There are 2,948 1st revisions procedures for infection that are excluded from this analysis. There are also a further 62 procedures excluded from the analysis of the 1st revision where the diagnosis was not infection. These include 32 removal of prostheses with no re-insertion, 26 cement spacers, 3 total femur replacements and one saddle prosthesis. The following analysis is based on 12,537 1st revision procedures.

DEMOGRAPHICS OF 1ST REVISION

The mean age at the 1st revision is 71.4 years. There is some variation depending on the reason for revision. For example, patients revised for fracture are slightly older (75.9 years).

The median time from the primary procedure to the 1st revision is 2.3 years, ranging from 0.8 years for dislocation/instability to 10.1 years for lysis. There are more females (54.7%) undergoing a 1st revision, and this is most pronounced with 1st revision for dislocation/instability (females 61%). Most patients have an ASA score of 3 (47.7%) and are non-obese (59.3%).

When an acetabular cup or femoral stem is revised at the 1st revision, cementless fixation is more likely to be used. The most common head size used in the 1st revision is >32mm (37.7%) and the most common bearing surface is metal/XLPE (34.7%), followed by ceramic/ceramic (22.8%). Although primary conventional THR with metal/metal bearing surfaces were excluded from the analysis, it is to be noted that there were 58 procedures where metal/metal bearings were used in the 1st revision.

Table RH1 provides demographic details of 1st revision procedures.

Table RH1 Summary of 1st Revisions of Known Primary Total Conventional Hip Replacement (Primary Diagnosis OA, Excluding 1st Revisions for Infection)

Variable	Loosening	Prosthesis Dislocation/ Instability	Fracture	Lysis	Other	TOTAL
Follow-up Years (Primary to 1st Revision)						
Mean ± SD	4.9 ± 4.5	2.7 ± 3.8	4.2 ± 4.7	9.5 ± 4.4	4.4 ± 4.3	4.2 ± 4.5
Median (IQR)	3.5 (1, 8)	0.8 (0.1, 3.8)	2.2 (0.1, 7.4)	10.1 (6.8, 12.7)	2.9 (0.9, 6.8)	2.3 (0.3, 7)
Minimum	0	0	0	0	0	0
Maximum	19.7	20	19	18.9	18.9	20
Age at 1st Revision						
Mean ± SD	70.4 ± 10.5	71.3 ± 10.8	75.9 ± 10.5	70.9 ± 9.7	65.5 ± 11.3	71.4 ± 11.2
Median (IQR)	71 (64, 78)	73 (65, 79)	77 (69, 84)	72 (66, 77.5)	66 (58, 74)	72 (64, 80)
Age at 1st Revision in Groups						
<55	286 (7.7%)	252 (7.5%)	111 (3.4%)	20 (6%)	285 (15.7%)	954 (7.6%)
55-64	719 (19.2%)	547 (16.3%)	368 (11.2%)	54 (16.3%)	499 (27.4%)	2,187 (17.4%)
65-74	1,316 (35.2%)	1,102 (32.9%)	855 (26%)	125 (37.7%)	631 (34.7%)	4,029 (32.1%)
≥75	1,417 (37.9%)	1,453 (43.3%)	1,960 (59.5%)	133 (40.1%)	404 (22.2%)	5,367 (42.8%)
Gender						
Male	1,832 (49%)	1,308 (39%)	1,538 (46.7%)	158 (47.6%)	848 (46.6%)	5,684 (45.3%)
Female	1,906 (51%)	2,046 (61%)	1,756 (53.3%)	174 (52.4%)	971 (53.4%)	6,853 (54.7%)
ASA at 1st Revision[1]						
ASA 1	137 (6.7%)	81 (4.6%)	64 (2.9%)	15 (7.1%)	110 (9.6%)	407 (5.5%)
ASA 2	961 (46.9%)	725 (41%)	604 (27.8%)	99 (46.7%)	580 (50.7%)	2,969 (40.4%)
ASA 3	872 (42.6%)	897 (50.7%)	1,220 (56.1%)	95 (44.8%)	418 (36.6%)	3,502 (47.7%)
ASA 4	78 (3.8%)	66 (3.7%)	278 (12.8%)	3 (1.4%)	35 (3.1%)	460 (6.3%)
ASA 5	1 (0%)		7 (0.3%)			8 (0.1%)
BMI at 1st Revision[2]						
Underweight	9 (0.6%)	15 (1.2%)	21 (1.7%)		6 (0.7%)	51 (1%)
Normal	254 (17.7%)	260 (21%)	370 (29.4%)	34 (22.1%)	141 (16.9%)	1,059 (21.5%)
Pre Obese	545 (37.9%)	461 (37.2%)	436 (34.6%)	62 (40.3%)	308 (37%)	1,812 (36.8%)
Obese Class 1	388 (27%)	307 (24.8%)	264 (21%)	39 (25.3%)	220 (26.4%)	1,218 (24.8%)
Obese Class 2	161 (11.2%)	130 (10.5%)	105 (8.3%)	16 (10.4%)	113 (13.6%)	525 (10.7%)
Obese Class 3	80 (5.6%)	66 (5.3%)	63 (5%)	3 (1.9%)	44 (5.3%)	256 (5.2%)
Fixation of Primary Procedure						
Cemented	639 (17.1%)	268 (8%)	212 (6.4%)	21 (6.3%)	52 (2.9%)	1,192 (9.5%)
Cementless	2,218 (59.3%)	1,906 (56.8%)	2,131 (64.7%)	210 (63.3%)	1,395 (76.7%)	7,860 (62.7%)
Hybrid	881 (23.6%)	1,180 (35.2%)	951 (28.9%)	101 (30.4%)	372 (20.5%)	3,485 (27.8%)
Femoral Fixation in 1st Revision						
Femoral Cemented	880 (23.5%)	270 (8.1%)	694 (21.1%)	48 (14.5%)	233 (12.8%)	2,125 (16.9%)
Femoral Cementless	1,352 (36.2%)	198 (5.9%)	2,114 (64.2%)	60 (18.1%)	365 (20.1%)	4,089 (32.6%)
No Femoral Component Inserted in 1st Revision	1,506 (40.3%)	2,886 (86%)	486 (14.8%)	224 (67.5%)	1,221 (67.1%)	6,323 (50.4%)
Acetabular Fixation in 1st Revision						
Acetabular Cemented	358 (9.6%)	225 (6.7%)	113 (3.4%)	29 (8.7%)	76 (4.2%)	801 (6.4%)
Acetabular Cementless	1,475 (39.5%)	1,134 (33.8%)	263 (8%)	148 (44.6%)	623 (34.2%)	3,643 (29.1%)

Variable	Loosening	Prosthesis Dislocation/ Instability	Fracture	Lysis	Other	TOTAL
No Acetabular Component Inserted in 1st Revision	1,905 (51%)	1,995 (59.5%)	2,918 (88.6%)	155 (46.7%)	1,120 (61.6%)	8,093 (64.6%)
Type of Acetabular Prosthesis in 1st Revision[3]						
Constrained Prosthesis	124 (3.4%)	899 (27.7%)	73 (2.4%)	11 (3.4%)	36 (2%)	1,143 (9.6%)
Dual Mobility Prosthesis	229 (6.3%)	490 (15.1%)	160 (5.4%)	22 (6.7%)	126 (7.1%)	1,027 (8.6%)
Acetabular Insert Internal Diameter >32mm	1,531 (42.3%)	876 (26.9%)	1,145 (38.4%)	114 (35%)	802 (45.2%)	4,468 (37.4%)
Acetabular Insert Internal Diameter 32mm	1,199 (33.1%)	663 (20.4%)	1,005 (33.7%)	138 (42.3%)	594 (33.5%)	3,599 (30.1%)
Acetabular Insert Internal Diameter <32mm	539 (14.9%)	323 (9.9%)	599 (20.1%)	41 (12.6%)	216 (12.2%)	1,718 (14.4%)
Bearing Surface of Primary						
Ceramic/Ceramic	781 (20.9%)	515 (15.4%)	790 (24%)	34 (10.2%)	740 (40.7%)	2,860 (22.8%)
Ceramic/Non XLPE	171 (4.6%)	104 (3.1%)	93 (2.8%)	43 (13%)	63 (3.5%)	474 (3.8%)
Ceramic/XLPE	488 (13.1%)	520 (15.5%)	529 (16.1%)	18 (5.4%)	268 (14.7%)	1,823 (14.5%)
Ceramic/Metal	7 (0.2%)	4 (0.1%)	4 (0.1%)	2 (0.6%)	6 (0.3%)	23 (0.2%)
Metal/Non XLPE	1,062 (28.4%)	556 (16.6%)	392 (11.9%)	170 (51.2%)	205 (11.3%)	2,385 (19%)
Metal/XLPE	1,089 (29.1%)	1,453 (43.3%)	1,316 (40%)	47 (14.2%)	450 (24.7%)	4,355 (34.7%)
Ceramicised Metal/Non XLPE	17 (0.5%)	9 (0.3%)	2 (0.1%)	10 (3%)	7 (0.4%)	45 (0.4%)
Ceramicised Metal/XLPE	121 (3.2%)	191 (5.7%)	163 (4.9%)	7 (2.1%)	79 (4.3%)	561 (4.5%)
Unknown	2 (0.1%)	2 (0.1%)	5 (0.2%)	1 (0.3%)	1 (0.1%)	11 (0.1%)
Bearing Surface of 1st Revision[4]						
Ceramic/Ceramic	154 (6.2%)	72 (2.5%)	48 (5.6%)	15 (4.7%)	234 (18.5%)	523 (6.7%)
Ceramic/Non XLPE	47 (1.9%)	82 (2.9%)	23 (2.7%)	7 (2.2%)	34 (2.7%)	193 (2.5%)
Ceramic/XLPE	456 (18.4%)	380 (13.3%)	133 (15.5%)	61 (19.2%)	360 (28.5%)	1,390 (17.9%)
Ceramic/Metal	4 (0.2%)	4 (0.1%)		3 (0.9%)	2 (0.2%)	13 (0.2%)
Metal/Metal	19 (0.8%)	26 (0.9%)	2 (0.2%)	3 (0.9%)	8 (0.6%)	58 (0.7%)
Metal/Non XLPE	1,652 (66.6%)	2,095 (73.3%)	615 (71.6%)	194 (61.2%)	543 (43%)	5,099 (65.6%)
Ceramicised Metal/Metal	1 (0%)	1 (0%)				2 (0%)
Ceramicised Metal/Non XLPE	4 (0.2%)	41 (1.4%)	2 (0.2%)	2 (0.6%)	4 (0.3%)	53 (0.7%)
Ceramicised Metal/XLPE	143 (5.8%)	156 (5.5%)	36 (4.2%)	32 (10.1%)	78 (6.2%)	445 (5.7%)
TOTAL	3,738	3,354	3,294	332	1,819	12,537

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

[1]Excludes 5,191 procedures with no ASA recorded at the 1st revision

[2]Excludes 7,616 procedures with no BMI recorded at the 1st revision

[3]Excludes 582 procedures where the acetabular prosthesis was not replaced in the 1st revision

[4]Excludes 4,761 procedures where the head and insert were not replaced in the 1st revision

OUTCOME OF 1ST REVISION

There are 1,745 revisions of 1st revision procedures and the cumulative percent 2nd revision at 15 years is 25.0% (Table RH2 and Figure RH1).

The cumulative percent 2nd revision at 15 years is 25.0%.

The most common reasons for 2nd revision are prosthesis dislocation/instability (33.7%), loosening (24.1%), infection (22.9%), and peri-prosthetic fracture (9.6%) (Table RH3 and Figure RH2).

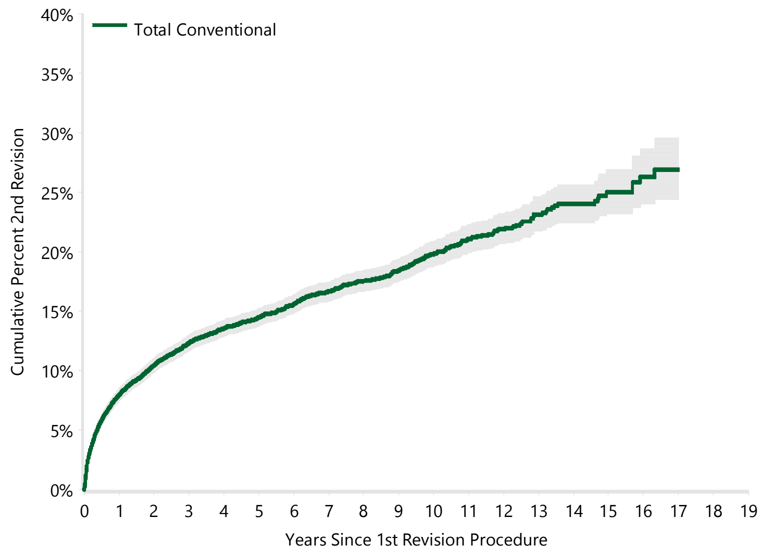
Revision of the acetabular component is the most common type of 2nd revision (24.9%), followed by head/insert (24.8%), femoral component (20.8%), THR (femoral/acetabular) (13.9%), and cement spacer (7.3%). All types of 2nd revision are listed in Table RH4.

Table RH2 Cumulative Percent 2nd Revision of Known Primary Total Conventional Hip Replacement (Primary Diagnosis OA, Excluding 1st Revision for Infection)

Revision of Primary	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Total Conventional	1745	12537	8.0 (7.5, 8.5)	12.3 (11.7, 13.0)	14.5 (13.8, 15.2)	19.8 (18.8, 20.8)	25.0 (23.2, 26.9)	
TOTAL	1745	12537						

Note: Excludes 1st revisions where no minor or major femoral/acetabular components have been inserted

Figure RH1 Cumulative Percent 2nd Revision of Known Primary Total Conventional Hip Replacement by (Primary Diagnosis OA, Excluding 1st Revision for Infection)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Total Conventional	12537	9953	7005	4746	1443	267	4

Note: Excludes 1st revisions where no minor or major femoral/acetabular components have been inserted

Table RH3 2nd Revision Diagnosis of Known Primary Total Conventional Hip Replacement (Primary Diagnosis OA, Excluding 1st Revision for Infection)

2nd Revision Diagnosis	Number	Percent
Prosthesis Dislocation/Instability	588	33.7
Loosening	421	24.1
Infection	399	22.9
Fracture	167	9.6
Pain	31	1.8
Lysis	22	1.3
Implant Breakage Acetabular	19	1.1
Implant Breakage Stem	16	0.9
Metal Related Pathology	16	0.9
Malposition	15	0.9
Implant Breakage Acetabular Insert	12	0.7
Leg Length Discrepancy	9	0.5
Wear Acetabular Insert	3	0.2
Incorrect Sizing	3	0.2
Implant Breakage Head	2	0.1
Tumour	2	0.1
Heterotopic Bone	2	0.1
Synovitis	1	0.1
Wear Acetabulum	1	0.1
Other	16	0.9
TOTAL	1745	100.0

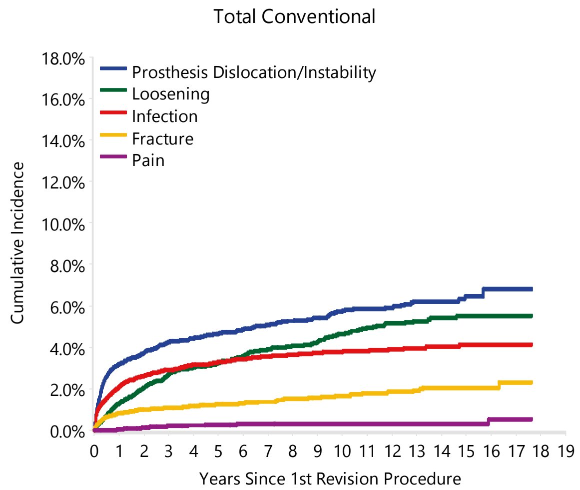
Note: Excludes 1st revisions where no minor or major femoral/acetabular components have been inserted

Table RH4 Type of 2nd Revision of Known Primary Total Conventional Hip Replacement (Primary Diagnosis OA, Excluding 1st Revision for Infection)

Type of 2nd Revision	Number	Percent
Acetabular Component	434	24.9
Head/Insert	432	24.8
Femoral Component	363	20.8
THR (Femoral/Acetabular)	243	13.9
Cement Spacer	127	7.3
Head Only	63	3.6
Minor Components	36	2.1
Insert Only	24	1.4
Removal of Prostheses	21	1.2
Reinsertion of Components	1	0.1
Bipolar Only	1	0.1
TOTAL	1745	100.0

Note: Excludes 1st revisions where no minor or major femoral/acetabular components have been inserted

Figure RH2 Cumulative Incidence 2nd Revision Diagnosis of Known Primary Total Conventional Hip Replacement (Primary Diagnosis OA, Excluding 1st Revision for Infection)



Note: Excludes 1st revisions where no minor or major femoral/acetabular components have been inserted

OUTCOME OF 1ST REVISION BY PATIENT CHARACTERISTICS

The outcome of the 1st revision varies by age and gender, with females aged <65 years having a higher rate of 2nd revision than females aged ≥65 years after 6 months.

Females aged <65 years have the highest rate of 2nd revision.

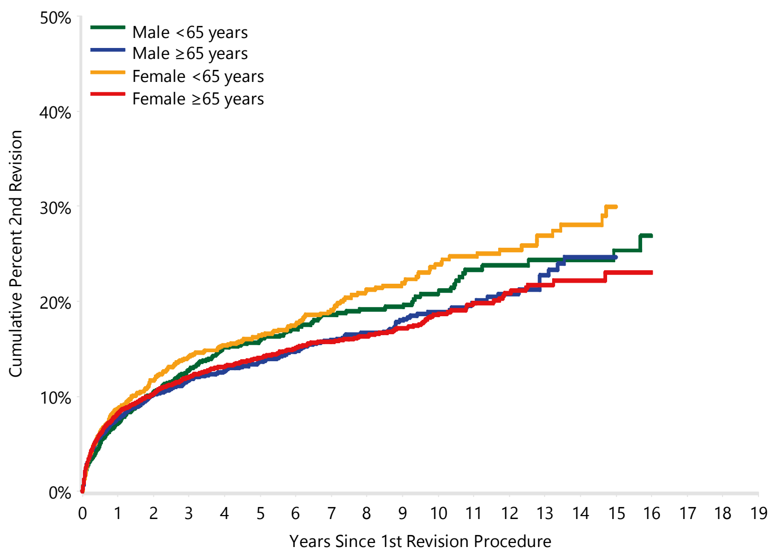
There is no difference in the rate of 2nd revision between age groups for males (Table RH5 and Figure RH3).

Table RH5 Cumulative Percent 2nd Revision of Known Primary Total Conventional Hip Replacement by Gender and Age (Primary Diagnosis OA, Excluding 1st Revision for Infection)

Gender	Age at 1st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Male	<65 years	239	1518	7.2 (6.0, 8.6)	12.7 (11.1, 14.7)	15.9 (13.9, 18.1)	20.8 (18.2, 23.6)	25.3 (21.6, 29.6)	
	≥65 years	528	4166	7.6 (6.9, 8.5)	11.7 (10.7, 12.8)	13.6 (12.5, 14.9)	18.8 (17.1, 20.8)	24.6 (21.3, 28.4)	
Female	<65 years	287	1623	8.7 (7.4, 10.2)	14.2 (12.5, 16.1)	16.4 (14.5, 18.4)	23.8 (21.1, 26.8)	30.0 (25.7, 34.7)	
	≥65 years	691	5230	8.2 (7.5, 9.0)	12.0 (11.1, 13.0)	14.1 (13.1, 15.2)	18.5 (17.0, 20.2)	23.0 (20.3, 26.0)	
TOTAL		1745	12537						

Note: Excludes 1st revisions where no minor or major femoral/acetabular components have been inserted

Figure RH3 Cumulative Percent 2nd Revision of Known Primary Total Conventional Hip Replacement by Gender and Age (Primary Diagnosis OA, Excluding 1st Revision for Infection)



Male <65 years vs Male ≥65 years
Entire Period: HR=1.11 (0.95, 1.29),p=0.183

Male <65 years vs Female <65 years
Entire Period: HR=0.90 (0.76, 1.07),p=0.245

Male ≥65 years vs Female ≥65 years
Entire Period: HR=0.99 (0.88, 1.11),p=0.869

Female <65 years vs Female ≥65 years
0 - 1Mth: HR=1.03 (0.79, 1.35),p=0.806
1Mth - 6Mth: HR=1.09 (0.88, 1.35),p=0.415
6Mth+: HR=1.33 (1.13, 1.56),p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Male	<65 years	1518	1264	904	641	245	70	1
	≥65 years	4166	3225	2206	1425	391	60	0
Female	<65 years	1623	1339	993	743	279	62	1
	≥65 years	5230	4125	2902	1937	528	75	2

Note: Excludes 1st revisions where no minor or major femoral/acetabular components have been inserted

ASA SCORE

ASA scores are available for 7,346 1st revision procedures. There are 8 patients with an ASA score of 5 and these were excluded from the comparative analysis.

Patients with ASA score 3 have a higher cumulative percent 2nd revision compared to patients with ASA score 1 (Table RH6 and Figure RH4).

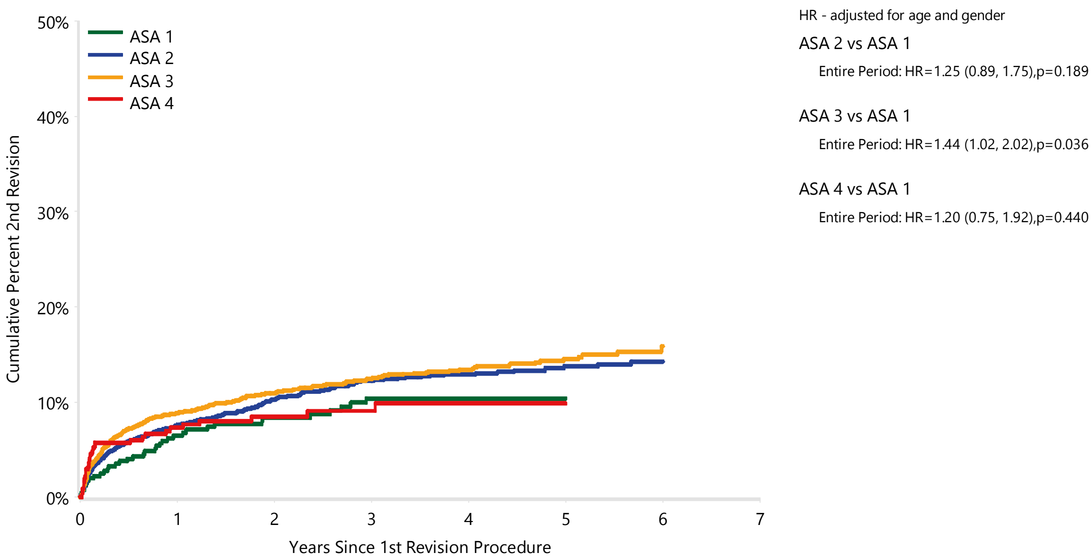
Prosthesis dislocation/instability is the most common reason for 2nd revision for patients with an ASA score of 2, 3 and 4 (Figure RH5).

Table RH6 Cumulative Percent 2nd Revision of Known Primary Total Conventional Hip Replacement by ASA Score (Primary Diagnosis OA, Excluding 1st Revision for Infection)

ASA Score	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
ASA 1	39	407	6.5 (4.4, 9.5)	8.3 (5.9, 11.7)	10.4 (7.5, 14.2)	10.4 (7.5, 14.2)	10.4 (7.5, 14.2)	
ASA 2	321	2969	7.6 (6.6, 8.6)	10.3 (9.2, 11.5)	12.3 (11.0, 13.7)	12.9 (11.6, 14.4)	13.7 (12.3, 15.3)	14.2 (12.7, 16.0)
ASA 3	388	3502	8.8 (7.9, 9.8)	10.9 (9.9, 12.1)	12.4 (11.2, 13.7)	13.4 (12.1, 14.8)	14.5 (13.0, 16.1)	15.8 (13.9, 18.0)
ASA 4	36	460	7.3 (5.1, 10.3)	8.5 (6.0, 11.8)	9.1 (6.5, 12.7)	9.8 (7.0, 13.8)	9.8 (7.0, 13.8)	
ASA 5	1	8	12.5 (1.9, 61.3)	12.5 (1.9, 61.3)				
TOTAL	785	7346						

Note: Excludes 1st revisions where no minor or major femoral/acetabular components have been inserted
Excludes 5,191 procedures with no ASA recorded

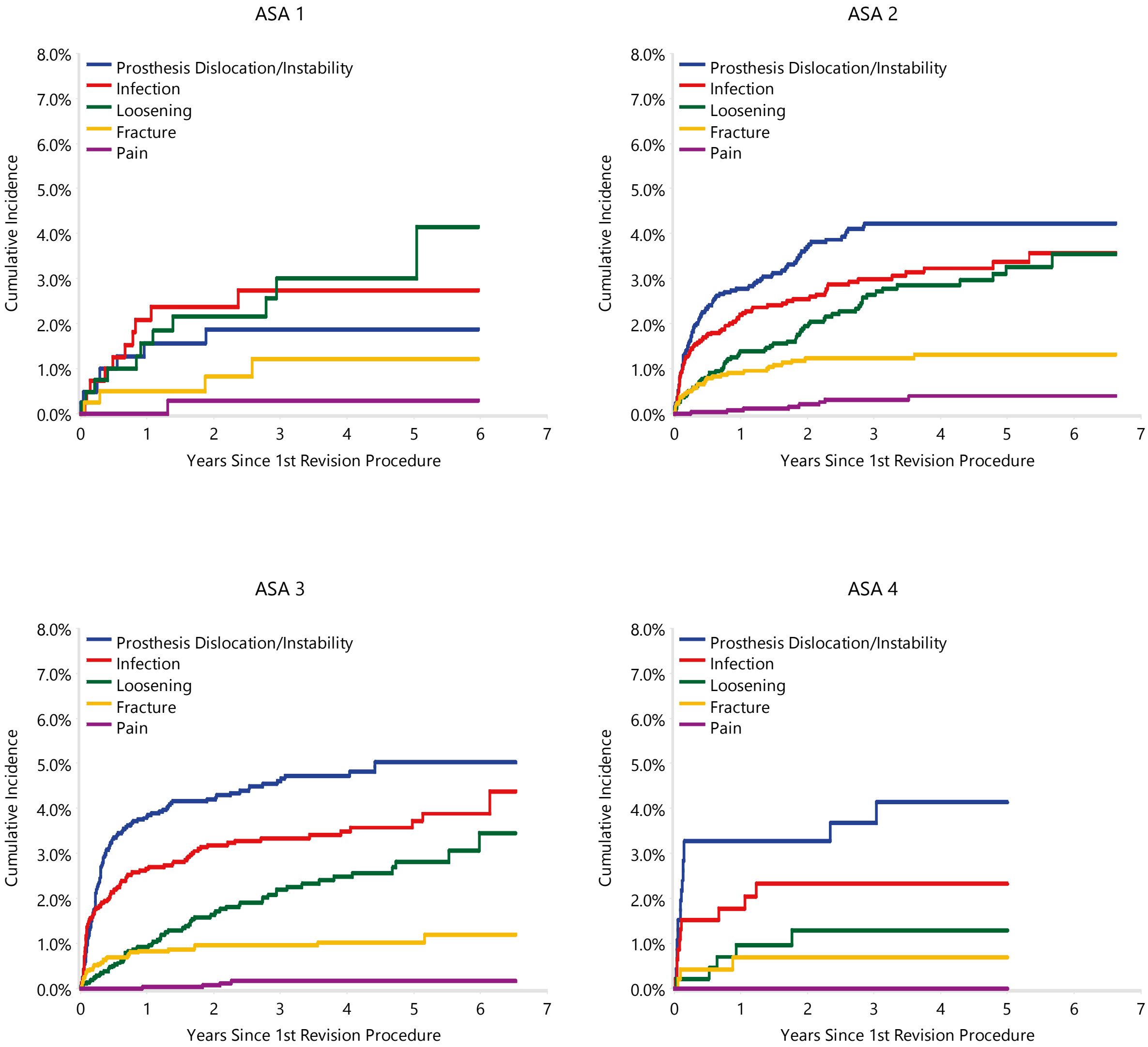
Figure RH4 Cumulative Percent 2nd Revision of Known Primary Total Conventional Hip Replacement by ASA Score (Primary Diagnosis OA, Excluding 1st Revision for Infection)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
ASA 1	407	326	272	206	143	79	39
ASA 2	2969	2266	1740	1278	850	510	195
ASA 3	3502	2449	1808	1262	825	443	147
ASA 4	460	272	179	119	74	41	11

Note: Excludes 1st revisions where no minor or major femoral/acetabular components have been inserted
Excludes 5,191 procedures with no ASA recorded

Figure RH5 **Cumulative Incidence 2nd Revision Diagnosis of Known Primary Total Conventional Hip Replacement by ASA Score (Primary Diagnosis OA, Excluding 1st Revision for Infection)**



BMI

BMI is available for 4,921 1st revision procedures.

Patients in obese classes 1, 2 and 3 have a higher cumulative percent 2nd revision compared to patients with a normal BMI (Table RH7 and Figure RH6).

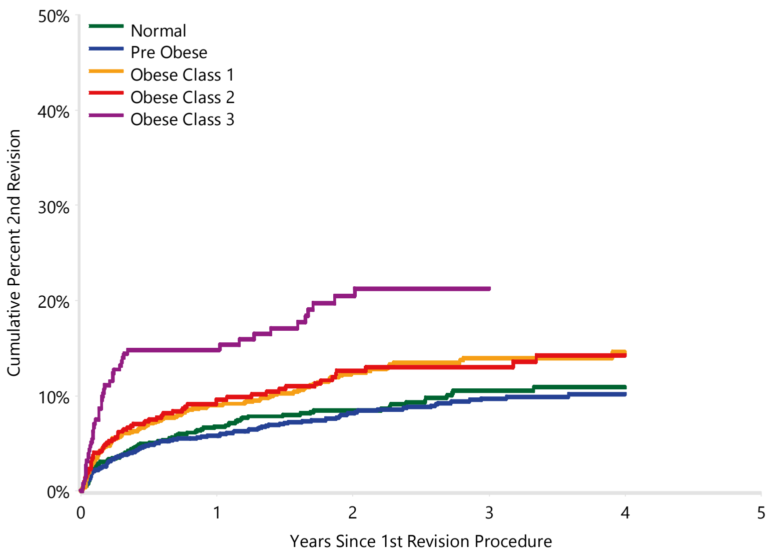
The most common reason for 2nd revision for patients in normal, pre-obese and obese class 1 is dislocation/instability and for patients in obese class 2 and 3 is infection (Figure RH7).

Table RH7 Cumulative Percent 2nd Revision of Known Primary Total Conventional Hip Replacement by BMI Category (Primary Diagnosis OA, Excluding 1st Revision for Infection)

BMI Category	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
Underweight	5	51	10.5 (4.5, 23.4)	10.5 (4.5, 23.4)	10.5 (4.5, 23.4)	10.5 (4.5, 23.4)	
Normal	87	1059	6.8 (5.3, 8.5)	8.5 (6.8, 10.5)	10.5 (8.5, 13.0)	10.9 (8.8, 13.5)	
Pre Obese	138	1812	5.8 (4.7, 7.0)	8.1 (6.8, 9.7)	9.7 (8.2, 11.5)	10.2 (8.5, 12.1)	
Obese Class 1	137	1218	9.0 (7.5, 10.9)	12.4 (10.5, 14.7)	13.9 (11.8, 16.4)	14.6 (12.2, 17.4)	
Obese Class 2	60	525	9.6 (7.3, 12.6)	12.6 (9.8, 16.1)	13.0 (10.1, 16.6)	14.3 (11.0, 18.3)	
Obese Class 3	48	256	14.8 (11.0, 19.9)	20.4 (15.6, 26.5)	21.2 (16.2, 27.5)		
TOTAL	475	4921					

Note: Excludes 1st revisions where no minor or major femoral/acetabular components have been inserted
Excludes 7,616 procedures with no BMI recorded

Figure RH6 Cumulative Percent 2nd Revision of Known Primary Total Conventional Hip Replacement by BMI Category (Primary Diagnosis OA, Excluding 1st Revision for Infection)



HR - adjusted for age and gender

Pre Obese vs Normal
Entire Period: HR=0.96 (0.73, 1.26),p=0.751

Obese Class 1 vs Normal
Entire Period: HR=1.43 (1.09, 1.88),p=0.009

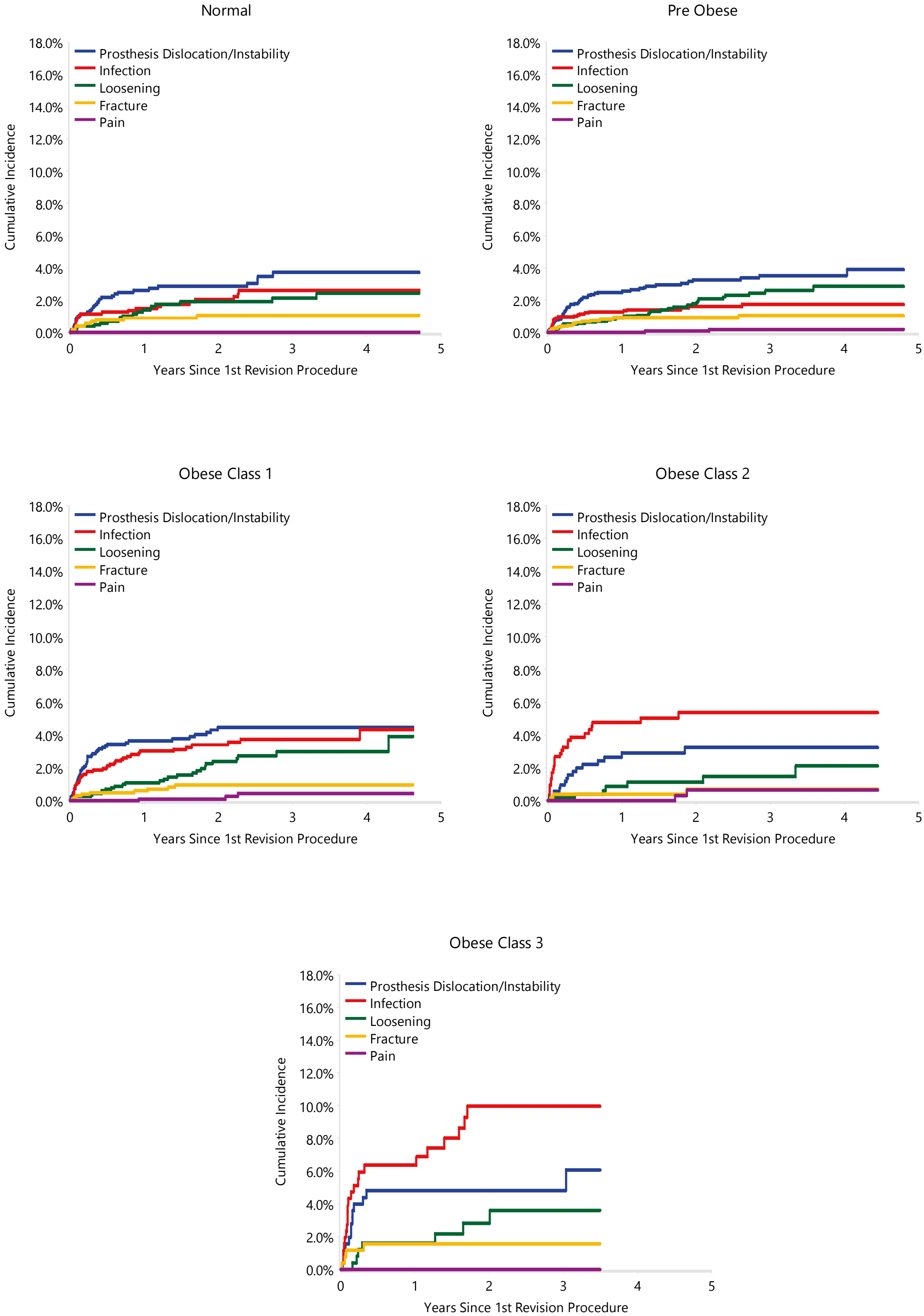
Obese Class 2 vs Normal
Entire Period: HR=1.40 (1.01, 1.96),p=0.045

Obese Class 3 vs Normal
Entire Period: HR=2.47 (1.73, 3.53),p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
Normal	1059	724	498	305	133	3
Pre Obese	1812	1245	867	524	229	3
Obese Class 1	1218	833	547	315	132	2
Obese Class 2	525	365	252	162	76	1
Obese Class 3	256	163	99	60	26	1

Note: Excludes 1st revisions where no minor or major femoral/acetabular components have been inserted
Excludes 7,616 procedures with no BMI recorded

Figure RH7 **Cumulative Incidence 2nd Revision Diagnosis of Known Primary Total Conventional Hip Replacement by BMI Category (Primary Diagnosis OA, Excluding 1st Revision for Infection)**



OUTCOMES OF 1ST REVISION BY CLASS OF 1ST REVISION

The outcomes of the 1st revision by class of 1st revision were also compared. Minor revisions have a higher rate of 2nd revision compared to both major total and major partial 1st revisions.

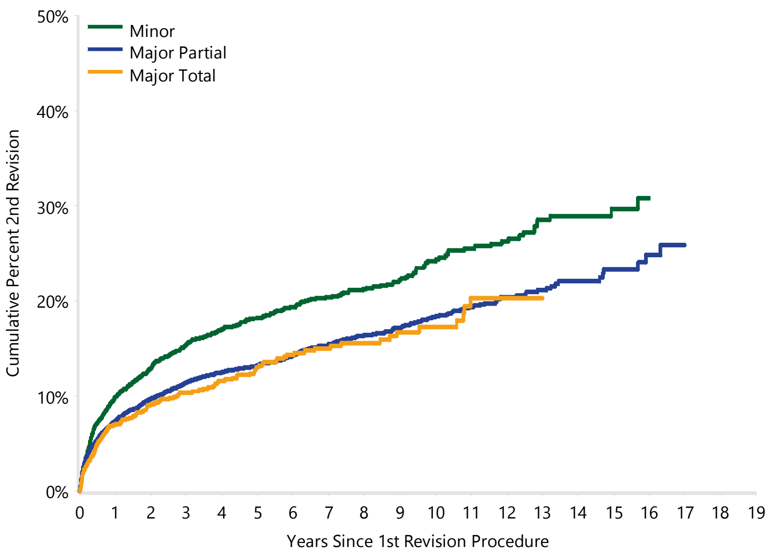
There is no difference between major total and major partial 1st revisions (Table RH8 and Figure RH8).

Table RH8 Cumulative Percent 2nd Revision of Known Primary Total Conventional Hip Replacement by Class of 1st Revision (Primary Diagnosis OA, Excluding 1st Revision for Infection)

Class of 1st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Minor	559	3151	9.9 (8.9, 11.0)	15.4 (14.1, 16.9)	18.2 (16.8, 19.8)	24.1 (22.1, 26.4)	29.7 (26.5, 33.1)	
Major Partial	1029	8105	7.4 (6.8, 8.0)	11.4 (10.7, 12.2)	13.2 (12.4, 14.1)	18.3 (17.1, 19.6)	23.3 (21.0, 25.8)	
Major Total	157	1281	7.0 (5.7, 8.6)	10.4 (8.7, 12.3)	13.0 (11.1, 15.3)	17.2 (14.5, 20.4)		
TOTAL	1745	12537						

Note: Excludes revisions where no minor or major femoral/acetabular components have been inserted

Figure RH8 Cumulative Percent 2nd Revision of Known Primary Total Conventional Hip Replacement by Class of 1st Revision (Primary Diagnosis OA, Excluding 1st Revision for Infection)



HR - adjusted for age and gender

Minor vs Major Total
Entire Period: HR=1.46 (1.22, 1.74),p<0.001

Minor vs Major Partial
Entire Period: HR=1.36 (1.23, 1.51),p<0.001

Major Partial vs Major Total
Entire Period: HR=1.07 (0.91, 1.27),p=0.420

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Minor	3151	2505	1769	1230	411	93	3
Major Partial	8105	6409	4499	3008	897	158	1
Major Total	1281	1039	737	508	135	16	0

OUTCOMES OF THE 1ST REVISION BY REASON FOR 1ST REVISION

The Registry has performed further analyses on the outcomes of the most common reasons for 1st revision. These include prosthesis dislocation/instability, loosening, and periprosthetic fracture.

The outcome of 1st revision for lysis is also reported. This is largely confined to prostheses with longer follow-up and non XLPE bearing surfaces. The reason for these analyses is to provide information on the comparative performance of the different approaches to the 1st revision for each of the different reasons for 1st revision.

When comparing the outcome of the 1st revision by reason for the 1st revision, prosthesis dislocation/instability has the highest rate of 2nd revision compared to other reasons for 1st revision (Table RH9 and Figure RH9).

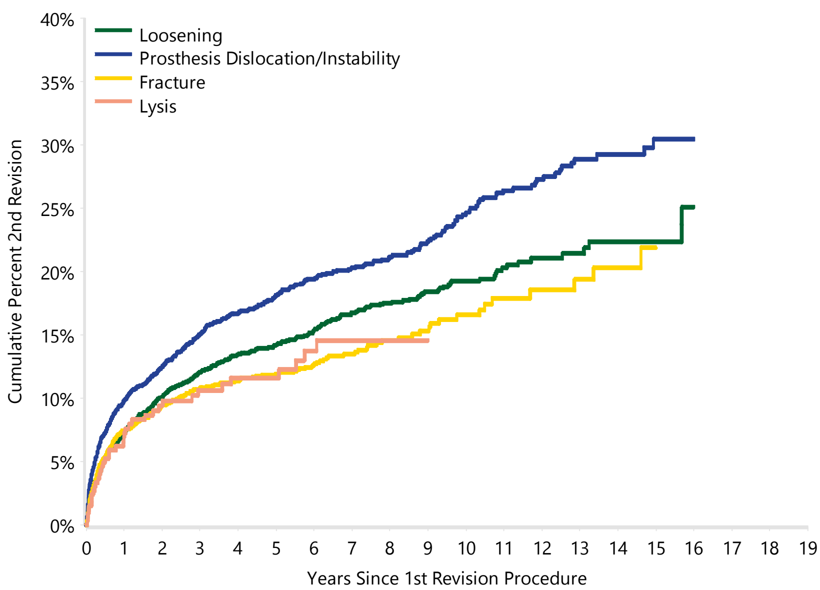
Prosthesis dislocation/instability has a 43.0% higher risk of 2nd revision compared to fracture, 61.0% higher risk compared to lysis, and 34.0% higher risk compared to loosening. There are no differences in the rate of 2nd revision when loosening, fracture and lysis are compared.

Table RH9 Cumulative Percent 2nd Revision of Known Primary Total Conventional Hip Replacement by Reason for 1st Revision (Primary Diagnosis OA)

Reason for 1st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Loosening	527	3738	7.3 (6.5, 8.2)	12.0 (11.0, 13.2)	14.2 (13.0, 15.5)	19.3 (17.6, 21.1)	22.3 (19.9, 25.0)	
Prosthesis Dislocation/Instability	604	3354	9.8 (8.9, 10.9)	15.1 (13.8, 16.4)	18.1 (16.7, 19.7)	24.5 (22.5, 26.7)	30.5 (27.4, 33.8)	
Fracture	350	3294	7.4 (6.6, 8.4)	10.8 (9.7, 12.1)	11.9 (10.7, 13.3)	16.6 (14.5, 19.0)	21.9 (17.5, 27.1)	
Lysis	40	332	7.3 (4.9, 10.7)	10.7 (7.6, 14.8)	11.6 (8.4, 16.0)			
TOTAL	1521	10718						

Note: Excludes 1st revisions where no minor or major femoral/acetabular components have been inserted

Figure RH9 Cumulative Percent 2nd Revision of Known Primary Total Conventional Hip Replacement by Reason for 1st Revision (Primary Diagnosis OA)



HR - adjusted for age and gender

Loosening vs Fracture
Entire Period: HR=1.06 (0.93, 1.22),p=0.384

Lysis vs Fracture
Entire Period: HR=0.89 (0.64, 1.23),p=0.469

Prosthesis Dislocation/Instability vs Fracture
Entire Period: HR=1.43 (1.25, 1.63),p<0.001

Loosening vs Lysis
Entire Period: HR=1.20 (0.87, 1.66),p=0.265

Prosthesis Dislocation/Instability vs Lysis
Entire Period: HR=1.61 (1.17, 2.23),p=0.003

Prosthesis Dislocation/Instability vs Loosening
Entire Period: HR=1.34 (1.19, 1.51),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Loosening	3738	3091	2240	1594	493	78	0
Prosthesis Dislocation/Instability	3354	2676	1904	1317	476	108	3
Fracture	3294	2443	1586	974	221	43	1
Lysis	332	269	210	144	28	0	0

Table RH10 **2nd Revision Diagnosis of Known Primary Total Conventional Hip Replacement by Reason for 1st Revision (Primary Diagnosis OA)**

2nd Revision Diagnosis	Loosening		Prosthesis Dislocation / Instability		Fracture		Lysis		TOTAL	
	N	Col%	N	Col%	N	Col%	N	Col%	N	Col%
Prosthesis Dislocation/Instability	130	24.7	304	50.3	77	22.0	11	27.5	522	34.3
Loosening	180	34.2	94	15.6	94	26.9	10	25.0	378	24.9
Infection	120	22.8	120	19.9	97	27.7	8	20.0	345	22.7
Fracture	43	8.2	43	7.1	59	16.9	4	10.0	149	9.8
Pain	9	1.7	6	1.0	7	2.0	1	2.5	23	1.5
Lysis	7	1.3	6	1.0	3	0.9	4	10.0	20	1.3
Implant Breakage Acetabular	5	0.9	9	1.5	2	0.6	1	2.5	17	1.1
Implant Breakage Stem	9	1.7	2	0.3	3	0.9	.	.	14	0.9
Implant Breakage Acetabular Insert	2	0.4	5	0.8	1	0.3	.	.	8	0.5
Metal Related Pathology	3	0.6	4	0.7	1	0.3	.	.	8	0.5
Malposition	4	0.8	2	0.3	1	0.3	.	.	7	0.5
Leg Length Discrepancy	4	0.8	.	.	3	0.9	.	.	7	0.5
Wear Acetabular Insert	1	0.2	1	0.2	.	.	.	.	2	0.1
Heterotopic Bone	1	0.2	1	0.2	.	.	.	.	2	0.1
Incorrect Sizing	2	0.4	.	.	.	.	.	.	2	0.1
Synovitis	1	0.2	.	.	.	.	.	.	1	0.1
Implant Breakage Head	1	0.2	.	.	.	.	.	.	1	0.1
Wear Acetabulum	.	.	1	0.2	.	.	.	.	1	0.1
Other	5	0.9	6	1.0	2	0.6	1	2.5	14	0.9
TOTAL	**527**	**100.0**	**604**	**100.0**	**350**	**100.0**	**40**	**100.0**	**1521**	**100.0**

Note: Excludes 1st revisions where no minor or major femoral/acetabular components have been inserted

Table RH11 **Type of 2nd Revision of Known Primary Total Conventional Hip Replacement by Reason for 1st Revision (Primary Diagnosis OA)**

Type of 2nd Revision	Loosening		Prosthesis Dislocation/Instability		Fracture		Lysis		TOTAL	
	N	Col%	N	Col%	N	Col%	N	Col%	N	Col%
Head/Insert	106	20.1	204	33.8	62	17.7	6	15.0	378	24.9
Acetabular Component	116	22.0	172	28.5	65	18.6	17	42.5	370	24.3
Femoral Component	130	24.7	70	11.6	121	34.6	7	17.5	328	21.6
THR (Femoral/Acetabular)	76	14.4	81	13.4	46	13.1	6	15.0	209	13.7
Cement Spacer	54	10.2	30	5.0	22	6.3	2	5.0	108	7.1
Head Only	21	4.0	15	2.5	17	4.9	.	.	53	3.5
Minor Components	13	2.5	7	1.2	10	2.9	1	2.5	31	2.0
Insert Only	4	0.8	13	2.2	5	1.4	1	2.5	23	1.5
Removal of Prostheses	7	1.3	10	1.7	2	0.6	.	.	19	1.2
Reinsertion of Components	.	.	1	0.2	.	.	.	.	1	0.1
Bipolar Only	.	.	1	0.2	.	.	.	.	1	0.1
TOTAL	**527**	**100.0**	**604**	**100.0**	**350**	**100.0**	**40**	**100.0**	**1521**	**100.0**

Note: Excludes 1st revisions where no minor or major femoral/acetabular components have been inserted

Loosening

There are 3,738 procedures performed for a 1st revision for loosening with 527 of these procedures undergoing a 2nd revision. The median time from primary procedure to 1st revision for loosening is 3.5 years, the mean patient age is 70.4 years with slightly more females (51.0%). Of the 3,738 1st revisions performed for loosening, the majority of the primary procedures are cementless (n=2218, 59.3%) followed by hybrid (n=881, 23.6%) and cemented (n=639, 17.1%) (Table RH1).

The cumulative percent 2nd revision at 15 years is 22.3% (Table RH9 and Figure RH9). The most common reason for 2nd revision is further loosening (34.2%), followed by prosthesis dislocation/instability (24.7%), infection (22.8%), and fracture (8.2%) (Table RH10).

Femoral component only (24.7%) and acetabular only revisions (22.0%) are the more commonly performed types of 2nd revision, followed by minor revisions that involve both head/insert exchange (20.1%).

The Registry is unclear why a minor revision is performed for loosening, but it could reflect surgeons revising with a longer femoral neck for leg shortening as a result of stem subsidence (Table RH11).

A THR revision has a lower rate of 2nd revision compared to other types of 1st revision (Table RH12 and Figure RH10).

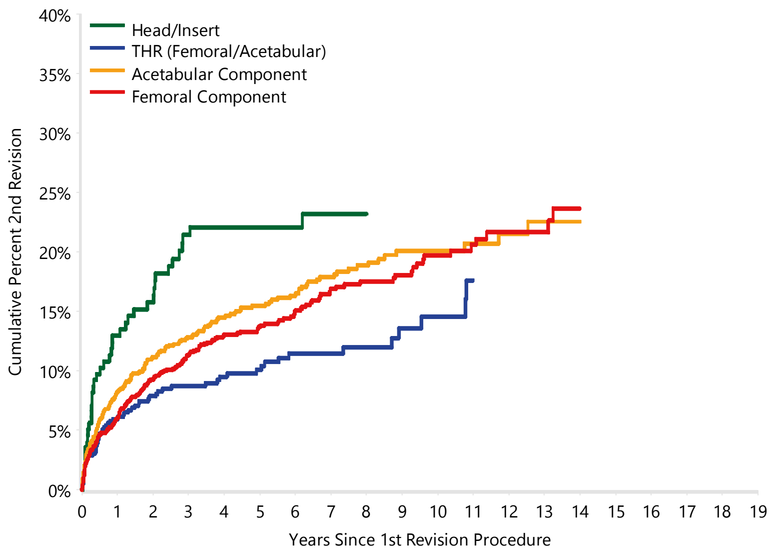
Cemented femoral fixation performed at the time of the 1st revision has a higher cumulative percent 2nd revision than cementless fixation after 9 months.

Cemented femoral fixation performed at the time of the 1st revision has a higher cumulative percent 2nd revision than cementless fixation after 9 months (Table RH13 and Figure RH11).

Table RH12 Cumulative Percent 2nd Revision of Known Primary Total Conventional Hip Replacement by Type of 1st Revision (Primary Diagnosis OA, 1st Revision for Loosening)

Type of 1st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Head/Insert	41	198	13.0 (8.9, 18.6)	21.4 (16.1, 28.2)	22.1 (16.7, 28.9)			
THR (Femoral/Acetabular)	65	626	6.0 (4.3, 8.2)	8.7 (6.7, 11.4)	10.1 (7.8, 13.0)	14.5 (10.9, 19.2)		
Acetabular Component	186	1207	8.2 (6.8, 10.0)	12.8 (11.0, 15.0)	15.5 (13.4, 17.9)	20.1 (17.4, 23.2)		
Femoral Component	216	1606	6.0 (5.0, 7.4)	11.3 (9.7, 13.1)	13.7 (11.9, 15.7)	19.7 (17.0, 22.7)		
TOTAL	508	3637						

Figure RH10 Cumulative Percent 2nd Revision of Known Primary Total Conventional Hip Replacement by Type of 1st Revision (Primary Diagnosis OA, 1st Revision for Loosening)



HR - adjusted for age and gender

Head/Insert vs THR (Femoral/Acetabular)

Entire Period: HR=2.01 (1.36, 2.98),p<0.001

Acetabular Component vs THR (Femoral/Acetabular)

Entire Period: HR=1.47 (1.10, 1.95),p=0.008

Femoral Component vs THR (Femoral/Acetabular)

Entire Period: HR=1.34 (1.01, 1.77),p=0.040

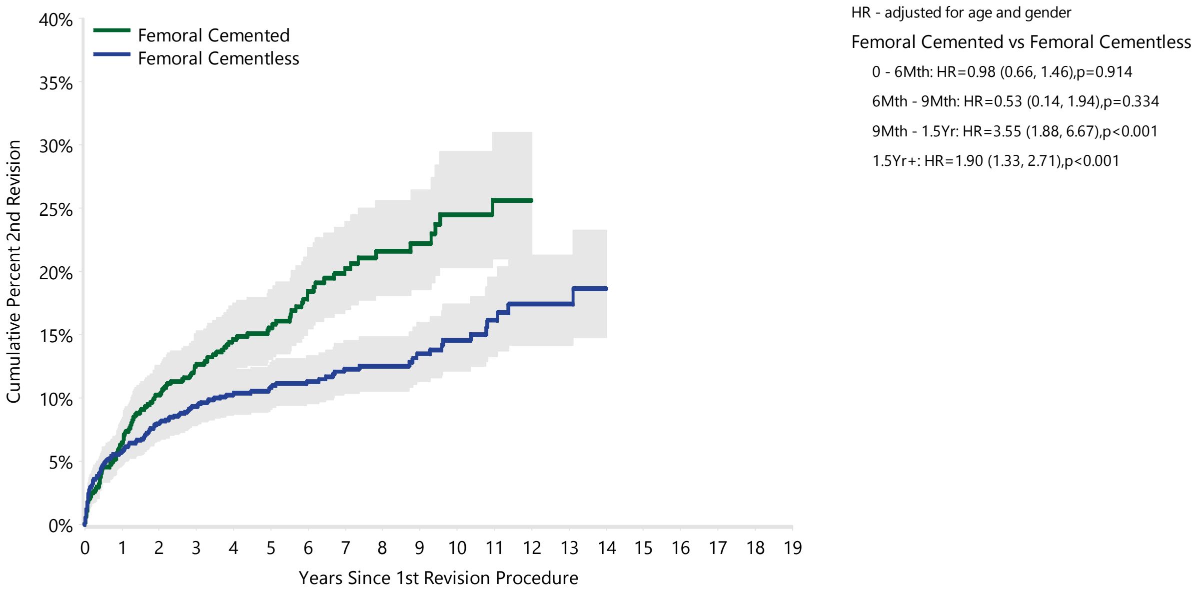
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Head/Insert	198	159	118	89	29	6	0
THR (Femoral/Acetabular)	626	527	387	284	74	6	0
Acetabular Component	1207	1001	737	537	158	30	0
Femoral Component	1606	1324	934	642	219	32	0

Table RH13 **Cumulative Percent 2nd Revision of Known Primary Total Conventional Hip Replacement by Femoral Fixation in 1st Revision (Primary Diagnosis OA, 1st Revision for Loosening)**

Femoral Fixation in 1st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Femoral Cemented	135	880	6.4 (5.0, 8.3)	12.5 (10.3, 15.1)	15.6 (13.0, 18.6)	24.5 (20.3, 29.4)		
Femoral Cementless	146	1352	5.7 (4.6, 7.1)	9.3 (7.8, 11.1)	10.8 (9.1, 12.8)	14.6 (12.1, 17.4)		
TOTAL	281	2232						

Note: Excludes 1st revisions where no minor or major femoral/acetabular components have been inserted.

Figure RH11 **Cumulative Percent 2nd Revision of Known Primary Total Conventional Hip Replacement by Femoral Fixation in 1st Revision (Primary Diagnosis OA, 1st Revision for Loosening)**



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Femoral Cemented	880	731	499	336	89	13	0
Femoral Cementless	1352	1120	822	590	204	25	0

Dislocation/Instability

There are 3,354 1st revision procedures performed for dislocation/instability with 604 of these undergoing a 2nd revision. The median time from primary procedure to revision for dislocation is 0.8 years and the mean age of patients is 71.3 years with more females undergoing revision (61.0%) (Table RH1).

The cumulative percent 2nd revision at 15 years is 30.5% (Table RH9 and Figure RH9). The most common reason for 2nd revision is for further dislocation/instability (50.3%) followed by infection (19.9%), loosening (15.6%), and fracture (7.1%) (Table RH10).

Minor revisions that involve both head/insert exchange are the most common type of 2nd revision (33.8%) followed by acetabular component only (28.5%), and THR (13.4%) (Table RH11).

The outcomes of the type of 1st revision performed for dislocation/instability have been compared. A minor revision involving head/insert exchange has a lower rate of 2nd revision compared to acetabular only revision for the first month only, but after this time the acetabular component revisions have a lower rate of 2nd revision. A THR revision has a higher rate of 2nd revision compared to acetabular only (Table RH14 and Figure RH12).

The effect of femoral head size, and constrained and dual mobility prostheses used at the time of 1st revision for dislocation/instability was also assessed. Femoral heads <32mm were used in 323 (9.9%) procedures, 32mm in 663 (20.4%), >32mm in 876 (26.9%), constrained liners in 899 (27.7%), and dual mobility in 490 (15.1%) procedures. There is no difference in the rate of overall 2nd revision between head sizes. Constrained prostheses have a higher rate of 2nd revision compared to dual mobility prostheses after 6 months (Table RH15 and Figure RH13).

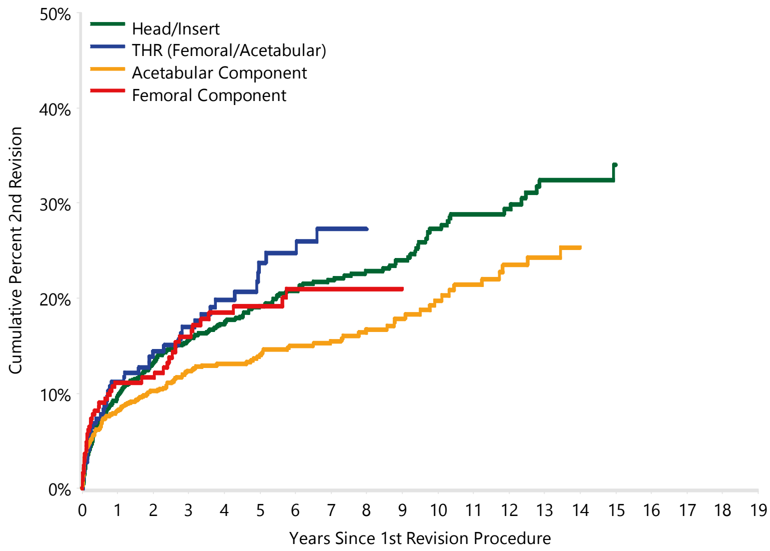
The outcome of the 1st revision for dislocation/instability where the 2nd revision diagnosis was for further dislocation/instability was also examined. Dual mobility prostheses have a lower rate of 2nd revision for dislocation/instability compared to head sizes ≤32mm, and also to constrained prostheses after 1 year. There is no difference when dual mobility prostheses are compared to head sizes >32mm (Table RH16 and Figure RH14).

When revising for dislocation, the risk of a 2nd dislocation is lowest if a dual mobility prosthesis and/or head size >32mm are used.

Table RH14 Cumulative Percent 2nd Revision of Known Primary Total Conventional Hip Replacement by Type of 1st Revision (Primary Diagnosis OA, 1st Revision for Prosthesis Dislocation/Instability)

Type of 1st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Head/Insert	275	1433	9.7 (8.3, 11.4)	15.7 (13.8, 17.8)	19.2 (17.0, 21.6)	27.3 (24.0, 30.9)	34.0 (28.9, 39.7)	
Acetabular Component	164	1138	8.2 (6.7, 10.0)	12.4 (10.5, 14.6)	14.0 (11.9, 16.4)	19.7 (16.6, 23.4)		
THR (Femoral/Acetabular)	47	221	11.2 (7.6, 16.2)	17.0 (12.4, 23.0)	23.7 (17.8, 31.2)			
Femoral Component	44	247	11.1 (7.8, 15.8)	16.0 (11.7, 21.5)	19.1 (14.4, 25.3)			
TOTAL	530	3039						

Figure RH12 Cumulative Percent 2nd Revision of Known Primary Total Conventional Hip Replacement by Type of 1st Revision (Primary Diagnosis OA, 1st Revision for Prosthesis Dislocation/Instability)



HR - adjusted for age and gender

Head/Insert vs Acetabular Component
0 - 1Mth: HR=0.61 (0.38, 0.98),p=0.040
1Mth+: HR=1.56 (1.27, 1.92),p<0.001

THR (Femoral/Acetabular) vs Acetabular Component
Entire Period: HR=1.50 (1.09, 2.08),p=0.013

Femoral Component vs Acetabular Component
Entire Period: HR=1.22 (0.87, 1.71),p=0.239

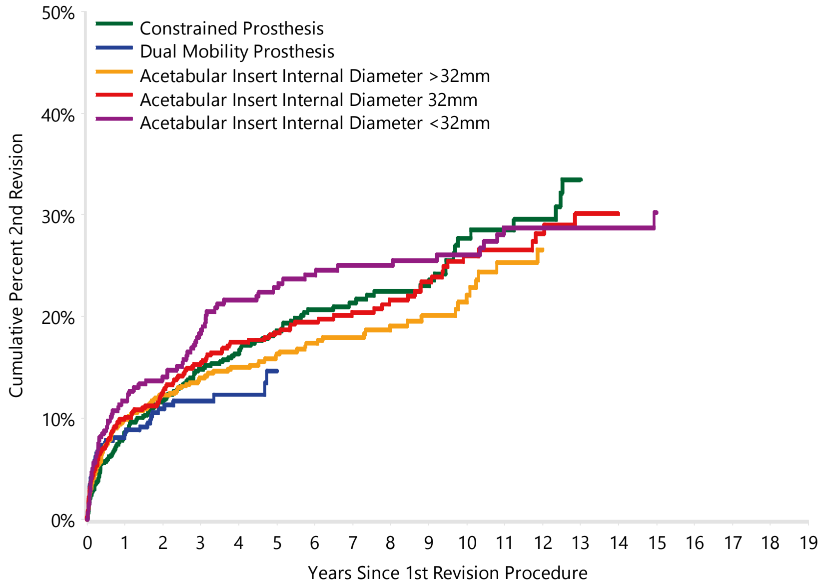
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Head/Insert	1433	1145	798	547	198	40	0
THR (Femoral/Acetabular)	221	179	127	75	26	4	0
Acetabular Component	1138	907	648	457	157	38	1
Femoral Component	247	201	144	100	36	8	0

Table RH15 Cumulative Percent 2nd Revision of Known Primary Total Conventional Hip Replacement by Prosthesis Used in 1st Revision (Primary Diagnosis OA, 1st Revision for Prosthesis Dislocation/Instability)

Prosthesis Used in 1st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Constrained Prosthesis	159	899	8.6 (6.9, 10.7)	14.8 (12.4, 17.5)	18.6 (15.8, 21.7)	27.7 (23.2, 32.9)		
Dual Mobility Prosthesis	53	490	8.3 (6.1, 11.2)	11.7 (8.9, 15.3)	14.6 (10.6, 19.9)			
Acetabular Insert Internal Diameter >32mm	145	876	9.9 (8.0, 12.1)	13.9 (11.7, 16.5)	16.3 (13.8, 19.1)	21.4 (17.8, 25.5)		
Acetabular Insert Internal Diameter 32mm	135	663	10.0 (8.0, 12.6)	15.4 (12.8, 18.5)	18.4 (15.5, 21.8)	25.9 (21.8, 30.6)		
Acetabular Insert Internal Diameter <32mm	81	323	11.7 (8.6, 15.7)	18.6 (14.7, 23.5)	22.8 (18.4, 28.1)	26.1 (21.3, 31.7)	30.2 (24.5, 36.9)	
TOTAL	573	3251						

Note: Excludes 1st revisions where no minor or major femoral/acetabular components have been inserted

Figure RH13 Cumulative Percent 2nd Revision of Known Primary Total Conventional Hip Replacement by Prosthesis Used in 1st Revision (Primary Diagnosis OA, 1st Revision for Prosthesis Dislocation/Instability)



HR - adjusted for age and gender

Constrained Prosthesis vs Dual Mobility Prosthesis

0 - 6Mth: HR=0.93 (0.62, 1.38),p=0.720

6Mth+: HR=1.68 (1.18, 2.37),p=0.003

Acetabular Insert Internal Diameter >32mm vs Dual Mobility Prosthesis

Entire Period: HR=1.11 (0.81, 1.53),p=0.512

Acetabular Insert Internal Diameter 32mm vs Dua Mobility Prosthesis

Entire Period: HR=1.27 (0.92, 1.75),p=0.148

Acetabular Insert Internal Diameter <32mm vs Dual Mobility Prosthesis

Entire Period: HR=1.40 (0.99, 2.00),p=0.059

Acetabular Insert Internal Diameter >32mm vs Acetabular Insert Internal Diameter 32mm

Entire Period: HR=0.88 (0.69, 1.11),p=0.273

Acetabular Insert Internal Diameter <32mm vs Acetabular Insert Internal Diameter 32mm

Entire Period: HR=1.11 (0.84, 1.47),p=0.461

Acetabular Insert Internal Diameter <32mm vs Acetabular Insert Internal Diameter >32mm

Entire Period: HR=1.27 (0.96, 1.67),p=0.093

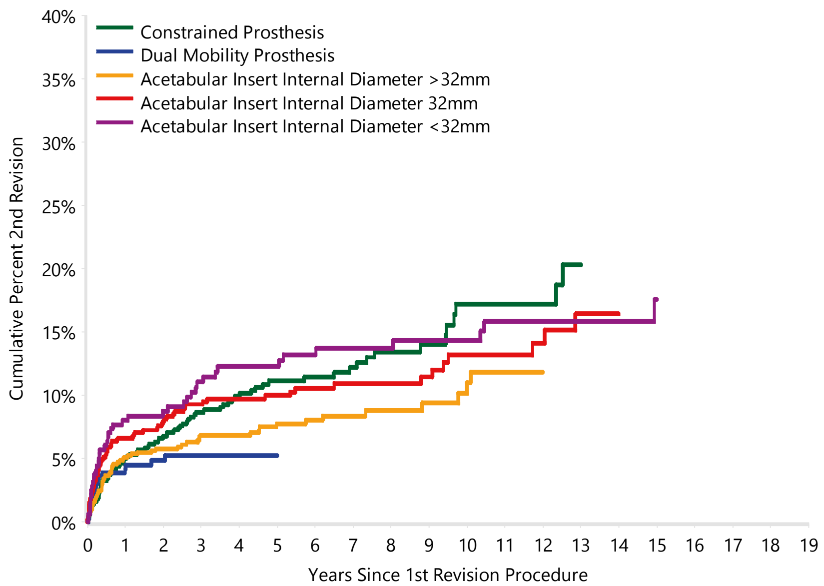
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Constrained Prosthesis	899	712	480	326	92	17	0
Dual Mobility Prosthesis	490	341	169	67	3	0	0
Acetabular Insert Internal Diameter >32mm	876	720	533	364	109	9	0
Acetabular Insert Internal Diameter 32mm	663	560	438	327	132	28	0
Acetabular Insert Internal Diameter <32mm	323	268	224	186	119	47	2

Table RH16 **Cumulative Percent 2nd Revision of Known Primary Total Conventional Hip Replacement by Prosthesis Used in 1st Revision (Primary Diagnosis OA, 1st Revision for Prosthesis Dislocation/Instability, 2nd Revision for Prosthesis Dislocation/Instability)**

Prosthesis Used in 1st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Constrained Prosthesis	89	899	5.0 (3.7, 6.8)	8.7 (6.8, 11.0)	11.1 (8.9, 13.9)	17.2 (13.3, 22.1)		
Dual Mobility Prosthesis	22	490	4.2 (2.7, 6.5)	5.2 (3.4, 7.9)	5.2 (3.4, 7.9)			
Acetabular Insert Internal Diameter >32mm	64	876	5.1 (3.8, 6.8)	6.8 (5.2, 8.8)	7.7 (6.0, 10.0)	10.2 (7.6, 13.6)		
Acetabular Insert Internal Diameter 32mm	70	663	6.6 (4.9, 8.8)	9.3 (7.2, 11.9)	10.0 (7.8, 12.7)	13.2 (10.2, 17.0)		
Acetabular Insert Internal Diameter <32mm	43	323	8.0 (5.5, 11.7)	11.0 (8.0, 15.2)	12.3 (9.0, 16.6)	14.3 (10.6, 19.1)	17.6 (12.7, 24.1)	
TOTAL	288	3251						

Note: Excludes 1st revisions where no minor or major femoral/acetabular components have been inserted

Figure RH14 **Cumulative Percent 2nd Revision of Known Primary Total Conventional Hip Replacement by Prosthesis Used in 1st Revision (Primary Diagnosis OA, 1st Revision for Prosthesis Dislocation/Instability, 2nd Revision for Prosthesis Dislocation/Instability)**



HR - adjusted for age and gender

Constrained Prosthesis vs Dual Mobility Prosthesis
- 0 - 3Mth: HR=0.89 (0.46, 1.73),p=0.724
- 3Mth - 1Yr: HR=1.75 (0.96, 3.21),p=0.068
- 1Yr+: HR=3.06 (1.75, 5.34),p<0.001

Acetabular Insert Internal Diameter >32mm vs Dual Mobility Prosthesis
- Entire Period: HR=1.31 (0.81, 2.14),p=0.271

Acetabular Insert Internal Diameter 32mm vs Dual Mobility Prosthesis
- Entire Period: HR=1.73 (1.07, 2.80),p=0.026

Acetabular Insert Internal Diameter <32mm vs Dual Mobility Prosthesis
- Entire Period: HR=2.03 (1.21, 3.42),p=0.007

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Constrained Prosthesis	899	712	480	326	92	17	0
Dual Mobility Prosthesis	490	341	169	67	3	0	0
Acetabular Insert Internal Diameter >32mm	876	720	533	364	109	9	0
Acetabular Insert Internal Diameter 32mm	663	560	438	327	132	28	0
Acetabular Insert Internal Diameter <32mm	323	268	224	186	119	47	2

Periprosthetic Fracture

There are 3,294 procedures performed for a 1st revision for fracture with 350 of these procedures undergoing a 2nd revision. The median time from primary procedure to revision for fracture is 2.2 years and the mean age of patients is slightly older at 75.9 years, with more females undergoing revision for fracture (53.3%) (Table RH1).

The cumulative percent 2nd revision at 15 years is 21.9% (Table RH9 and Figure RH9). The most common reason for 2nd revision is infection (27.7%), followed by loosening (26.9%), prosthesis dislocation/instability (22.0%), and further fracture (16.9%) (Table RH10).

A revision of the femoral component (34.6%) is the most common type of 2nd revision followed by acetabular revisions (18.6%) and minor revisions that involved both head/insert exchange (17.7%) (Table RH11).

There is no difference in the cumulative percent 2nd revision by type of 1st revision (Table RH17 and Figure RH15).

Lysis

There are 332 procedures revised for lysis. Of these procedures, 67.2% used non XLPE as the primary bearing surface. A further 40 procedures underwent a 2nd revision. The median time to revision for lysis is 10.1 years which is much longer compared to the other common reasons for revision. The mean age of patients is 70.9 years and more females are revised for lysis (52.4%) (Table RH1).

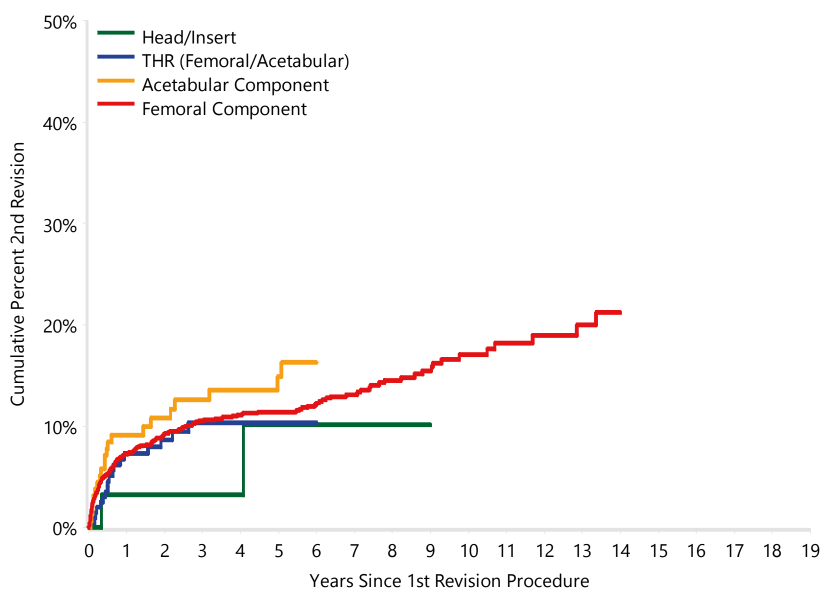
The cumulative percent 2nd revision at 5 years is 11.6% (Table RH9 and Figure RH9). The most common reason for 2nd revision is prosthesis dislocation/instability (27.5%), loosening (25.0%), infection (20.0%), and fracture (10.0%) (Table RH10).

There is no difference in the cumulative percent 2nd revision for head/insert revisions compared to acetabular revisions. However, there is a higher rate of 2nd revision for femoral component only compared to acetabular component only (Table RH18 and Figure RH16).

Table RH17 Cumulative Percent 2nd Revision of Known Primary Total Conventional Hip Replacement by Type of 1st Revision (Primary Diagnosis OA, 1st Revision for Fracture)

Type of 1st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Head/Insert	2	33	3.2 (0.5, 20.8)	3.2 (0.5, 20.8)	10.1 (2.4, 37.7)			
THR (Femoral/Acetabular)	19	214	7.3 (4.4, 12.1)	10.3 (6.6, 16.1)	10.3 (6.6, 16.1)			
Acetabular Component	21	162	9.1 (5.5, 14.9)	12.6 (8.1, 19.3)	14.9 (9.7, 22.4)			
Femoral Component	272	2594	7.2 (6.3, 8.4)	10.6 (9.3, 12.0)	11.4 (10.1, 12.9)	17.0 (14.5, 19.9)		
TOTAL	314	3003						

Figure RH15 Cumulative Percent 2nd Revision of Known Primary Total Conventional Hip Replacement by Type of 1st Revision (Primary Diagnosis OA, 1st Revision for Fracture)



HR - adjusted for age and gender

Head/Insert vs THR (Femoral/Acetabular)
Entire Period: HR=0.55 (0.13, 2.37),p=0.421

Acetabular Component vs
THR (Femoral/Acetabular)
Entire Period: HR=1.45 (0.78, 2.72),p=0.240

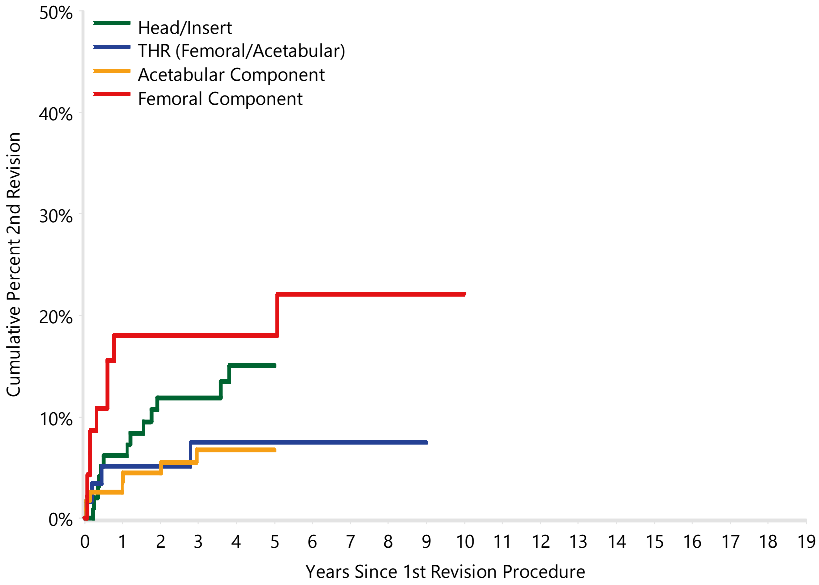
Femoral Component vs THR (Femoral/Acetabular)
Entire Period: HR=1.24 (0.78, 1.98),p=0.359

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Head/Insert	33	27	20	13	2	0	0
THR (Femoral/Acetabular)	214	161	91	54	13	3	0
Acetabular Component	162	122	90	64	8	0	0
Femoral Component	2594	1923	1256	757	178	31	0

Table RH18 **Cumulative Percent 2nd Revision of Known Primary Total Conventional Hip Replacement by Type of 1st Revision (Primary Diagnosis OA, 1st Revision for Lysis)**

Type of 1st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Head/Insert	15	102	6.1 (2.8, 13.1)	11.9 (6.8, 20.5)	15.0 (8.9, 24.7)			
THR (Femoral/Acetabular)	5	60	5.1 (1.7, 15.1)	7.5 (2.8, 18.9)	7.5 (2.8, 18.9)			
Acetabular Component	9	117	4.4 (1.9, 10.3)	6.7 (3.2, 13.6)	6.7 (3.2, 13.6)			
Femoral Component	9	48	18.0 (9.4, 32.9)	18.0 (9.4, 32.9)	18.0 (9.4, 32.9)	22.1 (11.8, 39.1)		
TOTAL	38	327						

Figure RH16 **Cumulative Percent 2nd Revision of Known Primary Total Conventional Hip Replacement by Type of 1st Revision (Primary Diagnosis OA, 1st Revision for Lysis)**



HR - adjusted for age and gender

Head/Insert vs Acetabular Component
Entire Period: HR=2.27 (0.98, 5.29),p=0.057

THR (Femoral/Acetabular) vs
Acetabular Component
Entire Period: HR=1.39 (0.46, 4.21),p=0.558

Femoral Component vs Acetabular Component
Entire Period: HR=3.35 (1.29, 8.70),p=0.013

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Head/Insert	102	85	64	49	11	0	0
THR (Femoral/Acetabular)	60	46	39	29	4	0	0
Acetabular Component	117	102	77	44	6	0	0
Femoral Component	48	32	27	20	6	0	0

MORTALITY FOLLOWING THE 1ST REVISION

Mortality following the 1st revision of primary conventional THR and the reason for the 1st revision have been examined.
The overall mortality of a 1st revision procedure is 0.8% at 30 days, 1.8% at 90 days, 4.3% at 1 year and 39.5% at 10 years.

Compared to other reasons for revision, 1st revision for fracture has the highest mortality, both early at 30 days, 90 days and 1 year, and later at 10 years.

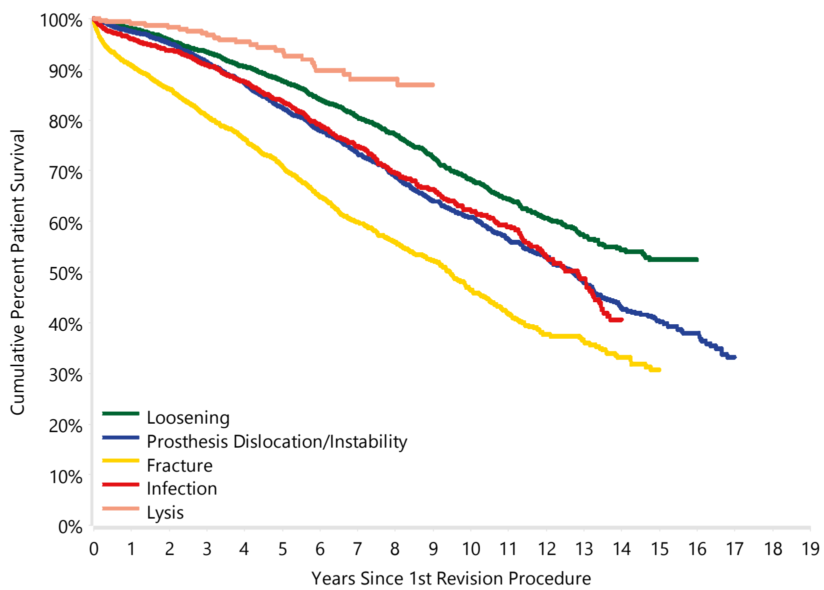
By 10 years, 53.6% of patients are deceased if revised for fracture (Table RH19 and Figure RH17).

1st revision for fracture has the highest mortality at all times compared to other reasons for 1st revision.

Table RH19 Cumulative Percent Patient Survival of Known Primary Total Conventional Hip Replacement Since 1st Revised by Reason for 1st Revision

Reason for 1st Revision	N Deceased	N Total	30 Day	90 Day	1 Yr	5 Yrs	10 Yrs	15 Yrs
Loosening	733	3738	99.7 (99.5, 99.9)	99.5 (99.2, 99.7)	98.1 (97.6, 98.5)	87.7 (86.5, 88.9)	68.2 (65.9, 70.5)	52.4 (48.7, 56.0)
Prosthesis Dislocation / Instability	920	3354	99.7 (99.5, 99.9)	99.3 (99.0, 99.6)	97.5 (96.8, 97.9)	82.4 (80.9, 83.9)	60.8 (58.4, 63.2)	40.4 (37.1, 43.6)
Fracture	1050	3294	97.7 (97.1, 98.1)	95.3 (94.6, 96.0)	90.7 (89.7, 91.7)	70.9 (69.0, 72.7)	46.4 (43.5, 49.3)	30.7 (26.8, 34.7)
Infection	475	2272	99.3 (98.9, 99.6)	98.3 (97.6, 98.7)	96.1 (95.1, 96.8)	83.7 (81.8, 85.5)	62.3 (58.7, 65.6)	
Lysis	34	332	100.0 (100.0, 100.0)	99.7 (97.8, 100.0)	99.0 (97.1, 99.7)	93.8 (89.8, 96.2)		
TOTAL	3212	12990	99.2 (99.0, 99.3)	98.2 (97.9, 98.4)	95.7 (95.4, 96.1)	81.7 (80.9, 82.5)	60.5 (59.1, 61.8)	41.3 (39.3, 43.3)

Figure RH17 Cumulative Percent Patient Survival of Known Primary Total Conventional Hip Replacement Since 1st Revised by Reason for 1st Revision



HR - adjusted for age and gender

Prosthesis Dislocation/Instability vs Loosening
Entire Period: HR=1.15 (1.05, 1.27),p=0.003

Fracture vs Loosening
0 - 3Mth: HR=4.46 (3.39, 5.87),p<0.001
3Mth - 6Mth: HR=2.51 (1.74, 3.62),p<0.001
6Mth - 3Yr: HR=1.86 (1.59, 2.16),p<0.001
3Yr+: HR=1.28 (1.14, 1.45),p<0.001

Infection vs Loosening
Entire Period: HR=1.25 (1.11, 1.40),p<0.001

Lysis vs Loosening
Entire Period: HR=0.85 (0.60, 1.19),p=0.338

Number at Risk	0 Yr	1 Yr	5 Yrs	10 Yrs	15 Yrs
Loosening	3738	3333	1882	626	111
Prosthesis Dislocation/Instability	3354	2970	1582	619	158
Fracture	3294	2633	1127	282	53
Infection	2272	1880	893	232	38
Lysis	332	290	162	33	1

OUTCOMES OF 1ST REVISION OVER TIME

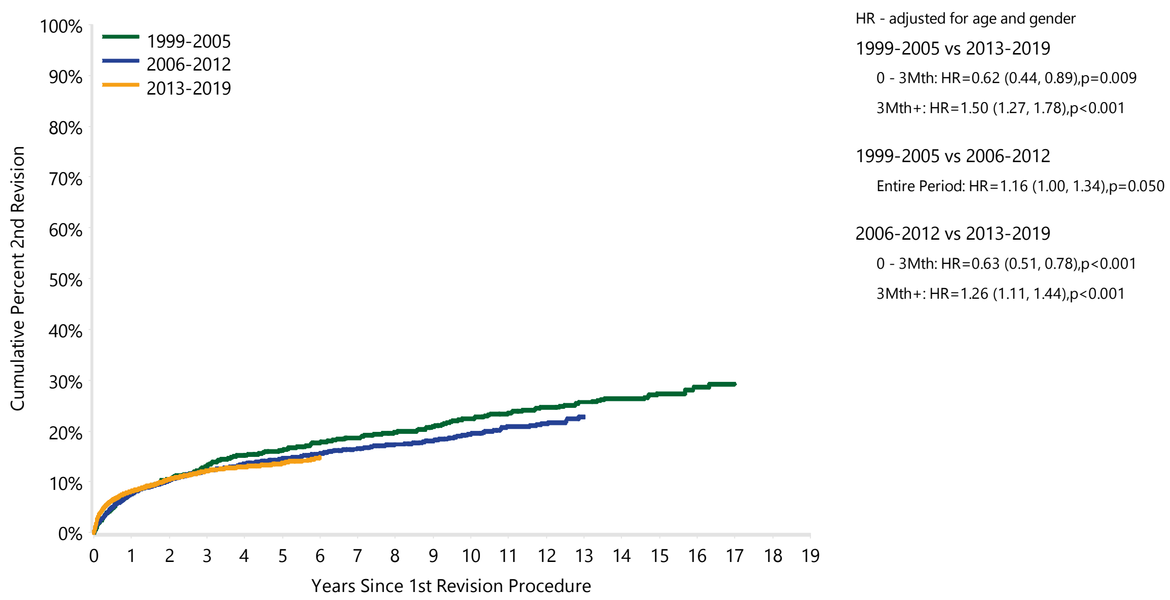
This analysis compares the outcomes of 1st revisions over three successive time periods: 1999-2005, 2006-2012 and 2013-2019. There has been an improvement in the outcomes of the 1st revision procedure. The latter time period, 2013-2019, has a lower cumulative percent 2nd revision after 3 months compared to the two earlier periods. There is no difference in the rate of 2nd revision between 2006-2012 and 1999-2005 (Table RH20 and Figure RH18).

Table RH20 Cumulative Percent 2nd Revision of Known Primary Total Conventional Hip Replacement by Year of 1st Revision (Primary Diagnosis OA, Excluding 1st Revision for Infection)

Year of 1st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
1999-2005	264	1141	7.6 (6.2, 9.3)	13.2 (11.4, 15.4)	16.2 (14.1, 18.5)	22.4 (19.9, 25.1)	27.3 (24.5, 30.5)	
2006-2012	648	3734	7.6 (6.8, 8.5)	12.1 (11.1, 13.3)	14.5 (13.4, 15.7)	19.3 (17.9, 20.8)		
2013-2019	833	7662	8.1 (7.5, 8.8)	12.1 (11.3, 13.0)	13.7 (12.8, 14.7)			
TOTAL	1745	12537						

Note: Excludes revisions where no minor or major femoral/acetabular components have been inserted

Figure RH18 Cumulative Percent 2nd Revision of Known Primary Total Conventional Hip Replacement by Year of 1st Revision (Primary Diagnosis OA, Excluding 1st Revision for Infection)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
1999-2005	1141	1022	907	803	572	267	4
2006-2012	3734	3337	2982	2660	871	0	0
2013-2019	7662	5594	3116	1283	0	0	0

REVISION OF TOTAL CONVENTIONAL HIP REPLACEMENT SUMMARY

The mean age of patients undergoing 1st revision is 71.4 years which is only 3 years older than the mean age of patients undergoing primary procedures.

The cumulative percent 2nd revision at 15 years is 25.0%. Minor 1st revisions have a higher cumulative percent 2nd revision than major total/partial total 1st revisions.

There are differences in outcomes by reason for 1st revision, with dislocation/instability having the highest rate of 2nd revision.

When a 1st revision is performed for loosening, cemented femoral fixation performed at the time of the 1st revision has a higher cumulative percent 2nd revision than cementless fixation after 9 months.

For all 1st revision diagnoses examined, infection is a common reason for the 2nd revision.

Patients revised for fracture have the highest mortality.

As with primary conventional THR, there are improvements in the outcomes of the 1st revision of conventional THR over time.

Revision of Total Resurfacing Hip Replacement

The Registry has information on 1,694 1st revisions of known primary total resurfacing hip replacement procedures where the primary diagnosis was osteoarthritis. There are 103 1st revision procedures for infection excluded from this analysis. There are also 4 procedures excluded where minor or major components were not inserted and the diagnosis was not infection. The following analysis is based on 1,587 1st revision procedures.

Demographics

The mean age at 1st revision is 58.8 years, which is 13 years younger than patients undergoing 1st revision for conventional THR. There is minimal difference in the age of patients revised for different reasons. The median time from the primary procedure to the 1st revision is 5.7 years, ranging from 3 years for fracture to 8 years for lysis.

There are more males (55.8%) undergoing a 1st revision. There are variations in gender with respect to the common reasons for revision with more males undergoing 1st revision for loosening (59.1%) and fracture (69.8%) and females for metal related pathology (54.6%). Most patients have an ASA score of 2 (57.5%) and are non-obese (65.5%).

When a femoral stem is revised at the 1st revision it is more likely to be with cementless fixation. The most common head size used in 1st revisions is >32mm (77.7%) and the most common bearing surface is ceramic/ceramic (41.2%). Table RH21 provides demographic details of the 1st revision procedures.

Table RH21 Summary of 1st Revisions of Known Primary Total Resurfacing Hip Replacement (Primary Diagnosis OA, Excluding 1st Revisions for Infection)

Variable	Metal Related Pathology	Loosening	Fracture	Lysis	Pain	Other	TOTAL
Follow-Up Years (Primary to 1st Revision)							
Mean ± SD	7.2 ± 3.5	6.7 ± 4.5	3 ± 4.4	8 ± 3.9	5.5 ± 3.9	5.1 ± 4.3	6.1 ± 4.4
Median (IQR)	6.9 (4.6, 9.4)	6.2 (2.9, 10.1)	0.5 (0.2, 4.5)	8 (4.7, 10.9)	4.8 (2, 8.3)	4.1 (1.4, 7.6)	5.7 (2.2, 9.4)
Minimum	0.6	0	0	0.2	0.2	0	0
Maximum	18.6	19.7	18.2	17.1	16.6	18	19.7
Age at 1st Revision							
Mean ± SD	59.4 ± 8.5	58.7 ± 9.3	58.8 ± 9.8	59.2 ± 8.5	56.6 ± 9.3	58.1 ± 9.7	58.8 ± 9.1
Median (IQR)	60 (54, 65)	59 (53, 65)	59 (52, 65)	59 (54, 65)	57 (50, 63)	59 (52, 65)	59 (53, 65)
Gender							
Male	213 (45.4%)	249 (59.1%)	206 (69.8%)	73 (47.1%)	58 (55.2%)	87 (61.3%)	886 (55.8%)
Female	256 (54.6%)	172 (40.9%)	89 (30.2%)	82 (52.9%)	47 (44.8%)	55 (38.7%)	701 (44.2%)
ASA at 1st Revision[1]							
ASA 1	32 (13.9%)	19 (11.4%)	6 (9.2%)	12 (14.8%)	3 (7.1%)	13 (27.1%)	85 (13.4%)
ASA 2	150 (64.9%)	77 (46.4%)	35 (53.8%)	53 (65.4%)	24 (57.1%)	25 (52.1%)	364 (57.5%)
ASA 3	48 (20.8%)	65 (39.2%)	21 (32.3%)	16 (19.8%)	14 (33.3%)	9 (18.8%)	173 (27.3%)
ASA 4	1 (0.4%)	5 (3.0%)	3 (4.6%)		1 (2.4%)	1 (2.1%)	11 (1.7%)
BMI at 1st Revision[2]							
Underweight						1 (3.1%)	1 (0.2%)
Normal	30 (22.9%)	28 (23.1%)	13 (31.7%)	12 (21.8%)	4 (13.8%)	9 (28.1%)	96 (23.5%)
Pre Obese	61 (46.6%)	53 (43.8%)	15 (36.6%)	25 (45.5%)	8 (27.6%)	9 (28.1%)	171 (41.8%)
Obese Class 1	32 (24.4%)	24 (19.8%)	8 (19.5%)	11 (20.0%)	10 (34.5%)	10 (31.3%)	95 (23.2%)
Obese Class 2	6 (4.6%)	12 (9.9%)	2 (4.9%)	5 (9.1%)	6 (20.7%)	3 (9.4%)	34 (8.3%)
Obese Class 3	2 (1.5%)	4 (3.3%)	3 (7.3%)	2 (3.6%)	1 (3.4%)		12 (2.9%)

Variable	Metal Related Pathology	Loosening	Fracture	Lysis	Pain	Other	TOTAL
Femoral Fixation in 1st Revision							
Femoral Cemented	69 (14.7%)	69 (16.4%)	46 (15.6%)	34 (21.9%)	22 (21.0%)	23 (16.2%)	263 (16.6%)
Femoral Cementless	397 (84.6%)	331 (78.6%)	249 (84.4%)	119 (76.8%)	82 (78.1%)	106 (74.6%)	1,284 (80.9%)
No Femoral Component Inserted in 1st Revision	3 (0.6%)	21 (5.0%)		2 (1.3%)	1 (1.0%)	13 (9.2%)	40 (2.5%)
Acetabular Fixation in 1st Revision							
Acetabular Cemented	15 (3.2%)	13 (3.1%)	5 (1.7%)	2 (1.3%)	4 (3.8%)	6 (4.2%)	45 (2.8%)
Acetabular Cementless	441 (94.0%)	334 (79.3%)	79 (26.8%)	139 (89.7%)	81 (77.1%)	97 (68.3%)	1,171 (73.8%)
No Acetabular Component Inserted in 1st Revision	13 (2.8%)	74 (17.6%)	211 (71.5%)	14 (9.0%)	20 (19%)	39 (27.5%)	371 (23.4%)
Type of Acetabular Prosthesis Used in 1st Revision[3]							
Constrained Prosthesis	3 (0.6%)		1 (0.3%)		1 (1.0%)	2 (1.6%)	7 (0.5%)
Dual Mobility Prosthesis	33 (7.1%)	24 (6.0%)	19 (6.5%)	15 (9.7%)	5 (4.8%)	16 (12.5%)	112 (7.2%)
Acetabular Insert Internal Diameter >32mm	350 (74.9%)	307 (76.9%)	255 (86.7%)	111 (72.1%)	81 (77.9%)	97 (75.8%)	1,201 (77.7%)
Acetabular Insert Internal Diameter 32mm	73 (15.6%)	58 (14.5%)	17 (5.8%)	26 (16.9%)	16 (15.4%)	8 (6.3%)	198 (12.8%)
Acetabular Insert Internal Diameter <32mm	8 (1.7%)	10 (2.5%)	2 (0.7%)	2 (1.3%)	1 (1.0%)	5 (3.9%)	28 (1.8%)
Bearing Surface in THR 1st Revision[4]							
Ceramic/Ceramic	194 (43.0%)	114 (35.1%)	31 (37.3%)	68 (48.9%)	37 (44%)	38 (42.7%)	482 (41.2%)
Ceramic/Non XLPE	7 (1.6%)	6 (1.8%)		2 (1.4%)	2 (2.4%)	3 (3.4%)	20 (1.7%)
Ceramic/XLPE	128 (28.4%)	81 (24.9%)	20 (24.1%)	36 (25.9%)	18 (21.4%)	24 (27.0%)	307 (26.2%)
Ceramic/Metal		1 (0.3%)		1 (0.7%)			2 (0.2%)
Metal/Metal		10 (3.1%)			2 (2.4%)	2 (2.2%)	14 (1.2%)
Metal/Non XLPE	5 (1.1%)	8 (2.5%)	2 (2.4%)		1 (1.2%)	2 (2.2%)	18 (1.5%)
Metal/XLPE	59 (13.1%)	58 (17.8%)	20 (24.1%)	23 (16.5%)	16 (19%)	10 (11.2%)	186 (15.9%)
Ceramicised Metal/XLPE	58 (12.9%)	47 (14.5%)	10 (12.0%)	9 (6.5%)	8 (9.5%)	10 (11.2%)	142 (12.1%)
TOTAL	469	421	295	155	105	142	1,587

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

[1]Excludes 954 procedures with an unknown ASA at the 1st revision

[2]Excludes 1,178 procedures with an unknown BMI at the 1st revision

[3]Excludes 41 procedures with an unknown type of acetabular prosthesis used in the 1st revision

[4]Restricted to 1st revision procedures where the type of 1st revision is THR (femoral/acetabular). Five procedures have an unknown bearing surface

OUTCOME OF 1ST REVISION

There are 254 revisions of 1st revision procedures and the cumulative percent 2nd revision at 15 years is 27.5% (Table RH22 and Figure RH19).

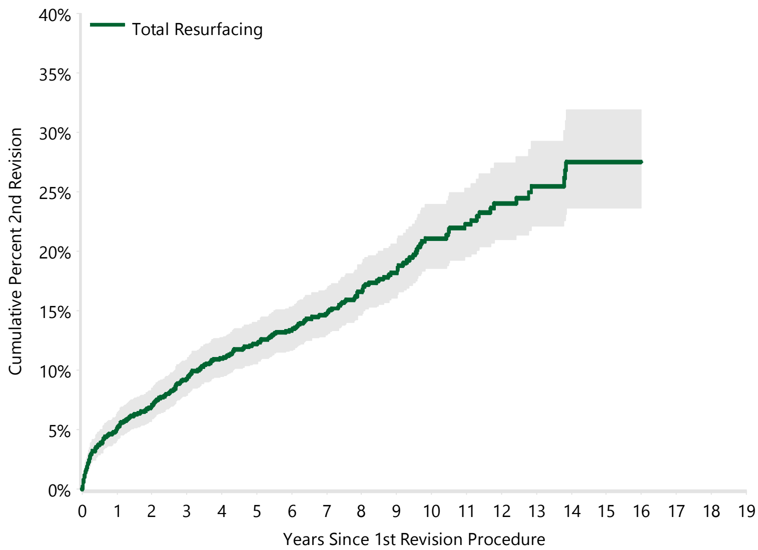
The most common reasons for 2nd revision are infection (20.5%), loosening (20.5%), metal related pathology (20.1%), and prosthesis dislocation/instability (18.1%) (Table RH23 and Figure RH20).

Revision of the acetabular component is the most common type of 2nd revision (40.9%), followed by head/insert (18.1%), THR (femoral/acetabular) (16.9%), femoral component (12.6%), and cement spacer (4.7%). All types of 2nd revision are listed in Table RH24.

Table RH22 Cumulative Percent 2nd Revision of Known Primary Total Resurfacing Hip Replacement by (Primary Diagnosis OA, Excluding 1st Revision for Infection)

Revision of Primary	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Total Resurfacing	254	1587	5.1 (4.1, 6.3)	9.3 (7.9, 10.8)	12.2 (10.6, 14.0)	21.1 (18.6, 23.9)	27.5 (23.6, 31.9)	
TOTAL	254	1587						

Figure RH19 Cumulative Percent 2nd Revision of Known Primary Total Resurfacing Hip Replacement (Primary Diagnosis OA, Excluding 1st Revision for Infection)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Total Resurfacing	1587	1412	1220	993	317	72	0

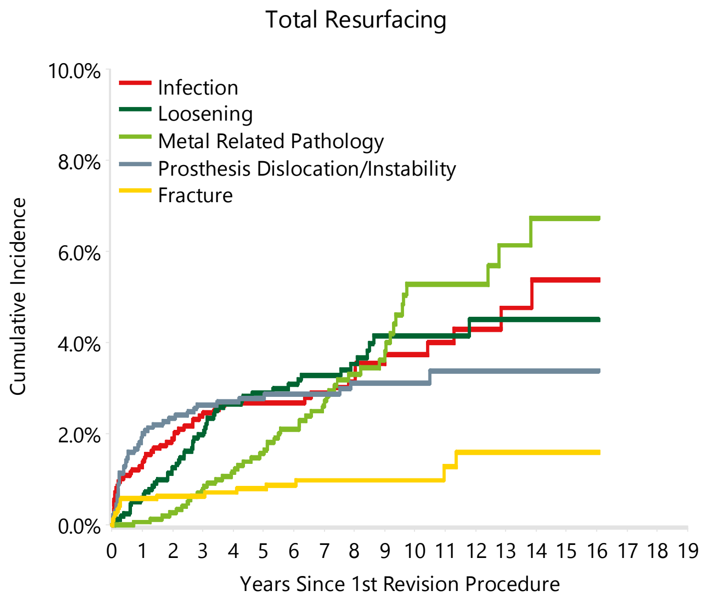
Table RH23 2nd Revision Diagnosis of Known Primary Total Resurfacing Hip Replacement (Primary Diagnosis OA, Excluding 1st Revision for Infection)

2nd Revision Diagnosis	Number	Percent
Infection	52	20.5
Loosening	52	20.5
Metal Related Pathology	51	20.1
Prosthesis Dislocation/Instability	46	18.1
Fracture	16	6.3
Lysis	13	5.1
Pain	7	2.8
Malposition	5	2.0
Leg Length Discrepancy	3	1.2
Implant Breakage Stem	2	0.8
Wear Head	2	0.8
Progression Of Disease	1	0.4
Implant Breakage Acetabular Insert	1	0.4
Other	3	1.2
TOTAL	254	100.0

Table RH24 Type of 2nd Revision of Known Primary Total Resurfacing Hip Replacement (Primary Diagnosis OA, Excluding 1st Revision for Infection)

Type of 2nd Revision	Number	Percent
Acetabular Component	104	40.9
Head/Insert	46	18.1
THR (Femoral/Acetabular)	43	16.9
Femoral Component	32	12.6
Cement Spacer	12	4.7
Head Only	9	3.5
Removal of Prostheses	4	1.6
Head/Neck	2	0.8
Minor Components	1	0.4
Head/Neck/Insert	1	0.4
TOTAL	254	100.0

Figure RH20 Cumulative Incidence 2nd Revision Diagnosis of Known Primary Total Resurfacing Hip Replacement (Primary Diagnosis OA, Excluding 1st Revision for Infection)



OUTCOME OF 1ST REVISION BY PATIENT CHARACTERISTICS

There are no differences in the rate of 2nd revision with respect to age, gender and ASA score.

The outcomes of the 1st revision by type of 1st revision have been compared. All 1st revisions are major as there is no liner or head change possible when revising a total resurfacing hip replacement. Most 1st revision procedures are THR revisions (74.1%), followed by femoral component only (23.3%), with only a few acetabular only revisions (2.5%).

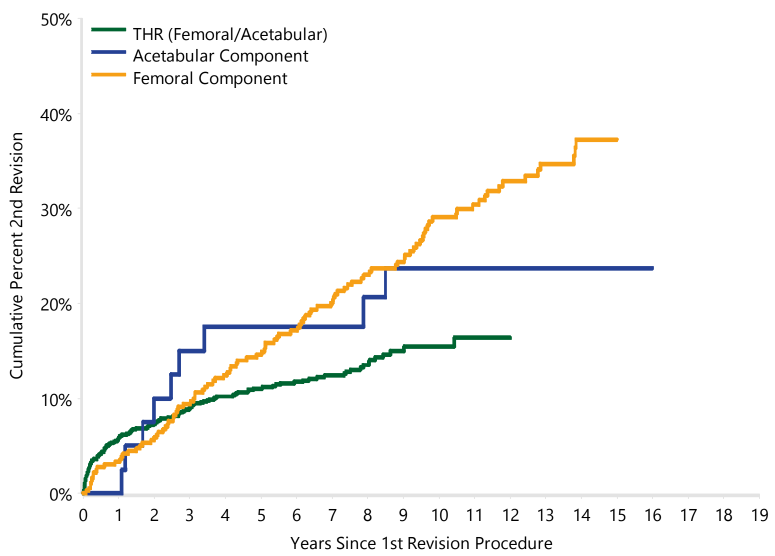
A THR performed at the time of the 1st revision has the lowest cumulative percent 2nd revision of 15.5% at 10 years compared to 23.7% for acetabular only, and 29.0% for femoral only.

Femoral component only revisions have almost three times the risk of 2nd revision compared to THR after 1.5 years. There is no difference between acetabular only revisions compared to THR revisions and femoral component only revisions (Table RH25 and Figure RH21).

Table RH25 Cumulative Percent 2nd Revision of Known Primary Total Resurfacing Hip Replacement by Type of 1st Revision (Primary Diagnosis OA, Excluding 1st Revision for Infection)

Type of 1st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
THR (Femoral/Acetabular)	139	1176	5.8 (4.6, 7.4)	8.9 (7.4, 10.8)	11.0 (9.3, 13.1)	15.5 (12.9, 18.4)		
Acetabular Component	9	40	0.0 (0.0, 0.0)	15.0 (7.0, 30.4)	17.6 (8.8, 33.4)	23.7 (13.0, 40.8)	23.7 (13.0, 40.8)	
Femoral Component	106	371	3.3 (1.9, 5.7)	9.4 (6.8, 13.0)	14.6 (11.3, 18.8)	29.0 (24.3, 34.5)	37.3 (31.4, 43.7)	
TOTAL	254	1587						

Figure RH21 Cumulative Percent 2nd Revision of Known Primary Total Resurfacing Hip Replacement by Type of 1st Revision (Primary Diagnosis OA, Excluding 1st Revision for Infection)



HR - adjusted for age and gender

Acetabular Component vs THR (Femoral/Acetabular)
Entire Period: HR=1.42 (0.72, 2.80),p=0.315

Acetabular Component vs Femoral Component
Entire Period: HR=0.70 (0.35, 1.39),p=0.308

Femoral Component vs THR (Femoral/Acetabular)
0 - 3Mth: HR=0.42 (0.16, 1.06),p=0.065
3Mth - 6Mth: HR=1.85 (0.62, 5.54),p=0.269
6Mth - 1.5Yr: HR=0.74 (0.32, 1.67),p=0.464
1.5Yr - 5.5Yr: HR=2.56 (1.67, 3.91),p<0.001
5.5Yr+: HR=3.51 (2.03, 6.05),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
THR (Femoral/Acetabular)	1176	1028	884	688	121	8	0
Acetabular Component	40	40	34	31	23	10	0
Femoral Component	371	344	302	274	173	54	0

OUTCOME BY PROSTHESIS CHARACTERISTICS

The Registry has examined the outcomes of the type of femoral fixation performed at the 1st revision for both THR and femoral only revisions. There is no difference in the rate of 2nd revision if the femoral component is cemented or cementless (Table RH26 and Figure RH22).

There are 1,171 THR performed at the 1st revision with 8 different bearing surfaces used. Metal/metal surfaces have the highest rate of 2nd revision at 5 years of 28.6%. There is no difference in the rate of 2nd revision between ceramic/ceramic, ceramic/XLPE and ceramicised metal/XLPE compared to metal/XLPE (Table RH27 and Figure RH23).

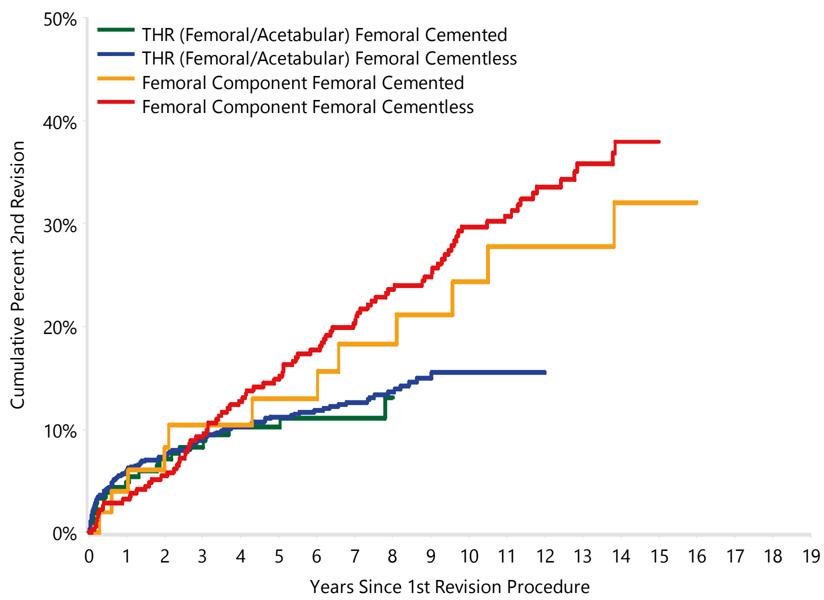
For THR performed at the 1st revision, the outcomes of the 1st revision procedures with head sizes <32mm, 32mm, >32mm and the use of constrained liners and dual mobility cups were analysed. There are 1,172 1st revision THR procedures, with large head sizes >32mm most commonly used (75.4%). There are no 2nd revisions with the use of constrained liner prostheses, but these have only been used in 7 procedures. There is no difference in the rate of 2nd revision between any of the groups (Table RH28 and Figure RH24).

The Registry has also investigated the use of dual mobility liners used when there was a femoral component revision with no acetabular major component revision. There are 54 1st revision procedures with a dual mobility liner of which 2 had a further revision, compared to 317 femoral only 1st revisions with no dual mobility liner of which 104 were revised. The cumulative percent 2nd revision of dual mobility liners is 4.3% at 5 years compared to 15.2% for other femoral component revisions (Table RH29).

Table RH26 Cumulative Percent 2nd Revision of Known Primary Total Resurfacing Hip Replacement by Type of 1st Revision and Femoral Fixation (Primary Diagnosis OA, Excluding 1st Revision for Infection)

Type of 1st Revision	Femoral Fixation Used in 1st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
THR (Femoral/Acetabular)	Femoral Cemented	23	210	4.9 (2.7, 8.9)	8.3 (5.1, 13.2)	10.2 (6.6, 15.6)			
	Femoral Cementless	116	966	6.0 (4.7, 7.8)	9.1 (7.4, 11.1)	11.2 (9.3, 13.5)	15.5 (12.8, 18.7)		
Femoral Component	Femoral Cemented	12	53	4.0 (1.0, 15.1)	10.4 (4.5, 23.3)	13.0 (6.0, 26.8)	24.3 (13.7, 41.0)	32.0 (19.0, 50.6)	
	Femoral Cementless	94	318	3.2 (1.7, 5.9)	9.3 (6.5, 13.1)	14.8 (11.3, 19.4)	29.7 (24.6, 35.6)	37.9 (31.7, 45.0)	
TOTAL		245	1547						

Figure RH22 Cumulative Percent 2nd Revision of Known Primary Total Resurfacing Hip Replacement by Type of 1st Revision and Femoral Fixation (Primary Diagnosis OA, Excluding 1st Revision for Infection)



HR - adjusted for age and gender

THR (Femoral/Acetabular) Femoral Cemented vs
THR (Femoral/Acetabular) Femoral Cementless
Entire Period: HR=1.00 (0.64, 1.57),p=0.991

Femoral Component Femoral Cemented vs
Femoral Component Femoral Cementless
Entire Period: HR=0.82 (0.45, 1.50),p=0.520

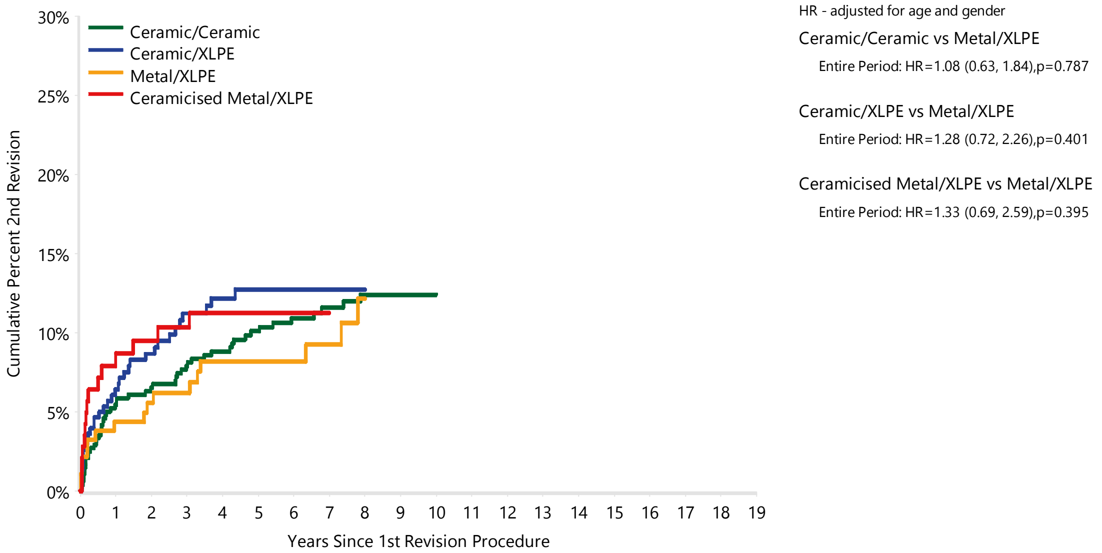
Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
THR (Femoral/Acetabular)	Femoral Cemented	210	182	146	102	13	0	0
	Femoral Cementless	966	846	738	586	108	8	0
Femoral Component	Femoral Cemented	53	47	39	34	24	13	0
	Femoral Cementless	318	297	263	240	149	41	0

Table RH27 Cumulative Percent 2nd Revision of Known Primary Total Resurfacing Hip Replacement by Bearing Surface in 1st Revision (Primary Diagnosis OA, Excluding 1st Revision for Infection)

Bearing Surface in 1st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Ceramic/Ceramic	54	482	5.5 (3.7, 7.9)	7.9 (5.8, 10.7)	10.1 (7.7, 13.3)	12.4 (9.6, 16.0)		
Ceramic/Non XLPE	5	20	10.0 (2.6, 34.4)	16.4 (5.5, 43.2)	16.4 (5.5, 43.2)	45.2 (18.2, 83.3)		
Ceramic/XLPE	34	307	6.4 (4.1, 9.9)	11.2 (8.0, 15.6)	12.7 (9.2, 17.4)			
Ceramic/Metal	0	2	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)				
Metal/Metal	8	14	0.0 (0.0, 0.0)	7.1 (1.0, 40.9)	28.6 (11.8, 59.4)	57.1 (34.0, 82.3)		
Metal/Non XLPE	2	18	0.0 (0.0, 0.0)	16.9 (4.5, 52.8)	16.9 (4.5, 52.8)	16.9 (4.5, 52.8)		
Metal/XLPE	18	186	4.4 (2.2, 8.6)	6.2 (3.5, 10.9)	8.2 (4.9, 13.5)			
Ceramicised Metal/XLPE	17	142	8.7 (5.0, 14.8)	10.4 (6.3, 16.9)	11.3 (6.9, 18.0)			
TOTAL	138	1171						

Note: Restricted to 1st revision procedures where the type of 1st revision is THR (femoral/acetabular)
Excludes 5 procedures where the insert was not replaced at the 1st revision

Figure RH23 Cumulative Percent 2nd Revision of Known Primary Total Resurfacing Hip Replacement by Bearing Surface in 1st Revision (Primary Diagnosis OA, Excluding 1st Revision for Infection)



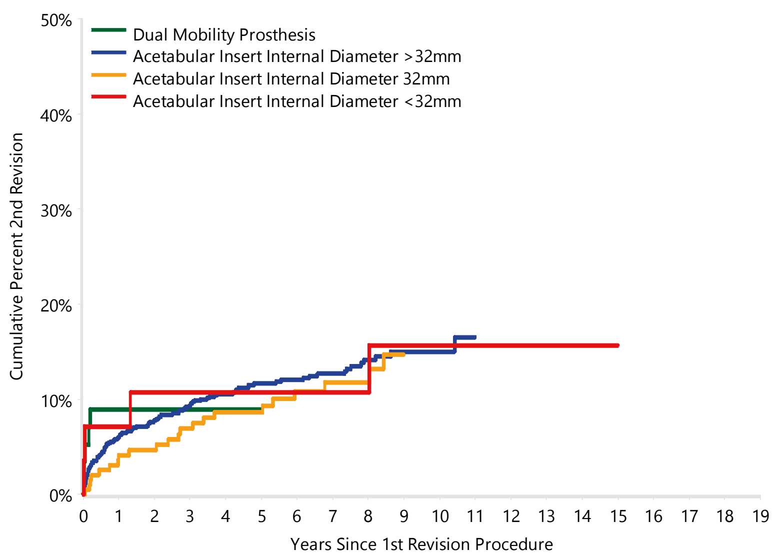
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Ceramic/Ceramic	482	441	403	340	61	3	0
Ceramic/XLPE	307	256	201	142	12	1	0
Metal/XLPE	186	167	140	109	24	1	0
Ceramicised Metal/XLPE	142	116	100	66	10	1	0

Table RH28 Cumulative Percent 2nd Revision of Known Primary Total Resurfacing Hip Replacement by Type of 1st Revision and Type of Acetabular Prosthesis in 1st Revision (Primary Diagnosis OA, Excluding 1st Revision for Infection)

Type of Acetabular Prosthesis in 1st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Constrained Prosthesis	0	7	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)			
Dual Mobility Prosthesis	5	58	8.9 (3.8, 20.1)	8.9 (3.8, 20.1)	8.9 (3.8, 20.1)			
Acetabular Insert Internal Diameter >32mm	107	884	6.0 (4.6, 7.8)	9.3 (7.5, 11.5)	11.7 (9.6, 14.1)	15.0 (12.3, 18.2)		
Acetabular Insert Internal Diameter 32mm	22	195	4.1 (2.1, 8.1)	6.9 (4.1, 11.6)	8.6 (5.4, 13.7)			
Acetabular Insert Internal Diameter <32mm	4	28	7.1 (1.8, 25.7)	10.7 (3.6, 29.6)	10.7 (3.6, 29.6)	15.7 (6.1, 37.1)	15.7 (6.1, 37.1)	
TOTAL	138	1172						

Note: Restricted to 1st revision procedures where the type of 1st revision is THR (femoral/acetabular)
Excludes 4 procedures where the femoral head was not replaced

Figure RH24 Cumulative Percent 2nd Revision of Known Primary Total Resurfacing Hip Replacement by Type of 1st Revision and Type of Acetabular Prosthesis in 1st Revision (Primary Diagnosis OA, Excluding 1st Revision for Infection)



HR - adjusted for age and gender
Dual Mobility Prosthesis vs
Acetabular Insert Internal Diameter >32mm
0 - 2Wk: HR=12.61 (2.10, 75.66),p=0.005
2Wk+: HR=0.77 (0.24, 2.45),p=0.663

Acetabular Insert Internal Diameter 32mm vs
Acetabular Insert Internal Diameter >32mm
Entire Period: HR=0.86 (0.54, 1.37),p=0.535

Acetabular Insert Internal Diameter <32mm vs
Acetabular Insert Internal Diameter >32mm
Entire Period: HR=1.00 (0.36, 2.76),p=0.997

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Dual Mobility Prosthesis	58	32	16	7	0	0	0
Acetabular Insert Internal Diameter >32mm	884	778	674	524	76	1	0
Acetabular Insert Internal Diameter 32mm	195	182	164	130	32	1	0
Acetabular Insert Internal Diameter <32mm	28	26	24	21	13	6	0

Table RH29 Cumulative Percent 2nd Revision of Known Primary Total Resurfacing Hip Replacement by Type of 1st Revision and Dual Mobility Liner (Primary Diagnosis OA, Excluding 1st Revision for Infection)

Dual Mobility Liner in 1st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Dual Mobility Liner	2	54	4.3 (1.1, 16.3)	4.3 (1.1, 16.3)	4.3 (1.1, 16.3)			
Non Dual Mobility Liner	104	317	3.2 (1.7, 5.8)	9.8 (7.0, 13.6)	15.2 (11.7, 19.7)	29.7 (24.8, 35.2)	37.8 (32.0, 44.3)	
TOTAL	106	371						

Note: Restricted to procedures where the femoral component only was replaced at the 1st revision

OUTCOMES BY REASON FOR 1ST REVISION

The Registry has performed further analyses on the outcomes by the most common reasons for 1st revision of total hip resurfacing. These are 1st revisions for metal related pathology, loosening, fracture, lysis and pain.

When comparing the outcome of the 1st revision by reason for the 1st revision, procedures revised for pain have the highest rate of 2nd revision at 5 years of 17.4%. There are some complexities in further comparison of the outcome of the 1st revision as there is likely to be overlap in the diagnoses recorded at the time of the 1st revision between metal related pathology, loosening, lysis and fracture. Pain could be also be related to all of these reasons for revision. The cumulative percent 2nd revision for these reasons are shown in Table RH30 and Figure RH25.

Metal Related Pathology

There are 469 procedures performed with a 1st revision diagnosis of metal related pathology, with 47 undergoing a 2nd revision. The median time from primary procedure to revision for metal related pathology is 6.9 years, the mean age is slightly older at 59.4 years with more females (54.6%) undergoing revision for metal related pathology (Table RH21). The cumulative percent 2nd revision at 5 years is 9.9% (Table RH30 and Figure RH25).

Females are more likely to undergo a 1st revision for metal related pathology.

Loosening

There are 421 procedures performed for a 1st revision diagnosis of loosening, with 73 of these procedures undergoing a 2nd revision. The median time from primary procedure to revision for loosening is 6.2 years, the mean age is 58.7 years and slightly more males (59.1%) are revised for loosening (Table RH21). The cumulative percent 2nd revision at 10 years is 22.0% (Table RH30 and Figure RH25).

Fracture

There are 295 procedures performed for a 1st revision diagnosis of fracture, with 71 of these procedures undergoing a 2nd revision. The median time from primary procedure to revision for fracture is 0.5 years, the mean age is 58.8 years with more males (69.8%) undergoing revision for fracture (Table RH21). The cumulative percent 2nd revision at 10 years is 26.5% (Table RH30 and Figure RH25).

Lysis

There are 155 procedures performed for a 1st revision diagnosis of lysis, with 17 of these procedures undergoing a 2nd revision. The median time to revision for lysis is 8 years which is longer compared to the other common reasons, except for metal related pathology as these two diagnoses are likely to be similar. The mean age is 59.2 years and more females (52.9%) are revised for lysis (Table RH21). The cumulative percent 2nd revision at 5 years is 10.8% (Table RH30 and Figure RH25).

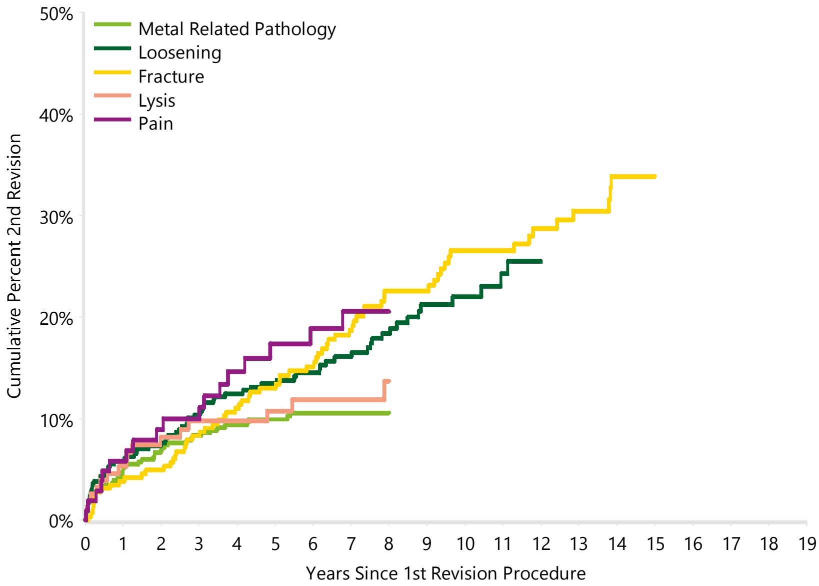
Pain

There are 105 procedures performed for a 1st revision diagnosis of pain, with 21 of these procedures undergoing a 2nd revision. The median time to revision for pain is 4.8 years. The mean age is 56.6 years and more males (55.2%) are revised for pain (Table RH21). The cumulative percent 2nd revision at 5 years is 17.4% (Table RH30 and Figure RH25).

Table RH30 Cumulative Percent 2nd Revision of Known Primary Total Resurfacing Hip Replacement by Reason for 1st Revision (Primary Diagnosis OA)

Reason for 1st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Metal Related Pathology	47	469	5.0 (3.4, 7.5)	8.4 (6.1, 11.4)	9.9 (7.4, 13.2)			
Loosening	73	421	5.8 (3.9, 8.5)	10.4 (7.7, 13.8)	13.4 (10.3, 17.3)	22.0 (17.5, 27.4)		
Fracture	71	295	3.8 (2.1, 6.8)	8.3 (5.6, 12.2)	13.0 (9.5, 17.6)	26.5 (21.2, 32.8)	33.9 (27.2, 41.6)	
Lysis	17	155	5.3 (2.7, 10.3)	9.7 (5.9, 15.9)	10.8 (6.6, 17.3)			
Pain	21	105	5.8 (2.6, 12.5)	10.0 (5.5, 17.7)	17.4 (10.9, 26.9)			
TOTAL	229	1445						

Figure RH25 Cumulative Percent 2nd Revision of Known Primary Total Resurfacing Hip Replacement by Reason for 1st Revision (Primary Diagnosis OA)



HR - adjusted for age and gender

Loosening vs Fracture
0 - 3Mth: HR=1.91 (0.87, 4.21),p=0.108
3Mth+: HR=0.76 (0.53, 1.09),p=0.137

Lysis vs Fracture
0 - 3Mth: HR=1.29 (0.40, 4.11),p=0.671
3Mth - 1.5Yr: HR=1.30 (0.56, 3.05),p=0.543
1.5Yr+: HR=0.31 (0.13, 0.72),p=0.006

Metal Related Pathology vs Fracture
0 - 1Mth: HR=1.98 (0.69, 5.67),p=0.204
1Mth - 1Yr: HR=0.92 (0.47, 1.81),p=0.819
1Yr - 2Yr: HR=0.86 (0.36, 2.06),p=0.737
2Yr+: HR=0.29 (0.16, 0.51),p<0.001

Pain vs Fracture
Entire Period: HR=1.04 (0.63, 1.71),p=0.886

Lysis vs Loosening
Entire Period: HR=0.67 (0.40, 1.14),p=0.140

Metal Related Pathology vs Loosening
Entire Period: HR=0.61 (0.42, 0.88),p=0.008

Pain vs Loosening
Entire Period: HR=1.17 (0.72, 1.90),p=0.534

Lysis vs Metal Related Pathology
Entire Period: HR=1.11 (0.63, 1.93),p=0.723

Pain vs Metal Related Pathology
Entire Period: HR=1.92 (1.15, 3.22),p=0.013

Pain vs Lysis
Entire Period: HR=1.73 (0.91, 3.29),p=0.091

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Metal Related Pathology	469	416	373	296	25	1	0
Loosening	421	374	308	253	93	18	0
Fracture	295	269	242	210	121	44	0
Lysis	155	136	113	85	20	2	0
Pain	105	92	80	58	18	3	0

MORTALITY FOLLOWING THE 1ST REVISION

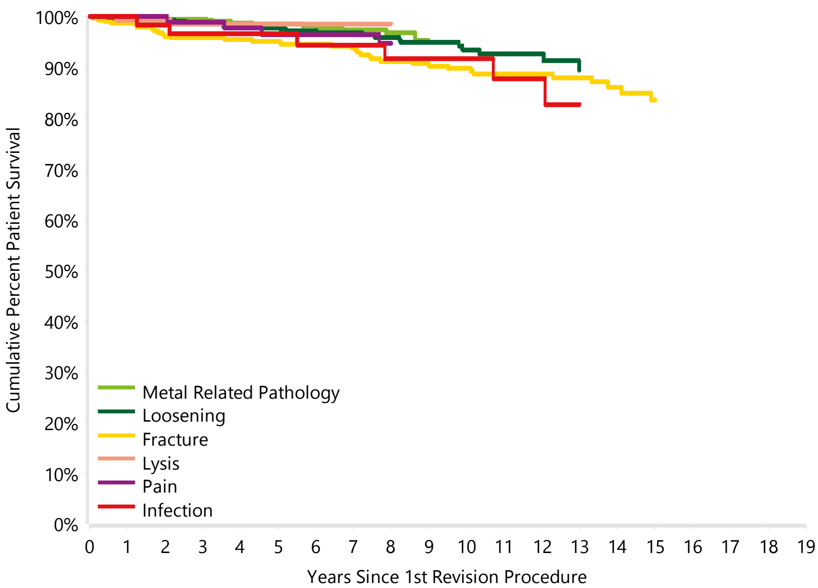
The Registry has examined mortality following the 1st revision of a primary resurfacing hip replacement and the reason for the 1st revision. Overall, the mortality of a 1st revision procedure is 0% at 30 days (no deaths), 0.2 % at 90 days, 0.5 % at 1 year, and 6.5 % at 10 years (Table RH31).

Unlike mortality of the 1st revision of conventional THR, there are no differences in mortality by reason for the 1st revision for resurfacing hip replacement (Figure RH26).

Table RH31 Cumulative Percent Patient Survival of Known Primary Total Resurfacing Hip Replacement Since 1st Revised by Reason for 1st Revision

Reason for 1st Revision	N Deceased	N Total	30 Day	90 Day	1 Yr	5 Yrs	10 Yrs	15 Yrs
Metal Related Pathology	11	469	100.0 (100.0, 100.0)	100.0 (100.0, 100.0)	100.0 (100.0, 100.0)	98.5 (96.7, 99.3)		
Loosening	22	421	100.0 (100.0, 100.0)	99.8 (98.3, 100.0)	99.3 (97.7, 99.8)	97.8 (95.6, 98.9)	93.4 (89.3, 96.0)	
Fracture	35	295	100.0 (100.0, 100.0)	99.3 (97.3, 99.8)	98.6 (96.3, 99.5)	95.0 (91.7, 97.0)	89.7 (85.2, 92.9)	83.5 (76.5, 88.5)
Lysis	2	155	100.0 (100.0, 100.0)	100.0 (100.0, 100.0)	99.3 (95.3, 99.9)	98.6 (94.4, 99.6)		
Pain	4	105	100.0 (100.0, 100.0)	100.0 (100.0, 100.0)	100.0 (100.0, 100.0)	96.5 (89.4, 98.9)		
Infection	7	61	100.0 (100.0, 100.0)	100.0 (100.0, 100.0)	100.0 (100.0, 100.0)	96.6 (87.1, 99.1)	91.6 (78.6, 96.8)	
TOTAL	81	1506	100.0 (100.0, 100.0)	99.8 (99.4, 99.9)	99.5 (98.9, 99.7)	97.4 (96.4, 98.1)	93.5 (91.6, 95.0)	86.9 (82.3, 90.3)

Figure RH26 Cumulative Percent Patient Survival of Known Primary Total Resurfacing Hip Replacement Since 1st Revised by Reason for 1st Revision



HR - adjusted for age and gender

Loosening vs Metal Related Pathology
Entire Period: HR=1.55 (0.75, 3.23),p=0.238

Fracture vs Metal Related Pathology
Entire Period: HR=1.33 (0.63, 2.78),p=0.453

Lysis vs Metal Related Pathology
Entire Period: HR=0.54 (0.12, 2.44),p=0.422

Pain vs Metal Related Pathology
Entire Period: HR=1.18 (0.37, 3.72),p=0.780

Infection vs Metal Related Pathology
Entire Period: HR=2.30 (0.88, 6.05),p=0.090

Number at Risk	0 Yr	1 Yr	5 Yrs	10 Yrs	15 Yrs
Metal Related Pathology	469	439	325	35	1
Loosening	421	397	289	128	25
Fracture	295	278	242	171	58
Lysis	155	144	95	25	2
Pain	105	97	72	26	4
Infection	61	60	45	24	4

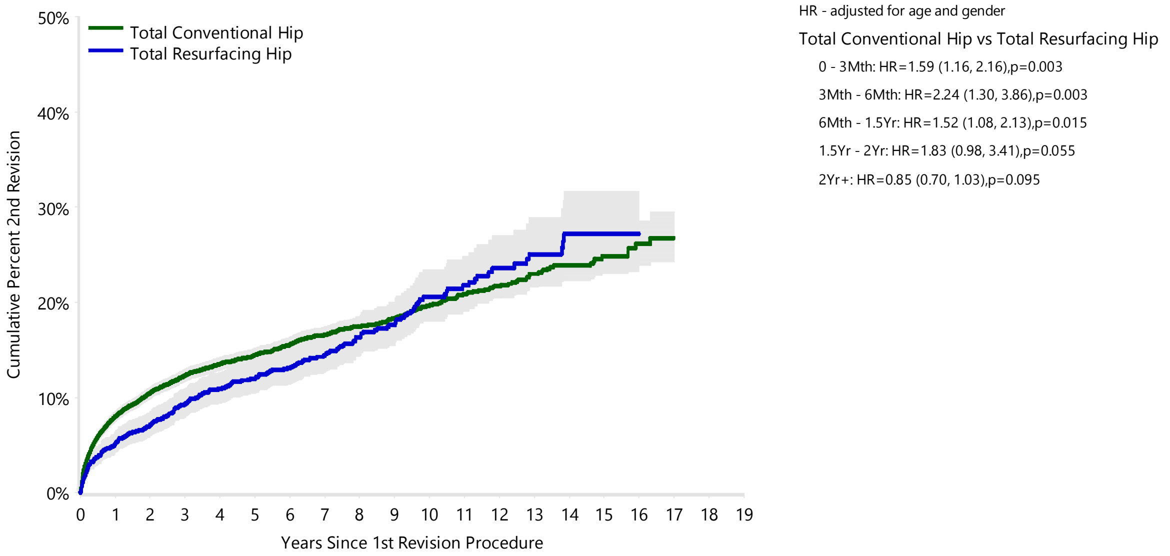
COMPARATIVE OUTCOMES OF 1ST REVISION

The outcomes of the 1st revisions for both total resurfacing and total conventional hip replacement were compared. There is a higher rate of 2nd revision of the 1st revision of total resurfacing hip replacement compared to the 1st revisions of conventional hip replacement for the first 1.5 years and after this time there is no difference (Table RH32 and Figure RH27).

Table RH32 Cumulative Percent 2nd Revision of Known Primary Hip Replacement by Class (Primary Diagnosis OA, Excluding 1st Revision for Infection, Excluding 1st Revision Metal/Metal)

Class	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Total Conventional Hip	1729	12479	8.0 (7.5, 8.5)	12.3 (11.7, 13.0)	14.5 (13.8, 15.2)	19.6 (18.6, 20.7)	24.8 (23.1, 26.7)	
Total Resurfacing Hip	246	1573	5.1 (4.1, 6.4)	9.3 (7.9, 10.9)	12.0 (10.4, 13.8)	20.5 (18.0, 23.4)	27.2 (23.2, 31.6)	
TOTAL	1975	14052						

Figure RH27 Cumulative Percent 2nd Revision of Known Primary Hip Replacement by Class (Primary Diagnosis OA, Excluding 1st Revision for Infection, Excluding 1st Revision Metal/Metal)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Total Conventional Hip	12479	9900	6960	4712	1426	266	4
Total Resurfacing Hip	1573	1398	1207	983	311	71	0

REVISION OF TOTAL RESURFACING HIP REPLACEMENT SUMMARY

The mean age of patients undergoing 1st revision of resurfacing hip replacement is 58.8 years which is 12 years younger than the mean age for 1st revision of conventional THR procedures.

The cumulative percent 2nd revision at 15 years is 27.5%. There are no differences in outcomes of 1st revision with respect to age, gender and ASA.

There are complexities involved in analysing 1st revisions by reason for 1st revision.

There is no difference in mortality for the different reasons for 1st revision.

Revision of Total Knee Replacement

The Registry has information on 27,580 1st revision total knee replacement (TKR) procedures where the primary diagnosis was osteoarthritis. There are 6,539 procedures excluded where the 1st revision was undertaken for infection.

There are 20,840 1st revision TKR procedures included in this analysis.

There are also 201 procedures excluded where minor or major TKR prostheses were not inserted, and the diagnosis was not infection. This group includes procedures where the prosthesis is removed and not replaced for indications such as patella fracture, patella component breakage or loosening (n=102), procedures where a cement spacer is inserted and the diagnosis is not recorded as infection (n=81), procedures that are cement only (n=9), or procedures where a total femoral replacement is used (n=12). This analysis includes 20,840 1st revision TKR procedures.

DEMOGRAPHICS OF 1ST REVISION

The mean age at 1st revision is 68.2 years. There is some variation in mean age with revision diagnosis, with patients revised for arthrofibrosis being younger (66.0 years) and those revised for fracture being older (74.0 years).

Revision TKR is more common in females (57.5%) and the highest proportion of patients have ASA score 2 (48.4%) and have a BMI in the obese class 1 category (31.6%). Demographic details for revision TKR procedures are shown in Table RK1.

Table RK1 Summary of 1st Revisions of Known Primary Knee Replacement (Primary Diagnosis OA, Excluding 1st Revision for Infection)

Variable	Loosening	Patella Reasons	Instability	Pain	Arthrofibrosis	Other	TOTAL
Follow-up Years (Primary to 1st Revision)							
Mean ± SD	4.3 ± 3.8	3.8 ± 3.4	3.4 ± 3.3	3.4 ± 3	2.3 ± 2.3	4.8 ± 4.5	4 ± 3.7
Median (IQR)	2.9 (1.4, 6.2)	2.4 (1.3, 5.4)	2.2 (1.1, 4.8)	2.3 (1.3, 4.5)	1.6 (0.9, 2.9)	3.3 (1.1, 8)	2.5 (1.2, 5.7)
Minimum	0	0	0	0	0	0	0
Maximum	18.9	19.8	17.3	18.2	16.2	18.9	19.8
Age at 1st Revision							
Mean ± SD	67.7 ± 9.2	68.8 ± 9.5	67 ± 9.6	68.3 ± 9	66 ± 8.8	69.2 ± 9.7	68.2 ± 9.4
Median (IQR)	68 (61, 74)	69 (63, 76)	67 (61, 74)	69 (62, 75)	66 (60, 72)	69 (63, 76)	68 (62, 75)
Age at 1st Revision in Groups							
<55	511 (7.6%)	310 (7.1%)	239 (10.2%)	155 (7.0%)	92 (9.3%)	286 (6.7%)	1,593 (7.6%)
55-64	1,925 (28.7%)	1,057 (24.3%)	703 (30%)	583 (26.2%)	317 (32.2%)	1,041 (24.5%)	5,626 (27.0%)
65-74	2,632 (39.3%)	1,717 (39.5%)	862 (36.8%)	904 (40.6%)	413 (41.9%)	1,632 (38.5%)	8,160 (39.2%)
≥75	1,632 (24.4%)	1,262 (29.0%)	537 (22.9%)	584 (26.2%)	163 (16.5%)	1,283 (30.2%)	5,461 (26.2%)
Gender							
Male	2,887 (43.1%)	1,855 (42.7%)	954 (40.8%)	968 (43.5%)	532 (54%)	1,660 (39.1%)	8,856 (42.5%)
Female	3,813 (56.9%)	2,491 (57.3%)	1,387 (59.2%)	1,258 (56.5%)	453 (46%)	2,582 (60.9%)	11,984 (57.5%)
ASA at 1st Revision[1]							
ASA 1	125 (3.7%)	104 (4.4%)	66 (4.1%)	41 (3.8%)	37 (7.0%)	85 (3.6%)	458 (4.1%)
ASA 2	1,612 (48.1%)	1,221 (51.5%)	766 (47.9%)	571 (52.3%)	287 (54.2%)	1,008 (42.7%)	5,465 (48.4%)
ASA 3	1,547 (46.2%)	1,021 (43.1%)	730 (45.7%)	463 (42.4%)	199 (37.5%)	1,163 (49.3%)	5,123 (45.3%)
ASA 4	67 (2.0%)	23 (1.0%)	37 (2.3%)	16 (1.5%)	7 (1.3%)	104 (4.4%)	254 (2.2%)
BMI at 1st Revision[2]							
Underweight	3 (0.1%)	2 (0.1%)	5 (0.4%)		3 (0.7%)	8 (0.5%)	21 (0.3%)
Normal	188 (7.8%)	149 (9.1%)	103 (8.1%)	63 (8.0%)	51 (12.6%)	175 (10.7%)	729 (9.0%)
Pre Obese	664 (27.7%)	503 (30.8%)	369 (29.1%)	226 (28.5%)	125 (30.8%)	478 (29.3%)	2,365 (29.1%)
Obese Class 1	732 (30.6%)	507 (31.1%)	425 (33.5%)	280 (35.4%)	123 (30.3%)	498 (30.5%)	2,565 (31.6%)
Obese Class 2	478 (19.9%)	298 (18.3%)	232 (18.3%)	151 (19.1%)	71 (17.5%)	266 (16.3%)	1,496 (18.4%)
Obese Class 3	331 (13.8%)	172 (10.5%)	133 (10.5%)	72 (9.1%)	33 (8.1%)	207 (12.7%)	948 (11.7%)
Fixation of Primary							
Cemented	3,430 (51.2%)	2,009 (46.2%)	1,262 (53.9%)	1,145 (51.4%)	525 (53.3%)	1,952 (46%)	10,323 (49.5%)
Cementless	1,790 (26.7%)	1,222 (28.1%)	505 (21.6%)	521 (23.4%)	261 (26.5%)	1,396 (32.9%)	5,695 (27.3%)
Hybrid (Tibial Cemented)	1,357 (20.3%)	1,029 (23.7%)	549 (23.5%)	521 (23.4%)	187 (19.0%)	845 (19.9%)	4,488 (21.5%)
Hybrid (Tibial Cementless)	123 (1.8%)	86 (2.0%)	25 (1.1%)	39 (1.8%)	12 (1.2%)	49 (1.2%)	334 (1.6%)
Femoral Fixation in 1st Revision							
Femoral Cemented	3,523 (52.6%)	26 (0.6%)	970 (41.4%)	423 (19.0%)	394 (40%)	1,976 (46.6%)	7,312 (35.1%)
Femoral Cementless	87 (1.3%)		11 (0.5%)	8 (0.4%)	9 (0.9%)	92 (2.2%)	207 (1.0%)
No Femoral Component Used	3,090 (46.1%)	4,320 (99.4%)	1,360 (58.1%)	1,795 (80.6%)	582 (59.1%)	2,174 (51.2%)	13,321 (63.9%)
Tibial Fixation in 1st Revision							
Tibia Cemented	4,586 (68.4%)	19 (0.4%)	830 (35.5%)	445 (20%)	356 (36.1%)	2,090 (49.3%)	8,326 (40%)
Tibia Cementless	138 (2.1%)		18 (0.8%)	12 (0.5%)	11 (1.1%)	67 (1.6%)	246 (1.2%)
No Tibial Component Used	1,976 (29.5%)	4,327 (99.6%)	1,493 (63.8%)	1,769 (79.5%)	618 (62.7%)	2,085 (49.2%)	12,268 (58.9%)
Patella Component Usage in Primary and 1st Revision							
Patella Component in Primary / Patella Component in 1st Revision	954 (14.2%)	89 (2%)	119 (5.1%)	298 (13.4%)	98 (9.9%)	595 (14%)	2,153 (10.3%)

Variable	Loosening	Patella Reasons	Instability	Pain	Arthrofibrosis	Other	TOTAL
Patella Component in Primary / No Patella Component in 1st Revision	2,538 (37.9%)	8 (0.2%)	1,176 (50.2%)	366 (16.4%)	410 (41.6%)	1,690 (39.8%)	6,188 (29.7%)
No Patella Component in Primary / Patella Component in 1st Revision	1,847 (27.6%)	4,242 (97.6%)	620 (26.5%)	1,470 (66.0%)	364 (37.0%)	1,080 (25.5%)	9,623 (46.2%)
No Patella Component in Primary / No Patella Component in 1st Revision	1,361 (20.3%)	7 (0.2%)	426 (18.2%)	92 (4.1%)	113 (11.5%)	877 (20.7%)	2,876 (13.8%)
Stability of Primary Procedure							
Fully Stabilised	22 (0.3%)	6 (0.1%)	16 (0.7%)	3 (0.1%)		21 (0.5%)	68 (0.3%)
Hinged	7 (0.1%)	7 (0.2%)	1 (0%)	4 (0.2%)		30 (0.7%)	49 (0.2%)
Medial Pivot Design	108 (1.6%)	90 (2.1%)	86 (3.7%)	52 (2.3%)	29 (2.9%)	65 (1.5%)	430 (2.1%)
Minimally Stabilised	4,436 (66.2%)	3,153 (72.5%)	1,582 (67.6%)	1,537 (69.0%)	668 (67.8%)	3,010 (71%)	14,386 (69%)
Posterior Stabilised	2,124 (31.7%)	1,090 (25.1%)	656 (28.0%)	629 (28.3%)	287 (29.1%)	1,113 (26.2%)	5,899 (28.3%)
Unknown	3 (0%)			1 (0%)	1 (0.1%)	3 (0.1%)	8 (0%)
Stability of 1st Revision[3]							
Fully Stabilised	1,272 (24.8%)	6 (20.0%)	362 (35.6%)	143 (27.8%)	131 (28.5%)	493 (20.4%)	2,407 (25.2%)
Hinged	321 (6.2%)		280 (27.6%)	21 (4.1%)	34 (7.4%)	481 (20%)	1,137 (11.9%)
Medial Pivot	49 (1.0%)		10 (1.0%)	6 (1.2%)	6 (1.3%)	20 (0.8%)	91 (1.0%)
Minimally Stabilised	1,584 (30.8%)	9 (30.0%)	77 (7.6%)	129 (25.1%)	89 (19.3%)	613 (25.4%)	2,501 (26.1%)
Posterior Stabilised	1,911 (37.2%)	15 (50.0%)	287 (28.2%)	215 (41.8%)	200 (43.5%)	804 (33.3%)	3,432 (35.9%)
Sleeve in 1st Revision[4]							
No Sleeve	4,517 (86.0%)	28 (93.3%)	800 (77.9%)	470 (90.2%)	400 (85.5%)	2,044 (82.7%)	8,259 (84.5%)
Sleeve	736 (14.0%)	2 (6.7%)	227 (22.1%)	51 (9.8%)	68 (14.5%)	428 (17.3%)	1,512 (15.5%)
Cones in 1st Revision[5]							
No Cone	5,174 (98.5%)	30 (100%)	1,005 (97.9%)	508 (97.5%)	464 (99.1%)	2,410 (97.5%)	9,591 (98.2%)
Cone	79 (1.5%)		22 (2.1%)	13 (2.5%)	4 (0.9%)	62 (2.5%)	180 (1.8%)
Augments in 1st Revision[6]							
Femoral and Tibial	52 (5.6%)	1 (14.3%)	9 (4.1%)	3 (3.2%)	3 (4.3%)	24 (5.6%)	92 (5.3%)
Femoral Only	700 (75.5%)	5 (71.4%)	184 (83.6%)	76 (80.9%)	57 (82.6%)	336 (78.0%)	1,358 (77.7%)
Tibial Only	175 (18.9%)	1 (14.3%)	27 (12.3%)	15 (16.0%)	9 (13.0%)	71 (16.5%)	298 (17.0%)
Stem Extension in 1st Revision[7]							
Femoral and Tibial	1,970 (37.5%)	9 (30.0%)	588 (57.3%)	216 (41.5%)	192 (41.0%)	1,128 (45.6%)	4,103 (42.0%)
Femoral Only	307 (5.8%)	5 (16.7%)	149 (14.5%)	37 (7.1%)	55 (11.8%)	336 (13.6%)	889 (9.1%)
Tibial Only	1,563 (29.8%)	4 (13.3%)	75 (7.3%)	103 (19.8%)	53 (11.3%)	470 (19.0%)	2,268 (23.2%)
Location Not Specified	58 (1.1%)		1 (0.1%)	2 (0.4%)	3 (0.6%)	16 (0.6%)	80 (0.8%)
No Stem Extension Used	1,355 (25.8%)	12 (40.0%)	214 (20.8%)	163 (31.3%)	165 (35.3%)	522 (21.1%)	2,431 (24.9%)
TOTAL	**6,700**	**4,346**	**2,341**	**2,226**	**985**	**4,242**	**20,840**

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

[1]Excludes 9,540 procedures with unknown ASA at the 1st revision

[2]Excludes 12,716 procedures with unknown BMI at the 1st revision

[3]Stability of 1st revision only presented for major partial and major total 1st revision procedures. Excludes 203 procedures where the insert component was not replaced

[4]Sleeve in 1st revision only presented for major partial and major total 1st revision procedures. (A metaphyseal sleeve is defined as an attachment to a major component (and often the stem) that is designed to substitute for a central metaphyseal bone defect and aid fixation of the major component)

[5]Cones in 1st revision only presented for major partial and major total 1st revision procedures. (A cone is defined as a component designed to substitute for a central metaphyseal defect that is independent of the major component or stem)

[6]Augments in 1st revision only presented when augments have been used in major partial and major total 1st revision procedures. (An augment is defined as an attachment to the non-articular surface of a major component that is used to substitute for bone deficiency at the articular surface level)

[7]Stem extension in 1st revision only presented for major partial and major total 1st revision procedures. (A stem extension is defined as an attachment to the major component used to aid fixation that is at least 15mm in length)

OUTCOME OF 1ST REVISION

There are 3,134 revisions of the 20,840 1st revision procedures and the cumulative percent 2nd revision at 15.0 years is 25.6% (Table RK2 and Figure RK1).

The most common reasons for 2nd revision are loosening (33.3%), infection (25.1%), instability (11.2%) and pain (7.9%) (Table RK3 and Figure RK2).

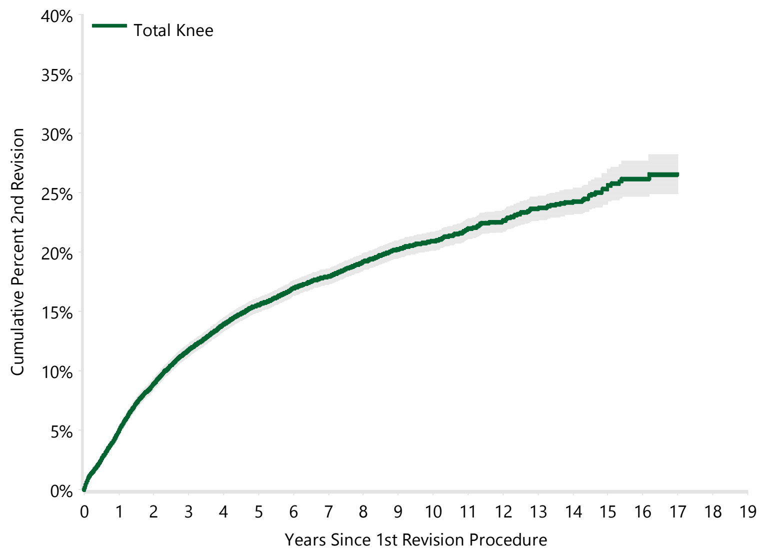
Revision of both the tibial and femoral components is the most common 2nd revision procedure (43.8%) followed by insert only (20.7%), femoral component only (7.8%), cement spacer (7.7%), patella only (7.7%), and tibial component only (7.6%) (Table RK4).

There are 3,134 2nd revision procedures with a cumulative percent 2nd revision of 25.6% at 15 years.

Table RK2 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement (Primary Diagnosis OA, Excluding 1st Revision for Infection)

Revision of Primary	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Total Knee	3134	20840	5.0 (4.7, 5.3)	11.7 (11.3, 12.2)	15.5 (15.0, 16.1)	20.9 (20.2, 21.7)	25.6 (24.3, 27.0)	
TOTAL	3134	20840						

Figure RK1 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement (Primary Diagnosis OA, Excluding 1st Revision for Infection)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Total Knee	20840	17838	13104	9376	2992	479	4

Table RK3 2nd Revision Diagnosis of Known Primary Total Knee Replacement (Primary Diagnosis OA, Excluding 1st Revision for Infection)

2nd Revision Diagnosis	Number	Percent
Loosening	1045	33.3
Infection	787	25.1
Instability	350	11.2
Pain	247	7.9
Arthrofibrosis	119	3.8
Malalignment	100	3.2
Fracture	58	1.9
Patellofemoral Pain	54	1.7
Lysis	51	1.6
Metal Related Pathology	41	1.3
Wear Tibial Insert	40	1.3
Incorrect Sizing	33	1.1
Prosthesis Dislocation	28	0.9
Patella Maltracking	28	0.9
Bearing Dislocation	28	0.9
Patella Erosion	24	0.8
Other	101	3.2
TOTAL	3134	100.0

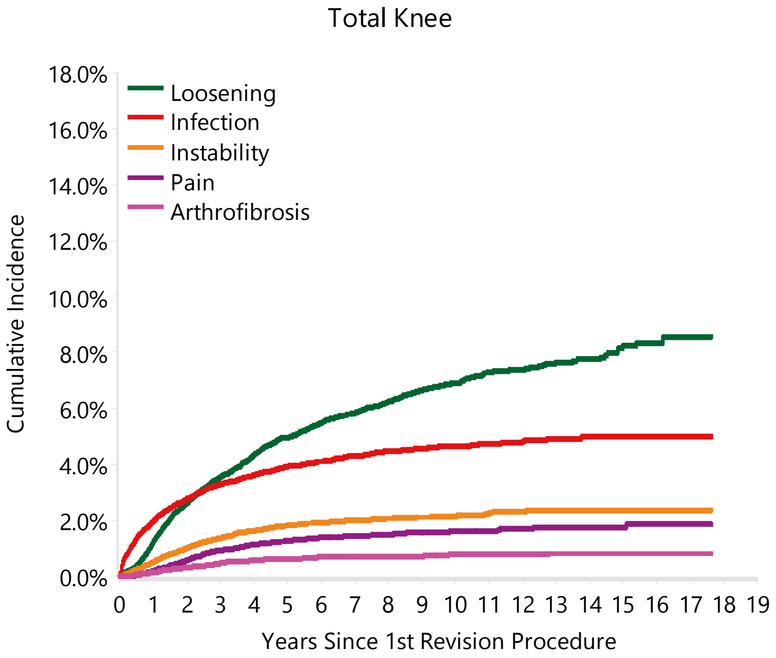
Note: Excludes 1st revisions where no minor or major femoral/ tibial components have been inserted

Table RK4 Type of 2nd Revision of Known Primary Total Knee Replacement (Primary Diagnosis OA, Excluding 1st Revision for Infection)

Type of 2nd Revision	Number	Percent
TKR (Tibial/Femoral)	1374	43.8
Insert Only	650	20.7
Femoral Component	246	7.8
Cement Spacer	242	7.7
Patella Only	242	7.7
Tibial Component	237	7.6
Insert/Patella	97	3.1
Removal of Prostheses	29	0.9
Minor Components	12	0.4
Total Femoral	3	0.1
Cement Only	2	0.1
TOTAL	3134	100.0

Note: Excludes 1st revisions where no minor or major femoral/ tibial components have been inserted

Figure RK2 Cumulative Incidence 2nd Revision Diagnosis of Known Primary Total Knee Replacement (Primary Diagnosis OA, Excluding 1st Revision for Infection)



OUTCOME OF 1ST REVISION BY PATIENT CHARACTERISTICS

The outcome of the 1st revision varies by age and gender. Males aged <65 years have a higher rate of 2nd revision (Table RK5 and Figure RK3).

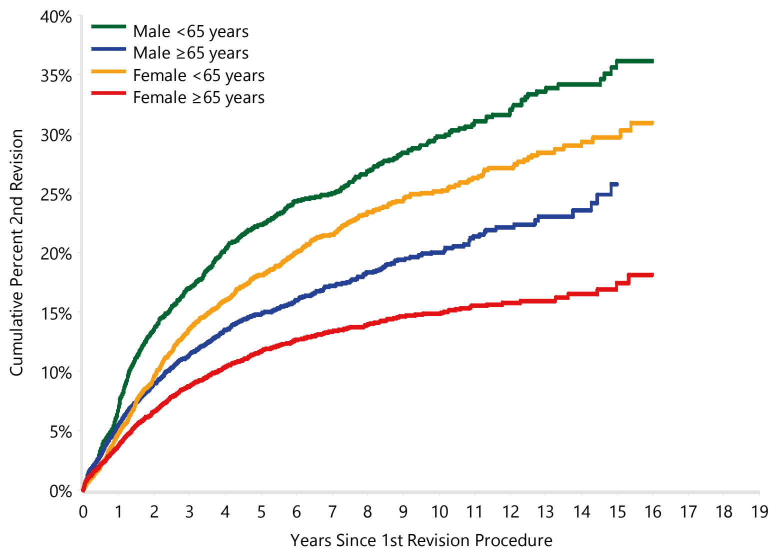
Males and younger patients have a higher risk of 2nd revision.

Table RK5 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by Gender and Age (Primary Diagnosis OA, Excluding 1st Revision for Infection)

Gender	Age at 1st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Male	<65 years	723	3161	7.0 (6.1, 8.0)	17.0 (15.7, 18.5)	22.4 (20.8, 24.0)	29.8 (27.8, 31.9)	36.1 (33.0, 39.4)	
	≥65 years	790	5695	5.5 (5.0, 6.2)	11.4 (10.6, 12.4)	14.8 (13.8, 15.9)	20.0 (18.6, 21.6)	25.8 (22.6, 29.3)	
Female	<65 years	775	4058	4.8 (4.2, 5.5)	13.6 (12.5, 14.7)	18.1 (16.8, 19.5)	25.1 (23.5, 26.9)	29.7 (27.4, 32.3)	
	≥65 years	846	7926	3.8 (3.4, 4.3)	8.8 (8.1, 9.5)	11.7 (10.9, 12.5)	14.9 (13.9, 15.9)	17.5 (15.6, 19.5)	
TOTAL		3134	20840						

Note: Excludes 1st revisions where no minor or major femoral/tibial components have been inserted

Figure RK3 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by Gender and Age (Primary Diagnosis OA, Excluding 1st Revision for Infection)



Male <65 years vs Male ≥65 years
0 - 9Mth: HR=1.16 (0.96, 1.40),p=0.131
9Mth - 1.5Yr: HR=2.04 (1.70, 2.45),p<0.001
1.5Yr+: HR=1.56 (1.37, 1.78),p<0.001

Male <65 years vs Female <65 years
0 - 1.5Yr: HR=1.49 (1.29, 1.72),p<0.001
1.5Yr+: HR=1.10 (0.97, 1.25),p=0.132

Male ≥65 years vs Female ≥65 years
Entire Period: HR=1.36 (1.24, 1.50),p<0.001

Female <65 years vs Female ≥65 years
0 - 1Mth: HR=0.54 (0.38, 0.78),p=0.001
1Mth - 6Mth: HR=1.30 (1.01, 1.67),p=0.041
6Mth - 2.5Yr: HR=1.70 (1.49, 1.94),p<0.001
2.5Yr+: HR=2.01 (1.74, 2.33),p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Male	<65 years	3161	2692	1995	1433	554	115	1
	≥65 years	5695	4784	3398	2348	654	80	0
Female	<65 years	4058	3562	2708	2043	722	132	0
	≥65 years	7926	6800	5003	3552	1062	152	3

ASA SCORE

ASA score is available for 11,300 1st revision TKR procedures. Patients with an ASA score of 1 have a higher rate of revision compared to patients with an ASA score of 2 but there is no difference when compared to other ASA scores (Table RK6 and Figure RK4).

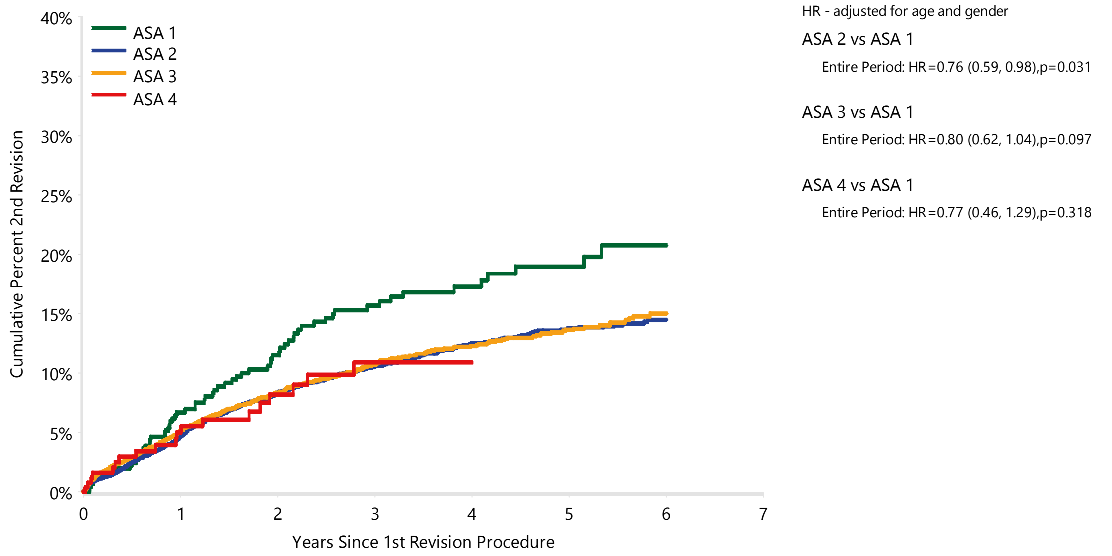
The number of patients with an ASA score of 1 is small (n=458). Patients with an ASA score of 1 are more likely to have a 2nd revision for loosening, infection and patellofemoral pain (Figure RK5).

Table RK6 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by ASA Score (Primary Diagnosis OA, Excluding 1st Revision for Infection)

ASA Score	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
ASA 1	68	458	6.7 (4.7, 9.6)	11.5 (8.7, 15.1)	15.7 (12.3, 19.9)	17.3 (13.7, 21.8)	19.0 (15.0, 23.8)	20.7 (16.3, 26.2)
ASA 2	543	5465	4.7 (4.1, 5.3)	8.4 (7.6, 9.2)	10.5 (9.7, 11.5)	12.5 (11.5, 13.6)	13.8 (12.6, 15.0)	14.5 (13.2, 15.8)
ASA 3	486	5123	5.2 (4.6, 5.9)	8.3 (7.5, 9.2)	10.7 (9.8, 11.8)	12.3 (11.2, 13.5)	13.6 (12.4, 15.0)	15.0 (13.5, 16.7)
ASA 4	19	254	5.0 (2.8, 8.9)	8.2 (5.1, 13.2)	10.9 (6.9, 16.9)	10.9 (6.9, 16.9)		
TOTAL	1116	11300						

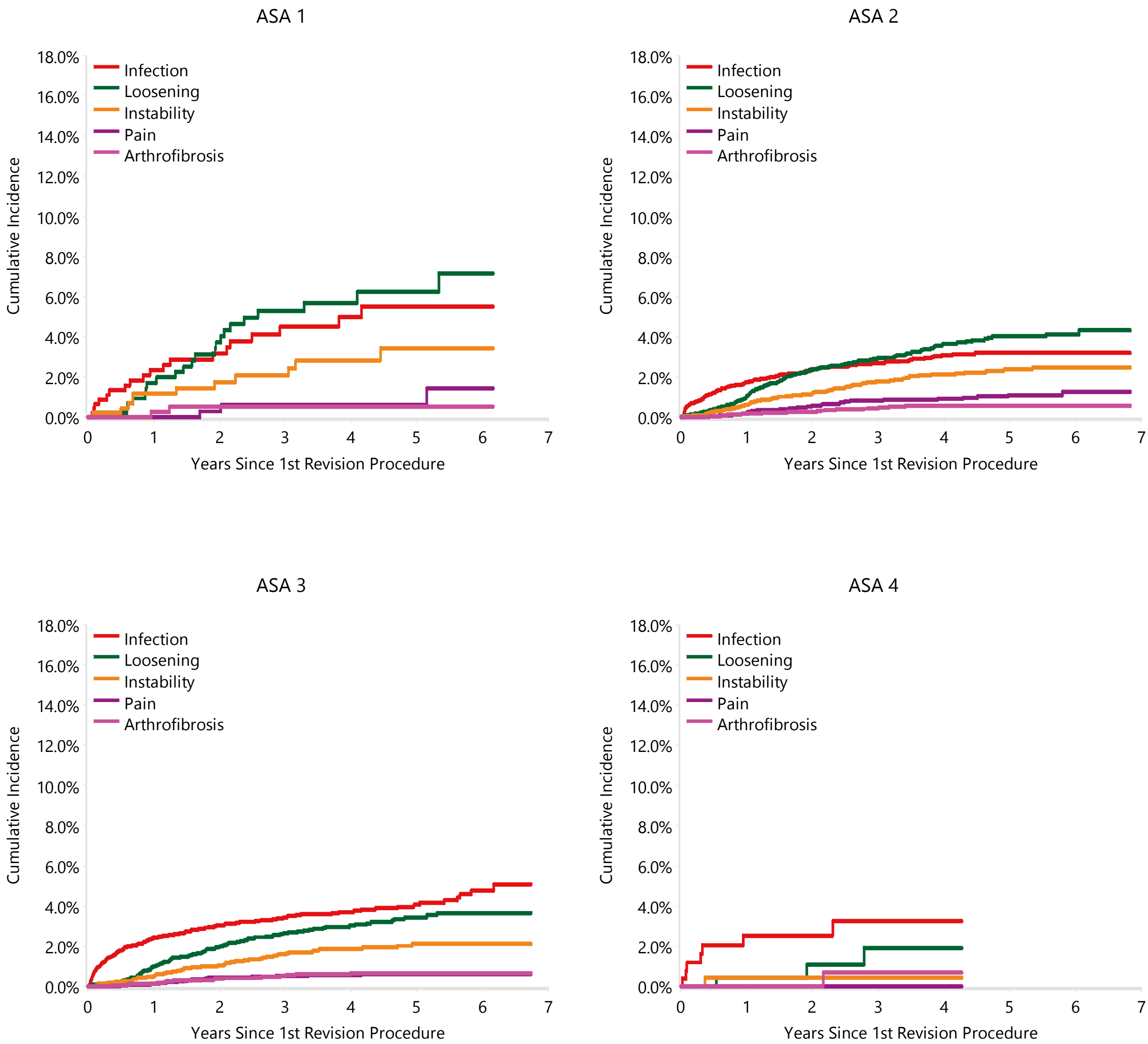
Note: Excludes 1st revisions where no minor or major femoral/tibial components have been inserted
Excludes 9,540 procedures with no ASA data

Figure RK4 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by ASA Score (Primary Diagnosis OA, Excluding 1st Revision for Infection)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
ASA 1	458	355	290	227	162	105	50
ASA 2	5465	4381	3444	2635	1844	1071	424
ASA 3	5123	3936	2945	2084	1401	823	305
ASA 4	254	181	124	76	46	19	10

Figure RK5 **Cumulative Incidence 2nd Revision Diagnosis of Known Primary Total Knee Replacement by ASA Score (Primary Diagnosis OA, Excluding 1st Revision for Infection)**



BMI

BMI is recorded for 8,124 1st revision procedures. Patients in obese class 3 have a higher rate of 2nd revision compared to patients with a normal BMI (Table RK7 and Figure RK6).

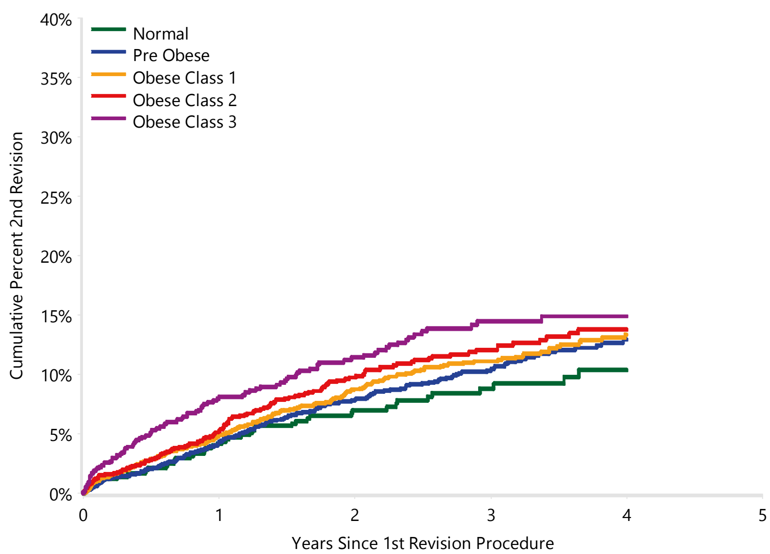
Patients in obese class 3 are more likely to have a 2nd revision for infection and instability (Figure RK7).

Table RK7 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by BMI Category (Primary Diagnosis OA, Excluding 1st Revision for Infection)

BMI Category	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
Underweight	0	21	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)		
Normal	52	729	4.2 (2.9, 6.1)	7.0 (5.2, 9.5)	8.8 (6.6, 11.7)	10.4 (7.7, 13.9)	
Pre Obese	194	2365	4.3 (3.5, 5.3)	7.9 (6.7, 9.2)	10.3 (8.9, 12.0)	12.9 (11.1, 15.0)	
Obese Class 1	223	2565	4.9 (4.1, 5.8)	8.8 (7.6, 10.1)	11.1 (9.7, 12.7)	13.4 (11.6, 15.4)	
Obese Class 2	140	1496	5.2 (4.1, 6.6)	9.7 (8.2, 11.6)	12.1 (10.2, 14.2)	13.8 (11.6, 16.3)	
Obese Class 3	103	948	8.1 (6.4, 10.2)	11.4 (9.3, 13.9)	14.5 (12.0, 17.5)	14.9 (12.3, 18.0)	
TOTAL	712	8124					

Note: Excludes 1st revisions where no minor or major femoral/tibial components have been inserted
Excludes 12,716 procedures with no BMI data

Figure RK6 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by BMI Category (Primary Diagnosis OA, Excluding 1st Revision for Infection)



HR - adjusted for age and gender

Pre Obese vs Normal
Entire Period: HR=1.08 (0.79, 1.46),p=0.634

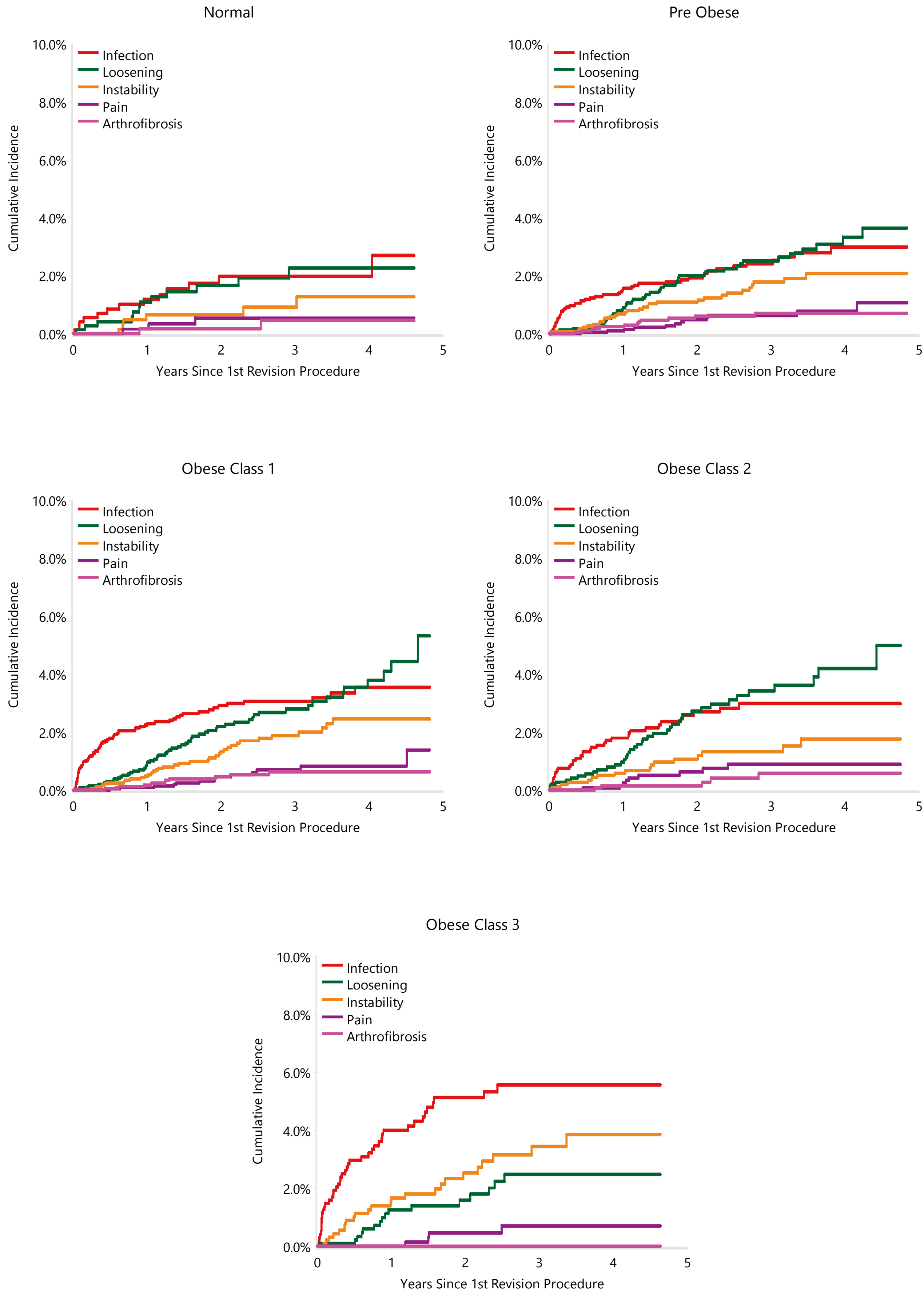
Obese Class 1 vs Normal
Entire Period: HR=1.16 (0.86, 1.58),p=0.327

Obese Class 2 vs Normal
Entire Period: HR=1.26 (0.91, 1.73),p=0.159

Obese Class 3 vs Normal
Entire Period: HR=1.53 (1.09, 2.15),p=0.013

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
Normal	729	538	377	228	114	2
Pre Obese	2365	1736	1245	778	340	4
Obese Class 1	2565	1868	1263	745	353	4
Obese Class 2	1496	1091	736	448	208	1
Obese Class 3	948	663	441	267	115	1

Figure RK7 **Cumulative Incidence 2nd Revision Diagnosis of Known Primary Total Knee Replacement by BMI Category (Primary Diagnosis OA, Excluding 1st Revision for Infection)**



OUTCOME OF 1ST REVISION BY CLASS OF REVISION

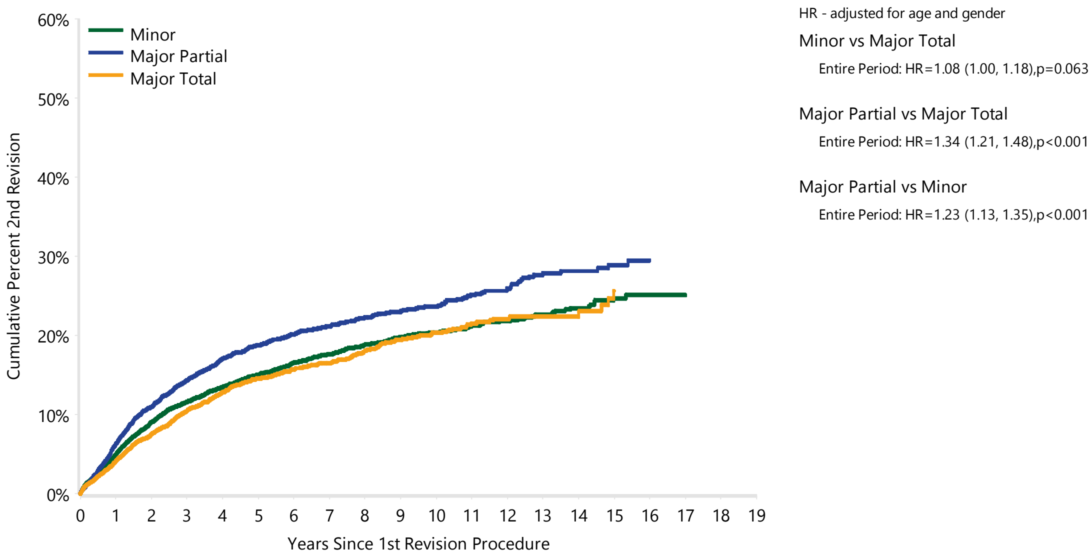
The outcome by class of the 1st revision is listed in Table RK8. There is no difference in the rate of 2nd revision when minor revisions are compared to major total revisions. Major partial revisions have a higher rate of 2nd revision compared to minor revisions and major total revisions (Figure RK8).

Major partial revisions have a higher rate of 2nd revision than minor or major total revisions.

Table RK8 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by Class of 1st Revision (Primary Diagnosis OA)

Class of 1st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Minor	1631	11069	5.0 (4.6, 5.4)	11.6 (11.0, 12.2)	15.0 (14.3, 15.8)	20.4 (19.4, 21.4)	24.7 (23.0, 26.6)	
Major Partial	680	3448	6.4 (5.6, 7.2)	14.3 (13.2, 15.6)	18.8 (17.4, 20.2)	23.7 (22.0, 25.5)	28.9 (26.5, 31.5)	
Major Total	823	6323	4.2 (3.7, 4.7)	10.5 (9.7, 11.3)	14.5 (13.5, 15.6)	20.3 (18.9, 21.9)	25.6 (22.2, 29.5)	
TOTAL	3134	20840						

Figure RK8 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by Class of 1st Revision (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Minor	11069	9511	6989	5007	1631	240	3
Major Partial	3448	3035	2356	1798	720	160	1

OUTCOME OF 1ST REVISION BY REASON FOR 1ST REVISION

As the risk of 2nd revision varies depending on the reason for the 1st revision, more detailed analyses have been carried out for the 1st revision diagnoses of loosening, patella reasons, instability, pain and arthrofibrosis. 'Patella reasons' include patella erosion, patellofemoral pain and patella mal-tracking.

Loosening, infection and a recurrence of the original revision diagnosis are the most common reasons for 2nd revision.

The lowest 10 year cumulative percent 2nd revision is 17.3% for malalignment and the highest is 23.7% for arthrofibrosis (Table RK9 and Figure RK9).

When compared to 1st revision for loosening, 1st revision for malalignment has a lower rate of 2nd revision, as do 1st revisions for pain and patella reasons, but only for the first 1.5 years.

For each reason for 1st revision, loosening, infection and a recurrence of the original revision diagnosis are the most common reasons for 2nd revision (apart from patella reasons) (Table RK10).

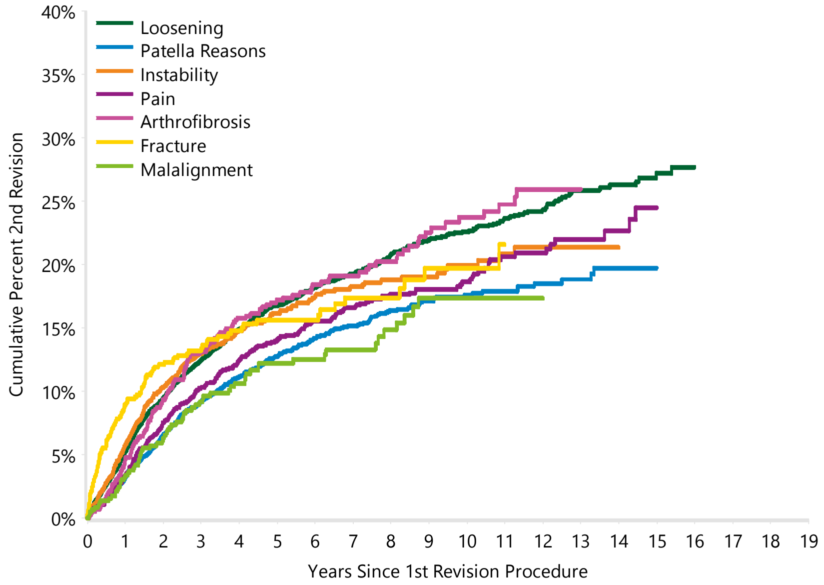
The most common type of 2nd revision procedure is revision of both tibial and femoral components (44.5%), insert only (19.9%), patella only (8.0%), tibial component only (7.8%), and femoral component only (7.6%) (Table RK11).

Table RK9 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by Reason for 1st Revision (Primary Diagnosis OA)

Reason for 1st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Loosening	1123	6700	5.2 (4.7, 5.8)	12.4 (11.6, 13.3)	16.8 (15.8, 17.8)	22.6 (21.3, 23.9)	27.2 (25.2, 29.3)	
Patella Reasons	543	4346	3.2 (2.7, 3.8)	9.2 (8.3, 10.1)	12.8 (11.7, 13.9)	17.6 (16.1, 19.1)	19.7 (17.7, 22.0)	
Instability	316	2341	5.7 (4.8, 6.8)	13.0 (11.5, 14.6)	16.2 (14.5, 18.0)	19.9 (17.7, 22.4)		
Pain	313	2226	3.4 (2.7, 4.2)	10.3 (9.0, 11.7)	14.0 (12.5, 15.7)	18.6 (16.7, 20.8)	24.5 (20.9, 28.6)	
Arthrofibrosis	165	985	4.7 (3.5, 6.3)	13.1 (11.0, 15.7)	17.2 (14.7, 20.1)	23.7 (20.3, 27.6)		
Fracture	115	840	9.0 (7.2, 11.2)	13.2 (10.9, 15.9)	15.6 (13.0, 18.7)	19.7 (16.0, 24.2)		
Malalignment	71	590	3.4 (2.2, 5.3)	9.2 (6.9, 12.0)	12.2 (9.6, 15.5)	17.3 (13.5, 22.0)		
TOTAL	2646	18028						

Note: Excludes 1st revisions where no minor or major femoral/tibial components have been inserted

Figure RK9 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by Reason for 1st Revision (Primary Diagnosis OA)



HR - adjusted for age and gender

Patella Reasons vs Loosening	0 - 1.5Yr: HR=0.62 (0.52, 0.72),p<0.001 1.5Yr+: HR=0.89 (0.78, 1.01),p=0.072
Instability vs Loosening	Entire Period: HR=0.95 (0.84, 1.08),p=0.423
Pain vs Loosening	0 - 1.5Yr: HR=0.69 (0.57, 0.85),p<0.001 1.5Yr+: HR=0.98 (0.83, 1.14),p=0.771
Arthrofibrosis vs Loosening	0 - 1.5Yr: HR=0.81 (0.62, 1.06),p=0.121 1.5Yr+: HR=1.18 (0.96, 1.45),p=0.114
Fracture vs Loosening	0 - 6Mth: HR=2.83 (2.07, 3.85),p<0.001 6Mth - 1.5Yr: HR=1.05 (0.74, 1.50),p=0.781 1.5Yr+: HR=0.74 (0.53, 1.05),p=0.089
Malalignment vs Loosening	Entire Period: HR=0.74 (0.58, 0.94),p=0.013
Instability vs Patella Reasons	0 - 1.5Yr: HR=1.68 (1.40, 2.03),p<0.001 1.5Yr+: HR=0.96 (0.79, 1.16),p=0.657
Pain vs Patella Reasons	Entire Period: HR=1.11 (0.97, 1.28),p=0.141
Arthrofibrosis vs Patella Reasons	Entire Period: HR=1.33 (1.11, 1.58),p=0.001
Fracture vs Patella Reasons	0 - 6Mth: HR=4.51 (3.28, 6.21),p<0.001 6Mth - 2Yr: HR=1.52 (1.10, 2.09),p=0.010 2Yr+: HR=0.78 (0.52, 1.16),p=0.219
Malalignment vs Patella Reasons	Entire Period: HR=0.97 (0.75, 1.24),p=0.781
Pain vs Instability	0 - 1.5Yr: HR=0.72 (0.58, 0.90),p=0.004 1.5Yr+: HR=1.04 (0.86, 1.25),p=0.709
Arthrofibrosis vs Instability	0 - 9Mth: HR=0.74 (0.50, 1.11),p=0.143 9Mth - 1Yr: HR=1.28 (0.76, 2.16),p=0.353 1Yr - 1.5Yr: HR=0.78 (0.48, 1.27),p=0.324 1.5Yr+: HR=1.25 (1.00, 1.57),p=0.053
Fracture vs Instability	0 - 1Mth: HR=4.63 (2.71, 7.90),p<0.001 1Mth - 6Mth: HR=2.45 (1.65, 3.62),p<0.001 6Mth+: HR=0.91 (0.70, 1.19),p=0.507
Malalignment vs Instability	Entire Period: HR=0.78 (0.60, 1.01),p=0.056
Arthrofibrosis vs Pain	Entire Period: HR=1.19 (0.99, 1.44),p=0.065
Fracture vs Pain	0 - 1Mth: HR=6.39 (3.73, 10.94),p<0.001 1Mth - 6Mth: HR=3.38 (2.27, 5.02),p<0.001 6Mth - 1Yr: HR=1.94 (1.24, 3.03),p=0.003 1Yr+: HR=0.82 (0.60, 1.11),p=0.201
Malalignment vs Pain	Entire Period: HR=0.87 (0.67, 1.13),p=0.289
Fracture vs Arthrofibrosis	0 - 1Mth: HR=5.32 (3.07, 9.20),p<0.001 1Mth - 6Mth: HR=2.81 (1.87, 4.23),p<0.001 6Mth - 9Mth: HR=1.80 (0.98, 3.30),p=0.056 9Mth+: HR=0.75 (0.56, 1.02),p=0.070
Malalignment vs Arthrofibrosis	Entire Period: HR=0.73 (0.55, 0.96),p=0.025
Malalignment vs Fracture	0 - 1.5Yr: HR=0.45 (0.29, 0.68),p<0.001 1.5Yr+: HR=0.93 (0.61, 1.41),p=0.738

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Loosening	6700	5781	4319	3186	1119	201	1
Patella Reasons	4346	3895	2946	2097	610	80	0
Instability	2341	1881	1239	767	219	27	0
Pain	2226	1934	1476	1093	407	61	1
Arthrofibrosis	985	834	597	448	176	25	0
Fracture	840	632	406	263	66	14	0
Malalignment	590	518	389	292	94	15	0

Table RK10 2nd Revision Diagnosis of Known Primary Total Knee Replacement by Reason for 1st Revision (Primary Diagnosis OA)

2nd Revision Diagnosis	Loosening		Patella Reasons		Instability		Pain		Arthrofibrosis		Other		TOTAL	
	N	Col%	N	Col%	N	Col%	N	Col%	N	Col%	N	Col%	N	Col%
Loosening	455	40.5	166	30.6	83	26.3	105	33.5	46	27.9	20	28.2	875	34.6
Infection	307	27.3	127	23.4	66	20.9	63	20.1	33	20.0	17	23.9	613	24.2
Instability	99	8.8	59	10.9	89	28.2	32	10.2	9	5.5	10	14.1	298	11.8
Pain	64	5.7	70	12.9	16	5.1	56	17.9	11	6.7	5	7.0	222	8.8
Arthrofibrosis	28	2.5	16	2.9	4	1.3	10	3.2	41	24.8	4	5.6	103	4.1
Malalignment	21	1.9	32	5.9	12	3.8	12	3.8	9	5.5	4	5.6	90	3.6
Patellofemoral Pain	25	2.2	.	.	9	2.8	5	1.6	2	1.2	.	.	41	1.6
Lysis	17	1.5	11	2.0	3	0.9	4	1.3	2	1.2	.	.	37	1.5
Wear Tibial Insert	10	0.9	14	2.6	1	0.3	3	1.0	1	0.6	2	2.8	31	1.2
Fracture	13	1.2	8	1.5	5	1.6	3	1.0	1	0.6	1	1.4	31	1.2
Metal Related Pathology	11	1.0	10	1.8	2	0.6	2	0.6	2	1.2	2	2.8	29	1.1
Patella Maltracking	5	0.4	5	0.9	5	1.6	5	1.6	1	0.6	1	1.4	22	0.9
Incorrect Sizing	7	0.6	9	1.7	.	.	4	1.3	1	0.6	.	.	21	0.8
Patella Erosion	12	1.1	.	.	4	1.3	.	.	2	1.2	.	.	18	0.7
Bearing Dislocation	13	1.2	.	.	1	0.3	1	0.3	1	0.6	1	1.4	17	0.7
Implant Breakage Patella	5	0.4	2	0.4	1	0.3	3	1.0	.	.	2	2.8	13	0.5
Prosthesis Dislocation	7	0.6	1	0.2	4	1.3	.	.	.	.	.	.	12	0.5
Implant Breakage Femoral	6	0.5	2	0.4	2	0.6	.	.	.	.	.	.	10	0.4
Implant Breakage Tibial Insert	2	0.2	1	0.2	1	0.3	2	0.6	1	0.6	.	.	7	0.3
Wear Patella	2	0.2	2	0.4	1	0.3	1	0.3	.	.	.	.	6	0.2
Implant Breakage Tibial	.	.	1	0.2	4	1.3	.	.	.	.	1	1.4	6	0.2
Other	14	1.2	7	1.3	3	0.9	2	0.6	2	1.2	1	1.4	29	1.1
TOTAL	1123	100.0	543	100.0	316	100.0	313	100.0	165	100.0	71	100.0	2531	100.0

Note: Excludes 1st revisions where no minor or major femoral/tibial components have been inserted

Table RK11 Type of 2nd Revision of Known Primary Total Knee Replacement by Reason for 1st Revision (Primary Diagnosis OA)

Type of 2nd Revision	Loosening		Patella Reasons		Instability		Pain		Arthrofibrosis		Other		TOTAL	
	N	Col%	N	Col%	N	Col%	N	Col%	N	Col%	N	Col%	N	Col%
TKR (Tibial/Femoral)	454	40.4	255	47.0	145	45.9	154	49.2	87	52.7	32	45.1	1127	44.5
Insert Only	222	19.8	124	22.8	58	18.4	54	17.3	25	15.2	20	28.2	503	19.9
Patella Only	91	8.1	44	8.1	30	9.5	30	9.6	4	2.4	3	4.2	202	8.0
Tibial Component	112	10.0	29	5.3	16	5.1	21	6.7	14	8.5	5	7.0	197	7.8
Femoral Component	95	8.5	36	6.6	27	8.5	24	7.7	10	6.1	1	1.4	193	7.6
Cement Spacer	97	8.6	34	6.3	21	6.6	20	6.4	13	7.9	6	8.5	191	7.5
Insert/Patella	33	2.9	17	3.1	16	5.1	8	2.6	8	4.8	3	4.2	85	3.4
Removal of Prostheses	13	1.2	4	0.7	2	0.6	2	0.6	3	1.8	1	1.4	25	1.0
Minor Components	4	0.4	.	.	1	0.3	.	.	1	0.6	.	.	6	0.2
Cement Only	2	0.2	.	.	.	.	.	.	.	.	.	.	2	0.1
TOTAL	1123	100.0	543	100.0	316	100.0	313	100.0	165	100.0	71	100.0	2531	100.0

Note: Excludes 1st revisions where no minor or major femoral/tibial components have been inserted

Loosening

Loosening is the most common 1st revision diagnosis for total knee replacements with a primary diagnosis of osteoarthritis (24.7%). There are 6,700 1st revision total knee procedures for loosening. There are more females revised for loosening (56.9%). The mean age at the time of 1st revision is 67.7 years and the median time to 1st revision is 2.9 years (Table RK1).

The most common type of 1st revision procedures for loosening are TKR (both tibial and femoral components revised) (46.0%), tibial only (25.0%), and femoral only (8.0%). Patella components are used in 13.0% of 1st revisions for loosening, either alone or with the addition of a polyethylene insert. Insert only revision is performed in 9.0% of 1st revisions for loosening.

Where major components are revised in a 1st revision for loosening, cement fixation is used for 97.6% of the femoral components and 97.1% of the tibial components. Stem extensions are used in 74.2% of these major revisions. Stems are added to both femoral and tibial components in 37.5% of procedures, 29.8% have only a tibial stem, 5.8% have only a femoral stem and in 1.1% the location of the stem is unknown.

Augment use is recorded for major component 1st revisions for loosening. Where these are used, 75.5% are added to the femoral component only, 18.9% to the tibial component only, and 5.6% have both femoral and tibial augments.

Metaphyseal sleeves are used in 14% of major revisions for loosening and cones in 1.5% (Table RK1).

Of the 6,700 primary total knee replacements revised for loosening, 1,123 have undergone a 2nd revision. The 15 year cumulative percent 2nd revision for this reason is 27.2% (Table RK9 and Figure RK9).

Where the 1st revision was for loosening, the most common reasons for the 2nd revision are further loosening (40.5%), infection (27.3%) and instability (8.8%) (Table RK10).

In 1st revisions for loosening, revising both femoral and tibial components results in a lower rate of 2nd revision compared to femoral or tibial only revisions.

When a major revision is performed for loosening, revising both femoral and tibial components results in a lower rate of 2nd revision compared to revising only the femoral or tibial components alone (Table RK12 and Figure RK10).

There is a lower rate of 2nd revision when a stem extension is used compared to when it is not used (Table RK13 and Figure RK11).

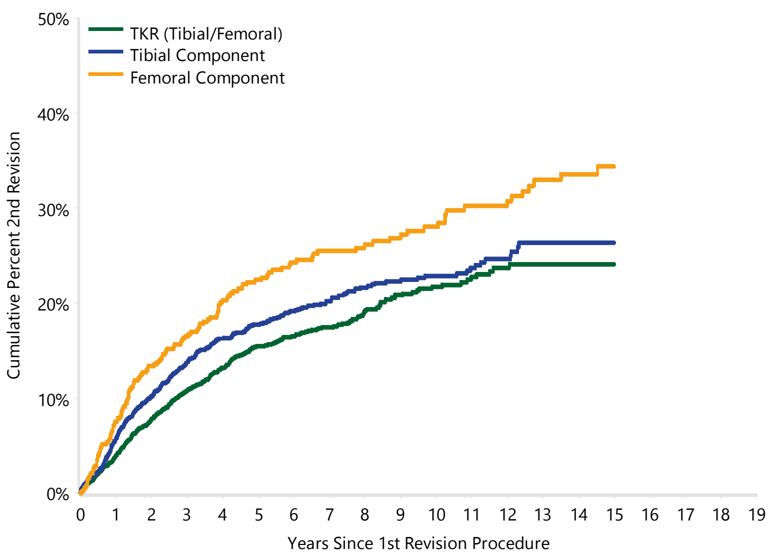
The use of a metaphyseal sleeve has a lower rate of 2nd revision compared to when no sleeve is used (Table RK14 and Figure RK12).

There is no difference in the rate of 2nd revision when a cone is used compared to when a cone is not used (Table RK15 and Figure RK13).

Table RK12 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by Type of 1st Revision (Primary Diagnosis OA, 1st Revision for Loosening)

Type of 1st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
TKR (Tibial/Femoral)	434	3081	3.9 (3.3, 4.7)	10.8 (9.6, 12.0)	15.4 (14.0, 17.0)	21.7 (19.7, 23.9)	24.1 (21.6, 26.8)	
Tibial Component	307	1643	5.8 (4.7, 7.1)	13.7 (12.1, 15.6)	17.7 (15.8, 19.8)	22.9 (20.5, 25.4)	26.3 (23.3, 29.7)	
Femoral Component	140	529	7.5 (5.5, 10.1)	16.5 (13.5, 20.0)	22.4 (19.0, 26.4)	28.0 (24.0, 32.6)	34.3 (29.4, 39.9)	
TOTAL	881	5253						

Figure RK10 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by Type of 1st Revision (Primary Diagnosis OA, 1st Revision for Loosening)



HR - adjusted for age and gender

Tibial Component vs TKR (Tibial/Femoral)
Entire Period: HR=1.20 (1.04, 1.39),p=0.014

Femoral Component vs TKR (Tibial/Femoral)
Entire Period: HR=1.54 (1.27, 1.87),p<0.001

Femoral Component vs Tibial Component
Entire Period: HR=1.28 (1.05, 1.57),p=0.014

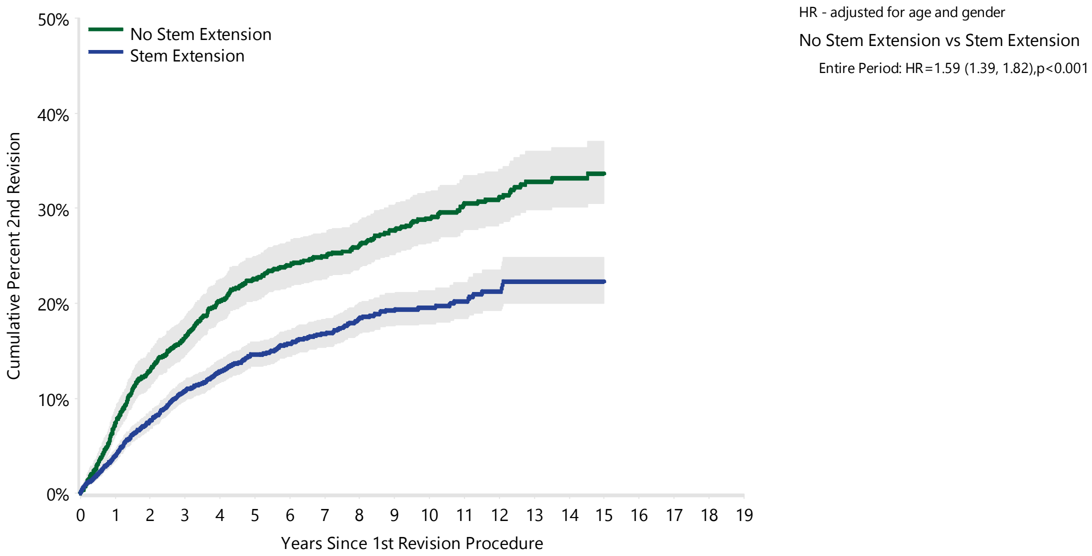
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
TKR (Tibial/Femoral)	3081	2635	1891	1300	372	51	0
Tibial Component	1643	1456	1142	885	338	53	1
Femoral Component	529	472	383	312	169	67	0

Table RK13 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by Stem Extension used in 1st Revision (Primary Diagnosis OA, 1st Revision for Loosening)

Stem Extension in 1st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
No Stem Extension	366	1355	7.4 (6.1, 9.0)	16.5 (14.6, 18.6)	22.5 (20.3, 24.9)	28.9 (26.4, 31.7)	33.6 (30.5, 37.0)	
Stem Extension	515	3898	4.0 (3.4, 4.6)	10.7 (9.7, 11.9)	14.6 (13.3, 15.9)	19.5 (17.9, 21.3)	22.3 (20.0, 24.8)	
TOTAL	881	5253						

Note: Restricted to TKR (femoral/tibial), femoral only and tibial only 1st revisions

Figure RK11 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by Stem Extension used in 1st Revision (Primary Diagnosis OA, 1st Revision for Loosening)



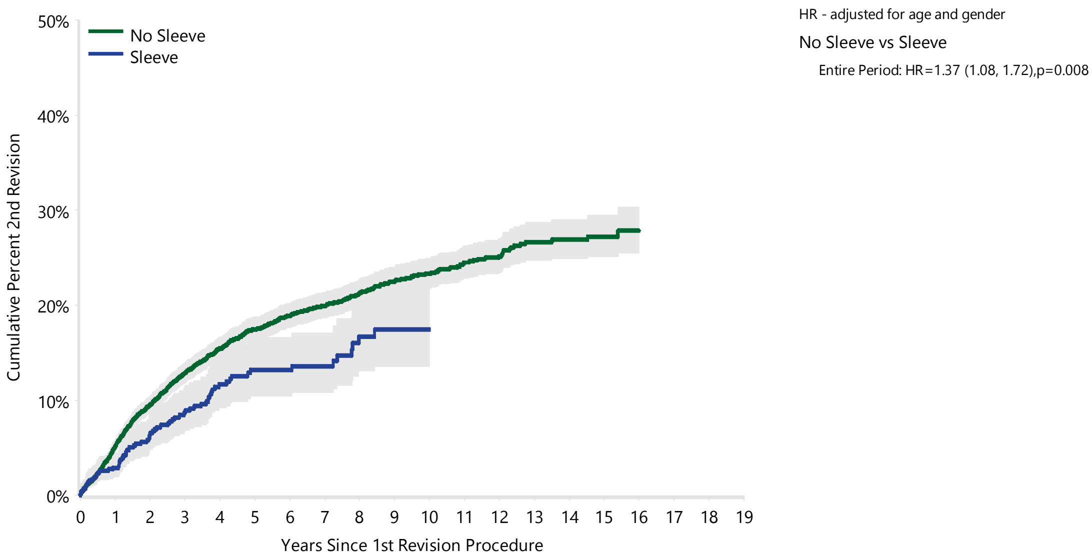
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
No Stem Extension	1355	1226	1031	863	445	104	0
Stem Extension	3898	3337	2385	1634	434	67	1

Table RK14 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by Sleeves used in 1st Revision (Primary Diagnosis OA, 1st Revision for Loosening)

Sleeves Used in 1st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
No Sleeve	803	4517	5.2 (4.6, 5.9)	12.9 (11.9, 13.9)	17.5 (16.3, 18.7)	23.3 (21.8, 25.0)	27.2 (25.1, 29.4)	
Sleeve	78	736	2.9 (1.9, 4.4)	8.7 (6.6, 11.3)	13.2 (10.4, 16.5)	17.4 (13.6, 22.1)		
TOTAL	881	5253						

Note: Restricted to TKR (femoral/tibial), femoral only and tibial only 1st revisions

Figure RK12 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by Sleeves used in 1st Revision (Primary Diagnosis OA, 1st Revision for Loosening)



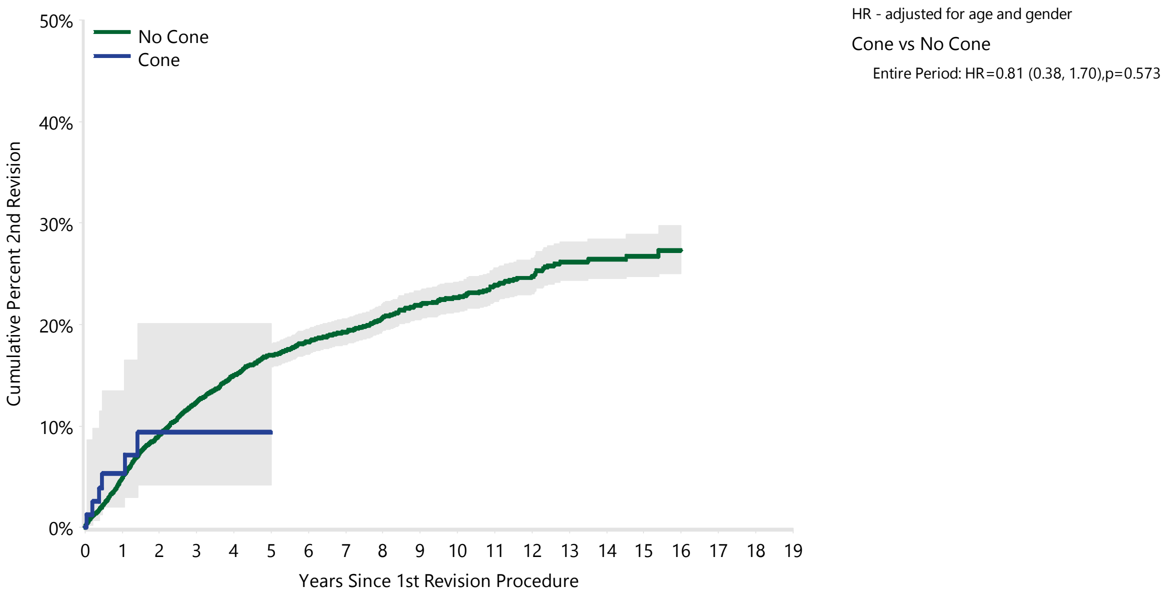
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
No Sleeve	4517	3968	3011	2228	825	165	1
Sleeve	736	595	405	269	54	6	0

Table RK15 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by Cones used in 1st Revision (Primary Diagnosis OA, 1st Revision for Loosening)

Cones Used in 1st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
No Cone	874	5174	4.9 (4.3, 5.5)	12.3 (11.4, 13.3)	17.0 (15.9, 18.1)	22.7 (21.2, 24.2)	26.7 (24.7, 28.9)	
Cone	7	79	5.3 (2.0, 13.5)	9.3 (4.2, 20.1)	9.3 (4.2, 20.1)			
TOTAL	881	5253						

Note: Restricted to TKR (femoral/tibial), femoral only and tibial only 1st revisions

Figure RK13 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by Cones used in 1st Revision (Primary Diagnosis OA, 1st Revision for Loosening)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
No Cone	5174	4510	3393	2486	878	171	1
Cone	79	53	23	11	1	0	0

Patella Reasons

After loosening and infection, revision for patella reasons is the third most common reason for 1st revision (15.8%). There are 4,346 primary TKR that have been revised for patella reasons. There are more females revised for patella reasons (57.3%). The mean age at revision is 68.8 years and the median time to revision is 2.4 years (Table RK1).

When the 1st revision is for patella reasons the most common type of 1st revision is patella only (79.3%) followed by insert/patella (19.8%). Of those revised for patella reasons, 97.8% did not have a patella component inserted in the primary procedure. There are 89 revisions for patella reasons where the initial procedure included a patella component and that patella component was revised. There are only 15 revision procedures that did not use a patella component in the revision procedure, and 8 of these had a prior patella prosthesis (Table RK1).

Of the 4,346 1st revisions for patella reasons, 543 have had a 2nd revision. The 15 year cumulative percent 2nd revision is 19.7% (Table RK9 and Figure RK9).

Where the 1st revision was for patella reasons, the most common reasons for the 2nd revision are loosening (30.6%), infection (23.4%), pain (12.9%), and instability (10.9%). Further revision for any patella cause is uncommon (Table RK10).

After 1st revision for patella reasons, further revision for any patella cause is uncommon.

The most common type of 2nd revision are revision of both tibial and femoral components (47.0%), insert only (22.8%), patella only (8.1%), and femoral component only (6.6%) (Table RK11).

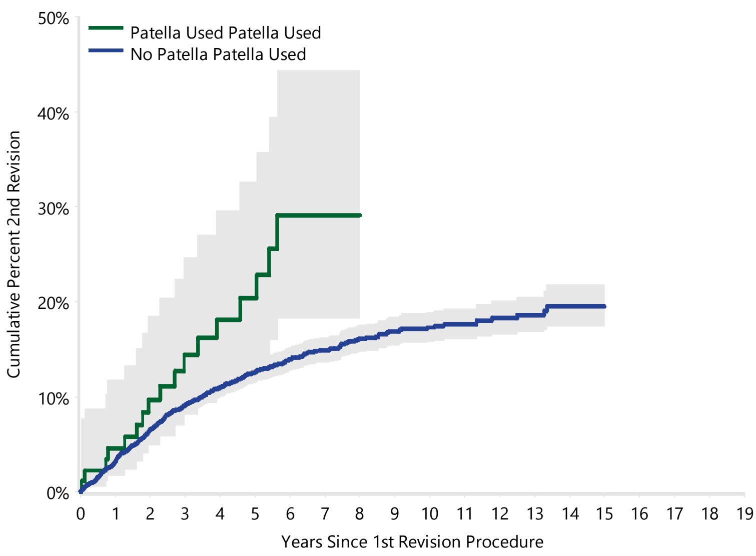
When 1st revision for patella reasons is performed, the rate of 2nd revision is lower when an un-resurfaced patella has a patella component inserted compared to when the patella component is revised (Table RK16 and Figure RK14).

Table RK16 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by Patella Usage in Primary and 1st Revision (Primary Diagnosis OA, 1st Revision for Patella Reasons)

Patella Usage in Primary	Patella Usage in 1st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Patella Used	Patella Used	17	89	4.6 (1.7, 11.7)	14.4 (8.2, 24.7)	20.4 (12.4, 32.6)			
No Patella	Patella Used	523	4242	3.2 (2.7, 3.8)	9.1 (8.2, 10.0)	12.6 (11.5, 13.8)	17.3 (15.8, 18.9)	19.5 (17.4, 21.8)	
TOTAL		540	4331						

Note: Excludes 1st revisions where no minor or major femoral/tibial components have been inserted

Figure RK14 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by Patella Usage in Primary and 1st Revision (Primary Diagnosis OA, 1st Revision for Patella Reasons)



HR - adjusted for age and gender

Patella Used Patella Used vs

No Patella Patella Used

Entire Period: HR=1.74 (1.07, 2.82),p=0.025

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Patella Used	Patella Used	89	82	50	33	5	1	0
No Patella	Patella Used	4242	3798	2883	2054	603	79	0

Instability

There are 2,341(8.5%) primary TKR that have been revised for instability. More females are revised for instability (59.2%). The mean age at time of revision for instability is 67.0 years and the median time to revision is 2.2 years (Table RK1).

The most common types of 1st revision procedures for instability are insert only (39.1%), TKR (34.3%), insert/patella (15.0%), and femoral component only (7.6%). When a TKR revision is performed for instability, minimally stabilised prostheses are used in 7.6%, posterior stabilised in 28.2%, fully stabilised in 35.6%, and hinged components in 27.6% of the revision procedures (Table RK1).

Of the 2,341 primary TKR revised for instability, 316 have had a 2nd revision. The 10 year cumulative percent 2nd revision for this reason is 19.9% (Table RK9 and Figure RK9).

Where the 1st revision was for instability, the most common reasons for the 2nd revision are further instability (28.2%), loosening (26.3%), infection (20.9%), and pain (5.1%) (Table RK10).

The most common types of 2nd revision are revision of both tibial and femoral components (45.9%), insert only (18.4%), patella only (9.5%), and femoral component only (8.5%) (Table RK11).

After the 1st revision for instability, the most common reason for 2nd revision is further instability (28.2%).

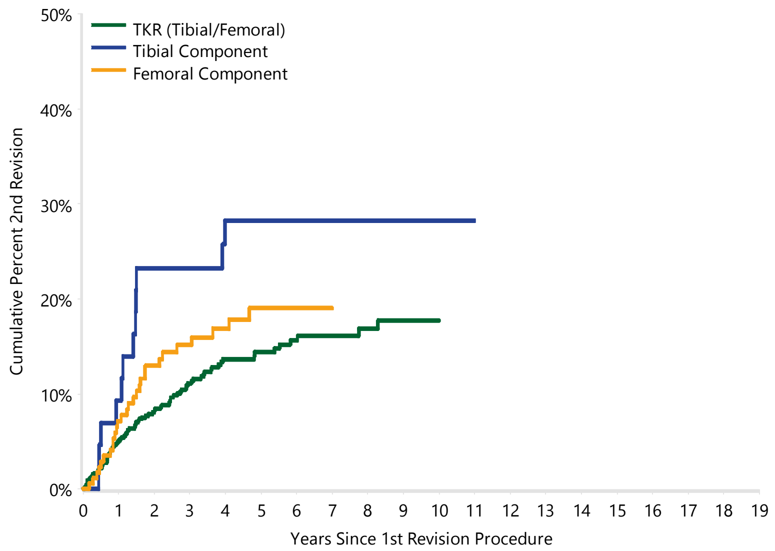
When comparing major 1st revisions for instability, revising both femoral and tibial components has a lower rate of 2nd revision than revising the tibial component alone, but there is no difference when compared to femoral component revision only (Table RK17 and Figure RK15).

There is no difference in the rate of 2nd revision when the level of constraint used in the revision is compared (Table RK18 and Figure RK16).

Table RK17 **Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by Type of 1st Revision (Primary Diagnosis OA, 1st Revision for Instability)**

Type of 1st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
TKR (Tibial/Femoral)	90	802	5.0 (3.6, 6.8)	11.1 (8.9, 13.9)	14.4 (11.6, 17.7)	17.7 (14.1, 22.1)		
Tibial Component	12	46	9.3 (3.6, 22.9)	23.3 (13.3, 38.9)	28.2 (17.1, 44.3)	28.2 (17.1, 44.3)		
Femoral Component	29	179	7.2 (4.1, 12.3)	15.1 (10.4, 21.8)	19.0 (13.4, 26.6)			
TOTAL	131	1027						

Figure RK15 **Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by Type of 1st Revision (Primary Diagnosis OA, 1st Revision for Instability)**



HR - adjusted for age and gender

Tibial Component vs TKR (Tibial/Femoral)
Entire Period: HR=1.83 (1.00, 3.36),p=0.049

Tibial Component vs Femoral Component
Entire Period: HR=1.43 (0.73, 2.81),p=0.297

Femoral Component vs TKR (Tibial/Femoral)
Entire Period: HR=1.28 (0.84, 1.95),p=0.246

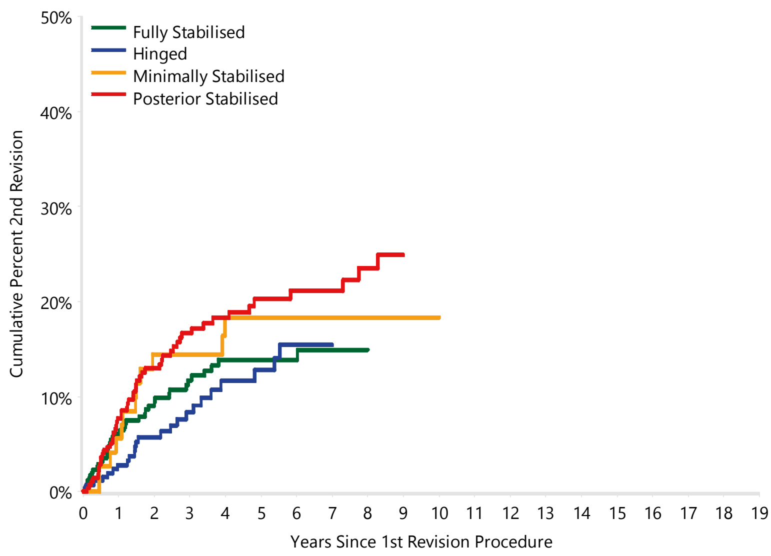
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
TKR (Tibial/Femoral)	802	624	397	230	54	7	0
Tibial Component	46	39	32	24	8	1	0
Femoral Component	179	151	105	63	23	3	0

Table RK18 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by Stability of 1st Revision (Primary Diagnosis OA, 1st Revision for Instability)

Stability of 1st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Fully Stabilised	39	362	6.1 (4.0, 9.3)	11.7 (8.5, 16.1)	13.9 (10.2, 18.8)			
Hinged	25	280	2.8 (1.3, 5.8)	8.3 (5.2, 13.2)	12.8 (8.4, 19.3)			
Medial Pivot	1	10	0.0 (0.0, 0.0)	20.0 (3.1, 79.6)	20.0 (3.1, 79.6)			
Minimally Stabilised	12	77	5.6 (2.1, 14.2)	14.4 (8.0, 25.2)	18.3 (10.8, 30.2)	18.3 (10.8, 30.2)		
Posterior Stabilised	53	287	7.7 (5.1, 11.6)	16.7 (12.6, 21.9)	20.3 (15.6, 26.2)			
TOTAL	130	1016						

Note: Excludes 11 procedures where the insert component was not replaced in the 1st revision
Restricted to major partial and major total 1st revisions

Figure RK16 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by Stability of 1st Revision (Primary Diagnosis OA, 1st Revision for Instability)



HR - adjusted for age and gender

Fully Stabilised vs Minimally Stabilised
Entire Period: HR=0.82 (0.43, 1.57),p=0.556

Hinged vs Minimally Stabilised
Entire Period: HR=0.76 (0.38, 1.51),p=0.427

Posterior Stabilised vs Minimally Stabilised
Entire Period: HR=1.18 (0.63, 2.21),p=0.604

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Fully Stabilised	362	273	180	101	29	5	0
Hinged	280	220	127	74	11	1	0
Minimally Stabilised	77	66	52	34	12	1	0
Posterior Stabilised	287	241	167	104	33	4	0

Pain

There are 2,226 primary TKR procedures revised with a 1st revision diagnosis of pain (8.2%). Females are more commonly revised for pain (56.5%). The mean age at time of revision for pain is 68.3 years and the median time to revision is 2.3 years (Table RK1).

The most common type of 1st revision for pain are patella only (45.2%), insert/patella (21.9%), TKR (16.4%), and insert only (8.7%). Of those revised for pain, 70.1% did not have a patella component in the primary procedure and a patella component was inserted in 94.1% of these. Where major components were revised, 98.1% of femoral components and 97.4% of the tibial components used cement fixation.

Of the 2,226 primary total knee replacements revised for pain, 313 have had a 2nd revision. The 15 year cumulative percent 2nd revision for pain is 24.5% (Table RK9 and Figure RK9).

Where the 1st revision was for pain, the most common reasons for the 2nd revision are loosening (33.5%), infection (20.1%), further pain (17.9%), and instability (10.2%) (Table RK10).

The most common types of 2nd revision procedures are revision of both tibial and femoral components (49.2%), insert only (17.3%), patella only (9.6%), and femoral component only (7.7%) (Table RK11).

When a major 1st revision is performed for pain, there is no difference in rate of 2nd revision with the type of 1st revision (Table RK19 and Figure RK17).

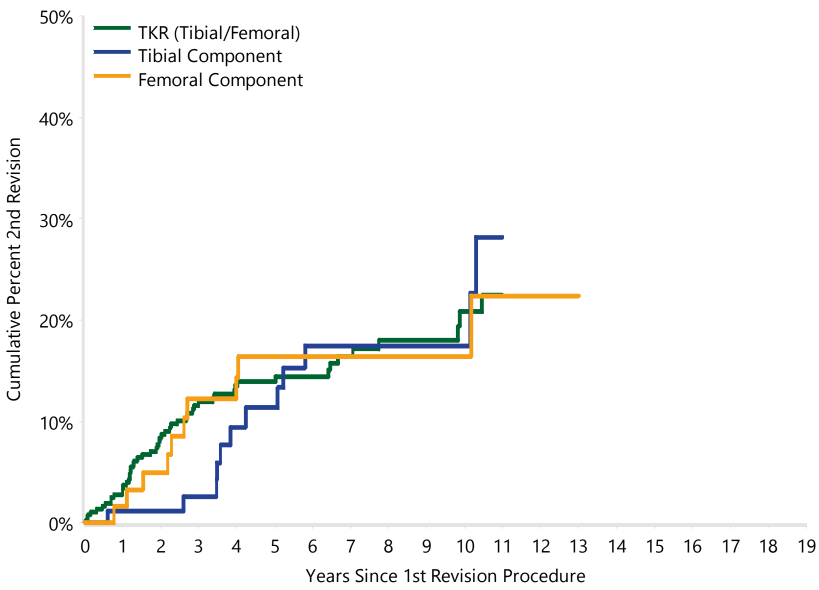
After the 1st revision for pain, the type of major revision or the use of a patella component did not influence the rate of 2nd revision.

There is no difference in the 2nd revision rate when using a patella component in revision for pain compared to when no patella component is used (Table RK20 and Figure RK18).

Table RK19 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by Type of 1st Revision (Primary Diagnosis OA, 1st Revision for Pain)

Type of 1st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
TKR (Tibial/Femoral)	52	368	3.4 (1.9, 5.9)	11.9 (8.8, 16.1)	13.9 (10.5, 18.4)	20.8 (15.4, 27.8)		
Tibial Component	12	89	1.2 (0.2, 8.1)	2.6 (0.7, 10.1)	11.4 (5.5, 22.6)	17.5 (9.7, 30.3)		
Femoral Component	10	63	1.6 (0.2, 11.1)	12.2 (6.0, 24.0)	16.4 (8.9, 29.3)	16.4 (8.9, 29.3)		
TOTAL	74	520						

Figure RK17 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by Type of 1st Revision (Primary Diagnosis OA, 1st Revision for Pain)



HR - adjusted for age and gender

TKR (Tibial/Femoral) vs Tibial Component

0 - 3Yr: HR=1.90 (0.84, 4.29),p=0.122

3Yr+: HR=0.51 (0.22, 1.20),p=0.122

Femoral Component vs Tibial Component

Entire Period: HR=1.07 (0.46, 2.48),p=0.873

Femoral Component vs TKR (Tibial/Femoral)

Entire Period: HR=1.02 (0.51, 2.01),p=0.964

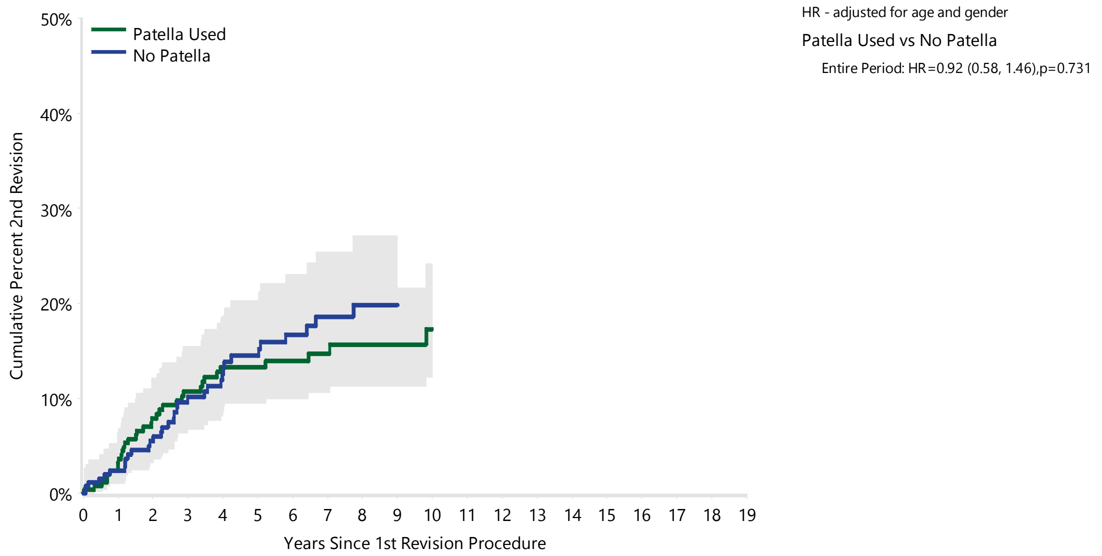
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
TKR (Tibial/Femoral)	368	325	236	181	54	8	0
Tibial Component	89	82	64	45	16	2	0
Femoral Component	63	60	45	35	14	3	0

Table RK20 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by Patella Usage in 1st Revision (Primary Diagnosis OA, 1st Revision for Pain)

Patella Usage in 1st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Patella Used	37	260	3.2 (1.6, 6.3)	10.7 (7.4, 15.5)	13.3 (9.5, 18.5)	17.3 (12.2, 24.1)		
No Patella	37	260	2.4 (1.1, 5.2)	10.1 (6.8, 15.0)	14.5 (10.2, 20.3)			
TOTAL	74	520						

Note: Restricted to TKR (femoral/tibial), femoral only and tibial only 1st revisions

Figure RK18 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by Patella Usage in 1st Revision (Primary Diagnosis OA, 1st Revision for Pain)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Patella Used	260	232	181	141	49	9	0
No Patella	260	235	164	120	35	4	0

Arthrofibrosis

Arthrofibrosis is the reason for 3.6% of 1st revisions of primary TKR procedures for osteoarthritis. There are 985 primary TKR procedures revised for arthrofibrosis. There are more males than females revised for arthrofibrosis (54.0%). The mean age at the time of revision for arthrofibrosis is 66.0 years and the median time to revision is 1.6 years (Table RK1).

The most common types of 1st revision for arthrofibrosis are TKR and insert only.

The most common types of 1st revision for arthrofibrosis are TKR (30.7%), insert only (28.5%), insert/patella (15.0%), femoral component only (10.3%), and patella only (8.9%).

Of the 985 primary TKR procedures revised for arthrofibrosis, 165 have had a 2nd revision. The 10 year cumulative percent 2nd revision for this reason is 23.7% (Table RK9 and Figure RK9).

Where the 1st revision was for arthrofibrosis, the most common reasons for the 2nd revision are loosening (27.9%), further arthrofibrosis (24.8%), infection (20%), and pain (6.7%) (Table RK10).

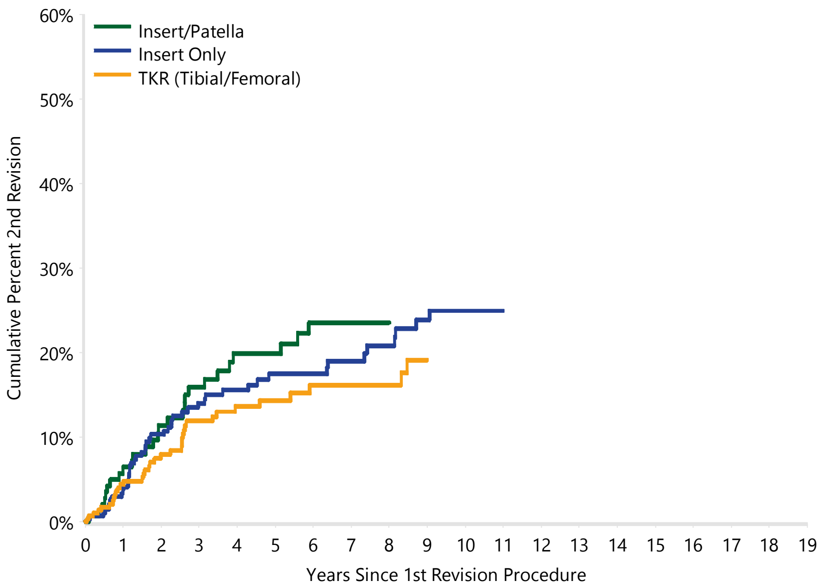
The most common type of 2nd revision are revision of both tibial and femoral components (52.7%), insert only (15.2%), tibial component only (8.5%), cement spacer (7.9%), and femoral component only (6.1%) (Table RK11).

When comparing the more common types of 1st revision procedures, there is no difference in the rate of 2nd revision (Table RK21 and Figure RK19).

Table RK21 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by Type of 1st Revision (Primary Diagnosis OA, 1st Revision for Arthrofibrosis)

Type of 1st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Insert/Patella	30	148	6.5 (3.4, 12.1)	15.9 (10.5, 23.7)	19.9 (13.7, 28.3)			
Insert Only	49	281	4.2 (2.3, 7.4)	14.0 (10.2, 19.1)	17.5 (13.0, 23.2)	25.0 (18.9, 32.5)		
TKR (Tibial/Femoral)	38	302	4.4 (2.5, 7.7)	11.9 (8.3, 16.8)	14.4 (10.3, 19.9)			
TOTAL	117	731						

Figure RK19 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by Type of 1st Revision (Primary Diagnosis OA, 1st Revision for Arthrofibrosis)



HR - adjusted for age and gender

Insert/Patella vs TKR (Tibial/Femoral)
Entire Period: HR=1.46 (0.90, 2.35),p=0.124

Insert/Patella vs Insert Only
Entire Period: HR=1.21 (0.77, 1.90),p=0.417

Insert Only vs TKR (Tibial/Femoral)
Entire Period: HR=1.21 (0.79, 1.85),p=0.387

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Insert/Patella	148	124	92	72	25	5	0
Insert Only	281	245	166	128	60	10	0
TKR (Tibial/Femoral)	302	243	167	111	36	1	0

MORTALITY FOLLOWING 1ST REVISION

Mortality following a 1st revision has been calculated for all 1st revision procedures and according to the more common 1st revision diagnoses.

The overall mortality is 0.4% at 30 days, 0.7% at 90 days, 1.5% at 1 year and 24.8% at 10 years (Table RK22).

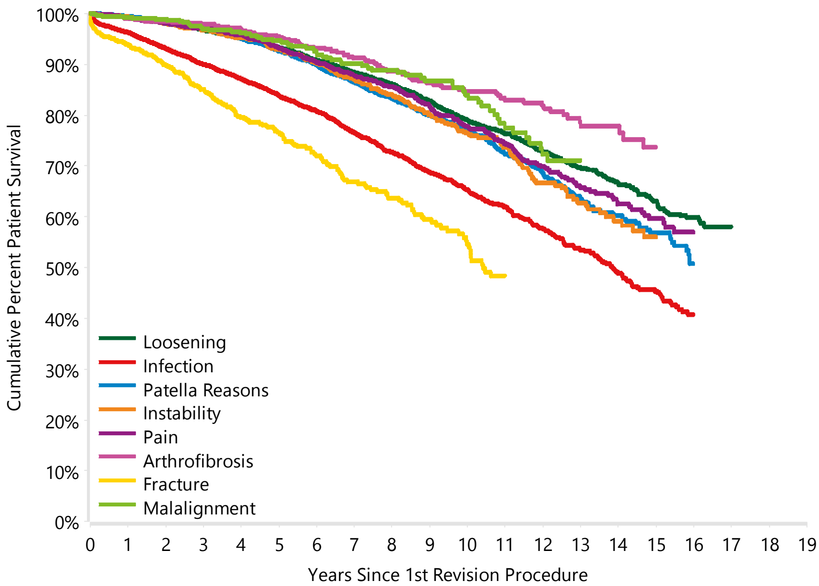
Compared to 1st revisions for loosening, 1st revisions for infection and fracture have a higher rate of mortality, while those revised for arthrofibrosis have a lower rate of mortality (Figure RK20).

1st revisions for fracture and infection have a higher rate of mortality compared to 1st revisions for loosening.

Table RK22 Cumulative Percent Patient Survival of Known Primary Total Knee Replacement Since 1st Revised by Reason for 1st Revision

Reason for 1st Revision	N Deceased	N Total	30 Day	90 Day	1 Yr	5 Yrs	10 Yrs	15 Yrs
Loosening	948	6700	99.9 (99.8, 100.0)	99.8 (99.7, 99.9)	99.3 (99.1, 99.5)	93.3 (92.6, 94.0)	79.1 (77.6, 80.5)	63.1 (60.4, 65.6)
Infection	1091	5088	99.0 (98.7, 99.2)	97.9 (97.5, 98.3)	96.3 (95.8, 96.8)	83.9 (82.6, 85.1)	65.4 (63.3, 67.5)	45.4 (41.8, 48.9)
Patella Reasons	637	4346	100.0 (99.8, 100.0)	100.0 (99.8, 100.0)	99.4 (99.1, 99.6)	92.6 (91.7, 93.5)	77.1 (75.1, 79.0)	56.9 (52.9, 60.7)
Instability	255	2341	99.9 (99.7, 100.0)	99.8 (99.5, 99.9)	99.4 (98.9, 99.6)	92.9 (91.4, 94.2)	76.5 (73.0, 79.5)	56.0 (49.3, 62.2)
Pain	342	2226	100.0 (99.7, 100.0)	99.9 (99.6, 100.0)	99.2 (98.7, 99.5)	93.2 (91.9, 94.3)	77.8 (75.1, 80.2)	59.6 (54.8, 64.1)
Arthrofibrosis	95	985	99.8 (99.2, 99.9)	99.7 (99.0, 99.9)	99.1 (98.3, 99.6)	95.5 (93.7, 96.8)	84.7 (81.0, 87.8)	73.7 (66.5, 79.6)
Fracture	227	840	97.1 (95.8, 98.1)	96.2 (94.6, 97.3)	94.0 (92.1, 95.4)	76.6 (73.0, 79.9)	54.6 (48.8, 60.1)	
Malalignment	66	590	100.0 (100.0, 100.0)	99.7 (98.6, 99.9)	99.3 (98.1, 99.7)	94.7 (92.1, 96.4)	84.0 (78.8, 88.0)	
TOTAL	3661	23116	99.6 (99.5, 99.7)	99.3 (99.2, 99.4)	98.5 (98.3, 98.6)	90.7 (90.3, 91.1)	75.2 (74.3, 76.0)	57.2 (55.6, 58.8)

Figure RK20 Cumulative Percent Patient Survival of Known Primary Total Knee Replacement Since 1st Revised by Reason for 1st Revision



HR - adjusted for age and gender

Infection vs Loosening
0 - 3Mth: HR=8.98 (5.80, 13.90),p<0.001
3Mth - 1.5Yr: HR=2.01 (1.58, 2.54),p<0.001
1.5Yr - 2Yr: HR=2.33 (1.68, 3.24),p<0.001
2Yr - 3Yr: HR=2.02 (1.58, 2.58),p<0.001
3Yr+: HR=1.24 (1.12, 1.38),p<0.001

Patella Reasons vs Loosening
0 - 2Yr: HR=0.74 (0.55, 0.98),p=0.038
2Yr - 2.5Yr: HR=1.35 (0.90, 2.03),p=0.145
2.5Yr - 6Yr: HR=1.03 (0.88, 1.21),p=0.723
6Yr+: HR=1.08 (0.95, 1.23),p=0.238

Instability vs Loosening
Entire Period: HR=1.15 (1.00, 1.32),p=0.050

Pain vs Loosening
Entire Period: HR=0.99 (0.87, 1.12),p=0.870

Arthrofibrosis vs Loosening
Entire Period: HR=0.69 (0.56, 0.85),p<0.001

Fracture vs Loosening
0 - 2Wk: HR=33.25 (17.09, 64.70),p<0.001
2Wk - 3Mth: HR=10.34 (5.32, 20.08),p<0.001
3Mth - 1.5Yr: HR=2.65 (1.79, 3.92),p<0.001
1.5Yr - 4Yr: HR=2.97 (2.30, 3.84),p<0.001
4Yr - 5.5Yr: HR=1.60 (1.05, 2.42),p=0.027
5.5Yr - 10.5Yr: HR=1.63 (1.24, 2.15),p<0.001
10.5Yr+: HR=1.11 (0.65, 1.90),p=0.708

Malalignment vs Loosening
Entire Period: HR=0.84 (0.66, 1.08),p=0.175

Number at Risk	0 Yr	1 Yr	5 Yrs	10 Yrs	15 Yrs
Loosening	6700	6094	3843	1499	317
Infection	5088	4340	2202	721	129
Patella Reasons	4346	4020	2403	777	108
Instability	2341	1996	916	285	42
Pain	2226	1998	1283	502	83
Arthrofibrosis	985	872	532	237	41
Fracture	840	689	309	84	16
Malalignment	590	536	333	117	23

OUTCOME OF 1ST REVISION OVER TIME

The outcome of 1st revision TKR is compared using three time periods: 1999-2005, 2006-2012 and 2013-2019.

There is an improvement in the rate of 2nd revision with each time period.

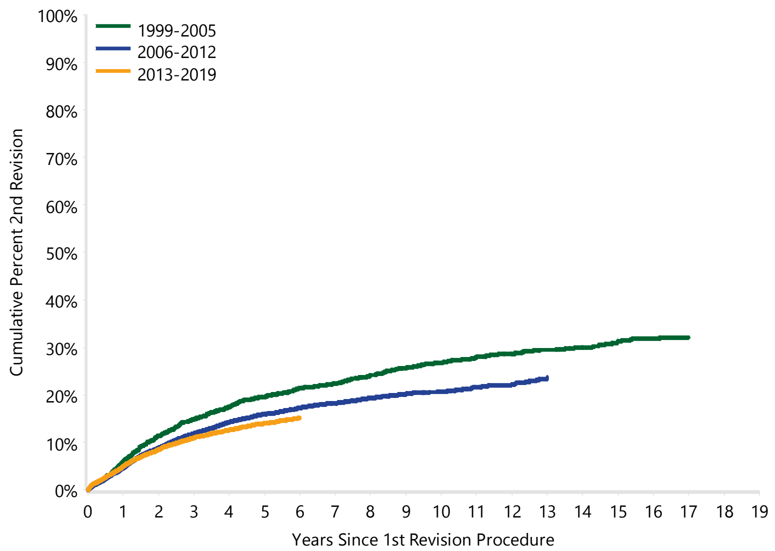
There is an improvement in the rate of 2nd revision when the time periods are compared (Table RK23 and Figure RK21).

Table RK23 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by Year of 1st Revision (Primary Diagnosis OA, Excluding 1st Revision for Infection)

Year of 1st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
1999-2005	492	1743	6.0 (5.0, 7.2)	14.8 (13.2, 16.6)	19.6 (17.7, 21.5)	26.8 (24.7, 29.1)	31.3 (28.9, 33.7)	
2006-2012	1441	7276	4.7 (4.2, 5.2)	11.9 (11.1, 12.6)	15.9 (15.1, 16.8)	20.7 (19.7, 21.7)		
2013-2019	1201	11821	5.0 (4.6, 5.4)	10.9 (10.3, 11.6)	14.0 (13.2, 14.9)			
TOTAL	3134	20840						

Note: Excludes revisions where no minor or major femoral/tibial components have been inserted

Figure RK21 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by Year of 1st Revision (Primary Diagnosis OA, Excluding 1st Revision for Infection)



HR - adjusted for age and gender

1999-2005 vs 2013-2019
0 - 6Mth: HR=1.04 (0.77, 1.42),p=0.779
6Mth - 4.5Yr: HR=1.59 (1.39, 1.82),p<0.001
4.5Yr+: HR=1.69 (1.35, 2.10),p<0.001

1999-2005 vs 2006-2012
Entire Period: HR=1.32 (1.19, 1.47),p<0.001

2006-2012 vs 2013-2019
0 - 1Yr: HR=0.95 (0.83, 1.09),p=0.480
1Yr - 1.5Yr: HR=1.31 (1.08, 1.60),p=0.005
1.5Yr+: HR=1.23 (1.09, 1.37),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
1999-2005	1743	1617	1426	1279	978	479	4
2006-2012	7276	6883	6224	5705	2014	0	0
2013-2019	11821	9338	5454	2392	0	0	0

REVISION OF TOTAL KNEE SUMMARY

The mean age of patients undergoing revision TKR is 68.2 years, which is similar to the age of those undergoing primary knee replacement. The cumulative percent 2nd revision at 15 years is 25.6%. The rate of 2nd revision varies with the reason for 1st revision, and at 10 years is highest where the 1st revision is for arthrofibrosis and lowest for malalignment.

Except for revision for patella reasons, for each reason for 1st revision, loosening, infection and a recurrence of the original revision diagnosis are the most common reasons for 2nd revision. When revising for loosening, there is a lower rate of 2nd revision if both femoral and tibial components are revised, and when stem extensions and sleeves are used.

Where the revision is for patella reasons, insertion of a patella component in a previously un-resurfaced patella results in a lower rate of 2nd revision compared to patella component revision.

While revision for instability often uses more constrained prostheses, the most common cause of 2nd revision is further instability and there is no difference in 2nd revision rate between levels of constraint used. Revisions for both pain and arthrofibrosis show no difference in the 2nd revision rate when comparing types of revision used.

Mortality is highest for patients revised for fracture.

There is an improvement in the rate of 2nd revision when time periods are compared.

Ten and Fifteen Year Prosthesis Outcomes

Ten and Fifteen Year Prosthesis 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.

This year, the number of individual combinations of femoral and acetabular hip prostheses with 10 year outcomes has increased by 6.5% and the number of individual combinations of femoral and tibial knee prostheses has increased by 7.6%.

HIP REPLACEMENT

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

When combinations include a variety of bearing surfaces, large head metal/metal surfaces have been reported separately.

There are 99 femoral and acetabular combinations with 10 year outcome data. This is 6 more than last year. These prosthesis combinations have been used in 68.5% of all primary total conventional hip procedures performed for osteoarthritis reported to the Registry. Of these 99 combinations, 48 were not used in 2019. These 48 combinations account for 10.7% of all primary total conventional hip procedures.

The 10 year cumulative percent revision for the individual prosthesis combinations ranges from 1.6% to 46.3%. A commonly accepted benchmark standard is a 5% cumulative percent revision at 10 years. There are 41 (41.4%) hip prosthesis combinations with a 10 year cumulative rate of revision (for any reason) of less than 5.0% (Table TY1).

Approaches to benchmarking hip and knee prostheses have been reviewed by an International Working Group. An important recommendation was to use confidence intervals rather than the estimated rate of revision as used above. The reason for this is that data quality is inherently reflected in the confidence interval. To identify better performing prosthesis combinations, the following two approaches were recommended:

Superiority approach: the upper confidence interval is less than, or equal to, the benchmark standard. If the benchmark is 5% at 10 years, then 16 (16.2%) hip prosthesis combinations would 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 5% at 10 years, the accepted upper confidence interval is 6% or less. Using this approach, an additional 18 prosthesis combinations can be benchmarked, i.e. 34 (34.3%) prosthesis combinations would receive a non-inferiority benchmark. These 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)

				Type of Revision						
Femoral Component	Acetabular Component	N Revised	N Total	THR	Femoral	Acetabular	Other	2 Yrs	5 Yrs	10 Yrs
ABGII	ABGII	303	2772	40	152	75	36	2.5 (2.0, 3.1)	4.2 (3.5, 5.0)	6.9 (5.9, 7.9)
ABGII	ABGII (Shell/Insert)	71	853	15	39	12	5	1.8 (1.1, 2.9)	2.7 (1.8, 4.1)	6.5 (4.9, 8.5)
ABGII	Trident (Shell)	241	2440	14	148	32	47	3.4 (2.8, 4.2)	5.0 (4.2, 5.9)	8.7 (7.6, 10.1)
Accolade I	Mitch TRH*MoM	77	357	34	11	22	10	3.7 (2.1, 6.2)	10.3 (7.5, 14.0)	18.7 (14.9, 23.3)
Accolade I	Trident (Shell)*	490	8573	55	191	95	149	2.4 (2.1, 2.7)	3.7 (3.3, 4.2)	5.7 (5.2, 6.2)
Adapter	Bionik*MoM	94	376	19	8	23	44	5.1 (3.3, 7.9)	15.3 (12.0, 19.5)	25.1 (20.8, 30.0)
Alloclassic	Allofit	283	5094	30	120	50	83	1.8 (1.5, 2.2)	2.9 (2.5, 3.4)	5.0 (4.4, 5.7)
Alloclassic	Durom*MoM	95	547	27	12	44	12	3.4 (2.1, 5.3)	7.4 (5.5, 10.0)	16.1 (13.1, 19.6)
Alloclassic	Fitmore*	128	1709	15	65	13	35	4.2 (3.4, 5.3)	5.6 (4.6, 6.8)	7.5 (6.3, 8.9)
Alloclassic	Metasul*	22	371	4	2	11	5	2.2 (1.1, 4.3)	3.6 (2.1, 6.1)	5.2 (3.3, 8.1)
Alloclassic	Trabecular Metal (Shell)*	47	957	5	13	5	24	2.5 (1.7, 3.7)	4.0 (2.9, 5.5)	5.1 (3.8, 6.9)
Alloclassic	Trilogy*	11	844	.	8	1	2	0.4 (0.1, 1.1)	0.5 (0.2, 1.3)	1.6 (0.8, 3.0)
Anthology	R3	179	6609	15	57	33	74	2.2 (1.9, 2.6)	2.6 (2.2, 3.0)	3.4 (2.9, 4.0)
Anthology	Reflection (Shell)*	38	909	4	14	12	8	2.3 (1.5, 3.5)	3.0 (2.1, 4.4)	4.5 (3.3, 6.2)
Apex	Fin II	47	924	5	9	19	14	2.3 (1.5, 3.5)	3.4 (2.4, 4.8)	5.4 (4.0, 7.2)
C-Stem	Duraloc*	87	894	13	22	14	38	2.8 (1.9, 4.2)	3.8 (2.7, 5.3)	6.9 (5.3, 8.9)
C-Stem	Elite Plus LPW*	22	367	10	4	8	.	1.1 (0.4, 3.0)	2.7 (1.4, 5.0)	5.3 (3.3, 8.6)
C-Stem	PINNACLE	29	800	2	12	6	9	1.9 (1.1, 3.1)	2.6 (1.7, 4.0)	3.9 (2.6, 5.7)
C-Stem AMT	PINNACLE	87	3704	7	34	10	36	1.7 (1.3, 2.2)	3.0 (2.4, 3.9)	5.3 (3.7, 7.5)
CLS	Allofit	56	813	5	31	13	7	2.5 (1.6, 3.8)	3.9 (2.8, 5.5)	6.0 (4.5, 8.0)
CLS	Fitmore	51	868	6	23	7	15	2.4 (1.6, 3.7)	4.2 (3.0, 5.9)	5.6 (4.1, 7.7)
CORAIL	ASR*MoM	1222	2654	216	39	912	55	5.1 (4.3, 6.0)	27.5 (25.8, 29.3)	46.3 (44.4, 48.3)
CORAIL	Duraloc*	90	1267	14	40	14	22	1.6 (1.0, 2.5)	2.5 (1.8, 3.6)	5.3 (4.1, 6.8)
CORAIL	Fitmore	13	495	.	3	3	7	2.3 (1.3, 4.1)	2.5 (1.4, 4.4)	3.1 (1.7, 5.6)
CORAIL	PINNACLE	1554	47155	132	566	248	608	2.1 (2.0, 2.3)	3.1 (3.0, 3.3)	5.1 (4.8, 5.4)
CORAIL	PINNACLE*MoM	110	880	17	36	20	37	2.9 (1.9, 4.2)	6.1 (4.7, 8.0)	12.3 (10.2, 14.8)
CPCS	R3	146	4976	17	41	32	56	2.3 (1.9, 2.7)	3.1 (2.6, 3.7)	4.6 (3.7, 5.7)
CPCS	Reflection (Cup)	67	770	22	2	30	13	1.3 (0.7, 2.5)	2.6 (1.6, 4.1)	8.2 (6.0, 11.1)
CPCS	Reflection (Shell)	96	2719	12	43	11	30	0.9 (0.6, 1.4)	1.7 (1.2, 2.2)	3.5 (2.7, 4.4)
CPT	Allofit	44	1365	6	20	3	15	1.2 (0.8, 2.0)	2.9 (2.0, 4.1)	5.1 (3.6, 7.2)
CPT	Trabecular Metal (Shell)	88	1811	7	37	16	28	2.9 (2.2, 3.8)	4.4 (3.5, 5.6)	7.0 (5.5, 8.8)
CPT	Trilogy	331	7542	32	120	35	144	2.2 (1.9, 2.6)	3.5 (3.1, 3.9)	5.1 (4.6, 5.7)
CPT	ZCA	35	839	13	7	9	6	0.9 (0.4, 1.8)	2.2 (1.4, 3.5)	4.7 (3.2, 6.8)
Charnley	Charnley Ogee*	63	630	37	9	5	12	2.1 (1.2, 3.6)	5.1 (3.6, 7.2)	9.1 (6.9, 11.9)
Charnley	Charnley*	46	563	36	7	3	.	0.9 (0.4, 2.2)	2.2 (1.3, 3.9)	6.5 (4.6, 9.1)
Charnley	Vitalock*	41	370	7	20	3	11	2.7 (1.5, 5.0)	4.4 (2.7, 7.1)	7.9 (5.5, 11.4)
Citation	Trident (Shell)*	54	1035	3	14	14	23	1.9 (1.3, 3.0)	3.3 (2.4, 4.6)	4.4 (3.3, 5.9)
Citation	Vitalock*	44	508	3	8	16	17	1.0 (0.4, 2.4)	2.0 (1.1, 3.7)	5.2 (3.5, 7.7)
Elite Plus	Duraloc*	106	953	15	64	6	21	2.2 (1.5, 3.4)	5.1 (3.9, 6.8)	9.1 (7.3, 11.3)
Epoch	Trilogy*	46	990	1	9	9	27	2.7 (1.9, 4.0)	3.6 (2.6, 4.9)	4.5 (3.4, 6.0)
Exeter	Contemporary*	39	428	10	7	14	8	2.9 (1.6, 5.0)	4.2 (2.6, 6.6)	6.0 (4.0, 8.9)
Exeter	Vitalock*	67	1076	11	12	25	19	2.0 (1.3, 3.0)	2.3 (1.5, 3.4)	4.6 (3.4, 6.1)
Exeter V40	ABGII*	35	976	8	12	9	6	0.8 (0.4, 1.6)	1.7 (1.0, 2.8)	3.3 (2.3, 4.8)
Exeter V40	Contemporary	269	4558	66	44	127	32	2.2 (1.8, 2.6)	3.2 (2.8, 3.8)	5.7 (4.9, 6.5)
Exeter V40	Exeter Contemporary	149	2914	50	32	45	22	1.9 (1.5, 2.5)	3.0 (2.5, 3.8)	4.8 (4.0, 5.7)
Exeter V40	Exeter*	98	1526	22	15	43	18	1.3 (0.8, 2.0)	2.9 (2.1, 3.9)	4.6 (3.6, 5.9)
Exeter V40	Hemispherical*	32	663	6	9	1	16	3.0 (2.0, 4.7)	3.5 (2.3, 5.2)	4.6 (3.1, 6.7)
Exeter V40	Mallory-Head	39	1434	6	23	3	7	0.6 (0.3, 1.2)	1.0 (0.6, 1.6)	2.3 (1.6, 3.4)
Exeter V40	PINNACLE	46	1742	2	18	11	15	1.7 (1.2, 2.4)	2.0 (1.4, 2.9)	4.9 (3.3, 7.1)
Exeter V40	R3	54	2107	1	9	16	28	1.8 (1.3, 2.5)	2.6 (1.9, 3.4)	3.6 (2.6, 4.8)
Exeter V40	Trabecular Metal (Shell)	20	408	2	2	2	14	3.3 (1.9, 5.6)	4.5 (2.8, 7.2)	5.9 (3.7, 9.1)
Exeter V40	Trident (Shell)	1638	60109	222	500	223	693	1.5 (1.4, 1.6)	2.3 (2.2, 2.4)	3.7 (3.5, 3.9)
Exeter V40	Trilogy*	18	516	2	5	2	9	2.3 (1.3, 4.1)	2.5 (1.5, 4.3)	3.7 (2.3, 6.0)
Exeter V40	Vitalock*	84	1795	15	24	24	21	1.4 (1.0, 2.1)	2.3 (1.7, 3.1)	3.2 (2.5, 4.2)
F2L	SPH-Blind*	60	571	10	20	15	15	3.9 (2.6, 5.8)	6.1 (4.4, 8.4)	7.6 (5.7, 10.2)
M/L Taper	Allofit	20	712	1	10	1	8	1.7 (1.0, 3.0)	2.1 (1.2, 3.5)	4.6 (2.6, 8.0)

Femoral Component	Acetabular Component	N Revised	N Total	THR	Femoral	Acetabular	Other	2 Yrs	5 Yrs	10 Yrs
				Type of Revision						
M/L Taper	Fitmore	17	471	.	6	1	10	3.3 (2.0, 5.4)	3.9 (2.4, 6.2)	3.9 (2.4, 6.2)
M/L Taper	Trabecular Metal (Shell)	14	362	1	4	2	7	1.7 (0.8, 3.7)	2.0 (0.9, 4.1)	6.0 (3.4, 10.4)
M/L Taper	Trilogy	26	780	.	8	6	12	1.2 (0.6, 2.2)	2.6 (1.6, 4.1)	3.8 (2.6, 5.7)
M/L Taper Kinectiv	Fitmore*	38	403	1	15	6	16	5.2 (3.4, 7.9)	8.0 (5.8, 11.2)	10.3 (7.6, 14.0)
MS 30	Allofit*	63	1539	13	18	19	13	1.3 (0.8, 2.0)	2.1 (1.5, 3.0)	3.7 (2.8, 5.0)
MS 30	Fitmore	26	679	1	6	9	10	1.1 (0.5, 2.2)	1.9 (1.1, 3.5)	3.0 (1.8, 5.1)
MS 30	Low Profile Cup	23	603	9	3	9	2	0.5 (0.2, 1.6)	1.3 (0.6, 2.7)	2.9 (1.7, 5.0)
Mallory-Head	Mallory-Head*	184	2908	17	13	62	92	2.1 (1.6, 2.7)	3.0 (2.4, 3.7)	4.8 (4.1, 5.8)
Mallory-Head	Recap*MoM	33	395	8	.	22	3	1.3 (0.5, 3.0)	2.6 (1.4, 4.7)	6.4 (4.3, 9.3)
Meridian	Vitalock*	36	354	2	2	15	17	1.4 (0.6, 3.4)	3.5 (2.0, 6.1)	6.7 (4.4, 10.0)
Natural Hip	Allofit*	12	529	1	3	3	5	0.9 (0.4, 2.3)	1.1 (0.5, 2.5)	2.3 (1.3, 4.1)
Natural Hip	Fitmore*	39	882	2	7	12	18	0.9 (0.5, 1.8)	2.0 (1.3, 3.2)	4.2 (3.0, 5.9)
Omnifit	Secur-Fit*	81	716	8	22	19	32	3.7 (2.5, 5.3)	6.2 (4.6, 8.2)	9.9 (7.9, 12.5)
Omnifit	Trident (Shell)	152	3788	13	37	25	77	2.2 (1.8, 2.7)	2.9 (2.4, 3.5)	3.8 (3.2, 4.6)
Polarstem	R3	271	10277	12	88	36	135	2.3 (2.0, 2.6)	3.1 (2.7, 3.5)	4.8 (3.2, 7.0)
Quadra-H	Trident (Shell)	26	893	4	9	1	12	2.0 (1.3, 3.2)	3.6 (2.3, 5.5)	6.9 (3.4, 13.6)
Quadra-H	Versafitcup CC	524	14973	47	228	117	132	2.1 (1.9, 2.4)	3.3 (3.0, 3.7)	6.1 (5.2, 7.0)
S-Rom	Duraloc Option*	26	523	4	9	5	8	2.1 (1.2, 3.8)	3.3 (2.1, 5.2)	4.6 (3.1, 6.8)
S-Rom	PINNACLE	132	2437	12	74	12	34	2.8 (2.2, 3.6)	4.4 (3.6, 5.3)	5.7 (4.8, 6.8)
SL-Plus	EP-Fit Plus	118	2106	5	53	20	40	2.0 (1.4, 2.7)	3.4 (2.7, 4.3)	5.5 (4.5, 6.6)
SL-Plus	R3	84	1628	3	24	21	36	3.3 (2.5, 4.3)	4.4 (3.5, 5.5)	6.2 (4.9, 7.8)
Secur-Fit	DeltaMotion	30	772	7	16	2	5	1.2 (0.6, 2.3)	2.5 (1.6, 3.9)	5.0 (3.4, 7.4)
Secur-Fit	Trident (Shell)	406	9348	24	180	74	128	2.3 (2.0, 2.7)	3.5 (3.1, 3.9)	4.7 (4.2, 5.2)
Secur-Fit Plus	Trident (Shell)	196	5657	13	50	48	85	1.5 (1.2, 1.9)	2.2 (1.9, 2.7)	3.3 (2.8, 3.8)
Spectron EF	BHR*MoM	67	430	12	.	48	7	2.6 (1.4, 4.6)	6.0 (4.1, 8.8)	15.9 (12.5, 20.1)
Spectron EF	R3	61	1868	10	9	14	28	2.1 (1.5, 2.8)	3.3 (2.5, 4.3)	4.7 (3.5, 6.4)
Spectron EF	Reflection (Cup)	120	1404	46	11	54	9	1.3 (0.8, 2.0)	2.9 (2.2, 4.0)	7.2 (5.8, 9.0)
Spectron EF	Reflection (Shell)	296	4645	66	96	47	87	1.5 (1.2, 1.9)	2.7 (2.3, 3.3)	5.4 (4.7, 6.1)
Stability	Duraloc*	52	374	2	9	16	25	1.3 (0.6, 3.2)	2.2 (1.1, 4.3)	8.9 (6.3, 12.5)
Summit	ASR*MoM	478	1041	15	6	432	25	3.0 (2.1, 4.2)	20.0 (17.6, 22.6)	44.4 (41.4, 47.6)
Summit	PINNACLE	137	4944	8	30	21	78	1.8 (1.5, 2.2)	2.3 (1.9, 2.8)	3.4 (2.9, 4.1)
Summit	PINNACLE*MoM	75	730	5	6	15	49	1.7 (0.9, 2.9)	3.5 (2.4, 5.1)	8.9 (7.0, 11.3)
Synergy	BHR*MoM	94	698	5	7	55	27	2.7 (1.8, 4.2)	4.8 (3.4, 6.7)	12.1 (9.9, 14.9)
Synergy	R3	124	4595	3	36	26	59	2.0 (1.6, 2.4)	2.6 (2.1, 3.1)	3.3 (2.8, 4.0)
Synergy	Reflection (Shell)	361	7438	34	74	120	133	2.0 (1.7, 2.4)	2.6 (2.3, 3.0)	3.9 (3.5, 4.4)
Synergy	Trident (Shell)*	16	438	.	4	5	7	1.2 (0.5, 2.7)	1.9 (0.9, 3.7)	3.9 (2.3, 6.7)
Taperloc	Exceed	62	2191	6	19	22	15	1.9 (1.4, 2.6)	2.5 (1.9, 3.2)	4.1 (2.9, 5.9)
Taperloc	M2a*MoM	64	471	12	2	44	6	2.6 (1.5, 4.5)	6.9 (4.9, 9.6)	12.2 (9.5, 15.6)
Taperloc	Mallory-Head	87	1900	9	16	29	33	2.2 (1.7, 3.0)	3.1 (2.4, 4.1)	5.1 (4.0, 6.6)
Taperloc	Recap*MoM	48	456	12	6	23	7	2.4 (1.4, 4.4)	5.6 (3.8, 8.2)	9.8 (7.3, 13.0)
Trabecular Metal	Allofit*	21	435	2	5	4	10	3.0 (1.8, 5.1)	4.5 (2.9, 6.9)	5.3 (3.4, 8.1)
Trabecular Metal	Trilogy*	24	425	3	10	3	8	4.0 (2.5, 6.4)	4.8 (3.1, 7.4)	6.6 (4.4, 9.8)
VerSys	Trilogy	238	4432	14	84	42	98	3.0 (2.6, 3.6)	3.9 (3.4, 4.5)	5.1 (4.5, 5.9)
TOTAL		**14304**	**301776**	**1820**	**4107**	**4021**	**4356**			

Note: Only prostheses with over 350 procedures have been listed

* Denotes prosthesis combinations with no reported use in primary total conventional hip procedures in 2019

MoM refers to metal/metal prosthesis combinations used with head size larger than 32mm

Green: prosthesis combination qualifies for a superiority benchmark

Blue: prosthesis combination qualifies for non-inferiority benchmark

KNEE REPLACEMENT

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

There are 71 total knee replacement combinations with 10 year outcome data. This is 5 more than last year. These prosthesis combinations were used in 86.9% of all primary total knee replacement procedures performed for osteoarthritis reported to the Registry. Of these 71 prosthesis combinations, 29 were not used in 2019. These 29 combinations account for 13.0% of all primary total knee procedures. The 10 year cumulative percent revision ranges from 2.1% to 13.3%. There are 20 (28.2%) knee prosthesis combinations with a 10 year cumulative percent revision (for any reason) of less than 5.0% (Table TY2).

Applying the recommendations of the International Benchmarking Working Group, there are 9 (12.7%) knee prosthesis combinations which would qualify for a superiority benchmark (highlighted in green) and an additional 22 prosthesis combinations, i.e. 31 (43.7%) prosthesis combinations would qualify for a non-inferiority benchmark (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
AGC	AGC*	295	5028	124	5	25	141	1.7 (1.4, 2.1)	3.2 (2.8, 3.8)	5.0 (4.3, 5.6)
Active Knee	Active Knee	713	9646	200	28	41	444	2.5 (2.2, 2.8)	4.8 (4.4, 5.3)	8.3 (7.7, 9.0)
Advance	Advance	55	956	20	4	8	23	3.8 (2.7, 5.3)	5.8 (4.4, 7.6)	7.9 (5.9, 10.5)
Advance	Advance II	110	1620	43	3	13	51	3.6 (2.8, 4.6)	5.0 (4.0, 6.2)	7.0 (5.7, 8.4)
Advantim	Advantim*	72	1454	37	4	3	28	1.7 (1.1, 2.5)	3.1 (2.3, 4.1)	5.1 (4.0, 6.5)
BalanSys	BalanSys	77	3722	21	3	7	46	1.2 (0.9, 1.7)	2.3 (1.8, 3.0)	4.5 (3.3, 6.1)
Buechel-Pappas	Buechel-Pappas*	50	467	16	2	2	30	4.3 (2.8, 6.6)	8.1 (5.9, 11.0)	10.9 (8.3, 14.3)
Columbus	Columbus	115	2999	31	4	7	73	2.8 (2.1, 3.6)	5.5 (4.4, 6.8)	8.7 (7.1, 10.7)
Duracon	Duracon*	1235	19828	328	30	68	809	2.1 (1.9, 2.3)	3.5 (3.2, 3.7)	5.2 (4.9, 5.5)
Evolis	Evolis	45	1439	18	1	7	19	1.3 (0.8, 2.0)	2.6 (1.9, 3.7)	4.3 (3.1, 6.0)
Genesis II CR	Genesis II	1019	23990	206	67	56	690	2.0 (1.8, 2.2)	3.5 (3.3, 3.8)	5.0 (4.7, 5.3)
Genesis II CR	Profix Mobile*	123	1209	49	9	8	57	2.7 (1.9, 3.8)	5.4 (4.2, 6.8)	8.8 (7.2, 10.6)
Genesis II Oxinium CR (ctd)	Genesis II	477	9089	88	27	25	337	1.9 (1.6, 2.2)	3.6 (3.2, 4.0)	6.1 (5.6, 6.8)
Genesis II Oxinium PS (ctd)	Genesis II	1119	19449	144	33	153	789	2.9 (2.6, 3.1)	5.2 (4.9, 5.5)	7.6 (7.1, 8.1)
Genesis II PS	Genesis II	806	19063	141	29	53	583	2.1 (1.9, 2.3)	3.7 (3.5, 4.0)	5.3 (4.9, 5.6)
Journey Oxinium	Journey*	311	2975	52	5	30	224	3.4 (2.8, 4.1)	6.5 (5.7, 7.5)	11.4 (10.2, 12.7)
Kinemax Plus	Kinemax Plus*	124	1815	71	3	5	45	1.8 (1.3, 2.6)	3.2 (2.4, 4.1)	4.6 (3.7, 5.8)
LCS CR	LCS	612	8317	249	24	88	251	2.5 (2.1, 2.8)	4.4 (4.0, 4.9)	6.4 (5.8, 6.9)
LCS CR	MBT	1197	30939	397	56	139	605	1.9 (1.8, 2.1)	3.4 (3.2, 3.7)	4.9 (4.6, 5.2)
LCS CR	MBT Duofix	756	14884	216	34	42	464	2.7 (2.4, 2.9)	4.1 (3.7, 4.4)	5.4 (5.0, 5.8)
LCS Duofix	MBT Duofix*	484	3606	348	27	7	102	3.7 (3.2, 4.4)	10.2 (9.2, 11.2)	13.3 (12.2, 14.5)
LCS Duofix	MBT*	133	1169	93	9	2	29	3.3 (2.4, 4.5)	8.1 (6.7, 9.9)	11.9 (10.1, 13.9)
LCS PS	MBT*	43	481	11	5	1	26	4.6 (3.1, 7.0)	6.6 (4.7, 9.3)	10.4 (7.7, 14.1)
Legion CR	Genesis II	147	5597	21	11	5	110	2.3 (1.9, 2.8)	3.5 (3.0, 4.2)	5.7 (3.8, 8.4)
Legion Oxinium CR	Genesis II	138	5910	33	14	3	88	1.8 (1.5, 2.3)	3.6 (3.0, 4.3)	4.6 (3.8, 5.7)
Legion Oxinium PS	Genesis II	515	13940	60	14	45	396	2.3 (2.1, 2.6)	4.4 (4.0, 4.8)	6.3 (5.5, 7.3)
Legion PS	Genesis II	147	5157	36	2	6	103	1.8 (1.5, 2.3)	3.1 (2.6, 3.7)	4.7 (3.6, 6.1)
MBK (Zimmer)	Nexgen*	35	448	19	1	1	14	2.3 (1.2, 4.1)	4.1 (2.6, 6.5)	6.2 (4.2, 8.9)
MRK	MRK	16	634	4	1	.	11	1.7 (0.9, 3.1)	2.1 (1.2, 3.6)	3.1 (1.8, 5.3)
Maxim	Maxim*	123	1819	35	9	6	73	2.1 (1.5, 2.8)	3.4 (2.6, 4.3)	5.2 (4.3, 6.4)
Maxim	Vanguard*	85	628	38	6	6	35	3.1 (2.0, 4.8)	5.6 (4.0, 7.7)	8.3 (6.3, 10.9)
Natural Knee Flex	Natural Knee II	129	5698	40	4	7	78	1.5 (1.2, 1.8)	2.4 (2.0, 2.9)	3.1 (2.6, 3.8)
Natural Knee II	Natural Knee II*	410	6443	179	10	59	162	1.6 (1.4, 2.0)	2.8 (2.4, 3.2)	5.1 (4.5, 5.7)
Nexgen CR	Nexgen	409	11450	134	20	31	224	1.2 (1.0, 1.5)	2.2 (1.9, 2.5)	3.1 (2.8, 3.5)
Nexgen CR	Nexgen TM CR	52	851	17	4	10	21	2.4 (1.6, 3.7)	5.6 (4.2, 7.5)	6.7 (5.1, 8.8)
Nexgen CR Flex	Natural Knee II	15	833	4	.	.	11	0.6 (0.3, 1.4)	1.4 (0.8, 2.5)	2.1 (1.2, 3.4)
Nexgen CR Flex	Nexgen	1281	56679	292	90	116	783	1.4 (1.3, 1.5)	2.3 (2.2, 2.5)	3.1 (2.9, 3.3)
Nexgen CR Flex	Nexgen TM CR	292	11559	86	21	27	158	1.3 (1.1, 1.5)	2.3 (2.0, 2.6)	3.2 (2.8, 3.7)
Nexgen LCCK	Nexgen	38	853	3	3	.	32	3.1 (2.1, 4.5)	5.0 (3.6, 7.0)	5.8 (4.1, 8.2)
Nexgen LPS	Nexgen	350	6997	89	20	33	208	2.0 (1.7, 2.3)	3.3 (2.9, 3.8)	5.0 (4.4, 5.6)
Nexgen LPS	Nexgen TM LPS	33	1373	10	3	6	14	1.0 (0.6, 1.7)	2.4 (1.6, 3.5)	3.2 (2.2, 4.7)
Nexgen LPS Flex	Nexgen	1415	36200	378	61	225	751	1.8 (1.6, 1.9)	3.2 (3.0, 3.4)	5.2 (4.9, 5.5)
Nexgen LPS Flex	Nexgen TM LPS	63	1556	30	4	5	24	2.0 (1.4, 2.8)	3.5 (2.7, 4.6)	4.3 (3.3, 5.5)
Optetrak-CR	Optetrak*	45	504	15	3	4	23	3.2 (2.0, 5.2)	6.1 (4.3, 8.7)	8.5 (6.2, 11.6)
Optetrak-PS	Optetrak	235	2363	93	4	27	111	3.4 (2.8, 4.2)	6.2 (5.3, 7.3)	10.2 (8.9, 11.6)
Optetrak-PS	Optetrak RBK	78	1112	21	3	3	51	2.8 (1.9, 3.9)	5.9 (4.6, 7.6)	8.7 (6.9, 10.9)
PFC Sigma CR	AMK Duofix*	64	1890	22	.	1	41	1.2 (0.8, 1.8)	2.3 (1.7, 3.1)	3.3 (2.5, 4.3)

Femoral Component	Tibial Component	N Revised	N Total	Type of Revision: TKR	Femoral	Tibial	Other	2 Yrs	5 Yrs	10 Yrs
PFC Sigma CR	MBT	311	6155	59	35	44	173	2.7 (2.3, 3.1)	4.0 (3.5, 4.5)	5.2 (4.6, 5.8)
PFC Sigma CR	MBT Duofix	148	3180	23	17	4	104	2.6 (2.1, 3.3)	3.7 (3.1, 4.5)	5.3 (4.4, 6.2)
PFC Sigma CR	PFC Sigma	802	24236	197	53	64	488	1.5 (1.4, 1.7)	2.5 (2.3, 2.7)	3.6 (3.3, 3.9)
PFC Sigma PS	MBT	319	6306	99	14	23	183	2.2 (1.8, 2.6)	3.9 (3.4, 4.4)	5.3 (4.7, 6.0)
PFC Sigma PS	MBT Duofix*	166	2212	33	4	6	123	3.5 (2.8, 4.4)	6.2 (5.2, 7.3)	8.7 (7.4, 10.1)
PFC Sigma PS	PFC Sigma	339	7866	113	11	26	189	1.9 (1.6, 2.3)	3.2 (2.9, 3.7)	4.8 (4.3, 5.4)
Profix	Profix Mobile*	108	986	37	6	5	60	5.1 (3.9, 6.7)	8.2 (6.6, 10.1)	9.9 (8.1, 12.0)
Profix	Profix*	290	5370	67	13	18	192	2.3 (1.9, 2.8)	3.8 (3.3, 4.3)	5.4 (4.8, 6.1)
Profix Oxinium (ctd)	Profix*	105	1049	22	5	14	64	4.1 (3.1, 5.5)	7.0 (5.6, 8.7)	8.8 (7.2, 10.8)
RBK	RBK	513	10735	195	13	41	264	2.4 (2.1, 2.7)	4.0 (3.6, 4.4)	5.4 (4.9, 5.9)
Rocc	Rocc*	41	575	14	1	2	24	3.3 (2.1, 5.2)	5.2 (3.6, 7.3)	6.8 (5.0, 9.3)
Rotaglide Plus	Rotaglide Plus*	80	616	36	1	5	38	3.3 (2.2, 5.1)	5.8 (4.1, 8.0)	11.2 (8.8, 14.2)
Score	Score	295	4801	106	19	10	160	3.5 (3.0, 4.1)	6.5 (5.8, 7.4)	10.5 (9.1, 12.1)
Scorpio CR	Scorpio+*	190	2448	45	10	30	105	2.0 (1.5, 2.7)	4.3 (3.6, 5.2)	7.1 (6.1, 8.2)
Scorpio CR	Series 7000*	607	11561	152	27	47	381	1.8 (1.6, 2.1)	3.3 (3.0, 3.6)	5.2 (4.8, 5.7)
Scorpio NRG CR	Series 7000*	190	5070	47	14	13	116	2.1 (1.7, 2.5)	3.2 (2.7, 3.7)	4.7 (4.0, 5.5)
Scorpio NRG PS	Series 7000*	168	3931	31	8	19	110	2.0 (1.6, 2.5)	3.7 (3.1, 4.3)	4.8 (4.1, 5.6)
Scorpio PS	Scorpio*	34	524	9	.	11	14	2.1 (1.2, 3.8)	4.5 (3.0, 6.7)	6.1 (4.3, 8.6)
Scorpio PS	Scorpio+*	150	2036	40	14	10	86	2.7 (2.1, 3.5)	5.1 (4.2, 6.2)	6.7 (5.7, 8.0)
Scorpio PS	Series 7000*	345	4696	112	9	69	155	2.6 (2.1, 3.1)	4.7 (4.1, 5.3)	6.9 (6.2, 7.7)
Triathlon CR	Triathlon	2132	95424	375	97	103	1557	1.5 (1.4, 1.6)	2.5 (2.4, 2.6)	3.8 (3.6, 4.0)
Triathlon PS	Triathlon	502	12216	90	26	69	317	2.5 (2.2, 2.8)	4.1 (3.7, 4.5)	5.8 (5.3, 6.4)
Vanguard CR	Vanguard	815	25812	173	30	63	549	1.7 (1.6, 1.9)	3.0 (2.8, 3.2)	5.0 (4.6, 5.5)
Vanguard PS	Vanguard	287	4967	66	7	56	158	3.4 (2.9, 4.0)	5.4 (4.8, 6.1)	7.6 (6.7, 8.7)
TOTAL		**25023**	**607411**	**6703**	**1154**	**2168**	**14998**			

Note: Only prosthesis combinations with over 350 procedures have been listed
* Denotes prosthesis combinations that have not had any reported use in primary total knee procedures in 2019
CR 'cruciate retaining' refers to minimally stabilised
Green: prosthesis combination qualifies for a superiority benchmark
Blue: prosthesis combination qualifies for non-inferiority benchmark

FIFTEEN YEAR OUTCOMES

This year, the Registry is reporting 15 year outcomes for 58 hip and 43 knee prosthesis combinations. A combination is included if more than 350 procedures have been reported to the Registry and the follow-up period is 15 or more years.

HIP REPLACEMENT

The listed prosthesis combinations were used in 50.9% of all primary total conventional hip replacement procedures performed for osteoarthritis. Of the 58 combinations, 30 had no reported use in 2019.

The 15 year cumulative percent revision ranges from 2.6% to 20.9%. There are 17 combinations which have a cumulative percent revision of less than 6.5% and 6 with less than 5.0%. These are indicated in bold text in Table FY1.

KNEE REPLACEMENT

The listed prosthesis combinations were used in 55.2% of all primary total knee replacement procedures performed for osteoarthritis. Of the 43 combinations, 21 had no reported use in 2019.

The 15 year cumulative percent revision ranges from 4.0% to 15.6%. Eight of the combinations have a cumulative percent revision of less than 6.5% and 3 with less than 5% at 15 years. These are indicated in bold text in Table FY2.

Table FY1 Cumulative Percent Revision of Primary Total Conventional Hip Replacement Prosthesis Combinations with 15 Year Data (Primary Diagnosis OA)

Femoral Stem	Acetabular Component	N Revised	N Total	Type of Revision: THR	Femoral	Acetabular	Other	5 Yrs	10 Yrs	15 Yrs
ABGII	ABGII	303	2772	40	152	75	36	4.2 (3.5, 5.0)	6.9 (5.9, 7.9)	11.7 (10.4, 13.2)
ABGII	ABGII (Shell/Insert)	71	853	15	39	12	5	2.7 (1.8, 4.1)	6.5 (4.9, 8.5)	10.2 (8.0, 12.9)
ABGII	Trident (Shell)	241	2440	14	148	32	47	5.0 (4.2, 5.9)	8.7 (7.6, 10.1)	14.3 (12.5, 16.4)
Accolade I	Trident (Shell)*	490	8573	55	191	95	149	3.7 (3.3, 4.2)	5.7 (5.2, 6.2)	7.1 (6.5, 7.8)
Alloclassic	Allofit	283	5094	30	120	50	83	2.9 (2.5, 3.4)	5.0 (4.4, 5.7)	8.4 (7.4, 9.6)
Alloclassic	Fitmore*	128	1709	15	65	13	35	5.6 (4.6, 6.8)	7.5 (6.3, 8.9)	9.1 (7.5, 10.9)
Alloclassic	Metasul*	22	371	4	2	11	5	3.6 (2.1, 6.1)	5.2 (3.3, 8.1)	6.6 (4.4, 9.8)
C-Stem	Duraloc*	87	894	13	22	14	38	3.8 (2.7, 5.3)	6.9 (5.3, 8.9)	12.3 (9.9, 15.3)
C-Stem	Elite Plus LPW*	22	367	10	4	8	.	2.7 (1.4, 5.0)	5.3 (3.3, 8.6)	9.0 (5.8, 13.8)
CLS	Allofit	56	813	5	31	13	7	3.9 (2.8, 5.5)	6.0 (4.5, 8.0)	8.7 (6.5, 11.6)
CLS	Fitmore	51	868	6	23	7	15	4.2 (3.0, 5.9)	5.6 (4.1, 7.7)	9.4 (7.0, 12.4)
CORAIL	Duraloc*	90	1267	14	40	14	22	2.5 (1.8, 3.6)	5.3 (4.1, 6.8)	10.7 (8.5, 13.4)
CORAIL	PINNACLE	1554	47155	132	566	248	608	3.1 (3.0, 3.3)	5.1 (4.8, 5.4)	7.7 (6.6, 9.0)
CPCS	Reflection (Cup)	67	770	22	2	30	13	2.6 (1.6, 4.1)	8.2 (6.0, 11.1)	20.9 (16.1, 26.7)
CPCS	Reflection (Shell)	96	2719	12	43	11	30	1.7 (1.2, 2.2)	3.5 (2.7, 4.4)	7.4 (5.6, 9.8)
CPT	Trilogy	331	7542	32	120	35	144	3.5 (3.1, 3.9)	5.1 (4.6, 5.7)	6.6 (5.8, 7.6)
CPT	ZCA	35	839	13	7	9	6	2.2 (1.4, 3.5)	4.7 (3.2, 6.8)	6.6 (4.5, 9.7)
Charnley	Charnley Ogee*	63	630	37	9	5	12	5.1 (3.6, 7.2)	9.1 (6.9, 11.9)	13.7 (10.7, 17.6)
Charnley	Charnley*	46	563	36	7	3	.	2.2 (1.3, 3.9)	6.5 (4.6, 9.1)	11.5 (8.5, 15.4)
Charnley	Vitalock*	41	370	7	20	3	11	4.4 (2.7, 7.1)	7.9 (5.5, 11.4)	11.5 (8.4, 15.7)
Citation	**Trident (Shell)***	**54**	**1035**	**3**	**14**	**14**	**23**	**3.3 (2.4, 4.6)**	**4.4 (3.3, 5.9)**	**6.2 (4.7, 8.2)**
Citation	Vitalock*	44	508	3	8	16	17	2.0 (1.1, 3.7)	5.2 (3.5, 7.7)	9.2 (6.8, 12.5)
Elite Plus	Duraloc*	106	953	15	64	6	21	5.1 (3.9, 6.8)	9.1 (7.3, 11.3)	14.8 (12.2, 17.9)
Epoch	**Trilogy***	**46**	**990**	**1**	**9**	**9**	**27**	**3.6 (2.6, 4.9)**	**4.5 (3.4, 6.0)**	**5.1 (3.8, 6.8)**
Exeter	Contemporary*	39	428	10	7	14	8	4.2 (2.6, 6.6)	6.0 (4.0, 8.9)	12.6 (9.0, 17.3)
Exeter	Vitalock*	67	1076	11	12	25	19	2.3 (1.5, 3.4)	4.6 (3.4, 6.1)	6.7 (5.2, 8.6)
Exeter V40	**ABGII***	**35**	**976**	**8**	**12**	**9**	**6**	**1.7 (1.0, 2.8)**	**3.3 (2.3, 4.8)**	**4.5 (3.2, 6.2)**
Exeter V40	Contemporary	269	4558	66	44	127	32	3.2 (2.8, 3.8)	5.7 (4.9, 6.5)	9.3 (8.1, 10.7)
Exeter V40	Exeter Contemporary	149	2914	50	32	45	22	3.0 (2.5, 3.8)	4.8 (4.0, 5.7)	8.2 (6.7, 10.0)

Femoral Stem	Acetabular Component	N Revised	N Total	Type of Revision THR	Femoral	Acetabular	Other	5 Yrs	10 Yrs	15 Yrs
Exeter V40	Exeter*	98	1526	22	15	43	18	2.9 (2.1, 3.9)	4.6 (3.6, 5.9)	9.5 (7.6, 11.9)
Exeter V40	**Mallory-Head**	**39**	**1434**	**6**	**23**	**3**	**7**	**1.0 (0.6, 1.6)**	**2.3 (1.6, 3.4)**	**4.7 (3.2, 6.8)**
Exeter V40	**Trident (Shell)**	**1638**	**60109**	**222**	**500**	**223**	**693**	**2.3 (2.2, 2.4)**	**3.7 (3.5, 3.9)**	**5.4 (5.1, 5.9)**
Exeter V40	**Trilogy***	**18**	**516**	**2**	**5**	**2**	**9**	**2.5 (1.5, 4.3)**	**3.7 (2.3, 6.0)**	**4.2 (2.6, 6.7)**
Exeter V40	**Vitalock***	**84**	**1795**	**15**	**24**	**24**	**21**	**2.3 (1.7, 3.1)**	**3.2 (2.5, 4.2)**	**5.1 (4.0, 6.4)**
F2L	SPH-Blind*	60	571	10	20	15	15	6.1 (4.4, 8.4)	7.6 (5.7, 10.2)	11.5 (9.0, 14.7)
MS 30	Allofit*	63	1539	13	18	19	13	2.1 (1.5, 3.0)	3.7 (2.8, 5.0)	7.6 (5.6, 10.2)
MS 30	Fitmore	26	679	1	6	9	10	1.9 (1.1, 3.5)	3.0 (1.8, 5.1)	7.4 (4.8, 11.4)
MS 30	**Low Profile Cup**	**23**	**603**	**9**	**3**	**9**	**2**	**1.3 (0.6, 2.7)**	**2.9 (1.7, 5.0)**	**5.3 (3.2, 8.8)**
Mallory-Head	Mallory-Head*	184	2908	17	13	62	92	3.0 (2.4, 3.7)	4.8 (4.1, 5.8)	8.7 (7.5, 10.2)
Meridian	Vitalock*	36	354	2	2	15	17	3.5 (2.0, 6.1)	6.7 (4.4, 10.0)	11.0 (8.0, 15.1)
Natural Hip	**Allofit***	**12**	**529**	**1**	**3**	**3**	**5**	**1.1 (0.5, 2.5)**	**2.3 (1.3, 4.1)**	**2.6 (1.5, 4.6)**
Natural Hip	**Fitmore***	**39**	**882**	**2**	**7**	**12**	**18**	**2.0 (1.3, 3.2)**	**4.2 (3.0, 5.9)**	**5.0 (3.6, 6.8)**
Omnifit	Secur-Fit*	81	716	8	22	19	32	6.2 (4.6, 8.2)	9.9 (7.9, 12.5)	12.9 (10.4, 16.0)
Omnifit	**Trident (Shell)**	**152**	**3788**	**13**	**37**	**25**	**77**	**2.9 (2.4, 3.5)**	**3.8 (3.2, 4.6)**	**5.3 (4.4, 6.3)**
S-Rom	**Duraloc Option***	**26**	**523**	**4**	**9**	**5**	**8**	**3.3 (2.1, 5.2)**	**4.6 (3.1, 6.8)**	**5.0 (3.4, 7.3)**
S-Rom	PINNACLE	132	2437	12	74	12	34	4.4 (3.6, 5.3)	5.7 (4.8, 6.8)	7.2 (5.9, 8.9)
SL-Plus	EP-Fit Plus	118	2106	5	53	20	40	3.4 (2.7, 4.3)	5.5 (4.5, 6.6)	7.0 (5.7, 8.5)
Secur-Fit	**Trident (Shell)**	**406**	**9348**	**24**	**180**	**74**	**128**	**3.5 (3.1, 3.9)**	**4.7 (4.2, 5.2)**	**6.0 (5.4, 6.8)**
Secur-Fit Plus	**Trident (Shell)**	**196**	**5657**	**13**	**50**	**48**	**85**	**2.2 (1.9, 2.7)**	**3.3 (2.8, 3.8)**	**4.5 (3.9, 5.3)**
Spectron EF	Reflection (Cup)	120	1404	46	11	54	9	2.9 (2.2, 4.0)	7.2 (5.8, 9.0)	14.7 (12.1, 17.8)
Spectron EF	Reflection (Shell)	296	4645	66	96	47	87	2.7 (2.3, 3.3)	5.4 (4.7, 6.1)	9.8 (8.6, 11.1)
Stability	Duraloc*	52	374	2	9	16	25	2.2 (1.1, 4.3)	8.9 (6.3, 12.5)	15.9 (12.1, 20.6)
Summit	**PINNACLE**	**137**	**4944**	**8**	**30**	**21**	**78**	**2.3 (1.9, 2.8)**	**3.4 (2.9, 4.1)**	**4.7 (3.7, 6.0)**
Summit	PINNACLE*[MoM]	75	730	5	6	15	49	3.5 (2.4, 5.1)	8.9 (7.0, 11.3)	11.9 (9.4, 14.9)
Synergy	**Reflection (Shell)**	**361**	**7438**	**34**	**74**	**120**	**133**	**2.6 (2.3, 3.0)**	**3.9 (3.5, 4.4)**	**5.8 (5.2, 6.5)**
Taperloc	M2a*[MoM]	64	471	12	2	44	6	6.9 (4.9, 9.6)	12.2 (9.5, 15.6)	14.8 (11.8, 18.6)
Taperloc	Mallory-Head	87	1900	9	16	29	33	3.1 (2.4, 4.1)	5.1 (4.0, 6.6)	8.0 (6.1, 10.4)
VerSys	**Trilogy**	**238**	**4432**	**14**	**84**	**42**	**98**	**3.9 (3.4, 4.5)**	**5.1 (4.5, 5.9)**	**6.0 (5.2, 6.8)**
TOTAL		**9747**	**224405**	**1276**	**3205**	**1983**	**3283**			

Note: Only prostheses with over 350 procedures have been listed
* denotes prosthesis combinations with no reported use in primary total conventional hip procedures in 2019
[MoM] refers to metal/metal prosthesis combinations used with head size larger than 32mm
Bold: Prosthesis combination has a cumulative percent revision of less than 6.5% at 15 years

Table FY2 Cumulative Percent Revision of Primary Total Knee Replacement Prosthesis Combinations with 15 Year Data (Primary Diagnosis OA)

Femoral Component	Tibial Component	N Revised	N Total	Type of Revision				5 Yrs	10 Yrs	15 Yrs
				TKR	Femoral	Tibial	Other			
AGC	AGC*	295	5028	124	5	25	141	3.2 (2.8, 3.8)	5.0 (4.3, 5.6)	7.7 (6.8, 8.7)
Active Knee	Active Knee	713	9646	200	28	41	444	4.8 (4.4, 5.3)	8.3 (7.7, 9.0)	11.9 (11.0, 13.0)
Advance	Advance II	110	1620	43	3	13	51	5.0 (4.0, 6.2)	7.0 (5.7, 8.4)	7.6 (6.3, 9.2)
Advantim	**Advantim***	**72**	**1454**	**37**	**4**	**3**	**28**	**3.1 (2.3, 4.1)**	**5.1 (4.0, 6.5)**	**6.2 (4.8, 8.0)**
BalanSys	BalanSys	77	3722	21	3	7	46	2.3 (1.8, 3.0)	4.5 (3.3, 6.1)	6.8 (4.3, 10.7)
Duracon	Duracon*	1235	19828	328	30	68	809	3.5 (3.2, 3.7)	5.2 (4.9, 5.5)	7.4 (6.9, 7.8)
Genesis II CR	**Genesis II**	**1019**	**23990**	**206**	**67**	**56**	**690**	**3.5 (3.3, 3.8)**	**5.0 (4.7, 5.3)**	**6.3 (5.8, 6.8)**
Genesis II CR	Profix Mobile*	123	1209	49	9	8	57	5.4 (4.2, 6.8)	8.8 (7.2, 10.6)	11.9 (9.9, 14.2)
Genesis II Oxinium CR (ctd)	Genesis II	477	9089	88	27	25	337	3.6 (3.2, 4.0)	6.1 (5.6, 6.8)	9.0 (8.1, 10.1)
Genesis II Oxinium PS (ctd)	Genesis II	1119	19449	144	33	153	789	5.2 (4.9, 5.5)	7.6 (7.1, 8.1)	10.3 (9.3, 11.5)
Genesis II PS	Genesis II	806	19063	141	29	53	583	3.7 (3.5, 4.0)	5.3 (4.9, 5.6)	6.6 (6.0, 7.3)
Kinemax Plus	Kinemax Plus*	124	1815	71	3	5	45	3.2 (2.4, 4.1)	4.6 (3.7, 5.8)	8.0 (6.7, 9.6)
LCS CR	LCS	612	8317	249	24	88	251	4.4 (4.0, 4.9)	6.4 (5.8, 6.9)	8.1 (7.5, 8.8)
LCS CR	**MBT**	**1197**	**30939**	**397**	**56**	**139**	**605**	**3.4 (3.2, 3.7)**	**4.9 (4.6, 5.2)**	**6.2 (5.7, 6.7)**
LCS CR	MBT Duofix	756	14884	216	34	42	464	4.1 (3.7, 4.4)	5.4 (5.0, 5.8)	7.4 (6.8, 8.0)
MBK (Zimmer)	Nexgen*	35	448	19	1	1	14	4.1 (2.6, 6.5)	6.2 (4.2, 8.9)	8.1 (5.8, 11.4)
Maxim	Maxim*	123	1819	35	9	6	73	3.4 (2.6, 4.3)	5.2 (4.3, 6.4)	9.1 (7.6, 11.0)
Maxim	Vanguard*	85	628	38	6	6	35	5.6 (4.0, 7.7)	8.3 (6.3, 10.9)	14.8 (11.9, 18.4)
Natural Knee II	Natural Knee II*	410	6443	179	10	59	162	2.8 (2.4, 3.2)	5.1 (4.5, 5.7)	9.1 (8.2, 10.1)
Nexgen CR	**Nexgen**	**409**	**11450**	**134**	**20**	**31**	**224**	**2.2 (1.9, 2.5)**	**3.1 (2.8, 3.5)**	**4.5 (4.1, 5.0)**
Nexgen CR	Nexgen TM CR	52	851	17	4	10	21	5.6 (4.2, 7.5)	6.7 (5.1, 8.8)	7.3 (5.6, 9.6)
Nexgen CR Flex	**Nexgen**	**1281**	**56679**	**292**	**90**	**116**	**783**	**2.3 (2.2, 2.5)**	**3.1 (2.9, 3.3)**	**4.0 (3.6, 4.5)**
Nexgen LPS	Nexgen	350	6997	89	20	33	208	3.3 (2.9, 3.8)	5.0 (4.4, 5.6)	6.7 (6.0, 7.6)
Nexgen LPS Flex	Nexgen	1415	36200	378	61	225	751	3.2 (3.0, 3.4)	5.2 (4.9, 5.5)	7.1 (6.6, 7.7)
Optetrak-CR	Optetrak*	45	504	15	3	4	23	6.1 (4.3, 8.7)	8.5 (6.2, 11.6)	12.5 (9.0, 17.2)
Optetrak-PS	Optetrak	235	2363	93	4	27	111	6.2 (5.3, 7.3)	10.2 (8.9, 11.6)	12.5 (10.9, 14.2)
PFC Sigma CR	**AMK Duofix***	**64**	**1890**	**22**	**.**	**1**	**41**	**2.3 (1.7, 3.1)**	**3.3 (2.5, 4.3)**	**4.4 (3.3, 5.7)**
PFC Sigma CR	MBT	311	6155	59	35	44	173	4.0 (3.5, 4.5)	5.2 (4.6, 5.8)	7.0 (6.1, 8.0)
PFC Sigma CR	MBT Duofix	148	3180	23	17	4	104	3.7 (3.1, 4.5)	5.3 (4.4, 6.2)	7.9 (6.4, 9.8)
PFC Sigma CR	**PFC Sigma**	**802**	**24236**	**197**	**53**	**64**	**488**	**2.5 (2.3, 2.7)**	**3.6 (3.3, 3.9)**	**5.6 (5.1, 6.2)**
PFC Sigma PS	MBT	319	6306	99	14	23	183	3.9 (3.4, 4.4)	5.3 (4.7, 6.0)	7.1 (6.2, 8.2)
PFC Sigma PS	MBT Duofix*	166	2212	33	4	6	123	6.2 (5.2, 7.3)	8.7 (7.4, 10.1)	10.0 (8.6, 11.7)
PFC Sigma PS	PFC Sigma	339	7866	113	11	26	189	3.2 (2.9, 3.7)	4.8 (4.3, 5.4)	6.8 (6.0, 7.8)
Profix	Profix Mobile*	108	986	37	6	5	60	8.2 (6.6, 10.1)	9.9 (8.1, 12.0)	11.9 (9.9, 14.3)
Profix	**Profix***	**290**	**5370**	**67**	**13**	**18**	**192**	**3.8 (3.3, 4.3)**	**5.4 (4.8, 6.1)**	**6.2 (5.5, 6.9)**
Profix Oxinium (ctd)	Profix*	105	1049	22	5	14	64	7.0 (5.6, 8.7)	8.8 (7.2, 10.8)	10.9 (9.0, 13.1)
RBK	RBK	513	10735	195	13	41	264	4.0 (3.6, 4.4)	5.4 (4.9, 5.9)	7.1 (6.3, 8.0)
Rotaglide Plus	Rotaglide Plus*	80	616	36	1	5	38	5.8 (4.1, 8.0)	11.2 (8.8, 14.2)	15.6 (12.6, 19.3)
Scorpio CR	Scorpio+*	190	2448	45	10	30	105	4.3 (3.6, 5.2)	7.1 (6.1, 8.2)	8.8 (7.6, 10.1)
Scorpio CR	Series 7000*	607	11561	152	27	47	381	3.3 (3.0, 3.6)	5.2 (4.8, 5.7)	7.2 (6.6, 7.8)
Scorpio PS	Scorpio*	34	524	9	.	11	14	4.5 (3.0, 6.7)	6.1 (4.3, 8.6)	7.7 (5.3, 10.9)
Scorpio PS	Scorpio+*	150	2036	40	14	10	86	5.1 (4.2, 6.2)	6.7 (5.7, 8.0)	8.4 (7.1, 9.8)
Scorpio PS	Series 7000*	345	4696	112	9	69	155	4.7 (4.1, 5.3)	6.9 (6.2, 7.7)	9.4 (8.4, 10.6)
TOTAL		**17746**	**386301**	**4864**	**815**	**1662**	**10405**			

Note: Only prosthesis combinations with over 350 procedures have been listed
*denotes prosthesis combinations that have not had any reported use in primary total knee procedures in 2019
Bold: Prosthesis combination has a cumulative percent revision of less than 6.5% at 15 years

Hip Replacement

Hip Replacement

CATEGORIES OF HIP REPLACEMENT

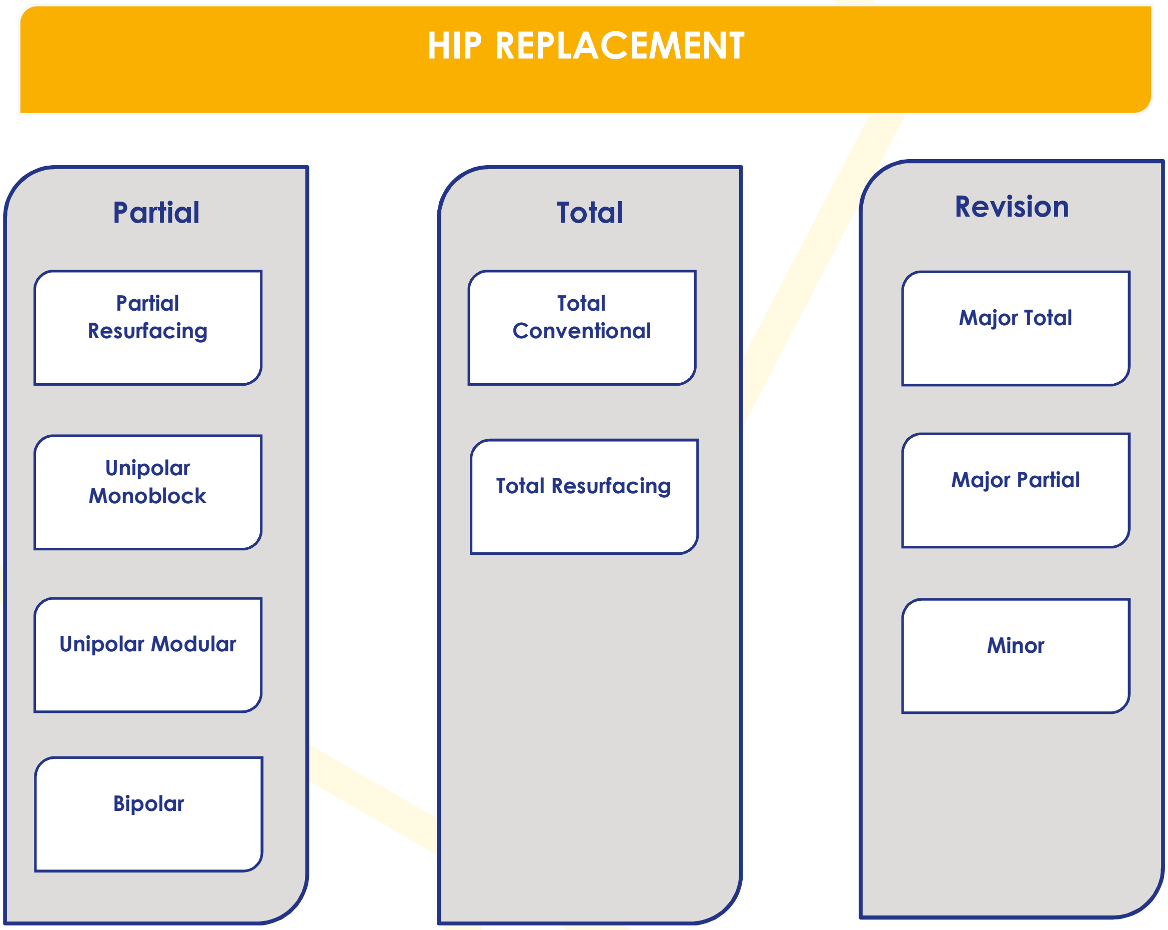
The Registry groups hip replacement into three broad categories: primary partial, primary total and revision hip replacement.

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-2020



USE OF HIP REPLACEMENT

This report includes 694,730 hip replacements reported to the Registry with a procedure date up to and including 31 December 2019. This is an additional 51,163 hip procedures compared to the number reported last year. When considering all hip procedures currently recorded by the Registry, primary partial hip accounts for 14.6%, primary total hip 74.6% and revision hip replacement 10.8% (Table H1).

Table H1 Number of Hip Replacements

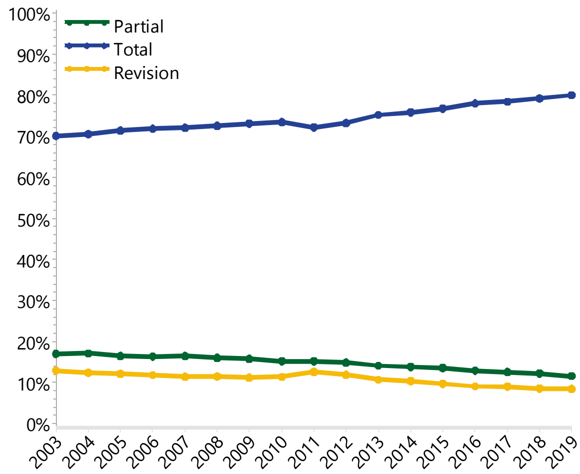
Hip Category	Number	Percent
Partial	101651	14.6
Total	517947	74.6
Revision	75132	10.8
TOTAL	**694730**	**100.0**

The number of hip replacement procedures undertaken in 2019 is 89.3% higher than the number undertaken in 2003. The corresponding increase in primary total hip replacement is 116.1%, primary partial 29.1% and revision hip replacement 23.0%.

The number of hip replacements undertaken in 2019 increased by 952 (1.9%) compared to 2018. During this time, the use of primary total hip replacement increased by 3.0%, accounting for 80.0% of all hip replacement procedures in 2019. Primary partial hip replacement decreased by 3.5%, accounting for 11.6% of hip procedures in 2019.

The proportion of revision hip procedures has declined from a peak of 12.9% in 2003 to 8.4% in 2019. This equates to 2,283 fewer revision procedures in 2019 than would have been expected if the proportion of revision procedures had remained at 12.9% (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). The Registry commenced collecting ASA score in 2012 and BMI data in 2015.

There are ASA score data on 307,085 hip replacement procedures and BMI data on 205,304 hip replacement procedures. Since its initial collection in 2012, ASA score has been recorded in 95.1% of procedures. BMI data have been recorded in 85.6% of procedures since 2015, when its collection commenced.

In 2019, ASA score is reported in 99.8% of hip replacement procedures and BMI in 90.9% 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 2019. The Registry recorded BMI data for 57.7% of primary partial hip, 96.1% of primary total hip, and 86.6% of revision hip replacement procedures.

ASA score and BMI are both known to impact the outcome of hip replacement surgery.

ASA Score

There are five ASA score classifications:

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

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

Overall, in 86.1% of procedures, patients have an ASA score of 2 or 3, 8.1% have a score of 1, and 5.7% have an ASA score of 4. Very few procedures were recorded where patients have an ASA score of 5.

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 (87.5%) compared to those undergoing primary total hip replacement (37.0%). Revision hip replacement procedures also have patients with higher ASA scores (60.2% have an ASA score of 3 or 4) compared to those having a primary total hip replacement, but not as high as patients having a partial hip replacement (Table H2).

BMI

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

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

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

For all hip replacements, the majority of procedures are undertaken in patients who are normal or pre-obese (60.4%). There is a similar proportion of primary total and revision hip replacement procedures, with patients normal or pre-obese in 59.0% of primary total hip procedures, and in 58.7% of revision hip replacement procedures.

In partial hip replacement procedures, patients generally have a lower BMI, with 59.8% of procedures undertaken in patients in either the normal or underweight categories, compared to 23.2% for primary total hip and 25.7% for revision hip replacement (Table H3).

Table H2 ASA Score for Hip Replacement

ASA Score	Partial N	Partial Col%	Total N	Total Col%	Revision N	Revision Col%	TOTAL N	TOTAL Col%
ASA 1	148	0.4	23490	9.8	1205	4.2	24843	8.1
ASA 2	4577	11.7	127299	53.2	10129	35.5	142005	46.2
ASA 3	23708	60.6	83908	35.0	14878	52.2	122494	39.9
ASA 4	10489	26.8	4775	2.0	2275	8.0	17539	5.7
ASA 5	168	0.4	16	0.0	20	0.1	204	0.1
TOTAL	**39090**	**100.0**	**239488**	**100.0**	**28507**	**100.0**	**307085**	**100.0**

Table H3 BMI Category for Hip Replacement

BMI Category	Partial N	Partial Col%	Total N	Total Col%	Revision N	Revision Col%	TOTAL N	TOTAL Col%
Underweight	1478	9.8	1823	1.1	301	1.7	3602	1.8
Normal	7580	50.1	38195	22.1	4206	24.0	49981	24.3
Pre Obese	4245	28.0	63658	36.9	6089	34.7	73992	36.0
Obese Class 1	1350	8.9	42315	24.5	4127	23.5	47792	23.3
Obese Class 2	354	2.3	17829	10.3	1828	10.4	20011	9.7
Obese Class 3	135	0.9	8791	5.1	1000	5.7	9926	4.8
TOTAL	**15142**	**100.0**	**172611**	**100.0**	**17551**	**100.0**	**205304**	**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. Previously, detailed information on partial hips was included in the Annual Report. It is now provided as a separate supplementary report. The Partial Hip Arthroplasty Report is one of 13 supplementary reports to complete the AOANJRR Annual Report for 2020 and is available on the AOANJRR website.

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.

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. This accounts for 45.6% of all partial hip procedures, followed by unipolar monoblock (28.5%) and bipolar (25.9%) (Table HP1).

Table HP1 Primary Partial Hip Replacement by Class

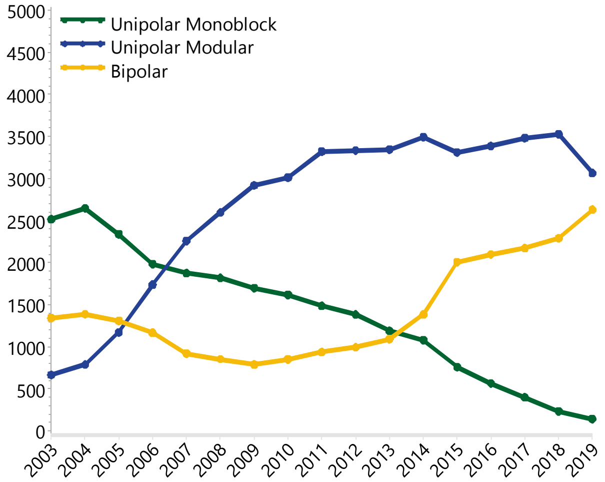
Hip Class	Number	Percent
Unipolar Monoblock	28995	28.5
Unipolar Modular	46303	45.6
Bipolar	26338	25.9
TOTAL	**101636**	**100.0**

Note: Excludes 15 partial resurfacing procedures

In 2019, there is a slight increase in the use of bipolar partial hip replacements and a decrease in the use of 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. In 2019, the Exeter V40, CPCS and CPT 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-2020

Figure HP1 Primary Partial Hip Replacement by Class



Detailed information on partial resurfacing hip replacement is available in the supplementary report 'Prosthesis Types No Longer Used' on the AOANJRR website: https://aoanjrr.sahmri.com/annual-reports-2020

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

2003		2016		2017		2018		2019	
N	Model	N	Model	N	Model	N	Model	N	Model
1988	Austin-Moore Type	2927	Exeter V40	2641	Exeter V40	2837	Exeter V40	2918	Exeter V40
810	Exeter V40	752	CPT	722	CPT	806	CPCS	718	CPCS
526	Thompson Type	637	CPCS	711	CPCS	620	CPT	708	CPT
186	Alloclassic	263	ETS	434	C-Stem AMT	458	C-Stem AMT	472	C-Stem AMT
127	Elite Plus	243	CORAIL	239	CORAIL	292	Absolut	175	Absolut
105	CPT	198	Austin-Moore Type	231	ETS	163	CORAIL	139	CORAIL
95	Spectron EF	186	C-Stem AMT	192	Absolut	163	ETS	114	ETS
74	C-Stem	105	Thompson Type	100	Austin-Moore Type	83	Quadra-C	95	Short Exeter V40
65	CPCS	102	Spectron EF	96	Spectron EF	83	Short Exeter V40	63	Spectron EF
63	Omnifit	65	Quadra-C	70	Thompson Type	58	Austin-Moore Type	61	twinSys
10 Most Used									
4039 (10)	89.3%	5478 (10)	90.5%	5436 (10)	89.8%	5563 (10)	92.0%	5463 (10)	93.6%
Remainder									
482 (52)	10.7%	574 (46)	9.5%	619 (45)	10.2%	486 (39)	8.0%	373 (35)	6.4%
TOTAL									
4521 (62)	100.0%	6052 (56)	100.0%	6055 (55)	100.0%	6049 (49)	100.0%	5836 (45)	100.0%

OUTCOME FOR FRACTURED NECK OF FEMUR

Fractured neck of femur is the principal diagnosis for the three main classes of primary partial hip replacement: unipolar monoblock (97.6%), unipolar modular (95.6%) and bipolar (92.3%). 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).

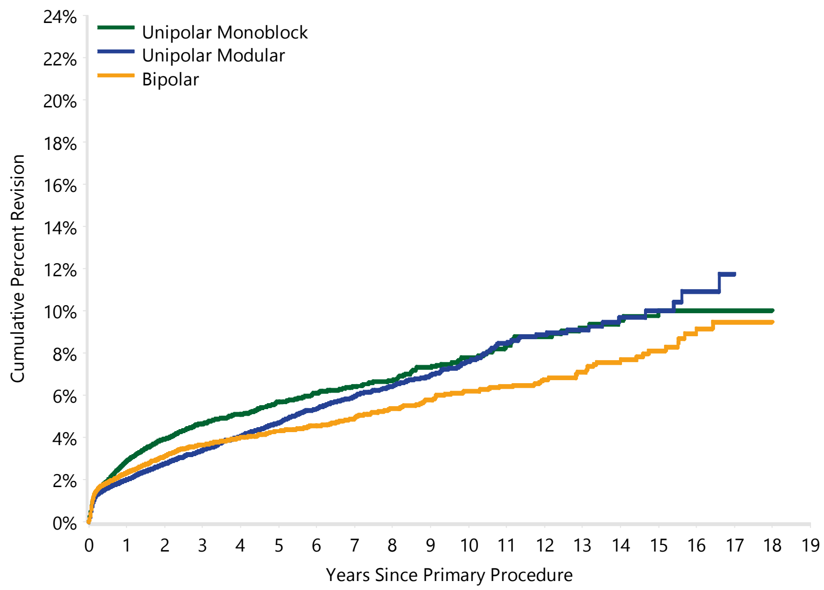
Table HP3 Cumulative Percent Mortality of Primary Partial Hip Replacement by Class (Primary Diagnosis Fractured NOF)

Hip Class	N Deceased	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Monoblock	24705	27593	36.9 (36.4, 37.5)	50.0 (49.4, 50.6)	60.8 (60.2, 61.4)	76.8 (76.3, 77.3)	86.1 (85.6, 86.5)	93.2 (92.9, 93.6)
Unipolar Modular	28126	42795	25.6 (25.2, 26.0)	36.4 (35.9, 36.9)	46.0 (45.5, 46.5)	61.9 (61.3, 62.4)	73.3 (72.8, 73.8)	83.6 (83.1, 84.1)
Bipolar	14528	23655	22.7 (22.2, 23.3)	32.8 (32.2, 33.5)	41.7 (41.0, 42.4)	56.4 (55.7, 57.1)	67.5 (66.7, 68.2)	78.9 (78.1, 79.6)
TOTAL	**67359**	**94043**						

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	1075	28312	2.9 (2.7, 3.1)	3.9 (3.7, 4.2)	4.6 (4.4, 5.0)	5.7 (5.3, 6.1)	6.4 (6.0, 6.9)	7.8 (7.2, 8.5)
Unipolar Modular	1514	44275	2.0 (1.9, 2.1)	2.8 (2.6, 2.9)	3.4 (3.2, 3.6)	4.7 (4.4, 5.0)	6.0 (5.6, 6.3)	7.6 (7.1, 8.2)
Bipolar	829	24314	2.3 (2.1, 2.5)	3.1 (2.9, 3.4)	3.7 (3.4, 3.9)	4.3 (4.0, 4.6)	4.9 (4.5, 5.3)	6.2 (5.6, 6.8)
TOTAL	**3418**	**96901**						

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



HR - adjusted for age and gender

Unipolar Monoblock vs Unipolar Modular
Entire Period: HR=1.36 (1.26, 1.48),p<0.001

Unipolar Monoblock vs Bipolar
0 - 2Wk: HR=1.67 (1.27, 2.19),p<0.001
2Wk - 3Mth: HR=0.99 (0.84, 1.16),p=0.903
3Mth+: HR=1.79 (1.60, 2.02),p<0.001

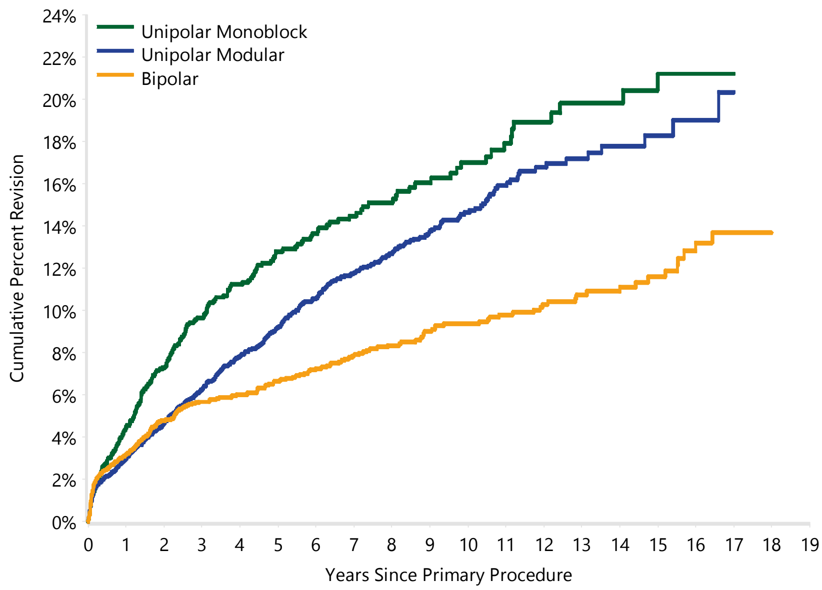
Bipolar vs Unipolar Modular
0 - 3Mth: HR=1.17 (1.03, 1.33),p=0.014
3Mth - 2.5Yr: HR=0.88 (0.77, 1.01),p=0.063
2.5Yr+: HR=0.62 (0.52, 0.74),p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Monoblock	28312	17270	13407	10315	5791	3238	1326
Unipolar Modular	44275	30167	23618	18332	10595	5827	2164
Bipolar	24314	16501	12900	10088	6042	3843	2037

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	240	2458	4.4 (3.6, 5.4)	7.3 (6.2, 8.6)	9.6 (8.3, 11.2)	12.8 (11.2, 14.6)	14.5 (12.7, 16.5)	17.0 (14.8, 19.5)
Unipolar Modular	562	6816	3.0 (2.6, 3.4)	4.6 (4.1, 5.2)	6.3 (5.6, 7.0)	9.2 (8.4, 10.1)	11.8 (10.8, 12.9)	14.6 (13.4, 16.0)
Bipolar	294	4634	3.2 (2.7, 3.8)	4.8 (4.2, 5.5)	5.7 (5.0, 6.5)	6.6 (5.8, 7.5)	7.8 (6.9, 8.9)	9.4 (8.2, 10.6)
TOTAL	**1096**	**13908**						

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



HR - adjusted for age and gender

Unipolar Monoblock vs Bipolar

0 - 3Mth: HR=1.04 (0.74, 1.48),p=0.816

3Mth+: HR=2.14 (1.78, 2.59),p<0.001

Unipolar Monoblock vs Unipolar Modular

Entire Period: HR=1.32 (1.14, 1.54),p<0.001

Unipolar Modular vs Bipolar

0 - 2.5Yr: HR=1.02 (0.86, 1.21),p=0.796

2.5Yr+: HR=2.29 (1.85, 2.84),p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Monoblock	2458	1667	1381	1144	779	563	315
Unipolar Modular	6816	5183	4342	3642	2554	1736	854
Bipolar	4634	3472	2907	2463	1779	1342	924

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-2020

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-2020

USE OF TOTAL HIP REPLACEMENT

The Registry has recorded 517,689 primary total hip replacement procedures. Of these, total conventional is the most common class (96.5%), followed by total resurfacing (3.5%) (Table HT1).

Table HT1 Primary Total Hip Replacement by Class

Total Hip Class	Number	Percent
Total Conventional	499439	96.5
Total Resurfacing	18250	3.5
TOTAL	**517689**	**100.0**

Osteoarthritis is the principal diagnosis for primary total hip replacement (88.5%).

Total conventional hip replacement (all bearing surfaces included) has a lower cumulative percent revision compared to total resurfacing at 19 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	19 Yrs
Total Resurfacing	1847	18250	1.7 (1.5, 1.9)	3.2 (2.9, 3.4)	4.9 (4.6, 5.2)	9.3 (8.8, 9.7)	12.7 (12.1, 13.3)	15.2 (14.0, 16.5)
Total Conventional	23643	499439	1.8 (1.7, 1.8)	2.8 (2.7, 2.8)	3.7 (3.7, 3.8)	6.3 (6.2, 6.4)	9.4 (9.2, 9.5)	12.2 (11.8, 12.6)
TOTAL	**25490**	**517689**						

PRIMARY TOTAL CONVENTIONAL HIP REPLACEMENT

DEMOGRAPHICS

There have been 499,439 primary total conventional hip replacement procedures reported to the Registry. This is an additional 40,174 procedures compared to the previous report.

There was a small increase of 2.6% in primary total conventional hip replacement procedures performed in 2019 compared to the previous year. There has been a 132.9% increase since 2003.

Primary total conventional hip replacement is more common in females (55.0%). This proportion has remained stable since 2003 (Figure HT1).

Figure HT2 Primary Total Conventional Hip Replacement by Age

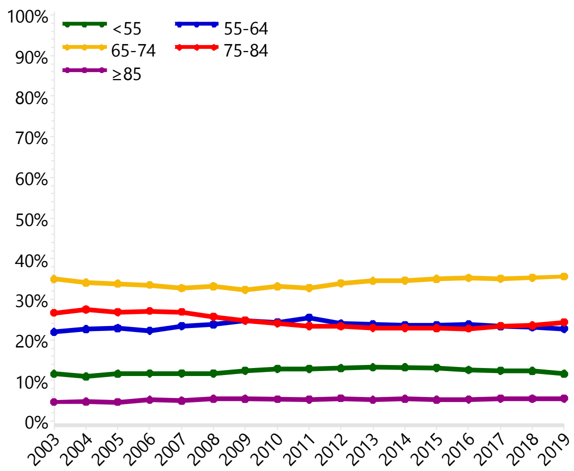
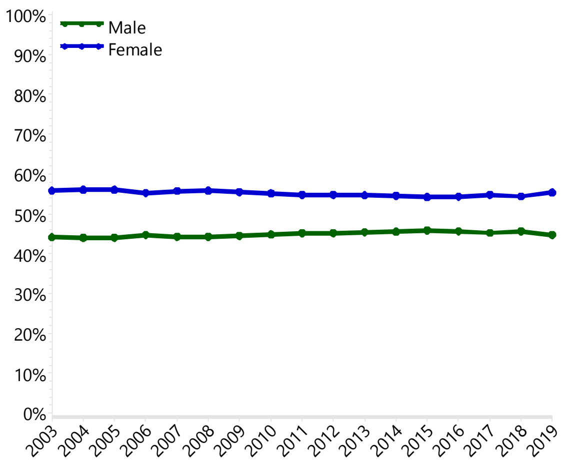
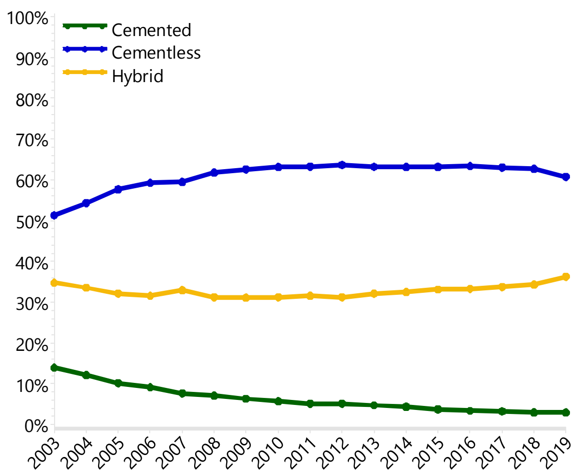


Figure HT1 Primary Total Conventional Hip Replacement by Gender



The use of cementless fixation has increased from 51.3% in 2003 to 60.8% in 2019. Cemented fixation has declined from 13.9% to 3.0% and hybrid fixation has increased from 34.8% to 36.3% over the same period (Figure HT3).

Figure HT3 Primary Total Conventional Hip Replacement by Fixation



The mean age of patients is 67.7 years. There has been minimal change in the proportion of patients aged 55-64 years (21.9% in 2003 to 22.8% in 2019) and patients <55 years (11.7% in both 2003 and 2019) (Table HT3 and Figure HT2).

Table HT3 Age and Gender of Primary Total Conventional Hip Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	224953	45.0%	12	102	67	66.3	11.5
Female	274486	55.0%	11	101	70	68.9	11.4
TOTAL	**499439**	**100.0%**	**11**	**102**	**69**	**67.7**	**11.5**

The Exeter V40, CORAIL, and Metafix are the most used femoral stems for primary total conventional hip replacement (Table HT4). In 2019, 66.6% 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. In 2019, the 10 most used cemented stems account for 93.3% of cemented stem procedures. The 10 most used cementless stems account for 75.6% of cementless stem procedures.

The Trident (Shell), PINNACLE, and Trinity are the most frequently used acetabular prostheses for primary total conventional hip replacement. In 2019, 83.8% 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		2016		2017		2018		2019	
N	Model	N	Model	N	Model	N	Model	N	Model
3901	Exeter V40	7499	Exeter V40	7318	Exeter V40	7358	Exeter V40	7733	Exeter V40
1029	ABGII	5861	CORAIL	5376	CORAIL	5313	CORAIL	4863	CORAIL
1000	Synergy	2756	Quadra-H	1944	Quadra-H	2238	Polarstem	2507	Metafix
819	Alloclassic	1827	Polarstem	1927	Polarstem	2136	Metafix	2374	Accolade II
809	VerSys	1327	Accolade II	1841	Accolade II	2070	Quadra-H	2319	Polarstem
780	Spectron EF	1232	CPT	1578	Metafix	1990	Accolade II	2007	Quadra-H
713	Secur-Fit Plus	990	Taperloc	1240	CPT	1184	Paragon	1281	Paragon
618	Omnifit	809	CPCS	1028	Taperloc	1160	CPT	1259	CPT
565	C-Stem	787	Tri-Fit TS	1022	AMIStem H	943	Taperloc	1076	Taperloc
485	S-Rom	785	AMIStem H	872	C-Stem AMT	903	CPCS	1051	C-Stem AMT
10 Most Used									
10719 (10) 62.8%		23873 (10) 66.0%		24146 (10) 64.7%		25295 (10) 65.3%		26470 (10) 66.6%	
Remainder									
6354 (73) 37.2%		12292 (92) 34.0%		13197 (94) 35.3%		13453 (88) 34.7%		13298 (91) 33.4%	
TOTAL									
17073 (83) 100.0%		36165 (102) 100.0%		37343 (104) 100.0%		38748 (98) 100.0%		39768 (101) 100.0%	

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

2003		2016		2017		2018		2019	
N	Model	N	Model	N	Model	N	Model	N	Model
3901	Exeter V40	7499	Exeter V40	7318	Exeter V40	7358	Exeter V40	7733	Exeter V40
780	Spectron EF	1232	CPT	1240	CPT	1160	CPT	1259	CPT
565	C-Stem	809	CPCS	872	C-Stem AMT	903	CPCS	1051	C-Stem AMT
477	CPT	621	C-Stem AMT	857	CPCS	885	C-Stem AMT	972	CPCS
445	Elite Plus	508	Short Exeter V40	556	Short Exeter V40	726	Quadra-C	829	Quadra-C
358	MS 30	412	Quadra-C	549	Quadra-C	681	Short Exeter V40	802	Short Exeter V40
338	Omnifit	369	Evolve	442	Evolve	590	Taper Fit	780	Taper Fit
321	Charnley	357	MS 30	393	MS 30	394	MS 30	380	Absolut
245	CPCS	227	Taper Fit	315	Taper Fit	387	Evolve	352	Evolve
123	Exeter	181	Spectron EF	235	Absolut	343	Absolut	319	MS 30
10 Most Used									
7553 (10) 91.7%		12215 (10) 92.8%		12777 (10) 92.9%		13427 (10) 93.3%		14477 (10) 93.3%	
Remainder									
680 (26) 8.3%		942 (17) 7.2%		975 (22) 7.1%		964 (21) 6.7%		1043 (23) 6.7%	
TOTAL									
8233 (36) 100.0%		13157 (27) 100.0%		13752 (32) 100.0%		14391 (31) 100.0%		15520 (33) 100.0%	

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

2003		2016		2017		2018		2019	
N	Model	N	Model	N	Model	N	Model	N	Model
1029	ABGII	5861	CORAIL	5376	CORAIL	5313	CORAIL	4863	CORAIL
980	Synergy	2756	Quadra-H	1944	Quadra-H	2238	Polarstem	2507	Metafix
819	Alloclassic	1827	Polarstem	1927	Polarstem	2136	Metafix	2374	Accolade II
739	VerSys	1327	Accolade II	1841	Accolade II	2070	Quadra-H	2316	Polarstem
713	Secur-Fit Plus	990	Taperloc	1578	Metafix	1990	Accolade II	2007	Quadra-H
485	S-Rom	787	Tri-Fit TS	1028	Taperloc	1184	Paragon	1281	Paragon
482	Secur-Fit	785	AMIStem H	1022	AMIStem H	943	Taperloc	1076	Taperloc
376	CORAIL	698	Anthology	797	Tri-Fit TS	857	AMIStem H	840	AMIStem H
334	Accolade I	646	Metafix	782	Paragon	577	Anthology	594	Taperloc Microplasty
334	Mallory-Head	544	Paragon	687	Anthology	550	Tri-Fit TS	477	Anthology
10 Most Used									
6291 (10) 71.2%		16221 (10) 70.5%		16982 (10) 72.0%		17858 (10) 73.3%		18335 (10) 75.6%	
Remainder									
2549 (47) 28.8%		6787 (72) 29.5%		6609 (69) 28.0%		6499 (64) 26.7%		5913 (69) 24.4%	
TOTAL									
8840 (57) 100.0%		23008 (82) 100.0%		23591 (79) 100.0%		24357 (74) 100.0%		24248 (79) 100.0%	

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

2003		2016		2017		2018		2019	
N	Model	N	Model	N	Model	N	Model	N	Model
3986	Trident (Shell)	7837	Trident (Shell)	8128	Trident (Shell)	8546	Trident (Shell)	9126	Trident (Shell)
1748	Reflection (Shell)	6938	PINNACLE	6590	PINNACLE	6377	PINNACLE	6083	PINNACLE
1524	Trilogy	3766	R3	3813	R3	3863	R3	4351	Trinity
955	Vitalock	2751	Versafitcup CC	2955	Trinity	3689	Trinity	3791	R3
907	Duraloc	1987	Trinity	2069	Versafitcup CC	1908	Mpact	2282	Mpact
827	ABGII	1327	Continuum	1402	Mpact	1836	Versafitcup CC	2202	G7
793	Allofit	1134	Mpact	1293	Continuum	1491	G7	1715	Versafitcup CC
729	Mallory-Head	1107	Trident/Tritanium (Shell)	1254	Logical G	1443	Logical G	1455	Logical G
539	Contemporary	801	Logical G	1143	Trident/Tritanium (Shell)	1319	Acetabular Shell (Global)	1208	Acetabular Shell (Global)
537	PINNACLE	759	Acetabular Shell (Global)	1051	G7	1196	Continuum	1099	Trident/Tritanium (Shell)
10 Most Used									
12545	(10) 73.5%	28407	(10) 78.5%	29698	(10) 79.5%	31668	(10) 81.7%	33312	(10) 83.8%
Remainder									
4528	(69) 26.5%	7758	(70) 21.5%	7645	(68) 20.5%	7080	(62) 18.3%	6456	(63) 16.2%
TOTAL									
17073	(79) 100.0%	36165	(80) 100.0%	37343	(78) 100.0%	38748	(72) 100.0%	39768	(73) 100.0%

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

2003		2016		2017		2018		2019	
N	Model	N	Model	N	Model	N	Model	N	Model
539	Contemporary	538	Exeter X3 Rimfit	503	Exeter X3 Rimfit	532	Exeter X3 Rimfit	569	Exeter X3 Rimfit
256	Exeter	140	Contemporary	110	Marathon	105	Contemporary	90	Marathon
251	Reflection (Cup)	118	Marathon	96	ZCA	81	Marathon	73	Contemporary
227	Exeter Contemporary	105	Exeter Contemporary	94	Contemporary	81	ZCA	65	Novae E
199	Charnley Ogee	78	ZCA	68	Reflection (Cup)	53	Reflection (Cup)	49	Reflection (Cup)
149	Elite Plus LPW	66	Reflection (Cup)	67	Exeter Contemporary	52	Novae E	46	Avantage
130	Low Profile Cup	37	Muller	47	Avantage	40	Avantage	40	ZCA
110	Elite Plus Ogee	24	Avantage	45	Novae E	33	Apricot	35	Apricot
102	Charnley	17	Low Profile Cup	38	Muller	32	Exeter Contemporary	34	Low Profile Cup
90	ZCA	15	Polarcup	26	Apricot	24	Muller	33	Exeter Contemporary
10 Most Used									
2053	(10) 85.4%	1138	(10) 92.8%	1094	(10) 90.2%	1033	(10) 89.7%	1034	(10) 88.9%
Remainder									
351	(16) 14.6%	88	(14) 7.2%	119	(19) 9.8%	119	(18) 10.3%	129	(20) 11.1%
TOTAL									
2404	(26) 100.0%	1226	(24) 100.0%	1213	(29) 100.0%	1152	(28) 100.0%	1163	(30) 100.0%

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

2003		2016		2017		2018		2019	
N	Model	N	Model	N	Model	N	Model	N	Model
3986	Trident (Shell)	7835	Trident (Shell)	8128	Trident (Shell)	8546	Trident (Shell)	9126	Trident (Shell)
1748	Reflection (Shell)	6938	PINNACLE	6590	PINNACLE	6376	PINNACLE	6082	PINNACLE
1524	Trilogy	3766	R3	3813	R3	3863	R3	4351	Trinity
955	Vitalock	2751	Versafitcup CC	2955	Trinity	3689	Trinity	3790	R3
907	Duraloc	1987	Trinity	2069	Versafitcup CC	1907	Mpact	2282	Mpact
827	ABGII	1327	Continuum	1402	Mpact	1836	Versafitcup CC	2202	G7
793	Allofit	1134	Mpact	1292	Continuum	1491	G7	1715	Versafitcup CC
729	Mallory-Head	1107	Trident/Tritanium (Shell)	1254	Logical G	1443	Logical G	1455	Logical G
537	PINNACLE	801	Logical G	1143	Trident/Tritanium (Shell)	1319	Acetabular Shell (Global)	1207	Acetabular Shell (Global)
521	Fitmore	759	Acetabular Shell (Global)	1051	G7	1195	Continuum	1099	Trident/Tritanium (Shell)
10 Most Used									
12527	(10) 85.4%	28405	(10) 81.3%	29697	(10) 82.2%	31665	(10) 84.2%	33309	(10) 86.3%
Remainder									
2142	(43) 14.6%	6534	(54) 18.7%	6433	(48) 17.8%	5931	(43) 15.8%	5296	(44) 13.7%
TOTAL									
14669	(53) 100.0%	34939	(64) 100.0%	36130	(58) 100.0%	37596	(53) 100.0%	38605	(54) 100.0%

Note: In 2019, 10 shells in the cementless group were inserted with cement

OUTCOME FOR ALL DIAGNOSES

In 2014, the Registry excluded large head metal/metal bearings from many comparative analyses of primary total conventional hip replacement outcomes due to several factors: it is no longer used, accounts for an increasingly small proportion of procedures (currently 3.3%) and has a much higher rate of revision than other bearing surfaces (28.5% at 15 years). In addition, large head metal/metal was also preferentially used in younger patients with cementless fixation and with particular femoral stem and acetabular prosthesis combinations.

Since 2019, the Registry has excluded all metal/metal bearing surfaces (including head sizes ≤32mm in diameter) from comparative analyses. Small head metal/metal bearings were not used in 2019 and make up a small proportion of all primary total conventional hip replacement procedures (1.2%).

Consequently, in specific analyses metal/metal bearings have the potential to be a major confounding factor. It is 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.

Osteoarthritis is the principal diagnosis (88.2%), followed by fractured neck of femur (4.8%), osteonecrosis (3.2%), developmental dysplasia (1.3%), rheumatoid arthritis (0.9%) and tumour (0.6%) (Table HT10).

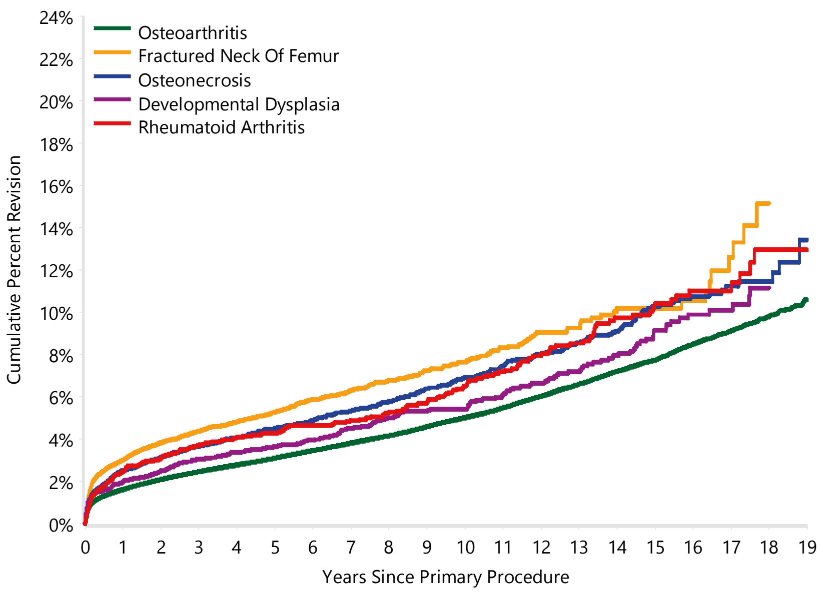
Osteoarthritis has a lower rate of revision compared to fractured neck of femur, osteonecrosis (in the first 9 years only) and rheumatoid arthritis. It also has a lower rate of revision compared to developmental dysplasia. However, this difference is only evident in the first 2 weeks (Figure HT4).

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

Primary Diagnosis	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Osteoarthritis	16369	421141	1.6 (1.6, 1.7)	2.5 (2.4, 2.5)	3.1 (3.1, 3.2)	5.0 (4.9, 5.1)	7.8 (7.6, 7.9)	10.6 (10.1, 11.0)
Fractured Neck of Femur	1127	22848	3.0 (2.8, 3.3)	4.4 (4.1, 4.7)	5.3 (5.0, 5.6)	7.7 (7.1, 8.2)	10.2 (9.2, 11.4)	
Osteonecrosis	820	15308	2.5 (2.3, 2.8)	3.6 (3.4, 4.0)	4.5 (4.2, 4.9)	6.9 (6.4, 7.5)	10.3 (9.4, 11.3)	13.4 (11.0, 16.4)
Developmental Dysplasia	295	6061	2.0 (1.6, 2.4)	3.1 (2.6, 3.5)	3.6 (3.2, 4.2)	5.4 (4.8, 6.2)	9.1 (7.9, 10.5)	
Rheumatoid Arthritis	259	4332	2.5 (2.1, 3.0)	3.7 (3.2, 4.3)	4.3 (3.7, 5.0)	6.5 (5.7, 7.5)	10.4 (9.0, 12.0)	12.9 (10.7, 15.7)
Tumour	151	2675	4.4 (3.6, 5.4)	7.6 (6.2, 9.1)	9.2 (7.6, 11.2)	13.6 (10.6, 17.4)		
Failed Internal Fixation	147	2051	4.6 (3.8, 5.6)	6.6 (5.5, 7.9)	7.8 (6.6, 9.2)	9.5 (7.8, 11.4)	14.2 (10.5, 19.1)	
Other Inflammatory Arthritis	102	2007	1.8 (1.3, 2.5)	2.9 (2.2, 3.8)	3.9 (3.0, 4.9)	6.6 (5.3, 8.3)	9.2 (7.2, 11.6)	
Other (3)	79	901	5.3 (4.0, 7.1)	7.6 (6.0, 9.7)	8.4 (6.6, 10.7)	12.7 (9.8, 16.3)	13.7 (10.4, 18.0)	
TOTAL	**19349**	**477324**						

Note: All procedures using metal/metal prostheses have been excluded
Only prostheses with over 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=1.75 (1.64, 1.86),p<0.001

Osteonecrosis vs Osteoarthritis
0 - 6Mth: HR=1.38 (1.23, 1.56),p<0.001
6Mth - 9Mth: HR=2.31 (1.77, 3.01),p<0.001
9Mth - 1.5Yr: HR=1.34 (1.07, 1.69),p=0.012
1.5Yr - 9Yr: HR=1.31 (1.16, 1.47),p<0.001
9Yr+: HR=1.09 (0.89, 1.32),p=0.401

Developmental Dysplasia vs Osteoarthritis
0 - 2Wk: HR=1.89 (1.33, 2.69),p<0.001
2Wk - 1Mth: HR=1.30 (0.91, 1.84),p=0.143
1Mth+: HR=1.04 (0.91, 1.18),p=0.596

Rheumatoid Arthritis vs Osteoarthritis
Entire Period: HR=1.33 (1.17, 1.50),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Osteoarthritis	421141	376562	299643	228947	94661	27202	1245
Fractured Neck of Femur	22848	18248	12331	7985	2087	372	11
Osteonecrosis	15308	13532	10547	7999	3481	1112	63
Developmental Dysplasia	6061	5348	4249	3320	1699	705	38
Rheumatoid Arthritis	4332	3942	3324	2691	1375	519	43

Note: Only primary diagnoses with over 2,500 procedures have been listed

PROSTHESIS TYPES

There are 3,231 different stem and acetabular combinations for primary total conventional hip replacement recorded by the Registry. This is an additional 167 prosthesis combinations since the previous report. Prosthesis combinations using large head metal/metal bearings are listed separately.

The cumulative percent revision of the 138 prosthesis combinations with more than 500 procedures are listed in Table HT11 to Table HT13. Although the listed combinations are a small proportion of the possible combinations, they represent 84.6% of all primary total conventional hip replacement procedures.

The 'Other' group consists of all prosthesis combinations with less than 500 procedures. This group accounts for 15.4% of all primary total conventional hip replacement procedures.

There are 11 primary total conventional stem and acetabular combinations with more than 500 procedures using cemented fixation. The CPT/ZCA has the lowest 15 year cumulative percent revision of 7.2% (Table HT11).

There are 89 cementless primary total conventional stem and acetabular combinations listed. The Secur-Fit Plus/Trident (Shell) has the lowest 19 year cumulative percent revision of 5.5% (Table HT12).

There are 38 combinations of primary total conventional hip replacement prostheses with hybrid fixation. The Exeter/Vitalock has the lowest cumulative percent revision at 19 years (9.5%) (Table HT13).

Table HT11 Cumulative Percent Revision of Primary Total Conventional Hip Replacement with Cemented Fixation by Prosthesis Combination

Femoral Component	Acetabular Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
C-Stem AMT	Marathon	16	562	1.9 (1.0, 3.5)	2.5 (1.4, 4.3)	3.2 (1.9, 5.4)			
CPCS	Reflection (Cup)	81	1026	1.5 (0.9, 2.5)	2.7 (1.8, 4.0)	3.4 (2.4, 4.8)	8.2 (6.2, 10.8)	20.4 (16.0, 25.9)	
CPT	ZCA	45	1008	0.7 (0.3, 1.5)	2.0 (1.3, 3.2)	2.7 (1.8, 4.0)	5.0 (3.5, 7.0)	7.2 (5.0, 10.3)	
Charnley	Charnley Ogee*	68	709	1.0 (0.5, 2.1)	3.0 (1.9, 4.5)	4.9 (3.5, 6.9)	8.9 (6.9, 11.6)	13.4 (10.5, 16.9)	
	Charnley*	47	591	0.5 (0.2, 1.6)	1.0 (0.5, 2.3)	2.2 (1.2, 3.8)	6.2 (4.4, 8.8)	11.1 (8.2, 14.8)	
Exeter V40	Contemporary	342	5670	1.7 (1.4, 2.1)	3.0 (2.5, 3.5)	3.6 (3.1, 4.1)	6.2 (5.5, 7.0)	10.0 (8.8, 11.4)	
	Exeter Contemporary	180	3415	1.5 (1.1, 1.9)	2.4 (1.9, 3.0)	3.1 (2.6, 3.8)	5.0 (4.2, 5.8)	8.6 (7.1, 10.3)	
	Exeter X3 Rimfit	114	4389	1.5 (1.2, 1.9)	2.4 (2.0, 3.0)	2.9 (2.4, 3.5)			
	Exeter*	116	1712	0.8 (0.5, 1.4)	1.9 (1.3, 2.7)	3.1 (2.4, 4.1)	5.0 (4.0, 6.3)	10.0 (8.1, 12.3)	
MS 30	Low Profile Cup	31	724	0.7 (0.3, 1.7)	0.9 (0.4, 1.9)	1.4 (0.7, 2.7)	3.1 (1.9, 5.0)	7.3 (4.8, 11.1)	
Spectron EF	Reflection (Cup)	132	1663	1.1 (0.7, 1.7)	1.8 (1.2, 2.5)	2.8 (2.1, 3.8)	7.2 (5.9, 8.9)	14.4 (11.9, 17.4)	
Other (528)		655	10662	1.8 (1.6, 2.1)	3.1 (2.7, 3.4)	4.2 (3.8, 4.6)	7.1 (6.5, 7.8)	11.6 (10.7, 12.7)	14.0 (12.7, 15.4)
TOTAL		**1827**	**32131**						

Note: Some cementless components have been cemented
Procedures using metal/metal prostheses have been included
*denotes prosthesis combination with no reported use in primary total conventional hip procedures in 2019
Only prostheses with over 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	19 Yrs
ABGII	ABGII	322	2985	1.8 (1.4, 2.4)	3.1 (2.5, 3.8)	4.2 (3.5, 5.0)	6.8 (5.9, 7.8)	11.6 (10.3, 13.0)	
	ABGII (Shell/Insert)	77	908	1.4 (0.8, 2.5)	2.2 (1.4, 3.4)	2.8 (1.9, 4.1)	6.6 (5.1, 8.6)	10.6 (8.4, 13.3)	
	Trident (Shell)	261	2571	2.8 (2.3, 3.6)	4.4 (3.7, 5.3)	5.3 (4.5, 6.3)	9.0 (7.9, 10.3)	14.5 (12.7, 16.6)	
AMIStem H	Mpact	27	1165	2.1 (1.4, 3.2)	3.0 (1.9, 4.9)				
	Versafitcup CC	64	2818	1.4 (1.0, 1.9)	2.1 (1.6, 2.8)	3.8 (2.3, 6.2)			
Accolade I	Trident (Shell)*	534	9304	1.7 (1.5, 2.0)	3.0 (2.7, 3.4)	3.7 (3.4, 4.2)	5.7 (5.3, 6.3)	7.2 (6.6, 7.9)	
	Trident/ Tritanium (Shell)*	37	756	1.3 (0.7, 2.4)	2.4 (1.5, 3.8)	3.5 (2.4, 5.1)			
Accolade II	Trident (Shell)	140	7196	1.6 (1.3, 1.9)	2.2 (1.8, 2.6)	2.8 (2.3, 3.4)			
	Trident/ Tritanium (Shell)	52	1796	2.5 (1.8, 3.3)	3.4 (2.5, 4.5)				
Alloclassic	Allofit	346	5911	1.5 (1.2, 1.9)	2.4 (2.1, 2.9)	3.2 (2.8, 3.7)	5.5 (4.9, 6.2)	8.9 (7.9, 10.0)	
	Durom*$^{\text{MoM}}$	104	621	1.3 (0.7, 2.6)	5.0 (3.5, 7.0)	7.1 (5.3, 9.4)	15.2 (12.5, 18.5)		
	Fitmore*	141	1883	3.3 (2.6, 4.2)	4.6 (3.8, 5.7)	5.6 (4.6, 6.7)	7.5 (6.3, 8.8)	9.1 (7.6, 10.8)	
	Trabecular Metal (Shell)*	51	1065	2.4 (1.6, 3.5)	2.9 (2.1, 4.2)	4.1 (3.0, 5.5)	5.1 (3.9, 6.7)		
	Trilogy*	18	955	0.6 (0.3, 1.4)	0.8 (0.4, 1.7)	1.1 (0.6, 2.0)	2.2 (1.4, 3.6)		
Anthology	R3	202	7174	2.0 (1.7, 2.3)	2.4 (2.1, 2.8)	2.7 (2.3, 3.1)	3.5 (3.0, 4.1)		
	Reflection (Shell)*	39	991	1.8 (1.2, 2.9)	2.1 (1.4, 3.3)	2.9 (2.0, 4.2)	4.3 (3.1, 5.8)		
Apex	Acetabular Shell (Global)	26	533	3.3 (2.0, 5.2)	4.7 (3.1, 7.0)	6.3 (4.1, 9.5)			
	Fin II	53	1009	1.9 (1.2, 2.9)	2.5 (1.7, 3.7)	3.7 (2.6, 5.0)	5.6 (4.2, 7.4)		
Avenir	Continuum	47	1596	2.2 (1.6, 3.1)	2.7 (2.0, 3.6)	3.1 (2.3, 4.2)			
	Trilogy*	11	626	1.0 (0.4, 2.1)	1.1 (0.5, 2.3)	1.3 (0.6, 2.6)			
C2	Delta-TT	20	834	1.0 (0.5, 2.0)	2.0 (1.2, 3.3)	2.6 (1.6, 4.1)			
CL2	C2	28	760	2.8 (1.9, 4.3)	3.2 (2.1, 4.7)	3.4 (2.3, 5.1)			
	Logical G	8	532	1.4 (0.7, 2.9)	1.7 (0.8, 3.4)				
CLS	Allofit	62	873	1.6 (1.0, 2.7)	3.4 (2.4, 4.8)	3.9 (2.8, 5.4)	6.1 (4.6, 8.0)	8.8 (6.7, 11.6)	
	Fitmore	55	940	1.7 (1.1, 2.8)	3.6 (2.5, 5.1)	4.2 (3.0, 5.8)	5.5 (4.1, 7.5)	9.1 (6.9, 12.0)	
CORAIL	ASR*$^{\text{MoM}}$	1320	2901	2.2 (1.7, 2.8)	11.2 (10.1, 12.4)	27.1 (25.5, 28.8)	46.1 (44.2, 48.1)		
	DeltaMotion	31	1353	1.0 (0.6, 1.7)	1.9 (1.3, 2.8)	2.3 (1.6, 3.4)			
	Duraloc*	106	1433	1.4 (0.9, 2.2)	2.3 (1.6, 3.2)	2.9 (2.2, 4.0)	5.8 (4.6, 7.3)	10.9 (8.9, 13.4)	
	Fitmore	14	513	2.2 (1.2, 3.9)	2.4 (1.4, 4.2)	2.4 (1.4, 4.2)	4.6 (2.1, 9.7)		
	PINNACLE	1771	5168	1.7 (1.6, 1.9)	2.7 (2.6, 2.8)	3.3 (3.1, 3.5)	5.2 (4.9, 5.5)	7.7 (6.7, 8.9)	
	PINNACLE*$^{\text{MoM}}$	121	966	2.2 (1.4, 3.3)	3.7 (2.6, 5.1)	5.9 (4.6, 7.6)	12.4 (10.4, 14.8)		
	Trinity	8	571	1.3 (0.6, 2.8)	1.7 (0.8, 3.5)				
Citation	Trident (Shell)*	61	1147	1.7 (1.1, 2.7)	2.5 (1.8, 3.6)	3.3 (2.4, 4.5)	4.5 (3.4, 5.9)	6.3 (4.9, 8.2)	
	Vitalock*	56	555	0.5 (0.2, 1.7)	2.2 (1.2, 3.8)	2.8 (1.7, 4.5)	6.9 (5.0, 9.5)	10.9 (8.3, 14.1)	
Epoch	Trilogy*	47	1021	2.5 (1.7, 3.6)	3.4 (2.4, 4.7)	3.7 (2.7, 5.0)	4.4 (3.3, 5.9)	5.0 (3.8, 6.7)	
F2L	SPH-Blind*	64	615	3.1 (2.0, 4.8)	4.9 (3.5, 7.0)	6.1 (4.5, 8.3)	7.6 (5.7, 10.0)	11.3 (8.9, 14.4)	
H-Max	Delta-TT	60	1562	1.9 (1.3, 2.7)	3.5 (2.6, 4.6)	4.2 (3.2, 5.5)			
HACTIV	Logical G	42	891	4.3 (3.1, 6.0)					
M/L Taper	Allofit	22	777	1.6 (0.9, 2.7)	1.8 (1.1, 3.1)	2.2 (1.3, 3.5)	4.4 (2.6, 7.5)		
	Continuum	51	1529	2.1 (1.5, 3.0)	3.1 (2.3, 4.2)	3.4 (2.6, 4.5)			
	Fitmore	19	514	3.0 (1.8, 4.9)	4.0 (2.6, 6.2)	4.0 (2.6, 6.2)	4.0 (2.6, 6.2)		
	Trilogy	30	875	1.3 (0.7, 2.3)	1.5 (0.9, 2.6)	2.8 (1.9, 4.3)	4.0 (2.7, 5.8)		
M/L Taper	Continuum*	86	2217	2.1 (1.6, 2.8)	3.1 (2.4, 3.9)	3.5 (2.8, 4.4)			
Mallory-Head	Mallory-Head*	200	3018	1.8 (1.4, 2.4)	2.3 (1.8, 2.9)	3.1 (2.6, 3.8)	5.1 (4.3, 6.0)	9.1 (7.8, 10.5)	11.6 (9.7, 13.8)
Metafix	Trinity	155	8233	1.6 (1.3, 1.9)	2.3 (2.0, 2.8)	2.8 (2.3, 3.4)			
MiniHip	Trinity	35	1052	2.7 (1.9, 3.9)	3.4 (2.4, 4.7)	3.5 (2.5, 4.9)			
Nanos	R3	9	659	0.9 (0.4, 2.0)	1.2 (0.6, 2.4)	1.2 (0.6, 2.4)			

Femoral Component	Acetabular Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Natural Hip	Fitmore*	45	890	1.0 (0.5, 1.9)	1.6 (0.9, 2.7)	2.4 (1.6, 3.7)	4.6 (3.4, 6.3)	5.3 (3.9, 7.2)	
Omnifit	Secur-Fit*	66	508	3.2 (1.9, 5.1)	5.0 (3.4, 7.3)	6.6 (4.7, 9.2)	10.8 (8.3, 14.0)	14.3 (11.3, 18.1)	
	Trident (Shell)	85	1280	1.9 (1.3, 2.8)	3.2 (2.3, 4.3)	4.1 (3.1, 5.3)	5.7 (4.5, 7.1)	7.6 (6.1, 9.5)	
Optimys	RM Cup	13	1112	1.1 (0.6, 2.0)	1.3 (0.7, 2.2)	1.3 (0.7, 2.2)			
Origin	Logical G	41	1591	2.0 (1.4, 2.8)	3.1 (2.3, 4.2)	3.1 (2.3, 4.2)			
Paragon	Acetabular Shell (Global)	54	3209	1.5 (1.1, 2.0)	1.9 (1.5, 2.5)	2.2 (1.6, 3.2)			
	Novae	14	718	1.1 (0.5, 2.2)	2.3 (1.4, 4.1)	2.7 (1.6, 4.6)			
Polarstem	EP-Fit Plus	10	2032	0.3 (0.1, 0.6)	0.6 (0.3, 1.1)	0.7 (0.4, 1.4)			
	R3	293	1101	2.1 (1.8, 2.4)	2.7 (2.4, 3.0)	3.1 (2.8, 3.5)	4.7 (3.2, 6.7)		
Profemur L	Dynasty	72	1644	3.6 (2.8, 4.7)	4.9 (3.8, 6.1)	5.5 (4.2, 7.1)			
	Procotyl L	14	708	1.6 (0.9, 2.9)	2.2 (1.3, 3.6)	2.2 (1.3, 3.6)			
Quadra-H	Mpact	109	3982	1.8 (1.4, 2.3)	3.2 (2.6, 3.9)	4.6 (3.6, 5.8)			
	Trident (Shell)	27	918	1.6 (0.9, 2.7)	2.6 (1.7, 3.9)	3.6 (2.4, 5.5)	6.8 (3.5, 13.3)		
	Versafitcup CC	553	1567	1.8 (1.6, 2.0)	2.7 (2.4, 2.9)	3.4 (3.1, 3.7)	6.2 (5.3, 7.2)		
	Versafitcup DM	30	572	4.4 (3.0, 6.6)	6.0 (4.2, 8.5)				
S-Rom	Duraloc Option*	36	666	1.5 (0.8, 2.8)	2.4 (1.5, 3.9)	3.4 (2.2, 5.0)	4.7 (3.3, 6.6)	5.4 (3.9, 7.5)	
	PINNACLE	196	3488	2.4 (1.9, 3.0)	3.9 (3.3, 4.6)	4.5 (3.9, 5.3)	6.1 (5.3, 7.1)	7.8 (6.5, 9.4)	
SL-Plus	EP-Fit Plus	128	2332	1.6 (1.2, 2.2)	2.7 (2.1, 3.4)	3.4 (2.7, 4.2)	5.3 (4.4, 6.4)	7.5 (5.8, 9.7)	
	R3	96	1780	2.6 (2.0, 3.5)	4.1 (3.3, 5.2)	4.5 (3.6, 5.6)	6.6 (5.3, 8.1)		
Secur-Fit	DeltaMotion	32	821	0.7 (0.3, 1.6)	2.0 (1.3, 3.3)	2.6 (1.7, 4.0)	5.0 (3.5, 7.3)		
	Trident (Shell)	446	1010	1.8 (1.6, 2.1)	2.8 (2.5, 3.2)	3.5 (3.2, 3.9)	4.7 (4.3, 5.2)	6.1 (5.5, 6.8)	
Secur-Fit Plus	Trident (Shell)	225	6133	1.2 (1.0, 1.6)	1.9 (1.6, 2.3)	2.4 (2.0, 2.8)	3.5 (3.0, 4.0)	4.8 (4.2, 5.5)	5.5 (4.7, 6.5)
Summit	ASR*MoM	510	1118	1.2 (0.7, 2.0)	6.5 (5.2, 8.1)	20.1 (17.8, 22.6)	44.3 (41.3, 47.4)		
	PINNACLE	149	5295	1.4 (1.1, 1.8)	2.1 (1.7, 2.5)	2.4 (2.0, 2.8)	3.4 (2.9, 4.1)	5.1 (3.9, 6.5)	
	PINNACLE*MoM	79	784	1.5 (0.9, 2.7)	2.2 (1.4, 3.5)	3.5 (2.4, 5.1)	8.7 (6.9, 11.0)	11.7 (9.3, 14.6)	
Synergy	BHR*MoM	110	819	1.6 (0.9, 2.7)	3.1 (2.1, 4.5)	5.0 (3.7, 6.7)	12.1 (10.0, 14.7)		
	R3	148	5011	1.8 (1.4, 2.2)	2.3 (1.9, 2.8)	2.8 (2.3, 3.3)	3.7 (3.1, 4.4)		
	Reflection (Shell)	401	8052	1.6 (1.3, 1.9)	2.4 (2.1, 2.7)	2.8 (2.4, 3.1)	4.1 (3.7, 4.6)	6.0 (5.4, 6.6)	
Taperloc	Continuum	13	646	1.7 (1.0, 3.1)					
	Exceed	66	2322	1.5 (1.1, 2.0)	2.2 (1.7, 2.9)	2.5 (1.9, 3.2)	4.1 (2.9, 5.9)		
	G7	52	2697	1.8 (1.4, 2.5)	2.4 (1.8, 3.2)	2.4 (1.8, 3.2)			
	M2a*MoM	69	512	1.8 (0.9, 3.4)	4.4 (2.9, 6.5)	7.4 (5.4, 10.1)	12.2 (9.6, 15.5)	15.2 (12.1, 18.9)	
	Mallory-Head	90	2038	1.9 (1.4, 2.6)	2.5 (1.9, 3.3)	3.1 (2.4, 4.0)	4.8 (3.8, 6.2)	7.7 (5.9, 9.9)	
	Recap*MoM	56	500	2.4 (1.4, 4.2)	4.3 (2.8, 6.5)	6.2 (4.4, 8.8)	10.5 (8.1, 13.7)		
	Regenerex	18	643	1.7 (1.0, 3.1)	2.2 (1.3, 3.7)	2.6 (1.6, 4.2)			
Taperloc	G7	18	1450	1.3 (0.8, 2.0)	1.3 (0.8, 2.0)	1.3 (0.8, 2.0)			
Trabecular	Continuum*	47	684	5.1 (3.7, 7.1)	6.0 (4.5, 8.1)	6.5 (4.9, 8.6)			
Tri-Fit TS	Trinity	76	3817	1.3 (1.0, 1.7)	2.1 (1.7, 2.7)	2.3 (1.8, 2.9)			
Tri-Lock	DeltaMotion*	15	806	0.6 (0.3, 1.5)	0.9 (0.4, 1.8)	1.4 (0.8, 2.5)			
	PINNACLE	24	970	1.6 (1.0, 2.6)	2.3 (1.5, 3.6)	2.7 (1.8, 4.1)			
VerSys	Trilogy	251	4498	2.6 (2.2, 3.1)	3.4 (2.9, 4.0)	4.0 (3.5, 4.7)	5.2 (4.6, 5.9)	6.3 (5.5, 7.1)	
twinSys (cless)	RM Cup	41	1310	2.2 (1.6, 3.2)	2.9 (2.1, 4.0)	3.1 (2.2, 4.3)			
Other (1508)		3682	4668	2.4 (2.3, 2.6)	4.0 (3.8, 4.2)	5.3 (5.1, 5.5)	9.1 (8.8, 9.4)	13.2 (12.7, 13.7)	16.2 (15.1, 17.3)
TOTAL		**15533**	**3017**						

Note: 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 2019
Only prostheses with over 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	19 Yrs
Absolut	Acetabular Shell (Global)	15	791	1.3 (0.7, 2.4)	2.5 (1.4, 4.1)	2.5 (1.4, 4.1)			
C-Stem	Duraloc*	97	981	2.4 (1.6, 3.5)	3.1 (2.2, 4.4)	4.0 (2.9, 5.5)	7.3 (5.7, 9.2)	12.3 (10.0, 15.1)	
	PINNACLE	33	884	1.7 (1.0, 2.8)	2.3 (1.5, 3.6)	2.7 (1.8, 4.1)	4.1 (2.8, 5.9)		
C-Stem AMT	PINNACLE	118	4738	1.4 (1.1, 1.8)	2.4 (1.9, 2.9)	3.4 (2.7, 4.1)	5.6 (4.1, 7.5)		
CPCS	R3	209	6332	2.2 (1.8, 2.6)	3.1 (2.6, 3.6)	3.5 (3.0, 4.0)	5.4 (4.5, 6.6)		
	Reflection (Shell)	118	3092	0.9 (0.6, 1.3)	1.3 (0.9, 1.8)	1.7 (1.3, 2.3)	3.8 (3.1, 4.7)	8.0 (6.2, 10.3)	
CPT	Allofit	53	1521	1.4 (0.9, 2.1)	1.9 (1.3, 2.8)	3.2 (2.3, 4.4)	5.4 (3.9, 7.3)		
	Continuum	150	3243	2.9 (2.4, 3.6)	4.0 (3.4, 4.8)	4.8 (4.0, 5.6)			
	G7	18	722	2.6 (1.5, 4.3)					
	Trabecular Metal (Shell)	119	2229	2.7 (2.1, 3.5)	3.9 (3.1, 4.8)	5.1 (4.2, 6.2)	7.6 (6.2, 9.2)		
	Trilogy	390	8541	1.9 (1.6, 2.2)	2.8 (2.5, 3.2)	3.7 (3.3, 4.1)	5.4 (4.8, 6.0)	7.0 (6.2, 8.0)	
E2	C2	20	745	1.3 (0.7, 2.5)	2.3 (1.4, 3.8)	3.2 (2.0, 5.0)			
Elite Plus	Duraloc*	125	1078	2.0 (1.3, 3.0)	3.6 (2.7, 5.0)	5.4 (4.2, 7.0)	10.0 (8.2, 12.2)	15.7 (13.2, 18.7)	
Evolve	Logical G	27	1580	1.3 (0.9, 2.0)	1.8 (1.2, 2.6)	2.3 (1.4, 3.5)			
Exeter	Vitalock*	80	1218	1.6 (1.0, 2.4)	2.3 (1.6, 3.4)	2.5 (1.8, 3.6)	4.7 (3.6, 6.2)	7.0 (5.6, 8.9)	9.5 (7.5, 11.9)
Exeter V40	ABGII*	44	1098	1.1 (0.6, 1.9)	1.5 (0.9, 2.4)	2.1 (1.4, 3.1)	3.6 (2.6, 5.0)	4.9 (3.6, 6.6)	
	Fixa	20	722	1.8 (1.1, 3.1)	2.4 (1.5, 3.9)	2.9 (1.8, 4.5)			
	Hemispherical*	35	717	2.5 (1.6, 4.0)	3.5 (2.4, 5.2)	3.7 (2.5, 5.3)	4.6 (3.2, 6.6)		
	Mallory-Head	45	1508	0.6 (0.3, 1.2)	1.0 (0.6, 1.6)	1.1 (0.7, 1.8)	2.7 (1.9, 3.8)	5.2 (3.7, 7.3)	
	PINNACLE	62	2180	1.6 (1.1, 2.2)	2.1 (1.6, 2.8)	2.4 (1.8, 3.2)	5.0 (3.6, 6.9)		
	R3	73	2329	1.8 (1.3, 2.4)	2.7 (2.1, 3.5)	3.3 (2.6, 4.2)	4.2 (3.2, 5.4)		
	Trabecular Metal (Shell)	25	521	3.0 (1.8, 4.9)	3.6 (2.3, 5.7)	4.4 (2.9, 6.7)	5.9 (3.9, 8.7)		
	Trident (Shell)	2037	69726	1.3 (1.2, 1.4)	2.0 (1.9, 2.1)	2.6 (2.4, 2.7)	4.1 (3.9, 4.3)	5.9 (5.5, 6.3)	
	Trident/ Tritanium(Shell)	144	4800	1.7 (1.3, 2.1)	2.7 (2.3, 3.3)	3.5 (2.9, 4.2)			
	Trilogy*	20	605	1.7 (0.9, 3.1)	2.4 (1.4, 4.0)	2.6 (1.5, 4.2)	3.6 (2.3, 5.7)	4.0 (2.6, 6.3)	
	Vitalock*	98	1959	0.9 (0.6, 1.5)	1.7 (1.2, 2.3)	2.3 (1.7, 3.1)	3.4 (2.7, 4.4)	5.5 (4.4, 6.7)	
MS 30	Allofit*	68	1647	1.2 (0.7, 1.8)	1.7 (1.1, 2.4)	2.2 (1.5, 3.0)	3.9 (3.0, 5.2)	7.9 (5.8, 10.6)	
	Continuum	16	803	1.7 (1.0, 2.9)	1.8 (1.1, 3.1)	2.8 (1.3, 5.9)			
	Fitmore	32	796	1.2 (0.6, 2.2)	1.6 (0.9, 2.8)	2.3 (1.4, 3.8)	3.6 (2.3, 5.6)	7.5 (5.1, 11.1)	
Omnifit	Trident (Shell)	101	2955	1.7 (1.3, 2.3)	2.7 (2.1, 3.3)	2.9 (2.3, 3.6)	3.6 (2.9, 4.4)	4.6 (3.6, 5.8)	
Quadra-C	Mpact	23	1689	1.3 (0.8, 2.0)	1.8 (1.2, 2.7)	1.8 (1.2, 2.7)			
	Versafitcup CC	32	1431	1.9 (1.3, 2.8)	2.2 (1.5, 3.1)	2.5 (1.8, 3.7)			
Short Exeter	Trident (Shell)	38	2034	1.5 (1.0, 2.1)	2.4 (1.7, 3.5)				
Spectron EF	BHR*MoM	84	532	0.8 (0.3, 2.0)	2.9 (1.8, 4.8)	6.3 (4.5, 8.8)	16.2 (13.1, 20.0)		
	R3	72	2120	1.5 (1.1, 2.2)	2.5 (1.9, 3.3)	3.2 (2.5, 4.2)	5.6 (4.1, 7.5)		
	Reflection (Shell)	337	5210	1.1 (0.9, 1.5)	2.0 (1.6, 2.4)	2.8 (2.4, 3.3)	5.5 (4.9, 6.3)	10.1 (8.9, 11.4)	15.9 (12.4, 20.3)
Taper Fit	Trinity	42	2185	1.7 (1.2, 2.4)	2.5 (1.8, 3.4)	3.5 (2.3, 5.4)			
X-Acta	Versafitcup CC	5	582	0.7 (0.3, 2.0)	1.0 (0.4, 2.4)	1.0 (0.4, 2.4)			
Other (1057)		1258	19745	1.9 (1.7, 2.1)	3.3 (3.0, 3.5)	4.5 (4.2, 4.8)	7.9 (7.4, 8.4)	11.0 (10.4, 11.7)	13.7 (12.6, 15.0)
TOTAL		**6283**	**16558**						

Note: 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 2019

Only prostheses with over 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. The 19 year cumulative percent revision of primary total conventional hip replacement undertaken for osteoarthritis is 10.6% (Table HT14 and Figure HT5).

Reason for Revision

The most common reasons for revision of primary total conventional hip replacement are loosening (24.2%), fracture (21.1%), prosthesis dislocation (20.3%), and infection (18.6%) (Table HT15).

The most common reason for revision varies with time. In the first 5 years, dislocation is the most frequent reason for revision. After 7 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 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 only (33.3%), acetabular only (20.9%), head and insert (20.6%), total hip replacement (femoral/acetabular) (12.1%), and head only (4.7%) (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 6 months, 55-64 years after 2 years, and patients 65-74 years after 11 years (Table HT17 and Figure HT7).

Males have a higher rate of revision after 1.5 years. The cumulative percent revision at 19 years is 11.7% for males and 9.6% 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 initially, compared to the younger age groups. However, the rate of revision decreases with increasing age as time progresses (Table HT18 and Figure HT9).

For females, the rate of revision decreases with increasing age. After 3 months, females aged <55 years have almost twice the rate of revision compared to females aged ≥75 years (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 early outcome of 208,451 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).

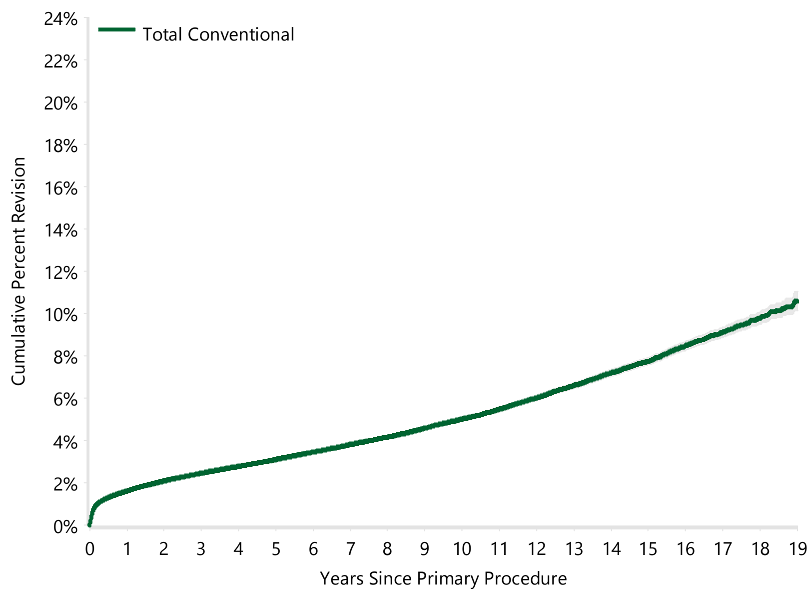
BMI data have been collected since 2015. The early revision outcomes are reported for 153,036 primary total conventional hip replacement procedures for osteoarthritis. When compared to patients in the normal BMI class, there is no difference in the rate of revision for patients in the underweight or pre-obese classes. The rate of revision increases for obese class 1, obese class 2, and obese class 3 (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 2.0% for obese class 3 compared to 1.3% for obese class 2 and 0.8% for obese class 1. The revision for infection for patients in obese class 3 is 6-fold compared to patients in the normal BMI category (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	19 Yrs
Total Conventional	16369	421141	1.6 (1.6, 1.7)	2.5 (2.4, 2.5)	3.1 (3.1, 3.2)	5.0 (4.9, 5.1)	7.8 (7.6, 7.9)	10.6 (10.1, 11.0)
TOTAL	**16369**	**421141**						

Note: 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	19 Yrs
Total Conventional	421141	376562	299643	228947	94661	27202	1245

Note: 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
Loosening	3958	24.2
Fracture	3447	21.1
Prosthesis Dislocation	3329	20.3
Infection	3038	18.6
Lysis	357	2.2
Pain	322	2.0
Leg Length Discrepancy	257	1.6
Malposition	234	1.4
Instability	221	1.4
Implant Breakage Stem	192	1.2
Implant Breakage Acetabular Insert	151	0.9
Wear Acetabular Insert	142	0.9
Metal Related Pathology	141	0.9
Incorrect Sizing	106	0.6
Implant Breakage Acetabular	100	0.6
Implant Breakage Head	47	0.3
Other	327	2.0
TOTAL	**16369**	**100.0**

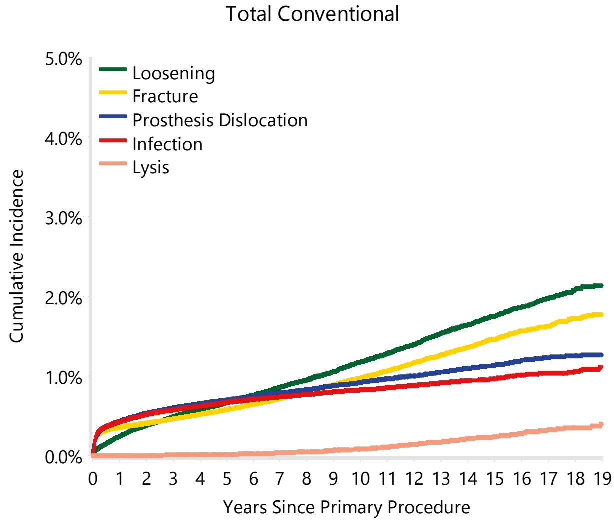
Note: All procedures using metal/metal prostheses have been excluded

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

Type of Revision	Number	Percent
Femoral Component	5457	33.3
Acetabular Component	3422	20.9
Head/Insert	3370	20.6
THR (Femoral/Acetabular)	1982	12.1
Head Only	763	4.7
Cement Spacer	665	4.1
Minor Components	296	1.8
Insert Only	168	1.0
Removal of Prostheses	98	0.6
Head/Neck/Insert	67	0.4
Head/Neck	48	0.3
Reinsertion of Components	18	0.1
Neck Only	5	0.0
Total Femoral	3	0.0
Bipolar Only	3	0.0
Neck/Insert	1	0.0
Saddle	1	0.0
Bipolar Head and Femoral	1	0.0
Cement Only	1	0.0
TOTAL	**16369**	**100.0**

Note: All procedures using metal/metal prostheses have been excluded
Femoral heads are usually replaced when the acetabular component or femoral stem is revised

Figure HT6 Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement (Primary Diagnosis OA)



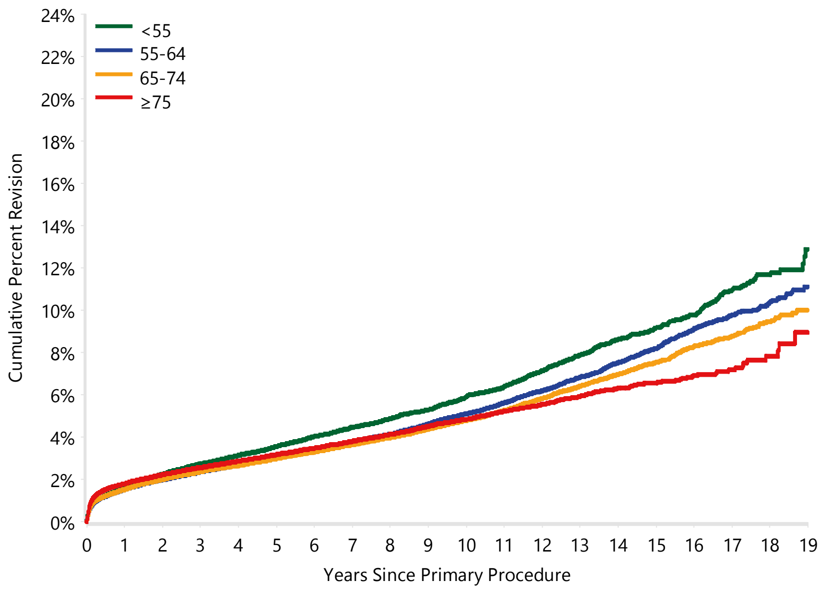
Note: All procedures using metal/metal prostheses have been excluded

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	19 Yrs
<55	2101	44763	1.6 (1.5, 1.7)	2.7 (2.6, 2.9)	3.6 (3.4, 3.8)	5.9 (5.6, 6.2)	9.1 (8.7, 9.7)	12.9 (11.6, 14.3)
55-64	4136	99873	1.5 (1.4, 1.6)	2.4 (2.3, 2.5)	3.0 (2.9, 3.1)	5.1 (4.9, 5.3)	8.2 (7.9, 8.5)	11.1 (10.4, 11.9)
65-74	5766	151060	1.5 (1.5, 1.6)	2.4 (2.3, 2.4)	3.0 (2.9, 3.1)	4.8 (4.6, 4.9)	7.5 (7.3, 7.8)	10.0 (9.4, 10.6)
≥75	4366	125445	1.8 (1.7, 1.9)	2.6 (2.5, 2.7)	3.2 (3.1, 3.3)	4.8 (4.7, 5.0)	6.6 (6.3, 6.9)	9.0 (7.6, 10.6)
TOTAL	**16369**	**421141**						

Note: 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=1.07 (0.89, 1.28),p=0.470
2Wk - 3Mth: HR=0.67 (0.59, 0.76),p<0.001
3Mth - 6Mth: HR=1.00 (0.82, 1.22),p=0.984
6Mth+: HR=1.44 (1.35, 1.53),p<0.001

55-64 vs ≥75
0 - 2Wk: HR=0.85 (0.73, 0.98),p=0.028
2Wk - 1Mth: HR=0.67 (0.59, 0.76),p<0.001
1Mth - 6Mth: HR=0.81 (0.73, 0.89),p<0.001
6Mth - 1.5Yr: HR=1.21 (1.08, 1.35),p<0.001
1.5Yr - 2Yr: HR=0.94 (0.78, 1.14),p=0.537
2Yr - 7Yr: HR=1.15 (1.06, 1.24),p<0.001
7Yr - 11Yr: HR=1.24 (1.12, 1.39),p<0.001
11Yr+: HR=1.50 (1.31, 1.71),p<0.001

65-74 vs ≥75
0 - 6Mth: HR=0.80 (0.75, 0.85),p<0.001
6Mth - 1.5Yr: HR=1.15 (1.04, 1.27),p=0.005
1.5Yr - 2Yr: HR=0.99 (0.84, 1.17),p=0.924
2Yr - 3.5Yr: HR=1.11 (1.00, 1.24),p=0.047
3.5Yr - 4Yr: HR=0.84 (0.68, 1.03),p=0.093
4Yr - 5.5Yr: HR=1.12 (0.99, 1.26),p=0.077
5.5Yr - 11Yr: HR=1.07 (0.99, 1.17),p=0.103
11Yr+: HR=1.32 (1.16, 1.50),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
<55	44763	40405	32497	25066	10654	4040	241
55-64	99873	90014	72857	56942	25661	8715	486
65-74	151060	135291	108251	83551	36872	10827	429
≥75	125445	110852	86038	63388	21474	3620	89

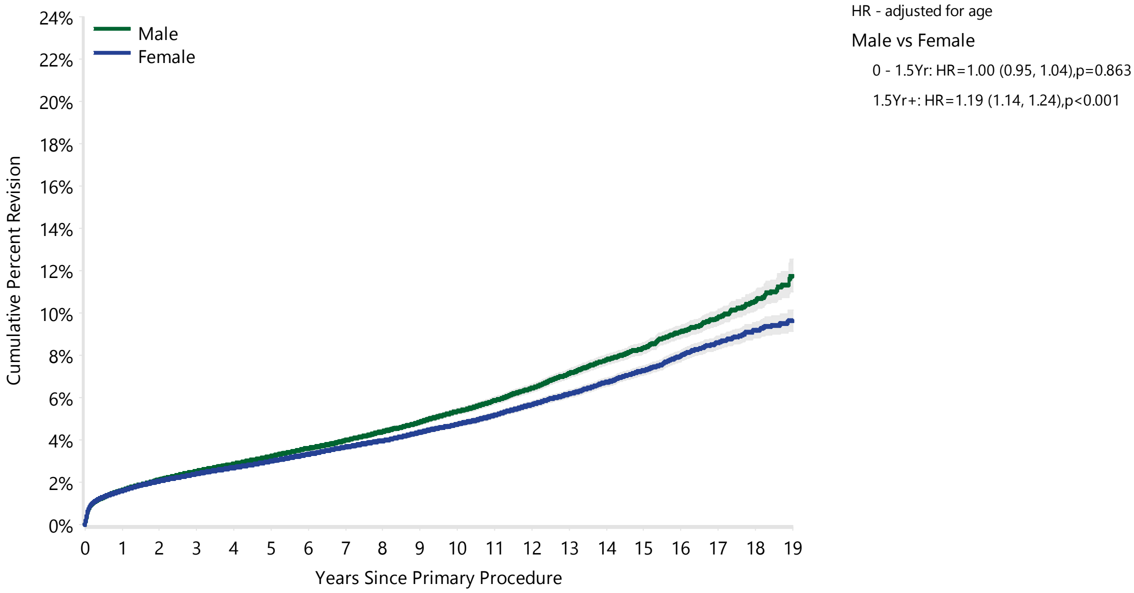
Note: All procedures using metal/metal prostheses have been excluded

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	19 Yrs
Male		**7786**	**193159**	**1.6 (1.6, 1.7)**	**2.5 (2.5, 2.6)**	**3.2 (3.1, 3.3)**	**5.4 (5.2, 5.5)**	**8.4 (8.1, 8.6)**	**11.7 (11.0, 12.5)**
	<55	1092	24908	1.5 (1.3, 1.7)	2.6 (2.4, 2.8)	3.4 (3.1, 3.6)	5.7 (5.3, 6.1)	8.7 (8.1, 9.4)	12.5 (10.7, 14.6)
	55-64	2071	49920	1.5 (1.4, 1.7)	2.4 (2.2, 2.5)	3.0 (2.9, 3.2)	5.2 (4.9, 5.5)	8.5 (8.1, 9.0)	11.9 (10.7, 13.2)
	65-74	2709	68868	1.5 (1.4, 1.6)	2.4 (2.2, 2.5)	3.0 (2.9, 3.2)	5.1 (4.9, 5.3)	8.0 (7.6, 8.4)	11.4 (10.3, 12.6)
	≥75	1914	49463	2.0 (1.8, 2.1)	2.9 (2.7, 3.0)	3.6 (3.4, 3.8)	5.7 (5.4, 6.0)	8.0 (7.4, 8.6)	
Female		**8583**	**227982**	**1.6 (1.6, 1.7)**	**2.4 (2.3, 2.5)**	**3.0 (2.9, 3.1)**	**4.7 (4.6, 4.9)**	**7.3 (7.1, 7.5)**	**9.6 (9.1, 10.1)**
	<55	1009	19855	1.8 (1.6, 2.0)	2.9 (2.7, 3.2)	3.8 (3.5, 4.1)	6.2 (5.8, 6.6)	9.7 (8.9, 10.4)	13.3 (11.4, 15.3)
	55-64	2065	49953	1.5 (1.4, 1.6)	2.3 (2.2, 2.5)	3.0 (2.8, 3.1)	5.0 (4.8, 5.3)	7.9 (7.4, 8.3)	10.3 (9.6, 11.2)
	65-74	3057	82192	1.6 (1.5, 1.6)	2.4 (2.3, 2.5)	2.9 (2.8, 3.1)	4.5 (4.4, 4.7)	7.2 (6.8, 7.5)	9.0 (8.4, 9.6)
	≥75	2452	75982	1.7 (1.6, 1.8)	2.3 (2.2, 2.5)	2.9 (2.8, 3.0)	4.3 (4.1, 4.5)	5.8 (5.5, 6.2)	8.4 (6.7, 10.5)
TOTAL		**16369**	**421141**						

Note: All procedures using metal/metal prostheses have been excluded

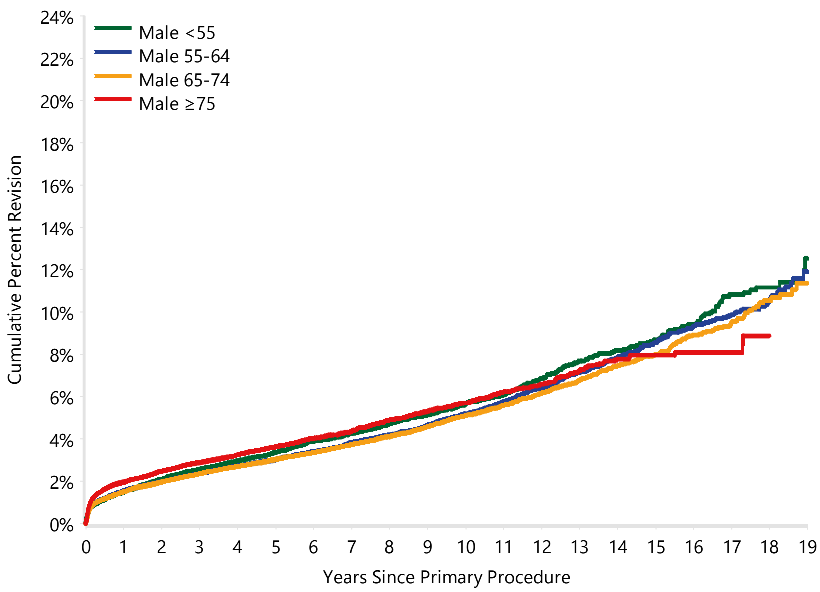
Figure HT8 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Gender (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Male	193159	172299	135726	102259	40670	11955	571
Female	227982	204263	163917	126688	53991	15247	674

Note: 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=1.14 (0.89, 1.47),p=0.294
2Wk - 3Mth: HR=0.61 (0.51, 0.73),p<0.001
3Mth - 9Mth: HR=0.83 (0.67, 1.03),p=0.094
9Mth - 1Yr: HR=0.92 (0.64, 1.34),p=0.674
1Yr - 1.5Yr: HR=1.15 (0.89, 1.50),p=0.291
1.5Yr+: HR=1.13 (1.02, 1.25),p=0.020

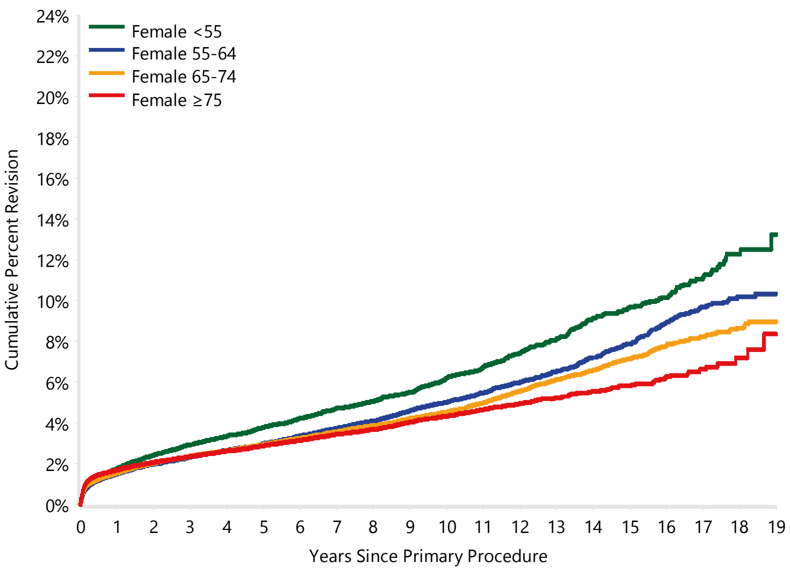
Male 55-64 vs Male ≥75
0 - 2Wk: HR=0.90 (0.72, 1.11),p=0.317
2Wk - 1Mth: HR=0.70 (0.59, 0.84),p<0.001
1Mth - 9Mth: HR=0.79 (0.70, 0.90),p<0.001
9Mth - 1.5Yr: HR=0.89 (0.74, 1.07),p=0.212
1.5Yr - 2Yr: HR=0.73 (0.56, 0.95),p=0.020
2Yr - 7Yr: HR=0.97 (0.87, 1.09),p=0.594
7Yr - 8Yr: HR=0.82 (0.62, 1.09),p=0.177
8Yr - 11Yr: HR=1.16 (0.97, 1.38),p=0.104
11Yr+: HR=1.18 (0.99, 1.39),p=0.060

Male 65-74 vs Male≥75
0 - 1.5Yr: HR=0.79 (0.73, 0.86),p<0.001
1.5Yr - 2Yr: HR=0.78 (0.62, 0.99),p=0.040
2Yr - 3.5Yr: HR=0.98 (0.84, 1.14),p=0.793
3.5Yr - 4.5Yr: HR=0.84 (0.68, 1.03),p=0.100
4.5Yr - 6Yr: HR=0.90 (0.75, 1.08),p=0.268
6Yr+: HR=1.05 (0.93, 1.17),p=0.442

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Male	<55	24908	22439	17806	13510	5445	2149	147
	55-64	49920	44826	35929	27690	12024	4256	226
	65-74	68868	61764	49331	37893	16183	4563	179
	≥75	49463	43270	32660	23166	7018	987	19

Note: All procedures using metal/metal prostheses have been excluded

Figure HT10 Cumulative Percent Revision of Primary Total Conventional Hip Replacement in Females by Age (Primary Diagnosis OA)



Female <55 vs Female ≥75
0 - 2Wk: HR=1.05 (0.81, 1.36),p=0.705
2Wk - 3Mth: HR=0.77 (0.64, 0.92),p=0.004
3Mth+: HR=1.72 (1.58, 1.87),p<0.001

Female 55-64 vs Female ≥75
0 - 3Mth: HR=0.77 (0.69, 0.86),p<0.001
3Mth - 6Mth: HR=1.15 (0.93, 1.42),p=0.193
6Mth - 1.5Yr: HR=1.34 (1.17, 1.54),p<0.001
1.5Yr - 3Yr: HR=1.19 (1.02, 1.39),p=0.025
3Yr - 6Yr: HR=1.33 (1.17, 1.52),p<0.001
6Yr+: HR=1.46 (1.32, 1.62),p<0.001

Female 65-74 vs Female ≥75
0 - 3Mth: HR=0.84 (0.77, 0.92),p<0.001
3Mth+: HR=1.19 (1.12, 1.27),p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Female	<55	19855	17966	14691	11556	5209	1891	94
	55-64	49953	45188	36928	29252	13637	4459	260
	65-74	82192	73527	58920	45658	20689	6264	250
	≥75	75982	67582	53378	40222	14456	2633	70

Note: 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)

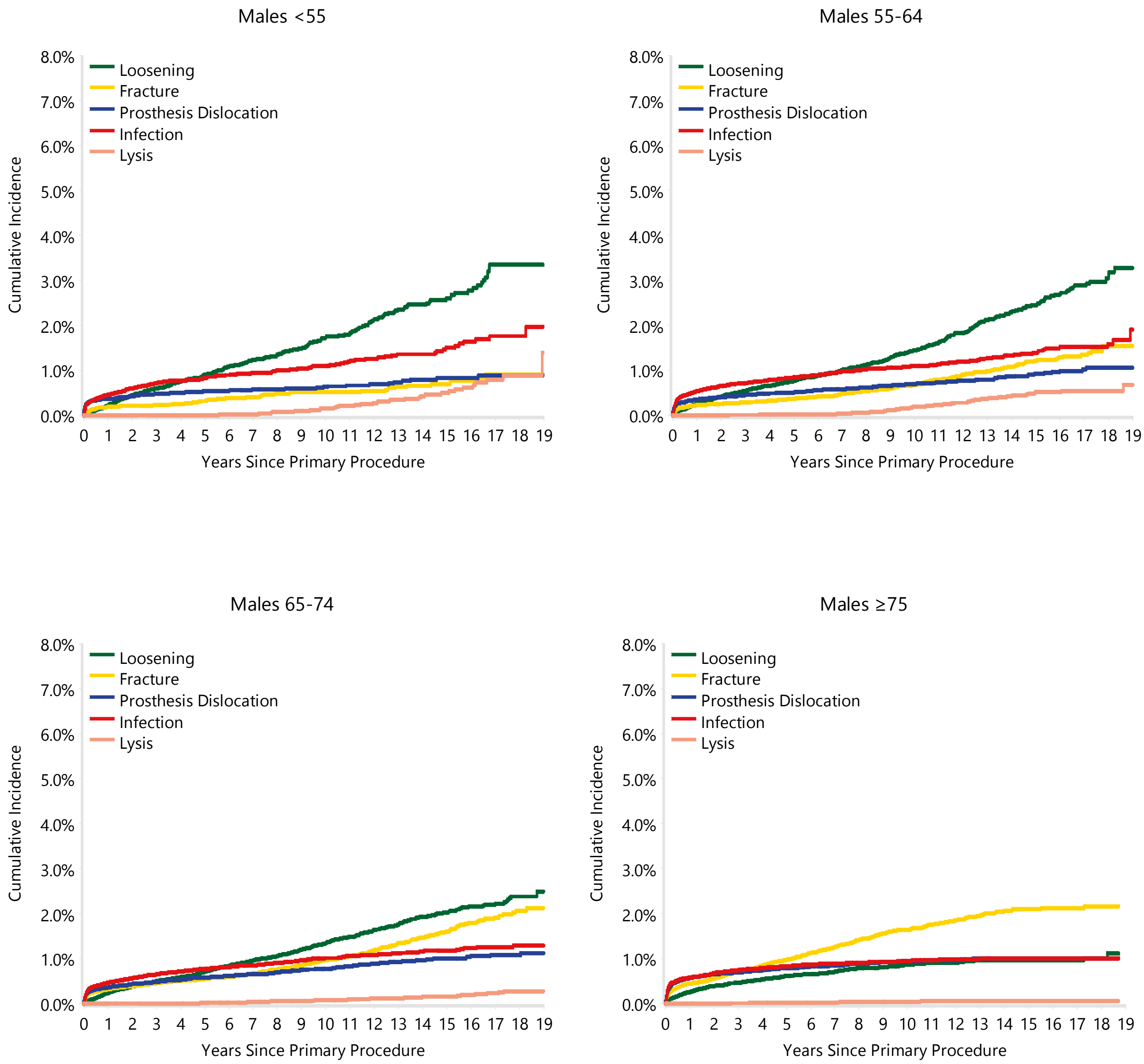


Figure HT12 Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement in Females by Age (Primary Diagnosis OA)

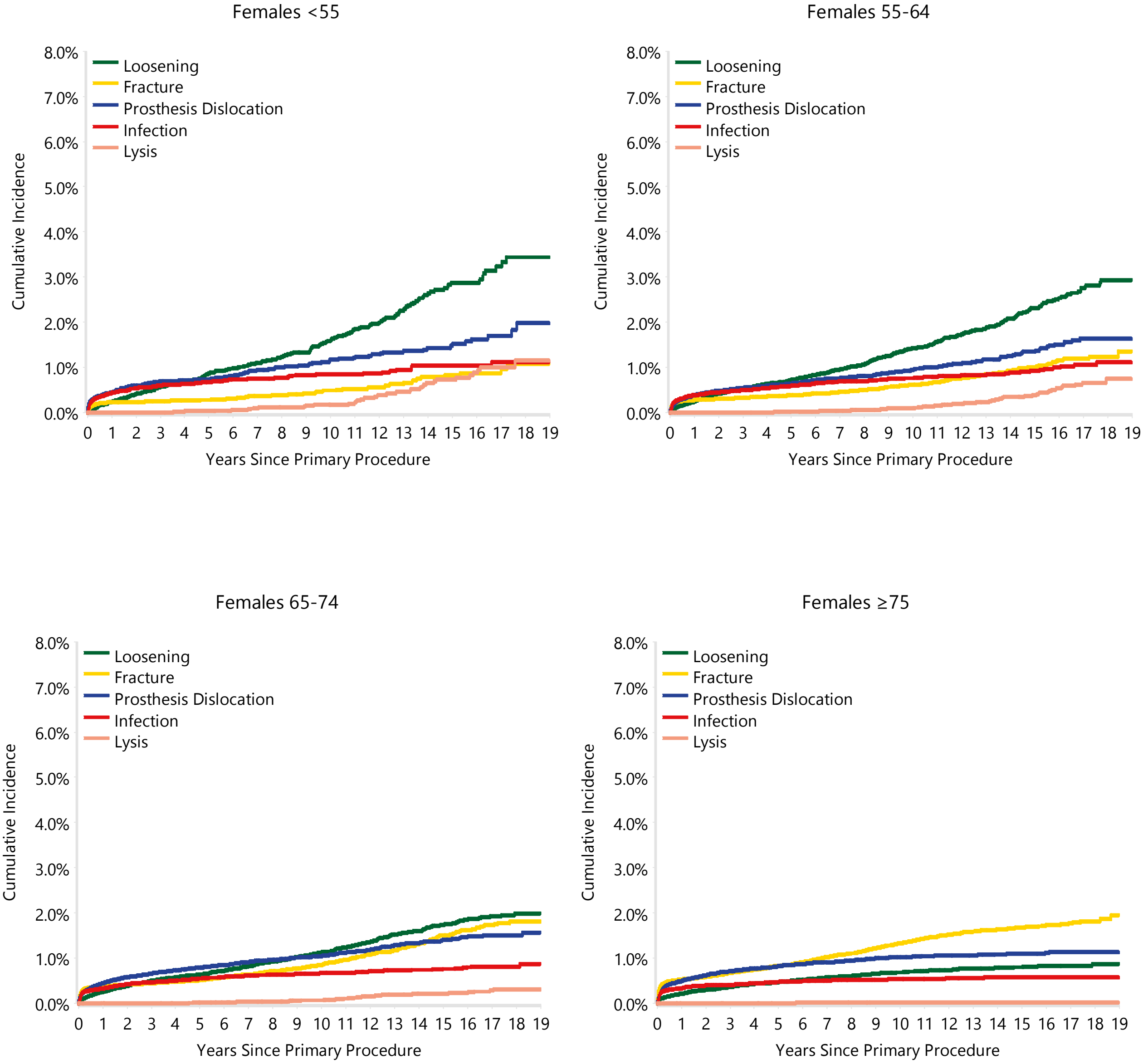
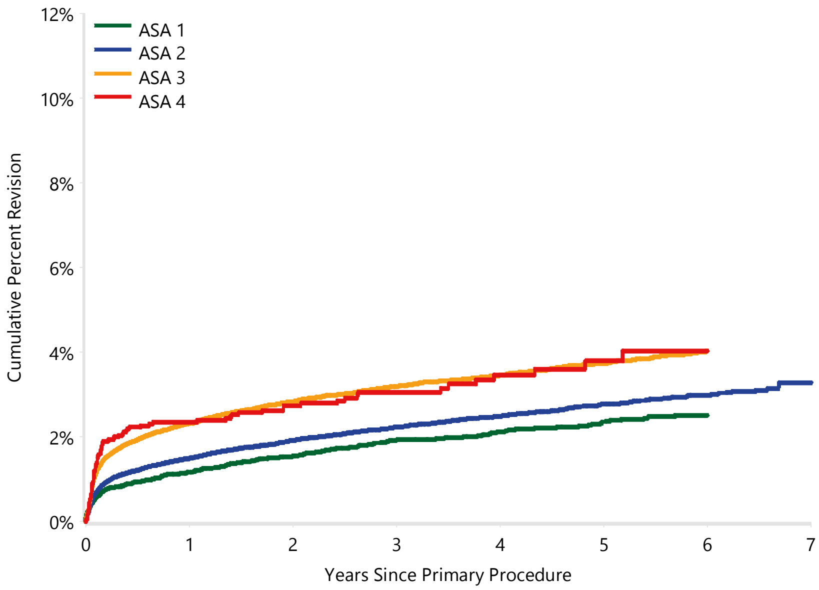


Table HT19 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by ASA Score (Primary Diagnosis OA)

ASA Score	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	7 Yrs
ASA 1	374	20146	1.2 (1.0, 1.3)	1.5 (1.4, 1.7)	1.9 (1.7, 2.1)	2.1 (1.9, 2.4)	2.4 (2.1, 2.6)	2.5 (2.2, 2.8)
ASA 2	2490	114305	1.5 (1.4, 1.6)	1.9 (1.8, 2.0)	2.2 (2.1, 2.3)	2.5 (2.4, 2.6)	2.8 (2.7, 2.9)	3.0 (2.9, 3.1)
ASA 3	2131	71029	2.3 (2.2, 2.4)	2.8 (2.7, 3.0)	3.2 (3.1, 3.3)	3.5 (3.3, 3.6)	3.7 (3.6, 3.9)	4.0 (3.8, 4.2)
ASA 4	87	2962	2.3 (1.8, 3.0)	2.7 (2.2, 3.4)	3.1 (2.5, 3.8)	3.5 (2.8, 4.3)	3.8 (3.0, 4.8)	4.0 (3.1, 5.2)
ASA 5	0	9	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)
TOTAL	**5082**	**208451**						

Note: All procedures using metal/metal prostheses have been excluded

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=1.25 (1.12, 1.40),p<0.001

ASA 3 vs ASA 1

Entire Period: HR=1.84 (1.64, 2.06),p<0.001

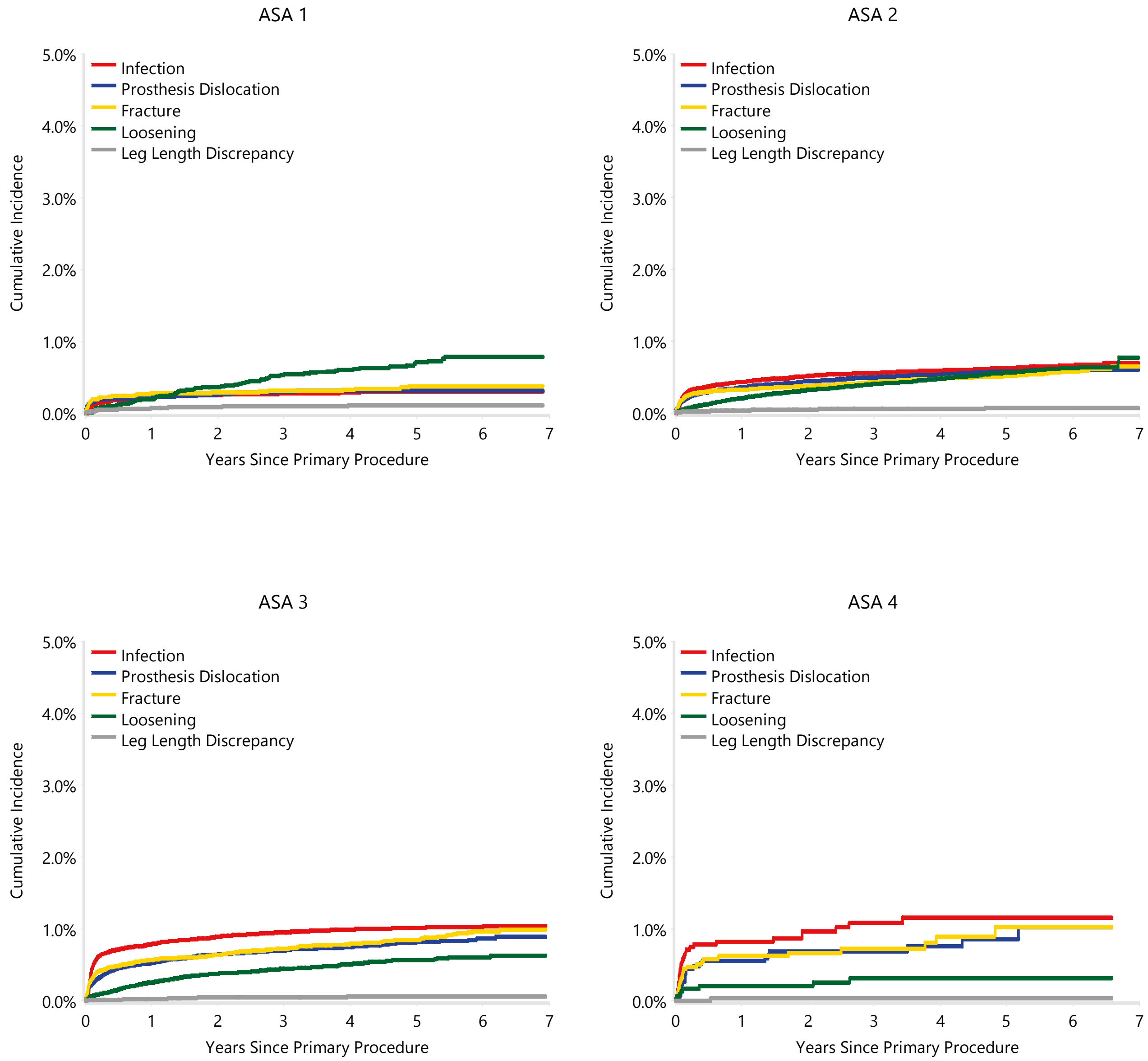
ASA 4 vs ASA 1

Entire Period: HR=1.87 (1.47, 2.37),p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	7 Yrs
ASA 1	20146	17124	13990	10880	7849	4867	2021
ASA 2	114305	94005	75470	57633	40148	23919	9255
ASA 3	71029	56029	43144	31486	21106	12041	4447
ASA 4	2962	2300	1738	1233	809	470	170

Note: All procedures using metal/metal prostheses have been excluded

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



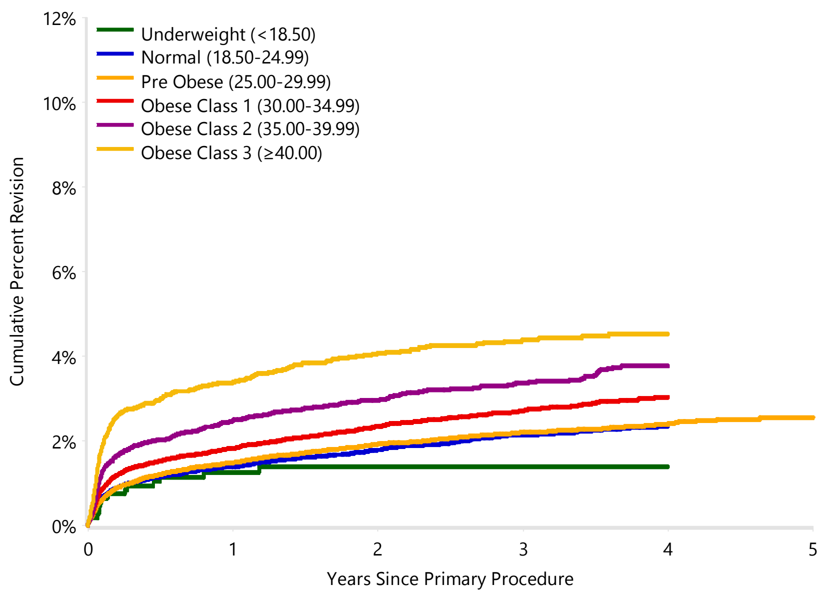
Note: All procedures using metal/metal prostheses have been excluded

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
Underweight	14	1090	1.3 (0.7, 2.2)	1.4 (0.8, 2.3)	1.4 (0.8, 2.3)	1.4 (0.8, 2.3)
Normal	576	31703	1.4 (1.3, 1.5)	1.8 (1.6, 2.0)	2.1 (2.0, 2.3)	2.3 (2.1, 2.6)
Pre Obese	1070	56732	1.5 (1.4, 1.6)	1.9 (1.8, 2.1)	2.2 (2.1, 2.3)	2.4 (2.3, 2.6)
Obese Class 1	913	38832	1.8 (1.7, 2.0)	2.3 (2.2, 2.5)	2.7 (2.5, 2.9)	3.0 (2.8, 3.3)
Obese Class 2	495	16540	2.5 (2.2, 2.7)	3.0 (2.7, 3.3)	3.4 (3.1, 3.7)	3.8 (3.4, 4.2)
Obese Class 3	319	8139	3.4 (3.0, 3.8)	4.1 (3.6, 4.5)	4.4 (3.9, 4.9)	4.5 (4.0, 5.1)
TOTAL	**3387**	**153036**				

Note: All procedures using metal/metal prostheses have been excluded
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=0.71 (0.42, 1.21),p=0.206

Pre Obese (25.00-29.99) vs Normal (18.50-24.99)
Entire Period: HR=1.04 (0.94, 1.15),p=0.481

Obese Class 1 (30.00-34.99) vs Normal (18.50-24.99)
Entire Period: HR=1.31 (1.18, 1.45),p<0.001

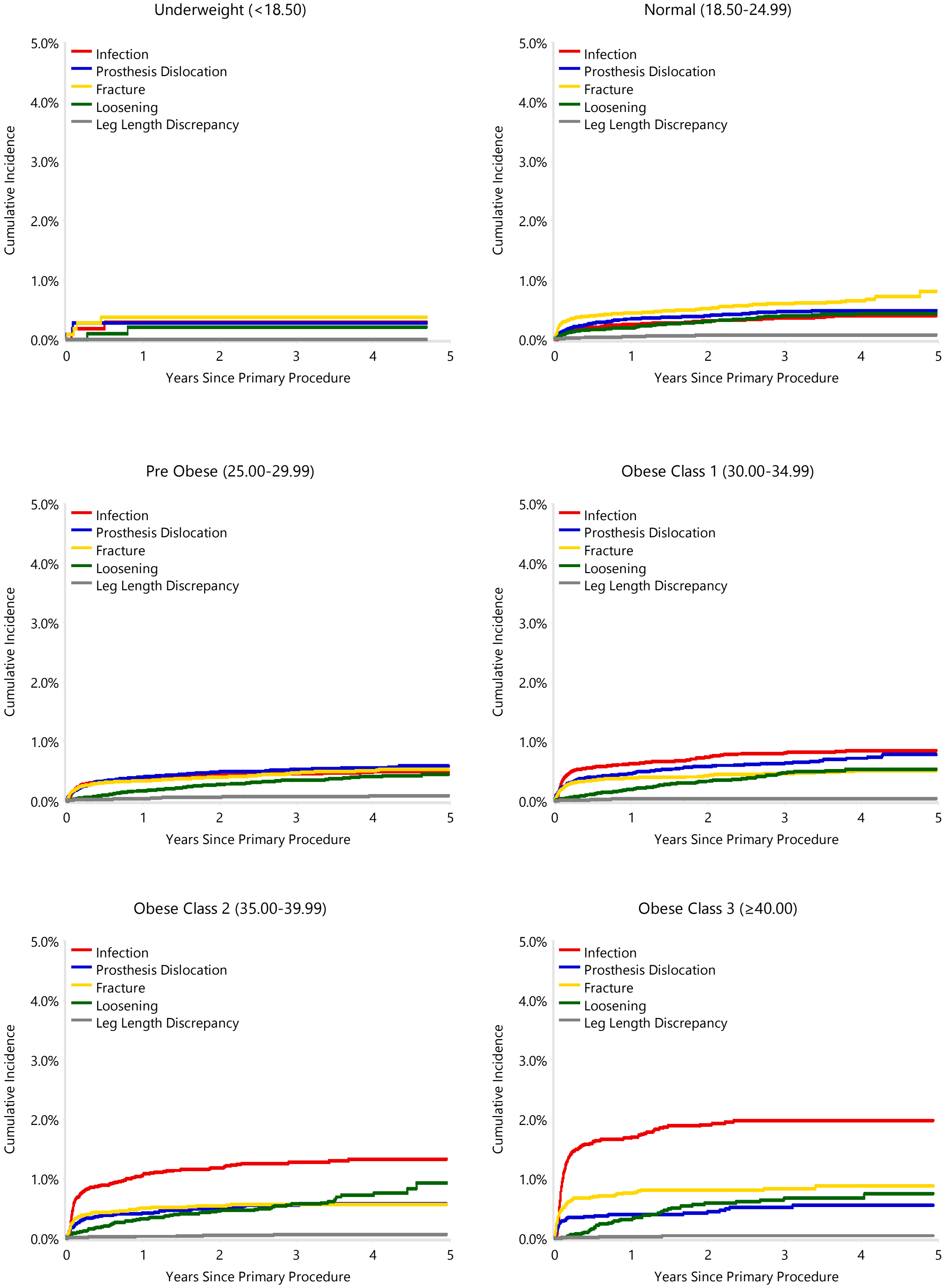
Obese Class 2 (35.00-39.99) vs Normal (18.50-24.99)
Entire Period: HR=1.70 (1.50, 1.92),p<0.001

Obese Class 3 (≥40.00) vs Normal (18.50-24.99)
0 - 3Mth: HR=2.90 (2.47, 3.41),p<0.001
3Mth+: HR=1.55 (1.25, 1.92),p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs
Underweight	1090	810	588	365	165
Normal	31703	24174	17277	10868	5014
Pre Obese	56732	43206	30811	19453	8900
Obese Class 1	38832	29452	20893	13012	5880
Obese Class 2	16540	12361	8782	5435	2403
Obese Class 3	8139	6007	4280	2714	1243

Note: All procedures using metal/metal prostheses have been excluded
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
BMI has not been presented for patients aged ≤19 years

OUTCOME FOR OSTEOARTHRITIS - PROSTHESIS CHARACTERISTICS

The analysis of prosthesis fixation was performed using only modern bearing surfaces. All other analyses have been undertaken excluding all procedures using metal/metal bearing surfaces. These include mixed ceramic/mixed ceramic and all femoral head materials used in conjunction with cross-linked polyethylene (XLPE).

Fixation

Modern bearing surfaces account for 96.5% of all primary total conventional hip procedures performed in 2019.

There is no difference in the rate of revision for cemented compared to hybrid fixation. Cementless fixation has a higher rate of revision than hybrid fixation. Cementless fixation has a higher rate of revision than cemented fixation for the first month and after this time there is no difference (Table HT21 and Figure HT17).

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. Cementless fixation has a higher rate of revision in the first 3 months for patients aged 65-74 years when compared to hybrid fixation. Cementless fixation has a higher rate of revision for patients aged ≥75 years compared to hybrid and cemented fixation (Table HT22 and Figure HT18 to Figure HT21).

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 6,110 procedures using a mini stem prosthesis undertaken for osteoarthritis. This represents less than 1.5% of all primary total conventional hip procedures. There were 1,222 procedures recorded in 2019 using a mini stem prosthesis. This is an increase of 8.0% compared to 2018. The 15 year cumulative percent revision for primary total conventional hip replacement using a mini stem is 6.3% compared to 7.8% for other femoral stems. Mini stems have a reduced rate of revision after 2 years (Table HT23 and Figure HT22). There is an increased cumulative incidence of loosening for procedures using a mini stem compared to other femoral stems at 15 years (2.2% compared to 1.7%) (Figure HT23). The types of revision are presented in Table HT24.

The Registry has information on 13 different mini stem prostheses. Rates of revision vary depending on the type of prosthesis (Table HT25).

Femoral Stems with Exchangeable Necks

A femoral stem with an exchangeable neck has a separate neck that connects proximally to the stem. Femoral stems with exchangeable necks were introduced to enable surgeons to have increased choice with respect to determining femoral neck version, offset and length during primary total conventional hip replacement.

The Registry has recorded 10,286 primary procedures using femoral stems with exchangeable necks undertaken for osteoarthritis. There were 51 procedures reported in 2019. This is a 68.1% decrease compared to 2018. The proportion of procedures using exchangeable necks peaked in 2010 at 6.3% of all primary total conventional hip procedures. This proportion continues to decrease. In 2019, 0.1% of all procedures used a stem with an exchangeable neck.

The cumulative percent revision at 15 years is 12.3% for stems with exchangeable necks compared to 7.6% for fixed neck stems. Femoral stems with exchangeable necks have almost twice the rate of revision compared to fixed neck stems (Table HT26 and Figure HT24). The increase in the rate of revision is due to a higher cumulative incidence of loosening (2.6% at 15 years compared to 1.7% for fixed femoral neck stems), prosthesis dislocation (1.9% compared to 1.1%) and fracture (2.0% compared to 1.4%) (Figure HT25).

Of the revisions of femoral stems with exchangeable necks, 3.3% are for implant breakage of the femoral component compared to 1.1% for fixed neck stems (Table HT27). The higher rate of revision when using stems with exchangeable necks is evident for all bearing surfaces (Figure HT26).

The Registry has previously identified that the stem/neck metal combination has an effect on the rate of revision. There are 5 different stem/neck metal combinations. Only the 2 principal combinations are included in a comparative analysis. These are titanium stem/titanium neck and titanium stem/cobalt chrome neck. The titanium/cobalt chrome combination has a higher rate of revision compared to the titanium/titanium combination (Table HT28 and Figure HT27).

The reason for this difference is a higher cumulative incidence for each of the 5 main reasons for revision. At 15 years, the cumulative incidence of metal related pathology is 3.9% for titanium/cobalt chrome compared to 0.1% for titanium/titanium (Figure HT28).

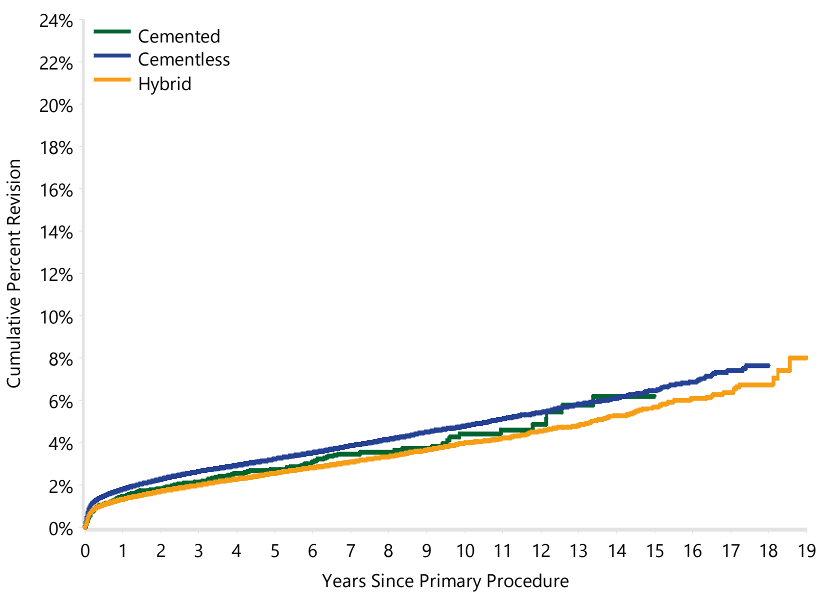
The Registry has information on 14 different exchangeable femoral neck prostheses that have been used in more than 60 procedures. The outcomes of each of these stems are detailed in Table HT29.

Table HT21 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Fixation (Primary Diagnosis OA)

Fixation	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Cemented	192	6751	1.5 (1.2, 1.8)	2.1 (1.8, 2.5)	2.7 (2.3, 3.2)	4.4 (3.6, 5.4)	6.2 (4.7, 8.1)	
Cementless	7467	220473	1.8 (1.7, 1.9)	2.7 (2.6, 2.7)	3.2 (3.2, 3.3)	4.8 (4.7, 4.9)	6.5 (6.2, 6.7)	
Hybrid	3289	117756	1.3 (1.3, 1.4)	2.0 (1.9, 2.1)	2.6 (2.5, 2.7)	4.0 (3.8, 4.2)	5.7 (5.4, 6.0)	8.0 (6.6, 9.8)
TOTAL	**10948**	**344980**						

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

Figure HT17 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=1.09 (0.94, 1.26),p=0.270

Cementless vs Hybrid

0 - 2Wk: HR=2.15 (1.83, 2.51),p<0.001

2Wk - 1Mth: HR=1.38 (1.23, 1.55),p<0.001

1Mth - 1.5Yr: HR=1.23 (1.15, 1.32),p<0.001

1.5Yr+: HR=1.13 (1.07, 1.21),p<0.001

Cementless vs Cemented

0 - 2Wk: HR=1.98 (1.60, 2.44),p<0.001

2Wk - 1Mth: HR=1.27 (1.06, 1.52),p=0.009

1Mth - 1.5Yr: HR=1.13 (0.97, 1.32),p=0.106

1.5Yr+: HR=1.04 (0.90, 1.22),p=0.568

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Cemented	6751	5992	4655	3286	602	111	1
Cementless	220473	194040	147887	106008	30362	4908	28
Hybrid	117756	103480	79460	57955	20700	3979	50

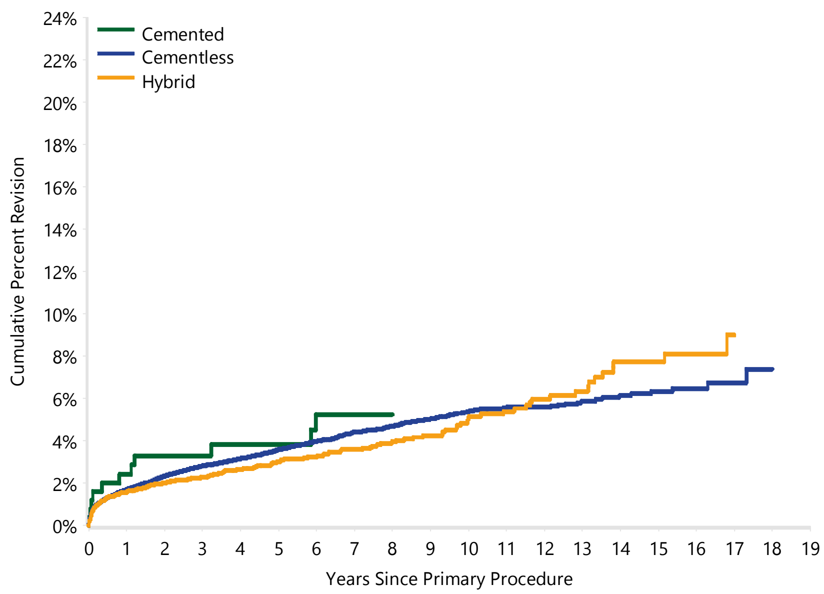
Note: Includes mixed ceramic/mixed ceramic and cross-linked polyethylene (XLPE) bearing surfaces

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

Age	Fixation	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
<55		**1304**	**36076**	**1.7 (1.6, 1.8)**	**2.7 (2.6, 2.9)**	**3.5 (3.3, 3.7)**	**5.4 (5.0, 5.7)**	**6.7 (6.2, 7.3)**	
	Cemented	14	253	2.4 (1.1, 5.3)	3.3 (1.7, 6.5)	3.8 (2.0, 7.2)			
	Cementless	1094	29929	1.7 (1.6, 1.9)	2.8 (2.6, 3.0)	3.6 (3.4, 3.8)	5.4 (5.0, 5.8)	6.3 (5.8, 7.0)	
	Hybrid	196	5894	1.6 (1.3, 1.9)	2.3 (1.9, 2.7)	3.0 (2.6, 3.5)	5.0 (4.2, 6.0)	7.7 (6.3, 9.6)	
55-64		**2581**	**81049**	**1.6 (1.5, 1.6)**	**2.3 (2.2, 2.4)**	**2.9 (2.7, 3.0)**	**4.5 (4.3, 4.7)**	**6.4 (6.0, 6.8)**	
	Cemented	29	767	2.2 (1.3, 3.5)	3.1 (2.0, 4.6)	3.2 (2.2, 4.8)	4.5 (3.0, 6.8)		
	Cementless	1971	62100	1.6 (1.5, 1.7)	2.4 (2.3, 2.5)	2.9 (2.8, 3.1)	4.5 (4.2, 4.7)	6.2 (5.8, 6.7)	
	Hybrid	581	18182	1.3 (1.2, 1.5)	2.0 (1.8, 2.3)	2.7 (2.4, 2.9)	4.5 (4.1, 5.0)	6.7 (5.9, 7.6)	
65-74		**3804**	**124803**	**1.5 (1.5, 1.6)**	**2.3 (2.2, 2.4)**	**2.8 (2.7, 2.9)**	**4.2 (4.1, 4.4)**	**5.9 (5.6, 6.2)**	
	Cemented	64	2106	1.3 (0.9, 1.8)	2.0 (1.4, 2.7)	2.6 (2.0, 3.5)	5.1 (3.7, 7.0)	6.7 (4.4, 10.1)	
	Cementless	2554	80650	1.7 (1.6, 1.8)	2.5 (2.4, 2.6)	3.0 (2.9, 3.2)	4.4 (4.2, 4.6)	6.1 (5.7, 6.5)	
	Hybrid	1186	42047	1.2 (1.1, 1.3)	1.9 (1.8, 2.1)	2.5 (2.3, 2.7)	3.9 (3.6, 4.2)	5.5 (5.0, 6.0)	
≥75		**3259**	**103052**	**1.8 (1.7, 1.9)**	**2.5 (2.4, 2.6)**	**3.1 (3.0, 3.2)**	**4.5 (4.4, 4.7)**	**6.1 (5.7, 6.6)**	
	Cemented	85	3625	1.3 (1.0, 1.8)	1.9 (1.5, 2.5)	2.6 (2.1, 3.3)	3.1 (2.5, 4.0)		
	Cementless	1848	47794	2.3 (2.2, 2.4)	3.1 (3.0, 3.3)	3.7 (3.6, 3.9)	5.5 (5.2, 5.9)	7.7 (7.0, 8.5)	
	Hybrid	1326	51633	1.4 (1.3, 1.5)	2.0 (1.9, 2.2)	2.5 (2.4, 2.7)	3.7 (3.5, 4.0)	4.9 (4.5, 5.4)	
TOTAL		**10948**	**344980**						

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

Figure HT18 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=1.56 (0.90, 2.68),p=0.110

Cemented vs Cementless

Entire Period: HR=1.43 (0.85, 2.43),p=0.180

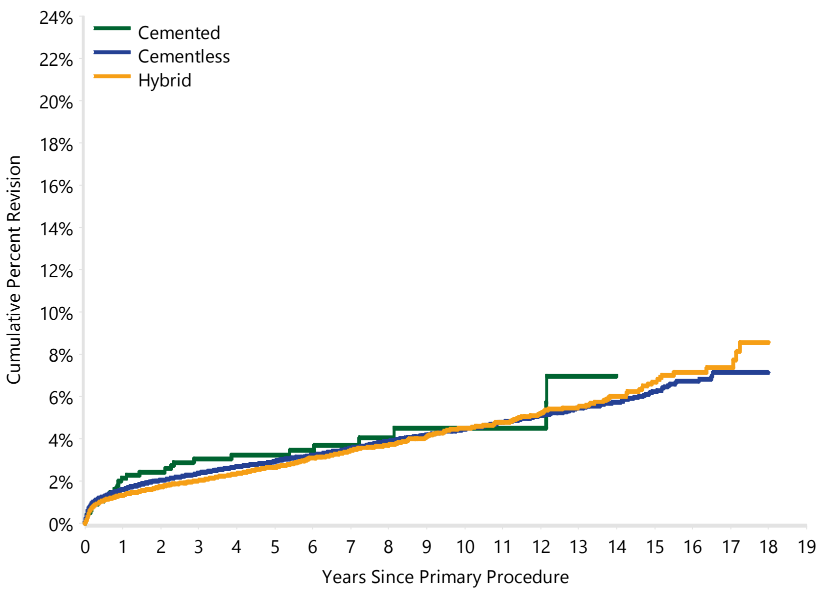
Cementless vs Hybrid

Entire Period: HR=1.09 (0.93, 1.26),p=0.289

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Cemented	253	225	192	161	24	7	1
Cementless	29929	26618	20477	14777	3995	792	4
Hybrid	5894	5133	3885	2688	898	260	5

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

Figure HT19 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=1.17 (0.80, 1.69),p=0.420

Cemented vs Cementless

Entire Period: HR=1.12 (0.78, 1.61),p=0.547

Cementless vs Hybrid

0 - 2Wk: HR=2.38 (1.54, 3.68),p<0.001

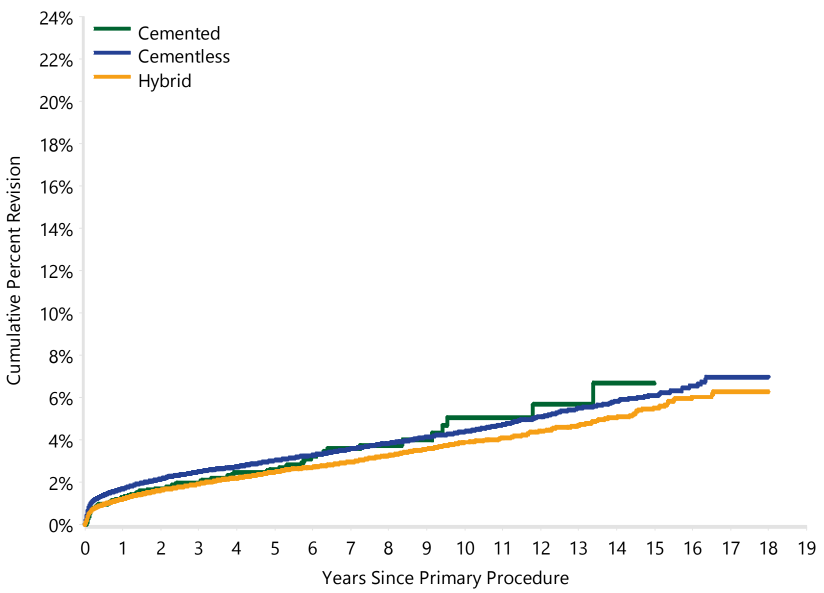
2Wk - 1Mth: HR=1.51 (1.11, 2.07),p=0.009

1Mth+: HR=0.95 (0.86, 1.04),p=0.267

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Cemented	767	703	594	472	109	23	0
Cementless	62100	54963	42481	30934	9337	1713	12
Hybrid	18182	16102	12527	9285	3652	911	14

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

Figure HT20 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=1.14 (0.89, 1.47),p=0.293

Cementless vs Hybrid

0 - 2Wk: HR=2.18 (1.64, 2.89),p<0.001

2Wk - 3Mth: HR=1.40 (1.21, 1.60),p<0.001

3Mth+: HR=1.08 (1.00, 1.18),p=0.057

Cementless vs Cemented

0 - 1Mth: HR=1.47 (1.10, 1.96),p=0.009

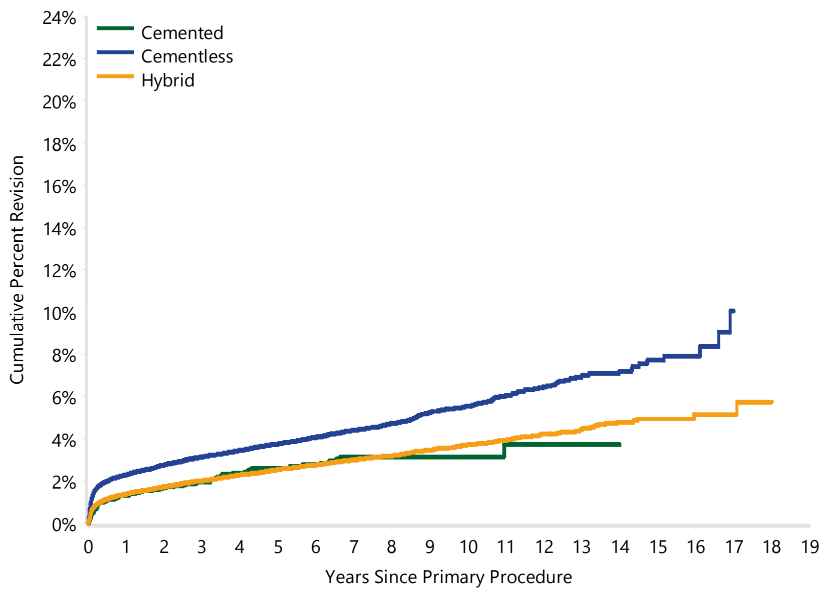
1Mth - 3Mth: HR=1.17 (0.86, 1.59),p=0.318

3Mth+: HR=0.95 (0.74, 1.22),p=0.672

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Cemented	2106	1914	1557	1112	232	59	0
Cementless	80650	70897	53906	38703	11612	1899	10
Hybrid	42047	37210	29139	21928	8984	1941	25

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

Figure HT21 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=0.98 (0.79, 1.22),p=0.872

Cementless vs Hybrid

0 - 2Wk: HR=2.55 (2.01, 3.24),p<0.001

2Wk - 3Mth: HR=1.67 (1.47, 1.90),p<0.001

3Mth+: HR=1.36 (1.24, 1.48),p<0.001

Cementless vs Cemented

0 - 2Wk: HR=2.60 (1.90, 3.57),p<0.001

2Wk+: HR=1.48 (1.19, 1.85),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Cemented	3625	3150	2312	1541	237	22	0
Cementless	47794	41562	31023	21594	5418	504	2
Hybrid	51633	45035	33909	24054	7166	867	6

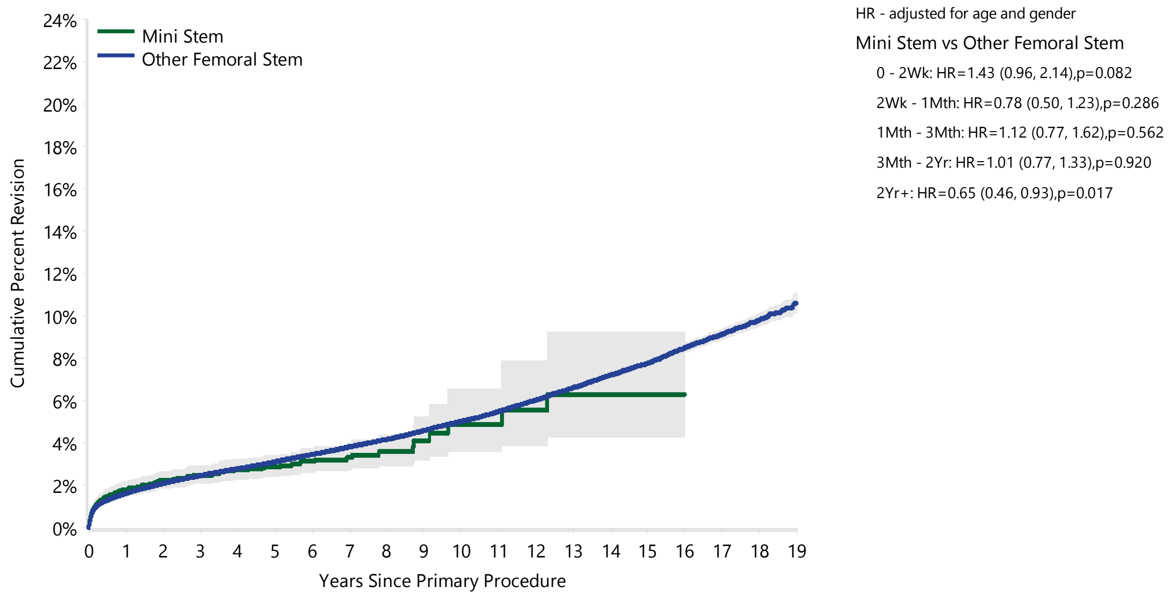
Note: Includes mixed ceramic/mixed ceramic and cross-linked polyethylene (XLPE) bearing surfaces

Table HT23 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	10 Yrs	15 Yrs	19 Yrs
Mini Stem	154	6110	1.8 (1.5, 2.2)	2.5 (2.1, 2.9)	2.9 (2.4, 3.4)	4.9 (3.6, 6.6)	6.3 (4.3, 9.2)	
Other Femoral Stem	16215	415031	1.6 (1.6, 1.7)	2.5 (2.4, 2.5)	3.1 (3.1, 3.2)	5.0 (4.9, 5.1)	7.8 (7.6, 7.9)	10.6 (10.2, 11.1)
TOTAL	**16369**	**421141**						

Note: All procedures using metal/metal prostheses have been excluded

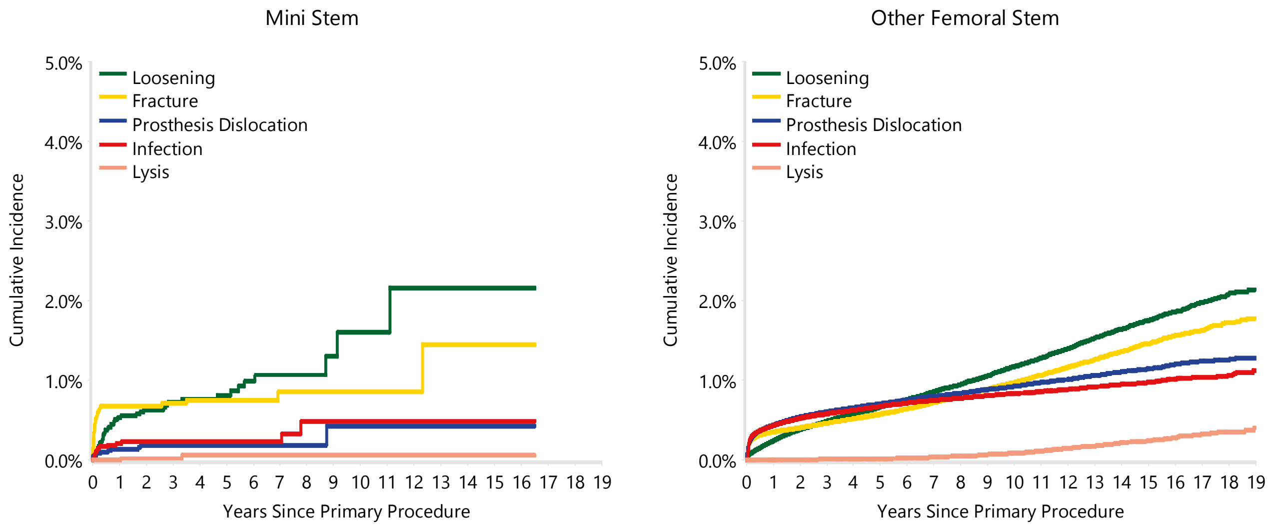
Figure HT22 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Stem Type (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Mini Stem	6110	4789	2780	1722	195	78	1
Other Femoral Stem	415031	371773	296863	227225	94466	27124	1244

Note: All procedures using metal/metal prostheses have been excluded

Figure HT23 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

Table HT24 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	72	1.2	46.8	5385	1.3	33.2
Acetabular Component	33	0.5	21.4	3389	0.8	20.9
Head/Insert	19	0.3	12.3	3351	0.8	20.7
THR (Femoral/Acetabular)	9	0.1	5.8	1973	0.5	12.2
Head Only	12	0.2	7.8	751	0.2	4.6
Cement Spacer	4	0.1	2.6	661	0.2	4.1
Minor Components	3	0.0	1.9	293	0.1	1.8
Other	2	0.0	1.3	412	0.1	2.5
N Revision	**154**	**2.5**	**100.0**	**16215**	**3.9**	**100.0**
N Primary	**6110**			**415031**		

Note: All procedures using metal/metal prostheses have been excluded

Table HT25 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	19 Yrs
C.F.P.*	10	124	4.0 (1.7, 9.4)	4.0 (1.7, 9.4)	4.9 (2.2, 10.5)	7.7 (4.1, 14.2)	8.7 (4.8, 15.7)	
Mallory-Head*	6	121	2.5 (0.8, 7.5)	5.0 (2.3, 10.8)	5.0 (2.3, 10.8)			
Mayo*	7	96	2.1 (0.5, 8.1)	4.2 (1.6, 10.8)	4.2 (1.6, 10.8)	6.7 (3.1, 14.4)	9.3 (4.3, 19.7)	
Metha	5	112	2.7 (0.9, 8.1)	4.5 (1.9, 10.6)	4.5 (1.9, 10.6)			
MiniHip	39	1133	2.5 (1.7, 3.6)	3.0 (2.1, 4.3)	3.8 (2.8, 5.3)			
MiniMax	17	320	4.7 (2.8, 7.9)					
Nanos	9	670	0.9 (0.4, 2.0)	1.2 (0.6, 2.4)	1.2 (0.6, 2.4)			
Optimys	21	1475	0.9 (0.5, 1.6)	1.7 (1.0, 2.7)	2.5 (1.4, 4.4)			
Silent*	4	50	4.0 (1.0, 15.1)	6.0 (2.0, 17.5)	6.0 (2.0, 17.5)			
Taperloc Microplasty	33	1987	1.5 (1.1, 2.2)	1.8 (1.2, 2.6)	2.1 (1.4, 3.1)			
Other (3)	3	22	4.5 (0.7, 28.1)	4.5 (0.7, 28.1)	4.5 (0.7, 28.1)	28.4 (9.3, 68.0)		
TOTAL	**154**	**6110**						

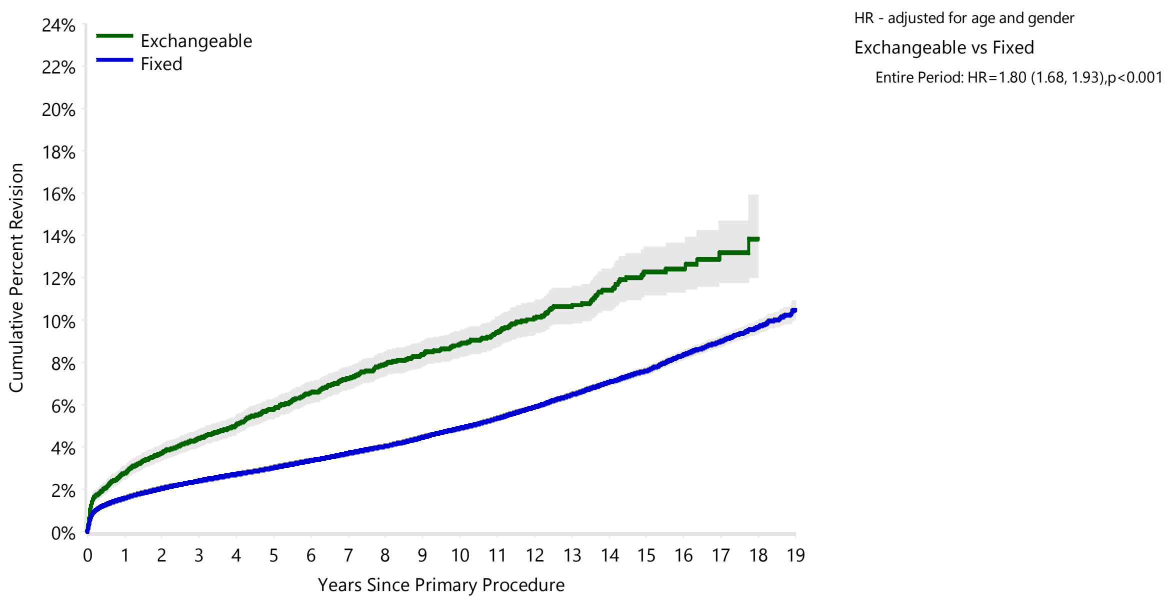
Note: All procedures using metal/metal prostheses have been excluded
* denotes mini stem with no recorded use in total primary conventional hip replacement in 2019
Only prostheses with over 50 procedures have been listed

Table HT26 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Type of Femoral Neck (Primary Diagnosis OA)

Femoral Neck	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Exchangeable	822	10286	2.8 (2.5, 3.1)	4.4 (4.0, 4.8)	5.8 (5.3, 6.3)	8.9 (8.3, 9.5)	12.3 (11.2, 13.5)	
Fixed	15547	410855	1.6 (1.5, 1.6)	2.4 (2.4, 2.5)	3.0 (3.0, 3.1)	4.9 (4.8, 5.0)	7.6 (7.4, 7.8)	10.5 (10.0, 10.9)
TOTAL	**16369**	**421141**						

Note: All procedures using metal/metal prostheses have been excluded

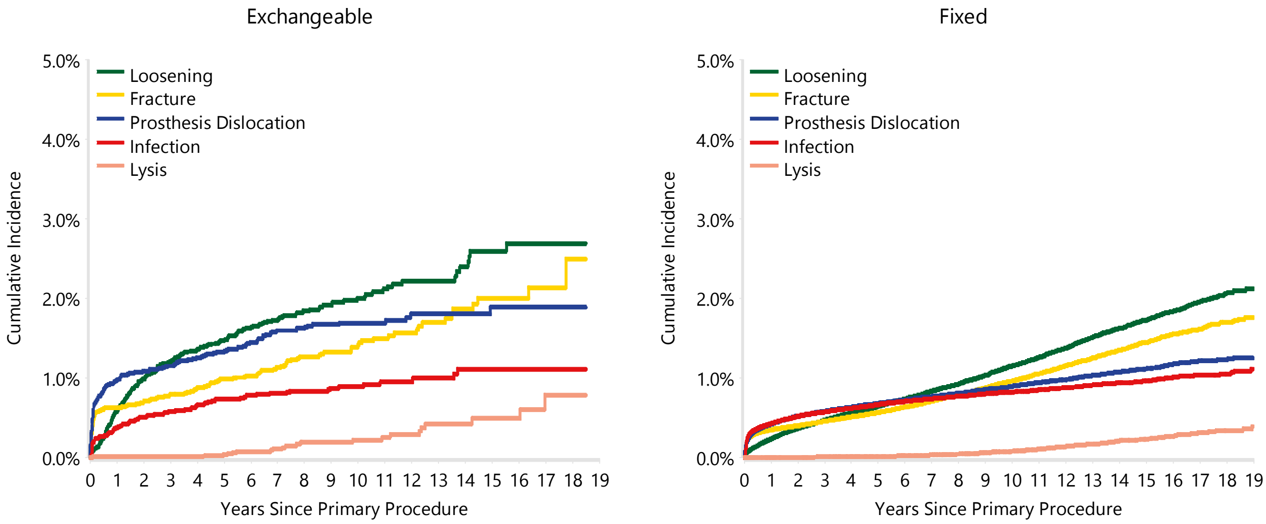
Figure HT24 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Type of Femoral Neck (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Exchangeable	10286	9868	9053	7825	2818	665	19
Fixed	410855	366694	290590	221122	91843	26537	1226

Note: All procedures using metal/metal prostheses have been excluded

Figure HT25 Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement by Type of Femoral Neck (Primary Diagnosis OA)



Note: All procedures using metal/metal prostheses have been excluded

Table HT27 Primary Total Conventional Hip Replacement by Reason for Revision and Type of Femoral Neck (Primary Diagnosis OA)

Reason for Revision	Exchangeable Number	Exchangeable % Primaries Revised	Exchangeable % Revisions	Fixed Number	Fixed % Primaries Revised	Fixed % Revisions
Loosening	200	1.9	24.3	3758	0.9	24.2
Fracture	143	1.4	17.4	3304	0.8	21.3
Prosthesis Dislocation	167	1.6	20.3	3162	0.8	20.3
Infection	90	0.9	10.9	2948	0.7	19.0
Lysis	25	0.2	3.0	332	0.1	2.1
Pain	20	0.2	2.4	302	0.1	1.9
Leg Length Discrepancy	10	0.1	1.2	247	0.1	1.6
Malposition	13	0.1	1.6	221	0.1	1.4
Instability	13	0.1	1.6	208	0.1	1.3
Implant Breakage Stem	27	0.3	3.3	165	0.0	1.1
Wear Acetabular Insert	1	0.0	0.1	141	0.0	0.9
Implant Breakage Acetabular Insert	14	0.1	1.7	137	0.0	0.9
Incorrect Sizing	5	0.0	0.6	101	0.0	0.6
Implant Breakage Acetabular	14	0.1	1.7	86	0.0	0.6
Metal Related Pathology	68	0.7	8.3	73	0.0	0.5
Wear Head	3	0.0	0.4	66	0.0	0.4
Implant Breakage Head	3	0.0	0.4	44	0.0	0.3
Heterotopic Bone				25	0.0	0.2
Tumour				17	0.0	0.1
Wear Acetabulum				15	0.0	0.1
Synovitis	1	0.0	0.1	2	0.0	0.0
Other	5	0.0	0.6	193	0.0	1.2
N Revision	**822**	**8.0**	**100.0**	**15547**	**3.8**	**100.0**
N Primary	**10286**			**410855**		

Note: All procedures using metal/metal prostheses have been excluded

Figure HT26 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Type of Femoral Neck and Bearing Surface (Primary Diagnosis OA)

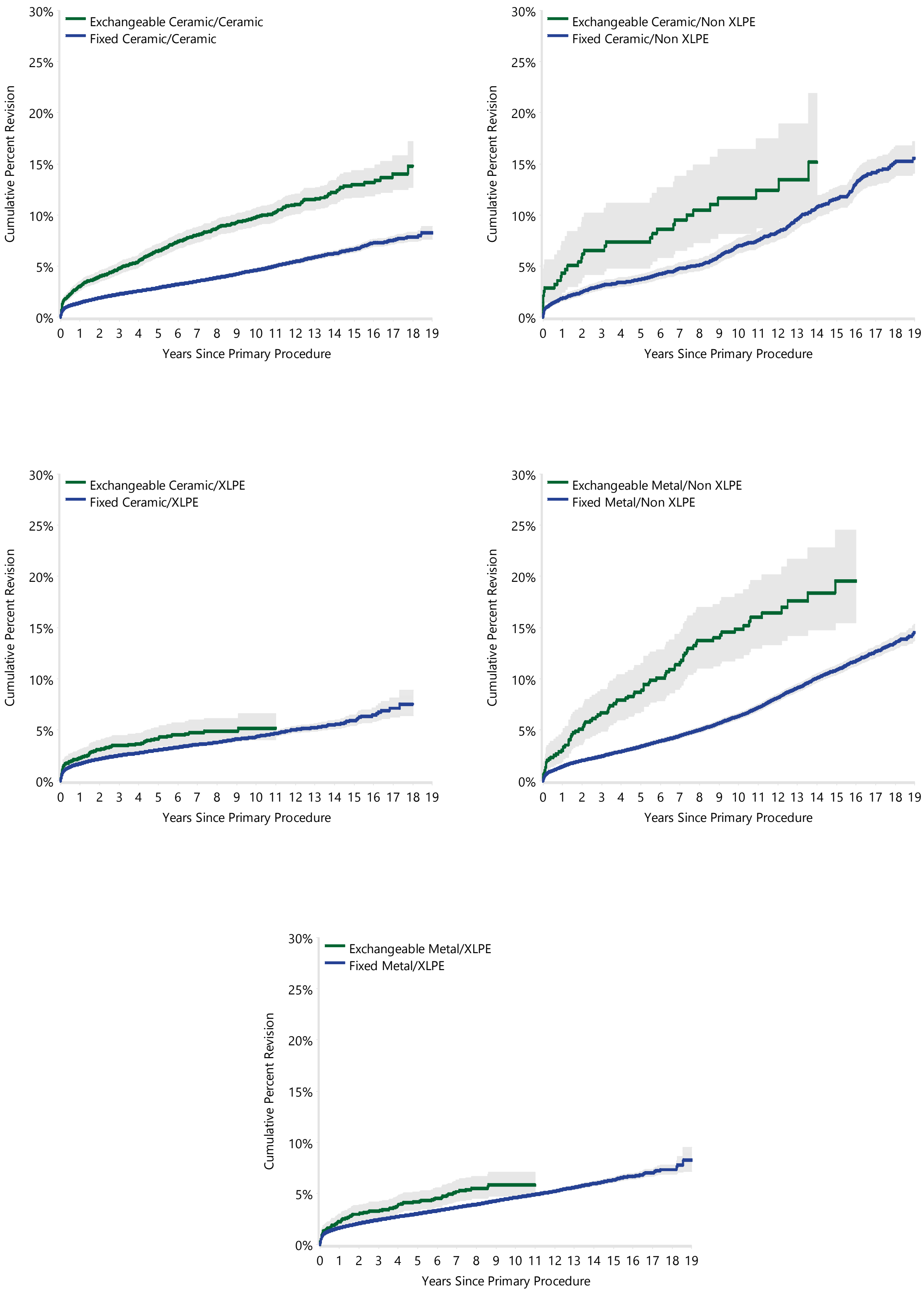
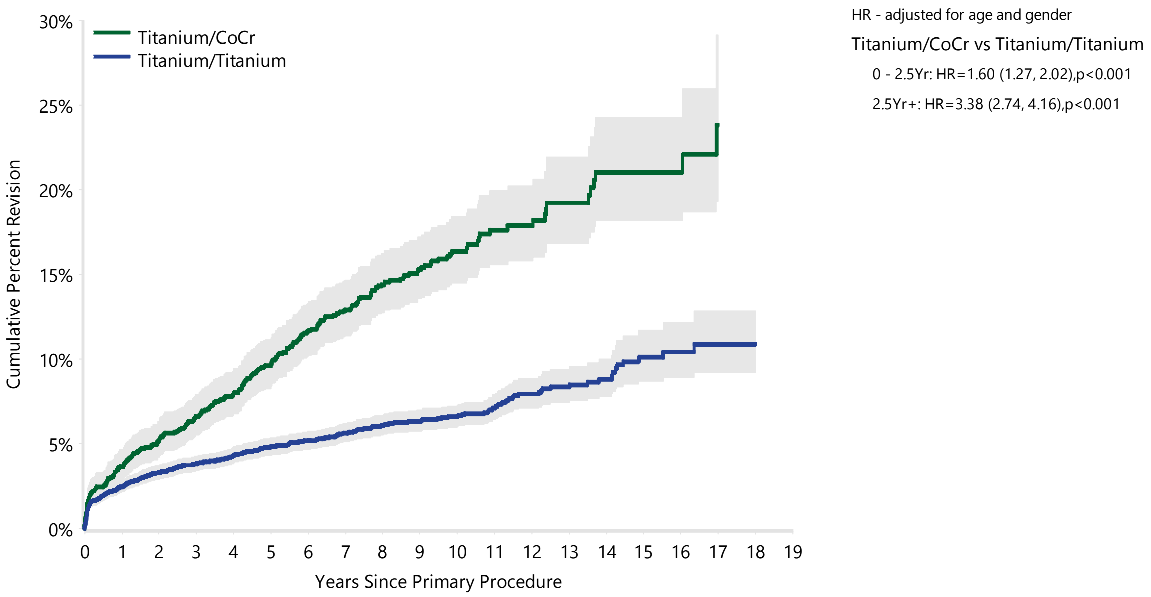


Table HT28 Cumulative Percent Revision of Primary Total Conventional Hip Replacement Using an Exchangeable Femoral Neck by Stem/Neck Metal Combination (Primary Diagnosis OA)

Stem/Neck Metal Combination	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
CoCr/CoCr	93	754	4.0 (2.8, 5.7)	5.9 (4.5, 7.9)	7.3 (5.7, 9.5)	12.2 (10.0, 15.0)	14.4 (11.8, 17.6)	
CoCr/Titanium	2	111	1.8 (0.5, 7.0)	1.8 (0.5, 7.0)	1.8 (0.5, 7.0)			
Stainless Steel/CoCr	2	46	2.2 (0.3, 14.7)	4.6 (1.2, 17.2)	4.6 (1.2, 17.2)	4.6 (1.2, 17.2)		
Titanium/CoCr	259	1684	3.6 (2.8, 4.6)	6.6 (5.5, 7.9)	9.6 (8.3, 11.1)	16.4 (14.5, 18.4)	21.0 (18.2, 24.3)	
Titanium/Titanium	466	7691	2.5 (2.2, 2.9)	3.8 (3.4, 4.3)	4.8 (4.3, 5.3)	6.6 (6.0, 7.3)	10.1 (8.7, 11.7)	
TOTAL	**822**	**10286**						

Note: All procedures using metal/metal prostheses have been excluded

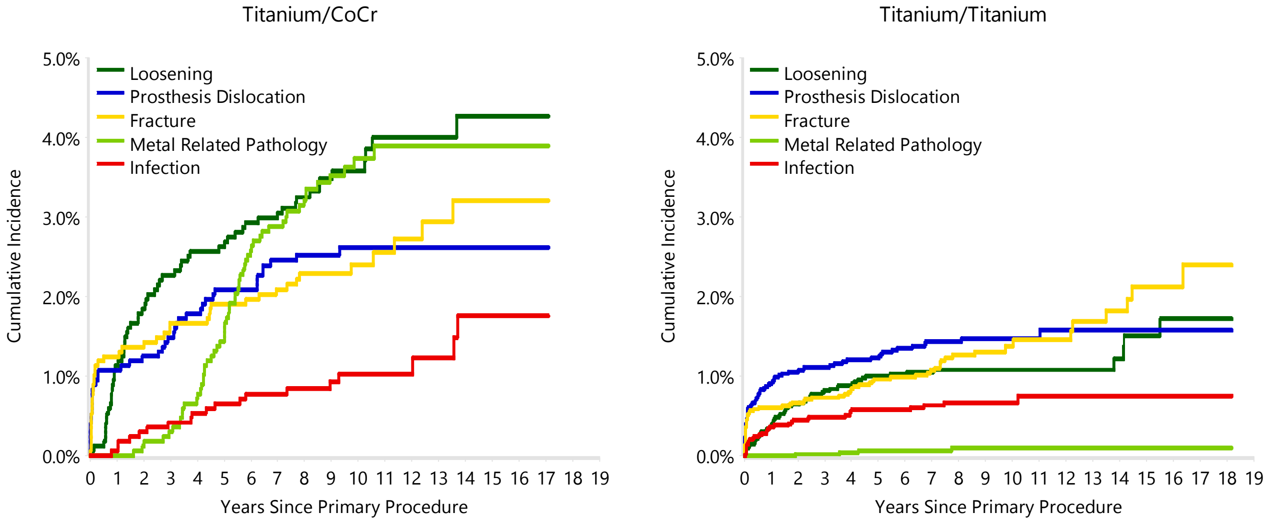
Figure HT27 Cumulative Percent Revision of Primary Total Conventional Hip Replacement Using an Exchangeable Femoral Neck by Stem/Neck Metal Combination (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Titanium/CoCr	1684	1605	1506	1388	504	117	0
Titanium/Titanium	7691	7406	6742	5697	1837	333	10

Note: All procedures using metal/metal prostheses have been excluded

Figure HT28 Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement Using an Exchangeable Femoral Neck by Stem/Neck Metal Combination (Primary Diagnosis OA)



Note: All procedures using metal/metal prostheses have been excluded

Table HT29 Cumulative Percent Revision of Primary Total Conventional Hip Replacement Using an Exchangeable Femoral Neck by Prosthesis Type (Primary Diagnosis OA)

Prosthesis Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
ABGII*	76	228	4.4 (2.4, 8.1)	11.1 (7.7, 16.0)	20.4 (15.6, 26.3)	35.6 (29.3, 42.7)		
Adapter*	62	374	3.8 (2.2, 6.3)	7.6 (5.3, 10.8)	10.2 (7.5, 13.9)	17.6 (13.8, 22.3)		
Apex	171	2631	2.7 (2.1, 3.4)	4.0 (3.3, 4.9)	5.2 (4.4, 6.2)	7.4 (6.3, 8.6)		
F2L*	78	685	3.2 (2.1, 4.8)	5.4 (4.0, 7.4)	6.8 (5.2, 9.0)	8.8 (6.9, 11.2)	12.6 (10.1, 15.6)	
Femoral Neck (Amplitude)*	23	580	0.9 (0.4, 2.1)	2.2 (1.2, 3.8)	4.0 (2.6, 6.1)	4.5 (3.0, 6.9)		
H-Max*	1	71	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	1.6 (0.2, 10.7)			
M-Cor*	13	110	0.0 (0.0, 0.0)	2.8 (0.9, 8.4)	4.7 (2.0, 11.0)	10.1 (5.5, 18.0)		
M/L Taper Kinectiv*	126	2974	2.3 (1.8, 2.9)	3.2 (2.6, 3.9)	3.8 (3.2, 4.6)	4.9 (4.1, 5.9)		
MBA*	70	630	2.1 (1.2, 3.5)	4.0 (2.7, 5.9)	6.3 (4.6, 8.5)	11.1 (8.7, 14.1)	14.5 (11.4, 18.4)	
MSA*	23	174	7.5 (4.4, 12.6)	9.9 (6.2, 15.4)	11.1 (7.2, 16.8)			
Margron*	84	543	5.2 (3.6, 7.4)	7.5 (5.5, 10.0)	9.4 (7.2, 12.2)	14.4 (11.7, 17.8)	16.6 (13.6, 20.3)	
Metha*	12	84	10.7 (5.7, 19.6)	11.9 (6.6, 21.0)	11.9 (6.6, 21.0)	14.4 (8.4, 23.9)		
Profemur	60	884	3.1 (2.1, 4.5)	4.7 (3.5, 6.4)	5.3 (4.0, 7.1)	7.6 (5.8, 9.9)		
R120*	8	178	1.1 (0.3, 4.4)	2.3 (0.9, 6.1)	2.3 (0.9, 6.1)	6.8 (3.3, 13.8)		
Other (5)	15	140	2.9 (1.1, 7.4)	5.0 (2.4, 10.3)	6.9 (3.6, 12.8)			
TOTAL	**822**	**10286**						

Note: Only prostheses with over 60 procedures have been listed
* denotes exchangeable neck with no recorded use in primary total conventional hip replacement in 2019
All procedures using metal/metal prostheses have been excluded

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.

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 more than 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 2 years (Table HT30 and Figure HT29). The Registry acknowledges that there may be prosthesis specific factors that are confounders in the analysis of bearing surface.

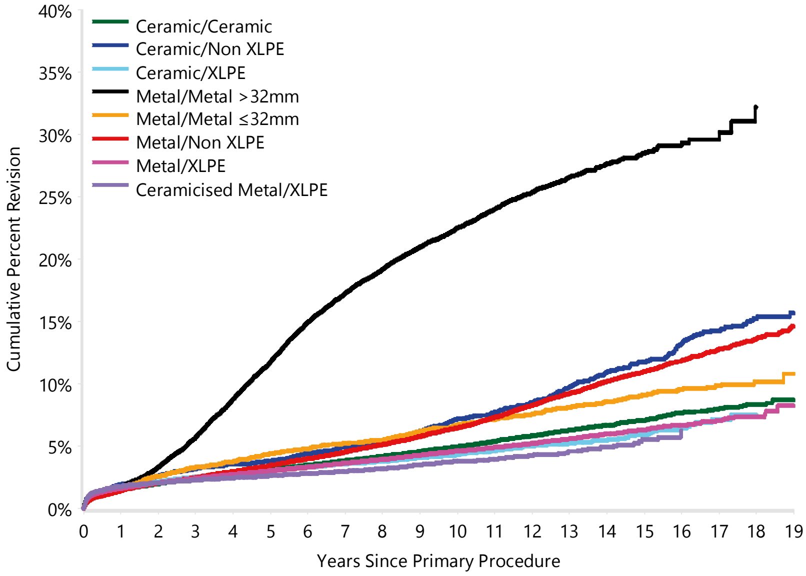
Detailed information on the analysis of metal/metal and metal/ceramic bearing surfaces are available in the supplementary reports 'Metal/Metal Bearing Surface in Total Conventional Hip Arthroplasty' and 'Prosthesis Types No Longer Used' on the AOANJRR website: https://aoanjrr.sahmri.com/annual-reports-2020

Table HT30 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	19 Yrs
Ceramic/Ceramic	3876	94733	1.5 (1.4, 1.6)	2.4 (2.3, 2.5)	3.1 (3.0, 3.2)	5.0 (4.8, 5.1)	7.1 (6.8, 7.4)	8.4 (7.9, 8.8)
Ceramic/Non XLPE	582	7986	1.9 (1.6, 2.3)	3.2 (2.8, 3.6)	3.8 (3.4, 4.3)	7.2 (6.5, 7.9)	11.8 (10.8, 12.9)	15.3 (13.9, 16.7)
Ceramic/XLPE	2484	91245	1.7 (1.6, 1.8)	2.5 (2.4, 2.6)	3.1 (2.9, 3.2)	4.3 (4.1, 4.6)	5.9 (5.4, 6.4)	7.5 (6.4, 8.8)
Ceramic/Metal	26	299	1.7 (0.7, 4.0)	3.7 (2.1, 6.6)	4.4 (2.6, 7.4)	8.4 (5.7, 12.3)		
Metal/Metal >32mm	3415	14422	1.7 (1.5, 1.9)	5.7 (5.3, 6.1)	11.8 (11.2, 12.3)	22.5 (21.8, 23.2)	28.5 (27.5, 29.5)	32.2 (29.1, 35.5)
Metal/Metal ≤32mm	411	5146	1.6 (1.3, 2.0)	3.3 (2.9, 3.8)	4.4 (3.9, 5.0)	6.7 (6.0, 7.4)	9.1 (8.3, 10.1)	10.1 (9.1, 11.3)
Metal/Non XLPE	2821	35265	1.4 (1.3, 1.6)	2.5 (2.3, 2.7)	3.5 (3.3, 3.7)	6.5 (6.2, 6.7)	11.0 (10.6, 11.4)	13.6 (13.0, 14.2)
Metal/XLPE	5792	165771	1.6 (1.6, 1.7)	2.4 (2.3, 2.5)	3.0 (2.9, 3.1)	4.6 (4.5, 4.7)	6.3 (6.1, 6.6)	7.3 (6.9, 7.8)
Ceramicised Metal/Non XLPE	50	297	1.7 (0.7, 4.0)	3.8 (2.1, 6.7)	4.1 (2.4, 7.2)	12.5 (8.9, 17.3)	20.7 (15.7, 27.1)	
Ceramicised Metal/XLPE	724	25323	1.8 (1.6, 2.0)	2.3 (2.1, 2.5)	2.6 (2.4, 2.9)	3.8 (3.5, 4.1)	5.5 (4.8, 6.3)	
TOTAL	**20181**	**440487**						

Note: Excludes 213 procedures with unknown bearing surface, 1 procedure with ceramicised metal/ceramic bearing surface, 8 procedures with metal/ceramic bearing surface

Figure HT29 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, 1.05),p=0.826	Metal/Metal ≤32mm vs Metal/XLPE	Entire Period: HR=1.32 (1.20, 1.47),p<0.001
Ceramic/XLPE vs Metal/XLPE	0 - 2Wk: HR=1.11 (0.96, 1.27),p=0.154 2Wk - 1Mth: HR=1.05 (0.93, 1.18),p=0.417 1Mth - 2Yr: HR=1.03 (0.97, 1.11),p=0.324 2Yr+: HR=0.83 (0.77, 0.91),p<0.001	Ceramicised Metal/XLPE vs Metal/XLPE	0 - 6Mth: HR=1.14 (1.03, 1.28),p=0.014 6Mth - 1Yr: HR=1.01 (0.79, 1.28),p=0.937 1Yr - 2Yr: HR=0.59 (0.46, 0.76),p<0.001 2Yr+: HR=0.61 (0.54, 0.70),p<0.001
Metal/Metal >32mm vs Metal/XLPE	0 - 2Wk: HR=1.29 (0.97, 1.72),p=0.074 2Wk - 1Mth: HR=0.47 (0.32, 0.69),p<0.001 1Mth - 3Mth: HR=0.83 (0.63, 1.10),p=0.195 3Mth - 6Mth: HR=1.09 (0.79, 1.52),p=0.592 6Mth - 9Mth: HR=1.19 (0.82, 1.73),p=0.363 9Mth - 1Yr: HR=2.56 (1.92, 3.42),p<0.001 1Yr - 1.5Yr: HR=2.63 (2.14, 3.24),p<0.001 1.5Yr - 2Yr: HR=4.26 (3.53, 5.15),p<0.001 2Yr - 3Yr: HR=6.26 (5.53, 7.09),p<0.001 3Yr - 5Yr: HR=9.66 (8.85, 10.55),p<0.001 5Yr - 5.5Yr: HR=11.16 (9.46, 13.15),p<0.001 5.5Yr - 7Yr: HR=8.46 (7.56, 9.47),p<0.001 7Yr - 8Yr: HR=7.27 (6.23, 8.48),p<0.001 8Yr - 10Yr: HR=5.44 (4.82, 6.14),p<0.001 10Yr - 12Yr: HR=4.81 (4.15, 5.57),p<0.001 12Yr+: HR=3.30 (2.72, 4.00),p<0.001	Metal/Non XLPE vs Metal/XLPE	0 - 2Wk: HR=0.76 (0.60, 0.98),p=0.031 2Wk - 1Mth: HR=0.73 (0.59, 0.90),p=0.002 1Mth - 6Mth: HR=0.92 (0.80, 1.07),p=0.272 6Mth - 2Yr: HR=1.36 (1.21, 1.52),p<0.001 2Yr - 3.5Yr: HR=1.32 (1.15, 1.52),p<0.001 3.5Yr - 5Yr: HR=1.55 (1.34, 1.79),p<0.001 5Yr - 7Yr: HR=1.69 (1.48, 1.92),p<0.001 7Yr - 10Yr: HR=1.96 (1.75, 2.19),p<0.001 10Yr+: HR=2.50 (2.28, 2.74),p<0.001
		Ceramic/Non XLPE vs Metal/XLPE	0 - 2Yr: HR=1.25 (1.08, 1.45),p=0.002 2Yr - 3.5Yr: HR=1.49 (1.12, 1.97),p=0.005 3.5Yr - 5Yr: HR=0.97 (0.65, 1.44),p=0.885 5Yr - 6.5Yr : HR=1.55 (1.11, 2.17),p=0.009 6.5Yr - 8Yr: HR=1.56 (1.08, 2.24),p=0.017 8Yr+: HR=2.60 (2.27, 2.99),p<0.001

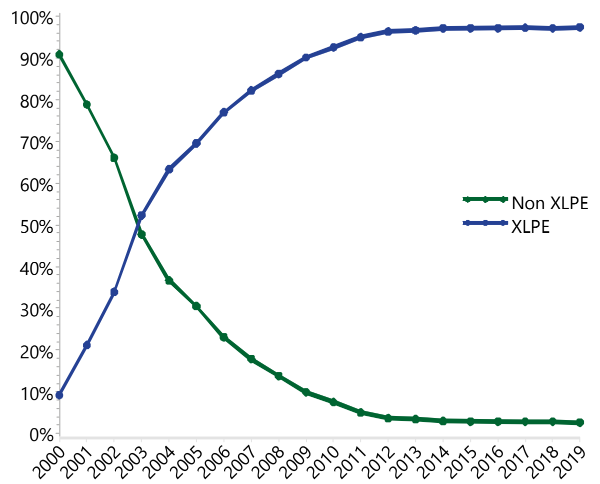
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Ceramic/Ceramic	94733	88235	75367	60540	25246	7687	225
Ceramic/Non XLPE	7986	7195	5872	4826	3185	1735	260
Ceramic/XLPE	91245	74042	47213	28315	7380	1247	14
Metal/Metal >32mm	14422	14061	13215	11982	8459	833	16
Metal/Metal ≤32mm	5155	5024	4841	4637	3725	1764	73
Metal/Non XLPE	35265	33907	31463	28682	19728	8838	680
Metal/XLPE	165762	150139	121668	93002	34353	6968	65
Ceramicised Metal/XLPE	25323	22256	17318	12883	4341	624	0

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

Cross-linked Polyethylene (XLPE)

XLPE has been used in 282,339 procedures reported to the Registry. This includes 20,735 procedures that have XLPE with the addition of an antioxidant. In 2019, when polyethylene was used as a bearing surface in primary total conventional hip procedures, the proportion of XLPE was 97.4% (Figure HT30).

Figure HT30 Primary Total Conventional Hip Replacement by Polyethylene Type (Primary Diagnosis OA)



XLPE has a lower rate of revision compared to non XLPE after 6 months (Table HT31 and Figure HT31). The difference increases with time and at 19 years the cumulative percent revision is 8.2% and 14.9%, respectively. The cumulative incidence of loosening, prosthesis dislocation and lysis at 19 years is 1.2%, 1.3% and 0.1% for XLPE, compared to 3.7%,1.8% and 0.8% for non XLPE bearings, respectively (Figure HT32).

Rates of revision vary depending on head size. This is most evident for non XLPE where the rate of revision increases with larger head sizes. For XLPE, 32mm head size has the lowest rate of revision. There is no difference between head sizes <32mm and >32mm (Figure HT33 and Figure HT34).

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 80.5% of XLPE procedures and in only 12.6% of non XLPE procedures. The Registry has previously shown that this increased use of larger head size with XLPE is the reason for reduced revision for dislocation (Figure HT35).

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 HT36).

At 19 years, the cumulative percent revision of total conventional hip replacement with XLPE is 8.2%.

Prosthesis Specific

Further analysis has been undertaken for specific acetabular prostheses that have both XLPE and non XLPE bearing options and at least 500 procedures in each group. Six prostheses fulfil these criteria. Five have a reduced rate of revision when XLPE is used and for one prosthesis there is no difference.

The Allofit Shell has a 17 year follow-up with an insert using both types of polyethylene. XLPE is used in 91.1% of Allofit Shell primary total conventional hip procedures. XLPE has a lower rate of revision than non XLPE (Table HT32 and Figure HT37).

The Duraloc Shell has a 17 year follow-up with an insert using both types of polyethylene. XLPE is used in 36.4% of Duraloc Shell primary total conventional hip procedures. XLPE has a lower rate of revision compared to non XLPE after 5 years (Table HT32 and Figure HT38).

The Mallory-Head Shell has a 10 year follow-up with an insert using both types of polyethylene. XLPE is used in 45.3% of Mallory-Head Shell primary total conventional hip procedures. XLPE has a lower rate of revision compared to non XLPE after 1.5 years (Table HT32 and Figure HT39).

The Reflection Cup has a 15 year follow-up for both types of polyethylene. XLPE has been used in 53.3% of Reflection Cup primary total conventional hip procedures. After 2 years, XLPE has a lower rate of revision than non XLPE (Table HT32 and Figure HT40).

The Reflection Shell has a 17 year follow-up with an insert using both types of polyethylene. XLPE is used in 84.0% of Reflection Shell primary total conventional hip procedures. XLPE has a lower rate of revision after 3 months compared to non XLPE (Table HT32 and Figure HT41).

The Vitalock Shell has a 15 year follow-up with an insert using both types of polyethylene. XLPE is used in 22.7% of Vitalock Shell primary total conventional hip procedures. There is no difference in the rate of revision between XLPE and non XLPE (Table HT32 and Figure HT42).

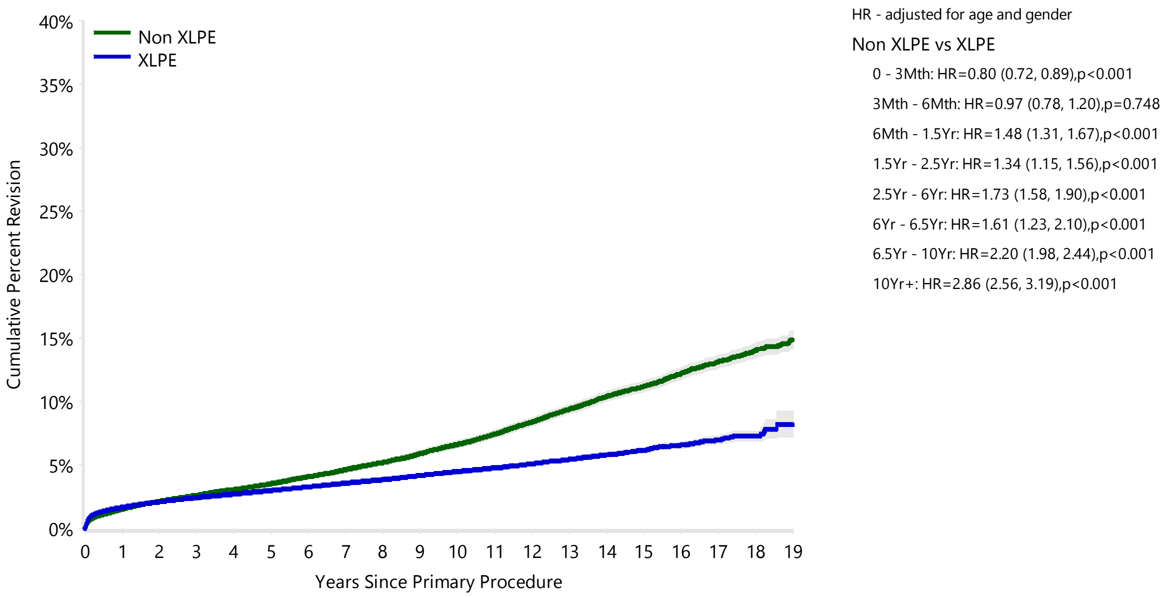
Prosthesis Specific (Antioxidant)

The Registry has performed a separate analysis of acetabular components that have both XLPE and XLPE with antioxidant. There has been a 30.9% increase in procedures using antioxidant compared to 2018. There were 3 components that had both types of polyethylene: the G7, Trinity, and Ringloc inserts. There was no difference when comparing the rate of revision between XLPE and XLPE with antioxidant within these prostheses (Table HT33).

Table HT31 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	19 Yrs
Non XLPE		**3453**	**43548**	**1.5 (1.4, 1.6)**	**2.6 (2.5, 2.8)**	**3.5 (3.4, 3.7)**	**6.6 (6.4, 6.9)**	**11.2 (10.8, 11.6)**	**14.9 (14.2, 15.6)**
	<32mm	3117	38051	1.5 (1.4, 1.6)	2.5 (2.4, 2.7)	3.5 (3.3, 3.7)	6.5 (6.3, 6.8)	11.1 (10.7, 11.5)	14.7 (14.1, 15.5)
	32mm	301	5154	1.7 (1.3, 2.0)	3.1 (2.6, 3.6)	3.8 (3.3, 4.4)	7.0 (6.1, 7.9)	11.5 (10.0, 13.3)	
	>32mm	35	343	3.6 (2.1, 6.2)	6.3 (4.1, 9.7)	8.7 (6.0, 12.6)	14.2 (9.8, 20.4)		
XLPE		**9000**	**282339**	**1.7 (1.6, 1.7)**	**2.4 (2.4, 2.5)**	**3.0 (2.9, 3.1)**	**4.5 (4.4, 4.6)**	**6.2 (6.0, 6.4)**	**8.2 (7.2, 9.2)**
	<32mm	2347	55181	1.6 (1.5, 1.7)	2.4 (2.3, 2.6)	3.1 (2.9, 3.2)	4.6 (4.4, 4.8)	6.2 (6.0, 6.5)	8.3 (7.3, 9.4)
	32mm	3450	119683	1.6 (1.6, 1.7)	2.4 (2.3, 2.5)	2.8 (2.7, 2.9)	4.1 (4.0, 4.3)	5.6 (5.2, 6.0)	
	>32mm	3203	107475	1.7 (1.7, 1.8)	2.5 (2.4, 2.6)	3.1 (3.0, 3.3)	4.9 (4.7, 5.1)	7.1 (6.4, 7.9)	
TOTAL		**12453**	**325887**						

Figure HT31 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Polyethylene Type (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Non XLPE	43548	41389	37604	33760	23089	10643	940
XLPE	282339	246437	186199	134200	46074	8839	79

Figure HT32 Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement by Polyethylene Type (Primary Diagnosis OA)

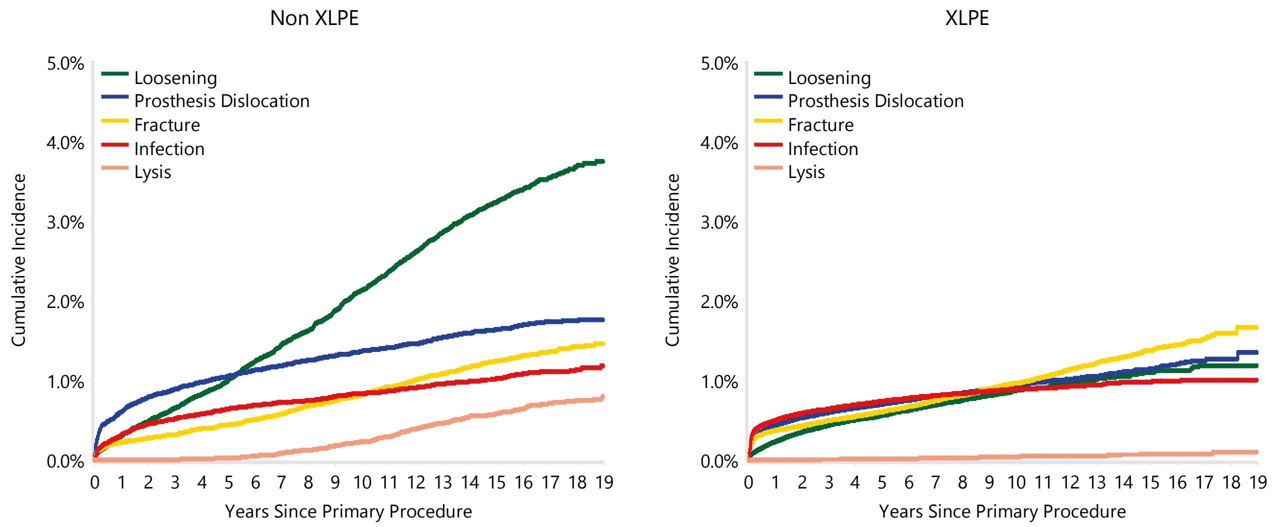
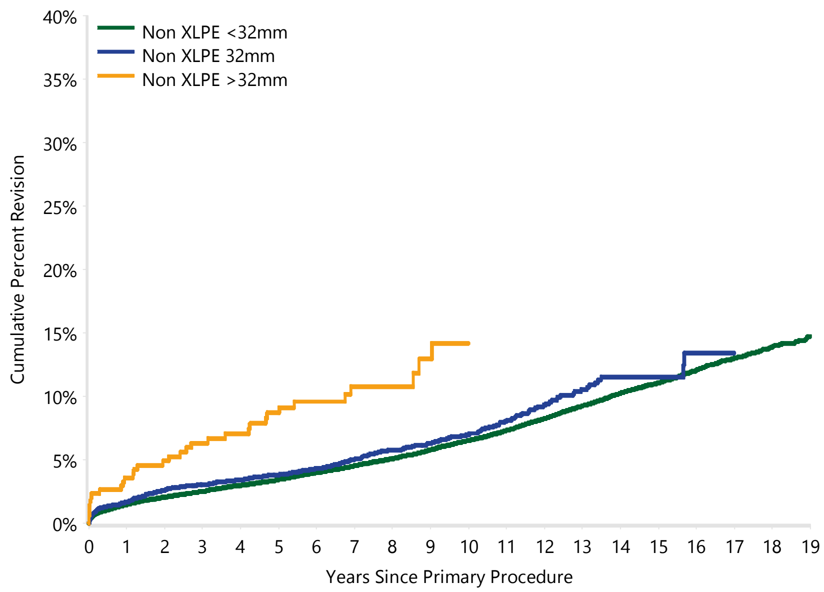


Figure HT33 Cumulative Percent Revision of Primary Total Conventional Hip Replacement using Non XLPE by Head Size (Primary Diagnosis OA)



HR - adjusted for age and gender

Non XLPE 32mm vs Non XLPE <32mm

Entire Period: HR=1.22 (1.08, 1.38),p=0.001

Non XLPE >32mm vs Non XLPE <32mm

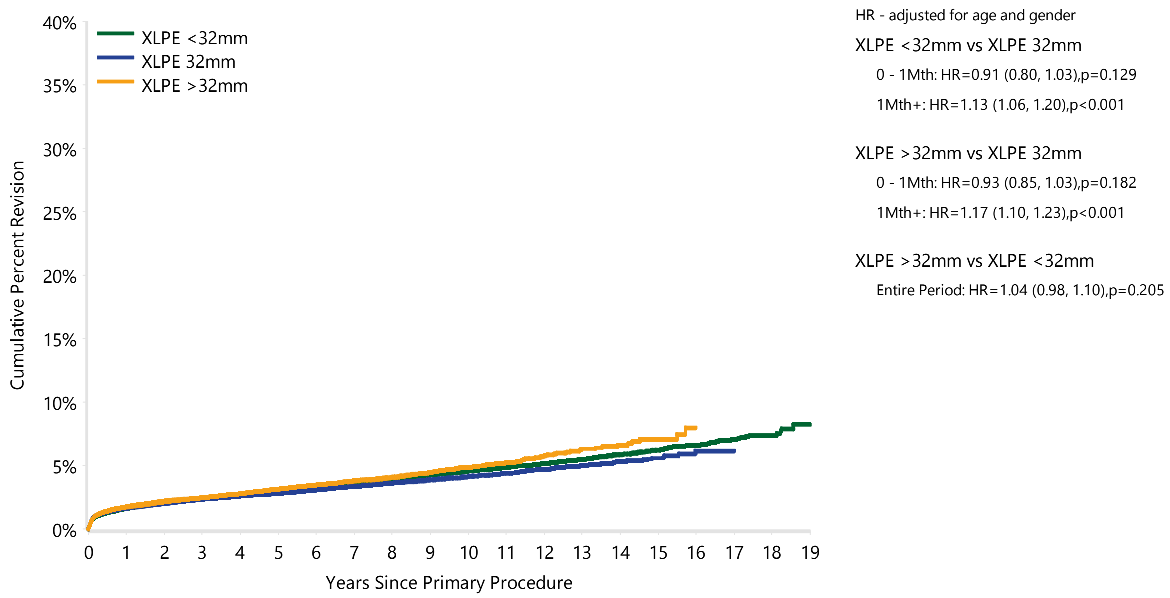
Entire Period: HR=2.37 (1.70, 3.31),p<0.001

Non XLPE >32mm vs Non XLPE 32mm

Entire Period: HR=1.94 (1.37, 2.75),p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Non XLPE	<32mm	38051	36289	33252	30163	21643	10482	939
	32mm	5154	4794	4096	3386	1399	158	1
	>32mm	343	306	256	211	47	3	0

Figure HT34 Cumulative Percent Revision of Primary Total Conventional Hip Replacement using XLPE by Head Size (Primary Diagnosis OA)



Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
XLPE	<32mm	55181	50736	44805	39177	22819	7382	78
	32mm	119683	105608	79012	54090	14334	1082	1
	>32mm	107475	90093	62382	40933	8921	375	0

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

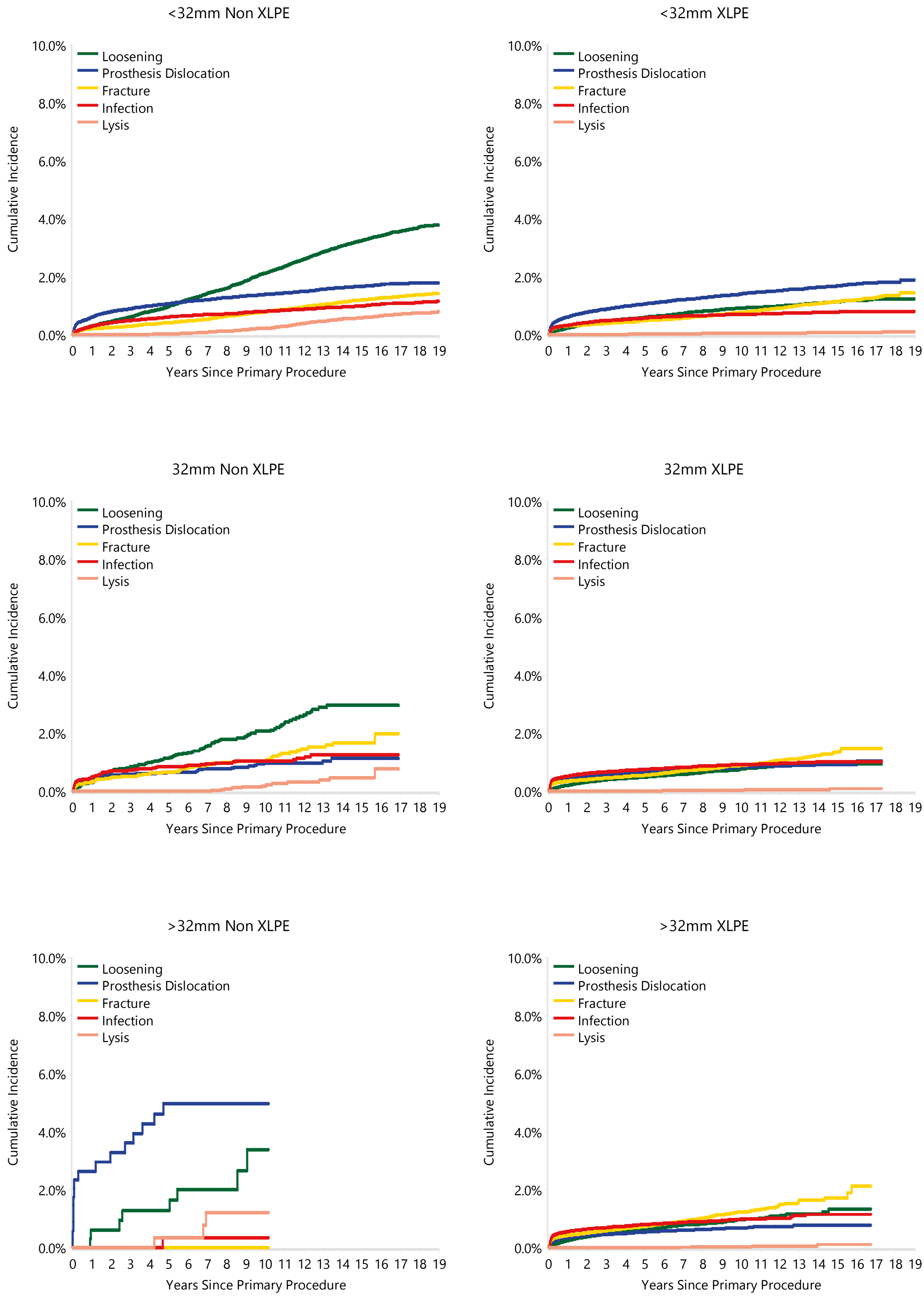
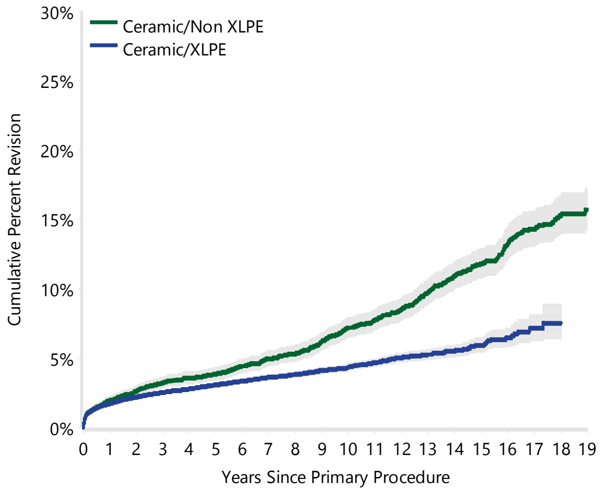
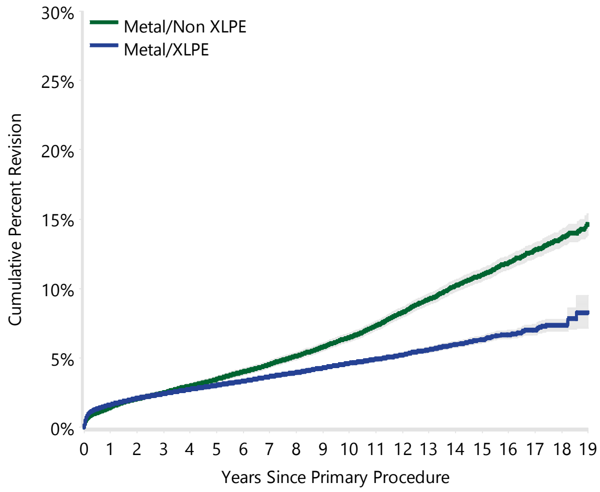


Figure HT36 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Head Surface and Polyethylene Type (Primary Diagnosis OA)





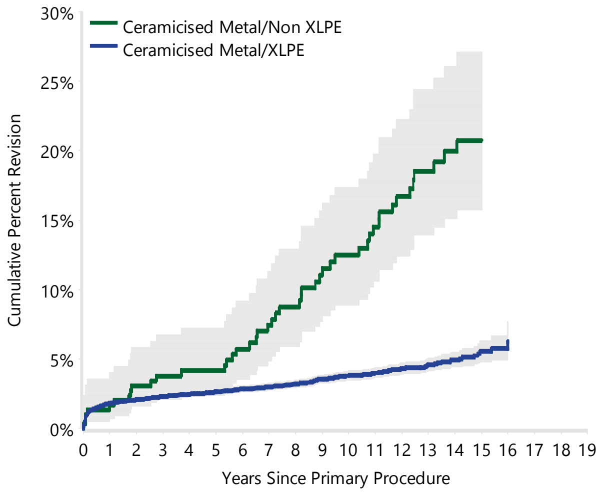
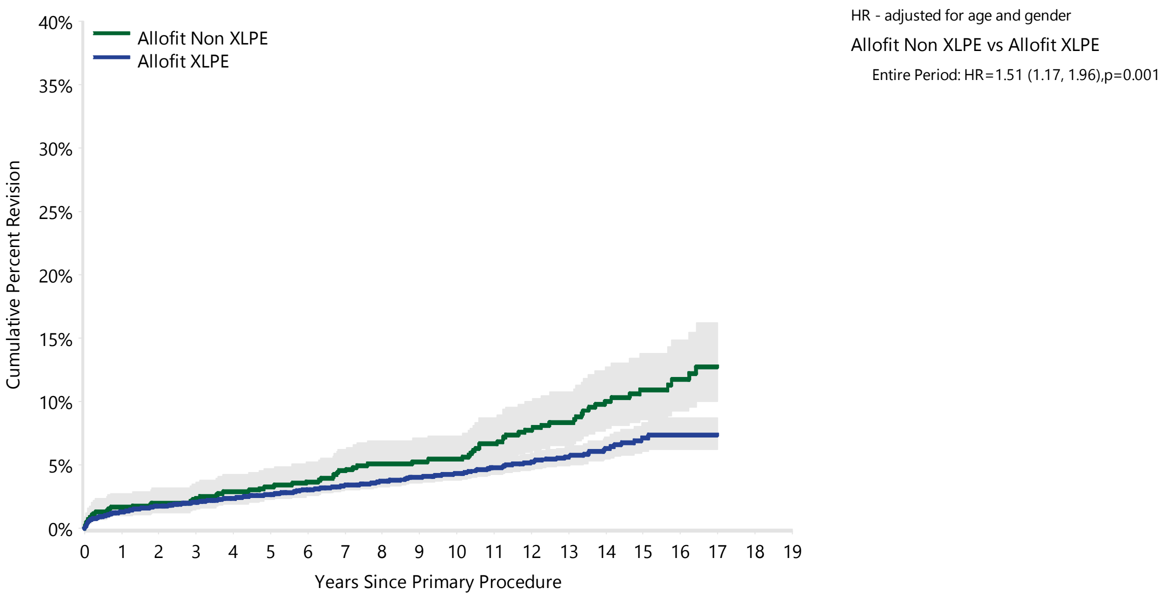


Table HT32 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Prosthesis Type and Polyethylene Type (Primary Diagnosis OA)

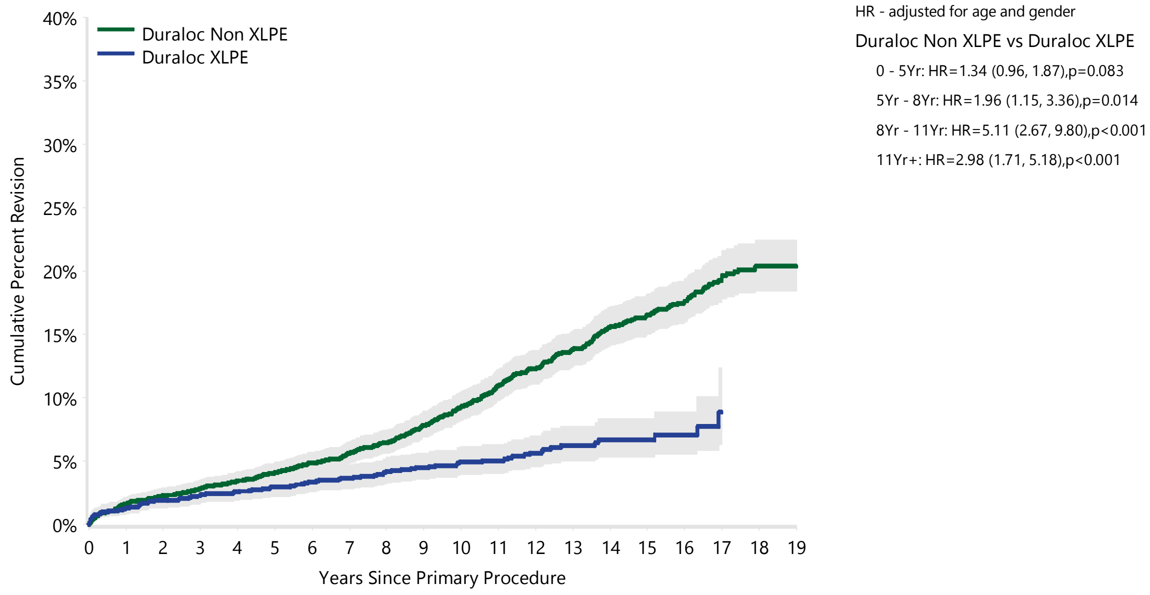
Prosthesis Type	Polyethylene Type	N Revised	N Total	5 Yrs	10 Yrs	12 Yrs	15 Yrs	17 Yrs
Allofit		**404**	**9548**	**2.7 (2.4, 3.1)**	**4.4 (4.0, 4.9)**	**5.6 (5.0, 6.3)**	**7.9 (6.9, 9.0)**	**8.9 (7.6, 10.4)**
	Non XLPE	73	848	3.3 (2.3, 4.7)	5.4 (4.0, 7.3)	7.8 (6.0, 10.0)	10.9 (8.6, 13.8)	12.7 (10.0, 16.2)
	XLPE	331	8700	2.7 (2.3, 3.0)	4.3 (3.8, 4.8)	5.2 (4.6, 5.9)	7.1 (6.1, 8.4)	7.4 (6.2, 8.7)
Duraloc		**499**	**4711**	**3.7 (3.2, 4.3)**	**7.8 (7.0, 8.6)**	**10.0 (9.1, 11.1)**	**13.6 (12.4, 14.9)**	**16.6 (15.1, 18.2)**
	Non XLPE	409	2995	4.1 (3.4, 4.9)	9.3 (8.2, 10.5)	12.3 (11.1, 13.7)	16.6 (15.0, 18.2)	19.6 (17.8, 21.6)
	XLPE	90	1716	3.0 (2.2, 3.9)	4.9 (3.9, 6.2)	5.6 (4.5, 7.0)	6.7 (5.3, 8.3)	8.8 (6.3, 12.4)
Mallory-Head		**371**	**7459**	**2.5 (2.2, 2.9)**	**4.2 (3.7, 4.7)**	**5.6 (5.0, 6.3)**	**7.8 (7.0, 8.8)**	**9.0 (7.9, 10.1)**
	Non XLPE	292	4084	2.8 (2.3, 3.3)	4.8 (4.2, 5.6)	6.3 (5.5, 7.2)	8.5 (7.5, 9.5)	9.6 (8.5, 10.8)
	XLPE	79	3375	2.2 (1.8, 2.8)	2.7 (2.1, 3.5)			
Reflection (Cup)		**208**	**2312**	**3.0 (2.3, 3.8)**	**7.9 (6.7, 9.4)**	**10.5 (9.0, 12.3)**	**17.3 (15.0, 20.0)**	**18.9 (16.2, 22.0)**
	Non XLPE	167	1079	3.4 (2.4, 4.7)	11.3 (9.3, 13.6)	15.4 (13.0, 18.2)	23.9 (20.6, 27.6)	25.5 (22.0, 29.5)
	XLPE	41	1233	2.6 (1.8, 3.7)	4.0 (2.8, 5.5)	4.0 (2.8, 5.5)	5.7 (3.9, 8.4)	
Reflection (Shell)		**741**	**14530**	**2.4 (2.2, 2.7)**	**4.4 (4.0, 4.8)**	**5.5 (5.1, 5.9)**	**7.5 (6.9, 8.2)**	**9.8 (8.9, 10.9)**
	Non XLPE	328	2322	4.3 (3.5, 5.2)	9.6 (8.4, 11.0)	13.0 (11.5, 14.6)	17.0 (15.2, 18.9)	20.6 (18.4, 22.9)
	XLPE	413	12208	2.1 (1.8, 2.3)	3.3 (3.0, 3.7)	3.8 (3.4, 4.2)	5.0 (4.4, 5.6)	6.0 (5.1, 7.1)
Vitalock		**310**	**4619**	**2.5 (2.1, 3.0)**	**4.6 (4.0, 5.3)**	**5.5 (4.9, 6.3)**	**7.3 (6.5, 8.2)**	**8.9 (7.9, 9.9)**
	Non XLPE	262	3569	2.6 (2.1, 3.1)	4.9 (4.2, 5.7)	5.8 (5.1, 6.7)	7.8 (6.9, 8.9)	9.4 (8.3, 10.6)
	XLPE	48	1050	2.4 (1.6, 3.5)	3.9 (2.8, 5.3)	4.4 (3.3, 6.0)	5.4 (4.0, 7.2)	
TOTAL		**2533**	**43179**					

Figure HT37 Cumulative Percent Revision of Allofit Primary Total Conventional Hip Replacement by Polyethylene Type (Primary Diagnosis OA)



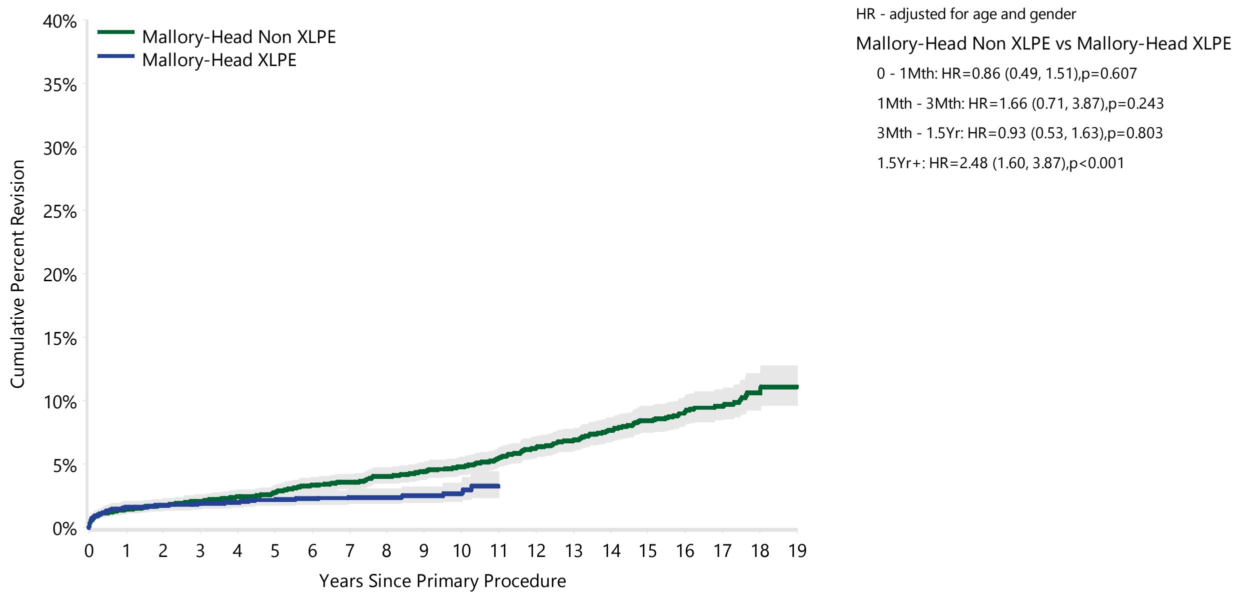
Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Allofit	Non XLPE	848	828	793	738	556	277	4
	XLPE	8700	8278	7349	6144	2747	438	0

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



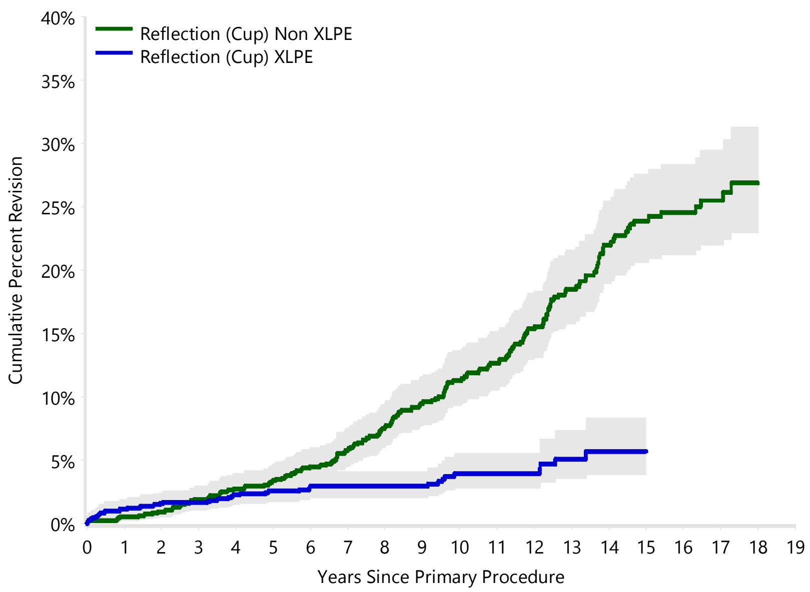
Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Duraloc	Non XLPE	2995	2915	2745	2569	1942	1112	72
	XLPE	1716	1668	1575	1461	1031	267	0

Figure HT39 Cumulative Percent Revision of Mallory-Head Primary Total Conventional Hip Replacement by Polyethylene Type (Primary Diagnosis OA)



Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Mallory-Head	Non XLPE	4084	3977	3814	3626	2930	1366	139
	XLPE	3375	3254	2801	2138	385	0	0

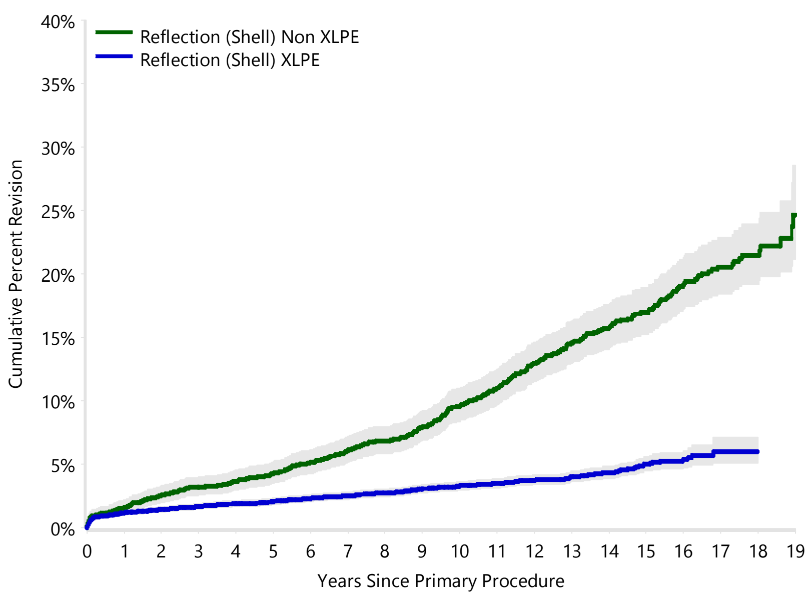
Figure HT40 Cumulative Percent Revision of Reflection (Cup) Primary Total Conventional Hip Replacement by Polyethylene Type (Primary Diagnosis OA)



HR - adjusted for age and gender
Reflection (Cup) Non XLPE vs
Reflection (Cup) XLPE
0 - 2Yr: HR=0.57 (0.27, 1.23),p=0.154
2Yr - 12.5Yr: HR=5.10 (3.18, 8.19),p<0.001
12.5Yr+: HR=6.15 (1.46, 25.84),p=0.013

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Reflection (Cup)	Non XLPE	1079	1052	975	894	612	242	16
	XLPE	1233	1171	1051	880	440	77	0

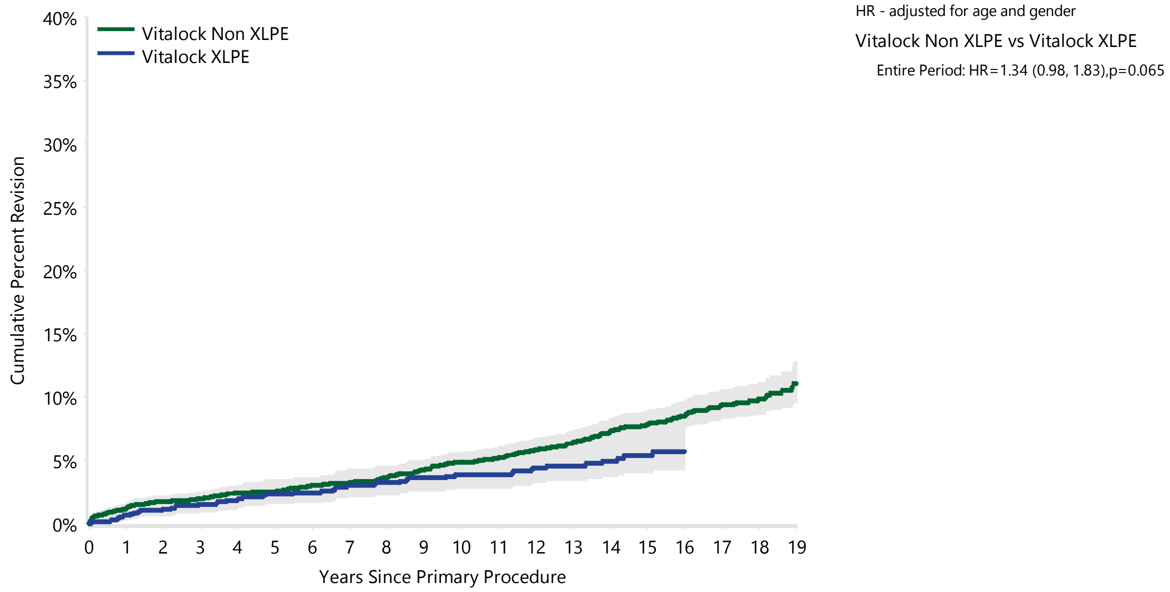
Figure HT41 Cumulative Percent Revision of Reflection (Shell) Primary Total Conventional Hip Replacement by Polyethylene Type (Primary Diagnosis OA)



HR - adjusted for age and gender
Reflection (Shell) Non XLPE vs
Reflection (Shell) XLPE
0 - 1Mth: HR=1.53 (0.92, 2.55),p=0.103
1Mth - 3Mth: HR=0.54 (0.19, 1.52),p=0.246
3Mth - 6.5Yr: HR=2.91 (2.27, 3.72),p<0.001
6.5Yr - 12Yr: HR=6.04 (4.61, 7.91),p<0.001
12Yr+: HR=4.72 (3.19, 6.99),p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Reflection (Shell)	Non XLPE	2322	2242	2116	1964	1471	772	73
	XLPE	12208	11817	11137	10131	6426	1436	5

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



Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Vitalock	Non XLPE	3569	3478	3333	3163	2559	1787	274
	XLPE	1050	1032	985	936	731	311	0

Table HT33 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	1 Yr	2 Yrs	3 Yrs	4 Yrs	6 Yrs	9 Yrs
G7		**73**	**3974**	**1.7 (1.3, 2.1)**	**2.0 (1.5, 2.5)**	**2.2 (1.7, 2.8)**	**2.2 (1.7, 2.8)**		
	XLPE	6	238	0.8 (0.2, 3.3)	2.1 (0.9, 5.1)	2.6 (1.2, 5.8)	2.6 (1.2, 5.8)		
	XLPE + Antioxidant	67	3736	1.7 (1.3, 2.2)	1.9 (1.5, 2.4)	2.1 (1.7, 2.8)	2.1 (1.7, 2.8)		
Ringloc		**153**	**6106**	**1.6 (1.3, 1.9)**	**1.8 (1.5, 2.2)**	**2.0 (1.7, 2.4)**	**2.2 (1.8, 2.6)**	**2.4 (2.0, 2.8)**	**3.0 (2.5, 3.6)**
	XLPE	78	3239	1.4 (1.0, 1.8)	1.6 (1.3, 2.2)	1.7 (1.3, 2.3)	1.9 (1.5, 2.4)	2.1 (1.7, 2.7)	2.7 (2.1, 3.4)
	XLPE + Antioxidant	75	2867	1.8 (1.4, 2.4)	2.0 (1.6, 2.6)	2.3 (1.8, 2.9)	2.5 (2.0, 3.2)	2.7 (2.1, 3.3)	3.4 (2.5, 4.8)
Trinity		**194**	**10577**	**1.6 (1.3, 1.8)**	**2.0 (1.7, 2.3)**	**2.3 (2.0, 2.7)**	**2.4 (2.1, 2.9)**	**2.8 (2.3, 3.4)**	
	XLPE	33	1574	1.3 (0.8, 2.0)	1.7 (1.1, 2.5)	2.2 (1.5, 3.2)	2.6 (1.8, 3.8)	3.2 (2.0, 5.2)	
	XLPE + Antioxidant	161	9003	1.6 (1.4, 1.9)	2.0 (1.7, 2.4)	2.4 (2.0, 2.8)	2.4 (2.0, 2.8)	2.6 (2.1, 3.1)	
TOTAL		**420**	**20657**						

Ceramic/Ceramic Bearings

Ceramic/ceramic bearings have been used in 94,733 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 2019, mixed ceramic accounted for 98.9% of all procedures with a ceramic/ceramic bearing surface (Figure HT43).

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. 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 HT34 and Figure HT44).

At 1 year, the cumulative incidence of dislocation is 1.6% for head sizes ≤28mm compared to 0.4% for 32mm, 0.3% for 36-38mm, and 0.2% for head sizes ≥40mm (Figure HT45).

Figure HT43 Primary Total Conventional Hip Replacement with Ceramic Femoral Heads by Ceramic Type (Primary Diagnosis OA)

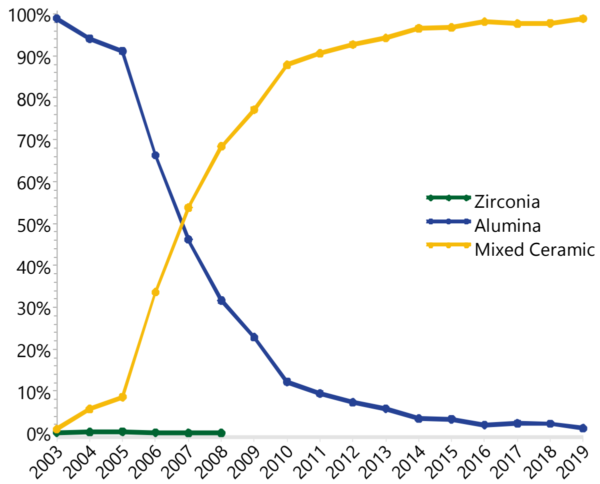
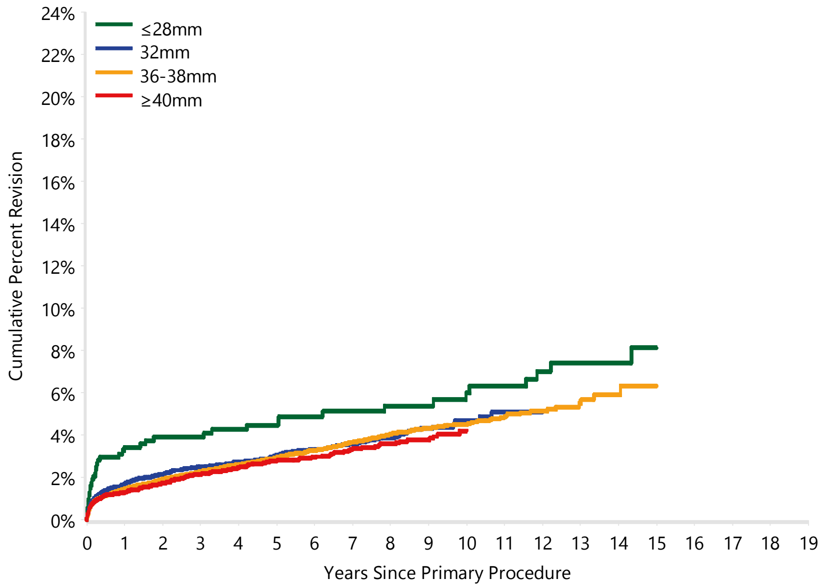


Table HT34 Cumulative Percent Revision of Mixed Ceramic/Mixed Ceramic Primary Total Conventional Hip Replacement by Head Size (Primary Diagnosis OA)

Head Size	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
≤28mm	41	685	3.4 (2.3, 5.1)	3.9 (2.7, 5.7)	4.5 (3.1, 6.4)	6.0 (4.3, 8.4)	8.1 (5.8, 11.4)	
32mm	352	11223	1.7 (1.5, 2.0)	2.5 (2.2, 2.8)	3.0 (2.7, 3.4)	4.7 (4.1, 5.4)		
36-38mm	1339	43519	1.5 (1.3, 1.6)	2.3 (2.2, 2.5)	2.9 (2.8, 3.1)	4.5 (4.2, 4.8)	6.3 (5.3, 7.6)	
≥40mm	216	7214	1.3 (1.1, 1.6)	2.2 (1.8, 2.5)	2.8 (2.4, 3.2)	4.2 (3.6, 5.0)		
TOTAL	**1948**	**62641**						

Figure HT44 Cumulative Percent Revision of Mixed Ceramic/Mixed Ceramic Primary Total Conventional Hip Replacement by Head Size (Primary Diagnosis OA)



HR - adjusted for age and gender

≤28mm vs 32mm

Entire Period: HR=1.39 (1.00, 1.94),p=0.049

36-38mm vs 32mm

Entire Period: HR=0.95 (0.84, 1.08),p=0.420

≥40mm vs 32mm

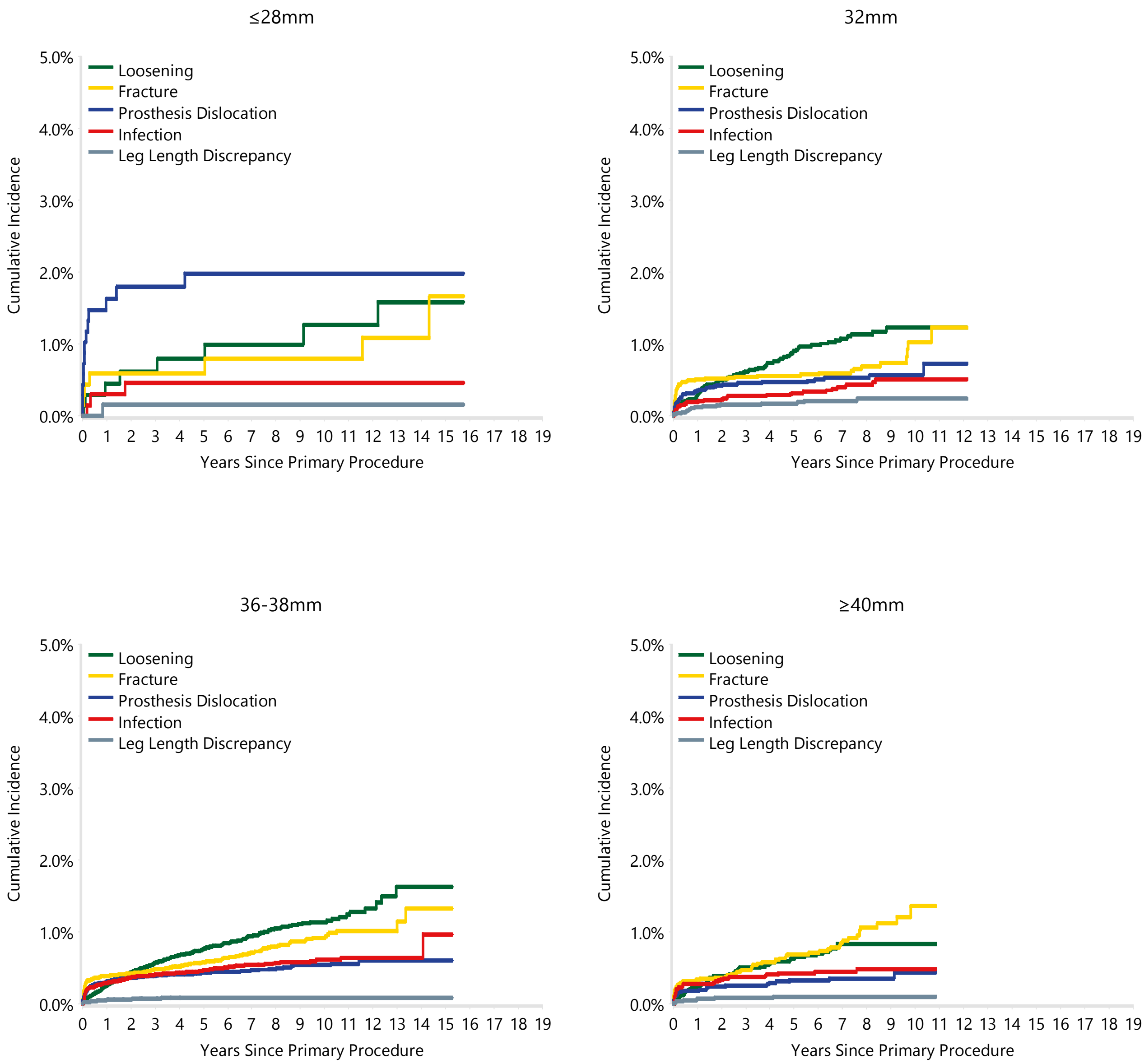
Entire Period: HR=0.86 (0.72, 1.03),p=0.103

36-38mm vs ≥40mm

Entire Period: HR=1.10 (0.95, 1.27),p=0.187

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
≤28mm	685	611	535	460	296	98	0
32mm	11223	10148	8065	5767	719	0	0
36-38mm	43519	39606	31411	22127	4126	61	0
≥40mm	7214	6710	5792	4695	449	0	0

Figure HT45 Cumulative Incidence Revision Diagnosis of Mixed Ceramic/Mixed Ceramic Primary Total Conventional Hip Replacement by Head Size (Primary Diagnosis OA)



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 2,166 procedures using constrained acetabular prostheses for primary total conventional hip replacement. Of these, 911 procedures were constrained acetabular inserts and 1,255 procedures were constrained cups. There were 86 procedures reported in 2019. This is an increase of 14.7% compared to 2018.

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 HT35).

When all diagnoses are included, constrained acetabular prostheses have a higher rate of revision compared to other acetabular prostheses (Table HT36 and Figure HT46). When only those procedures with a diagnosis of osteoarthritis are included, there is no difference (Table HT37 and Figure HT47).

Gender is not a risk factor for revision (Table HT38 and Figure HT48). However, there is a difference in outcome with respect to age. Constrained prostheses have a higher rate of revision if they are used in patients aged <70 years (Table HT39 and Figure HT49).

There is no difference in the rate of revision with regards to acetabular fixation of constrained prostheses (Table HT40 and Figure HT50). There is no difference in the rate of revision with respect to acetabular fixation when used with cemented femoral fixation (Table HT41 and Figure HT51). There are not enough constrained prostheses with cementless femoral fixation to make a comparison with respect to acetabular fixation.

Table HT35 Primary Total Conventional Hip Replacement by Primary Diagnosis and Acetabular Type

	Constrained Prosthesis		Other Acetabular Prosthesis	
Primary Diagnosis	N	Col%	N	Col%
Osteoarthritis	836	38.6	420305	88.5
Fractured Neck Of Femur	756	34.9	22092	4.6
Osteonecrosis	82	3.8	15226	3.2
Developmental Dysplasia	27	1.2	6034	1.3
Rheumatoid Arthritis	23	1.1	4309	0.9
Tumour	251	11.6	2424	0.5
Failed Internal Fixation	135	6.2	1916	0.4
Other Inflammatory Arthritis	6	0.3	2001	0.4
Fracture/Dislocation	37	1.7	564	0.1
Arthrodesis Takedown	10	0.5	119	0.0
Other	3	0.1	168	0.0
TOTAL	**2166**	**100.0**	**475158**	**100.0**

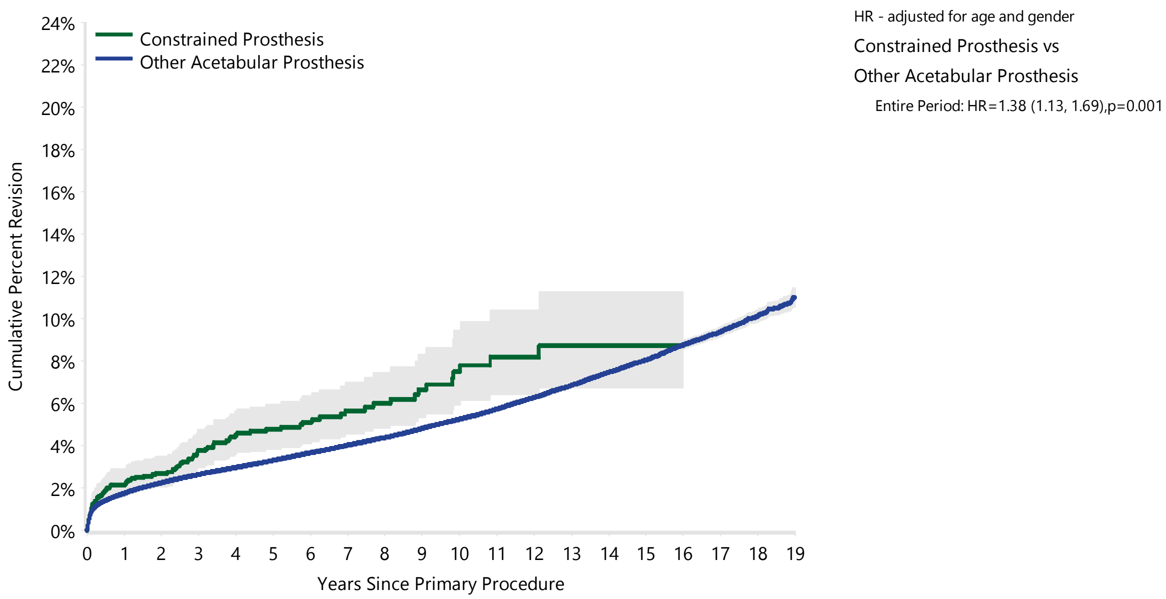
Note: All procedures using metal/metal prostheses have been excluded

Table HT36 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	19 Yrs
Constrained Prosthesis	98	2166	2.2 (1.6, 2.9)	3.8 (3.0, 4.8)	4.8 (3.8, 6.0)	7.5 (5.9, 9.5)	8.7 (6.7, 11.3)	
Other Acetabular Prosthesis	19251	475158	1.8 (1.7, 1.8)	2.6 (2.6, 2.7)	3.3 (3.3, 3.4)	5.3 (5.2, 5.3)	8.1 (7.9, 8.2)	11.0 (10.6, 11.5)
TOTAL	**19349**	**477324**						

Note: All procedures using metal/metal prostheses have been excluded

Figure HT46 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Acetabular Type (All Diagnoses)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Constrained Prosthesis	2166	1749	1274	936	296	70	2
Other Acetabular Prosthesis	475158	421435	332577	252688	104035	30173	1418

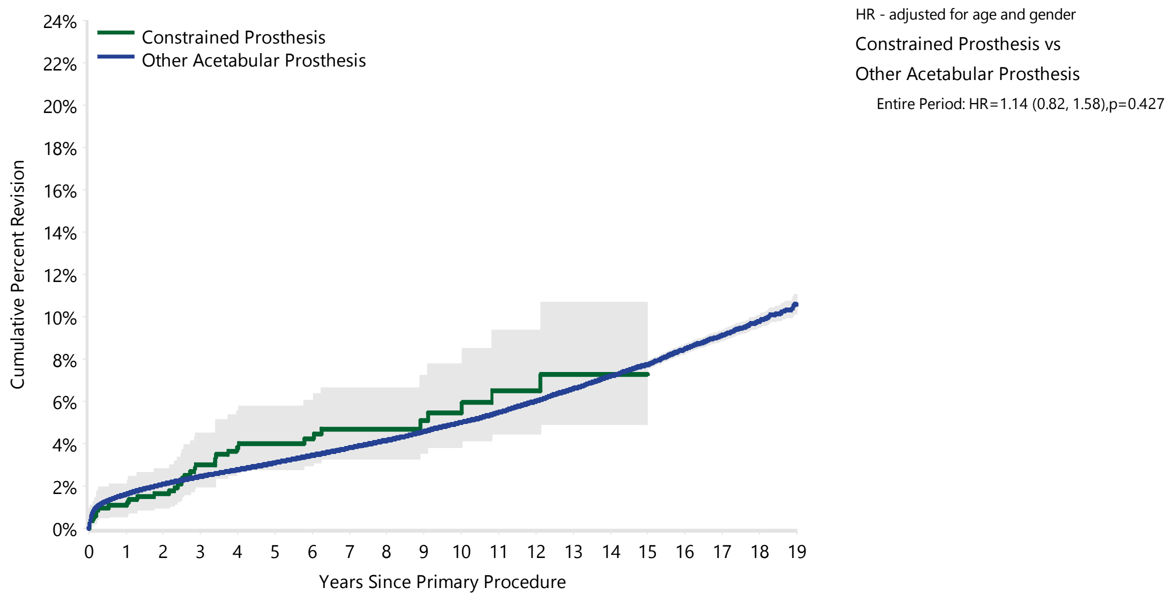
Note: All procedures using metal/metal prostheses have been excluded

Table HT37 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	19 Yrs
Constrained Prosthesis	36	836	1.1 (0.6, 2.1)	3.0 (2.0, 4.5)	4.0 (2.8, 5.8)	5.5 (3.8, 7.8)	7.3 (4.9, 10.7)	
Other Acetabular Prosthesis	16333	420305	1.6 (1.6, 1.7)	2.5 (2.4, 2.5)	3.1 (3.0, 3.2)	5.0 (4.9, 5.1)	7.8 (7.6, 7.9)	10.6 (10.1, 11.0)
TOTAL	**16369**	**421141**						

Note: All procedures using metal/metal prostheses have been excluded

Figure HT47 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	19 Yrs
Constrained Prosthesis	836	758	615	480	199	55	1
Other Acetabular Prosthesis	420305	375804	299028	228467	94462	27147	1244

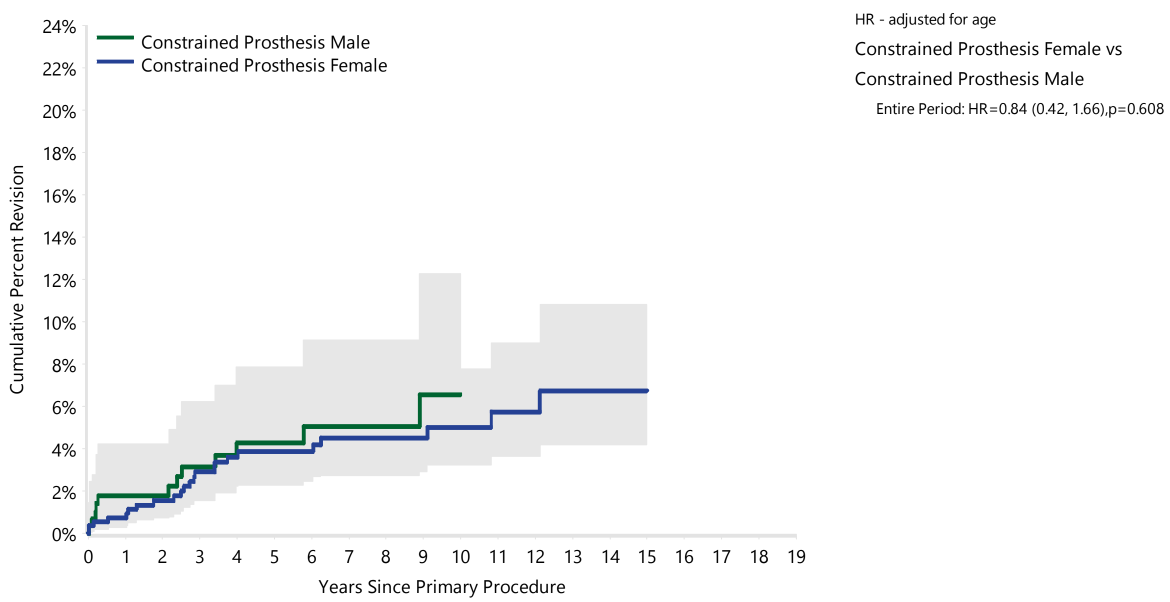
Note: All procedures using metal/metal prostheses have been excluded

Table HT38 Cumulative Percent Revision of Constrained Primary Total Conventional Hip Replacement by Gender (Primary Diagnosis OA)

Acetabular Type	Gender	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Constrained Prosthesis	Male	13	287	1.8 (0.7, 4.2)	3.1 (1.6, 6.2)	4.3 (2.3, 7.9)	6.6 (3.4, 12.3)		
	Female	23	549	0.7 (0.3, 2.0)	2.9 (1.7, 4.9)	3.9 (2.4, 6.1)	5.0 (3.2, 7.8)	6.8 (4.2, 10.8)	
TOTAL		**36**	**836**						

Note: All procedures using metal/metal prostheses have been excluded

Figure HT48 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	10 Yrs	15 Yrs	19 Yrs
Constrained Prosthesis	Male	287	256	189	139	47	11	0
	Female	549	502	426	341	152	44	1

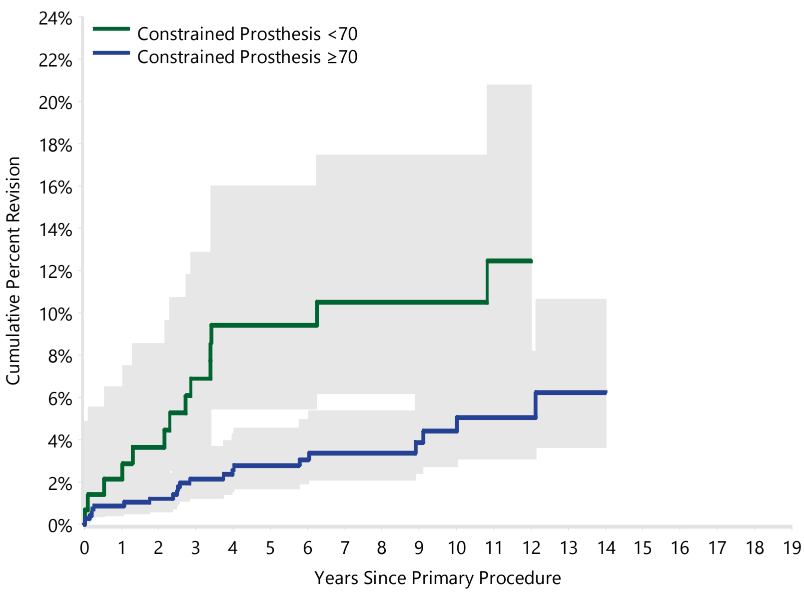
Note: All procedures using metal/metal prostheses have been excluded

Table HT39 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	19 Yrs
Constrained Prosthesis	<70	14	142	2.1 (0.7, 6.5)	6.9 (3.6, 12.9)	9.4 (5.5, 16.0)	10.5 (6.2, 17.5)		
	≥70	22	694	0.9 (0.4, 2.0)	2.1 (1.2, 3.7)	2.8 (1.7, 4.6)	4.4 (2.7, 7.1)		
TOTAL		**36**	**836**						

Note: All procedures using metal/metal prostheses have been excluded

Figure HT49 Cumulative Percent Revision of Constrained Primary Total Conventional Hip Replacement by Age (Primary Diagnosis OA)



HR - adjusted for gender
Constrained Prosthesis ≥70 vs
Constrained Prosthesis <70
Entire Period: HR=0.38 (0.19, 0.74),p=0.004

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Constrained Prosthesis	<70	142	131	112	95	54	20	0
	≥70	694	627	503	385	145	35	1

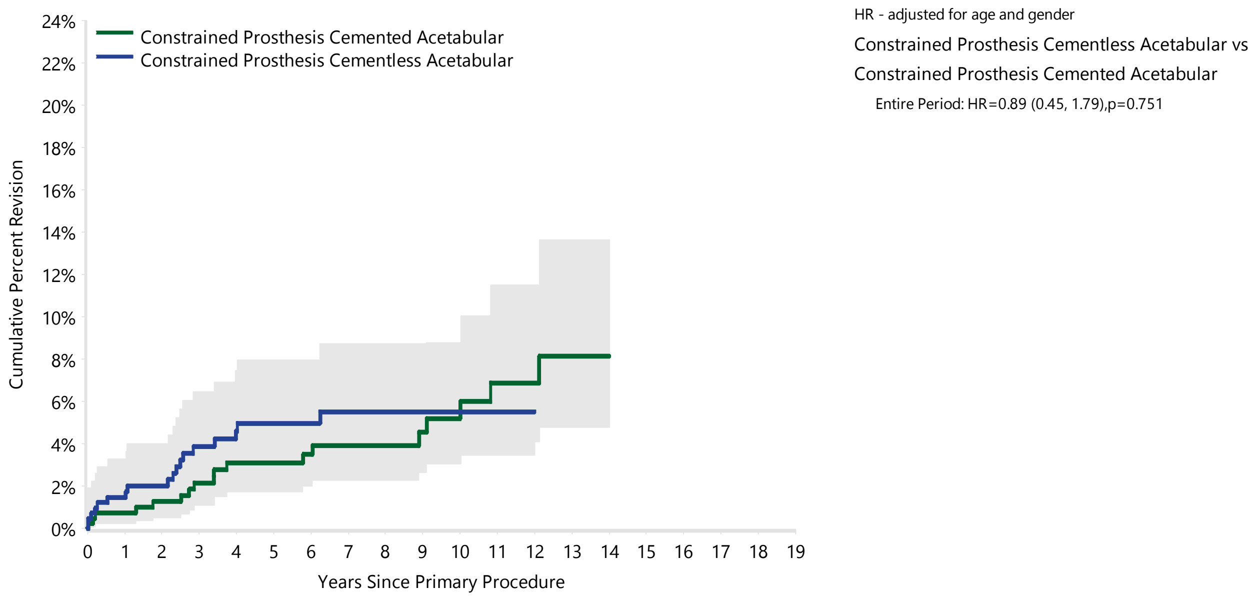
Note: All procedures using metal/metal prostheses have been excluded

Table HT40 Cumulative Percent Revision of Constrained Primary Total Conventional Hip Replacement by Acetabular Fixation (Primary Diagnosis OA)

Acetabular Type	Acetabular Fixation	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Constrained Prosthesis	Cementless	18	417	1.5 (0.7, 3.3)	3.9 (2.3, 6.5)	5.0 (3.1, 7.9)	5.5 (3.5, 8.7)		
	Cemented	18	419	0.7 (0.2, 2.2)	2.2 (1.1, 4.3)	3.1 (1.7, 5.5)	5.2 (3.1, 8.8)		
TOTAL		**36**	**836**						

Note: All procedures using metal/metal prostheses have been excluded

Figure HT50 Cumulative Percent Revision of Constrained Primary Total Conventional Hip Replacement by Acetabular Fixation (Primary Diagnosis OA)



Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Constrained Prosthesis	Cemented Acetabular	419	387	325	269	120	34	0
	Cementless Acetabular	417	371	290	211	79	21	1

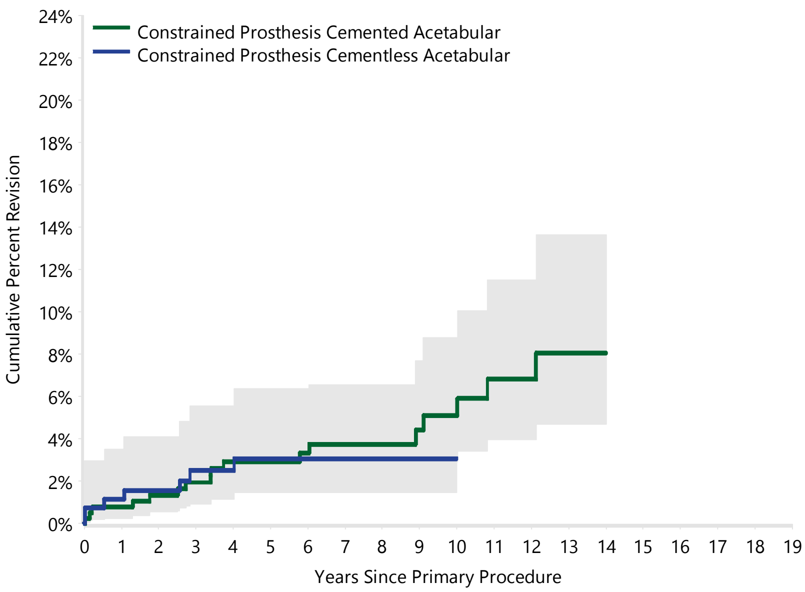
Note: All procedures using metal/metal prostheses have been excluded

Table HT41 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	19 Yrs
Constrained Prosthesis	Cementless	7	268	1.1 (0.4, 3.5)	2.5 (1.1, 5.5)	3.1 (1.5, 6.4)	3.1 (1.5, 6.4)		
	Cemented	17	400	0.8 (0.2, 2.3)	1.9 (0.9, 4.0)	2.9 (1.6, 5.4)	5.1 (2.9, 8.8)		
TOTAL		**24**	**668**						

Note: All procedures using metal/metal prostheses have been excluded

Figure HT51 Cumulative Percent Revision of Constrained Primary Total Conventional Hip Replacement with Cemented Femoral Fixation by Acetabular Fixation (Primary Diagnosis OA)



HR - adjusted for age and gender

Constrained Prosthesis Cementless Acetabular vs Constrained Prosthesis Cemented Acetabular

Entire Period: HR=0.58 (0.23, 1.44),p=0.240

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Constrained Prosthesis	Cemented Acetabular	400	370	314	261	118	34	0
	Cementless Acetabular	268	240	200	150	57	17	1

Note: All procedures using metal/metal prostheses have been excluded

Dual Mobility Acetabular Prostheses

Dual mobility prostheses have a femoral head which moves within a polyethylene component, which also moves within a fixed acetabular shell.

There have been 11,843 primary total conventional hip replacement procedures using dual mobility prostheses. 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 HT42).

When all diagnoses are included, dual mobility prostheses have a higher rate of revision compared to other acetabular prostheses (Table HT43 and Figure HT52).

For the diagnosis of osteoarthritis, there is no difference in the rate of revision when dual mobility prostheses are used (Table HT44 and Figure HT53).

Gender is not a risk factor for revision of dual mobility prostheses (Table HT45 and Figure HT54). However, patients <70 years have a higher rate of revision after 3 months (Table HT46 and Figure HT55).

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 HT47 and Figure HT56). There are not enough dual mobility prostheses with a cemented acetabular component recorded to perform a comparative analysis with regards to type of femoral fixation.

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

	Dual Mobility Prosthesis		Other Acetabular Prosthesis	
Primary Diagnosis	N	Col%	N	Col%
Osteoarthritis	7945	67.1	413196	88.8
Fractured Neck Of Femur	2457	20.7	20391	4.4
Osteonecrosis	461	3.9	14847	3.2
Developmental Dysplasia	220	1.9	5841	1.3
Rheumatoid Arthritis	67	0.6	4265	0.9
Tumour	331	2.8	2344	0.5
Failed Internal Fixation	210	1.8	1841	0.4
Other Inflammatory Arthritis	56	0.5	1951	0.4
Fracture/Dislocation	70	0.6	531	0.1
Arthrodesis Takedown	12	0.1	117	0.0
Other	14	0.1	157	0.0
TOTAL	**11843**	**100.0**	**465481**	**100.0**

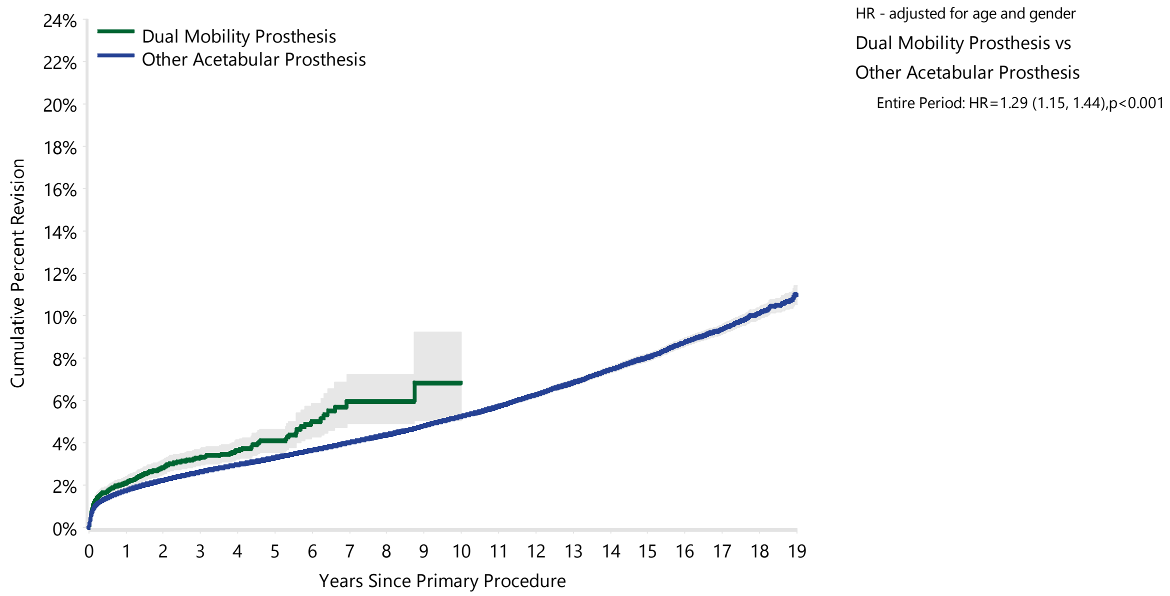
Note: All procedures using metal/metal prostheses have been excluded

Table HT43 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	19 Yrs
Dual Mobility Prosthesis	329	11843	2.1 (1.9, 2.4)	3.3 (2.9, 3.7)	4.1 (3.6, 4.7)	6.8 (5.1, 9.2)		
Other Acetabular Prosthesis	19020	465481	1.7 (1.7, 1.8)	2.6 (2.6, 2.7)	3.3 (3.2, 3.4)	5.2 (5.2, 5.3)	8.0 (7.9, 8.2)	11.0 (10.6, 11.4)
TOTAL	**19349**	**477324**						

Note: All procedures using metal/metal prostheses have been excluded

Figure HT52 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	19 Yrs
Dual Mobility Prosthesis	11843	7711	3340	1256	64	0	0
Other Acetabular Prosthesis	465481	415473	330511	252368	104267	30243	1420

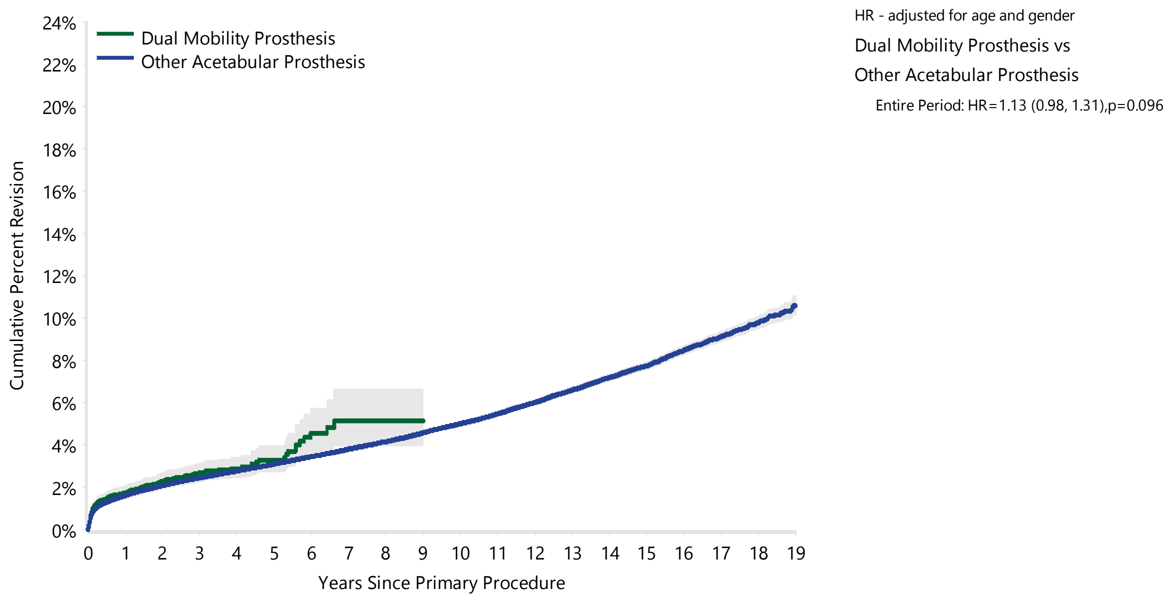
Note: All procedures using metal/metal prostheses have been excluded

Table HT44 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	19 Yrs
Dual Mobility Prosthesis	182	7945	1.7 (1.5, 2.1)	2.7 (2.3, 3.2)	3.3 (2.8, 4.0)			
Other Acetabular Prosthesis	16187	413196	1.6 (1.6, 1.7)	2.5 (2.4, 2.5)	3.1 (3.0, 3.2)	5.0 (4.9, 5.1)	7.7 (7.6, 7.9)	10.6 (10.1, 11.0)
TOTAL	**16369**	**421141**						

Note: All procedures using metal/metal prostheses have been excluded

Figure HT53 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	19 Yrs
Dual Mobility Prosthesis	7945	5181	2249	849	33	0	0
Other Acetabular Prosthesis	413196	371381	297394	228098	94628	27202	1245

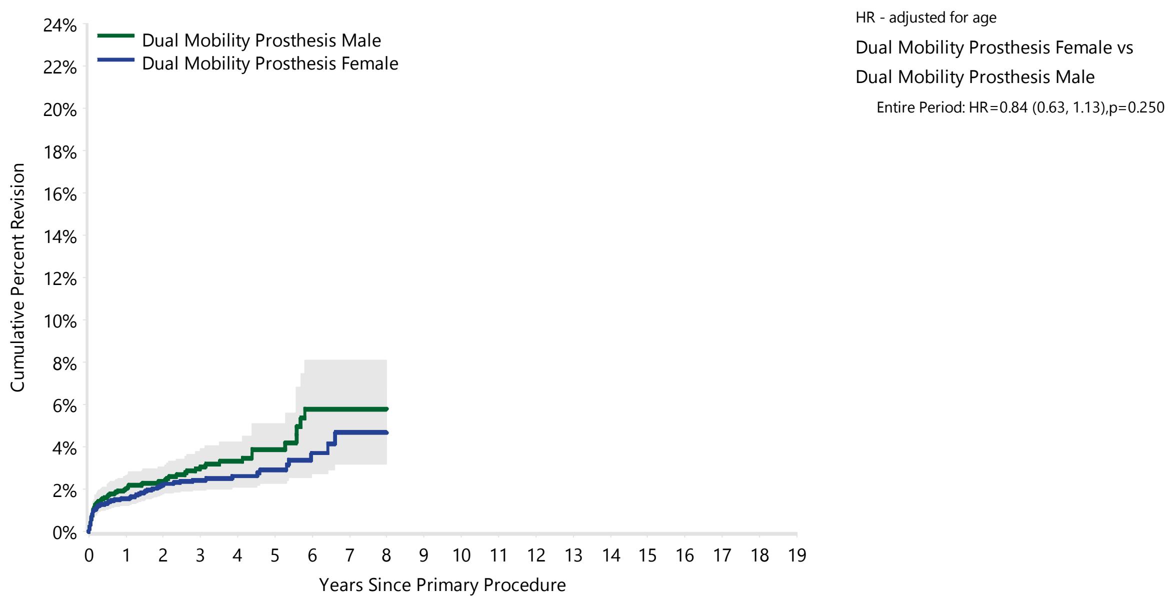
Note: All procedures using metal/metal prostheses have been excluded

Table HT45 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	19 Yrs
Dual Mobility Prosthesis	Male	80	3013	2.0 (1.6, 2.6)	3.1 (2.4, 3.9)	3.9 (3.0, 5.1)			
	Female	102	4932	1.6 (1.2, 2.0)	2.4 (2.0, 3.0)	2.9 (2.3, 3.7)			
TOTAL		**182**	**7945**						

Note: All procedures using metal/metal prostheses have been excluded

Figure HT54 Cumulative Percent Revision of Dual Mobility Primary Total Conventional Hip Replacement by Gender (Primary Diagnosis OA)



Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Dual Mobility Prosthesis	Male	3013	1973	913	353	5	0	0
	Female	4932	3208	1336	496	28	0	0

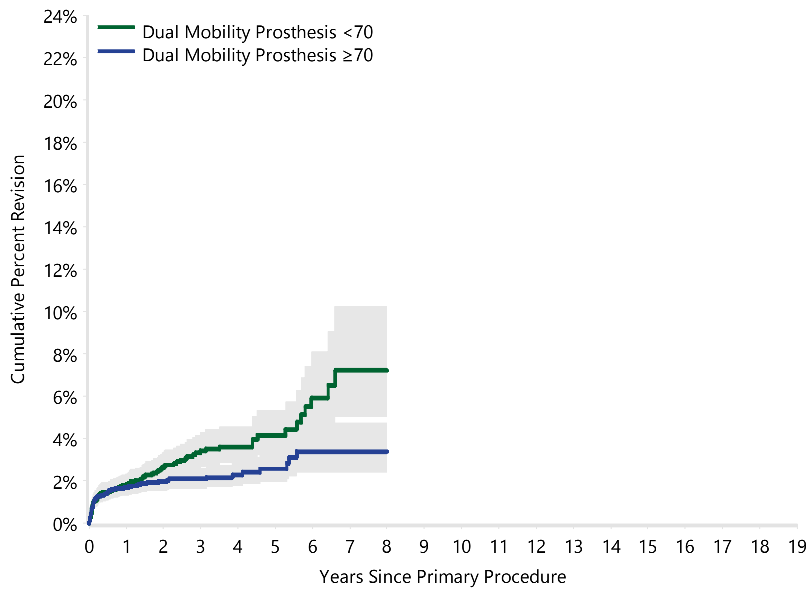
Note: All procedures using metal/metal prostheses have been excluded

Table HT46 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	19 Yrs
Dual Mobility Prosthesis	<70	95	3423	1.8 (1.4, 2.3)	3.4 (2.7, 4.3)	4.2 (3.2, 5.3)			
	≥70	87	4522	1.7 (1.3, 2.1)	2.1 (1.7, 2.6)	2.6 (2.0, 3.4)			
TOTAL		**182**	**7945**						

Note: All procedures using metal/metal prostheses have been excluded

Figure HT55 Cumulative Percent Revision of Dual Mobility Primary Total Conventional Hip Replacement by Age (Primary Diagnosis OA)



HR - adjusted for gender
Dual Mobility Prosthesis ≥70 vs
Dual Mobility Prosthesis <70
0 - 3Mth: HR=1.05 (0.70, 1.56),p=0.815
3Mth+: HR=0.47 (0.30, 0.74),p=0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Dual Mobility Prosthesis	<70	3423	2313	1034	398	12	0	0
	≥70	4522	2868	1215	451	21	0	0

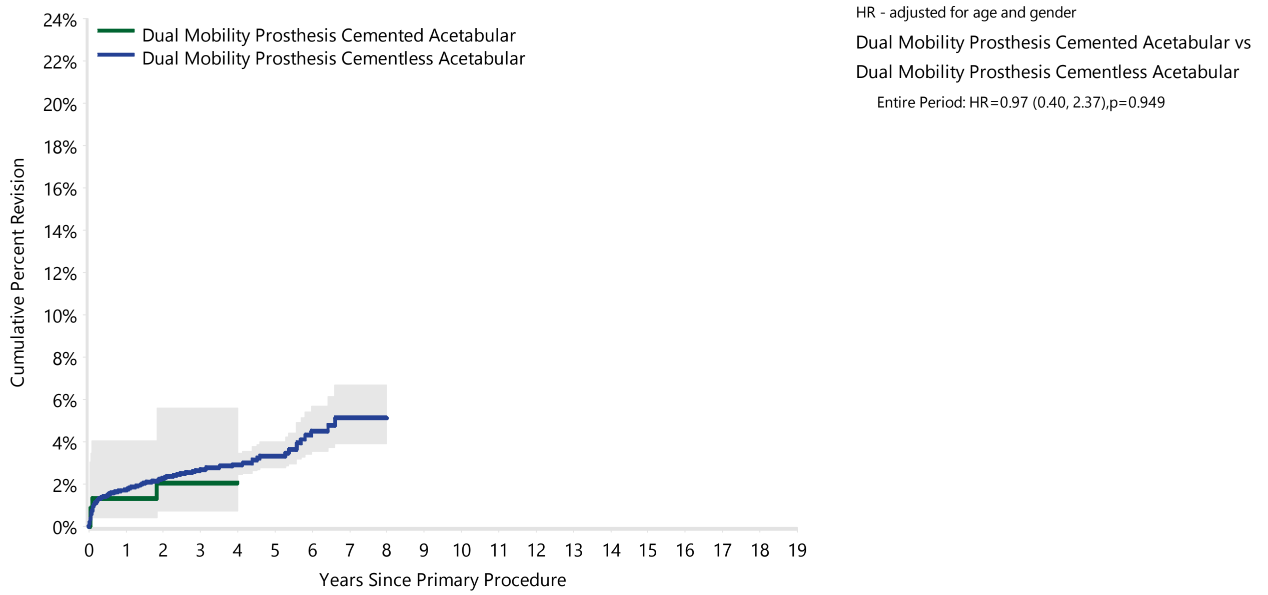
Note: All procedures using metal/metal prostheses have been excluded

Table HT47 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	19 Yrs
Dual Mobility Prosthesis	Cementless	177	7716	1.8 (1.5, 2.1)	2.7 (2.3, 3.2)	3.3 (2.8, 4.0)			
	Cemented	5	229	1.3 (0.4, 4.0)	2.1 (0.8, 5.6)				
TOTAL		**182**	**7945**						

Note: All procedures using metal/metal prostheses have been excluded

Figure HT56 Cumulative Percent Revision of Dual Mobility Primary Total Conventional Hip Replacement by Acetabular Fixation (Primary Diagnosis OA)



Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Dual Mobility Prosthesis	Cemented Acetabular	229	165	82	34	6	0	0
	Cementless Acetabular	7716	5016	2167	815	27	0	0

Note: All procedures using metal/metal prostheses have been excluded

SURGICAL APPROACH

The Registry commenced collection of approach in 2015 and can now report on the early outcomes for 42,189 anterior, 29,055 lateral and 85,955 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 HT48 to Table HT50).

There is no difference in the overall rate of revision when surgical approach is compared (Table HT51 and Figure HT57). However, there are differences in the types of revision and reasons for revision between the approaches.

There is no difference between the posterior and lateral approaches (Table HT52 and Figure HT58). The following analyses were performed with hazard ratios adjusted for age, gender, ASA score, BMI category, femoral fixation, and head size. The most common reasons for revision of primary total hip replacement in the first 4 years include loosening, fracture, infection, and dislocation (Figure HT59).

There is a higher rate of revision for loosening with the anterior approach compared to both posterior and lateral approaches (Table HT53 and Figure HT60). The anterior approach also has a higher rate of revision for fracture for the first 3 months compared to the lateral approach and for the entire period for the posterior approach (Table HT54 and Figure HT61). There is no difference between the posterior and lateral approaches.

There is a lower rate of revision for infection for the anterior approach compared to the posterior approach, and for the first 3 months compared to the lateral approach. There is no difference between the posterior and lateral approaches (Table HT55 and Figure HT62).

The anterior approach has a lower rate of revision for dislocation compared to the posterior approach and for the first 6 months compared to the lateral approach. The posterior approach has a higher rate of revision for dislocation compared to the lateral approach (Table HT56 and Figure HT63).

Table HT48 Primary Total Conventional Hip Replacement by Age and Surgical Approach (Primary Diagnosis OA)

	Anterior		Lateral		Posterior	
Age	N	Col%	N	Col%	N	Col%
<55	5499	13.0	2946	10.1	9184	10.7
55-64	11092	26.3	6731	23.2	20140	23.4
65-74	15277	36.2	10692	36.8	31301	36.4
≥75	10321	24.5	8686	29.9	25330	29.5
TOTAL	**42189**	**100.0**	**29055**	**100.0**	**85955**	**100.0**

Note: All procedures using metal/metal prostheses have been excluded

Table HT49 Primary Total Conventional Hip Replacement by BMI Category and Surgical Approach (Primary Diagnosis OA)

	Anterior		Lateral		Posterior	
BMI Category	N	Col%	N	Col%	N	Col%
Underweight	318	0.8	206	0.7	557	0.7
Normal	9894	24.2	5345	19.4	15926	19.5
Pre Obese	16341	40.0	9853	35.8	29454	36.0
Obese Class 1	9588	23.4	7291	26.5	21188	25.9
Obese Class 2	3406	8.3	3230	11.8	9574	11.7
Obese Class 3	1345	3.3	1560	5.7	5092	6.2
TOTAL	**40892**	**100.0**	**27485**	**100.0**	**81791**	**100.0**

Note: All procedures using metal/metal prostheses have been excluded
BMI has not been presented for patients aged ≤19 years

Table HT50 Primary Total Conventional Hip Replacement by ASA Score and Surgical Approach (Primary Diagnosis OA)

	Anterior		Lateral		Posterior	
ASA Score	N	Col%	N	Col%	N	Col%
ASA 1	5326	12.6	2348	8.1	6923	8.1
ASA 2	23684	56.2	15470	53.4	46250	53.9
ASA 3	12679	30.1	10737	37.1	31248	36.4
ASA 4	421	1.0	417	1.4	1364	1.6
ASA 5	.	.	1	0.0	2	0.0
TOTAL	**42110**	**100.0**	**28973**	**100.0**	**85787**	**100.0**

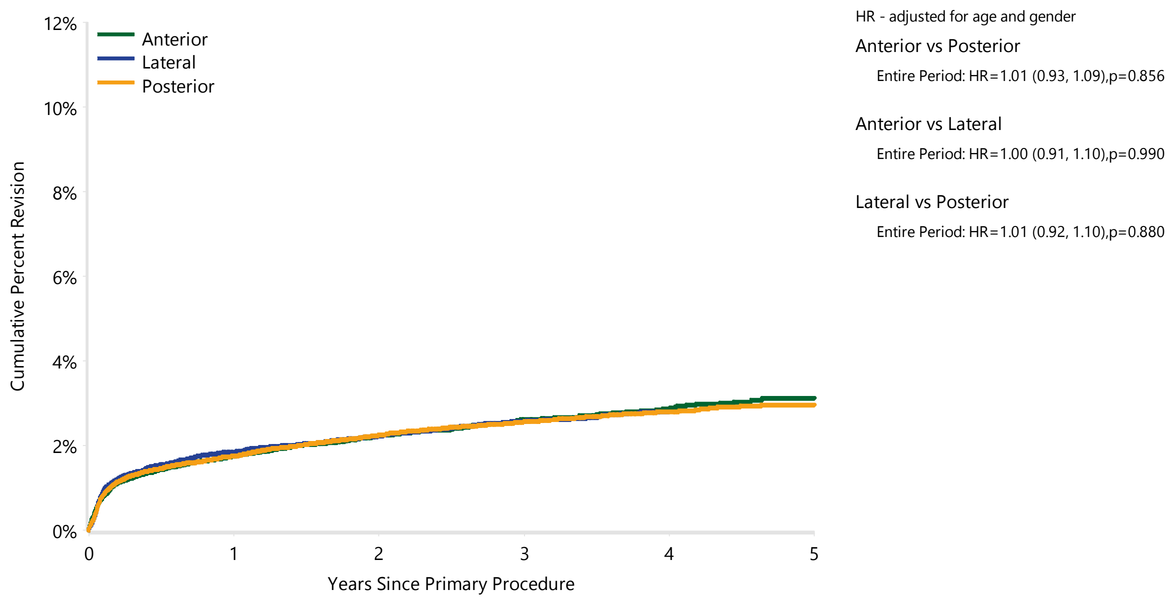
Note: All procedures using metal/metal prostheses have been excluded

Table HT51 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
Anterior	927	42189	1.7 (1.6, 1.9)	2.2 (2.1, 2.4)	2.6 (2.4, 2.8)	2.9 (2.7, 3.1)	3.1 (2.9, 3.4)
Lateral	685	29055	1.9 (1.7, 2.0)	2.2 (2.1, 2.4)	2.6 (2.4, 2.8)	2.8 (2.6, 3.0)	
Posterior	1889	85955	1.8 (1.7, 1.8)	2.2 (2.1, 2.4)	2.6 (2.4, 2.7)	2.8 (2.7, 2.9)	3.0 (2.8, 3.1)
TOTAL	**3501**	**157199**					

Note: All procedures using metal/metal prostheses have been excluded

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



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
Anterior	42189	31447	21725	13262	5858	77
Lateral	29055	23828	18440	12503	5982	25
Posterior	85955	64305	45158	27562	12266	81

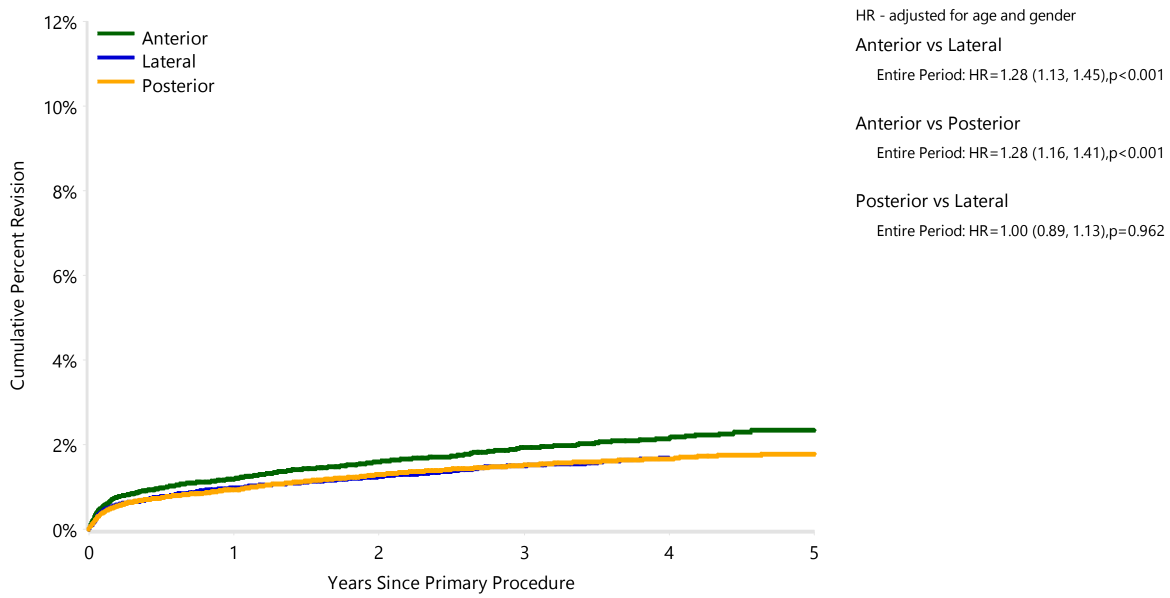
Note: All procedures using metal/metal prostheses have been excluded

Table HT52 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	671	42189	1.2 (1.1, 1.3)	1.6 (1.5, 1.7)	1.9 (1.8, 2.1)	2.2 (2.0, 2.4)	2.3 (2.1, 2.6)	
Lateral	392	29055	1.0 (0.9, 1.1)	1.2 (1.1, 1.4)	1.5 (1.4, 1.7)	1.7 (1.5, 1.9)		
Posterior	1079	85955	0.9 (0.9, 1.0)	1.3 (1.2, 1.4)	1.5 (1.4, 1.6)	1.7 (1.6, 1.8)	1.8 (1.6, 1.9)	
TOTAL	**2142**	**157199**						

Note: All procedures using metal/metal prostheses have been excluded
Excludes procedures with unknown ASA score, BMI category or head size

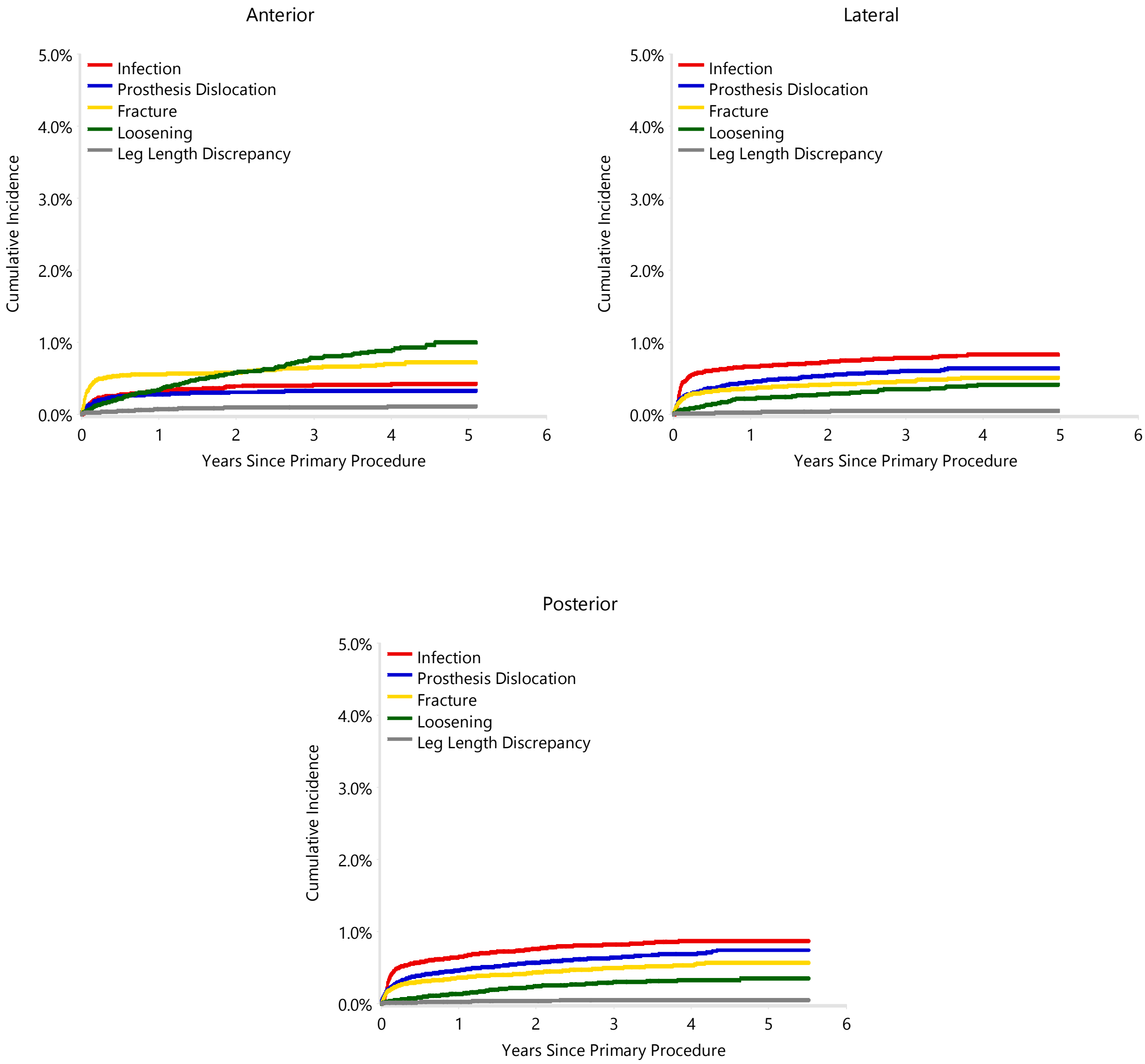
Figure HT58 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Surgical Approach (Primary Diagnosis OA, Major Revisions)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Anterior	42189	31447	21725	13262	5858	77	3
Lateral	29055	23828	18440	12503	5982	25	9
Posterior	85955	64305	45158	27562	12266	81	27

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 3-4 were combined
Due to low numbers, BMI categories underweight and normal were combined

Figure HT59 Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement by Surgical Approach (Primary Diagnosis OA)



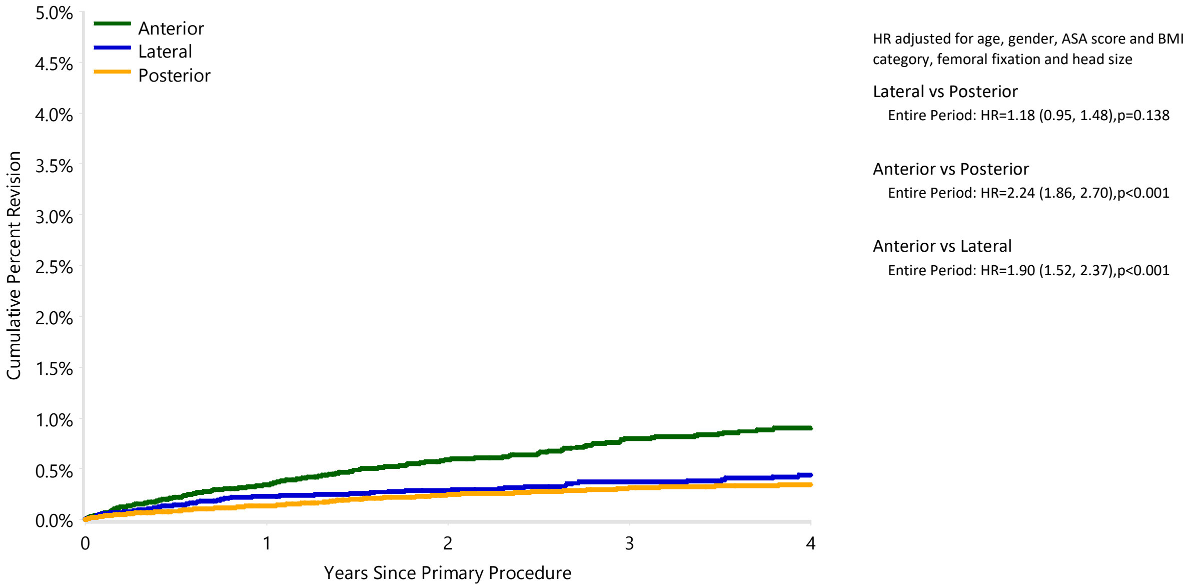
Note: All procedures using metal/metal prostheses have been excluded

Table HT53 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	235	40836	0.3 (0.3, 0.4)	0.6 (0.5, 0.7)	0.8 (0.7, 0.9)	0.9 (0.8, 1.0)		
Lateral	87	27423	0.2 (0.2, 0.3)	0.3 (0.2, 0.4)	0.4 (0.3, 0.5)	0.4 (0.3, 0.6)		
Posterior	185	81681	0.1 (0.1, 0.2)	0.2 (0.2, 0.3)	0.3 (0.3, 0.4)	0.3 (0.3, 0.4)		
TOTAL	**507**	**149940**						

Note: All procedures using metal/metal prostheses have been excluded
Excludes procedures with unknown ASA score, BMI category or head size

Figure HT60 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	40836	30258	20727	12483	5389	20	2
Lateral	27423	22329	17108	11458	5406	19	6
Posterior	81681	60506	42051	25366	11131	22	3

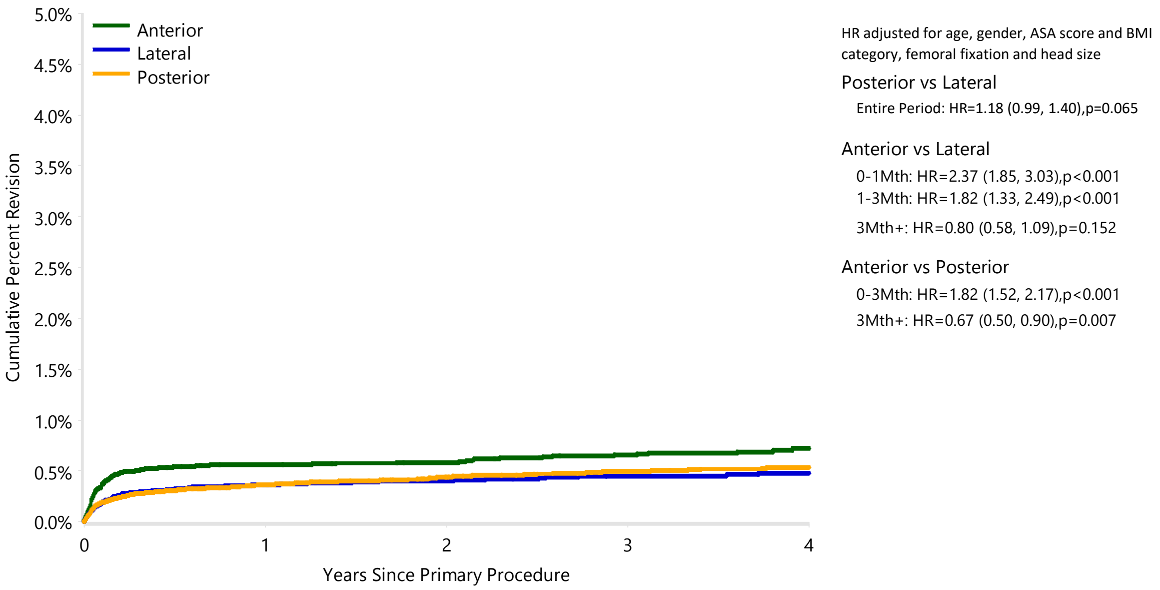
Note: All procedures using metal/metal prostheses have been excluded
Excludes procedures with unknown ASA score, BMI category or head size
Due to low numbers, ASA scores 1-2 and 3-4 were combined
Due to low numbers, BMI categories underweight and normal were combined

Table HT54 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	247	40836	0.6 (0.5, 0.6)	0.6 (0.5, 0.7)	0.7 (0.6, 0.7)	0.7 (0.6, 0.8)		
Lateral	113	27423	0.4 (0.3, 0.4)	0.4 (0.3, 0.5)	0.5 (0.4, 0.5)	0.5 (0.4, 0.6)		
Posterior	348	81681	0.4 (0.3, 0.4)	0.4 (0.4, 0.5)	0.5 (0.4, 0.6)	0.5 (0.5, 0.6)		
TOTAL	**708**	**149940**						

Note: All procedures using metal/metal prostheses have been excluded
Excludes procedures with unknown ASA score, BMI category or head size

Figure HT61 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	40836	30258	20727	12483	5389	20	2
Lateral	27423	22329	17108	11458	5406	19	6
Posterior	81681	60506	42051	25366	11131	22	3

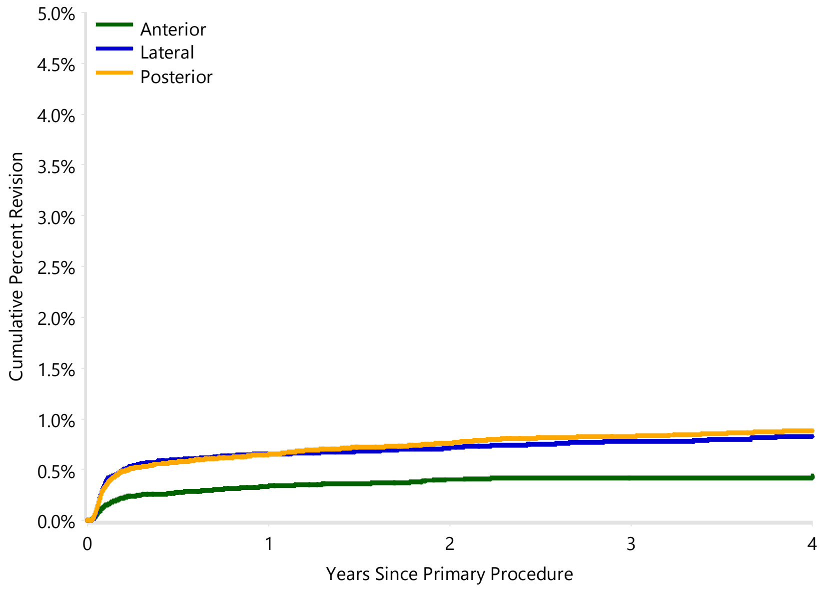
Note: All procedures using metal/metal prostheses have been excluded
Excludes procedures with unknown ASA score, BMI category or head size.
Due to low numbers ASA scores 1-2, and 3-4 were combined
Due to low numbers, BMI categories underweight and normal were combined

Table HT55 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	149	40836	0.3 (0.3, 0.4)	0.4 (0.3, 0.5)	0.4 (0.4, 0.5)	0.4 (0.4, 0.5)		
Lateral	199	27423	0.7 (0.6, 0.8)	0.7 (0.6, 0.8)	0.8 (0.7, 0.9)	0.8 (0.7, 1.0)		
Posterior	598	81681	0.7 (0.6, 0.7)	0.8 (0.7, 0.8)	0.8 (0.8, 0.9)	0.9 (0.8, 1.0)		
TOTAL	**946**	**149940**						

Note: All procedures using metal/metal prostheses have been excluded
Excludes procedures with unknown ASA score, BMI category or head size

Figure HT62 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
0-1Mth: HR=1.83 (1.43, 2.34),p<0.001
1Mth-3Mth: HR=1.77 (1.36, 2.32),p<0.001
3Mth+: HR=1.30 (0.98, 1.72),p=0.067

Posterior vs Anterior
Entire Period: HR=1.57 (1.33, 1.86),p<0.001

Posterior vs Lateral
0-3Mth: HR=0.97 (0.83, 1.13),p=0.667
3Mth+: HR=1.05 (0.85, 1.30),p=0.645

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Anterior	40836	30258	20727	12483	5389	20	2
Lateral	27423	22329	17108	11458	5406	19	6
Posterior	81681	60506	42051	25366	11131	22	3

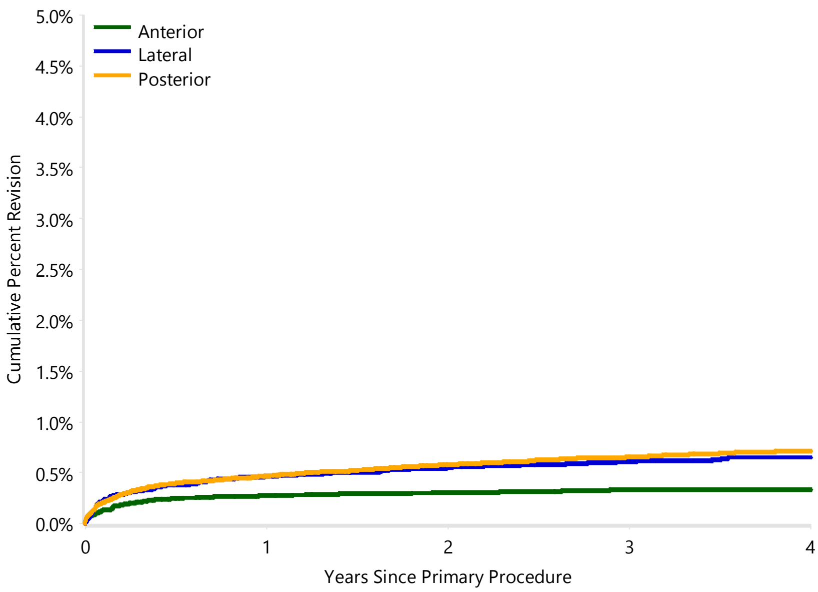
Note: All procedures using metal/metal prostheses have been excluded
Excludes procedures with unknown ASA score, BMI category or head size
Due to low numbers, ASA scores 1-2 and 3-4 were combined
Due to low numbers, BMI categories underweight and normal were combined

Table HT56 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Surgical Approach (Primary Diagnosis OA, Revision for Dislocation)

Surgical Approach	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Anterior	118	40836	0.3 (0.2, 0.3)	0.3 (0.3, 0.4)	0.3 (0.3, 0.4)	0.3 (0.3, 0.4)		
Lateral	151	27423	0.5 (0.4, 0.6)	0.6 (0.5, 0.7)	0.6 (0.5, 0.7)	0.7 (0.6, 0.8)		
Posterior	458	81681	0.5 (0.4, 0.5)	0.6 (0.5, 0.6)	0.7 (0.6, 0.7)	0.7 (0.6, 0.8)		
TOTAL	**727**	**149940**						

Note: All procedures using metal/metal prostheses have been excluded
Excludes procedures with unknown ASA score, BMI category or head size

Figure HT63 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Surgical Approach (Primary Diagnosis OA, Revision for Dislocation)



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

Lateral vs Anterior
0-6Mth: HR=1.53 (1.22, 1.91),p<0.001
6Mth+: HR=1.33 (0.96, 1.83),p=0.081

Posterior vs Anterior
Entire Period: HR=1.84 (1.55, 2.20),p<0.001

Posterior vs Lateral
Entire Period: HR=1.27 (1.10, 1.48),p=0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Anterior	40836	30258	20727	12483	5389	20	2
Lateral	27423	22329	17108	11458	5406	19	6
Posterior	81681	60506	42051	25366	11131	22	3

Note: All procedures using metal/metal prostheses have been excluded
Excludes procedures with unknown head size, ASA score or BMI
ASA scores 1-2 and 3-4 were combined due to low numbers
BMI categories underweight and normal were combined due to low numbers

OUTCOME FOR FRACTURED NECK OF FEMUR

There have been 22,848 primary total conventional hip replacement procedures recorded by the Registry with a diagnosis of fractured neck of femur.

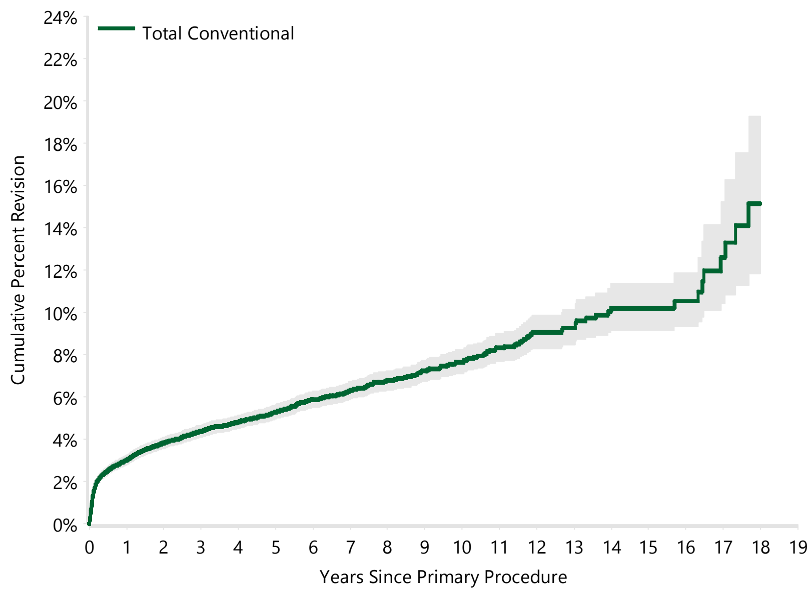
The cumulative percent revision of primary total conventional hip replacement for fractured neck of femur is 8.3% at 11 years (Table HT57 and Figure HT64).

Table HT57 Cumulative Percent Revision of Primary Total Conventional Hip Replacement (Primary Diagnosis Fractured NOF)

Hip Class	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	11 Yrs
Total Conventional	1127	22848	3.0 (2.8, 3.3)	3.8 (3.6, 4.1)	4.4 (4.1, 4.7)	5.3 (5.0, 5.6)	6.3 (5.9, 6.7)	8.3 (7.7, 9.0)
TOTAL	**1127**	**22848**						

Note: All procedures using metal/metal prostheses have been excluded

Figure HT64 Cumulative Percent Revision of Primary Total Conventional Hip Replacement (Primary Diagnosis Fractured NOF)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	11 Yrs
Total Conventional	22848	18248	15144	12331	7985	4949	1548

Reasons for Revision

Prosthesis dislocation is the most common reason for revision (31.3%), followed by fracture (27.5%), infection (17.4%), and loosening (16.1%) (Table HT58 and Figure HT65).

Type of Revision

Replacement of the femoral component only is the most common type of revision (36.3%), followed by head and insert (22.2%), acetabular only (18.8%), and total hip replacement (femoral/acetabular) (9.3%) (Table HT59).

Table HT58 Primary Total Conventional Hip Replacement by Reason for Revision (Primary Diagnosis Fractured NOF)

Reason for Revision	Number	Percent
Prosthesis Dislocation	353	31.3
Fracture	310	27.5
Infection	196	17.4
Loosening	182	16.1
Instability	11	1.0
Leg Length Discrepancy	11	1.0
Lysis	10	0.9
Malposition	9	0.8
Pain	9	0.8
Implant Breakage Stem	8	0.7
Implant Breakage Acetabular	5	0.4
Heterotopic Bone	3	0.3
Implant Breakage Acetabular Insert	3	0.3
Wear Acetabular Insert	2	0.2
Incorrect Sizing	2	0.2
Metal Related Pathology	2	0.2
Tumour	1	0.1
Progression Of Disease	1	0.1
Other	9	0.8
TOTAL	**1127**	**100.0**

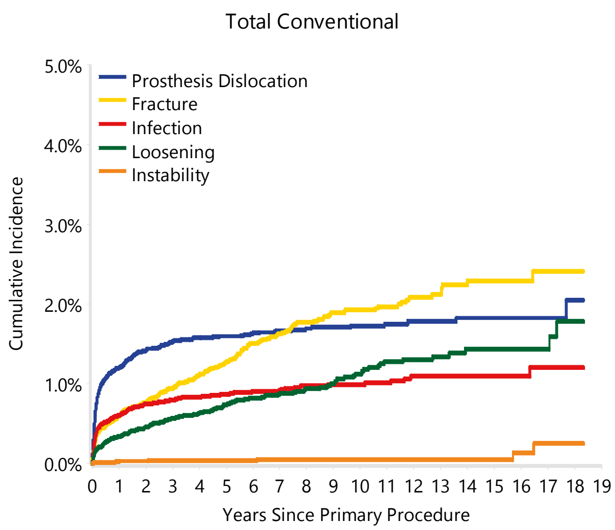
Note: All procedures using metal/metal prostheses have been excluded

Table HT59 Primary Total Conventional Hip Replacement by Type of Revision (Primary Diagnosis Fractured NOF)

Type of Revision	Number	Percent
Femoral Component	409	36.3
Head/Insert	250	22.2
Acetabular Component	212	18.8
THR (Femoral/Acetabular)	105	9.3
Head Only	51	4.5
Cement Spacer	45	4.0
Minor Components	23	2.0
Insert Only	15	1.3
Removal of Prostheses	7	0.6
Head/Neck/Insert	3	0.3
Reinsertion of Components	2	0.2
Head/Neck	2	0.2
Total Femoral	2	0.2
Neck Only	1	0.1
TOTAL	**1127**	**100.0**

Note: All procedures using metal/metal prostheses have been excluded
Femoral heads are usually replaced when the acetabular component or femoral stem is revised

Figure HT65 Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement (Primary Diagnosis Fractured NOF)



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 12,995 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, there is no difference in the rate of revision for patients with an ASA score of 2, whereas patients with ASA scores of 3 and 4 have a higher rate of revision (Table HT60 and Figure HT66). The most common reasons for revision for each ASA score are shown in Figure HT67. The difference in the rate of revision is partially due to an increase in revision for dislocation and infection with increasing ASA score.

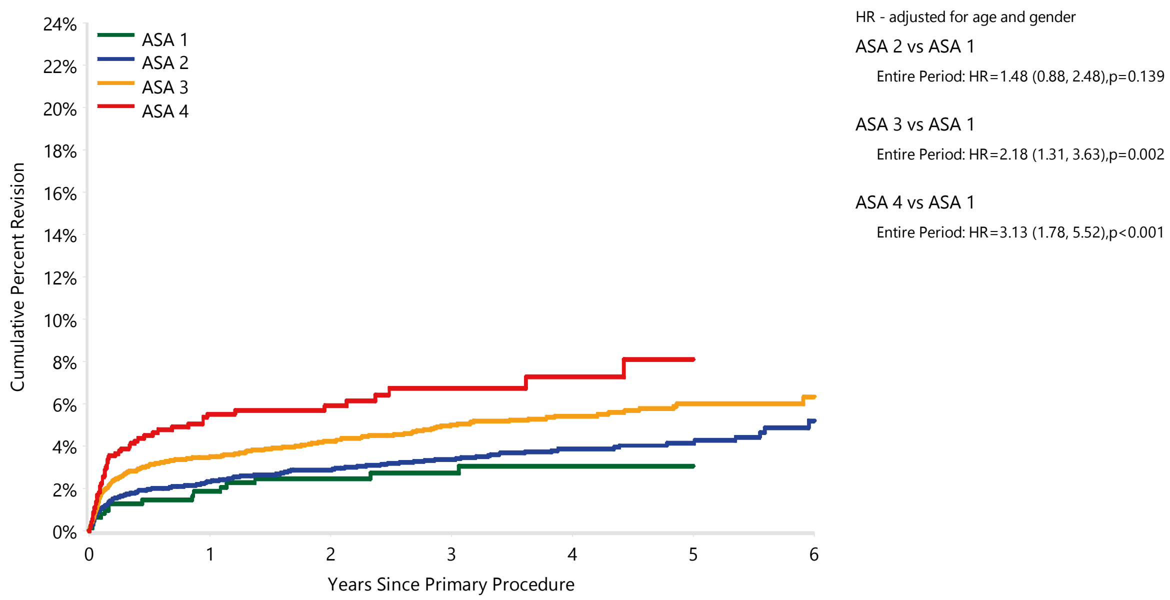
There is a larger proportion of fractured neck of femur patients with an ASA score of 3 or above (57.3%) than patients with osteoarthritis (35.5%) (Table HT61).

BMI data have been collected since 2015. The early revision outcomes are reported for 6,860 primary total conventional hip replacement procedures for fractured neck of femur. Patients in obese class 3 have a higher rate of revision compared to the normal BMI class (Table HT62 and Figure HT68). The most common reasons for revision are shown in Figure HT69.

Table HT60 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by ASA Score (Primary Diagnosis Fractured NOF)

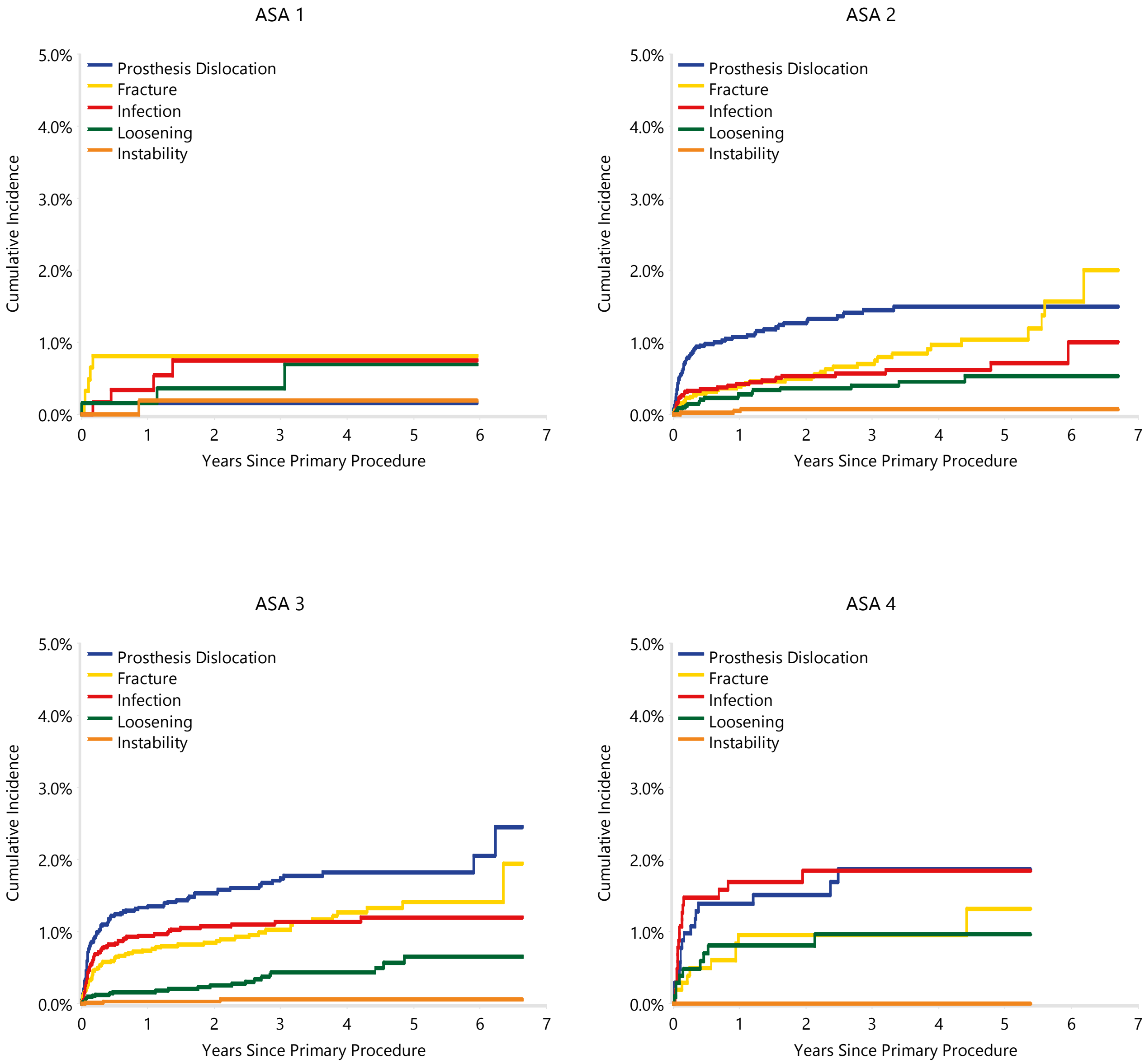
ASA Score	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	7 Yrs
ASA 1	16	626	1.9 (1.0, 3.3)	2.5 (1.5, 4.2)	2.7 (1.6, 4.5)	3.1 (1.9, 5.0)	3.1 (1.9, 5.0)	
ASA 2	160	4927	2.3 (1.9, 2.8)	2.9 (2.4, 3.4)	3.4 (2.9, 4.0)	3.9 (3.3, 4.6)	4.1 (3.5, 4.9)	
ASA 3	278	6391	3.5 (3.1, 4.0)	4.2 (3.7, 4.8)	5.0 (4.4, 5.7)	5.4 (4.8, 6.2)	6.0 (5.2, 6.9)	
ASA 4	56	1045	5.5 (4.2, 7.2)	5.9 (4.5, 7.7)	6.7 (5.1, 8.8)	7.3 (5.4, 9.7)	8.1 (5.8, 11.2)	
ASA 5	0	6	0.0 (0.0, 0.0)					
TOTAL	**510**	**12995**						

Figure HT66 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by ASA Score (Primary Diagnosis Fractured NOF)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	7 Yrs
ASA 1	626	498	400	296	193	116	0
ASA 2	4927	3870	2966	2086	1369	763	3
ASA 3	6391	4558	3296	2193	1358	716	4
ASA 4	1045	613	408	249	147	69	0

Figure HT67 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

Table HT61 Primary Total Conventional Hip Replacement by ASA Score and Primary Diagnosis

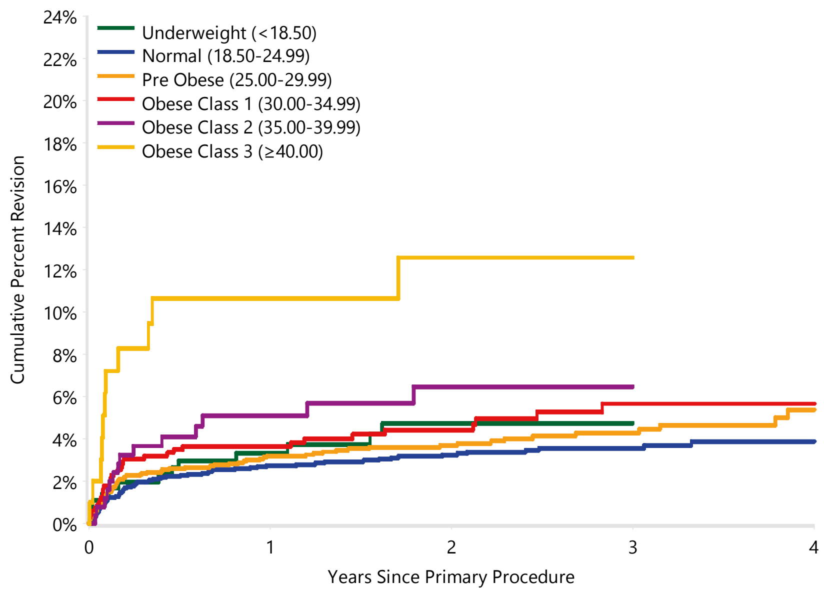
ASA Score	Fractured Neck Of Femur		Osteoarthritis		TOTAL	
	N	Col%	N	Col%	N	Col%
ASA 1	626	4.8	20146	9.7	20772	9.4
ASA 2	4927	37.9	114305	54.8	119232	53.8
ASA 3	6391	49.2	71029	34.1	77420	35.0
ASA 4	1045	8.0	2962	1.4	4007	1.8
ASA 5	6	0.0	9	0.0	15	0.0
TOTAL	**12995**	**100.0**	**208451**	**100.0**	**221446**	**100.0**

Table HT62 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
Underweight	14	370	3.3 (1.9, 6.0)	4.7 (2.8, 8.0)	4.7 (2.8, 8.0)		
Normal	91	3009	2.7 (2.2, 3.4)	3.2 (2.6, 4.0)	3.6 (2.9, 4.4)	3.9 (3.1, 4.8)	
Pre Obese	85	2321	3.2 (2.5, 4.0)	3.7 (3.0, 4.6)	4.3 (3.4, 5.4)	5.4 (4.1, 7.1)	
Obese Class 1	36	804	3.6 (2.5, 5.2)	4.4 (3.1, 6.2)	5.7 (4.0, 8.0)	5.7 (4.0, 8.0)	
Obese Class 2	14	256	5.1 (2.9, 8.8)	6.5 (3.8, 10.9)	6.5 (3.8, 10.9)		
Obese Class 3	11	100	10.6 (5.9, 18.9)	12.6 (7.0, 21.9)	12.6 (7.0, 21.9)		
TOTAL	**251**	**6860**					

Note: All procedures using metal/metal prostheses have been excluded
BMI has not been presented for patients aged ≤19 years

Figure HT68 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=1.35 (0.77, 2.37),p=0.298

Pre Obese (25.00-29.99) vs Normal (18.50-24.99)
Entire Period: HR=1.17 (0.87, 1.58),p=0.291

Obese Class 1 (30.00-34.99) vs Normal (18.50-24.99)
Entire Period: HR=1.39 (0.94, 2.05),p=0.096

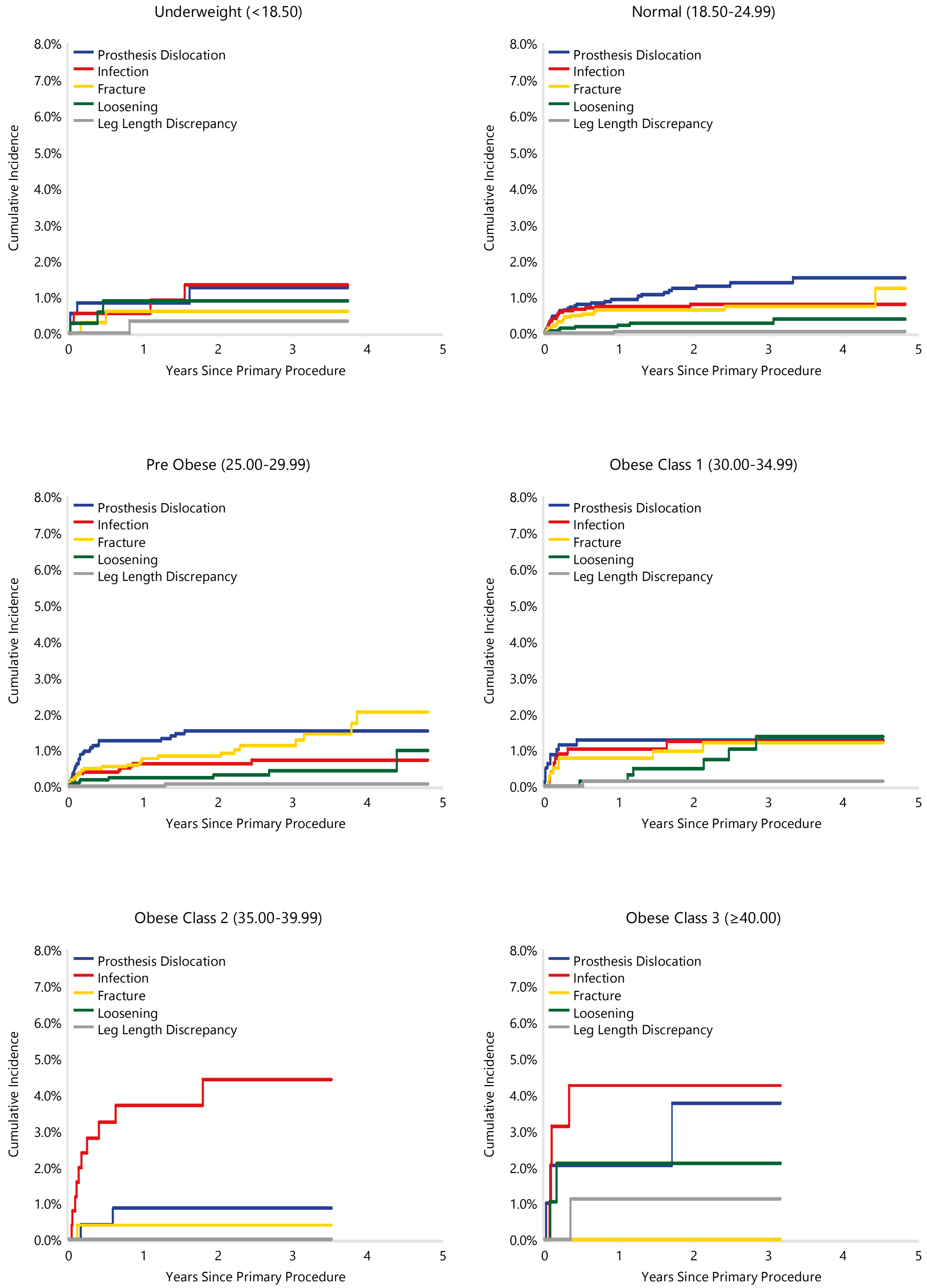
Obese Class 2 (35.00-39.99) vs Normal (18.50-24.99)
Entire Period: HR=1.73 (0.99, 3.05),p=0.056

Obese Class 3 (≥40.00) vs Normal (18.50-24.99)
Entire Period: HR=3.90 (2.08, 7.31),p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
Underweight	370	244	170	88	29	0
Normal	3009	2061	1348	756	289	3
Pre Obese	2321	1552	1027	553	222	4
Obese Class 1	804	553	386	217	94	0
Obese Class 2	256	174	110	62	29	0
Obese Class 3	100	61	34	12	4	0

Note: All procedures using metal/metal prostheses have been excluded
BMI has not been presented for patients aged ≤19 years

Figure HT69 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
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 bearing surfaces and restricted to mixed ceramic/mixed ceramic and all femoral head materials used in combination with XLPE.

The Registry has recorded 1,213 procedures with cemented fixation, 6,059 with cementless fixation and 11,816 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 HT63 and Figure HT70).

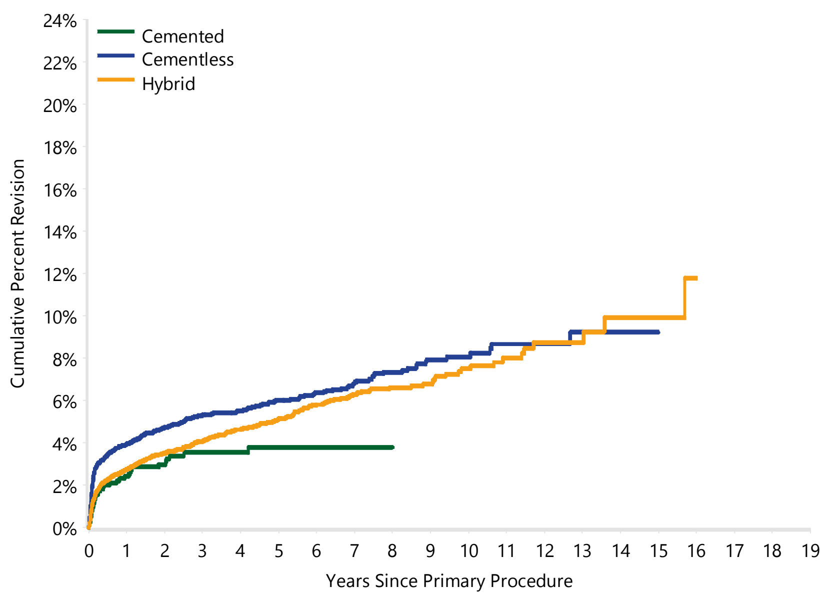
There are differences in outcome with respect to fixation and age. For patients aged <70 years, there is no difference in the rate of revision between the three different fixation methods (Table HT64 and Figure HT71). However, for patients aged ≥70 years, cementless fixation has a higher rate of revision 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 HT64 and Figure HT72).

Table HT63 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	11 Yrs
Cemented	37	1213	2.4 (1.7, 3.5)	3.0 (2.1, 4.2)	3.5 (2.6, 4.9)	3.8 (2.7, 5.3)	3.8 (2.7, 5.3)	
Cementless	348	6059	3.9 (3.5, 4.5)	4.7 (4.2, 5.3)	5.3 (4.8, 6.0)	6.0 (5.4, 6.7)	6.8 (6.1, 7.6)	8.7 (7.5, 10.0)
Hybrid	517	11816	2.7 (2.4, 3.1)	3.5 (3.2, 3.9)	4.1 (3.7, 4.5)	5.1 (4.6, 5.6)	6.3 (5.7, 6.9)	8.0 (7.0, 9.1)
TOTAL	**902**	**19088**						

Note: Includes mixed ceramic/mixed ceramic and XLPE bearing surfaces

Figure HT70 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=1.52 (1.08, 2.14),p=0.015

Cementless vs Hybrid
0 - 3Mth: HR=1.65 (1.35, 2.01),p<0.001
3Mth+: HR=0.88 (0.73, 1.06),p=0.175

Hybrid vs Cemented
Entire Period: HR=1.30 (0.93, 1.81),p=0.124

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	11 Yrs
Cemented	1213	907	729	560	315	123	10
Cementless	6059	4991	4248	3542	2369	1532	376
Hybrid	11816	9224	7438	5841	3440	1900	463

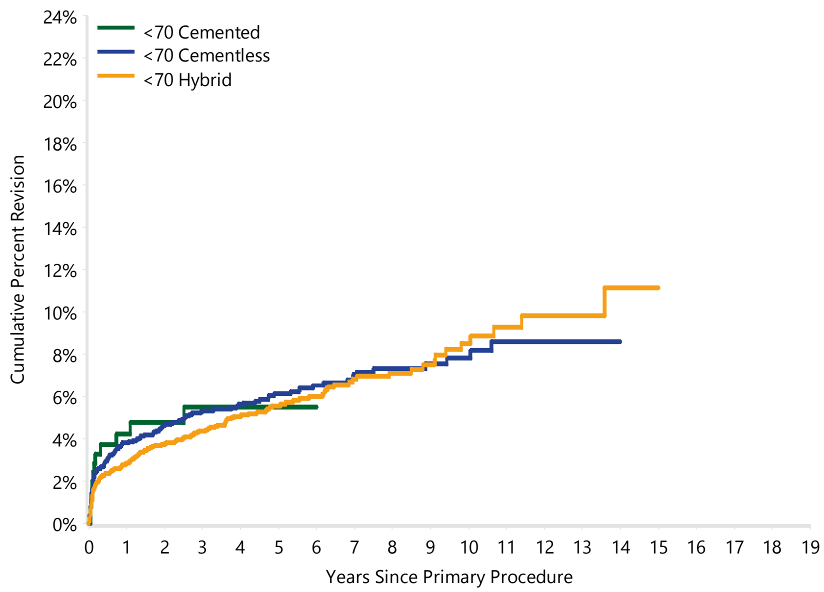
Note: Includes mixed ceramic/mixed ceramic and XLPE bearing surfaces

Table HT64 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	11 Yrs
<70		**332**	**6250**	**3.3 (2.9, 3.8)**	**4.1 (3.6, 4.7)**	**4.8 (4.3, 5.4)**	**5.8 (5.1, 6.5)**	**6.8 (6.1, 7.7)**	**8.8 (7.6, 10.2)**
	Cemented	12	256	4.2 (2.3, 7.7)	4.8 (2.7, 8.5)	5.5 (3.1, 9.6)	5.5 (3.1, 9.6)		
	Cementless	140	2384	3.8 (3.1, 4.7)	4.6 (3.8, 5.6)	5.3 (4.5, 6.4)	6.1 (5.1, 7.3)	7.0 (5.9, 8.4)	8.6 (7.0, 10.6)
	Hybrid	180	3610	2.8 (2.3, 3.5)	3.7 (3.1, 4.5)	4.4 (3.7, 5.2)	5.6 (4.7, 6.5)	6.8 (5.8, 8.0)	9.3 (7.5, 11.4)
≥70		**570**	**12838**	**3.0 (2.7, 3.3)**	**3.7 (3.4, 4.1)**	**4.3 (3.9, 4.7)**	**5.0 (4.6, 5.5)**	**6.0 (5.4, 6.6)**	**7.5 (6.6, 8.5)**
	Cemented	25	957	1.9 (1.2, 3.1)	2.5 (1.6, 3.8)	3.0 (2.0, 4.5)	3.3 (2.2, 5.0)	3.3 (2.2, 5.0)	
	Cementless	208	3675	4.0 (3.4, 4.7)	4.7 (4.1, 5.5)	5.3 (4.6, 6.1)	5.9 (5.1, 6.8)	6.6 (5.7, 7.7)	8.7 (7.2, 10.5)
	Hybrid	337	8206	2.7 (2.3, 3.1)	3.4 (3.0, 3.8)	3.9 (3.5, 4.4)	4.9 (4.3, 5.5)	6.0 (5.3, 6.8)	7.2 (6.1, 8.5)
TOTAL		**902**	**19088**						

Note: Includes mixed ceramic/mixed ceramic and XLPE bearing surfaces

Figure HT71 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=1.09 (0.60, 1.95),p=0.783

<70 Cemented vs <70 Cementless

Entire Period: HR=1.03 (0.57, 1.85),p=0.931

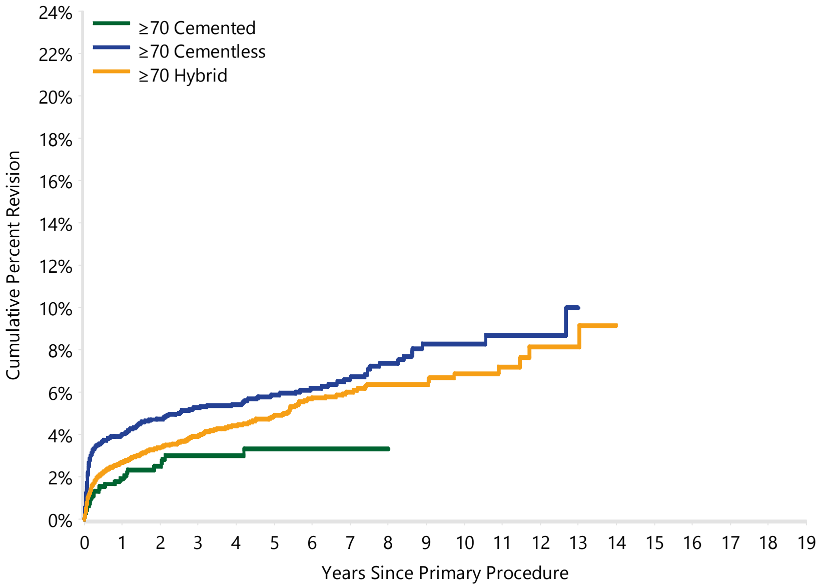
<70 Cementless vs <70 Hybrid

Entire Period: HR=1.06 (0.85, 1.32),p=0.621

Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	11 Yrs
<70	Cemented	256	185	144	114	69	38	2
	Cementless	2384	2015	1745	1494	1047	707	189
	Hybrid	3610	2871	2359	1882	1163	705	192

Note: Includes mixed ceramic/mixed ceramic and XLPE bearing surfaces

Figure HT72 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=1.85 (1.22, 2.80),p=0.003

≥70 Cementless vs ≥70 Hybrid
0 - 3Mth: HR=1.94 (1.52, 2.48),p<0.001
3Mth+: HR=0.83 (0.65, 1.07),p=0.151

≥70 Hybrid vs ≥70 Cemented
Entire Period: HR=1.47 (0.98, 2.21),p=0.062

Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	11 Yrs
≥70	Cemented	957	722	585	446	246	85	8
	Cementless	3675	2976	2503	2048	1322	825	187
	Hybrid	8206	6353	5079	3959	2277	1195	271

Note: Includes mixed ceramic/mixed ceramic and XLPE bearing surfaces

Head Size

When used for fractured neck of femur, 32mm head size has a lower rate of revision after 6 months compared to head sizes <32mm. There is no difference when head sizes >32mm are compared to head sizes <32mm (Table HT65 and Figure HT73).

Constrained Acetabular Prostheses

When used for fractured neck of femur, constrained prostheses have a lower rate of revision compared to other acetabular prostheses (Table HT66 and Figure HT74).

Dual Mobility

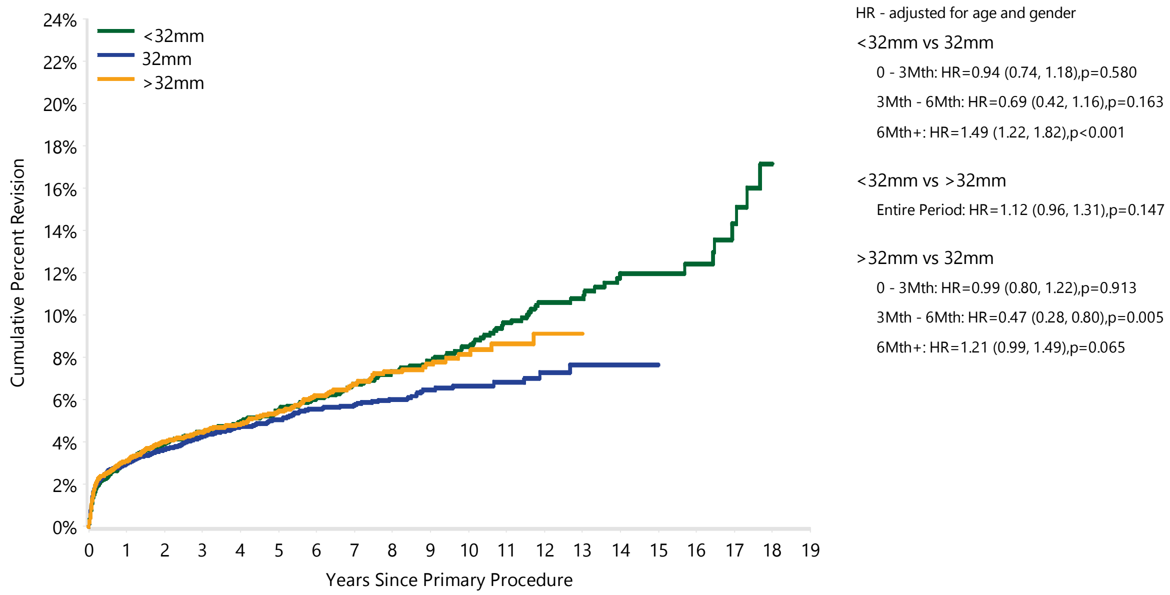
There is no difference in the rate of revision when dual mobility prostheses are used (Table HT67 and Figure HT75).

Table HT65 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	11 Yrs
<32mm	335	6030	3.0 (2.6, 3.5)	3.9 (3.4, 4.5)	4.5 (3.9, 5.1)	5.5 (4.9, 6.2)	6.7 (5.9, 7.6)	9.6 (8.4, 11.0)
32mm	433	9460	3.0 (2.7, 3.4)	3.6 (3.3, 4.0)	4.3 (3.8, 4.7)	5.1 (4.6, 5.6)	5.7 (5.2, 6.3)	6.8 (6.0, 7.7)
>32mm	359	7327	3.1 (2.7, 3.5)	4.0 (3.5, 4.5)	4.4 (4.0, 5.0)	5.4 (4.8, 6.1)	6.7 (6.0, 7.6)	8.6 (7.4, 10.0)
TOTAL	**1127**	**22817**						

Note: All procedures using metal/metal prostheses have been excluded
Excludes 31 procedures with unknown head size

Figure HT73 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Head Size (Primary Diagnosis Fractured NOF)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	11 Yrs
<32mm	6030	4712	3829	3196	2159	1477	737
32mm	9460	7797	6597	5356	3440	2040	539
>32mm	7327	5716	4696	3761	2372	1426	272

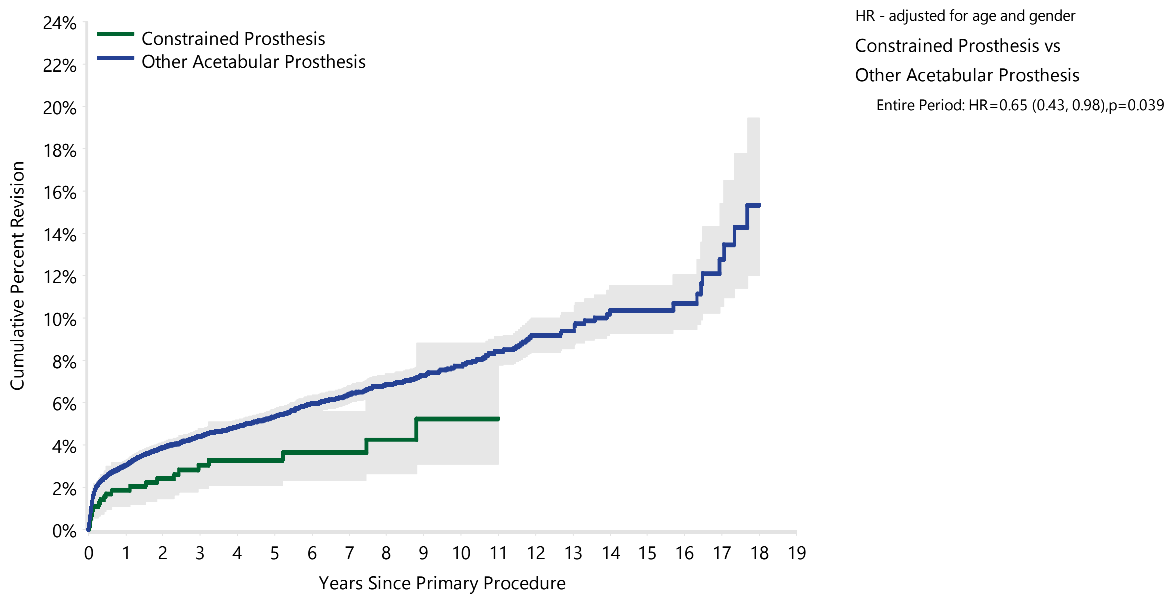
Note: All procedures using metal/metal prostheses have been excluded

Table HT66 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	11 Yrs
Constrained Prosthesis	23	756	1.9 (1.1, 3.2)	2.4 (1.5, 3.9)	3.1 (1.9, 4.8)	3.3 (2.1, 5.1)	3.6 (2.3, 5.6)	5.2 (3.1, 8.8)
Other Acetabular Prosthesis	1104	22092	3.1 (2.8, 3.3)	3.9 (3.6, 4.1)	4.4 (4.1, 4.7)	5.3 (5.0, 5.7)	6.4 (6.0, 6.8)	8.4 (7.8, 9.1)
TOTAL	**1127**	**22848**						

Note: All procedures using metal/metal prostheses have been excluded

Figure HT74 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Acetabular Type (Primary Diagnosis Fractured NOF)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	11 Yrs
Constrained Prosthesis	756	588	506	413	301	191	49
Other Acetabular Prosthesis	22092	17660	14638	11918	7684	4758	1499

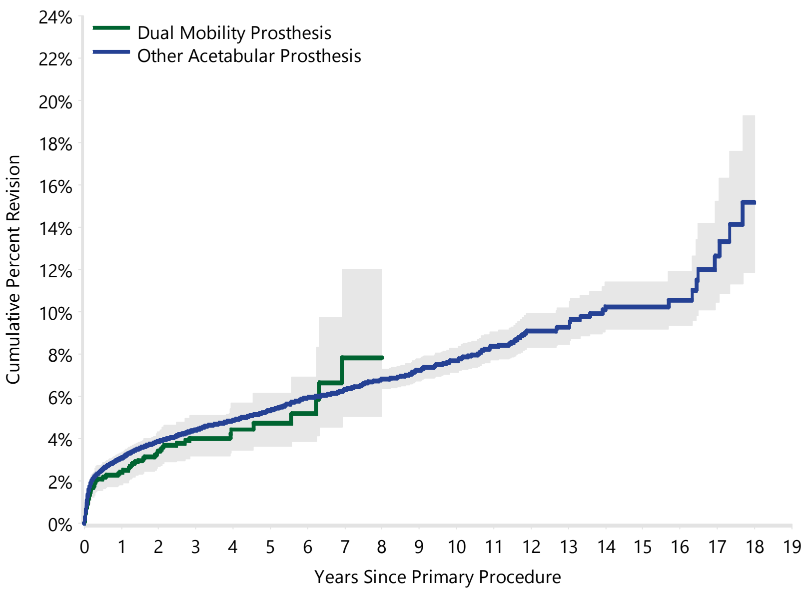
Note: All procedures using metal/metal prostheses have been excluded

Table HT67 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	11 Yrs
Dual Mobility Prosthesis	81	2457	2.4 (1.8, 3.1)	3.4 (2.7, 4.3)	4.0 (3.2, 5.1)	4.7 (3.6, 6.1)	7.8 (5.1, 12.0)	
Other Acetabular Prosthesis	1046	20391	3.1 (2.9, 3.3)	3.9 (3.6, 4.2)	4.4 (4.1, 4.7)	5.3 (5.0, 5.7)	6.3 (5.9, 6.7)	8.4 (7.7, 9.1)
TOTAL	**1127**	**22848**						

Note: All procedures using metal/metal prostheses have been excluded

Figure HT75 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Acetabular Mobility (Primary Diagnosis Fractured NOF)



HR - adjusted for age and gender
Dual Mobility Prosthesis vs
Other Acetabular Prosthesis
Entire Period: HR=0.88 (0.70, 1.11),p=0.290

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	11 Yrs
Dual Mobility Prosthesis	2457	1634	1081	723	264	77	9
Other Acetabular Prosthesis	20391	16614	14063	11608	7721	4872	1539

Note: All procedures using metal/metal prostheses have been excluded

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 1.5 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 HT68 and Figure HT76)

For patients <70 years of age, unipolar monoblock has a higher rate of revision after 3 months compared to total conventional hip replacement. The use of unipolar monoblock components in patients aged <70 years may be representative of patients having significant comorbidities.

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Unipolar modular has a higher rate of revision than total conventional hip replacement after 1.5 years. There is no difference between bipolar and total conventional hip replacement in this age group (Table HT69 and Figure HT77).

Unipolar modular has a lower rate of revision for the first 1.5 years. After 1.5 years, there is no difference.

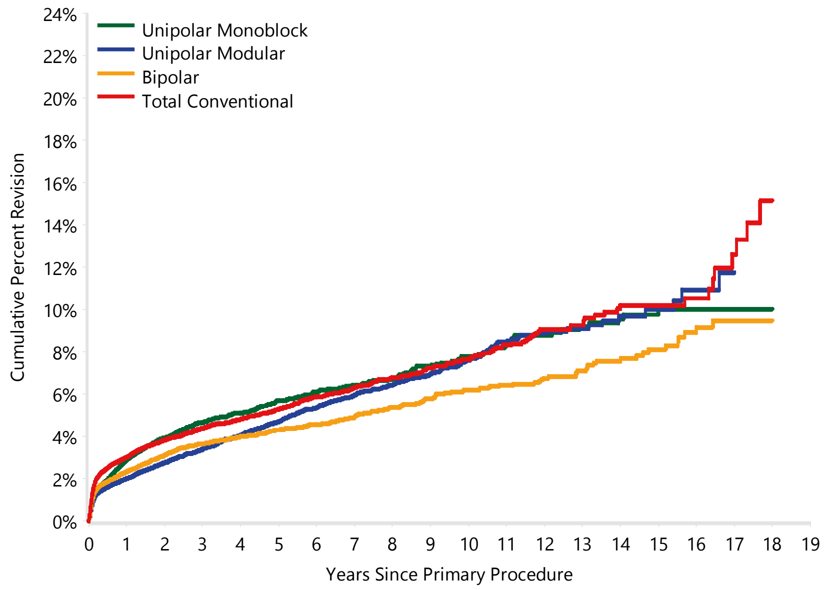
For patients aged ≥70 years, there are time-dependent variations in the comparative rates of revision. Unipolar monoblock has a lower rate of revision compared to total conventional hip replacement between 2 weeks and 3 months and a higher rate of revision between 6 months and 1 year. Unipolar modular has a lower rate of revision for the first 1.5 years. After 1.5 years, there is no difference. Bipolar hip replacement has a lower rate of revision than total conventional hip replacement for the entire period (Figure HT78).

Table HT68 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	11 Yrs
Unipolar Monoblock	1075	28312	2.9 (2.7, 3.1)	3.9 (3.7, 4.2)	4.6 (4.4, 5.0)	5.7 (5.3, 6.1)	6.4 (6.0, 6.9)	8.4 (7.6, 9.2)
Unipolar Modular	1514	44275	2.0 (1.9, 2.1)	2.8 (2.6, 2.9)	3.4 (3.2, 3.6)	4.7 (4.4, 5.0)	6.0 (5.6, 6.3)	8.5 (7.8, 9.2)
Bipolar	829	24314	2.3 (2.1, 2.5)	3.1 (2.9, 3.4)	3.7 (3.4, 3.9)	4.3 (4.0, 4.6)	4.9 (4.5, 5.3)	6.4 (5.8, 7.1)
Total Conventional	1127	22848	3.0 (2.8, 3.3)	3.8 (3.6, 4.1)	4.4 (4.1, 4.7)	5.3 (5.0, 5.6)	6.3 (5.9, 6.7)	8.3 (7.7, 9.0)
TOTAL	**4545**	**119749**						

Note: All procedures using metal/metal prostheses have been excluded

Figure HT76 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=1.00 (0.87, 1.15),p=0.980
3Mth+: HR=1.76 (1.58, 1.97),p<0.001

Unipolar Modular vs Total Conventional
0 - 1Mth: HR=0.74 (0.63, 0.87),p<0.001
1Mth - 3Mth: HR=0.95 (0.80, 1.12),p=0.504
3Mth - 1.5Yr: HR=0.93 (0.80, 1.07),p=0.298
1.5Yr+: HR=1.61 (1.43, 1.82),p<0.001

Bipolar vs Total Conventional
0 - 3Mth: HR=0.95 (0.83, 1.10),p=0.501
3Mth+: HR=1.02 (0.91, 1.15),p=0.714

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	11 Yrs
Unipolar Monoblock	28312	17270	13407	10315	5791	3238	994
Unipolar Modular	44275	30167	23618	18332	10595	5827	1458
Bipolar	24314	16501	12900	10088	6042	3843	1661
Total Conventional	22848	18248	15144	12331	7985	4949	1548

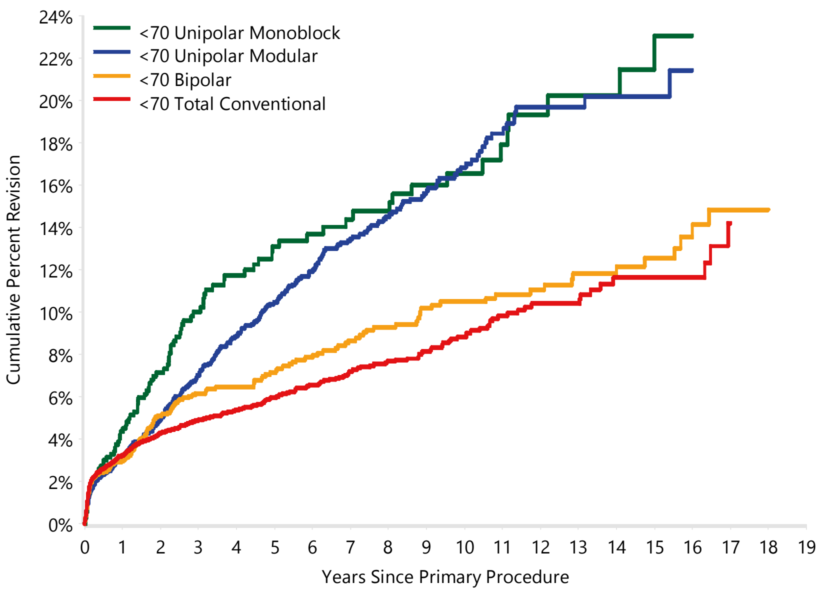
Note: All procedures using metal/metal prostheses have been excluded

Table HT69 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	11 Yrs
<70		**1022**	**13964**	**3.2 (2.9, 3.5)**	**4.7 (4.3, 5.1)**	**5.9 (5.5, 6.4)**	**7.6 (7.1, 8.2)**	**9.4 (8.8, 10.0)**	**12.5 (11.6, 13.4)**
	Unipolar Monoblock	94	917	4.4 (3.1, 6.1)	7.1 (5.4, 9.3)	10.0 (7.9, 12.6)	13.1 (10.5, 16.2)	14.4 (11.6, 17.7)	17.9 (14.3, 22.2)
	Unipolar Modular	326	3390	3.1 (2.6, 3.8)	4.9 (4.2, 5.8)	7.0 (6.1, 8.1)	10.5 (9.2, 11.8)	13.5 (12.0, 15.1)	18.4 (16.3, 20.8)
	Bipolar	173	2472	3.0 (2.4, 3.8)	5.1 (4.2, 6.2)	6.2 (5.2, 7.3)	7.2 (6.0, 8.5)	8.7 (7.3, 10.2)	10.8 (9.2, 12.8)
	Total Conventional	429	7185	3.2 (2.8, 3.7)	4.3 (3.8, 4.8)	4.9 (4.4, 5.5)	5.9 (5.4, 6.6)	7.2 (6.5, 8.0)	9.8 (8.7, 11.1)
≥70		**3523**	**105785**	**2.4 (2.3, 2.5)**	**3.1 (3.0, 3.2)**	**3.6 (3.5, 3.7)**	**4.5 (4.3, 4.6)**	**5.2 (5.0, 5.4)**	**6.8 (6.5, 7.2)**
	Unipolar Monoblock	981	27395	2.8 (2.6, 3.1)	3.8 (3.5, 4.1)	4.4 (4.1, 4.7)	5.3 (5.0, 5.7)	6.0 (5.6, 6.5)	7.8 (7.1, 8.6)
	Unipolar Modular	1188	40885	1.9 (1.8, 2.0)	2.6 (2.4, 2.7)	3.0 (2.8, 3.2)	4.0 (3.8, 4.3)	5.0 (4.7, 5.4)	6.8 (6.2, 7.5)
	Bipolar	656	21842	2.3 (2.1, 2.5)	2.8 (2.6, 3.1)	3.3 (3.1, 3.6)	3.9 (3.6, 4.2)	4.3 (3.9, 4.7)	5.6 (5.0, 6.2)
	Total Conventional	698	15663	2.9 (2.7, 3.2)	3.6 (3.3, 3.9)	4.1 (3.8, 4.5)	4.9 (4.6, 5.4)	5.8 (5.3, 6.3)	7.3 (6.6, 8.1)
TOTAL		**4545**	**119749**						

Note: All procedures using metal/metal prostheses have been excluded

Figure HT77 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=0.98 (0.60, 1.61),p=0.937
3Mth+: HR=2.37 (1.85, 3.04),p<0.001

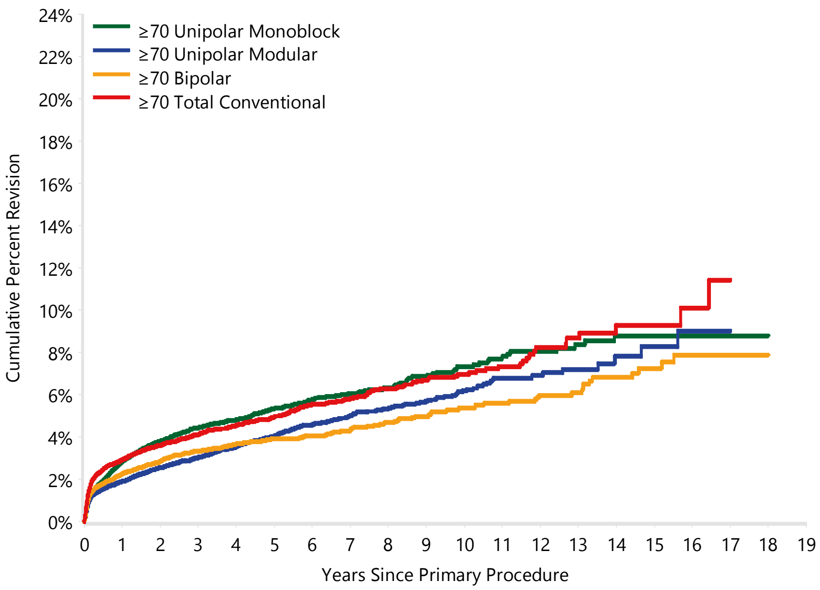
<70 Unipolar Modular vs <70 Total Conventional
0 - 1.5Yr: HR=1.04 (0.84, 1.28),p=0.744
1.5Yr - 3Yr: HR=2.25 (1.65, 3.06),p<0.001
3Yr - 3.5Yr: HR=4.26 (2.26, 8.01),p<0.001
3.5Yr+: HR=2.64 (2.07, 3.36),p<0.001

<70 Bipolar vs <70 Total Conventional
Entire Period: HR=1.15 (0.96, 1.37),p=0.128

Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	11 Yrs
<70	Unipolar Monoblock	917	619	518	435	307	234	117
	Unipolar Modular	3390	2576	2157	1836	1317	898	338
	Bipolar	2472	1864	1574	1332	978	748	472
	Total Conventional	7185	5882	4985	4179	2891	1964	715

Note: All procedures using metal/metal prostheses have been excluded

Figure HT78 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=1.05 (0.81, 1.36),p=0.715
- 2Wk - 1Mth: HR=0.73 (0.58, 0.90),p=0.003
- 1Mth - 3Mth: HR=0.62 (0.50, 0.76),p<0.001
- 3Mth - 6Mth: HR=1.25 (0.97, 1.62),p=0.090
- 6Mth - 1Yr: HR=1.80 (1.45, 2.23),p<0.001
- 1Yr - 1.5Yr: HR=1.28 (0.98, 1.67),p=0.072
- 1.5Yr+: HR=1.09 (0.93, 1.28),p=0.287

≥70 Unipolar Modular vs ≥70 Total Conventional
- 0 - 3Mth: HR=0.64 (0.56, 0.73),p<0.001
- 3Mth - 1.5Yr: HR=0.72 (0.61, 0.84),p<0.001
- 1.5Yr+: HR=1.02 (0.88, 1.18),p=0.801

≥70 Bipolar vs ≥70 Total Conventional
- Entire Period: HR=0.77 (0.69, 0.85),p<0.001

	Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	11 Yrs
≥70	Unipolar Monoblock	27395	16651	12889	9880	5484	3004	877
	Unipolar Modular	40885	27591	21461	16496	9278	4929	1120
	Bipolar	21842	14637	11326	8756	5064	3095	1189
	Total Conventional	15663	12366	10159	8152	5094	2985	833

Note: All procedures using metal/metal prostheses have been excluded

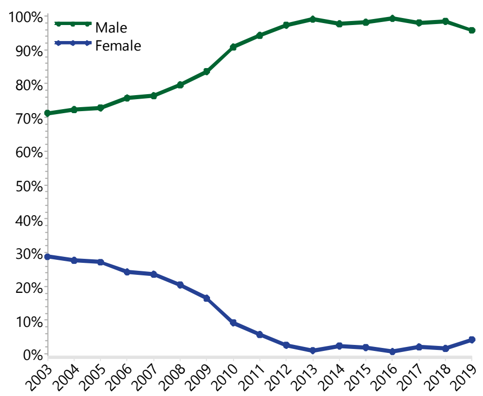
PRIMARY TOTAL RESURFACING HIP REPLACEMENT

DEMOGRAPHICS

There have been 18,250 primary total resurfacing hip replacement procedures reported to the Registry. This is an additional 521 procedures compared to the last report.

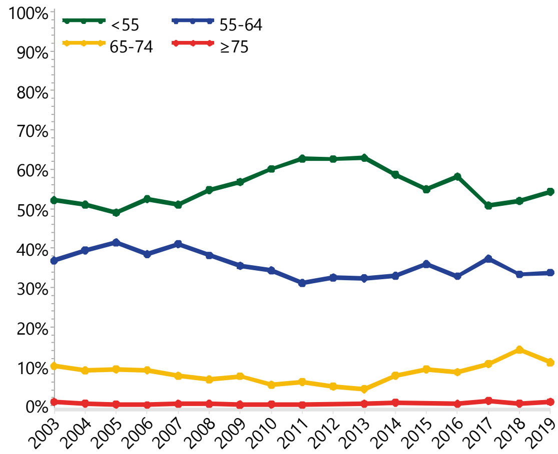
The use of primary total resurfacing hip replacement in Australia has been declining since 2005. In 2019, the number of primary total resurfacing procedures is 36.7% more than in 2018, and 71.6% less than in 2005. Primary total resurfacing hip replacement represents 1.0% of all hip replacements performed in 2019.
In 2019, 80.2% of primary total resurfacing hip replacements were undertaken in males (Table HT70 and Figure HT79).

Figure HT79 Primary Total Resurfacing Hip Replacement by Gender



There is a small decrease in the proportion of patients aged 65-74 years receiving primary total resurfacing hip replacement in 2019 (Figure HT80).

Figure HT80 Primary Total Resurfacing Hip Replacement by Age



There were only three different types of resurfacing prostheses used in 2019, with the Adept the most commonly used, accounting for 57.0% of procedures. The ReCerf resurfacing head was used for the first time in 2018 (Table HT71).

Table HT70 Age and Gender of Primary Total Resurfacing Hip Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	14639	80.2%	13	82	54	53.4	9.1
Female	3611	19.8%	14	81	53	51.6	8.6
TOTAL	**18250**	**100.0%**	**13**	**82**	**54**	**53.1**	**9.0**

Table HT71 Most Used Resurfacing Heads in Primary Total Resurfacing Hip Replacement

2003		2016		2017		2018		2019	
N	Model	N	Model	N	Model	N	Model	N	Model
1359	BHR	258	Adept	268	Adept	246	Adept	297	Adept
58	Durom	165	BHR	126	BHR	132	BHR	143	BHR
43	ASR					3	ReCerf	81	ReCerf
42	Cormet								
38	Cormet 2000 HAP								
7	Conserve Plus								
10 Most Used									
1547	(6) 100.0%	423	(2) 100.0%	394	(2) 100.0%	381	(3) 100.0%	521	(3) 100.0%

OUTCOME FOR ALL DIAGNOSES

Primary Diagnosis

The principal diagnosis for primary total resurfacing hip replacement is osteoarthritis (95.4%), followed by developmental dysplasia (2.2%) and osteonecrosis (1.6%). Primary total resurfacing hip replacement for osteoarthritis has a lower rate of revision compared to developmental dysplasia. There is no difference in the rate of revision for osteonecrosis compared to osteoarthritis (Table HT72 and Figure HT81).

Prosthesis Types

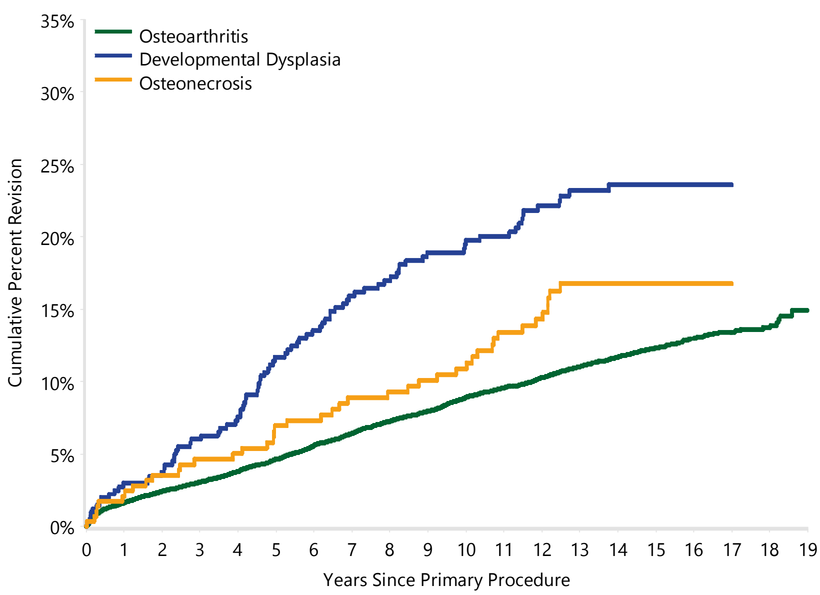
The cumulative percent revision of different primary total resurfacing hip prosthesis combinations with more than 100 procedures is listed in Table HT73. At 10 years, the prosthesis with the lowest cumulative percent revision is the Mitch TRH (5.3%).

Table HT72 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement by Primary Diagnosis

Primary Diagnosis	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Osteoarthritis	1694	17414	1.6 (1.5, 1.8)	2.4 (2.2, 2.7)	4.7 (4.3, 5.0)	8.9 (8.5, 9.4)	12.3 (11.7, 12.9)	14.9 (13.6, 16.3)
Developmental Dysplasia	89	407	3.0 (1.7, 5.2)	3.7 (2.3, 6.1)	11.7 (8.9, 15.3)	19.7 (16.1, 24.1)	23.6 (19.6, 28.3)	
Osteonecrosis	42	290	2.1 (0.9, 4.6)	3.5 (1.9, 6.5)	6.9 (4.5, 10.7)	10.9 (7.7, 15.3)	16.8 (12.6, 22.1)	
Other (6)	22	139	2.2 (0.7, 6.5)	3.7 (1.5, 8.6)	9.3 (5.4, 15.9)	15.7 (10.3, 23.5)	18.1 (12.1, 26.7)	
TOTAL	**1847**	**18250**						

Note: Only primary diagnoses with over 100 procedures have been listed

Figure HT81 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement by Primary Diagnosis



HR - adjusted for age and gender

Developmental Dysplasia vs Osteoarthritis
Entire Period: HR=1.40 (1.12, 1.74),p=0.002

Developmental Dysplasia vs Osteonecrosis
Entire Period: HR=1.05 (0.73, 1.52),p=0.784

Osteonecrosis vs Osteoarthritis
Entire Period: HR=1.33 (0.97, 1.81),p=0.075

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Osteoarthritis	17414	16607	15563	14468	10969	4020	74
Developmental Dysplasia	407	387	370	340	285	144	4
Osteonecrosis	290	275	254	243	216	116	6

Table HT73 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement by Prosthesis Combination

Head Component	Acetabular Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
ASR	ASR*	392	1168	3.4 (2.5, 4.6)	7.2 (5.9, 8.8)	15.4 (13.4, 17.6)	29.8 (27.2, 32.5)	35.5 (32.7, 38.5)	
Adept	Adept	51	2017	0.9 (0.6, 1.5)	1.5 (1.0, 2.2)	2.1 (1.5, 3.0)	5.4 (3.9, 7.6)		
BHR	BHR	961	11782	1.4 (1.2, 1.6)	2.5 (2.2, 2.8)	3.5 (3.1, 3.8)	6.6 (6.2, 7.1)	9.7 (9.1, 10.3)	12.3 (11.0, 13.7)
Bionik	Bionik*	59	200	3.5 (1.7, 7.2)	12.5 (8.7, 18.0)	18.6 (13.8, 24.7)	27.4 (21.7, 34.2)		
Cormet	Cormet*	127	626	2.1 (1.2, 3.6)	5.6 (4.1, 7.7)	9.7 (7.6, 12.3)	17.3 (14.5, 20.5)	22.8 (19.3, 26.8)	
Durom	Durom*	110	847	3.3 (2.3, 4.8)	5.6 (4.2, 7.3)	7.7 (6.1, 9.7)	11.0 (9.0, 13.3)	14.0 (11.7, 16.7)	
Icon	Icon*	17	118	1.7 (0.4, 6.6)	4.2 (1.8, 9.9)	5.9 (2.9, 12.0)	11.2 (6.6, 18.5)		
Mitch TRH	Mitch TRH*	55	1024	1.2 (0.7, 2.1)	2.1 (1.4, 3.2)	2.6 (1.8, 3.8)	5.3 (4.0, 6.9)		
Recap	Recap*	29	196	5.1 (2.8, 9.3)	8.7 (5.5, 13.6)	10.2 (6.7, 15.4)	14.5 (10.2, 20.3)		
Other (9)		46	272	4.3 (2.3, 7.9)	6.5 (3.9, 10.7)	8.6 (5.5, 13.4)	17.6 (12.8, 23.8)	24.6 (18.9, 31.6)	
TOTAL		**1847**	**18250**						

Note: Only combinations with over 100 procedures have been listed
* denotes prosthesis combinations with no reported use in primary total resurfacing hip replacement in 2019

OUTCOME FOR OSTEOARTHRITIS

The cumulative percent revision at 19 years for primary total resurfacing hip replacement undertaken for osteoarthritis is 14.9% (Table HT74 and Figure HT82).

Reasons for Revision

The main reasons for revision of primary total resurfacing hip replacement are metal related pathology (27.7%), loosening (24.9%) and fracture (17.5%) (Table HT75).

Metal related pathology is the most common reason for revision after 7 years.

The five most common reasons for revision are shown in Figure HT83. 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 metal related pathology 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 (72.3%). Femoral only revision is much less common (22.4%) and acetabular only revision is rarely undertaken (2.6%) (Table HT76).

Age and Gender

In the first 6 months, patients aged ≥65 years have a higher rate of revision compared to patients aged <55 years and patients aged 55-64 years. After 6 months, patients aged ≥65 years have a lower rate of revision compared to patients aged <55 years and patients aged 55-64 years (Table HT77 and Figure HT84).

Females have a higher rate of revision compared to males. After 1 year, the rate of revision is over two times higher (Table HT78 and Figure HT85). Males aged ≥65 years have a higher rate of revision compared to males aged <55 years and 55-64 years, for the first 6 months only. After this time, they have a lower rate of revision (Figure HT86). Females aged ≥65 years have a lower rate of revision compared to females aged <55 years after 3 months (Figure HT87).

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. There is no difference for head sizes 50-54mm compared to ≥55mm (Table HT79 and Figure HT88).

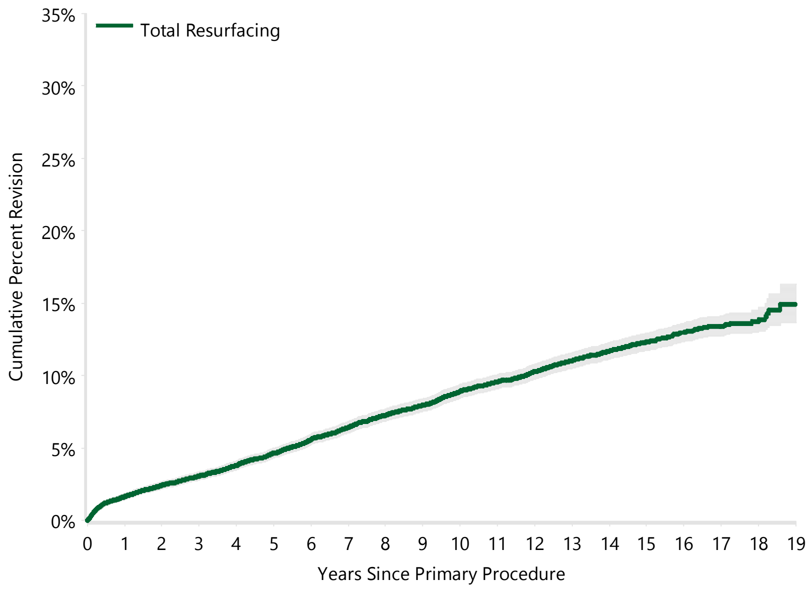
The reason for revision varies with head size. Head sizes <50mm have a higher cumulative incidence of metal related pathology, loosening, fracture, pain, and lysis compared to head sizes ≥50mm (Figure HT89).

This effect of femoral component head size is evident in both males and females (Table HT80 and Figure HT90).

Table HT74 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	19 Yrs
Total Resurfacing	1694	17414	1.6 (1.5, 1.8)	3.1 (2.8, 3.3)	4.7 (4.3, 5.0)	8.9 (8.5, 9.4)	12.3 (11.7, 12.9)	14.9 (13.6, 16.3)
TOTAL	**1694**	**17414**						

Figure HT82 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	19 Yrs
Total Resurfacing	17414	16607	15563	14468	10969	4020	74

Table HT75 Primary Total Resurfacing Hip Replacement by Reason for Revision (Primary Diagnosis OA)

Reason for Revision	Number	Percent
Metal Related Pathology	470	27.7
Loosening	422	24.9
Fracture	296	17.5
Lysis	155	9.1
Pain	105	6.2
Infection	103	6.1
Osteonecrosis	42	2.5
Prosthesis Dislocation	23	1.4
Malposition	22	1.3
Other (10)	36	2.1
Other	20	1.2
TOTAL	**1694**	**100.0**

Table HT76 Primary Total Resurfacing Hip Replacement by Type of Revision (Primary Diagnosis OA)

Type of Revision	Number	Percent
THR (Femoral/Acetabular)	1224	72.3
Femoral Component	380	22.4
Acetabular Component	44	2.6
Cement Spacer	36	2.1
Removal of Prostheses	10	0.6
TOTAL	**1694**	**100.0**

Figure HT83 Cumulative Incidence Revision Diagnosis of Primary Total Resurfacing Hip Replacement (Primary Diagnosis OA)

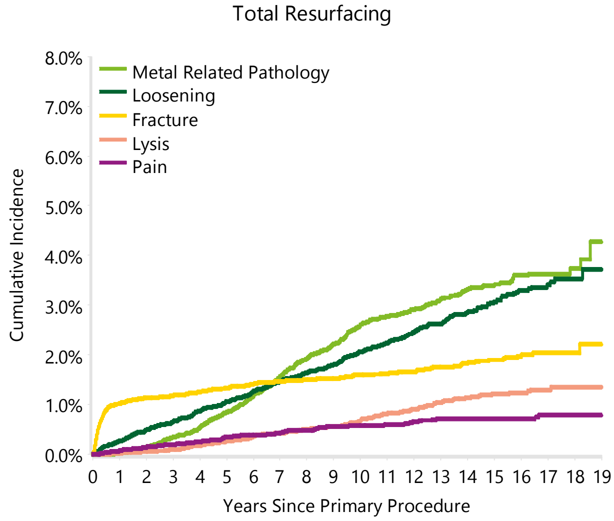
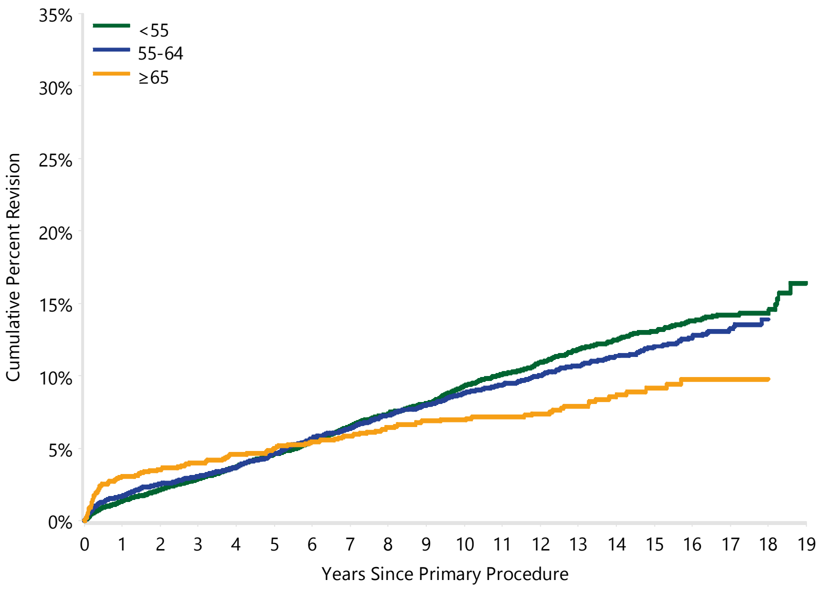


Table HT77 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement by Age (Primary Diagnosis OA)

Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
<55	936	9178	1.4 (1.1, 1.6)	2.9 (2.6, 3.3)	4.6 (4.2, 5.1)	9.3 (8.7, 10.0)	13.1 (12.3, 14.0)	16.4 (14.4, 18.7)
55-64	641	6630	1.7 (1.4, 2.1)	3.1 (2.7, 3.5)	4.6 (4.1, 5.2)	8.8 (8.1, 9.6)	12.0 (11.1, 13.0)	
≥65	117	1606	3.0 (2.3, 4.0)	4.0 (3.1, 5.1)	5.0 (4.0, 6.2)	7.0 (5.8, 8.4)	9.1 (7.6, 11.0)	
TOTAL	**1694**	**17414**						

Figure HT84 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement by Age (Primary Diagnosis OA)



HR - adjusted for gender

55-64 vs <55
0 - 5.5Yr: HR=1.07 (0.93, 1.23),p=0.356
5.5Yr+: HR=0.86 (0.75, 0.99),p=0.032

≥65 vs <55
0 - 3Mth: HR=2.96 (1.94, 4.54),p<0.001
3Mth - 6Mth: HR=2.60 (1.43, 4.75),p=0.001
6Mth+: HR=0.66 (0.52, 0.83),p<0.001

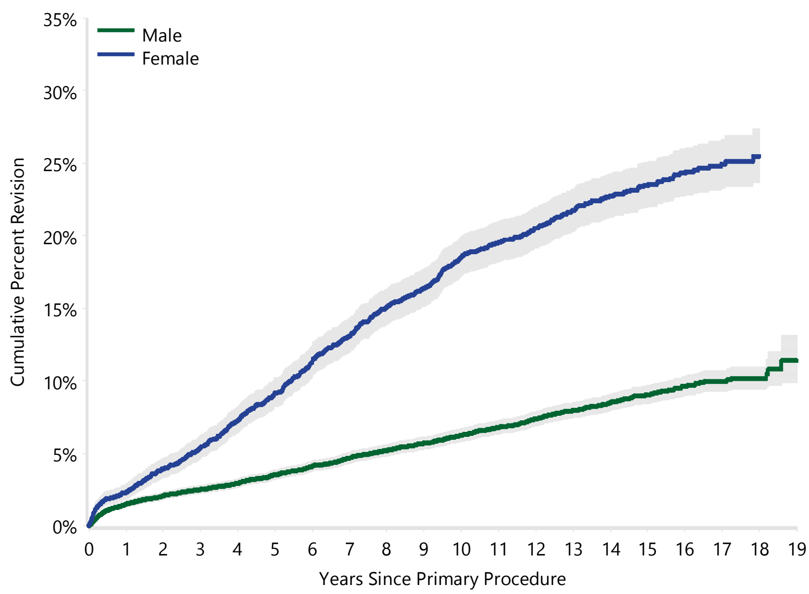
≥65 vs 55-64
0 - 6Mth: HR=2.33 (1.62, 3.35),p<0.001
6Mth+: HR=0.71 (0.56, 0.90),p=0.005

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
<55	9178	8782	8249	7649	5641	2124	50
55-64	6630	6336	5955	5563	4338	1535	21
≥65	1606	1489	1359	1256	990	361	3

Table HT78 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	19 Yrs
Male		**963**	**14127**	**1.5 (1.3, 1.7)**	**2.5 (2.3, 2.8)**	**3.5 (3.2, 3.8)**	**6.3 (5.8, 6.7)**	**9.0 (8.5, 9.7)**	**11.4 (9.9, 13.1)**
	<55	501	7284	1.2 (0.9, 1.4)	2.3 (2.0, 2.7)	3.3 (2.9, 3.7)	6.2 (5.6, 6.8)	9.4 (8.6, 10.3)	
	55-64	365	5370	1.5 (1.2, 1.9)	2.4 (2.0, 2.9)	3.6 (3.1, 4.1)	6.3 (5.6, 7.1)	8.8 (7.9, 9.8)	
	≥65	97	1473	3.0 (2.2, 4.0)	3.8 (2.9, 4.9)	4.7 (3.7, 5.9)	6.3 (5.1, 7.8)	8.2 (6.7, 10.1)	
Female		**731**	**3287**	**2.3 (1.8, 2.9)**	**5.4 (4.7, 6.2)**	**9.2 (8.2, 10.2)**	**18.5 (17.2, 19.9)**	**23.5 (22.0, 25.1)**	
	<55	435	1894	2.1 (1.6, 2.9)	5.1 (4.2, 6.2)	9.3 (8.1, 10.8)	19.2 (17.5, 21.1)	24.3 (22.3, 26.4)	
	55-64	276	1260	2.4 (1.7, 3.4)	5.7 (4.6, 7.2)	9.0 (7.5, 10.7)	18.1 (16.0, 20.4)	22.9 (20.5, 25.5)	
	≥65	20	133	3.8 (1.6, 8.8)	6.0 (3.1, 11.7)	8.3 (4.7, 14.5)	13.1 (8.3, 20.2)	16.9 (11.1, 25.3)	
TOTAL		**1694**	**17414**						

Figure HT85 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement by Gender (Primary Diagnosis OA)



HR - adjusted for age

Female vs Male

0 - 3Mth: HR=2.09 (1.46, 2.98),p<0.001

3Mth - 6Mth: HR=1.27 (0.74, 2.18),p=0.388

6Mth - 1Yr: HR=0.93 (0.51, 1.69),p=0.802

1Yr - 1.5Yr: HR=2.65 (1.65, 4.25),p<0.001

1.5Yr - 2.5Yr: HR=2.95 (2.02, 4.31),p<0.001

2.5Yr - 5Yr: HR=3.93 (3.13, 4.93),p<0.001

5Yr - 6Yr: HR=3.94 (2.82, 5.50),p<0.001

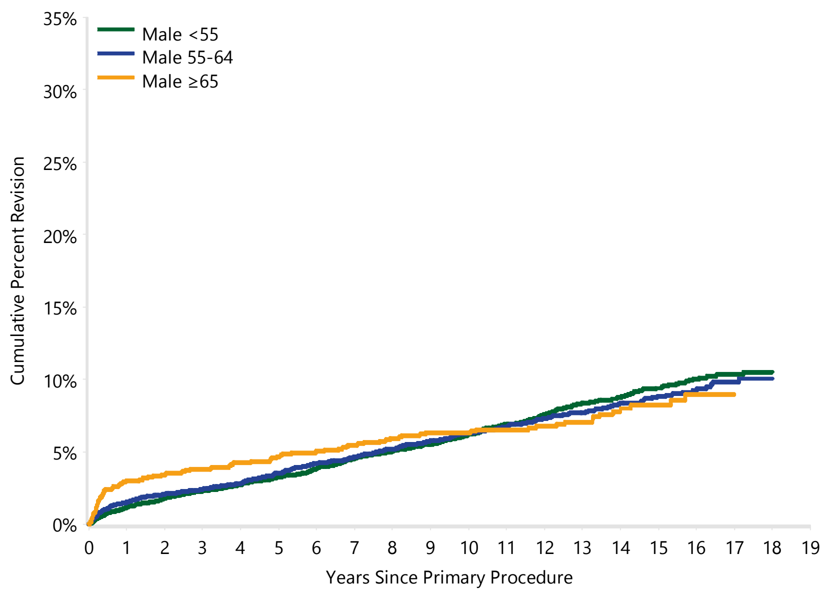
6Yr - 6.5Yr: HR=4.74 (2.82, 7.95),p<0.001

6.5Yr - 9.5Yr: HR=3.66 (2.96, 4.53),p<0.001

9.5Yr+: HR=2.16 (1.77, 2.64),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Male	14127	13417	12492	11540	8498	2957	53
Female	3287	3190	3129	3071	2928	2778	2281

Figure HT86 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement in Males by Age (Primary Diagnosis OA)



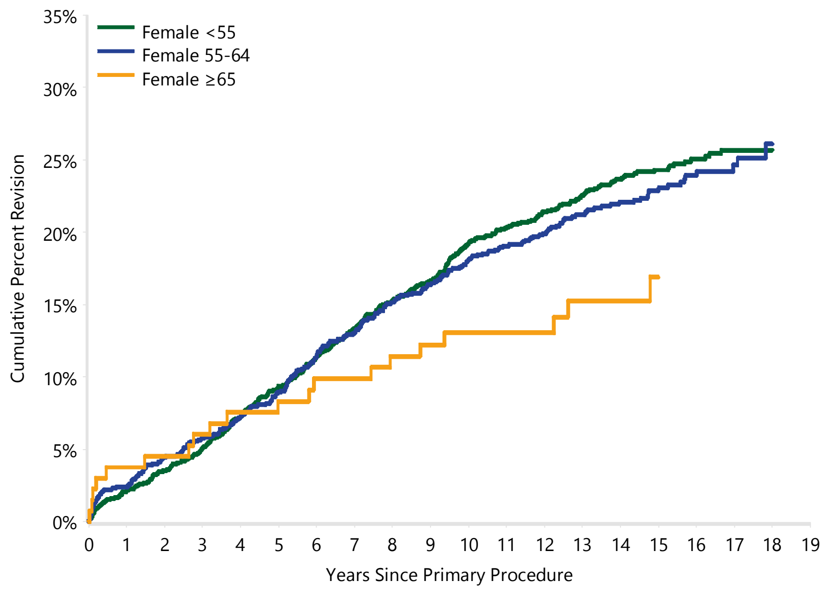
Male 55-64 vs Male <55
0 - 1Mth: HR=2.46 (1.15, 5.24),p=0.019
1Mth+: HR=0.94 (0.82, 1.08),p=0.366

Male ≥65 vs Male <55
0 - 6Mth: HR=2.83 (1.92, 4.18),p<0.001
6Mth+: HR=0.71 (0.54, 0.93),p=0.011

Male ≥65 vs Male 55-64
0 - 6Mth: HR=2.62 (1.78, 3.86),p<0.001
6Mth+: HR=0.75 (0.57, 0.98),p=0.037

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Male	<55	7284	6942	6476	5968	4224	1530	34
	55-64	5370	5114	4780	4435	3387	1112	16
	≥65	1473	1361	1236	1137	887	315	3

Figure HT87 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement in Females by Age (Primary Diagnosis OA)



Female 55-64 vs Female <55
Entire Period: HR=0.95 (0.81, 1.10),p=0.481

Female ≥65 vs Female <55
0 - 3Mth: HR=2.29 (0.82, 6.39),p=0.115
3Mth+: HR=0.55 (0.33, 0.90),p=0.017

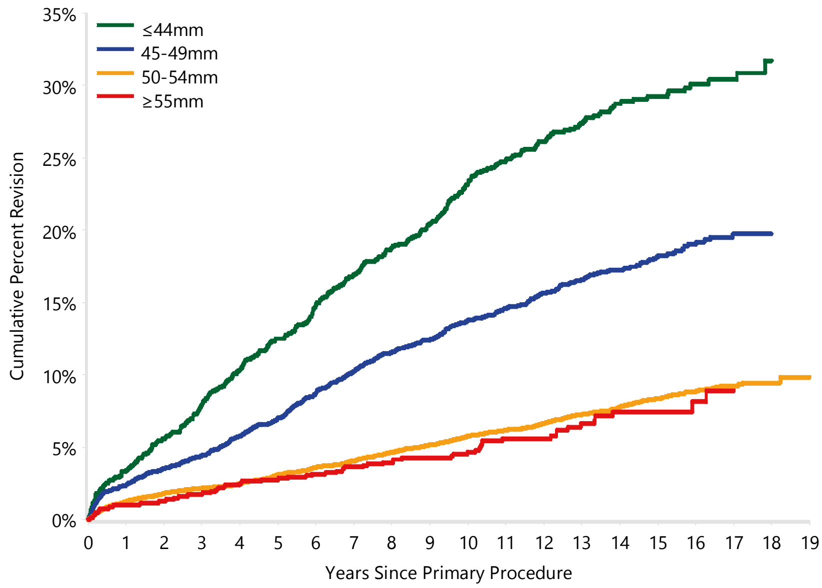
Female ≥65 vs Female 55-64
Entire Period: HR=0.68 (0.43, 1.07),p=0.096

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Female	<55	1894	1840	1773	1681	1417	594	16
	55-64	1260	1222	1175	1128	951	423	5
	≥65	133	128	123	119	103	46	0

Table HT79 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	19 Yrs
≤44mm	336	1203	3.4 (2.5, 4.6)	8.0 (6.6, 9.6)	12.5 (10.8, 14.5)	23.2 (20.9, 25.7)	29.2 (26.6, 32.0)	
45-49mm	593	3900	2.4 (1.9, 2.9)	4.4 (3.8, 5.1)	7.0 (6.2, 7.9)	13.8 (12.7, 15.0)	18.2 (16.8, 19.6)	
50-54mm	698	11082	1.3 (1.1, 1.5)	2.2 (1.9, 2.5)	3.1 (2.8, 3.5)	5.8 (5.3, 6.3)	8.4 (7.7, 9.0)	9.8 (8.8, 11.0)
≥55mm	67	1229	1.0 (0.6, 1.7)	1.8 (1.2, 2.7)	2.7 (2.0, 3.9)	4.6 (3.5, 6.1)	7.4 (5.8, 9.6)	
TOTAL	**1694**	**17414**						

Figure HT88 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=2.98 (2.23, 4.00),p<0.001

45-49mm vs ≥55mm

Entire Period: HR=2.09 (1.60, 2.73),p<0.001

50-54mm vs ≥55mm

Entire Period: HR=1.11 (0.86, 1.43),p=0.418

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
≤44mm	1203	1153	1094	1034	855	379	7
45-49mm	3900	3715	3517	3280	2552	885	13
50-54mm	11082	10562	9837	9119	6815	2563	49
≥55mm	1229	1177	1115	1035	747	193	5

Figure HT89 Cumulative Incidence Revision Diagnosis of Primary Total Resurfacing Hip Replacement by Head Size (Primary Diagnosis OA)

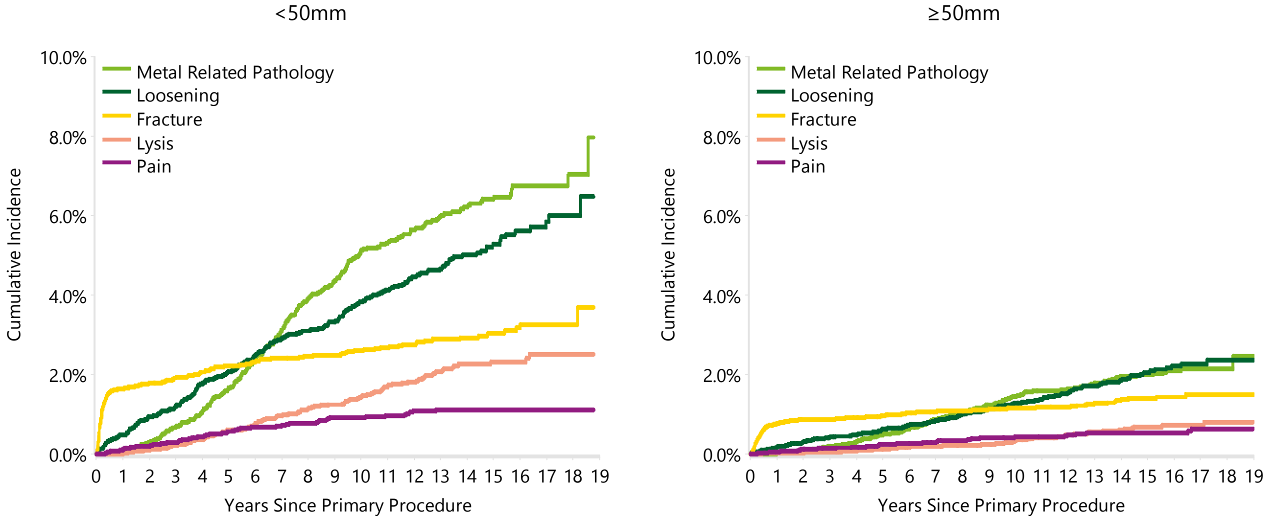
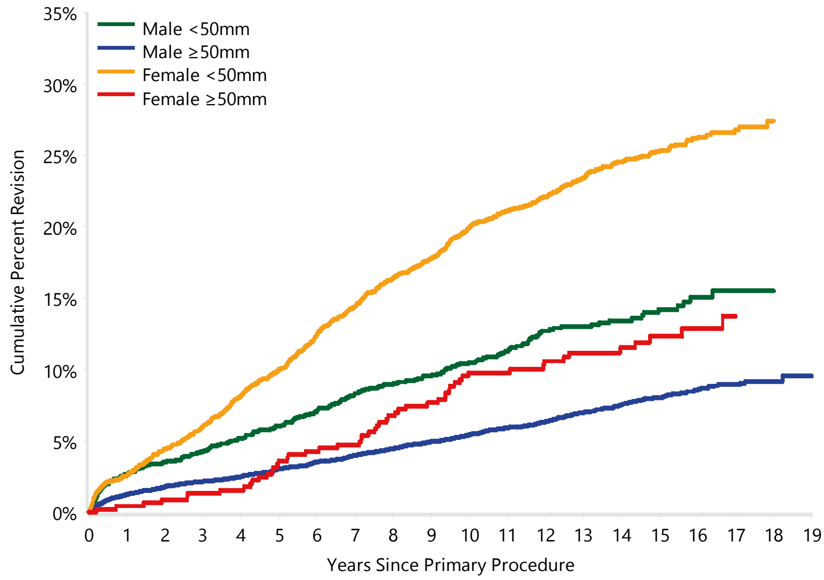


Table HT80 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement by Gender and Femoral Head Size (Primary Diagnosis OA)

Gender	Femoral Head Size	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Male		**963**	**14127**	**1.5 (1.3, 1.7)**	**2.5 (2.3, 2.8)**	**3.5 (3.2, 3.8)**	**6.3 (5.8, 6.7)**	**9.0 (8.5, 9.7)**	**11.4 (9.9, 13.1)**
	<50mm	251	2268	2.7 (2.1, 3.4)	4.3 (3.5, 5.2)	6.0 (5.1, 7.1)	10.5 (9.2, 12.0)	14.2 (12.5, 16.1)	
	≥50mm	712	11859	1.3 (1.1, 1.5)	2.2 (1.9, 2.4)	3.0 (2.7, 3.4)	5.4 (5.0, 5.9)	8.1 (7.5, 8.7)	9.5 (8.5, 10.7)
Female		**731**	**3287**	**2.3 (1.8, 2.9)**	**5.4 (4.7, 6.2)**	**9.2 (8.2, 10.2)**	**18.5 (17.2, 19.9)**	**23.5 (22.0, 25.1)**	
	<50mm	678	2835	2.6 (2.1, 3.2)	6.0 (5.2, 7.0)	10.0 (9.0, 11.2)	19.9 (18.5, 21.5)	25.3 (23.6, 27.0)	
	≥50mm	53	452	0.4 (0.1, 1.8)	1.3 (0.6, 3.0)	3.6 (2.2, 5.8)	9.8 (7.3, 13.0)	12.3 (9.5, 16.0)	
TOTAL		**1694**	**17414**						

Figure HT90 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=1.93 (1.67, 2.22),p<0.001

Male <50mm vs Female <50mm
0 - 6Mth: HR=0.76 (0.54, 1.06),p=0.109
6Mth+: HR=0.51 (0.44, 0.60),p<0.001

Male ≥50mm vs Female ≥50mm
0 - 7Yr: HR=0.89 (0.58, 1.38),p=0.608
7Yr - 9Yr: HR=0.32 (0.18, 0.56),p<0.001
9Yr+: HR=0.58 (0.36, 0.92),p=0.020

Female <50mm vs Female ≥50mm
0 - 4.5Yr: HR=3.98 (2.19, 7.25),p<0.001
4.5Yr - 5Yr: HR=0.80 (0.32, 2.00),p=0.635
5Yr+: HR=1.95 (1.39, 2.72),p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Male	<50mm	2268	2126	1980	1814	1313	392	3
	≥50mm	11859	11291	10512	9726	7185	2565	50
Female	<50mm	2835	2742	2631	2500	2094	872	17
	≥50mm	452	448	440	428	377	191	4

OUTCOMES OF PRIMARY TOTAL RESURFACING COMPARED TO PRIMARY TOTAL CONVENTIONAL HIP REPLACEMENT

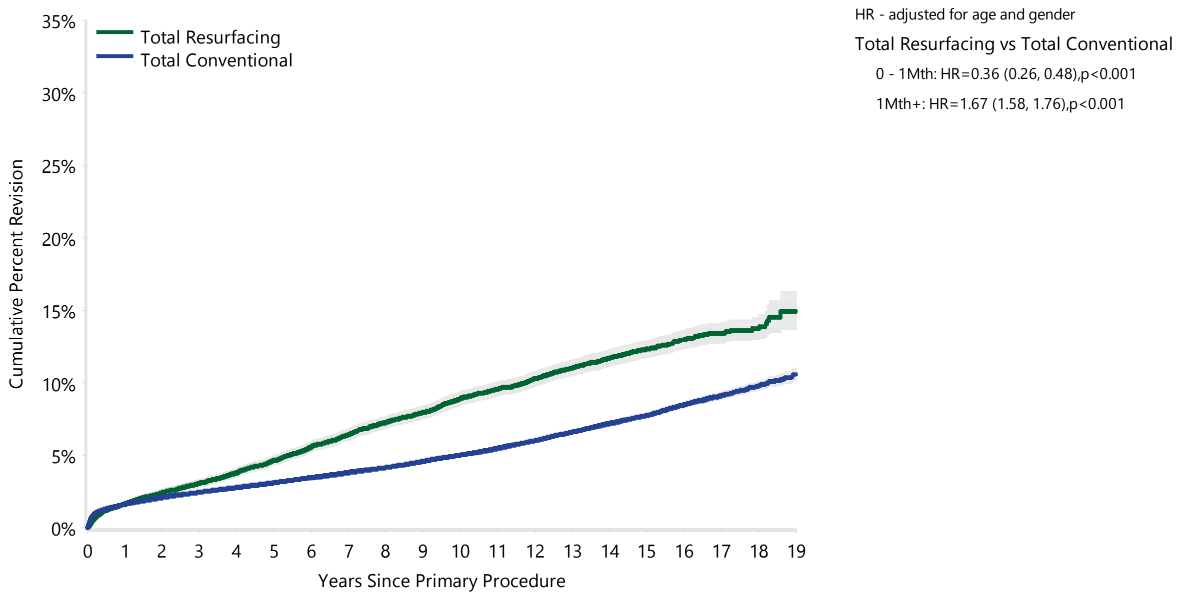
The rate of revision for osteoarthritis in primary total resurfacing and primary total conventional hip replacement were compared. Primary total resurfacing has a lower rate of revision than primary total conventional hip replacement in the first month. After this time, primary total resurfacing has a higher rate of revision (Table HT81 and Figure HT91).

Table HT81 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	19 Yrs
Total Resurfacing	1694	17414	1.6 (1.5, 1.8)	3.1 (2.8, 3.3)	4.7 (4.3, 5.0)	8.9 (8.5, 9.4)	12.3 (11.7, 12.9)	14.9 (13.6, 16.3)
Total Conventional	16369	421141	1.6 (1.6, 1.7)	2.5 (2.4, 2.5)	3.1 (3.1, 3.2)	5.0 (4.9, 5.1)	7.8 (7.6, 7.9)	10.6 (10.1, 11.0)
TOTAL	**18063**	**438555**						

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

Figure HT91 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	19 Yrs
Total Resurfacing	17414	16607	15563	14468	10969	4020	74
Total Conventional	421141	376562	299643	228947	94661	27202	1245

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

Knee Replacement

Knee Replacement

CATEGORIES OF KNEE REPLACEMENT

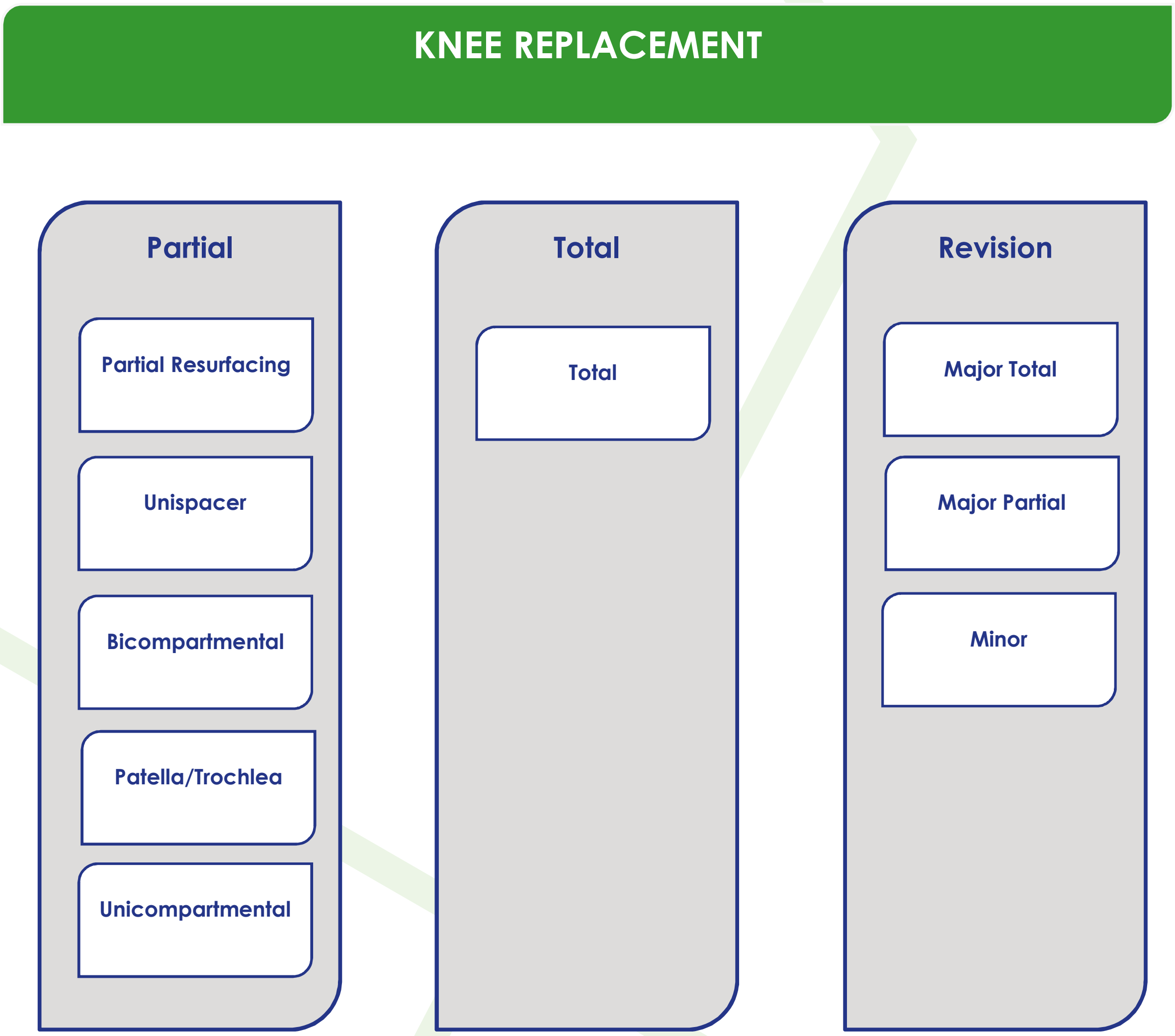
The Registry groups knee replacement into three broad categories: primary partial, primary total and revision knee replacement.

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, or 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-2020



USE OF KNEE REPLACEMENT

This report analyses 849,329 knee replacements with a procedure date up to and including 31 December 2019. This is an additional 66,729 knee procedures compared to the number reported last year. When considering all knee procedures currently recorded by the Registry, primary partial knee accounts for 7.7%, primary total knee 84.3% and revision knee replacement 8.1% (Table K1).

Table K1 Number of Knee Replacements

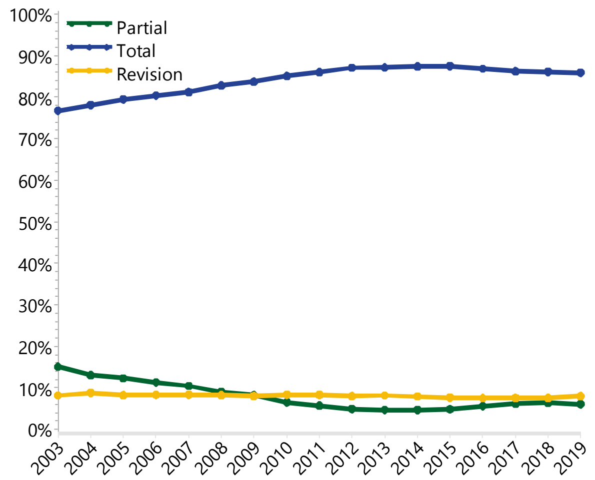
Knee Category	Number	Percent
Partial	65064	7.7
Total	715785	84.3
Revision	68480	8.1
TOTAL	**849329**	**100.0**

In 2019, the number of knee replacements undertaken has increased by 847 (1.3%) compared to 2018. During the last year, primary partial knee replacement decreased by 3.0% and primary total knee replacement increased by 1.1%. There was an increase in revision knee replacement (7.6%).

Since 2003, the number of knee replacement procedures undertaken annually has increased by 133.1%. Primary total knee replacement has increased by 160.9% and revision knee replacement by 129.3%. Primary partial knee replacement has decreased by 6.0%.

In 2019, primary total knee replacement accounts for 85.9% of all knee replacement procedures. This has increased from 76.7% in 2003. Primary partial knee replacement decreased from 15.1% in 2003 to 6.1% in 2019. The proportion of revision knee procedures has declined from a peak of 8.8% in 2004 to 8.0% in 2019. This equates to 515 fewer revision procedures in 2019 than would have been expected if the proportion of revision procedures had remained at 8.8% (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). The Registry commenced collecting ASA score in 2012 and BMI data in 2015.

There are ASA score data on 401,475 and BMI data on 292,969 knee replacement procedures. Since its initial collection in 2012, ASA score has been recorded for 95.8% of procedures. BMI has been recorded for 93.3% of procedures since 2015, when its collection commenced.

In 2019, ASA score is reported in 99.9% of knee replacement procedures and BMI data are reported in 98.1% of procedures.

BMI data are reported for 98.7% of primary partial knees, 98.5% of primary total knees and 93.0% of revision knee replacement procedures.

ASA score and BMI are both known to impact the outcome of knee replacement surgery.

ASA Score

There are five ASA score classifications:

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

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

Overall, in 92.6% of procedures, patients have an ASA score of 2 or 3, 6.1% 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 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 (74.6% and 60.9%, respectively). For patients undergoing revision knee replacement surgery, there are a lower proportion with ASA scores 1 or 2 (46.0%) (Table K2).

BMI

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

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

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

For all knee replacements, the majority of procedures are undertaken in patients that are either pre-obese or obese class 1 (62.3%). There is almost no 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, with 55.3% of procedures undertaken in patients in either the normal or pre-obese categories, compared to 41.5% for primary total knee and 40.8% for revision knee replacement (Table K3).

Table K2 ASA Score for Knee Replacement

ASA Score	Partial		Total		Revision		TOTAL	
	N	Col%	N	Col%	N	Col%	N	Col%
ASA 1	2929	13.1	20554	5.9	1186	3.8	24669	6.1
ASA 2	13822	61.6	191563	55.0	13384	43.2	218769	54.5
ASA 3	5584	24.9	132056	37.9	15188	49.0	152828	38.1
ASA 4	108	0.5	3839	1.1	1241	4.0	5188	1.3
ASA 5			10	0.0	11	0.0	21	0.0
TOTAL	**22443**	**100.0**	**348022**	**100.0**	**31010**	**100.0**	**401475**	**100.0**

Table K3 BMI Category for Knee Replacement

BMI Category	Partial		Total		Revision		TOTAL	
	N	Col%	N	Col%	N	Col%	N	Col%
Underweight	32	0.2	504	0.2	75	0.4	611	0.2
Normal	2568	14.8	26477	10.4	2306	10.8	31351	10.7
Pre Obese	7061	40.6	78993	31.1	6418	30.0	92472	31.6
Obese Class 1	5290	30.4	78126	30.7	6526	30.5	89942	30.7
Obese Class 2	1800	10.3	43202	17.0	3715	17.4	48717	16.6
Obese Class 3	657	3.8	26876	10.6	2343	11.0	29877	10.2
TOTAL	**17408**	**100.0**	**254178**	**100.0**	**21383**	**100.0**	**292969**	**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. Previously, detailed information on partial knees was included in the Annual Report. Since 2019, it has been provided as a separate supplementary report with the aim of streamlining the Annual Report. The Partial Knee Arthroplasty Report is one of 13 supplementary reports that complete the AOANJRR Annual Report for 2020 and is available on the AOANJRR website.

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 92.8% of all partial knee replacement procedures. The second most common class is patella/trochlear replacement (6.5%). Within the remaining three classes (partial resurfacing, unispacer and bicompartmental knee replacement) only small numbers of procedures have been reported (Table KP1).

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. These classes of partial knee replacement are not presented in detail in this report.

Detailed information on unispacer and bicompartmental knee replacement is available in the supplementary report 'Prosthesis Types No Longer Used' on the AOANJRR website: https://aoanjrr.sahmri.com/annual-reports-2020

Table KP1 Partial Knee Replacement by Class

Partial Knee Class	Number	Percent
Partial Resurfacing	245	0.4
Unispacer	40	0.1
Bicompartmental	165	0.3
Patella/Trochlea	4227	6.5
Unicompartmental	60387	92.8
TOTAL	**65064**	**100.0**

PARTIAL RESURFACING

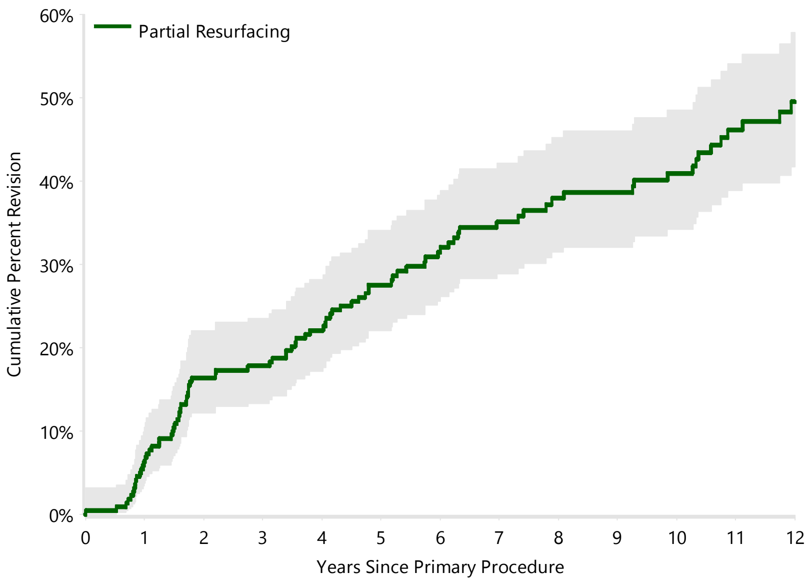
The Registry has recorded 245 partial resurfacing knee procedures undertaken for all diagnoses. This is an additional 1 procedure compared to the number reported last year. All recorded partial resurfacing procedures used the 'Hemicap' range of prostheses. A single cap was used in 75.1% of procedures, with most (n=145) implanted on the femoral articular surface. There are 85 procedures that involve resurfacing the patella/trochlear joint either on one side (n=27) or both sides (n=58).

The cumulative percent revision of partial resurfacing undertaken for osteoarthritis is 49.5% at 12 years and is an increase of 3.9% compared to 2018 (Table KP2 and Figure KP1). Most primary partial resurfacing replacements are revised to either a total knee replacement (65.0%) or a unicompartmental knee replacement (19.0%).

Table KP2 Cumulative Percent Revision of Primary Partial Resurfacing Knee Replacement (Primary Diagnosis OA)

Knee Type	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	8 Yrs	12 Yrs
Partial Resurfacing	93	220	6.4 (3.8, 10.5)	16.4 (12.1, 22.0)	17.8 (13.3, 23.6)	27.6 (22.1, 34.1)	37.9 (31.4, 45.2)	49.5 (41.8, 57.8)
TOTAL	**93**	**220**						

Figure KP1 Cumulative Percent Revision of Primary Partial Resurfacing Knee Replacement (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	8 Yrs	12 Yrs
Partial Resurfacing	220	206	181	174	140	87	42

More information regarding partial resurfacing procedures is available in the 'Partial Knee Arthroplasty Supplementary Report' available on the AOANJRR website: https://aoanjrr.sahmri.com/annual-reports-2020

PATELLA/TROCHLEA

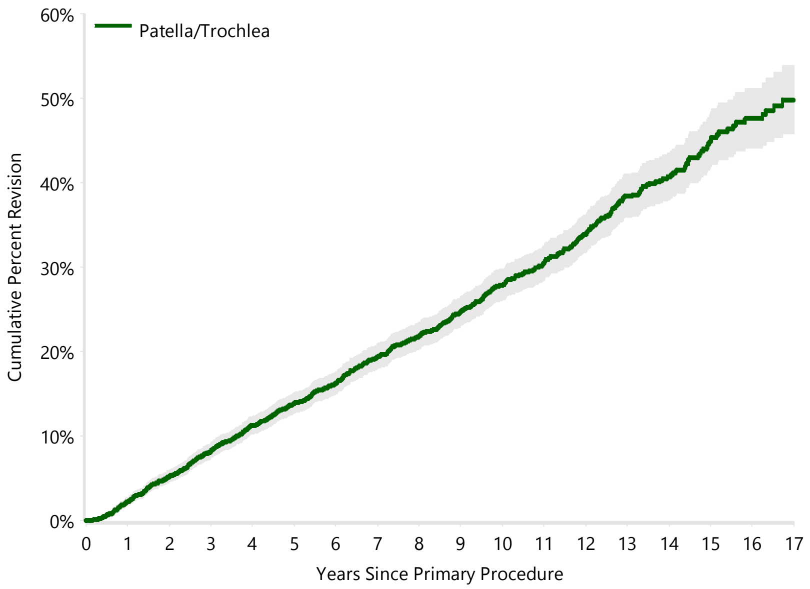
There have been 4,227 patella/trochlear knee replacement procedures undertaken for all diagnoses. This is an additional 299 procedures compared to the previous report. The principal diagnosis for patella/trochlea procedures is osteoarthritis (99.0%). The mean age of patients is 58.6 years, with this procedure undertaken more frequently in females (76.9%).

The Registry has recorded 875 revisions of primary patella/trochlea knee replacement for osteoarthritis. The cumulative percent revision of patella/trochlea replacement at 17 years is 49.8% (Table KP3 and Figure KP2). The most common reason for revision is progression of disease (52.8%), an increase of 2.3% compared to 2018, with most revised to a total knee replacement (86.1%). Both age and gender are risk factors for revision with patients aged <65 years and males having a higher rate of revision.

Table KP3 Cumulative Percent Revision of Primary Patella/Trochlear Knee Replacement (Primary Diagnosis OA)

Knee Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	13 Yrs	17 Yrs
Patella/Trochlea	875	4183	2.2 (1.8, 2.7)	8.2 (7.3, 9.1)	13.9 (12.7, 15.1)	27.8 (26.0, 29.8)	38.4 (35.9, 41.0)	49.8 (45.8, 53.9)
TOTAL	**875**	**4183**						

Figure KP2 Cumulative Percent Revision of Primary Patella/Trochlear Knee Replacement (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	13 Yrs	17 Yrs
Patella/Trochlea	4183	3793	2938	2245	916	401	69

More information regarding patella/trochlea procedures is available at available in the 'Partial Knee Arthroplasty Supplementary Report' available on the AOANJRR website: https://aoanjrr.sahmri.com/annual-reports-2020

UNICOMPARTMENTAL

DEMOGRAPHICS

This year, the Registry is reporting on 60,387 primary unicompartmental knee procedures. This is an additional 3,759 procedures compared to the last report.

The use of unicompartmental knee replacement decreased from 5.8% in 2018 to 5.6% of all knee procedures in 2019. Although the proportion of unicompartmental knee replacements has increased over the last 5 years (from 4.2% in 2014), it is still considerably less than in 2003 (14.5%). Osteoarthritis is the principal diagnosis, accounting for 99.0% of primary unicompartmental knee replacement procedures.

This procedure is undertaken more often in males (53.7%) (Table KP4). The proportion of males has increased from 50.3% in 2007 to 57.1% in 2019 (Figure KP3).

Unicompartmental knee replacement is most frequently undertaken in patients aged 55-74 years (66.7%). The age distribution has remained relatively stable since 2003 (Figure KP4). The mean age of patients is 65.3 years (Table KP4).

Figure KP3 Primary Unicompartmental Knee Replacement by Gender

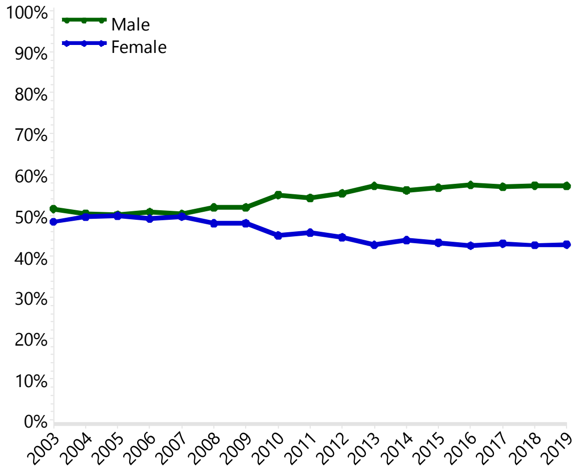
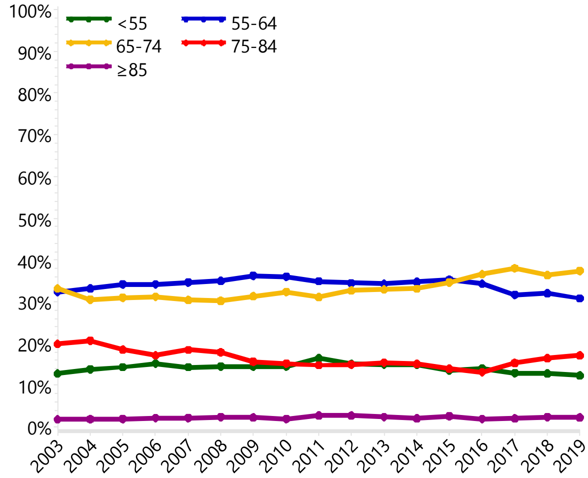


Figure KP4 Primary Unicompartmental Knee Replacement by Age



The proportion of unicompartmental knee replacements using robotic assistance had risen from 6.9% in 2015 to 31.8% in 2018 but decreased to 30.3% in 2019 (Figure KP5).

In 2019, the 10 most used tibial prostheses account for 99.0% of all unicompartmental procedures. The Restoris MCK, ZUK and Oxford (cementless) are the most used prostheses in 2019 (Table KP5).

The outcomes of unicompartmental knee prosthesis combinations with more than 200 procedures are presented in Table KP6.

Figure KP5 Primary Unicompartmental Knee Replacement by Robotic Assistance

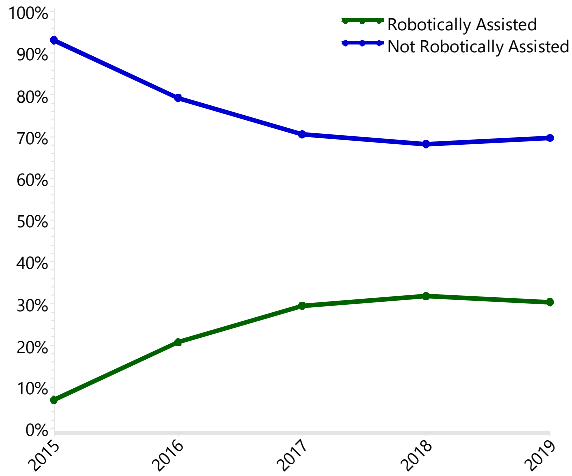


Table KP4 Age and Gender of Primary Unicompartmental Knee Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	32430	53.7%	24	98	66	65.8	9.6
Female	27957	46.3%	13	98	65	64.9	10.2
TOTAL	**60387**	**100.0%**	**13**	**98**	**65**	**65.3**	**9.9**

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

2003		2016		2017		2018		2019	
N	Model	N	Model	N	Model	N	Model	N	Model
1366	Oxford (ctd)	784	Oxford (cless)	1027	Restoris MCK	1148	Restoris MCK	1081	Restoris MCK
444	Repicci II	742	ZUK	915	ZUK	984	ZUK	890	ZUK
373	Preservation Fixed	610	Restoris MCK	912	Oxford (cless)	799	Oxford (cless)	828	Oxford (cless)
353	M/G	383	Oxford (ctd)	262	Oxford (ctd)	201	Journey Uni (v2)	208	BalanSys Uni Fixed
336	Allegretto Uni	156	Sigma HP	175	Journey Uni (v2)	196	Oxford (ctd)	193	Journey Uni (v2)
321	GRU	137	Journey Uni (v2)	136	Sigma HP	146	Sigma HP	168	Oxford (ctd)
275	Genesis	62	Unix	62	Triathlon PKR	139	BalanSys Uni Fixed	161	Sigma HP
260	Unix	40	Endo-Model Sled	43	Endo-Model Sled	46	Triathlon PKR	116	Genus
121	Preservation Mobile	40	Triathlon PKR	27	Journey Uni All Poly	36	Genus	21	Journey Uni All Poly
101	Endo-Model Sled	17	GMK-UNI	25	Repicci II	29	GMK-UNI	17	Endo-Model Sled
10 Most Used									
3950	(10) 96.1%	2971	(10) 97.2%	3584	(10) 98.0%	3724	(10) 98.0%	3683	(10) 99.0%
Remainder									
159	(7) 3.9%	86	(8) 2.8%	74	(8) 2.0%	76	(7) 2.0%	39	(6) 1.0%
TOTAL									
4109	(17) 100.0%	3057	(18) 100.0%	3658	(18) 100.0%	3800	(17) 100.0%	3722	(16) 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	19 Yrs
Allegretto Uni	Allegretto Uni*	388	2035	3.2 (2.5, 4.0)	6.0 (5.0, 7.1)	8.3 (7.2, 9.6)	14.8 (13.3, 16.5)	21.5 (19.6, 23.7)	
	ZUK	16	263	0.8 (0.2, 3.3)	4.6 (2.5, 8.5)	8.3 (4.8, 14.1)			
BalanSys Uni	BalanSys Uni Fixed	38	747	2.6 (1.6, 4.1)	3.9 (2.6, 5.9)	4.7 (3.2, 7.0)	8.4 (5.9, 12.0)		
Endo-Model Sled	Endo-Model Sled	197	1309	1.3 (0.8, 2.1)	5.1 (4.1, 6.5)	7.7 (6.3, 9.3)	14.7 (12.6, 17.0)	22.4 (19.4, 25.7)	
Freedom PKR/Active	Freedom PKR/Active*	417	1505	1.7 (1.1, 2.5)	7.9 (6.6, 9.4)	13.7 (12.0, 15.5)	27.4 (25.0, 30.0)		
GRU	GRU	322	2084	1.4 (1.0, 2.0)	4.6 (3.8, 5.6)	6.4 (5.4, 7.6)	13.6 (12.1, 15.2)	20.8 (18.7, 23.2)	
Genesis	Genesis*	363	1864	2.7 (2.0, 3.5)	8.3 (7.1, 9.6)	11.0 (9.6, 12.5)	16.5 (14.9, 18.3)	22.7 (20.6, 25.1)	
Journey Uni	Journey Uni (v2)	38	894	2.6 (1.7, 3.9)	5.2 (3.7, 7.3)	6.4 (4.5, 9.1)			
	Journey Uni All Poly	29	313	1.0 (0.3, 3.1)	6.9 (4.4, 10.6)	9.0 (6.1, 13.2)			
M/G	M/G*	329	2135	1.6 (1.1, 2.2)	4.2 (3.4, 5.1)	6.5 (5.5, 7.6)	11.1 (9.8, 12.6)	17.0 (15.3, 18.9)	
Oxford (cless)	Oxford (cless)	428	6700	2.8 (2.4, 3.2)	4.8 (4.3, 5.4)	6.3 (5.6, 7.0)	11.9 (10.4, 13.5)		
	Oxford (ctd)	39	446	3.4 (2.1, 5.6)	6.5 (4.5, 9.3)	9.8 (6.9, 13.8)			
Oxford (ctd)	Oxford (ctd)	2315	13322	2.2 (2.0, 2.5)	5.8 (5.4, 6.2)	8.3 (7.8, 8.8)	14.7 (14.1, 15.4)	22.8 (21.9, 23.8)	30.6 (28.7, 32.5)
Preservation	Preservation Fixed*	452	2318	2.5 (1.9, 3.2)	7.1 (6.1, 8.2)	9.5 (8.4, 10.8)	15.6 (14.1, 17.1)	22.1 (20.3, 24.1)	
	Preservation Mobile*	145	400	5.3 (3.5, 7.9)	15.5 (12.3, 19.5)	19.1 (15.6, 23.3)	27.2 (23.1, 31.9)	36.6 (31.9, 41.7)	
Repicci II	Repicci II	744	3099	1.7 (1.3, 2.2)	4.8 (4.1, 5.6)	8.0 (7.1, 9.0)	18.5 (17.1, 20.0)	29.7 (27.8, 31.8)	
Restoris MCK	Restoris MCK	84	4011	1.6 (1.2, 2.1)	2.8 (2.2, 3.5)				
Sigma HP	Sigma HP	50	1301	1.0 (0.6, 1.7)	2.9 (2.0, 4.1)	4.7 (3.5, 6.3)	7.5 (5.1, 10.8)		
Triathlon PKR	Triathlon PKR	26	348	3.2 (1.8, 5.8)	6.5 (4.2, 10.0)	7.8 (5.1, 11.8)			
Uniglide	Uniglide	168	755	4.8 (3.5, 6.6)	10.7 (8.7, 13.2)	12.9 (10.7, 15.6)	20.0 (17.2, 23.2)	28.7 (24.6, 33.4)	
Unix	Unix*	529	3883	2.4 (2.0, 3.0)	5.3 (4.6, 6.0)	7.0 (6.2, 7.9)	11.9 (10.9, 13.1)	18.5 (16.9, 20.3)	
ZUK	ZUK	451	8609	1.4 (1.2, 1.7)	3.6 (3.2, 4.1)	4.8 (4.3, 5.4)	8.3 (7.5, 9.2)		
Other (38)		385	2046	3.7 (2.9, 4.6)	8.7 (7.6, 10.1)	11.2 (9.8, 12.7)	18.9 (17.1, 20.9)	27.0 (24.4, 29.9)	
TOTAL		**7953**	**60387**						

Note: Only combinations with over 200 procedures have been listed

* denotes prosthesis combination with no reported use in unicompartmental knee replacement in 2019

OUTCOME FOR OSTEOARTHRITIS

The Registry has recorded 7,864 revisions of primary unicompartmental knee replacements with an initial diagnosis of osteoarthritis.

The cumulative percent revision for primary unicompartmental knee replacement undertaken for osteoarthritis is 14.3% at 10 years and 29.5% at 19 years (Table KP7 and Figure KP6).

The main reasons for revision are loosening (37.6%), progression of disease (34.4%) and pain (7.8%) (Table KP8 and Figure KP7). The main type of revision is a total knee replacement (87.8%) (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. The effect of age on the rate of revision is evident in both males and females (Table KP11 and Figure KP9).

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	19 Yrs
Unicompartmental	7864	59810	2.2 (2.1, 2.3)	5.5 (5.3, 5.6)	7.7 (7.5, 8.0)	14.3 (13.9, 14.6)	22.1 (21.6, 22.6)	29.5 (28.1, 30.9)
TOTAL	**7864**	**59810**						

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	19 Yrs
Unicompartmental	59810	54669	45000	37821	22813	7428	226

Table KP8 Primary Unicompartmental Knee Replacement by Reason for Revision (Primary Diagnosis OA)

Reason for Revision	Number	Percent
Loosening	2958	37.6
Progression of Disease	2704	34.4
Pain	613	7.8
Infection	298	3.8
Lysis	223	2.8
Fracture	175	2.2
Bearing Dislocation	161	2.0
Wear Tibial Insert	138	1.8
Instability	99	1.3
Malalignment	84	1.1
Implant Breakage Tibial	51	0.6
Wear Tibial	51	0.6
Patellofemoral Pain	48	0.6
Other (15)	261	3.3
TOTAL	**7864**	**100.0**

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

Type of Revision	Number	Percent
TKR (Tibial/Femoral)	6903	87.8
Uni Insert Only	479	6.1
Uni Tibial Component	222	2.8
Uni Femoral Component	78	1.0
UKR (Uni Tibial/Uni Femoral)	77	1.0
Cement Spacer	57	0.7
Patella/Trochlear Resurfacing	20	0.3
Removal of Prostheses	9	0.1
Reinsertion of Components	6	0.1
Patella Only	5	0.1
Femoral Component*	4	0.1
Tibial Component	2	0.0
Cement Only	2	0.0
TOTAL	**7864**	**100.0**

Note: *Bicompartmental component

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

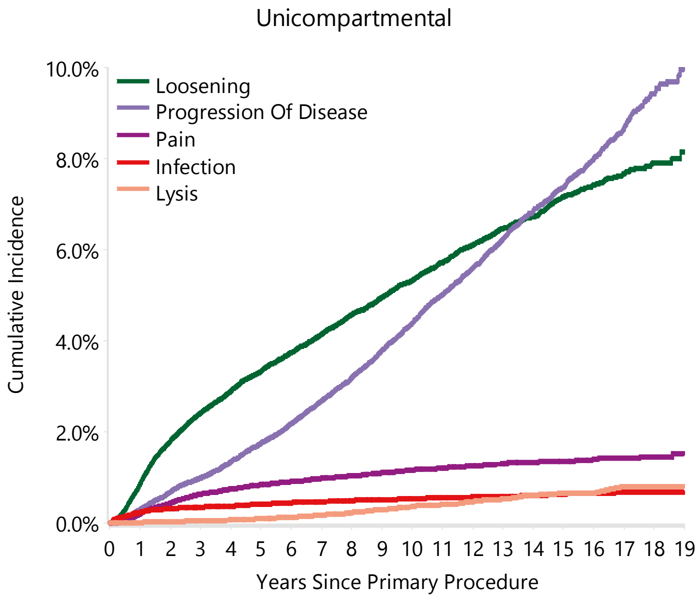
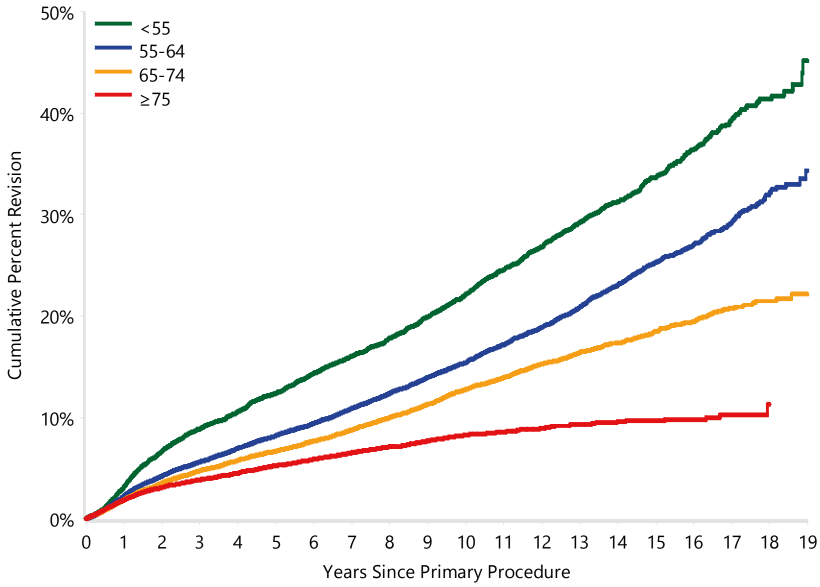


Table KP10 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement by Age (Primary Diagnosis OA)

Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
<55	1854	8380	3.1 (2.8, 3.6)	8.9 (8.2, 9.5)	12.4 (11.6, 13.1)	22.1 (21.1, 23.2)	33.7 (32.2, 35.2)	45.1 (41.2, 49.3)
55-64	3101	20012	2.3 (2.1, 2.5)	5.6 (5.3, 6.0)	8.2 (7.8, 8.6)	15.4 (14.8, 16.0)	25.3 (24.4, 26.2)	34.3 (31.9, 36.9)
65-74	2181	19913	1.9 (1.7, 2.1)	4.7 (4.4, 5.0)	6.7 (6.3, 7.1)	12.7 (12.2, 13.3)	18.5 (17.7, 19.3)	22.1 (20.7, 23.7)
≥75	728	11505	1.8 (1.6, 2.1)	3.8 (3.5, 4.2)	5.3 (4.8, 5.7)	8.3 (7.7, 8.9)	9.6 (8.9, 10.5)	
TOTAL	**7864**	**59810**						

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



HR - adjusted for gender

<55 vs ≥75
0 - 9Mth: HR=1.56 (1.28, 1.90),p<0.001
9Mth - 1.5Yr: HR=2.47 (2.06, 2.96),p<0.001
1.5Yr - 4.5Yr: HR=3.18 (2.76, 3.67),p<0.001
4.5Yr - 10Yr: HR=3.12 (2.73, 3.58),p<0.001
10Yr+: HR=9.92 (7.15, 13.77),p<0.001

55-64 vs ≥75
0 - 6Mth: HR=1.12 (0.91, 1.38),p=0.300
6Mth - 1.5Yr: HR=1.39 (1.19, 1.62),p<0.001
1.5Yr - 2Yr: HR=1.78 (1.42, 2.23),p<0.001
2Yr - 5Yr: HR=2.11 (1.84, 2.41),p<0.001
5Yr - 10Yr: HR=2.20 (1.94, 2.50),p<0.001
10Yr - 12.5Yr: HR=6.72 (4.81, 9.41),p<0.001
12.5Yr - 13.5Yr: HR=8.25 (5.57, 12.22),p<0.001
13.5Yr+: HR=7.99 (5.62, 11.36),p<0.001

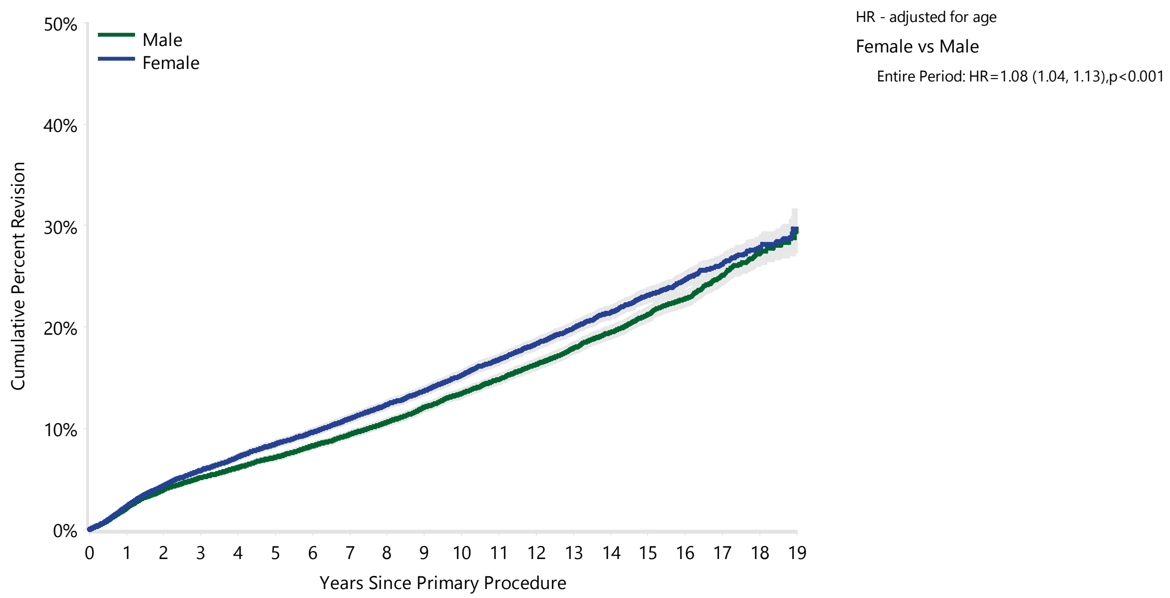
65-74 vs ≥75
0 - 1.5Yr: HR=1.07 (0.92, 1.23),p=0.368
1.5Yr - 9Yr: HR=1.69 (1.51, 1.90),p<0.001
9Yr - 10Yr: HR=2.12 (1.68, 2.68),p<0.001
10Yr - 11.5Yr: HR=4.54 (3.16, 6.55),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
<55	8380	7668	6302	5341	3310	1158	42
55-64	20012	18410	15446	13109	8336	2852	80
65-74	19913	18133	14742	12343	7515	2580	88
≥75	11505	10458	8510	7028	3652	838	16

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	19 Yrs
Male		**3850**	**32167**	**2.1 (1.9, 2.2)**	**5.1 (4.9, 5.4)**	**7.1 (6.8, 7.4)**	**13.4 (13.0, 13.9)**	**21.2 (20.5, 22.0)**	**29.4 (27.3, 31.5)**
	<55	823	3799	3.2 (2.7, 3.9)	8.9 (8.0, 9.9)	11.8 (10.8, 13.0)	21.8 (20.3, 23.5)	35.1 (32.8, 37.5)	
	55-64	1610	10861	2.3 (2.0, 2.6)	5.5 (5.1, 6.0)	8.0 (7.5, 8.6)	15.3 (14.5, 16.1)	24.7 (23.5, 26.0)	35.6 (32.0, 39.4)
	65-74	1076	11289	1.7 (1.5, 1.9)	4.3 (3.9, 4.7)	5.9 (5.4, 6.4)	11.4 (10.6, 12.1)	16.8 (15.7, 17.9)	20.9 (18.5, 23.7)
	≥75	341	6218	1.7 (1.4, 2.0)	3.6 (3.1, 4.1)	4.7 (4.1, 5.3)	7.4 (6.7, 8.3)	8.9 (7.8, 10.1)	
Female		**4014**	**27643**	**2.3 (2.1, 2.5)**	**5.8 (5.5, 6.1)**	**8.4 (8.1, 8.8)**	**15.2 (14.7, 15.7)**	**23.1 (22.4, 23.8)**	**29.7 (27.8, 31.7)**
	<55	1031	4581	3.1 (2.6, 3.6)	8.8 (8.0, 9.7)	12.8 (11.8, 13.8)	22.4 (21.0, 23.8)	32.7 (30.8, 34.6)	
	55-64	1491	9151	2.3 (2.0, 2.6)	5.8 (5.3, 6.3)	8.4 (7.8, 9.0)	15.4 (14.6, 16.3)	25.8 (24.5, 27.1)	
	65-74	1105	8624	2.1 (1.8, 2.4)	5.3 (4.8, 5.8)	7.7 (7.1, 8.3)	14.4 (13.6, 15.4)	20.5 (19.3, 21.8)	23.8 (22.1, 25.7)
	≥75	387	5287	2.0 (1.7, 2.4)	4.2 (3.6, 4.8)	5.9 (5.3, 6.6)	9.1 (8.2, 10.1)	10.5 (9.4, 11.6)	
TOTAL		**7864**	**59810**						

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	19 Yrs
Male	32167	29266	23787	19735	11392	3668	115
Female	27643	25403	21213	18086	11421	3760	111

OUTCOME BY PROSTHESIS CHARACTERISTICS

Fixation

Most unicompartmental knee replacements use cement fixation (80.2%), a smaller number use cementless fixation (18.3%) and few use hybrid fixation (1.5%). There are only 6 prostheses that can be used with cementless fixation. When cementless is compared to cement fixation there is a higher rate of revision for the first 6 months, then after this time there is a lower rate of revision. Cementless fixation has a lower rate of revision compared to hybrid fixation. Cement fixation also has a lower rate of revision compared to hybrid fixation, but only for the first 6 months (Table KP12 and Figure KP10).

The Oxford unicompartmental knee accounts for 60.4% of the cementless unicompartmental knees. When this prosthesis is used without cement there is a higher rate of revision for the first 6 months, then there is a lower rate of revision until 7 years, after which time there is no difference (Table KP13 and Figure KP11).

Bearing Mobility

Fixed bearings are used in 63.7% of unicompartmental knee replacements, while in 36.3% the bearing insert is mobile. Seven different prostheses have a mobile bearing. Fixed bearing prostheses have a lower rate of revision compared to mobile bearing prostheses for the first 9 months, and after this time there is no difference (Table KP14 and Figure KP12).

Robotic Assistance

There have been 4,209 robotically assisted unicompartmental knee replacement procedures recorded by the Registry since 2015. In 2019, 30.4% of unicompartmental knee procedures used robotic assistance. There are only 5 unicompartmental combinations that have used robotic assistance.

Unicompartmental knee procedures using robotic assistance have a lower rate of revision compared to unicompartmental procedures without robotic assistance (Table KP15 and Figure KP13). When using robotic assistance there are fewer revisions for loosening, progression of disease and pain, but more revisions for infection (Table KP16 and Figure KP14).

Position

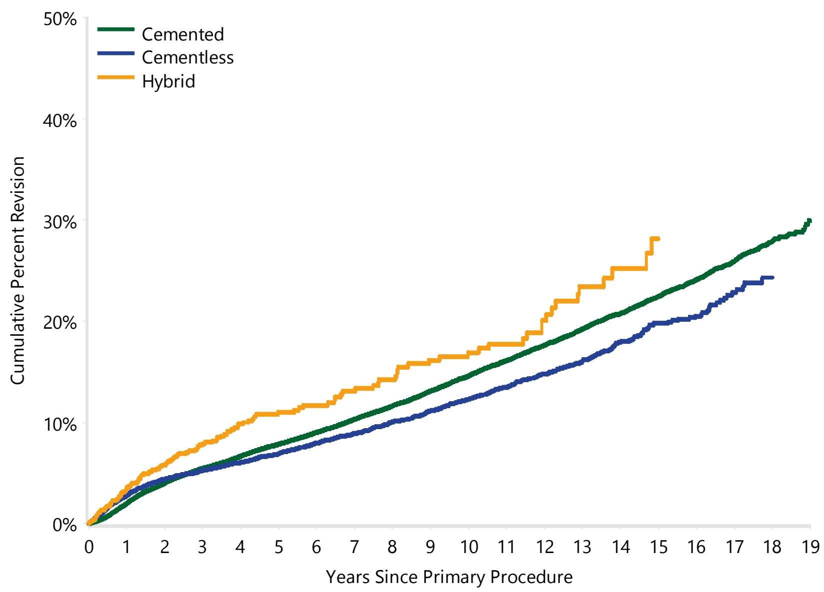
The Registry has recorded 2,361 lateral unicompartmental knee procedures undertaken for osteoarthritis. There is no difference in the rate of revision when lateral unicompartmental knee replacement is compared to medial unicompartmental knee replacement (Table KP17 and Figure KP15). The most common reason for revision of lateral unicompartmental knees is progression of disease, while loosening is the most common reason for revision for those placed medially (Table KP18 and Figure KP16).

The outcome of prosthesis combinations with more than 50 procedures used in lateral unicompartmental knee replacement is presented in Table KP19.

Table KP12 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement by Fixation (Primary Diagnosis OA)

Fixation	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Cemented	6702	47988	2.0 (1.9, 2.1)	5.4 (5.2, 5.7)	7.8 (7.6, 8.1)	14.6 (14.2, 15.0)	22.4 (21.9, 23.0)	29.9 (28.4, 31.5)
Cementless	1041	10917	2.8 (2.5, 3.1)	5.3 (4.8, 5.7)	6.9 (6.4, 7.5)	12.3 (11.5, 13.1)	19.8 (18.3, 21.4)	
Hybrid	121	905	3.4 (2.4, 4.8)	7.9 (6.3, 10.0)	11.0 (8.9, 13.5)	16.9 (13.9, 20.5)	28.2 (22.3, 35.2)	
TOTAL	**7864**	**59810**						

Figure KP10 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement by Fixation (Primary Diagnosis OA)



HR - adjusted for age and gender

Cemented vs Cementless

0 - 3Mth: HR=0.41 (0.32, 0.54),p<0.001

3Mth - 6Mth: HR=0.57 (0.45, 0.73),p<0.001

6Mth - 2Yr: HR=1.19 (1.05, 1.35),p=0.005

2Yr+: HR=1.40 (1.29, 1.52),p<0.001

Hybrid vs Cementless

Entire Period: HR=1.42 (1.17, 1.71),p<0.001

Hybrid vs Cemented

0 - 6Mth: HR=2.12 (1.26, 3.55),p=0.004

6Mth - 9Mth: HR=0.97 (0.43, 2.17),p=0.937

9Mth - 1.5Yr: HR=1.32 (0.86, 2.01),p=0.203

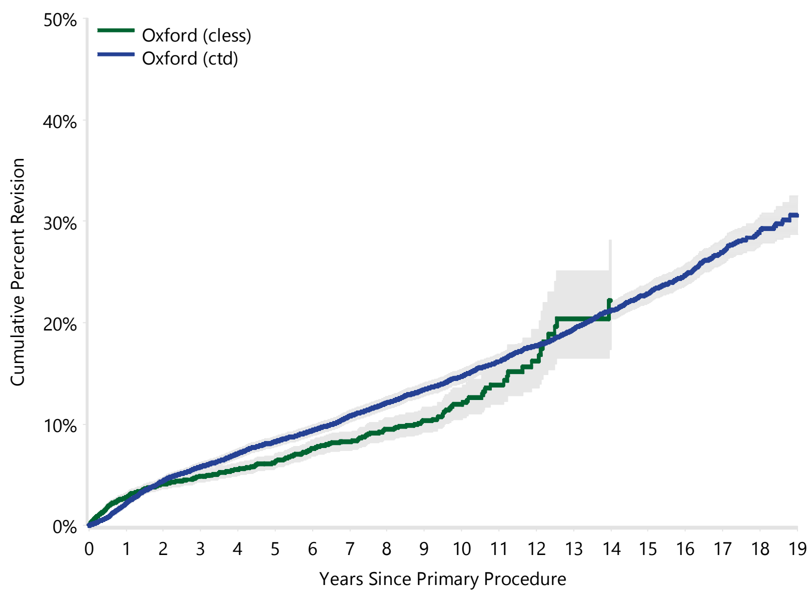
1.5Yr+: HR=1.09 (0.87, 1.36),p=0.455

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Cemented	47988	44139	36629	31413	19894	6689	205
Cementless	10917	9694	7725	5999	2708	696	19
Hybrid	905	836	646	409	211	43	2

Table KP13 Cumulative Percent Revision of Oxford/Oxford Primary Unicompartmental Knee Replacement by Fixation (Primary Diagnosis OA)

Fixation	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Oxford (cless)	426	6650	2.8 (2.4, 3.2)	4.8 (4.3, 5.4)	6.3 (5.6, 7.0)	11.9 (10.5, 13.5)		
Oxford (ctd)	2288	13166	2.2 (1.9, 2.5)	5.8 (5.4, 6.2)	8.3 (7.8, 8.7)	14.7 (14.0, 15.4)	22.9 (21.9, 23.8)	30.6 (28.7, 32.5)
TOTAL	**2714**	**19816**						

Figure KP11 Cumulative Percent Revision of Oxford/Oxford Primary Unicompartmental Knee Replacement by Fixation (Primary Diagnosis OA)



HR - adjusted for age and gender

Oxford (ctd) vs Oxford (cless)

0 - 6Mth: HR=0.43 (0.33, 0.56),p<0.001

6Mth - 1.5Yr: HR=1.47 (1.18, 1.83),p<0.001

1.5Yr - 7Yr: HR=1.67 (1.40, 1.99),p<0.001

7Yr - 8.5Yr: HR=1.38 (0.86, 2.21),p=0.177

8.5Yr+: HR=0.76 (0.54, 1.07),p=0.118

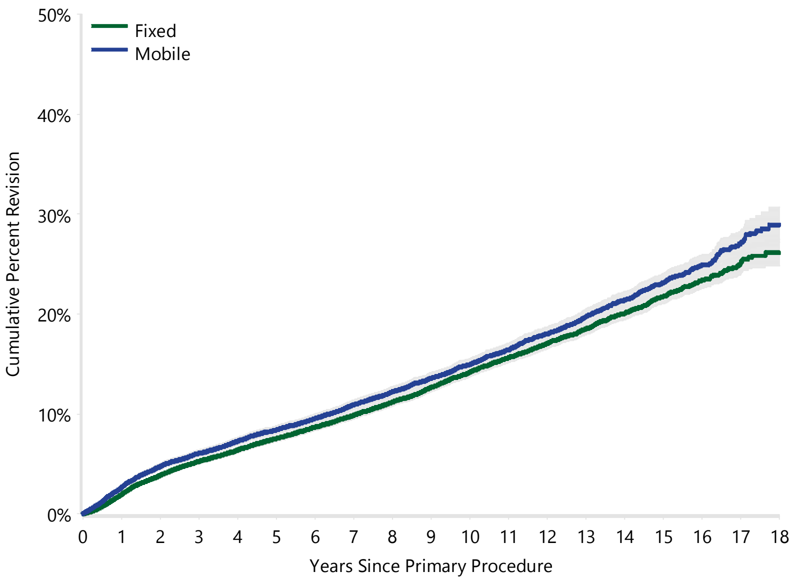
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Oxford (cless)	6650	5660	3898	2472	433	5	0
Oxford (ctd)	13166	12668	11651	10511	6991	2744	113

Table KP14 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	19 Yrs
Fixed	4745	38084	1.9 (1.8, 2.1)	5.1 (4.9, 5.4)	7.4 (7.1, 7.7)	14.0 (13.6, 14.4)	21.5 (20.9, 22.2)	28.4 (26.2, 30.8)
Mobile	3113	21692	2.6 (2.4, 2.8)	6.0 (5.7, 6.3)	8.3 (7.9, 8.7)	14.7 (14.2, 15.3)	23.2 (22.3, 24.0)	31.2 (29.3, 33.2)
TOTAL	**7858**	**59776**						

Note: Excludes 34 primary unicompartmental knee procedures with unknown/missing mobility

Figure KP12 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement by Mobility (Primary Diagnosis OA)



HR - adjusted for age and gender

Mobile vs Fixed

0 - 3Mth: HR=2.18 (1.66, 2.85),p<0.001

3Mth - 9Mth: HR=1.34 (1.15, 1.57),p<0.001

9Mth - 2Yr: HR=1.11 (0.99, 1.24),p=0.065

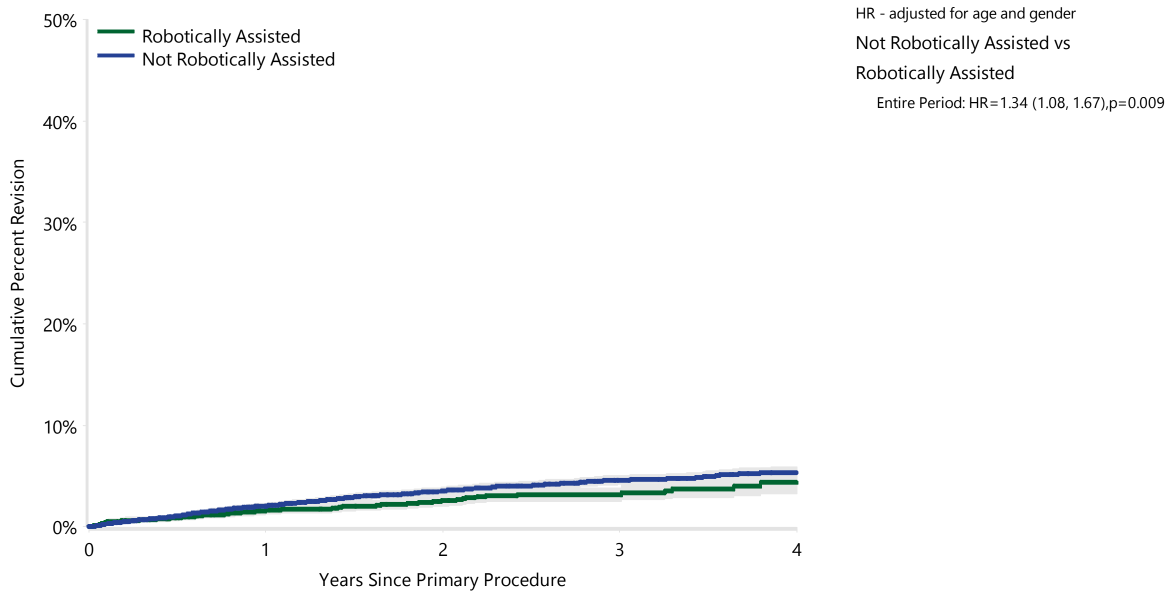
2Yr+: HR=1.04 (0.99, 1.10),p=0.143

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Fixed	38084	34565	27933	23598	14556	4405	106
Mobile	21692	20072	17040	14197	8236	3016	120

Table KP15 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
Robotically Assisted	97	4209	1.6 (1.2, 2.0)	2.6 (2.1, 3.2)	3.1 (2.5, 3.9)	4.3 (3.2, 5.8)
Not Robotically Assisted	458	12460	2.0 (1.8, 2.3)	3.5 (3.2, 3.9)	4.6 (4.2, 5.0)	5.3 (4.8, 5.9)
TOTAL	**555**	**16669**				

Figure KP13 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement Since 2015 by Robotic Assistance (Primary Diagnosis OA)



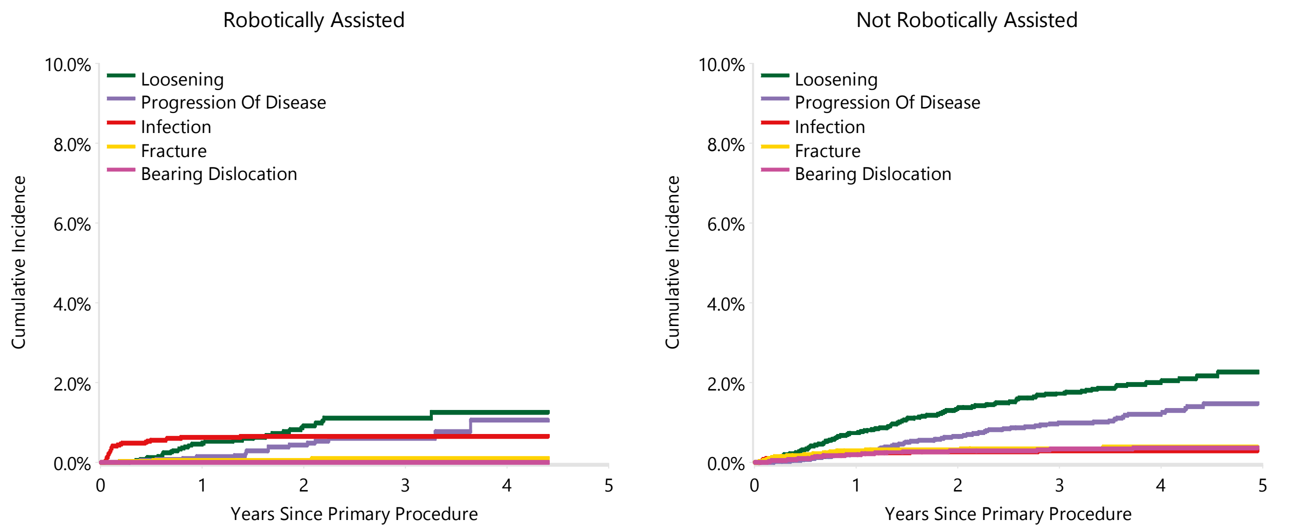
Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs
Robotically Assisted	4209	3029	1827	780	168
Not Robotically Assisted	12460	9658	6997	4448	2169

Table KP16 Revision Diagnosis of Primary Unicompartmental Knee Replacement Since 2015 by Robotic Assistance (Primary Diagnosis OA)

Revision Diagnosis	Robotically Assisted Number	Robotically Assisted % Primaries Revised	Robotically Assisted % Revisions	Not Robotically Assisted Number	Not Robotically Assisted % Primaries Revised	Not Robotically Assisted % Revisions
Loosening	31	0.7	32.0	171	1.4	37.3
Progression Of Disease	17	0.4	17.5	95	0.8	20.7
Fracture	3	0.1	3.1	40	0.3	8.7
Bearing Dislocation				34	0.3	7.4
Infection	26	0.6	26.8	32	0.3	7.0
Pain	4	0.1	4.1	30	0.2	6.6
Instability	5	0.1	5.2	15	0.1	3.3
Malalignment	2	0.0	2.1	13	0.1	2.8
Incorrect Sizing				4	0.0	0.9
Lysis	3	0.1	3.1	4	0.0	0.9
Prosthesis Dislocation				4	0.0	0.9
Implant Breakage Tibial				3	0.0	0.7
Patellofemoral Pain	1	0.0	1.0	2	0.0	0.4
Arthrofibrosis				1	0.0	0.2
Metal Related Pathology				1	0.0	0.2
Osteonecrosis				1	0.0	0.2
Synovitis				1	0.0	0.2
Wear Tibial Insert	1	0.0	1.0	1	0.0	0.2
Other	4	0.1	4.1	6	0.0	1.3
N Revision	**97**	**2.3**	**100.0**	**458**	**3.7**	**100.0**
N Primary	**4209**			**12460**		

Note: This table is restricted to revisions within 4.8 years for all groups to allow a time-matched comparison of revisions

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

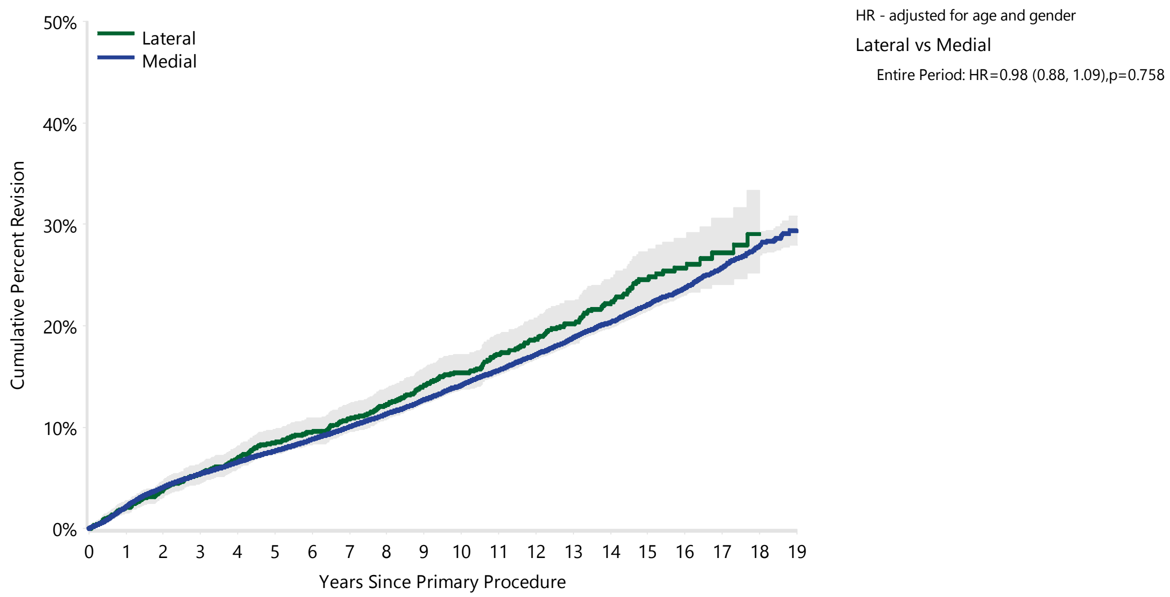


TableKP17 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement by Position (Primary Diagnosis OA)

Position	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Lateral	354	2361	2.1 (1.6, 2.8)	5.4 (4.5, 6.4)	8.5 (7.3, 9.8)	15.4 (13.7, 17.2)	24.6 (22.1, 27.3)	
Medial	6854	53998	2.1 (2.0, 2.3)	5.4 (5.2, 5.6)	7.6 (7.4, 7.9)	14.1 (13.8, 14.5)	22.0 (21.5, 22.6)	29.4 (28.0, 30.8)
TOTAL	**7208**	**56359**						

Note: Excludes 3,451 primary unicompartmental knee procedures with unknown/missing position

Figure KP15 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement by Position (Primary Diagnosis OA)

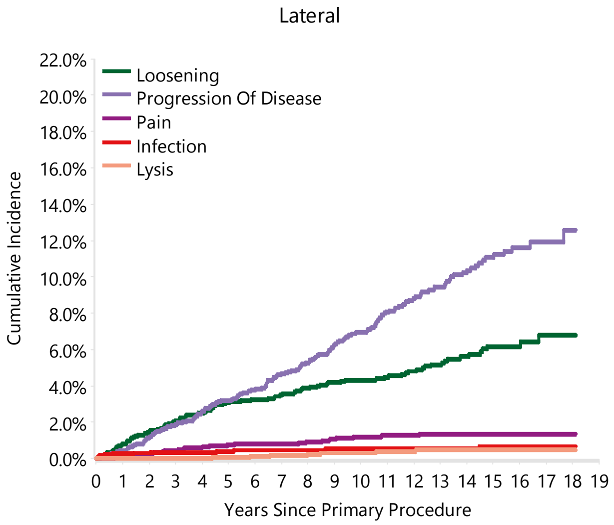


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Lateral	2361	2186	1840	1564	1009	303	13
Medial	53998	49170	40077	33356	19742	6022	161

Table KP18 Revision Diagnosis of Primary Unicompartmental Knee Replacement by Position (Primary Diagnosis OA)

Revision Diagnosis	Lateral			Medial		
	Number	% Primaries Revised	% Revisions	Number	% Primaries Revised	% Revisions
Loosening	104	4.4	29.4	2603	4.8	38.0
Progression Of Disease	174	7.4	49.2	2293	4.2	33.5
Pain	25	1.1	7.1	544	1.0	7.9
Infection	12	0.5	3.4	274	0.5	4.0
Lysis	7	0.3	2.0	191	0.4	2.8
Fracture	5	0.2	1.4	157	0.3	2.3
Bearing Dislocation	6	0.3	1.7	153	0.3	2.2
Wear Tibial Insert	4	0.2	1.1	120	0.2	1.8
Instability	5	0.2	1.4	91	0.2	1.3
Malalignment	4	0.2	1.1	73	0.1	1.1
Other	8	0.3	2.3	355	0.7	5.2
N Revision	**354**	**15.0**	**100.0**	**6854**	**12.7**	**100.0**
N Primary	**2361**			**53998**		

Figure KP16 Cumulative Incidence Revision Diagnosis of Primary Unicompartmental Knee Replacement by Position (Primary Diagnosis OA)



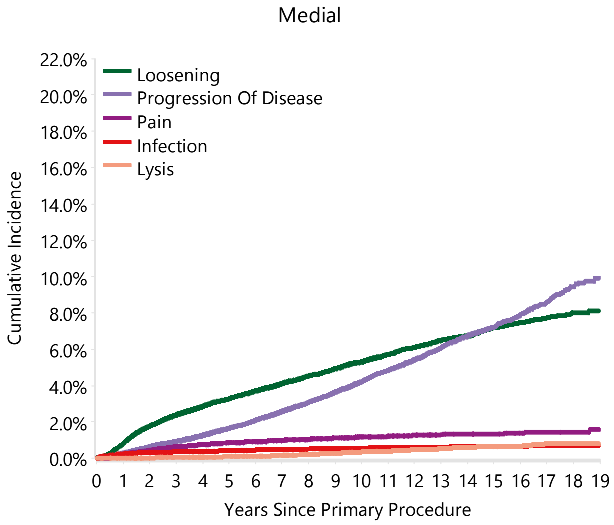


Table KP19 Cumulative Percent Revision of Lateral Primary Unicompartmental Knee Replacement by Prosthesis Combination (Primary Diagnosis OA)

Uni Femoral	Uni Tibial	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Endo-Model Sled	Endo-Model Sled	22	152	0.0 (0.0, 0.0)	4.2 (1.9, 9.1)	7.4 (4.0, 13.3)	14.1 (8.7, 22.4)		
Freedom PKR/Active	Freedom PKR/Active*	32	151	0.7 (0.1, 4.6)	6.0 (3.2, 11.3)	9.6 (5.8, 15.7)	18.6 (12.7, 26.6)		
GRU	GRU	31	193	3.1 (1.4, 6.8)	4.7 (2.5, 8.8)	6.8 (4.0, 11.5)	14.0 (9.7, 20.0)	18.2 (12.6, 25.8)	
Genesis	Genesis*	28	132	1.5 (0.4, 5.9)	6.1 (3.1, 11.8)	9.9 (5.9, 16.5)	17.2 (11.7, 25.0)		
M/G	M/G*	10	53	1.9 (0.3, 12.6)	3.8 (1.0, 14.4)	3.8 (1.0, 14.4)	10.4 (4.4, 23.2)	22.2 (11.8, 39.4)	
Oxford (cless)	Oxford (ctd)	7	78	4.0 (1.3, 11.9)	5.9 (2.2, 15.1)	5.9 (2.2, 15.1)			
Oxford (ctd)	Oxford (ctd)	37	167	6.0 (3.3, 10.9)	9.2 (5.6, 14.8)	13.3 (8.9, 19.7)	22.8 (16.4, 31.2)		
Preservation	Preservation Fixed*	19	149	0.0 (0.0, 0.0)	3.4 (1.4, 8.0)	6.8 (3.7, 12.3)	9.8 (5.9, 16.0)		
Repicci II	Repicci II	78	263	2.7 (1.3, 5.5)	7.7 (5.0, 11.7)	13.3 (9.7, 18.2)	22.0 (17.3, 27.8)	35.8 (29.3, 43.2)	
Restoris MCK	Restoris MCK	1	168	0.0 (0.0, 0.0)					
Unix	Unix*	26	185	1.1 (0.3, 4.3)	3.8 (1.8, 7.8)	7.2 (4.3, 12.1)	12.4 (8.2, 18.4)		
ZUK	ZUK	14	277	0.7 (0.2, 2.9)	2.5 (1.1, 5.4)	4.6 (2.4, 8.9)			
Other (28)		49	393	3.7 (2.2, 6.2)	7.0 (4.7, 10.1)	8.4 (5.9, 11.9)	12.9 (9.4, 17.6)		
TOTAL		**354**	**2361**						

Note: Only prostheses with over 50 procedures have been listed
* denotes prosthesis combinations with no recorded use in unicompartmental knee replacement in 2019

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 are 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 system subdivision is not uniformly applied to all knee systems at this time.

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 715,785 primary total knee replacement procedures reported to the Registry. This is an additional 57,189 procedures compared to the last report.

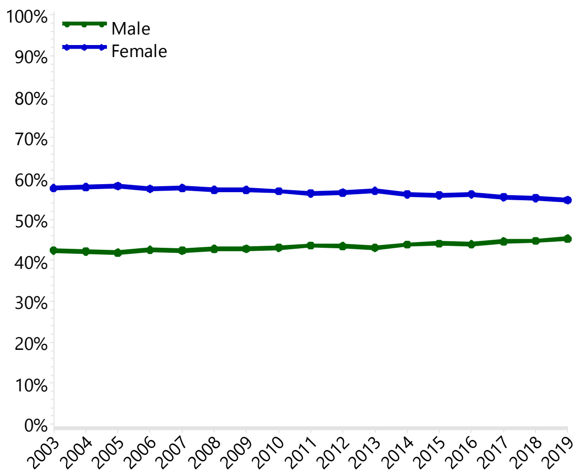
Primary total knee replacement continues to increase. In 2019, there were 1.1% more procedures than in 2018 and 160.9% more than in 2003. As a proportion of all knee replacement procedures, primary total knee replacement increased from 76.7% in 2003 to 85.9% in 2019.

Osteoarthritis is the most common diagnosis for primary total knee replacement (97.7%).

There have been 715,785 primary total knee replacement procedures reported to the Registry. This is an additional 57,189 procedures compared to the last report.

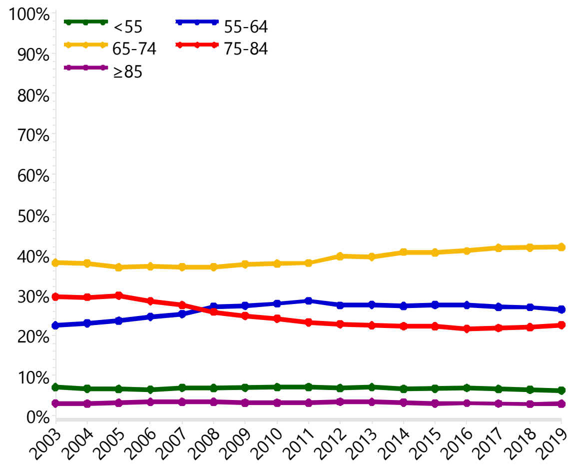
Primary total knee replacement remains more common in females (56.4%). This proportion has remained constant since 2003. The mean age of patients is 68.5 years (Table KT1 and Figure KT1).

Figure KT1 Primary Total Knee Replacement by Gender



There has been a decrease in the proportion of patients aged 75-84 years from 29.5% in 2003 to 22.5% in 2019. The proportion of patients aged <55 years remains small (6.3% in 2019) and there has been little change in that proportion since 2003 (Figure KT2).

Figure KT2 Primary Total Knee Replacement by Age



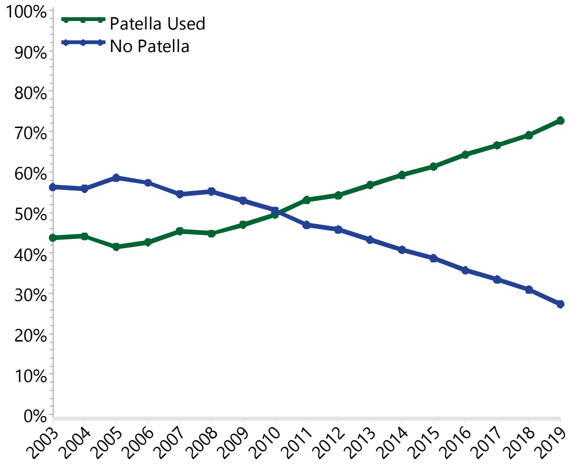
Detailed demographic information on primary total knee replacement is available in the supplementary report 'Demographics of Hip, Knee and Shoulder Arthroplasty' on the AOANJRR website:
https://aoanjrr.sahmri.com/annual-reports-2020

Table KT1 Age and Gender of Primary Total Knee Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	311994	43.6%	8	101	68	68.1	9.1
Female	403791	56.4%	8	103	69	68.8	9.4
TOTAL	**715785**	**100.0%**	**8**	**103**	**69**	**68.5**	**9.3**

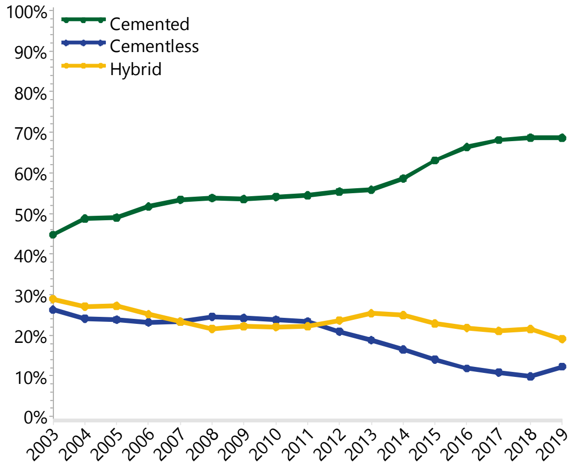
Patella resurfacing at the time of the primary total knee replacement continues to increase from a low of 41.5% in 2005 to 72.7% in 2019 (Figure KT3).

Figure KT3 Primary Total Knee Replacement by Patella Usage



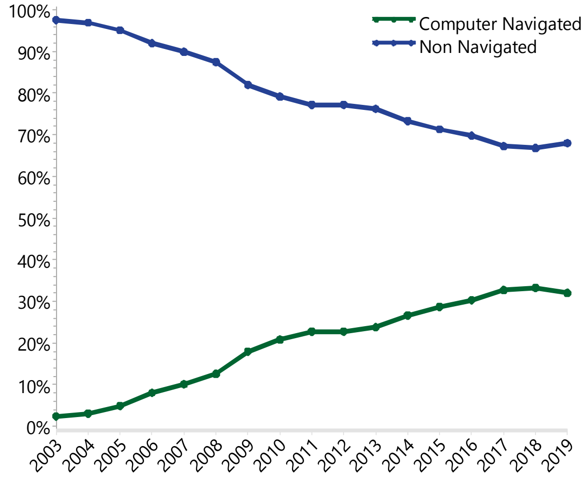
The most common method of fixation is cementing both femoral and tibial components. This has increased from 44.8% in 2003 to 68.6% in 2019. The use of cementless fixation decreased from a peak of 26.3% in 2003 to 9.9% in 2018, but has increased to 12.3% in 2019 (Figure KT4).

Figure KT4 Primary Total Knee Replacement by Fixation



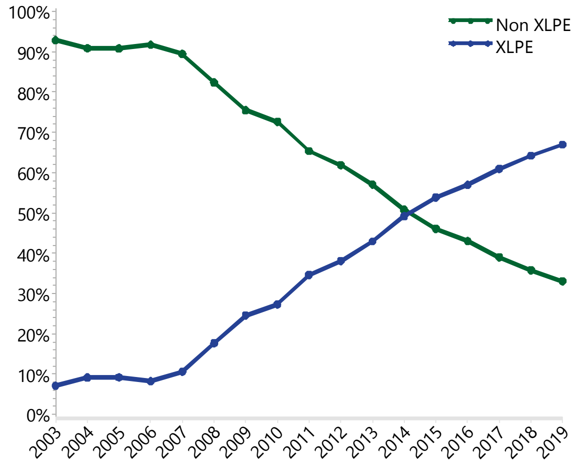
The proportion of primary total knee replacement procedures inserted with computer navigation increased from 2.4% in 2003 to 33.2% in 2018, but decreased slightly to 32.0% in 2019 (Figure KT5).

Figure KT5 Primary Total Knee Replacement by Computer Navigation



The use of cross-linked polyethylene (XLPE) in primary total knee replacement continues to increase. The proportion of procedures using XLPE was 7.1% in 2003 compared to 67.0% in 2019 (Figure KT6).

Figure KT6 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 2019, the most commonly used femoral prostheses were the Triathlon CR (23.5%), Persona (11.5%) and Nexgen CR Flex (7.6%) (Table KT2). The most used prostheses are also reported based on fixation (cemented, cementless and hybrid) (Table KT3 to Table KT5).

Table KT2 10 Most Used Femoral Prostheses in Primary Total Knee Replacement

2003		2016		2017		2018		2019	
N	Model	N	Model	N	Model	N	Model	N	Model
3184	LCS CR	9528	Triathlon CR	10495	Triathlon CR	12311	Triathlon CR	13311	Triathlon CR
2846	Duracon	6486	Nexgen CR Flex	6644	Nexgen CR Flex	5786	Nexgen CR Flex	5631	Persona CR
2150	Nexgen CR	2998	Nexgen LPS Flex	3195	Attune CR	3585	Persona CR	4282	Nexgen CR Flex
1419	PFC Sigma CR	2860	Vanguard CR	2649	LCS CR	3243	Attune CR	3386	Attune CR
1354	Scorpio CR	2745	LCS CR	2644	Nexgen LPS Flex	2186	Nexgen LPS Flex	2721	GMK Sphere Primary
1059	Genesis II CR	2488	Attune CR	2388	Vanguard CR	2145	GMK Sphere Primary	1822	LCS CR
1002	Natural Knee II	1957	Legion Oxinium PS	1752	Evolution	2081	LCS CR	1786	Attune PS
902	Nexgen LPS	1539	GMK Sphere Primary	1583	Legion Oxinium PS	1953	Vanguard CR	1560	Vanguard CR
883	Profix	1481	Genesis II Oxinium PS	1538	GMK Sphere Primary	1661	Evolution	1530	Evolution
751	Scorpio PS	1454	Evolution	1484	Persona CR	1408	Apex Knee CR	1467	Apex Knee CR
10 Most Used									
15550	(10) 71.5%	33536	(10) 63.9%	34372	(10) 62.4%	36359	(10) 64.8%	37496	(10) 66.1%
Remainder									
6185	(47) 28.5%	18979	(71) 36.1%	20732	(70) 37.6%	19752	(73) 35.2%	19208	(66) 33.9%
TOTAL									
21735	(57) 100.0%	52515	(81) 100.0%	55104	(80) 100.0%	56111	(83) 100.0%	56704	(76) 100.0%

Table KT3 10 Most Used Femoral Prostheses in Cemented Primary Total Knee Replacement

2003		2016		2017		2018		2019	
N	Model	N	Model	N	Model	N	Model	N	Model
1213	Duracon	5398	Triathlon CR	6019	Triathlon CR	6684	Triathlon CR	6606	Triathlon CR
948	LCS CR	3247	Nexgen CR Flex	3420	Nexgen CR Flex	3155	Attune CR	3401	Persona CR
824	Nexgen LPS	2679	Nexgen LPS Flex	3175	Attune CR	2948	Nexgen CR Flex	3266	Attune CR
761	Nexgen CR	2487	Attune CR	2327	Nexgen LPS Flex	2392	Persona CR	2720	GMK Sphere Primary
690	Nexgen LPS Flex	1957	Legion Oxinium PS	1745	Evolution	2145	GMK Sphere Primary	2299	Nexgen CR Flex
642	Genesis II CR	1538	GMK Sphere Primary	1582	Legion Oxinium PS	1914	Nexgen LPS Flex	1767	Attune PS
495	Profix	1481	Genesis II Oxinium PS	1538	GMK Sphere Primary	1621	Evolution	1504	Evolution
471	Genesis II Oxinium CR	1454	Evolution	1431	Genesis II Oxinium PS	1390	Legion Oxinium PS	1372	Legion Oxinium CR
471	PFC Sigma PS	1147	Vanguard CR	1353	Attune PS	1362	Attune PS	1258	Genesis II Oxinium PS
419	Genesis II PS	1048	Attune PS	1187	Persona CR	1340	Genesis II Oxinium PS	1257	Legion Oxinium PS
10 Most Used									
6934	(10) 71.3%	22436	(10) 64.5%	23777	(10) 63.4%	24951	(10) 64.8%	25450	(10) 65.4%
Remainder									
2795	(41) 28.7%	12375	(68) 35.5%	13749	(69) 36.6%	13576	(70) 35.2%	13464	(65) 34.6%
TOTAL									
9729	(51) 100.0%	34811	(78) 100.0%	37526	(79) 100.0%	38527	(80) 100.0%	38914	(75) 100.0%

Table KT4 10 Most Used Femoral Prostheses in Cementless Primary Total Knee Replacement

2003		2016		2017		2018		2019	
N	Model	N	Model	N	Model	N	Model	N	Model
1470	LCS CR	1363	Nexgen CR Flex	1357	Nexgen CR Flex	1621	Triathlon CR	3334	Triathlon CR
793	Nexgen CR	1254	LCS CR	1288	Triathlon CR	1176	Nexgen CR Flex	890	Nexgen CR Flex
500	Natural Knee II	1224	Triathlon CR	1177	LCS CR	847	LCS CR	750	LCS CR
487	Active Knee	393	Scorpio NRG CR	272	Scorpio NRG CR	219	PFC Sigma CR	458	Persona CR
476	Duracon	286	Vanguard CR	229	PFC Sigma CR	209	Score	194	PFC Sigma CR
320	Scorpio CR	265	RBK	218	Nexgen LPS Flex	200	Nexgen LPS Flex	192	ACS
314	PFC Sigma CR	227	Nexgen LPS Flex	205	Vanguard CR	167	GMK Primary	145	Nexgen LPS Flex
303	RBK	169	Score	200	RBK	144	RBK	144	Score
187	Profix	139	GMK Primary	158	Score	142	Vanguard CR	137	GMK Primary
181	Scorpio PS	131	PFC Sigma CR	157	Natural Knee Flex	119	Natural Knee Flex	91	Triathlon PS
10 Most Used									
5031	(10) 88.1%	5451	(10) 87.7%	5261	(10) 87.6%	4844	(10) 87.7%	6335	(10) 91.0%
Remainder									
681	(14) 11.9%	765	(16) 12.3%	745	(15) 12.4%	680	(18) 12.3%	626	(16) 9.0%
TOTAL									
5712	(24) 100.0%	6216	(26) 100.0%	6006	(25) 100.0%	5524	(28) 100.0%	6961	(26) 100.0%

Table KT5 10 Most Used Femoral Prostheses in Hybrid Primary Total Knee Replacement

2003		2016		2017		2018		2019	
N	Model	N	Model	N	Model	N	Model	N	Model
1157	Duracon	2906	Triathlon CR	3188	Triathlon CR	4006	Triathlon CR	3371	Triathlon CR
766	LCS CR	1876	Nexgen CR Flex	1867	Nexgen CR Flex	1662	Nexgen CR Flex	1772	Persona CR
764	PFC Sigma CR	1427	Vanguard CR	1200	Vanguard CR	1157	Persona CR	1093	Nexgen CR Flex
737	Scorpio CR	700	LCS CR	752	LCS CR	897	Vanguard CR	750	Vanguard CR
596	Nexgen CR	523	Genesis II CR	551	Apex Knee CR	617	Apex Knee CR	599	Apex Knee CR
364	Genesis II CR	450	Apex Knee CR	407	Legion CR	599	LCS CR	555	LCS CR
255	Maxim	383	PFC Sigma CR	387	Genesis II CR	548	Legion CR	488	Legion CR
247	Natural Knee II	378	BalanSys	318	BalanSys	366	BalanSys	384	BalanSys
204	AGC	363	Scorpio CR	299	PFC Sigma CR	307	PFC Sigma CR	351	PFC Sigma CR
203	Scorpio PS	310	Legion CR	299	Scorpio CR	299	Genesis II CR	253	Genesis II CR
10 Most Used									
5293	(10) 84.1%	9316	(10) 81.1%	9268	(10) 80.1%	10458	(10) 86.7%	9616	(10) 88.8%
Remainder									
1001	(27) 15.9%	2172	(34) 18.9%	2304	(29) 19.9%	1602	(26) 13.3%	1213	(26) 11.2%
TOTAL									
6294	(37) 100.0%	11488	(44) 100.0%	11572	(39) 100.0%	12060	(36) 100.0%	10829	(36) 100.0%

OUTCOME FOR ALL DIAGNOSES

Primary Diagnosis

The most common diagnosis for primary total knee replacement is osteoarthritis (97.7%), followed by rheumatoid arthritis (1.3%), other inflammatory arthritis (0.5%) and osteonecrosis (0.3%).

Rheumatoid arthritis has a higher rate of revision in the first 3 months compared to osteoarthritis. After 9 months, rheumatoid arthritis has a lower rate of revision. Osteonecrosis has a higher rate of revision compared to osteoarthritis.

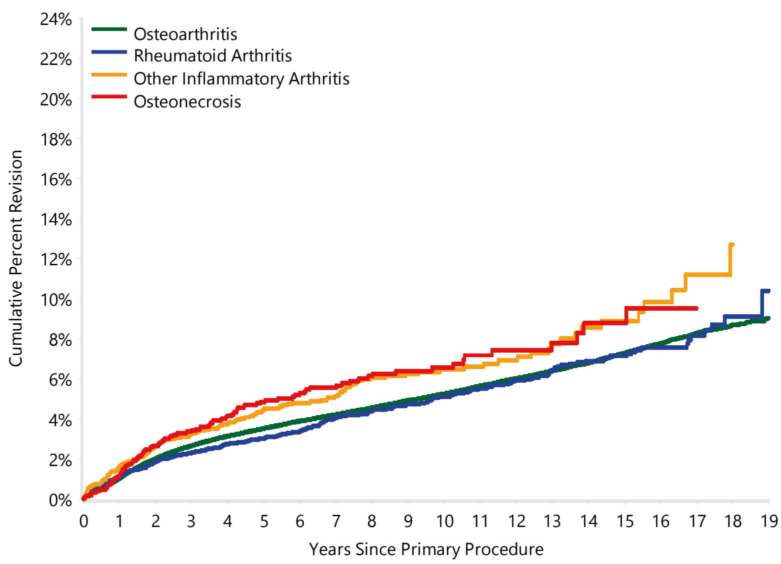
Other inflammatory arthritis has a higher rate of revision compared to osteoarthritis in the first 3 months. After this time, there is no difference (Table KT6 and Figure KT7).

Rheumatoid arthritis has a lower rate of revision compared to osteoarthritis after 9 months.

Table KT6 Cumulative Percent Revision of Primary Total Knee Replacement by Primary Diagnosis

Primary Diagnosis	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Osteoarthritis	27580	699283	1.0 (1.0, 1.0)	2.7 (2.6, 2.7)	3.5 (3.5, 3.6)	5.2 (5.2, 5.3)	7.3 (7.2, 7.4)	9.0 (8.7, 9.3)
Rheumatoid Arthritis	383	9016	1.1 (0.9, 1.3)	2.3 (2.0, 2.7)	3.0 (2.7, 3.4)	5.1 (4.6, 5.7)	7.1 (6.3, 8.0)	10.4 (7.8, 13.8)
Other Inflammatory Arthritis	177	3616	1.6 (1.3, 2.1)	3.2 (2.7, 3.9)	4.5 (3.8, 5.3)	6.5 (5.5, 7.6)	8.9 (7.3, 10.9)	
Osteonecrosis	114	2236	1.2 (0.8, 1.7)	3.4 (2.7, 4.3)	4.8 (3.9, 5.9)	6.6 (5.4, 8.0)	8.8 (6.8, 11.2)	
Other (5)	197	1634	3.5 (2.7, 4.6)	9.0 (7.6, 10.8)	12.5 (10.7, 14.7)	20.1 (17.3, 23.3)	29.6 (24.4, 35.6)	
TOTAL	**28451**	**715785**						

Figure KT7 Cumulative Percent Revision of Primary Total Knee Replacement by Primary Diagnosis



HR - adjusted for age and gender

Rheumatoid Arthritis vs Osteoarthritis
- 0 - 3Mth: HR=1.40 (1.05, 1.85),p=0.021
- 3Mth - 9Mth: HR=0.76 (0.54, 1.06),p=0.103
- 9Mth - 1.5Yr: HR=0.52 (0.39, 0.70),p<0.001
- 1.5Yr+: HR=0.77 (0.68, 0.87),p<0.001

Other Inflammatory Arthritis vs Osteoarthritis
- 0 - 3Mth: HR=1.86 (1.24, 2.77),p=0.002
- 3Mth - 1.5Yr: HR=0.96 (0.72, 1.29),p=0.798
- 1.5Yr+: HR=1.11 (0.92, 1.34),p=0.266

Osteonecrosis vs Osteoarthritis
- Entire Period: HR=1.34 (1.11, 1.61),p=0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Osteoarthritis	699283	632388	503655	387930	162939	39445	1384
Rheumatoid Arthritis	9016	8317	6998	5678	2864	944	49
Other Inflammatory Arthritis	3616	3226	2509	1867	772	227	13
Osteonecrosis	2236	2032	1610	1214	516	125	1

Note: Only primary diagnoses with over 1,000 procedures have been listed

PROSTHESIS TYPES

There have been 568 femoral and tibial prosthesis combinations used in primary total knee replacement reported to the Registry. In 2019, 184 femoral and tibial combinations were used. This is 9 fewer combinations than in 2018.

The cumulative percent revision of the 154 combinations with more than 400 procedures per combination are listed in Table KT7 to Table KT9. Although the listed combinations are a small proportion of all possible combinations, they represent 96.9% of all primary total knee replacement procedures. The 'other' group is the combined outcome of the remaining 414 prosthesis combinations with less than 400 procedures reported per combination.

There are 70 cemented femoral and tibial prosthesis combinations with more than 400 procedures. Of those combinations with a 19 year cumulative percent revision, the Nexgen CR/Nexgen is the lowest at 5.7% (Table KT7).

There are 40 cementless femoral and tibial prosthesis combinations with more than 400 procedures. Of those combinations with a 19 year cumulative percent revision, the Nexgen CR/Nexgen is the lowest at 5.3% (Table KT8).

There have been 568 different femoral and tibial prosthesis combinations reported to the Registry. Outcomes at 19 years are being reported for the first time.

There are 44 combinations of primary total knee replacement using hybrid fixation with more than 400 procedures. The PFC Sigma CR/PFC Sigma has the lowest 19 year cumulative percent revision (6.0%) (Table KT9).

Table KT7 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	19 Yrs
ACS	ACS Fixed	17	670	1.5 (0.8, 2.8)	2.3 (1.4, 4.0)	3.2 (2.0, 5.2)			
	ACS Mobile	23	956	0.8 (0.4, 1.6)	1.9 (1.2, 3.2)	3.9 (2.5, 6.2)			
AGC	AGC*	235	3499	0.5 (0.3, 0.9)	2.5 (2.1, 3.1)	3.7 (3.1, 4.4)	5.6 (4.8, 6.5)	8.8 (7.7, 10.1)	11.4 (9.4, 13.9)
Active Knee	Active Knee	93	2673	1.0 (0.7, 1.4)	2.7 (2.1, 3.5)	3.7 (2.9, 4.6)	5.7 (4.5, 7.1)		
Advance	Advance II	66	918	1.5 (0.9, 2.6)	4.4 (3.3, 6.0)	5.1 (3.9, 6.8)	7.3 (5.7, 9.4)	8.4 (6.5, 11.0)	
Anatomic	Anatomic	6	869	0.5 (0.2, 1.3)	1.0 (0.4, 2.3)				
Apex Knee CR	Apex Knee	26	3255	0.4 (0.3, 0.8)	1.0 (0.7, 1.6)	2.0 (1.2, 3.4)			
Apex Knee PS	Apex Knee	71	4061	0.8 (0.6, 1.2)	2.2 (1.7, 2.8)	2.6 (2.0, 3.3)			
Attune CR	Attune	290	15300	0.9 (0.8, 1.1)	2.4 (2.1, 2.7)	3.0 (2.7, 3.5)			
Attune PS	Attune	111	7179	0.8 (0.6, 1.1)	1.9 (1.6, 2.4)	2.6 (2.1, 3.3)			
BalanSys	BalanSys	50	2024	0.4 (0.2, 0.8)	1.5 (1.0, 2.2)	2.0 (1.4, 2.8)	4.3 (3.1, 6.0)	6.5 (4.2, 10.1)	
Columbus	Columbus	25	2254	0.7 (0.4, 1.2)	1.8 (1.2, 2.8)	1.8 (1.2, 2.8)	2.3 (1.3, 4.0)		
Duracon	Duracon*	529	8967	1.0 (0.8, 1.2)	2.4 (2.1, 2.8)	3.3 (2.9, 3.7)	5.1 (4.6, 5.6)	7.2 (6.6, 7.9)	9.4 (7.5, 11.7)
E.Motion	E.Motion	36	780	2.0 (1.2, 3.3)	4.3 (3.0, 6.1)	4.9 (3.5, 6.9)			
Evolis	Evolis	21	1007	0.3 (0.1, 1.0)	1.1 (0.6, 2.1)	1.7 (1.0, 2.9)	3.6 (2.1, 6.1)		
Evolution	Evolution	166	7978	0.9 (0.7, 1.2)	2.6 (2.2, 3.0)	3.6 (2.9, 4.3)			
GMK Primary	GMK Primary	22	667	1.1 (0.5, 2.3)	2.6 (1.6, 4.2)	3.2 (2.0, 5.0)			
GMK Sphere Primary	GMK Primary	182	8374	1.4 (1.2, 1.7)	2.9 (2.5, 3.4)	3.3 (2.8, 3.9)			
	GMK Sphere Primary	33	1432	0.8 (0.4, 1.5)	3.0 (2.0, 4.4)	4.7 (3.1, 7.1)			
Genesis II CR	Genesis II	601	15642	0.9 (0.8, 1.1)	2.4 (2.2, 2.7)	3.1 (2.8, 3.4)	4.4 (4.1, 4.8)	5.8 (5.3, 6.4)	6.7 (5.9, 7.7)
	Profix Mobile*	47	490	1.7 (0.8, 3.3)	3.4 (2.1, 5.4)	5.4 (3.6, 7.8)	10.2 (7.6, 13.6)	13.4 (9.6, 18.6)	
Genesis II Oxinium CR	Genesis II	470	9145	1.0 (0.8, 1.3)	2.7 (2.4, 3.1)	3.5 (3.2, 4.0)	6.1 (5.5, 6.7)	8.9 (8.0, 10.0)	
Genesis II Oxinium PS	Genesis II	1127	19859	1.5 (1.3, 1.6)	3.7 (3.4, 4.0)	5.1 (4.8, 5.4)	7.5 (7.1, 8.0)	10.4 (9.3, 11.6)	
Genesis II PS	Genesis II	740	18485	1.2 (1.0, 1.3)	2.7 (2.5, 3.0)	3.7 (3.4, 4.0)	5.0 (4.7, 5.4)	6.3 (5.7, 7.0)	
Journey Oxinium	Journey*	313	3032	1.4 (1.0, 1.9)	4.6 (3.9, 5.4)	6.5 (5.6, 7.4)	11.2 (10.0, 12.5)		
Kinemax Plus	Kinemax Plus*	123	1826	0.9 (0.5, 1.4)	2.4 (1.8, 3.2)	3.1 (2.4, 4.0)	4.6 (3.7, 5.7)	7.9 (6.6, 9.5)	

Femoral Component	Tibial Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
LCS CR	LCS	332	3939	1.0 (0.7, 1.4)	3.7 (3.2, 4.4)	5.1 (4.4, 5.8)	7.3 (6.5, 8.2)	9.5 (8.5, 10.5)	11.0 (9.7, 12.4)
	MBT	499	12516	0.8 (0.7, 1.0)	2.5 (2.3, 2.8)	3.5 (3.2, 3.9)	5.3 (4.8, 5.8)	6.1 (5.5, 6.9)	
LCS PS	MBT*	45	492	1.4 (0.7, 3.0)	5.6 (3.9, 8.0)	6.9 (4.9, 9.5)	10.6 (7.9, 14.1)		
Legion CR	Genesis II	54	2743	1.1 (0.7, 1.5)	2.0 (1.5, 2.7)	2.7 (2.0, 3.6)	4.6 (2.7, 7.9)		
Legion	Genesis II	139	5974	0.8 (0.6, 1.0)	2.6 (2.1, 3.1)	3.5 (3.0, 4.2)	4.6 (3.7, 5.6)		
Legion	Genesis II	518	14123	1.1 (0.9, 1.3)	3.1 (2.8, 3.5)	4.4 (4.0, 4.8)	6.3 (5.4, 7.2)		
Legion PS	Genesis II	150	5280	1.2 (0.9, 1.5)	2.4 (2.0, 2.9)	3.1 (2.6, 3.7)	4.7 (3.6, 6.1)		
MRK	MRK	11	550	0.8 (0.3, 2.0)	1.6 (0.8, 3.2)	1.6 (0.8, 3.2)	2.5 (1.3, 4.8)		
Natural Knee Flex	Natural Knee II	59	2332	1.1 (0.7, 1.6)	2.5 (1.9, 3.3)	2.9 (2.2, 3.8)	3.9 (2.9, 5.2)		
Natural Knee II	Natural Knee II*	61	1754	0.5 (0.2, 0.9)	1.3 (0.8, 1.9)	2.0 (1.4, 2.8)	3.5 (2.6, 4.6)	5.1 (3.8, 6.8)	
Nexgen CR	Nexgen	145	4094	0.7 (0.5, 1.0)	1.6 (1.2, 2.0)	2.1 (1.6, 2.6)	3.0 (2.5, 3.7)	4.9 (4.1, 5.8)	5.7 (4.7, 6.9)
Nexgen CR Flex	Natural Knee II	13	806	0.2 (0.1, 1.0)	0.9 (0.4, 1.8)	1.2 (0.6, 2.2)	1.9 (1.1, 3.3)		
	Nexgen	544	28180	0.7 (0.6, 0.8)	1.5 (1.4, 1.7)	2.0 (1.9, 2.2)	2.9 (2.6, 3.2)	3.7 (3.2, 4.3)	
Nexgen LCCK	Nexgen	45	962	2.0 (1.3, 3.2)	3.7 (2.6, 5.2)	5.3 (3.9, 7.2)	6.0 (4.4, 8.2)		
Nexgen LPS	Nexgen	297	6158	1.1 (0.9, 1.4)	2.4 (2.1, 2.8)	3.1 (2.7, 3.6)	4.7 (4.2, 5.4)	6.6 (5.8, 7.4)	8.2 (6.9, 9.9)
Nexgen LPS Flex	Nexgen	1367	35150	0.9 (0.8, 1.0)	2.3 (2.1, 2.4)	3.1 (2.9, 3.3)	5.1 (4.8, 5.4)	7.0 (6.5, 7.6)	
Nexgen RH	Nexgen	31	555	2.1 (1.1, 3.7)	4.2 (2.7, 6.5)	5.7 (3.8, 8.5)	9.8 (6.6, 14.3)		
Optetrak Logic CR	Optetrak Logic	10	566	1.0 (0.4, 2.3)	2.3 (1.2, 4.6)				
Optetrak Logic PS	Optetrak Logic	14	542	1.8 (1.0, 3.5)	3.0 (1.7, 5.2)				
	Optetrak Logic RBK	10	517	1.5 (0.7, 3.3)	2.6 (1.3, 5.1)				
Optetrak-PS	Optetrak	219	2236	1.5 (1.1, 2.1)	4.7 (3.9, 5.6)	6.3 (5.3, 7.4)	10.1 (8.8, 11.6)	12.4 (10.8, 14.2)	
	Optetrak RBK	50	944	1.3 (0.7, 2.2)	3.4 (2.4, 4.9)	4.5 (3.2, 6.1)	7.3 (5.4, 9.7)		
PFC Sigma CR	MBT	39	1187	0.8 (0.5, 1.6)	1.9 (1.2, 2.8)	2.3 (1.6, 3.4)	3.3 (2.4, 4.6)	4.2 (2.8, 6.5)	
	PFC Sigma	441	13271	0.8 (0.7, 1.0)	2.1 (1.8, 2.3)	2.6 (2.3, 2.9)	3.6 (3.3, 4.0)	5.7 (5.0, 6.5)	
PFC Sigma PS	MBT	306	6126	1.0 (0.8, 1.3)	2.9 (2.5, 3.3)	3.8 (3.3, 4.3)	5.3 (4.7, 5.9)	6.9 (6.0, 7.9)	
	PFC Sigma	351	8170	1.2 (1.0, 1.4)	2.5 (2.2, 2.9)	3.2 (2.8, 3.6)	4.8 (4.2, 5.3)	6.8 (6.0, 7.8)	
Persona CR	Nexgen	5	414	0.7 (0.2, 2.3)					
	Persona	62	6978	0.8 (0.6, 1.1)	1.9 (1.3, 2.6)	2.5 (1.6, 3.9)			
Persona PS	Persona	32	2703	0.8 (0.5, 1.3)	1.9 (1.3, 2.8)	1.9 (1.3, 2.8)			
Profix	Profix*	158	3285	1.1 (0.8, 1.6)	2.6 (2.1, 3.2)	3.3 (2.7, 3.9)	4.8 (4.1, 5.7)	5.5 (4.7, 6.5)	
Profix Oxinium	Profix*	95	999	1.9 (1.2, 3.0)	5.0 (3.8, 6.5)	6.6 (5.2, 8.4)	8.4 (6.8, 10.3)	10.4 (8.5, 12.7)	
RBK	RBK	109	2609	1.0 (0.7, 1.5)	2.5 (2.0, 3.2)	3.3 (2.7, 4.1)	5.1 (4.2, 6.2)	6.8 (5.0, 9.2)	
SAIPH	SAIPH	47	3429	0.5 (0.3, 0.8)	1.9 (1.4, 2.6)	2.3 (1.6, 3.1)			
Score	Score	27	887	1.3 (0.7, 2.3)	2.2 (1.4, 3.5)	3.3 (2.2, 4.9)	4.4 (2.9, 6.8)		
Scorpio CR	Series 7000*	100	1799	0.8 (0.5, 1.4)	2.2 (1.6, 3.0)	2.9 (2.2, 3.8)	4.8 (3.9, 6.0)	6.8 (5.5, 8.3)	
Scorpio	Series 7000*	44	1697	0.7 (0.4, 1.2)	1.5 (1.0, 2.2)	2.1 (1.5, 2.9)	3.3 (2.4, 4.5)		
Scorpio NRG PS	Series 7000*	79	2599	0.6 (0.4, 1.0)	1.6 (1.2, 2.2)	2.3 (1.8, 3.0)	3.3 (2.6, 4.2)		
Scorpio PS	Scorpio*	34	511	1.2 (0.5, 2.6)	3.8 (2.4, 5.9)	4.4 (2.9, 6.6)	6.3 (4.4, 8.9)	7.8 (5.5, 11.2)	
	Scorpio+*	72	900	1.3 (0.8, 2.3)	4.2 (3.0, 5.7)	5.8 (4.5, 7.6)	7.3 (5.7, 9.3)	9.5 (7.5, 12.0)	
	Series 7000*	218	3236	1.1 (0.8, 1.5)	2.8 (2.3, 3.5)	4.0 (3.4, 4.7)	6.6 (5.8, 7.6)	9.5 (8.1, 11.0)	
Triathlon CR	Triathlon	1132	50402	0.8 (0.8, 0.9)	2.0 (1.9, 2.2)	2.5 (2.4, 2.7)	3.9 (3.7, 4.2)		
Triathlon PS	Triathlon	357	8755	1.5 (1.2, 1.7)	3.1 (2.8, 3.5)	4.0 (3.6, 4.5)	6.1 (5.5, 6.9)		
Vanguard CR	Vanguard	338	11570	0.7 (0.6, 0.9)	2.1 (1.9, 2.4)	2.7 (2.4, 3.1)	4.8 (4.1, 5.5)		
Vanguard PS	Vanguard	268	4416	2.0 (1.6, 2.4)	4.5 (3.9, 5.2)	5.6 (5.0, 6.4)	8.0 (7.0, 9.2)		
Other (198)		750	9326	2.1 (1.8, 2.4)	4.9 (4.4, 5.4)	6.8 (6.2, 7.4)	9.6 (8.9, 10.3)	12.6 (11.6, 13.6)	16.1 (13.6, 19.0)
TOTAL		**15100**	**417024**						

Note: Some cementless components have been cemented
Only combinations with over 400 procedures have been listed
* denotes prosthesis combinations that have not had any reported use in primary total knee procedures in 2019

Table KT8 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	19 Yrs
ACS	ACS Fixed	45	973	1.6 (1.0, 2.7)	4.6 (3.4, 6.4)	5.9 (4.4, 8.0)			
Active Knee	Active Knee	507	4899	1.3 (1.1, 1.7)	4.0 (3.4, 4.5)	5.6 (5.0, 6.3)	9.7 (8.9, 10.6)	13.4 (12.2, 14.7)	
Advance	Advance	52	890	1.8 (1.1, 2.9)	5.3 (3.9, 7.1)	6.3 (4.8, 8.3)	7.7 (5.7, 10.4)		
Advantim	Advantim*	70	1255	0.8 (0.4, 1.5)	2.7 (2.0, 3.8)	3.6 (2.7, 4.8)	5.7 (4.4, 7.3)	7.0 (5.4, 9.2)	
Apex Knee CR	Apex Knee	26	440	2.7 (1.5, 4.8)	5.9 (4.0, 8.8)	6.2 (4.2, 9.2)			
Columbus	Columbus	64	500	3.2 (2.0, 5.2)	7.7 (5.6, 10.4)	9.7 (7.4, 12.7)	13.3 (10.5, 16.8)		
Duracon	Duracon*	255	3538	1.1 (0.8, 1.4)	2.7 (2.3, 3.3)	3.7 (3.1, 4.4)	5.7 (4.9, 6.5)	8.7 (7.6, 9.9)	
GMK Primary	GMK Primary	36	1190	1.1 (0.6, 1.9)	3.0 (2.1, 4.3)	3.7 (2.6, 5.2)			
Genesis II CR	Genesis II	37	725	1.6 (0.9, 2.8)	4.2 (2.9, 6.1)	5.0 (3.5, 7.1)	7.0 (5.0, 9.8)		
	Profix Mobile*	42	505	1.4 (0.7, 2.9)	2.0 (1.1, 3.7)	3.0 (1.8, 4.9)	4.6 (3.0, 6.8)	8.0 (5.8, 11.0)	
Genesis II PS	Genesis II	23	420	1.7 (0.8, 3.5)	3.3 (2.0, 5.6)	3.9 (2.4, 6.2)	5.9 (3.9, 8.9)		
LCS CR	LCS	167	2363	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)	8.9 (7.6, 10.4)
	MBT	411	8936	1.1 (0.9, 1.4)	3.3 (2.9, 3.7)	4.0 (3.6, 4.5)	5.5 (4.9, 6.1)	7.7 (6.6, 8.9)	
	MBT Duofix	737	14226	1.3 (1.1, 1.5)	3.3 (3.0, 3.6)	4.1 (3.8, 4.4)	5.4 (5.0, 5.9)	7.5 (6.8, 8.1)	
LCS Duofix	MBT Duofix*	491	3650	1.6 (1.2, 2.1)	6.2 (5.5, 7.0)	10.2 (9.2, 11.2)	13.3 (12.2, 14.5)		
Maxim	Maxim*	41	554	1.8 (1.0, 3.4)	2.9 (1.8, 4.7)	3.1 (2.0, 5.0)	4.9 (3.3, 7.2)	9.0 (6.6, 12.3)	
Natural Knee Flex	Natural Knee II	36	1564	0.7 (0.4, 1.3)	1.7 (1.2, 2.6)	2.2 (1.5, 3.2)	3.1 (2.2, 4.3)		
Natural Knee II	Natural Knee II*	261	2890	1.0 (0.7, 1.4)	2.2 (1.7, 2.8)	3.3 (2.7, 4.1)	6.8 (5.9, 7.8)	12.1 (10.7, 13.7)	
Nexgen CR	Nexgen	122	3435	0.6 (0.4, 0.9)	1.7 (1.3, 2.2)	2.1 (1.7, 2.7)	3.0 (2.5, 3.7)	4.1 (3.4, 4.9)	5.3 (4.1, 6.7)
	Nexgen TM CR	47	731	1.3 (0.7, 2.4)	4.4 (3.1, 6.2)	6.3 (4.7, 8.4)	7.1 (5.4, 9.5)	7.6 (5.7, 10.0)	
Nexgen CR Flex	Nexgen	292	8400	1.1 (0.9, 1.4)	2.8 (2.5, 3.2)	3.3 (2.9, 3.8)	4.3 (3.8, 4.9)	5.1 (4.4, 6.1)	
	Nexgen TM CR	275	10792	0.5 (0.4, 0.7)	1.8 (1.6, 2.1)	2.3 (2.1, 2.7)	3.3 (2.9, 3.8)		
Nexgen LPS	Nexgen TM LPS	32	1350	0.7 (0.4, 1.3)	1.2 (0.7, 2.0)	2.2 (1.5, 3.3)	3.1 (2.1, 4.6)		
Nexgen LPS Flex	Nexgen	42	1115	2.8 (2.0, 4.0)	4.1 (3.0, 5.5)	4.2 (3.1, 5.7)			
	Nexgen TM LPS	45	1051	1.3 (0.7, 2.2)	3.1 (2.2, 4.4)	4.3 (3.2, 5.8)			
PFC Sigma CR	AMK Duofix*	67	1911	0.7 (0.4, 1.2)	1.6 (1.1, 2.3)	2.3 (1.7, 3.1)	3.4 (2.6, 4.4)	4.5 (3.4, 5.8)	
	MBT	69	995	2.3 (1.5, 3.5)	4.9 (3.7, 6.4)	5.6 (4.3, 7.3)	6.8 (5.3, 8.7)	9.0 (6.7, 12.0)	
	MBT Duofix	147	3190	1.0 (0.7, 1.5)	2.9 (2.3, 3.6)	3.6 (3.0, 4.4)	5.2 (4.3, 6.2)	7.9 (6.4, 9.8)	
Persona CR	Persona	0	420	0.0 (0.0, 0.0)					
Profix	Profix*	103	1488	1.1 (0.7, 1.8)	3.5 (2.6, 4.5)	4.6 (3.7, 5.9)	6.9 (5.7, 8.3)	8.0 (6.6, 9.8)	
RBK	RBK	341	6721	1.3 (1.1, 1.6)	3.2 (2.8, 3.7)	4.2 (3.7, 4.7)	5.6 (5.0, 6.2)	7.0 (6.1, 8.1)	
Score	Score	199	2390	1.8 (1.3, 2.4)	5.7 (4.8, 6.8)	7.8 (6.7, 9.1)	12.7 (10.9, 14.9)		
Scorpio CR	Series 7000*	235	3135	1.4 (1.0, 1.8)	3.4 (2.9, 4.1)	4.8 (4.1, 5.6)	7.4 (6.5, 8.5)	9.3 (8.1, 10.6)	
Scorpio NRG CR	Series 7000*	112	2641	1.1 (0.8, 1.6)	3.3 (2.7, 4.1)	3.9 (3.2, 4.8)	5.2 (4.2, 6.3)		
Scorpio NRG PS	Series 7000*	75	1143	1.2 (0.7, 2.1)	4.8 (3.7, 6.2)	6.2 (4.9, 7.8)	7.7 (6.1, 9.7)		
Scorpio PS	Series 7000*	48	570	2.5 (1.5, 4.1)	5.3 (3.7, 7.5)	6.2 (4.5, 8.6)	7.9 (5.9, 10.5)	9.0 (6.8, 11.9)	
Triathlon CR	Triathlon	544	19509	1.1 (1.0, 1.3)	2.3 (2.1, 2.6)	3.0 (2.8, 3.3)	4.2 (3.9, 4.7)		
Triathlon PS	Triathlon	59	1177	2.0 (1.4, 3.0)	3.8 (2.8, 5.1)	4.8 (3.7, 6.3)	5.8 (4.5, 7.5)		
Vanguard CR	Regenerex	78	1693	1.2 (0.8, 1.8)	3.4 (2.6, 4.5)	4.3 (3.4, 5.5)			
	Vanguard	92	1692	1.4 (0.9, 2.1)	4.0 (3.2, 5.1)	4.7 (3.8, 5.9)	6.8 (5.3, 8.7)		
Other (80)		620	5750	2.7 (2.3, 3.1)	7.3 (6.6, 8.0)	8.9 (8.2, 9.7)	11.4 (10.5, 12.3)	13.8 (12.7, 15.0)	
TOTAL		**6945**	**130817**						

Note: Only combinations with over 400 procedures have been listed
* denotes prosthesis combinations that have not had any reported use in primary total knee procedures in 2019

Table KT9 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	19 Yrs
ACS	ACS Fixed	55	1223	1.5 (1.0, 2.4)	5.0 (3.8, 6.5)	5.6 (4.3, 7.4)			
AGC	AGC*	69	1644	0.6 (0.3, 1.1)	1.4 (1.0, 2.1)	2.1 (1.5, 2.9)	3.5 (2.6, 4.6)	5.5 (4.2, 7.1)	
Active Knee	Active Knee	133	2282	0.6 (0.4, 1.0)	2.8 (2.2, 3.5)	3.9 (3.1, 4.8)	6.7 (5.6, 8.1)	9.5 (7.8, 11.5)	
Advance	Advance II	24	477	1.1 (0.4, 2.5)	2.8 (1.6, 4.8)	3.8 (2.4, 6.0)	5.8 (3.8, 8.7)	6.2 (4.2, 9.3)	
Apex Knee CR	Apex Knee	37	2688	1.0 (0.6, 1.4)	1.6 (1.1, 2.2)	2.3 (1.5, 3.4)			
BalanSys	BalanSys	31	1776	1.0 (0.6, 1.6)	2.1 (1.4, 3.1)	3.0 (1.9, 4.8)			
Duracon	Duracon*	493	7963	1.2 (1.0, 1.5)	2.7 (2.4, 3.1)	3.5 (3.1, 3.9)	5.1 (4.6, 5.6)	7.1 (6.5, 7.8)	9.3 (8.1, 10.7)
GMK Primary	GMK Primary	23	643	0.8 (0.3, 2.0)	3.6 (2.4, 5.6)	4.1 (2.7, 6.2)			
Genesis II CR	Genesis II	407	8214	0.9 (0.7, 1.2)	3.1 (2.7, 3.5)	4.2 (3.8, 4.7)	5.8 (5.2, 6.4)	7.1 (6.3, 7.9)	
Genesis II PS	Genesis II	63	707	1.7 (1.0, 3.0)	4.4 (3.1, 6.2)	5.5 (4.0, 7.4)	8.7 (6.7, 11.1)	10.0 (7.8, 12.7)	
LCS CR	LCS	145	2364	1.0 (0.7, 1.5)	2.7 (2.1, 3.5)	3.8 (3.1, 4.7)	5.5 (4.6, 6.5)	6.7 (5.7, 8.0)	7.6 (6.4, 9.1)
	MBT	319	10270	0.8 (0.6, 1.0)	2.2 (1.9, 2.5)	2.9 (2.5, 3.3)	4.0 (3.6, 4.5)	4.7 (4.1, 5.4)	
	MBT Duofix	36	959	1.4 (0.8, 2.4)	3.3 (2.4, 4.7)	3.5 (2.5, 4.9)	4.6 (3.2, 6.5)		
LCS Duofix	MBT*	71	822	1.5 (0.8, 2.6)	5.5 (4.1, 7.3)	7.3 (5.7, 9.3)	9.2 (7.3, 11.4)		
Legion CR	Genesis II	97	2917	1.4 (1.0, 1.9)	3.8 (3.1, 4.7)	4.4 (3.6, 5.4)			
Maxim	Maxim*	68	1060	0.8 (0.4, 1.5)	2.4 (1.6, 3.5)	3.3 (2.4, 4.6)	5.3 (4.0, 6.9)	9.0 (7.0, 11.6)	
Natural Knee Flex	Natural Knee II	38	1902	0.4 (0.2, 0.9)	1.3 (0.9, 2.0)	2.0 (1.4, 2.8)	2.6 (1.8, 3.6)		
Natural Knee II	Natural Knee II*	102	1966	1.2 (0.8, 1.8)	2.2 (1.6, 3.0)	2.5 (1.9, 3.4)	4.0 (3.2, 5.1)	7.4 (6.0, 9.1)	
Nexgen CR	Nexgen	153	4331	0.6 (0.4, 0.9)	1.7 (1.4, 2.2)	2.2 (1.8, 2.7)	3.3 (2.7, 3.9)	4.5 (3.8, 5.4)	
Nexgen CR Flex	Nexgen	476	21023	0.7 (0.6, 0.9)	1.8 (1.7, 2.0)	2.3 (2.1, 2.5)	3.0 (2.7, 3.3)	4.0 (3.0, 5.3)	
	Nexgen TM CR	21	840	0.7 (0.3, 1.6)	1.6 (0.9, 2.7)	1.7 (1.0, 2.9)	2.5 (1.6, 3.9)		
Nexgen LPS	Nexgen	56	1021	0.5 (0.2, 1.2)	2.7 (1.9, 4.0)	4.2 (3.1, 5.7)	5.5 (4.2, 7.2)	6.7 (5.1, 8.8)	
Nexgen LPS Flex	Nexgen	55	1047	2.2 (1.4, 3.3)	4.7 (3.5, 6.2)	5.9 (4.6, 7.7)			
	Nexgen TM LPS	18	508	0.6 (0.2, 1.8)	1.8 (0.9, 3.4)	2.0 (1.1, 3.7)	2.9 (1.7, 4.8)		
Optetrak Logic CR	Optetrak Logic	18	806	1.6 (0.9, 2.8)	3.3 (2.0, 5.5)				
Optetrak-CR	Optetrak*	36	415	1.5 (0.7, 3.2)	3.7 (2.2, 6.1)	4.7 (3.0, 7.3)	8.4 (5.9, 11.8)	11.8 (8.3, 16.7)	
PFC Sigma CR	MBT	207	4056	1.2 (0.9, 1.6)	3.1 (2.6, 3.7)	4.1 (3.5, 4.8)	5.3 (4.6, 6.1)	7.3 (6.1, 8.6)	
	PFC Sigma	377	11438	0.6 (0.5, 0.8)	1.9 (1.7, 2.2)	2.5 (2.2, 2.8)	3.6 (3.2, 4.0)	5.5 (4.8, 6.3)	6.0 (5.1, 7.0)
PFC Sigma PS	MBT Duofix*	166	2251	1.8 (1.3, 2.5)	4.5 (3.7, 5.5)	6.2 (5.2, 7.3)	8.4 (7.2, 9.8)	9.8 (8.3, 11.4)	
Persona CR	Persona	38	3357	1.2 (0.8, 1.7)	2.4 (1.6, 3.7)				
Profix	Profix Mobile*	58	592	1.9 (1.0, 3.4)	5.8 (4.2, 8.1)	7.4 (5.6, 9.9)	9.4 (7.3, 12.2)	10.8 (8.4, 13.8)	
	Profix*	35	769	0.8 (0.4, 1.7)	2.4 (1.5, 3.8)	3.8 (2.6, 5.4)	4.7 (3.4, 6.5)	4.9 (3.5, 6.8)	
RBK	RBK	69	1588	1.1 (0.7, 1.7)	3.0 (2.3, 4.0)	3.9 (3.0, 5.0)	4.9 (3.8, 6.3)	7.8 (5.4, 11.3)	
Score	Score	71	1549	1.7 (1.2, 2.5)	4.4 (3.4, 5.7)	6.3 (4.9, 8.1)			
Scorpio CR	Scorpio+*	159	1893	1.0 (0.6, 1.6)	2.9 (2.2, 3.7)	4.4 (3.5, 5.4)	7.7 (6.6, 9.1)	9.5 (8.1, 11.1)	
	Series 7000*	287	6882	0.7 (0.5, 0.9)	1.9 (1.6, 2.3)	2.7 (2.3, 3.1)	4.3 (3.8, 4.9)	6.4 (5.6, 7.3)	
Scorpio NRG CR	Series 7000*	36	795	0.4 (0.1, 1.2)	2.2 (1.4, 3.5)	3.0 (2.0, 4.5)	5.8 (4.0, 8.4)		
Scorpio PS	Scorpio+*	49	905	1.0 (0.5, 1.9)	2.6 (1.7, 3.9)	3.4 (2.4, 4.8)	4.7 (3.5, 6.4)	6.3 (4.7, 8.4)	
	Series 7000*	95	1079	1.2 (0.7, 2.1)	4.3 (3.3, 5.7)	5.7 (4.5, 7.3)	7.3 (5.9, 9.1)	10.8 (8.7, 13.4)	
Trekking	Trekking	12	514	0.8 (0.3, 2.2)	2.4 (1.3, 4.5)	3.4 (1.7, 7.0)			
Triathlon CR	Triathlon	501	27240	0.6 (0.6, 0.8)	1.6 (1.5, 1.8)	2.1 (1.9, 2.3)	3.2 (2.9, 3.6)		
Triathlon PS	Triathlon	101	2781	1.7 (1.3, 2.3)	2.7 (2.2, 3.4)	3.6 (3.0, 4.5)	5.1 (4.1, 6.5)		
Vanguard CR	Vanguard	398	12905	0.8 (0.7, 1.0)	2.3 (2.0, 2.5)	3.0 (2.7, 3.4)	5.0 (4.4, 5.6)		
Vanguard PS	Vanguard	30	665	1.2 (0.6, 2.4)	3.0 (1.9, 4.6)	4.2 (2.8, 6.1)	6.1 (4.1, 9.0)		
Other (136)		673	6817	2.3 (1.9, 2.7)	5.9 (5.3, 6.5)	7.3 (6.7, 8.0)	10.5 (9.7, 11.4)	14.0 (12.8, 15.2)	16.8 (15.0, 18.9)
TOTAL		**6406**	**167944**						

Note: Only combinations with over 400 procedures have been listed
* denotes prosthesis combinations that have not had any reported use in primary total knee procedures in 2019

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 19 years, the cumulative percent revision of all primary total knee replacement procedures undertaken for osteoarthritis is 9.0% (Table KT10 and Figure KT8).

The Registry recognises that knee replacement prosthesis use and availability changes with time. In order to keep Registry data contemporaneous, this year there has also been an analysis of primary total knee replacement excluding prosthesis combinations that have no recorded use in the past year. It is anticipated that this will become the standard for comparisons in future reports.

There were 602,592 procedures that had currently used prosthesis combinations available for this analysis. This excluded 96,691 procedures using prostheses that are no longer used. At 19 years, the cumulative percent revision for currently used primary total knee replacement undertaken for osteoarthritis is 8.0% (Table KT13 and Figure KT10).

Reason for Revision

When all prostheses are assessed, loosening is the main reason for revision (24.7%), followed by infection (23.7%), patellofemoral pain (9.1%), instability (8.5%), and pain (8.2%) (Table KT11 and Figure KT9). If only currently used prostheses are assessed, infection is the most common reason for revision (26.1%) followed by loosening (23.1%), instability (9.2%), patellofemoral pain (8.9%), and pain (8.2%) (Table KT14 and Figure KT11).

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 bone resorption.

Types of Revision

If all procedures are included, the most common types of revision are replacement of both the femoral and tibial prostheses (26.5%), insert only exchange (23.7%), and patella only replacement (19.4%) (Table KT12).

If currently used prostheses are assessed, the most common type of revision is insert only (26.1%), both femoral and tibial components (24.2%), and patella only (19.1%) (Table KT15).

Age and Gender

Age is a major factor affecting the outcome of primary total knee replacement. The rate of revision decreases with increasing age. This difference becomes more evident with time. Patients aged <55 years have more than 3 times the rate of revision after 6 months and more than 6 times after 7.5 years, compared to patients aged ≥75 years (Table KT16 and Figure KT12).

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 KT17 and Figure KT13). Loosening is a more common reason for revision in females. Males have a higher incidence of revision for infection, with a 19 year cumulative incidence of 1.9% compared to 1.0% for females (Figure KT14).

Age related differences in the rate of revision are evident for both males and females (Table KT17, Figure KT15 and Figure KT16).

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 reports on the outcome of 341,179 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 KT18 and Figure KT17). 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 KT18).

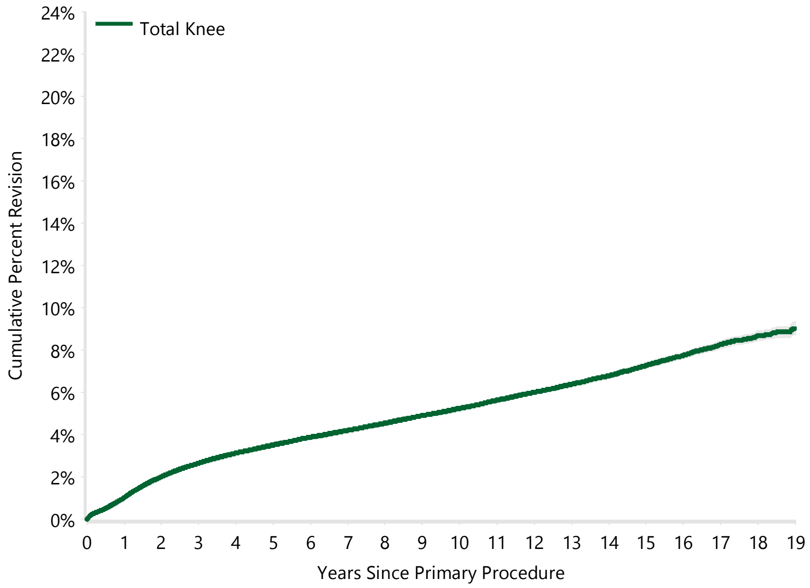
BMI data have been collected since 2015. The early revision outcomes are reported for 249,290 primary total knee replacement procedures with BMI data undertaken for osteoarthritis. When compared to patients with a normal BMI, there is no difference in the rate of revision for patients who are pre-obese or obese class 1.

However, the rate of revision is increased for patients in obese class 2 for the first 3 months and obese class 3 in the first 6 months only (Table KT19 and Figure KT19). The most common reasons for revision are shown in Figure KT20. The cumulative incidence of infection increases with increasing BMI class.

Table KT10 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	19 Yrs
Total Knee	27580	699283	1.0 (1.0, 1.0)	2.7 (2.6, 2.7)	3.5 (3.5, 3.6)	5.2 (5.2, 5.3)	7.3 (7.2, 7.4)	9.0 (8.7, 9.3)
TOTAL	**27580**	**699283**						

Figure KT8 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	19 Yrs
Total Knee	699283	632388	503655	387930	162939	39445	1384

Table KT11 Primary Total Knee Replacement by Reason for Revision (Primary Diagnosis OA)

Reason for Revision	Number	Percent
Loosening	6805	24.7
Infection	6539	23.7
Patellofemoral Pain	2519	9.1
Instability	2345	8.5
Pain	2250	8.2
Patella Erosion	1645	6.0
Arthrofibrosis	990	3.6
Fracture	860	3.1
Malalignment	592	2.1
Lysis	541	2.0
Wear Tibial Insert	521	1.9
Metal Related Pathology	354	1.3
Incorrect Sizing	295	1.1
Other	1324	4.8
TOTAL	**27580**	**100.0**

Table KT12 Primary Total Knee Replacement by Type of Revision (Primary Diagnosis OA)

Type of Revision	Number	Percent
TKR (Tibial/Femoral)	7317	26.5
Insert Only	6523	23.7
Patella Only	5341	19.4
Insert/Patella	2873	10.4
Tibial Component	2362	8.6
Cement Spacer	1476	5.4
Femoral Component	1443	5.2
Removal of Prostheses	147	0.5
Minor Components	58	0.2
Cement Only	16	0.1
Total Femoral	13	0.0
Reinsertion of Components	11	0.0
TOTAL	**27580**	**100.0**

Figure KT9 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement (Primary Diagnosis OA)

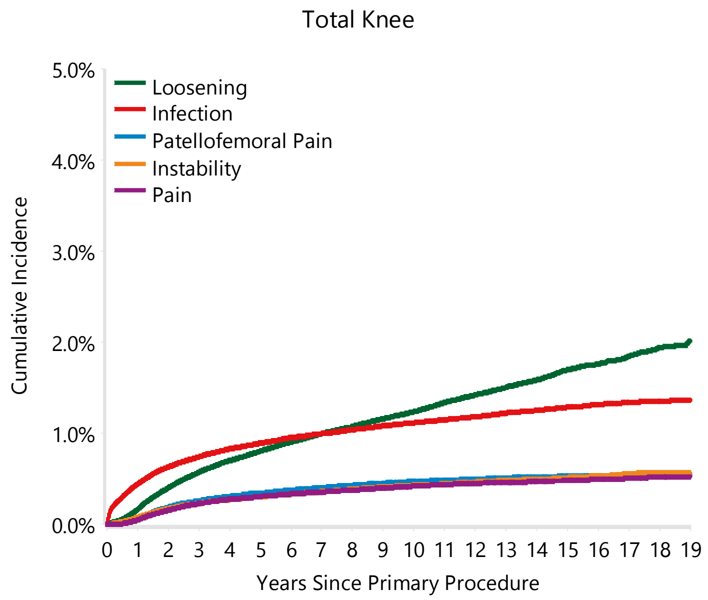
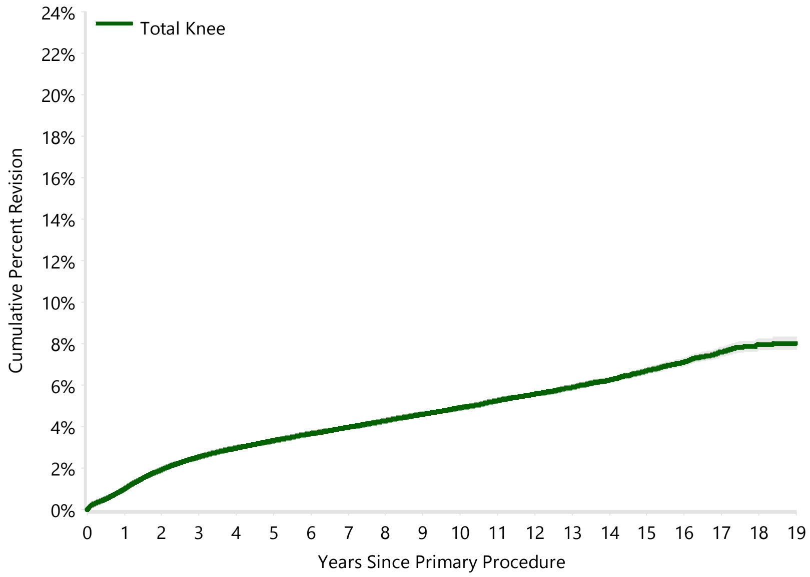


Table KT13 Cumulative Percent Revision of Primary Total Knee Replacement (Primary Diagnosis OA, Excluding Combinations with No Recorded Use in 2019)

Knee Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Total Knee	20834	602592	1.0 (1.0, 1.0)	2.5 (2.5, 2.6)	3.3 (3.3, 3.4)	4.9 (4.8, 5.0)	6.7 (6.6, 6.8)	8.0 (7.7, 8.3)
TOTAL	**20834**	**602592**						

Figure KT10 Cumulative Percent Revision of Primary Knee Replacement (Primary Diagnosis OA, Excluding Combinations with No Recorded Use in 2019)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Total Knee	602592	537797	414897	306676	108269	22366	709

Table KT14 Primary Total Knee Replacement by Reason for Revision (Primary Diagnosis OA, Excluding Combinations with No Recorded Use in 2019)

Reason for Revision	Number	Percent
Infection	5443	26.1
Loosening	4814	23.1
Instability	1910	9.2
Patellofemoral Pain	1850	8.9
Pain	1705	8.2
Patella Erosion	1275	6.1
Arthrofibrosis	795	3.8
Fracture	676	3.2
Malalignment	490	2.4
Lysis	273	1.3
Wear Tibial Insert	267	1.3
Incorrect Sizing	234	1.1
Metal Related Pathology	100	0.5
Other	1002	4.8
TOTAL	**20834**	**100.0**

Table KT15 Primary Total Knee Replacement by Type of Revision (Primary Diagnosis OA, Excluding Combinations with No Recorded Use in 2019)

Type of Revision	Number	Percent
Insert Only	5437	26.1
TKR (Tibial/Femoral)	5043	24.2
Patella Only	3986	19.1
Insert/Patella	2145	10.3
Tibial Component	1832	8.8
Cement Spacer	1139	5.5
Femoral Component	1057	5.1
Removal of Prostheses	117	0.6
Minor Components	47	0.2
Cement Only	12	0.1
Total Femoral	11	0.1
Reinsertion of Components	8	0.0
TOTAL	**20834**	**100.0**

Figure KT11 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement (Primary Diagnosis OA, Excluding Combinations with No Recorded Use in 2019)

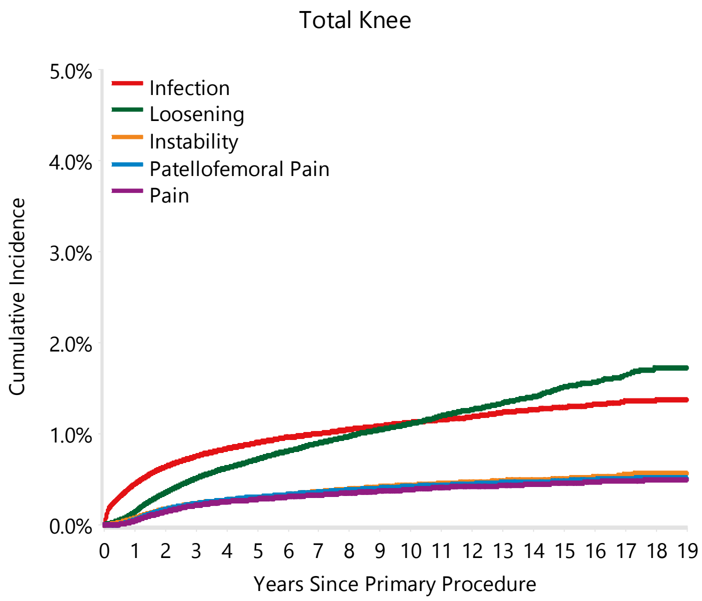
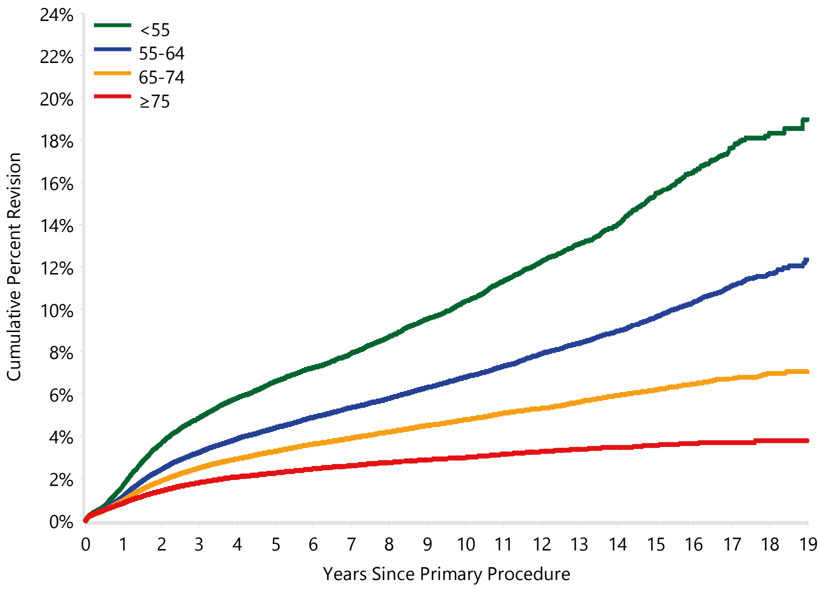


Table KT16 Cumulative Percent Revision of Primary Total Knee Replacement by Age (Primary Diagnosis OA)

Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
<55	3772	45651	1.7 (1.6, 1.8)	4.9 (4.7, 5.1)	6.6 (6.3, 6.8)	10.4 (10.0, 10.7)	15.5 (14.9, 16.1)	19.0 (17.7, 20.3)
55-64	9615	184518	1.2 (1.1, 1.2)	3.2 (3.1, 3.3)	4.4 (4.3, 4.5)	6.8 (6.6, 6.9)	9.6 (9.4, 9.9)	12.3 (11.7, 13.0)
65-74	9855	276884	1.0 (0.9, 1.0)	2.5 (2.4, 2.6)	3.3 (3.2, 3.4)	4.8 (4.7, 4.9)	6.2 (6.0, 6.3)	7.0 (6.8, 7.3)
≥75	4338	192230	0.8 (0.8, 0.9)	1.8 (1.7, 1.9)	2.3 (2.2, 2.3)	3.0 (2.9, 3.1)	3.6 (3.4, 3.7)	3.8 (3.5, 4.0)
TOTAL	**27580**	**699283**						

Figure KT12 Cumulative Percent Revision of Primary Total Knee Replacement by Age (Primary Diagnosis OA)



HR - adjusted for gender

<55 vs ≥75
0 - 6Mth: HR=1.38 (1.21, 1.56),p<0.001
6Mth - 1.5Yr: HR=3.24 (2.98, 3.53),p<0.001
1.5Yr - 2Yr: HR=3.46 (3.06, 3.91),p<0.001
2Yr - 4Yr: HR=3.29 (2.99, 3.62),p<0.001
4Yr - 6.5Yr: HR=4.23 (3.77, 4.75),p<0.001
6.5Yr - 7.5Yr: HR=5.53 (4.59, 6.66),p<0.001
7.5Yr - 10Yr: HR=6.25 (5.45, 7.19),p<0.001
10Yr+: HR=7.75 (6.81, 8.81),p<0.001

55-64 vs ≥75
0 - 6Mth: HR=1.07 (0.98, 1.17),p=0.154
6Mth - 9Mth: HR=1.85 (1.65, 2.07),p<0.001
9Mth - 2Yr: HR=2.12 (1.99, 2.26),p<0.001
2Yr - 4Yr: HR=2.17 (2.01, 2.34),p<0.001
4Yr - 4.5Yr: HR=2.90 (2.49, 3.38),p<0.001
4.5Yr - 6.5Yr: HR=2.98 (2.70, 3.28),p<0.001
6.5Yr - 7Yr: HR=3.37 (2.78, 4.08),p<0.001
7Yr - 7.5Yr: HR=2.99 (2.45, 3.64),p<0.001
7.5Yr - 10Yr: HR=3.55 (3.16, 3.98),p<0.001
10Yr - 13.5Yr: HR=4.12 (3.64, 4.67),p<0.001
13.5Yr+: HR=4.84 (4.09, 5.71),p<0.001

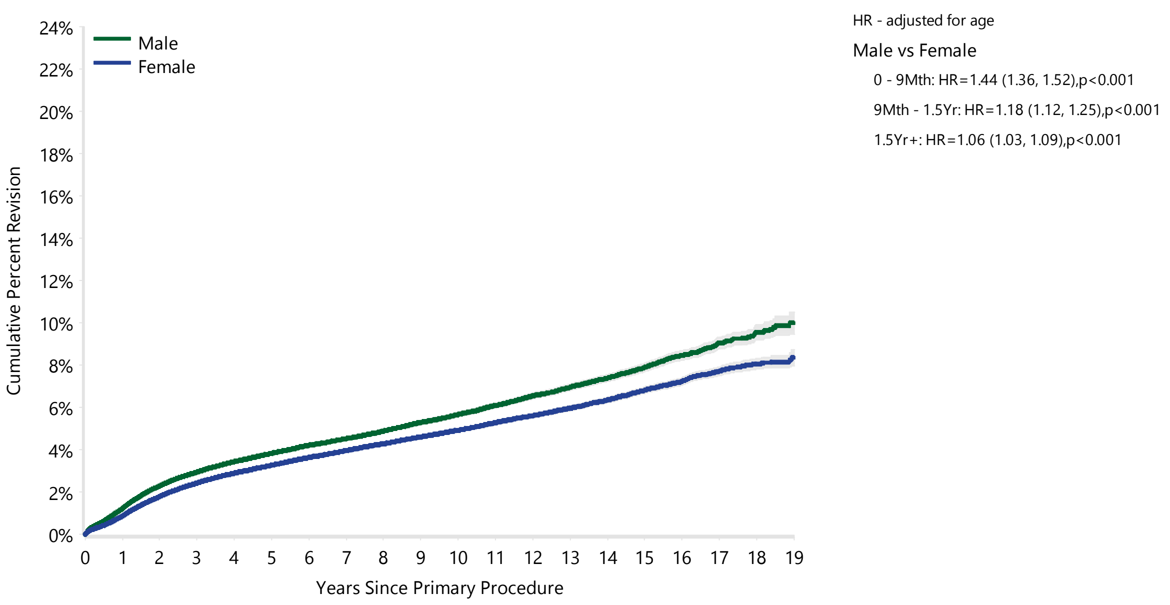
65-74 vs ≥75
0 - 6Mth: HR=0.98 (0.90, 1.06),p=0.599
6Mth - 2Yr: HR=1.53 (1.44, 1.62),p<0.001
2Yr - 4Yr: HR=1.56 (1.45, 1.69),p<0.001
4Yr+: HR=2.01 (1.87, 2.17),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
<55	45651	41452	33274	26169	12151	3671	154
55-64	184518	167378	134165	104675	46729	12767	503
65-74	276884	249818	197989	152755	66345	17000	607
≥75	192230	173740	138227	104331	37714	6007	120

Table KT17 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	19 Yrs
Male		**12931**	**306742**	**1.2 (1.2, 1.3)**	**2.9 (2.9, 3.0)**	**3.8 (3.8, 3.9)**	**5.7 (5.6, 5.8)**	**7.9 (7.7, 8.1)**	**10.0 (9.5, 10.5)**
	<55	1683	19706	2.0 (1.8, 2.2)	5.3 (4.9, 5.6)	6.9 (6.5, 7.3)	10.6 (10.1, 11.2)	15.8 (14.9, 16.8)	18.8 (17.4, 20.3)
	55-64	4667	85231	1.4 (1.3, 1.5)	3.6 (3.4, 3.7)	4.7 (4.6, 4.9)	7.2 (7.0, 7.5)	10.1 (9.7, 10.4)	12.9 (11.9, 14.0)
	65-74	4691	123932	1.2 (1.1, 1.2)	2.7 (2.6, 2.8)	3.5 (3.4, 3.7)	5.1 (4.9, 5.3)	6.7 (6.4, 6.9)	8.1 (7.5, 8.8)
	≥75	1890	77873	1.0 (0.9, 1.0)	2.0 (1.9, 2.1)	2.5 (2.4, 2.6)	3.2 (3.1, 3.4)	3.9 (3.6, 4.2)	
Female		**14649**	**392541**	**0.9 (0.8, 0.9)**	**2.4 (2.4, 2.5)**	**3.3 (3.2, 3.3)**	**4.9 (4.8, 5.0)**	**6.8 (6.7, 7.0)**	**8.4 (8.0, 8.7)**
	<55	2089	25945	1.4 (1.3, 1.6)	4.6 (4.3, 4.8)	6.4 (6.0, 6.7)	10.2 (9.7, 10.7)	15.2 (14.4, 16.0)	19.1 (17.1, 21.4)
	55-64	4948	99287	1.0 (0.9, 1.1)	2.9 (2.8, 3.1)	4.1 (4.0, 4.2)	6.4 (6.2, 6.6)	9.2 (8.9, 9.6)	11.9 (11.0, 12.8)
	65-74	5164	152952	0.8 (0.8, 0.8)	2.3 (2.2, 2.4)	3.1 (3.0, 3.2)	4.5 (4.4, 4.6)	5.8 (5.6, 6.0)	6.3 (6.1, 6.6)
	≥75	2448	114357	0.7 (0.7, 0.8)	1.6 (1.6, 1.7)	2.1 (2.0, 2.2)	2.8 (2.7, 2.9)	3.4 (3.2, 3.5)	3.6 (3.3, 4.0)
TOTAL		**27580**	**699283**						

Figure KT13 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	19 Yrs
Male	306742	275401	216614	164757	66729	15606	548
Female	392541	356987	287041	223173	96210	23839	836

Figure KT14 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by Gender (Primary Diagnosis OA)

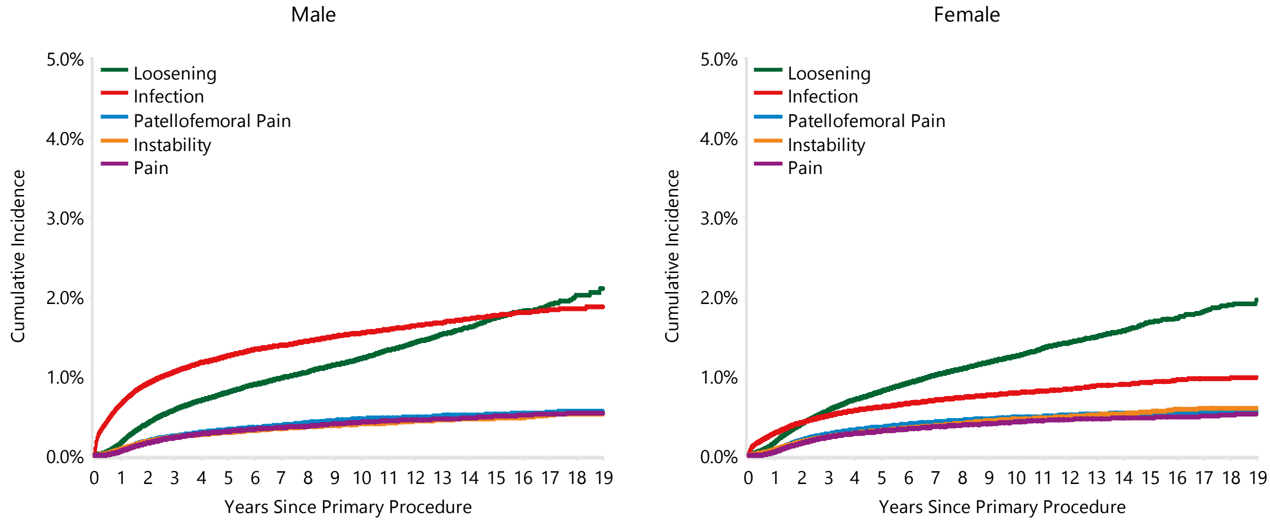
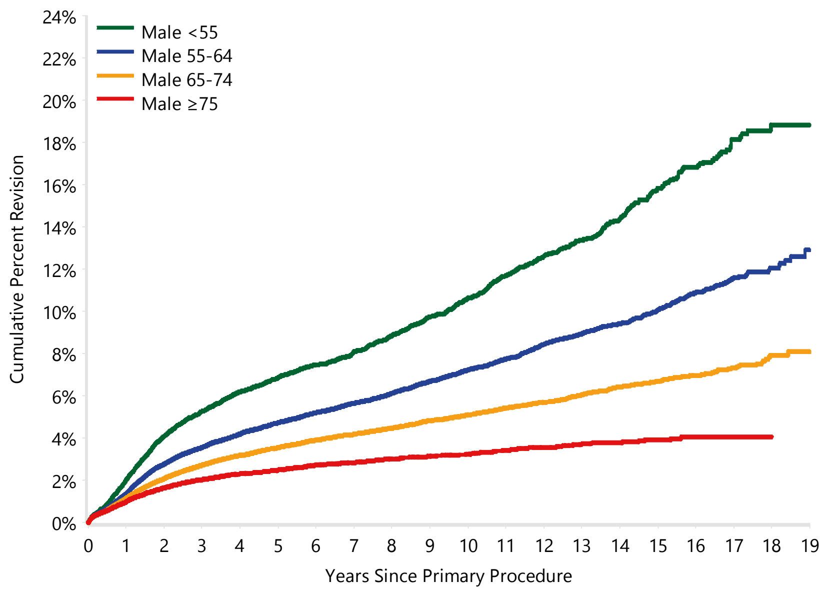


Figure KT15 Cumulative Percent Revision of Primary Total Knee Replacement in Males by Age (Primary Diagnosis OA)



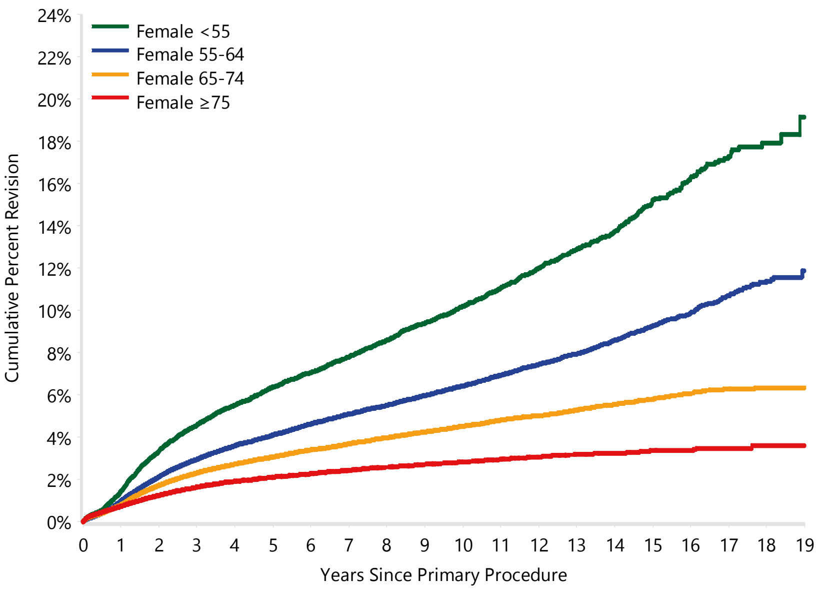
Male <55 vs Male ≥75
- 0 - 6Mth: HR=1.62 (1.36, 1.93),p<0.001
- 6Mth - 9Mth: HR=2.67 (2.15, 3.31),p<0.001
- 9Mth - 3.5Yr: HR=3.19 (2.91, 3.49),p<0.001
- 3.5Yr - 7.5Yr: HR=3.60 (3.15, 4.11),p<0.001
- 7.5Yr+: HR=5.86 (5.10, 6.72),p<0.001

Male 55-64 vs Male ≥75
- 0 - 3Mth: HR=1.17 (1.01, 1.35),p=0.031
- 3Mth - 1Yr: HR=1.63 (1.48, 1.80),p<0.001
- 1Yr - 5.5Yr: HR=2.23 (2.08, 2.38),p<0.001
- 5.5Yr - 8.5Yr: HR=2.84 (2.50, 3.22),p<0.001
- 8.5Yr+: HR=3.49 (3.07, 3.96),p<0.001

Male 65-74 vs Male ≥75
- 0 - 6Mth: HR=1.09 (0.97, 1.22),p=0.140
- 6Mth - 2.5Yr: HR=1.45 (1.35, 1.56),p<0.001
- 2.5Yr+: HR=1.78 (1.65, 1.93),p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Male	<55	19706	17745	14187	11188	5259	1631	72
	55-64	85231	76726	60798	47100	20777	5521	230
	65-74	123932	111251	87373	66740	27715	6635	212
	≥75	77873	69679	54256	39729	12978	1819	34

Figure KT16 Cumulative Percent Revision of Primary Total Knee Replacement in Females by Age (Primary Diagnosis OA)



Female <55 vs Female ≥75
- 0 - 6Mth: HR=1.23 (1.02, 1.48),p=0.033
- 6Mth - 3Yr: HR=3.52 (3.24, 3.82),p<0.001
- 3Yr - 7Yr: HR=4.18 (3.77, 4.64),p<0.001
- 7Yr - 11Yr: HR=6.07 (5.24, 7.02),p<0.001
- 11Yr+: HR=8.58 (7.12, 10.33),p<0.001

Female 55-64 vs Female ≥75
- 0 - 3Mth: HR=0.76 (0.64, 0.89),p<0.001
- 3Mth - 6Mth: HR=1.22 (1.01, 1.47),p=0.035
- 6Mth - 3.5Yr: HR=2.22 (2.08, 2.37),p<0.001
- 3.5Yr - 8Yr: HR=2.80 (2.57, 3.05),p<0.001
- 8Yr - 12Yr: HR=3.57 (3.13, 4.08),p<0.001
- 12Yr - 15Yr: HR=4.67 (3.81, 5.72),p<0.001
- 15Yr+: HR=6.32 (4.64, 8.61),p<0.001

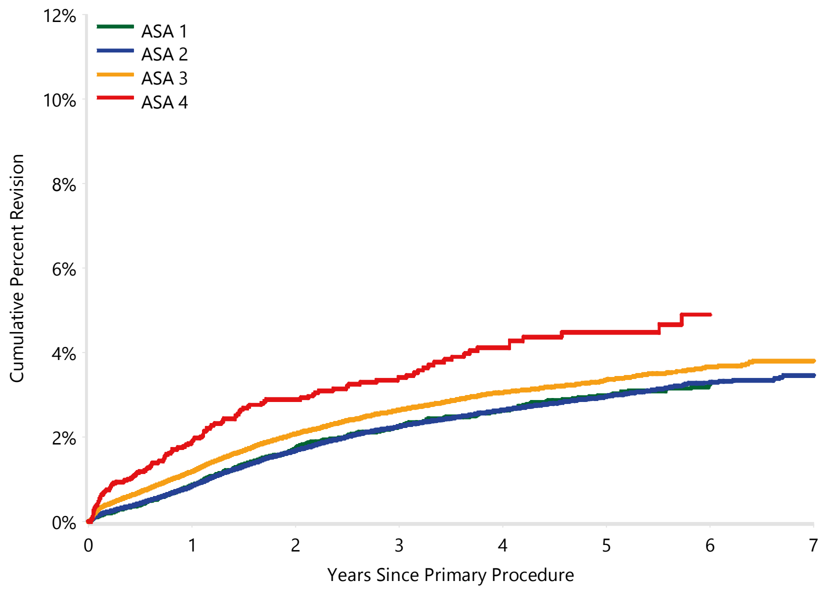
Female 65-74 vs Female ≥75
- 0 - 6Mth: HR=0.92 (0.82, 1.03),p=0.163
- 6Mth - 5Yr: HR=1.65 (1.55, 1.75),p<0.001
- 5Yr+: HR=1.90 (1.73, 2.09),p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Female	<55	25945	23707	19087	14981	6892	2040	82
	55-64	99287	90652	73367	57575	25952	7246	273
	65-74	152952	138567	110616	86015	38630	10365	395
	≥75	114357	104061	83971	64602	24736	4188	86

Table KT18 Cumulative Percent Revision of Primary Total Knee Replacement by ASA Score (Primary Diagnosis OA)

ASA Score	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs
ASA 1	438	20306	0.9 (0.7, 1.0)	1.7 (1.6, 2.0)	2.3 (2.0, 2.5)	2.6 (2.4, 2.9)	3.0 (2.7, 3.3)	3.2 (2.9, 3.6)	
ASA 2	3968	188640	0.8 (0.8, 0.9)	1.7 (1.6, 1.7)	2.3 (2.2, 2.3)	2.6 (2.6, 2.7)	3.0 (2.9, 3.1)	3.3 (3.2, 3.4)	3.5 (3.3, 3.6)
ASA 3	3025	128551	1.2 (1.1, 1.3)	2.1 (2.0, 2.2)	2.6 (2.5, 2.7)	3.1 (2.9, 3.2)	3.4 (3.2, 3.5)	3.7 (3.5, 3.8)	3.8 (3.6, 4.0)
ASA 4	121	3672	1.9 (1.5, 2.4)	2.9 (2.4, 3.5)	3.4 (2.8, 4.1)	4.1 (3.4, 5.0)	4.5 (3.7, 5.4)	4.9 (4.0, 6.1)	
ASA 5	0	10	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)			
TOTAL	**7552**	**341179**							

Figure KT17 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=1.20 (1.08, 1.32),p<0.001

ASA 3 vs ASA 1
0 - 6Mth: HR=2.09 (1.83, 2.38),p<0.001
6Mth+: HR=1.37 (1.24, 1.53),p<0.001

ASA 4 vs ASA 1
0 - 1.5Yr: HR=2.82 (2.24, 3.56),p<0.001
1.5Yr+: HR=1.46 (1.03, 2.08),p=0.033

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs
ASA 1	20306	17137	13985	10782	7799	4794	2057	20
ASA 2	188640	157364	126444	96448	68311	41053	16460	145
ASA 3	128551	103771	80563	59186	39829	23048	8748	72
ASA 4	3672	2943	2281	1706	1186	714	290	7

Figure KT18 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by ASA Score (Primary Diagnosis OA)

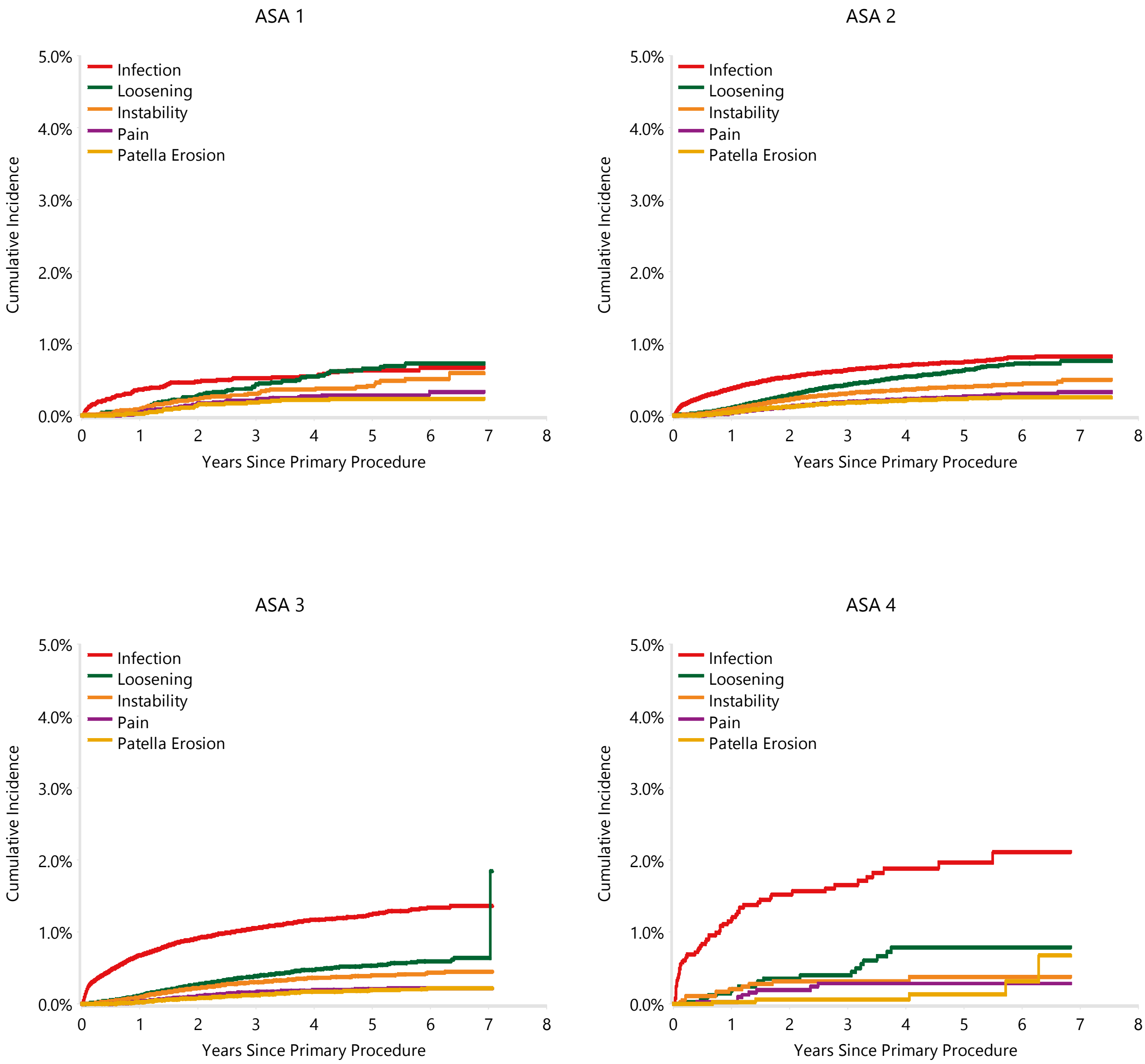
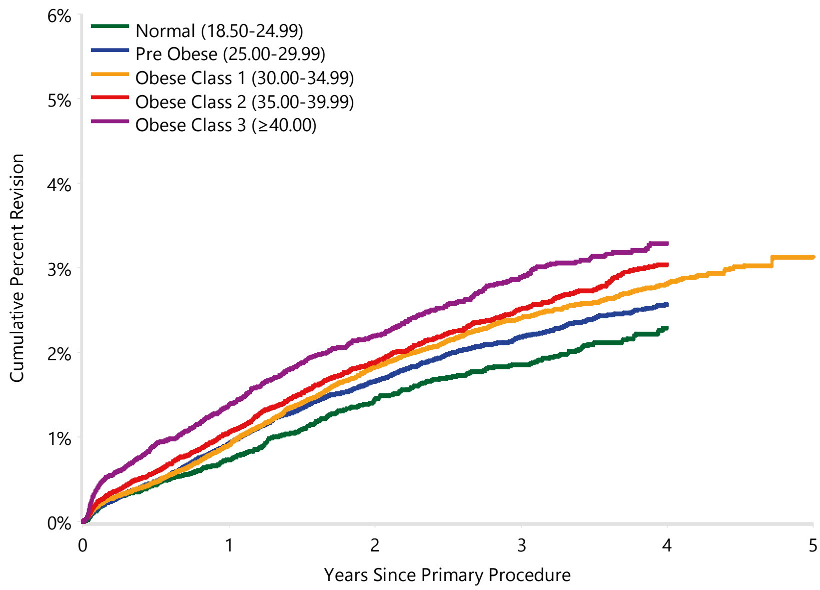


Table KT19 Cumulative Percent Revision of Primary Total Knee Replacement by BMI Category (Primary Diagnosis OA)

BMI Category	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
Underweight	6	439	0.9 (0.4, 2.5)	1.3 (0.5, 3.2)	1.3 (0.5, 3.2)	1.3 (0.5, 3.2)	
Normal	377	25581	0.7 (0.6, 0.9)	1.4 (1.3, 1.6)	1.8 (1.7, 2.1)	2.3 (2.0, 2.6)	
Pre Obese	1311	77407	0.9 (0.9, 1.0)	1.7 (1.6, 1.8)	2.2 (2.1, 2.3)	2.6 (2.4, 2.7)	
Obese Class 1	1404	76859	0.9 (0.8, 1.0)	1.8 (1.7, 1.9)	2.4 (2.3, 2.5)	2.8 (2.7, 3.0)	3.1 (2.9, 3.4)
Obese Class 2	831	42505	1.1 (1.0, 1.2)	1.9 (1.7, 2.0)	2.5 (2.3, 2.7)	3.0 (2.8, 3.3)	
Obese Class 3	598	26499	1.4 (1.2, 1.5)	2.2 (2.0, 2.4)	2.9 (2.7, 3.1)	3.3 (3.0, 3.6)	
TOTAL	**4527**	**249290**					

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

Figure KT19 Cumulative Percent Revision of Primary Total Knee Replacement by BMI Category (Primary Diagnosis OA)



HR - adjusted for age and gender

Pre Obese (25.00-29.99) vs Normal (18.50-24.99)
Entire Period: HR=1.06 (0.94, 1.19),p=0.344

Obese Class 1 (30.00-34.99) vs Normal (18.50-24.99)
Entire Period: HR=1.11 (0.99, 1.24),p=0.077

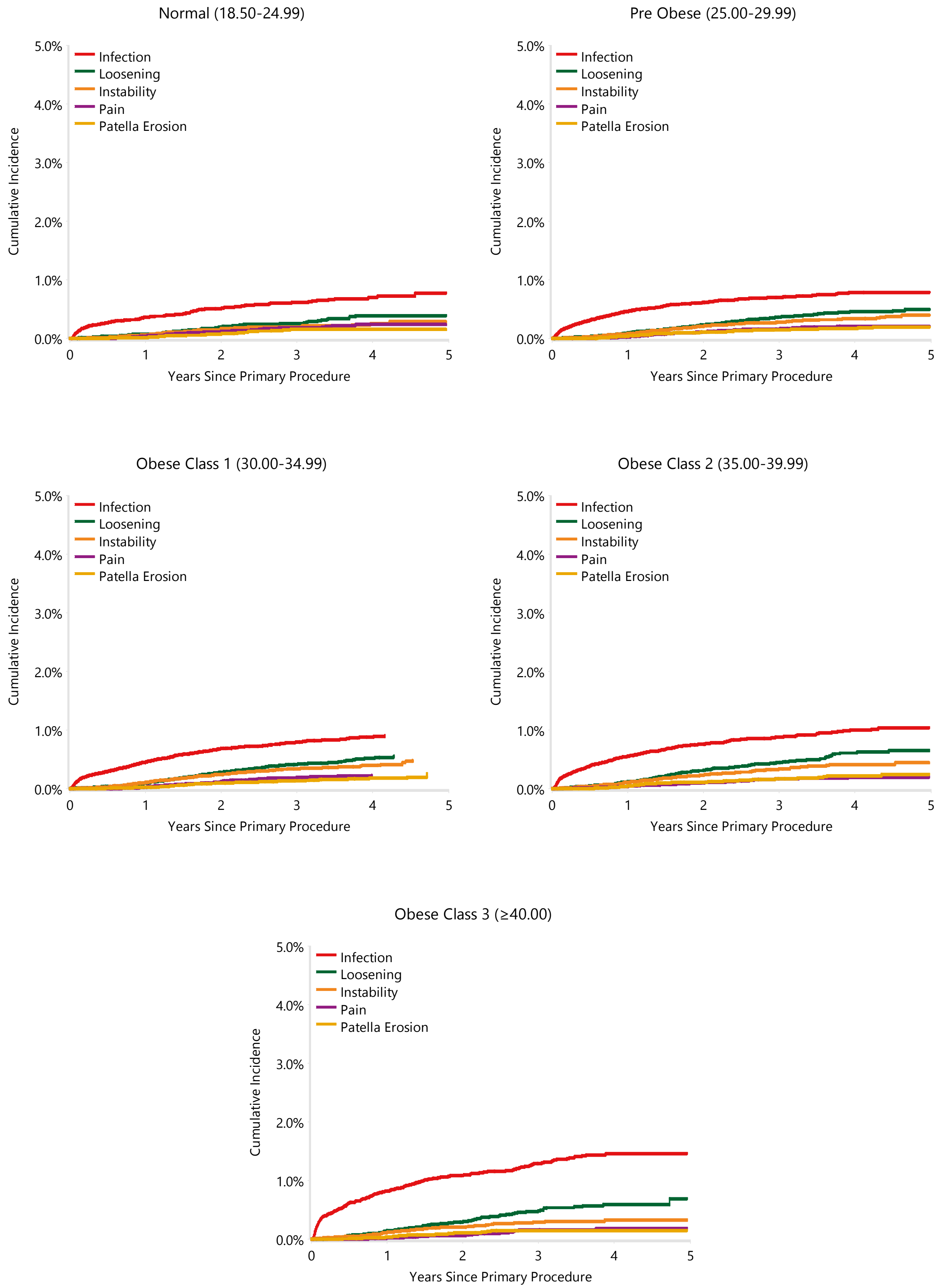
Obese Class 2 (35.00-39.99) vs Normal (18.50-24.99)
0 - 3Mth: HR=1.32 (1.08, 1.61),p=0.007
3Mth - 1.5Yr: HR=1.14 (0.98, 1.32),p=0.082
1.5Yr+: HR=1.14 (0.97, 1.34),p=0.116

Obese Class 3 (≥40.00) vs Normal (18.50-24.99)
0 - 1Mth: HR=2.43 (1.88, 3.13),p<0.001
1Mth - 3Mth: HR=1.69 (1.27, 2.24),p<0.001
3Mth - 6Mth: HR=1.86 (1.42, 2.42),p<0.001
6Mth - 1.5Yr: HR=1.12 (0.94, 1.34),p=0.219
1.5Yr+: HR=1.06 (0.88, 1.28),p=0.539

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
Normal	25581	19619	14049	8847	4141	13
Pre Obese	77407	59504	42572	26546	12087	35
Obese Class 1	76859	58936	42058	26141	11962	41
Obese Class 2	42505	32787	23115	14343	6524	21
Obese Class 3	26499	20348	14491	8976	3970	10

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

Figure KT20 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by BMI Category (Primary Diagnosis OA)



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

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. After this time, mobile bearings have a lower rate of revision (Table KT20 and Figure KT21).

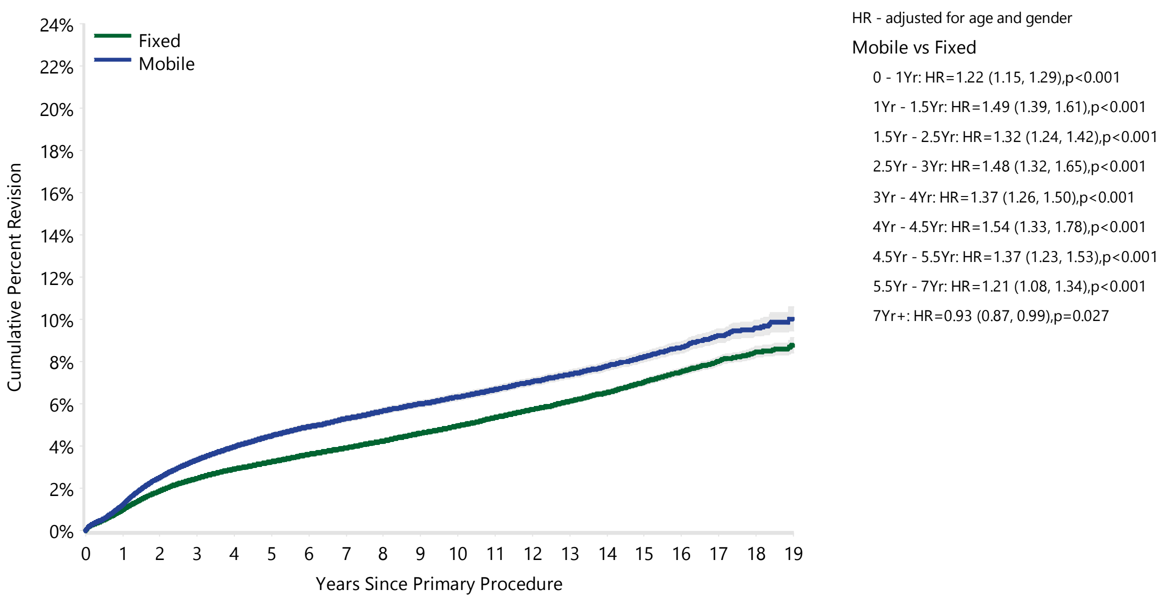
When types of fixed bearings are compared, moulded non-modular tibial prostheses have the lowest rate of revision. However, this only includes a limited number of prosthesis types. There is no difference when comparing all-polyethylene to fixed modular tibial prostheses (Table KT21 and Figure KT22).

Table KT20 Cumulative Percent Revision of Primary Total Knee Replacement by Bearing Mobility (Primary Diagnosis OA)

Bearing Mobility	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Fixed	20319	564324	1.0 (1.0, 1.0)	2.5 (2.4, 2.5)	3.3 (3.2, 3.3)	5.0 (4.9, 5.0)	7.0 (6.9, 7.2)	8.8 (8.4, 9.1)
Mobile	7252	134764	1.2 (1.2, 1.3)	3.4 (3.3, 3.5)	4.5 (4.4, 4.6)	6.3 (6.2, 6.5)	8.2 (8.0, 8.5)	10.0 (9.5, 10.6)
TOTAL	**27571**	**699088**						

Note: Excludes 195 procedures with unknown bearing mobility

Figure KT21 Cumulative Percent Revision of Primary Total Knee Replacement by Bearing Mobility (Primary Diagnosis OA)

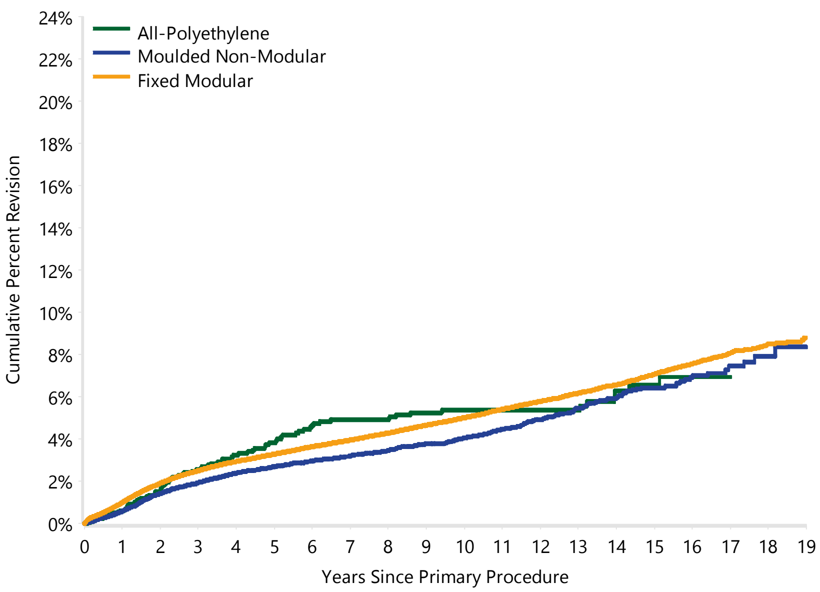


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Fixed	564324	506761	397364	299907	118245	27460	948
Mobile	134764	125442	106130	87881	44621	11965	434

Table KT21 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	19 Yrs
All-Polyethylene	80	1831	0.6 (0.3, 1.1)	2.6 (1.9, 3.4)	3.8 (3.0, 4.9)	5.4 (4.3, 6.7)	6.6 (5.1, 8.4)	
Moulded Non-Modular	878	24094	0.6 (0.5, 0.7)	1.9 (1.8, 2.1)	2.7 (2.5, 2.9)	4.1 (3.8, 4.4)	6.4 (5.9, 7.0)	8.4 (7.1, 9.9)
Fixed Modular	19361	538399	1.0 (1.0, 1.0)	2.5 (2.5, 2.5)	3.3 (3.2, 3.3)	5.0 (4.9, 5.1)	7.1 (6.9, 7.2)	8.8 (8.4, 9.2)
TOTAL	**20319**	**564324**						

Figure KT22 Cumulative Percent Revision of Primary Total Knee Replacement by Fixed Bearing Type (Primary Diagnosis OA)



HR - adjusted for age and gender

All-Polyethylene vs Moulded Non-Modular
Entire Period: HR=1.42 (1.13, 1.79),p=0.002

All-Polyethylene vs Fixed Modular
Entire Period: HR=1.16 (0.93, 1.45),p=0.176

Fixed Modular vs Moulded Non-Modular
0 - 3Mth: HR=2.81 (1.97, 4.01),p<0.001
3Mth - 1.5Yr: HR=1.33 (1.17, 1.52),p<0.001
1.5Yr+: HR=1.12 (1.04, 1.21),p=0.004

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
All-Polyethylene	1831	1719	1374	1094	759	261	2
Moulded Non-Modular	24094	23046	20485	17642	7766	1513	70
Fixed Modular	538399	481996	375505	281171	109720	25686	876

Stability

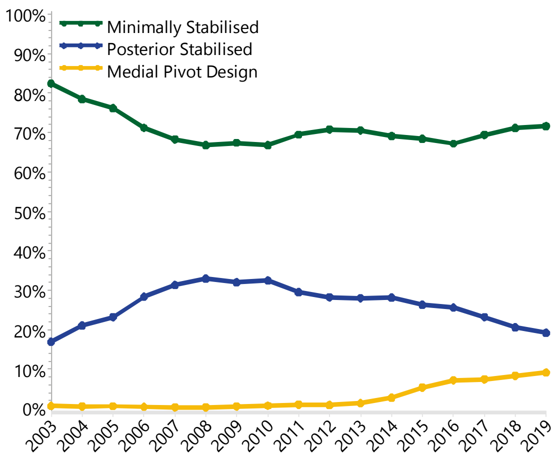
Stability refers to particular prosthetic features intended to substitute for the intrinsic stability of knee ligaments. Since 2018, the Registry has expanded the classification to include the medial pivot designs separately. The five categories are now: minimally stabilised, medial pivot design, posterior stabilised, fully stabilised and hinged prostheses.

The five major categories for stability are now: 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, or less frequently, a cam and groove.

The use of minimally stabilised prostheses has remained relatively constant over the last 10 years. In 2019, these accounted for 71.6% of primary procedures. The use of posterior stabilised prostheses has declined from 32.9% in 2008 to 19.2% in 2019. Medial pivot design prostheses have been used in small numbers since the Registry began collecting data. In 2019, the use of medial pivot design prostheses increased, accounting for 9.2% of primary procedures (Figure KT23).

Figure KT23 Primary Total Knee Replacement by Stability (Primary Diagnosis OA)



Posterior stabilised and medial pivot design prostheses have a higher rate of revision compared to minimally stabilised prostheses (Table KT22 and Figure KT24). The cumulative incidence for the different reasons for revision varies depending on stability. Posterior stabilised prostheses have a higher cumulative incidence of 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 KT25).

As with minimally stabilised and posterior stabilised prostheses, there is a variation in the rate of revision when different prostheses are compared within the medial pivot design group. This group only contains 7 prostheses (Table KT23). The Advance/Advance is identified as a prosthesis combination with a higher than anticipated rate of revision. When this combination is excluded from the analysis comparing minimally stabilised and medial pivot design prostheses, there is no difference and when compared to posterior stabilised the medial pivot design has a lower rate of revision (Table KT24 and Figure KT26).

Prosthesis performance can also be analysed by polyethylene design or shape. Some prostheses offer tibial polyethylene designs 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 designs with more than 500 procedures in each category using a fixed bearing XLPE insert, with a follow-up of greater than 3 years. The Triathlon prosthesis with the cruciate retaining polyethylene has a lower rate of revision when compared to the condylar stabilising polyethylene design, and also in the first 1.5 years when compared to posterior stabilised. The condylar stabilising polyethylene has a lower rate of revision when compared to posterior stabilised for the first 1.5 years (Table KT25 and Figure KT27).

The PFC Sigma knee shows no difference in revision rates when the cruciate retaining (curved), curved plus and posterior stabilised designs are compared. However, the follow-up is short (Table KT26 and Figure KT28).

Alternative approaches are the ultra-congruent or 'conforming' polyethylene shapes that can add additional sagittal stability without the need for a peg and box design. There is one prosthesis with more than 500 procedures in each category using a fixed bearing XLPE insert with a follow-up of greater than 3 years. The Natural Knee has both cruciate retaining and ultra-congruent components, but no posterior stabilised option. When these two varieties of polyethylene shape are compared, there is no difference in the rate of revision (Table KT27 and Figure KT29).

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. These designs of knee prostheses are usually considered to be revision components. These prostheses are used in 0.4% of primary procedures (Table KT22). However, they can also be used in complex primary clinical situations. Whereas osteoarthritis is the diagnosis for 97.7% of 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 KT28).

Fully stabilised prostheses have been used in 2,900 procedures and hinged prostheses in 2,115 primary total knee procedures. For these two knee designs, the cumulative percent revision for all diagnoses are shown in Table KT29 and Figure KT30.

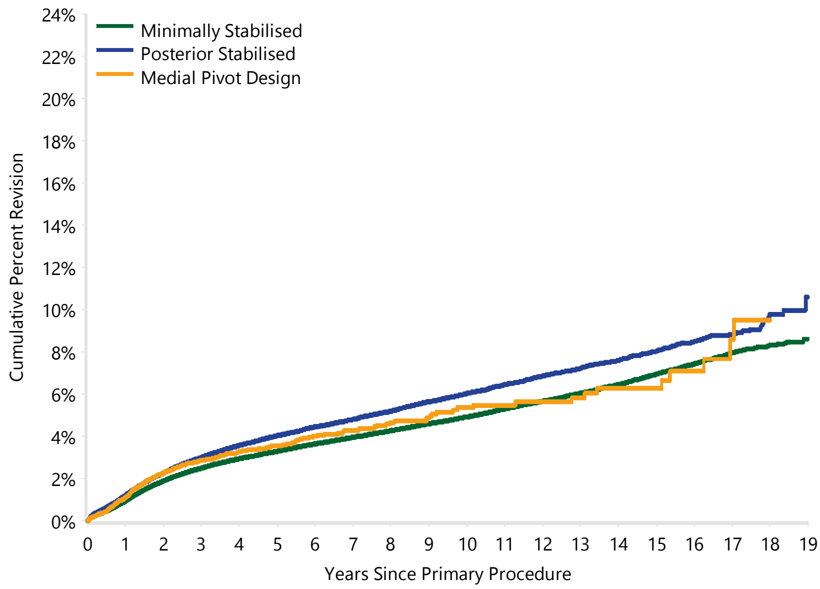
When the outcome for osteoarthritis alone is considered, fully stabilised and hinged knee prostheses both have higher rates of revision compared to minimally stabilised prostheses (Figure KT31). For both of these designs, infection is the most common reason for revision, followed by loosening for fully stabilised and fracture for hinged prostheses (Table KT30 and Figure KT32).

Table KT22 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	19 Yrs
Minimally Stabilised	18639	494151	0.9 (0.9, 1.0)	2.5 (2.5, 2.5)	3.3 (3.2, 3.4)	4.9 (4.8, 5.0)	7.0 (6.8, 7.1)	8.6 (8.3, 8.9)
Posterior Stabilised	8093	177097	1.2 (1.2, 1.3)	3.0 (2.9, 3.1)	4.0 (3.9, 4.1)	6.0 (5.9, 6.2)	8.0 (7.8, 8.3)	10.6 (9.2, 12.2)
Medial Pivot Design	599	24066	1.1 (1.0, 1.3)	2.9 (2.6, 3.1)	3.5 (3.2, 3.9)	5.4 (4.7, 6.1)	6.3 (5.3, 7.4)	
Fully Stabilised	154	2626	2.6 (2.0, 3.3)	4.8 (4.0, 5.8)	6.3 (5.3, 7.5)	9.3 (7.7, 11.2)	11.5 (9.0, 14.6)	
Hinged	86	1148	3.3 (2.4, 4.6)	6.4 (5.0, 8.2)	8.4 (6.6, 10.6)	12.7 (9.9, 16.2)		
TOTAL	**27571**	**699088**						

Note: Excludes 195 procedures with unknown stability

Figure KT24 Cumulative Percent Revision of Primary Total Knee Replacement by Stability (Primary Diagnosis OA)



HR - adjusted for age and gender

Posterior Stabilised vs Minimally Stabilised

0 - 1Yr: HR=1.29 (1.23, 1.36),p<0.001

1Yr - 2Yr: HR=1.09 (1.03, 1.15),p=0.004

2Yr - 2.5Yr: HR=1.27 (1.15, 1.39),p<0.001

2.5Yr+: HR=1.22 (1.17, 1.27),p<0.001

Posterior Stabilised vs Medial Pivot Design

Entire Period: HR=1.09 (1.01, 1.19),p=0.033

Medial Pivot Design vs Minimally Stabilised

Entire Period: HR=1.11 (1.02, 1.20),p=0.015

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Minimally Stabilised	494151	447048	357238	278540	120923	32823	1243
Posterior Stabilised	177097	163285	134218	104181	40755	6287	134
Medial Pivot Design	24066	18708	9912	3707	839	250	4
Fully Stabilised	2626	2246	1561	992	268	54	1
Hinged	1148	916	565	368	81	11	0

Figure KT25 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by Stability (Primary Diagnosis OA)

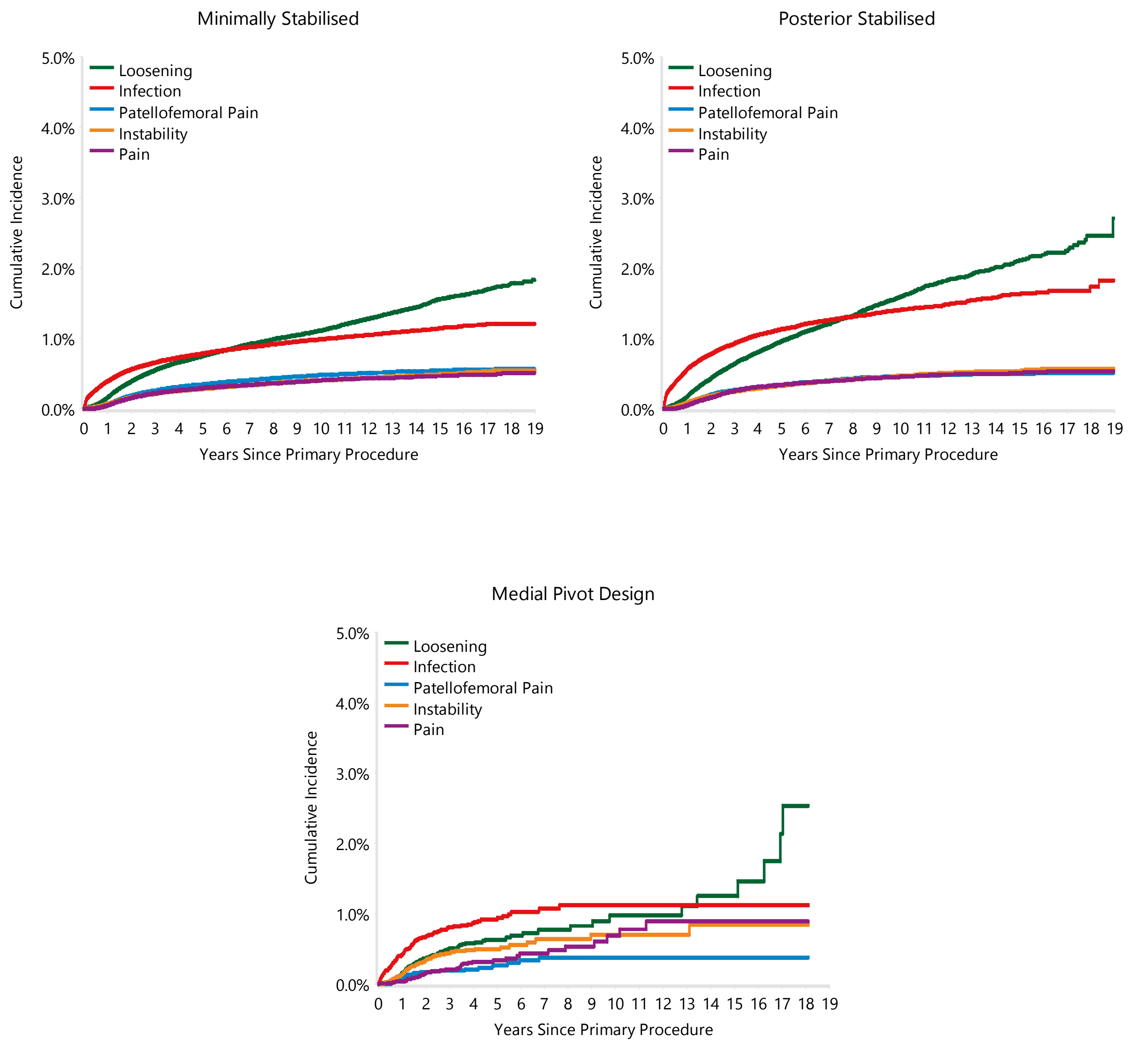


Table KT23 Cumulative Percent Revision of Primary Total Knee Replacement with Medial Pivot Design by Insert (Primary Diagnosis OA)

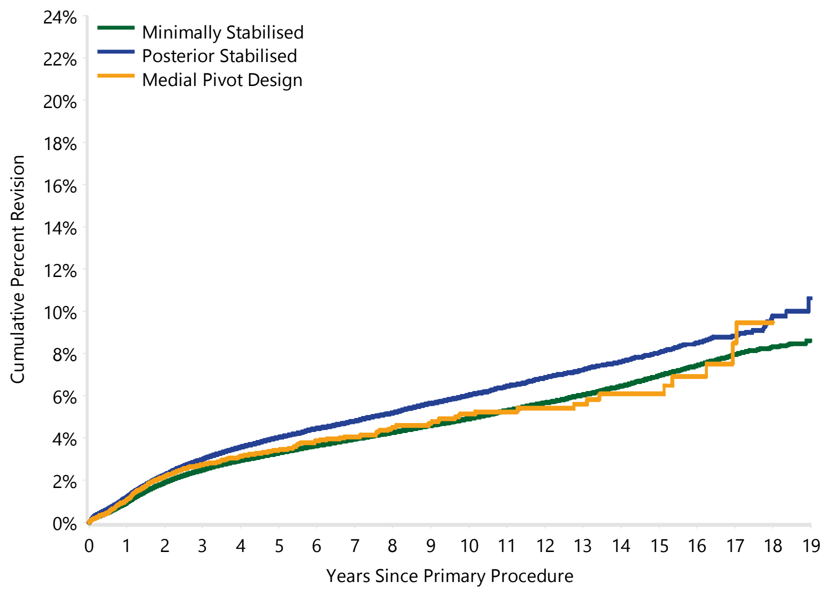
Insert	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Advance	36	721	1.4 (0.8, 2.6)	4.6 (3.2, 6.5)	5.4 (3.8, 7.4)	6.1 (4.4, 8.5)		
Advance I	5	15	6.7 (1.0, 38.7)	13.3 (3.5, 43.6)	13.3 (3.5, 43.6)	35.0 (16.3, 64.9)	35.0 (16.3, 64.9)	35.0 (16.3, 64.9)
Advance II	119	1690	1.8 (1.3, 2.6)	4.5 (3.6, 5.6)	5.5 (4.5, 6.7)	7.4 (6.2, 8.9)	8.2 (6.7, 9.9)	
Evolution	166	7974	0.9 (0.7, 1.2)	2.6 (2.2, 3.0)	3.6 (2.9, 4.3)			
GMK Sphere Primary	211	9650	1.3 (1.1, 1.6)	2.9 (2.5, 3.3)	3.5 (3.0, 4.0)			
MRK	16	634	0.8 (0.3, 1.9)	2.1 (1.2, 3.6)	2.1 (1.2, 3.6)	3.1 (1.8, 5.3)		
SAIPH	46	3382	0.5 (0.3, 0.8)	1.9 (1.4, 2.6)	2.2 (1.6, 3.1)			
TOTAL	**599**	**24066**						

Table KT24 Cumulative Percent Revision of Primary Total Knee Replacement by Stability (Primary Diagnosis OA, Excluding Advance/Advance)

Stability	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Minimally Stabilised	18639	494151	0.9 (0.9, 1.0)	2.5 (2.5, 2.5)	3.3 (3.2, 3.4)	4.9 (4.8, 5.0)	7.0 (6.8, 7.1)	8.6 (8.3, 8.9)
Posterior Stabilised	8092	177062	1.2 (1.2, 1.3)	3.0 (2.9, 3.1)	4.0 (3.9, 4.1)	6.0 (5.9, 6.2)	8.0 (7.8, 8.3)	10.6 (9.2, 12.2)
Medial Pivot Design	545	23148	1.1 (0.9, 1.2)	2.8 (2.5, 3.0)	3.4 (3.1, 3.8)	5.1 (4.4, 5.9)	6.1 (5.0, 7.3)	
Fully Stabilised	154	2626	2.6 (2.0, 3.3)	4.8 (4.0, 5.8)	6.3 (5.3, 7.5)	9.3 (7.7, 11.2)	11.5 (9.0, 14.6)	
Hinged	86	1148	3.3 (2.4, 4.6)	6.4 (5.0, 8.2)	8.4 (6.6, 10.6)	12.7 (9.9, 16.2)		
TOTAL	**27516**	**698135**						

Note: Excludes 195 procedures with unknown stability

Figure KT26 Cumulative Percent Revision of Primary Total Knee Replacement by Stability (Primary Diagnosis OA, Excluding Advance/Advance)



HR - adjusted for age and gender

Posterior Stabilised vs Minimally Stabilised

0 - 1Yr: HR=1.29 (1.23, 1.36),p<0.001

1Yr - 2Yr: HR=1.09 (1.03, 1.15),p=0.003

2Yr - 2.5Yr: HR=1.27 (1.15, 1.39),p<0.001

2.5Yr+: HR=1.22 (1.17, 1.27),p<0.001

Posterior Stabilised vs Medial Pivot Design

Entire Period: HR=1.13 (1.04, 1.23),p=0.006

Medial Pivot Design vs Minimally Stabilised

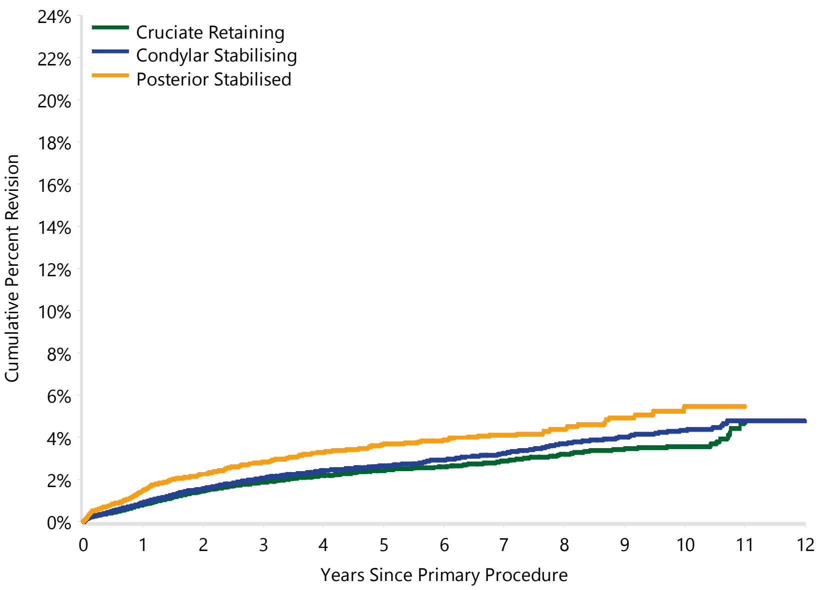
Entire Period: HR=1.07 (0.98, 1.17),p=0.111

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Minimally Stabilised	494151	447048	357238	278540	120923	32823	1243
Posterior Stabilised	177062	163253	134188	104153	40730	6265	134
Medial Pivot Design	23148	17872	9263	3243	776	241	0

Table KT25 Cumulative Percent Revision of Triathlon/Triathlon Primary Total Knee Replacement with XLPE by Poly Shape (Primary Diagnosis OA)

Poly Shape	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Cruciate Retaining	852	41302	0.8 (0.7, 0.9)	1.9 (1.7, 2.0)	2.4 (2.3, 2.6)	2.9 (2.7, 3.1)	3.6 (3.3, 3.9)	
Condylar Stabilising	957	43198	0.9 (0.8, 1.0)	2.1 (1.9, 2.2)	2.6 (2.5, 2.8)	3.2 (3.0, 3.5)	4.3 (3.9, 4.7)	4.8 (4.2, 5.4)
Posterior Stabilised	267	8007	1.5 (1.3, 1.8)	2.8 (2.5, 3.2)	3.7 (3.3, 4.2)	4.1 (3.6, 4.7)	5.4 (4.6, 6.5)	
TOTAL	**2076**	**92507**						

Figure KT27 Cumulative Percent Revision of Triathlon/Triathlon Primary Total Knee Replacement with XLPE by Poly Shape (Primary Diagnosis OA)



HR - adjusted for age and gender

Condylar Stabilising vs Cruciate Retaining
Entire Period: HR=1.12 (1.02, 1.23),p=0.015

Posterior Stabilised vs Cruciate Retaining
0 - 1.5Yr: HR=1.73 (1.45, 2.07),p<0.001
1.5Yr+: HR=1.21 (0.99, 1.47),p=0.061

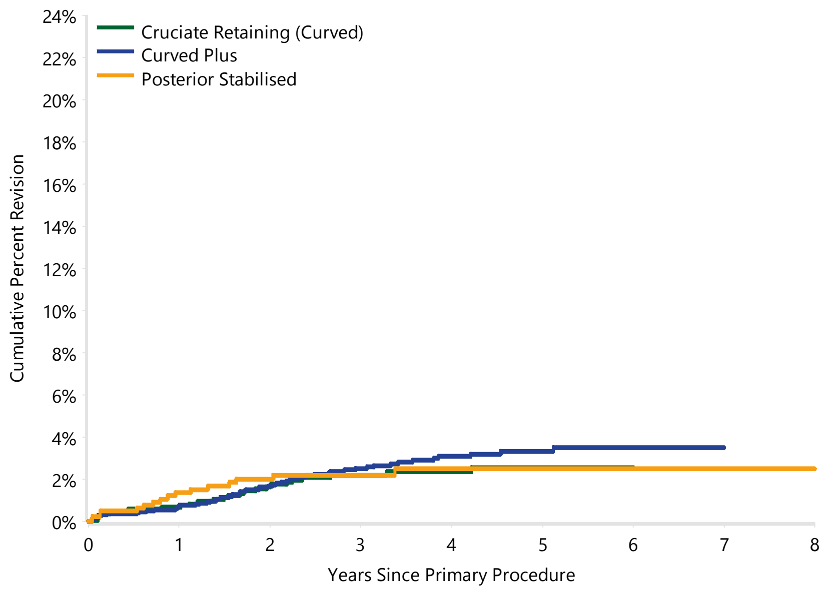
Posterior Stabilised vs Condylar Stabilising
0 - 1.5Yr: HR=1.54 (1.29, 1.84),p<0.001
1.5Yr+: HR=1.08 (0.88, 1.31),p=0.454

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Cruciate Retaining	41302	34797	24112	16128	8857	1538	30
Condylar Stabilising	43198	35928	23918	14502	7812	1626	108
Posterior Stabilised	8007	7106	5352	3632	2093	409	28

Table KT26 Cumulative Percent Revision of PFC Sigma/PFC Sigma Primary Total Knee Replacement with XLPE by Poly Shape (Primary Diagnosis OA)

Poly Shape	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	8 Yrs
Cruciate Retaining (Curved)	26	1402	0.7 (0.3, 1.3)	1.7 (1.1, 2.6)	2.2 (1.5, 3.3)	2.6 (1.7, 3.8)		
Curved Plus	56	2189	0.8 (0.5, 1.2)	1.7 (1.2, 2.4)	2.5 (1.9, 3.4)	3.3 (2.5, 4.4)	3.5 (2.7, 4.6)	
Posterior Stabilised	16	792	1.4 (0.7, 2.5)	2.0 (1.2, 3.4)	2.2 (1.3, 3.7)	2.5 (1.5, 4.1)	2.5 (1.5, 4.1)	2.5 (1.5, 4.1)
TOTAL	**98**	**4383**						

Figure KT28 Cumulative Percent Revision of PFC Sigma/ PFC Sigma Primary Total Knee Replacement with XLPE by Poly Shape (Primary Diagnosis OA)



HR - adjusted for age and gender

Curved Plus vs Cruciate Retaining (Curved)
Entire Period: HR=1.23 (0.77, 1.96),p=0.389

Curved Plus vs Posterior Stabilised
Entire Period: HR=1.15 (0.66, 2.00),p=0.630

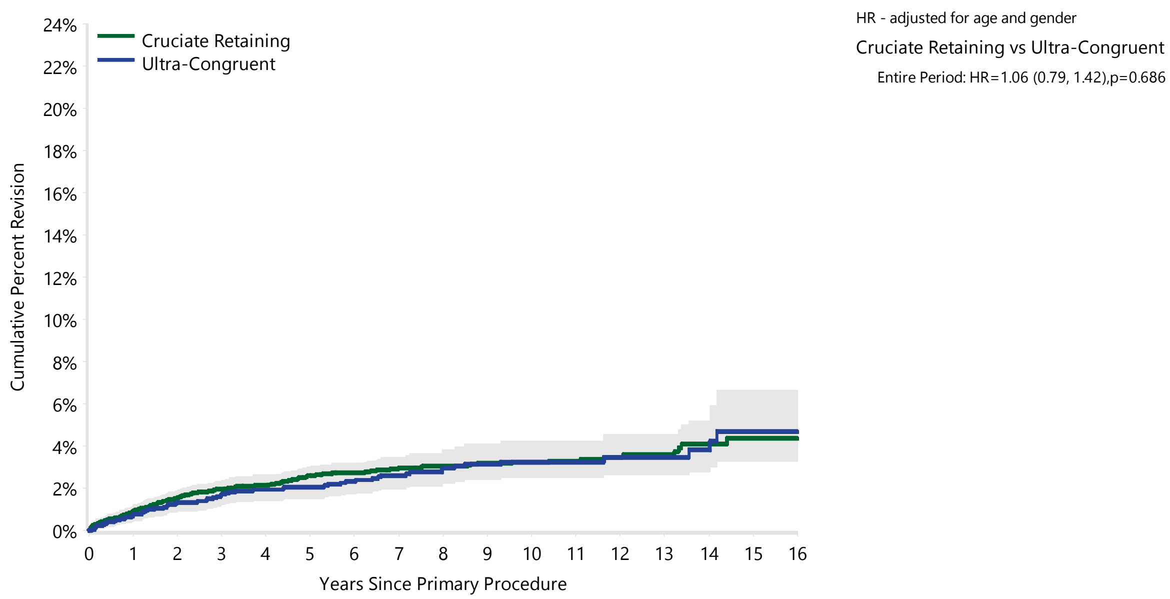
Posterior Stabilised vs
Cruciate Retaining (Curved)
Entire Period: HR=1.07 (0.57, 2.00),p=0.829

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	8 Yrs
Cruciate Retaining (Curved)	1402	1125	920	751	389	4	4
Curved Plus	2189	1973	1680	1357	592	126	31
Posterior Stabilised	792	652	539	416	190	130	43

Table KT27 **Cumulative Percent Revision of Natural Knee/Natural Knee Primary Total Knee Replacement with XLPE by Poly Shape (Primary Diagnosis OA)**

Poly Shape	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	11 Yrs	16 Yrs
Cruciate Retaining	182	6700	0.9 (0.7, 1.2)	2.0 (1.6, 2.3)	2.6 (2.2, 3.0)	2.9 (2.5, 3.4)	3.3 (2.8, 3.9)	4.4 (3.5, 5.5)
Ultra-Congruent	61	2254	0.8 (0.5, 1.2)	1.7 (1.2, 2.4)	2.1 (1.5, 2.8)	2.6 (2.0, 3.4)	3.2 (2.5, 4.2)	4.7 (3.3, 6.7)
TOTAL	**243**	**8954**						

Figure KT29 **Cumulative Percent Revision of Natural Knee/Natural Knee Primary Total Knee Replacement with XLPE by Poly Shape (Primary Diagnosis OA)**



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	11 Yrs	16 Yrs
Cruciate Retaining	6700	6308	5377	4249	3125	1221	131
Ultra-Congruent	2254	2153	1816	1535	1296	548	63

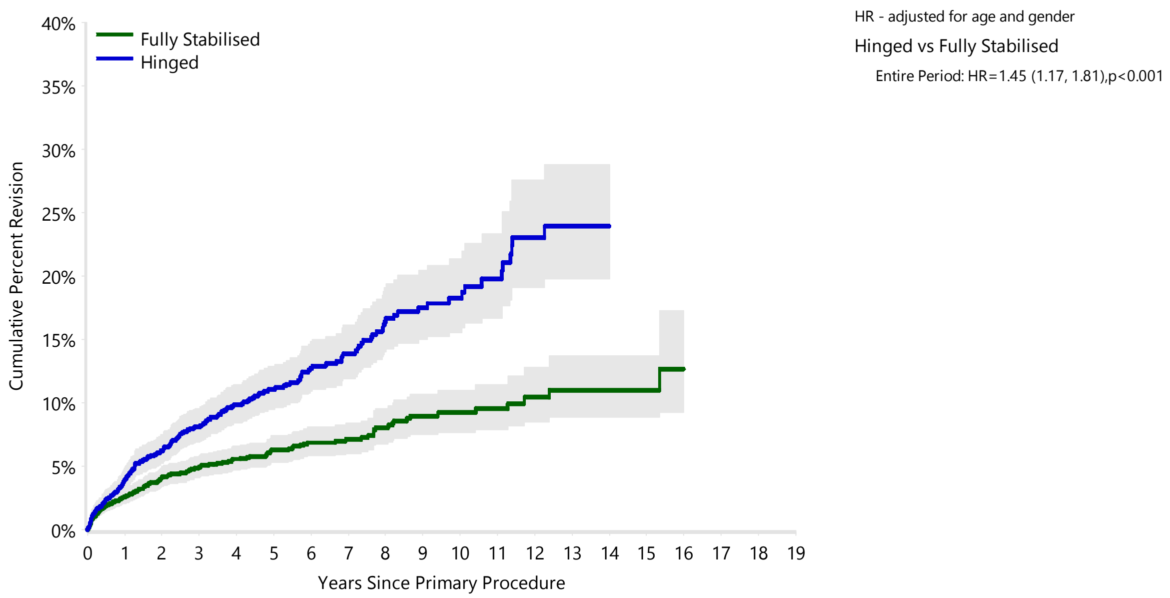
Table KT28 Primary Total Knee Replacement by Primary Diagnosis and Stability

Primary Diagnosis	Fully Stabilised		Hinged		TOTAL	
	N	Col%	N	Col%	N	Col%
Osteoarthritis	2626	90.6	1148	54.3	3774	75.3
Tumour	7	0.2	588	27.8	595	11.9
Fracture	45	1.6	202	9.6	247	4.9
Rheumatoid Arthritis	143	4.9	68	3.2	211	4.2
Osteonecrosis	33	1.1	30	1.4	63	1.3
Other Inflammatory Arthritis	24	0.8	29	1.4	53	1.1
Other	22	0.8	50	2.4	72	1.4
TOTAL	**2900**	**100.0**	**2115**	**100.0**	**5015**	**100.0**

Table KT29 Cumulative Percent Revision of Primary Total Knee Replacement by Stability (All Diagnoses)

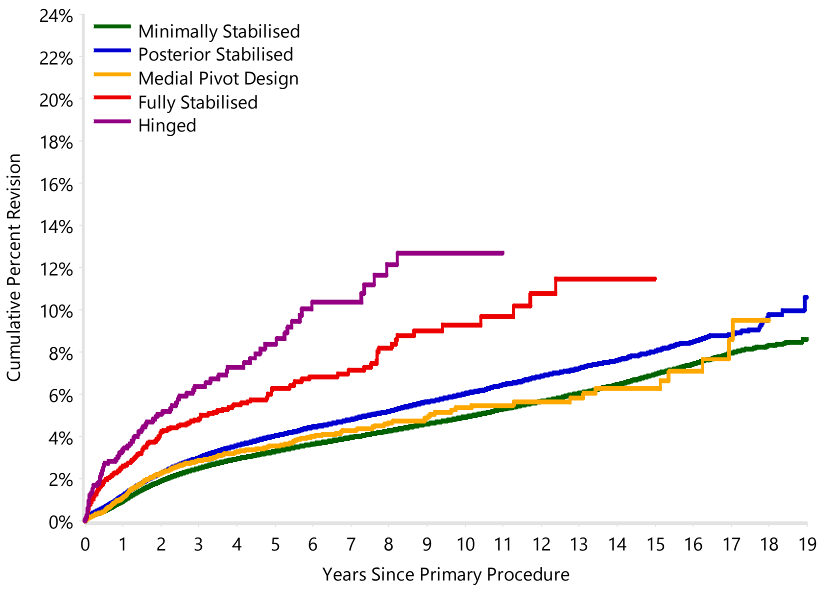
Stability	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Fully Stabilised	170	2900	2.6 (2.1, 3.3)	4.9 (4.1, 5.8)	6.3 (5.3, 7.4)	9.2 (7.7, 11.0)	11.0 (8.8, 13.7)	
Hinged	209	2115	3.9 (3.1, 4.9)	8.1 (6.9, 9.6)	11.1 (9.5, 12.9)	18.3 (15.6, 21.3)		
TOTAL	**379**	**5015**						

Figure KT30 Cumulative Percent Revision of Primary Total Knee Replacement by Stability (All Diagnoses)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Fully Stabilised	2900	2474	1733	1113	309	65	1
Hinged	2115	1636	1011	649	174	31	2

Figure KT31 Cumulative Percent Revision of Primary Total Knee Replacement by Stability (Primary Diagnosis OA)



HR - adjusted for age and gender

Posterior Stabilised vs Minimally Stabilised
0 - 1Yr: HR=1.29 (1.23, 1.36),p<0.001
1Yr - 2Yr: HR=1.09 (1.03, 1.15),p=0.004
2Yr - 2.5Yr: HR=1.27 (1.16, 1.40),p<0.001
2.5Yr - 5Yr: HR=1.27 (1.20, 1.34),p<0.001
5Yr+: HR=1.18 (1.12, 1.24),p<0.001

Medial Pivot Design vs Minimally Stabilised
Entire Period: HR=1.11 (1.02, 1.20),p=0.014

Fully Stabilised vs Minimally Stabilised
0 - 6Mth: HR=4.02 (3.02, 5.35),p<0.001
6Mth - 1.5Yr: HR=1.45 (1.03, 2.04),p=0.033
1.5Yr+: HR=1.70 (1.35, 2.14),p<0.001

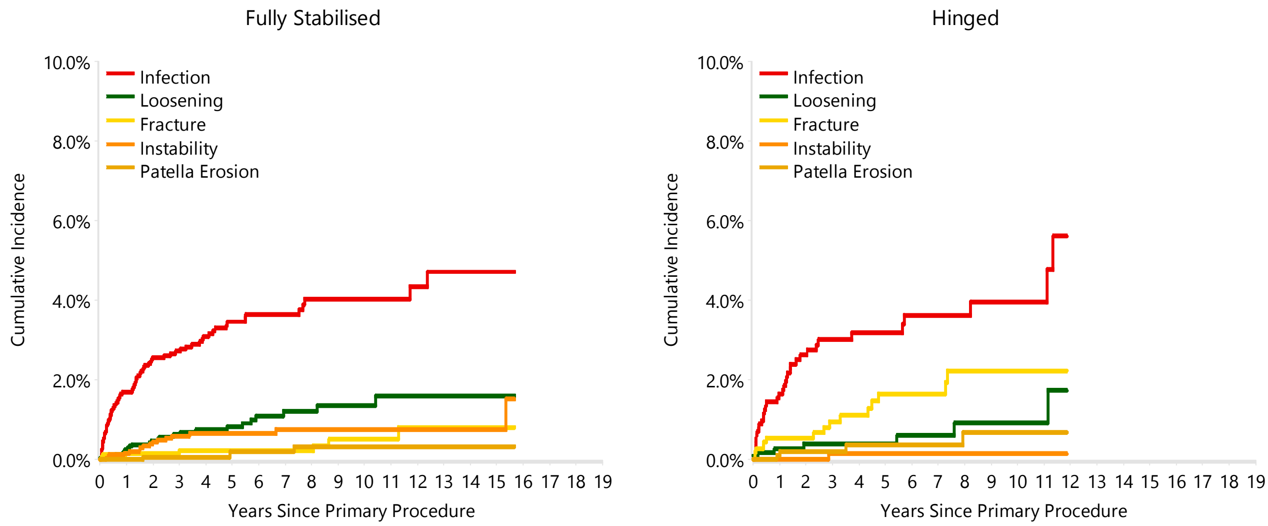
Hinged vs Minimally Stabilised
0 - 6Mth: HR=5.52 (3.83, 7.96),p<0.001
6Mth+: HR=2.15 (1.66, 2.79),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Minimally Stabilised	494151	447048	357238	278540	120923	32823	1243
Posterior Stabilised	177097	163285	134218	104181	40755	6287	134
Medial Pivot Design	24066	18708	9912	3707	839	250	4
Fully Stabilised	2626	2246	1561	992	268	54	1
Hinged	1148	916	565	368	81	11	0

Table KT30 Revision Diagnosis of Primary Total Knee Replacement by Stability (Primary Diagnosis OA)

Revision Diagnosis	Fully Stabilised			Hinged		
	Number	% Primaries Revised	% Revisions	Number	% Primaries Revised	% Revisions
Infection	83	3.2	53.9	36	3.1	41.9
Loosening	24	0.9	15.6	7	0.6	8.1
Instability	16	0.6	10.4	1	0.1	1.2
Fracture	8	0.3	5.2	15	1.3	17.4
Bearing Dislocation	4	0.2	2.6	3	0.3	3.5
Patella Erosion	4	0.2	2.6	4	0.3	4.7
Other	15	0.6	9.7	20	1.7	23.3
N Revision	**154**	**5.9**	**100.0**	**86**	**7.5**	**100.0**
N Primary	**2626**			**1148**		

Figure KT32 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by Stability (Primary Diagnosis OA)



Patella Resurfacing

Primary total knee replacement procedures with patellar resurfacing have a lower rate of revision compared to procedures without patellar resurfacing (Table KT31 and Figure KT33).

When resurfacing the patella, the rate of revision is lower for minimally stabilised compared to posterior stabilised prostheses for the first 11 years. Posterior stabilised without patellar resurfacing has the highest rate of revision (Table KT32 and Figure KT34).

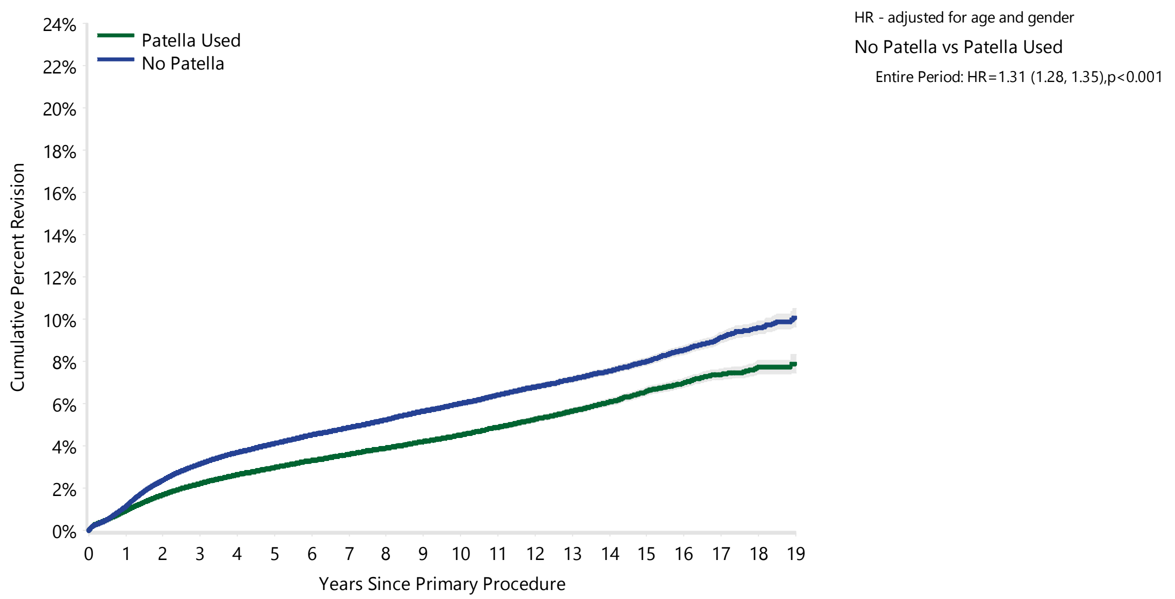
When the patella is resurfaced, there is no difference in the rate of revision for medial pivot design prostheses compared to minimally stabilised prostheses. When the patella is not resurfaced, medial pivot design prostheses have a higher rate of revision than minimally stabilised knee prostheses (Figure KT35).

Outcomes related to the use of patellar resurfacing vary depending on the type of prosthesis used.

Table KT31 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	19 Yrs
Patella Used	12241	390002	0.9 (0.9, 1.0)	2.2 (2.2, 2.3)	3.0 (2.9, 3.0)	4.5 (4.4, 4.6)	6.6 (6.4, 6.8)	7.9 (7.5, 8.3)
No Patella	15339	309281	1.1 (1.1, 1.2)	3.2 (3.1, 3.2)	4.1 (4.0, 4.2)	6.0 (5.9, 6.1)	8.0 (7.8, 8.2)	10.1 (9.6, 10.5)
TOTAL	**27580**	**699283**						

Figure KT33 Cumulative Percent Revision of Primary Total Knee Replacement by Patella Usage (Primary Diagnosis OA)

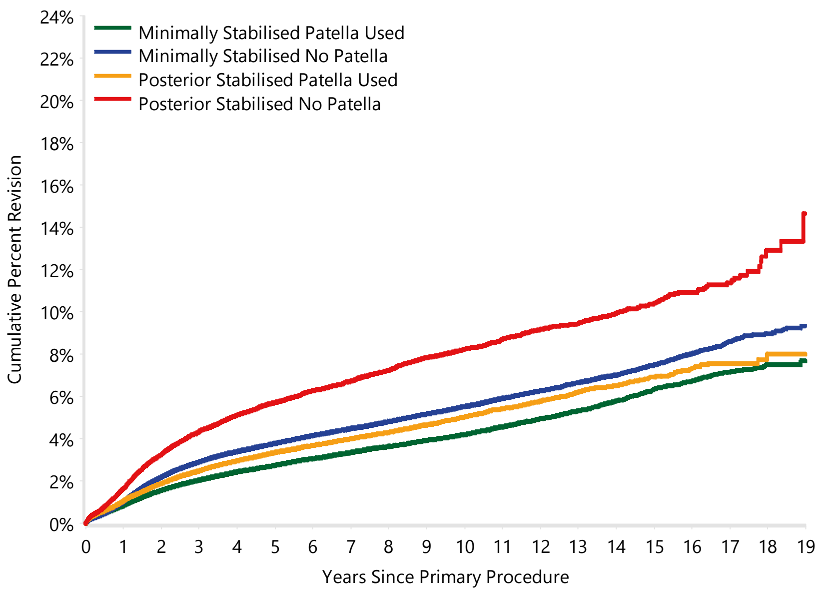


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Patella Used	390002	344008	261432	191826	72355	17128	448
No Patella	309281	288380	242223	196104	90584	22317	936

Table KT32 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	19 Yrs
Minimally Stabilised	Patella Used	7176	242962	0.8 (0.8, 0.9)	2.0 (2.0, 2.1)	2.7 (2.7, 2.8)	4.2 (4.1, 4.3)	6.3 (6.1, 6.6)	7.7 (7.2, 8.2)
	No Patella	11494	251344	1.0 (1.0, 1.1)	2.9 (2.8, 3.0)	3.8 (3.7, 3.9)	5.5 (5.4, 5.6)	7.5 (7.3, 7.7)	9.3 (8.9, 9.7)
Posterior Stabilised	Patella Used	4670	130141	1.1 (1.0, 1.1)	2.5 (2.4, 2.6)	3.3 (3.2, 3.5)	5.0 (4.9, 5.2)	6.9 (6.6, 7.2)	8.0 (7.3, 8.8)
	No Patella	3423	46956	1.6 (1.5, 1.8)	4.3 (4.2, 4.5)	5.7 (5.5, 5.9)	8.2 (8.0, 8.5)	10.4 (10.0, 10.8)	14.6 (11.9, 17.9)
Medial Pivot Design	Patella Used	245	14250	0.9 (0.7, 1.1)	2.2 (1.9, 2.5)	2.7 (2.3, 3.1)	3.7 (2.9, 4.6)	4.6 (3.0, 7.0)	
	No Patella	354	9816	1.4 (1.2, 1.7)	3.7 (3.3, 4.1)	4.5 (4.0, 5.1)	6.8 (5.8, 7.9)	7.7 (6.4, 9.2)	
TOTAL		**27362**	**695469**						

Figure KT34 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
Entire Period: HR=0.78 (0.75, 0.80),p<0.001

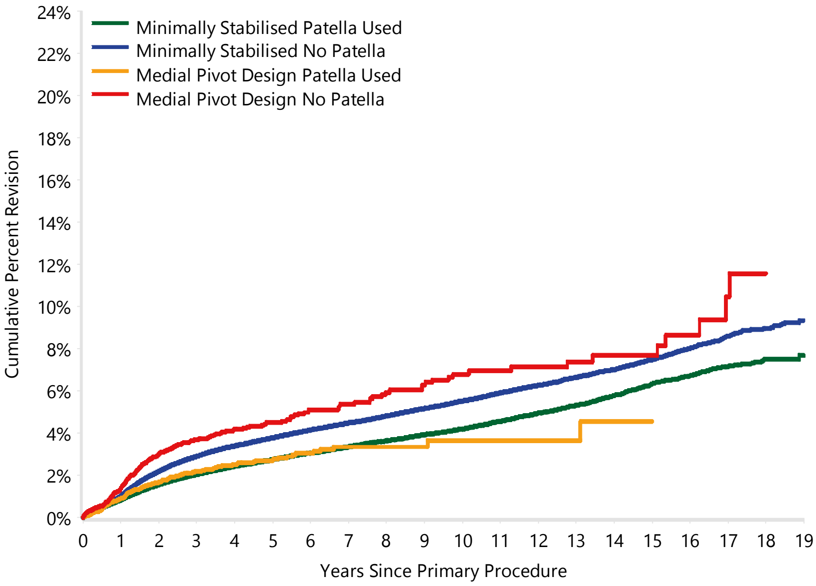
Minimally Stabilised Patella Used vs Posterior Stabilised Patella Used
0 - 2Yr: HR=0.83 (0.79, 0.87),p<0.001
2Yr - 2.5Yr: HR=0.73 (0.66, 0.81),p<0.001
2.5Yr - 3.5Yr: HR=0.80 (0.73, 0.88),p<0.001
3.5Yr - 4Yr: HR=0.94 (0.82, 1.08),p=0.412
4Yr - 5Yr: HR=0.85 (0.75, 0.95),p=0.004
5Yr - 5.5Yr: HR=0.98 (0.83, 1.16),p=0.824
5.5Yr - 6Yr: HR=0.86 (0.72, 1.03),p=0.112
6Yr - 11Yr: HR=0.94 (0.87, 1.01),p=0.090
11Yr+: HR=1.15 (1.03, 1.28),p=0.011

Minimally Stabilised No Patella vs Posterior Stabilised No Patella
0 - 2Yr: HR=0.65 (0.61, 0.69),p<0.001
2Yr - 3.5Yr: HR=0.64 (0.58, 0.69),p<0.001
3.5Yr - 4Yr: HR=0.56 (0.47, 0.66),p<0.001
4Yr - 6Yr: HR=0.66 (0.59, 0.73),p<0.001
6Yr - 7Yr: HR=0.77 (0.64, 0.93),p=0.005
7Yr - 7.5Yr: HR=0.55 (0.43, 0.69),p<0.001
7.5Yr - 8Yr: HR=0.76 (0.58, 1.00),p=0.051
8Yr - 8.5Yr: HR=0.51 (0.40, 0.64),p<0.001
8.5Yr+: HR=0.88 (0.78, 0.98),p=0.016

Posterior Stabilised Patella Used vs Posterior Stabilised No Patella
Entire Period: HR=0.60 (0.58, 0.63),p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Minimally Stabilised	Patella Used	242962	212938	160615	119268	47803	13387	373
	No Patella	251344	234253	196711	159332	73127	19436	870
Posterior Stabilised	Patella Used	130141	118347	94508	70014	24166	3663	74
	No Patella	46956	44938	39710	34167	16589	2624	60

Figure KT35 **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
Entire Period: HR=0.78 (0.75, 0.80),p<0.001

Minimally Stabilised Patella Used vs
Medial Pivot Design Patella Used
Entire Period: HR=1.01 (0.89, 1.15),p=0.854

Minimally Stabilised No Patella vs
Medial Pivot Design No Patella
Entire Period: HR=0.80 (0.72, 0.89),p<0.001

Medial Pivot Design Patella Used vs
Medial Pivot Design No Patella
Entire Period: HR=0.61 (0.52, 0.72),p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Minimally Stabilised	Patella Used	242962	212938	160615	119268	47803	13387	373
	No Patella	251344	234253	196711	159332	73127	19436	870
Medial Pivot Design	Patella Used	14250	10553	4928	1699	198	44	0
	No Patella	9816	8155	4984	2008	641	206	4

FIXATION

The effect of fixation varies depending on prosthesis stability.

For minimally stabilised prostheses, there is no difference between cemented and hybrid fixation and both have a lower rate of revision compared to cementless fixation (Table KT33 and Figure KT36).

When a posterior stabilised knee is used, cemented fixation has a lower rate of revision compared to cementless fixation within the first 2.5 years. After 4.5 years, cementless fixation has a lower rate of revision. Hybrid fixation has a higher rate of revision compared to both cemented and cementless fixation (Table KT34 and Figure KT37).

Cementing the tibial component gives the best outcome for minimally stabilised knee replacement.

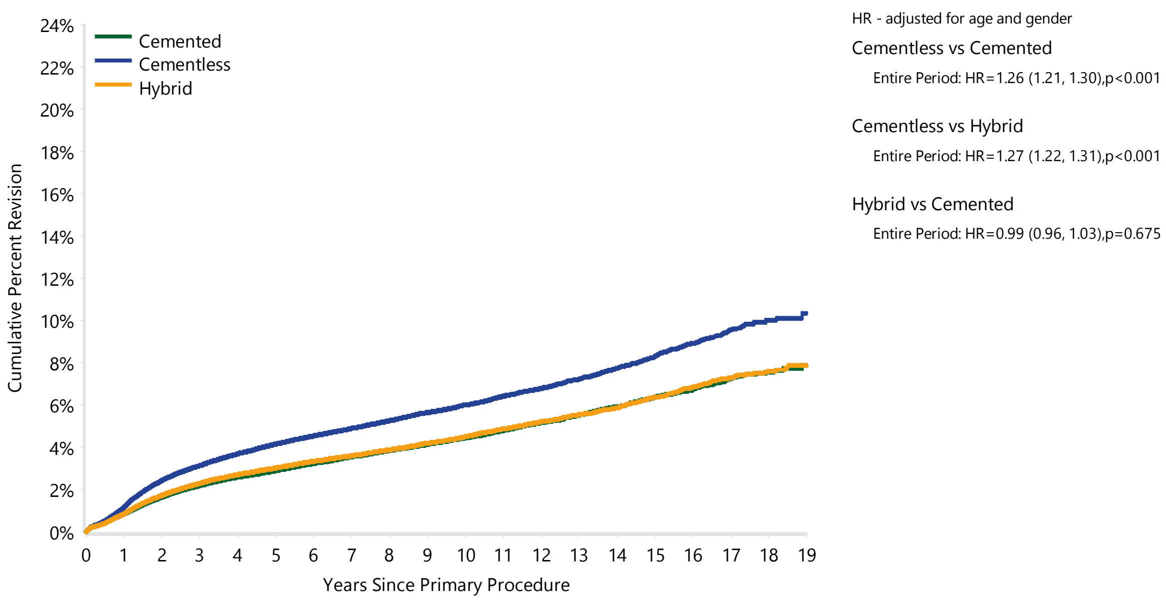
When a medial pivot design prosthesis is used, there is no difference between cemented and hybrid fixation or between hybrid and cementless fixation. Cementless fixation has a higher rate of revision compared to cemented fixation (Table KT35 and Figure KT38).

Table KT33 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	19 Yrs
Cemented	6975	223714	0.8 (0.8, 0.9)	2.2 (2.1, 2.3)	2.9 (2.8, 3.0)	4.4 (4.3, 4.6)	6.4 (6.2, 6.6)	7.9 (7.4, 8.4)
Cementless	6170	118992	1.2 (1.1, 1.2)	3.1 (3.0, 3.2)	4.1 (4.0, 4.3)	6.0 (5.8, 6.1)	8.3 (8.0, 8.6)	10.3 (9.7, 11.0)
Hybrid	5291	151026	0.9 (0.8, 0.9)	2.3 (2.2, 2.4)	3.0 (2.9, 3.1)	4.5 (4.4, 4.6)	6.4 (6.1, 6.6)	7.9 (7.4, 8.3)
TOTAL	**18436**	**493732**						

Note: Excluding cementless Genesis Oxinium and Profix Oxinium femoral prostheses

Figure KT36 Cumulative Percent Revision of Minimally Stabilised Primary Total Knee Replacement by Fixation (Primary Diagnosis OA)

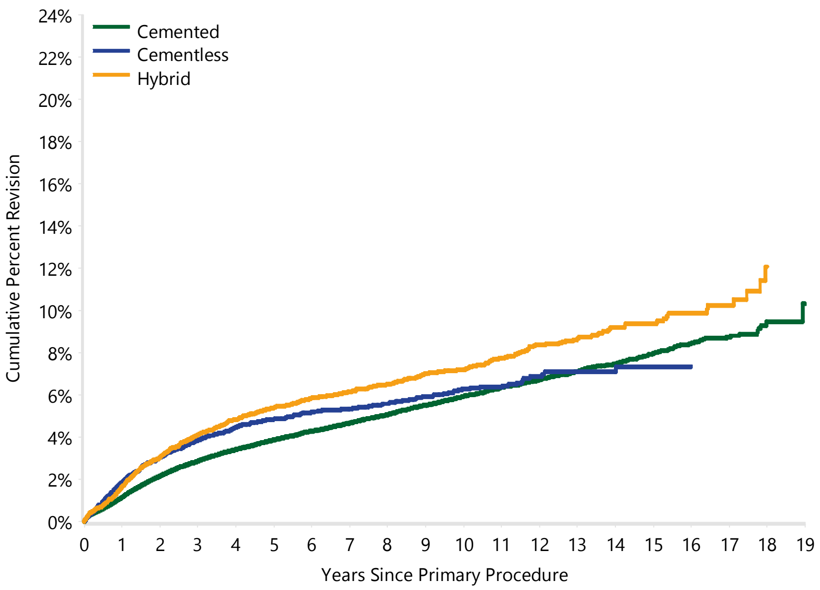


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Cemented	223714	197826	148436	109764	45699	12156	501
Cementless	118992	110424	96269	81127	37985	9788	340
Hybrid	151026	138441	112301	87429	37065	10750	402

Table KT34 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	19 Yrs
Cemented	6816	155861	1.1 (1.1, 1.2)	2.9 (2.8, 2.9)	3.9 (3.8, 4.0)	5.9 (5.8, 6.1)	7.9 (7.7, 8.2)	10.3 (8.6, 12.3)
Cementless	428	8214	1.9 (1.6, 2.2)	3.8 (3.4, 4.3)	4.9 (4.4, 5.4)	6.3 (5.7, 6.9)	7.3 (6.5, 8.3)	
Hybrid	849	13022	1.7 (1.4, 1.9)	4.1 (3.8, 4.5)	5.4 (5.0, 5.8)	7.2 (6.7, 7.7)	9.4 (8.6, 10.2)	
TOTAL	**8093**	**177097**						

Figure KT37 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 - 2.5Yr: HR=1.24 (1.09, 1.40),p<0.001
- 2.5Yr - 3Yr: HR=1.22 (0.83, 1.81),p=0.312
- 3Yr - 4.5Yr: HR=1.01 (0.77, 1.32),p=0.969
- 4.5Yr+: HR=0.61 (0.48, 0.76),p<0.001

Hybrid vs Cemented
- 0 - 1.5Yr: HR=1.43 (1.28, 1.61),p<0.001
- 1.5Yr - 2.5Yr: HR=1.21 (1.00, 1.45),p=0.044
- 2.5Yr - 3Yr: HR=1.67 (1.26, 2.21),p<0.001
- 3Yr+: HR=1.06 (0.95, 1.19),p=0.291

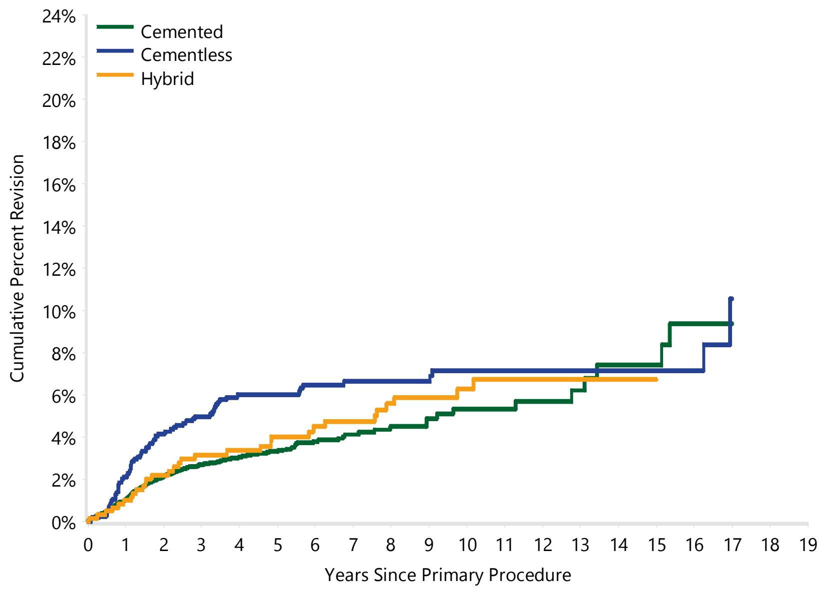
Hybrid vs Cementless
- 0 - 1.5Yr: HR=1.20 (1.03, 1.41),p=0.022
- 1.5Yr - 2Yr: HR=0.93 (0.70, 1.24),p=0.631
- 2Yr+: HR=1.33 (1.14, 1.54),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Cemented	155861	143189	117080	89821	34030	5198	96
Cementless	8214	7668	6493	5363	2095	258	1
Hybrid	13022	12428	10645	8997	4630	831	37

Table KT35 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	19 Yrs
Cemented	497	22269	1.0 (0.9, 1.2)	2.7 (2.5, 3.0)	3.3 (3.0, 3.7)	5.3 (4.4, 6.5)	7.4 (5.4, 10.1)	
Cementless	71	1171	2.1 (1.4, 3.1)	5.0 (3.8, 6.5)	6.0 (4.7, 7.6)	7.2 (5.6, 9.1)	7.2 (5.6, 9.1)	
Hybrid	31	626	1.0 (0.4, 2.2)	3.2 (2.0, 5.0)	4.0 (2.7, 6.1)	6.3 (4.4, 9.0)	6.7 (4.7, 9.6)	
TOTAL	**599**	**24066**						

Figure KT38 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

Entire Period: HR=1.55 (1.20, 2.01),p<0.001

Cementless vs Hybrid

Entire Period: HR=1.23 (0.81, 1.88),p=0.338

Hybrid vs Cemented

Entire Period: HR=1.26 (0.87, 1.84),p=0.219

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Cemented	22269	17045	8544	2607	371	103	4
Cementless	1171	1077	873	670	251	104	0
Hybrid	626	586	495	430	217	43	0

Computer Navigation

There have been 153,056 primary total knee replacement procedures reported to the Registry in which computer navigation was used. In 2019, computer navigation was used in 33.3% of all primary total knee replacement procedures.

Patients aged <65 years, have a lower rate of revision when computer navigation is used compared to when it is not used. In the first 6 months, patients aged ≥65 years have a higher rate of revision when computer navigation is used. After this time, they have a lower rate of revision compared to non-navigated patients (Table KT36 and Figure KT39). There is a reduction in the rate of revision for loosening with computer navigated knee replacement in both age groups (Table KT37 and Figure KT40).

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 43,246 primary total knee replacement procedures undertaken using IDI since 2009. In 2019, IDI was used in 13.2% of all primary total knee replacement procedures.

IDI usage has a higher rate of revision compared to when IDI is not used (Table KT38 and Figure KT41). When reasons for revision are compared, there is an increased proportion of revision for loosening when IDI is used (Figure KT42).

Where IDI is used for patients aged ≥65 years, there is a lower rate of revision in the first 3 months and 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 KT39 and Figure KT43).

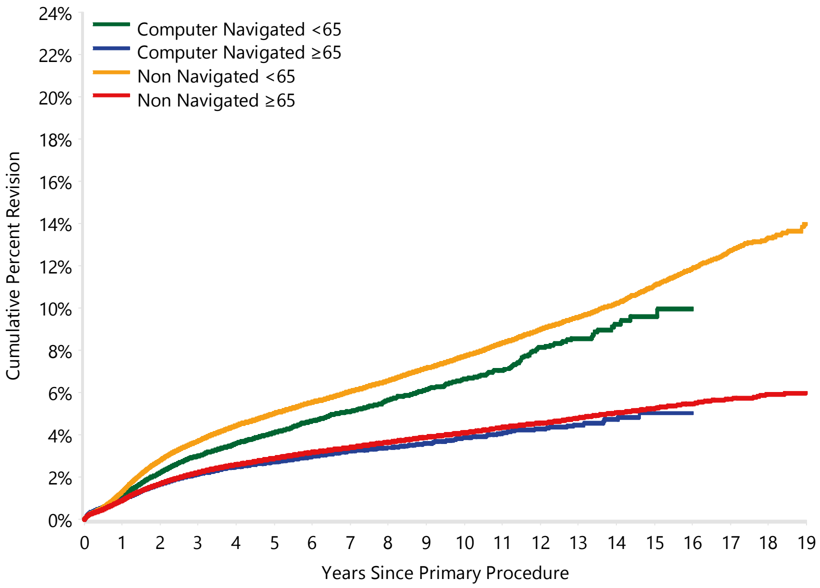
There are prosthesis specific differences in revision rates when IDI is used. There are 12 prostheses with over 500 procedures each with and without IDI, which have over 3 years follow-up. There is no difference in the rate of revision for 10 of these knee prostheses when IDI is used, compared to when it is not used.

When IDI is used, the Genesis II PS has a higher rate of revision. The Legion PS has a higher rate of revision between 1.5 and 3.5 years, with no difference after this time (Table KT40 and Table KT41).

Table KT36 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	19 Yrs
Computer Navigated		**4432**	**153056**	**1.0 (0.9, 1.0)**	**2.4 (2.4, 2.5)**	**3.2 (3.1, 3.3)**	**4.9 (4.7, 5.1)**	**6.8 (6.3, 7.4)**	
	<65	2065	53573	1.1 (1.0, 1.2)	3.0 (2.8, 3.2)	4.1 (3.9, 4.3)	6.6 (6.3, 7.0)	9.6 (8.7, 10.6)	
	≥65	2367	99483	0.9 (0.9, 1.0)	2.1 (2.0, 2.2)	2.7 (2.6, 2.8)	3.9 (3.7, 4.1)	5.0 (4.5, 5.7)	
Non Navigated		**23148**	**546227**	**1.0 (1.0, 1.1)**	**2.7 (2.7, 2.8)**	**3.6 (3.5, 3.6)**	**5.3 (5.2, 5.4)**	**7.4 (7.2, 7.5)**	**9.1 (8.8, 9.4)**
	<65	11322	176596	1.3 (1.3, 1.4)	3.7 (3.6, 3.8)	5.0 (4.9, 5.1)	7.7 (7.6, 7.9)	11.1 (10.8, 11.3)	14.0 (13.4, 14.6)
	≥65	11826	369631	0.9 (0.9, 0.9)	2.2 (2.2, 2.3)	2.9 (2.8, 2.9)	4.1 (4.0, 4.2)	5.3 (5.1, 5.4)	6.0 (5.8, 6.2)
TOTAL		**27580**	**699283**						

Figure KT39 Cumulative Percent Revision of Primary Total Knee Replacement by Computer Navigation and Age (Primary Diagnosis OA)



HR - adjusted for gender

Computer Navigated <65 vs Computer Navigated ≥65
0 - 6Mth: HR=0.95 (0.82, 1.09),p=0.449
6Mth - 1.5Yr: HR=1.48 (1.34, 1.63),p<0.001
1.5Yr - 2Yr: HR=1.62 (1.40, 1.88),p<0.001
2Yr - 2.5Yr: HR=1.78 (1.52, 2.09),p<0.001
2.5Yr - 4Yr: HR=1.68 (1.48, 1.90),p<0.001
4Yr - 5.5Yr: HR=2.06 (1.76, 2.40),p<0.001
5.5Yr - 11.5Yr: HR=2.37 (2.09, 2.68),p<0.001
11.5Yr+: HR=3.28 (2.25, 4.79),p<0.001

Computer Navigated <65 vs Non Navigated <65
Entire Period: HR=0.83 (0.80, 0.88),p<0.001

Computer Navigated ≥65 vs Non Navigated ≥65
0 - 6Mth: HR=1.19 (1.08, 1.31),p<0.001
6Mth+: HR=0.90 (0.85, 0.94),p<0.001

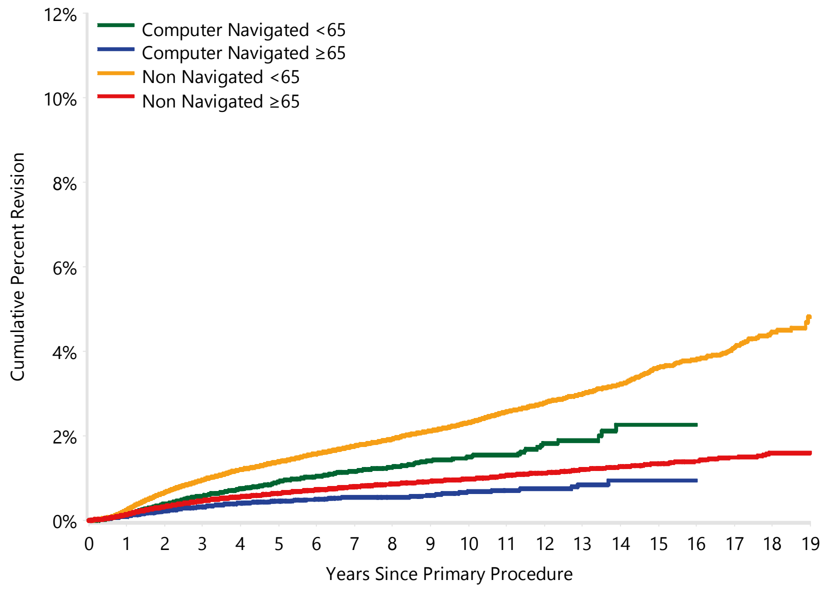
Non Navigated <65 vs Non Navigated ≥65
0 - 3Mth: HR=1.09 (1.00, 1.20),p=0.057
3Mth - 9Mth: HR=1.56 (1.44, 1.68),p<0.001
9Mth - 2Yr: HR=1.84 (1.76, 1.93),p<0.001
2Yr - 3Yr: HR=1.74 (1.62, 1.86),p<0.001
3Yr - 5Yr: HR=1.99 (1.87, 2.13),p<0.001
5Yr - 5.5Yr: HR=1.83 (1.58, 2.12),p<0.001
5.5Yr - 7Yr: HR=2.26 (2.05, 2.49),p<0.001
7Yr - 7.5Yr: HR=2.02 (1.69, 2.42),p<0.001
7.5Yr - 8Yr: HR=2.20 (1.82, 2.65),p<0.001
8Yr - 8.5Yr: HR=2.52 (2.07, 3.05),p<0.001
8.5Yr - 9Yr: HR=2.34 (1.91, 2.86),p<0.001
9Yr - 10Yr: HR=2.86 (2.43, 3.36),p<0.001
10Yr - 11Yr: HR=2.46 (2.08, 2.89),p<0.001
11Yr - 12.5Yr: HR=3.34 (2.83, 3.95),p<0.001
12.5Yr - 13Yr: HR=1.97 (1.47, 2.64),p<0.001
13Yr+: HR=3.46 (2.99, 4.01),p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	8 Yrs	9 Yrs
Computer Navigated		**153056**	**132415**	**92259**	**60314**	**37355**	**28252**	**19871**
	<65	53573	46663	32910	21930	14240	10998	7804
	≥65	99483	85752	59349	38384	23115	17254	12067
Non Navigated		**546227**	**499973**	**411396**	**327616**	**249725**	**213982**	**180579**
	<65	176596	162167	134529	108914	85150	74238	63542
	≥65	369631	337806	276867	218702	164575	139744	117037

Table KT37 Cumulative Percent Revision for Loosening 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	19 Yrs
Computer Navigated		**805**	**153056**	**0.1 (0.1, 0.1)**	**0.4 (0.4, 0.5)**	**0.6 (0.6, 0.7)**	**1.0 (0.9, 1.1)**	**1.5 (1.2, 1.8)**	
	<65	430	53573	0.1 (0.1, 0.2)	0.6 (0.5, 0.7)	0.9 (0.8, 1.0)	1.5 (1.3, 1.7)	2.3 (1.8, 2.9)	
	≥65	375	99483	0.1 (0.1, 0.1)	0.3 (0.3, 0.4)	0.5 (0.4, 0.5)	0.7 (0.6, 0.8)	0.9 (0.7, 1.3)	
Non Navigated		**6000**	**546227**	**0.2 (0.2, 0.2)**	**0.6 (0.6, 0.7)**	**0.9 (0.9, 0.9)**	**1.4 (1.4, 1.5)**	**2.2 (2.1, 2.2)**	**2.9 (2.6, 3.1)**
	<65	3271	176596	0.3 (0.2, 0.3)	1.0 (0.9, 1.0)	1.4 (1.3, 1.5)	2.3 (2.2, 2.4)	3.6 (3.5, 3.8)	4.8 (4.4, 5.3)
	≥65	2729	369631	0.1 (0.1, 0.2)	0.5 (0.4, 0.5)	0.6 (0.6, 0.7)	1.0 (0.9, 1.0)	1.3 (1.3, 1.4)	1.6 (1.5, 1.7)
TOTAL		**6805**	**699283**						

Figure KT40 Cumulative Percent Revision for Loosening of Primary Total Knee Replacement by Computer Navigation and Age (Primary Diagnosis OA)



HR - adjusted for gender

Computer Navigated <65 vs Computer Navigated ≥65
- 0 - 6Mth: HR=1.06 (0.68, 1.66),p=0.790
- 6Mth - 1.5Yr: HR=1.76 (1.41, 2.20),p<0.001
- 1.5Yr - 2.5Yr: HR=2.00 (1.57, 2.55),p<0.001
- 2.5Yr+: HR=2.54 (2.13, 3.02),p<0.001

Computer Navigated <65 vs Non Navigated <65
- Entire Period: HR=0.63 (0.57, 0.70),p<0.001

Computer Navigated ≥65 vs Non Navigated ≥65
- Entire Period: HR=0.69 (0.62, 0.77),p<0.001

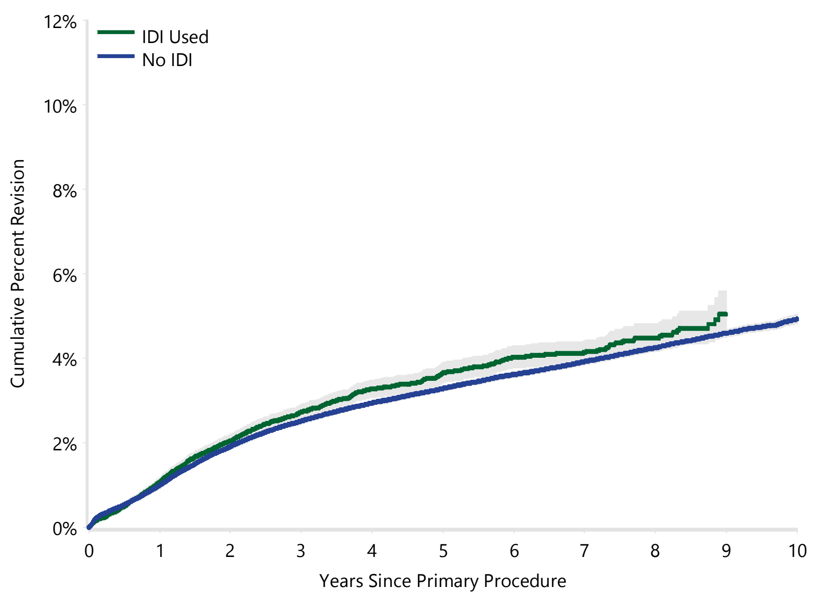
Non Navigated <65 vs Non Navigated ≥65
- 0 - 6Mth: HR=1.25 (1.01, 1.56),p=0.040
- 6Mth - 9Mth: HR=1.82 (1.44, 2.30),p<0.001
- 9Mth - 3Yr: HR=2.18 (2.02, 2.36),p<0.001
- 3Yr - 4Yr: HR=2.68 (2.28, 3.14),p<0.001
- 4Yr - 8.5Yr: HR=2.51 (2.27, 2.78),p<0.001
- 8.5Yr+: HR=3.30 (2.90, 3.76),p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Computer Navigated		**153056**	**132415**	**92259**	**60314**	**13082**	**638**	**0**
	<65	53573	46663	32910	21930	5227	285	0
	≥65	99483	85752	59349	38384	7855	353	0
Non Navigated		**546227**	**499973**	**411396**	**327616**	**149857**	**38807**	**1384**
	<65	176596	162167	134529	108914	53653	16153	657
	≥65	369631	337806	276867	218702	96204	22654	727

Table KT38 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	9 Yrs	10 Yrs
IDI Used	1123	43246	1.1 (1.0, 1.2)	2.7 (2.5, 2.9)	3.7 (3.4, 3.9)	4.1 (3.9, 4.4)	5.0 (4.5, 5.6)	
No IDI	13966	464277	1.0 (1.0, 1.0)	2.5 (2.5, 2.6)	3.3 (3.2, 3.3)	3.9 (3.9, 4.0)	4.6 (4.5, 4.7)	4.9 (4.8, 5.0)
TOTAL	**15089**	**507523**						

Figure KT41 Cumulative Percent Revision of Primary Total Knee Replacement Since 2009 by IDI Usage (Primary Diagnosis OA)



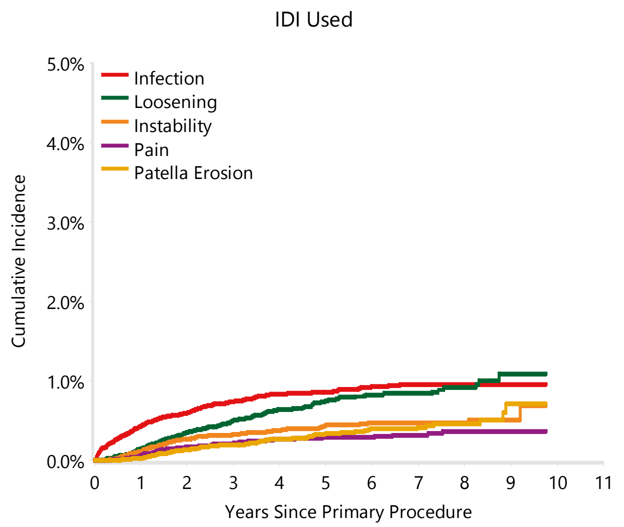
HR - adjusted for age and gender

IDI Used vs No IDI

Entire Period: HR=1.06 (0.99, 1.12),p=0.079

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
IDI Used	43246	35365	21076	10324	4526	690	23
No IDI	464277	409244	303692	208289	124610	54789	25177

Figure KT42 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement Since 2009 by IDI Usage (Primary Diagnosis OA)



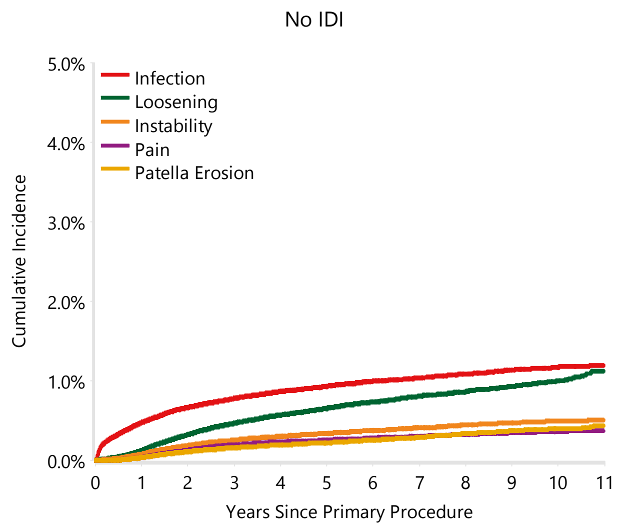
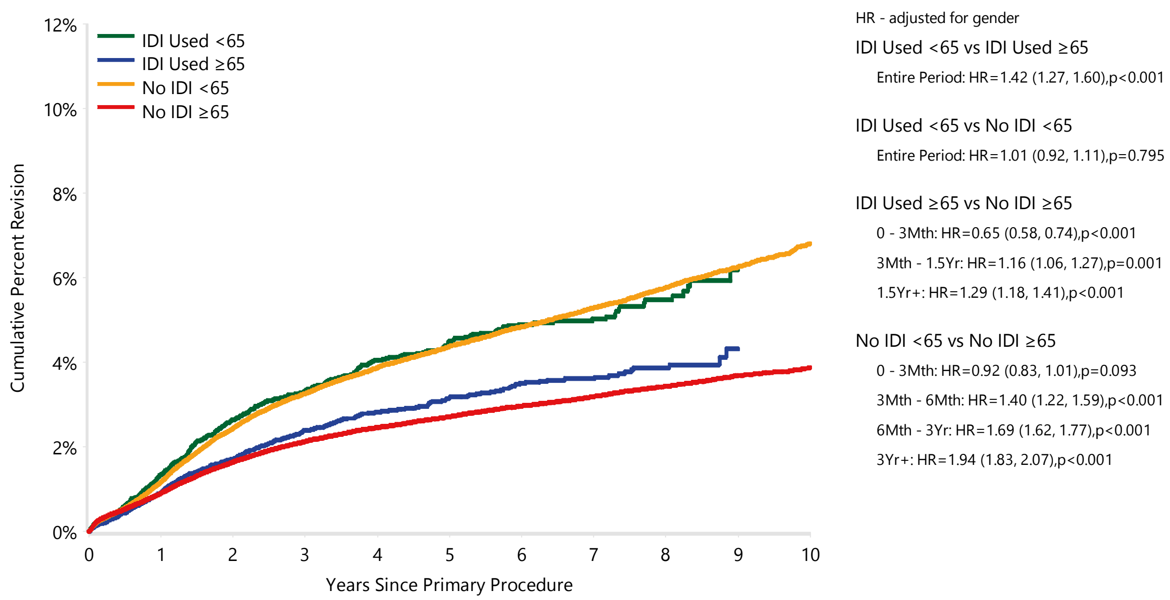


Table KT39 Cumulative Percent Revision of Primary Total Knee Replacement Since 2009 by IDI Usage and Age (Primary Diagnosis OA)

IDI Usage	Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
IDI Used		**1123**	**43246**	**1.1 (1.0, 1.2)**	**2.7 (2.5, 2.9)**	**3.7 (3.4, 3.9)**	**4.1 (3.9, 4.4)**	**5.0 (4.5, 5.6)**	
	<65	510	15463	1.4 (1.2, 1.6)	3.3 (3.0, 3.7)	4.5 (4.1, 4.9)	5.0 (4.6, 5.5)	6.2 (5.4, 7.2)	
	≥65	613	27783	0.9 (0.8, 1.0)	2.4 (2.2, 2.6)	3.2 (2.9, 3.4)	3.6 (3.3, 4.0)	4.3 (3.7, 5.0)	
No IDI		**13966**	**464277**	**1.0 (1.0, 1.0)**	**2.5 (2.5, 2.6)**	**3.3 (3.2, 3.3)**	**3.9 (3.9, 4.0)**	**4.6 (4.5, 4.7)**	**4.9 (4.8, 5.0)**
	<65	6458	156744	1.2 (1.1, 1.2)	3.3 (3.2, 3.4)	4.4 (4.3, 4.5)	5.3 (5.2, 5.4)	6.3 (6.1, 6.4)	6.8 (6.6, 7.0)
	≥65	7508	307533	0.9 (0.9, 0.9)	2.1 (2.1, 2.2)	2.7 (2.6, 2.8)	3.2 (3.1, 3.3)	3.7 (3.6, 3.8)	3.9 (3.8, 4.0)
TOTAL		**15089**	**507523**						

Figure KT43 Cumulative Percent Revision of Primary Total Knee Replacement Since 2009 by IDI Usage and Age (Primary Diagnosis OA)



Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
IDI Used	<65	15463	12783	7914	4078	1869	318	12
	≥65	27783	22582	13162	6246	2657	372	11
No IDI	<65	156744	139162	104754	73568	45845	21095	9854
	≥65	307533	270082	198938	134721	78765	33694	15323

Table KT40 Cumulative Percent Revision of Primary Total Knee Replacement Since 2009 by Prosthesis Combination and IDI Usage (Primary Diagnosis OA)

Prosthesis Combination	IDI Usage	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	8 Yrs	9 Yrs
Attune CR	IDI Used	13	640	1.3 (0.6, 2.7)	3.3 (1.8, 5.9)				
	No IDI	274	14694	0.9 (0.8, 1.1)	2.4 (2.1, 2.7)	3.0 (2.6, 3.4)			
Evolution	IDI Used	78	3467	1.2 (0.9, 1.7)	2.8 (2.2, 3.6)	5.4 (3.5, 8.4)			
	No IDI	88	4504	0.7 (0.5, 1.0)	2.4 (1.9, 3.0)	3.0 (2.3, 3.8)			
GMK Primary	IDI Used	24	1104	0.8 (0.4, 1.7)	2.7 (1.8, 4.1)	3.3 (2.2, 5.1)			
	No IDI	55	1336	1.1 (0.7, 1.9)	3.3 (2.5, 4.5)	3.9 (3.0, 5.2)	4.7 (3.5, 6.3)	5.5 (3.8, 8.0)	5.5 (3.8, 8.0)
Genesis II CR	IDI Used	49	1152	1.4 (0.9, 2.3)	3.4 (2.5, 4.7)	4.5 (3.4, 6.1)	5.0 (3.7, 6.6)	6.1 (4.3, 8.6)	
	No IDI	489	13826	1.0 (0.8, 1.1)	2.5 (2.3, 2.8)	3.4 (3.1, 3.7)	4.2 (3.8, 4.6)	4.5 (4.1, 5.0)	4.9 (4.4, 5.4)
Genesis II PS	IDI Used	124	2772	1.5 (1.1, 2.0)	3.5 (2.9, 4.4)	5.4 (4.5, 6.5)	6.0 (5.0, 7.2)	6.3 (5.2, 7.6)	7.1 (5.4, 9.3)
	No IDI	1023	25395	1.2 (1.1, 1.4)	2.9 (2.7, 3.2)	4.0 (3.8, 4.3)	4.8 (4.5, 5.2)	5.2 (4.9, 5.5)	5.5 (5.1, 5.9)
Legion CR	IDI Used	58	2389	0.9 (0.6, 1.4)	3.1 (2.3, 4.1)	4.3 (3.2, 5.8)	5.2 (3.7, 7.3)		
	No IDI	222	8984	1.0 (0.8, 1.2)	2.7 (2.3, 3.1)	3.4 (3.0, 3.9)	4.0 (3.5, 4.7)	4.0 (3.5, 4.7)	4.2 (3.6, 4.9)
Legion PS	IDI Used	106	2396	1.3 (0.9, 1.9)	4.1 (3.3, 5.0)	6.5 (5.3, 7.9)	7.1 (5.7, 8.7)	7.1 (5.7, 8.7)	
	No IDI	540	16490	1.1 (0.9, 1.2)	2.8 (2.5, 3.1)	3.7 (3.4, 4.1)	4.3 (4.0, 4.8)	4.6 (4.2, 5.1)	4.9 (4.4, 5.5)
Natural Knee Flex	IDI Used	7	586	0.7 (0.3, 1.8)	0.9 (0.4, 2.2)	1.7 (0.8, 3.8)	1.7 (0.8, 3.8)	1.7 (0.8, 3.8)	
	No IDI	118	4854	0.8 (0.6, 1.1)	2.1 (1.7, 2.6)	2.6 (2.2, 3.2)	3.1 (2.6, 3.8)	3.3 (2.8, 4.1)	3.3 (2.8, 4.1)
Nexgen CR Flex	IDI Used	152	7260	0.7 (0.5, 0.9)	1.9 (1.6, 2.3)	2.4 (2.0, 2.8)	2.6 (2.2, 3.0)	2.8 (2.3, 3.5)	3.1 (2.4, 4.0)
	No IDI	1112	50496	0.8 (0.7, 0.9)	1.9 (1.8, 2.0)	2.4 (2.2, 2.5)	2.8 (2.6, 3.0)	3.0 (2.8, 3.2)	3.1 (2.9, 3.3)
Nexgen LPS Flex	IDI Used	51	2137	1.3 (0.9, 1.9)	2.1 (1.5, 2.8)	2.5 (1.9, 3.4)	3.4 (2.4, 5.0)	4.3 (2.6, 7.0)	
	No IDI	742	24414	1.0 (0.9, 1.1)	2.2 (2.1, 2.4)	3.0 (2.8, 3.3)	3.6 (3.3, 3.9)	4.0 (3.7, 4.3)	4.3 (4.0, 4.7)
Vanguard CR	IDI Used	126	3975	0.8 (0.6, 1.2)	2.5 (2.0, 3.0)	3.1 (2.6, 3.7)	3.8 (3.1, 4.5)	3.9 (3.3, 4.7)	4.3 (3.6, 5.3)
	No IDI	657	21909	0.8 (0.7, 1.0)	2.4 (2.2, 2.6)	3.0 (2.7, 3.2)	3.6 (3.3, 3.9)	4.0 (3.7, 4.4)	5.0 (4.5, 5.5)
Vanguard PS	IDI Used	64	1121	2.0 (1.3, 3.0)	4.6 (3.5, 6.1)	5.9 (4.5, 7.7)	7.1 (5.5, 9.1)	7.8 (6.0, 10.1)	8.8 (6.4, 12.1)
	No IDI	180	3296	1.7 (1.3, 2.2)	4.1 (3.4, 4.8)	5.1 (4.4, 6.0)	5.7 (4.9, 6.7)	6.1 (5.3, 7.1)	6.5 (5.5, 7.5)
TOTAL		**6352**	**219197**						

Note: Evolution includes Evolution/Evolution
GMK Primary includes GMK Primary/GMK Primary
Genesis II CR includes Genesis II CR/Genesis II
Genesis II PS includes Genesis II Oxinium PS/Genesis II and Genesis II PS/Genesis II
Legion CR includes Legion CR/Genesis II and Legion Oxinium CR/Genesis II
Legion PS includes Legion Oxinium PS/Genesis II and Legion PS/Genesis II
Nexgen CR Flex includes Nexgen CR Flex/Nexgen and Nexgen CR Flex/Nexgen TM CR
Nexgen LPS Flex includes Nexgen LPS Flex/Nexgen
Vanguard CR includes Vanguard CR/Maxim, Vanguard CR/Regenerex and Vanguard CR/Vanguard
Vanguard PS includes Vanguard PS/Maxim

Table KT41 Hazard Ratios of IDI Used vs No IDI in Primary Total Knee Replacement Since 2009 by Prosthesis Combination (Primary Diagnosis OA)

Prosthesis Combination	Hazard Ratio		P-Value
Attune CR	Entire Period	1.27 (0.73, 2.21)	0.403
Evolution	Entire Period	1.32 (0.97, 1.80)	0.074
GMK Primary	Entire Period	0.79 (0.48, 1.29)	0.345
Genesis II CR	Entire Period	1.28 (0.95, 1.72)	0.098
Genesis II PS	Entire Period	1.22 (1.01, 1.47)	0.035
Legion CR	Entire Period	1.14 (0.85, 1.53)	0.368
Legion PS	0 - 1.5Yr	1.21 (0.88, 1.66)	0.246
	1.5Yr - 3Yr	1.80 (1.25, 2.60)	0.001
	3Yr - 3.5Yr	6.30 (3.09, 12.85)	<0.001
	3.5Yr+	1.42 (0.81, 2.48)	0.215
Natural Knee Flex	Entire Period	0.49 (0.23, 1.06)	0.069
Nexgen CR Flex	Entire Period	0.95 (0.80, 1.12)	0.520
Nexgen LPS Flex	Entire Period	0.97 (0.73, 1.28)	0.808
Vanguard CR	Entire Period	1.00 (0.83, 1.21)	0.994
Vanguard PS	Entire Period	1.19 (0.89, 1.58)	0.244

Bearing Surface

There are two tibial bearing surfaces 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 37,255 procedures with the addition of an antioxidant. XLPE is now used more frequently (67.0% in 2019) than non XLPE.

Prostheses using XLPE have a cumulative percent revision rate of 5.0% at 15 years, compared to 7.8% for non XLPE (Table KT42 and Figure KT44). As previously reported, when comparing all prostheses, the XLPE group again has a lower rate of revision compared to the non XLPE group. The major reason for this difference is a reduced cumulative incidence for loosening (0.9% at 15 years for XLPE compared to 1.9% for non XLPE) (Figure KT45).

The difference between XLPE and non XLPE is more evident in younger patients. The 15 year cumulative percent revision rate for patients aged <65 years for XLPE is 7.0% and for non XLPE is 11.7%. For patients aged ≥65 years, the 15 year cumulative percent revision for XLPE is 3.8% and for non XLPE is 5.6% (Table KT43 and Figure KT46).

There is the potential for the difference between XLPE and non XLPE to be confounded by prosthesis use. To address this issue, an analysis was undertaken to compare the rate of revision for specific prostheses that have used both XLPE and non XLPE bearings in at least 500 procedures.

There were 18 prosthesis combinations in this analysis. The rate of revision was lower when XLPE was used for 5 of these prostheses. There was no difference in rate of revision for the remaining prostheses (Table KT44 and Table KT45).

XLPE with Antioxidant

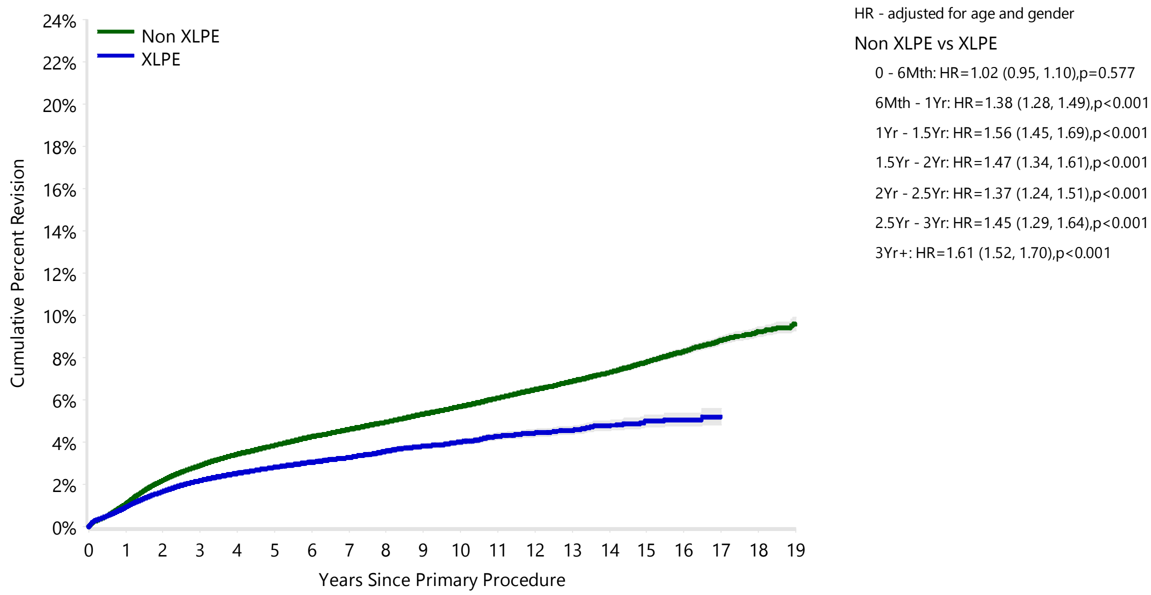
An analysis comparing the rate of revision of XLPE and XLPE with antioxidant has been undertaken. The follow-up for XLPE with antioxidant is relatively short (5 years). There are only a small number of prostheses that use this bearing. There is no difference in the rate of revision between XLPE with antioxidant and XLPE (Table KT46, Figure KT47 and Figure KT48). The Attune was used in over 60.3% of these procedures. When the Attune is excluded from the analysis, there is no difference in the rate of revision between XLPE and XLPE with antioxidant (Table KT47 and Figure KT49).

Table KT42 Cumulative Percent Revision of Primary Total Knee Replacement by Polyethylene Type (Primary Diagnosis OA)

Polyethylene Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Non XLPE	21180	430183	1.1 (1.1, 1.1)	2.9 (2.8, 3.0)	3.9 (3.8, 3.9)	5.7 (5.6, 5.8)	7.8 (7.7, 7.9)	9.6 (9.3, 9.9)
XLPE	5825	231543	0.9 (0.9, 1.0)	2.2 (2.1, 2.3)	2.8 (2.7, 2.9)	4.0 (3.9, 4.1)	5.0 (4.7, 5.3)	
TOTAL	**27005**	**661726**						

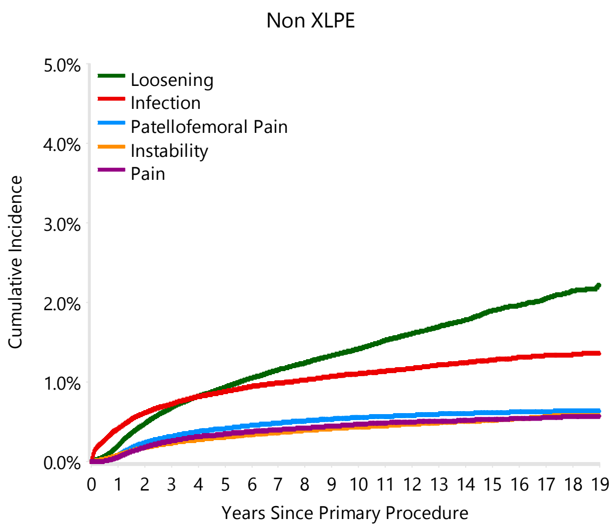
Note: Includes 37,255 procedures using XLPE + antioxidant
Excludes 302 procedures with unknown polyethylene

Figure KT44 Cumulative Percent Revision of Primary Total Knee Replacement by Polyethylene Type (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Non XLPE	430183	404164	348219	290292	143433	37124	1382
XLPE	231543	202756	145645	95432	19433	2301	0

Figure KT45 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by Polyethylene Type (Primary Diagnosis OA)



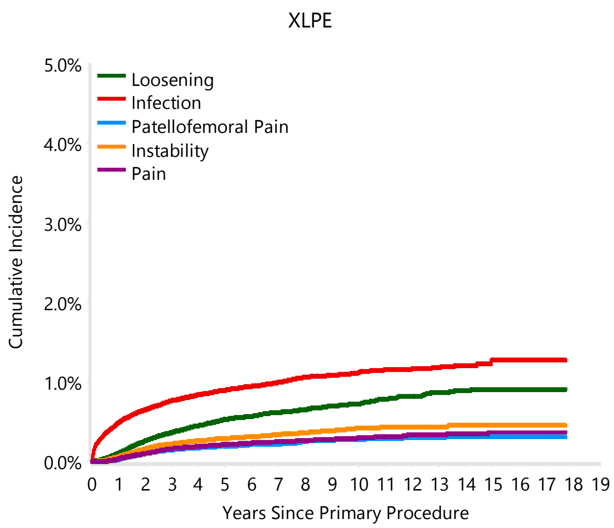
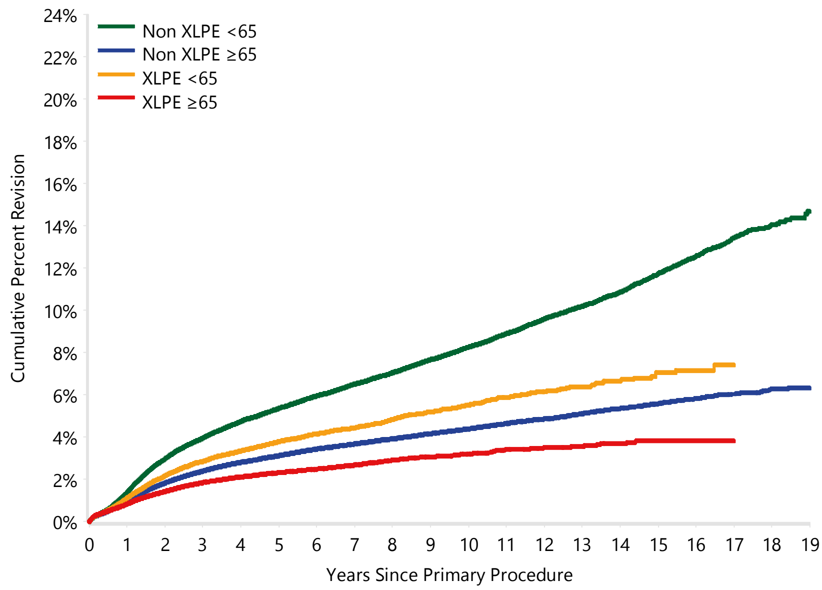


Table KT43 **Cumulative Percent Revision of Primary Total Knee Replacement by Polyethylene Type and Age (Primary Diagnosis OA)**

Polyethylene Type	Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Non XLPE		**21180**	**430183**	**1.1 (1.1, 1.1)**	**2.9 (2.8, 3.0)**	**3.9 (3.8, 3.9)**	**5.7 (5.6, 5.8)**	**7.8 (7.7, 7.9)**	**9.6 (9.3, 9.9)**
	<65	10453	139516	1.4 (1.3, 1.4)	4.0 (3.8, 4.1)	5.3 (5.2, 5.5)	8.3 (8.1, 8.4)	11.7 (11.5, 12.0)	14.7 (14.1, 15.3)
	≥65	10727	290667	0.9 (0.9, 1.0)	2.4 (2.3, 2.4)	3.1 (3.1, 3.2)	4.4 (4.3, 4.5)	5.6 (5.4, 5.7)	6.3 (6.1, 6.6)
XLPE		**5825**	**231543**	**0.9 (0.9, 1.0)**	**2.2 (2.1, 2.3)**	**2.8 (2.7, 2.9)**	**4.0 (3.9, 4.1)**	**5.0 (4.7, 5.3)**	
	<65	2686	77837	1.1 (1.0, 1.2)	2.8 (2.7, 3.0)	3.8 (3.6, 3.9)	5.5 (5.3, 5.8)	7.0 (6.5, 7.6)	
	≥65	3139	153706	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 (3.5, 4.1)	
TOTAL		**27005**	**661726**						

Figure KT46 **Cumulative Percent Revision of Primary Total Knee Replacement by Polyethylene Type and Age (Primary Diagnosis OA)**



HR - adjusted for gender

Non XLPE <65 vs Non XLPE ≥65

0 - 3Mth: HR=1.05 (0.94, 1.17),p=0.374
3Mth - 9Mth: HR=1.55 (1.43, 1.69),p<0.001
9Mth - 3.5Yr: HR=1.80 (1.73, 1.87),p<0.001
3.5Yr - 6Yr: HR=2.02 (1.90, 2.15),p<0.001
6Yr - 6.5Yr: HR=2.15 (1.81, 2.55),p<0.001
6.5Yr - 7Yr: HR=2.62 (2.21, 3.12),p<0.001
7Yr - 8Yr: HR=2.14 (1.88, 2.43),p<0.001
8Yr - 9.5Yr: HR=2.53 (2.25, 2.84),p<0.001
9.5Yr - 10Yr: HR=2.92 (2.34, 3.64),p<0.001
10Yr - 10.5Yr: HR=2.31 (1.83, 2.92),p<0.001
10.5Yr - 11.5Yr: HR=2.89 (2.45, 3.42),p<0.001
11.5Yr+: HR=3.30 (2.96, 3.69),p<0.001

Non XLPE <65 vs XLPE <65

0 - 6Mth: HR=1.04 (0.95, 1.15),p=0.400
6Mth - 1Yr: HR=1.47 (1.34, 1.60),p<0.001
1Yr - 1.5Yr: HR=1.59 (1.46, 1.74),p<0.001
1.5Yr - 2.5Yr: HR=1.40 (1.30, 1.52),p<0.001
2.5Yr - 3.5Yr: HR=1.40 (1.28, 1.54),p<0.001
3.5Yr - 8.5Yr: HR=1.67 (1.56, 1.79),p<0.001
8.5Yr - 9Yr: HR=2.03 (1.66, 2.49),p<0.001
9Yr - 10Yr: HR=2.16 (1.83, 2.54),p<0.001
10Yr - 13Yr: HR=2.20 (1.96, 2.48),p<0.001
13Yr+: HR=2.81 (2.41, 3.28),p<0.001

Non XLPE ≥65 vs XLPE ≥65

0 - 6Mth: HR=0.96 (0.88, 1.05),p=0.388
6Mth+: HR=1.46 (1.40, 1.53),p<0.001

XLPE <65 vs XLPE ≥65

0 - 3Mth: HR=0.99 (0.89, 1.11),p=0.894
3Mth - 6Mth: HR=1.41 (1.21, 1.65),p<0.001
6Mth - 1.5Yr: HR=1.66 (1.52, 1.81),p<0.001
1.5Yr+: HR=1.87 (1.74, 2.01),p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Non XLPE	<65	139516	131403	114055	96557	51486	15388	656
	≥65	290667	272761	234164	193735	91947	21736	726
XLPE	<65	77837	68639	50050	33502	7371	1042	0
	≥65	153706	134117	95595	61930	12062	1259	0

Table KT44 Cumulative Percent Revision of Primary Total Knee Replacement by Prosthesis Combination and Polyethylene Type (Primary Diagnosis OA)

Prosthesis Combination	Polyethylene Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
Genesis II CR/Genesis II	Non XLPE	966	21517	0.9 (0.8, 1.1)	2.7 (2.5, 2.9)	3.5 (3.3, 3.8)	5.0 (4.7, 5.3)	6.3 (5.8, 6.8)	7.1 (6.5, 7.9)
	XLPE	52	2467	1.3 (0.9, 1.9)	2.2 (1.7, 3.0)	2.9 (2.2, 3.9)			
Genesis II Oxinium CR/Genesis II	Non XLPE	462	6506	1.3 (1.0, 1.6)	3.4 (3.0, 3.9)	4.4 (3.9, 4.9)	6.9 (6.3, 7.6)	9.8 (8.8, 10.8)	
	XLPE	61	2688	0.9 (0.6, 1.3)	2.5 (1.9, 3.3)	2.9 (2.2, 3.8)			
Genesis II Oxinium PS/Genesis II	Non XLPE	836	11635	1.6 (1.4, 1.8)	3.9 (3.5, 4.3)	5.3 (4.9, 5.7)	7.8 (7.2, 8.3)	10.5 (9.4, 11.7)	
	XLPE	282	7810	1.4 (1.2, 1.7)	3.5 (3.1, 4.0)	5.0 (4.4, 5.6)			
Genesis II PS/Genesis II	Non XLPE	683	14729	1.2 (1.0, 1.4)	2.8 (2.6, 3.1)	3.7 (3.4, 4.0)	5.2 (4.8, 5.6)	6.5 (5.9, 7.2)	
	XLPE	123	4322	1.1 (0.8, 1.5)	2.8 (2.3, 3.5)	4.4 (3.6, 5.4)			
Legion CR/Genesis II	Non XLPE	83	2319	1.3 (0.9, 1.8)	3.4 (2.7, 4.2)	4.0 (3.2, 5.0)	6.0 (4.0, 8.8)		
	XLPE	64	3277	1.1 (0.8, 1.6)	2.6 (2.0, 3.4)	2.9 (2.2, 3.9)			
Legion Oxinium CR/Genesis II	Non XLPE	54	2090	0.8 (0.5, 1.3)	2.1 (1.6, 2.9)	2.9 (2.2, 3.8)	3.4 (2.6, 4.5)		
	XLPE	84	3820	0.7 (0.5, 1.1)	3.0 (2.3, 3.9)	4.4 (3.4, 5.7)			
Legion Oxinium PS/Genesis II	Non XLPE	281	5379	1.5 (1.2, 1.9)	3.7 (3.2, 4.2)	5.3 (4.7, 6.0)	7.0 (6.0, 8.1)		
	XLPE	234	8559	0.8 (0.6, 1.0)	2.8 (2.4, 3.2)	3.6 (3.1, 4.1)			
Legion PS/Genesis II	Non XLPE	57	2064	0.9 (0.6, 1.5)	1.9 (1.4, 2.6)	2.4 (1.8, 3.2)	4.0 (2.9, 5.6)		
	XLPE	90	3092	1.4 (1.1, 1.9)	2.8 (2.3, 3.5)	3.9 (3.1, 4.8)			
Natural Knee II/Natural Knee II	Non XLPE	289	2865	0.8 (0.5, 1.2)	2.0 (1.6, 2.6)	3.1 (2.5, 3.8)	7.0 (6.1, 8.1)	12.8 (11.4, 14.4)	
	XLPE	121	3576	1.0 (0.7, 1.4)	2.0 (1.5, 2.5)	2.5 (2.0, 3.1)	3.3 (2.7, 4.0)	4.6 (3.7, 5.7)	
Nexgen CR Flex/Nexgen	Non XLPE	117	4840	0.6 (0.5, 0.9)	1.7 (1.4, 2.2)	2.3 (1.9, 2.8)	3.3 (2.7, 4.0)		
	XLPE	1164	51829	0.8 (0.7, 0.9)	1.8 (1.7, 2.0)	2.3 (2.2, 2.5)	3.1 (2.9, 3.3)	4.1 (3.6, 4.6)	
Nexgen CR/Nexgen	Non XLPE	244	5916	0.5 (0.3, 0.7)	1.6 (1.3, 1.9)	2.0 (1.7, 2.4)	3.1 (2.7, 3.7)	5.1 (4.4, 5.8)	6.8 (5.8, 7.8)
	XLPE	165	5528	0.8 (0.6, 1.1)	1.8 (1.5, 2.2)	2.3 (1.9, 2.8)	3.1 (2.6, 3.7)	3.8 (3.2, 4.4)	
Nexgen LPS Flex/Nexgen	Non XLPE	752	15189	0.8 (0.7, 1.0)	2.2 (2.0, 2.5)	3.2 (2.9, 3.5)	5.3 (4.9, 5.7)	7.2 (6.6, 7.8)	
	XLPE	662	20992	1.1 (1.0, 1.2)	2.4 (2.2, 2.7)	3.2 (2.9, 3.4)	4.9 (4.5, 5.4)		
PFC Sigma CR/PFC Sigma	Non XLPE	720	20635	0.7 (0.6, 0.9)	1.9 (1.8, 2.1)	2.5 (2.3, 2.7)	3.5 (3.3, 3.8)	5.6 (5.1, 6.2)	6.2 (5.5, 7.0)
	XLPE	82	3591	0.7 (0.5, 1.1)	2.4 (1.9, 3.0)	3.1 (2.4, 3.8)			
PFC Sigma PS/PFC Sigma	Non XLPE	323	7059	1.2 (0.9, 1.4)	2.5 (2.2, 2.9)	3.3 (2.9, 3.7)	4.9 (4.3, 5.5)	6.9 (6.0, 7.9)	
	XLPE	16	792	1.4 (0.7, 2.5)	2.2 (1.3, 3.7)	2.5 (1.5, 4.1)			
Scorpio NRG PS/Series 7000	Non XLPE	20	503	0.6 (0.2, 1.8)	1.6 (0.8, 3.2)	3.1 (1.9, 5.1)	3.8 (2.4, 6.0)		
	XLPE	148	3428	0.9 (0.6, 1.2)	2.9 (2.4, 3.5)	3.8 (3.2, 4.5)	4.9 (4.1, 5.8)		
Triathlon CR/Triathlon	Non XLPE	325	10923	0.7 (0.6, 0.9)	1.9 (1.7, 2.2)	2.4 (2.2, 2.8)	3.5 (3.1, 3.9)		
	XLPE	1807	84494	0.9 (0.8, 0.9)	2.0 (1.9, 2.1)	2.5 (2.4, 2.7)	3.9 (3.7, 4.2)		
Triathlon PS/Triathlon	Non XLPE	224	3983	1.7 (1.3, 2.1)	3.6 (3.1, 4.3)	4.6 (4.0, 5.3)	6.4 (5.6, 7.3)		
	XLPE	278	8233	1.5 (1.3, 1.8)	2.8 (2.5, 3.2)	3.8 (3.3, 4.2)	5.6 (4.7, 6.6)		
Vanguard CR/Vanguard	Non XLPE	797	24746	0.8 (0.7, 0.9)	2.3 (2.2, 2.6)	3.0 (2.8, 3.3)	5.0 (4.6, 5.5)		
	XLPE	18	1059	0.9 (0.5, 1.8)	1.8 (1.1, 2.9)	2.1 (1.2, 3.6)			
TOTAL		**12684**	**382455**						

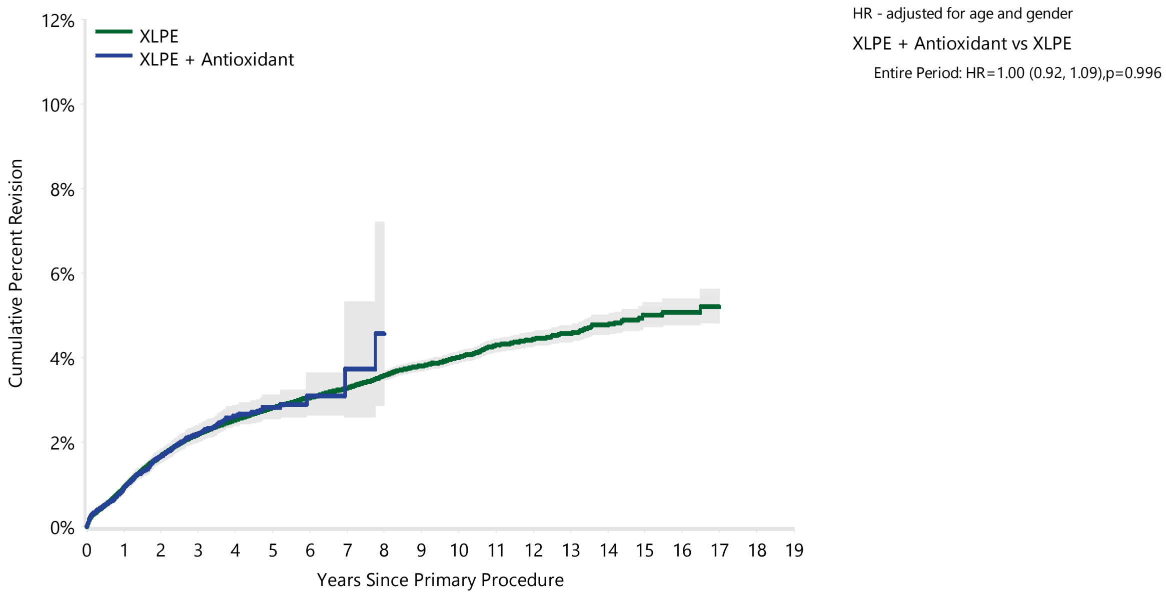
Table KT45 Hazard Ratios of XLPE vs Non XLPE in Primary Total Knee Replacement by Prosthesis Combination (Primary Diagnosis OA)

Prosthesis Combination	Hazard Ratio		P-Value
Genesis II CR/Genesis II	Entire Period	0.87 (0.66, 1.15)	0.334
Genesis II Oxinium CR/Genesis II	Entire Period	0.77 (0.58, 1.01)	0.062
Genesis II Oxinium PS/Genesis II	Entire Period	0.93 (0.81, 1.07)	0.284
Genesis II PS/Genesis II	Entire Period	1.08 (0.89, 1.32)	0.419
Legion CR/Genesis II	Entire Period	0.80 (0.58, 1.12)	0.195
Legion Oxinium CR/Genesis II	Entire Period	1.52 (1.07, 2.17)	0.019
Legion Oxinium PS/Genesis II	Entire Period	0.68 (0.57, 0.81)	<0.001
Legion PS/Genesis II	Entire Period	1.38 (0.98, 1.95)	0.068
Natural Knee II/Natural Knee II	0 - 6Mth	1.79 (0.85, 3.75)	0.125
	6Mth - 3.5Yr	0.80 (0.55, 1.18)	0.261
	3.5Yr+	0.20 (0.15, 0.28)	<0.001
Nexgen CR Flex/Nexgen	Entire Period	0.91 (0.75, 1.10)	0.326
Nexgen CR/Nexgen	0 - 3Yr	1.06 (0.79, 1.41)	0.710
	3Yr - 3.5Yr	1.88 (0.63, 5.60)	0.259
	3.5Yr - 4Yr	0.64 (0.23, 1.75)	0.382
	4Yr - 5Yr	0.87 (0.34, 2.20)	0.764
	5Yr+	0.42 (0.30, 0.60)	<0.001
Nexgen LPS Flex/Nexgen	0 - 6Mth	1.42 (1.06, 1.90)	0.017
	6Mth - 1.5Yr	0.86 (0.68, 1.08)	0.192
	1.5Yr+	0.91 (0.80, 1.05)	0.197
PFC Sigma CR/PFC Sigma	Entire Period	1.13 (0.89, 1.43)	0.308
PFC Sigma PS/PFC Sigma	Entire Period	0.75 (0.45, 1.24)	0.262
Scorpio NRG PS/Series 7000	Entire Period	1.24 (0.77, 2.02)	0.376
Triathlon CR/Triathlon	Entire Period	1.09 (0.97, 1.23)	0.152
Triathlon PS/Triathlon	Entire Period	0.82 (0.68, 0.98)	0.028
Vanguard CR/Vanguard	Entire Period	0.81 (0.51, 1.30)	0.380

Table KT46 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	19 Yrs
XLPE	5825	231543	0.9 (0.9, 1.0)	2.2 (2.1, 2.3)	2.8 (2.7, 2.9)	4.0 (3.9, 4.1)	5.0 (4.7, 5.3)	
XLPE + Antioxidant	567	37255	0.9 (0.8, 1.0)	2.2 (2.0, 2.4)	2.8 (2.6, 3.1)			
TOTAL	**6392**	**268798**						

Figure KT47 Cumulative Percent Revision of XLPE Primary Total Knee Replacement by Polyethylene Type (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
XLPE	231543	202756	145645	95432	19433	2301	0
XLPE + Antioxidant	37255	25249	9631	2064	0	0	0

Figure KT48 **Cumulative Incidence Revision Diagnosis of XLPE Primary Total Knee Replacement by Polyethylene Type (Primary Diagnosis OA)**

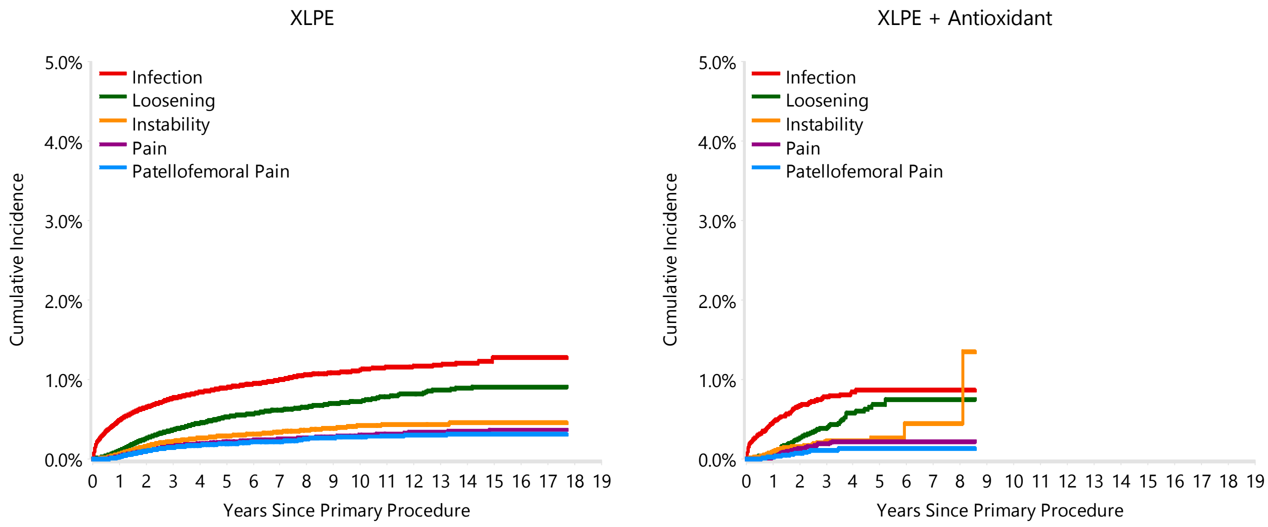
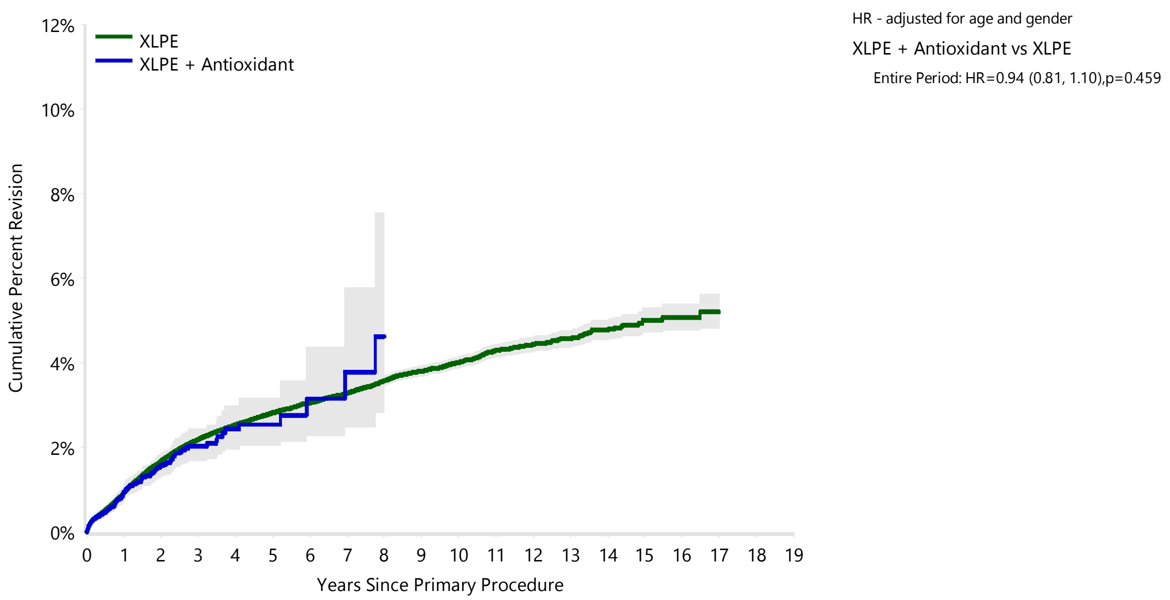


Table KT47 **Cumulative Percent Revision of XLPE Primary Total Knee Replacement by Polyethylene Type (Primary Diagnosis OA, Excluding Attune)**

Polyethylene Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
XLPE	5825	231543	0.9 (0.9, 1.0)	2.2 (2.1, 2.3)	2.8 (2.7, 2.9)	4.0 (3.9, 4.1)	5.0 (4.7, 5.3)	
XLPE + Antioxidant	170	14783	0.9 (0.8, 1.1)	2.0 (1.7, 2.4)	2.5 (2.0, 3.2)			
TOTAL	**5995**	**246326**						

Figure KT49 **Cumulative Percent Revision of XLPE Primary Total Knee Replacement by Polyethylene Type (Primary Diagnosis OA, Excluding Attune)**



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	19 Yrs
XLPE	231543	202756	145645	95432	19433	2301	0
XLPE + Antioxidant	14783	8151	1734	509	0	0	0

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.

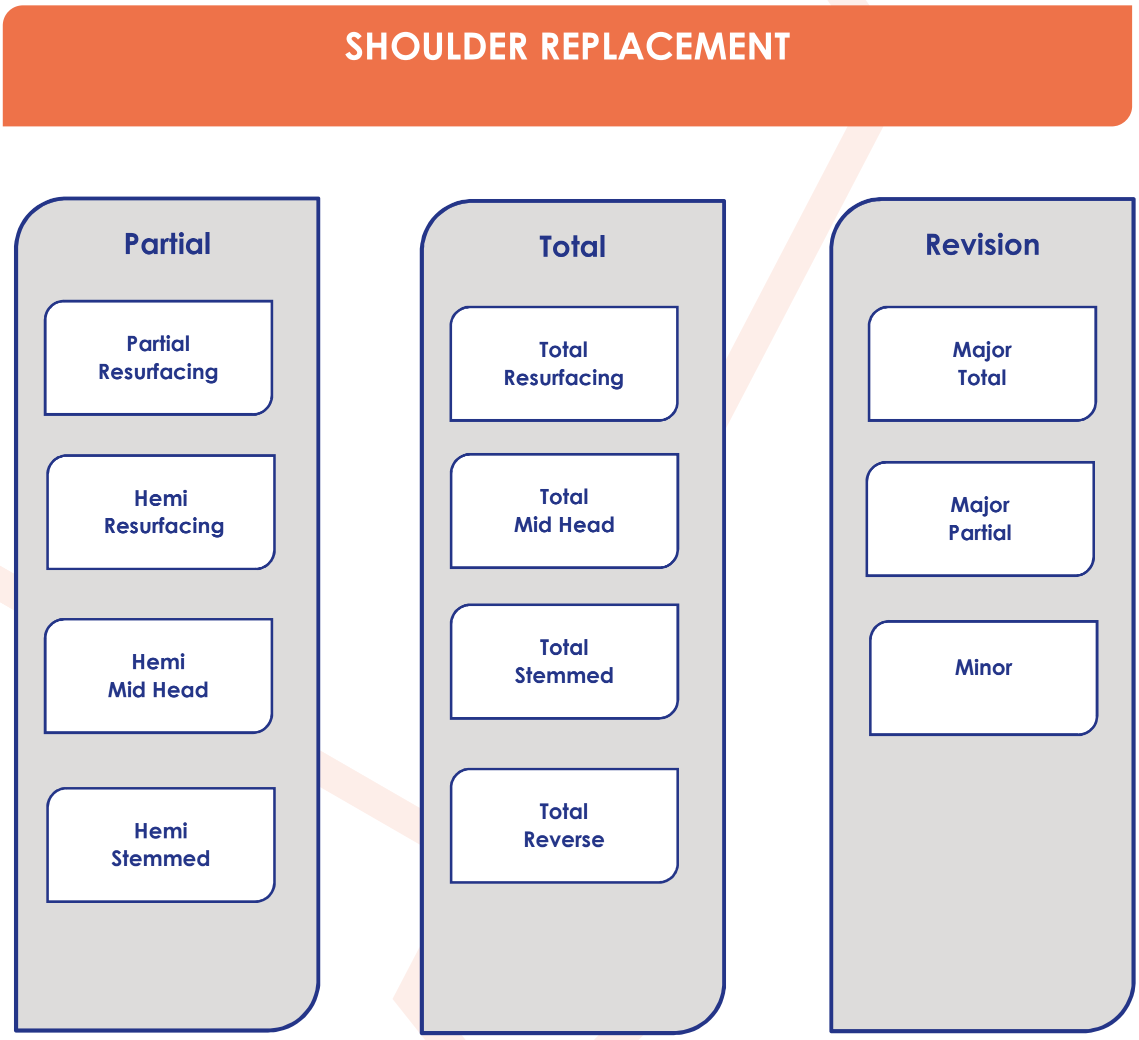
A primary replacement is an initial procedure undertaken on a joint and involves replacing either part (partial) or all (total) of the articular surface.

Primary partial and primary total shoulder replacements are further subcategorised into classes depending on the type of prosthesis used. Partial shoulder classes include: partial resurfacing, hemi resurfacing, hemi mid head and hemi stemmed replacement.
Total shoulder classes include: total resurfacing, total mid head, total stemmed and total reverse shoulder replacement. Definitions for each of these 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. Revision procedures include re-operations of primary partial, primary total, or previous revision procedures.

Shoulder revision procedures are subcategorised into three classes: 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-2020



USE OF SHOULDER REPLACEMENT

This report is an analysis of 59,787 shoulder replacement procedures reported to the Registry with a procedure date up to and including 31 December 2019. This is an additional 7,735 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 2019 increased by 353 (4.9%) compared to the previous year and by 186.6% since 2008.

The proportion of total shoulder replacements has increased from 57.6% in 2008 to 88.0% in 2019.

When considering all shoulder replacement procedures currently recorded by the Registry, primary total shoulder replacement is the most common category (78.5%), followed by primary partial (11.8%) and revision procedures (9.7%) (Table S1).

Table S1 Number of Shoulder Replacements

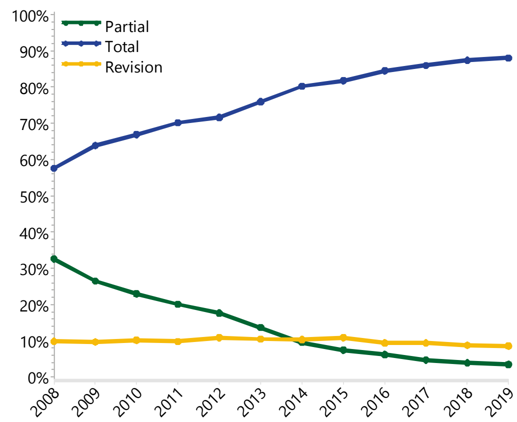
Shoulder Category	Number	Percent
Partial	7062	11.8
Total	46919	78.5
Revision	5806	9.7
TOTAL	**59787**	**100.0**

Since 2008, partial shoulder replacement has decreased from 32.6% to 3.5% in 2019. In 2008, the proportion of revision procedures was 9.8%. This peaked at 10.9% in 2012.

In 2019, the proportion of revision procedures has declined to 8.5%.

This equates to 177 less revision procedures in 2019 than would have been expected if the proportion of revision procedures had remained at the peak of 10.9% (Figure S1).

Figure S1 Proportion of Shoulder Replacement



ASA SCORE AND BMI

Data are reported on shoulder replacement procedures for both the American Society of Anaesthesiologists - Physical Status Classification (ASA score) and Body Mass Index (BMI). The Registry commenced collecting ASA score in 2012 and BMI data in 2015.

There are ASA score data on 38,441 procedures and BMI data on 28,155 shoulder replacement procedures. Since its initial collection, ASA score has been recorded in 92.9% of procedures. BMI data have been recorded in 87.0% of procedures since collection commenced.

In 2019, ASA score is reported in 99.2% of shoulder replacement procedures and BMI is reported in 94.9% of procedures.

In 2019, the percentage of procedures with ASA score reported for primary partial shoulder is 98.9%, primary total shoulder 99.2% and revision shoulder replacement 99.2%. BMI data are reported for 96.2% of primary partial shoulder, 95.1% of primary total shoulder and 92.1% of revision shoulder replacements.

ASA score and BMI are both known to impact the outcome of shoulder replacement surgery.

ASA SCORE

There are five ASA score classifications:

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

Further information on ASA score is available from
https://www.asahq.org/resources/clinical-information/asa-physical-status-classification-system

Overall, in 92.6% of procedures, patients have an ASA score of 2 or 3, 4.6% have a score of 1 and 2.9% have a score of 4. In 4 procedures, patients have an ASA score of 5.

There is a difference depending on the class of shoulder replacement. Revision shoulder replacement procedures have a higher proportion of patients with an ASA score of 3 (54.4%) compared to primary partial shoulder replacement (42.0%), or total shoulder replacement (47.6%) (Table S2).

BMI

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

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

Further information on BMI classification is available from
http://www.euro.who.int/en/health-topics/disease-prevention/nutrition/a-healthy-lifestyle/body-mass-index-bmi

For all shoulder replacements, the majority of procedures are undertaken in patients who are pre-obese or obese class 1 (61.5%). There is a slightly higher proportion of primary total shoulder replacement procedures where the patients are pre-obese or obese class 1 (61.9%), compared to partial shoulder replacement (59.4%), and revision shoulder replacement (59.6%) (Table S3).

Table S2 ASA Score for Shoulder Replacement

ASA Score	Partial		Total		Revision		TOTAL	
	N	Col%	N	Col%	N	Col%	N	Col%
ASA 1	250	11.0	1376	4.2	131	3.6	1757	4.6
ASA 2	989	43.5	14803	45.5	1378	38.0	17170	44.7
ASA 3	954	42.0	15484	47.6	1975	54.4	18413	47.9
ASA 4	79	3.5	873	2.7	145	4.0	1097	2.9
ASA 5			4	0.0			4	0.0
TOTAL	**2272**	**100.0**	**32540**	**100.0**	**3629**	**100.0**	**38441**	**100.0**

Note: A further 21,346 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	17	1.3	194	0.8	30	1.2	241	0.9
Normal	242	19.1	4066	16.7	466	18.3	4774	17.0
Pre Obese	436	34.5	8330	34.2	825	32.3	9591	34.1
Obese Class 1	315	24.9	6727	27.6	696	27.3	7738	27.5
Obese Class 2	161	12.7	3203	13.2	338	13.2	3702	13.1
Obese Class 3	94	7.4	1817	7.5	198	7.8	2109	7.5
TOTAL	**1265**	**100.0**	**24337**	**100.0**	**2553**	**100.0**	**28155**	**100.0**

Note: BMI has not been presented for patients aged ≤19 years
A further 31,632 procedures did not have BMI recorded

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.

There are CT scan usage data on 18,911 procedures and glenoid morphology data on 14,605 procedures. Since its initial collection, the use of CT scans have been recorded in 88.4% of procedures. Glenoid morphology data have been recorded in 68.7% of procedures since collection commenced. Glenoid morphology has been collected for procedures when a CT scan was undertaken and when it was not.

CT SCANS

There is a difference depending on the class of shoulder replacement. Total shoulder replacement procedures have a higher proportion of CT scans (67.6%) compared to revision shoulder replacement (34.3%) and partial shoulder replacement (37.3%) (Table S4).

Overall, a CT scan was undertaken in 63.5% of shoulder replacements.

GLENOID MORPHOLOGY

There are 5 glenoid morphology categories based on the Walch classification[2]:

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

For all shoulder replacement types, the majority of procedures are undertaken for a glenoid morphology of A1 (45.1%). There is a slightly lower proportion of revision shoulder replacements that had a glenoid morphology of A1 (37.1%), compared to partial shoulder replacement (42.6%) and primary total shoulder replacement (45.5%) (Table S5).

Table S4 Usage of CT Scan for Shoulder Replacement

	Partial		Total		Revision		TOTAL	
CT Scan Usage	N	Col%	N	Col%	N	Col%	N	Col%
Yes	274	37.3	11156	67.6	577	34.3	12007	63.5
No	432	58.8	5048	30.6	996	59.3	6476	34.2
Unknown	29	3.9	292	1.8	107	6.4	428	2.3
TOTAL	**735**	**100.0**	**16496**	**100.0**	**1680**	**100.0**	**18911**	**100.0**

Note: A further 40,876 procedures did not have CT scan usage recorded

Table S5 Glenoid Morphology for Shoulder Replacement

	Partial		Total		Revision		TOTAL	
Glenoid Morphology	N	Col%	N	Col%	N	Col%	N	Col%
A1	189	42.6	6186	45.5	205	37.1	6580	45.1
A2	74	16.7	3072	22.6	173	31.3	3319	22.7
B1	44	9.9	2026	14.9	64	11.6	2134	14.6
B2	91	20.5	1771	13.0	58	10.5	1920	13.1
C	46	10.4	554	4.1	52	9.4	652	4.5
TOTAL	**444**	**100.0**	**13609**	**100.0**	**552**	**100.0**	**14605**	**100.0**

Note: 45 procedures have been excluded where a glenoid morphology of B3 was recorded
A further 45,137 procedures did not have glenoid morphology recorded

[2] 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

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 metaphyseal or diaphyseal fixation.

USE OF PARTIAL SHOULDER REPLACEMENT

There have been 7,062 primary partial shoulder replacements reported to the Registry up to 31 December 2019. This is an additional 272 procedures compared to the number reported last year.

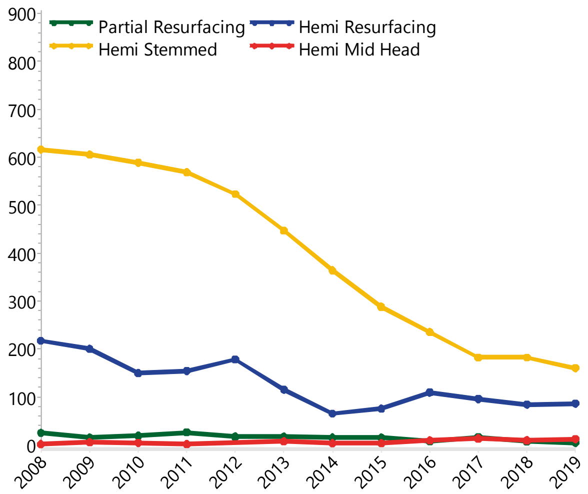
The most common class of primary partial shoulder replacement is hemi stemmed. This accounts for 72.6% of all partial shoulder replacements, followed by hemi resurfacing (23.7%), partial resurfacing (2.7%) and hemi mid head (0.9%) (Table SP1).

Table SP1 Primary Partial Shoulder Replacement by Class

Shoulder Class	Number	Percent
Partial Resurfacing	191	2.7
Hemi Resurfacing	1675	23.7
Hemi Stemmed	5129	72.6
Hemi Mid Head	67	0.9
TOTAL	**7062**	**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 86 in 2019. The number of hemi stemmed procedures decreased from 616 in 2008 to 160 in 2019 (Figure SP1).

Figure SP1 Primary Partial Shoulder Replacement by Class



There is gender variation depending on the class of primary partial shoulder replacement. The proportions of primary partial shoulder replacement for females are: hemi stemmed (71.0%), hemi mid head (41.8%), hemi resurfacing (41.7%) and partial resurfacing (23.0%) (Table SP2).

The proportion of patients aged ≥65 years also varies depending on the class of primary partial shoulder replacement: hemi stemmed (68.6%), hemi resurfacing (49.7%), hemi mid head (29.9%) and partial resurfacing (18.9%) (Table SP3).

Overall, males undergoing primary partial shoulder replacement are younger (mean age 61.1 years) compared to females (71.2 years) (Table SP4).

The most common primary diagnosis for females is fracture (53.1%). For males, the most common primary diagnosis is osteoarthritis (56.8%) (Table SP5).

The cumulative percent revision varies depending on class. Partial resurfacing and hemi mid head have only been used in small numbers (191 and 67 procedures, respectively). This makes any assessment of comparative performance difficult. However, there is a clear difference in the two more commonly used classes. Devices in these classes have a longer follow-up and the cumulative percent revision at 10 years for hemi resurfacing is greater than for hemi stemmed replacement (17.7% compared to 11.8%, respectively) (Table SP6 and Figure SP2).

Table SP2 Primary Partial Shoulder Replacement by Class and Gender

Shoulder Class	Male		Female		TOTAL	
	N	%	N	%	N	%
Partial Resurfacing	147	77.0	44	23.0	191	100.0
Hemi Resurfacing	977	58.3	698	41.7	1675	100.0
Hemi Stemmed	1488	29.0	3641	71.0	5129	100.0
Hemi Mid Head	39	58.2	28	41.8	67	100.0
TOTAL	**2651**	**37.5**	**4411**	**62.5**	**7062**	**100.0**

Table SP3 Primary Partial Shoulder Replacement by Class and Age

Shoulder Class	<55		55-64		65-74		≥75		TOTAL	
	N	%	N	%	N	%	N	%	N	%
Partial Resurfacing	141	73.8	14	7.3	20	10.5	16	8.4	191	100.0
Hemi Resurfacing	385	23.0	457	27.3	503	30.0	330	19.7	1675	100.0
Hemi Stemmed	574	11.2	1033	20.1	1494	29.1	2028	39.5	5129	100.0
Hemi Mid Head	29	43.3	18	26.9	15	22.4	5	7.5	67	100.0
TOTAL	**1129**	**16.0**	**1522**	**21.6**	**2032**	**28.8**	**2379**	**33.7**	**7062**	**100.0**

Table SP4 Age and Gender of Primary Partial Shoulder Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	2651	37.5%	14	94	62	61.1	14.5
Female	4411	62.5%	13	101	72	71.2	11.7
TOTAL	**7062**	**100.0%**	**13**	**101**	**69**	**67.4**	**13.7**

Table SP5 Primary Partial Shoulder Replacement by Primary Diagnosis and Gender

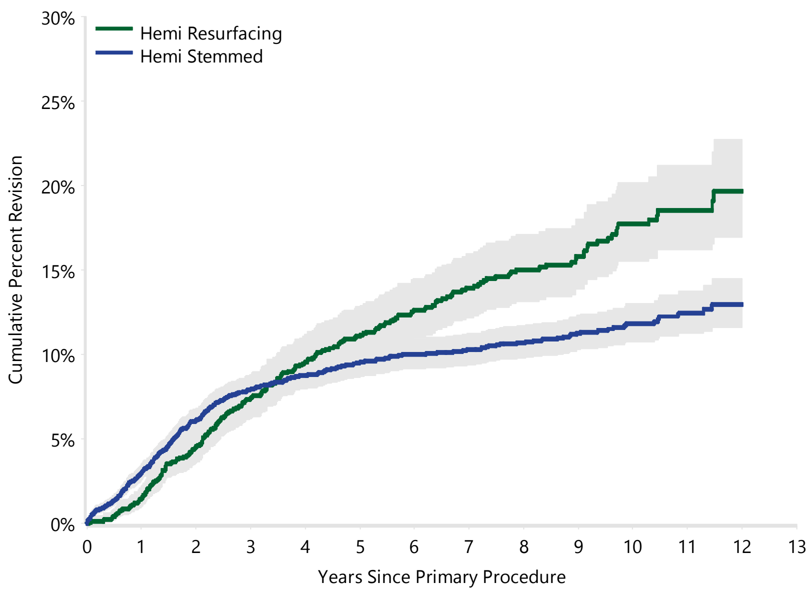
Primary Diagnosis	Male		Female		TOTAL	
	N	Col%	N	Col%	N	Col%
Fracture	682	25.7	2341	53.1	3023	42.8
Osteoarthritis	1505	56.8	1476	33.5	2981	42.2
Rotator Cuff Arthropathy	121	4.6	203	4.6	324	4.6
Osteonecrosis	100	3.8	135	3.1	235	3.3
Instability	120	4.5	65	1.5	185	2.6
Tumour	89	3.4	69	1.6	158	2.2
Rheumatoid Arthritis	21	0.8	105	2.4	126	1.8
Other Inflammatory Arthritis	11	0.4	16	0.4	27	0.4
Osteochondritis Dissecans	2	0.1	.	.	2	0.0
Other	.	.	1	0.0	1	0.0
TOTAL	**2651**	**100.0**	**4411**	**100.0**	**7062**	**100.0**

Note: Instability includes instability, dislocation and Hills-Sachs Defect

Table SP6 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	13 Yrs
Partial Resurfacing	10	191	0.5 (0.1, 3.7)	1.6 (0.5, 5.0)	3.0 (1.3, 7.1)	5.4 (2.7, 10.6)	6.6 (3.4, 12.6)	
Hemi Resurfacing	217	1675	1.5 (1.0, 2.2)	7.4 (6.2, 8.8)	11.1 (9.5, 12.8)	13.9 (12.2, 15.9)	17.7 (15.5, 20.2)	
Hemi Stemmed	477	5129	3.0 (2.6, 3.5)	7.9 (7.2, 8.8)	9.5 (8.7, 10.4)	10.3 (9.4, 11.2)	11.8 (10.8, 13.0)	
Hemi Mid Head	7	67	1.8 (0.2, 11.8)	14.0 (6.3, 29.4)	19.4 (9.0, 39.0)			
TOTAL	**711**	**7062**						

Figure SP2 Cumulative Percent Revision of Primary Partial Shoulder Replacement by Class (All Diagnoses)



HR - adjusted for age and gender

Hemi Stemmed vs Hemi Resurfacing

0 - 9Mth: HR=2.98 (1.70, 5.20),p<0.001

9Mth - 1.5Yr: HR=1.01 (0.71, 1.44),p=0.959

1.5Yr - 2Yr: HR=1.64 (0.93, 2.87),p=0.087

2Yr+: HR=0.50 (0.40, 0.62),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Hemi Resurfacing	1675	1558	1271	1004	786	364	14
Hemi Stemmed	5129	4624	3717	2923	2046	772	18

PRIMARY PARTIAL RESURFACING SHOULDER REPLACEMENT

DEMOGRAPHICS AND OUTCOMES

There have been 191 primary partial resurfacing shoulder replacement procedures reported to the Registry. This is an additional 5 procedures compared to the previous report.

This procedure is undertaken more commonly in males (77.0%). The mean age for males is 38.7 years compared to 55.6 years for females (Table SP7).

The most common primary diagnosis for males is instability (55.8%), whereas the most common primary diagnosis for females is osteoarthritis (47.7%) (Table SP8).

The cumulative percent revision at 10 years is 6.6% (Table SP6). Of the 10 revisions, 6 are for glenoid erosion, 2 are for instability/dislocation, 1 is for rotator cuff insufficiency and 1 is for loosening. All were revised to a total shoulder replacement (6 of which were total stemmed).

Table SP7 Age and Gender of Primary Partial Resurfacing Shoulder Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	147	77.0%	14	87	35	38.7	17.6
Female	44	23.0%	16	88	56	55.6	19.9
TOTAL	**191**	**100.0%**	**14**	**88**	**40**	**42.6**	**19.4**

Table SP8 Primary Partial Resurfacing Shoulder Replacement by Primary Diagnosis and Gender

Primary Diagnosis	Male		Female		TOTAL	
	N	Col%	N	Col%	N	Col%
Instability	82	55.8	17	38.6	99	51.8
Osteoarthritis	49	33.3	21	47.7	70	36.6
Fracture	10	6.8	2	4.5	12	6.3
Osteonecrosis	2	1.4	3	6.8	5	2.6
Osteochondritis Dissecans	2	1.4	.	.	2	1.0
Rotator Cuff Arthropathy	2	1.4	.	.	2	1.0
Rheumatoid Arthritis	.	.	1	2.3	1	0.5
TOTAL	**147**	**100.0**	**44**	**100.0**	**191**	**100.0**

Note: Instability includes instability, dislocation and Hill-Sachs Defect

PRIMARY HEMI RESURFACING SHOULDER REPLACEMENT

DEMOGRAPHICS

There have been 1,675 primary hemi resurfacing shoulder replacements reported to the Registry. This is an additional 87 procedures compared to the previous report. The use of primary hemi resurfacing has declined by 55.8% since 2008.

This procedure is more common in males (58.3%). The mean age is 60.3 years for males and 68.0 years for females (Table SP9).

Osteoarthritis is the most common primary diagnosis (88.4%). The range of diagnoses is similar for males and females (Table SP10).

The most used prostheses in 2019 are the PyroTITAN, Copeland, Global CAP and SMR (Table SP11).

Table SP9 Age and Gender of Primary Hemi Resurfacing Shoulder Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	977	58.3%	19	90	61	60.3	12.1
Female	698	41.7%	27	100	69	68.0	11.4
TOTAL	**1675**	**100.0%**	**19**	**100**	**64**	**63.5**	**12.4**

Table SP10 Primary Hemi Resurfacing Shoulder Replacement by Primary Diagnosis and Gender

	Male		Female		TOTAL	
Primary Diagnosis	N	Col%	N	Col%	N	Col%
Osteoarthritis	872	89.3	609	87.2	1481	88.4
Rotator Cuff Arthropathy	49	5.0	35	5.0	84	5.0
Osteonecrosis	19	1.9	18	2.6	37	2.2
Rheumatoid Arthritis	9	0.9	19	2.7	28	1.7
Instability	15	1.5	6	0.9	21	1.3
Fracture	10	1.0	4	0.6	14	0.8
Other Inflammatory Arthritis	3	0.3	7	1.0	10	0.6
TOTAL	**977**	**100.0**	**698**	**100.0**	**1675**	**100.0**

Note: Instability includes instability and dislocation

Table SP11 Most Used Humeral Head Prostheses in Primary Hemi Resurfacing Shoulder Replacement

2008		2016		2017		2018		2019	
N	Model	N	Model	N	Model	N	Model	N	Model
124	Copeland	81	PyroTITAN	75	PyroTITAN	73	PyroTITAN	77	PyroTITAN
45	Global CAP	14	Copeland	13	Copeland	7	Copeland	4	Copeland
34	SMR	10	Global CAP	7	Global CAP	4	Global CAP	4	Global CAP
11	Aequalis	4	SMR	1	Aequalis			1	SMR
2	Epoca RH								
1	Buechel-Pappas								
Most Used									
217	(6) 100.0%	109	(4) 100.0%	96	(4) 100.0%	84	(3) 100.0%	86	(4) 100.0%

OUTCOME FOR ALL DIAGNOSES

Reason for Revision

The main reasons for revision of primary hemi resurfacing shoulder replacement are glenoid erosion (25.8%), pain (22.6%), rotator cuff insufficiency (11.5%) and instability/dislocation (10.1%) (Table SP12).

Prior to 2019, there had been 10 reported breakges of the PyroTITAN prosthesis. Three of these breakages were reported secondary to loosening.

Table SP12 Primary Hemi Resurfacing Shoulder Replacement by Reason for Revision

Reason for Revision	Number	Percent
Glenoid Erosion	56	25.8
Pain	49	22.6
Rotator Cuff Insufficiency	25	11.5
Instability/Dislocation	22	10.1
Loosening	21	9.7
Lysis	9	4.1
Implant Breakage Head	9	4.1
Infection	7	3.2
Fracture	4	1.8
Malposition	3	1.4
Metal Related Pathology	3	1.4
Arthrofibrosis	2	0.9
Wear Glenoid Insert	2	0.9
Incorrect Sizing	2	0.9
Implant Breakage Humeral	2	0.9
Osteonecrosis	1	0.5
TOTAL	**217**	**100.0**

Type of Revision

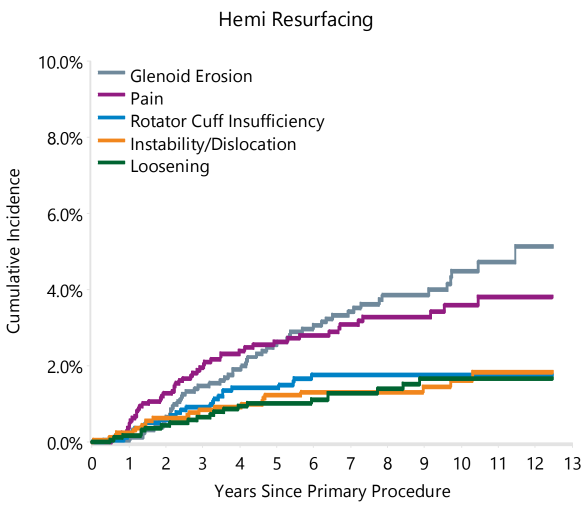
The most common type of revision is to a total shoulder replacement (88.5%) (Table SP13). Of these, 114 (59.4%) were revised to a total reverse shoulder and 78 (40.6%) to a total stemmed shoulder replacement.

Glenoid erosion or pain are the reasons for 48.4% of all hemi resurfacing shoulder revisions.

Table SP13 Primary Hemi Resurfacing Shoulder Replacement by Type of Revision

Type of Revision	Number	Percent
Humeral/Glenoid	192	88.5
Humeral Component	12	5.5
Glenoid Component	6	2.8
Cement Spacer	3	1.4
Removal of Prostheses	2	0.9
Reoperation	1	0.5
Head Only	1	0.5
TOTAL	**217**	**100.0**

Figure SP3 Cumulative Incidence Revision Diagnosis of Primary Hemi Resurfacing Shoulder Replacement



OUTCOME FOR OSTEOARTHRITIS

Age and Gender

Patients aged 65-74 years have a lower rate of revision after 2.5 years compared to patients aged <55 years, whereas patients aged ≥75 years have a lower rate of revision from 2.5-3.5 years and after 4 years (Table SP14 and Figure SP4).

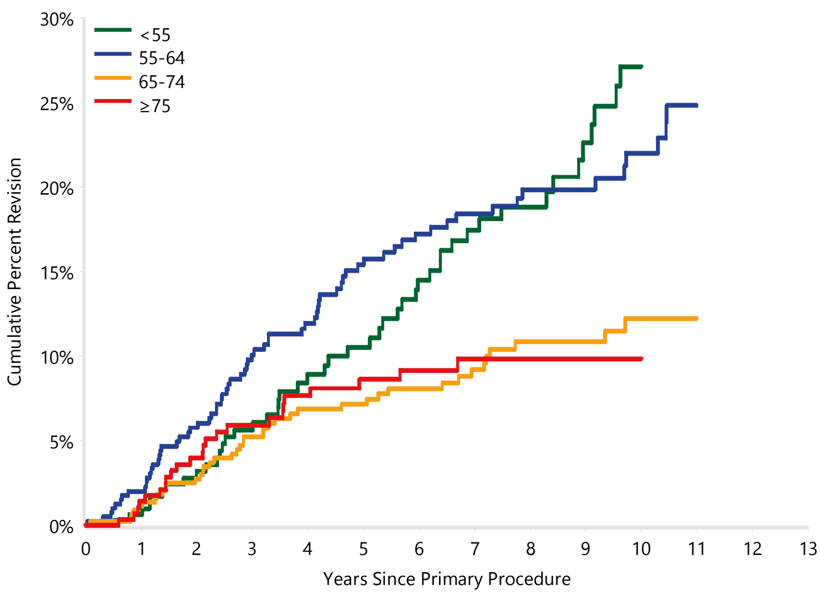
There is no difference in the rate of revision between males and females (Table SP15 and Figure SP5).

The outcomes of the most commonly used prostheses are listed in Table SP16.

Table SP14 Cumulative Percent Revision of Primary Hemi Resurfacing Shoulder Replacement by Age (Primary Diagnosis OA)

Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
<55	48	326	0.7 (0.2, 2.6)	5.6 (3.4, 9.2)	10.5 (7.2, 15.3)	17.5 (12.9, 23.5)	27.1 (20.5, 35.3)	
55-64	70	408	2.0 (1.0, 4.0)	10.1 (7.4, 13.7)	15.4 (12.0, 19.7)	18.4 (14.6, 23.1)	22.0 (17.5, 27.5)	
65-74	41	455	1.1 (0.5, 2.7)	5.2 (3.5, 7.9)	7.2 (5.0, 10.2)	9.2 (6.7, 12.6)	12.2 (9.0, 16.6)	
≥75	24	292	1.4 (0.5, 3.7)	5.9 (3.7, 9.5)	8.6 (5.7, 12.8)	9.9 (6.7, 14.5)	9.9 (6.7, 14.5)	
TOTAL	**183**	**1481**						

Figure SP4 Cumulative Percent Revision of Primary Hemi Resurfacing Shoulder Replacement by Age (Primary Diagnosis OA)



HR - adjusted for gender

55-64 vs <55

0 - 3Yr: HR=1.51 (0.87, 2.61),p=0.140

3Yr+: HR=0.69 (0.42, 1.12),p=0.134

65-74 vs <55

0 - 2.5Yr: HR=0.74 (0.38, 1.47),p=0.395

2.5Yr+: HR=0.36 (0.21, 0.60),p<0.001

≥75 vs <55

0 - 1.5Yr: HR=0.87 (0.36, 2.09),p=0.753

1.5Yr - 2.5Yr: HR=1.19 (0.46, 3.07),p=0.725

2.5Yr - 3.5Yr: HR=0.19 (0.04, 0.83),p=0.027

3.5Yr - 4Yr: HR=1.08 (0.26, 4.45),p=0.919

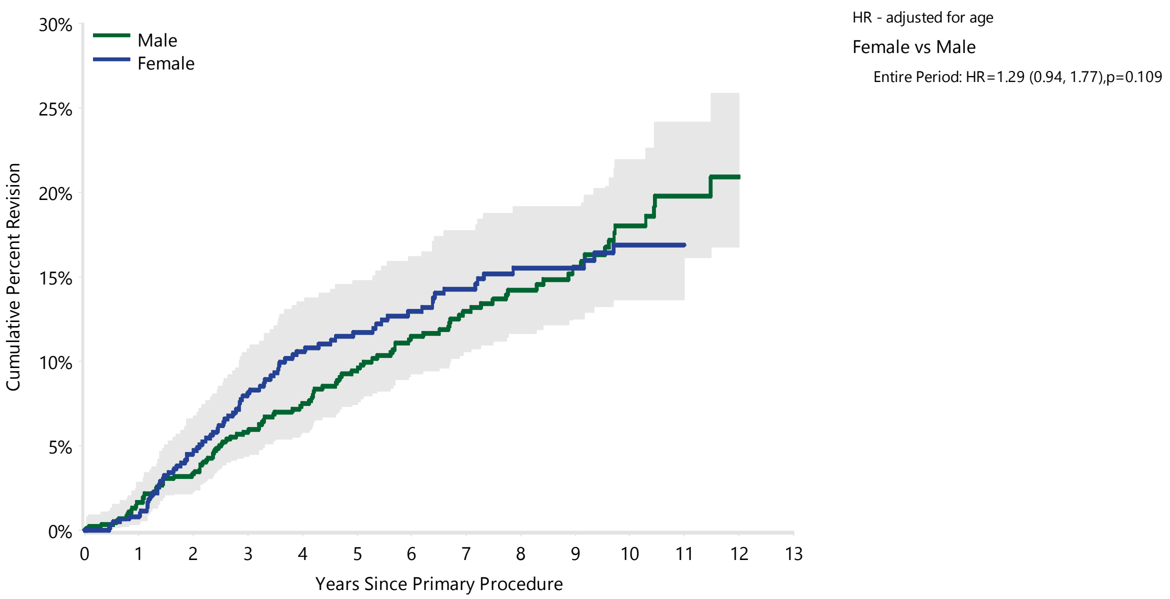
4Yr+: HR=0.14 (0.05, 0.41),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
<55	326	289	218	161	127	50	3
55-64	408	374	304	238	197	97	5
65-74	455	433	366	300	235	108	3
≥75	292	278	227	175	123	62	0

Table SP15 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	13 Yrs
Male	104	872	1.7 (1.0, 2.8)	5.8 (4.4, 7.7)	9.4 (7.5, 11.9)	13.0 (10.6, 15.8)	18.0 (14.8, 21.9)	
Female	79	609	0.8 (0.3, 2.0)	8.1 (6.1, 10.7)	11.7 (9.2, 14.8)	14.3 (11.5, 17.7)	16.9 (13.6, 20.8)	
TOTAL	**183**	**1481**						

Figure SP5 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	13 Yrs
Male	872	792	647	500	387	168	6
Female	609	582	468	374	295	149	5

Table SP16 Cumulative Percent Revision of Primary Hemi Resurfacing Shoulder Replacement by Humeral Head (Primary Diagnosis OA)

Humeral Head	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Aequalis	16	79	1.3 (0.2, 8.8)	9.0 (4.4, 18.0)	14.6 (8.3, 24.8)	18.5 (11.0, 30.0)	25.9 (16.3, 39.8)	
Copeland	70	553	1.6 (0.9, 3.1)	6.2 (4.4, 8.6)	9.4 (7.2, 12.3)	12.3 (9.7, 15.5)	14.6 (11.6, 18.3)	
Global CAP	39	222	0.5 (0.1, 3.2)	9.4 (6.2, 14.2)	12.4 (8.6, 17.8)	15.5 (11.1, 21.4)	21.5 (15.9, 28.7)	
PyroTITAN	22	458	1.7 (0.8, 3.4)	4.3 (2.7, 7.0)	6.3 (3.9, 10.1)	7.7 (4.8, 12.2)		
SMR	30	146	0.0 (0.0, 0.0)	7.0 (3.8, 12.6)	14.5 (9.6, 21.5)	20.1 (14.1, 28.2)		
Other (3)	6	23	4.3 (0.6, 27.1)	17.4 (6.9, 39.9)	17.4 (6.9, 39.9)	22.9 (10.1, 46.9)	22.9 (10.1, 46.9)	
TOTAL	**183**	**1481**						

Note: Only prostheses with over 50 procedures have been listed

PRIMARY HEMI MID HEAD SHOULDER REPLACEMENT

DEMOGRAPHICS AND OUTCOME

There have been 67 primary hemi mid head shoulder replacement procedures reported to the Registry. This is an additional 12 procedures compared to the previous report.

This procedure is undertaken more commonly in males (58.2%). The mean age is 51.3 years for males and 64.6 years for females (Table SP17).

Osteoarthritis is the most common primary diagnosis (59.7%) (Table SP18).

Of the 7 revisions reported, 2 are for glenoid erosion, 2 for rotator cuff insufficiency, and 1 each for fracture, pain and loosening (Table SP19). The most common type of revision is to a total shoulder replacement (Table SP20).

The most common humeral head and stem prosthesis combinations are the Affinis (n=39), the Eclipse (n=10) and the Affiniti (n=7).

Outcomes for the most used prosthesis combinations are presented in Table SP21.

Table SP17 Age and Gender of Primary Hemi Mid Head Shoulder Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	39	58.2%	24	83	50	51.3	12.2
Female	28	41.8%	30	85	66	64.6	10.8
TOTAL	**67**	**100.0%**	**24**	**85**	**56**	**56.9**	**13.3**

Table SP18 Primary Hemi Mid Head Shoulder Replacement by Primary Diagnosis and Gender

Primary Diagnosis	Male		Female		TOTAL	
	N	Col%	N	Col%	N	Col%
Osteoarthritis	23	59.0	17	60.7	40	59.7
Osteonecrosis	13	33.3	6	21.4	19	28.4
Fracture	1	2.6	3	10.7	4	6.0
Rotator Cuff Arthropathy	2	5.1	.	.	2	3.0
Rheumatoid Arthritis	.	.	1	3.6	1	1.5
Instability	.	.	1	3.6	1	1.5
TOTAL	**39**	**100.0**	**28**	**100.0**	**67**	**100.0**

Table SP19 Primary Hemi Mid Head Shoulder Replacement by Reason for Revision

Reason for Revision	Number	Percent
Glenoid Erosion	2	28.6
Rotator Cuff Insufficiency	2	28.6
Fracture	1	14.3
Pain	1	14.3
Loosening	1	14.3
TOTAL	**7**	**100.0**

Note: Fracture includes proximal humerus fracture

Table SP20 Primary Hemi Mid Head Shoulder Replacement by Type of Revision

Type of Revision	Number	Percent
Humeral/Glenoid	4	57.1
Glenoid Component	2	28.6
Humeral Component	1	14.3
TOTAL	**7**	**100.0**

Table SP21 Cumulative Percent Revision of Primary Hemi Mid Head Shoulder Replacement by Prosthesis Combination

Humeral Head	Humeral Stem	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Affinis	Affinis	2	39	3.3 (0.5, 21.4)	6.9 (1.8, 25.0)				
Eclipse	Eclipse	1	10	0.0 (0.0, 0.0)	11.1 (1.6, 56.7)	11.1 (1.6, 56.7)	11.1 (1.6, 56.7)	11.1 (1.6, 56.7)	
Other (6)		4	18	0.0 (0.0, 0.0)	23.1 (7.8, 57.0)	38.5 (14.9, 76.8)			
TOTAL		**7**	**67**						

Note: Only prostheses with over 10 procedures have been listed

PRIMARY HEMI STEMMED SHOULDER REPLACEMENT

DEMOGRAPHICS

There have been 5,129 primary hemi stemmed shoulder replacement procedures reported to the Registry. This is an additional 168 procedures compared to the previous report.

This procedure is more common in females (71.0%). The mean age is 72.1 years for females and 64.0 years for males (Table SP22).

The most common primary diagnosis is fracture (58.4%), followed by osteoarthritis (27.1%) (Table SP23). In 2019, the number of primary hemi stemmed shoulder replacements undertaken for fracture decreased by 91.5% compared to 2008. In 2019, the number of primary hemi stemmed shoulder replacements undertaken for osteoarthritis decreased by 49.4% compared to 2008 (Figure SP6).

The most common humeral head prostheses used in 2019 are the Ascend Flex, Global Unite, Mutars and SMR CTA. The 10 most used humeral head prostheses account for 95.6% of all primary hemi stemmed procedures in 2019. This has decreased from 98.2% in 2008 (Table SP24).

The most common humeral stem prostheses used in 2019 are the Ascend Flex, SMR, Mutars and Comprehensive. The 10 most used humeral stem prostheses account for 98.1% of all primary hemi stemmed procedures in 2019. This has increased from 97.2% in 2008 (Table SP25).

There has been a major decline in the use of primary hemi stemmed shoulder replacement for the management of osteoarthritis and fracture.

Table SP22 Age and Gender of Primary Hemi Stemmed Shoulder Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	1488	29.0%	14	94	65	64.0	13.5
Female	3641	71.0%	13	101	73	72.1	11.3
TOTAL	**5129**	**100.0%**	**13**	**101**	**71**	**69.7**	**12.5**

Table SP23 Primary Hemi Stemmed Shoulder Replacement by Primary Diagnosis and Gender

Primary Diagnosis	Male		Female		TOTAL	
	N	Col%	N	Col%	N	Col%
Fracture	661	44.4	2332	64.0	2993	58.4
Osteoarthritis	561	37.7	829	22.8	1390	27.1
Rotator Cuff Arthropathy	68	4.6	168	4.6	236	4.6
Osteonecrosis	66	4.4	108	3.0	174	3.4
Tumour	89	6.0	69	1.9	158	3.1
Rheumatoid Arthritis	12	0.8	84	2.3	96	1.9
Instability	23	1.5	41	1.1	64	1.2
Other Inflammatory Arthritis	8	0.5	9	0.2	17	0.3
Other	.	.	1	0.0	1	0.0
TOTAL	**1488**	**100.0**	**3641**	**100.0**	**5129**	**100.0**

Note: Instability includes instability and dislocation

Figure SP6 Primary Hemi Stemmed Shoulder Replacement by Primary Diagnosis

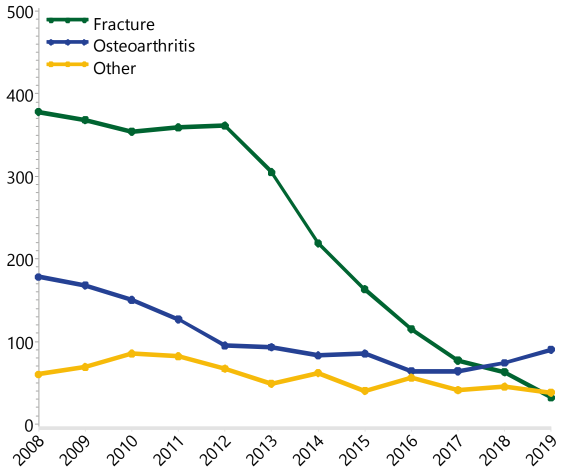


Table SP24 10 Most Used Humeral Head Prostheses in Primary Hemi Stemmed Shoulder Replacement

2008		2016		2017		2018		2019	
N	Model	N	Model	N	Model	N	Model	N	Model
197	Global Advantage	37	Global Unite	45	Ascend Flex	64	Ascend Flex	79	Ascend Flex
177	SMR	31	SMR	16	Global Unite	20	Global Unite	15	Global Unite
98	Aequalis	27	Ascend Flex	15	Comprehensive	17	Comprehensive	12	Mutars
38	Bigliani/Flatow	20	Global AP	15	SMR	16	SMR	11	SMR CTA
31	SMR CTA	18	Aequalis	13	Aequalis	10	Equinoxe	10	Comprehensive
22	Global Advantage CTA	16	Comprehensive	13	Equinoxe	9	SMR CTA	8	Aequalis
15	Bio-Modular	14	Bigliani/Flatow	12	Affinis	8	Aequalis	6	SMR
13	Solar	12	SMR CTA	9	Global AP	7	Affinis	5	Equinoxe
8	Global AP	11	Bio-Modular	9	SMR CTA	6	Delta Xtend	4	Affinis
6	Univers 3D	11	Global Advantage	7	Bigliani/Flatow	5	Bio-Modular	3	Delta Xtend
10 Most Used									
605	(10) 98.2%	197	(10) 83.8%	154	(10) 84.6%	162	(10) 89.0%	153	(10) 95.6%
Remainder									
11	(4) 1.8%	38	(9) 16.2%	28	(6) 15.4%	20	(7) 11.0%	7	(5) 4.4%
TOTAL									
616	(14) 100.0%	235	(19) 100.0%	182	(16) 100.0%	182	(17) 100.0%	160	(15) 100.0%

Table SP25 10 Most Used Humeral Stem Prostheses in Primary Hemi Stemmed Shoulder Replacement

2008		2016		2017		2018		2019	
N	Model	N	Model	N	Model	N	Model	N	Model
207	SMR	43	SMR	45	Ascend Flex	64	Ascend Flex	79	Ascend Flex
138	Global FX	37	Global Unite	24	SMR	25	SMR	17	SMR
98	Aequalis	27	Ascend Flex	20	Comprehensive	22	Comprehensive	12	Mutars
81	Global Advantage	27	Comprehensive	17	Global AP	12	Global AP	11	Comprehensive
26	Bigliani/Flatow TM	25	Global AP	14	Global Unite	12	Global Unite	11	Global Unite
13	Solar	18	Aequalis	13	Aequalis	10	Equinoxe	8	Aequalis
11	Bigliani/Flatow	12	Global Advantage	13	Equinoxe	8	Aequalis	7	Global AP
11	Bio-Modular	11	Bigliani/Flatow TM	12	Affinis	7	Affinis	5	Equinoxe
8	Global AP	9	Global FX	6	Bigliani/Flatow	6	Delta Xtend	4	Affinis
6	Univers 3D	8	Mutars	6	Global FX	5	Mutars	3	Delta Xtend
10 Most Used									
599	(10) 97.2%	217	(10) 92.3%	170	(10) 93.4%	171	(10) 94.0%	157	(10) 98.1%
Remainder									
17	(7) 2.8%	18	(7) 7.7%	12	(4) 6.6%	11	(5) 6.0%	3	(2) 1.9%
TOTAL									
616	(17) 100.0%	235	(17) 100.0%	182	(14) 100.0%	182	(15) 100.0%	160	(12) 100.0%

OUTCOME FOR ALL DIAGNOSES

Primary Diagnosis

There is no difference in the rate of revision when primary hemi stemmed shoulder replacement is performed for fracture or osteoarthritis (Table SP26 and Figure SP7).

Reason for Revision

Reasons for revision vary depending on the primary diagnosis. Rotator cuff insufficiency occurs more frequently in hemi stemmed shoulder replacement undertaken for fracture (27.9%), whereas glenoid erosion occurs more frequently in procedures undertaken for osteoarthritis (29.3%) (Table SP27 and Figure SP8).

Type of Revision

The most common type of revision is to a total shoulder replacement for both primary diagnoses (71.1% for fracture and 57.7% for osteoarthritis) (Table SP28). Most were revised to a total reverse shoulder replacement (97.6% when used for fracture and 85.9% for osteoarthritis). Glenoid component only revision occurs more commonly in procedures undertaken for osteoarthritis (26.8% compared to 4.7% for fracture).

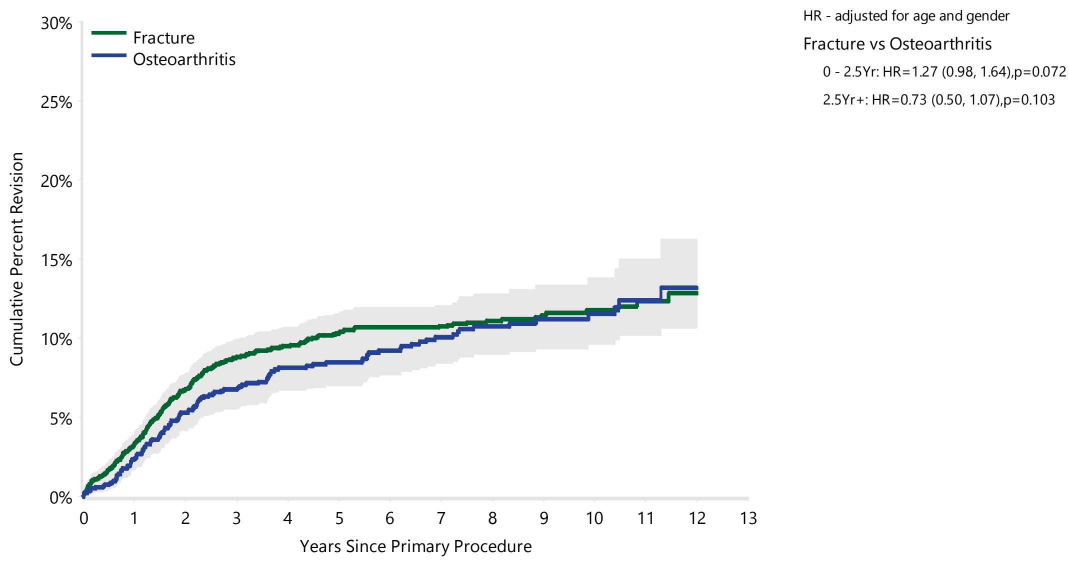
There is no difference in the rate of revision when primary hemi stemmed shoulder replacement is performed for fracture or osteoarthritis.

Table SP26 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	13 Yrs
Fracture	298	2993	3.4 (2.8, 4.1)	8.8 (7.8, 9.9)	10.4 (9.3, 11.6)	10.7 (9.6, 12.0)	11.8 (10.5, 13.2)	
Osteoarthritis	123	1390	2.4 (1.7, 3.4)	6.8 (5.5, 8.3)	8.5 (7.0, 10.2)	10.1 (8.4, 12.0)	11.5 (9.6, 13.8)	
Rotator Cuff Arthropathy	16	236	2.2 (0.9, 5.2)	5.7 (3.3, 9.9)	7.6 (4.6, 12.3)	7.6 (4.6, 12.3)		
Osteonecrosis	14	174	2.3 (0.9, 6.1)	5.6 (3.0, 10.5)	7.5 (4.2, 13.4)	8.7 (4.9, 15.1)		
Tumour	14	158	3.9 (1.6, 9.2)	12.3 (6.5, 22.7)				
Other (4)	12	178	2.9 (1.2, 6.7)	5.2 (2.8, 9.8)	5.2 (2.8, 9.8)	5.2 (2.8, 9.8)		
TOTAL	**477**	**5129**						

Note: Only primary diagnoses with over 100 procedures have been listed

Figure SP7 Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Primary Diagnosis



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Fracture	2993	2742	2245	1762	1213	441	7
Osteoarthritis	1390	1245	1004	801	578	247	5

Note: Only primary diagnoses with over 1000 procedures have been listed

Table SP27 Primary Hemi Stemmed Shoulder Replacement by Primary Diagnosis and Revision Diagnosis

Revision Diagnosis	Fracture Number	Fracture % Primaries Revised	Fracture % Revisions	Osteoarthritis Number	Osteoarthritis % Primaries Revised	Osteoarthritis % Revisions
Rotator Cuff Insufficiency	83	2.8	27.9	19	1.4	15.4
Instability/Dislocation	56	1.9	18.8	26	1.9	21.1
Glenoid Erosion	17	0.6	5.7	36	2.6	29.3
Infection	34	1.1	11.4	8	0.6	6.5
Loosening	28	0.9	9.4	9	0.6	7.3
Pain	27	0.9	9.1	14	1.0	11.4
Fracture	24	0.8	8.1	4	0.3	3.3
Arthrofibrosis	7	0.2	2.3	2	0.1	1.6
Malposition	7	0.2	2.3	1	0.1	0.8
Dissociation	3	0.1	1.0	1	0.1	0.8
Incorrect Sizing	2	0.1	0.7	1	0.1	0.8
Lysis	2	0.1	0.7			
Heterotopic Bone	1	0.0	0.3			
Osteonecrosis				1	0.1	0.8
Other	7	0.2	2.3	1	0.1	0.8
N Revision	**298**	**10.0**	**100.0**	**123**	**8.8**	**100.0**
N Primary	**2993**			**1390**		

Figure SP8 Cumulative Incidence Revision Diagnosis of Primary Hemi Stemmed Shoulder by Primary Diagnosis

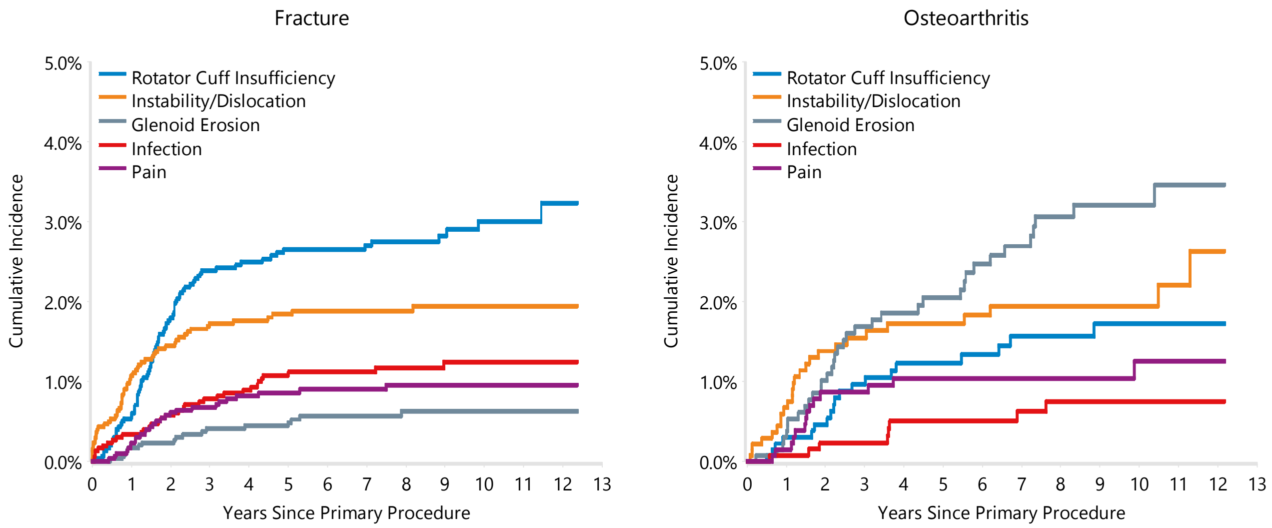


Table SP28 Primary Hemi Stemmed Shoulder Replacement by Primary Diagnosis and Type of Revision

Type of Revision	Fracture			Osteoarthritis		
	Number	% Primaries Revised	% Revisions	Number	% Primaries Revised	% Revisions
Humeral/Glenoid	212	7.1	71.1	71	5.1	57.7
Glenoid Component	14	0.5	4.7	33	2.4	26.8
Humeral Component	27	0.9	9.1	6	0.4	4.9
Cement Spacer	16	0.5	5.4	3	0.2	2.4
Head Only	16	0.5	5.4	3	0.2	2.4
Removal of Prostheses	7	0.2	2.3	1	0.1	0.8
Cement Only	4	0.1	1.3			
Reoperation	2	0.1	0.7	4	0.3	3.3
Head/Insert				1	0.1	0.8
Minor Components				1	0.1	0.8
N Revision	**298**	**10.0**	**100.0**	**123**	**8.8**	**100.0**
N Primary	**2993**			**1390**		

OUTCOME FOR FRACTURE

Age and Gender

The rate of revision is lower for patients aged ≥75 years compared to all other age groups (Table SP29 and Figure SP9).

Females have a higher rate of revision after 1.5 years compared to males (Table SP30 and Figure SP10).

Humeral Stem

There is no difference in the rate of revision for fracture humeral stems compared to non-fracture humeral stems (Table SP31 and Figure SP11).

The use of cement for stem fixation in fracture hemiarthroplasty has a lower rate of revision when a cemented non-fracture stem is used (Table SP32 and Figure SP12).

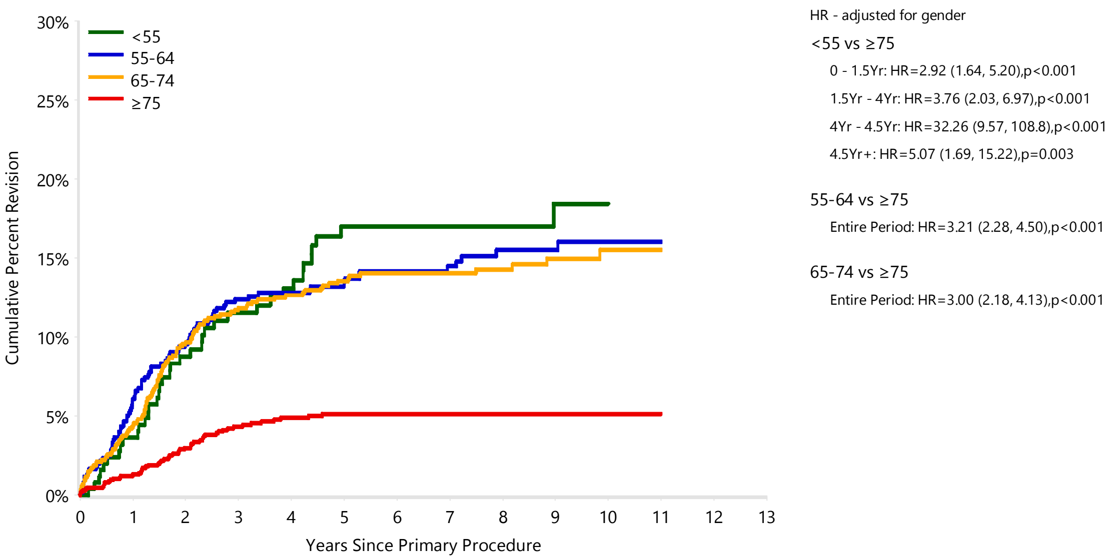
The use of cement for stem fixation in fracture hemiarthroplasty has a lower rate of revision when a cemented non-fracture stem is used.

The outcomes for the most used prosthesis combinations in the treatment of fracture are listed in Table SP33. The outcomes for individual fracture stems are presented separately in Table SP34 and for non-fracture humeral stems in Table SP35.

Table SP29 Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Age (Primary Diagnosis Fracture)

Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
<55	40	255	3.6 (1.9, 6.8)	11.5 (8.0, 16.4)	17.0 (12.5, 22.7)	17.0 (12.5, 22.7)	18.4 (13.4, 25.0)	
55-64	85	606	6.1 (4.4, 8.3)	12.4 (9.9, 15.4)	13.4 (10.9, 16.6)	14.5 (11.8, 17.7)	16.0 (13.0, 19.6)	
65-74	117	864	4.3 (3.2, 5.9)	11.8 (9.8, 14.2)	13.5 (11.4, 16.1)	14.0 (11.8, 16.6)	15.5 (12.9, 18.6)	
≥75	56	1268	1.3 (0.8, 2.1)	4.3 (3.3, 5.7)	5.1 (4.0, 6.6)	5.1 (4.0, 6.6)	5.1 (4.0, 6.6)	
TOTAL	**298**	**2993**						

Figure SP9 Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Age (Primary Diagnosis Fracture)

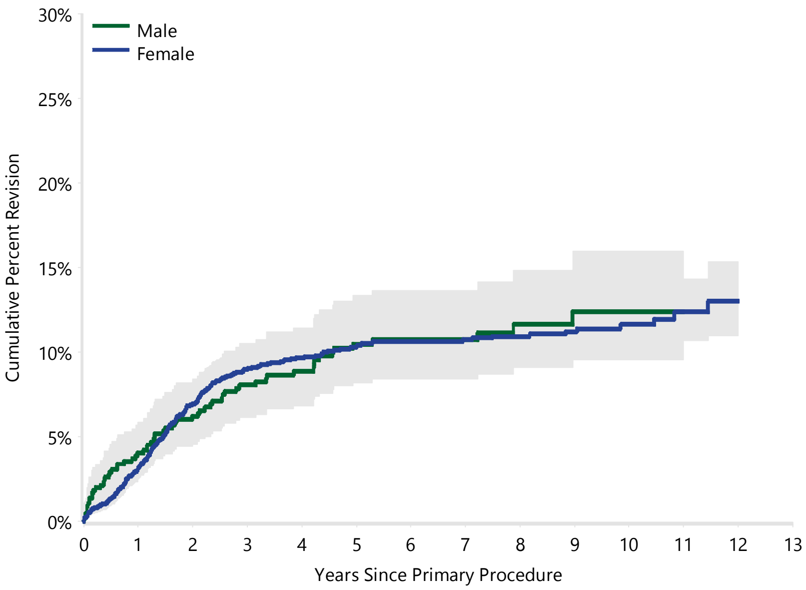


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
<55	255	232	183	134	97	41	0
55-64	606	546	454	373	271	117	0
65-74	864	802	672	551	390	149	5
≥75	1268	1162	936	704	455	134	2

Table SP30 Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Gender (Primary Diagnosis Fracture)

Gender	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Male	64	661	4.0 (2.8, 5.9)	8.1 (6.1, 10.5)	10.5 (8.2, 13.3)	10.7 (8.4, 13.6)	12.4 (9.6, 16.0)	
Female	234	2332	3.2 (2.5, 4.0)	9.0 (7.9, 10.3)	10.3 (9.1, 11.7)	10.7 (9.5, 12.2)	11.6 (10.2, 13.2)	
TOTAL	**298**	**2993**						

Figure SP10 Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Gender (Primary Diagnosis Fracture)



HR - adjusted for age

Female vs Male

0 - 1Yr: HR=1.10 (0.69, 1.74),p=0.686

1Yr - 1.5Yr: HR=1.97 (0.96, 4.07),p=0.065

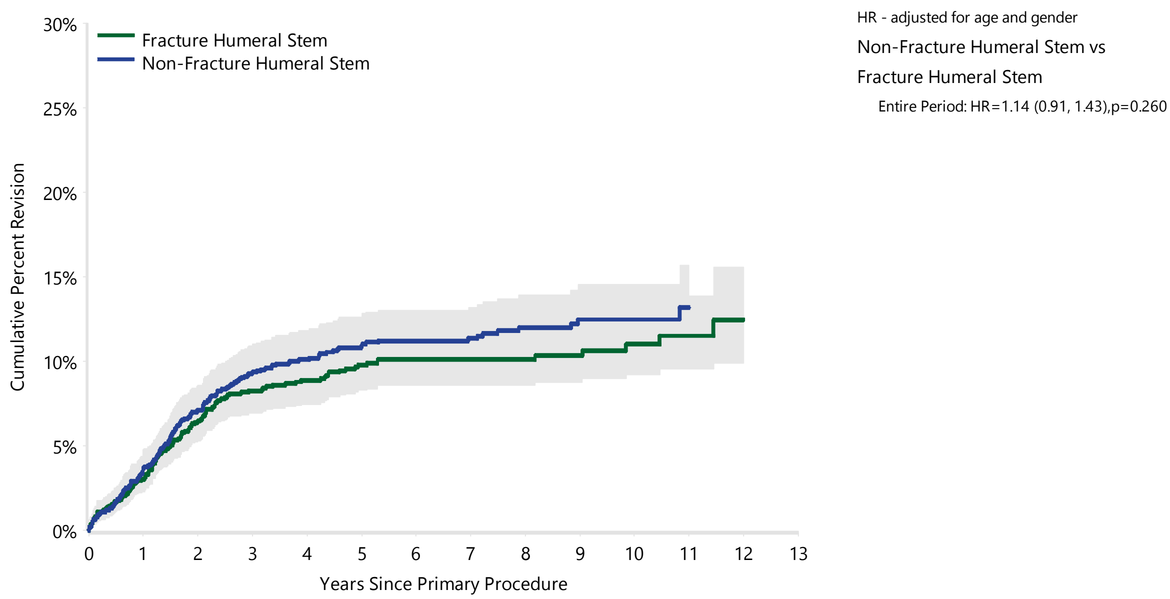
1.5Yr+: HR=1.54 (1.01, 2.34),p=0.043

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Male	661	588	477	357	237	90	1
Female	2332	2154	1768	1405	976	351	6

Table SP31 Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Stem Type (Primary Diagnosis Fracture)

Stem Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Fracture Humeral Stem	138	1480	3.0 (2.3, 4.1)	8.3 (6.9, 9.8)	9.8 (8.3, 11.5)	10.1 (8.6, 11.9)	11.0 (9.2, 13.1)	
Non-Fracture Humeral Stem	160	1513	3.7 (2.8, 4.8)	9.4 (7.9, 11.0)	10.9 (9.4, 12.7)	11.4 (9.8, 13.2)	12.5 (10.7, 14.5)	
TOTAL	**298**	**2993**						

Figure SP11 Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Stem Type (Primary Diagnosis Fracture)

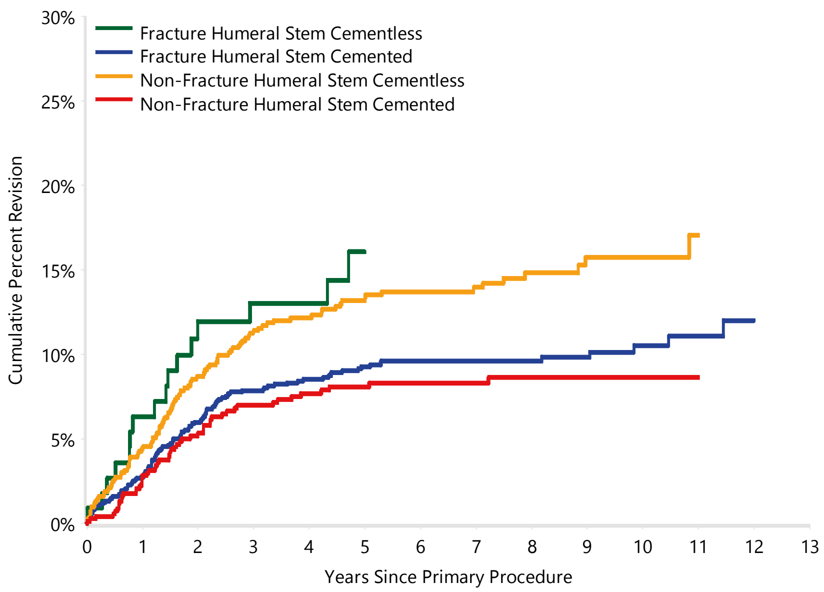


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Fracture Humeral Stem	1480	1367	1108	855	573	218	2
Non-Fracture Humeral Stem	1513	1375	1137	907	640	223	5

Table SP32 Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Stem Type and Humeral Fixation (Primary Diagnosis Fracture)

Stem Type	Humeral Fixation	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Fracture Humeral Stem	Cementless	16	111	6.3 (3.1, 12.8)	13.0 (7.9, 21.0)	16.1 (10.0, 25.2)			
	Cemented	122	1369	2.8 (2.0, 3.8)	7.9 (6.5, 9.5)	9.3 (7.8, 11.1)	9.6 (8.1, 11.4)	10.5 (8.7, 12.7)	
Non-Fracture Humeral Stem	Cementless	107	808	4.4 (3.2, 6.1)	11.4 (9.3, 13.9)	13.4 (11.1, 16.1)	14.0 (11.6, 16.7)	15.7 (13.0, 18.9)	
	Cemented	53	705	2.8 (1.8, 4.4)	7.0 (5.2, 9.2)	8.1 (6.2, 10.5)	8.3 (6.4, 10.8)	8.6 (6.6, 11.2)	
TOTAL		**298**	**2993**						

Figure SP12 Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Stem Type and Humeral Fixation (Primary Diagnosis Fracture)



HR - adjusted for age and gender

Fracture Humeral Stem Cementless vs Fracture Humeral Stem Cemented
Entire Period: HR=1.39 (0.83, 2.35),p=0.214

Fracture Humeral Stem Cementless vs Non-Fracture Humeral Stem Cementless
Entire Period: HR=0.96 (0.57, 1.63),p=0.891

Fracture Humeral Stem Cemented vs Non-Fracture Humeral Stem Cemented
Entire Period: HR=1.17 (0.84, 1.61),p=0.350

Non-Fracture Humeral Stem Cementless vs Non-Fracture Humeral Stem Cemented
Entire Period: HR=1.69 (1.21, 2.35),p=0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Fracture Humeral Stem	Cementless	111	104	80	47	21	3	0
	Cemented	1369	1263	1028	808	552	215	2
Non-Fracture Humeral Stem	Cementless	808	734	595	491	341	117	2
	Cemented	705	641	542	416	299	106	3

Table SP33 Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Humeral Head and Humeral Stem (Primary Diagnosis Fracture)

Humeral Head	Humeral Stem	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Aequalis	Aequalis	31	456	2.5 (1.4, 4.4)	6.1 (4.2, 8.8)	7.0 (4.9, 9.9)	7.0 (4.9, 9.9)	7.6 (5.3, 10.9)	
Affinis	Affinis	5	38	5.8 (1.5, 21.3)	11.9 (4.6, 28.6)	18.2 (7.4, 40.6)	18.2 (7.4, 40.6)	18.2 (7.4, 40.6)	
Bigliani/Flatow	Bigliani/Flatow TM	10	293	1.4 (0.5, 3.7)	3.6 (2.0, 6.7)	3.6 (2.0, 6.7)	3.6 (2.0, 6.7)		
Bio-Modular	Comprehensive	7	79	2.6 (0.6, 9.9)	8.1 (3.7, 17.1)	10.0 (4.8, 20.0)	10.0 (4.8, 20.0)		
Comprehensive	Comprehensive	4	57	3.6 (0.9, 13.5)	8.2 (3.1, 20.9)	8.2 (3.1, 20.9)	8.2 (3.1, 20.9)		
Global Advantage	Global Advantage	10	53	7.7 (2.9, 19.1)	15.7 (8.1, 28.9)	17.8 (9.7, 31.4)	17.8 (9.7, 31.4)	17.8 (9.7, 31.4)	
	Global FX	57	695	2.2 (1.3, 3.6)	6.3 (4.7, 8.4)	8.1 (6.2, 10.6)	8.8 (6.8, 11.3)	9.8 (7.5, 12.9)	
Global Unite	Global Unite	32	159	8.3 (4.9, 13.9)	21.0 (15.2, 28.5)	22.2 (16.2, 30.2)			
SMR	SMR	113	885	4.1 (2.9, 5.6)	10.9 (8.9, 13.2)	12.9 (10.8, 15.4)	13.6 (11.4, 16.2)	15.3 (12.7, 18.3)	
SMR CTA	SMR	4	39	2.9 (0.4, 18.6)	10.4 (3.4, 29.3)	15.1 (5.8, 36.1)	15.1 (5.8, 36.1)		
Solar	Solar	5	40	7.9 (2.6, 22.5)	10.5 (4.1, 25.7)	13.7 (5.9, 30.0)	13.7 (5.9, 30.0)	13.7 (5.9, 30.0)	
Other (23)		20	199	3.1 (1.4, 6.9)	10.3 (6.6, 15.9)	11.1 (7.2, 16.9)	11.1 (7.2, 16.9)		
TOTAL		**298**	**2993**						

Note: Only combinations with over 30 procedures have been listed

Table SP34 Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Humeral Head and Fracture Stem (Primary Diagnosis Fracture)

Humeral Head	Fracture Stem	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Aequalis	Aequalis	30	439	2.3 (1.3, 4.3)	6.1 (4.2, 8.9)	7.0 (4.9, 10.0)	7.0 (4.9, 10.0)	7.7 (5.3, 11.1)	
Affinis	Affinis	5	36	6.2 (1.6, 22.5)	12.6 (4.9, 30.3)	19.4 (7.9, 42.8)	19.4 (7.9, 42.8)		
Bio-Modular	Comprehensive	7	79	2.6 (0.6, 9.9)	8.1 (3.7, 17.1)	10.0 (4.8, 20.0)	10.0 (4.8, 20.0)		
Comprehensive	Comprehensive	4	45	4.4 (1.1, 16.6)	9.9 (3.8, 24.5)	9.9 (3.8, 24.5)	9.9 (3.8, 24.5)		
Global Advantage	Global FX	57	695	2.2 (1.3, 3.6)	6.3 (4.7, 8.4)	8.1 (6.2, 10.6)	8.8 (6.8, 11.3)	9.8 (7.5, 12.9)	
Global Unite	Global Unite	32	158	8.4 (5.0, 14.0)	21.1 (15.3, 28.7)	22.4 (16.3, 30.3)			
Other (4)		3	28	0.0 (0.0, 0.0)	12.3 (4.1, 33.7)	12.3 (4.1, 33.7)	12.3 (4.1, 33.7)		
TOTAL		**138**	**1480**						

Note: Only combinations with over 30 procedures have been listed

Table SP35 Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Humeral Head and Non-Fracture Stem (Primary Diagnosis Fracture)

Humeral Head	Non Fracture Humeral Stem	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Bigliani/Flatow	Bigliani/Flatow TM	10	293	1.4 (0.5, 3.7)	3.6 (2.0, 6.7)	3.6 (2.0, 6.7)	3.6 (2.0, 6.7)		
Global Advantage	Global Advantage	10	53	7.7 (2.9, 19.1)	15.7 (8.1, 28.9)	17.8 (9.7, 31.4)	17.8 (9.7, 31.4)	17.8 (9.7, 31.4)	
SMR	SMR	113	885	4.1 (2.9, 5.6)	10.9 (8.9, 13.2)	12.9 (10.8, 15.4)	13.6 (11.4, 16.2)	15.3 (12.7, 18.3)	
SMR CTA	SMR	4	39	2.9 (0.4, 18.6)	10.4 (3.4, 29.3)	15.1 (5.8, 36.1)	15.1 (5.8, 36.1)		
Solar	Solar	5	40	7.9 (2.6, 22.5)	10.5 (4.1, 25.7)	13.7 (5.9, 30.0)	13.7 (5.9, 30.0)	13.7 (5.9, 30.0)	
Other (25)		18	203	3.6 (1.8, 7.5)	9.0 (5.6, 14.3)	9.8 (6.2, 15.4)	9.8 (6.2, 15.4)		
TOTAL		**160**	**1513**						

Note: Only combinations with over 30 procedures have been listed

OUTCOME FOR OSTEOARTHRITIS

Age and Gender

The rate of revision is lower for patients aged ≥75 years compared to patients in the <55 years (after 2.5 years) and 55-64 year age groups (Table SP36 and Figure SP13).

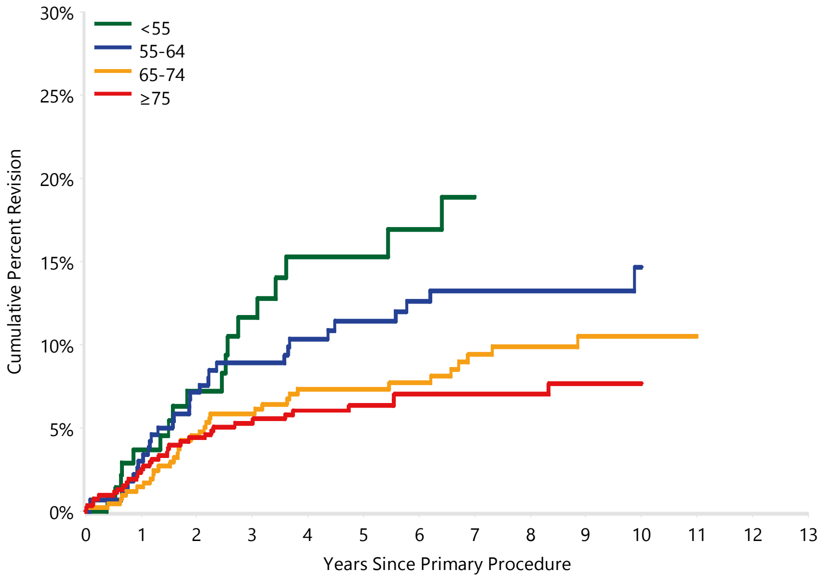
Gender is not a risk factor for revision (Table SP37 and Figure SP14).

The outcomes of the most used prosthesis combinations for osteoarthritis are listed in Table SP38.

Table SP36 Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Age (Primary Diagnosis OA)

Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
<55	23	156	3.7 (1.6, 8.7)	11.6 (6.9, 19.4)	15.3 (9.5, 24.0)	18.9 (12.0, 29.0)		
55-64	32	289	3.0 (1.5, 6.0)	8.9 (6.0, 13.2)	11.4 (7.9, 16.3)	13.2 (9.4, 18.5)	14.7 (10.2, 20.8)	
65-74	35	418	1.5 (0.7, 3.2)	5.9 (3.9, 8.7)	7.3 (5.1, 10.5)	9.4 (6.7, 13.1)	10.5 (7.5, 14.6)	
≥75	33	527	2.5 (1.5, 4.3)	5.3 (3.6, 7.7)	6.4 (4.5, 9.0)	7.0 (5.0, 9.9)	7.7 (5.4, 10.9)	
TOTAL	**123**	**1390**						

Figure SP13 Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Age (Primary Diagnosis OA)



HR - adjusted for gender
<55 vs ≥75
0 - 1.5Yr: HR=2.04 (0.86, 4.85),p=0.105
1.5Yr - 2.5Yr: HR=1.69 (0.49, 5.82),p=0.408
2.5Yr+: HR=7.78 (3.76, 16.09),p<0.001

55-64 vs ≥75
Entire Period: HR=2.00 (1.21, 3.31),p=0.006

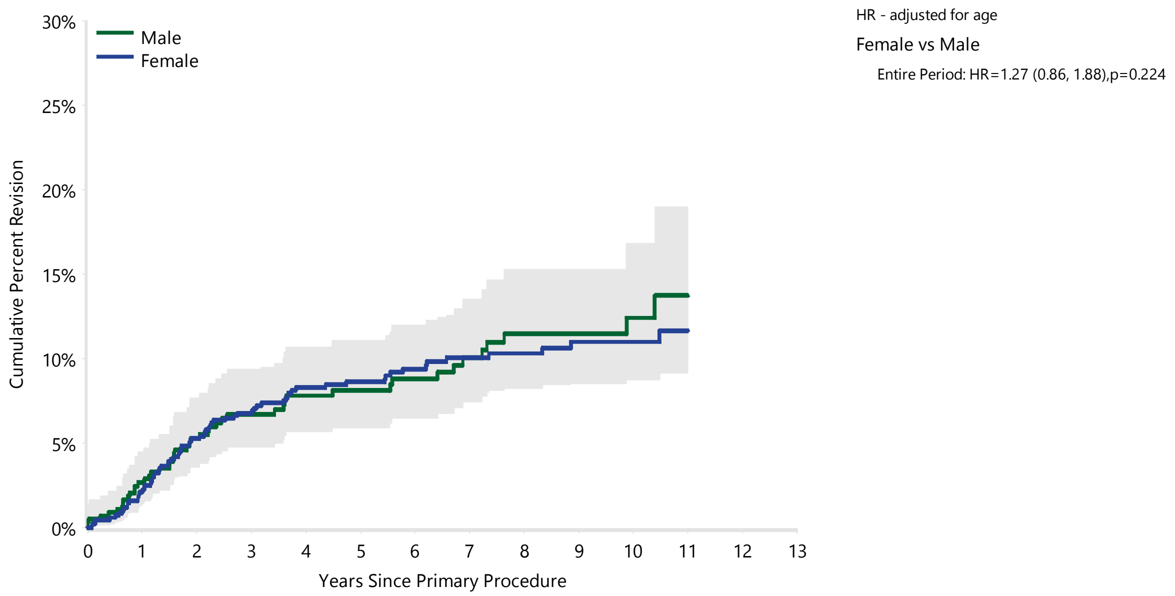
65-74 vs ≥75
Entire Period: HR=1.29 (0.80, 2.07),p=0.303

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
<55	156	119	77	59	41	21	0
55-64	289	244	196	158	119	56	2
65-74	418	398	330	270	203	101	1
≥75	527	484	401	314	215	69	2

Table SP37 Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Gender (Primary Diagnosis OA)

Gender	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Male	47	561	2.7 (1.6, 4.5)	6.7 (4.8, 9.4)	8.1 (5.9, 11.1)	10.1 (7.4, 13.5)	12.4 (9.1, 16.8)	
Female	76	829	2.2 (1.4, 3.5)	6.8 (5.2, 8.8)	8.6 (6.8, 10.9)	10.1 (8.0, 12.6)	11.0 (8.8, 13.8)	
TOTAL	**123**	**1390**						

Figure SP14 Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Gender (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Male	561	480	358	282	210	83	3
Female	829	765	646	519	368	164	2

Table SP38 Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Humeral Head and Humeral Stem (Primary Diagnosis OA)

Humeral Head	Humeral Stem	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Aequalis	Aequalis	11	138	1.5 (0.4, 5.7)	5.2 (2.5, 10.6)	6.0 (3.1, 11.7)	9.2 (5.1, 16.2)		
Ascend Flex	Ascend Flex	6	202	1.2 (0.3, 4.8)	4.7 (1.9, 11.6)				
Bigliani/Flatow	Bigliani/Flatow TM	5	53	3.8 (1.0, 14.3)	7.5 (2.9, 18.9)	7.5 (2.9, 18.9)	10.8 (4.5, 24.9)	10.8 (4.5, 24.9)	
Comprehensive	Comprehensive	2	21	0.0 (0.0, 0.0)	14.9 (3.9, 47.7)	14.9 (3.9, 47.7)			
Delta Xtend	Delta Xtend	3	31	3.2 (0.5, 20.8)	11.0 (3.7, 30.5)	11.0 (3.7, 30.5)	11.0 (3.7, 30.5)		
Global AP	Global AP	9	168	0.6 (0.1, 4.2)	3.7 (1.7, 8.0)	5.1 (2.6, 10.0)	6.2 (3.2, 11.8)		
Global AP CTA	Global AP	5	45	2.2 (0.3, 14.7)	11.5 (5.0, 25.5)	11.5 (5.0, 25.5)	11.5 (5.0, 25.5)		
Global Advantage	Global Advantage	15	144	0.7 (0.1, 4.8)	5.0 (2.4, 10.2)	7.3 (4.0, 13.1)	8.1 (4.6, 14.2)	11.3 (6.8, 18.6)	
	Global FX	4	31	3.2 (0.5, 20.8)	10.0 (3.3, 28.1)	10.0 (3.3, 28.1)	10.0 (3.3, 28.1)		
Global Advantage CTA	Global Advantage	1	39	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	4.0 (0.6, 25.2)	4.0 (0.6, 25.2)	
Global Unite	Global Unite	0	22	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)			
SMR	SMR	43	274	4.1 (2.3, 7.3)	9.4 (6.5, 13.7)	13.1 (9.6, 17.9)	15.5 (11.6, 20.7)	17.5 (13.1, 23.0)	
SMR CTA	SMR	8	96	5.4 (2.3, 12.4)	9.1 (4.6, 17.4)	9.1 (4.6, 17.4)	9.1 (4.6, 17.4)	9.1 (4.6, 17.4)	
Other (24)		11	126	4.2 (1.8, 9.7)	8.0 (4.2, 14.9)	9.2 (5.0, 16.6)	9.2 (5.0, 16.6)		
TOTAL		**123**	**1390**						

Note: Only combinations with over 20 procedures have been listed

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.

USE OF TOTAL SHOULDER REPLACEMENT

Since 2008, the number of total shoulder replacements has increased by 338.0%. In 2019, there have been 46,919 total shoulder replacements reported to the Registry which is an additional 6,789 procedures compared to the previous report.

The two main classes of primary total shoulder replacement are total reverse (64.6%) and total stemmed (30.3%). Total mid head and total resurfacing shoulder replacements are used infrequently (4.5% and 0.5%, respectively) (Table ST1). The proportion of total reverse shoulder replacements has increased from 42.2% in 2009 to 80.4% in 2019 (Figure ST1).

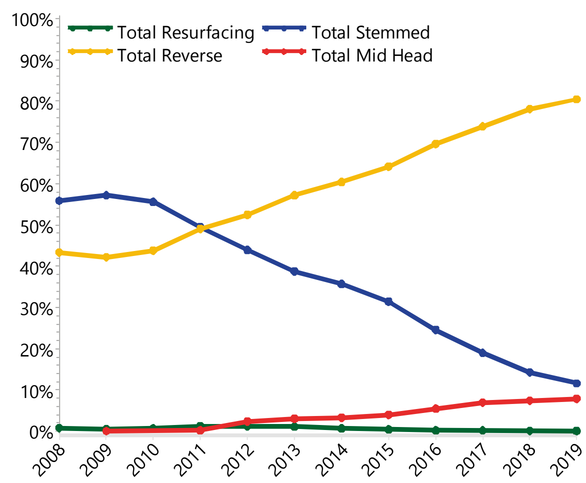
Table ST1 Primary Total Shoulder Replacement by Class

Shoulder Class	Number	Percent
Total Resurfacing	234	0.5
Total Stemmed	14231	30.3
Total Reverse	30330	64.6
Total Mid Head	2124	4.5
TOTAL	**46919**	**100.0**

There is gender variation depending on the class of primary total shoulder replacement. The proportions of primary total shoulder replacement for females are: total reverse (63.9%), total stemmed (57.5%), total mid head (53.8%) and total resurfacing (40.2%) (Table ST2).

The mean age for total shoulder replacement is 73.5 years for females and 70.2 years for males (Table ST3).

Figure ST1 Primary Total Shoulder Replacement by Class



Most patients are aged ≥65 years (82.3%). The proportion of patients in this age group varies depending on the class of shoulder replacement: total reverse (88.8%), total stemmed (71.6%), total mid head (64.5%) and total resurfacing (53.0%) (Table ST4).

The most common primary diagnoses are osteoarthritis (61.9%), rotator cuff arthropathy (23.2%) and fracture (10.1%). Rheumatoid arthritis and osteonecrosis account for 1.8% and 1.3%, respectively (Table ST5).

There are 234 total resurfacing shoulder replacements reported to the Registry, 20 of which have been revised. The cumulative percent revision at 7 years is 7.2% (Table ST6).

Total mid head shoulder replacement has been used in 2,124 procedures. There have been 58 revisions and the 7 year cumulative percent revision is 4.6% (Table ST6).

Total mid head shoulder replacement has a lower rate of revision compared to total stemmed over the entire period. It also has a lower revision rate compared to total reverse shoulder replacement in the first 3 months (Figure ST2).

At 10 years, the cumulative percent revision for total stemmed and total reverse shoulder replacement is 12.3% and 6.3%, respectively (Table ST6).

Total reverse shoulder replacement has a higher rate of revision compared to total stemmed in the first 3 months. However, after 3 months total reverse shoulder replacement has a lower rate of revision.

An additional analysis has been undertaken with the SMR L2 glenoid prosthesis excluded from both total stemmed and total reverse shoulder procedures. The SMR L2 glenoid prosthesis has been identified as having a higher than anticipated rate of revision and has subsequently been withdrawn.

After excluding the SMR L2 glenoid prosthesis from both total stemmed and total reverse shoulder procedures, the 10 year cumulative percent revision for total stemmed and total reverse shoulder replacement is 10.0% and 6.4%, respectively. Total reverse shoulder replacement continues to have a higher rate of revision in the first 3 months. After this time, total reverse shoulder replacement has a lower rate of revision (Table ST7 and Figure ST3).

Table ST2 Primary Total Shoulder Replacement by Class and Gender

Shoulder Class	Male		Female		TOTAL	
	N	Row%	N	Row%	N	Row%
Total Resurfacing	140	59.8	94	40.2	234	100.0
Total Stemmed	6042	42.5	8189	57.5	14231	100.0
Total Reverse	10941	36.1	19389	63.9	30330	100.0
Total Mid Head	981	46.2	1143	53.8	2124	100.0
TOTAL	**18104**	**38.6**	**28815**	**61.4**	**46919**	**100.0**

Table ST3 Age and Gender of Primary Total Shoulder Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	18104	38.6%	17	96	71	70.2	9.0
Female	28815	61.4%	13	102	74	73.5	8.4
TOTAL	**46919**	**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 Resurfacing	33	14.1	77	32.9	105	44.9	19	8.1	234	100.0
Total Stemmed	768	5.4	3274	23.0	6321	44.4	3868	27.2	14231	100.0
Total Reverse	451	1.5	2953	9.7	11544	38.1	15382	50.7	30330	100.0
Total Mid Head	178	8.4	575	27.1	945	44.5	426	20.1	2124	100.0
TOTAL	**1430**	**3.0**	**6879**	**14.7**	**18915**	**40.3**	**19695**	**42.0**	**46919**	**100.0**

Table ST5 Primary Total Shoulder Replacement by Primary Diagnosis and Gender

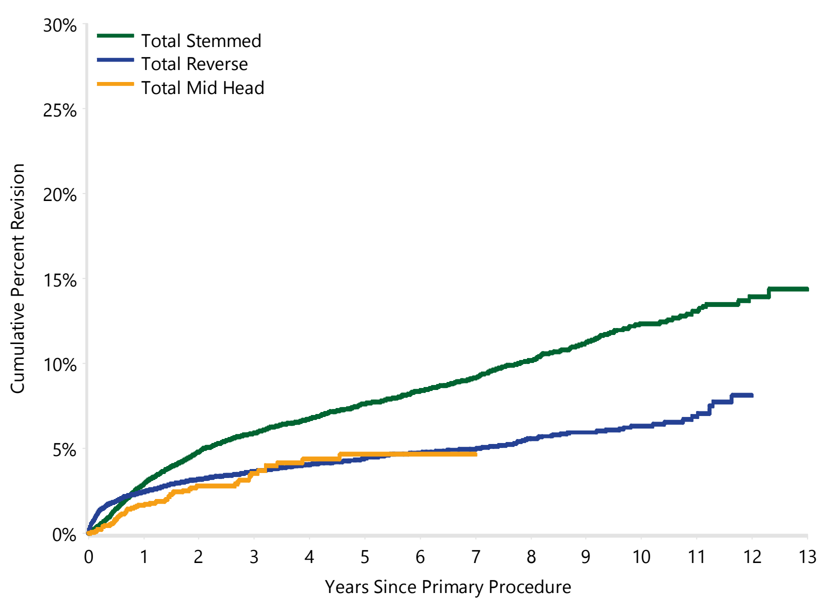
Primary Diagnosis	Male		Female		TOTAL	
	N	Col%	N	Col%	N	Col%
Osteoarthritis	11939	65.9	17090	59.3	29029	61.9
Rotator Cuff Arthropathy	4778	26.4	6126	21.3	10904	23.2
Fracture	753	4.2	3981	13.8	4734	10.1
Rheumatoid Arthritis	188	1.0	650	2.3	838	1.8
Osteonecrosis	139	0.8	493	1.7	632	1.3
Instability	140	0.8	231	0.8	371	0.8
Other Inflammatory Arthritis	66	0.4	149	0.5	215	0.5
Tumour	95	0.5	89	0.3	184	0.4
Other	6	0.0	6	0.0	12	0.0
TOTAL	**18104**	**100.0**	**28815**	**100.0**	**46919**	**100.0**

Note: Instability includes instability and dislocation

Table ST6 Cumulative Percent Revision of Primary Total Shoulder Replacement by Class (All Prostheses)

Shoulder Class	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Total Resurfacing	20	234	1.7 (0.6, 4.5)	4.4 (2.4, 8.1)	5.9 (3.5, 10.0)	7.2 (4.4, 11.8)		
Total Stemmed	1182	14231	2.9 (2.6, 3.2)	5.9 (5.5, 6.3)	7.6 (7.2, 8.1)	9.2 (8.6, 9.7)	12.3 (11.6, 13.2)	14.4 (13.0, 15.9)
Total Reverse	1111	30330	2.5 (2.3, 2.6)	3.6 (3.4, 3.9)	4.4 (4.1, 4.7)	5.0 (4.6, 5.3)	6.3 (5.8, 6.9)	
Total Mid Head	58	2124	1.7 (1.2, 2.4)	3.5 (2.7, 4.7)	4.6 (3.5, 6.2)	4.6 (3.5, 6.2)		
TOTAL	**2371**	**46919**						

Figure ST2 Cumulative Percent Revision of Primary Total Shoulder Replacement by Class (All Prostheses)



HR - adjusted for age and gender

Total Stemmed vs Total Reverse

0 - 3Mth: HR=0.36 (0.28, 0.45),p<0.001

3Mth+: HR=2.03 (1.83, 2.24),p<0.001

Total Stemmed vs Total Mid Head

Entire Period: HR=1.87 (1.43, 2.43),p<0.001

Total Mid Head vs Total Reverse

0 - 3Mth: HR=0.21 (0.10, 0.42),p<0.001

3Mth+: HR=1.07 (0.80, 1.43),p=0.643

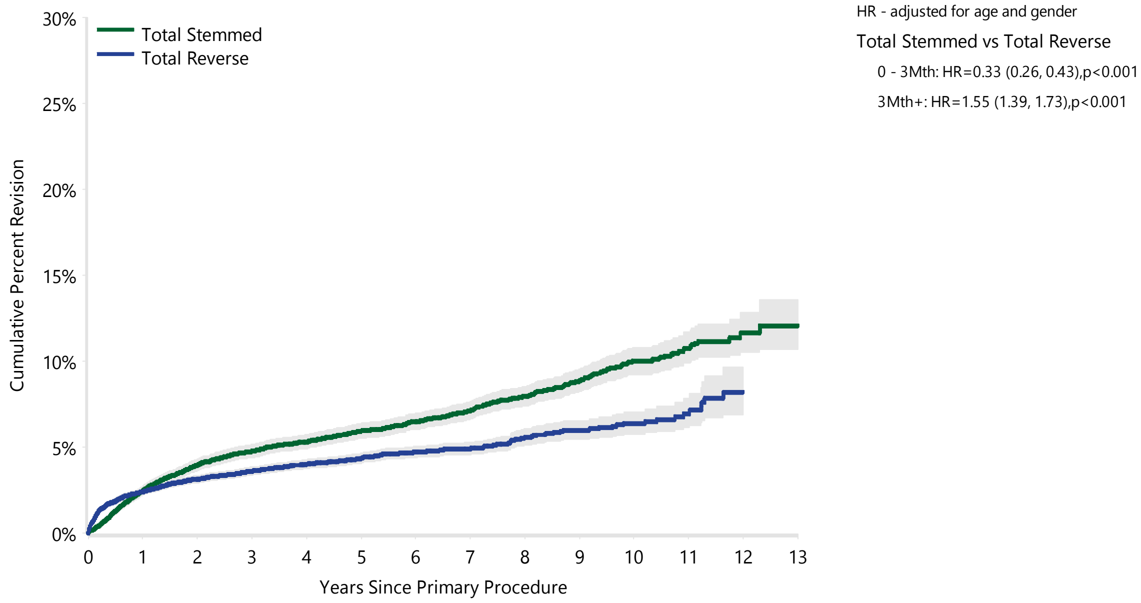
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Total Stemmed	14231	12964	10449	7652	4978	1730	51
Total Reverse	30330	23910	14135	7830	3945	1005	27
Total Mid Head	2124	1568	707	271	70	1	0

Table ST7 Cumulative Percent Revision of Primary Total Shoulder Replacement by Class (Excluding SMR L2)

Shoulder Class	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Total Stemmed	874	13373	2.5 (2.2, 2.7)	4.8 (4.4, 5.2)	6.0 (5.5, 6.4)	7.1 (6.6, 7.7)	10.0 (9.2, 10.8)	12.1 (10.7, 13.6)
Total Reverse	1042	29189	2.4 (2.2, 2.6)	3.6 (3.4, 3.8)	4.3 (4.1, 4.6)	4.9 (4.6, 5.3)	6.4 (5.8, 7.1)	
TOTAL	**1916**	**42562**						

Note: The SMR L2 prosthesis has been excluded from total reverse and total stemmed replacement procedures

Figure ST3 Cumulative Percent Revision of Primary Total Shoulder Replacement by Class (Excluding SMR L2)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Total Stemmed	13373	12195	9800	7093	4480	1712	51
Total Reverse	29189	22834	13132	6934	3159	987	27

Note: The SMR L2 prosthesis has been excluded from total reverse and total stemmed replacement procedures

PRIMARY TOTAL RESURFACING SHOULDER REPLACEMENT

DEMOGRAPHICS AND OUTCOME

There have been 234 primary total resurfacing shoulder replacements reported to the Registry. This is an additional 4 procedures compared to the previous report.

Primary total resurfacing shoulder replacement is undertaken more often in males (59.8%). The mean age is 62.2 years for males and 67.0 years for females (Table ST8).

Osteoarthritis is the most common primary diagnosis (96.2%) (Table ST9).

The Global CAP/Global Advantage combination is used in all of the 4 procedures reported in 2019 (Table ST10 and Table ST11).

The cumulative percent revision at 7 years is 7.2% (Table ST6). There have been 20 revisions in this class. The most common reason for revision is loosening (40.0%) (Table ST12). The most common type of revision is to a total shoulder replacement (45.0%), 6 of which were to a total reverse shoulder replacement (Table ST13).

Table ST8 Age and Gender of Primary Total Resurfacing Shoulder Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	140	59.8%	35	83	63	62.2	9.8
Female	94	40.2%	46	86	67	67.0	6.8
TOTAL	**234**	**100.0%**	**35**	**86**	**65**	**64.1**	**9.0**

Table ST9 Primary Total Resurfacing Shoulder Replacement by Primary Diagnosis and Gender

Primary Diagnosis	Male		Female		TOTAL	
	N	Col%	N	Col%	N	Col%
Osteoarthritis	136	97.1	89	94.7	225	96.2
Rheumatoid Arthritis	1	0.7	2	2.1	3	1.3
Fracture	1	0.7	1	1.1	2	0.9
Other Inflammatory Arthritis	.	.	1	1.1	1	0.4
Instability	1	0.7	.	.	1	0.4
Rotator Cuff Arthropathy	.	.	1	1.1	1	0.4
Osteonecrosis	1	0.7	.	.	1	0.4
TOTAL	**140**	**100.0**	**94**	**100.0**	**234**	**100.0**

Note: Instability includes instability and dislocation

Table ST10 Most Used Humeral Head Prostheses in Primary Total Resurfacing Shoulder Replacement

2008		2016		2017		2018		2019	
N	Model	N	Model	N	Model	N	Model	N	Model
5	SMR	9	Global CAP	8	Global CAP	9	Global CAP	4	Global CAP
4	Aequalis	1	Epoca RH	2	Epoca RH				
2	Copeland	1	SMR						
1	Global CAP								
Most Used									
12	(4) 100.0%	11	(3) 100.0%	10	(2) 100.0%	9	(1) 100.0%	4	(1) 100.0%

Table ST11 Most Used Glenoid Prostheses in Primary Total Resurfacing Shoulder Replacement

2008		2016		2017		2018		2019	
N	Model	N	Model	N	Model	N	Model	N	Model
4	Aequalis	9	Global	8	Global	9	Global	4	Global
3	SMR L1	1	Epoca	2	Epoca				
2	Copeland	1	SMR						
2	SMR								
1	Global								
Most Used									
12	(5) 100.0%	11	(3) 100.0%	10	(2) 100.0%	9	(1) 100.0%	4	(1) 100.0%

Table ST12 Primary Total Resurfacing Shoulder Replacement by Reason for Revision

Reason for Revision	Number	Percent
Loosening	8	40.0
Instability/Dislocation	3	15.0
Implant Breakage Glenoid Insert	3	15.0
Infection	2	10.0
Wear Glenoid Insert	1	5.0
Fracture	1	5.0
Implant Breakage Glenoid	1	5.0
Rotator Cuff Insufficiency	1	5.0
TOTAL	**20**	**100.0**

Table ST13 Primary Total Resurfacing Shoulder Replacement by Type of Revision

Type of Revision	Number	Percent
Humeral/Glenoid	9	45.0
Humeral Component	6	30.0
Insert Only	2	10.0
Cement Spacer	1	5.0
Head Only	1	5.0
Reoperation	1	5.0
TOTAL	**20**	**100.0**

Note: Humeral heads are replaced when the humeral component is revised

PRIMARY TOTAL MID HEAD SHOULDER REPLACEMENT

DEMOGRAPHICS AND OUTCOME

There have been 2,124 primary total mid head shoulder replacements reported to the Registry. This is an additional 529 procedures compared to the previous report.

The use of primary mid head shoulder replacement has increased by 638.0% since its first full year of use in 2012.

Primary total mid head shoulder replacement is undertaken more often in females (53.8%). The mean age is 69.2 years for females and 65.0 years for males (Table ST14).

Osteoarthritis is the most common primary diagnosis (95.0%) (Table ST15).

The cumulative percent revision at 7 years is 4.6% (Table ST6). There have been 58 revisions in this class. The main reasons for revision are instability/dislocation (41.4%), rotator cuff insufficiency (19.0%), loosening (15.5%), and infection (10.3%) (Table ST16).

The most common types of revision involve replacement of the humeral and glenoid components (62.1%), replacement of the humeral component (13.8%), and replacement of the head only (8.6%). Of the 36 humeral/glenoid revisions, 32 have been revised to a total reverse requiring revision of the stem, and 4 have been revised to a total stemmed shoulder replacement (Table ST17).

The Affinis is the most used total mid head shoulder prosthesis in 2019 (Table ST18 and Table ST19). The outcomes of prosthesis combinations are presented in Table ST20.

Table ST14 Age and Gender of Primary Total Mid Head Shoulder Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	981	46.2%	34	95	66	65.0	9.1
Female	1143	53.8%	37	94	70	69.2	8.2
TOTAL	**2124**	**100.0%**	**34**	**95**	**68**	**67.2**	**8.8**

Table ST15 Primary Total Mid Head Shoulder Replacement by Primary Diagnosis and Gender

Primary Diagnosis	Male		Female		TOTAL	
	N	Col%	N	Col%	N	Col%
Osteoarthritis	944	96.2	1073	93.9	2017	95.0
Osteonecrosis	11	1.1	30	2.6	41	1.9
Rotator Cuff Arthropathy	11	1.1	9	0.8	20	0.9
Rheumatoid Arthritis	3	0.3	15	1.3	18	0.8
Instability	9	0.9	3	0.3	12	0.6
Other Inflammatory Arthritis	2	0.2	9	0.8	11	0.5
Fracture	1	0.1	4	0.3	5	0.2
TOTAL	**981**	**100.0**	**1143**	**100.0**	**2124**	**100.0**

Table ST16 Primary Total Mid Head Shoulder Replacement by Reason for Revision

Reason for Revision	Number	Percent
Instability/Dislocation	24	41.4
Rotator Cuff Insufficiency	11	19.0
Loosening	9	15.5
Infection	6	10.3
Pain	3	5.2
Malposition	1	1.7
Incorrect Sizing	1	1.7
Lysis	1	1.7
Arthrofibrosis	1	1.7
Other	1	1.7
TOTAL	**58**	**100.0**

Table ST17 Primary Total Mid Head Shoulder Replacement by Type of Revision

Type of Revision	Number	Percent
Humeral/Glenoid	36	62.1
Humeral Component	8	13.8
Head Only	5	8.6
Cement Spacer	3	5.2
Removal of Prostheses	2	3.4
Reoperation	2	3.4
Reinsertion of Components	1	1.7
Glenoid Component	1	1.7
TOTAL	**58**	**100.0**

Table ST18 Most Used Humeral Stem Prostheses in Primary Total Mid Head Shoulder Replacement

2011		2016		2017		2018		2019	
N	Model	N	Model	N	Model	N	Model	N	Model
2	Simpliciti	220	Affinis	266	Affinis	270	Affinis	308	Affinis
2	TESS	19	Simpliciti	68	Simpliciti	107	Simpliciti	116	Simpliciti
1	Affinis	12	Sidus	27	SMR	39	Comprehensive	50	Comprehensive
		10	Comprehensive	22	Comprehensive	29	SMR	33	SMR
		10	SMR	8	Sidus	13	Global Icon	17	Global Icon
						10	Sidus		
Most Used									
5	(3) 100.0%	271	(5) 100.0%	391	(5) 100.0%	468	(6) 100.0%	524	(5) 100.0%

Table ST19 Most Used Glenoid Prostheses in Primary Total Mid Head Shoulder Replacement

2011		2016		2017		2018		2019	
N	Model	N	Model	N	Model	N	Model	N	Model
2	Aequalis	218	Affinis	266	Affinis	257	Affinis	295	Affinis
1	Affinis	17	Aequalis	53	Aequalis	80	Perform	117	Perform
1	Comprehensive	14	Comprehensive	20	Comprehensive	38	Comprehensive	50	Comprehensive
1	TESS	6	SMR L1	15	Perform	27	Aequalis	29	Global
		4	SMR	14	SMR L1	27	Global	25	SMR L1
		3	Bigliani/Flatow	13	SMR	15	SMR	8	SMR
		2	Anatomical Shoulder	7	Anatomical Shoulder	14	SMR L1		
		2	Bigliani/Flatow TM	2	Custom Made (Comprehensive)	7	Anatomical Shoulder		
		2	Global	1	Bigliani/Flatow TM	1	Bigliani/Flatow		
		2	Perform			1	Bigliani/Flatow TM		
Most Used									
5	(4) 100.0%	270	(10) 99.6%	391	(9) 100.0%	467	(10) 99.8%	524	(6) 100.0%

Table ST20 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	13 Yrs
Affinis	Affinis	37	1304	1.5 (0.9, 2.4)	3.6 (2.6, 5.2)	4.7 (3.3, 6.7)	4.7 (3.3, 6.7)		
	Global	0	25	0.0 (0.0, 0.0)					
Comprehensive	Comprehensive	6	118	4.3 (1.6, 10.9)					
Global Icon	Global	0	30	0.0 (0.0, 0.0)					
SMR	SMR	2	40	3.0 (0.4, 19.6)					
	SMR L1	3	62	4.2 (1.1, 15.8)	14.9 (3.6, 50.8)				
Sidus	Anatomical Shoulder	1	36	2.8 (0.4, 18.1)	2.8 (0.4, 18.1)				
	Bigliani/Flatow	2	22	0.0 (0.0, 0.0)	5.3 (0.8, 31.9)				
	Bigliani/Flatow TM	1	25	4.0 (0.6, 25.2)	4.0 (0.6, 25.2)	4.0 (0.6, 25.2)			
Simpliciti	Aequalis	4	167	1.8 (0.6, 5.5)	1.8 (0.6, 5.5)	3.0 (1.1, 8.3)			
	Perform	1	278	0.4 (0.1, 2.7)	0.4 (0.1, 2.7)	0.4 (0.1, 2.7)			
Other (9)		1	17	6.7 (1.0, 38.7)	6.7 (1.0, 38.7)	6.7 (1.0, 38.7)	6.7 (1.0, 38.7)		
TOTAL		**58**	**2124**						

Note: Only prostheses with over 10 procedures have been listed.

PRIMARY TOTAL STEMMED SHOULDER REPLACEMENT

DEMOGRAPHICS

There have been 14,231 total stemmed shoulder replacements reported to the Registry. This is an additional 785 procedures compared to the previous report.

The use of total stemmed shoulder replacement has declined from 55.9% of all total shoulder replacements in 2008 to 11.6% in 2019.

The proportion of males has increased from 38.7% in 2008 to 48.4% in 2019 (Figure ST4).

This procedure is most commonly undertaken in females (57.5%) (Table ST21). The mean age is 70.4 years for females and 67.0 years for males (Table ST21). In 2019, most procedures were undertaken in the 65-74 year age group, accounting for 46.9% of all procedures (Figure ST5).

Osteoarthritis is the most common primary diagnosis, accounting for 94.3% of all procedures (Table ST22).

The use of total stemmed shoulder replacement has declined from 55.9% of all total shoulder replacements in 2008 to 11.6% in 2019.

Figure ST4 Primary Total Stemmed Shoulder Replacement by Gender

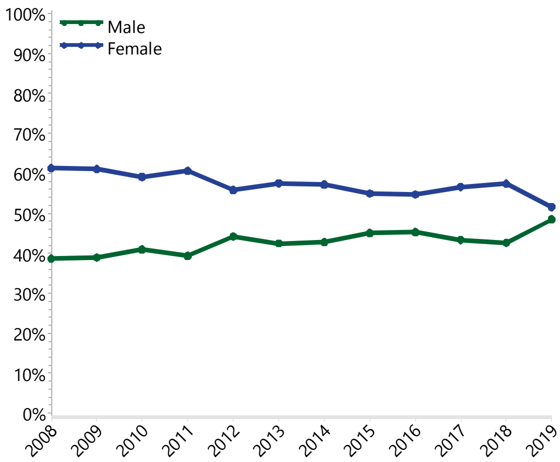


Figure ST5 Primary Total Stemmed Shoulder Replacement by Age

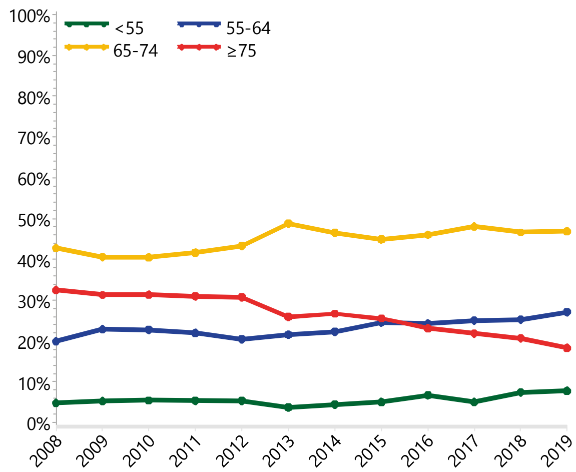


Table ST21 Age and Gender of Primary Total Stemmed Shoulder Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	6042	42.5%	21	93	67	67.0	9.0
Female	8189	57.5%	21	96	71	70.4	8.5
TOTAL	**14231**	**100.0%**	**21**	**96**	**69**	**69.0**	**8.8**

Table ST22 Primary Total Stemmed Shoulder Replacement by Primary Diagnosis and Gender

Primary Diagnosis	Male		Female		TOTAL	
	N	Col%	N	Col%	N	Col%
Osteoarthritis	5780	95.7	7633	93.2	13413	94.3
Rheumatoid Arthritis	63	1.0	185	2.3	248	1.7
Osteonecrosis	63	1.0	164	2.0	227	1.6
Fracture	34	0.6	92	1.1	126	0.9
Other Inflammatory Arthritis	28	0.5	56	0.7	84	0.6
Rotator Cuff Arthropathy	39	0.6	36	0.4	75	0.5
Instability	28	0.5	14	0.2	42	0.3
Tumour	4	0.1	6	0.1	10	0.1
Other	3	0.0	3	0.0	6	0.0
TOTAL	**6042**	**100.0**	**8189**	**100.0**	**14231**	**100.0**

Note: Instability includes dislocation

In 2019, 79.8% of procedures used hybrid fixation (cementless humerus and cemented glenoid). This has increased from a low of 55.8% in 2010. In 2019, cementless fixation was used in 13.3% of procedures, declining from a peak of 33.7% in 2011 (Figure ST6).

Hybrid fixation with a cemented glenoid has increased from 55.8% in 2010 to 79.8% in 2019.

The 10 most used humeral stem and glenoid prostheses are listed in Table ST23 and Table ST24. The Ascend Flex, Global Unite and Comprehensive are the most commonly used humeral stem prostheses in 2019. The 10 most used humeral stem prostheses account for 99.2% of all primary total stemmed shoulder procedures. The Global, Perform and Comprehensive are the most commonly used glenoid prostheses in 2019. The 10 most used glenoid prostheses account for 99.0% of all primary total stemmed shoulder procedures.

Figure ST6 Primary Total Stemmed Shoulder Replacement by Fixation

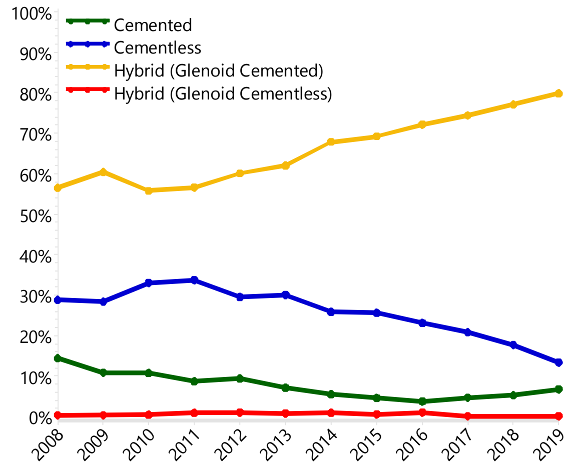


Table ST23 10 Most Used Humeral Stem Prostheses in Primary Total Stemmed Shoulder Replacement

2008		2016		2017		2018		2019	
N	Model	N	Model	N	Model	N	Model	N	Model
298	SMR	234	Global Unite	199	SMR	175	Ascend Flex	172	Ascend Flex
167	Aequalis	230	SMR	179	Global AP	146	SMR	127	Global Unite
117	Global Advantage	187	Global AP	178	Global Unite	145	Comprehensive	119	Comprehensive
91	Global AP	111	Bigliani/Flatow TM	135	Comprehensive	137	Global Unite	115	SMR
40	Bigliani/Flatow	93	Comprehensive	122	Ascend Flex	134	Global AP	102	Equinoxe
37	Bigliani/Flatow TM	88	Aequalis	71	Equinoxe	80	Equinoxe	81	Global AP
32	Solar	84	Ascend Flex	69	Bigliani/Flatow TM	36	Bigliani/Flatow TM	29	Bigliani/Flatow TM
27	Affinis	68	Ascend	49	Aequalis	16	Global Advantage	10	Global Advantage
11	Univers 3D	45	Global Advantage	25	Global Advantage	14	Turon	6	MSS
10	Cofield 2	42	Equinoxe	20	Turon	11	Aequalis	5	Turon
10 Most Used									
830	(10) 97.9%	1182	(10) 97.7%	1047	(10) 97.9%	894	(10) 99.4%	766	(10) 99.2%
Remainder									
18	(7) 2.1%	28	(8) 2.3%	23	(5) 2.1%	5	(3) 0.6%	6	(2) 0.8%
TOTAL									
848	(17) 100.0%	1210	(18) 100.0%	1070	(15) 100.0%	899	(13) 100.0%	772	(12) 100.0%

Table ST24 10 Most Used Glenoid Prostheses in Primary Total Stemmed Shoulder Replacement

2008		2016		2017		2018		2019	
N	Model	N	Model	N	Model	N	Model	N	Model
237	SMR L1	468	Global	381	Global	287	Global	220	Global
209	Global	195	SMR L1	172	SMR L1	152	Perform	176	Perform
167	Aequalis	160	Aequalis	131	Comprehensive	138	Comprehensive	114	Comprehensive
79	Bigliani/Flatow	94	Comprehensive	97	Aequalis	129	SMR L1	102	Equinoxe
57	SMR	85	Bigliani/Flatow TM	86	Perform	80	Equinoxe	94	SMR L1
32	Solar	79	Perform	71	Equinoxe	34	Aequalis	23	Bigliani/Flatow
27	Affinis	42	Equinoxe	37	Bigliani/Flatow TM	21	Bigliani/Flatow	18	SMR
11	Univers 3D	33	SMR	32	Bigliani/Flatow	16	Bigliani/Flatow TM	6	Bigliani/Flatow TM
10	Cofield 2	27	Bigliani/Flatow	23	SMR	14	SMR	6	MSS
7	Promos	10	Turon	20	Turon	14	Turon	5	Custom Made (Comprehensive)
10 Most Used									
836	(10) 98.6%	1193	(10) 98.6%	1050	(10) 98.1%	885	(10) 98.4%	764	(10) 99.0%
Remainder									
12	(6) 1.4%	17	(7) 1.4%	20	(8) 1.9%	14	(5) 1.6%	8	(3) 1.0%
TOTAL									
848	(16) 100.0%	1210	(17) 100.0%	1070	(18) 100.0%	899	(15) 100.0%	772	(13) 100.0%

OUTCOME FOR ALL DIAGNOSES

Primary Diagnosis

The cumulative percent revision of primary total stemmed shoulder replacement for osteoarthritis is 14.3% at 13 years. There is no difference in the rate of revision when osteoarthritis is compared to fracture and osteonecrosis. Rheumatoid arthritis has a lower rate of revision compared to osteoarthritis (Table ST25 and Figure ST7).

Reason for Revision

The Registry has recorded 1,182 revisions of primary total stemmed shoulder replacements. Rotator cuff insufficiency is the most common reason for revision of primary total stemmed shoulder replacement. It accounts for 25.5% of all revisions, followed by instability/dislocation (22.4%) and loosening (17.6%) (Table ST26). The cumulative incidence of the 5 most common reasons for revision are presented in Figure ST8.

Type of Revision

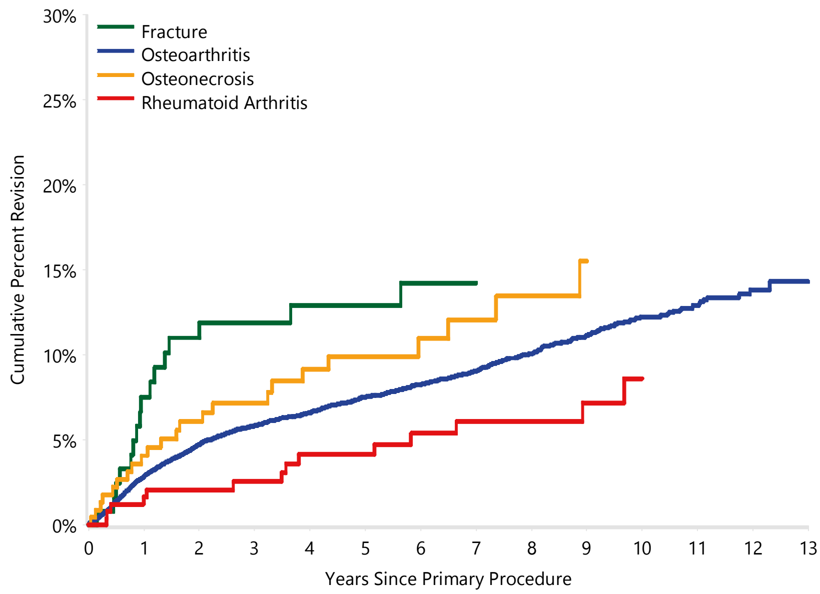
The most common type of revision is of the humeral component only (52.5%) (Table ST27). This may include the revision of a humeral component (epiphysis and/or humeral stem) and additional minor components, such as the humeral head/glenosphere and/or removal of the glenoid component. Of the 620 humeral component revisions, 545 (87.9%) were revised to a total reverse shoulder replacement. The humeral stem was not revised in 518 (83.5%) procedures.

Table ST25 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement by Primary Diagnosis

Primary Diagnosis	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Osteoarthritis	1100	13413	2.8 (2.6, 3.1)	5.8 (5.4, 6.3)	7.5 (7.1, 8.0)	9.1 (8.5, 9.6)	12.2 (11.4, 13.1)	14.3 (12.9, 15.9)
Rheumatoid Arthritis	15	248	1.6 (0.6, 4.3)	2.5 (1.2, 5.6)	4.1 (2.2, 7.8)	6.1 (3.5, 10.6)	8.6 (4.9, 14.9)	
Osteonecrosis	23	227	4.1 (2.1, 7.7)	7.2 (4.4, 11.6)	9.9 (6.4, 15.2)	12.1 (7.8, 18.4)		
Fracture	16	126	7.5 (4.0, 14.0)	11.9 (7.2, 19.3)	12.9 (8.0, 20.5)	14.2 (8.9, 22.3)		
Other Inflammatory Arthritis	9	84	2.4 (0.6, 9.4)	3.7 (1.2, 11.2)	10.7 (5.1, 21.4)	12.9 (6.5, 24.8)	15.8 (8.3, 29.2)	
Rotator Cuff Arthropathy	10	75	5.6 (2.1, 14.2)	12.6 (6.4, 23.7)	14.6 (7.8, 26.4)	14.6 (7.8, 26.4)		
Instability	8	42	7.3 (2.4, 21.0)	20.0 (10.0, 37.8)	20.0 (10.0, 37.8)	20.0 (10.0, 37.8)		
Other (2)	1	16	0.0 (0.0, 0.0)	9.1 (1.3, 49.2)	9.1 (1.3, 49.2)	9.1 (1.3, 49.2)		
TOTAL	**1182**	**14231**						

Note: Only primary diagnoses with over 30 procedures have been listed

Figure ST7 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement by Primary Diagnosis



HR - adjusted for age and gender

Fracture vs Osteoarthritis

Entire Period: HR=1.45 (0.88, 2.37),p=0.143

Osteonecrosis vs Osteoarthritis

Entire Period: HR=1.07 (0.71, 1.63),p=0.742

Rheumatoid Arthritis vs Osteoarthritis

Entire Period: HR=0.54 (0.32, 0.90),p=0.018

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Fracture	126	108	90	78	48	15	1
Osteoarthritis	13413	12233	9874	7208	4666	1607	45
Osteonecrosis	227	202	149	107	73	31	1
Rheumatoid Arthritis	248	235	195	163	126	54	2

Note: Only primary diagnoses with over 100 procedures have been listed

Table ST26 Primary Total Stemmed Shoulder Replacement by Reason for Revision

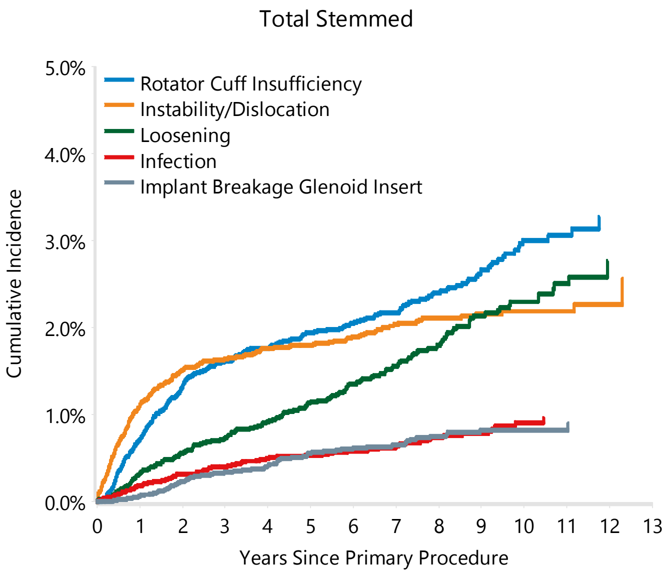
Reason for Revision	Number	Percent
Rotator Cuff Insufficiency	301	25.5
Instability/Dislocation	265	22.4
Loosening	208	17.6
Infection	87	7.4
Implant Breakage Glenoid Insert	82	6.9
Fracture	32	2.7
Dissociation	32	2.7
Implant Breakage Glenoid	29	2.5
Pain	23	1.9
Arthrofibrosis	19	1.6
Incorrect Sizing	19	1.6
Metal Related Pathology	15	1.3
Wear Glenoid Insert	12	1.0
Lysis	10	0.8
Malposition	10	0.8
Glenoid Erosion	3	0.3
Implant Breakage Humeral	1	0.1
Implant Breakage Head	1	0.1
Progression Of Disease	1	0.1
Other	32	2.7
TOTAL	**1182**	**100.0**

Table ST27 Primary Total Stemmed Shoulder Replacement by Type of Revision

Type of Revision	Number	Percent
Humeral Component	620	52.5
Humeral/Glenoid	289	24.5
Head Only	96	8.1
Glenoid Component	66	5.6
Cement Spacer	50	4.2
Head/Insert	32	2.7
Removal of Prostheses	16	1.4
Minor Components	6	0.5
Reoperation	5	0.4
Reinsertion of Components	1	0.1
Insert Only	1	0.1
TOTAL	**1182**	**100.0**

Note: Humeral heads are replaced when the humeral component is revised

Figure ST8 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Shoulder Replacement



OUTCOME FOR OSTEOARTHRITIS - PATIENT CHARACTERISTICS

Age and Gender

Patients aged ≥55 years have a lower rate of revision compared to patients aged <55 years (Table ST28 and Figure ST9).

There is no difference in the rate of revision between males and females (Table ST29 and Figure ST10).

There is no difference in the rate of revision between males and females.

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.

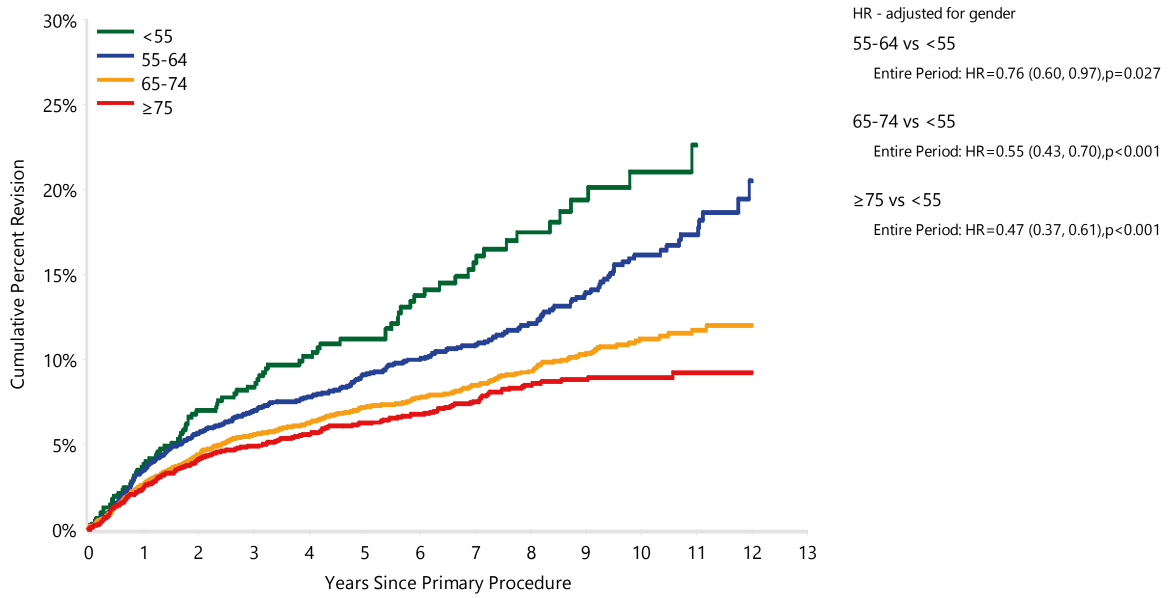
The Registry can now report on the early outcome of 6,739 primary total stemmed shoulder replacement procedures for osteoarthritis in relation to these scores. There is no difference in the rate of revision when patients with an ASA score of 2 or 3 are compared to patients with an ASA score of 1 (Table ST30 and Figure ST11). The most common reasons for revision can be found in Figure ST12.

BMI data have been collected since 2015. The early revision outcomes are reported for 4,371 primary total stemmed shoulder replacement procedures for osteoarthritis. BMI is not a risk factor for revision (Table ST31 and Figure ST13). The most common reasons for revision by BMI category are shown in Figure ST14.

Table ST28 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	13 Yrs
<55	82	626	3.8 (2.6, 5.7)	8.4 (6.4, 11.0)	11.2 (8.7, 14.2)	15.7 (12.5, 19.6)	21.0 (16.7, 26.4)	
55-64	314	3037	3.5 (2.9, 4.2)	7.0 (6.1, 8.0)	9.1 (8.0, 10.3)	10.9 (9.7, 12.2)	16.1 (14.2, 18.3)	
65-74	457	6047	2.7 (2.3, 3.1)	5.6 (5.0, 6.2)	7.2 (6.5, 7.9)	8.5 (7.7, 9.3)	11.2 (10.1, 12.5)	
≥75	247	3703	2.4 (2.0, 3.0)	4.9 (4.2, 5.7)	6.2 (5.5, 7.1)	7.5 (6.6, 8.5)	8.9 (7.8, 10.2)	
TOTAL	**1100**	**13413**						

Figure ST9 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement by Age (Primary Diagnosis OA)

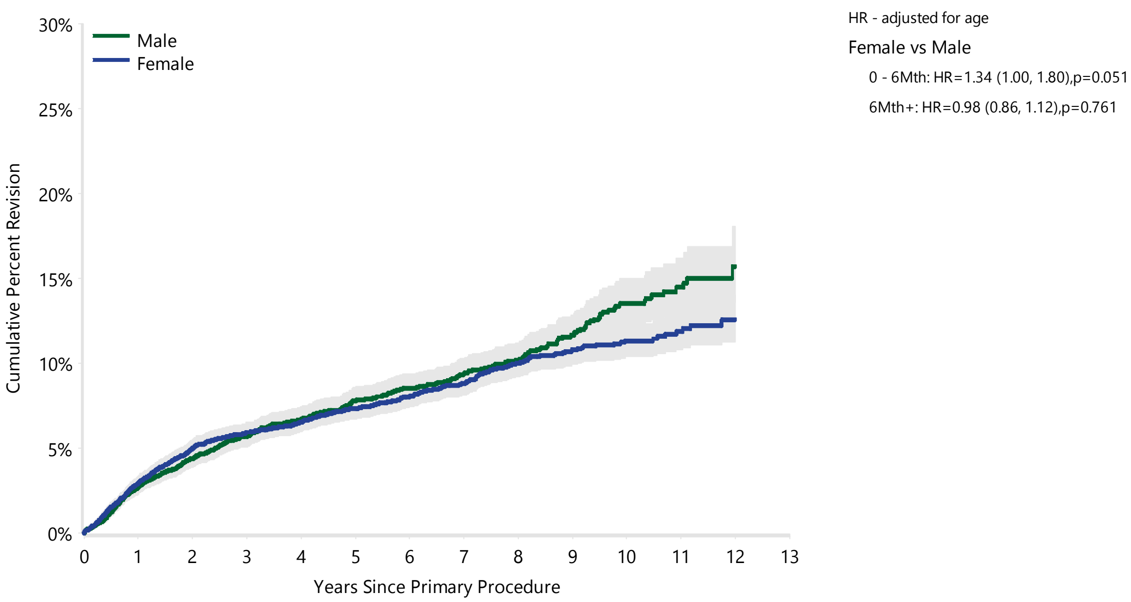


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
<55	626	553	434	302	207	79	2
55-64	3037	2732	2185	1569	1055	393	11
65-74	6047	5512	4413	3233	2051	718	22
≥75	3703	3436	2842	2104	1353	417	10

Table ST29 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	13 Yrs
Male	483	5780	2.7 (2.3, 3.2)	5.7 (5.1, 6.4)	7.8 (7.1, 8.6)	9.4 (8.5, 10.3)	13.5 (12.2, 15.0)	
Female	617	7633	2.9 (2.6, 3.3)	5.9 (5.4, 6.5)	7.3 (6.7, 8.0)	8.8 (8.1, 9.6)	11.3 (10.4, 12.4)	
TOTAL	**1100**	**13413**						

Figure ST10 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement by Gender (Primary Diagnosis OA)

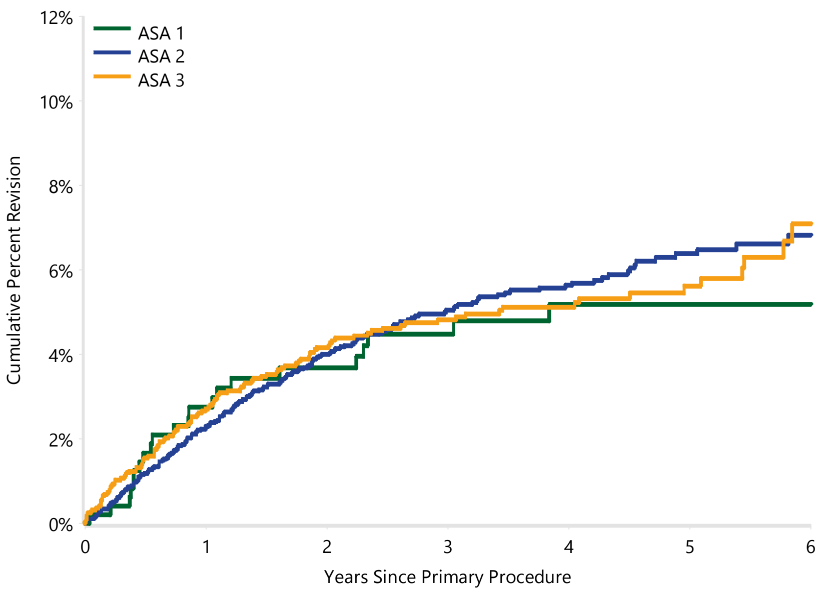


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Male	5780	5236	4202	2971	1895	632	18
Female	7633	6997	5672	4237	2771	975	27

Table ST30 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	4 Yrs	5 Yrs	6 Yrs
ASA 1	22	487	2.8 (1.6, 4.7)	3.7 (2.3, 5.9)	4.5 (2.9, 6.9)	5.2 (3.4, 7.8)	5.2 (3.4, 7.8)	5.2 (3.4, 7.8)
ASA 2	187	3728	2.3 (1.8, 2.8)	4.0 (3.4, 4.7)	5.0 (4.3, 5.9)	5.6 (4.9, 6.5)	6.4 (5.5, 7.4)	6.8 (5.8, 8.0)
ASA 3	116	2452	2.7 (2.1, 3.5)	4.2 (3.4, 5.1)	4.8 (4.0, 5.8)	5.1 (4.2, 6.2)	5.6 (4.6, 6.8)	7.1 (5.6, 9.0)
ASA 4	2	70	3.1 (0.8, 11.8)	3.1 (0.8, 11.8)	3.1 (0.8, 11.8)	3.1 (0.8, 11.8)	3.1 (0.8, 11.8)	3.1 (0.8, 11.8)
ASA 5	1	2						
TOTAL	**328**	**6739**						

Figure ST11 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

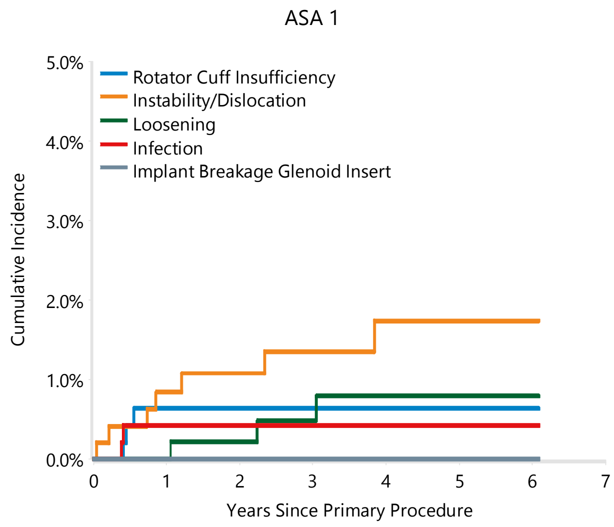
Entire Period: HR=1.27 (0.81, 1.99),p=0.289

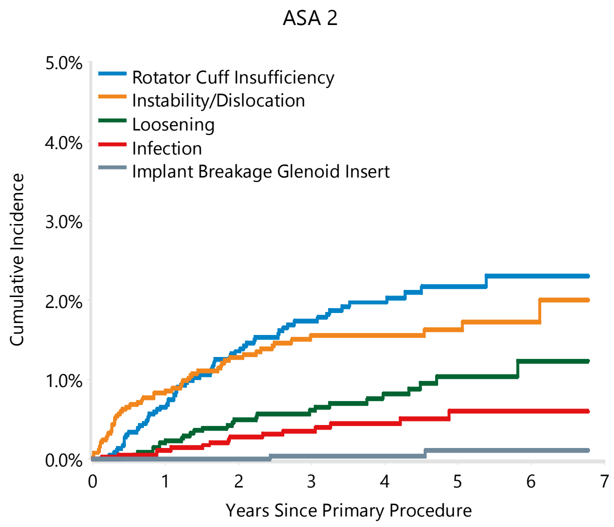
ASA 3 vs ASA 1

Entire Period: HR=1.31 (0.82, 2.10),p=0.253

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
ASA 1	487	437	374	314	228	140	47
ASA 2	3728	3243	2740	2129	1559	922	371
ASA 3	2452	2089	1734	1382	948	540	184

Figure ST12 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Shoulder Replacement by ASA Score (Primary Diagnosis OA)





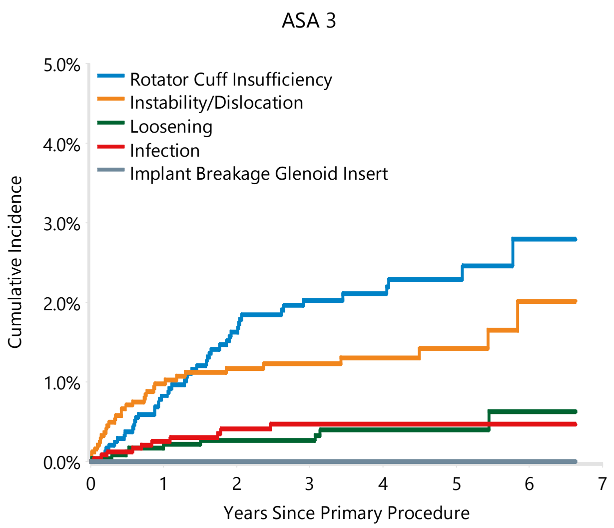
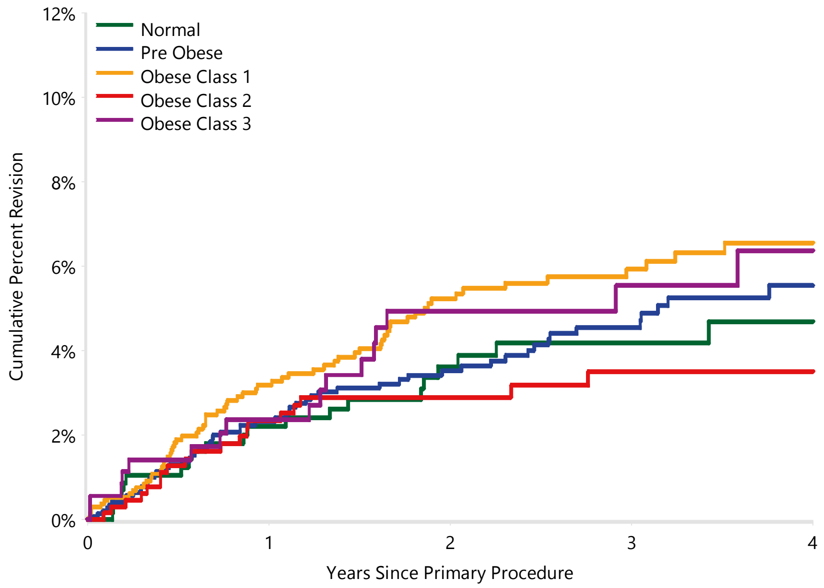


Table ST31 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement by BMI Category (Primary Diagnosis OA)

BMI Category	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs
Underweight	0	12	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)		
Normal	21	581	2.2 (1.3, 3.8)	3.6 (2.3, 5.7)	4.2 (2.7, 6.4)	4.7 (3.0, 7.3)
Pre Obese	57	1446	2.3 (1.6, 3.3)	3.5 (2.6, 4.7)	4.5 (3.5, 6.0)	5.5 (4.2, 7.3)
Obese Class 1	67	1322	3.2 (2.3, 4.3)	5.2 (4.1, 6.7)	5.9 (4.6, 7.5)	6.6 (5.1, 8.4)
Obese Class 2	20	654	2.3 (1.4, 3.9)	2.9 (1.8, 4.6)	3.5 (2.2, 5.5)	3.5 (2.2, 5.5)
Obese Class 3	17	356	2.4 (1.2, 4.7)	4.9 (3.0, 8.1)	5.5 (3.4, 9.0)	6.4 (3.9, 10.4)
TOTAL	**182**	**4371**				

Figure ST13 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=1.14 (0.69, 1.89),p=0.605

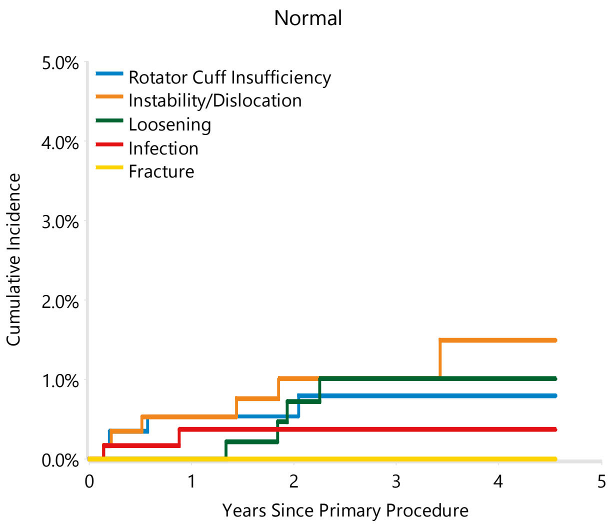
Obese Class 1 vs Normal
Entire Period: HR=1.43 (0.88, 2.34),p=0.151

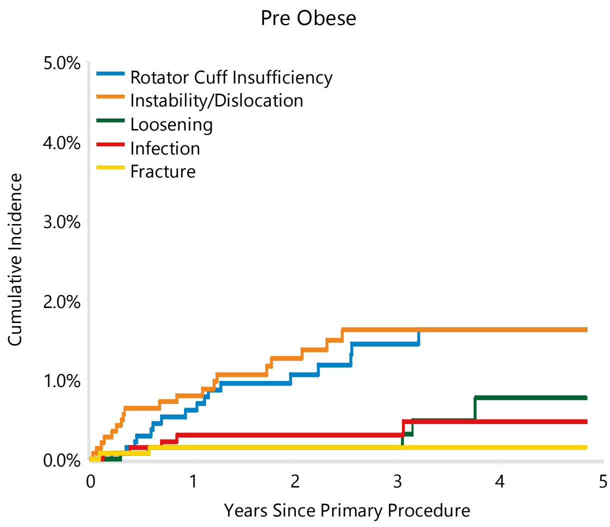
Obese Class 2 vs Normal
Entire Period: HR=0.83 (0.45, 1.53),p=0.547

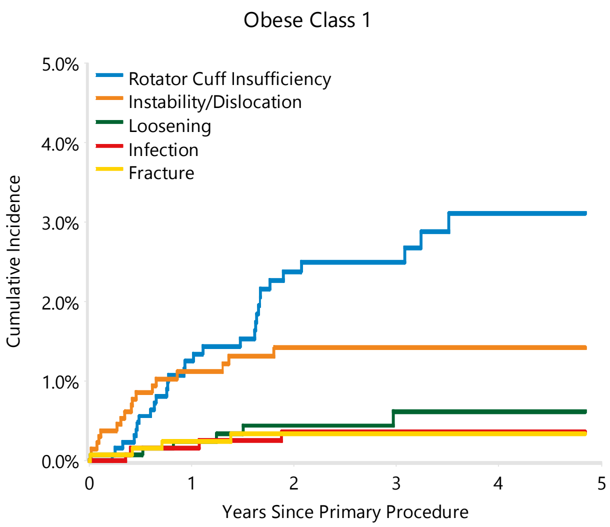
Obese Class 3 vs Normal
Entire Period: HR=1.21 (0.64, 2.30),p=0.562

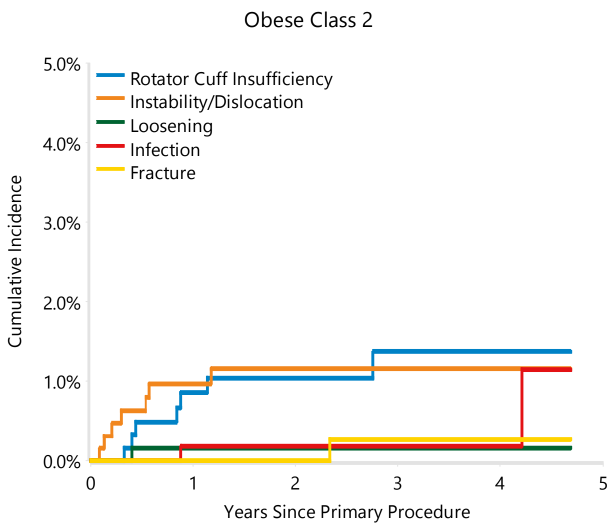
Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs
Normal	581	483	365	238	120
Pre Obese	1446	1157	881	574	267
Obese Class 1	1322	1072	812	518	255
Obese Class 2	654	528	398	266	124
Obese Class 3	356	296	225	156	76

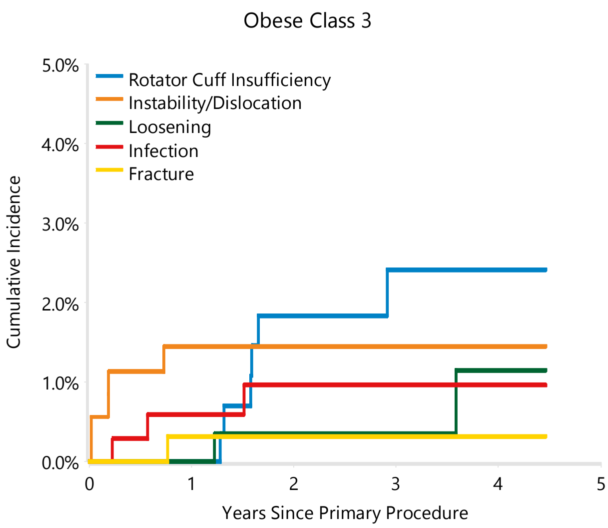
Figure ST14 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Shoulder Replacement by BMI Category (Primary Diagnosis OA)











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 ST32 and Figure ST15).

The fixation analysis was repeated excluding the SMR L2 glenoid prosthesis. The SMR L2 glenoid prosthesis has been identified as having a higher than anticipated rate of revision and has subsequently been withdrawn. The outcome of fixation remained the same, with cementless fixation of the glenoid being associated with a higher rate of revision (Table ST33 and Figure ST16).

Glenoid Type and Design

A further 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. All-polyethylene glenoid prostheses were used in 71.9% of primary total stemmed shoulder replacements, the majority of which were cemented (99.6%). These prostheses have a lower rate of revision compared to modular metal backed glenoids over the entire period and non modular metal backed glenoid prostheses in the first 3 months. Modular metal backed glenoids have a higher rate of revision compared to non modular metal backed glenoids (Table ST34 and Figure ST17).

The revision rate is increased if the glenoid is cementless.

When a modular metal backed glenoid was revised, 80.9% 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 these revisions (22 out of the total 534 procedures).

The above analysis was repeated excluding the SMR L2 glenoid prosthesis, and the results remained consistent (Table ST35 and Figure ST18).

Pegged and keeled all-polyethylene glenoid prostheses were also compared. The majority of all-polyethylene glenoid prostheses are pegged (87.3%). There is no difference in the rate of revision between these prostheses (Table ST36 and Figure ST19).

The use of cross-linked polyethylene (XLPE) glenoids has increased from 10.7% in 2008 to 30.6% in 2019 (Figure ST20).

When the SMR L2 glenoid prosthesis is excluded, XLPE glenoids have a lower cumulative percent revision at 10 years compared to non XLPE glenoids (4.2% compared to 11.7%, respectively) (Table ST37 and Figure ST21).

When the SMR L2 glenoid prosthesis is excluded, XLPE glenoids have a lower cumulative percent revision at 10 years.

This is also the case when all-polyethylene glenoids are compared (Table ST38 and Figure ST22). However, it remains uncertain if these differences are due to the XLPE or the prosthesis with which it is used.

Humeral Heads

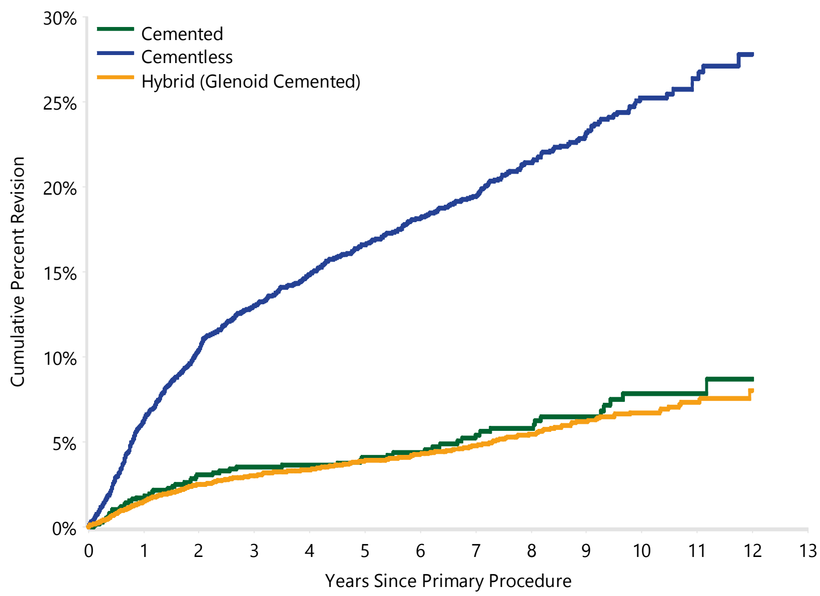
Humeral head sizes <44mm have the highest rate of revision. This rate of revision decreases with increasing head size with humeral heads >50mm having the lowest rate of revision (Table ST39 and Figure ST23). This remains the same when the SMR L2 glenoid prosthesis is excluded. The cumulative incidence for the most common reasons for revision is shown in Figure ST24.

The outcomes of the most commonly used prosthesis combinations are listed in Table ST40. The most commonly used cementless prosthesis combinations are listed in Table ST41. The most commonly used prosthesis combinations with hybrid (glenoid cemented) fixation are listed in Table ST42.

Table ST32 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	13 Yrs
Cemented	56	999	1.7 (1.1, 2.8)	3.5 (2.5, 4.9)	4.1 (3.0, 5.6)	5.4 (4.0, 7.2)	7.9 (5.9, 10.4)	
Cementless	659	3553	6.2 (5.5, 7.1)	13.0 (11.9, 14.2)	16.6 (15.3, 17.9)	19.5 (18.0, 21.0)	25.2 (23.3, 27.3)	
Hybrid (Glenoid Cemented)	373	8794	1.5 (1.3, 1.8)	3.0 (2.7, 3.4)	3.9 (3.5, 4.4)	4.8 (4.3, 5.4)	6.7 (6.0, 7.6)	
Hybrid (Glenoid Cementless)	12	67	9.1 (4.2, 19.1)	10.6 (5.2, 21.0)	19.0 (10.9, 32.1)	19.0 (10.9, 32.1)		
TOTAL	**1100**	**13413**						

Figure ST15 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement by Fixation (Primary Diagnosis OA)



HR - adjusted for age and gender

Cemented vs Hybrid (Glenoid Cemented)
Entire Period: HR=1.17 (0.88, 1.55),p=0.269

Cementless vs Hybrid (Glenoid Cemented)
Entire Period: HR=4.29 (3.78, 4.87),p<0.001

Cementless vs Cemented
Entire Period: HR=3.66 (2.78, 4.81),p<0.001

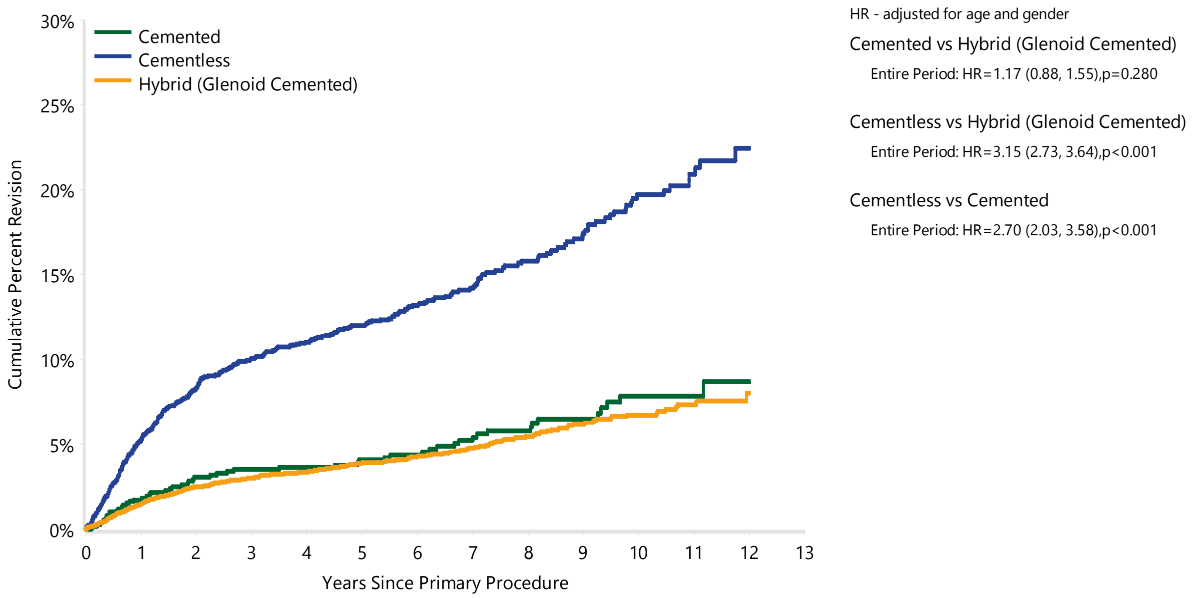
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Cemented	999	926	791	669	505	215	4
Cementless	3553	3213	2616	1940	1242	414	12
Hybrid (Glenoid Cemented)	8794	8035	6411	4563	2895	973	29

Note: Only fixations with over 100 procedures have been listed

Table ST33 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement by Fixation (Primary Diagnosis OA, Excluding SMR L2)

Fixation	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Cemented	56	999	1.7 (1.1, 2.8)	3.5 (2.5, 4.9)	4.1 (3.0, 5.6)	5.4 (4.0, 7.2)	7.9 (5.9, 10.4)	
Cementless	373	2767	5.3 (4.5, 6.2)	10.0 (9.0, 11.3)	12.0 (10.8, 13.4)	14.2 (12.8, 15.8)	19.7 (17.5, 22.1)	
Hybrid (Glenoid Cemented)	373	8794	1.5 (1.3, 1.8)	3.0 (2.7, 3.4)	3.9 (3.5, 4.4)	4.8 (4.3, 5.4)	6.7 (6.0, 7.6)	
Hybrid (Glenoid Cementless)	8	54	7.5 (2.9, 18.7)	9.5 (4.0, 21.2)	18.3 (9.4, 34.1)	18.3 (9.4, 34.1)		
TOTAL	**810**	**12614**						

Figure ST16 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement by Fixation (Primary Diagnosis OA, Excluding SMR L2)



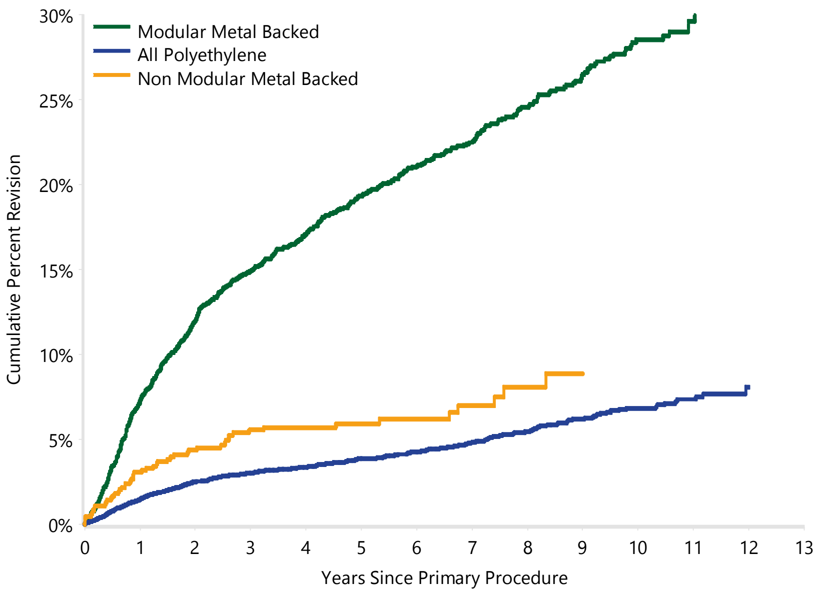
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Cemented	999	926	791	669	505	215	4
Cementless	2767	2509	2024	1432	785	400	12
Hybrid (Glenoid Cemented)	8794	8035	6411	4563	2895	973	29

Note: Only fixations with over 100 procedures have been listed

Table ST34 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	13 Yrs
Modular Metal Backed	627	2916	7.2 (6.3, 8.2)	14.9 (13.6, 16.3)	19.3 (17.8, 20.9)	22.5 (20.8, 24.2)	28.5 (26.4, 30.8)	
All Polyethylene	422	9649	1.5 (1.3, 1.7)	3.0 (2.7, 3.4)	3.9 (3.5, 4.3)	4.8 (4.4, 5.4)	6.9 (6.1, 7.7)	
Non Modular Metal Backed	51	848	3.1 (2.1, 4.5)	5.6 (4.1, 7.4)	5.9 (4.4, 7.9)	7.0 (5.2, 9.4)		
TOTAL	**1100**	**13413**						

Figure ST17 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=4.93 (4.35, 5.57),p<0.001

Modular Metal Backed vs
Non Modular Metal Backed

0 - 3Mth: HR=1.72 (1.00, 2.96),p=0.049
3Mth - 6Mth: HR=2.72 (1.64, 4.50),p<0.001
6Mth - 1.5Yr: HR=2.90 (1.95, 4.32),p<0.001
1.5Yr - 2Yr: HR=3.98 (2.26, 7.00),p<0.001
2Yr - 2.5Yr: HR=6.02 (3.21, 11.27),p<0.001
2.5Yr+: HR=4.11 (2.58, 6.55),p<0.001

Non Modular Metal Backed vs All Polyethylene

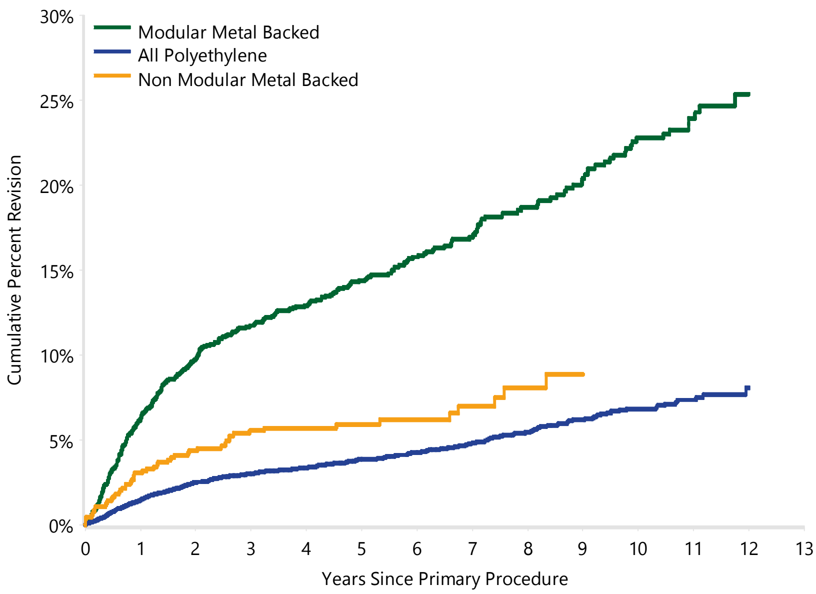
0 - 3Mth: HR=3.46 (1.73, 6.95),p<0.001
3Mth - 6Mth: HR=1.40 (0.57, 3.44),p=0.465
6Mth - 2.5Yr: HR=1.39 (0.91, 2.13),p=0.124
2.5Yr+: HR=1.24 (0.72, 2.13),p=0.430

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Modular Metal Backed	2916	2598	2087	1580	1044	401	12
All Polyethylene	9649	8881	7176	5234	3409	1188	33
Non Modular Metal Backed	848	754	611	394	213	18	0

Table ST35 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement by Glenoid Type (Primary Diagnosis OA, Excluding SMR L2)

Glenoid Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Modular Metal Backed	337	2117	6.2 (5.3, 7.4)	11.7 (10.4, 13.2)	14.4 (12.9, 16.1)	17.0 (15.2, 18.9)	22.8 (20.3, 25.5)	
All Polyethylene	422	9649	1.5 (1.3, 1.7)	3.0 (2.7, 3.4)	3.9 (3.5, 4.3)	4.8 (4.4, 5.4)	6.9 (6.1, 7.7)	
Non Modular Metal Backed	51	848	3.1 (2.1, 4.5)	5.6 (4.1, 7.4)	5.9 (4.4, 7.9)	7.0 (5.2, 9.4)		
TOTAL	**810**	**12614**						

Figure ST18 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement by Glenoid Type (Primary Diagnosis OA, Excluding SMR L2)



HR - adjusted for age and gender

Modular Metal Backed vs All Polyethylene
Entire Period: HR=3.70 (3.20, 4.27),p<0.001

Modular Metal Backed vs
Non Modular Metal Backed
0 - 2Yr: HR=2.23 (1.60, 3.09),p<0.001
2Yr - 2.5Yr: HR=3.97 (2.08, 7.61),p<0.001
2.5Yr+: HR=2.79 (1.83, 4.27),p<0.001

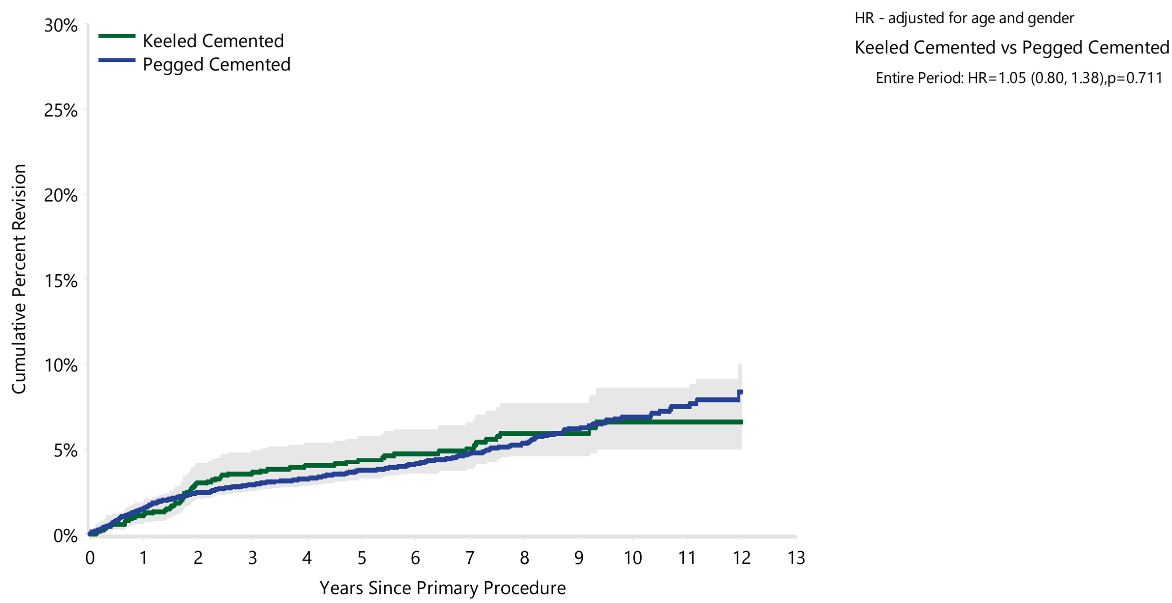
Non Modular Metal Backed vs All Polyethylene
0 - 3Mth: HR=2.93 (1.45, 5.91),p=0.002
3Mth - 6Mth: HR=1.27 (0.51, 3.15),p=0.602
6Mth - 2.5Yr: HR=1.43 (0.93, 2.20),p=0.099
2.5Yr+: HR=1.32 (0.77, 2.26),p=0.320

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Modular Metal Backed	2117	1883	1484	1062	578	387	12
All Polyethylene	9649	8881	7176	5234	3409	1188	33
Non Modular Metal Backed	848	754	611	394	213	18	0

Table ST36 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	13 Yrs
Keeled Cemented	61	1223	1.2 (0.7, 2.0)	3.6 (2.7, 4.9)	4.4 (3.3, 5.7)	5.0 (3.9, 6.6)	6.6 (5.0, 8.6)	
Pegged Cemented	356	8382	1.5 (1.3, 1.8)	2.9 (2.6, 3.3)	3.8 (3.3, 4.2)	4.8 (4.2, 5.3)	6.9 (6.1, 7.8)	
TOTAL	**417**	**9605**						

Figure ST19 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	13 Yrs
Keeled Cemented	1223	1167	1036	839	560	200	6
Pegged Cemented	8382	7672	6103	4371	2834	987	27

Figure ST20 Primary Total Stemmed Shoulder Replacement by Polyethylene Type (All Diagnoses)

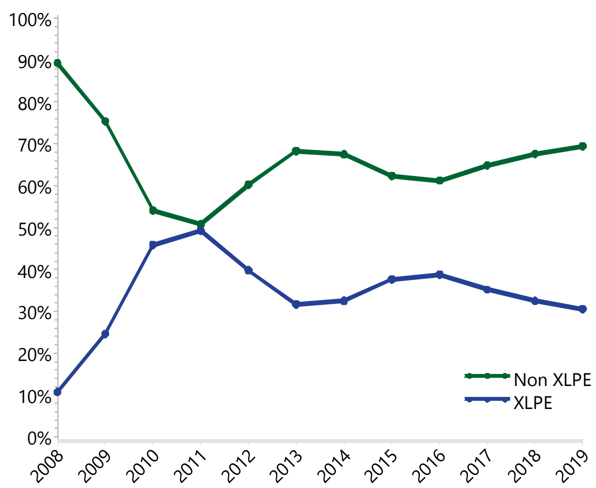
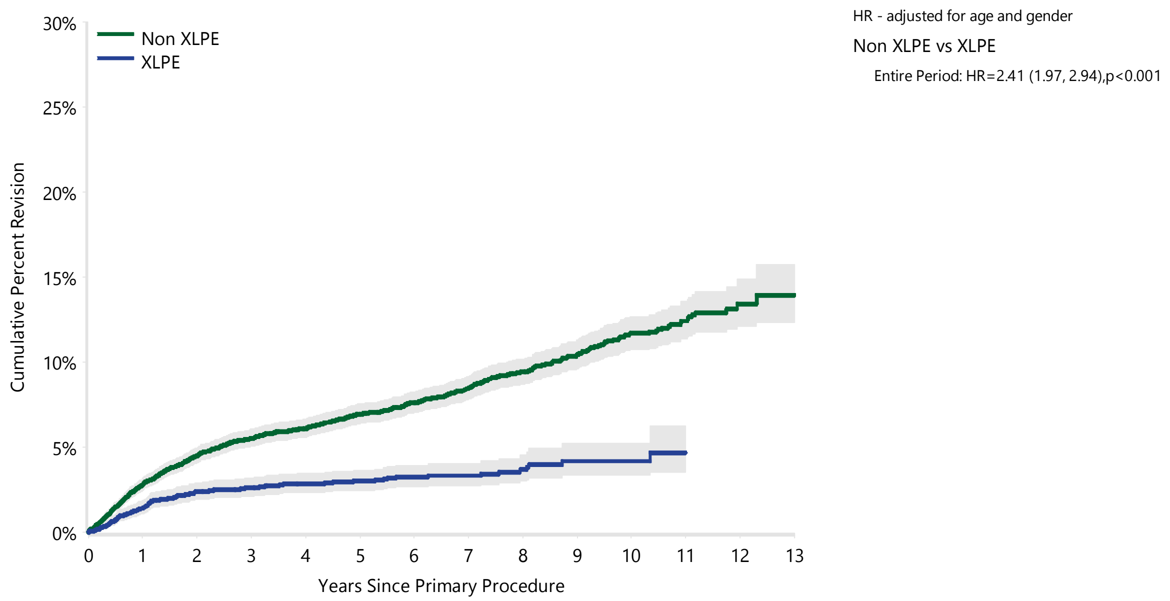


Table ST37 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement using All Types of Glenoid by Polyethylene Type (Primary Diagnosis OA, Excluding SMR L2)

Polyethylene Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Non XLPE	696	8842	2.8 (2.5, 3.2)	5.5 (5.1, 6.1)	7.0 (6.4, 7.6)	8.5 (7.8, 9.2)	11.7 (10.8, 12.7)	13.9 (12.3, 15.7)
XLPE	113	3754	1.4 (1.1, 1.9)	2.6 (2.1, 3.2)	3.0 (2.5, 3.7)	3.3 (2.7, 4.0)	4.2 (3.3, 5.2)	
TOTAL	**809**	**12596**						

Figure ST21 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement using All Types of Glenoid by Polyethylene Type (Primary Diagnosis OA, Excluding SMR L2)

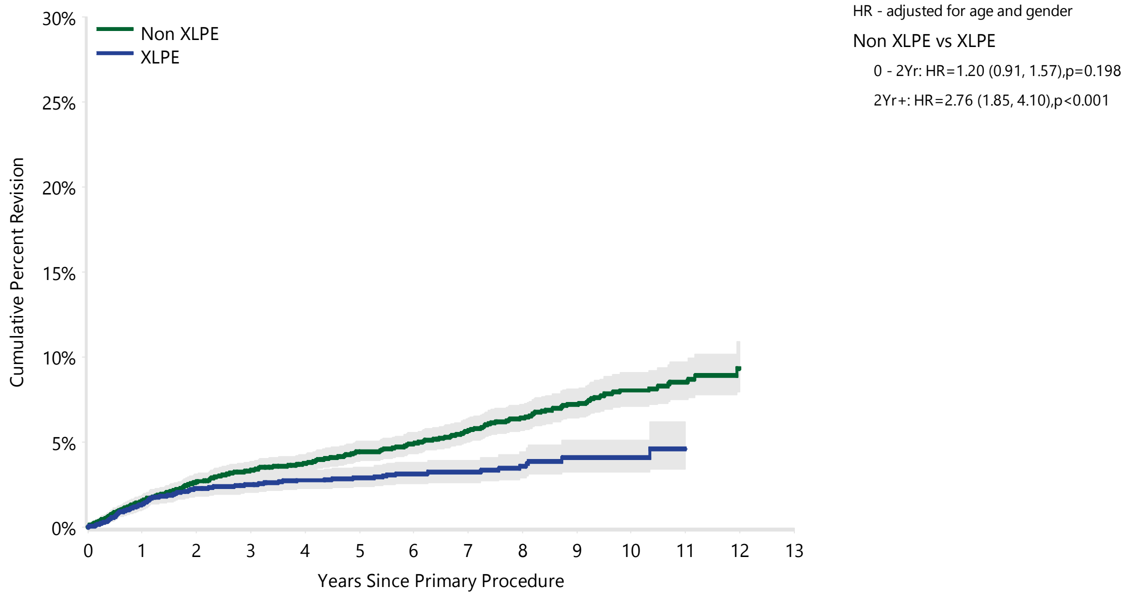


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Non XLPE	8842	8040	6514	4888	3196	1350	40
XLPE	3754	3463	2746	1796	1004	243	5

Table ST38 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement Using 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	13 Yrs
Non XLPE	313	5907	1.6 (1.3, 1.9)	3.4 (2.9, 3.9)	4.5 (3.9, 5.1)	5.7 (5.0, 6.4)	8.0 (7.1, 9.1)	
XLPE	109	3742	1.4 (1.0, 1.8)	2.5 (2.0, 3.1)	2.9 (2.4, 3.6)	3.2 (2.7, 3.9)	4.1 (3.2, 5.1)	
TOTAL	422	9649						

Figure ST22 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement Using All-Polyethylene Glenoids by Polyethylene Type (Primary Diagnosis OA)



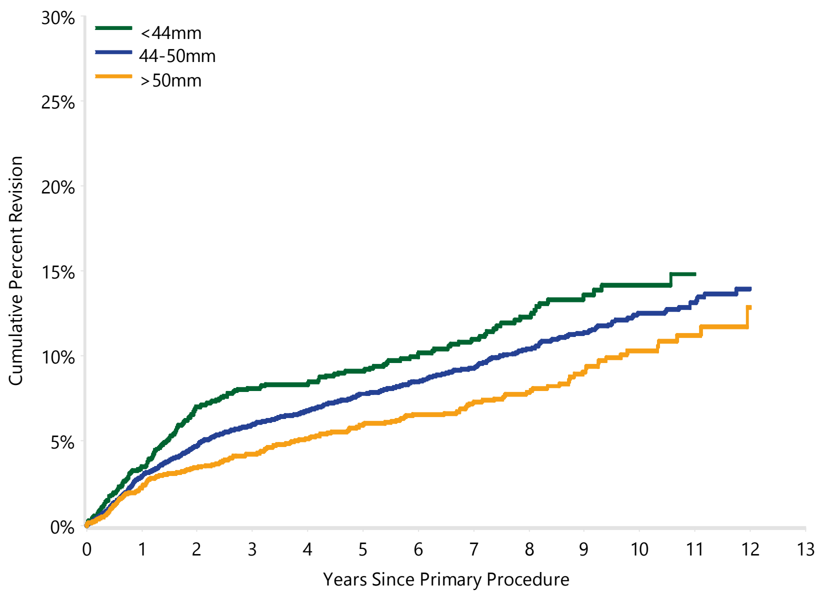
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Non XLPE	5907	5426	4430	3438	2405	945	28
XLPE	3742	3455	2746	1796	1004	243	5

Table ST39 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	13 Yrs
<44mm	178	1796	3.5 (2.7, 4.5)	8.1 (6.9, 9.5)	9.1 (7.8, 10.6)	11.0 (9.4, 12.8)	14.2 (12.1, 16.6)	
44-50mm	717	8470	2.9 (2.6, 3.3)	5.9 (5.4, 6.5)	7.8 (7.2, 8.4)	9.3 (8.6, 10.0)	12.5 (11.5, 13.6)	
>50mm	204	3145	2.2 (1.7, 2.8)	4.2 (3.5, 5.0)	6.0 (5.1, 7.0)	7.3 (6.3, 8.4)	10.3 (8.8, 12.1)	
TOTAL	**1099**	**13411**						

Note: A further 2 procedures did not have humeral head size recorded

Figure ST23 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement by Humeral Head Size (Primary Diagnosis OA)



HR - adjusted for age and gender

<44mm vs >50mm

Entire Period: HR=2.00 (1.58, 2.54),p<0.001

<44mm vs 44-50mm

Entire Period: HR=1.31 (1.10, 1.56),p=0.002

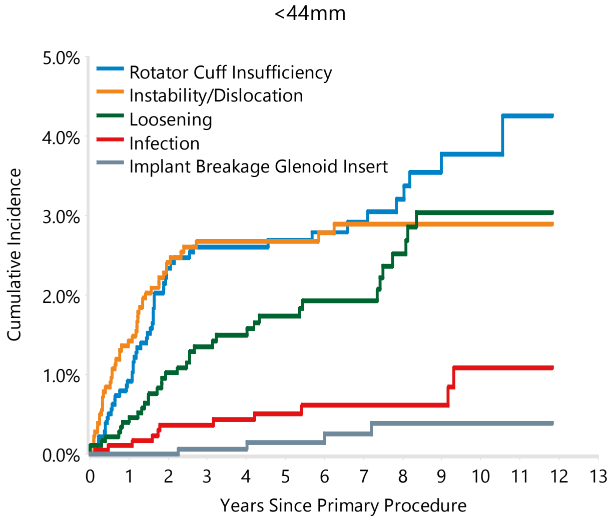
44-50mm vs >50mm

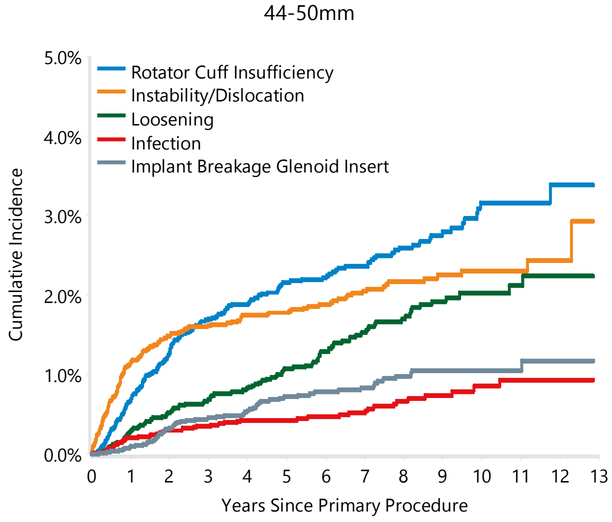
Entire Period: HR=1.53 (1.29, 1.82),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
<44mm	1796	1617	1261	946	592	201	4
44-50mm	8470	7748	6298	4613	2990	1034	30
>50mm	3145	2867	2314	1648	1084	372	11

Note: A further 2 procedures did not have humeral head size recorded

Figure ST24 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Shoulder Replacement by Humeral Head Size (Primary Diagnosis OA)





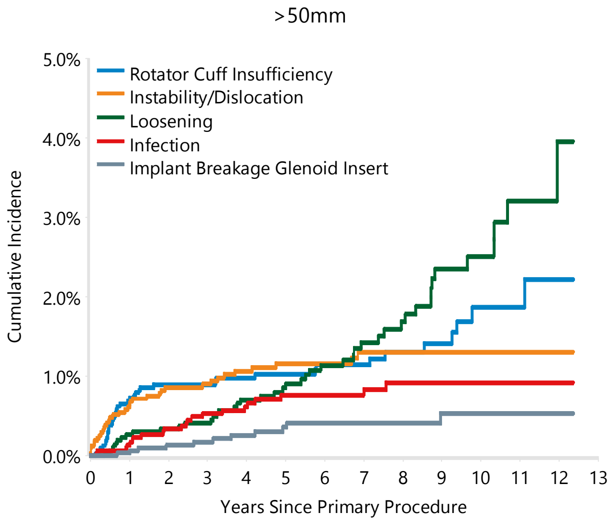


Table ST40 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement by Prosthesis Combination (Primary Diagnosis OA)

Humeral Stem	Glenoid	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Aequalis	Aequalis	75	1564	1.3 (0.8, 2.0)	2.5 (1.8, 3.4)	3.3 (2.5, 4.4)	4.4 (3.4, 5.6)	6.0 (4.7, 7.6)	
	Perform	7	125	3.2 (1.2, 8.3)	5.8 (2.8, 11.8)	5.8 (2.8, 11.8)			
Affinis	Affinis	13	181	0.0 (0.0, 0.0)	1.7 (0.6, 5.2)	4.8 (2.4, 9.4)	5.5 (2.9, 10.3)	8.7 (5.1, 14.7)	
Ascend	Aequalis	14	236	1.7 (0.6, 4.5)	3.0 (1.4, 6.2)	7.3 (4.0, 13.1)	8.7 (4.8, 15.3)		
	Perform	4	107	0.9 (0.1, 6.4)	2.9 (0.9, 8.6)	3.9 (1.5, 10.0)			
Ascend Flex	Aequalis	3	83	1.2 (0.2, 8.2)	3.8 (1.2, 11.2)				
	Perform	7	644	0.5 (0.2, 1.6)	1.3 (0.6, 2.9)	1.7 (0.8, 3.7)			
Bigliani/Flatow	Bigliani/Flatow	11	142	2.1 (0.7, 6.4)	3.6 (1.5, 8.4)	3.6 (1.5, 8.4)	5.3 (2.6, 10.8)	8.3 (4.5, 15.0)	
Bigliani/Flatow TM	Bigliani/Flatow	26	441	1.9 (0.9, 3.7)	4.4 (2.8, 6.9)	5.3 (3.5, 8.0)	6.1 (4.1, 9.1)	8.0 (5.3, 12.0)	
	Bigliani/Flatow TM	36	641	2.3 (1.4, 3.9)	4.8 (3.4, 6.8)	5.0 (3.5, 7.0)	6.1 (4.3, 8.6)		
Comprehensive	Comprehensive	30	615	3.9 (2.6, 5.8)	4.9 (3.4, 7.1)	5.9 (4.0, 8.7)			
Epoca	Epoca	5	51	0.0 (0.0, 0.0)	4.1 (1.0, 15.3)	8.8 (3.4, 21.8)	11.6 (5.0, 25.9)	11.6 (5.0, 25.9)	
Equinoxe	Equinoxe	27	396	3.5 (2.0, 6.1)	7.5 (4.9, 11.4)	10.8 (6.9, 16.8)			
Global AP	Global	105	2792	1.5 (1.1, 2.0)	2.7 (2.1, 3.3)	3.1 (2.5, 3.8)	3.9 (3.1, 4.8)	5.9 (4.6, 7.4)	
Global Advantage	Global	43	704	1.3 (0.7, 2.5)	3.5 (2.4, 5.2)	3.9 (2.7, 5.7)	5.3 (3.8, 7.5)	7.4 (5.3, 10.2)	
Global Unite	Global	13	839	0.8 (0.3, 1.7)	1.6 (0.9, 2.9)				
SMR	SMR	23	455	1.8 (0.9, 3.6)	4.4 (2.8, 6.8)	4.7 (3.0, 7.1)	5.0 (3.3, 7.6)	6.0 (4.0, 9.1)	
	SMR L1	300	2020	5.9 (5.0, 7.1)	11.3 (9.9, 12.8)	13.7 (12.2, 15.4)	15.7 (13.9, 17.6)	21.1 (18.6, 23.8)	
	SMR L2	289	798	9.7 (7.8, 12.0)	22.6 (19.8, 25.6)	30.2 (27.1, 33.6)	34.0 (30.8, 37.5)		
Solar	Solar	6	169	0.6 (0.1, 4.1)	2.4 (0.9, 6.2)	3.0 (1.3, 7.1)	3.0 (1.3, 7.1)	3.7 (1.7, 8.2)	
Turon	Turon	5	108	2.8 (0.9, 8.4)	3.8 (1.5, 9.9)				
Other (35)		58	302	5.1 (3.1, 8.3)	9.8 (6.9, 13.9)	14.9 (11.1, 19.8)	19.1 (14.6, 24.7)	24.5 (19.2, 31.0)	
TOTAL		**1100**	**13413**						

Note: Only combinations with over 50 procedures have been listed

Table ST41 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	13 Yrs
Bigliani/Flatow TM	Bigliani/Flatow TM	34	614	2.1 (1.2, 3.6)	4.7 (3.3, 6.8)	4.9 (3.4, 7.0)	6.1 (4.2, 8.6)		
Comprehensive	Custom Made (Comprehensive)	4	12	25.0 (8.8, 59.2)					
Epoca	Epoca	5	37	0.0 (0.0, 0.0)	5.7 (1.5, 21.0)	12.5 (4.8, 30.1)	16.8 (7.2, 36.4)		
Equinoxe	Equinoxe	5	36	11.4 (4.4, 27.5)	14.3 (6.2, 31.0)	14.3 (6.2, 31.0)			
SMR	SMR L1	294	1989	5.9 (5.0, 7.1)	11.3 (9.9, 12.8)	13.6 (12.0, 15.3)	15.5 (13.8, 17.4)	21.0 (18.5, 23.7)	
	SMR L2	285	785	9.6 (7.7, 11.9)	22.7 (19.9, 25.8)	30.3 (27.2, 33.7)	34.2 (31.0, 37.7)		
Univers 3D	Univers 3D	14	26	7.7 (2.0, 27.4)	19.2 (8.5, 40.2)	23.3 (11.2, 44.7)	35.4 (20.2, 57.1)	47.5 (30.3, 68.3)	
Vaios	Vaios	14	24	16.7 (6.6, 38.5)	29.2 (15.1, 51.6)	42.2 (25.3, 64.3)	56.7 (37.7, 77.2)		
Other (14)		4	30	6.7 (1.7, 24.1)	6.7 (1.7, 24.1)	12.5 (4.0, 35.5)	12.5 (4.0, 35.5)	27.1 (8.7, 66.4)	
TOTAL		**659**	**3553**						

Note: Only combinations with over 10 procedures have been listed

Table ST42 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	13 Yrs
Aequalis	Aequalis	65	1373	1.2 (0.8, 2.0)	2.2 (1.6, 3.1)	3.1 (2.3, 4.2)	4.3 (3.3, 5.7)	6.1 (4.7, 7.9)	
	Perform	5	107	1.9 (0.5, 7.3)	4.9 (2.1, 11.5)	4.9 (2.1, 11.5)			
Affinis	Affinis	13	177	0.0 (0.0, 0.0)	1.8 (0.6, 5.4)	4.9 (2.5, 9.5)	5.5 (2.9, 10.4)	8.8 (5.2, 14.9)	
Ascend	Aequalis	11	223	1.8 (0.7, 4.7)	2.7 (1.2, 5.9)	6.1 (3.2, 11.4)			
	Perform	4	103	1.0 (0.1, 6.7)	3.0 (1.0, 8.9)	4.0 (1.5, 10.4)			
Ascend Flex	Aequalis	3	81	1.2 (0.2, 8.4)	3.9 (1.3, 11.5)				
	Perform	7	582	0.6 (0.2, 1.8)	1.4 (0.6, 3.2)	1.9 (0.9, 4.0)			
Bigliani/Flatow	Bigliani/Flatow	9	121	2.5 (0.8, 7.5)	4.2 (1.8, 9.7)	4.2 (1.8, 9.7)	5.2 (2.4, 11.2)	7.5 (3.8, 14.5)	
Bigliani/Flatow TM	Bigliani/Flatow	19	410	1.2 (0.5, 3.0)	3.4 (2.0, 5.8)	4.4 (2.7, 7.1)	4.8 (3.0, 7.7)	6.2 (3.9, 9.9)	
Comprehensive	Comprehensive	30	607	3.9 (2.6, 5.9)	5.0 (3.5, 7.2)	6.0 (4.1, 8.8)			
Equinoxe	Equinoxe	22	341	2.7 (1.4, 5.4)	7.0 (4.3, 11.4)	11.0 (6.6, 18.0)			
Global AP	Global	96	2498	1.5 (1.1, 2.1)	2.8 (2.2, 3.6)	3.3 (2.6, 4.1)	4.1 (3.3, 5.0)	6.0 (4.6, 7.8)	
Global Advantage	Global	32	580	1.2 (0.6, 2.5)	3.8 (2.5, 5.7)	4.0 (2.7, 6.0)	4.9 (3.3, 7.2)	6.6 (4.5, 9.7)	
Global Unite	Global	12	764	0.7 (0.3, 1.7)	1.6 (0.9, 3.0)				
SMR	SMR	21	438	1.9 (0.9, 3.7)	4.1 (2.6, 6.5)	4.4 (2.8, 6.8)	4.7 (3.0, 7.3)	5.8 (3.7, 9.0)	
Solar	Solar	4	114	0.9 (0.1, 6.1)	1.8 (0.4, 6.9)	2.7 (0.9, 8.0)	2.7 (0.9, 8.0)	3.7 (1.4, 9.5)	
Turon	Turon	4	101	2.0 (0.5, 7.8)	3.1 (1.0, 9.4)				
Other (28)		16	174	1.2 (0.3, 4.6)	3.7 (1.7, 8.0)	7.9 (4.6, 13.6)	9.8 (5.9, 16.2)	12.2 (7.5, 19.4)	
TOTAL		**373**	**8794**						

Note: Only combinations with over 50 procedures have been listed

PRIMARY TOTAL REVERSE SHOULDER REPLACEMENT

DEMOGRAPHICS

There have been 30,330 primary total reverse shoulder replacement procedures reported to the Registry. This is an increase of 5,471 procedures compared to the previous report. Primary total reverse shoulder replacement has increased from 43.3% of all total shoulder replacements in 2008 to 80.4% in 2019.

The proportion of total reverse shoulder replacements for osteoarthritis declined from 57.9% in 2008 to 40.5% in 2013 and is 42.8% in 2019. The diagnosis of rotator cuff arthropathy was added to the procedure form in 2008. The proportion of primary total reverse shoulder procedures undertaken for rotator cuff arthropathy increased from 21.1% in 2008 to 37.9% in 2013 and is 38.1% in 2019. The proportion of total reverse shoulder replacements for fracture has increased from 12.2% in 2008 to 14.5% in 2019 (Figure ST25).

Primary total reverse shoulder replacement is more commonly undertaken in females (63.9%) (Table ST43). There has been minimal change in gender distribution since 2008 (Figure ST26).

Figure ST25 Primary Total Reverse Shoulder Replacement by Primary Diagnosis

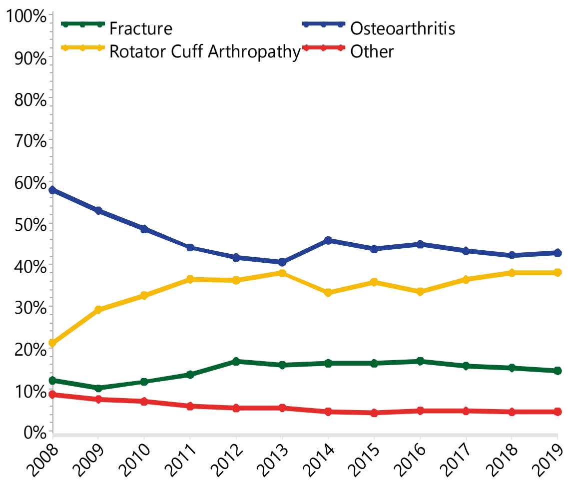
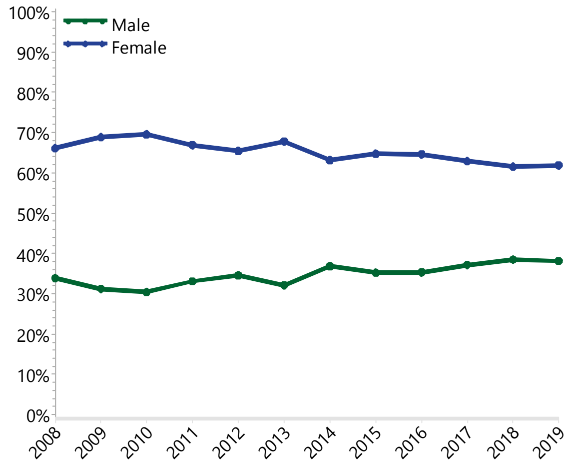


Figure ST26 Primary Total Reverse Shoulder Replacement by Gender



The mean age is 75.1 years for females and 72.6 years for males. The proportion of patients aged ≥75 years has declined from 61.3% in 2010 to 47.2% in 2019 (Figure ST27).

The majority of procedures use cementless fixation (77.1%). Hybrid (humerus cemented) fixation is used in 21.5% of procedures. There has been little variation in the use of fixation since 2008 (Figure ST28).

The most common primary diagnoses are osteoarthritis (44.1%), rotator cuff arthropathy (35.6%) and fracture (15.2%).

The most common primary diagnoses are osteoarthritis (44.1%), rotator cuff arthropathy (35.6%) and fracture (15.2%) (Table ST44).

The most used humeral stems are the SMR, Delta Xtend, and Equinoxe (Table ST45). The most used glenoid prostheses are the Delta Xtend, SMR L1 and Aequalis (Table ST46).

Table ST43 Age and Gender of Primary Total Reverse Shoulder Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	10941	36.1%	17	96	73	72.6	8.2
Female	19389	63.9%	13	102	76	75.1	8.0
TOTAL	**30330**	**100.0%**	**13**	**102**	**75**	**74.2**	**8.1**

Figure ST27 Primary Total Reverse Shoulder Replacement by Age

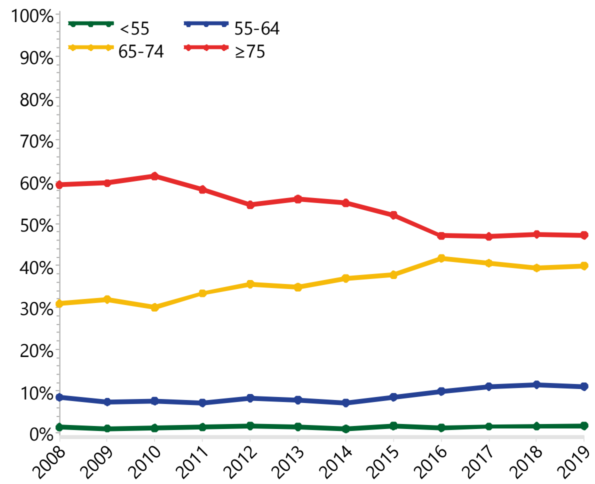


Figure ST28 Primary Total Reverse Shoulder Replacement by Fixation

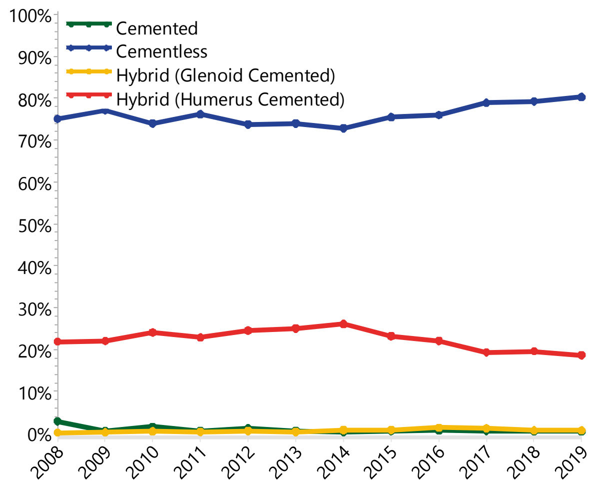


Table ST44 Primary Total Reverse Shoulder Replacement by Primary Diagnosis and Gender

Primary Diagnosis	Male		Female		TOTAL	
	N	Col%	N	Col%	N	Col%
Osteoarthritis	5079	46.4	8295	42.8	13374	44.1
Rotator Cuff Arthropathy	4728	43.2	6080	31.4	10808	35.6
Fracture	717	6.6	3884	20.0	4601	15.2
Rheumatoid Arthritis	121	1.1	448	2.3	569	1.9
Osteonecrosis	64	0.6	299	1.5	363	1.2
Instability	102	0.9	214	1.1	316	1.0
Tumour	91	0.8	83	0.4	174	0.6
Other Inflammatory Arthritis	36	0.3	83	0.4	119	0.4
Other	3	0.0	3	0.0	6	0.0
TOTAL	**10941**	**100.0**	**19389**	**100.0**	**30330**	**100.0**

Table ST45 10 Most Used Humeral Stem Prostheses in Primary Total Reverse Shoulder Replacement

2008		2016		2017		2018		2019	
N	Model	N	Model	N	Model	N	Model	N	Model
263	SMR	1033	Delta Xtend	1026	Delta Xtend	1070	SMR	1069	SMR
252	Delta Xtend	926	SMR	935	SMR	1064	Delta Xtend	960	Delta Xtend
76	Aequalis	366	Aequalis	371	Aequalis	494	Comprehensive	651	Equinoxe
42	Trabecular Metal	207	Trabecular Metal	364	Comprehensive	493	Equinoxe	629	Comprehensive
21	Delta CTA	200	Comprehensive	350	RSP	420	RSP	475	Ascend Flex
2	Custom Made (Lima)	179	RSP	332	Equinoxe	373	Ascend Flex	397	RSP
1	Generic Humeral Stem	172	Equinoxe	262	Affinis	356	Aequalis	372	Aequalis
1	Promos	113	Affinis	203	Trabecular Metal	324	Affinis	329	Affinis
		105	Global Unite	161	Ascend Flex	182	Trabecular Metal	178	Trabecular Metal
		94	Ascend Flex	125	Global Unite	95	Global Unite	155	Global Unite
10 Most Used									
658	(8) 100.0%	3395	(10) 99.1%	4129	(10) 99.3%	4871	(10) 99.1%	5215	(10) 97.5%
Remainder									
0	(0) 0%	32	(3) 0.9%	30	(4) 0.7%	43	(6) 0.9%	134	(5) 2.5%
TOTAL									
658	(8) 100.0%	3427	(13) 100.0%	4159	(14) 100.0%	4914	(16) 100.0%	5349	(15) 100.0%

Table ST46 10 Most Used Glenoid Prostheses in Primary Total Reverse Shoulder Replacement

2008		2016		2017		2018		2019	
N	Model	N	Model	N	Model	N	Model	N	Model
264	SMR L1	1138	Delta Xtend	1151	Delta Xtend	1157	Delta Xtend	1114	Delta Xtend
252	Delta Xtend	914	SMR L1	929	SMR L1	1042	SMR L1	1019	SMR L1
76	Aequalis	461	Aequalis	532	Aequalis	698	Aequalis	747	Aequalis
42	Trabecular Metal	232	Trabecular Metal	373	Comprehensive Reverse	517	Comprehensive Reverse	671	Comprehensive Reverse
21	Delta CTA	185	Comprehensive Reverse	351	RSP	493	Equinoxe	651	Equinoxe
1	Generic Metaglene	179	RSP	332	Equinoxe	431	RSP	475	RSP
1	Promos	168	Equinoxe	262	Affinis	323	Affinis	329	Affinis
1	SMR	113	Affinis	191	Trabecular Metal	153	Trabecular Metal	135	Trabecular Metal
		7	SMR Axioma	12	Custom Made (Comprehensive)	31	Perform Reversed	100	Perform Reversed
		6	Anatomical Shoulder	11	Mets	19	Custom Made (Comprehensive)	32	SMR Axioma
10 Most Used									
658	(8) 100.0%	3403	(10) 99.3%	4144	(10) 99.6%	4864	(10) 99.0%	5273	(10) 98.6%
Remainder									
0	(0) 0%	24	(6) 0.7%	15	(4) 0.4%	50	(7) 1.0%	76	(6) 1.4%
TOTAL									
658	(8) 100.0%	3427	(16) 100.0%	4159	(14) 100.0%	4914	(17) 100.0%	5349	(16) 100.0%

OUTCOME FOR ALL DIAGNOSES

Primary Diagnosis

Fracture has a higher rate of revision in the first 3 months compared to osteoarthritis. After this time, there is no difference but there is a difference between rheumatoid arthritis and osteoarthritis and there is also a difference between instability and osteoarthritis (Table ST47 and Figure ST29).

Reason for Revision

Instability/dislocation is the most common reason for revision (34.1%), followed by infection (22.1%), loosening (17.4%) and fracture (12.0%) (Table ST48 and Figure ST30).

Type of Revision

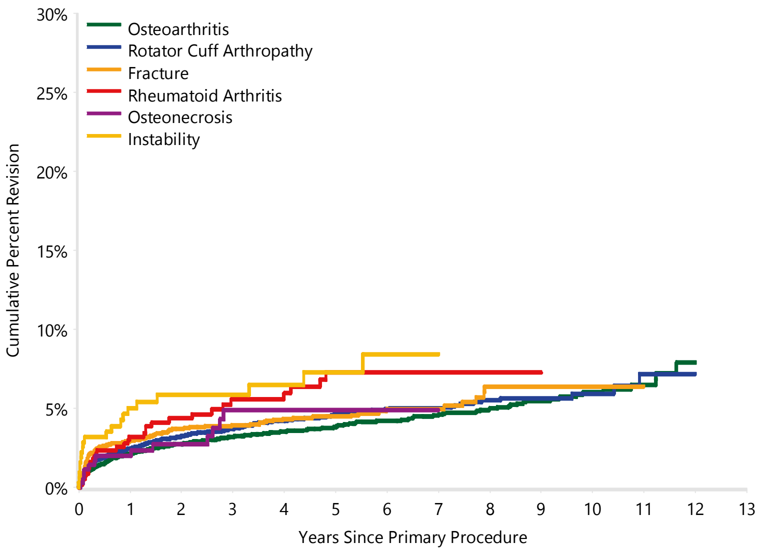
The four most common types of revision are: replacement of both cup (liner) and glenosphere (21.6%), humeral component only (21.2%), cup only (18.5%), and humeral head only (converted to a hemi arthroplasty) (12.6%) (Table ST49). When only the humeral component is revised, this may be associated with exchange of the epiphysis and/or humeral stem and additional minor components such as the liner.

Table ST47 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Primary Diagnosis

Primary Diagnosis	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Osteoarthritis	446	13374	2.1 (1.9, 2.4)	3.2 (2.9, 3.5)	3.8 (3.5, 4.2)	4.6 (4.1, 5.1)	6.0 (5.2, 7.0)	
Rotator Cuff Arthropathy	394	10808	2.5 (2.2, 2.8)	3.7 (3.3, 4.1)	4.7 (4.2, 5.2)	5.0 (4.5, 5.6)	5.9 (5.1, 6.9)	
Fracture	178	4601	3.0 (2.5, 3.5)	3.9 (3.4, 4.6)	4.5 (3.8, 5.2)	4.9 (4.2, 5.9)	6.4 (5.0, 8.1)	
Rheumatoid Arthritis	31	569	3.2 (2.0, 5.1)	5.6 (3.8, 8.1)	7.3 (5.0, 10.5)	7.3 (5.0, 10.5)		
Osteonecrosis	13	363	2.0 (1.0, 4.1)	4.9 (2.8, 8.5)	4.9 (2.8, 8.5)	4.9 (2.8, 8.5)		
Instability	22	316	5.0 (3.1, 8.2)	5.8 (3.7, 9.3)	7.3 (4.6, 11.5)	8.4 (5.2, 13.5)		
Other (3)	27	299	5.1 (3.0, 8.6)	11.4 (7.4, 17.2)	12.5 (8.2, 18.9)			
TOTAL	**1111**	**30330**						

Note: Only primary diagnoses with over 300 procedures have been listed

Figure ST29 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=1.11 (0.97, 1.27),p=0.124

Fracture vs Osteoarthritis
0 - 3Mth: HR=2.10 (1.66, 2.66),p<0.001
3Mth+: HR=1.07 (0.84, 1.37),p=0.564

Rheumatoid Arthritis vs Osteoarthritis
Entire Period: HR=1.50 (1.04, 2.17),p=0.030

Osteonecrosis vs Osteoarthritis
Entire Period: HR=1.14 (0.66, 1.99),p=0.639

Instability vs Osteoarthritis
Entire Period: HR=2.02 (1.32, 3.10),p=0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Osteoarthritis	13374	10704	6554	3706	1936	577	14
Rotator Cuff Arthropathy	10808	8438	4830	2654	1288	256	10
Fracture	4601	3591	2045	1044	472	93	1
Rheumatoid Arthritis	569	454	295	194	115	36	2
Osteonecrosis	363	285	156	81	47	13	0
Instability	316	248	161	97	53	22	0

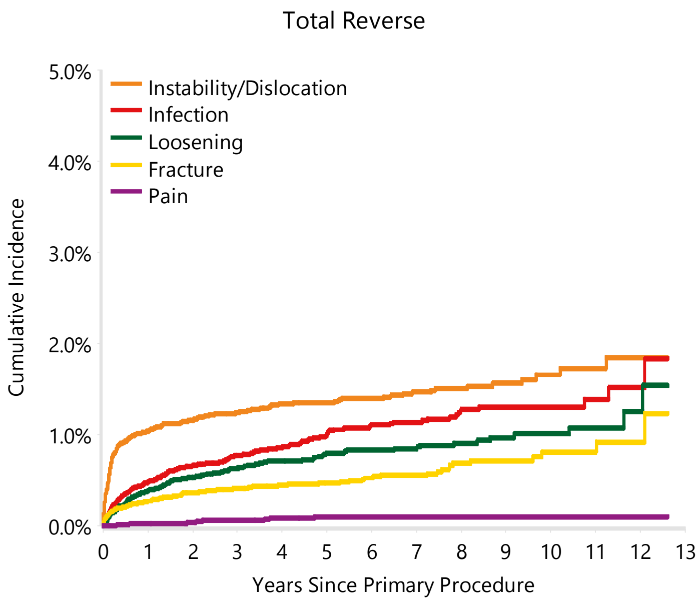
Table ST48 Primary Total Reverse Shoulder Replacement by Reason for Revision

Reason for Revision	Number	Percent
Instability/Dislocation	379	34.1
Infection	246	22.1
Loosening	193	17.4
Fracture	133	12.0
Pain	19	1.7
Lysis	15	1.4
Malposition	11	1.0
Dissociation	10	0.9
Incorrect Sizing	10	0.9
Arthrofibrosis	10	0.9
Implant Breakage Glenoid	8	0.7
Metal Related Pathology	7	0.6
Rotator Cuff Insufficiency	6	0.5
Wear Humeral Cup	2	0.2
Tumour	2	0.2
Wear Glenoid Insert	1	0.1
Implant Breakage Head	1	0.1
Synovitis	1	0.1
Heterotopic Bone	1	0.1
Other	56	5.0
TOTAL	**1111**	**100.0**

Table ST49 Primary Total Reverse Shoulder Replacement by Type of Revision

Type of Revision	Number	Percent
Cup/Head	240	21.6
Humeral Component	236	21.2
Cup Only	206	18.5
Head Only	140	12.6
Cement Spacer	90	8.1
Glenoid Component	83	7.5
Humeral/Glenoid	70	6.3
Removal of Prostheses	22	2.0
Reoperation	9	0.8
Minor Components	9	0.8
Cement Only	3	0.3
Reinsertion of Components	2	0.2
Head/Insert	1	0.1
TOTAL	**1111**	**100.0**

Figure ST30 Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement



OUTCOME FOR OSTEOARTHRITIS – PATIENT CHARACTERISTICS

Age and Gender

Primary total reverse shoulder replacement is most commonly used in patients aged ≥75 years. Patients aged 55-64 years and 65-74 years have a higher rate of revision compared to patients aged ≥75 years. Primary total reverse shoulder replacement in patients <55 years has only been used in small numbers (Table ST50 and Figure ST31).

Males have a higher rate of revision compared to females (Table ST51 and Figure ST32). The increase in the rate of revision is due to a higher cumulative incidence of instability/dislocation (2.0% for males at 10 years compared to 1.3% for females) and infection (2.3% compared to 0.6%) (Figure ST33).

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

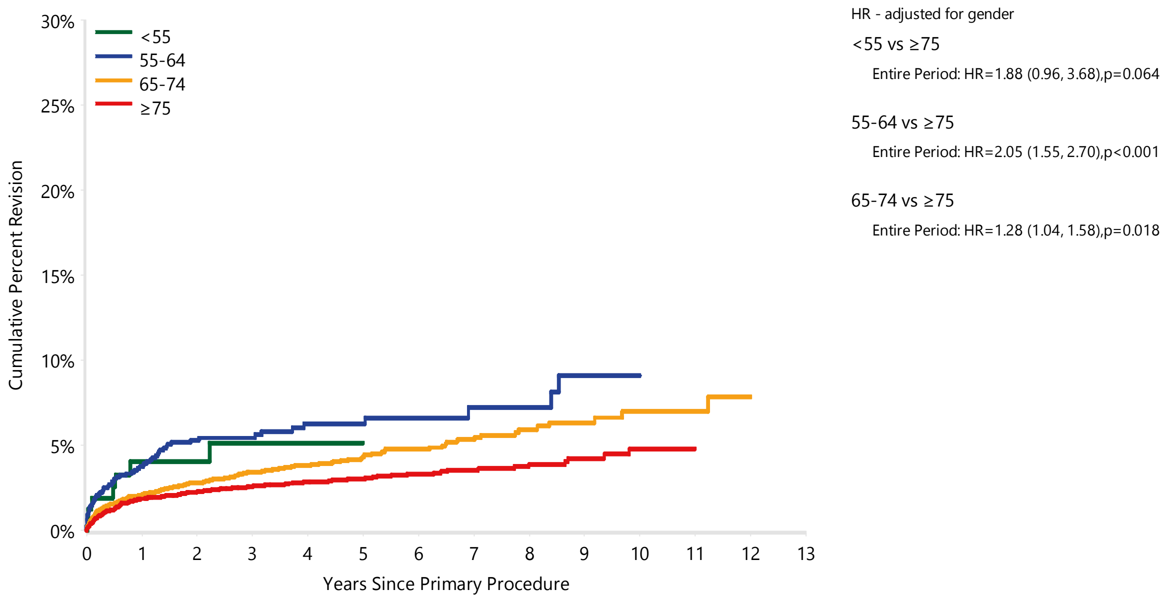
ASA scores are an indication of comorbidity and have been collected since 2012. The definitions for these scores can be found in the introductory chapter. The Registry can now report on the early outcome of 10,094 primary total reverse shoulder replacement procedures for osteoarthritis in relation to these scores. When compared to patients with ASA score 2, patients with ASA scores 3 and 4 have higher rates of revision (Table ST52 and Figure ST34). The most common reasons for revision can be found in Figure ST35. The rate of instability/dislocation increases with increasing ASA score.

BMI data have been collected since 2015. The early revision outcomes are reported for 7,898 primary total reverse shoulder replacement procedures for osteoarthritis. There is no difference in the rate of revision when patients in pre-obese and obese classes 1, 2 and 3 are compared to patients in the normal BMI class (Table ST53 and Figure ST36). The most common reasons for revision are shown in Figure ST37.

Table ST50 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	13 Yrs
<55	9	159	4.0 (1.8, 8.8)	5.1 (2.4, 10.6)	5.1 (2.4, 10.6)			
55-64	71	1220	3.7 (2.8, 5.0)	5.4 (4.2, 7.0)	6.3 (4.9, 8.1)	7.2 (5.4, 9.6)	9.1 (6.3, 13.0)	
65-74	184	5127	2.1 (1.7, 2.5)	3.4 (2.9, 4.1)	4.3 (3.7, 5.1)	5.3 (4.5, 6.3)	7.0 (5.6, 8.7)	
≥75	182	6868	1.9 (1.6, 2.2)	2.6 (2.2, 3.0)	3.0 (2.6, 3.6)	3.5 (3.0, 4.2)	4.8 (3.8, 6.1)	
TOTAL	**446**	**13374**						

Figure ST31 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Age (Primary Diagnosis OA)

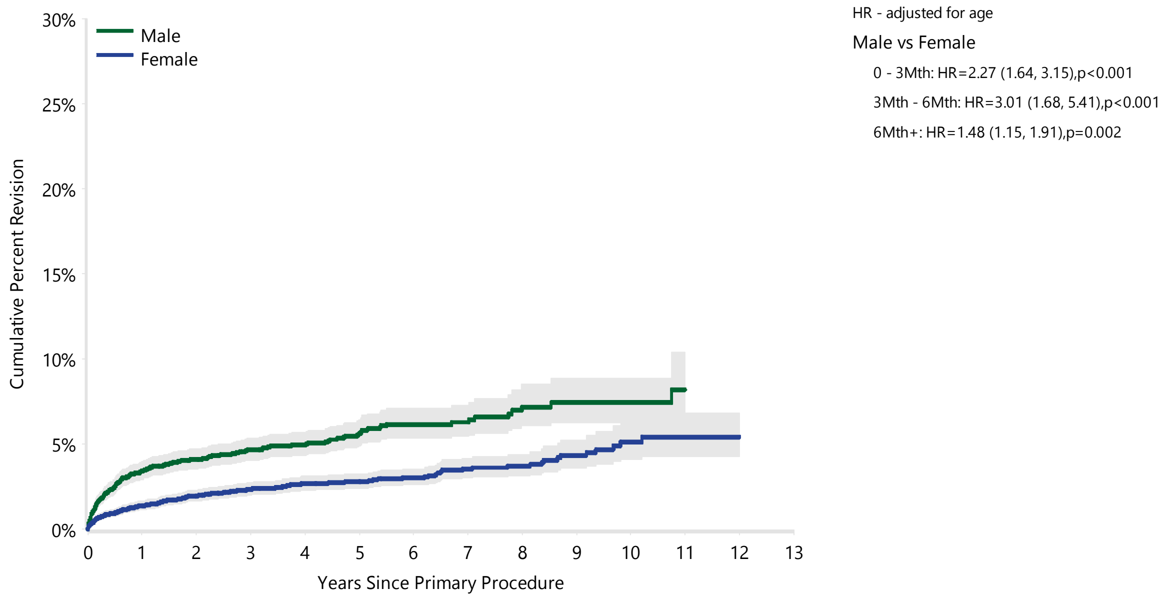


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
<55	159	119	69	40	21	10	1
55-64	1220	938	517	279	154	52	1
65-74	5127	4090	2469	1349	719	237	4
≥75	6868	5557	3499	2038	1042	278	8

Table ST51 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Gender (Primary Diagnosis OA)

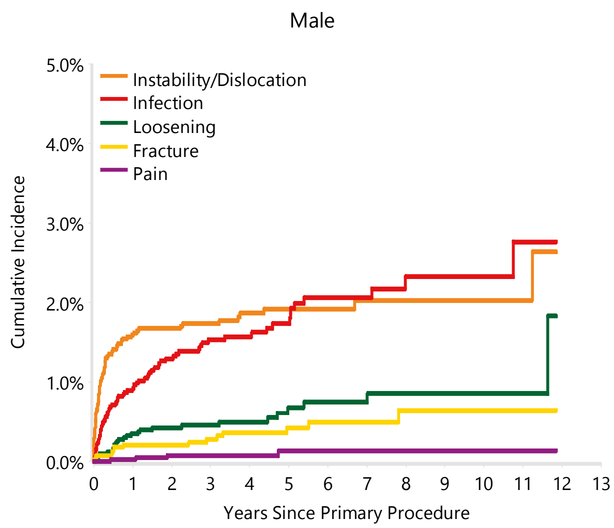
Gender	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Male	239	5079	3.4 (2.9, 4.0)	4.7 (4.1, 5.3)	5.6 (4.9, 6.4)	6.3 (5.4, 7.3)	7.5 (6.3, 8.9)	
Female	207	8295	1.4 (1.1, 1.6)	2.3 (2.0, 2.7)	2.8 (2.4, 3.2)	3.5 (3.0, 4.2)	5.1 (4.1, 6.4)	
TOTAL	**446**	**13374**						

Figure ST32 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	13 Yrs
Male	5079	3943	2339	1289	645	192	4
Female	8295	6761	4215	2417	1291	385	10

Figure ST33 Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement by Gender (Primary Diagnosis OA)



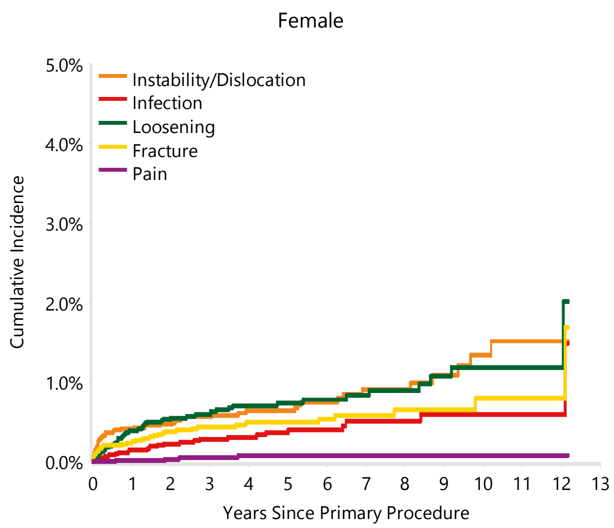
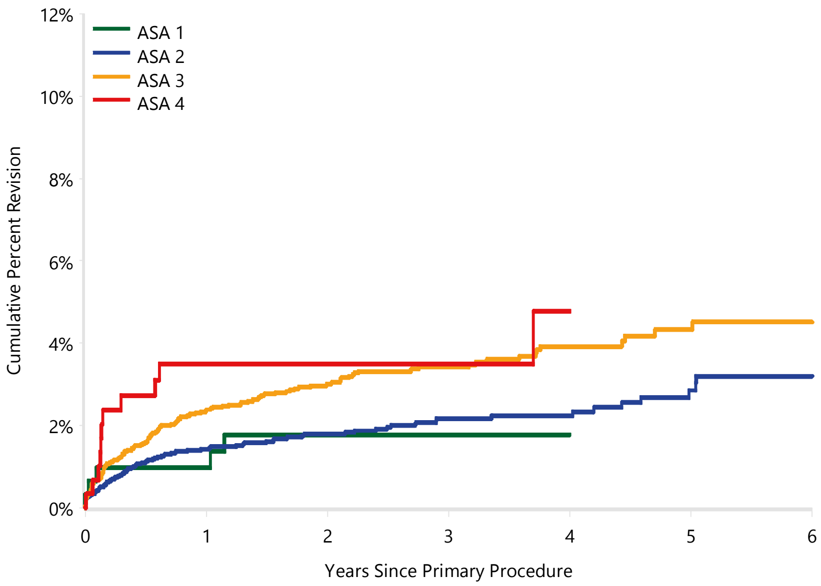


Table ST52 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by ASA Score (Primary Diagnosis OA)

ASA Score	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
ASA 1	5	313	1.0 (0.3, 3.0)	1.8 (0.7, 4.2)	1.8 (0.7, 4.2)	1.8 (0.7, 4.2)	
ASA 2	86	4424	1.4 (1.1, 1.8)	1.8 (1.4, 2.3)	2.2 (1.7, 2.7)	2.2 (1.8, 2.8)	2.8 (2.2, 3.7)
ASA 3	151	5054	2.4 (2.0, 2.8)	3.0 (2.5, 3.6)	3.4 (2.9, 4.0)	3.9 (3.3, 4.7)	4.3 (3.6, 5.2)
ASA 4	11	302	3.5 (1.9, 6.4)	3.5 (1.9, 6.4)	3.5 (1.9, 6.4)	4.8 (2.4, 9.4)	
ASA 5	0	1					
TOTAL	**253**	**10094**					

Figure ST34 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by ASA Score (Primary Diagnosis OA)



HR - adjusted for age and gender

ASA 1 vs ASA 2

Entire Period: HR=0.66 (0.27, 1.64),p=0.371

ASA 3 vs ASA 2

Entire Period: HR=1.73 (1.33, 2.26),p<0.001

ASA 4 vs ASA 2

Entire Period: HR=2.11 (1.12, 3.96),p=0.020

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
ASA 2	313	249	175	123	76	38	13
ASA 3	4424	3414	2538	1708	1062	562	189
ASA 4	5054	3696	2603	1728	1006	515	157

Figure ST35 Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement by ASA Score (Primary Diagnosis OA)

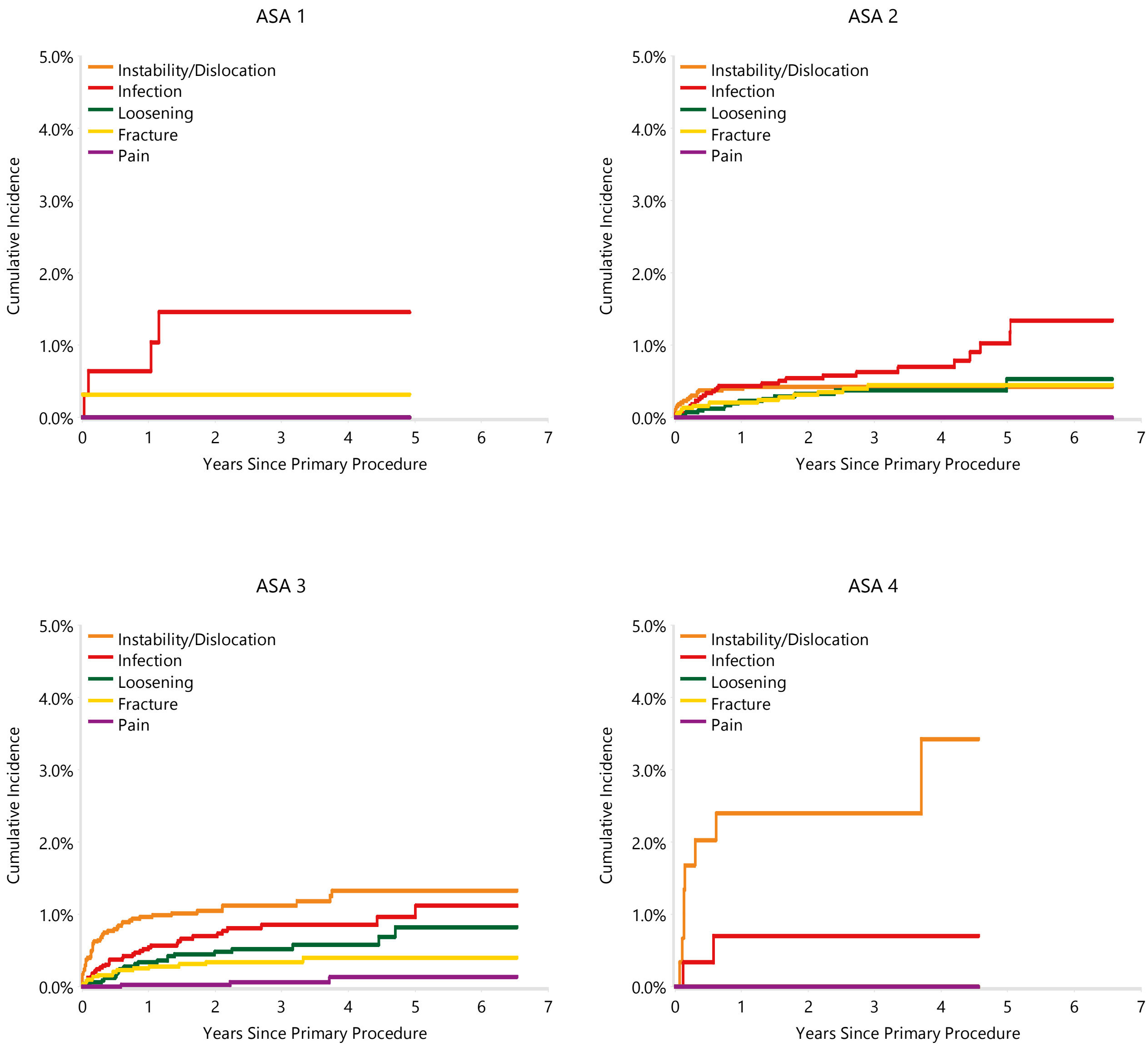
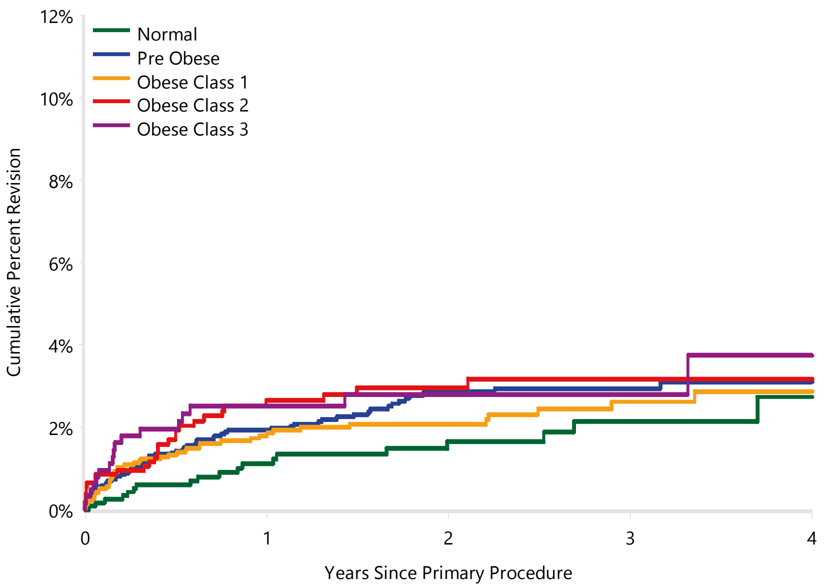


Table ST53 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by BMI Category (Primary Diagnosis OA)

BMI Category	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs
Underweight	3	46	4.7 (1.2, 17.5)	8.1 (2.6, 23.5)	8.1 (2.6, 23.5)	
Normal	19	1216	1.1 (0.6, 2.0)	1.6 (1.0, 2.7)	2.1 (1.3, 3.5)	2.7 (1.5, 4.9)
Pre Obese	65	2747	1.9 (1.4, 2.5)	2.8 (2.2, 3.7)	2.9 (2.3, 3.8)	3.1 (2.4, 4.0)
Obese Class 1	45	2192	1.8 (1.3, 2.5)	2.1 (1.5, 2.8)	2.6 (1.9, 3.6)	2.9 (2.0, 4.0)
Obese Class 2	29	1068	2.6 (1.8, 3.9)	3.0 (2.0, 4.3)	3.2 (2.2, 4.6)	3.2 (2.2, 4.6)
Obese Class 3	17	629	2.5 (1.5, 4.1)	2.8 (1.7, 4.5)	2.8 (1.7, 4.5)	3.7 (2.0, 6.9)
TOTAL	**178**	**7898**				

Figure ST36 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=1.32 (0.79, 2.21),p=0.285

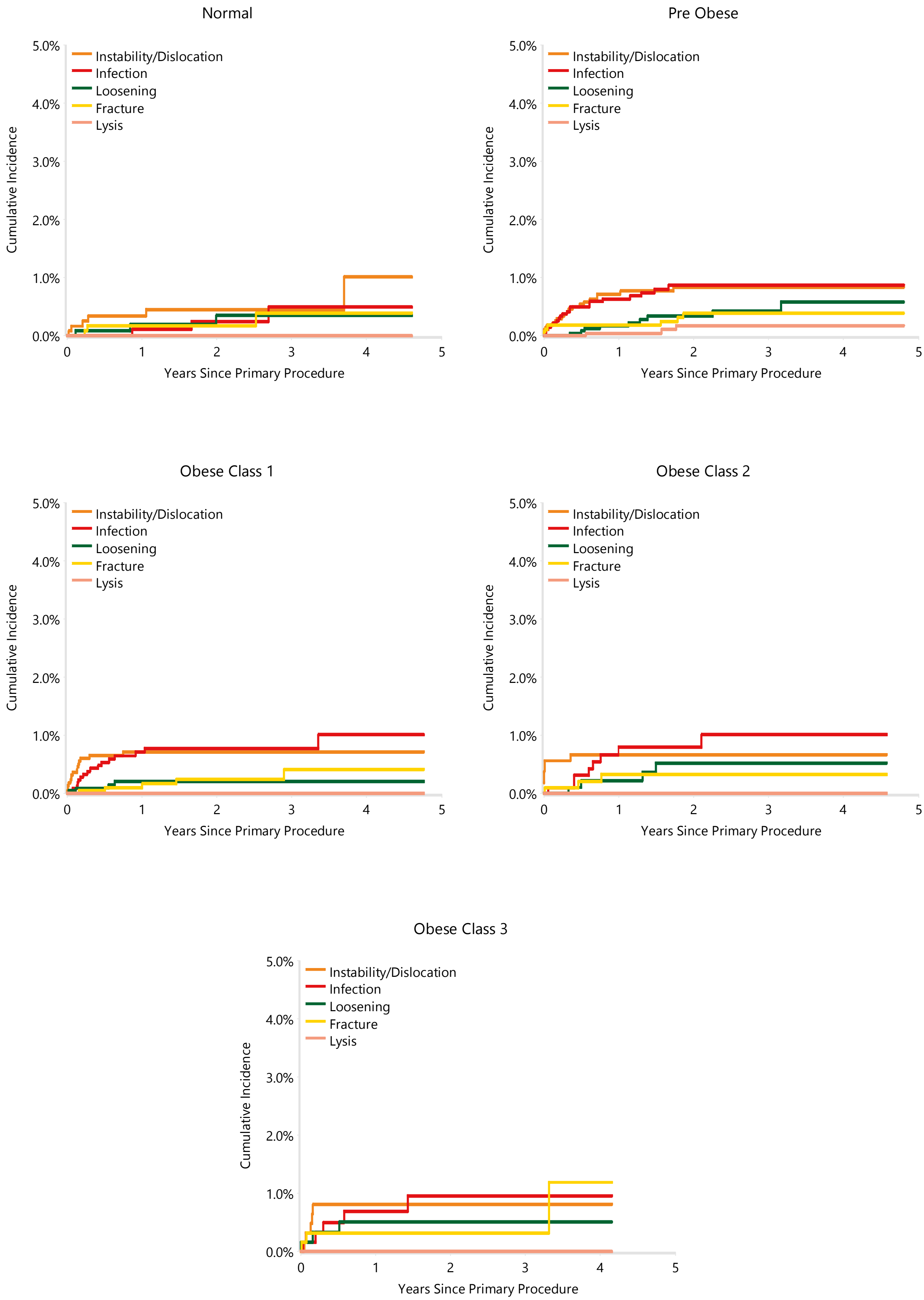
Obese Class 1 vs Normal
Entire Period: HR=1.16 (0.67, 1.98),p=0.598

Obese Class 2 vs Normal
0 - 6Mth: HR=1.92 (1.00, 3.70),p=0.051
6Mth+: HR=1.38 (0.63, 3.06),p=0.419

Obese Class 3 vs Normal
Entire Period: HR=1.76 (0.91, 3.42),p=0.094

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs
Normal	1216	890	596	300	116
Pre Obese	2747	1928	1262	682	262
Obese Class 1	2192	1515	931	528	207
Obese Class 2	1068	740	467	256	101
Obese Class 3	629	427	269	140	49

Figure ST37 Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement by BMI Category (Primary Diagnosis OA)



OUTCOME FOR OSTEOARTHRITIS – PROSTHESIS CHARACTERISTICS

Fixation

Fixation is not a risk factor for revision. There is no difference between hybrid (humerus cemented) and cementless humeral stems (Table ST54 and Figure ST38). This is also the case when the SMR L2 prosthesis is excluded from the analysis (Table ST55 and Figure ST39).

Glenosphere Size

Glenosphere sizes <38mm have a higher rate of revision compared to 38-40mm sizes, and sizes >40mm (Table ST56 and Figure ST40). The cumulative incidence for the most common reasons for revision is presented in Figure ST41.

The outcomes of the most commonly used primary total reverse shoulder prostheses are listed in Table ST57.

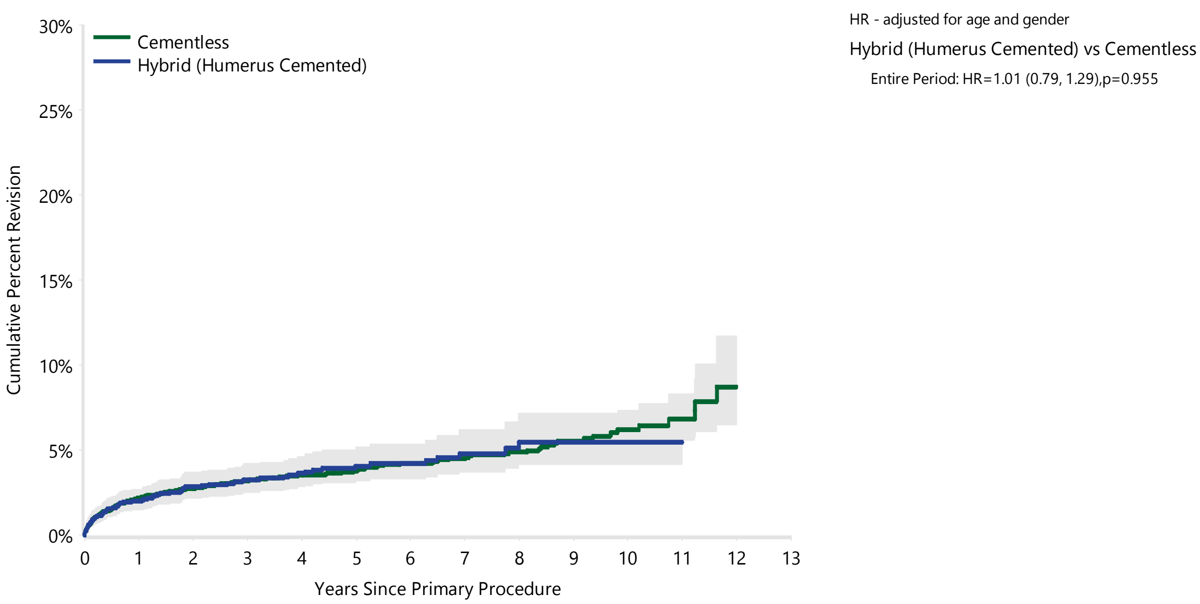
Glenosphere sizes <38mm have a higher rate of revision.

The outcomes for the most used prosthesis combinations using cementless fixation are listed in Table ST58. The most commonly used prosthesis combinations using hybrid (humerus cemented) fixation are listed in Table ST59.

Table ST54 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	13 Yrs
Cemented	3	95	1.1 (0.2, 7.5)	2.4 (0.6, 9.1)	4.3 (1.3, 13.1)	4.3 (1.3, 13.1)	4.3 (1.3, 13.1)	
Cementless	365	11132	2.2 (1.9, 2.5)	3.2 (2.8, 3.6)	3.8 (3.4, 4.2)	4.5 (4.0, 5.1)	6.2 (5.2, 7.4)	
Hybrid (Glenoid Cemented)	3	82	2.4 (0.6, 9.4)	3.9 (1.3, 11.7)	3.9 (1.3, 11.7)			
Hybrid (Humerus Cemented)	75	2065	2.0 (1.5, 2.7)	3.3 (2.5, 4.2)	4.1 (3.2, 5.2)	4.8 (3.7, 6.2)	5.5 (4.1, 7.2)	
TOTAL	**446**	**13374**						

Figure ST38 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Fixation (Primary Diagnosis OA)



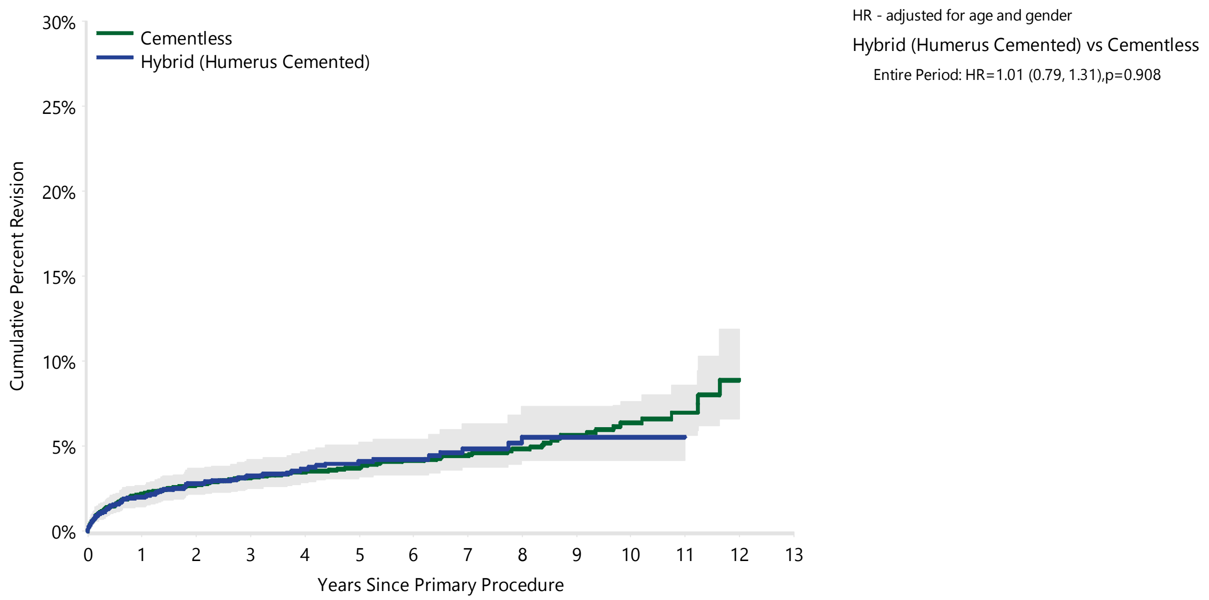
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Cementless	11132	8771	5200	2888	1488	443	14
Hybrid (Humerus Cemented)	2065	1779	1247	756	407	121	0

Note: Only fixations with over 100 procedures have been listed

Table ST55 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Fixation (Primary Diagnosis OA, Excluding SMR L2)

Fixation	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Cemented	3	95	1.1 (0.2, 7.5)	2.4 (0.6, 9.1)	4.3 (1.3, 13.1)	4.3 (1.3, 13.1)	4.3 (1.3, 13.1)	
Cementless	342	10681	2.2 (1.9, 2.5)	3.2 (2.8, 3.6)	3.7 (3.3, 4.2)	4.4 (3.9, 5.0)	6.4 (5.3, 7.6)	
Hybrid (Glenoid Cemented)	3	80	2.5 (0.6, 9.6)	4.0 (1.3, 12.0)	4.0 (1.3, 12.0)			
Hybrid (Humerus Cemented)	74	2036	2.0 (1.4, 2.7)	3.3 (2.5, 4.2)	4.1 (3.2, 5.2)	4.9 (3.8, 6.3)	5.5 (4.2, 7.3)	
TOTAL	**422**	**12892**						

Figure ST39 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Fixation (Primary Diagnosis OA, Excluding SMR L2)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Cementless	10681	8339	4794	2520	1163	431	14
Hybrid (Humerus Cemented)	2036	1752	1221	732	387	121	0

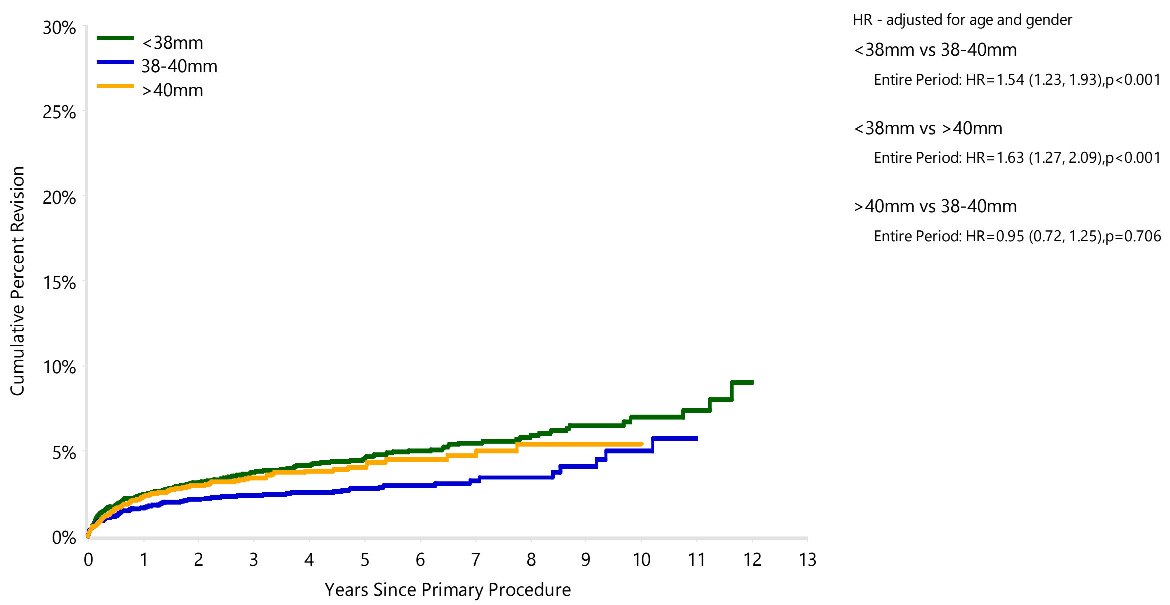
Note: Only fixations with over 100 procedures have been listed

Table ST56 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	13 Yrs
<38mm	217	5117	2.4 (2.0, 2.9)	3.7 (3.2, 4.3)	4.6 (3.9, 5.3)	5.5 (4.7, 6.4)	7.0 (5.8, 8.3)	
38-40mm	121	4971	1.7 (1.3, 2.1)	2.4 (2.0, 2.9)	2.8 (2.3, 3.4)	3.3 (2.6, 4.1)	5.0 (3.5, 7.0)	
>40mm	103	3155	2.3 (1.8, 3.0)	3.4 (2.8, 4.2)	4.1 (3.3, 5.0)	4.7 (3.8, 5.9)	5.4 (4.1, 7.1)	
TOTAL	**441**	**13243**						

Note: Excludes 131 procedures with unknown glenosphere size

Figure ST40 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Glenosphere Size (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
<38mm	5117	4233	2858	1796	1042	349	13
38-40mm	4971	3958	2289	1189	546	152	0
>40mm	3155	2454	1399	719	347	75	1

Figure ST41 Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement by Glenosphere Size (Primary Diagnosis OA)

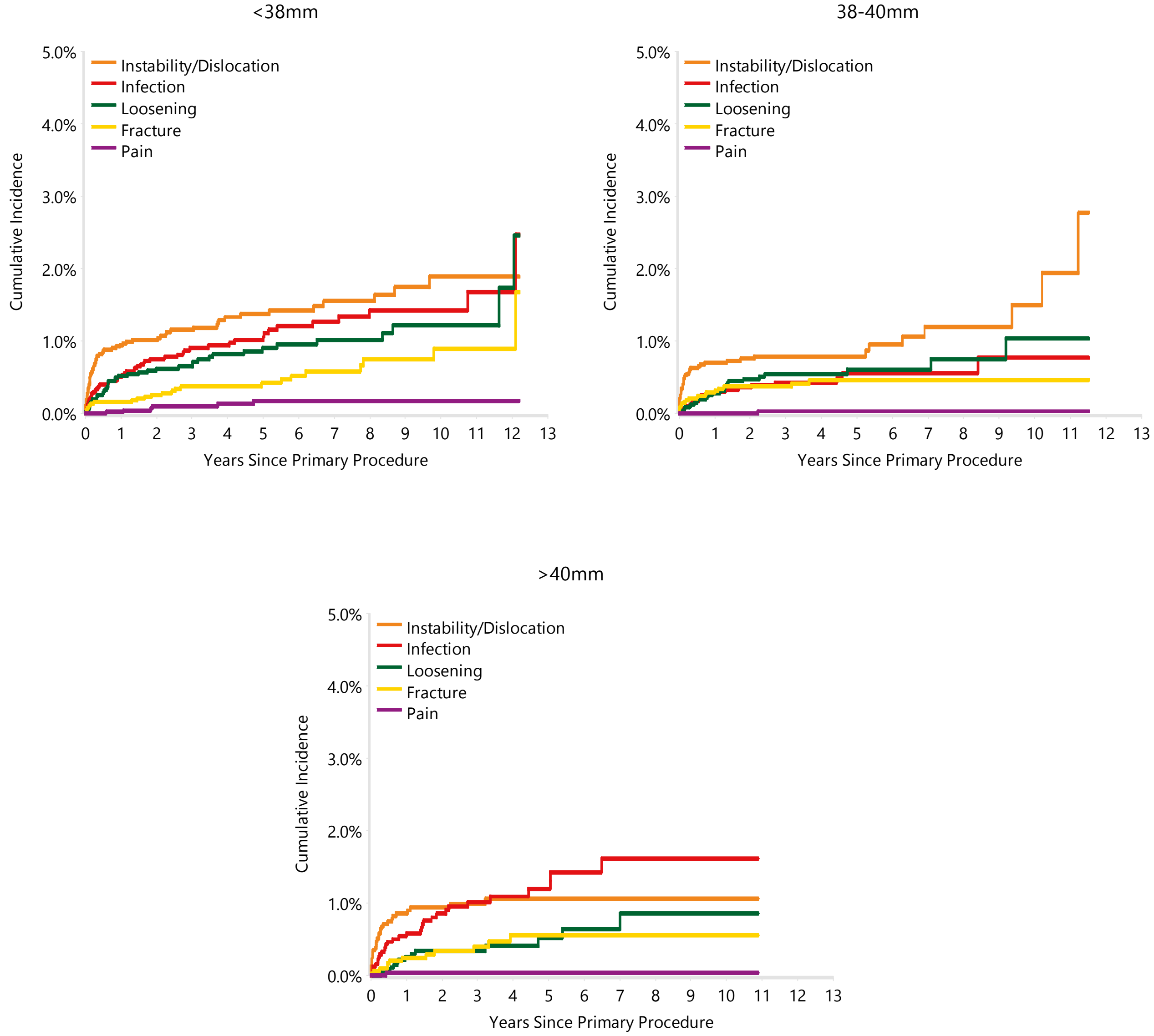


Table ST57 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Prosthesis Combination (Primary Diagnosis OA)

Humeral Stem	Glenoid Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Aequalis	Aequalis	61	1270	2.1 (1.4, 3.1)	3.6 (2.7, 4.9)	4.5 (3.4, 6.0)	5.9 (4.5, 7.7)	8.6 (5.9, 12.5)	
	Perform Reversed	0	26	0.0 (0.0, 0.0)					
Affinis	Affinis	11	427	1.8 (0.8, 3.7)	3.5 (1.9, 6.5)				
AltiVate Reverse	RSP	0	28						
Ascend Flex	Aequalis	15	541	2.3 (1.3, 4.1)	3.7 (2.1, 6.5)				
	Perform Reversed	0	39	0.0 (0.0, 0.0)					
Comprehensive	Comprehensive Reverse	16	867	1.4 (0.8, 2.5)	2.1 (1.2, 3.7)	3.8 (1.9, 7.4)			
	Custom Made	0	32	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)				
Delta CTA	Delta CTA	10	64	7.8 (3.3, 17.8)	9.4 (4.3, 19.8)	9.4 (4.3, 19.8)	11.4 (5.6, 22.5)	11.4 (5.6, 22.5)	
Delta Xtend	Delta Xtend	111	3846	1.8 (1.4, 2.3)	2.5 (2.0, 3.1)	3.0 (2.4, 3.7)	3.6 (2.9, 4.5)	5.0 (3.8, 6.7)	
Equinoxe	Equinoxe	24	950	2.2 (1.4, 3.4)	3.2 (2.1, 4.8)				
Global Unite	Delta Xtend	8	209	1.1 (0.3, 4.2)	5.2 (2.6, 10.2)				
Promos	Promos	3	40	0.0 (0.0, 0.0)	5.0 (1.3, 18.5)	5.0 (1.3, 18.5)	5.0 (1.3, 18.5)	8.1 (2.7, 23.1)	
RSP	RSP	27	713	3.0 (2.0, 4.7)	4.4 (2.9, 6.5)	6.5 (3.7, 11.2)			
SMR	SMR Axioma	1	42	3.7 (0.5, 23.5)					
	SMR L1	103	3035	2.5 (2.0, 3.1)	3.3 (2.7, 4.1)	3.6 (2.9, 4.4)	4.3 (3.4, 5.5)	6.0 (4.3, 8.2)	
	SMR L2	24	482	2.3 (1.3, 4.1)	3.6 (2.2, 5.7)	4.3 (2.8, 6.6)	5.1 (3.4, 7.5)		
Trabecular Metal	Comprehensive Reverse	0	49	0.0 (0.0, 0.0)					
	Trabecular Metal	22	594	1.9 (1.1, 3.4)	3.2 (2.0, 5.1)	4.4 (2.8, 6.7)	4.4 (2.8, 6.7)		
Other (20)		10	120	7.9 (4.0, 15.3)	9.3 (4.9, 17.3)				
TOTAL		**446**	**13374**						

Note: Only combinations with over 25 procedures have been listed

Table ST58 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	13 Yrs
Aequalis	Aequalis	52	981	2.2 (1.4, 3.3)	4.0 (2.9, 5.6)	4.9 (3.6, 6.6)	6.7 (5.0, 9.0)	9.7 (6.3, 14.7)	
Affinis	Affinis	6	260	1.3 (0.4, 4.0)	3.3 (1.4, 7.5)				
AltiVate Reverse	RSP	0	27						
Ascend Flex	Aequalis	14	500	2.3 (1.2, 4.2)	3.8 (2.1, 6.9)				
	Perform Reversed	0	33	0.0 (0.0, 0.0)					
Comprehensive	Comprehensive	15	830	1.4 (0.8, 2.6)	2.2 (1.3, 3.9)	3.0 (1.6, 5.7)			
	Custom Made	0	31	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)				
Delta CTA	Delta CTA	6	35	8.6 (2.8, 24.3)	8.6 (2.8, 24.3)	8.6 (2.8, 24.3)	11.7 (4.6, 28.3)	11.7 (4.6, 28.3)	26.4 (11.6, 53.6)
Delta Xtend	Delta Xtend	82	2738	2.1 (1.6, 2.7)	2.7 (2.1, 3.4)	3.2 (2.5, 4.0)	3.5 (2.8, 4.5)	5.6 (3.9, 8.1)	
Equinoxe	Equinoxe	21	907	2.0 (1.2, 3.3)	2.9 (1.8, 4.5)				
Global Unite	Delta Xtend	6	183	1.2 (0.3, 4.8)	4.2 (1.9, 9.3)				
Promos	Promos	3	38	0.0 (0.0, 0.0)	5.3 (1.3, 19.4)	5.3 (1.3, 19.4)	5.3 (1.3, 19.4)	8.4 (2.8, 24.0)	
RSP	RSP	12	413	2.9 (1.6, 5.2)					
SMR	SMR Axioma	1	41	3.8 (0.6, 24.3)					
	SMR L1	98	2954	2.4 (1.9, 3.1)	3.2 (2.6, 4.0)	3.5 (2.8, 4.3)	4.2 (3.3, 5.4)	6.0 (4.3, 8.3)	
	SMR L2	23	451	2.2 (1.2, 4.1)	3.6 (2.2, 5.8)	4.4 (2.8, 6.7)	5.2 (3.4, 7.8)		
Trabecular Metal	Comprehensive	0	48	0.0 (0.0, 0.0)					
	Trabecular Metal	18	534	1.9 (1.0, 3.6)	2.9 (1.7, 4.8)	3.8 (2.4, 6.2)	3.8 (2.4, 6.2)		
Other (18)		8	128	5.9 (2.6, 12.8)	7.5 (3.6, 15.6)				
TOTAL		**365**	**11132**						

Note: Only combinations with over 25 procedures have been listed

Table ST59 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	13 Yrs
Aequalis	Aequalis	9	268	1.9 (0.8, 4.6)	2.4 (1.1, 5.3)	3.6 (1.8, 7.3)	3.6 (1.8, 7.3)		
Affinis	Affinis	4	155	2.6 (1.0, 6.9)					
Ascend Flex	Aequalis	1	39	2.7 (0.4, 17.7)	2.7 (0.4, 17.7)	2.7 (0.4, 17.7)			
Comprehensive	Comprehensive Reverse	1	32	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	12.5 (1.9, 61.3)			
Delta CTA	Delta CTA	4	29	6.9 (1.8, 24.9)	10.5 (3.5, 29.1)	10.5 (3.5, 29.1)	10.5 (3.5, 29.1)	10.5 (3.5, 29.1)	
Delta Xtend	Delta Xtend	28	1051	1.3 (0.7, 2.1)	2.2 (1.4, 3.3)	2.5 (1.6, 3.7)	3.6 (2.4, 5.5)	4.1 (2.7, 6.3)	
Equinoxe	Equinoxe	3	42	5.5 (1.4, 20.2)	8.9 (2.9, 25.2)				
RSP	RSP	11	257	2.4 (1.1, 5.3)	3.9 (2.1, 7.5)	6.8 (3.3, 13.8)			
SMR	SMR L1	5	61	5.1 (1.7, 15.0)	9.2 (3.9, 20.7)	9.2 (3.9, 20.7)	9.2 (3.9, 20.7)		
	SMR L2	1	29	3.4 (0.5, 22.1)	3.4 (0.5, 22.1)	3.4 (0.5, 22.1)	3.4 (0.5, 22.1)		
Trabecular Metal	Trabecular Metal	4	51	2.0 (0.3, 13.1)	6.8 (2.2, 19.8)	11.0 (4.1, 28.2)	11.0 (4.1, 28.2)		
Other (14)		4	51	4.8 (1.2, 18.5)	12.1 (4.6, 29.8)	12.1 (4.6, 29.8)			
TOTAL		**75**	**2065**						

Note: Only combinations with over 25 procedures have been listed

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 ST60 and Figure ST42).

Males have a higher rate of revision compared to females (Table ST61 and Figure ST43).

The rate of instability/dislocation increases with increasing BMI class.

The increase in the rate of revision is due to a higher cumulative incidence of instability/ dislocation (1.5% at 10 years for males compared to 1.0% for females) and infection (2.3% compared to 0.6%) (Figure ST44).

ASA and BMI

The Registry is now reporting on the early outcome of 8,612 primary total reverse shoulder replacement procedures for rotator cuff arthropathy in relation to ASA score.

There is no difference in the rate of revision when patients with ASA scores 2, 3 and 4 are compared to patients with ASA score 1 (Table ST62 and Figure ST45). The most common reasons for revision can be found in Figure ST46.

BMI data have been collected since 2015. The early revision outcomes are reported for 6,903 primary total reverse shoulder replacement procedures for rotator cuff arthropathy.

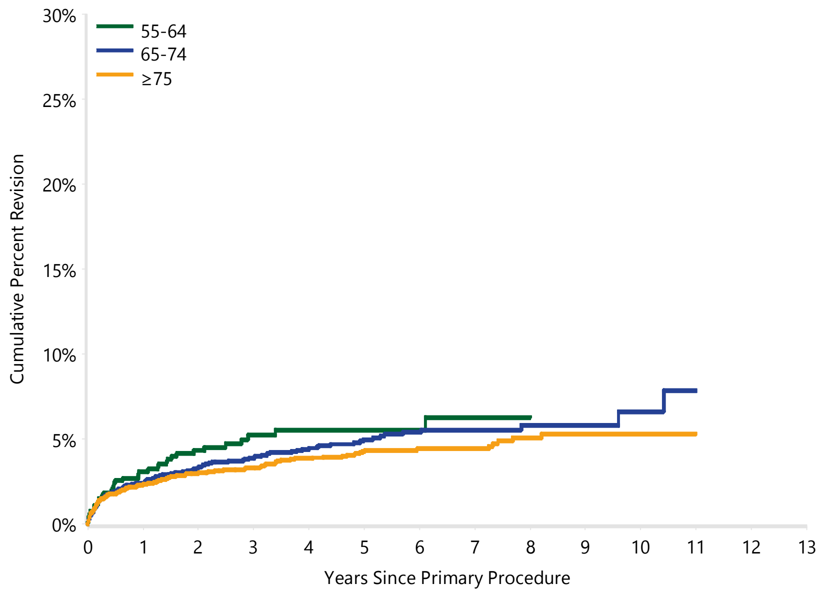
There is no difference in the rate of revision when patients who are BMI categories of pre-obese, and obese classes 1, 2 and 3 are compared to patients with a normal BMI (Table ST63 and Figure ST47).

The most common reasons for revision are shown in Figure ST48. The rate of instability/ dislocation increases with increasing BMI class.

Table ST60 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	13 Yrs
<55	5	98	4.2 (1.6, 10.7)	4.2 (1.6, 10.7)	4.2 (1.6, 10.7)			
55-64	42	938	3.1 (2.1, 4.5)	5.2 (3.8, 7.2)	5.5 (4.0, 7.6)	6.3 (4.4, 9.0)		
65-74	159	4193	2.4 (2.0, 3.0)	3.9 (3.3, 4.6)	5.0 (4.2, 5.9)	5.5 (4.6, 6.6)	6.6 (5.0, 8.8)	
≥75	188	5579	2.3 (2.0, 2.8)	3.3 (2.8, 3.8)	4.3 (3.7, 5.0)	4.4 (3.8, 5.2)	5.3 (4.4, 6.5)	
TOTAL	**394**	**10808**						

Figure ST42 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Age (Primary Diagnosis Rotator Cuff Arthropathy)



HR - adjusted for gender

55-64 vs ≥75

Entire Period: HR=1.24 (0.88, 1.74),p=0.213

55-64 vs 65-74

Entire Period: HR=1.14 (0.81, 1.61),p=0.437

65-74 vs ≥75

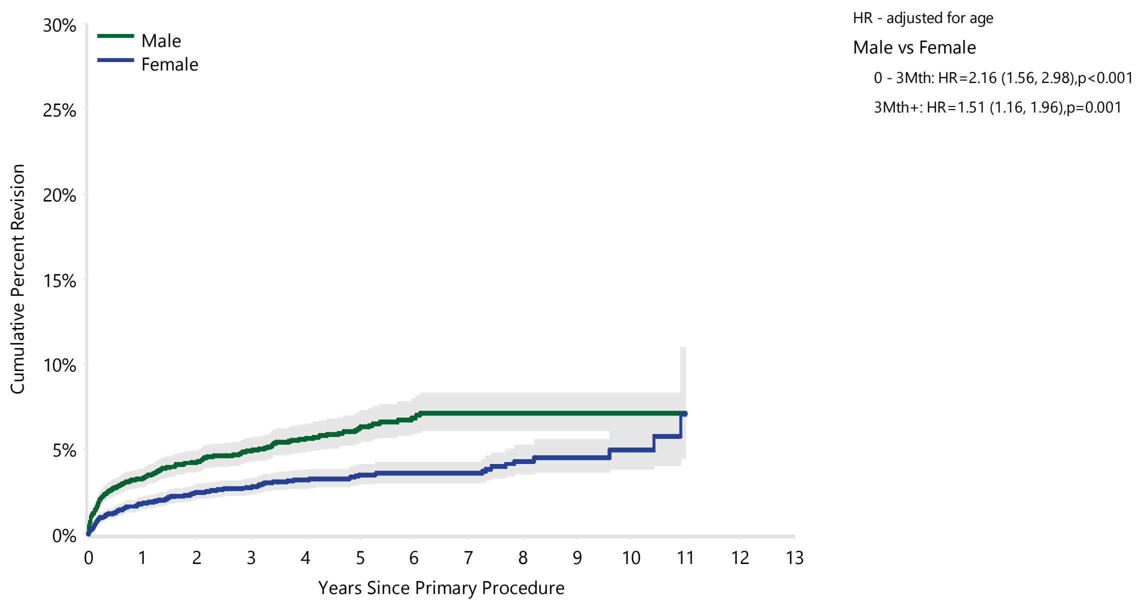
Entire Period: HR=1.08 (0.88, 1.34),p=0.464

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
55-64	938	714	361	178	90	22	0
65-74	4193	3231	1825	990	507	100	5
≥75	5579	4427	2613	1472	683	132	5

Table ST61 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	13 Yrs
Male	225	4728	3.3 (2.8, 3.8)	4.9 (4.3, 5.6)	6.2 (5.4, 7.2)	7.1 (6.1, 8.3)	7.1 (6.1, 8.3)	
Female	169	6080	1.8 (1.5, 2.2)	2.7 (2.3, 3.2)	3.5 (3.0, 4.1)	3.6 (3.0, 4.2)	5.0 (3.8, 6.4)	
TOTAL	**394**	**10808**						

Figure ST43 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	13 Yrs
Male	4728	3623	1944	1025	472	93	5
Female	6080	4815	2886	1629	816	163	5

Figure ST44 Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement by Gender (Primary Diagnosis Rotator Cuff Arthropathy)

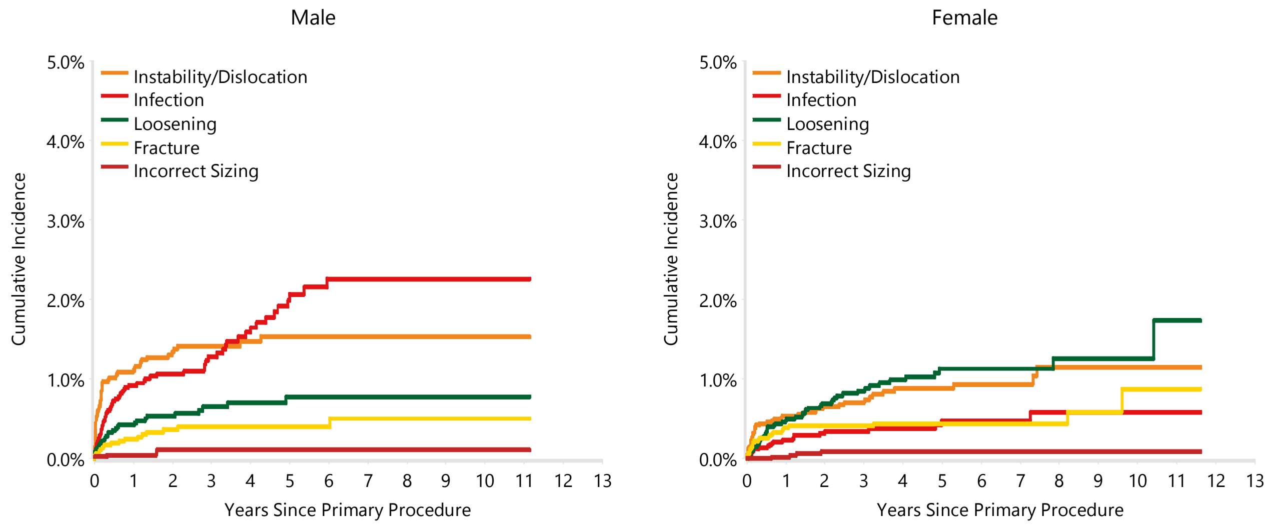
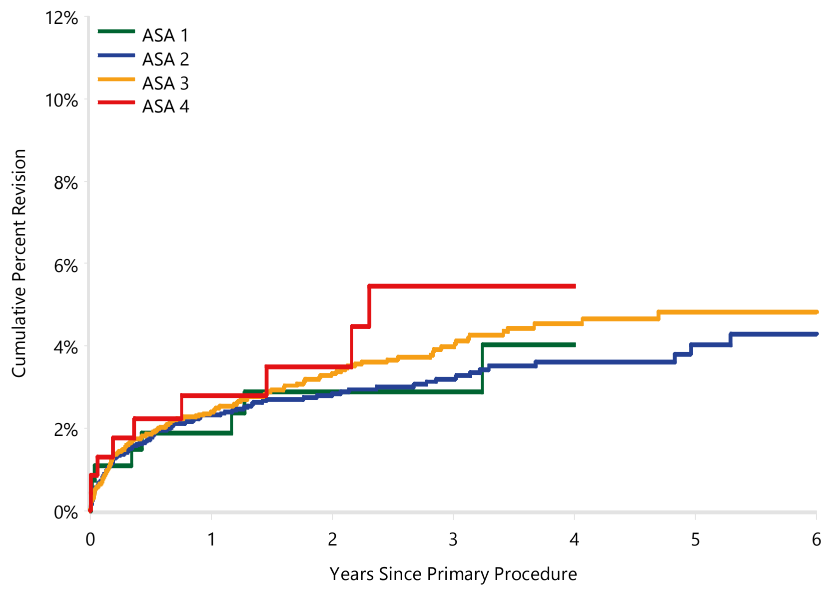


Table ST62 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by ASA Score (Primary Diagnosis Rotator Cuff Arthropathy)

ASA Score	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
ASA 1	8	273	1.9 (0.8, 4.5)	2.9 (1.4, 6.0)	2.9 (1.4, 6.0)	4.0 (1.9, 8.5)		
ASA 2	108	3742	2.3 (1.9, 2.9)	2.8 (2.3, 3.5)	3.2 (2.6, 3.9)	3.6 (2.9, 4.4)	4.0 (3.2, 5.1)	4.3 (3.3, 5.5)
ASA 3	144	4364	2.4 (2.0, 2.9)	3.3 (2.8, 4.0)	4.0 (3.3, 4.7)	4.5 (3.8, 5.4)	4.8 (4.0, 5.8)	4.8 (4.0, 5.8)
ASA 4	10	232	2.8 (1.3, 6.1)	3.5 (1.7, 7.3)	5.4 (2.8, 10.6)	5.4 (2.8, 10.6)		
ASA 5	0	1						
TOTAL	**270**	**8612**						

Figure ST45 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=1.14 (0.55, 2.34),p=0.727

ASA 3 vs ASA 1

Entire Period: HR=1.39 (0.68, 2.85),p=0.367

ASA 4 vs ASA 1

Entire Period: HR=1.85 (0.73, 4.72),p=0.197

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
ASA 1	273	216	144	91	66	38	17
ASA 2	3742	2804	2002	1331	860	435	171
ASA 3	4364	3166	2178	1392	832	435	154
ASA 4	232	159	103	75	42	27	10

Figure ST46 Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement by ASA Score (Primary Diagnosis Rotator Cuff Arthropathy)

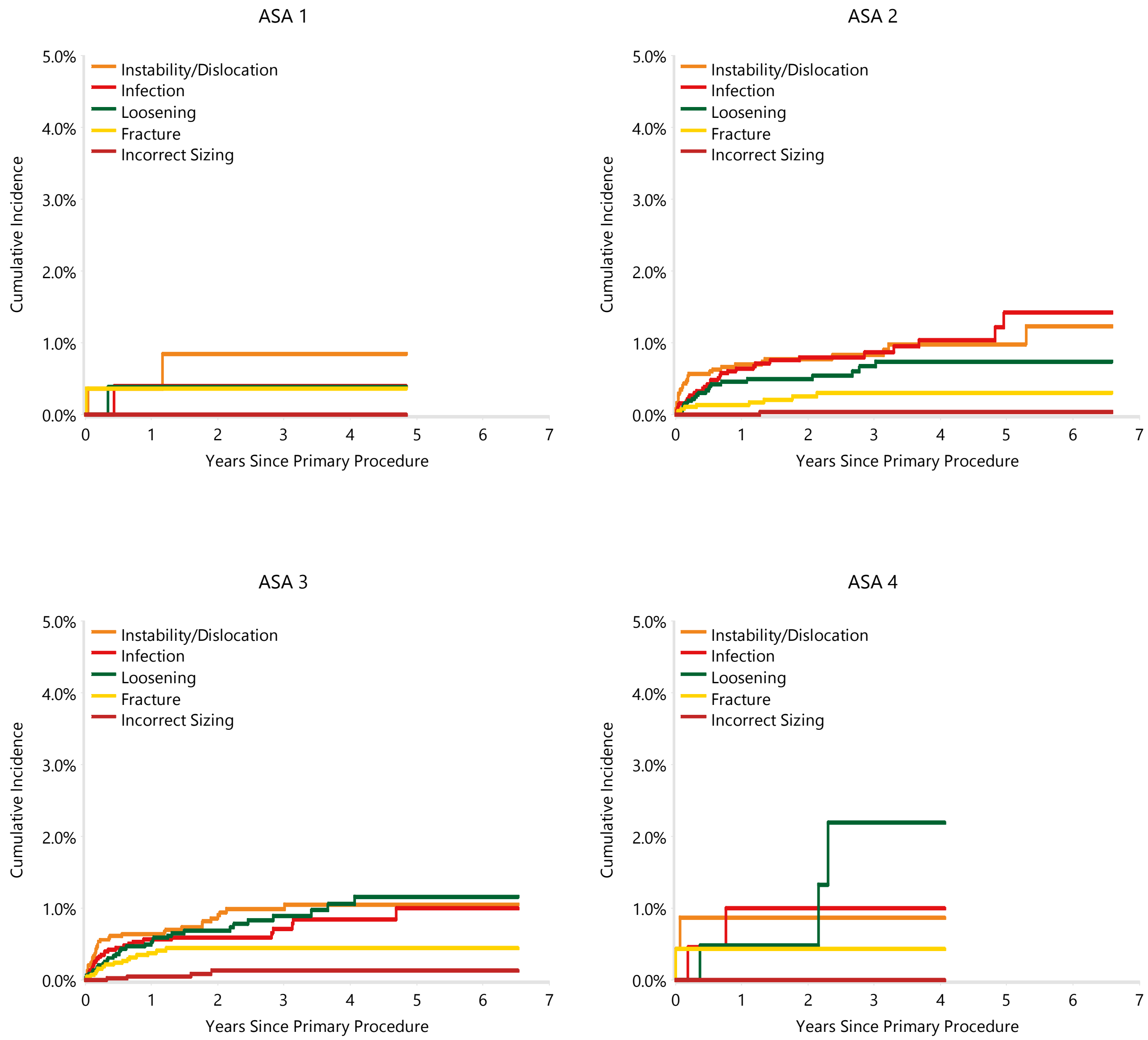
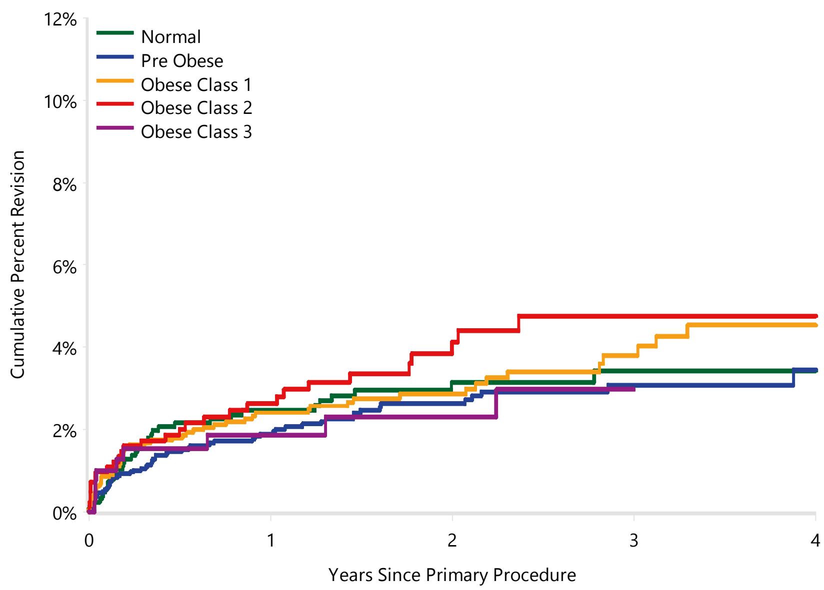


Table ST63 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by BMI Category (Primary Diagnosis Rotator Cuff Arthropathy)

BMI Category	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs
Underweight	1	54	2.0 (0.3, 13.4)	2.0 (0.3, 13.4)	2.0 (0.3, 13.4)	
Normal	35	1280	2.5 (1.7, 3.5)	3.1 (2.2, 4.4)	3.4 (2.4, 4.9)	3.4 (2.4, 4.9)
Pre Obese	58	2440	1.9 (1.4, 2.6)	2.6 (2.0, 3.4)	3.1 (2.3, 4.0)	3.5 (2.5, 4.8)
Obese Class 1	56	1901	2.4 (1.8, 3.2)	2.9 (2.1, 3.8)	3.8 (2.8, 5.1)	4.5 (3.3, 6.1)
Obese Class 2	29	830	2.6 (1.7, 4.0)	4.1 (2.8, 6.0)	4.8 (3.2, 6.9)	4.8 (3.2, 6.9)
Obese Class 3	10	398	1.9 (0.9, 3.9)	2.3 (1.1, 4.6)	3.0 (1.5, 5.9)	
TOTAL	**189**	**6903**				

Figure ST47 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 (0.52, 1.22),p=0.295

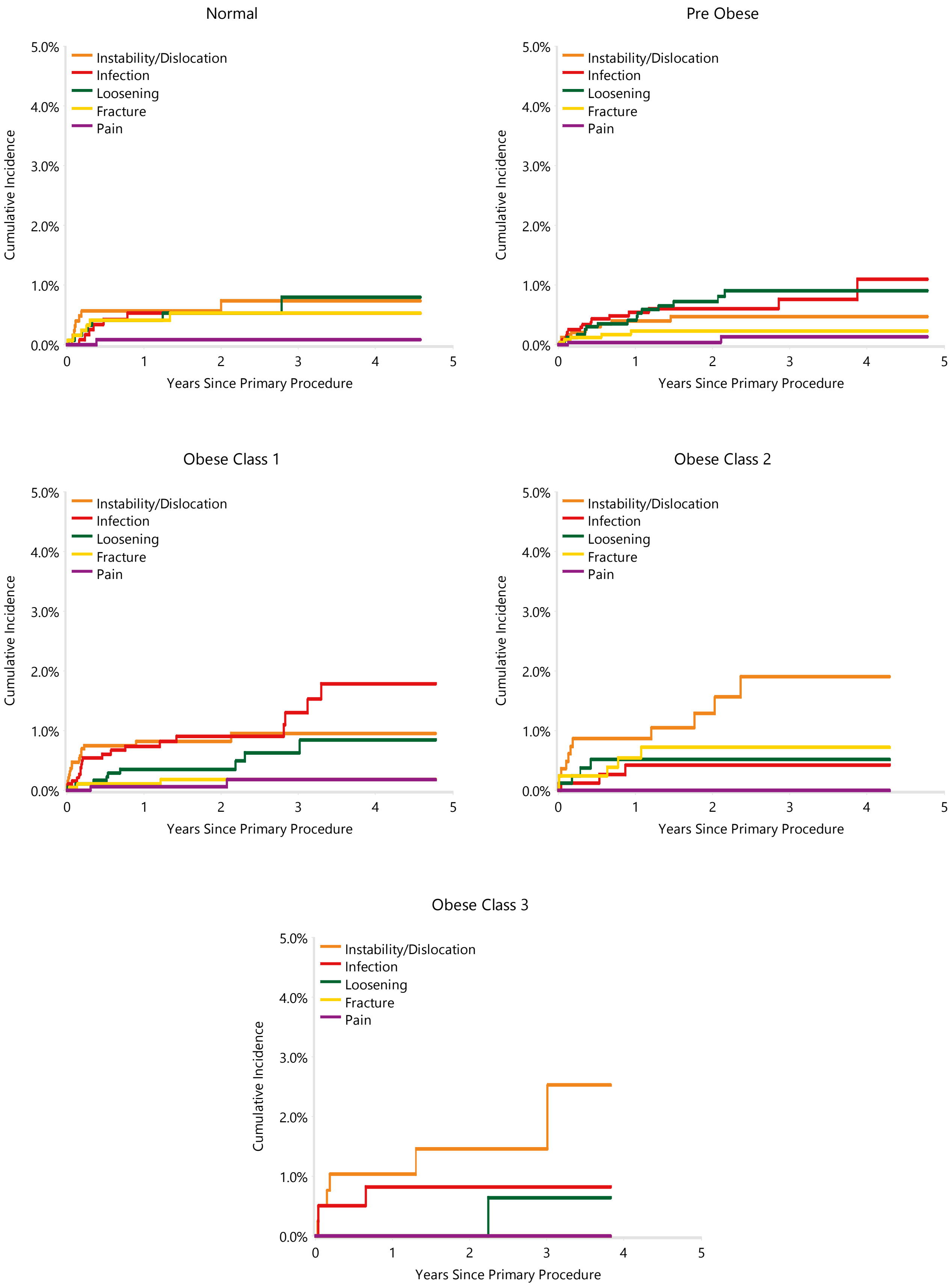
Obese Class 1 vs Normal
Entire Period: HR=0.98 (0.64, 1.50),p=0.921

Obese Class 2 vs Normal
Entire Period: HR=1.19 (0.72, 1.96),p=0.493

Obese Class 3 vs Normal
Entire Period: HR=0.92 (0.45, 1.87),p=0.813

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs
Normal	1280	893	541	293	113
Pre Obese	2440	1677	1069	529	230
Obese Class 1	1901	1309	799	435	175
Obese Class 2	830	571	346	168	55
Obese Class 3	398	255	160	88	36

Figure ST48 Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement by BMI Category (Primary Diagnosis Rotator Cuff Arthropathy)



OUTCOME FOR ROTATOR CUFF ARTHROPATHY – PROSTHESIS CHARACTERISTICS

Fixation

Fixation is not a risk factor for revision (Table ST64 and Figure ST49). This is also the case when the SMR L2 total reverse shoulder prosthesis is excluded from the analysis (Table ST65 and Figure ST50).

Glenosphere Size

Glenosphere sizes <38mm have a higher rate of revision compared to sizes >40mm for rotator cuff arthropathy (Table ST66 and Figure ST51). The cumulative incidence for the most common reasons for revision are shown in Figure ST52.

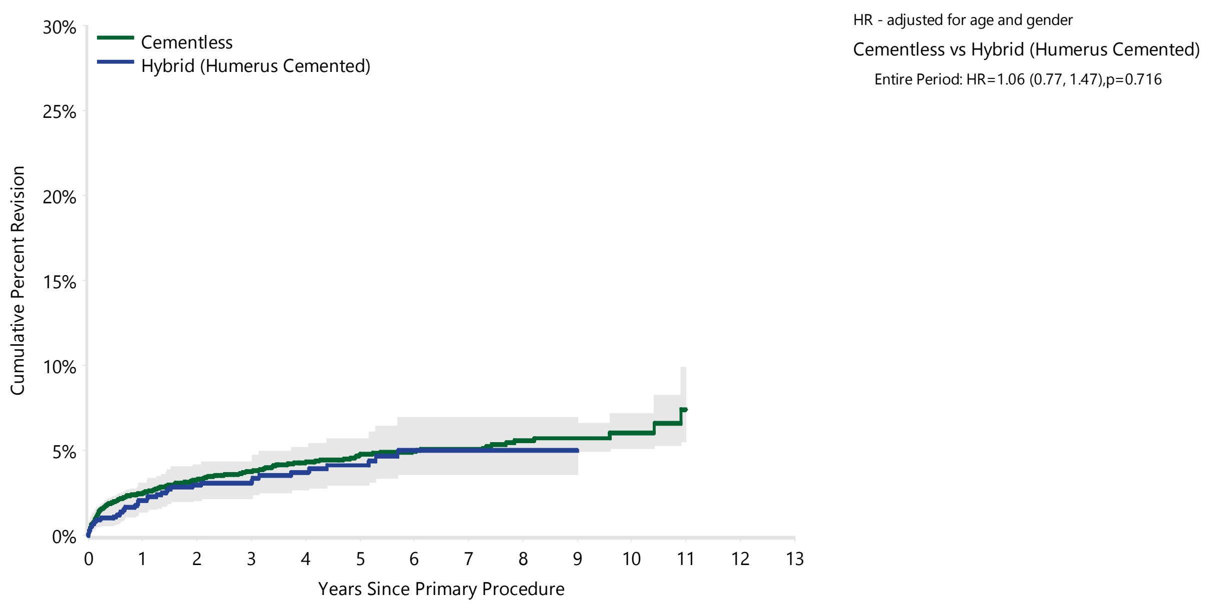
The outcomes of the most commonly used prosthesis combinations are listed in Table ST67.

The most commonly used prosthesis combinations using cementless fixation for rotator cuff arthropathy are listed in Table ST68. The most commonly used prosthesis combinations using hybrid (humerus cemented) fixation for rotator cuff arthropathy are listed in Table ST69.

Table ST64 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	13 Yrs
Cemented	0	21	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	350	9509	2.5 (2.2, 2.8)	3.8 (3.4, 4.2)	4.7 (4.2, 5.3)	5.0 (4.5, 5.7)	6.1 (5.1, 7.2)	
Hybrid (Glenoid Cemented)	3	81	3.8 (1.2, 11.4)	3.8 (1.2, 11.4)	3.8 (1.2, 11.4)			
Hybrid (Humerus Cemented)	41	1197	2.1 (1.4, 3.1)	3.1 (2.2, 4.3)	4.1 (3.0, 5.7)	5.0 (3.6, 6.9)		
TOTAL	**394**	**10808**						

Figure ST49 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Fixation (Primary Diagnosis Rotator Cuff Arthropathy)



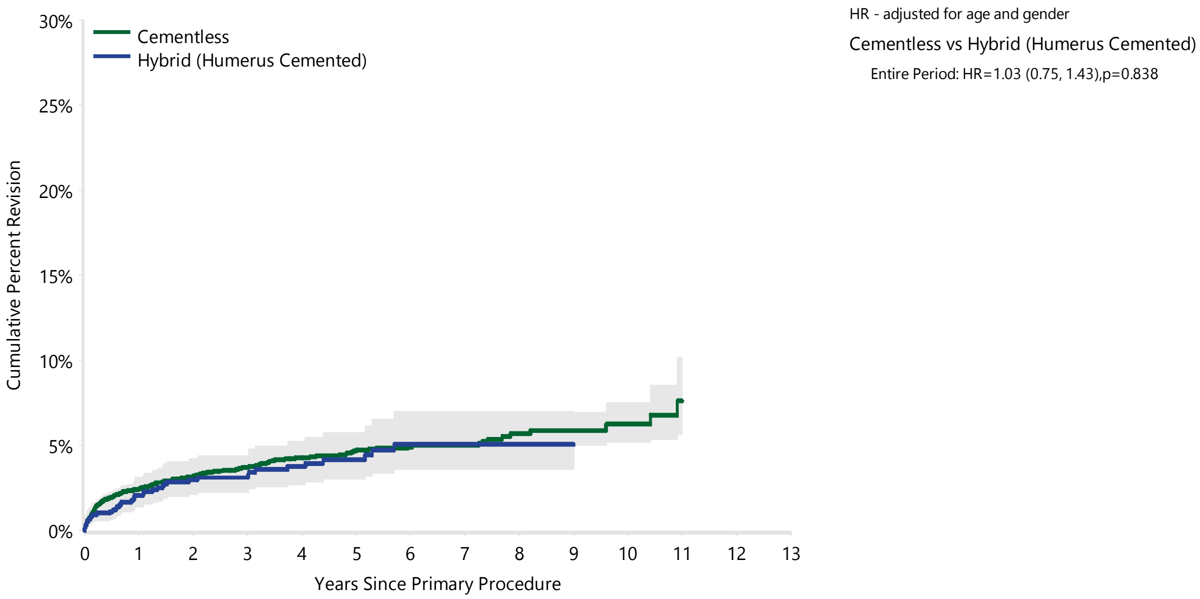
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Cementless	9509	7396	4147	2249	1129	229	10
Hybrid (Humerus Cemented)	1197	964	636	384	152	25	0

Note: Only fixations with over 100 procedures have been listed

Table ST65 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Fixation (Primary Diagnosis Rotator Cuff Arthropathy, Excluding SMR L2)

Fixation	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Cemented	0	21	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	327	9136	2.4 (2.1, 2.8)	3.7 (3.3, 4.2)	4.7 (4.2, 5.3)	5.0 (4.4, 5.6)	6.2 (5.2, 7.5)	
Hybrid (Glenoid Cemented)	3	81	3.8 (1.2, 11.4)	3.8 (1.2, 11.4)	3.8 (1.2, 11.4)			
Hybrid (Humerus Cemented)	41	1189	2.1 (1.4, 3.1)	3.1 (2.2, 4.4)	4.2 (3.0, 5.8)	5.0 (3.6, 7.0)		
TOTAL	**371**	**10427**						

Figure ST50 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Fixation (Primary Diagnosis Rotator Cuff Arthropathy, Excluding SMR L2)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Cementless	9136	7043	3817	1952	866	226	10
Hybrid (Humerus Cemented)	1189	956	629	378	148	25	0

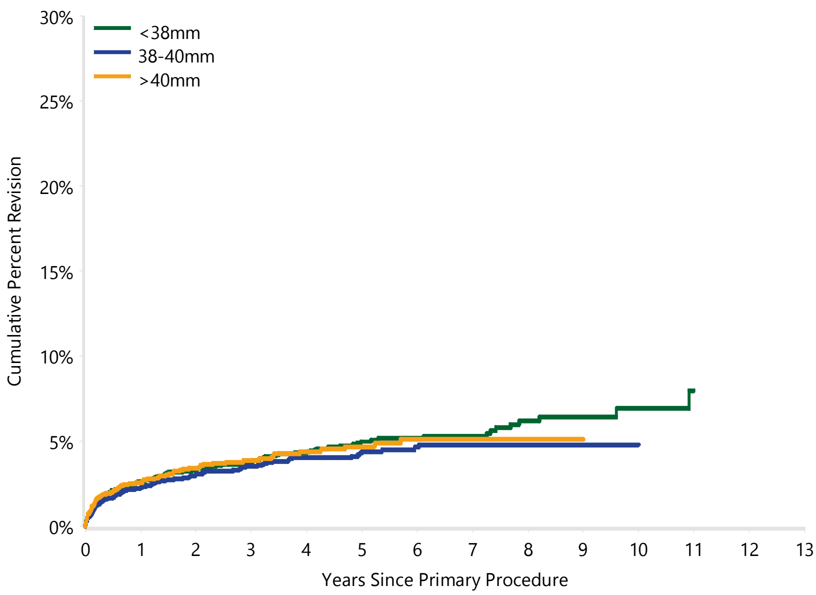
Note: Only fixations with over 100 procedures have been listed

Table ST66 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	13 Yrs
<38mm	157	3888	2.6 (2.2, 3.2)	3.7 (3.1, 4.4)	5.0 (4.2, 5.9)	5.3 (4.4, 6.3)	6.9 (5.5, 8.7)	
38-40mm	139	4115	2.3 (1.8, 2.8)	3.6 (3.0, 4.3)	4.3 (3.6, 5.2)	4.8 (4.0, 5.8)	4.8 (4.0, 5.8)	
>40mm	97	2701	2.6 (2.0, 3.3)	3.9 (3.1, 4.8)	4.7 (3.8, 5.8)	5.1 (4.1, 6.4)		
TOTAL	**393**	**10704**						

Note: Excludes 104 procedures with unknown glenosphere size

Figure ST51 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=1.16 (0.92, 1.45),p=0.215

>40mm vs 38-40mm

Entire Period: HR=0.85 (0.64, 1.11),p=0.224

>40mm vs <38mm

Entire Period: HR=0.73 (0.56, 0.95),p=0.021

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
<38mm	3888	3093	1863	1120	627	155	10
38-40mm	4115	3265	1881	980	452	76	0
>40mm	2701	2036	1080	550	205	24	0

Figure ST52 Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement by Glenosphere Size (Primary Diagnosis Rotator Cuff Arthropathy)

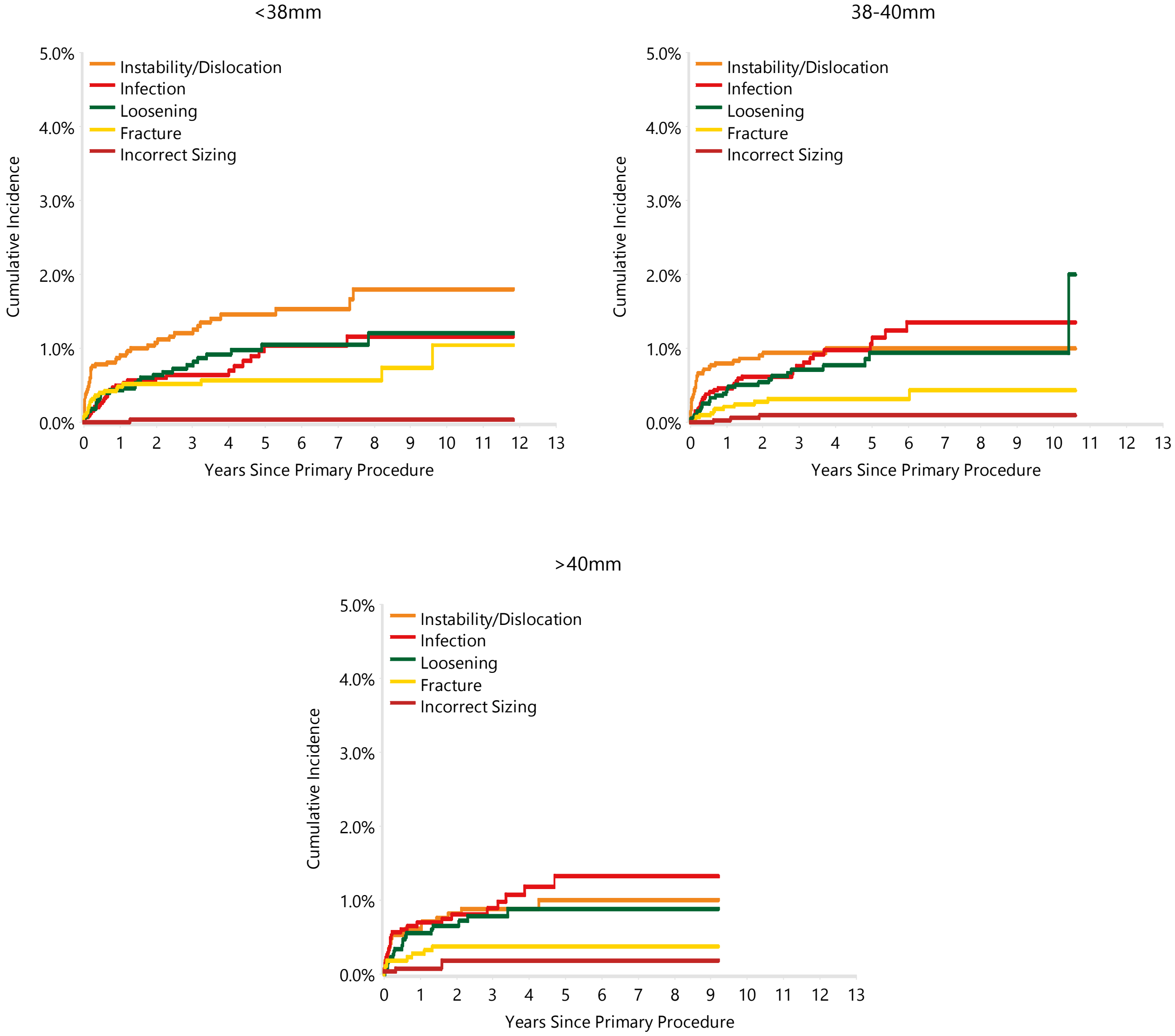


Table ST67 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Prosthesis Combination (Primary Diagnosis Rotator Cuff Arthropathy)

Humeral Stem	Glenoid Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Aequalis	Aequalis	42	972	2.3 (1.5, 3.5)	3.7 (2.6, 5.2)	4.8 (3.5, 6.6)	5.1 (3.7, 7.0)	6.8 (4.7, 9.8)	
	Perform Reversed	0	26	0.0 (0.0, 0.0)					
Affinis	Affinis	10	390	2.2 (1.1, 4.6)					
AltiVate Reverse	RSP	0	46						
Anatomical Shoulder	Trabecular Metal	4	48	6.3 (2.1, 18.1)	8.6 (3.3, 21.3)				
Ascend Flex	Aequalis	18	527	2.6 (1.5, 4.5)	5.1 (3.1, 8.2)				
	Perform Reversed	1	31						
Comprehensive	Comprehensive Reverse	8	623	1.2 (0.6, 2.4)	1.2 (0.6, 2.4)				
Delta Xtend	Delta Xtend	111	3217	2.1 (1.6, 2.6)	3.3 (2.7, 4.0)	4.1 (3.4, 5.0)	4.6 (3.8, 5.7)	4.6 (3.8, 5.7)	
Equinoxe	Equinoxe	12	634	1.5 (0.7, 2.9)	2.7 (1.4, 5.1)				
Global Unite	Delta Xtend	8	191	2.7 (1.1, 6.3)	4.0 (1.9, 8.3)				
RSP	RSP	24	672	2.3 (1.4, 3.9)	3.3 (2.0, 5.2)	7.4 (4.3, 12.5)			
SMR	SMR L1	92	2276	3.0 (2.4, 3.9)	4.1 (3.3, 5.1)	5.0 (4.0, 6.2)	5.0 (4.0, 6.2)	5.8 (4.1, 8.2)	
	SMR L2	23	381	3.9 (2.4, 6.5)	5.0 (3.2, 7.8)	5.9 (3.9, 8.9)	6.3 (4.2, 9.3)		
Trabecular Metal	Comprehensive Reverse	2	57	4.0 (1.0, 15.1)					
	Trabecular Metal	35	607	4.0 (2.7, 5.9)	5.4 (3.8, 7.6)	5.7 (4.0, 8.0)	6.1 (4.3, 8.6)		
Other (17)		4	110	1.8 (0.5, 7.2)	1.8 (0.5, 7.2)				
TOTAL		**394**	**10808**						

Note: Only combinations with over 25 procedures have been listed

Table ST68 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	13 Yrs
Aequalis	Aequalis	33	796	2.1 (1.3, 3.4)	3.5 (2.3, 5.2)	4.9 (3.4, 7.0)	4.9 (3.4, 7.0)		
Affinis	Affinis	7	238	1.9 (0.7, 5.0)					
AltiVate Reverse	RSP	0	40						
Anatomical Shoulder	Trabecular Metal	3	45	6.7 (2.2, 19.3)	6.7 (2.2, 19.3)				
Ascend Flex	Aequalis	17	478	2.6 (1.5, 4.7)	5.4 (3.3, 8.9)				
	Perform Reversed	1	28	3.8 (0.6, 24.3)					
Comprehensive	Comprehensive Reverse	8	615	1.2 (0.6, 2.4)	1.2 (0.6, 2.4)				
Delta Xtend	Delta Xtend	99	2716	2.1 (1.6, 2.8)	3.5 (2.8, 4.3)	4.4 (3.6, 5.4)	5.0 (4.0, 6.2)	5.0 (4.0, 6.2)	
Equinoxe	Equinoxe	12	616	1.5 (0.7, 3.0)	2.8 (1.5, 5.3)				
Global Unite	Delta Xtend	7	176	2.9 (1.2, 6.8)	3.7 (1.7, 8.0)				
RSP	RSP	14	457	2.7 (1.5, 4.9)					
SMR	SMR L1	86	2190	2.9 (2.3, 3.7)	3.9 (3.2, 4.9)	4.9 (3.9, 6.1)	4.9 (3.9, 6.1)	5.8 (4.0, 8.2)	
	SMR L2	23	373	4.0 (2.5, 6.6)	5.1 (3.3, 7.9)	6.1 (4.0, 9.1)	6.4 (4.3, 9.5)		
Trabecular Metal	Comprehensive Reverse	2	56	4.0 (1.0, 15.4)					
	Trabecular Metal	34	567	4.1 (2.8, 6.1)	5.6 (3.9, 7.9)	5.9 (4.2, 8.3)	6.4 (4.5, 9.1)		
Other (17)		4	118	1.7 (0.4, 6.7)	1.7 (0.4, 6.7)				
TOTAL		**350**	**9509**						

Note: Only combinations with over 25 procedures have been listed

Table ST69 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	13 Yrs
Aequalis	Aequalis	9	172	3.0 (1.3, 7.0)	5.0 (2.5, 9.8)	5.0 (2.5, 9.8)	6.2 (3.2, 12.0)		
Affinis	Affinis	3	142	3.1 (1.0, 9.2)					
Ascend Flex	Aequalis	0	48	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)				
Delta Xtend	Delta Xtend	12	487	1.7 (0.9, 3.4)	2.3 (1.2, 4.2)	2.6 (1.4, 4.7)	3.2 (1.7, 5.7)		
RSP	RSP	10	196	1.6 (0.5, 4.8)	2.1 (0.8, 5.6)				
SMR	SMR L1	4	38	8.1 (2.7, 23.1)	11.1 (4.3, 26.9)	11.1 (4.3, 26.9)	11.1 (4.3, 26.9)		
Trabecular Metal	Trabecular Metal	1	36	2.8 (0.4, 18.1)	2.8 (0.4, 18.1)	2.8 (0.4, 18.1)	2.8 (0.4, 18.1)		
Other (13)		2	78	0.0 (0.0, 0.0)	4.3 (1.1, 16.1)	4.3 (1.1, 16.1)			
TOTAL		**41**	**1197**						

Note: Only combinations with over 25 procedures have been listed

OUTCOME FOR FRACTURE – PATIENT CHARACTERISTICS

Age and Gender

For the diagnosis of fracture, patients aged 55-64 years have a higher rate of revision compared to patients aged ≥75 years. Patients aged 55-64 years also have a higher rate of revision compared to patients aged 65-74 years (Table ST70 and Figure ST53).

Males have a higher rate of revision than females in the first 3 months (Table ST71 and Figure ST54). The higher rate of revision for males is due to an increased incidence of instability/dislocation (Figure ST55).

ASA and BMI

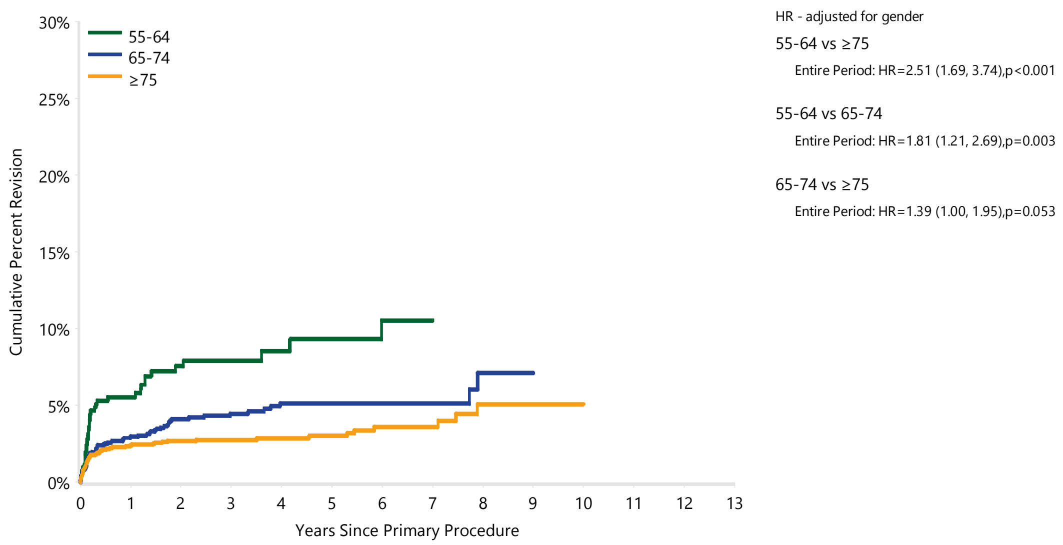
The Registry is now reporting on the early outcome of 3,575 primary total reverse shoulder replacement procedures for fracture in relation to ASA score. There is no difference in the rate of revision when comparing patients with ASA scores 3 and 4 with ASA score 2 (Table ST72 and Figure ST56). The most common reasons for revision can be found in Figure ST57.

The early revision outcomes are reported for 2,340 primary total reverse shoulder replacement procedures for fracture in relation to BMI category. There is no difference in the rate of revision when pre-obese and obese classes 1,2 and 3 patients are compared to patients with a normal BMI (Table ST73 and Figure ST58). The most common reasons for revision are shown in Figure ST59.

Table ST70 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	13 Yrs
<55	3	60	3.5 (0.9, 13.1)	3.5 (0.9, 13.1)	8.8 (2.4, 29.3)			
55-64	38	509	5.5 (3.8, 8.0)	7.9 (5.7, 10.9)	9.3 (6.6, 13.1)	10.5 (7.2, 15.3)		
65-74	68	1634	3.0 (2.2, 3.9)	4.4 (3.5, 5.7)	5.1 (4.0, 6.6)	5.1 (4.0, 6.6)		
≥75	69	2398	2.4 (1.8, 3.1)	2.8 (2.2, 3.5)	3.0 (2.3, 3.9)	3.6 (2.7, 4.8)	5.1 (3.4, 7.4)	
TOTAL	**178**	**4601**						

Figure ST53 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Age (Primary Diagnosis Fracture)

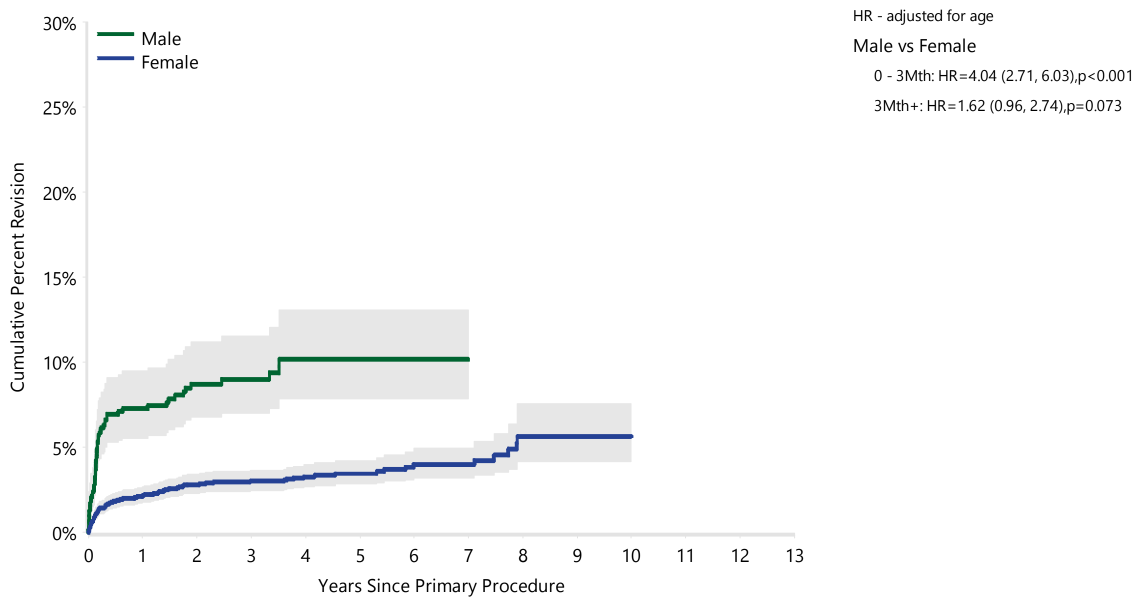


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
55-64	509	369	181	92	55	15	0
65-74	1634	1288	706	355	151	33	0
≥75	2398	1891	1139	590	263	43	1

Table ST71 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Gender (Primary Diagnosis Fracture)

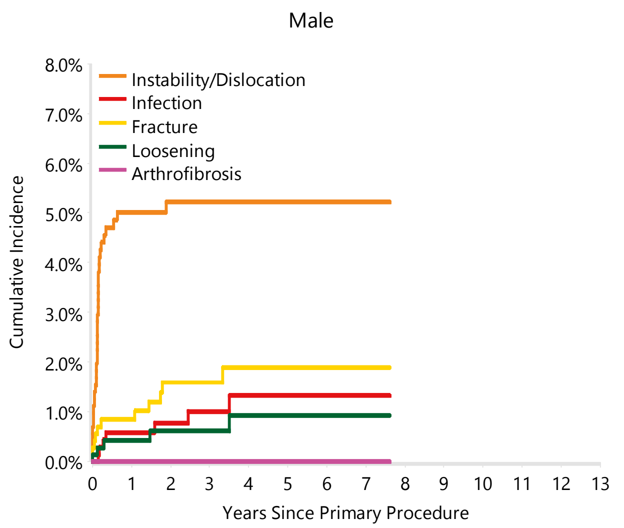
Gender	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Male	61	717	7.3 (5.5, 9.5)	9.0 (7.0, 11.5)	10.2 (7.9, 13.1)	10.2 (7.9, 13.1)		
Female	117	3884	2.2 (1.7, 2.7)	3.0 (2.5, 3.6)	3.4 (2.8, 4.2)	4.0 (3.2, 5.0)	5.6 (4.2, 7.6)	
TOTAL	**178**	**4601**						

Figure ST54 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	13 Yrs
Male	717	524	271	132	62	12	0
Female	3884	3067	1774	912	410	81	1

Figure ST55 Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement by Gender (Primary Diagnosis Fracture)



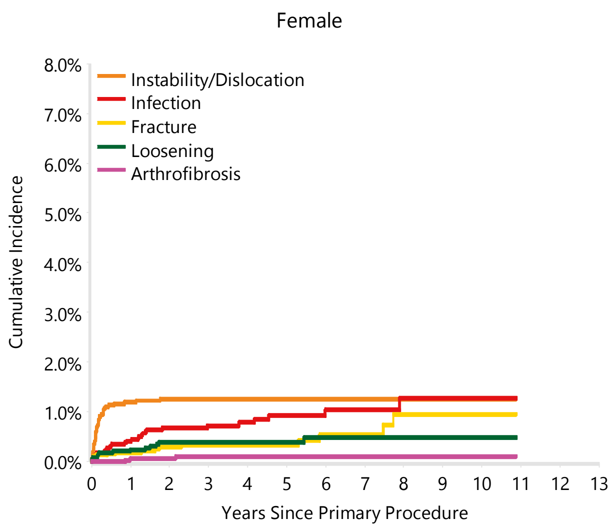
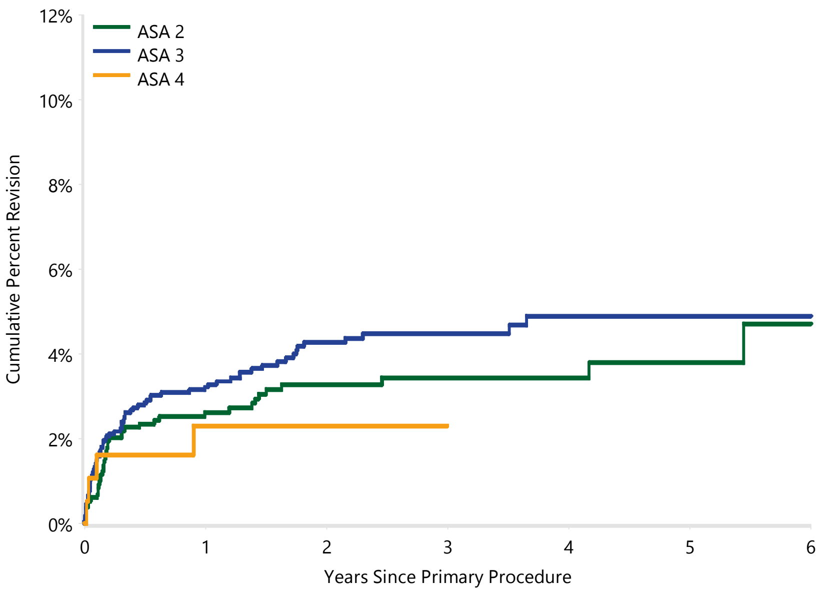


Table ST72 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by ASA Score (Primary Diagnosis Fracture)

ASA Score	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
ASA 1	3	84	3.6 (1.2, 10.7)	3.6 (1.2, 10.7)	3.6 (1.2, 10.7)	3.6 (1.2, 10.7)		
ASA 2	42	1319	2.6 (1.9, 3.7)	3.3 (2.4, 4.5)	3.4 (2.5, 4.7)	3.4 (2.5, 4.7)	3.8 (2.7, 5.3)	4.7 (3.0, 7.5)
ASA 3	77	1982	3.2 (2.5, 4.1)	4.3 (3.4, 5.4)	4.5 (3.6, 5.6)	4.9 (3.9, 6.2)	4.9 (3.9, 6.2)	4.9 (3.9, 6.2)
ASA 4	4	190	2.3 (0.9, 6.1)	2.3 (0.9, 6.1)	2.3 (0.9, 6.1)			
TOTAL	**126**	**3575**						

Figure ST56 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by ASA Score (Primary Diagnosis Fracture)



HR - adjusted for age and gender

ASA 3 vs ASA 2

Entire Period: HR=1.32 (0.90, 1.93),p=0.156

ASA 3 vs ASA 4

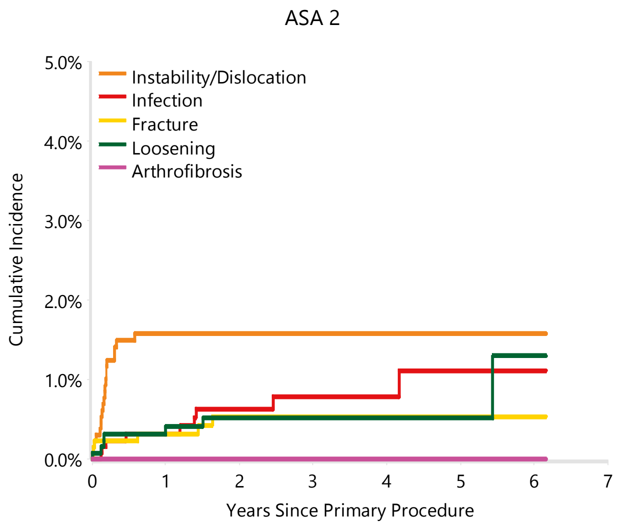
Entire Period: HR=1.70 (0.62, 4.65),p=0.302

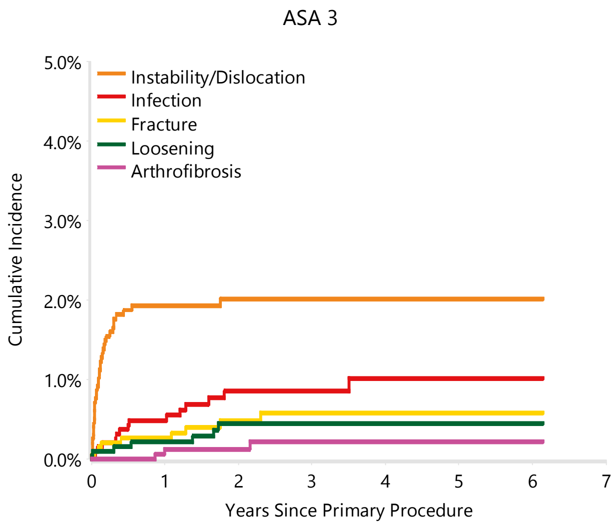
ASA 4 vs ASA 2

Entire Period: HR=0.78 (0.28, 2.17),p=0.628

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
ASA 2	1319	1006	740	481	299	153	53
ASA 3	1982	1441	978	646	365	177	55
ASA 4	190	138	90	54	35	15	4

Figure ST57 Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement by ASA Score (Primary Diagnosis Fracture)





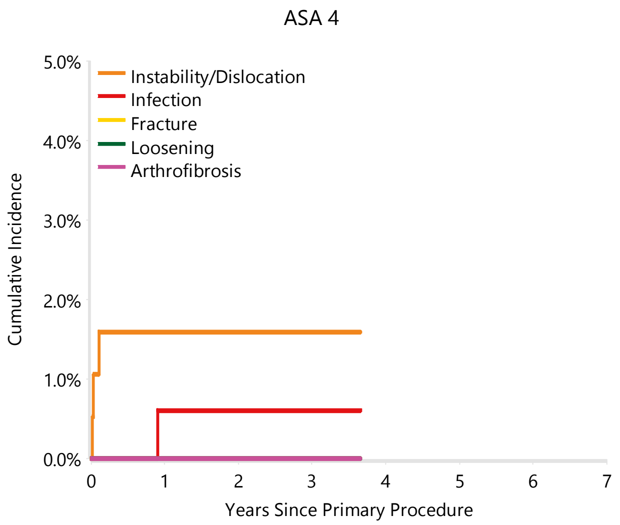
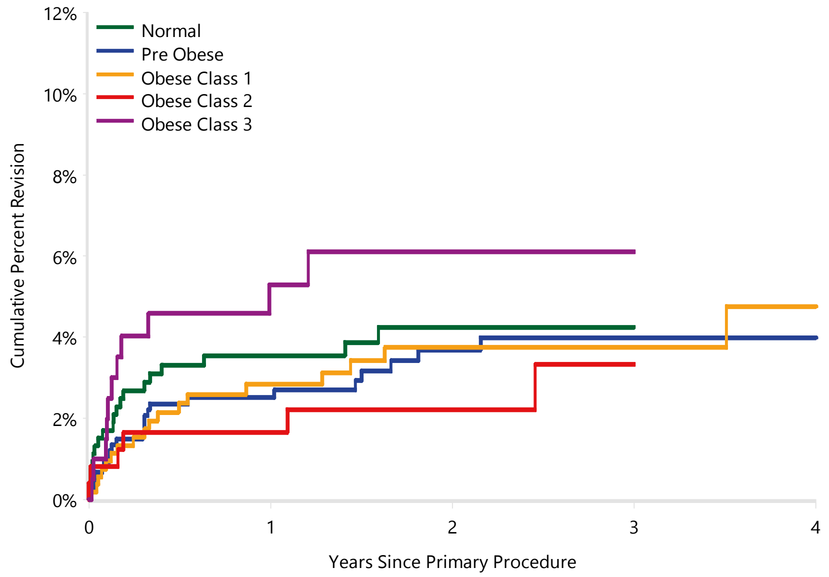


Table ST73 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by BMI Category (Primary Diagnosis Fracture)

BMI Category	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs
Underweight	1	51	2.0 (0.3, 13.1)	2.0 (0.3, 13.1)	2.0 (0.3, 13.1)	
Normal	20	537	3.5 (2.2, 5.6)	4.2 (2.7, 6.6)	4.2 (2.7, 6.6)	
Pre Obese	24	758	2.5 (1.6, 4.0)	3.7 (2.4, 5.6)	4.0 (2.6, 6.0)	4.0 (2.6, 6.0)
Obese Class 1	18	542	2.8 (1.7, 4.7)	3.7 (2.3, 6.0)	3.7 (2.3, 6.0)	4.8 (2.7, 8.3)
Obese Class 2	6	248	1.7 (0.6, 4.3)	2.2 (0.9, 5.3)	3.3 (1.4, 7.9)	
Obese Class 3	12	204	5.3 (2.9, 9.7)	6.1 (3.4, 10.9)	6.1 (3.4, 10.9)	
TOTAL	**81**	**2340**				

Figure ST58 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=0.75 (0.41, 1.36),p=0.341

Obese Class 1 vs Normal

Entire Period: HR=0.75 (0.40, 1.44),p=0.389

Obese Class 2 vs Normal

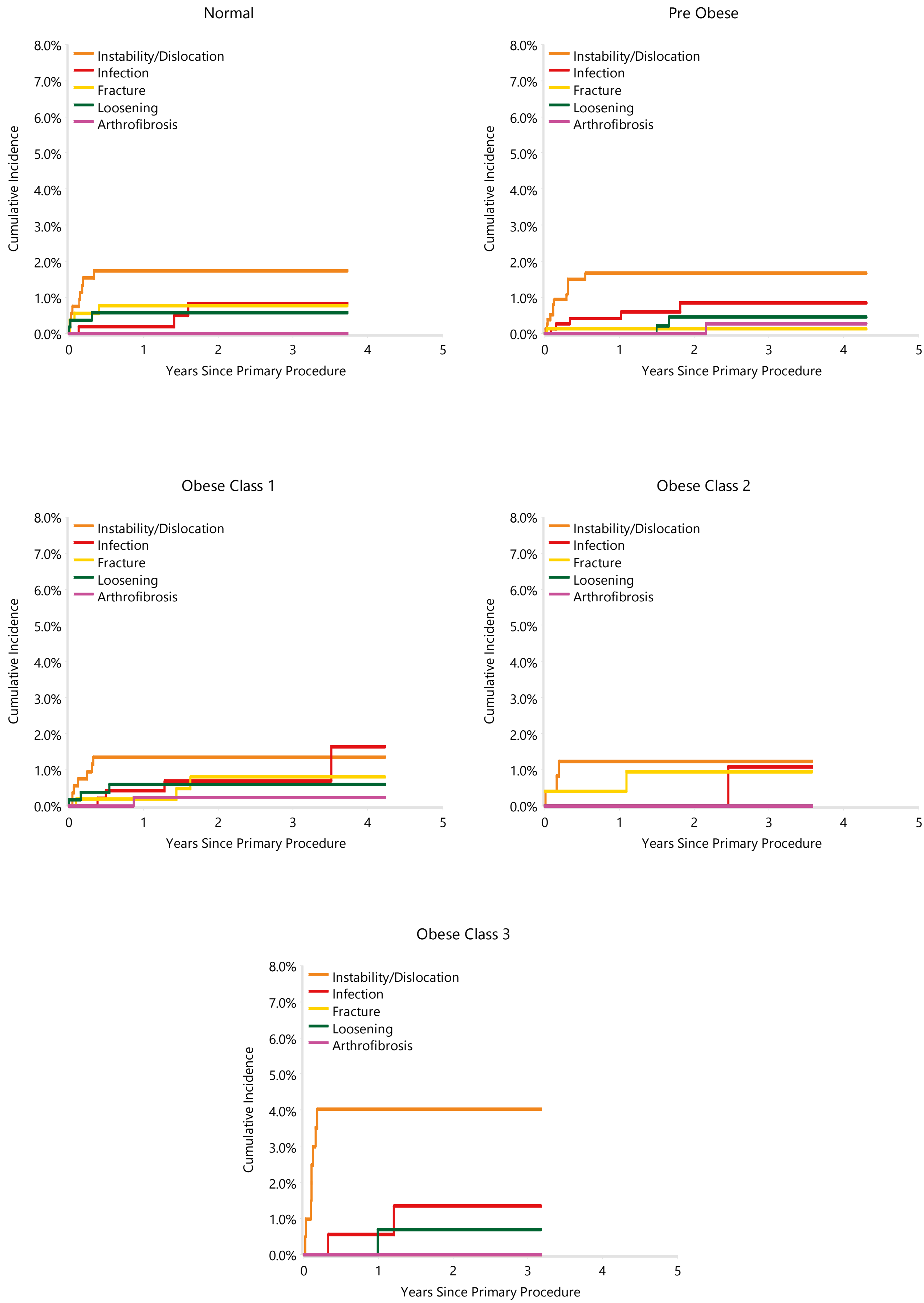
Entire Period: HR=0.55 (0.22, 1.39),p=0.208

Obese Class 3 vs Normal

Entire Period: HR=1.31 (0.63, 2.76),p=0.470

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs
Normal	537	361	206	100	31
Pre Obese	758	515	338	168	63
Obese Class 1	542	386	246	133	58
Obese Class 2	248	183	114	64	26
Obese Class 3	204	132	82	47	12

Figure ST59 Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement by BMI Category (Primary Diagnosis Fracture)



OUTCOME FOR FRACTURE – PROSTHESIS CHARACTERISTICS

Fixation

Cementless fixation has a higher rate of revision when used for the treatment of fracture compared to hybrid fixation (humerus cemented) (Table ST74 and Figure ST60). A difference was not observed when the SMR L2 prosthesis was excluded (Table ST75 and Figure ST61).

Cementless fixation has a higher rate of revision than hybrid fixation (humerus cemented) for fracture.

Glenosphere Size

Glenosphere size is not a risk factor for revision when undertaken for fracture (Table ST76, Figure ST62 and Figure ST63).

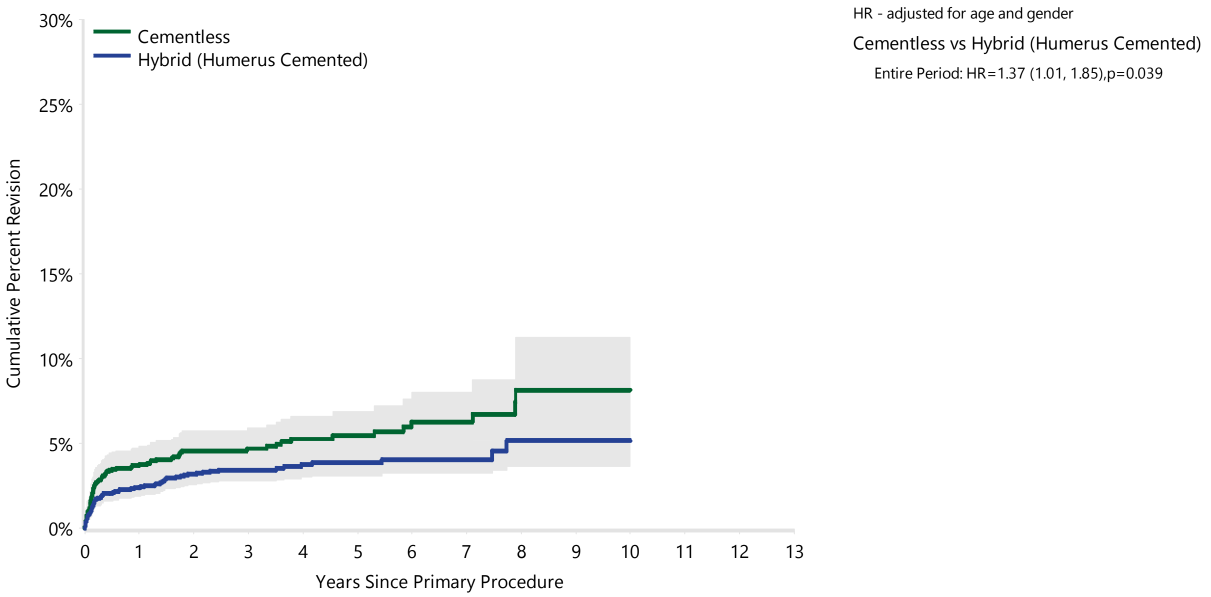
Glenosphere size is not a risk factor for revision when undertaken for fracture.

The outcomes of the most commonly used prosthesis combinations used in total reverse shoulder replacement for fracture are listed in Table ST77. The cementless prosthesis combinations are listed in Table ST78. The hybrid (humerus cemented) prosthesis combinations are listed in Table ST79.

Table ST74 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	13 Yrs
Cemented	4	68	6.2 (2.4, 15.6)	6.2 (2.4, 15.6)	6.2 (2.4, 15.6)	6.2 (2.4, 15.6)		
Cementless	82	1656	3.8 (2.9, 4.8)	4.7 (3.7, 5.9)	5.5 (4.3, 6.9)	6.3 (4.9, 8.0)	8.2 (5.9, 11.2)	
Hybrid (Glenoid Cemented)	1	47	2.3 (0.3, 15.4)	2.3 (0.3, 15.4)				
Hybrid (Humerus Cemented)	91	2830	2.4 (1.9, 3.1)	3.4 (2.8, 4.3)	3.9 (3.1, 4.8)	4.1 (3.2, 5.1)	5.2 (3.7, 7.3)	
TOTAL	**178**	**4601**						

Figure ST60 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Fixation (Primary Diagnosis Fracture)



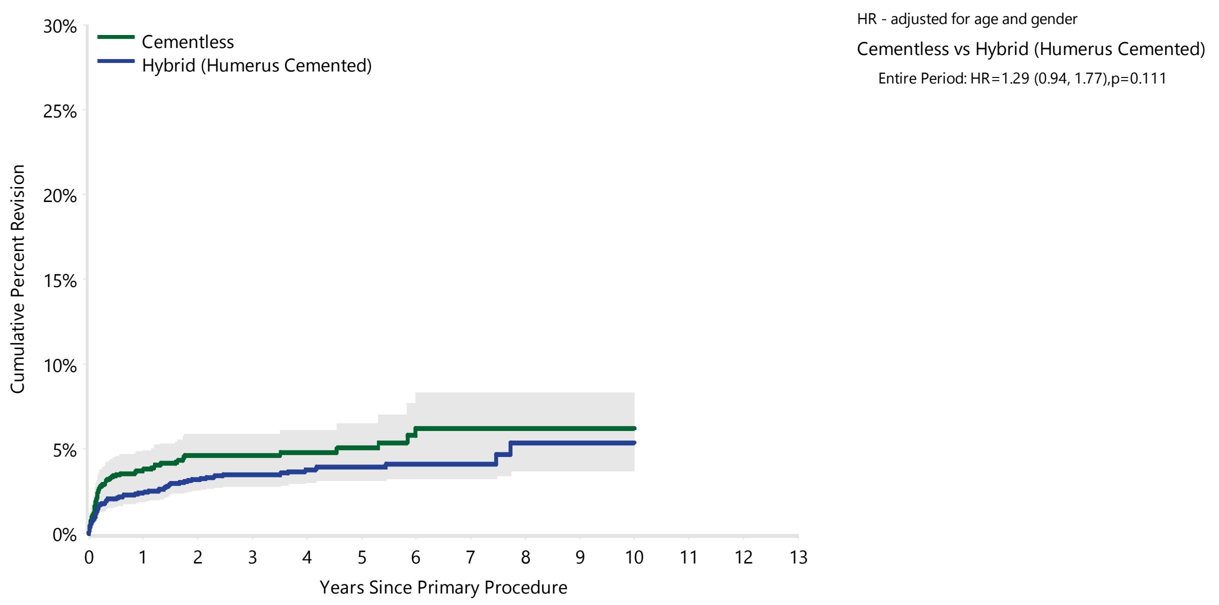
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Cementless	1656	1331	795	443	219	47	0
Hybrid (Humerus Cemented)	2830	2173	1204	580	240	42	1

Note: Only fixations with over 60 procedures have been listed

Table ST75 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Fixation (Primary Diagnosis Fracture, Excluding SMR L2)

Fixation	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Cemented	4	66	6.4 (2.4, 16.1)	6.4 (2.4, 16.1)	6.4 (2.4, 16.1)	6.4 (2.4, 16.1)		
Cementless	69	1508	3.8 (2.9, 4.9)	4.6 (3.6, 5.9)	5.0 (3.9, 6.5)	6.2 (4.6, 8.3)	6.2 (4.6, 8.3)	
Hybrid (Glenoid Cemented)	1	47	2.3 (0.3, 15.4)	2.3 (0.3, 15.4)				
Hybrid (Humerus Cemented)	90	2782	2.4 (1.9, 3.1)	3.5 (2.8, 4.3)	3.9 (3.1, 4.9)	4.1 (3.3, 5.2)	5.4 (3.7, 7.7)	
TOTAL	**164**	**4403**						

Figure ST61 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Fixation (Primary Diagnosis Fracture, Excluding SMR L2)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Cementless	1508	1190	667	333	125	47	0
Hybrid (Humerus Cemented)	2782	2131	1165	549	215	41	1

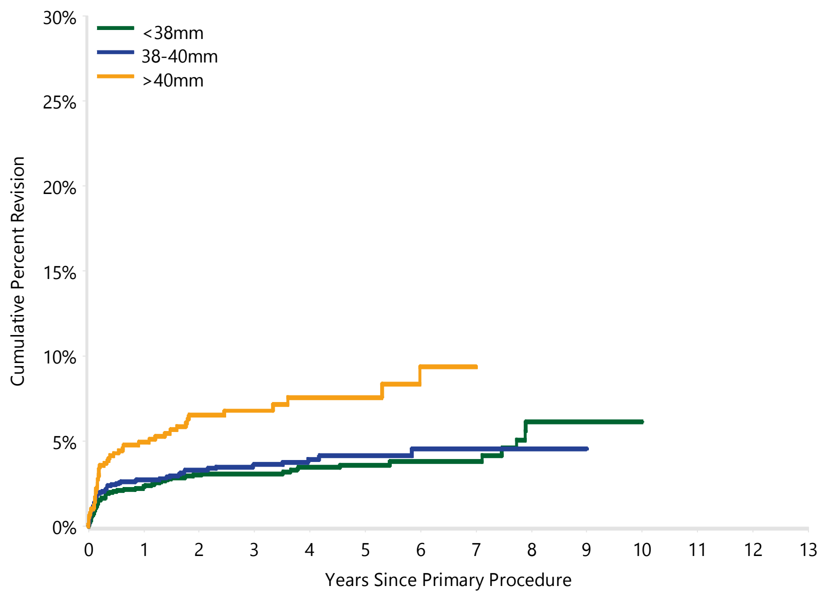
Note: Only fixations with over 60 procedures have been listed

Table ST76 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	13 Yrs
<38mm	65	1950	2.4 (1.8, 3.1)	3.1 (2.4, 4.0)	3.6 (2.8, 4.7)	3.8 (2.9, 5.0)	6.1 (4.2, 8.8)	
38-40mm	63	1858	2.8 (2.1, 3.6)	3.6 (2.8, 4.7)	4.1 (3.2, 5.4)	4.6 (3.4, 6.1)		
>40mm	49	780	4.9 (3.6, 6.8)	6.8 (5.1, 9.1)	7.6 (5.6, 10.2)	9.4 (6.6, 13.3)		
TOTAL	**177**	**4588**						

Note: Excludes 13 procedures with unknown glenosphere size

Figure ST62 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=1.12 (0.79, 1.58),p=0.530

>40mm vs <38mm

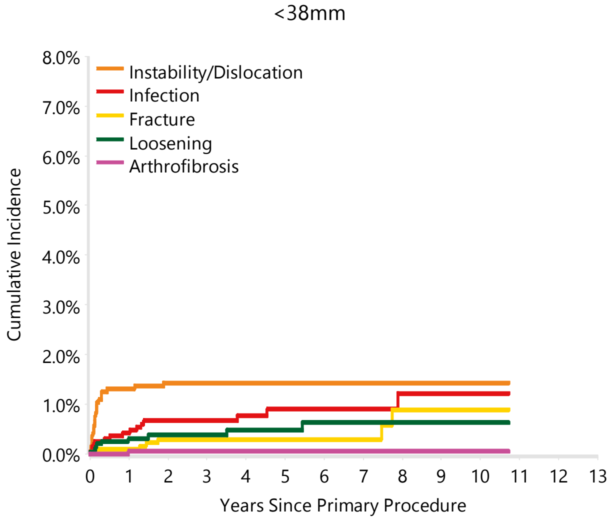
Entire Period: HR=1.47 (1.00, 2.18),p=0.051

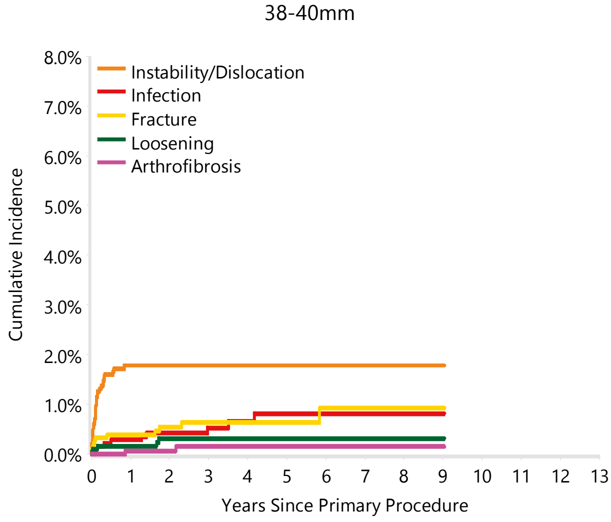
>40mm vs 38-40mm

Entire Period: HR=1.32 (0.89, 1.96),p=0.171

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
<38mm	1950	1588	980	547	279	65	1
38-40mm	1858	1432	783	358	137	24	0
>40mm	780	564	277	136	55	4	0

Figure ST63 Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement by Glenosphere Size (Primary Diagnosis Fracture)





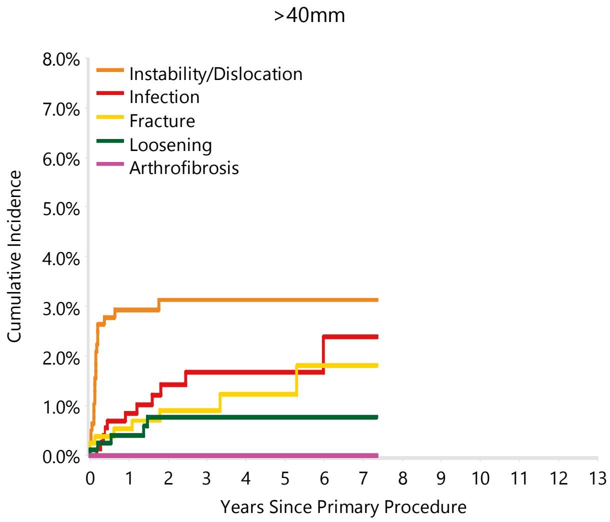


Table ST77 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Prosthesis Combination (Primary Diagnosis Fracture)

Humeral Stem	Glenoid Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Aequalis	Aequalis	21	754	1.8 (1.0, 3.1)	2.3 (1.4, 3.8)	3.2 (1.9, 5.2)	3.9 (2.2, 6.6)		
Affinis	Affinis	5	224	1.5 (0.5, 4.5)					
Comprehensive	Comprehensive Reverse	5	281	1.7 (0.6, 4.5)	1.7 (0.6, 4.5)				
Delta Xtend	Delta Xtend	48	1128	3.5 (2.5, 4.7)	4.3 (3.2, 5.7)	4.7 (3.5, 6.3)	5.1 (3.8, 6.9)		
Equinoxe	Equinoxe	3	163	0.6 (0.1, 4.3)					
Global Unite	Delta Xtend	4	174	2.4 (0.9, 6.2)					
RSP	RSP	11	193	3.8 (1.8, 7.8)	7.6 (4.1, 13.6)				
SMR	SMR L1	59	1133	4.3 (3.3, 5.7)	5.4 (4.2, 7.0)	5.6 (4.3, 7.3)	6.5 (4.9, 8.7)	6.5 (4.9, 8.7)	
	SMR L2	14	198	3.0 (1.4, 6.7)	4.2 (2.1, 8.2)	5.9 (3.3, 10.5)	5.9 (3.3, 10.5)		
Trabecular Metal	Trabecular Metal	7	228	2.7 (1.2, 6.0)	3.3 (1.6, 6.7)	3.3 (1.6, 6.7)			
Other (17)		1	125	0.8 (0.1, 5.8)	0.8 (0.1, 5.8)				
TOTAL		**178**	**4601**						

Note: Only combinations with over 50 procedures have been listed

Table ST78 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	13 Yrs
Aequalis	Aequalis	2	53	1.9 (0.3, 12.9)	1.9 (0.3, 12.9)	7.1 (1.6, 28.8)	7.1 (1.6, 28.8)		
Comprehensive	Comprehensive Reverse	1	65	1.8 (0.3, 12.2)	1.8 (0.3, 12.2)				
Delta Xtend	Delta Xtend	6	179	1.7 (0.6, 5.2)	3.0 (1.3, 7.2)	3.0 (1.3, 7.2)			
Global Unite	Delta Xtend	2	62	3.3 (0.8, 12.4)	3.3 (0.8, 12.4)				
SMR	SMR L1	55	991	4.7 (3.5, 6.3)	5.7 (4.3, 7.4)	5.9 (4.5, 7.7)	7.0 (5.1, 9.6)		
	SMR L2	13	148	3.4 (1.4, 8.0)	4.9 (2.3, 9.9)	7.2 (3.9, 12.9)	7.2 (3.9, 12.9)		
Trabecular Metal	Trabecular Metal	2	56	3.6 (0.9, 13.5)	3.6 (0.9, 13.5)	3.6 (0.9, 13.5)	3.6 (0.9, 13.5)		
Other (12)		1	102	1.0 (0.1, 6.8)					
TOTAL		**82**	**1656**						

Note: Only combinations with over 50 procedures have been listed

Table ST79 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	13 Yrs
Aequalis	Aequalis	19	688	1.8 (1.0, 3.2)	2.4 (1.5, 4.0)	2.8 (1.7, 4.6)	3.6 (2.0, 6.4)		
Affinis	Affinis	5	214	1.5 (0.5, 4.7)					
Comprehensive	Comprehensive Reverse	4	200	1.8 (0.6, 5.6)	1.8 (0.6, 5.6)				
Delta Xtend	Delta Xtend	39	927	3.5 (2.5, 5.0)	4.3 (3.1, 5.9)	4.8 (3.5, 6.6)	4.8 (3.5, 6.6)		
Equinoxe	Equinoxe	2	117	0.0 (0.0, 0.0)					
Global Unite	Delta Xtend	2	104	2.1 (0.5, 8.0)					
RSP	RSP	10	160	3.9 (1.8, 8.5)	8.5 (4.5, 15.7)				
SMR	SMR L1	3	134	0.8 (0.1, 5.6)	2.9 (0.9, 8.7)	2.9 (0.9, 8.7)			
Trabecular Metal	Trabecular Metal	5	159	2.6 (1.0, 6.9)	3.4 (1.4, 8.1)	3.4 (1.4, 8.1)			
Other (15)		2	127	1.6 (0.4, 6.3)	1.6 (0.4, 6.3)	1.6 (0.4, 6.3)			
TOTAL		**91**	**2830**						

Note: Only combinations with over 50 procedures have been listed

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. The comparator group includes all other prostheses within the same class regardless of their rate of revision. 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 prostheses in the same class. It is an automated analysis that identifies prostheses based on set criteria. These include:

1. The revision rate (per 100 component years) exceeds twice that for the group, and
2. The Poisson probability of observing that number of revisions, given the rate of the group is significant ($p<0.05$), and
   either:
3. There are at least 10 primary procedures for that component,
   or
4. The proportion revised is at least 75% and there have been at least two revisions.

The Registry has the capacity to assess the outcome of individual prostheses or combinations of prostheses used in a procedure. It is apparent from previous reports that individual prostheses that perform well in one combination, may not perform well in another. Therefore, the outcome of an individual prosthesis is partly dependent on the combination of the different prostheses used.

Consequently, the Registry undertakes two different analyses in Stage 1. The first assesses the outcome of all combinations. The second assesses all individual prostheses regardless of the combination. Both analyses are reviewed to determine if a higher revision rate is identified with a single combination, multiple combinations, or uniformly with all combinations. If prostheses are identified in a single combination, that combination progresses to Stage 2. An individual prosthesis progresses to Stage 2 if it is identified in multiple combinations or uniformly across all combinations.

If a prosthesis is identified in more than two combinations with 10 or more procedures in Stage 1, an additional analysis of the individual prosthesis is undertaken for review at Stage 2, regardless of whether the individual prosthesis was identified in Stage 1. The purpose of this is to simplify the reporting of an individual prosthesis and to avoid identifying the same prosthesis in multiple combinations when it may be more appropriate to identify it individually.

A prosthesis or combination may also be brought to the attention of the Registry by the Therapeutic Goods Administration (TGA) or a member of the AOA. A further investigation may then be undertaken as outlined in Stage 2.

Stage 2

In Stage 2, the AOANJRR 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 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 Arthroplasty Society. The panel meets with Registry staff at a joint specific workshop to review the Stage 2 analysis and determine which prostheses will be identified in the Annual Report.

IDENTIFIED PROSTHESES

Identified prostheses are listed in one of three groups. The first group, 'Newly Identified', lists prostheses that are identified for the first time and are still used

The second group is 'Re-identified and still used'. This listing identifies prostheses 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. This year, due to COVID-19 restrictions, workshops were held online rather than face-to-face. The workshop format was modified to accommodate the online delivery. This enabled a larger than usual number of surgeons to attend.

In addition to AOANJRR and SAHMRI staff, and the AOA Executive, 31 AOA members with expertise in hip and knee arthroplasty attended the Hip and Knee Surgeon Review Workshop.

Members of the AOA with expertise in shoulder surgery were invited to attend a separate workshop to review this section of the report. In addition to AOANJRR and SAHMRI staff, and the AOA Executive, 15 AOA members with expertise in shoulder arthroplasty attended the Shoulder Surgeon Review Workshop.

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-2020

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	469	2.34	Entire Period: HR=2.17 (1.20, 3.92),p=0.010

Note: Components have been compared to all other 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	18 Yrs
Identified and no longer used					
Unipolar Head (JRI) / Furlong LOL	6.4 (3.1, 13.0)	9.7 (5.3, 17.4)			

Table IP3 Yearly Usage of Unipolar Modular Hip Prostheses identified as having a Higher than Anticipated Rate of Revision

Year of Implant	≤2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
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 Rate of Individual 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	76	172	4.07	Entire Period: HR=3.60 (1.71, 7.58),p<0.001
Identified and no longer used	.	.	.	.	
UHR/ABGII	20	177	974	2.05	Entire Period: HR=2.51 (1.61, 3.91),p<0.001
UHR/Omnifit (cless)	8	40	255	3.13	Entire Period: HR=3.50 (1.75, 7.04),p<0.001
**Basis	18	156	754	2.39	0 - 1Yr: HR=0.50 (0.13, 2.01),p=0.330
	.	.	.	.	1Yr+: HR=4.67 (2.83, 7.71),p<0.001
**Synergy	9	55	405	2.22	Entire Period: HR=2.47 (1.28, 4.77),p=0.007

Note: All components have been compared to all other bipolar hip components
** Femoral stem

Table IP5 Cumulative Percent Revision of Individual Bipolar Hip Prostheses Identified as having a Higher than Anticipated Rate of Revision

CPR	1 Yr	3 Yrs	5 Yrs	10 Yrs	18 Yrs
Re-Identified and Still Used					
**Quadra-H	7.2 (2.7, 18.1)	12.8 (5.8, 26.9)	17.6 (8.2, 35.7)		
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)	12.7 (7.6, 20.7)		
**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

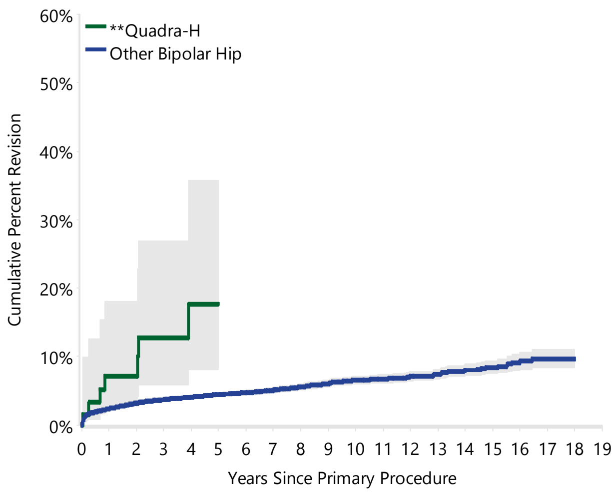
Table IP6 Yearly Usage of Individual Bipolar Hip Prostheses Identified as having a Higher than Anticipated Rate of Revision

Year of Implant	≤2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Re-Identified and Still Used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
**Quadra-H	.	.	.	.	.	.	.	11	7	5	6	4	11	9	7	4	7	5
Identified and no longer used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
UHR/ABGII	25	25	36	34	10	15	20	7	5	.	.	.	.	.	.	.	.	.
UHR/Omnifit (cless)	11	10	7	5	4	1	2	.	.	.	.	.	.	.	.	.	.	.
**Basis	37	5	.	10	13	9	11	4	7	8	21	24	6	1	.	.	.	.
**Synergy	12	13	9	10	3	2	1	1	.	1	.	2	.	.	.	1	.	.

Note: ** Femoral stem component

Figure IP1 Cumulative Percent Revision of Re-identified and still used Individual 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 2 newly identified total conventional hip prostheses.

The MiniMax femoral stem has been used in 349 procedures since 2016. The 2 year cumulative percent revision is 6.8%. Of the 17 revisions, 12 were major revisions including 9 femoral components and 5 were minor revisions. All the primary total conventional hip replacements that were revised were performed through an anterior approach. There were 9 revisions for fracture, 2 for leg length discrepancy and 2 for infection.

The Profemur L femoral stem has been used in 2,396 procedures since 2012. The 6 year cumulative percent revision is 4.4% and the Profemur L has a higher rate of revision than other total conventional hip replacement for the first 3 months. Of the 86 revisions, 66 were major revisions including 34 femoral components, and 20 were minor revisions. There were 26 revisions for fracture, 22 for dislocation and 16 for loosening.

The Linear femoral stem has previously been identified in combination with the Acetabular Shell (Global). This year only the femoral stem is identified. The Linear femoral stem has been used in 286 procedures since 2012. The 6 year cumulative percent revision is 5.9%. Of the 16 revisions, 13 were major revisions, including 9 femoral components, and 3 were minor revisions. There were 7 revisions for dislocation/instability and 4 revisions for loosening.

The GHE femoral stem is identified for the first time and is no longer used.

The Corae/Fixa combination and the Procotyl L acetabular component are no longer identified as they no longer have a significantly higher rate of revision.

Table IP7 Revision Rate of Individual 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	.	.	.	.	
*Linear	16	286	1188	1.35	Entire Period: HR=1.82 (1.11, 2.96),p=0.017
*MiniMax	17	349	417	4.08	Entire Period: HR=2.66 (1.65, 4.27),p<0.001
*Profemur L	86	2396	6573	1.31	0 - 3Mth: HR=1.81 (1.37, 2.39),p<0.001
	.	.	.	.	3Mth+: HR=1.12 (0.80, 1.55),p=0.508
Re-Identified and Still Used	.	.	.	.	
Accolade II/Trident Tritanium (Shell)	52	1799	3490	1.49	Entire Period: HR=1.33 (1.02, 1.75),p=0.038
Avenir/Fitmore	12	200	397	3.02	Entire Period: HR=2.84 (1.61, 5.01),p<0.001
CORAIL/Trabecular Metal (Shell)	11	97	594	1.85	Entire Period: HR=2.94 (1.63, 5.31),p<0.001
CPT/Fitmore	20	277	1378	1.45	Entire Period: HR=2.23 (1.44, 3.45),p<0.001
CPT/Low Profile Cup	13	185	901	1.44	Entire Period: HR=2.22 (1.29, 3.83),p=0.004
Friendly Hip/Delta-TT	6	74	352	1.71	Entire Period: HR=2.62 (1.18, 5.81),p=0.017
HACTIV/Logical G	42	891	1167	3.60	Entire Period: HR=2.50 (1.85, 3.39),p<0.001
Secur-Fit Plus/PINNACLE	13	246	949	1.37	Entire Period: HR=1.83 (1.07, 3.16),p=0.028
Taperloc/G7	52	2701	5914	0.88	0 - 2Wk: HR=1.79 (1.06, 3.04),p=0.029
	.	.	.	.	2Wk - 1Mth: HR=1.07 (0.61, 1.89),p=0.817
	.	.	.	.	1Mth+: HR=0.63 (0.43, 0.92),p=0.017
*Apex	164	2572	18936	0.87	Entire Period: HR=1.42 (1.22, 1.66),p<0.001
*Excia (cless)	27	424	2028	1.33	Entire Period: HR=1.93 (1.33, 2.82),p<0.001
*Furlong Evolution	24	359	778	3.09	Entire Period: HR=3.03 (2.03, 4.53),p<0.001
*Novation	61	1328	5679	1.07	0 - 2Wk: HR=3.14 (1.78, 5.54),p<0.001
	.	.	.	.	2Wk - 1Mth: HR=1.82 (0.98, 3.38),p=0.060
	.	.	.	.	1Mth - 3Mth: HR=2.36 (1.39, 3.99),p=0.001
	.	.	.	.	3Mth+: HR=0.97 (0.66, 1.44),p=0.897
*Taper Fit	93	2604	7697	1.21	0 - 3Mth: HR=0.80 (0.53, 1.21),p=0.291
	.	.	.	.	3Mth - 2.5Yr: HR=1.40 (0.98, 2.00),p=0.067
	.	.	.	.	2.5Yr+: HR=2.73 (2.00, 3.72),p<0.001
**Continuum	500	12883	61441	0.81	0 - 3Mth: HR=1.64 (1.44, 1.86),p<0.001
	.	.	.	.	3Mth - 1.5Yr: HR=1.04 (0.86, 1.26),p=0.684
	.	.	.	.	1.5Yr - 2Yr: HR=1.35 (0.95, 1.91),p=0.092
	.	.	.	.	2Yr+: HR=0.79 (0.66, 0.95),p=0.011
**Delta-One-TT	9	146	526	1.71	Entire Period: HR=2.16 (1.12, 4.15),p=0.020
**Dynasty	85	1798	5306	1.60	Entire Period: HR=1.84 (1.48, 2.27),p<0.001
**Fin II	137	2109	16476	0.83	Entire Period: HR=1.42 (1.20, 1.68),p<0.001
**Furlong	53	806	4361	1.22	0 - 1.5Yr: HR=2.76 (2.05, 3.73),p<0.001
	.	.	.	.	1.5Yr+: HR=0.75 (0.41, 1.40),p=0.370
**Mueller	12	58	489	2.45	Entire Period: HR=4.01 (2.28, 7.06),p<0.001
**Versafitcup DM	44	928	2254	1.95	Entire Period: HR=2.03 (1.51, 2.73),p<0.001
Identified and no longer used	.	.	.	.	
+*GHE	10	114	698	1.43	Entire Period: HR=2.34 (1.26, 4.35),p=0.006
Anatomic II/Duraloc Option	9	60	623	1.45	Entire Period: HR=2.51 (1.31, 4.82),p=0.005
Anca-Fit/PINNACLE	15	101	933	1.61	Entire Period: HR=2.84 (1.71, 4.71),p<0.001
F2L/Delta-PF	19	107	1138	1.67	Entire Period: HR=2.89 (1.84, 4.53),p<0.001
Friendly Hip/Cup (Exactech)	14	97	993	1.41	Entire Period: HR=2.51 (1.49, 4.24),p<0.001
MBA (exch neck)/PINNACLE	25	225	1699	1.47	Entire Period: HR=2.54 (1.72, 3.76),p<0.001
Secur-Fit Plus/Secur-Fit	30	197	2420	1.24	Entire Period: HR=2.11 (1.47, 3.02),p<0.001
Taperloc/M2a^{MoM}	70	515	5880	1.19	Entire Period: HR=2.05 (1.62, 2.60),p<0.001
Taperloc/Versafitcup CC	7	120	353	1.98	Entire Period: HR=2.18 (1.04, 4.57),p=0.038
*ABGII (exch neck)	81	246	1791	4.52	0 - 1Mth: HR=4.10 (1.95, 8.61),p<0.001
	.	.	.	.	1Mth - 2.5Yr: HR=3.63 (2.19, 6.03),p<0.001

Femoral Stem/Acetabular	N Revised	N Total	Obs. Years	Revisions/100 Obs. Yrs	Hazard Ratio, P Value
	.	.	.	.	2.5Yr - 4Yr: HR=11.73 (6.80, 20.23),p<0.001
	.	.	.	.	4Yr - 4.5Yr: HR=33.84 (18.61, 61.51),p<0.001
	.	.	.	.	4.5Yr - 5Yr: HR=9.04 (2.91, 28.10),p<0.001
	.	.	.	.	5Yr - 6Yr: HR=29.24 (18.34, 46.63),p<0.001
	.	.	.	.	6Yr+: HR=6.17 (3.65, 10.42),p<0.001
*Adapter (cless)	147	744	6318	2.33	0 - 2Wk: HR=3.75 (1.87, 7.51),p<0.001
	.	.	.	.	2Wk - 1Mth: HR=1.62 (0.68, 3.91),p=0.278
	.	.	.	.	1Mth - 6Mth: HR=0.77 (0.29, 2.05),p=0.601
	.	.	.	.	6Mth - 3Yr: HR=3.73 (2.65, 5.25),p<0.001
	.	.	.	.	3Yr - 3.5Yr: HR=10.82 (6.12, 19.14),p<0.001
	.	.	.	.	3.5Yr - 6.5Yr: HR=6.35 (4.64, 8.67),p<0.001
	.	.	.	.	6.5Yr+: HR=4.54 (3.38, 6.09),p<0.001
*Adapter (ctd)	31	148	1156	2.68	0 - 6Mth: HR=1.98 (0.74, 5.27),p=0.172
	.	.	.	.	6Mth+: HR=5.81 (3.98, 8.47),p<0.001
*BMHR VST	29	260	2159	1.34	Entire Period: HR=2.15 (1.49, 3.09),p<0.001
*CBH Stem	37	274	2180	1.70	Entire Period: HR=2.90 (2.10, 4.00),p<0.001
*Edinburgh	18	138	992	1.81	Entire Period: HR=3.13 (1.97, 4.97),p<0.001
*Elite Plus	261	2841	30629	0.85	0 - 1Mth: HR=0.26 (0.11, 0.62),p=0.002
	.	.	.	.	1Mth - 9Mth: HR=0.97 (0.65, 1.45),p=0.888
	.	.	.	.	9Mth+: HR=1.78 (1.57, 2.03),p<0.001
*Emperion	51	507	3621	1.41	Entire Period: HR=2.25 (1.71, 2.96),p<0.001
*K2	78	601	4956	1.57	Entire Period: HR=2.73 (2.19, 3.42),p<0.001
*LYDERIC II	15	164	1413	1.06	Entire Period: HR=1.86 (1.12, 3.08),p=0.016
*ML Taper Kinectiv	174	3532	23278	0.75	0 - 3Mth: HR=1.44 (1.11, 1.86),p=0.005
	.	.	.	.	3Mth+: HR=1.13 (0.94, 1.36),p=0.191
*MSA	35	224	1624	2.16	Entire Period: HR=3.45 (2.48, 4.81),p<0.001
*Margron	116	688	8157	1.42	0 - 3Mth: HR=2.22 (1.40, 3.53),p<0.001
	.	.	.	.	3Mth - 6Mth: HR=5.30 (2.75, 10.22),p<0.001
	.	.	.	.	6Mth - 1Yr: HR=5.69 (3.30, 9.83),p<0.001
	.	.	.	.	1Yr - 2Yr: HR=2.40 (1.20, 4.80),p=0.013
	.	.	.	.	2Yr - 2.5Yr: HR=4.52 (2.03, 10.10),p<0.001
	.	.	.	.	2.5Yr - 7Yr: HR=3.85 (2.78, 5.32),p<0.001
	.	.	.	.	7Yr+: HR=1.13 (0.76, 1.68),p=0.540
*Mayo	17	168	1757	0.97	Entire Period: HR=1.70 (1.06, 2.73),p=0.028
*Metha (exch neck)	14	88	708	1.98	Entire Period: HR=3.33 (1.98, 5.62),p<0.001
*Profemur Z	26	186	1908	1.36	Entire Period: HR=2.36 (1.61, 3.46),p<0.001
*Trabecular Metal	120	1904	13444	0.89	0 - 1Mth: HR=2.58 (1.85, 3.59),p<0.001
	.	.	.	.	1Mth - 3Mth: HR=1.95 (1.21, 3.14),p=0.006
	.	.	.	.	3Mth+: HR=1.14 (0.90, 1.45),p=0.281
*UniSyn	54	466	4053	1.33	Entire Period: HR=2.23 (1.71, 2.91),p<0.001
**2000 Plus	19	135	1178	1.61	Entire Period: HR=2.80 (1.79, 4.40),p<0.001
**ASR	1979	4421	36347	5.44	0 - 2Wk: HR=1.22 (0.75, 2.00),p=0.426
	.	.	.	.	2Wk - 1Mth: HR=0.21 (0.08, 0.56),p=0.001
	.	.	.	.	1Mth - 9Mth: HR=1.03 (0.76, 1.40),p=0.839
	.	.	.	.	9Mth - 1.5Yr: HR=3.56 (2.80, 4.52),p<0.001
	.	.	.	.	1.5Yr - 2Yr: HR=6.44 (5.00, 8.29),p<0.001
	.	.	.	.	2Yr - 2.5Yr: HR=11.47 (9.33, 14.09),p<0.001
	.	.	.	.	2.5Yr - 3Yr: HR=15.17 (12.49, 18.44),p<0.001
	.	.	.	.	3Yr - 5Yr: HR=25.19 (23.03, 27.55),p<0.001
	.	.	.	.	5Yr - 5.5Yr: HR=31.26 (26.32, 37.12),p<0.001
	.	.	.	.	5.5Yr - 6Yr: HR=25.17 (20.75, 30.55),p<0.001
	.	.	.	.	6Yr - 7Yr: HR=18.05 (15.37, 21.19),p<0.001
	.	.	.	.	7Yr - 8.5Yr: HR=13.91 (11.92, 16.23),p<0.001

Femoral Stem/Acetabular	N Revised	N Total	Obs. Years	Revisions/100 Obs. Yrs	Hazard Ratio, P Value
	.	.	.	.	8.5Yr - 10Yr: HR=7.85 (6.48, 9.51),p<0.001
	.	.	.	.	10Yr+: HR=4.80 (4.02, 5.74),p<0.001
**Adept	19	121	1106	1.72	Entire Period: HR=2.85 (1.82, 4.47),p<0.001
**Artek	68	179	2253	3.02	0 - 1Yr: HR=1.53 (0.64, 3.67),p=0.342
	.	.	.	.	1Yr - 1.5Yr: HR=3.90 (0.97, 15.60),p=0.054
	.	.	.	.	1.5Yr - 4Yr: HR=9.06 (5.46, 15.04),p<0.001
	.	.	.	.	4Yr - 4.5Yr: HR=3.68 (0.52, 26.16),p=0.193
	.	.	.	.	4.5Yr - 6Yr: HR=14.78 (8.37, 26.09),p<0.001
	.	.	.	.	6Yr+: HR=4.37 (3.10, 6.16),p<0.001
**BHR	466	2988	29937	1.56	0 - 2Wk: HR=0.78 (0.37, 1.65),p=0.522
	.	.	.	.	2Wk - 1Mth: HR=0.16 (0.04, 0.62),p=0.008
	.	.	.	.	1Mth - 3Mth: HR=1.13 (0.69, 1.86),p=0.615
	.	.	.	.	3Mth - 1Yr: HR=0.49 (0.26, 0.95),p=0.034
	.	.	.	.	1Yr - 1.5Yr: HR=1.39 (0.78, 2.45),p=0.261
	.	.	.	.	1.5Yr+: HR=3.73 (3.38, 4.12),p<0.001
**Bionik	145	608	5206	2.79	0 - 3Mth: HR=1.57 (0.87, 2.83),p=0.135
	.	.	.	.	3Mth+: HR=5.78 (4.88, 6.86),p<0.001
**Conserve Plus	20	135	1470	1.36	Entire Period: HR=2.35 (1.52, 3.64),p<0.001
**Cormet	128	803	8113	1.58	0 - 1.5Yr: HR=1.07 (0.67, 1.70),p=0.773
	.	.	.	.	1.5Yr - 2Yr: HR=0.54 (0.08, 3.85),p=0.540
	.	.	.	.	2Yr+: HR=3.81 (3.15, 4.60),p<0.001
**DeltaLox	26	222	1463	1.78	Entire Period: HR=2.99 (2.04, 4.39),p<0.001
**Duraloc	590	5354	59612	0.99	0 - 3Mth: HR=0.80 (0.60, 1.06),p=0.113
	.	.	.	.	3Mth - 9Mth: HR=1.30 (0.91, 1.87),p=0.150
	.	.	.	.	9Mth - 2Yr: HR=1.63 (1.25, 2.13),p<0.001
	.	.	.	.	2Yr - 2.5Yr: HR=0.76 (0.38, 1.53),p=0.443
	.	.	.	.	2.5Yr - 3Yr: HR=1.84 (1.13, 2.97),p=0.013
	.	.	.	.	3Yr - 5.5Yr: HR=1.55 (1.20, 1.99),p<0.001
	.	.	.	.	5.5Yr+: HR=2.36 (2.12, 2.62),p<0.001
**Durom	190	1245	13371	1.42	0 - 1.5Yr: HR=0.72 (0.46, 1.13),p=0.151
	.	.	.	.	1.5Yr+: HR=3.27 (2.81, 3.80),p<0.001
**ExpanSys	13	71	750	1.73	Entire Period: HR=3.03 (1.76, 5.23),p<0.001
**Hedrocel	12	46	554	2.17	Entire Period: HR=3.62 (2.06, 6.36),p<0.001
**Icon	95	401	3632	2.62	0 - 2.5Yr: HR=2.42 (1.62, 3.61),p<0.001
	.	.	.	.	2.5Yr+: HR=6.02 (4.77, 7.61),p<0.001
**Inter-Op	9	33	357	2.52	Entire Period: HR=4.29 (2.23, 8.24),p<0.001
**MBA	17	124	1078	1.58	Entire Period: HR=2.75 (1.71, 4.42),p<0.001
**Mitch TRH	123	731	6985	1.76	0 - 3Mth: HR=0.57 (0.24, 1.38),p=0.213
	.	.	.	.	3Mth - 2Yr: HR=2.21 (1.39, 3.50),p<0.001
	.	.	.	.	2Yr+: HR=4.26 (3.50, 5.19),p<0.001
**Plasmacup	34	482	3419	0.99	Entire Period: HR=1.64 (1.17, 2.30),p=0.003
**SPH-Blind	123	952	11840	1.04	0 - 1Mth: HR=2.38 (1.46, 3.88),p<0.001
	.	.	.	.	1Mth+: HR=1.70 (1.41, 2.06),p<0.001
**seleXys (excluding seleXys PC)	49	391	2909	1.68	Entire Period: HR=2.82 (2.13, 3.73),p<0.001

Note: Components have been compared to all other total conventional hip components
*Femoral stem
**Acetabular component
+ Newly identified and no longer used

Table IP8 Cumulative Percent Revision of Individual Total Conventional Hip Prostheses Identified as having a Higher than Anticipated Rate of Revision

CPR	1 Yr	3 Yrs	5 Yrs	10 Yrs	18 Yrs
Newly Identified					
*Linear	2.1 (1.0, 4.6)	5.5 (3.3, 8.9)	5.9 (3.7, 9.5)		
*MiniMax	4.3 (2.6, 7.3)				
*Profemur L	3.0 (2.3, 3.7)	4.0 (3.2, 5.0)	4.4 (3.5, 5.5)		
Re-Identified and Still Used					
Accolade II/Trident Tritanium (Shell)	2.4 (1.8, 3.3)	3.4 (2.5, 4.4)			
Avenir/Fitmore	5.4 (2.9, 9.9)	6.2 (3.4, 11.0)			
CORAIL/Trabecular Metal (Shell)	6.2 (2.8, 13.3)	9.8 (5.2, 18.0)	12.4 (7.1, 21.4)	12.4 (7.1, 21.4)	
CPT/Fitmore	4.1 (2.3, 7.3)	6.5 (4.0, 10.4)	7.2 (4.5, 11.5)		
CPT/Low Profile Cup	4.4 (2.2, 8.7)	5.9 (3.2, 10.8)	8.7 (5.1, 14.7)		
Friendly Hip/Delta-TT	5.5 (2.1, 14.0)	8.4 (3.9, 17.8)	8.4 (3.9, 17.8)		
HACTIV/Logical G	4.3 (3.1, 6.0)				
Secur-Fit Plus/PINNACLE	3.3 (1.7, 6.5)	4.7 (2.6, 8.4)	5.4 (3.1, 9.3)		
Taperloc/G7	1.8 (1.4, 2.5)	2.4 (1.8, 3.2)	2.4 (1.8, 3.2)		
*Apex	2.2 (1.7, 2.9)	3.3 (2.7, 4.1)	4.8 (4.0, 5.8)	7.4 (6.3, 8.8)	
*Excia (cless)	4.3 (2.7, 6.7)	5.3 (3.5, 8.0)	6.2 (4.1, 9.1)		
*Furlong Evolution	5.8 (3.7, 9.0)	7.6 (5.1, 11.3)	8.9 (5.7, 13.8)		
*Novation	3.6 (2.7, 4.8)	4.4 (3.4, 5.7)	4.7 (3.6, 6.0)		
*Taper Fit	1.7 (1.2, 2.3)	2.8 (2.2, 3.8)	5.0 (3.8, 6.7)	10.3 (7.7, 13.8)	
**Continuum	2.6 (2.3, 2.8)	3.4 (3.1, 3.7)	3.9 (3.6, 4.3)	5.6 (4.7, 6.5)	
**Delta-One-TT	3.5 (1.5, 8.2)	6.2 (3.1, 12.1)	7.7 (3.9, 14.6)		
**Dynasty	3.5 (2.8, 4.5)	4.9 (3.9, 6.1)	5.7 (4.5, 7.3)		
**Fin II	2.7 (2.1, 3.5)	3.6 (2.9, 4.5)	4.7 (3.9, 5.8)	7.4 (6.3, 8.8)	
**Furlong	4.5 (3.2, 6.2)	6.3 (4.8, 8.3)	6.7 (5.1, 8.8)	7.4 (5.6, 9.7)	
**Mueller	1.8 (0.3, 12.0)	12.8 (5.9, 26.4)	15.1 (7.5, 29.2)	24.2 (13.6, 40.9)	31.8 (18.9, 50.3)
**Versafitcup DM	3.9 (2.8, 5.4)	5.5 (4.0, 7.3)			
Identified and no longer used					
+*GHE	2.6 (0.9, 8.0)	5.3 (2.4, 11.5)	8.3 (4.4, 15.4)		
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)	
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)	
MBA (exch neck)/PINNACLE	2.2 (0.9, 5.3)	3.6 (1.8, 7.1)	7.6 (4.7, 12.1)	13.6 (9.3, 19.7)	
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, 15.7)	
Taperloc/Versafitcup CC	5.8 (2.8, 11.8)	5.8 (2.8, 11.8)			
*ABGII (exch neck)	4.5 (2.5, 8.0)	11.1 (7.8, 15.8)	20.5 (15.9, 26.2)	34.5 (28.6, 41.3)	
*Adapter (cless)	3.2 (2.2, 4.8)	6.9 (5.2, 8.9)	11.7 (9.5, 14.3)	20.2 (17.3, 23.5)	
*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)	
*BMHR VST	1.9 (0.8, 4.6)	4.6 (2.7, 8.0)	7.0 (4.5, 10.8)	13.8 (9.2, 20.5)	
*CBH Stem	4.0 (2.3, 7.2)	7.4 (4.9, 11.3)	9.9 (6.8, 14.1)	14.9 (10.9, 20.0)	
*Edinburgh	6.0 (3.1, 11.7)	9.6 (5.6, 16.4)	12.5 (7.7, 20.0)	17.0 (10.8, 26.2)	
*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)	14.2 (12.5, 16.2)
*Emperion	4.8 (3.2, 7.0)	6.0 (4.2, 8.4)	7.1 (5.1, 9.8)	14.0 (10.4, 18.7)	
*K2	5.2 (3.7, 7.3)	7.5 (5.7, 10.0)	9.8 (7.7, 12.6)	13.8 (11.2, 17.0)	
*LYDERIC II	3.1 (1.3, 7.2)	5.7 (3.0, 10.6)	7.1 (4.0, 12.5)	12.2 (7.2, 20.1)	
*ML Taper Kinectiv	2.4 (2.0, 3.0)	3.6 (3.0, 4.2)	4.4 (3.7, 5.1)	5.9 (5.0, 6.9)	
*MSA	5.8 (3.4, 9.8)	9.5 (6.3, 14.1)	11.3 (7.8, 16.3)		
*Margron	5.8 (4.3, 7.9)	8.6 (6.7, 10.9)	10.4 (8.3, 13.0)	15.6 (13.0, 18.6)	
*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)	

CPR	1 Yr	3 Yrs	5 Yrs	10 Yrs	18 Yrs
*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)	5.5 (4.5, 6.6)	7.2 (6.0, 8.7)	
*UniSyn	3.2 (2.0, 5.3)	5.9 (4.1, 8.5)	6.7 (4.7, 9.4)	12.2 (9.2, 16.0)	
**2000 Plus	3.0 (1.1, 7.8)	6.8 (3.6, 12.7)	9.2 (5.3, 15.7)	14.1 (9.0, 21.8)	
**ASR	1.9 (1.5, 2.3)	9.6 (8.8, 10.5)	24.4 (23.2, 25.8)	45.0 (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, 24.1)	
**Artek	2.8 (1.2, 6.7)	8.0 (4.8, 13.1)	16.1 (11.4, 22.4)	26.3 (20.3, 33.6)	41.8 (34.6, 50.0)
**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, 28.2)	
**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)	13.6 (11.3, 16.4)	
**DeltaLox	5.9 (3.5, 9.9)	8.7 (5.6, 13.2)	10.1 (6.8, 15.0)		
**Duraloc	1.8 (1.5, 2.2)	3.0 (2.6, 3.5)	4.1 (3.6, 4.7)	8.4 (7.6, 9.2)	17.8 (16.3, 19.5)
**Durom	1.1 (0.7, 1.9)	3.6 (2.7, 4.8)	5.5 (4.3, 6.9)	13.3 (11.5, 15.5)	
**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)	20.4 (10.7, 37.0)	
**Icon	3.0 (1.7, 5.3)	7.8 (5.5, 10.9)	12.7 (9.7, 16.4)	23.4 (19.4, 28.2)	
**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)	15.0 (12.5, 17.9)	
**Plasmacup	4.4 (2.9, 6.6)	5.6 (3.9, 8.1)	5.8 (4.1, 8.4)	7.6 (5.4, 10.8)	
**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)	15.1 (12.7, 17.8)
**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, 17.6)	

Note: * Femoral Stem
**Acetabular Component
+ Newly identified and no longer used

Table IP9 Yearly Usage of Individual Total Conventional Hip Prostheses Identified as having a Higher than Anticipated Rate of Revision

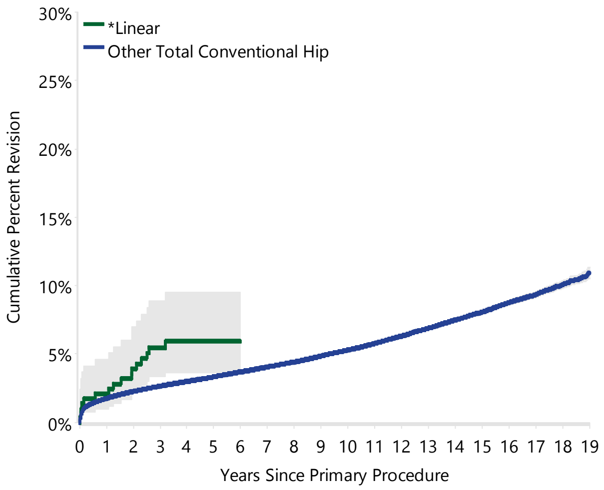
Year of Implant	≤2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Newly Identified	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
*Linear	.	.	.	.	.	.	.	.	.	.	23	31	31	88	70	27	12	4
*MiniMax	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	43	170	132
*Profemur L	.	.	.	.	.	.	.	.	.	.	2	47	288	383	406	405	439	426
Re-Identified and Still Used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Accolade II/Trident Tritanium (Shell)	.	.	.	.	.	.	.	.	.	.	1	1	30	119	258	483	401	506
Avenir/Fitmore	.	.	.	.	.	.	.	.	.	.	.	2	7	5	46	44	42	54
CORAIL/Trabecular Metal (Shell)	.	.	.	.	.	5	10	17	21	8	8	8	6	1	6	2	4	1
CPT/Fitmore	.	.	19	6	6	4	16	12	15	24	14	30	30	22	18	16	20	25
CPT/Low Profile Cup	.	.	15	9	8	7	7	6	9	16	26	20	6	5	2	3	15	31
Friendly Hip/Delta-TT	.	.	.	.	.	.	.	.	.	14	12	13	13	9	6	4	2	1
HACTIV/Logical G	.	.	.	.	.	.	.	.	.	1	.	.	.	.	18	169	395	308
Secur-Fit Plus/PINNACLE	.	.	1	3	.	.	.	.	.	.	.	42	42	53	25	33	31	16
Taperloc/G7	.	.	.	.	.	.	.	.	.	.	.	19	147	334	415	482	505	799
*Apex	.	.	.	75	247	223	265	197	169	190	219	246	188	193	168	88	60	44
*Excia (cless)	.	.	.	.	.	.	6	34	8	47	58	38	17	42	35	65	64	10
*Furlong Evolution	.	.	.	.	.	.	.	.	.	.	.	29	25	32	11	54	102	106
*Novation	.	.	.	.	.	.	.	4	32	53	130	137	226	266	148	90	99	143
*Taper Fit	30	34	65	50	66	26	18	6	8	17	55	45	110	162	227	315	590	780
**Continuum	.	.	.	.	.	.	.	175	1117	1245	1333	1502	1492	1359	1327	1293	1196	844
**Delta-One-TT	.	.	.	.	.	.	.	.	4	7	7	15	37	13	12	14	14	23
**Dynasty	.	.	.	.	.	.	.	.	.	40	31	49	178	298	317	306	307	272
**Fin II	.	.	.	39	128	175	251	269	318	286	205	247	101	6	.	.	9	75
**Furlong	27	4	.	.	.	4	7	61	90	85	73	76	64	66	12	55	100	82
**Mueller	37	3	4	3	.	1	2	.	.	.	1	.	1	1	.	1	1	3
**Versafitcup DM	.	.	.	.	.	.	.	.	.	10	12	4	19	139	184	195	182	183
Identified and no longer used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
+*GHE	.	.	.	.	.	.	.	.	9	4	47	28	14	12	.	.	.	.
Anatomic II/Duraloc Option	.	.	.	4	33	23	.	.	.	.	.	.	.	.	.	.	.	.
Anca-Fit/PINNACLE	.	.	.	.	30	55	16	.	.	.	.	.	.	.	.	.	.	.
F2L/Delta-PF	.	.	7	62	28	10	.	.	.	.	.	.	.	.	.	.	.	.
Friendly Hip/Cup (Exactech)	8	16	18	16	19	12	2	6	.	.	.	.	.	.	.	.	.	.
MBA (exch neck)/PINNACLE	.	.	.	.	.	24	45	9	43	46	14	44	.	.	.	.	.	.
Secur-Fit Plus/Secur-Fit	101	27	21	26	22	.	.	.	.	.	.	.	.	.	.	.	.	.
Taperloc/M2a MoM	18	79	113	74	38	43	76	49	23	2	.	.	.	.	.	.	.	.
Taperloc/Versafitcup CC	.	.	.	.	.	.	.	.	.	.	2	.	.	.	74	44	.	.
*ABGII (exch neck)	.	.	.	.	.	10	39	69	58	63	7	.	.	.	.	.	.	.
*Adapter (cless)	.	.	.	19	140	131	122	158	113	60	.	1	.	.	.	.	.	.
*Adapter (ctd)	.	.	.	7	41	52	33	8	7	.	.	.	.	.	.	.	.	.
*BMHR VST	.	.	.	.	.	.	2	65	81	71	22	13	5	1	.	.	.	.
*CBH Stem	.	.	12	7	14	37	28	27	45	53	43	7	.	1	.	.	.	.
*Edinburgh	.	.	.	20	37	29	18	23	10	1	.	.	.	.	.	.	.	.
*Elite Plus	1609	445	353	249	112	46	26	.	.	1	.	.	.	.	.	.	.	.
*Emperion	.	.	.	1	13	21	26	65	87	72	44	53	38	41	34	12	.	.
*K2	.	.	.	.	1	22	80	172	204	122	.	.	.	.	.	.	.	.
*LYDERIC II	33	16	64	23	12	8	8	.	.	.	.	.	.	.	.	.	.	.
*ML Taper Kinectiv	.	.	.	.	.	.	36	341	647	576	515	384	345	256	199	159	74	.
*MSA	.	.	.	.	.	2	3	11	58	76	46	21	7	.	.	.	.	.
*Margron	214	123	140	96	85	28	2	.	.	.	.	.	.	.	.	.	.	.

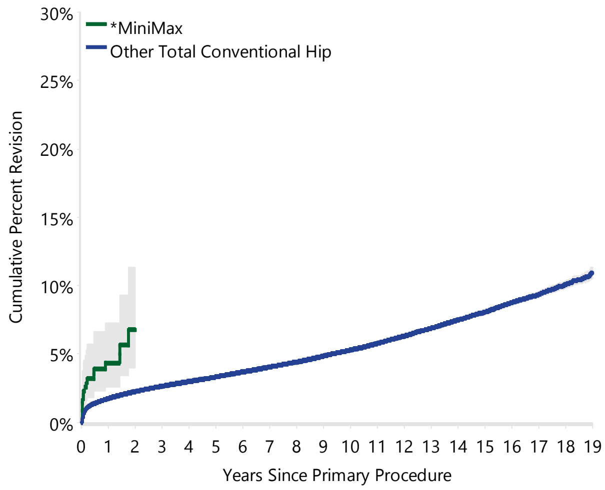
Year of Implant	≤2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
*Mayo	10	11	14	23	24	25	29	30	2	.	.	.	.	.	.	.	.	.
*Metha (exch neck)	.	.	.	.	.	.	.	20	53	15	.	.	.	.	.	.	.	.
*Profemur Z	.	.	41	79	56	6	1	2	1	.	.	.	.	.	.	.	.	.
*Trabecular Metal	.	.	.	.	6	101	148	198	242	272	276	186	220	112	106	32	5	.
*UniSyn	1	14	41	74	33	37	46	48	36	22	19	23	27	23	17	5	.	.
**2000 Plus	.	.	.	11	23	42	14	18	25	2	.	.	.	.	.	.	.	.
**ASR	.	.	84	584	958	1185	1180	430	.	.	.	.	.	.	.	.	.	.
**Adept	.	.	.	.	19	20	29	30	11	12	.	.	.	.	.	.	.	.
**Artek	179	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
**BHR	39	66	127	288	550	581	477	404	276	134	27	13	5	1	.	.	.	.
**Bionik	.	.	.	11	147	136	138	134	38	4	.	.	.	.	.	.	.	.
**Conserve Plus	.	.	19	16	46	24	15	14	1	.	.	.	.	.	.	.	.	.
**Cormet	9	53	74	103	114	73	129	124	93	26	4	1	.	.	.	.	.	.
**DeltaLox	.	.	.	.	.	.	.	.	32	86	72	24	8	.	.	.	.	.
**Duraloc	2147	907	631	448	301	253	293	187	82	84	18	3	.	.	.	.	.	.
**Durom	.	5	79	265	322	257	218	85	13	1	.	.	.	.	.	.	.	.
**ExpanSys	.	1	7	24	30	8	1	.	.	.	.	.	.	.	.	.	.	.
**Hedrocel	37	9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
**Icon	.	.	3	40	80	84	68	78	37	11	.	.	.	.	.	.	.	.
**Inter-Op	33	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
**MBA	49	29	19	11	9	5	2	.	.	.	.	.	.	.	.	.	.	.
**Mitch TRH	.	.	.	.	45	273	164	130	82	37	.	.	.	.	.	.	.	.
**Plasmacup	.	.	.	10	16	13	7	54	60	59	77	70	44	51	21	.	.	.
**SPH-Blind	377	261	205	41	49	19	.	.	.	.	.	.	.	.	.	.	.	.
**seleXys (excluding seleXys PC)	.	.	.	.	35	33	20	21	53	70	89	57	13	.	.	.	.	.

Note: *Femoral stem
**Acetabular component
+ Newly identified and no longer used

Figure IP2 Cumulative Percent Revision of Newly Identified Total Conventional Hip Prostheses

Newly Identified





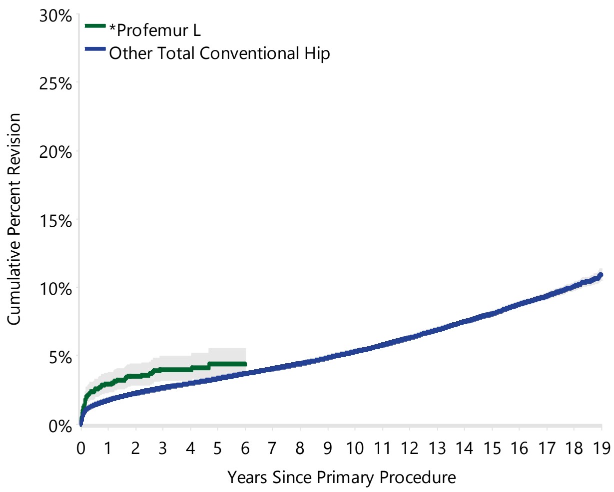
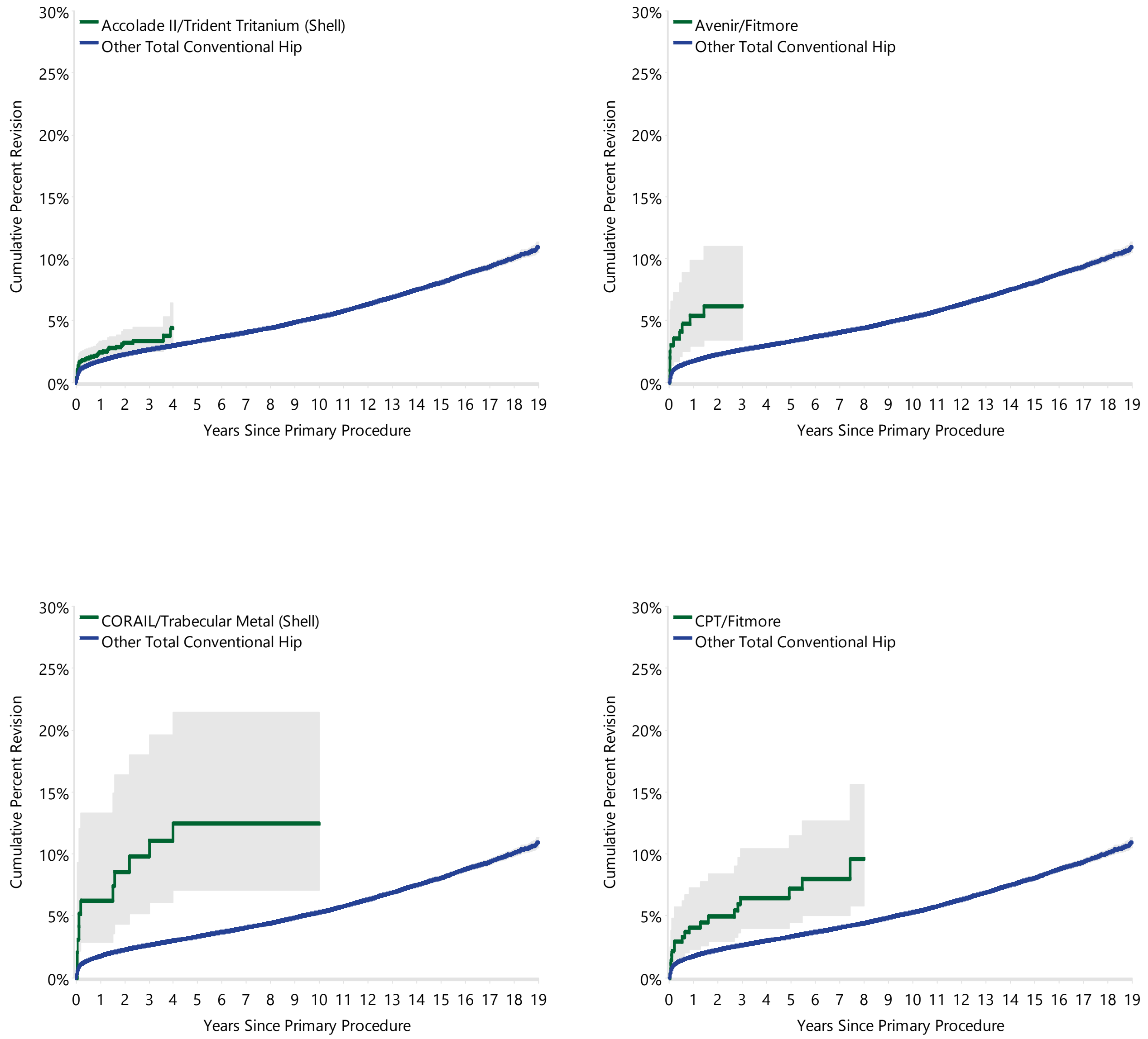
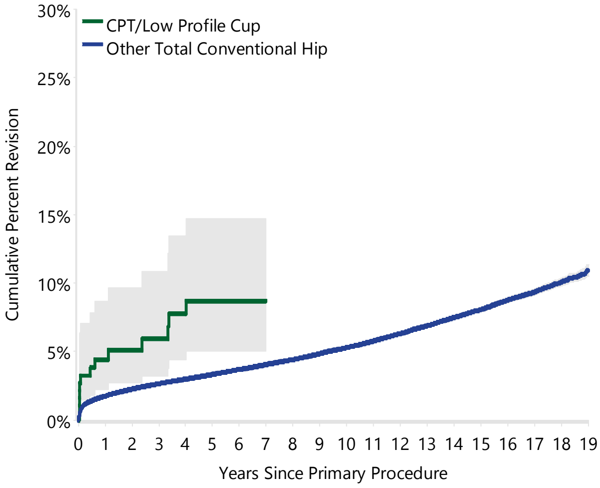
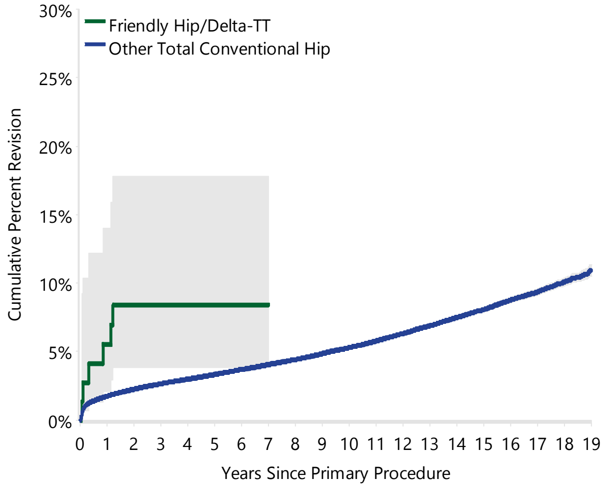


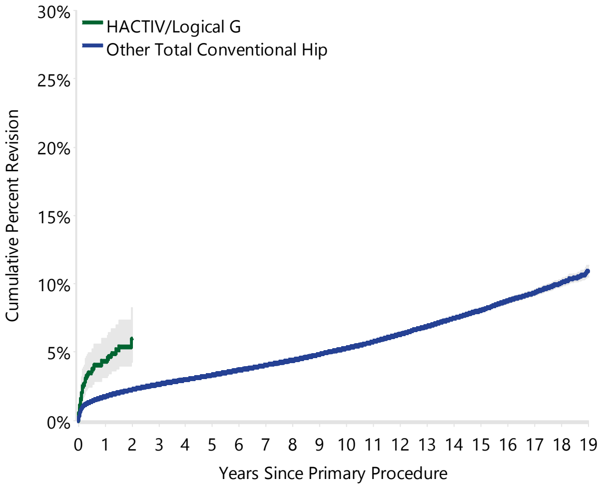
Figure IP3 Cumulative Percent Revision of Re-identified and Still Used Individual Total Conventional Hip Prostheses

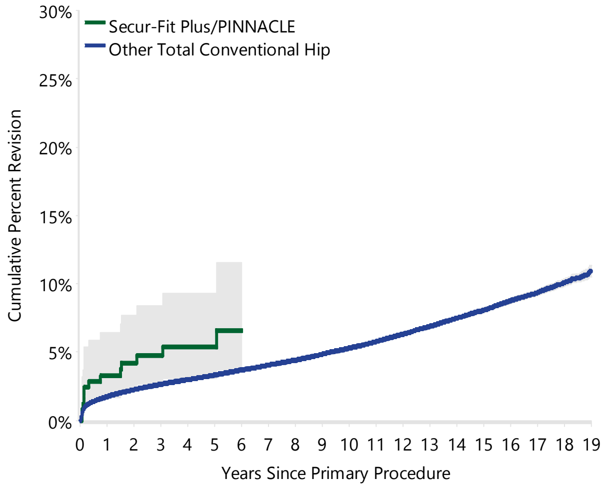
Re-identified and Still Used

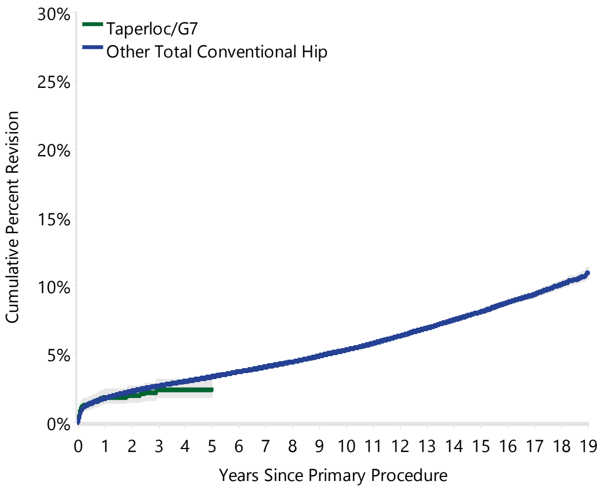


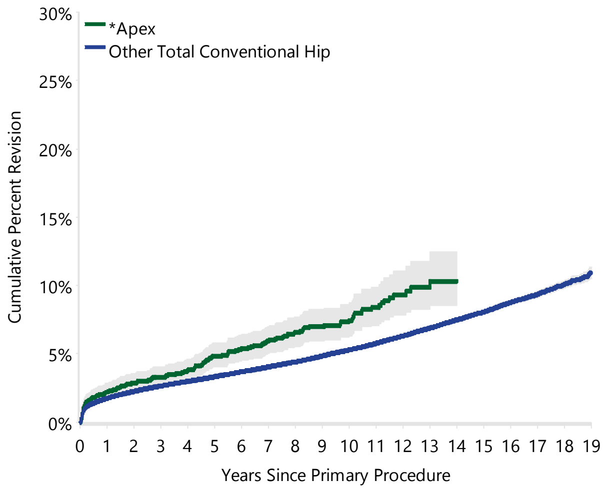

CPT/Low Profile Cup
Other Total Conventional Hip
Cumulative Percent Revision
30%
25%
20%
15%
10%
5%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Years Since Primary Procedure

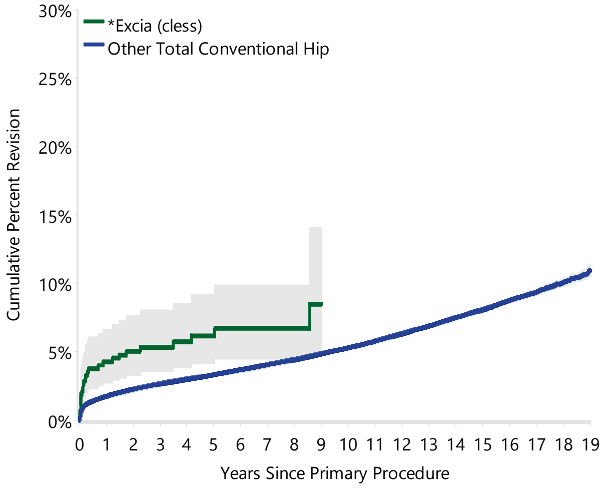

Friendly Hip/Delta-TT
Other Total Conventional Hip
Cumulative Percent Revision
30%
25%
20%
15%
10%
5%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Years Since Primary Procedure

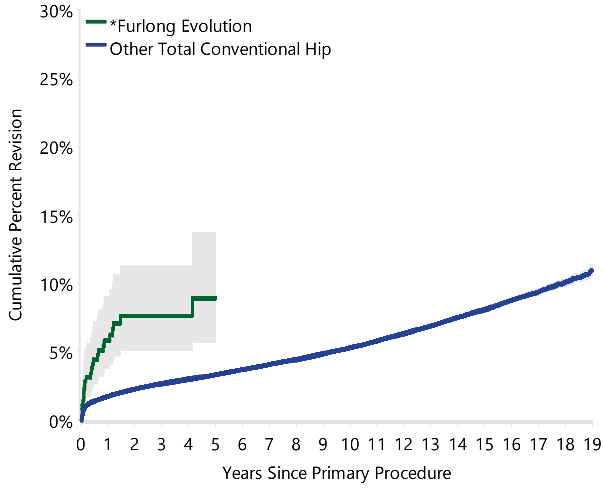

HACTIV/Logical G
Other Total Conventional Hip
Cumulative Percent Revision
30%
25%
20%
15%
10%
5%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Years Since Primary Procedure

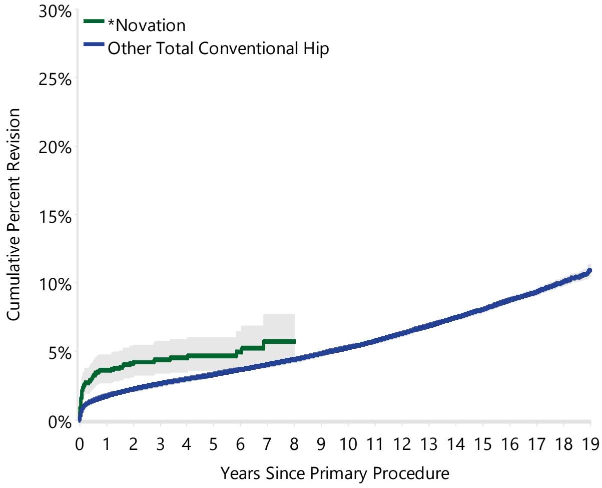

Secur-Fit Plus/PINNACLE
Other Total Conventional Hip
Cumulative Percent Revision
30%
25%
20%
15%
10%
5%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Years Since Primary Procedure

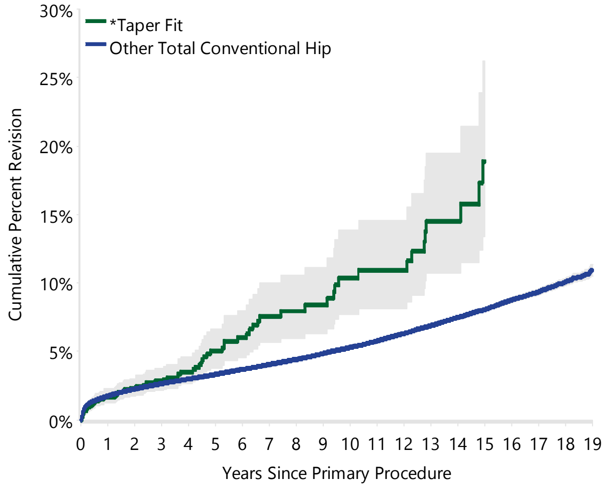

Taperloc/G7
Other Total Conventional Hip
Cumulative Percent Revision
30%
25%
20%
15%
10%
5%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Years Since Primary Procedure

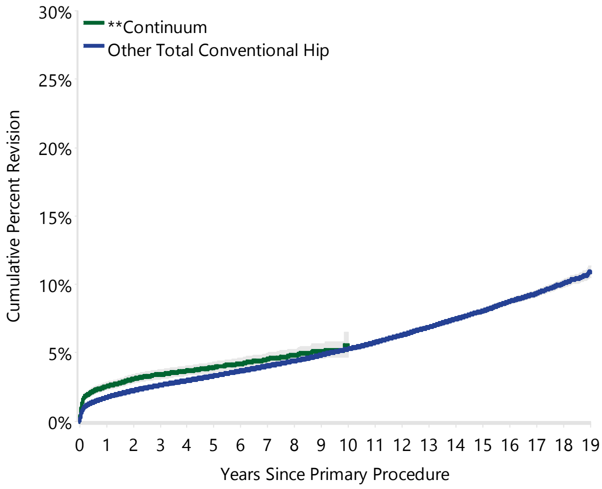

*Apex
Other Total Conventional Hip
Cumulative Percent Revision
30%
25%
20%
15%
10%
5%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Years Since Primary Procedure

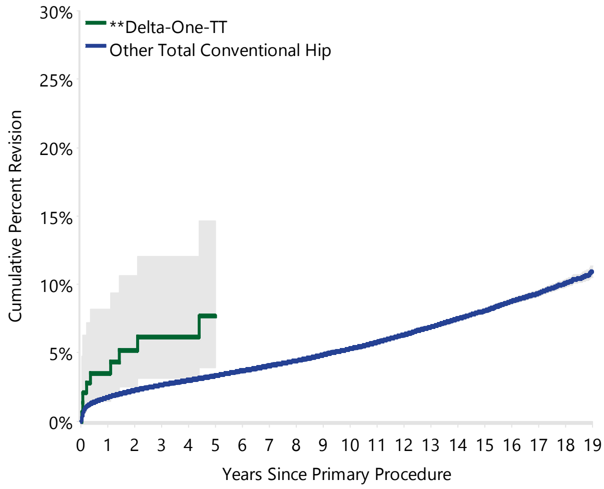

*Excia (cless)
Other Total Conventional Hip
Cumulative Percent Revision
30%
25%
20%
15%
10%
5%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Years Since Primary Procedure

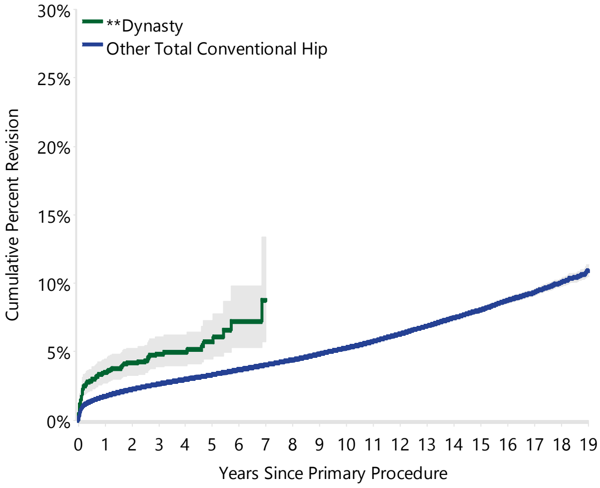

*Furlong Evolution
Other Total Conventional Hip
Cumulative Percent Revision
30%
25%
20%
15%
10%
5%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Years Since Primary Procedure

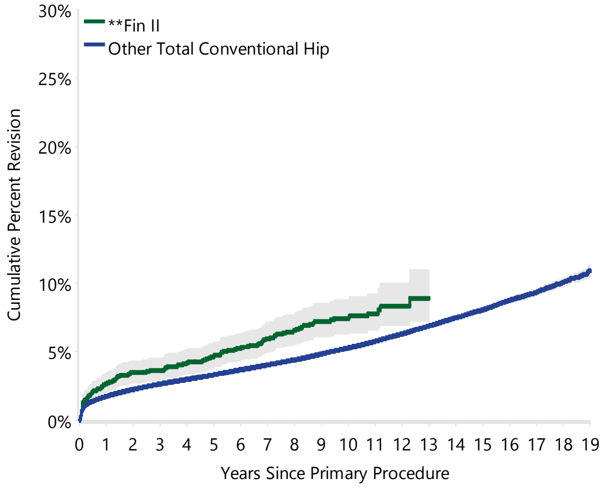

*Novation
Other Total Conventional Hip
Cumulative Percent Revision
30%
25%
20%
15%
10%
5%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Years Since Primary Procedure

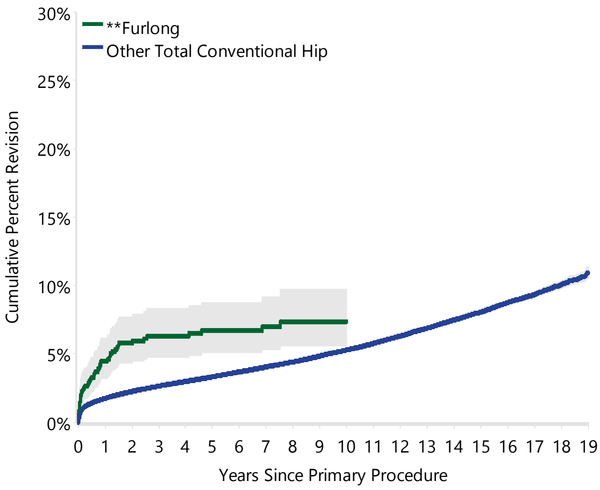

*Taper Fit
Other Total Conventional Hip
Cumulative Percent Revision
30%
25%
20%
15%
10%
5%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Years Since Primary Procedure

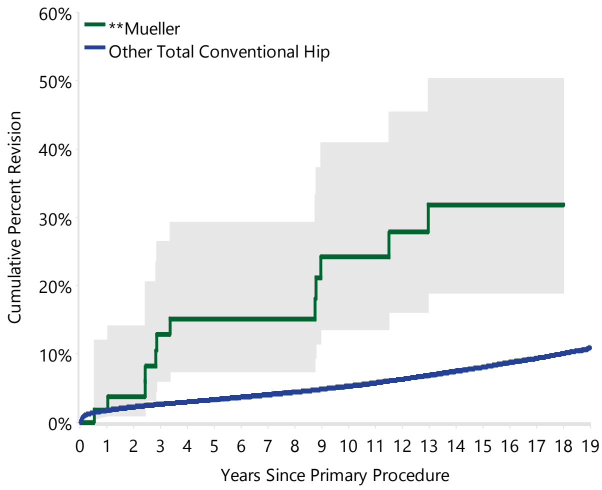

**Continuum
Other Total Conventional Hip
Cumulative Percent Revision
30%
25%
20%
15%
10%
5%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Years Since Primary Procedure

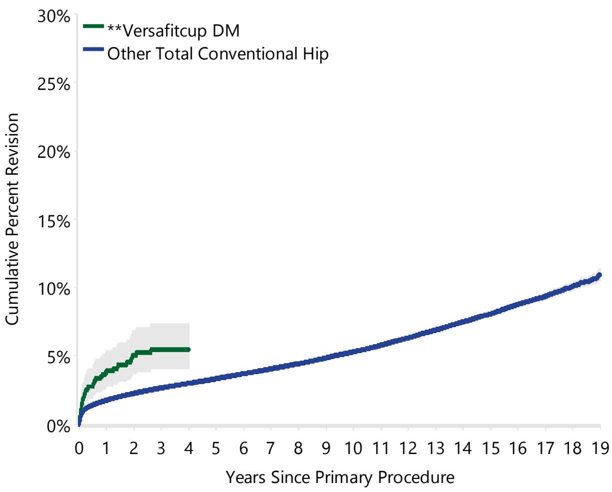

**Delta-One-TT
Other Total Conventional Hip
Cumulative Percent Revision
30%
25%
20%
15%
10%
5%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Years Since Primary Procedure


**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
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
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
Years Since Primary Procedure


**Mueller
Other Total Conventional Hip
Cumulative Percent Revision
60%
50%
40%
30%
20%
10%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
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
Years Since Primary Procedure

TOTAL RESURFACING

There are no newly identified total resurfacing hip prostheses.

Table IP10 Revision Rate of Individual 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	392	1168	12402	3.16	0 - 3Mth: HR=1.80 (1.10, 2.95),p=0.019
	.	.	.	.	3Mth - 3Yr: HR=2.42 (1.86, 3.15),p<0.001
	.	.	.	.	3Yr - 4.5Yr: HR=5.75 (4.27, 7.74),p<0.001
	.	.	.	.	4.5Yr - 5Yr: HR=9.44 (6.00, 14.85),p<0.001
	.	.	.	.	5Yr - 5.5Yr: HR=5.23 (3.08, 8.88),p<0.001
	.	.	.	.	5.5Yr - 6Yr: HR=7.33 (4.60, 11.68),p<0.001
	.	.	.	.	6Yr - 7.5Yr: HR=6.23 (4.61, 8.42),p<0.001
	.	.	.	.	7.5Yr - 9.5Yr: HR=3.51 (2.52, 4.87),p<0.001
	.	.	.	.	9.5Yr+: HR=2.87 (2.19, 3.76),p<0.001
Bionik/Bionik	59	200	1887	3.13	Entire Period: HR=3.54 (2.73, 4.59),p<0.001
Conserve Plus/Conserve Plus	16	63	802	2.00	Entire Period: HR=1.85 (1.13, 3.03),p=0.014
Cormet/Cormet	127	626	6987	1.82	Entire Period: HR=1.89 (1.58, 2.27),p<0.001
Durom/Durom	110	847	10311	1.07	0 - 4.5Yr: HR=1.82 (1.41, 2.35),p<0.001
	.	.	.	.	4.5Yr+: HR=0.82 (0.62, 1.10),p=0.195
Recap/Recap	29	196	2070	1.40	0 - 6Mth: HR=2.48 (1.10, 5.58),p=0.028
	.	.	.	.	6Mth - 1.5Yr: HR=5.16 (2.53, 10.52),p<0.001
	.	.	.	.	1.5Yr+: HR=1.00 (0.60, 1.66),p=0.998
*Cormet 2000 HAP	25	95	1256	1.99	Entire Period: HR=2.38 (1.60, 3.53),p<0.001

Note: Components have been compared to all other total resurfacing hip components
*Head component

Table IP11 Cumulative Percent Revision of Individual Total Resurfacing Hip Prostheses Identified as having a Higher than Anticipated Rate of Revision

CPR	1 Yr	3 Yrs	5 Yrs	10 Yrs	18 Yrs
Identified and no longer used					
ASR/ASR	3.4 (2.5, 4.6)	7.2 (5.9, 8.8)	15.4 (13.4, 17.6)	29.8 (27.2, 32.5)	
Bionik/Bionik	3.5 (1.7, 7.2)	12.5 (8.7, 18.0)	18.6 (13.8, 24.7)	27.4 (21.7, 34.2)	
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)	17.3 (14.5, 20.5)	
Durom/Durom	3.3 (2.3, 4.8)	5.6 (4.2, 7.3)	7.7 (6.1, 9.7)	11.0 (9.0, 13.3)	
Recap/Recap	5.1 (2.8, 9.3)	8.7 (5.5, 13.6)	10.2 (6.7, 15.4)	14.5 (10.2, 20.3)	
*Cormet 2000 HAP	6.3 (2.9, 13.5)	8.4 (4.3, 16.1)	9.5 (5.0, 17.4)	21.1 (14.2, 30.7)	

Note: * Head component

Table IP12 Yearly Usage of Individual Total Resurfacing Hip Prostheses Identified as having a Higher than Anticipated Rate of Revision

Year of Implant	≤2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Identified and no longer used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
ASR/ASR	.	43	165	302	258	176	133	91	.	.	.	.	.	.	.	.	.	.
Bionik/Bionik	.	.	.	12	33	33	46	54	20	2	.	.	.	.	.	.	.	.
Conserve Plus/Conserve Plus	8	7	18	15	11	3	.	1	.	.	.	.	.	.	.	.	.	.
Cormet/Cormet	62	42	50	85	74	76	94	75	50	10	4	4	.	.	.	.	.	.
Durom/Durom	.	58	166	207	143	105	88	46	24	10	.	.	.	.	.	.	.	.
Recap/Recap	.	.	27	14	10	42	46	38	16	3	.	.	.	.	.	.	.	.
*Cormet 2000 HAP	18	38	39	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Note: * Head component

PRIMARY PARTIAL KNEE REPLACEMENT

PATELLA/TROCHLEA

There are no newly identified patella/trochlear knee prostheses.

Table IP13 Revision Rate of Individual 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	.	.	.	.	
**LCS	199	413	3828	5.20	Entire Period: HR=1.64 (1.40, 1.92),p<0.001

Note: Components have been compared to all other patella/trochlear knee components
** Trochlear component

Table IP14 Cumulative Percent Revision of Individual Patella/Trochlear Knee Prostheses Identified as having a Higher than Anticipated Rate of Revision

CPR	1 Yr	3 Yrs	5 Yrs	10 Yrs	18 Yrs
Identified and no longer used					
**LCS	3.9 (2.4, 6.2)	11.9 (9.1, 15.4)	20.7 (17.1, 25.0)	40.6 (35.9, 45.7)	

Note: ** Trochlear component

Table IP15 Yearly Usage of Individual Patella/Trochlear Knee Prostheses Identified as having a Higher than Anticipated Rate of Revision

Year of Implant	≤2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Identified and no longer used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
**LCS	26	56	68	47	65	64	60	27	.	.	.	.	.	.	.	.	.	.

Note:** Trochlear component

UNICOMPARTMENTAL

There are no newly identified unicompartmental knee prostheses.

Table IP16 Revision Rate of Individual 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	31	156	643	4.82	Entire Period: HR=2.60 (1.83, 3.71),p<0.001
Uniglide/Uniglide	168	755	7398	2.27	0 - 1.5Yr: HR=2.02 (1.53, 2.66),p<0.001
	.	.	.	.	1.5Yr+: HR=1.13 (0.94, 1.36),p=0.192
Identified and no longer used	.	.	.	.	
Advance/Advance	16	37	311	5.15	Entire Period: HR=3.38 (2.07, 5.51),p<0.001
BalanSys Uni/BalanSys Uni Mobile	51	199	2112	2.42	0 - 6Mth: HR=4.19 (2.09, 8.43),p<0.001
	.	.	.	.	6Mth - 2Yr: HR=2.20 (1.30, 3.72),p=0.003
	.	.	.	.	2Yr+: HR=1.03 (0.72, 1.49),p=0.864
**Preservation Mobile	145	400	4650	3.12	0 - 1.5Yr: HR=2.29 (1.64, 3.19),p<0.001
	.	.	.	.	1.5Yr - 3Yr: HR=2.89 (1.97, 4.23),p<0.001
	.	.	.	.	3Yr+: HR=1.25 (1.00, 1.55),p=0.045

Note: Components have been compared to all other unicompartmental knee components
** Tibial component

Table IP17 Cumulative Percent Revision of Individual Unicompartmental Knee Prostheses Identified as having a Higher than Anticipated Rate of Revision

CPR	1 Yr	3 Yrs	5 Yrs	10 Yrs	18 Yrs
Re-Identified and Still Used					
GMK-UNI/GMK-UNI	5.9 (3.1, 11.0)	18.4 (12.7, 26.1)	22.6 (16.1, 31.2)		
Uniglide/Uniglide	4.8 (3.5, 6.6)	10.7 (8.7, 13.2)	12.9 (10.7, 15.6)	20.0 (17.2, 23.2)	
Identified and no longer used					
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)	
**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)	

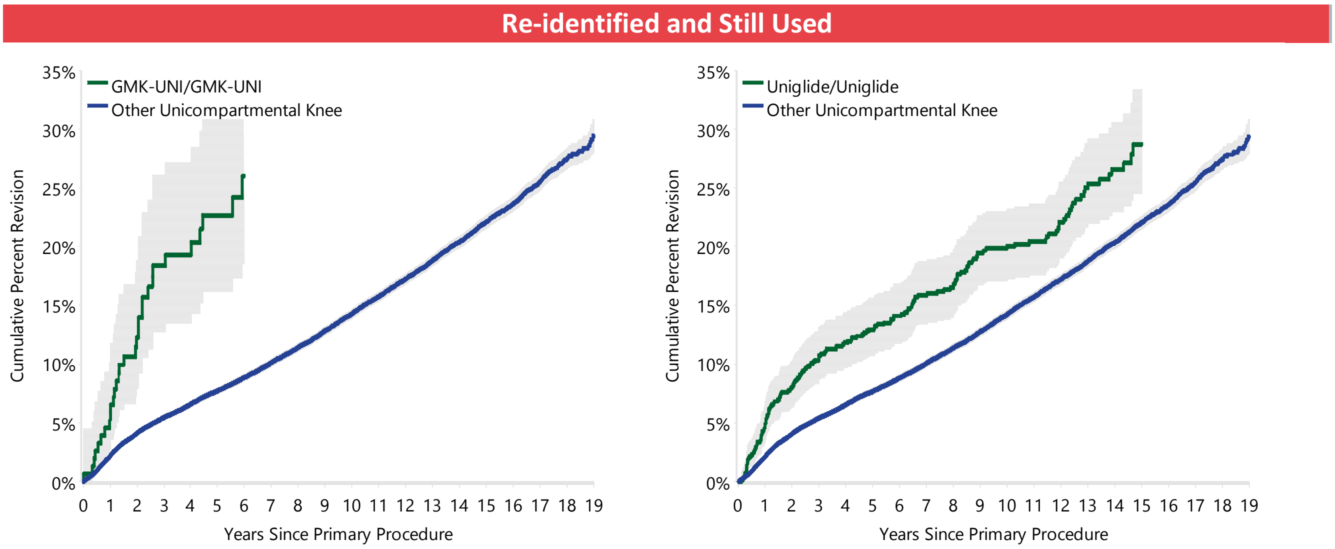
Note: ** Tibial component

Table IP18 Yearly Usage of Individual Unicompartmental Knee Prostheses Identified as having a Higher than Anticipated Rate of Revision

Year of Implant	≤2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Re-Identified and Still Used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
GMK-UNI/GMK-UNI	.	.	.	.	.	.	5	10	2	.	21	22	16	19	17	12	29	3
Uniglide/Uniglide	.	80	66	123	84	107	93	61	30	38	25	22	9	5	8	3	.	1
Identified and no longer used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Advance/Advance	.	13	11	7	2	3	1	.	.	.	.	.	.	.	.	.	.	.
BalanSys Uni/BalanSys Uni Mobile	.	.	37	51	63	33	9	2	4	.	.	.	.	.	.	.	.	.
**Preservation Mobile	164	121	59	26	17	13	.	.	.	.	.	.	.	.	.	.	.	.

Note: ** Tibial component

Figure IP4 Cumulative Percent Revision of Re-identified and Still Used Individual Unicompartmental Knee Prostheses



PRIMARY TOTAL KNEE REPLACEMENT

The Maxim (cementless)/Vanguard (cemented) femoral combination is identified for the first time and no longer used.

Table IP19 Revision Rate of Individual 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
Re-Identified and Still Used	.	.	.	.	
ACS (cless)/ACS Fixed	100	2193	7933	1.26	Entire Period: HR=1.60 (1.31, 1.94),p<0.001
Active Knee (cless)/Active Knee	637	7173	67711	0.94	0 - 3Yr: HR=1.24 (1.10, 1.41),p<0.001
	.	.	.	.	3Yr+: HR=1.90 (1.72, 2.10),p<0.001
Advance/Advance	60	973	5648	1.06	Entire Period: HR=1.56 (1.21, 2.01),p<0.001
Apex Knee CR (cless)/Apex Knee (cless)	26	443	2019	1.29	Entire Period: HR=1.80 (1.23, 2.65),p=0.002
Columbus/Columbus	117	3045	11424	1.02	Entire Period: HR=1.52 (1.27, 1.82),p<0.001
E.Motion/E.Motion	74	1254	5880	1.26	0 - 1.5Yr: HR=2.36 (1.76, 3.16),p<0.001
	.	.	.	.	1.5Yr+: HR=1.29 (0.89, 1.85),p=0.175
Nexgen LPS Flex (cless)/Nexgen	94	2013	8303	1.13	0 - 9Mth: HR=2.80 (2.07, 3.80),p<0.001
	.	.	.	.	9Mth - 1.5Yr: HR=1.15 (0.71, 1.85),p=0.572
	.	.	.	.	1.5Yr+: HR=1.12 (0.81, 1.57),p=0.489
Optetrak-PS/Optetrak	241	2410	22412	1.08	0 - 1.5Yr: HR=1.52 (1.17, 1.96),p=0.001
	.	.	.	.	1.5Yr+: HR=2.10 (1.81, 2.43),p<0.001
Optetrak-PS/Optetrak RBK	80	1127	8023	1.00	Entire Period: HR=1.69 (1.36, 2.10),p<0.001
Score (cless)/Score (cless)	200	2413	13211	1.51	0 - 1.5Yr: HR=1.76 (1.39, 2.22),p<0.001
	.	.	.	.	1.5Yr+: HR=2.28 (1.92, 2.71),p<0.001
Score (cless)/Score (ctd)	69	1520	5067	1.36	Entire Period: HR=1.63 (1.29, 2.07),p<0.001
Trekking/Trekking	52	1177	4879	1.07	0 - 6Mth: HR=2.61 (1.60, 4.24),p<0.001
	.	.	.	.	6Mth - 1.5Yr: HR=1.27 (0.77, 2.11),p=0.355
	.	.	.	.	1.5Yr+: HR=1.10 (0.72, 1.69),p=0.649
Vanguard PS/Regenerex	30	465	2425	1.24	0 - 9Mth: HR=2.88 (1.59, 5.20),p<0.001
	.	.	.	.	9Mth - 2Yr: HR=1.75 (0.94, 3.25),p=0.077
	.	.	.	.	2Yr+: HR=1.12 (0.58, 2.16),p=0.727
Vanguard PS/Vanguard	299	5094	31738	0.94	0 - 1.5Yr: HR=1.81 (1.54, 2.13),p<0.001
	.	.	.	.	1.5Yr+: HR=1.26 (1.07, 1.47),p=0.004
**Legion Revision Tibial Baseplate	51	720	3429	1.49	0 - 6Mth: HR=5.11 (3.33, 7.83),p<0.001
	.	.	.	.	6Mth - 9Mth: HR=1.67 (0.54, 5.19),p=0.373
	.	.	.	.	9Mth - 1.5Yr: HR=0.71 (0.27, 1.90),p=0.500
	.	.	.	.	1.5Yr+: HR=1.53 (1.02, 2.31),p=0.040
Identified and no longer used	.	.	.	.	
+Maxim (cless)/Vanguard (ctd)	62	413	4967	1.25	0 - 2Yr: HR=1.41 (0.80, 2.48),p=0.235
	.	.	.	.	2Yr - 2.5Yr: HR=0.66 (0.09, 4.69),p=0.678
	.	.	.	.	2.5Yr+: HR=2.84 (2.15, 3.76),p<0.001
ACS/ACS Mobile PC (cless)	27	131	728	3.71	Entire Period: HR=5.24 (3.60, 7.64),p<0.001
AMK/AMK	25	203	2436	1.03	Entire Period: HR=1.98 (1.34, 2.94),p<0.001
Buechel-Pappas/Buechel-Pappas	50	479	4350	1.15	Entire Period: HR=1.94 (1.47, 2.57),p<0.001
Eska RP/Eska RP	9	40	337	2.67	Entire Period: HR=5.20 (2.72, 9.97),p<0.001
Evolis (cless)/Evolis (cless)	9	87	646	1.39	Entire Period: HR=2.12 (1.11, 4.08),p=0.023
Gemini MK II/Gemini MK II	7	21	210	3.34	Entire Period: HR=5.81 (2.78, 12.12),p<0.001
Genesis (ctd)/Genesis (ctd)	11	62	667	1.65	Entire Period: HR=3.36 (1.86, 6.07),p<0.001
Genesis II CR (cless)/Profix Mobile (ctd)	34	241	2639	1.29	Entire Period: HR=2.48 (1.77, 3.47),p<0.001
Genesis II Oxinium CR (cless)/Genesis II	47	110	942	4.99	0 - 1.5Yr: HR=12.92 (8.66, 19.26),p<0.001
	.	.	.	.	1.5Yr - 2.5Yr: HR=21.46 (12.93, 35.63),p<0.001

Femoral/Tibial	N Revised	N Total	Obs. Years	Revisions/100 Obs. Yrs	Hazard Ratio, P Value
	.	.	.	.	2.5Yr+: HR=2.41 (1.21, 4.82),p=0.012
Genesis II Oxinium CR (cless)/Profix Mobile	56	88	590	9.49	0 - 6Mth: HR=7.30 (2.74, 19.46),p<0.001
	.	.	.	.	6Mth - 9Mth: HR=48.30 (26.75, 87.20),p<0.001
	.	.	.	.	9Mth - 1.5Yr: HR=34.26 (22.32, 52.59),p<0.001
	.	.	.	.	1.5Yr - 2Yr: HR=28.47 (13.56, 59.78),p<0.001
	.	.	.	.	2Yr - 4Yr: HR=9.09 (3.78, 21.84),p<0.001
	.	.	.	.	4Yr+: HR=4.53 (2.26, 9.06),p<0.001
Genesis II Oxinium PS (ctd)/Genesis II (cless)	17	56	399	4.26	0 - 1Yr: HR=16.44 (9.13, 29.58),p<0.001
	.	.	.	.	1Yr+: HR=2.87 (1.29, 6.38),p=0.009
Genesis II Oxinium PS (ctd)/Genesis II (keel)	67	269	2649	2.53	Entire Period: HR=4.53 (3.57, 5.75),p<0.001
HLS Noetos/HLS Noetos	40	294	2581	1.55	Entire Period: HR=2.68 (1.97, 3.66),p<0.001
IB II/IB II	39	199	2463	1.58	0 - 2Yr: HR=0.84 (0.27, 2.59),p=0.757
	.	.	.	.	2Yr - 2.5Yr: HR=4.72 (1.52, 14.63),p=0.007
	.	.	.	.	2.5Yr+: HR=4.66 (3.31, 6.56),p<0.001
Interax/Interax	11	52	512	2.15	0 - 3.5Yr: HR=1.48 (0.37, 5.91),p=0.580
	.	.	.	.	3.5Yr+: HR=7.72 (4.02, 14.84),p<0.001
Journey Oxinium/Journey	313	3033	25962	1.21	0 - 3Mth: HR=0.28 (0.09, 0.88),p=0.029
	.	.	.	.	3Mth - 1.5Yr: HR=1.99 (1.60, 2.49),p<0.001
	.	.	.	.	1.5Yr - 2Yr: HR=1.60 (1.04, 2.45),p=0.032
	.	.	.	.	2Yr+: HR=2.36 (2.06, 2.71),p<0.001
Optetrak-CR (ctd)/Optetrak (ctd)	10	92	751	1.33	Entire Period: HR=2.43 (1.31, 4.51),p=0.004
Optetrak-PS/Optetrak-PS	14	55	508	2.76	Entire Period: HR=5.44 (3.22, 9.19),p<0.001
PFC Sigma PS (ctd)/MBT (cless)	24	316	2223	1.08	Entire Period: HR=1.60 (1.07, 2.39),p=0.021
Profix Oxinium (cless)/Profix	33	75	678	4.87	0 - 9Mth: HR=5.80 (2.18, 15.45),p<0.001
	.	.	.	.	9Mth - 2Yr: HR=23.71 (15.45, 36.39),p<0.001
	.	.	.	.	2Yr+: HR=2.98 (1.49, 5.95),p=0.002
Profix Oxinium (cless)/Profix Mobile	71	158	1290	5.50	0 - 9Mth: HR=3.08 (1.16, 8.18),p=0.024
	.	.	.	.	9Mth - 1.5Yr: HR=23.64 (16.41, 34.06),p<0.001
	.	.	.	.	1.5Yr - 2Yr: HR=16.24 (8.44, 31.25),p<0.001
	.	.	.	.	2Yr - 2.5Yr: HR=32.97 (19.51, 55.74),p<0.001
	.	.	.	.	2.5Yr - 3Yr: HR=21.25 (9.53, 47.37),p<0.001
	.	.	.	.	3Yr+: HR=2.31 (1.20, 4.44),p=0.012
Profix Oxinium (ctd)/Profix (cless)	14	100	1129	1.24	Entire Period: HR=1.95 (1.16, 3.29),p=0.012
Profix Oxinium (ctd)/Profix Mobile	28	228	2860	0.98	Entire Period: HR=1.59 (1.10, 2.31),p=0.014
Profix/Profix Mobile	111	1005	11563	0.96	0 - 2.5Yr: HR=2.63 (2.05, 3.39),p<0.001
	.	.	.	.	2.5Yr+: HR=1.29 (0.97, 1.70),p=0.075
Rotaglide Plus/Rotaglide Plus	82	631	7239	1.13	0 - 1.5Yr: HR=1.23 (0.70, 2.17),p=0.474
	.	.	.	.	1.5Yr - 2Yr: HR=3.11 (1.55, 6.23),p=0.001
	.	.	.	.	2Yr+: HR=2.36 (1.84, 3.03),p<0.001
SAL/SAL	13	56	712	1.83	0 - 8.5Yr: HR=1.46 (0.55, 3.88),p=0.451
	.	.	.	.	8.5Yr+: HR=7.23 (3.76, 13.91),p<0.001
Scorpio NRG PS (cless)/Series 7000 (cless)	79	1172	8572	0.92	Entire Period: HR=1.30 (1.04, 1.62),p=0.020
TC-Plus (cless)/TC-Plus (ctd)	8	63	655	1.22	Entire Period: HR=2.49 (1.25, 4.96),p=0.009
Trac/Trac	27	138	1606	1.68	Entire Period: HR=3.00 (2.06, 4.38),p<0.001
*LCS Duofix	631	4866	47819	1.32	Entire Period: HR=2.40 (2.21, 2.59),p<0.001
*LCS PS	68	638	4819	1.41	Entire Period: HR=2.43 (1.92, 3.09),p<0.001
*Renasys	16	121	1329	1.20	Entire Period: HR=2.31 (1.42, 3.77),p<0.001

Note: Components have been compared to all other total knee components
* Femoral component
** Tibial Component
+ Newly identified and no longer used

Table IP20 Cumulative Percent Revision of Individual Total Knee Prostheses Identified as having a Higher than Anticipated Rate of Revision

CPR	1 Yr	3 Yrs	5 Yrs	10 Yrs	18 Yrs
Re-Identified and Still Used					
ACS (cless)/ACS Fixed	1.6 (1.1, 2.2)	4.8 (3.9, 5.9)	5.7 (4.7, 7.0)		
Active Knee (cless)/Active Knee	1.1 (0.9, 1.4)	3.6 (3.2, 4.0)	5.1 (4.6, 5.6)	8.9 (8.2, 9.6)	
Advance/Advance	1.9 (1.2, 3.0)	5.2 (3.9, 6.9)	6.3 (4.8, 8.2)	8.4 (6.3, 11.0)	
Apex Knee CR (cless)/Apex Knee (cless)	2.7 (1.5, 4.8)	5.9 (3.9, 8.7)	6.2 (4.2, 9.1)		
Columbus/Columbus	1.2 (0.9, 1.7)	4.2 (3.3, 5.2)	5.6 (4.5, 6.9)	8.7 (7.1, 10.7)	
E.Motion/E.Motion	2.4 (1.7, 3.4)	5.7 (4.5, 7.3)	6.6 (5.3, 8.3)		
Nexgen LPS Flex (cless)/Nexgen	2.6 (2.0, 3.4)	4.7 (3.8, 5.8)	5.5 (4.5, 6.7)		
Optetrak-PS/Optetrak	1.5 (1.1, 2.0)	4.8 (4.0, 5.7)	6.3 (5.4, 7.4)	10.2 (9.0, 11.6)	
Optetrak-PS/Optetrak RBK	1.8 (1.2, 2.7)	4.7 (3.6, 6.2)	5.9 (4.6, 7.6)	8.8 (7.0, 11.0)	
Score (cless)/Score (cless)	1.8 (1.3, 2.4)	5.7 (4.8, 6.8)	7.8 (6.7, 9.1)	12.7 (10.9, 14.9)	
Score (cless)/Score (ctd)	1.8 (1.2, 2.6)	4.4 (3.4, 5.7)	6.3 (4.8, 8.1)		
Trekking/Trekking	2.2 (1.5, 3.2)	3.7 (2.7, 5.1)	4.9 (3.7, 6.6)		
Vanguard PS/Regenerex	3.3 (2.0, 5.3)	6.3 (4.4, 9.1)	6.6 (4.6, 9.5)		
Vanguard PS/Vanguard	1.9 (1.5, 2.3)	4.3 (3.8, 4.9)	5.4 (4.8, 6.1)	7.8 (6.8, 8.8)	
**Legion Revision Tibial Baseplate	3.6 (2.4, 5.3)	5.4 (3.9, 7.5)	6.8 (5.0, 9.2)	11.4 (8.2, 15.6)	
Identified and no longer used					
+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)	
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)	14.6 (9.8, 21.4)
Buechel-Pappas/Buechel-Pappas	1.9 (1.0, 3.6)	5.7 (3.9, 8.2)	7.9 (5.8, 10.7)	10.7 (8.1, 14.0)	
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)	10.3 (5.5, 18.9)	
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)	14.2 (10.1, 19.6)	
Genesis II Oxinium CR (cless)/Genesis II	11.8 (7.0, 19.5)	38.9 (30.4, 48.7)	39.8 (31.3, 49.7)	42.8 (34.0, 52.7)	
Genesis II Oxinium CR (cless)/Profix Mobile	24.0 (16.3, 34.4)	52.8 (42.8, 63.5)	57.4 (47.4, 67.9)	61.1 (51.0, 71.3)	
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)	13.8 (10.2, 18.5)	
IB II/IB II	0.0 (0.0, 0.0)	3.5 (1.7, 7.3)	7.8 (4.8, 12.6)	15.8 (11.3, 22.0)	25.0 (18.2, 33.6)
Interax/Interax	0.0 (0.0, 0.0)	2.0 (0.3, 13.4)	8.3 (3.2, 20.7)	13.0 (6.0, 26.8)	
Journey Oxinium/Journey	1.4 (1.0, 1.9)	4.6 (3.9, 5.4)	6.5 (5.6, 7.4)	11.2 (10.0, 12.5)	
Optetrak-CR (ctd)/Optetrak (ctd)	0.0 (0.0, 0.0)	6.6 (3.0, 14.0)	10.1 (5.4, 18.5)	10.1 (5.4, 18.5)	
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)		
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)	30.6 (18.9, 47.2)
Scorpio NRG PS (cless)/Series 7000 (cless)	1.2 (0.7, 2.0)	4.9 (3.8, 6.4)	6.3 (5.0, 7.9)	7.8 (6.2, 9.7)	
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)	
*LCS Duofix	1.5 (1.2, 1.9)	5.9 (5.3, 6.6)	9.7 (8.9, 10.6)	13.0 (12.1, 14.0)	
*LCS PS	2.1 (1.2, 3.5)	6.7 (5.0, 9.0)	8.5 (6.6, 11.0)	12.1 (9.6, 15.2)	
*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
+ Newly identified and no longer used

Table IP21 Yearly Usage of Individual Total Knee Prostheses Identified as having a Higher than Anticipated Rate of Revision

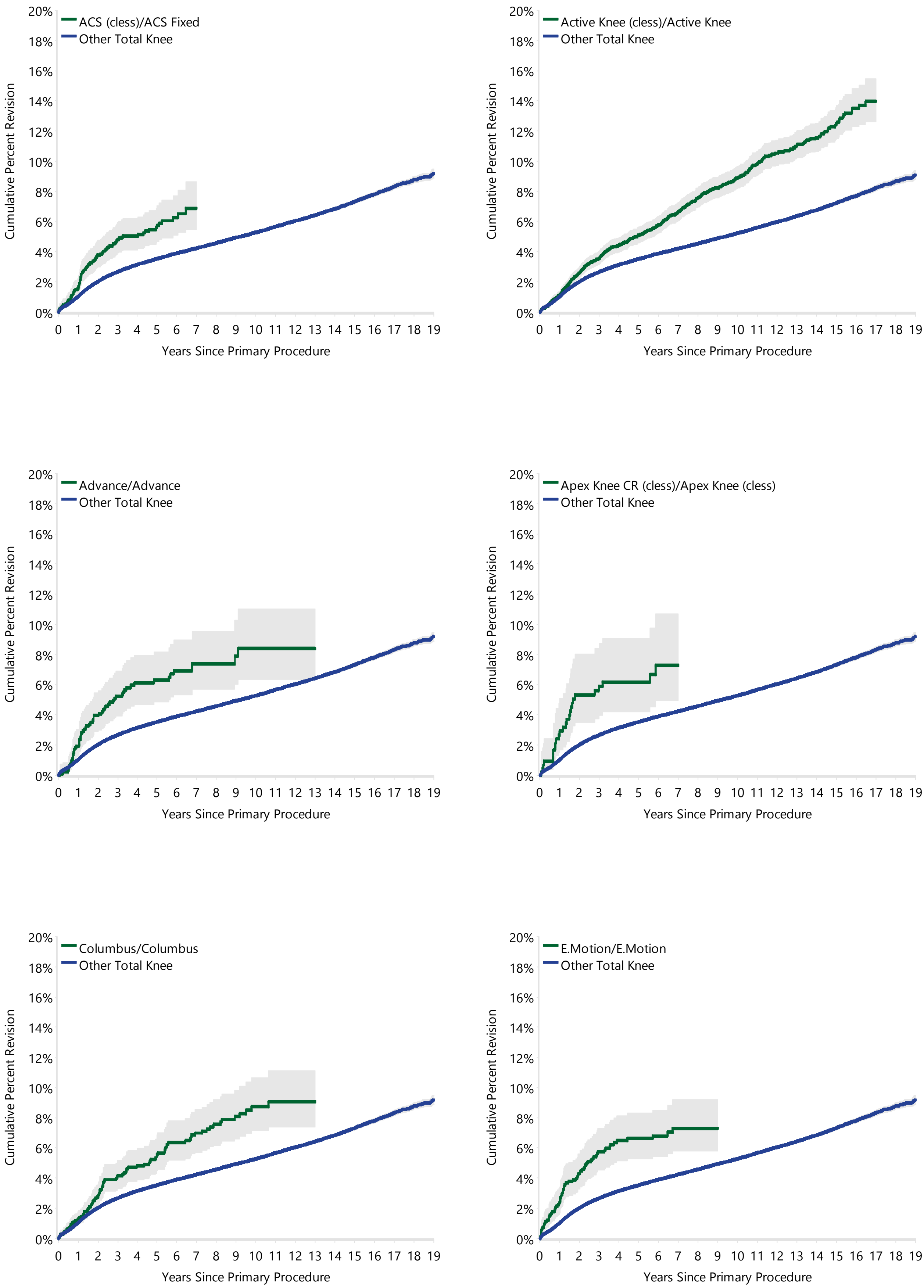
Year of Implant	≤2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Re-Identified and Still Used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
ACS (cless)/ACS Fixed	.	.	.	.	.	.	.	.	.	41	119	283	337	331	238	266	259	319
Active Knee (cless)/Active Knee	221	613	790	693	466	510	483	412	479	601	500	427	319	336	176	91	35	21
Advance/Advance	53	.	8	12	16	2	5	43	115	138	74	7	92	92	100	90	69	57
Apex Knee CR (cless)/Apex Knee (cless)	.	.	.	.	.	.	.	.	.	.	69	83	118	78	11	3	29	52
Columbus/Columbus	.	.	.	49	91	90	148	156	134	136	108	69	36	60	118	358	671	821
E.Motion/E.Motion	.	.	.	.	.	.	.	12	87	114	129	236	106	113	125	140	99	93
Nexgen LPS Flex (cless)/Nexgen	.	.	.	.	.	.	.	.	73	78	149	312	238	280	225	251	221	186
Optetrak-PS/Optetrak	126	130	155	252	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
Score (cless)/Score (cless)	.	.	.	1	.	11	135	212	187	204	196	238	273	263	171	160	214	148
Score (cless)/Score (ctd)	.	.	3	.	.	3	3	3	.	5	15	90	181	324	300	267	122	204
Trekking/Trekking	.	.	.	.	.	.	.	.	35	102	133	107	108	106	129	215	144	98
Vanguard PS/Regenerex	.	.	.	.	.	.	.	4	121	54	27	15	21	18	76	59	56	14
Vanguard PS/Vanguard	.	.	.	22	81	145	321	430	478	607	561	451	523	445	331	309	205	185
**Legion Revision Tibial Baseplate	.	.	.	.	16	33	48	40	56	47	63	54	47	38	50	50	86	92
Identified and no longer used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
+Maxim (cless)/Vanguard (ctd)	86	94	106	64	23	30	10	.	.	.	.	.	.	.	.	.	.	.
ACS/ACS Mobile PC (cless)	.	.	.	.	.	.	.	.	.	20	37	57	17	.	.	.	.	.
AMK/AMK	200	2	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
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	14	7	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Genesis (ctd)/Genesis (ctd)	45	6	3	8	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Genesis II CR (cless)/Profix Mobile (ctd)	126	26	10	4	2	5	12	6	9	17	2	22	.	.	.	.	.	.
Genesis II Oxinium CR (cless)/Genesis II	4	106	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Genesis II Oxinium CR (cless)/Profix Mobile	22	66	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
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	.	.	2	2	47	45	45	56	48	28	20	1	.	.	.	.	.	.
IB II/IB II	187	12	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Interax/Interax	52	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Journey Oxinium/Journey	.	.	.	.	134	337	541	555	464	334	343	325	.	.	.	.	.	.
Optetrak-CR (ctd)/Optetrak (ctd)	7	7	6	2	9	7	7	4	.	5	6	8	24	.	.	.	.	.
Optetrak-PS/Optetrak-PS	.	.	8	14	18	15	.	.	.	.	.	.	.	.	.	.	.	.
PFC Sigma PS (ctd)/MBT (cless)	.	.	.	47	2	.	.	.	.	25	89	110	42	.	1	.	.	.
Profix Oxinium (cless)/Profix	10	65	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Profix Oxinium (cless)/Profix Mobile	63	95	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Profix Oxinium (ctd)/Profix (cless)	5	5	29	17	15	8	10	8	2	.	1	.	.	.	.	.	.	.
Profix Oxinium (ctd)/Profix Mobile	72	31	91	24	3	4	1	2	.	.	.	.	.	.	.	.	.	.
Profix/Profix Mobile	197	173	258	245	51	56	11	12	2	.	.	.	.	.	.	.	.	.
Rotaglide Plus/Rotaglide Plus	181	151	110	101	43	30	15	.	.	.	.	.	.	.	.	.	.	.

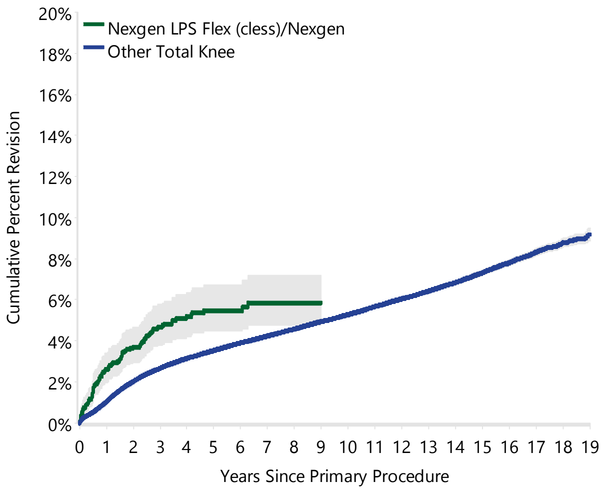
Year of Implant	≤2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
SAL/SAL	56	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Scorpio NRG PS (cless)/Series 7000 (cless)	.	.	.	.	.	76	185	171	166	114	67	71	76	72	77	69	28	.
TC-Plus (cless)/TC-Plus (ctd)	.	1	27	27	5	3	.	.	.	.	.	.	.	.	.	.	.	.
Trac/Trac	128	9	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
*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
+ Newly identified and no longer used

Figure IP5 Cumulative Percent Revision of Re-identified and Still Used Individual Total Knee Prostheses

Re-identified and Still Used




Nexgen LPS Flex (cless)/Nexgen
Other Total Knee
Cumulative Percent Revision
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
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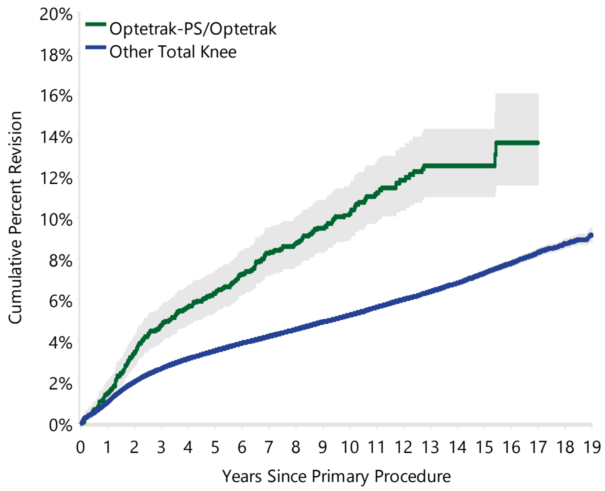
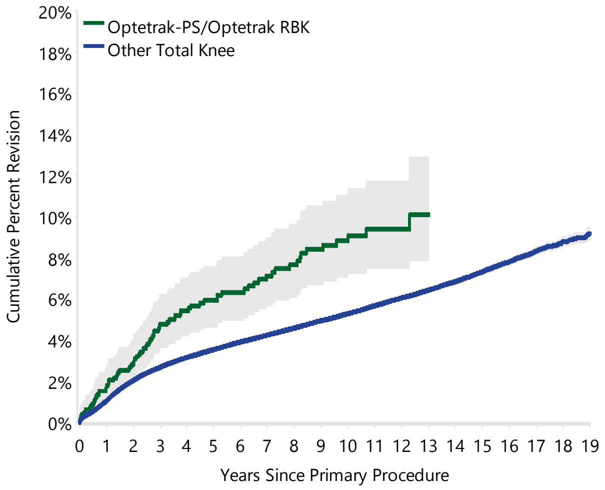
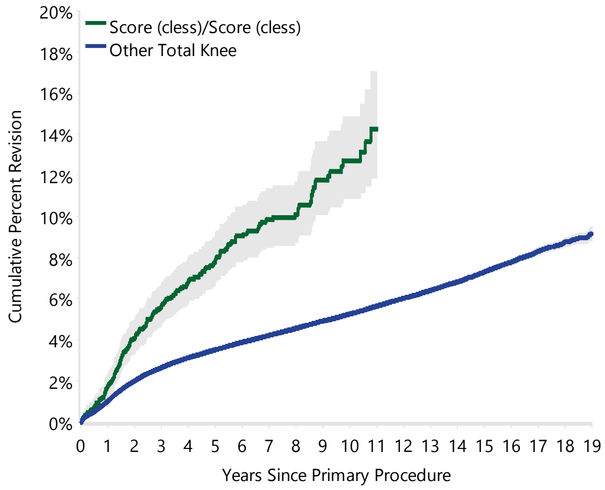
Years Since Primary Procedure


Optetrak-PS/Optetrak
Other Total Knee
Cumulative Percent Revision
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Years Since Primary Procedure


Optetrak-PS/Optetrak RBK
Other Total Knee
Cumulative Percent Revision
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Years Since Primary Procedure


Score (cless)/Score (cless)
Other Total Knee
Cumulative Percent Revision
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
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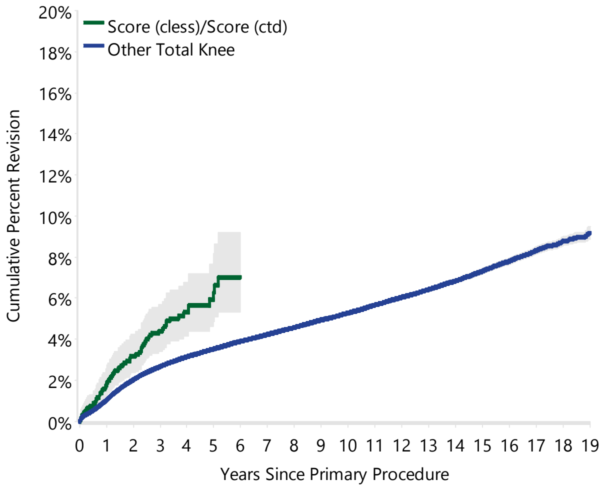
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Years Since Primary Procedure


Score (cless)/Score (ctd)
Other Total Knee
Cumulative Percent Revision
20%
18%
16%
14%
12%
10%
8%
6%
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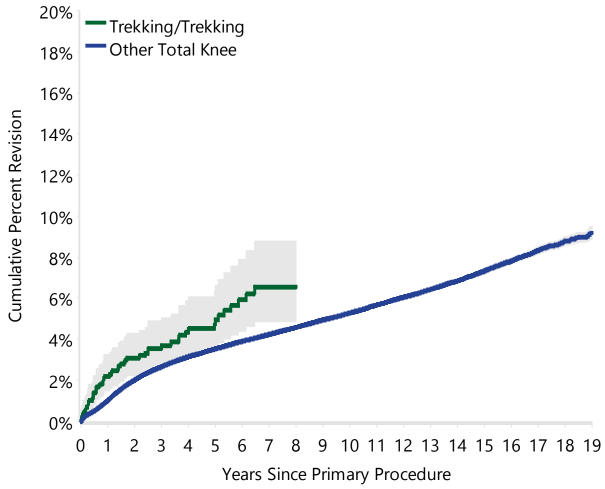
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Years Since Primary Procedure


Trekking/Trekking
Other Total Knee
Cumulative Percent Revision
20%
18%
16%
14%
12%
10%
8%
6%
4%
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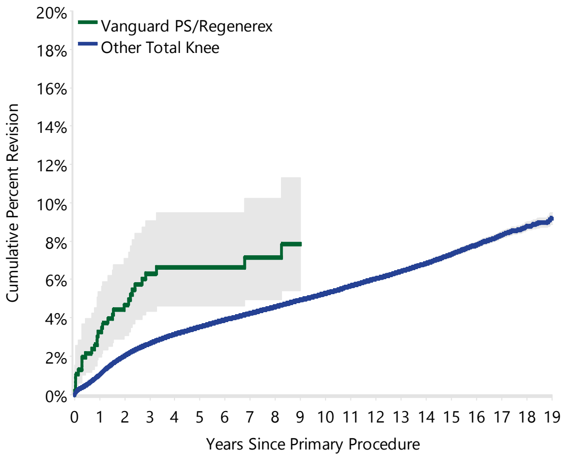
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Years Since Primary Procedure


Vanguard PS/Regenerex
Other Total Knee
Cumulative Percent Revision
20%
18%
16%
14%
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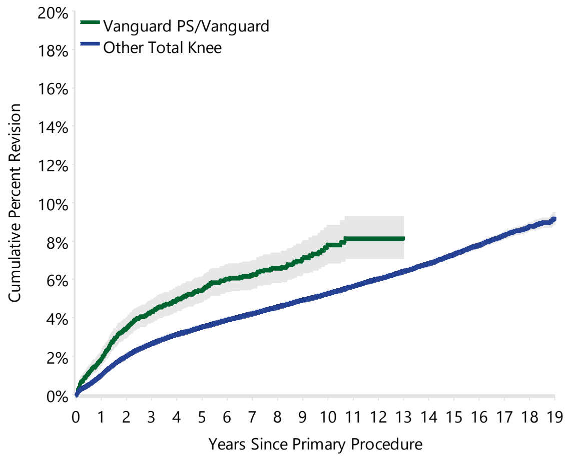
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Years Since Primary Procedure


Vanguard PS/Vanguard
Other Total Knee
Cumulative Percent Revision
20%
18%
16%
14%
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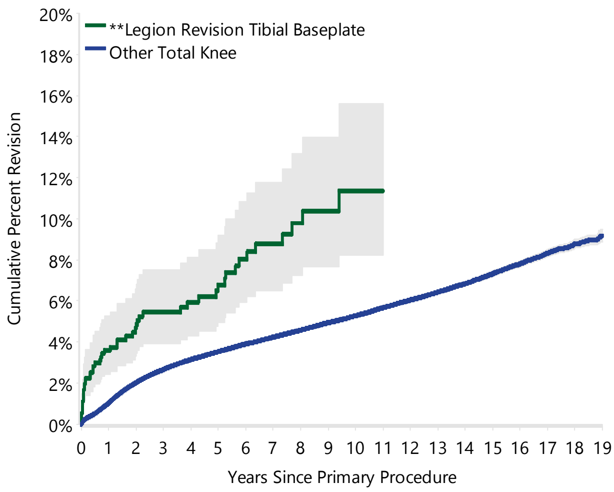
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Years Since Primary Procedure


**Legion Revision Tibial Baseplate
Other Total Knee
Cumulative Percent Revision
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Years Since Primary Procedure

PRIMARY PARTIAL SHOULDER REPLACEMENT

HEMI STEMMED

There are no newly identified hemi stemmed shoulder prostheses.

Table IP22 Revision Rate of Individual 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	.	.	.	.	
Delta Xtend/Delta Xtend	13	74	358	3.63	Entire Period: HR=2.41 (1.39, 4.19),p=0.001
Global Unite/Global Unite	33	189	683	4.83	Entire Period: HR=1.98 (1.39, 2.83),p<0.001

Note: Components have been compared to all other hemi stemmed shoulder components

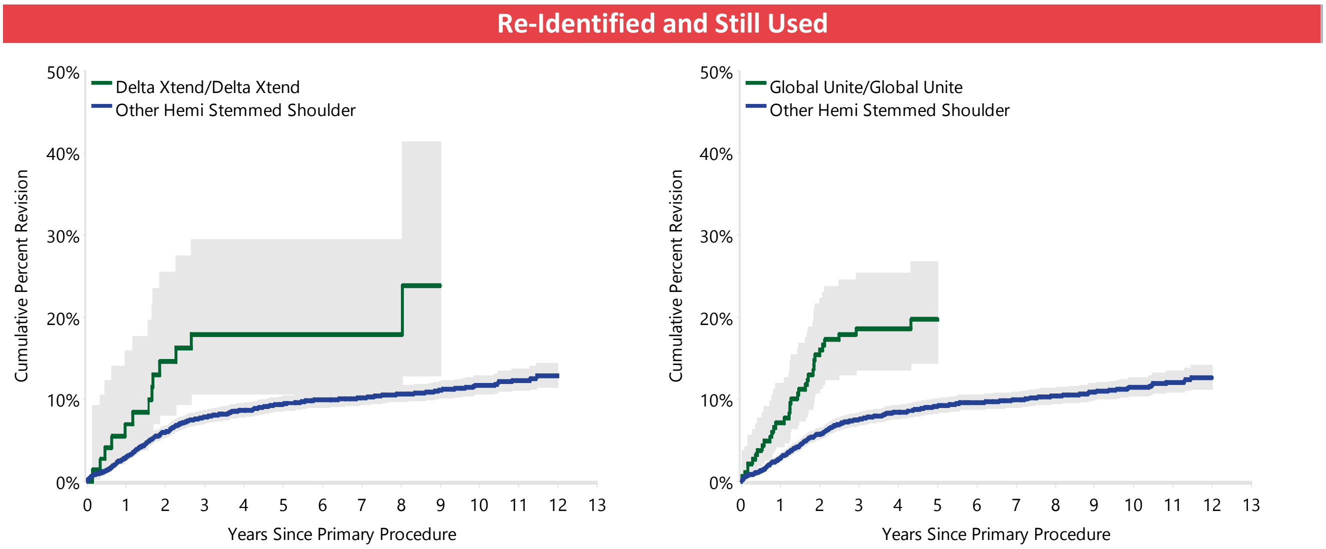
Table IP23 Cumulative Percent Revision of Individual Hemi Stemmed Shoulder Prostheses Identified as having a Higher than Anticipated Rate of Revision

CPR	1 Yr	3 Yrs	5 Yrs	7 Yrs	12 Yrs
Re-Identified and Still Used					
Delta Xtend/Delta Xtend	6.9 (2.9, 15.9)	17.9 (10.6, 29.5)	17.9 (10.6, 29.5)	17.9 (10.6, 29.5)	
Global Unite/Global Unite	7.1 (4.2, 11.9)	18.6 (13.5, 25.3)	19.7 (14.3, 26.7)		

Table IP24 Yearly Usage of Individual 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
Re-Identified and Still Used	.	.	.	.	.	.	.	.	.	.	.	.	.
Delta Xtend/Delta Xtend	2	5	9	9	5	10	7	6	5	4	3	6	3
Global Unite/Global Unite	.	.	.	.	.	15	37	25	38	37	14	12	11

Figure IP6 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 Individual 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	324	2164	11545	2.81	Entire Period: HR=2.16 (1.90, 2.45),p<0.001
Identified and no longer used	.	.	.	.	
SMR/SMR L2	307	856	5314	5.78	0 - 9Mth: HR=3.55 (2.66, 4.74),p<0.001
	.	.	.	.	9Mth - 1.5Yr: HR=5.36 (3.96, 7.25),p<0.001
	.	.	.	.	1.5Yr - 3.5Yr: HR=7.46 (5.84, 9.53),p<0.001
	.	.	.	.	3.5Yr - 5Yr: HR=8.43 (5.78, 12.30),p<0.001
	.	.	.	.	5Yr - 5.5Yr: HR=10.62 (4.76, 23.71),p<0.001
	.	.	.	.	5.5Yr+: HR=3.47 (2.49, 4.83),p<0.001
Univers 3D/Univers 3D	16	34	272	5.88	Entire Period: HR=4.66 (2.84, 7.65),p<0.001
Vaios/Vaios	18	36	183	9.83	Entire Period: HR=6.40 (4.01, 10.20),p<0.001

Note: Components have been compared to all other total stemmed shoulder components

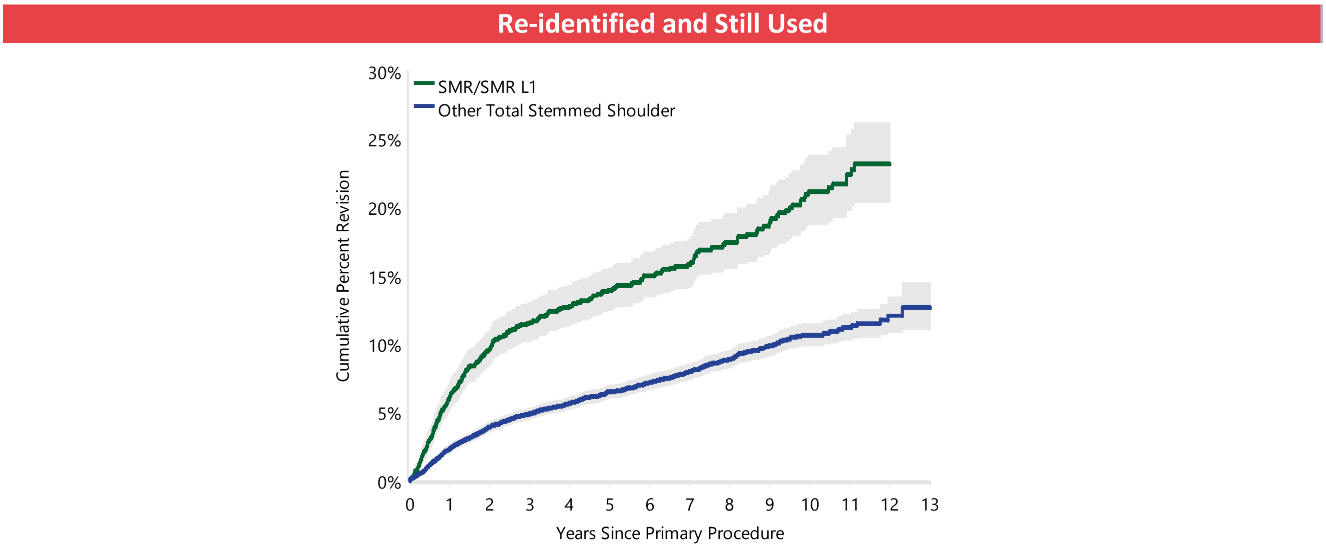
Table IP26 Cumulative Percent Revision of Individual Total Stemmed Shoulder Prostheses Identified as having a Higher than Anticipated Rate of Revision

CPR	1 Yr	3 Yrs	5 Yrs	7 Yrs	12 Yrs
Re-Identified and Still Used					
SMR/SMR L1	6.1 (5.2, 7.2)	11.5 (10.2, 13.0)	13.9 (12.4, 15.6)	15.8 (14.2, 17.7)	23.2 (20.4, 26.2)
Identified and no longer used					
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)	50.8 (33.5, 70.9)
Vaios/Vaios	13.9 (6.0, 30.2)	27.8 (16.0, 45.5)	39.1 (25.3, 57.0)	49.1 (33.8, 66.9)	

Table IP27 Yearly Usage of Individual 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
Re-Identified and Still Used	.	.	.	.	.	.	.	.	.	.	.	.	.
SMR/SMR L1	135	237	247	.	.	157	301	255	242	195	172	129	94
Identified and no longer used	.	.	.	.	.	.	.	.	.	.	.	.	.
SMR/SMR L2	.	.	43	343	336	134	.	.	.	.	.	.	.
Univers 3D/Univers 3D	23	11	.	.	.	.	.	.	.	.	.	.	.
Vaios/Vaios	.	.	.	.	16	17	2	1	.	.	.	.	.

Figure IP7 Cumulative Percent Revision of Re-identified and Still Used Total Stemmed Shoulder Prostheses



TOTAL REVERSE

There are no newly identified total reverse shoulder prostheses.

Table IP28 Revision Rate of Individual 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	271	6756	23650	1.15	0 - 3Mth: HR=1.35 (1.09, 1.66),p=0.005
	.	.	.	.	3Mth - 9Mth: HR=1.29 (0.95, 1.74),p=0.098
	.	.	.	.	9Mth+: HR=0.80 (0.64, 1.01),p=0.065

Note: Components have been compared to all other total reverse shoulder components

Table IP29 Cumulative Percent Revision of Individual Total Reverse Shoulder Prostheses Identified as having a Higher than Anticipated Rate of Revision

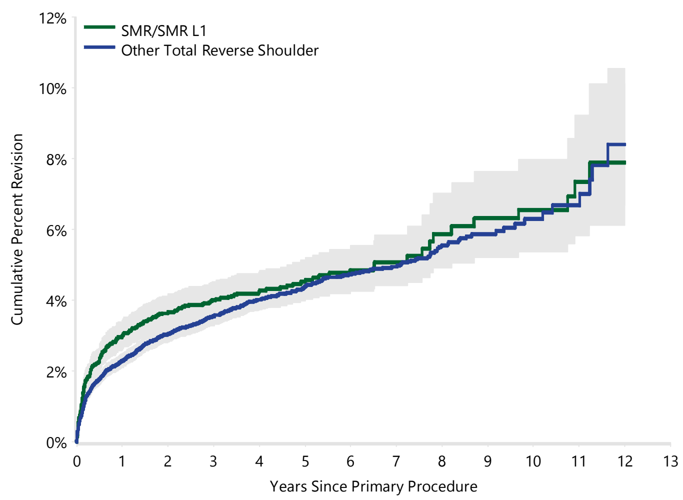
CPR	1 Yr	3 Yrs	5 Yrs	7 Yrs	12 Yrs
Re-Identified and Still Used					
SMR/SMR L1	3.0 (2.6, 3.4)	4.0 (3.5, 4.5)	4.5 (4.0, 5.1)	5.1 (4.4, 5.8)	7.9 (6.1, 10.1)

Table IP30 Yearly Usage of Individual 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
Re-Identified and Still Used	.	.	.	.	.	.	.	.	.	.	.	.	.
SMR/SMR L1	145	262	271	.	.	249	562	632	731	914	929	1042	1019

Figure IP8 Cumulative Percent Revision of Re-identified and Still Used Individual Total Reverse Shoulder Prostheses

Re-identified and Still Used



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	Sian Guns	Beleura Private Hospital	Jean Leyland
Ballarat Health Service	M Nicholson/B Anderson	Bellbird Private Hospital	Belinda Van Denberg
Bass Coast Regional Health	Fanella King	Cabrini Private Hospital, Brighton	Tegan Colliver
Bendigo Health Care Group	S Sharp/C Jensen	Epping Private Hospital	Jooly Jose
Box Hill Hospital	Lisa Bingham	Epworth Eastern Hospital	Linda* Dennehy
Broadmeadows Hospital	Grant Taylor	Epworth Freemasons	Claudia Nozzolillo
Cohuna District Hospital	Karyn Storm	Epworth Geelong	Christian King
Colac Area Health	Amanda Tout	Epworth Richmond	Lynne Moyes
Dandenong Hospital	K Ferguson/M Murray	Essendon Private Hospital	Elaine Jordan
Djerriwarrh Health Services Bacchus Marsh Campus	J Dehnert/C Clifford	Frankston Private Hospital	Tracy McIndoe-Norton
East Grampians Health Service	K Carr/J Sargent	Glenferrie Private Hospital	Marianne Westley
Echuca Regional Health	K Giorgianni/H Lias	Holmesglen Private Hospital	Nicole Groves
Footscray Hospital	Cassandra Mules	John Fawkner Hospital	Belinda Emmett
Frankston Hospital	Donna Anderson	Knox Private Hospital	J Assauw/H McCarty/E George
Goulburn Valley Health	Andrea Stevens	Linacre Private Hospital	D Tyler/M Dillon
Hamilton Base Hospital	Rosalie Broadfoot	Maryvale Private Hospital	Glenda Chambers
Kyabram District Health Service	L Walker/L Fleming	Masada Private Hospital	A Bonato/J Walsh
Latrobe Regional Hospital	Simone Lovison	Melbourne Private Hospital	Tracey Perkins
Maroondah Hospital	Benjamin Connelly	Mildura Private Hospital	Sue Malcolm
Mildura Base Hospital	Kaylene Mailes	Mitcham Private Hospital	J Nankivell/J Lonthyil
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	L Benci/D Reidy	Peninsula Private Hospital	Ruth Honan
Portland Hospital	Donna Eichler	Ringwood Private Hospital	Carol Burns
Sandringham Hospital	L Scopel/G Jack	Shepparton Private Hospital	Niki Miller
Seymour District Memorial Hospital	Karen Lamaro	St John of God Ballarat Hospital	Gitty Mathachan
South West Health Care Warrnambool Campus	Tony Kelly	St John of God Bendigo Hospital	Alanna Sheehan
St Vincents Public Hospital	S Osman/A Lynskey	St John of God Berwick Hospital	Rebecca Jamieson
Stawell Regional Health	C Ellen/S Campigli	St John of God Geelong Hospital	Colin Hay
Sunshine Hospital	Cassandra Mules	St John of God Warrnambool Hospital	G Wheaton/L McPherson
Swan Hill District Health	Donna Hartland	St Vincent's Private East Melbourne	Brandi Lyon
The Alfred	Caroline McMurray	St Vincent's Private Fitzroy	D Dellevirgini/N Carter
The Northern Hospital	Siew Perry	St Vincent's Private Kew	J Miller/H Xing
The Royal Children's Hospital	Sonia Mouat	St Vincent's Private Werribee	Cecilia Ipio
The Royal Melbourne Hospital	Brycelyn Bennett	The Avenue Hospital	John Davidson
University Hospital Geelong Barwon Health	D Barber/M Quinn	The Bays Hospital	L Kerr/S Burton
West Gippsland Healthcare Group	B Norman/S Backman	The Melbourne Eastern Private Hospital	Jay Phillpotts
West Wimmera Health Service	Michelle Borain	Vermont Private Hospital	Dionne Smithwick
Williamstown Hospital	M Clark/Paul Buso	Wangaratta Private Hospital	Janet Mckie
Wimmera Health Care Group	Maree Markby	Warringal Private Hospital	Marilyn Dey
		Waverley Private Hospital	Alfred Monleon
		Werribee Mercy Hospital	Jamil Anwar
		Western Private Hospital	Sharryn McKinley

NEW SOUTH WALES

PUBLIC HOSPITALS		PRIVATE HOSPITALS	
Albury Base Hospital	Laurel Rhodes	Albury Wodonga Private Hospital	Dom Mahaffey
Armidale Hospital	Amber Prater	Armidale Private Hospital	Katherine Latter
Auburn Health Service	Sarah Sisson	Baringa Private Hospital	E Ford/K Henderson/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	Jenny Jones	Calvary Health Care Riverina	Annette Somerville
Blacktown Hospital	June Tsang	Campbelltown Private Hospital	Sarah Clancy
Bowral and District Hospital	Julie Elsing	Dalcross Adventist Hospital	A Carroll/K Legg
Broken Hill Health Service	Sue Beahl	Delmar Private Hospital	Cathy Byrne
Campbelltown Hospital	Susan Birch	Dubbo Private Hospital	K Troth/S Cross
Canterbury Hospital	Jenny Cubitt	Dudley Private Hospital	Pam Fullgrabe
Chris O'Brien Lifehouse	Fiona Strachan	East Sydney Private Hospital	Thea Woodgate
Coffs Harbour Health Campus	Janice Chew	Forster Private Hospital	Janet Hickman
Concord Repatriation Hospital	David Debello	Gosford Private Hospital	Amy Maguire
Dubbo Base Hospital	Kathy Chapman	Hawkesbury District Health Service	E Jones/S Garden
Fairfield Hospital	Caroline Youkhana	Holroyd Private Hospital	Mynard Brosas
Gosford Hospital	K Brown/M Farthing/T Hoad	Hunter Valley Private Hospital	Renae Ross
Goulburn Base Hospital	K Goode/D Hay	Hurstville Private Hospital	Simelibuhle (Simmy) Masuku
Grafton Base Hospital	Anthony Corkett	Insight Clinic Private Hospital	Debbie van de Stadt
Hornsby Ku-Ring-Gai Hospital	B Chu/J Colville	Kareena Private Hospital	Anita Burazer
Inst of Rheum & Orthopaedic Surgery	Maria Hatziandreou	Kogarah Private Hospital	S Schofield/K Gardner
John Hunter Hospital	Felicia Bristow	Lake Macquarie Private Hospital	V Jones/E Miles
Lismore Base Hospital	Glen Nettle	Lakeview Private Hospital	Hailey MacAllister
Liverpool Health Service	John Murphy	Lingard Private Hospital	A Dagg/A Flaherty
Maitland Hospital	Karen Cheers	Macquarie University Hospital	Julie Guthrie
Manning Rural Referral Hospital	Grahame Cooke	Maitland Private Hospital	J Chalmers/M Mead
Mount Druitt Hospital	Charmaine Boyd	Mayo Private Hospital	Stacey Dunk
Murwillumbah District Hospital	Glenda Jacklin	Nepean Private Hospital	Jacintha Vimalraj
Nepean Hospital	Debbie Dobbs	Newcastle Private Hospital	J Kelly/D Fogarty
Orange Health Service	Alexandra Woods	North Shore Private Hospital	Satheesh Jose
Port Macquarie Base Hospital	F Cheney/J Atkins	Northern Beaches Hospital	Jojo Sebastian
Royal Newcastle Centre	Graham Cutler	Norwest Private Hospital	J Woodward/R Shepherd
Royal North Shore Hospital	Kay Crawford	Nowra Private Hospital	Linda Wright
Royal Prince Alfred Hospital	Jennifer Wilkie	Port Macquarie Private Hospital	Tresna Bell
Ryde Hospital	Karen Jones	Shellharbour Private Hospital	Jenny Fraser
Shoalhaven District Memorial Hospital	Leanne McTavish	Southern Highlands Hospital	Lynne Byrne
South East Regional Hospital	Leanne Williams	St George Private Hospital	L Mayo/S Tanevska
St George Hospital	David Gray	St Lukes Care	Celeste Gaspar
St Vincents Public Hospital	M Ellis/A Baker/MT Butler	St Vincent's Private Community Hospital Griffith	Margaret Blackman
Sutherland Hospital	Claire Kirgan	St Vincents Private Hospital Darlinghurst	Hannah George
Tamworth Base Hospital	Molly Lebrocq	St Vincents Private Hospital Lismore	Janelle Hospers
The Children's Hospital Westmead	Ariella Galstaun	Strathfield Private Hospital	John Mati
The Prince of Wales Hospital	Elena Katz	Sydney Adventist Private Hospital	J Parker/M Ng
Tweed Hospital	N Prestage/A Budd	Sydney Private Hospital	Margaret Haughton
Wagga Wagga Base Hospital	A Giese/M O'Reilly	Sydney South West Private Hospital	Hong Tran
Westmead Public Hospital	Dee Martic	Tamara Private Hospital	Kris Wall
Wollongong Hospital	Carol Jackson	The Mater Hospital	Namor Guerrero
Wyong Hospital	M Randall/T Clancy	The Prince of Wales Private Hospital	E Perez/R Gengania
		Toronto Private Hospital	Stephanie Keys

NEW SOUTH WALES continued

PUBLIC HOSPITALS		PRIVATE HOSPITALS	
		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	K Jankulovski/C Gillespie
		Wollongong Private Hospital	

QUEENSLAND

PUBLIC HOSPITALS		PRIVATE HOSPITALS	
Bundaberg Base Hospital	J Anderson/J Larsen/D Norman	Brisbane Private Hospital	L Drabble/J Oddy
Cairns Base Hospital	Sharon Ryrie	Buderim Private Hospital	Phil Hall
Gold Coast Hospital, Robina Campus	A Brooks/H McGuire	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	M Christensen/S Costello
Maryborough Hospital	B Christiansen/Y Howlett	Hillcrest Private Hospital, Rockhampton	Lyn Martin
Mater Hospital Brisbane	C Steains/L Evans	John Flynn Hospital, Tugun	Lynda Wise
Nambour General Hospital	Renee Hutchison	Mater Health Services North Queensland	Joanne Humphreys
Prince Charles Hospital	L Tuppin/R Seddon	Mater Misericordiae Hospital, Bundaberg	J Zillmann/L Zunker/M Mooney
Princess Alexandra Hospital	Jo-Anne de Plater	Mater Misericordiae Hospital, Gladstone	Saroj Saini
Queen Elizabeth II Jubilee Hospital	Donna Cal	Mater Misericordiae Hospital, Mackay	Hazel Douglas
Queensland Children's Hospital	A Jesbert/A Reid	Mater Misericordiae Hospital, Rockhampton	T Harkin/M Havik
Redcliffe Hospital	G van Fleet/R Kitchin/E Nugent	Mater Private Hospital Brisbane	J Windsor/M Baltais/S Pfeffer
Redland Public Hospital	Sara Mackenzie	Mater Private Hospital Redland	J Golding/J Garnsey
Rockhampton Base Hospital	Simone Platzke	Mater Private Hospital Springfield	C James/K Lording
Royal Brisbane and Women's Hospital	G McPhee/B Ballantyne/A Dowe	Nambour Selangor Private Hospital	T Dempsey/S Pfeffer
Sunshine Coast University Hospital	C Jones/F Tognolini	Noosa Hospital	Judy Anderson
Toowoomba Hospital	F Chadwick/A Lostroh	North West Private Hospital	D Campbell/T Auckland
Townsville Hospital	Tara Cudmore	Peninsula Private Hospital	Lindsey Hawkins
		Pindara Private Hospital	Esther* Moire
		St Andrews Hospital, Toowoomba	Anna Nell
		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 Ryan/L Shannon
		St Vincents Hospital	Amanda Fitzgerald
		Sunnybank Private Hospital	Francina Robinston
		Sunshine Coast University Private Hospital	Tanya Prothero
		Wesley Hospital	K Patel/C Gregory

WESTERN AUSTRALIA

PUBLIC HOSPITALS		PRIVATE HOSPITALS	
Albany Regional Hospital	Paula Karra	Bethesda Hospital	Hannelie Hanekom
Armadale Health Service	E Griffiths/D Carkeek	Bethesda Hospital	Helen Collis
Bunbury Regional Hospital	Anthea Amonini	Bethesda Hospital	Julie Fitzroy
Busselton Health Campus	Heather Thomson	Hollywood Private Hospital	Michelle Connor
Fiona Stanley Hospital	Jarrod Duncan	Joondalup Health Campus	J Holmes/D Crowley
Fremantle Hospital	Elsy Jiji	Mount Hospital	M Gontran/M Huyser
Geraldton Hospital	Vicki Richards	Peel Health Campus	Geraldine Keogh
Kalgoorlie Health Campus	Nicole Hintz	South Perth Hospital	Deb Waters
Osborne Park Hospital	Jenny Misiewicz	St John of God Bunbury Hospital	Corne Habig
Rockingham General Hospital	Carol Beaney	St John of God Geraldton Hospital	Kristie Hutton
Royal Perth Hospital	Kerry Hodgkinson	St John of God Midland Hospital	Grace Loh
Sir Charles Gairdner Hospital	Angela Bibb	St John of God Mt Lawley Hospital	S Meek/F Campos
		St John of God Murdoch Hospital	Christopher Sheen
		St John of God Subiaco Hospital	Philip Emrose
		Waikiki Private Hospital	Bill Muir

SOUTH AUSTRALIA

PUBLIC HOSPITALS		PRIVATE HOSPITALS	
Clare Hospital and Health Services	J Knappstein/M Bradley	Ashford Community Hospital	Lisa Kowalik
Flinders Medical Centre	J Platten/A Ware	Burnside War Memorial Hospital	Trent Batchelor
Gawler Health Services	Sharon Mewett	Calvary Adelaide Hospital	I Snowball/T Heinrich
Lyell McEwin Hospital	Lisa Wills	Calvary Central Districts Hospital	Linda Keech
Modbury Public Hospital	Brenda Foster	Calvary North Adelaide Hospital	Arlene Somido
Mount Barker District Soldiers Memorial Hospital	Emma Crowder	Flinders Private Hospital	Marcus Ender
Mount Gambier Hospital	Kylie Duncan	Glenelg Community Hospital	N Russell-Higgins/V Lawrence/R English
Murray Bridge Soldiers Memorial Hospital	Janine Colwell	North Eastern Community Hospital	Laura Shaw
Naracoorte Health Service	Trina Berry	Parkwynd Private Hospital	M Andersen/S English
Noarlunga Hospital	Carole Dawson	Sportsmed SA	F Penning/S Smith
Port Augusta Hospital	P Williams/J Haynes	St Andrews Private Hospital	L White/K Kowalick
Port Lincoln Hospital	Christine Weber	Stirling District Hospital	Kylie Buck
Port Pirie Regional Health Service	Sarah Zanker	The Memorial Hospital	J Emery/J Ohlson
Queen Elizabeth Hospital	Kasey Irwin	Western Hospital	Sharon Till
Riverland General Hospital	Michiela Gardner		
Royal Adelaide Hospital	L Davies/D Stoica		
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	Stuart Kirkham	Calvary Hospital	B Stephensen/A Copping/K Harrex
		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 John James Memorial Hospital	Samjith Sreesan
Calvary Public Hospital	Fiona Carruthers	The National Capital Private	R Barancewicz/G Palada
		Canberra Private Hospital	M Gower/S Phillips/M Rogina/L Tuohy
		Calvary Bruce Private Hospital	Carlene Morris

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

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 ($\chi 2$) Test: Any test whose statistic has a chi-square distribution under the null hypothesis is called a chi-square test. A common example is a test for association between two categorical variables whose data are arrayed in a cross-classification table of counts (Pearson's chi-square test). This can be generalised to many situations where the distribution of observed data is being compared to an expected theoretical distribution.

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
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
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
2	Infection	
3	Incorrect Side	Surgical procedure
4	Incorrect Sizing	
5	Malposition	
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
Assistant Deputy Director, Mr Bill Donnelly
Manager, Ms Cindy Turner
Research Coordinator, Dr Sophia Rainbird
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 number of people who have a joint operation may at some time require another operation on that joint. This may occur due to a variety of reasons. For instance, if you have had a joint replacement the most common cause is that the joint replacement has worn out. How quickly this occurs depends on which of the many different types of artificial joints have been used. For those patients having a knee osteotomy the aim is to delay or prevent the need for having a joint replacement. In order to improve the success of these operations, the Australian Orthopaedic Association set up the National Joint Replacement Registry in 1999. The purpose is to monitor and report on the results of these operations. This information helps everyone working in the health system to ensure patients get the best treatment possible both now and in the future. Another important Registry role is that it assists hospitals and doctors to locate people in the uncommon event a problem with any medical device used is identified.

To do this it is important for the Registry to record a small amount of information on as many people having these operations as possible. It is also important to record if any subsequent operations have occurred. By analysing this information, it is possible to identify which of the medical devices are working best and the best type of operation for each patient. We are asking you to participate in the Registry, by allowing us to document information relevant to your operation.

Your Involvement - *the information we need*

The information we require includes your name, date of birth, address, Medicare number, hospital identity number, the name of the hospital and the reason you are having a joint replacement or knee osteotomy. This information is necessary to accurately link you to the medical device inserted as well as linking any following joint surgery you may have, to your previous records. We will also record the day of the operation, which joint was operated on and the type of medical device used. No other personal information is recorded. Government Departments also provide information so that the Registry can check the accuracy of the data and update records to reflect if someone has died.

Information - *how we will keep your information confidential*

Your personal information is confidential and safety measures are in place to protect this information. Your personal information is protected by an Act of Parliament. This means you cannot be identified in any reports produced by the Registry. On occasion, your data may be linked to other government health datasets to further enhance the Registry's ability to improve patient outcomes. Your de-identified data may be used for other research projects and may be shared with national and international collaborators.

How we will collect the information

Although we are asking to record your operation details in the Registry you are not required to do anything. Your surgeon and/or theatre staff will complete the form that contains your personal details at the time of your operation and send it to us. The information will be entered into the secure Registry database which is stored in the South Australian Health & Medical Research Institute, Adelaide, South Australia.

Risks and Benefits - *to you*

There are no risks to you by having your details in the Registry. The Registry produces general reports on a variety of factors that influence the success of joint operations. The results of joint operations have greatly improved because of this information.

What to do if you don't want to be in the Registry

We understand that not everyone is comfortable about having his or her personal details documented in a registry. If you feel this way and do not want your details recorded, please contact the Manager on 1800 068 419 *(freecall)* as well as making your decision known to hospital staff. A decision on whether or not you wish to be involved in the Registry does not affect your treatment in any way. If you have any questions, concerns or require further information on the National Joint Replacement Registry please do not hesitate to contact Ms Cindy Turner.

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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