Australian Orthopaedic Association National Joint Replacement Registry

AOA
AUSTRALIAN ORTHOPAEDIC ASSOCIATION

20th

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Australian Orthopaedic Association
National Joint Replacement Registry

2019 Annual Report

Hip, Knee & Shoulder Arthroplasty

September 1999 – December 2018

20 YEARS OF THE AOANJRR

1999	Declared a Federal Quality Assurance Activity (FQAA)
1999	Hip & knee data collection commenced
1999	Partnership with University of Adelaide established
2000	First AOANJRR Annual Report
2002	Full national collection achieved
2007	First surgeon workshop held to review Annual Report
2007	Shoulder, wrist, ankle & spinal disc data collection commences nationally
2009	Federal funding legislated
2012	Secure online portals launched providing outcome data
2014	FQAA protection from subpoena upheld in court
2015	Over 1 million joint replacement procedures recorded
2015	Partnership established with the South Australian Health & Medical Research Institute and relocation to the Biomedical Precinct
2016	Annual individual Surgeon Outcome Reports released online
2018	Automated Industry Reporting System developed
2018	PROMs data collection commenced
2019	Registry Nested Clinical Trials commenced
2019	20th Annual Report produced

Preface

It is my pleasure to present the Australian Orthopaedic Association National Joint Replacement Registry (AOANJRR) 2019 Annual Report. The orthopaedic community continually strives to ensure continuous evidence-based improvement in the results of this surgery. The reason the AOA established the Registry was to provide quality information so this could be achieved. This Annual Report is the 20th produced by Registry and as such is an important milestone for orthopaedics, not only in Australia but globally. The AOANJRR has been at the national and international forefront of identifying best practice and providing that information, locally and globally, to surgeons and all other healthcare stakeholders including patients. The data it provides has contributed in a very major way to the ongoing reduction in revision rates for all forms of joint replacement seen in this country and elsewhere since its implementation.

In this Annual Report, the AOANJRR is providing its usual detailed assessment of joint replacement surgery outcomes. This includes information on the comparative performance of different techniques, the many classes and individual prostheses used and how different patient factors impact on those outcomes. For this report specifically, it has also included a section which provides an overview of major changes in practice and outcomes that have occurred since it commenced data collection over 20 years ago. Although many changes and new technologies have been beneficial, this is not always the case. It is important to review the information provided and consider the important lessons learned during this time. However, it is evident that the increasing adoption of Registry-identified best practice continues to enhance the outcomes of this highly beneficial surgery.

It is important to emphasise that the AOANJRR is continuing to develop and expand. In October 2019, the AOANJRR is due to report on the outcomes of a two-year pilot on its capacity to collect both pre and post-operative data directly from patients using an AOANJRR developed automated electronic system. This data collection is important as it provides additional real-world, real-time data on the outcomes of this surgery from the patient perspective. It has also established systems to undertake Registry nested trials and is currently undertaking a large randomised clinical trial comparing the effectiveness of aspirin and clexane at preventing deep vein thrombosis. This clinical trial capacity is also being provided to industry to support better, more rapid and a very cost-effective approach to assess new technologies. A further important development is the linkage of Registry data to other large data sets, including other registries and government administrative health data sets. This will enable the Registry to better assess additional outcomes and factors that influence these outcomes.

I would like to take this opportunity to thank all those involved with the production of the report and the continued development and success of the Registry. This includes AOANJRR staff as well as the South Australian Health and Medical Research Institute (SAHMRI) and the University of South Australia which are the AOA's partners in managing the Registry and progressing registry science. The AOA is also very grateful for the continued support of the Commonwealth Government which provides funding for the core activities of the Registry through a legislated cost recovery program. The Department of Health also provides ongoing support and advice in many other ways. In addition, there are many other stakeholders supporting the Registry which include: state and territory governments, the Therapeutic Goods Administration, and industry particularly orthopaedic manufacturers. Finally, 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.

David Martin

President of the Australian Orthopaedic Association

Highlights of 2018

Reporting

1,492,892
Total number of joint replacement procedures recorded in the Registry at the end of 2018

Joint replacement procedures in 2018
122,500

879
Individual Surgeon Outcome Reports produced

1388
CPD Certificates released online via secure Surgeon Portal

Journal Articles Published 22

Podium Presentations 65

Conference Posters 13

39
Hospital Audit Reports produced

228
Ad Hoc Reports produced

Automated Industry Reporting System (AIRS) produced **802** reports in 2018

2018 Annual Report downloaded 31,883 times

Lay Summary downloaded 2,008 times

Projects underway

Grant Funded Projects

- **Stakeholder Access to Real-time PROMs Data** for Joint Replacement, Rapid Applied Research Translation (RART), MRFF Grant.
- **CRISTAL** - Comparing Two Standard Drug Protocols used for Preventing Venous Thromboembolism (VTE) Prophylaxis after Joint Replacement: A 10,000 Patient Registry Nested Clinical Trial (RNCT) MRFF Grant.
- Enhancing Joint Replacement Outcomes through **National Data Linkage**, NHMRC Grant.
- **Rehabilitation Outcomes** for Patients Receiving Joint Replacements: A Data Linkage Project, HCF Grant.
- Are Total Hip and Knee Replacements Associated with an **Increased Cancer Risk**? A Nationwide Cohort Study.

PROMs Patient Reported Outcomes Measures Pilot Study

45 ***hospitals participating***

9,116 ***Pre-op PROMs recorded***

2,277 ***Post-op PROMs recorded***

Knee Osteotomy Registry

25 **Hospitals now approved and another 21 hospitals with approval processes underway**

ICT System built to deliver **Registry Nested Clinical Trials (RNCTs)**

Executive Summary

This summary provides a brief overview of some of the major findings from this year's Annual Report. The basic structure of the report is similar to previous years. The standard AOANJRR analysis and reporting of hip, knee and shoulder replacement outcomes has been updated to include 2018 data and extended to include additional data in some areas. There were 1,478,219 (643,567 hip, 782,600 knee and 52,052 shoulder) joint replacement procedures included in these analyses. Not all standard information previously available has been included in the main report. The reason for this is that in recent years the size of the report has been increasing. To address and manage this, several previously included sections have been removed. These sections are clearly identified and summarised within the report. A link has been provided to the full analyses for these updated sections which are available online as supplementary reports. As in previous years, the range of supplementary reports includes a Lay Summary and 12 different reports on arthroplasty topics. All available supplementary reports are listed in the introduction of the Annual Report and are accessible from the AOANJRR website. Detailed analyses of all prostheses identified as having a higher than anticipated rate of revision are also available online (https://aoanjrr.sahmri.com/annual-reports-2019).

Each year one or more new topics are selected for detailed analysis. As this is the 20th AOANJRR Annual Report the focus of this year's new analysis has been to provide an overview of the change in practice and outcome of primary hip and primary knee replacement since the AOANJRR commenced data collection. An analysis of the impact of some of those changes has also been provided.

Change in Practice and Outcome of Hip and Knee Replacement – 20 year experience
A description of change in practice with respect to prosthesis class use, patient selection and changing prosthesis characteristics has been provided for both primary hip and primary knee replacement. To assess the outcomes of the identified change in practice, three time periods were compared (1999-2005, 2006-2012 and 2013-2018).

The revision of primary hip replacement was highest for procedures undertaken in 2006-2012 and lowest for those performed in 2013-2018. The higher revision rates in 2006 were due to the use of a number of different classes of hip prosthesis associated with increased rates of revision. In particular, large head metal/metal conventional total hip prostheses. Patient factors had no impact on the comparative revision rates across the three time periods. A number of prosthesis factors had major effects on revision rates. Greater use of cementless fixation increased revision for early loosening and femoral fracture. The change in practice using larger femoral head sizes has been responsible for a reduction in revision for dislocation. The use of XLPE bearings has been associated with a major reduction in revision for late loosening.

There has been a continuous decline in primary knee replacement revision rates since the Registry commenced data collection. The reasons for this decrease are a reduction in the use of unicompartmental knee replacement and reduced revision for loosening and pain when total knee replacement is used. The reduction in revision for loosening is largely due to the increased use of cement fixation. The reduction in revision for pain is associated with an increased use of patella resurfacing.

A potential important issue that has been identified is the increase in early revision for infection in both primary hip and primary knee replacement. This is not due to prostheses or identifiable patient factors. Further analysis of the reasons for this finding will need to be undertaken and evaluated.

10 and 15 Year Outcome Data
The Registry continues to highlight the 10 and 15 year cumulative percent revision of prosthesis combinations used in primary total conventional hip and primary total knee replacement. These are important milestones to benchmark comparative prosthesis performance. The approach used was recommended by the International Benchmarking Working Group. It identifies prostheses that are associated with proven long-term success. This year the Registry is reporting that 17.2% of hip prosthesis combinations and 12.1% of knee prosthesis combinations achieved a 10 year superiority benchmark. Primary shoulder prostheses have yet to be included in this section of the report as data collection for these procedures commenced later. Currently there is insufficient follow up to enable adequate comparative 10 year data to be reported.

Hip Replacement Data
In 2018, the rate of hip replacement increased by 1.7% and revision burden declined to 8.4%. There has been an ongoing decrease in revision burden since the Registry commenced data collection and this current burden is the lowest reported by the Registry. The use of primary partial hip replacement continues to decline and accounted for only 12.1% of hip procedures undertaken in 2018. This class of prosthesis is used principally for the management of fractured neck of femur. Cement fixation of the femoral component and the use of bipolar prostheses is associated with the lowest rate of revision for the management of this diagnosis.

To ensure that the analysis of primary total hip replacement remains relevant to modern surgical practice, it has been limited to procedures using modern bearings (XLPE with metal, ceramic or ceramicised metal heads and ceramic on ceramic bearings using mixed ceramic) where appropriate. These bearings are associated with lower rates of revision particularly in the long-term compared to other previously used bearings. There is little difference between the different types of modern bearings. There is no evidence to support the use of other bearing types.

The Registry commenced data collection on operative approach in 2015 and for the first time is reporting outcomes associated with this. There was no difference in the overall early rate of revision when surgical approach was compared. The anterior approach has a lower rate of revision for infection and dislocation. However, it has a higher rate of revision for aseptic loosening and early fracture.

Knee Replacement Data
In 2018, knee replacement increased by 1.2% and the revision burden was 8.7%. This is a relatively small increase in the use of these procedures compared to previous years. There has been little change in overall revision burden for knee replacement in the last 2 years. Last year, the Registry reported a small increase in the proportional use of unicompartmental knee replacement. This remained largely consistent in 2018 (5.8% compared to 5.7%). When assessing the impact of patient factors, prosthesis factors and techniques used to implant knee prostheses, the outcome of knee replacement surgery remains similar to what has previously been reported.

Shoulder Replacement Data
In 2018, shoulder replacement increased by 8.1% and revision burden was lowest at 8.7%. The Registry now has data on 52,052 shoulder replacement procedures which makes it currently the largest shoulder registry globally. The use of total reverse shoulder replacement continues to increase in use and in 2018 accounted for 77.9% of all total shoulder replacements. After 3 months, total reverse shoulder replacement has a lower rate of revision compared to total stemmed shoulder replacement. Cement fixation of the glenoid component in total stemmed shoulder replacement has a lower rate of revision.

Prostheses with Higher than Anticipated Rates of Revision
Each year, the AOANJRR identifies prostheses with higher than anticipated rates of revision. This year, 10 new prostheses have been identified; seven total conventional hip combinations, one acetabular prosthesis, and two total knee combinations.

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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Many thanks to the Data Entry Team

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Peter Lewis	Deputy Director (South Australia)
Ian Harris	Deputy Director (New South Wales)
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Richard Page	Shoulder & Elbow Society Representative
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Matthew Scott-Young	Spine Society of Australia Representative
James Stoney	Assistant Deputy Director (observer status)
Bill Donnelly	Assistant Deputy Director (observer status)

Contents

Introduction

The 2019 Hip, Knee and Shoulder Arthroplasty Report is based on the analysis of 1,478,219 (643,567 hip, 782,600 knee and 52,052 shoulder) primary and revision procedures recorded by the Registry, with a procedure date up to and including 31 December 2018. 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 2019:

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 – 2017/2018
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-2019

All hospitals, public and private, undertaking joint replacement submit their data to the Registry. Currently, there are 315 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 (228 in 2018). 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 2018, equating to 2,201 fewer hip revisions in 2018. The percentage of revision knee procedures has declined from a peak of 8.8% in 2004 to 7.5% in 2018, equating to 879 fewer knee revisions in 2018. Revision shoulder arthroplasty peaked at 10.9% in 2012 and has declined to 8.7% in 2018.

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.

Consultative Committee Members

1. Chair, Department of Health
2. AOANJRR Director
3. A representative of:
    a. Department of Health
    b. Australian Orthopaedic Association
    c. Consumers Health Forum
    d. Therapeutic Goods Administration
    e. Prostheses List Advisory Committee
    f. Private Healthcare Australia
    g. Australian Private Hospitals Association
    h. Orthopaedic Industry (2):
        i. Medical Technology Association of Australia
        ii. Non Medical Technology Association of Australia

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 data on specific Registry forms, which are completed in theatre at the time of surgery and submitted to the Registry each month. Examples of Registry data 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 2017/18 financial year, the Registry received 762 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 first revision using the Kaplan-Meier estimates of survivorship. The cumulative percent revision at a certain time, for example five 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.

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

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

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

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

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

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

The Registry is currently investigating the introduction of different analytical methods to cope with competing risks. Cumulative incidence is one method of estimating the probability of revision in the presence of competing risks. Cumulative incidence revision diagnosis graphs deal with the competing risks of reasons for revision, highlighting the differences between groups in the pattern of revision over time. They also provide important insight into different mechanisms of failure. A further approach to address the issue of death is to assess the probability of revision in only those patients that are still alive at the time of assessment. This is referred to as conditional probability. This year the Registry has used these three different approaches when assessing revision in the elderly population.

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

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

REPORT REVIEW PRIOR TO PUBLICATION

Prior to publication there are two workshops held to review, comment, and provide advice on the report. Members of the AOA and Arthroplasty Society are invited to attend a two-day hip and knee surgeon workshop, to review all sections of the report other than the shoulder procedures section. This workshop was held in Adelaide on the weekend of 3 and 4 August 2019. Members of the AOA with expertise in shoulder surgery are invited to attend a separate workshop to review this section of the report. This workshop was held in Adelaide on 10 August 2019. Following these workshops, the report was provided to the AOA Board for consideration and final approval prior to publication.

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

2019

Change in Practice and Outcome of Hip and Knee Replacement Surgery in Australia

The 20 year experience

INTRODUCTION

As this is the 20th edition of the AOANJRR Annual Report, it was felt to be an opportune time to review what has happened with respect to change in outcomes and practice of joint replacement surgery since data collection commenced.

The Australian Orthopaedic Association established the AOANJRR to enhance the outcomes for all patients receiving joint replacement surgery. The principal outcome measure used by the Registry is revision. This is influenced by many factors that have the potential to interact in complex ways.

In addition to prosthesis specific information, the AOANJRR routinely reports variation in revision by class of prosthesis, patient selection, and specific prosthesis characteristics. The aim has been to identify best practice and assist surgeons to make informed choices. There are many examples where AOANJRR data has changed practice in a beneficial way. Some of these have been mentioned in the introductory section of this report.

What the AOANJRR has not done previously is to provide an overview of change in revision over time and how change in practice has influenced this. The purpose of this section is to provide that information for primary hip and primary knee replacement. A similar approach has been used for both.

Change in revision was assessed by comparing three time periods: 1999-2005, 2006-2012, and 2013-2018. These were chosen to enable adequate follow-up for meaningful comparisons to be made. Comparisons involving the 2013-2018 period had a maximum follow-up of 5 years. When 2006-2012 was compared to 1999-2005 the maximum follow-up was 10 years.

Variation in prosthesis class use, patient selection, and use of specific prosthesis characteristics, were the factors considered in assessing practice change. These changes are reported for the three time periods as well as the entire period of data collection.

The influence of practice change on revision for each of the three time periods was determined. Both descriptive and statistical analyses were used. Some of the analytical approaches have not been reported by the Registry previously, so where relevant an explanation has been provided. A similar approach was used for the hip and knee analyses.

PRIMARY HIP REPLACEMENT

The cumulative percent revision (CPR) for primary hip replacement undertaken in each of the three time periods were compared. All classes of partial and total hip replacement were included. There was no adjustment or stratification for factors that may affect revision. The purpose of the analysis is to provide an overview of the national revision rate for all primary hip replacement procedures and how it has changed irrespective of prosthesis class, patient selection, and specific prosthesis characteristics.

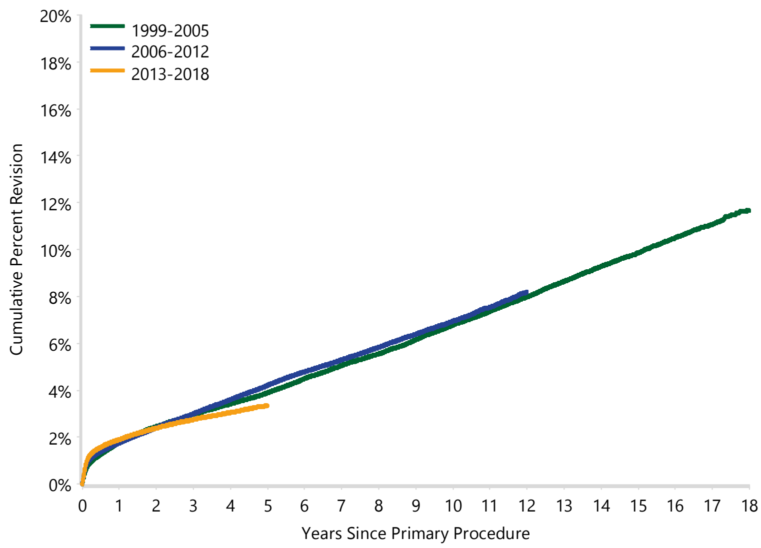
The CPR (after 1 year) was lowest in the most recent time period (2013-2018) and the highest at 5 years for procedures undertaken in 2006-2012. The early rate of revision (0-3 months) differed in that it progressively increased with each time period and was highest in 2013-2018 (Table CPH1 and Figure CPH1).

The CPR was lowest after 1 year in the most recent time period (2013-2018) and highest at 5 years for procedures undertaken in 2006-2012.

Table CPH1 Cumulative Percent Revision of Primary Hip Replacement by Year of Implant (Partial and Total, All Bearing Surfaces, All Diagnoses)

Year of Implant	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
1999-2005	8589	115224	1.8 (1.7, 1.8)	3.0 (2.9, 3.1)	3.9 (3.8, 4.0)	6.8 (6.6, 6.9)	9.9 (9.7, 10.1)	11.7 (11.3, 12.0)
2006-2012	11813	211988	1.8 (1.7, 1.8)	3.0 (2.9, 3.1)	4.2 (4.1, 4.3)	6.9 (6.8, 7.1)		
2013-2018	6067	245625	1.9 (1.8, 2.0)	2.8 (2.7, 2.8)	3.3 (3.2, 3.4)			
TOTAL	**26469**	**572837**						

Figure CPH1 Cumulative Percent Revision of Primary Hip Replacement by Year of Implant (Partial and Total, All Bearing Surfaces, All Diagnoses)



2013-2018 vs 2006-2012
0 - 3Mth: HR=1.22 (1.16, 1.29),p<0.001
3Mth - 6Mth: HR=0.96 (0.86, 1.06),p=0.417
6Mth - 2Yr: HR=0.75 (0.71, 0.80),p<0.001
2Yr+: HR=0.57 (0.53, 0.61),p<0.001

2013-2018 vs 1999-2005
0 - 3Mth: HR=1.37 (1.28, 1.46),p<0.001
3Mth - 6Mth: HR=0.86 (0.75, 0.98),p=0.028
6Mth - 2Yr: HR=0.69 (0.64, 0.74),p<0.001
2Yr+: HR=0.66 (0.61, 0.72),p<0.001

2006-2012 vs 1999-2005
0 - 3Mth: HR=1.18 (1.10, 1.26),p<0.001
3Mth - 6Mth: HR=0.84 (0.73, 0.97),p=0.014
6Mth - 2Yr: HR=0.86 (0.80, 0.92),p<0.001
2Yr - 5Yr: HR=1.23 (1.16, 1.31),p<0.001
5Yr+: HR=0.98 (0.93, 1.02),p=0.315

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
1999-2005	115224	105699	96724	88406	68344	28024	1809
2006-2012	211988	195213	179260	164079	48675	0	0
2013-2018	245625	186253	98535	28261	0	0	0

FACTORS AFFECTING REVISION RATE

To understand the variation in revision, it is necessary to know how practice has changed and assess the contribution of that change on revision for each time period.

The factors considered were class of primary hip replacement, patient factors, and specific prosthesis characteristics.

HIP REPLACEMENT CLASS

There are a number of different classes of partial and total hip replacement. These are known to have different revision rates and varied use with time.

Five different classes were considered. They were partial hip, large head (LH) metal/metal >32mm, total resurfacing, exchangeable neck prostheses, and all remaining total hip prostheses excluding each of these classes. This class is subsequently referred to as 'all remaining total hip replacement (THR)'.

The three different classes of partial hip replacement (monoblock, modular and bipolar) were not considered separately. They are almost exclusively used for the management of fractured neck of femur. To assess the individual impact of the changing use of these three classes it would be necessary to limit the analysis to this specific diagnosis. In addition, the changing use and the difference in class-specific partial hip replacement revision rates have been reported previously and are also provided elsewhere in this report.

It is known that each class of hip replacement has been selectively used in specific patient populations which vary with respect to age, gender, comorbidities, and diagnosis.

In this analysis, selective patient use was not considered. The reason for this was two-fold. The intent was to provide an overview of the impact on revision associated with the use of each class and an understanding that the largest class (all remaining THR) is an alternative, particularly to the three total hip replacement classes.
The proportional use of each of the five classes is reported for the three time periods as well as annually.

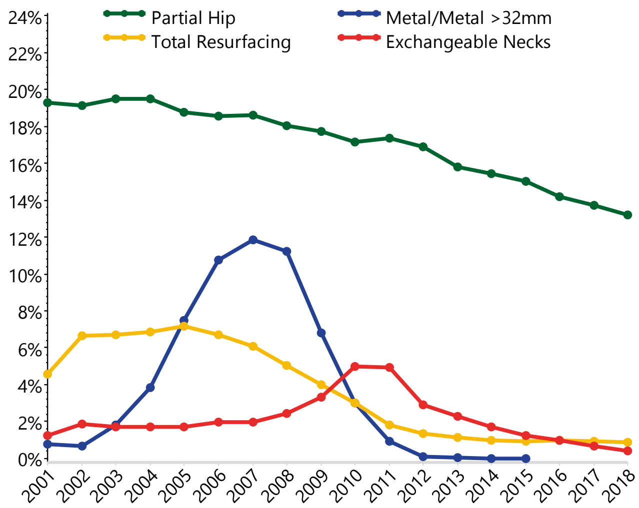
The use of partial hip replacement has declined progressively. LH metal/metal peaked in 2007 (11.8%) and was most used in 2006-2012. Total resurfacing peaked in 2005 (7.2%) and was most used in 1999-2005. Exchangeable neck prostheses peaked in 2010 (5.0%) and were most used in 2006-2012 (Table CPH2 and Figure CPH2).

There was almost no use of LH metal/metal, and minimal use of resurfacing and exchangeable neck prostheses in 2013-2018. The 'all remaining THR' class was most used in 2013-2018 and peak use occurred in 2018 (85.6%) (Table CPH2).

Table CPH2 Primary Hip Replacement by Hip Class (All Diagnoses)

Hip Class	1999-2005 %	2006-2012 %	2013-2018 %	Entire Period %
Partial Hip	19.5%	17.7%	14.5%	16.7%
Metal/Metal >32mm	3.1%	6.0%	0.0%	2.8%
Total Resurfacing	6.3%	3.8%	1.0%	3.1%
Exchangeable Necks	1.6%	3.3%	1.2%	2.0%
All Remaining THR	69.5%	69.2%	83.2%	75.4%

Figure CPH2 Primary Hip Replacement by Hip Classes (All Diagnoses)



Assessing the effect of each class on the CPR of primary hip replacement for the three time periods is complex. In addition to the time-related variation in use, it is also a product of the difference in revision associated with each class and whether that class-specific revision has also changed with time.

It was decided that the simplest and most understandable approach was to sequentially remove each class from the analysis and re-assess the change in all-cause CPR for each time period.

There are limitations with this approach. While it is possible to undertake a statistical comparison of the different time periods for each class removal it is not possible to statistically compare changes between the different class removal groups. Reviewing the change in the CPR between these groups can, however, provide some clinical insight into the impact of removing each class on all-cause revision.

The data from this analysis are presented in three ways:

1. A table of CPRs for the three time periods for each of the class removal groups.
2. A table of hazard ratios comparing time periods within each group. Three comparisons are reported (2013-2018 vs 2006-2012, 2013-2018 vs 1999-2005 and 2006-2012 vs 1999-2005).
3. A Forest Plot which is a graphical representation of the hazard ratio data. This has been included to assist in the interpretation. For ease of use, only two comparisons are presented (2013-2018 vs 2006-2012 and 2013-2018 vs 1999-2005).

The removal of partial hips resulted in a small reduction in CPR for the first two periods only. There was no major change in the comparative outcomes when the three different time periods were compared (Table CPH3, Table CPH4 and Figure CPH3).

The three total hip classes with little to no use in 2013-2018 were then sequentially removed. There was a reduction in CPRs related to the removal of each of the classes and this reduction was most evident at 5 and 10 years.

Removal of LH metal/metal resulted in the largest reduction in CPR. The 5 and 10 year CPRs were reduced by 0.1% and 0.4% for 1999-2005 and 0.7% and 1.6% for 2006-2012 (Table CPH3). There was also a change in the comparative outcomes when the three time periods were compared. Prior to the removal of LH metal/metal, 2006-2012 had an increased rate of revision at 2-5 years compared to 1999-2005 and the rate of revision at ≥5 years was no different. Following the removal of LH metal/metal, the rate of revision at both 2-5 years and ≥5 years was less in 2006-2012 compared to 1999-2005 (Table CPH4 and Figure CPH4).

Removing total resurfacing and exchangeable neck prostheses resulted in additional but smaller reductions in CPR for both 1999-2005 and 2006-2012. The removal of total resurfacing reduced the 5 and 10 year CPRs by 0.1% and 0.3% for both 1999-2005 and 2006-2012. The removal of exchangeable neck prostheses further reduced the 5 and 10 year CPRs by 0.1% and 0.2% for 1999-2005, and by 0.2% for both years for the 2006-2012 period.

There was no major change in the comparative outcomes when the three different time periods were compared following the removal of each of these hip classes (Table CPH3, Table CPH4 and Figure CPH4).

In the 'all remaining THR' class, in both 2013-2018 and 2006-2012, there was a lower rate of revision after 6 months compared to 1999-2005. There was no difference in revision after 6 months when 2013-2018 was compared to 2006-2012 (Table CPH4, Figure CPH3).

The progressive increase in early revision (0-3 months) previously observed in the all primary hip analysis did not change with the sequential removal of the different classes of hip replacement (Table CPH4, Figure CPH4).

The proportional contribution of each class to revisions that occurred within 5 and 10 years of the primary procedure for each year were also calculated. Almost 50% of revisions within 5 and 10 years for procedures done in 2007 and 2008 were due to revisions of LH metal/metal, total resurfacing and exchangeable neck prostheses, with LH metal/metal contributing approximately 40% of all revisions. This contrasts with the proportion of primary hip procedures using LH metal/metal in 2008 which was 11.2% (Figure CPH5).

The higher CPR for procedures undertaken in 2006-2012 is largely due to increased use of LH metal/metal prostheses during that period.

This class-specific analysis has identified that the higher CPR for procedures undertaken in 2006-2012 is largely due to the increased use of LH metal/metal prostheses during that period. The use of total resurfacing and exchangeable neck prostheses in the first two periods contributed much less to the increased revision observed for these periods. In the 'all remaining THR' class (after 12 months) the two later periods have lower CPRs and there is no difference between these two periods (after 6 months) although follow-up for 2013-2018 remains short. Finally, the progressive increase in revision seen in the first 3 months is not related to the class of prosthesis.

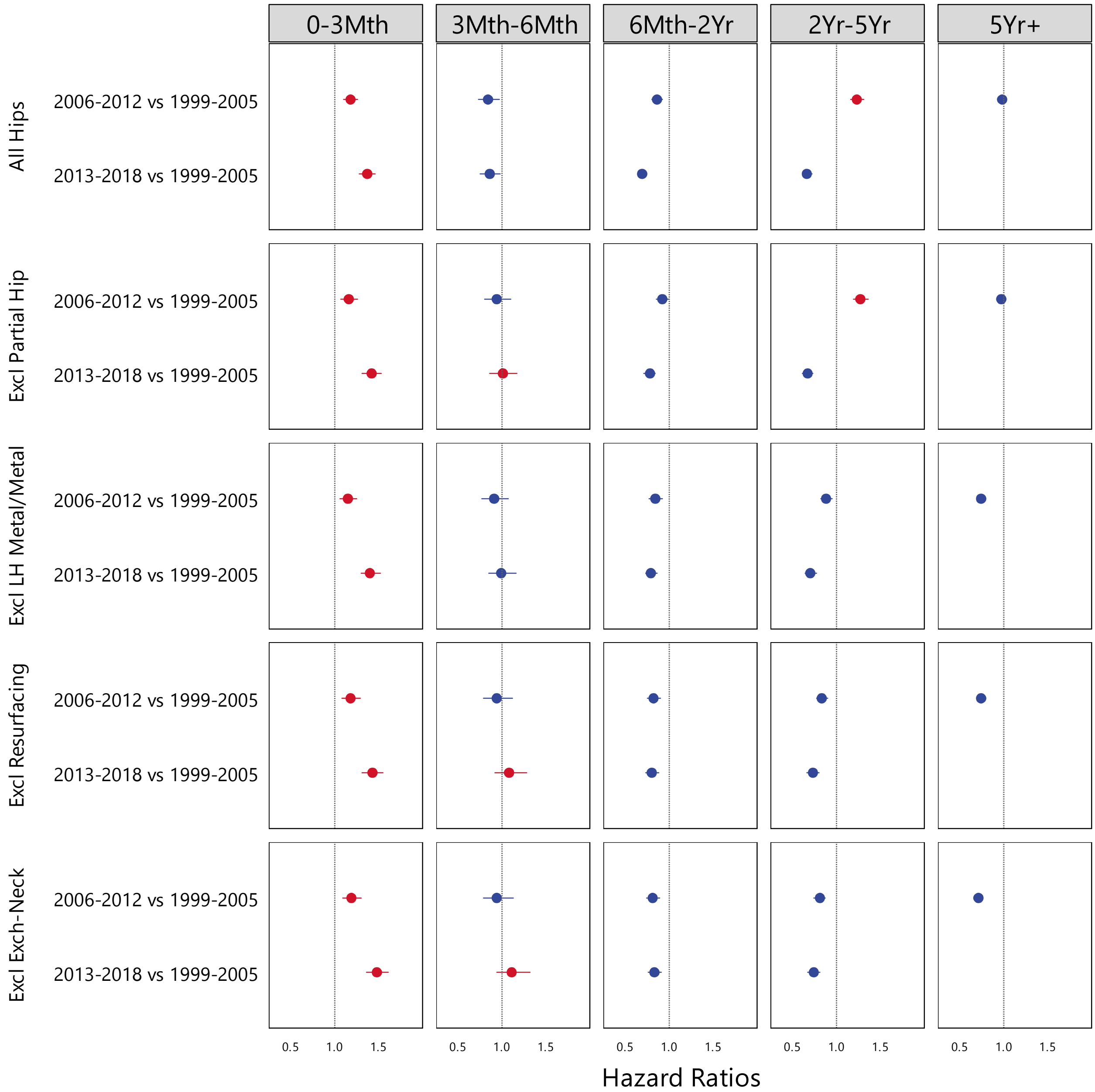
Table CPH3 Cumulative Percent Revision of Primary Hip Replacement with Sequential Removal of Partials, LH Metal/Metal, Total Resurfacing, Exchangeable Neck Prostheses (All Diagnoses)

Year of Implant	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs
	Primary Hip Replacement					
1999-2005	8589	115224	1.8 (1.7, 1.8)	3.0 (2.9, 3.1)	3.9 (3.8, 4.0)	6.8 (6.6, 6.9)
2006-2012	11813	211988	1.8 (1.7, 1.8)	3.0 (2.9, 3.1)	4.2 (4.1, 4.3)	6.9 (6.8, 7.1)
2013-2018	6067	245625	1.9 (1.8, 2.0)	2.8 (2.7, 2.8)	3.3 (3.2, 3.4)	
TOTAL	**26469**	**572837**				
	Primary Total Hip (excluding partial hips)					
1999-2005	7507	92661	1.6 (1.5, 1.7)	2.7 (2.6, 2.8)	3.6 (3.5, 3.7)	6.5 (6.3, 6.7)
2006-2012	10288	174296	1.6 (1.6, 1.7)	2.8 (2.7, 2.9)	4.0 (4.0, 4.1)	6.8 (6.7, 6.9)
2013-2018	5236	210037	1.9 (1.8, 1.9)	2.7 (2.6, 2.8)	3.3 (3.2, 3.4)	
TOTAL	**23031**	**476994**				
	Primary Total Hip (excluding conventional LH metal/metal)					
1999-2005	6815	89076	1.6 (1.5, 1.7)	2.7 (2.6, 2.8)	3.5 (3.4, 3.6)	6.1 (5.9, 6.3)
2006-2012	7336	161602	1.6 (1.6, 1.7)	2.6 (2.5, 2.6)	3.3 (3.2, 3.4)	5.2 (5.1, 5.3)
2013-2018	5235	210017	1.9 (1.8, 1.9)	2.7 (2.6, 2.8)	3.3 (3.2, 3.4)	
TOTAL	**19386**	**460695**				
	Primary Total Hip (excluding conventional LH metal/metal and total resurfacing)					
1999-2005	5912	81803	1.6 (1.5, 1.7)	2.6 (2.5, 2.7)	3.4 (3.3, 3.5)	5.8 (5.6, 5.9)
2006-2012	6548	153494	1.6 (1.6, 1.7)	2.5 (2.4, 2.6)	3.2 (3.1, 3.3)	4.9 (4.8, 5.0)
2013-2018	5194	207669	1.9 (1.8, 1.9)	2.7 (2.6, 2.8)	3.3 (3.2, 3.4)	
TOTAL	**17654**	**442966**				
	All Remaining THR (excluding conventional LH metal/metal and total resurfacing and exchangeable neck prostheses)					
1999-2005	5672	79931	1.5 (1.4, 1.6)	2.5 (2.4, 2.6)	3.3 (3.2, 3.4)	5.6 (5.5, 5.8)
2006-2012	5980	146521	1.6 (1.5, 1.6)	2.4 (2.3, 2.5)	3.0 (3.0, 3.1)	4.7 (4.5, 4.8)
2013-2018	5085	204819	1.9 (1.8, 1.9)	2.7 (2.6, 2.8)	3.3 (3.2, 3.4)	
TOTAL	**16737**	**431271**				

Table CPH4 **Hazard Ratios for Primary Hip Replacement with Sequential Removal of Partials, LH Metal/Metal, Total Resurfacing, Exchangeable Neck Prostheses (All Diagnoses)**

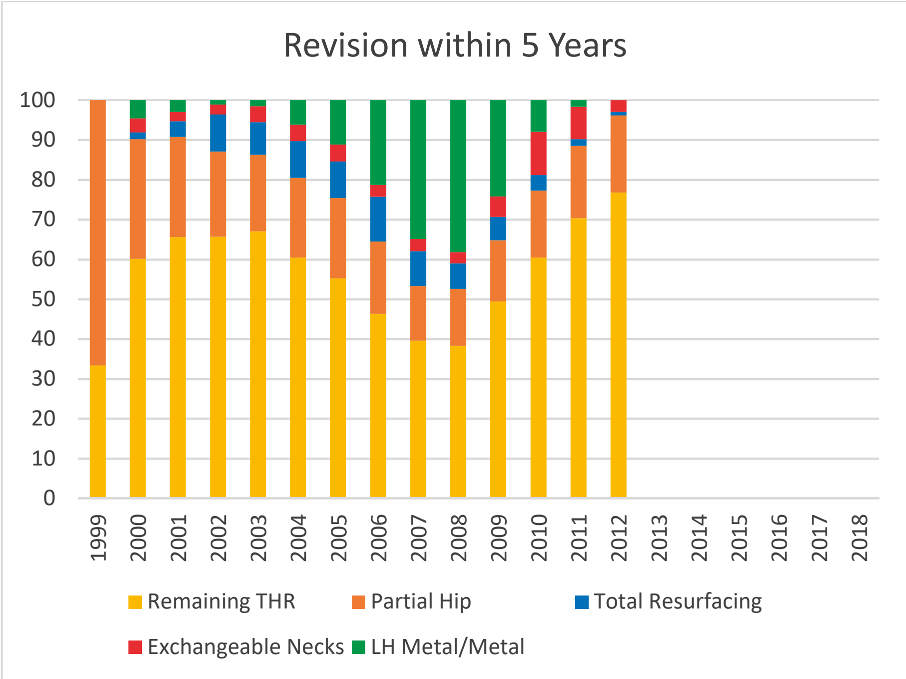
Year of Implant	0 - 3Mth	3Mth - 6Mth	6Mth - 2Yr	2Yr - 5Yr	5Yr+
			All Primary Hip Replacement		
2013-2018 vs 2006-2012	1.22 (1.16, 1.29) p<0.001	0.96 (0.86, 1.06) p=0.417	0.75 (0.71, 0.8) p<0.001	0.57 (0.53, 0.61) p<0.001	
2013-2018 vs 1999-2005	1.37 (1.28, 1.46) p<0.001	0.86 (0.75, 0.98) p=0.028	0.69 (0.64, 0.74) p<0.001	0.66 (0.61, 0.72) p<0.001	
2006-2012 vs 1999-2005	1.18 (1.1, 1.26) p<0.001	0.84 (0.73, 0.97) p=0.014	0.86 (0.8, 0.92) p<0.001	1.23 (1.16, 1.31) p<0.001	0.98 (0.93, 1.02) p=0.315
			Primary Total Hip (excluding partial hips)		
2013-2018 vs 2006-2012	1.27 (1.2, 1.34) p<0.001	1.04 (0.92, 1.17) p=0.542	0.81 (0.75, 0.86) p<0.001	0.56 (0.52, 0.61) p<0.001	
2013-2018 vs 1999-2005	1.42 (1.31, 1.53) p<0.001	1.01 (0.86, 1.17) p=0.919	0.78 (0.71, 0.84) p<0.001	0.67 (0.61, 0.73) p<0.001	
2006-2012 vs 1999-2005	1.16 (1.07, 1.26) p<0.001	0.94 (0.8, 1.1) p=0.429	0.92 (0.85, 0.99) p=0.035	1.27 (1.19, 1.36) p<0.001	0.97 (0.93, 1.02) p=0.270
			Primary Total Hip (excluding conventional LH metal/metal)		
2013-2018 vs 2006-2012	1.27 (1.2, 1.35) p<0.001	1.05 (0.93, 1.19) p=0.398	0.93 (0.86, 0.99) p=0.029	0.83 (0.77, 0.9) p<0.001	
2013-2018 vs 1999-2005	1.40 (1.3, 1.52) p<0.001	0.99 (0.85, 1.16) p=0.932	0.79 (0.73, 0.86) p<0.001	0.70 (0.64, 0.77) p<0.001	
2006-2012 vs 1999-2005	1.15 (1.06, 1.25) p<0.001	0.91 (0.77, 1.07) p=0.245	0.84 (0.77, 0.92) p<0.001	0.88 (0.82, 0.95) p<0.001	0.74 (0.7, 0.78) p<0.001
			Primary Total Hip (excluding conventional LH metal/metal and total resurfacing)		
2013-2018 vs 2006-2012	1.26 (1.19, 1.34) p<0.001	1.11 (0.99, 1.26) p=0.083	0.95 (0.89, 1.02) p=0.182	0.90 (0.83, 0.98) p=0.012	
2013-2018 vs 1999-2005	1.43 (1.31, 1.55) p<0.001	1.08 (0.92, 1.28) p=0.334	0.8 (0.73, 0.88) p<0.001	0.73 (0.66, 0.8) p<0.001	
2006-2012 vs 1999-2005	1.18 (1.08, 1.29) p<0.001	0.94 (0.79, 1.12) p=0.508	0.82 (0.75, 0.9) p<0.001	0.83 (0.77, 0.9) p<0.001	0.74 (0.69, 0.79) p<0.001
			All Remaining THR (excluding conventional LH metal/metal, total resurfacing and exchangeable neck prostheses)		
2013-2018 v 2006-2012	1.30 (1.22, 1.38) p<0.001	1.14 (1.01, 1.29) p=0.037	0.99 (0.92, 1.07) p=0.882	0.94 (0.86, 1.02) p=0.140	
2013-2018 vs 1999-2005	1.48 (1.36, 1.61) p<0.001	1.11 (0.94, 1.32) p=0.205	0.83 (0.76, 0.91) p<0.001	0.74 (0.67, 0.81) p<0.001	
2006-2012 vs 1999-2005	1.19 (1.09, 1.3) p<0.001	0.94 (0.79, 1.13) p=0.528	0.81 (0.74, 0.89) p<0.001	0.81 (0.74, 0.87) p<0.001	0.71 (0.67, 0.76) p<0.001

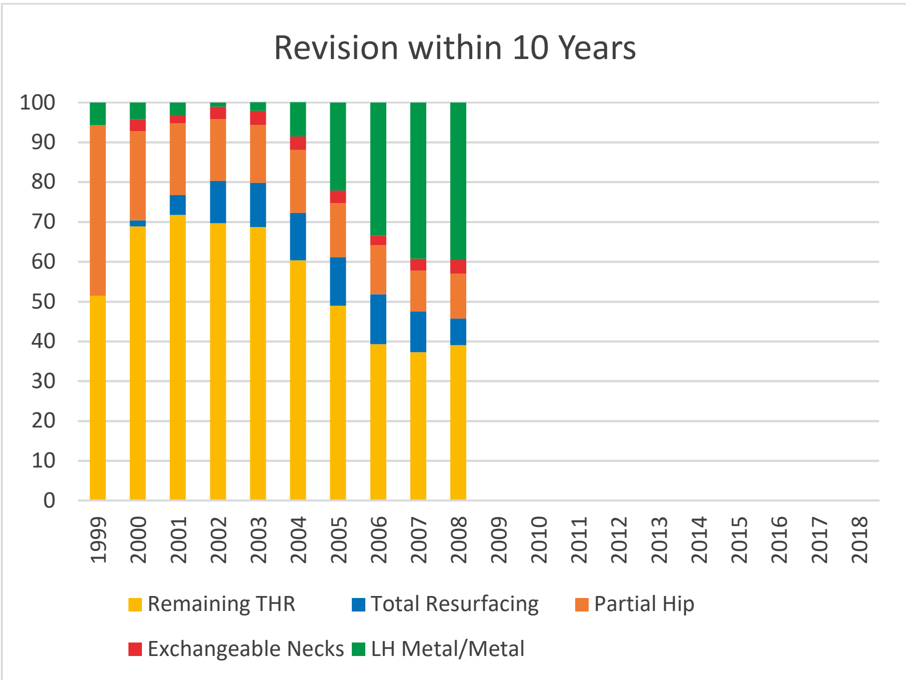
Figure CPH3 Forest Plot of Hazard Ratios of Primary Hip Replacement with Sequential Removal of Partials, LH Metal/Metal, Total Resurfacing and Exchangeable Neck Protheses (All Diagnoses)



Note: The circle represents the hazard ratio and the horizontal line that runs through the circle represents the lower to upper 95% confidence intervals. The dashed vertical line represents the line of no effect. The distance between the vertical dashed line and the circle indicates the extent of change. A red circle indicates an increase in revision for the first of the time periods involved in the comparison.

Figure CPH4 Hip Class Contribution to Revisions within 5 and 10-Years by Year of Implant (All Diagnoses)





PATIENT FACTORS

Patient factors assessed were age, gender, primary diagnosis and comorbidity. The Registry has data on American Society of Anaesthesiologists - Physical Status Classification (ASA) score, nationally from 2012 and Body Mass Index (BMI) data from 2015. Prior to this, it has a limited amount of data on both measures. This was also included for completeness.

Recently, the AOANJRR has also been provided with access to de-identified individual patient Registry data linked to the national Pharmaceutical Benefits Scheme (PBS). This was used to calculate the Rx-Risk score for each patient and was available for individuals having joint replacement surgery from 2003-2017. Rx-Risk is a pharmacy-based measure of comorbidity. It is analogous to other comorbidity scores used for population-based studies and is an accurate measure of general health status.[1]

Change in patient factors was assessed for the three time periods and annually for Rx-Risk. To limit known class specificity and to exclude classes with no or little current use since 2013, the analysis was confined to the 'all remaining THR' class (i.e. excluding partial hip, LH metal/metal, total resurfacing and exchangeable neck prostheses).

There was minimal change in age, gender, and age within gender over the three time periods (Table CPH5). There was no change in ASA score or BMI, although data availability for these measures was limited to more recent years (Table CPH5). Rx-Risk comorbidity assessment did not substantially change (Figure CPH5).

Osteoarthritis (OA) was the most common diagnosis (88.3%) and this did not change over the three time periods. There were changes in some of the other less common diagnoses. Fractured neck of femur was the only diagnosis to increase from 2.8% in 1999-2005 to 5.4% in 2013-2018. The incidence of the remaining diagnoses was low. Hip replacement for osteonecrosis and rheumatoid arthritis declined and developmental dysplasia and all other diagnoses remained constant (Table CPH6).

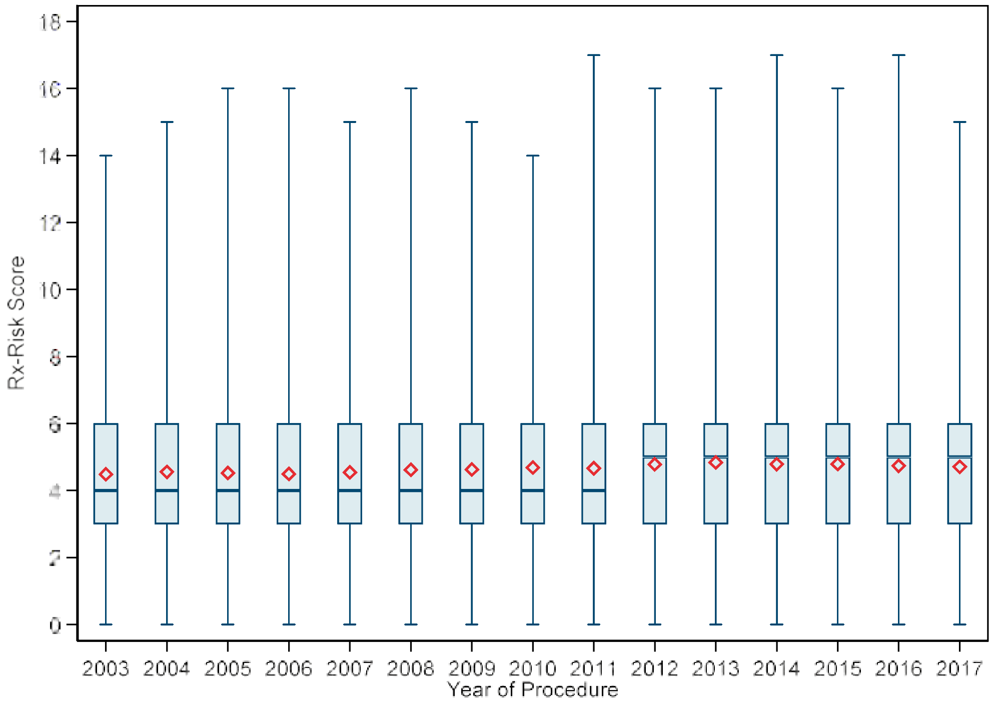
There has been no appreciable change in patient age, gender or comorbidities.

Table CPH5 Demographics of Primary Total Conventional Hip Replacement by Year of Implant (Primary Diagnosis OA, Excluding LH Metal/Metal and Exchangeable Neck Prostheses)

Year of Implant	Number	Male	Mean Age	Mean Age Males	Mean Age Females	Mean ASA	Mean BMI
1999-2005	70471	45.4%	68.91	67.6	70.0		
2006-2012	129511	44.7%	68.42	67.3	69.3	2.2	29.3
2013-2018	180722	46.8%	67.71	66.4	68.9	2.3	29.6

1. Maria C. S. Inacio, Nicole L. Pratt, Elizabeth E. Roughead and Stephen E. Graves Comparing co-morbidities in total joint arthroplasty patients using the RxRisk-V, Elixhauser, and Charlson Measures: a cross-sectional evaluation BMC Musculoskeletal Disorders 2015. 16:385 DOI 10.1186/s12891-015-0835-4.

Figure CPH5 Distribution of Rx-Risk Comorbidity Index Scores for Patients undergoing Primary Total Conventional Hip Replacement for Osteoarthritis, 2003-2017



Note: Limits represent maximum and minimum value of Rx-Risk Score
Diamonds represent mean Rx-Score

Table CPH6 Primary Total Conventional Hip Replacement (Excluding LH Metal/Metal and Exchangeable Neck Prostheses)

	Developmental Dysplasia		Fractured Neck Of Femur		Osteoarthritis		Osteonecrosis		Rheumatoid Arthritis		Other	
Year of Implant	N	Row%	N	Row%	N	Row%	N	Row%	N	Row%	N	Row%
1999-2005	1130	1.4	2255	2.8	70471	88.2	3319	4.2	1343	1.7	1413	1.8
2006-2012	1711	1.2	6768	4.6	129511	88.4	4584	3.1	1415	1.0	2532	1.7
2013-2018	2575	1.3	10994	5.4	180722	88.2	6155	3.0	1340	0.7	3033	1.5
TOTAL	**5416**	**1.3**	**20017**	**4.6**	**380704**	**88.3**	**14058**	**3.3**	**4098**	**1.0**	**6978**	**1.6**

There has been no appreciable change of most patient factors assessed since the Registry commenced data collection; i.e. patient selection for the 'all remaining THR' class has remained relatively constant. Patient factors can only impact the observed time-related differences in revision for this class if they change with time. As most factors have not changed, the identified differences in revision across the three time periods are not due to these patient factors.

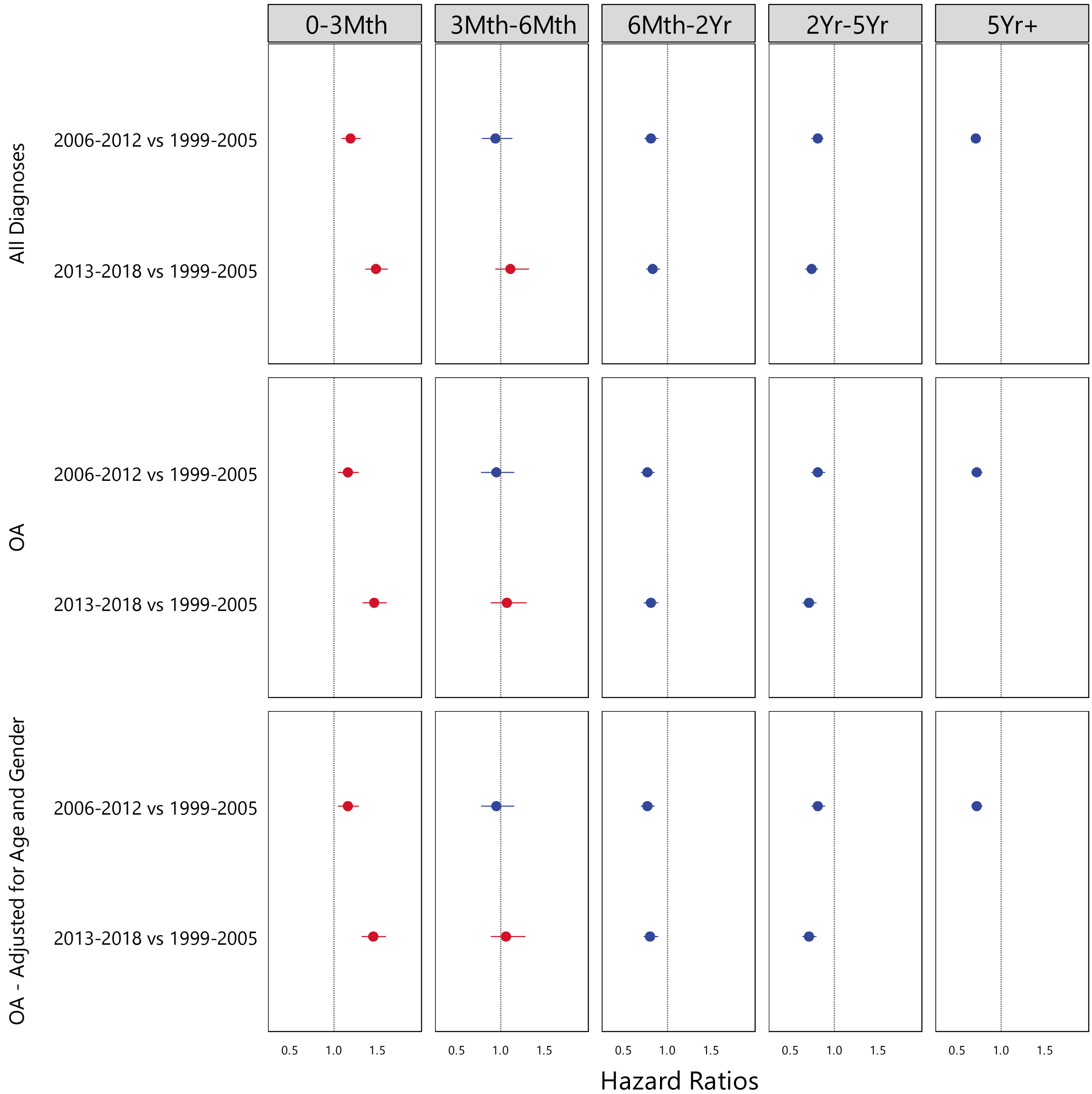
The one patient factor that has changed is the small difference in the proportion of procedures undertaken for less common primary diagnoses. To assess if this affected the revision rate, a similar approach to the hip class analysis was used. All diagnoses other than OA were removed from the analysis and the CPRs calculated for all procedures irrespective of diagnosis and OA only. The CPRs in the OA only group are less than the all diagnoses group and this appears to be relatively constant for each time period. There is no apparent change in the comparative revision rates for the three time periods (Table CPH7 and Figure CPH7).

To confirm the minimal impact of patient factors other than diagnoses on the outcomes of the 'all remaining THR' class (OA only), a further analysis of this group has been provided that has been risk-adjusted for age and gender. The result appears the same as the unadjusted analysis (Figure CPH6).

Table CPH7 Cumulative Percent Revision of All Remaining THR by Year of Implant

Year of Implant	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs
			All Diagnoses			
1999-2005	5672	79931	1.5 (1.4, 1.6)	2.5 (2.4, 2.6)	3.3 (3.2, 3.4)	5.6 (5.5, 5.8)
2006-2012	5980	146521	1.6 (1.5, 1.6)	2.4 (2.3, 2.5)	3.0 (3.0, 3.1)	4.7 (4.5, 4.8)
2013-2018	5085	204819	1.9 (1.8, 1.9)	2.7 (2.6, 2.8)	3.3 (3.2, 3.4)	
TOTAL	**16737**	**431271**				
			OA Only			
1999-2005	4889	70471	1.4 (1.3, 1.5)	2.4 (2.3, 2.5)	3.1 (3.0, 3.3)	5.4 (5.2, 5.6)
2006-2012	5062	129511	1.4 (1.3, 1.5)	2.2 (2.1, 2.3)	2.8 (2.7, 2.9)	4.4 (4.3, 4.6)
2013-2018	4153	180722	1.7 (1.7, 1.8)	2.5 (2.4, 2.6)	3.0 (2.9, 3.1)	
TOTAL	**14104**	**380704**				

Figure CPH6 Forest Plot of Hazard Ratios of All Remaining THR by Year of Implant



Note: The circle represents the hazard ratio and the horizontal line that runs through the circle represents the lower to upper 95% confidence intervals. The dashed vertical line represents the line of no effect. The distance between the vertical dashed line and the circle indicates the extent of change. A red circle indicates an increase in revision for the first of the time periods involved in the comparison.

PROSTHESIS CHARACTERISTICS AND SPECIFIC REASONS FOR REVISION

Many prosthesis characteristics (attributes) are known to affect revision. It is also known that particular attributes preferentially affect specific reasons for revision. Since the Registry commenced data collection, there have been major changes in the use of different attributes. To understand the effect of this, it is necessary to know how attributes have changed and also how reasons for revision have changed.

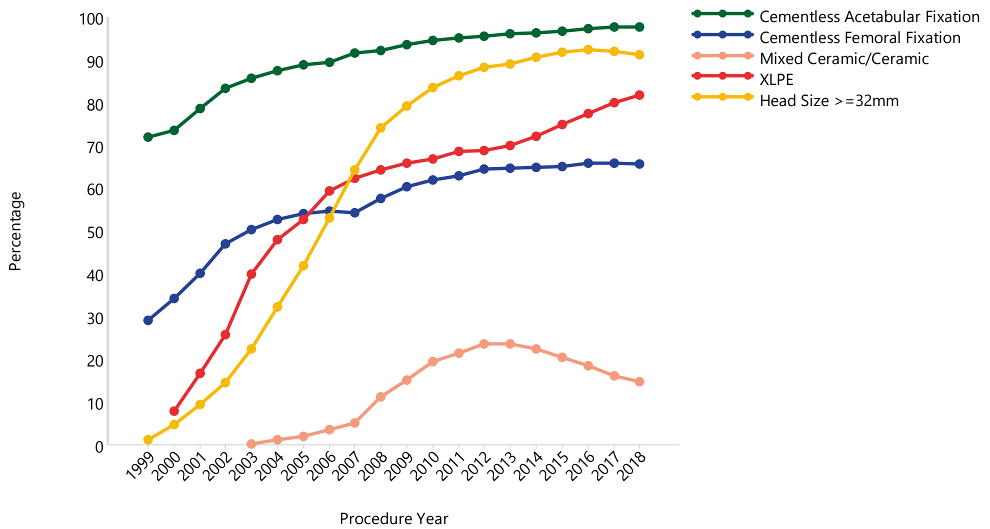
This analysis was limited to the 'all remaining THR' class undertaken for OA. The attributes considered were femoral head size (≥32mm), bearing surface (cross-linked polyethylene (XLPE) and ceramic/ceramic using only mixed ceramic), and cementless fixation (femoral and acetabular). Only the major reasons for revision were assessed. These included aseptic loosening, dislocation, infection and fracture.

The use of each of the prosthesis attributes selected has increased almost continuously over the entire period of data collection with the exception of mixed ceramic/ceramic. The use of this bearing surface peaked in 2013 and has declined since then. Most of the increase in the use of femoral head sizes (≥32mm), cementless femoral stems and cementless acetabular prostheses occurred prior to 2013. The proportional use of XLPE continued to increase during the 2013-2018 period (Table CPH8 and Figure CPH7).

Table CPH8 Prosthesis Attributes for All Remaining THR (Primary Diagnosis OA)

Prosthesis Attributes	1999-2005 %	2006-2012 %	2013-2018 %	Entire Period %
Head Size ≥32 mm	24.4%	77.5%	91.3%	74.2%
XLPE	36.8%	65.7%	76.4%	65.5%
Mixed Ceramic/Ceramic	0.7%	15.5%	19.0%	14.5%
Cementless femoral fixation	48.8%	60.1%	65.4%	60.5%
Cementless Acetabular Fixation	84.8%	93.5%	97.0%	93.6%

Figure CPH7 Prosthesis Attributes for All Remaining THR (Primary Diagnosis OA)



Change in reasons for revision was determined by comparing revision diagnosis-specific CPRs for each of the three time periods and calculating hazard ratios.

Revision for loosening, after the first 3 months, decreased (46% after 5 years) in 2006-2012 compared to 1999-2005. Dislocation also decreased (44%, 2-5 years) when the same two time periods were compared. There was no difference in revision for loosening or dislocation when 2006-2012 was compared to 2013-2018 (Table CPH9, Table CPH10 and Figure CPH8).

Revision for infection, particularly early infection, increased progressively and was highest in 2013-2018. In the first 3 months after surgery, it increased by 129% when the first two time periods were compared and a further 72% in 2013-2018 compared to 2006-2012 (Table CPH9, Table CPH10 and Figure CPH8).

Revision has decreased for loosening but has increased for fracture and infection.

Revision for fracture also increased. This was evident both early and late (Table CPH9, Table CPH10 and Figure CPH8).

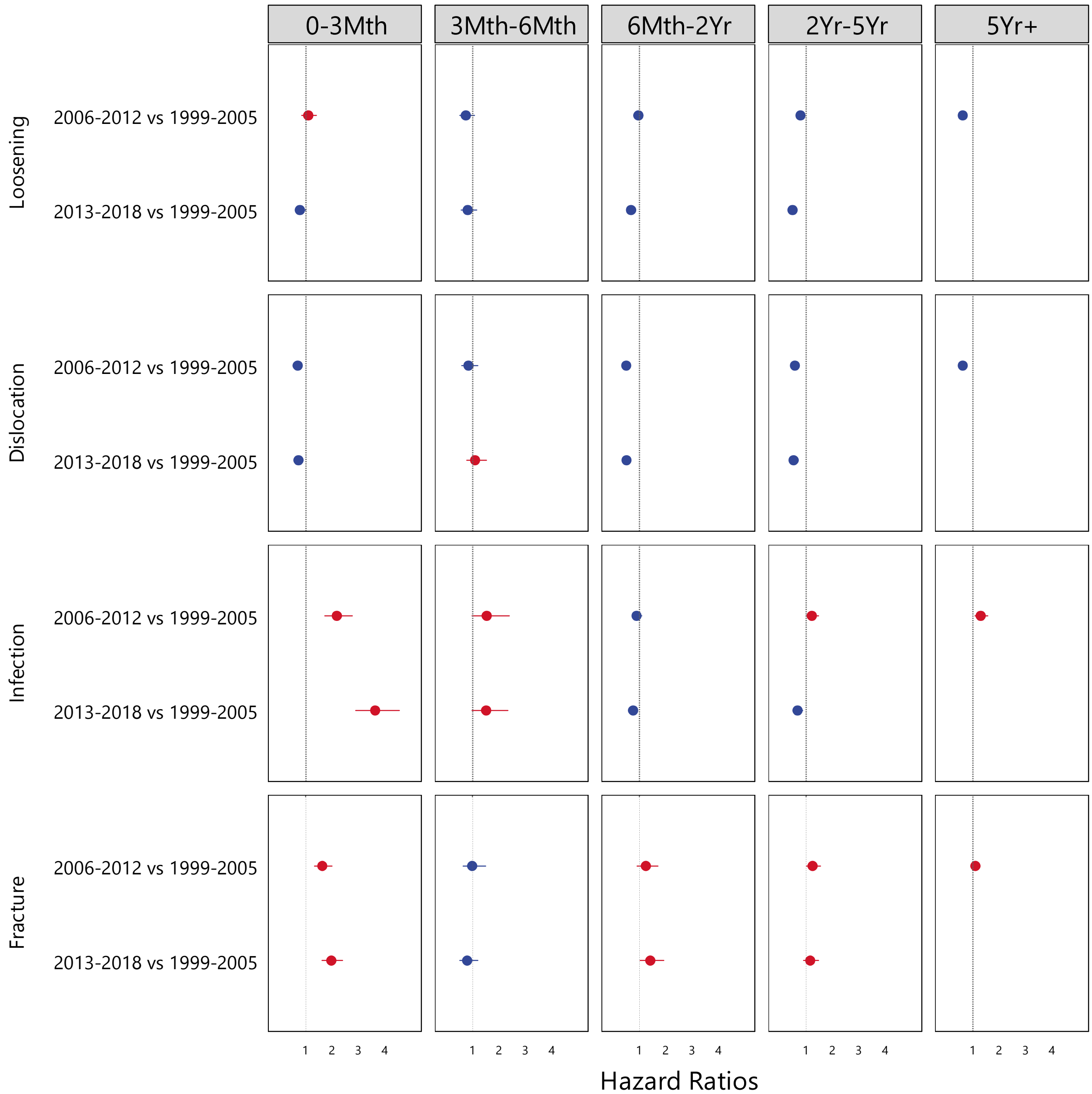
Table CPH9 Cumulative Percent Revision of All Remaining THR by Year of Implant (Primary Diagnosis OA)

Year of Implant	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs
				Loosening		
1999-2005	1558	70471	0.3 (0.2, 0.3)	0.6 (0.5, 0.7)	0.9 (0.8, 1.0)	1.8 (1.7, 1.9)
2006-2012	1241	129511	0.2 (0.2, 0.3)	0.5 (0.5, 0.5)	0.7 (0.6, 0.7)	1.1 (1.0, 1.2)
2013-2018	704	180722	0.2 (0.2, 0.3)	0.4 (0.4, 0.5)	0.6 (0.6, 0.7)	
TOTAL	**3503**	**380704**				
				Prosthesis Dislocation		
1999-2005	1070	70471	0.6 (0.5, 0.6)	0.9 (0.8, 0.9)	1.0 (0.9, 1.1)	1.4 (1.3, 1.5)
2006-2012	942	129511	0.4 (0.3, 0.4)	0.5 (0.5, 0.6)	0.6 (0.6, 0.6)	0.8 (0.8, 0.9)
2013-2018	918	180722	0.4 (0.4, 0.4)	0.6 (0.5, 0.6)	0.6 (0.6, 0.7)	
TOTAL	**2930**	**380704**				
				Infection		
1999-2005	545	70471	0.2 (0.2, 0.3)	0.4 (0.4, 0.4)	0.5 (0.4, 0.6)	0.7 (0.6, 0.8)
2006-2012	975	129511	0.4 (0.3, 0.4)	0.5 (0.5, 0.6)	0.6 (0.6, 0.7)	0.8 (0.8, 0.9)
2013-2018	1093	180722	0.5 (0.5, 0.5)	0.7 (0.6, 0.7)	0.7 (0.7, 0.8)	
TOTAL	**2613**	**380704**				
				Fracture		
1999-2005	889	70471	0.2 (0.2, 0.3)	0.3 (0.3, 0.4)	0.4 (0.4, 0.5)	0.9 (0.8, 1.0)
2006-2012	1138	129511	0.3 (0.3, 0.4)	0.4 (0.4, 0.5)	0.6 (0.5, 0.6)	1.1 (1.0, 1.1)
2013-2018	887	180722	0.4 (0.4, 0.4)	0.5 (0.5, 0.6)	0.6 (0.6, 0.7)	
TOTAL	**2914**	**380704**				

Table CPH10 Hazard Ratios of All Remaining THR by Year of Implant (Primary Diagnosis OA)

Year of Implant	0 - 3Mth	3Mth - 6Mth	6Mth - 2Yr	2Yr - 5Yr	5Yr+
			Loosening		
2013-2018 vs 2006-2012	0.83 (0.67, 1.02) p=0.077	1.08 (0.80, 1.46) p=0.614	0.89 (0.76, 1.04) p=0.133	0.88 (0.73, 1.06) p=0.178	
2013-2018 vs 1999-2005	0.82 (0.63, 1.07) p=0.151	0.91 (0.62, 1.33) p=0.633	0.75 (0.63, 0.91) p=0.002	0.55 (0.45, 0.66) p<0.001	
2006-2012 vs 1999-2005	1.05 (0.80, 1.37) p=0.742	0.81 (0.54, 1.21) p=0.305	0.84 (0.70, 1.00) p=0.055	0.63 (0.54, 0.73) p<0.001	0.54 (0.47, 0.61) p<0.001
			Prosthesis Dislocation		
2013-2018 vs 2006-2012	1.10 (0.96, 1.25) p=0.166	1.48 (1.13, 1.94) p=0.004	0.97 (0.81, 1.17) p=0.740	0.96 (0.75, 1.23) p=0.747	
2013-2018 vs 1999-2005	0.73 (0.63, 0.85) p<0.001	1.06 (0.75, 1.51) p=0.726	0.50 (0.42, 0.61) p<0.001	0.54 (0.42, 0.69) p<0.001	
2006-2012 vs 1999-2005	0.68 (0.58, 0.80) p<0.001	0.78 (0.53, 1.14) p=0.202	0.49 (0.40, 0.60) p<0.001	0.56 (0.45, 0.69) p<0.001	0.59 (0.48, 0.71) p<0.001
			Infection		
2013-2018 vs 2006-2012	1.72 (1.51, 1.95) p<0.001	1.02 (0.75, 1.37) p=0.919	0.88 (0.73, 1.06) p=0.166	0.70 (0.55, 0.89) p=0.003	
2013-2018 vs 1999-2005	3.65 (2.89, 4.62) p<0.001	1.43 (0.93, 2.22) p=0.106	0.83 (0.66, 1.04) p=0.107	0.74 (0.57, 0.98) p=0.032	
2006-2012 vs 1999-2005	2.29 (1.79, 2.94) p<0.001	1.34 (0.85, 2.11) p=0.209	0.86 (0.68, 1.07) p=0.178	1.07 (0.86, 1.34) p=0.538	0.99 (0.79, 1.24) p=0.932
			Fracture		
2013-2018 vs 2006-2012	1.36 (1.18, 1.56) p<0.001	0.69 (0.49, 0.96) p=0.028	1.08 (0.86, 1.37) p=0.503	0.98 (0.79, 1.21) p=0.851	
2013-2018 vs 1999-2005	1.99 (1.62, 2.45) p<0.001	0.76 (0.49, 1.17) p=0.206	1.52 (1.09, 2.11) p=0.012	1.14 (0.89, 1.46) p=0.303	
2006-2012 vs 1999-2005	1.50 (1.20, 1.86) p<0.001	0.99 (0.64, 1.52) p=0.947	1.41 (1.00, 1.97) p=0.046	1.17 (0.93, 1.46) p=0.181	1.08 (0.93, 1.24) p=0.311

Figure CPH8 Funnel Plot of Hazard Ratios of All Remaining THR by Year of Implant (Primary Diagnosis OA)



Note: The circle represents the hazard ratio and the horizontal line that runs through the circle represents the lower to upper 95% confidence intervals. The dashed vertical line represents the line of no effect. The distance between the vertical dashed line and the circle indicates the extent of change. A red circle indicates an increase in revision for the first of the time periods involved in the comparison.

The Registry has previously reported that particular prosthesis attributes have important effects on the different reasons for revision. It is known the use of ≥32mm femoral head sizes reduces revision for dislocation, XLPE is associated with reduced wear-related loosening, and cementless femoral stem fixation increases early femoral fracture, particularly in the elderly.

It remains unclear whether the identified decline in revision for dislocation and loosening and the increase in revision for fracture are solely due to changing prosthesis attribute use or if there are other factors also contributing.

An important principle used in the following analysis is that a standardised prosthesis construct used in the same patient population will have the same outcome over time. If there is a change, then this may indicate that factors, other than the prosthesis and the patient, have contributed to that change.

The standardised construct chosen was a total conventional hip replacement using a combination of cementless femoral stem, cementless acetabular prosthesis, modern bearings (XLPE and mixed ceramic/ceramic) and femoral head size ≥32mm. This is the most common total conventional hip replacement construct currently used in Australia. Only procedures undertaken for OA were included. Hazard ratios were adjusted for age and gender.

To assess revision for dislocation using the standardised prothesis construct, an analysis was undertaken on three different groups. The CPRs for each group were calculated and compared for the three different time periods (1999-2005, 2006-2012, and 2013-2018).

The first was the standardised construct including all femoral head sizes. This was necessary to determine if the changing rate of revision for dislocation differed, from the previously observed changes in the 'all remaining THR' class. Any difference may indicate that prosthesis factors other than femoral head size are also contributing to the change. The two remaining groups were the standardised construct using different femoral head sizes ≥32mm and <32mm.

The previously observed reduction in revision for dislocation comparing 2006-2012 to 1999-2005 is still apparent and the extent of the change is similar to that previously observed for 'all remaining THR' class.

For procedures using <32mm femoral heads, the CPR for dislocation is increased compared to ≥32 mm femoral heads.

Reduction in revision for disclocation is largely due to an increased use of ≥32mm femoral heads.

The reduction in revision for dislocation for procedures using ≥32mm is at least 50% compared to <32mm head sizes (Table CPH11). There is no change in the risk of revision for dislocation for either <32mm and ≥32mm femoral head sizes when the three time periods are compared (Table PH12).

This data strongly suggests that the reduction in revision for dislocation over the last 20 years is largely due to the increasing use of ≥32mm femoral heads and that other factors have not significantly contributed to that reduction.

Table CPH11 Cumulative Percent Revision of Total Conventional Hip Replacement with Modern Bearings, Cementless Acetabular and Cementless Femoral Fixation (Primary Diagnosis OA, Revision for Prosthesis Dislocation)

Year of Implant	N Revised	N Total	1 Y	3 Yrs	5 Yrs	10 Yrs
				All Head Sizes		
1999-2005	191	12684	0.5 (0.4, 0.6)	0.7 (0.6, 0.9)	0.9 (0.8, 1.1)	1.3 (1.2, 1.6)
2006-2012	460	65713	0.4 (0.3, 0.4)	0.5 (0.5, 0.6)	0.6 (0.5, 0.6)	0.8 (0.7, 0.9)
2013-2018	574	113698	0.4 (0.4, 0.4)	0.5 (0.5, 0.6)	0.6 (0.6, 0.7)	
TOTAL	**1225**	**192095**				
				<32mm Head Sizes Only		
1999-2005	158	8458	0.6 (0.4, 0.8)	0.8 (0.7, 1.1)	1.1 (0.9, 1.3)	1.6 (1.4, 1.9)
2006-2012	131	8633	0.8 (0.6, 1.0)	1.1 (0.9, 1.3)	1.2 (1.0, 1.5)	1.7 (1.4, 2.0)
2013-2018	60	5559	0.9 (0.7, 1.2)	1.2 (0.9, 1.5)	1.3 (1.0, 1.6)	
TOTAL	**349**	**22650**				
				≥32mm Head Sizes Only		
1999-2005	33	4226	0.3 (0.2, 0.6)	0.5 (0.3, 0.8)	0.6 (0.4, 0.8)	0.8 (0.6, 1.1)
2006-2012	329	57080	0.3 (0.3, 0.4)	0.4 (0.4, 0.5)	0.5 (0.4, 0.5)	0.6 (0.6, 0.7)
2013-2018	514	108139	0.4 (0.3, 0.4)	0.5 (0.5, 0.6)	0.6 (0.5, 0.7)	
TOTAL	**876**	**169445**				

Table CPH12 Hazard Ratios of Total Conventional Hip Replacement with Modern Bearings, Cementless Acetabular and Cementless Femoral Fixation (Primary Diagnosis OA, Revision for Prosthesis Dislocation)

Year of Implant	0 - 3Mth	3Mth - 6Mth	6Mth - 2Yr	2Yr - 5Yr	5Yr+
			All Head Sizes		
2013-2018 vs 2006-2012	1.12 (0.94, 1.35) p=0.201	1.35 (0.94, 1.96) p=0.108	1.14 (0.89, 1.47) p=0.297	0.97 (0.71, 1.33) p=0.866	
2013-2018 vs 1999-2005	0.78 (0.57, 1.07) p=0.125	1.14 (0.55, 2.37) p=0.718	0.85 (0.54, 1.32) p=0.457	0.44 (0.30, 0.66) p<0.001	
2006-2012 vs 1999-2005	0.73 (0.52, 1.01) p=0.055	0.92 (0.43, 1.98) p=0.833	0.78 (0.50, 1.23) p=0.291	0.40 (0.27, 0.59) p<0.001	0.51 (0.36, 0.71) p<0.001
			<32mm Head Sizes Only		
2013-2018 vs 2006-2012	1.29 (0.84, 1.97) p=0.242	2.15 (0.96, 4.83) p=0.063	0.88 (0.45, 1.72) p=0.718	0.74 (0.32, 1.73) p=0.487	
2013-2018 vs 1999-2005	1.42 (0.88, 2.30) p=0.152	2.24 (0.85, 5.91) p=0.101	1.12 (0.53, 2.39) p=0.760	0.62 (0.26, 1.48) p=0.282	
2006-2012 vs 1999-2005	1.21 (0.77, 1.89) p=0.416	1.09 (0.40, 3.02) p=0.864	1.53 (0.85, 2.77) p=0.153	0.68 (0.39, 1.19) p=0.175	0.80 (0.50, 1.25) p=0.324
			≥32mm Head Sizes Only		
2013-2018 vs 2006-2012	1.18 (0.96, 1.45) p=0.125	1.30 (0.85, 2.00) p=0.226	1.33 (0.99, 1.79) p=0.061	1.26 (0.87, 1.81) p=0.224	
2013-2018 vs 1999-2005	1.01 (0.55, 1.84) p=0.982	2.79 (0.39, 20.0) p=0.308	1.26 (0.52, 3.08) p=0.611	0.85 (0.40, 1.79) p=0.667	
2006-2012 vs 1999-2005	0.85 (0.46, 1.58) p=0.615	2.25 (0.31, 16.4) p=0.425	0.96 (0.38, 2.37) p=0.922	0.64 (0.30, 1.38) p=0.260	0.88 (0.45, 1.73) p=0.704

Note: HRs Adjusted for Age and Gender

The effect of femoral fixation on aseptic loosening was assessed. Aseptic loosening may occur as a result of not achieving adequate initial fixation or it may be wear-related. Loosening related to wear occurs later than failure to gain fixation. To assess if the decline in revision for loosening was due to changes in femoral fixation, cementless and cemented femoral fixation were compared. Only procedures that used cementless acetabular prostheses, modern bearings and ≥32mm femoral head sizes undertaken for OA were included. Hazard ratios were adjusted for age and gender.

Cementless femoral stems, when all other prosthesis factors are controlled for, have a higher rate of revision for loosening compared to cemented femoral stems. The risk of revision for loosening with cementless stem use, did not change when the three time periods were compared. This was also true for loosening associated with cemented stems and also all stem fixation.

Cementless femoral stem fixation is associated with an increased risk of early loosening.

Revision for loosening for the 'all remaining THR' class has declined. The increased use of cementless femoral stems has not contributed to this decline. Rather, cementless femoral stems are associated with an increased risk of revision for loosening, and that loosening has occurred prior to 10 years (Table CPH13 and Table CPH14).

Table CPH13 Cumulative Percent Revision of Total Conventional Hip Replacement with Modern Bearings, Cementless Acetabular and Head Sizes ≥32mm (Primary Diagnosis OA, Revision for Loosening)

Year of Implant	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs
			All Femoral Fixation			
1999-2005	62	6372	0.3 (0.2, 0.4)	0.5 (0.3, 0.7)	0.6 (0.4, 0.8)	1.0 (0.8, 1.3)
2006-2012	743	83855	0.2 (0.2, 0.3)	0.5 (0.5, 0.6)	0.7 (0.6, 0.7)	1.0 (1.0, 1.1)
2013-2018	603	157004	0.2 (0.2, 0.3)	0.4 (0.4, 0.5)	0.6 (0.5, 0.7)	
TOTAL	**1408**	**247231**				
			Cemented Femoral Fixation Only			
1999-2005	21	2146	0.2 (0.1, 0.5)	0.3 (0.2, 0.7)	0.4 (0.2, 0.9)	1.1 (0.7, 1.8)
2006-2012	127	26775	0.1 (0.1, 0.2)	0.2 (0.2, 0.3)	0.3 (0.3, 0.4)	0.6 (0.5, 0.7)
2013-2018	88	48865	0.1 (0.1, 0.2)	0.2 (0.2, 0.3)	0.3 (0.2, 0.3)	
TOTAL	**236**	**77786**				
			Cementless Femoral Fixation Only			
1999-2005	41	4226	0.3 (0.2, 0.5)	0.6 (0.4, 0.8)	0.7 (0.5, 1.0)	0.9 (0.7, 1.3)
2006-2012	616	57080	0.3 (0.3, 0.4)	0.6 (0.6, 0.7)	0.8 (0.7, 0.9)	1.2 (1.1, 1.3)
2013-2018	515	108139	0.3 (0.3, 0.3)	0.5 (0.5, 0.6)	0.8 (0.7, 0.8)	
TOTAL	**1172**	**169445**				

Table CPH14 Hazard Ratios of Total Conventional Hip Replacement with Modern Bearings, Cementless Acetabular and Head Sizes ≥32mm (Primary Diagnosis OA, Revision for Loosening)

Year of Implant	0 - 3Mth	3Mth - 6Mth	6Mth - 2Yr	2Yr - 5Yr	5Yr+
			All Femoral Fixation		
2013-2018 vs 2006-2012	0.72 (0.57, 0.93) p=0.011	1.01 (0.70, 1.46) p=0.948	0.90 (0.74, 1.08) p=0.251	0.86 (0.69, 1.06) p=0.156	
2013-2018 vs 1999-2005	0.51 (0.28, 0.94) p=0.031	0.79 (0.29, 2.15) p=0.639	1.22 (0.65, 2.30) p=0.537	1.08 (0.66, 1.78) p=0.747	
2006-2012 vs 1999-2005	0.68 (0.36, 1.26) p=0.217	0.75 (0.27, 2.11) p=0.590	1.38 (0.73, 2.60) p=0.324	1.28 (0.77, 2.11) p=0.338	1.24 (0.82, 1.87) p=0.306
			Cemented Femoral Fixation Only		
2013-2018 vs 2006-2012	0.76 (0.44, 1.31) p=0.327	1.55 (0.55, 4.41) p=0.410	0.92 (0.53, 1.59) p=0.762	0.60 (0.35, 1.05) p=0.071	
2013-2018 vs 1999-2005	0.42 (0.13, 1.38) p=0.153	0.53 (0.07, 4.11) p=0.546	1.51 (0.21, 11.1) p=0.684	0.45 (0.16, 1.21) p=0.111	
2006-2012 vs 1999-2005	0.54 (0.16, 1.82) p=0.323	0.31 (0.03, 2.77) p=0.295	1.77 (0.24, 13.1) p=0.575	0.78 (0.30, 2.03) p=0.604	0.49 (0.25, 0.96) p=0.037
			Cementless Femoral Fixation Only		
2013-2018 vs 2006-2012	0.72 (0.54, 0.95) p=0.020	0.95 (0.64, 1.40) p=0.780	0.89 (0.73, 1.08) p=0.244	0.91 (0.73, 1.15) p=0.453	
2013-2018 vs 1999-2005	0.55 (0.27, 1.13) p=0.102	0.87 (0.27, 2.78) p=0.820	1.19 (0.61, 2.31) p=0.613	1.51 (0.82, 2.76) p=0.183	
2006-2012 vs 1999-2005	0.73 (0.35, 1.51) p=0.399	0.90 (0.28, 2.92) p=0.862	1.33 (0.68, 2.61) p=0.399	1.64 (0.89, 3.03) p=0.114	1.90 (1.12, 3.24) p=0.017

Note: HRs Adjusted for Age and Gender

The same prosthesis construct was used to assess the effect of stem fixation on revision for fracture.

Cementless femoral stem fixation has a higher CPR for early fracture compared to cement fixation (Table CPH15). For the two time periods (1999-2005 and 2006-2012), the CPR for fracture with cementless stem use did not change. This was not the case in 2013-2018. For this period, the all femoral fixation group and cementless stems group had a higher rate of revision for fracture in the first 6 months compared to the other two time periods and to 2006-2012, respectively (Table CPH16). This indicates that there is another factor contributing to the increase in early fracture in addition to cementless stem fixation in 2013-2018. A possible candidate is the increased use of the anterior approach.

Cementless femoral stem fixation is associated with an increased risk of early fracture.

Table CPH15 Cumulative Percent Revision of Total Conventional Hip Replacement with Modern Bearings, Cementless Acetabular and Head Sizes ≥32mm (Primary Diagnosis OA, Revision for Fracture)

Year of Implant	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs
			All Femoral Fixation			
1999-2005	77	6372	0.3 (0.2, 0.5)	0.4 (0.3, 0.6)	0.6 (0.4, 0.8)	0.9 (0.7, 1.2)
2006-2012	723	83855	0.3 (0.3, 0.4)	0.5 (0.4, 0.5)	0.6 (0.5, 0.6)	1.1 (1.0, 1.2)
2013-2018	774	157004	0.4 (0.4, 0.4)	0.5 (0.5, 0.6)	0.6 (0.6, 0.7)	
TOTAL	**1574**	**247231**				
			Cemented Femoral Fixation Only			
1999-2005	24	2146	0.1 (0.0, 0.4)	0.3 (0.2, 0.7)	0.6 (0.4, 1.1)	1.0 (0.6, 1.6)
2006-2012	231	26775	0.2 (0.1, 0.2)	0.4 (0.3, 0.5)	0.6 (0.5, 0.7)	1.2 (1.0, 1.3)
2013-2018	203	48865	0.3 (0.2, 0.3)	0.5 (0.4, 0.5)	0.6 (0.5, 0.7)	
TOTAL	**458**	**77786**				
			Cementless Femoral Fixation Only			
1999-2005	53	4226	0.4 (0.2, 0.6)	0.5 (0.3, 0.7)	0.5 (0.4, 0.8)	0.9 (0.6, 1.2)
2006-2012	492	57080	0.4 (0.4, 0.5)	0.5 (0.4, 0.6)	0.6 (0.5, 0.7)	1.1 (1.0, 1.2)
2013-2018	571	108139	0.5 (0.4, 0.5)	0.6 (0.5, 0.6)	0.6 (0.6, 0.7)	
TOTAL	**1116**	**169445**				

Table CPH16 Hazard Ratios of Total Conventional Hip Replacement with Modern Bearings, Cementless Acetabular and Head Sizes ≥32mm (Primary Diagnosis OA, Revision for Fracture)

Year of Implant	0Mth - 6Mth	6Mth - 2Yr	2Yr - 5Yr	5Yr+
	All Femoral Fixation			
2013-2018 vs 2006-2012	1.24 (1.07, 1.44) p=0.004	1.06 (0.81, 1.38) p=0.678	0.97 (0.76, 1.24) p=0.813	
2013-2018 vs 1999-2005	1.67 (1.00, 2.79) p=0.049	1.08 (0.50, 2.31) p=0.844	1.03 (0.62, 1.71) p=0.922	
2006-2012 vs 1999-2005	1.36 (0.81, 2.29) p=0.248	1.01 (0.47, 2.18) p=0.984	1.03 (0.61, 1.73) p=0.909	1.24 (0.86, 1.79) p=0.249
	Cemented Femoral Fixation Only			
2013-2018 vs 2006-2012	1.40 (0.96, 2.06) p=0.084	1.19 (0.81, 1.75) p=0.380	1.08 (0.76, 1.53) p=0.659	
2013-2018 vs 1999-2005	4.15 (0.58, 29.66) p=0.156	1.00 (0.36, 2.73) p=0.993	1.09 (0.53, 2.26) p=0.816	
2006-2012 vs 1999-2005	3.10 (0.43, 22.48) p=0.263	0.82 (0.29, 2.29) p=0.700	1.00 (0.48, 2.09) p=0.992	1.07 (0.58, 1.95) p=0.835
	Cementless Femoral Fixation Only			
2013-2018 vs 2006-2012	1.21 (1.03, 1.42) p=0.023	0.96 (0.67, 1.40) p=0.847	0.90 (0.64, 1.26) p=0.528	
2013-2018 vs 1999-2005	1.48 (0.87, 2.51) p=0.150	1.22 (0.38, 3.89) p=0.733	0.97 (0.48, 1.99) p=0.944	
2006-2012 vs 1999-2005	1.22 (0.71, 2.10) p=0.464	1.27 (0.39, 4.08) p=0.689	1.05 (0.51, 2.17) p=0.885	1.34 (0.85, 2.11) p=0.213

Note: HRs Adjusted for Age and Gender

The effect of XLPE on revision for loosening was also assessed. XLPE and non XLPE bearings were compared using the prosthesis construct (cementless femoral stem, cementless acetabular component and femoral head size ≥32mm). The CPR for loosening is reduced by almost 50% at 10 years when XLPE is compared to non XLPE. The lower CPR associated with XLPE becomes evident at 5 years (Table CPH17).

CPR for loosening when either non XLPE or XLPE were used did not change when the three time periods were compared except for 0-3 months for XLPE used in 2013-2018 (Table CPH17 and Table CPH18).

XLPE is associated with a lower rate of late loosening.

Table CPH17 Cumulative Percent Revision of Total Conventional Hip Replacement with Cementless Acetabular and Cementless Femoral Fixation, All Head Sizes (Primary Diagnosis OA, Revision for Loosening)

Year of Implant	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs
				All Polyethylene		
1999-2005	351	19844	0.4 (0.3, 0.5)	0.7 (0.6, 0.8)	0.9 (0.7, 1.0)	1.5 (1.3, 1.7)
2006-2012	577	48870	0.4 (0.3, 0.4)	0.7 (0.6, 0.8)	0.9 (0.8, 1.0)	1.3 (1.2, 1.5)
2013-2018	387	84783	0.3 (0.3, 0.3)	0.5 (0.5, 0.6)	0.7 (0.6, 0.8)	
TOTAL	**1315**	**153497**				
				XLPE		
1999-2005	147	12203	0.4 (0.3, 0.5)	0.7 (0.5, 0.8)	0.8 (0.7, 1.0)	1.2 (1.0, 1.4)
2006-2012	531	46992	0.3 (0.3, 0.4)	0.7 (0.6, 0.8)	0.9 (0.8, 0.9)	1.3 (1.2, 1.4)
2013-2018	371	82669	0.3 (0.3, 0.3)	0.5 (0.5, 0.6)	0.7 (0.6, 0.8)	
TOTAL	**1049**	**141864**				
				Non XLPE		
1999-2005	204	7641	0.4 (0.2, 0.5)	0.7 (0.5, 0.9)	1.0 (0.8, 1.2)	2.0 (1.7, 2.3)
2006-2012	46	1878	0.6 (0.4, 1.1)	1.3 (0.8, 1.9)	1.5 (1.0, 2.2)	2.6 (1.9, 3.5)
2013-2018	16	2114	0.5 (0.2, 0.9)	0.8 (0.5, 1.5)	1.2 (0.6, 2.3)	
TOTAL	**266**	**11633**				

Table CPH18 Hazard Ratios of Total Conventional Hip Replacement with Cementless Acetabular, Cementless Femoral and All Head Sizes (Primary Diagnosis OA, Revision for Loosening)

Year of Implant	0 - 3Mth	3Mth - 6Mth	6Mth - 2Yr	2Yr - 5Yr	5Yr+
			All Polyethylene		
2013-2018 vs 2006-2012	0.67 (0.51, 0.88) p=0.003	0.98 (0.65, 1.46) p=0.908	0.80 (0.65, 0.99) p=0.036	0.84 (0.65, 1.10) p=0.201	
2013-2018 vs 1999-2005	0.64 (0.43, 0.94) p=0.023	0.91 (0.50, 1.65) p=0.760	0.77 (0.57, 1.03) p=0.075	0.93 (0.66, 1.29) p=0.647	
2006-2012 vs 1999-2005	0.97 (0.65, 1.43) p=0.859	0.93 (0.50, 1.74) p=0.820	0.97 (0.72, 1.30) p=0.822	1.20 (0.88, 1.63) p=0.242	0.80 (0.63, 1.01) p=0.058
			XLPE		
2013-2018 vs 2006-2012	0.64 (0.48, 0.85) p=0.002	1.01 (0.66, 1.55) p=0.963	0.77 (0.62, 0.96) p=0.017	0.82 (0.62, 1.08) p=0.155	
2013-2018 vs 1999-2005	0.59 (0.37, 0.93) p=0.023	0.99 (0.47, 2.08) p=0.975	0.75 (0.53, 1.07) p=0.114	1.23 (0.80, 1.89) p=0.344	
2006-2012 vs 1999-2005	0.87 (0.55, 1.38) p=0.554	0.94 (0.43, 2.06) p=0.879	0.94 (0.66, 1.34) p=0.747	1.61 (1.06, 2.44) p=0.025	1.27 (0.91, 1.77) p=0.154
			Non XLPE		
2013-2018 vs 2006-2012	0.73 (0.24, 2.21) p=0.574	0.39 (0.05, 3.13) p=0.375	0.81 (0.33, 2.00) p=0.644	1.30 (0.49, 3.43) p=0.595	
2013-2018 vs 1999-2005	1.17 (0.38, 3.63) p=0.787	0.63 (0.08, 5.21) p=0.666	1.16 (0.47, 2.83) p=0.752	1.90 (0.73, 4.92) p=0.188	
2006-2012 vs 1999-2005	2.18 (0.82, 5.82) p=0.118	2.19 (0.55, 8.76) p=0.267	1.46 (0.66, 3.26) p=0.352	1.61 (0.78, 3.32) p=0.197	1.16 (0.70, 1.90) p=0.566

Note: HRs Adjusted for Age and Gender

OTHER FACTORS

There are other factors that may contribute to variation in all-cause revision and revision for specific reasons. Examples include surgeon and operative factors as well as device-specific use within class. For this 20 year overview, the Registry has not attempted to analyse these factors for a number of reasons. There are complex interactions between many of these factors, consequently isolating factor-specific effects is difficult. The comparison over time further compounds the complexity of the analysis. There are also limitations in data availability. Many surgeons are not linked to individual procedures prior to 2008, so it is not possible to adjust for surgeon factors prior to that time. Some novel implantation techniques have only been used in later years and their use remains limited. Data on surgical approach has only been collected since 2015.

HIP SUMMARY

There has been a change in primary hip revision rates since the Registry first collected data. The highest revision rate occurred in the 2006-2012 period. This was due to the use of a number of different classes of hip replacement: LH metal/metal, total hip resurfacing and exchangeable neck prostheses. When these were removed from the analysis, there was no difference after 6 months when 2006-2012 was compared to 2013-2018. Patient factors had no impact on the comparative revision rates across the three time periods.

A number of prosthesis factors had major effects on revision rates. Increasing use of cementless fixation in addition to one or more other unidentified factors increased revision for early loosening and femoral fracture. The increasing use of ≥32mm head sizes reduced revision for dislocation. The increasing use of XLPE reduced revision for late loosening. These effects were most apparent in the 2006-2012 period. It can be anticipated that the continued increase in use of both ≥32mm head sizes and XLPE will result in further reductions in revision risk.

A potential important issue that has been identified is the increase in early revision for infection. Further analysis of this is beyond the scope of this chapter but is clearly an issue that needs to be further evaluated.

PRIMARY KNEE REPLACEMENT

A similar analysis was undertaken for primary knee replacement. The same three time periods were compared (1999-2005, 2006-2012, and 2013-2018). Survival analysis was undertaken to determine unadjusted all-cause revision irrespective of class. This assessment was undertaken to determine change in the national revision rate over time for all primary knee replacement.

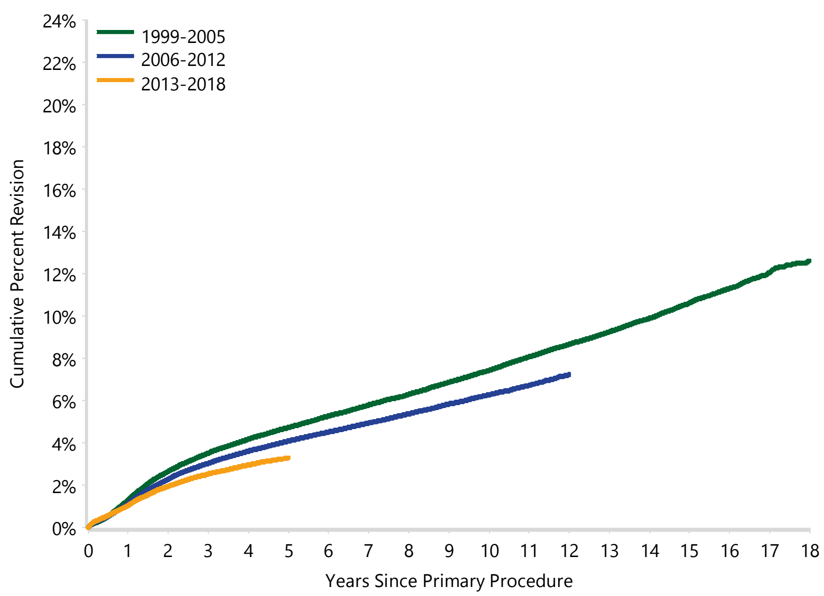
Apart from the first 6 months, the CPR for procedures undertaken in each of the three time periods successively decreased. In the first 3 months, it successively increased (Table CPK1 and Figure CPK1).

Knee Replacement revision decreased with time, apart from the first 6 months after surgery.

Table CPK1 Cumulative Percent Revision of Primary Knee Replacement by Year of Implant (Partial and Total, All Diagnoses)

Year of Implant	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
1999-2005	11585	127769	1.3 (1.3, 1.4)	3.5 (3.4, 3.6)	4.7 (4.6, 4.9)	7.4 (7.3, 7.6)	10.6 (10.4, 10.8)	12.6 (12.3, 12.9)
2006-2012	14965	266864	1.1 (1.1, 1.2)	3.0 (3.0, 3.1)	4.1 (4.0, 4.2)	6.3 (6.2, 6.4)		
2013-2018	7121	324968	1.0 (1.0, 1.1)	2.5 (2.5, 2.6)	3.3 (3.2, 3.4)			
TOTAL	**33671**	**719601**						

Figure CPK1 Cumulative Percent Revision of Primary Knee Replacement by Year of Implant (Partial and Total, All Diagnoses)



2013-2018 vs 2006-2012
0 - 3Mth: HR=1.25 (1.15, 1.35),p<0.001
3Mth - 6Mth: HR=0.97 (0.88, 1.08),p=0.567
6Mth - 2Yr: HR=0.78 (0.75, 0.81),p<0.001
2Yr+: HR=0.77 (0.73, 0.81),p<0.001

2013-2018 vs 1999-2005
0 - 3Mth: HR=1.31 (1.16, 1.48),p<0.001
3Mth - 6Mth: HR=0.84 (0.73, 0.96),p=0.011
6Mth - 2Yr: HR=0.64 (0.61, 0.68),p<0.001
2Yr+: HR=0.66 (0.62, 0.70),p<0.001

2006-2012 vs 1999-2005
0 - 3Mth: HR=1.17 (1.03, 1.32),p=0.012
3Mth - 6Mth: HR=0.88 (0.77, 1.01),p=0.069
6Mth - 2Yr: HR=0.81 (0.78, 0.85),p<0.001
2Yr - 5Yr: HR=0.87 (0.83, 0.91),p<0.001
5Yr+: HR=0.79 (0.76, 0.83),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
1999-2005	127769	124695	118186	111485	89778	34436	1874
2006-2012	266864	261824	250583	238835	73615	0	0
2013-2018	324968	260846	142537	42466	0	0	0

FACTORS AFFECTING REVISION RATE

To understand the variation in revision it is necessary to know how practice has changed and assess the contribution of that change on revision for each time period.

The factors considered were class of primary knee replacement, patient factors and specific prosthesis characteristics.

KNEE REPLACEMENT CLASS

There are a number of different classes of partial and total knee replacement. These are known to have different revision rates and varied use with time.

Five different classes were considered (two partial and three total replacement classes). They were: partial knee replacement other than unicompartmental, unicompartmental knee replacement, complex primary TKR (which included fully stabilised (FS) and hinged total knee prostheses), posterior stabilised (PS) total knee replacement and minimally stabilised (MS) total knee replacement. Medial pivot TKR was not included as a separate class as they have only been used in a small proportion of procedures and most often since 2013.

The proportional use of each class is presented for the three time periods, as well as annually. The use of two classes (partial knee other than unicompartmental, and complex primary TKR) did not exceed 1% at any time.

Unicompartmental knee replacement declined in use for each time period and annually from a peak of 16.5% in 2002 to 4.5% in 2013.

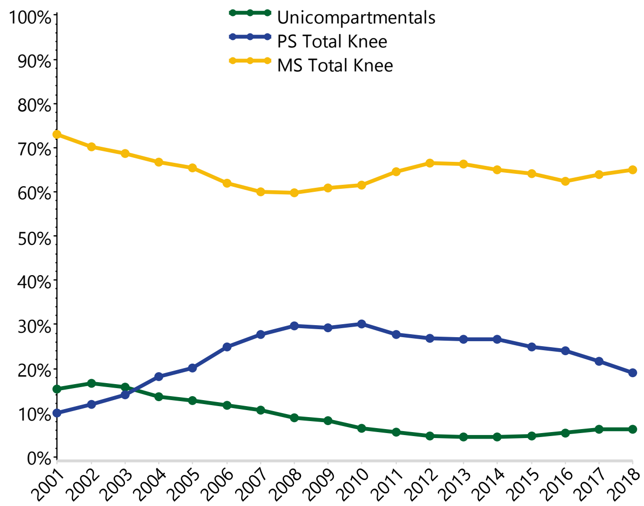
MS total knee replacement was the most used primary knee class. In 2001, it accounted for 73.1% of all primary knee replacement, declining to 59.8% in 2008 with a subsequent increase in use since that time. From an initial low of 9.8% in 2001, PS total knee replacement increased in use to 30.1% in 2010. Its use has declined since then (Table CPK2 and Figure CPK2).

Table CPK2 Primary Knee Replacement by Knee Class (All Diagnoses)

Knee Class	1999-2005 %	2006-2012 %	2013-2018 %	Entire Period %
Partial	0.6%	0.7%	0.5%	0.6%
Unicompartmental	14.5%	7.7%	5.4%	7.9%
Complex Total Knee	0.3%	0.5%	0.8%	0.6%
PS Total Knee	15.3%	28.0%	23.6%	23.8%
MS Total Knee	68.6%	62.4%	64.4%	64.4%

Note: partial knee replacement exclude unicompartmental knee replacements as these are analysed as a separate class

Figure CPK2 Primary Knee Replacement by Knee Class (All Diagnoses)



These classes are known to have different risks of revision. It is also known that they may be selectively used in specific patient populations which vary with respect to age, gender, comorbidities and primary diagnosis.

The approach taken to assess the effect of the changing use of the different knee classes on the CPR for primary knee procedures was the same as previously reported for the hip class analysis. Patient selection was not considered. Classes were sequentially removed and the change in all-cause CPR was re-assessed. This was done for each of the three time periods. The analysis was not adjusted or stratified for other factors. The data is presented in the same way as the hip class analysis.

Removal of all classes other than unicompartmental partial knee replacement had little effect on the CPR for each of the three time periods. Removal of unicompartmental knee replacement resulted in the largest CPR reduction. This was greatest for the two earlier time periods. In 1999-2005, the 5 and 10 year CPRs declined by 0.7% and 1.4% and in 2006-2012 the decline was 0.3% and 0.7%.

Removal of the complex primary TKR class which also included medial pivot knees, had little effect on the CPR for each time period. Removal of PS total knee replacement was associated with a small reduction in CPRs in all periods but to a greater extent in 2006-2012.

The CPR declined for each successive period for the remaining MS total knee replacement class. This indicates that a within-class improvement has occurred with time for at least this class (Table CPK3, Table CPK4 and Figure CPK3).

The progressive increase in early revision (0-3 months) identified in the all primary knee analysis did not change with the sequential removal of the different classes of primary knee replacement, indicating that this difference was independent of class (Table CPK4 and Figure CPK3).

The proportional contribution of each class to the revisions that occurred within 5 and 10 years of the primary procedure for each year were also calculated. Knee revisions due to unicompartmental knee decreased but was at least twice the proportional use of that class. The proportion of revisions due to MS TKR was always less than its proportional use for each year (Figure CPK4).

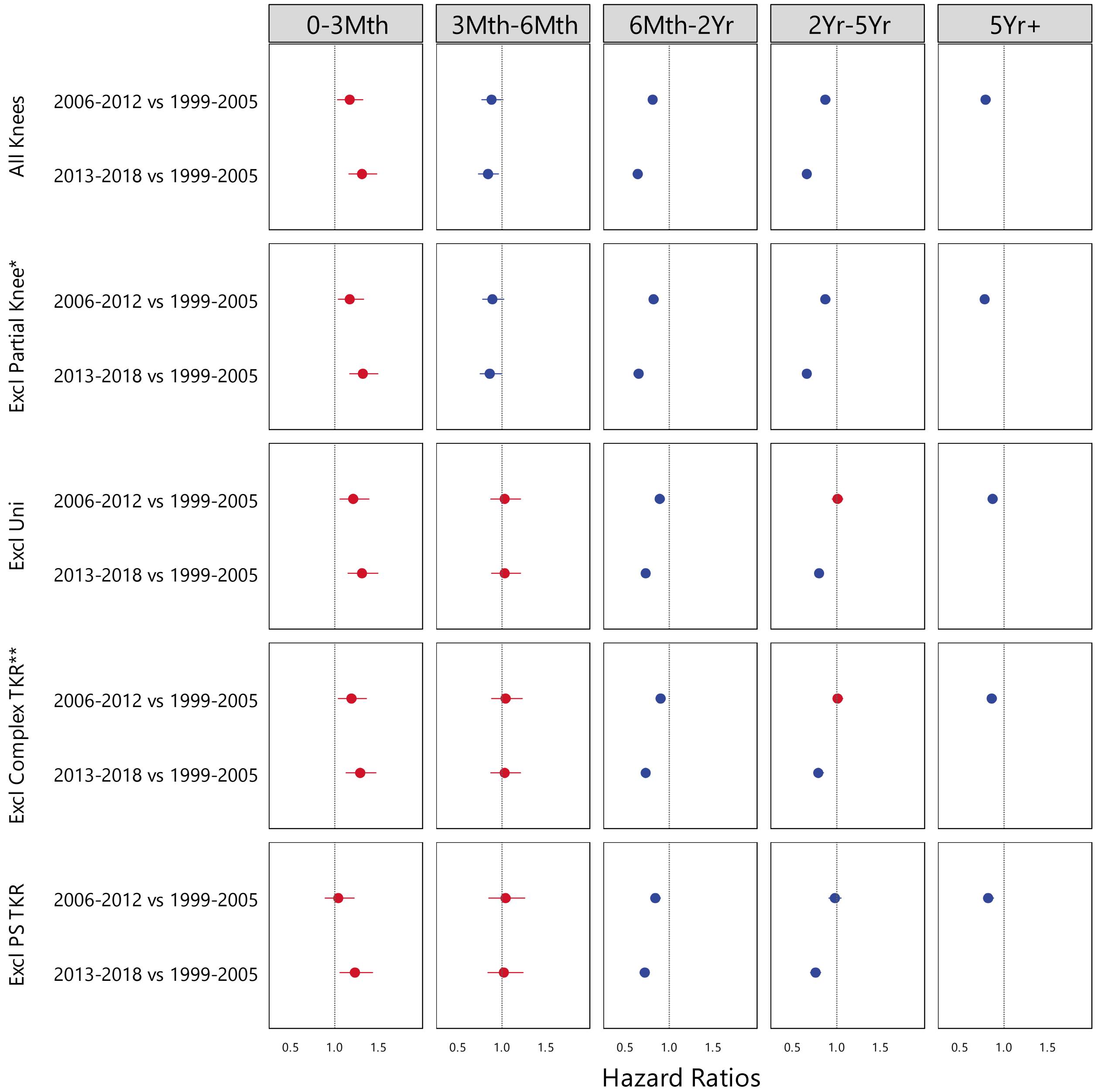
Table CPK3 Cumulative Percent Revision of All Primary Knee Replacement with Sequential Removal of Partial other than Unicompartmental, Unicompartmental, Complex Total Knees and PS Knees (All Diagnoses)

Year of Implant	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs
	All Primary Knee Replacement					
1999-2005	11585	127769	1.3 (1.3, 1.4)	3.5 (3.4, 3.6)	4.7 (4.6, 4.9)	7.4 (7.3, 7.6)
2006-2012	14965	266864	1.1 (1.1, 1.2)	3.0 (3.0, 3.1)	4.1 (4.0, 4.2)	6.3 (6.2, 6.4)
2013-2018	7121	324968	1.0 (1.0, 1.1)	2.5 (2.5, 2.6)	3.3 (3.2, 3.4)	
TOTAL	**33671**	**719601**				
	Primary Unicompartmental and Total Knee (excluding partial knee)					
1999-2005	11248	127027	1.3 (1.2, 1.4)	3.5 (3.4, 3.6)	4.6 (4.5, 4.8)	7.3 (7.1, 7.4)
2006-2012	14501	264961	1.1 (1.1, 1.2)	3.0 (2.9, 3.1)	4.0 (3.9, 4.1)	6.1 (6.0, 6.2)
2013-2018	7001	323236	1.0 (1.0, 1.1)	2.5 (2.4, 2.6)	3.3 (3.2, 3.3)	
TOTAL	**32750**	**715224**				
	Primary Total Knee Replacement (excluding Unicompartmental)					
1999-2005	7268	108456	1.1 (1.0, 1.1)	2.9 (2.8, 3.0)	3.9 (3.7, 4.0)	5.7 (5.6, 5.8)
2006-2012	11837	244346	1.1 (1.0, 1.1)	2.8 (2.7, 2.9)	3.7 (3.6, 3.8)	5.4 (5.3, 5.5)
2013-2018	6370	305794	1.0 (1.0, 1.0)	2.4 (2.3, 2.5)	3.1 (3.0, 3.2)	
TOTAL	**25475**	**658596**				
	MS and PS Total Knee Replacement (excluding Complex TKR and MP TKR)					
1999-2005	7144	107231	1.1 (1.0, 1.1)	2.9 (2.8, 3.0)	3.8 (3.7, 3.9)	5.6 (5.5, 5.8)
2006-2012	11639	241346	1.0 (1.0, 1.1)	2.8 (2.7, 2.8)	3.7 (3.6, 3.8)	5.4 (5.3, 5.5)
2013-2018	5918	285873	1.0 (0.9, 1.0)	2.4 (2.3, 2.4)	3.1 (3.0, 3.2)	
TOTAL	**24701**	**634450**				
	MS Total Knee Replacement (excluding PS TKR)					
1999-2005	5744	87652	1.0 (1.0, 1.1)	2.8 (2.7, 2.9)	3.7 (3.6, 3.9)	5.5 (5.3, 5.6)
2006-2012	7416	166533	0.9 (0.9, 1.0)	2.6 (2.5, 2.6)	3.4 (3.3, 3.5)	4.9 (4.8, 5.1)
2013-2018	4057	209267	0.9 (0.9, 0.9)	2.3 (2.2, 2.3)	2.9 (2.8, 3.0)	
TOTAL	**17217**	**463452**				

Table CPK4 Cumulative Percent Revision of All Primary Knee Replacement with Sequential Removal of Partial other than Unicompartmental, Unicompartmental, Complex Total Knees and PS knees (All Diagnoses)

Year of Implant	0 - 3Mth	3Mth - 6Mth	6Mth - 2Yr	2Yr - 5Yr	5Yr+
	All Primary Knee Replacement				
2013-2018 vs 2006-2012	1.23 (1.13, 1.34) p<0.001	0.96 (0.86, 1.06) p=0.434	0.78 (0.75, 0.81) p<0.001	0.77 (0.73, 0.81) p<0.001	
2013-2018 vs 1999-2005	1.31 (1.16, 1.48) p<0.001	0.84 (0.73, 0.96) p=0.011	0.64 (0.61, 0.68) p<0.001	0.66 (0.62, 0.70) p<0.001	
2006-2012 vs 1999-2005	1.17 (1.03, 1.32) p=0.012	0.88 (0.77, 1.01) p=0.069	0.81 (0.78, 0.85) p<0.001	0.87 (0.83, 0.91) p<0.001	0.79 (0.76, 0.83) p<0.001
	Primary Unicompartmental and Total Knee (excluding partial knee)				
2013-2018 vs 2006-2012	1.24 (1.14, 1.34) p<0.001	0.97 (0.88, 1.08) p=0.626	0.78 (0.75, 0.82) p<0.001	0.78 (0.74, 0.82) p<0.001	
2013-2018 vs 1999-2005	1.32 (1.17, 1.49) p<0.001	0.86 (0.75, 0.99) p=0.032	0.65 (0.61, 0.68) p<0.001	0.66 (0.62, 0.70) p<0.001	
2006-2012 vs 1999-2005	1.17 (1.04, 1.33) p=0.011	0.89 (0.78, 1.02) p=0.101	0.82 (0.78, 0.86) p<0.001	0.87 (0.83, 0.91) p<0.001	0.78 (0.75, 0.82) p<0.001
	Primary Total Knee Replacement (excluding Unicompartmental)				
2013-2018 vs 2006-2012	1.15 (1.06, 1.26) p=0.001	1.02 (0.91, 1.14) p=0.737	0.81 (0.77, 0.84) p<0.001	0.82 (0.77, 0.87) p<0.001	
2013-2018 vs 1999-2005	1.31 (1.15, 1.49) p<0.001	1.03 (0.88, 1.21) p=0.725	0.73 (0.69, 0.78) p<0.001	0.80 (0.75, 0.85) p<0.001	
2006-2012 vs 1999-2005	1.21 (1.06, 1.39) p=0.004	1.03 (0.87, 1.21) p=0.747	0.89 (0.84, 0.94) p<0.001	1.01 (0.95, 1.07) p=0.805	0.87 (0.82, 0.91) p<0.001
	MS and PS Total Knee Replacement (excluding Complex TKR and MP TKR)				
2013-2018 vs 2006-2012	1.15 (1.05, 1.26) p=0.002	1.01 (0.90, 1.13) p=0.888	0.80 (0.76, 0.83) p<0.001	0.81 (0.76, 0.86) p<0.001	
2013-2018 vs 1999-2005	1.29 (1.13, 1.47) p<0.001	1.03 (0.87, 1.21) p=0.732	0.73 (0.69, 0.77) p<0.001	0.79 (0.74, 0.85) p<0.001	
2006-2012 vs 1999-2005	1.19 (1.04, 1.36) p=0.013	1.04 (0.88, 1.23) p=0.617	0.90 (0.85, 0.95) p<0.001	1.01 (0.96, 1.07) p=0.677	0.86 (0.82, 0.91) p<0.001
	MS Total Knee Replacement (excluding PS TKR)				
2013-2018 vs 2006-2012	1.24 (1.11, 1.39) p<0.001	1.04 (0.90, 1.20) p=0.633	0.84 (0.79, 0.88) p<0.001	0.80 (0.75, 0.86) p<0.001	
2013-2018 vs 1999-2005	1.23 (1.06, 1.43) p=0.007	1.02 (0.84, 1.24) p=0.848	0.72 (0.67, 0.77) p<0.001	0.76 (0.70, 0.82) p<0.001	
2006-2012 vs 1999-2005	1.04 (0.89, 1.22) p=0.588	1.04 (0.85, 1.26) p=0.722	0.84 (0.79, 0.90) p<0.001	0.98 (0.91, 1.05) p=0.497	0.82 (0.77, 0.88) p<0.001

Figure CPK3 Forest Plot of Hazard Ratios of All Primary Knee Replacement with Sequential Removal of Partial other than Unicompartmental, Unicompartmental, Complex Total Knees and PS, and PS knees (All Diagnoses)

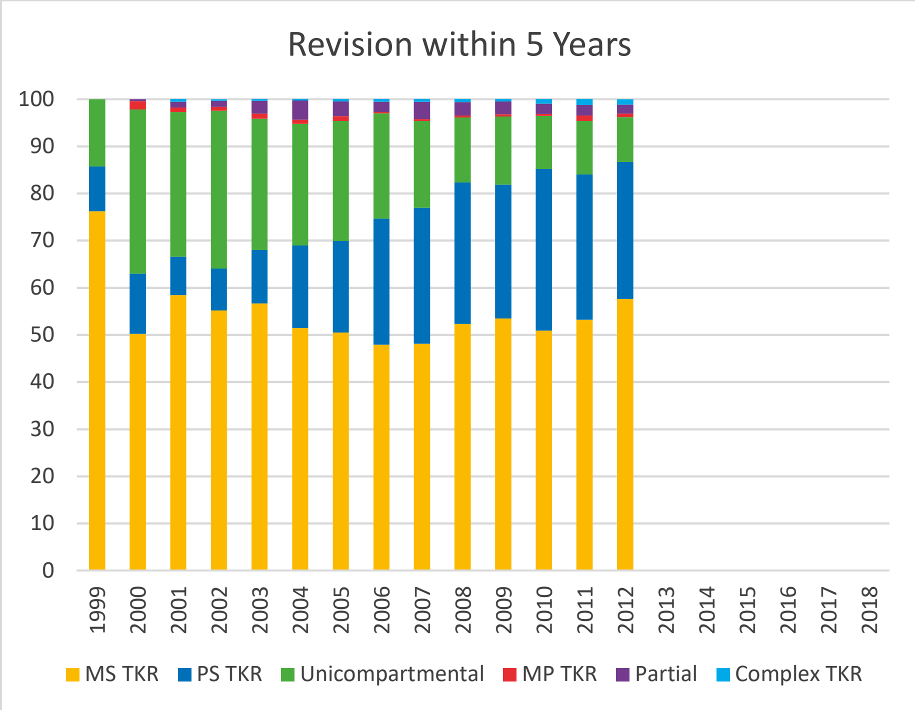


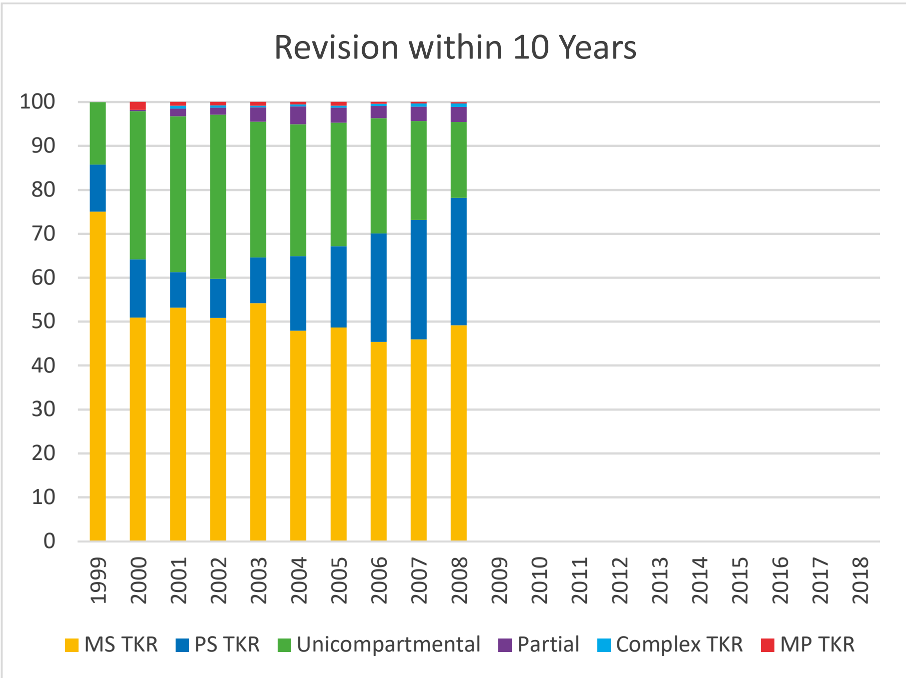
Note: The circle represents the hazard ratio and the horizontal line that runs through the circle represents the lower to upper 95% confidence intervals. The dashed vertical line represents the line of no effect. The distance between the vertical dashed line and the circle indicates the extent of change. A red circle indicates an increase in revision for the first of the time periods involved in the comparison.

*Partial other than Unicompartmental

**Excluding Complex TKR and MP TKR

Figure CPK4 Knee Class Contribution to Revision within 5 and 10-year Revision Rates by Year of Implant (All Diagnoses)





PATIENT FACTORS

Patient factors assessed were age, gender, primary diagnosis and comorbidity. The Registry has collected data on American Society of Anaesthesiologists - Physical Status Classification (ASA) score nationally from 2012 and Body Mass Index (BMI) data from 2015. Prior to this the Registry has a limited amount of data on both measures. This was also included for completeness.

The Rx-Risk comorbidity score was obtained through linkage of individual patient Registry data to the national Pharmaceutical Benefits Scheme (PBS). This data was available for the period 2003-2017.

Change in patient factors was assessed for the three time periods and annually for Rx-Risk. The analysis was limited to MS and PS primary total knee replacement.

There was minimal change in age, gender, and age within gender (Table CPK5). There were also no changes in ASA score or BMI although data for these measures was only available for more recent years (Table CPK5). Rx-Risk comorbidity score did not substantially change (Figure CPK5).

The majority of procedures were undertaken for OA (97.8%). Rheumatoid arthritis and osteonecrosis accounted for most of the remaining procedures. The proportion of procedures undertaken for rheumatoid arthritis decreased by over 50% between 1999–2005 and 2013-2018 (Table CPK7).

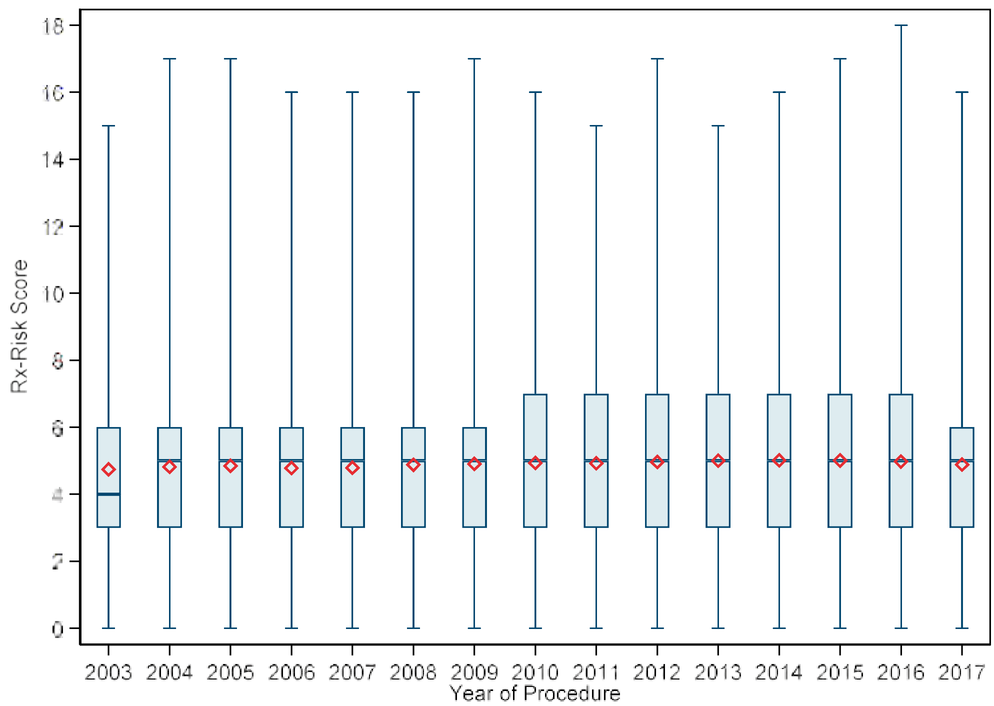
To assess if this change in diagnoses affected the CPRs, all diagnoses other than OA were removed from the analysis (Table CPK7 and Figure CPK6). The OA analysis was subsequently adjusted for age and gender which did not change the CPRs (Table CPK8).

There has been no appreciable change in patient age, gender or comorbidities.

Table CPK5 Demographics of Primary Total Knee Replacement by Year of Implant (MS and PS Only, All Diagnoses)

Year of Implant	Number	Male	Mean Age	Mean Age Males	Mean Age Females	Mean ASA	Mean BMI
1999-2005	107231	42.7%	69.40	68.9	69.8		
2006-2012	241346	43.1%	68.51	68.2	68.8	2.3	33.9
2013-2018	285873	44.0%	68.18	67.9	68.4	2.3	32.2

Figure CPK5 Distribution of Rx-Risk Comorbidity Index Scores for Patients Undergoing Primary Total Knee Replacement for Osteoarthritis, 2003-2017



Note: Limits represent maximum and minimum value of Rx-Risk Score
Diamonds represent mean Rx-Score

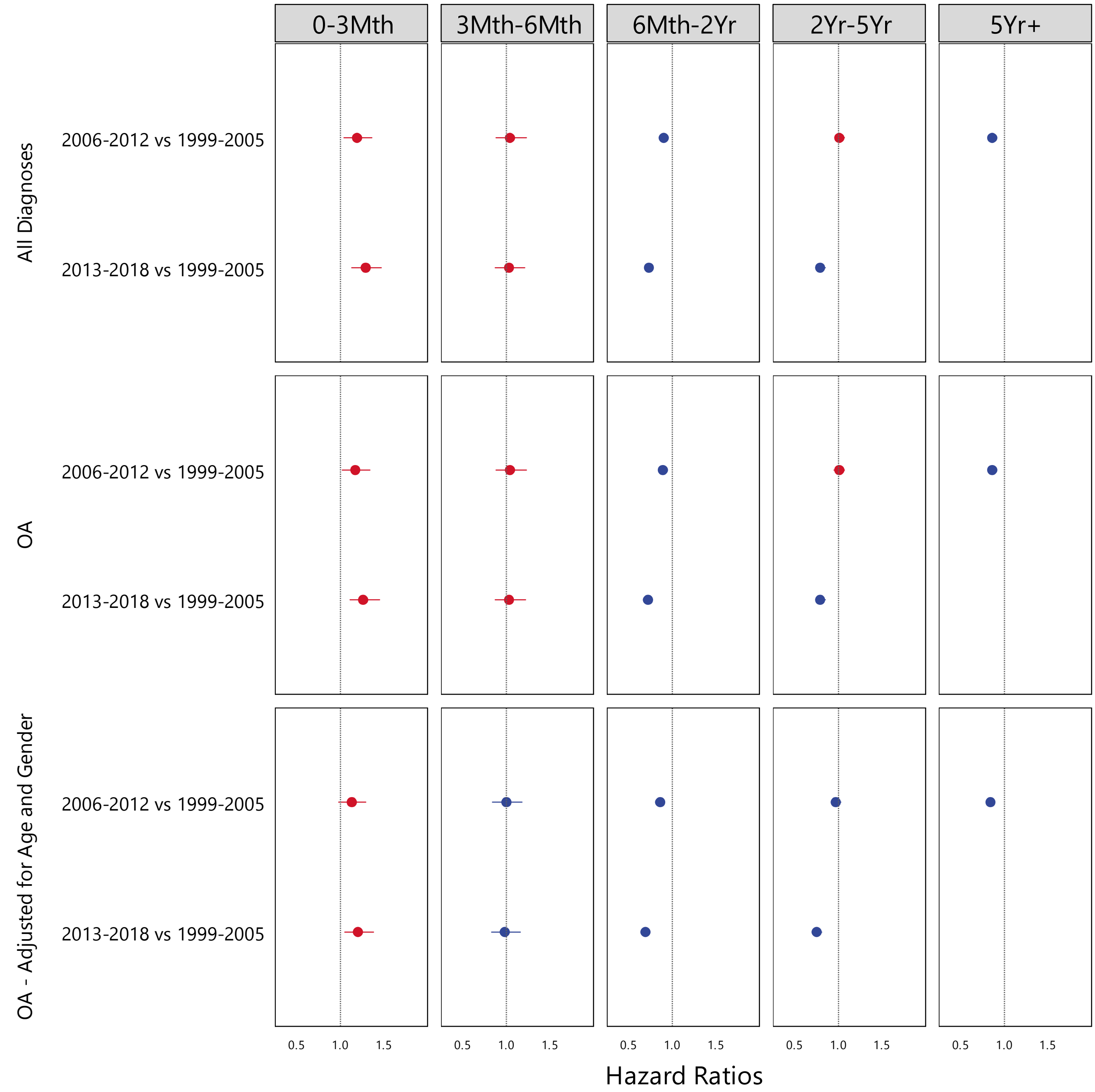
Table CPK6 Primary Diagnosis of Primary Total Knee Replacement by Year of Implant (MS and PS Only)

	Osteoarthritis		Osteonecrosis		Rheumatoid Arthritis		Other	
Year of Implant	N	Row%	N	Row%	N	Row%	N	Row%
1999-2005	103663	96.7	430	0.4	2432	2.3	706	0.7
2006-2012	236176	97.9	725	0.3	3094	1.3	1351	0.6
2013-2018	280650	98.2	841	0.3	2665	0.9	1717	0.6
TOTAL	**620489**	**97.8**	**1996**	**0.3**	**8191**	**1.3**	**3774**	**0.6**

Table CPK7 Cumulative Percent Revision of Primary Total Knee Replacement by Year of Implant (MS and PS Only)

Year of Implant	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs
				All Diagnoses		
1999-2005	7144	107231	1.1 (1.0, 1.1)	2.9 (2.8, 3.0)	3.8 (3.7, 3.9)	5.6 (5.5, 5.8)
2006-2012	11639	241346	1.0 (1.0, 1.1)	2.8 (2.7, 2.8)	3.7 (3.6, 3.8)	5.4 (5.3, 5.5)
2013-2018	5918	285873	1.0 (0.9, 1.0)	2.4 (2.3, 2.4)	3.1 (3.0, 3.2)	
TOTAL	**24701**	**634450**				
				OA Only		
1999-2005	6923	103663	1.1 (1.0, 1.1)	2.9 (2.8, 3.0)	3.8 (3.7, 4.0)	5.7 (5.5, 5.8)
2006-2012	11352	236176	1.0 (1.0, 1.1)	2.8 (2.7, 2.8)	3.7 (3.6, 3.8)	5.3 (5.2, 5.4)
2013-2018	5797	280650	1.0 (0.9, 1.0)	2.4 (2.3, 2.4)	3.1 (3.0, 3.1)	
TOTAL	**24072**	**620489**				

Figure CPK6 **Forest Plot of Hazard Ratios for Primary Total Knee Replacement by Year of Implant (MS and PS TKR Only, All Diagnoses vs Primary Diagnosis OA)**



Note: The circle represents the hazard ratio and the horizontal line that runs through the circle represents the lower to upper 95% confidence intervals. The dashed vertical line represents the line of no effect. The distance between the vertical dashed line and the circle indicates the extent of change. A red circle indicates an increase in revision for the first of the time periods involved in the comparison.

PROSTHESIS CHARACTERISTICS AND SPECIFIC REASONS FOR REVISION

Many prosthesis characteristics (attributes) are known to affect revision. It is also known that particular attributes preferentially affect specific reasons for revision. Since the Registry commenced data collection there have been major changes in the use of different attributes. To understand the effect of this, it is necessary to not only know how attributes have changed but also how reasons for revision have changed.

The prosthesis attributes considered were limited to patella use, bearing surface (XLPE), and fixation (cementless femur, cementless tibial).

This was done only for MS and PS total knee replacement undertaken for OA. These were considered separately.

The proportion of procedures undertaken with patella resurfacing and with XLPE has increased over time. Cementless femoral and cementless tibial fixation has decreased. These changes occurred both for MS and PS total knee replacement (Table CPK8, Table CPK9, Figure CPK7 and Figure CPK8).

The use of patella resurfacing was more common with PS total knee replacement. The use of XLPE is similar except for 1999-2005. In that period, there was no use of XLPE in PS total knee replacement. The use of cementless femoral and tibial fixation is much less in PS total knee replacement (Table CPK8, Table CPK9, Figure CPK7 and Figure CPK8).

The use of patella resurfacing and cement fixation has increased for both MS and PS knee replacement.

Table CPK8 Prosthesis Attributes for MS Primary Total Knee Replacement (Primary Diagnosis OA)

Prosthesis Attributes	1999-2005 %	2006-2012 %	2013-2018 %	Entire Period %
Patella Resurfacing	39.3%	41.2%	55.9%	47.5%
XLPE	7.9%	26.9%	58.5%	37.7%
Cementless Femoral Fixation	61.1%	60.0%	48.9%	55.2%
Cementless Tibial Fixation	29.4%	32.3%	18.4%	25.5%

Table CPK9 Prosthesis Attributes for PS Primary Total Knee Replacement (Primary Diagnosis OA)

Prosthesis Attributes	1999-2005 %	2006-2012 %	2013-2018 %	Entire Period %
Patella Resurfacing	56.7%	64.7%	83.7%	72.3%
XLPE	0.0%	20.2%	59.9%	35.8%
Cementless Femoral Fixation	14.5%	11.7%	7.6%	10.2%
Cementless Tibial Fixation	5.3%	8.8%	5.5%	6.9%

Figure CPK7 Prosthesis Attributes for MS Primary Total Knee Replacement (Primary Diagnosis OA)

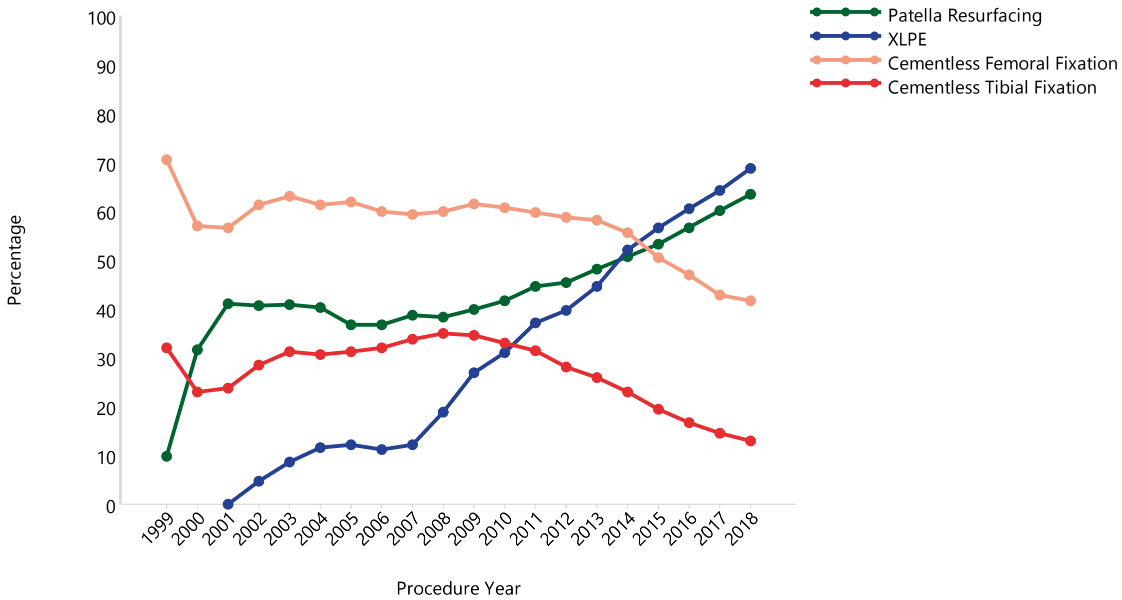
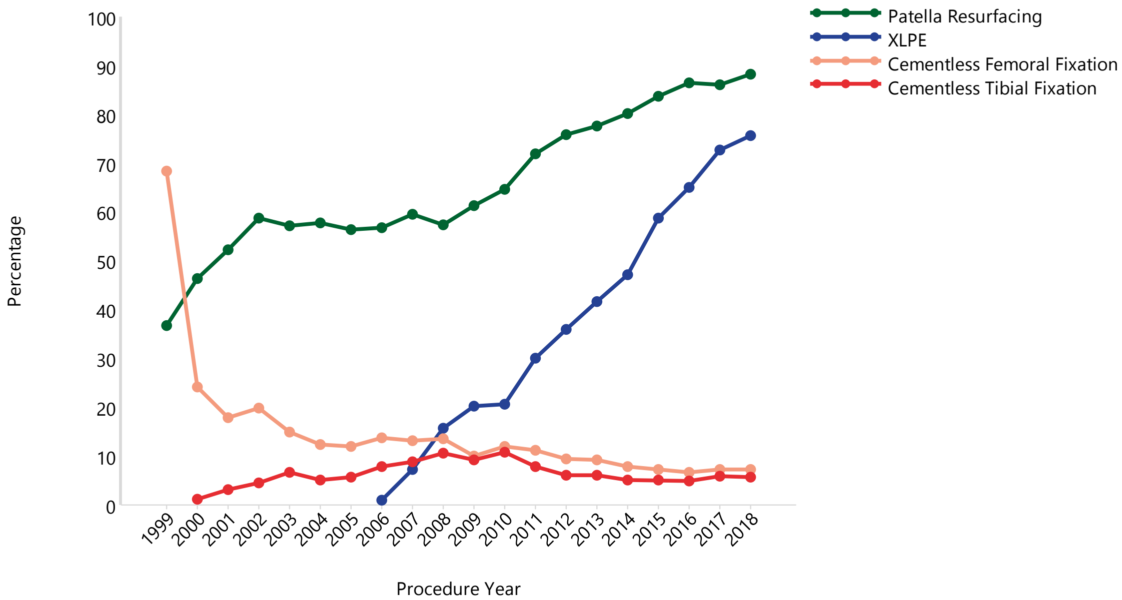


Figure CPK8 Prosthesis Attributes for PS Primary Total Knee Replacement (Primary Diagnosis OA)



Changes in the most common reasons for revision were assessed. This was done for MS and PS total knee replacement undertaken for OA. The reasons included loosening, infection, pain (patellofemoral and unspecified combined) and instability. There are differences in the CPRs for these reasons when the three time periods are compared.

Revision for loosening and pain has decreased, revision for infection and instability has increased.

Revision for loosening and pain decreased since 1999-2005. Late loosening reduced by 37% (≥5 years) in 2006-2012 compared to 1999-2005. After 6 months, there was a further reduction in revision for loosening in 2013-2018 compared to 2006-2012.

The reduction in revision for pain occurred mostly in 2013-2018 and was reduced by 54% (2-5 years) (2013-2018 compared to 1999-2005). Both infection and instability increased. Revision for infection progressively increased, particularly early infection. In the first 3 months after surgery, this increased by 44% (2006-2012 compared to 1999-2005) and by a further 25% when the two most recent time periods were compared.

The number of procedures revised for instability is small. However, it increased by 33% (2-5 years) in 2006-2012 compared to 1999-2005, and by a further 45% (2-5 years) when the two later periods were compared (Table CPK10 and Table CPK11 and Figure CPK9).

Table CPK10 Cumulative Percent Revision of Primary Total Knee Replacement by Year of Implant (MS and PS TKR, Primary Diagnosis OA)

Year of Implant	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs
				Loosening		
1999-2005	2340	104736	0.3 (0.3, 0.3)	0.9 (0.9, 1.0)	1.3 (1.2, 1.3)	1.9 (1.8, 2.0)
2006-2012	2748	238766	0.2 (0.2, 0.2)	0.6 (0.6, 0.7)	0.9 (0.8, 0.9)	1.3 (1.3, 1.4)
2013-2018	1095	299699	0.1 (0.1, 0.1)	0.4 (0.4, 0.5)	0.6 (0.6, 0.7)	
TOTAL	**6183**	**643201**				
				Infection		
1999-2005	1163	104736	0.3 (0.3, 0.4)	0.6 (0.6, 0.7)	0.8 (0.7, 0.8)	1.0 (1.0, 1.1)
2006-2012	2530	238766	0.4 (0.4, 0.4)	0.7 (0.7, 0.8)	0.9 (0.9, 0.9)	1.2 (1.1, 1.2)
2013-2018	2073	299699	0.5 (0.5, 0.5)	0.8 (0.7, 0.8)	0.9 (0.9, 1.0)	
TOTAL	**5766**	**643201**				
				Pain*		
1999-2005	1352	104736	0.2 (0.1, 0.2)	0.7 (0.6, 0.7)	0.9 (0.9, 1.0)	1.3 (1.2, 1.4)
2006-2012	2288	238766	0.1 (0.1, 0.2)	0.6 (0.6, 0.6)	0.8 (0.8, 0.8)	1.1 (1.0, 1.1)
2013-2018	809	299699	0.1 (0.1, 0.1)	0.3 (0.3, 0.4)	0.5 (0.4, 0.5)	
TOTAL	**4449**	**643201**				
				Instability		
1999-2005	407	104736	0.1 (0.0, 0.1)	0.2 (0.1, 0.2)	0.2 (0.2, 0.3)	0.3 (0.3, 0.4)
2006-2012	859	238766	0.1 (0.1, 0.1)	0.2 (0.2, 0.2)	0.3 (0.2, 0.3)	0.4 (0.4, 0.5)
2013-2018	728	299699	0.1 (0.1, 0.1)	0.3 (0.3, 0.3)	0.4 (0.3, 0.4)	
TOTAL	**1994**	**643201**				

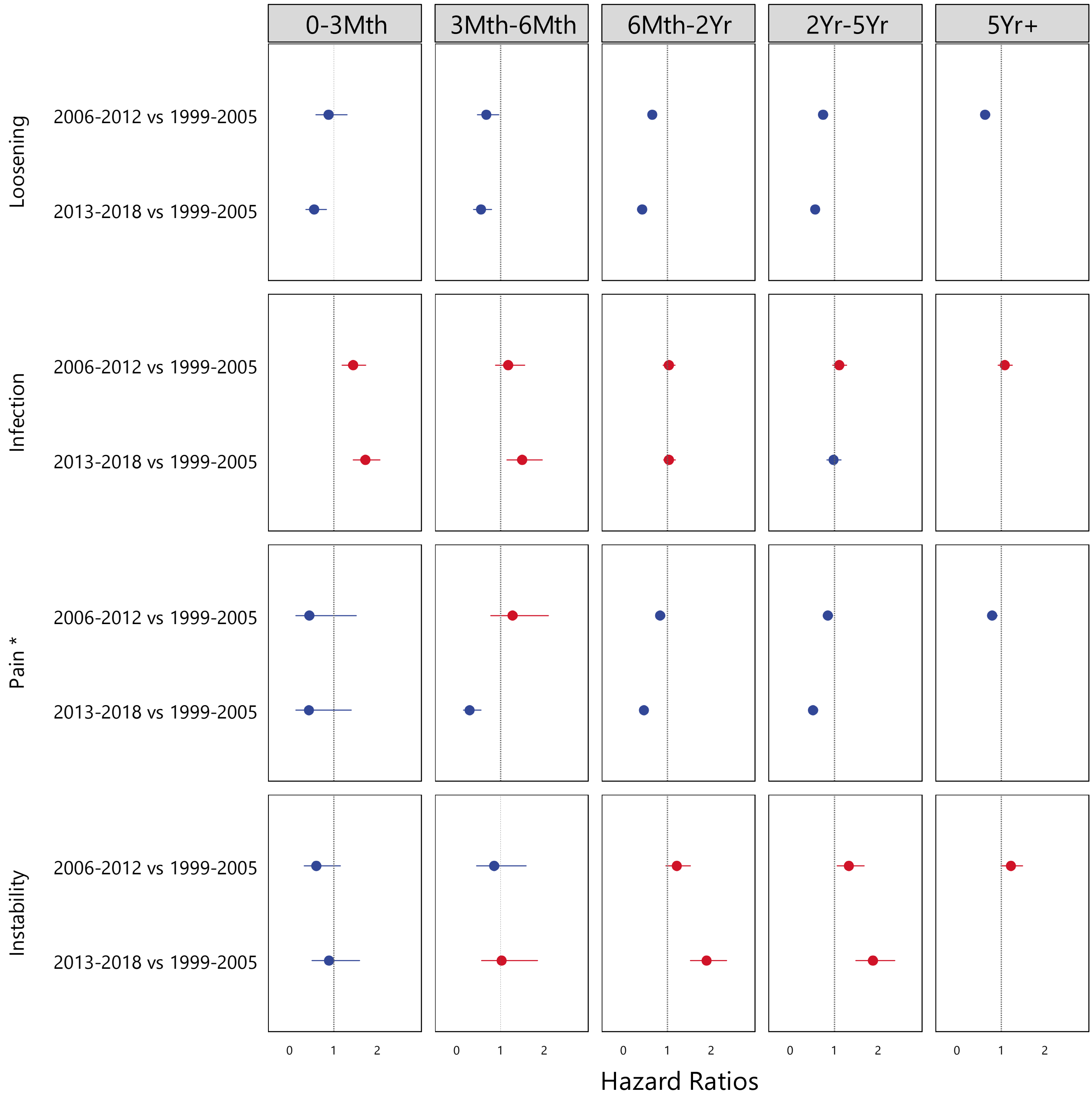
*Pain includes Pain and Patellofemoral pain.

Table CPK11 Hazard Ratios of Primary Total Knee Replacement by Year of Implant (MS and PS TKR, Primary Diagnosis OA)

Year of Implant	0 - 3Mth	3Mth - 6Mth	6Mth - 2Yr	2Yr - 5Yr	5Yr+
			Loosening		
2013-2018 vs 2006-2012	0.71 (0.51, 0.98) p=0.038	0.85 (0.63, 1.14) p=0.269	0.65 (0.58, 0.71) p<0.001	0.78 (0.69, 0.87) p<0.001	
2013-2018 vs 1999-2005	0.55 (0.36, 0.83) p=0.004	0.55 (0.38, 0.79) p=0.001	0.42 (0.38, 0.47) p<0.001	0.56 (0.49, 0.63) p<0.001	
2006-2012 vs 1999-2005	0.88 (0.59, 1.30) p=0.513	0.67 (0.47, 0.96) p=0.029	0.65 (0.58, 0.72) p<0.001	0.74 (0.67, 0.82) p<0.001	0.63 (0.57, 0.70) p<0.001
			Infection		
2013-2018 vs 2006-2012	1.25 (1.12, 1.40) p<0.001	1.26 (1.06, 1.51) p=0.009	0.98 (0.89, 1.07) p=0.638	0.89 (0.78, 1.02) p=0.082	
2013-2018 vs 1999-2005	1.72 (1.44, 2.05) p<0.001	1.49 (1.14, 1.95) p=0.003	1.03 (0.91, 1.18) p=0.618	0.98 (0.83, 1.15) p=0.793	
2006-2012 vs 1999-2005	1.44 (1.19, 1.73) p<0.001	1.17 (0.88, 1.55) p=0.272	1.03 (0.90, 1.17) p=0.690	1.11 (0.96, 1.28) p=0.167	1.08 (0.93, 1.25) p=0.333
			Pain*		
2013-2018 vs 2006-2012	0.75 (0.27, 2.06) p=0.573	0.26 (0.15, 0.44) p<0.001	0.55 (0.49, 0.61) p<0.001	0.60 (0.53, 0.69) p<0.001	
2013-2018 vs 1999-2005	0.43 (0.13, 1.40) p=0.161	0.29 (0.15, 0.55) p<0.001	0.46 (0.40, 0.52) p<0.001	0.51 (0.44, 0.59) p<0.001	
2006-2012 vs 1999-2005	0.44 (0.13, 1.51) p=0.192	1.27 (0.77, 2.09) p=0.341	0.83 (0.75, 0.93) p=0.001	0.85 (0.76, 0.96) p=0.009	0.79 (0.69, 0.91) p=0.001
			Instability		
2013-2018 vs 2006-2012	1.21 (0.77, 1.90) p=0.411	1.12 (0.73, 1.73) p=0.602	1.58 (1.37, 1.82) p<0.001	1.45 (1.22, 1.72) p<0.001	
2013-2018 vs 1999-2005	0.89 (0.50, 1.59) p=0.692	1.02 (0.56, 1.84) p=0.949	1.89 (1.52, 2.35) p<0.001	1.88 (1.49, 2.38) p<0.001	
2006-2012 vs 1999-2005	0.60 (0.32, 1.15) p=0.123	0.85 (0.45, 1.58) p=0.601	1.21 (0.96, 1.52) p=0.098	1.33 (1.06, 1.68) p=0.014	1.22 (0.99, 1.49) p=0.064

*Pain includes Pain and Patellofemoral pain.

Figure CPK9 Forest Plot of Hazard Ratios of Primary Total Knee Replacement by Year of Implant (MS and PS TKR, Primary Diagnosis OA)



Note: The circle represents the hazard ratio and the horizontal line that runs through the circle represents the lower to upper 95% confidence intervals. The dashed vertical line represents the line of no effect. The distance between the vertical dashed line and the circle indicates the extent of change. A red circle indicates an increase in revision for the first of the time periods involved in the comparison

*Pain includes Pain and Patellofemoral pain

The Registry has assessed how change in use of prosthesis attributes over time has affected specific reasons for revision.

A similar approach to the hip attribute analysis was taken. The standardised total knee replacement construct was a fully cemented MS total knee replacement with the patella resurfaced and a XLPE tibial insert used in the management of OA. Currently this is the most used TKR construct in Australia.

One prosthesis attribute was changed for each analysis (e.g. patella versus no patella resurfacing), while keeping all other prosthesis attributes constant. The effect of this change was then assessed for one or more specific reasons for revision. Not all reasons were assessed for all individual prosthesis attributes.

Specific reasons were assessed for each change based on previously reported Registry data.

A separate analysis for PS knees was not undertaken. This was because XLPE was not used with this class of knee in 1999-2005 so comparisons were only possible for the later two time periods. In addition, most PS TKR procedures have had both cement fixation and patella resurfacing for many years which the Registry has previously identified as being beneficial.

The effect of prosthesis attributes on the increased early infection was also not assessed. Its aetiology is multifactorial, consequently, the effect of specific prothesis attributes are difficult to isolate and they are also unlikely to affect early revision for infection.

Cement fixation reduced the rate of revision for loosening.

The effect of fixation on loosening using the standardised MS TKR construct was assessed. Cement fixation has a lower CPR for loosening compared to cementless fixation. This difference was greatest early. There is almost no loosening in the first 12 months when cement fixation is used (Table CPK12 and Table CPK13).

There is no evidence to suggest that other factors are affecting the difference in loosening when cement and cementless fixation are compared for the MS total knee construct.

Patella resurfacing reduced the rate of revision for pain.

The effect of patella resurfacing on revision for pain (patellofemoral and unspecified) was also assessed. The standardised total knee replacement construct was used (with or without patella resurfacing). There was no revision for pain in the first year when the patella was resurfaced. After this time, revision for pain was reduced when the patella was resurfaced (Table CPK14 and Table CPK15).

Revision for pain for the MS total knee replacement no patella group declined in 2013-2018 compared to other periods. However, revision for pain was still less in this period when the patella was resurfaced.

Table CPK12 Cumulative Percent Revision of Primary Total Knee Replacement by Year of Implant (MS TKR, XLPE and Patella Resurfaced, Primary Diagnosis OA, Revision for Loosening)

Year of Implant	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs
			All Fixation			
1999-2005	35	3016	0.2 (0.1, 0.4)	0.4 (0.3, 0.8)	0.7 (0.5, 1.1)	1.0 (0.7, 1.5)
2006-2012	111	21012	0.1 (0.1, 0.1)	0.3 (0.3, 0.4)	0.5 (0.4, 0.6)	0.6 (0.5, 0.7)
2013-2018	159	71927	0.1 (0.1, 0.1)	0.3 (0.2, 0.3)	0.4 (0.3, 0.5)	
TOTAL	**305**	**95955**				
			Fully Cementless Fixation			
1999-2005	15	1038	0.3 (0.1, 0.9)	0.7 (0.3, 1.4)	1.1 (0.6, 2.0)	1.3 (0.8, 2.3)
2006-2012	42	4528	0.2 (0.1, 0.4)	0.7 (0.5, 0.9)	0.9 (0.6, 1.2)	0.9 (0.7, 1.3)
2013-2018	36	6427	0.2 (0.1, 0.4)	0.7 (0.5, 1.0)	0.8 (0.5, 1.0)	
TOTAL	**93**	**11993**				
			Fully Cemented Fixation			
1999-2005	8	1045	0.0 (0.0, 0.0)	0.1 (0.0, 0.7)	0.3 (0.1, 0.9)	0.5 (0.2, 1.3)
2006-2012	45	10237	0.0 (0.0, 0.1)	0.2 (0.2, 0.4)	0.4 (0.3, 0.5)	0.5 (0.4, 0.7)
2013-2018	71	42700	0.0 (0.0, 0.1)	0.2 (0.2, 0.3)	0.3 (0.2, 0.4)	
TOTAL	**124**	**53982**				

Table CPK13 Hazard Ratios of Primary Total Knee Replacement by Year of Implant (MS TKR, XLPE and Patella Resurfaced, Primary Diagnosis OA, Revision for Loosening)

Year of Implant	0-6mth	6Mth – 2Yr	2Yr – 5Yr	5Yr+
	All Fixation			
2013-2018 vs 2006-2012	1.67 (0.63, 4.43) p=0.300	0.95 (0.66, 1.35) p=0.755	0.78 (0.52, 1.18) p=0.240	
2013-2018 vs 1999-2005	0.97 (0.13, 7.16) p=0.972	0.54 (0.28, 1.04) p=0.067	0.52 (0.27, 0.99) p=0.047	
2006-2012 vs 1999-2005	0.58 (0.06, 5.17) p=0.623	0.58 (0.29, 1.15) p=0.117	0.71 (0.37, 1.35) p=0.293	0.42 (0.19, 0.89) p=0.023
	Fully Cementless Fixation			
2013-2018 vs 2006-2012	1.23 (0.33, 4.62) p=0.758	1.28 (0.71, 2.30) p=0.409	0.55 (0.22, 1.37) p=0.197	
2013-2018 vs 1999-2005	0.78 (0.09, 6.66) p=0.819	1.16 (0.40, 3.34) p=0.781	0.31 (0.10, 0.95) p=0.040	
2006-2012 vs 1999-2005	0.62 (0.06, 5.92) p=0.674	0.97 (0.33, 2.87) p=0.962	0.53 (0.21, 1.34) p=0.181	0.60 (0.11, 3.22) p=0.555
		0- 2Yr	**2Yr - 5Yr**	**5Yr+**
	Fully Cemented Fixation			
2013-2018 vs 2006-2012		1.41 (0.76, 2.62) p=0.274	0.63 (0.35, 1.14) p=0.125	
2013-2018 vs 1999-2005		1.82 (0.25, 13.20) p=0.551	0.87 (0.25, 3.03) p=0.829	
2006-2012 vs 1999-2005		1.33 (0.17, 10.24) p=0.783	1.60 (0.44, 5.74) p=0.474	0.43 (0.13, 1.48) p=0.180

Note: HRs Adjusted for Age and Gender

Table CPK14 Cumulative Percent Revision of Primary Total Knee Replacement (MS TKR, XLPE and Fully Cemented, Primary Diagnosis OA, Revision for *Pain)

Year of Implant	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs
	Patella and No Patella					
1999-2005	11	1813	0.1 (0.0, 0.4)	0.4 (0.2, 0.8)	0.5 (0.2, 0.9)	0.6 (0.3, 1.1)
2006-2012	124	18765	0.1 (0.1, 0.2)	0.4 (0.3, 0.5)	0.5 (0.4, 0.6)	0.8 (0.6, 0.9)
2013-2018	131	70001	0.1 (0.0, 0.1)	0.3 (0.2, 0.3)	0.4 (0.3, 0.4)	
TOTAL	**266**	**90579**				
	Patella Resurfacing					
1999-2005	3	1045	0.0 (0.0, 0.0)	0.1 (0.0, 0.7)	0.2 (0.1, 0.8)	0.2 (0.1, 0.8)
2006-2012	13	10237	0.0 (0.0, 0.1)	0.1 (0.0, 0.2)	0.1 (0.1, 0.2)	0.1 (0.1, 0.2)
2013-2018	36	42700	0.0 (0.0, 0.0)	0.1 (0.1, 0.2)	0.2 (0.1, 0.2)	
TOTAL	**52**	**53982**				
	No Patella					
1999-2005	8	768	0.3 (0.1, 1.0)	0.8 (0.4, 1.8)	0.8 (0.4, 1.8)	1.1 (0.6, 2.2)
2006-2012	111	8528	0.2 (0.1, 0.3)	0.9 (0.7, 1.1)	1.1 (0.9, 1.3)	1.5 (1.2, 1.9)
2013-2018	95	27301	0.1 (0.1, 0.1)	0.5 (0.4, 0.6)	0.6 (0.5, 0.8)	
TOTAL	**214**	**36597**				

*Pain includes Pain and Patellofemoral pain

Table CPK15 Hazard Ratios of Primary Total Knee Replacement (MS TKR, XLPE, and Fully Cemented, Primary Diagnosis OA, Revision for *Pain)

Year of Implant	0-6mth	6Mth - 2Yr	2Yr - 5Yr	5Yr+
	Patella and No Patella			
2013-2018 vs 2006-2012	0.60 (0.11, 3.26) p=0.550	0.52 (0.37, 0.72) p<0.001	0.81 (0.53, 1.23) p=0.317	
2013-2018 vs 1999-2005		0.49 (0.22, 1.13) p=0.095	1.53 (0.43, 5.42) p=0.507	
2006-2012 vs 1999-2005		0.92 (0.40, 2.13) p=0.847	1.93 (0.54, 6.95) p=0.315	2.23 (0.62, 7.96) p=0.217
	Patella Resurfacing			
2013-2018 vs 2006-2012		1.61 (0.65, 4.02) p=0.303	1.20 (0.44, 3.27) p=0.727	
2013-2018 vs 1999-2005		0.93 (0.13, 6.86) p=0.943	1.06 (0.13, 8.65) p=0.957	
2006-2012 vs 1999-2005		0.55 (0.06, 4.73) p=0.588	0.91 (0.11, 7.28) p=0.928	
	No Patella			
2013-2018 vs 2006-2012	0.35 (0.05, 2.50) p=0.296	0.46 (0.31, 0.66) p<0.001	0.78 (0.49, 1.25) p=0.309	
2013-2018 vs 1999-2005		0.41 (0.17, 1.03) p=0.058	2.01 (0.43, 9.42) p=0.376	
2006-2012 vs 1999-2005		0.89 (0.36, 2.23) p=0.804	2.69 (0.56, 12.95) p=0.216	1.73 (0.46, 6.53) p=0.419

Note: HRs Adjusted for Age and Gender
*Pain includes Pain and Patellofemoral pain

KNEE SUMMARY

There has been a continuous decline in the CPR for primary knee replacement since the Registry commenced data collection. The reasons for this decrease are a reduction in the use of unicompartmental knee replacement and reduced revision for loosening and pain when total knee replacement is used.

The reduction in revision for loosening is largely due to the increased use of cement fixation. The reduction in revision for pain is associated with an increased use of patella resurfacing.

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 14.8% and the number of individual combinations of femoral and tibial knee prostheses has increased by 10.0%.

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 93 femoral and acetabular combinations with 10 year outcome data. This is 12 more than last year. These prosthesis combinations have been used in 67.7% of all primary total conventional hip procedures performed for osteoarthritis reported to the Registry. Of these 93 combinations, 42 were not used in 2018. These 42 combinations account for 8.1% of all primary total conventional hip procedures.

The 10 year cumulative percent revision for the individual prosthesis combinations ranges from 1.7% to 46.2%. A commonly accepted benchmark standard is a 5% cumulative percent revision at 10 years. There are 40 (43.0%) 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 has 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 (17.2%) 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 11 prosthesis combinations can be benchmarked, i.e. 27 (29.0%) 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 Combinations with 10 Year Data (Primary Diagnosis OA)

Femoral Component	Acetabular Component	N Revised	N Total	Type of Revision				2 Yrs	5 Yrs	10 Yrs
				THR	Femoral	Acetabular	Other			
ABGII	ABGII	278	2769	38	136	71	33	2.5 (2.0, 3.1)	4.2 (3.5, 5.0)	6.9 (5.9, 7.9)
ABGII	ABGII (Shell/Insert)	66	852	13	37	12	4	1.8 (1.1, 2.9)	2.8 (1.8, 4.1)	6.4 (4.9, 8.5)
ABGII	Trident (Shell)	225	2439	13	137	31	44	3.4 (2.7, 4.2)	4.9 (4.1, 5.9)	8.6 (7.4, 9.9)
Accolade I	Mitch TRH*MoM	67	357	29	8	21	9	3.7 (2.1, 6.2)	10.3 (7.5, 14.0)	18.2 (14.4, 22.8)
Accolade I	Trident (Shell)	461	8573	53	179	89	140	2.4 (2.1, 2.7)	3.7 (3.3, 4.2)	5.6 (5.1, 6.2)
Adapter	Bionik*MoM	90	376	18	8	21	43	5.1 (3.3, 7.9)	15.3 (12.0, 19.5)	24.8 (20.5, 29.7)
Alloclassic	Allofit	262	5059	29	106	48	79	1.8 (1.4, 2.2)	2.8 (2.4, 3.3)	5.0 (4.4, 5.7)
Alloclassic	Durom*MoM	94	547	26	12	44	12	3.4 (2.1, 5.3)	7.4 (5.5, 10.0)	16.2 (13.2, 19.7)
Alloclassic	Fitmore*	121	1709	12	62	12	35	4.2 (3.4, 5.3)	5.6 (4.6, 6.8)	7.3 (6.1, 8.8)
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)*	44	957	4	13	4	23	2.5 (1.7, 3.7)	4.0 (2.9, 5.5)	5.0 (3.7, 6.8)
Alloclassic	Trilogy*	10	844	.	7	1	2	0.4 (0.1, 1.1)	0.5 (0.2, 1.3)	1.7 (0.9, 3.3)
Anthology	R3	156	6177	13	52	27	64	2.1 (1.8, 2.5)	2.5 (2.1, 2.9)	3.5 (2.9, 4.2)
Anthology	Reflection (Shell)*	36	909	3	14	11	8	2.3 (1.5, 3.5)	3.1 (2.1, 4.4)	4.4 (3.1, 6.1)
Apex	Fin II*	45	923	4	9	18	14	2.3 (1.5, 3.5)	3.5 (2.4, 4.9)	5.7 (4.3, 7.7)
C-Stem	Duraloc*	84	894	11	22	14	37	2.8 (1.9, 4.2)	3.8 (2.7, 5.3)	6.9 (5.3, 8.9)
C-Stem	Elite Plus LPW*	21	367	10	4	7	.	1.1 (0.4, 3.0)	2.7 (1.4, 5.0)	5.3 (3.3, 8.6)
C-Stem	PINNACLE	28	792	2	11	6	9	1.9 (1.2, 3.2)	2.7 (1.7, 4.1)	4.1 (2.8, 6.2)
C-Stem AMT	PINNACLE	57	3017	4	24	7	22	1.3 (1.0, 1.8)	2.5 (1.9, 3.3)	4.3 (2.8, 6.8)
CLS	Allofit	56	809	5	31	13	7	2.5 (1.6, 3.8)	4.0 (2.8, 5.6)	6.2 (4.6, 8.2)
CLS	Fitmore	47	810	5	22	7	13	2.6 (1.7, 4.0)	4.3 (3.0, 6.1)	5.8 (4.2, 7.9)
CORAIL	ASR*MoM	1190	2654	210	37	891	52	5.1 (4.3, 6.0)	27.4 (25.8, 29.2)	46.2 (44.2, 48.2)
CORAIL	Duraloc*	83	1267	13	37	13	20	1.6 (1.0, 2.5)	2.5 (1.8, 3.6)	5.3 (4.1, 6.9)
CORAIL	PINNACLE	1344	43071	116	482	212	534	2.1 (2.0, 2.3)	3.1 (3.0, 3.3)	5.2 (4.8, 5.5)
CORAIL	PINNACLE*MoM	107	880	18	35	19	35	2.9 (1.9, 4.2)	6.1 (4.7, 8.0)	12.6 (10.4, 15.1)
CPCS	R3	122	4311	16	35	22	49	2.3 (1.8, 2.8)	3.1 (2.6, 3.8)	4.9 (3.7, 6.4)
CPCS	Reflection (Cup)	63	756	21	2	27	13	1.4 (0.7, 2.5)	2.7 (1.7, 4.2)	8.5 (6.2, 11.5)
CPCS	Reflection (Shell)	85	2689	10	37	11	27	0.9 (0.6, 1.3)	1.6 (1.2, 2.2)	3.5 (2.7, 4.5)
CPT	Allofit	38	1236	6	15	3	14	1.3 (0.8, 2.1)	3.1 (2.1, 4.4)	4.8 (3.3, 7.1)
CPT	Trabecular Metal (Shell)	76	1669	5	33	13	25	2.8 (2.1, 3.8)	4.4 (3.4, 5.6)	7.0 (5.5, 9.0)
CPT	Trilogy	307	7425	29	106	34	138	2.2 (1.9, 2.6)	3.4 (3.0, 3.9)	5.0 (4.5, 5.7)
CPT	ZCA	35	829	13	7	9	6	0.9 (0.4, 1.8)	2.3 (1.4, 3.6)	5.0 (3.4, 7.3)
Charnley	Charnley Ogee*	62	630	36	9	5	12	2.1 (1.2, 3.6)	5.1 (3.6, 7.2)	9.1 (7.0, 11.9)
Charnley	Charnley*	44	563	34	7	3	.	0.9 (0.4, 2.2)	2.2 (1.3, 3.9)	6.3 (4.4, 8.9)
Charnley	Vitalock*	40	370	7	19	3	11	2.7 (1.5, 5.0)	4.4 (2.7, 7.1)	7.9 (5.5, 11.4)
Citation	Trident (Shell)*	51	1035	3	12	13	23	1.9 (1.3, 3.0)	3.3 (2.4, 4.6)	4.3 (3.2, 5.7)
Citation	Vitalock*	40	508	3	7	14	16	1.0 (0.4, 2.4)	2.0 (1.1, 3.7)	5.2 (3.5, 7.7)
Elite Plus	Duraloc*	102	953	14	61	6	21	2.2 (1.5, 3.4)	5.1 (3.9, 6.8)	8.9 (7.1, 11.1)
Epoch	Trilogy*	45	990	1	9	9	26	2.7 (1.9, 4.0)	3.6 (2.6, 4.9)	4.6 (3.4, 6.1)
Exeter	Contemporary*	37	428	9	7	13	8	2.9 (1.6, 5.0)	4.2 (2.6, 6.6)	6.0 (4.0, 8.9)
Exeter	Vitalock*	65	1076	9	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)	3.4 (2.4, 4.8)
Exeter V40	Contemporary	254	4507	59	41	122	32	2.2 (1.8, 2.7)	3.3 (2.8, 3.9)	5.8 (5.0, 6.6)
Exeter V40	Exeter Contemporary	141	2891	45	31	43	22	1.9 (1.4, 2.4)	3.0 (2.4, 3.7)	4.7 (3.9, 5.7)
Exeter V40	Exeter*	93	1526	19	15	41	18	1.3 (0.8, 2.0)	2.9 (2.1, 3.9)	4.7 (3.7, 6.0)
Exeter V40	Hemispherical*	30	663	6	8	1	15	3.0 (2.0, 4.7)	3.5 (2.3, 5.2)	4.8 (3.2, 7.1)
Exeter V40	Mallory-Head	35	1424	5	20	3	7	0.6 (0.3, 1.2)	1.0 (0.6, 1.7)	2.4 (1.7, 3.6)
Exeter V40	PINNACLE	37	1594	1	15	8	13	1.7 (1.2, 2.5)	2.1 (1.5, 3.0)	4.2 (2.7, 6.6)
Exeter V40	R3	47	1979	1	6	13	27	1.8 (1.2, 2.5)	2.7 (2.0, 3.6)	3.2 (2.3, 4.4)

Femoral Component	Acetabular Component	N Revised	N Total	Type of Revision				2 Yrs	5 Yrs	10 Yrs
				THR	Femoral	Acetabular	Other			
Exeter V40	Trabecular Metal (Shell)	20	391	2	2	2	14	3.4 (2.0, 5.8)	4.7 (2.9, 7.4)	6.4 (4.0, 10.2)
Exeter V40	Trident (Shell)	1427	55104	191	430	204	602	1.5 (1.4, 1.6)	2.3 (2.1, 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)	3.8 (2.3, 6.2)
Exeter V40	Vitalock*	78	1795	15	22	23	18	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	18	702	1	10	1	6	1.8 (1.0, 3.1)	2.0 (1.1, 3.4)	4.3 (2.3, 8.0)
M/L Taper	Fitmore	16	419	.	6	1	9	3.5 (2.1, 5.9)	4.1 (2.6, 6.7)	4.1 (2.6, 6.7)
M/L Taper	Trabecular Metal (Shell)	11	358	1	3	2	5	1.7 (0.8, 3.7)	2.0 (1.0, 4.1)	4.7 (2.4, 8.8)
M/L Taper	Trilogy	26	770	.	8	6	12	1.2 (0.6, 2.2)	2.7 (1.7, 4.3)	4.2 (2.8, 6.3)
MS 30	Allofit	59	1539	11	18	18	12	1.3 (0.8, 2.0)	2.1 (1.4, 2.9)	3.8 (2.8, 5.1)
MS 30	Fitmore	22	647	1	4	8	9	1.0 (0.4, 2.1)	1.9 (1.0, 3.5)	2.8 (1.6, 4.8)
MS 30	Low Profile Cup	20	602	8	2	8	2	0.5 (0.2, 1.6)	1.3 (0.6, 2.8)	2.7 (1.5, 4.7)
Mallory-Head	Mallory-Head	174	2908	16	13	56	89	2.1 (1.6, 2.7)	3.0 (2.4, 3.7)	4.9 (4.1, 5.8)
Mallory-Head	Recap*[MoM]	30	395	8	.	20	2	1.3 (0.5, 3.0)	2.6 (1.4, 4.7)	6.4 (4.4, 9.5)
Meridian	Vitalock*	35	354	2	2	15	16	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)	2.4 (1.3, 4.2)
Natural Hip	Fitmore*	38	882	2	6	12	18	0.9 (0.5, 1.8)	2.0 (1.3, 3.2)	4.1 (2.9, 5.8)
Omnifit	Secur-Fit*	79	716	8	21	18	32	3.7 (2.5, 5.3)	6.2 (4.6, 8.2)	9.9 (7.9, 12.5)
Omnifit	Trident (Shell)	146	3732	12	35	23	76	2.2 (1.7, 2.7)	2.9 (2.4, 3.6)	3.8 (3.2, 4.5)
Quadra-H	Versafitcup CC	447	14208	39	190	99	119	2.1 (1.9, 2.4)	3.3 (3.0, 3.6)	6.0 (4.9, 7.3)
S-Rom	Duraloc Option*	25	523	4	9	5	7	2.1 (1.2, 3.8)	3.3 (2.1, 5.2)	4.6 (3.1, 6.8)
S-Rom	PINNACLE	125	2386	11	71	12	31	2.9 (2.3, 3.6)	4.4 (3.7, 5.4)	5.8 (4.9, 6.9)
SL-Plus	EP-Fit Plus	112	2102	5	49	20	38	2.0 (1.5, 2.7)	3.5 (2.7, 4.4)	5.4 (4.5, 6.5)
SL-Plus	R3	71	1579	3	20	18	30	2.9 (2.2, 3.9)	4.2 (3.2, 5.3)	5.6 (4.4, 7.1)
Secur-Fit	Trident (Shell)	376	9161	22	169	67	118	2.3 (2.0, 2.7)	3.4 (3.1, 3.9)	4.6 (4.1, 5.1)
Secur-Fit Plus	Trident (Shell)	180	5553	14	46	44	76	1.6 (1.3, 1.9)	2.2 (1.8, 2.6)	3.2 (2.7, 3.7)
Spectron EF	BHR*[MoM]	65	430	12	.	47	6	2.6 (1.4, 4.6)	6.0 (4.1, 8.8)	16.8 (13.2, 21.3)
Spectron EF	R3	56	1760	9	7	14	26	2.2 (1.6, 3.0)	3.4 (2.5, 4.5)	4.6 (3.4, 6.3)
Spectron EF	Reflection (Cup)	116	1402	43	10	54	9	1.3 (0.8, 2.1)	2.9 (2.2, 4.0)	7.3 (5.8, 9.0)
Spectron EF	Reflection (Shell)	277	4620	59	93	42	83	1.5 (1.2, 1.9)	2.7 (2.3, 3.2)	5.3 (4.6, 6.1)
Stability	Duraloc*	48	374	2	9	13	24	1.3 (0.6, 3.2)	2.2 (1.1, 4.3)	8.9 (6.3, 12.5)
Summit	ASR*[MoM]	463	1041	15	6	418	24	3.0 (2.1, 4.2)	19.9 (17.6, 22.5)	44.4 (41.3, 47.6)
Summit	PINNACLE	122	4684	7	27	18	70	1.8 (1.4, 2.2)	2.3 (1.9, 2.8)	3.4 (2.7, 4.1)
Summit	PINNACLE*[MoM]	68	730	5	5	12	46	1.7 (0.9, 2.9)	3.4 (2.3, 5.0)	8.9 (6.9, 11.3)
Synergy	BHR*[MoM]	87	698	5	6	52	24	2.7 (1.8, 4.2)	4.8 (3.4, 6.7)	12.0 (9.7, 14.9)
Synergy	R3	109	4392	3	34	22	50	2.0 (1.6, 2.4)	2.5 (2.1, 3.0)	2.9 (2.3, 3.5)
Synergy	Reflection (Shell)	334	7399	31	69	108	126	2.0 (1.7, 2.4)	2.6 (2.3, 3.0)	3.9 (3.5, 4.4)
Synergy	Trident (Shell)*	14	438	.	3	5	6	1.2 (0.5, 2.7)	1.9 (0.9, 3.7)	3.7 (2.1, 6.5)
Taperloc	Exceed	58	2180	4	19	21	14	1.9 (1.4, 2.6)	2.4 (1.9, 3.2)	5.7 (2.8, 11.4)
Taperloc	M2a*[MoM]	61	471	11	2	42	6	2.6 (1.5, 4.5)	6.9 (4.9, 9.6)	12.3 (9.6, 15.7)
Taperloc	Mallory-Head	80	1877	7	16	28	29	2.3 (1.7, 3.1)	3.0 (2.3, 3.9)	5.2 (4.0, 6.8)
Taperloc	Recap*[MoM]	46	456	11	5	23	7	2.4 (1.4, 4.4)	5.6 (3.8, 8.2)	9.8 (7.4, 13.1)
Trabecular Metal	Trilogy	23	424	3	10	3	7	4.1 (2.5, 6.4)	4.9 (3.2, 7.5)	6.5 (4.2, 9.8)
VerSys	Trilogy	226	4430	14	81	39	92	3.0 (2.5, 3.6)	3.9 (3.3, 4.5)	5.1 (4.4, 5.8)
TOTAL		**12756**	**274699**	**1643**	**3579**	**3723**	**3811**			

Note: Only prosthesis combinations with over 350 procedures have been listed
* Denotes prosthesis combinations with no reported use in primary total conventional hip procedures in 2018
[MoM] refers to metal/metal prosthesis combinations used with head size larger than 32mm
Green: prosthesis combination qualifies for 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 66 total knee replacement combinations with 10 year outcome data. This is 6 more than last year. These prosthesis combinations were used in 87.3% of all primary total knee replacement procedures performed for osteoarthritis reported to the Registry. Of these 66 prosthesis combinations, 22 were not used in 2018. These 22 combinations account for 9.0% of all primary total knee procedures. The 10 year cumulative percent revision ranges from 2.9% to 13.2%. There are 20 (30.3%) 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 8 (12.1%) knee prosthesis combinations which would qualify for a superiority benchmark (highlighted in green) and an additional 23 prosthesis combinations can be benchmarked, i.e. 31 (47.0%) 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. It is clear however 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 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	277	5028	111	5	25	136	1.7 (1.4, 2.1)	3.2 (2.7, 3.7)	4.9 (4.3, 5.6)
Active Knee	Active Knee	644	9358	181	28	38	397	2.5 (2.2, 2.8)	4.8 (4.3, 5.3)	8.2 (7.6, 9.0)
Advance	Advance	49	900	15	4	8	22	3.9 (2.7, 5.4)	5.5 (4.1, 7.4)	8.7 (5.9, 12.7)
Advance	Advance II	106	1615	41	2	13	50	3.6 (2.8, 4.6)	5.0 (4.0, 6.2)	7.0 (5.7, 8.5)
Advantim	Advantim*	69	1454	34	4	3	28	1.7 (1.1, 2.5)	3.1 (2.3, 4.1)	5.2 (4.0, 6.6)
BalanSys	BalanSys	60	3235	11	3	6	40	1.1 (0.8, 1.6)	2.2 (1.6, 2.9)	4.7 (3.2, 6.7)
Buechel-Pappas	Buechel-Pappas*	46	467	13	2	2	29	4.3 (2.8, 6.6)	8.1 (5.9, 11.0)	10.5 (7.9, 14.0)
Columbus	Columbus	106	2187	30	4	5	67	3.5 (2.6, 4.5)	6.6 (5.3, 8.1)	9.9 (8.1, 12.2)
Duracon	Duracon*	1178	19828	300	30	68	780	2.1 (1.9, 2.3)	3.5 (3.2, 3.7)	5.2 (4.9, 5.5)
Evolis	Evolis	41	1368	16	1	7	17	1.2 (0.8, 2.0)	2.6 (1.8, 3.7)	3.9 (2.8, 5.3)
Genesis II CR	Genesis II	922	23153	175	64	56	627	2.0 (1.8, 2.2)	3.5 (3.2, 3.7)	4.9 (4.5, 5.2)
Genesis II CR	Profix Mobile*	116	1209	46	9	8	53	2.7 (1.9, 3.8)	5.4 (4.2, 6.8)	8.6 (7.1, 10.5)
Genesis II Oxinium CR (ctd)	Genesis II	438	8625	76	26	24	312	1.9 (1.6, 2.2)	3.6 (3.2, 4.1)	6.3 (5.7, 7.0)
Genesis II Oxinium PS (ctd)	Genesis II	1007	18214	121	31	149	706	2.9 (2.7, 3.2)	5.2 (4.9, 5.6)	7.7 (7.2, 8.2)
Genesis II PS	Genesis II	755	18213	122	27	51	555	2.2 (1.9, 2.4)	3.8 (3.5, 4.1)	5.4 (5.0, 5.8)
Journey Oxinium	Journey*	289	2975	47	5	30	207	3.4 (2.8, 4.1)	6.5 (5.7, 7.5)	11.4 (10.1, 12.8)
Kinemax Plus	Kinemax Plus*	120	1815	68	3	5	44	1.8 (1.3, 2.6)	3.2 (2.4, 4.1)	4.6 (3.7, 5.8)
LCS CR	LCS	592	8311	242	23	87	240	2.5 (2.1, 2.8)	4.4 (4.0, 4.9)	6.3 (5.8, 6.9)
LCS CR	MBT	1076	29514	356	47	132	541	1.9 (1.7, 2.0)	3.4 (3.2, 3.6)	4.9 (4.5, 5.2)
LCS CR	MBT Duofix	708	14510	196	33	40	439	2.7 (2.4, 3.0)	4.1 (3.8, 4.4)	5.4 (5.0, 5.8)
LCS Duofix	MBT Duofix*	470	3606	339	27	7	97	3.7 (3.2, 4.4)	10.2 (9.2, 11.2)	13.2 (12.2, 14.4)
LCS Duofix	MBT*	132	1169	93	9	2	28	3.3 (2.4, 4.5)	8.1 (6.7, 9.9)	11.9 (10.1, 14.0)
Legion Oxinium CR	Genesis II	107	4541	26	12	3	66	2.1 (1.7, 2.6)	3.5 (2.8, 4.2)	4.5 (3.5, 5.7)
Legion Oxinium PS	Genesis II	431	12706	43	12	40	336	2.3 (2.1, 2.6)	4.4 (4.0, 4.9)	6.0 (5.2, 7.0)
MBK (Zimmer)	Nexgen*	33	448	18	1	1	13	2.3 (1.2, 4.1)	4.1 (2.6, 6.5)	5.9 (4.0, 8.6)
Maxim	Maxim*	116	1819	33	9	6	68	2.1 (1.5, 2.8)	3.4 (2.6, 4.3)	5.2 (4.2, 6.4)
Maxim	Vanguard*	79	628	32	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	111	5349	34	4	7	66	1.5 (1.2, 1.9)	2.3 (1.9, 2.8)	3.0 (2.4, 3.7)
Natural Knee II	Natural Knee II*	396	6443	171	9	59	157	1.6 (1.4, 2.0)	2.8 (2.4, 3.2)	5.1 (4.6, 5.8)
Nexgen CR	Nexgen	388	11351	122	16	31	219	1.2 (1.0, 1.4)	2.1 (1.9, 2.4)	3.1 (2.8, 3.5)
Nexgen CR	Nexgen TM CR	49	833	16	3	10	20	2.5 (1.6, 3.8)	5.5 (4.1, 7.3)	6.5 (4.9, 8.6)
Nexgen CR Flex	Nexgen	1138	53004	247	81	109	701	1.4 (1.3, 1.5)	2.3 (2.2, 2.5)	3.2 (3.0, 3.4)
Nexgen CR Flex	Nexgen TM CR	258	10965	70	21	26	141	1.3 (1.1, 1.5)	2.3 (2.0, 2.6)	3.1 (2.8, 3.6)
Nexgen LCCK	Nexgen	33	799	2	3	.	28	3.1 (2.0, 4.7)	5.2 (3.6, 7.4)	5.2 (3.6, 7.4)
Nexgen LPS	Nexgen	328	6879	82	20	33	193	1.9 (1.6, 2.3)	3.3 (2.8, 3.7)	4.9 (4.4, 5.5)
Nexgen LPS	Nexgen TM LPS	29	1286	7	3	5	14	1.1 (0.6, 1.9)	2.6 (1.8, 3.7)	2.9 (2.0, 4.2)
Nexgen LPS Flex	Nexgen	1269	34853	332	57	210	670	1.7 (1.6, 1.9)	3.2 (3.0, 3.4)	5.2 (4.9, 5.5)
Nexgen LPS Flex	Nexgen TM LPS	55	1525	25	4	5	21	1.9 (1.3, 2.7)	3.3 (2.5, 4.4)	4.0 (3.1, 5.3)
Optetrak-CR	Optetrak*	42	504	13	3	4	22	3.2 (2.0, 5.2)	6.0 (4.2, 8.5)	8.4 (6.1, 11.6)
Optetrak-PS	Optetrak	214	2361	80	4	27	103	3.4 (2.8, 4.2)	6.3 (5.3, 7.3)	9.8 (8.5, 11.2)
Optetrak-PS	Optetrak RBK	72	1099	17	2	3	50	2.8 (2.0, 4.0)	5.9 (4.5, 7.6)	8.8 (6.9, 11.1)
PFC Sigma CR	AMK Duofix*	60	1890	19	.	1	40	1.2 (0.8, 1.8)	2.3 (1.7, 3.1)	3.1 (2.4, 4.1)
PFC Sigma CR	MBT	294	6017	52	33	43	166	2.7 (2.3, 3.2)	4.1 (3.6, 4.6)	5.2 (4.6, 5.8)
PFC Sigma CR	MBT Duofix	135	2987	21	17	3	94	2.7 (2.2, 3.4)	3.9 (3.2, 4.7)	5.5 (4.6, 6.6)

Femoral Component	Tibial Component	N Revised	N Total	Type of Revision				2 Yrs	5 Yrs	10 Yrs
				TKR	Femoral	Tibial	Other			
PFC Sigma CR	PFC Sigma	740	23776	175	52	60	453	1.5 (1.3, 1.7)	2.5 (2.3, 2.7)	3.5 (3.2, 3.8)
PFC Sigma PS	MBT	297	6281	90	13	21	173	2.1 (1.8, 2.5)	3.7 (3.3, 4.2)	5.3 (4.7, 6.0)
PFC Sigma PS	MBT Duofix	154	2212	28	4	6	116	3.6 (2.9, 4.5)	6.4 (5.4, 7.6)	8.6 (7.3, 10.1)
PFC Sigma PS	PFC Sigma	318	7737	105	10	25	178	1.9 (1.6, 2.2)	3.2 (2.9, 3.7)	4.8 (4.3, 5.4)
Profix	Profix Mobile*	103	986	32	6	5	60	5.1 (3.9, 6.7)	8.2 (6.6, 10.1)	9.8 (8.0, 11.8)
Profix	Profix*	281	5370	64	13	18	186	2.3 (1.9, 2.8)	3.8 (3.3, 4.3)	5.4 (4.8, 6.0)
Profix Oxinium (ctd)	Profix*	98	1049	21	4	14	59	4.1 (3.1, 5.5)	7.0 (5.6, 8.7)	8.8 (7.2, 10.7)
RBK	RBK	480	10514	180	13	39	248	2.4 (2.1, 2.7)	4.0 (3.6, 4.4)	5.4 (4.9, 6.0)
Rocc	Rocc*	38	575	12	1	2	23	3.3 (2.1, 5.2)	5.2 (3.6, 7.3)	6.8 (5.0, 9.3)
Rotaglide Plus	Rotaglide Plus*	77	616	35	1	5	36	3.3 (2.2, 5.1)	5.8 (4.1, 8.0)	11.2 (8.8, 14.2)
Score	Score	238	4378	74	19	10	135	3.3 (2.8, 4.0)	6.2 (5.4, 7.2)	10.5 (8.7, 12.6)
Scorpio CR	Scorpio+*	185	2448	43	10	29	103	2.0 (1.5, 2.7)	4.3 (3.6, 5.2)	7.1 (6.1, 8.2)
Scorpio CR	Series 7000	578	11561	145	27	46	360	1.8 (1.6, 2.1)	3.3 (3.0, 3.7)	5.2 (4.8, 5.7)
Scorpio NRG CR	Series 7000	171	5070	41	12	13	105	2.1 (1.7, 2.5)	3.1 (2.6, 3.7)	4.6 (3.9, 5.4)
Scorpio NRG PS	Series 7000	155	3931	25	8	19	103	2.0 (1.6, 2.5)	3.7 (3.1, 4.4)	4.7 (4.0, 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, 8.7)
Scorpio PS	Scorpio+*	145	2036	37	14	10	84	2.7 (2.1, 3.5)	5.1 (4.2, 6.2)	6.8 (5.7, 8.0)
Scorpio PS	Series 7000	327	4696	105	9	65	148	2.6 (2.1, 3.1)	4.7 (4.1, 5.3)	6.8 (6.1, 7.6)
Triathlon CR	Triathlon	1778	82250	298	81	95	1304	1.5 (1.5, 1.6)	2.5 (2.4, 2.7)	3.7 (3.5, 3.9)
Triathlon PS	Triathlon	423	11365	73	26	54	270	2.4 (2.1, 2.7)	4.0 (3.6, 4.4)	5.3 (4.8, 5.9)
Vanguard CR	Vanguard	707	24267	146	29	60	472	1.7 (1.6, 1.9)	3.0 (2.8, 3.3)	5.1 (4.6, 5.6)
Vanguard PS	Vanguard	264	4785	62	7	54	141	3.4 (2.9, 3.9)	5.3 (4.7, 6.1)	7.8 (6.7, 9.1)
TOTAL		**22429**	**561468**	**5895**	**1066**	**2059**	**13409**			

Note: Only prosthesis combinations with over 350 procedures have been listed
*Denotes prosthesis combinations with no reported use in primary total knee procedures in 2018
CR 'cruciate retaining' refers to minimally stabilised
Green: prosthesis combination qualifies for superiority benchmark
Blue: prosthesis combination qualifies for non inferiority benchmark

FIFTEEN YEAR OUTCOMES

This year, the Registry is reporting 15 year outcomes for 56 hip and 42 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 52.1% of all primary total conventional hip replacement procedures performed for osteoarthritis. Of the 56 combinations, 25 had no reported use in 2018.
The 15 year cumulative percent revision ranges from 2.7% to 20.6%. 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 49.9% of all primary total knee replacement procedures performed for osteoarthritis. Of the 42 combinations, 17 had no reported use in 2018.

The 15 year cumulative percent revision ranges from 4.3% to 15.5%. Seven of the combinations have a cumulative percent revision of less than 6.5% and 2 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 Combinations with 15 Year Data (Primary Diagnosis OA)

Femoral Component	Acetabular Component	N Revised	N Total	Type of Revision: THR	Femoral	Acetabular	Other	5 Yrs	10 Yrs	15 Yrs
ABGII	ABGII	278	2769	38	136	71	33	4.2 (3.5, 5.0)	6.9 (5.9, 7.9)	11.6 (10.3, 13.1)
ABGII	ABGII (Shell/Insert)	66	852	13	37	12	4	2.8 (1.8, 4.1)	6.4 (4.9, 8.5)	11.1 (8.5, 14.3)
ABGII	Trident (Shell)	225	2439	13	137	31	44	4.9 (4.1, 5.9)	8.6 (7.4, 9.9)	14.4 (12.4, 16.6)
Accolade I	Trident (Shell)	461	8573	53	179	89	140	3.7 (3.3, 4.2)	5.6 (5.1, 6.2)	7.0 (6.3, 7.8)
Alloclassic	Allofit	262	5059	29	106	48	79	2.8 (2.4, 3.3)	5.0 (4.4, 5.7)	8.4 (7.2, 9.7)
Alloclassic	Fitmore*	121	1709	12	62	12	35	5.6 (4.6, 6.8)	7.3 (6.1, 8.8)	9.1 (7.4, 11.2)
Alloclassic	Metasul*	22	371	4	2	11	5	3.6 (2.1, 6.1)	5.2 (3.3, 8.1)	6.6 (4.4, 9.9)
C-Stem	Duraloc*	84	894	11	22	14	37	3.8 (2.7, 5.3)	6.9 (5.3, 8.9)	12.7 (10.1, 15.9)
C-Stem	Elite Plus LPW*	21	367	10	4	7	.	2.7 (1.4, 5.0)	5.3 (3.3, 8.6)	8.9 (5.6, 14.1)
CLS	Allofit	56	809	5	31	13	7	4.0 (2.8, 5.6)	6.2 (4.6, 8.2)	9.4 (6.9, 12.7)
CLS	Fitmore	47	810	5	22	7	13	4.3 (3.0, 6.1)	5.8 (4.2, 7.9)	8.7 (6.5, 11.8)
CORAIL	Duraloc*	83	1267	13	37	13	20	2.5 (1.8, 3.6)	5.3 (4.1, 6.9)	10.9 (8.6, 13.8)
CORAIL	PINNACLE	1344	43071	116	482	212	534	3.1 (3.0, 3.3)	5.2 (4.8, 5.5)	6.8 (5.9, 7.9)
CPCS	Reflection (Cup)	63	756	21	2	27	13	2.7 (1.7, 4.2)	8.5 (6.2, 11.5)	20.6 (15.6, 27.0)
CPCS	Reflection (Shell)	85	2689	10	37	11	27	1.6 (1.2, 2.2)	3.5 (2.7, 4.5)	7.3 (5.2, 10.1)
CPT	Trilogy	307	7425	29	106	34	138	3.4 (3.0, 3.9)	5.0 (4.5, 5.7)	6.6 (5.7, 7.7)
CPT	ZCA	35	829	13	7	9	6	2.3 (1.4, 3.6)	5.0 (3.4, 7.3)	7.0 (4.7, 10.3)
Charnley	Charnley Ogee*	62	630	36	9	5	12	5.1 (3.6, 7.2)	9.1 (7.0, 11.9)	14.3 (11.0, 18.4)
Charnley	Charnley*	44	563	34	7	3	.	2.2 (1.3, 3.9)	6.3 (4.4, 8.9)	12.1 (8.8, 16.4)
Charnley	Vitalock*	40	370	7	19	3	11	4.4 (2.7, 7.1)	7.9 (5.5, 11.4)	11.6 (8.4, 15.8)
Citation	**Trident (Shell)***	**51**	**1035**	**3**	**12**	**13**	**23**	**3.3 (2.4, 4.6)**	**4.3 (3.2, 5.7)**	**6.0 (4.5, 8.1)**
Citation	Vitalock*	40	508	3	7	14	16	2.0 (1.1, 3.7)	5.2 (3.5, 7.7)	9.1 (6.7, 12.5)
Elite Plus	Duraloc*	102	953	14	61	6	21	5.1 (3.9, 6.8)	8.9 (7.1, 11.1)	14.6 (12.0, 17.7)
Epoch	**Trilogy***	**45**	**990**	**1**	**9**	**9**	**26**	**3.6 (2.6, 4.9)**	**4.6 (3.4, 6.1)**	**5.1 (3.8, 7.0)**
Exeter	Contemporary*	37	428	9	7	13	8	4.2 (2.6, 6.6)	6.0 (4.0, 8.9)	12.6 (9.0, 17.3)
Exeter	Vitalock*	65	1076	9	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)**	**3.4 (2.4, 4.8)**	**4.5 (3.2, 6.3)**
Exeter V40	Contemporary	254	4507	59	41	122	32	3.3 (2.8, 3.9)	5.8 (5.0, 6.6)	9.6 (8.2, 11.2)

Femoral Component	Acetabular Component	N Revised	N Total	Type of Revision THR	Femoral	Acetabular	Other	5 Yrs	10 Yrs	15 Yrs
Exeter V40	Exeter Contemporary	141	2891	45	31	43	22	3.0 (2.4, 3.7)	4.7 (3.9, 5.7)	9.0 (7.0, 11.4)
Exeter V40	Exeter*	93	1526	19	15	41	18	2.9 (2.1, 3.9)	4.7 (3.7, 6.0)	9.7 (7.6, 12.2)
Exeter V40	**Mallory-Head**	**35**	**1424**	**5**	**20**	**3**	**7**	**1.0 (0.6, 1.7)**	**2.4 (1.7, 3.6)**	**4.2 (2.8, 6.1)**
Exeter V40	**Trident (Shell)**	**1427**	**55104**	**191**	**430**	**204**	**602**	**2.3 (2.1, 2.4)**	**3.7 (3.5, 3.9)**	**5.3 (4.9, 5.7)**
Exeter V40	**Vitalock***	**78**	**1795**	**15**	**22**	**23**	**18**	**2.3 (1.7, 3.1)**	**3.2 (2.5, 4.2)**	**5.1 (4.0, 6.5)**
F2L	SPH-Blind*	60	571	10	20	15	15	6.1 (4.4, 8.4)	7.6 (5.7, 10.2)	11.7 (9.1, 15.0)
MS 30	Allofit	59	1539	11	18	18	12	2.1 (1.4, 2.9)	3.8 (2.8, 5.1)	8.0 (5.7, 11.2)
MS 30	**Fitmore**	**22**	**647**	**1**	**4**	**8**	**9**	**1.9 (1.0, 3.5)**	**2.8 (1.6, 4.8)**	**6.4 (3.9, 10.2)**
MS 30	**Low Profile Cup**	**20**	**602**	**8**	**2**	**8**	**2**	**1.3 (0.6, 2.8)**	**2.7 (1.5, 4.7)**	**5.3 (3.1, 8.9)**
Mallory-Head	Mallory-Head	174	2908	16	13	56	89	3.0 (2.4, 3.7)	4.9 (4.1, 5.8)	9.1 (7.7, 10.7)
Meridian	Vitalock*	35	354	2	2	15	16	3.5 (2.0, 6.1)	6.7 (4.4, 10.0)	10.7 (7.7, 14.8)
Natural Hip	**Allofit***	**12**	**529**	**1**	**3**	**3**	**5**	**1.1 (0.5, 2.5)**	**2.4 (1.3, 4.2)**	**2.7 (1.5, 4.7)**
Natural Hip	**Fitmore***	**38**	**882**	**2**	**6**	**12**	**18**	**2.0 (1.3, 3.2)**	**4.1 (2.9, 5.8)**	**4.9 (3.5, 6.8)**
Omnifit	Secur-Fit*	79	716	8	21	18	32	6.2 (4.6, 8.2)	9.9 (7.9, 12.5)	12.7 (10.2, 15.7)
Omnifit	**Trident (Shell)**	**146**	**3732**	**12**	**35**	**23**	**76**	**2.9 (2.4, 3.6)**	**3.8 (3.2, 4.5)**	**5.4 (4.5, 6.5)**
S-Rom	**Duraloc Option***	**25**	**523**	**4**	**9**	**5**	**7**	**3.3 (2.1, 5.2)**	**4.6 (3.1, 6.8)**	**5.0 (3.4, 7.4)**
S-Rom	PINNACLE	125	2386	11	71	12	31	4.4 (3.7, 5.4)	5.8 (4.9, 6.9)	6.7 (5.5, 8.1)
Secur-Fit	**Trident (Shell)**	**376**	**9161**	**22**	**169**	**67**	**118**	**3.4 (3.1, 3.9)**	**4.6 (4.1, 5.1)**	**5.9 (5.2, 6.7)**
Secur-Fit Plus	**Trident (Shell)**	**180**	**5553**	**14**	**46**	**44**	**76**	**2.2 (1.8, 2.6)**	**3.2 (2.7, 3.7)**	**4.4 (3.7, 5.1)**
Spectron EF	Reflection (Cup)	116	1402	43	10	54	9	2.9 (2.2, 4.0)	7.3 (5.8, 9.0)	15.2 (12.4, 18.6)
Spectron EF	Reflection (Shell)	277	4620	59	93	42	83	2.7 (2.3, 3.2)	5.3 (4.6, 6.1)	10.0 (8.7, 11.4)
Stability	Duraloc*	48	374	2	9	13	24	2.2 (1.1, 4.3)	8.9 (6.3, 12.5)	15.8 (12.0, 20.6)
Summit	**PINNACLE**	**122**	**4684**	**7**	**27**	**18**	**70**	**2.3 (1.9, 2.8)**	**3.4 (2.7, 4.1)**	**4.7 (3.5, 6.3)**
Summit	PINNACLE*MoM	68	730	5	5	12	46	3.4 (2.3, 5.0)	8.9 (6.9, 11.3)	11.5 (9.0, 14.6)
Synergy	**Reflection (Shell)**	**334**	**7399**	**31**	**69**	**108**	**126**	**2.6 (2.3, 3.0)**	**3.9 (3.5, 4.4)**	**5.8 (5.1, 6.5)**
Taperloc	M2a*MoM	61	471	11	2	42	6	6.9 (4.9, 9.6)	12.3 (9.6, 15.7)	14.3 (11.2, 18.0)
Taperloc	Mallory-Head	80	1877	7	16	28	29	3.0 (2.3, 3.9)	5.2 (4.0, 6.8)	8.4 (6.3, 11.2)
VerSys	**Trilogy**	**226**	**4430**	**14**	**81**	**39**	**92**	**3.9 (3.3, 4.5)**	**5.1 (4.4, 5.8)**	**5.8 (5.0, 6.6)**
TOTAL		**8792**	**211555**	**1154**	**2854**	**1817**	**2967**			

Note: Only prostheses with over 350 procedures have been listed
MoM refers to metal/metal prosthesis combinations used with head size larger than 32mm
*denotes prosthesis combinations that have not had any reported use in primary total conventional hip procedures in 2018
Bold: prosthesis combination has a cumulative percent revision rate of less than 6.5% at 15 years

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

Femoral Component	Tibial Component	N Revised	N Total	TKR	Femoral	Tibial	Other	5 Yrs	10 Yrs	15 Yrs
				Type of Revision						
AGC	AGC	277	5028	111	5	25	136	3.2 (2.7, 3.7)	4.9 (4.3, 5.6)	7.5 (6.6, 8.5)
Active Knee	Active Knee	644	9358	181	28	38	397	4.8 (4.3, 5.3)	8.2 (7.6, 9.0)	11.9 (10.8, 13.1)
Advance	Advance II	106	1615	41	2	13	50	5.0 (4.0, 6.2)	7.0 (5.7, 8.5)	7.6 (6.2, 9.2)
Advantim	Advantim*	69	1454	34	4	3	28	3.1 (2.3, 4.1)	5.2 (4.0, 6.6)	6.5 (4.9, 8.4)
BalanSys	**BalanSys**	**60**	**3235**	**11**	**3**	**6**	**40**	**2.2 (1.6, 2.9)**	**4.7 (3.2, 6.7)**	**5.9 (3.9, 8.9)**
Duracon	Duracon*	1178	19828	300	30	68	780	3.5 (3.2, 3.7)	5.2 (4.9, 5.5)	7.4 (6.9, 7.8)
Genesis II CR	**Genesis II**	**922**	**23153**	**175**	**64**	**56**	**627**	**3.5 (3.2, 3.7)**	**4.9 (4.5, 5.2)**	**5.9 (5.5, 6.4)**
Genesis II CR	Profix Mobile*	116	1209	46	9	8	53	5.4 (4.2, 6.8)	8.6 (7.1, 10.5)	11.5 (9.5, 13.8)
Genesis II Oxinium CR (ctd)	Genesis II	438	8625	76	26	24	312	3.6 (3.2, 4.1)	6.3 (5.7, 7.0)	9.5 (8.3, 10.7)
Genesis II Oxinium PS (ctd)	Genesis II	1007	18214	121	31	149	706	5.2 (4.9, 5.6)	7.7 (7.2, 8.2)	10.2 (8.7, 12.1)
Genesis II PS	Genesis II	755	18213	122	27	51	555	3.8 (3.5, 4.1)	5.4 (5.0, 5.8)	6.5 (5.9, 7.2)
Kinemax Plus	Kinemax Plus*	120	1815	68	3	5	44	3.2 (2.4, 4.1)	4.6 (3.7, 5.8)	8.2 (6.8, 9.8)
LCS CR	LCS	592	8311	242	23	87	240	4.4 (4.0, 4.9)	6.3 (5.8, 6.9)	8.0 (7.4, 8.7)
LCS CR	**MBT**	**1076**	**29514**	**356**	**47**	**132**	**541**	**3.4 (3.2, 3.6)**	**4.9 (4.5, 5.2)**	**6.3 (5.7, 6.9)**
LCS CR	MBT Duofix	708	14510	196	33	40	439	4.1 (3.8, 4.4)	5.4 (5.0, 5.8)	7.4 (6.7, 8.2)
MBK (Zimmer)	Nexgen*	33	448	18	1	1	13	4.1 (2.6, 6.5)	5.9 (4.0, 8.6)	7.9 (5.6, 11.1)
Maxim	Maxim*	116	1819	33	9	6	68	3.4 (2.6, 4.3)	5.2 (4.2, 6.4)	9.3 (7.6, 11.3)
Maxim	Vanguard*	79	628	32	6	6	35	5.6 (4.0, 7.7)	8.3 (6.3, 10.9)	15.1 (12.0, 18.8)
Natural Knee II	Natural Knee II*	396	6443	171	9	59	157	2.8 (2.4, 3.2)	5.1 (4.6, 5.8)	9.3 (8.3, 10.3)
Nexgen CR	**Nexgen**	**388**	**11351**	**122**	**16**	**31**	**219**	**2.1 (1.9, 2.4)**	**3.1 (2.8, 3.5)**	**4.5 (4.1, 5.0)**
Nexgen CR	Nexgen TM CR	49	833	16	3	10	20	5.5 (4.1, 7.3)	6.5 (4.9, 8.6)	7.2 (5.4, 9.6)
Nexgen LPS	Nexgen	328	6879	82	20	33	193	3.3 (2.8, 3.7)	4.9 (4.4, 5.5)	6.7 (5.9, 7.5)
Nexgen LPS Flex	Nexgen	1269	34853	332	57	210	670	3.2 (3.0, 3.4)	5.2 (4.9, 5.5)	7.3 (6.6, 8.1)
Optetrak-CR	Optetrak*	42	504	13	3	4	22	6.0 (4.2, 8.5)	8.4 (6.1, 11.6)	12.6 (8.8, 17.7)
Optetrak-PS	Optetrak	214	2361	80	4	27	103	6.3 (5.3, 7.3)	9.8 (8.5, 11.2)	12.1 (10.5, 14.0)
PFC Sigma CR	**AMK Duofix***	**60**	**1890**	**19**	**.**	**1**	**40**	**2.3 (1.7, 3.1)**	**3.1 (2.4, 4.1)**	**4.3 (3.2, 5.7)**
PFC Sigma CR	MBT	294	6017	52	33	43	166	4.1 (3.6, 4.6)	5.2 (4.6, 5.8)	7.1 (6.0, 8.3)
PFC Sigma CR	MBT Duofix	135	2987	21	17	3	94	3.9 (3.2, 4.7)	5.5 (4.6, 6.6)	8.4 (6.5, 10.8)
PFC Sigma CR	**PFC Sigma**	**740**	**23776**	**175**	**52**	**60**	**453**	**2.5 (2.3, 2.7)**	**3.5 (3.2, 3.8)**	**5.9 (5.3, 6.7)**
PFC Sigma PS	MBT	297	6281	90	13	21	173	3.7 (3.3, 4.2)	5.3 (4.7, 6.0)	7.1 (6.1, 8.4)
PFC Sigma PS	MBT Duofix	154	2212	28	4	6	116	6.4 (5.4, 7.6)	8.6 (7.3, 10.1)	9.9 (8.3, 11.7)
PFC Sigma PS	PFC Sigma	318	7737	105	10	25	178	3.2 (2.9, 3.7)	4.8 (4.3, 5.4)	7.1 (6.1, 8.2)
Profix	Profix Mobile*	103	986	32	6	5	60	8.2 (6.6, 10.1)	9.8 (8.0, 11.8)	11.6 (9.6, 13.9)
Profix	**Profix***	**281**	**5370**	**64**	**13**	**18**	**186**	**3.8 (3.3, 4.3)**	**5.4 (4.8, 6.0)**	**6.0 (5.3, 6.8)**
Profix Oxinium (ctd)	Profix*	98	1049	21	4	14	59	7.0 (5.6, 8.7)	8.8 (7.2, 10.7)	10.2 (8.4, 12.4)
RBK	RBK	480	10514	180	13	39	248	4.0 (3.6, 4.4)	5.4 (4.9, 6.0)	7.2 (6.2, 8.2)
Rotaglide Plus	Rotaglide Plus*	77	616	35	1	5	36	5.8 (4.1, 8.0)	11.2 (8.8, 14.2)	15.5 (12.4, 19.3)
Scorpio CR	Scorpio+*	185	2448	43	10	29	103	4.3 (3.6, 5.2)	7.1 (6.1, 8.2)	8.8 (7.6, 10.3)
Scorpio CR	Series 7000	578	11561	145	27	46	360	3.3 (3.0, 3.7)	5.2 (4.8, 5.7)	7.1 (6.5, 7.8)
Scorpio PS	Scorpio*	34	524	9	.	11	14	4.5 (3.0, 6.7)	6.1 (4.3, 8.7)	8.1 (5.5, 11.7)
Scorpio PS	Scorpio+*	145	2036	37	14	10	84	5.1 (4.2, 6.2)	6.8 (5.7, 8.0)	8.3 (7.0, 9.8)
Scorpio PS	Series 7000	327	4696	105	9	65	148	4.7 (4.1, 5.3)	6.8 (6.1, 7.6)	9.4 (8.3, 10.7)
TOTAL		**15288**	**320901**	**4140**	**689**	**1493**	**8966**			

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 2018
Bold: prosthesis combination has a cumulative percent revision rate 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.

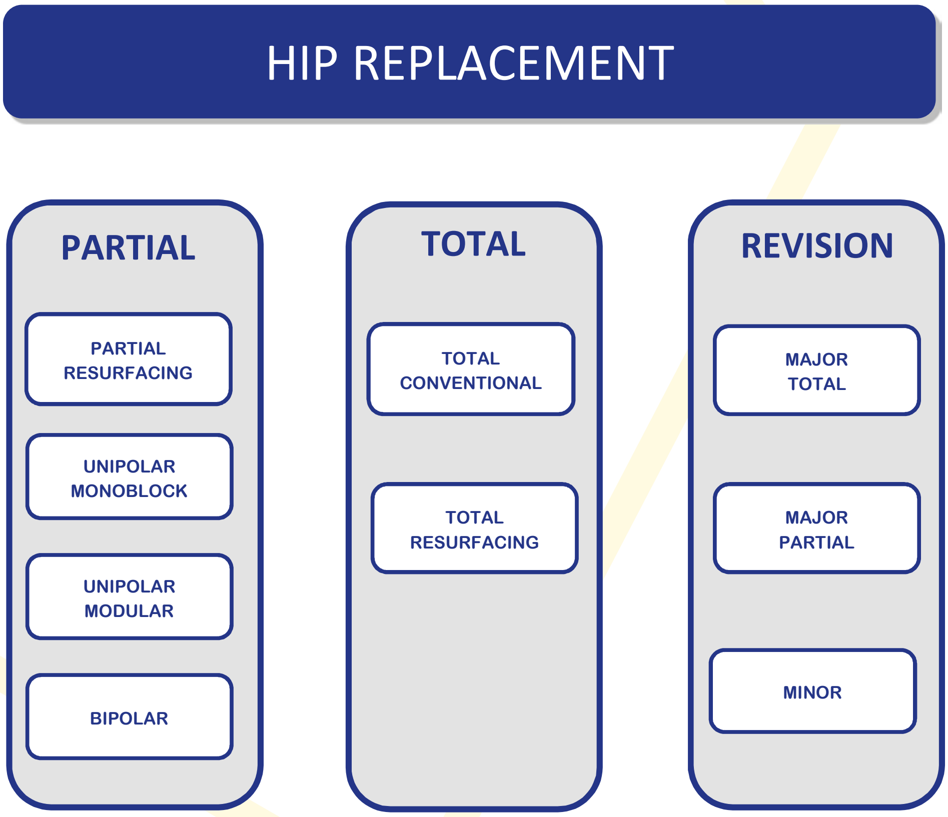
A primary replacement is an initial replacement procedure undertaken on a joint and involves replacing either part (partial) or all (total) of the articular surface.

Primary partial and primary total hip replacement are further sub-categorised into classes depending on the type of prostheses used. Partial hip classes are: partial resurfacing, unipolar monoblock, unipolar modular, and bipolar. Total hip classes are: 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 sub-categorised 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-2019



USE OF HIP REPLACEMENT

This report includes 643,567 hip replacements reported to the Registry with a procedure date up to and including 31 December 2018. This is an additional 49,764 hip procedures compared to the number reported last year. When considering all hip procedures currently recorded by the Registry, primary partial hip accounts for 14.9%, primary total hip 74.2% and revision hip replacement 11.0% (Table H1).

Table H1 Number of Hip Replacements

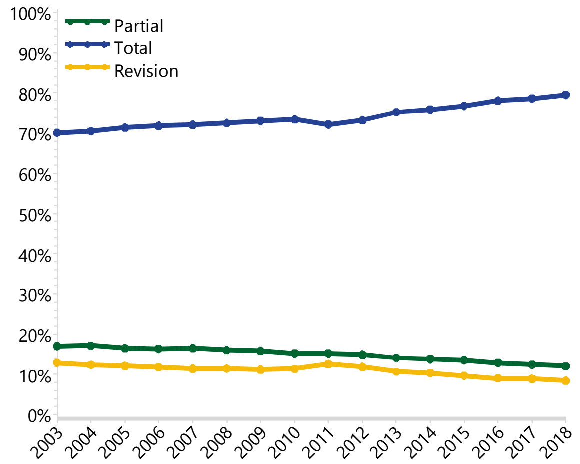
Hip Category	Number	Percent
Partial	95585	14.9
Total	477252	74.2
Revision	70730	11.0
TOTAL	**643567**	**100.0**

The number of hip replacement procedures undertaken in 2018 is 83.4% higher than the number undertaken in 2003. The corresponding increase in primary total hip replacement is 108.1%, primary partial 30.2% and revision hip replacement 19.5%.

The number of hip replacements undertaken in 2018 increased by 806 (1.7%) compared to 2017. During this time, the use of primary total hip replacement increased by 2.9% accounting for 79.5% of all hip replacement procedures in 2018. Primary partial hip replacement decreased by 1.9% accounting for 12.1% of hip procedures in 2018.

The proportion of revision hip procedures has declined from a peak of 12.9% in 2003 to 8.4% in 2018. This equates to 2,201 fewer revision procedures in 2018 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 is 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 is ASA score data on 256,072 hip replacement procedures and BMI data on 159,060 hip replacement procedures. Since its initial collection in 2012, ASA score has been recorded in 94.2% of procedures. BMI data has been recorded in 84.3% of procedures since 2015, when its collection commenced.

In 2018, ASA score is reported in 99.8% of hip replacement procedures and BMI in 89.7% of hip replacement procedures.

There is no variation in reporting of ASA score based on procedure type. However, there is some variation in the reporting of BMI in 2018. The Registry recorded BMI data for 56.0% of primary partial hip, 95.2% of primary total hip, and 86.4% 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 86.0% of procedures, patients have an ASA score of 2 or 3, 8.3% 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 (87.0%) compared to those undergoing primary total hip replacement (36.4%). Revision hip replacement procedures also have patients with higher ASA scores compared to those having a primary total hip replacement, but not as high as patients having a partial hip replacement (59.3% have ASA score 3 or 4) (Table H2).

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 hip replacements, the majority of procedures are undertaken in patients who are normal or pre-obese (60.5%). There is a similar proportion of primary total and revision hip replacement procedures, with patients normal or pre-obese in 59.1% of primary total hip procedures, and in 59.0% of revision hip replacement procedures.

In partial hip replacement procedures, patients generally have a lower BMI, with 59.8% of patients being normal or underweight, when compared to other hip procedure types (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	133	0.4	20109	10.1	1061	4.4	21303	8.3
ASA 2	4036	12.2	106347	53.5	8752	36.3	119135	46.5
ASA 3	20127	60.9	68439	34.4	12394	51.4	100960	39.4
ASA 4	8626	26.1	3968	2.0	1905	7.9	14499	5.7
ASA 5	139	0.4	19	0.0	17	0.1	175	0.1
TOTAL	**33061**	**100.0**	**198882**	**100.0**	**24129**	**100.0**	**256072**	**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	1132	9.7	1404	1.1	225	1.6	2761	1.7
Normal	5868	50.1	29683	22.2	3349	24.3	38900	24.5
Pre Obese	3263	27.8	49238	36.9	4781	34.7	57282	36.0
Obese Class 1	1061	9.1	32766	24.5	3233	23.5	37060	23.3
Obese Class 2	286	2.4	13722	10.3	1415	10.3	15423	9.7
Obese Class 3	110	0.9	6744	5.0	780	5.7	7634	4.8
TOTAL	**11720**	**100.0**	**133557**	**100.0**	**13783**	**100.0**	**159060**	**100.0**

Note: BMI has not been presented for patients aged 19 and under

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. In 2019, it is now provided as a separate supplementary report with the aim of streamlining the Annual Report. The Partial Hip Arthroplasty Report is one of 13 supplementary reports to complete the AOANJRR Annual Report for 2019 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 45.1% of all partial hip procedures, followed by unipolar monoblock (30.2%) and bipolar (24.7%) (Table HP1).

Table HP1 Primary Partial Hip Replacement by Class

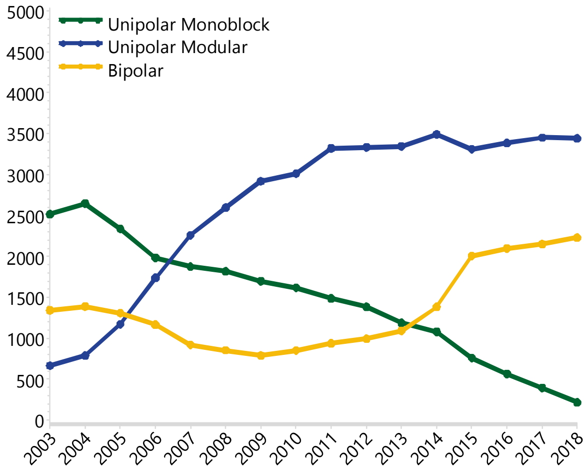
Hip Class	Number	Percent
Unipolar Monoblock	28829	30.2
Unipolar Modular	43116	45.1
Bipolar	23625	24.7
TOTAL	**95570**	**100.0**

Note: Excludes 15 partial resurfacing procedures.

In 2018, there is a slight increase in the use of bipolar and unipolar modular partial hip replacements, and 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 2018, 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-2019

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-2019

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

2003		2015		2016		2017		2018	
N	Model	N	Model	N	Model	N	Model	N	Model
1988	Austin-Moore Type	2644	Exeter V40	2925	Exeter V40	2613	Exeter V40	2760	Exeter V40
810	Exeter V40	820	CPT	752	CPT	719	CPT	787	CPCS
526	Thompson Type	609	CPCS	638	CPCS	699	CPCS	607	CPT
186	Alloclassic	333	Austin-Moore Type	263	ETS	434	C-Stem AMT	452	C-Stem AMT
127	Elite Plus	225	CORAIL	243	CORAIL	239	CORAIL	288	Absolut
105	CPT	222	ETS	197	Austin-Moore Type	227	ETS	159	CORAIL
95	Spectron EF	205	Thompson Type	185	C-Stem AMT	192	Absolut	150	ETS
74	C-Stem	197	Spectron EF	105	Thompson Type	97	Austin-Moore Type	83	Short Exeter V40
65	CPCS	134	C-Stem AMT	101	Spectron EF	95	Spectron EF	77	Quadra-C
63	Omnifit	76	SL-Plus	65	Quadra-C	70	Thompson Type	57	Austin-Moore Type
10 Most Used									
4039	(10) 89.3%	5465	(10) 89.9%	5474	(10) 90.5%	5385	(10) 89.8%	5420	(10) 92.1%
Remainder									
482	(52) 10.7%	611	(54) 10.1%	574	(46) 9.5%	612	(45) 10.2%	466	(36) 7.9%
TOTAL									
4521	(62) 100.0%	6076	(64) 100.0%	6048	(56) 100.0%	5997	(55) 100.0%	5886	(46) 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 (97.7%), unipolar modular (95.5%) and bipolar (91.9%). A comparative analysis of partial hip replacement and total conventional hip replacement was undertaken for fractured neck of femur and is presented in the primary total hip replacement chapter of this report.

The outcome of primary partial hip replacement varies depending on the class. Outcomes are restricted to 10 years because of the high mortality in this group. The prosthesis class variation in mortality is almost certainly due to patient selection (Table HP3). At 10 years, bipolar has the lowest cumulative percent revision for fractured neck of femur, followed by unipolar modular, and unipolar monoblock (Table HP4 and Figure HP2). The difference in outcome between classes is most apparent in patients aged less than 75 years (Table HP5 and Figure HP3).

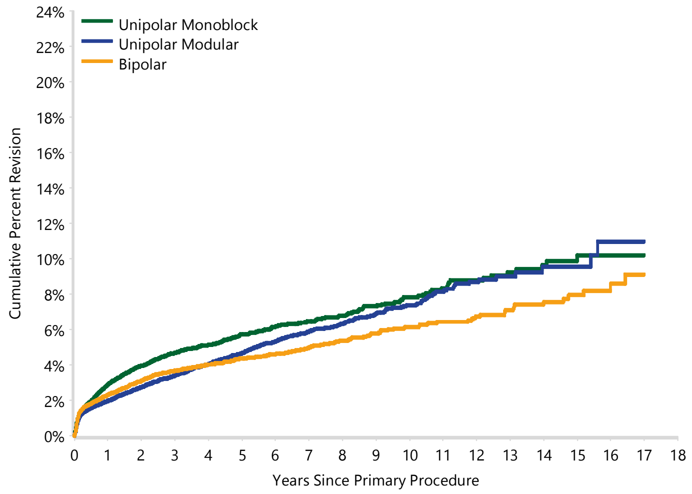
Table HP3 Cumulative Percent Mortality of Primary Partial Hip Replacement by Class (Primary Diagnosis Fractured NOF)

Hip Class	N Deceased	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Monoblock	24204	27441	36.9 (36.3, 37.5)	50.0 (49.4, 50.6)	60.7 (60.2, 61.3)	76.7 (76.1, 77.2)	85.9 (85.5, 86.3)	93.1 (92.8, 93.5)
Unipolar Modular	24992	39834	24.9 (24.4, 25.3)	35.5 (35.0, 36.0)	45.1 (44.6, 45.6)	61.1 (60.5, 61.6)	72.5 (72.0, 73.1)	83.0 (82.4, 83.5)
Bipolar	12863	21153	22.2 (21.6, 22.8)	32.1 (31.5, 32.8)	40.9 (40.1, 41.6)	55.3 (54.6, 56.1)	66.6 (65.8, 67.4)	78.2 (77.4, 79.0)
TOTAL	**62059**	**88428**						

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	1069	28152	2.9 (2.7, 3.1)	3.9 (3.7, 4.2)	4.7 (4.4, 5.0)	5.7 (5.4, 6.1)	6.5 (6.0, 6.9)	7.8 (7.2, 8.5)
Unipolar Modular	1371	41158	2.0 (1.8, 2.1)	2.7 (2.6, 2.9)	3.4 (3.2, 3.6)	4.7 (4.4, 5.0)	5.9 (5.5, 6.3)	7.4 (6.8, 8.0)
Bipolar	745	21717	2.3 (2.1, 2.5)	3.1 (2.9, 3.4)	3.7 (3.4, 4.0)	4.4 (4.0, 4.7)	4.9 (4.5, 5.4)	6.2 (5.6, 6.8)
TOTAL	**3185**	**91027**						

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=1.40 (1.29, 1.52),p<0.001

Unipolar Monoblock vs Bipolar
0 - 2Wk: HR=1.71 (1.30, 2.27),p<0.001
2Wk - 3Mth: HR=1.02 (0.87, 1.21),p=0.772
3Mth+: HR=1.79 (1.59, 2.02),p<0.001

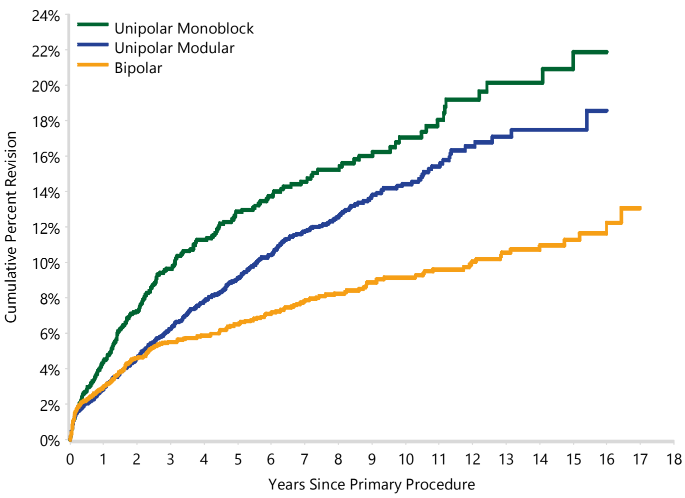
Bipolar vs Unipolar Modular
0 - 3Mth: HR=1.17 (1.03, 1.34),p=0.019
3Mth - 2.5Yr: HR=0.89 (0.78, 1.02),p=0.101
2.5Yr+: HR=0.64 (0.54, 0.77),p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Monoblock	28152	17129	13257	10163	5651	3129	1247
Unipolar Modular	41158	27862	21765	16761	9518	5103	1747
Bipolar	21717	14943	11687	9077	5575	3612	1898

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	237	2438	4.4 (3.6, 5.4)	7.3 (6.2, 8.5)	9.6 (8.3, 11.2)	12.8 (11.2, 14.7)	14.6 (12.7, 16.6)	17.1 (14.8, 19.6)
Unipolar Modular	512	6461	2.9 (2.5, 3.3)	4.6 (4.0, 5.2)	6.3 (5.6, 7.0)	9.1 (8.2, 10.0)	11.8 (10.7, 12.9)	14.4 (13.1, 15.9)
Bipolar	260	4206	3.0 (2.5, 3.6)	4.6 (4.0, 5.4)	5.5 (4.8, 6.4)	6.5 (5.7, 7.5)	7.8 (6.8, 8.9)	9.1 (8.0, 10.4)
TOTAL	**1009**	**13105**						

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=1.15 (0.80, 1.65),p=0.444
3Mth+: HR=2.19 (1.81, 2.65),p<0.001

Unipolar Monoblock vs Unipolar Modular
Entire Period: HR=1.36 (1.17, 1.59),p<0.001

Unipolar Modular vs Bipolar
0 - 2.5Yr: HR=1.07 (0.89, 1.27),p=0.489
2.5Yr+: HR=2.25 (1.80, 2.81),p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Monoblock	2438	1655	1364	1125	763	543	292
Unipolar Modular	6461	4881	4080	3396	2353	1551	695
Bipolar	4206	3216	2663	2262	1672	1269	874

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-2019

Primary Total Hip Replacement

CLASSES OF TOTAL HIP REPLACEMENT

A total hip procedure replaces both the femoral and acetabular articular surfaces. The Registry sub-categorises 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-2019

USE OF TOTAL HIP REPLACEMENT

The Registry has recorded 476,994 primary total hip replacement procedures. Of these, total conventional is the most common class (96.3%), followed by total resurfacing (3.7%) (Table HT1).

Table HT1 Primary Total Hip Replacement by Class

Total Hip Class	Number	Percent
Total Conventional	459265	96.3
Total Resurfacing	17729	3.7
TOTAL	**476994**	**100.0**

Osteoarthritis is the principal diagnosis for primary total hip replacement (88.6%).

Total conventional hip replacement (all bearing surfaces included) has a lower cumulative percent revision compared to total resurfacing at 18 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	18 Yrs
Total Conventional	21299	459265	1.7 (1.7, 1.8)	2.8 (2.7, 2.8)	3.7 (3.7, 3.8)	6.4 (6.3, 6.5)	9.5 (9.3, 9.7)	11.4 (11.1, 11.8)
Total Resurfacing	1732	17729	1.7 (1.5, 1.9)	3.2 (3.0, 3.5)	4.9 (4.6, 5.3)	9.4 (8.9, 9.8)	12.7 (12.1, 13.3)	13.8 (13.0, 14.6)
TOTAL	**23031**	**476994**						

PRIMARY TOTAL CONVENTIONAL HIP REPLACEMENT

DEMOGRAPHICS

There have been 459,265 primary total conventional hip replacement procedures reported to the Registry. This is an additional 39,005 procedures compared to the previous report.

There was a small increase of 3.0% in primary total conventional hip replacement procedures performed in 2018 compared to the previous year. There has been a 124.9% increase since 2003.

Primary total conventional hip replacement is more common in females (54.9%). This proportion has remained stable since 2003 (Figure HT1).

Figure HT2 Primary Total Conventional Hip Replacement by Age

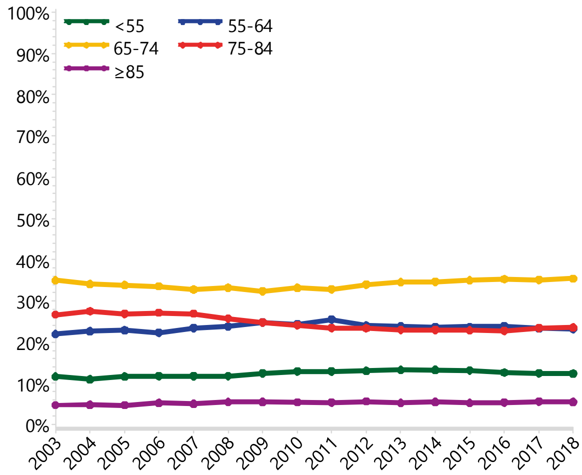
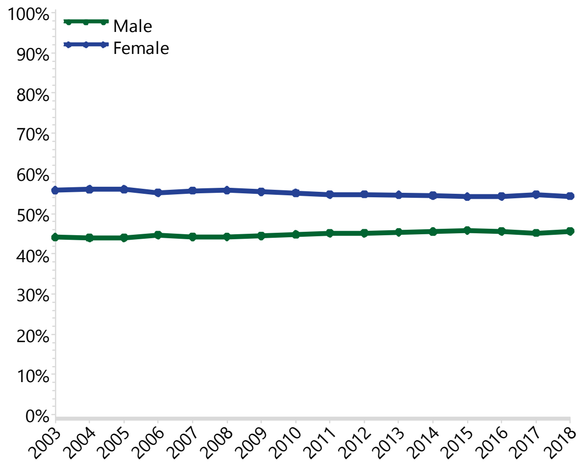
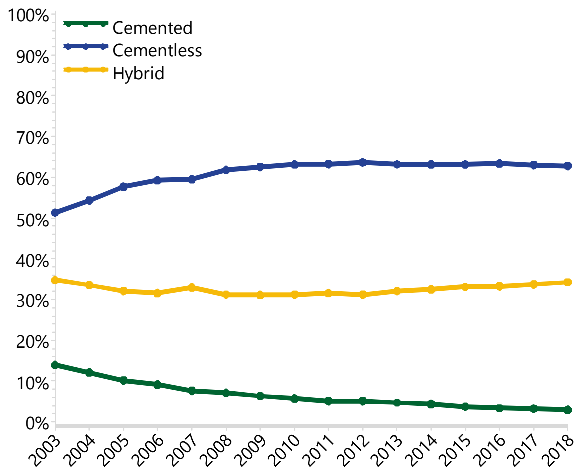


Figure HT1 Primary Total Conventional Hip Replacement by Gender



The use of cementless fixation has increased from 51.3% in 2003 to 62.8% in 2018. Cemented fixation has declined from 13.9% to 3.0% and hybrid fixation from 34.8% to 34.2% 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 to 64 years (21.9% in 2003 to 23.2% in 2018) and patients <55 years (11.7% in 2003 to 12.4% in 2018) (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	206997	45.1%	12	102	67	66.3	11.5
Female	252268	54.9%	11	101	70	68.9	11.4
TOTAL	**459265**	**100.0%**	**11**	**102**	**69**	**67.7**	**11.5**

The Exeter V40, CORAIL, and Polarstem are the most used femoral stems for primary total conventional hip replacement (Table HT4). In 2018, 65.3% 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 2018, the 10 most used cemented stems account for 93.3% of cemented stem procedures. The 10 most used cementless stems account for 73.3% of cementless stem procedures.

The Trident (Shell), PINNACLE, and R3 remain the most frequently used acetabular prostheses for primary total conventional hip replacement. In 2018, 81.7% 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		2015		2016		2017		2018	
N	Model	N	Model	N	Model	N	Model	N	Model
3901	Exeter V40	7466	Exeter V40	7498	Exeter V40	7312	Exeter V40	7282	Exeter V40
1029	ABGII	5421	CORAIL	5862	CORAIL	5372	CORAIL	5283	CORAIL
1000	Synergy	2843	Quadra-H	2755	Quadra-H	1937	Quadra-H	2228	Polarstem
819	Alloclassic	1519	Polarstem	1827	Polarstem	1925	Polarstem	2116	Metafix
809	VerSys	1303	CPT	1326	Accolade II	1839	Accolade II	2063	Quadra-H
780	Spectron EF	905	Accolade II	1232	CPT	1577	Metafix	1961	Accolade II
713	Secur-Fit Plus	844	Taperloc	990	Taperloc	1238	CPT	1165	Paragon
618	Omnifit	815	CPCS	809	CPCS	1027	Taperloc	1148	CPT
565	C-Stem	779	Anthology	787	Tri-Fit TS	1016	AMIStem H	933	Taperloc
485	S-Rom	579	Tri-Fit TS	785	AMIStem H	871	C-Stem AMT	892	CPCS
10 Most Used									
10719	(10) 62.8%	22474	(10) 66.1%	23871	(10) 66.0%	24114	(10) 64.7%	25071	(10) 65.3%
Remainder									
6354	(73) 37.2%	11543	(99) 33.9%	12294	(91) 34.0%	13176	(93) 35.3%	13330	(87) 34.7%
TOTAL									
17073	(83) 100.0%	34017	(109) 100.0%	36165	(101) 100.0%	37290	(103) 100.0%	38401	(97) 100.0%

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

2003		2015		2016		2017		2018	
N	Model	N	Model	N	Model	N	Model	N	Model
3901	Exeter V40	7466	Exeter V40	7498	Exeter V40	7312	Exeter V40	7282	Exeter V40
780	Spectron EF	1303	CPT	1232	CPT	1238	CPT	1148	CPT
565	C-Stem	815	CPCS	809	CPCS	871	C-Stem AMT	892	CPCS
477	CPT	412	C-Stem AMT	621	C-Stem AMT	854	CPCS	874	C-Stem AMT
445	Elite Plus	332	MS 30	508	Short Exeter V40	556	Short Exeter V40	716	Quadra-C
358	MS 30	288	Quadra-C	412	Quadra-C	543	Quadra-C	676	Short Exeter V40
338	Omnifit	270	Evolve	369	Evolve	442	Evolve	580	Taper Fit
321	Charnley	263	Short Exeter V40	357	MS 30	392	MS 30	390	MS 30
245	CPCS	241	Spectron EF	227	Taper Fit	315	Taper Fit	382	Evolve
123	Exeter	162	Taper Fit	181	Spectron EF	235	Absolut	338	Absolut
10 Most Used									
7553	(10) 91.7%	11552	(10) 92.8%	12214	(10) 92.8%	12758	(10) 92.9%	13278	(10) 93.3%
Remainder									
680	(26) 8.3%	892	(24) 7.2%	942	(17) 7.2%	975	(22) 7.1%	951	(21) 6.7%
TOTAL									
8233	(36) 100.0%	12444	(34) 100.0%	13156	(27) 100.0%	13733	(32) 100.0%	14229	(31) 100.0%

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

2003		2015		2016		2017		2018	
N	Model	N	Model	N	Model	N	Model	N	Model
1029	ABGII	5421	CORAIL	5862	CORAIL	5372	CORAIL	5283	CORAIL
980	Synergy	2843	Quadra-H	2755	Quadra-H	1937	Quadra-H	2228	Polarstem
819	Alloclassic	1519	Polarstem	1827	Polarstem	1925	Polarstem	2116	Metafix
739	VerSys	905	Accolade II	1326	Accolade II	1839	Accolade II	2063	Quadra-H
713	Secur-Fit Plus	844	Taperloc	990	Taperloc	1577	Metafix	1961	Accolade II
485	S-Rom	779	Anthology	787	Tri-Fit TS	1027	Taperloc	1165	Paragon
482	Secur-Fit	579	Tri-Fit TS	785	AMIStem H	1016	AMIStem H	933	Taperloc
376	CORAIL	565	Avenir	699	Anthology	797	Tri-Fit TS	849	AMIStem H
334	Accolade I	551	Secur-Fit	646	Metafix	781	Paragon	573	Anthology
334	Mallory-Head	475	Metafix	544	Paragon	683	Anthology	547	Tri-Fit TS
10 Most Used									
6291	(10) 71.2%	14481	(10) 67.1%	16221	(10) 70.5%	16954	(10) 72.0%	17718	(10) 73.3%
Remainder									
2549	(47) 28.8%	7092	(74) 32.9%	6788	(72) 29.5%	6603	(69) 28.0%	6454	(64) 26.7%
TOTAL									
8840	(57) 100.0%	21573	(84) 100.0%	23009	(82) 100.0%	23557	(79) 100.0%	24172	(74) 100.0%

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

2003		2015		2016		2017		2018	
N	Model	N	Model	N	Model	N	Model	N	Model
3986	Trident (Shell)	7473	Trident (Shell)	7835	Trident (Shell)	8122	Trident (Shell)	8450	Trident (Shell)
1748	Reflection (Shell)	6617	PINNACLE	6939	PINNACLE	6585	PINNACLE	6333	PINNACLE
1524	Trilogy	3635	R3	3767	R3	3803	R3	3838	R3
955	Vitalock	3031	Versafitcup CC	2751	Versafitcup CC	2953	Trinity	3657	Trinity
907	Duraloc	1577	Trinity	1987	Trinity	2059	Versafitcup CC	1893	Mpact
827	ABGII	1359	Continuum	1327	Continuum	1397	Mpact	1824	Versafitcup CC
793	Allofit	892	Trilogy	1133	Mpact	1293	Continuum	1475	G7
729	Mallory-Head	769	Trident/Tritanium (Shell)	1107	Trident/Tritanium (Shell)	1252	Logical G	1429	Logical G
539	Contemporary	635	Acetabular Shell (Global)	801	Logical G	1142	Trident/Tritanium (Shell)	1303	Acetabular Shell (Global)
537	PINNACLE	608	Exeter X3 Rimfit	759	Acetabular Shell (Global)	1050	G7	1185	Continuum
10 Most Used									
12545 (10) 73.5%		26596 (10) 78.2%		28406 (10) 78.5%		29656 (10) 79.5%		31387 (10) 81.7%	
Remainder									
4528 (69) 26.5%		7421 (67) 21.8%		7759 (70) 21.5%		7634 (68) 20.5%		7014 (62) 18.3%	
TOTAL									
17073 (79) 100.0%		34017 (77) 100.0%		36165 (80) 100.0%		37290 (78) 100.0%		38401 (72) 100.0%	

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

2003		2015		2016		2017		2018	
N	Model	N	Model	N	Model	N	Model	N	Model
539	Contemporary	608	Exeter X3 Rimfit	538	Exeter X3 Rimfit	503	Exeter X3 Rimfit	528	Exeter X3 Rimfit
256	Exeter	181	Contemporary	140	Contemporary	110	Marathon	103	Contemporary
251	Reflection (Cup)	130	Marathon	118	Marathon	96	ZCA	80	ZCA
227	Exeter Contemporary	104	ZCA	105	Exeter Contemporary	94	Contemporary	79	Marathon
199	Charnley Ogee	81	Reflection (Cup)	78	ZCA	68	Reflection (Cup)	52	Reflection (Cup)
149	Elite Plus LPW	52	Exeter Contemporary	66	Reflection (Cup)	67	Exeter Contemporary	51	Novae E
130	Low Profile Cup	21	CCB	37	Muller	47	Avantage	39	Avantage
110	Elite Plus Ogee	20	Low Profile Cup	24	Avantage	45	Novae E	33	Apricot
102	Charnley	17	Muller	17	Low Profile Cup	38	Muller	32	Exeter Contemporary
90	ZCA	12	Polarcup	15	Polarcup	26	Apricot	22	Muller
10 Most Used									
2053 (10) 85.4%		1226 (10) 96.2%		1138 (10) 92.8%		1094 (10) 90.2%		1019 (10) 89.8%	
Remainder									
351 (16) 14.6%		49 (14) 3.8%		88 (14) 7.2%		119 (19) 9.8%		116 (18) 10.2%	
TOTAL									
2404 (26) 100.0%		1275 (24) 100.0%		1226 (24) 100.0%		1213 (29) 100.0%		1135 (28) 100.0%	

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

2003		2015		2016		2017		2018	
N	Model	N	Model	N	Model	N	Model	N	Model
3986	Trident (Shell)	7472	Trident (Shell)	7833	Trident (Shell)	8122	Trident (Shell)	8450	Trident (Shell)
1748	Reflection (Shell)	6617	PINNACLE	6939	PINNACLE	6585	PINNACLE	6332	PINNACLE
1524	Trilogy	3635	R3	3767	R3	3803	R3	3838	R3
955	Vitalock	3030	Versafitcup CC	2751	Versafitcup CC	2953	Trinity	3657	Trinity
907	Duraloc	1577	Trinity	1987	Trinity	2059	Versafitcup CC	1892	Mpact
827	ABGII	1359	Continuum	1327	Continuum	1397	Mpact	1824	Versafitcup CC
793	Allofit	892	Trilogy	1133	Mpact	1292	Continuum	1475	G7
729	Mallory-Head	769	Trident/Tritanium (Shell)	1107	Trident/Tritanium (Shell)	1252	Logical G	1429	Logical G
537	PINNACLE	635	Acetabular Shell (Global)	801	Logical G	1142	Trident/Tritanium (Shell)	1303	Acetabular Shell (Global)
521	Fitmore	539	G7	759	Acetabular Shell (Global)	1050	G7	1184	Continuum
10 Most Used									
12527	(10) 85.4%	26525	(10) 81.0%	28404	(10) 81.3%	29655	(10) 82.2%	31384	(10) 84.2%
Remainder									
2142	(43) 14.6%	6217	(52) 19.0%	6535	(54) 18.7%	6422	(48) 17.8%	5882	(43) 15.8%
TOTAL									
14669	(53) 100.0%	32742	(62) 100.0%	34939	(64) 100.0%	36077	(58) 100.0%	37266	(53) 100.0%

Note: In 2018, three 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 increasingly small proportion of procedures (currently 3.5%) and has a much higher rate of revision than other bearing surfaces (28.7% 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 2018, 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 2018 and make up a small proportion of all primary total conventional hip replacement procedures (1.3%).

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 (88.3%), followed by fractured neck of femur (4.6%), osteonecrosis (3.2%), developmental dysplasia (1.3%), rheumatoid arthritis (0.9%) and tumour (0.6%) (Table HT10).

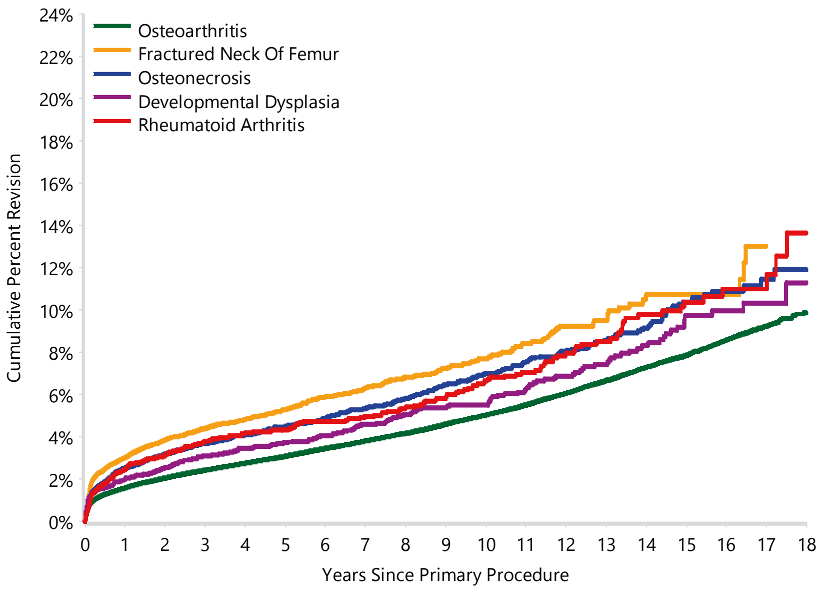
Osteoarthritis has a lower rate of revision compared to fractured neck of femur, osteonecrosis and rheumatoid arthritis. It also has a lower rate of revision compared to developmental dysplasia. However, this difference is only evident in the first 2 weeks (Figure HT4).

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	18 Yrs
Osteoarthritis	14533	386101	1.6 (1.5, 1.6)	2.4 (2.4, 2.5)	3.1 (3.0, 3.2)	5.0 (4.9, 5.1)	7.9 (7.7, 8.0)	9.9 (9.5, 10.3)
Fractured Neck Of Femur	993	20296	3.0 (2.8, 3.3)	4.4 (4.1, 4.7)	5.3 (4.9, 5.7)	7.7 (7.1, 8.3)	10.7 (9.5, 12.1)	
Osteonecrosis	745	14156	2.5 (2.3, 2.8)	3.7 (3.4, 4.0)	4.5 (4.1, 4.9)	7.0 (6.5, 7.6)	10.4 (9.4, 11.5)	11.9 (10.4, 13.6)
Developmental Dysplasia	264	5466	2.0 (1.7, 2.4)	3.1 (2.6, 3.6)	3.7 (3.2, 4.3)	5.5 (4.8, 6.3)	9.7 (8.3, 11.3)	11.3 (9.0, 14.1)
Rheumatoid Arthritis	240	4096	2.5 (2.0, 3.0)	3.8 (3.2, 4.4)	4.3 (3.7, 5.1)	6.7 (5.8, 7.7)	10.4 (8.9, 12.1)	13.6 (10.5, 17.6)
Tumour	133	2452	4.4 (3.5, 5.4)	7.4 (6.1, 9.1)	9.1 (7.4, 11.2)	14.1 (10.7, 18.3)		
Other (5)	291	4586	3.5 (3.0, 4.1)	5.2 (4.6, 5.9)	6.2 (5.4, 7.0)	8.7 (7.7, 10.0)	11.9 (10.1, 14.0)	
TOTAL	**17199**	**437153**						

Note: All procedures using metal/metal prostheses have been excluded
Only primary diagnoses 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=1.78 (1.66, 1.89),p<0.001

Osteonecrosis vs Osteoarthritis
0 - 6Mth: HR=1.43 (1.26, 1.61),p<0.001
6Mth - 9Mth: HR=2.41 (1.83, 3.16),p<0.001
9Mth+: HR=1.25 (1.14, 1.38),p<0.001

Developmental Dysplasia vs Osteoarthritis
0 - 2Wk: HR=1.93 (1.34, 2.80),p<0.001
2Wk - 1Mth: HR=1.34 (0.93, 1.94),p=0.120
1Mth+: HR=1.05 (0.92, 1.21),p=0.460

Rheumatoid Arthritis vs Osteoarthritis
Entire Period: HR=1.34 (1.18, 1.53),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Osteoarthritis	386101	343423	269596	203221	80701	19744	1342
Fractured Neck Of Femur	20296	16151	10776	6868	1708	263	11
Osteonecrosis	14156	12385	9562	7236	3018	842	67
Developmental Dysplasia	5466	4824	3804	2977	1457	508	40
Rheumatoid Arthritis	4096	3714	3100	2503	1239	409	44

Note: All procedures using metal/metal prostheses have been excluded
Only primary diagnoses with over 2,500 procedures have been listed

PROSTHESIS TYPES

There are 3,111 different stem and acetabular combinations for primary total conventional hip replacement recorded by the Registry. This is an additional 47 prosthesis combinations since the previous report. Prosthesis combinations using large head metal/metal bearings are listed separately.

The cumulative percent revision of the 128 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 83.3% 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 16.7% 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 MS 30/Low Profile Cup has the lowest 15 year cumulative percent revision of 7.4% (Table HT11).

There are 82 cementless primary total conventional stem and acetabular combinations listed. The Secur-Fit Plus/Trident (Shell) has the lowest 18 year cumulative percent revision of 5.1% (Table HT12).

There are 35 combinations of primary total conventional hip replacement prostheses with hybrid fixation. The Exeter/Vitalock has the lowest cumulative percent revision at 18 years (8.3%) (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	18 Yrs
C-Stem AMT	Marathon	13	500	1.9 (1.0, 3.7)	2.6 (1.4, 4.7)	3.0 (1.7, 5.3)			
CPCS	Reflection (Cup)	76	988	1.5 (0.9, 2.5)	2.7 (1.8, 4.0)	3.4 (2.4, 4.9)	8.4 (6.3, 11.1)	20.4 (15.7, 26.4)	
CPT	ZCA	43	985	0.7 (0.3, 1.5)	2.1 (1.3, 3.3)	2.8 (1.9, 4.1)	5.3 (3.7, 7.4)	7.7 (5.4, 11.1)	
Charnley	Charnley Ogee*	67	709	1.0 (0.5, 2.1)	3.0 (1.9, 4.5)	4.9 (3.5, 6.9)	9.0 (6.9, 11.6)	13.8 (10.8, 17.6)	
Charnley	Charnley*	45	591	0.5 (0.2, 1.6)	1.0 (0.5, 2.3)	2.2 (1.2, 3.8)	6.0 (4.3, 8.6)	11.6 (8.5, 15.7)	
Exeter V40	Contemporary	323	5602	1.8 (1.4, 2.1)	3.0 (2.6, 3.5)	3.6 (3.2, 4.2)	6.3 (5.6, 7.1)	10.3 (8.9, 11.8)	
Exeter V40	Exeter Contemporary	170	3382	1.4 (1.1, 1.9)	2.3 (1.8, 2.9)	3.1 (2.5, 3.7)	4.9 (4.1, 5.8)	9.4 (7.6, 11.6)	
Exeter V40	Exeter X3 Rimfit	99	3903	1.5 (1.1, 1.9)	2.4 (2.0, 3.0)	2.9 (2.3, 3.5)			
Exeter V40	Exeter*	110	1712	0.8 (0.5, 1.4)	1.9 (1.3, 2.7)	3.1 (2.4, 4.1)	5.1 (4.1, 6.4)	10.2 (8.2, 12.6)	
MS 30	Low Profile Cup	28	723	0.7 (0.3, 1.7)	0.9 (0.4, 1.9)	1.4 (0.7, 2.7)	2.8 (1.7, 4.7)	7.4 (4.8, 11.4)	
Spectron EF	Reflection (Cup)	127	1660	1.1 (0.7, 1.7)	1.8 (1.2, 2.5)	2.8 (2.1, 3.8)	7.2 (5.9, 8.9)	14.9 (12.3, 18.1)	
Other (510)		613	10185	1.8 (1.6, 2.1)	3.0 (2.6, 3.3)	4.1 (3.7, 4.6)	7.0 (6.4, 7.7)	11.7 (10.7, 12.7)	13.3 (12.1, 14.7)
TOTAL		**1714**	**30940**						

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 2018
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	18 Yrs
ABGII	ABGII	296	2982	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	ABGII (Shell/Insert)	72	906	1.4 (0.8, 2.5)	2.2 (1.4, 3.4)	2.8 (1.9, 4.1)	6.6 (5.1, 8.6)	11.5 (9.0, 14.7)	
ABGII	Trident (Shell)	245	2570	2.9 (2.3, 3.6)	4.4 (3.7, 5.3)	5.3 (4.5, 6.2)	8.9 (7.8, 10.2)	14.6 (12.7, 16.9)	
AMIStem H	Mpact	16	772	2.1 (1.3, 3.4)					
AMIStem H	Versafitcup CC	46	2380	1.3 (0.9, 1.9)	1.9 (1.3, 2.8)	3.8 (2.0, 7.2)			
Accolade I	Trident (Shell)	501	9304	1.7 (1.5, 2.0)	3.0 (2.7, 3.4)	3.8 (3.4, 4.2)	5.7 (5.2, 6.2)	7.1 (6.4, 7.9)	
Accolade I	Trident/ Tritanium (Shell)*	32	756	1.3 (0.7, 2.4)	2.4 (1.5, 3.8)	3.6 (2.4, 5.2)			
Accolade II	Trident (Shell)	98	5313	1.5 (1.2, 1.9)	2.2 (1.8, 2.7)	2.8 (2.1, 3.6)			
Accolade II	Trident/ Tritanium (Shell)	37	1282	2.6 (1.8, 3.7)	3.5 (2.5, 5.0)				
Alloclassic	Allofit	323	5869	1.5 (1.2, 1.9)	2.4 (2.0, 2.8)	3.1 (2.7, 3.6)	5.4 (4.8, 6.1)	8.9 (7.8, 10.1)	
Alloclassic	Durom*MoM	101	621	1.3 (0.7, 2.6)	5.0 (3.5, 7.0)	7.1 (5.3, 9.4)	15.3 (12.5, 18.6)		
Alloclassic	Fitmore*	134	1883	3.3 (2.6, 4.2)	4.6 (3.8, 5.7)	5.6 (4.6, 6.7)	7.3 (6.1, 8.7)	9.1 (7.5, 11.1)	
Alloclassic	Trabecular Metal (Shell)*	49	1065	2.4 (1.6, 3.5)	3.0 (2.1, 4.2)	4.1 (3.1, 5.5)	5.0 (3.8, 6.7)		
Alloclassic	Trilogy*	17	955	0.6 (0.3, 1.4)	0.8 (0.4, 1.7)	1.1 (0.6, 2.0)	2.4 (1.4, 3.9)		
Anthology	R3	177	6700	1.9 (1.6, 2.2)	2.3 (2.0, 2.7)	2.6 (2.2, 3.0)	3.5 (3.0, 4.3)		
Anthology	Reflection (Shell)*	37	991	1.8 (1.2, 2.9)	2.1 (1.4, 3.3)	2.9 (2.0, 4.2)	4.1 (3.0, 5.7)		
Apex	Fin II*	50	1008	1.9 (1.2, 2.9)	2.5 (1.7, 3.7)	3.7 (2.7, 5.1)	5.8 (4.4, 7.7)		
Avenir	Continuum	42	1466	2.3 (1.6, 3.2)	2.7 (2.0, 3.7)	3.2 (2.3, 4.4)			
Avenir	Trilogy	9	626	1.0 (0.4, 2.1)	1.1 (0.5, 2.3)	1.3 (0.7, 2.6)			
C2	Delta-TT	18	764	1.1 (0.5, 2.2)	2.2 (1.3, 3.7)	2.9 (1.8, 4.6)			
CL2	C2	23	683	2.7 (1.7, 4.3)	2.9 (1.8, 4.5)	3.2 (2.0, 5.1)			
CLS	Allofit	61	869	1.6 (1.0, 2.7)	3.4 (2.4, 4.8)	3.9 (2.8, 5.5)	6.3 (4.7, 8.2)	9.5 (7.1, 12.6)	
CLS	Fitmore	50	880	1.8 (1.1, 3.0)	3.7 (2.6, 5.3)	4.2 (3.0, 5.8)	5.6 (4.1, 7.6)	8.5 (6.4, 11.3)	
CORAIL	ASR*MoM	1287	2901	2.2 (1.7, 2.8)	11.2 (10.1, 12.4)	27.0 (25.4, 28.7)	46.0 (44.1, 47.9)		
CORAIL	DeltaMotion	27	1321	1.0 (0.6, 1.7)	1.7 (1.1, 2.7)	2.2 (1.4, 3.3)			
CORAIL	Duraloc*	99	1433	1.4 (0.9, 2.2)	2.3 (1.6, 3.2)	2.9 (2.2, 4.0)	5.9 (4.6, 7.4)	11.2 (9.0, 13.8)	
CORAIL	PINNACLE	1534	47247	1.7 (1.6, 1.9)	2.7 (2.5, 2.8)	3.3 (3.1, 3.5)	5.3 (5.0, 5.7)	6.8 (6.0, 7.8)	
CORAIL	PINNACLE*MoM	117	966	2.2 (1.4, 3.3)	3.7 (2.6, 5.1)	5.9 (4.6, 7.6)	12.5 (10.4, 15.0)		
Citation	Trident (Shell)*	57	1147	1.7 (1.1, 2.7)	2.5 (1.8, 3.6)	3.3 (2.4, 4.5)	4.3 (3.3, 5.7)	6.1 (4.6, 8.0)	
Citation	Vitalock*	52	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)	10.8 (8.2, 14.1)	
Epoch	Trilogy*	46	1021	2.5 (1.7, 3.6)	3.4 (2.4, 4.7)	3.7 (2.7, 5.0)	4.5 (3.3, 6.0)	5.0 (3.7, 6.8)	
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)	11.5 (9.0, 14.6)	
H-Max	Delta-TT	52	1435	1.8 (1.2, 2.7)	3.6 (2.6, 4.8)	4.6 (3.4, 6.1)			
HACTIV	Logical G	18	582	3.4 (2.1, 5.4)					
M/L Taper	Allofit	20	767	1.6 (0.9, 2.8)	1.9 (1.1, 3.2)	2.1 (1.3, 3.4)	4.2 (2.3, 7.6)		
M/L Taper	Continuum	44	1431	1.9 (1.3, 2.8)	3.0 (2.2, 4.1)	3.3 (2.4, 4.5)			
M/L Taper	Trilogy	30	865	1.3 (0.7, 2.3)	1.5 (0.9, 2.6)	3.0 (2.0, 4.6)	4.3 (3.0, 6.3)		
M/L Taper Kinectiv	Continuum	82	2217	2.1 (1.6, 2.8)	3.1 (2.4, 3.9)	3.5 (2.8, 4.4)			
Mallory-Head	Mallory-Head	190	3018	1.8 (1.4, 2.4)	2.3 (1.8, 2.9)	3.2 (2.6, 3.9)	5.1 (4.3, 6.0)	9.4 (8.1, 11.0)	12.0 (9.7, 14.8)
Metafix	Trinity	104	5755	1.6 (1.3, 2.0)	2.5 (2.0, 3.0)	2.7 (2.1, 3.3)			
MiniHip	Trinity	29	934	2.8 (1.9, 4.2)	3.3 (2.3, 4.7)	3.5 (2.4, 5.0)			
Nanos	R3*	9	658	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	18 Yrs
Natural Hip	Fitmore*	43	889	1.0 (0.5, 1.9)	1.6 (0.9, 2.7)	2.4 (1.6, 3.7)	4.5 (3.3, 6.2)	5.3 (3.9, 7.2)	
Omnifit	Secur-Fit*	64	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)	14.1 (11.1, 17.8)	
Omnifit	Trident (Shell)	81	1280	1.9 (1.3, 2.8)	3.2 (2.3, 4.3)	4.0 (3.0, 5.2)	5.5 (4.4, 7.0)	7.7 (6.1, 9.6)	
Optimys	RM Cup	6	751	0.7 (0.3, 1.7)	0.9 (0.4, 2.1)				
Origin	Logical G	26	1266	1.7 (1.1, 2.6)	2.7 (1.8, 4.0)				
Paragon	Acetabular Shell (Global)	27	2272	1.2 (0.8, 1.8)	1.4 (0.9, 2.0)				
Paragon	Novae	12	583	1.3 (0.6, 2.8)	2.5 (1.4, 4.7)	3.2 (1.7, 5.8)			
Polarstem	EP-Fit Plus	8	1719	0.3 (0.1, 0.7)	0.5 (0.2, 1.1)	0.7 (0.3, 1.7)			
Polarstem	R3	234	9135	2.0 (1.7, 2.3)	2.7 (2.3, 3.1)	3.2 (2.8, 3.6)			
Profemur L	Dynasty	52	1370	3.4 (2.6, 4.6)	4.4 (3.3, 5.8)				
Profemur L	Procotyl L	12	582	1.6 (0.8, 3.1)	2.3 (1.3, 4.1)				
Quadra-H	Mpact	73	3028	1.7 (1.2, 2.2)	2.9 (2.2, 3.8)	4.4 (3.2, 5.9)			
Quadra-H	Trident (Shell)	22	826	1.5 (0.9, 2.7)	2.4 (1.5, 3.8)	3.5 (2.1, 5.7)			
Quadra-H	Versafitcup CC	473	14867	1.8 (1.6, 2.0)	2.6 (2.4, 2.9)	3.3 (3.0, 3.6)	6.3 (5.2, 7.8)		
S-Rom	Duraloc Option*	35	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)	5.5 (3.9, 7.6)	
S-Rom	PINNACLE	185	3405	2.4 (2.0, 3.0)	3.9 (3.3, 4.7)	4.7 (4.0, 5.4)	6.2 (5.4, 7.2)	7.3 (6.1, 8.6)	
SL-Plus	EP-Fit Plus	121	2328	1.6 (1.2, 2.2)	2.7 (2.1, 3.4)	3.4 (2.8, 4.3)	5.3 (4.4, 6.3)	8.6 (5.6, 13.2)	
SL-Plus	R3	81	1727	2.3 (1.7, 3.1)	3.9 (3.1, 5.0)	4.3 (3.4, 5.4)	5.8 (4.6, 7.3)		
Secur-Fit	DeltaMotion	28	812	0.8 (0.3, 1.7)	2.1 (1.3, 3.4)	2.5 (1.6, 3.9)			
Secur-Fit	Trident (Shell)	412	9907	1.8 (1.6, 2.1)	2.8 (2.5, 3.2)	3.5 (3.1, 3.9)	4.6 (4.2, 5.1)	5.9 (5.3, 6.7)	
Secur-Fit Plus	Trident (Shell)	208	6021	1.3 (1.0, 1.6)	1.9 (1.6, 2.3)	2.4 (2.0, 2.8)	3.4 (2.9, 3.9)	4.7 (4.0, 5.4)	5.1 (4.3, 6.1)
Summit	ASR*^{MoM}	496	1118	1.2 (0.7, 2.0)	6.5 (5.2, 8.1)	20.0 (17.7, 22.5)	44.2 (41.3, 47.3)		
Summit	PINNACLE	131	5007	1.4 (1.1, 1.7)	2.0 (1.7, 2.5)	2.3 (1.9, 2.8)	3.3 (2.7, 4.1)	4.8 (3.6, 6.4)	
Summit	PINNACLE*^{MoM}	72	784	1.5 (0.9, 2.7)	2.2 (1.4, 3.5)	3.4 (2.3, 4.9)	8.7 (6.8, 11.0)	11.4 (9.0, 14.3)	
Synergy	BHR*^{MoM}	101	819	1.6 (0.9, 2.7)	3.1 (2.1, 4.5)	4.8 (3.6, 6.6)	11.9 (9.8, 14.5)		
Synergy	R3	132	4795	1.8 (1.4, 2.2)	2.4 (2.0, 2.9)	2.7 (2.3, 3.3)	3.3 (2.7, 3.9)		
Synergy	Reflection (Shell)	374	8009	1.6 (1.3, 1.9)	2.4 (2.1, 2.7)	2.7 (2.4, 3.1)	4.0 (3.6, 4.5)	6.0 (5.3, 6.7)	
Taperloc	Exceed	61	2309	1.4 (1.0, 2.0)	2.2 (1.6, 2.9)	2.4 (1.8, 3.1)	5.6 (2.8, 10.9)		
Taperloc	G7	29	1898	1.5 (1.0, 2.2)	1.8 (1.2, 2.6)				
Taperloc	M2a*^{MoM}	66	512	1.8 (0.9, 3.4)	4.4 (2.9, 6.5)	7.4 (5.4, 10.1)	12.3 (9.7, 15.6)	14.9 (11.7, 18.8)	
Taperloc	Mallory-Head	83	2012	2.0 (1.4, 2.7)	2.5 (1.9, 3.3)	2.9 (2.3, 3.8)	4.9 (3.8, 6.3)	8.1 (6.1, 10.7)	
Taperloc	Recap*^{MoM}	53	500	2.4 (1.4, 4.2)	4.3 (2.8, 6.5)	6.2 (4.4, 8.8)	10.6 (8.1, 13.8)		
Taperloc	Regenerex	17	629	1.8 (1.0, 3.2)	2.3 (1.4, 3.8)	2.7 (1.7, 4.4)			
Taperloc Microplasty	G7	9	972	1.0 (0.5, 1.9)	1.0 (0.5, 1.9)				
Trabecular Metal	Continuum*	45	684	5.1 (3.7, 7.1)	6.0 (4.5, 8.1)	6.4 (4.8, 8.5)			
Tri-Fit TS	Trinity	62	3391	1.3 (1.0, 1.8)	2.1 (1.6, 2.7)	2.4 (1.8, 3.2)			
Tri-Lock	DeltaMotion	13	806	0.6 (0.3, 1.5)	0.9 (0.4, 1.8)	1.3 (0.7, 2.4)			
Tri-Lock	PINNACLE	21	870	1.5 (0.9, 2.6)	2.4 (1.5, 3.7)	2.7 (1.7, 4.2)			
VerSys	Trilogy	237	4495	2.5 (2.1, 3.1)	3.4 (2.9, 4.0)	4.0 (3.4, 4.6)	5.2 (4.5, 5.9)	6.1 (5.3, 6.9)	
twinSys	RM Cup	36	1176	2.3 (1.5, 3.3)	3.0 (2.1, 4.2)	3.0 (2.1, 4.2)			
Other (1457)		3467	47093	2.4 (2.3, 2.5)	4.0 (3.8, 4.1)	5.3 (5.1, 5.5)	9.2 (8.9, 9.5)	13.2 (12.7, 13.7)	15.0 (14.2, 16.0)
TOTAL		**14003**	**277334**						

Note: Procedures using metal/metal prostheses have been included
^{MoM} denotes metal/metal prostheses with head size larger than 32mm
* denotes prosthesis combination with no reported use in primary total conventional hip procedures in 2018
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	18 Yrs
Absolut	Acetabular Shell (Global)	11	604	1.4 (0.7, 2.7)	2.4 (1.3, 4.5)				
C-Stem	Duraloc*	93	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)	12.6 (10.2, 15.7)	
C-Stem	PINNACLE	32	875	1.7 (1.0, 2.9)	2.4 (1.5, 3.6)	2.8 (1.9, 4.2)	4.4 (3.0, 6.3)		
C-Stem AMT	PINNACLE	82	3794	1.2 (0.9, 1.6)	2.1 (1.7, 2.8)	3.0 (2.4, 3.9)	4.8 (3.3, 6.9)		
CPCS	R3	174	5465	2.2 (1.8, 2.6)	3.0 (2.6, 3.6)	3.5 (3.0, 4.2)	5.3 (4.2, 6.7)		
CPCS	Reflection (Shell)	107	3061	0.9 (0.6, 1.3)	1.3 (0.9, 1.7)	1.7 (1.3, 2.2)	3.8 (3.1, 4.8)	8.1 (6.0, 10.8)	
CPT	Allofit	45	1377	1.4 (0.9, 2.2)	2.1 (1.4, 3.0)	3.3 (2.4, 4.6)	4.9 (3.5, 7.0)		
CPT	Continuum	129	3045	2.8 (2.2, 3.4)	3.8 (3.2, 4.6)	4.6 (3.9, 5.5)			
CPT	Trabecular Metal (Shell)	103	2058	2.8 (2.1, 3.6)	3.9 (3.1, 4.9)	4.9 (4.0, 6.1)	7.4 (6.0, 9.1)		
CPT	Trilogy	363	8374	1.9 (1.6, 2.2)	2.8 (2.5, 3.2)	3.6 (3.2, 4.1)	5.3 (4.7, 5.9)	7.1 (6.2, 8.2)	
E2	C2	17	708	1.4 (0.8, 2.6)	2.4 (1.4, 4.0)	3.4 (2.0, 5.7)			
Elite Plus	Duraloc*	121	1078	2.0 (1.3, 3.0)	3.6 (2.7, 5.0)	5.4 (4.2, 7.0)	9.9 (8.1, 12.0)	15.5 (13.0, 18.5)	
Evolve	Logical G	17	1339	1.1 (0.7, 1.9)	1.2 (0.7, 2.0)				
Exeter	Vitalock*	78	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)	8.3 (6.6, 10.4)
Exeter V40	ABGII	43	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)	5.0 (3.7, 6.7)	
Exeter V40	Fixa	19	682	1.8 (1.0, 3.1)	2.5 (1.5, 4.0)	3.0 (1.9, 4.7)			
Exeter V40	Hemispherical*	33	717	2.5 (1.6, 4.0)	3.5 (2.4, 5.2)	3.7 (2.5, 5.3)	4.8 (3.3, 7.0)		
Exeter V40	Mallory-Head	40	1498	0.6 (0.3, 1.2)	1.0 (0.6, 1.6)	1.1 (0.7, 1.8)	2.7 (1.9, 3.9)	4.6 (3.2, 6.6)	
Exeter V40	PINNACLE	51	1997	1.6 (1.1, 2.3)	2.2 (1.6, 3.0)	2.5 (1.8, 3.3)	4.3 (2.9, 6.3)		
Exeter V40	R3	64	2174	1.7 (1.3, 2.4)	2.7 (2.1, 3.5)	3.4 (2.6, 4.4)	3.8 (2.9, 5.0)		
Exeter V40	Trident (Shell)	1774	63669	1.3 (1.2, 1.4)	1.9 (1.8, 2.0)	2.5 (2.4, 2.6)	4.1 (3.8, 4.3)	5.7 (5.3, 6.1)	
Exeter V40	Trident/ Tritanium (Shell)	118	4314	1.6 (1.3, 2.1)	2.6 (2.1, 3.1)	3.4 (2.8, 4.1)			
Exeter V40	Trilogy*	20	605	1.7 (0.9, 3.1)	2.4 (1.4, 4.0)	2.6 (1.5, 4.2)	3.7 (2.3, 5.8)	4.2 (2.6, 6.6)	
Exeter V40	Vitalock*	89	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)	5.4 (4.4, 6.7)	
MS 30	Allofit	64	1647	1.2 (0.7, 1.8)	1.7 (1.2, 2.5)	2.1 (1.5, 3.0)	4.0 (3.0, 5.4)	8.6 (6.1, 11.9)	
MS 30	Continuum	12	714	1.4 (0.8, 2.7)	1.7 (0.9, 3.0)	1.7 (0.9, 3.0)			
MS 30	Fitmore	26	751	1.0 (0.5, 2.0)	1.4 (0.8, 2.6)	2.1 (1.2, 3.6)	3.2 (1.9, 5.1)	6.4 (4.1, 9.8)	
Omnifit	Trident (Shell)	97	2893	1.8 (1.3, 2.3)	2.7 (2.1, 3.3)	2.9 (2.3, 3.6)	3.4 (2.8, 4.2)	4.6 (3.5, 5.9)	
Quadra-C	Mpact	16	1096	1.3 (0.8, 2.2)	2.0 (1.2, 3.6)				
Quadra-C	Versafitcup CC	25	1261	1.8 (1.2, 2.7)	1.9 (1.3, 2.9)	2.2 (1.4, 3.4)			
Short Exeter V40	Trident (Shell)	22	1406	1.4 (0.8, 2.2)	2.8 (1.6, 4.8)				
Spectron EF	BHR*MoM	82	532	0.8 (0.3, 2.0)	2.9 (1.8, 4.8)	6.3 (4.5, 8.8)	17.1 (13.7, 21.1)		
Spectron EF	R3	66	2002	1.6 (1.1, 2.2)	2.6 (1.9, 3.4)	3.3 (2.5, 4.3)	6.1 (4.0, 9.5)		
Spectron EF	Reflection (Shell)	316	5185	1.1 (0.9, 1.4)	2.0 (1.6, 2.4)	2.8 (2.3, 3.3)	5.5 (4.8, 6.3)	10.3 (9.1, 11.7)	12.9 (11.0, 15.0)
Taper Fit	Trinity	27	1425	1.7 (1.1, 2.6)	2.3 (1.5, 3.5)	4.3 (2.4, 7.8)			
Other (1016)		1206	19389	1.9 (1.7, 2.1)	3.2 (3.0, 3.5)	4.5 (4.2, 4.8)	7.8 (7.4, 8.3)	11.0 (10.3, 11.8)	12.7 (11.7, 13.7)
TOTAL		**5582**	**150991**						

Note: Procedures using metal/metal prostheses have been included
MoM denotes metal/metal prostheses with head size larger than 32mm
* denotes prosthesis combination with no reported use in primary total conventional hip procedures in 2018
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 18 year cumulative percent revision of primary total conventional hip replacement undertaken for osteoarthritis is 9.9% (Table HT14 and Figure HT5).

Reason for Revision

The most common reasons for revision of primary total conventional hip replacement are loosening (24.6%), prosthesis dislocation (20.8%), fracture (20.7%), and infection (18.2%) (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 (33.2%), acetabular only (21.0%), head and insert (20.2%), total hip replacement (femoral/acetabular) (12.1%) and head only (4.8%) (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 4 years (Table HT17 and Figure HT7).

Males have a higher rate of revision after 1.5 years. The cumulative percent revision at 18 years is 10.5% for males and 9.3% 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 173,484 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 rate of revision for each ASA score is partially due to an increase in revision for infection with increasing ASA score (Figure HT14).

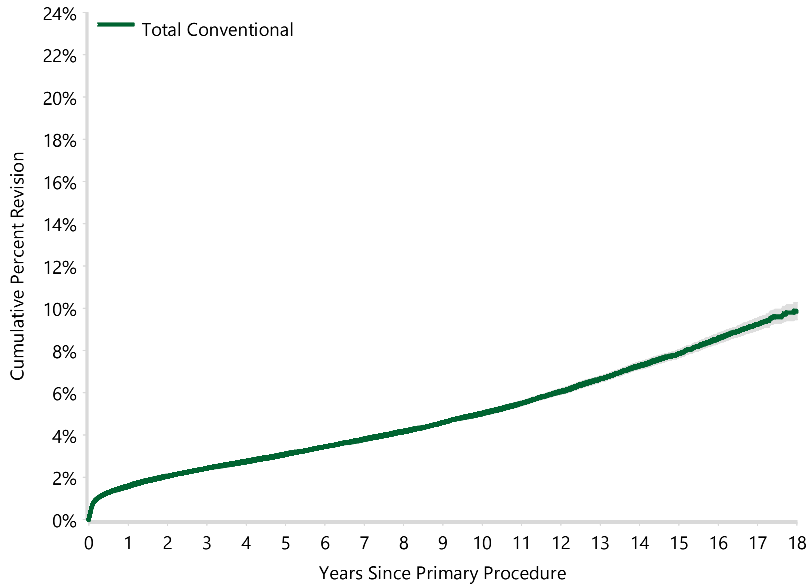
BMI data has been collected since 2015. The early revision outcomes are reported for 118,667 primary total conventional hip replacement procedures for osteoarthritis. When compared to patients in the normal BMI class, there is no difference in the rate of revision for patients in the underweight or pre-obese 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 2 years, the cumulative incidence of infection is 2.0% for obese class 3 compared to 1.2% 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	18 Yrs
Total Conventional	14533	386101	1.6 (1.5, 1.6)	2.4 (2.4, 2.5)	3.1 (3.0, 3.2)	5.0 (4.9, 5.1)	7.9 (7.7, 8.0)	9.9 (9.5, 10.3)
TOTAL	**14533**	**386101**						

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	18 Yrs
Total Conventional	386101	343423	269596	203221	80701	19744	1342

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	3579	24.6
Prosthesis Dislocation	3030	20.8
Fracture	3006	20.7
Infection	2647	18.2
Lysis	310	2.1
Pain	279	1.9
Leg Length Discrepancy	227	1.6
Malposition	209	1.4
Instability	192	1.3
Implant Breakage Stem	163	1.1
Implant Breakage Acetabular Insert	131	0.9
Wear Acetabular Insert	121	0.8
Metal Related Pathology	120	0.8
Incorrect Sizing	96	0.7
Implant Breakage Acetabular	92	0.6
Implant Breakage Head	45	0.3
Other	286	2.0
TOTAL	**14533**	**100.0**

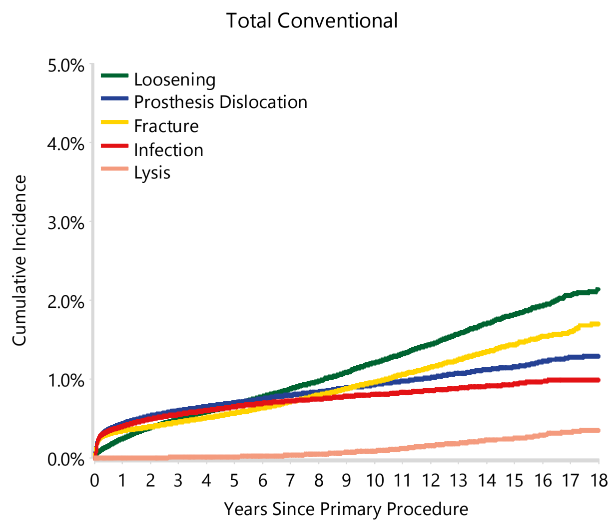
Note: All procedures using metal/metal prostheses have been excluded

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

Type of Revision	Number	Percent
Femoral Component	4818	33.2
Acetabular Component	3057	21.0
Head/Insert	2934	20.2
THR (Femoral/Acetabular)	1764	12.1
Head Only	694	4.8
Cement Spacer	614	4.2
Minor Components	261	1.8
Insert Only	155	1.1
Removal of Prostheses	91	0.6
Head/Neck/Insert	66	0.5
Head/Neck	48	0.3
Reinsertion of Components	16	0.1
Neck Only	5	0.0
Bipolar Only	3	0.0
Total Femoral	3	0.0
Cement Only	1	0.0
Saddle	1	0.0
Neck/Insert	1	0.0
Bipolar Head and Femoral	1	0.0
TOTAL	**14533**	**100.0**

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

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



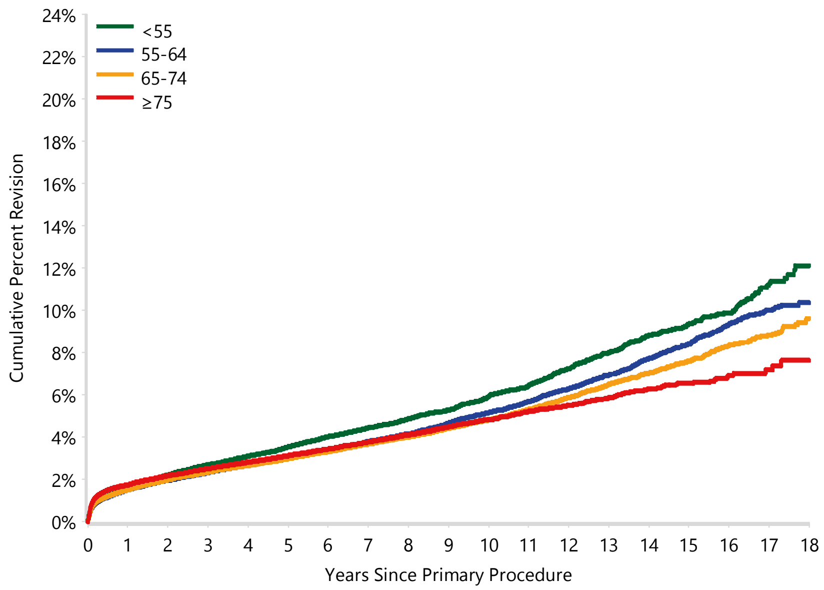
Note: All procedures using metal/metal prostheses have been excluded

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	18 Yrs
<55	1843	41123	1.6 (1.5, 1.7)	2.7 (2.5, 2.9)	3.5 (3.3, 3.7)	5.9 (5.6, 6.2)	9.3 (8.8, 9.9)	12.1 (11.0, 13.3)
55-64	3659	91607	1.5 (1.4, 1.6)	2.3 (2.2, 2.4)	3.0 (2.9, 3.1)	5.2 (5.0, 5.4)	8.4 (8.0, 8.8)	10.4 (9.8, 11.0)
65-74	5128	138188	1.5 (1.4, 1.6)	2.3 (2.3, 2.4)	3.0 (2.9, 3.1)	4.8 (4.7, 5.0)	7.6 (7.3, 7.9)	9.6 (8.9, 10.3)
≥75	3903	115183	1.8 (1.7, 1.8)	2.5 (2.4, 2.6)	3.1 (3.0, 3.2)	4.8 (4.6, 5.0)	6.5 (6.2, 6.9)	7.6 (6.8, 8.5)
TOTAL	**14533**	**386101**						

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=1.08 (0.89, 1.31),p=0.418
2Wk - 3Mth: HR=0.66 (0.58, 0.75),p<0.001
3Mth - 6Mth: HR=1.00 (0.81, 1.23),p=0.988
6Mth+: HR=1.44 (1.35, 1.55),p<0.001

55-64 vs ≥75
0 - 2Wk: HR=0.88 (0.76, 1.02),p=0.097
2Wk - 1Mth: HR=0.65 (0.57, 0.74),p<0.001
1Mth - 6Mth: HR=0.80 (0.72, 0.89),p<0.001
6Mth - 1.5Yr: HR=1.25 (1.12, 1.40),p<0.001
1.5Yr - 2Yr: HR=0.98 (0.81, 1.18),p=0.816
2Yr - 7Yr: HR=1.15 (1.06, 1.25),p<0.001
7Yr+: HR=1.35 (1.24, 1.48),p<0.001

65-74 vs ≥75
0 - 6Mth: HR=0.80 (0.75, 0.86),p<0.001
6Mth - 1.5Yr: HR=1.18 (1.07, 1.31),p=0.001
1.5Yr - 3.5Yr: HR=1.08 (0.98, 1.19),p=0.100
3.5Yr - 4Yr: HR=0.88 (0.70, 1.09),p=0.229
4Yr+: HR=1.14 (1.06, 1.22),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
<55	41123	36684	29001	21756	8965	3009	248
55-64	91607	82032	65275	50340	21581	6272	510
65-74	138188	123140	97200	74151	31627	7909	472
≥75	115183	101567	78120	56974	18528	2554	112

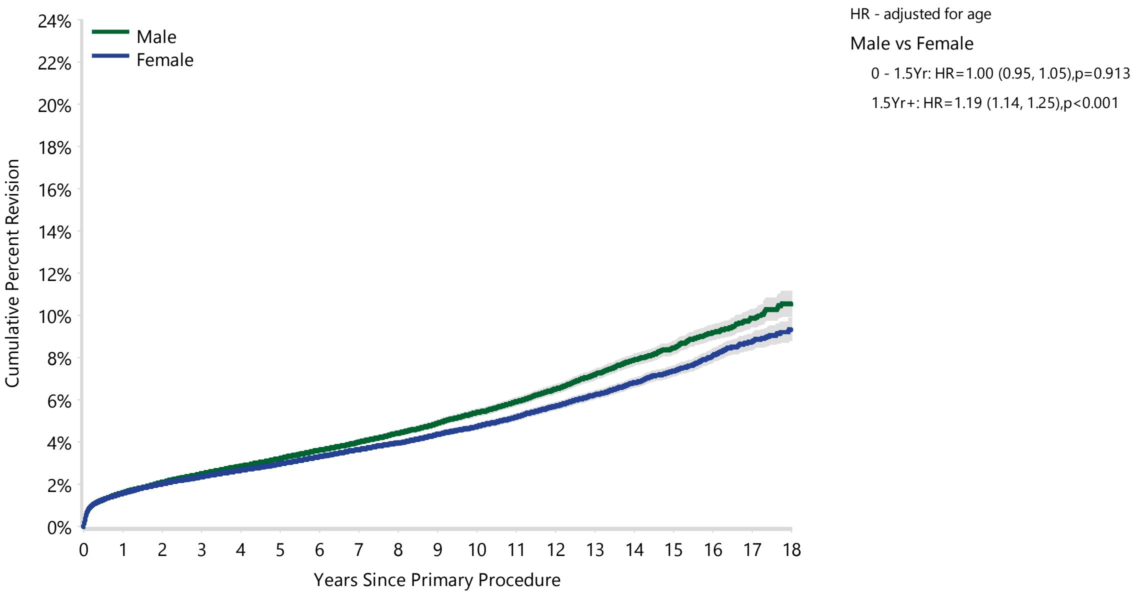
Note: All procedures using metal/metal prostheses have been excluded

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	18 Yrs
Male		**6912**	**177014**	**1.6 (1.5, 1.7)**	**2.5 (2.4, 2.6)**	**3.2 (3.1, 3.3)**	**5.4 (5.3, 5.6)**	**8.5 (8.2, 8.8)**	**10.5 (10.0, 11.1)**
	<55	948	22802	1.4 (1.3, 1.6)	2.5 (2.3, 2.7)	3.4 (3.1, 3.6)	5.7 (5.3, 6.1)	8.9 (8.1, 9.6)	11.2 (9.9, 12.6)
	55-64	1830	45675	1.5 (1.4, 1.7)	2.4 (2.2, 2.5)	3.0 (2.9, 3.2)	5.2 (5.0, 5.5)	8.7 (8.2, 9.3)	10.8 (9.8, 11.8)
	65-74	2420	63197	1.5 (1.4, 1.6)	2.4 (2.2, 2.5)	3.1 (2.9, 3.2)	5.2 (4.9, 5.4)	8.1 (7.7, 8.6)	10.3 (9.3, 11.3)
	≥75	1714	45340	1.9 (1.8, 2.1)	2.8 (2.7, 3.0)	3.6 (3.4, 3.8)	5.7 (5.4, 6.1)	7.9 (7.3, 8.6)	
Female		**7621**	**209087**	**1.6 (1.5, 1.6)**	**2.4 (2.3, 2.4)**	**3.0 (2.9, 3.1)**	**4.7 (4.6, 4.9)**	**7.4 (7.1, 7.6)**	**9.3 (8.8, 9.9)**
	<55	895	18321	1.7 (1.6, 1.9)	2.9 (2.7, 3.2)	3.7 (3.5, 4.1)	6.2 (5.7, 6.7)	9.9 (9.1, 10.7)	13.3 (11.5, 15.4)
	55-64	1829	45932	1.5 (1.4, 1.6)	2.3 (2.2, 2.4)	3.0 (2.8, 3.1)	5.1 (4.8, 5.4)	8.1 (7.6, 8.6)	10.0 (9.3, 10.8)
	65-74	2708	74991	1.5 (1.4, 1.6)	2.3 (2.2, 2.5)	2.9 (2.8, 3.1)	4.5 (4.3, 4.7)	7.2 (6.8, 7.6)	9.1 (8.2, 10.0)
	≥75	2189	69843	1.6 (1.5, 1.7)	2.3 (2.2, 2.4)	2.8 (2.7, 3.0)	4.3 (4.1, 4.5)	5.8 (5.4, 6.2)	6.9 (6.0, 7.9)
TOTAL		**14533**	**386101**						

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

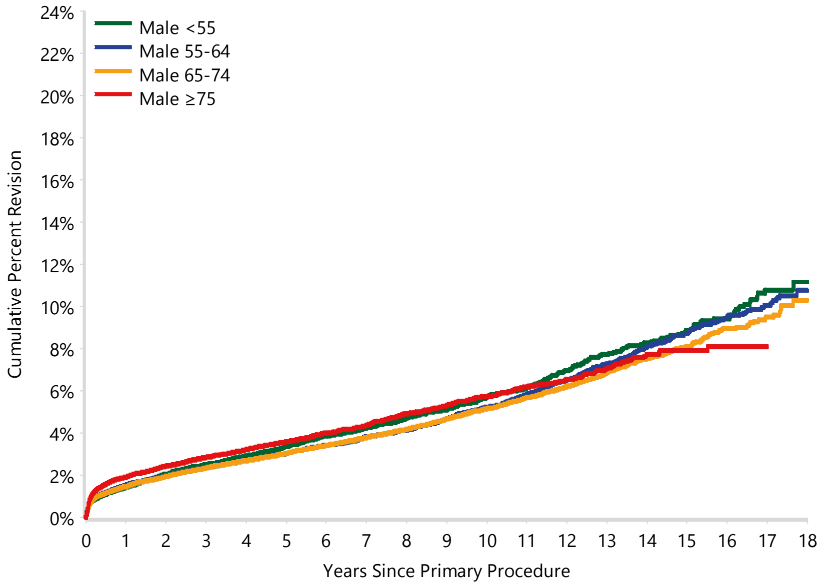
Figure HT8 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Gender (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Male	177014	156749	121711	90381	34715	8800	616
Female	209087	186674	147885	112840	45986	10944	726

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=1.10 (0.85, 1.44),p=0.465
2Wk - 3Mth: HR=0.59 (0.49, 0.71),p<0.001
3Mth - 6Mth: HR=0.72 (0.52, 1.00),p=0.050
6Mth+: HR=1.12 (1.02, 1.23),p=0.020

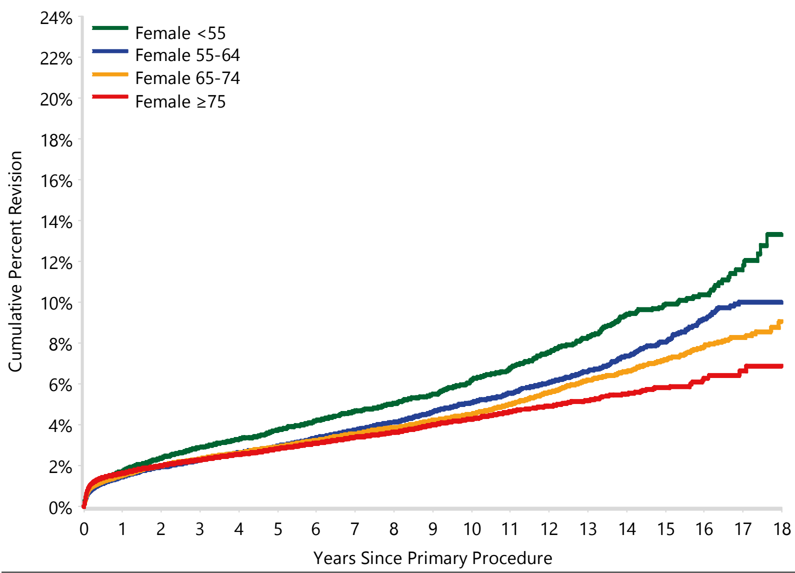
Male 55-64 vs Male ≥75
0 - 2Wk: HR=0.89 (0.71, 1.11),p=0.301
2Wk - 1Mth: HR=0.69 (0.57, 0.83),p<0.001
1Mth - 9Mth: HR=0.78 (0.69, 0.90),p<0.001
9Mth - 1.5Yr: HR=1.03 (0.84, 1.26),p=0.768
1.5Yr - 2Yr: HR=0.76 (0.58, 1.00),p=0.050
2Yr - 7Yr: HR=0.97 (0.86, 1.09),p=0.578
7Yr - 8Yr: HR=0.72 (0.53, 0.98),p=0.034
8Yr - 11Yr: HR=1.18 (0.99, 1.42),p=0.065
11Yr+: HR=1.21 (1.01, 1.44),p=0.042

Male 65-74 vs Male ≥75
0 - 3Mth: HR=0.75 (0.67, 0.84),p<0.001
3Mth - 9Mth: HR=0.75 (0.63, 0.89),p=0.001
9Mth - 1.5Yr: HR=1.03 (0.86, 1.24),p=0.734
1.5Yr - 2Yr: HR=0.81 (0.64, 1.03),p=0.092
2Yr+: HR=0.99 (0.90, 1.08),p=0.805

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Male	<55	22802	20268	15792	11626	4586	1604	149
	55-64	45675	40726	32023	24374	10210	3142	239
	65-74	63197	56278	44402	33696	13926	3359	201
	≥75	45340	39477	29494	20685	5993	695	27

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=1.06 (0.81, 1.39),p=0.687
2Wk - 3Mth: HR=0.76 (0.63, 0.92),p=0.004
3Mth+: HR=1.75 (1.60, 1.92),p<0.001

Female 55-64 vs Female ≥75
0 - 3Mth: HR=0.75 (0.67, 0.84),p<0.001
3Mth - 6Mth: HR=1.17 (0.93, 1.46),p=0.173
6Mth - 1.5Yr: HR=1.40 (1.21, 1.62),p<0.001
1.5Yr - 2.5Yr: HR=1.09 (0.89, 1.33),p=0.387
2.5Yr+: HR=1.45 (1.33, 1.59),p<0.001

Female 65-74 vs Female ≥75
0 - 3Mth: HR=0.85 (0.77, 0.94),p<0.001
3Mth+: HR=1.21 (1.13, 1.29),p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Female	<55	18321	16416	13209	10130	4379	1405	99
	55-64	45932	41306	33252	25966	11371	3130	271
	65-74	74991	66862	52798	40455	17701	4550	271
	≥75	69843	62090	48626	36289	12535	1859	85

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)

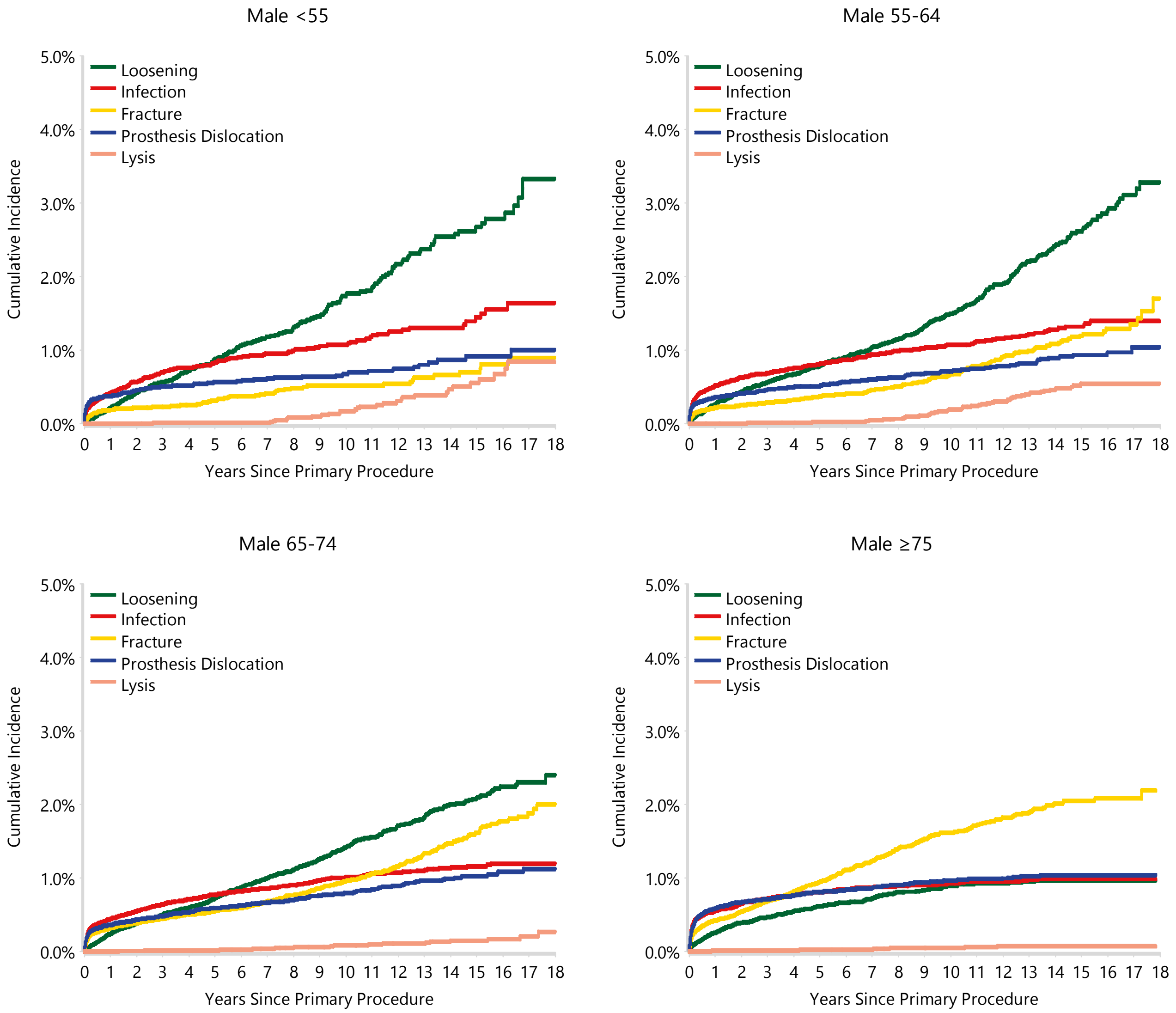


Figure HT12 **Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement in Females by Age (Primary Diagnosis OA)**

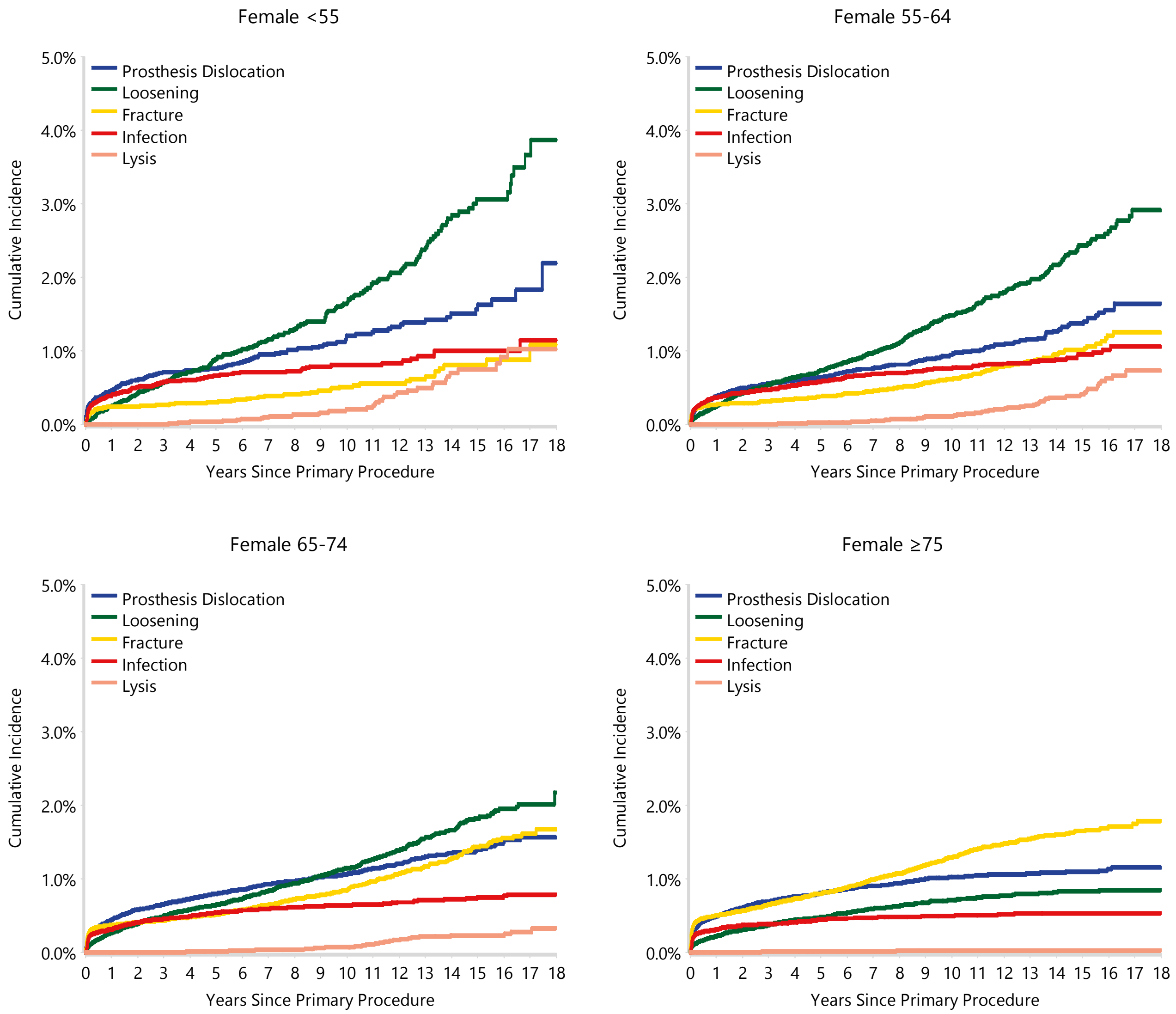
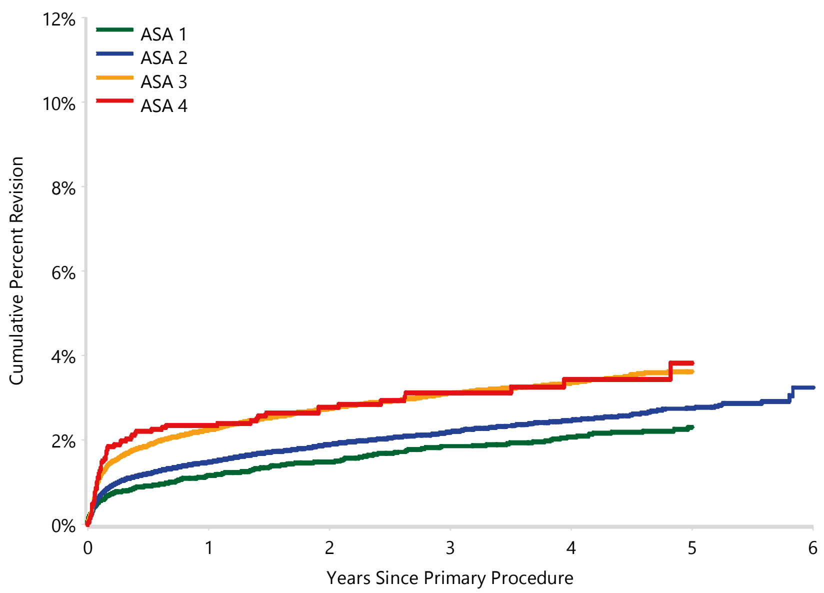


Table HT19 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by ASA Score (Primary Diagnosis OA)

ASA Score	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
ASA 1	292	17303	1.2 (1.0, 1.3)	1.5 (1.3, 1.7)	1.9 (1.6, 2.1)	2.1 (1.8, 2.3)	2.3 (2.0, 2.6)	
ASA 2	1943	95641	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 (2.6, 2.9)	3.2 (2.8, 3.8)
ASA 3	1616	58039	2.2 (2.1, 2.4)	2.7 (2.6, 2.9)	3.1 (3.0, 3.3)	3.4 (3.2, 3.5)	3.6 (3.4, 3.8)	
ASA 4	70	2488	2.3 (1.8, 3.0)	2.8 (2.2, 3.5)	3.1 (2.4, 4.0)	3.4 (2.7, 4.4)	3.8 (2.8, 5.2)	
ASA 5	0	13	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)		
TOTAL	**3921**	**173484**						

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=1.27 (1.12, 1.44),p<0.001

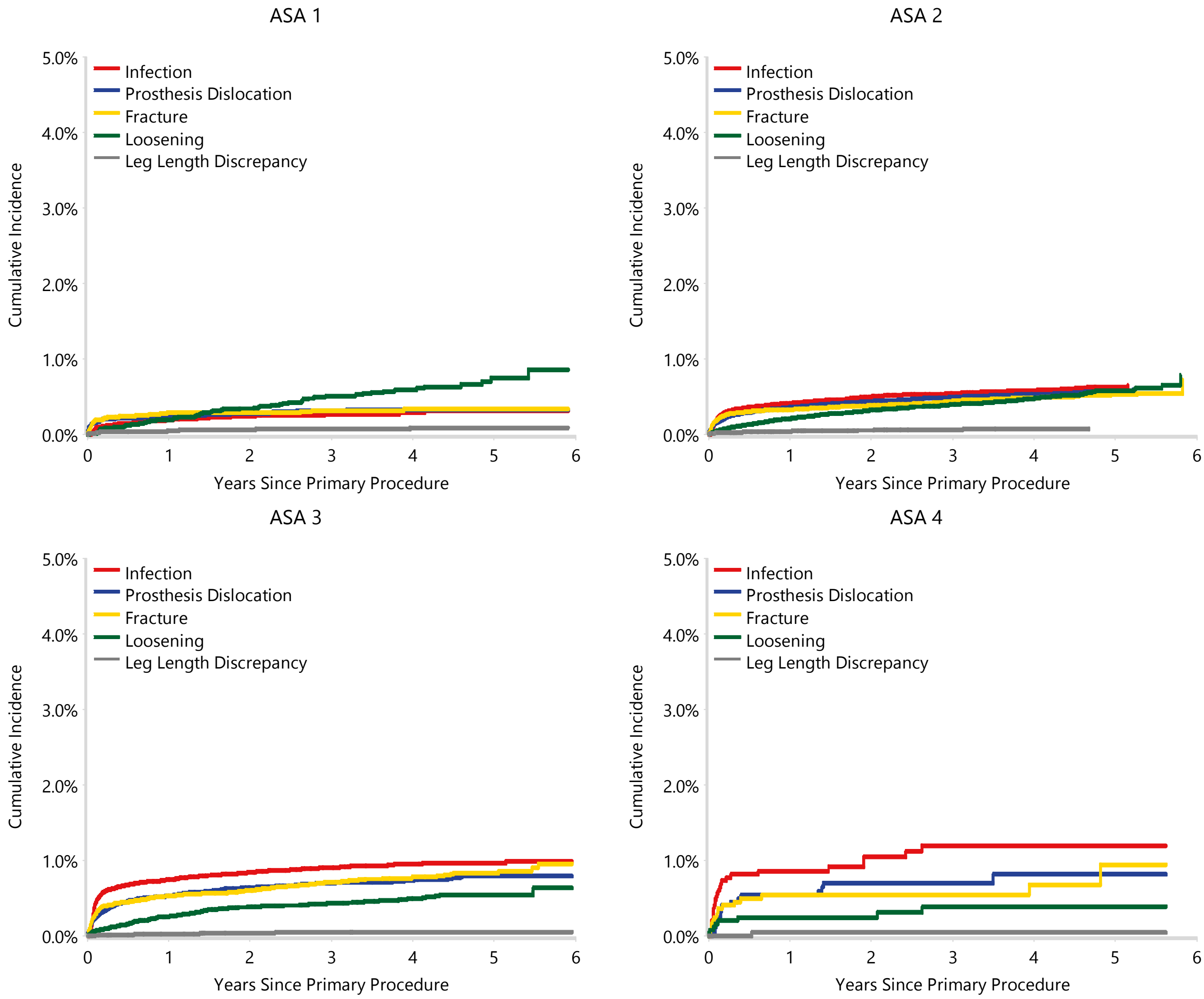
ASA 3 vs ASA 1
Entire Period: HR=1.84 (1.61, 2.09),p<0.001

ASA 4 vs ASA 1
Entire Period: HR=1.92 (1.47, 2.50),p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
ASA 1	17303	14073	10949	7894	4896	2029	14
ASA 2	95641	76259	58290	40736	24322	9444	41
ASA 3	58039	44178	32480	21850	12555	4652	25
ASA 4	2488	1850	1358	868	519	200	0

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)



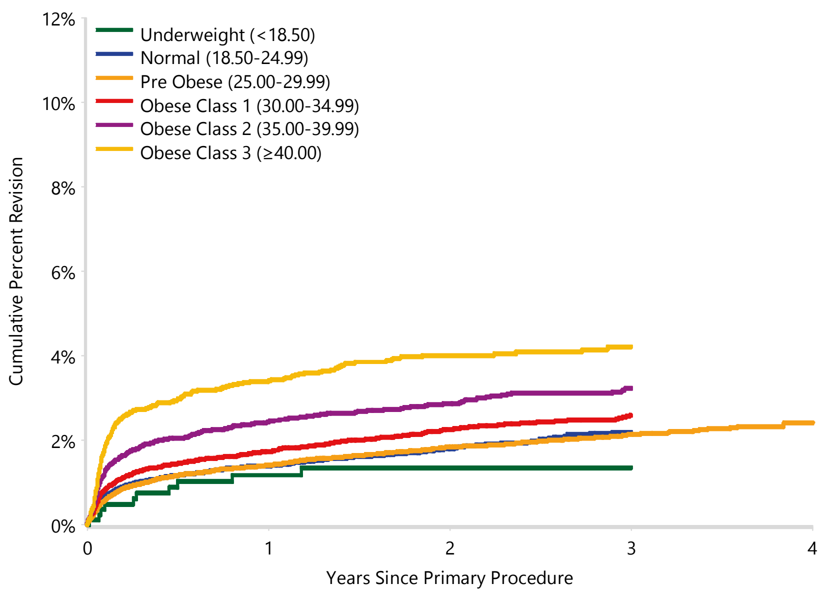
Note: All procedures using metal/metal prostheses have been excluded

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 (<18.50)	10	838	1.2 (0.6, 2.3)	1.4 (0.7, 2.5)	1.4 (0.7, 2.5)	
Normal (18.50-24.99)	421	24697	1.4 (1.2, 1.6)	1.8 (1.6, 2.0)	2.2 (2.0, 2.4)	
Pre Obese (25.00-29.99)	747	44068	1.4 (1.3, 1.5)	1.8 (1.7, 2.0)	2.1 (2.0, 2.3)	2.4 (2.2, 2.7)
Obese Class 1 (30.00-34.99)	619	30101	1.7 (1.6, 1.9)	2.3 (2.1, 2.5)	2.6 (2.4, 2.8)	
Obese Class 2 (35.00-39.99)	346	12710	2.4 (2.2, 2.7)	2.9 (2.6, 3.2)	3.2 (2.9, 3.6)	
Obese Class 3 (≥40.00)	231	6253	3.4 (3.0, 3.9)	4.0 (3.5, 4.6)	4.2 (3.7, 4.8)	
TOTAL	**2374**	**118667**				

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

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=0.70 (0.37, 1.31),p=0.260

Pre Obese (25.00-29.99) vs Normal (18.50-24.99)
Entire Period: HR=0.99 (0.88, 1.12),p=0.903

Obese Class 1 (30.00-34.99) vs Normal (18.50-24.99)
Entire Period: HR=1.22 (1.08, 1.39),p=0.001

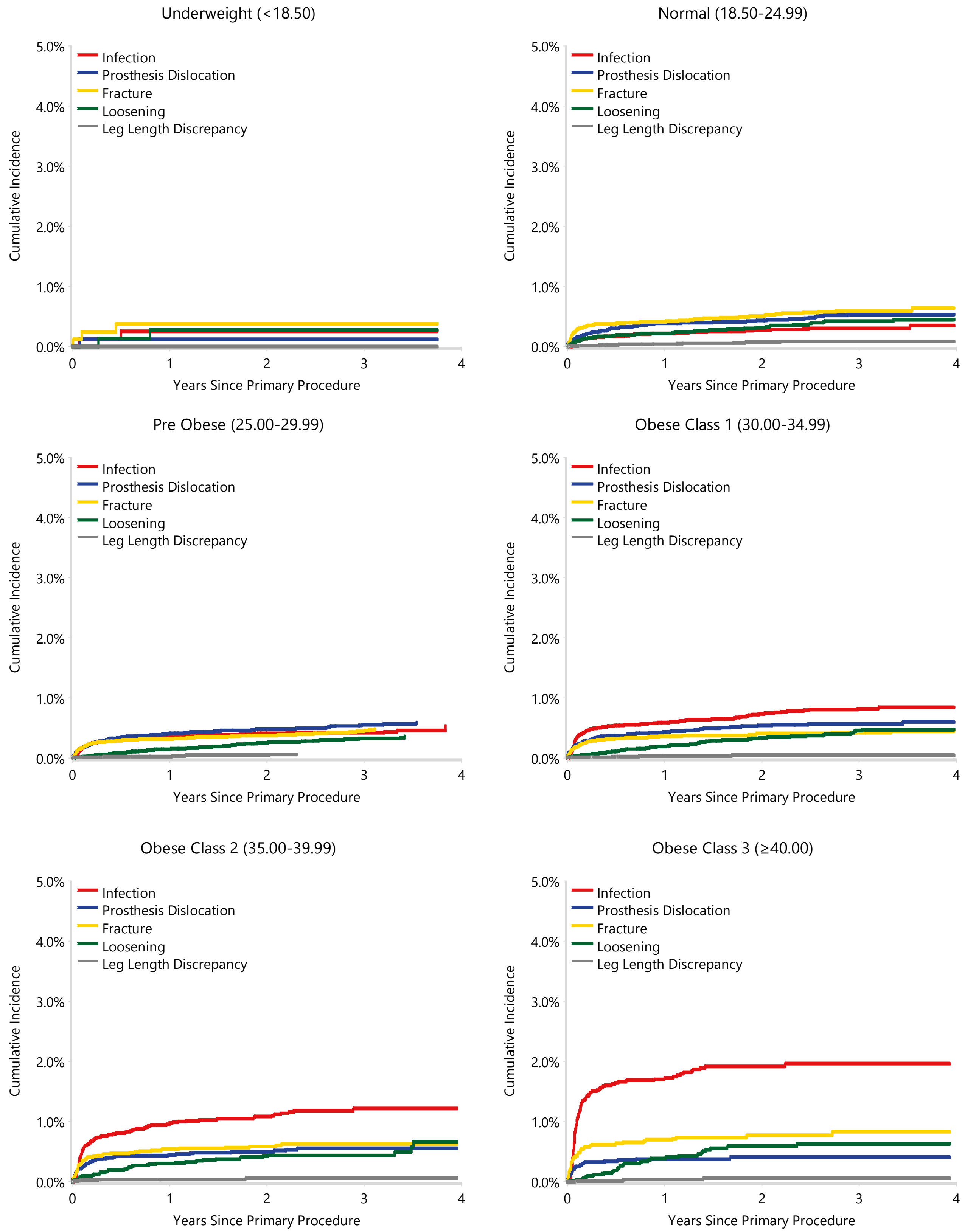
Obese Class 2 (35.00-39.99) vs Normal (18.50-24.99)
Entire Period: HR=1.65 (1.43, 1.90),p<0.001

Obese Class 3 (≥40.00) vs Normal (18.50-24.99)
0 - 3Mth: HR=2.86 (2.37, 3.44),p<0.001
3Mth+: HR=1.51 (1.16, 1.97),p=0.002

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs
Underweight (<18.50)	838	604	378	176	0
Normal (18.50-24.99)	24697	17588	11103	5118	18
Pre Obese (25.00-29.99)	44068	31248	19749	9057	42
Obese Class 1 (30.00-34.99)	30101	21178	13215	5993	25
Obese Class 2 (35.00-39.99)	12710	8909	5521	2448	7
Obese Class 3 (≥40.00)	6253	4342	2763	1260	5

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

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 or less

OUTCOME FOR OSTEOARTHRITIS - PROSTHESIS CHARACTERISTICS

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

Fixation

Modern bearing surfaces account for 97.2% of all primary total conventional hip procedures performed in 2018.

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 compared to hybrid fixation for all patients aged ≥65 years, and when compared to cemented fixation for patients aged ≥75 years (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 4,689 procedures using a mini stem prosthesis undertaken for osteoarthritis. This represents less than 1.2% of all primary total conventional hip procedures. There were 974 procedures recorded in 2018 using a mini stem prosthesis. This is an increase of 17.3% compared to 2017. The 15 year cumulative percent revision for primary total conventional hip replacement using a mini stem is 6.5% compared to 7.9% for other femoral stems.

There is no difference in the overall rate of revision when a mini stem is used (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 (2.6% compared to 1.8%) (Figure HT23). The types of revision are presented in Table HT24.

The Registry has information on 11 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 10,235 primary procedures using femoral stems with exchangeable necks undertaken for osteoarthritis. There were 160 procedures reported in 2018. This is a 40.3% decrease compared to 2017. 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 2018, 0.5% of all primary total conventional hip procedures used a stem with an exchangeable neck.

The cumulative percent revision at 15 years is 12.5% for stems with exchangeable necks compared to 7.7% 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 1.8% for fixed femoral neck stems), prosthesis dislocation (2.0% 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 1.0% 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 two 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).

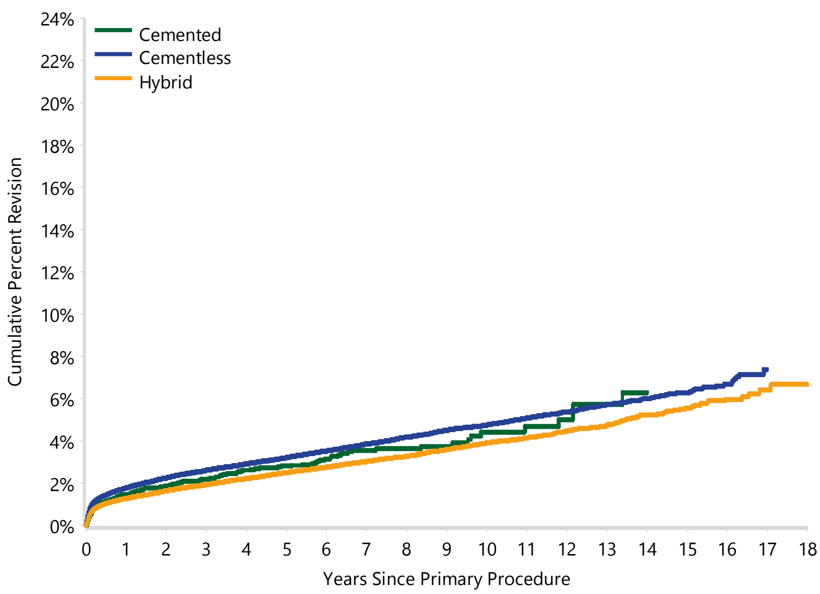
The Registry has information on 14 different exchangeable femoral neck prostheses that have been used in more than 60 procedures. The outcomes of each of these stems are detailed in Table HT29.

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	18 Yrs
Cemented	173	6186	1.5 (1.2, 1.8)	2.2 (1.8, 2.6)	2.8 (2.4, 3.3)	4.4 (3.6, 5.5)		
Cementless	6459	198675	1.8 (1.7, 1.8)	2.6 (2.6, 2.7)	3.2 (3.1, 3.3)	4.8 (4.6, 4.9)	6.3 (6.0, 6.6)	
Hybrid	2832	106177	1.3 (1.2, 1.4)	1.9 (1.9, 2.0)	2.5 (2.4, 2.6)	3.9 (3.7, 4.1)	5.6 (5.2, 5.9)	6.7 (5.9, 7.6)
TOTAL	**9464**	**311038**						

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=1.14 (0.98, 1.33),p=0.100

Cementless vs Hybrid
0 - 2Wk: HR=2.11 (1.78, 2.49),p<0.001
2Wk - 1Mth: HR=1.40 (1.24, 1.59),p<0.001
1Mth - 1.5Yr: HR=1.28 (1.19, 1.38),p<0.001
1.5Yr+: HR=1.14 (1.07, 1.22),p<0.001

Cementless vs Cemented
0 - 2Wk: HR=1.85 (1.49, 2.31),p<0.001
2Wk - 1Mth: HR=1.23 (1.02, 1.49),p=0.030
1Mth - 1.5Yr: HR=1.13 (0.96, 1.32),p=0.151
1.5Yr+: HR=1.00 (0.85, 1.18),p=0.969

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Cemented	6186	5475	4146	2661	508	33	1
Cementless	198675	172958	128488	89517	22700	2886	32
Hybrid	106177	93101	70478	50640	17170	2477	55

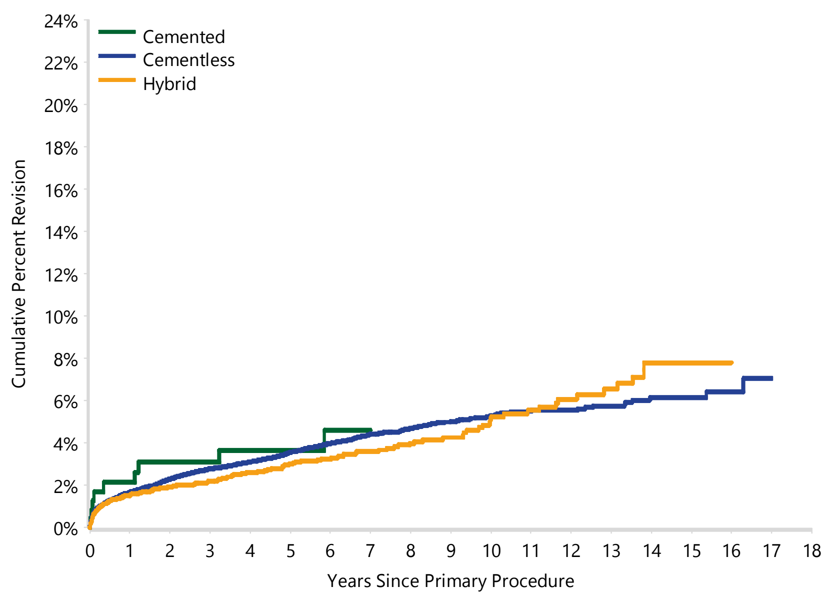
Note: Includes mixed ceramic/mixed ceramic and cross-linked polyethylene (XLPE) bearing surfaces

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	18 Yrs
<55		**1116**	**32560**	**1.6 (1.5, 1.8)**	**2.7 (2.5, 2.9)**	**3.5 (3.2, 3.7)**	**5.3 (4.9, 5.7)**	**6.6 (6.0, 7.3)**	
	Cemented	11	238	2.1 (0.9, 5.0)	3.1 (1.5, 6.4)	3.6 (1.8, 7.2)			
	Cementless	939	27094	1.7 (1.5, 1.8)	2.8 (2.6, 3.0)	3.6 (3.3, 3.8)	5.3 (4.9, 5.7)	6.1 (5.5, 6.8)	
	Hybrid	166	5228	1.5 (1.2, 1.9)	2.2 (1.8, 2.6)	3.0 (2.5, 3.6)	5.1 (4.2, 6.2)	7.8 (6.1, 9.9)	
55-64		**2211**	**73026**	**1.5 (1.4, 1.6)**	**2.3 (2.2, 2.4)**	**2.9 (2.7, 3.0)**	**4.5 (4.3, 4.7)**	**6.2 (5.8, 6.7)**	
	Cemented	27	723	2.3 (1.4, 3.7)	3.2 (2.1, 4.9)	3.4 (2.3, 5.1)	4.2 (2.8, 6.3)		
	Cementless	1679	55930	1.6 (1.5, 1.7)	2.3 (2.2, 2.5)	2.9 (2.7, 3.0)	4.5 (4.2, 4.7)	6.0 (5.5, 6.5)	
	Hybrid	505	16373	1.4 (1.2, 1.5)	2.1 (1.8, 2.3)	2.7 (2.5, 3.0)	4.5 (4.1, 5.0)	6.7 (5.8, 7.7)	
65-74		**3300**	**112308**	**1.5 (1.4, 1.6)**	**2.3 (2.2, 2.4)**	**2.8 (2.7, 2.9)**	**4.2 (4.0, 4.4)**	**5.7 (5.4, 6.1)**	
	Cemented	60	1961	1.3 (0.9, 1.9)	2.1 (1.5, 2.9)	2.8 (2.1, 3.8)	5.1 (3.7, 7.2)		
	Cementless	2232	72428	1.7 (1.6, 1.8)	2.5 (2.4, 2.6)	3.1 (2.9, 3.2)	4.4 (4.2, 4.6)	5.9 (5.5, 6.3)	
	Hybrid	1008	37919	1.2 (1.1, 1.3)	1.8 (1.7, 2.0)	2.4 (2.2, 2.6)	3.8 (3.5, 4.1)	5.3 (4.8, 5.8)	
≥75		**2837**	**93144**	**1.8 (1.7, 1.8)**	**2.5 (2.4, 2.6)**	**3.0 (2.9, 3.2)**	**4.5 (4.3, 4.7)**	**6.2 (5.7, 6.7)**	
	Cemented	75	3264	1.3 (1.0, 1.8)	1.9 (1.5, 2.5)	2.6 (2.0, 3.3)	3.2 (2.5, 4.1)		
	Cementless	1609	43223	2.3 (2.1, 2.4)	3.1 (2.9, 3.3)	3.7 (3.5, 3.9)	5.4 (5.1, 5.8)	7.9 (6.9, 9.1)	
	Hybrid	1153	46657	1.3 (1.2, 1.4)	2.0 (1.8, 2.1)	2.5 (2.3, 2.6)	3.7 (3.4, 3.9)	4.9 (4.4, 5.5)	
TOTAL		**9464**	**311038**						

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=1.39 (0.76, 2.57),p=0.286

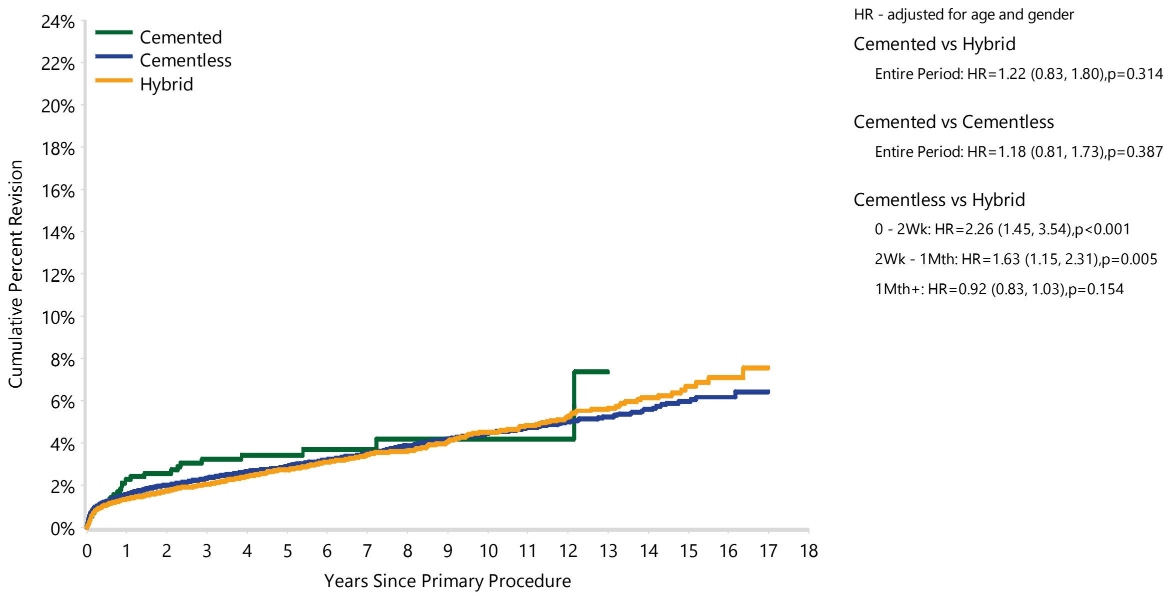
Cemented vs Cementless
Entire Period: HR=1.27 (0.70, 2.30),p=0.427

Cementless vs Hybrid
Entire Period: HR=1.10 (0.93, 1.29),p=0.278

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Cemented	238	209	177	134	22	5	1
Cementless	27094	23664	17688	12215	2891	470	4
Hybrid	5228	4538	3330	2206	727	183	5

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

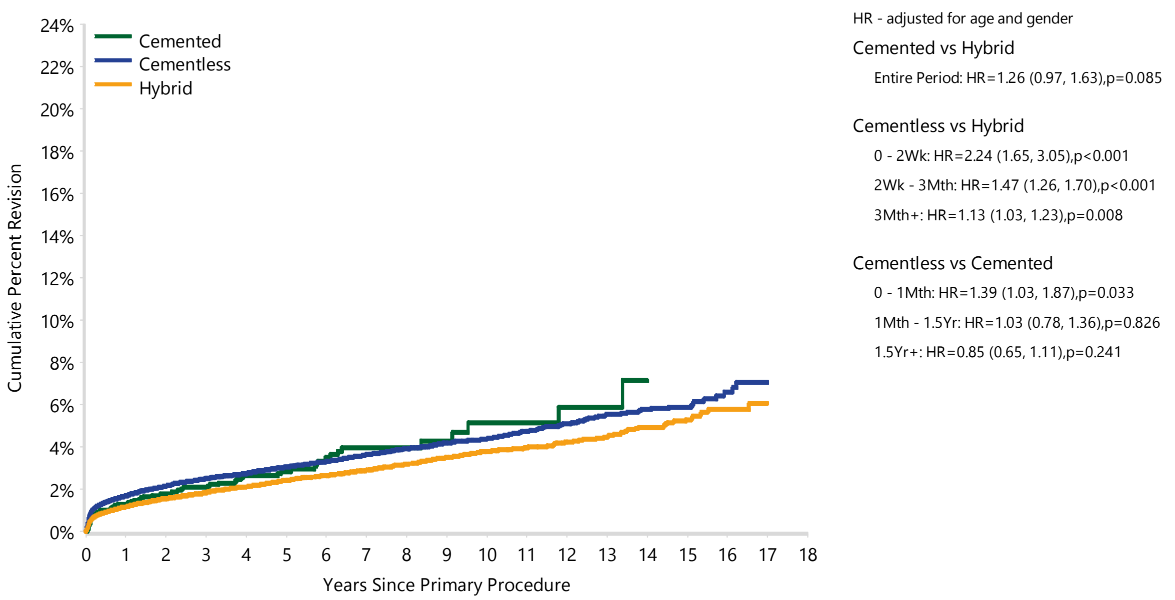
Figure HT19 Cumulative Percent Revision of Primary Total Conventional Hip Replacement in Patients Aged 55-64 Years by Fixation (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Cemented	723	670	543	397	95	3	0
Cementless	55930	48996	36807	26049	6841	1001	13
Hybrid	16373	14407	10947	7987	3004	559	15

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

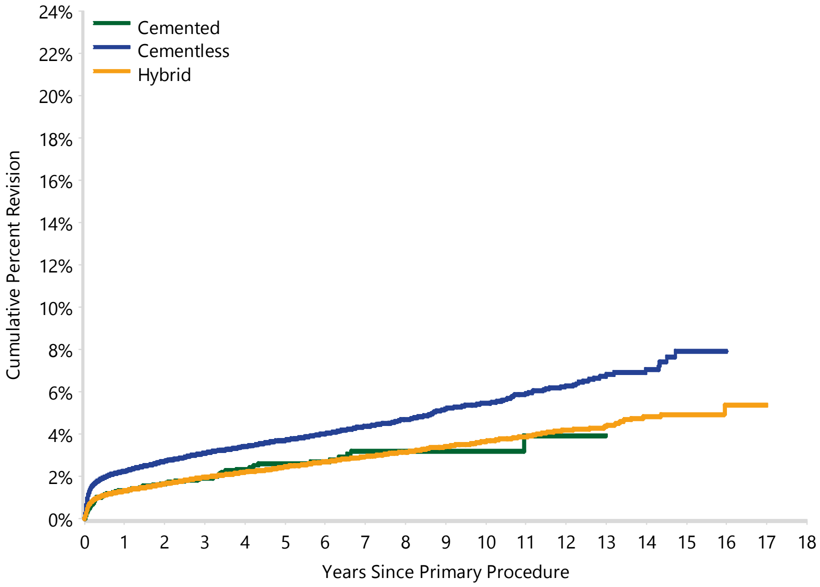
Figure HT20 Cumulative Percent Revision of Primary Total Conventional Hip Replacement in Patients Aged 65-74 Years by Fixation (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Cemented	1961	1777	1379	899	199	17	0
Cementless	72428	62963	46704	32632	8803	1139	12
Hybrid	37919	33521	25912	19223	7497	1215	26

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=1.01 (0.80, 1.28),p=0.913

Cementless vs Hybrid

0 - 2Wk: HR=2.42 (1.88, 3.10),p<0.001

2Wk - 3Mth: HR=1.69 (1.48, 1.94),p<0.001

3Mth+: HR=1.38 (1.25, 1.52),p<0.001

Cementless vs Cemented

0 - 1Mth: HR=1.94 (1.49, 2.53),p<0.001

1Mth+: HR=1.41 (1.11, 1.79),p=0.004

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Cemented	3264	2819	2047	1231	192	8	0
Cementless	43223	37335	27289	18621	4165	276	3
Hybrid	46657	40635	30289	21224	5942	520	9

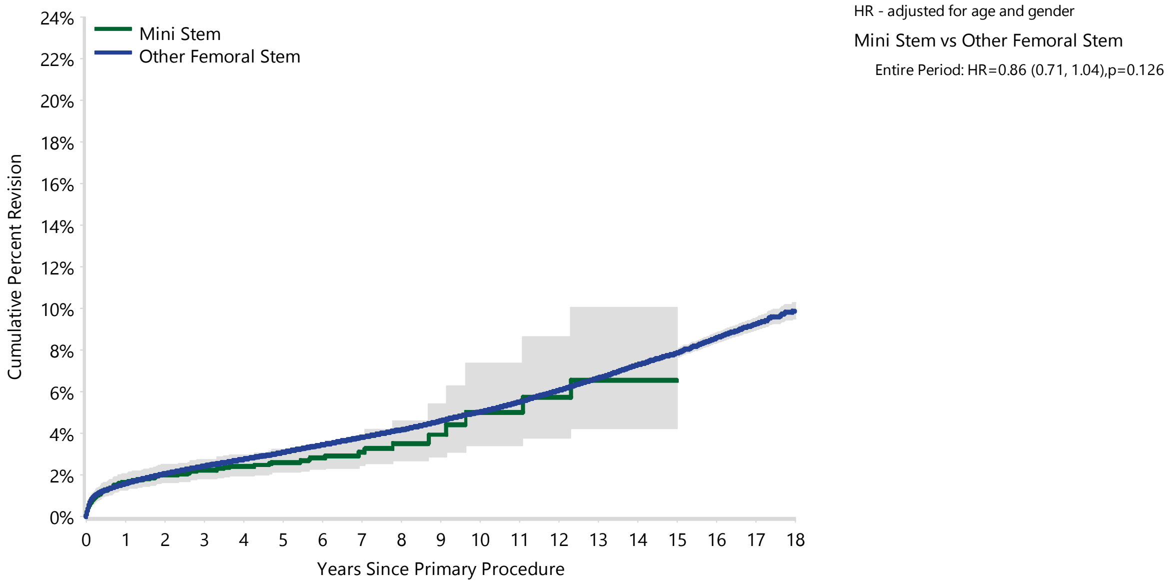
Note: Includes mixed ceramic/mixed ceramic and cross-linked polyethylene (XLPE) bearing surfaces

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	18 Yrs
Mini Stem	108	4689	1.6 (1.3, 2.1)	2.2 (1.8, 2.7)	2.6 (2.1, 3.2)	5.0 (3.4, 7.4)	6.5 (4.2, 10.1)	
Other Femoral Stem	14425	381412	1.6 (1.5, 1.6)	2.4 (2.4, 2.5)	3.1 (3.0, 3.2)	5.0 (4.9, 5.1)	7.9 (7.7, 8.0)	9.9 (9.5, 10.3)
TOTAL	**14533**	**386101**						

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

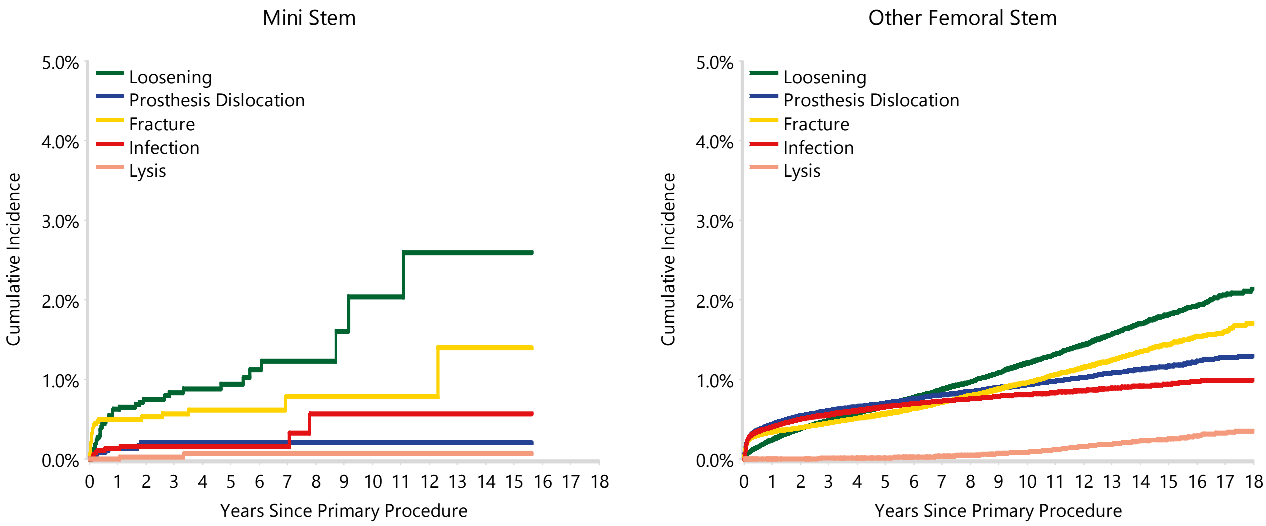
Figure HT22 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Stem Type (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Mini Stem	4689	3641	2201	1307	153	58	1
Other Femoral Stem	381412	339782	267395	201914	80548	19686	1341

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)

	Mini Stem			Other Femoral Stem		
Type of Revision	Number	% Primaries Revised	% Revisions	Number	% Primaries Revised	% Revisions
Femoral Component	54	1.2	50.0	4764	1.2	33.0
Acetabular Component	23	0.5	21.3	3034	0.8	21.0
Head/Insert	11	0.2	10.2	2923	0.8	20.3
THR (Femoral/Acetabular)	8	0.2	7.4	1756	0.5	12.2
Head Only	7	0.1	6.5	687	0.2	4.8
Cement Spacer	2	0.0	1.9	612	0.2	4.2
Minor Components	3	0.1	2.8	258	0.1	1.8
Other				391	0.1	2.7
N Revision	**108**	**2.3**	**100.0**	**14425**	**3.8**	**100.0**
N Primary	**4689**			**381412**		

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	18 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 (4.0, 14.2)	8.7 (4.8, 15.7)	
Mallory-Head	6	121	2.5 (0.8, 7.5)	5.2 (2.4, 11.3)	5.2 (2.4, 11.3)			
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)		
Metha	5	109	2.8 (0.9, 8.3)	4.6 (2.0, 10.7)	4.6 (2.0, 10.7)			
MiniHip	34	1013	2.6 (1.8, 3.8)	3.0 (2.1, 4.3)	4.1 (2.9, 5.9)			
Nanos	9	668	0.9 (0.4, 2.0)	1.2 (0.6, 2.4)	1.2 (0.6, 2.4)			
Optimys	10	1053	0.6 (0.3, 1.3)	1.3 (0.7, 2.6)				
Silent*	3	50	4.0 (1.0, 15.1)	6.0 (2.0, 17.5)	6.0 (2.0, 17.5)			
Taperloc Microplasty	21	1436	1.4 (0.9, 2.2)	1.6 (1.0, 2.5)	1.9 (1.2, 3.3)			
Other (2)	3	19	5.3 (0.8, 31.9)	5.3 (0.8, 31.9)	5.3 (0.8, 31.9)	28.9 (9.7, 68.2)		
TOTAL	**108**	**4689**						

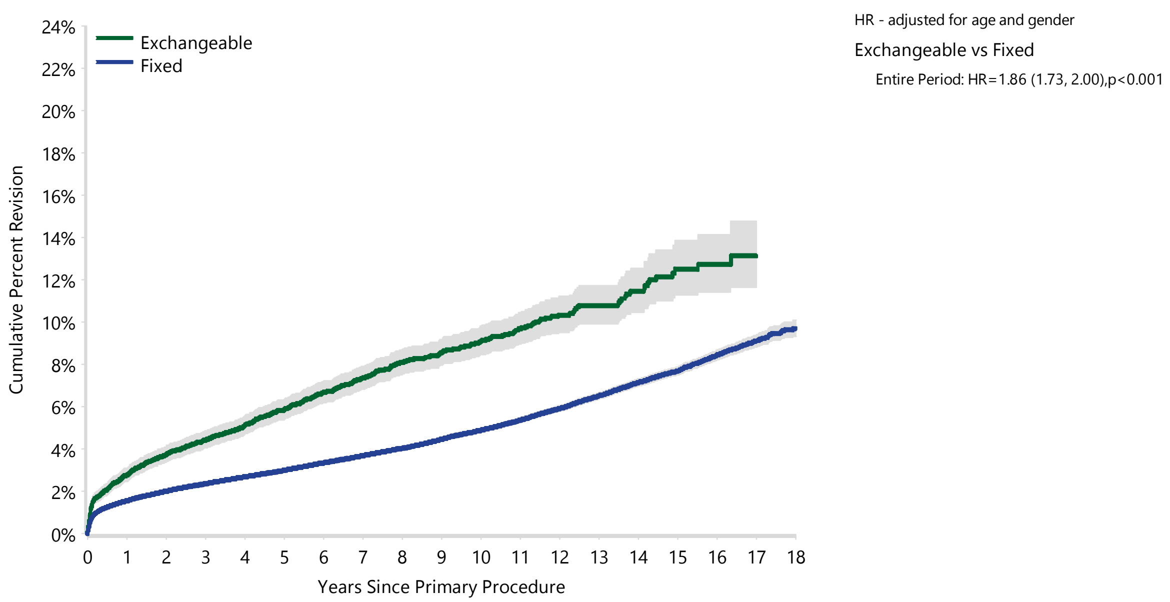
Note: All procedures using metal/metal prostheses have been excluded
* denotes mini stem with no recorded use in total primary conventional hip replacement in 2018
Only prostheses with over 50 procedures have been listed

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	18 Yrs
Exchangeable	783	10235	2.8 (2.5, 3.1)	4.4 (4.0, 4.9)	5.8 (5.4, 6.3)	9.1 (8.4, 9.8)	12.5 (11.3, 13.9)	
Fixed	13750	375866	1.6 (1.5, 1.6)	2.4 (2.3, 2.4)	3.0 (2.9, 3.1)	4.9 (4.8, 5.0)	7.7 (7.5, 7.9)	9.7 (9.3, 10.1)
TOTAL	**14533**	**386101**						

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

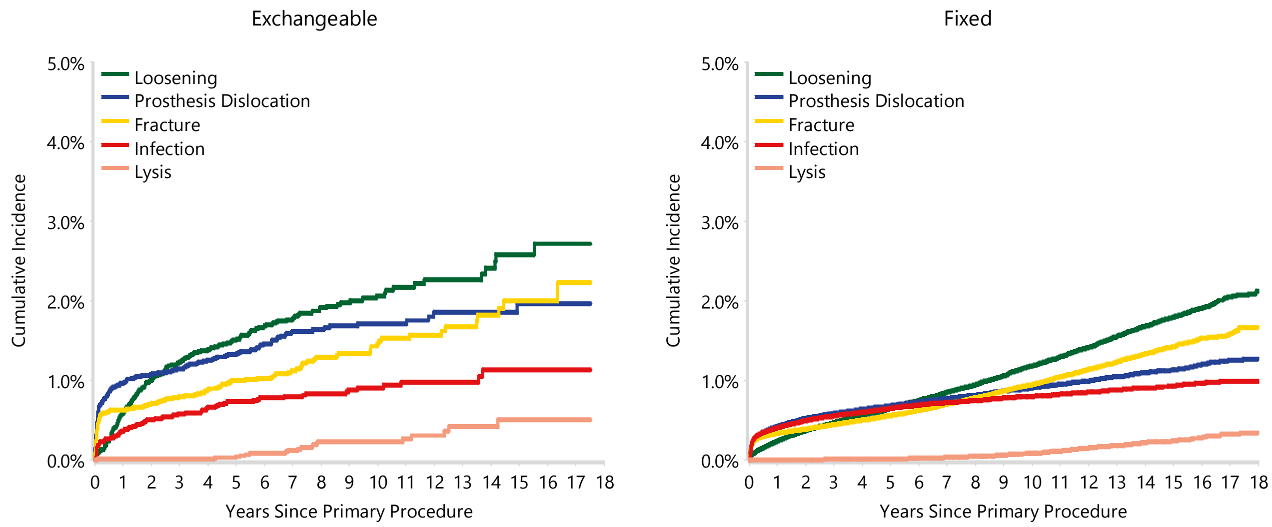
Figure HT24 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Type of Femoral Neck (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Exchangeable	10235	9711	8717	7301	2189	479	19
Fixed	375866	333712	260879	195920	78512	19265	1323

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	193	1.9	24.6	3386	0.9	24.6
Fracture	135	1.3	17.2	2871	0.8	20.9
Prosthesis Dislocation	163	1.6	20.8	2867	0.8	20.9
Infection	86	0.8	11.0	2561	0.7	18.6
Lysis	21	0.2	2.7	289	0.1	2.1
Pain	17	0.2	2.2	262	0.1	1.9
Leg Length Discrepancy	10	0.1	1.3	217	0.1	1.6
Malposition	13	0.1	1.7	196	0.1	1.4
Instability	12	0.1	1.5	180	0.0	1.3
Implant Breakage Stem	26	0.3	3.3	137	0.0	1.0
Wear Acetabular Insert				121	0.0	0.9
Implant Breakage Acetabular Insert	13	0.1	1.7	118	0.0	0.9
Incorrect Sizing	5	0.0	0.6	91	0.0	0.7
Implant Breakage Acetabular	14	0.1	1.8	78	0.0	0.6
Metal Related Pathology	63	0.6	8.0	57	0.0	0.4
Wear Head	3	0.0	0.4	58	0.0	0.4
Implant Breakage Head	3	0.0	0.4	42	0.0	0.3
Heterotopic Bone				22	0.0	0.2
Tumour				16	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	164	0.0	1.2
N Revision	**783**	**7.7**	**100.0**	**13750**	**3.7**	**100.0**
N Primary	**10235**			**375866**		

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

Figure HT26 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Bearing Surface and Type of Femoral Neck (Primary Diagnosis OA)

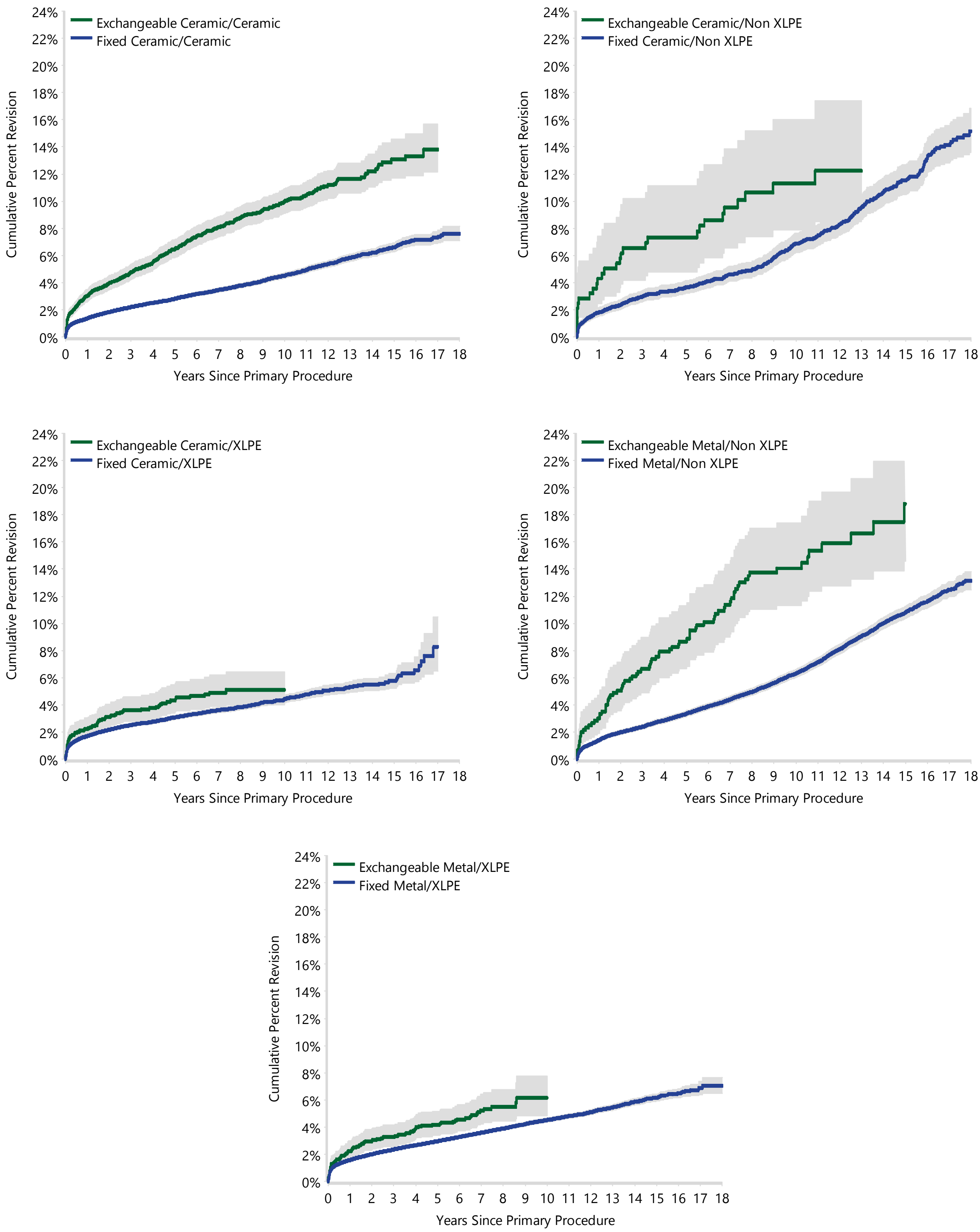
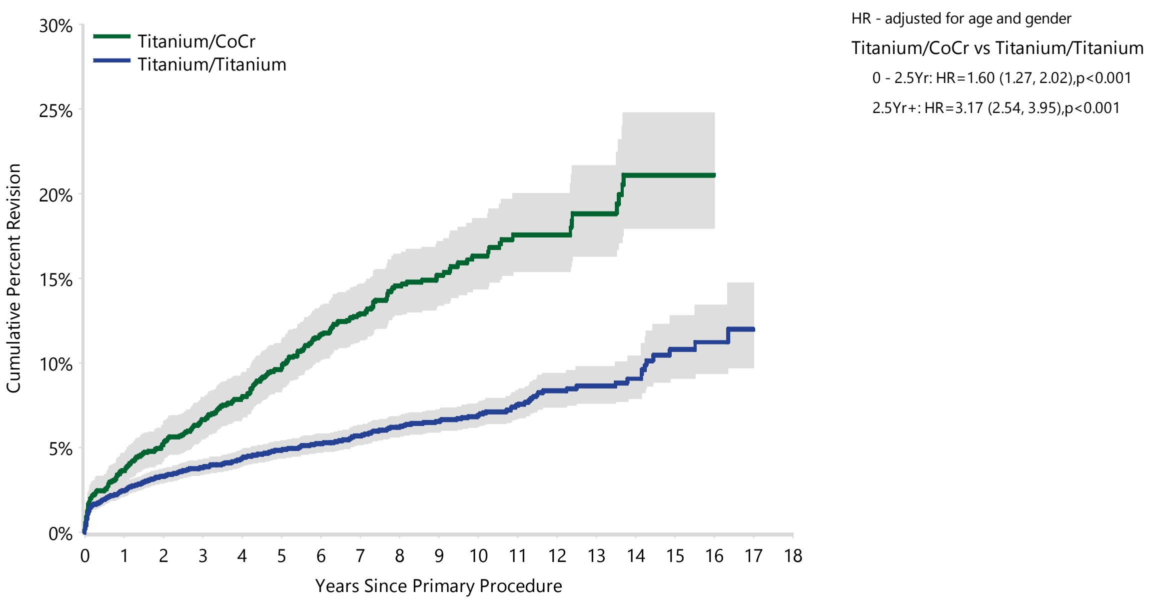


Table HT28 Cumulative Percent Revision of Primary Total Conventional Hip Replacement Using an Exchangeable Femoral Neck by Stem/Neck Metal Combination (Primary Diagnosis OA)

Stem/Neck Material	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
CoCr/CoCr	87	754	4.0 (2.8, 5.7)	5.8 (4.3, 7.7)	7.2 (5.6, 9.4)	11.9 (9.7, 14.6)	13.5 (10.9, 16.6)	
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	244	1679	3.6 (2.8, 4.7)	6.6 (5.5, 7.9)	9.6 (8.3, 11.2)	16.3 (14.4, 18.5)	21.1 (17.9, 24.8)	
Titanium/Titanium	448	7645	2.5 (2.1, 2.9)	3.8 (3.4, 4.3)	4.9 (4.4, 5.4)	6.9 (6.2, 7.6)	10.8 (9.1, 12.8)	
TOTAL	**783**	**10235**						

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

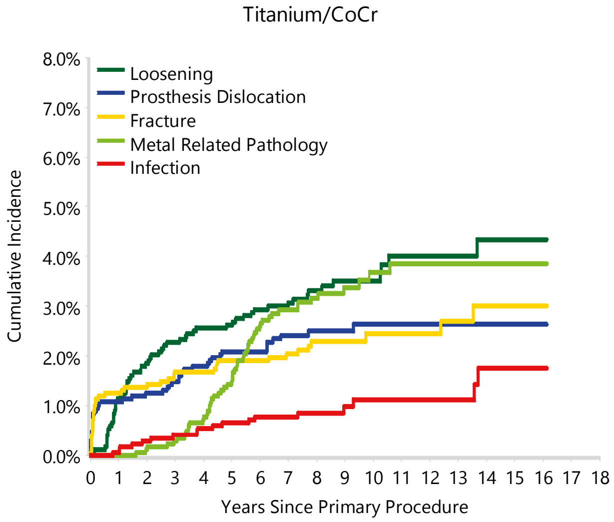
Figure HT27 Cumulative Percent Revision of Primary Total Conventional Hip Replacement Using an Exchangeable Femoral Neck by Stem/Neck Metal Combination (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Titanium/CoCr	1679	1601	1506	1380	372	85	0
Titanium/Titanium	7645	7253	6405	5198	1355	246	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	18 Yrs
ABGII*	73	228	4.4 (2.4, 8.1)	11.1 (7.7, 16.0)	20.4 (15.6, 26.3)			
Adapter*	58	374	3.8 (2.2, 6.3)	7.6 (5.3, 10.8)	10.2 (7.5, 13.9)	16.7 (13.0, 21.4)		
Apex	162	2590	2.7 (2.1, 3.4)	4.0 (3.3, 4.9)	5.2 (4.3, 6.1)	7.6 (6.4, 8.9)		
F2L*	77	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)	12.7 (10.2, 15.8)	
Femoral Neck (Amplitude)	22	580	0.9 (0.4, 2.1)	2.3 (1.3, 4.0)	4.2 (2.7, 6.5)	4.9 (3.2, 7.5)		
H-Max*	1	71	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	1.6 (0.2, 11.1)			
M-Cor*	11	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	122	2974	2.2 (1.8, 2.8)	3.2 (2.6, 3.9)	3.9 (3.2, 4.7)			
MBA*	64	630	2.1 (1.2, 3.5)	4.0 (2.7, 5.9)	6.3 (4.6, 8.5)	10.5 (8.1, 13.6)	14.5 (11.2, 18.8)	
MSA*	22	174	7.5 (4.4, 12.6)	9.9 (6.2, 15.4)	11.1 (7.2, 16.8)			
Margron*	79	543	5.2 (3.6, 7.4)	7.3 (5.4, 9.8)	9.2 (7.0, 12.0)	14.0 (11.3, 17.3)	15.6 (12.6, 19.2)	
Metha*	12	84	10.7 (5.7, 19.6)	11.9 (6.6, 21.0)	11.9 (6.6, 21.0)			
Profemur	58	875	3.1 (2.1, 4.5)	4.8 (3.5, 6.4)	5.4 (4.1, 7.1)	7.4 (5.6, 9.7)		
R120*	8	178	1.1 (0.3, 4.4)	2.3 (0.9, 6.1)	2.3 (0.9, 6.1)	7.5 (3.6, 15.3)		
Other (5)	14	139	2.9 (1.1, 7.5)	5.2 (2.5, 10.7)	7.3 (3.8, 13.8)			
TOTAL	**783**	**10235**						

Note: Only prostheses with over 60 procedures have been listed
* denotes exchangeable neck with no recorded use in primary total conventional hip replacement in 2018
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.

There is no difference in the rate of revision between ceramic/XLPE and metal/XLPE (Table HT30 and Figure HT29). The Registry acknowledges that there may be prosthesis specific factors that are confounders in the analysis of bearing surface.

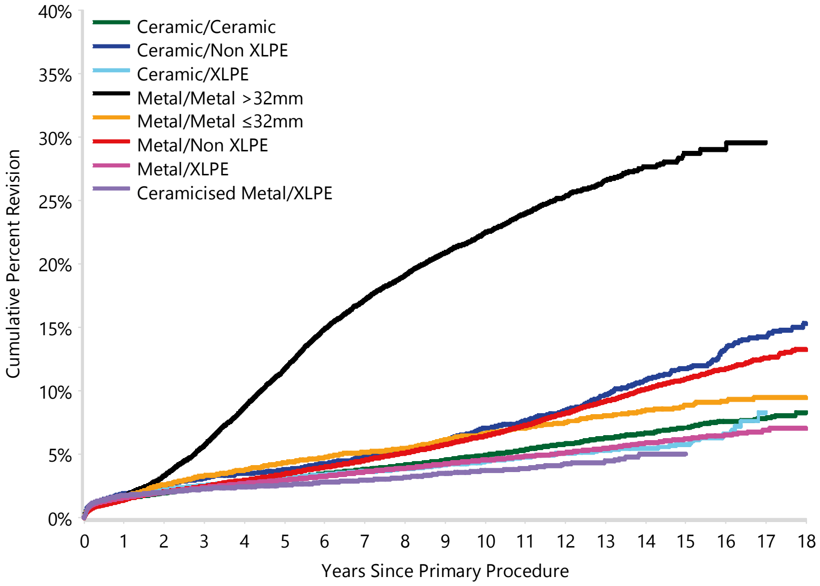
Detailed information on the analysis of metal/metal and metal/ceramic bearing surfaces are available in the supplementary reports 'Metal/Metal Bearing Surface in Total Conventional Hip Arthroplasty' and 'Prosthesis Types No Longer Used' on the AOANJRR website: https://aoanjrr.sahmri.com/annual-reports-2019.

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	18 Yrs
Ceramic/Ceramic	3460	89894	1.5 (1.4, 1.6)	2.4 (2.3, 2.5)	3.1 (3.0, 3.2)	4.9 (4.7, 5.1)	7.1 (6.8, 7.4)	8.3 (7.6, 9.0)
Ceramic/Non XLPE	529	7401	1.9 (1.6, 2.2)	3.1 (2.7, 3.6)	3.8 (3.3, 4.3)	7.1 (6.4, 7.8)	11.8 (10.7, 12.9)	15.3 (13.8, 17.0)
Ceramic/XLPE	2046	75636	1.7 (1.6, 1.8)	2.5 (2.4, 2.7)	3.1 (3.0, 3.3)	4.4 (4.2, 4.7)	5.8 (5.3, 6.4)	
Ceramic/Metal	22	299	1.7 (0.7, 4.0)	3.7 (2.1, 6.6)	4.4 (2.6, 7.4)	7.3 (4.8, 11.0)		
Metal/Metal >32mm	3267	14422	1.7 (1.5, 1.9)	5.7 (5.3, 6.1)	11.7 (11.2, 12.3)	22.5 (21.8, 23.2)	28.7 (27.5, 30.0)	
Metal/Metal ≤32mm	386	5146	1.6 (1.3, 2.0)	3.3 (2.9, 3.8)	4.4 (3.8, 5.0)	6.6 (6.0, 7.4)	8.8 (8.0, 9.8)	9.5 (8.5, 10.5)
Metal/Non XLPE	2661	35054	1.4 (1.3, 1.5)	2.5 (2.3, 2.6)	3.5 (3.3, 3.7)	6.4 (6.2, 6.7)	10.9 (10.5, 11.4)	13.3 (12.6, 13.9)
Metal/XLPE	5135	154524	1.6 (1.5, 1.7)	2.4 (2.3, 2.4)	3.0 (2.9, 3.1)	4.5 (4.4, 4.7)	6.2 (5.9, 6.5)	7.1 (6.5, 7.7)
Ceramicised Metal/Non XLPE	44	294	1.7 (0.7, 4.0)	3.8 (2.1, 6.8)	4.2 (2.4, 7.2)	12.6 (9.0, 17.5)		
Ceramicised Metal/XLPE	624	22783	1.7 (1.6, 1.9)	2.3 (2.1, 2.5)	2.6 (2.4, 2.8)	3.7 (3.4, 4.1)	5.0 (4.4, 5.8)	
TOTAL	**18174**	**405453**						

Note: Excludes 207 procedures with unknown bearing surface, 1 procedure with ceramicised metal/ceramic bearing surface and 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=1.01 (0.96, 1.05),p=0.711
Ceramic/Non XLPE vs Metal/XLPE	0 - 3Mth: HR=1.07 (0.86, 1.33),p=0.566
	3Mth - 2Yr: HR=1.40 (1.14, 1.72),p=0.001
	2Yr - 2.5Yr: HR=2.05 (1.35, 3.12),p<0.001
	2.5Yr - 6.5Yr: HR=1.25 (1.00, 1.57),p=0.049
	6.5Yr+: HR=2.51 (2.19, 2.87),p<0.001
Ceramic/XLPE vs Metal/XLPE	Entire Period: HR=1.01 (0.96, 1.06),p=0.747
Metal/Metal >32mm vs Metal/XLPE	0 - 2Wk: HR=1.27 (0.96, 1.69),p=0.096
	2Wk - 1Mth: HR=0.48 (0.32, 0.70),p<0.001
	1Mth - 3Mth: HR=0.85 (0.64, 1.13),p=0.257
	3Mth - 9Mth: HR=1.10 (0.86, 1.42),p=0.434
	9Mth - 1.5Yr: HR=2.65 (2.23, 3.14),p<0.001
	1.5Yr - 2Yr: HR=4.22 (3.49, 5.10),p<0.001
	2Yr - 3Yr: HR=6.55 (5.77, 7.42),p<0.001
	3Yr - 6Yr: HR=10.32 (9.59, 11.11),p<0.001
	6Yr - 9.5Yr: HR=6.74 (6.17, 7.36),p<0.001
	9.5Yr+: HR=4.61 (4.08, 5.21),p<0.001
Metal/Metal ≤32mm vs Metal/XLPE	Entire Period: HR=1.33 (1.20, 1.48),p<0.001
Metal/Non XLPE vs Metal/XLPE	0 - 1Mth: HR=0.73 (0.62, 0.86),p<0.001
	1Mth - 6Mth: HR=0.93 (0.80, 1.08),p=0.319
	6Mth - 1.5Yr: HR=1.42 (1.25, 1.62),p<0.001
	1.5Yr - 2.5Yr: HR=1.15 (0.97, 1.37),p=0.104
	2.5Yr - 3.5Yr: HR=1.51 (1.28, 1.79),p<0.001
	3.5Yr - 11Yr: HR=1.87 (1.74, 2.01),p<0.001
	11Yr+: HR=2.59 (2.31, 2.90),p<0.001
Ceramicised Metal/XLPE vs Metal/XLPE	0 - 3Mth: HR=1.14 (1.00, 1.29),p=0.042
	3Mth+: HR=0.71 (0.63, 0.79),p<0.001

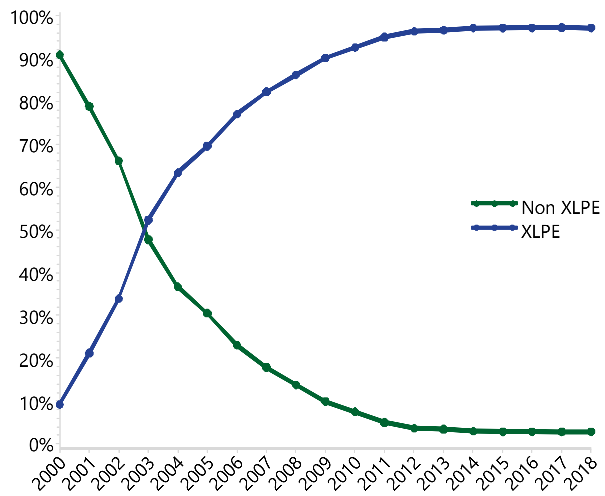
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Ceramic/Ceramic	89894	82930	69138	53688	20982	5406	232
Ceramic/Non XLPE	7401	6594	5457	4571	3098	1489	277
Ceramic/XLPE	75636	60443	37466	22237	5637	775	14
Metal/Metal >32mm	14422	14062	13216	11982	7297	352	18
Metal/Metal ≤32mm	5146	5024	4840	4595	3514	1400	74
Metal/Non XLPE	35054	33704	31218	28421	18999	7429	743
Metal/XLPE	154524	139087	110239	82551	28068	4404	74
Ceramicised Metal/XLPE	22783	19883	15342	11082	3596	192	0

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

Cross-linked Polyethylene (XLPE)

XLPE has been used in 252,943 procedures reported to the Registry. This includes 14,895 procedures that have XLPE with the addition of an antioxidant. In 2018, when polyethylene was used as a bearing surface in primary total conventional hip procedures, the proportion of XLPE was 97.1% (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 18 years the cumulative percent revision is 7.2% and 13.7%, respectively. The cumulative incidence of loosening, prosthesis dislocation and lysis at 18 years is 1.2%, 1.3% and 0.1% for XLPE, compared to 3.6%,1.8% and 0.7% 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 of ≥32mm have been used in 79.4% of XLPE procedures and in only 12.4% of non XLPE procedures. The Registry has previously shown that this increased use of larger head size with XLPE is the reason

At 18 years the cumulative percent revision of total conventional hip replacement with XLPE is 7.2%.

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).

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 16 year follow-up with an insert using both types of polyethylene. XLPE is used in 90.9% 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 16 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 44.9% 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 12 year follow-up for both types of polyethylene. XLPE has been used in 53.0% 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 16 year follow-up with an insert using both types of polyethylene. XLPE is used in 83.9% 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).

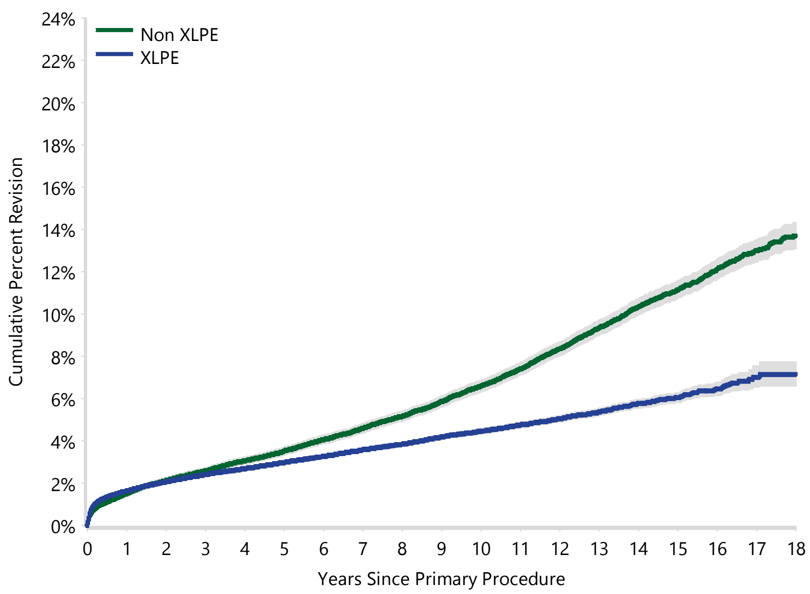
Prosthesis Specific (Antioxidant)

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 2017. There were three 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	18 Yrs
Non XLPE		**3234**	**42749**	**1.5 (1.4, 1.6)**	**2.6 (2.4, 2.7)**	**3.5 (3.3, 3.7)**	**6.6 (6.3, 6.9)**	**11.2 (10.7, 11.6)**	**13.7 (13.1, 14.3)**
	<32mm	2926	37434	1.5 (1.3, 1.6)	2.5 (2.3, 2.7)	3.4 (3.3, 3.6)	6.5 (6.2, 6.8)	11.0 (10.6, 11.5)	13.6 (13.0, 14.2)
	32mm	280	4991	1.6 (1.3, 2.0)	3.1 (2.6, 3.6)	3.8 (3.3, 4.5)	7.2 (6.3, 8.1)	11.0 (9.4, 13.0)	
	>32mm	28	324	3.5 (1.9, 6.2)	6.0 (3.8, 9.3)	8.0 (5.4, 11.9)			
XLPE		**7805**	**252943**	**1.6 (1.6, 1.7)**	**2.4 (2.3, 2.5)**	**3.0 (2.9, 3.1)**	**4.5 (4.4, 4.6)**	**6.1 (5.8, 6.3)**	**7.2 (6.6, 7.7)**
	<32mm	2157	52171	1.6 (1.5, 1.7)	2.4 (2.3, 2.5)	3.0 (2.9, 3.2)	4.6 (4.4, 4.8)	6.1 (5.8, 6.5)	7.3 (6.7, 7.9)
	32mm	2983	108227	1.6 (1.5, 1.7)	2.3 (2.3, 2.4)	2.8 (2.7, 2.9)	4.1 (3.9, 4.3)	5.3 (4.9, 5.7)	
	>32mm	2665	92545	1.7 (1.6, 1.8)	2.5 (2.4, 2.6)	3.1 (3.0, 3.3)	4.8 (4.6, 5.1)	7.1 (6.1, 8.3)	
TOTAL		**11039**	**295692**						

Figure HT31 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Polyethylene Type (Primary Diagnosis OA)



HR - adjusted for age and gender

Non XLPE vs XLPE

0 - 1Mth: HR=0.78 (0.68, 0.90),p<0.001

1Mth - 3Mth: HR=0.85 (0.71, 1.01),p=0.058

3Mth - 6Mth: HR=0.97 (0.78, 1.20),p=0.753

6Mth - 1.5Yr: HR=1.49 (1.32, 1.69),p<0.001

1.5Yr - 2.5Yr: HR=1.28 (1.09, 1.50),p=0.002

2.5Yr - 6.5Yr: HR=1.69 (1.54, 1.85),p<0.001

6.5Yr - 9Yr: HR=2.10 (1.85, 2.38),p<0.001

9Yr - 11Yr: HR=2.79 (2.36, 3.30),p<0.001

11Yr+: HR=2.98 (2.57, 3.45),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Non XLPE	42749	40584	36942	33235	22270	8944	1020
XLPE	252943	219413	163047	115870	37301	5371	88

Figure HT32 Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement by Polyethylene Type (Primary Diagnosis OA)

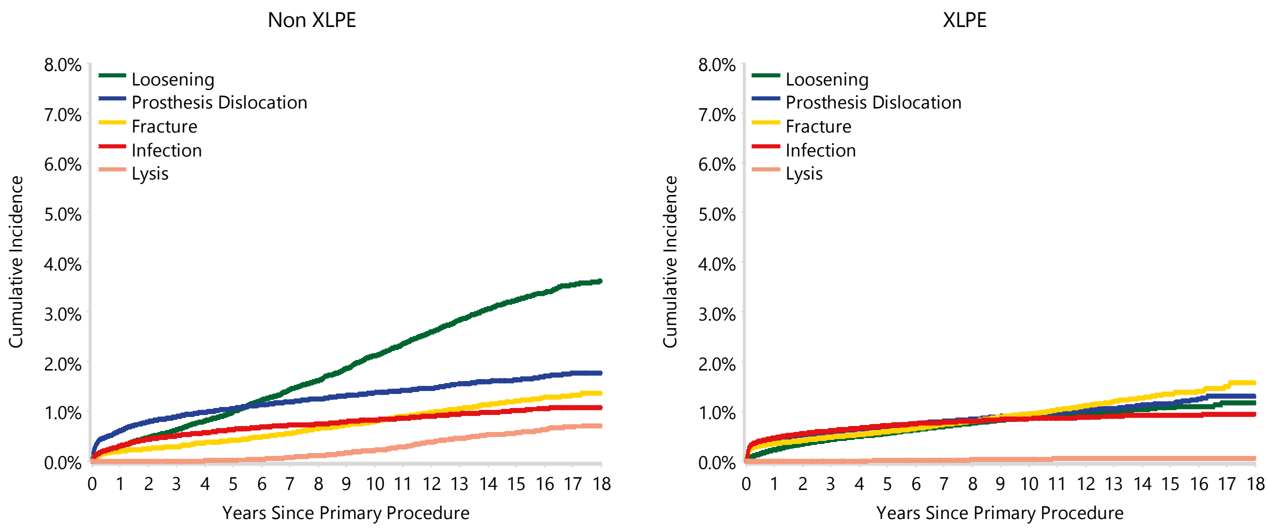
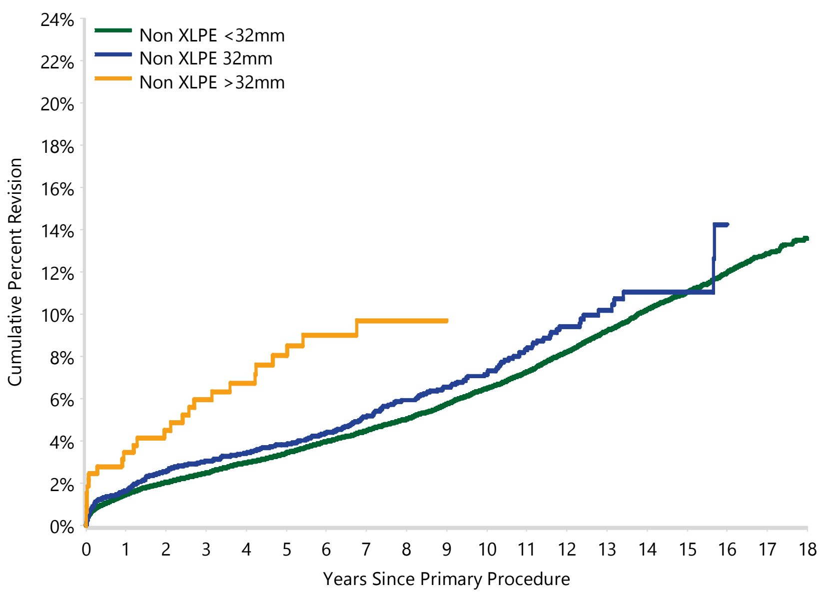


Figure HT33 Cumulative Percent Revision of Primary Total Conventional Hip Replacement using Non XLPE by Head Size (Primary Diagnosis OA)



HR - adjusted for age and gender

Non XLPE 32mm vs Non XLPE <32mm

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

Non XLPE >32mm vs Non XLPE <32mm

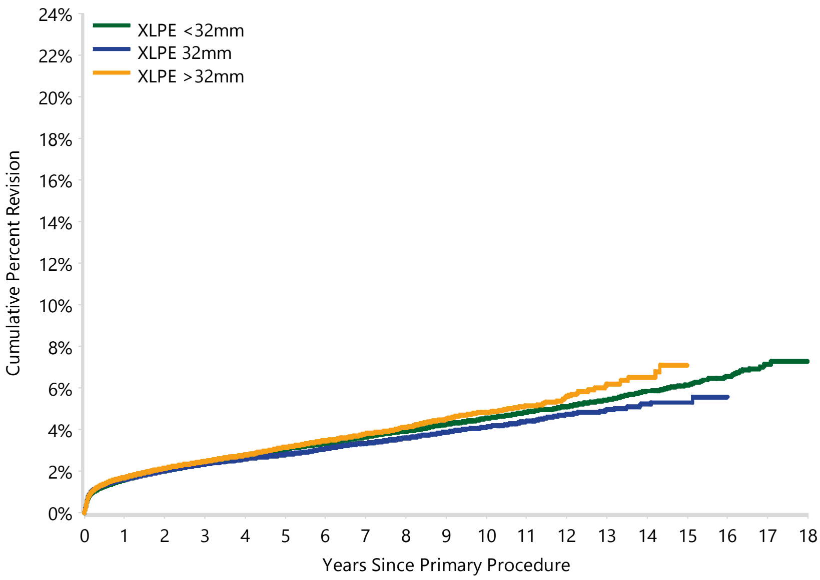
Entire Period: HR=2.13 (1.47, 3.09),p<0.001

Non XLPE >32mm vs Non XLPE 32mm

Entire Period: HR=1.70 (1.16, 2.51),p=0.007

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
XLPE	<32mm	37434	35673	32784	29844	21052	8857	1018
	32mm	4991	4621	3906	3194	1186	87	2
	>32mm	324	290	252	197	32	0	0

Figure HT34 Cumulative Percent Revision of Primary Total Conventional Hip Replacement using XLPE by Head Size (Primary Diagnosis OA)



HR - adjusted for age and gender

XLPE <32mm vs XLPE 32mm
0 - 3Mth: HR=0.94 (0.85, 1.04),p=0.209
3Mth+: HR=1.15 (1.07, 1.23),p<0.001

XLPE >32mm vs XLPE 32mm
0 - 1Mth: HR=0.93 (0.84, 1.04),p=0.197
1Mth+: HR=1.16 (1.09, 1.23),p<0.001

XLPE >32mm vs XLPE <32mm
Entire Period: HR=1.03 (0.97, 1.10),p=0.285

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
XLPE	<32mm	52171	48557	43143	37265	20884	4816	87
	32mm	108227	93856	67608	44846	10714	402	1
	>32mm	92545	77000	52296	33759	5703	153	0

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

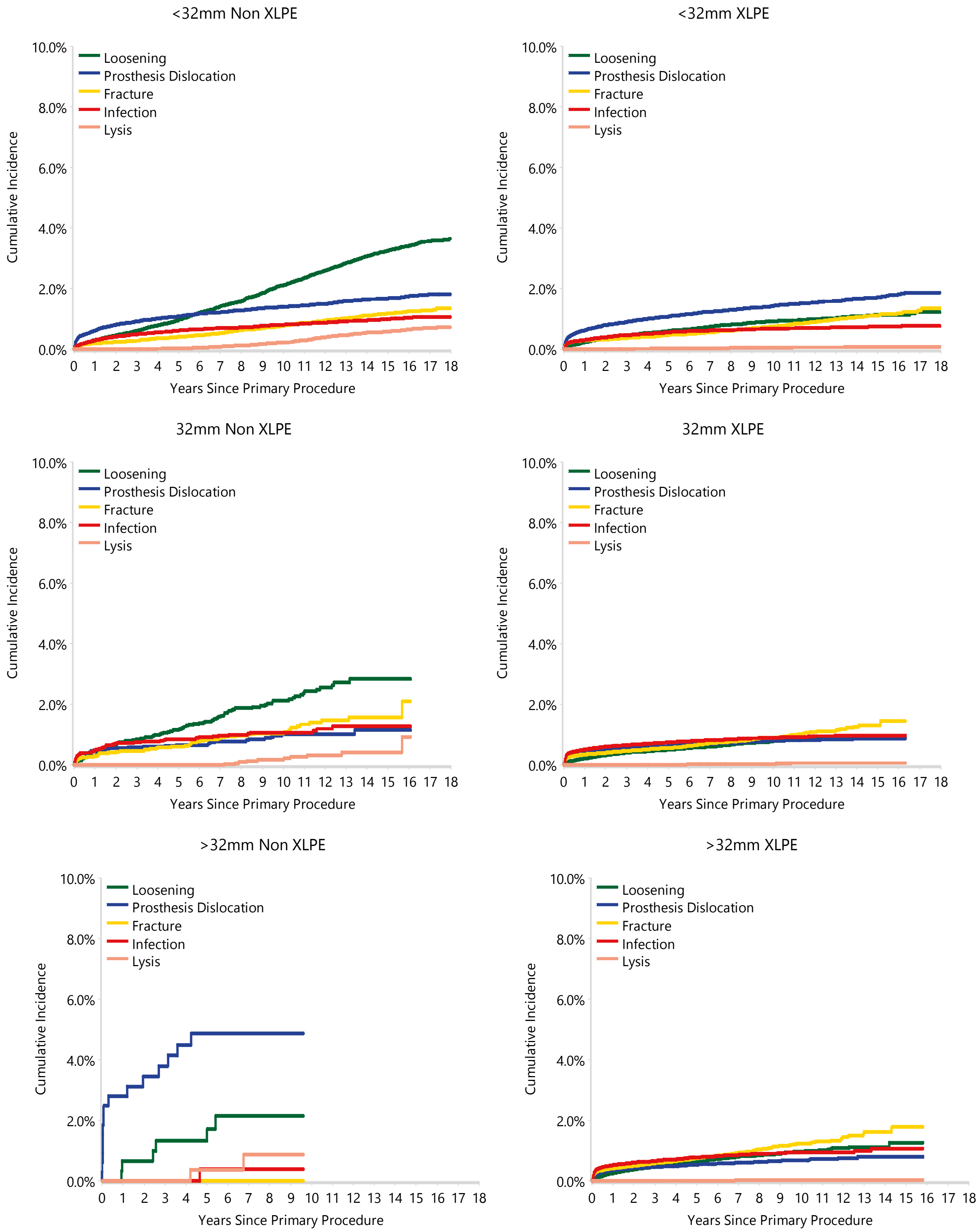


Figure HT36 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Head Surface and Polyethylene Type (Primary Diagnosis OA)

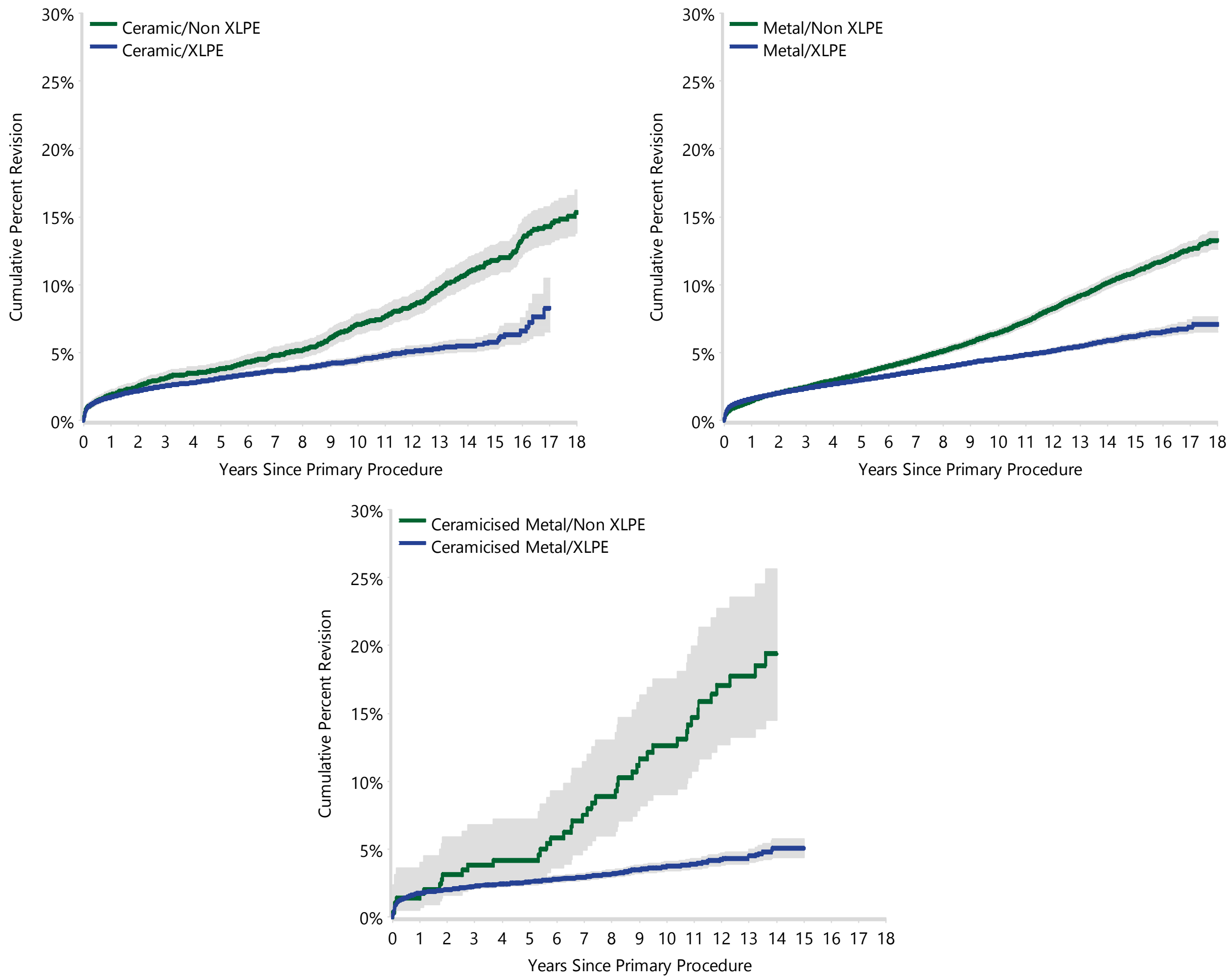
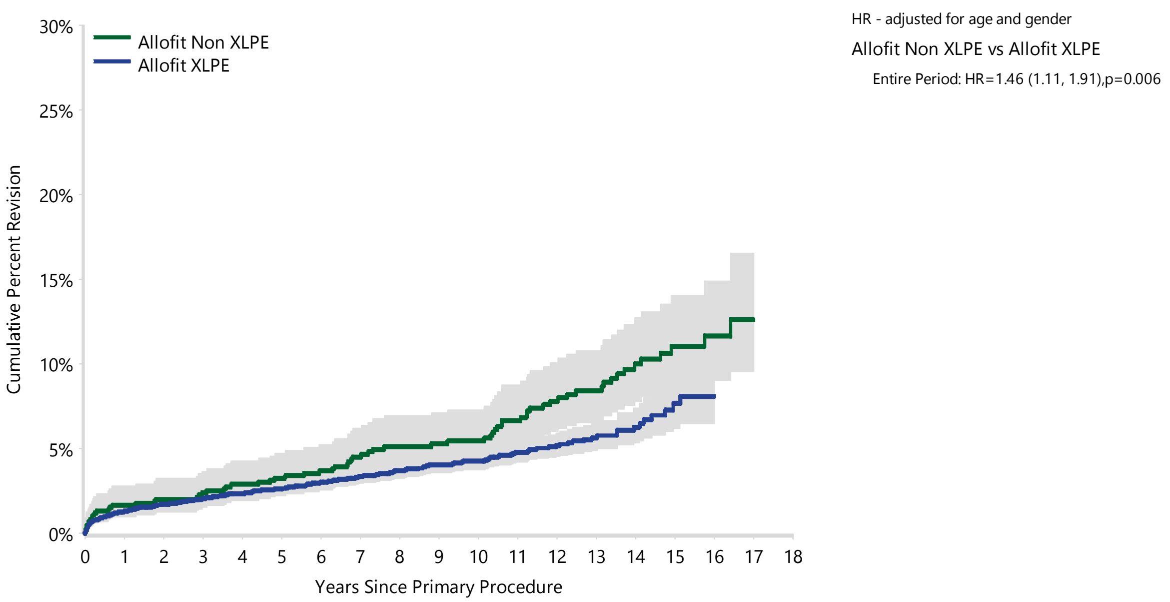


Table HT32 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Prosthesis Type and Polyethylene Type (Primary Diagnosis OA)

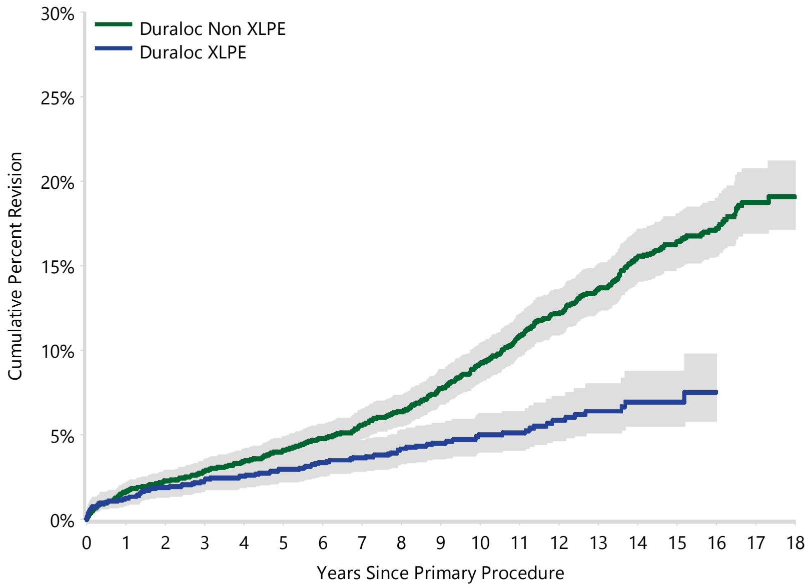
Prosthesis Type	Polyethylene Type	N Revised	N Total	5 Yrs	10 Yrs	12 Yrs	15 Yrs	16 Yrs
Allofit		**375**	**9332**	**2.7 (2.4, 3.1)**	**4.4 (3.9, 4.9)**	**5.7 (5.0, 6.4)**	**8.4 (7.2, 9.8)**	**9.0 (7.6, 10.6)**
	Non XLPE	70	848	3.3 (2.3, 4.7)	5.4 (4.0, 7.3)	7.8 (6.0, 10.1)	11.0 (8.6, 14.1)	11.6 (9.0, 14.9)
	XLPE	305	8484	2.6 (2.3, 3.0)	4.2 (3.8, 4.8)	5.2 (4.5, 5.9)	7.7 (6.2, 9.4)	8.1 (6.5, 10.1)
Duraloc		**473**	**4711**	**3.7 (3.2, 4.3)**	**7.8 (7.0, 8.6)**	**10.1 (9.2, 11.2)**	**13.8 (12.6, 15.1)**	**14.6 (13.3, 16.0)**
	Non XLPE	385	2995	4.1 (3.4, 4.9)	9.2 (8.2, 10.4)	12.2 (10.9, 13.6)	16.4 (14.9, 18.1)	17.2 (15.6, 19.0)
	XLPE	88	1716	3.0 (2.2, 3.9)	5.0 (4.0, 6.3)	5.8 (4.7, 7.3)	7.0 (5.5, 8.8)	7.5 (5.8, 9.8)
Mallory-Head		**348**	**7418**	**2.5 (2.2, 2.9)**	**4.2 (3.7, 4.8)**	**5.7 (5.1, 6.4)**	**8.1 (7.1, 9.1)**	**8.7 (7.7, 9.9)**
	Non XLPE	276	4084	2.8 (2.3, 3.3)	4.8 (4.2, 5.5)	6.3 (5.5, 7.1)	8.6 (7.6, 9.7)	9.2 (8.1, 10.5)
	XLPE	72	3334	2.2 (1.7, 2.7)	2.7 (2.0, 3.7)			
Reflection (Cup)		**198**	**2294**	**3.0 (2.4, 3.9)**	**8.0 (6.8, 9.5)**	**10.7 (9.1, 12.5)**	**17.8 (15.2, 20.7)**	**18.1 (15.5, 21.2)**
	Non XLPE	160	1079	3.4 (2.4, 4.7)	11.3 (9.3, 13.6)	15.3 (12.9, 18.1)	23.7 (20.3, 27.5)	24.1 (20.7, 27.9)
	XLPE	38	1215	2.6 (1.8, 3.8)	3.8 (2.7, 5.4)	3.8 (2.7, 5.4)		
Reflection (Shell)		**690**	**14436**	**2.4 (2.2, 2.7)**	**4.4 (4.0, 4.8)**	**5.5 (5.1, 6.0)**	**7.7 (7.0, 8.4)**	**9.0 (8.1, 10.0)**
	Non XLPE	303	2322	4.3 (3.5, 5.2)	9.6 (8.4, 11.0)	12.9 (11.4, 14.5)	16.6 (14.8, 18.6)	18.4 (16.4, 20.6)
	XLPE	387	12114	2.0 (1.8, 2.3)	3.2 (2.9, 3.6)	3.7 (3.3, 4.1)	5.1 (4.4, 5.9)	5.4 (4.6, 6.3)
Vitalock		**292**	**4619**	**2.5 (2.1, 3.0)**	**4.6 (4.0, 5.3)**	**5.4 (4.8, 6.2)**	**7.2 (6.4, 8.2)**	**7.9 (7.0, 8.9)**
	Non XLPE	246	3569	2.6 (2.1, 3.1)	4.8 (4.1, 5.6)	5.7 (5.0, 6.6)	7.7 (6.8, 8.8)	8.3 (7.3, 9.5)
	XLPE	46	1050	2.4 (1.6, 3.5)	3.9 (2.8, 5.3)	4.5 (3.3, 6.0)	5.5 (4.0, 7.4)	
TOTAL		**2376**	**42810**					

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	18 Yrs
Allofit	Non XLPE	848	828	793	738	554	219	4
	XLPE	8484	8022	6938	5657	2245	239	0

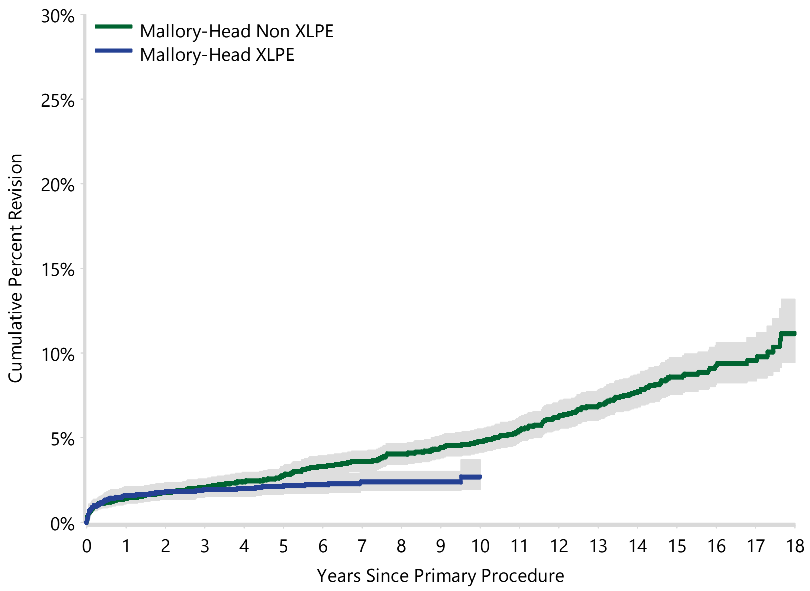
Figure HT38 Cumulative Percent Revision of Duraloc Primary Total Conventional Hip Replacement by Polyethylene Type (Primary Diagnosis OA)



HR - adjusted for age and gender
Duraloc Non XLPE vs Duraloc XLPE
0 - 5Yr: HR=1.34 (0.96, 1.88),p=0.082
5Yr - 11Yr: HR=2.91 (1.93, 4.38),p<0.001
11Yr+: HR=2.56 (1.41, 4.66),p=0.002

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Duraloc	Non XLPE	2995	2915	2744	2568	1944	971	76
	XLPE	1716	1668	1575	1461	927	175	0

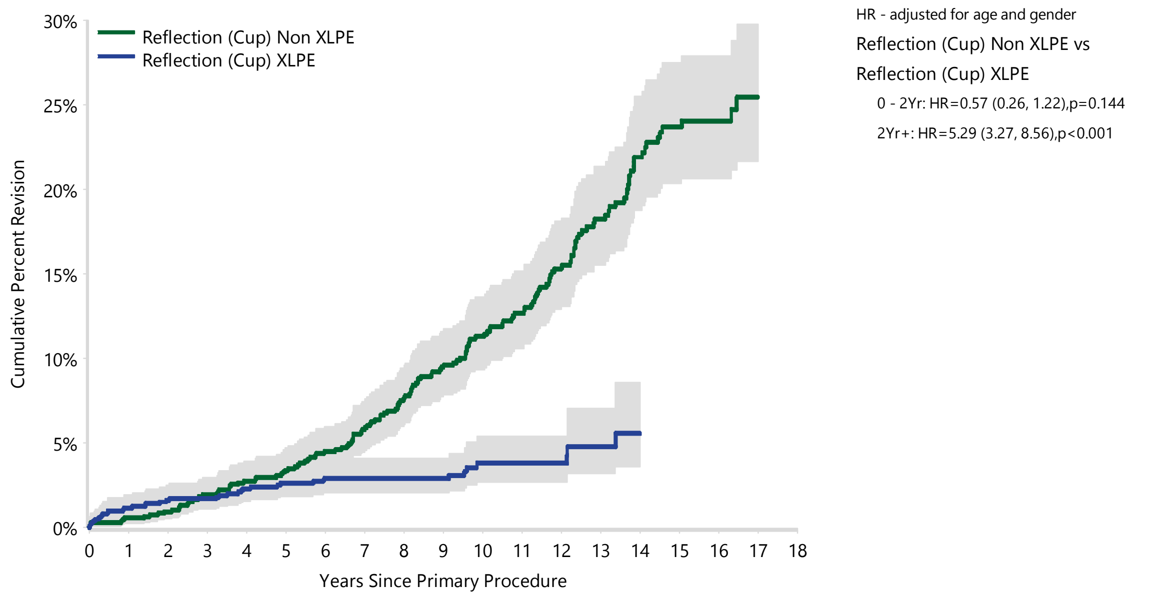
Figure HT39 Cumulative Percent Revision of Mallory-Head Primary Total Conventional Hip Replacement by Polyethylene Type (Primary Diagnosis OA)



HR - adjusted for age and gender
Mallory-Head Non XLPE vs Mallory-Head XLPE
0 - 1Mth: HR=0.85 (0.49, 1.49),p=0.575
1Mth - 3Mth: HR=1.63 (0.70, 3.81),p=0.259
3Mth - 1.5Yr: HR=0.90 (0.51, 1.58),p=0.709
1.5Yr+: HR=2.83 (1.69, 4.75),p<0.001

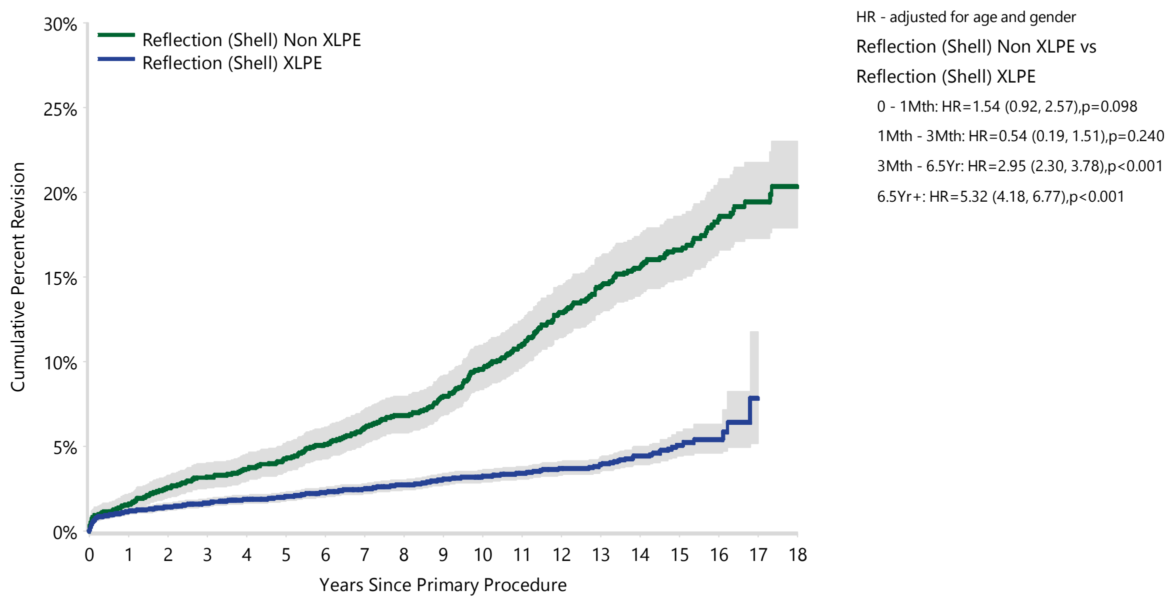
Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Mallory-Head	Non XLPE	4084	3977	3812	3623	2907	1098	150
	XLPE	3334	3121	2517	1837	193	0	0

Figure HT40 Cumulative Percent Revision of Reflection (Cup) Primary Total Conventional Hip Replacement by Polyethylene Type (Primary Diagnosis OA)



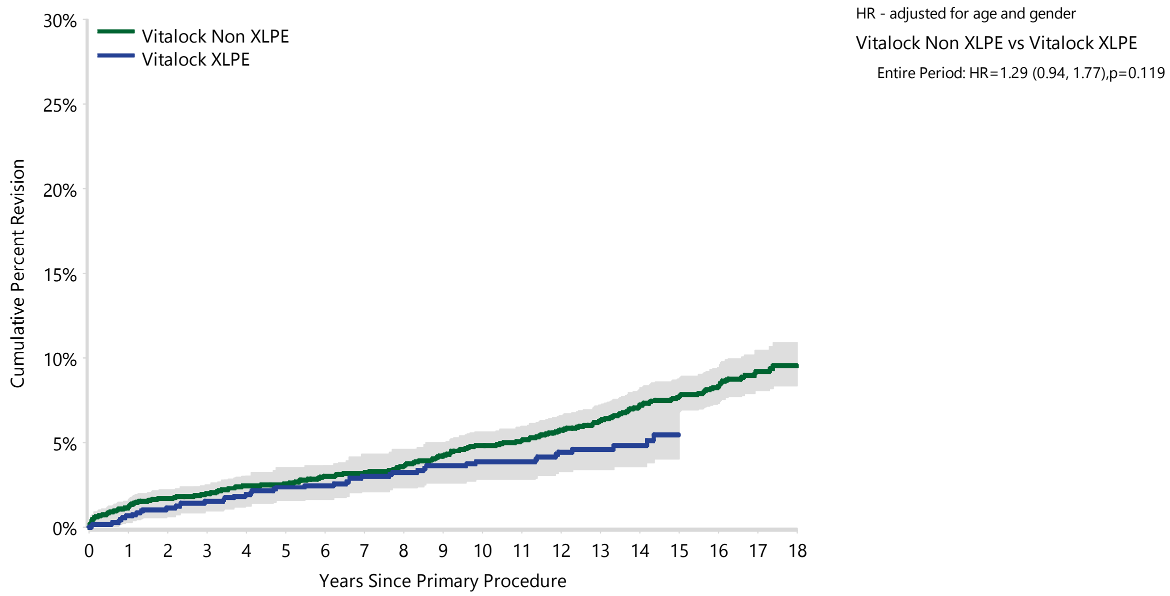
Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Reflection (Cup)	Non XLPE	1079	1052	975	894	600	217	19
	XLPE	1215	1149	1024	844	394	17	0

Figure HT41 Cumulative Percent Revision of Reflection (Shell) 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	18 Yrs
Reflection (Shell)	Non XLPE	2322	2243	2117	1964	1472	669	82
	XLPE	12114	11716	10969	9755	5858	756	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	18 Yrs
Vitalock	Non XLPE	3569	3478	3333	3164	2561	1625	291
	XLPE	1050	1032	985	936	731	188	0

Table HT33 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Prosthesis Type and XLPE Type (Primary Diagnosis OA)

Prosthesis Type	Polyethylene Type	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	6 Yrs	8 Yrs
G7		**45**	**2729**	**1.5 (1.1, 2.0)**	**1.8 (1.3, 2.4)**	**2.0 (1.5, 2.7)**	**2.0 (1.5, 2.7)**		
	XLPE	6	238	0.8 (0.2, 3.3)	2.3 (1.0, 5.5)	2.9 (1.3, 6.3)	2.9 (1.3, 6.3)		
	XLPE + Antioxidant	39	2491	1.6 (1.1, 2.2)	1.7 (1.2, 2.3)	1.8 (1.3, 2.5)	1.8 (1.3, 2.5)		
Ringloc		**141**	**6046**	**1.6 (1.3, 2.0)**	**1.9 (1.6, 2.2)**	**2.0 (1.7, 2.4)**	**2.2 (1.8, 2.6)**	**2.3 (2.0, 2.8)**	**2.6 (2.2, 3.1)**
	XLPE	74	3228	1.4 (1.0, 1.8)	1.7 (1.3, 2.2)	1.8 (1.4, 2.3)	1.9 (1.5, 2.5)	2.2 (1.7, 2.8)	2.5 (2.0, 3.2)
	XLPE + Antioxidant	67	2818	1.9 (1.4, 2.4)	2.1 (1.6, 2.7)	2.4 (1.9, 3.0)	2.5 (1.9, 3.1)	2.5 (1.9, 3.1)	2.5 (1.9, 3.1)
Trinity		**133**	**7304**	**1.6 (1.3, 1.9)**	**2.0 (1.7, 2.4)**	**2.4 (2.0, 2.9)**	**2.5 (2.1, 3.0)**	**2.9 (2.2, 3.7)**	
	XLPE	27	1304	1.4 (0.9, 2.2)	1.8 (1.2, 2.8)	2.5 (1.7, 3.7)	2.9 (1.8, 4.5)	2.9 (1.8, 4.5)	
	XLPE + Antioxidant	106	6000	1.6 (1.3, 2.0)	2.1 (1.7, 2.6)	2.4 (1.9, 2.9)	2.4 (1.9, 2.9)	2.9 (2.1, 4.0)	
TOTAL		**319**	**16079**						

Ceramic/Ceramic Bearings

Ceramic/ceramic bearings have been used in 89,894 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 2018, mixed ceramic accounted for 97.8% 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 ≥40mm have a lower rate of revision than 32mm heads. When compared to 32mm head sizes, there is no difference in the rate of revision for ≤28mm head sizes after 3 months or for 36-38mm heads 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 one year, the cumulative incidence of dislocation is 1.7% 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)**

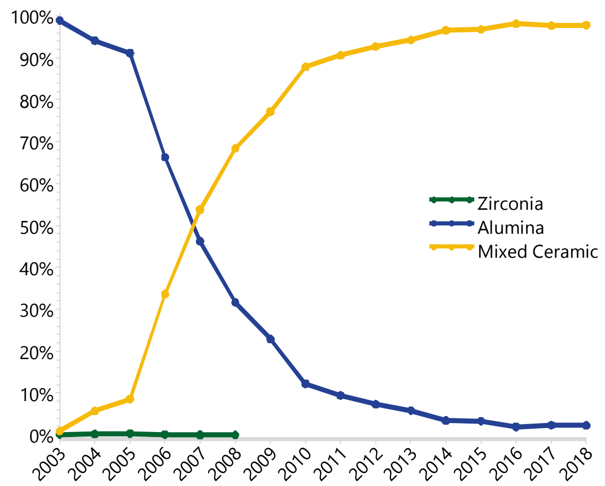
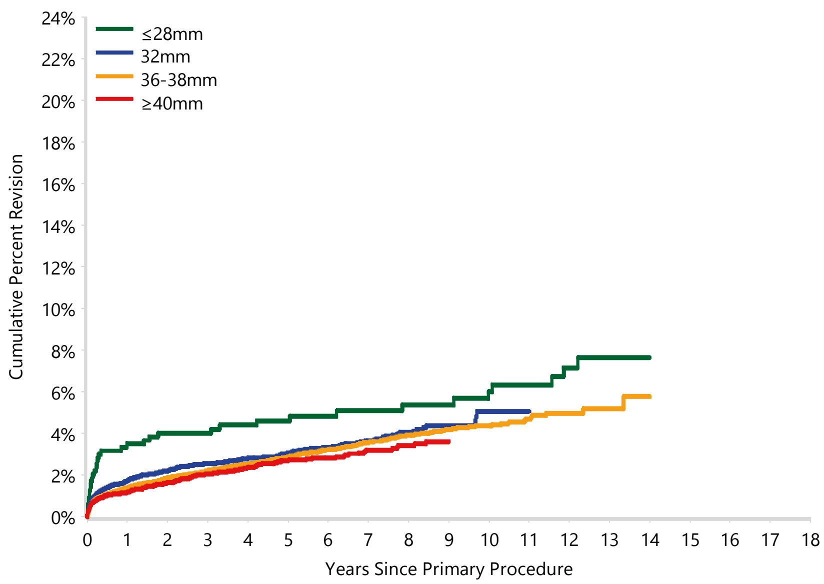


Table HT34 Cumulative Percent Revision of Mixed Ceramic/Mixed Ceramic Primary Total Conventional Hip Replacement by Head Size (Primary Diagnosis OA)

Head Size	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
≤28mm	37	635	3.5 (2.3, 5.3)	4.0 (2.7, 5.9)	4.6 (3.2, 6.6)	6.0 (4.3, 8.4)		
32mm	312	10346	1.8 (1.5, 2.0)	2.5 (2.2, 2.9)	3.0 (2.7, 3.4)	5.1 (4.2, 6.1)		
36-38mm	1127	40291	1.4 (1.3, 1.5)	2.2 (2.1, 2.4)	2.9 (2.7, 3.1)	4.4 (4.0, 4.7)		
≥40mm	183	6823	1.2 (0.9, 1.5)	2.0 (1.7, 2.4)	2.7 (2.3, 3.2)			
TOTAL	**1659**	**58095**						

Figure HT44 Cumulative Percent Revision of Mixed Ceramic/Mixed Ceramic Primary Total Conventional Hip Replacement by Head Size (Primary Diagnosis OA)



HR - adjusted for age and gender

≤28mm vs 32mm
0 - 3Mth: HR=2.67 (1.63, 4.37),p<0.001
3Mth+: HR=0.97 (0.61, 1.54),p=0.891

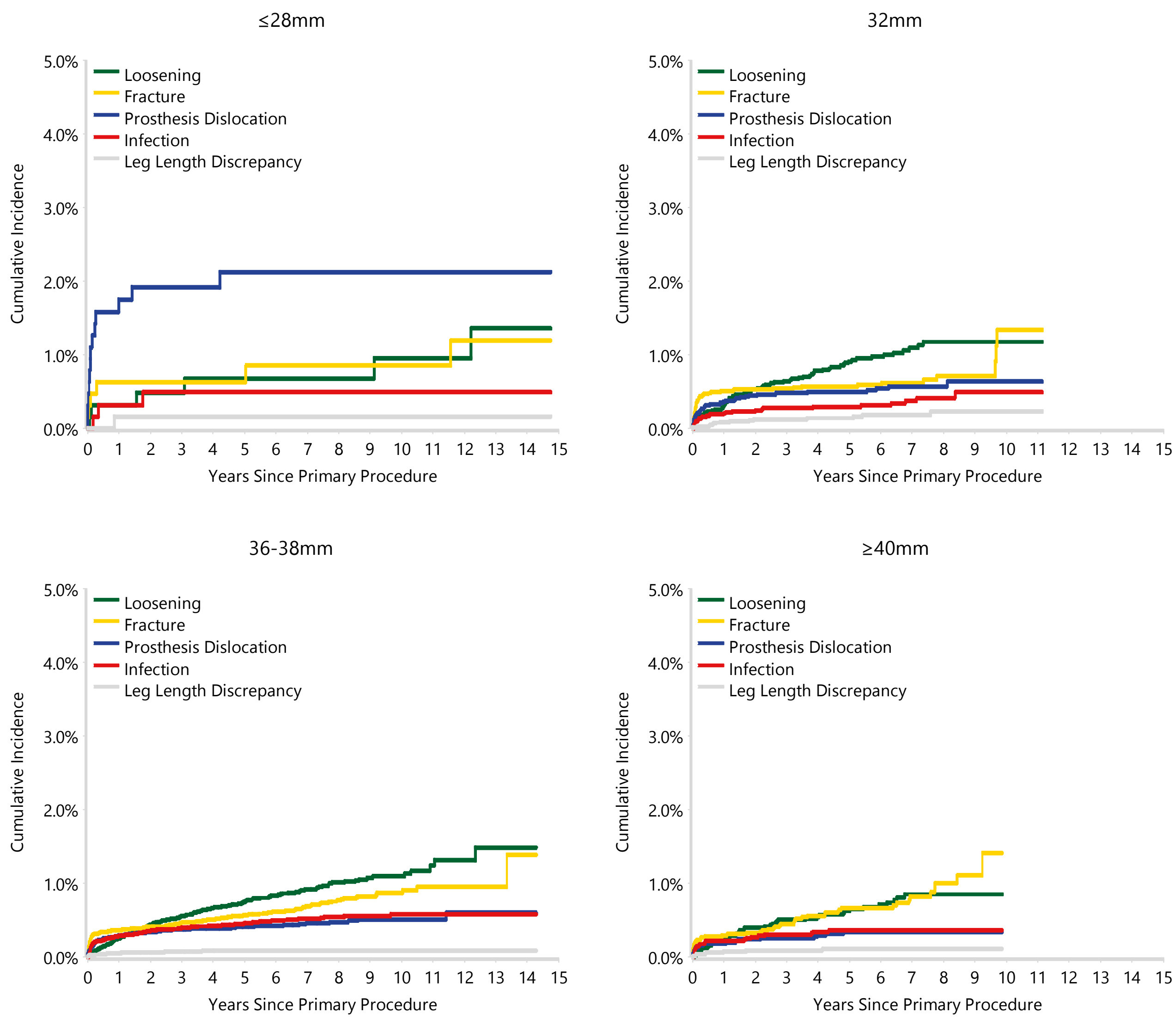
36-38mm vs 32mm
Entire Period: HR=0.91 (0.79, 1.04),p=0.161

≥40mm vs 32mm
Entire Period: HR=0.82 (0.67, 0.99),p=0.040

36-38mm vs ≥40mm
Entire Period: HR=1.11 (0.95, 1.30),p=0.186

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
≤28mm	635	578	510	424	291	25	0
32mm	10346	9210	7002	4706	294	0	0
36-38mm	40291	36030	27197	17882	2481	0	0
≥40mm	6823	6303	5356	3936	11	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 2,079 procedures using constrained acetabular prostheses for primary total conventional hip replacement. Of these, 849 procedures were constrained acetabular inserts and 1,230 procedures were constrained cups. There were 74 procedures reported in 2018. This is a decrease of 3.9% compared to 2017.

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	814	39.2	385287	88.6
Fractured Neck Of Femur	722	34.7	19574	4.5
Osteonecrosis	80	3.8	14076	3.2
Developmental Dysplasia	24	1.2	5442	1.3
Rheumatoid Arthritis	23	1.1	4073	0.9
Tumour	237	11.4	2215	0.5
Failed Internal Fixation	125	6.0	1772	0.4
Other Inflammatory Arthritis	6	0.3	1849	0.4
Fracture/Dislocation	35	1.7	515	0.1
Arthrodesis Takedown	10	0.5	114	0.0
Other	3	0.1	157	0.0
TOTAL	**2079**	**100.0**	**435074**	**100.0**

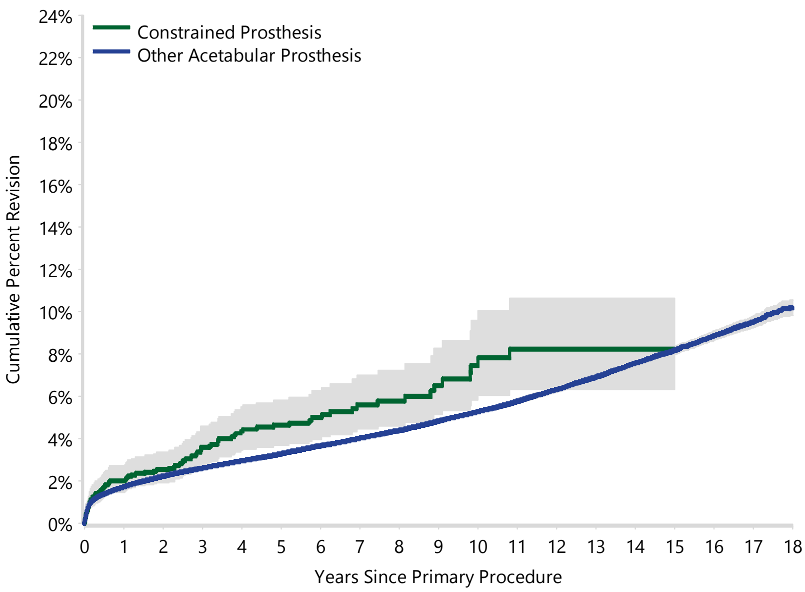
Note: All procedures using metal/metal prostheses have been excluded

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	18 Yrs
Constrained Prosthesis	90	2079	2.0 (1.5, 2.7)	3.6 (2.8, 4.6)	4.6 (3.7, 5.8)	7.5 (5.8, 9.6)	8.2 (6.3, 10.7)	
Other Acetabular Prosthesis	17109	435074	1.7 (1.7, 1.8)	2.6 (2.6, 2.7)	3.3 (3.2, 3.4)	5.3 (5.2, 5.4)	8.2 (8.0, 8.4)	10.2 (9.8, 10.6)
TOTAL	**17199**	**437153**						

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)



HR - adjusted for age and gender
Constrained Prosthesis vs
Other Acetabular Prosthesis
Entire Period: HR=1.35 (1.10, 1.66),p=0.004

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Constrained Prosthesis	2079	1682	1234	893	268	47	2
Other Acetabular Prosthesis	435074	383916	299012	224323	88756	21979	1522

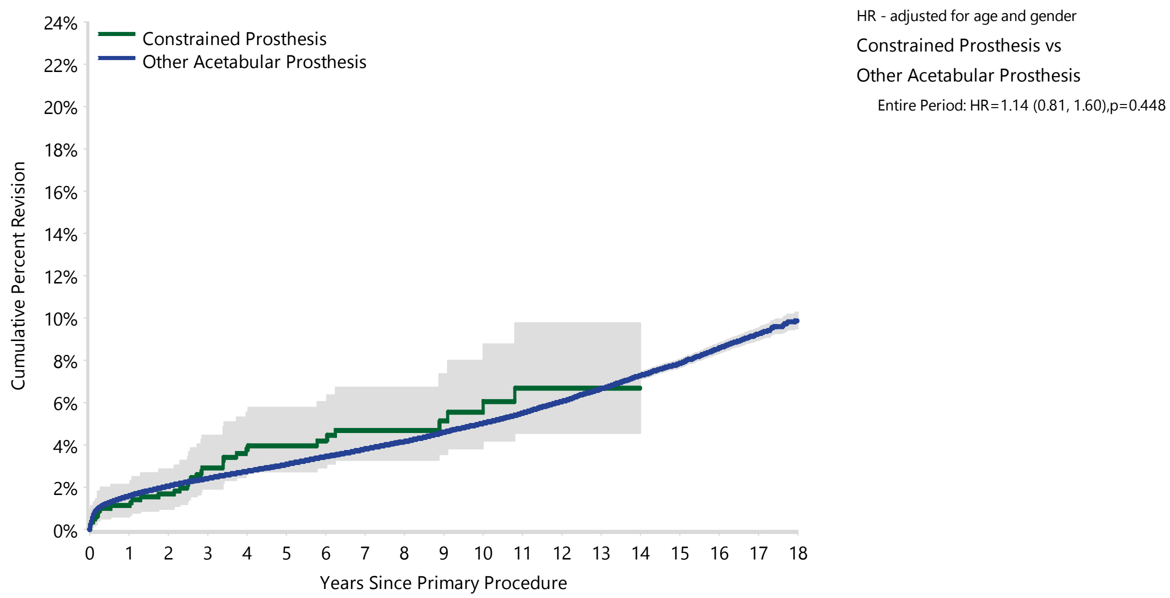
Note: All procedures using metal/metal prostheses have been excluded

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	18 Yrs
Constrained Prosthesis	34	814	1.1 (0.6, 2.2)	2.9 (1.9, 4.5)	4.0 (2.7, 5.8)	5.6 (3.8, 8.0)		
Other Acetabular Prosthesis	14499	385287	1.6 (1.5, 1.6)	2.4 (2.4, 2.5)	3.1 (3.0, 3.1)	5.0 (4.9, 5.1)	7.9 (7.7, 8.0)	9.9 (9.5, 10.3)
TOTAL	**14533**	**386101**						

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	18 Yrs
Constrained Prosthesis	814	741	602	460	184	36	1
Other Acetabular Prosthesis	385287	342682	268994	202761	80517	19708	1341

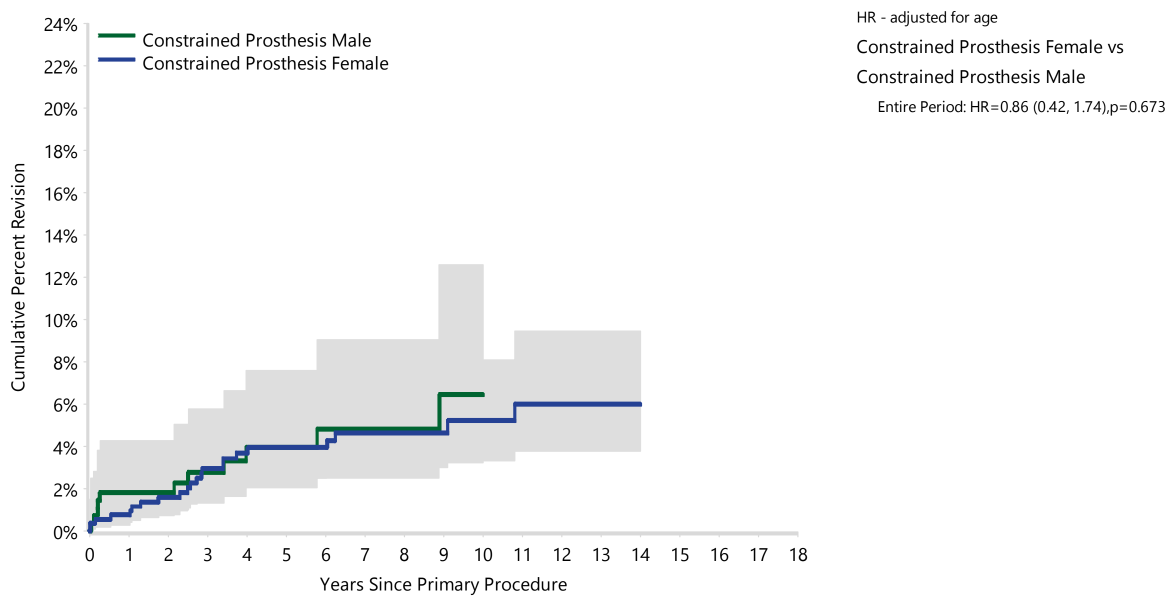
Note: All procedures using metal/metal prostheses have been excluded

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	18 Yrs
Constrained Prosthesis	Male	12	280	1.8 (0.8, 4.3)	2.8 (1.3, 5.8)	4.0 (2.0, 7.6)	6.4 (3.2, 12.6)		
	Female	22	534	0.8 (0.3, 2.0)	3.0 (1.8, 5.0)	3.9 (2.5, 6.2)	5.2 (3.3, 8.1)		
TOTAL		**34**	**814**						

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	18 Yrs
Constrained Prosthesis	Male	280	247	182	129	41	6	0
	Female	534	494	420	331	143	30	1

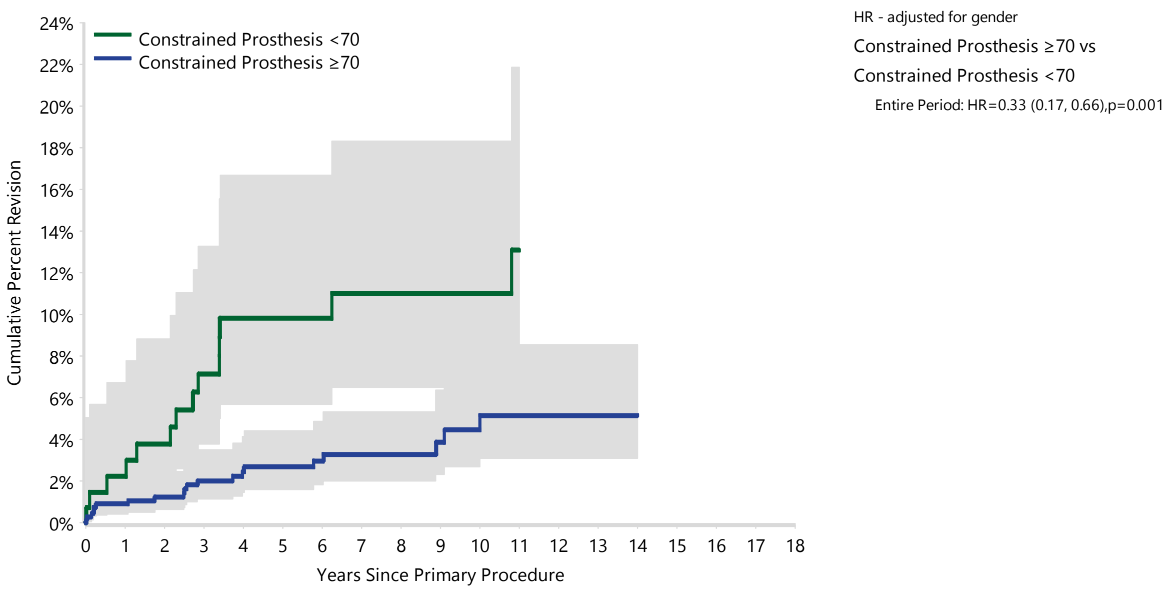
Note: All procedures using metal/metal prostheses have been excluded

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	18 Yrs
Constrained Prosthesis	<70	14	138	2.2 (0.7, 6.7)	7.1 (3.8, 13.3)	9.8 (5.7, 16.7)	11.0 (6.5, 18.3)		
	≥70	20	676	0.9 (0.4, 2.0)	2.0 (1.1, 3.5)	2.7 (1.6, 4.4)	4.5 (2.7, 7.4)		
TOTAL		**34**	**814**						

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)



Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Constrained Prosthesis	<70	138	127	107	89	48	15	0
	≥70	676	614	495	371	136	21	1

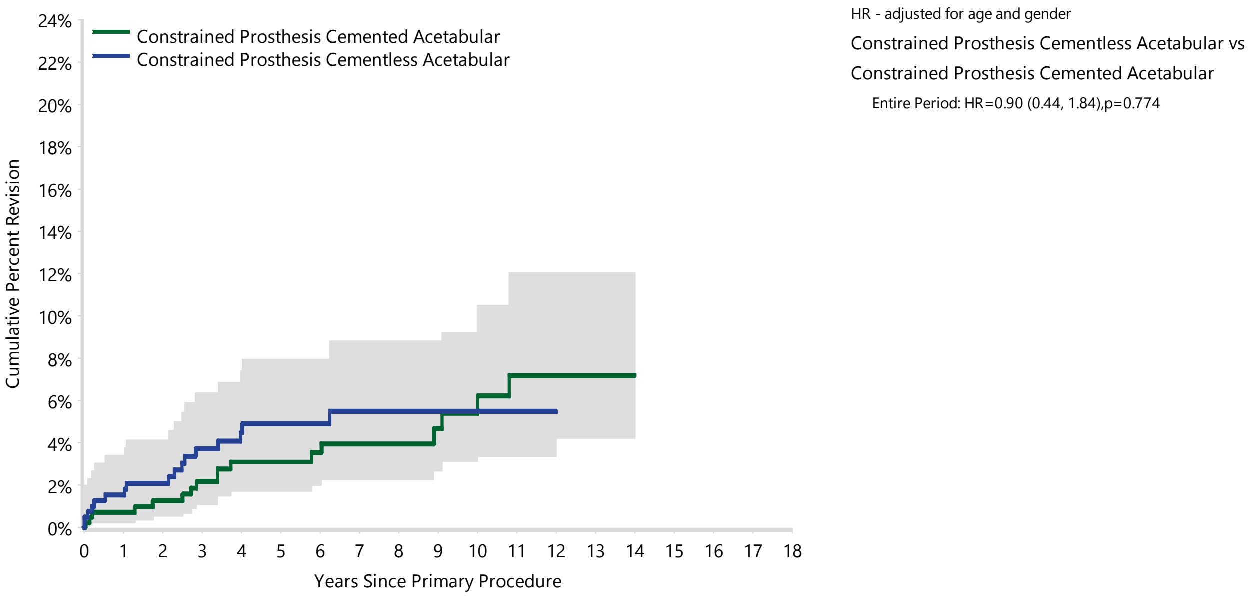
Note: All procedures using metal/metal prostheses have been excluded

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	18 Yrs
Constrained Prosthesis	Cementless	17	399	1.5 (0.7, 3.4)	3.7 (2.2, 6.4)	4.9 (3.0, 8.0)	5.5 (3.4, 8.8)		
	Cemented	17	415	0.7 (0.2, 2.3)	2.2 (1.1, 4.3)	3.1 (1.7, 5.6)	5.4 (3.2, 9.2)		
TOTAL		**34**	**814**						

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	18 Yrs
Constrained Prosthesis	Cemented Acetabular	415	384	324	264	116	24	0
	Cementless Acetabular	399	357	278	196	68	12	1

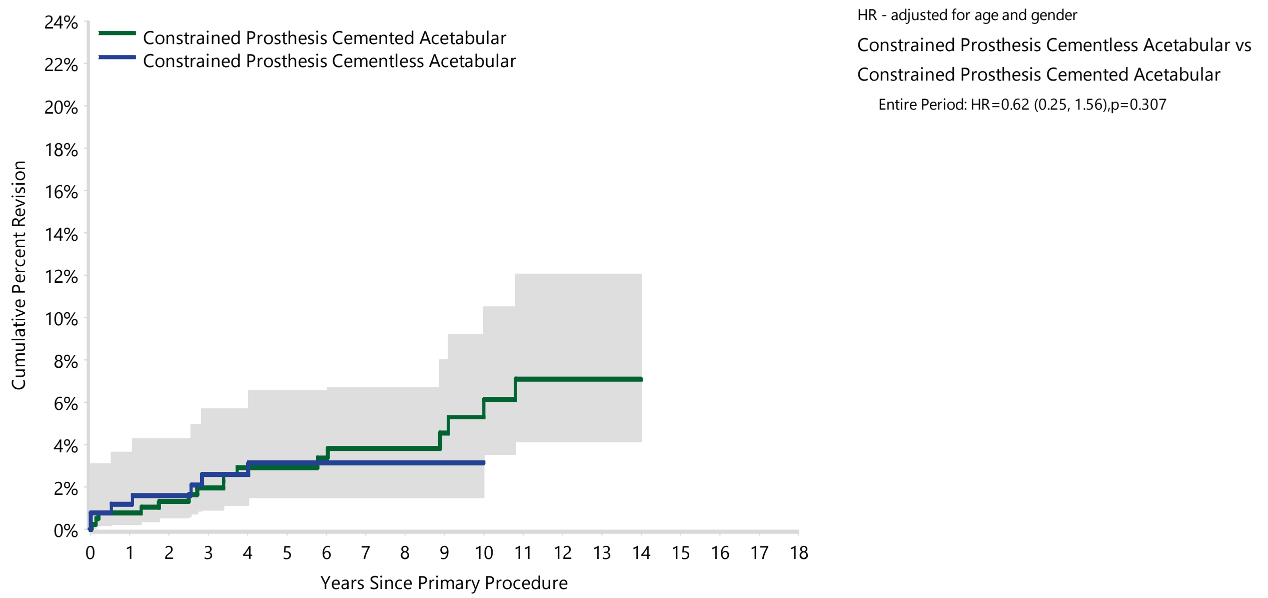
Note: All procedures using metal/metal prostheses have been excluded

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	18 Yrs
Constrained Prosthesis	Cementless	7	258	1.2 (0.4, 3.7)	2.6 (1.2, 5.7)	3.2 (1.5, 6.6)	3.2 (1.5, 6.6)		
	Cemented	16	396	0.8 (0.2, 2.4)	2.0 (0.9, 4.1)	2.9 (1.6, 5.4)	5.3 (3.0, 9.2)		
TOTAL		**23**	**654**						

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)



Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Constrained Prosthesis	Cemented Acetabular	396	367	314	256	115	24	0
	Cementless Acetabular	258	234	194	140	49	11	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 8,207 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).

Dual mobility prostheses have a higher rate of revision if they are used in males (Table HT45 and Figure HT54). Age is not a risk factor for revision (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

Primary Diagnosis	Dual Mobility Prosthesis N	Dual Mobility Prosthesis Col%	Other Acetabular Prosthesis N	Other Acetabular Prosthesis Col%
Osteoarthritis	5347	65.2	380754	88.8
Fractured Neck Of Femur	1805	22.0	18491	4.3
Osteonecrosis	339	4.1	13817	3.2
Developmental Dysplasia	148	1.8	5318	1.2
Rheumatoid Arthritis	46	0.6	4050	0.9
Tumour	246	3.0	2206	0.5
Failed Internal Fixation	167	2.0	1730	0.4
Other Inflammatory Arthritis	30	0.4	1825	0.4
Fracture/Dislocation	58	0.7	492	0.1
Arthrodesis Takedown	9	0.1	115	0.0
Other	12	0.1	148	0.0
TOTAL	**8207**	**100.0**	**428946**	**100.0**

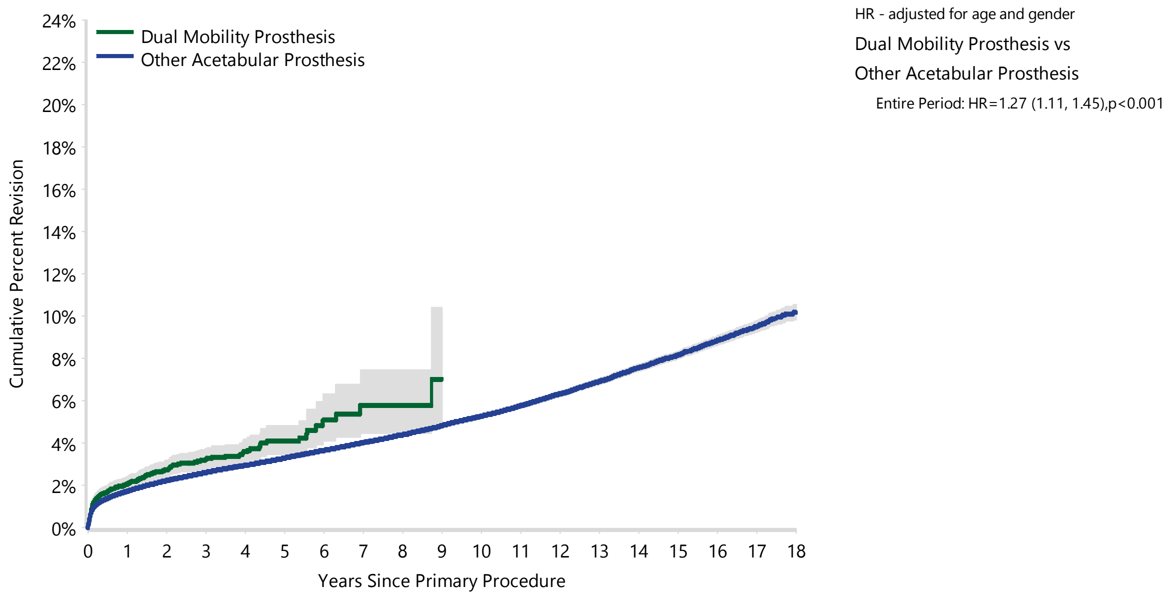
Note: All procedures using metal/metal prostheses have been excluded

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	18 Yrs
Dual Mobility Prosthesis	220	8207	2.1 (1.8, 2.4)	3.2 (2.8, 3.7)	4.1 (3.5, 4.8)			
Other Acetabular Prosthesis	16979	428946	1.7 (1.7, 1.8)	2.6 (2.6, 2.7)	3.3 (3.2, 3.3)	5.3 (5.2, 5.4)	8.2 (8.0, 8.3)	10.2 (9.8, 10.5)
TOTAL	**17199**	**437153**						

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	18 Yrs
Dual Mobility Prosthesis	8207	5299	2238	772	32	0	0
Other Acetabular Prosthesis	428946	380299	298008	224444	88992	22026	1524

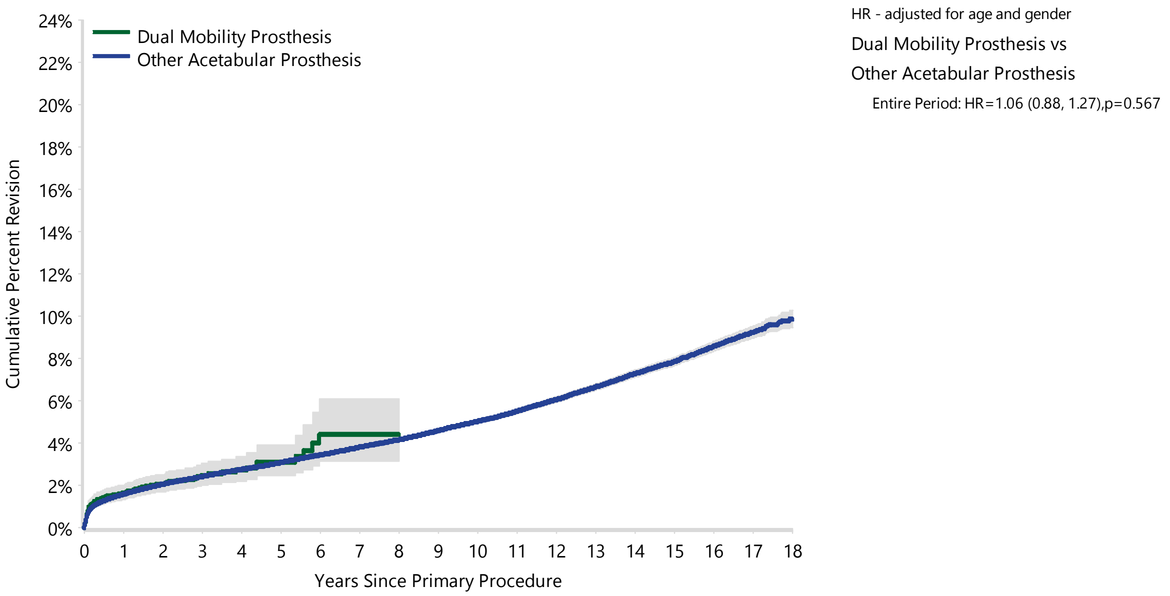
Note: All procedures using metal/metal prostheses have been excluded

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	18 Yrs
Dual Mobility Prosthesis	112	5347	1.6 (1.3, 2.0)	2.5 (2.0, 3.0)	3.1 (2.5, 3.9)			
Other Acetabular Prosthesis	14421	380754	1.6 (1.5, 1.6)	2.4 (2.4, 2.5)	3.1 (3.0, 3.2)	5.0 (4.9, 5.1)	7.8 (7.7, 8.0)	9.9 (9.5, 10.3)
TOTAL	**14533**	**386101**						

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	18 Yrs
Dual Mobility Prosthesis	5347	3511	1495	511	17	0	0
Other Acetabular Prosthesis	380754	339912	268101	202710	80684	19744	1342

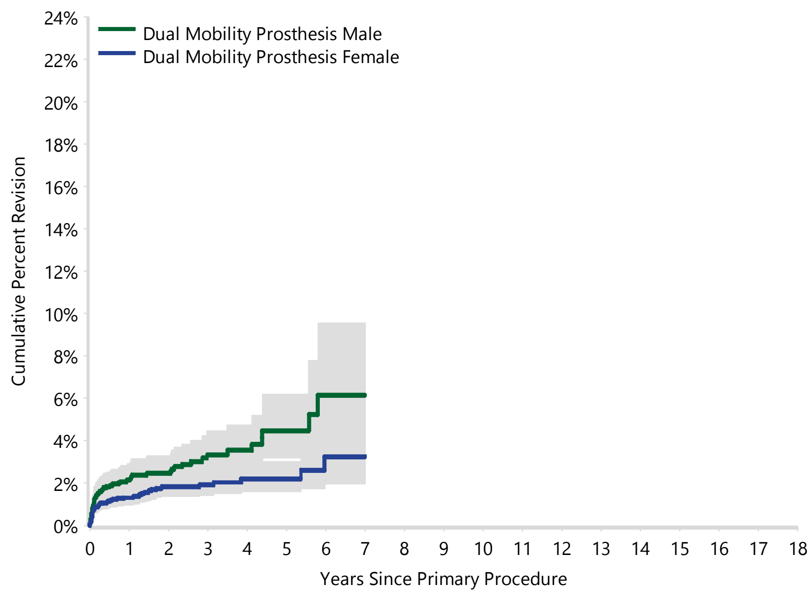
Note: All procedures using metal/metal prostheses have been excluded

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	18 Yrs
Dual Mobility Prosthesis	Male	58	2059	2.1 (1.6, 2.9)	3.3 (2.5, 4.5)	4.5 (3.2, 6.2)			
	Female	54	3288	1.3 (1.0, 1.8)	1.9 (1.4, 2.6)	2.2 (1.6, 3.0)			
TOTAL		**112**	**5347**						

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)**



HR - adjusted for age
Dual Mobility Prosthesis Female vs
Dual Mobility Prosthesis Male
Entire Period: HR=0.64 (0.44, 0.94),p=0.021

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Dual Mobility Prosthesis	Male	2059	1376	603	205	3	0	0
	Female	3288	2135	892	306	14	0	0

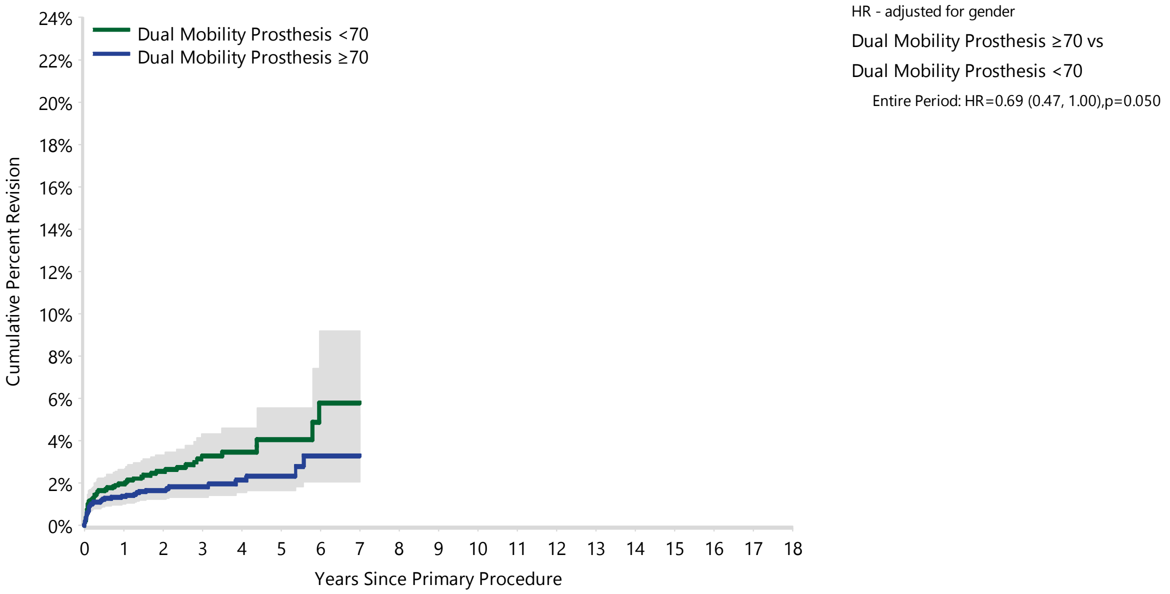
Note: All procedures using metal/metal prostheses have been excluded

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	18 Yrs
Dual Mobility Prosthesis	<70	62	2373	2.0 (1.5, 2.6)	3.3 (2.5, 4.3)	4.1 (3.0, 5.5)			
	≥70	50	2974	1.4 (1.0, 1.9)	1.8 (1.3, 2.5)	2.3 (1.7, 3.3)			
TOTAL		**112**	**5347**						

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)



Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Dual Mobility Prosthesis	<70	2373	1581	665	225	6	0	0
	≥70	2974	1930	830	286	11	0	0

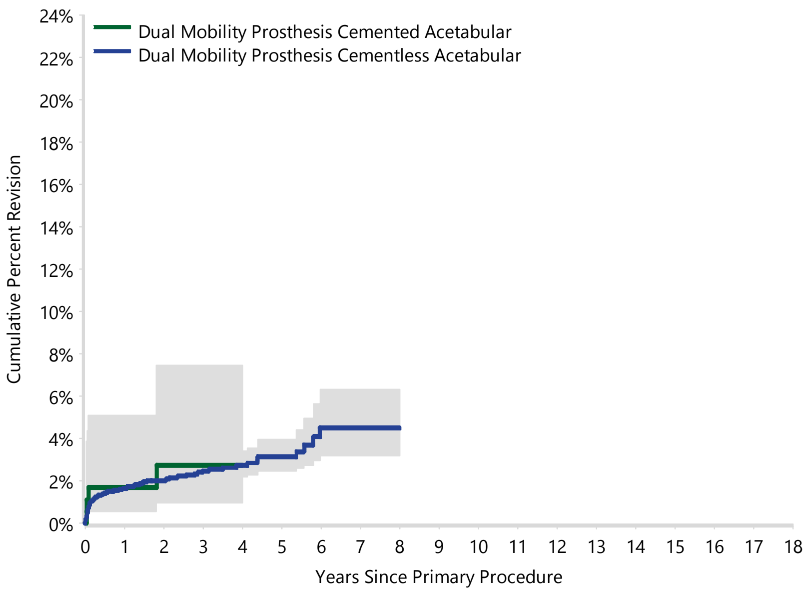
Note: All procedures using metal/metal prostheses have been excluded

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	18 Yrs
Dual Mobility Prosthesis	Cementless	108	5165	1.6 (1.3, 2.0)	2.5 (2.0, 3.0)	3.1 (2.5, 4.0)			
	Cemented	4	182	1.7 (0.5, 5.1)	2.7 (1.0, 7.5)				
TOTAL		**112**	**5347**						

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)



HR - adjusted for age and gender

Dual Mobility Prosthesis Cemented Acetabular vs Dual Mobility Prosthesis Cementless Acetabular

Entire Period: HR=1.17 (0.43, 3.18),p=0.762

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Dual Mobility Prosthesis	Cemented Acetabular	182	132	57	23	3	0	0
	Cementless Acetabular	5165	3379	1438	488	14	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 32,086 anterior, 24,468 lateral and 65,791 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, Table HT49 and Table HT50).

There was no difference in the overall rate of revision when surgical approach is compared (Table HT51 and Figure HT57). However, there were differences in the types of revision and reasons for revision between the approaches.

The following analyses were performed with hazard ratios adjusted for age, gender, ASA score, BMI category, femoral fixation and head size. The anterior approach has a higher rate of major revisions when compared with posterior and lateral approaches, but there was no difference between the posterior and lateral approaches (Table HT52 and Figure HT58). The most common reasons for revision 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 posterior and lateral approaches. After 3 months, the anterior approach has a lower rate of revision for fracture compared to 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	4287	13.4	2510	10.3	7212	11.0
55-64	8586	26.8	5673	23.2	15482	23.5
65-74	11541	36.0	9008	36.8	23926	36.4
≥75	7672	23.9	7277	29.7	19171	29.1
TOTAL	**32086**	**100.0**	**24468**	**100.0**	**65791**	**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 (<18.50)	235	0.8	183	0.8	411	0.7
Normal (18.50-24.99)	7562	24.5	4516	19.7	12103	19.5
Pre Obese (25.00-29.99)	12408	40.1	8265	36.0	22346	36.0
Obese Class 1 (30.00-34.99)	7178	23.2	6033	26.3	16166	26.1
Obese Class 2 (35.00-39.99)	2554	8.3	2677	11.6	7159	11.5
Obese Class 3 (≥40.00)	988	3.2	1305	5.7	3820	6.2
TOTAL	**30925**	**100.0**	**22979**	**100.0**	**62005**	**100.0**

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

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	4275	13.4	2016	8.3	5475	8.3
ASA 2	18009	56.3	13092	53.7	35724	54.4
ASA 3	9398	29.4	8931	36.6	23396	35.6
ASA 4	334	1.0	350	1.4	1044	1.6
ASA 5	.	.	2	0.0	4	0.0
TOTAL	**32016**	**100.0**	**24391**	**100.0**	**65643**	**100.0**

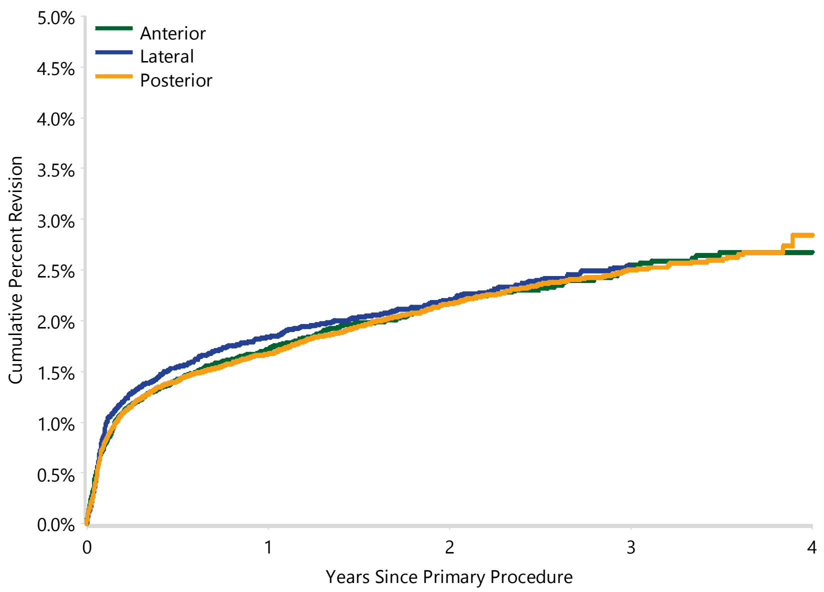
Note: All procedures using metal/metal prostheses have been excluded

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	634	32086	1.7 (1.6, 1.9)	2.2 (2.0, 2.4)	2.6 (2.3, 2.8)	2.7 (2.4, 2.9)	
Lateral	532	24468	1.8 (1.7, 2.0)	2.2 (2.0, 2.4)	2.5 (2.3, 2.8)		
Posterior	1306	65791	1.7 (1.6, 1.8)	2.2 (2.0, 2.3)	2.5 (2.4, 2.7)	2.8 (2.6, 3.2)	
TOTAL	**2472**	**122345**					

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)



HR - adjusted for age and gender

Anterior vs Posterior

Entire Period: HR=1.01 (0.92, 1.11),p=0.881

Anterior vs Lateral

Entire Period: HR=0.97 (0.86, 1.08),p=0.557

Lateral vs Posterior

Entire Period: HR=1.04 (0.94, 1.15),p=0.416

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
Anterior	32086	21969	13456	5949	77	2
Lateral	24468	18697	12738	6122	26	9
Posterior	65791	45949	28068	12505	85	28

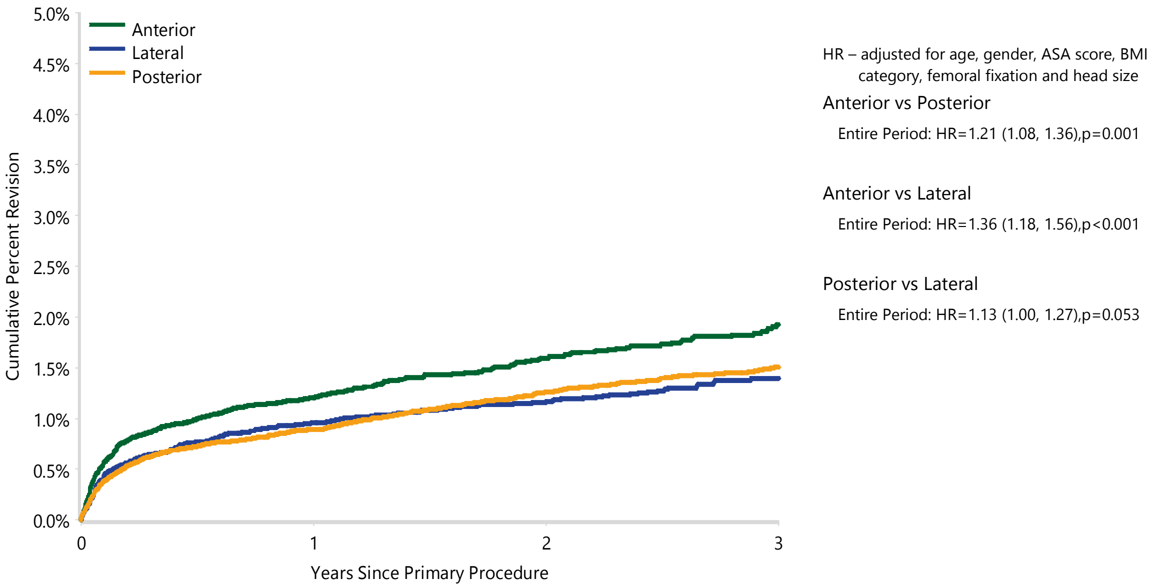
Note: All procedures using metal/metal prostheses have been excluded

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
Anterior	445	30873	1.2 (1.1, 1.3)	1.6 (1.4, 1.8)	1.9 (1.7, 2.1)		
Lateral	264	22922	1.0 (0.8, 1.1)	1.2 (1.0, 1.3)	1.4 (1.2, 1.6)		
Posterior	693	61912	0.9 (0.8, 1.0)	1.3 (1.2, 1.4)	1.5 (1.4, 1.6)		
TOTAL	**1402**	**115707**					

Note: All procedures using metal/metal prostheses have been excluded
Excludes procedures with unknown ASA score, BMI category or head size

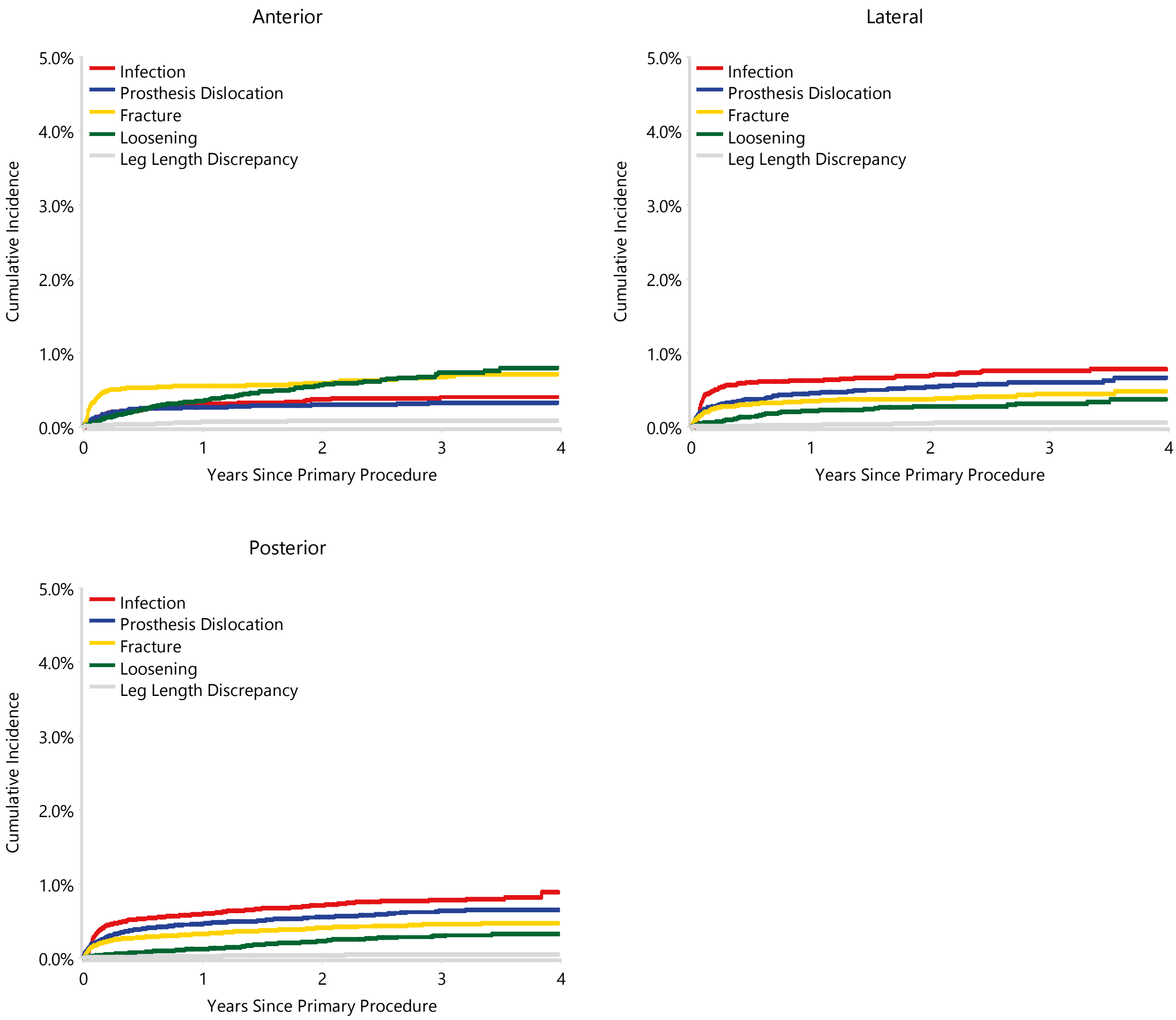
Figure HT58 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Surgical Approach (Primary Diagnosis OA, Major Revisions)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
Anterior	30873	20957	12656	5472	20	1
Lateral	22922	17340	11678	5528	20	6
Posterior	61912	42788	25820	11344	25	4

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 number 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)



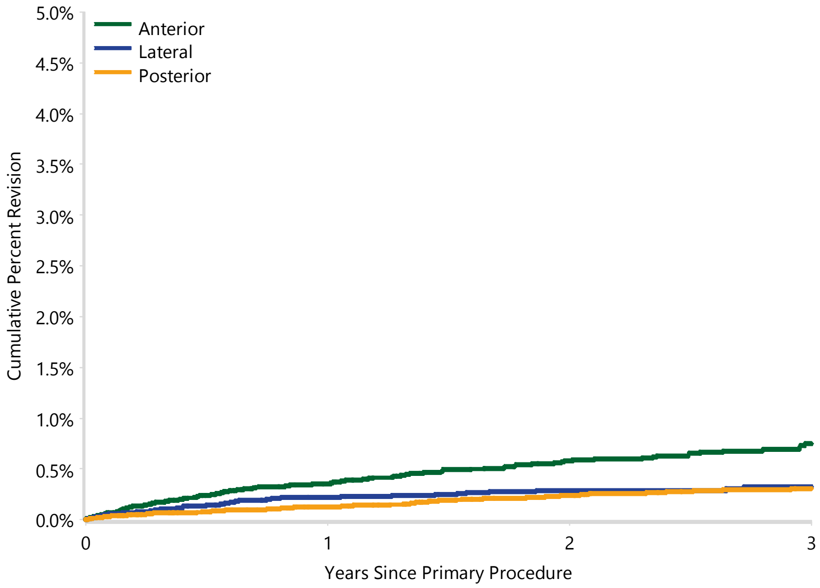
Note: All procedures using metal/metal prostheses have been excluded

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
Anterior	150	30873	0.4 (0.3, 0.4)	0.6 (0.5, 0.7)	0.7 (0.6, 0.9)		
Lateral	60	22922	0.2 (0.2, 0.3)	0.3 (0.2, 0.4)	0.3 (0.2, 0.4)		
Posterior	123	61912	0.1 (0.1, 0.2)	0.2 (0.2, 0.3)	0.3 (0.3, 0.4)		
TOTAL	**333**	**115707**					

Note: All procedures using metal/metal prostheses have been excluded
Excludes procedures with unknown ASA score, BMI category or head size

Figure HT60 Percent Revision of Primary Total Conventional Hip Replacement by Surgical Approach (Primary Diagnosis OA, Revision for Loosening)



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

Anterior vs Posterior
Entire Period: HR=2.16 (1.71, 2.73),p<0.001

Anterior vs Lateral
Entire Period: HR=1.82 (1.37, 2.41),p<0.001

Lateral vs Posterior
Entire Period: HR=1.19 (0.91, 1.56),p=0.211

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
Anterior	30873	20957	12656	5472	20	1
Lateral	22922	17340	11678	5528	20	6
Posterior	61912	42788	25820	11344	25	4

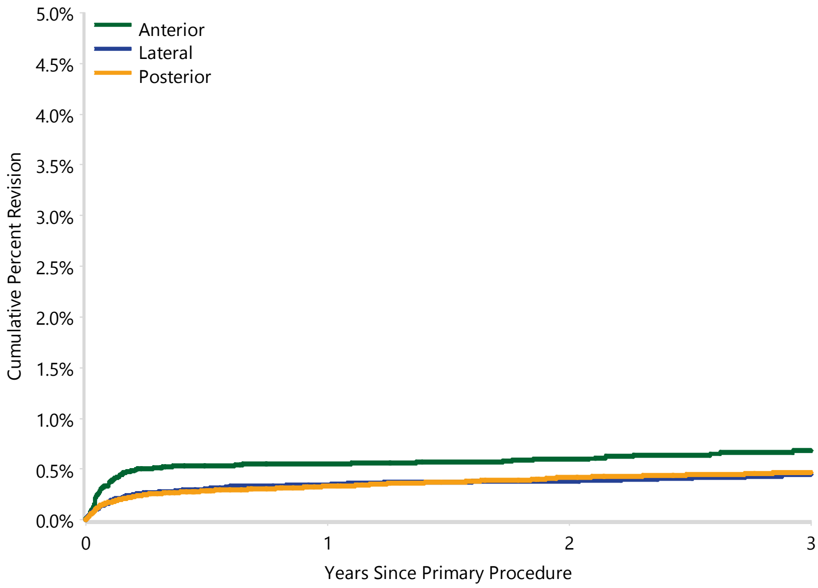
Note: All procedures using metal/metal prostheses have been excluded
Excludes procedures with unknown ASA score, BMI category or head size.
Due to low numbers ASA scores 1-2, and 3-4 were combined
Due to low number BMI categories underweight and normal were combined

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
Anterior	182	30873	0.6 (0.5, 0.6)	0.6 (0.5, 0.7)	0.7 (0.6, 0.8)		
Lateral	88	22922	0.3 (0.3, 0.4)	0.4 (0.3, 0.5)	0.4 (0.4, 0.6)		
Posterior	232	61912	0.3 (0.3, 0.4)	0.4 (0.4, 0.5)	0.5 (0.4, 0.5)		
TOTAL	**502**	**115707**					

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)



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

Anterior vs Lateral
0-1Mth: HR=2.41 (1.79, 3.23),p<0.001
1-3Mth: HR=1.94 (1.35, 2.80),p<0.001
3Mth+: HR=0.69 (0.45, 1.04),p=0.075

Anterior vs Posterior
0-3Mth: HR=2.01 (1.63, 2.49),p<0.001
3Mth+: HR=0.62 (0.42, 0.92),p=0.016

Posterior vs Lateral
Entire Period: HR=1.11 (0.89, 1.37),p=0.358

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
Anterior	30873	20957	12656	5472	20	1
Lateral	22922	17340	11678	5528	20	6
Posterior	61912	42788	25820	11344	25	4

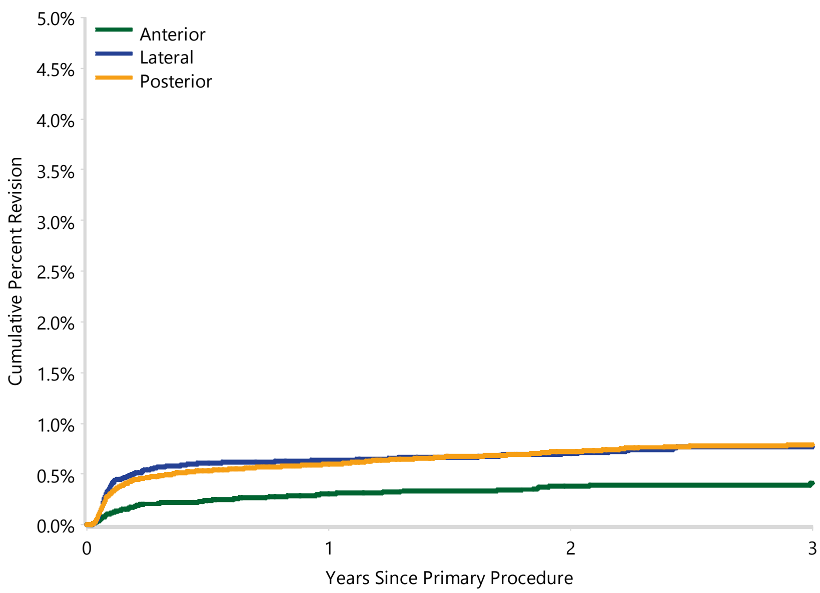
Note: All procedures using metal/metal prostheses have been excluded
Excludes procedures with unknown ASA score, BMI category or head size.
Due to low numbers ASA scores 1-2, and 3-4 were combined
Due to low number BMI categories underweight and normal were combined

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
Anterior	100	30873	0.3 (0.2, 0.4)	0.4 (0.3, 0.5)	0.4 (0.3, 0.5)		
Lateral	158	22922	0.6 (0.5, 0.8)	0.7 (0.6, 0.8)	0.8 (0.7, 0.9)		
Posterior	410	61912	0.6 (0.5, 0.7)	0.7 (0.7, 0.8)	0.8 (0.7, 0.9)		
TOTAL	**668**	**115707**					

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, BMI category, femoral fixation and head size

Lateral vs Anterior
0-1Mth: HR=1.99 (1.49, 2.65),p<0.001
1Mth-3Mth: HR=1.85 (1.35, 2.55),p<0.001
3Mth+: HR=1.05 (0.74, 1.49),p=0.786

Posterior vs Anterior
Entire Period: HR=1.58 (1.29, 1.95),p<0.001

Posterior vs Lateral
0-3Mth: HR=0.91 (0.76, 1.09),p=0.324
3Mth+: HR=1.11 (0.86, 1.45),p=0.418

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
Anterior	30873	20957	12656	5472	20	1
Lateral	22922	17340	11678	5528	20	6
Posterior	61912	42788	25820	11344	25	4

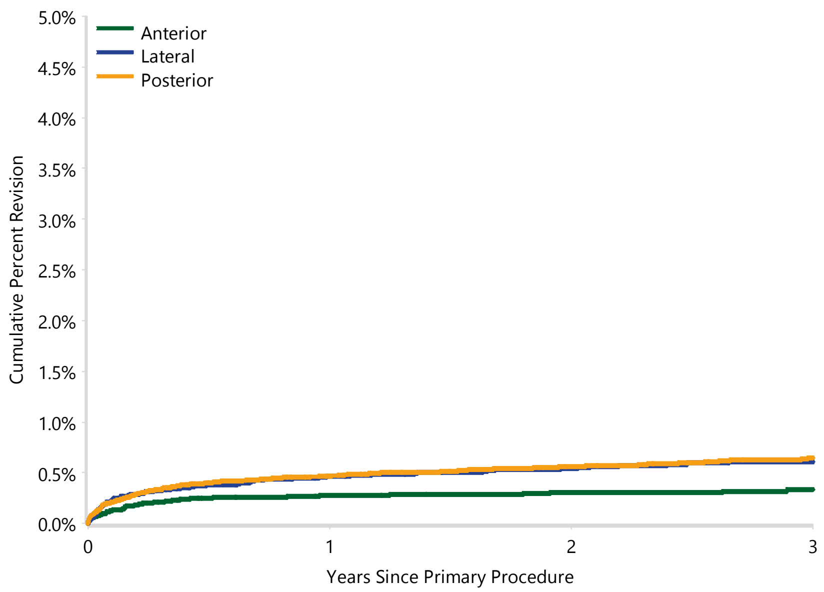
Note: All procedures using metal/metal prostheses have been excluded
Excludes procedures with unknown ASA score, BMI category or head size
Due to low numbers ASA scores 1-2, and 3-4 were combined
Due to low numbers BMI categories underweight and normal were combined

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
Anterior	86	30873	0.3 (0.2, 0.3)	0.3 (0.2, 0.4)	0.3 (0.3, 0.4)		
Lateral	120	22922	0.5 (0.4, 0.6)	0.5 (0.5, 0.7)	0.6 (0.5, 0.7)		
Posterior	319	61912	0.5 (0.4, 0.5)	0.6 (0.5, 0.6)	0.6 (0.6, 0.7)		
TOTAL	**525**	**115707**					

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, BMI category, femoral fixation and head size

Lateral vs Anterior
0-6Mth: HR=1.48 (1.14, 1.93),p=0.003
6Mth+: HR=1.46 (0.98, 2.17),p=0.062

Posterior vs Anterior
Entire Period: HR=1.87 (1.51, 2.32),p<0.001

Posterior vs Lateral
Entire Period: HR=1.27 (1.07, 1.51),p=0.007

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
Anterior	30873	20957	12656	5472	20	1
Lateral	22922	17340	11678	5528	20	6
Posterior	61912	42788	25820	11344	25	4

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

OUTCOME FOR FRACTURED NECK OF FEMUR

There have been 20,296 primary total conventional hip replacement procedures recorded by the Registry with a diagnosis of fractured neck of femur.

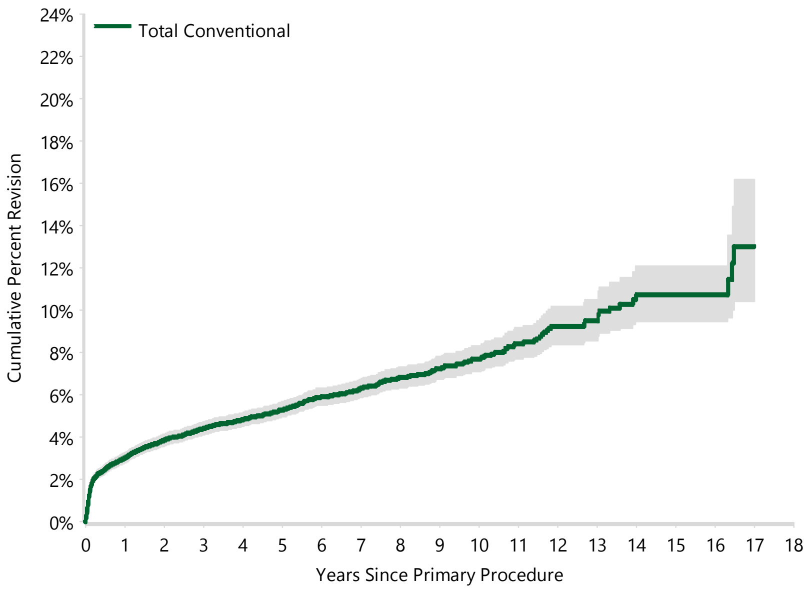
The cumulative percent revision of primary total conventional hip replacement for fractured neck of femur is 7.7% at 10 years (Table HT57 and Figure HT64).

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	10 Yrs
Total Conventional	993	20296	3.0 (2.8, 3.3)	3.9 (3.6, 4.1)	4.4 (4.1, 4.7)	5.3 (4.9, 5.7)	6.3 (5.9, 6.7)	7.7 (7.1, 8.3)
TOTAL	**993**	**20296**						

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	10 Yrs
Total Conventional	20296	16151	13189	10776	6868	4238	1708

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

Reasons for Revision

Prosthesis dislocation is the most common reason for revision (31.7%), followed by fracture (27.4%), infection (17.0%), and loosening (16.7%) (Table HT58 and Figure HT65).

Type of Revision

Replacement of the femoral component only is the most common type of revision (36.5%), followed by head and insert (21.1%), acetabular only (19.7%), and total hip replacement (femoral/acetabular) (9.2%) (Table HT59).

Table HT58 Primary Total Conventional Hip Replacement by Reason for Revision (Primary Diagnosis Fractured NOF)

Reason for Revision	Number	Percent
Prosthesis Dislocation	315	31.7
Fracture	272	27.4
Infection	169	17.0
Loosening	166	16.7
Pain	9	0.9
Lysis	9	0.9
Malposition	8	0.8
Implant Breakage Stem	8	0.8
Instability	8	0.8
Leg Length Discrepancy	6	0.6
Implant Breakage Acetabular	5	0.5
Heterotopic Bone	3	0.3
Implant Breakage Acetabular Insert	3	0.3
Incorrect Sizing	2	0.2
Metal Related Pathology	2	0.2
Tumour	1	0.1
Progression Of Disease	1	0.1
Wear Acetabular Insert	1	0.1
Other	5	0.5
TOTAL	**993**	**100.0**

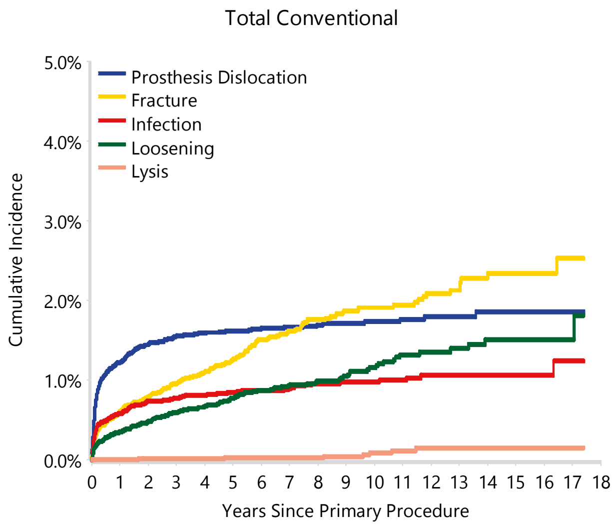
Note: All procedures using metal/metal prostheses have been excluded

Table HT59 Primary Total Conventional Hip Replacement by Type of Revision (Primary Diagnosis Fractured NOF)

Type of Revision	Number	Percent
Femoral Component	362	36.5
Head/Insert	210	21.1
Acetabular Component	196	19.7
THR (Femoral/Acetabular)	91	9.2
Head Only	45	4.5
Cement Spacer	42	4.2
Minor Components	21	2.1
Insert Only	12	1.2
Removal of Prostheses	5	0.5
Head/Neck/Insert	3	0.3
Head/Neck	2	0.2
Reinsertion of Components	2	0.2
Neck Only	1	0.1
Total Femoral	1	0.1
TOTAL	**993**	**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 10,451 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 (56.6%) than patients with osteoarthritis (34.9%) (Table HT61).

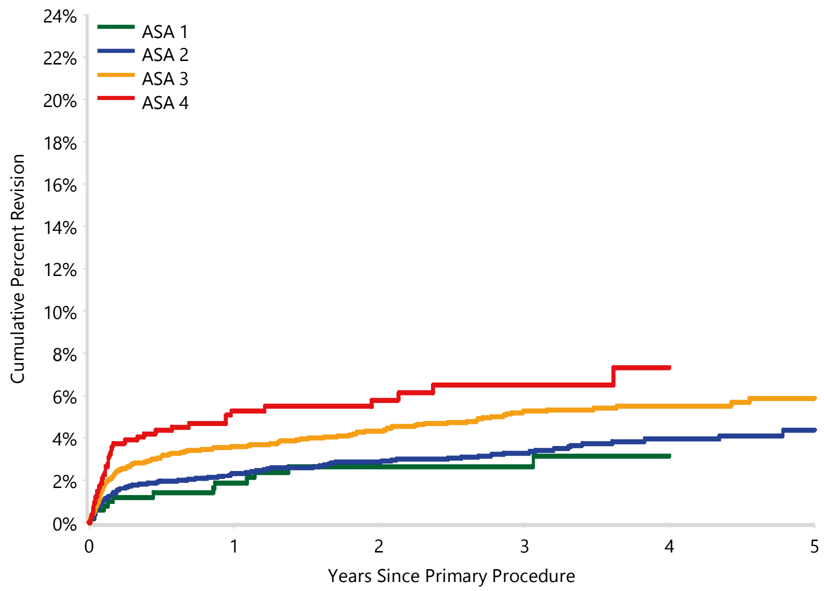
BMI data has been collected since 2015. The early revision outcomes are reported for 5,098 primary total conventional hip replacement procedures for fractured neck of femur. There is no difference in the rate of revision with respect to BMI (Table HT62 and Figure HT68). The most common reasons for revision 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	6 Yrs
ASA 1	13	507	1.9 (1.0, 3.6)	2.6 (1.5, 4.6)	2.6 (1.5, 4.6)	3.2 (1.8, 5.5)		
ASA 2	122	4023	2.3 (1.9, 2.8)	2.9 (2.4, 3.5)	3.3 (2.7, 4.0)	4.0 (3.2, 4.8)	4.4 (3.5, 5.5)	
ASA 3	216	5073	3.6 (3.1, 4.2)	4.3 (3.8, 5.0)	5.3 (4.6, 6.1)	5.5 (4.8, 6.4)	5.9 (5.0, 6.9)	
ASA 4	43	843	5.3 (3.9, 7.2)	5.8 (4.2, 7.9)	6.5 (4.8, 8.9)	7.3 (5.1, 10.4)		
ASA 5	0	5	0.0 (0.0, 0.0)					
TOTAL	**394**	**10451**						

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

Figure HT66 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by ASA Score (Primary Diagnosis Fractured NOF)



HR - adjusted for age and gender

ASA 2 vs ASA 1

Entire Period: HR=1.39 (0.78, 2.47),p=0.263

ASA 3 vs ASA 1

Entire Period: HR=2.11 (1.20, 3.73),p=0.009

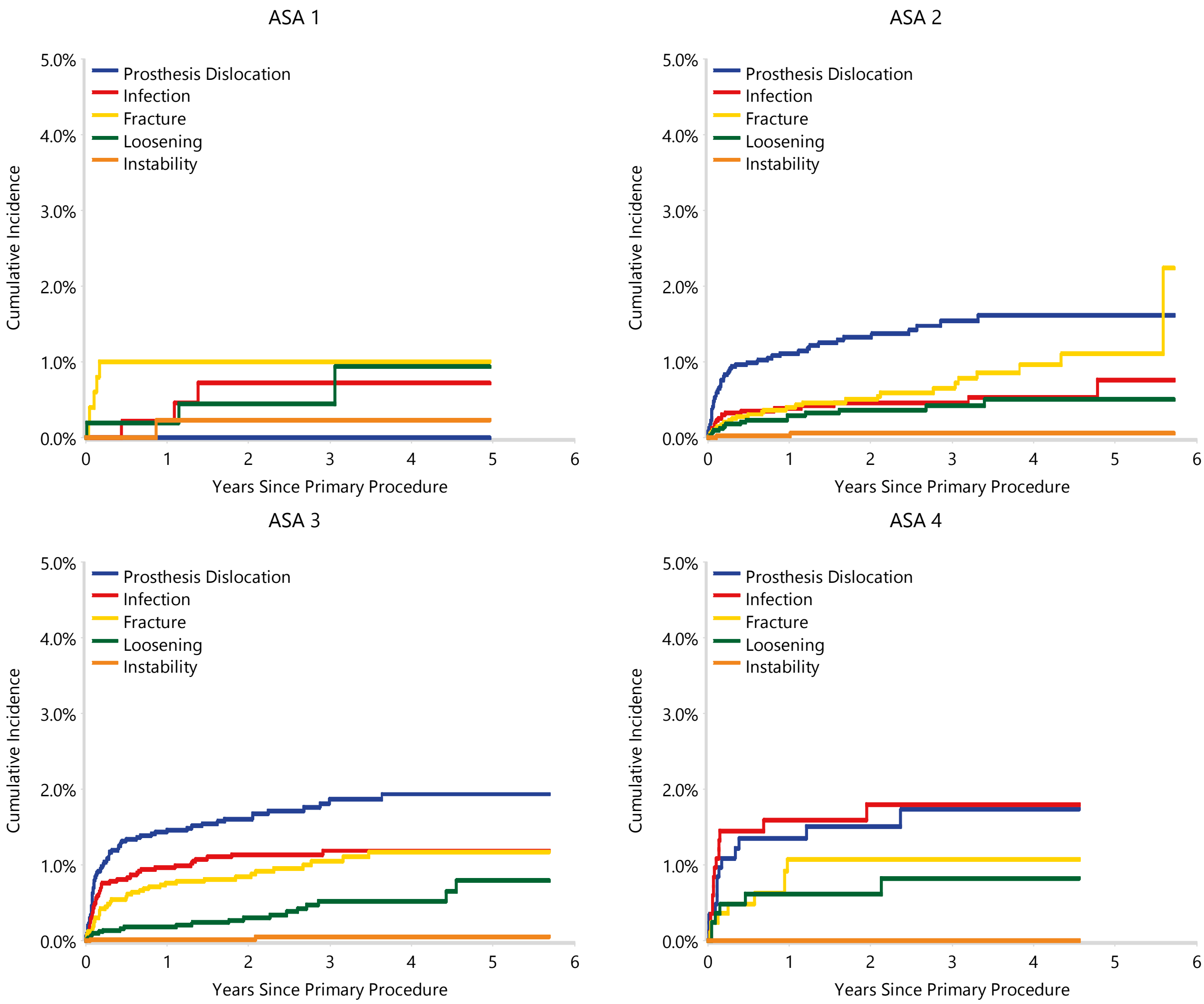
ASA 4 vs ASA 1

Entire Period: HR=2.91 (1.55, 5.49),p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
ASA 1	507	408	299	197	117	39	0
ASA 2	4023	3016	2153	1425	791	281	4
ASA 3	5073	3534	2371	1484	790	248	5
ASA 4	843	488	297	174	85	22	0

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

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 N	Fractured Neck Of Femur Col%	Osteoarthritis N	Osteoarthritis Col%	TOTAL N	TOTAL Col%
ASA 1	507	4.9	17303	10.0	17810	9.7
ASA 2	4023	38.5	95641	55.1	99664	54.2
ASA 3	5073	48.5	58039	33.5	63112	34.3
ASA 4	843	8.1	2488	1.4	3331	1.8
ASA 5	5	0.0	13	0.0	18	0.0
TOTAL	**10451**	**100.0**	**173484**	**100.0**	**183935**	**100.0**

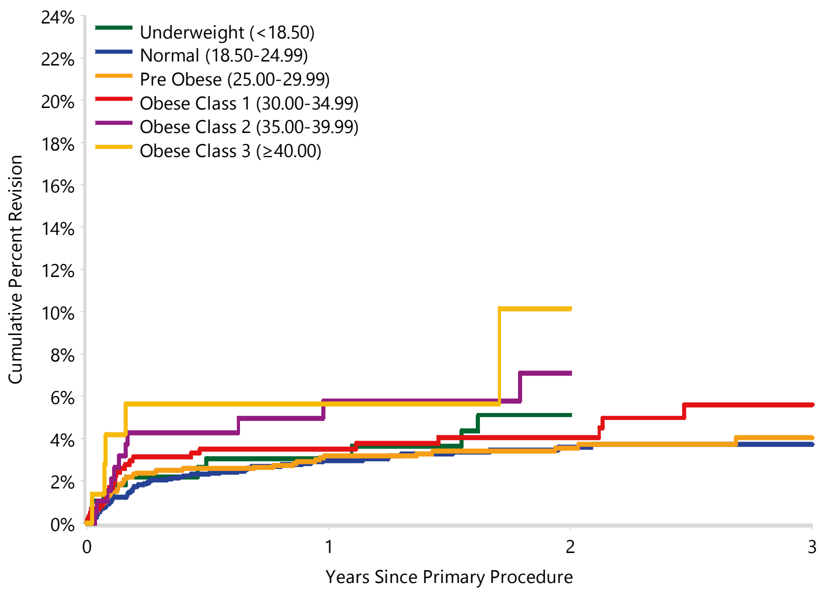
Note: All procedures using metal/metal prostheses have been excluded

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
Underweight (<18.50)	11	285	3.1 (1.5, 6.1)	5.1 (2.8, 9.3)		
Normal (18.50-24.99)	70	2251	3.0 (2.3, 3.8)	3.6 (2.8, 4.6)	3.7 (2.9, 4.7)	
Pre Obese (25.00-29.99)	55	1696	3.2 (2.4, 4.2)	3.6 (2.7, 4.7)	4.0 (3.0, 5.4)	
Obese Class 1 (30.00-34.99)	25	595	3.5 (2.3, 5.4)	4.1 (2.7, 6.2)	5.6 (3.6, 8.6)	
Obese Class 2 (35.00-39.99)	11	199	5.8 (3.1, 10.5)	7.1 (3.8, 12.9)		
Obese Class 3 (≥40.00)	5	72	5.7 (2.2, 14.4)	10.2 (3.7, 26.1)		
TOTAL	**177**	**5098**				

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

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=1.33 (0.70, 2.51),p=0.382

Pre Obese (25.00-29.99) vs Normal (18.50-24.99)
Entire Period: HR=1.01 (0.71, 1.44),p=0.951

Obese Class 1 (30.00-34.99) vs Normal (18.50-24.99)
Entire Period: HR=1.26 (0.80, 1.99),p=0.323

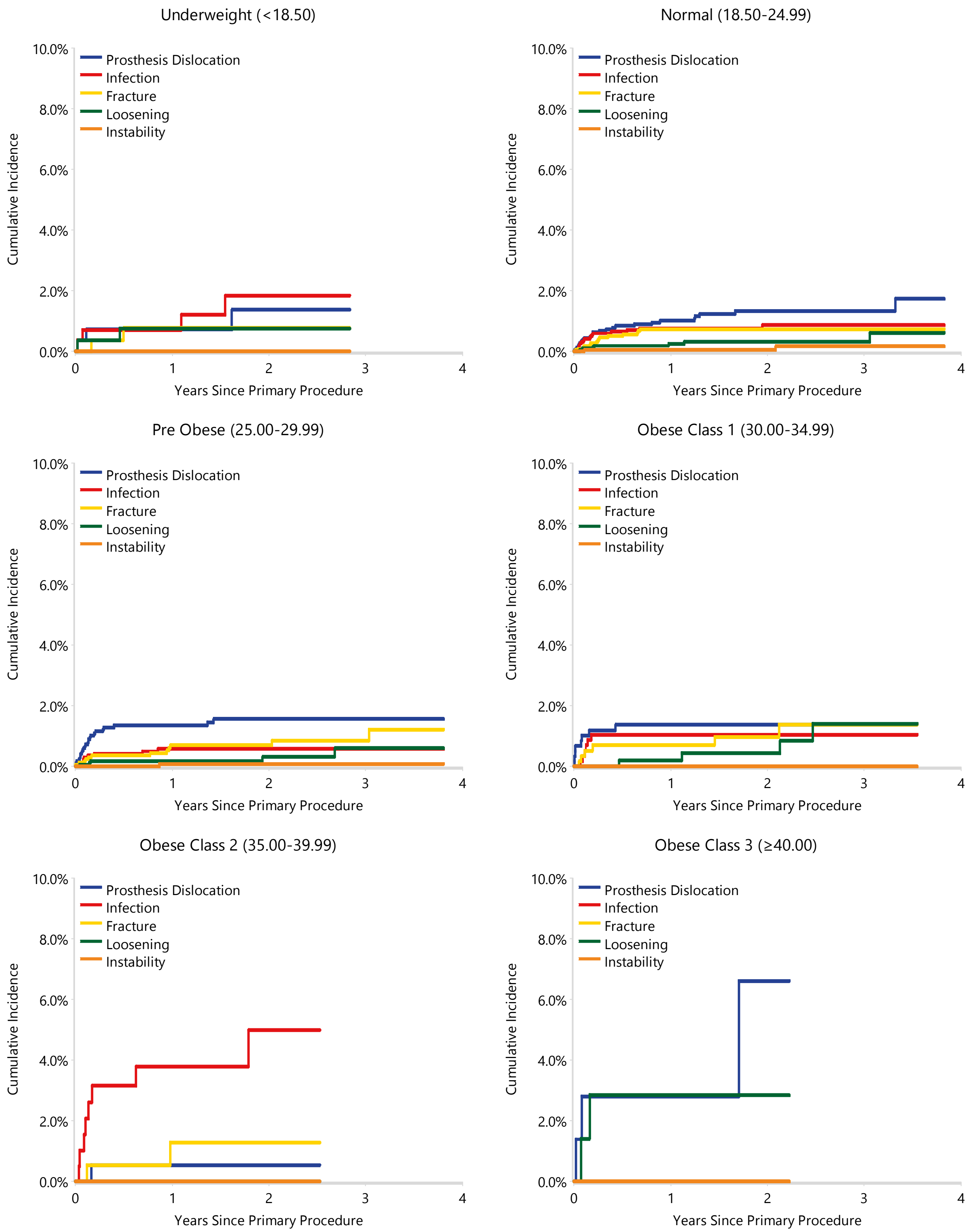
Obese Class 2 (35.00-39.99) vs Normal (18.50-24.99)
Entire Period: HR=1.76 (0.93, 3.33),p=0.083

Obese Class 3 (≥40.00) vs Normal (18.50-24.99)
Entire Period: HR=2.29 (0.92, 5.71),p=0.074

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs
Underweight (<18.50)	285	181	93	36	0
Normal (18.50-24.99)	2251	1418	790	308	4
Pre Obese (25.00-29.99)	1696	1063	583	237	4
Obese Class 1 (30.00-34.99)	595	403	231	98	0
Obese Class 2 (35.00-39.99)	199	116	64	29	0
Obese Class 3 (≥40.00)	72	37	13	4	0

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

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 or less

Fixation

The analysis for fractured neck of femur and fixation has been performed for modern bearing surfaces, these include mixed ceramic/mixed ceramic and all femoral head materials used in combination with XLPE.

The Registry has recorded 1,067 procedures with cemented fixation, 5,494 with cementless fixation and 10,115 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).

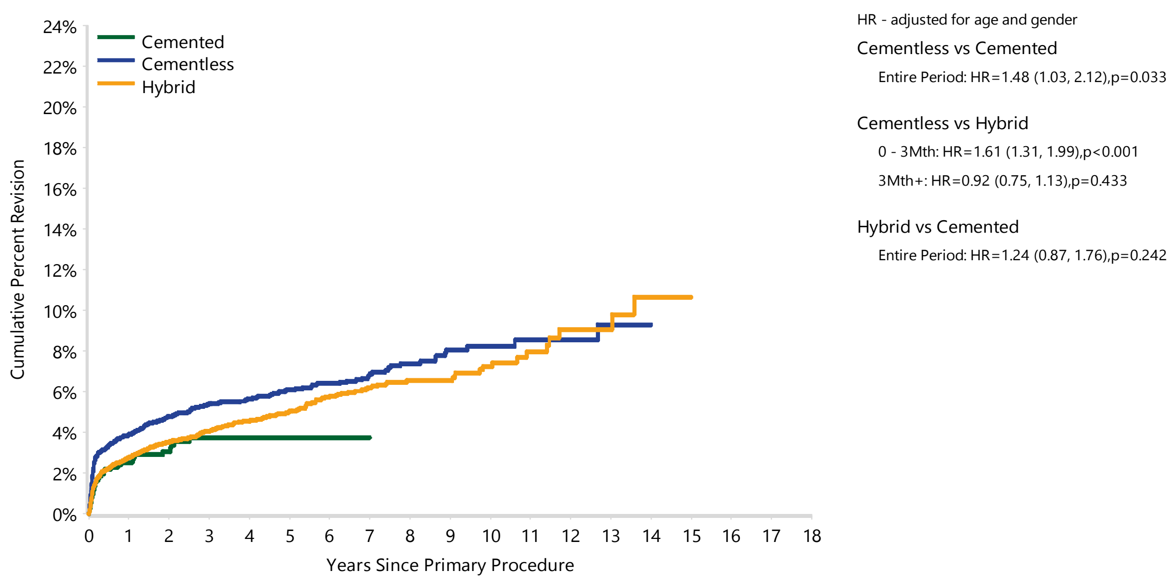
There are differences in outcome with respect to fixation and age. For patients aged <70 years, there is no difference in the rate of revision between the three different fixation methods (Table HT64 and Figure HT71). For patients aged ≥70 years, cementless fixation has a higher rate of revision than 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	10 Yrs
Cemented	33	1067	2.5 (1.7, 3.7)	3.1 (2.1, 4.4)	3.7 (2.7, 5.3)	3.7 (2.7, 5.3)	3.7 (2.7, 5.3)	
Cementless	312	5494	3.9 (3.4, 4.5)	4.8 (4.2, 5.4)	5.4 (4.8, 6.1)	6.1 (5.4, 6.8)	6.8 (6.0, 7.7)	8.2 (7.2, 9.5)
Hybrid	433	10115	2.8 (2.5, 3.1)	3.5 (3.2, 3.9)	4.1 (3.7, 4.5)	5.0 (4.5, 5.6)	6.2 (5.6, 6.9)	7.3 (6.3, 8.3)
TOTAL	**778**	**16676**						

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)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Cemented	1067	797	602	468	228	73	11
Cementless	5494	4485	3734	3134	2045	1266	407
Hybrid	10115	7860	6222	4853	2794	1565	516

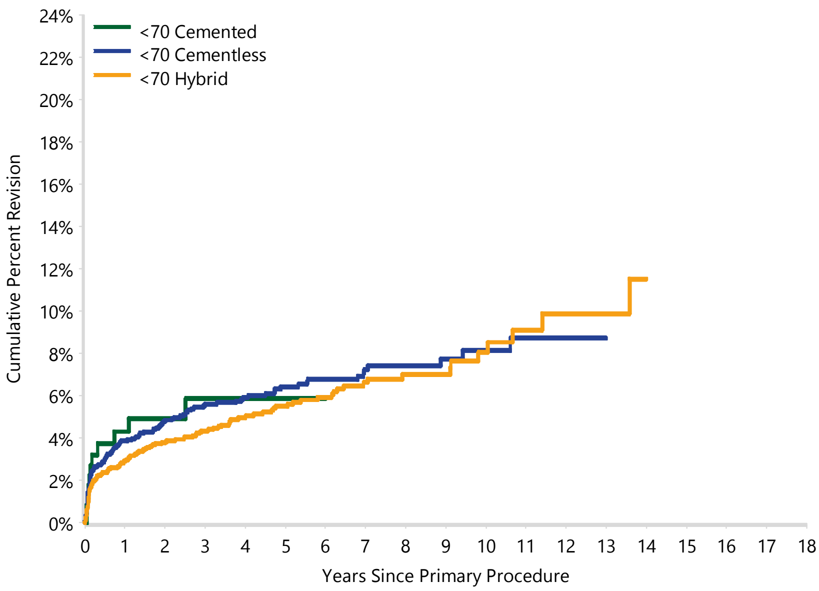
Note: Includes mixed ceramic/mixed ceramic and XLPE bearing surfaces

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	10 Yrs
<70		**287**	**5451**	**3.4 (2.9, 3.9)**	**4.2 (3.7, 4.8)**	**4.9 (4.3, 5.6)**	**5.9 (5.2, 6.7)**	**6.8 (6.0, 7.8)**	**8.0 (6.9, 9.3)**
	Cemented	11	231	4.3 (2.3, 8.1)	4.9 (2.7, 9.0)	5.9 (3.2, 10.6)	5.9 (3.2, 10.6)		
	Cementless	127	2144	3.9 (3.1, 4.8)	4.8 (3.9, 5.8)	5.6 (4.6, 6.7)	6.4 (5.4, 7.7)	7.3 (6.0, 8.7)	8.1 (6.6, 10.0)
	Hybrid	149	3076	2.9 (2.4, 3.6)	3.8 (3.1, 4.6)	4.3 (3.6, 5.2)	5.5 (4.6, 6.5)	6.6 (5.5, 8.0)	8.1 (6.5, 10.1)
≥70		**491**	**11225**	**3.0 (2.7, 3.4)**	**3.7 (3.4, 4.1)**	**4.3 (3.9, 4.7)**	**5.0 (4.5, 5.5)**	**5.9 (5.3, 6.6)**	**7.1 (6.3, 8.1)**
	Cemented	22	836	2.1 (1.3, 3.3)	2.6 (1.6, 4.0)	3.2 (2.1, 4.8)	3.2 (2.1, 4.8)	3.2 (2.1, 4.8)	
	Cementless	185	3350	3.9 (3.3, 4.7)	4.7 (4.0, 5.5)	5.3 (4.5, 6.1)	5.9 (5.0, 6.8)	6.5 (5.5, 7.6)	8.3 (6.9, 10.0)
	Hybrid	284	7039	2.7 (2.3, 3.1)	3.4 (3.0, 3.9)	3.9 (3.5, 4.5)	4.8 (4.2, 5.5)	6.0 (5.2, 6.9)	6.8 (5.8, 8.0)
TOTAL		**778**	**16676**						

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=1.18 (0.64, 2.19),p=0.590

<70 Cemented vs <70 Cementless

Entire Period: HR=1.07 (0.57, 1.98),p=0.840

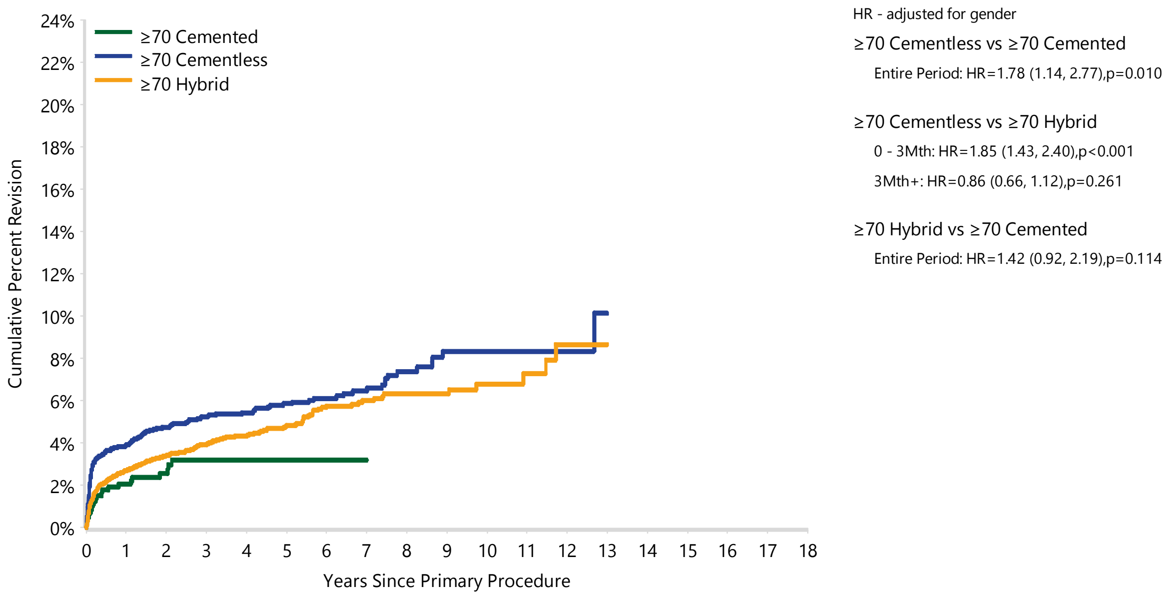
<70 Cementless vs <70 Hybrid

Entire Period: HR=1.11 (0.88, 1.41),p=0.385

Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<70	Cemented	231	158	118	92	51	19	2
	Cementless	2144	1791	1534	1295	873	565	197
	Hybrid	3076	2440	1954	1544	952	573	203

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)



	Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
≥70	Cemented	836	639	484	376	177	54	9
	Cementless	3350	2694	2200	1839	1172	701	210
	Hybrid	7039	5420	4268	3309	1842	992	313

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 3 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

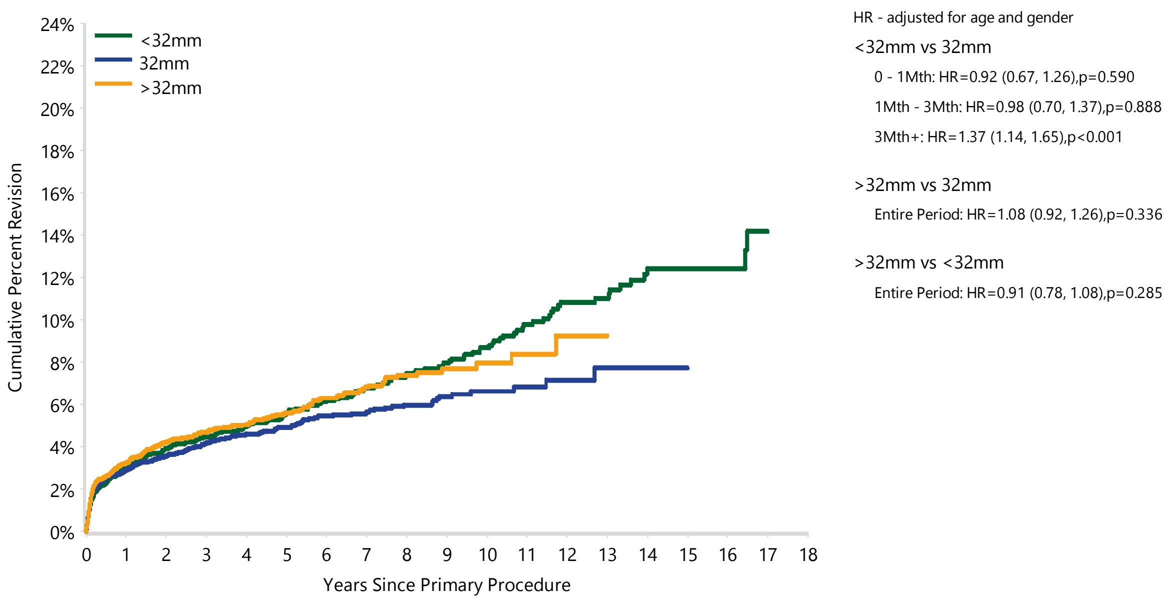
There is no difference in the rate of revision when dual mobility prostheses are used (Table HT67 and Figure HT75).

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	10 Yrs
<32mm	299	5295	3.0 (2.5, 3.5)	3.9 (3.4, 4.5)	4.4 (3.9, 5.1)	5.6 (4.9, 6.4)	6.8 (5.9, 7.7)	8.7 (7.6, 9.9)
32mm	377	8583	2.9 (2.6, 3.3)	3.6 (3.2, 4.0)	4.2 (3.7, 4.7)	4.9 (4.4, 5.5)	5.6 (5.0, 6.3)	6.6 (5.8, 7.5)
>32mm	317	6391	3.2 (2.8, 3.7)	4.2 (3.7, 4.8)	4.7 (4.1, 5.3)	5.6 (5.0, 6.3)	6.8 (6.0, 7.7)	8.0 (6.9, 9.2)
TOTAL	**993**	**20269**						

Note: All procedures using metal/metal prostheses have been excluded
Excludes 27 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	10 Yrs
<32mm	5295	4153	3428	2874	1962	1390	826
32mm	8583	6984	5713	4672	2889	1693	588
>32mm	6391	4992	4027	3214	2006	1149	294

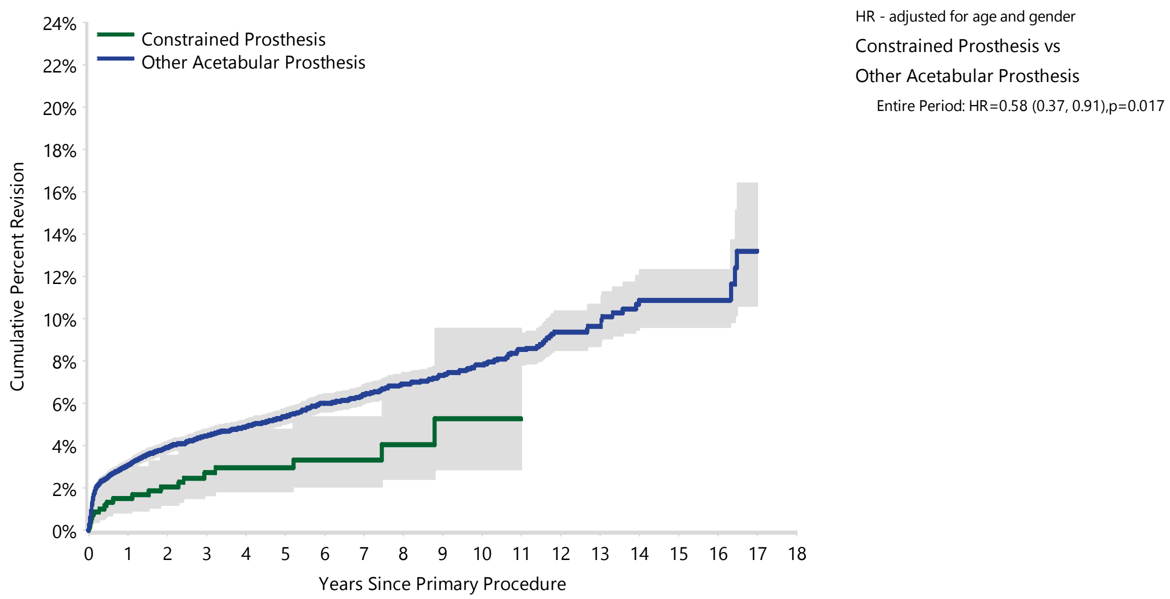
Note: All procedures using metal/metal prostheses have been excluded

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	10 Yrs
Constrained Prosthesis	20	722	1.5 (0.8, 2.8)	2.1 (1.2, 3.5)	2.7 (1.7, 4.4)	3.0 (1.8, 4.8)	3.3 (2.1, 5.4)	5.3 (2.9, 9.5)
Other Acetabular Prosthesis	973	19574	3.1 (2.8, 3.3)	3.9 (3.6, 4.2)	4.5 (4.2, 4.8)	5.4 (5.0, 5.8)	6.4 (6.0, 6.9)	7.8 (7.2, 8.5)
TOTAL	**993**	**20296**						

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	10 Yrs
Constrained Prosthesis	722	568	495	405	287	170	56
Other Acetabular Prosthesis	19574	15583	12694	10371	6581	4068	1652

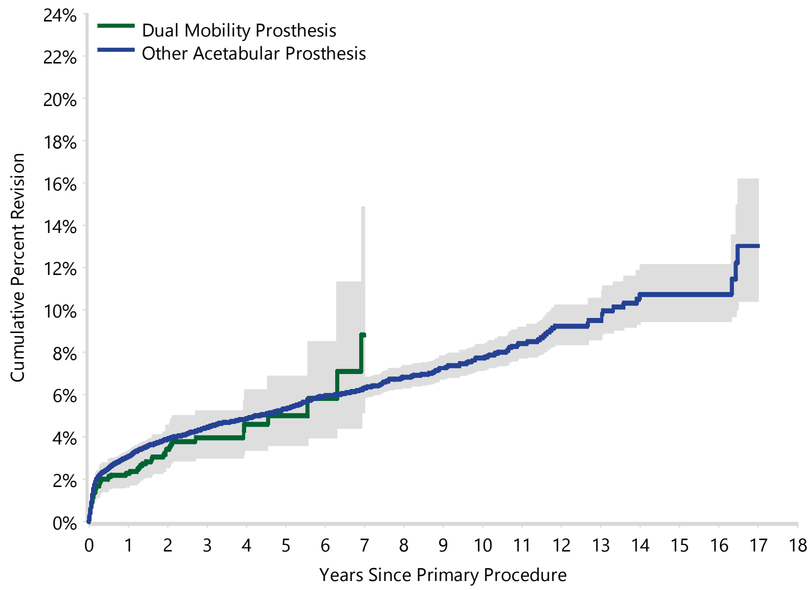
Note: All procedures using metal/metal prostheses have been excluded

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	10 Yrs
Dual Mobility Prosthesis	59	1805	2.3 (1.7, 3.1)	3.4 (2.6, 4.5)	4.0 (3.0, 5.3)	5.0 (3.6, 6.9)	8.8 (5.2, 14.9)	
Other Acetabular Prosthesis	934	18491	3.1 (2.8, 3.3)	3.9 (3.6, 4.2)	4.4 (4.1, 4.8)	5.3 (5.0, 5.7)	6.3 (5.9, 6.8)	7.7 (7.1, 8.4)
TOTAL	**993**	**20296**						

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=0.89 (0.69, 1.17),p=0.410

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Dual Mobility Prosthesis	1805	1161	785	484	166	52	11
Other Acetabular Prosthesis	18491	14990	12404	10292	6702	4186	1697

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 3 months. From 3 months to 1.5 years there is no difference, but after this time unipolar modular has a higher rate of revision. Bipolar hip replacement has a higher rate of revision compared to total conventional hip replacement from 1.5-2.5 years. After this time there is no difference (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. Unipolar modular has a higher rate of revision than total conventional hip replacement after 3 months. There is no difference between bipolar and total conventional hip replacement in this age group (Table HT69 and Figure HT77).

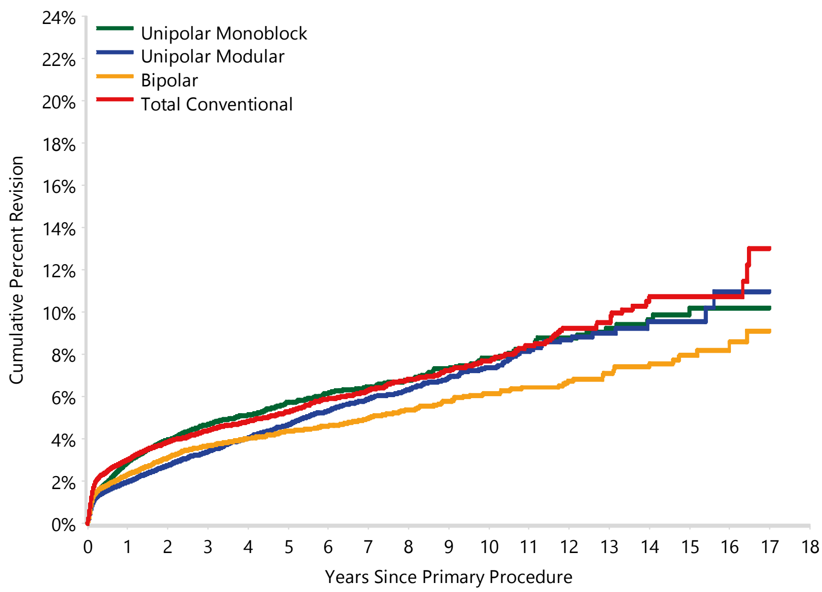
For patients aged ≥70 years, there are time-dependent variations in the comparative rates of revision. Unipolar monoblock has a lower rate of revision compared to total conventional hip replacement between 2 weeks and 3 months and a higher rate of revision between 6 months and 1 year. Unipolar modular 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 (Table HT69 and 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	10 Yrs
Unipolar Monoblock	1069	28152	2.9 (2.7, 3.1)	3.9 (3.7, 4.2)	4.7 (4.4, 5.0)	5.7 (5.4, 6.1)	6.5 (6.0, 6.9)	7.8 (7.2, 8.5)
Unipolar Modular	1371	41158	2.0 (1.8, 2.1)	2.7 (2.6, 2.9)	3.4 (3.2, 3.6)	4.7 (4.4, 5.0)	5.9 (5.5, 6.3)	7.4 (6.8, 8.0)
Bipolar	745	21717	2.3 (2.1, 2.5)	3.1 (2.9, 3.4)	3.7 (3.4, 4.0)	4.4 (4.0, 4.7)	4.9 (4.5, 5.4)	6.2 (5.6, 6.8)
Total Conventional	993	20296	3.0 (2.8, 3.3)	3.9 (3.6, 4.1)	4.4 (4.1, 4.7)	5.3 (4.9, 5.7)	6.3 (5.9, 6.7)	7.7 (7.1, 8.3)
TOTAL	**4178**	**111323**						

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, 1.16),p=0.970

3Mth+: HR=1.77 (1.57, 1.98),p<0.001

Unipolar Modular vs Total Conventional

0 - 3Mth: HR=0.80 (0.70, 0.91),p=0.001

3Mth - 1.5Yr: HR=0.91 (0.79, 1.06),p=0.242

1.5Yr+: HR=1.61 (1.42, 1.84),p<0.001

Bipolar vs Total Conventional

0 - 3Mth: HR=0.92 (0.79, 1.07),p=0.288

3Mth - 1.5Yr: HR=0.95 (0.80, 1.13),p=0.563

1.5Yr - 2.5Yr: HR=1.56 (1.23, 1.99),p<0.001

2.5Yr+: HR=0.92 (0.76, 1.11),p=0.393

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Monoblock	28152	17129	13257	10163	5651	3129	1247
Unipolar Modular	41158	27862	21765	16761	9518	5103	1747
Bipolar	21717	14943	11687	9077	5575	3612	1898
Total Conventional	20296	16151	13189	10776	6868	4238	1708

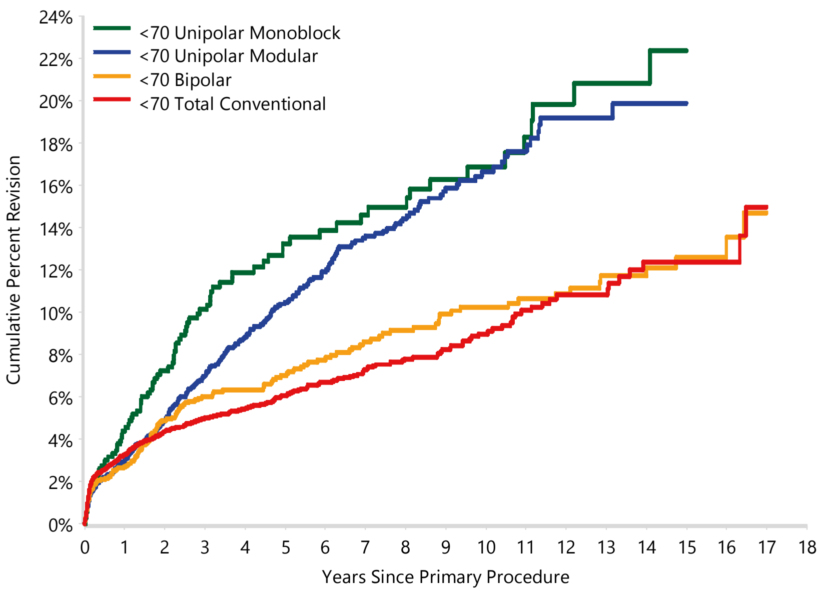
Note: All procedures using metal/metal prostheses have been excluded

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	10 Yrs
<70		**925**	**12778**	**3.2 (2.9, 3.5)**	**4.7 (4.4, 5.2)**	**6.0 (5.5, 6.5)**	**7.8 (7.2, 8.4)**	**9.6 (8.9, 10.3)**	**11.6 (10.8, 12.5)**
	Unipolar Monoblock	94	912	4.4 (3.1, 6.1)	7.2 (5.5, 9.4)	10.1 (8.0, 12.8)	13.3 (10.7, 16.4)	14.6 (11.8, 18.0)	16.9 (13.6, 20.8)
	Unipolar Modular	298	3243	3.0 (2.4, 3.6)	4.9 (4.1, 5.7)	7.0 (6.0, 8.1)	10.5 (9.2, 11.9)	13.6 (12.1, 15.3)	16.6 (14.7, 18.8)
	Bipolar	154	2258	2.7 (2.1, 3.5)	4.9 (4.0, 6.0)	6.0 (5.0, 7.2)	7.0 (5.9, 8.4)	8.6 (7.2, 10.2)	10.2 (8.6, 12.1)
	Total Conventional	379	6365	3.3 (2.8, 3.7)	4.4 (3.9, 4.9)	5.0 (4.5, 5.6)	6.1 (5.4, 6.8)	7.3 (6.5, 8.2)	9.0 (7.9, 10.1)
≥70		**3253**	**98545**	**2.4 (2.3, 2.5)**	**3.1 (3.0, 3.2)**	**3.6 (3.5, 3.8)**	**4.5 (4.3, 4.7)**	**5.2 (5.0, 5.4)**	**6.3 (6.0, 6.7)**
	Unipolar Monoblock	975	27240	2.8 (2.6, 3.1)	3.8 (3.6, 4.1)	4.5 (4.2, 4.8)	5.4 (5.0, 5.8)	6.1 (5.6, 6.5)	7.3 (6.7, 8.0)
	Unipolar Modular	1073	37915	1.9 (1.7, 2.0)	2.5 (2.4, 2.7)	3.0 (2.8, 3.2)	4.0 (3.7, 4.3)	4.9 (4.5, 5.2)	5.9 (5.4, 6.5)
	Bipolar	591	19459	2.3 (2.1, 2.5)	2.9 (2.6, 3.1)	3.3 (3.1, 3.7)	4.0 (3.6, 4.3)	4.3 (3.9, 4.7)	5.4 (4.9, 6.0)
	Total Conventional	614	13931	2.9 (2.6, 3.2)	3.6 (3.3, 4.0)	4.1 (3.8, 4.5)	4.9 (4.5, 5.4)	5.8 (5.3, 6.3)	7.0 (6.3, 7.7)
TOTAL		**4178**	**111323**						

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=0.97 (0.59, 1.60),p=0.907
3Mth+: HR=2.42 (1.88, 3.11),p<0.001

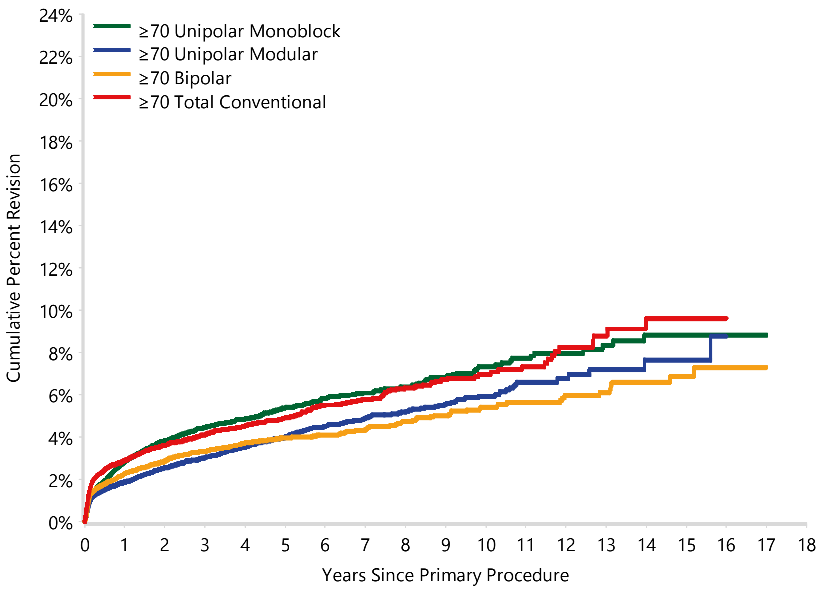
<70 Unipolar Modular vs <70 Total Conventional
0 - 3Mth: HR=0.82 (0.60, 1.11),p=0.200
3Mth - 2Yr: HR=1.38 (1.05, 1.80),p=0.021
2Yr+: HR=2.68 (2.16, 3.31),p<0.001

<70 Bipolar vs <70 Total Conventional
Entire Period: HR=1.10 (0.91, 1.32),p=0.337

	Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<70	Unipolar Monoblock	912	613	509	428	299	226	133
	Unipolar Modular	3243	2433	2036	1730	1196	815	375
	Bipolar	2258	1745	1440	1220	922	704	503
	Total Conventional	6365	5176	4320	3605	2471	1649	749

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=1.10 (0.85, 1.44),p=0.461
- 2Wk - 1Mth: HR=0.74 (0.60, 0.92),p=0.007
- 1Mth - 3Mth: HR=0.63 (0.52, 0.78),p<0.001
- 3Mth - 6Mth: HR=1.23 (0.95, 1.58),p=0.118
- 6Mth - 1Yr: HR=1.70 (1.37, 2.10),p<0.001
- 1Yr+: HR=1.13 (0.98, 1.31),p=0.097

≥70 Unipolar Modular vs ≥70 Total Conventional
- 0 - 1.5Yr: HR=0.66 (0.59, 0.73),p<0.001
- 1.5Yr+: HR=1.01 (0.87, 1.18),p=0.897

≥70 Bipolar vs ≥70 Total Conventional
- Entire Period: HR=0.77 (0.69, 0.86),p<0.001

	Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
≥70	Unipolar Monoblock	27240	16516	12748	9735	5352	2903	1114
	Unipolar Modular	37915	25429	19729	15031	8322	4288	1372
	Bipolar	19459	13198	10247	7857	4653	2908	1395
	Total Conventional	13931	10975	8869	7171	4397	2589	959

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

PRIMARY TOTAL RESURFACING HIP REPLACEMENT

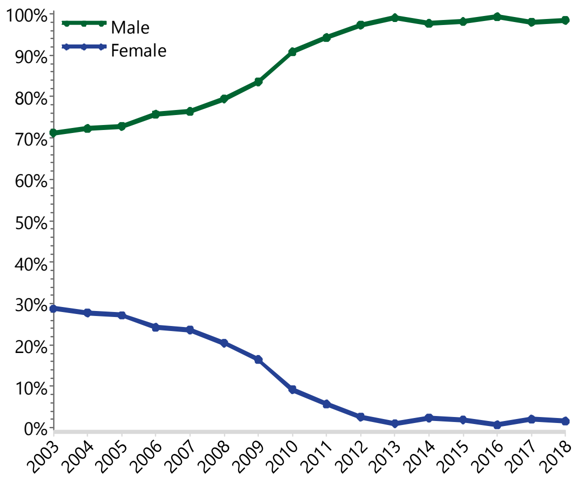
DEMOGRAPHICS

There have been 17,729 primary total resurfacing hip replacement procedures reported to the Registry. This is an additional 384 procedures compared to the last report.

The use of primary total resurfacing hip replacement in Australia has been declining since 2005. In 2018, the number of primary total resurfacing procedures is 3.3% less than in 2017, and 79.3% less than in 2005. Primary total resurfacing hip replacement represents 0.8% of all hip replacements performed in 2018.

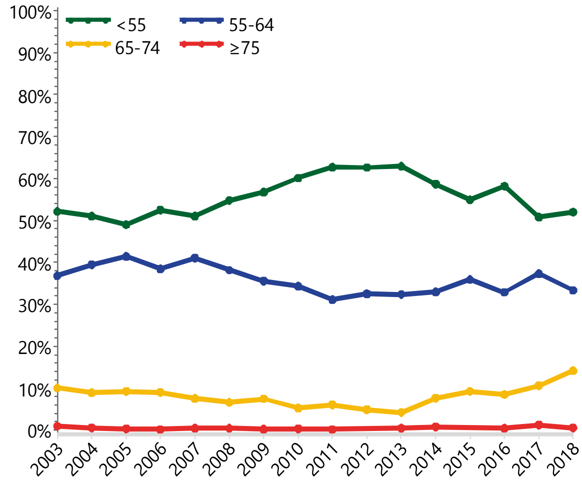
In 2018, 98.4% of primary total resurfacing hip replacements were undertaken in males (Table HT70 and Figure HT79).

Figure HT79 Primary Total Resurfacing Hip Replacement by Gender



There is a small increase in the proportion of patients aged 65-74 years receiving primary total resurfacing hip replacement in 2018 (Figure HT80).

Figure HT80 Primary Total Resurfacing Hip Replacement by Age



There were only three different types of resurfacing prostheses used in 2018, with the Adept the most commonly used, accounting for 64.6% 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	14137	79.7%	13	82	54	53.4	9.0
Female	3592	20.3%	14	81	53	51.6	8.6
TOTAL	**17729**	**100.0%**	**13**	**82**	**54**	**53.1**	**9.0**

Table HT71 Most Used Resurfacing Heads in Primary Total Resurfacing Hip Replacement

2003		2015		2016		2017		2018	
N	Model	N	Model	N	Model	N	Model	N	Model
1359	BHR	196	Adept	258	Adept	268	Adept	246	Adept
58	Durom	172	BHR	165	BHR	126	BHR	132	BHR
43	ASR							3	ReCerf
42	Cormet								
38	Cormet 2000 HAP								
7	Conserve Plus								
Most Used									
1547	(6) 100.0%	368	(2) 100.0%	423	(2) 100.0%	394	(2) 100.0%	381	(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 (2.3%) 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

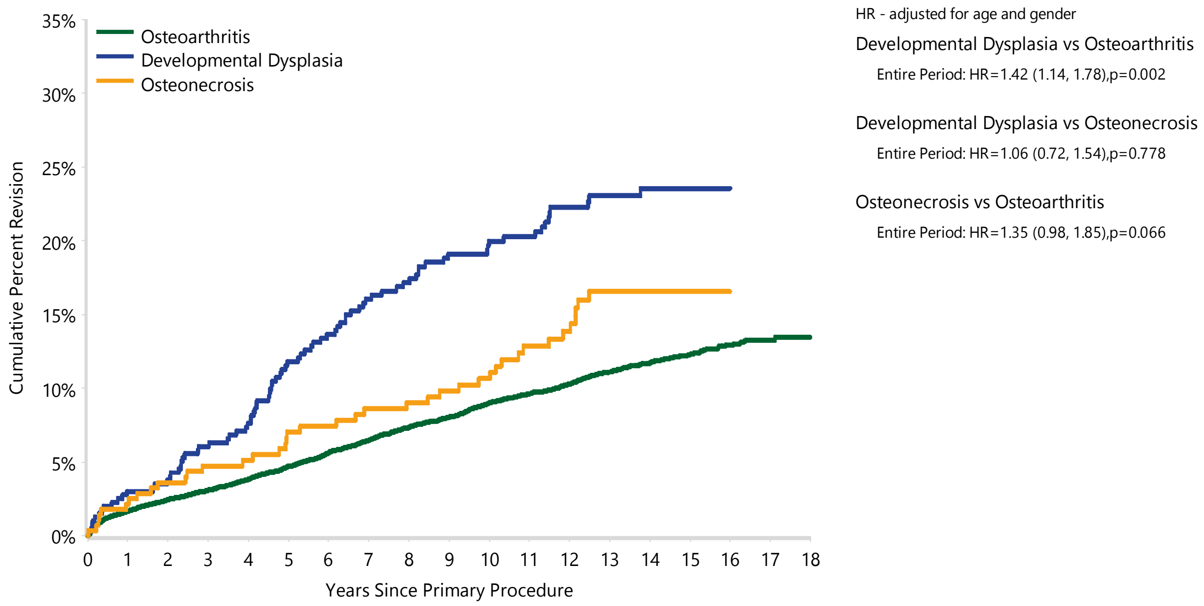
The cumulative percent revision of different primary total resurfacing hip prosthesis combinations with more than 100 procedures is listed in Table HT73. At 10 years, the prosthesis with the lowest cumulative percent revision is the Mitch TRH (5.6%).

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	18 Yrs
Osteoarthritis	1584	16910	1.7 (1.5, 1.9)	3.1 (2.8, 3.4)	4.7 (4.4, 5.0)	9.0 (8.5, 9.5)	12.3 (11.7, 12.9)	13.5 (12.7, 14.3)
Developmental Dysplasia	86	399	3.0 (1.7, 5.3)	6.1 (4.1, 8.9)	11.8 (9.0, 15.4)	20.0 (16.3, 24.4)	23.6 (19.5, 28.3)	
Osteonecrosis	40	282	2.2 (1.0, 4.7)	4.7 (2.8, 8.0)	7.1 (4.6, 10.8)	10.7 (7.5, 15.1)	16.6 (12.4, 22.0)	
Other (6)	22	138	2.2 (0.7, 6.7)	5.4 (2.6, 10.9)	9.6 (5.5, 16.2)	16.0 (10.5, 24.1)		
TOTAL	**1732**	**17729**						

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



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Osteoarthritis	16910	16241	15163	14114	9921	2773	76
Developmental Dysplasia	399	384	366	335	271	102	4
Osteonecrosis	282	270	249	241	211	85	6

Note: Only primary diagnoses with over 100 procedures have been listed

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	18 Yrs
ASR	ASR*	382	1168	3.4 (2.5, 4.6)	7.2 (5.9, 8.8)	15.4 (13.4, 17.6)	29.9 (27.3, 32.6)		
Adept	Adept	45	1720	1.0 (0.6, 1.6)	1.6 (1.1, 2.4)	2.2 (1.5, 3.3)	6.1 (4.3, 8.5)		
BHR	BHR	889	11639	1.4 (1.2, 1.6)	2.4 (2.2, 2.7)	3.5 (3.1, 3.8)	6.6 (6.1, 7.1)	9.6 (9.0, 10.3)	10.8 (10.0, 11.7)
Bionik	Bionik*	53	200	3.5 (1.7, 7.2)	12.0 (8.2, 17.4)	17.6 (13.0, 23.6)	25.4 (19.9, 32.1)		
Cormet	Cormet*	119	626	2.1 (1.2, 3.6)	5.6 (4.1, 7.7)	9.7 (7.6, 12.3)	17.1 (14.3, 20.4)	21.7 (18.3, 25.6)	
Durom	Durom*	102	847	3.3 (2.3, 4.8)	5.6 (4.2, 7.3)	7.7 (6.1, 9.7)	11.0 (9.1, 13.4)	12.9 (10.7, 15.5)	
Icon	Icon*	17	118	1.7 (0.4, 6.6)	4.2 (1.8, 9.9)	5.9 (2.9, 12.0)	11.3 (6.7, 18.7)		
Mitch TRH	Mitch TRH*	53	1024	1.2 (0.7, 2.1)	2.1 (1.4, 3.2)	2.6 (1.8, 3.8)	5.6 (4.2, 7.3)		
Recap	Recap*	29	196	5.1 (2.8, 9.3)	8.7 (5.5, 13.6)	10.2 (6.7, 15.4)	14.6 (10.3, 20.5)		
Other (9)		43	191	5.3 (2.9, 9.6)	7.4 (4.5, 12.2)	9.6 (6.1, 14.8)	17.4 (12.6, 23.7)	24.6 (18.8, 31.7)	
TOTAL		**1732**	**17729**						

Note: Only combinations with over 100 procedures have been listed
* denotes prosthesis combinations with no reported use in primary total resurfacing hip replacement in 2018

OUTCOME FOR OSTEOARTHRITIS

The cumulative percent revision at 18 years for primary total resurfacing hip replacement undertaken for osteoarthritis is 13.5% (Table HT74 and Figure HT82).

Reasons for Revision

The main reasons for revision of primary total resurfacing hip replacement are metal related pathology (27.3%), loosening (24.8%) and fracture (17.8%) (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 primary total resurfacing hip replacement is revision of both the femoral and acetabular components (71.5%). Femoral only revision is much less common (22.9%) and acetabular only revision is rarely undertaken (2.8%) (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 one 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 (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).

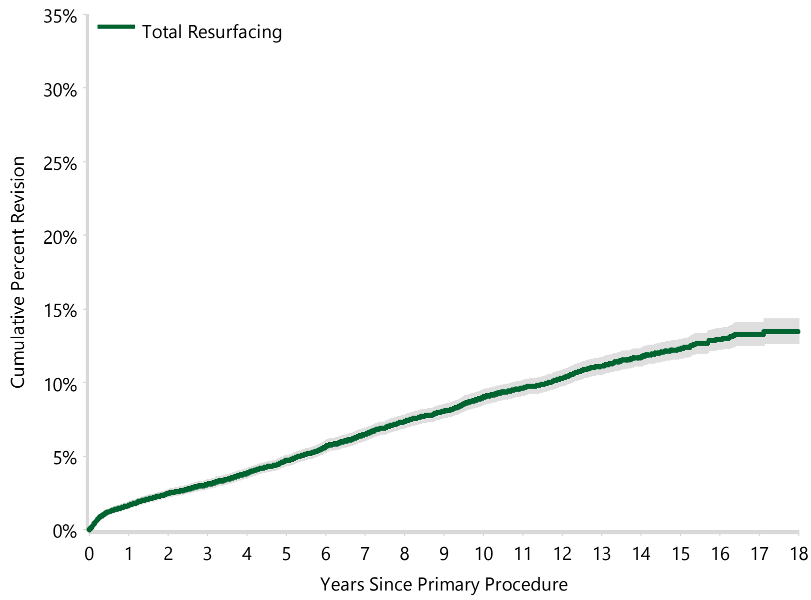
The reason for revision varies with head size. Head sizes <50mm have a higher cumulative incidence of metal related pathology, loosening, fracture, infection, and lysis compared to head sizes ≥50mm (Figure HT89).

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	18 Yrs
Total Resurfacing	1584	16910	1.7 (1.5, 1.9)	3.1 (2.8, 3.4)	4.7 (4.4, 5.0)	9.0 (8.5, 9.5)	12.3 (11.7, 12.9)	13.5 (12.7, 14.3)
TOTAL	**1584**	**16910**						

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	18 Yrs
Total Resurfacing	16910	16241	15163	14114	9921	2773	76

Table HT75 Primary Total Resurfacing Hip Replacement by Reason for Revision (Primary Diagnosis OA)

Reason for Revision	Number	Percent
Metal Related Pathology	433	27.3
Loosening	393	24.8
Fracture	282	17.8
Lysis	145	9.2
Infection	102	6.4
Pain	96	6.1
Osteonecrosis	41	2.6
Prosthesis Dislocation	22	1.4
Malposition	20	1.3
Other (11)	50	3.2
TOTAL	**1584**	**100.0**

Table HT76 Primary Total Resurfacing Hip Replacement by Type of Revision (Primary Diagnosis OA)

Type of Revision	Number	Percent
THR (Femoral/Acetabular)	1132	71.5
Femoral Component	363	22.9
Acetabular Component	44	2.8
Cement Spacer	35	2.2
Removal of Prostheses	10	0.6
TOTAL	**1584**	**100.0**

Figure HT83 Cumulative Incidence Revision Diagnosis of Primary Total Resurfacing Hip Replacement (Primary Diagnosis OA)

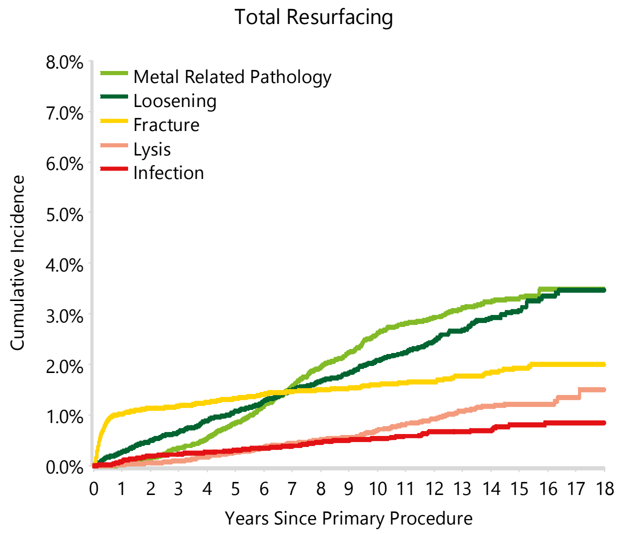
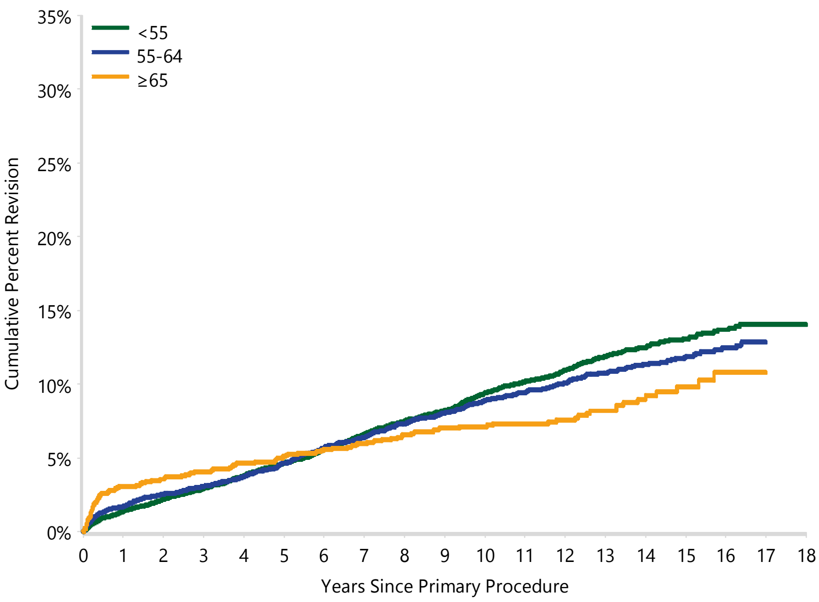


Table HT77 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement by Age (Primary Diagnosis OA)

Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
<55	869	8907	1.4 (1.2, 1.6)	2.9 (2.6, 3.3)	4.7 (4.2, 5.1)	9.4 (8.8, 10.1)	13.1 (12.2, 14.0)	14.1 (13.0, 15.1)
55-64	599	6459	1.7 (1.4, 2.1)	3.1 (2.7, 3.5)	4.6 (4.1, 5.2)	8.9 (8.2, 9.7)	11.8 (10.9, 12.8)	
≥65	116	1544	3.1 (2.3, 4.1)	4.1 (3.2, 5.2)	5.1 (4.1, 6.4)	7.1 (5.9, 8.6)	9.8 (8.0, 12.0)	
TOTAL	**1584**	**16910**						

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=1.06 (0.92, 1.23),p=0.413

5.5Yr+: HR=0.86 (0.74, 1.00),p=0.048

≥65 vs <55

0 - 3Mth: HR=3.03 (1.98, 4.63),p<0.001

3Mth - 6Mth: HR=2.67 (1.46, 4.89),p=0.001

6Mth+: HR=0.70 (0.55, 0.89),p=0.003

≥65 vs 55-64

0 - 6Mth: HR=2.40 (1.67, 3.45),p<0.001

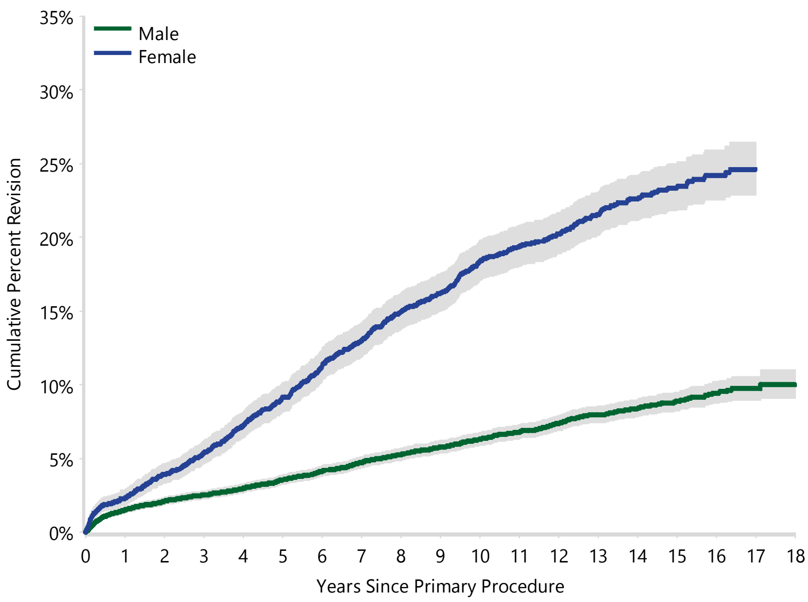
6Mth+: HR=0.76 (0.59, 0.96),p=0.023

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
<55	8907	8591	8012	7439	5053	1489	51
55-64	6459	6215	5828	5448	3959	1040	22
≥65	1544	1435	1323	1227	909	244	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	18 Yrs
Male		**887**	**13638**	**1.5 (1.3, 1.7)**	**2.5 (2.3, 2.8)**	**3.6 (3.2, 3.9)**	**6.3 (5.9, 6.8)**	**8.9 (8.3, 9.5)**	**10.0 (9.1, 11.0)**
	<55	453	7023	1.2 (1.0, 1.5)	2.3 (2.0, 2.7)	3.3 (2.9, 3.8)	6.3 (5.7, 6.9)	9.1 (8.3, 10.1)	
	55-64	338	5205	1.6 (1.3, 2.0)	2.4 (2.0, 2.9)	3.6 (3.1, 4.1)	6.3 (5.6, 7.1)	8.6 (7.6, 9.6)	
	≥65	96	1410	3.0 (2.2, 4.1)	3.9 (3.0, 5.0)	4.8 (3.8, 6.1)	6.5 (5.2, 8.0)	8.8 (7.1, 10.9)	
Female		**697**	**3272**	**2.3 (1.8, 2.9)**	**5.4 (4.6, 6.2)**	**9.1 (8.2, 10.2)**	**18.3 (17.0, 19.7)**	**23.4 (21.8, 25.0)**	
	<55	416	1884	2.1 (1.6, 2.9)	5.1 (4.2, 6.2)	9.4 (8.1, 10.8)	18.9 (17.2, 20.8)	24.3 (22.2, 26.5)	
	55-64	261	1254	2.4 (1.7, 3.4)	5.7 (4.5, 7.1)	8.9 (7.4, 10.6)	18.0 (16.0, 20.3)	22.6 (20.2, 25.3)	
	≥65	20	134	3.7 (1.6, 8.7)	6.0 (3.0, 11.6)	8.3 (4.7, 14.5)	13.0 (8.3, 20.1)		
TOTAL		**1584**	**16910**						

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=2.05 (1.44, 2.93),p<0.001

3Mth - 6Mth: HR=1.26 (0.73, 2.16),p=0.410

6Mth - 1Yr: HR=0.92 (0.50, 1.68),p=0.780

1Yr - 2.5Yr: HR=2.79 (2.07, 3.76),p<0.001

2.5Yr - 4.5Yr: HR=4.19 (3.24, 5.42),p<0.001

4.5Yr - 6Yr: HR=3.51 (2.66, 4.65),p<0.001

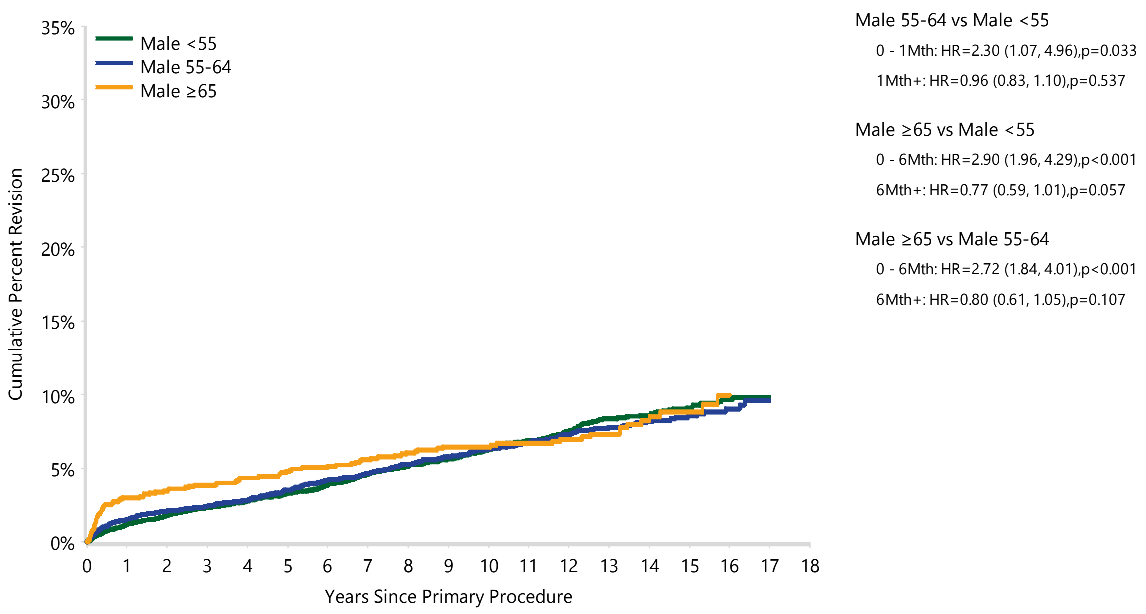
6Yr - 6.5Yr: HR=4.76 (2.82, 8.03),p<0.001

6.5Yr - 9.5Yr: HR=3.47 (2.79, 4.31),p<0.001

9.5Yr+: HR=2.38 (1.91, 2.98),p<0.001

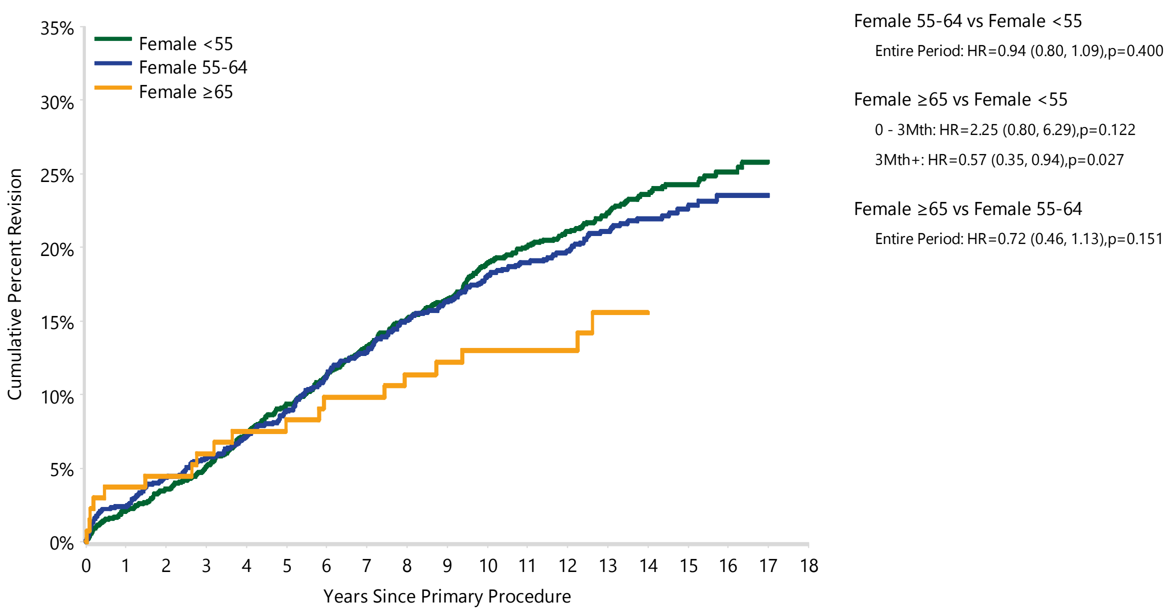
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Male	13638	13053	12091	11189	7586	2007	55
Female	3272	3188	3072	2925	2335	766	21

Figure HT86 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement in Males by Age (Primary Diagnosis OA)



Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Male	<55	7023	6753	6239	5759	3721	1055	35
	55-64	5205	4993	4653	4322	3051	743	17
	≥65	1410	1307	1199	1108	814	209	3

Figure HT87 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement in Females by Age (Primary Diagnosis OA)

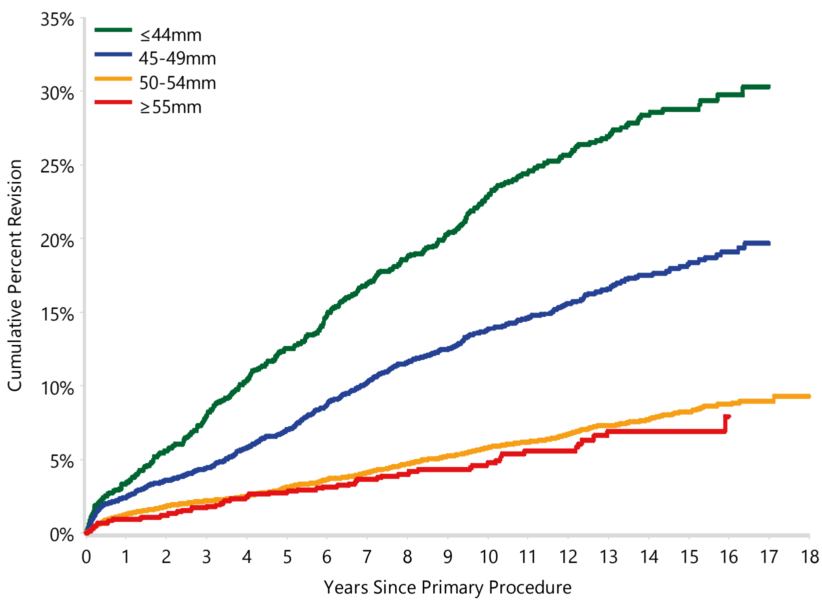


Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Female	<55	1884	1838	1773	1680	1332	434	16
	55-64	1254	1222	1175	1126	908	297	5
	≥65	134	128	124	119	95	35	0

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	18 Yrs
≤44mm	319	1196	3.4 (2.5, 4.6)	8.0 (6.6, 9.6)	12.5 (10.8, 14.5)	22.8 (20.5, 25.3)	28.8 (26.1, 31.7)	
45-49mm	560	3811	2.4 (2.0, 3.0)	4.4 (3.8, 5.1)	7.0 (6.2, 7.9)	13.9 (12.7, 15.1)	18.3 (16.8, 19.8)	
50-54mm	645	10712	1.3 (1.1, 1.5)	2.2 (1.9, 2.5)	3.1 (2.8, 3.5)	5.8 (5.3, 6.3)	8.3 (7.6, 9.0)	9.3 (8.3, 10.4)
≥55mm	60	1191	0.9 (0.5, 1.7)	1.7 (1.1, 2.7)	2.7 (1.9, 3.9)	4.8 (3.6, 6.3)	6.9 (5.3, 9.1)	
TOTAL	**1584**	**16910**						

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=3.05 (2.24, 4.14),p<0.001

45-49mm vs ≥55mm

Entire Period: HR=2.16 (1.63, 2.86),p<0.001

50-54mm vs ≥55mm

Entire Period: HR=1.14 (0.87, 1.48),p=0.335

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
≤44mm	1196	1153	1094	1033	812	281	7
45-49mm	3811	3665	3462	3228	2317	602	13
50-54mm	10712	10267	9518	8861	6162	1757	51
≥55mm	1191	1156	1089	992	630	133	5

Figure HT89 **Cumulative Incidence Revision Diagnosis of Primary Total Resurfacing Hip Replacement by Head Size (Primary Diagnosis OA)**

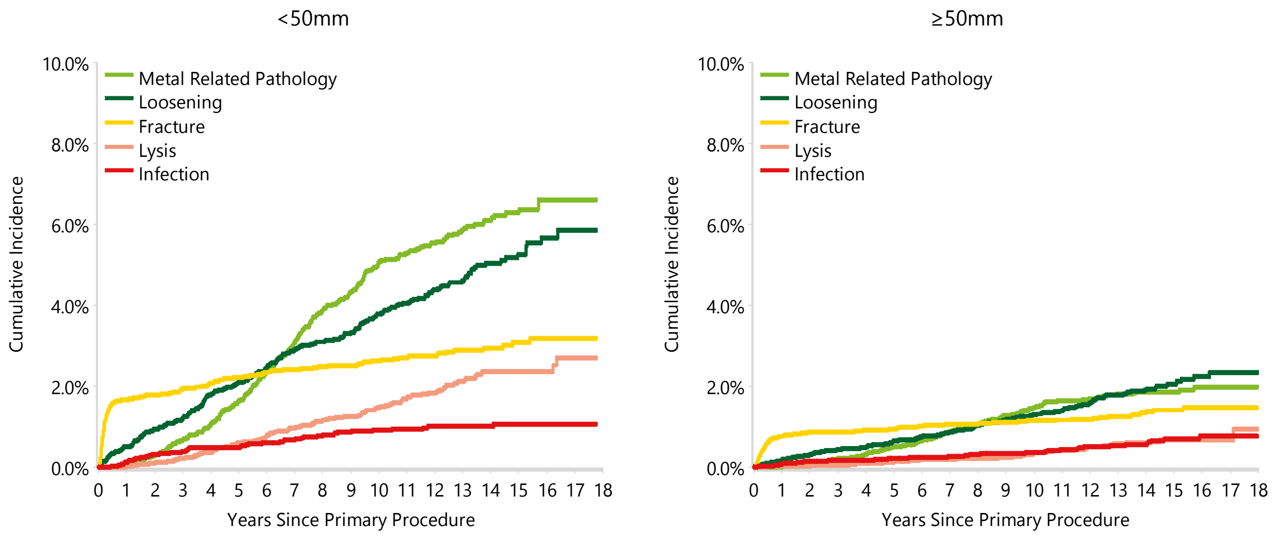
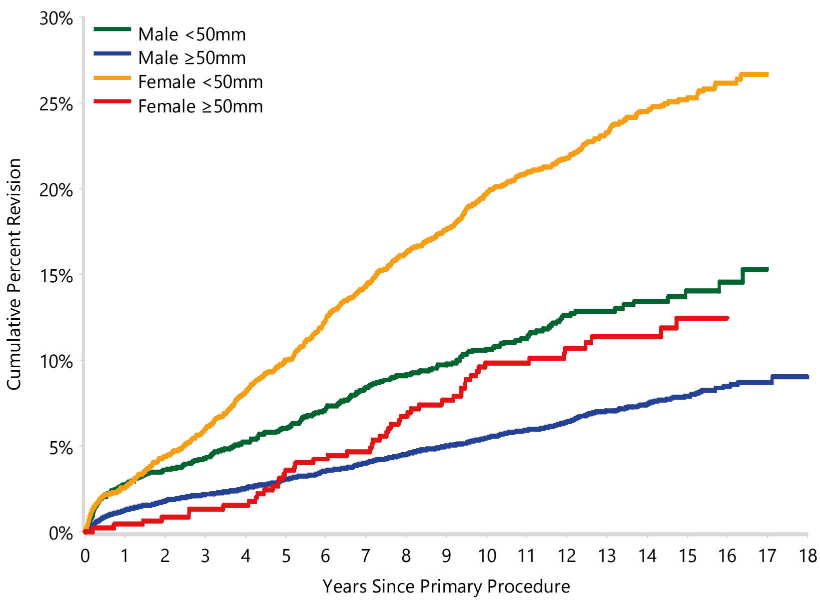


Table HT80 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement by Gender and Femoral Head Size (Primary Diagnosis OA)

Gender	Femoral Head Size	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Male		**887**	**13638**	**1.5 (1.3, 1.7)**	**2.5 (2.3, 2.8)**	**3.6 (3.2, 3.9)**	**6.3 (5.9, 6.8)**	**8.9 (8.3, 9.5)**	**10.0 (9.1, 11.0)**
	<50mm	232	2188	2.8 (2.2, 3.5)	4.3 (3.5, 5.3)	6.1 (5.1, 7.2)	10.6 (9.3, 12.1)	14.0 (12.2, 16.1)	
	≥50mm	655	11450	1.3 (1.1, 1.5)	2.2 (1.9, 2.5)	3.1 (2.8, 3.4)	5.5 (5.0, 6.0)	7.9 (7.3, 8.6)	9.0 (8.0, 10.1)
Female		**697**	**3272**	**2.3 (1.8, 2.9)**	**5.4 (4.6, 6.2)**	**9.1 (8.2, 10.2)**	**18.3 (17.0, 19.7)**	**23.4 (21.8, 25.0)**	
	<50mm	647	2819	2.6 (2.1, 3.2)	6.0 (5.2, 7.0)	10.0 (9.0, 11.2)	19.7 (18.3, 21.3)	25.2 (23.4, 27.0)	
	≥50mm	50	453	0.4 (0.1, 1.8)	1.3 (0.6, 2.9)	3.6 (2.2, 5.8)	9.8 (7.4, 13.0)	12.5 (9.5, 16.3)	
TOTAL		**1584**	**16910**						

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 (1.66, 2.25),p<0.001

Male <50mm vs Female <50mm

0 - 6Mth: HR=0.78 (0.55, 1.08),p=0.137

6Mth+: HR=0.50 (0.43, 0.59),p<0.001

Male ≥50mm vs Female ≥50mm

0 - 7Yr: HR=0.89 (0.58, 1.38),p=0.615

7Yr - 9Yr: HR=0.32 (0.18, 0.56),p<0.001

9Yr+: HR=0.56 (0.34, 0.93),p=0.025

Female <50mm vs Female ≥50mm

0 - 4.5Yr: HR=4.04 (2.22, 7.35),p<0.001

4.5Yr - 5Yr: HR=0.83 (0.33, 2.07),p=0.686

5Yr+: 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	18 Yrs
Male	<50mm	2188	2078	1927	1766	1154	253	3
	≥50mm	11450	10975	10164	9423	6432	1754	52
Female	<50mm	2819	2740	2629	2495	1975	630	17
	≥50mm	453	448	443	430	360	136	4

OUTCOMES OF PRIMARY TOTAL RESURFACING COMPARED TO PRIMARY TOTAL CONVENTIONAL HIP REPLACEMENT

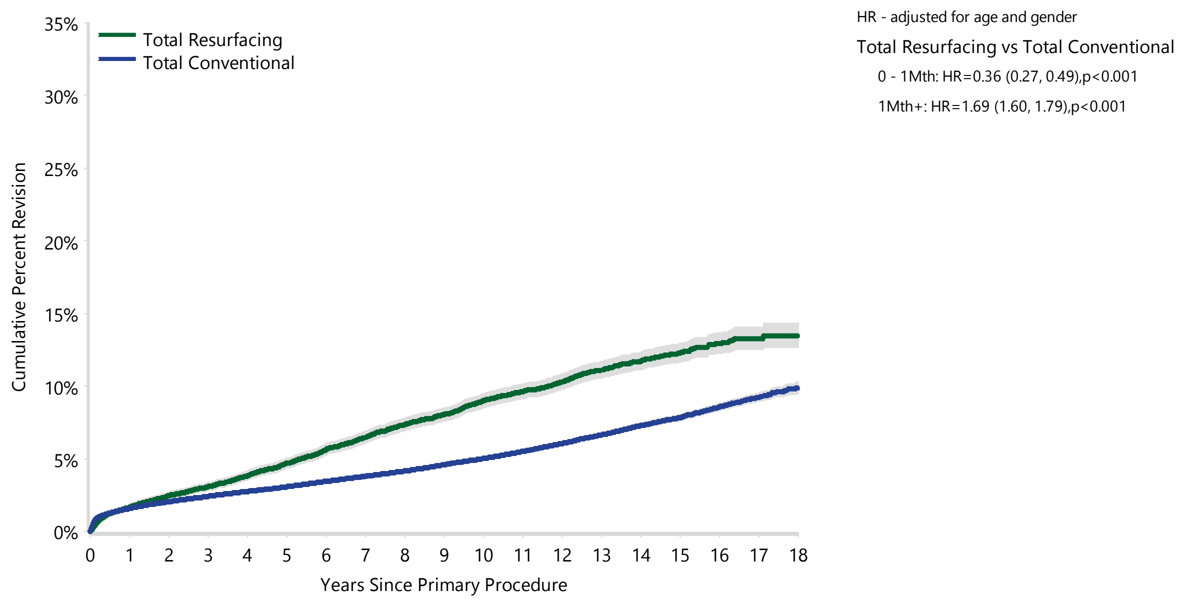
The rate of revision for osteoarthritis in primary total resurfacing and primary total conventional hip replacement were compared. Primary total resurfacing has a lower rate of revision than primary total conventional hip replacement in the first month. After this time, primary total resurfacing has 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	18 Yrs
Total Resurfacing	1584	16910	1.7 (1.5, 1.9)	3.1 (2.8, 3.4)	4.7 (4.4, 5.0)	9.0 (8.5, 9.5)	12.3 (11.7, 12.9)	13.5 (12.7, 14.3)
Total Conventional	14533	386101	1.6 (1.5, 1.6)	2.4 (2.4, 2.5)	3.1 (3.0, 3.2)	5.0 (4.9, 5.1)	7.9 (7.7, 8.0)	9.9 (9.5, 10.3)
TOTAL	**16117**	**403011**						

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	18 Yrs
Total Resurfacing	16910	16241	15163	14114	9921	2773	76
Total Conventional	386101	343423	269596	203221	80701	19744	1342

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

Knee Replacement

Knee Replacement

CATEGORIES OF KNEE REPLACEMENT

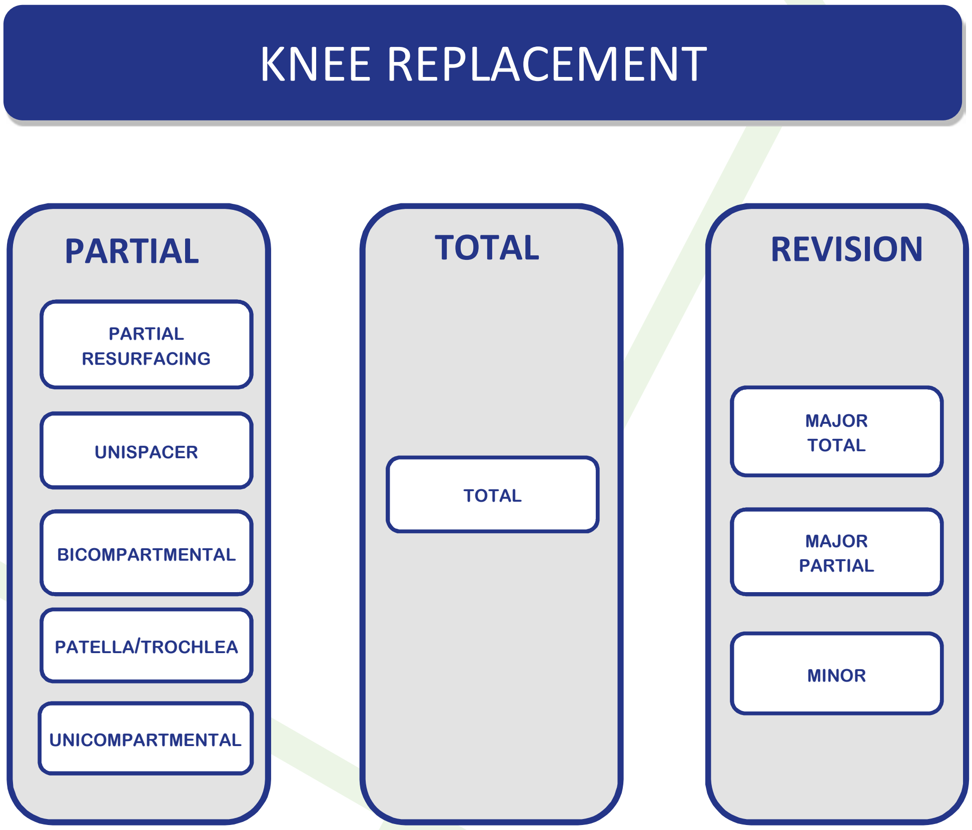
The Registry groups knee replacement into three broad categories: primary partial, primary total and revision knee replacement.

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 sub-categorised 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 sub-categorised 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-2019



USE OF KNEE REPLACEMENT

This report analyses 782,600 knee replacements with a procedure date up to and including 31 December 2018. This is an additional 65,266 knee procedures compared to the number reported last year. When considering all knee procedures currently recorded by the Registry, primary partial knee accounts for 7.8%, primary total knee 84.2% and revision knee replacement 8.0% (Table K1).

Table K1 Number of Knee Replacements

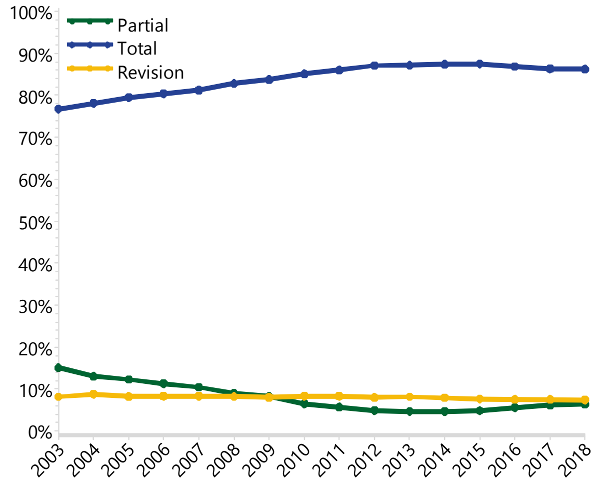
Knee Category	Number	Percent
Partial	61005	7.8
Total	658596	84.2
Revision	62999	8.0
TOTAL	**782600**	**100.0**

In 2018, the number of knee replacements undertaken has increased by 794 (1.2%) compared to 2017. During the last year, primary partial and primary total knee replacement has increased by 3.8% and 1.1%, respectively. There was an increase in revision knee replacement (0.5%).

Since 2003, the number of knee replacement procedures undertaken annually has increased by 128.1%. Primary total knee replacement has increased by 156.2% and revision knee replacement by 108.2%. Primary partial knee replacement has decreased by 4.0%.

In 2018, primary total knee replacement accounts for 86.2% of all knee replacement procedures. This has increased from 76.7% in 2003. Primary partial knee replacement decreased from 15.1% in 2003 to 6.4% in 2018. The proportion of revision knee procedures has declined from a peak of 8.8% in 2004 to 7.5% in 2018. This equates to 879 fewer revision procedures in 2018 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 is 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 is ASA score data on 334,860 and BMI data on 227,591 knee replacement procedures. Since its initial collection in 2012, ASA score has been recorded for 95.0% of procedures. BMI data has been recorded for 92.1% of procedures since 2015, when its collection commenced.

In 2018, ASA score is reported in 99.8% of knee replacement procedures and BMI data is reported in 97.1% of procedures.

BMI data is reported for 98.1% of primary partial knees, 97.4% of primary total knees and 92.5% 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 92.4% of procedures patients have an ASA score of 2 or 3, 6.3% 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 (75.0% and 61.5%, respectively). For patients undergoing revision knee replacement surgery, there are a lower proportion with ASA scores 1 or 2 (48.1%) (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 (62.2%). 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 55.1% of procedures undertaken in patients in either the normal or pre-obese categories, compared to 41.5% for primary total knee and 40.6% for revision knee replacement (Table K3).

Table K2 ASA Score for Knee Replacement

	Partial		Total		Revision		TOTAL	
ASA Score	N	Col%	N	Col%	N	Col%	N	Col%
ASA 1	2500	13.6	17500	6.0	997	3.9	20997	6.3
ASA 2	11286	61.4	161508	55.5	11298	44.2	184092	55.0
ASA 3	4509	24.5	108664	37.4	12284	48.0	125457	37.5
ASA 4	90	0.5	3217	1.1	980	3.8	4287	1.3
ASA 5	3	0.0	16	0.0	8	0.0	27	0.0
TOTAL	**18388**	**100.0**	**290905**	**100.0**	**25567**	**100.0**	**334860**	**100.0**

Table K3 BMI Category for Knee Replacement

	Partial		Total		Revision		TOTAL	
BMI Category	N	Col%	N	Col%	N	Col%	N	Col%
Underweight	26	0.2	385	0.2	59	0.4	470	0.2
Normal	1913	14.3	20600	10.4	1747	10.7	24260	10.7
Pre Obese	5473	40.8	61556	31.1	4880	29.9	71909	31.6
Obese Class 1	4109	30.7	60611	30.6	5015	30.7	69735	30.6
Obese Class 2	1366	10.2	33745	17.1	2859	17.5	37970	16.7
Obese Class 3	516	3.8	20964	10.6	1767	10.8	23247	10.2
TOTAL	**13403**	**100.0**	**197861**	**100.0**	**16327**	**100.0**	**227591**	**100.0**

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

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. In 2019, it is now 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 to complete the AOANJRR Annual Report for 2019 and is available on the AOANJRR website.

CLASSES OF PARTIAL KNEE REPLACEMENT

The Registry sub-categorises 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/trochlea replacement (6.4%). 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-2019

Table KP1 Partial Knee Replacement by Class

Partial Knee Class	Number	Percent
Partial Resurfacing	244	0.4
Unispacer	40	0.1
Bicompartmental	165	0.3
Patella/Trochlear	3928	6.4
Unicompartmental	56628	92.8
TOTAL	**61005**	**100.0**

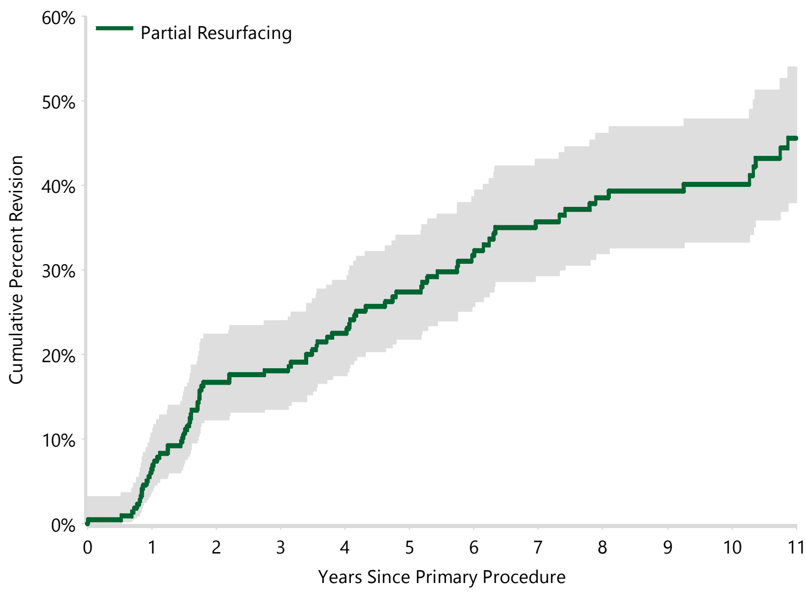
PARTIAL RESURFACING

The Registry has recorded 244 partial resurfacing knee procedures. This is an additional 4 procedures 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% of procedures, with most (144) implanted on the femoral articular surface. There are 85 procedures that involve resurfacing the patella/trochlear joint either on one side (27) or both sides (58).
The cumulative percent revision of partial resurfacing undertaken for osteoarthritis is 45.6% at 11 years (Table KP2 and Figure KP1). Most primary partial resurfacing replacements are revised to either a total knee replacement (62.2%) or a unicompartmental knee replacement (21.1%).

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	11 Yrs
Partial Resurfacing	85	219	6.5 (3.9, 10.7)	16.7 (12.3, 22.4)	18.1 (13.6, 23.9)	27.4 (21.8, 34.0)	38.6 (31.9, 46.1)	45.6 (38.0, 53.9)
TOTAL	**85**	**219**						

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	11 Yrs
Partial Resurfacing	219	202	178	169	128	84	45

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-2019

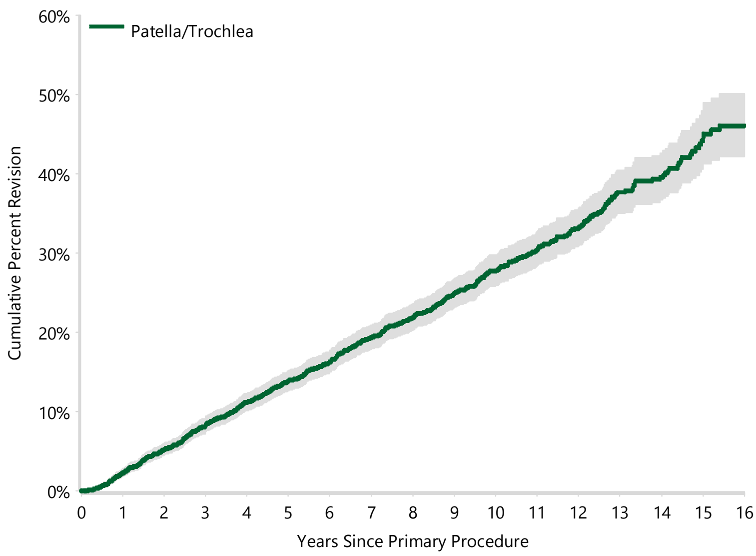
PATELLA/TROCHLEA

There have been 3,928 patella/trochlea knee replacements reported to the Registry. This is an additional 335 procedures compared to the previous report. The principal diagnosis for patella/trochlea procedures is osteoarthritis (98.9%). The mean age of patients is 58.6 years, with this procedure undertaken more frequently in females (76.8%).
The Registry has recorded 762 revisions of primary patella/trochlea knee replacement for osteoarthritis. The cumulative percent revision of patella/trochlea replacement at 16 years is 46.1% (Table KP3 and Figure KP2). The most common reason for revision is progression of disease (50.5%), with most revised to a total knee replacement (84.8%). 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/Trochlea Knee Replacement (Primary Diagnosis OA)

Knee Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	13 Yrs	16 Yrs
Patella/Trochlea	762	3886	2.3 (1.8, 2.8)	8.2 (7.3, 9.2)	13.8 (12.6, 15.1)	27.7 (25.8, 29.7)	37.7 (35.0, 40.5)	46.1 (42.1, 50.1)
TOTAL	**762**	**3886**						

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



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	13 Yrs	16 Yrs
Patella/Trochlea	3886	3468	2658	2043	777	310	72

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-2019.

UNICOMPARTMENTAL

DEMOGRAPHICS

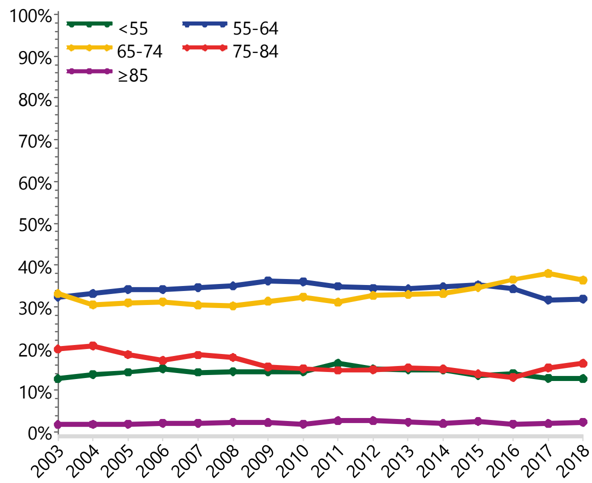
This year, the Registry is reporting on 56,628 primary unicompartmental knee procedures. This is an additional 3,814 procedures compared to the last report.

The use of unicompartmental knee replacement increased from 5.7% in 2017 to 5.8% of all knee procedures in 2018. Although the proportion of unicompartmental knee replacements has increased over the last 4 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 (53.5%).The proportion of males has increased from 50.3% in 2007 to 57.2% in 2018 (Table KP4 and Figure KP3).

Unicompartmental knee replacement is most frequently undertaken in patients aged 55-74 years (66.6%). The age distribution has remained relatively stable since 2003 (Figure KP4). The mean age of patients is 65.3 years (Table KP4).

Figure KP4 Primary Unicompartmental Knee Replacement by Age



In 2018, the 10 most used tibial prostheses account for 98.0% of all unicompartmental procedures. The Restoris MCK, ZUK and Oxford (cementless) are the most used prostheses in 2018 (Table KP5).

The outcomes of unicompartmental knee prosthesis combinations with more than 200 procedures are presented in Table KP6.

Figure KP3 Primary Unicompartmental Knee Replacement by Gender

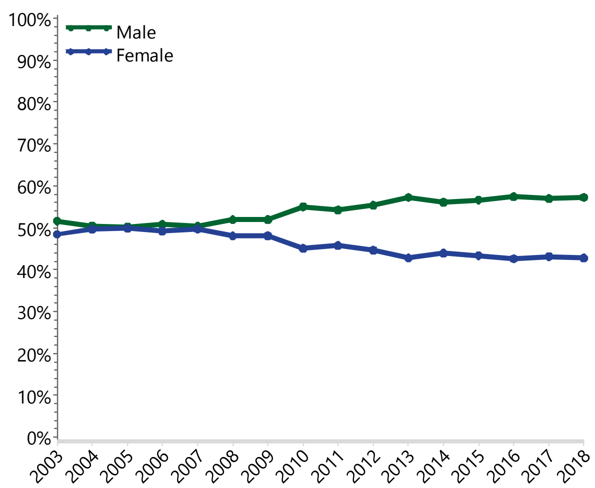


Table KP4 Age and Gender of Primary Unicompartmental Knee

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	30277	53.5%	24	98	66	65.7	9.6
Female	26351	46.5%	23	98	65	64.8	10.2
TOTAL	**56628**	**100.0%**	**23**	**98**	**65**	**65.3**	**9.9**

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

2003		2014		2015		2016		2018	
N	Model	N	Model	N	Model	N	Model	N	Model
1366	Oxford (ctd)	748	ZUK	784	Oxford (cless)	1025	Restoris MCK	1141	Restoris MCK
444	Repicci II	704	Oxford (cless)	742	ZUK	913	ZUK	973	ZUK
373	Preservation Fixed	394	Oxford (ctd)	610	Restoris MCK	910	Oxford (cless)	796	Oxford (cless)
353	M/G	145	Restoris MCK	383	Oxford (ctd)	262	Oxford (ctd)	196	Journey Uni (v2)
336	Allegretto Uni	129	Sigma HP	156	Sigma HP	175	Journey Uni (v2)	195	Oxford (ctd)
321	GRU	113	Unix	137	Journey Uni (v2)	136	Sigma HP	146	Sigma HP
275	Genesis	54	Triathlon PKR	62	Unix	62	Triathlon PKR	139	BalanSys Uni Fixed
260	Unix	48	Repicci II	40	Endo-Model Sled	43	Endo-Model Sled	44	Triathlon PKR
121	Preservation Mobile	46	GRU	40	Triathlon PKR	27	Journey Uni All Poly	35	Genus
101	Endo-Model Sled	40	Journey Uni (v2)	17	GMK-UNI	25	Repicci II	29	GMK-UNI
10 Most Used									
3950	(10) 96.1%	2421	(10) 94.7%	2971	(10) 97.2%	3578	(10) 98.0%	3694	(10) 98.0%
Remainder									
159	(7) 3.9%	136	(10) 5.3%	86	(8) 2.8%	74	(8) 2.0%	75	(7) 2.0%
TOTAL									
4109	(17) 100.0%	2557	(20) 100.0%	3057	(18) 100.0%	3652	(18) 100.0%	3769	(17) 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	18 Yrs
Allegretto Uni	Allegretto Uni*	370	2035	3.2 (2.5, 4.0)	6.0 (5.0, 7.1)	8.3 (7.2, 9.6)	14.7 (13.2, 16.4)	21.5 (19.4, 23.7)	26.2 (23.2, 29.6)
Allegretto Uni	ZUK	11	233	1.0 (0.2, 3.9)	4.5 (2.3, 9.0)	7.1 (3.6, 13.5)			
BalanSys Uni	BalanSys Uni Fixed	30	539	2.0 (1.0, 3.8)	3.5 (2.1, 5.8)	4.4 (2.8, 6.9)	8.5 (5.8, 12.5)		
Endo-Model Sled	Endo-Model Sled	187	1292	1.3 (0.8, 2.1)	5.2 (4.1, 6.6)	7.8 (6.4, 9.5)	14.7 (12.6, 17.1)	23.2 (19.7, 27.2)	
Freedom PKR/Active	Freedom PKR/Active*	383	1505	1.7 (1.1, 2.5)	7.9 (6.6, 9.4)	13.6 (11.9, 15.4)	26.9 (24.5, 29.5)		
GRU	GRU	298	2075	1.4 (1.0, 2.0)	4.6 (3.8, 5.6)	6.3 (5.3, 7.5)	13.4 (11.9, 15.1)	20.8 (18.3, 23.5)	
Genesis	Genesis*	347	1864	2.7 (2.0, 3.5)	8.3 (7.1, 9.6)	11.0 (9.6, 12.5)	16.6 (14.9, 18.4)	23.0 (20.7, 25.6)	
Journey Uni	Journey Uni (v2)	23	696	2.8 (1.8, 4.6)	4.6 (3.0, 7.0)	4.6 (3.0, 7.0)			
Journey Uni	Journey Uni All Poly	24	291	1.1 (0.4, 3.3)	7.1 (4.5, 11.0)	8.9 (5.9, 13.3)			
M/G	M/G*	310	2135	1.6 (1.1, 2.2)	4.2 (3.4, 5.1)	6.4 (5.5, 7.6)	10.9 (9.6, 12.3)	17.1 (15.3, 19.1)	
Oxford (cless)	Oxford (cless)	348	5884	2.9 (2.5, 3.4)	4.8 (4.2, 5.4)	6.2 (5.5, 6.9)	12.2 (10.3, 14.4)		
Oxford (cless)	Oxford (ctd)	34	433	3.6 (2.2, 5.8)	6.4 (4.3, 9.4)	11.3 (7.6, 16.5)			
Oxford (ctd)	Oxford (ctd)	2154	13166	2.2 (1.9, 2.4)	5.8 (5.4, 6.2)	8.3 (7.8, 8.8)	14.8 (14.2, 15.5)	22.7 (21.8, 23.7)	28.2 (26.6, 29.9)
Preservation	Preservation Fixed*	431	2318	2.5 (1.9, 3.2)	7.1 (6.1, 8.2)	9.5 (8.4, 10.8)	15.6 (14.1, 17.2)	22.4 (20.4, 24.5)	
Preservation	Preservation Mobile*	139	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)	36.4 (31.7, 41.7)	
Repicci II	Repicci II	695	3090	1.7 (1.3, 2.2)	4.7 (4.0, 5.6)	7.9 (7.0, 9.0)	18.2 (16.8, 19.7)	29.4 (27.4, 31.5)	
Restoris MCK	Restoris MCK	47	2921	1.5 (1.1, 2.0)	2.5 (1.8, 3.5)				
Sigma HP	Sigma HP	41	1140	0.9 (0.5, 1.7)	2.9 (2.0, 4.2)	4.8 (3.5, 6.6)	5.9 (4.2, 8.3)		
Triathlon PKR	Triathlon PKR	20	330	2.6 (1.3, 5.2)	6.6 (4.1, 10.5)	7.5 (4.7, 12.0)			
Uniglide	Uniglide*	156	754	4.8 (3.5, 6.6)	10.6 (8.6, 13.1)	12.9 (10.6, 15.5)	19.9 (17.1, 23.1)		
Unix	Unix*	477	3883	2.4 (2.0, 3.0)	5.3 (4.6, 6.0)	6.9 (6.2, 7.8)	11.8 (10.8, 13.0)	18.0 (16.2, 20.0)	
ZUK	ZUK	391	7736	1.4 (1.2, 1.7)	3.6 (3.2, 4.1)	4.9 (4.3, 5.5)	8.7 (7.8, 9.7)		
Other (38)		359	1908	3.8 (3.1, 4.8)	8.9 (7.7, 10.3)	11.4 (10.0, 13.0)	19.4 (17.5, 21.5)	26.8 (24.0, 29.9)	
TOTAL		**7275**	**56628**						

Note: Only combinations with over 200 procedures have been listed
 * denotes prosthesis combination with no reported use in unicompartmental knee replacement in 2018

OUTCOME FOR OSTEOARTHRITIS

The Registry has recorded 7,193 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 7.9% at 5 years and 27.3% at 18 years (Table KP7 and Figure KP5).

The main reasons for revision are loosening (38.4%), progression of disease (33.5%) and pain (8.1%) (Table KP8 and Figure KP6). The main type of revision is a total knee replacement (87.5%) (Table KP9).

Patient characteristics

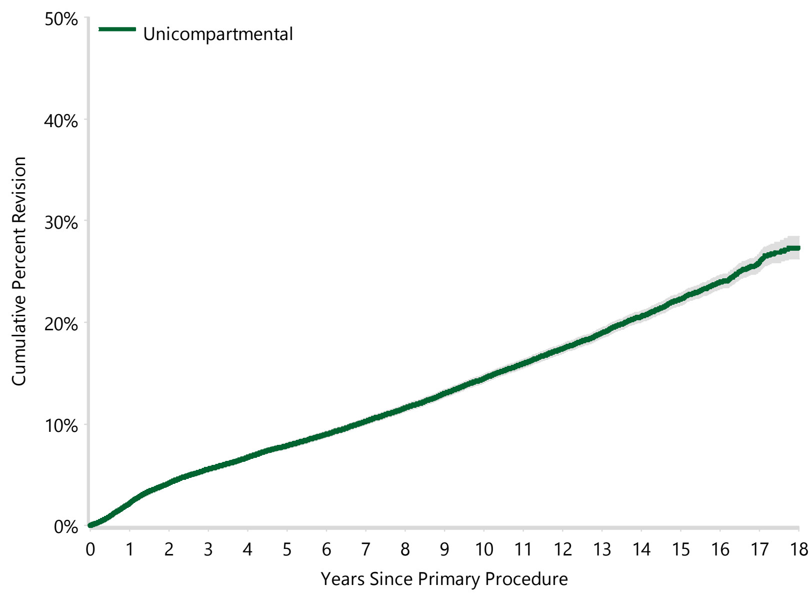
Age is a major factor affecting the outcome of primary unicompartmental knee replacement, with the rate of revision decreasing with increasing age (Table KP10 and Figure KP7).

Females have a higher rate of revision (Figure KP8). The effect of age on the rate of revision is evident in both males and females (Table KP11).

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	18 Yrs
Unicompartmental	7193	56068	2.2 (2.1, 2.3)	5.5 (5.3, 5.7)	7.9 (7.6, 8.1)	14.4 (14.1, 14.8)	22.3 (21.7, 22.8)	27.3 (26.2, 28.4)
TOTAL	**7193**	**56068**						

Figure KP5 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	18 Yrs
Unicompartmental	56068	50982	42152	35796	20546	5489	249

Table KP8 Primary Unicompartmental Knee Replacement by Reason for Revision (Primary Diagnosis OA)

Reason for Revision	Number	Percent
Loosening	2765	38.4
Progression Of Disease	2413	33.5
Pain	583	8.1
Infection	271	3.8
Lysis	197	2.7
Fracture	157	2.2
Bearing Dislocation	147	2.0
Wear Tibial Insert	119	1.7
Instability	84	1.2
Malalignment	76	1.1
Wear Tibial	51	0.7
Patellofemoral Pain	47	0.7
Implant Breakage Tibial	46	0.6
Other (15)	237	3.3
TOTAL	**7193**	**100.0**

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

Type of Revision	Number	Percent
TKR (Tibial/Femoral)	6291	87.5
Uni Insert Only	434	6.0
Uni Tibial Component	218	3.0
Uni Femoral Component	76	1.1
UKR (Uni Tibial/Uni Femoral)	75	1.0
Cement Spacer	53	0.7
Patella/Trochlear Resurfacing	18	0.3
Removal of Prostheses	8	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
Insert Only	1	0.0
TOTAL	**7193**	**100.0**

Note: *Bicompartmental Component

Figure KP6 Cumulative Incidence Revision Diagnosis of Primary Unicompartmental Knee Replacement (Primary Diagnosis OA)

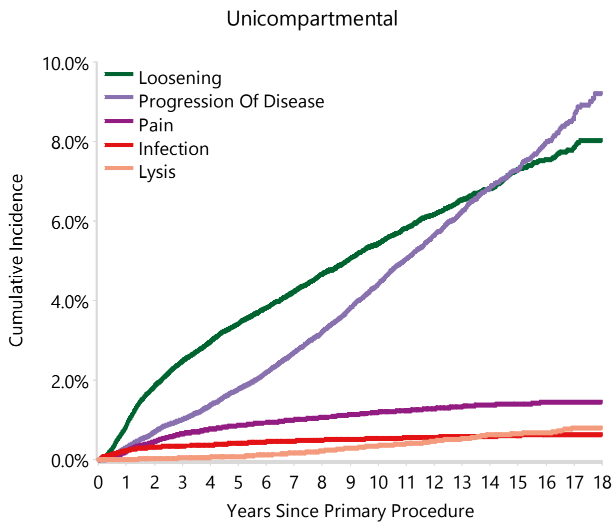
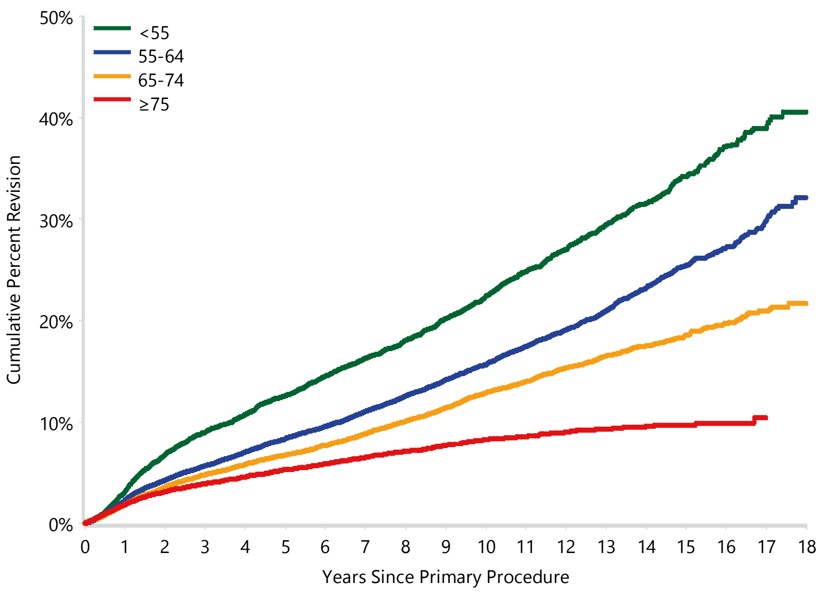


Table KP10 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement by Age (Primary Diagnosis OA)

Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
<55	1690	7916	3.2 (2.8, 3.6)	9.0 (8.3, 9.7)	12.6 (11.8, 13.4)	22.4 (21.3, 23.5)	34.2 (32.6, 35.8)	40.6 (38.1, 43.1)
55-64	2813	18853	2.3 (2.1, 2.6)	5.7 (5.4, 6.1)	8.4 (7.9, 8.8)	15.6 (15.0, 16.2)	25.4 (24.4, 26.4)	32.1 (30.1, 34.2)
65-74	2004	18517	1.9 (1.7, 2.1)	4.8 (4.5, 5.2)	6.7 (6.3, 7.1)	12.8 (12.3, 13.5)	18.6 (17.7, 19.5)	21.7 (20.3, 23.2)
≥75	686	10782	1.8 (1.6, 2.1)	3.9 (3.5, 4.3)	5.3 (4.9, 5.8)	8.3 (7.6, 8.9)	9.7 (8.9, 10.5)	
TOTAL	**7193**	**56068**						

Figure KP7 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement by Age (Primary Diagnosis OA)



HR - adjusted for gender

<55 vs ≥75
- 0 - 6Mth: HR=1.37 (1.06, 1.78),p=0.017
- 6Mth - 2Yr: HR=2.45 (2.12, 2.83),p<0.001
- 2Yr - 2.5Yr: HR=3.03 (2.31, 3.96),p<0.001
- 2.5Yr - 4.5Yr: HR=2.85 (2.37, 3.42),p<0.001
- 4.5Yr - 5Yr: HR=2.32 (1.61, 3.34),p<0.001
- 5Yr - 10Yr: HR=3.77 (3.17, 4.48),p<0.001
- 10Yr - 12.5Yr: HR=6.14 (4.70, 8.03),p<0.001
- 12.5Yr+: HR=15.40 (7.58, 31.29),p<0.001

55-64 vs ≥75
- 0 - 6Mth: HR=1.10 (0.88, 1.36),p=0.401
- 6Mth - 2Yr: HR=1.47 (1.28, 1.68),p<0.001
- 2Yr - 5Yr: HR=1.91 (1.64, 2.22),p<0.001
- 5Yr - 10Yr: HR=2.65 (2.26, 3.12),p<0.001
- 10Yr - 12.5Yr: HR=4.22 (3.28, 5.43),p<0.001
- 12.5Yr+: HR=12.39 (6.15, 24.96),p<0.001

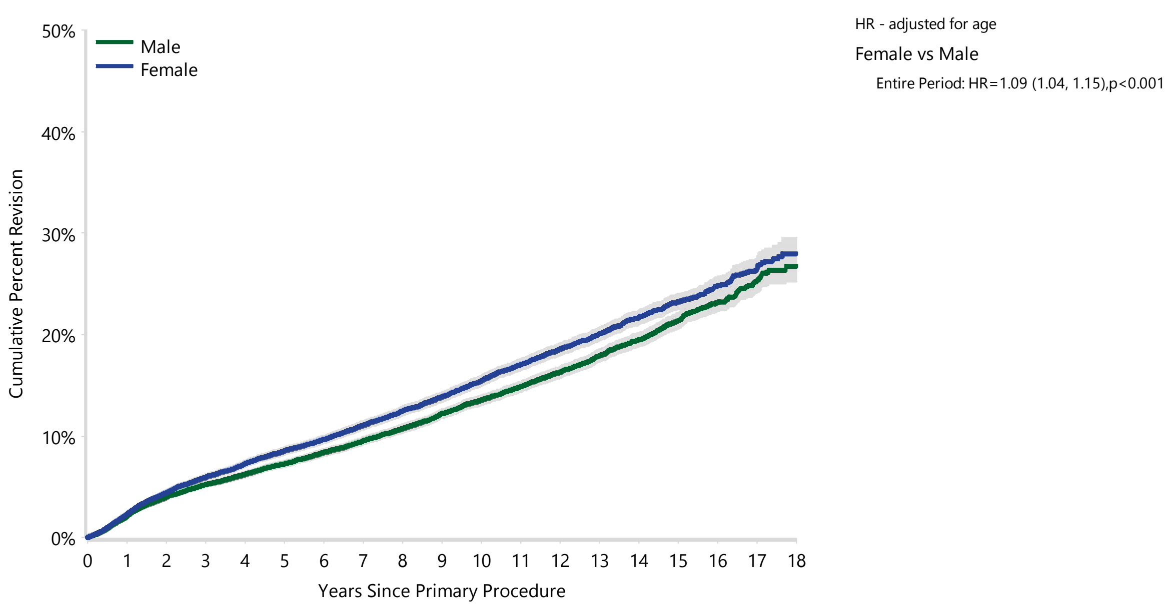
65-74 vs ≥75
- 0 - 1.5Yr: HR=1.09 (0.95, 1.26),p=0.218
- 1.5Yr - 5Yr: HR=1.45 (1.26, 1.67),p<0.001
- 5Yr - 9Yr: HR=2.09 (1.75, 2.49),p<0.001
- 9Yr - 12.5Yr: HR=2.67 (2.15, 3.31),p<0.001
- 12.5Yr - 13Yr: HR=8.34 (3.77, 18.44),p<0.001
- 13Yr+: HR=5.62 (2.74, 11.53),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
<55	7916	7200	5908	5050	2971	843	45
55-64	18853	17226	14458	12377	7427	2064	87
65-74	18517	16786	13694	11653	6807	1960	98
≥75	10782	9770	8092	6716	3341	622	19

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	18 Yrs
Male		**3498**	**30022**	**2.1 (1.9, 2.3)**	**5.2 (5.0, 5.5)**	**7.3 (6.9, 7.6)**	**13.5 (13.0, 14.0)**	**21.4 (20.6, 22.2)**	**26.7 (25.2, 28.4)**
	<55	745	3561	3.3 (2.7, 3.9)	9.0 (8.1, 10.0)	12.2 (11.1, 13.4)	22.0 (20.5, 23.7)	35.7 (33.2, 38.4)	
	55-64	1447	10202	2.3 (2.0, 2.6)	5.6 (5.1, 6.1)	8.2 (7.6, 8.8)	15.4 (14.6, 16.3)	24.8 (23.5, 26.2)	32.4 (29.6, 35.4)
	65-74	980	10456	1.7 (1.4, 1.9)	4.4 (4.0, 4.8)	5.9 (5.4, 6.4)	11.4 (10.6, 12.2)	16.8 (15.7, 18.0)	19.6 (17.9, 21.5)
	≥75	326	5803	1.7 (1.4, 2.1)	3.7 (3.2, 4.2)	4.8 (4.2, 5.5)	7.6 (6.8, 8.5)	9.0 (7.9, 10.3)	
Female		**3695**	**26046**	**2.3 (2.1, 2.5)**	**5.9 (5.6, 6.2)**	**8.5 (8.2, 8.9)**	**15.4 (14.9, 15.9)**	**23.2 (22.4, 24.0)**	**28.0 (26.5, 29.5)**
	<55	945	4355	3.1 (2.6, 3.7)	9.0 (8.1, 9.9)	12.9 (11.9, 14.0)	22.6 (21.2, 24.1)	33.1 (31.1, 35.2)	
	55-64	1366	8651	2.3 (2.0, 2.7)	5.9 (5.4, 6.4)	8.5 (7.9, 9.2)	15.8 (15.0, 16.8)	26.0 (24.6, 27.5)	
	65-74	1024	8061	2.1 (1.8, 2.4)	5.4 (4.9, 5.9)	7.8 (7.2, 8.4)	14.6 (13.7, 15.6)	20.7 (19.4, 22.0)	24.0 (21.8, 26.3)
	≥75	360	4979	2.0 (1.6, 2.4)	4.2 (3.6, 4.8)	5.8 (5.2, 6.6)	9.0 (8.1, 9.9)	10.4 (9.3, 11.6)	
TOTAL		**7193**	**56068**						

Figure KP8 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	18 Yrs
Male	30022	27157	22149	18599	10241	2743	124
Female	26046	23825	20003	17197	10305	2746	125

OUTCOME BY PROSTHESIS CHARACTERISTICS

Fixation

Most unicompartmental knee replacements use cement fixation (80.6%), a smaller number use cementless fixation (17.8%) 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 1.5 years there is a lower rate of revision. Both cementless and cement fixation (for the first 4.5 years) have lower rates of revision compared to hybrid fixation (Table KP12 and Figure KP9).

The Oxford unicompartmental knee accounts for 57.8% 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 KP10).

Bearing Mobility

Fixed bearings are used in 63.0% of unicompartmental knee replacements, while in 36.9% 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 KP11).

Robotic Assisted

There have been 3,068 robotically assisted unicompartmental knee replacement procedures recorded by the Registry since 2015. In 2018, 31.8% of unicompartmental knees used robotic assistance. There are only 4 unicompartmental combinations that have used robotic assistance.

Unicompartmental knee procedures using robotic assistance have a lower rate of revision between 9 months and 1.5 years compared to unicompartmental procedures without robotic assistance (Table KP15 and Figure KP12). When using robotic assistance there are fewer revisions for loosening, progression of disease, fracture and pain, but more revisions for infection (Table KP16 and Figure KP13).

Position

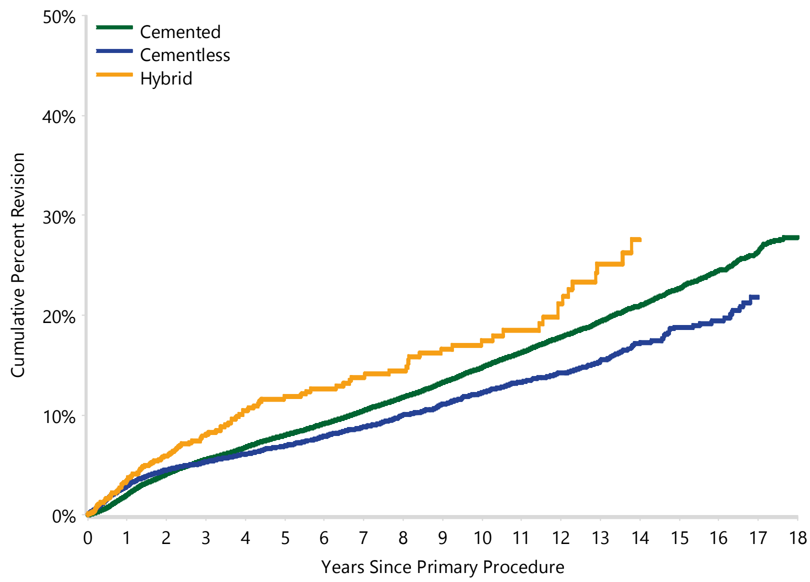
The Registry has recorded 2,242 lateral unicompartmental knee procedures undertaken for osteoarthritis. There is no difference in the rate of revision when lateral unicompartmental knee replacement is compared to medial unicompartmental knee replacement (Table KP17 and Figure KP14). The most common reason 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 KP15).

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	18 Yrs
Cemented	6183	45194	2.0 (1.9, 2.1)	5.5 (5.3, 5.8)	8.0 (7.7, 8.2)	14.7 (14.3, 15.1)	22.7 (22.1, 23.3)	27.8 (26.7, 28.9)
Cementless	900	10005	2.9 (2.6, 3.3)	5.3 (4.9, 5.8)	6.9 (6.4, 7.5)	12.2 (11.4, 13.1)	18.8 (17.2, 20.5)	
Hybrid	110	869	3.5 (2.4, 4.9)	8.1 (6.4, 10.3)	11.8 (9.5, 14.6)	17.4 (14.2, 21.3)		
TOTAL	**7193**	**56068**						

Figure KP9 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 (0.31, 0.54),p<0.001
- 3Mth - 6Mth: HR=0.56 (0.44, 0.72),p<0.001
- 6Mth - 1.5Yr: HR=1.13 (0.98, 1.31),p=0.087
- 1.5Yr - 2Yr: HR=1.42 (1.08, 1.87),p=0.012
- 2Yr+: HR=1.50 (1.37, 1.64),p<0.001

Hybrid vs Cementless
- Entire Period: HR=1.48 (1.21, 1.80),p<0.001

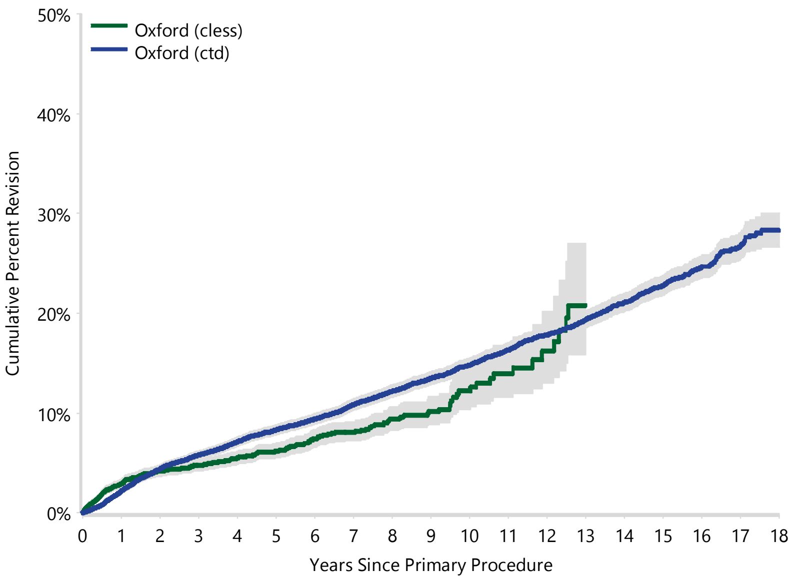
Hybrid vs Cemented
- 0 - 4.5Yr: HR=1.44 (1.15, 1.80),p=0.001
- 4.5Yr - 8Yr: HR=0.60 (0.32, 1.12),p=0.110
- 8Yr+: HR=1.11 (0.72, 1.70),p=0.638

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Cemented	45194	41279	34658	30086	18139	4945	226
Cementless	10005	8921	6963	5360	2230	517	21
Hybrid	869	782	531	350	177	27	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	18 Yrs
Oxford (cless)	346	5837	2.9 (2.5, 3.4)	4.8 (4.2, 5.4)	6.2 (5.5, 6.9)	12.2 (10.3, 14.4)		
Oxford (ctd)	2129	13010	2.2 (1.9, 2.4)	5.8 (5.4, 6.2)	8.3 (7.8, 8.8)	14.8 (14.1, 15.5)	22.8 (21.8, 23.8)	28.3 (26.7, 30.0)
TOTAL	**2475**	**18847**						

Figure KP10 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=0.41 (0.31, 0.54),p<0.001

6Mth - 1.5Yr: HR=1.41 (1.12, 1.76),p=0.003

1.5Yr - 7Yr: HR=1.86 (1.52, 2.27),p<0.001

7Yr+: HR=1.00 (0.71, 1.41),p=0.992

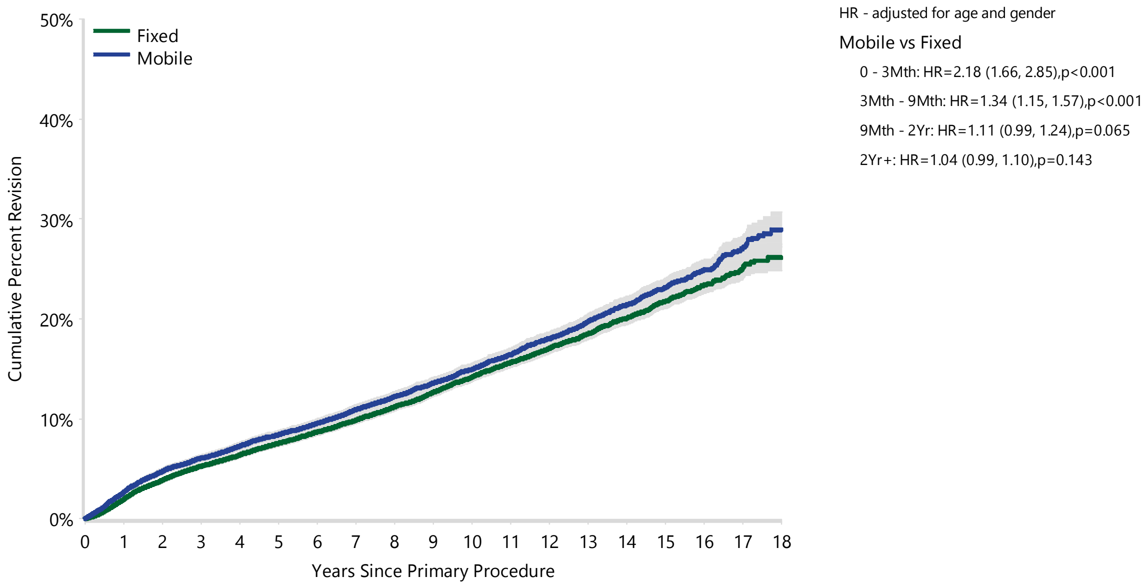
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Oxford (cless)	5837	4905	3196	1907	235	0	0
Oxford (ctd)	13010	12509	11388	10196	6456	2144	127

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	18 Yrs
Fixed	4338	35341	1.9 (1.8, 2.1)	5.2 (5.0, 5.5)	7.5 (7.2, 7.8)	14.1 (13.7, 14.6)	21.7 (21.0, 22.5)	26.1 (24.8, 27.5)
Mobile	2850	20693	2.6 (2.4, 2.9)	6.0 (5.7, 6.4)	8.4 (8.0, 8.8)	14.9 (14.4, 15.5)	23.1 (22.2, 24.0)	28.9 (27.2, 30.7)
TOTAL	**7188**	**56034**						

Note: Excludes 34 primary unicompartmental knee procedures with unknown/missing mobility

Figure KP11 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement by Mobility (Primary Diagnosis OA)

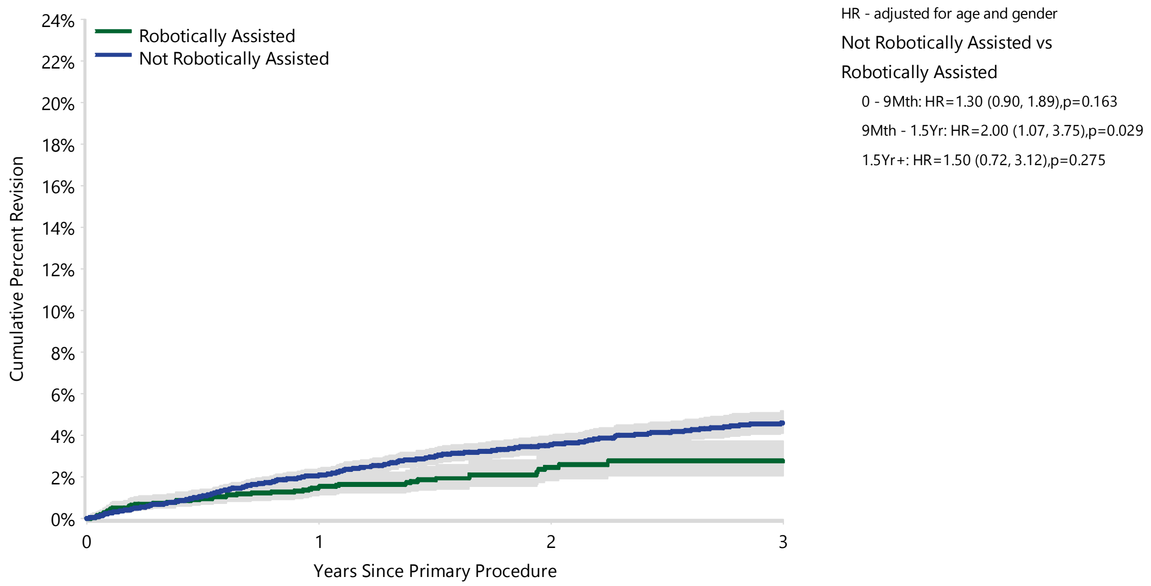


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Fixed	35341	31838	26166	22517	13075	3160	114
Mobile	20693	19114	15959	13255	7454	2325	135

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
Robotically Assisted	53	3068	1.5 (1.1, 2.1)	2.5 (1.8, 3.3)	2.8 (2.0, 3.7)
Not Robotically Assisted	317	9859	2.1 (1.8, 2.4)	3.6 (3.1, 4.0)	4.6 (4.1, 5.2)
TOTAL	**370**	**12927**			

Figure KP12 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
Robotically Assisted	3068	1850	785	170
Not Robotically Assisted	9859	7149	4529	2207

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	13	0.4	24.5	122	1.2	38.5
Progression Of Disease	9	0.3	17.0	68	0.7	21.5
Fracture	1	0.0	1.9	26	0.3	8.2
Bearing Dislocation				25	0.3	7.9
Infection	19	0.6	35.8	25	0.3	7.9
Pain	3	0.1	5.7	16	0.2	5.0
Malalignment	2	0.1	3.8	9	0.1	2.8
Instability	3	0.1	5.7	8	0.1	2.5
Incorrect Sizing				3	0.0	0.9
Prosthesis Dislocation				3	0.0	0.9
Lysis				2	0.0	0.6
Patellofemoral Pain	1	0.0	1.9	2	0.0	0.6
Implant Breakage Tibial				1	0.0	0.3
Metal Related Pathology				1	0.0	0.3
Osteonecrosis				1	0.0	0.3
Synovitis				1	0.0	0.3
Wear Tibial Insert				1	0.0	0.3
Other	2	0.1	3.8	3	0.0	0.9
N Revision	**53**	**1.7**	**100.0**	**317**	**3.2**	**100.0**
N Primary	**3068**			**9859**		

Note: This table is restricted to revisions within 3.8 years for all groups to allow a time-matched comparison of revisions

Figure KP13 Cumulative Incidence Primary Unicompartmental Knee Replacement since 2015 by Robotic Assistance (Primary Diagnosis OA)

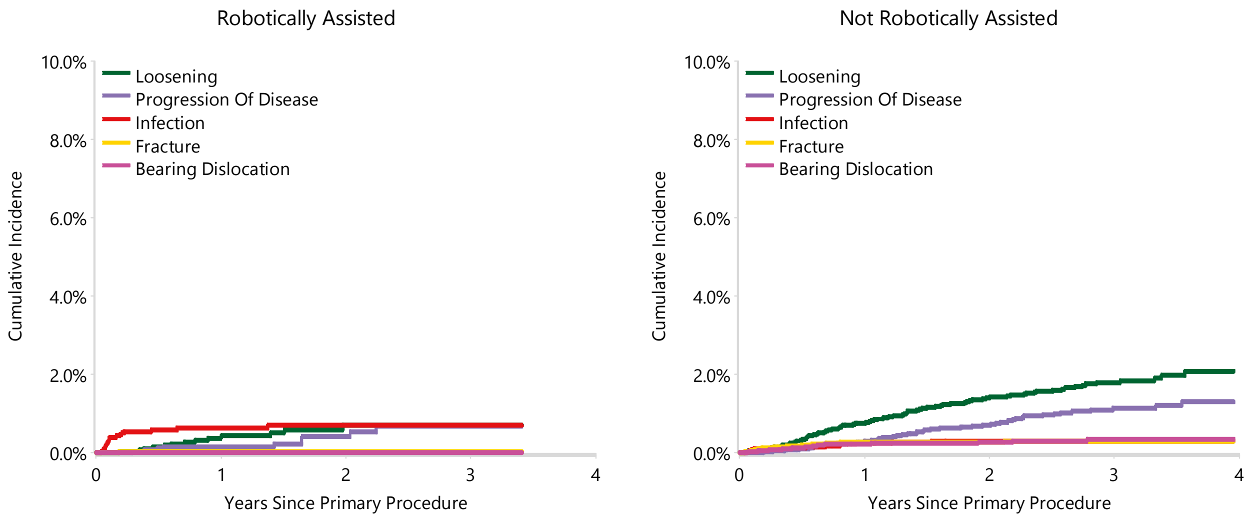
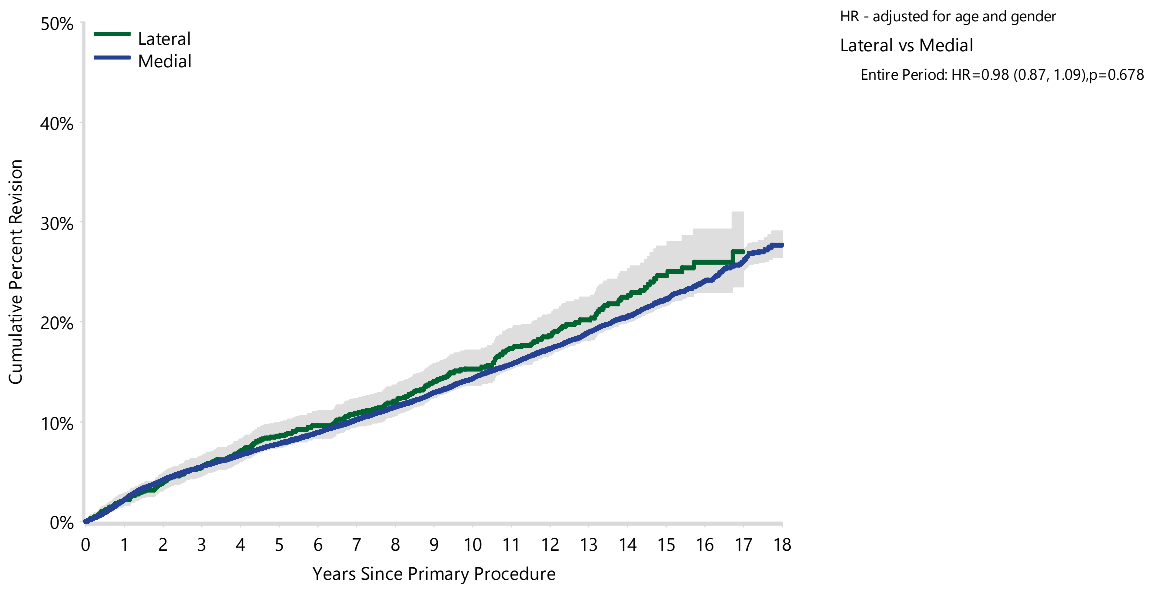


Table KP17 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement by Position (Primary Diagnosis OA)

Position	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Lateral	325	2242	2.2 (1.6, 2.9)	5.5 (4.6, 6.5)	8.6 (7.4, 9.9)	15.3 (13.6, 17.2)	24.6 (21.9, 27.6)	
Medial	6251	50411	2.2 (2.0, 2.3)	5.5 (5.3, 5.7)	7.8 (7.5, 8.0)	14.3 (13.9, 14.7)	22.2 (21.6, 22.9)	27.7 (26.4, 29.0)
TOTAL	**6576**	**52653**						

Note: Excludes 3,415 primary unicompartmental knee procedures with unknown/missing position

Figure KP14 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	18 Yrs
Lateral	2242	2067	1752	1492	926	214	14
Medial	50411	45625	37323	31432	17647	4275	179

Table KP18 Reason for Revision of Primary Unicompartmental Knee Replacement by Position (Primary Diagnosis OA)

Revision Diagnosis	Lateral			Medial		
	Number	% Primaries Revised	% Revisions	Number	% Primaries Revised	% Revisions
Loosening	97	4.3	29.8	2426	4.8	38.8
Progression Of Disease	160	7.1	49.2	2038	4.0	32.6
Pain	22	1.0	6.8	519	1.0	8.3
Infection	11	0.5	3.4	248	0.5	4.0
Lysis	7	0.3	2.2	166	0.3	2.7
Bearing Dislocation	5	0.2	1.5	141	0.3	2.3
Fracture	4	0.2	1.2	141	0.3	2.3
Wear Tibial Insert	4	0.2	1.2	102	0.2	1.6
Instability	4	0.2	1.2	77	0.2	1.2
Malalignment	4	0.2	1.2	65	0.1	1.0
Other	7	0.3	2.2	328	0.7	5.2
N Revision	**325**	**14.5**	**100.0**	**6251**	**12.4**	**100.0**
N Primary	**2242**			**50411**		

Figure KP15 Cumulative Incidence Revision Diagnosis of Primary Unicompartmental Knee Replacement by Position (Primary Diagnosis OA)

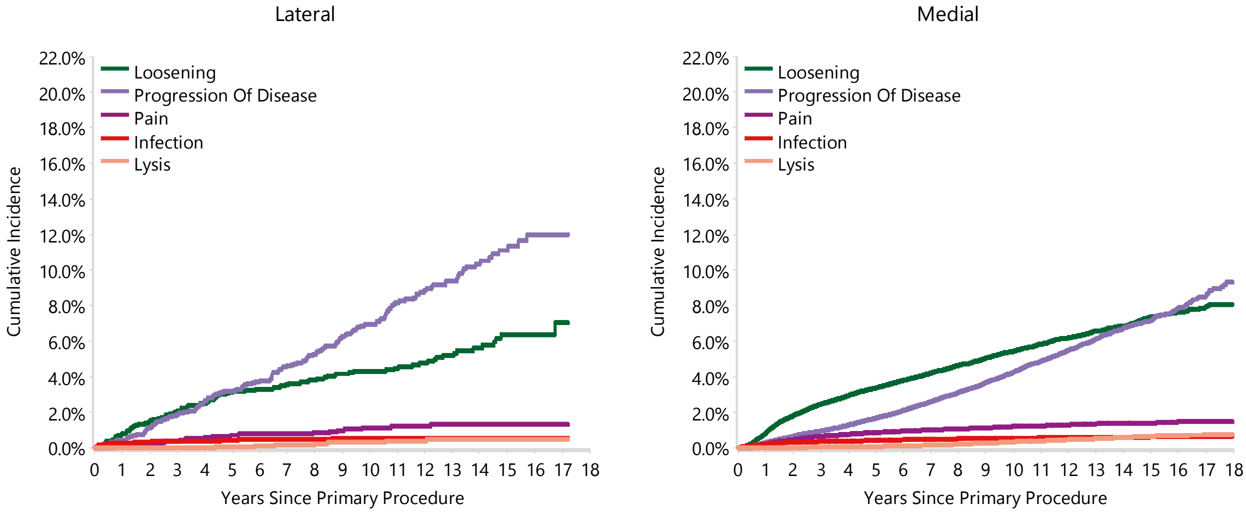


Table KP19 Cumulative Percent Revision of Lateral Primary Unicompartmental Knee Replacement by Prosthesis Combination (Primary Diagnosis OA)

Uni Femoral	Uni Tibial	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Endo-Model Sled	Endo-Model Sled	20	151	0.0 (0.0, 0.0)	4.4 (2.0, 9.5)	7.7 (4.2, 13.8)	13.9 (8.5, 22.5)		
Freedom PKR/Active	Freedom PKR/Active*	29	151	0.7 (0.1, 4.6)	6.1 (3.2, 11.3)	9.8 (5.9, 16.0)	18.5 (12.5, 26.8)		
GRU	GRU	28	194	3.1 (1.4, 6.8)	4.7 (2.5, 8.8)	6.3 (3.6, 10.8)	13.5 (9.2, 19.5)		
Genesis	Genesis*	28	133	1.5 (0.4, 5.9)	6.0 (3.1, 11.7)	9.8 (5.8, 16.4)	17.2 (11.7, 25.0)		
M/G	M/G*	10	54	1.9 (0.3, 12.4)	3.7 (0.9, 14.1)	3.7 (0.9, 14.1)	10.2 (4.3, 22.8)	23.1 (12.1, 41.5)	
Oxford (cless)	Oxford (ctd)	5	71	4.4 (1.5, 13.1)	6.7 (2.5, 17.3)	6.7 (2.5, 17.3)			
Oxford (ctd)	Oxford (ctd)	33	164	6.1 (3.3, 11.1)	8.7 (5.2, 14.3)	12.3 (8.0, 18.7)	21.3 (15.0, 29.7)		
Preservation	Preservation Fixed*	17	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	73	263	2.7 (1.3, 5.5)	7.4 (4.8, 11.3)	13.1 (9.5, 17.9)	22.0 (17.2, 27.8)	34.4 (27.9, 41.9)	
Restoris MCK	Restoris MCK	0	113	0.0 (0.0, 0.0)					
Unix	Unix*	25	185	1.1 (0.3, 4.3)	3.8 (1.8, 7.9)	7.3 (4.3, 12.3)	12.1 (7.9, 18.2)		
ZUK	ZUK	12	245	0.8 (0.2, 3.3)	2.3 (0.9, 5.4)	4.9 (2.4, 9.9)			
Other (28)		45	369	3.7 (2.2, 6.3)	7.2 (4.9, 10.5)	8.7 (6.1, 12.4)	13.6 (9.9, 18.6)		
TOTAL		**325**	**2242**						

Note: Only combinations with over 50 procedures have been listed
*denotes prosthesis combinations with no recorded use in unicompartmental knee replacement in 2018

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 characteristics 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 658,596 primary total knee replacement procedures reported to the Registry. This is an additional 56,147 procedures compared to the last report.

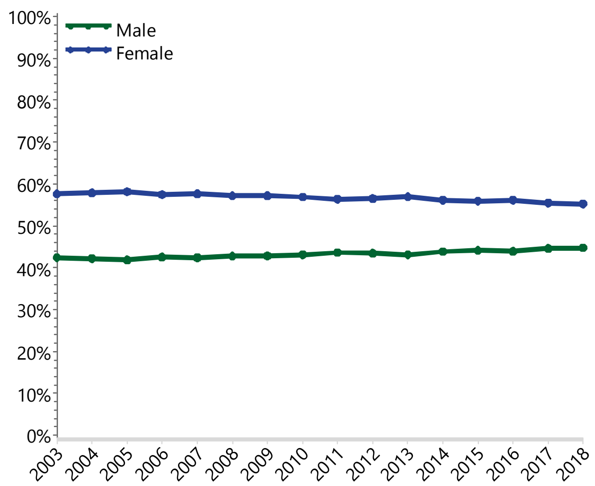
Primary total knee replacement continues to increase. In 2018, there were 1.1% more procedures than in 2017 and 156.2% more than in 2003. As a proportion of all knee replacement procedures, primary total knee replacement increased from 76.7% in 2003 to 86.2% in 2018.

Osteoarthritis is the most common diagnosis for primary total knee replacement (97.7%).

There have been 658,596 primary total knee replacement procedures reported to the Registry. This is an additional 56,147 procedures compared to the last report.

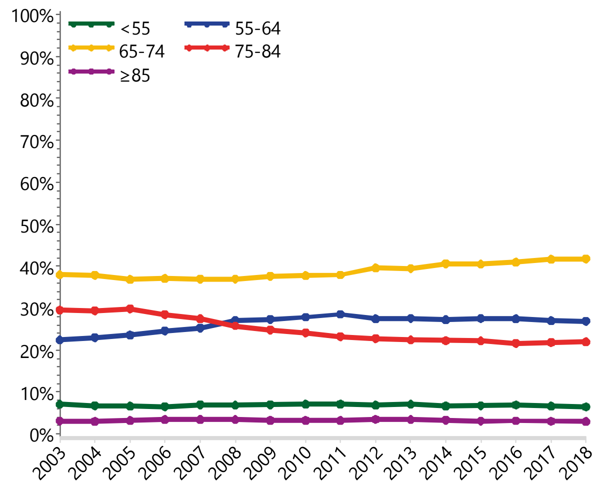
In 2018, primary total knee replacement remains more common in females (55.2%). This proportion has remained constant since 2003 (Figure KT1). The mean age of patients is 68.5 years (Table KT1).

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 21.9% in 2018. The proportion of patients aged <55 years remains small (6.5% in 2018) and there has been little change in that proportion since 2003 (Figure KT2).

Figure KT2 Primary Total Knee Replacement by Age



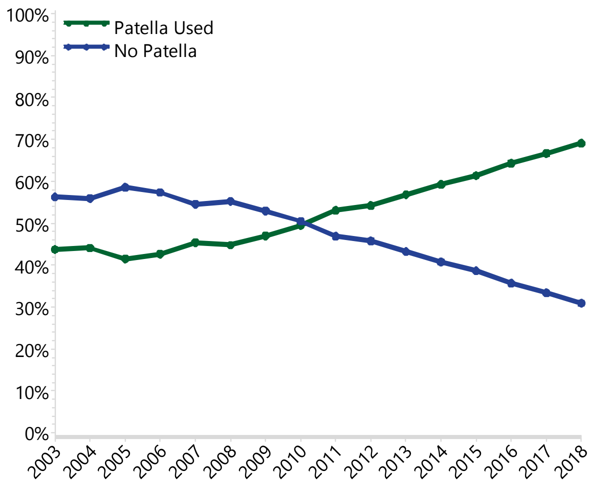
Detailed demographic information on primary total knee replacement is available in the supplementary report 'Demographics of Hip, Knee and Shoulder Arthroplasty' on the AOANJRR website:
https://aoanjrr.sahmri.com/annual-reports-2019

Table KT1 Age and Gender of Primary Total Knee Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	286101	43.4%	8	101	68	68.1	9.1
Female	372495	56.6%	8	103	69	68.8	9.4
TOTAL	**658596**	**100.0%**	**8**	**103**	**69**	**68.5**	**9.3**

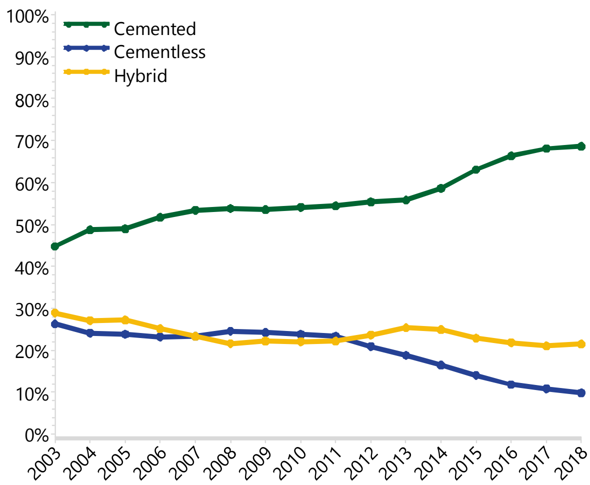
Patella resurfacing at the time of the primary total knee replacement continues to increase from a low of 41.5% in 2005 to 69.1% in 2018 (Figure KT3).

Figure KT3 **Primary Total Knee Replacement by Patella Usage**



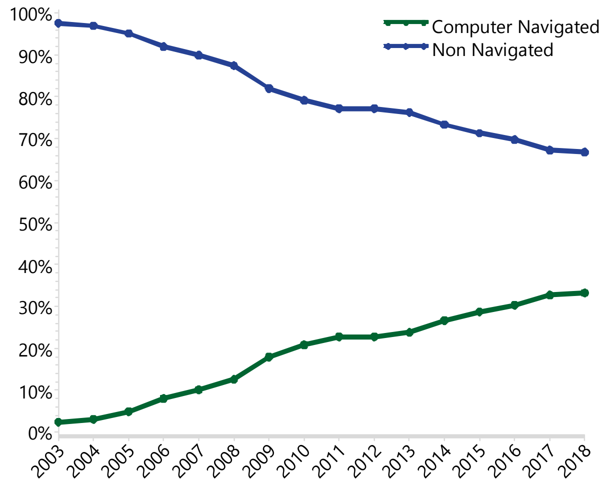
The most common method of fixation is cementing both femoral and tibial components. This has increased from 44.8% in 2003 to 68.6% in 2018. The use of cementless fixation continues to decrease from a peak of 26.3% in 2003 to 9.9% in 2018 (Figure KT4).

Figure KT4 **Primary Total Knee Replacement by Fixation**



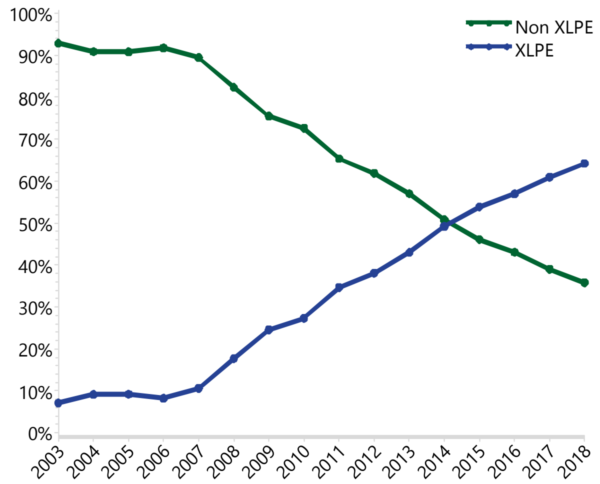
The proportion of primary total knee replacement procedures inserted with computer navigation has increased from 2.4% in 2003 to 33.2% in 2018 (Figure KT5).

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 64.2% in 2018 (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 2018, the most commonly used femoral prostheses were the Triathlon CR (22.0%), Nexgen CR Flex (10.3%) and Persona (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		2015		2016		2017		2018	
N	Model	N	Model	N	Model	N	Model	N	Model
3184	LCS CR	8717	Triathlon CR	9528	Triathlon CR	10489	Triathlon CR	12245	Triathlon CR
2846	Duracon	6345	Nexgen CR Flex	6485	Nexgen CR Flex	6636	Nexgen CR Flex	5749	Nexgen CR Flex
2150	Nexgen CR	3326	Vanguard CR	2998	Nexgen LPS Flex	3192	Attune CR	4237	Persona
1419	PFC Sigma CR	3109	Nexgen LPS Flex	2860	Vanguard CR	2643	LCS CR	3205	Attune CR
1354	Scorpio CR	2926	LCS CR	2745	LCS CR	2643	Nexgen LPS Flex	2159	Nexgen LPS Flex
1059	Genesis II CR	2218	Attune CR	2488	Attune CR	2390	Vanguard CR	2133	GMK Sphere Primary
1002	Natural Knee II	2001	Legion Oxinium PS	1957	Legion Oxinium PS	2227	Persona	2065	LCS CR
902	Nexgen LPS	1455	PFC Sigma CR	1539	GMK Sphere Primary	1748	Evolution	1934	Vanguard CR
883	Profix	1399	Genesis II CR	1481	Genesis II Oxinium PS	1582	Legion Oxinium PS	1656	Evolution
751	Scorpio PS	1392	Genesis II Oxinium PS	1454	Evolution	1534	GMK Sphere Primary	1400	Apex Knee CR
10 Most Used									
15550 (10)	71.5%	32888 (10)	64.8%	33535 (10)	63.9%	35084 (10)	63.7%	36783 (10)	66.1%
Remainder									
6185 (47)	28.5%	17874 (76)	35.2%	18980 (70)	36.1%	19973 (69)	36.3%	18893 (72)	33.9%
TOTAL									
21735 (57)	100.0%	50762 (86)	100.0%	52515 (80)	100.0%	55057 (79)	100.0%	55676 (82)	100.0%

Table KT3 10 Most Used Femoral Prostheses in Cemented Primary Total Knee Replacement

2003		2015		2016		2017		2018	
N	Model	N	Model	N	Model	N	Model	N	Model
1213	Duracon	4673	Triathlon CR	5399	Triathlon CR	6018	Triathlon CR	6649	Triathlon CR
948	LCS CR	2746	Nexgen CR Flex	3247	Nexgen CR Flex	3419	Nexgen CR Flex	3117	Attune CR
824	Nexgen LPS	2746	Nexgen LPS Flex	2679	Nexgen LPS Flex	3172	Attune CR	3053	Persona
761	Nexgen CR	2218	Attune CR	2487	Attune CR	2326	Nexgen LPS Flex	2926	Nexgen CR Flex
690	Nexgen LPS Flex	2001	Legion Oxinium PS	1957	Legion Oxinium PS	1930	Persona	2133	GMK Sphere Primary
642	Genesis II CR	1391	Genesis II Oxinium PS	1538	GMK Sphere Primary	1741	Evolution	1890	Nexgen LPS Flex
495	Profix	1329	Vanguard CR	1481	Genesis II Oxinium PS	1581	Legion Oxinium PS	1616	Evolution
471	Genesis II Oxinium CR	1189	Genesis II PS	1454	Evolution	1534	GMK Sphere Primary	1377	Legion Oxinium PS
471	PFC Sigma PS	1133	GMK Sphere Primary	1147	Vanguard CR	1428	Genesis II Oxinium PS	1338	Attune PS
419	Genesis II PS	1089	Evolution	1048	Attune PS	1351	Attune PS	1333	Genesis II Oxinium PS
10 Most Used									
6934 (10)	71.3%	20515 (10)	64.1%	22437 (10)	64.4%	24500 (10)	65.3%	25432 (10)	66.6%
Remainder									
2795 (41)	28.7%	11499 (73)	35.9%	12377 (67)	35.6%	12996 (68)	34.7%	12770 (69)	33.4%
TOTAL									
9729 (51)	100.0%	32014 (83)	100.0%	34814 (77)	100.0%	37496 (78)	100.0%	38202 (79)	100.0%

Table KT4 10 Most Used Femoral Prostheses in Cementless Primary Total Knee Replacement

2003		2015		2016		2017		2018	
N	Model	N	Model	N	Model	N	Model	N	Model
1470	LCS CR	1565	Nexgen CR Flex	1363	Nexgen CR Flex	1356	Nexgen CR Flex	1611	Triathlon CR
793	Nexgen CR	1364	Triathlon CR	1254	LCS CR	1286	Triathlon CR	1172	Nexgen CR Flex
500	Natural Knee II	1266	LCS CR	1224	Triathlon CR	1174	LCS CR	841	LCS CR
487	Active Knee	405	Vanguard CR	393	Scorpio NRG CR	272	Scorpio NRG CR	219	PFC Sigma CR
476	Duracon	360	Scorpio NRG CR	286	Vanguard CR	229	PFC Sigma CR	209	Score
320	Scorpio CR	347	RBK	265	RBK	218	Nexgen LPS Flex	197	Nexgen LPS Flex
314	PFC Sigma CR	257	Score	227	Nexgen LPS Flex	205	Vanguard CR	165	GMK Primary
303	RBK	242	Nexgen LPS Flex	168	Score	200	RBK	144	RBK
187	Profix	184	PFC Sigma CR	139	GMK Primary	157	Natural Knee Flex	141	Vanguard CR
181	Scorpio PS	128	ACS	131	PFC Sigma CR	157	Score	119	Natural Knee Flex
10 Most Used									
5031	(10) 88.1%	6118	(10) 85.9%	5450	(10) 87.7%	5254	(10) 87.6%	4818	(10) 87.7%
Remainder									
681	(14) 11.9%	1002	(20) 14.1%	765	(16) 12.3%	745	(15) 12.4%	677	(18) 12.3%
TOTAL									
5712	(24) 100.0%	7120	(30) 100.0%	6215	(26) 100.0%	5999	(25) 100.0%	5495	(28) 100.0%

Table KT5 10 Most Used Femoral Prostheses in Hybrid Primary Total Knee Replacement

2003		2015		2016		2017		2018	
N	Model	N	Model	N	Model	N	Model	N	Model
1157	Duracon	2680	Triathlon CR	2905	Triathlon CR	3185	Triathlon CR	3985	Triathlon CR
766	LCS CR	2034	Nexgen CR Flex	1875	Nexgen CR Flex	1861	Nexgen CR Flex	1651	Nexgen CR Flex
764	PFC Sigma CR	1592	Vanguard CR	1427	Vanguard CR	1201	Vanguard CR	1149	Persona
737	Scorpio CR	781	LCS CR	700	LCS CR	750	LCS CR	884	Vanguard CR
596	Nexgen CR	521	Genesis II CR	523	Genesis II CR	551	Apex Knee CR	611	Apex Knee CR
364	Genesis II CR	393	Scorpio CR	450	Apex Knee CR	407	Legion CR	593	LCS CR
255	Maxim	370	Legion CR	383	PFC Sigma CR	388	Genesis II CR	545	Legion CR
247	Natural Knee II	364	PFC Sigma CR	378	BalanSys	318	BalanSys	364	BalanSys
204	AGC	324	Score	363	Scorpio CR	299	Scorpio CR	306	PFC Sigma CR
203	Scorpio PS	305	Natural Knee Flex	310	Legion CR	298	PFC Sigma CR	296	Genesis II CR
10 Most Used									
5293	(10) 84.1%	9364	(10) 80.5%	9314	(10) 81.1%	9258	(10) 80.1%	10384	(10) 86.7%
Remainder									
1001	(27) 15.9%	2264	(37) 19.5%	2172	(34) 18.9%	2304	(29) 19.9%	1595	(26) 13.3%
TOTAL									
6294	(37) 100.0%	11628	(47) 100.0%	11486	(44) 100.0%	11562	(39) 100.0%	11979	(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 9 months. After this time there is no difference (Table KT6 and Figure KT7).

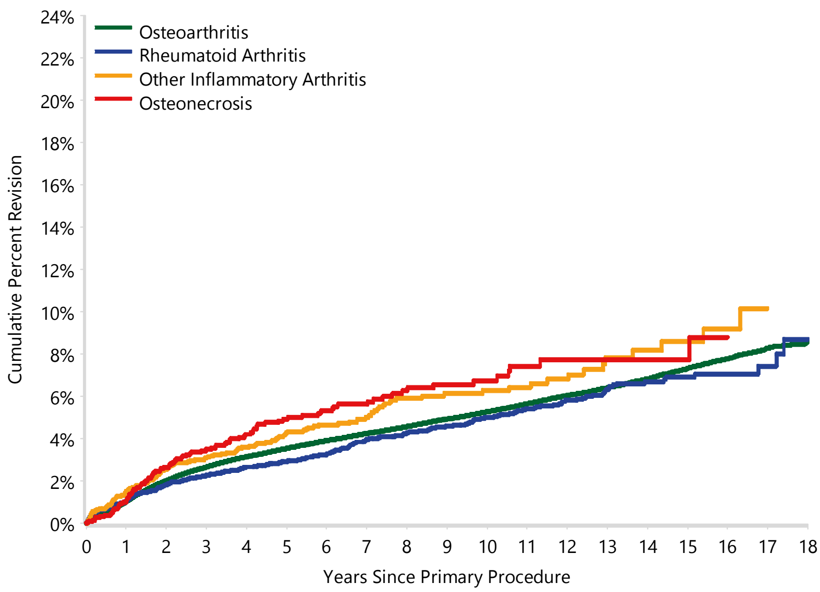
Rheumatoid arthritis has a lower rate of revision compared to osteoarthritis after 9 months.

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	18 Yrs
Osteoarthritis	24722	643201	1.0 (1.0, 1.1)	2.7 (2.6, 2.7)	3.5 (3.5, 3.6)	5.3 (5.2, 5.3)	7.3 (7.2, 7.5)	8.6 (8.3, 8.8)
Rheumatoid Arthritis	339	8528	1.1 (0.9, 1.3)	2.3 (2.0, 2.6)	2.9 (2.6, 3.3)	5.0 (4.5, 5.6)	6.9 (6.1, 7.9)	8.7 (6.8, 11.1)
Other Inflammatory Arthritis	150	3306	1.5 (1.1, 2.0)	3.1 (2.5, 3.8)	4.3 (3.6, 5.1)	6.3 (5.3, 7.5)	8.6 (6.9, 10.7)	
Osteonecrosis	103	2085	1.1 (0.7, 1.6)	3.5 (2.7, 4.5)	4.9 (4.0, 6.1)	6.7 (5.5, 8.3)	7.7 (6.2, 9.6)	
Other (5)	161	1476	3.0 (2.2, 4.1)	8.4 (6.9, 10.2)	11.9 (9.9, 14.1)	19.0 (16.0, 22.5)		
TOTAL	**25475**	**658596**						

Note: Only primary diagnoses with over 1000 procedures have been listed

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=1.37 (1.02, 1.84),p=0.035
- 3Mth - 9Mth: HR=0.75 (0.53, 1.06),p=0.100
- 9Mth - 1.5Yr: HR=0.53 (0.39, 0.72),p<0.001
- 1.5Yr+: HR=0.72 (0.63, 0.83),p<0.001

Other Inflammatory Arthritis vs Osteoarthritis
- 0 - 9Mth: HR=1.50 (1.10, 2.05),p=0.010
- 9Mth - 1.5Yr: HR=0.71 (0.45, 1.11),p=0.134
- 1.5Yr+: HR=1.05 (0.85, 1.29),p=0.654

Osteonecrosis vs Osteoarthritis
- Entire Period: HR=1.33 (1.10, 1.62),p=0.003

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Osteoarthritis	643201	578190	454630	345647	137800	27725	1527
Rheumatoid Arthritis	8528	7824	6558	5287	2593	721	56
Other Inflammatory Arthritis	3306	2919	2263	1689	662	178	16
Osteonecrosis	2085	1880	1468	1089	449	88	3

PROSTHESIS TYPES

There have been 554 femoral and tibial prosthesis combinations used in primary total knee replacement reported to the Registry. In 2018, 193 femoral and tibial combinations were used. This is one less combination than in 2017.

The cumulative percent revision of the 148 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 96.7% of all primary total knee replacement procedures. The other group is the combined outcome of the remaining 406 prosthesis combinations with less than 400 procedures reported per combination.

There are 66 cemented femoral and tibial prosthesis combinations with more than 400 procedures. Of those combinations with an 18 year cumulative percent revision, the Nexgen CR/Nexgen is the lowest at 5.9% (Table KT7).

There are 38 cementless femoral and tibial prosthesis combinations with more than 400 procedures. Of those combinations with an 18 year cumulative percent revision, the Nexgen CR/Nexgen is the lowest at 5.1% (Table KT8).

There have been 554 different femoral and tibial prosthesis combinations reported to the Registry. Outcomes at 18 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 and Scorpio CR/Series 7000 have the lowest 18 year cumulative percent revision (6.4%) (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	18 Yrs
ACS	ACS Fixed	15	612	1.4 (0.7, 2.9)	2.5 (1.4, 4.4)	3.7 (2.2, 6.3)			
ACS	ACS Mobile	19	816	0.8 (0.3, 1.7)	1.9 (1.1, 3.4)	4.5 (2.6, 7.6)			
AGC	AGC	220	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)	8.6 (7.4, 9.9)	9.9 (8.2, 11.8)
Active Knee	Active Knee	69	2403	1.0 (0.6, 1.5)	2.4 (1.8, 3.2)	3.4 (2.6, 4.5)	4.6 (3.5, 5.9)		
Advance	Advance II	63	918	1.5 (0.9, 2.6)	4.4 (3.3, 6.0)	5.1 (3.9, 6.8)	7.4 (5.7, 9.6)	8.3 (6.3, 10.9)	
Anatomic	Anatomic	3	551	0.4 (0.1, 1.6)					
Apex Knee CR	Apex Knee	15	2437	0.3 (0.1, 0.6)	1.0 (0.5, 1.8)	2.3 (1.1, 5.0)			
Apex Knee PS	Apex Knee	57	3180	0.9 (0.6, 1.3)	2.4 (1.9, 3.2)	2.5 (1.9, 3.3)			
Attune CR	Attune	171	11993	0.8 (0.7, 1.0)	2.1 (1.8, 2.5)	2.3 (1.9, 2.7)			
Attune PS	Attune	69	5386	0.7 (0.5, 1.0)	1.7 (1.3, 2.2)	2.3 (1.6, 3.3)			
BalanSys	BalanSys	41	1921	0.4 (0.2, 0.8)	1.4 (0.9, 2.1)	1.8 (1.2, 2.6)	4.3 (2.9, 6.4)	6.8 (4.1, 10.9)	
Columbus	Columbus	17	1431	0.6 (0.3, 1.2)	2.4 (1.4, 4.1)	2.4 (1.4, 4.1)	3.0 (1.7, 5.4)		
Duracon	Duracon*	510	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 (6.5, 7.9)	8.1 (7.2, 9.2)
E.Motion	E.Motion	32	711	2.2 (1.3, 3.6)	4.7 (3.2, 6.7)	5.1 (3.6, 7.3)			
Evolis	Evolis	18	936	0.3 (0.1, 1.0)	1.0 (0.5, 1.9)	1.6 (0.9, 2.8)	3.0 (1.8, 4.8)		
Evolution	Evolution	115	6468	0.9 (0.7, 1.2)	2.7 (2.2, 3.2)	3.5 (2.7, 4.5)			
GMK Primary	GMK Primary	21	634	1.0 (0.4, 2.2)	2.6 (1.6, 4.2)	3.3 (2.1, 5.2)			
GMK Sphere Primary	GMK Primary	137	7079	1.4 (1.1, 1.7)	2.6 (2.2, 3.2)	3.4 (2.7, 4.2)			
Genesis II CR	Genesis II	548	15099	0.9 (0.8, 1.1)	2.4 (2.2, 2.7)	3.1 (2.8, 3.4)	4.4 (4.0, 4.8)	5.4 (4.9, 6.0)	6.1 (5.1, 7.2)
Genesis II CR	Profix Mobile*	44	490	1.7 (0.8, 3.3)	3.4 (2.1, 5.4)	5.4 (3.6, 7.8)	10.0 (7.3, 13.5)		
Genesis II Oxinium CR	Genesis II	431	8675	1.0 (0.8, 1.3)	2.7 (2.4, 3.1)	3.6 (3.2, 4.0)	6.2 (5.6, 6.9)	9.3 (8.2, 10.6)	

Femoral Component	Tibial Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Genesis II Oxinium PS	Genesis II	1009	18592	1.5 (1.3, 1.7)	3.7 (3.5, 4.0)	5.1 (4.8, 5.5)	7.6 (7.1, 8.1)	10.1 (8.5, 11.8)	
Genesis II PS	Genesis II	689	17616	1.2 (1.0, 1.4)	2.8 (2.5, 3.0)	3.7 (3.4, 4.0)	5.1 (4.7, 5.6)	6.1 (5.5, 6.9)	
Journey Oxinium	Journey*	291	3032	1.4 (1.0, 1.9)	4.6 (3.9, 5.4)	6.5 (5.6, 7.4)	11.2 (10.0, 12.6)		
Kinemax Plus	Kinemax Plus*	119	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)	8.1 (6.7, 9.7)	
LCS CR	LCS	320	3939	1.0 (0.7, 1.4)	3.7 (3.2, 4.4)	5.0 (4.4, 5.8)	7.2 (6.4, 8.1)	9.5 (8.5, 10.5)	10.0 (9.0, 11.3)
LCS CR	MBT	454	11993	0.9 (0.7, 1.0)	2.5 (2.2, 2.8)	3.5 (3.1, 3.9)	5.2 (4.7, 5.8)	6.3 (5.4, 7.3)	
LCS PS	MBT*	42	492	1.4 (0.7, 3.0)	5.6 (3.9, 8.0)	6.9 (5.0, 9.6)			
Legion CR	Genesis II	40	2223	1.0 (0.6, 1.5)	2.0 (1.4, 2.8)	2.8 (2.0, 4.0)			
Legion Oxinium CR	Genesis II	108	4593	0.9 (0.6, 1.2)	2.7 (2.2, 3.4)	3.4 (2.8, 4.2)	4.4 (3.4, 5.7)		
Legion Oxinium PS	Genesis II	434	12869	1.1 (0.9, 1.3)	3.1 (2.8, 3.5)	4.4 (4.0, 4.9)	6.0 (5.2, 7.0)		
Legion PS	Genesis II	130	4920	1.2 (0.9, 1.5)	2.4 (2.0, 3.0)	3.0 (2.5, 3.7)			
MRK	MRK	9	503	0.8 (0.3, 2.2)	1.7 (0.9, 3.4)	1.7 (0.9, 3.4)			
Natural Knee Flex	Natural Knee II	49	2096	1.1 (0.7, 1.7)	2.5 (1.8, 3.4)	2.9 (2.1, 3.9)	3.6 (2.6, 4.9)		
Natural Knee II	Natural Knee II*	58	1754	0.5 (0.2, 0.9)	1.3 (0.8, 1.9)	1.9 (1.3, 2.7)	3.3 (2.5, 4.4)	5.3 (3.8, 7.2)	
Nexgen CR	Nexgen	137	4039	0.7 (0.4, 1.0)	1.5 (1.2, 2.0)	2.0 (1.6, 2.5)	3.0 (2.5, 3.6)	4.9 (4.1, 5.8)	5.9 (4.6, 7.6)
Nexgen CR Flex	Natural Knee II*	11	805	0.2 (0.1, 1.0)	0.9 (0.4, 1.9)	0.9 (0.4, 1.9)			
Nexgen CR Flex	Nexgen	473	25867	0.7 (0.6, 0.9)	1.6 (1.4, 1.7)	2.1 (1.9, 2.3)	3.0 (2.6, 3.3)		
Nexgen LCCK	Nexgen	39	897	2.0 (1.2, 3.2)	3.8 (2.7, 5.4)	5.3 (3.8, 7.4)	5.3 (3.8, 7.4)		
Nexgen LPS	Nexgen	275	6043	1.0 (0.8, 1.3)	2.4 (2.0, 2.8)	3.0 (2.6, 3.5)	4.7 (4.1, 5.3)	6.5 (5.7, 7.4)	7.0 (6.1, 8.1)
Nexgen LPS Flex	Nexgen	1230	33942	0.9 (0.8, 1.0)	2.2 (2.1, 2.4)	3.1 (2.9, 3.3)	5.1 (4.8, 5.5)	7.2 (6.5, 8.0)	
Nexgen RH	Nexgen	27	494	2.3 (1.3, 4.2)	4.3 (2.7, 6.8)	5.6 (3.6, 8.6)			
Optetrak Logic CR	Optetrak Logic	4	474	0.8 (0.3, 2.4)	1.1 (0.4, 3.0)				
Optetrak Logic PS	Optetrak Logic	8	422	1.6 (0.7, 3.6)	2.4 (1.2, 4.8)				
Optetrak-PS	Optetrak	199	2234	1.5 (1.1, 2.1)	4.7 (3.9, 5.6)	6.3 (5.3, 7.4)	9.7 (8.4, 11.1)	12.0 (10.3, 13.9)	
Optetrak-PS	Optetrak RBK	45	931	1.2 (0.7, 2.2)	3.3 (2.3, 4.8)	4.3 (3.1, 6.0)	7.5 (5.5, 10.2)		
PFC Sigma CR	MBT	38	1178	0.9 (0.5, 1.6)	1.9 (1.3, 2.9)	2.4 (1.6, 3.4)	3.3 (2.4, 4.6)	5.0 (2.7, 9.1)	
PFC Sigma CR	PFC Sigma	401	13022	0.8 (0.7, 1.0)	2.0 (1.8, 2.2)	2.5 (2.2, 2.7)	3.5 (3.2, 3.9)	5.9 (5.1, 6.9)	
PFC Sigma PS	MBT	283	6099	1.0 (0.7, 1.2)	2.7 (2.4, 3.2)	3.6 (3.2, 4.1)	5.2 (4.6, 5.9)	6.8 (5.8, 8.0)	
PFC Sigma PS	PFC Sigma	329	8034	1.1 (0.9, 1.4)	2.5 (2.2, 2.9)	3.2 (2.9, 3.7)	4.8 (4.3, 5.4)	7.0 (6.0, 8.1)	
Persona	Persona	35	5478	0.6 (0.4, 0.8)	1.3 (0.8, 2.2)	1.7 (1.0, 2.9)			
Profix	Profix*	154	3285	1.1 (0.8, 1.6)	2.6 (2.1, 3.2)	3.3 (2.7, 3.9)	4.8 (4.1, 5.6)	5.5 (4.6, 6.5)	
Profix Oxinium	Profix*	89	999	1.9 (1.2, 3.0)	5.0 (3.8, 6.5)	6.6 (5.2, 8.4)	8.3 (6.7, 10.3)	10.0 (8.1, 12.2)	
RBK	RBK	99	2504	1.0 (0.7, 1.5)	2.5 (2.0, 3.2)	3.4 (2.7, 4.2)	5.1 (4.1, 6.3)	7.2 (4.9, 10.7)	
SAIPH	SAIPH	33	2661	0.5 (0.3, 0.8)	2.0 (1.4, 2.9)	2.3 (1.5, 3.4)			
Score	Score	18	818	1.0 (0.5, 2.0)	1.5 (0.8, 2.6)	2.4 (1.4, 4.0)			
Scorpio CR	Series 7000	95	1799	0.8 (0.5, 1.4)	2.2 (1.6, 3.0)	2.9 (2.2, 3.8)	4.9 (3.9, 6.0)	6.8 (5.5, 8.3)	
Scorpio NRG CR	Series 7000	42	1697	0.7 (0.4, 1.3)	1.5 (1.0, 2.2)	2.2 (1.5, 3.1)	3.6 (2.6, 4.9)		
Scorpio NRG PS	Series 7000	68	2599	0.6 (0.4, 1.0)	1.6 (1.2, 2.2)	2.3 (1.8, 3.0)	3.1 (2.4, 4.0)		

Femoral Component	Tibial Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
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)	8.3 (5.7, 12.0)	
Scorpio PS	Scorpio+*	68	900	1.3 (0.8, 2.3)	4.2 (3.0, 5.7)	5.8 (4.5, 7.6)	7.3 (5.8, 9.3)	9.3 (7.2, 12.0)	
Scorpio PS	Series 7000	203	3236	1.1 (0.8, 1.5)	2.8 (2.3, 3.5)	3.9 (3.3, 4.7)	6.5 (5.6, 7.5)	9.1 (7.7, 10.8)	
Triathlon CR	Triathlon	938	43761	0.8 (0.8, 0.9)	2.0 (1.9, 2.2)	2.6 (2.4, 2.7)	3.8 (3.5, 4.1)		
Triathlon PS	Triathlon	293	8088	1.4 (1.2, 1.7)	3.0 (2.6, 3.4)	3.9 (3.5, 4.4)	5.4 (4.8, 6.2)		
Vanguard CR	Vanguard	289	10796	0.7 (0.5, 0.9)	2.1 (1.9, 2.5)	2.7 (2.4, 3.1)	4.9 (4.1, 5.9)		
Vanguard PS	Vanguard	245	4245	1.9 (1.6, 2.4)	4.5 (3.9, 5.2)	5.6 (4.9, 6.4)	8.2 (7.0, 9.6)		
Other (194)		675	9248	1.9 (1.6, 2.2)	4.6 (4.1, 5.1)	6.5 (5.9, 7.1)	9.2 (8.5, 9.9)	12.0 (11.0, 13.1)	14.1 (12.6, 15.8)
TOTAL		**13244**	**377760**						

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 2018

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	18 Yrs
ACS	ACS Fixed	40	782	1.8 (1.0, 3.0)	5.0 (3.6, 7.0)	5.8 (4.2, 8.0)			
Active Knee	Active Knee	471	4899	1.3 (1.1, 1.7)	4.0 (3.4, 4.5)	5.6 (5.0, 6.3)	9.7 (8.8, 10.6)	13.3 (12.0, 14.8)	
Advance	Advance	45	833	1.8 (1.0, 3.0)	5.1 (3.7, 7.0)	5.9 (4.4, 8.0)			
Advantim	Advantim*	67	1255	0.8 (0.4, 1.5)	2.7 (2.0, 3.8)	3.6 (2.7, 4.8)	5.8 (4.5, 7.4)	7.4 (5.6, 9.8)	
Columbus	Columbus	63	500	3.2 (2.0, 5.2)	7.7 (5.6, 10.4)	9.7 (7.4, 12.7)	13.2 (10.4, 16.6)		
Duracon	Duracon*	238	3538	1.1 (0.8, 1.4)	2.7 (2.3, 3.3)	3.7 (3.1, 4.4)	5.6 (4.9, 6.5)	8.7 (7.5, 10.0)	
GMK Primary	GMK Primary	31	1051	1.2 (0.7, 2.1)	3.4 (2.4, 4.9)	3.9 (2.7, 5.5)			
Genesis II CR	Genesis II	33	677	1.4 (0.7, 2.6)	4.1 (2.8, 6.1)	4.8 (3.3, 7.0)	7.4 (5.1, 10.6)		
Genesis II CR	Profix Mobile*	39	505	1.4 (0.7, 2.9)	2.0 (1.1, 3.7)	3.0 (1.8, 4.9)	4.6 (3.0, 6.9)	7.7 (5.6, 10.7)	
Genesis II PS	Genesis II	22	420	1.7 (0.8, 3.5)	3.3 (2.0, 5.6)	3.9 (2.4, 6.3)	5.6 (3.7, 8.5)		
LCS CR	LCS	163	2357	1.4 (1.0, 2.0)	3.4 (2.7, 4.2)	4.3 (3.5, 5.2)	6.0 (5.1, 7.1)	7.3 (6.2, 8.5)	9.1 (7.5, 11.0)
LCS CR	MBT	363	8537	1.1 (0.9, 1.3)	3.3 (2.9, 3.7)	4.0 (3.6, 4.5)	5.4 (4.8, 6.0)	7.4 (6.3, 8.8)	
LCS CR	MBT Duofix	687	13872	1.3 (1.1, 1.5)	3.3 (3.0, 3.6)	4.1 (3.8, 4.5)	5.4 (5.0, 5.8)	7.4 (6.8, 8.2)	
LCS Duofix	MBT Duofix*	476	3650	1.6 (1.2, 2.1)	6.2 (5.5, 7.0)	10.1 (9.2, 11.2)	13.3 (12.2, 14.4)		
Maxim	Maxim*	37	554	1.8 (1.0, 3.4)	2.9 (1.8, 4.7)	3.1 (2.0, 5.0)	4.7 (3.2, 6.9)	8.8 (6.3, 12.0)	
Natural Knee Flex	Natural Knee II	31	1474	0.7 (0.4, 1.3)	1.8 (1.2, 2.7)	2.1 (1.5, 3.1)	2.8 (1.9, 4.1)		
Natural Knee II	Natural Knee II*	251	2890	1.0 (0.7, 1.4)	2.2 (1.7, 2.8)	3.4 (2.7, 4.1)	6.9 (6.0, 8.0)	12.1 (10.6, 13.8)	
Nexgen CR	Nexgen	118	3426	0.6 (0.4, 0.9)	1.7 (1.3, 2.2)	2.1 (1.7, 2.7)	3.1 (2.5, 3.7)	4.2 (3.4, 5.0)	5.1 (4.0, 6.5)
Nexgen CR	Nexgen TM CR	44	714	1.3 (0.7, 2.5)	4.2 (2.9, 6.0)	6.2 (4.6, 8.3)	6.9 (5.1, 9.2)	7.3 (5.4, 9.8)	
Nexgen CR Flex	Nexgen	268	8082	1.2 (0.9, 1.4)	2.8 (2.4, 3.2)	3.3 (2.9, 3.8)	4.3 (3.8, 4.9)		
Nexgen CR Flex	Nexgen TM CR	246	10215	0.5 (0.4, 0.7)	1.8 (1.6, 2.1)	2.4 (2.1, 2.7)	3.3 (2.9, 3.8)		
Nexgen LPS	Nexgen TM LPS	28	1268	0.7 (0.4, 1.4)	1.3 (0.8, 2.1)	2.4 (1.6, 3.5)	2.8 (1.9, 4.1)		
Nexgen LPS Flex	Nexgen	35	997	2.7 (1.8, 4.0)	4.0 (2.8, 5.5)	4.2 (3.0, 5.8)			
Nexgen LPS Flex	Nexgen TM LPS	39	1021	1.2 (0.7, 2.1)	2.8 (1.9, 4.1)	4.0 (2.9, 5.6)			
PFC Sigma CR	AMK Duofix*	61	1911	0.7 (0.4, 1.2)	1.6 (1.1, 2.3)	2.3 (1.7, 3.1)	3.1 (2.4, 4.1)	4.3 (3.2, 5.8)	
PFC Sigma CR	MBT	65	995	2.3 (1.5, 3.5)	4.9 (3.7, 6.4)	5.6 (4.3, 7.3)	6.8 (5.3, 8.8)		
PFC Sigma CR	MBT Duofix	133	2996	1.1 (0.8, 1.5)	3.0 (2.4, 3.7)	3.8 (3.1, 4.6)	5.4 (4.5, 6.5)	8.4 (6.5, 10.8)	
Profix	Profix*	98	1488	1.1 (0.7, 1.8)	3.5 (2.6, 4.5)	4.6 (3.7, 5.9)	6.8 (5.5, 8.2)	7.6 (6.2, 9.3)	
RBK	RBK	327	6640	1.3 (1.1, 1.7)	3.2 (2.8, 3.7)	4.2 (3.7, 4.7)	5.7 (5.0, 6.3)	7.2 (6.2, 8.5)	
Score	Score	168	2244	1.7 (1.2, 2.3)	5.5 (4.6, 6.7)	7.6 (6.5, 9.0)	12.9 (10.6, 15.6)		
Scorpio CR	Series 7000	226	3135	1.4 (1.0, 1.8)	3.4 (2.9, 4.1)	4.8 (4.1, 5.6)	7.4 (6.4, 8.4)	9.2 (8.0, 10.6)	
Scorpio NRG CR	Series 7000	99	2641	1.1 (0.8, 1.6)	3.1 (2.5, 3.9)	3.7 (3.0, 4.6)	4.9 (4.0, 6.1)		
Scorpio NRG PS	Series 7000	72	1143	1.2 (0.7, 2.1)	5.0 (3.9, 6.5)	6.4 (5.1, 8.1)	8.1 (6.3, 10.3)		
Scorpio PS	Series 7000	46	570	2.5 (1.5, 4.1)	5.3 (3.7, 7.5)	6.2 (4.5, 8.6)	7.6 (5.7, 10.2)	8.4 (6.3, 11.1)	
Triathlon CR	Triathlon	462	16163	1.1 (1.0, 1.3)	2.3 (2.1, 2.6)	3.0 (2.7, 3.3)	4.1 (3.7, 4.5)		
Triathlon PS	Triathlon	56	1085	2.2 (1.4, 3.3)	3.9 (2.8, 5.2)	4.9 (3.7, 6.4)	6.0 (4.6, 7.8)		
Vanguard CR	Regenerex	71	1676	1.2 (0.8, 1.9)	3.7 (2.8, 4.8)	4.6 (3.6, 5.9)			
Vanguard CR	Vanguard	87	1668	1.4 (0.9, 2.1)	4.0 (3.1, 5.0)	4.7 (3.8, 5.9)	7.4 (5.4, 10.1)		
Other (80)		619	5948	2.7 (2.3, 3.2)	7.3 (6.6, 8.0)	8.9 (8.2, 9.7)	11.3 (10.5, 12.2)	13.8 (12.6, 15.0)	
TOTAL		**6425**	**123820**						

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 2018

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	18 Yrs
ACS	ACS Fixed	47	1095	1.7 (1.0, 2.7)	5.2 (3.9, 7.0)	5.2 (3.9, 7.0)			
AGC	AGC	65	1644	0.6 (0.3, 1.1)	1.4 (1.0, 2.1)	2.0 (1.4, 2.9)	3.5 (2.6, 4.6)	5.3 (4.1, 7.0)	
Active Knee	Active Knee	121	2261	0.6 (0.3, 1.0)	2.6 (2.0, 3.3)	3.8 (3.0, 4.7)	6.7 (5.5, 8.2)	9.7 (7.8, 12.0)	
Advance	Advance II	22	472	1.1 (0.4, 2.5)	2.6 (1.5, 4.6)	3.4 (2.1, 5.6)	5.5 (3.6, 8.5)		
Apex Knee CR	Apex Knee	19	2083	0.8 (0.5, 1.4)	1.0 (0.6, 1.6)	1.7 (0.9, 3.3)			
BalanSys	BalanSys	20	1390	1.0 (0.6, 1.8)	2.2 (1.3, 3.7)	3.0 (1.6, 5.8)			
Duracon	Duracon*	470	7963	1.2 (1.0, 1.5)	2.7 (2.4, 3.1)	3.5 (3.1, 3.9)	5.0 (4.6, 5.6)	7.1 (6.5, 7.8)	8.2 (7.2, 9.3)
GMK Primary	GMK Primary	21	584	0.9 (0.4, 2.2)	3.8 (2.4, 5.9)	4.3 (2.8, 6.6)			
Genesis II CR	Genesis II	364	7960	0.9 (0.7, 1.1)	3.0 (2.6, 3.4)	4.1 (3.6, 4.6)	5.5 (4.9, 6.1)	6.7 (5.9, 7.7)	
Genesis II PS	Genesis II	62	707	1.7 (1.0, 3.0)	4.4 (3.1, 6.2)	5.5 (4.0, 7.5)	8.8 (6.8, 11.2)	10.3 (8.0, 13.1)	
LCS CR	LCS	137	2364	1.0 (0.7, 1.5)	2.7 (2.1, 3.5)	3.8 (3.1, 4.6)	5.3 (4.4, 6.3)	6.4 (5.4, 7.6)	7.7 (6.1, 9.8)
LCS CR	MBT	291	9732	0.8 (0.6, 1.0)	2.1 (1.9, 2.5)	2.8 (2.5, 3.2)	4.0 (3.5, 4.6)	5.0 (4.2, 5.9)	
LCS CR	MBT Duofix	35	934	1.4 (0.8, 2.4)	3.3 (2.3, 4.7)	3.5 (2.5, 4.9)	4.8 (3.3, 7.0)		
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 (7.4, 11.5)		
Legion CR	Genesis II	82	2428	1.5 (1.1, 2.1)	4.2 (3.4, 5.3)	5.0 (4.0, 6.3)			
Maxim	Maxim*	66	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)	9.6 (7.2, 12.8)	
Natural Knee Flex	Natural Knee II	32	1872	0.4 (0.2, 0.8)	1.3 (0.8, 1.9)	1.9 (1.3, 2.8)	2.4 (1.6, 3.6)		
Natural Knee II	Natural Knee II*	101	1966	1.2 (0.8, 1.8)	2.2 (1.6, 3.0)	2.5 (1.9, 3.4)	4.1 (3.2, 5.2)	8.0 (6.4, 10.0)	
Nexgen CR	Nexgen	143	4287	0.6 (0.4, 0.9)	1.7 (1.3, 2.1)	2.2 (1.8, 2.7)	3.3 (2.7, 3.9)	4.5 (3.7, 5.4)	
Nexgen CR Flex	Nexgen	426	19927	0.7 (0.6, 0.9)	1.8 (1.6, 2.0)	2.3 (2.1, 2.5)	3.0 (2.7, 3.4)		
Nexgen CR Flex	Nexgen TM CR	16	823	0.5 (0.2, 1.3)	1.4 (0.8, 2.5)	1.5 (0.9, 2.7)	2.1 (1.3, 3.5)		
Nexgen LPS	Nexgen	54	1018	0.5 (0.2, 1.2)	2.7 (1.8, 3.9)	4.1 (3.0, 5.6)	5.5 (4.2, 7.2)	6.8 (5.0, 9.1)	
Nexgen LPS Flex	Nexgen	50	971	2.1 (1.4, 3.3)	4.6 (3.4, 6.3)	6.1 (4.6, 8.1)			
Nexgen LPS Flex	Nexgen TM LPS	16	507	0.6 (0.2, 1.8)	1.8 (0.9, 3.4)	2.0 (1.1, 3.7)	2.9 (1.7, 4.9)		
Optetrak Logic CR	Optetrak Logic	11	611	1.8 (0.9, 3.5)	2.7 (1.4, 5.0)				
Optetrak-CR	Optetrak*	34	415	1.5 (0.7, 3.2)	3.7 (2.2, 6.1)	4.7 (3.0, 7.3)	8.5 (6.0, 12.1)	12.0 (8.2, 17.2)	
PFC Sigma CR	MBT	195	3926	1.2 (0.9, 1.7)	3.2 (2.7, 3.8)	4.2 (3.6, 4.9)	5.3 (4.6, 6.2)	7.1 (5.9, 8.6)	
PFC Sigma CR	PFC Sigma	355	11214	0.6 (0.5, 0.8)	1.9 (1.7, 2.2)	2.5 (2.2, 2.8)	3.5 (3.1, 3.9)	5.8 (5.0, 6.8)	6.4 (5.3, 7.6)
PFC Sigma PS	MBT Duofix	154	2251	1.9 (1.4, 2.5)	4.6 (3.8, 5.6)	6.4 (5.4, 7.6)	8.3 (7.1, 9.8)	9.6 (8.1, 11.3)	
Persona	Persona	12	1590	0.8 (0.4, 1.6)	1.8 (0.9, 3.6)				
Profix	Profix Mobile*	56	592	1.9 (1.0, 3.4)	5.8 (4.2, 8.1)	7.4 (5.6, 9.9)	9.2 (7.1, 12.0)	10.4 (8.0, 13.4)	
Profix	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 (3.6, 6.8)	
RBK	RBK	60	1549	1.1 (0.6, 1.7)	2.8 (2.1, 3.8)	3.8 (2.9, 4.9)	4.7 (3.6, 6.1)	6.9 (4.5, 10.5)	
Score	Score	54	1341	1.8 (1.2, 2.7)	4.6 (3.5, 6.0)	5.4 (4.1, 7.2)			
Scorpio CR	Scorpio+*	154	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)	9.4 (8.0, 11.0)	
Scorpio CR	Series 7000	271	6882	0.7 (0.5, 0.9)	2.0 (1.6, 2.3)	2.8 (2.4, 3.2)	4.3 (3.7, 4.9)	6.2 (5.4, 7.1)	6.4 (5.5, 7.3)
Scorpio NRG CR	Series 7000	32	795	0.4 (0.1, 1.2)	2.2 (1.4, 3.5)	3.1 (2.0, 4.6)	5.5 (3.7, 8.1)		
Scorpio PS	Scorpio+*	48	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)	6.5 (4.8, 8.7)	
Scorpio PS	Series 7000	90	1079	1.2 (0.7, 2.1)	4.3 (3.3, 5.8)	5.7 (4.5, 7.3)	7.3 (5.9, 9.1)	11.1 (8.8, 14.1)	
Trekking	Trekking	6	459	0.7 (0.2, 2.3)	1.6 (0.6, 3.9)	1.6 (0.6, 3.9)			
Triathlon CR	Triathlon	415	23844	0.6 (0.5, 0.8)	1.6 (1.5, 1.8)	2.1 (1.9, 2.4)	3.2 (2.8, 3.6)		
Triathlon PS	Triathlon	87	2647	1.7 (1.2, 2.3)	2.6 (2.1, 3.3)	3.7 (3.0, 4.6)	4.7 (3.6, 6.2)		
Vanguard CR	Vanguard	343	12140	0.8 (0.7, 1.0)	2.3 (2.0, 2.6)	3.0 (2.7, 3.4)	4.8 (4.2, 5.5)		
Vanguard PS	Vanguard	28	651	1.2 (0.6, 2.5)	3.1 (2.0, 4.8)	4.2 (2.8, 6.3)	6.1 (4.0, 9.3)		
Other (132)		635	6593	2.2 (1.9, 2.6)	5.9 (5.4, 6.5)	7.3 (6.7, 8.0)	10.6 (9.8, 11.5)	14.3 (13.1, 15.6)	15.8 (14.2, 17.5)
TOTAL		**5806**	**157016**						

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 2018

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 18 years, the cumulative percent revision of primary total knee replacement undertaken for osteoarthritis is 8.6% (Table KT10 and Figure KT8).

Reason for Revision

Loosening is the main reason for revision (25.0%), followed by infection (23.3%), patellofemoral pain (9.8%), pain (8.2%) and instability (8.1%) (Table 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.

The five most common reasons for revision are shown in Figure KT9. Infection is the most common reason for early revision. Loosening becomes the most common reason after 7 years.

Type of Revision

The most common types of revision are replacement of both the femoral and tibial prostheses (26.0%), insert only exchange (23.1%) and patella only replacement (19.8%) (Table KT12).

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 10 years, compared to patients aged ≥75 years (Table KT13 and Figure KT10).

Males have a higher rate of revision compared to females (Table KT14 and Figure KT11).

Loosening is the most common reason for revision in both males and females. Males have a higher incidence of revision for infection, with an 18 year cumulative incidence of 1.8% compared to 0.9% for females (Figure KT12).

Males have a higher rate of revision which is largely due to an increased incidence of infection.

Age related differences in the rate of revision are evident for both males and females (Table KT14, Figures KT13 and KT14).

ASA and BMI

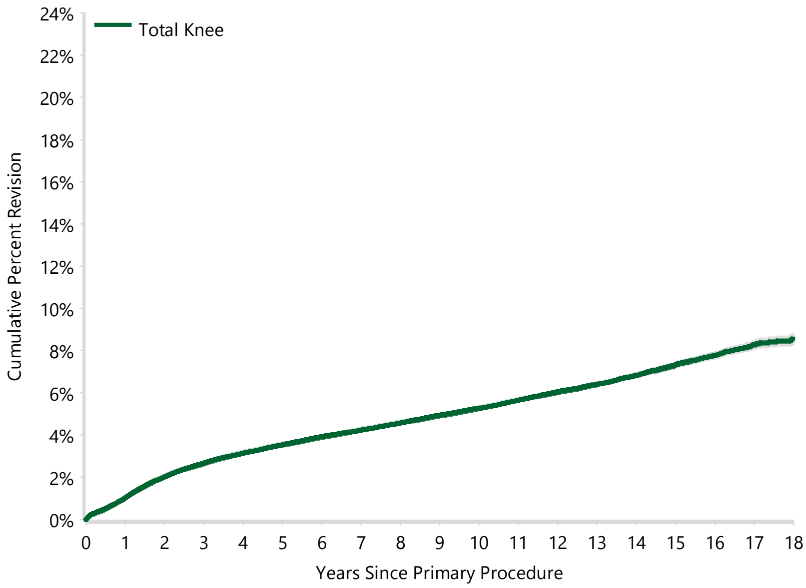
ASA scores are an indication of comorbidity and have been collected since 2012. The definitions for these scores can be found in the introductory chapter. The Registry reports on the outcome of 285,168 primary total knee replacement procedures for osteoarthritis in relation to these scores. When compared to patients with an ASA score of 1, patients in all other ASA groups have a higher rate of revision (Table KT15 and Figure KT15). The difference in the rate of revision for each ASA score is partially due to an increase in the cumulative incidence of infection with increasing ASA score (Figure KT16).

BMI data has been collected since 2015. The early revision outcomes are reported for 194,029 primary total knee replacement procedures 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, but the rate of revision is increased for patients in obese class 2 and in obese class 3 for the first 6 months only (Table KT16 and Figure KT17). The most common reasons for revision are shown in Figure KT18. 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	18 Yrs
Total Knee	24722	643201	1.0 (1.0, 1.1)	2.7 (2.6, 2.7)	3.5 (3.5, 3.6)	5.3 (5.2, 5.3)	7.3 (7.2, 7.5)	8.6 (8.3, 8.8)
TOTAL	**24722**	**643201**						

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	18 Yrs
Total Knee	643201	578190	454630	345647	137800	27725	1527

Table KT11 Primary Total Knee Replacement by Reason for Revision (Primary Diagnosis OA)

Reason for Revision	Number	Percent
Loosening	6183	25.0
Infection	5766	23.3
Patellofemoral Pain	2425	9.8
Pain	2024	8.2
Instability	1994	8.1
Patella Erosion	1427	5.8
Arthrofibrosis	884	3.6
Fracture	736	3.0
Malalignment	537	2.2
Lysis	487	2.0
Wear Tibial Insert	459	1.9
Metal Related Pathology	340	1.4
Incorrect Sizing	273	1.1
Other	1187	4.8
TOTAL	**24722**	**100.0**

Table KT12 Primary Total Knee Replacement by Type of Revision (Primary Diagnosis OA)

Type of Revision	Number	Percent
TKR (Tibial/Femoral)	6434	26.0
Insert Only	5705	23.1
Patella Only	4901	19.8
Insert/Patella	2558	10.3
Tibial Component	2226	9.0
Femoral Component	1349	5.5
Cement Spacer	1335	5.4
Removal of Prostheses	129	0.5
Minor Components	51	0.2
Cement Only	13	0.1
Total Femoral	11	0.0
Reinsertion of Components	10	0.0
TOTAL	**24722**	**100.0**

Figure KT9 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement (Primary Diagnosis OA)

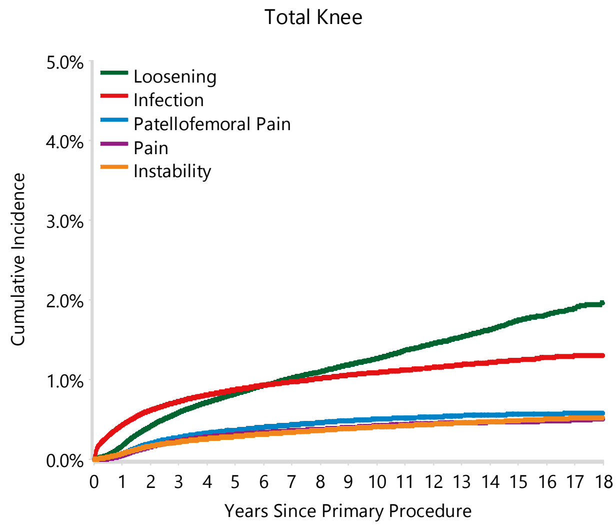
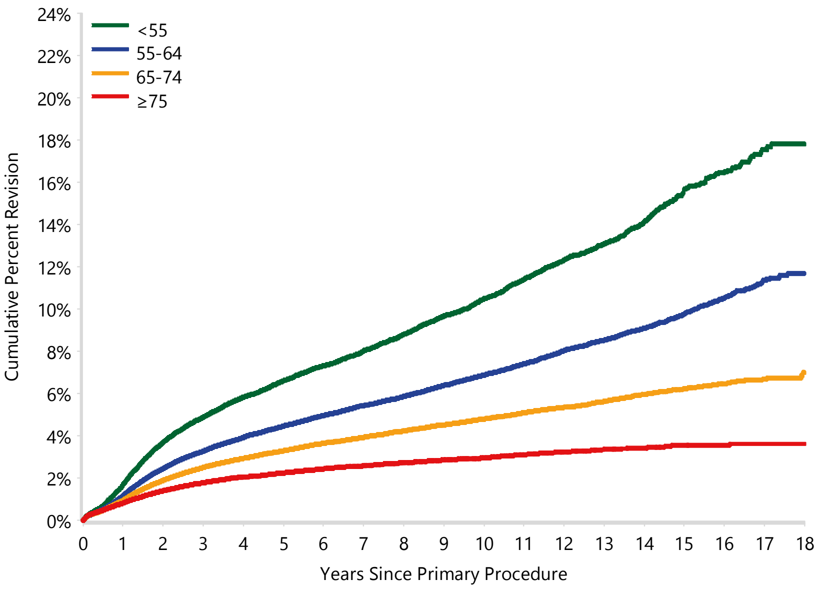


Table KT13 Cumulative Percent Revision of Primary Total Knee Replacement by Age (Primary Diagnosis OA)

Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
<55	3352	42243	1.7 (1.6, 1.8)	4.9 (4.7, 5.1)	6.6 (6.3, 6.9)	10.5 (10.1, 10.9)	15.7 (15.0, 16.4)	17.8 (16.8, 18.9)
55-64	8613	169719	1.2 (1.1, 1.2)	3.3 (3.2, 3.4)	4.5 (4.4, 4.6)	6.9 (6.7, 7.0)	9.8 (9.5, 10.0)	11.7 (11.2, 12.2)
65-74	8824	253322	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, 6.4)	7.0 (6.6, 7.4)
≥75	3933	177917	0.8 (0.8, 0.9)	1.8 (1.7, 1.8)	2.2 (2.2, 2.3)	3.0 (2.9, 3.1)	3.5 (3.4, 3.7)	3.6 (3.4, 3.8)
TOTAL	**24722**	**643201**						

Figure KT10 Cumulative Percent Revision of Primary Total Knee Replacement by Age (Primary Diagnosis OA)



HR - adjusted for gender

<55 vs ≥75
0 - 6Mth: HR=1.45 (1.27, 1.66),p<0.001
6Mth - 2Yr: HR=3.28 (3.06, 3.53),p<0.001
2Yr - 2.5Yr: HR=3.10 (2.69, 3.58),p<0.001
2.5Yr - 4Yr: HR=3.32 (2.97, 3.70),p<0.001
4Yr - 6.5Yr: HR=4.46 (3.95, 5.04),p<0.001
6.5Yr - 10Yr: HR=6.06 (5.33,6.88),p<0.001
10Yr - 14Yr: HR=6.98 (5.96, 8.19),p<0.001
14Yr+: HR=10.29 (7.85, 13.50),p<0.001

55-64 vs ≥75
0 - 3Mth: HR=0.99 (0.89, 1.11),p=0.869
3Mth - 9Mth: HR=1.60 (1.47, 1.75),p<0.001
9Mth - 4Yr: HR=2.16 (2.05, 2.27),p<0.001
4Yr - 4.5Yr: HR=3.37 (2.77, 4.09),p<0.001
4.5Yr - 6.5Yr: HR=2.96 (2.66, 3.28),p<0.001
6.5Yr - 7Yr: HR=3.53 (2.89, 4.31),p<0.001
7Yr - 7.5Yr: HR=3.09 (2.50, 3.82),p<0.001
7.5Yr - 10Yr: HR=3.54 (3.14, 4.01),p<0.001
10Yr - 15Yr: HR=4.14 (3.64, 4.71),p<0.001
15Yr+: HR=8.10 (5.83, 11.26),p<0.001

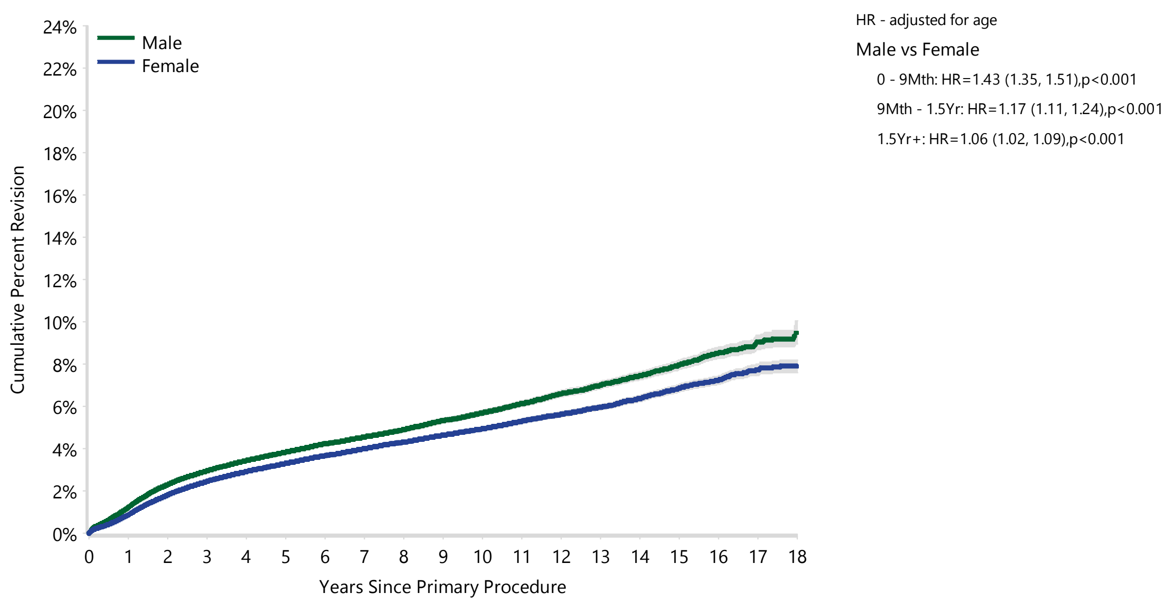
65-74 vs ≥75
0 - 6Mth: HR=1.03 (0.95, 1.12),p=0.508
6Mth - 2.5Yr: HR=1.52 (1.45, 1.60),p<0.001
2.5Yr - 4Yr: HR=1.55 (1.43, 1.68),p<0.001
4Yr - 4.5Yr: HR=2.36 (1.94, 2.86),p<0.001
4.5Yr+: HR=2.02 (1.85, 2.19),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
<55	42243	38045	29988	23359	10234	2594	164
55-64	169719	152725	120536	92830	38809	8838	534
65-74	253322	227093	177715	135185	56122	12026	678
≥75	177917	160327	126391	94273	32635	4267	151

Table KT14 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	18 Yrs
Male		**11568**	**281219**	**1.2 (1.2, 1.3)**	**2.9 (2.9, 3.0)**	**3.8 (3.8, 3.9)**	**5.7 (5.6, 5.8)**	**8.0 (7.8, 8.2)**	**9.5 (9.0, 10.0)**
	<55	1482	18158	2.0 (1.8, 2.2)	5.3 (4.9, 5.6)	6.8 (6.4, 7.2)	10.6 (10.1, 11.2)	15.8 (14.8, 16.9)	18.1 (16.6, 19.8)
	55-64	4206	78009	1.4 (1.3, 1.5)	3.6 (3.5, 3.7)	4.8 (4.6, 5.0)	7.3 (7.1, 7.6)	10.3 (9.9, 10.7)	12.3 (11.5, 13.0)
	65-74	4170	113197	1.1 (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, 7.0)	7.9 (6.9, 9.1)
	≥75	1710	71855	1.0 (0.9, 1.0)	2.0 (1.9, 2.1)	2.5 (2.3, 2.6)	3.2 (3.1, 3.4)	4.0 (3.7, 4.3)	4.0 (3.7, 4.3)
Female		**13154**	**361982**	**0.9 (0.8, 0.9)**	**2.4 (2.4, 2.5)**	**3.3 (3.2, 3.4)**	**4.9 (4.9, 5.0)**	**6.9 (6.7, 7.0)**	**7.9 (7.6, 8.2)**
	<55	1870	24085	1.5 (1.3, 1.6)	4.6 (4.3, 4.9)	6.5 (6.1, 6.8)	10.4 (9.9, 10.9)	15.6 (14.7, 16.6)	17.6 (16.3, 19.0)
	55-64	4407	91710	1.0 (0.9, 1.1)	3.0 (2.9, 3.1)	4.2 (4.0, 4.3)	6.5 (6.3, 6.7)	9.3 (8.9, 9.7)	11.2 (10.5, 12.0)
	65-74	4654	140125	0.8 (0.8, 0.8)	2.3 (2.2, 2.4)	3.1 (3.0, 3.2)	4.6 (4.4, 4.7)	5.9 (5.6, 6.1)	6.4 (6.1, 6.7)
	≥75	2223	106062	0.7 (0.7, 0.8)	1.6 (1.6, 1.7)	2.1 (2.0, 2.2)	2.8 (2.7, 2.9)	3.3 (3.1, 3.5)	3.4 (3.2, 3.7)
TOTAL		**24722**	**643201**						

Figure KT11 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	18 Yrs
Male	281219	251134	195269	146443	56292	10988	603
Female	361982	327056	259361	199204	81508	16737	924

Figure KT12 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by Gender (Primary Diagnosis OA)

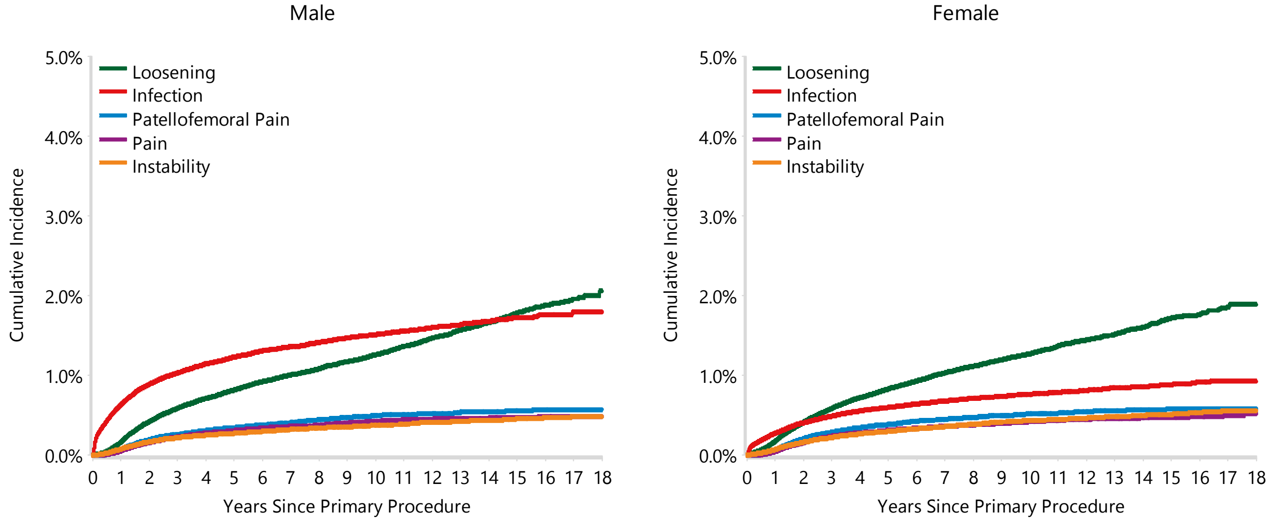
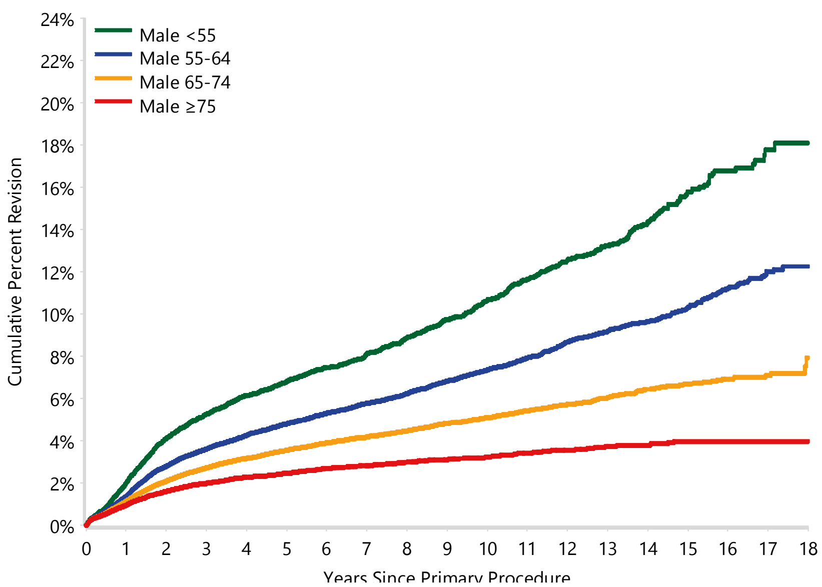


Figure KT13 Cumulative Percent Revision of Primary Total Knee Replacement in Males by Age (Primary Diagnosis OA)



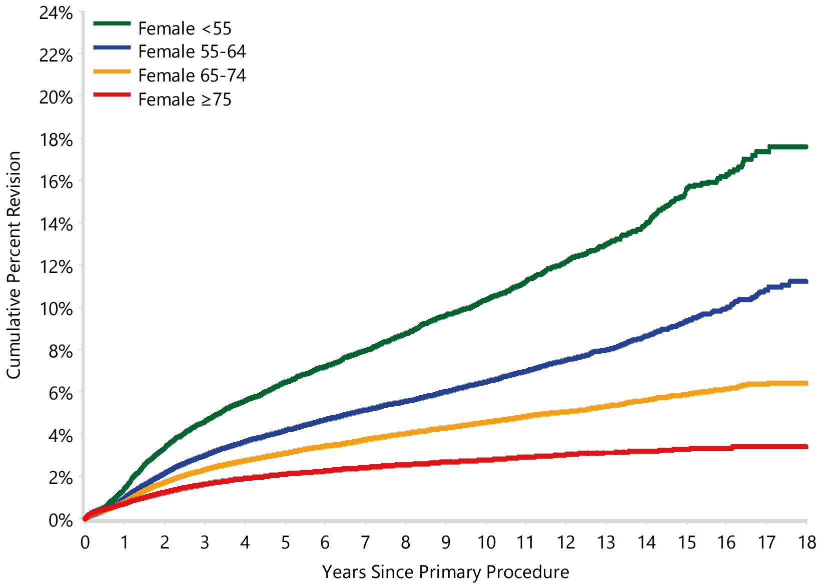
Male <55 vs Male ≥75
- 0 - 6Mth: HR=1.59 (1.33, 1.91),p<0.001
- 6Mth - 1.5Yr: HR=2.95 (2.61, 3.33),p<0.001
- 1.5Yr - 2Yr: HR=3.66 (3.04, 4.41),p<0.001
- 2Yr - 2.5Yr: HR=2.81 (2.23, 3.53),p<0.001
- 2.5Yr - 3Yr: HR=3.74 (2.91, 4.80),p<0.001
- 3Yr - 3.5Yr: HR=2.97 (2.23, 3.95),p<0.001
- 3.5Yr - 7Yr: HR=3.69 (3.18, 4.29),p<0.001
- 7Yr - 8.5Yr: HR=4.61 (3.60, 5.90),p<0.001
- 8.5Yr - 10Yr: HR=6.20 (4.75, 8.10),p<0.001
- 10Yr+: HR=6.17 (5.06, 7.53),p<0.001

Male 55-64 vs Male ≥75
- 0 - 3Mth: HR=1.20 (1.03, 1.39),p=0.020
- 3Mth - 9Mth: HR=1.53 (1.35, 1.73),p<0.001
- 9Mth - 1Yr: HR=1.79 (1.52, 2.11),p<0.001
- 1Yr - 4Yr: HR=2.24 (2.08, 2.42),p<0.001
- 4Yr - 4.5Yr: HR=2.96 (2.35, 3.72),p<0.001
- 4.5Yr - 8.5Yr: HR=2.78 (2.47, 3.13),p<0.001
- 8.5Yr+: HR=3.80 (3.28, 4.39),p<0.001

Male 65-74 vs Male ≥75
- 0 - 6Mth: HR=1.08 (0.96, 1.22),p=0.218
- 6Mth - 1.5Yr: HR=1.40 (1.28, 1.53),p<0.001
- 1.5Yr - 2.5Yr: HR=1.57 (1.40, 1.75),p<0.001
- 2.5Yr+: HR=1.81 (1.66, 1.97),p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Male	<55	18158	16263	12795	10035	4431	1178	76
	55-64	78009	69680	54575	41716	17231	3835	246
	65-74	113197	100993	78417	58908	23423	4695	235
	≥75	71855	64198	49482	35784	11207	1280	46

Figure KT14 Cumulative Percent Revision of Primary Total Knee Replacement in Females by Age (Primary Diagnosis OA)



Female <55 vs Female ≥75
- 0 - 6Mth: HR=1.29 (1.06, 1.56),p=0.010
- 6Mth - 1.5Yr: HR=3.50 (3.12, 3.93),p<0.001
- 1.5Yr - 3Yr: HR=3.26 (2.90, 3.68),p<0.001
- 3Yr - 4Yr: HR=3.78 (3.15, 4.54),p<0.001
- 4Yr - 7.5Yr: HR=5.21 (4.52, 5.99),p<0.001
- 7.5Yr - 8.5Yr: HR=7.38 (5.68, 9.60),p<0.001
- 8.5Yr - 9Yr: HR=5.35 (3.53, 8.11),p<0.001
- 9Yr+: HR=8.07 (6.79, 9.59),p<0.001

Female 55-64 vs Female ≥75
- 0 - 3Mth: HR=0.76 (0.64, 0.90),p=0.001
- 3Mth - 9Mth: HR=1.56 (1.37, 1.78),p<0.001
- 9Mth - 1Yr: HR=2.44 (2.07, 2.86),p<0.001
- 1Yr - 3Yr: HR=2.15 (1.99, 2.33),p<0.001
- 3Yr - 4Yr: HR=2.44 (2.12, 2.80),p<0.001
- 4Yr - 6.5Yr: HR=3.17 (2.80, 3.59),p<0.001
- 6.5Yr - 9Yr: HR=3.20 (2.75, 3.73),p<0.001
- 9Yr - 11Yr: HR=4.17 (3.43, 5.06),p<0.001
- 11Yr+: HR=4.93 (4.12, 5.90),p<0.001

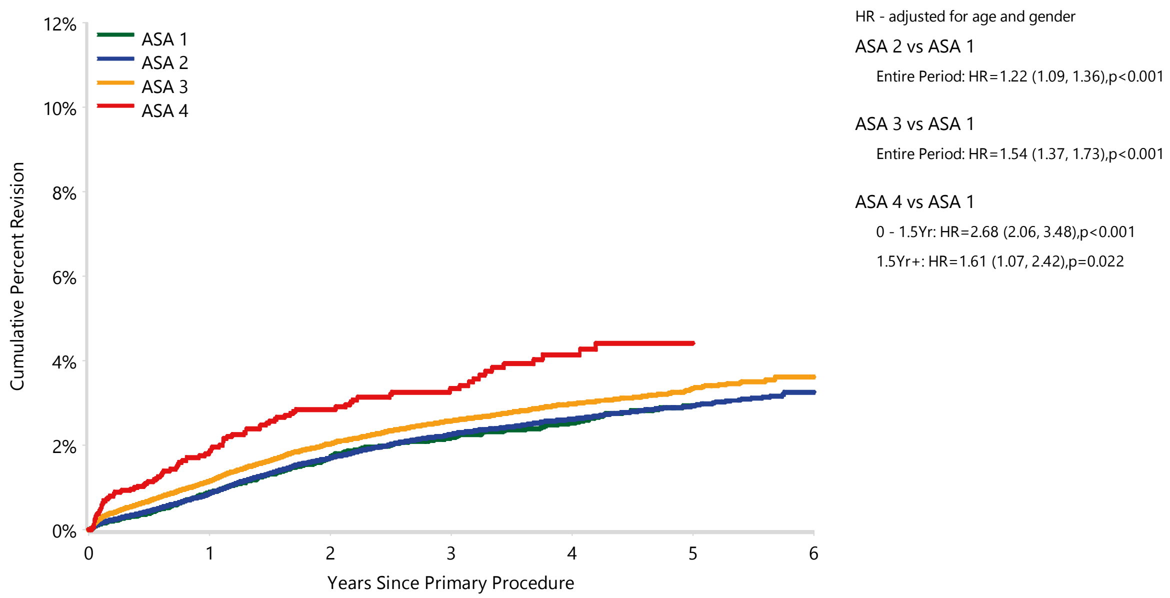
Female 65-74 vs Female ≥75
- 0 - 6Mth: HR=0.95 (0.84, 1.07),p=0.428
- 6Mth - 1Yr: HR=1.38 (1.22, 1.57),p<0.001
- 1Yr - 1.5Yr: HR=1.80 (1.61, 2.02),p<0.001
- 1.5Yr - 2Yr: HR=1.61 (1.42, 1.83),p<0.001
- 2Yr - 4Yr: HR=1.55 (1.41, 1.71),p<0.001
- 4Yr+: HR=2.10 (1.89, 2.33),p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Female	<55	24085	21782	17193	13324	5803	1416	88
	55-64	91710	83045	65961	51114	21578	5003	288
	65-74	140125	126100	99298	76277	32699	7331	443
	≥75	106062	96129	76909	58489	21428	2987	105

Table KT15 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
ASA 1	333	17284	0.9 (0.7, 1.0)	1.7 (1.5, 2.0)	2.2 (2.0, 2.5)	2.5 (2.3, 2.8)	2.9 (2.6, 3.3)	
ASA 2	3037	159030	0.9 (0.8, 0.9)	1.7 (1.6, 1.8)	2.3 (2.2, 2.3)	2.6 (2.5, 2.7)	2.9 (2.8, 3.1)	3.2 (3.1, 3.5)
ASA 3	2254	105757	1.2 (1.1, 1.2)	2.0 (1.9, 2.1)	2.6 (2.5, 2.7)	3.0 (2.8, 3.1)	3.3 (3.2, 3.5)	3.6 (3.4, 3.9)
ASA 4	94	3081	1.8 (1.4, 2.4)	2.9 (2.3, 3.6)	3.3 (2.7, 4.1)	4.1 (3.3, 5.1)	4.4 (3.5, 5.5)	
ASA 5	0	16	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)		
TOTAL	**5718**	**285168**						

Figure KT15 Cumulative Percent Revision of Primary Total Knee Replacement by ASA Score (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
ASA 1	17284	14143	10873	7862	4829	2083	21
ASA 2	159030	128199	97777	69323	41763	16765	150
ASA 3	105757	82356	60696	40980	23815	9072	78
ASA 4	3081	2393	1804	1267	766	313	7

Figure KT16 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by ASA Score (Primary Diagnosis OA)

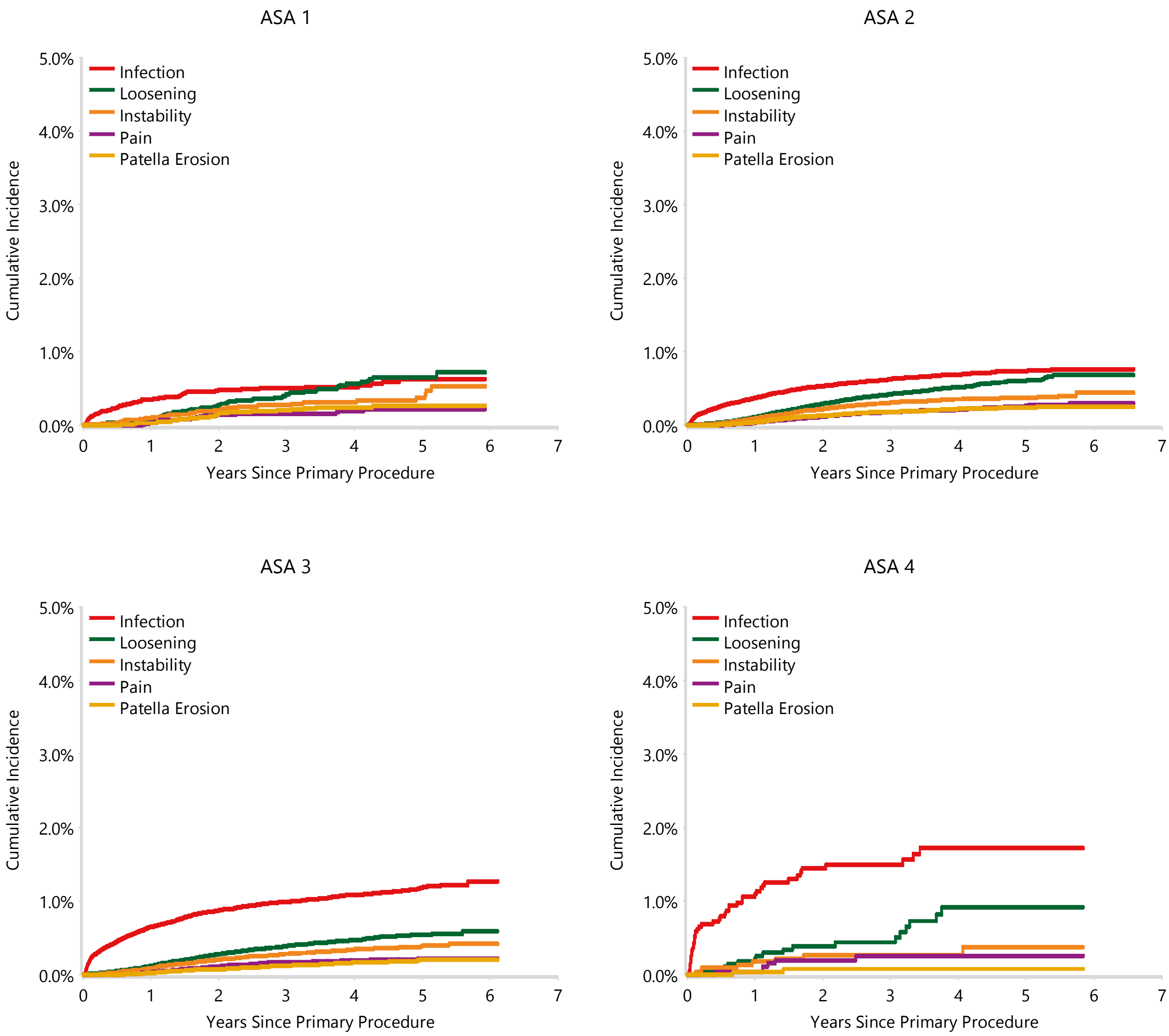
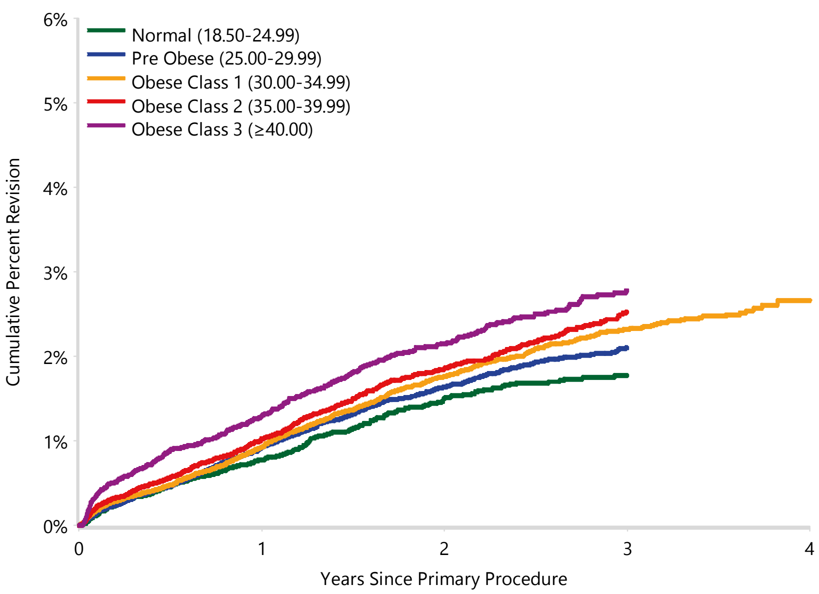


Table KT16 Cumulative Percent Revision of Primary Total Knee Replacement by BMI Category (Primary Diagnosis OA)

BMI Category	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs
Underweight (<18.50)	4	337	0.9 (0.3, 2.9)	1.5 (0.5, 4.1)	1.5 (0.5, 4.1)	
Normal (18.50-24.99)	254	19877	0.8 (0.7, 0.9)	1.5 (1.3, 1.7)	1.8 (1.6, 2.0)	
Pre Obese (25.00-29.99)	859	60305	0.9 (0.8, 1.0)	1.6 (1.5, 1.8)	2.1 (2.0, 2.3)	
Obese Class 1 (30.00-34.99)	915	59624	0.9 (0.8, 1.0)	1.8 (1.6, 1.9)	2.3 (2.2, 2.5)	2.7 (2.4, 2.9)
Obese Class 2 (35.00-39.99)	554	33207	1.0 (0.9, 1.2)	1.9 (1.7, 2.0)	2.5 (2.3, 2.8)	
Obese Class 3 (≥40.00)	398	20679	1.3 (1.1, 1.5)	2.2 (1.9, 2.4)	2.8 (2.5, 3.1)	
TOTAL	**2984**	**194029**				

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

Figure KT17 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=1.03 (0.89, 1.18),p=0.698

Obese Class 1 (30.00-34.99) vs Normal (18.50-24.99)
Entire Period: HR=1.08 (0.94, 1.24),p=0.287

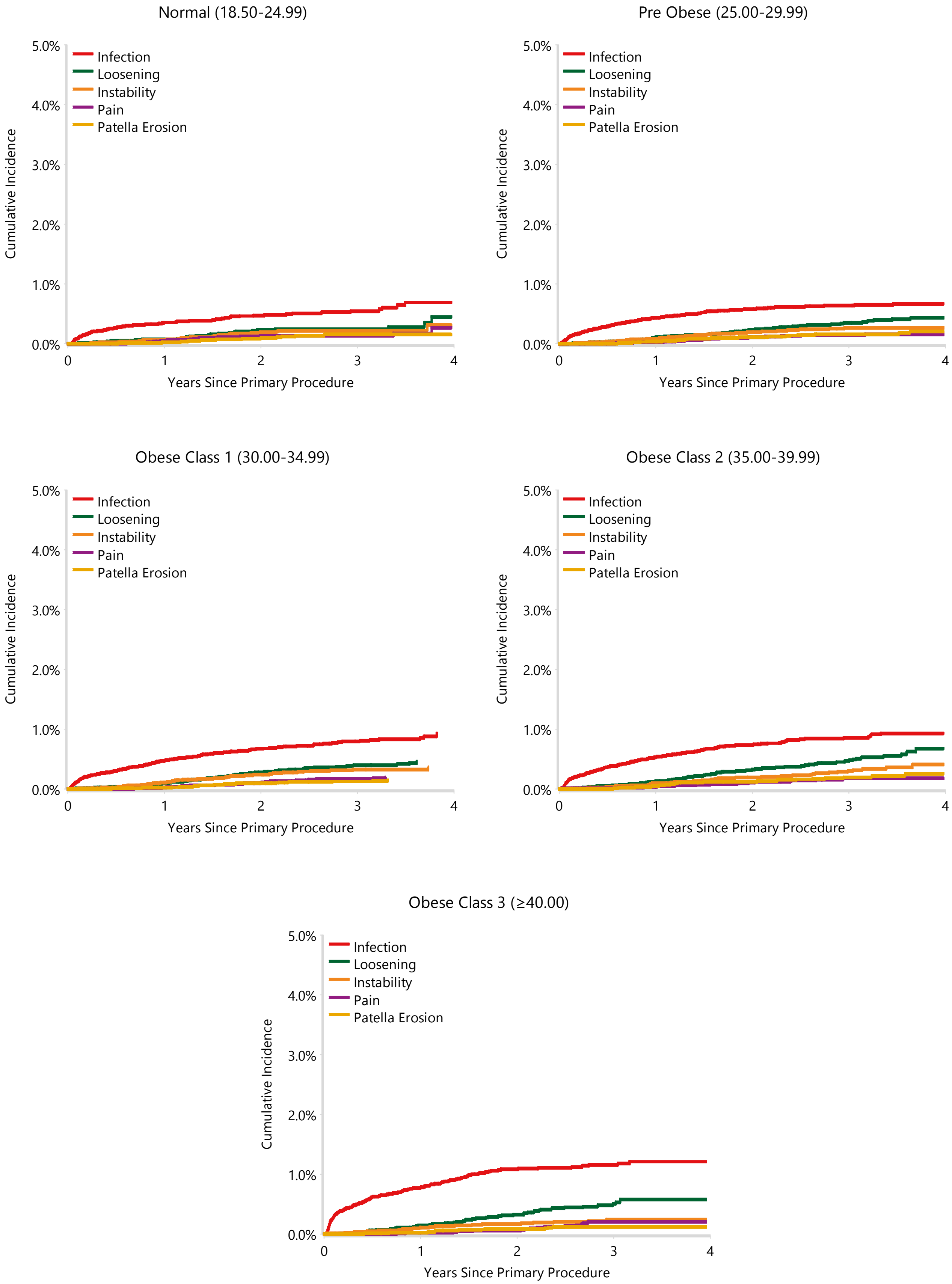
Obese Class 2 (35.00-39.99) vs Normal (18.50-24.99)
Entire Period: HR=1.17 (1.01, 1.36),p=0.040

Obese Class 3 (≥40.00) vs Normal (18.50-24.99)
0 - 6Mth: HR=1.87 (1.53, 2.29),p<0.001
6Mth+: HR=1.08 (0.90, 1.30),p=0.405

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs
Normal (18.50-24.99)	19877	14300	9041	4239	12
Pre Obese (25.00-29.99)	60305	43249	27000	12353	36
Obese Class 1 (30.00-34.99)	59624	42718	26612	12164	44
Obese Class 2 (35.00-39.99)	33207	23507	14576	6654	24
Obese Class 3 (≥40.00)	20679	14722	9125	4035	11

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

Figure KT18 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 or less

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 8 years. After this time, mobile bearings have a lower rate of revision (Table KT17 and Figure KT19).

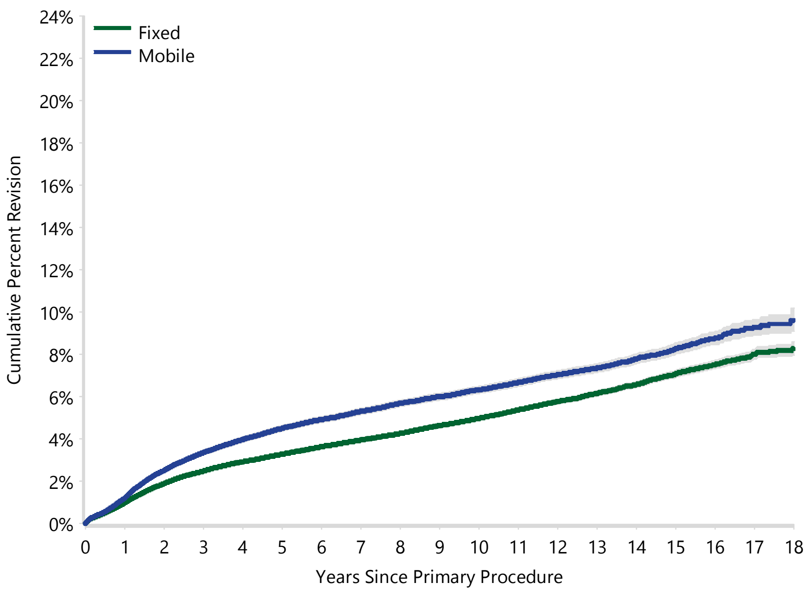
When types of fixed bearings are compared, moulded non-modular tibial prostheses have the lowest rate of revision. However, this only includes a limited number of prosthesis types. There is no difference when comparing all-polyethylene to fixed modular tibial prostheses (Table KT18 and Figure KT20).

Table KT17 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	18 Yrs
Fixed	18044	515200	1.0 (1.0, 1.0)	2.5 (2.4, 2.5)	3.3 (3.2, 3.3)	5.0 (4.9, 5.1)	7.1 (6.9, 7.2)	8.3 (7.9, 8.6)
Mobile	6671	127815	1.2 (1.1, 1.3)	3.4 (3.2, 3.5)	4.5 (4.4, 4.6)	6.3 (6.2, 6.5)	8.3 (8.0, 8.5)	9.6 (9.1, 10.2)
TOTAL	**24715**	**643015**						

Note: Excludes 186 procedures with unknown bearing mobility

Figure KT19 Cumulative Percent Revision of Primary Total Knee Replacement by Bearing Mobility (Primary Diagnosis OA)



HR - adjusted for age and gender

Mobile vs Fixed

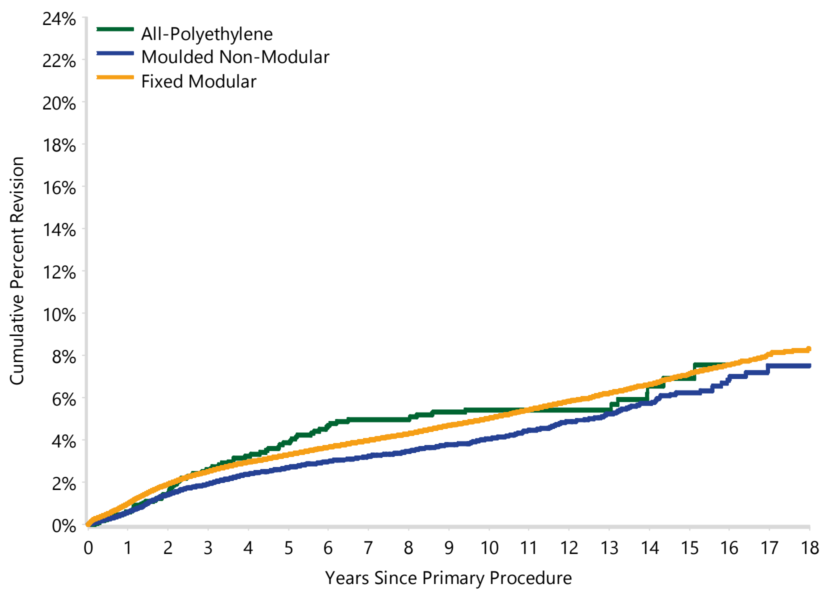
- 0 - 1Yr: HR=1.20 (1.14, 1.28),p<0.001
- 1Yr - 1.5Yr: HR=1.48 (1.37, 1.60),p<0.001
- 1.5Yr - 2.5Yr: HR=1.32 (1.23, 1.41),p<0.001
- 2.5Yr - 3Yr: HR=1.48 (1.31, 1.66),p<0.001
- 3Yr - 4Yr: HR=1.37 (1.25, 1.51),p<0.001
- 4Yr - 5Yr: HR=1.48 (1.32, 1.65),p<0.001
- 5Yr - 5.5Yr: HR=1.28 (1.08, 1.51),p=0.004
- 5.5Yr - 8Yr: HR=1.17 (1.07, 1.27),p<0.001
- 8Yr+: HR=0.88 (0.81, 0.95),p=0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Fixed	515200	459326	355013	264299	98909	19289	1051
Mobile	127815	118683	99462	81218	38824	8421	474

Table KT18 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	18 Yrs
All-Polyethylene	76	1754	0.6 (0.3, 1.1)	2.6 (1.9, 3.5)	3.9 (3.0, 5.0)	5.4 (4.3, 6.8)	6.9 (5.3, 9.0)	
Moulded Non-Modular	799	23358	0.6 (0.5, 0.7)	1.9 (1.8, 2.1)	2.7 (2.5, 2.9)	4.1 (3.8, 4.4)	6.2 (5.6, 6.9)	7.5 (6.5, 8.8)
Fixed Modular	17169	490088	1.0 (1.0, 1.0)	2.5 (2.5, 2.6)	3.3 (3.2, 3.4)	5.0 (4.9, 5.1)	7.1 (7.0, 7.3)	8.3 (8.0, 8.7)
TOTAL	**18044**	**515200**						

Figure KT20 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=1.48 (1.17, 1.87),p=0.001

All-Polyethylene vs Fixed Modular
Entire Period: HR=1.19 (0.95, 1.49),p=0.133

Fixed Modular vs Moulded Non-Modular
0 - 9Mth: HR=1.92 (1.57, 2.35),p<0.001
9Mth - 1.5Yr: HR=1.28 (1.08, 1.51),p=0.003
1.5Yr+: HR=1.14 (1.05, 1.24),p=0.002

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
All-Polyethylene	1754	1606	1246	1052	734	161	2
Moulded Non-Modular	23358	22214	19641	16242	6480	1084	77
Fixed Modular	490088	435506	334126	247005	91695	18044	972

Stability

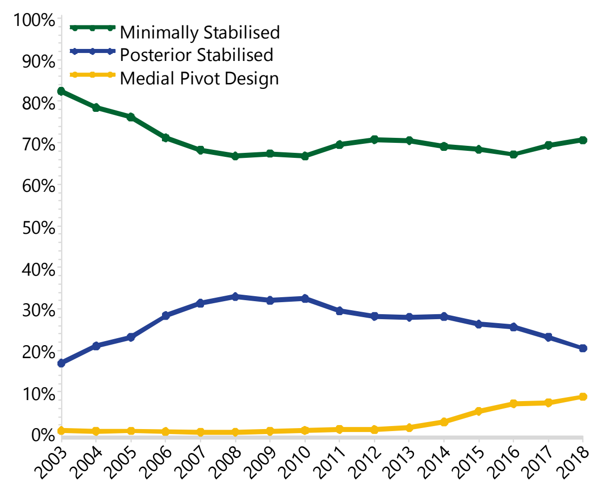
Stability refers to particular prosthetic features intended to substitute for the intrinsic stability of knee ligaments. Since 2017, the Registry has expanded the classification to include the medial pivot designs separately. The three major categories are now: minimally stabilised, medial pivot design and posterior stabilised.

The three major categories of stability reported by the Registry are minimally stabilised, medial pivot design and posterior stabilised.

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 2018, these accounted for 70.6% of primary procedures. The use of posterior stabilised prostheses has declined from 32.9% in 2008 to 20.5% in 2018. Medial pivot design prostheses have been used in small numbers since the Registry began collecting data. In 2018, the use of medial pivot design prostheses increased, accounting for 8.9% of primary procedures (Figure KT21).

Figure KT21 Primary Total Knee Replacement by Stability (Primary Diagnosis OA)



Fully stabilised (large peg and box design) and hinged, are less used prostheses that provide additional collateral, as well as posterior ligament stability. These prostheses are used in 0.5% of primary procedures (Table KT19). They are usually used in complex clinical situations.

Posterior stabilised and medial pivot design prostheses have a higher rate of revision compared to minimally stabilised prostheses (Table KT19 and Figure KT22). 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 KT23).

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 8 prostheses (Table KT20). 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 (Table KT21 and Figure KT24).

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 year when compared to posterior stabilised. The condylar stabilising polyethylene has a lower rate of revision when compared to the posterior stabilised for the first 1.5 years (Table KT22 and Figure KT25). 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 KT23 and Figure KT26).

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 KT24 and Figure KT27).

Fully Stabilised and Hinge 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. 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 KT25).

Fully stabilised prostheses have been used in 2,595 procedures and hinged prostheses in 1,771 primary total knee procedures. For these two knee designs, the cumulative percent revision for all diagnoses are shown in Table KT26 and Figure KT28.

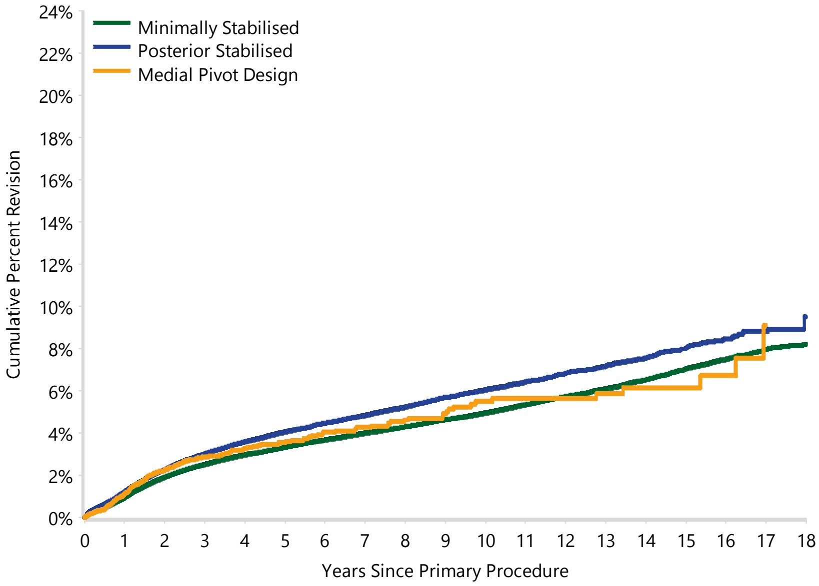
When the outcome for osteoarthritis alone is considered, fully stabilised and hinged knee prostheses both have higher rates of revision compared to minimally stabilised prostheses (Figure KT29). For both of these designs, infection is the most common reason for revision, followed by loosening for fully stabilised and fracture for hinged prostheses (Table KT27 and Figure KT30).

Table KT19 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	18 Yrs
Minimally Stabilised	16785	454074	0.9 (0.9, 1.0)	2.5 (2.5, 2.6)	3.3 (3.3, 3.4)	4.9 (4.9, 5.0)	7.0 (6.9, 7.2)	8.2 (7.9, 8.5)
Posterior Stabilised	7287	166415	1.2 (1.2, 1.3)	3.0 (2.9, 3.1)	4.1 (3.9, 4.2)	6.0 (5.9, 6.2)	8.0 (7.7, 8.3)	9.5 (8.3, 10.8)
Medial Pivot Design	447	19249	1.1 (1.0, 1.3)	2.9 (2.6, 3.2)	3.5 (3.2, 4.0)	5.5 (4.7, 6.4)	6.2 (5.1, 7.4)	
Fully Stabilised	129	2344	2.5 (1.9, 3.2)	4.7 (3.9, 5.7)	6.1 (5.0, 7.4)	9.0 (7.3, 11.2)		
Hinged	67	933	3.2 (2.2, 4.6)	6.0 (4.5, 8.0)	8.1 (6.2, 10.6)	13.2 (10.0, 17.5)		
TOTAL	**24715**	**643015**						

Note: Excludes 186 procedures with unknown stability

Figure KT22 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 (1.22, 1.36),p<0.001
- 1Yr - 2Yr: HR=1.08 (1.02, 1.14),p=0.013
- 2Yr - 2.5Yr: HR=1.27 (1.15, 1.40),p<0.001
- 2.5Yr - 3Yr: HR=1.17 (1.04, 1.32),p=0.007
- 3Yr - 3.5Yr: HR=1.26 (1.11, 1.42),p<0.001
- 3.5Yr - 5.5Yr: HR=1.26 (1.17, 1.36),p<0.001
- 5.5Yr - 6Yr: HR=1.37 (1.15, 1.62),p<0.001
- 6Yr - 7.5Yr: HR=1.24 (1.10, 1.39),p<0.001
- 7.5Yr - 8Yr: HR=1.06 (0.84, 1.32),p=0.638
- 8Yr - 9.5Yr: HR=1.41 (1.23, 1.61),p<0.001
- 9.5Yr+: HR=0.99 (0.89, 1.11),p=0.870

Posterior Stabilised vs Medial Pivot Design
- Entire Period: HR=1.09 (0.99, 1.20),p=0.068

Medial Pivot Design vs Minimally Stabilised
- Entire Period: HR=1.10 (1.00, 1.21),p=0.041

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Minimally Stabilised	454074	408801	324542	249415	103974	23573	1366
Posterior Stabilised	166415	152276	121781	92407	32801	3890	154
Medial Pivot Design	19249	14222	6398	2560	694	199	4

Figure KT23 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by Stability (Primary Diagnosis OA)

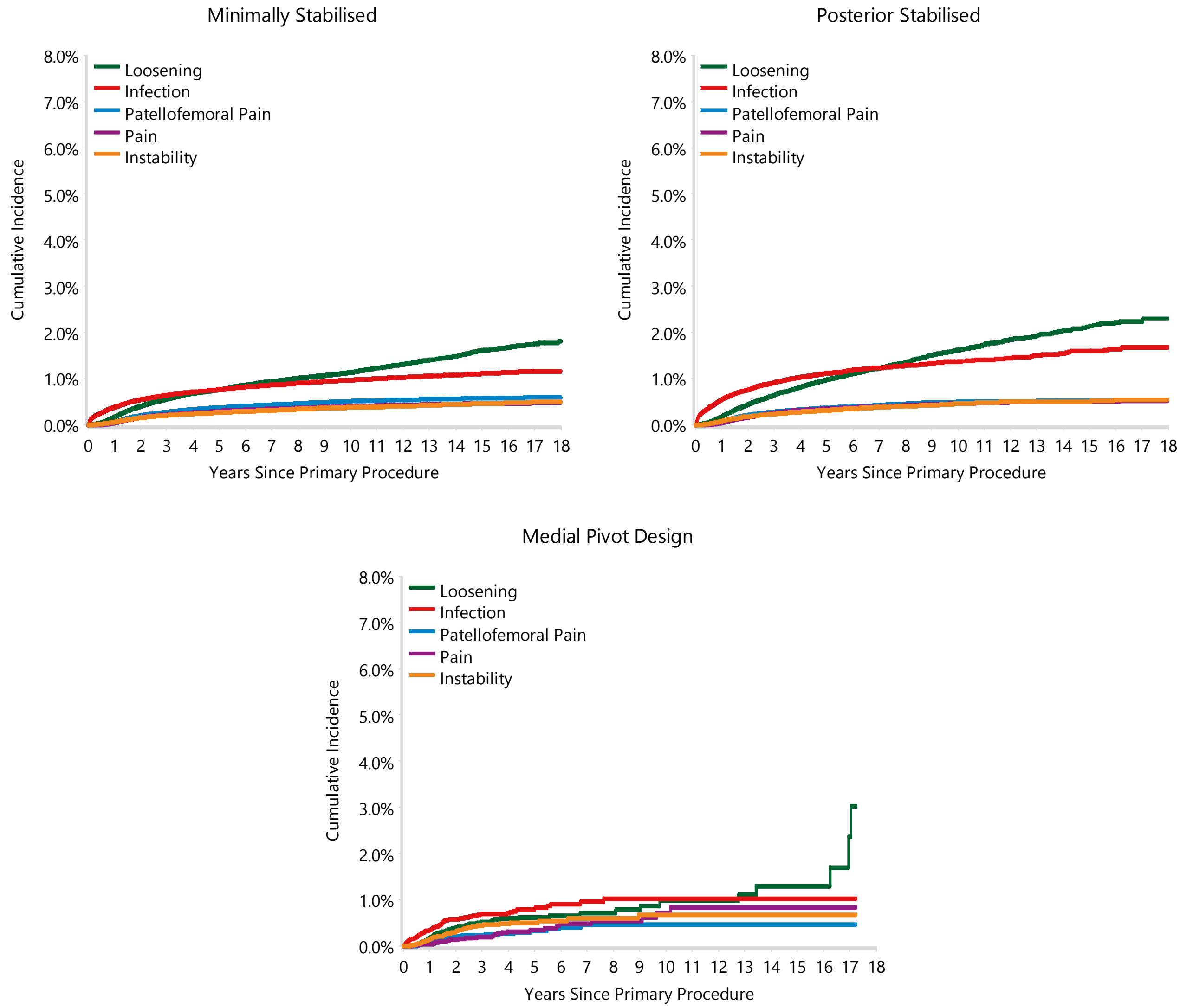


Table KT20 Cumulative Percent Revision of Primary Total Knee Replacement with Medial Pivot Design by Insert (Primary Diagnosis OA)

Insert	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Advance	32	685	1.3 (0.7, 2.6)	4.5 (3.1, 6.5)	5.2 (3.7, 7.5)			
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	113	1665	1.8 (1.3, 2.6)	4.4 (3.5, 5.5)	5.4 (4.3, 6.6)	7.4 (6.1, 9.0)	8.1 (6.6, 9.9)	
Evolution	113	6448	0.9 (0.7, 1.2)	2.6 (2.2, 3.2)	3.4 (2.6, 4.5)			
GMK Sphere Primary	137	6956	1.4 (1.1, 1.7)	2.7 (2.3, 3.2)	3.4 (2.7, 4.3)			
MRK	13	588	0.9 (0.4, 2.1)	2.2 (1.3, 3.9)	2.2 (1.3, 3.9)			
Persona*	1	270						
SAIPH	33	2622	0.5 (0.3, 0.8)	2.0 (1.4, 2.9)	2.3 (1.6, 3.5)			
TOTAL	**447**	**19249**						

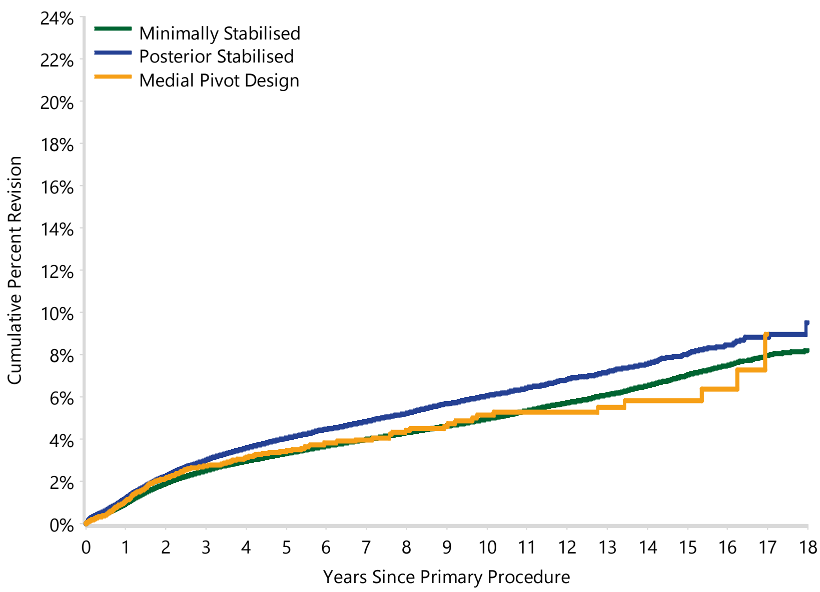
Note: *CPR not provided due to an insufficient number of procedures with one year follow up at the time of reporting

Table KT21 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	18 Yrs
Minimally Stabilised	16785	454074	0.9 (0.9, 1.0)	2.5 (2.5, 2.6)	3.3 (3.3, 3.4)	4.9 (4.9, 5.0)	7.0 (6.9, 7.2)	8.2 (7.9, 8.5)
Posterior Stabilised	7286	166380	1.2 (1.2, 1.3)	3.0 (2.9, 3.1)	4.1 (3.9, 4.2)	6.0 (5.9, 6.2)	8.0 (7.7, 8.3)	9.5 (8.4, 10.8)
Medial Pivot Design	399	18387	1.1 (0.9, 1.3)	2.7 (2.5, 3.1)	3.4 (3.0, 3.8)	5.1 (4.3, 6.1)	5.8 (4.7, 7.1)	
Fully Stabilised	129	2344	2.5 (1.9, 3.2)	4.7 (3.9, 5.7)	6.1 (5.0, 7.4)	9.0 (7.3, 11.2)		
Hinged	67	933	3.2 (2.2, 4.6)	6.0 (4.5, 8.0)	8.1 (6.2, 10.6)	13.2 (10.0, 17.5)		
TOTAL	**24666**	**642118**						

Note: Excludes 186 procedures with unknown stability

Figure KT24 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 (1.22, 1.36),p<0.001
1Yr - 2Yr: HR=1.08 (1.02, 1.14),p=0.012
2Yr - 2.5Yr: HR=1.27 (1.15, 1.40),p<0.001
2.5Yr - 3Yr: HR=1.17 (1.04, 1.32),p=0.007
3Yr - 3.5Yr: HR=1.26 (1.11, 1.42),p<0.001
3.5Yr - 5.5Yr: HR=1.26 (1.17, 1.36),p<0.001
5.5Yr - 6Yr: HR=1.38 (1.16, 1.63),p<0.001
6Yr - 7.5Yr: HR=1.24 (1.10, 1.39),p<0.001
7.5Yr - 8Yr: HR=1.05 (0.84, 1.32),p=0.646
8Yr - 9.5Yr: HR=1.41 (1.24, 1.62),p<0.001
9.5Yr+: HR=0.99 (0.89, 1.11),p=0.890

Posterior Stabilised vs Medial Pivot Design
Entire Period: HR=1.14 (1.03, 1.26),p=0.013

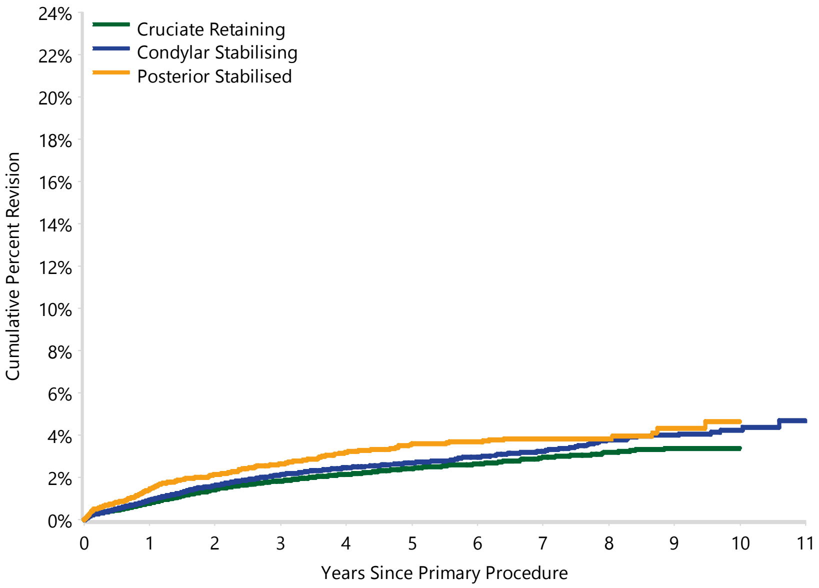
Medial Pivot Design vs Minimally Stabilised
Entire Period: HR=1.06 (0.96, 1.17),p=0.242

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Minimally Stabilised	454074	408801	324542	249415	103974	23573	1366
Posterior Stabilised	166380	152244	121751	92379	32776	3868	154
Medial Pivot Design	18387	13453	5837	2173	662	194	0

Table KT22 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	11 Yrs
Cruciate Retaining	697	35259	0.8 (0.7, 0.9)	1.8 (1.7, 2.0)	2.4 (2.2, 2.6)	3.0 (2.7, 3.2)	3.4 (3.1, 3.7)	
Condylar Stabilising	785	36428	0.9 (0.8, 1.0)	2.1 (2.0, 2.3)	2.7 (2.5, 2.9)	3.3 (3.0, 3.5)	4.2 (3.8, 4.7)	4.7 (3.9, 5.6)
Posterior Stabilised	214	7259	1.5 (1.2, 1.8)	2.6 (2.3, 3.1)	3.6 (3.1, 4.1)	3.8 (3.3, 4.4)	4.6 (3.7, 5.8)	
TOTAL	**1696**	**78946**						

Figure KT25 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=1.14 (1.03, 1.26),p=0.011

Posterior Stabilised vs Cruciate Retaining
0 - 1Yr: HR=1.79 (1.44, 2.23),p<0.001
1Yr+: HR=1.14 (0.93, 1.40),p=0.201

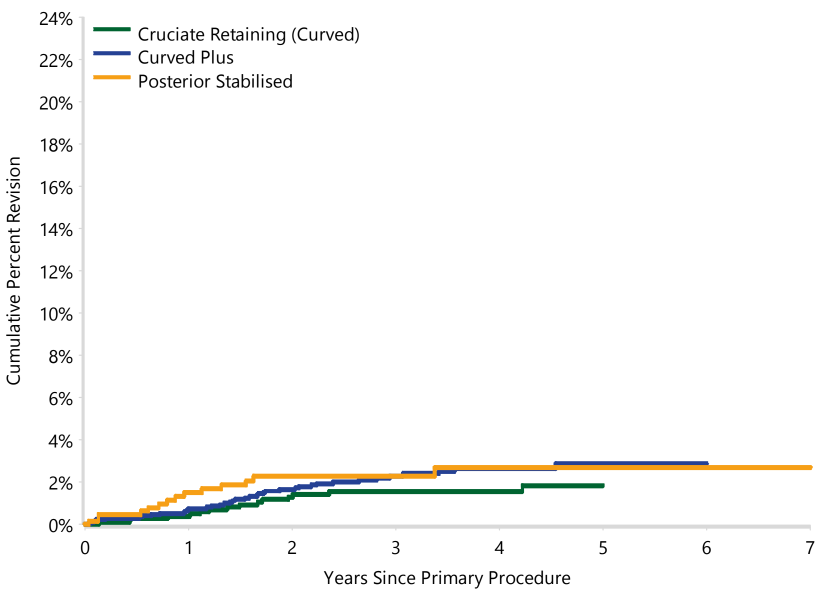
Posterior Stabilised vs Condylar Stabilising
0 - 1.5Yr: HR=1.45 (1.20, 1.76),p<0.001
1.5Yr+: HR=0.96 (0.77, 1.21),p=0.759

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
Cruciate Retaining	35259	29280	20423	12693	6040	402	31
Condylar Stabilising	36428	29934	19129	11050	5420	678	110
Posterior Stabilised	7259	6334	4591	2825	1448	165	30

Table KT23 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	6 Yrs	7 Yrs
Cruciate Retaining (Curved)	15	1134	0.4 (0.1, 1.0)	1.3 (0.7, 2.3)	1.6 (0.9, 2.7)	1.8 (1.1, 3.1)		
Curved Plus	40	1999	0.8 (0.4, 1.3)	1.6 (1.1, 2.4)	2.3 (1.7, 3.2)	2.9 (2.1, 4.0)	2.9 (2.1, 4.0)	
Posterior Stabilised	14	664	1.5 (0.8, 2.9)	2.3 (1.3, 3.9)	2.3 (1.3, 3.9)	2.7 (1.6, 4.6)	2.7 (1.6, 4.6)	2.7 (1.6, 4.6)
TOTAL	**69**	**3797**						

Figure KT26 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=1.48 (0.82, 2.69),p=0.194

Curved Plus vs Posterior Stabilised

Entire Period: HR=0.90 (0.49, 1.66),p=0.742

Posterior Stabilised vs Cruciate Retaining (Curved)

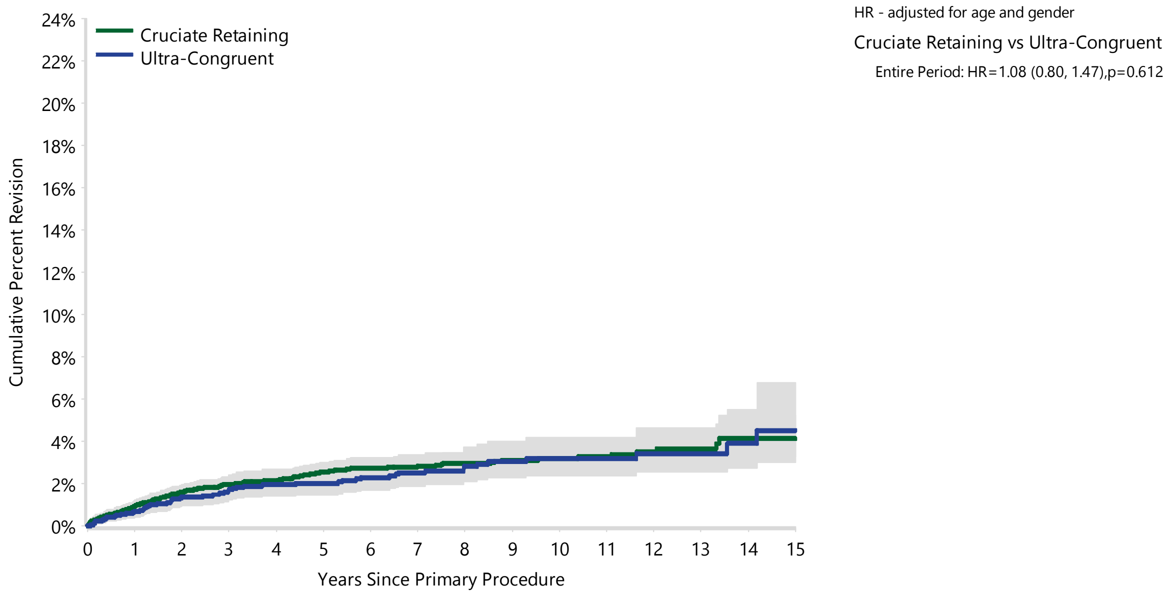
Entire Period: HR=1.64 (0.79, 3.40),p=0.182

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	6 Yrs	7 Yrs
Cruciate Retaining (Curved)	1134	937	768	536	143	5	4
Curved Plus	1999	1710	1396	984	301	130	33
Posterior Stabilised	664	546	423	290	168	131	45

Table KT24 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	10 Yrs	16 Yrs
Cruciate Retaining	165	6411	0.9 (0.7, 1.2)	2.0 (1.6, 2.3)	2.5 (2.2, 3.0)	2.8 (2.4, 3.3)	3.2 (2.7, 3.7)	
Ultra-Congruent	55	2194	0.7 (0.4, 1.2)	1.7 (1.2, 2.4)	2.0 (1.5, 2.8)	2.5 (1.9, 3.4)	3.2 (2.4, 4.2)	
TOTAL	**220**	**8605**						

Figure KT27 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	10 Yrs	16 Yrs
Cruciate Retaining	6411	5970	4931	3750	2676	1286	34
Ultra-Congruent	2194	2012	1704	1460	1164	582	9

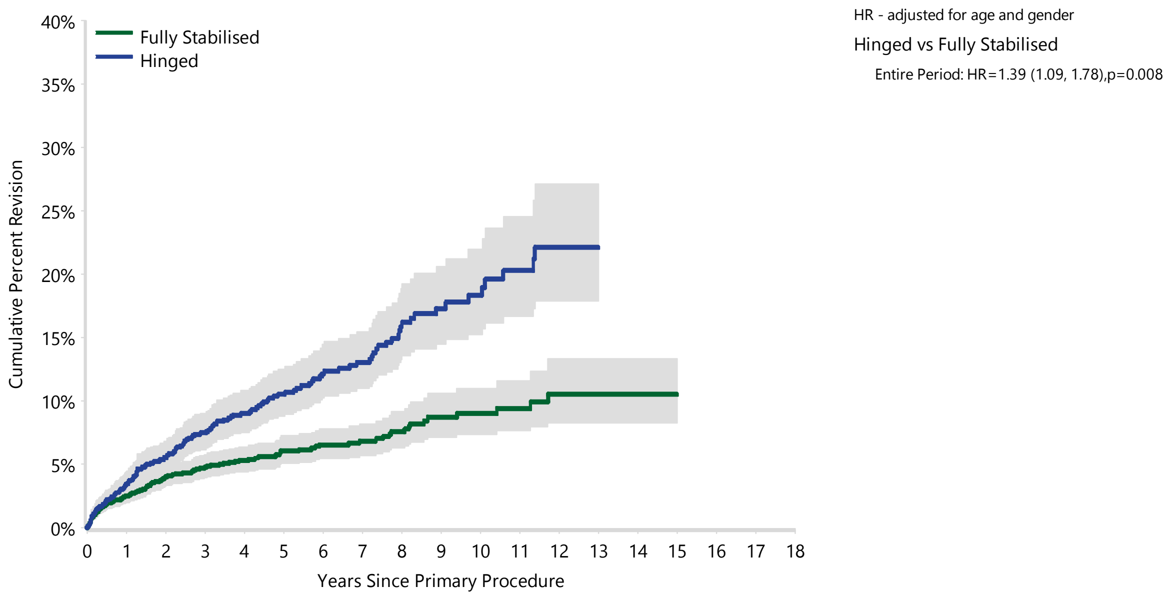
Table KT25 Primary Knee Replacement by Primary Diagnosis and Stability

	Fully Stabilised		Hinged		TOTAL	
Primary Diagnosis	N	Col%	N	Col%	N	Col%
Osteoarthritis	2344	90.3	933	52.7	3277	75.1
Tumour	7	0.3	529	29.9	536	12.3
Fracture	39	1.5	159	9.0	198	4.5
Rheumatoid Arthritis	131	5.0	56	3.2	187	4.3
Osteonecrosis	29	1.1	26	1.5	55	1.3
Other Inflammatory Arthritis	23	0.9	24	1.4	47	1.1
Other	22	0.8	44	2.5	66	1.5
TOTAL	**2595**	**100.0**	**1771**	**100.0**	**4366**	**100.0**

Table KT26 Cumulative Percent Revision of Primary Total Knee Replacement by Stability (All Diagnosis)

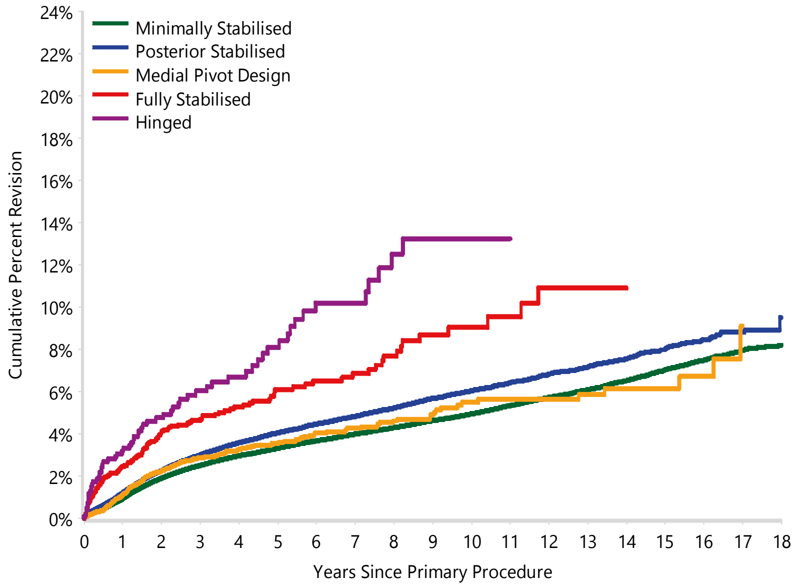
Stability	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Fully Stabilised	143	2595	2.5 (2.0, 3.2)	4.8 (3.9, 5.8)	6.1 (5.1, 7.3)	9.0 (7.4, 11.0)	10.5 (8.3, 13.3)	
Hinged	161	1771	3.4 (2.6, 4.4)	7.5 (6.2, 9.0)	10.5 (8.8, 12.5)	18.4 (15.3, 22.0)		
TOTAL	**304**	**4366**						

Figure KT28 Cumulative Percent Revision of Primary Total Knee Replacement by Stability (All Diagnosis)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Fully Stabilised	2595	2180	1457	948	245	48	1
Hinged	1771	1366	842	554	134	19	2

Figure KT29 Cumulative Percent Revision of Primary Total Knee Replacement by Stability (Primary Diagnosis OA)



HR - adjusted for age and gender

Posterior Stabilised vs Minimally Stabilised
0 - 1Yr: HR=1.29 (1.22, 1.36),p<0.001
1Yr - 2Yr: HR=1.08 (1.01, 1.14),p=0.014
2Yr - 2.5Yr: HR=1.27 (1.15, 1.40),p<0.001
2.5Yr - 3Yr: HR=1.18 (1.05, 1.32),p=0.006
3Yr - 3.5Yr: HR=1.26 (1.12, 1.43),p<0.001
3.5Yr - 5Yr: HR=1.32 (1.21, 1.43),p<0.001
5Yr - 5.5Yr: HR=1.07 (0.90, 1.26),p=0.467
5.5Yr - 6Yr: HR=1.37 (1.15, 1.62),p<0.001
6Yr - 7.5Yr: HR=1.24 (1.11, 1.39),p<0.001
7.5Yr - 8Yr: HR=1.04 (0.83, 1.31),p=0.708
8Yr - 9.5Yr: HR=1.41 (1.23, 1.61),p<0.001
9.5Yr+: HR=0.99 (0.89, 1.11),p=0.879

Medial Pivot Design vs Minimally Stabilised
Entire Period: HR=1.10 (1.00, 1.21),p=0.040

Fully Stabilised vs Minimally Stabilised
0 - 6Mth: HR=4.06 (3.01, 5.49),p<0.001
6Mth - 1.5Yr: HR=1.24 (0.84, 1.83),p=0.286
1.5Yr+: HR=1.69 (1.31, 2.17),p<0.001

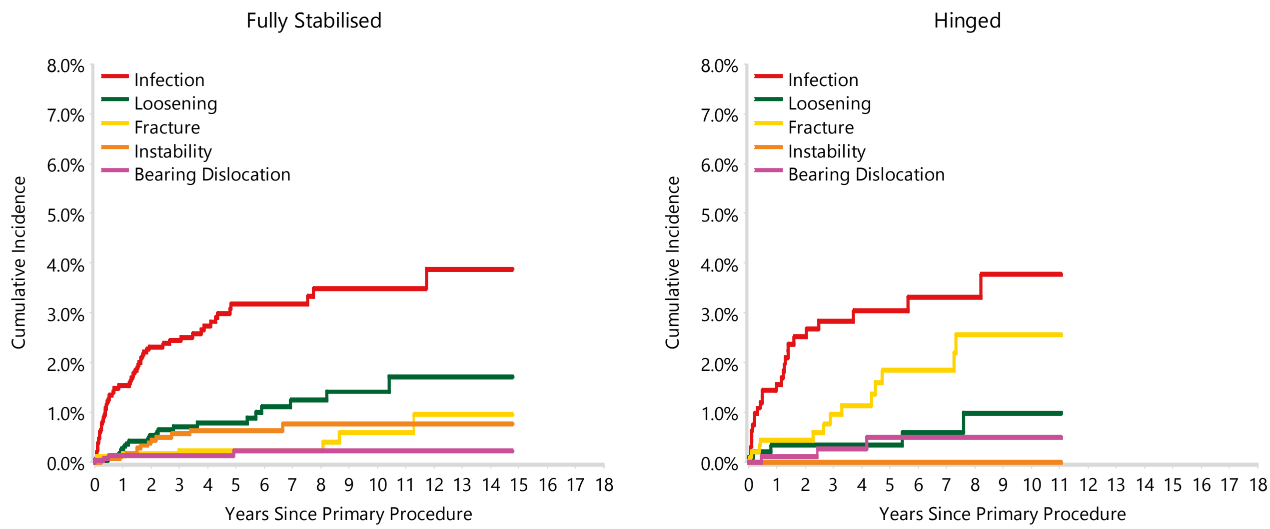
Hinged vs Minimally Stabilised
0 - 6Mth: HR=5.72 (3.83, 8.56),p<0.001
6Mth - 1.5Yr: HR=1.53 (0.87, 2.70),p=0.139
1.5Yr+: HR=2.28 (1.61, 3.25),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Minimally Stabilised	454074	408801	324542	249415	103974	23573	1366
Posterior Stabilised	166415	152276	121781	92407	32801	3890	154
Medial Pivot Design	19249	14222	6398	2560	694	199	4
Fully Stabilised	2344	1975	1300	838	206	39	1
Hinged	933	735	454	297	58	9	0

Table KT27 Revision Diagnosis of Primary Total Knee Replacement by Stability (Primary Diagnosis OA)

Revision Diagnosis	Fully Stabilised Number	Fully Stabilised % Primaries Revised	Fully Stabilised % Revisions	Hinged Number	Hinged % Primaries Revised	Hinged % Revisions
Infection	64	2.7	49.6	27	2.9	40.3
Loosening	22	0.9	17.1	5	0.5	7.5
Instability	14	0.6	10.9			
Fracture	8	0.3	6.2	13	1.4	19.4
Bearing Dislocation	4	0.2	3.1	3	0.3	4.5
Patella Erosion	4	0.2	3.1	2	0.2	3.0
Other	13	0.6	10.1	17	1.8	25.4
N Revision	**129**	**5.5**	**100.0**	**67**	**7.2**	**100.0**
N Primary	**2344**			**933**		

Figure KT30 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by Stability (Primary Diagnosis OA)



Patella Resurfacing

In primary total knee replacement procedures where the patella is resurfaced, there is a lower rate of revision compared to procedures without patellar resurfacing (Table KT28 and Figure KT31).

When resurfacing the patella, the rate of revision is lower for minimally stabilised compared to posterior stabilised prostheses within the first 5 years. Posterior stabilised without patellar resurfacing has the highest rate of revision (Table KT29 and Figure KT32).

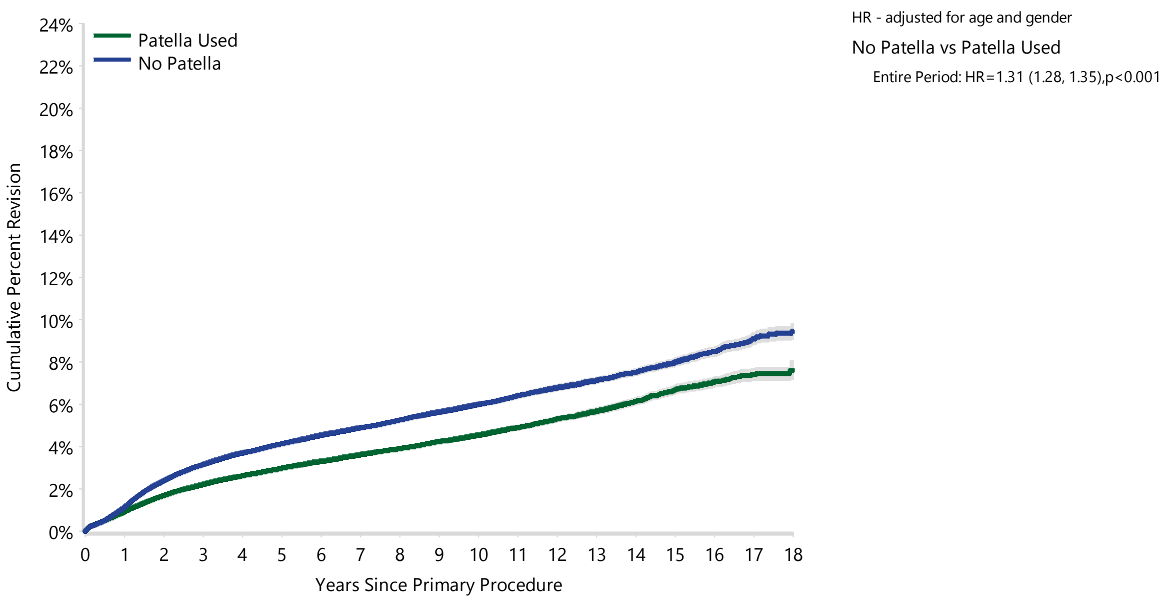
When the patella is resurfaced, there is no difference in the rate of revision for medial pivot design prostheses compared to minimally stabilised prostheses. When the patella is not resurfaced, medial pivot design prostheses have a higher rate of revision than minimally stabilised knee prostheses (Figure KT33).

Outcomes related to the use of patellar resurfacing vary depending on the type of prosthesis used.

Table KT28 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	18 Yrs
Patella Used	10710	349255	0.9 (0.9, 1.0)	2.2 (2.2, 2.3)	3.0 (2.9, 3.0)	4.5 (4.4, 4.6)	6.7 (6.5, 6.9)	7.6 (7.2, 8.1)
No Patella	14012	293946	1.1 (1.1, 1.2)	3.2 (3.1, 3.2)	4.1 (4.1, 4.2)	6.0 (5.9, 6.1)	8.0 (7.8, 8.2)	9.4 (9.1, 9.8)
TOTAL	**24722**	**643201**						

Figure KT31 Cumulative Percent Revision of Primary Total Knee Replacement by Patella Usage (Primary Diagnosis OA)

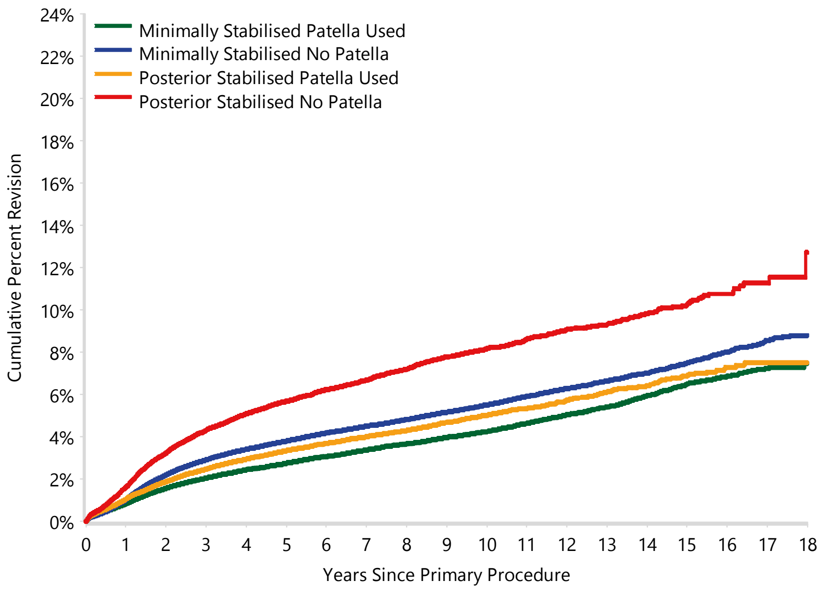


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Patella Used	349255	306613	229861	166678	60416	11922	490
No Patella	293946	271577	224769	178969	77384	15803	1037

Table KT29 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	18 Yrs
Minimally Stabilised	Patella Used	6317	215786	0.8 (0.8, 0.9)	2.1 (2.0, 2.1)	2.8 (2.7, 2.8)	4.2 (4.1, 4.4)	6.5 (6.3, 6.8)	7.5 (7.0, 8.0)
	No Patella	10497	238440	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)	8.8 (8.5, 9.2)
Posterior Stabilised	Patella Used	4114	120350	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 (6.5, 7.3)	7.5 (7.0, 8.1)
	No Patella	3173	46065	1.6 (1.5, 1.7)	4.3 (4.1, 4.5)	5.7 (5.5, 5.9)	8.2 (7.9, 8.5)	10.3 (9.8, 10.8)	12.7 (10.5, 15.4)
Medial Pivot Design	Patella Used	162	10877	0.9 (0.7, 1.1)	2.1 (1.8, 2.5)	2.5 (2.1, 3.0)	3.4 (2.5, 4.7)		
	No Patella	285	8372	1.4 (1.2, 1.7)	3.7 (3.2, 4.2)	4.6 (4.0, 5.3)	7.0 (5.9, 8.3)	7.9 (6.5, 9.5)	
TOTAL		**24548**	**639890**						

Figure KT32 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 (0.76, 0.81), p<0.001

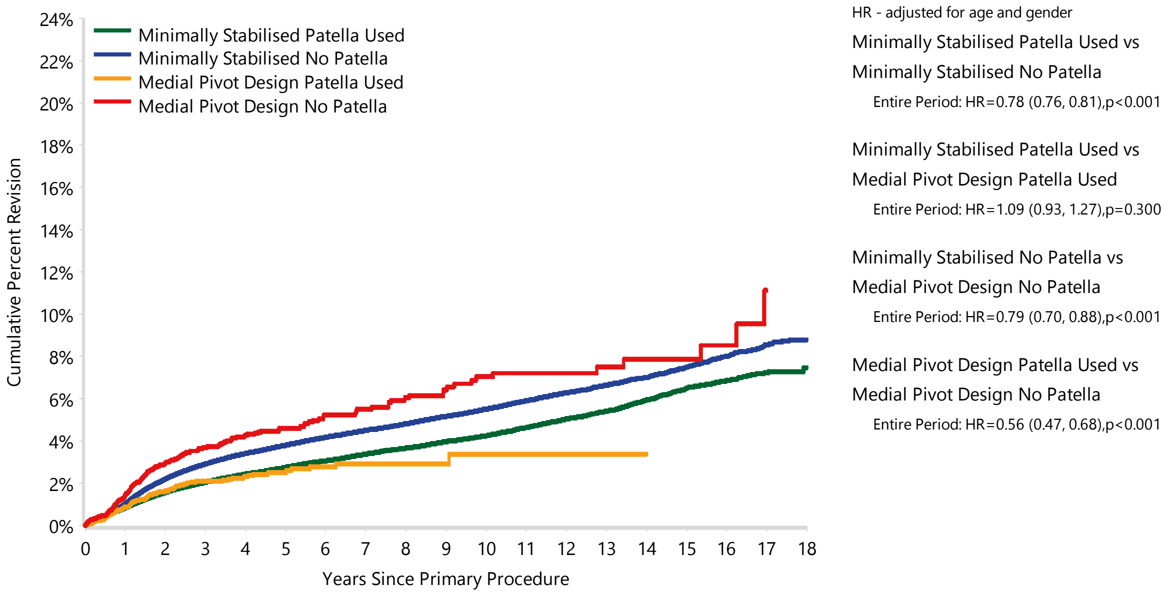
Minimally Stabilised Patella Used vs Posterior Stabilised Patella Used
0 - 2Yr: HR=0.83 (0.79, 0.88), p<0.001
2Yr - 2.5Yr: HR=0.73 (0.65, 0.81), p<0.001
2.5Yr - 3Yr: HR=0.83 (0.73, 0.94), p=0.004
3Yr - 3.5Yr: HR=0.79 (0.69, 0.91), p<0.001
3.5Yr - 5Yr: HR=0.86 (0.78, 0.95), p=0.003
5Yr - 5.5Yr: HR=0.99 (0.83, 1.18), p=0.898
5.5Yr - 6Yr: HR=0.87 (0.72, 1.05), p=0.146
6Yr+: HR=1.05 (0.98, 1.13), p=0.172

Minimally Stabilised No Patella vs Posterior Stabilised No Patella
Entire Period: HR=0.67 (0.65, 0.70), p<0.001

Posterior Stabilised Patella Used vs Posterior Stabilised No Patella
Entire Period: HR=0.60 (0.58, 0.63), p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Minimally Stabilised	Patella Used	215786	188602	142001	104392	40925	9614	408
	No Patella	238440	220313	182617	145067	63052	13959	958
Posterior Stabilised	Patella Used	120350	108590	83705	60489	19196	2247	81
	No Patella	46065	43686	38076	31918	13605	1643	73

Figure KT33 Cumulative Percent Revision of Primary Total Knee Replacement by Stability and Patella Usage (Primary Diagnosis OA)



Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Minimally Stabilised	Patella Used	215786	188602	142001	104392	40925	9614	408
	No Patella	238440	220313	182617	145067	63052	13959	958
Medial Pivot Design	Patella Used	10877	7601	3035	1116	153	35	0
	No Patella	8372	6621	3363	1444	541	164	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 KT30 and Figure KT34).

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 KT31 and Figure KT35).

Cementing the tibial component gives the best outcome for minimally stabilised and medial pivot design prostheses. Cementing both tibial and femoral components gives the best outcome for posterior stabilised prostheses.

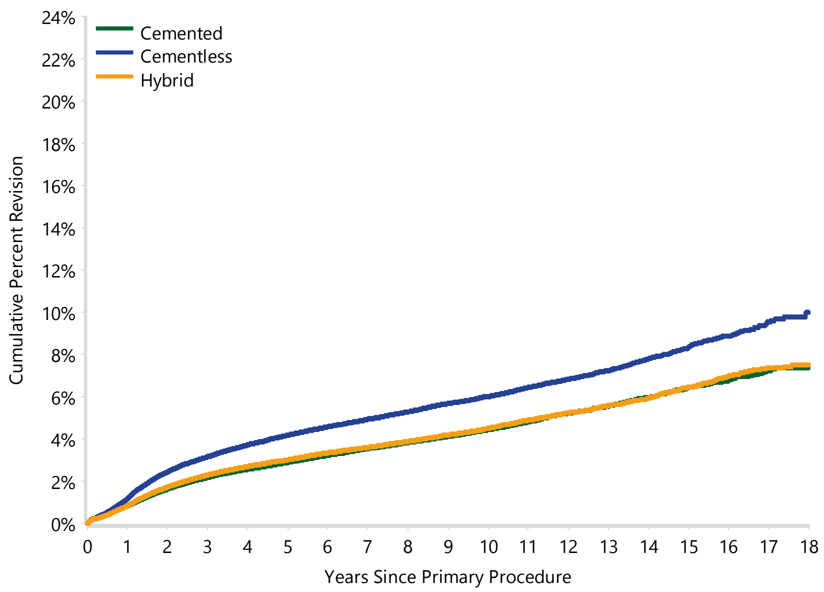
When a medial pivot design prosthesis is used there is no difference between cemented and hybrid fixation or between hybrid and cementless fixation. Cementless fixation has a higher rate of revision compared to cemented fixation (Table KT32 and Figure KT36).

Table KT30 Cumulative Percent Revision of Minimally Stabilised Primary Total Knee Replacement by Fixation (Primary Diagnosis OA)

Fixation	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Cemented	6115	200710	0.8 (0.8, 0.9)	2.2 (2.1, 2.3)	2.9 (2.8, 3.0)	4.4 (4.3, 4.6)	6.5 (6.2, 6.7)	7.4 (7.0, 7.8)
Cementless	5702	112480	1.2 (1.1, 1.2)	3.2 (3.1, 3.3)	4.2 (4.1, 4.3)	6.0 (5.8, 6.2)	8.3 (8.1, 8.6)	10.0 (9.3, 10.7)
Hybrid	4766	140465	0.8 (0.8, 0.9)	2.3 (2.2, 2.4)	3.0 (2.9, 3.1)	4.5 (4.4, 4.6)	6.5 (6.2, 6.7)	7.5 (7.1, 8.0)
TOTAL	**16583**	**453655**						

Note: Excluding cementless Genesis Oxinium and Profix Oxinium femoral prostheses

Figure KT34 Cumulative Percent Revision of Minimally Stabilised Primary Total Knee Replacement by Fixation (Primary Diagnosis OA)



HR - adjusted for age and gender

Cementless vs Cemented
- 0 - 3Mth: HR=1.03 (0.91, 1.16),p=0.676
- 3Mth - 1.5Yr: HR=1.46 (1.37, 1.55),p<0.001
- 1.5Yr - 2Yr: HR=1.32 (1.19, 1.47),p<0.001
- 2Yr - 2.5Yr: HR=1.20 (1.06, 1.35),p=0.004
- 2.5Yr - 3.5Yr: HR=1.23 (1.11, 1.36),p<0.001
- 3.5Yr - 5Yr: HR=1.34 (1.21, 1.49),p<0.001
- 5Yr+: HR=1.12 (1.05, 1.20),p<0.001

Cementless vs Hybrid
- 0 - 6Mth: HR=1.14 (1.03, 1.26),p=0.008
- 6Mth - 9Mth: HR=1.39 (1.21, 1.59),p<0.001
- 9Mth - 1.5Yr: HR=1.52 (1.41, 1.64),p<0.001
- 1.5Yr - 2Yr: HR=1.33 (1.20, 1.48),p<0.001
- 2Yr - 2.5Yr: HR=1.20 (1.06, 1.36),p=0.003
- 2.5Yr - 3Yr: HR=1.22 (1.06, 1.40),p=0.005
- 3Yr - 3.5Yr: HR=1.26 (1.09, 1.46),p=0.002
- 3.5Yr - 5Yr: HR=1.35 (1.22, 1.50),p<0.001
- 5Yr+: HR=1.13 (1.06, 1.21),p<0.001

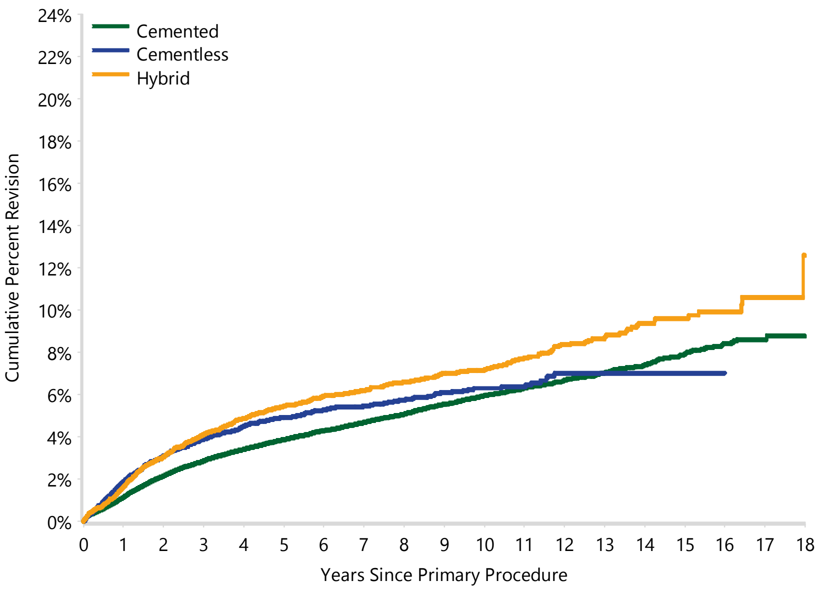
Hybrid vs Cemented
- Entire Period: HR=0.99 (0.96, 1.03),p=0.768

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Cemented	200710	175548	131210	97141	39484	8773	556
Cementless	112480	105547	90988	74645	32225	6889	368
Hybrid	140465	127349	102112	77409	32091	7782	442

Table KT31 Cumulative Percent Revision of Posterior Stabilised Primary Total Knee Replacement by Fixation (Primary Diagnosis OA)

Fixation	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Cemented	6096	145817	1.1 (1.1, 1.2)	2.9 (2.8, 3.0)	3.9 (3.8, 4.0)	5.9 (5.8, 6.1)	7.9 (7.6, 8.2)	8.8 (8.2, 9.4)
Cementless	400	7859	1.9 (1.6, 2.2)	3.9 (3.5, 4.3)	4.9 (4.4, 5.5)	6.3 (5.7, 7.0)	7.0 (6.2, 7.9)	
Hybrid	791	12739	1.7 (1.4, 1.9)	4.1 (3.8, 4.5)	5.4 (5.0, 5.9)	7.2 (6.7, 7.7)	9.6 (8.7, 10.5)	12.6 (9.1, 17.3)
TOTAL	**7287**	**166415**						

Figure KT35 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=1.26 (1.11, 1.43),p<0.001
- 2.5Yr - 4.5Yr: HR=1.05 (0.83, 1.32),p=0.696
- 4.5Yr+: HR=0.63 (0.49, 0.80),p<0.001

Hybrid vs Cemented
- 0 - 1.5Yr: HR=1.44 (1.28, 1.62),p<0.001
- 1.5Yr+: HR=1.15 (1.05, 1.27),p=0.003

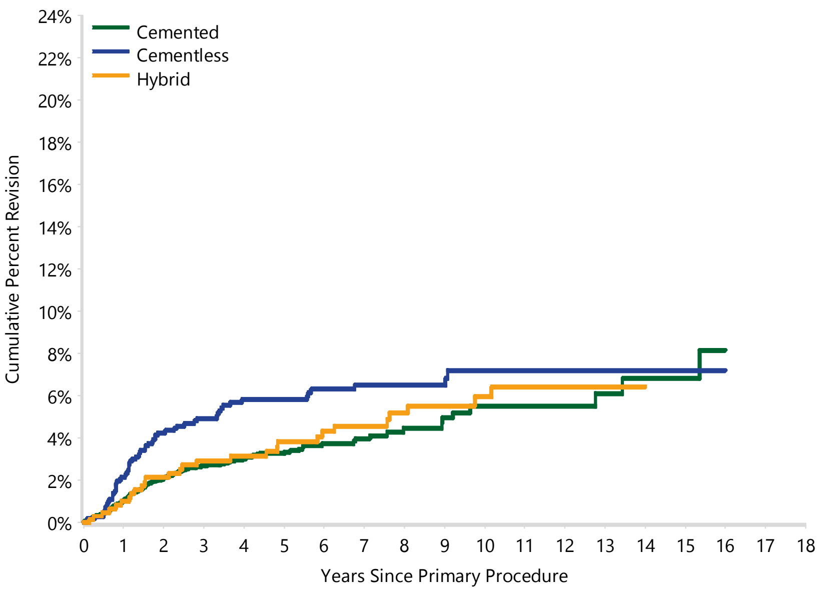
Hybrid vs Cementless
- 0 - 1.5Yr: HR=1.20 (1.02, 1.41),p=0.028
- 1.5Yr - 2Yr: HR=0.89 (0.66, 1.19),p=0.432
- 2Yr+: HR=1.31 (1.12, 1.53),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Cemented	145817	133180	105664	79148	27187	3148	109
Cementless	7859	7249	6078	4913	1627	147	1
Hybrid	12739	11847	10039	8346	3987	595	44

Table KT32 Cumulative Percent Revision of Medial Pivot Design Primary Total Knee Replacement by Fixation (Primary Diagnosis OA)

Fixation	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Cemented	354	17430	1.1 (0.9, 1.2)	2.7 (2.4, 3.0)	3.3 (2.9, 3.7)	5.5 (4.3, 7.0)	6.8 (4.9, 9.4)	
Cementless	65	1115	2.1 (1.4, 3.2)	4.9 (3.8, 6.4)	5.8 (4.5, 7.5)	7.2 (5.5, 9.3)	7.2 (5.5, 9.3)	
Hybrid	28	704	1.0 (0.5, 2.2)	2.9 (1.8, 4.7)	3.8 (2.5, 5.9)	6.0 (4.1, 8.7)		
TOTAL	**447**	**19249**						

Figure KT36 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=1.60 (1.21, 2.10),p<0.001

Cementless vs Hybrid

Entire Period: HR=1.29 (0.82, 2.01),p=0.269

Hybrid vs Cemented

Entire Period: HR=1.24 (0.84, 1.85),p=0.282

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Cemented	17430	12675	5139	1555	295	79	4
Cementless	1115	1010	786	593	192	96	0
Hybrid	704	537	473	412	207	24	0

Computer Navigation

There have been 132,211 primary total knee replacement procedures reported to the Registry in which computer navigation was used. In 2018, 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-navigation patients (Table KT33 and Figure KT37). There is a reduction in the rate of revision for loosening with computer navigated knee replacement in both age groups (Figure KT38).

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 34,573 primary total knee replacement procedures undertaken using IDI since 2009. In 2018, IDI was used in 12.2% of all primary total knee replacement procedures.

There is no difference in the rate of revision when IDI is used compared to when it is not used (Table KT34 and Figure KT39). When reasons for revision are compared, there is an increased proportion of revision for loosening when IDI is used (Figure KT40).

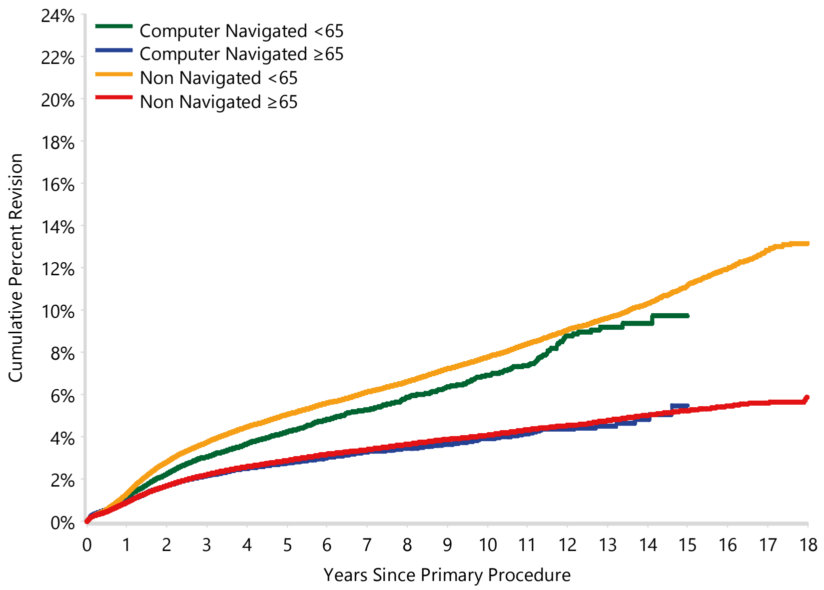
Where IDI is used for patients aged ≥65 years, there is a lower rate of revision in the first 3 months and a higher rate of revision after 3 months compared to when it is not used. There is no difference with IDI use for patients aged <65 years (Table KT35 and Figure KT41).

There are prosthesis specific differences in revision rates when IDI is used. There are 11 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 9 of these knee prostheses when IDI is used compared to when it is not used. The Evolution and Legion PS (after 1.5 years) have a higher rate of revision when IDI is used (Table KT36 and Table KT37).

Table KT33 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	18 Yrs
Computer Navigated		**3750**	**132211**	**1.0 (0.9, 1.0)**	**2.5 (2.4, 2.6)**	**3.3 (3.2, 3.4)**	**5.0 (4.8, 5.2)**	**7.1 (6.4, 7.9)**	
	<65	1752	46454	1.1 (1.0, 1.2)	3.0 (2.9, 3.2)	4.2 (4.0, 4.5)	6.9 (6.5, 7.3)	9.7 (8.7, 10.9)	
	≥65	1998	85757	0.9 (0.9, 1.0)	2.2 (2.1, 2.3)	2.8 (2.6, 2.9)	3.9 (3.7, 4.1)	5.5 (4.5, 6.7)	
Non Navigated		**20972**	**510990**	**1.0 (1.0, 1.1)**	**2.7 (2.7, 2.8)**	**3.6 (3.5, 3.7)**	**5.3 (5.2, 5.4)**	**7.4 (7.2, 7.5)**	**8.6 (8.3, 8.9)**
	<65	10213	165508	1.3 (1.3, 1.4)	3.7 (3.6, 3.8)	5.1 (4.9, 5.2)	7.8 (7.6, 7.9)	11.2 (10.9, 11.5)	13.2 (12.7, 13.6)
	≥65	10759	345482	0.9 (0.9, 0.9)	2.2 (2.2, 2.3)	2.9 (2.8, 2.9)	4.1 (4.0, 4.2)	5.2 (5.1, 5.4)	5.9 (5.5, 6.2)
TOTAL		**24722**	**643201**						

Figure KT37 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=0.97 (0.83, 1.13),p=0.729
- 6Mth - 2Yr: HR=1.50 (1.35, 1.66),p<0.001
- 2Yr - 2.5Yr: HR=1.82 (1.52, 2.17),p<0.001
- 2.5Yr - 4Yr: HR=1.71 (1.48, 1.98),p<0.001
- 4Yr+: HR=2.36 (2.09, 2.67),p<0.001

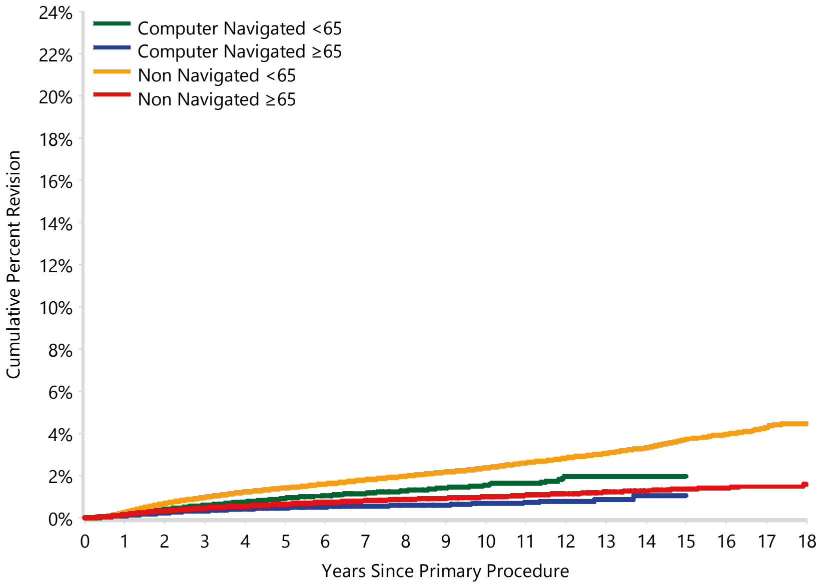
Computer Navigated <65 vs Non Navigated <65
- Entire Period: HR=0.85 (0.81, 0.90),p<0.001

Computer Navigated ≥65 vs Non Navigated ≥65
- 0 - 6Mth: HR=1.21 (1.09, 1.34),p<0.001
- 6Mth - 2Yr: HR=0.92 (0.85, 0.99),p=0.033
- 2Yr+: HR=0.91 (0.84, 0.99),p=0.019

Non Navigated <65 vs Non Navigated ≥65
- 0 - 3Mth: HR=1.10 (1.00, 1.21),p=0.056
- 3Mth - 9Mth: HR=1.57 (1.45, 1.70),p<0.001
- 9Mth - 2Yr: HR=1.85 (1.76, 1.94),p<0.001
- 2Yr - 3Yr: HR=1.78 (1.65, 1.91),p<0.001
- 3Yr - 5Yr: HR=2.01 (1.88, 2.15),p<0.001
- 5Yr - 5.5Yr: HR=1.87 (1.60, 2.18),p<0.001
- 5.5Yr - 7Yr: HR=2.29 (2.06, 2.53),p<0.001
- 7Yr - 7.5Yr: HR=2.01 (1.66, 2.45),p<0.001
- 7.5Yr - 8Yr: HR=2.16 (1.76, 2.64),p<0.001
- 8Yr - 10Yr: HR=2.68 (2.39, 3.01),p<0.001
- 10Yr - 10.5Yr: HR=2.31 (1.79, 2.97),p<0.001
- 10.5Yr+: HR=3.15 (2.83, 3.51),p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Computer Navigated		**132211**	**112256**	**76528**	**48929**	**8506**	**260**	**0**
	<65	46454	39638	27275	17880	3368	108	0
	≥65	85757	72618	49253	31049	5138	152	0
Non Navigated		**510990**	**465934**	**378102**	**296718**	**129294**	**27465**	**1527**
	<65	165508	151132	123249	98309	45675	11324	698
	≥65	345482	314802	254853	198409	83619	16141	829

Figure KT38 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=1.08 (0.68, 1.73),p=0.743

6Mth - 9Mth: HR=1.66 (1.04, 2.64),p=0.033

9Mth - 1.5Yr: HR=1.80 (1.39, 2.33),p<0.001

1.5Yr - 2.5Yr: HR=1.81 (1.38, 2.37),p<0.001

2.5Yr+: HR=2.46 (2.03, 2.98),p<0.001

Computer Navigated <65 vs Non Navigated <65

Entire Period: HR=0.63 (0.57, 0.71),p<0.001

Computer Navigated ≥65 vs Non Navigated≥65

Entire Period: HR=0.71 (0.63, 0.80),p<0.001

Non Navigated <65 vs Non Navigated ≥65

0 - 6Mth: HR=1.35 (1.09, 1.67),p=0.005

6Mth - 9Mth: HR=1.70 (1.35, 2.15),p<0.001

9Mth - 1.5Yr: HR=2.23 (1.98, 2.52),p<0.001

1.5Yr - 3.5Yr: HR=2.20 (2.00, 2.42),p<0.001

3.5Yr - 4Yr: HR=3.07 (2.38, 3.94),p<0.001

4Yr - 8.5Yr: HR=2.56 (2.30, 2.85),p<0.001

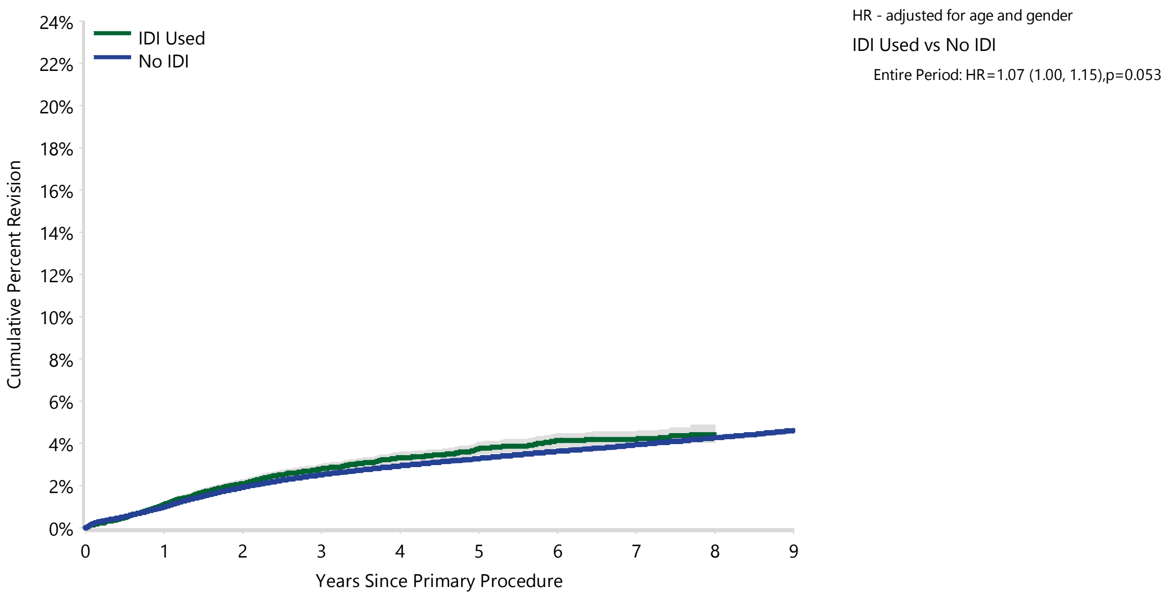
8.5Yr+: HR=3.33 (2.89, 3.84),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Computer Navigated	**132211**	**112256**	**76528**	**48929**	**8506**	**260**	**0**
<65	46454	39638	27275	17880	3368	108	0
≥65	85757	72618	49253	31049	5138	152	0
Non Navigated	**510990**	**465934**	**378102**	**296718**	**129294**	**27465**	**1527**
<65	165508	151132	123249	98309	45675	11324	698
≥65	345482	314802	254853	198409	83619	16141	829

Table KT34 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	8 Yrs	9 Yrs
IDI Used	858	34573	1.1 (1.0, 1.2)	2.8 (2.6, 3.0)	3.7 (3.5, 4.0)	4.2 (3.9, 4.5)	4.4 (4.1, 4.9)	
No IDI	11890	416870	1.0 (1.0, 1.0)	2.5 (2.5, 2.6)	3.3 (3.2, 3.4)	3.9 (3.9, 4.0)	4.3 (4.2, 4.3)	4.6 (4.5, 4.7)
TOTAL	**12748**	**451443**						

Figure KT39 Cumulative Percent Revision of Primary Total Knee Replacement since 2009 by IDI Usage (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	8 Yrs	9 Yrs
IDI Used	34573	27473	15086	7428	2511	717	27
No IDI	416870	362941	260657	168893	91138	57059	26223

Figure KT40 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement since 2009 by IDI Usage (Primary Diagnosis OA)

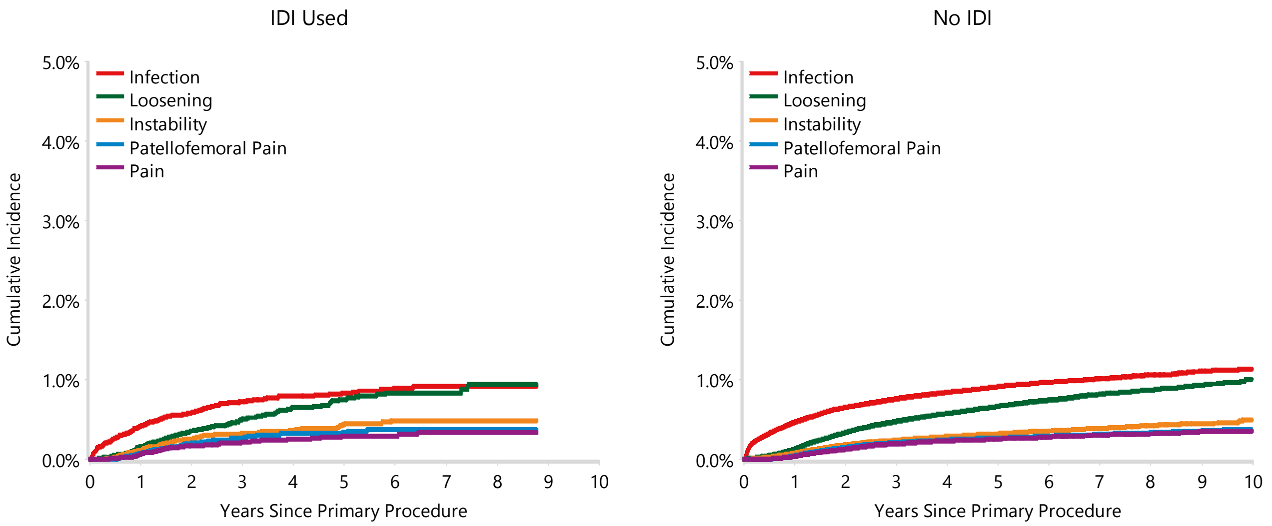
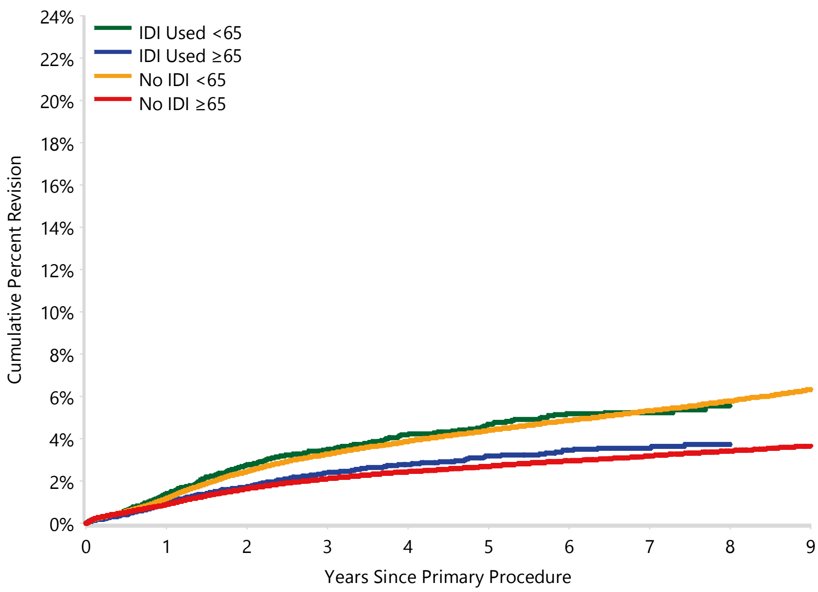


Table KT35 Cumulative Percent Revision of Primary Total Knee Replacement since 2009 by IDI Usage and Age (Primary Diagnosis OA)

IDI Usage	Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	8 Yrs	9 Yrs
IDI Used		**858**	**34573**	**1.1 (1.0, 1.2)**	**2.8 (2.6, 3.0)**	**3.7 (3.5, 4.0)**	**4.2 (3.9, 4.5)**	**4.4 (4.1, 4.9)**	
	<65	403	12540	1.4 (1.2, 1.6)	3.5 (3.1, 3.9)	4.7 (4.2, 5.2)	5.3 (4.7, 5.9)	5.6 (4.9, 6.3)	
	≥65	455	22033	0.9 (0.8, 1.1)	2.4 (2.2, 2.7)	3.2 (2.9, 3.5)	3.6 (3.2, 4.0)	3.7 (3.3, 4.2)	
No IDI		**11890**	**416870**	**1.0 (1.0, 1.0)**	**2.5 (2.5, 2.6)**	**3.3 (3.2, 3.4)**	**3.9 (3.9, 4.0)**	**4.3 (4.2, 4.3)**	**4.6 (4.5, 4.7)**
	<65	5497	141458	1.2 (1.1, 1.2)	3.3 (3.2, 3.4)	4.4 (4.3, 4.5)	5.3 (5.2, 5.5)	5.8 (5.6, 6.0)	6.3 (6.1, 6.5)
	≥65	6393	275412	0.9 (0.9, 0.9)	2.1 (2.1, 2.2)	2.7 (2.6, 2.8)	3.2 (3.1, 3.3)	3.4 (3.3, 3.5)	3.7 (3.6, 3.8)
TOTAL		**12748**	**451443**						

Figure KT41 Cumulative Percent Revision of Primary Total Knee Replacement since 2009 by IDI Usage and Age (Primary Diagnosis OA)



HR - adjusted for gender

IDI Used <65 vs IDI Used ≥65

Entire Period: HR=1.49 (1.30, 1.70),p<0.001

IDI Used <65 vs No IDI <65

Entire Period: HR=1.05 (0.95, 1.16),p=0.350

IDI Used ≥65 vs No IDI ≥65

0 - 3Mth: HR=0.66 (0.57, 0.75),p<0.001

3Mth - 1.5Yr: HR=1.17 (1.05, 1.29),p=0.003

1.5Yr+: HR=1.28 (1.16, 1.42),p<0.001

No IDI <65 vs No IDI ≥65

0 - 3Mth: HR=0.93 (0.84, 1.04),p=0.190

3Mth - 6Mth: HR=1.41 (1.23, 1.62),p<0.001

6Mth - 1.5Yr: HR=1.71 (1.60, 1.82),p<0.001

1.5Yr - 2Yr: HR=1.64 (1.48, 1.82),p<0.001

2Yr+: HR=1.87 (1.77, 1.98),p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	8 Yrs	9 Yrs
IDI Used		**34573**	**27473**	**15086**	**7428**	**2511**	**717**	**27**
	<65	12540	10075	5799	3004	1047	319	12
	≥65	22033	17398	9287	4424	1464	398	15
No IDI		**416870**	**362941**	**260657**	**168893**	**91138**	**57059**	**26223**
	<65	141458	123808	89951	59982	33780	21437	10027
	≥65	275412	239133	170706	108911	57358	35622	16196

Table KT36 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
Evolution	IDI Used	51	2626	1.2 (0.9, 1.8)	3.2 (2.3, 4.3)				
	No IDI	62	3823	0.7 (0.4, 1.0)	2.3 (1.8, 3.0)	2.9 (2.1, 3.9)			
GMK Primary	IDI Used	20	858	1.0 (0.5, 2.1)	3.4 (2.2, 5.4)	4.1 (2.5, 6.8)			
	No IDI	51	1353	1.1 (0.6, 1.8)	3.2 (2.4, 4.3)	3.8 (2.9, 5.0)	5.1 (3.1, 8.2)	6.6 (3.7, 11.6)	
Genesis II CR	IDI Used	39	1084	1.4 (0.9, 2.3)	3.2 (2.3, 4.6)	4.3 (3.1, 6.0)	4.7 (3.4, 6.5)		
	No IDI	424	13057	0.9 (0.8, 1.1)	2.5 (2.2, 2.8)	3.3 (3.0, 3.7)	4.1 (3.7, 4.5)	4.4 (4.0, 4.9)	4.8 (4.3, 5.4)
Genesis II PS	IDI Used	100	2495	1.6 (1.1, 2.1)	3.5 (2.8, 4.4)	5.2 (4.3, 6.4)	5.7 (4.6, 7.0)	5.7 (4.6, 7.0)	
	No IDI	917	23587	1.3 (1.1, 1.4)	3.0 (2.8, 3.2)	4.1 (3.8, 4.4)	5.0 (4.6, 5.3)	5.4 (5.0, 5.8)	5.7 (5.3, 6.2)
Legion CR	IDI Used	43	1787	1.0 (0.6, 1.6)	3.8 (2.8, 5.3)	4.6 (3.2, 6.5)			
	No IDI	179	7230	1.1 (0.8, 1.4)	2.8 (2.4, 3.3)	3.6 (3.1, 4.2)	4.2 (3.5, 4.9)	4.2 (3.5, 4.9)	4.2 (3.5, 4.9)
Legion PS	IDI Used	93	2070	1.5 (1.0, 2.2)	4.6 (3.7, 5.8)	7.8 (6.2, 9.8)	8.3 (6.5, 10.5)		
	No IDI	449	15239	1.1 (0.9, 1.3)	2.7 (2.5, 3.0)	3.6 (3.3, 4.0)	4.3 (3.8, 4.7)	4.7 (4.1, 5.3)	5.2 (4.4, 6.1)
Natural Knee Flex	IDI Used	5	544	0.7 (0.3, 2.0)	0.7 (0.3, 2.0)	1.4 (0.5, 3.8)	1.4 (0.5, 3.8)		
	No IDI	102	4547	0.8 (0.5, 1.1)	2.1 (1.7, 2.6)	2.6 (2.1, 3.2)	3.0 (2.4, 3.7)	3.2 (2.6, 4.0)	3.2 (2.6, 4.0)
Nexgen CR Flex	IDI Used	129	6701	0.7 (0.5, 0.9)	2.0 (1.6, 2.4)	2.5 (2.1, 3.0)	2.6 (2.2, 3.2)	2.6 (2.2, 3.2)	
	No IDI	974	46789	0.8 (0.7, 0.9)	1.9 (1.8, 2.1)	2.4 (2.2, 2.6)	2.9 (2.7, 3.1)	3.1 (2.9, 3.3)	3.2 (3.0, 3.5)
Nexgen LPS Flex	IDI Used	39	2025	1.2 (0.8, 1.8)	1.9 (1.3, 2.6)	2.4 (1.7, 3.5)	3.1 (1.8, 5.2)		
	No IDI	637	23179	1.0 (0.8, 1.1)	2.2 (2.0, 2.4)	3.0 (2.7, 3.2)	3.6 (3.3, 3.9)	4.0 (3.7, 4.3)	4.3 (4.0, 4.8)
Vanguard CR	IDI Used	109	3806	0.8 (0.6, 1.2)	2.5 (2.0, 3.1)	3.1 (2.6, 3.8)	3.8 (3.1, 4.6)	3.9 (3.2, 4.8)	
	No IDI	567	20516	0.8 (0.7, 0.9)	2.4 (2.2, 2.6)	3.0 (2.7, 3.3)	3.6 (3.3, 4.0)	4.0 (3.6, 4.4)	5.1 (4.5, 5.8)
Vanguard PS	IDI Used	56	1001	1.9 (1.2, 3.0)	4.5 (3.3, 6.1)	6.0 (4.6, 7.9)	7.1 (5.4, 9.3)	8.7 (6.2, 12.1)	
	No IDI	166	3234	1.7 (1.3, 2.2)	4.1 (3.4, 4.8)	5.0 (4.3, 5.9)	5.8 (5.0, 6.8)	6.1 (5.2, 7.2)	6.6 (5.6, 7.9)
TOTAL		**5212**	**187551**						

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 and Vanguard PS includes Vanguard PS/Maxim

Table KT37 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
Evolution	Entire Period	1.46 (1.00, 2.13)	0.047
GMK Primary	Entire Period	1.03 (0.61, 1.75)	0.904
Genesis II CR	Entire Period	1.23 (0.88, 1.70)	0.223
Genesis II PS	Entire Period	1.15 (0.93, 1.41)	0.192
Legion CR	Entire Period	1.17 (0.84, 1.64)	0.357
Legion PS	0 - 1.5Yr	1.30 (0.93, 1.82)	0.123
	1.5Yr+	2.51 (1.86, 3.40)	<0.001
Natural Knee Flex	Entire Period	0.43 (0.17, 1.04)	0.062
Nexgen CR Flex	Entire Period	0.94 (0.78, 1.13)	0.514
Nexgen LPS Flex	Entire Period	0.93 (0.67, 1.29)	0.677
Vanguard CR	Entire Period	1.02 (0.83, 1.25)	0.864
Vanguard PS	Entire Period	1.20 (0.89, 1.63)	0.231

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 also includes 25,507 procedures with the addition of an antioxidant. XLPE is now used more frequently (64.3% in 2018) than non XLPE.

Prostheses using XLPE have a cumulative percent revision rate of 4.9% at 15 years, compared to 7.8% for non XLPE (Table KT38). As previously reported, when comparing all prostheses, the XLPE group again has a lower rate of revision compared to the non XLPE group (Figure KT42). 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 KT43).

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 7.1% and for non XLPE is 11.8%. For patients aged ≥65 years, the 15 year cumulative percent revision for XLPE is 3.7% and for non XLPE is 5.6% (Table KT39 and Figure KT44).

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 (Tables KT40 and KT41).

XLPE with Antioxidant

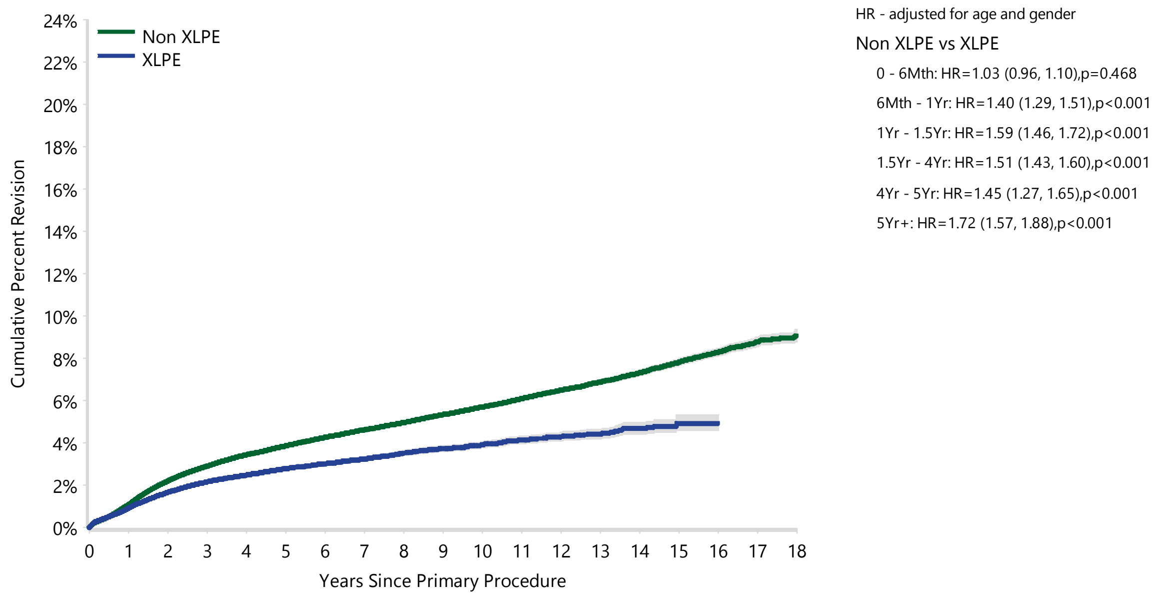
An analysis comparing the rate of revision of XLPE and XLPE with antioxidant has been undertaken. The follow up for XLPE with antioxidant is relatively short (5 years). There are only a small number of prostheses that use this bearing. XLPE with antioxidant has a lower rate of revision than XLPE (Table KT42, Figures KT45 and KT46). The Attune was used in over 67% of these procedures. When the Attune is excluded from the analysis. There is no difference in the rate of revision between XLPE and XLPE + antioxidant (Table KT43 and Figure KT47).

Table KT38 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	18 Yrs
Non XLPE	19505	411672	1.1 (1.0, 1.1)	2.9 (2.8, 3.0)	3.9 (3.8, 3.9)	5.7 (5.6, 5.8)	7.8 (7.7, 8.0)	9.1 (8.8, 9.4)
XLPE	5212	231307	0.9 (0.9, 1.0)	2.2 (2.1, 2.2)	2.8 (2.7, 2.9)	3.9 (3.8, 4.0)	4.9 (4.6, 5.3)	
TOTAL	**24717**	**642979**						

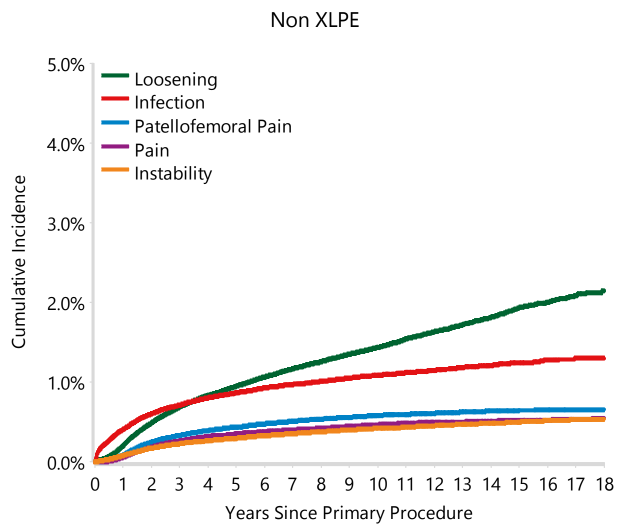
Note: Includes 25,507 procedures using XLPE + antioxidant
Excludes 222 procedures with unknown polyethylene

Figure KT42 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	18 Yrs
Non XLPE	411672	384792	327166	268927	124674	26530	1525
XLPE	231307	193220	127309	76590	13059	1180	0

Figure KT43 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by Polyethylene Type (Primary Diagnosis OA)



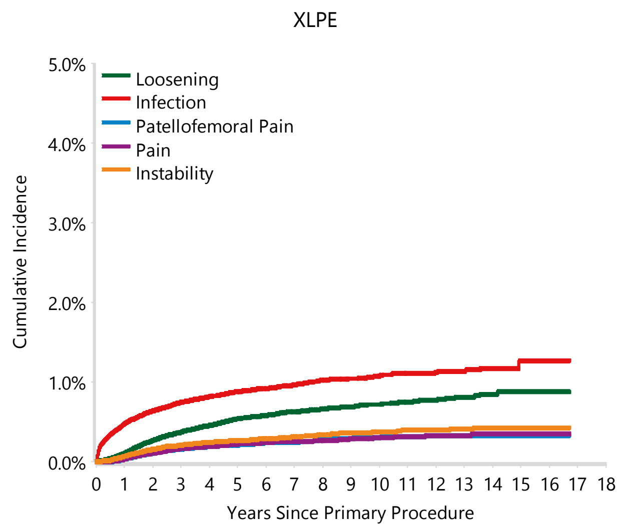
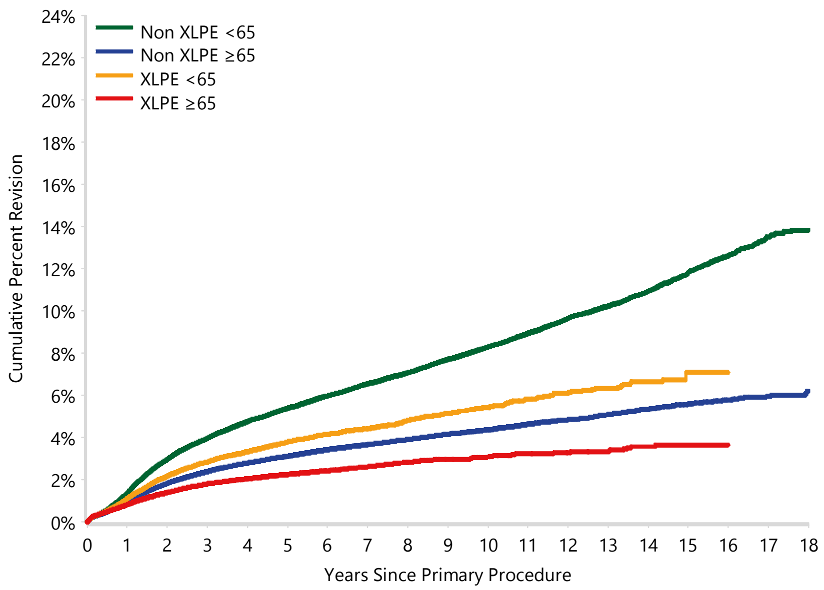


Table KT39 Cumulative Percent Revision of Primary Total Knee Replacement by Polyethylene Type and Age (Primary Diagnosis OA)

Polyethylene Type	Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Non XLPE		**19505**	**411672**	**1.1 (1.0, 1.1)**	**2.9 (2.8, 3.0)**	**3.9 (3.8, 3.9)**	**5.7 (5.6, 5.8)**	**7.8 (7.7, 8.0)**	**9.1 (8.8, 9.4)**
	<65	9547	133566	1.4 (1.3, 1.4)	4.0 (3.9, 4.1)	5.4 (5.3, 5.5)	8.3 (8.1, 8.5)	11.8 (11.5, 12.1)	13.8 (13.4, 14.3)
	≥65	9958	278106	0.9 (0.9, 1.0)	2.4 (2.3, 2.4)	3.1 (3.0, 3.2)	4.4 (4.3, 4.5)	5.6 (5.4, 5.7)	6.2 (5.9, 6.6)
XLPE		**5212**	**231307**	**0.9 (0.9, 1.0)**	**2.2 (2.1, 2.2)**	**2.8 (2.7, 2.9)**	**3.9 (3.8, 4.0)**	**4.9 (4.6, 5.3)**	
	<65	2415	78316	1.1 (1.0, 1.2)	2.8 (2.7, 3.0)	3.8 (3.6, 4.0)	5.4 (5.1, 5.7)	7.1 (6.4, 7.8)	
	≥65	2797	152991	0.8 (0.8, 0.9)	1.8 (1.7, 1.9)	2.3 (2.2, 2.3)	3.1 (2.9, 3.2)	3.7 (3.3, 4.0)	
TOTAL		**24717**	**642979**						

Figure KT44 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=0.412
- 3Mth - 9Mth: HR=1.57 (1.44, 1.71),p<0.001
- 9Mth - 3.5Yr: HR=1.81 (1.73, 1.88),p<0.001
- 3.5Yr - 6.5Yr: HR=2.05 (1.93, 2.18),p<0.001
- 6.5Yr - 7Yr: HR=2.64 (2.20, 3.18),p<0.001
- 7Yr - 8Yr: HR=2.12 (1.84, 2.44),p<0.001
- 8Yr - 10Yr: HR=2.73 (2.44, 3.05),p<0.001
- 10Yr - 10.5Yr: HR=2.29 (1.78, 2.94),p<0.001
- 10.5Yr - 11.5Yr: HR=2.94 (2.44, 3.54),p<0.001
- 11.5Yr+: HR=3.32 (2.92, 3.76),p<0.001

Non XLPE <65 vs XLPE <65
- 0 - 3Mth: HR=0.92 (0.82, 1.04),p=0.186
- 3Mth - 6Mth: HR=1.28 (1.11, 1.47),p<0.001
- 6Mth - 1Yr: HR=1.45 (1.32, 1.59),p<0.001
- 1Yr - 1.5Yr: HR=1.58 (1.44, 1.72),p<0.001
- 1.5Yr - 3.5Yr: HR=1.43 (1.34, 1.54),p<0.001
- 3.5Yr - 4Yr: HR=1.71 (1.49, 1.97),p<0.001
- 4Yr - 7Yr: HR=1.67 (1.53, 1.81),p<0.001
- 7Yr - 8.5Yr: HR=1.79 (1.58, 2.03),p<0.001
- 8.5Yr - 10Yr: HR=2.24 (1.94, 2.59),p<0.001
- 10Yr - 10.5Yr: HR=1.83 (1.41, 2.36),p<0.001
- 10.5Yr+: HR=2.54 (2.26, 2.87),p<0.001

Non XLPE ≥65 vs XLPE ≥65
- 0 - 6Mth: HR=0.97 (0.89, 1.05),p=0.425
- 6Mth+: HR=1.51 (1.44, 1.58),p<0.001

XLPE <65 vs XLPE ≥65
- 0 - 3Mth: HR=1.04 (0.93, 1.17),p=0.502
- 3Mth - 6Mth: HR=1.32 (1.12, 1.55),p<0.001
- 6Mth - 1.5Yr: HR=1.73 (1.58, 1.89),p<0.001
- 1.5Yr - 2Yr: HR=1.90 (1.66, 2.17),p<0.001
- 2Yr+: HR=1.91 (1.75, 2.08),p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Non XLPE		**411672**	**384792**	**327166**	**268927**	**124674**	**26530**	**1525**
	<65	133566	124994	106818	89148	44152	10873	697
	≥65	278106	259798	220348	179779	80522	15657	828
XLPE		**231307**	**193220**	**127309**	**76590**	**13059**	**1180**	**0**
	<65	78316	65726	43662	27004	4871	554	0
	≥65	152991	127494	83647	49586	8188	626	0

Table KT40 **Cumulative Percent Revision of Primary Total Knee Replacement by Prosthesis Combination and Polyethylene Type (Primary Diagnosis OA)**

Femoral/Tibial Combination	Polyethylene Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
Genesis II CR/Genesis II	Non XLPE	882	21140	0.9 (0.8, 1.1)	2.7 (2.5, 2.9)	3.5 (3.2, 3.8)	4.9 (4.5, 5.2)	5.9 (5.5, 6.5)	6.4 (5.8, 7.0)
	XLPE	39	2007	1.2 (0.8, 1.8)	2.1 (1.5, 3.0)	3.1 (2.2, 4.5)			
Genesis II Oxinium CR/Genesis II	Non XLPE	436	6460	1.3 (1.0, 1.6)	3.4 (3.0, 3.9)	4.4 (3.9, 4.9)	7.1 (6.4, 7.8)	10.1 (9.0, 11.3)	
	XLPE	48	2270	0.8 (0.5, 1.3)	2.6 (1.9, 3.5)	2.9 (2.1, 4.0)			
Genesis II Oxinium PS/Genesis II	Non XLPE	785	11626	1.6 (1.4, 1.8)	3.9 (3.6, 4.3)	5.4 (5.0, 5.8)	7.9 (7.3, 8.4)	10.4 (8.8, 12.3)	
	XLPE	221	6585	1.5 (1.2, 1.9)	3.6 (3.1, 4.2)	4.8 (4.2, 5.5)			
Genesis II PS/Genesis II	Non XLPE	650	14673	1.2 (1.0, 1.4)	2.8 (2.5, 3.1)	3.7 (3.4, 4.0)	5.3 (4.8, 5.7)	6.4 (5.8, 7.1)	
	XLPE	105	3529	1.2 (0.9, 1.7)	3.1 (2.5, 3.9)	4.9 (4.0, 6.1)			
Legion CR/Genesis II	Non XLPE	70	2170	1.3 (0.9, 1.9)	3.4 (2.6, 4.3)	4.2 (3.3, 5.3)			
	XLPE	50	2439	1.2 (0.8, 1.8)	3.0 (2.2, 4.1)	3.6 (2.6, 5.0)			
Legion Oxinium CR/Genesis II	Non XLPE	48	1961	0.9 (0.5, 1.4)	2.2 (1.6, 3.1)	2.9 (2.2, 3.9)	3.5 (2.5, 4.9)		
	XLPE	59	2580	0.8 (0.5, 1.3)	3.4 (2.5, 4.5)	4.4 (3.2, 5.9)			
Legion Oxinium PS/Genesis II	Non XLPE	243	5172	1.4 (1.1, 1.8)	3.6 (3.1, 4.2)	5.1 (4.5, 5.9)	6.4 (5.5, 7.5)		
	XLPE	188	7532	0.9 (0.7, 1.1)	2.8 (2.4, 3.3)	3.7 (3.2, 4.4)			
Legion PS/Genesis II	Non XLPE	52	2028	0.9 (0.6, 1.4)	1.8 (1.3, 2.5)	2.3 (1.7, 3.1)			
	XLPE	75	2785	1.5 (1.1, 2.0)	3.0 (2.4, 3.8)	3.8 (3.0, 4.9)			
Natural Knee II/Natural Knee II	Non XLPE	281	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 (11.3, 14.4)	
	XLPE	115	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)	4.4 (3.5, 5.5)	
Nexgen CR Flex/Nexgen	Non XLPE	107	4417	0.7 (0.5, 1.0)	1.8 (1.4, 2.2)	2.3 (1.9, 2.9)	3.4 (2.7, 4.1)		
	XLPE	1031	48578	0.8 (0.7, 0.9)	1.8 (1.7, 2.0)	2.3 (2.2, 2.5)	3.1 (2.9, 3.4)		
Nexgen CR/Nexgen	Non XLPE	232	5908	0.5 (0.3, 0.7)	1.6 (1.3, 1.9)	2.0 (1.7, 2.4)	3.2 (2.7, 3.7)	5.0 (4.4, 5.8)	6.7 (5.6, 7.9)
	XLPE	156	5437	0.8 (0.6, 1.0)	1.8 (1.5, 2.2)	2.3 (1.9, 2.7)	3.1 (2.6, 3.6)	3.8 (3.2, 4.6)	
Nexgen LPS Flex/Nexgen	Non XLPE	706	15102	0.8 (0.7, 1.0)	2.2 (2.0, 2.5)	3.2 (2.9, 3.5)	5.3 (4.9, 5.7)	7.4 (6.6, 8.2)	
	XLPE	562	19732	1.1 (0.9, 1.2)	2.4 (2.1, 2.6)	3.1 (2.9, 3.4)	4.9 (4.4, 5.4)		
PFC Sigma CR/PFC Sigma	Non XLPE	685	20634	0.7 (0.6, 0.9)	1.9 (1.8, 2.1)	2.4 (2.2, 2.7)	3.5 (3.2, 3.8)	5.9 (5.3, 6.7)	6.8 (5.8, 8.0)
	XLPE	55	3133	0.6 (0.4, 1.0)	2.0 (1.5, 2.7)	2.5 (1.9, 3.3)			
PFC Sigma PS/PFC Sigma	Non XLPE	304	7059	1.1 (0.9, 1.4)	2.5 (2.1, 2.9)	3.3 (2.9, 3.7)	4.9 (4.3, 5.5)	7.1 (6.1, 8.3)	
	XLPE	14	664	1.5 (0.8, 2.9)	2.3 (1.3, 3.9)	2.7 (1.6, 4.6)			
Scorpio NRG PS/Series 7000	Non XLPE	19	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	136	3428	0.9 (0.6, 1.2)	2.9 (2.4, 3.6)	3.8 (3.2, 4.5)	4.9 (4.0, 6.0)		
Triathlon CR/Triathlon	Non XLPE	298	10558	0.7 (0.6, 0.9)	1.9 (1.7, 2.2)	2.5 (2.2, 2.8)	3.4 (3.0, 3.8)		
	XLPE	1480	71685	0.9 (0.8, 0.9)	2.0 (1.9, 2.1)	2.6 (2.4, 2.7)	3.8 (3.5, 4.1)		
Triathlon PS/Triathlon	Non XLPE	201	3921	1.7 (1.3, 2.1)	3.6 (3.1, 4.3)	4.6 (3.9, 5.3)	6.1 (5.3, 7.0)		
	XLPE	222	7444	1.5 (1.2, 1.8)	2.6 (2.3, 3.1)	3.7 (3.2, 4.2)	4.8 (3.9, 5.9)		
Vanguard CR/Vanguard	Non XLPE	694	23388	0.8 (0.7, 0.9)	2.4 (2.2, 2.6)	3.0 (2.8, 3.3)	5.1 (4.6, 5.6)		
	XLPE	13	872	0.8 (0.4, 1.8)	1.7 (0.9, 3.1)	2.4 (1.2, 4.7)			
TOTAL		**11262**	**353861**						

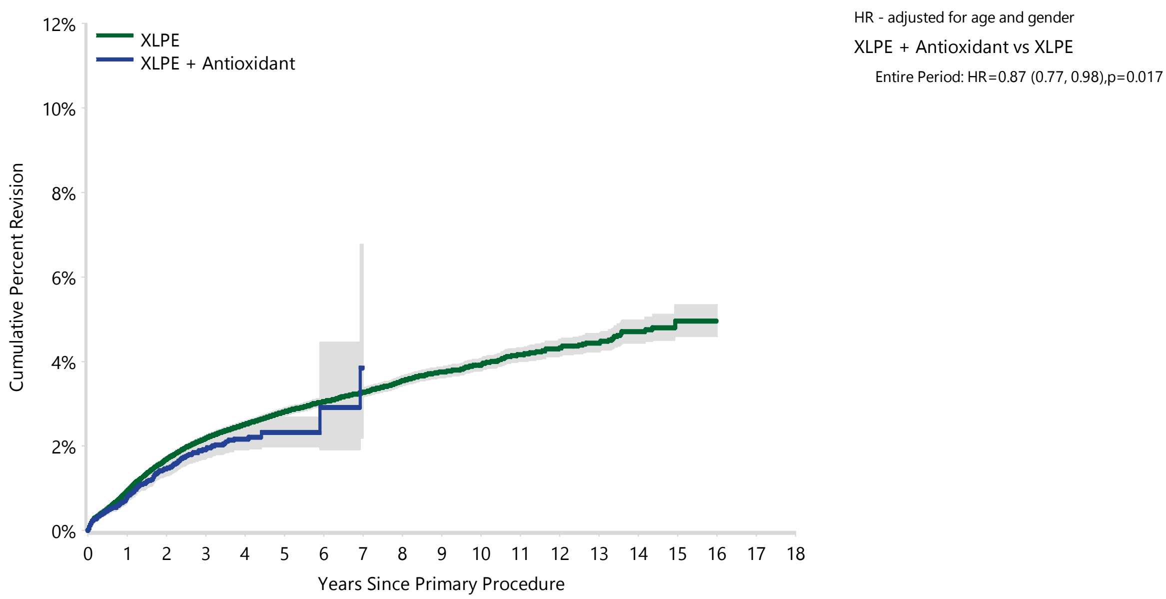
Table KT41 Hazard Ratios of XLPE vs Non XLPE in Primary Total Knee Replacement by Prosthesis Combination (Primary Diagnosis OA)

Prosthesis Combination	Hazard Ratio		P-Value
Genesis II CR/Genesis II	Entire Period	0.89 (0.65, 1.23)	0.487
Genesis II Oxinium CR/Genesis II	Entire Period	0.78 (0.57, 1.06)	0.116
Genesis II Oxinium PS/Genesis II	Entire Period	0.91 (0.78, 1.06)	0.225
Genesis II PS/Genesis II	Entire Period	1.20 (0.97, 1.48)	0.088
Legion CR/Genesis II	Entire Period	0.92 (0.63, 1.32)	0.636
Legion Oxinium CR/Genesis II	Entire Period	1.47 (0.99, 2.18)	0.054
Legion Oxinium PS/Genesis II	Entire Period	0.72 (0.59, 0.88)	<0.001
Legion PS/Genesis II	Entire Period	1.43 (0.99, 2.07)	0.057
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 (0.14, 0.28)	<0.001
Nexgen CR Flex/Nexgen	Entire Period	0.90 (0.74, 1.10)	0.297
Nexgen CR/Nexgen	0 - 3Yr	1.04 (0.77, 1.39)	0.808
	3Yr - 4Yr	1.02 (0.49, 2.11)	0.966
	4Yr+	0.50 (0.36, 0.69)	<0.001
Nexgen LPS Flex/Nexgen	0 - 1Yr	1.24 (0.99, 1.55)	0.059
	1Yr - 1.5Yr	0.62 (0.44, 0.89)	0.010
	1.5Yr+	0.92 (0.79, 1.06)	0.263
PFC Sigma CR/PFC Sigma	Entire Period	0.95 (0.72, 1.26)	0.724
PFC Sigma PS/PFC Sigma	Entire Period	0.85 (0.49, 1.45)	0.547
Scorpio NRG PS/Series 7000	Entire Period	1.20 (0.73, 1.98)	0.471
Triathlon CR/Triathlon	Entire Period	1.10 (0.96, 1.25)	0.158
Triathlon PS/Triathlon	Entire Period	0.77 (0.63, 0.93)	0.007
Vanguard CR/Vanguard	Entire Period	0.79 (0.46, 1.37)	0.409

Table KT42 Cumulative Percent Revision of XLPE Primary Total Knee Replacement by Polyethylene Type (Primary Diagnosis OA)

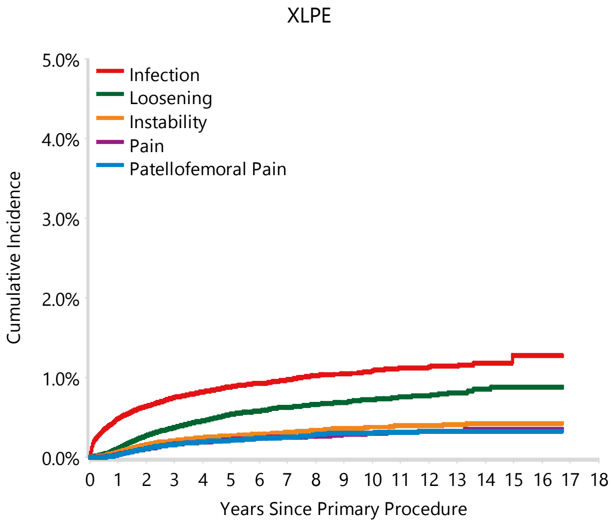
Polyethylene Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
XLPE	4898	205800	0.9 (0.9, 1.0)	2.2 (2.1, 2.3)	2.8 (2.7, 2.9)	3.9 (3.8, 4.1)	5.0 (4.6, 5.3)	
XLPE + Antioxidant	314	25507	0.8 (0.7, 0.9)	1.9 (1.7, 2.2)	2.3 (2.0, 2.7)			
TOTAL	**5212**	**231307**						

Figure KT45 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	18 Yrs
XLPE	205800	176539	121788	76102	13059	1180	0
XLPE + Antioxidant	25507	16681	5521	488	0	0	0

Figure KT46 Cumulative Incidence Revision Diagnosis of XLPE Primary Total Knee Replacement by Polyethylene Type (Primary Diagnosis OA)



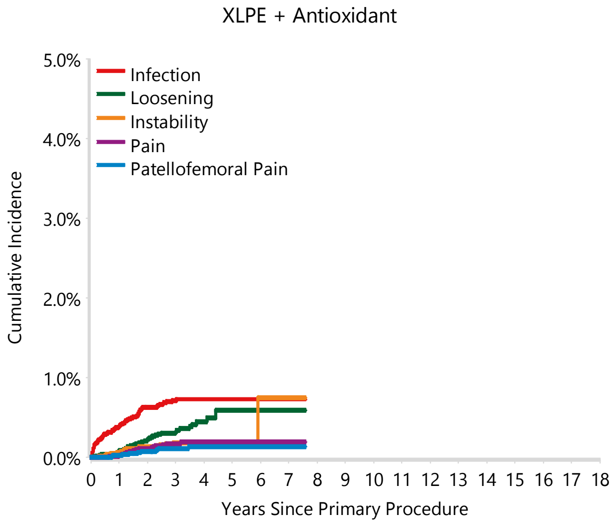
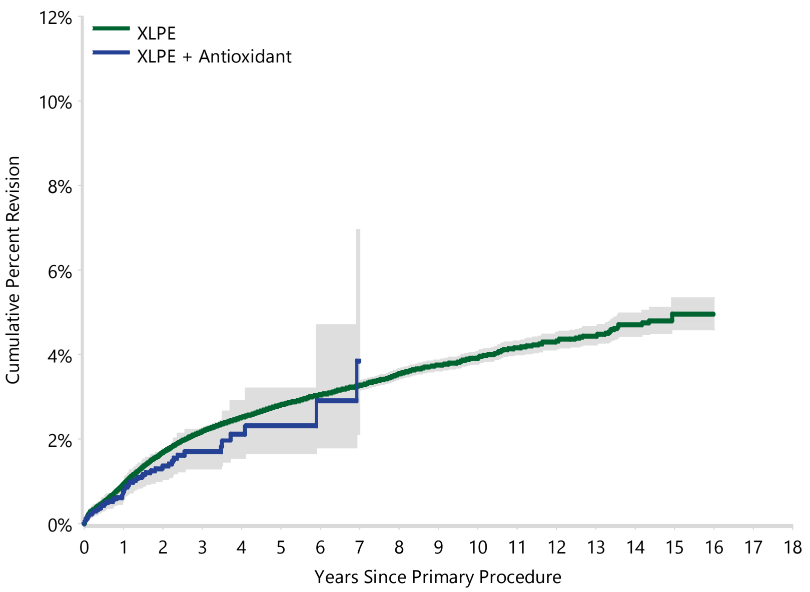


Table KT43 Cumulative Percent Revision of XLPE Primary Total Knee Replacement by Polyethylene Type (Primary Diagnosis OA, Excluding Attune)

Polyethylene Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
XLPE	4898	205800	0.9 (0.9, 1.0)	2.2 (2.1, 2.3)	2.8 (2.7, 2.9)	3.9 (3.8, 4.1)	5.0 (4.6, 5.3)	
XLPE + Antioxidant	78	8255	0.8 (0.6, 1.0)	1.7 (1.3, 2.2)	2.3 (1.7, 3.2)			
TOTAL	**4976**	**214055**						

Figure KT47 Cumulative Percent Revision of XLPE Primary Total Knee Replacement by Polyethylene Type (Primary Diagnosis OA, Excluding Attune)



HR - adjusted for age and gender

XLPE + Antioxidant vs XLPE

Entire Period: HR=0.84 (0.67, 1.05),p=0.118

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	18 Yrs
XLPE	205800	176539	121788	76102	13059	1180	0
XLPE + Antioxidant	8255	4085	943	271	0	0	0

Shoulder Replacement

SHOULDER REPLACEMENT

CATEGORIES OF SHOULDER REPLACEMENT

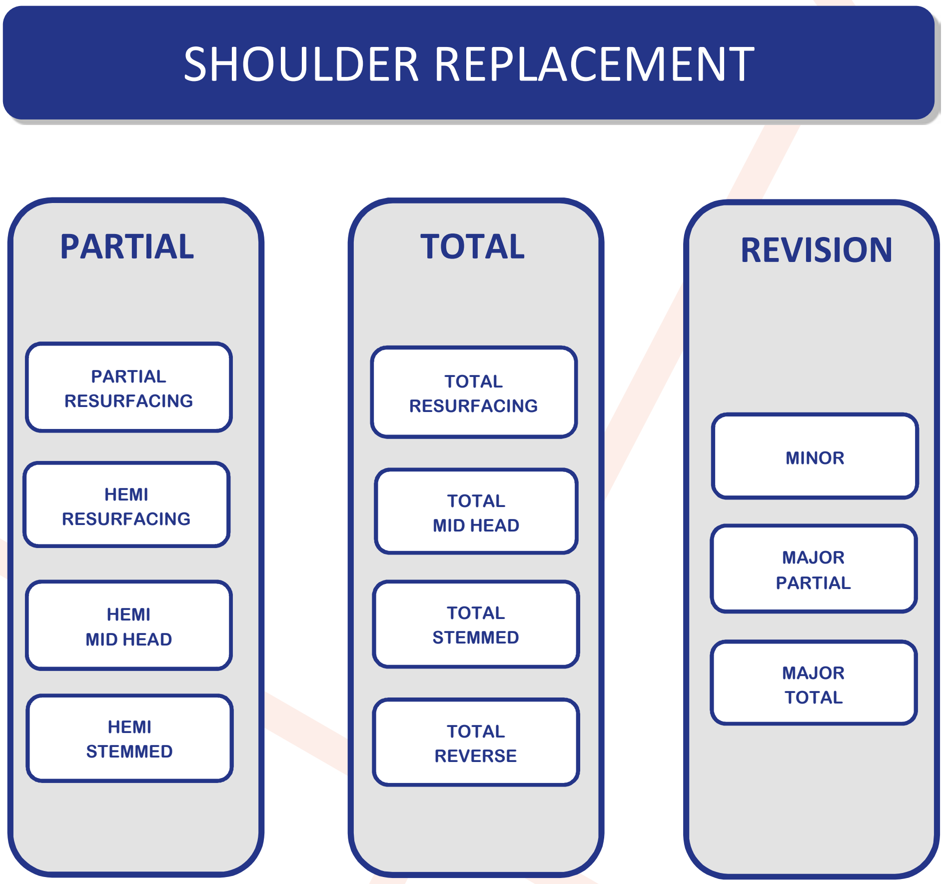
The Registry groups shoulder replacement into three broad categories: primary partial, primary total and revision shoulder replacement.

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: minor, major partial and major total shoulder replacement.



USE OF SHOULDER REPLACEMENT

This report is an analysis of 52,052 shoulder replacement procedures reported to the Registry with a procedure date up to and including 31 December 2018. This is an additional 7,251 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 2018 increased by 526 (8.1%) compared to the previous year and by 167.6% since 2008.

Shoulder replacement procedures increased by 8.1% in 2018 and increased by 167.6% since 2008.

When considering all shoulder replacement procedures currently recorded by the Registry, primary total shoulder replacement is the most common category (77.1%), followed by primary partial (13.0%) and revision procedures (9.9%) (Table S1).

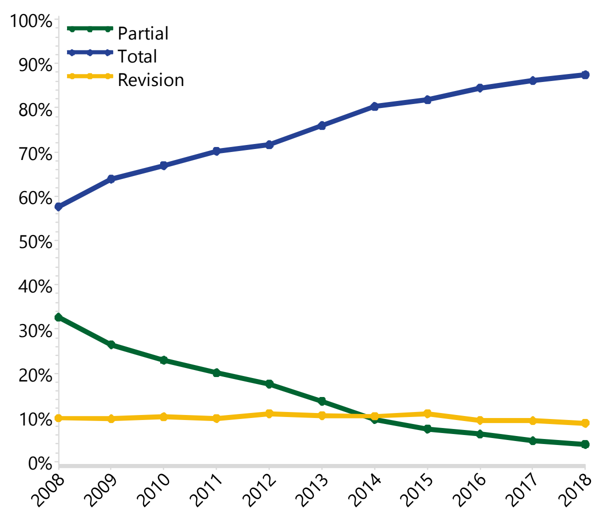
Table S1 Number of Shoulder Replacements

Shoulder Category	Number	Percent
Partial	6790	13.0
Total	40130	77.1
Revision	5132	9.9
TOTAL	**52052**	**100.0**

The proportion of total shoulder replacements has increased from 57.6% in 2008 to 87.4% in 2018. Since 2008, partial shoulder replacement has decreased from 32.6% to 3.9% in 2018. In 2008, the proportion of revision procedures was 9.8%. This peaked at 10.9% in 2012. In 2018, the proportion of revision procedures has declined to 8.7%. This equates to 155 less revision procedures in 2018 than would have been expected if the proportion of revision procedures had remained at the peak of 10.9% (Figure S1).

The decline in the proportion of revision procedures to 8.7% in 2018 equates to 155 fewer revision procedures than if the proportion had remained at the peak of 10.9%

Figure S1 Proportion of Shoulder Replacement by Shoulder Category



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 is ASA score data on 30,773 procedures and BMI data on 20,841 shoulder replacement procedures. Since its initial collection, ASA score has been recorded in 91.5% of procedures. BMI data have been recorded in 84.6% of procedures since its collection commenced.

In 2018, ASA score is reported in 99.4% of shoulder replacement procedures and BMI is reported in 93.8% of procedures.

In 2018, the percentage of procedures with ASA score reported for primary partial shoulder is 98.9%, primary total shoulder 99.4% and revision shoulder replacement 99.5%. BMI data is reported for 94.9% of primary partial shoulder, 93.9% of primary total shoulder and 93.0% 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 92.3% of procedures, patients have an ASA score of 2 or 3, 4.8% have a score of 1 and 2.9% have a score of 4. In three 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 (53.6%) compared to primary partial shoulder replacement (42.7%), or total shoulder replacement (46.6%) (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 (61.8%), compared to partial shoulder replacement (59.6%), and revision shoulder replacement (60.2%) (Table S3).

Table S2 ASA Score for Shoulder Replacement

	Partial		Total		Revision		TOTAL	
ASA Score	N	Col%	N	Col%	N	Col%	N	Col%
ASA 1	211	10.5	1148	4.4	114	3.9	1473	4.8
ASA 2	864	43.1	11931	46.2	1148	38.8	13943	45.3
ASA 3	856	42.7	12028	46.6	1586	53.6	14470	47.0
ASA 4	72	3.6	700	2.7	112	3.8	884	2.9
ASA 5	.	.	3	0.0	.	.	3	0.0
TOTAL	**2003**	**100.0**	**25810**	**100.0**	**2960**	**100.0**	**30773**	**100.0**

Table S3 BMI Category for Shoulder Replacement

	Partial		Total		Revision		TOTAL	
BMI Category	N	Col%	N	Col%	N	Col%	N	Col%
Underweight	16	1.6	149	0.8	22	1.1	187	0.9
Normal	192	19.1	3032	16.9	354	18.3	3578	17.2
Pre Obese	360	35.8	6118	34.2	632	32.7	7110	34.1
Obese Class 1	240	23.9	4944	27.6	532	27.5	5716	27.4
Obese Class 2	124	12.3	2336	13.0	251	13.0	2711	13.0
Obese Class 3	74	7.4	1324	7.4	141	7.3	1539	7.4
TOTAL	**1006**	**100.0**	**17903**	**100.0**	**1932**	**100.0**	**20841**	**100.0**

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

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 is CT scan usage data on 11,642 procedures and glenoid morphology data on 8,770 procedures. Since its initial collection, the use of CT scans have been recorded in 85.2% of procedures. Glenoid morphology data have been recorded in 64.5% 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

Overall a CT scan was undertaken in 60.2% of shoulder replacements.

There is a difference depending on the class of shoulder replacement. Total shoulder replacement procedures have a higher proportion of CT scans (64.4%) compared to revision shoulder replacement (33.0%) and partial shoulder replacement (30.6%) (Table S4).

GLENOID MORPHOLOGY

There are five 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 replacements, the majority of procedures are undertaken for a glenoid morphology of A1 (46.1%). There is a slightly lower proportion of revision shoulder replacements that had a glenoid morphology of A1 (38.5%), compared to partial shoulder replacement (46.7%) and primary total shoulder replacement (46.7%) (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	147	30.6	6517	64.4	344	33.0	7008	60.2
No	306	63.8	3380	33.4	620	59.6	4306	37.0
Unknown	27	5.6	224	2.2	77	7.4	328	2.8
TOTAL	**480**	**100.0**	**10121**	**100.0**	**1041**	**100.0**	**11642**	**100.0**

Table S5 Glenoid Morphology for Shoulder Replacement

	Partial		Total		Revision		TOTAL	
Glenoid Morphology	N	Col%	N	Col%	N	Col%	N	Col%
A1	122	46.7	3782	46.4	129	38.5	4033	46.1
A2	45	17.2	1830	22.4	102	30.4	1977	22.6
B1	22	8.4	1211	14.9	40	11.9	1273	14.5
B2	42	16.1	1007	12.3	29	8.7	1078	12.3
C	30	11.5	324	4.0	35	10.4	389	4.4
TOTAL	**261**	**100.0**	**8154**	**100.0**	**335**	**100.0**	**8750**	**100.0**

Note: 19 procedures have been excluded where a glenoid morphology of B3 was recorded

[2] Walch G, Badet R, Boulahia A, Khoury A. Morphologic study of the glenoid in primary glenohumeral osteoarthritis. The Journal of 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 6,790 primary partial shoulder replacements reported to the Registry up to 31 December 2018. This is an additional 286 procedures compared to the number reported last year.

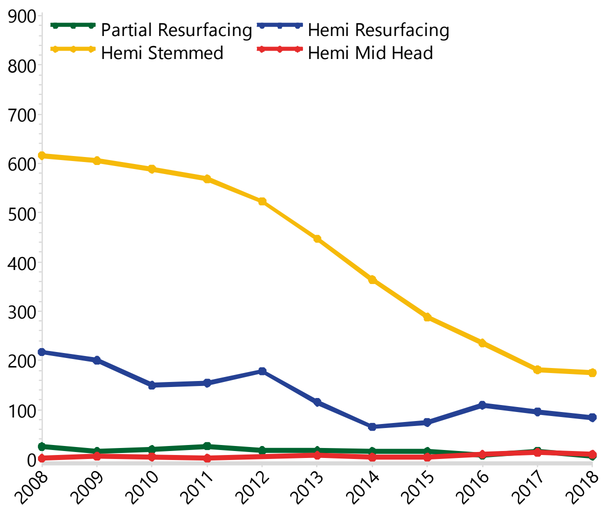
The most common class of primary partial shoulder replacement is hemi stemmed. This accounts for 73.1% of all partial shoulder replacements, followed by hemi resurfacing (23.4%), partial resurfacing (2.7%) and hemi mid head (0.8%) (Table SP1).

Table SP1 Primary Partial Shoulder Replacement by Class

Shoulder Class	Number	Percent
Partial Resurfacing	186	2.7
Hemi Resurfacing	1588	23.4
Hemi Stemmed	4961	73.1
Hemi Mid Head	55	0.8
TOTAL	**6790**	**100.0**

The use of the two main classes of primary partial shoulder replacement has declined over the last eight years. The number of hemi resurfacing procedures decreased from 178 in 2012 to 84 in 2018. The number of hemi stemmed procedures decreased from 616 in 2008 to 175 in 2018 (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 (71.7%), hemi mid head (43.6%), hemi resurfacing (42.7%) and partial resurfacing (22.6%) (Table SP2).

The proportion of patients aged ≥65 years also varies depending on the class of primary partial shoulder replacement: hemi stemmed (69.8%), hemi resurfacing (50.9%), hemi mid head (34.5%) and partial resurfacing (19.4%) (Table SP3).

Overall, males undergoing primary partial shoulder replacement are younger (mean age 61.5 years) compared to females (71.3 years) (Table SP4).

The most common primary diagnosis for females is fracture (53.8%). For males, the most common primary diagnosis is osteoarthritis (55.2%) (Table SP5).

The cumulative percent revision varies depending on class. Partial resurfacing and hemi mid head have only been used in small numbers (186 and 55 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 (17.3% compared to 12.1%, respectively) (Table SP6 and Figure SP2).

Table SP2 Primary Partial Shoulder Replacement by Class and Gender

	Male		Female		TOTAL	
Shoulder Class	N	Row%	N	Row%	N	Row%
Partial Resurfacing	144	77.4	42	22.6	186	100.0
Hemi Resurfacing	910	57.3	678	42.7	1588	100.0
Hemi Stemmed	1402	28.3	3559	71.7	4961	100.0
Hemi Mid Head	31	56.4	24	43.6	55	100.0
TOTAL	**2487**	**36.6**	**4303**	**63.4**	**6790**	**100.0**

Table SP3 Primary Partial Shoulder Replacement by Class and Age

	<55		55-64		65-74		≥75		TOTAL	
Shoulder Class	N	Row%	N	Row%	N	Row%	N	Row%	N	Row%
Partial Resurfacing	136	73.1	14	7.5	20	10.8	16	8.6	186	100.0
Hemi Resurfacing	347	21.9	433	27.3	484	30.5	324	20.4	1588	100.0
Hemi Stemmed	525	10.6	974	19.6	1469	29.6	1993	40.2	4961	100.0
Hemi Mid Head	21	38.2	15	27.3	14	25.5	5	9.1	55	100.0
TOTAL	**1029**	**15.2**	**1436**	**21.1**	**1987**	**29.3**	**2338**	**34.4**	**6790**	**100.0**

Table SP4 Age and Gender of Primary Partial Shoulder Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	2487	36.6%	14	94	63	61.5	14.5
Female	4303	63.4%	13	101	73	71.3	11.5
TOTAL	**6790**	**100.0%**	**13**	**101**	**69**	**67.7**	**13.6**

Table SP5 Primary Partial Shoulder Replacement by Primary Diagnosis and Gender

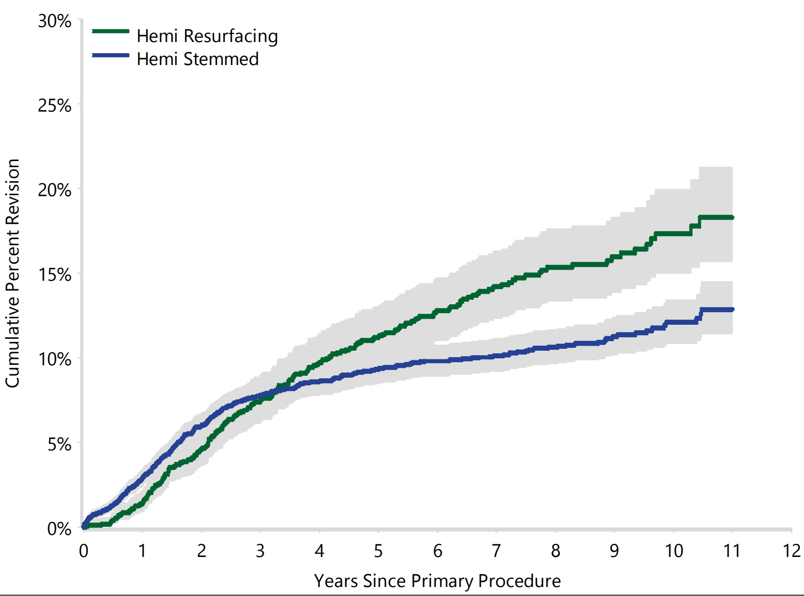
	Male		Female		TOTAL	
Primary Diagnosis	N	Col%	N	Col%	N	Col%
Fracture	670	26.9	2316	53.8	2986	44.0
Osteoarthritis	1373	55.2	1424	33.1	2797	41.2
Rotator Cuff Arthropathy	120	4.8	194	4.5	314	4.6
Osteonecrosis	96	3.9	127	3.0	223	3.3
Instability	114	4.6	61	1.4	175	2.6
Tumour	81	3.3	61	1.4	142	2.1
Rheumatoid Arthritis	20	0.8	104	2.4	124	1.8
Other Inflammatory Arthritis	11	0.4	16	0.4	27	0.4
Osteochondritis Dissecans	2	0.1	.	.	2	0.0
TOTAL	**2487**	**100.0**	**4303**	**100.0**	**6790**	**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	12 Yrs
Partial Resurfacing	9	186	0.6 (0.1, 3.9)	1.7 (0.6, 5.3)	3.3 (1.4, 7.7)	6.0 (3.0, 11.7)		
Hemi Resurfacing	196	1588	1.4 (0.9, 2.2)	7.5 (6.2, 9.0)	11.2 (9.6, 13.0)	14.2 (12.3, 16.3)	17.3 (15.0, 20.0)	
Hemi Stemmed	446	4961	2.9 (2.5, 3.4)	7.8 (7.0, 8.6)	9.3 (8.5, 10.3)	10.1 (9.2, 11.1)	12.1 (10.9, 13.4)	
Hemi Mid Head	7	55	1.9 (0.3, 12.9)	18.5 (8.3, 38.2)	24.7 (11.7, 47.8)	24.7 (11.7, 47.8)		
TOTAL	**658**	**6790**						

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=2.84 (1.59, 5.06),p<0.001

9Mth - 1.5Yr: HR=1.01 (0.70, 1.45),p=0.965

1.5Yr - 2Yr: HR=1.46 (0.82, 2.57),p=0.196

2Yr+: HR=0.51 (0.40, 0.64),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Hemi Resurfacing	1588	1474	1165	955	651	234	15
Hemi Stemmed	4961	4451	3527	2668	1716	479	19

PRIMARY PARTIAL RESURFACING SHOULDER REPLACEMENT

DEMOGRAPHICS AND OUTCOMES

There have been 186 primary partial resurfacing shoulder replacement procedures reported to the Registry. This is an additional 11 procedures compared to the previous report.

This procedure is undertaken more commonly in males (77.4%). The mean age for males is 39.0 years compared to 56.8 years for females (Table SP7).

The most common primary diagnosis for males is instability (54.9%), whereas the most common primary diagnosis for females is osteoarthritis (50.0%) (Table SP8).

The cumulative percent revision at 7 years is 6.0% (Table SP6). Of the 9 revisions, 5 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 (5 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	144	77.4%	14	87	36	39.0	17.6
Female	42	22.6%	16	88	59	56.8	19.7
TOTAL	**186**	**100.0%**	**14**	**88**	**40**	**43.0**	**19.5**

Table SP8 Primary Partial Resurfacing Shoulder Replacement by Primary Diagnosis and Gender

	Male		Female		TOTAL	
Primary Diagnosis	N	Col%	N	Col%	N	Col%
Instability	79	54.9	15	35.7	94	50.5
Osteoarthritis	49	34.0	21	50.0	70	37.6
Fracture	10	6.9	2	4.8	12	6.5
Osteonecrosis	2	1.4	3	7.1	5	2.7
Osteochondritis Dissecans	2	1.4	.	.	2	1.1
Rotator Cuff Arthropathy	2	1.4	.	.	2	1.1
Rheumatoid Arthritis	.	.	1	2.4	1	0.5
TOTAL	**144**	**100.0**	**42**	**100.0**	**186**	**100.0**

Note: Instability includes instability, dislocation and Hill-Sachs Defect

PRIMARY HEMI RESURFACING SHOULDER REPLACEMENT

DEMOGRAPHICS

There have been 1,588 primary hemi resurfacing shoulder replacements reported to the Registry. This is an additional 88 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 (57.3%). The mean age is 60.9 years for males and 68 years for females (Table SP9).

Osteoarthritis is the most common primary diagnosis (88.0%). The range of diagnoses is similar for males and females (Table SP10).

The prostheses used in 2018 are the PyroTITAN, Copeland and Global CAP (Table SP11).

Table SP9 Age and Gender of Primary Hemi Resurfacing Shoulder Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	910	57.3%	19	90	62	60.9	12.0
Female	678	42.7%	27	93	69	68.0	11.3
TOTAL	**1588**	**100.0%**	**19**	**93**	**65**	**63.9**	**12.3**

Table SP10 Primary Hemi Resurfacing Shoulder Replacement by Primary Diagnosis and Gender

	Male		Female		TOTAL	
Primary Diagnosis	N	Col%	N	Col%	N	Col%
Osteoarthritis	808	88.8	590	87.0	1398	88.0
Rotator Cuff Arthropathy	49	5.4	34	5.0	83	5.2
Osteonecrosis	18	2.0	18	2.7	36	2.3
Rheumatoid Arthritis	9	1.0	19	2.8	28	1.8
Instability	13	1.4	6	0.9	19	1.2
Fracture	10	1.1	4	0.6	14	0.9
Other Inflammatory Arthritis	3	0.3	7	1.0	10	0.6
TOTAL	**910**	**100.0**	**678**	**100.0**	**1588**	**100.0**

Note: Instability includes instability and dislocation

Table SP11 Most Used Humeral Head Prostheses in Primary Hemi Resurfacing Shoulder Replacement

2008		2015		2016		2017		2018	
N	Model	N	Model	N	Model	N	Model	N	Model
124	Copeland	27	Copeland	81	PyroTITAN	75	PyroTITAN	73	PyroTITAN
45	Global CAP	21	PyroTITAN	14	Copeland	13	Copeland	7	Copeland
34	SMR	16	Global CAP	10	Global CAP	7	Global CAP	4	Global CAP
11	Aequalis	6	SMR	4	SMR	1	Aequalis		
2	Epoca RH	4	Aequalis						
1	Buechel-Pappas								
Most Used									
217	(6) 100.0%	74	(5) 100.0%	109	(4) 100.0%	96	(4) 100.0%	84	(3) 100.0%

OUTCOME FOR ALL DIAGNOSES

Reason for Revision

The main reasons for revision of primary hemi resurfacing shoulder replacement are glenoid erosion (24.5%), pain (23.5%), rotator cuff insufficiency (12.2%) and instability/dislocation (11.2%) (Table SP12 and Figure SP3).

There have been no head breakages of the PyroTITAN prosthesis reported this year. Prior to 2017, there had been 5 reported breakges of this prosthesis. Three of these breakages were reported secondary to loosening.

Glenoid erosion or pain are the reasons for 48.0% of all hemi resurfacing shoulder revisions.

Type of Revision

The most common type of revision is to a total shoulder replacement (89.3%) (Table SP13). Of these, 100 (57.1%) were revised to a total reverse shoulder and 75 (42.9%) to a total stemmed shoulder replacement.

Table SP12 Primary Hemi Resurfacing Shoulder Replacement by Reason for Revision (All Diagnoses)

Reason for Revision	Number	Percent
Glenoid Erosion	48	24.5
Pain	46	23.5
Rotator Cuff Insufficiency	24	12.2
Instability/Dislocation	22	11.2
Loosening	20	10.2
Lysis	8	4.1
Infection	6	3.1
Implant Breakage Head	5	2.6
Malposition	3	1.5
Metal Related Pathology	3	1.5
Arthrofibrosis	2	1.0
Wear Glenoid Insert	2	1.0
Fracture	2	1.0
Incorrect Sizing	2	1.0
Osteonecrosis	1	0.5
Implant Breakage Humeral	1	0.5
Implant Breakage Glenoid	1	0.5
TOTAL	**196**	**100.0**

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).

Females have a higher rate of revision than males (Table SP15 and Figure SP5).

The outcomes of the most commonly used prostheses are listed in Table SP16.

Table SP13 Primary Hemi Resurfacing Shoulder Replacement by Type of Revision (All Diagnoses)

Type of Revision	Number	Percent
Humeral/Glenoid	175	89.3
Humeral Component	10	5.1
Glenoid Component	6	3.1
Cement Spacer	2	1.0
Removal of Prostheses	1	0.5
Reoperation	1	0.5
Head Only	1	0.5
TOTAL	**196**	**100.0**

Figure SP3 Cumulative Incidence Revision Diagnosis of Primary Hemi Resurfacing Shoulder Replacement (All Diagnoses)

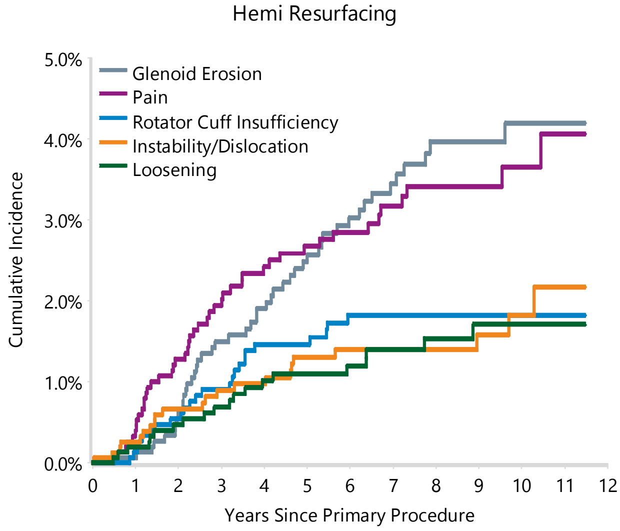
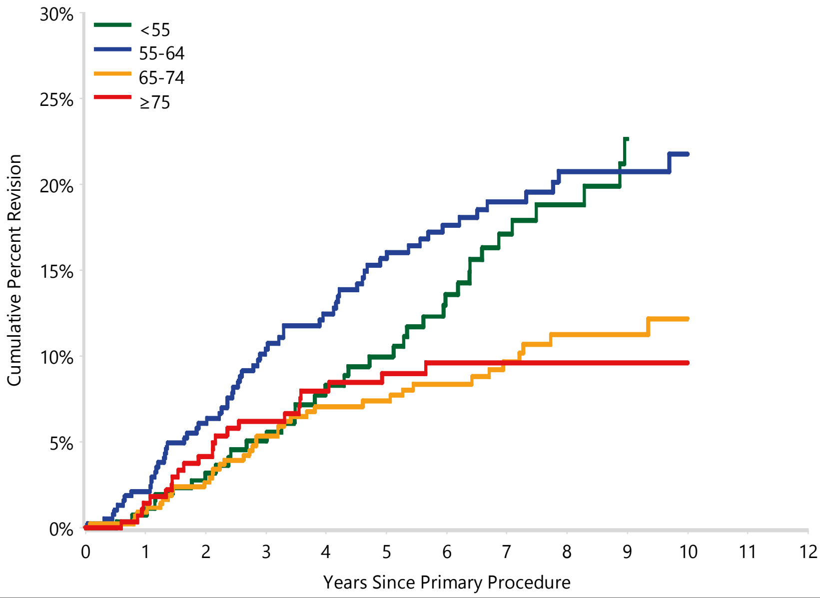


Table SP14 Cumulative Percent Revision of Primary Hemi Resurfacing Shoulder Replacement by Age (Primary Diagnosis OA)

Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
<55	39	291	0.7 (0.2, 3.0)	5.0 (2.9, 8.7)	10.0 (6.6, 15.0)	17.1 (12.3, 23.5)		
55-64	65	384	2.1 (1.1, 4.2)	10.4 (7.6, 14.2)	15.7 (12.1, 20.2)	19.0 (15.0, 23.9)	21.8 (17.1, 27.4)	
65-74	38	437	0.9 (0.4, 2.5)	5.3 (3.5, 8.1)	7.4 (5.1, 10.5)	9.7 (7.0, 13.4)	12.2 (8.8, 16.8)	
≥75	23	286	1.5 (0.5, 3.8)	6.2 (3.8, 9.9)	9.0 (6.0, 13.4)	9.6 (6.5, 14.2)	9.6 (6.5, 14.2)	
TOTAL	**165**	**1398**						

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 - 2.5Yr: HR=1.78 (0.89, 3.57),p=0.104

2.5Yr+: HR=0.81 (0.49, 1.32),p=0.395

65-74 vs <55

0 - 2.5Yr: HR=0.79 (0.37, 1.72),p=0.560

2.5Yr+: HR=0.39 (0.22, 0.68),p=0.001

≥75 vs <55

0 - 1Yr: HR=1.17 (0.34, 4.05),p=0.801

1Yr - 1.5Yr: HR=0.81 (0.24, 2.71),p=0.733

1.5Yr - 2.5Yr: HR=1.30 (0.47, 3.60),p=0.609

2.5Yr - 3.5Yr: HR=0.18 (0.04, 0.77),p=0.021

3.5Yr - 4Yr: HR=1.09 (0.26, 4.53),p=0.909

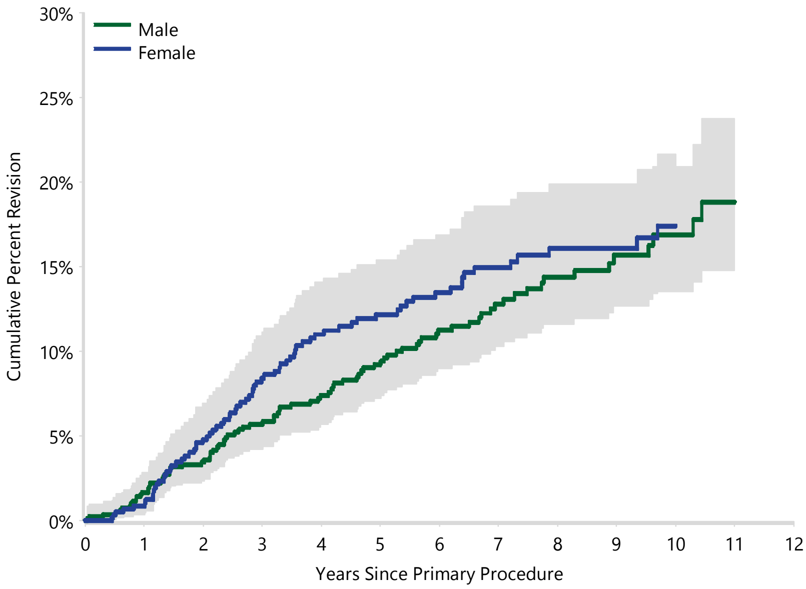
4Yr+: HR=0.13 (0.04, 0.44),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
<55	291	254	186	157	104	34	3
55-64	384	354	276	226	158	69	5
65-74	437	415	337	284	192	65	3
≥75	286	269	219	163	108	42	1

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	12 Yrs
Male	89	808	1.7 (1.0, 2.9)	5.7 (4.2, 7.7)	9.2 (7.2, 11.7)	12.8 (10.3, 15.9)	16.9 (13.5, 20.9)	
Female	76	590	0.9 (0.4, 2.1)	8.4 (6.3, 11.1)	12.2 (9.6, 15.4)	15.0 (12.0, 18.6)	17.4 (13.9, 21.7)	
TOTAL	**165**	**1398**						

Figure SP5 Cumulative Percent Revision of Primary Hemi Resurfacing Shoulder Replacement by Gender (Primary Diagnosis OA)



HR - adjusted for age
Female vs Male
Entire Period: HR=1.41 (1.01, 1.96),p=0.040

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Male	808	742	576	477	307	114	7
Female	590	550	442	353	255	96	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	12 Yrs
Aequalis	15	79	1.3 (0.2, 8.8)	9.1 (4.4, 18.1)	14.8 (8.5, 25.2)	19.3 (11.5, 31.5)	25.0 (15.3, 39.3)	
Copeland	64	549	1.5 (0.7, 2.9)	6.1 (4.3, 8.5)	9.0 (6.8, 11.9)	11.8 (9.2, 15.1)	13.8 (10.8, 17.6)	
Global CAP	34	218	0.5 (0.1, 3.3)	8.8 (5.6, 13.6)	12.1 (8.2, 17.5)	15.5 (10.9, 21.6)	20.4 (14.7, 27.9)	
PyroTITAN	18	383	2.0 (1.0, 4.2)	4.5 (2.7, 7.5)	6.6 (4.0, 10.7)			
SMR	29	146	0.0 (0.0, 0.0)	7.0 (3.8, 12.6)	14.7 (9.7, 21.9)	20.8 (14.5, 29.2)		
Other (3)	5	23	4.3 (0.6, 27.1)	17.4 (6.9, 39.9)	17.4 (6.9, 39.9)	23.3 (10.3, 47.7)	23.3 (10.3, 47.7)	
TOTAL	**165**	**1398**						

Note: Only prostheses with over 50 procedures have been listed

PRIMARY HEMI MID HEAD SHOULDER REPLACEMENT

DEMOGRAPHICS AND OUTCOME

There have been 55 primary hemi mid head shoulder replacement procedures reported to the Registry. This is an additional 9 procedures compared to the previous report.

This procedure is undertaken more commonly in males (56.4%). The mean age is 52.8 years for males and 65.3 years for females (Table SP17).

Osteoarthritis is the most common primary diagnosis (56.4%) (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 (28), the Eclipse (10) and the Affiniti (7).

Table SP17 Age and Gender of Primary Hemi Mid Head Shoulder Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	31	56.4%	24	83	52	52.8	12.5
Female	24	43.6%	30	85	66	65.3	11.2
TOTAL	**55**	**100.0%**	**24**	**85**	**59**	**58.3**	**13.4**

Table SP18 Primary Hemi Mid Head Shoulder Replacement by Primary Diagnosis and Gender

	Male		Female		TOTAL	
Primary Diagnosis	N	Col%	N	Col%	N	Col%
Osteoarthritis	16	51.6	15	62.5	31	56.4
Osteonecrosis	12	38.7	6	25.0	18	32.7
Fracture	1	3.2	2	8.3	3	5.5
Rotator Cuff Arthropathy	2	6.5	.	.	2	3.6
Rheumatoid Arthritis	.	.	1	4.2	1	1.8
TOTAL	**31**	**100.0**	**24**	**100.0**	**55**	**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**

PRIMARY HEMI STEMMED SHOULDER REPLACEMENT

DEMOGRAPHICS

There have been 4,961 primary hemi stemmed shoulder replacement procedures reported to the Registry. This is an additional 178 procedures compared to the previous report.

This procedure is more common in females (71.7%). The mean age is 72.2 years for females and 64.4 years for males (Table SP21).

The most common primary diagnosis is fracture (59.6%), followed by osteoarthritis (26.2%) (Table SP22). In 2018, the number of primary hemi stemmed shoulder replacements undertaken for fracture decreased by 84.4% compared to 2008. In 2018, the number of primary hemi stemmed shoulder replacements undertaken for osteoarthritis decreased by 59.0% compared to 2008 (Figure SP6).

The most common humeral head prostheses used in 2018 are the Ascend Flex, Global Unite, SMR and Comprehensive. The 10 most used humeral head prostheses account for 89.1% of all primary hemi stemmed procedures in 2018. This has decreased from 98.2% in 2008 (Table SP23).

The most common humeral stem prostheses used in 2018 are the Ascend Flex, SMR, Comprehensive and Global AP. The 10 most used humeral stem prostheses account for 94.3% of all primary hemi stemmed procedures in 2018. This has decreased from 97.2% in 2008 (Table SP24).

There has been a major decline in the use of primary hemi stemmed shoulder replacement for the management of osteoarthritis and fracture.

Table SP21 Age and Gender of Primary Hemi Stemmed Shoulder Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	1402	28.3%	14	94	65	64.4	13.5
Female	3559	71.7%	13	101	73	72.2	11.2
TOTAL	**4961**	**100.0%**	**13**	**101**	**71**	**70.0**	**12.4**

Table SP22 Primary Hemi Stemmed Shoulder Replacement by Primary Diagnosis and Gender

	Male		Female		TOTAL	
Primary Diagnosis	N	Col%	N	Col%	N	Col%
Fracture	649	46.3	2308	64.8	2957	59.6
Osteoarthritis	500	35.7	798	22.4	1298	26.2
Rotator Cuff Arthropathy	67	4.8	160	4.5	227	4.6
Osteonecrosis	64	4.6	100	2.8	164	3.3
Tumour	81	5.8	61	1.7	142	2.9
Rheumatoid Arthritis	11	0.8	83	2.3	94	1.9
Instability	22	1.6	40	1.1	62	1.2
Other Inflammatory Arthritis	8	0.6	9	0.3	17	0.3
TOTAL	**1402**	**100.0**	**3559**	**100.0**	**4961**	**100.0**

Note: Instability includes instability and dislocation

Figure SP6 Primary Hemi Stemmed Shoulder Replacement by Primary Diagnosis

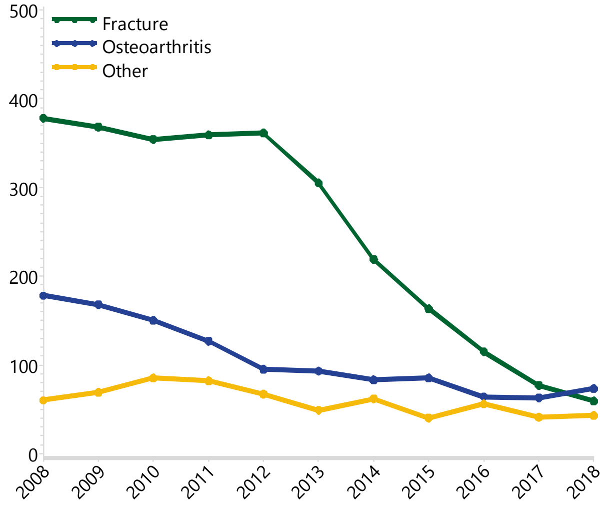


Table SP23 10 Most Used Humeral Head Prostheses in Primary Hemi Stemmed Shoulder Replacement

2008		2015		2016		2017		2018	
N	Model	N	Model	N	Model	N	Model	N	Model
197	Global Advantage	49	SMR	37	Global Unite	44	Ascend Flex	63	Ascend Flex
177	SMR	38	Global Unite	31	SMR	16	Global Unite	19	Global Unite
98	Aequalis	31	Ascend Flex	27	Ascend Flex	15	Comprehensive	16	SMR
38	Bigliani/Flatow	31	Global Advantage	20	Global AP	15	SMR	15	Comprehensive
31	SMR CTA	29	Bigliani/Flatow	18	Aequalis	13	Aequalis	10	Equinoxe
22	Global Advantage CTA	26	Global AP	16	Comprehensive	13	Equinoxe	9	SMR CTA
15	Bio-Modular	18	Aequalis	14	Bigliani/Flatow	12	Affinis	8	Aequalis
13	Solar	10	SMR CTA	12	SMR CTA	9	Global AP	6	Delta Xtend
8	Global AP	9	Bio-Modular	11	Bio-Modular	9	SMR CTA	5	Affinis
6	Univers 3D	7	Global AP CTA	11	Global Advantage	7	Bigliani/Flatow	5	Bio-Modular
10 Most Used									
605	(10) 98.2%	248	(10) 86.1%	197	(10) 83.8%	153	(10) 84.5%	156	(10) 89.1%
Remainder									
11	(4) 1.8%	40	(12) 13.9%	38	(9) 16.2%	28	(6) 15.5%	19	(7) 10.9%
TOTAL									
616	(14) 100.0%	288	(22) 100.0%	235	(19) 100.0%	181	(16) 100.0%	175	(17) 100.0%

Table SP24 10 Most Used Humeral Stem Prostheses in Primary Hemi Stemmed Shoulder Replacement

2008		2015		2016		2017		2018	
N	Model	N	Model	N	Model	N	Model	N	Model
207	SMR	60	SMR	43	SMR	44	Ascend Flex	63	Ascend Flex
138	Global FX	38	Global Unite	37	Global Unite	24	SMR	25	SMR
98	Aequalis	33	Global AP	27	Ascend Flex	20	Comprehensive	20	Comprehensive
81	Global Advantage	31	Ascend Flex	27	Comprehensive	17	Global AP	12	Global AP
26	Bigliani/Flatow TM	30	Global FX	25	Global AP	14	Global Unite	11	Global Unite
13	Solar	22	Bigliani/Flatow TM	18	Aequalis	13	Aequalis	10	Equinoxe
11	Bigliani/Flatow	18	Aequalis	12	Global Advantage	13	Equinoxe	8	Aequalis
11	Bio-Modular	14	Comprehensive	11	Bigliani/Flatow TM	12	Affinis	6	Delta Xtend
8	Global AP	5	Delta Xtend	9	Global FX	6	Bigliani/Flatow TM	5	Affinis
6	Univers 3D	5	Equinoxe	8	Mutars	6	Global FX	5	Mutars
10 Most Used									
599	(10) 97.2%	256	(10) 88.9%	217	(10) 92.3%	169	(10) 93.4%	165	(10) 94.3%
Remainder									
17	(7) 2.8%	32	(10) 11.1%	18	(7) 7.7%	12	(4) 6.6%	10	(5) 5.7%
TOTAL									
616	(17) 100.0%	288	(20) 100.0%	235	(17) 100.0%	181	(14) 100.0%	175	(15) 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 SP25 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 (28.2%), whereas glenoid erosion occurs more frequently in procedures undertaken for osteoarthritis (30.4%) (Table SP26 and Figure SP8).

Type of Revision

The most common type of revision is to a total shoulder replacement for both primary diagnoses (70.4% for fracture and 58.3% for osteoarthritis) (Table SP27). Most were revised to a total reverse shoulder replacement (97.5% when used for fracture and 85.1% for osteoarthritis). Glenoid component only revision occurs more commonly in procedures undertaken for osteoarthritis (27.0% compared to 4.9% for fracture).

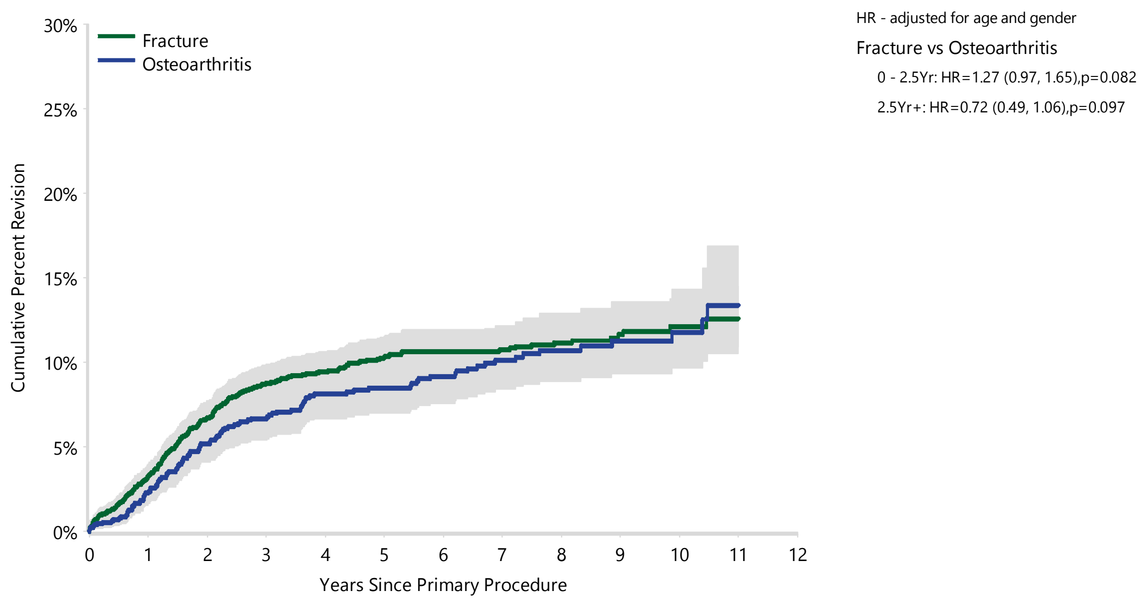
There is no difference in the rate of revision when primary hemi stemmed shoulder replacement is performed for fracture or osteoarthritis.

Table SP25 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	12 Yrs
Fracture	287	2957	3.3 (2.7, 4.0)	8.8 (7.8, 9.9)	10.3 (9.2, 11.6)	10.7 (9.6, 12.0)	12.1 (10.7, 13.7)	
Osteoarthritis	115	1298	2.3 (1.6, 3.4)	6.7 (5.4, 8.3)	8.5 (7.0, 10.3)	10.1 (8.4, 12.2)	11.8 (9.7, 14.3)	
Rotator Cuff Arthropathy	13	227	1.8 (0.7, 4.8)	5.1 (2.8, 9.3)	6.4 (3.7, 11.1)	6.4 (3.7, 11.1)		
Osteonecrosis	11	164	1.9 (0.6, 5.8)	4.0 (1.8, 8.8)	6.2 (3.1, 12.2)	7.4 (3.8, 14.1)		
Tumour	10	142	4.5 (1.9, 10.4)					
Other (3)	10	173	2.3 (0.9, 6.1)	4.2 (2.0, 8.6)	4.2 (2.0, 8.6)	4.2 (2.0, 8.6)		
TOTAL	**446**	**4961**						

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	12 Yrs
Fracture	2957	2683	2155	1617	999	267	7
Osteoarthritis	1298	1172	948	732	507	162	6

Note: Only primary diagnoses with over 1000 procedures have been listed

Table SP26 Primary Hemi Stemmed Shoulder Replacement by Reason for Revision and Primary Diagnosis

	Fracture			Osteoarthritis		
Revision Diagnosis	Number	% Primaries Revised	% Revisions	Number	% Primaries Revised	% Revisions
Rotator Cuff Insufficiency	81	2.7	28.2	18	1.4	15.7
Instability/Dislocation	51	1.7	17.8	21	1.6	18.3
Glenoid Erosion	17	0.6	5.9	35	2.7	30.4
Infection	32	1.1	11.1	7	0.5	6.1
Pain	27	0.9	9.4	14	1.1	12.2
Loosening	26	0.9	9.1	9	0.7	7.8
Fracture	24	0.8	8.4	4	0.3	3.5
Arthrofibrosis	7	0.2	2.4	2	0.2	1.7
Malposition	7	0.2	2.4	1	0.1	0.9
Dissociation	3	0.1	1.0	1	0.1	0.9
Incorrect Sizing	2	0.1	0.7	1	0.1	0.9
Lysis	2	0.1	0.7			
Heterotopic Bone	1	0.0	0.3			
Osteonecrosis				1	0.1	0.9
Other	7	0.2	2.4	1	0.1	0.9
N Revision	**287**	**9.7**	**100.0**	**115**	**8.9**	**100.0**
N Primary	**2957**			**1298**		

Figure SP8 Cumulative Incidence Revision Diagnosis of Primary Hemi Stemmed Shoulder by Primary Diagnosis

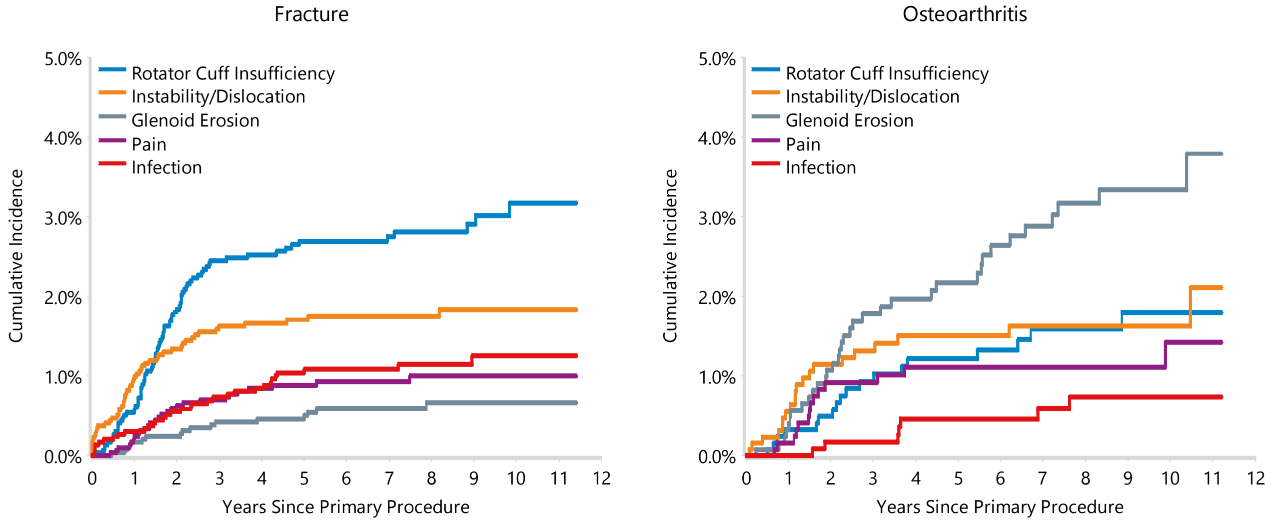


Table SP27 Primary Hemi Stemmed Shoulder Replacement by Type of Revision and Primary Diagnosis

Type of Revision	Fracture Number	Fracture % Primaries Revised	Fracture % Revisions	Osteoarthritis Number	Osteoarthritis % Primaries Revised	Osteoarthritis % Revisions
Humeral/Glenoid	202	6.8	70.4	67	5.2	58.3
Glenoid Component	14	0.5	4.9	31	2.4	27.0
Humeral Component	27	0.9	9.4	6	0.5	5.2
Head Only	16	0.5	5.6	3	0.2	2.6
Cement Spacer	15	0.5	5.2	2	0.2	1.7
Removal of Prostheses	7	0.2	2.4	1	0.1	0.9
Cement Only	4	0.1	1.4			
Reoperation	2	0.1	0.7	3	0.2	2.6
Head/Insert				1	0.1	0.9
Minor Components				1	0.1	0.9
N Revision	**287**	**9.7**	**100.0**	**115**	**8.9**	**100.0**
N Primary	**2957**			**1298**		

OUTCOME FOR FRACTURE

Age and Gender

The rate of revision is lower for patients aged ≥75 years compared to all other age groups (Table SP28 and Figure SP9).

Females have a higher rate of revision compared to males (Table SP29 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 SP30 and Figure SP11).

The use of cement for stem fixation in fracture hemiarthroplasty has a lower rate of revision when a non-fracture stem is used (Table SP31 and Figure SP12).

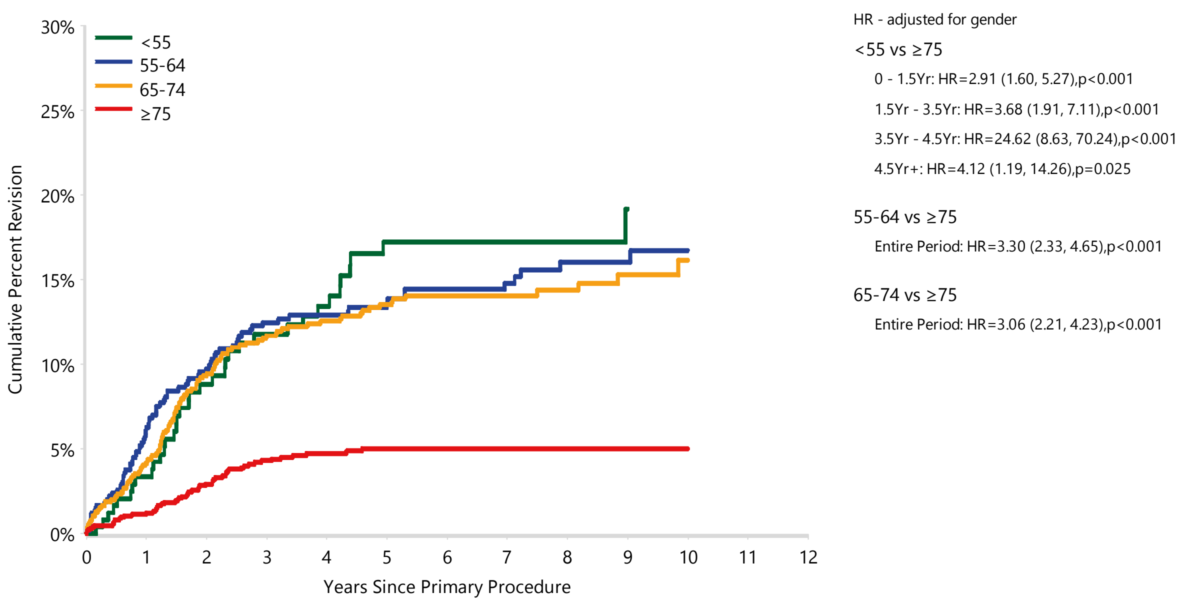
Cemented stem fixation for fracture has a lower rate of revision when a non-fracture stem is used.

The outcomes for the most used prosthesis combinations in the treatment of fracture are listed in Table SP32. The outcomes for individual fracture stems are presented separately in Table SP33 and for non-fracture humeral stems in Table SP34.

Table SP28 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	12 Yrs
<55	37	246	3.4 (1.7, 6.6)	11.8 (8.2, 16.9)	17.2 (12.6, 23.3)	17.2 (12.6, 23.3)		
55-64	82	593	6.3 (4.6, 8.6)	12.5 (10.0, 15.5)	13.6 (11.0, 16.8)	14.8 (12.0, 18.2)	16.7 (13.5, 20.7)	
65-74	114	857	4.1 (3.0, 5.7)	11.7 (9.7, 14.1)	13.5 (11.3, 16.1)	14.0 (11.8, 16.7)	16.2 (13.2, 19.7)	
≥75	54	1261	1.2 (0.7, 2.0)	4.3 (3.3, 5.7)	5.0 (3.9, 6.5)	5.0 (3.9, 6.5)	5.0 (3.9, 6.5)	
TOTAL	**287**	**2957**						

Figure SP9 Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Age (Primary Diagnosis Fracture)

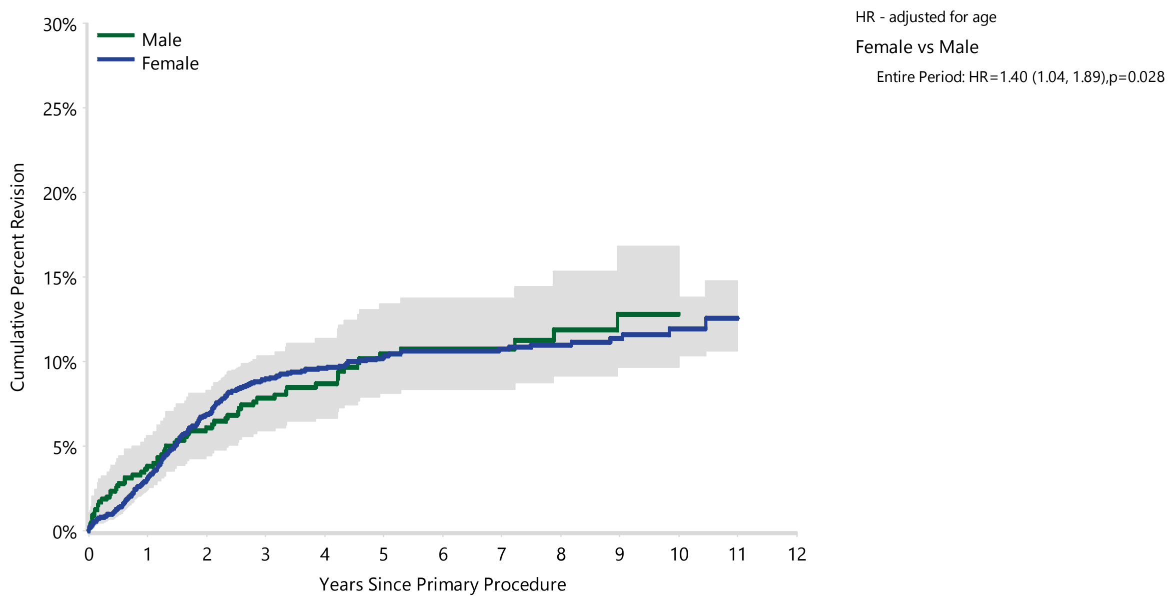


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
<55	246	220	170	122	73	23	0
55-64	593	521	432	337	228	76	0
65-74	857	791	640	501	311	86	5
≥75	1261	1151	913	657	387	82	2

Table SP29 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	12 Yrs
Male	61	649	3.8 (2.6, 5.6)	7.8 (5.9, 10.3)	10.5 (8.1, 13.4)	10.8 (8.4, 13.8)	12.8 (9.7, 16.8)	
Female	226	2308	3.1 (2.5, 3.9)	9.0 (7.9, 10.3)	10.3 (9.0, 11.7)	10.7 (9.4, 12.2)	12.0 (10.4, 13.8)	
TOTAL	**287**	**2957**						

Figure SP10 Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Gender (Primary Diagnosis Fracture)

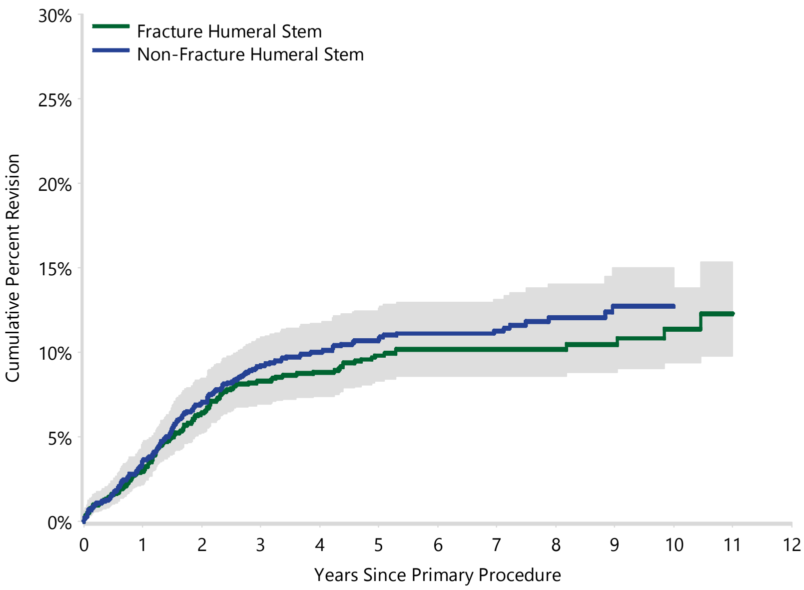


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Male	649	564	451	322	188	55	1
Female	2308	2119	1704	1295	811	212	6

Table SP30 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	12 Yrs
Fracture Humeral Stem	133	1460	3.0 (2.2, 4.0)	8.3 (6.9, 9.9)	9.8 (8.3, 11.6)	10.2 (8.6, 12.0)	11.4 (9.4, 13.8)	
Non-Fracture Humeral Stem	154	1497	3.6 (2.8, 4.7)	9.2 (7.8, 10.9)	10.8 (9.2, 12.6)	11.3 (9.7, 13.1)	12.7 (10.8, 15.0)	
TOTAL	**287**	**2957**						

Figure SP11 Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Stem Type (Primary Diagnosis Fracture)



HR - adjusted for age and gender

Non-Fracture Humeral Stem vs Fracture Humeral Stem

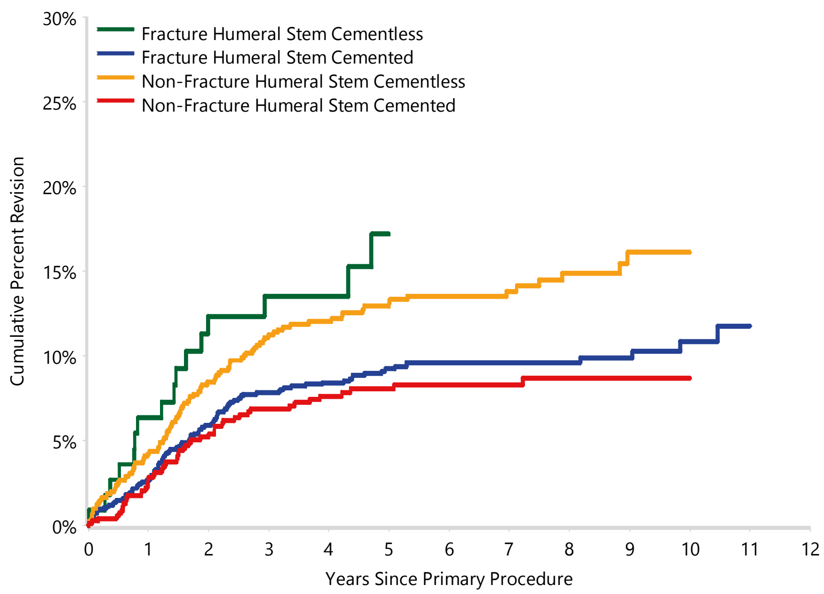
Entire Period: HR=1.12 (0.89, 1.41),p=0.331

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Fracture Humeral Stem	1460	1330	1054	780	462	145	2
Non-Fracture Humeral Stem	1497	1353	1101	837	537	122	5

Table SP31 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	12 Yrs
Fracture Humeral Stem	Cementless	16	111	6.3 (3.1, 12.9)	13.5 (8.2, 21.9)	17.2 (10.6, 27.1)			
	Cemented	117	1349	2.7 (1.9, 3.7)	7.8 (6.5, 9.5)	9.2 (7.7, 11.1)	9.6 (8.1, 11.5)	10.9 (8.8, 13.3)	
Non-Fracture Humeral Stem	Cementless	102	797	4.2 (3.0, 5.9)	11.3 (9.2, 13.8)	13.1 (10.9, 15.9)	13.8 (11.4, 16.7)	16.1 (13.1, 19.7)	
	Cemented	52	700	2.9 (1.8, 4.4)	6.9 (5.2, 9.2)	8.1 (6.2, 10.5)	8.3 (6.4, 10.8)	8.7 (6.7, 11.3)	
TOTAL		**287**	**2957**						

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=1.49 (0.88, 2.52),p=0.136

Fracture Humeral Stem Cementless vs Non-Fracture Humeral Stem Cementless
Entire Period: HR=1.05 (0.62, 1.78),p=0.867

Fracture Humeral Stem Cemented vs Non-Fracture Humeral Stem Cemented
Entire Period: HR=1.16 (0.84, 1.61),p=0.376

Non-Fracture Humeral Stem Cementless vs Non-Fracture Humeral Stem Cemented
Entire Period: HR=1.65 (1.18, 2.31),p=0.003

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Fracture Humeral Stem	Cementless	111	99	73	40	10	1	0
	Cemented	1349	1231	981	740	452	144	2
Non-Fracture Humeral Stem	Cementless	797	720	574	448	289	62	2
	Cemented	700	633	527	389	248	60	3

Table SP33 Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Humeral Head and Stem (Primary Diagnosis Fracture)

Humeral Head	Humeral Stem	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Aequalis	Aequalis	31	449	2.5 (1.4, 4.5)	6.2 (4.3, 9.0)	7.1 (5.0, 10.1)	7.1 (5.0, 10.1)	8.1 (5.5, 11.8)	
Affinis	Affinis	5	35	6.8 (1.7, 24.5)	14.2 (5.6, 33.7)	20.8 (8.8, 44.8)	20.8 (8.8, 44.8)		
Bigliani/Flatow	Bigliani/Flatow TM	9	293	1.4 (0.5, 3.7)	3.3 (1.7, 6.2)	3.3 (1.7, 6.2)	3.3 (1.7, 6.2)		
Bio-Modular	Comprehensive	6	79	2.6 (0.6, 9.9)	7.0 (3.0, 16.1)	9.2 (4.2, 19.8)	9.2 (4.2, 19.8)		
Comprehensive	Comprehensive	4	51	4.0 (1.0, 14.9)	9.8 (3.7, 24.6)	9.8 (3.7, 24.6)			
Global Advantage	Global Advantage	9	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 Advantage	Global FX	55	694	2.2 (1.3, 3.6)	6.3 (4.7, 8.5)	8.1 (6.2, 10.5)	8.7 (6.7, 11.3)	10.1 (7.5, 13.5)	
Global Unite	Global Unite	30	153	7.4 (4.2, 12.9)	21.6 (15.5, 29.7)				
SMR	SMR	110	881	4.0 (2.8, 5.5)	10.7 (8.8, 13.1)	12.7 (10.6, 15.3)	13.5 (11.3, 16.2)	15.7 (12.9, 19.1)	
SMR CTA	SMR	4	36	3.0 (0.4, 19.6)	11.0 (3.6, 30.5)	15.9 (6.2, 37.6)	15.9 (6.2, 37.6)		
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)		
Other (23)		19	193	2.8 (1.2, 6.6)	10.3 (6.5, 16.1)	11.3 (7.2, 17.4)	11.3 (7.2, 17.4)		
TOTAL		**287**	**2957**						

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	12 Yrs
Aequalis	Aequalis	30	432	2.4 (1.3, 4.4)	6.2 (4.2, 9.1)	7.2 (5.0, 10.2)	7.2 (5.0, 10.2)	8.2 (5.5, 12.1)	
Affinis	Affinis	5	33	7.3 (1.9, 26.1)	15.0 (5.9, 35.2)	22.1 (9.3, 47.1)	22.1 (9.3, 47.1)		
Bio-Modular	Comprehensive	6	79	2.6 (0.6, 9.9)	7.0 (3.0, 16.1)	9.2 (4.2, 19.8)	9.2 (4.2, 19.8)		
Comprehensive	Comprehensive	4	43	4.7 (1.2, 17.5)	11.2 (4.3, 27.7)	11.2 (4.3, 27.7)			
Global Advantage	Global FX	55	694	2.2 (1.3, 3.6)	6.3 (4.7, 8.5)	8.1 (6.2, 10.5)	8.7 (6.7, 11.3)	10.1 (7.5, 13.5)	
Global Unite	Global Unite	30	152	7.4 (4.2, 13.0)	21.7 (15.6, 29.9)				
Other (4)		3	27	0.0 (0.0, 0.0)	12.8 (4.3, 35.0)	12.8 (4.3, 35.0)			
TOTAL		**133**	**1460**						

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	12 Yrs
Bigliani/Flatow	Bigliani/Flatow TM	9	293	1.4 (0.5, 3.7)	3.3 (1.7, 6.2)	3.3 (1.7, 6.2)	3.3 (1.7, 6.2)		
Global Advantage	Global Advantage	9	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	110	881	4.0 (2.8, 5.5)	10.7 (8.8, 13.1)	12.7 (10.6, 15.3)	13.5 (11.3, 16.2)	15.7 (12.9, 19.1)	
SMR CTA	SMR	4	36	3.0 (0.4, 19.6)	11.0 (3.6, 30.5)	15.9 (6.2, 37.6)	15.9 (6.2, 37.6)		
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)		
Other (25)		17	194	3.3 (1.5, 7.3)	9.1 (5.5, 14.6)	10.0 (6.2, 15.8)	10.0 (6.2, 15.8)		
TOTAL		**154**	**1497**						

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 and 55-64 years age groups (Table SP35 and Figure SP13).

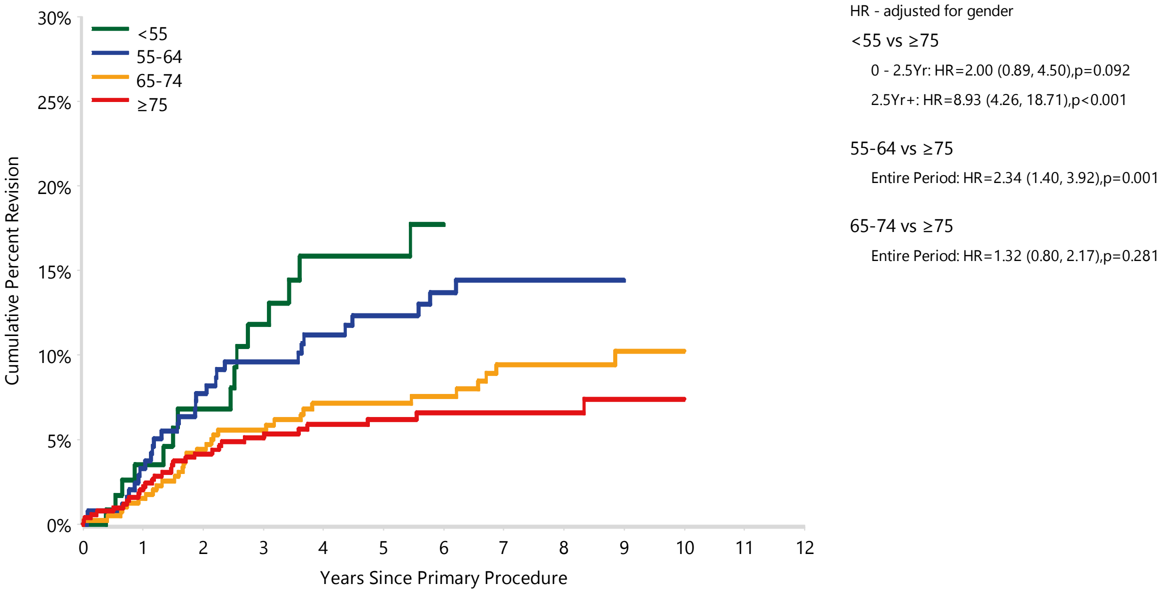
Gender is not a risk factor for revision (Table SP36 and Figure SP14).

The outcomes of the most used prosthesis combinations for osteoarthritis are listed in Table SP37.

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	12 Yrs
<55	21	124	3.6 (1.4, 9.2)	11.8 (6.7, 20.5)	15.9 (9.6, 25.5)			
55-64	32	256	3.3 (1.7, 6.6)	9.6 (6.4, 14.2)	12.4 (8.6, 17.6)	14.4 (10.2, 20.1)		
65-74	32	406	1.5 (0.7, 3.4)	5.6 (3.7, 8.4)	7.1 (4.9, 10.3)	9.5 (6.7, 13.3)	10.3 (7.2, 14.5)	
≥75	30	512	2.2 (1.2, 4.0)	5.1 (3.5, 7.5)	6.2 (4.3, 8.9)	6.6 (4.6, 9.4)	7.4 (5.0, 10.9)	
TOTAL	**115**	**1298**						

Figure SP13 Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Age (Primary Diagnosis OA)

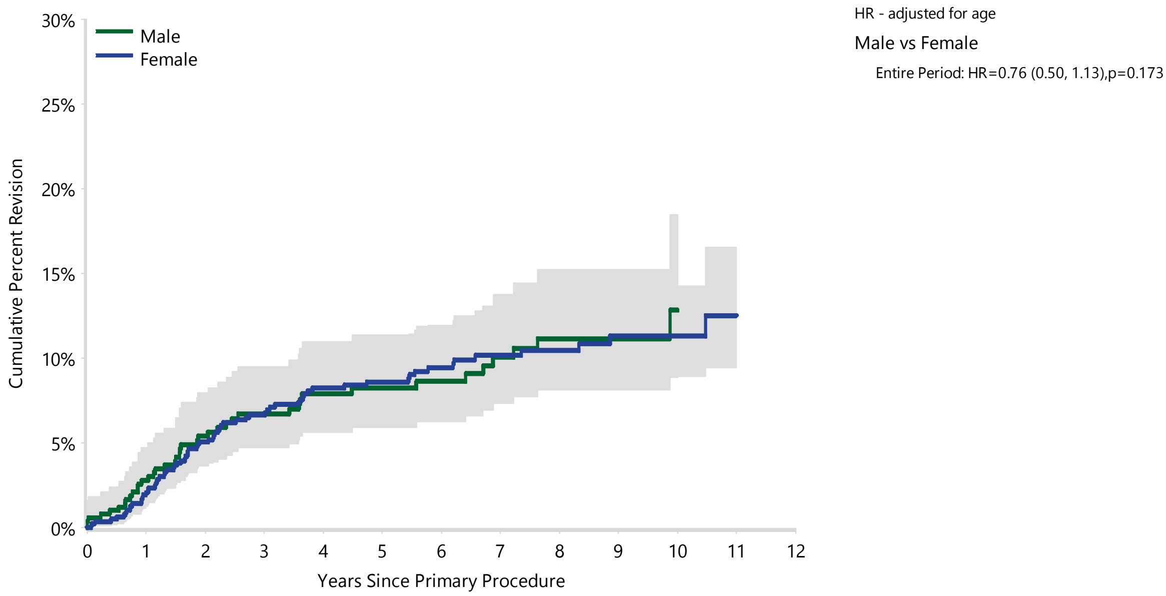


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
<55	124	100	70	48	36	14	0
55-64	256	225	184	147	104	38	2
65-74	406	381	315	247	177	64	1
≥75	512	466	379	290	190	46	3

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	12 Yrs
Male	42	500	2.8 (1.6, 4.7)	6.7 (4.7, 9.5)	8.2 (5.9, 11.4)	10.1 (7.3, 13.7)	12.8 (8.9, 18.4)	
Female	73	798	2.1 (1.3, 3.4)	6.6 (5.1, 8.7)	8.6 (6.8, 10.9)	10.2 (8.1, 12.8)	11.3 (8.9, 14.3)	
TOTAL	**115**	**1298**						

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	12 Yrs
Male	500	429	342	254	176	49	3
Female	798	743	606	478	331	113	3

Table SP38 Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Humeral Head and Stem (Primary Diagnosis OA)

Humeral Head	Humeral Stem	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Aequalis	Aequalis	11	138	1.5 (0.4, 5.7)	5.2 (2.5, 10.6)	6.0 (3.1, 11.7)	9.6 (5.3, 17.0)		
Ascend Flex	Ascend Flex	4	136	1.0 (0.1, 6.6)	4.5 (1.4, 14.2)				
Bigliani/Flatow	Bigliani/Flatow TM	4	53	3.8 (1.0, 14.3)	5.7 (1.9, 16.6)	5.7 (1.9, 16.6)	9.2 (3.4, 23.7)		
Delta Xtend	Delta Xtend	2	29	0.0 (0.0, 0.0)	8.2 (2.1, 28.9)	8.2 (2.1, 28.9)	8.2 (2.1, 28.9)		
Global AP	Global AP	8	166	0.6 (0.1, 4.2)	3.8 (1.7, 8.4)	5.5 (2.8, 10.7)	5.5 (2.8, 10.7)		
Global AP CTA	Global AP	5	44	2.3 (0.3, 15.1)	11.8 (5.1, 26.0)	11.8 (5.1, 26.0)	11.8 (5.1, 26.0)		
Global Advantage	Global Advantage	14	144	0.7 (0.1, 4.8)	5.0 (2.4, 10.2)	7.3 (4.0, 13.2)	8.1 (4.6, 14.2)	11.1 (6.3, 19.0)	
Global Advantage	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)	
SMR	SMR	43	273	4.1 (2.3, 7.3)	9.5 (6.5, 13.8)	13.3 (9.7, 18.1)	15.7 (11.7, 21.0)	18.0 (13.5, 23.9)	
SMR CTA	SMR	8	93	5.6 (2.4, 13.0)	9.5 (4.9, 18.2)	9.5 (4.9, 18.2)	9.5 (4.9, 18.2)	9.5 (4.9, 18.2)	
Other (26)		11	152	2.8 (1.1, 7.3)	7.0 (3.7, 13.1)	8.2 (4.4, 14.8)	8.2 (4.4, 14.8)		
TOTAL		**115**	**1298**						

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

There have been 40,130 total shoulder replacements reported to the Registry. This is an additional 6,317 procedures compared to the previous report.

The two main classes of primary total shoulder replacement are total reverse (61.9%) and total stemmed (33.5%). Total mid head and total resurfacing shoulder replacements are used infrequently (4.0% and 0.6%, respectively) (Table ST1). The proportion of total reverse shoulder replacements has increased from 42.2% in 2009 to 77.9% in 2018 (Figure ST1).

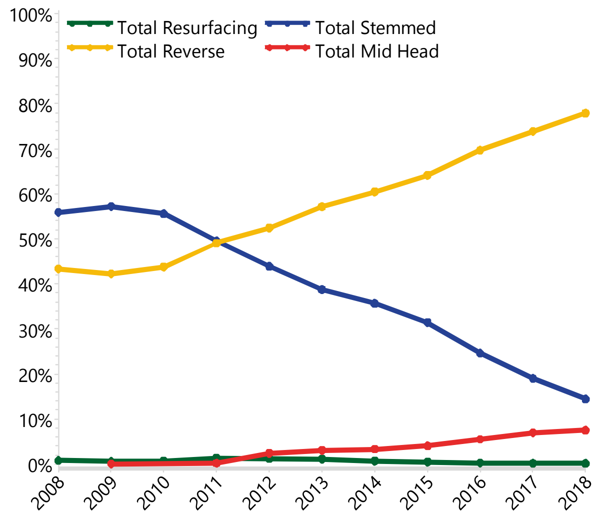
Table ST1 Primary Total Shoulder Replacement by Class

Shoulder Class	Number	Percent
Total Resurfacing	230	0.6
Total Stemmed	13446	33.5
Total Reverse	24859	61.9
Total Mid Head	1595	4.0
TOTAL	**40130**	**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 (64.3%), total stemmed (57.9%), total mid head (54.2%) and total resurfacing (40.4%) (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 (82.2%). The proportion of patients in this age group varies depending on the class of shoulder replacement: total reverse (89.2%), total stemmed (72.0%), total mid head (64.6%) and total resurfacing (52.6%) (Table ST4).

The most common primary diagnoses are osteoarthritis (63.4%), rotator cuff arthropathy (22.0%) and fracture (9.8%). Rheumatoid arthritis and osteonecrosis account for 1.8% and 1.3%, respectively (Table ST5).

There are 230 total resurfacing shoulder replacements reported to the Registry, 19 of which have been revised. The cumulative percent revision at 7 years is 6.9% (Table ST6).

Total mid head shoulder replacement has been used in 1,595 procedures. There have been 43 revisions and the 5 year cumulative percent revision is 5.1% (Table ST6).

At 10 years, the cumulative percent revision for total stemmed and total reverse shoulder replacement is 12.4% and 6.6%, 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.

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).

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 reverse shoulder procedures, the 10 year cumulative percent revision for total stemmed and total reverse shoulder replacement is 9.9% and 6.6%, 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

	Male		Female		TOTAL	
Shoulder Class	N	Row%	N	Row%	N	Row%
Total Resurfacing	137	59.6	93	40.4	230	100.0
Total Stemmed	5665	42.1	7781	57.9	13446	100.0
Total Reverse	8864	35.7	15995	64.3	24859	100.0
Total Mid Head	730	45.8	865	54.2	1595	100.0
TOTAL	**15396**	**38.4**	**24734**	**61.6**	**40130**	**100.0**

Table ST3 Primary Total Shoulder Replacement by Age and Gender

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	15396	38.4%	17	96	71	70.2	9.0
Female	24734	61.6%	13	102	74	73.5	8.5
TOTAL	**40130**	**100.0%**	**13**	**102**	**73**	**72.2**	**8.8**

Table ST4 Primary Total Shoulder Replacement by Class and Age

	<55		55-64		65-74		≥75		TOTAL	
Shoulder Class	N	Row%	N	Row%	N	Row%	N	Row%	N	Row%
Total Resurfacing	33	14.3	76	33.0	103	44.8	18	7.8	230	100.0
Total Stemmed	708	5.3	3059	22.8	5955	44.3	3724	27.7	13446	100.0
Total Reverse	356	1.4	2340	9.4	9364	37.7	12799	51.5	24859	100.0
Total Mid Head	137	8.6	428	26.8	704	44.1	326	20.4	1595	100.0
TOTAL	**1234**	**3.1**	**5903**	**14.7**	**16126**	**40.2**	**16867**	**42.0**	**40130**	**100.0**

Table ST5 Primary Total Shoulder Replacement by Primary Diagnosis and Gender

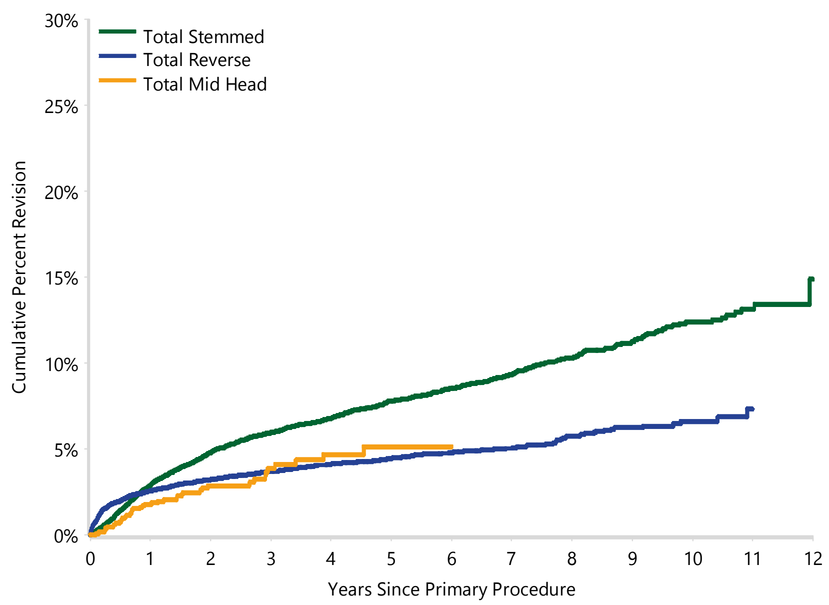
Primary Diagnosis	Male N	Male Col%	Female N	Female Col%	TOTAL N	TOTAL Col%
Osteoarthritis	10390	67.5	15055	60.9	25445	63.4
Rotator Cuff Arthropathy	3830	24.9	4987	20.2	8817	22.0
Fracture	628	4.1	3289	13.3	3917	9.8
Rheumatoid Arthritis	164	1.1	572	2.3	736	1.8
Osteonecrosis	121	0.8	419	1.7	540	1.3
Instability	118	0.8	204	0.8	322	0.8
Other Inflammatory Arthritis	57	0.4	126	0.5	183	0.5
Tumour	83	0.5	76	0.3	159	0.4
Other	5	0.0	6	0.0	11	0.0
TOTAL	**15396**	**100.0**	**24734**	**100.0**	**40130**	**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	12 Yrs
Total Resurfacing	19	230	1.8 (0.7, 4.7)	4.6 (2.5, 8.4)	6.2 (3.6, 10.5)	6.9 (4.1, 11.4)		
Total Stemmed	1055	13446	2.9 (2.6, 3.2)	6.0 (5.5, 6.4)	7.8 (7.3, 8.3)	9.3 (8.8, 10.0)	12.4 (11.5, 13.3)	14.9 (12.1, 18.3)
Total Reverse	906	24859	2.6 (2.4, 2.8)	3.7 (3.4, 4.0)	4.5 (4.1, 4.8)	5.0 (4.7, 5.4)	6.6 (5.9, 7.4)	
Total Mid Head	43	1595	1.8 (1.2, 2.6)	3.9 (2.8, 5.4)	5.1 (3.6, 7.3)			
TOTAL	**2023**	**40130**						

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=0.34 (0.27, 0.43),p<0.001

3Mth+: HR=2.08 (1.86, 2.33),p<0.001

Total Stemmed vs Total Mid Head

Entire Period: HR=1.74 (1.28, 2.37),p<0.001

Total Mid Head vs Total Reverse

0 - 3Mth: HR=0.20 (0.09, 0.45),p<0.001

3Mth - 6Mth: HR=0.75 (0.31, 1.83),p=0.529

6Mth+: HR=1.31 (0.91, 1.87),p=0.147

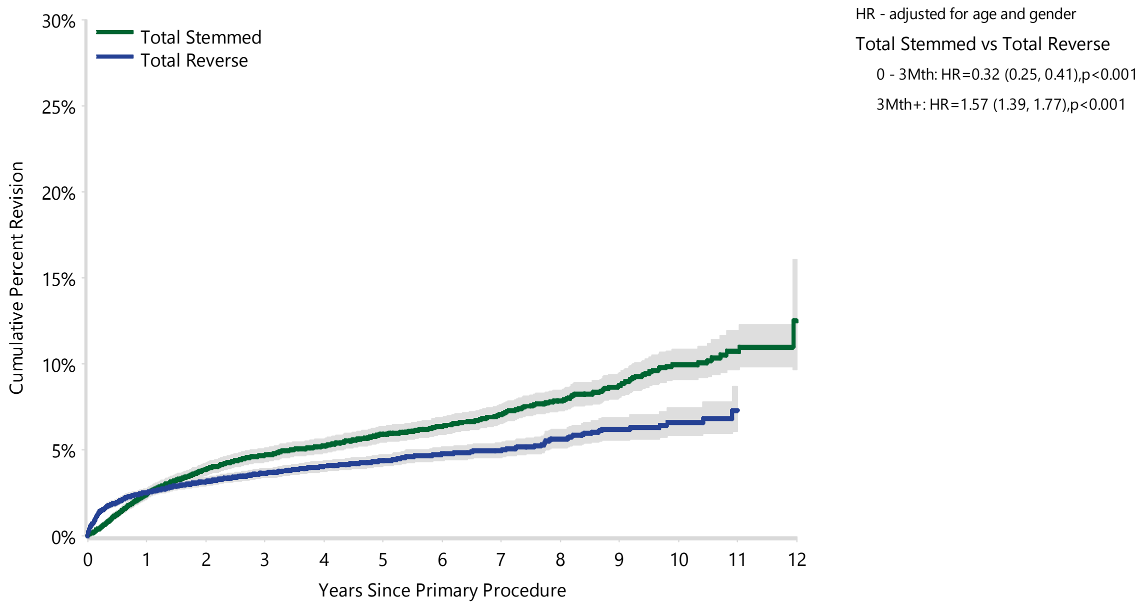
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Total Stemmed	13446	12088	9331	6452	3963	958	55
Total Reverse	24859	19167	11052	6008	2862	537	34
Total Mid Head	1595	1108	447	162	6	0	0

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	12 Yrs
Total Stemmed	760	12588	2.4 (2.2, 2.7)	4.7 (4.3, 5.1)	5.9 (5.5, 6.4)	7.1 (6.5, 7.6)	9.9 (9.1, 10.9)	12.5 (9.7, 16.1)
Total Reverse	838	23718	2.5 (2.3, 2.8)	3.7 (3.4, 3.9)	4.4 (4.1, 4.7)	5.0 (4.6, 5.4)	6.6 (5.8, 7.4)	
TOTAL	**1598**	**36306**						

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	12 Yrs
Total Stemmed	12588	11319	8682	5893	3546	958	55
Total Reverse	23718	18091	10049	5112	2257	537	34

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 230 primary total resurfacing shoulder replacements reported to the Registry. This is an additional 9 procedures compared to the previous report.

Primary total resurfacing shoulder replacement is undertaken more often in males (59.6%). The mean age is 62 years for males and 66.8 years for females (Table ST8).

Osteoarthritis is the most common primary diagnosis (96.1%) (Table ST9).

The Global CAP/Global Advantage combination is used in all of the 9 procedures reported in 2018 (Table ST10 and Table ST11).

The cumulative percent revision at 7 years is 6.9% (Table ST6). There have been 19 revisions in this class. The most common reason for revision is loosening (42.1%)(Table ST12). The most common type of revision is to a total shoulder replacement (42.1%), 5 of which were to a total reverse shoulder replacement (Table ST13).

Table ST8 Primary Total Resurfacing Shoulder Replacement by Age and Gender

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	137	59.6%	35	83	63	62.0	9.8
Female	93	40.4%	46	86	67	66.8	6.7
TOTAL	**230**	**100.0%**	**35**	**86**	**65**	**64.0**	**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	133	97.1	88	94.6	221	96.1
Rheumatoid Arthritis	1	0.7	2	2.2	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	**137**	**100.0**	**93**	**100.0**	**230**	**100.0**

Note: Instability includes instability and dislocation

Table ST10 Most Used Humeral Head Prostheses in Primary Total Resurfacing Shoulder Replacement

2008		2015		2016		2017		2018	
N	Model	N	Model	N	Model	N	Model	N	Model
5	SMR	12	Global CAP	9	Global CAP	8	Global CAP	9	Global CAP
4	Aequalis	4	Epoca RH	1	Epoca RH	2	Epoca RH		
2	Copeland	2	Aequalis	1	SMR				
1	Global CAP	1	SMR						
Most Used									
12	(4) 100.0%	19	(4) 100.0%	11	(3) 100.0%	10	(2) 100.0%	9	(1) 100.0%

Table ST11 Most Used Glenoid Prostheses in Primary Total Resurfacing Shoulder Replacement

2008		2015		2016		2017		2018	
N	Model	N	Model	N	Model	N	Model	N	Model
4	Aequalis	12	Global	9	Global	8	Global	9	Global
3	SMR L1	4	Epoca	1	Epoca	2	Epoca		
2	Copeland	2	Aequalis	1	SMR				
2	SMR	1	SMR						
1	Global								
Most Used									
12	(5) 100.0%	19	(4) 100.0%	11	(3) 100.0%	10	(2) 100.0%	9	(1) 100.0%

Table ST12 Primary Total Resurfacing Shoulder Replacement by Reason for Revision

Reason for Revision	Number	Percent
Loosening	8	42.1
Implant Breakage Glenoid Insert	3	15.8
Instability/Dislocation	2	10.5
Infection	2	10.5
Wear Glenoid Insert	1	5.3
Fracture	1	5.3
Implant Breakage Glenoid	1	5.3
Rotator Cuff Insufficiency	1	5.3
TOTAL	**19**	**100.0**

Table ST13 Primary Total Resurfacing Shoulder Replacement by Type of Revision

Type of Revision	Number	Percent
Humeral/Glenoid	8	42.1
Humeral Component	6	31.6
Insert Only	2	10.5
Cement Spacer	1	5.3
Head Only	1	5.3
Reoperation	1	5.3
TOTAL	**19**	**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 1,595 primary total mid head shoulder replacements reported to the Registry. This is an additional 467 procedures compared to the previous report. The use of primary mid head shoulder replacement has increased by 553.5% since its first full year of use in 2012.

Primary total mid head shoulder replacement is undertaken more often in females (54.2%). The mean age is 69.2 years for females and 65 years for males (Table ST14).

Osteoarthritis is the most common primary diagnosis (95.1%) (Table ST15).

The cumulative percent revision at 5 years is 5.1% (Table ST6). There have been 43 revisions in this class. The main reasons for revision are instability/dislocation (39.5%), loosening (20.9%), rotator cuff insufficiency (14.0%) and infection (11.6%) (Table ST16).

The most common types of revision involve replacement of the humeral and glenoid components (51.2%), replacement of the humeral component (18.6%), and replacement of the head only (11.6%). Of the 22 humeral/glenoid revisions, 19 have been revised to a total reverse requiring revision of the stem, and 3 have been revised to a total stemmed shoulder replacement (Table ST17).

The Affinis is the most used total mid head shoulder prosthesis in 2018 (Table ST18 and Table ST19).

Table ST14 Primary Total Mid Head Shoulder Replacement by Age and Gender

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	730	45.8%	34	95	66	65.0	9.2
Female	865	54.2%	37	94	70	69.2	8.2
TOTAL	**1595**	**100.0%**	**34**	**95**	**68**	**67.3**	**8.9**

Table ST15 Primary Total Mid Head Shoulder Replacement by Primary Diagnosis and Gender

	Male		Female		TOTAL	
Primary Diagnosis	N	Col%	N	Col%	N	Col%
Osteoarthritis	703	96.3	814	94.1	1517	95.1
Osteonecrosis	10	1.4	23	2.7	33	2.1
Rheumatoid Arthritis	2	0.3	10	1.2	12	0.8
Other Inflammatory Arthritis	2	0.3	9	1.0	11	0.7
Rotator Cuff Arthropathy	7	1.0	4	0.5	11	0.7
Instability	5	0.7	2	0.2	7	0.4
Fracture	1	0.1	3	0.3	4	0.3
TOTAL	**730**	**100.0**	**865**	**100.0**	**1595**	**100.0**

Table ST16 Primary Total Mid Head Shoulder Replacement by Reason for Revision

Reason for Revision	Number	Percent
Instability/Dislocation	17	39.5
Loosening	9	20.9
Rotator Cuff Insufficiency	6	14.0
Infection	5	11.6
Pain	3	7.0
Malposition	1	2.3
Incorrect Sizing	1	2.3
Arthrofibrosis	1	2.3
TOTAL	**43**	**100.0**

Table ST17 Primary Total Mid Head Shoulder Replacement by Type of Revision

Type of Revision	Number	Percent
Humeral/Glenoid	22	51.2
Humeral Component	8	18.6
Head Only	5	11.6
Cement Spacer	3	7.0
Removal of Prostheses	2	4.7
Reinsertion of Components	1	2.3
Reoperation	1	2.3
Glenoid Component	1	2.3
TOTAL	**43**	**100.0**

Table ST18 Most Used Humeral Stem Prostheses in Primary Total Mid Head Shoulder Replacement

2011		2015		2016		2017		2018	
N	Model	N	Model	N	Model	N	Model	N	Model
2	Simpliciti	109	Affinis	219	Affinis	266	Affinis	266	Affinis
2	TESS	46	Sidus	19	Simpliciti	68	Simpliciti	106	Simpliciti
1	Affinis	11	Simpliciti	12	Sidus	27	SMR	40	Comprehensive
		3	SMR	10	Comprehensive	22	Comprehensive	29	SMR
				10	SMR	8	Sidus	13	Global Icon
								10	Sidus
Most Used									
5	(3) 100.0%	169	(4) 100.0%	270	(5) 100.0%	391	(5) 100.0%	464	(6) 100.0%

Table ST19 Most Used Glenoid Prostheses in Primary Total Mid Head Shoulder Replacement

2011		2015		2016		2017		2018	
N	Model	N	Model	N	Model	N	Model	N	Model
2	Aequalis	109	Affinis	217	Affinis	266	Affinis	253	Affinis
1	Affinis	18	Anatomical Shoulder	17	Aequalis	53	Aequalis	79	Perform
1	Comprehensive	15	Bigliani/Flatow	14	Comprehensive	20	Comprehensive	39	Comprehensive
1	TESS	12	Bigliani/Flatow TM	6	SMR L1	15	Perform	27	Aequalis
		9	Perform	4	SMR	14	SMR L1	27	Global
		3	SMR L1	3	Bigliani/Flatow	13	SMR	15	SMR
		2	Aequalis	2	Anatomical Shoulder	7	Anatomical Shoulder	14	SMR L1
		1	Global	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%	169	(8) 100.0%	269	(10) 99.6%	391	(9) 100.0%	463	(10) 99.8%
Remainder									
0	(0) 0%	0	(0) 0%	1	(1) 0.4%	0	(0) 0%	1	(1) 0.2%
TOTAL									
5	(4) 100.0%	169	(8) 100.0%	270	(11) 100.0%	391	(9) 100.0%	464	(11) 100.0%

PRIMARY TOTAL STEMMED SHOULDER REPLACEMENT

DEMOGRAPHICS

There have been 13,446 total stemmed shoulder replacements reported to the Registry. This is an additional 911 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 14.4% in 2018.

The proportion of males has increased slightly from 38.7% in 2008 to 42.9% in 2018 (Figure ST4).

This procedure is most commonly undertaken in females (57.9%) (Table ST20). The mean age is 70.5 years for females and 67.1 years for males (Table ST20). In 2018, most procedures were undertaken in the 65-74 year age group, accounting for 46.8% of all procedures (Figure ST5).

Osteoarthritis is the most common primary diagnosis, accounting for 94.2% of all procedures (Table ST21).

The use of total stemmed shoulder replacement has declined from 55.9% of all total shoulder replacements in 2008 to 14.4% in 2018.

Figure ST4 Primary Total Stemmed Shoulder Replacement by Gender

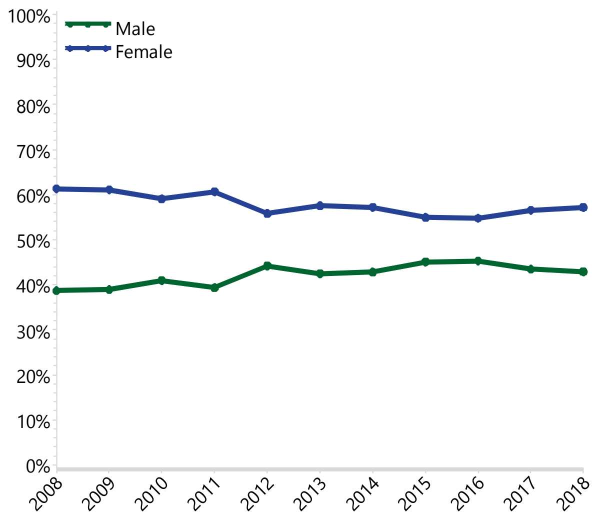


Figure ST5 Primary Total Stemmed Shoulder Replacement by Age

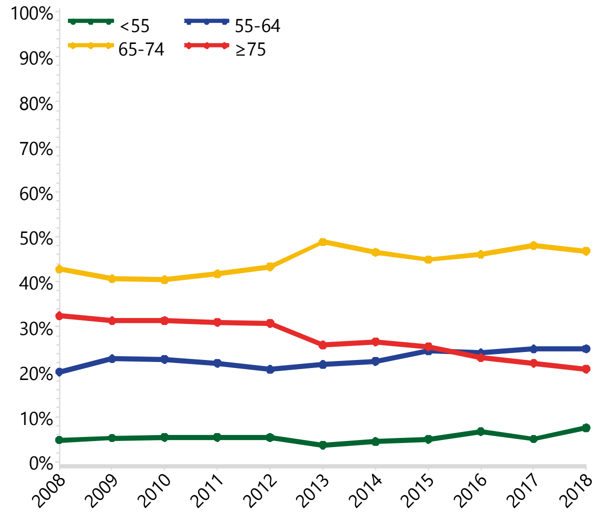


Table ST20 Primary Total Stemmed Shoulder Replacement by Age and Gender

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	5665	42.1%	21	93	67	67.1	8.9
Female	7781	57.9%	21	96	71	70.5	8.5
TOTAL	**13446**	**100.0%**	**21**	**96**	**69**	**69.1**	**8.8**

Table ST21 Primary Total Stemmed Shoulder Replacement by Primary Diagnosis and Gender

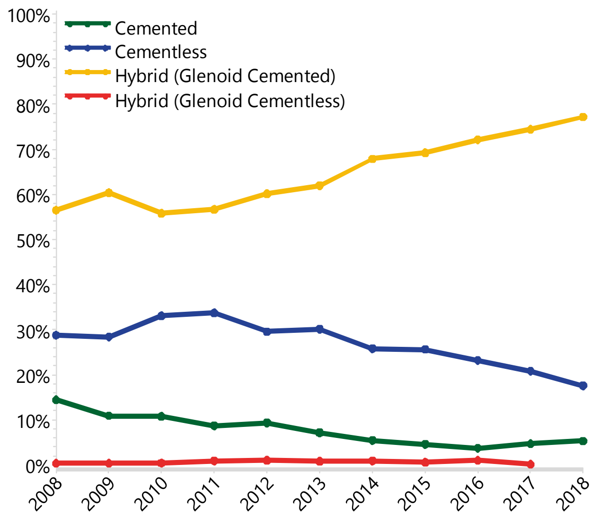
	Male		Female		TOTAL	
Primary Diagnosis	N	Col%	N	Col%	N	Col%
Osteoarthritis	5426	95.8	7245	93.1	12671	94.2
Rheumatoid Arthritis	61	1.1	179	2.3	240	1.8
Osteonecrosis	55	1.0	157	2.0	212	1.6
Fracture	30	0.5	90	1.2	120	0.9
Other Inflammatory Arthritis	25	0.4	55	0.7	80	0.6
Rotator Cuff Arthropathy	36	0.6	32	0.4	68	0.5
Instability	25	0.4	14	0.2	39	0.3
Tumour	4	0.1	6	0.1	10	0.1
Other	3	0.1	3	0.0	6	0.0
TOTAL	**5665**	**100.0**	**7781**	**100.0**	**13446**	**100.0**

Note: Instability includes dislocation

In 2018, 77.2% of procedures used hybrid fixation (cementless humerus and cemented glenoid). This has increased from a low of 55.8% in 2010. In 2018, cementless fixation was used in 17.5% 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 77.2% in 2018.

Figure ST6 Primary Total Stemmed Shoulder Replacement by Fixation



The 10 most used humeral stem and glenoid prostheses are listed in Table ST22 and Table ST23. The Ascend Flex, SMR and Comprehensive are the most commonly used humeral stem prostheses in 2018. The 10 most used humeral stem prostheses account for 99.4% of all primary total stemmed shoulder procedures.

The Global, Perform and Comprehensive are the most commonly used glenoid prostheses in 2018. The 10 most used glenoid prostheses account for 98.4% of all primary total stemmed shoulder procedures.

Table ST22 10 Most Used Humeral Stem Prostheses in Primary Total Stemmed Shoulder Replacement

2008		2015		2016		2017		2018	
N	Model	N	Model	N	Model	N	Model	N	Model
298	SMR	278	SMR	234	Global Unite	198	SMR	175	Ascend Flex
167	Aequalis	259	Global AP	230	SMR	179	Global AP	143	SMR
117	Global Advantage	203	Global Unite	186	Global AP	178	Global Unite	141	Comprehensive
91	Global AP	120	Bigliani/Flatow TM	111	Bigliani/Flatow TM	133	Comprehensive	136	Global Unite
40	Bigliani/Flatow	104	Aequalis	93	Comprehensive	122	Ascend Flex	134	Global AP
37	Bigliani/Flatow TM	81	Ascend	88	Aequalis	71	Equinoxe	80	Equinoxe
32	Solar	73	Comprehensive	84	Ascend Flex	69	Bigliani/Flatow TM	34	Bigliani/Flatow TM
27	Affinis	69	Ascend Flex	68	Ascend	49	Aequalis	16	Global Advantage
11	Univers 3D	50	Global Advantage	45	Global Advantage	25	Global Advantage	14	Turon
10	Cofield 2	46	Equinoxe	42	Equinoxe	20	Turon	11	Aequalis
10 Most Used									
830	(10) 97.9%	1283	(10) 97.0%	1181	(10) 97.7%	1044	(10) 97.8%	884	(10) 99.4%
Remainder									
18	(7) 2.1%	40	(4) 3.0%	28	(8) 2.3%	24	(6) 2.2%	5	(3) 0.6%
TOTAL									
848	(17) 100.0%	1323	(14) 100.0%	1209	(18) 100.0%	1068	(16) 100.0%	889	(13) 100.0%

Table ST23 10 Most Used Glenoid Prostheses in Primary Total Stemmed Shoulder Replacement

2008		2015		2016		2017		2018	
N	Model	N	Model	N	Model	N	Model	N	Model
237	SMR L1	513	Global	467	Global	381	Global	286	Global
209	Global	242	SMR L1	195	SMR L1	171	SMR L1	152	Perform
167	Aequalis	165	Aequalis	160	Aequalis	130	Comprehensive	134	Comprehensive
79	Bigliani/Flatow	89	Perform	94	Comprehensive	97	Aequalis	127	SMR L1
57	SMR	85	Bigliani/Flatow TM	85	Bigliani/Flatow TM	86	Perform	80	Equinoxe
32	Solar	74	Comprehensive	79	Perform	71	Equinoxe	34	Aequalis
27	Affinis	46	Equinoxe	42	Equinoxe	37	Bigliani/Flatow TM	20	Bigliani/Flatow
11	Univers 3D	37	Bigliani/Flatow	33	SMR	32	Bigliani/Flatow	15	Bigliani/Flatow TM
10	Cofield 2	30	SMR	27	Bigliani/Flatow	23	SMR	14	Turon
7	Promos	24	Turon	10	Turon	20	Turon	13	SMR
10 Most Used									
836	(10) 98.6%	1305	(10) 98.6%	1192	(10) 98.6%	1048	(10) 98.1%	875	(10) 98.4%
Remainder									
12	(6) 1.4%	18	(3) 1.4%	17	(7) 1.4%	20	(8) 1.9%	14	(5) 1.6%
TOTAL									
848	(16) 100.0%	1323	(13) 100.0%	1209	(17) 100.0%	1068	(18) 100.0%	889	(15) 100.0%

OUTCOME FOR ALL DIAGNOSES

Primary Diagnosis

The cumulative percent revision of primary total stemmed shoulder replacement for osteoarthritis is 14.8% at 12 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 ST24 and Figure ST7).

Reason for Revision

The Registry has recorded 1,055 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 24.7% of all revisions, followed by instability/dislocation (21.9%) and loosening (17.5%) (Table ST25). The cumulative incidence of the five most common reasons for revision are presented in Figure ST8.

Type of Revision

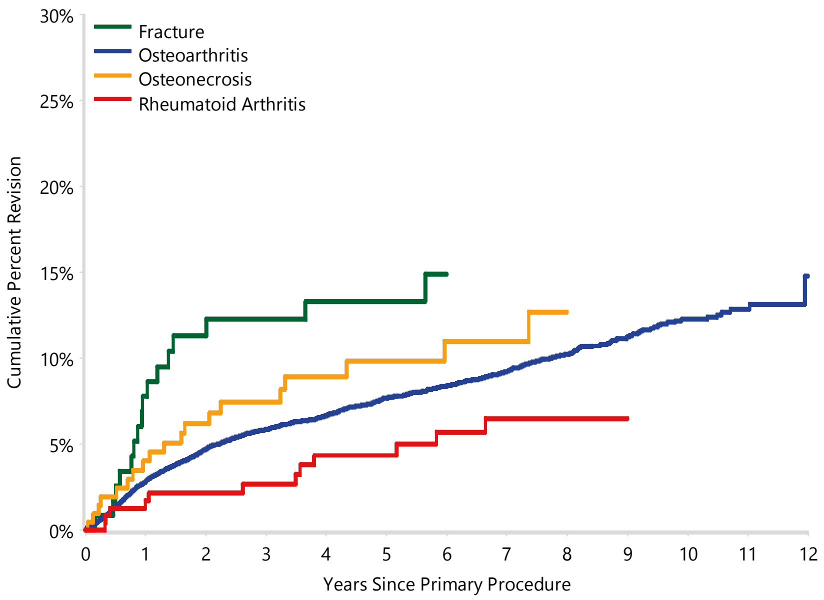
The most common type of revision is of the humeral component only (53.2%) (Table ST26). This may include the revision of a humeral component (epiphysis and/or humeral stem) and additional minor components, such as the humeral head/glenosphere and/or removal of the glenoid component. Of the 561 humeral component revisions, 489 (87.2%) were revised to a total reverse shoulder replacement. The humeral stem was not revised in 465 (82.9%) procedures.

Table ST24 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	12 Yrs
Osteoarthritis	981	12671	2.8 (2.6, 3.1)	5.9 (5.5, 6.3)	7.7 (7.2, 8.2)	9.2 (8.7, 9.9)	12.3 (11.4, 13.2)	14.8 (11.7, 18.6)
Rheumatoid Arthritis	14	240	1.7 (0.7, 4.5)	2.7 (1.2, 5.9)	4.4 (2.3, 8.3)	6.5 (3.7, 11.3)		
Osteonecrosis	19	212	4.0 (2.0, 7.9)	7.5 (4.5, 12.3)	9.8 (6.2, 15.5)	11.0 (6.9, 17.2)		
Fracture	16	120	7.8 (4.1, 14.4)	12.3 (7.5, 19.9)	13.3 (8.2, 21.1)			
Other Inflammatory Arthritis	7	80	1.3 (0.2, 8.9)	2.7 (0.7, 10.5)	8.9 (3.7, 20.5)	11.6 (5.2, 24.6)		
Rotator Cuff Arthropathy	10	68	6.4 (2.4, 16.2)	14.1 (7.2, 26.3)	16.3 (8.8, 29.2)	16.3 (8.8, 29.2)		
Instability	7	39	8.1 (2.7, 23.2)	18.5 (8.7, 36.9)	18.5 (8.7, 36.9)	18.5 (8.7, 36.9)		
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	**1055**	**13446**						

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=1.59 (0.97, 2.60),p=0.067

Osteonecrosis vs Osteoarthritis
Entire Period: HR=1.03 (0.65, 1.63),p=0.899

Rheumatoid Arthritis vs Osteoarthritis
Entire Period: HR=0.56 (0.33, 0.95),p=0.032

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Fracture	120	106	87	62	37	7	1
Osteoarthritis	12671	11411	8807	6067	3707	899	49
Osteonecrosis	212	182	133	85	57	15	1
Rheumatoid Arthritis	240	223	181	148	110	26	2

Note: Only primary diagnoses with over 100 procedures have been listed

Table ST25 Primary Total Stemmed Shoulder Replacement by Reason for Revision

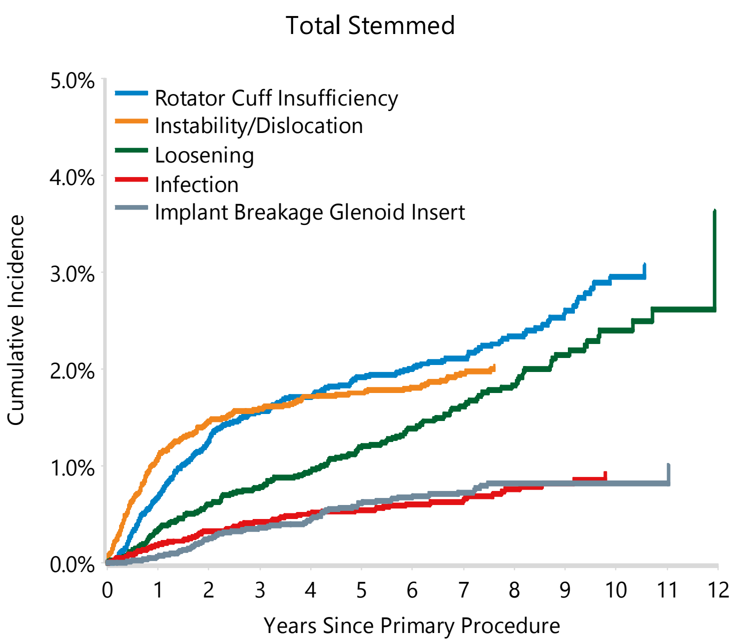
Reason for Revision	Number	Percent
Rotator Cuff Insufficiency	261	24.7
Instability/Dislocation	231	21.9
Loosening	185	17.5
Infection	78	7.4
Implant Breakage Glenoid Insert	77	7.3
Dissociation	31	2.9
Implant Breakage Glenoid	28	2.7
Fracture	28	2.7
Pain	22	2.1
Arthrofibrosis	18	1.7
Incorrect Sizing	17	1.6
Metal Related Pathology	14	1.3
Wear Glenoid Insert	11	1.0
Malposition	10	0.9
Lysis	8	0.8
Glenoid Erosion	3	0.3
Implant Breakage Head	1	0.1
Implant Breakage Humeral	1	0.1
Progression Of Disease	1	0.1
Other	30	2.8
TOTAL	**1055**	**100.0**

Table ST26 Primary Total Stemmed Shoulder Replacement by Type of Revision

Type of Revision	Number	Percent
Humeral Component	561	53.2
Humeral/Glenoid	233	22.1
Head Only	92	8.7
Glenoid Component	65	6.2
Cement Spacer	45	4.3
Head/Insert	32	3.0
Removal of Prostheses	15	1.4
Minor Components	6	0.6
Reoperation	4	0.4
Reinsertion of Components	1	0.1
Insert Only	1	0.1
TOTAL	**1055**	**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 ST27 and Figure ST9).

There is no difference in the rate of revision between males and females (Table ST28 and Figure ST10).

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 5,999 primary total stemmed shoulder replacement procedures for osteoarthritis in relation to these scores.

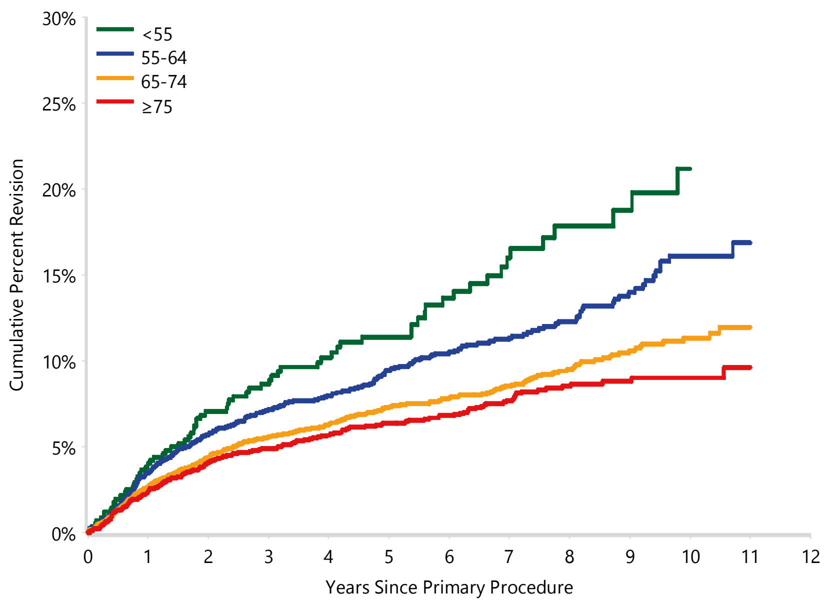
There is no difference in the rate of revision when patients with an ASA score of 2 or 3 are compared to patients with an ASA score of 1 (Table ST29 and Figure ST11). The most common reasons for revision can be found in Figure ST12.

BMI data has been collected since 2015. The early revision outcomes are reported for 3,641 primary total stemmed shoulder replacement procedures for osteoarthritis. BMI is not a risk factor for revision (Table ST30 and Figure ST13). The most common reasons for revision by BMI category are shown in Figure ST14.

Table ST27 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	12 Yrs
<55	71	578	4.0 (2.7, 6.1)	8.6 (6.5, 11.5)	11.4 (8.8, 14.7)	16.0 (12.5, 20.3)	21.2 (16.2, 27.4)	
55-64	274	2836	3.5 (2.9, 4.3)	7.2 (6.2, 8.2)	9.5 (8.3, 10.8)	11.3 (10.0, 12.8)	16.1 (13.9, 18.6)	
65-74	408	5690	2.7 (2.3, 3.1)	5.6 (5.0, 6.2)	7.3 (6.6, 8.1)	8.5 (7.7, 9.4)	11.3 (10.1, 12.7)	
≥75	228	3567	2.4 (1.9, 2.9)	4.9 (4.2, 5.7)	6.3 (5.5, 7.3)	7.7 (6.7, 8.8)	9.0 (7.8, 10.4)	
TOTAL	**981**	**12671**						

Figure ST9 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement by Age (Primary Diagnosis OA)



HR - adjusted for gender

55-64 vs <55

Entire Period: HR=0.77 (0.59, 1.00),p=0.045

65-74 vs <55

Entire Period: HR=0.56 (0.44, 0.73),p<0.001

≥75 vs <55

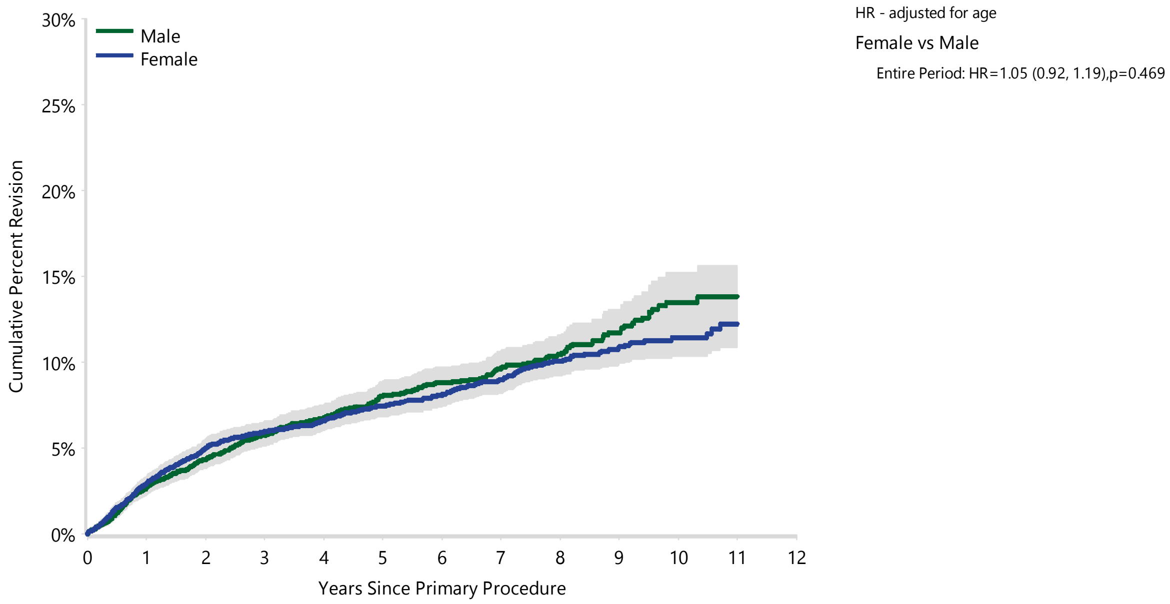
Entire Period: HR=0.49 (0.37, 0.64),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
<55	578	501	371	257	161	50	2
55-64	2836	2526	1931	1324	856	202	12
65-74	5690	5122	3908	2693	1615	406	22
≥75	3567	3262	2597	1793	1075	241	13

Table ST28 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	12 Yrs
Male	425	5426	2.7 (2.3, 3.2)	5.7 (5.1, 6.4)	8.1 (7.3, 8.9)	9.7 (8.7, 10.7)	13.5 (12.0, 15.2)	
Female	556	7245	2.9 (2.6, 3.4)	6.0 (5.4, 6.6)	7.4 (6.8, 8.1)	9.0 (8.2, 9.8)	11.4 (10.4, 12.6)	
TOTAL	**981**	**12671**						

Figure ST10 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement by Gender (Primary Diagnosis OA)

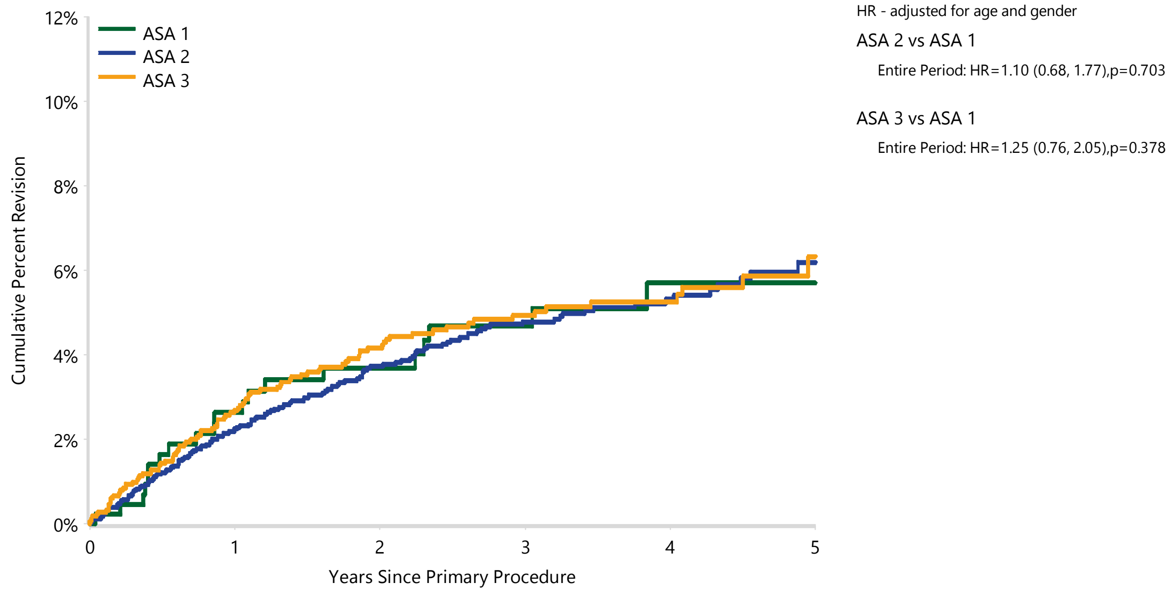


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Male	5426	4883	3704	2472	1469	347	19
Female	7245	6528	5103	3595	2238	552	30

Table ST29 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement by ASA Score (Primary Diagnosis OA)

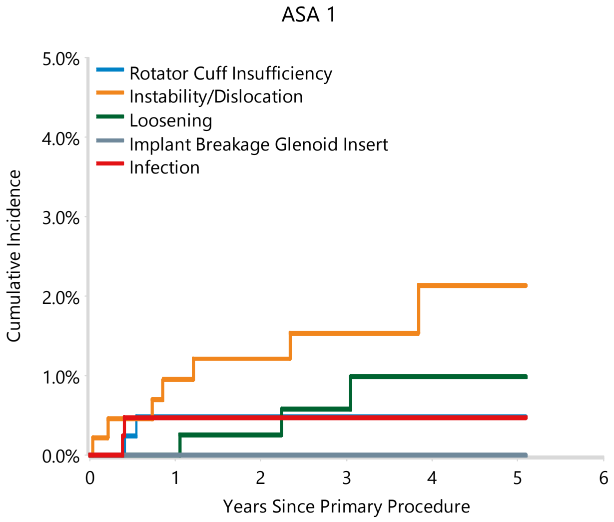
ASA Score	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
ASA 1	20	450	2.6 (1.5, 4.7)	3.7 (2.2, 6.1)	4.7 (3.0, 7.3)	5.7 (3.6, 8.9)	5.7 (3.6, 8.9)
ASA 2	143	3323	2.2 (1.8, 2.8)	3.7 (3.1, 4.5)	4.8 (4.0, 5.7)	5.3 (4.5, 6.3)	6.2 (5.1, 7.4)
ASA 3	97	2160	2.7 (2.1, 3.5)	4.2 (3.4, 5.2)	4.9 (4.0, 6.1)	5.3 (4.3, 6.4)	6.3 (4.9, 8.1)
ASA 4	2	64	3.8 (0.9, 14.2)	3.8 (0.9, 14.2)	3.8 (0.9, 14.2)	3.8 (0.9, 14.2)	3.8 (0.9, 14.2)
ASA 5	1	2					
TOTAL	**263**	**5999**					

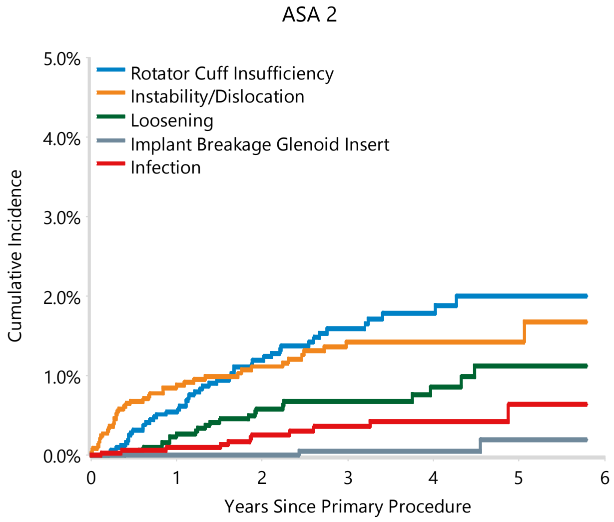
Figure ST11 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement by ASA Score (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
ASA 1	450	380	317	231	141	47
ASA 2	3323	2796	2165	1584	947	375
ASA 3	2160	1790	1421	979	548	193

Figure ST12 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Shoulder Replacement by ASA Score (Primary Diagnosis OA)





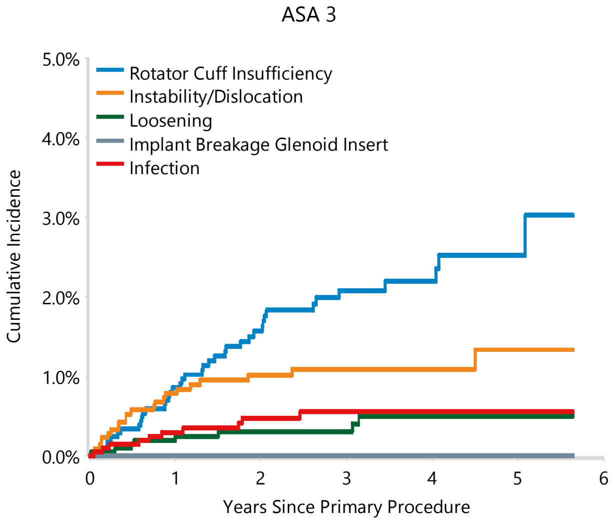
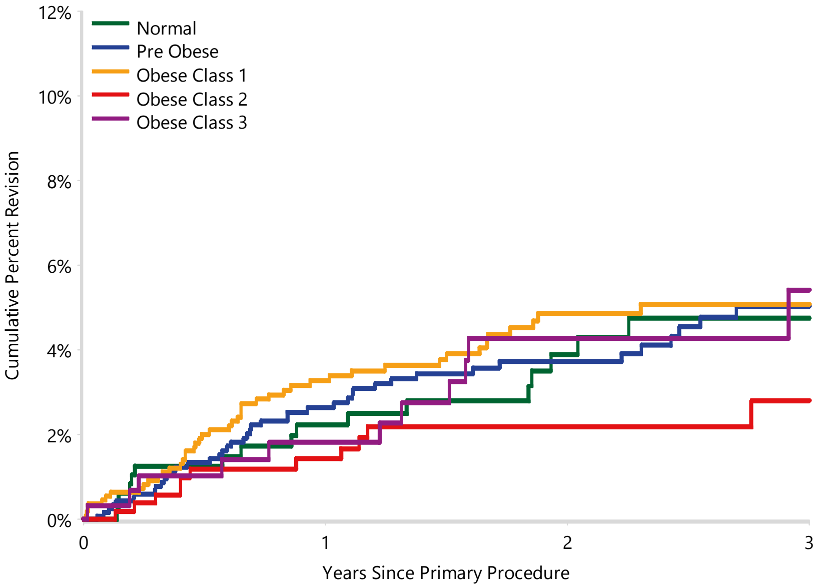


Table ST30 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement by BMI Category (Primary Diagnosis OA)

BMI Category	N Revised	N Total	1 Yr	2 Yrs	3 Yrs
Underweight	0	6	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)
Normal	17	496	2.2 (1.2, 4.1)	3.9 (2.3, 6.5)	4.7 (2.9, 7.7)
Pre Obese	46	1191	2.6 (1.8, 3.8)	3.7 (2.7, 5.1)	5.0 (3.7, 6.9)
Obese Class 1	46	1109	3.3 (2.3, 4.6)	4.9 (3.6, 6.5)	5.1 (3.8, 6.8)
Obese Class 2	11	537	1.4 (0.7, 3.0)	2.2 (1.2, 4.0)	2.8 (1.5, 5.3)
Obese Class 3	11	302	1.8 (0.8, 4.3)	4.3 (2.3, 7.9)	5.4 (2.9, 10.1)
TOTAL	**131**	**3641**			

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

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=1.16 (0.66, 2.03),p=0.597

Obese Class 1 vs Normal
Entire Period: HR=1.22 (0.70, 2.14),p=0.479

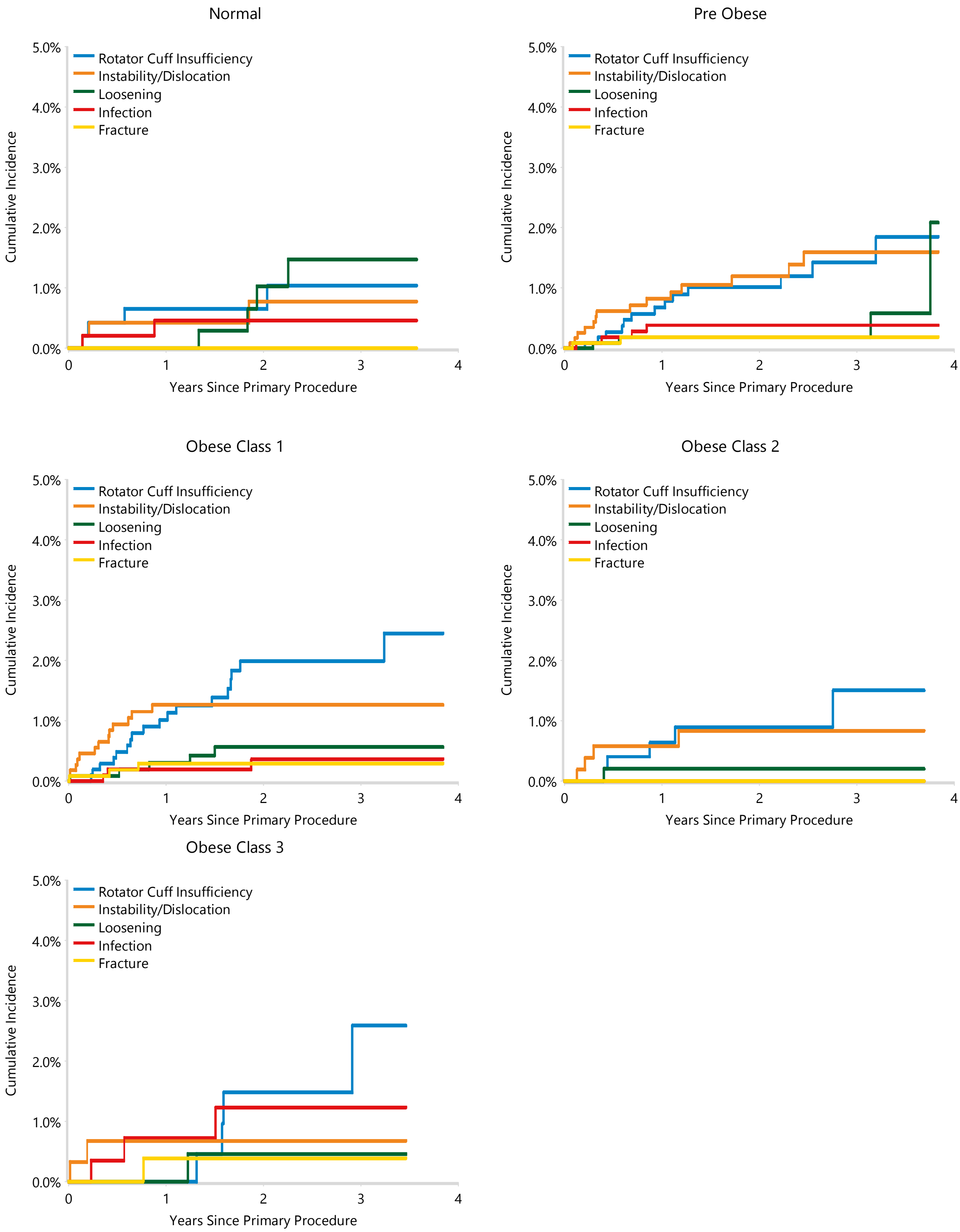
Obese Class 2 vs Normal
Entire Period: HR=0.57 (0.27, 1.21),p=0.142

Obese Class 3 vs Normal
Entire Period: HR=0.93 (0.44, 2.00),p=0.856

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs
Normal	496	376	243	127
Pre Obese	1191	895	587	273
Obese Class 1	1109	837	526	257
Obese Class 2	537	404	272	126
Obese Class 3	302	233	158	76

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

Figure ST14 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Shoulder Replacement by BMI Category (Primary Diagnosis OA)



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

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 ST31 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 ST32 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 71.6% of primary total stemmed shoulder replacements, the majority of which were cemented (99.5%). These prostheses have a lower rate of revision compared to modular metal backed glenoid over the entire period and non modular metal backed glenoid prostheses in the first 3 months. A modular metal backed glenoid has a higher rate of revision compared to a non modular metal backed glenoid (Table ST33 and Figure ST17).

The revision rate is increased if the glenoid is cementless.

When a modular metal backed glenoid was revised, 79.3% 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 (19 out of the total 478 procedures).

The above analysis was repeated excluding the SMR L2 glenoid prosthesis, and the results remained consistent (Table ST34 and Figure ST18).

Pegged and keeled all-polyethylene glenoid prostheses were also compared. The majority of all-polyethylene glenoid prostheses are pegged (86.8%). There is no difference in the rate of revision between these prostheses (Table ST35 and Figure ST19).

The use of cross-linked polyethylene (XLPE) glenoids has increased from 10.7% in 2008 to 32.5% in 2018 (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 (4.3% compared to 11.5%, respectively) (Table ST36 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 ST37 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

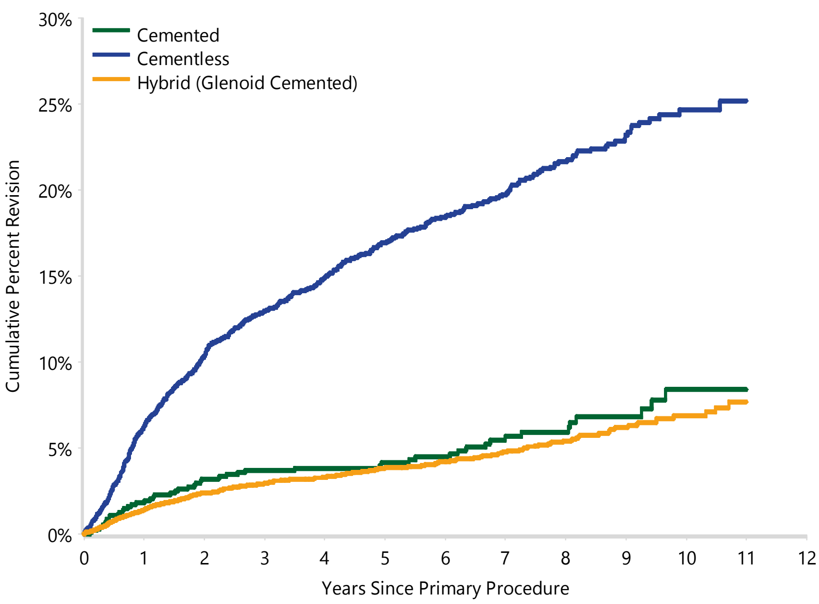
Humeral head sizes <44mm have the highest rate of revision. This rate of revision decreases with increasing head size, with humeral heads >50mm having the lowest rate of revision (Table ST38 and Figure ST23). This remains the same when the SMR L2 glenoid prosthesis is excluded. The cumulative incidence 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 ST39. The most commonly used cementless prosthesis combinations are listed in Table ST40. The most commonly used prosthesis combinations with hybrid (glenoid cemented) fixation are listed in Table ST41.

Table ST31 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	12 Yrs
Cemented	51	951	1.8 (1.1, 2.9)	3.7 (2.6, 5.2)	4.2 (3.0, 5.7)	5.7 (4.2, 7.6)	8.4 (6.1, 11.5)	
Cementless	598	3453	6.2 (5.5, 7.1)	12.9 (11.8, 14.2)	16.9 (15.6, 18.3)	19.7 (18.2, 21.3)	24.7 (22.6, 26.9)	
Hybrid (Glenoid Cemented)	321	8201	1.4 (1.2, 1.7)	3.0 (2.6, 3.4)	3.9 (3.4, 4.4)	4.8 (4.2, 5.4)	6.9 (6.0, 7.9)	
Hybrid (Glenoid Cementless)	11	66	9.1 (4.2, 19.2)	10.8 (5.3, 21.3)	20.5 (11.6, 34.6)	20.5 (11.6, 34.6)		
TOTAL	**981**	**12671**						

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=1.19 (0.88, 1.60),p=0.252

Cementless vs Hybrid (Glenoid Cemented)

Entire Period: HR=4.37 (3.82, 5.01),p<0.001

Cementless vs Cemented

Entire Period: HR=3.68 (2.76, 4.90),p<0.001

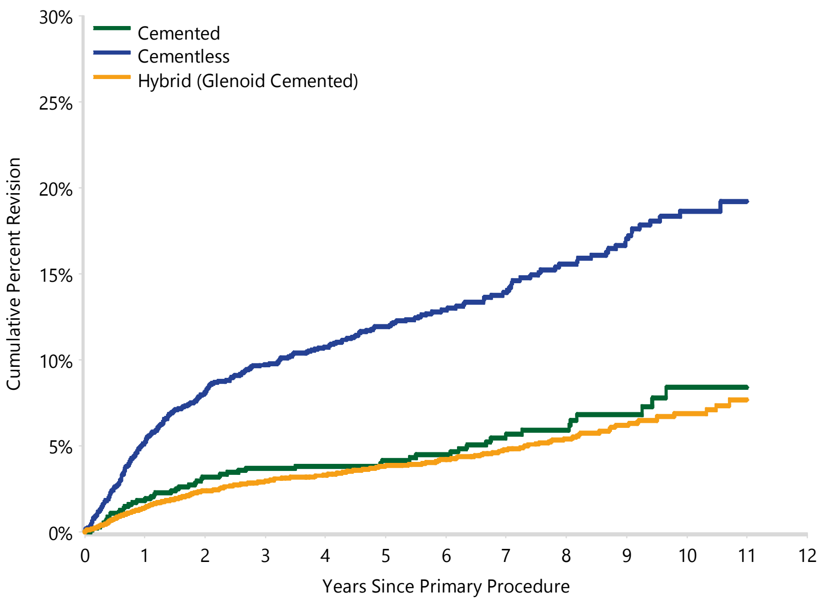
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Cemented	951	884	753	613	423	130	4
Cementless	3453	3075	2386	1656	986	232	15
Hybrid (Glenoid Cemented)	8201	7393	5621	3768	2281	534	30

Note: Only fixations with over 100 procedures have been listed

Table ST32 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	12 Yrs
Cemented	51	951	1.8 (1.1, 2.9)	3.7 (2.6, 5.2)	4.2 (3.0, 5.7)	5.7 (4.2, 7.6)	8.4 (6.1, 11.5)	
Cementless	324	2667	5.2 (4.4, 6.1)	9.7 (8.6, 11.0)	11.9 (10.7, 13.4)	13.9 (12.4, 15.6)	18.7 (16.4, 21.2)	
Hybrid (Glenoid Cemented)	321	8201	1.4 (1.2, 1.7)	3.0 (2.6, 3.4)	3.9 (3.4, 4.4)	4.8 (4.2, 5.4)	6.9 (6.0, 7.9)	
Hybrid (Glenoid Cementless)	8	53	7.6 (2.9, 19.0)	9.6 (4.1, 21.6)	20.6 (10.3, 38.6)	20.6 (10.3, 38.6)		
TOTAL	**704**	**11872**						

Figure ST16 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement by Fixation (Primary Diagnosis OA, Excluding SMR L2)



HR - adjusted for age and gender

Cemented vs Hybrid (Glenoid Cemented)
Entire Period: HR=1.19 (0.88, 1.60),p=0.259

Cementless vs Hybrid (Glenoid Cemented)
Entire Period: HR=3.11 (2.66, 3.62),p<0.001

Cementless vs Cemented
Entire Period: HR=2.62 (1.95, 3.52),p<0.001

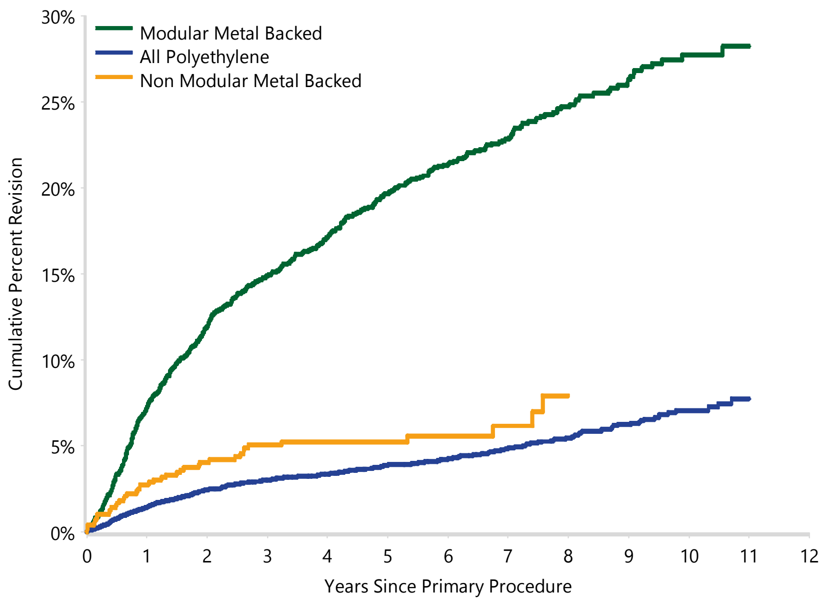
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Cemented	951	884	753	613	423	130	4
Cementless	2667	2371	1794	1148	604	232	15
Hybrid (Glenoid Cemented)	8201	7393	5621	3768	2281	534	30

Note: Only fixations with over 100 procedures have been listed

Table ST33 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	12 Yrs
Modular Metal Backed	570	2821	7.2 (6.3, 8.3)	14.9 (13.6, 16.3)	19.7 (18.1, 21.3)	22.8 (21.1, 24.7)	27.7 (25.5, 30.2)	
All Polyethylene	370	9069	1.5 (1.2, 1.7)	3.0 (2.7, 3.4)	3.9 (3.5, 4.4)	4.9 (4.4, 5.5)	7.1 (6.2, 8.1)	
Non Modular Metal Backed	41	781	2.8 (1.8, 4.2)	5.0 (3.7, 6.9)	5.2 (3.8, 7.2)	6.2 (4.4, 8.7)		
TOTAL	**981**	**12671**						

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=4.97 (4.36, 5.66),p<0.001

Modular Metal Backed vs
Non Modular Metal Backed

0 - 3Mth: HR=2.11 (1.21, 3.66),p=0.008

3Mth - 6Mth: HR=2.99 (1.79, 5.00),p<0.001

6Mth - 2Yr: HR=3.48 (2.37, 5.10),p<0.001

2Yr - 2.5Yr: HR=3.97 (2.23, 7.07),p<0.001

2.5Yr+: HR=4.63 (2.37, 9.03),p<0.001

Non Modular Metal Backed vs All Polyethylene

0 - 3Mth: HR=3.41 (1.63, 7.11),p=0.001

3Mth - 2.5Yr: HR=1.31 (0.87, 1.99),p=0.200

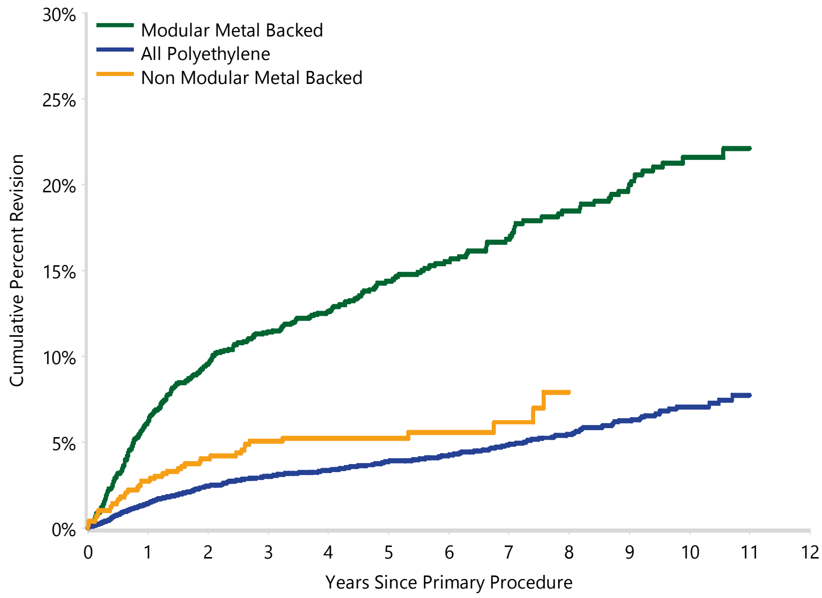
2.5Yr+: HR=1.05 (0.54, 2.05),p=0.881

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Modular Metal Backed	2821	2477	1930	1374	853	236	15
All Polyethylene	9069	8227	6359	4395	2711	663	34
Non Modular Metal Backed	781	707	518	298	143	0	0

Table ST34 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	12 Yrs
Modular Metal Backed	293	2022	6.2 (5.2, 7.4)	11.4 (10.1, 13.0)	14.4 (12.8, 16.2)	16.8 (14.9, 19.0)	21.6 (19.1, 24.4)	
All Polyethylene	370	9069	1.5 (1.2, 1.7)	3.0 (2.7, 3.4)	3.9 (3.5, 4.4)	4.9 (4.4, 5.5)	7.1 (6.2, 8.1)	
Non Modular Metal Backed	41	781	2.8 (1.8, 4.2)	5.0 (3.7, 6.9)	5.2 (3.8, 7.2)	6.2 (4.4, 8.7)		
TOTAL	**704**	**11872**						

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=3.61 (3.10, 4.22),p<0.001

Modular Metal Backed vs

Non Modular Metal Backed

Entire Period: HR=2.57 (1.86, 3.57),p<0.001

Non Modular Metal Backed vs All Polyethylene

0 - 3Mth: HR=2.84 (1.35, 5.96),p=0.005

3Mth - 2.5Yr: HR=1.32 (0.87, 2.00),p=0.197

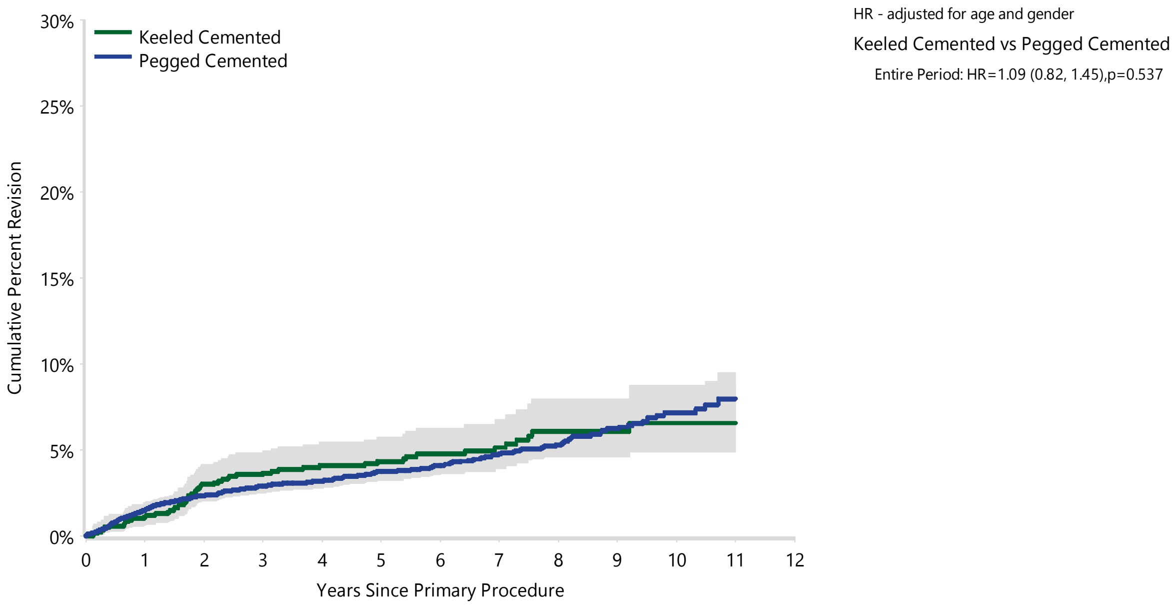
2.5Yr+: HR=1.14 (0.58, 2.23),p=0.704

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Modular Metal Backed	2022	1762	1327	856	463	236	15
All Polyethylene	9069	8227	6359	4395	2711	663	34
Non Modular Metal Backed	781	707	518	298	143	0	0

Table ST35 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	12 Yrs
Keeled Cemented	57	1192	1.1 (0.7, 1.9)	3.7 (2.7, 5.0)	4.3 (3.3, 5.8)	5.2 (3.9, 6.8)	6.6 (4.9, 8.8)	
Pegged Cemented	309	7834	1.5 (1.3, 1.8)	2.9 (2.5, 3.3)	3.8 (3.3, 4.3)	4.8 (4.2, 5.4)	7.2 (6.2, 8.3)	
TOTAL	**366**	**9026**						

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	12 Yrs
Keeled Cemented	1192	1129	962	725	462	124	6
Pegged Cemented	7834	7056	5364	3648	2237	539	28

Figure ST20 Primary Total Stemmed Shoulder Replacement by Polyethylene Type (All Diagnoses)

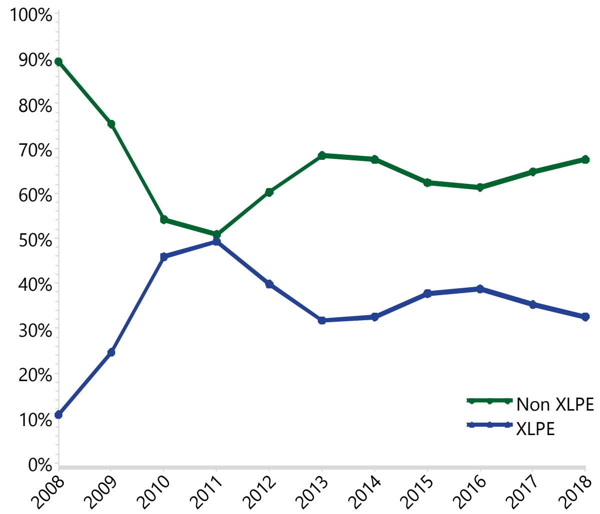
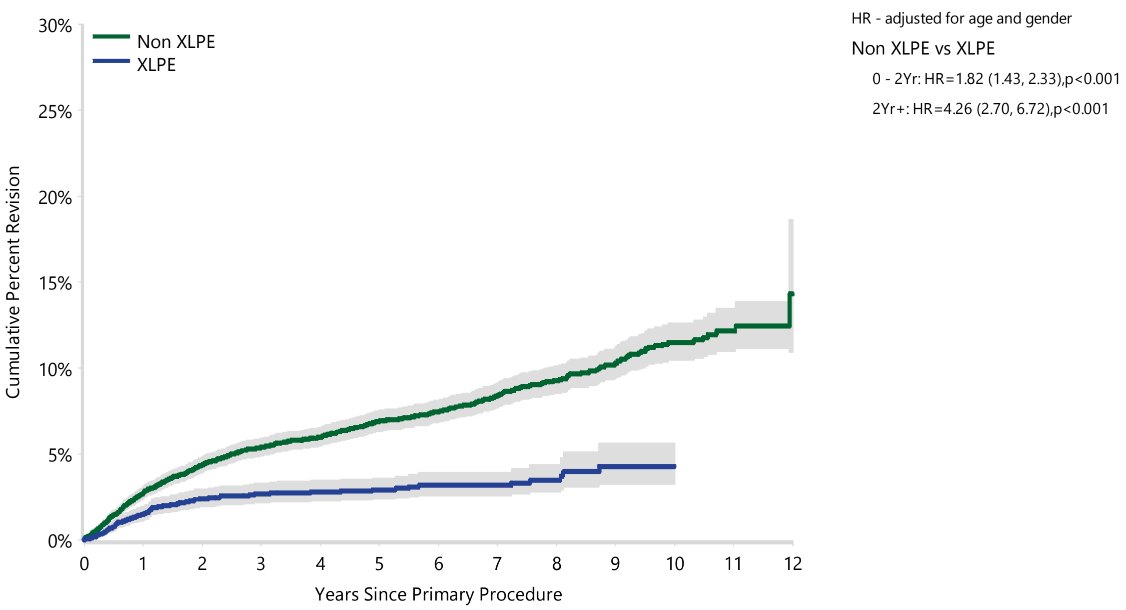


Table ST36 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement using All Types of Glenoid by Polyethylene Type (Primary Diagnosis OA, Excluding SMR L2)

Polyethylene Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Non XLPE	604	8325	2.7 (2.4, 3.1)	5.4 (4.9, 5.9)	6.9 (6.3, 7.6)	8.4 (7.7, 9.1)	11.5 (10.5, 12.6)	14.3 (10.9, 18.7)
XLPE	99	3532	1.5 (1.1, 2.0)	2.7 (2.2, 3.3)	2.9 (2.4, 3.6)	3.2 (2.6, 3.9)	4.3 (3.2, 5.7)	
TOTAL	**703**	**11857**						

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)

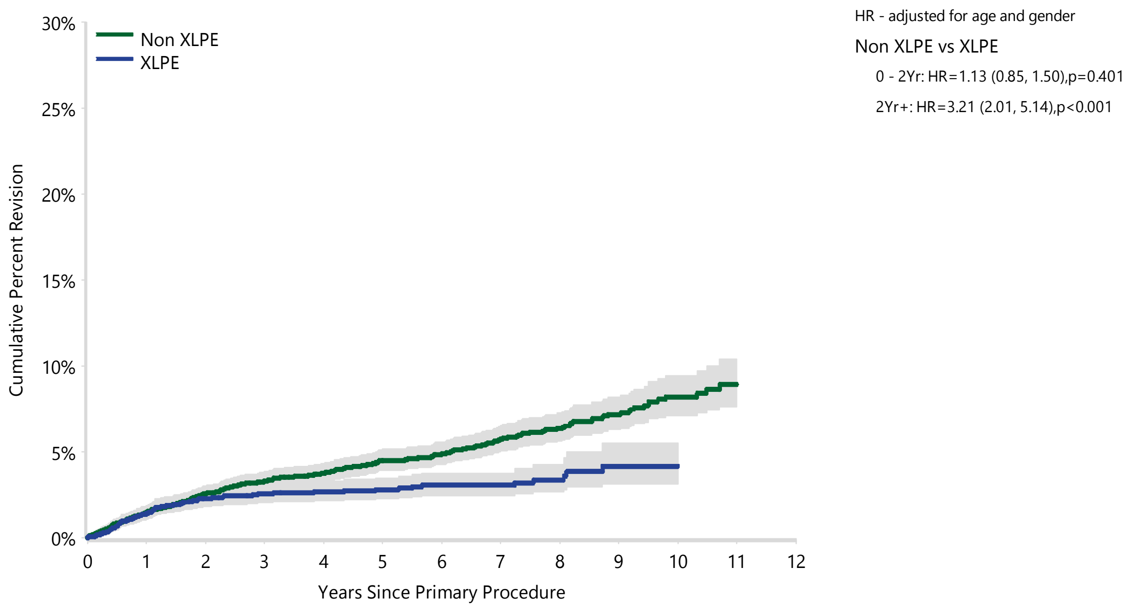


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Non XLPE	8325	7488	5868	4136	2611	806	43
XLPE	3532	3194	2326	1413	706	93	6

Table ST37 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	12 Yrs
Non XLPE	275	5548	1.5 (1.2, 1.8)	3.3 (2.8, 3.8)	4.5 (3.9, 5.2)	5.8 (5.1, 6.5)	8.2 (7.1, 9.4)	
XLPE	95	3521	1.4 (1.1, 1.9)	2.6 (2.1, 3.2)	2.8 (2.3, 3.5)	3.1 (2.5, 3.8)	4.2 (3.1, 5.5)	
TOTAL	**370**	**9069**						

Figure ST22 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement using All-Polyethylene Glenoids by Polyethylene Type (Primary Diagnosis OA)



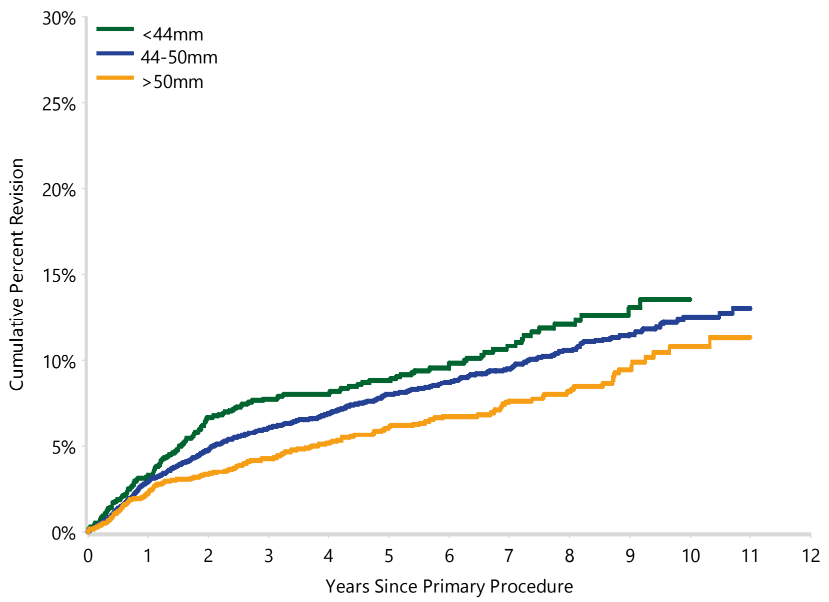
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Non XLPE	5548	5036	4033	2982	2005	570	28
XLPE	3521	3191	2326	1413	706	93	6

Table ST38 **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	12 Yrs
<44mm	153	1686	3.3 (2.6, 4.3)	7.7 (6.5, 9.2)	8.8 (7.4, 10.4)	10.8 (9.2, 12.8)	13.5 (11.3, 16.2)	
44-50mm	644	8026	2.9 (2.6, 3.3)	6.1 (5.5, 6.6)	8.0 (7.4, 8.7)	9.5 (8.7, 10.3)	12.5 (11.4, 13.7)	
>50mm	183	2957	2.2 (1.7, 2.8)	4.2 (3.5, 5.1)	6.1 (5.2, 7.2)	7.6 (6.5, 9.0)	10.8 (9.0, 12.9)	
TOTAL	**980**	**12669**						

Note: Excludes two procedures with unknown head size

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=1.86 (1.45, 2.40),p<0.001

<44mm vs 44-50mm

Entire Period: HR=1.24 (1.04, 1.50),p=0.019

44-50mm vs >50mm

Entire Period: HR=1.50 (1.25, 1.80),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
<44mm	1686	1491	1133	781	480	105	4
44-50mm	8026	7253	5625	3908	2361	583	33
>50mm	2957	2666	2048	1377	866	211	12

Figure ST24 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Shoulder Replacement by Humeral Head Size (Primary Diagnosis OA)

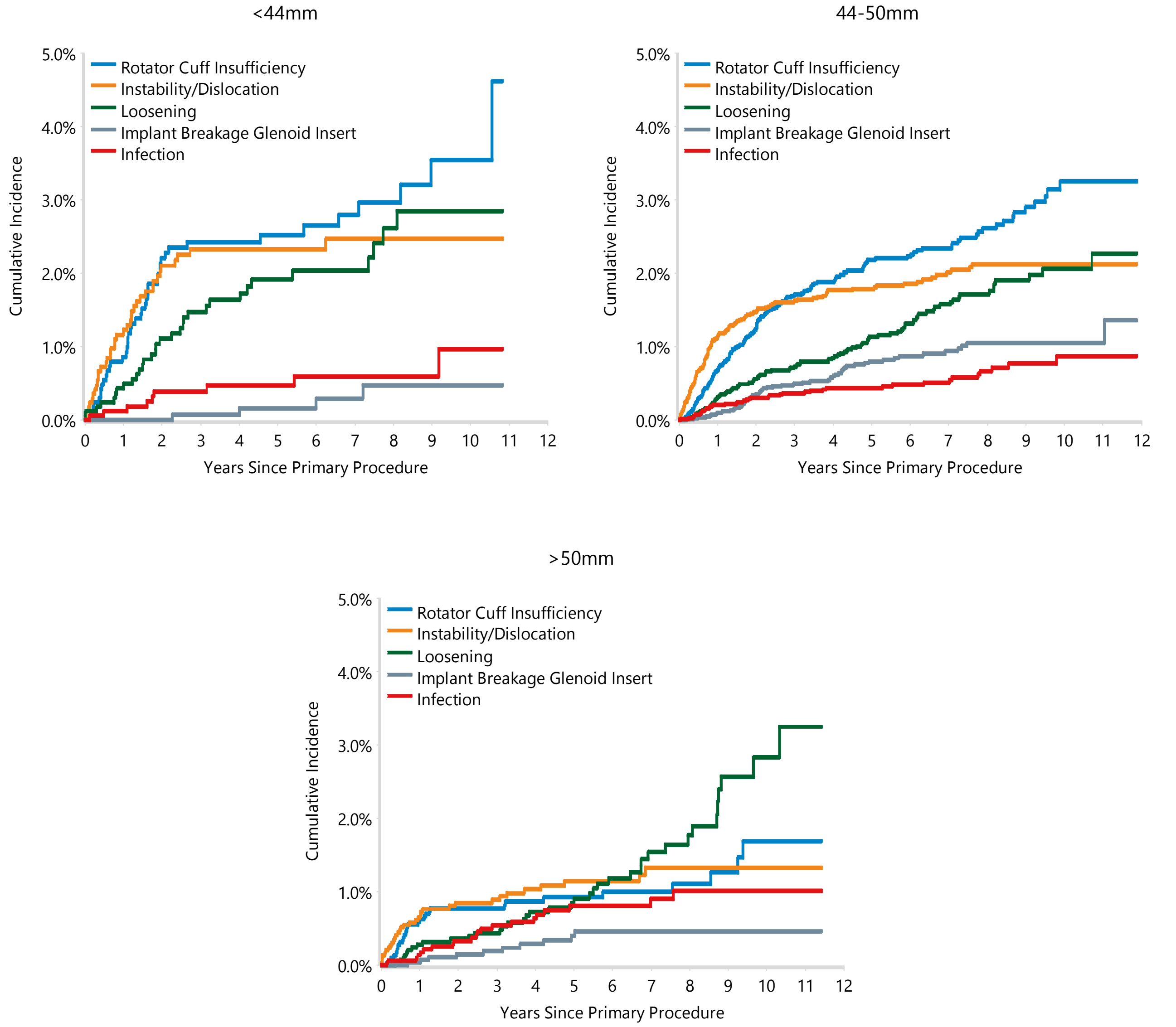


Table ST39 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement by Prosthesis Combination (Primary Diagnosis OA)

Humeral Stem	Glenoid	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Aequalis	Aequalis	68	1564	1.3 (0.8, 2.0)	2.5 (1.8, 3.4)	3.3 (2.5, 4.4)	4.4 (3.5, 5.7)	6.2 (4.7, 8.2)	
Aequalis	Perform	7	122	3.3 (1.2, 8.5)	6.0 (2.9, 12.2)				
Affinis	Affinis	13	180	0.0 (0.0, 0.0)	1.8 (0.6, 5.4)	4.9 (2.5, 9.5)	5.6 (2.9, 10.4)		
Ascend	Aequalis	12	236	1.7 (0.6, 4.5)	3.0 (1.4, 6.2)	7.8 (4.1, 14.8)			
Ascend	Perform	4	107	0.9 (0.1, 6.4)	2.9 (0.9, 8.6)	4.0 (1.5, 10.4)			
Ascend Flex	Aequalis	1	83	0.0 (0.0, 0.0)	4.5 (0.7, 28.1)				
Ascend Flex	Perform	3	476	0.3 (0.0, 1.9)	0.7 (0.2, 2.7)				
Bigliani/Flatow	Bigliani/Flatow	11	142	2.1 (0.7, 6.5)	3.6 (1.5, 8.4)	3.6 (1.5, 8.4)	5.3 (2.6, 10.9)	8.8 (4.8, 16.1)	
Bigliani/Flatow TM	Bigliani/Flatow	26	417	2.0 (1.0, 3.9)	4.7 (3.0, 7.3)	5.7 (3.7, 8.6)	6.6 (4.4, 9.9)		
Bigliani/Flatow TM	Bigliani/Flatow TM	32	634	2.4 (1.4, 3.9)	4.7 (3.2, 6.7)	4.9 (3.4, 7.0)	5.8 (4.0, 8.5)		
Comprehensive	Comprehensive	20	503	3.3 (2.0, 5.5)	4.2 (2.6, 6.5)	5.8 (3.5, 9.5)			
Epoca	Epoca	4	51	0.0 (0.0, 0.0)	4.2 (1.1, 15.6)	9.2 (3.5, 22.9)	9.2 (3.5, 22.9)		
Equinoxe	Equinoxe	21	300	3.1 (1.5, 6.0)	7.9 (4.8, 12.8)				
Global AP	Global	92	2716	1.5 (1.1, 2.0)	2.6 (2.1, 3.3)	3.0 (2.4, 3.8)	3.9 (3.1, 4.9)	6.5 (4.5, 9.3)	
Global Advantage	Global	36	694	1.3 (0.7, 2.5)	3.5 (2.3, 5.2)	3.7 (2.5, 5.5)	4.7 (3.3, 6.9)	6.7 (4.7, 9.7)	
Global Unite	Global	11	720	0.9 (0.4, 2.0)	2.1 (1.1, 4.0)				
SMR	SMR	21	436	1.9 (0.9, 3.7)	4.3 (2.7, 6.8)	4.6 (3.0, 7.1)	5.0 (3.2, 7.7)	5.7 (3.6, 8.9)	
SMR	SMR L1	258	1930	5.9 (4.9, 7.0)	10.9 (9.5, 12.4)	13.6 (12.0, 15.4)	15.2 (13.4, 17.2)	19.6 (17.2, 22.4)	
SMR	SMR L2	276	798	9.7 (7.8, 12.0)	22.6 (19.8, 25.6)	30.2 (27.1, 33.6)	34.0 (30.7, 37.4)		
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)	3.9 (1.7, 8.5)	
Turon	Turon	4	103	3.1 (1.0, 9.4)	4.4 (1.7, 11.4)				
Other (34)		55	290	5.3 (3.2, 8.6)	10.1 (7.1, 14.4)	15.7 (11.7, 20.8)	20.1 (15.4, 25.9)	24.6 (19.1, 31.3)	
TOTAL		**981**	**12671**						

Note: Only combinations with over 50 procedures have been listed

Table ST40 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	12 Yrs
Bigliani/Flatow TM	Bigliani/Flatow TM	30	607	2.2 (1.3, 3.7)	4.6 (3.1, 6.6)	4.8 (3.3, 6.9)	5.8 (3.9, 8.5)		
Comprehensive	Custom Made (Comprehensive)	4	11	27.3 (9.7, 62.9)					
Epoca	Epoca	4	37	0.0 (0.0, 0.0)	5.9 (1.5, 21.5)	13.4 (5.2, 32.3)	13.4 (5.2, 32.3)		
Equinoxe	Equinoxe	5	35	11.7 (4.6, 28.2)	14.8 (6.5, 32.1)				
SMR	SMR L1	252	1899	5.8 (4.9, 7.0)	10.9 (9.5, 12.5)	13.4 (11.8, 15.2)	15.0 (13.2, 17.0)	19.5 (17.0, 22.3)	
SMR	SMR L2	273	785	9.6 (7.7, 11.9)	22.7 (19.9, 25.8)	30.3 (27.2, 33.7)	34.1 (30.9, 37.6)		
Univers 3D	Univers 3D	13	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	13	24	16.7 (6.6, 38.5)	29.2 (15.1, 51.6)	42.2 (25.3, 64.3)			
Other (14)		4	29	7.2 (1.8, 25.8)	7.2 (1.8, 25.8)	13.8 (4.4, 38.9)	13.8 (4.4, 38.9)		
TOTAL		**598**	**3453**						

Note: Only combinations with over 10 procedures have been listed

Table ST41 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	12 Yrs
Aequalis	Aequalis	59	1373	1.2 (0.8, 2.0)	2.2 (1.6, 3.2)	3.1 (2.3, 4.2)	4.4 (3.3, 5.8)	6.5 (4.8, 8.7)	
Aequalis	Perform	5	104	1.9 (0.5, 7.5)	5.2 (2.2, 12.0)				
Affinis	Affinis	13	176	0.0 (0.0, 0.0)	1.8 (0.6, 5.5)	4.9 (2.5, 9.6)	5.6 (3.0, 10.5)		
Ascend	Aequalis	9	223	1.8 (0.7, 4.7)	2.7 (1.2, 5.9)	6.8 (3.2, 13.8)			
Ascend	Perform	4	103	1.0 (0.1, 6.7)	3.0 (1.0, 8.9)	4.2 (1.6, 10.8)			
Ascend Flex	Aequalis	1	81	0.0 (0.0, 0.0)	4.8 (0.7, 29.3)				
Ascend Flex	Perform	3	430	0.3 (0.0, 2.1)	0.7 (0.2, 2.8)				
Bigliani/Flatow	Bigliani/Flatow	9	121	2.5 (0.8, 7.5)	4.2 (1.8, 9.8)	4.2 (1.8, 9.8)	5.2 (2.4, 11.3)	7.9 (3.9, 15.4)	
Bigliani/Flatow TM	Bigliani/Flatow	19	388	1.3 (0.5, 3.1)	3.6 (2.1, 6.2)	4.7 (2.9, 7.6)	5.2 (3.2, 8.4)		
Comprehensive	Comprehensive	20	496	3.4 (2.1, 5.6)	4.2 (2.7, 6.7)	5.9 (3.5, 9.7)			
Equinoxe	Equinoxe	16	255	1.8 (0.7, 4.7)	7.1 (3.9, 12.7)				
Global AP	Global	83	2426	1.5 (1.1, 2.1)	2.8 (2.2, 3.6)	3.2 (2.6, 4.1)	4.1 (3.2, 5.1)	6.5 (4.3, 9.6)	
Global Advantage	Global	28	571	1.2 (0.6, 2.6)	3.7 (2.4, 5.7)	4.0 (2.6, 6.1)	4.3 (2.8, 6.5)	5.9 (3.8, 9.0)	
Global Unite	Global	10	661	0.8 (0.3, 2.0)	2.1 (1.1, 4.1)				
SMR	SMR	19	419	1.9 (1.0, 3.8)	4.0 (2.5, 6.4)	4.3 (2.7, 6.8)	4.7 (3.0, 7.4)	5.4 (3.4, 8.7)	
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)		
Turon	Turon	3	96	2.3 (0.6, 8.9)	3.7 (1.2, 11.0)				
Other (25)		16	164	1.2 (0.3, 4.8)	3.8 (1.7, 8.3)	8.5 (4.9, 14.6)	10.5 (6.3, 17.2)		
TOTAL		**321**	**8201**						

Note: Only combinations with over 50 procedures have been listed

PRIMARY TOTAL REVERSE SHOULDER REPLACEMENT

DEMOGRAPHICS

There have been 24,859 primary total reverse shoulder replacement procedures reported to the Registry. This is an increase of 4,930 procedures compared to the previous report. Primary total reverse shoulder replacement has increased from 43.3% of all total shoulder replacements in 2008 to 77.9% in 2018.

The proportion of total reverse shoulder replacements for osteoarthritis declined from 57.9% in 2008 to 40.5% in 2013, and is 42.2% in 2018. 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 38.3% in 2018. The proportion of total reverse shoulder replacements for fracture has increased from 12.2% in 2008 to 14.9% in 2018 (Figure ST25).

Primary total reverse shoulder replacement is more commonly undertaken in females (64.3%) (Table ST42). There has been minimal change in gender distribution since 2008 (Figure ST26).

Figure ST25 Primary Total Reverse Shoulder Replacement by Primary Diagnosis

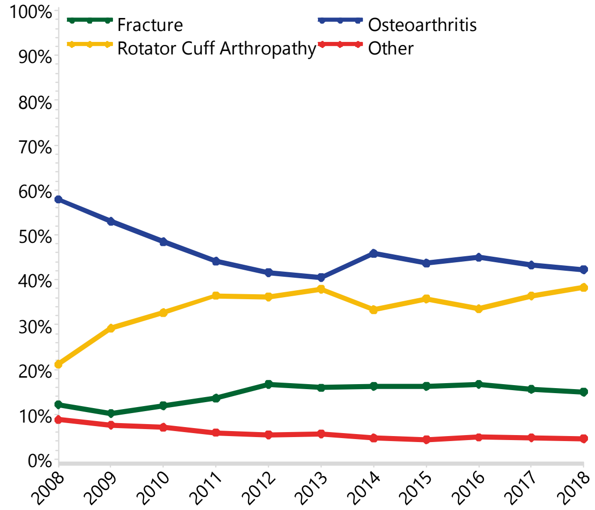
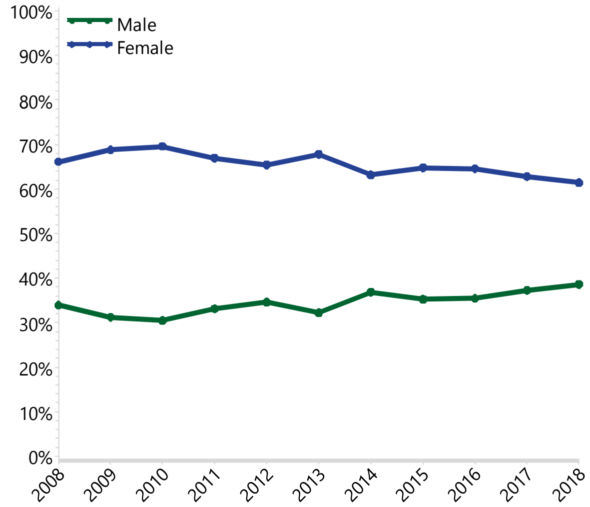


Figure ST26 Primary Total Reverse Shoulder Replacement by Gender



The mean age is 75.2 years for females and 72.7 years for males. The proportion of patients aged ≥75 years has declined from 61.3% in 2010 to 47.5% in 2018 (Figure ST27).

The majority of procedures use cementless fixation (76.5%). Hybrid (humerus cemented) fixation is used in 22.0% of procedures. There has been little variation in the use of fixation since 2008 (Figure ST28).

The most common primary diagnoses are osteoarthritis (44.4%), rotator cuff arthropathy (35.1%) and fracture (15.3%).

The most common primary diagnoses are osteoarthritis (44.4%), rotator cuff arthropathy (35.1%) and fracture (15.3%) (Table ST43).

The most used humeral stems are the SMR, Delta Xtend, and Equinoxe (Table ST44). The most used glenoid prostheses are the Delta Xtend, SMR L1 and Aequalis (Table ST45).

Table ST42 Primary Total Reverse Shoulder Replacement by Age and Gender

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	8864	35.7%	17	96	73	72.7	8.1
Female	15995	64.3%	13	102	76	75.2	8.0
TOTAL	**24859**	**100.0%**	**13**	**102**	**75**	**74.3**	**8.1**

Figure ST27 Primary Total Reverse Shoulder Replacement by Age

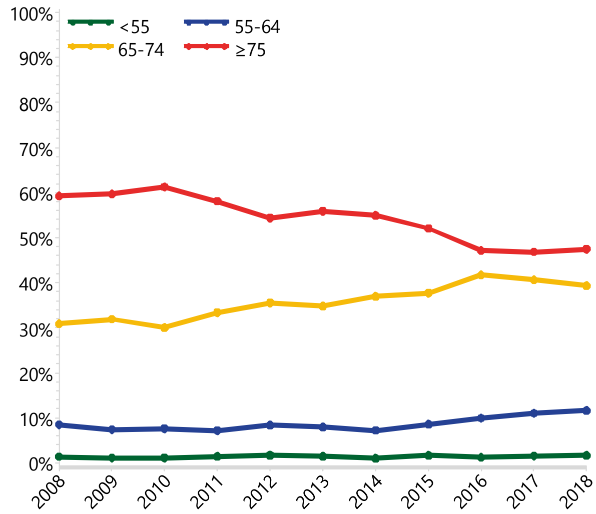


Figure ST28 Primary Total Reverse Shoulder Replacement by Fixation

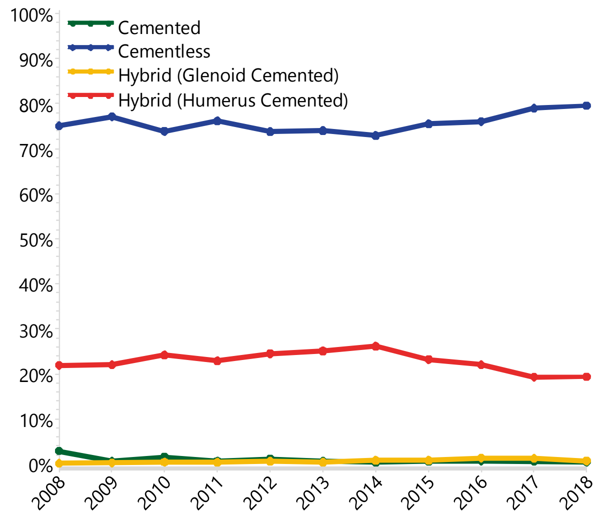


Table ST43 Primary Total Reverse Shoulder Replacement by Primary Diagnosis and Gender

	Male		Female		TOTAL	
Primary Diagnosis	N	Col%	N	Col%	N	Col%
Osteoarthritis	4128	46.6	6908	43.2	11036	44.4
Rotator Cuff Arthropathy	3787	42.7	4950	30.9	8737	35.1
Fracture	596	6.7	3195	20.0	3791	15.3
Rheumatoid Arthritis	100	1.1	381	2.4	481	1.9
Osteonecrosis	55	0.6	239	1.5	294	1.2
Instability	87	1.0	188	1.2	275	1.1
Tumour	79	0.9	70	0.4	149	0.6
Other Inflammatory Arthritis	30	0.3	61	0.4	91	0.4
Other	2	0.0	3	0.0	5	0.0
TOTAL	**8864**	**100.0**	**15995**	**100.0**	**24859**	**100.0**

Table ST44 10 Most Used Humeral Stem Prostheses in Primary Total Reverse Shoulder Replacement

2008		2015		2016		2017		2018	
N	Model	N	Model	N	Model	N	Model	N	Model
263	SMR	963	Delta Xtend	1032	Delta Xtend	1025	Delta Xtend	1058	SMR
252	Delta Xtend	733	SMR	925	SMR	932	SMR	1041	Delta Xtend
76	Aequalis	267	Aequalis	365	Aequalis	369	Aequalis	479	Equinoxe
42	Trabecular Metal	191	Trabecular Metal	207	Trabecular Metal	361	Comprehensive	473	Comprehensive
21	Delta CTA	142	RSP	201	Comprehensive	349	RSP	412	RSP
2	Custom Made (Lima)	105	Comprehensive	179	RSP	332	Equinoxe	366	Ascend Flex
1	Generic Humeral Stem	103	Equinoxe	172	Equinoxe	261	Affinis	349	Aequalis
1	Promos	67	Global Unite	113	Affinis	203	Trabecular Metal	318	Affinis
		48	Ascend Flex	105	Global Unite	161	Ascend Flex	181	Trabecular Metal
		44	Anatomical Shoulder	93	Ascend Flex	125	Global Unite	92	Global Unite
10 Most Used									
658	(8) 100.0%	2663	(10) 98.5%	3392	(10) 99.1%	4118	(10) 99.3%	4769	(10) 99.3%
Remainder									
0	(0) 0%	40	(3) 1.5%	32	(3) 0.9%	30	(4) 0.7%	36	(5) 0.7%
TOTAL									
658	(8) 100.0%	2703	(13) 100.0%	3424	(13) 100.0%	4148	(14) 100.0%	4805	(15) 100.0%

Table ST45 10 Most Used Glenoid Prostheses in Primary Total Reverse Shoulder Replacement

2008		2015		2016		2017		2018	
N	Model	N	Model	N	Model	N	Model	N	Model
264	SMR L1	1030	Delta Xtend	1137	Delta Xtend	1150	Delta Xtend	1131	Delta Xtend
252	Delta Xtend	732	SMR L1	913	SMR L1	925	SMR L1	1031	SMR L1
76	Aequalis	315	Aequalis	459	Aequalis	530	Aequalis	685	Aequalis
42	Trabecular Metal	216	Trabecular Metal	232	Trabecular Metal	370	Comprehensive Reverse	481	Comprehensive Reverse
21	Delta CTA	142	RSP	186	Comprehensive Reverse	350	RSP	479	Equinoxe
1	Generic Metaglene	103	Comprehensive Reverse	179	RSP	332	Equinoxe	416	RSP
1	Promos	103	Equinoxe	168	Equinoxe	261	Affinis	317	Affinis
1	SMR	33	Affinis	113	Affinis	191	Trabecular Metal	150	Trabecular Metal
		19	Anatomical Shoulder	7	SMR Axioma	12	Custom Made (Comprehensive)	30	Perform Reversed
		6	Mets	6	Anatomical Shoulder	11	Mets	19	Custom Made (Comprehensive)
10 Most Used									
658	(8) 100.0%	2699	(10) 99.9%	3400	(10) 99.3%	4132	(10) 99.6%	4739	(10) 98.6%
Remainder									
0	(0) 0%	4	(2) 0.1%	24	(7) 0.7%	16	(4) 0.4%	66	(8) 1.4%
TOTAL									
658	(8) 100.0%	2703	(12) 100.0%	3424	(17) 100.0%	4148	(14) 100.0%	4805	(18) 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 in the rate of revision of total reverse shoulder replacement when primary diagnosis is considered (Table ST46 and Figure ST29).

Reason for Revision

Instability/dislocation is the most common reason for revision (35.2%), followed by infection (20.3%), loosening (18.0%) and fracture (12.4%) (Table ST47 and Figure ST30).

Type of Revision

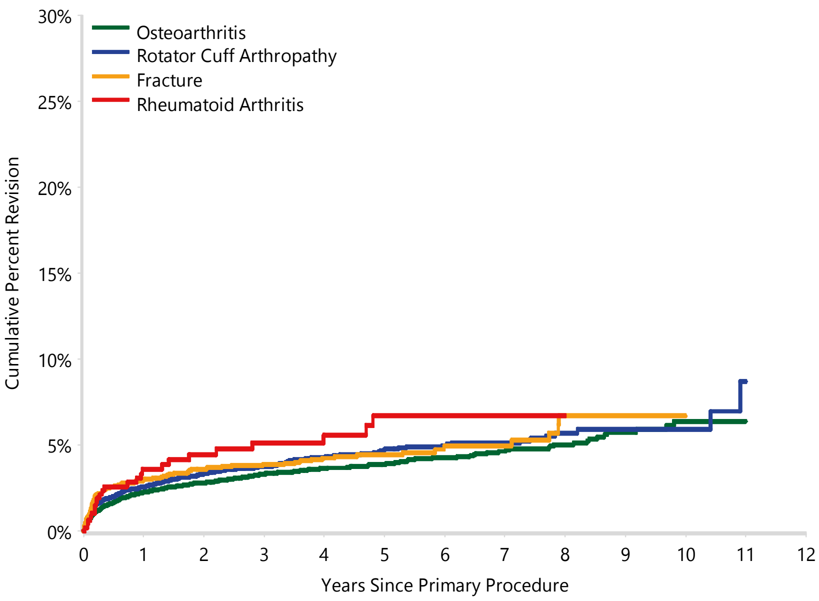
The four most common types of revision are: replacement of both cup (liner) and glenosphere (21.2%), humeral component only (20.6%), cup only (19.2%) and humeral head only (converted to a hemi arthroplasty) (14.1%) (Table ST48). When only the humeral component is revised, this may be associated with exchange of the epiphysis and/or humeral stem and additional minor components such as the liner.

Table ST46 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	12 Yrs
Osteoarthritis	367	11036	2.3 (2.0, 2.6)	3.3 (3.0, 3.7)	3.9 (3.5, 4.3)	4.6 (4.1, 5.2)	6.4 (5.3, 7.6)	
Rotator Cuff Arthropathy	320	8737	2.6 (2.3, 2.9)	3.8 (3.3, 4.2)	4.7 (4.2, 5.3)	5.1 (4.5, 5.8)	5.9 (5.0, 7.0)	
Fracture	143	3791	3.0 (2.5, 3.6)	3.9 (3.3, 4.6)	4.4 (3.7, 5.3)	4.9 (4.1, 6.0)	6.7 (5.0, 9.0)	
Rheumatoid Arthritis	24	481	3.6 (2.2, 5.8)	5.1 (3.4, 7.8)	6.7 (4.4, 10.1)	6.7 (4.4, 10.1)		
Other (5)	52	814	4.2 (3.0, 5.9)	7.0 (5.1, 9.4)	8.0 (5.9, 10.8)	8.6 (6.3, 11.6)		
TOTAL	**906**	**24859**						

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=1.12 (0.97, 1.30),p=0.133

Fracture vs Osteoarthritis

0 - 3Mth: HR=1.95 (1.50, 2.53),p<0.001

3Mth+: HR=1.08 (0.82, 1.42),p=0.586

Rheumatoid Arthritis vs Osteoarthritis

Entire Period: HR=1.39 (0.91, 2.11),p=0.124

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Osteoarthritis	11036	8683	5124	2856	1472	314	16
Rotator Cuff Arthropathy	8737	6638	3793	2038	887	122	13
Fracture	3791	2875	1571	771	311	56	1
Rheumatoid Arthritis	481	370	250	159	86	17	4

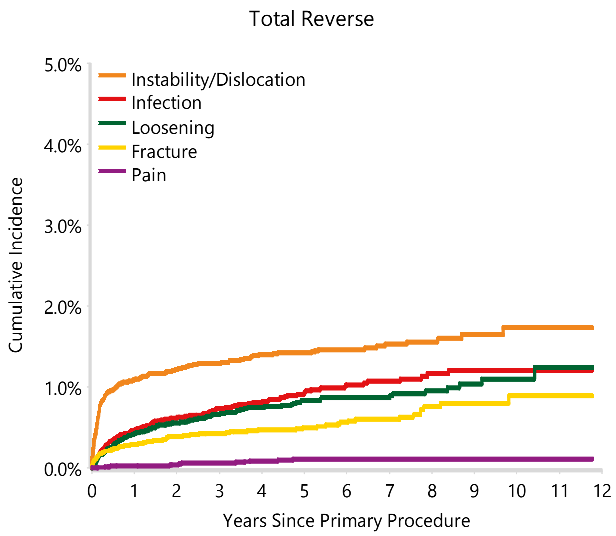
Table ST47 Primary Total Reverse Shoulder Replacement by Reason for Revision

Reason for Revision	Number	Percent
Instability/Dislocation	319	35.2
Infection	184	20.3
Loosening	163	18.0
Fracture	112	12.4
Pain	17	1.9
Lysis	12	1.3
Incorrect Sizing	8	0.9
Arthrofibrosis	8	0.9
Dissociation	7	0.8
Malposition	7	0.8
Metal Related Pathology	7	0.8
Implant Breakage Glenoid	5	0.6
Rotator Cuff Insufficiency	5	0.6
Wear Humeral Cup	2	0.2
Wear Glenoid Insert	1	0.1
Post Operative Haematoma	1	0.1
Implant Breakage Head	1	0.1
Synovitis	1	0.1
Tumour	1	0.1
Other	45	5.0
TOTAL	**906**	**100.0**

Table ST48 Primary Total Reverse Shoulder Replacement by Type of Revision

Type of Revision	Number	Percent
Cup/Glenosphere	192	21.2
Humeral Component	187	20.6
Cup Only	174	19.2
Head Only	128	14.1
Glenoid Component	66	7.3
Humeral/Glenoid	60	6.6
Cement Spacer	59	6.5
Removal of Prostheses	20	2.2
Reoperation	7	0.8
Minor Components	7	0.8
Cement Only	3	0.3
Reinsertion of Components	2	0.2
Head/Insert	1	0.1
TOTAL	**906**	**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 the ≥75 years age group. The age groups 55-64 years and 65-74 years have a higher rate of revision compared to the ≥75 years age group. Primary total reverse shoulder replacement in the <55 year age group has only been used in small numbers (Table ST49 and Figure ST31).

Males have a higher rate of revision compared to females in the first 6 months (Table ST50 and Figure ST32). The increase in the rate of revision is due to a higher cumulative incidence of instability/dislocation (2.2% for males at 10 years compared to 1.4% for females) and infection (1.7% compared to 0.7%) (Figure ST33).

Males have a higher rate of revision compared to females in the first 6 months. The increase in the rate of revision is due to a higher cumulative incidence of instability/dislocation and infection.

ASA and BMI

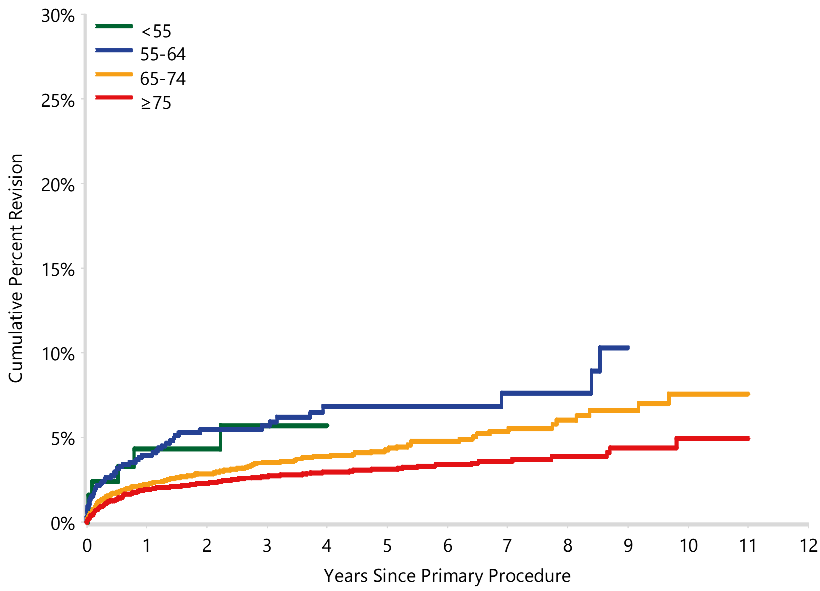
ASA scores are an indication of comorbidity and have been collected since 2012. The definitions for these scores can be found in the introductory chapter. The Registry can now report on the early outcome of 7,779 primary total reverse shoulder replacement procedures for osteoarthritis in relation to these scores. When compared to patients with ASA score 2, patients with ASA scores 3 and 4 have higher rates of revision (Table ST51 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 has been collected since 2015. The early revision outcomes are reported for 5,656 primary total reverse shoulder replacement procedures for osteoarthritis. There is no difference in the rate of revision when pre obese and obese classes 1, 2 and 3 are compared to the normal BMI class (Table ST52 and Figure ST36). The most common reasons for revision are shown in Figure ST37.

Table ST49 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	12 Yrs
<55	7	126	4.3 (1.8, 10.1)	5.7 (2.6, 12.6)				
55-64	56	976	3.9 (2.9, 5.4)	5.7 (4.3, 7.6)	6.8 (5.1, 9.1)	7.6 (5.5, 10.5)		
65-74	150	4190	2.2 (1.8, 2.8)	3.6 (3.0, 4.3)	4.3 (3.6, 5.1)	5.4 (4.4, 6.5)	7.6 (5.8, 9.9)	
≥75	154	5744	1.9 (1.6, 2.4)	2.7 (2.3, 3.2)	3.1 (2.6, 3.7)	3.6 (3.0, 4.3)	4.9 (3.6, 6.7)	
TOTAL	**367**	**11036**						

Figure ST31 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Age (Primary Diagnosis OA)



HR - adjusted for gender

<55 vs ≥75
Entire Period: HR=1.86 (0.87, 3.99),p=0.107

55-64 vs ≥75
Entire Period: HR=2.05 (1.51, 2.80),p<0.001

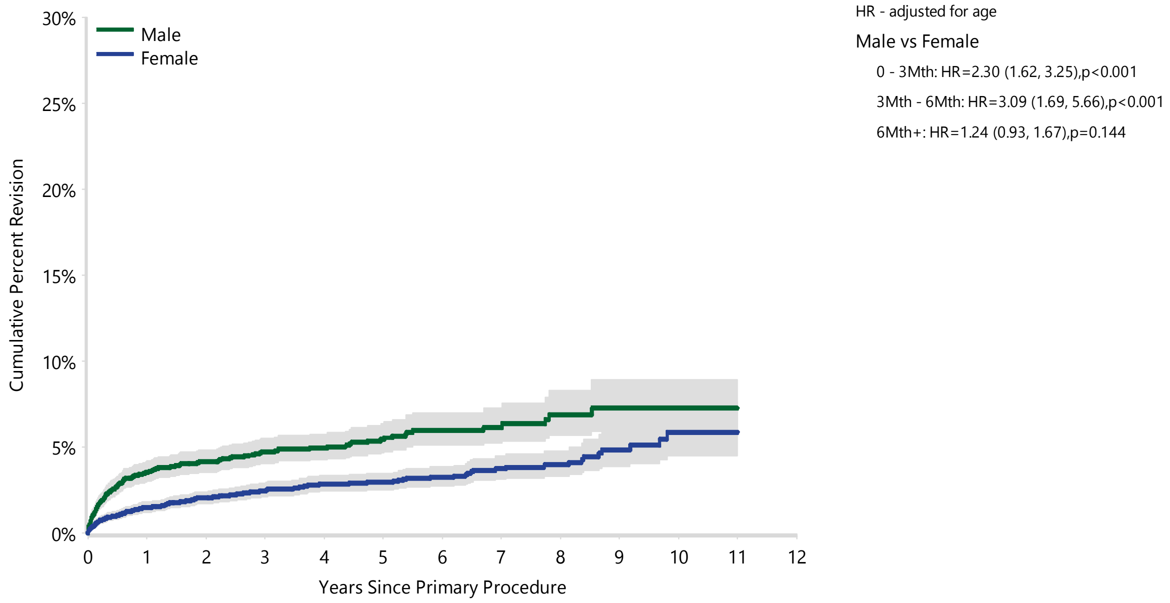
65-74 vs ≥75
Entire Period: HR=1.29 (1.03, 1.62),p=0.028

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
<55	126	94	53	33	16	6	1
55-64	976	704	386	215	116	31	2
65-74	4190	3292	1836	1008	536	128	5
≥75	5744	4593	2849	1600	804	149	8

Table ST50 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Gender (Primary Diagnosis OA)

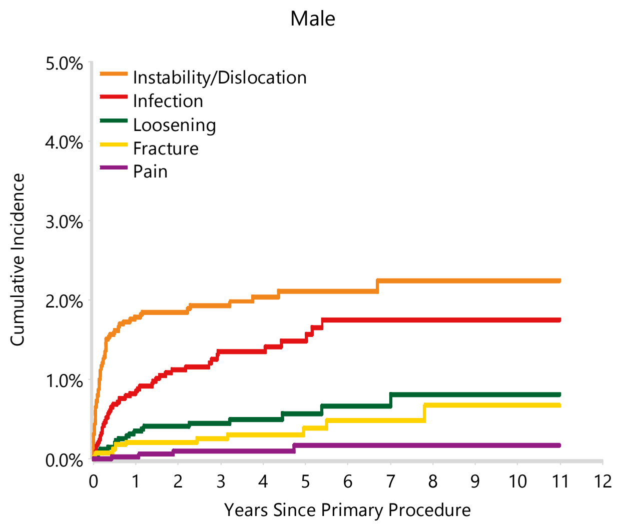
Gender	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Male	189	4128	3.6 (3.0, 4.2)	4.7 (4.1, 5.5)	5.5 (4.7, 6.4)	6.2 (5.2, 7.3)	7.3 (5.9, 8.9)	
Female	178	6908	1.5 (1.2, 1.8)	2.5 (2.1, 2.9)	3.0 (2.5, 3.5)	3.7 (3.1, 4.5)	5.9 (4.5, 7.6)	
TOTAL	**367**	**11036**						

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	12 Yrs
Male	4128	3154	1816	969	477	105	4
Female	6908	5529	3308	1887	995	209	12

Figure ST33 Cumulative Incidence Revision Diagnosis of Total Reverse Shoulder by Gender (Primary Diagnosis OA)



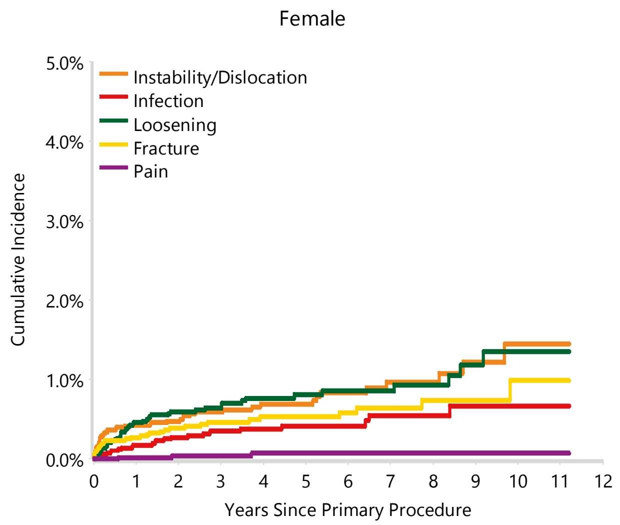
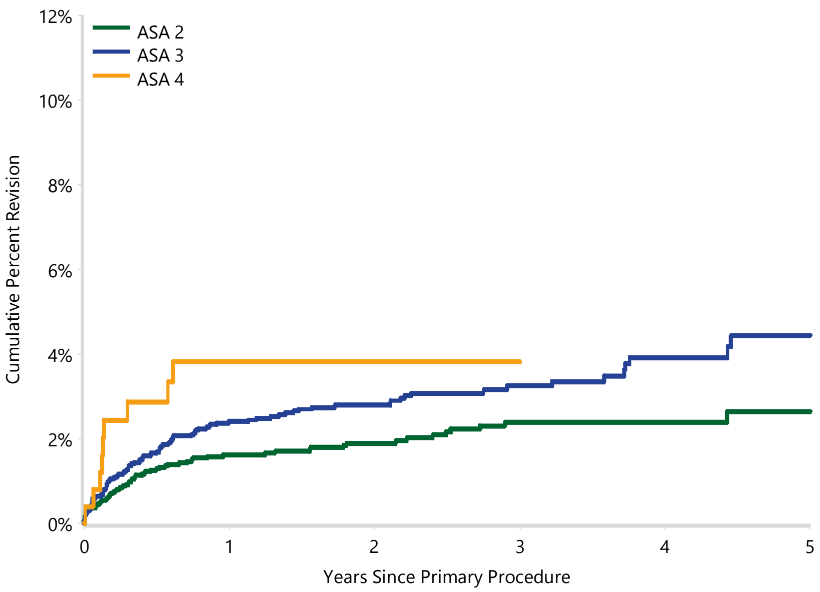


Table ST51 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by ASA Score (Primary Diagnosis OA)

ASA Score	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
ASA 1	3	250	0.8 (0.2, 3.2)	1.4 (0.4, 4.3)	1.4 (0.4, 4.3)	1.4 (0.4, 4.3)	
ASA 2	66	3470	1.6 (1.2, 2.1)	1.9 (1.5, 2.5)	2.4 (1.9, 3.1)	2.4 (1.9, 3.1)	2.6 (2.0, 3.5)
ASA 3	106	3808	2.4 (1.9, 3.0)	2.8 (2.3, 3.4)	3.2 (2.6, 4.0)	3.9 (3.1, 4.9)	4.4 (3.4, 5.7)
ASA 4	9	251	3.8 (2.0, 7.2)	3.8 (2.0, 7.2)	3.8 (2.0, 7.2)		
TOTAL	**184**	**7779**					

Figure ST34 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by ASA Score (Primary Diagnosis OA)



HR - adjusted for age and gender

ASA 3 vs ASA 2

Entire Period: HR=1.62 (1.19, 2.21),p=0.002

ASA 4 vs ASA 2

Entire Period: HR=2.11 (1.05, 4.24),p=0.036

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
ASA 2	3470	2567	1743	1086	579	196
ASA 3	3808	2663	1799	1052	551	169
ASA 4	251	178	118	66	38	15

Figure ST35 Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement by ASA Score (Primary Diagnosis OA)

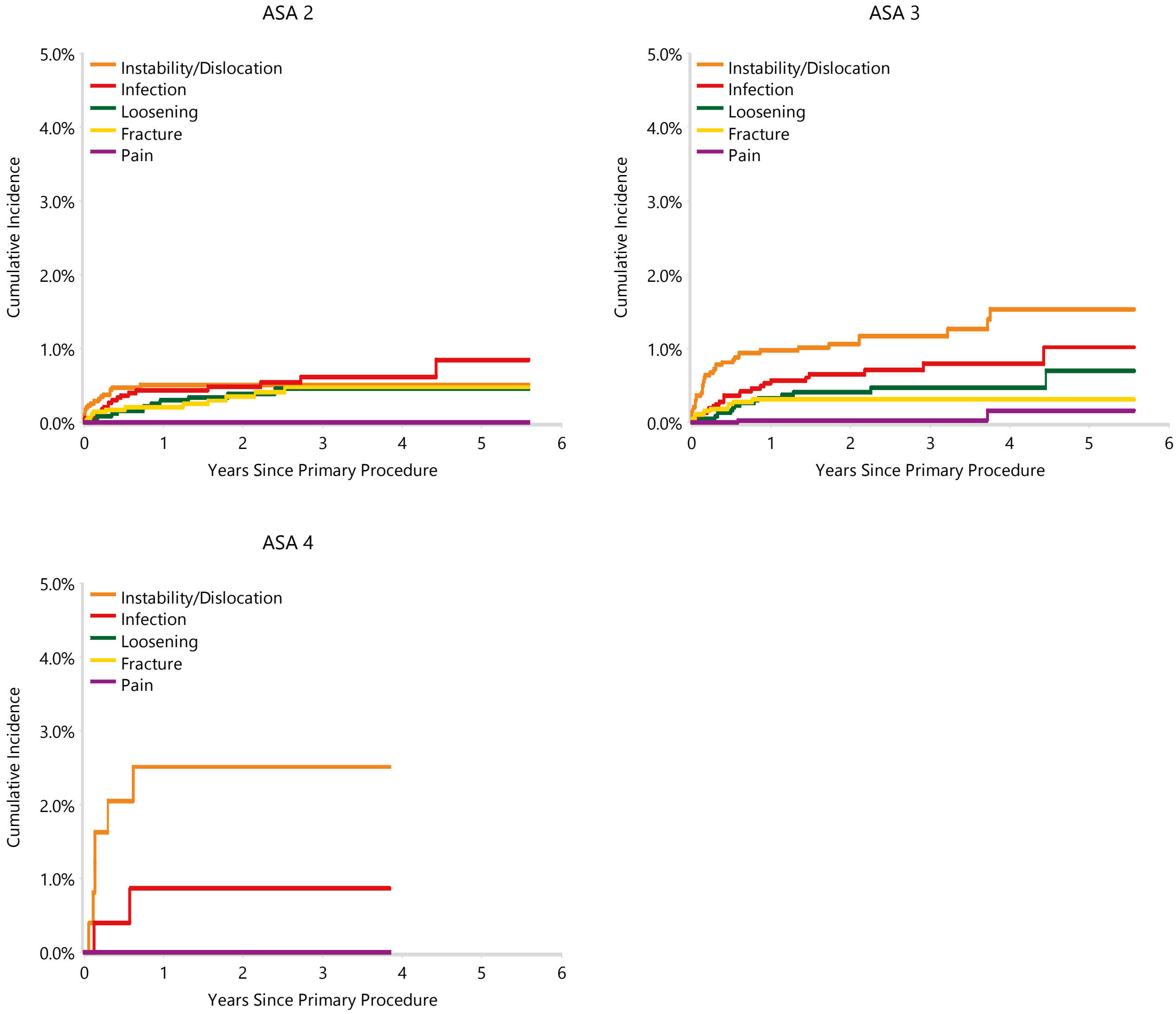
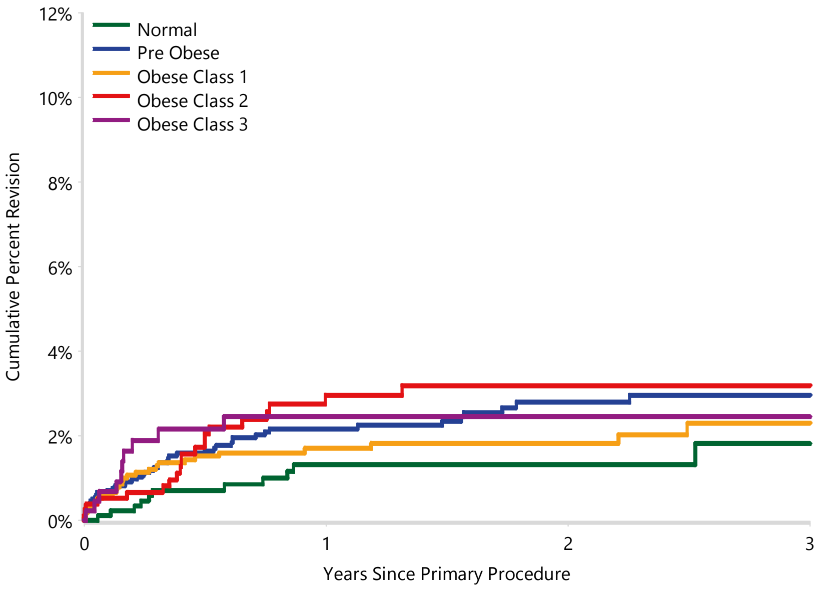


Table ST52 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by BMI Category (Primary Diagnosis OA)

BMI Category	N Revised	N Total	1 Yr	2 Yrs	3 Yrs
Underweight	3	35	6.2 (1.6, 22.6)	10.6 (3.5, 30.1)	
Normal	11	904	1.3 (0.7, 2.4)	1.3 (0.7, 2.4)	1.8 (0.9, 3.6)
Pre Obese	46	1982	2.2 (1.6, 3.0)	2.8 (2.1, 3.8)	3.0 (2.2, 4.0)
Obese Class 1	27	1538	1.7 (1.1, 2.5)	1.8 (1.2, 2.7)	2.3 (1.5, 3.5)
Obese Class 2	20	757	3.0 (1.9, 4.6)	3.2 (2.1, 4.9)	3.2 (2.1, 4.9)
Obese Class 3	10	440	2.5 (1.3, 4.5)	2.5 (1.3, 4.5)	2.5 (1.3, 4.5)
TOTAL	**117**	**5656**			

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

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=1.60 (0.83, 3.10),p=0.160

Obese Class 1 vs Normal
Entire Period: HR=1.22 (0.61, 2.48),p=0.572

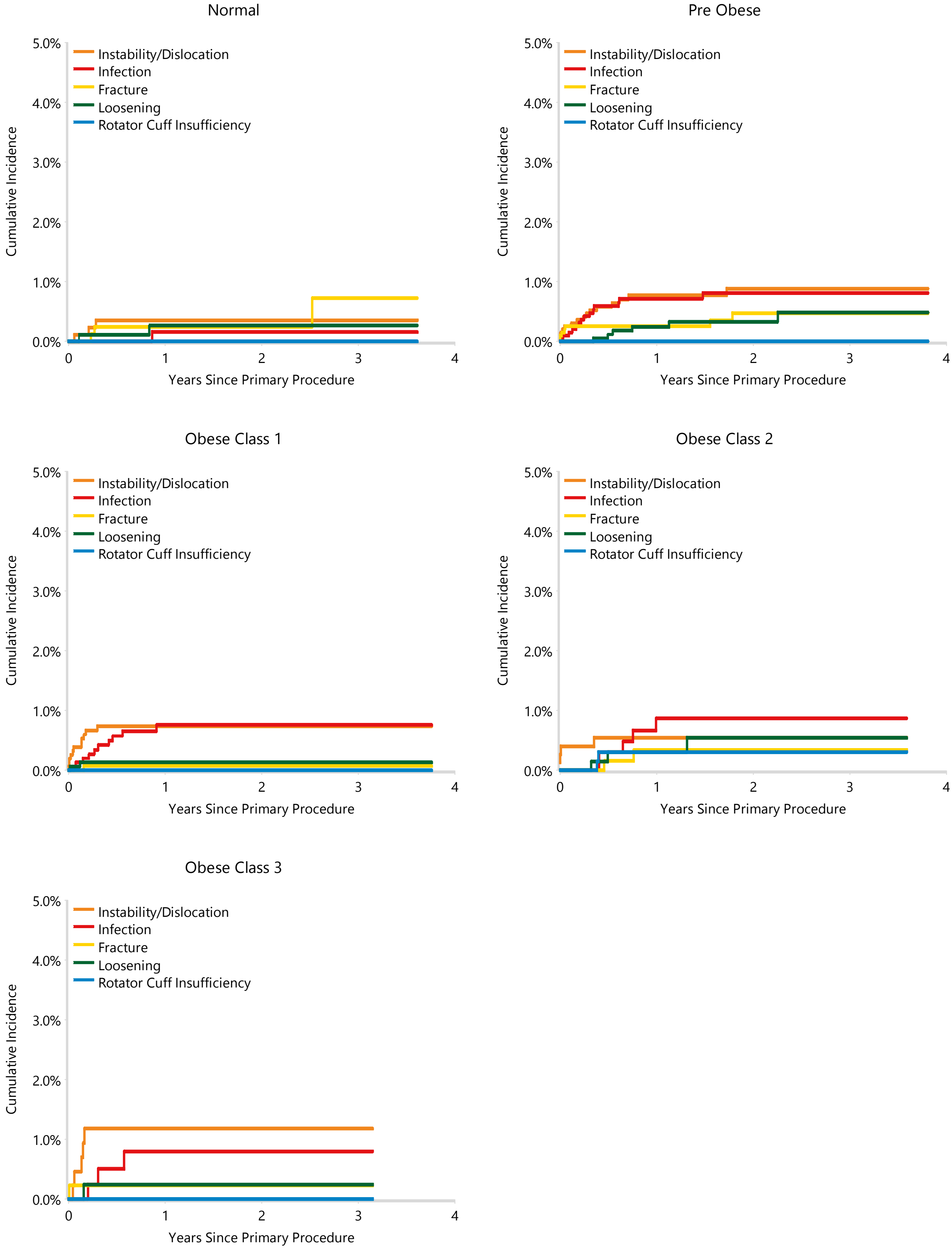
Obese Class 2 vs Normal
Entire Period: HR=1.99 (0.95, 4.17),p=0.069

Obese Class 3 vs Normal
Entire Period: HR=1.80 (0.75, 4.28),p=0.185

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs
Normal	904	605	310	119
Pre Obese	1982	1285	698	269
Obese Class 1	1538	946	544	212
Obese Class 2	757	478	258	104
Obese Class 3	440	272	148	51

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

Figure ST37 Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement by BMI Category (Primary Diagnosis OA)



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

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 ST53 and Figure ST38). This is also the case when the SMR L2 prosthesis is excluded from the analysis (Table ST54 and Figure ST39).

Glenosphere Size

Glenosphere sizes <38mm have a higher rate of revision compared to 38-40mm sizes, and sizes >40mm (Table ST55 and Figure ST40). The cumulative incidence for the most common reasons for revision is presented in Figure ST41.

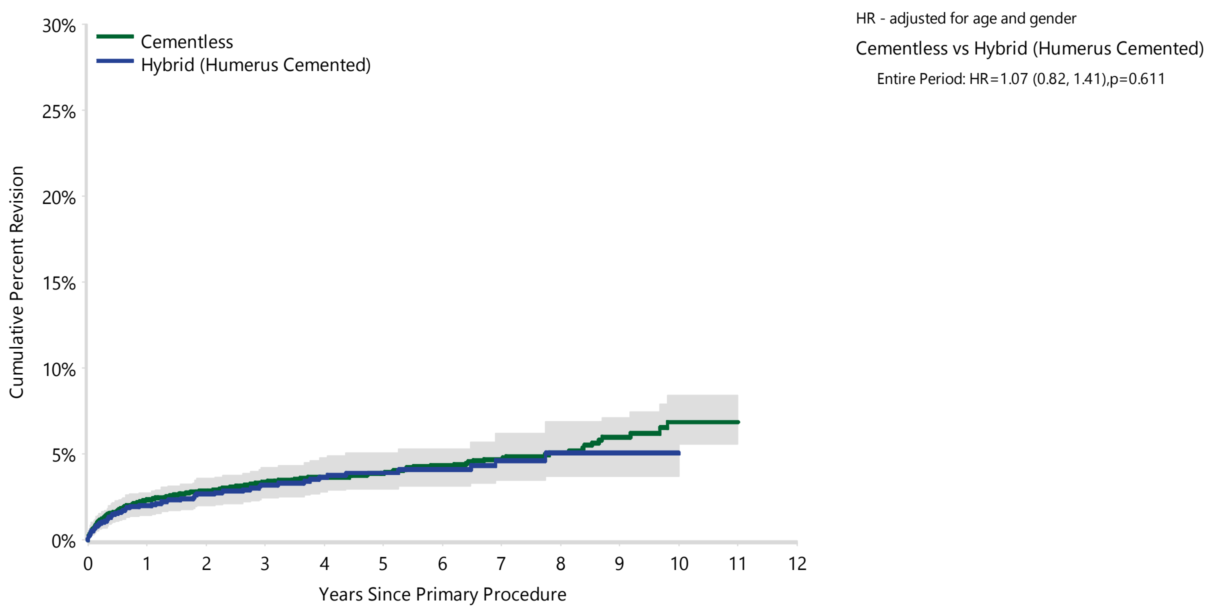
Glenosphere sizes <38mm have a higher rate of revision.

The outcomes of the most commonly used primary total reverse shoulder prostheses are listed in Table ST56. The outcomes for the most used prosthesis combinations using cementless fixation are listed in Table ST57. The most commonly used prosthesis combinations using hybrid (humerus cemented) fixation are listed in Table ST58.

Table ST53 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	12 Yrs
Cemented	1	90	1.2 (0.2, 8.2)	1.2 (0.2, 8.2)	1.2 (0.2, 8.2)	1.2 (0.2, 8.2)	1.2 (0.2, 8.2)	
Cementless	302	9039	2.3 (2.0, 2.7)	3.3 (2.9, 3.8)	3.9 (3.4, 4.4)	4.7 (4.1, 5.4)	6.9 (5.6, 8.4)	
Hybrid (Glenoid Cemented)	3	69	2.9 (0.7, 11.3)	4.6 (1.5, 13.6)	4.6 (1.5, 13.6)			
Hybrid (Humerus Cemented)	61	1838	2.0 (1.4, 2.8)	3.2 (2.4, 4.2)	3.9 (3.0, 5.1)	4.6 (3.5, 6.2)	5.1 (3.7, 6.9)	
TOTAL	**367**	**11036**						

Figure ST38 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Fixation (Primary Diagnosis OA)



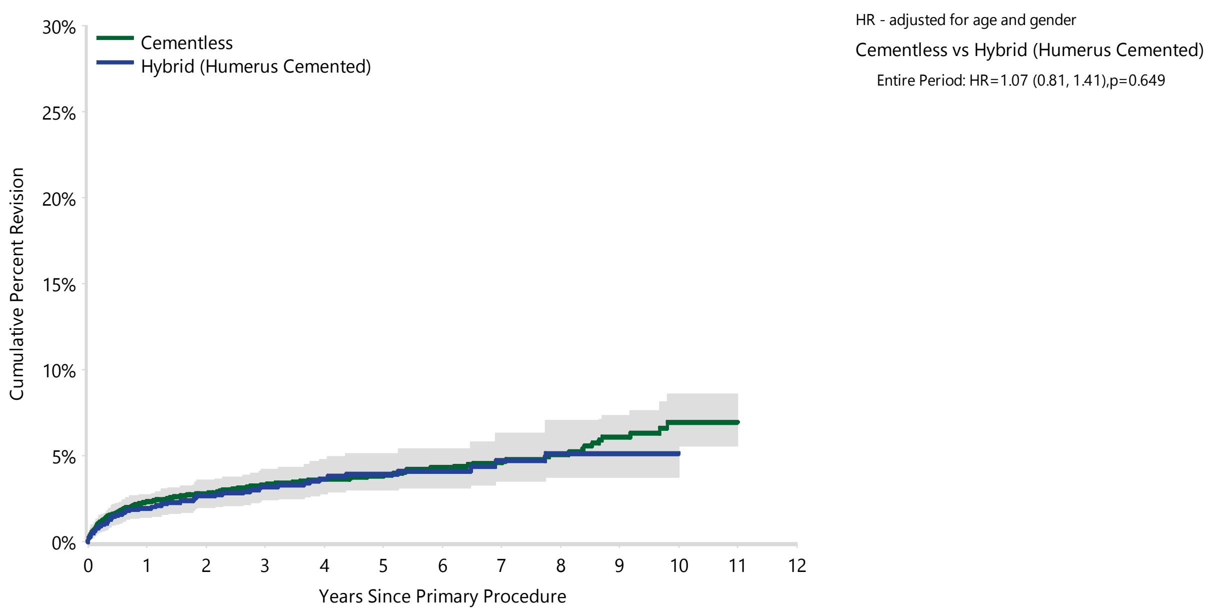
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Cementless	9039	6994	4026	2212	1135	239	16
Hybrid (Humerus Cemented)	1838	1550	1020	591	303	64	0

Note: Only fixations with over 100 procedures have been listed

Table ST54 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	12 Yrs
Cemented	1	90	1.2 (0.2, 8.2)	1.2 (0.2, 8.2)	1.2 (0.2, 8.2)	1.2 (0.2, 8.2)	1.2 (0.2, 8.2)	
Cementless	280	8588	2.3 (2.0, 2.7)	3.3 (2.9, 3.8)	3.8 (3.4, 4.4)	4.6 (4.0, 5.3)	6.9 (5.6, 8.6)	
Hybrid (Glenoid Cemented)	3	67	3.0 (0.8, 11.6)	4.7 (1.5, 14.0)				
Hybrid (Humerus Cemented)	60	1809	2.0 (1.4, 2.7)	3.2 (2.4, 4.2)	3.9 (3.0, 5.1)	4.7 (3.5, 6.3)	5.1 (3.8, 7.0)	
TOTAL	**344**	**10554**						

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	12 Yrs
Cementless	8588	6562	3620	1844	876	239	16
Hybrid (Humerus Cemented)	1809	1523	994	567	287	64	0

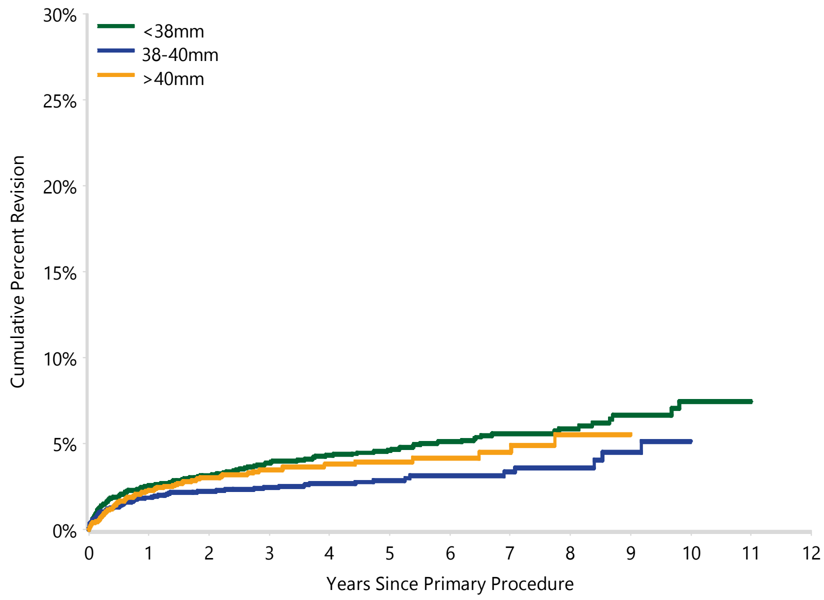
Note: Only fixations with over 100 procedures have been listed

Table ST55 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	12 Yrs
<38mm	185	4394	2.5 (2.1, 3.1)	3.9 (3.3, 4.5)	4.6 (3.9, 5.4)	5.6 (4.7, 6.6)	7.4 (6.0, 9.3)	
38-40mm	99	4055	1.9 (1.5, 2.3)	2.5 (2.0, 3.1)	2.9 (2.3, 3.6)	3.4 (2.6, 4.3)	5.2 (3.5, 7.6)	
>40mm	79	2521	2.3 (1.8, 3.0)	3.5 (2.7, 4.4)	3.9 (3.1, 5.0)	4.5 (3.4, 5.9)		
TOTAL	**363**	**10970**						

Note: Excludes 66 procedures with unknown glenoshere size

Figure ST40 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Glenosphere Size (Primary Diagnosis OA)



HR - adjusted for age and gender

<38mm vs 38-40mm

Entire Period: HR=1.52 (1.19, 1.94),p<0.001

<38mm vs >40mm

Entire Period: HR=1.62 (1.23, 2.14),p<0.001

>40mm vs 38-40mm

0 - 3Mth: HR=0.66 (0.41, 1.07),p=0.089

3Mth+: HR=1.12 (0.79, 1.60),p=0.530

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
<38mm	4394	3630	2373	1452	846	193	15
38-40mm	4055	3138	1706	856	405	82	0
>40mm	2521	1906	1041	547	220	39	1

Figure ST41 Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement by Glenosphere Size (Primary Diagnosis OA)

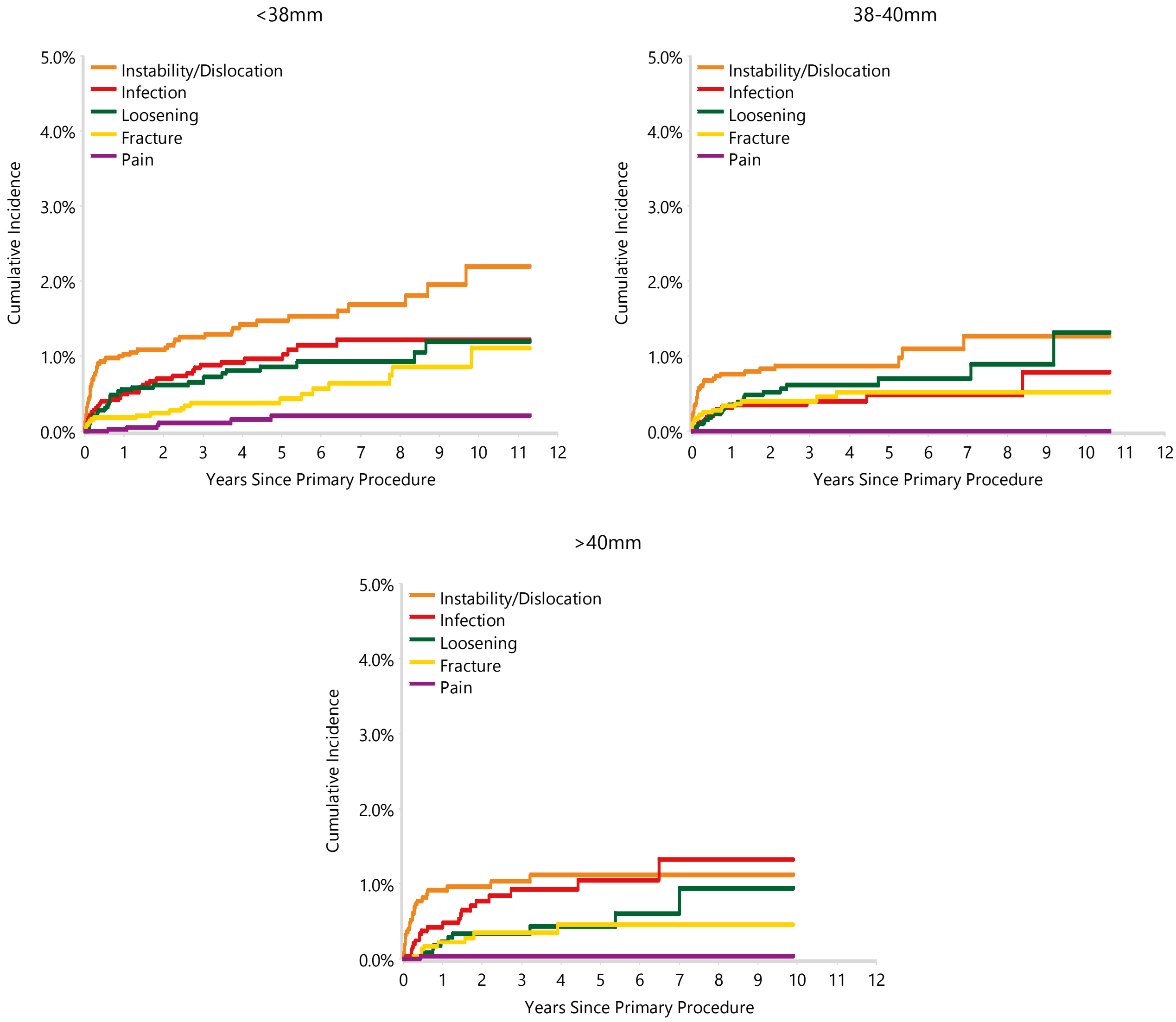


Table ST56 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Prosthesis Combination (Primary Diagnosis OA)

Humeral Stem	Glenoid Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Aequalis	Aequalis	56	1189	2.2 (1.5, 3.3)	3.9 (2.9, 5.3)	4.8 (3.6, 6.4)	6.3 (4.7, 8.4)		
Affinis	Affinis	8	307	1.9 (0.8, 4.5)					
Ascend Flex	Aequalis	7	337	2.2 (1.0, 4.8)	3.1 (1.4, 6.9)				
Comprehensive	Comprehensive Reverse	12	584	1.7 (0.9, 3.2)	2.7 (1.4, 5.2)				
Delta CTA	Delta CTA	9	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	95	3406	2.0 (1.5, 2.5)	2.6 (2.1, 3.2)	3.0 (2.4, 3.7)	3.6 (2.8, 4.6)	5.1 (3.7, 7.0)	
Equinoxe	Equinoxe	16	634	2.4 (1.4, 4.2)	3.2 (1.9, 5.4)				
Global Unite	Delta Xtend	5	160	0.7 (0.1, 4.8)	4.1 (1.7, 9.7)				
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)		
RSP	RSP	18	544	2.9 (1.7, 4.8)	4.4 (2.6, 7.4)				
SMR	SMR L1	89	2563	2.7 (2.1, 3.4)	3.5 (2.8, 4.3)	3.8 (3.0, 4.8)	4.4 (3.3, 5.7)	6.2 (4.4, 8.8)	
SMR	SMR L2	23	482	2.3 (1.3, 4.1)	3.6 (2.2, 5.7)	4.3 (2.8, 6.6)	5.1 (3.4, 7.6)		
Trabecular Metal	Comprehensive Reverse	0	27	0.0 (0.0, 0.0)					
Trabecular Metal	Trabecular Metal	21	546	2.1 (1.2, 3.7)	3.5 (2.2, 5.7)	4.7 (3.0, 7.3)	4.7 (3.0, 7.3)		
Other (25)		5	153	3.2 (1.2, 8.5)	4.6 (1.9, 11.0)				
TOTAL		**367**	**11036**						

Note: Only combinations with over 25 procedures have been listed

Table ST57 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	12 Yrs
Aequalis	Aequalis	48	923	2.3 (1.5, 3.6)	4.4 (3.1, 6.1)	5.1 (3.7, 7.0)	7.2 (5.2, 9.8)		
Affinis	Affinis	6	193	1.8 (0.6, 5.5)					
Ascend Flex	Aequalis	6	309	2.0 (0.8, 5.0)	3.1 (1.3, 7.5)				
Comprehensive	Comprehensive Reverse	12	556	1.7 (0.9, 3.3)	2.8 (1.5, 5.5)				
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)	11.7 (4.6, 28.3)
Delta Xtend	Delta Xtend	72	2380	2.3 (1.8, 3.1)	2.9 (2.3, 3.7)	3.4 (2.6, 4.3)	3.7 (2.8, 4.8)	5.9 (3.9, 8.8)	
Equinoxe	Equinoxe	14	599	2.2 (1.2, 3.9)	3.0 (1.7, 5.3)				
Global Unite	Delta Xtend	3	144	0.8 (0.1, 5.3)	2.6 (0.8, 7.8)				
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)		
RSP	RSP	6	267	2.4 (1.1, 5.4)					
SMR	SMR L1	84	2493	2.7 (2.1, 3.4)	3.3 (2.6, 4.2)	3.7 (2.9, 4.7)	4.3 (3.2, 5.7)	6.2 (4.3, 8.9)	
SMR	SMR L2	22	451	2.2 (1.2, 4.1)	3.6 (2.2, 5.8)	4.4 (2.8, 6.7)	5.2 (3.5, 7.8)		
Trabecular Metal	Comprehensive Reverse	0	27	0.0 (0.0, 0.0)					
Trabecular Metal	Trabecular Metal	17	490	2.1 (1.1, 3.9)	3.2 (1.9, 5.3)	4.0 (2.4, 6.6)	4.0 (2.4, 6.6)		
Other (21)		3	134	1.8 (0.5, 7.3)					
TOTAL		**302**	**9039**						

Note: Only combinations with over 25 procedures have been listed

Table ST58 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	12 Yrs
Aequalis	Aequalis	8	245	2.1 (0.9, 5.0)	2.7 (1.2, 5.9)	4.0 (2.0, 8.0)	4.0 (2.0, 8.0)		
Affinis	Affinis	2	103	2.2 (0.6, 8.6)					
Ascend Flex	Aequalis	1	26	3.8 (0.6, 24.3)	3.8 (0.6, 24.3)				
Comprehensive	Comprehensive Reverse	0	25	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)				
Delta CTA	Delta CTA	3	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	23	973	1.2 (0.6, 2.1)	1.9 (1.2, 3.1)	2.3 (1.5, 3.6)	3.5 (2.1, 5.6)		
Equinoxe	Equinoxe	2	34	6.4 (1.6, 23.2)	6.4 (1.6, 23.2)				
RSP	RSP	8	236	2.2 (0.9, 5.3)	3.8 (1.8, 8.1)				
SMR	SMR L1	5	56	5.6 (1.8, 16.4)	10.1 (4.3, 22.6)	10.1 (4.3, 22.6)	10.1 (4.3, 22.6)		
SMR	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	48	2.1 (0.3, 13.9)	7.8 (2.5, 22.8)	12.4 (4.6, 31.3)	12.4 (4.6, 31.3)		
Other (12)		4	34	6.5 (1.7, 23.9)	15.6 (6.0, 37.1)				
TOTAL		**61**	**1838**						

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 ST59 and Figure ST42).

Males have a higher rate of revision compared to females (Table ST60 and Figure ST43). The increase in the rate of revision is due to a higher cumulative incidence of instability/dislocation (1.6% at 10 years for males compared to 1.0% for females) and infection (2.1% compared to 0.7%) (Figure ST44).

ASA AND BMI

The Registry is now reporting on the early outcome of 6,553 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 ASA scores 2, 3 and 4 are compared to ASA score 1 (Table ST61 and Figure ST45). The most common reasons for revision can be found in Figure ST46.

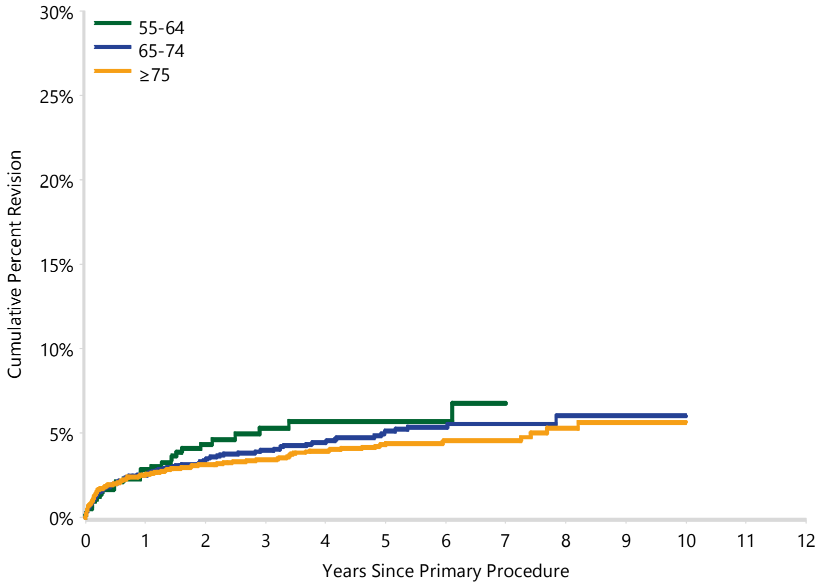
BMI data has been collected since 2015. The early revision outcomes are reported for 4,881 primary total reverse shoulder replacement procedures for rotator cuff arthropathy. There is no difference in the rate of revision when BMI categories of pre-obese, and obese classes 1, 2 and 3 are compared to the normal BMI class (Table ST62 and Figure ST47). The most common reasons for revision are shown in Figure ST48. The rate of instability/dislocation increases with increasing BMI class.

The rate of instability/dislocation increases with increasing BMI class.

Table ST59 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	12 Yrs
<55	3	70	2.9 (0.7, 11.0)	2.9 (0.7, 11.0)	2.9 (0.7, 11.0)			
55-64	32	737	2.8 (1.8, 4.4)	5.3 (3.6, 7.7)	5.7 (3.9, 8.3)	6.8 (4.4, 10.4)		
65-74	126	3328	2.5 (2.0, 3.1)	4.0 (3.3, 4.8)	5.1 (4.2, 6.2)	5.6 (4.5, 6.8)	6.0 (4.7, 7.6)	
≥75	159	4602	2.6 (2.1, 3.1)	3.4 (2.9, 4.0)	4.3 (3.7, 5.1)	4.5 (3.8, 5.4)	5.7 (4.4, 7.2)	
TOTAL	**320**	**8737**						

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=1.19 (0.81, 1.75),p=0.364

55-64 vs 65-74

Entire Period: HR=1.14 (0.77, 1.67),p=0.522

65-74 vs ≥75

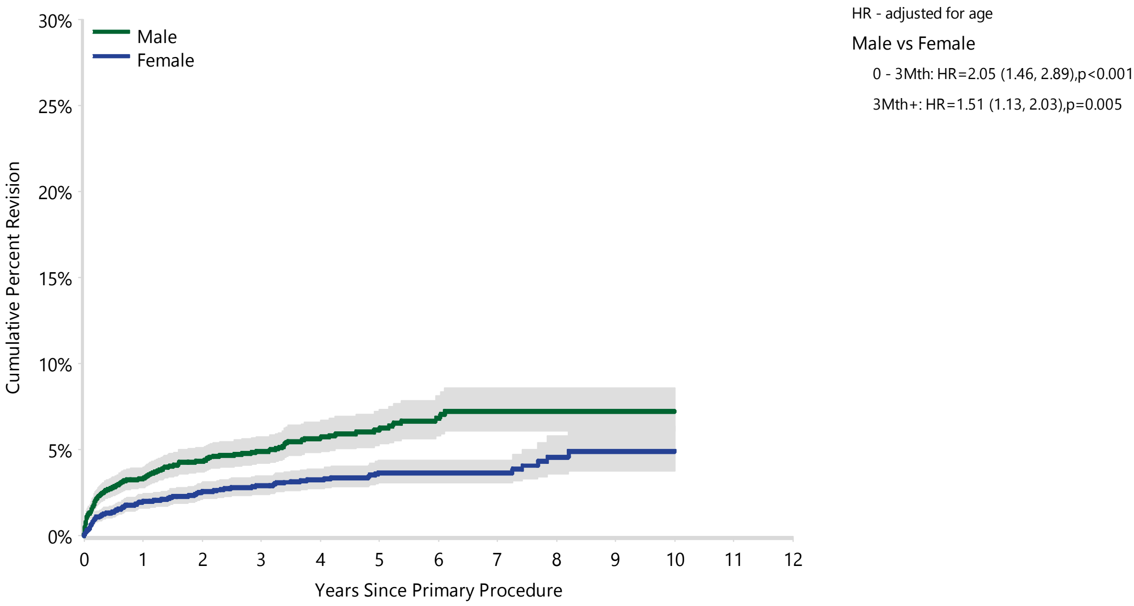
Entire Period: HR=1.05 (0.83, 1.33),p=0.675

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
55-64	737	531	255	134	59	10	0
65-74	3328	2516	1388	761	327	48	6
≥75	4602	3545	2127	1131	496	62	7

Table ST60 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	12 Yrs
Male	179	3787	3.3 (2.8, 4.0)	4.9 (4.2, 5.8)	6.1 (5.2, 7.2)	7.2 (6.1, 8.6)	7.2 (6.1, 8.6)	
Female	141	4950	2.0 (1.6, 2.4)	2.9 (2.4, 3.5)	3.7 (3.1, 4.4)	3.7 (3.1, 4.4)	4.9 (3.8, 6.4)	
TOTAL	**320**	**8737**						

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	12 Yrs
Male	3787	2774	1500	761	312	47	6
Female	4950	3864	2293	1277	575	75	7

Figure ST44 Cumulative Incidence Revision Diagnosis of Total Reverse Shoulder Replacement by Gender (Primary Diagnosis Rotator Cuff Arthropathy)

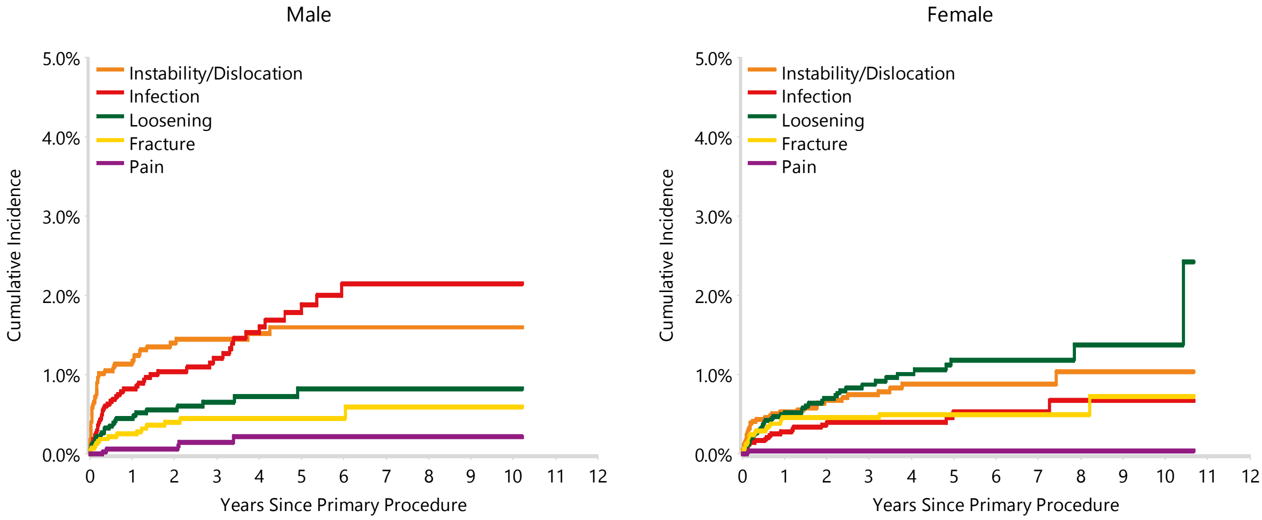
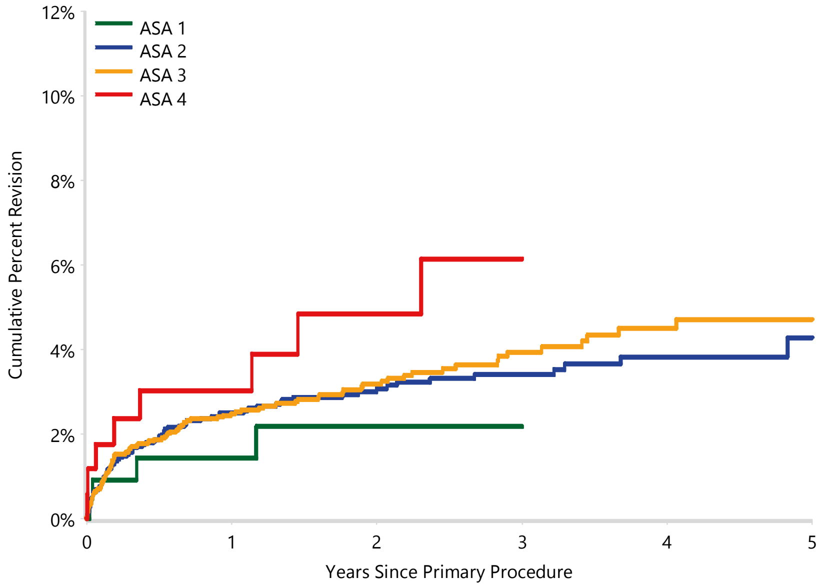


Table ST61 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by ASA Score (Primary Diagnosis Rotator Cuff Arthropathy)

ASA Score	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
ASA 1	5	218	1.4 (0.5, 4.4)	2.2 (0.8, 5.8)	2.2 (0.8, 5.8)		
ASA 2	85	2893	2.5 (2.0, 3.2)	3.1 (2.5, 3.9)	3.4 (2.7, 4.3)	3.8 (3.0, 4.8)	4.3 (3.2, 5.7)
ASA 3	102	3271	2.5 (2.0, 3.1)	3.2 (2.6, 3.9)	3.9 (3.2, 4.9)	4.5 (3.6, 5.6)	4.7 (3.7, 5.9)
ASA 4	8	170	3.0 (1.3, 7.1)	4.8 (2.3, 10.0)	6.1 (3.0, 12.3)		
ASA 5	0	1					
TOTAL	**200**	**6553**					

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=1.38 (0.56, 3.42),p=0.481

ASA 3 vs ASA 1

Entire Period: HR=1.54 (0.62, 3.79),p=0.351

ASA 4 vs ASA 1

Entire Period: HR=2.26 (0.74, 6.97),p=0.153

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
ASA 1	218	148	93	67	38	17
ASA 2	2893	2034	1363	883	454	176
ASA 3	3271	2257	1463	869	467	171
ASA 4	170	113	81	50	30	10

Figure ST46 Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement by ASA Score (Primary Diagnosis Rotator Cuff Arthropathy)

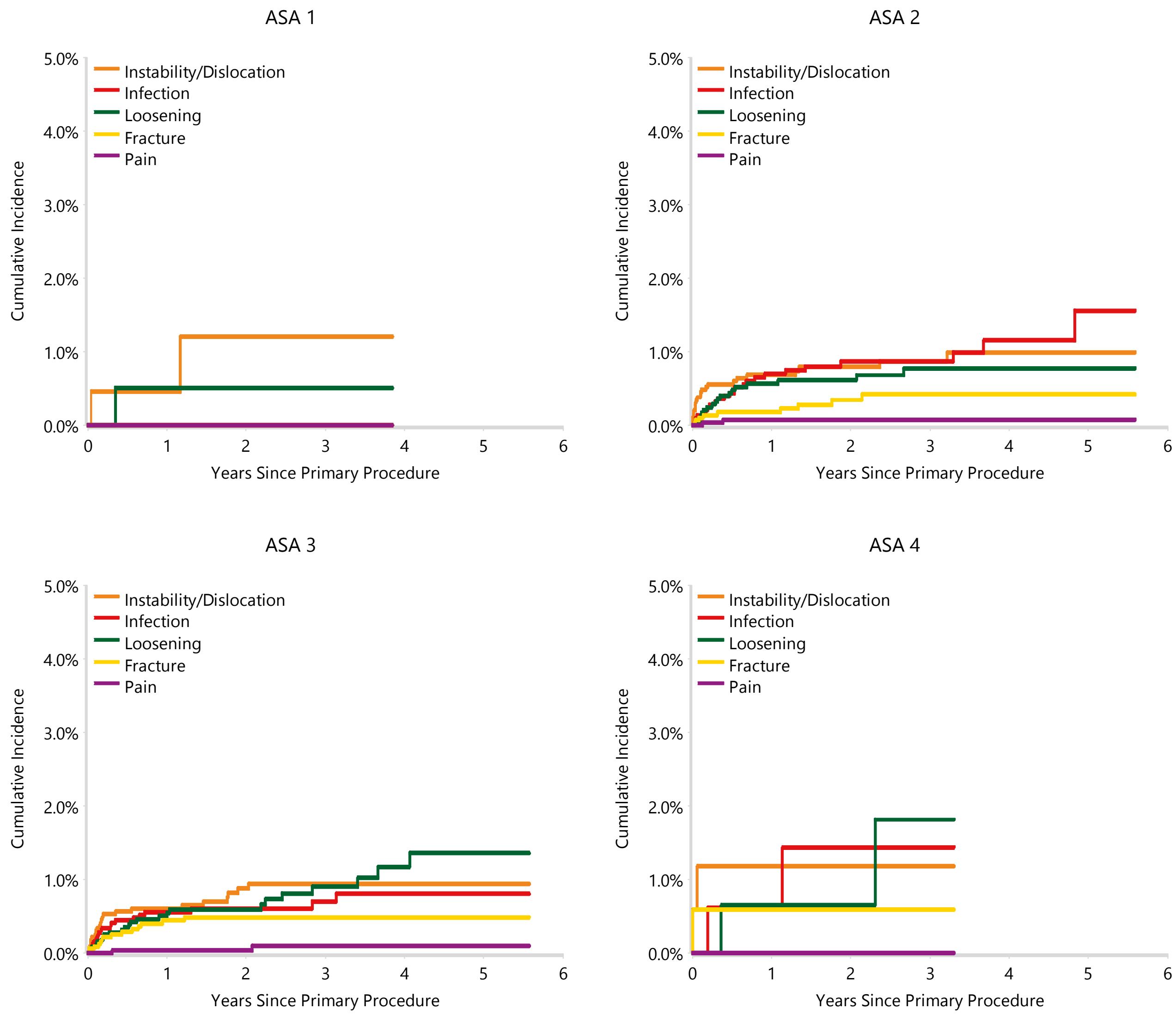
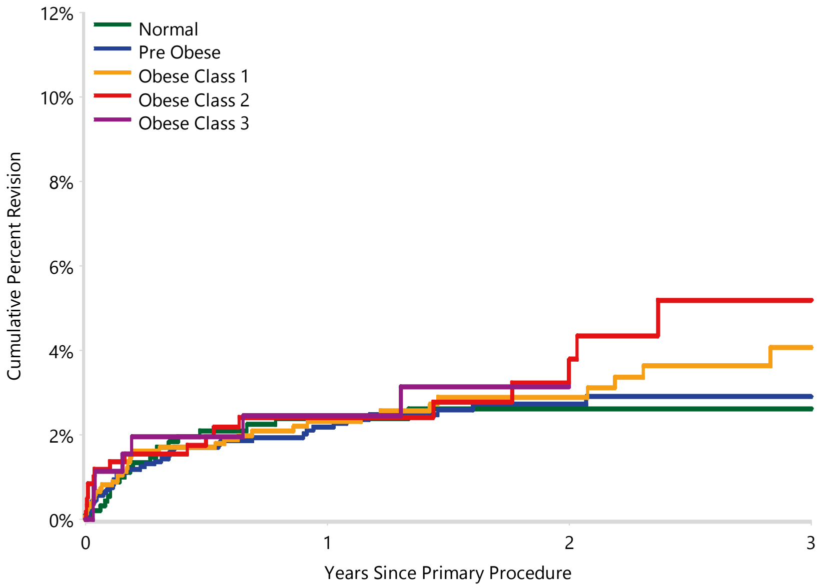


Table ST62 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by BMI Category (Primary Diagnosis Rotator Cuff Arthropathy)

BMI Category	N Revised	N Total	1 Yr	2 Yrs	3 Yrs
Underweight	1	43	2.6 (0.4, 16.8)	2.6 (0.4, 16.8)	
Normal	21	919	2.4 (1.5, 3.7)	2.6 (1.7, 4.0)	2.6 (1.7, 4.0)
Pre Obese	40	1722	2.2 (1.6, 3.1)	2.7 (2.0, 3.7)	2.9 (2.1, 4.0)
Obese Class 1	37	1346	2.3 (1.6, 3.4)	2.9 (2.0, 4.1)	4.1 (2.8, 6.0)
Obese Class 2	18	585	2.4 (1.4, 4.1)	3.8 (2.2, 6.4)	5.2 (3.0, 8.9)
Obese Class 3	8	266	2.5 (1.1, 5.4)	3.1 (1.5, 6.6)	
TOTAL	**125**	**4881**			

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

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=0.92 (0.54, 1.57),p=0.767

Obese Class 1 vs Normal
Entire Period: HR=1.11 (0.64, 1.90),p=0.715

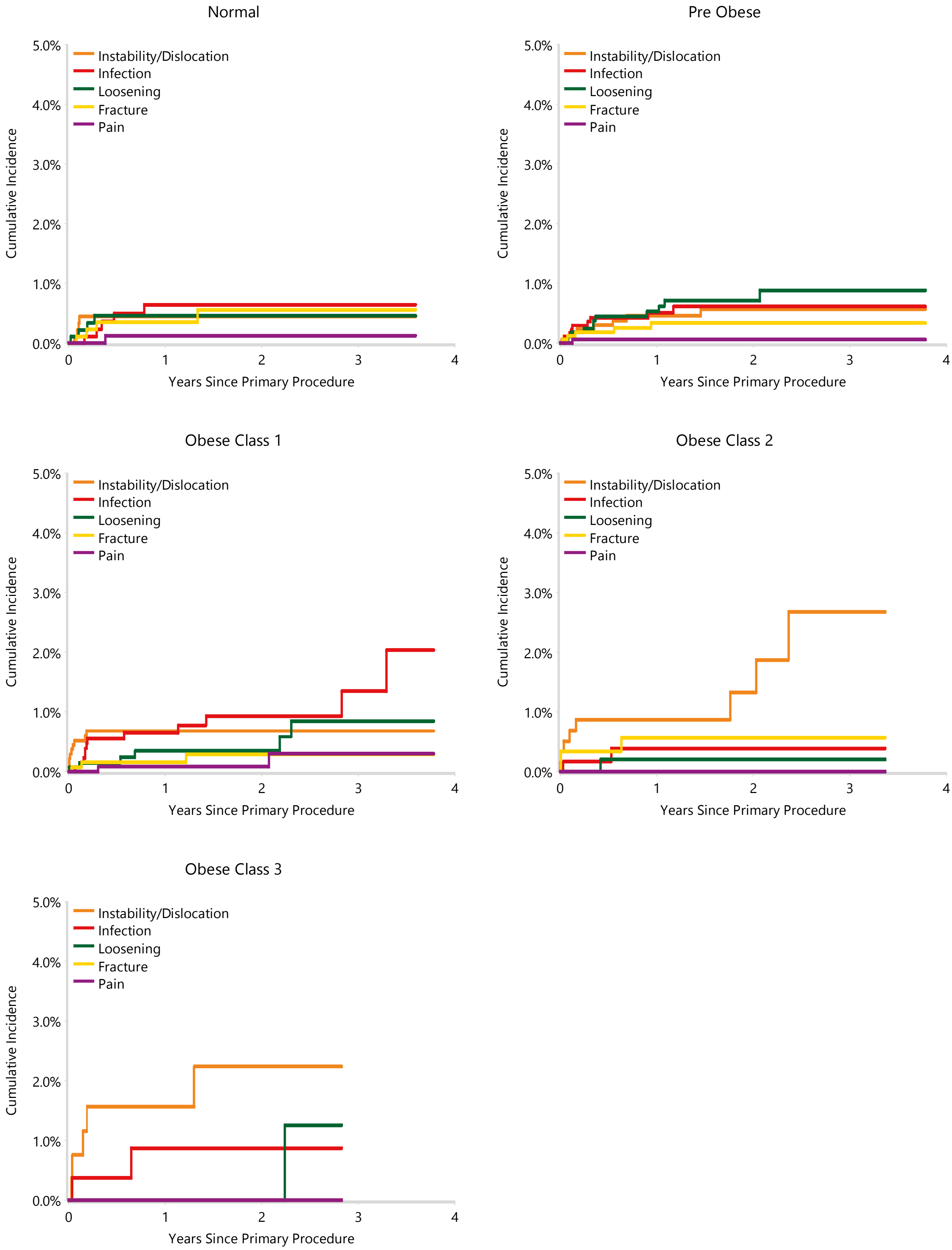
Obese Class 2 vs Normal
Entire Period: HR=1.31 (0.69, 2.48),p=0.410

Obese Class 3 vs Normal
Entire Period: HR=1.35 (0.59, 3.10),p=0.473

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs
Normal	919	559	302	116
Pre Obese	1722	1094	553	238
Obese Class 1	1346	821	446	183
Obese Class 2	585	356	176	56
Obese Class 3	266	163	90	37

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

Figure ST48 Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement by BMI Category (Primary Diagnosis Rotator Cuff Arthropathy)



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

OUTCOME FOR ROTATOR CUFF ARTHROPATHY – PROSTHESIS CHARACTERISTICS

Fixation

Fixation is not a risk factor for revision (Table ST63 and Figure ST49). This is also the case when the SMR L2 total reverse shoulder prosthesis is excluded from the analysis (Table ST64 and Figure ST50).

Glenosphere Size

Glenosphere sizes <38mm have a higher rate of revision compared to sizes >40mm for rotator cuff arthropathy (Table ST65 and Figure ST51).

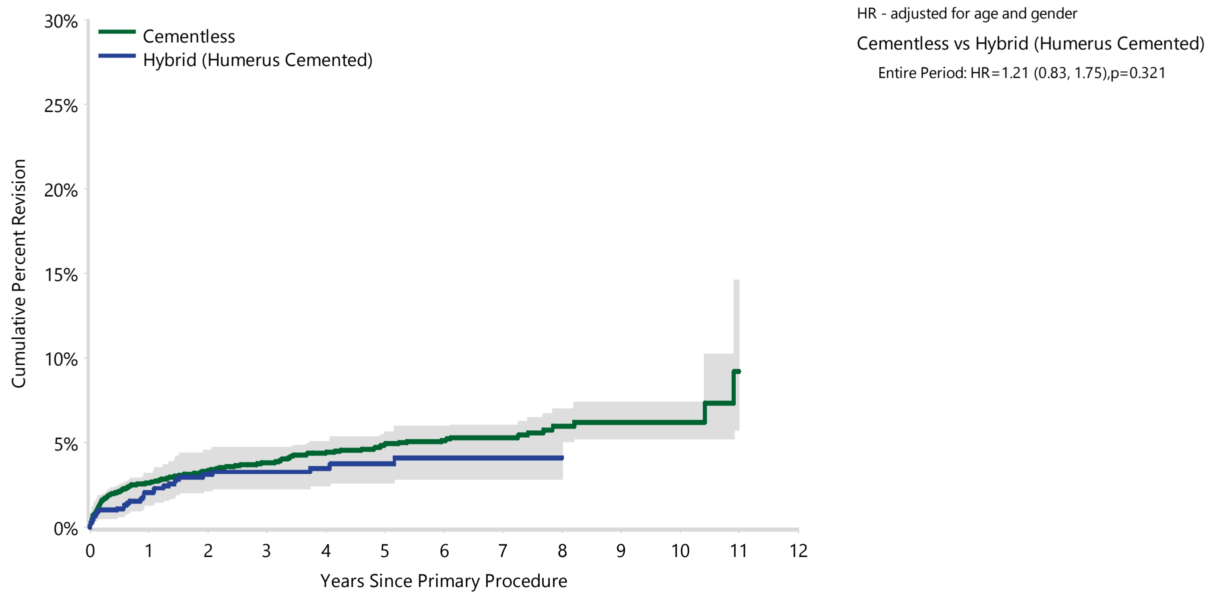
The cumulative incidence for the most common reasons for revision are shown in Figure ST52.

The outcomes of the most commonly used prosthesis combinations are listed in Table ST66. The most commonly used prosthesis combinations using cementless fixation for rotator cuff arthropathy are listed in Table ST67. The most commonly used prosthesis combinations using hybrid (humerus cemented) fixation for rotator cuff arthropathy are listed in Table ST68.

Table ST63 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	12 Yrs
Cemented	0	15	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)		
Cementless	287	7652	2.6 (2.3, 3.0)	3.8 (3.4, 4.3)	4.9 (4.3, 5.5)	5.3 (4.6, 6.1)	6.2 (5.2, 7.4)	
Hybrid (Glenoid Cemented)	2	68	3.0 (0.8, 11.4)	3.0 (0.8, 11.4)				
Hybrid (Humerus Cemented)	31	1002	2.1 (1.3, 3.2)	3.3 (2.3, 4.7)	3.7 (2.6, 5.4)	4.1 (2.8, 6.0)		
TOTAL	**320**	**8737**						

Figure ST49 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Fixation (Primary Diagnosis Rotator Cuff Arthropathy)



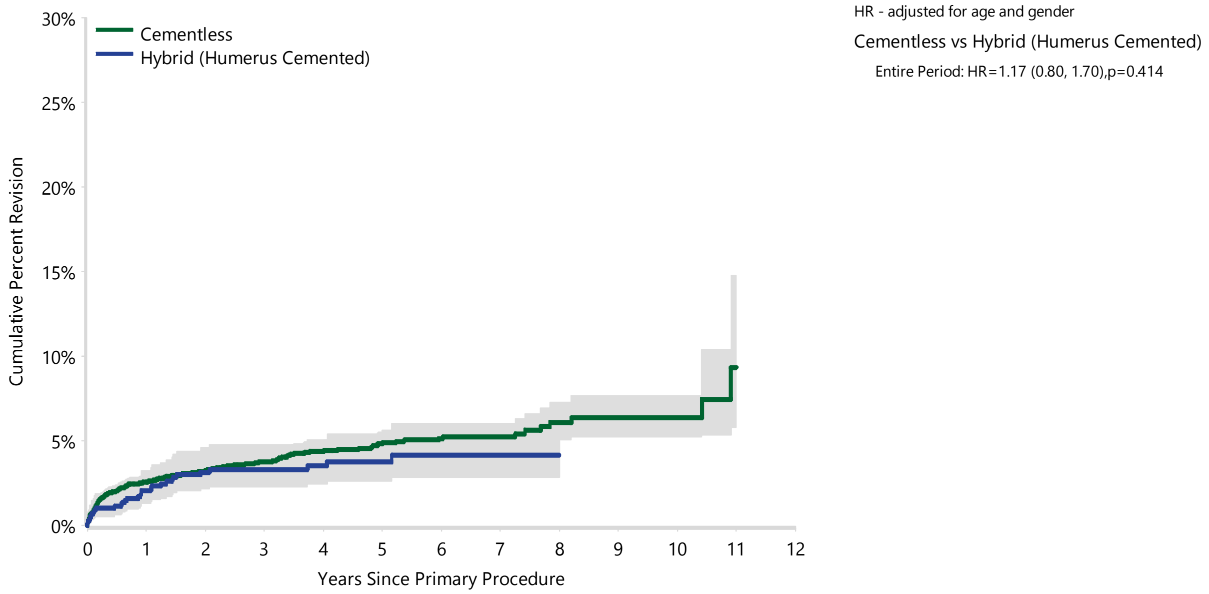
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Cementless	7652	5785	3242	1743	781	112	12
Hybrid (Humerus Cemented)	1002	789	522	279	101	8	1

Note: Only fixations with over 100 procedures have been listed

Table ST64 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	12 Yrs
Cemented	0	15	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)		
Cementless	264	7279	2.6 (2.2, 3.0)	3.8 (3.3, 4.3)	4.8 (4.2, 5.5)	5.3 (4.5, 6.1)	6.3 (5.2, 7.7)	
Hybrid (Glenoid Cemented)	2	68	3.0 (0.8, 11.4)	3.0 (0.8, 11.4)				
Hybrid (Humerus Cemented)	31	994	2.1 (1.3, 3.2)	3.3 (2.3, 4.8)	3.8 (2.6, 5.4)	4.2 (2.9, 6.0)		
TOTAL	**297**	**8356**						

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	12 Yrs
Cementless	7279	5432	2912	1446	587	112	12
Hybrid (Humerus Cemented)	994	781	515	273	97	8	1

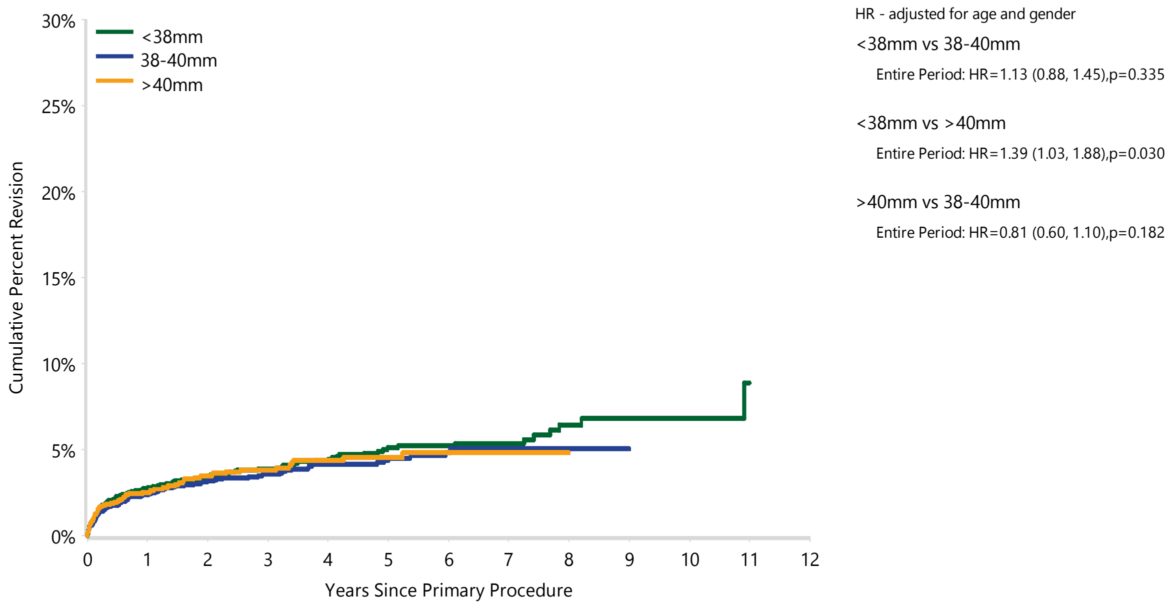
Note: Only fixations with over 100 procedures have been listed

Table ST65 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	12 Yrs
<38mm	131	3213	2.8 (2.3, 3.4)	3.9 (3.2, 4.7)	5.1 (4.2, 6.2)	5.4 (4.4, 6.5)	6.8 (5.4, 8.6)	
38-40mm	116	3370	2.4 (1.9, 3.0)	3.6 (3.0, 4.4)	4.4 (3.6, 5.4)	5.1 (4.1, 6.3)		
>40mm	73	2108	2.5 (1.9, 3.3)	3.8 (3.0, 4.9)	4.5 (3.6, 5.8)	4.8 (3.7, 6.2)		
TOTAL	**320**	**8691**						

Note: Excludes 46 procedures with unknown glenosphere size

Figure ST51 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Glenosphere Size (Primary Diagnosis Rotator Cuff Arthropathy)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
<38mm	3213	2500	1531	912	469	87	13
38-40mm	3370	2588	1454	738	300	28	0
>40mm	2108	1543	803	384	114	6	0

Figure ST52 Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement by Glenosphere Size (Primary Diagnosis Rotator Cuff Arthropathy)

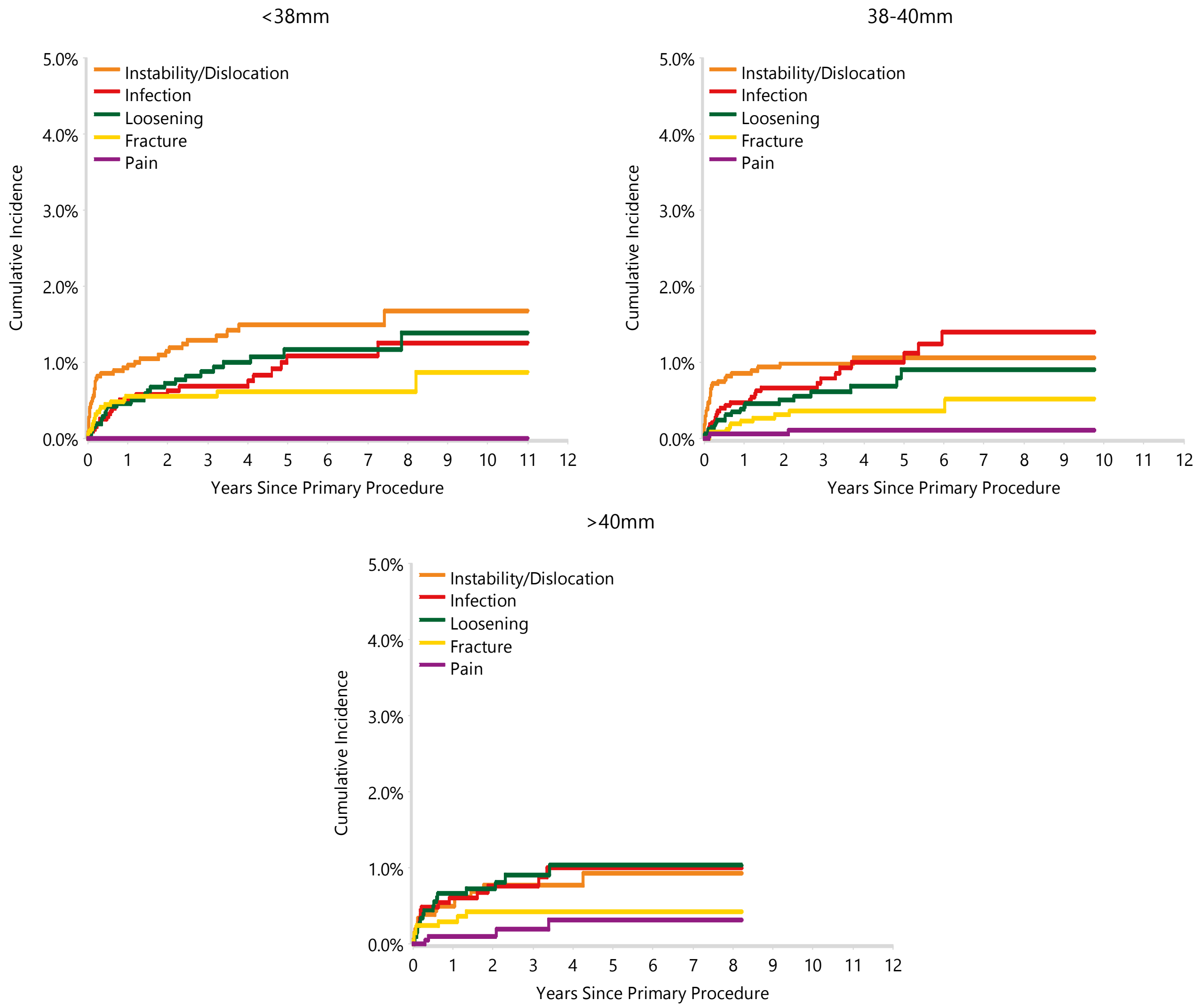


Table ST66 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Prosthesis Combination (Primary Diagnosis Rotator Cuff Arthropathy)

Humeral Stem	Glenoid Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Aequalis	Aequalis	37	869	2.2 (1.4, 3.4)	3.7 (2.5, 5.3)	4.7 (3.4, 6.7)	5.1 (3.6, 7.1)		
Affinis	Affinis	6	258	2.8 (1.2, 6.8)					
Anatomical Shoulder	Trabecular Metal	4	43	7.1 (2.3, 20.4)	10.4 (4.0, 25.8)				
Ascend Flex	Aequalis	11	338	3.1 (1.6, 5.8)	5.1 (2.6, 9.8)				
Comprehensive	Comprehensive Reverse	4	388	0.8 (0.3, 2.5)	0.8 (0.3, 2.5)				
Delta Xtend	Delta Xtend	96	2825	2.1 (1.6, 2.7)	3.3 (2.6, 4.1)	4.1 (3.3, 5.1)	4.7 (3.8, 5.9)		
Equinoxe	Equinoxe	8	375	1.4 (0.6, 3.4)	3.0 (1.3, 6.9)				
Global Unite	Delta Xtend	5	171	2.5 (0.9, 6.4)					
RSP	RSP	12	487	2.3 (1.2, 4.3)	2.8 (1.5, 5.0)				
SMR	SMR L1	81	1920	3.3 (2.5, 4.2)	4.3 (3.4, 5.5)	5.6 (4.4, 7.1)	5.6 (4.4, 7.1)	6.4 (4.6, 9.0)	
SMR	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	1	25	4.0 (0.6, 25.2)					
Trabecular Metal	Trabecular Metal	29	561	4.0 (2.6, 6.0)	5.1 (3.5, 7.3)	5.4 (3.7, 7.8)	6.0 (4.1, 8.8)		
Other (19)		3	96	2.2 (0.6, 8.5)	2.2 (0.6, 8.5)	2.2 (0.6, 8.5)	2.2 (0.6, 8.5)	6.8 (1.7, 25.3)	
TOTAL		**320**	**8737**						

Note: Only combinations with over 25 procedures have been listed

Table ST67 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	12 Yrs
Aequalis	Aequalis	28	704	1.9 (1.1, 3.3)	3.3 (2.1, 5.1)	4.7 (3.1, 6.9)	4.7 (3.1, 6.9)		
Affinis	Affinis	4	165	2.1 (0.7, 6.5)					
Anatomical Shoulder	Trabecular Metal	3	40	7.6 (2.5, 21.9)	7.6 (2.5, 21.9)				
Ascend Flex	Aequalis	10	301	3.1 (1.5, 6.1)	5.3 (2.6, 10.5)				
Comprehensive	Comprehensive Reverse	4	382	0.8 (0.3, 2.5)	0.8 (0.3, 2.5)				
Delta Xtend	Delta Xtend	87	2406	2.2 (1.6, 2.8)	3.5 (2.8, 4.4)	4.4 (3.5, 5.6)	5.2 (4.1, 6.6)		
Equinoxe	Equinoxe	8	365	1.5 (0.6, 3.5)	3.1 (1.3, 7.1)				
Global Unite	Delta Xtend	4	157	2.7 (1.0, 7.0)					
RSP	RSP	8	280	3.4 (1.7, 6.7)					
SMR	SMR L1	76	1847	3.1 (2.4, 4.1)	4.2 (3.3, 5.3)	5.5 (4.2, 7.1)	5.5 (4.2, 7.1)	6.4 (4.5, 9.0)	
SMR	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	1	25	4.0 (0.6, 25.2)					
Trabecular Metal	Trabecular Metal	28	522	4.1 (2.7, 6.2)	5.3 (3.6, 7.7)	5.6 (3.9, 8.2)	6.3 (4.3, 9.3)		
Other (18)		3	85	2.5 (0.6, 9.6)	2.5 (0.6, 9.6)	2.5 (0.6, 9.6)	2.5 (0.6, 9.6)	7.9 (2.0, 29.0)	
TOTAL		**287**	**7652**						

Note: Only combinations with over 25 procedures have been listed

Table ST68 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	12 Yrs
Aequalis	Aequalis	9	161	3.2 (1.3, 7.5)	5.4 (2.7, 10.5)	5.4 (2.7, 10.5)			
Affinis	Affinis	2	86	6.0 (1.5, 22.9)					
Ascend Flex	Aequalis	0	36	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)				
Delta Xtend	Delta Xtend	9	409	1.5 (0.7, 3.3)	2.1 (1.1, 4.2)	2.5 (1.3, 4.8)	2.5 (1.3, 4.8)		
RSP	RSP	4	188	1.1 (0.3, 4.4)	1.8 (0.6, 5.4)				
SMR	SMR L1	4	37	8.5 (2.8, 24.1)	12.2 (4.7, 29.5)	12.2 (4.7, 29.5)			
Trabecular Metal	Trabecular Metal	1	35	2.9 (0.4, 18.6)	2.9 (0.4, 18.6)	2.9 (0.4, 18.6)	2.9 (0.4, 18.6)		
Other (9)		2	50	0.0 (0.0, 0.0)	5.7 (1.5, 21.1)	5.7 (1.5, 21.1)	5.7 (1.5, 21.1)		
TOTAL		**31**	**1002**						

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 55-74 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 ST69 and Figure ST53).

Males have a higher rate of revision than females in the first 3 months (Table ST70 and Figure ST54). The higher rate of revision for males is due to an increased incidence of instability/dislocation (Figure ST55).

ASA and BMI

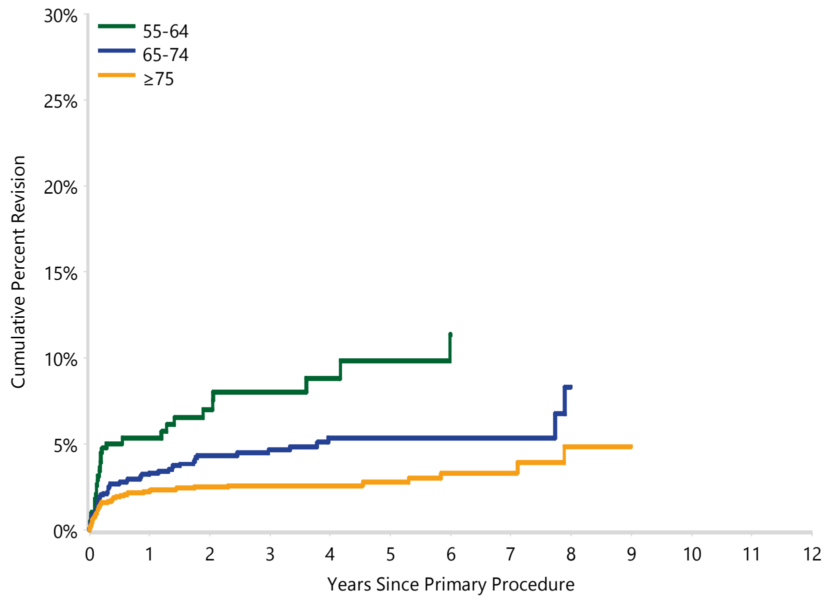
The Registry is now reporting on the early outcome of 2,777 primary total reverse shoulder replacement procedures for fracture in relation to ASA score. There is no difference in the rate of revision when comparing patients with ASA scores 2 and 3 (Table ST71 and Figure ST56). The most common reasons for revision can be found in Figure ST57.

The early revision outcomes are reported for 1,692 primary total shoulder replacement procedures for fracture in relation to BMI category. There is no difference in the rate of revision when BMI pre-obese and obese classes 1,2 and 3 are compared to the normal BMI class (Table ST72 and Figure ST58). The most common reasons for revision are shown in Figure ST59.

Table ST69 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	12 Yrs
<55	3	46	4.5 (1.1, 16.8)	4.5 (1.1, 16.8)				
55-64	29	390	5.3 (3.5, 8.2)	8.0 (5.5, 11.7)	9.8 (6.6, 14.6)			
65-74	58	1339	3.3 (2.5, 4.5)	4.7 (3.6, 6.1)	5.4 (4.1, 7.1)	5.4 (4.1, 7.1)		
≥75	53	2016	2.3 (1.7, 3.1)	2.6 (2.0, 3.4)	2.8 (2.1, 3.7)	3.3 (2.4, 4.7)		
TOTAL	**143**	**3791**						

Figure ST53 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Age (Primary Diagnosis Fracture)



HR - adjusted for gender

55-64 vs ≥75

Entire Period: HR=2.74 (1.74, 4.32),p<0.001

55-64 vs 65-74

Entire Period: HR=1.71 (1.10, 2.67),p=0.018

65-74 vs ≥75

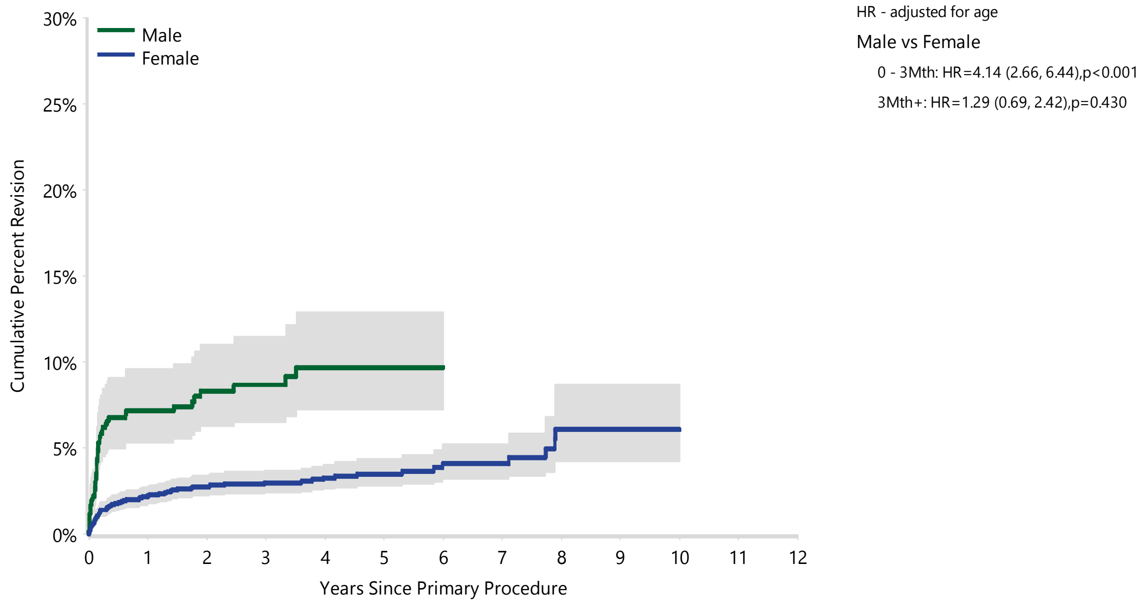
Entire Period: HR=1.60 (1.10, 2.33),p=0.013

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
55-64	390	269	131	74	36	9	0
65-74	1339	1015	534	247	93	21	0
≥75	2016	1559	890	445	179	24	1

Table ST70 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	12 Yrs
Male	48	596	7.1 (5.3, 9.6)	8.7 (6.5, 11.5)	9.7 (7.2, 12.9)			
Female	95	3195	2.2 (1.8, 2.8)	3.0 (2.4, 3.7)	3.5 (2.8, 4.4)	4.1 (3.2, 5.2)	6.1 (4.2, 8.7)	
TOTAL	**143**	**3791**						

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	12 Yrs
Male	596	424	207	96	36	9	0
Female	3195	2451	1364	675	275	47	1

Figure ST55 Cumulative Incidence Revision Diagnosis of Total Reverse Shoulder by Gender (Primary Diagnosis Fracture)

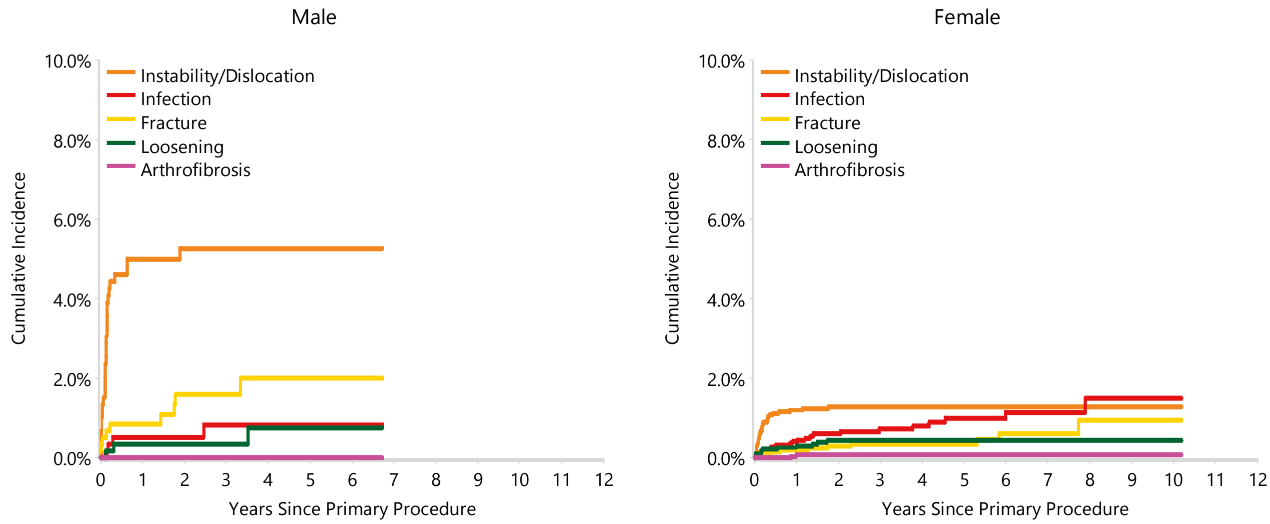
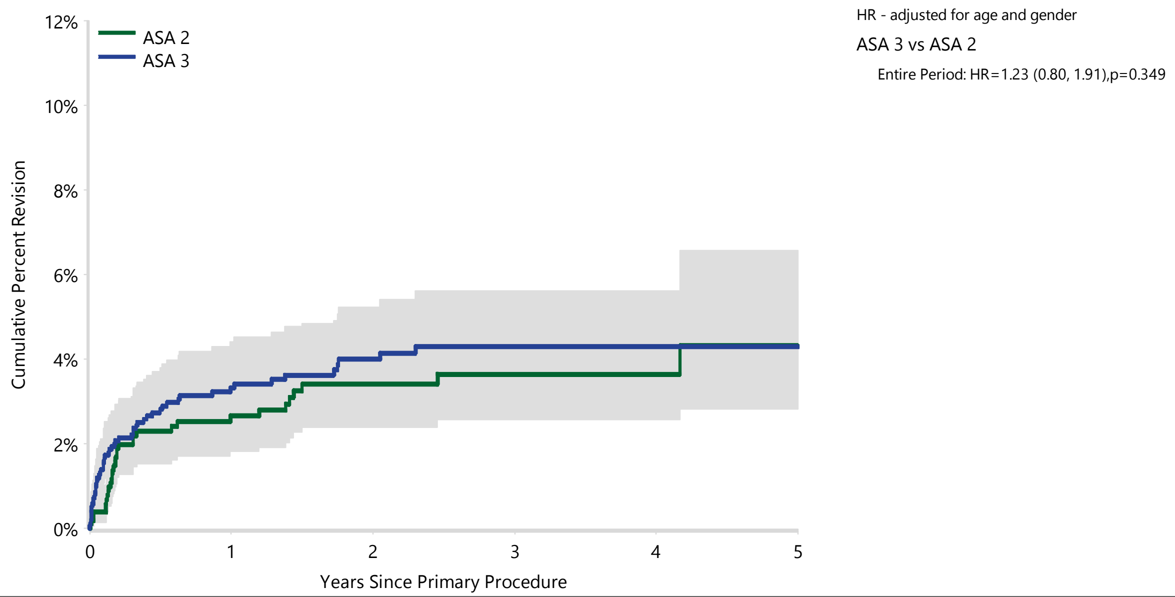


Table ST71 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by ASA Score (Primary Diagnosis Fracture)

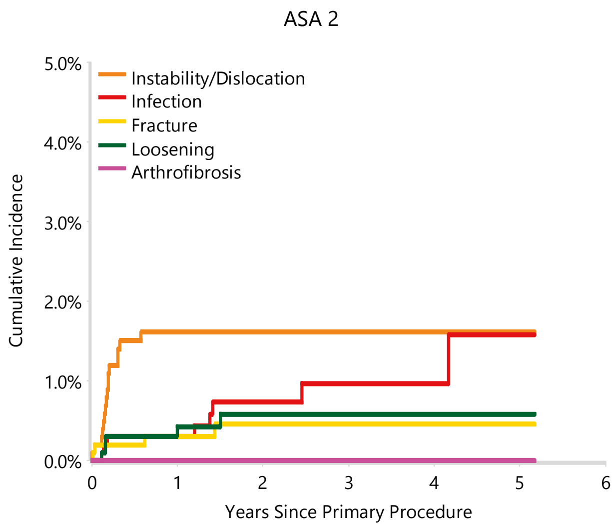
ASA Score	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
ASA 1	2	62	3.2 (0.8, 12.3)	3.2 (0.8, 12.3)	3.2 (0.8, 12.3)		
ASA 2	33	1035	2.7 (1.8, 3.9)	3.4 (2.4, 4.8)	3.6 (2.6, 5.2)	3.6 (2.6, 5.2)	4.3 (2.8, 6.6)
ASA 3	55	1521	3.3 (2.5, 4.4)	4.0 (3.1, 5.2)	4.3 (3.3, 5.6)	4.3 (3.3, 5.6)	4.3 (3.3, 5.6)
ASA 4	3	159	2.2 (0.7, 6.8)	2.2 (0.7, 6.8)			
TOTAL	93	2777					

Figure ST56 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by ASA Score (Primary Diagnosis Fracture)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
ASA 2	1035	756	492	306	165	55
ASA 3	1521	1035	699	391	197	59

Figure ST57 Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement by ASA Score (Primary Diagnosis Fracture)



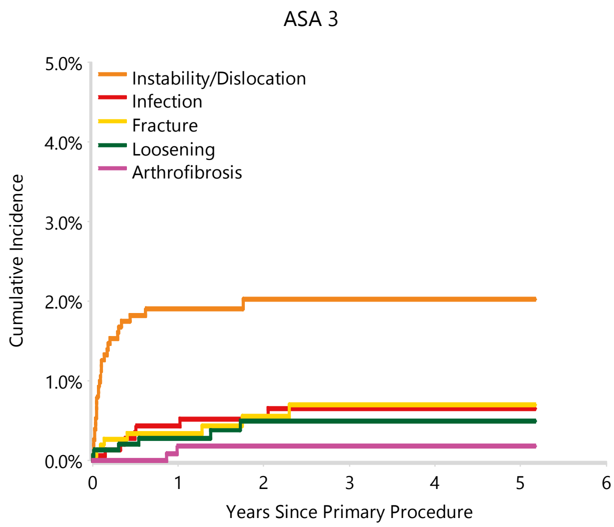
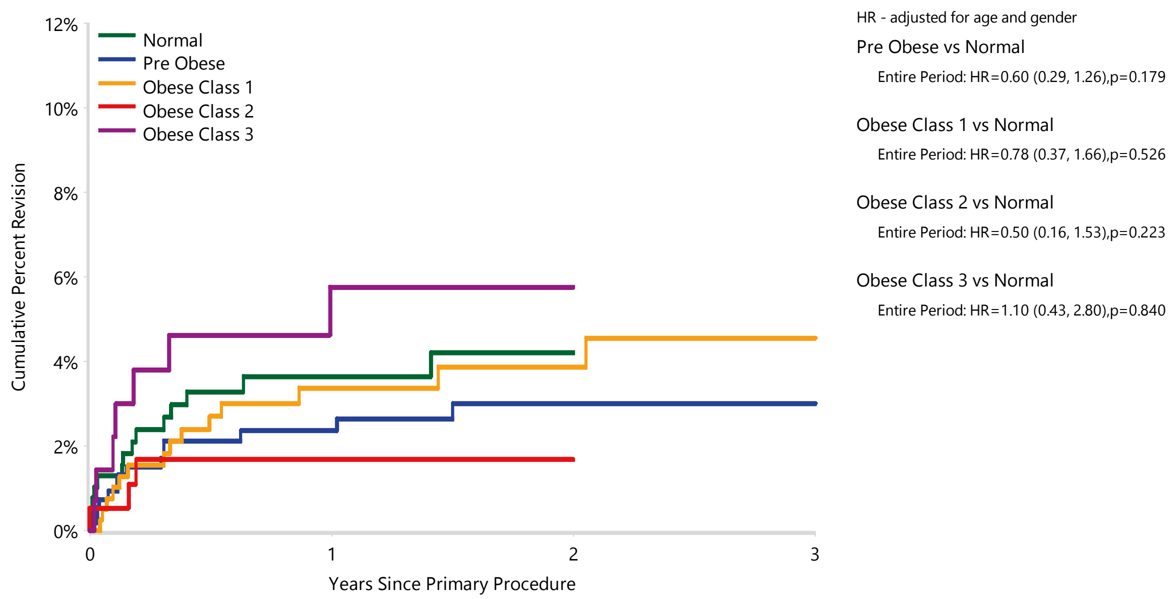


Table ST72 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by BMI Category (Primary Diagnosis Fracture)

BMI Category	N Revised	N Total	1 Yr	2 Yrs	3 Yrs
Underweight	0	40	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)
Normal	14	388	3.6 (2.1, 6.2)	4.2 (2.5, 7.1)	
Pre Obese	14	539	2.4 (1.3, 4.1)	3.0 (1.8, 5.1)	3.0 (1.8, 5.1)
Obese Class 1	14	399	3.4 (1.9, 5.9)	3.9 (2.2, 6.7)	4.6 (2.6, 7.8)
Obese Class 2	4	187	1.7 (0.5, 5.1)	1.7 (0.5, 5.1)	
Obese Class 3	7	139	5.8 (2.8, 11.8)	5.8 (2.8, 11.8)	
TOTAL	**53**	**1692**			

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

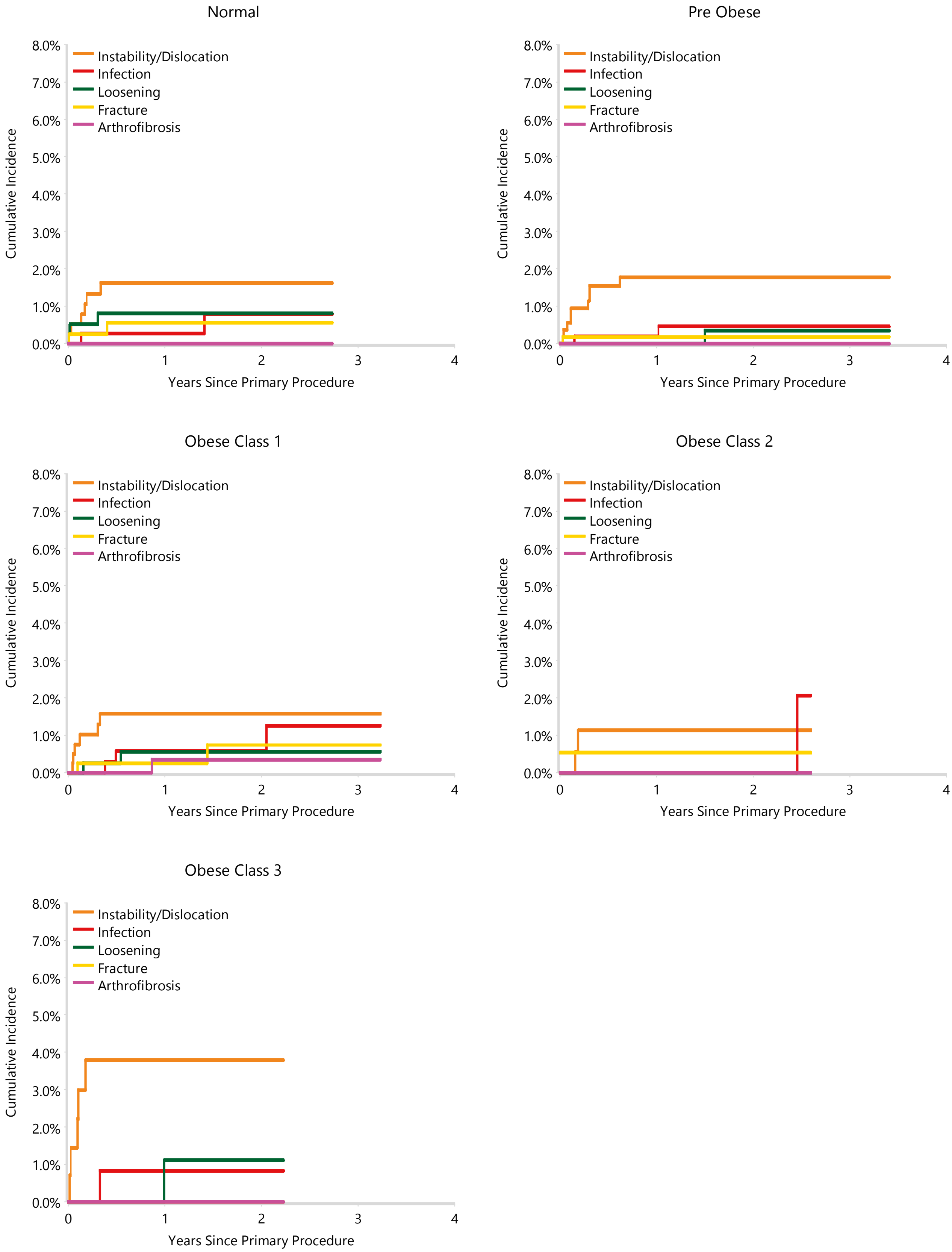
Figure ST58 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by BMI Category (Primary Diagnosis Fracture)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs
Normal	388	220	111	32
Pre Obese	539	358	175	64
Obese Class 1	399	251	140	59
Obese Class 2	187	116	68	28
Obese Class 3	139	83	51	13

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

Figure ST59 Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement by BMI Category (Primary Diagnosis Fracture)



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

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 ST73 and Figure ST60). A similar result was observed when the SMR L2 prosthesis was excluded (Table ST74 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 ST75, Figure ST62 and Figure ST63).

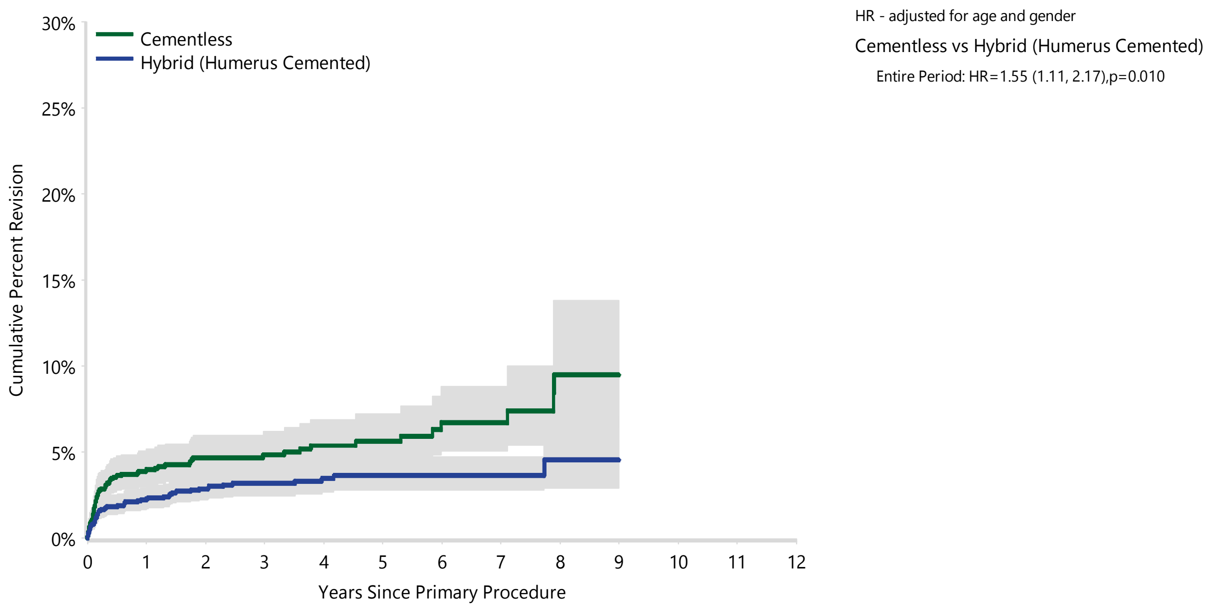
Glenosphere size is not a risk factor for revision when undertaken for fracture.

The outcomes of the most commonly used prosthesis combinations used in total reverse shoulder replacement for fracture are listed in Table ST76. The cementless prosthesis combinations are listed in Table ST77. The hybrid (humerus cemented) prosthesis combinations are listed in Table ST78.

Table ST73 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	12 Yrs
Cemented	4	57	7.4 (2.9, 18.6)	7.4 (2.9, 18.6)	7.4 (2.9, 18.6)			
Cementless	72	1417	4.0 (3.1, 5.2)	4.8 (3.8, 6.2)	5.6 (4.4, 7.2)	6.7 (5.1, 8.8)		
Hybrid (Glenoid Cemented)	1	38	2.9 (0.4, 19.1)	2.9 (0.4, 19.1)				
Hybrid (Humerus Cemented)	66	2279	2.3 (1.7, 3.0)	3.2 (2.5, 4.1)	3.6 (2.8, 4.7)	3.6 (2.8, 4.7)		
TOTAL	**143**	**3791**						

Figure ST60 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Fixation (Primary Diagnosis Fracture)



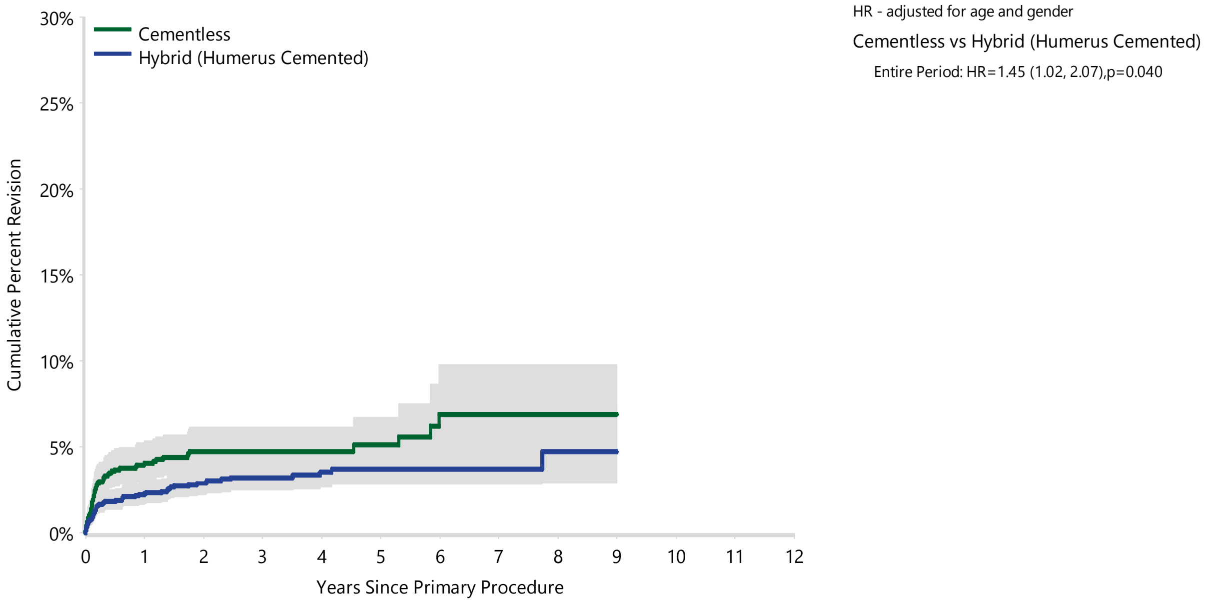
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Cementless	1417	1090	615	343	146	27	0
Hybrid (Humerus Cemented)	2279	1717	921	408	157	27	1

Note: Only fixations with over 60 procedures have been listed

Table ST74 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	12 Yrs
Cemented	4	55	7.7 (3.0, 19.3)	7.7 (3.0, 19.3)	7.7 (3.0, 19.3)			
Cementless	59	1269	4.1 (3.1, 5.3)	4.8 (3.7, 6.2)	5.1 (3.9, 6.7)	6.9 (4.8, 9.8)		
Hybrid (Glenoid Cemented)	1	38	2.9 (0.4, 19.1)	2.9 (0.4, 19.1)				
Hybrid (Humerus Cemented)	65	2231	2.3 (1.7, 3.0)	3.2 (2.5, 4.1)	3.7 (2.8, 4.8)	3.7 (2.8, 4.8)		
TOTAL	**129**	**3593**						

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	12 Yrs
Cementless	1269	949	487	233	74	27	0
Hybrid (Humerus Cemented)	2231	1675	882	377	140	27	1

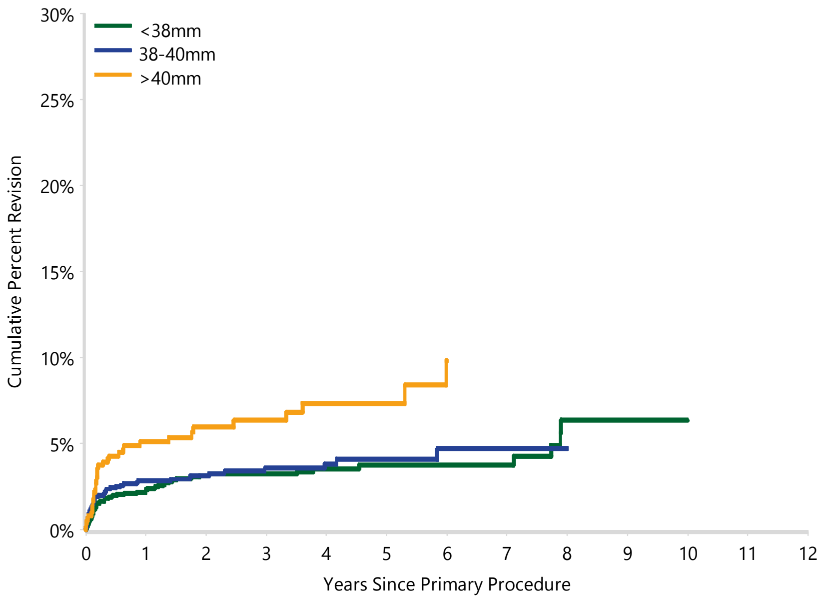
Note: Only fixations with over 60 procedures have been listed

Table ST75 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	12 Yrs
<38mm	55	1665	2.3 (1.7, 3.2)	3.2 (2.4, 4.3)	3.7 (2.8, 5.0)	3.7 (2.8, 5.0)	6.4 (4.1, 9.8)	
38-40mm	50	1508	2.8 (2.1, 3.8)	3.6 (2.7, 4.8)	4.1 (3.0, 5.6)	4.7 (3.2, 6.8)		
>40mm	37	610	5.1 (3.6, 7.3)	6.3 (4.5, 8.9)	7.4 (5.2, 10.4)			
TOTAL	**142**	**3783**						

Note: Excludes eight 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=1.11 (0.75, 1.63),p=0.607

>40mm vs <38mm

Entire Period: HR=1.47 (0.95, 2.27),p=0.083

>40mm vs 38-40mm

Entire Period: HR=1.33 (0.85, 2.08),p=0.214

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
<38mm	1665	1317	782	433	199	41	1
38-40mm	1508	1120	576	237	85	12	0
>40mm	610	432	208	99	26	3	0

Figure ST63 Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement by Glenosphere Size (Primary Diagnosis Fracture)

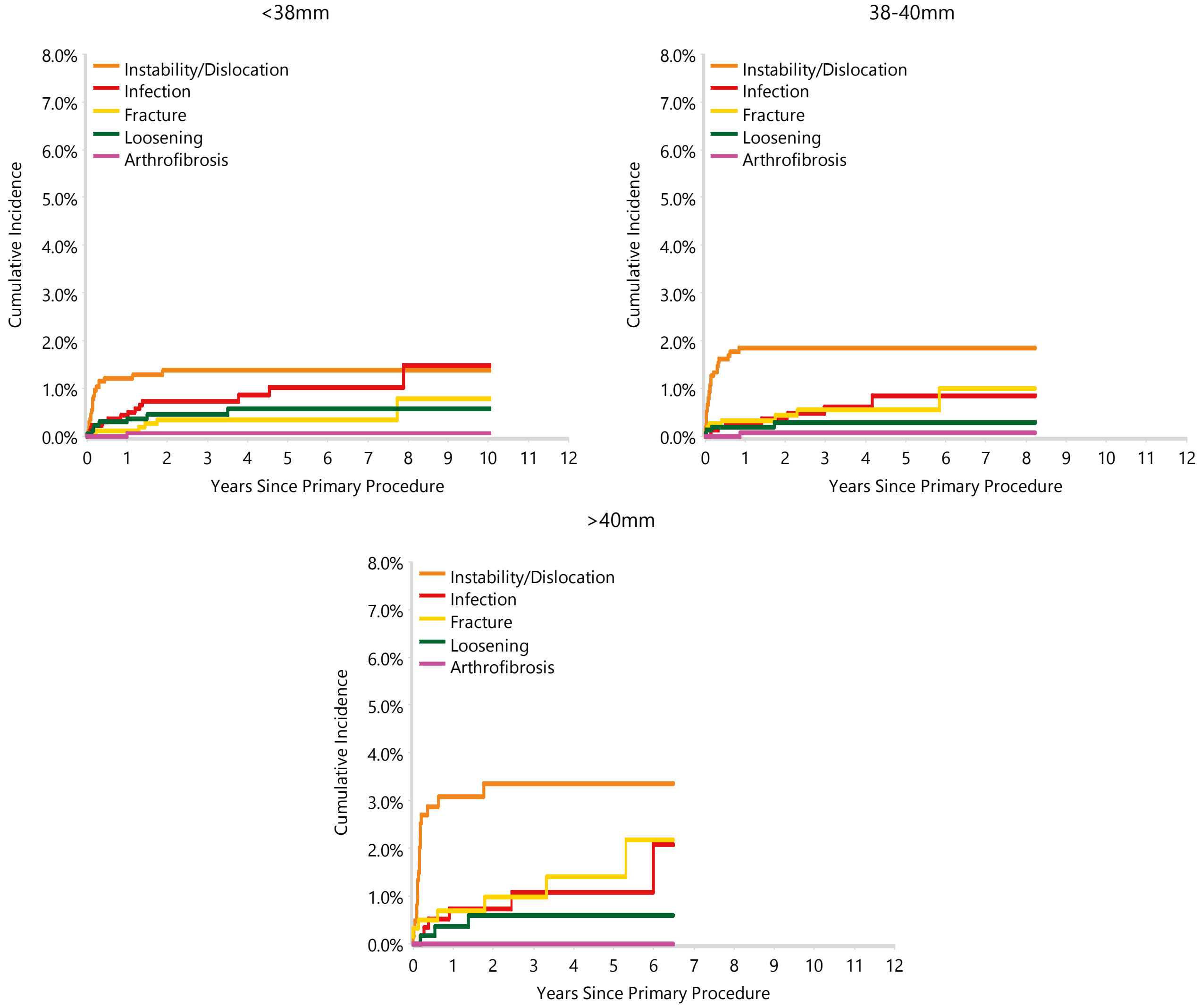


Table ST76 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Prosthesis Combination (Primary Diagnosis Fracture)

Humeral Stem	Glenoid Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	12 Yrs
Aequalis	Aequalis	16	605	1.7 (0.9, 3.2)	2.4 (1.4, 4.2)	3.5 (2.0, 6.2)			
Affinis	Affinis	3	154	1.4 (0.3, 5.4)					
Comprehensive	Comprehensive Reverse	2	192	1.4 (0.3, 5.4)					
Delta Xtend	Delta Xtend	40	1017	3.3 (2.3, 4.6)	4.0 (2.9, 5.5)	4.6 (3.3, 6.3)	5.2 (3.6, 7.4)		
Equinoxe	Equinoxe	1	101	1.0 (0.1, 6.8)					
Global Unite	Delta Xtend	1	90	1.1 (0.2, 7.9)	1.1 (0.2, 7.9)				
RSP	RSP	9	156	3.4 (1.4, 8.1)					
SMR	SMR L1	50	978	4.6 (3.5, 6.2)	5.4 (4.1, 7.1)	5.4 (4.1, 7.1)	6.7 (4.7, 9.6)		
SMR	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	6	213	2.5 (1.1, 5.9)	3.2 (1.4, 6.9)	3.2 (1.4, 6.9)			
Other (16)		1	87	1.2 (0.2, 8.2)	1.2 (0.2, 8.2)				
TOTAL		**143**	**3791**						

Note: Only combinations with over 50 procedures have been listed

Table ST77 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	12 Yrs
Aequalis	Aequalis	2	50	2.1 (0.3, 13.9)	2.1 (0.3, 13.9)	8.6 (1.9, 35.1)			
Delta Xtend	Delta Xtend	5	168	1.8 (0.6, 5.5)	2.6 (1.0, 6.9)	2.6 (1.0, 6.9)			
SMR	SMR L1	48	848	5.1 (3.8, 6.9)	5.9 (4.5, 7.9)	5.9 (4.5, 7.9)	7.6 (5.2, 11.1)		
SMR	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	1	53	2.0 (0.3, 13.4)	2.0 (0.3, 13.4)	2.0 (0.3, 13.4)	2.0 (0.3, 13.4)		
Other (15)		3	150	2.1 (0.7, 6.3)					
TOTAL		**72**	**1417**						

Note: Only combinations with over 50 procedures have been listed

Table ST78 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	12 Yrs
Aequalis	Aequalis	14	546	1.7 (0.9, 3.2)	2.5 (1.4, 4.3)	3.0 (1.7, 5.2)			
Affinis	Affinis	3	145	1.5 (0.4, 5.7)					
Comprehensive	Comprehensive Reverse	1	137	1.1 (0.1, 7.2)					
Delta Xtend	Delta Xtend	32	830	3.3 (2.2, 4.7)	4.0 (2.8, 5.7)	4.7 (3.3, 6.7)	4.7 (3.3, 6.7)		
Equinoxe	Equinoxe	0	72	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)				
RSP	RSP	8	131	3.3 (1.2, 8.6)					
SMR	SMR L1	1	122	0.9 (0.1, 6.2)	0.9 (0.1, 6.2)				
Trabecular Metal	Trabecular Metal	5	147	2.9 (1.1, 7.7)	3.9 (1.6, 9.2)				
Other (13)		2	149	1.4 (0.3, 5.4)	1.4 (0.3, 5.4)				
TOTAL		**66**	**2279**						

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 a snap shot 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.

This year, 21 independent arthroplasty specialists together with the Chairperson of the AOANJRR Committee, AOANJRR Director, three Deputy Directors, two assistant Deputy Directors and SAHMRI Registry staff attended the two day Hip and Knee Surgeon Review Workshop.

There were 5 independent arthroplasty specialists who attended a one day Shoulder Surgeon Review Workshop under the leadership of Professor Richard Page, together with two Deputy Directors and SAHMRI Registry staff.

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-2019.

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	10	132	444	2.25	Entire Period: HR=2.06 (1.11, 3.83),p=0.022

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	6.3 (3.1, 12.9)	9.6 (5.3, 17.2)			

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
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.

Previously, the Quadra-H femoral stem was identified in combination with the Bipolar Head (Medacta) head. This year, the Quadra-H stem is identified individually.

The Basis femoral stem was previously identified in combination with the Tandem bipolar head. This year, the Basis is identified individually, meaning the combination is no longer identified.

Table IP4 Revision Rate of Bipolar Hip Prostheses Identified as having a Higher than Anticipated Rate of Revision

Bipolar/Femoral Stem	N Revised	N Total	Obs. Years	Revisions/100 Obs. Yrs	Hazard Ratio, P Value
Re-Identified and Still Used	.	.	.	.	
**Quadra-H	7	70	155	4.53	Entire Period: HR=3.89 (1.85, 8.18),p<0.001
Identified and no longer used	.	.	.	.	
UHR/ABGII	20	177	957	2.09	Entire Period: HR=2.55 (1.64, 3.97),p<0.001
UHR/Omnifit (cless)	7	40	249	2.81	Entire Period: HR=3.17 (1.50, 6.67),p=0.002
**Basis	17	156	722	2.35	0 - 1Yr: HR=0.51 (0.13, 2.06),p=0.347
	.	.	.	.	1Yr+: HR=4.52 (2.69, 7.59),p<0.001
**Synergy	9	55	390	2.31	Entire Period: HR=2.57 (1.33, 4.97),p=0.004

Note: All components have been compared to all other bipolar hip components
** Femoral Stem Component

Table IP5 Cumulative Percent Revision of Bipolar Hip Prostheses Identified as having a Higher than Anticipated Rate of Revision

CPR	1 Yr	3 Yrs	5 Yrs	10 Yrs	18 Yrs
Re-Identified and Still Used					
**Quadra-H	7.7 (2.9, 19.4)	13.6 (6.2, 28.6)			
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, 20.8)		
**Synergy	7.3 (2.8, 18.4)	9.5 (4.1, 21.5)	12.2 (5.6, 25.5)	18.2 (9.3, 33.7)	

Note: ** Femoral Stem Component

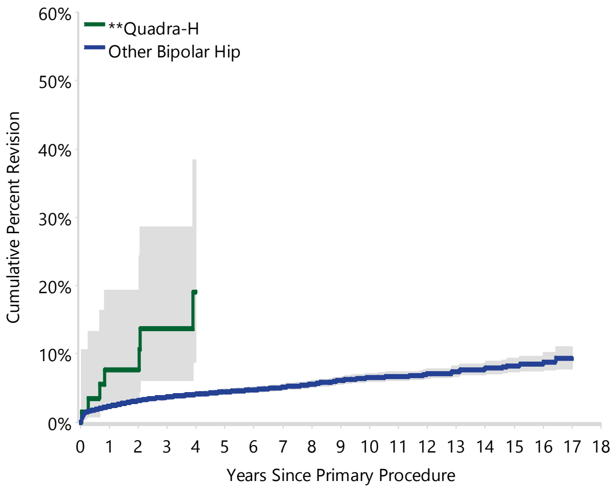
Table IP6 Yearly Usage of Bipolar Hip Prostheses Identified as having a Higher than Anticipated Rate of Revision

Year of Implant	≤2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Re-Identified and Still Used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
**Quadra-H	.	.	.	.	.	.	.	11	7	5	6	4	11	9	7	4	6
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 Bipolar Hip Prostheses

Re-identified and Still Used



Note: ** Femoral Stem Component

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 six newly identified total conventional hip combinations.

The Accolade II/Trident Tritanium (Shell) combination has been used in 1,285 procedures since 2012. The 3 year cumulative percent revision is 3.5%. Of the 37 revisions, 23 were major revisions including 18 femoral components and 14 were minor revisions. There were 14 revisions for infection and 12 for fracture.

The Avenir/Fitmore combination has been used in 146 procedures since 2013. The 2 year cumulative percent revision is 4.2%. Of the 7 revisions, 2 were major and 5 were minor. The most common reason for revision was infection (n=3, 42.9%).

The Corae/Fixa combination has been used in 81 procedures since 2012. The 3 year cumulative percent revision is 9.1%. Of the 5 revisions, 3 were major and 2 were minor.

The Friendly Hip/Delta-TT combination has been used in 73 procedures since 2011. The 7 year cumulative percent revision is 8.6%. Of the 6 revisions, 5 were major. The most common reasons for revision were loosening (n=2, 33.3%) and fracture (n= 2, 33.3%).

The HACTIV/Logical G combination has been used in 582 procedures since 2016. The 1 year cumulative percent revision is 3.4%. Of the 18 revisions, 14 were major and 4 were minor. The most common reasons for revision were infection (n=6, 33.3%) and fracture (n=5, 27.8%).

The Secur-Fit Plus/PINNACLE combination has been used in 230 procedures since 2004. The 5 year cumulative percent revision is 5.2%. Of the 11 revisions, 8 were major and 3 were minor. Fracture was the most common reason for revision (n=7, 63.6%).

The Dynasty acetabular component has previously been identified in combination with the Profemur TL and Profemur L femoral stems. This year, only the acetabular component is identified. The Dynasty acetabular component has been used in 1,522 procedures since 2011. The 6 year cumulative percent revision is 7.5%. Of the 64 revisions, 50 were major and 14 were minor. The most common reasons for revision were prosthesis dislocation (n=19, 29.7%), fracture (n=19, 29.7%) and loosening (n=14, 21.9%).

The Mueller acetabular component has previously been identified with the H Moos femoral stem. This year, only the acetabular component is identified. The Mueller acetabular component has been used in 55 procedures since 2000. The 17 year cumulative percent revision is 32.0%. Of the 12 revisions, 8 were revised to a THR (Femoral/Acetabular) and there were 2 acetabular only revisions. The most common reason for revision was loosening (n=10, 83.3%).

Two primary total conventional hip prostheses are identified for the first time and no longer used: the Linear/Acetabular Shell (Global) combination and Conserve Plus acetabular component.

Table IP7 Revision Rate of Total Conventional Hip Prostheses Identified as having a Higher than Anticipated Rate of Revision

Femoral Stem/Acetabular	N Revised	N Total	Obs. Years	Revisions/100 Obs. Yrs	Hazard Ratio, P Value
Newly Identified	.	.	.	.	
Accolade II/Trident Tritanium (Shell)	37	1285	2013	1.84	Entire Period: HR=1.45 (1.05, 2.00),p=0.023
Avenir/Fitmore	7	146	242	2.90	Entire Period: HR=2.47 (1.18, 5.17),p=0.016
Corae/Fixa	5	81	157	3.18	Entire Period: HR=2.98 (1.24, 7.15),p=0.014
Friendly Hip/Delta-TT	6	73	300	2.00	Entire Period: HR=2.87 (1.29, 6.38),p=0.009
HACTIV/Logical G	18	582	447	4.03	Entire Period: HR=2.03 (1.28, 3.23),p=0.002
Secur-Fit Plus/PINNACLE	11	230	735	1.50	Entire Period: HR=1.84 (1.02, 3.32),p=0.043
Re-Identified and Still Used	.	.	.	.	
CORAIL/Trabecular Metal (Shell)	11	96	528	2.08	Entire Period: HR=3.22 (1.79, 5.82),p<0.001
CPT/Fitmore	17	252	1214	1.40	Entire Period: HR=2.13 (1.32, 3.43),p=0.001
CPT/Low Profile Cup	11	154	811	1.36	Entire Period: HR=2.17 (1.20, 3.92),p=0.010
Taperloc/G7	29	1899	3732	0.78	0 - 2Wk: HR=2.03 (1.12, 3.67),p=0.019
	.	.	.	.	2Wk+: HR=0.51 (0.32, 0.81),p=0.004
*Apex	154	2528	16908	0.91	Entire Period: HR=1.46 (1.25, 1.71),p<0.001
*Excia (cless)	22	409	1655	1.33	0 - 3Mth: HR=2.84 (1.65, 4.89),p<0.001
	.	.	.	.	3Mth+: HR=1.20 (0.62, 2.31),p=0.582
*Furlong Evolution	14	253	493	2.84	Entire Period: HR=2.71 (1.61, 4.58),p<0.001
*ML Taper Kinectiv	169	3532	20281	0.83	Entire Period: HR=1.30 (1.12, 1.51),p<0.001
*Novation	50	1183	4536	1.10	0 - 1Mth: HR=1.96 (1.20, 3.20),p=0.007
	.	.	.	.	1Mth - 3Mth: HR=2.13 (1.18, 3.85),p=0.012
	.	.	.	.	3Mth+: HR=1.09 (0.72, 1.64),p=0.675
*Taper Fit	71	1814	5802	1.22	0 - 1Mth: HR=0.58 (0.28, 1.22),p=0.149
	.	.	.	.	1Mth - 3Mth: HR=1.08 (0.54, 2.17),p=0.820
	.	.	.	.	3Mth - 9Mth: HR=1.59 (0.86, 2.97),p=0.141
	.	.	.	.	9Mth - 4Yr: HR=1.46 (0.90, 2.34),p=0.122
	.	.	.	.	4Yr - 6Yr: HR=4.71 (2.67, 8.31),p<0.001
	.	.	.	.	6Yr+: HR=2.59 (1.61, 4.17),p<0.001
*Trabecular Metal	115	1903	11873	0.97	0 - 1Mth: HR=2.63 (1.88, 3.67),p<0.001
	.	.	.	.	1Mth - 3Mth: HR=1.99 (1.24, 3.21),p=0.004
	.	.	.	.	3Mth+: HR=1.18 (0.92, 1.52),p=0.184
**Continuum	443	12028	50457	0.88	0 - 3Mth: HR=1.67 (1.46, 1.90),p<0.001
	.	.	.	.	3Mth+: HR=0.95 (0.83, 1.08),p=0.429
**Delta-One-TT	8	123	414	1.93	Entire Period: HR=2.37 (1.19, 4.72),p=0.014
**Dynasty	64	1522	3776	1.70	Entire Period: HR=1.78 (1.39, 2.27),p<0.001
**Fin II	130	2034	14954	0.87	Entire Period: HR=1.47 (1.24, 1.75),p<0.001
**Furlong	42	724	3724	1.13	0 - 2Wk: HR=3.89 (1.94, 7.79),p<0.001
	.	.	.	.	2Wk+: HR=1.49 (1.06, 2.09),p=0.020
**Mueller	12	55	473	2.54	Entire Period: HR=4.20 (2.39, 7.40),p<0.001
**Procotyl L	62	1391	6588	0.94	Entire Period: HR=1.37 (1.07, 1.76),p=0.012
**Versafitcup DM	28	743	1486	1.88	Entire Period: HR=1.77 (1.22, 2.56),p=0.002
Identified and no longer used	.	.	.	.	
+**Conserve Plus	18	135	1386	1.30	Entire Period: HR=2.23 (1.41, 3.54),p<0.001
+Linear/Acetabular Shell (Global)	7	96	311	2.25	Entire Period: HR=2.70 (1.29, 5.62),p=0.008
Anatomic II/Duraloc Option	8	60	592	1.35	Entire Period: HR=2.34 (1.17, 4.67),p=0.015
Anca-Fit/PINNACLE	15	101	882	1.70	Entire Period: HR=3.00 (1.81, 4.98),p<0.001
F2L/Delta-PF	18	107	1079	1.67	Entire Period: HR=2.88 (1.81, 4.57),p<0.001
Friendly Hip/Cup (Exactech)	14	97	951	1.47	Entire Period: HR=2.63 (1.56, 4.43),p<0.001
MBA (exch neck)/PINNACLE	22	225	1558	1.41	Entire Period: HR=2.38 (1.57, 3.61),p<0.001

Femoral Stem/Acetabular	N Revised	N Total	Obs. Years	Revisions/100 Obs. Yrs	Hazard Ratio, P Value
Secur-Fit Plus/Secur-Fit	29	197	2321	1.25	Entire Period: HR=2.13 (1.48, 3.06),p<0.001
Taperloc/M2a^{MoM}	67	515	5548	1.21	Entire Period: HR=2.08 (1.64, 2.64),p<0.001
Taperloc/Versafitcup CC	7	120	242	2.90	Entire Period: HR=2.60 (1.25, 5.43),p=0.010
*ABGII (exch neck)	77	246	1659	4.64	0 - 1Mth: HR=4.18 (1.99, 8.77),p<0.001
	.	.	.	.	1Mth - 2.5Yr: HR=3.66 (2.21, 6.08),p<0.001
	.	.	.	.	2.5Yr - 4Yr: HR=11.56 (6.70, 19.96),p<0.001
	.	.	.	.	4Yr - 4.5Yr: HR=33.81 (18.59, 61.51),p<0.001
	.	.	.	.	4.5Yr - 5Yr: HR=8.88 (2.86, 27.63),p<0.001
	.	.	.	.	5Yr - 6Yr: HR=28.31 (17.75, 45.17),p<0.001
	.	.	.	.	6Yr+: HR=5.91 (3.18, 11.00),p<0.001
*Adapter (cless)	138	744	5940	2.32	0 - 2Wk: HR=3.79 (1.89, 7.60),p<0.001
	.	.	.	.	2Wk - 1Mth: HR=1.66 (0.69, 4.00),p=0.255
	.	.	.	.	1Mth - 6Mth: HR=0.78 (0.29, 2.09),p=0.624
	.	.	.	.	6Mth - 3Yr: HR=3.74 (2.65, 5.26),p<0.001
	.	.	.	.	3Yr - 3.5Yr: HR=10.51 (5.94, 18.61),p<0.001
	.	.	.	.	3.5Yr+: HR=5.25 (4.19, 6.59),p<0.001
*Adapter (ctd)	31	148	1105	2.81	0 - 6Mth: HR=2.02 (0.76, 5.37),p=0.160
	.	.	.	.	6Mth+: HR=6.13 (4.20, 8.95),p<0.001
*BMHR VST	26	260	1935	1.34	Entire Period: HR=2.09 (1.42, 3.06),p<0.001
*CBH Stem	36	274	2006	1.79	Entire Period: HR=3.01 (2.17, 4.17),p<0.001
*Edinburgh	18	138	948	1.90	Entire Period: HR=3.27 (2.06, 5.18),p<0.001
*Elite Plus	253	2841	29802	0.85	0 - 1Mth: HR=0.26 (0.11, 0.63),p=0.002
	.	.	.	.	1Mth - 9Mth: HR=0.99 (0.66, 1.47),p=0.944
	.	.	.	.	9Mth+: HR=1.78 (1.56, 2.03),p<0.001
*Emperion	49	507	3207	1.53	Entire Period: HR=2.34 (1.77, 3.10),p<0.001
*K2	76	601	4525	1.68	Entire Period: HR=2.87 (2.29, 3.59),p<0.001
*LYDERIC II	15	164	1391	1.08	Entire Period: HR=1.89 (1.14, 3.13),p=0.014
*MSA	30	224	1456	2.06	Entire Period: HR=3.21 (2.24, 4.59),p<0.001
*Margron	111	688	7805	1.42	0 - 3Mth: HR=2.26 (1.43, 3.60),p<0.001
	.	.	.	.	3Mth - 6Mth: HR=5.35 (2.77, 10.30),p<0.001
	.	.	.	.	6Mth - 1Yr: HR=5.76 (3.34, 9.95),p<0.001
	.	.	.	.	1Yr - 2Yr: HR=2.39 (1.19, 4.78),p=0.014
	.	.	.	.	2Yr - 7Yr: HR=3.78 (2.79, 5.13),p<0.001
	.	.	.	.	7Yr+: HR=1.05 (0.68, 1.61),p=0.819
*Mayo	17	168	1657	1.03	Entire Period: HR=1.80 (1.12, 2.89),p=0.015
*Metha (exch neck)	14	88	636	2.20	Entire Period: HR=3.60 (2.13, 6.09),p<0.001
*Profemur Z	26	186	1819	1.43	Entire Period: HR=2.48 (1.69, 3.63),p<0.001
*UniSyn	53	466	3741	1.42	Entire Period: HR=2.34 (1.79, 3.06),p<0.001
**2000 Plus	19	135	1116	1.70	Entire Period: HR=2.95 (1.88, 4.62),p<0.001
**ASR	1929	4421	34696	5.56	0 - 2Wk: HR=1.24 (0.75, 2.02),p=0.400
	.	.	.	.	2Wk - 1Mth: HR=0.22 (0.08, 0.58),p=0.002
	.	.	.	.	1Mth - 9Mth: HR=1.05 (0.77, 1.42),p=0.771
	.	.	.	.	9Mth - 1.5Yr: HR=3.57 (2.81, 4.54),p<0.001
	.	.	.	.	1.5Yr - 2Yr: HR=6.38 (4.95, 8.23),p<0.001
	.	.	.	.	2Yr - 2.5Yr: HR=11.58 (9.41, 14.25),p<0.001
	.	.	.	.	2.5Yr - 3Yr: HR=15.08 (12.39, 18.35),p<0.001
	.	.	.	.	3Yr - 5Yr: HR=24.70 (22.56, 27.05),p<0.001
	.	.	.	.	5Yr - 5.5Yr: HR=30.42 (25.56, 36.22),p<0.001
	.	.	.	.	5.5Yr - 6Yr: HR=23.91 (19.66, 29.09),p<0.001
	.	.	.	.	6Yr - 7Yr: HR=17.80 (15.13, 20.95),p<0.001

Femoral Stem/Acetabular	N Revised	N Total	Obs. Years	Revisions/100 Obs. Yrs	Hazard Ratio, P Value
	.	.	.	.	7Yr - 8.5Yr: HR=13.62 (11.65, 15.92),p<0.001
	.	.	.	.	8.5Yr - 10Yr: HR=7.60 (6.25, 9.25),p<0.001
	.	.	.	.	10Yr+: HR=4.96 (3.99, 6.16),p<0.001
**Adept	19	121	1025	1.85	Entire Period: HR=3.05 (1.95, 4.79),p<0.001
**Artek	66	179	2192	3.01	0 - 1Yr: HR=1.55 (0.65, 3.73),p=0.325
	.	.	.	.	1Yr - 1.5Yr: HR=3.88 (0.97, 15.55),p=0.055
	.	.	.	.	1.5Yr - 4Yr: HR=8.38 (4.96, 14.16),p<0.001
	.	.	.	.	4Yr - 4.5Yr: HR=3.64 (0.51, 25.89),p=0.196
	.	.	.	.	4.5Yr - 6Yr: HR=14.26 (8.07, 25.17),p<0.001
	.	.	.	.	6Yr+: HR=4.52 (3.18, 6.40),p<0.001
**BHR	435	2987	28040	1.55	0 - 2Wk: HR=0.79 (0.38, 1.67),p=0.543
	.	.	.	.	2Wk - 1Mth: HR=0.16 (0.04, 0.64),p=0.009
	.	.	.	.	1Mth - 3Mth: HR=1.16 (0.71, 1.89),p=0.559
	.	.	.	.	3Mth - 1Yr: HR=0.50 (0.26, 0.96),p=0.037
	.	.	.	.	1Yr - 1.5Yr: HR=1.38 (0.78, 2.44),p=0.264
	.	.	.	.	1.5Yr+: HR=3.77 (3.40, 4.18),p<0.001
**Bionik	138	608	4924	2.80	0 - 3Mth: HR=1.60 (0.89, 2.89),p=0.119
	.	.	.	.	3Mth+: HR=5.82 (4.89, 6.93),p<0.001
**Cormet	116	803	7608	1.52	0 - 1.5Yr: HR=1.08 (0.68, 1.72),p=0.730
	.	.	.	.	1.5Yr - 2Yr: HR=0.54 (0.08, 3.82),p=0.534
	.	.	.	.	2Yr+: HR=3.70 (3.03, 4.53),p<0.001
**DeltaLox	22	222	1306	1.68	0 - 2Wk: HR=8.12 (3.38, 19.47),p<0.001
	.	.	.	.	2Wk+: HR=2.29 (1.42, 3.68),p<0.001
**Duraloc	561	5354	57394	0.98	0 - 3Mth: HR=0.81 (0.61, 1.08),p=0.149
	.	.	.	.	3Mth - 9Mth: HR=1.31 (0.92, 1.88),p=0.138
	.	.	.	.	9Mth - 2Yr: HR=1.63 (1.25, 2.13),p<0.001
	.	.	.	.	2Yr - 2.5Yr: HR=0.77 (0.38, 1.54),p=0.460
	.	.	.	.	2.5Yr - 3Yr: HR=1.83 (1.13, 2.96),p=0.014
	.	.	.	.	3Yr - 5.5Yr: HR=1.52 (1.18, 1.96),p=0.001
	.	.	.	.	5.5Yr+: HR=2.35 (2.10, 2.63),p<0.001
**Durom	180	1245	12558	1.43	0 - 1.5Yr: HR=0.73 (0.46, 1.14),p=0.168
	.	.	.	.	1.5Yr+: HR=3.35 (2.86, 3.92),p<0.001
**ExpanSys	12	71	712	1.68	Entire Period: HR=2.95 (1.67, 5.19),p<0.001
**Hedrocel	11	46	533	2.06	Entire Period: HR=3.44 (1.91, 6.21),p<0.001
**Icon	88	401	3403	2.59	0 - 2.5Yr: HR=2.45 (1.64, 3.66),p<0.001
	.	.	.	.	2.5Yr+: HR=6.01 (4.70, 7.69),p<0.001
**Inter-Op	9	33	350	2.57	Entire Period: HR=4.38 (2.28, 8.42),p<0.001
**MBA	17	124	1069	1.59	Entire Period: HR=2.77 (1.72, 4.46),p<0.001
**Mitch TRH	109	731	6505	1.68	0 - 3Mth: HR=0.58 (0.24, 1.41),p=0.230
	.	.	.	.	3Mth - 2Yr: HR=2.21 (1.39, 3.51),p<0.001
	.	.	.	.	2Yr+: HR=4.07 (3.29, 5.03),p<0.001
**Plasmacup	32	482	3006	1.06	Entire Period: HR=1.69 (1.19, 2.39),p=0.003
**SPH-Blind	122	952	11346	1.08	Entire Period: HR=1.83 (1.53, 2.19),p<0.001
**seleXys (excluding seleXys PC)	48	391	2633	1.82	Entire Period: HR=2.98 (2.24, 3.95),p<0.001

Note: Components have been compared to all other total conventional hip components
*Femoral Stem Component
**Acetabular Component
+ Newly identified and no longer used

Table IP8 Cumulative Percent Revision of Total Conventional Hip Prostheses Identified as having a Higher than Anticipated Rate of Revision

CPR	1 Yr	3 Yrs	5 Yrs	10 Yrs	18 Yrs
Newly Identified					
Accolade II/Trident Tritanium (Shell)	2.6 (1.8, 3.7)	3.5 (2.5, 5.0)			
Avenir/Fitmore	4.2 (1.9, 9.2)				
Corae/Fixa	5.2 (2.0, 13.2)	9.1 (3.4, 23.4)			
Friendly Hip/Delta-TT	5.6 (2.1, 14.2)	8.6 (4.0, 18.3)	8.6 (4.0, 18.3)		
HACTIV/Logical G	3.4 (2.1, 5.4)				
Secur-Fit Plus/PINNACLE	2.7 (1.2, 5.9)	4.4 (2.3, 8.3)	5.2 (2.8, 9.5)		
Re-Identified and Still Used					
CORAIL/Trabecular Metal (Shell)	6.3 (2.9, 13.6)	10.0 (5.3, 18.4)	12.7 (7.2, 21.9)		
CPT/Fitmore	4.1 (2.2, 7.5)	5.7 (3.3, 9.6)	6.6 (3.9, 11.1)		
CPT/Low Profile Cup	4.1 (1.8, 8.8)	5.6 (2.8, 11.0)	8.4 (4.7, 14.9)		
Taperloc/G7	1.5 (1.0, 2.2)	1.8 (1.2, 2.6)			
*Apex	2.2 (1.7, 2.9)	3.3 (2.7, 4.1)	4.8 (4.0, 5.8)	7.7 (6.5, 9.2)	
*Excia (cless)	4.0 (2.5, 6.4)	5.4 (3.5, 8.2)	5.9 (3.8, 9.0)		
*Furlong Evolution	4.3 (2.3, 7.8)	6.5 (3.8, 11.3)			
*ML Taper Kinectiv	2.4 (1.9, 3.0)	3.6 (3.0, 4.3)	4.5 (3.8, 5.2)		
*Novation	3.2 (2.3, 4.4)	4.1 (3.1, 5.4)	4.4 (3.3, 5.8)		
*Taper Fit	1.6 (1.1, 2.4)	2.8 (2.0, 3.9)	5.6 (4.1, 7.7)	11.5 (8.5, 15.3)	
*Trabecular Metal	3.5 (2.7, 4.4)	4.8 (3.9, 5.9)	5.4 (4.5, 6.6)	7.5 (6.1, 9.3)	
**Continuum	2.5 (2.2, 2.8)	3.4 (3.1, 3.7)	3.9 (3.6, 4.3)		
**Delta-One-TT	3.3 (1.3, 8.6)	6.3 (3.1, 12.9)			
**Dynasty	3.4 (2.6, 4.4)	4.5 (3.5, 5.8)	5.3 (3.9, 7.3)		
**Fin II	2.7 (2.1, 3.5)	3.6 (2.9, 4.5)	4.7 (3.9, 5.8)	7.7 (6.4, 9.2)	
**Furlong	3.7 (2.6, 5.4)	5.4 (4.0, 7.5)	5.9 (4.3, 8.0)		
**Mueller	1.9 (0.3, 12.6)	12.9 (6.0, 26.6)	15.3 (7.6, 29.5)	24.4 (13.7, 41.1)	
**Procotyl L	2.9 (2.1, 4.0)	4.1 (3.1, 5.4)	4.6 (3.5, 5.9)		
**Versafitcup DM	3.7 (2.5, 5.4)	4.4 (3.0, 6.3)			
Identified and no longer used					
+**Conserve Plus	1.5 (0.4, 5.8)	3.0 (1.1, 7.8)	3.8 (1.6, 8.8)	10.9 (6.5, 18.1)	
+Linear/Acetabular Shell (Global)	2.1 (0.5, 8.1)	7.5 (3.6, 15.1)			
Anatomic II/Duraloc Option	1.7 (0.2, 11.2)	6.7 (2.6, 16.8)	10.1 (4.7, 21.1)	12.1 (6.0, 23.9)	
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)		
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 (9.8, 15.7)	
Taperloc/Versafitcup CC	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)		
*Adapter (cless)	3.2 (2.2, 4.8)	6.9 (5.2, 8.9)	11.7 (9.5, 14.3)	19.5 (16.6, 22.8)	
*Adapter (ctd)	4.1 (1.9, 8.9)	9.1 (5.4, 15.2)	17.0 (11.6, 24.5)	23.7 (17.1, 32.3)	
*BMHR VST	1.9 (0.8, 4.6)	4.6 (2.7, 8.0)	7.0 (4.5, 10.9)		
*CBH Stem	4.0 (2.3, 7.2)	7.4 (4.9, 11.3)	9.9 (6.8, 14.1)	14.7 (10.8, 20.0)	
*Edinburgh	6.0 (3.1, 11.7)	9.6 (5.6, 16.4)	12.5 (7.7, 20.0)	17.6 (11.1, 27.2)	
*Elite Plus	1.5 (1.1, 2.0)	2.8 (2.3, 3.5)	4.2 (3.5, 5.1)	7.7 (6.7, 8.8)	13.7 (12.0, 15.6)
*Emperion	4.8 (3.2, 7.0)	6.0 (4.2, 8.5)	7.2 (5.2, 10.0)	17.7 (11.9, 25.9)	
*K2	5.2 (3.7, 7.3)	7.5 (5.7, 10.0)	9.8 (7.7, 12.6)	14.0 (11.2, 17.4)	
*LYDERIC II	3.1 (1.3, 7.2)	5.7 (3.0, 10.6)	7.1 (4.0, 12.5)	12.0 (7.2, 19.9)	
*MSA	5.8 (3.4, 9.8)	9.5 (6.3, 14.1)	11.3 (7.8, 16.3)		

CPR	1 Yr	3 Yrs	5 Yrs	10 Yrs	18 Yrs
*Margron	5.8 (4.3, 7.9)	8.4 (6.5, 10.8)	10.2 (8.2, 12.8)	15.3 (12.7, 18.2)	
*Mayo	3.0 (1.3, 7.0)	6.6 (3.7, 11.6)	6.6 (3.7, 11.6)	8.7 (5.2, 14.2)	
*Metha (exch neck)	12.5 (7.1, 21.4)	13.6 (8.0, 22.8)	13.6 (8.0, 22.8)		
*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)	
*UniSyn	3.2 (2.0, 5.3)	5.9 (4.1, 8.5)	6.7 (4.8, 9.5)	12.6 (9.5, 16.6)	
**2000 Plus	3.0 (1.1, 7.8)	6.8 (3.6, 12.7)	9.2 (5.3, 15.7)	14.3 (9.0, 22.2)	
**ASR	1.9 (1.5, 2.3)	9.6 (8.8, 10.5)	24.4 (23.1, 25.7)	44.9 (43.4, 46.4)	
**Adept	4.1 (1.7, 9.6)	8.4 (4.6, 15.0)	9.3 (5.3, 16.2)	16.1 (10.5, 24.5)	
**Artek	2.8 (1.2, 6.7)	8.0 (4.8, 13.1)	15.5 (10.9, 21.8)	25.7 (19.8, 33.0)	
**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)	23.7 (20.3, 27.5)	
**Cormet	1.5 (0.9, 2.6)	3.5 (2.4, 5.1)	5.2 (3.9, 7.0)	13.9 (11.5, 16.8)	
**DeltaLox	5.9 (3.5, 9.9)	8.7 (5.6, 13.2)	9.6 (6.4, 14.4)		
**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)	17.2 (15.6, 19.0)
**Durom	1.1 (0.7, 1.9)	3.6 (2.7, 4.8)	5.5 (4.3, 6.9)	13.2 (11.4, 15.3)	
**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)	22.8 (18.7, 27.6)	
**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)	
**MBA	4.0 (1.7, 9.4)	8.2 (4.5, 14.8)	10.2 (5.9, 17.2)	16.0 (9.9, 25.3)	
**Mitch TRH	1.5 (0.8, 2.7)	4.6 (3.3, 6.4)	7.7 (6.0, 10.0)	14.7 (12.2, 17.8)	
**Plasmacup	4.4 (2.9, 6.6)	5.6 (3.9, 8.1)	5.9 (4.1, 8.4)		
**SPH-Blind	3.8 (2.8, 5.2)	5.8 (4.5, 7.5)	7.3 (5.8, 9.2)	10.4 (8.6, 12.6)	
**seleXys (excluding seleXys PC)	4.6 (2.9, 7.2)	7.8 (5.5, 11.0)	10.6 (7.9, 14.1)	13.9 (10.4, 18.3)	

Note: * Femoral Component,
**Acetabular Component
+ Newly identified and no longer used

Table IP9 Yearly Usage of Total Conventional Hip Prostheses Identified as having a Higher than Anticipated Rate of Revision

Year of Implant	≤2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Newly Identified	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Accolade II/Trident Tritanium (Shell)	.	.	.	.	.	.	.	.	.	.	1	1	30	119	258	482	394
Avenir/Fitmore	.	.	.	.	.	.	.	.	.	.	.	2	7	5	46	44	42
Corae/Fixa	.	.	.	.	.	.	.	.	.	.	2	9	.	5	20	18	27
Friendly Hip/Delta-TT	.	.	.	.	.	.	.	.	.	14	12	13	13	9	6	4	2
HACTIV/Logical G	.	.	.	.	.	.	.	.	.	.	.	.	.	.	18	169	395
Secur-Fit Plus/PINNACLE	.	.	1	3	.	.	.	.	.	.	.	42	42	53	25	33	31
Re-Identified and Still Used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
CORAIL/Trabecular Metal (Shell)	.	.	.	.	.	5	10	17	21	8	8	8	6	1	6	2	4
CPT/Fitmore	.	.	19	6	6	4	16	12	15	24	14	30	30	22	18	16	20
CPT/Low Profile Cup	.	.	15	9	8	7	7	6	9	16	26	20	6	5	2	3	15
Taperloc/G7	.	.	.	.	.	.	.	.	.	.	.	19	147	334	415	482	502
*Apex	.	.	.	75	247	223	265	197	169	190	219	246	188	193	168	88	60
*Excia (cless)	.	.	.	.	.	.	6	34	8	47	58	38	17	42	35	65	59
*Furlong Evolution	.	.	.	.	.	.	.	.	.	.	.	29	25	32	11	54	102
*ML Taper Kinectiv	.	.	.	.	.	.	36	341	647	576	515	384	345	256	199	159	74
*Novation	.	.	.	.	.	.	.	4	32	53	130	137	226	266	148	90	97
*Taper Fit	30	34	65	50	66	26	18	6	8	17	55	45	110	162	227	315	580
*Trabecular Metal	.	.	.	.	6	101	147	198	242	272	276	186	220	112	106	32	5
**Continuum	.	.	.	.	.	.	.	175	1117	1245	1333	1502	1492	1359	1327	1293	1185
**Delta-One-TT	.	.	.	.	.	.	.	.	4	7	7	15	37	13	12	14	14
**Dynasty	.	.	.	.	.	.	.	.	.	40	31	49	178	298	317	305	304
**Fin II	.	.	.	39	128	175	251	269	318	286	205	247	101	6	.	.	9
**Furlong	27	4	.	.	.	4	7	61	90	85	73	76	64	66	12	55	100
**Mueller	37	3	4	3	.	1	2	.	.	.	1	.	1	1	.	1	1
**Procotyl L	.	.	.	.	.	.	8	32	268	342	67	26	121	104	110	141	172
**Versafitcup DM	.	.	.	.	.	.	.	.	.	10	12	4	19	139	184	193	182
Identified and no longer used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
+**Conserve Plus	.	.	19	16	46	24	15	14	1	.	.	.	.	.	.	.	.
+Linear/Acetabular Shell (Global)	.	.	.	.	.	.	.	.	.	.	.	.	14	62	20	.	.
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	.	.	.	.	.	.	.	.	.	.
*MSA	.	.	.	.	.	2	3	11	58	76	46	21	7	.	.	.	.

Year of Implant	≤2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
*Margron	214	123	140	96	85	28	2	.	.	.	.	.	.	.	.	.	.
*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	.	.	.	.	.	.	.	.
*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	476	404	276	134	27	13	5	1	.	.	.
**Bionik	.	.	.	11	147	136	138	134	38	4	.	.	.	.	.	.	.
**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 Component,
**Acetabular Component
+ Newly identified and no longer used

Figure IP2 Cumulative Percent Revision of Newly Identified Total Conventional Hip Prostheses

Newly Identified

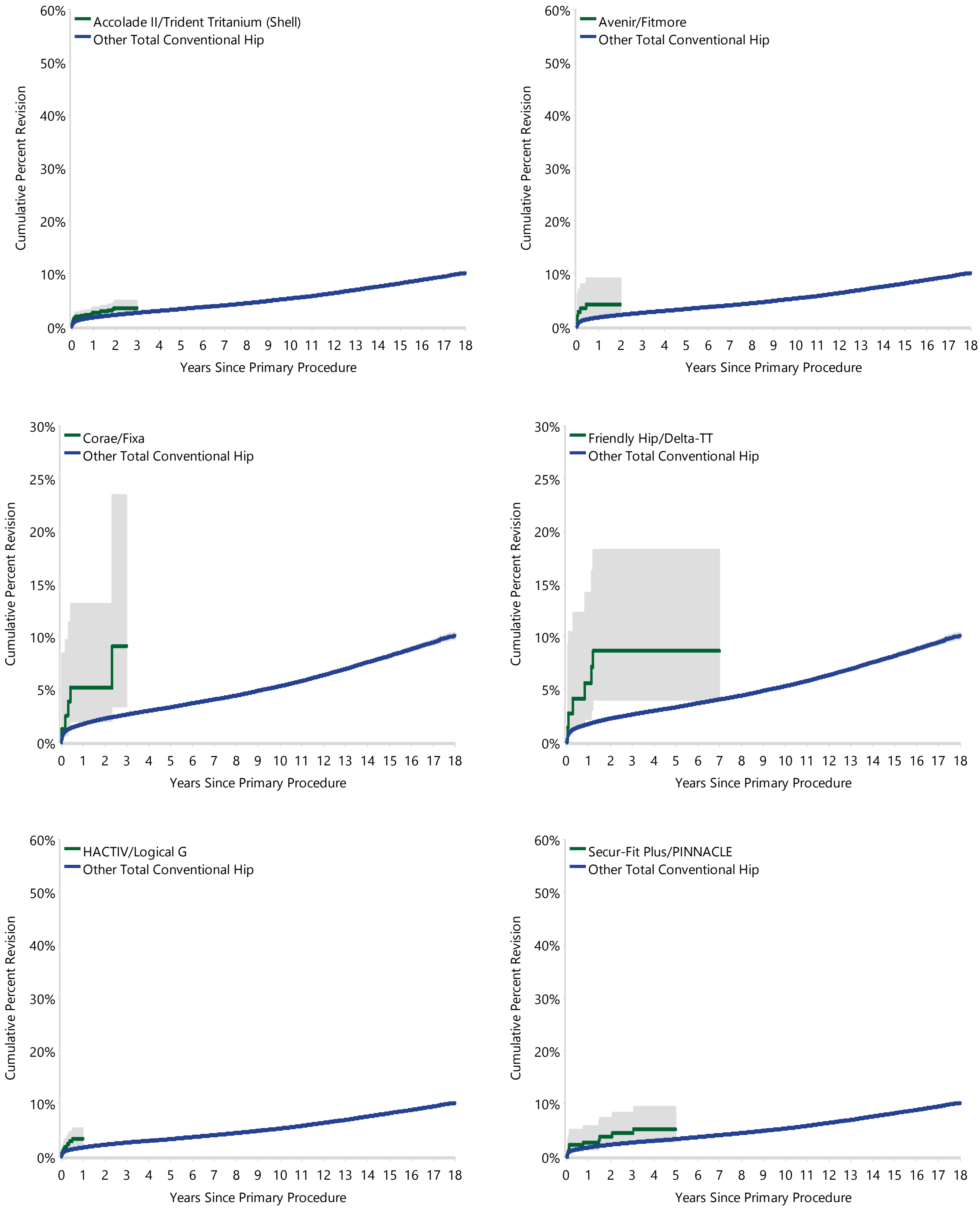
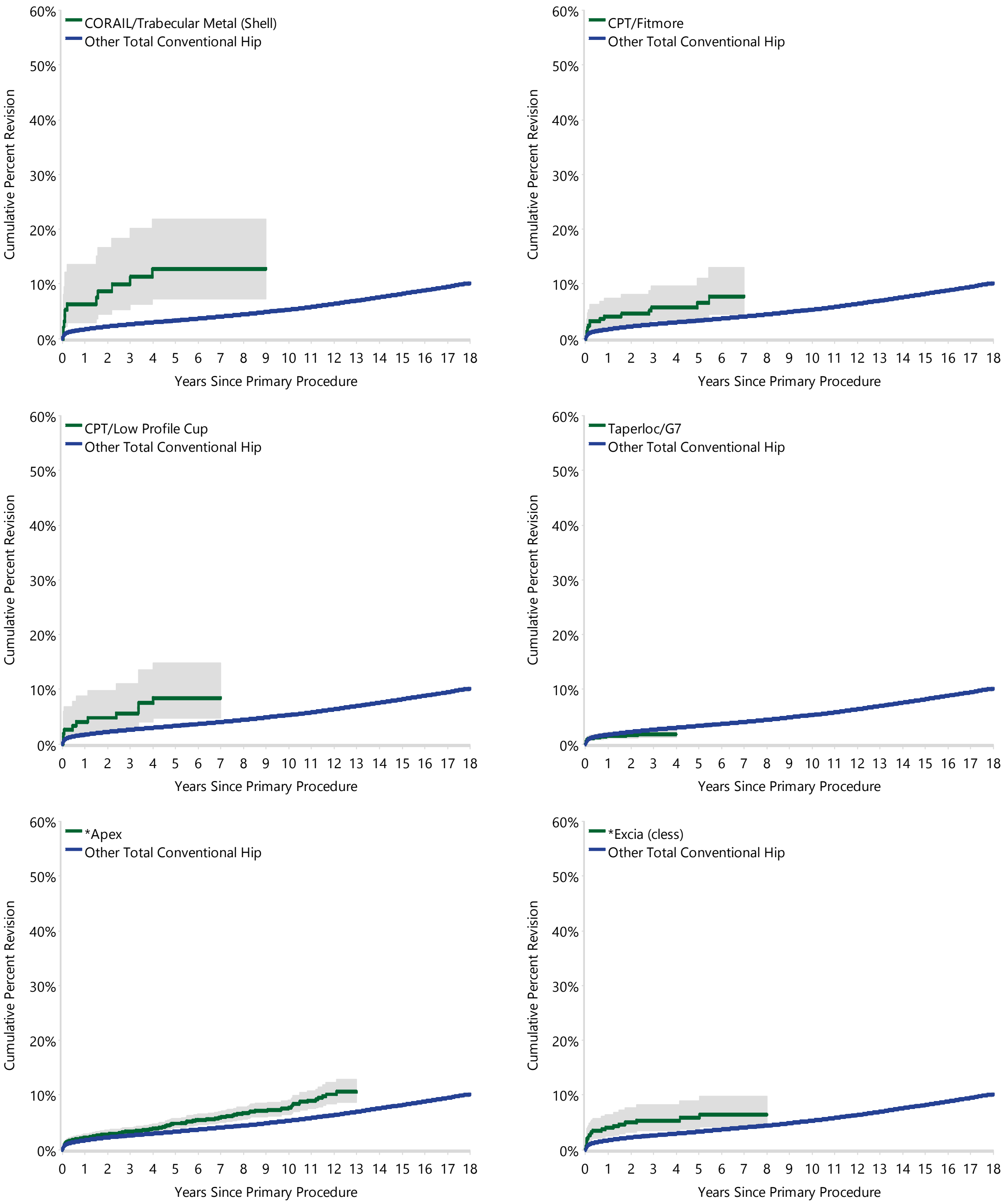
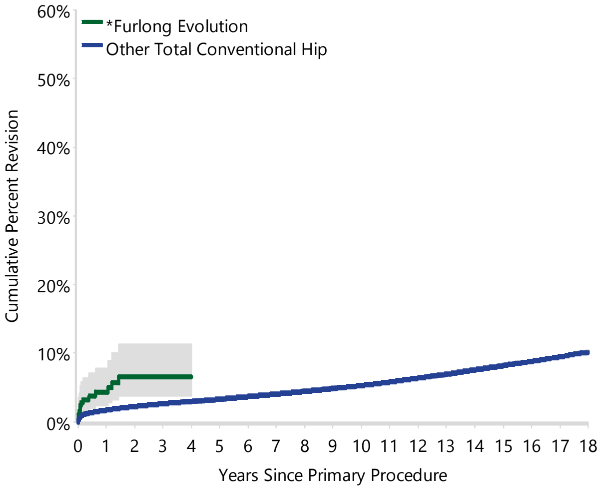
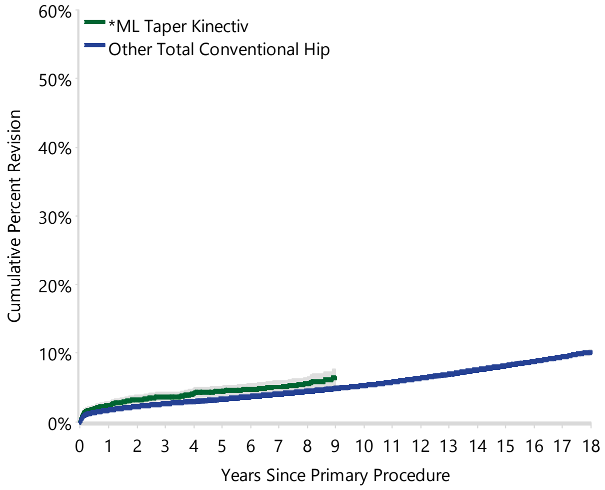


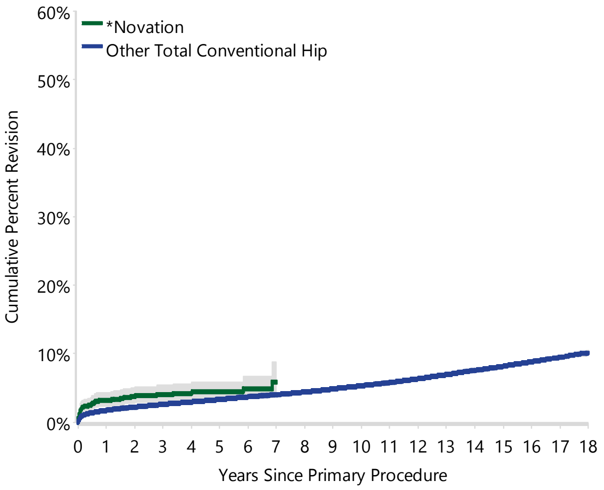
Figure IP3 Cumulative Percent Revision of Re-identified and Still Used Total Conventional Hip Prostheses

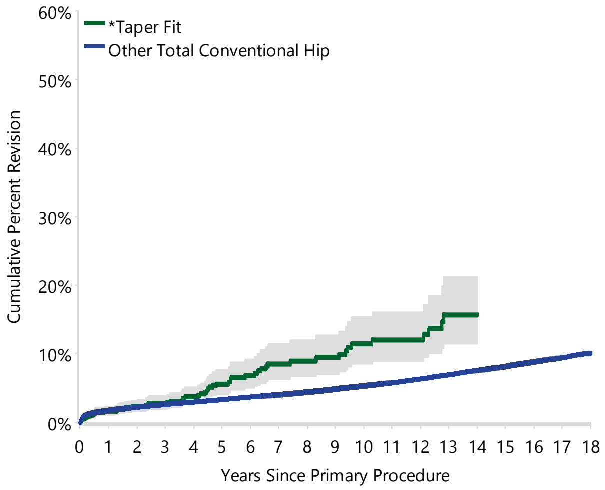
Re-Identified and Still Used

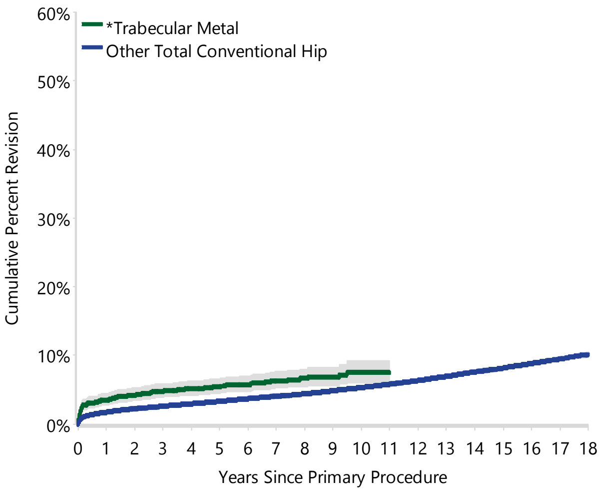


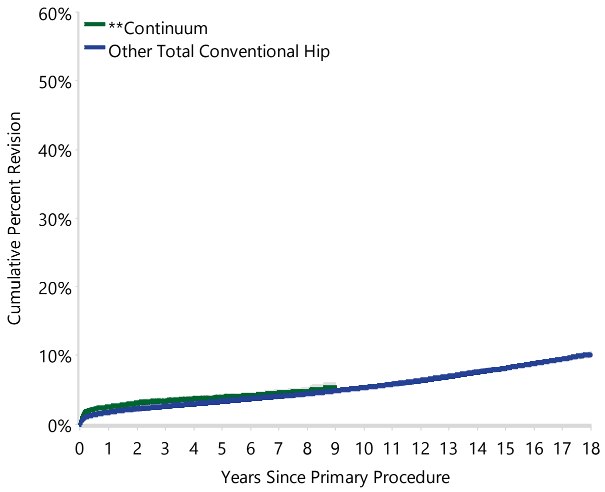

*Furlong Evolution
Other Total Conventional Hip
Cumulative Percent Revision
Years Since Primary Procedure

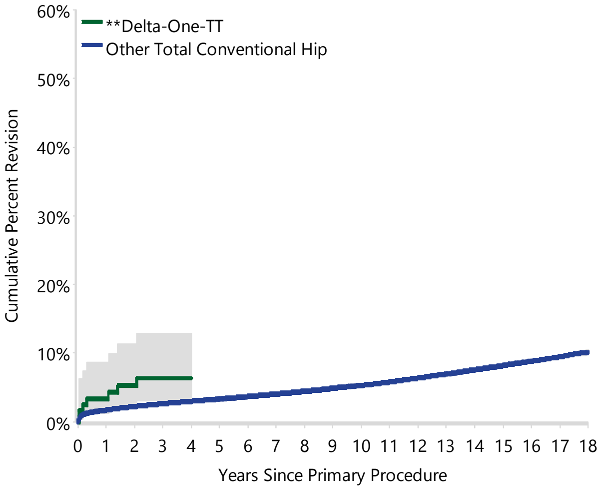

*ML Taper Kinectiv
Other Total Conventional Hip
Cumulative Percent Revision
Years Since Primary Procedure


*Novation
Other Total Conventional Hip
Cumulative Percent Revision
Years Since Primary Procedure

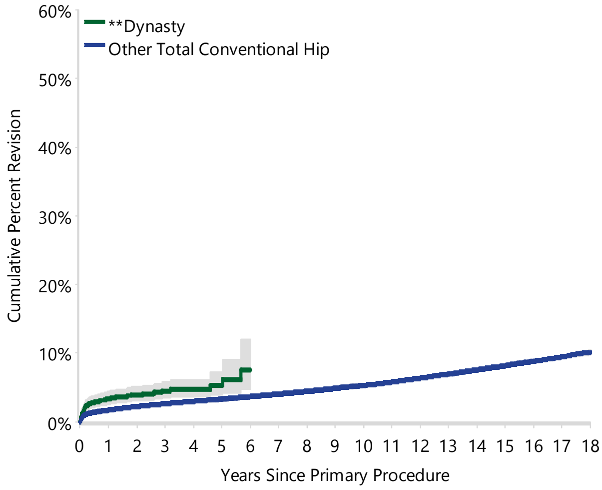

*Taper Fit
Other Total Conventional Hip
Cumulative Percent Revision
Years Since Primary Procedure


*Trabecular Metal
Other Total Conventional Hip
Cumulative Percent Revision
Years Since Primary Procedure

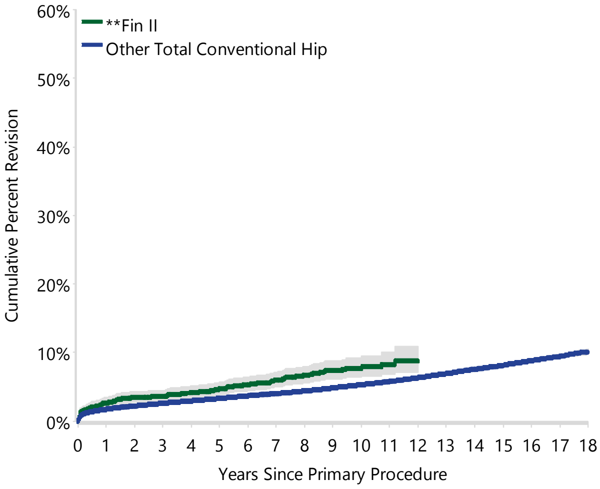

**Continuum
Other Total Conventional Hip
Cumulative Percent Revision
Years Since Primary Procedure



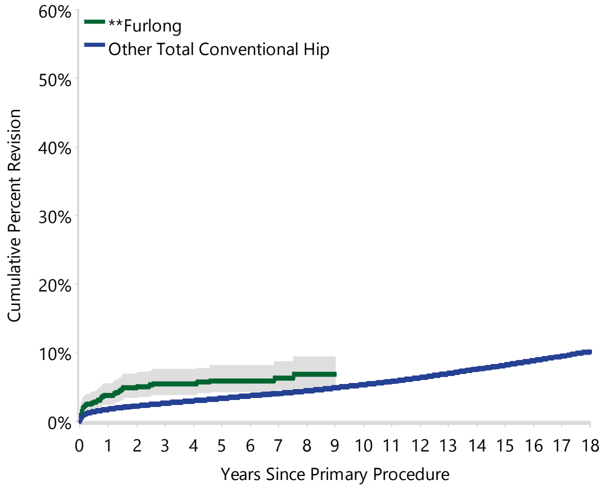
**Delta-One-TT
Other Total Conventional Hip
Cumulative Percent Revision
60%
50%
40%
30%
20%
10%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
Years Since Primary Procedure



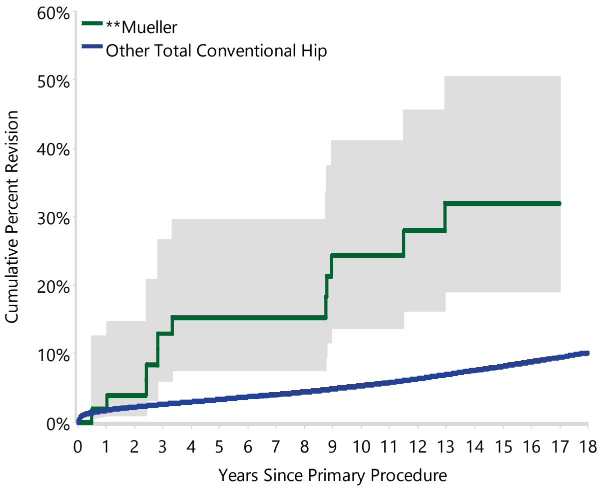
**Dynasty
Other Total Conventional Hip
Cumulative Percent Revision
60%
50%
40%
30%
20%
10%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
Years Since Primary Procedure



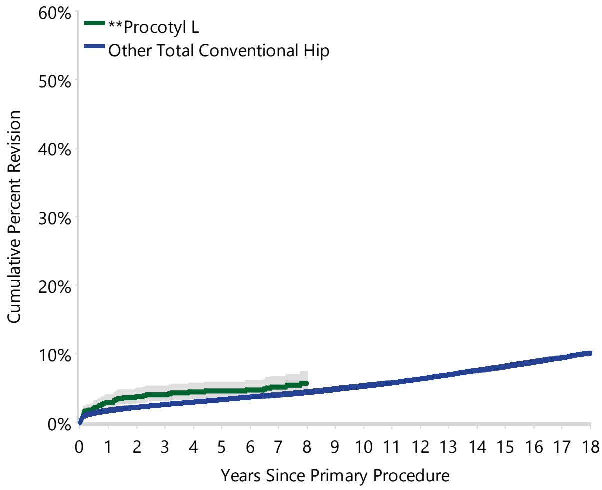
**Fin II
Other Total Conventional Hip
Cumulative Percent Revision
60%
50%
40%
30%
20%
10%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
Years Since Primary Procedure



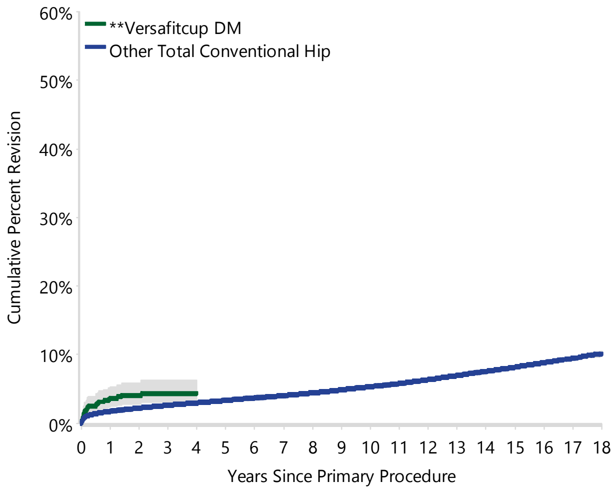
**Furlong
Other Total Conventional Hip
Cumulative Percent Revision
60%
50%
40%
30%
20%
10%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
Years Since Primary Procedure



**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
Years Since Primary Procedure



**Procotyl L
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
Years Since Primary Procedure



Note: *Femoral Component
**Acetabular Component

TOTAL RESURFACING

There are no newly identified total hip resurfacing hip prostheses.

Table IP10 Revision Rate of Total Resurfacing Hip Prostheses Identified as having a Higher than Anticipated Rate of Revision

Head/Acetabular	N Revised	N Total	Obs. Years	Revisions/100 Obs. Yrs	Hazard Ratio, P Value
Identified and no longer used	.	.	.	.	
ASR/ASR	382	1168	11677	3.27	0 - 3Mth: HR=1.77 (1.08, 2.90),p=0.023
	.	.	.	.	3Mth - 3Yr: HR=2.42 (1.86, 3.15),p<0.001
	.	.	.	.	3Yr - 4Yr: HR=5.08 (3.43, 7.53),p<0.001
	.	.	.	.	4Yr - 4.5Yr: HR=6.88 (4.34, 10.89),p<0.001
	.	.	.	.	4.5Yr - 5Yr: HR=9.24 (5.87, 14.54),p<0.001
	.	.	.	.	5Yr - 5.5Yr: HR=5.34 (3.13, 9.10),p<0.001
	.	.	.	.	5.5Yr - 7.5Yr: HR=6.55 (5.08, 8.44),p<0.001
	.	.	.	.	7.5Yr+: HR=3.33 (2.67, 4.16),p<0.001
Bionik/Bionik	53	200	1765	3.00	Entire Period: HR=3.34 (2.54, 4.39),p<0.001
Conserve Plus/Conserve Plus	15	63	765	1.96	Entire Period: HR=1.78 (1.07, 2.95),p=0.026
Cormet/Cormet	119	626	6541	1.82	Entire Period: HR=1.86 (1.55, 2.25),p<0.001
Durom/Durom	102	847	9621	1.06	0 - 4.5Yr: HR=1.81 (1.40, 2.35),p<0.001
	.	.	.	.	4.5Yr+: HR=0.75 (0.54, 1.03),p=0.075
Recap/Recap	29	196	1913	1.52	0 - 6Mth: HR=2.46 (1.09, 5.52),p=0.030
	.	.	.	.	6Mth - 1.5Yr: HR=5.18 (2.54, 10.56),p<0.001
	.	.	.	.	1.5Yr+: HR=1.09 (0.65, 1.81),p=0.743
*Cormet 2000 HAP	23	95	1200	1.92	Entire Period: HR=2.24 (1.49, 3.39),p<0.001

Note: Components have been compared to all other total resurfacing hip components
*Head Component

Table IP11 Cumulative Percent Revision of Total Resurfacing Hip Prostheses Identified as having a Higher than Anticipated Rate of Revision

CPR	1 Yr	3 Yrs	5 Yrs	10 Yrs	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)	29.9 (27.3, 32.6)	
Bionik/Bionik	3.5 (1.7, 7.2)	12.0 (8.2, 17.4)	17.6 (13.0, 23.6)	25.4 (19.9, 32.1)	
Conserve Plus/Conserve Plus	4.8 (1.6, 14.0)	6.4 (2.4, 16.1)	9.6 (4.4, 20.1)	12.8 (6.6, 24.0)	
Cormet/Cormet	2.1 (1.2, 3.6)	5.6 (4.1, 7.7)	9.7 (7.6, 12.3)	17.1 (14.3, 20.4)	
Durom/Durom	3.3 (2.3, 4.8)	5.6 (4.2, 7.3)	7.7 (6.1, 9.7)	11.0 (9.1, 13.4)	
Recap/Recap	5.1 (2.8, 9.3)	8.7 (5.5, 13.6)	10.2 (6.7, 15.4)	14.6 (10.3, 20.5)	
*Cormet 2000 HAP	6.3 (2.9, 13.5)	8.4 (4.3, 16.1)	9.5 (5.0, 17.4)	20.0 (13.3, 29.6)	

Note: * Head Component

Table IP12 Yearly Usage of Total Resurfacing Hip Prostheses Identified as having a Higher than Anticipated Rate of Revision

Year of Implant	≤2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
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.

The Vanguard trochlear prosthesis is no longer identified as it does not have a significantly higher rate of revision. The prosthesis has no recorded use since 2015.

Table IP13 Revision Rate of Patella/Trochlear Knee Prostheses Identified as having a Higher than Anticipated Rate of Revision

Patella/Trochlear	N Revised	N Total	Obs. Years	Revisions/100 Obs. Yrs	Hazard Ratio, P Value
Identified and no longer used	.	.	.	.	
**LCS	188	413	3669	5.12	Entire Period: HR=1.71 (1.45, 2.02),p<0.001

Note: Components have been compared to all other patella/trochlear knee components
** Trochlear Component

Table IP14 Cumulative Percent Revision of Patella/Trochlear Knee Prostheses Identified as having a Higher than Anticipated Rate of Revision

CPR	1 Yr	3 Yrs	5 Yrs	10 Yrs	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)	40.7 (35.9, 45.8)	

Note: ** Trochlear Component

Table IP15 Yearly Usage of Patella/Trochlear Knee Prostheses Identified as having a Higher than Anticipated Rate of Revision

Year of Implant	≤2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
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 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	29	153	525	5.53	Entire Period: HR=2.99 (2.08, 4.31),p<0.001
Identified and no longer used	.	.	.	.	
Advance/Advance	16	37	299	5.34	Entire Period: HR=3.51 (2.15, 5.73),p<0.001
BalanSys Uni/BalanSys Uni Mobile	51	199	1988	2.57	0 - 6Mth: HR=4.19 (2.09, 8.43),p<0.001
	.	.	.	.	6Mth+: HR=1.34 (0.99, 1.81),p=0.057
Uniglide/Uniglide	156	754	6920	2.25	0 - 1.5Yr: HR=1.99 (1.51, 2.63),p<0.001
	.	.	.	.	1.5Yr+: HR=1.11 (0.91, 1.34),p=0.304
**Preservation Mobile	139	400	4454	3.12	0 - 1.5Yr: HR=2.26 (1.62, 3.16),p<0.001
	.	.	.	.	1.5Yr - 3Yr: HR=2.85 (1.95, 4.18),p<0.001
	.	.	.	.	3Yr+: HR=1.25 (1.00, 1.57),p=0.050

Note: Components have been compared to all other unicompartmental knee components
** Tibial Component

Table IP17 Cumulative Percent Revision of Unicompartmental Knee Prostheses Identified as having a Higher than Anticipated Rate of Revision

CPR	1 Yr	3 Yrs	5 Yrs	10 Yrs	18 Yrs
Re-Identified and Still Used					
GMK-UNI/GMK-UNI	6.6 (3.5, 12.3)	19.1 (13.1, 27.4)	24.2 (17.1, 33.7)		
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)	
Uniglide/Uniglide	4.8 (3.5, 6.6)	10.6 (8.6, 13.1)	12.9 (10.6, 15.5)	19.9 (17.1, 23.1)	
**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

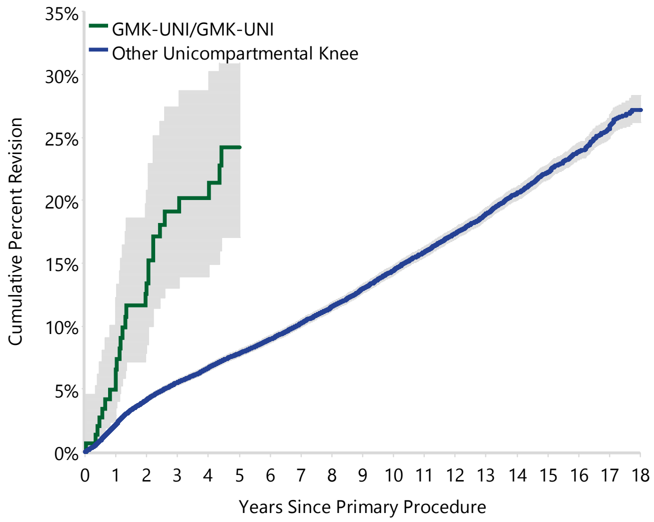
Table IP18 Yearly Usage of Unicompartmental Knee Prostheses Identified as having a Higher than Anticipated Rate of Revision

Year of Implant	≤2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Re-Identified and Still Used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
GMK-UNI/GMK-UNI	.	.	.	.	.	.	5	10	2	.	21	22	16	19	17	12	29
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	.	.	.	.	.	.	.	.
Uniglide/Uniglide	.	80	66	123	84	107	93	61	30	38	25	22	9	5	8	3	.
**Preservation Mobile	164	121	59	26	17	13	.	.	.	.	.	.	.	.	.	.	.

Note: ** Tibial Component

Figure IP4 Cumulative Percent Revision of Re-identified and Still Used Unicompartmental Knee Prostheses

Re-identified and Still Used



PRIMARY TOTAL KNEE REPLACEMENT

The Score (cementless)/Score (cemented) combination is newly identified. The combination has been used in 1,315 procedures since 2004. The 5 year cumulative percent revision is 5.3%. Of the 52 revisions, 40 were major and 12 were minor. The most common reasons for revision were loosening (n=17, 32.7%), infection (n=17, 32.7%) and instability (n=7, 13.5%).

The Optetrak-CR (cemented)/Optetrak (cemented) combination is identified for the first time and no longer used.

The previously identified Vanguard PS/Maxim combination is now named Vanguard PS/Vanguard.

Table IP19 Revision Rate of Total Knee Prostheses Identified as having a Higher than Anticipated Rate of Revision

Femoral/Tibial	N Revised	N Total	Obs. Years	Revisions/100 Obs. Yrs	Hazard Ratio, P Value
Newly Identified	.	.	.	.	
Score (cless)/Score (ctd)	52	1315	3746	1.39	Entire Period: HR=1.55 (1.18, 2.03),p=0.001
Re-Identified and Still Used	.	.	.	.	
ACS (cless)/ACS Fixed	87	1874	6072	1.43	Entire Period: HR=1.71 (1.39, 2.12),p<0.001
Active Knee (cless)/Active Knee	589	7152	62478	0.94	0 - 3Yr: HR=1.22 (1.07, 1.38),p=0.002
	.	.	.	.	3Yr+: HR=1.89 (1.70, 2.11),p<0.001
Advance/Advance	53	916	4858	1.09	Entire Period: HR=1.55 (1.18, 2.03),p=0.001
Apex Knee CR (cless)/Apex Knee (cless)	23	391	1649	1.39	Entire Period: HR=1.82 (1.21, 2.74),p=0.004
Columbus/Columbus	108	2222	9133	1.18	Entire Period: HR=1.83 (1.52, 2.21),p<0.001
E.Motion/E.Motion	68	1158	4819	1.41	0 - 1.5Yr: HR=2.57 (1.92, 3.44),p<0.001
	.	.	.	.	1.5Yr+: HR=1.25 (0.83, 1.88),p=0.283
Nexgen LPS Flex (cless)/Nexgen	81	1824	6569	1.23	0 - 1.5Yr: HR=1.92 (1.46, 2.53),p<0.001
	.	.	.	.	1.5Yr+: HR=1.23 (0.86, 1.76),p=0.251
Optetrak-PS/Optetrak	220	2408	20810	1.06	Entire Period: HR=1.84 (1.61, 2.10),p<0.001
Optetrak-PS/Optetrak RBK	74	1114	7134	1.04	Entire Period: HR=1.72 (1.37, 2.16),p<0.001
Score (cless)/Score (cless)	169	2263	11192	1.51	0 - 9Mth: HR=1.23 (0.81, 1.85),p=0.327
	.	.	.	.	9Mth+: HR=2.17 (1.85, 2.56),p<0.001
Scorpio NRG PS (cless)/Series 7000 (cless)	76	1172	7585	1.00	Entire Period: HR=1.35 (1.08, 1.69),p=0.008
Trekking/Trekking	42	1076	3839	1.09	0 - 1.5Yr: HR=1.74 (1.20, 2.52),p=0.003
	.	.	.	.	1.5Yr - 2Yr: HR=0.28 (0.04, 2.01),p=0.206
	.	.	.	.	2Yr+: HR=1.17 (0.68, 2.02),p=0.570
Vanguard PS/Regenerex	25	448	2022	1.24	0 - 9Mth: HR=3.13 (1.73, 5.65),p<0.001
	.	.	.	.	9Mth+: HR=1.20 (0.71, 2.03),p=0.490
Vanguard PS/Vanguard	274	4909	27549	0.99	0 - 1.5Yr: HR=1.81 (1.53, 2.14),p<0.001
	.	.	.	.	1.5Yr+: HR=1.27 (1.07, 1.51),p=0.005
**Legion Revision Tibial Baseplate	38	627	2921	1.30	0 - 3Mth: HR=5.25 (2.98, 9.25),p<0.001
	.	.	.	.	3Mth - 1.5Yr: HR=0.91 (0.43, 1.90),p=0.793
	.	.	.	.	1.5Yr+: HR=1.46 (0.93, 2.28),p=0.102
Identified and no longer used	.	.	.	.	
+Optetrak-CR (ctd)/Optetrak (ctd)	9	92	693	1.30	Entire Period: HR=2.29 (1.19, 4.41),p=0.012
ACS/ACS Mobile PC (cless)	26	131	636	4.09	Entire Period: HR=5.42 (3.70, 7.95),p<0.001
AMK/AMK	24	203	2392	1.00	Entire Period: HR=1.94 (1.30, 2.90),p=0.001
Buechel-Pappas/Buechel-Pappas	46	479	3995	1.15	Entire Period: HR=1.89 (1.41, 2.52),p<0.001
Eska RP/Eska RP	9	40	319	2.82	Entire Period: HR=5.44 (2.85, 10.40),p<0.001
Evolis (cless)/Evolis (cless)	9	87	573	1.57	Entire Period: HR=2.29 (1.19, 4.38),p=0.012
Gemini MK II/Gemini MK II	7	21	205	3.42	Entire Period: HR=5.96 (2.86, 12.42),p<0.001
Genesis (ctd)/Genesis (ctd)	11	62	650	1.69	Entire Period: HR=3.43 (1.90, 6.19),p<0.001

Femoral/Tibial	N Revised	N Total	Obs. Years	Revisions/100 Obs. Yrs	Hazard Ratio, P Value
Genesis II CR (cless)/Profix Mobile (ctd)	33	241	2521	1.31	Entire Period: HR=2.49 (1.77, 3.50),p<0.001
Genesis II Oxinium CR (cless)/Genesis II	47	110	906	5.19	0 - 1.5Yr: HR=12.91 (8.66, 19.25),p<0.001
	.	.	.	.	1.5Yr - 2.5Yr: HR=21.30 (12.83, 35.36),p<0.001
	.	.	.	.	2.5Yr+: HR=2.57 (1.28, 5.13),p=0.007
Genesis II Oxinium CR (cless)/Profix Mobile	56	88	570	9.83	0 - 6Mth: HR=7.38 (2.77, 19.67),p<0.001
	.	.	.	.	6Mth - 9Mth: HR=47.73 (26.42, 86.23),p<0.001
	.	.	.	.	9Mth - 1.5Yr: HR=34.04 (22.17, 52.26),p<0.001
	.	.	.	.	1.5Yr - 2Yr: HR=28.06 (13.36, 58.92),p<0.001
	.	.	.	.	2Yr+: HR=5.92 (3.44, 10.20),p<0.001
Genesis II Oxinium PS (ctd)/Genesis II (cless)	17	56	362	4.69	0 - 1Yr: HR=16.48 (9.16, 29.66),p<0.001
	.	.	.	.	1Yr+: HR=3.08 (1.38, 6.85),p=0.005
Genesis II Oxinium PS (ctd)/Genesis II (keel)	65	269	2501	2.60	Entire Period: HR=4.57 (3.59, 5.83),p<0.001
HLS Noetos/HLS Noetos	37	294	2402	1.54	Entire Period: HR=2.59 (1.88, 3.58),p<0.001
IB II/IB II	35	199	2413	1.45	0 - 2Yr: HR=0.83 (0.27, 2.58),p=0.748
	.	.	.	.	2Yr - 2.5Yr: HR=4.71 (1.52, 14.62),p=0.007
	.	.	.	.	2.5Yr+: HR=4.21 (2.92, 6.06),p<0.001
Interax/Interax	11	52	506	2.17	0 - 3.5Yr: HR=1.47 (0.37, 5.88),p=0.585
	.	.	.	.	3.5Yr+: HR=7.85 (4.09, 15.09),p<0.001
Journey Oxinium/Journey	291	3033	23692	1.23	0 - 3Mth: HR=0.29 (0.09, 0.90),p=0.031
	.	.	.	.	3Mth - 1.5Yr: HR=1.98 (1.58, 2.47),p<0.001
	.	.	.	.	1.5Yr - 2Yr: HR=1.57 (1.02, 2.42),p=0.038
	.	.	.	.	2Yr - 2.5Yr: HR=2.08 (1.38, 3.14),p<0.001
	.	.	.	.	2.5Yr - 3Yr: HR=1.43 (0.81, 2.52),p=0.219
	.	.	.	.	3Yr+: HR=2.51 (2.14, 2.94),p<0.001
Optetrak-PS/Optetrak-PS	14	55	486	2.88	Entire Period: HR=5.62 (3.33, 9.49),p<0.001
PFC Sigma PS (ctd)/MBT (cless)	24	316	1966	1.22	Entire Period: HR=1.72 (1.15, 2.56),p=0.008
Profix Oxinium (cless)/Profix	32	75	653	4.90	0 - 9Mth: HR=5.83 (2.19, 15.52),p<0.001
	.	.	.	.	9Mth - 2Yr: HR=23.50 (15.31, 36.06),p<0.001
	.	.	.	.	2Yr+: HR=2.74 (1.30, 5.74),p=0.007
Profix Oxinium (cless)/Profix Mobile	71	158	1250	5.68	0 - 9Mth: HR=3.09 (1.16, 8.21),p=0.023
	.	.	.	.	9Mth - 1.5Yr: HR=23.48 (16.30, 33.83),p<0.001
	.	.	.	.	1.5Yr - 2Yr: HR=16.01 (8.32, 30.80),p<0.001
	.	.	.	.	2Yr - 2.5Yr: HR=33.02 (19.53, 55.83),p<0.001
	.	.	.	.	2.5Yr - 3Yr: HR=21.18 (9.50, 47.23),p<0.001
	.	.	.	.	3Yr+: HR=2.44 (1.27, 4.69),p=0.007
Profix Oxinium (ctd)/Profix (cless)	13	100	1068	1.22	Entire Period: HR=1.89 (1.10, 3.25),p=0.021
Profix Oxinium (ctd)/Profix Mobile	28	228	2735	1.02	Entire Period: HR=1.65 (1.14, 2.40),p=0.007
Profix/Profix Mobile	106	1005	11059	0.96	0 - 1.5Yr: HR=2.55 (1.87, 3.48),p<0.001
	.	.	.	.	1.5Yr - 2.5Yr: HR=2.77 (1.81, 4.26),p<0.001
	.	.	.	.	2.5Yr - 3Yr: HR=1.15 (0.37, 3.59),p=0.803
	.	.	.	.	3Yr - 3.5Yr: HR=2.08 (0.86, 5.01),p=0.101
	.	.	.	.	3.5Yr - 4Yr: HR=1.48 (0.48, 4.60),p=0.496
	.	.	.	.	4Yr - 6.5Yr: HR=1.72 (1.02, 2.91),p=0.043
	.	.	.	.	6.5Yr+: HR=0.94 (0.60, 1.45),p=0.764
Rotaglide Plus/Rotaglide Plus	79	631	6964	1.13	0 - 1.5Yr: HR=1.23 (0.70, 2.16),p=0.481
	.	.	.	.	1.5Yr - 2Yr: HR=3.06 (1.53, 6.13),p=0.001
	.	.	.	.	2Yr+: HR=2.36 (1.83, 3.05),p<0.001
SAL/SAL	13	56	690	1.88	0 - 8.5Yr: HR=1.45 (0.54, 3.86),p=0.457
	.	.	.	.	8.5Yr+: HR=7.99 (4.17, 15.33),p<0.001
TC-Plus (cless)/TC-Plus (ctd)	8	63	630	1.27	Entire Period: HR=2.57 (1.29, 5.12),p=0.007
Trac/Trac	27	138	1570	1.72	Entire Period: HR=3.06 (2.10, 4.47),p<0.001

Femoral/Tibial	N Revised	N Total	Obs. Years	Revisions/100 Obs. Yrs	Hazard Ratio, P Value
*LCS Duofix	615	4866	44729	1.37	0 - 2Yr: HR=1.79 (1.54, 2.08),p<0.001
	.	.	.	.	2Yr - 3.5Yr: HR=3.73 (3.18, 4.38),p<0.001
	.	.	.	.	3.5Yr - 4Yr: HR=5.24 (3.95, 6.95),p<0.001
	.	.	.	.	4Yr - 5.5Yr: HR=4.36 (3.59, 5.29),p<0.001
	.	.	.	.	5.5Yr - 6.5Yr: HR=2.91 (2.14, 3.96),p<0.001
	.	.	.	.	6.5Yr+: HR=1.30 (1.04, 1.62),p=0.020
*LCS PS	65	638	4342	1.50	Entire Period: HR=2.45 (1.92, 3.13),p<0.001
*Renasys	15	121	1260	1.19	Entire Period: HR=2.25 (1.36, 3.73),p=0.001

Note: Components have been compared to all other total knee components
* Femoral Component
+ Newly identified and no longer used
** Tibial Component

Table IP20 Cumulative Percent Revision of Total Knee Prostheses Identified as having a Higher than Anticipated Rate of Revision

CPR	1 Yr	3 Yrs	5 Yrs	10 Yrs	18 Yrs
Newly Identified					
Score (cless)/Score (ctd)	1.8 (1.2, 2.7)	4.6 (3.5, 6.0)	5.3 (4.0, 7.0)		
Re-Identified and Still Used					
ACS (cless)/ACS Fixed	1.7 (1.2, 2.4)	5.2 (4.2, 6.4)	5.5 (4.4, 6.9)		
Active Knee (cless)/Active Knee	1.1 (0.9, 1.4)	3.5 (3.1, 4.0)	5.0 (4.6, 5.6)	8.9 (8.1, 9.6)	
Advance/Advance	1.9 (1.2, 3.1)	5.1 (3.8, 6.8)	6.0 (4.5, 7.9)	9.1 (6.4, 13.0)	
Apex Knee CR (cless)/Apex Knee (cless)	2.7 (1.4, 4.9)	6.0 (4.0, 9.0)	6.4 (4.3, 9.4)		
Columbus/Columbus	1.4 (0.9, 2.0)	5.1 (4.1, 6.5)	6.6 (5.4, 8.2)	10.0 (8.1, 12.2)	
E.Motion/E.Motion	2.6 (1.8, 3.7)	6.1 (4.8, 7.8)	6.9 (5.4, 8.7)		
Nexgen LPS Flex (cless)/Nexgen	2.5 (1.8, 3.3)	4.6 (3.6, 5.7)	5.6 (4.5, 7.0)		
Optetrak-PS/Optetrak	1.5 (1.1, 2.0)	4.8 (4.0, 5.7)	6.4 (5.4, 7.4)	9.8 (8.5, 11.2)	
Optetrak-PS/Optetrak RBK	1.8 (1.1, 2.8)	4.8 (3.6, 6.3)	5.9 (4.6, 7.6)	8.9 (7.0, 11.2)	
Score (cless)/Score (cless)	1.7 (1.2, 2.3)	5.5 (4.6, 6.6)	7.6 (6.5, 9.0)	12.9 (10.6, 15.6)	
Scorpio NRG PS (cless)/Series 7000 (cless)	1.2 (0.7, 2.0)	5.2 (4.0, 6.7)	6.5 (5.2, 8.2)	8.1 (6.4, 10.4)	
Trekking/Trekking	2.2 (1.5, 3.4)	3.4 (2.4, 4.8)	4.3 (3.0, 6.0)		
Vanguard PS/Regenerex	3.5 (2.1, 5.8)	5.9 (3.9, 8.7)	5.9 (3.9, 8.7)		
Vanguard PS/Vanguard	1.8 (1.5, 2.3)	4.3 (3.7, 4.9)	5.4 (4.8, 6.1)	7.9 (6.8, 9.2)	
**Legion Revision Tibial Baseplate	2.6 (1.6, 4.3)	4.5 (3.0, 6.6)	5.7 (3.9, 8.1)	9.4 (6.6, 13.4)	
Identified and no longer used					
+Optetrak-CR (ctd)/Optetrak (ctd)	0.0 (0.0, 0.0)	6.6 (3.0, 14.0)	9.4 (4.7, 18.0)	9.4 (4.7, 18.0)	
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)	
Buechel-Pappas/Buechel-Pappas	1.9 (1.0, 3.6)	5.7 (3.9, 8.2)	7.9 (5.8, 10.7)	10.3 (7.7, 13.7)	
Eska RP/Eska RP	7.5 (2.5, 21.5)	12.7 (5.5, 27.9)	18.2 (9.1, 34.5)	21.1 (11.1, 37.9)	
Evolis (cless)/Evolis (cless)	2.3 (0.6, 8.9)	8.0 (3.9, 16.1)	10.7 (5.7, 19.6)	10.7 (5.7, 19.6)	
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)	13.9 (9.9, 19.5)	
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)		
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)	13.2 (9.6, 17.9)	
IB II/IB II	0.0 (0.0, 0.0)	3.5 (1.7, 7.3)	7.8 (4.8, 12.6)	15.3 (10.8, 21.4)	
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, 12.6)	
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, 10.6)		
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)	9.9 (8.2, 12.0)	
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)	
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 (12.0, 14.0)	
*LCS PS	2.1 (1.2, 3.5)	6.7 (5.0, 9.0)	8.5 (6.6, 11.0)		
*Renasys	2.5 (0.8, 7.5)	4.2 (1.8, 9.8)	8.5 (4.6, 15.1)	11.2 (6.7, 18.5)	

Note: * Femoral Component
+ Newly identified and no longer used
** Tibial Component

Table IP21 Yearly Usage of 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
Newly Identified	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Score (cless)/Score (ctd)	.	.	3	.	.	3	3	3	.	5	15	90	181	324	300	267	121
Re-Identified and Still Used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
ACS (cless)/ACS Fixed	.	.	.	.	.	.	.	.	.	41	119	283	337	332	238	266	258
Active Knee (cless)/Active Knee	221	613	790	693	466	510	483	412	479	601	500	427	319	336	176	91	35
Advance/Advance	53	.	8	12	16	2	5	43	115	138	74	7	92	92	100	90	69
Apex Knee CR (cless)/Apex Knee (cless)	.	.	.	.	.	.	.	.	.	.	69	83	118	78	11	3	29
Columbus/Columbus	.	.	.	49	91	90	148	156	134	136	108	69	36	60	119	357	669
E.Motion/E.Motion	.	.	.	.	.	.	.	12	87	114	129	236	106	113	125	140	96
Nexgen LPS Flex (cless)/Nexgen	.	.	.	.	.	.	.	.	73	78	149	312	238	280	225	251	218
Optetrak-PS/Optetrak	126	130	155	252	253	216	168	202	198	202	200	151	115	30	3	5	2
Optetrak-PS/Optetrak RBK	.	.	.	1	81	173	166	119	82	40	37	50	100	56	46	88	75
Score (cless)/Score (cless)	.	.	.	1	.	11	135	212	187	204	196	238	273	263	170	159	214
Scorpio NRG PS (cless)/Series 7000 (cless)	.	.	.	.	.	76	185	171	166	114	67	71	76	72	77	69	28
Trekking/Trekking	.	.	.	.	.	.	.	.	35	102	133	107	108	106	129	214	142
Vanguard PS/Regenerex	.	.	.	.	.	.	.	4	121	54	27	15	21	18	76	59	53
Vanguard PS/Vanguard	.	.	.	22	81	145	321	430	478	607	561	451	523	445	331	309	205
**Legion Revision Tibial Baseplate	.	.	.	.	16	33	48	40	56	47	63	54	47	38	50	49	86
Identified and no longer used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
+Optetrak-CR (ctd)/Optetrak (ctd)	7	7	6	2	9	7	7	4	.	5	6	8	24	.	.	.	.
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-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
SAL/SAL	56	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
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
+ Newly identified and no longer used
**Tibial Component

Figure IP5 Cumulative Percent Revision of Newly Identified Total Knee Prostheses

Newly Identified

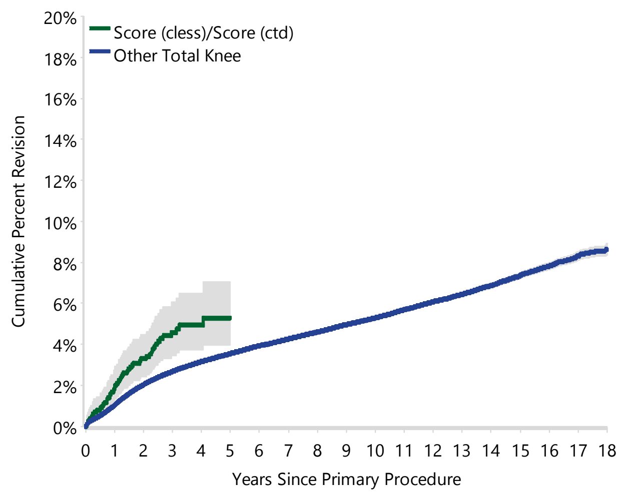
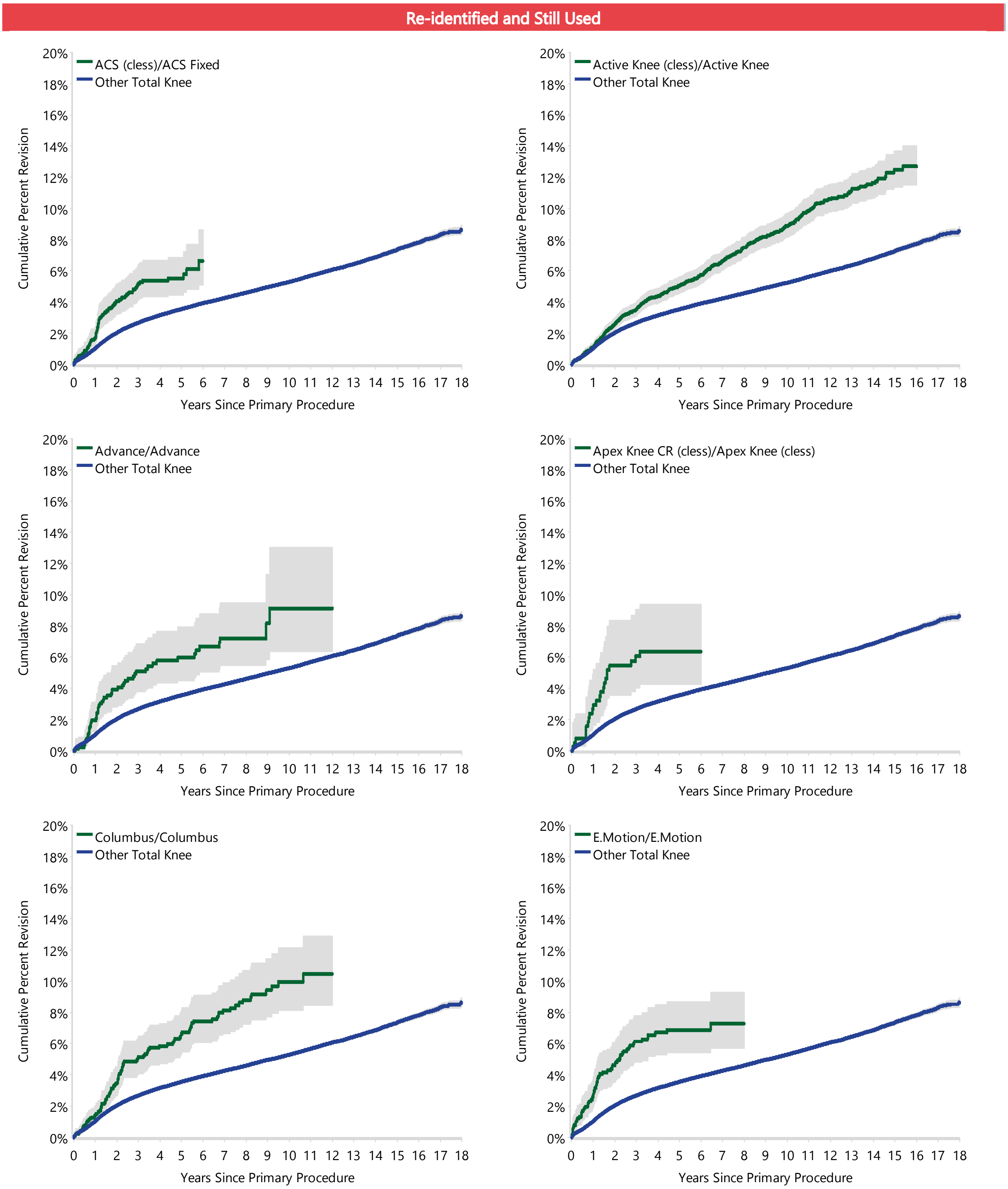
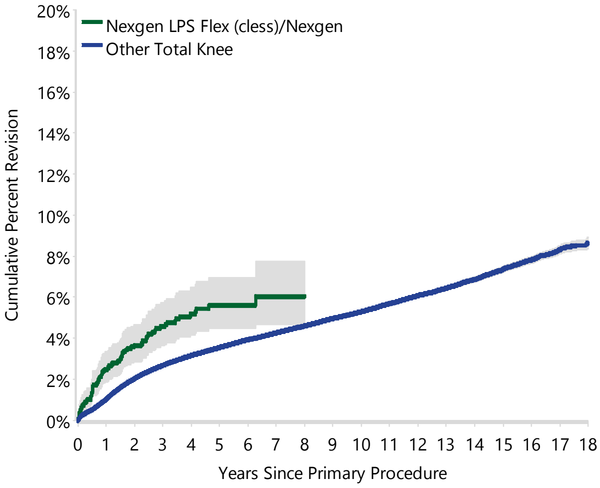
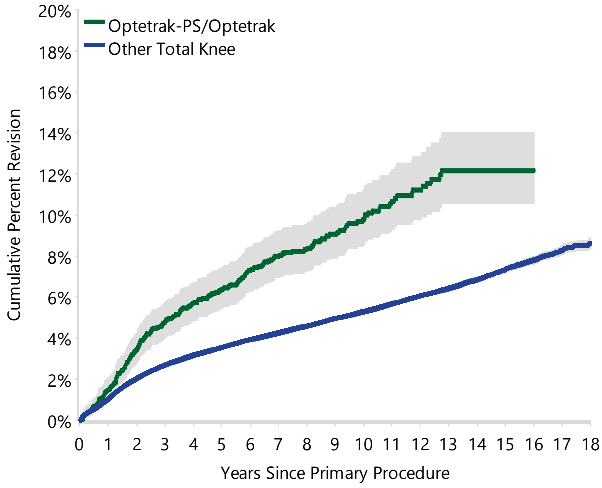
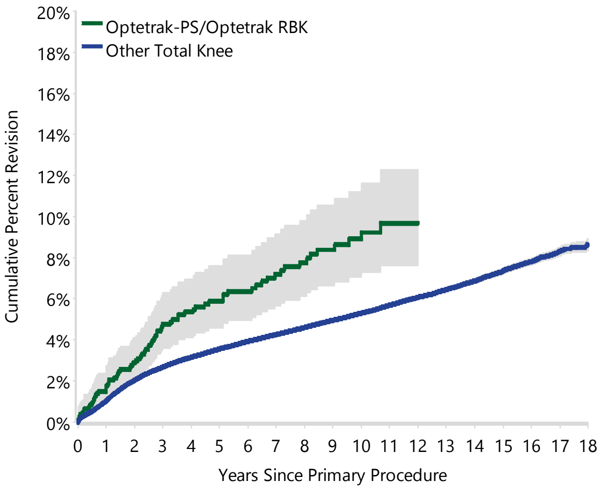


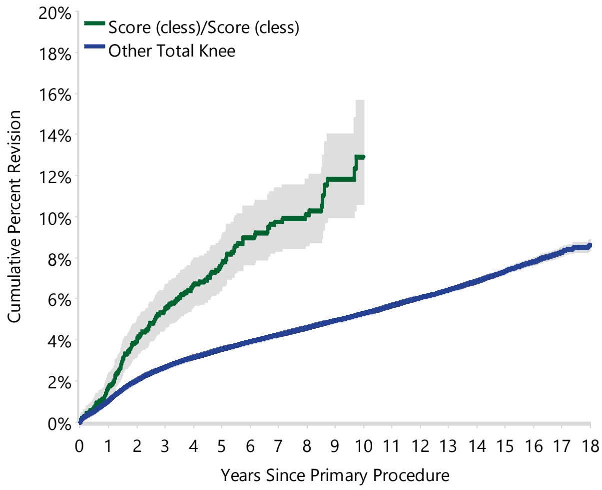
Figure IP6 Cumulative Percent Revision of Re-identified and Still Used Total Knee Prostheses

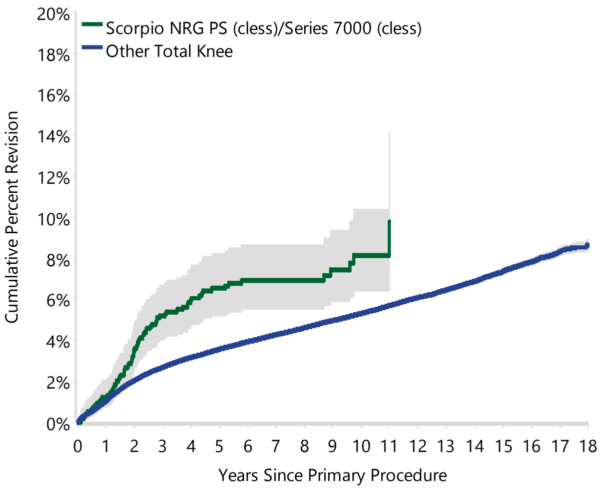


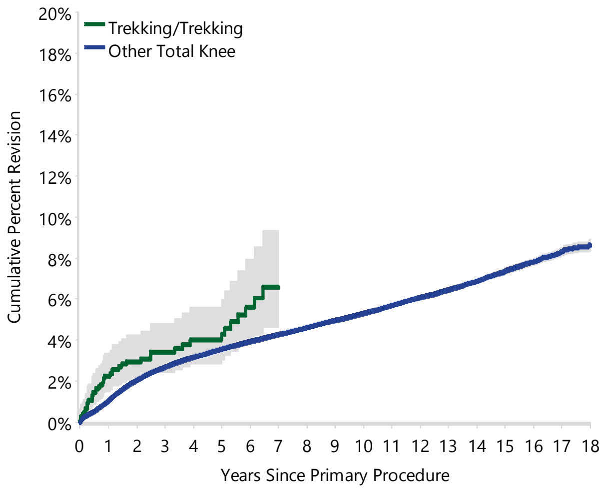

Nexgen LPS Flex (cless)/Nexgen
Other Total Knee
Cumulative Percent Revision
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
Years Since Primary Procedure

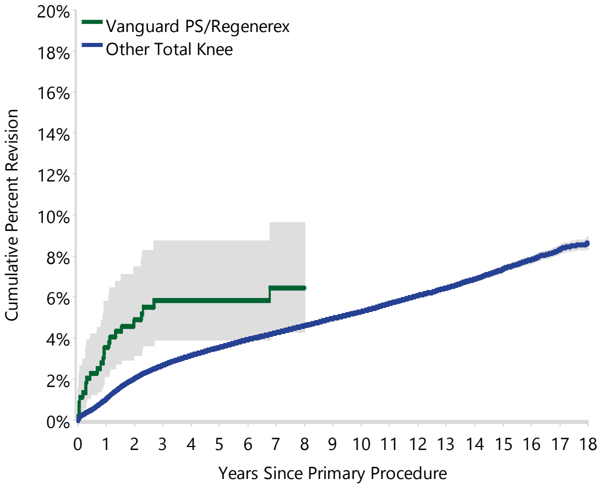

Optetrak-PS/Optetrak
Other Total Knee
Cumulative Percent Revision
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
Years Since Primary Procedure

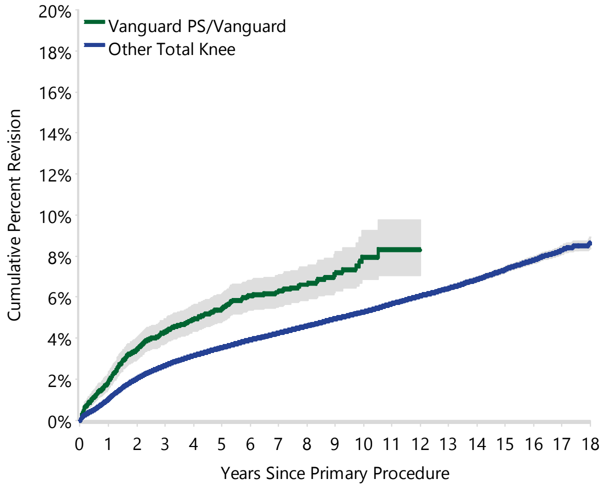

Optetrak-PS/Optetrak RBK
Other Total Knee
Cumulative Percent Revision
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
Years Since Primary Procedure

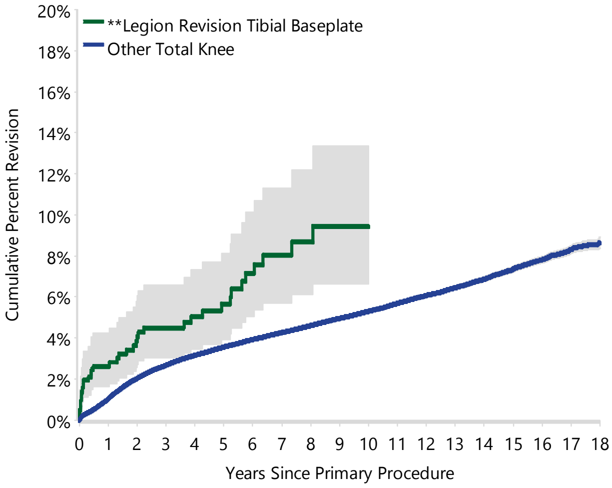

Score (cless)/Score (cless)
Other Total Knee
Cumulative Percent Revision
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
Years Since Primary Procedure


Scorpio NRG PS (cless)/Series 7000 (cless)
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
Years Since Primary Procedure


Trekking/Trekking
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
Years Since Primary Procedure







**Tibial Component

PRIMARY PARTIAL SHOULDER REPLACEMENT

HEMI STEMMED

There are no newly identified hemi stemmed shoulder prostheses.

Table IP22 Revision Rate of Hemi Stemmed Shoulder Prostheses Identified as having a Higher than Anticipated Rate of Revision

Humeral Stem/Head	N Revised	N Total	Obs. Years	Revisions/100 Obs. Yrs	Hazard Ratio, P Value
Re-Identified and Still Used	.	.	.	.	
Delta Xtend/Delta Xtend	12	71	319	3.77	Entire Period: HR=2.40 (1.35, 4.26),p=0.002
Global Unite/Global Unite	31	177	548	5.65	Entire Period: HR=2.14 (1.48, 3.10),p<0.001

Note: Components have been compared to all other hemi stemmed shoulder components

Table IP23 Cumulative Percent Revision of Hemi Stemmed Shoulder Prostheses Identified as having a Higher than Anticipated Rate of Revision

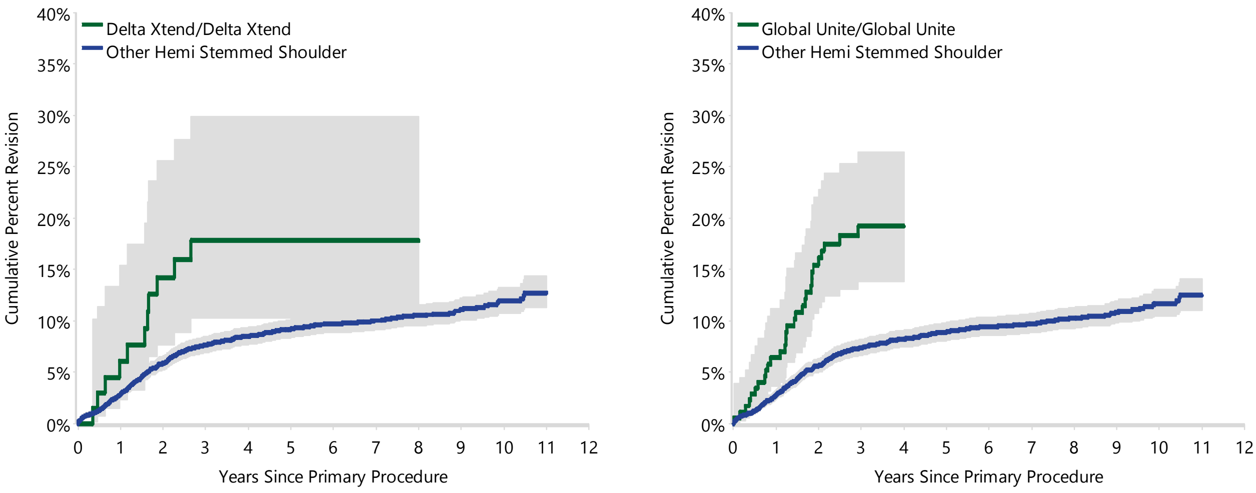
CPR	1 Yr	3 Yrs	5 Yrs	7 Yrs	12 Yrs
Re-Identified and Still Used					
Delta Xtend/Delta Xtend	6.1 (2.3, 15.4)	17.8 (10.3, 29.9)	17.8 (10.3, 29.9)	17.8 (10.3, 29.9)	
Global Unite/Global Unite	6.4 (3.6, 11.2)	19.2 (13.8, 26.4)			

Table IP24 Yearly Usage of Hemi Stemmed Shoulder Prostheses Identified as having a Higher than Anticipated Rate of Revision

Year of Implant	≤2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Re-Identified and Still Used	.	.	.	.	.	.	.	.	.	.	.	.
Delta Xtend/Delta Xtend	2	5	9	9	5	10	7	6	5	4	3	6
Global Unite/Global Unite	.	.	.	.	.	15	37	25	38	37	14	11

Re-Identified and Still Used

Figure IP7 Cumulative Percent Revision of Re-Identified and Still Used Hemi Stemmed Shoulder Prostheses



PRIMARY TOTAL SHOULDER REPLACEMENT

TOTAL STEMMED

There are no newly identified total stemmed shoulder prostheses.

Table IP25 Revision Rate of Total Stemmed Shoulder Prostheses Identified as having a Higher than Anticipated Rate of Revision

Humeral Stem/Glenoid	N Revised	N Total	Obs. Years	Revisions/100 Obs. Yrs	Hazard Ratio, P Value
Re-Identified and Still Used	.	.	.	.	
SMR/SMR L1	281	2067	9942	2.83	0 - 1.5Yr: HR=2.62 (2.18, 3.17),p<0.001
	.	.	.	.	1.5Yr+: HR=1.60 (1.31, 1.96),p<0.001
Identified and no longer used	.	.	.	.	
SMR/SMR L2	294	856	4868	6.04	0 - 9Mth: HR=3.59 (2.68, 4.81),p<0.001
	.	.	.	.	9Mth - 1.5Yr: HR=5.47 (4.03, 7.43),p<0.001
	.	.	.	.	1.5Yr - 3.5Yr: HR=7.53 (5.87, 9.67),p<0.001
	.	.	.	.	3.5Yr - 5Yr: HR=7.91 (5.38, 11.63),p<0.001
	.	.	.	.	5Yr - 5.5Yr: HR=11.46 (4.87, 26.99),p<0.001
	.	.	.	.	5.5Yr+: HR=3.80 (2.56, 5.65),p<0.001
Univers 3D/Univers 3D	15	34	261	5.74	Entire Period: HR=4.27 (2.53, 7.18),p<0.001
Vaios/Vaios	17	36	170	10.0	Entire Period: HR=6.37 (3.94, 10.29),p<0.001

Note: Components have been compared to all other total stemmed shoulder components

Table IP26 Cumulative Percent Revision of Total Stemmed Shoulder Prostheses Identified as having a Higher than Anticipated Rate of Revision

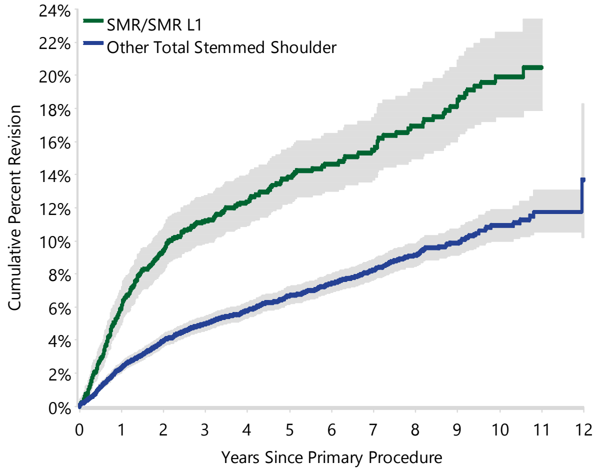
CPR	1 Yr	3 Yrs	5 Yrs	7 Yrs	12 Yrs
Re-Identified and Still Used					
SMR/SMR L1	6.0 (5.1, 7.2)	11.2 (9.9, 12.7)	13.8 (12.3, 15.6)	15.5 (13.7, 17.4)	
Identified and no longer used					
SMR/SMR L2	9.5 (7.7, 11.7)	22.2 (19.6, 25.2)	29.7 (26.8, 33.0)	33.9 (30.8, 37.2)	
Univers 3D/Univers 3D	5.9 (1.5, 21.5)	14.7 (6.4, 31.8)	21.2 (10.7, 39.4)	31.0 (18.0, 50.1)	
Vaios/Vaios	13.9 (6.0, 30.2)	27.8 (16.0, 45.5)	39.1 (25.3, 57.0)	49.3 (33.9, 67.1)	

Table IP27 Yearly Usage of Total Stemmed Shoulder Prostheses Identified as having a Higher than Anticipated Rate of Revision

Year of Implant	≤2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Re-Identified and Still Used	.	.	.	.	.	.	.	.	.	.	.	.
SMR/SMR L1	135	237	247	.	.	157	301	255	242	195	171	127
Identified and no longer used	.	.	.	.	.	.	.	.	.	.	.	.
SMR/SMR L2	.	.	43	343	336	134	.	.	.	.	.	.
Univers 3D/Univers 3D	23	11	.	.	.	.	.	.	.	.	.	.
Vaios/Vaios	.	.	.	.	16	17	2	1	.	.	.	.

Re-identified and Still Used

Figure IP8 Cumulative Percent Revision of Newly Identified Total Stemmed Shoulder Prostheses



PRIMARY TOTAL REVERSE SHOULDER REPLACEMENT

There are no newly identified total reverse shoulder prostheses.

The Trabecular Metal combination is no longer identified as it no longer has a significantly higher rate of revision. In 2018 there were an additional 15 procedures and no revisions recorded.

Table IP28 Revision Rate of Total Reverse Shoulder Prostheses Identified as having a Higher than Anticipated Rate of Revision

Humeral Stem/Glenoid	N Revised	N Total	Obs. Years	Revisions/100 Obs. Yrs	Hazard Ratio, P Value
Re-Identified and Still Used	.	.	.	.	
SMR/SMR L1	235	5721	18353	1.28	Entire Period: HR=1.16 (1.00, 1.35),p=0.044

Note: Components have been compared to all other total reverse shoulder components

Table IP29 Cumulative Percent Revision of Total Reverse Shoulder Prostheses Identified as having a Higher than Anticipated Rate of Revision

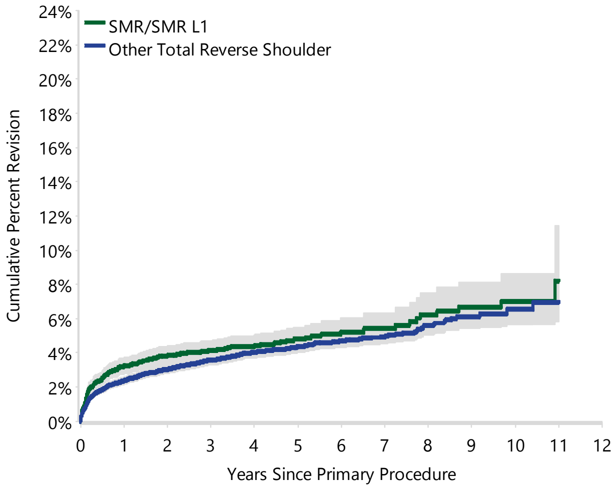
CPR	1 Yr	3 Yrs	5 Yrs	7 Yrs	12 Yrs
Re-Identified and Still Used					
SMR/SMR L1	3.2 (2.8, 3.7)	4.1 (3.6, 4.7)	4.8 (4.2, 5.5)	5.4 (4.6, 6.4)	

Table IP30 Yearly Usage of Total Reverse Shoulder Prostheses Identified as having a Higher than Anticipated Rate of Revision

Year of Implant	≤2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Re-Identified and Still Used	.	.	.	.	.	.	.	.	.	.	.	.
SMR/SMR L1	145	262	271	.	.	249	562	632	731	913	925	1031

Re-identified and Still Used

Figure IP9 Cumulative Percent Revision of Re-identified and Still Used Total Reverse Shoulder Prostheses



Appendices

Appendices

APPENDIX 1

PARTICIPATING HOSPITALS & COORDINATORS

VICTORIA

PUBLIC HOSPITALS

Austin Health	Ross Kentish/Bev Murray
Bairnsdale Regional Health Service	Sian Guns
Ballarat Health Services	Bernie Anderson/Michelle Nicholson
Bass Coast Regional Health	Andrea Crestani
Bendigo Health Care Group	Catherine Jensen/Shelly Sharp
Box Hill Hospital	Lisa Bingham
Broadmeadows Hospital	Zoe Devenish
Cohuna District Hospital	Karyn Storm
Colac Area Health	Amanda Tout
Dandenong Hospital	Karen Ferguson/Melanie Murray
Djerriwarrh Health Services	Kate Anderson/Judy Dehnert
East Grampians Health Service	J Smith/J Sargent/K Carr
Echuca Regional Health	Kerryn Giorgianni
Footscray Hospital	Vicki Mahaljcek/Cassandra Mules
Frankston Hospital	Donna Anderson
Goulburn Valley Health	Andrea Stevens
Hamilton Base Hospital	Rosalie Broadfoot
Kyabram & District Health Services	Lynda Walker/Lee Fleming
Latrobe Regional Hospital	Simone Lovison
Maroondah Hospital	Benjamin Connelly
Mildura Base Hospital	Kaylene Miles
Monash Medical Centre, Clayton	Jessica Cranston
Monash Medical Centre, Moorabbin	Carol Jackson/Lisa Mason
Northeast Health Wangaratta	Lynn Reid/Larissa Benci
Portland Hospital	Donna Eichler
Sandringham & District Memorial	Jack Gaye/Laura Scopel
Seymour District Memorial Hospital	Karen Lamaro
South West Healthcare	Tony Kelly
St Vincent's Public Hospital	Shazeli Osman/Amanda Vary
Stawell Regional Health	S Campigli/J Body/T Moloney
Sunshine Hospital	Cassandra Mules
Swan Hill District Hospital	Donna Hartland
The Alfred	Caroline McMurray
The Northern Hospital	Siew Perry
The Royal Children's Hospital	Sonia Mouat
The Royal Melbourne Hospital	Brychelyn Bennett
Uni Hospital Geelong Barwon Health	David Barber/Michelle Quinn
West Gippsland Healthcare Group	Stefanie Backman/Bernie Norman
West Wimmera Health Service	Kim Stasinowsky/Christine Dufty
Williamstown Hospital	Paul Buso/Maureen Clark
Wimmera Health Care Group	Maree Markby

PRIVATE HOSPITALS

Beleura Private Hospital	Jean Leyland
Bellbird Private Hospital	Belinda Van Denberg
Cabrini Private Hospital, Brighton	Tegan Colliver
Cabrini Private Hospital, Malvern	Tegan Colliver
Cotham Private Hospital	Marianne Westley
Epworth Eastern Hospital	Linda Dennehy
Epworth Freemason Hospital	Claudia Nozzolillo
Epworth Geelong	Christian King
Epworth Richmond	Lynne Moyes
Essendon Private Hospital	Elaine Jordan
Frankston Private Hospital	Tracey McIndoe-Norton
Geelong Private Hospital	Wilna Steyn
Glenferrie Private Hospital	Samantha Jervios
Holmesglen Private	Nicole Groves/Gillian Wilson
John Fawkner Hospital	Belinda Emmett
Knox Private Hospital	Bronwyn Hawkins/Laura Tilley
Linacre Private Hospital	Melissa Dillon/Denice Tyler
Maryvale Private Hospital	Glenda Chambers
Masada Private Hospital	Anna Bonato/Lisa Butler
Melbourne Private Hospital	Karen Grant/Tracey Perkins
Mildura Private Hospital	Sue Malcolm
Mitcham Private Hospital	Julie Nankivell/Joshie Lonthyil
Mulgrave Private Hospital	Anthony Puzon
Northpark Private Hospital	Kath Morris
Peninsula Private Hospital	Ruth Honan
Ringwood Private Hospital	Carol Burns
Shepparton Private Hospital	Niki Miller
St John of God Ballarat Hospital	Gitty Mathachan
St John of God Bendigo Hospital	Karen Rayner
St John of God Geelong Hospital	Colin Hay
St John of God Warrnambool	Leanne McPherson/Gill Wheaton
St John of God Hospital, Berwick	Rebecca Jamieson
St Vincent's Private East Melb	Jan Gammon
St Vincent's Private Fitzroy	Naomi Carter/Deanna Dellevirgini
St Vincent's Private Kew	Joy Miller/Sue Zidziunas
St Vincent's Private Werribee	Cecilia Ipio
The Avenue Hospital	John Davidson
The Bays	Sharon Burton/Liz Kerr
The Melbourne East Private	Jay Phillpotts
Wangaratta Private Hospital	Janet McKie
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

Albury Base Hospital	Laurel Rhodes
Armidale Hospital	Amber Prater
Auburn Health Service	Sarah Sisson
Bankstown/Lidcombe Hospital	Karen Och
Bathurst Base Hospital	Kylie Peers
Belmont Hospital	Jenny Jones
Blacktown Hospital	June Tsang
Bowral and District Hospital	Julie Elsing
Broken Hill Health Service	Sue Beahl/Brock Roberts
Campbelltown Hospital	Susan Birch
Canterbury Hospital	Jenny Cubitt
Chris O'Brian Lifehouse	Fiona Strachan
Coffs Harbour Health Campus	Eric Dorman
Concord Repatriation Hospital	David Debello
Dubbo Base Hospital	Kathy Chapman
Fairfield Hospital	Caroline Youkhana
Gosford Hospital	Kirstie Brown/Toni Hoad
Goulburn Base Hospital	Karen Goode/Debbie Hay
Grafton Base Hospital	Anthony Corkett
Hornsby & Ku-Ring-Gai Hospital	Bessie Chu
Inst Rheum & Orthopaedic Surgery	Maria Hatziandreou
John Hunter Hospital	Felicia Bristow
Lismore Base Hospital	Glen Nettle
Liverpool Health Service	John Murphy
Maitland Hospital	Karen Cheers
Manly District Hospital	Heather Liddle/Maryann Howell
Manning Rural Referral Hospital	Grahame Cooke
Mona Vale Hospital	Bronwyn Friend
Mt Druitt Hospital	Charmaine Boyd
Murwillumbah District Hospital	Linda Gahan
Nepean Hospital	Debbie Dobbs
Orange Health Service	Alexandra Woods
Port Macquarie Base Hospital	Fiona Cheney/Jo Atkins
Royal Newcastle Centre	Graham Cutler
Royal North Shore Hospital	Kay Crawford
Royal Prince Alfred Hospital	Chris Chiapoco/Jennifer Wilkie
Ryde Hospital	Karen Jones
Shoalhaven District Memorial Hospital	Leanne McTavish
South East Regional Hospital	Leanne Williams
St George Hospital	Simon Cheng
St Vincent's Public Hospital	MT Butler/M Ellis/A Baker
Sutherland Hospital	Sara Hogan
Tamworth Base Hospital	Kathleen Cook
The Children's Hospital Westmead	Ariella Galstaun
The Prince of Wales Hospital	Elena Katz
The Tweed Hospital	Amanda Budd/Neroli Prestage
Wagga Wagga Base Hospital	Alison Giese/Melissa O'Reilly
Westmead Public Hospital	Dee Martic
Wollongong Hospital	Carol Jackson
Wyong Hospital	Marilyn Randall

PRIVATE HOSPITALS

Albury Wodonga Private Hospital	Ben Sutton/Dom Mahaffey
Armidale Private Hospital	Katherine Latter
Baringa Private Hospital	E Ford/F Howson/K Henderson
Bathurst Private Hospital	Diane Carter
Berkeley Vale Private Hospital	Michelle Turner
Brisbane Waters Private Hospital	Adele Ryan
Calvary Health Care Riverina	Annette Somerville
Campbelltown Private Hospital	Yvonne Quinn
Dalcross Adventist Hospital	Anne Carroll/Kerrie Legg
Delmar Private Hospital	Cathy Byrne
Dubbo Private Hospital	Sallie Cross/Kim Troth
Dudley Private Hospital	Michele Englart/Pam Fullgrabe
East Sydney Private	Thea Woodgate/Jane Telfer
Forster Private Hospital	Janet Hickman
Gosford Private Hospital	Amy Maguire
Hawkesbury District Health Service	Sharon Garden/Elizabeth Jones
Holroyd Private Hospital	Christine Aldana
Hunters Hill Private	Jenny May
Hunter Valley Private	Renae Ross
Hurstville Private	Simelibuhle Masuku
Insight Clinic Private Hospital	Debbie van de Stadt
Kareena Private Hospital	Anita Burazer
Lake Macquarie Private Hospital	Vanessa Jones/Edward Miles
Lakeview Private Hospital	Hailey MacAllister
Lingard Private Hospital	Adam Dagg
Maitland Private Hospital	Martine Mead/Joanne Chalmers
Macquarie University Hospital	Julie Guthrie
Mayo Private Hospital	Stacey Dunk
National Day Surgery Sydney	Stephanie Schofield/Kerry Gardner
Nepean Private Hospital	Jacintha Vimalraj
Newcastle Private Hospital	Darren Fogarty/Jodi Kelly
North Shore Private Hospital	Satheesh Jose
Northern Beaches Hospital	Jojo Sebastian
Norwest Private Hospital	Reece Shepherd
Nowra Private Hospital	Linda Wright
Port Macquarie Private Hospital	Tresna Bell
Shellharbour Private Hospital	Jenny Fraser
Southern Highlands Hospital	Lynne Byrne
St George Private & Medical Centre	Lee Mayo/Susy Tanevska
St Luke's Care	Celeste Gaspar
St Vincent's Private Griffith	Margaret Blackman
St Vincent's Private Darlinghurst	Hannah George/Vivien Law
St Vincent's Private Lismore	Janelle Hospers
Strathfield Private Hospital	John Mati
Sydney Adventist Hospital	Jill Parker/Melissa Ng
Sydney Private Hospital	Margaret Haughton
Sydney South West Private	Tran Hong
Tamara Private Hospital	Kris Wall
The Mater Hospital	Namor Guerrero
The Prince of Wales Private	Ellaine Perez/Rodin Gengania
Toronto Private Hospital	Stephanie Keys
Waratah Private Hospital	Kim Graham
Warners Bay Private Hospital	Annette Harrison
Westmead Private Hospital	Katrina Teren
Wollongong Private Hospital	Kathy Jankulovski/Cristie Gillspie

QUEENSLAND

PUBLIC HOSPITALS

Bundaberg Base Hospital	J Anderson/J Larsen/D Norman
Cairns Base Hospital	Sharon Ryrie
Gold Coast Hospital, Robina Campus	Annemarie Brooks/Helen McGuire
Gold Coast University Hospital	Karen Morton
Hervey Bay Hospital	Sarah Dane Smith
Hervey Bay Surgical Centre	Margo Christensen
Ipswich Hospital	Ross Howells/Jannah O'Sullivan
Lady Cilento Children's Hospital	Andrew Jesbert/Aimee Reid
Logan Hospital	Denise Maher
Mackay Base Hospital	Tamara Mulder
Maryborough Hospital	H Zillmann/B Christiansen
Mater Misericordiae Public Adult's	Lucy Evans/Craig Steains
Nambour General Hospital	Renee Hutchinson
Prince Charles Hospital	Louise Tuppin/Rose Seddon
Princess Alexandra Hospital	Jo-Anne de Plater
Queen Elizabeth II Jubilee Hospital	Donna Cal
Redcliffe Hospital	Gemma van Fleet/Ellen Nugent
Redland Public Hospital	Sara Mackenzie
Rockhampton Base Hospital	Gabrielle Sellen
Royal Brisbane & Women's	Brodie Ballantyne/Anna Dowe
Sunshine Coast University Hospital	S Colquist/F Tognolini/C Jones
Toowoomba Hospital	Amanda Lostroh/Freya Chadwick
Townsville Hospital	Tara Cudmore

PRIVATE HOSPITALS

Brisbane Private Hospital	Julie Oddy/Liz Drabble
Buderim Private Hospital	Phill Hall
Caboolture Private Hospital	Dee Ireland
Cairns Private Hospital	Louisa Smith
Friendly Society's Hospital	Karen Smith
Gold Coast Private Hospital	Kathryn Schott
Gold Coast Surgical Hospital	Damien Knight
Greenslopes Private Hospital	Kelly Williams/Rhonda Griffin
Hervey Bay Surgical Centre	Margo Christensen
Hillcrest Rockhampton Private	Lyn Martin
John Flynn Hospital	Lynda Wise
Mater Health Services North Qld	Joanne Humphreys
Mater Misericordiae Bundaberg	L Zunker/J Zillmann/M Mooney
Mater Misericordiae Gladstone	Saroj Saini
Mater Misericordiae Mackay	Hazel Douglas
Mater Misericordiae Rockhampton	Michelle Havik/Tim Harkin
Mater Misericordiae Private Hospital	S Pfeffer/J Windsor/M Baltais
Mater Private Hospital Redland	Merryl Hoey
Mater Private Springfield	Carole James/Krystal Lording
Nambour Selangor Private Hospital	Simon Pfeiffer/Trevor Dempsey
Noosa Hospital	Janet McMeekin
North West Private Hospital	Teressa Auckland/David Campbell
Peninsula Private Hospital	Lesley Henderson
Pindara Private Hospital	Michael Young/Esther Moire
St Andrew's Private Hospital, Ipswich	Mel Grant
St Andrew's Hospital, Toowoomba	Jeff van Leeuwen
St Andrew's War Memorial Hospital	Kerrie Jenkins
St Stephen's Private Hospital	Karen McLaughlan
St Vincent's Hospital Northside	Lexie Shannon
St Vincent's Hospital	Amanda Fitzgerald
Sunnybank Private Hospital	Francina Robinston
Sunshine Coast University Private	Tanya Prother
Wesley Hospital	Carole Gregory

WESTERN AUSTRALIA

PUBLIC HOSPITALS

Albany Regional Hospital	Jodie Hayton
Armadale Health Service	Eleri Griffiths/Deb Carkeek
Bunbury Regional Hospital	Anthea Amonini
Busselton Health Campus	Heather Thomson
Fremantle Hospital	Elsy Jiji
Fiona Stanley Hospital	Jarrod Duncan
Geraldton Hospital	Vicki Richards
Kalgoorlie Health Campus	Nicole Hintz
Osborne Park Hospital	Jenny Misiewicz
Rockingham General Hospital	Carol Beaney
Royal Perth Hospital, Wellington St	Kerry Hodgkinson
Sir Charles Gairdner Hospital	Angela Bibb

PRIVATE HOSPITALS

Bethesda Hospital	H Hanekom/H Collis/J Fitzroy
Hollywood Private Hospital	Michelle Connor
Joondalup Health Campus	Denise Crowley/Julie Holmes
Mount Hospital	Jacqui McDonald
Peel Health Campus	Geraldine Keogh
South Perth Hospital	Deb Waters
St John of God Health Care Bunbury	Corne Habig
St John of God Health Care Geraldton	Kristie Hutton
St John of God Health Care Midland	Grace Loh
St John of God Health Care Murdoch	Christopher Sheen
St John of God Mt Lawley	Francisco Campos/Stuart Meek
St John of God Health Care Subiaco	Phillip Emrose
Waikiki Private Hospital	Bill Muir

SOUTH AUSTRALIA

PUBLIC HOSPITALS

Clare Hospital and Health Services	Melissa Bradley/Jo Knappstein
Flinders Medical Centre	Amy Ware
Gawler Health Service	Sharon Mewett
Lyell McEwin Hospital	Craig Keley
Modbury Public Hospital	Lisa Pearson
Mt Barker DSM Hospital	Emma Crowder
Mt Gambier Regional Hospital	Kylie Duncan
Murray Bridge Soldiers Memorial	Janine Colwell
Naracoorte Health Service	Trina Berry
Noarlunga Hospital	Carole Dawson
Port Augusta	Janine Haynes/Paola Williams
Port Lincoln Hospital	Christine Weber
Port Pirie Hospital	Sue Wilkinson
Queen Elizabeth Hospital	Kasey Irwin
Repatriation General Hospital	Joy Telfer/Alistair Smith
Riverland Regional Hospital	Leanne Zerna
Royal Adelaide Hospital	Lisa Davies/Dana Stoica
South Coast District Hospital	Anne Price/Jo Hunt
Whyalla Health Service	Michael Prunty
Women's and Children's Hospital	Margaret Betterman

PRIVATE HOSPITALS

Ashford Community Hospital	Lisa Kowalik
Burnside War Memorial Hospital	Trent Batchelor
Calvary Central Districts Hospital	Linda Keech
Calvary North Adelaide Hospital	Maria Young
Calvary Wakefield Hospital	F Hansen/I Snowball/T Heinrich
Flinders Private Hospital	Marcus Ender
Glenelg Community Hospital	N Russell-Higgins/V Lawrence
North Eastern Community Hospital	Anne Sciacca
Parkwynd Private Hospital	Anna-Claire Naylor
Sportsmed SA	F Penning/S Smith/K Stapleton/M Odgaard
St Andrew's Private Hospital	Cheryl McAllister/Leeandra White
Stirling District Hospital	Nick Clarke/Tanya Hanlon
The Memorial Hospital	Evelyn Carroll/Joanne Ohlson
Western Hospital	Sharon Till

TASMANIA

PUBLIC HOSPITALS

Launceston General Hospital	E Davidson/M Postmus
North West Regional, Burnie Campus	Bill Kerr/Ryan Dicker
Royal Hobart Hospital	Stuart Kirkham

PRIVATE HOSPITALS

Calvary Health Care, St John's	Cate Farrell
Calvary Health Care, St Luke's	Gary Stratton/Toni Morice
Calvary Hospital	B Stephensen/A Copping/S Ransley
Hobart Private Hospital	Janine Dohnt
North-West Private Hospital	Kylie Smith/Danielle Jenner

AUSTRALIAN CAPITAL TERRITORY

PUBLIC HOSPITALS

The Canberra Hospital	Helen Boyd/Jose Abraham
Calvary Public Hospital	Fiona Carruthers

PRIVATE HOSPITALS

Calvary John James Memorial Hospital	Samjith Sreesan
The National Capital Private	M Liebhardt/G Palada
Canberra Private Hospital	M Gower/S Phillips/M Rogina/L Tuohy
Calvary Bruce Private Hospital	Carlene Morris

NORTHERN TERRITORY

PUBLIC HOSPITALS

Alice Springs Hospital	Debra Mullan
Royal Darwin Hospital	Wendy Rogers

PRIVATE HOSPITALS

Darwin Private Hospital	Beverley Hinchcliffe/Vanessa Frewin

APPENDIX 2

GLOSSARY

Statistical Terms

Adjustment: The process of re-estimating a crude measure, such as a rate or rate ratio, to minimise the effects of a difference in the distribution of a characteristic, such as age, between groups being compared on that measure. Adjustment may be carried out in the context of a modelling procedure, for example, linear or proportional hazards regression models, or by standardising the data set against a reference population with a known age distribution, for example, the World Standard Population or the Australian population defined by the Australian Bureau of Statistics Census in a specified year.

Censoring: When the outcome of interest is the time to a defined event, for example, revision of a prosthesis, the event may not occur during the available period of observation. For example, the Registry analyses its data on prosthesis revision for the period ending 31 December each year, and many prostheses will not have been revised by that time. Unless the prosthesis was revised prior to 31 December the outcome is unknown. For the majority, we only know that up until 31 December they had not yet been revised. The times to revision for these prostheses are said to have been censored at 31 December. Statistical methods exist to ensure that censored data are not ignored in analysis, rather information on survival up until the time of censoring is used to give the best possible estimates of survival or revision probabilities.

Chi-Square Test (χ2) Test: Any test whose statistic has a chi-square distribution under the null hypothesis is called a chi-square test. A common example is a test for association between two categorical variables whose data are arrayed in a cross-classification table of counts (Pearson's chi-square test). This can be generalised to many situations where the distribution of observed data is being compared to an expected theoretical distribution.

Competing Risk: Any event that changes the probability of occurrence of another event is known as a competing risk for the other event. For example, death is a competing risk for revision because the probability of revision after death cannot be assumed to be the same as the probability of revision before death. Another example is that if interest centres on specific causes of revision, then each cause (infection, loosening etc) is a competing risk for each other cause. Treating a competing risk event as a right censoring will bias the estimation of the risk of the event of interest.

Conditional Probability is the probability of revision given that a patient is still able to experience the event just prior to time *t*. For example, it is the probability of revision at three years given a patient is still alive at 2.99 years. Thus, only those who are alive at 2.99 years contribute to the risk set. Conditional Probability of revision = cumulative incidence of revision / (1 - cumulative incidence of death). If there is no competing event (such as death), then the conditional probability of revision will be same as the cumulative incidence of revision, which will be the same as the cumulative percent revision. The cumulative incidence and the cumulative percent revision only changes when there is an event of interest, however the conditional probability changes when there is a competing risk event as well as an 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 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.

Forest Plot: illustrates the variation between hazard ratios (see 'Hazard Ratio' section below). Each panel corresponds to a time-varying hazard ratio for a particular group of interest. Within each panel, the vertical line represents the line of no effect – the point at which there is no difference. The circle represents the hazard ratio and the horizontal line that runs through the circle represents the lower to upper 95% confidence intervals. If the confidence interval crosses the line of no effect the result between the two groups being compared is not statistically significant (p-value ≥0.050).

Funnel Plot: A funnel plot is a scatter plot where each point represents a single surgeon or single hospital. The X (horizontal) axis represents volume: the total number of relevant surgical procedures recorded by the Registry for each surgeon or hospital. The Y-axis is a measure of performance given by the standardised proportion. This is calculated for each surgeon or hospital as the ratio of the number of revisions observed to the number of revisions expected, multiplied by the overall proportion of revisions. To calculate the expected number of revisions, a logistic regression model is used to determine the probability of revision based on a patient's age and gender. The sum of these predicted values for each surgeon or hospital is the estimate of the expected number of revisions.

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, an IRR of 1 results.

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 (31/12/2018) 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 1/1/2018 was revised on 1/7/2018. 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 1/1/2018 died without being revised on 1/4/2018. This procedure contributes 0.25 component years.
A primary procedure occurs on 1/1/2018 and has not been revised. This procedure contributes 1 component year (as observation time is censored at 31/12/2018).

Rx-Risk is a measure used to establish an individual's current comorbidities from their prescription medicine dispensing. Rx-Risk is analogous to other comorbidity scores used for population-based studies in measuring general health status. The Rx-Risk Index comprises 47 comorbidity categories with medicines mapped to these categories. Where an individual had ≥1 dispensing for a medicine in a given category, then they were considered to have been treated (using medicines) for that comorbidity. A Rx-Risk Score is generated from a count of the comorbidity categories reflecting treatment for a comorbidity, with a possible score ranging from 0 to 47.

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 FOR REVISION HIP REPLACEMENT

Rank	Diagnosis	Category
1 2	Tumour Infection	*Dominant diagnosis independent of prosthesis/surgery*
3 4 5	Leg Length Discrepancy Incorrect Sizing Malposition	*Surgical procedure*
6 7 8	Metal Related Pathology Loosening Lysis	*Reaction to prosthesis*
9 10 11 12 13 14 15	Wear Hip Insert Wear Acetabular Cup/Shell Wear Head Implant Breakage Head Implant Breakage Stem Implant Breakage Hip Insert Implant Breakage Acetabular Cup/Shell	*Wear and implant breakage*
16 17	Prosthesis Dislocation Instability	*Stability of prosthesis*
18	Fracture (Femur/Acetabular/Neck/Periprosthetic)	*Fracture of bone*
19 20	Chondrolysis/Acetabular Erosion Progression of Disease	*Progression of disease on non-operated part of joint*
21 22 23	Synovitis Osteonecrosis/AVN Heterotopic Bone	*New diseases occurring in association with joint replacement*
24	Pain	*Pain*
25	Other	*Remaining diagnoses*

DIAGNOSIS HIERARCHY FOR REVISION KNEE REPLACEMENT

Rank	Diagnosis	Category
1	Tumour	*Dominant diagnosis independent of prosthesis/surgery*
2	Infection	
3	Incorrect Side	*Surgical procedure*
4	Incorrect Sizing	
5	Malalignment	
6	Metal Related Pathology	*Reaction to prosthesis*
7	Loosening	
8	Lysis	
9	Wear Knee Insert	*Wear and implant breakage*
10	Wear Tibial Tray	
11	Wear Femoral	
12	Wear Patella	
13	Implant Breakage Femoral	
14	Implant Breakage Knee Insert	
15	Implant Breakage Tibial Tray	
16	Implant Breakage Patella	
17	Bearing Dislocation	*Stability of prosthesis/knee*
18	Patellar Dislocation	
19	Prosthesis Dislocation	
20	Instability	
21	Patellar Maltracking	
22	Fracture (Femur/Tibia/Patella/Periprosthetic)	*Fracture of bone*
23	Progression of Disease	*Progression of disease on non-operated part of joint*
24	Patellar Erosion	
25	Synovitis	*New diseases occurring in association with joint replacement*
26	Arthrofibrosis	
27	Osteonecrosis/AVN	
28	Heterotopic Bone	
29	Patellofemoral Pain	*Pain*
30	Pain	
31	Other	*Remaining diagnoses*

DIAGNOSIS HIERARCHY FOR REVISION SHOULDER REPLACEMENT

Rank	Diagnosis	Category
1	Tumour	*Dominant diagnosis independent of prosthesis/surgery*
2	Infection	
3	Incorrect Side	*Surgical procedure*
4	Incorrect Sizing	
5	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
Project Manager, Ms Grace O'Donohue
Project Officer, Ms Zoe Grivell
Administration Officer, Ms Frances Parolin

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 internet 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

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 or 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.

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.

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 OF NATIONAL JOINT REPLACEMENT REGISTRY FOR HIP, KNEE & SHOULDER

The Registry was implemented in a staged manner on a state-by-state basis. The table below shows the commencement date for each state. 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.

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

HIP REPLACEMENT

PARTIAL HIP REPLACEMENT

49315-00	Partial arthroplasty (excludes Austin-Moore)
47522-00	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 of hip 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 REPLACEMENT

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 patellar 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	Patellar resurfacing

SHOULDER REPLACEMENT

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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