NATIONAL JOINT REPLACEMENT REGISTRY

AUSTRALIAN
ORTHOPAEDIC
ASSOCIATION

Hip, Knee & Shoulder Arthroplasty

ANNUAL REPORT 2018

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AUSTRALIAN ORTHOPAEDIC ASSOCIATION
NATIONAL JOINT REPLACEMENT REGISTRY

2018 ANNUAL REPORT

HIP, KNEE & SHOULDER ARTHROPLASTY

September 1999 to December 2017

Preface

Preface

I present with great pleasure, the Australian Orthopaedic Association National Joint Replacement Registry (AOANJRR) 2018 Annual Report. The AOANJRR Director, Deputy Directors and supporting staff are to be congratulated for producing this updated quality report. Their diligence, dedication and efforts improve the capacity and value of AOANJRR, not only for AOA members, but also to the wider health care community. The international standing of AOANJRR is a source of pride to all AOA members.

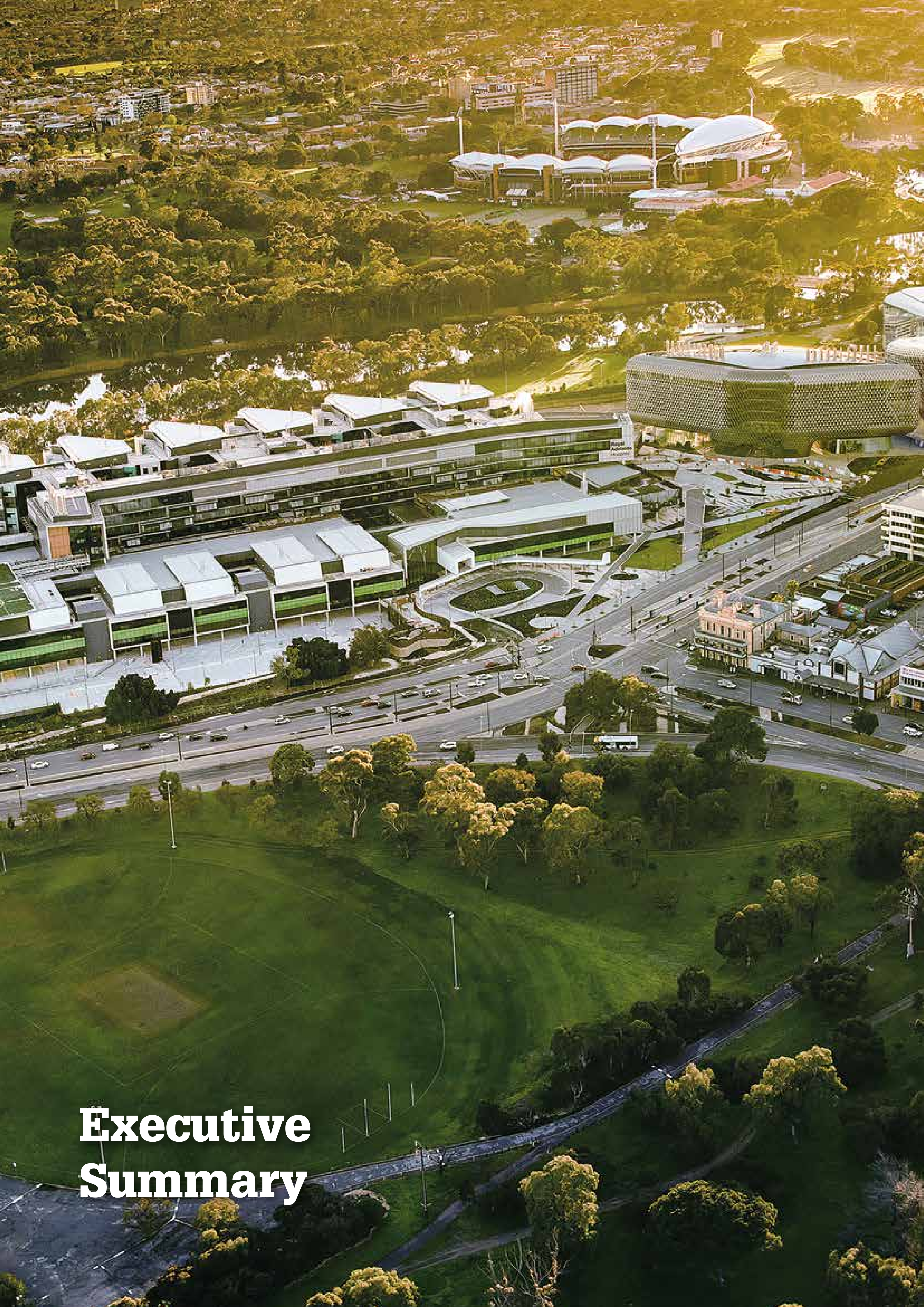
The impact of AOANJRR upon joint replacement surgery is evident at the national and global platform, consistent with the quality information provided by AOANJRR. This year in addition to the routine data update, a detailed analysis of the outcome of primary and revision hip and knee replacement in patients aged 80 years or more is presented. Information on the success of surgery and how best to optimise outcomes for this patient group is both timely and important. Another initiative for 2018 is AOANJRR reporting the impact of ASA score and BMI. AOANJRR commenced collecting data on these items a number of years ago following recommendations by the Arthroplasty Society and AOANJRR committees.

It has been an exciting year for AOANJRR as data reporting analysis has expanded with a number of initiatives. Individual surgeon reports were first made available in 2017, with updated reports available in December 2018 and annually thereafter. Industry has been provided with access to real time automated reports on the performance of individual prostheses. The implementation of a pilot project to test the feasibility of collecting Patient Reported Outcome Measures (PROMs)using an automated web-based system has commenced. The pilot is being initiated in 50 hospitals across the country. By obtaining information directly from patients on their general health status, pain, function, pre- and post-operative comorbidities as well as pre-operative expectations and post-operative satisfaction, a new dimension to AOANJRR data is added. It will provide capacity to assess a wider range of outcomes. Major data linkage projects have commenced with core AOANJRR data sets linked to MBS and PBS data as well as data from other national registries and potentially, in the near future, state health departments. These linkages expand the AOANJRR data set to provide the ability to better risk adjust as well as to assess a wider range of additional outcomes and complications. In 2019, the AOANJRR will commence a randomised registry nested trial of 10,000 patients using purpose-built software to assess the comparative effectiveness of aspirin versus clexane for DVT prophylaxis.

A major strategic focus for AOA is to advance excellence of orthopaedic practice in the interests of patients and the community, and in the training of surgeons to world-class standards. As the AOANJRR moves into its 20th year, it has and continues to play a major role for AOA. The continued growth, development and effectiveness of the AOANJRR will continue to be dependent upon the universal cooperation of all orthopaedic surgeons. The degree of cooperation and support by members for this important clinician lead initiative is something of which we should be very proud.

Lawrie Malisano

President of the Australian Orthopaedic Association



Executive Summary

Executive Summary

This summary provides a brief overview of some of the major findings from this year's Annual Report. The design and structure of the report is similar to last year. Previously reported analysis on the outcome of primary hip, knee and shoulder replacement have been updated and extended. The analysis was undertaken on 1,355,938 joint replacement procedures (593,803 hips, 717,334 knees, and 44,801 shoulders) reported to the AOANJRR up to the end of 2017. As with previous annual reports, a number of new topics have been selected for more detailed analysis. The outcomes of both primary and revision hip and knee replacement in elderly patients are the new topics for this year's report.

As in previous years, in addition to the main report the Registry is also publishing supplementary reports. These supplementary reports are listed in the introduction and will be available on the AOANJRR website https://aoanjrr.sahmri.com/annual-reports-2018 from 1 October 2018. They include a Lay Summary of the main report,10 different reports on arthroplasty topics, as well as detailed analysis of all prostheses identified as having a higher than anticipated rate of revision.

Primary and Revision Hip and Knee Replacement in the Elderly
The reason that the AOANJRR focused on the issue of elective joint replacement surgery for osteoarthritis in the elderly is because an increasing number of patients aged ≥80 years are undergoing primary and revision hip and knee joint replacement. The purpose of the analysis is to provide further insight into the risk of mortality, revision and the approaches that can be taken to improve the outcome of joint replacement in this group of patients.

As expected, there is an increased risk of mortality both early (one month and three months post-surgery) and late. Although perioperative mortality is increased, it is not that high, indicating that total hip and total knee replacement can be done safely in this age group. The elderly can benefit for many years following joint replacement surgery with 80% of those in the 80-89 age group and 60% of the ≥90 age group surviving at least five years. At 10 years, over 40% of the 80-89 age group and almost 15% of the ≥90 age group are still alive. The impact of gender, ASA score, BMI and prosthesis related factors are also reported.

Assessing revision risk in the elderly is complicated by the higher mortality rates in this age group. There are a number of statistical approaches to address this issue. The AOANJRR used three different methods to assess revision. Early revision risk is increased in the elderly (the first six months following primary total hip replacement and the first three months following primary total knee replacement). There is a reduced later risk, not because joint replacement surgery performs better in this age group, but due to patients not surviving long enough to be revised. For those patients that do survive, the probability of being revised increases with time and is higher compared to younger patients. This increased probability of later revision is higher for primary total hip than for primary total knee replacement.

Fracture is the main reason for revision following primary total hip replacement, occurring early and continuing to increase with time. It is often associated with the use of cementless femoral stems. Infection is the main reason for revision following primary total knee replacement. However, the risk of infection does not increase with increasing age. The most important prosthesis related factors associated with reduced revision following primary total hip and knee replacement are reported. Mortality following revision hip and knee procedures and the risk of having a subsequent revision following a first revision are also reported.

Ten and Fifteen Year Outcome Data
The Registry continues to highlight the 10 and 15 year cumulative percent revision of prosthesis combinations used in primary total hip and primary total knee replacement. These are important milestones to benchmark comparative prosthesis performance. This year the AOANJRR applied the benchmarking approach recently recommended by an International Working Group to identify those devices that have superior and non-inferior performance at 10 years. These benchmarks reflect proven long-term success. The approach used is explained and the prostheses achieving these benchmarks are highlighted.

Hip Replacement Data
In 2017, hip replacement has increased by 1.1%. The revision burden in 2017 is 8.9%. This is the same as 2016, and remains the lowest level reported by the Registry. In primary partial hip replacement, the use of bipolar prostheses continues to increase and has a lower rate of revision compared to other types of partial hip replacement for the management of fractured neck of femur. This difference is most evident in patients aged <75 years at the time of surgery.

This year, all metal/metal bearings including small head metal/metal, have been excluded. In addition, where appropriate non cross-linked polyethylene (non XLPE) bearings have also been excluded to ensure that the analysis presented remains relevant to modern surgical practice.

The effect of ASA score and BMI data on revision rates (five year rates for ASA and three year rates for BMI) and reasons for revision are reported for the first time. The risk of revision for infection, fracture and dislocation increases with increasing ASA score and this difference is most evident early on. There is also an increased risk of revision associated with increasing BMI due to a higher rate of revision for infection. Outcomes related to specific prosthesis factors have been updated. There are no major differences to the previous report.

Knee Replacement Data
In 2017, knee replacement increased by 5.0%. The revision burden was 7.4%. This is the same as 2016 and is the lowest level reported by the Registry. The use of unicompartmental knee replacement after declining for many years has shown a small increase each year for the last three years. Most of this increase can be attributed to the use of one device used in association with robotic surgery. The effect of ASA score and BMI on revision rates (five year rates for ASA and three year rates for BMI) and reasons for revision are reported for the first time. The risk of revision increases with increasing ASA score, due to a higher rate of revision for infection. Compared to normal BMI, a difference in revision rate in the first three years is only evident for patients in obese class 3, due to an increased rate of revision for infection. Outcomes related to specific prostheses factors have been updated.

Shoulder Replacement Data
In 2017, shoulder replacement increased by 10.0%. The revision burden was 9.1%. This is the same as 2016 and is the lowest level reported by the Registry. The use of partial shoulder replacement has declined rapidly in recent years and that decline continues in 2017. In total shoulder replacement, although the use of total mid head shoulder replacement has remained low, its use is steadily increasing. It has a lower rate of revision compared to total stemmed shoulder replacement and a lower rate of revision in the first three months compared to total reverse shoulder replacement. In total stemmed shoulder replacement, the use of cemented all-polyethylene glenoid components is associated with the lowest risk of revision. There is no difference if the all-polyethylene component is a keeled or pegged design. The use of XLPE is associated with lower revision rates. The method of fixation does not effect the revision rate for total reverse shoulder replacement. However, the use of smaller glenosphere size is associated with an increased risk of revision when used for the treatment of osteoarthritis, but not rotator cuff arthropathy or fracture.

Prostheses with Higher than Anticipated Rates of Revision
Each year, the AOANJRR identifies prostheses with higher than anticipated rates of revision. This year, 11 new prostheses have been identified: one acetabular prosthesis, three hip prosthesis combinations, six primary total knee prosthesis combinations and one shoulder prosthesis combination.

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 this report (Appendix 1).

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.

DEPUTY DIRECTORS

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Mr Peter Lewis
Professor Ian Harris

DIRECTOR

Professor Stephen Graves

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Ms Grace O'Donohue
Mr Jake Platt

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Mr James Stoney
Mr Bill Donnelly

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Professor Richard Page (Upper Limb Joint Replacement)
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Ms Alesha Hatton
Ms Janey Barrow
Mr Robert Armitage
Many thanks to the Data Entry Team

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David Hale	Chairperson
Stephen Graves	Director
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Peter Lewis	Deputy Director (South Australia)
Ian Harris	Deputy Director (New South Wales)
Roger Brighton	New South Wales
John Radovanovic	Queensland
Alexander Burns	Australian Capital Territory
Markus Kuster	Western Australia
Michael Pritchard	Tasmania
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Neil Bergman	AOA Representative - AOANJRR Consultative Committee
Peter Myers	Australian Knee Society
Richard Page	Shoulder & Elbow Society Representative
Andrew Beischer	Foot & Ankle Society Representative
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 2018 Hip, Knee and Shoulder Arthroplasty Report is based on the analysis of 1,355,938 (593,803 hip, 717,334 knee and 44,801 shoulder) primary and revision procedures recorded by the Registry, with a procedure date up to and including 31 December 2017. Shoulder arthroplasty has been included in this report with hip and knee arthroplasty since 2017.

In addition, there are 11 supplementary reports that complete the AOANJRR Annual Report for 2018:

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 – 2016/2017

In addition to the 11 supplementary reports, investigations of prostheses with higher than anticipated rates of revision are published on https://aoanjrr.sahmri.com/annual-reports-2018

All hospitals, public and private, undertaking joint replacement submit their data to the Registry. Currently, there are 312 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 (303 in 2017). 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 8.9% in 2017, equating to 1,908 fewer hip revisions in 2017. The percentage of revision knee procedures has declined from a peak of 8.8% in 2004 to 7.4% in 2017, equating to 877 fewer knee revisions in 2017. Revision shoulder arthroplasty peaked at 10.9% in 2012, and has declined to 9.1% in 2017.

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.

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 Officer, 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 2016/17 financial year, the Registry received 142 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 98.8% of hip, knee and shoulder joint replacement procedures undertaken in Australia. On initial submission of forms from participating hospitals, the Registry's capture rate is 96.1% for these procedures. Following verification against health department data, checking of unmatched data and subsequent retrieval of unreported procedures, the Registry is able to obtain an almost complete dataset 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.
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 workshop to review all sections of the report other than the shoulder procedures section. This workshop was held in Adelaide on the weekend of 4 and 5 August 2018. 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 29 July 2018. 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.

2018

Primary Total and Revision Hip Replacement in Older Patients

The purpose of this analysis is to provide more detailed information on the use and outcomes of both primary and revision hip replacement in older patients.

The focus of the primary analysis is total conventional hip replacement undertaken for osteoarthritis in patients aged ≥80 years. Where there is sufficient data the analysis has been undertaken separately for patients aged 80-89 and ≥90 years.

An analysis of the outcome of all initial revisions of primary procedures reported to the Registry has also been undertaken. As there are fewer revisions compared to primary procedures. The revision analysis has been undertaken on all patients aged ≥80 years as a single group.

DEMOGRAPHICS

The number, but not the proportion, of primary total conventional hip replacements performed for osteoarthritis in this age group has increased. In 2017, 4,406 procedures were performed in the ≥80 age group (4,122 in patients aged 80-89 years, and 284 in the ≥90 year age group). This number has increased compared to when 2,188 procedures were undertaken in 2003 (2,089 in those aged 80-89 years and 99 in the ≥90 age group) (Table EH1).

The proportion of patients having primary total conventional hip replacement for osteoarthritis in these age groups has remained relatively constant since 2003 (Table EH1).

Females are more likely to have total conventional hip replacement for osteoarthritis than males and this proportion increases with increasing age (52.1% for <80 year, 63.2% for 80-89 year and 70.4% for ≥90 year age groups) (Table EH2).

The incidence of primary total conventional hip replacement per 100,000 of the Australian population has increased annually since 2003. This increase is apparent in all age groups (Table EH3).

The gender difference with increasing age is not so apparent when the age adjusted incidence of primary total conventional hip replacement for osteoarthritis is compared. In 2017, the incidence per 100,000 in the 80-89 year age group is 565.1 for females and 486.8 for males and for the ≥90 age group it is 154.8 for females and 146.8 for males (Table EH3).

Table EH1 Primary Total Conventional Hip Replacement by Age (Primary Diagnosis OA)

	<80		80-89		≥90		TOTAL	
Procedure Year	N	Row%	N	Row%	N	Row%	N	Row%
≤2002	23416	85.8	3694	13.5	180	0.7	27290	100.0
2003	12845	85.4	2089	13.9	99	0.7	15033	100.0
2004	13676	84.8	2337	14.5	112	0.7	16125	100.0
2005	14296	85.1	2387	14.2	109	0.6	16792	100.0
2006	14745	84.7	2553	14.7	110	0.6	17408	100.0
2007	15468	85.5	2519	13.9	108	0.6	18095	100.0
2008	16847	85.1	2798	14.1	143	0.7	19788	100.0
2009	17987	85.4	2925	13.9	148	0.7	21060	100.0
2010	19242	85.3	3149	14.0	173	0.8	22564	100.0
2011	20312	85.8	3183	13.4	187	0.8	23682	100.0
2012	20967	85.5	3366	13.7	195	0.8	24528	100.0
2013	22631	85.9	3505	13.3	200	0.8	26336	100.0
2014	24756	86.4	3665	12.8	225	0.8	28646	100.0
2015	26157	86.8	3737	12.4	237	0.8	30131	100.0
2016	27634	86.7	3977	12.5	249	0.8	31860	100.0
2017	27749	86.3	4122	12.8	284	0.9	32155	100.0
TOTAL	**318728**	**85.8**	**50006**	**13.5**	**2759**	**0.7**	**371493**	**100.0**

Table EH2 Primary Total Conventional Hip Replacement by Gender and Age (Primary Diagnosis OA)

	<80		80-89		≥90		TOTAL	
Gender	N	Col%	N	Col%	N	Col%	N	Col%
Female	165980	52.1	31583	63.2	1942	70.4	199505	53.7
Male	152748	47.9	18423	36.8	817	29.6	171988	46.3
TOTAL	**318728**	**100.0**	**50006**	**100.0**	**2759**	**100.0**	**371493**	**100.0**

Table EH3 Incidence of Primary Total Conventional Hip Replacement per 100,000 between 2003 to 2017 by Age and Gender (Primary Diagnosis OA, Relative to the Australian population for that year)

	<80			80-89			≥90			TOTAL		
	Male	Female	TOTAL	Male	Female	TOTAL	Male	Female	TOTAL	Male	Female	TOTAL
Procedure Year	N	N	N	N	N	N	N	N	N	N	N	N
2003	63.7	71.0	67.3	348.2	398.6	379.7	135.7	97.7	107.7	69.9	82.5	76.2
2004	66.8	75.1	71.0	381.4	428.3	410.5	132.5	110.0	115.9	73.9	87.8	80.9
2005	68.8	78.0	73.4	364.3	427.9	403.5	132.0	97.1	106.4	75.7	90.7	83.2
2006	71.4	78.1	74.7	375.7	441.9	416.1	90.8	107.8	103.3	78.6	91.5	85.1
2007	72.7	81.4	77.0	347.6	426.5	395.4	112.4	91.7	97.3	79.5	94.2	86.9
2008	77.5	87.1	82.3	390.3	446.4	424.1	111.8	131.4	126.0	85.3	100.8	93.1
2009	80.9	91.4	86.1	393.1	454.0	429.6	119.9	130.6	127.6	88.9	105.3	97.1
2010	86.6	94.8	90.7	393.2	488.0	449.8	132.8	143.1	140.1	94.7	110.1	102.4
2011	90.8	98.3	94.5	399.3	475.3	444.4	139.0	143.8	142.4	99.0	112.9	106.0
2012	91.7	100.1	95.9	413.1	500.0	464.3	134.4	140.4	138.6	100.4	115.4	107.9
2013	97.5	106.0	101.7	433.1	509.6	477.8	144.4	129.0	133.6	106.6	121.1	113.9
2014	105.0	114.3	109.7	459.5	519.2	494.1	157.6	133.9	141.2	114.7	129.2	122.0
2015	110.6	117.8	114.2	460.1	527.5	498.9	137.0	142.8	141.0	120.1	132.8	126.5
2016	114.4	123.3	118.8	488.4	548.7	522.9	118.0	151.1	140.5	124.5	138.8	131.7
2017	112.5	122.3	117.4	486.8	565.1	531.3	146.8	154.8	152.2	122.9	138.4	130.7
TOTAL	**88.5**	**97.1**	**92.8**	**414.7**	**480.5**	**453.8**	**131.8**	**130.1**	**130.6**	**96.9**	**111.4**	**104.2**

MORTALITY

The following analysis includes patients that have had primary total conventional hip replacement for osteoarthritis. Patients that have been revised are censored at the time of revision. The risk of both early and late mortality increases with increasing age.

Early mortality at 30 and 90 days is higher in the older age groups. At 30 days it is 1/1000 (<80 years), 5/1000 (80-89 years) and 13/1000 (≥90 years). At 90 days it is 2/1000, 9/1000 and 27/1000, respectively (Table EH4).

The five and 10 year survivorship for patients aged <80 years is 94.4% and 82.9%. For those aged 80-89 years it is 78.5% and 41.8%, and ≥90 years it is 57.1% and 14.6%. Patients aged ≥90 years have 2.5 times the increased risk of mortality compared to those aged 80-89 years (Table EH4 and Figure EH1).

Males have a higher rate of mortality compared to females for both the 80-89 and ≥90 age groups (Table EH5 and Figure EH2).

In the ≥80 age group, increasing ASA score is associated with higher rates of mortality (Table EH6 and Figure EH3).

BMI also affects mortality in the ≥80 age group. Patients in the pre-obese class have a lower mortality compared to patients with a normal BMI. There is no difference in the mortality when the other BMI classes are compared to the normal BMI class (Table EH7 and Figure EH4).

The effect of fixation on mortality was also examined. This was because of concern that the use of cement, particularly in the elderly, may be associated with increased early mortality. Prior to the analysis being undertaken, the distribution of ASA scores for cementless, hybrid and cement fixation was determined. Due to the small sample size in the ≥90 age group, analysis of the 80-89 age group and ≥90 age group was combined. The distribution of ASA scores is similar for cementless and hybrid fixation. Cemented procedures have an increased proportion of patients with ASA scores 3 and 4 (Table EH8).

In the ≥80 age group, increasing ASA score is associated with higher rates of mortality.

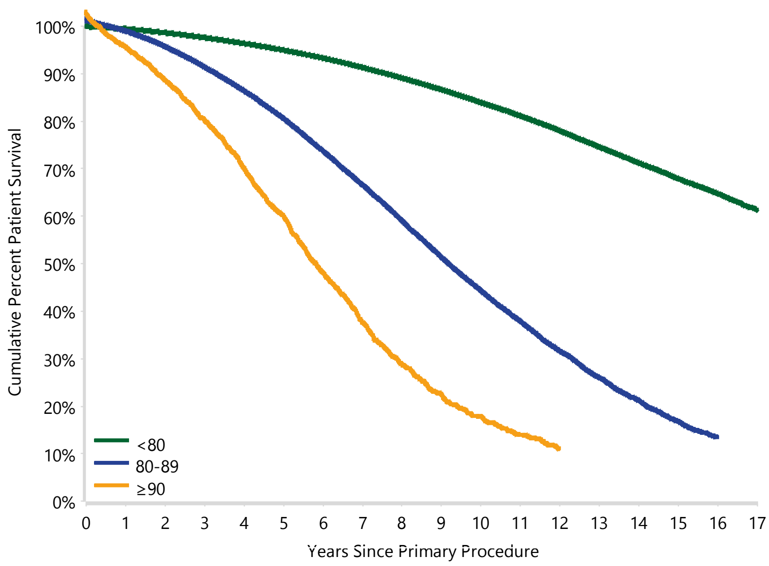
To adjust for this difference, the mortality analysis comparing the three different types of fixation is stratified by ASA score. It was not possible to stratify ASA score 1 and ASA score 5 due to insufficient numbers in one or more fixation groups. There was no difference in mortality for the different types of fixation when stratified by the remaining three ASA scores (2, 3 and 4) (Tables EH9 to EH11, and Figures EH5 to EH7).

Table EH4 Cumulative Percent Survival of Patients with Primary Total Conventional Hip Replacement by Age (Primary Diagnosis OA)

Age	N Death	N Total	30 Days	90 Days	1 Yr	2 Yr	5 Yr	10 Yr
<80	34729	300482	99.9 (99.9, 99.9)	99.8 (99.8, 99.8)	99.3 (99.3, 99.4)	98.4 (98.4, 98.5)	94.4 (94.3, 94.5)	82.9 (82.7, 83.1)
80-89	18205	48737	99.5 (99.4, 99.5)	99.1 (99.0, 99.1)	97.3 (97.1, 97.4)	93.9 (93.7, 94.1)	78.5 (78.1, 78.9)	41.8 (41.1, 42.5)
≥90	1383	2707	98.7 (98.2, 99.1)	97.3 (96.6, 97.8)	92.7 (91.7, 93.7)	85.7 (84.2, 87.0)	57.1 (54.8, 59.3)	14.6 (12.4, 16.9)
TOTAL	**54317**	**351926**						

Note: All primary procedures using metal/metal prostheses have been excluded
Patients who have been revised are censored

Figure EH1 Cumulative Percent Survival of Patients with Primary Total Conventional Hip Replacement by Age (Primary Diagnosis OA)



HR - adjusted for gender
80-89 vs <80
0 - 1Mth: HR=5.65 (4.76, 6.69),p<0.001
1Mth - 3Mth: HR=5.01 (4.18, 6.01),p<0.001
3Mth - 5Yr: HR=4.32 (4.20, 4.45),p<0.001
5Yr+: HR=5.13 (5.01, 5.25),p<0.001
≥90 vs <80
0 - 1Mth: HR=14.63 (10.29, 20.78),p<0.001
1Mth - 3Mth: HR=17.17 (12.22, 24.12),p<0.001
3Mth - 1Yr: HR=11.21 (9.29, 13.53),p<0.001
1Yr - 5Yr: HR=10.04 (9.29, 10.86),p<0.001
5Yr - 10Yr: HR=12.46 (11.36, 13.66),p<0.001
10Yr+: HR=6.57 (5.04, 8.56),p<0.001
≥90 vs 80-89
0 - 1Mth: HR=2.59 (1.82, 3.69),p<0.001
1Mth - 3Mth: HR=3.44 (2.43, 4.86),p<0.001
3Mth - 1Yr: HR=2.60 (2.15, 3.13),p<0.001
1Yr - 5Yr: HR=2.33 (2.15, 2.52),p<0.001
5Yr - 10Yr: HR=2.43 (2.21, 2.67),p<0.001
10Yr+: HR=1.28 (0.98, 1.67),p=0.067

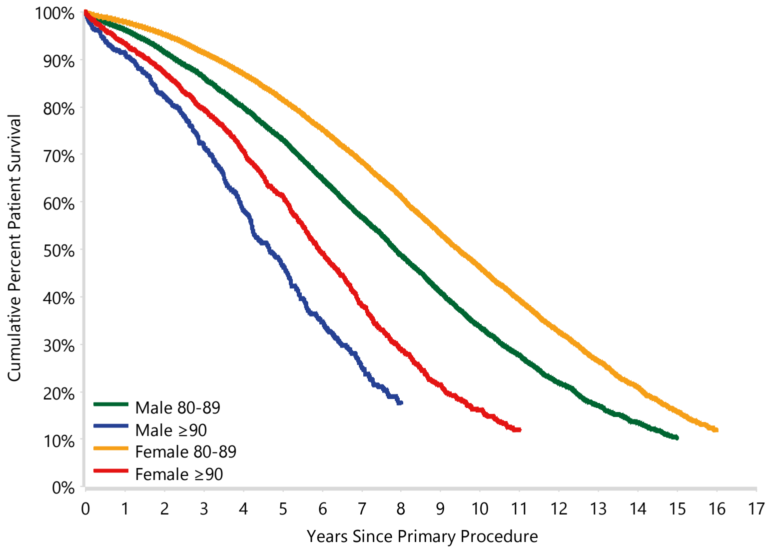
Number at Risk	0 Days	30 Days	90 Days	1 Yr	2 Yr	5 Yr	10 Yr
<80	300482	298331	292906	270868	241024	161234	66708
80-89	48737	48247	47284	43322	38019	22915	5760
≥90	2707	2653	2562	2232	1847	853	97

Table EH5 Cumulative Percent Survival of Patients with Primary Total Conventional Hip Replacement by Gender and Age (Primary Diagnosis OA)

Gender	Age	N Death	N Total	30 Days	90 Days	1 Yr	2 Yr	5 Yr	10 Yr
Male	80-89	7192	17881	99.2 (99.1, 99.3)	98.7 (98.5, 98.8)	96.2 (95.9, 96.5)	91.6 (91.1, 92.0)	73.1 (72.3, 73.8)	33.6 (32.5, 34.7)
	≥90	431	799	98.0 (96.7, 98.8)	96.2 (94.6, 97.3)	91.3 (89.0, 93.1)	82.1 (79.1, 84.8)	46.6 (42.3, 50.9)	
Female	80-89	11013	30856	99.6 (99.6, 99.7)	99.3 (99.2, 99.4)	97.9 (97.7, 98.1)	95.3 (95.0, 95.5)	81.5 (81.0, 82.0)	46.1 (45.3, 47.0)
	≥90	952	1908	99.0 (98.4, 99.4)	97.7 (96.9, 98.3)	93.3 (92.1, 94.4)	87.2 (85.5, 88.7)	61.4 (58.7, 63.9)	16.1 (13.4, 18.9)
TOTAL		**19588**	**51444**						

Note: All primary procedures using metal/metal prostheses have been excluded
Patients who have been revised are censored.

Figure EH2 Cumulative Percent Survival of Patients with Primary Total Conventional Hip Replacement by Gender and Age (Primary Diagnosis OA)



Male 80-89 vs Male ≥90
Entire Period: HR=0.44 (0.40, 0.48),p<0.001
Male 80-89 vs Female 80-89
0 - 2.5Yr: HR=1.75 (1.64, 1.87),p<0.001
2.5Yr - 3Yr: HR=1.37 (1.20, 1.56),p<0.001
3Yr - 3.5Yr: HR=1.63 (1.43, 1.85),p<0.001
3.5Yr - 5Yr: HR=1.41 (1.30, 1.52),p<0.001
5Yr - 7Yr: HR=1.45 (1.36, 1.55),p<0.001
7Yr - 7.5Yr: HR=1.19 (1.03, 1.38),p=0.020
7.5Yr - 8Yr: HR=1.48 (1.29, 1.71),p<0.001
8Yr+: HR=1.25 (1.17, 1.32),p<0.001
Male ≥90 vs Female ≥90
Entire Period: HR=1.42 (1.27, 1.60),p<0.001
Female 80-89 vs Female ≥90
0 - 4.5Yr: HR=0.39 (0.36, 0.43),p<0.001
4.5Yr - 5Yr: HR=0.52 (0.38, 0.71),p<0.001
5Yr - 6.5Yr: HR=0.39 (0.33, 0.45),p<0.001
6.5Yr - 7Yr: HR=0.31 (0.23, 0.41),p<0.001
7Yr - 7.5Yr: HR=0.39 (0.28, 0.55),p<0.001
7.5Yr - 11.5Yr: HR=0.49 (0.41, 0.59),p<0.001
11.5Yr - 12Yr: HR=0.48 (0.24, 0.98),p=0.042
12Yr+: HR=1.26 (0.73, 2.18),p=0.402

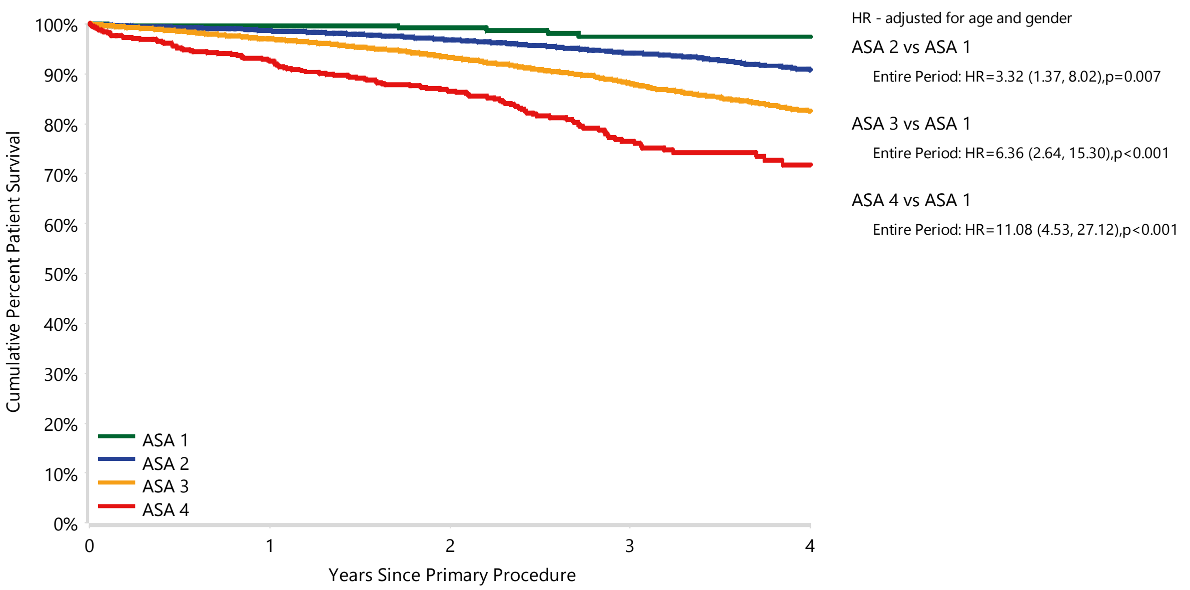
Number at risk		0 Days	30 Days	90 Days	1 Yr	2 Yr	5 Yr	10 Yr
Male	80-89	17881	17640	17227	15597	13349	7436	1540
	≥90	799	774	743	641	519	194	18
Female	80-89	30856	30607	30057	27725	24670	15479	4220
	≥90	1908	1879	1819	1591	1328	659	79

Table EH6 Cumulative Percent Survival of Patients Aged ≥80 Years with Primary Total Conventional Hip Replacement by ASA Score (Primary Diagnosis OA)

ASA Score	N Death	N Total	30 Days	90 Days	1 Yr	2 Yr	3 Yr	4 Yr
ASA 1	5	333	100.0 (100.0, 100.0)	99.7 (97.9, 100.0)	99.7 (97.9, 100.0)	99.3 (97.0, 99.8)	97.4 (93.8, 99.0)	97.4 (93.8, 99.0)
ASA 2	346	7594	99.7 (99.6, 99.8)	99.5 (99.3, 99.6)	98.6 (98.3, 98.9)	96.8 (96.3, 97.2)	94.2 (93.5, 94.9)	90.8 (89.6, 91.9)
ASA 3	890	10132	99.7 (99.6, 99.8)	99.2 (99.0, 99.4)	96.9 (96.6, 97.3)	93.2 (92.6, 93.8)	87.9 (87.0, 88.8)	82.4 (81.1, 83.6)
ASA 4	120	717	98.3 (97.1, 99.0)	97.0 (95.5, 98.0)	92.5 (90.1, 94.3)	86.4 (83.3, 89.0)	76.3 (71.7, 80.2)	71.7 (66.2, 76.5)
ASA 5	0	2	100.0 (100.0, 100.0)	100.0 (100.0, 100.0)	100.0 (100.0, 100.0)	100.0 (100.0, 100.0)	100.0 (100.0, 100.0)	
TOTAL	1361	18778						

Note: All primary procedures using metal/metal prostheses have been excluded
Patients who have been revised are censored

Figure EH3 Cumulative Percent Survival of Patients Aged ≥80 Years with Primary Total Conventional Hip Replacement by ASA Score (Primary Diagnosis OA)



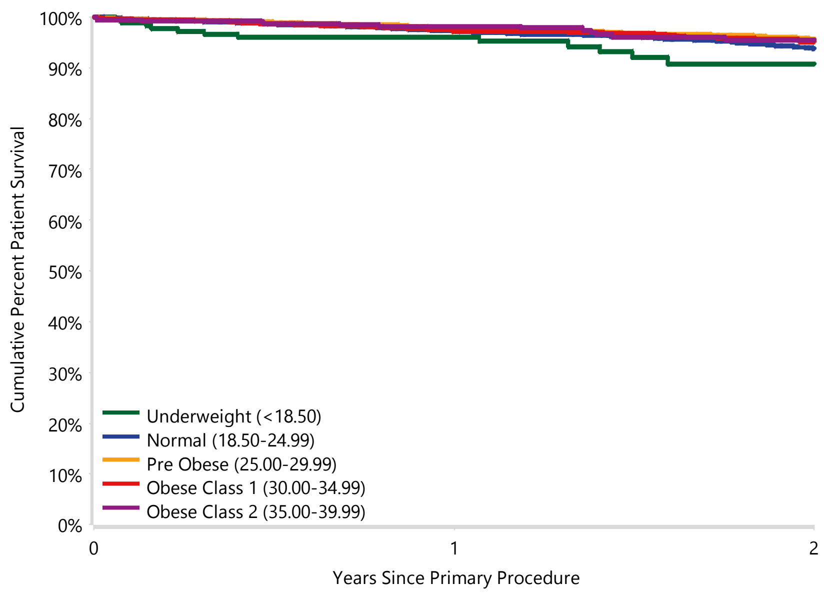
Number at Risk	0 Days	30 Days	90 Days	1 Yr	2 Yr	3 Yr	4 Yr
ASA 1	333	332	318	277	212	123	54
ASA 2	7594	7483	7163	5806	4057	2432	952
ASA 3	10132	9953	9459	7401	5001	2877	1047
ASA 4	717	690	650	510	327	190	74

Table EH7 Cumulative Percent Survival of Patients Aged ≥80 Years with Primary Total Conventional Hip Replacement by BMI (Primary Diagnosis OA)

BMI	N Death	N Total	30 Days	90 Days	1 Yr	2 Yr
Underweight (<18.50)	13	189	98.9 (95.8, 99.7)	97.2 (93.5, 98.8)	96.0 (91.9, 98.1)	90.7 (83.8, 94.8)
Normal (18.50-24.99)	157	3653	99.7 (99.4, 99.8)	99.3 (98.9, 99.5)	97.3 (96.7, 97.9)	93.8 (92.6, 94.8)
Pre Obese (25.00-29.99)	139	4651	99.6 (99.4, 99.8)	99.4 (99.1, 99.6)	97.9 (97.3, 98.3)	95.7 (94.8, 96.4)
Obese Class 1 (30.00-34.99)	77	2113	99.7 (99.3, 99.8)	99.4 (98.9, 99.6)	97.2 (96.3, 97.9)	95.1 (93.7, 96.2)
Obese Class 2 (35.00-39.99)	16	520	99.4 (98.2, 99.8)	99.2 (97.9, 99.7)	98.2 (96.4, 99.1)	95.5 (92.3, 97.4)
Obese Class 3 (≥40.00)	3	156	99.3 (95.4, 99.9)	98.6 (94.6, 99.7)	97.7 (93.0, 99.3)	97.7 (93.0, 99.3)
TOTAL	**405**	**11282**				

Note: All primary procedures using metal/metal prostheses have been excluded
Patients who have been revised are censored

Figure EH4 Cumulative Percent Survival of Patients Aged ≥80 Years with Primary Total Conventional Hip Replacement by BMI (Primary Diagnosis OA)



HR - adjusted for age and gender

Underweight (<18.50) vs Normal (18.50-24.99)
Entire Period: HR=1.68 (0.95, 2.95),p=0.074

Pre Obese (25.00-29.99) vs Normal (18.50-24.99)
Entire Period: HR=0.73 (0.58, 0.92),p=0.008

Obese Class 1 (30.00-34.99) vs Normal (18.50-24.99)
Entire Period: HR=0.96 (0.73, 1.27),p=0.784

Obese Class 2 (35.00-39.99) vs Normal (18.50-24.99)
Entire Period: HR=1.00 (0.60, 1.68),p=0.993

Number at Risk	0 Days	30 Days	90 Days	1 Yr	2 Yr
Underweight (<18.50)	189	184	167	116	55
Normal (18.50-24.99)	3653	3567	3311	2276	1018
Pre Obese (25.00-29.99)	4651	4534	4225	2840	1282
Obese Class 1 (30.00-34.99)	2113	2061	1908	1295	584
Obese Class 2 (35.00-39.99)	520	508	462	302	130

Table EH8 Primary Total Conventional Hip Replacement in Patients Aged ≥80 Years by ASA Score and Fixation (Primary Diagnosis OA)

	Cemented		Cementless		Hybrid	
ASA Score	N	Col%	N	Col%	N	Col%
ASA 1	13	1.0	174	2.2	146	1.5
ASA 2	511	37.6	3201	40.7	3882	40.6
ASA 3	775	57.1	4178	53.1	5179	54.2
ASA 4	59	4.3	312	4.0	346	3.6
ASA 5	.	.	1	0.0	1	0.0
TOTAL	**1358**	**100.0**	**7866**	**100.0**	**9554**	**100.0**

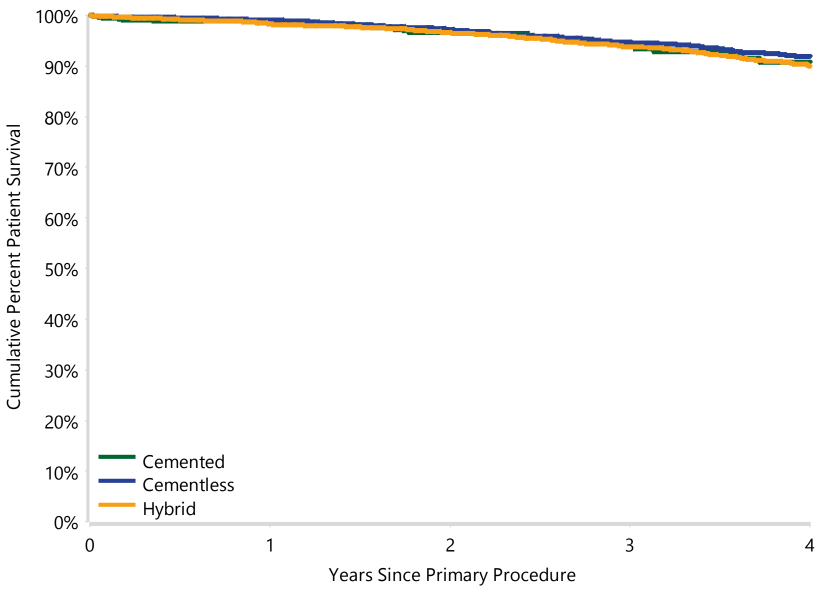
Note: All primary procedures using metal/metal prostheses have been excluded

Table EH9 Cumulative Percent Survival of Patients with Primary Total Conventional Hip Replacement Aged ≥80 Years with ASA Score 2 by Fixation (Primary Diagnosis OA)

Fixation	N Death	N Total	30 Days	90 Days	1 Yr	2 Yr	3 Yr	4 Yr
Cemented	29	511	99.4 (98.2, 99.8)	99.0 (97.6, 99.6)	98.6 (97.0, 99.3)	96.7 (94.4, 98.0)	94.1 (91.0, 96.2)	90.8 (86.4, 93.8)
Cementless	129	3201	99.7 (99.5, 99.9)	99.6 (99.3, 99.8)	99.0 (98.6, 99.3)	97.2 (96.4, 97.8)	94.7 (93.5, 95.6)	91.9 (90.1, 93.3)
Hybrid	188	3882	99.8 (99.6, 99.9)	99.4 (99.1, 99.6)	98.2 (97.7, 98.6)	96.5 (95.8, 97.1)	93.8 (92.7, 94.8)	89.9 (88.0, 91.5)
TOTAL	**346**	**7594**						

Note: All primary procedures using metal/metal prostheses have been excluded
Patients who have been revised are censored.

Figure EH5 Cumulative Percent Survival of Patients with Primary Total Conventional Hip Replacement Aged ≥80 Years with ASA Score 2 by Fixation (Primary Diagnosis OA)



HR - adjusted for age and gender

Cemented vs Cementless
Entire Period: HR=1.14 (0.76, 1.71),p=0.533

Hybrid vs Cementless
Entire Period: HR=1.23 (0.98, 1.55),p=0.067

Hybrid vs Cemented
Entire Period: HR=1.08 (0.73, 1.61),p=0.683

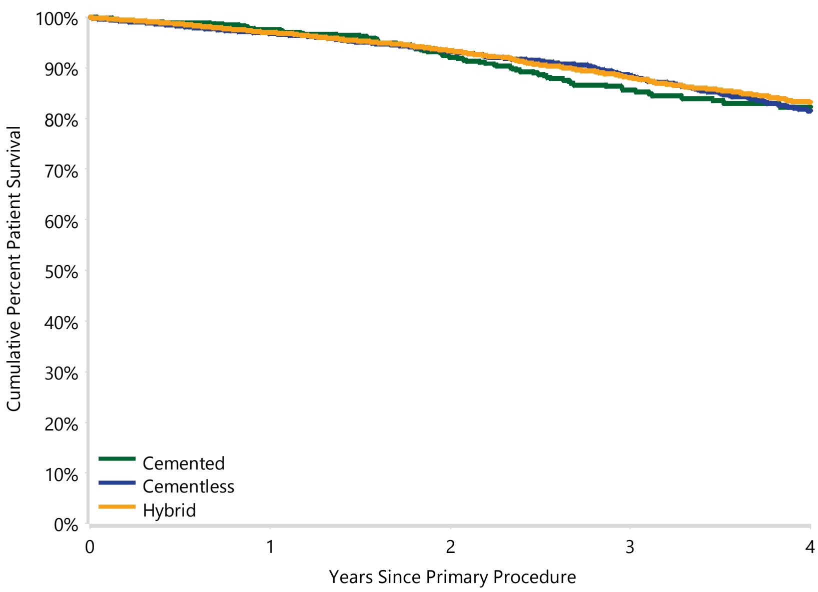
Number at Risk	0 Days	30 Days	90 Days	1 Yr	2 Yr	3 Yr	4 Yr
Cemented	511	507	484	414	318	227	86
Cementless	3201	3160	3034	2438	1718	1033	417
Hybrid	3882	3816	3645	2954	2021	1172	449

Table EH10 Cumulative Percent Survival of Patients with Primary Total Conventional Hip Replacement Aged ≥80 Years with ASA Score 3 by Fixation (Primary Diagnosis OA)

Fixation	N Death	N Total	30 Days	90 Days	1 Yr	2 Yr	3 Yr	4 Yr
Cemented	75	775	99.9 (99.1, 100.0)	99.2 (98.2, 99.6)	97.5 (96.0, 98.4)	92.0 (89.4, 94.0)	85.6 (81.9, 88.6)	82.2 (77.7, 85.9)
Cementless	373	4178	99.6 (99.3, 99.7)	99.1 (98.7, 99.3)	96.8 (96.2, 97.3)	93.2 (92.2, 94.0)	88.4 (87.0, 89.6)	81.5 (79.3, 83.5)
Hybrid	442	5179	99.7 (99.5, 99.8)	99.3 (99.1, 99.5)	97.0 (96.4, 97.4)	93.4 (92.6, 94.2)	88.0 (86.7, 89.2)	83.2 (81.4, 84.8)
TOTAL	**890**	**10132**						

Note: All primary procedures using metal/metal prostheses have been excluded
Patients who have been revised are censored

Figure EH6 Cumulative Percent Survival of Patients with Primary Total Conventional Hip Replacement Aged ≥80 Years with ASA Score 3 by Fixation (Primary Diagnosis OA)



HR - adjusted for age and gender

Cemented vs Cementless
Entire Period: HR=1.04 (0.81, 1.34),p=0.753

Cemented vs Hybrid
Entire Period: HR=1.12 (0.88, 1.43),p=0.366

Hybrid vs Cementless
Entire Period: HR=0.93 (0.81, 1.07),p=0.304

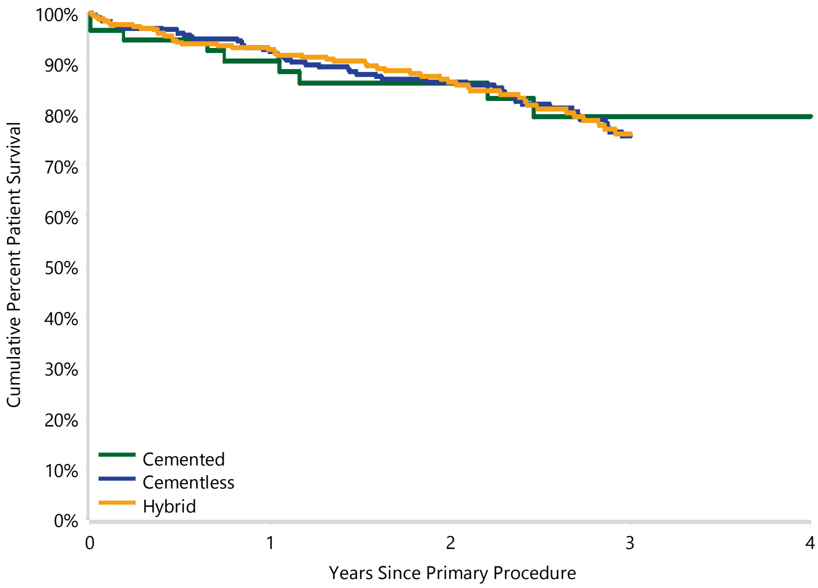
Number at Risk	0 Days	30 Days	90 Days	1 Yr	2 Yr	3 Yr	4 Yr
Cemented	775	764	719	581	400	233	86
Cementless	4178	4099	3895	3010	2034	1181	416
Hybrid	5179	5090	4845	3810	2567	1463	545

Table EH11 Cumulative Percent Survival of Patients with Primary Total Conventional Hip Replacement Aged ≥80 Years with ASA Score 4 by Fixation (Primary Diagnosis OA)

Fixation	N Death	N Total	30 Days	90 Days	1 Yr	2 Yr	3 Yr	4 Yr
Cemented	9	59	96.6 (87.1, 99.1)	94.8 (84.7, 98.3)	90.6 (78.7, 96.0)	86.2 (73.0, 93.2)	79.6 (63.4, 89.2)	79.6 (63.4, 89.2)
Cementless	52	312	98.4 (96.2, 99.3)	97.1 (94.4, 98.5)	92.4 (88.5, 95.0)	86.4 (81.3, 90.1)	75.7 (68.7, 81.4)	
Hybrid	59	346	98.5 (96.5, 99.4)	97.4 (95.0, 98.6)	92.8 (89.4, 95.2)	86.4 (81.5, 90.1)	76.1 (69.1, 81.8)	
TOTAL	**120**	**717**						

Note: All primary procedures using metal/metal prostheses have been excluded
Patients who have been revised are censored.

Figure EH7 Cumulative Percent Survival of Patients with Primary Total Conventional Hip Replacement Aged ≥80 Years with ASA Score 4 by Fixation (Primary Diagnosis OA)



HR - adjusted for age and gender

Cementless vs Cemented

Entire Period: HR=0.88 (0.43, 1.81),p=0.734

Cementless vs Hybrid

Entire Period: HR=0.86 (0.59, 1.27),p=0.459

Hybrid vs Cemented

Entire Period: HR=1.02 (0.50, 2.07),p=0.952

Number at Risk	0 Days	30 Days	90 Days	1 Yr	2 Yr	3 Yr	4 Yr
Cemented	59	54	51	41	32	15	8
Cementless	312	301	278	220	148	91	38
Hybrid	346	335	321	249	147	84	28

REVISION

In this analysis, the rate of revision has been reported using three different approaches. Each provides different information. The difference in the three approaches is the way that each deals with death. If there are no deaths the three approaches would give the same result.

The usual Registry approach to calculate time to first revision is to use Kaplan-Meier (KM) estimates of survivorship, or as is the case with the AOANJRR, the complement (in probability) of this; referred to as the cumulative percent revision.

Using this approach, those who have died are censored at the time of death. In this analysis an assumption is made that if patients censored for death had survived, they would be revised at the same rate as those who were not censored for death. The risk set at each time changes, as it includes all censored people up to that time, but not after. It answers the question of 'what is the chance of revision at a particular time, making the assumption that the patient will still be alive?'

There are alternative approaches to calculating the probability of revision and allowing for death. If death occurs, then a procedure is no longer able to be revised. Consequently, death is regarded as a competing risk to revision. In the presence of a competing risk, KM is said to over-estimate the probability of revision because the competing risk of death is ignored.

For most joint replacement analyses this is not a major issue, for two reasons. Firstly, the mortality rate is not regarded as high in the first 10 to 15 years. Secondly, the mortality rate is most often similar for the comparator groups of interest. This is not the case when comparing revision rates of older patients to younger patients.

Last year, the Registry introduced the concept of competing risk analysis when reporting on the outcomes of primary total hip replacement used for the management of fractured neck of femur. The reason for undertaking this analysis was because of the higher mortality rate in patients with fractured neck of femur. Competing risk analysis has been applied to this analysis for the same reason.

A competing risk analysis involves calculating the incidence of the two events of interest (death and revision). This is referred to as the cumulative incidence function. Whereas KM removes death from the risk set using a competing risk approach. These are included in the risk set. Consequently, the cumulative incidence for revision will be lower than the cumulative percent revision. The cumulative incidence for revision, with death as a competing risk, provides the actual percentage of revision.

This approach answers the question of how many of the orginal number of patients will end up being revised and how many will end up having died. These incidences are calculated for specific time periods after the orginal surgery. This information is not necessarily that useful for patients or surgeons, but is excellent for providing an overall view of the impact on health systems.

The third approach, is to determine the conditional probability of revision. This is the probability of revision given that a patient is able to experience that event up until the time of interest. Put simply, this determines the probability of a patient being revised if they are still alive at that time.

The cumulative percent revision at five years is 3.1%, 3.1% and 3.4% and at 10 years is 5.1%, 4.6% and 4.4%, respectively for the three age groups <80, 80-89 and ≥90 years (Table EH12).

The likely reason that older patients have a lower rate of revision is that they do not survive long enough to be revised.

The Registry has previously reported that there is a decreasing rate of revision with increasing age. The comparison of the three age groups, <80, 80-89 and ≥90 years, confirms that the 80-89 age group has a lower cumulative percent revision after six months compared to the <80 age group. However, it is higher in the first three months. There is no difference in cumulative percent revision for the ≥90 age group compared to the other two age groups (Figure EH8).

Despite the higher mortality rate in older individuals, the cumulative incidence of revision for these three age groups is not greatly reduced. It does however, reduce slightly more for the older age groups. The five year cumulative incidence is 3.0%, 2.9% and 3.1% and at 10 years it is 4.9%, 3.8% and 3.5% for the three age groups <80, 80-89 and ≥90 years, respectively. The increased risk of early revision in the older age groups is more evident in this analysis (Table EH13, Figures EH9 and EH10).

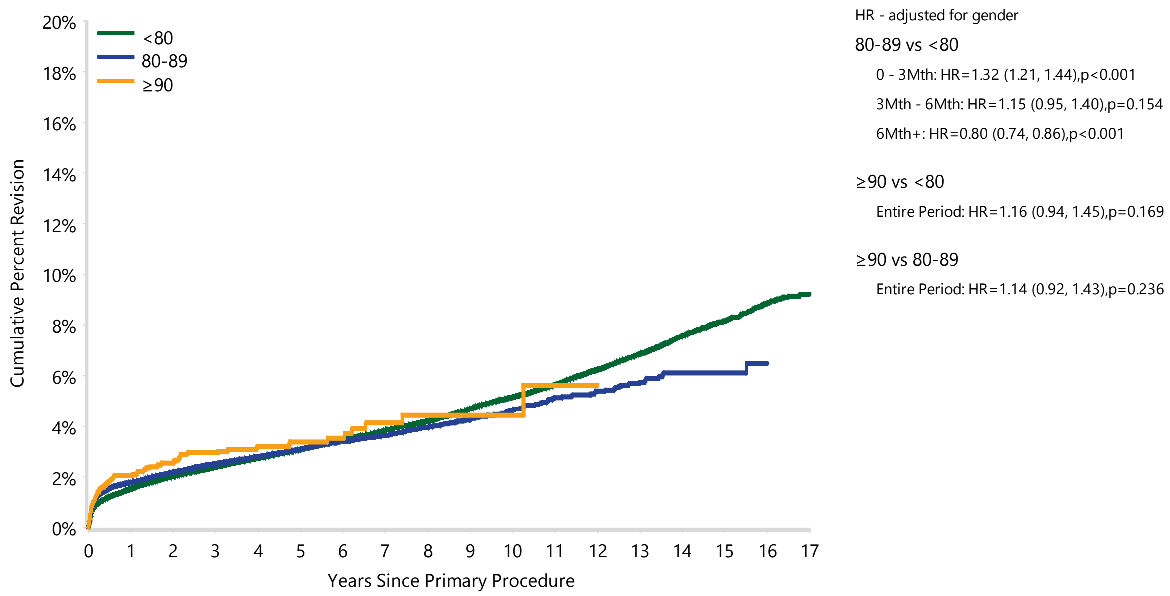
The conditional probability of revision, unlike cumulative percent revision and cumulative incidence, increases with increasing age. At five years the conditional probability is 3.2%, 3.7% and 5.4% (<80, 80-89 and ≥90 age groups) and at 10 years it is 5.9%, 9.0% and 21.0%, respectively (Table EH13 and Figure EH11). This information indicates that older patients who survive are revised more frequently. The likely reason that older patients have a lower rate of revision, as assessed by cumulative percent revision or cumulative incidence, is because these patients do not survive long enough to be revised; rather than the procedure performing better or that there is a higher threshold for revision in the elderly.

Table EH12 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Age (Primary Diagnosis OA)

Age	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<80	11290	300482	1.5 (1.5, 1.6)	2.0 (2.0, 2.1)	2.4 (2.3, 2.5)	3.1 (3.0, 3.2)	3.8 (3.8, 3.9)	5.1 (5.0, 5.3)
80-89	1535	48737	1.8 (1.7, 1.9)	2.2 (2.1, 2.3)	2.5 (2.4, 2.7)	3.1 (2.9, 3.3)	3.7 (3.5, 3.9)	4.6 (4.4, 4.9)
≥90	82	2707	2.0 (1.6, 2.7)	2.6 (2.0, 3.3)	2.9 (2.3, 3.7)	3.4 (2.7, 4.3)	4.1 (3.2, 5.3)	4.4 (3.4, 5.9)
TOTAL	**12907**	**351926**						

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

Figure EH8 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Age (Primary Diagnosis OA)



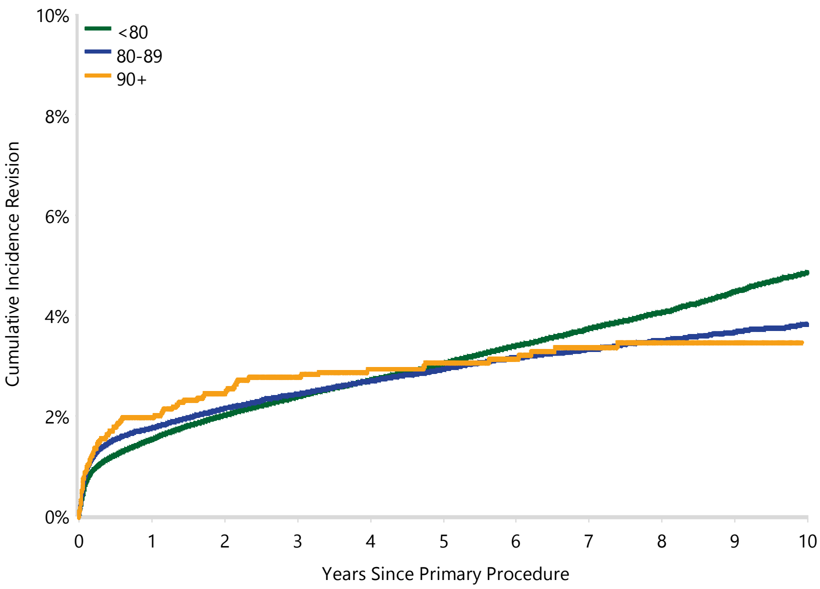
Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<80	300482	266807	236316	207704	156468	112737	63306
80-89	48737	42596	37240	32046	22281	13953	5539
≥90	2707	2197	1811	1443	831	358	92

Table EH13 Summary of Cumulative Incidence and Conditional Probability of Primary Total Conventional Hip Replacement (Primary Diagnosis OA)

Outcome	Age	1 Yrs	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
CIF(Alive, Unrevised)	<80	97.8%	96.4%	94.9%	91.4%	86.9%	78.1%
	80-89	95.5%	91.8%	87.1%	75.7%	61.2%	38.8%
	≥90	90.8%	83.3%	74.6%	54.5%	32.2%	13.1%
CIF(Revision)	<80	1.5%	2.0%	2.4%	3.0%	3.7%	4.9%
	80-89	1.8%	2.2%	2.5%	2.9%	3.3%	3.8%
	≥90	2.0%	2.5%	2.8%	3.1%	3.4%	3.5%
CIF(Mortality)	<80	0.7%	1.6%	2.7%	5.5%	9.4%	17.0%
	80-89	2.7%	6.1%	10.4%	21.4%	35.4%	57.4%
	≥90	7.2%	14.2%	22.6%	42.4%	64.4%	83.4%
CP(Revised, if alive)	<80	1.5%	2.0%	2.4%	3.2%	4.1%	5.9%
	80-89	1.8%	2.3%	2.7%	3.7%	5.2%	9.0%
	≥90	2.2%	2.9%	3.6%	5.4%	9.5%	21.0%

Note: CIF = Cumulative Incidence Function
CP = Conditional Probability

Figure EH9 Cumulative Incidence Revision of Primary Total Conventional Hip Replacement by Age (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yrs	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<80	300482	266807	236316	207704	156468	112737	63306
80-89	48737	42596	37240	32046	22281	13953	5539
≥90	2707	2197	1811	1443	831	358	92

Figure EH10 Cumulative Incidence Function of Primary Total Conventional Hip Replacement by Age

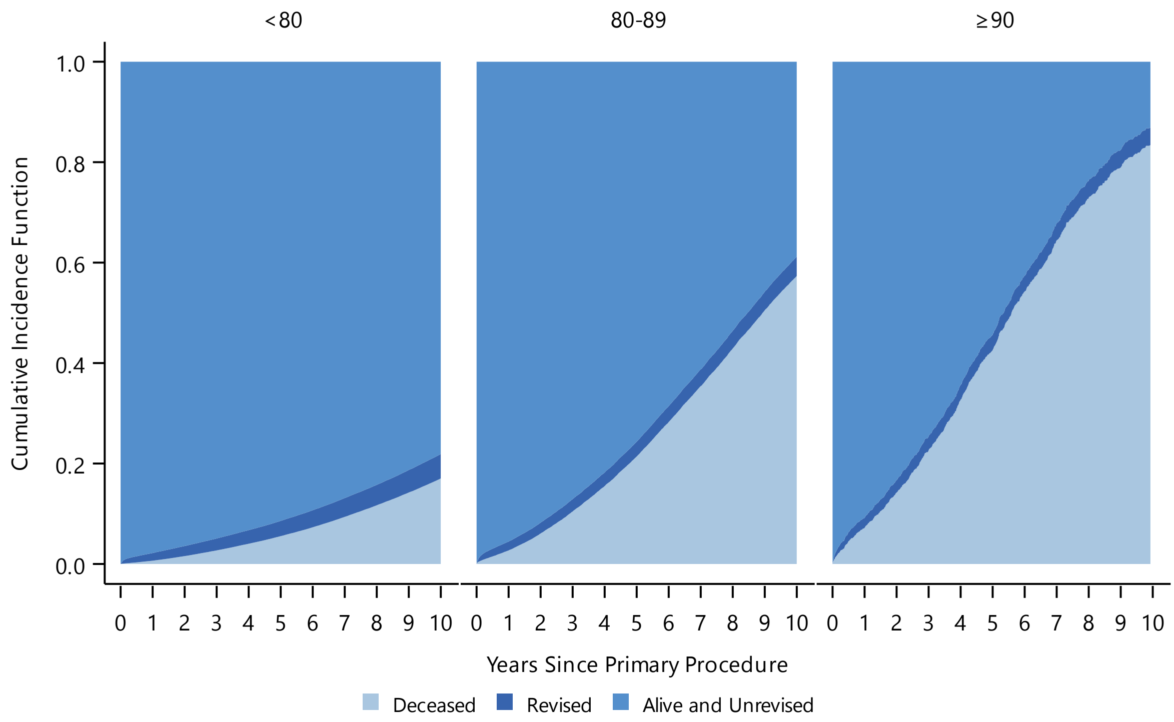
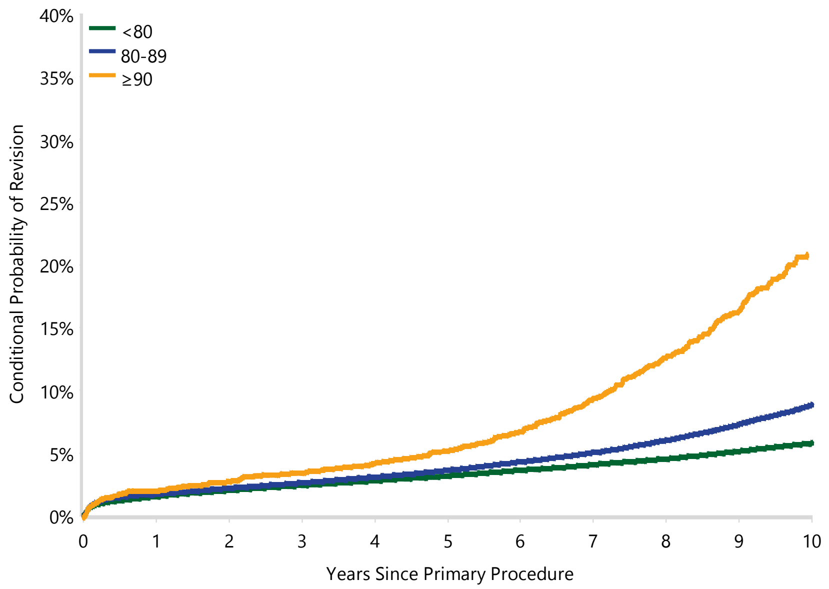


Figure EH11 Conditional Probability of Revision of Primary Total Conventional Hip Replacement by Age (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yrs	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<80	300482	266807	236316	207704	156468	112737	63306
80-89	48737	42596	37240	32046	22281	13953	5539
≥90	2707	2197	1811	1443	831	358	92

Reasons for Revision

The major reasons for revision vary between the age groups. Loosening and infection are less common in the elderly. There is no difference in revision for dislocation, however, the incidence of revision for fracture is higher (Table EH14 and Figure EH12).

Types of Revision

The main difference in the type of revision is a higher proportion of femoral component only revisions in the elderly (Table EH15).

Table EH14 Revision Diagnosis of Primary Total Conventional Hip Replacement by Age (Primary Diagnosis OA)

Revision Diagnosis	<80			80-89			≥90		
	Number	% Primaries Revised	% Revisions	Number	% Primaries Revised	% Revisions	Number	% Primaries Revised	% Revisions
Loosening	2957	1.0	26.2	256	0.5	16.7	10	0.4	12.2
Prosthesis Dislocation	2287	0.8	20.3	411	0.8	26.8	22	0.8	26.8
Infection	2095	0.7	18.6	225	0.5	14.7	12	0.4	14.6
Fracture	2028	0.7	18.0	566	1.2	36.9	32	1.2	39.0
Lysis	270	0.1	2.4	6	0.0	0.4	2	0.1	2.4
Pain	233	0.1	2.1	8	0.0	0.5			
Leg Length Discrepancy	197	0.1	1.7	4	0.0	0.3	1	0.0	1.2
Malposition	180	0.1	1.6	8	0.0	0.5	1	0.0	1.2
Instability	141	0.0	1.2	14	0.0	0.9	1	0.0	1.2
Other	902	0.3	8.0	37	0.1	2.4	1	0.0	1.2
N Revision	**11290**	**3.8**	**100.0**	**1535**	**3.1**	**100.0**	**82**	**3.0**	**100.0**
N Primary	**300482**			**48737**			**2707**		

Figure EH12 **Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement by Age (Primary Diagnosis OA)**

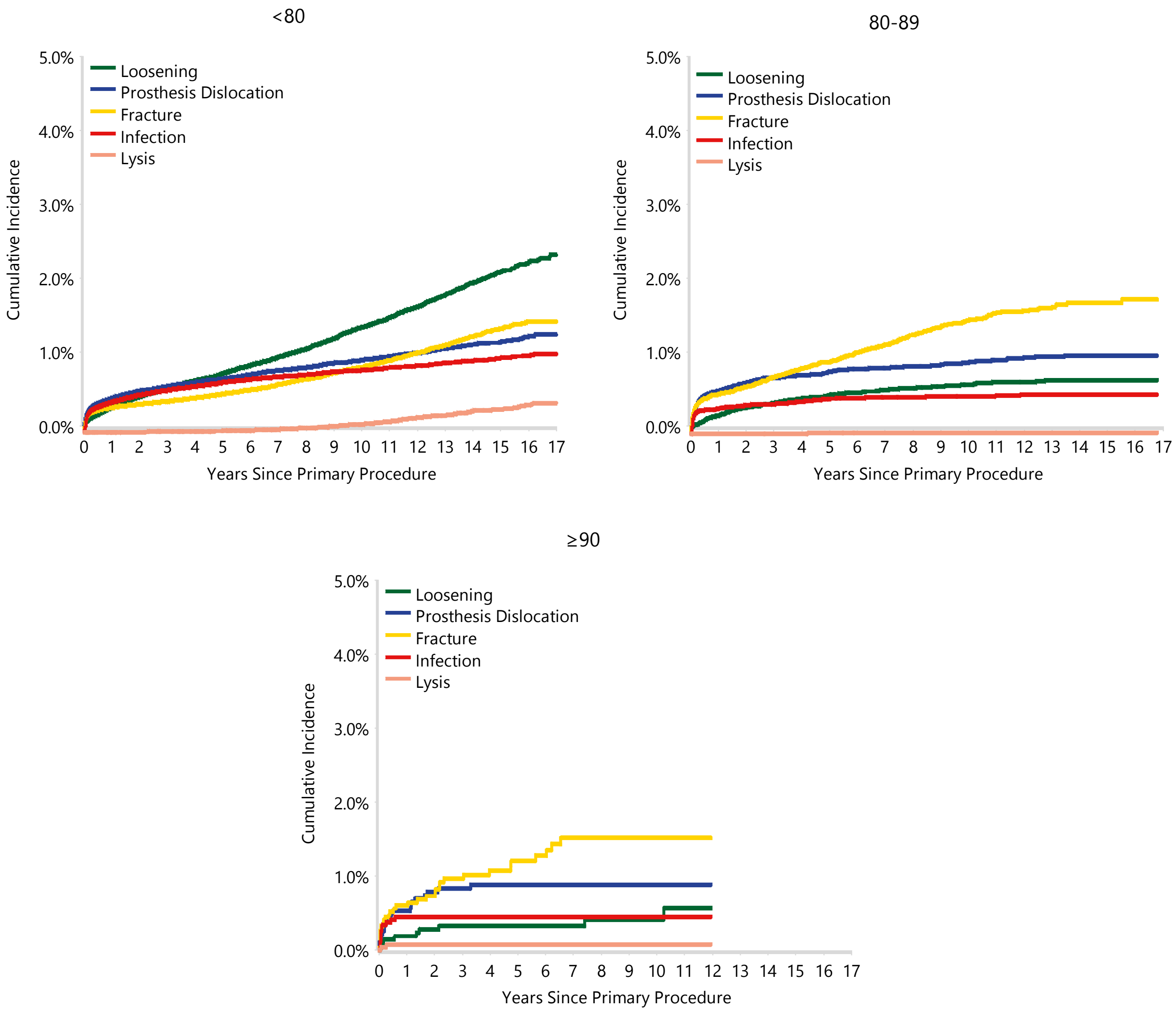


Table EH15 Type of Revision of Primary Total Conventional Hip Replacement by Age (Primary Diagnosis OA)

Type of Revision	<80			80-89			≥90		
	Number	% Primaries Revised	% Revisions	Number	% Primaries Revised	% Revisions	Number	% Primaries Revised	% Revisions
Femoral Component	3574	1.2	31.7	659	1.4	42.9	33	1.2	40.2
Acetabular Component	2479	0.8	22.0	246	0.5	16.0	17	0.6	20.7
Head/Insert	2246	0.7	19.9	323	0.7	21.0	14	0.5	17.1
THR (Femoral/Acetabular)	1441	0.5	12.8	106	0.2	6.9	5	0.2	6.1
Head Only	547	0.2	4.8	69	0.1	4.5	4	0.1	4.9
Cement Spacer	520	0.2	4.6	36	0.1	2.3			
Minor Components	172	0.1	1.5	48	0.1	3.1	6	0.2	7.3
Insert Only	116	0.0	1.0	26	0.1	1.7	1	0.0	1.2
Removal of Prostheses	73	0.0	0.6	11	0.0	0.7			
Head/Neck/Insert	55	0.0	0.5	6	0.0	0.4	1	0.0	1.2
Head/Neck	44	0.0	0.4	3	0.0	0.2	1	0.0	1.2
Reinsertion of Components	11	0.0	0.1	1	0.0	0.1			
Other	12	0.0	0.1	1	0.0	0.1			
N Revision	**11290**	**3.8**	**0.1**	**1535**	**3.1**	**0.1**	**82**	**3.0**	**100.0**
N Primary	**300482**			**48737**			**2707**		

PATIENT FACTORS

In the 80-89 age group, males have an increased rate of revision compared to females after three months. This increase is not evident in the ≥90 age group. However, the smaller numbers in this age group make it more difficult to identify any difference (Table EH16 and Figure EH13).

The effect of ASA and BMI on revision was also examined. The majority of patients have ASA scores 2 or 3. Patients aged ≥90 years are more likely to have a higher ASA score (Table EH17).

Considering the entire ≥80 age group, ASA score does not affect the revision rate when ASA scores 2, 3 and 4 are compared (Table EH18 and Figure EH14).

The most common BMI class in each of the age groups is either normal, pre-obese or obese class 1. Patients aged ≥90 years are more likely to have a lower BMI. In the 80-89 age group, the percentage of patients in the three most common classes is 31.3% (normal), 41.7% (pre-obese) and 19.2% (obese class 1). In the ≥90 age group the percentage is 49.4%, 34.4% and 10.5%, respectively (Table EH19).

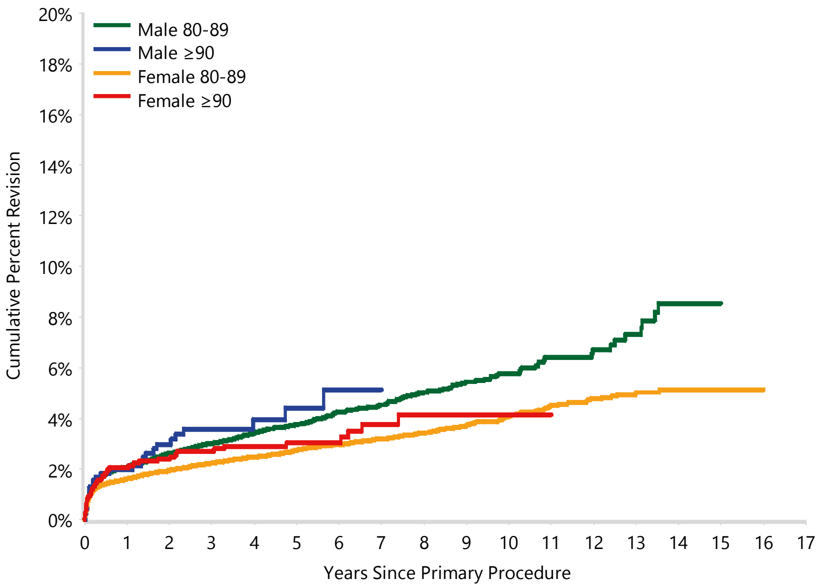
Considering the entire ≥80 age group, the revision rate varied depending on the BMI class. Obese class 2 and 3 have higher revision rates compared to patients in the normal BMI class (Table EH20 and Figure EH15).

Table EH16 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Gender and Age (Primary Diagnosis OA)

Gender	Age	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Male	80-89	657	17881	2.1 (1.9, 2.3)	2.6 (2.4, 2.9)	3.0 (2.8, 3.3)	3.7 (3.4, 4.1)	4.5 (4.2, 4.9)	5.8 (5.2, 6.4)
	≥90	28	799	2.0 (1.2, 3.2)	3.0 (1.9, 4.5)	3.6 (2.4, 5.3)	4.4 (2.9, 6.7)	5.1 (3.3, 8.0)	
Female	80-89	878	30856	1.6 (1.5, 1.8)	1.9 (1.8, 2.1)	2.2 (2.1, 2.4)	2.7 (2.5, 2.9)	3.2 (3.0, 3.4)	4.1 (3.8, 4.4)
	≥90	54	1908	2.1 (1.5, 2.8)	2.4 (1.8, 3.2)	2.7 (2.0, 3.6)	3.0 (2.3, 4.0)	3.8 (2.7, 5.1)	4.1 (3.0, 5.8)
TOTAL		**1617**	**51444**						

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

Figure EH13 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Gender and Age (Primary Diagnosis OA)



Male 80-89 vs Male ≥90
Entire Period: HR=0.89 (0.61, 1.29),p=0.527

Male ≥90 vs Female ≥90
Entire Period: HR=1.35 (0.86, 2.14),p=0.192

Male 80-89 vs Female 80-89
0 - 3Mth: HR=1.17 (0.99, 1.37),p=0.059
3Mth+: HR=1.60 (1.41, 1.82),p<0.001

Female 80-89 vs Female ≥90
Entire Period: HR=0.86 (0.65, 1.13),p=0.275

Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Male	80-89	17881	15293	13028	10945	7200	4195	1468
	≥90	799	633	506	382	186	68	16
Female	80-89	30856	27303	24212	21101	15081	9758	4071
	≥90	1908	1564	1305	1061	645	290	76

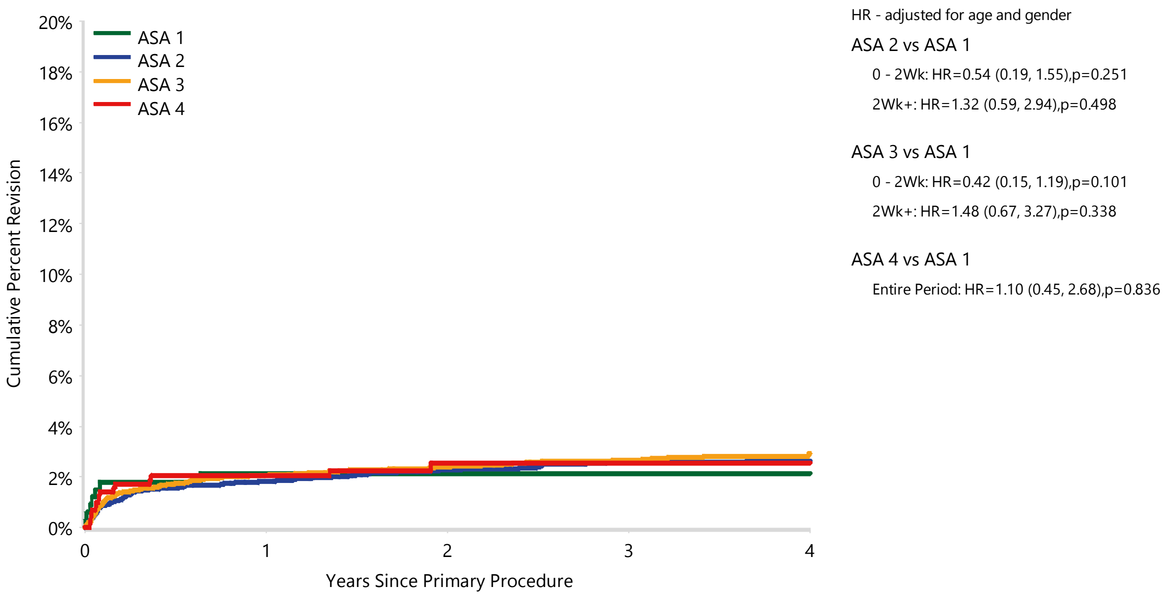
Table EH17 Primary Total Conventional Hip Replacement by ASA Score and Age (Primary Diagnosis OA)

	80-89		≥90	
ASA Score	N	Col%	N	Col%
ASA 1	319	1.8	14	1.3
ASA 2	7259	41.1	335	29.9
ASA 3	9447	53.5	685	61.2
ASA 4	632	3.6	85	7.6
ASA 5	2	0.0	.	.
TOTAL	**17659**	**100.0**	**1119**	**100.0**

Table EH18 Cumulative Percent Revision of Primary Total Conventional Hip Replacement for Patients Aged ≥80 Years by ASA Score (Primary Diagnosis OA)

ASA Score	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs
ASA 1	7	333	2.1 (1.0, 4.4)	2.1 (1.0, 4.4)	2.1 (1.0, 4.4)	2.1 (1.0, 4.4)
ASA 2	167	7594	1.8 (1.5, 2.2)	2.3 (1.9, 2.6)	2.6 (2.2, 3.0)	2.6 (2.2, 3.1)
ASA 3	235	10132	2.1 (1.8, 2.4)	2.4 (2.1, 2.7)	2.7 (2.3, 3.0)	2.9 (2.5, 3.4)
ASA 4	16	717	2.0 (1.2, 3.4)	2.6 (1.5, 4.2)	2.6 (1.5, 4.2)	2.6 (1.5, 4.2)
ASA 5	0	2	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	
TOTAL	**425**	**18778**				

Figure EH14 Cumulative Percent Revision of Primary Total Conventional Hip Replacement for Patients Aged ≥80 Years by ASA Score (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs
ASA 1	333	272	210	122	54
ASA 2	7594	5704	3964	2369	932
ASA 3	10132	7253	4885	2802	1020
ASA 4	717	503	323	187	73

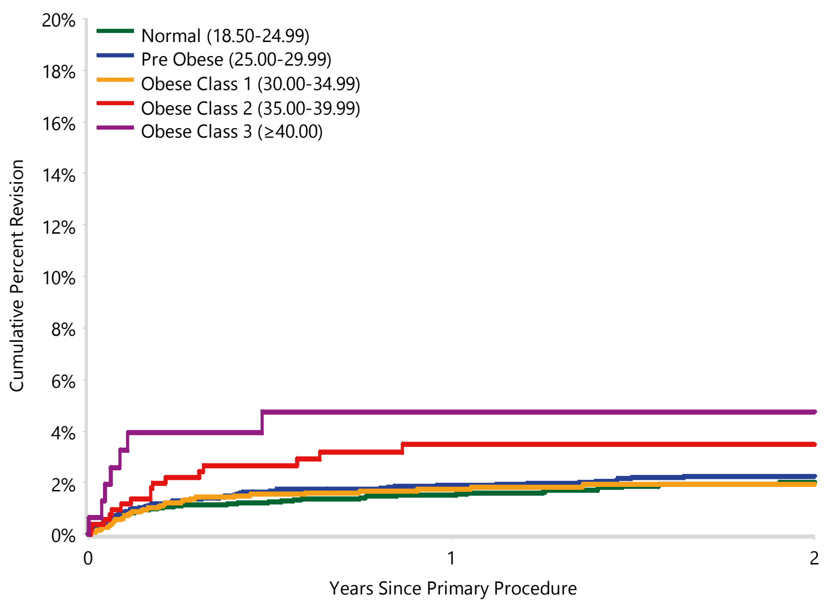
Table EH19 Primary Total Conventional Hip Replacement by BMI and Age (Primary Diagnosis OA)

	80-89		≥90	
BMI	N	Col%	N	Col%
Underweight (<18.50)	163	1.5	26	3.9
Normal (18.50-24.99)	3320	31.3	333	49.4
Pre Obese (25.00-29.99)	4419	41.7	232	34.4
Obese Class 1 (30.00-34.99)	2042	19.2	71	10.5
Obese Class 2 (35.00-39.99)	511	4.8	9	1.3
Obese Class 3 (≥40.00)	153	1.4	3	0.4
TOTAL	**10608**	**100.0**	**674**	**100.0**

Table EH20 Cumulative Percent Revision of Primary Total Conventional Hip Replacement for Patients Aged ≥80 Years by BMI (Primary Diagnosis OA)

BMI	N Revised	N Total	1 Yr	2 Yrs
Underweight (<18.50)	2	189	1.2 (0.3, 4.9)	1.2 (0.3, 4.9)
Normal (18.50-24.99)	61	3653	1.5 (1.1, 2.0)	2.0 (1.6, 2.7)
Pre Obese (25.00-29.99)	90	4651	1.9 (1.5, 2.4)	2.3 (1.8, 2.8)
Obese Class 1 (30.00-34.99)	38	2113	1.8 (1.3, 2.4)	1.9 (1.4, 2.7)
Obese Class 2 (35.00-39.99)	16	520	3.5 (2.1, 5.6)	3.5 (2.1, 5.6)
Obese Class 3 (≥40.00)	7	156	4.8 (2.3, 9.8)	4.8 (2.3, 9.8)
TOTAL	**214**	**11282**		

Figure EH15 Cumulative Percent Revision of Primary Total Conventional Hip Replacement for Patients Aged ≥80 Years by BMI (Primary Diagnosis OA)



HR - adjusted for age and gender

Pre Obese (25.00-29.99) vs Normal (18.50-24.99)
Entire Period: HR=1.13 (0.82, 1.58),p=0.450

Obese Class 1 (30.00-34.99) vs Normal (18.50-24.99)
Entire Period: HR=1.07 (0.71, 1.61),p=0.750

Obese Class 2 (35.00-39.99) vs Normal (18.50-24.99)
Entire Period: HR=1.94 (1.11, 3.38),p=0.019

Obese Class 3 (≥40.00) vs Normal (18.50-24.99)
Entire Period: HR=2.89 (1.31, 6.34),p=0.008

Number at Risk	0 Yr	1 Yr	2 Yrs
Normal (18.50-24.99)	3653	2244	996
Pre Obese (25.00-29.99)	4651	2792	1257
Obese Class 1 (30.00-34.99)	2113	1271	573
Obese Class 2 (35.00-39.99)	520	292	122
Obese Class 3 (≥40.00)	156	92	42

PROSTHESIS FACTORS

The most important prosthesis factor that affects the rate of revision is the use of cementless femoral stems.

In the ≥80 age group, cementless total conventional primary hip replacement has a higher rate of revision compared to hybrid and cement fixation. The risk of revision is highest in the first three months, and remains higher for the entire follow up period (Table EH21 and Figure EH16).

The main reason for the increased revision rate associated with cementless fixation in both age groups is a higher incidence of fracture (Table EH22 and Figure EH17).

The effect of femoral head size and bearing surface was also assessed. Due to the higher revision rate of cementless fixation, these analyses only incuded procedures using hybrid or cement fixation.

Three head sizes (<32mm, 32mm and >32 mm) were compared. The only difference identified was a higher rate of revision for 32mm femoral heads in the first month compared to <32mm head sizes (Table EH23 and Figure EH18).

Only modern bearings were compared (metal/XLPE, mixed ceramic/XLPE and mixed ceramic/mixed ceramic). The bearing surfaces used did not affect the revision rate (Table EH24 and Figure EH19).

Analyses were undertaken to determine the revision rate for the most commonly used femoral and acetabular prosthesis combinations in the ≥80 age group. Only prosthesis combinations with 250 or more procedures were included. There were 40 prosthesis combinations identified (5 cemented, 16 cementless and 19 hybrid). Of these, 21 had sufficient follow up to have a 10 year cumulative percent revision (4 cemented, 9 cementless and 8 hybrid).

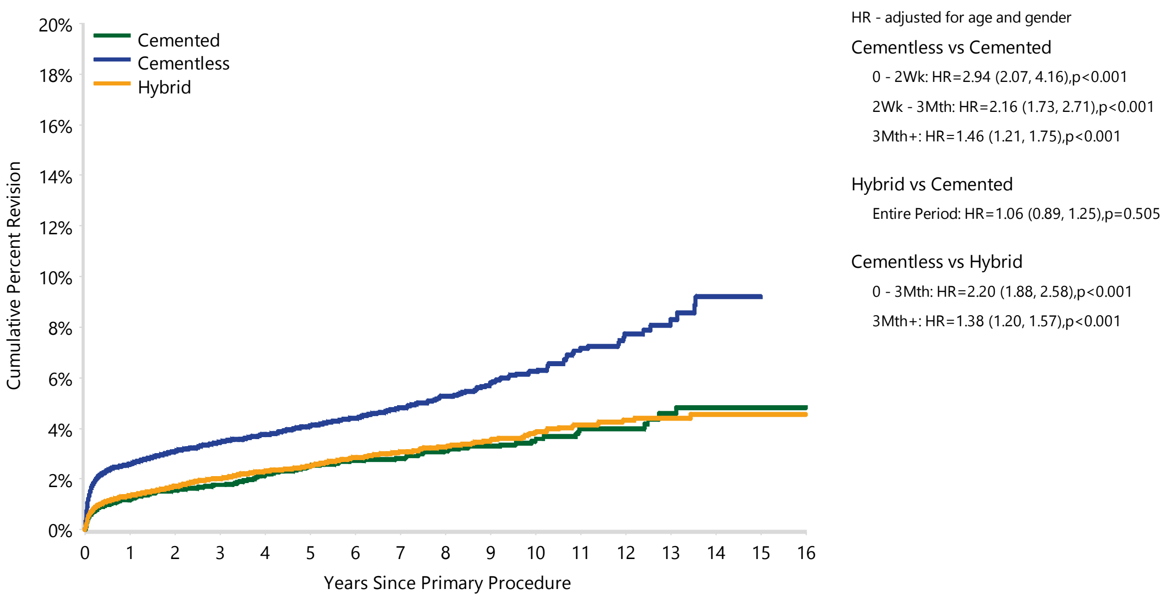
The five combinations with the lowest cumulative percent revision, assessed by using the upper 95% confidence interval, included 2 cemented and 3 hybrid combinations. The cumulative percent revision for all identified combinations are provided in Table EH25.

Table EH21 Cumulative Percent Revision of Primary Total Conventional Hip Replacement for Patients Aged ≥80 Years by Fixation (Primary Diagnosis OA)

Fixation	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Cemented	172	6490	1.2 (1.0, 1.5)	1.6 (1.3, 1.9)	1.8 (1.5, 2.1)	2.5 (2.1, 3.0)	2.8 (2.4, 3.3)	3.5 (3.0, 4.1)
Cementless	805	19392	2.6 (2.4, 2.8)	3.1 (2.8, 3.4)	3.5 (3.2, 3.7)	4.1 (3.8, 4.4)	4.8 (4.5, 5.2)	6.2 (5.7, 6.8)
Hybrid	640	25562	1.3 (1.2, 1.5)	1.7 (1.6, 1.9)	2.0 (1.9, 2.2)	2.5 (2.3, 2.7)	3.1 (2.8, 3.3)	3.8 (3.5, 4.2)
TOTAL	**1617**	**51444**						

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

Figure EH16 Cumulative Percent Revision of Primary Total Conventional Hip Replacement for Patients Aged ≥80 Years by Fixation (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Cemented	6490	5932	5383	4825	3621	2482	1182
Cementless	19392	16573	14329	12188	8111	4763	1676
Hybrid	25562	22288	19339	16476	11380	7066	2773

Table EH22 **Revision Diagnosis of Primary Total Conventional Hip Replacement for Patients Aged ≥80 Years by Fixation (Primary Diagnosis OA)**

Revision Diagnosis	Cemented			Cementless			Hybrid		
	Number	% Primaries Revised	% Revisions	Number	% Primaries Revised	% Revisions	Number	% Primaries Revised	% Revisions
Fracture	46	0.7	26.7	352	1.8	43.7	200	0.8	31.3
Prosthesis Dislocation	49	0.8	28.5	189	1.0	23.5	195	0.8	30.5
Loosening	44	0.7	25.6	138	0.7	17.1	84	0.3	13.1
Infection	27	0.4	15.7	82	0.4	10.2	128	0.5	20.0
Instability	1	0.0	0.6	9	0.0	1.1	5	0.0	0.8
Implant Breakage Stem	1	0.0	0.6	5	0.0	0.6	7	0.0	1.1
Malposition				6	0.0	0.7	3	0.0	0.5
Incorrect Sizing				3	0.0	0.4	5	0.0	0.8
Pain	1	0.0	0.6	5	0.0	0.6	2	0.0	0.3
Leg Length Discrepancy				4	0.0	0.5	1	0.0	0.2
Other	3	0.0	1.7	12	0.1	1.5	10	0.0	1.6
N Revision	**172**	**2.7**	**100.0**	**805**	**4.2**	**100.0**	**640**	**2.5**	**100.0**
N Primary	**6490**			**19392**			**25562**		

Figure EH17 **Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement for Patients Aged ≥80 Years by Fixation (Primary Diagnosis OA)**

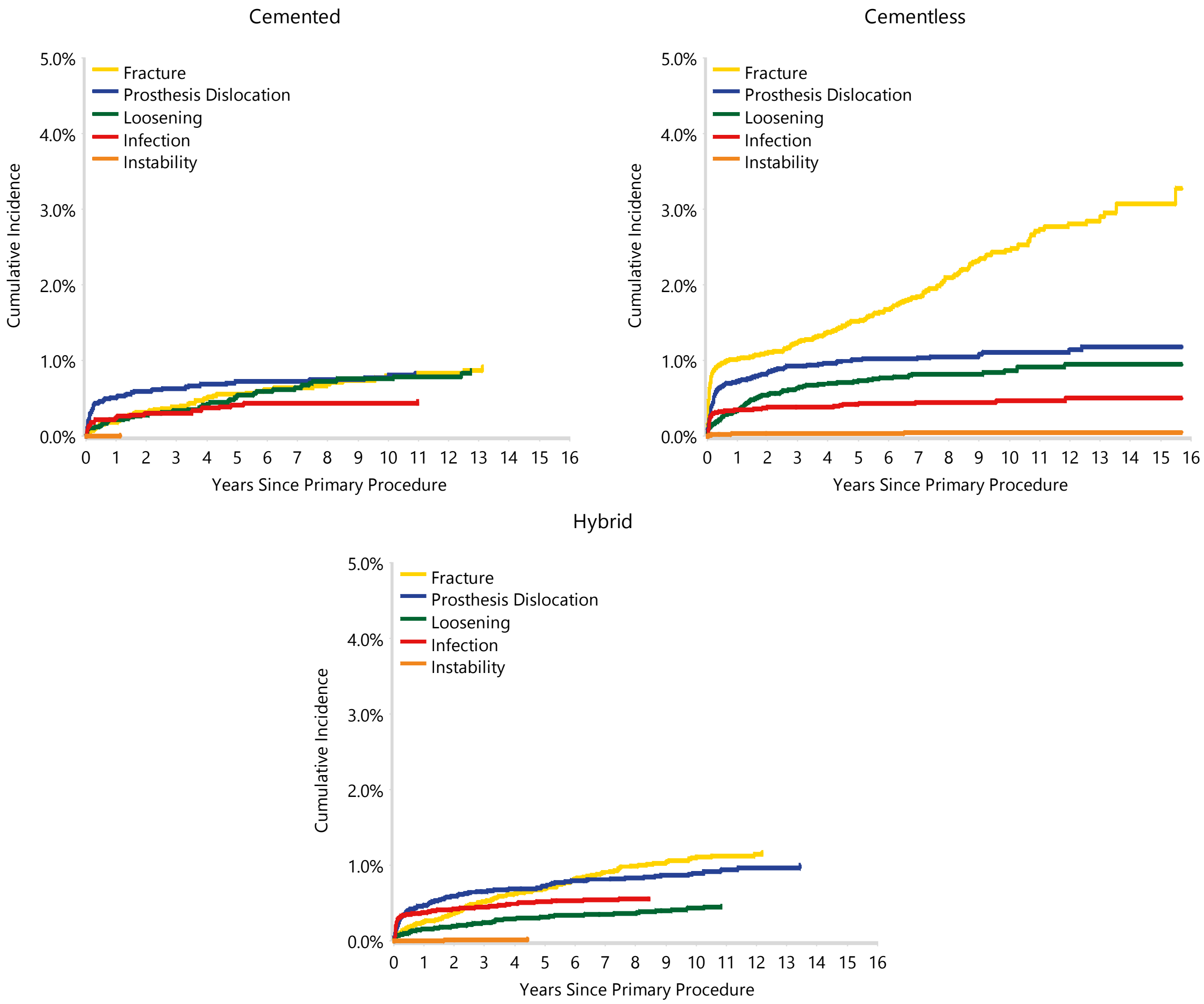
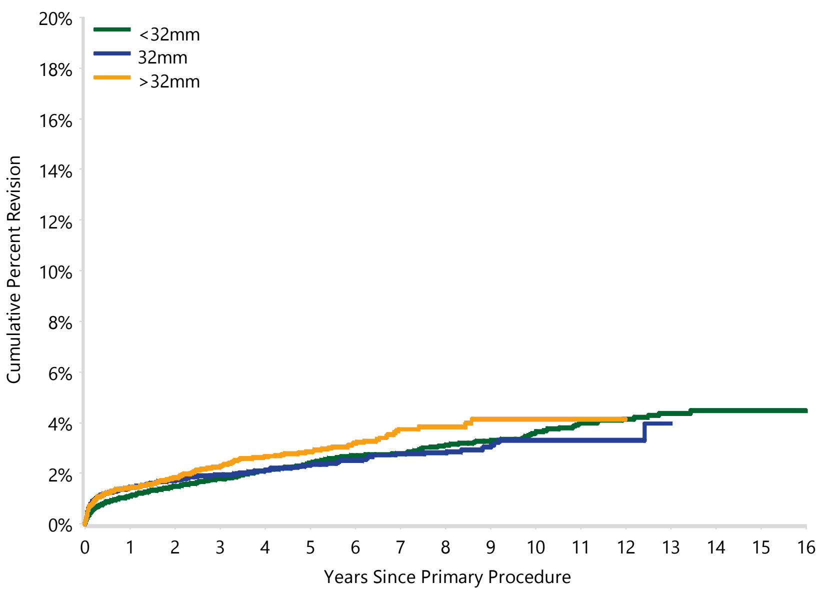


Table EH23 Cumulative Percent Revision of Femoral Cemented Primary Total Conventional Hip Replacement for Patients Aged ≥80 Years by Head Size (Primary Diagnosis OA)

Head Size	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<32mm	339	12017	1.1 (0.9, 1.3)	1.5 (1.3, 1.7)	1.8 (1.5, 2.0)	2.4 (2.1, 2.7)	2.8 (2.5, 3.1)	3.6 (3.2, 4.0)
32mm	253	11640	1.4 (1.2, 1.7)	1.7 (1.5, 2.0)	1.9 (1.7, 2.2)	2.3 (2.0, 2.6)	2.8 (2.4, 3.2)	3.3 (2.8, 3.9)
>32mm	204	8223	1.4 (1.2, 1.7)	1.8 (1.5, 2.2)	2.3 (2.0, 2.7)	2.8 (2.4, 3.3)	3.7 (3.2, 4.4)	4.1 (3.4, 5.0)
TOTAL	**796**	**31880**						

Note: 20 procedures did not have head size recorded
All primary procedures using metal/metal prostheses have been excluded

Figure EH18 Cumulative Percent Revision of Femoral Cemented Primary Total Conventional Hip Replacement for Patients Aged ≥80 Years by Head Size (Primary Diagnosis OA)



HR - adjusted for age and gender
32mm vs <32mm
0 - 1Mth: HR=1.58 (1.14, 2.18),p=0.005
1Mth - 3Mth: HR=1.25 (0.85, 1.83),p=0.261
3Mth+: HR=0.83 (0.67, 1.02),p=0.071

>32mm vs <32mm
Entire Period: HR=1.17 (0.98, 1.40),p=0.089

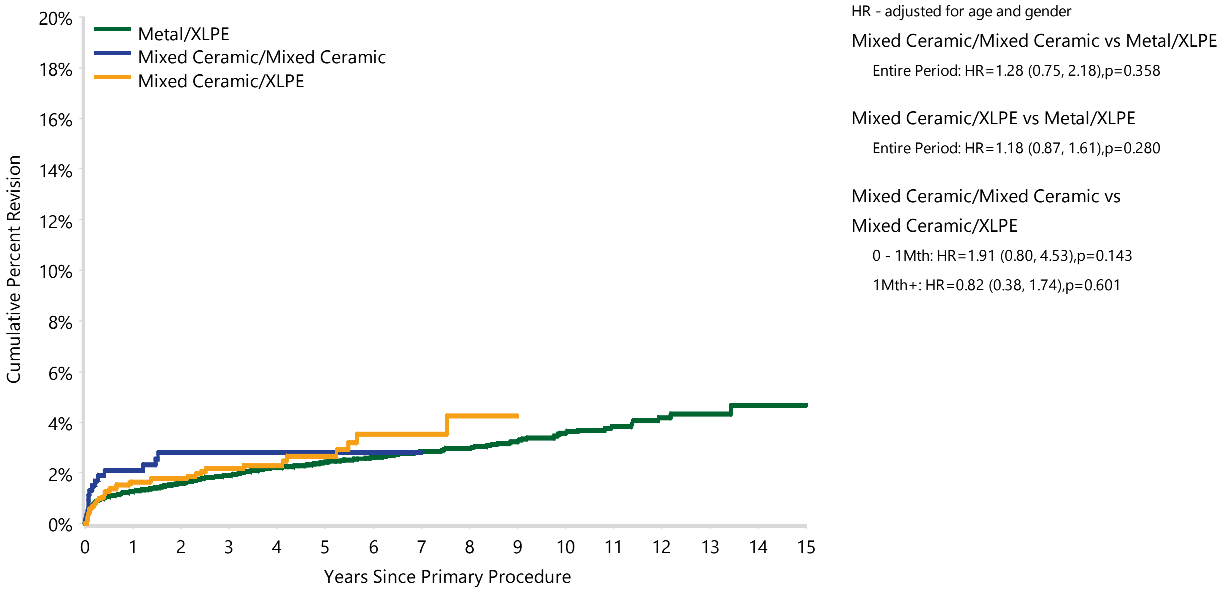
>32mm vs 32mm
0 - 3Mth: HR=0.94 (0.71, 1.24),p=0.646
3Mth+: HR=1.28 (1.02, 1.62),p=0.036

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<32mm	12017	11150	10411	9588	7816	5807	3073
32mm	11640	10042	8545	7040	4408	2366	633
>32mm	8223	6882	5642	4565	2693	1320	221

Table EH24 **Cumulative Percent Revision of Femoral Cemented Primary Total Conventional Hip Replacement for Patients Aged ≥80 Years by Bearing Surface (Primary Diagnosis OA)**

Bearing Surface	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Metal/XLPE	471	20484	1.3 (1.1, 1.4)	1.6 (1.4, 1.8)	1.9 (1.7, 2.1)	2.4 (2.2, 2.7)	2.8 (2.6, 3.1)	3.6 (3.2, 4.0)
Mixed Ceramic/Mixed Ceramic	14	542	2.1 (1.2, 3.7)	2.8 (1.7, 4.7)	2.8 (1.7, 4.7)	2.8 (1.7, 4.7)	2.8 (1.7, 4.7)	
Mixed Ceramic/XLPE	45	2088	1.6 (1.2, 2.3)	1.8 (1.3, 2.5)	2.2 (1.6, 3.0)	2.6 (1.9, 3.7)	3.5 (2.4, 5.1)	
TOTAL	**530**	**23114**						

Figure EH19 **Cumulative Percent Revision of Femoral Cemented Primary Total Conventional Hip Replacement for Patients Aged ≥80 Years by Bearing Surface (Primary Diagnosis OA)**



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Metal/XLPE	20484	17871	15441	13091	8704	5068	1743
Mixed Ceramic/Mixed Ceramic	542	443	360	292	146	61	13
Mixed Ceramic/XLPE	2088	1605	1204	834	406	179	28

Table EH25 Cumulative Percent Revision of Primary Total Conventional Hip Replacement for Patients Aged ≥80 Years by Prosthesis Combination and Fixation (Primary Diagnosis OA)

Fixation	Femoral/Acetabular	N Revised	N Total	1 Yr	2 Yrs	5 Yrs	7 Yrs	10 Yrs
Cemented	Exeter V40/Contemporary	49	1264	1.6 (1.0, 2.5)	2.4 (1.6, 3.4)	3.6 (2.7, 4.9)	4.2 (3.1, 5.7)	4.6 (3.4, 6.2)
	Exeter V40/Exeter	9	309	0.7 (0.2, 2.6)	1.0 (0.3, 3.1)	2.6 (1.2, 5.3)	3.0 (1.5, 5.9)	3.0 (1.5, 5.9)
	Exeter V40/Exeter Contemporary	13	649	1.3 (0.6, 2.5)	1.6 (0.9, 2.9)	2.0 (1.1, 3.5)	2.2 (1.3, 3.9)	2.2 (1.3, 3.9)
	Exeter V40/Exeter X3 Rimfit	12	823	1.1 (0.6, 2.2)	1.3 (0.7, 2.4)	2.0 (1.0, 3.7)		
	Spectron EF/Reflection (Cup)	9	459	0.9 (0.3, 2.3)	0.9 (0.3, 2.3)	1.4 (0.6, 3.0)	1.7 (0.8, 3.5)	2.1 (1.0, 4.2)
Cementless	Accolade I/Trident (Shell)	38	772	2.9 (1.9, 4.3)	3.7 (2.6, 5.3)	4.7 (3.4, 6.5)	4.9 (3.5, 6.7)	6.2 (4.2, 9.1)
	Accolade II/Trident (Shell)	4	265	1.6 (0.6, 4.2)	1.6 (0.6, 4.2)			
	Alloclassic/Allofit	17	522	1.6 (0.8, 3.1)	1.8 (0.9, 3.4)	2.2 (1.2, 4.0)	3.3 (1.9, 5.7)	5.0 (3.0, 8.3)
	Anthology/R3	17	478	2.6 (1.5, 4.6)	3.2 (1.9, 5.3)	4.8 (2.9, 7.9)	4.8 (2.9, 7.9)	
	Corail/Pinnacle	131	3850	2.2 (1.7, 2.7)	2.6 (2.2, 3.2)	3.6 (3.0, 4.4)	4.3 (3.5, 5.2)	6.0 (4.7, 7.7)
	Metafix/Trinity	4	282	1.6 (0.6, 4.3)	1.6 (0.6, 4.3)			
	Polarstem/R3	27	672	3.4 (2.2, 5.1)	3.6 (2.4, 5.3)	5.0 (3.3, 7.4)		
	Quadra-H/Versafitcup CC	32	1107	2.3 (1.5, 3.4)	2.4 (1.6, 3.5)	2.9 (2.1, 4.2)	3.4 (2.3, 5.1)	
	SL-Plus/EP-Fit Plus	13	298	2.0 (0.9, 4.5)	2.0 (0.9, 4.5)	3.7 (2.0, 6.8)	5.2 (3.0, 8.9)	5.2 (3.0, 8.9)
	Secur-Fit Plus/Trident (Shell)	16	356	2.5 (1.3, 4.8)	4.0 (2.4, 6.7)	4.4 (2.7, 7.2)	4.4 (2.7, 7.2)	5.1 (3.1, 8.4)
	Secur-Fit/Trident (Shell)	37	775	2.6 (1.7, 4.0)	3.2 (2.2, 4.7)	4.4 (3.1, 6.3)	5.0 (3.5, 7.0)	6.2 (4.2, 9.2)
	Summit/Pinnacle	12	335	2.4 (1.2, 4.8)	2.4 (1.2, 4.8)	2.9 (1.5, 5.6)	4.7 (2.4, 9.0)	
	Synergy/R3	11	264	3.4 (1.8, 6.5)	3.9 (2.1, 7.1)	4.4 (2.4, 7.7)	4.4 (2.4, 7.7)	
	Synergy/Reflection (Shell)	18	580	2.4 (1.5, 4.1)	2.4 (1.5, 4.1)	2.6 (1.6, 4.3)	2.9 (1.8, 4.7)	3.7 (2.3, 6.0)
	Taperloc/Mallory-Head	10	263	1.9 (0.8, 4.6)	2.4 (1.1, 5.2)	3.6 (1.8, 7.2)	3.6 (1.8, 7.2)	6.3 (3.1, 12.5)
	VerSys/Trilogy	25	321	5.0 (3.1, 8.1)	6.0 (3.9, 9.3)	7.9 (5.3, 11.5)	8.3 (5.7, 12.1)	8.3 (5.7, 12.1)
Hybrid	C-Stem AMT/Pinnacle	16	696	1.4 (0.7, 2.7)	1.9 (1.0, 3.4)	3.7 (2.1, 6.4)	3.7 (2.1, 6.4)	
	CPCS/R3	27	1146	1.4 (0.8, 2.3)	2.1 (1.3, 3.1)	2.5 (1.6, 3.7)	4.1 (2.5, 6.7)	
	CPCS/Reflection (Shell)	14	561	1.1 (0.5, 2.4)	1.3 (0.6, 2.7)	1.9 (1.0, 3.5)	2.8 (1.6, 4.9)	3.3 (1.9, 5.6)
	CPT/Allofit	7	282	1.4 (0.5, 3.8)	1.4 (0.5, 3.8)	3.1 (1.4, 6.4)	3.1 (1.4, 6.4)	
	CPT/Continuum	21	508	2.6 (1.5, 4.5)	3.4 (2.1, 5.5)	5.1 (3.2, 8.0)		
	CPT/Trabecular Metal (Shell)	14	433	1.5 (0.7, 3.2)	1.8 (0.8, 3.7)	3.9 (2.2, 6.9)	5.2 (3.0, 9.0)	
	CPT/Trilogy	50	1507	1.7 (1.1, 2.5)	1.9 (1.3, 2.7)	3.1 (2.3, 4.2)	3.9 (2.9, 5.2)	4.9 (3.5, 6.9)
	Exeter V40/Mallory-Head	2	292	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	1.8 (0.5, 7.0)
	Exeter V40/Pinnacle	16	464	1.6 (0.8, 3.3)	2.1 (1.1, 4.0)	3.6 (2.0, 6.5)	5.4 (2.9, 9.9)	
	Exeter V40/R3	4	261	0.8 (0.2, 3.1)	0.8 (0.2, 3.1)	2.2 (0.8, 6.0)	2.2 (0.8, 6.0)	
	Exeter V40/Trident (Shell)	216	9482	1.3 (1.1, 1.5)	1.6 (1.3, 1.8)	2.3 (2.0, 2.7)	2.8 (2.4, 3.2)	3.7 (3.1, 4.4)
	Exeter V40/Trident/Tritanium (Shell)	12	758	1.1 (0.5, 2.2)	1.4 (0.8, 2.7)	2.0 (1.1, 3.6)		
	Exeter V40/Vitalock	11	322	0.3 (0.0, 2.2)	0.3 (0.0, 2.2)	2.1 (0.9, 4.6)	2.9 (1.4, 5.7)	2.9 (1.4, 5.7)
	MS 30/Allofit	9	305	1.3 (0.5, 3.5)	1.3 (0.5, 3.5)	2.5 (1.2, 5.3)	3.1 (1.5, 6.1)	3.1 (1.5, 6.1)
	Omnifit/Trident (Shell)	15	707	1.4 (0.8, 2.7)	1.9 (1.1, 3.3)	2.1 (1.3, 3.5)	2.1 (1.3, 3.5)	2.1 (1.3, 3.5)
	Quadra-C/Versafitcup CC	9	347	2.7 (1.4, 5.1)	2.7 (1.4, 5.1)	2.7 (1.4, 5.1)		
	Spectron EF/R3	9	442	1.4 (0.6, 3.1)	1.6 (0.8, 3.4)	2.4 (1.2, 4.7)	2.4 (1.2, 4.7)	
	Spectron EF/Reflection (Shell)	19	1060	1.0 (0.6, 1.9)	1.1 (0.7, 2.0)	1.6 (1.0, 2.6)	1.8 (1.1, 2.8)	2.3 (1.4, 3.8)
	Taper Fit/Trinity	7	289	2.8 (1.4, 5.9)	2.8 (1.4, 5.9)			
Other (1118)		635	16938	2.0 (1.8, 2.3)	2.6 (2.3, 2.8)	3.5 (3.2, 3.9)	4.2 (3.9, 4.6)	5.4 (5.0, 6.0)
TOTAL		**1617**	**51444**					

Note: All primary procedures using metal/metal prostheses have been excluded
Only prostheses with over 250 procedures have been listed

FIRST REVISION OF HIP REPLACEMENT

This analysis reports the outcome of the first revision of a known primary total conventional hip replacement (i.e. this means that the Registry has information on both the primary and first revision procedures).

As the data available on revision procedures is limited in the ≥90 age group, the information provided on both mortality and risk of second revision combines data from the 80-89 and ≥90 age groups.

Mortality following first revision is compared to mortality following primary procedures in the same age group. Patients having a first revision procedure have a higher rate of mortality and this difference is greatest in the period soon after surgery. The 30 day mortality is 23/1000 for revision and 6/1000 for primary procedures. The 90 day mortality is 43/1000 for revision and 11/1000 for primary procedures. At five years, the survivorship is 66.3% for patients having a first revision compared to 78.6% for primary procedures (Table EH26 and Figure EH20).

The rate of second revision is lower for patients aged ≥80 years compared to those patients aged <80 years. The cumulative percent revision of first revision at five years is 14.8% (≥80 years) and 21.7% (<80 years), and at 10 years is 17.8% and 26.8%, respectively (Table EH27 and Figure EH21).

The cumulative incidence for first revision is similar to the cumulative percent revision. At five years the cumulative incidence is 13.1% (≥80 years), and 21.1% (<80 years), and at 10 years it is 14.4% and 25.2%, respectively (Table EH28, Figures EH22 and EH23).

The conditional probability of revision, unlike cumulative percent revision and cumulative incidence, is higher after seven years in the older age group. At five years, the conditional probability is 20.3% (≥80 years) and 23.5% (<80 years), and at 10 years it is 42.2% and 32.8%, respectively (Figure EH24).

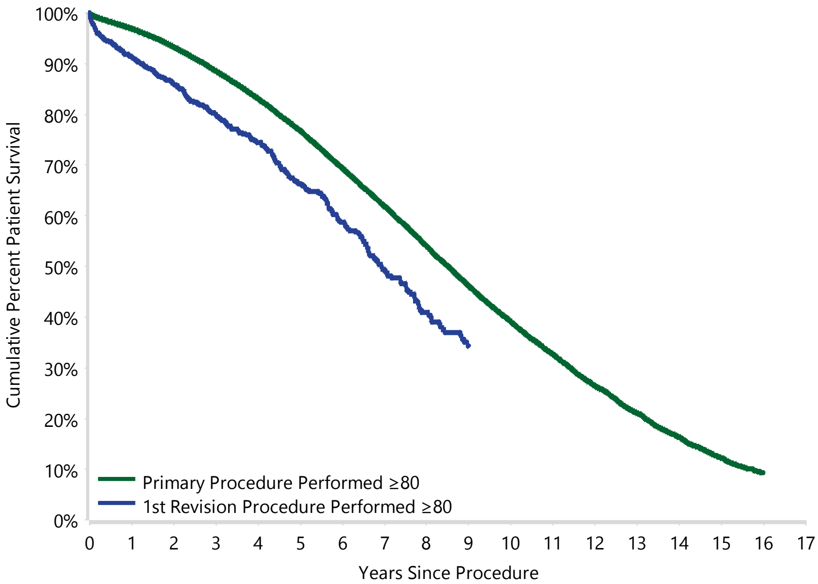
Reasons for second revision vary between the two age groups. Older patients are revised more often for fracture, but less often for loosening and infection (Table EH29).

The types of second revision performed are similar when the two age groups are compared (Table EH30).

Table EH26 Cumulative Percent Survival of Patients Aged ≥80 Years with Primary Total Conventional Hip Replacement by Procedure Type (Primary Diagnosis OA)

Procedure Type	N Death	N Total	30 Days	90 Days	1 Yr	2 Yr	5 Yr	10 Yr
Primary Procedure Performed ≥80 Years	20352	51444	99.4 (99.4, 99.5)	98.9 (98.8, 99.0)	96.9 (96.8, 97.1)	93.3 (93.0, 93.5)	76.8 (76.3, 77.2)	39.1 (38.4, 39.7)
1st Revision Procedure Performed ≥80 Years	412	1299	97.7 (96.7, 98.4)	95.7 (94.5, 96.7)	91.4 (89.7, 92.8)	85.9 (83.7, 87.8)	66.3 (62.8, 69.6)	
TOTAL	**20764**	**52743**						

Figure EH20 Cumulative Percent Survival of Patients Aged ≥80 Years with Primary Total Conventional Hip Replacement by Procedure Type (Primary Diagnosis OA)



HR - adjusted for age and gender
1st Revision Procedure Performed ≥80 vs
Primary Procedure Performed ≥80
0 - 3Mth: HR=9.71 (7.34, 12.84),p<0.001
3Mth - 1.5Yr: HR=4.81 (3.83, 6.04),p<0.001
1.5Yr - 2.5Yr: HR=3.63 (2.78, 4.73),p<0.001
2.5Yr - 5Yr: HR=2.66 (2.19, 3.24),p<0.001
5Yr - 5.5Yr: HR=1.24 (0.64, 2.39),p=0.518
5.5Yr+: HR=2.50 (2.07, 3.03),p<0.001

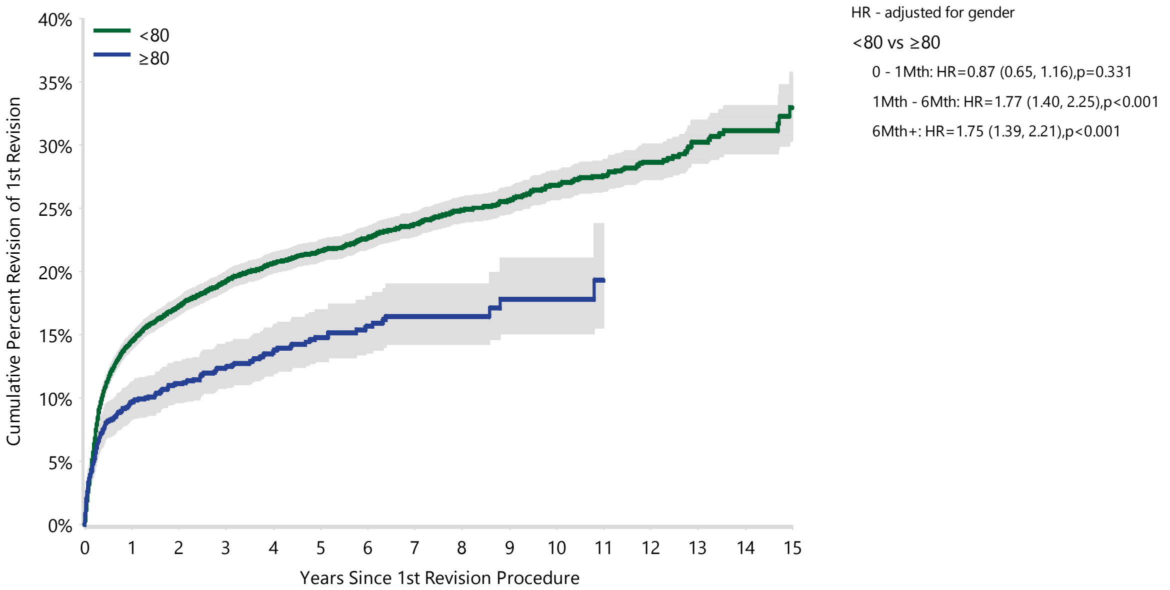
Number at Risk	0 Days	30 Days	90 Days	1 Yr	2 Yr	5 Yr	10 Yr
Primary Procedure Performed ≥80 Years	51444	50900	49846	45554	39866	23768	5857
1st Revision Procedure Performed ≥80 Years	1299	1258	1197	997	779	316	28

Table EH27 Cumulative Percent Revision of 1st Revision of Primary Total Conventional Hip Replacement by Age (Primary Diagnosis OA)

Age	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<80	2298	11290	14.5 (13.9, 15.2)	17.3 (16.6, 18.0)	19.3 (18.5, 20.1)	21.7 (20.8, 22.5)	23.8 (22.8, 24.7)	26.8 (25.7, 28.0)
≥80	202	1617	9.7 (8.3, 11.3)	11.2 (9.6, 12.9)	12.4 (10.8, 14.3)	14.8 (12.9, 17.0)	16.5 (14.3, 19.0)	17.8 (15.1, 21.0)
TOTAL	**2500**	**12907**						

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

Figure EH21 Cumulative Percent Revision of 1st Revision of Primary Total Conventional Hip Replacement by Age (Primary Diagnosis OA)

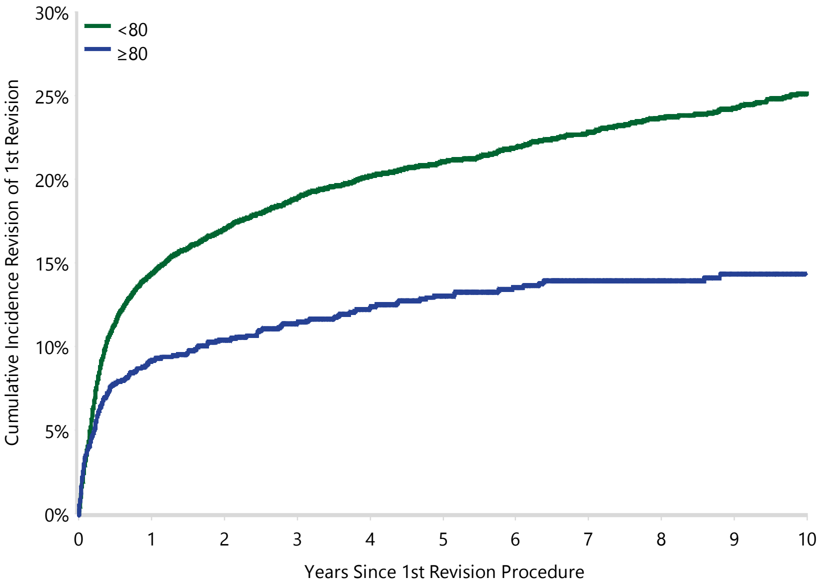


Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<80	11290	8325	6860	5673	3741	2378	1060
≥80	1617	1159	963	775	462	249	76

Table EH28 Summary of Cumulative Incidence and Conditional Probability of 1st Revision of Primary Total Conventional Hip Replacement

Outcome		1 Yrs	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
CIF(Alive, Unrevised)	<80	83.4%	78.9%	75.1%	68.5%	61.7%	51.7%
	≥80	80.1%	73.9%	66.9%	51.7%	36.9%	19.8%
CIF(Revision)	<80	14.4%	17.1%	18.9%	21.1%	22.9%	25.2%
	≥80	9.2%	10.5%	11.5%	13.1%	14.0%	14.4%
CIF(Mortality)	<80	2.2%	4.0%	6.0%	10.4%	15.4%	23.1%
	≥80	10.7%	15.7%	21.7%	35.2%	49.1%	65.8%
CP(Revised, if alive)	<80	14.7%	17.8%	20.1%	23.5%	27.0%	32.8%
	≥80	10.3%	12.4%	14.6%	20.3%	27.5%	42.2%

Figure EH22 Cumulative Incidence Revision of 1st Revision of Primary Total Conventional Hip Replacement by Age (Primary Diagnosis OA)



Number at Risk	1 Yrs	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<80	8325	6860	5673	3741	2378	1060
≥80	1159	963	775	462	249	76

Figure EH23 **Cumulative Incidence Function of 1st Revision of Primary Total Conventional Hip Replacement by Age (Primary Diagnosis OA)**

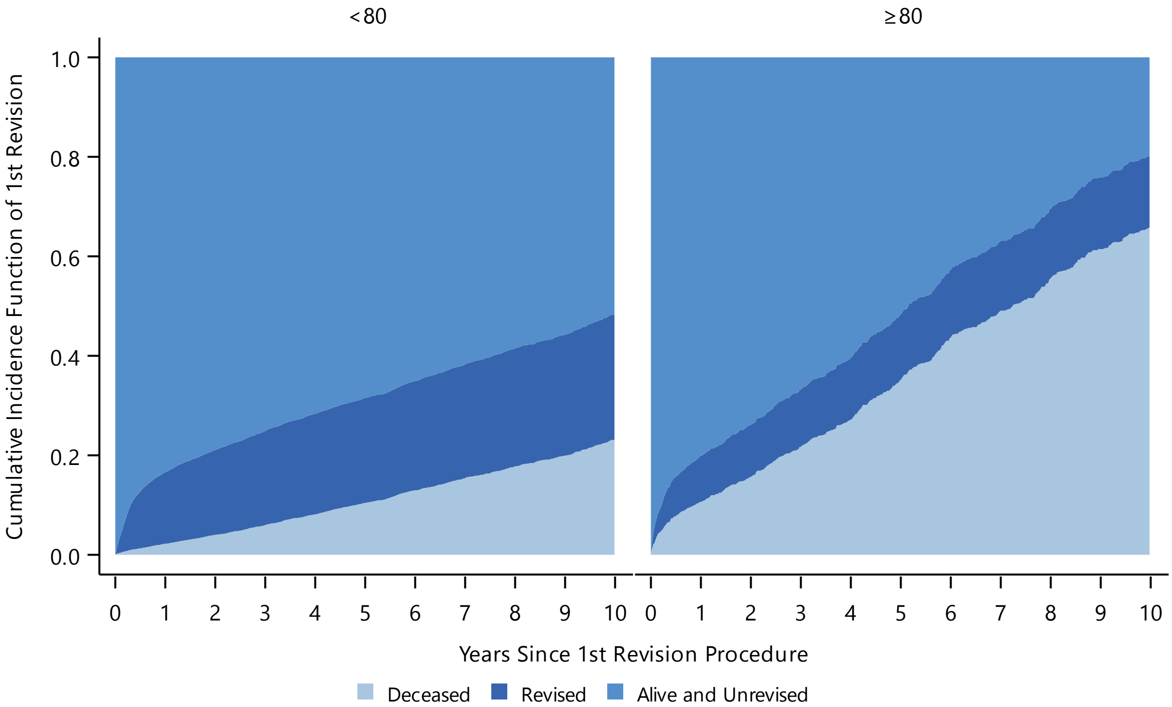
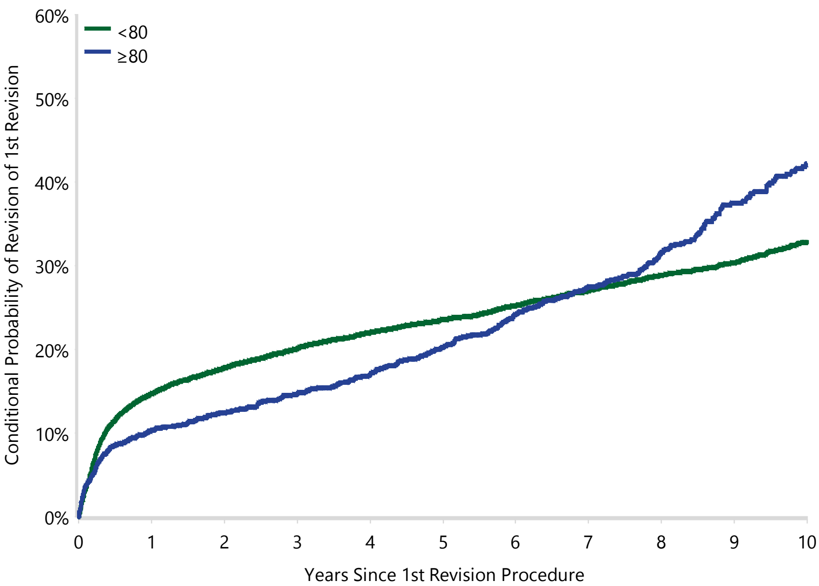


Figure EH24 **Conditional Probability of Revision of 1st Revision of Primary Total Conventional Hip Replacement by Age (Primary Diagnosis OA)**



Number at Risk	1 Yrs	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<80	8325	6860	5673	3741	2378	1060
≥80	1159	963	775	462	249	76

Table EH29 2nd Revision Diagnosis of Primary Total Conventional Hip Replacement by Age (Primary Diagnosis OA)

2nd Revision Diagnosis	<80			≥80		
	Number	% 1st Revisions Revised	% 2nd Revisions	Number	% 1st Revisions Revised	% 2nd Revisions
Infection	1154	10.2	50.2	83	5.1	41.1
Prosthesis Dislocation	452	4.0	19.7	53	3.3	26.2
Loosening	373	3.3	16.2	29	1.8	14.4
Fracture	130	1.2	5.7	25	1.5	12.4
Pain	29	0.3	1.3			
Instability	26	0.2	1.1	3	0.2	1.5
Lysis	24	0.2	1.0	1	0.1	0.5
Metal Related Pathology	17	0.2	0.7	1	0.1	0.5
Implant Breakage Stem	16	0.1	0.7			
Implant Breakage Acetabular	15	0.1	0.7	3	0.2	1.5
Malposition	14	0.1	0.6			
Other	48	0.4	2.1	4	0.2	2.0
N 2nd Revision	**2298**	**20.4**	**100.0**	**202**	**12.5**	**100.0**
N 1st Revision	**11290**			**1617**		

Table EH30 Type of 2nd Revision of Primary Total Conventional Hip Replacement by Age (Primary Diagnosis OA)

Type of 2nd Revision	<80			≥80		
	Number	% 1st Revisions Revised	% 2nd Revisions	Number	% 1st Revisions Revised	% 2nd Revisions
THR (Femoral/Acetabular)	855	7.6	37.2	49	3.0	24.3
Acetabular Component	374	3.3	16.3	35	2.2	17.3
Head/Insert	340	3.0	14.8	42	2.6	20.8
Femoral Component	311	2.8	13.5	38	2.4	18.8
Cement Spacer	246	2.2	10.7	19	1.2	9.4
Head Only	61	0.5	2.7	5	0.3	2.5
Removal of Prostheses	36	0.3	1.6	4	0.2	2.0
Minor Components	35	0.3	1.5	4	0.2	2.0
Insert Only	24	0.2	1.0	4	0.2	2.0
Head/Neck	4	0.0	0.2	1	0.1	0.5
Other	12	0.1	0.5	1	0.1	0.5
N 2nd Revision	**2298**	**20.4**	**100.0**	**202**	**12.5**	**100.0**
N 1st Revision	**11290**			**1617**		

Primary Total and Revision Knee Replacement in Older Patients

The purpose of this analysis is to provide more detailed information on the use and outcomes of both primary and revision knee replacement in older patients.

The focus of the primary analysis is total knee replacement undertaken for osteoarthritis in patients aged ≥80 years. Where there is sufficient data, the analysis has been undertaken separately for patients aged 80-89 years and ≥90 years.

The revision analysis includes all patients having a first knee revision. As there are fewer revision compared to primary procedures, the revision analysis has been undertaken for all patients aged ≥80 years as a single group.

DEMOGRAPHICS

The number of primary total knee replacement procedures for osteoarthritis in the ≥80 age group has increased almost every year since 2003. In 2017, 5,577 procedures were performed (5,376 in the 80-89 age group and 201 in the ≥90 age group). This compares to 2,786 in 2003, (2,703 in the 80-89 age group and 83 in the ≥90 age group) (Table EK1).

The proportion of patients having primary total knee replacement for osteoarthritis in the ≥80 age group has declined from 13.3% in 2003 to 10.4% in 2017. This decline has occurred in the 80-89 age group (12.9% in 2003 and 10.0% in 2017). The proportion of patients in the ≥90 age group is small and has remained relatively constant (0.4% in 2017) (Table EK1).

Females have primary total knee replacement for osteoarthritis more frequently than males and this difference is increased in those aged ≥80 years (55.8% for <80 years, 61.0% for 80-89 years and 62.0% for ≥90 years) (Table EK2)

The incidence of primary total knee replacement per 100,000 of the Australian population has increased annually since 2003. This increase is apparent in all age groups (Table EK3).

The age adjusted incidence per 100,000 of primary total knee replacement for females compared to males is higher in the <80 and 80-89 age groups. In the ≥90 age group, males have a higher age adjusted incidence. In 2017, the incidence per 100,000 by gender is 222.2 (females) and 184.3 (males) in the <80 age group, 733.6 (females) and 639.3 (males) in the 80-89 age group, and 90.2 (females) and 143.5 (males) in the ≥90 age group (Table EK3).

Table EK1 Primary Total Knee Replacement by Age (Primary Diagnosis OA)

Procedure Year	<80		80-89		≥90		TOTAL	
	N	Row%	N	Row%	N	Row%	N	Row%
≤2002	30646	86.8	4544	12.9	112	0.3	35302	100.0
2003	18201	86.7	2703	12.9	83	0.4	20987	100.0
2004	19791	86.6	3000	13.1	70	0.3	22861	100.0
2005	22041	86.1	3457	13.5	87	0.3	25585	100.0
2006	22996	86.4	3527	13.2	103	0.4	26626	100.0
2007	24589	86.2	3845	13.5	106	0.4	28540	100.0
2008	27653	86.8	4094	12.9	107	0.3	31854	100.0
2009	29223	87.1	4233	12.6	96	0.3	33552	100.0
2010	32457	87.5	4523	12.2	118	0.3	37098	100.0
2011	34724	87.8	4696	11.9	131	0.3	39551	100.0
2012	36495	87.8	4884	11.8	165	0.4	41544	100.0
2013	38443	88.2	4951	11.4	180	0.4	43574	100.0
2014	41326	89.1	4902	10.6	178	0.4	46406	100.0
2015	44349	89.3	5147	10.4	180	0.4	49676	100.0
2016	46077	89.6	5131	10.0	209	0.4	51417	100.0
2017	48040	89.6	5376	10.0	201	0.4	53617	100.0
TOTAL	517051	87.9	69013	11.7	2126	0.4	588190	100.0

Table EK2 Primary Total Knee Replacement by Gender and Age (Primary Diagnosis OA)

Gender	<80		80-89		≥90		TOTAL	
	N	Col%	N	Col%	N	Col%	N	Col%
Female	288261	55.8	42119	61.0	1318	62.0	331698	56.4
Male	228790	44.2	26894	39.0	808	38.0	256492	43.6
TOTAL	**517051**	**100.0**	**69013**	**100.0**	**2126**	**100.0**	**588190**	**100.0**

Table EK3 Incidence of Primary Total Knee Replacement per 100,000 between 2003 to 2017 by Age and Gender (Primary Diagnosis OA, Relative to the Australian Population for That Year)

Procedure Year	<80			80-89			≥90			TOTAL		
	Male	Female	TOTAL	Male	Female	TOTAL	Male	Female	TOTAL	Male	Female	TOTAL
	N	N	N	N	N	N	N	N	N	N	N	N
2003	83.2	107.7	95.4	484.1	495.6	491.3	127.5	76.9	90.3	91.7	120.9	106.4
2004	89.2	116.3	102.7	513.7	535.1	526.9	105.2	60.6	72.5	98.5	130.6	114.7
2005	96.7	129.7	113.1	588.5	581.7	584.3	121.0	71.8	84.9	107.9	145.4	126.8
2006	101.5	131.7	116.5	571.9	576.7	574.8	94.3	97.6	96.7	112.5	147.6	130.2
2007	106.2	138.9	122.5	581.5	617.9	603.6	152.1	74.3	95.5	117.8	156.0	137.0
2008	117.7	152.6	135.1	608.6	628.5	620.6	130.9	80.3	94.3	129.9	169.7	149.9
2009	122.3	157.6	139.9	592.8	641.1	621.7	86.1	81.4	82.7	134.0	175.1	154.7
2010	133.9	172.3	153.0	633.6	654.5	646.0	132.8	80.6	95.6	146.8	189.8	168.4
2011	143.1	180.2	161.6	639.1	666.9	655.6	136.4	84.8	99.7	156.1	197.8	177.0
2012	147.4	186.5	166.9	645.4	693.5	673.7	151.2	103.0	117.3	160.5	204.8	182.7
2013	151.0	194.7	172.8	636.0	702.6	674.9	139.9	111.8	120.3	163.8	212.7	188.4
2014	163.3	202.9	183.1	617.3	692.5	660.9	153.5	93.2	111.7	175.4	219.7	197.7
2015	173.5	213.9	193.7	648.0	716.0	687.2	140.8	91.7	107.1	186.0	230.8	208.6
2016	177.1	219.2	198.2	613.9	720.0	674.7	137.3	108.7	117.9	188.8	236.0	212.5
2017	184.3	222.2	203.3	639.3	733.6	693.0	143.5	90.2	107.7	196.6	239.1	218.0
TOTAL	**134.9**	**171.0**	**152.9**	**606.6**	**649.0**	**631.8**	**133.3**	**89.0**	**102.0**	**146.8**	**187.7**	**167.4**

MORTALITY

The following analysis includes patients that have had primary total knee replacement for osteoarthritis. Patients that have been revised are censored at the time of revision. The risk of both early and late mortality increases with increasing age.

Early mortality at 30 and 90 days is higher in the older age groups. At 30 days it is 1/1000 (<80 years), 3/1000 (80-89 years) and 8/1000 (≥90 years). At 90 days it is 2/1000, 6/1000 and 16/1000, respectively (Table EK4).

The five and 10 year survivorship for patients aged <80 years is 95.1% and 83.8%. For those aged 80-89 years it is 80.7% and 44.0%, and for patients aged ≥90 years it is 58.1% and 12.9%. In the first 10 years, ≥90 year old patients have a 2.5 times increased risk of mortality compared to those aged 80-89 years (Table EK4 and Figure EK10).

Males have a higher mortality in both the 80-89 and ≥90 age groups, compared to females (Table EK5 and Figure EK2).

In the ≥80 age group, increasing ASA score is associated with higher rates of mortality (Table EK6 and Figure EK3).

The risk of both early and late mortality increases with increasing age.

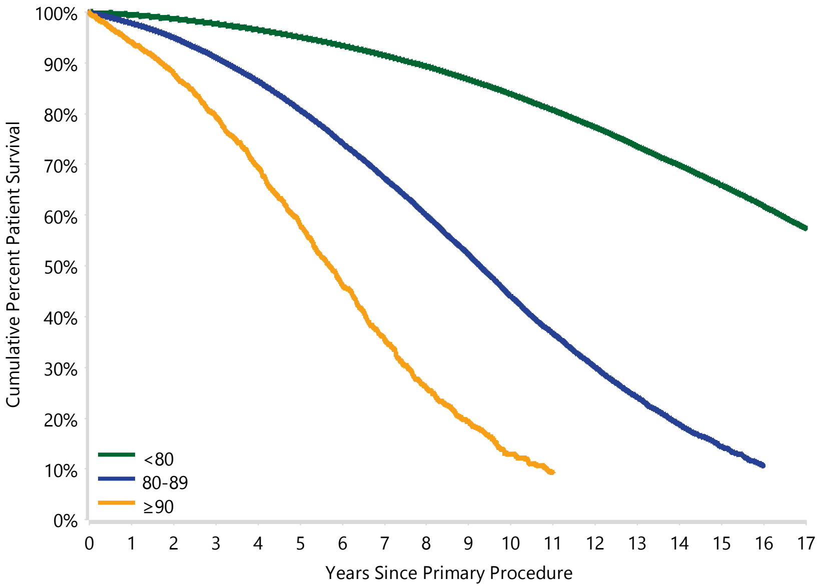
BMI also affects mortality in the ≥80 age group. There is no difference in the mortality rate when the other BMI classes are compared to the normal BMI class (Table EK7 and Figure EK4).

Table EK4 Cumulative Percent Survival of Patients with Primary Total Knee Replacement by Age (Primary Diagnosis OA)

Age	N Death	N Total	30 Days	90 Days	1 Yr	2 Yr	5 Yr	10 Yr
<80	56220	517051	99.9 (99.9, 99.9)	99.8 (99.8, 99.9)	99.5 (99.4, 99.5)	98.7 (98.6, 98.7)	95.1 (95.0, 95.1)	83.8 (83.7, 84.0)
80-89	25130	69013	99.7 (99.6, 99.7)	99.4 (99.3, 99.4)	97.8 (97.7, 97.9)	95.0 (94.8, 95.1)	80.7 (80.3, 81.0)	44.0 (43.4, 44.6)
≥90	1078	2126	99.2 (98.8, 99.5)	98.4 (97.7, 98.8)	94.1 (93.0, 95.0)	87.9 (86.3, 89.3)	58.1 (55.5, 60.6)	12.9 (10.6, 15.4)
TOTAL	**82428**	**588190**						

Note: Patients who have been revised are censored.

Figure EK1 Cumulative Percent Survival of Patients with Primary Total Knee Replacement by Age (Primary Diagnosis OA)



HR - adjusted for gender

80-89 vs <80

0 - 4Yr: HR=4.19 (4.08, 4.31),p<0.001

4Yr - 5.5Yr: HR=4.62 (4.44, 4.81),p<0.001

5.5Yr - 9Yr: HR=4.88 (4.76, 5.02),p<0.001

9Yr - 10Yr: HR=5.31 (5.03, 5.61),p<0.001

10Yr+: HR=4.86 (4.68, 5.04),p<0.001

≥90 vs <80

Entire Period: HR=11.37 (10.70, 12.08),p<0.001

≥90 vs 80-89

Entire Period: HR=2.53 (2.38, 2.69),p<0.001

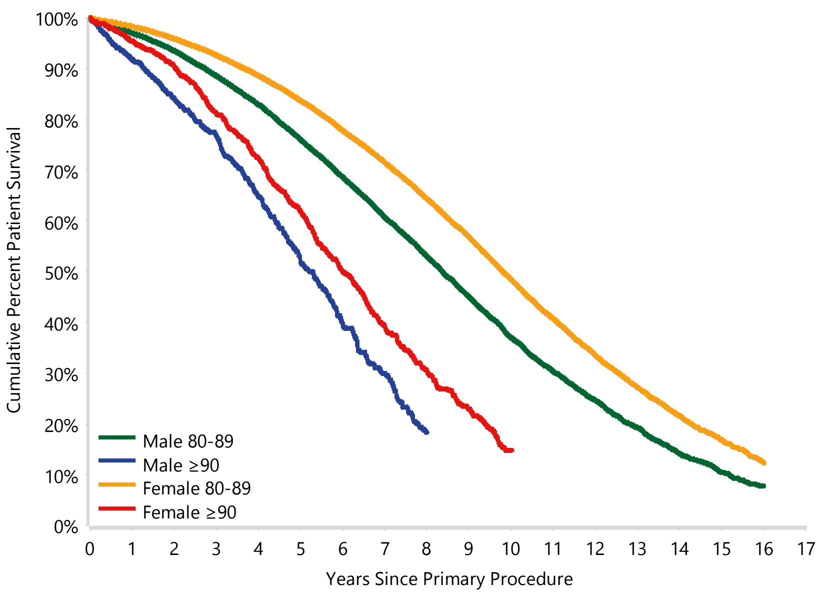
Number at Risk	0 Days	30 Days	90 Days	1 Yr	2 Yr	5 Yr	10 Yr
<80	517051	513953	504439	466403	417071	282776	112710
80-89	69013	68550	67333	62192	55469	34724	8764
≥90	2126	2097	2040	1806	1495	672	69

Table EK5 Cumulative Percent Survival of Patients with Primary Total Knee Replacement by Gender and Age (Primary Diagnosis OA)

Gender	Age	N Death	N Total	30 Days	90 Days	1 Yr	2 Yr	5 Yr	10 Yr
Male	80-89	10756	26894	99.6 (99.5, 99.6)	99.2 (99.0, 99.3)	97.0 (96.8, 97.2)	93.5 (93.2, 93.8)	76.0 (75.4, 76.6)	37.0 (36.1, 37.8)
	≥90	419	808	99.3 (98.4, 99.7)	97.6 (96.3, 98.5)	91.9 (89.7, 93.6)	84.1 (81.2, 86.6)	51.7 (47.3, 55.9)	
Female	80-89	14374	42119	99.8 (99.7, 99.8)	99.5 (99.4, 99.6)	98.3 (98.2, 98.4)	95.9 (95.7, 96.1)	83.7 (83.2, 84.1)	48.4 (47.6, 49.1)
	≥90	659	1318	99.2 (98.6, 99.6)	98.9 (98.1, 99.3)	95.4 (94.1, 96.4)	90.1 (88.2, 91.7)	61.7 (58.5, 64.8)	14.8 (11.8, 18.2)
TOTAL		**26208**	**71139**						

Note: Patients who have been revised are censored

Figure EK2 Cumulative Percent Survival of Patients with Primary Total Knee Replacement by Gender and Age (Primary Diagnosis OA)



Male 80-89 vs Male ≥90
Entire Period: HR=0.42 (0.38, 0.46),p<0.001

Male 80-89 vs Female 80-89
0 - 4.5Yr: HR=1.56 (1.50, 1.62),p<0.001
4.5Yr - 7Yr: HR=1.42 (1.36, 1.49),p<0.001
7Yr+: HR=1.23 (1.18, 1.28),p<0.001

Male ≥90 vs Female ≥90
Entire Period: HR=1.32 (1.17, 1.50),p<0.001

Female 80-89 vs Female ≥90
Entire Period: HR=0.38 (0.35, 0.41),p<0.001

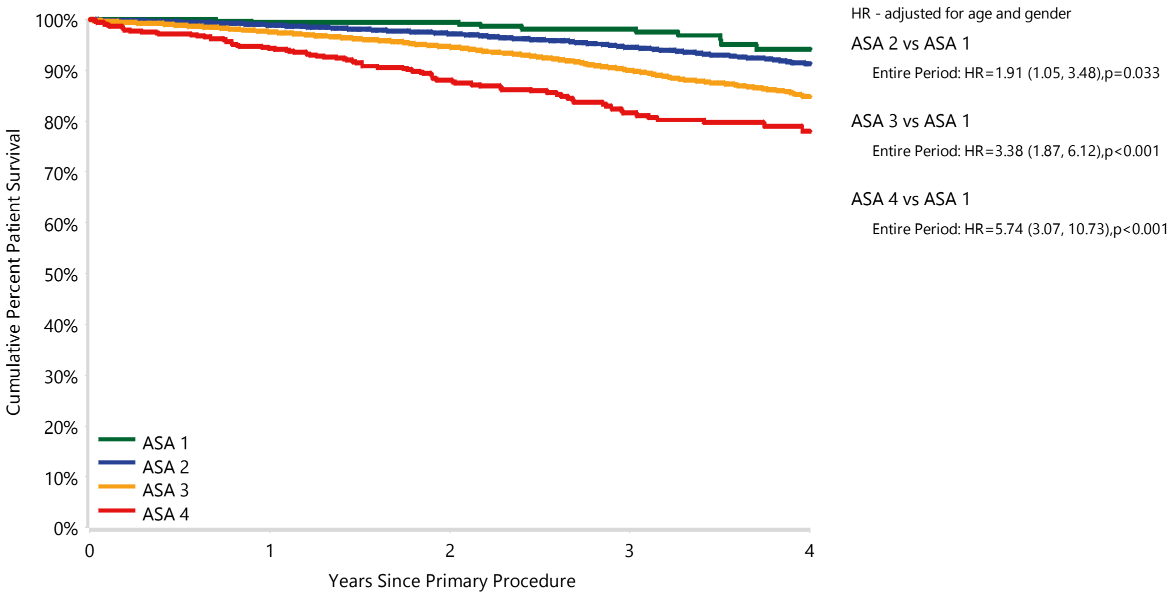
Number at Risk		0 Days	30 Days	90 Days	1 Yr	2 Yr	5 Yr	10 Yr
Male	80-89	26894	26675	26146	23994	21231	12620	2755
	≥90	808	794	761	658	533	218	16
Female	80-89	42119	41875	41187	38198	34238	22104	6009
	≥90	1318	1303	1279	1148	962	454	53

Table EK6 Cumulative Percent Survival of Patients Aged ≥80 Years with Primary Total Knee Replacement by ASA Score (Primary Diagnosis OA)

ASA Score	N Death	N Total	30 Days	90 Days	1 Yr	2 Yr	3 Yr	4 Yr
ASA 1	11	421	100.0 (100.0, 100.0)	100.0 (100.0, 100.0)	99.4 (97.7, 99.9)	99.4 (97.7, 99.9)	98.2 (95.7, 99.3)	94.1 (88.7, 97.0)
ASA 2	479	10929	99.9 (99.8, 99.9)	99.8 (99.7, 99.9)	98.9 (98.7, 99.1)	97.2 (96.8, 97.6)	94.6 (94.0, 95.1)	91.3 (90.4, 92.1)
ASA 3	960	12717	99.7 (99.6, 99.8)	99.4 (99.2, 99.5)	97.6 (97.3, 97.9)	94.6 (94.2, 95.1)	89.9 (89.2, 90.6)	84.8 (83.7, 85.8)
ASA 4	92	623	99.0 (97.9, 99.6)	97.7 (96.1, 98.6)	94.3 (92.0, 95.9)	88.0 (84.7, 90.6)	81.6 (77.2, 85.2)	78.0 (72.7, 82.4)
ASA 5	0	2	100.0 (100.0, 100.0)	100.0 (100.0, 100.0)	100.0 (100.0, 100.0)	100.0 (100.0, 100.0)		
TOTAL	**1542**	**24692**						

Note: Patients who have been revised are censored

Figure EK3 Cumulative Percent Survival of Patients Aged ≥80 Years with Primary Total Knee Replacement by ASA Score (Primary Diagnosis OA)



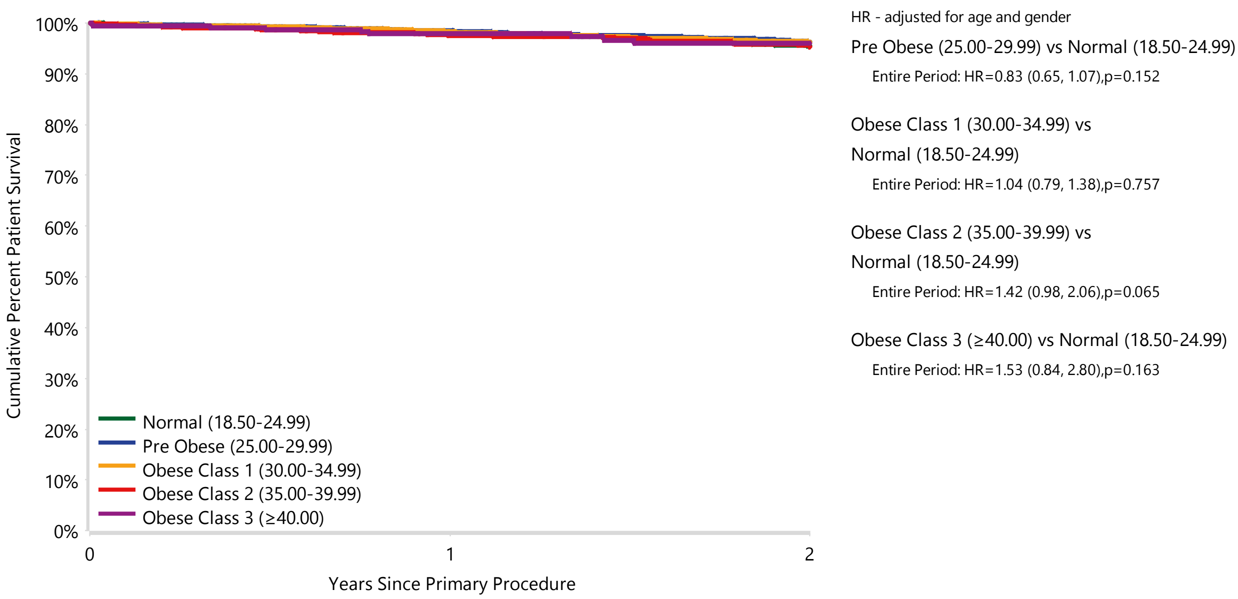
Number at Risk	0 Days	30 Days	90 Days	1 Yr	2 Yr	3 Yr	4 Yr
ASA 1	421	411	398	338	258	164	67
ASA 2	10929	10804	10384	8510	6124	3698	1466
ASA 3	12717	12554	11921	9439	6494	3759	1462
ASA 4	623	608	575	465	319	185	83

Table EK7 Cumulative Percent Survival of Patients Aged ≥80 Years with Primary Total Knee Replacement by BMI (Primary Diagnosis OA)

BMI	N Death	N Total	30 Days	90 Days	1 Yr	2 Yr
Underweight (<18.50)	1	83	100.0 (100.0, 100.0)	100.0 (100.0, 100.0)	100.0 (100.0, 100.0)	100.0 (100.0, 100.0)
Normal (18.50-24.99)	100	3061	99.8 (99.6, 99.9)	99.6 (99.3, 99.8)	98.1 (97.5, 98.6)	95.5 (94.4, 96.4)
Pre Obese (25.00-29.99)	154	6177	99.8 (99.7, 99.9)	99.6 (99.4, 99.7)	98.4 (98.0, 98.7)	96.3 (95.5, 96.9)
Obese Class 1 (30.00-34.99)	103	3692	99.8 (99.6, 99.9)	99.5 (99.2, 99.7)	98.3 (97.8, 98.7)	96.2 (95.3, 97.0)
Obese Class 2 (35.00-39.99)	40	1197	99.7 (99.1, 99.9)	99.2 (98.5, 99.6)	97.6 (96.4, 98.4)	95.3 (93.4, 96.7)
Obese Class 3 (≥40.00)	12	338	99.4 (97.7, 99.9)	99.4 (97.7, 99.9)	97.9 (95.2, 99.0)	96.0 (92.2, 97.9)
TOTAL	**410**	**14548**				

Note: Patients who have been revised are censored.

Figure EK4 Cumulative Percent Survival of Patients Aged ≥80 Years with Primary Total Knee Replacement by BMI (Primary Diagnosis OA)



Number at Risk	0 Days	30 Days	90 Days	1 Yr	2 Yr
Normal (18.50-24.99)	3061	3004	2795	1958	927
Pre Obese (25.00-29.99)	6177	6063	5615	3839	1735
Obese Class 1 (30.00-34.99)	3692	3622	3371	2315	1065
Obese Class 2 (35.00-39.99)	1197	1173	1092	723	334
Obese Class 3 (≥40.00)	338	330	307	199	93

REVISION

The three appoaches used to report the rate of revision following primary total hip replacement in elderly patients have also been used for the primary total knee analysis.

The AOANJRR has previously reported that there is a decreasing rate of revision with increasing age. The comparison of the three age groups <80, 80-89 and ≥90 years confirms that the 80-89 age group has a lower rate of revision after three months compared to <80 years and the difference in revision rate between these two age groups increases with time. The rate of revision in the 80-89 age group, however, is higher in the first three months compared to the <80 age group. The ≥90 age group has an increased rate of revision in the first three months compared to the 80-89 age group, but it is lower after that time (Table EK8 and Figure EK5).

The cumulative percent revision at five years is 3.8%, 2.0% and 1.5% for the three age groups, and at 10 years it is 5.7%, 2.5% and 1.5%, respectively (Table EK8 and Figure EK5).

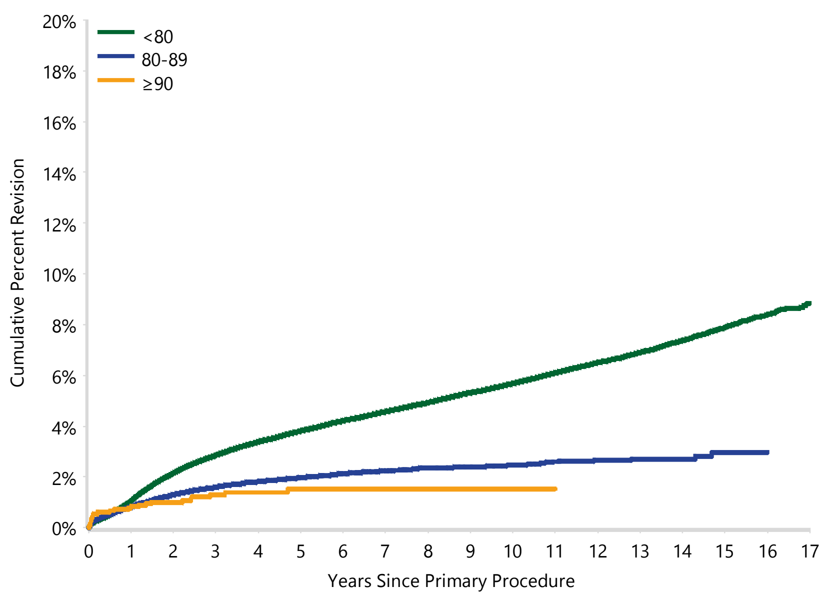
The cumulative incidence of revision is similar to the cumulative percent revision at these time points. At five years the cumulative incidence is 3.8%, 1.9% and 1.4%, and at 10 years it is 5.4%, 2.2% and 1.4%, respectively (Table EK9, and Figures EK6 to EK7).

The lower revision rate comparing the 80-89 and ≥80 age groups is also evident when the conditional probability of revision is calculated. In the ≥90 age group the conditional probability increases with time. Initally it is is lower than the other two age groups, but as time progresses it becomes higher. At five years the conditional probability is 3.9%, 2.3% and 2.4%, and at 10 years it is 6.5%, 5.0% and 10.0%, respectively. Patients in the ≥90 age group, if they are alive after seven years, have a higher probability of being revised compared to the other age groups. The difference increases further as time progresses (Table EK9 and Figure EK8).

Table EK8 Cumulative Percent Revision of Primary Total Knee Replacement by Age (Primary Diagnosis OA)

Age	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<80	20908	517051	1.1 (1.0, 1.1)	2.1 (2.1, 2.2)	2.9 (2.8, 2.9)	3.8 (3.8, 3.9)	4.6 (4.5, 4.6)	5.7 (5.6, 5.8)
80-89	1271	69013	0.8 (0.7, 0.9)	1.3 (1.2, 1.4)	1.6 (1.5, 1.7)	2.0 (1.9, 2.1)	2.2 (2.1, 2.4)	2.5 (2.3, 2.6)
≥90	26	2126	0.8 (0.5, 1.3)	1.0 (0.7, 1.6)	1.3 (0.9, 1.9)	1.5 (1.0, 2.3)	1.5 (1.0, 2.3)	1.5 (1.0, 2.3)
TOTAL	**22205**	**588190**						

Figure EK5 Cumulative Percent Revision of Primary Total Knee Replacement by Age (Primary Diagnosis OA)



HR - adjusted for gender

<80 vs 80-89
- 0 - 3Mth: HR=0.83 (0.72, 0.94),p=0.004
- 3Mth - 6Mth: HR=1.32 (1.08, 1.63),p=0.007
- 6Mth - 9Mth: HR=1.68 (1.37, 2.05),p<0.001
- 9Mth - 2Yr: HR=2.24 (2.02, 2.49),p<0.001
- 2Yr - 2.5Yr: HR=2.04 (1.68, 2.48),p<0.001
- 2.5Yr - 8Yr: HR=2.70 (2.41, 3.02),p<0.001
- 8Yr+: HR=5.77 (4.03, 8.28),p<0.001

≥90 vs 80-89
- 0 - 3Mth: HR=1.67 (0.96, 2.92),p=0.070
- 3Mth+: HR=0.50 (0.29, 0.87),p=0.013

≥90 vs <80
- 0 - 3Mth: HR=2.02 (1.17, 3.49),p=0.011
- 3Mth - 9Mth: HR=0.23 (0.06, 0.91),p=0.035
- 9Mth - 2.5Yr: HR=0.28 (0.14, 0.55),p<0.001
- 2.5Yr - 3Yr: HR=0.25 (0.04, 1.79),p=0.168
- 3Yr+: HR=0.13 (0.03, 0.53),p=0.004

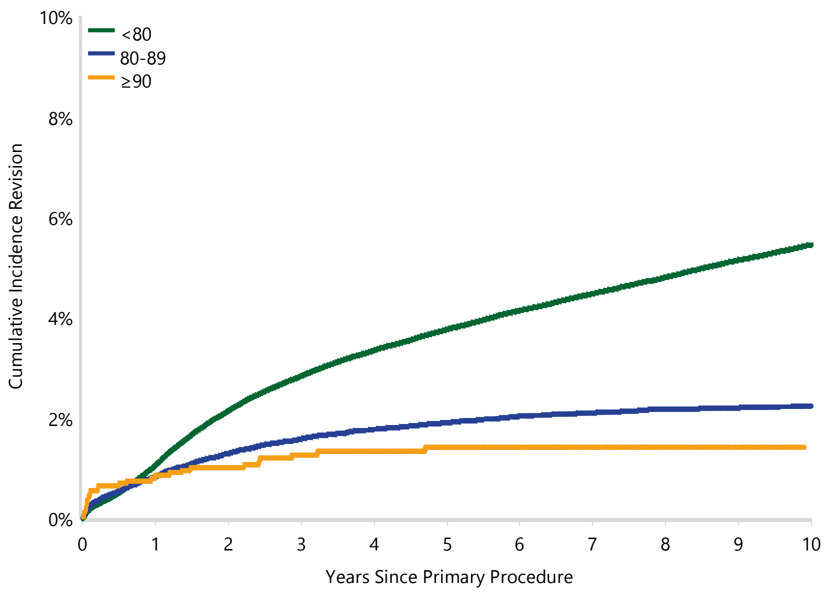
Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<80	517051	461508	408039	358592	271471	195802	105669
80-89	69013	61698	54770	47593	34044	21798	8552
≥90	2126	1792	1481	1196	661	306	69

Table EK9 Summary of Cumulative Incidence and Conditional Probability of Primary Total Knee Replacement (Primary Diagnosis OA)

Outcome	Age	1 Yrs	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
CIF(Alive, Unrevised)	<80	98.4%	96.5%	94.9%	91.3%	87.0%	78.4%
	80-89	97.0%	93.7%	89.5%	78.8%	65.3%	42.2%
	≥90	93.3%	86.9%	78.3%	56.8%	34.6%	12.4%
CIF(Revision)	<80	1.1%	2.1%	2.8%	3.8%	4.5%	5.4%
	80-89	0.8%	1.3%	1.6%	1.9%	2.1%	2.2%
	≥90	0.8%	1.0%	1.2%	1.4%	1.4%	1.4%
CIF(Mortality)	<80	0.5%	1.3%	2.3%	4.9%	8.6%	16.1%
	80-89	2.2%	5.0%	9.0%	19.3%	32.6%	55.6%
	≥90	5.9%	12.1%	20.5%	41.8%	64.1%	86.2%
CP(Revised, if alive)	<80	1.1%	2.2%	2.9%	3.9%	4.9%	6.5%
	80-89	0.8%	1.3%	1.7%	2.3%	3.1%	5.0%
	≥90	0.9%	1.1%	1.5%	2.4%	3.8%	10.0%

Note: CIF = Cumulative Incidence Function
CP = Conditional Probability

Figure EK6 Cumulative Incidence Revision of Primary Total Knee Replacement by Age (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yrs	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<80	517051	461508	408039	358592	271471	195802	105669
80-89	69013	61698	54770	47593	34044	21798	8552
≥90	2126	1792	1481	1196	661	306	69

Figure EK7 Cumulative Incidence Function of Primary Total Knee Replacement by Age (Primary Diagnosis OA)

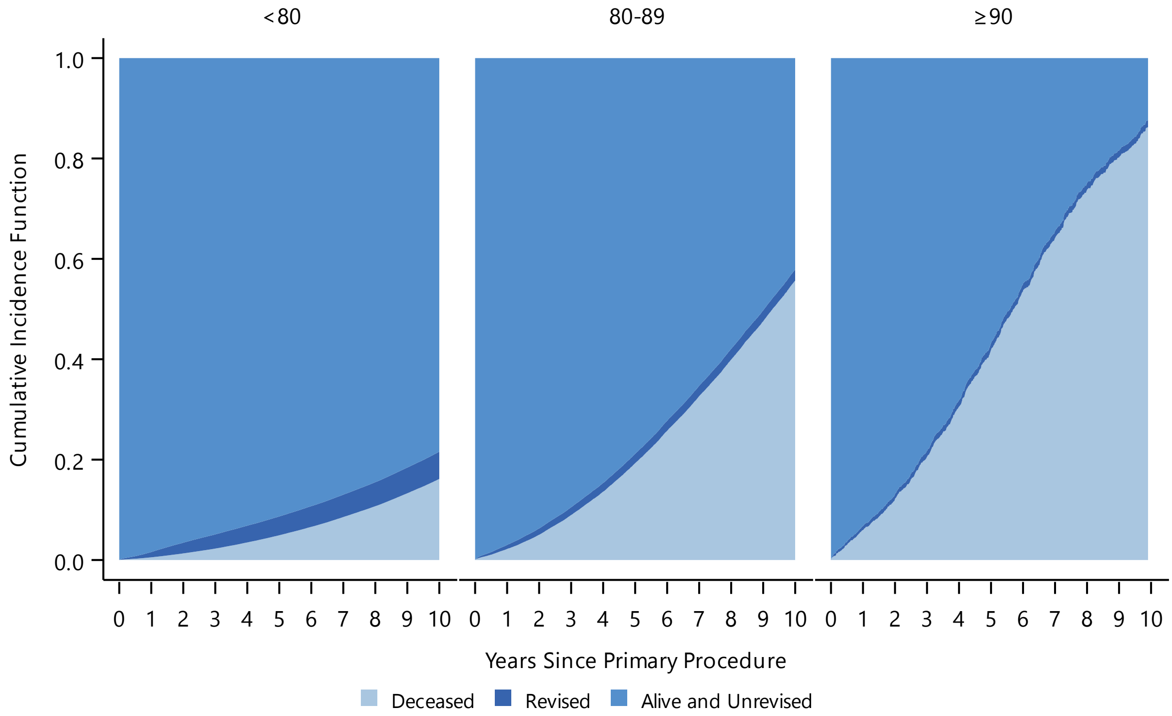
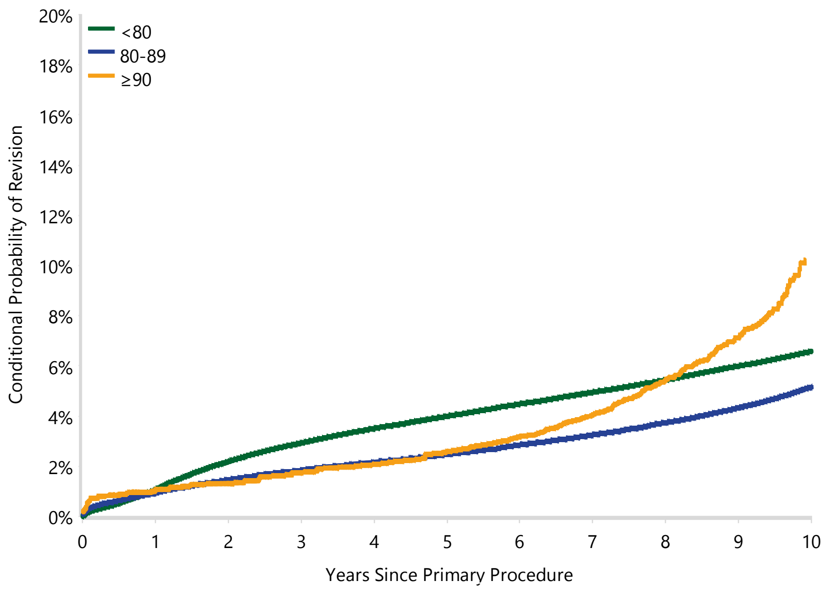


Figure EK8 Conditional Probability of Revision of Primary Total Knee Replacement by Age (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yrs	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
80	517051	461508	408039	358592	271471	195802	105669
80-89	69013	61698	54770	47593	34044	21798	8552
≥90	2126	1792	1481	1196	661	306	69

Reasons for Revision

The incidence of the major reasons for revision varies with age. Most are lower in the older age groups, particularly revision for loosening. The exception to this is revision for infection which is similar across the age groups. Infection is the most common reason for revision in older patients and accounts for 35.2% of all revisions in the 80-89 age group and 61.5% of all revisions in the ≥90 age group. In the <80 age group, infection accounts for a smaller proportion of revisions (22.1%) (Table EK10 and Figure EK9).

Revision for infection is the most common reason for revision in patients aged ≥80 years.

Types of Revision

Major revisions (total, tibial only or femoral only) occur more frequently in the younger age group. The main type of revision in the 80-89 and ≥90 age groups is insert only revisions, accounting for 34.6% and 65.4% of all revisions. Patella only revisions occur half as frequently in the 80-89 age group compared to the <80 age group. No patella only revisions have been reported in the ≥90 age group (Table EK11).

Table EK10 Revision Diagnosis of Primary Total Knee Replacement by Age (Primary Diagnosis OA)

Revision Diagnosis	<80			80-89			≥90		
	Number	% Primaries Revised	% Revisions	Number	% Primaries Revised	% Revisions	Number	% Primaries Revised	% Revisions
Loosening	5416	1.0	25.9	202	0.3	15.9	2	0.1	7.7
Infection	4621	0.9	22.1	448	0.6	35.2	16	0.8	61.5
Patellofemoral Pain	2168	0.4	10.4	136	0.2	10.7			
Pain	1751	0.3	8.4	86	0.1	6.8	1	0.0	3.8
Instability	1638	0.3	7.8	94	0.1	7.4	2	0.1	7.7
Other	5314	1.0	25.4	305	0.4	24.0	5	0.2	19.2
N Revision	**20908**	**4.0**	**100.0**	**1271**	**1.8**	**100.0**	**26**	**1.2**	**100.0**
N Primary	**517051**			**69013**			**2126**		

Figure EK9 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by Age (Primary Diagnosis OA)

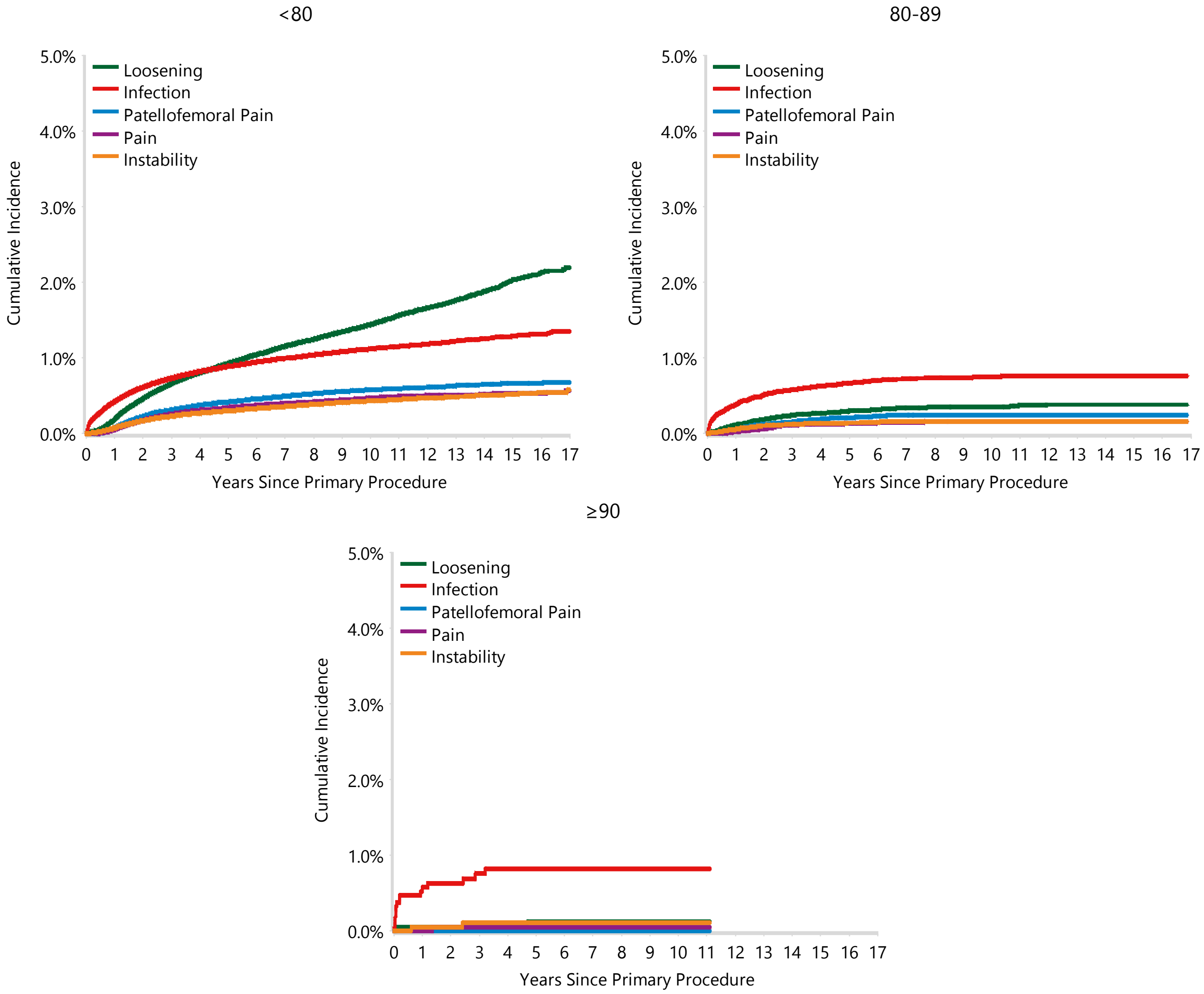


Table EK11 Type of Revision of Primary Total Knee Replacement by Age (Primary Diagnosis OA)

Type of Revision	<80			80-89			≥90		
	Number	% Primaries Revised	% Revisions	Number	% Primaries Revised	% Revisions	Number	% Primaries Revised	% Revisions
TKR (Tibial/Femoral)	5437	1.1	26.0	242	0.4	19.0	5	0.2	19.2
Insert Only	4542	0.9	21.7	440	0.6	34.6	17	0.8	65.4
Patella Only	4231	0.8	20.2	258	0.4	20.3			
Insert/Patella	2184	0.4	10.4	83	0.1	6.5	1	0.0	3.8
Tibial Component	1988	0.4	9.5	82	0.1	6.5	2	0.1	7.7
Femoral Component	1179	0.2	5.6	79	0.1	6.2	1	0.0	3.8
Cement Spacer	1173	0.2	5.6	71	0.1	5.6			
Removal of Prostheses	107	0.0	0.5	10	0.0	0.8			
Minor Components	43	0.0	0.2	2	0.0	0.2			
Total Femoral	9	0.0	0.0	1	0.0	0.1			
Reinsertion of Components	8	0.0	0.0	1	0.0	0.1			
Cement Only	7	0.0	0.0	2	0.0	0.2			
N Revision	**20908**	**4.0**	**100.0**	**1271**	**1.8**	**100.0**	**26**	**1.2**	**100.0**
N Primary	**517051**			**69013**			**2126**		

PATIENT FACTORS

Males have an increased rate of revision in both the 80-89 and ≥90 age groups compared to females. There is no difference in revision rate when males aged 80-89 years are compared to those aged ≥90 years. Females aged ≥90 years have a lower rate of revision after one month than those aged 80-89 years (Table EK12 and Figure EK10).

The effect of ASA and BMI on early revision was also examined. The majority of patients have ASA score 2 or 3 in both the 80-89 and ≥90 age groups (44.5% and 51.3% for the 80-89 age group and 37.4% and 56.0% for the ≥90 age group) (Table EK13).

Considering the entire ≥80 age group, ASA score has no effect on the revision rate when ASA scores 2, 3 and 4 are compared (Table EK14 and Figure EK11).

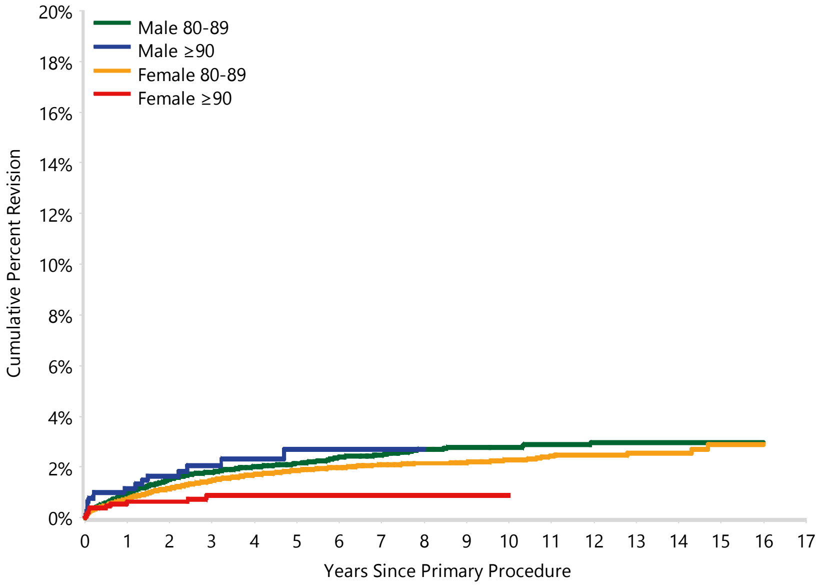
When all BMI classes are compared, BMI does not affect the revision rate of patients aged ≥80 years.

The most common BMI class for patients aged ≥80 are either normal, pre-obese or obese class 1 (20.4%, 42.4% and 25.8% for the 80-89 age group, and 38.1%, 43.3% and 14.4% for the ≥90 age group) (Table EK15). BMI does not affect the revision rate when the classes were compared in the entire ≥80 age group (Table EK16 and Figure EK12).

Table EK12 Cumulative Percent Revision of Primary Total Knee Replacement by Gender and Age (Primary Diagnosis OA)

Gender	Age	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Male	80-89	541	26894	0.9 (0.8, 1.1)	1.5 (1.4, 1.7)	1.8 (1.6, 2.0)	2.1 (2.0, 2.3)	2.5 (2.3, 2.7)	2.8 (2.5, 3.1)
	≥90	16	808	1.2 (0.6, 2.2)	1.6 (0.9, 2.9)	2.0 (1.2, 3.5)	2.7 (1.6, 4.6)	2.7 (1.6, 4.6)	
Female	80-89	730	42119	0.7 (0.7, 0.8)	1.1 (1.0, 1.3)	1.5 (1.4, 1.6)	1.9 (1.7, 2.0)	2.1 (1.9, 2.3)	2.3 (2.1, 2.5)
	≥90	10	1318	0.6 (0.3, 1.3)	0.6 (0.3, 1.3)	0.9 (0.5, 1.6)	0.9 (0.5, 1.6)	0.9 (0.5, 1.6)	0.9 (0.5, 1.6)
TOTAL		**1297**	**71139**						

Figure EK10 Cumulative Percent Revision of Primary Total Knee Replacement by Gender and Age (Primary Diagnosis OA)



Male 80-89 vs Male ≥90
Entire Period: HR=0.85 (0.52, 1.41),p=0.535

Male ≥90 vs Female ≥90
Entire Period: HR=2.86 (1.30, 6.30),p=0.009

Male 80-89 vs Female 80-89
Entire Period: HR=1.21 (1.08, 1.36),p<0.001

Female 80-89 vs Female ≥90
0 - 1Mth: HR=0.82 (0.26, 2.58),p=0.734
1Mth+: HR=2.52 (1.20, 5.31),p=0.014

Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Male	80-89	26894	23775	20924	17899	12353	7504	2677
	≥90	808	652	525	421	212	95	16
Female	80-89	42119	37923	33846	29694	21691	14294	5875
	≥90	1318	1140	956	775	449	211	53

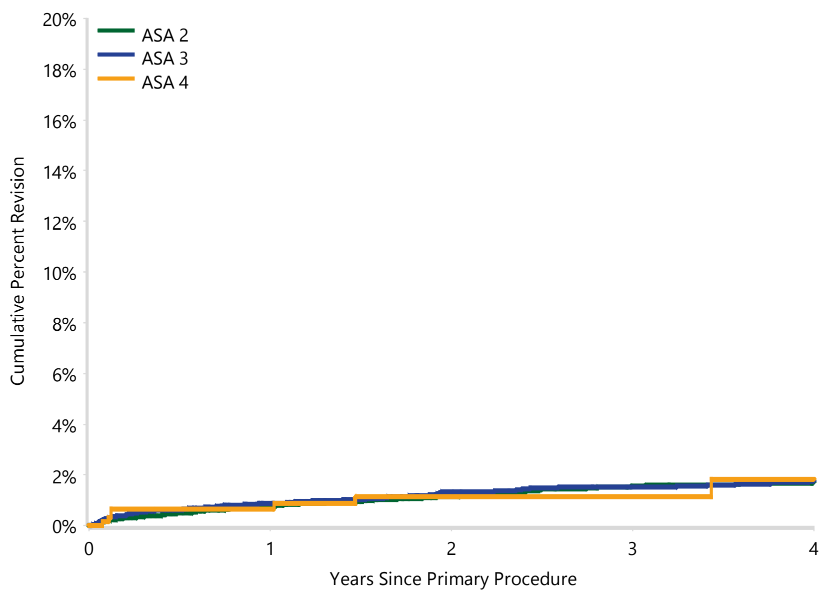
Table EK13 Primary Total Knee Replacement by ASA Score and Age (Primary Diagnosis OA)

ASA Score	<80 N	Col%	80-89 N	Col%	≥90 N	Col%
ASA 1	13842	6.7	409	1.7	12	1.3
ASA 2	118617	57.7	10592	44.5	337	37.4
ASA 3	71184	34.6	12212	51.3	505	56.0
ASA 4	1890	0.9	576	2.4	47	5.2
ASA 5	12	0.0	2	0.0	.	.
TOTAL	**205545**	**100.0**	**23791**	**100.0**	**901**	**100.0**

Table EK14 Cumulative Percent Revision of Primary Total Knee Replacement for Patients Aged ≥80 Years by ASA Score (Primary Diagnosis OA)

ASA Score	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs
ASA 1	2	421	0.3 (0.0, 1.9)	0.3 (0.0, 1.9)	0.3 (0.0, 1.9)	1.1 (0.2, 5.3)
ASA 2	130	10929	0.7 (0.6, 0.9)	1.1 (0.9, 1.4)	1.6 (1.3, 1.9)	1.7 (1.4, 2.1)
ASA 3	156	12717	0.9 (0.7, 1.1)	1.3 (1.1, 1.6)	1.5 (1.3, 1.8)	1.8 (1.5, 2.1)
ASA 4	7	623	0.7 (0.2, 1.8)	1.1 (0.5, 2.5)	1.1 (0.5, 2.5)	1.8 (0.7, 4.5)
ASA 5	0	2	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)		
TOTAL	**295**	**24692**				

Figure EK11 Cumulative Percent Revision of Primary Total Knee Replacement for Patients Aged ≥80 Years by ASA Score (Primary Diagnosis OA)



HR - adjusted for age and gender

ASA 2 vs ASA 3

Entire Period: HR=0.92 (0.73, 1.16),p=0.481

ASA 4 vs ASA 3

Entire Period: HR=0.91 (0.43, 1.94),p=0.808

ASA 2 vs ASA 4

Entire Period: HR=1.01 (0.47, 2.16),p=0.980

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs
ASA 2	10929	8447	6056	3642	1445
ASA 3	12717	9355	6411	3698	1436
ASA 4	623	462	317	184	83

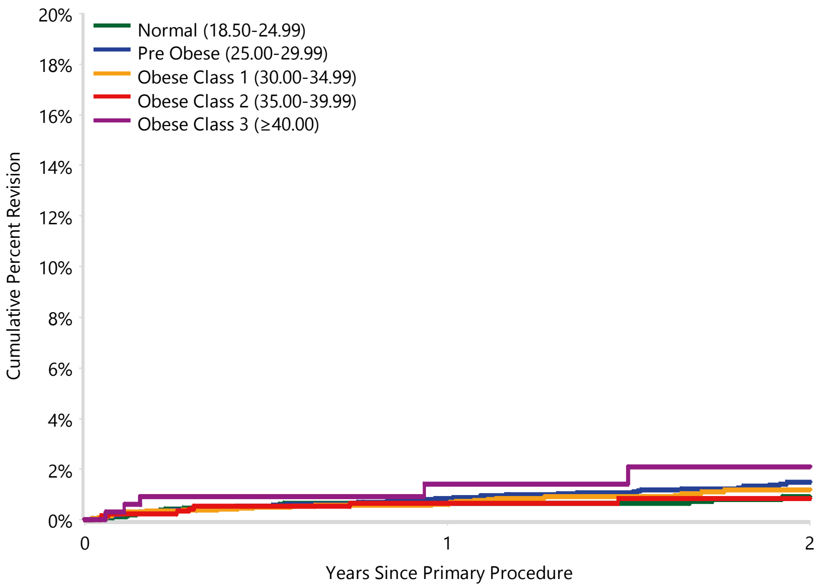
Table EK15 Primary Total Knee Replacement by BMI and Age (Primary Diagnosis OA)

BMI	<80		80-89		≥90	
	N	Col%	N	Col%	N	Col%
Underweight (<18.50)	167	0.1	78	0.6	5	1.0
Normal (18.50-24.99)	11433	9.1	2863	20.4	198	38.1
Pre Obese (25.00-29.99)	37635	29.9	5952	42.4	225	43.3
Obese Class 1 (30.00-34.99)	39489	31.4	3617	25.8	75	14.4
Obese Class 2 (35.00-39.99)	22598	17.9	1185	8.4	12	2.3
Obese Class 3 (≥40.00)	14615	11.6	333	2.4	5	1.0
TOTAL	**125937**	**100.0**	**14028**	**100.0**	**520**	**100.0**

Table EK16 Cumulative Percent Revision of Primary Total Knee Replacement for Patients Aged ≥80 Years by BMI (Primary Diagnosis OA)

BMI	N Revised	N Total	1 Yr	2 Yrs
Underweight (<18.50)	1	83	1.2 (0.2, 8.5)	1.2 (0.2, 8.5)
Normal (18.50-24.99)	21	3061	0.6 (0.4, 1.0)	0.9 (0.6, 1.4)
Pre Obese (25.00-29.99)	66	6177	0.8 (0.6, 1.1)	1.5 (1.1, 1.9)
Obese Class 1 (30.00-34.99)	32	3692	0.6 (0.4, 1.0)	1.2 (0.8, 1.7)
Obese Class 2 (35.00-39.99)	9	1197	0.6 (0.3, 1.4)	0.8 (0.4, 1.7)
Obese Class 3 (≥40.00)	5	338	1.4 (0.5, 3.8)	2.1 (0.8, 5.2)
TOTAL	**134**	**14548**		

Figure EK12 Cumulative Percent Revision of Primary Total Knee Replacement for Patients Aged ≥80 Years by BMI (Primary Diagnosis OA)



HR - adjusted for age and gender

Pre Obese (25.00-29.99) vs Normal (18.50-24.99)
Entire Period: HR=1.55 (0.94, 2.53),p=0.082

Obese Class 1 (30.00-34.99) vs
Normal (18.50-24.99)
Entire Period: HR=1.30 (0.74, 2.25),p=0.359

Obese Class 2 (35.00-39.99) vs
Normal (18.50-24.99)
Entire Period: HR=1.19 (0.54, 2.62),p=0.659

Obese Class 3 (≥40.00) vs Normal (18.50-24.99)
Entire Period: HR=2.40 (0.90, 6.40),p=0.080

Number at Risk	0 Yr	1 Yr	2 Yrs
Normal (18.50-24.99)	3061	1947	917
Pre Obese (25.00-29.99)	6177	3806	1710
Obese Class 1 (30.00-34.99)	3692	2302	1057
Obese Class 2 (35.00-39.99)	1197	718	333
Obese Class 3 (≥40.00)	338	196	90

PROSTHESIS FACTORS

A variety of prosthesis factors were examined to determine the effect on the revision rate of elderly patients. There were too few revisions in the ≥90 age group to undertake this analysis seperately, so the analysis includes all patients aged ≥80 years.

Minimally stabilised prostheses were used more commonly (72.8% of procedures). Minimally stablised prostheses have a lower cumulative percent revision compared for posterior stablised (2.3% and 2.7%) (Table EK17 and Figure EK13).

The method of fixation (cemented, hybrid or cementless) does not alter the revision rate for either minimally stabilised or posterior stabilised prostheses in this age group (Tables EK18 and EK19, Figures EK14 and EK15).

The reasons for revision vary depending on the type of fixation. This analysis combined minimally and posterior stabilised prostheses. Revision for infection was increased when cement fixation was used and revision for loosening was increased when cementless fixation was used. Other reasons for revision were similar for the three fixation methods. At this time, we are unable to determine if the increased infection rate is related to patient selection, surgeon, procedure or device factors (Table EK20 and Figure EK16).

The increased rate of revision for infection associated with cemented fixation and loosening with cementless fixation, are significant (Tables EK21 and EK22, and Figures EK17 and EK18).

The types of revision are similar for the three methods of fixation with the most common type of revision being insert only revisions (Table EK23).

Patella resurfacing was used in 46.5% of procedures using minimally stabilised prostheses and 70.3% of procedures using posterior stabilised prostheses. The use of patella resurfacing reduces the rate of revision for both minimally and posterior stabilised prostheses in the ≥80 age group (Table EK24 and Figure EK19).

Analyses to determine the revision rate of the most commonly used femoral and tibial prosthesis combinations in the ≥80 age group were undertaken. The combinations were divided into subgroups by both fixation and use of patella resurfacing. For each combination there are potentially 6 possible subgroups. Only those subgroups with 250 or more procedures are listed. Minimally and posterior stabilised prostheses were considered separately (Tables EK25 and EK26).

There were 21 minimally stabilised prosthesis combinations with 56 subgroups and 12 posterior stabilised with 18 subgroups identified. Of these, 37 of the minimally stabilised and 10 of the posterior stabilised subgroups had sufficient follow up to have a 10 year cumulative percent revision.

The upper 95% cumulative incidence was used to identify the 10 subgroups with the lowest 10 year cumulative percent revision. They included 9 minimally stabilised and 1 posterior stabilised subgroup. Of the 9 minimally stabilised subgroups, there were 5 from 16 cemented, 2 from 13 hybrid and 2 from 8 cementless subgroups that have a ≥10 year follow up (Tables EK25 and EK26).

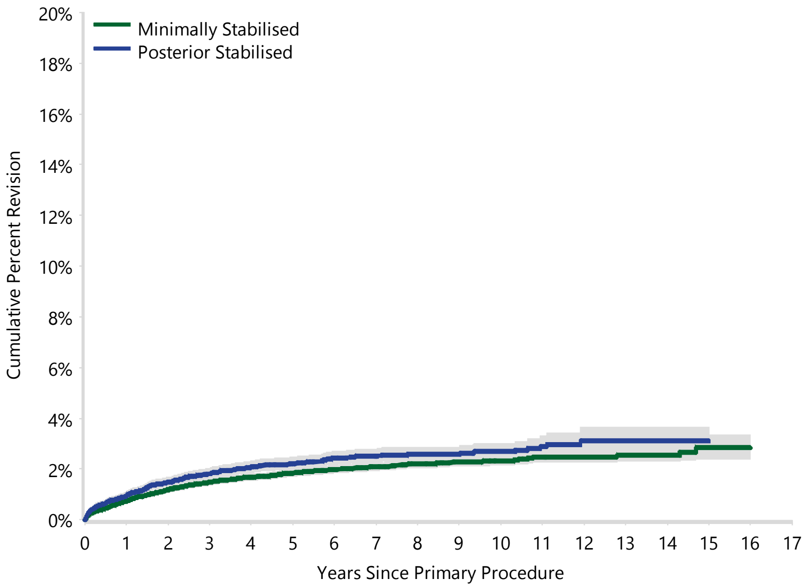
There were 14 minimally stabilised subgroups with a ≥10 year follow up that used patella resurfacing and 23 that did not. Of the 9 minimally stabilised that had the lowest cumulative percent revision, 6 used patella resurfacing and 3 did not (Table EK25).

The single posterior stabilised subgroup that was identified in the 10 subgroups with the lowest 10 year cumulative percent revision used cement fixation and patella resurfacing (Table EK26).

Table EK17 Cumulative Percent Revision of Primary Total Knee Replacement for Patients Aged ≥80 Years by Stability (Primary Diagnosis OA)

Stability	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Minimally Stabilised	866	50235	0.7 (0.7, 0.8)	1.2 (1.1, 1.3)	1.5 (1.4, 1.6)	1.8 (1.7, 2.0)	2.1 (2.0, 2.2)	2.3 (2.2, 2.5)
Posterior Stabilised	390	18742	0.9 (0.8, 1.1)	1.5 (1.3, 1.7)	1.8 (1.6, 2.0)	2.2 (2.0, 2.5)	2.5 (2.3, 2.8)	2.7 (2.4, 3.0)
TOTAL	**1256**	**68977**						

Figure EK13 Cumulative Percent Revision of Primary Total Knee Replacement for Patients Aged ≥80 Years by Stability (Primary Diagnosis OA)



HR - adjusted for age and gender

Posterior Stabilised vs Minimally Stabilised

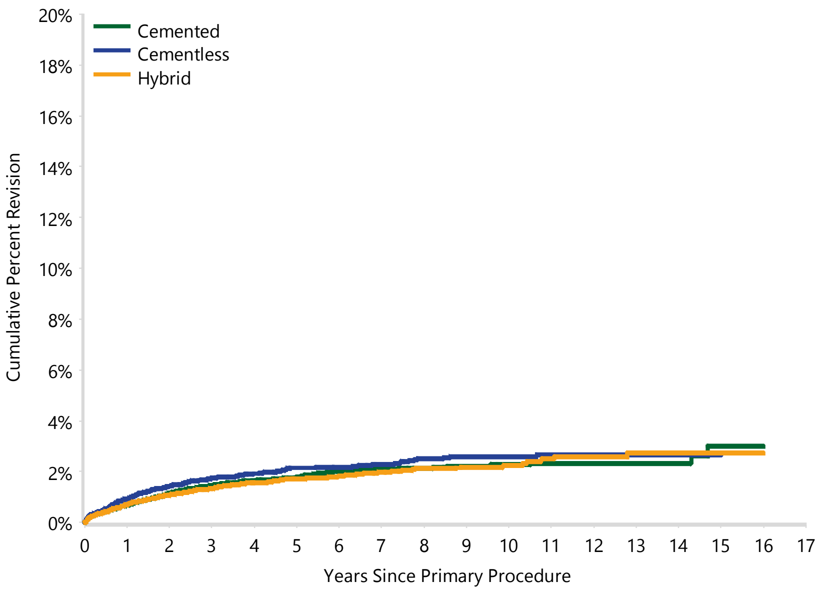
Entire Period: HR=1.22 (1.08, 1.37),p=0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Minimally Stabilised	50235	45003	40077	34898	24957	16052	6548
Posterior Stabilised	18742	16852	15010	13106	9303	5799	1988

Table EK18 Cumulative Percent Revision of Minimally Stabilised Primary Total Knee Replacement for Patients Aged ≥80 Years by Fixation (Primary Diagnosis OA)

Fixation	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Cemented	394	24301	0.7 (0.6, 0.8)	1.1 (1.0, 1.3)	1.5 (1.3, 1.6)	1.8 (1.6, 2.0)	2.1 (1.9, 2.3)	2.3 (2.1, 2.6)
Cementless	215	10485	0.9 (0.8, 1.1)	1.4 (1.2, 1.7)	1.7 (1.5, 2.0)	2.1 (1.9, 2.5)	2.3 (2.0, 2.6)	2.6 (2.2, 3.0)
Hybrid	257	15449	0.7 (0.6, 0.9)	1.1 (0.9, 1.2)	1.3 (1.2, 1.5)	1.7 (1.5, 2.0)	2.0 (1.7, 2.2)	2.2 (1.9, 2.6)
TOTAL	**866**	**50235**						

Figure EK14 Cumulative Percent Revision of Minimally Stabilised Primary Total Knee Replacement for Patients Aged ≥80 Years by Fixation (Primary Diagnosis OA)



HR - adjusted for age and gender

Cemented vs Hybrid
Entire Period: HR=1.04 (0.89, 1.22),p=0.594

Cementless vs Hybrid
Entire Period: HR=1.17 (0.97, 1.40),p=0.094

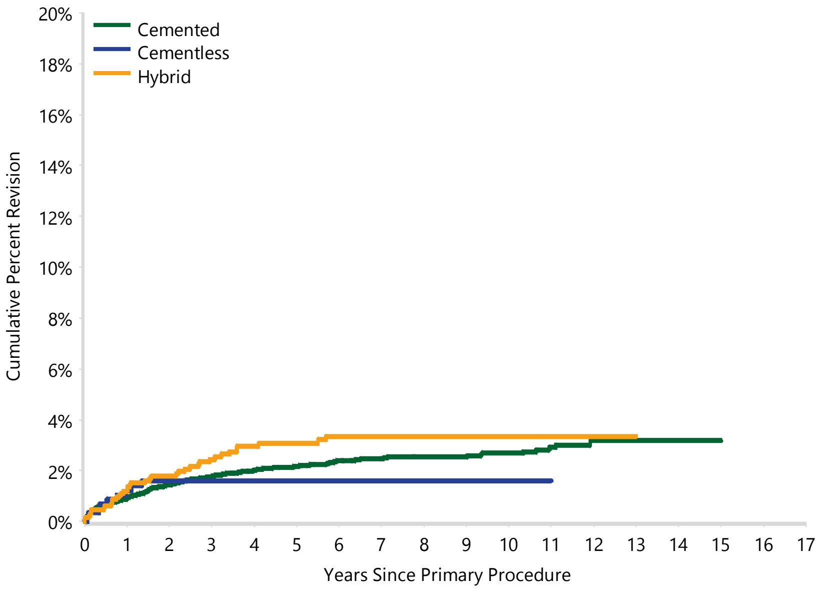
Cementless vs Cemented
Entire Period: HR=1.12 (0.95, 1.32),p=0.187

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Cemented	24301	21297	18543	15790	11019	6998	2858
Cementless	10485	9692	8892	8081	6015	3932	1594
Hybrid	15449	14014	12642	11027	7923	5122	2096

Table EK19 Cumulative Percent Revision of Posterior Stabilised Primary Total Knee Replacement for Patients Aged ≥80 Years by Fixation (Primary Diagnosis OA)

Fixation	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Cemented	344	16857	0.9 (0.8, 1.1)	1.4 (1.3, 1.6)	1.8 (1.6, 2.0)	2.2 (1.9, 2.4)	2.5 (2.2, 2.8)	2.7 (2.4, 3.0)
Cementless	9	593	1.2 (0.6, 2.6)	1.6 (0.8, 3.1)	1.6 (0.8, 3.1)	1.6 (0.8, 3.1)	1.6 (0.8, 3.1)	1.6 (0.8, 3.1)
Hybrid	37	1292	1.2 (0.7, 2.0)	1.8 (1.2, 2.7)	2.4 (1.7, 3.5)	3.1 (2.2, 4.3)	3.4 (2.4, 4.6)	3.4 (2.4, 4.6)
TOTAL	**390**	**18742**						

Figure EK15 Cumulative Percent Revision of Posterior Stabilised Primary Total Knee Replacement for Patients Aged ≥80 Years by Fixation (Primary Diagnosis OA)



HR - adjusted for age and gender

Cementless vs Cemented

Entire Period: HR=0.69 (0.36, 1.34),p=0.272

Hybrid vs Cemented

Entire Period: HR=1.30 (0.93, 1.83),p=0.127

Hybrid vs Cementless

Entire Period: HR=1.89 (0.91, 3.91),p=0.087

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Cemented	16857	15125	13419	11670	8235	5074	1705
Cementless	593	538	492	440	328	210	71
Hybrid	1292	1189	1099	996	740	515	212

Table EK20 Revision Diagnosis of Primary Total Knee Replacement for Patients Aged ≥80 Years by Fixation (Primary Diagnosis OA)

Revision Diagnosis	Cemented			Cementless			Hybrid		
	Number	% Primaries Revised	% Revisions	Number	% Primaries Revised	% Revisions	Number	% Primaries Revised	% Revisions
Infection	325	0.8	41.8	48	0.4	21.4	91	0.5	30.7
Loosening	104	0.2	13.4	53	0.5	23.7	47	0.3	15.9
Patellofemoral Pain	74	0.2	9.5	18	0.2	8.0	44	0.3	14.9
Fracture	58	0.1	7.5	19	0.2	8.5	27	0.2	9.1
Pain	52	0.1	6.7	15	0.1	6.7	20	0.1	6.8
Instability	51	0.1	6.6	19	0.2	8.5	26	0.2	8.8
Patella Erosion	29	0.1	3.7	11	0.1	4.9	12	0.1	4.1
Arthrofibrosis	12	0.0	1.5	5	0.0	2.2	4	0.0	1.4
Bearing Dislocation	10	0.0	1.3	5	0.0	2.2	2	0.0	0.7
Prosthesis Dislocation	9	0.0	1.2	1	0.0	0.4	3	0.0	1.0
Incorrect Sizing	8	0.0	1.0	3	0.0	1.3	1	0.0	0.3
Other	45	0.1	5.8	27	0.2	12.1	19	0.1	6.4
N Revision	**777**	**1.8**	**100.0**	**224**	**2.0**	**100.0**	**296**	**1.8**	**100.0**
N Primary	**43081**			**11194**			**16864**		

Figure EK16 **Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement for Patients Aged ≥80 Years by Fixation (Primary Diagnosis OA)**

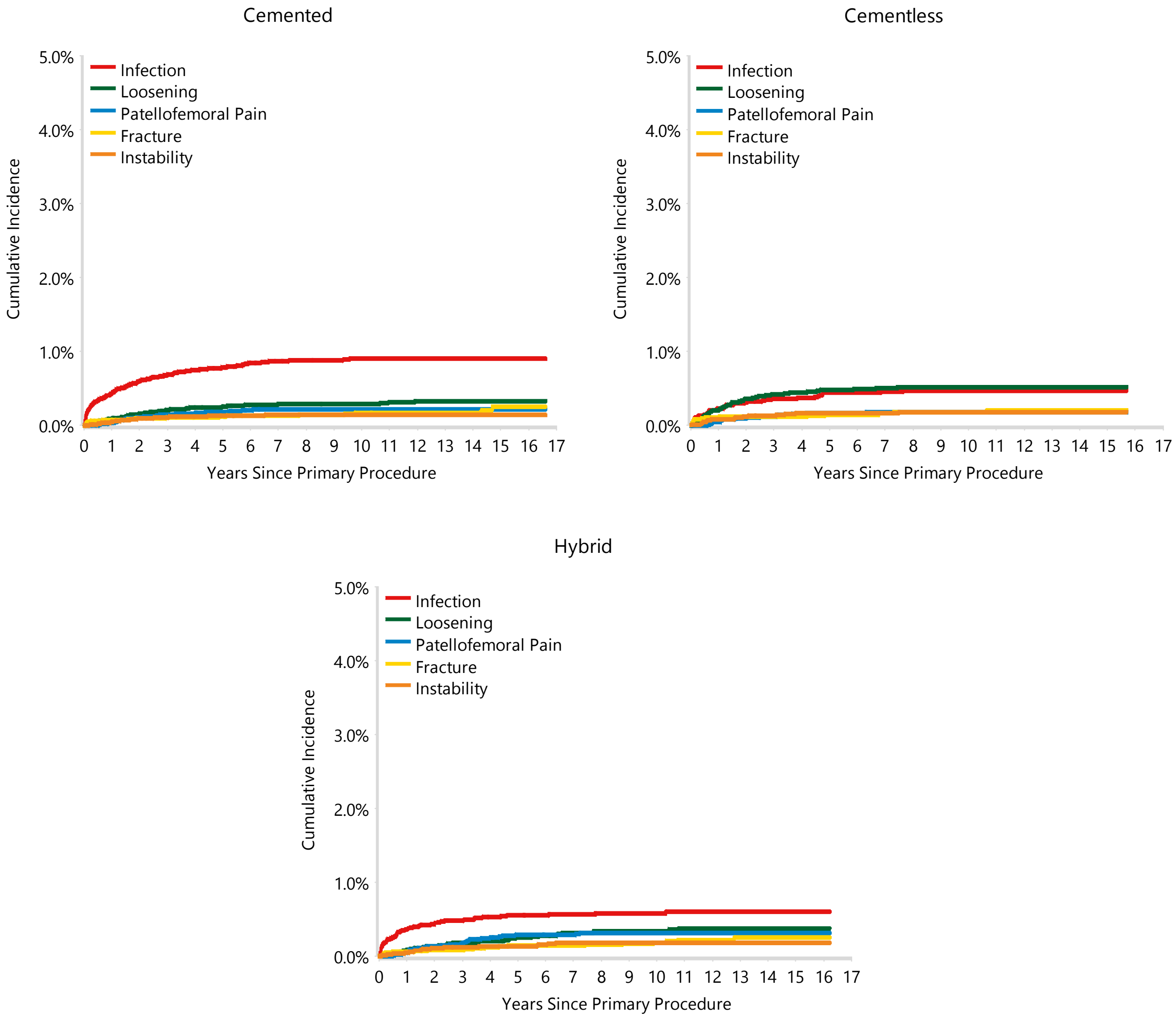
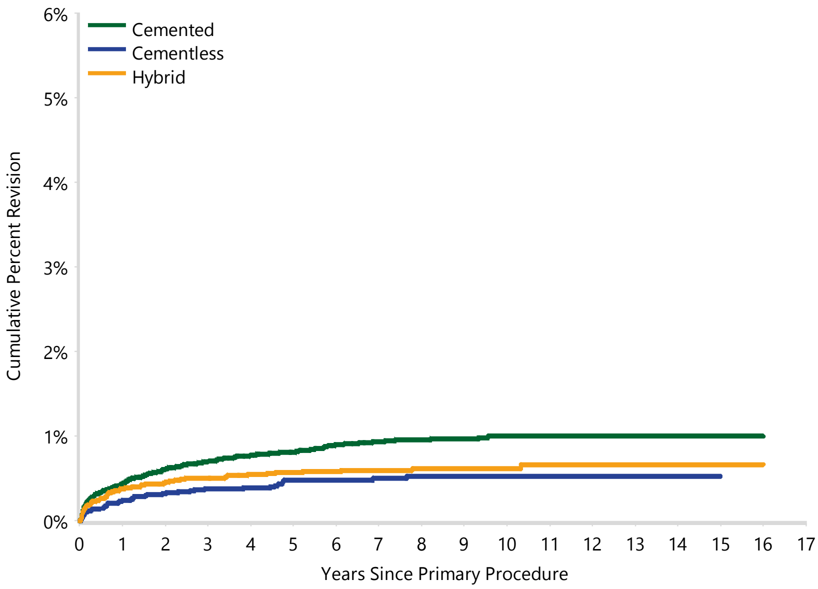


Table EK21 Cumulative Percent Revision of Primary Total Knee Replacement for Patents Aged ≥80 Years by Fixation (Primary Diagnosis OA, Revision for Infection)

Fixation	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Cemented	325	43081	0.4 (0.4, 0.5)	0.6 (0.5, 0.7)	0.7 (0.6, 0.8)	0.8 (0.7, 0.9)	0.9 (0.8, 1.0)	1.0 (0.9, 1.1)
Cementless	48	11194	0.2 (0.2, 0.4)	0.3 (0.2, 0.4)	0.4 (0.3, 0.5)	0.5 (0.4, 0.6)	0.5 (0.4, 0.7)	0.5 (0.4, 0.7)
Hybrid	91	16864	0.4 (0.3, 0.5)	0.4 (0.4, 0.6)	0.5 (0.4, 0.6)	0.6 (0.5, 0.7)	0.6 (0.5, 0.7)	0.6 (0.5, 0.8)
TOTAL	**464**	**71139**						

Figure EK17 Cumulative Percent Revision of Primary Total Knee Replacement for Patents Aged ≥80 Years by Fixation (Primary Diagnosis OA, Revision for Infection)



HR - adjusted for age and gender

Cemented vs Cementless

Entire Period: HR=2.00 (1.48, 2.71),p<0.001

Hybrid vs Cementless

Entire Period: HR=1.33 (0.94, 1.89),p=0.106

Cemented vs Hybrid

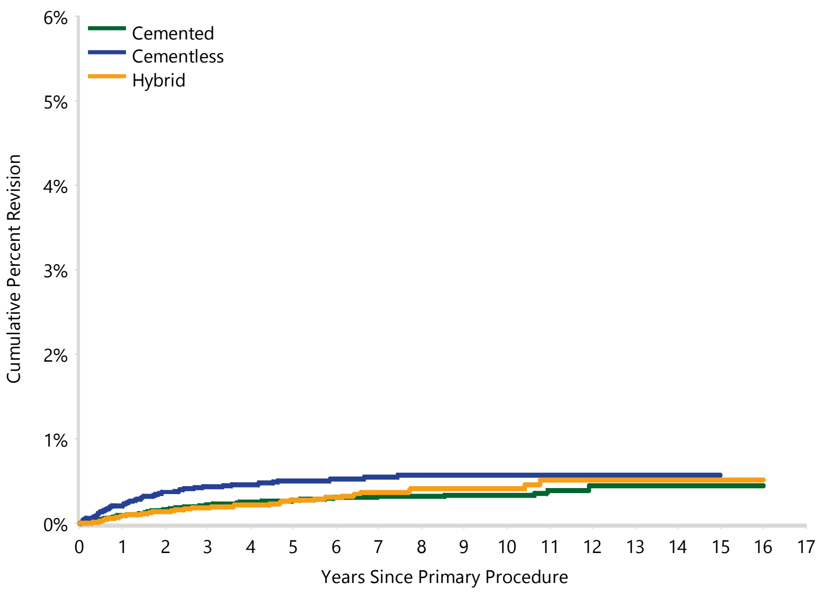
Entire Period: HR=1.50 (1.19, 1.89),p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Cemented	43081	37843	32939	28088	19572	12233	4607
Cementless	11194	10328	9467	8587	6395	4176	1675
Hybrid	16864	15319	13845	12114	8738	5695	2339

Table EK22 Cumulative Percent Revision of Primary Total Knee Replacement for Patents Aged ≥80 Years by Fixation (Primary Diagnosis OA, Revision for Loosening)

Fixation	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Cemented	104	43081	0.1 (0.1, 0.1)	0.2 (0.1, 0.2)	0.2 (0.2, 0.3)	0.3 (0.2, 0.3)	0.3 (0.3, 0.4)	0.3 (0.3, 0.4)
Cementless	53	11194	0.2 (0.1, 0.3)	0.4 (0.3, 0.5)	0.4 (0.3, 0.6)	0.5 (0.4, 0.7)	0.5 (0.4, 0.7)	0.6 (0.4, 0.8)
Hybrid	47	16864	0.1 (0.1, 0.1)	0.1 (0.1, 0.2)	0.2 (0.1, 0.3)	0.3 (0.2, 0.4)	0.4 (0.3, 0.5)	0.4 (0.3, 0.6)
TOTAL	**204**	**71139**						

Figure EK18 Cumulative Percent Revision of Primary Total Knee Replacement for Patents Aged ≥80 Years by Fixation (Primary Diagnosis OA, Revision for Loosening)



HR - adjusted for age and gender

Cemented vs Hybrid

Entire Period: HR=0.94 (0.67, 1.33),p=0.732

Cementless vs Hybrid

0 - 1.5Yr: HR=2.49 (1.55, 4.02),p<0.001

1.5Yr+: HR=0.99 (0.57, 1.72),p=0.974

Cementless vs Cemented

Entire Period: HR=1.74 (1.25, 2.42),p=0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Cemented	43081	37843	32939	28088	19572	12233	4607
Cementless	11194	10328	9467	8587	6395	4176	1675
Hybrid	16864	15319	13845	12114	8738	5695	2339

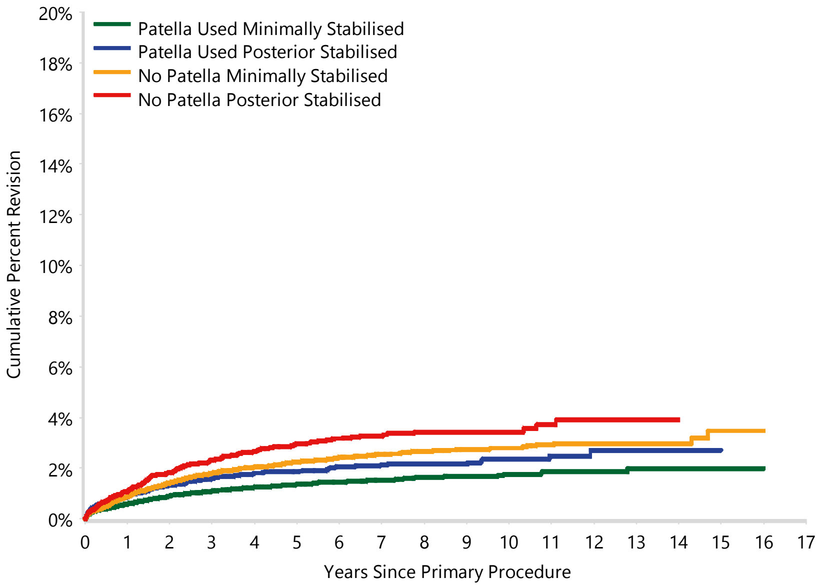
Table EK23 Type of Revision of Primary Total Knee Replacement for Patients Aged ≥80 Years by Fixation (Primary Diagnosis OA)

Type of Revision	Cemented			Cementless			Hybrid		
	Number	% Primaries Revised	% Revisions	Number	% Primaries Revised	% Revisions	Number	% Primaries Revised	% Revisions
Insert Only	313	0.7	40.3	59	0.5	26.3	85	0.5	28.7
Patella Only	146	0.3	18.8	42	0.4	18.8	70	0.4	23.6
TKR (Tibial/Femoral)	134	0.3	17.2	47	0.4	21.0	66	0.4	22.3
Insert/Patella	48	0.1	6.2	18	0.2	8.0	18	0.1	6.1
Cement Spacer	47	0.1	6.0	10	0.1	4.5	14	0.1	4.7
Tibial Component	42	0.1	5.4	27	0.2	12.1	15	0.1	5.1
Femoral Component	40	0.1	5.1	18	0.2	8.0	22	0.1	7.4
Other	7	0.0	0.9	3	0.0	1.3	6	0.0	2.0
N Revision	**777**	**1.8**	**100.0**	**224**	**2.0**	**100.0**	**296**	**1.8**	**100.0**
N Primary	**43081**			**11194**			**16864**		

Table EK24 Cumulative Percent Revision of Primary Total Knee Replacement for Patients Aged ≥80 Years by Patella Usage and Stability (Primary Diagnosis OA)

Patella Usage	Stability	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Patella Used	Minimally Stabilised	288	23365	0.6 (0.5, 0.7)	0.9 (0.8, 1.0)	1.1 (1.0, 1.2)	1.4 (1.2, 1.5)	1.5 (1.4, 1.7)	1.8 (1.5, 2.0)
	Posterior Stabilised	228	13177	0.9 (0.7, 1.0)	1.3 (1.1, 1.5)	1.6 (1.4, 1.8)	1.9 (1.6, 2.1)	2.1 (1.9, 2.4)	2.3 (2.0, 2.7)
No Patella	Minimally Stabilised	578	26870	0.9 (0.8, 1.0)	1.4 (1.3, 1.6)	1.8 (1.6, 2.0)	2.2 (2.0, 2.4)	2.5 (2.3, 2.8)	2.8 (2.6, 3.0)
	Posterior Stabilised	162	5565	1.1 (0.8, 1.4)	1.8 (1.5, 2.2)	2.3 (1.9, 2.8)	3.0 (2.5, 3.5)	3.3 (2.8, 3.8)	3.4 (2.9, 4.0)
TOTAL		**1256**	**68977**						

Figure EK19 Cumulative Percent Revision of Primary Total Knee Replacement for Patients Aged ≥80 Years by Patella Usage and Stability (Primary Diagnosis OA)



HR - adjusted for age and gender

Patella Used Minimally Stabilised vs
Patella Used Posterior Stabilised
Entire Period: HR=0.71 (0.60, 0.85),p<0.001

Patella Used Posterior Stabilised vs
No Patella Posterior Stabilised
0 - 3Mth: HR=1.09 (0.70, 1.69),p=0.714
3Mth+: HR=0.59 (0.48, 0.74),p<0.001

Patella Used Minimally Stabilised vs
No Patella Minimally Stabilised
Entire Period: HR=0.62 (0.54, 0.72),p<0.001

No Patella Minimally Stabilised vs
No Patella Posterior Stabilised
Entire Period: HR=0.77 (0.65, 0.92),p=0.003

Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Patella Used	Minimally Stabilised	23365	20514	17916	15276	10540	6562	2577
	Posterior Stabilised	13177	11648	10189	8733	5930	3522	1151
No Patella	Minimally Stabilised	26870	24489	22161	19622	14417	9490	3971
	Posterior Stabilised	5565	5204	4821	4373	3373	2277	837

Table EK25 Cumulative Percent Revision of Minimally Stabilised Primary Total Knee Replacement for Patients Aged ≥80 Years by Prostheses (Primary Diagnosis OA)

Femoral/Tibial	Fixation and Patella Usage	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
AGC/AGC*	Cemented No Patella	7	258	0.4 (0.1, 2.8)	0.8 (0.2, 3.2)	1.7 (0.6, 4.4)	2.7 (1.2, 5.9)	3.3 (1.6, 6.9)	3.3 (1.6, 6.9)
Attune CR/Attune	Cemented No Patella	2	332	0.8 (0.2, 3.4)	0.8 (0.2, 3.4)				
	Cemented Patella Used	5	563	0.4 (0.1, 1.4)	1.6 (0.6, 4.1)	1.6 (0.6, 4.1)			
Duracon/ Duracon*	Cemented No Patella	19	727	1.0 (0.5, 2.0)	1.7 (1.0, 3.0)	1.9 (1.1, 3.2)	2.5 (1.6, 4.0)	2.9 (1.8, 4.5)	2.9 (1.8, 4.5)
	Cemented Patella Used	14	595	1.2 (0.6, 2.5)	1.5 (0.8, 2.9)	1.9 (1.1, 3.4)	2.5 (1.5, 4.2)	2.5 (1.5, 4.2)	2.5 (1.5, 4.2)
	Cementless No Patella	12	398	1.3 (0.5, 3.0)	1.8 (0.9, 3.7)	2.1 (1.0, 4.1)	2.7 (1.4, 4.9)	2.7 (1.4, 4.9)	3.6 (2.0, 6.5)
	Hybrid No Patella	16	584	0.3 (0.1, 1.4)	1.4 (0.7, 2.8)	1.8 (1.0, 3.3)	2.2 (1.3, 3.9)	2.4 (1.4, 4.2)	3.1 (1.8, 5.1)
	Hybrid Patella Used	7	395	1.0 (0.4, 2.7)	1.0 (0.4, 2.7)	1.3 (0.5, 3.1)	1.9 (0.9, 4.1)	1.9 (0.9, 4.1)	1.9 (0.9, 4.1)
Genesis II CR/Genesis II	Cemented No Patella	35	1176	0.7 (0.3, 1.4)	1.5 (1.0, 2.4)	2.3 (1.6, 3.4)	2.7 (1.9, 3.9)	3.4 (2.4, 4.7)	3.6 (2.6, 5.1)
	Cemented Patella Used	12	1040	0.4 (0.1, 1.1)	0.8 (0.4, 1.7)	1.1 (0.6, 2.0)	1.2 (0.7, 2.2)	1.4 (0.8, 2.5)	1.4 (0.8, 2.5)
	Hybrid No Patella	12	641	0.8 (0.3, 1.9)	1.1 (0.5, 2.3)	1.7 (0.9, 3.1)	1.9 (1.1, 3.4)	1.9 (1.1, 3.4)	2.5 (1.3, 4.7)
Genesis II Oxinium CR/Genesis II	Cemented Patella Used	7	305	0.7 (0.2, 2.8)	1.8 (0.8, 4.4)	2.3 (1.0, 5.0)	2.3 (1.0, 5.0)	2.3 (1.0, 5.0)	
LCS CR/LCS	Cemented No Patella	8	390	1.3 (0.5, 3.1)	1.6 (0.7, 3.5)	1.6 (0.7, 3.5)	1.9 (0.9, 3.9)	2.2 (1.1, 4.4)	2.2 (1.1, 4.4)
	Hybrid No Patella	7	288	0.7 (0.2, 2.8)	0.7 (0.2, 2.8)	1.1 (0.3, 3.3)	1.9 (0.8, 4.4)	2.4 (1.1, 5.4)	2.4 (1.1, 5.4)
LCS CR/MBT	Cemented No Patella	15	1115	0.7 (0.4, 1.5)	0.8 (0.4, 1.6)	1.2 (0.7, 2.0)	1.4 (0.9, 2.5)	1.7 (1.0, 2.8)	1.7 (1.0, 2.8)
	Cemented Patella Used	12	597	0.7 (0.3, 1.8)	1.1 (0.5, 2.3)	1.3 (0.6, 2.6)	1.5 (0.7, 2.9)	2.9 (1.6, 5.3)	2.9 (1.6, 5.3)
	Cementless No Patella	10	549	0.8 (0.3, 2.0)	1.4 (0.7, 2.9)	1.9 (1.0, 3.6)	1.9 (1.0, 3.6)	1.9 (1.0, 3.6)	
	Hybrid No Patella	8	764	0.3 (0.1, 1.1)	0.4 (0.1, 1.3)	0.6 (0.2, 1.5)	0.8 (0.3, 1.9)	1.4 (0.6, 3.1)	1.8 (0.9, 3.9)
	Hybrid Patella Used	5	347	0.6 (0.2, 2.4)	1.3 (0.5, 3.4)	1.7 (0.7, 3.9)	1.7 (0.7, 3.9)	1.7 (0.7, 3.9)	
LCS CR/MBT Duofix	Cementless No Patella	16	858	1.2 (0.7, 2.2)	1.6 (0.9, 2.8)	1.6 (0.9, 2.8)	1.9 (1.2, 3.2)	2.2 (1.3, 3.6)	2.2 (1.3, 3.6)
	Cementless Patella Used	6	466	0.7 (0.2, 2.0)	0.9 (0.3, 2.4)	1.2 (0.5, 2.9)	1.2 (0.5, 2.9)	1.2 (0.5, 2.9)	1.8 (0.7, 4.3)
LCS Duofix/MBT Duofix*	Cementless No Patella	16	327	1.6 (0.7, 3.7)	2.9 (1.5, 5.4)	3.5 (2.0, 6.3)	5.0 (3.0, 8.1)	5.0 (3.0, 8.1)	5.6 (3.4, 9.1)
Natural Knee II/ Natural Knee II*	Cemented Patella Used	1	297	0.0 (0.0, 0.0)	0.4 (0.0, 2.5)	0.4 (0.0, 2.5)	0.4 (0.0, 2.5)	0.4 (0.0, 2.5)	0.4 (0.0, 2.5)
Nexgen CR Flex/Nexgen	Cemented No Patella	26	1372	0.9 (0.5, 1.6)	1.4 (0.8, 2.2)	1.6 (1.0, 2.5)	2.1 (1.3, 3.2)	2.8 (1.8, 4.3)	3.8 (2.1, 6.8)
	Cemented Patella Used	14	1623	0.6 (0.3, 1.1)	0.8 (0.5, 1.4)	1.0 (0.6, 1.7)	1.0 (0.6, 1.7)	1.0 (0.6, 1.7)	1.0 (0.6, 1.7)
	Cementless No Patella	1	370	0.3 (0.0, 2.0)	0.3 (0.0, 2.0)	0.3 (0.0, 2.0)	0.3 (0.0, 2.0)	0.3 (0.0, 2.0)	0.3 (0.0, 2.0)
	Hybrid No Patella	15	973	0.4 (0.2, 1.1)	0.9 (0.4, 1.8)	1.2 (0.6, 2.2)	1.5 (0.9, 2.7)	2.2 (1.2, 3.9)	2.7 (1.5, 4.9)
	Hybrid Patella Used	4	1034	0.3 (0.1, 0.9)	0.4 (0.2, 1.1)	0.4 (0.2, 1.1)	0.4 (0.2, 1.1)	0.4 (0.2, 1.1)	0.4 (0.2, 1.1)
Nexgen CR Flex/Nexgen TM CR	Cementless No Patella	9	767	0.7 (0.3, 1.6)	0.8 (0.4, 1.8)	1.2 (0.6, 2.3)	1.4 (0.7, 2.6)	1.4 (0.7, 2.6)	
Nexgen CR/Nexgen	Cemented No Patella	6	361	0.3 (0.0, 2.0)	0.6 (0.1, 2.3)	1.2 (0.5, 3.2)	1.2 (0.5, 3.2)	1.7 (0.7, 4.2)	1.7 (0.7, 4.2)
	Cementless No Patella	5	359	0.3 (0.0, 2.0)	0.9 (0.3, 2.7)	1.2 (0.4, 3.1)	1.2 (0.4, 3.1)	1.2 (0.4, 3.1)	1.2 (0.4, 3.1)

Femoral/Tibial	Fixation and Patella Usage	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
	Hybrid No Patella	6	355	0.9 (0.3, 2.7)	1.2 (0.4, 3.1)	1.5 (0.6, 3.5)	1.9 (0.8, 4.1)	1.9 (0.8, 4.1)	1.9 (0.8, 4.1)
	Hybrid Patella Used	3	267	0.0 (0.0, 0.0)	0.4 (0.1, 2.8)	0.8 (0.2, 3.3)	1.3 (0.4, 4.1)	1.3 (0.4, 4.1)	1.3 (0.4, 4.1)
PFC Sigma CR/MBT	Hybrid Patella Used	2	339	0.3 (0.0, 2.1)	0.6 (0.2, 2.5)	0.6 (0.2, 2.5)	0.6 (0.2, 2.5)	0.6 (0.2, 2.5)	
PFC Sigma CR/PFC Sigma	Cemented No Patella	21	884	0.7 (0.3, 1.5)	1.8 (1.1, 3.0)	2.4 (1.5, 3.7)	2.7 (1.7, 4.1)	2.7 (1.7, 4.1)	2.7 (1.7, 4.1)
	Cemented Patella Used	14	935	1.0 (0.5, 1.9)	1.0 (0.5, 1.9)	1.2 (0.7, 2.2)	1.5 (0.9, 2.7)	1.7 (1.0, 2.9)	1.7 (1.0, 2.9)
	Hybrid No Patella	10	647	0.5 (0.2, 1.5)	0.8 (0.3, 1.9)	1.4 (0.7, 2.7)	1.5 (0.8, 3.0)	1.8 (1.0, 3.4)	1.8 (1.0, 3.4)
	Hybrid Patella Used	6	662	0.5 (0.1, 1.4)	0.6 (0.2, 1.6)	0.8 (0.3, 1.9)	1.0 (0.4, 2.2)	1.0 (0.4, 2.2)	1.0 (0.4, 2.2)
Profix/Profix*	Cemented No Patella	5	346	0.9 (0.3, 2.7)	1.5 (0.6, 3.5)	1.5 (0.6, 3.5)	1.5 (0.6, 3.5)	1.5 (0.6, 3.5)	1.5 (0.6, 3.5)
RBK/RBK	Cemented Patella Used	6	343	0.9 (0.3, 2.7)	0.9 (0.3, 2.7)	1.2 (0.5, 3.3)	1.7 (0.7, 4.0)	1.7 (0.7, 4.0)	
	Cementless No Patella	15	301	2.7 (1.4, 5.4)	3.8 (2.1, 6.7)	4.2 (2.4, 7.3)	5.6 (3.4, 9.2)	5.6 (3.4, 9.2)	
	Cementless Patella Used	9	362	1.1 (0.4, 3.0)	2.0 (1.0, 4.2)	2.4 (1.2, 4.7)	2.8 (1.5, 5.4)	2.8 (1.5, 5.4)	
Scorpio CR/Series 7000	Cementless No Patella	8	380	1.1 (0.4, 2.9)	1.1 (0.4, 2.9)	1.4 (0.6, 3.3)	2.0 (1.0, 4.1)	2.0 (1.0, 4.1)	2.5 (1.2, 5.1)
	Hybrid No Patella	8	388	0.5 (0.1, 2.1)	0.8 (0.3, 2.4)	1.4 (0.6, 3.2)	2.3 (1.2, 4.6)	2.3 (1.2, 4.6)	2.3 (1.2, 4.6)
	Hybrid Patella Used	6	532	0.6 (0.2, 1.8)	0.8 (0.3, 2.1)	1.0 (0.4, 2.5)	1.0 (0.4, 2.5)	1.5 (0.6, 3.6)	1.5 (0.6, 3.6)
Triathlon CR/Triathlon	Cemented No Patella	39	2072	0.9 (0.6, 1.5)	1.4 (0.9, 2.0)	2.0 (1.4, 2.8)	2.4 (1.7, 3.4)	2.9 (2.1, 4.1)	2.9 (2.1, 4.1)
	Cemented Patella Used	26	2707	0.4 (0.2, 0.8)	0.7 (0.5, 1.2)	1.0 (0.7, 1.6)	1.1 (0.7, 1.7)	1.5 (0.9, 2.4)	2.1 (1.1, 4.2)
	Cementless No Patella	17	773	0.9 (0.4, 1.9)	1.5 (0.8, 2.7)	1.9 (1.1, 3.2)	2.7 (1.6, 4.3)	2.7 (1.6, 4.3)	
	Cementless Patella Used	7	497	1.1 (0.4, 2.5)	1.3 (0.6, 2.9)	1.3 (0.6, 2.9)	1.7 (0.8, 3.5)	1.7 (0.8, 3.5)	
	Hybrid No Patella	19	817	1.8 (1.1, 3.0)	2.1 (1.3, 3.4)	2.3 (1.4, 3.6)	2.7 (1.7, 4.3)	2.7 (1.7, 4.3)	
	Hybrid Patella Used	15	1302	1.0 (0.6, 1.7)	1.0 (0.6, 1.7)	1.3 (0.7, 2.2)	1.4 (0.9, 2.5)	1.4 (0.9, 2.5)	
Vanguard CR/Maxim	Cemented No Patella	10	504	0.8 (0.3, 2.2)	1.3 (0.6, 2.9)	2.2 (1.1, 4.1)	2.2 (1.1, 4.1)	2.2 (1.1, 4.1)	
	Cemented Patella Used	4	574	0.4 (0.1, 1.4)	0.8 (0.3, 2.1)	0.8 (0.3, 2.1)	0.8 (0.3, 2.1)	0.8 (0.3, 2.1)	
	Hybrid No Patella	11	483	0.7 (0.2, 2.0)	1.7 (0.8, 3.4)	2.3 (1.2, 4.3)	2.6 (1.4, 4.8)	3.3 (1.7, 6.2)	
	Hybrid Patella Used	5	399	0.8 (0.3, 2.5)	1.1 (0.4, 2.9)	1.1 (0.4, 2.9)	1.8 (0.7, 4.5)	1.8 (0.7, 4.5)	
Vanguard CR/Vanguard	Hybrid No Patella	3	260	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	1.0 (0.2, 3.9)	2.3 (0.6, 7.8)	
Other (338)		259	13235	0.8 (0.6, 0.9)	1.3 (1.1, 1.5)	1.6 (1.4, 1.8)	2.0 (1.8, 2.3)	2.3 (2.0, 2.6)	2.6 (2.3, 3.0)
TOTAL		**866**	**50235**						

Note: Only prostheses with over 250 procedures have been listed
* denotes prosthesis combinations that have not had any reported use in primary total conventional hip procedures in 2017

Table EK26 Cumulative Percent Revision of Posterior Stabilised Primary Total Knee Replacement for Patients Aged ≥80 Years by Prostheses (Primary Diagnosis OA)

Femoral/Tibial	Fixation and Patella Usage	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Attune PS/Attune	Cemented Patella Used	4	488	0.9 (0.3, 2.3)	0.9 (0.3, 2.3)	0.9 (0.3, 2.3)			
Genesis II Oxinium PS/Genesis II	Cemented No Patella	15	393	1.4 (0.6, 3.2)	2.9 (1.6, 5.3)	3.5 (2.0, 6.2)	4.4 (2.6, 7.3)	4.9 (2.9, 8.0)	
	Cemented Patella Used	17	699	1.2 (0.6, 2.4)	2.1 (1.2, 3.6)	2.7 (1.6, 4.3)	2.7 (1.6, 4.3)	3.0 (1.8, 4.8)	3.0 (1.8, 4.8)
Genesis II PS/Genesis II	Cemented No Patella	24	1025	0.8 (0.4, 1.6)	1.3 (0.8, 2.3)	1.7 (1.0, 2.7)	2.3 (1.5, 3.6)	2.8 (1.9, 4.2)	2.8 (1.9, 4.2)
	Cemented Patella Used	38	1907	0.9 (0.5, 1.4)	1.3 (0.9, 2.0)	1.8 (1.3, 2.6)	2.1 (1.5, 2.9)	2.4 (1.7, 3.3)	2.7 (1.8, 4.0)
Legion Oxinium PS/Genesis II	Cemented Patella Used	12	659	0.8 (0.3, 1.9)	1.4 (0.7, 2.7)	2.4 (1.3, 4.2)	2.4 (1.3, 4.2)		
Legion PS/Genesis II	Cemented Patella Used	15	722	1.3 (0.7, 2.4)	1.8 (1.0, 3.1)	2.2 (1.3, 3.7)	2.6 (1.5, 4.3)		
Nexgen LPS Flex/Nexgen	Cemented No Patella	23	993	1.4 (0.9, 2.4)	1.7 (1.0, 2.7)	1.8 (1.1, 2.8)	2.2 (1.4, 3.4)	2.4 (1.6, 3.7)	2.4 (1.6, 3.7)
	Cemented Patella Used	38	2946	0.5 (0.3, 0.8)	0.9 (0.6, 1.4)	1.0 (0.7, 1.5)	1.3 (0.9, 1.8)	1.5 (1.1, 2.1)	1.9 (1.2, 2.8)
Nexgen LPS/Nexgen	Cemented No Patella	10	257	0.8 (0.2, 3.1)	3.2 (1.6, 6.3)	3.7 (1.9, 6.9)	4.3 (2.3, 7.9)	4.3 (2.3, 7.9)	4.3 (2.3, 7.9)
	Cemented Patella Used	11	526	0.8 (0.3, 2.0)	1.2 (0.5, 2.6)	1.2 (0.5, 2.6)	1.7 (0.8, 3.3)	2.3 (1.2, 4.4)	2.3 (1.2, 4.4)
PFC Sigma PS/MBT	Cemented Patella Used	8	573	0.4 (0.1, 1.4)	0.7 (0.3, 1.9)	0.9 (0.4, 2.2)	1.1 (0.5, 2.5)	1.9 (0.9, 3.9)	1.9 (0.9, 3.9)
PFC Sigma PS/PFC Sigma	Cemented No Patella	4	274	0.7 (0.2, 2.9)	0.7 (0.2, 2.9)	0.7 (0.2, 2.9)	1.2 (0.4, 3.7)	1.8 (0.7, 4.9)	1.8 (0.7, 4.9)
	Cemented Patella Used	19	841	1.1 (0.6, 2.1)	1.5 (0.8, 2.6)	1.7 (1.0, 2.9)	2.4 (1.5, 3.9)	2.7 (1.7, 4.2)	2.7 (1.7, 4.2)
Scorpio NRG PS/Series 7000	Cemented Patella Used	3	346	0.3 (0.0, 2.1)	0.6 (0.2, 2.4)	0.9 (0.3, 2.9)	0.9 (0.3, 2.9)	0.9 (0.3, 2.9)	
Triathlon PS/Triathlon	Cemented No Patella	5	292	0.3 (0.0, 2.4)	0.7 (0.2, 2.9)	1.6 (0.6, 4.3)	1.6 (0.6, 4.3)	2.4 (1.0, 6.1)	
	Cemented Patella Used	12	604	1.2 (0.6, 2.6)	1.2 (0.6, 2.6)	1.7 (0.9, 3.3)	2.4 (1.3, 4.4)	3.0 (1.6, 5.4)	
Vanguard PS/Maxim	Cemented Patella Used	5	269	1.9 (0.8, 4.6)	1.9 (0.8, 4.6)	1.9 (0.8, 4.6)	1.9 (0.8, 4.6)	1.9 (0.8, 4.6)	
Other (216)		127	4928	1.1 (0.9, 1.5)	1.8 (1.5, 2.3)	2.2 (1.8, 2.7)	2.8 (2.3, 3.3)	2.9 (2.5, 3.5)	3.2 (2.7, 3.9)
TOTAL		**390**	**18742**						

Note: Only prostheses with over 250 procedures have been listed
* denotes prosthesis combinations that have not had any reported use in primary total conventional hip procedures in 2017.

FIRST REVISION KNEE REPLACEMENT

This analysis reports the outcome of the first revision of a known primary total knee replacement (i.e. this means that the Registry has information on both the primary and first revision procedure).

As the data on revision procedures is limited in this age group, the information provided only details mortality and risk of second revision following a first revision in patients aged ≥80 years.

Mortality following revision is compared to mortality following primary procedures in this age group. Patients having a first revision procedure have a higher rate of mortality and this difference is greatest in the period soon after surgery. The 30 day mortality is 14/1000 for revision and 3/1000 for primary procedures. The 90 day mortality is 25/1000 for revision and 7/1000 for primary procedures (Table EK27 and Figure EK20).

The rate of second revision is the same in the first six months between the two age groups. After this time, patients aged ≥80 years have a lower rate of second revision compared to those aged <80 years (Figure EK21).

The cumulative percent revision of first revision at five years is 16.6% (≥80 years) and 22.9% (<80 years) and at 10 years it is 18.3 and 28.1%, respectively (Table EK28).

The cumulative incidence for revision is similar to the cumulative percent revision. The cumulative incidence at five years is 15.7% (≥80 years) and 22.5% (<80 years) and at 10 years it is 16.4% and 27.0%, respectively (Table EK29, Figures EK22 and EK23).

The conditional probability of first revision, unlike cumulative percent revision and cumulative incidence, is higher after seven years for the ≥80 age group. At five years the conditional probability is 21.2% (≥80 years) and 24.0% (<80 years) and at 10 years it is 40.4% and 32.3%, respectively (Table EK29 and Figure EK24).

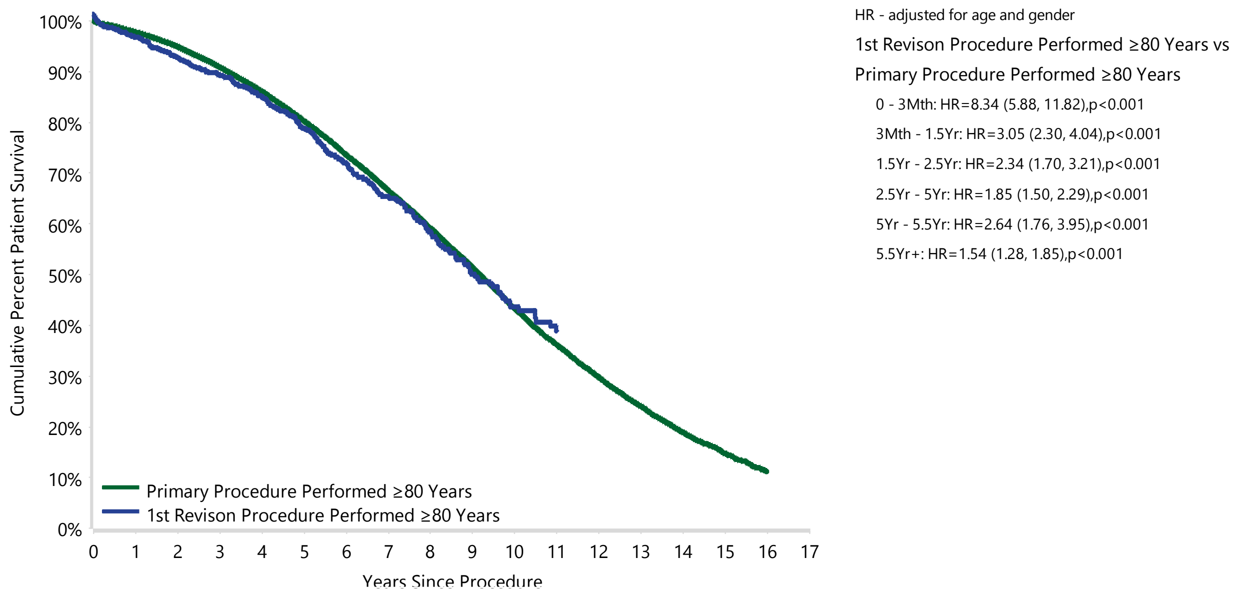
Patients aged ≥80 years are revised less often for all the major reasons for revision (Table EK30).

The types of second revision performed are similar when the two age groups are compared (Table EK31).

Table EK27 Cumulative Percent Survival of Patients with Primary Total Knee Replacement by Procedure Type (Primary Diagnosis OA)

Procedure Type	N Death	N Total	30 Days	90 Days	1 Yr	2 Yr	5 Yr	10 Yr
Primary Procedure Performed ≥80 Years	26746	71139	99.7 (99.6, 99.7)	99.3 (99.3, 99.4)	97.7 (97.5, 97.8)	94.7 (94.5, 94.9)	79.8 (79.4, 80.1)	42.3 (41.8, 42.9)
1st Revision Procedure Performed ≥80 Years	351	1381	98.6 (97.8, 99.1)	97.5 (96.5, 98.2)	95.4 (94.2, 96.4)	91.4 (89.7, 92.9)	77.5 (74.5, 80.2)	42.2 (36.6, 47.7)
TOTAL	**27097**	**72520**						

Figure EK20 Cumulative Percent Survival of Patients with Primary Total Knee Replacement by Procedure Type (Primary Diagnosis OA)

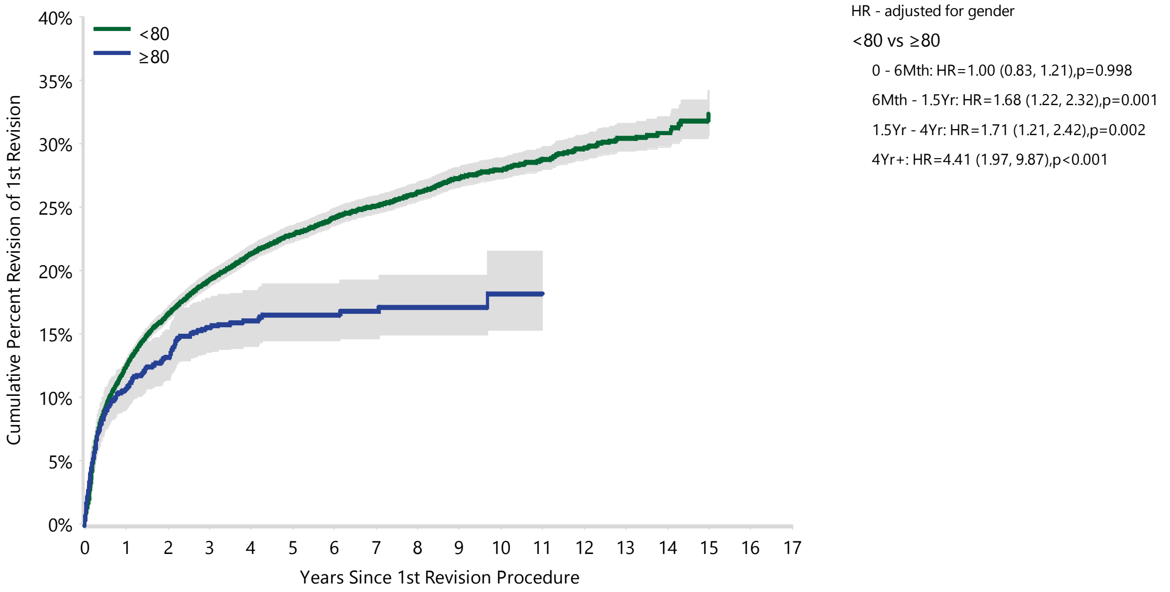


Number at Risk	0 Days	30 Days	90 Days	1 Yr	2 Yr	5 Yr	10 Yr
Primary Procedure Performed ≥80 Years	71139	70647	69373	63998	56964	35396	8833
1st Revision Procedure Performed ≥80 Years	1381	1352	1305	1129	921	457	69

Table EK28 Cumulative Percent Revision of 1st Revision of Primary Total Knee Replacement by Age (Primary Diagnosis OA)

Age	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<80	4473	20908	12.5 (12.1, 13.0)	16.6 (16.1, 17.2)	19.3 (18.8, 19.9)	22.9 (22.3, 23.6)	25.2 (24.5, 25.9)	28.1 (27.3, 28.9)
≥80	190	1297	10.8 (9.2, 12.7)	13.3 (11.5, 15.4)	15.6 (13.6, 17.9)	16.6 (14.5, 19.0)	16.9 (14.7, 19.3)	18.3 (15.4, 21.6)
TOTAL	**4663**	**22205**						

Figure EK21 Cumulative Percent Revision of 1st Revision of Primary Total Knee Replacement by Age (Primary Diagnosis OA)



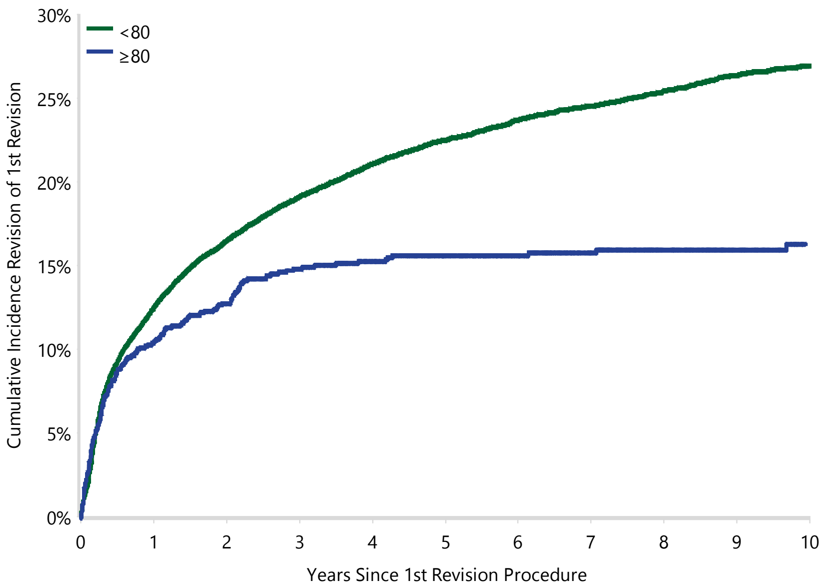
Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<80	20908	16185	13573	11367	7748	4880	2171
≥80	1297	994	826	687	440	241	67

Table EK29 Summary of Cumulative Incidence and Conditional Probability of 1st Revision of Primary Total Knee Replacement

Outcome	Age	1 Yrs	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
CIF(Alive, Unrevised)	<80	86.5%	81.4%	77.7%	71.5%	65.4%	56.5%
	≥80	84.3%	78.4%	72.6%	58.4%	44.1%	24.1%
CIF(Revision)	<80	12.5%	16.5%	19.1%	22.5%	24.6%	27.0%
	≥80	10.5%	12.8%	14.9%	15.7%	15.9%	16.4%
CIF(Mortality)	<80	1.1%	2.1%	3.1%	6.0%	10.0%	16.5%
	≥80	5.2%	8.8%	12.5%	25.9%	40.1%	59.5%
CP(Revised, if alive)	<80	12.6%	16.8%	19.8%	24.0%	27.3%	32.3%
	≥80	11.1%	14.1%	17.0%	21.2%	26.5%	40.4%

Note: CIF= Cumulative Incidence Function
CP= Conditional Probability

Figure EK22 Cumulative Incidence Revision of 1st Revision of Primary Total Knee Replacement by Age (Primary Diagnosis OA)



Number at Risk	1 Yrs	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<80	16185	13573	11367	7748	4880	2171
≥80	994	826	687	440	241	67

Figure EK23 Cumulative Incidence Function of 1st Revision of Primary Total Knee Replacement by Age (Primary Diagnosis OA)

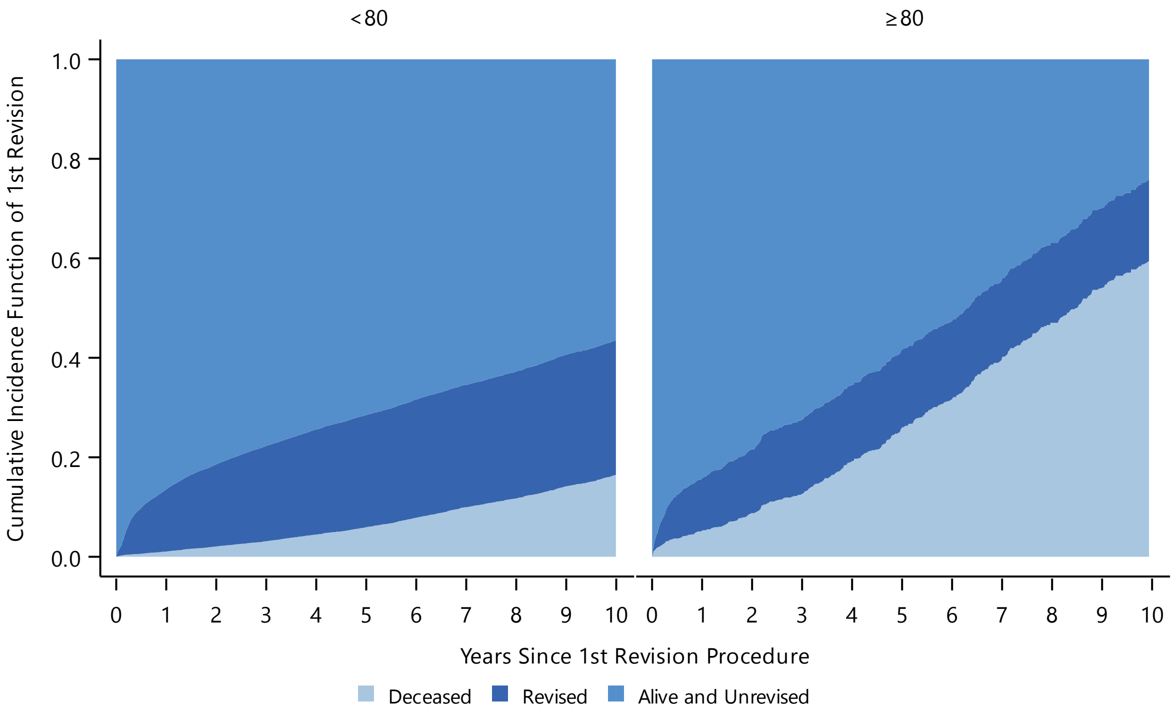
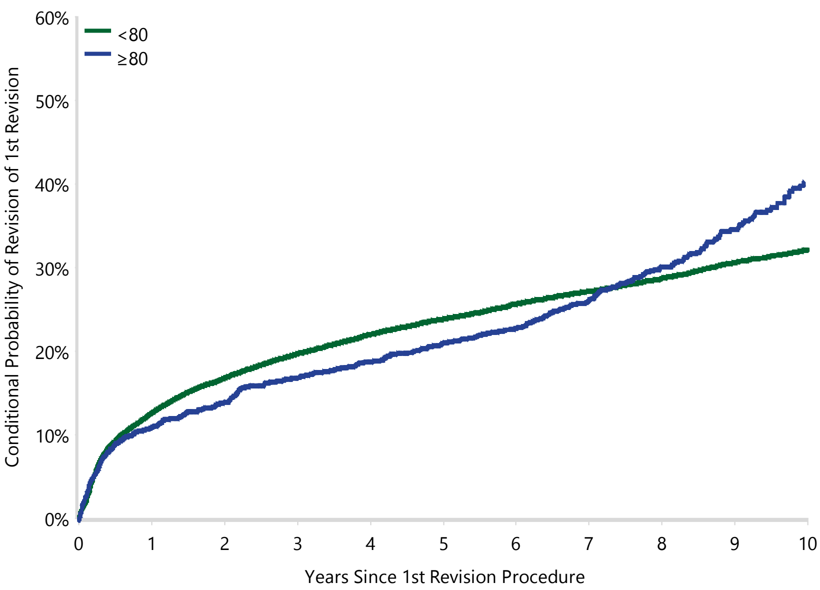


Figure EK24 Conditional Probability of Revision Since 1st Revision of Primary Total Knee Replacement by Age (Primary Diagnosis OA)



Number at Risk	1 Yrs	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<80	16185	13573	11367	7748	4880	2171
≥80	994	826	687	440	241	67

Table EK30 2nd Revision Diagnosis of Primary Total Knee Replacement by Age (Primary Diagnosis OA)

2nd Revision Diagnosis	<80			≥80		
	Number	% 1st Revisions Revised	% 2nd Revisions	Number	% 1st Revisions Revised	% 2nd Revisions
Infection	2382	11.4	53.3	123	9.5	64.7
Loosening	1019	4.9	22.8	27	2.1	14.2
Instability	249	1.2	5.6	9	0.7	4.7
Pain	224	1.1	5.0	7	0.5	3.7
Arthrofibrosis	103	0.5	2.3	3	0.2	1.6
Malalignment	75	0.4	1.7	3	0.2	1.6
Lysis	58	0.3	1.3	2	0.2	1.1
Patellofemoral Pain	58	0.3	1.3	3	0.2	1.6
Fracture	42	0.2	0.9	6	0.5	3.2
Metal Related Pathology	36	0.2	0.8	1	0.1	0.5
Other	227	1.1	5.1	6	0.5	3.2
N 2nd Revision	**4473**	**21.4**	**100.0**	**190**	**14.6**	**100.0**
N 1st Revision	**20908**			**1297**		

Table EK31 Type of 2nd Revision of Primary Total Knee Replacement by Age (Primary Diagnosis OA)

Type of 2nd Revision	<80			≥80		
	Number	% 1st Revisions Revised	% 2nd Revisions	Number	% 1st Revisions Revised	% 2nd Revisions
TKR (Tibial/Femoral)	2449	11.7	54.8	91	7.0	47.9
Insert Only	633	3.0	14.2	27	2.1	14.2
Cement Spacer	531	2.5	11.9	35	2.7	18.4
Femoral Component	278	1.3	6.2	8	0.6	4.2
Tibial Component	240	1.1	5.4	5	0.4	2.6
Patella Only	209	1.0	4.7	10	0.8	5.3
Insert/Patella	82	0.4	1.8	5	0.4	2.6
Removal of Prostheses	28	0.1	0.6	4	0.3	2.1
Minor Components	16	0.1	0.4	5	0.4	2.6
Cement Only	3	0.0	0.1			
Total Femoral	3	0.0	0.1			
Reinsertion of Components	1	0.0	0.0			
N 2nd Revision	**4473**	**21.4**	**100.0**	**190**	**14.6**	**100.0**
N 1st Revision	**20908**			**1297**		

Ten and Fifteen Year Prosthesis Outcomes

TEN YEAR OUTCOMES

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

This year, the number of individual combinations of femoral and acetabular hip prostheses with 10 year outcomes has increased by 3.8% and the number of individual combinations of femoral and tibial knee prostheses has increased by 7.1%.

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 81 femoral and acetabular combinations with 10 year outcome data. This is three more than last year. These prosthesis combinations have been used in 63.9% of all primary total conventional hip procedures performed for osteoarthritis reported to the Registry. Of these 81 combinations, 38 were not used in 2017. These 38 combinations account for 7.9% of all primary total conventional hip procedures.

The 10 year cumulative percent revision for the individual prosthesis combinations ranges from 1.9% to 46.1%. A commonly accepted benchmark standard is a 5% cumulative percent revision at 10 years. There are 33 (40.7%) 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 14 (17.3%) 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 12 prosthesis combinations can be benchmarked i.e. 26 (32.1%) 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 insufficient sample size, 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 TY1 Cumulative Percent Revision of Primary Total Conventional Hip Replacement Combinations with 10 Year Data (Primary Diagnosis OA)

Femoral Stem	Acetabular Component	N Revised	N Total	Type of Revision THR	Femoral	Acetabular	Other	2 Yrs	5 Yrs	10 Yrs
ABGII	ABGII	254	2762	34	126	64	30	2.5 (2.0, 3.1)	4.1 (3.4, 5.0)	6.9 (6.0, 7.9)
ABGII	ABGII (Shell/Insert)	61	847	11	35	11	4	1.8 (1.1, 2.9)	2.8 (1.9, 4.1)	6.5 (4.9, 8.6)
ABGII	Trident (Shell)	206	2415	11	126	25	44	3.3 (2.7, 4.1)	4.9 (4.1, 5.9)	8.7 (7.5, 10.0)
Accolade I	Mitch TRH* MoM	61	357	26	8	18	9	3.7 (2.1, 6.2)	10.3 (7.5, 14.0)	18.6 (14.6, 23.5)
Accolade I	Trident (Shell)	438	8557	51	171	84	132	2.4 (2.1, 2.7)	3.7 (3.4, 4.2)	5.6 (5.1, 6.2)
Adapter	Bionik* MoM	88	376	16	8	21	43	5.1 (3.3, 7.9)	15.3 (12.0, 19.5)	24.6 (20.4, 29.6)
Alloclassic	Allofit	243	4992	27	95	47	74	1.7 (1.4, 2.1)	2.8 (2.4, 3.3)	5.0 (4.3, 5.7)
Alloclassic	Durom* MoM	89	547	24	12	42	11	3.4 (2.1, 5.3)	7.4 (5.5, 10.0)	16.2 (13.1, 19.8)
Alloclassic	Fitmore*	119	1709	13	60	12	34	4.2 (3.4, 5.3)	5.6 (4.6, 6.9)	7.5 (6.2, 8.9)
Alloclassic	Metasul*	22	371	4	2	11	5	2.2 (1.1, 4.3)	3.6 (2.1, 6.1)	5.2 (3.3, 8.1)
Alloclassic	Trabecular Metal (Shell)	41	957	3	12	4	22	2.5 (1.7, 3.7)	4.0 (2.9, 5.5)	4.7 (3.4, 6.4)
Alloclassic	Trilogy	10	844	.	7	1	2	0.4 (0.1, 1.1)	0.5 (0.2, 1.3)	1.9 (1.0, 3.8)
Anthology	Reflection (Shell)	35	909	3	13	11	8	2.3 (1.5, 3.5)	3.1 (2.1, 4.5)	4.5 (3.2, 6.3)
Apex	Fin II*	41	923	4	8	17	12	2.3 (1.5, 3.5)	3.6 (2.5, 5.0)	5.6 (4.1, 7.7)
C-Stem	Duraloc*	77	894	10	20	13	34	2.8 (1.9, 4.2)	3.8 (2.7, 5.3)	6.9 (5.3, 9.0)
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	27	780	2	11	6	8	2.0 (1.2, 3.2)	2.8 (1.8, 4.3)	4.3 (2.8, 6.5)
C-Stem AMT	Pinnacle	48	2439	3	20	7	18	1.3 (0.9, 1.9)	2.6 (1.9, 3.6)	5.3 (3.1, 8.8)
CLS	Allofit	51	806	5	29	11	6	2.4 (1.5, 3.7)	3.8 (2.6, 5.4)	6.1 (4.5, 8.2)
CLS	Fitmore	47	748	5	22	7	13	2.8 (1.8, 4.3)	4.6 (3.2, 6.5)	6.2 (4.5, 8.4)
CPCS	Reflection (Cup)	59	737	21	2	23	13	1.4 (0.8, 2.6)	2.8 (1.8, 4.4)	8.6 (6.3, 11.8)
CPCS	Reflection (Shell)	73	2648	8	28	11	26	0.9 (0.6, 1.3)	1.6 (1.2, 2.2)	3.5 (2.7, 4.5)
CPT	Allofit	25	1125	3	11	.	11	1.0 (0.6, 1.9)	2.7 (1.8, 4.0)	3.0 (2.0, 4.6)
CPT	Trabecular Metal (Shell)	67	1481	5	29	10	23	2.7 (2.0, 3.7)	4.5 (3.4, 5.9)	7.1 (5.4, 9.3)
CPT	Trilogy	279	7255	27	89	33	130	2.2 (1.9, 2.6)	3.4 (2.9, 3.8)	4.9 (4.3, 5.6)
CPT	ZCA	30	809	10	6	8	6	0.9 (0.4, 1.9)	2.2 (1.4, 3.6)	4.7 (3.1, 7.0)
Charnley	Charnley Ogee*	59	630	35	8	4	12	2.1 (1.2, 3.6)	4.9 (3.5, 7.0)	8.8 (6.7, 11.6)
Charnley	Charnley*	41	563	31	7	3	.	0.9 (0.4, 2.2)	2.2 (1.3, 3.9)	6.5 (4.5, 9.1)
Charnley	Vitalock*	37	370	6	18	2	11	2.7 (1.5, 5.0)	4.4 (2.7, 7.1)	7.9 (5.5, 11.4)
Citation	Trident (Shell)*	48	1035	3	11	12	22	1.9 (1.3, 3.0)	3.3 (2.4, 4.6)	4.2 (3.1, 5.7)
Citation	Vitalock*	37	508	2	7	12	16	1.0 (0.4, 2.4)	2.0 (1.1, 3.7)	5.2 (3.5, 7.7)
Corail	ASR* MoM	1159	2653	206	37	870	46	5.1 (4.3, 6.0)	27.4 (25.7, 29.2)	46.1 (44.1, 48.1)
Corail	Duraloc*	74	1267	11	32	13	18	1.6 (1.0, 2.5)	2.5 (1.8, 3.6)	5.6 (4.3, 7.2)
Corail	Pinnacle	1169	38657	101	409	189	470	2.2 (2.0, 2.3)	3.2 (3.0, 3.4)	5.4 (5.0, 5.9)
Corail	Pinnacle* MoM	100	880	15	34	17	34	2.9 (1.9, 4.2)	6.1 (4.7, 8.0)	12.8 (10.5, 15.6)
Elite Plus	Duraloc*	100	953	14	59	6	21	2.2 (1.5, 3.4)	5.1 (3.9, 6.8)	8.9 (7.1, 11.1)
Epoch	Trilogy*	44	990	1	9	9	25	2.7 (1.9, 4.0)	3.6 (2.6, 4.9)	4.5 (3.3, 6.1)
Exeter	Contemporary*	37	427	9	7	13	8	2.9 (1.6, 5.0)	4.2 (2.6, 6.6)	6.0 (4.0, 8.9)
Exeter	Vitalock*	62	1076	9	11	24	18	2.0 (1.3, 3.0)	2.3 (1.5, 3.4)	4.5 (3.4, 6.1)
Exeter V40	ABGII	34	975	8	12	8	6	0.8 (0.4, 1.6)	1.6 (1.0, 2.7)	3.3 (2.3, 4.8)
Exeter V40	Contemporary	235	4450	55	40	109	31	2.2 (1.8, 2.6)	3.3 (2.8, 3.9)	5.8 (5.0, 6.7)

Femoral Stem	Acetabular Component	N Revised	N Total	Type of Revision: THR	Femoral	Acetabular	Other	2 Yrs	5 Yrs	10 Yrs
Exeter V40	Exeter Contemporary	129	2866	38	31	38	22	1.9 (1.4, 2.5)	3.0 (2.4, 3.7)	4.8 (3.9, 5.8)
Exeter V40	Exeter*	81	1526	16	14	34	17	1.3 (0.8, 2.0)	2.9 (2.1, 3.9)	4.6 (3.6, 5.9)
Exeter V40	Hemispherical	27	663	6	6	1	14	2.9 (1.9, 4.5)	3.4 (2.2, 5.1)	4.9 (3.2, 7.4)
Exeter V40	Mallory-Head	32	1386	3	20	2	7	0.7 (0.3, 1.3)	1.0 (0.6, 1.8)	2.6 (1.8, 3.9)
Exeter V40	Pinnacle	33	1460	1	14	8	10	1.6 (1.1, 2.4)	2.1 (1.4, 3.1)	5.0 (2.9, 8.5)
Exeter V40	Trident (Shell)	1241	50277	166	370	178	527	1.4 (1.3, 1.6)	2.2 (2.1, 2.4)	3.7 (3.5, 4.0)
Exeter V40	Trilogy*	18	516	2	5	2	9	2.3 (1.3, 4.1)	2.5 (1.5, 4.3)	3.9 (2.4, 6.4)
Exeter V40	Vitalock*	73	1795	15	21	22	15	1.4 (1.0, 2.1)	2.3 (1.7, 3.1)	3.2 (2.5, 4.2)
F2L	SPH-Blind*	57	571	9	19	15	14	3.9 (2.6, 5.8)	6.1 (4.4, 8.4)	7.6 (5.7, 10.2)
M/L Taper	Trilogy	21	743	.	4	6	11	1.2 (0.6, 2.3)	2.7 (1.7, 4.4)	3.9 (2.5, 6.0)
MS 30	Allofit	57	1522	9	18	18	12	1.3 (0.9, 2.1)	2.1 (1.5, 3.0)	3.8 (2.8, 5.2)
MS 30	Fitmore	21	606	1	4	7	9	0.9 (0.4, 2.1)	1.9 (1.0, 3.6)	2.8 (1.6, 4.9)
MS 30	Low Profile Cup	17	599	6	2	7	2	0.5 (0.2, 1.6)	1.3 (0.6, 2.8)	2.7 (1.5, 4.8)
Mallory-Head	Mallory-Head	162	2901	13	13	53	83	2.1 (1.6, 2.7)	3.0 (2.4, 3.7)	4.9 (4.1, 5.8)
Mallory-Head	Recap* MoM	27	395	6	.	19	2	1.3 (0.5, 3.0)	2.6 (1.4, 4.7)	6.3 (4.2, 9.4)
Meridian	Vitalock*	32	354	2	2	13	15	1.4 (0.6, 3.4)	3.5 (2.0, 6.1)	6.7 (4.4, 10.0)
Natural Hip	Allofit*	11	529	.	3	3	5	0.9 (0.4, 2.3)	1.1 (0.5, 2.5)	2.1 (1.1, 3.9)
Natural Hip	Fitmore*	37	882	2	6	12	17	0.9 (0.5, 1.8)	2.0 (1.3, 3.2)	4.2 (3.0, 5.9)
Omnifit	Secur-Fit*	78	716	8	21	17	32	3.7 (2.5, 5.3)	6.2 (4.6, 8.2)	9.9 (7.9, 12.5)
Omnifit	Trident (Shell)	138	3686	12	32	22	72	2.2 (1.8, 2.7)	3.0 (2.5, 3.6)	3.8 (3.2, 4.6)
Quadra-H	Versafitcup CC	379	13334	29	155	95	100	2.1 (1.9, 2.4)	3.1 (2.8, 3.5)	7.7 (5.4, 11.0)
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	114	2321	9	67	11	27	2.8 (2.2, 3.6)	4.2 (3.4, 5.1)	5.7 (4.7, 6.8)
SL-Plus	EP-Fit Plus	109	2074	5	48	20	36	2.0 (1.5, 2.7)	3.5 (2.8, 4.4)	5.6 (4.6, 6.7)
Secur-Fit	Trident (Shell)	347	8916	22	153	63	109	2.3 (2.0, 2.7)	3.4 (3.0, 3.8)	4.6 (4.1, 5.1)
Secur-Fit Plus	Trident (Shell)	164	5457	13	43	38	70	1.5 (1.2, 1.9)	2.2 (1.8, 2.6)	3.1 (2.7, 3.7)
Spectron EF	BHR* MoM	57	430	10	.	43	4	2.6 (1.4, 4.6)	6.0 (4.1, 8.8)	15.7 (12.1, 20.4)
Spectron EF	Reflection (Cup)	112	1400	41	10	52	9	1.3 (0.8, 2.1)	2.9 (2.1, 3.9)	7.3 (5.8, 9.1)
Spectron EF	Reflection (Shell)	262	4600	57	85	40	80	1.4 (1.1, 1.8)	2.7 (2.2, 3.2)	5.4 (4.7, 6.2)
Stability	Duraloc*	47	374	2	9	13	23	1.3 (0.6, 3.2)	2.2 (1.1, 4.3)	8.9 (6.3, 12.5)
Summit	ASR* MoM	448	1041	15	6	405	22	3.0 (2.1, 4.2)	19.7 (17.4, 22.3)	44.2 (41.1, 47.5)
Summit	Pinnacle	109	4398	7	24	16	62	1.8 (1.4, 2.2)	2.3 (1.8, 2.8)	3.3 (2.6, 4.2)
Summit	Pinnacle* MoM	64	730	4	5	12	43	1.7 (0.9, 2.9)	3.4 (2.3, 5.0)	8.8 (6.8, 11.2)
Synergy	BHR* MoM	83	698	4	6	50	23	2.7 (1.8, 4.2)	4.8 (3.4, 6.7)	12.2 (9.8, 15.2)
Synergy	Reflection (Shell)	311	7358	27	63	101	120	2.0 (1.7, 2.4)	2.6 (2.2, 3.0)	3.9 (3.4, 4.4)
Synergy	Trident (Shell)*	14	438	.	3	5	6	1.2 (0.5, 2.7)	1.9 (0.9, 3.7)	4.1 (2.3, 7.3)
Taperloc	M2a* MoM	59	471	11	2	41	5	2.6 (1.5, 4.5)	6.9 (4.9, 9.6)	12.3 (9.5, 15.8)
Taperloc	Mallory-Head	73	1807	6	15	27	25	2.2 (1.6, 3.1)	3.1 (2.3, 4.1)	5.5 (4.2, 7.2)
Taperloc	Recap* MoM	43	456	10	5	21	7	2.4 (1.4, 4.4)	5.6 (3.8, 8.2)	10.0 (7.5, 13.4)
VerSys	Trilogy	218	4398	14	77	38	89	3.0 (2.5, 3.5)	3.8 (3.3, 4.5)	5.0 (4.4, 5.8)
TOTAL		**11078**	**237306**	**1447**	**3045**	**3368**	**3218**			

Note: Only prostheses with over 350 procedures have been listed
* Denotes prosthesis combinations with no reported use in primary total conventional hip procedures in 2017
MoM refers to metal/metal 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 60 total knee replacement combinations with 10 year outcome data; 4 more than last year. These prosthesis combinations were used in 84.3% of all primary total knee replacement procedures performed for osteoarthritis reported to the Registry. Of these 60 prosthesis combinations, 22 were not used in 2017. These 22 combinations account for 10.7% of all primary total knee procedures.

The 10 year cumulative percent revision ranges from 3.0% to 13.3%. There are 18 (30.0%) 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 7 (11.7%) knee prosthesis combinations which would qualify for a superiority benchmark (highlighted in green) and 19 (43.3%) prosthesis combinations which 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 insufficient sample size, 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	Type of Revision: Femoral	Type of Revision: Tibial	Type of Revision: Other	2 Yrs	5 Yrs	10 Yrs
AGC	AGC*	264	5026	103	5	25	131	1.7 (1.4, 2.1)	3.2 (2.7, 3.7)	5.0 (4.4, 5.7)
Active Knee	Active Knee	591	9057	162	27	37	365	2.5 (2.2, 2.9)	4.9 (4.4, 5.4)	8.2 (7.5, 8.9)
Advance	Advance	41	829	13	2	8	18	3.8 (2.6, 5.5)	4.9 (3.5, 6.9)	9.4 (5.8, 15.0)
Advance	Advance II	104	1604	40	2	13	49	3.6 (2.8, 4.7)	5.1 (4.1, 6.3)	7.2 (5.9, 8.7)
Advantim	Advantim*	64	1454	30	3	3	28	1.7 (1.1, 2.5)	3.1 (2.3, 4.2)	4.8 (3.7, 6.3)
BalanSys	BalanSys	47	2753	9	3	4	31	1.1 (0.8, 1.7)	2.2 (1.6, 3.2)	4.8 (3.2, 7.3)
Buechel-Pappas	Buechel-Pappas*	43	467	12	2	2	27	4.3 (2.8, 6.6)	8.1 (5.9, 11.0)	10.1 (7.5, 13.6)
Columbus	Columbus	98	1521	30	4	5	59	4.0 (3.0, 5.2)	7.3 (5.9, 9.0)	10.9 (8.8, 13.4)
Duracon	Duracon*	1118	19828	276	29	67	746	2.1 (1.9, 2.3)	3.5 (3.2, 3.7)	5.1 (4.8, 5.5)
Genesis II CR	Genesis II	843	22172	158	60	54	571	2.0 (1.8, 2.2)	3.4 (3.2, 3.7)	4.7 (4.4, 5.1)
Genesis II CR	Profix Mobile*	107	1209	43	9	7	48	2.7 (1.9, 3.8)	5.4 (4.2, 6.8)	8.1 (6.5, 9.9)
Genesis II Oxinium CR (ctd)	Genesis II	396	8093	71	24	22	279	1.9 (1.6, 2.2)	3.7 (3.2, 4.1)	6.3 (5.7, 7.0)
Genesis II Oxinium PS (ctd)	Genesis II	910	16912	98	30	141	641	3.0 (2.7, 3.3)	5.3 (5.0, 5.7)	7.8 (7.3, 8.4)
Genesis II PS	Genesis II	696	17407	108	27	50	511	2.2 (1.9, 2.4)	3.8 (3.5, 4.1)	5.4 (5.0, 5.8)
Journey Oxinium	Journey*	271	2975	45	5	29	192	3.4 (2.8, 4.1)	6.6 (5.7, 7.5)	11.6 (10.2, 13.2)
Kinemax Plus	Kinemax Plus*	118	1815	67	3	5	43	1.8 (1.3, 2.6)	3.2 (2.4, 4.1)	4.6 (3.7, 5.8)
LCS CR	LCS	580	8305	236	23	86	235	2.5 (2.1, 2.8)	4.4 (4.0, 4.9)	6.3 (5.8, 6.9)
LCS CR	MBT	977	27887	311	44	127	495	1.9 (1.7, 2.1)	3.5 (3.2, 3.7)	4.9 (4.6, 5.3)
LCS CR	MBT Duofix	652	14084	175	29	39	409	2.7 (2.4, 3.0)	4.1 (3.7, 4.4)	5.3 (4.9, 5.8)

Femoral Component	Tibial Component	N Revised	N Total	Type of Revision				2 Yrs	5 Yrs	10 Yrs
				TKR	Femoral	Tibial	Other			
LCS Duofix	MBT Duofix*	460	3606	333	27	7	93	3.7 (3.2, 4.4)	10.2 (9.2, 11.2)	13.3 (12.2, 14.5)
LCS Duofix	MBT*	127	1169	89	10	2	26	3.3 (2.4, 4.5)	8.0 (6.6, 9.8)	11.6 (9.8, 13.7)
MBK (Zimmer)	Nexgen*	32	448	17	1	1	13	2.3 (1.2, 4.1)	4.1 (2.6, 6.5)	5.9 (4.0, 8.6)
Maxim	Maxim*	185	2447	59	15	12	99	2.3 (1.8, 3.0)	3.9 (3.2, 4.8)	6.0 (5.1, 7.1)
Natural Knee II	Natural Knee II*	375	6443	157	9	58	151	1.6 (1.4, 2.0)	2.8 (2.4, 3.2)	5.2 (4.7, 5.9)
Nexgen CR	Nexgen	362	11200	115	15	31	201	1.2 (1.0, 1.4)	2.1 (1.9, 2.4)	3.1 (2.8, 3.5)
Nexgen CR	Nexgen TM CR	47	809	14	3	10	20	2.5 (1.6, 3.9)	5.5 (4.1, 7.4)	6.4 (4.8, 8.5)
Nexgen CR Flex	Nexgen	955	47953	196	73	98	588	1.4 (1.3, 1.5)	2.3 (2.1, 2.5)	3.1 (2.8, 3.3)
Nexgen CR Flex	Nexgen TM CR	232	10286	64	19	26	123	1.3 (1.1, 1.5)	2.3 (2.0, 2.6)	3.2 (2.8, 3.7)
Nexgen LCCK	Nexgen	29	714	2	3	.	24	3.2 (2.0, 4.9)	5.1 (3.5, 7.5)	5.1 (3.5, 7.5)
Nexgen LPS	Nexgen	309	6755	75	19	32	183	1.9 (1.6, 2.2)	3.2 (2.8, 3.7)	4.9 (4.4, 5.6)
Nexgen LPS	Nexgen TM LPS	27	1203	7	2	5	13	1.1 (0.6, 1.9)	2.6 (1.7, 3.8)	3.0 (2.0, 4.4)
Nexgen LPS Flex	Nexgen	1146	32785	289	57	192	608	1.7 (1.6, 1.9)	3.2 (3.0, 3.4)	5.3 (5.0, 5.6)
Nexgen LPS Flex	Nexgen TM LPS	50	1485	24	4	5	17	2.0 (1.4, 2.8)	3.3 (2.5, 4.4)	3.9 (2.9, 5.1)
Optetrak-CR	Optetrak*	39	504	12	2	4	21	3.2 (2.0, 5.2)	5.9 (4.1, 8.4)	8.4 (6.1, 11.6)
Optetrak-PS	Optetrak	198	2359	68	4	26	100	3.4 (2.7, 4.2)	6.2 (5.3, 7.3)	9.7 (8.4, 11.2)
Optetrak-PS	Optetrak RBK	71	1024	17	2	3	49	3.0 (2.1, 4.3)	6.3 (4.9, 8.2)	9.7 (7.6, 12.3)
PFC Sigma CR	AMK Duofix*	57	1890	18	.	1	38	1.2 (0.8, 1.8)	2.3 (1.7, 3.1)	3.0 (2.3, 4.0)
PFC Sigma CR	MBT	278	5872	47	31	43	157	2.7 (2.3, 3.2)	4.0 (3.5, 4.6)	5.2 (4.6, 5.9)
PFC Sigma CR	MBT Duofix	127	2768	15	17	3	92	2.9 (2.3, 3.7)	4.1 (3.4, 5.0)	5.8 (4.8, 7.1)
PFC Sigma CR	PFC Sigma	670	23240	142	47	57	424	1.5 (1.3, 1.6)	2.4 (2.2, 2.6)	3.5 (3.2, 3.8)
PFC Sigma PS	MBT	273	6232	80	13	19	161	2.1 (1.7, 2.5)	3.7 (3.3, 4.2)	5.2 (4.6, 5.9)
PFC Sigma PS	MBT Duofix	143	2056	23	4	6	110	3.7 (3.0, 4.7)	6.8 (5.7, 8.1)	8.9 (7.6, 10.5)
PFC Sigma PS	PFC Sigma	295	7546	91	10	24	170	1.9 (1.6, 2.3)	3.3 (2.9, 3.8)	4.8 (4.2, 5.4)
Profix	Profix Mobile*	102	986	31	6	5	60	5.1 (3.9, 6.7)	8.2 (6.6, 10.1)	9.8 (8.0, 11.9)
Profix	Profix*	273	5370	62	13	18	180	2.3 (1.9, 2.8)	3.8 (3.3, 4.3)	5.3 (4.7, 5.9)
Profix Oxinium (ctd)	Profix*	93	1049	20	4	14	55	4.1 (3.1, 5.5)	7.0 (5.6, 8.7)	8.6 (7.0, 10.5)
RBK	RBK	446	10187	167	11	36	232	2.4 (2.1, 2.7)	4.0 (3.6, 4.4)	5.5 (5.0, 6.1)
Rocc	Rocc*	37	575	12	1	2	22	3.3 (2.1, 5.2)	5.2 (3.6, 7.3)	6.8 (5.0, 9.3)
Rotaglide Plus	Rotaglide Plus*	71	616	31	1	5	34	3.3 (2.2, 5.1)	5.8 (4.1, 8.0)	11.2 (8.8, 14.2)
Scorpio CR	Scorpio+*	174	2448	40	10	26	98	2.0 (1.5, 2.7)	4.3 (3.6, 5.2)	6.9 (6.0, 8.1)
Scorpio CR	Series 7000	539	11561	129	26	44	340	1.8 (1.6, 2.1)	3.4 (3.0, 3.7)	5.3 (4.8, 5.8)
Scorpio NRG CR	Series 7000	144	5032	34	11	13	86	1.9 (1.6, 2.4)	2.9 (2.4, 3.5)	4.5 (3.7, 5.4)
Scorpio NRG PS	Series 7000	147	3900	23	7	19	98	2.0 (1.6, 2.5)	3.8 (3.2, 4.4)	4.7 (3.9, 5.6)
Scorpio PS	Scorpio*	33	524	8	.	11	14	2.1 (1.2, 3.8)	4.5 (3.0, 6.7)	6.1 (4.3, 8.7)
Scorpio PS	Scorpio+*	141	2036	36	14	10	81	2.7 (2.1, 3.5)	5.1 (4.2, 6.2)	6.8 (5.7, 8.0)
Scorpio PS	Series 7000	313	4693	103	8	63	139	2.6 (2.2, 3.1)	4.7 (4.1, 5.3)	6.9 (6.1, 7.7)
Triathlon CR	Triathlon	1465	70145	230	69	79	1087	1.5 (1.4, 1.6)	2.5 (2.4, 2.7)	3.8 (3.5, 4.1)
Triathlon PS	Triathlon	377	10464	64	24	46	243	2.5 (2.2, 2.8)	4.0 (3.6, 4.4)	5.6 (4.9, 6.4)
Vanguard CR	Maxim	460	17706	102	21	41	296	1.7 (1.5, 1.9)	3.1 (2.8, 3.4)	4.6 (4.0, 5.3)
Vanguard PS	Maxim	236	4559	51	7	49	129	3.5 (3.0, 4.1)	5.5 (4.8, 6.3)	7.3 (6.2, 8.6)
TOTAL		**19458**	**496043**	**5084**	**951**	**1870**	**11553**			

Note: Only prostheses with over 350 procedures have been listed
*Denotes prosthesis combinations with no reported use in primary total knee procedures in 2017
CR 'cruciate retaining' refers to minimally stabilised
Green: prostheses combination qualifies for superiority benchmark. Blue: prostheses combination qualifies for inferiority benchmark

FIFTEEN YEAR OUTCOMES

This year, the Registry is reporting 15 year outcomes for 47 hip and 35 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 40.7% of all primary total conventional hip replacement procedures performed for osteoarthritis. Of the 47 combinations, 21 had no reported use in 2017.

The 15 year cumulative percent revision ranges from 2.5% to 16.6%. There are 16 combinations which have a cumulative percent revision of less than 6.5% and six with less than 5%. These are indicated in bold text in Table FY1.

KNEE REPLACEMENT

The listed prosthesis combinations were used in 48.7% of all primary total knee replacement procedures performed for osteoarthritis. Of the 35 combinations, 15 had no reported use in 2017.

The 15 year cumulative percent revision ranges from 4.4% to 14.3%. Seven of the combinations have a cumulative percent revision of less than 6.5% and two 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 Stem	Acetabular Component	N Revised	N Total	Type of Revision: THR	Type of Revision: Femoral	Type of Revision: Acetabular	Type of Revision: Other	5 Yrs	10 Yrs	15 Yrs
ABGII	ABGII	254	2762	34	126	64	30	4.1 (3.4, 5.0)	6.9 (6.0, 7.9)	11.6 (10.2, 13.1)
ABGII	Trident (Shell)	206	2415	11	126	25	44	4.9 (4.1, 5.9)	8.7 (7.5, 10.0)	14.0 (11.8, 16.6)
Accolade I	Trident (Shell)	438	8557	51	171	84	132	3.7 (3.4, 4.2)	5.6 (5.1, 6.2)	7.3 (6.4, 8.4)
Alloclassic	Allofit	243	4992	27	95	47	74	2.8 (2.4, 3.3)	5.0 (4.3, 5.7)	8.7 (7.4, 10.3)
Alloclassic	Fitmore*	119	1709	13	60	12	34	5.6 (4.6, 6.9)	7.5 (6.2, 8.9)	8.9 (7.1, 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*	77	894	10	20	13	34	3.8 (2.7, 5.3)	6.9 (5.3, 9.0)	13.0 (10.2, 16.6)
CLS	Allofit	51	806	5	29	11	6	3.8 (2.6, 5.4)	6.1 (4.5, 8.2)	10.4 (7.3, 14.8)
CLS	Fitmore	47	748	5	22	7	13	4.6 (3.2, 6.5)	6.2 (4.5, 8.4)	9.5 (7.0, 12.8)
CPCS	**Reflection (Shell)**	**73**	**2648**	**8**	**28**	**11**	**26**	**1.6 (1.2, 2.2)**	**3.5 (2.7, 4.5)**	**5.2 (3.8, 7.2)**
CPT	**Trilogy**	**279**	**7255**	**27**	**89**	**33**	**130**	**3.4 (2.9, 3.8)**	**4.9 (4.3, 5.6)**	**6.2 (5.3, 7.2)**
CPT	ZCA	30	809	10	6	8	6	2.2 (1.4, 3.6)	4.7 (3.1, 7.0)	6.9 (4.5, 10.5)
Charnley	Charnley Ogee*	59	630	35	8	4	12	4.9 (3.5, 7.0)	8.8 (6.7, 11.6)	14.1 (10.7, 18.4)
Charnley	Charnley*	41	563	31	7	3	.	2.2 (1.3, 3.9)	6.5 (4.5, 9.1)	11.6 (8.3, 16.0)
Charnley	Vitalock*	37	370	6	18	2	11	4.4 (2.7, 7.1)	7.9 (5.5, 11.4)	11.8 (8.5, 16.0)
Citation	**Trident (Shell)***	**48**	**1035**	**3**	**11**	**12**	**22**	**3.3 (2.4, 4.6)**	**4.2 (3.1, 5.7)**	**6.0 (4.4, 8.3)**
Citation	Vitalock*	37	508	2	7	12	16	2.0 (1.1, 3.7)	5.2 (3.5, 7.7)	9.3 (6.7, 12.8)
Corail	Duraloc*	74	1267	11	32	13	18	2.5 (1.8, 3.6)	5.6 (4.3, 7.2)	10.6 (8.1, 13.8)
Elite Plus	Duraloc*	100	953	14	59	6	21	5.1 (3.9, 6.8)	8.9 (7.1, 11.1)	14.8 (12.2, 18.0)
Exeter	Contemporary*	37	427	9	7	13	8	4.2 (2.6, 6.6)	6.0 (4.0, 8.9)	12.5 (9.0, 17.3)
Exeter	Vitalock*	62	1076	9	11	24	18	2.3 (1.5, 3.4)	4.5 (3.4, 6.1)	6.7 (5.2, 8.6)
Exeter V40	**ABGII**	**34**	**975**	**8**	**12**	**8**	**6**	**1.6 (1.0, 2.7)**	**3.3 (2.3, 4.8)**	**4.5 (3.2, 6.3)**
Exeter V40	Contemporary	235	4450	55	40	109	31	3.3 (2.8, 3.9)	5.8 (5.0, 6.7)	9.2 (7.8, 10.9)
Exeter V40	Exeter Contemporary	129	2866	38	31	38	22	3.0 (2.4, 3.7)	4.8 (3.9, 5.8)	9.9 (6.9, 14.1)
Exeter V40	Exeter*	81	1526	16	14	34	17	2.9 (2.1, 3.9)	4.6 (3.6, 5.9)	9.2 (7.1, 11.9)

Femoral Stem	Acetabular Component	N Revised	N Total	Type of Revision: THR	Femoral	Acetabular	Other	5 Yrs	10 Yrs	15 Yrs
Exeter V40	**Mallory-Head**	**32**	**1386**	**3**	**20**	**2**	**7**	**1.0 (0.6, 1.8)**	**2.6 (1.8, 3.9)**	**4.1 (2.8, 6.0)**
Exeter V40	**Trident (Shell)**	**1241**	**50277**	**166**	**370**	**178**	**527**	**2.2 (2.1, 2.4)**	**3.7 (3.5, 4.0)**	**5.1 (4.6, 5.6)**
Exeter V40	**Vitalock***	**73**	**1795**	**15**	**21**	**22**	**15**	**2.3 (1.7, 3.1)**	**3.2 (2.5, 4.2)**	**4.8 (3.8, 6.1)**
F2L	SPH-Blind*	57	571	9	19	15	14	6.1 (4.4, 8.4)	7.6 (5.7, 10.2)	11.6 (8.9, 15.0)
MS 30	Allofit	57	1522	9	18	18	12	2.1 (1.5, 3.0)	3.8 (2.8, 5.2)	9.2 (5.9, 14.2)
MS 30	Fitmore	21	606	1	4	7	9	1.9 (1.0, 3.6)	2.8 (1.6, 4.9)	6.6 (4.0, 10.7)
MS 30	**Low Profile Cup**	**17**	**599**	**6**	**2**	**7**	**2**	**1.3 (0.6, 2.8)**	**2.7 (1.5, 4.8)**	**4.2 (2.4, 7.3)**
Mallory-Head	Mallory-Head	162	2901	13	13	53	83	3.0 (2.4, 3.7)	4.9 (4.1, 5.8)	9.4 (7.9, 11.3)
Meridian	Vitalock*	32	354	2	2	13	15	3.5 (2.0, 6.1)	6.7 (4.4, 10.0)	10.3 (7.3, 14.4)
Natural Hip	**Allofit***	**11**	**529**	**.**	**3**	**3**	**5**	**1.1 (0.5, 2.5)**	**2.1 (1.1, 3.9)**	**2.5 (1.4, 4.6)**
Natural Hip	**Fitmore***	**37**	**882**	**2**	**6**	**12**	**17**	**2.0 (1.3, 3.2)**	**4.2 (3.0, 5.9)**	**5.0 (3.6, 7.0)**
Omnifit	Secur-Fit*	78	716	8	21	17	32	6.2 (4.6, 8.2)	9.9 (7.9, 12.5)	12.9 (10.4, 16.0)
Omnifit	**Trident (Shell)**	**138**	**3686**	**12**	**32**	**22**	**72**	**3.0 (2.5, 3.6)**	**3.8 (3.2, 4.6)**	**5.5 (4.5, 6.7)**
S-Rom	**Duraloc Option***	**25**	**523**	**4**	**9**	**5**	**7**	**3.3 (2.1, 5.2)**	**4.6 (3.1, 6.8)**	**5.1 (3.5, 7.5)**
Secur-Fit	**Trident (Shell)**	**347**	**8916**	**22**	**153**	**63**	**109**	**3.4 (3.0, 3.8)**	**4.6 (4.1, 5.1)**	**6.0 (5.2, 7.0)**
Secur-Fit Plus	**Trident (Shell)**	**164**	**5457**	**13**	**43**	**38**	**70**	**2.2 (1.8, 2.6)**	**3.1 (2.7, 3.7)**	**4.3 (3.6, 5.1)**
Spectron EF	Reflection (Cup)	112	1400	41	10	52	9	2.9 (2.1, 3.9)	7.3 (5.8, 9.1)	16.6 (13.4, 20.5)
Spectron EF	Reflection (Shell)	262	4600	57	85	40	80	2.7 (2.2, 3.2)	5.4 (4.7, 6.2)	10.4 (9.0, 12.1)
Stability	Duraloc*	47	374	2	9	13	23	2.2 (1.1, 4.3)	8.9 (6.3, 12.5)	15.9 (12.0, 21.0)
Synergy	**Reflection (Shell)**	**311**	**7358**	**27**	**63**	**101**	**120**	**2.6 (2.2, 3.0)**	**3.9 (3.4, 4.4)**	**5.9 (5.1, 6.7)**
Taperloc	Mallory-Head	73	1807	6	15	27	25	3.1 (2.3, 4.1)	5.5 (4.2, 7.2)	8.8 (6.4, 12.0)
VerSys	**Trilogy**	**218**	**4398**	**14**	**77**	**38**	**89**	**3.8 (3.3, 4.5)**	**5.0 (4.4, 5.8)**	**5.7 (5.0, 6.5)**
TOTAL		**6328**	**151269**	**874**	**2026**	**1350**	**2078**			

Note: Only prostheses with over 350 procedures have been listed
* denotes prosthesis combinations that have not had any reported use in primary total conventional hip procedures in 2017

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	Type of Revision TKR	Femoral	Tibial	Other	5 Yrs	10 Yrs	15 Yrs
AGC	AGC*	264	5026	103	5	25	131	3.2 (2.7, 3.7)	5.0 (4.4, 5.7)	7.6 (6.6, 8.7)
Active Knee	Active Knee	591	9057	162	27	37	365	4.9 (4.4, 5.4)	8.2 (7.5, 8.9)	12.3 (10.9, 13.8)
Advance	Advance II	104	1604	40	2	13	49	5.1 (4.1, 6.3)	7.2 (5.9, 8.7)	7.9 (6.4, 9.7)
Advantim	Advantim*	64	1454	30	3	3	28	3.1 (2.3, 4.2)	4.8 (3.7, 6.3)	6.3 (4.7, 8.5)
Duracon	Duracon*	1118	19828	276	29	67	746	3.5 (3.2, 3.7)	5.1 (4.8, 5.5)	7.4 (6.9, 7.9)
Genesis II CR	Genesis II	843	22172	158	60	54	571	3.4 (3.2, 3.7)	4.7 (4.4, 5.1)	6.0 (5.4, 6.5)
Genesis II CR	Profix Mobile*	107	1209	43	9	7	48	5.4 (4.2, 6.8)	8.1 (6.5, 9.9)	11.2 (9.2, 13.7)
Genesis II Oxinium CR (ctd)	Genesis II	396	8093	71	24	22	279	3.7 (3.2, 4.1)	6.3 (5.7, 7.0)	10.1 (8.6, 11.8)
Genesis II PS	Genesis II	696	17407	108	27	50	511	3.8 (3.5, 4.1)	5.4 (5.0, 5.8)	6.6 (5.9, 7.4)
Kinemax Plus	Kinemax Plus*	118	1815	67	3	5	43	3.2 (2.4, 4.1)	4.6 (3.7, 5.8)	8.4 (7.0, 10.1)
LCS CR	LCS	580	8305	236	23	86	235	4.4 (4.0, 4.9)	6.3 (5.8, 6.9)	7.9 (7.3, 8.6)
LCS CR	MBT	977	27887	311	44	127	495	3.5 (3.2, 3.7)	4.9 (4.6, 5.3)	6.1 (5.5, 6.9)
LCS CR	MBT Duofix	652	14084	175	29	39	409	4.1 (3.7, 4.4)	5.3 (4.9, 5.8)	7.5 (6.7, 8.5)
MBK (Zimmer)	Nexgen*	32	448	17	1	1	13	4.1 (2.6, 6.5)	5.9 (4.0, 8.6)	8.0 (5.6, 11.3)
Maxim	Maxim*	185	2447	59	15	12	99	3.9 (3.2, 4.8)	6.0 (5.1, 7.1)	11.1 (9.4, 13.1)
Natural Knee II	Natural Knee II*	375	6443	157	9	58	151	2.8 (2.4, 3.2)	5.2 (4.7, 5.9)	9.6 (8.5, 10.8)
Nexgen CR	**Nexgen**	**362**	**11200**	**115**	**15**	**31**	**201**	**2.1 (1.9, 2.4)**	**3.1 (2.8, 3.5)**	**4.6 (4.1, 5.2)**
Nexgen LPS	Nexgen	309	6755	75	19	32	183	3.2 (2.8, 3.7)	4.9 (4.4, 5.6)	6.7 (5.8, 7.6)
Nexgen LPS Flex	Nexgen	1146	32785	289	57	192	608	3.2 (3.0, 3.4)	5.3 (5.0, 5.6)	8.5 (6.9, 10.3)
Optetrak-CR	Optetrak*	39	504	12	2	4	21	5.9 (4.1, 8.4)	8.4 (6.1, 11.6)	11.4 (7.7, 16.7)
Optetrak-PS	Optetrak	198	2359	68	4	26	100	6.2 (5.3, 7.3)	9.7 (8.4, 11.2)	11.5 (9.9, 13.5)
PFC Sigma CR	**AMK Duofix***	**57**	**1890**	**18**	**.**	**1**	**38**	**2.3 (1.7, 3.1)**	**3.0 (2.3, 4.0)**	**4.4 (3.1, 6.2)**
PFC Sigma CR	MBT	278	5872	47	31	43	157	4.0 (3.5, 4.6)	5.2 (4.6, 5.9)	7.4 (6.0, 9.0)
PFC Sigma CR	MBT Duofix	127	2768	15	17	3	92	4.1 (3.4, 5.0)	5.8 (4.8, 7.1)	8.5 (6.5, 11.0)
PFC Sigma CR	PFC Sigma	670	23240	142	47	57	424	2.4 (2.2, 2.6)	3.5 (3.2, 3.8)	5.7 (5.0, 6.5)
PFC Sigma PS	MBT	273	6232	80	13	19	161	3.7 (3.3, 4.2)	5.2 (4.6, 5.9)	6.5 (5.5, 7.7)
PFC Sigma PS	PFC Sigma	295	7546	91	10	24	170	3.3 (2.9, 3.8)	4.8 (4.2, 5.4)	7.4 (6.2, 8.8)
Profix	Profix Mobile*	102	986	31	6	5	60	8.2 (6.6, 10.1)	9.8 (8.0, 11.9)	11.7 (9.6, 14.2)
Profix	Profix*	273	5370	62	13	18	180	3.8 (3.3, 4.3)	5.3 (4.7, 5.9)	6.0 (5.2, 6.9)
RBK	RBK	446	10187	167	11	36	232	4.0 (3.6, 4.4)	5.5 (5.0, 6.1)	7.9 (6.6, 9.5)
Rotaglide Plus	Rotaglide Plus*	71	616	31	1	5	34	5.8 (4.1, 8.0)	11.2 (8.8, 14.2)	14.3 (11.3, 17.9)
Scorpio CR	Scorpio+*	174	2448	40	10	26	98	4.3 (3.6, 5.2)	6.9 (6.0, 8.1)	8.8 (7.4, 10.4)
Scorpio CR	Series 7000	539	11561	129	26	44	340	3.4 (3.0, 3.7)	5.3 (4.8, 5.8)	6.9 (6.3, 7.6)
Scorpio PS	Scorpio+*	141	2036	36	14	10	81	5.1 (4.2, 6.2)	6.8 (5.7, 8.0)	8.4 (7.0, 10.1)
Scorpio PS	Series 7000	313	4693	103	8	63	139	4.7 (4.1, 5.3)	6.9 (6.1, 7.7)	10.0 (8.6, 11.6)
TOTAL		**12915**	**286327**	**3564**	**614**	**1245**	**7492**			

Note: Only prostheses with over 350 procedures have been listed
* denotes prosthesis combinations that have not had any reported use in primary total knee procedures in 2017

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.

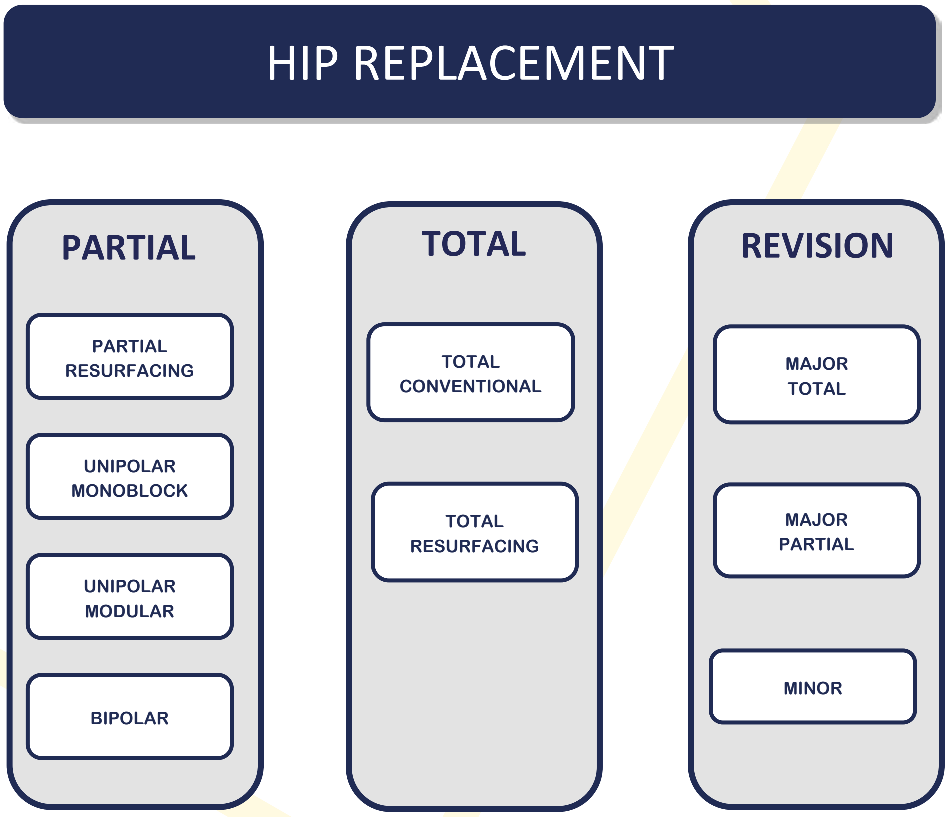
A primary replacement is an initial replacement procedure undertaken on a joint and involves replacing either part (partial) or all (total) of the articular surface.

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-2018



USE OF HIP REPLACEMENT

This report includes 593,803 hip replacements reported to the Registry with a procedure date up to and including 31 December 2017. This is an additional 47,972 hip procedures compared to the number reported last year. When considering all hip procedures currently recorded by the Registry, primary partial hip accounts for 15.1%, primary total hip 73.7% and revision hip replacement 11.2% (Table H1).

Table H1 Number of Hip Replacements

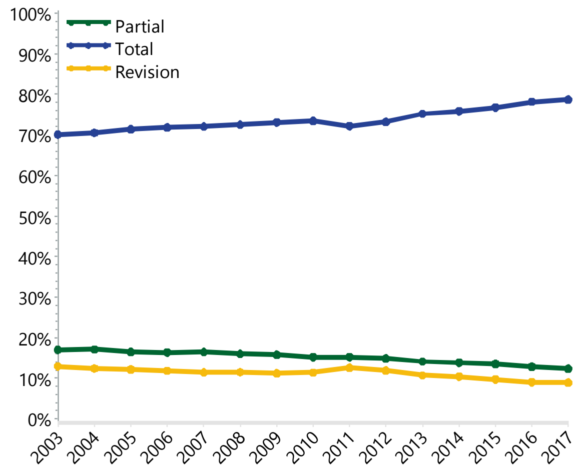
Hip Category	Number	Percent
Partial	89473	15.1
Total	437863	73.7
Revision	66467	11.2
TOTAL	**593803**	**100.0**

The number of hip replacement procedures undertaken in 2017 is 77.6% higher than the number undertaken in 2003. The corresponding increase in primary total hip replacement is 99.5%, primary partial 29.4% and revision hip replacement 22.2%.

The number of hip replacements undertaken in 2017 increased by 533 (1.1%) compared to 2016. During this time, the use of primary total hip replacement increased by 1.9% accounting for 78.7% of all hip replacement procedures in 2017. Primary partial hip replacement decreased by 2.5% accounting for 12.4% of hip procedures in 2017.

The proportion of revision hip procedures has declined from a peak of 12.9% in 2003 to 8.9% in 2017. This equates to 1,908 fewer revision procedures in 2017 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 206,448 hip replacement procedures and BMI data on 114,696 hip replacement procedures. Since its initial collection in 2012, ASA score has been recorded in 93.0% of procedures. BMI data has been recorded in 82.5% of procedures since 2015, when its collection commenced.

In 2017, ASA score is reported in 99.7% of hip replacement procedures and BMI in 87.6% 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 2017. The Registry recorded BMI data for 52.4% of primary partial hip, 93.5% of primary total hip, and 83.8% of revision hip replacement procedures.

ASA score and BMI are both known to impact the outcome of hip replacement surgery. In the future, this data will be used to risk adjust in a range of analyses.

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 85.8% of procedures, patients have an ASA score of 2 or 3, 8.5% have a score of 1, and 5.6% 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 (86.3%) compared to those undergoing primary total hip replacement (35.8%). 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 (58.5% 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://apps.who.int/bmi/index.jsp?introPage=intro_3.html

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 59.2% of primary total hip procedures, and in 59.3% of revision hip replacement procedures.

In partial hip replacement procedures, patients generally have a lower BMI, with 59.9% 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	117	0.4	16541	10.4	938	4.7	17596	8.5
ASA 2	3464	12.8	86008	53.9	7290	36.7	96762	46.9
ASA 3	16444	60.9	53857	33.8	10106	50.8	80407	38.9
ASA 4	6869	25.4	3143	2.0	1532	7.7	11544	5.6
ASA 5	109	0.4	17	0.0	13	0.1	139	0.1
TOTAL	**27003**	**100.0**	**159566**	**100.0**	**19879**	**100.0**	**206448**	**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	797	9.5	1054	1.1	169	1.7	2020	1.8
Normal	4215	50.4	21456	22.3	2484	24.5	28155	24.5
Pre Obese	2300	27.5	35465	36.9	3534	34.8	41299	36.0
Obese Class 1	769	9.2	23496	24.4	2356	23.2	26621	23.2
Obese Class 2	209	2.5	9867	10.3	1043	10.3	11119	9.7
Obese Class 3	79	0.9	4842	5.0	561	5.5	5482	4.8
TOTAL	**8369**	**100.0**	**96180**	**100.0**	**10147**	**100.0**	**114696**	**100.0**

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

Primary Partial Hip Replacement

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 44.2% of all partial hip procedures, followed by unipolar monoblock (31.9%) and bipolar (23.8%) (Table HP1).

Table HP1 Primary Partial Hip Replacement by Class

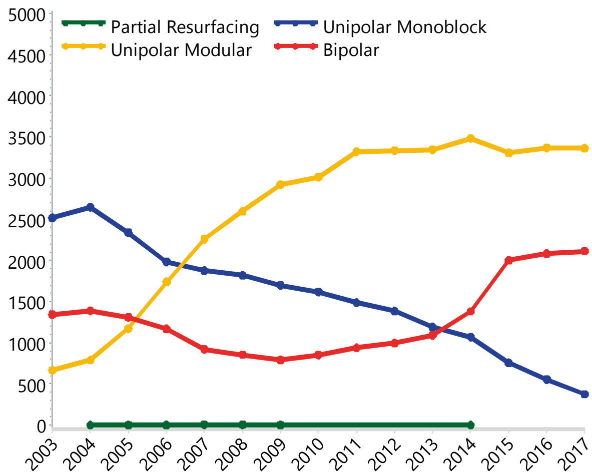
Partial Hip Class	Number	Percent
Unipolar Monoblock	28564	31.9
Unipolar Modular	39563	44.2
Bipolar	21331	23.8
TOTAL	**89458**	**100.0**

Note: Excludes 15 partial resurfacing procedures.

In 2017, there is a slight increase in the use of bipolar, the use of unipolar modular partial hip replacements remains largely unchanged, and the use of unipolar monoblock continues to decline (Figure HP1).

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-2018

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-2018

Fractured neck of femur is the principal diagnosis for the three main classes of primary partial hip replacement: unipolar monoblock (97.6%), unipolar modular (95.3%) and bipolar (91.7%). 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.

At 10 years, bipolar hip replacement has the lowest cumulative percent revision, followed by unipolar modular and unipolar monoblock.

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

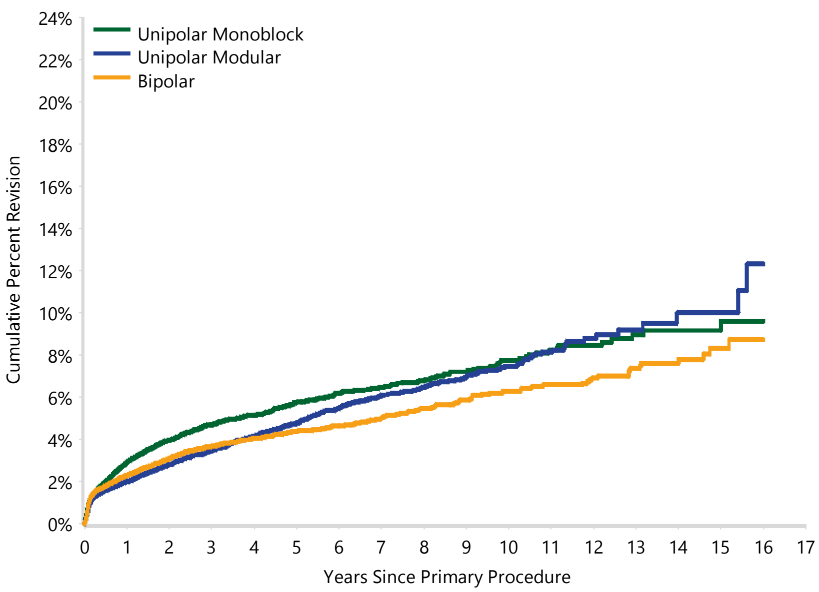
Table HP2 Cumulative Percent Mortality of Primary Partial Hip Replacement by Class (Primary Diagnosis Fractured NOF)

Hip Class	N Deceased	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Monoblock	23442	27185	36.8 (36.2, 37.4)	49.7 (49.1, 50.3)	60.4 (59.8, 61.0)	76.3 (75.7, 76.8)	85.5 (85.0, 85.9)	92.8 (92.4, 93.1)
Unipolar Modular	21752	36513	24.2 (23.7, 24.6)	34.5 (34.0, 35.0)	44.0 (43.5, 44.6)	59.9 (59.3, 60.5)	71.3 (70.7, 71.9)	81.9 (81.3, 82.5)
Bipolar	11282	19067	21.5 (20.9, 22.1)	31.3 (30.6, 32.0)	39.7 (38.9, 40.4)	54.1 (53.2, 54.9)	65.4 (64.6, 66.2)	77.4 (76.6, 78.2)
TOTAL	**56476**	**82765**						

Table HP3 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	1052	27890	2.9 (2.7, 3.1)	4.0 (3.7, 4.3)	4.7 (4.4, 5.0)	5.8 (5.4, 6.1)	6.5 (6.0, 6.9)	7.8 (7.1, 8.5)
Unipolar Modular	1265	37687	2.0 (1.8, 2.1)	2.8 (2.6, 3.0)	3.5 (3.2, 3.7)	4.8 (4.5, 5.1)	6.1 (5.7, 6.5)	7.5 (6.9, 8.1)
Bipolar	677	19560	2.3 (2.1, 2.5)	3.1 (2.8, 3.4)	3.7 (3.4, 4.0)	4.4 (4.0, 4.8)	5.0 (4.6, 5.4)	6.3 (5.7, 6.9)
TOTAL	**2994**	**85137**						

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=1.38 (1.27, 1.50),p<0.001

Bipolar vs Unipolar Modular

0 - 3Mth: HR=1.14 (0.99, 1.31),p=0.069

3Mth+: HR=0.79 (0.70, 0.89),p<0.001

Unipolar Monoblock vs Bipolar

0 - 2Wk: HR=1.75 (1.31, 2.33),p<0.001

2Wk - 3Mth: HR=1.06 (0.89, 1.26),p=0.503

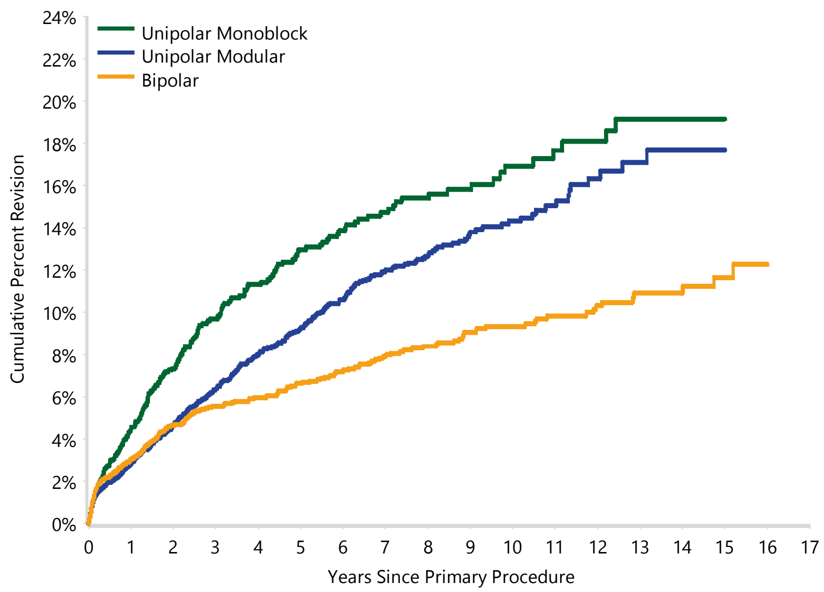
3Mth+: HR=1.75 (1.54, 1.98),p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Monoblock	27890	16917	13069	9943	5488	3010	1175
Unipolar Modular	37687	25581	19854	15238	8457	4331	1397
Bipolar	19560	13497	10491	8117	5211	3394	1755

Table HP4 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	230	2414	4.5 (3.6, 5.5)	7.3 (6.2, 8.6)	9.7 (8.4, 11.2)	13.0 (11.3, 14.8)	14.7 (12.9, 16.8)	16.9 (14.7, 19.4)
Unipolar Modular	472	6048	2.8 (2.4, 3.3)	4.6 (4.1, 5.2)	6.4 (5.7, 7.1)	9.2 (8.3, 10.2)	12.0 (10.9, 13.2)	14.3 (12.9, 15.8)
Bipolar	243	3874	3.1 (2.5, 3.7)	4.6 (4.0, 5.4)	5.6 (4.8, 6.4)	6.6 (5.8, 7.6)	7.9 (6.9, 9.1)	9.3 (8.1, 10.7)
TOTAL	**945**	**12336**						

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=1.18 (0.82, 1.70),p=0.365

3Mth+: HR=2.09 (1.72, 2.54),p<0.001

Unipolar Modular vs Bipolar

0 - 2.5Yr: HR=1.06 (0.88, 1.27),p=0.557

2.5Yr+: HR=2.20 (1.75, 2.78),p<0.001

Unipolar Monoblock vs Unipolar Modular

Entire Period: HR=1.35 (1.15, 1.58),p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Monoblock	2414	1634	1347	1101	747	524	271
Unipolar Modular	6048	4569	3819	3153	2155	1353	569
Bipolar	3874	2946	2445	2044	1574	1212	792

UNIPOLAR MONOBLOCK

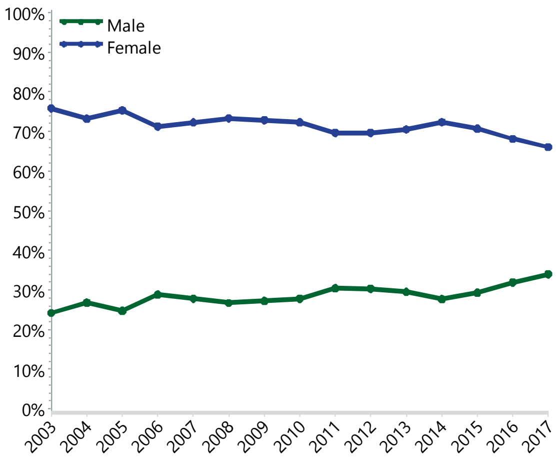
DEMOGRAPHICS

The Registry has recorded 28,564 unipolar monoblock procedures. This is an additional 442 procedures compared to the previous report.

The use of monoblock hip replacement in Australia continues to decline. The number of procedures reported in 2017 has decreased by 32.6% compared to 2016 and by 85.1% compared to 2003.

Fractured neck of femur is the principal diagnosis for primary unipolar monoblock hip replacement (97.6%).

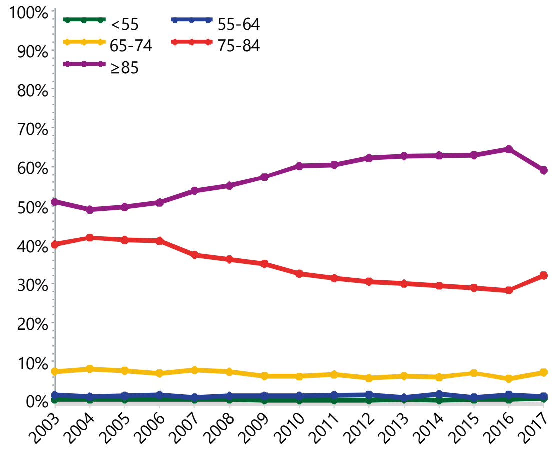
Figure HP4 Primary Unipolar Monoblock Hip Replacement by Gender



The majority of patients are female (73.0%) and aged 75 years or older (91.3%).

The proportion of patients aged 85 years or older has increased from 51.0% in 2003 to 59.1% in 2017. The mean age of patients is 84.5 years (Figures HP4 and HP5, and Table HP5).

Figure HP5 Primary Unipolar Monoblock Hip Replacement by Age



The three types of unipolar monoblock prostheses are: the Exeter Trauma Stem (ETS), Austin-Moore Type and Thompson Type. In 2017, the use of the Austin-Moore Type decreased by 53.1% compared to 2016, and by 95.4% compared to 2003. The Thompson Type decreased by 35.0% compared to 2016, and by 87.3% compared to 2003. In 2017, the use of the ETS decreased by 16.3% compared to 2016, and accounts for 57.8% of all unipolar monoblock prostheses (Table HP6).

Table HP5 Age and Gender of Primary Unipolar Monoblock Hip Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	7707	27.0%	32	107	84	83.4	7.8
Female	20857	73.0%	16	108	86	84.9	7.1
TOTAL	**28564**	**100.0%**	**16**	**108**	**85**	**84.5**	**7.4**

Table HP6 Most Used Monoblock Prostheses in Primary Unipolar Monoblock Hip Replacement

2003		2014		2015		2016		2017	
N	Model	N	Model	N	Model	N	Model	N	Model
1988	Austin-Moore Type	519	Austin-Moore Type	327	Austin-Moore Type	258	ETS	216	ETS
526	Thompson Type	283	ETS	222	ETS	194	Austin-Moore Type	91	Austin-Moore Type
		268	Thompson Type	205	Thompson Type	103	Thompson Type	67	Thompson Type
Most Used									
2514 (2)	100.0%	1070 (3)	100.0%	754 (3)	100.0%	555 (3)	100.0%	374 (3)	100.0%

OUTCOME FOR FRACTURED NECK OF FEMUR

The cumulative percent revision at 10 years for unipolar monoblock replacement undertaken for fractured neck of femur is 7.8% (Table HP7 and Figure HP6).

The main reason for revision is loosening (43.2%), followed by fracture (19.8%), and prosthesis dislocation (11.2%) (Table HP8). The majority of unipolar monoblock hip replacements are revised to a total hip replacement (60.5%). Revision to another unipolar hip replacement (femoral component only) has occurred in 18.2% of revisions (Table HP9).

Age is a risk factor for revision. The rate of revision decreases with increasing age (Table HP10 and Figure HP7).

There is no difference in the outcome between males and females (Table HP11and Figure HP8).

Fixation is a risk factor for revision. In the first 2.5 years, cementless fixation has a higher rate of revision compared to cemented fixation. After this time, the rate of revision for cementless fixation is lower (Table HP12 and Figure HP9).

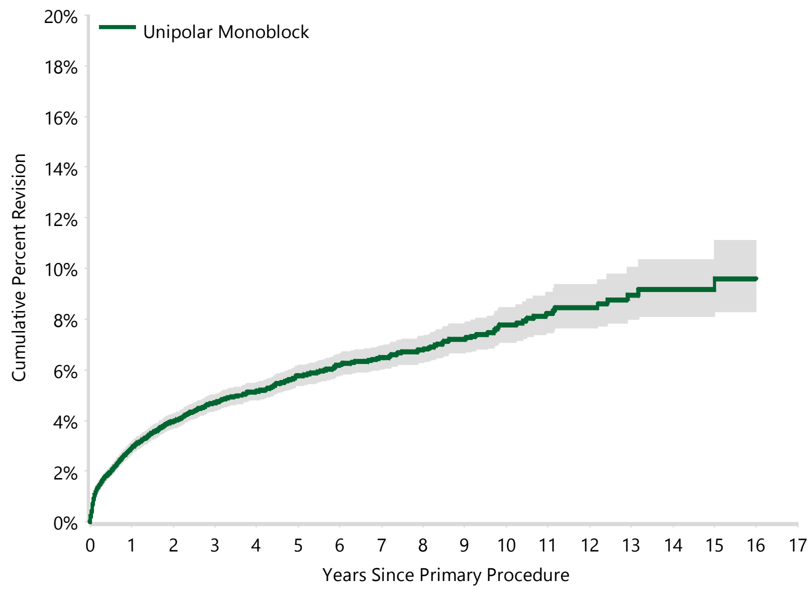
The Thompson Type prosthesis, though designed to be cemented, has been inserted without cement in 588 procedures. This has the highest rate of revision (Table HP12 and Figure HP10).

The Thompson Type cemented and Austin-Moore Type cementless have a higher rate of revision compared to the (cemented) ETS, but there is no difference for the Austin-Moore Type when it is used with cement (Figure HP10).

Table HP7 Cumulative Percent Revision of Primary Unipolar Monoblock Hip Replacement (Primary Diagnosis Fractured NOF)

Hip Type	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Monoblock	1052	27890	2.9 (2.7, 3.1)	4.0 (3.7, 4.3)	4.7 (4.4, 5.0)	5.8 (5.4, 6.1)	6.5 (6.0, 6.9)	7.8 (7.1, 8.5)
TOTAL	**1052**	**27890**						

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



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Monoblock	27890	16917	13069	9943	5488	3010	1175

Table HP8 Primary Unipolar Monoblock Hip Replacement by Reason for Revision (Primary Diagnosis Fractured NOF)

Reason for Revision	Number	Percent
Loosening	454	43.2
Fracture	208	19.8
Prosthesis Dislocation	118	11.2
Infection	112	10.6
Pain	78	7.4
Chondrolysis/Acetab. Erosion	48	4.6
Malposition	12	1.1
Lysis	9	0.9
Other	13	1.2
TOTAL	**1052**	**100.0**

Table HP9 Primary Unipolar Monoblock Hip Replacement by Type of Revision (Primary Diagnosis Fractured NOF)

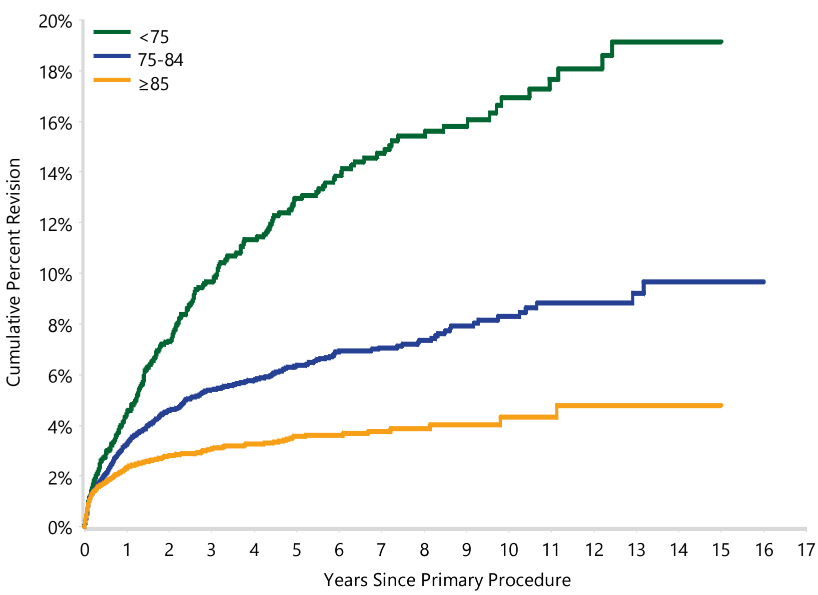
Type of Revision	Number	Percent
THR (Femoral/Acetabular)	636	60.5
Femoral Component	191	18.2
Bipolar Head and Femoral	99	9.4
Removal of Prostheses	55	5.2
Cement Spacer	45	4.3
Minor Components	17	1.6
Reinsertion of Components	6	0.6
Incomplete	1	0.1
Bipolar Only	1	0.1
Insert Only	1	0.1
TOTAL	**1052**	**100.0**

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

Table HP10 Cumulative Percent Revision of Primary Unipolar Monoblock Hip Replacement by Age (Primary Diagnosis Fractured NOF)

Age	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<75	230	2414	4.5 (3.6, 5.5)	7.3 (6.2, 8.6)	9.7 (8.4, 11.2)	13.0 (11.3, 14.8)	14.7 (12.9, 16.8)	16.9 (14.7, 19.4)
75-84	471	10426	3.3 (2.9, 3.7)	4.6 (4.1, 5.1)	5.4 (4.9, 6.0)	6.3 (5.8, 7.0)	7.1 (6.4, 7.8)	8.3 (7.4, 9.3)
≥85	351	15050	2.3 (2.1, 2.6)	2.8 (2.5, 3.1)	3.1 (2.7, 3.4)	3.6 (3.2, 4.0)	3.8 (3.3, 4.3)	4.3 (3.6, 5.2)
TOTAL	**1052**	**27890**						

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



HR - adjusted for gender

<75 vs ≥85
0 - 3Mth: HR=1.26 (0.90, 1.77),p=0.174
3Mth - 1Yr: HR=3.14 (2.25, 4.39),p<0.001
1Yr - 2Yr: HR=5.49 (3.82, 7.89),p<0.001
2Yr+: HR=7.22 (5.38, 9.70),p<0.001

75-84 vs ≥85
0 - 3Mth: HR=1.02 (0.82, 1.27),p=0.867
3Mth+: HR=2.35 (1.94, 2.83),p<0.001

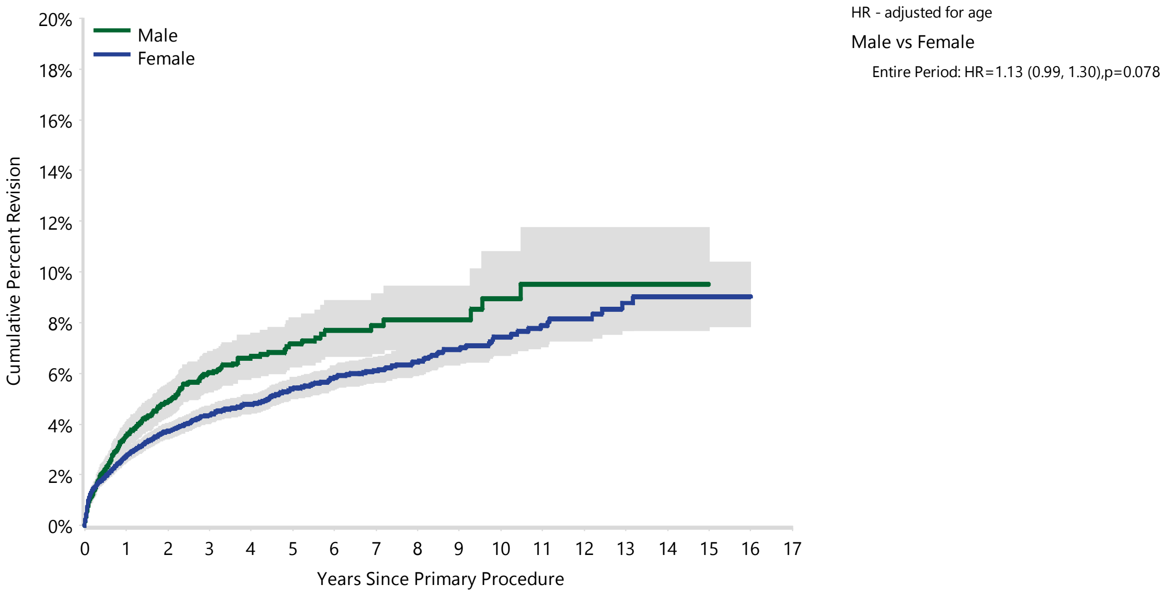
<75 vs 75-84
0 - 1Yr: HR=1.29 (1.02, 1.64),p=0.032
1Yr - 1.5Yr: HR=2.73 (1.77, 4.21),p<0.001
1.5Yr+: HR=2.79 (2.19, 3.54),p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<75	2414	1634	1347	1101	747	524	271
75-84	10426	6770	5410	4267	2595	1493	604
≥85	15050	8513	6312	4575	2146	993	300

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

Gender	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Male	273	7527	3.5 (3.1, 4.1)	4.9 (4.3, 5.6)	6.0 (5.3, 6.9)	7.2 (6.2, 8.2)	7.9 (6.8, 9.1)	8.9 (7.4, 10.8)
Female	779	20363	2.7 (2.5, 3.0)	3.7 (3.4, 4.0)	4.4 (4.0, 4.7)	5.4 (5.0, 5.8)	6.1 (5.6, 6.6)	7.4 (6.7, 8.2)
TOTAL	**1052**	**27890**						

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



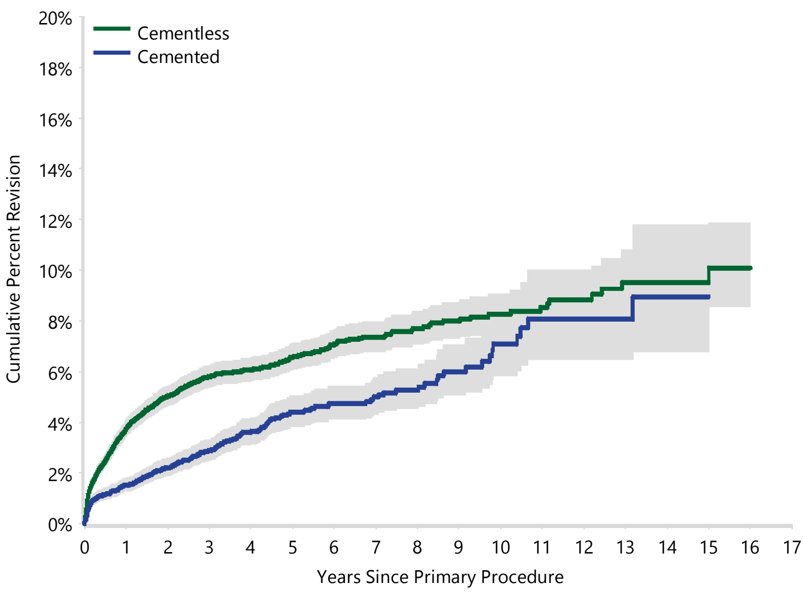
Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Male	7527	3549	2449	1700	840	438	177
Female	20363	13368	10620	8243	4648	2572	998

Table HP12 Cumulative Percent Revision of Primary Unipolar Monoblock Hip Replacement by Femoral Fixation and Prosthesis Type (Primary Diagnosis Fractured NOF)

Femoral Fixation	Unipolar Monoblock	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Cementless		**780**	**17588**	**3.7 (3.4, 4.1)**	**5.0 (4.7, 5.4)**	**5.8 (5.4, 6.2)**	**6.6 (6.1, 7.1)**	**7.4 (6.8, 8.0)**	**8.3 (7.5, 9.1)**
	Austin-Moore	731	17000	3.6 (3.3, 4.0)	4.9 (4.6, 5.3)	5.7 (5.2, 6.1)	6.3 (5.9, 6.8)	7.1 (6.6, 7.8)	8.0 (7.3, 8.8)
	Thompson	49	588	6.5 (4.6, 9.1)	7.4 (5.3, 10.2)	9.2 (6.7, 12.5)	12.5 (9.2, 17.0)	13.3 (9.7, 17.9)	
Cemented		**272**	**10301**	**1.5 (1.3, 1.8)**	**2.2 (1.9, 2.6)**	**2.9 (2.5, 3.3)**	**4.4 (3.8, 5.1)**	**5.0 (4.3, 5.8)**	**7.1 (5.8, 8.6)**
	Austin-Moore	21	948	1.5 (0.8, 2.8)	2.4 (1.4, 4.1)	3.3 (2.0, 5.3)	4.6 (2.9, 7.4)	4.6 (2.9, 7.4)	
	ETS	67	3185	1.4 (1.1, 2.0)	1.8 (1.4, 2.5)	2.3 (1.8, 3.1)	3.1 (2.4, 4.2)	4.1 (3.0, 5.6)	5.5 (3.5, 8.5)
	Thompson	184	6168	1.6 (1.2, 1.9)	2.4 (2.0, 2.9)	3.1 (2.6, 3.7)	5.0 (4.2, 5.9)	5.5 (4.6, 6.4)	8.0 (6.4, 10.0)
TOTAL		**1052**	**27889**						

Note: One ETS procedure which was cementless has been excluded

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



HR - adjusted for age and gender

Cementless vs Cemented

0 - 3Mth: HR=1.92 (1.51, 2.43),p<0.001

3Mth - 9Mth: HR=4.35 (2.86, 6.62),p<0.001

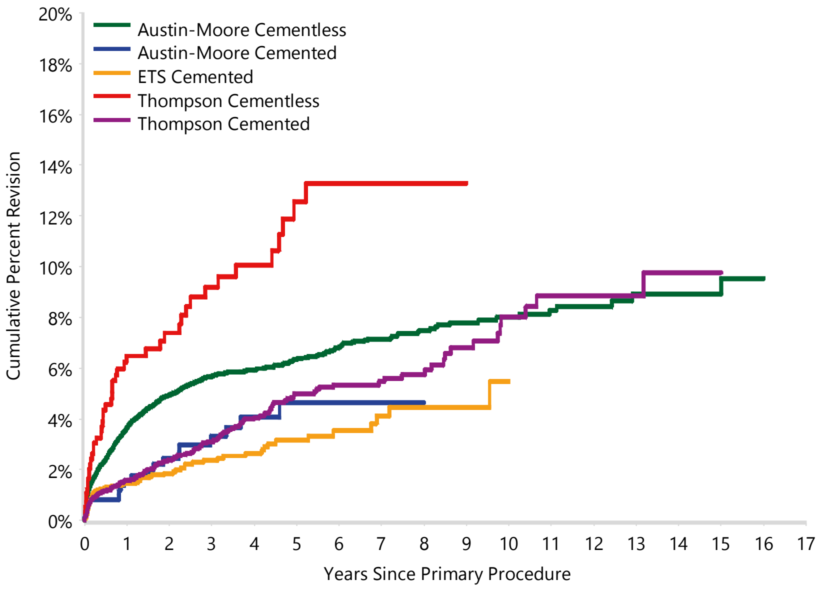
9Mth - 1.5Yr: HR=2.41 (1.68, 3.46),p<0.001

1.5Yr - 2.5Yr: HR=1.61 (1.08, 2.39),p=0.019

2.5Yr+: HR=0.71 (0.54, 0.95),p=0.021

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Cementless	17590	10412	7986	6111	3411	1924	820
Cemented	10300	6505	5083	3832	2077	1086	355

Figure HP10 Cumulative Percent Revision of Primary Unipolar Monoblock Hip Replacement by Prosthesis Type and Femoral Fixation (Primary Diagnosis Fractured NOF)



HR - adjusted for age and gender

Austin-Moore Cementless vs ETS Cemented
Entire Period: HR=2.20 (1.71, 2.83),p<0.001

Austin-Moore Cemented vs ETS Cemented
Entire Period: HR=1.30 (0.80, 2.12),p=0.293

Thompson Cementless vs ETS Cemented
Entire Period: HR=3.84 (2.65, 5.55),p<0.001

Thompson Cemented vs ETS Cemented
Entire Period: HR=1.40 (1.06, 1.85),p=0.018

Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Austin-Moore	Cementless	17000	10044	7698	5888	3284	1846	791
	Cemented	948	507	391	288	145	65	17
ETS	Cemented	3185	1983	1513	1146	618	306	68
Thompson	Cementless	588	367	287	223	127	78	29
	Cemented	6168	4016	3180	2398	1314	715	270

UNIPOLAR MODULAR

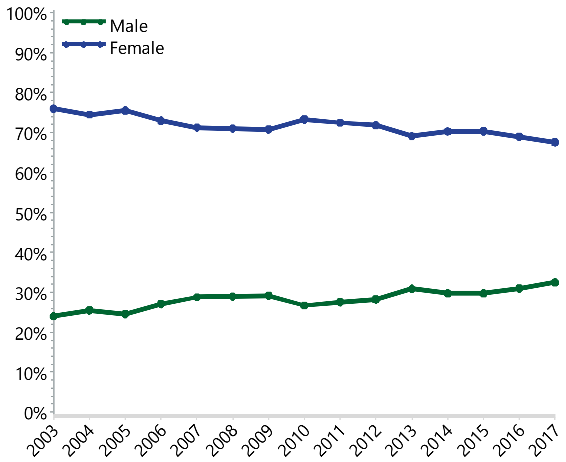
DEMOGRAPHICS

There have been 39,563 unipolar modular procedures reported to the Registry. This is an additional 3,473 procedures compared to the previous report.

In 2017, the number of unipolar modular procedures decreased by only two procedures (0.1%) compared to 2016, and increased by 405.1% since 2003.

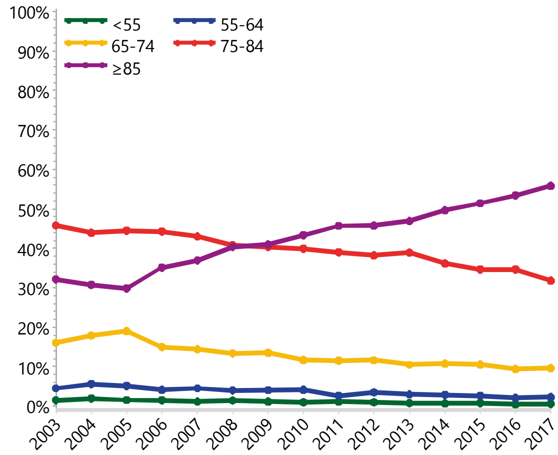
Fractured neck of femur is the principal diagnosis for primary unipolar modular hip replacement (95.3%).

Figure HP11 Primary Unipolar Modular Hip Replacement by Gender



The majority of patients are female (71.0%) and aged 75 years or older (83.5%). The proportion of patients aged 85 years or older has increased from 32.1% in 2003 to 55.8% in 2017. The mean age of patients is 82.2 years (Table HP13, Figures HP11 and HP12).

Figure HP12 Primary Unipolar Modular Hip Replacement by Age



Overall, there have been 227 unipolar modular head and stem combinations recorded by the Registry. The 10 most frequently used unipolar modular head prostheses and femoral stems are listed in Tables HP14 and HP15.

In 2017, 18 different unipolar modular head prostheses were used. The Unitrax head is the most frequently used (54.3%). The 10 most used unipolar modular head prostheses account for 99.2% of all primary unipolar modular hip procedures.

There were 37 different stem prostheses used in 2017. The most frequently used stem in 2017 is the Exeter V40 (53.5%). The 10 most used femoral stems account for 94.6% of all primary unipolar modular hip procedures.

The cumulative percent revision of unipolar modular head/stem prosthesis combinations with more than 100 procedures is detailed in Table HP16.

Table HP13 Age and Gender of Primary Unipolar Modular Hip Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	11455	29.0%	19	106	83	81.2	9.5
Female	28108	71.0%	18	108	84	82.7	8.5
TOTAL	**39563**	**100.0%**	**18**	**108**	**84**	**82.2**	**8.8**

Table HP14 10 Most Used Unipolar Head Prostheses in Primary Unipolar Modular Hip Replacement

2003		2014		2015		2016		2017	
N	Model	N	Model	N	Model	N	Model	N	Model
193	Unitrax	1614	Unitrax	1892	Unitrax	2078	Unitrax	1828	Unitrax
142	Unipolar Head (Zimmer)	960	Unipolar Head (S&N)	840	Unipolar Head (S&N)	654	Unipolar Head (S&N)	523	Unipolar Head (S&N)
127	Unipolar Head (S&N)	524	VerSys	203	Cathcart	252	Cathcart	435	Cathcart
75	VerSys	162	Cathcart	168	VerSys	169	VerSys	165	VerSys
64	Unipolar Head (Mathys)	60	Pharo	61	Unipolar Head (Corin)	63	Unipolar Head (Corin)	158	BioBall
46	Elite	52	Unipolar Head (Corin)	39	Unipolar Head (Lima)	54	Unipolar Head (Signature)	133	Unipolar Head (Signature)
16	Ultima	38	Unipolar Head (JRI)	21	Unipolar Head (JRI)	25	Endo II	37	Endo II
1	Metasul	25	Unipolar Head (Lima)	19	FMP	17	Endo Head	28	Unipolar Head (Corin)
1	Optimom	15	Unipolar Head (Zimmer)	18	Pharo	12	BioBall	19	Unipolar Head (Mathys)
1	Unipolar Head (Sulzer)	14	FMP	14	Unipolar Head (Mathys)	10	Unipolar Head (Lima)	11	Endo Head
10 Most Used									
666 (10) 100.0%		3464 (10) 99.5%		3275 (10) 99.0%		3334 (10) 99.0%		3337 (10) 99.2%	
Remainder									
0 (0) 0%		17 (7) 0.5%		32 (11) 1.0%		32 (9) 1.0%		27 (8) 0.8%	
TOTAL									
666 (10) 100.0%		3481 (17) 100.0%		3307 (21) 100.0%		3366 (19) 100.0%		3364 (18) 100.0%	

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

2003		2014		2015		2016		2017	
N	Model	N	Model	N	Model	N	Model	N	Model
180	Exeter V40	1560	Exeter V40	1852	Exeter V40	2049	Exeter V40	1801	Exeter V40
111	Alloclassic	566	CPCS	531	CPCS	509	CPCS	421	CPCS
91	CPT	486	CPT	192	Spectron EF	141	C-Stem AMT	359	C-Stem AMT
70	Spectron EF	189	Spectron EF	150	CPT	137	CPT	190	Absolut
49	Fullfix	123	SL-Plus	107	C-Stem AMT	113	Corail	140	CPT
38	SL-Plus	88	C-Stem AMT	98	Corail	93	Spectron EF	74	Corail
33	Elite Plus	74	Corail	73	SL-Plus	53	Metafix	70	Spectron EF
18	Basis	59	Pharo	59	Metafix	31	Short Exeter V40	50	E2
15	CCA	52	Metafix	35	H-Max	29	E2	41	Evolve
15	Thompson Modular Stem	44	Omnifit	24	Absolut	25	Sirius	36	Sirius
10 Most Used									
620 (10) 93.1%		3241 (10) 93.1%		3121 (10) 94.4%		3180 (10) 94.5%		3182 (10) 94.6%	
Remainder									
46 (13) 6.9%		240 (35) 6.9%		186 (35) 5.6%		186 (27) 5.5%		182 (27) 5.4%	
TOTAL									
666 (23) 100.0%		3481 (45) 100.0%		3307 (45) 100.0%		3366 (37) 100.0%		3364 (37) 100.0%	

Table HP16 Cumulative Percent Revision of Primary Unipolar Modular Hip Replacement by Prosthesis Combination

Unipolar Head	Femoral Component	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
BioBall	Absolut*	4	180						
Cathcart	C-Stem AMT	8	786	1.2 (0.6, 2.6)	1.2 (0.6, 2.6)	1.2 (0.6, 2.6)			
Cathcart	Corail	82	1437	3.2 (2.4, 4.4)	4.5 (3.4, 5.9)	5.9 (4.6, 7.6)	7.5 (5.9, 9.6)	10.0 (7.8, 12.8)	14.0 (9.9, 19.6)
Endo II	Taperloc	7	103	5.1 (2.2, 11.8)	5.1 (2.2, 11.8)	5.1 (2.2, 11.8)			
Metasul	Alloclassic	16	345	2.5 (1.3, 4.9)	2.9 (1.5, 5.5)	3.7 (2.1, 6.7)	4.3 (2.4, 7.5)	7.6 (4.5, 12.8)	
Metasul	CPT	4	215	1.6 (0.5, 4.9)	1.6 (0.5, 4.9)	2.4 (0.9, 6.6)	2.4 (0.9, 6.6)		
Pharo	Pharo	6	144	3.1 (1.2, 8.0)	5.1 (2.3, 11.0)	5.1 (2.3, 11.0)			
U2	E2	3	232	0.0 (0.0, 0.0)	0.7 (0.1, 4.8)	1.5 (0.4, 5.9)	2.5 (0.8, 7.6)		
Ultima	Thompson Modular Stem	1	133	0.8 (0.1, 5.5)	0.8 (0.1, 5.5)	0.8 (0.1, 5.5)	0.8 (0.1, 5.5)	0.8 (0.1, 5.5)	
Unipolar Head (Corin)	Metafix	16	476	2.2 (1.1, 4.2)	3.3 (1.9, 5.9)	3.3 (1.9, 5.9)	7.2 (4.0, 12.7)		
Unipolar Head (Corin)	Taper Fit	19	325	2.1 (0.9, 4.6)	3.4 (1.8, 6.5)	5.5 (3.2, 9.5)	7.0 (4.2, 11.6)	7.9 (4.8, 12.9)	
Unipolar Head (Corin)	Tri-Fit	10	288	1.5 (0.6, 4.0)	2.1 (0.9, 5.0)	2.6 (1.2, 5.9)	2.6 (1.2, 5.9)	4.7 (2.2, 10.0)	6.9 (3.1, 15.0)
Unipolar Head (JRI)	Furlong LOL	10	132	6.3 (3.1, 12.9)	9.6 (5.3, 17.2)	9.6 (5.3, 17.2)			
Unipolar Head (Mathys)	CCA	10	357	1.0 (0.3, 3.0)	2.1 (1.0, 4.7)	2.6 (1.2, 5.3)	2.6 (1.2, 5.3)	3.5 (1.7, 7.4)	3.5 (1.7, 7.4)
Unipolar Head (Mathys)	Fullfix	8	226	1.5 (0.5, 4.7)	2.8 (1.1, 6.5)	2.8 (1.1, 6.5)	2.8 (1.1, 6.5)	6.1 (3.0, 12.4)	6.1 (3.0, 12.4)
Unipolar Head (Plus)	SL-Plus	8	193	2.2 (0.8, 5.8)	2.9 (1.2, 6.9)	3.6 (1.6, 8.0)	4.6 (2.2, 9.7)	5.9 (2.9, 11.9)	
Unipolar Head (S&N)	Anthology	6	100	4.5 (1.7, 11.7)	4.5 (1.7, 11.7)	4.5 (1.7, 11.7)	8.1 (3.0, 21.1)	8.1 (3.0, 21.1)	
Unipolar Head (S&N)	Basis	28	578	2.0 (1.1, 3.7)	2.0 (1.1, 3.7)	3.1 (1.8, 5.2)	7.2 (4.9, 10.7)	8.3 (5.6, 12.1)	8.3 (5.6, 12.1)
Unipolar Head (S&N)	CPCS	122	5053	1.7 (1.4, 2.2)	2.2 (1.8, 2.7)	2.8 (2.3, 3.4)	3.6 (3.0, 4.4)	4.5 (3.6, 5.7)	5.4 (3.7, 7.9)
Unipolar Head (S&N)	Platform	6	110	4.1 (1.5, 10.5)	4.1 (1.5, 10.5)	4.1 (1.5, 10.5)	6.0 (2.4, 14.5)		
Unipolar Head (S&N)	SL-Plus	48	1068	2.3 (1.5, 3.4)	3.2 (2.2, 4.6)	4.5 (3.3, 6.2)	5.1 (3.7, 7.0)	6.4 (4.5, 8.9)	
Unipolar Head (S&N)	Spectron EF	102	2924	1.6 (1.2, 2.2)	2.5 (2.0, 3.2)	2.9 (2.3, 3.7)	4.1 (3.3, 5.2)	5.7 (4.5, 7.1)	7.5 (5.9, 9.7)
Unipolar Head (Zimmer)	Alloclassic	64	1085	3.2 (2.2, 4.5)	4.1 (3.0, 5.6)	4.5 (3.4, 6.1)	6.0 (4.6, 7.9)	8.6 (6.6, 11.1)	9.1 (7.0, 11.9)
Unipolar Head (Zimmer)	CPT	11	173	1.9 (0.6, 5.8)	3.3 (1.4, 7.7)	4.1 (1.8, 8.8)	5.9 (3.0, 11.6)	7.2 (3.7, 13.7)	9.0 (4.7, 16.9)
Unitrax	Accolade I	10	130	1.7 (0.4, 6.7)	5.7 (2.6, 12.3)	6.8 (3.3, 13.7)	6.8 (3.3, 13.7)		
Unitrax	Exeter V40	497	15947	1.9 (1.7, 2.1)	2.7 (2.4, 3.0)	3.4 (3.1, 3.8)	4.8 (4.4, 5.4)	6.1 (5.4, 6.8)	7.6 (6.6, 8.7)
Unitrax	Omnifit	7	253	2.7 (1.2, 5.9)	3.2 (1.5, 6.7)	3.2 (1.5, 6.7)	3.2 (1.5, 6.7)		
VerSys	CPT	148	4400	2.0 (1.6, 2.4)	3.0 (2.5, 3.6)	3.5 (2.9, 4.2)	4.6 (3.9, 5.5)	5.6 (4.6, 6.8)	6.1 (4.9, 7.4)
VerSys	VerSys	5	175	3.1 (1.1, 8.1)	3.1 (1.1, 8.1)	3.1 (1.1, 8.1)			
Other (198)		96	1995	3.3 (2.5, 4.3)	4.6 (3.6, 5.8)	5.3 (4.2, 6.7)	7.0 (5.6, 8.8)	9.3 (7.3, 11.7)	9.9 (7.7, 12.6)
TOTAL		**1362**	**39563**						

Note: Only combinations with over 100 procedures have been listed
* CPR not provided as insufficient procedures had one year follow up at the time of reporting

OUTCOME FOR FRACTURED NECK OF FEMUR

The cumulative percent revision at 10 years for unipolar modular hip replacement, when undertaken for fractured neck of femur, is 7.5% (Table HP17 and Figure HP13).

The Registry has recorded 1,265 revisions of primary unipolar modular hip replacement with a primary diagnosis of fractured neck of femur.

The main reasons for revision are: infection (20.1%), prosthesis dislocation (19.4%), fracture (16.3%), chondrolysis/acetabular erosion (16.2%), loosening (12.1%), and pain (12.0%) (Table HP18).

Most revisions are acetabular only (44.7%), followed by total hip replacement (femoral/acetabular) (17.3%) (Table HP19).

Age, gender and femoral stem fixation are risk factors for revision. The rate of revision decreases with increasing age (Table HP20 and Figure HP14). Males have a higher rate of revision in the first 1.5 years (Table HP21 and Figure HP15).

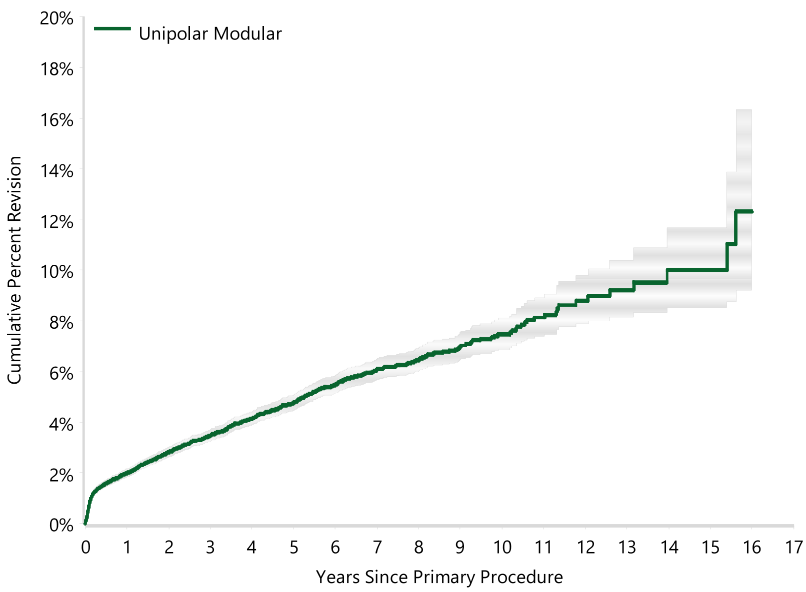
The cumulative incidence for loosening and fracture is higher for cementless compared to cemented fixation.

Cementless fixation has a higher rate of revision compared to cemented fixation (Table HP22 and Figure HP16). The cumulative incidence for loosening, fracture and chondrolysis is higher for cementless compared to cemented fixation (Figure HP17).

Table HP17 Cumulative Percent Revision of Primary Unipolar Modular Hip Replacement (Primary Diagnosis Fractured NOF)

Hip Type	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Modular	1265	37687	2.0 (1.8, 2.1)	2.8 (2.6, 3.0)	3.5 (3.2, 3.7)	4.8 (4.5, 5.1)	6.1 (5.7, 6.5)	7.5 (6.9, 8.1)
TOTAL	1265	37687						

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



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Modular	37687	25581	19854	15238	8457	4331	1397

Table HP18 Primary Unipolar Modular Hip Replacement by Reason for Revision (Primary Diagnosis Fractured NOF)

Reason for Revision	Number	Percent
Infection	254	20.1
Prosthesis Dislocation	246	19.4
Fracture	206	16.3
Chondrolysis/Acetab. Erosion	205	16.2
Loosening	153	12.1
Pain	152	12.0
Lysis	15	1.2
Malposition	3	0.2
Other	31	2.5
TOTAL	**1265**	**100.0**

Table HP19 Primary Unipolar Modular Hip Replacement by Type of Revision (Primary Diagnosis Fractured NOF)

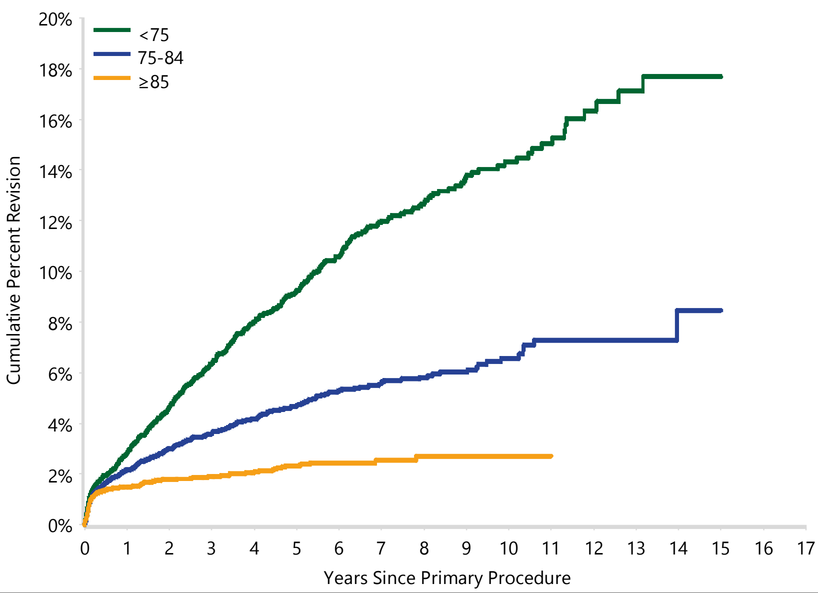
Type of Revision	Number	Percent
Acetabular Component	565	44.7
THR (Femoral/Acetabular)	219	17.3
Head Only	157	12.4
Femoral Component	138	10.9
Cement Spacer	53	4.2
Minor Components	42	3.3
Bipolar Head and Femoral	39	3.1
Removal of Prostheses	35	2.8
Bipolar Only	11	0.9
Reinsertion of Components	4	0.3
Head/Insert	1	0.1
Cement Only	1	0.1
TOTAL	**1265**	**100.0**

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

Table HP20 Cumulative Percent Revision of Primary Unipolar Modular Hip Replacement by Age (Primary Diagnosis Fractured NOF)

Age	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<75	472	6048	2.8 (2.4, 3.3)	4.6 (4.1, 5.2)	6.4 (5.7, 7.1)	9.2 (8.3, 10.2)	12.0 (10.9, 13.2)	14.3 (12.9, 15.8)
75-84	520	14582	2.2 (1.9, 2.4)	3.0 (2.7, 3.3)	3.6 (3.3, 4.0)	4.7 (4.3, 5.2)	5.6 (5.1, 6.2)	6.6 (5.8, 7.4)
≥85	273	17057	1.5 (1.3, 1.7)	1.8 (1.6, 2.0)	1.9 (1.7, 2.1)	2.3 (2.0, 2.6)	2.5 (2.2, 3.0)	2.7 (2.2, 3.3)
TOTAL	**1265**	**37687**						

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



HR - adjusted for gender

<75 vs ≥85
- 0 - 3Mth: HR=1.26 (0.98, 1.62),p=0.076
- 3Mth - 9Mth: HR=3.68 (2.47, 5.49),p<0.001
- 9Mth - 2Yr: HR=6.59 (4.83, 9.00),p<0.001
- 2Yr+: HR=9.16 (6.96, 12.06),p<0.001

75-84 vs ≥85
- 0 - 3Mth: HR=1.06 (0.86, 1.30),p=0.588
- 3Mth+: HR=3.18 (2.52, 4.01),p<0.001

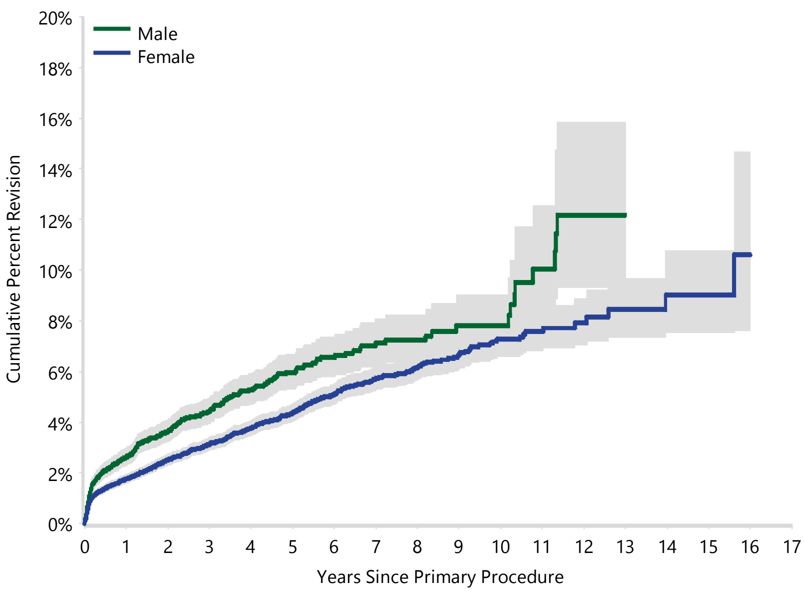
<75 vs 75-84
- 0 - 1.5Yr: HR=1.39 (1.17, 1.65),p<0.001
- 1.5Yr - 2Yr: HR=2.01 (1.30, 3.12),p=0.001
- 2Yr+: HR=2.87 (2.36, 3.50),p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<75	6048	4569	3819	3153	2155	1353	569
75-84	14582	10626	8546	6827	4007	2085	653
≥85	17057	10386	7489	5258	2295	893	175

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

Gender	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Male	396	10898	2.6 (2.3, 3.0)	3.6 (3.2, 4.0)	4.4 (4.0, 5.0)	6.0 (5.3, 6.7)	7.1 (6.3, 8.1)	7.8 (6.8, 9.0)
Female	869	26789	1.8 (1.6, 1.9)	2.5 (2.3, 2.7)	3.1 (2.9, 3.4)	4.4 (4.0, 4.7)	5.7 (5.3, 6.2)	7.3 (6.6, 8.0)
TOTAL	**1265**	**37687**						

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



HR - adjusted for age

Male vs Female

0 - 1.5Yr: HR=1.39 (1.20, 1.62),p<0.001

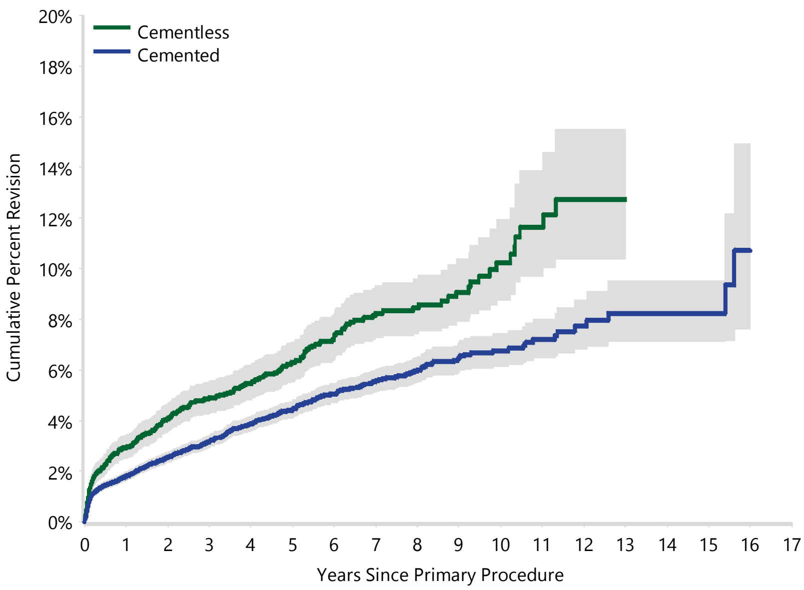
1.5Yr+: HR=1.00 (0.81, 1.22),p=0.976

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Male	10898	6384	4614	3357	1663	821	247
Female	26789	19197	15240	11881	6794	3510	1150

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

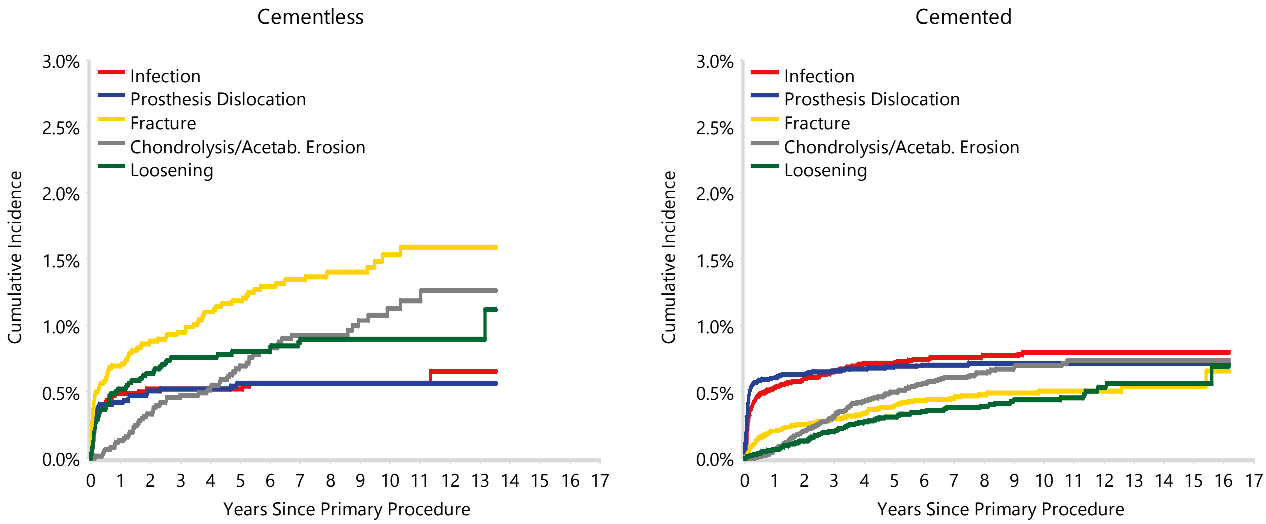
Femoral Fixation	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Cementless	322	6209	2.9 (2.5, 3.4)	4.1 (3.6, 4.6)	4.9 (4.3, 5.5)	6.3 (5.6, 7.1)	8.2 (7.3, 9.3)	10.2 (8.8, 11.9)
Cemented	943	31478	1.8 (1.6, 2.0)	2.5 (2.4, 2.8)	3.2 (2.9, 3.4)	4.4 (4.1, 4.8)	5.6 (5.1, 6.0)	6.8 (6.1, 7.4)
TOTAL	**1265**	**37687**						

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



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Cementless	6209	4535	3722	3005	1802	1028	315
Cemented	31478	21046	16132	12233	6655	3303	1082

Figure HP17 Cumulative Incidence Revision Diagnosis of Primary Unipolar Modular Hip Replacement by Femoral Fixation (Primary Diagnosis Fractured NOF)



BIPOLAR

DEMOGRAPHICS

There have been 21,331 bipolar hip replacement procedures reported to the Registry. This is an additional 2,168 procedures compared to the previous report.

Since 2010, there has been an increase in the number of bipolar procedures undertaken each year, with 1.5% more procedures in 2017 compared to 2016. The total number of bipolar procedures has increased by 57.5% since 2003.

Fractured neck of femur is the principal diagnosis for bipolar hip replacement (91.7%).

The majority of patients are female (71.0%) and aged 75 years or older (78.4%). The proportion of patients aged 85 years or older has increased from 26.0% in 2003 to 48.8% in 2017. The mean age of patients is 80.6 years (Table HP23, Figures HP18 and HP19).

Figure HP18 Primary Bipolar Hip Replacement by Gender

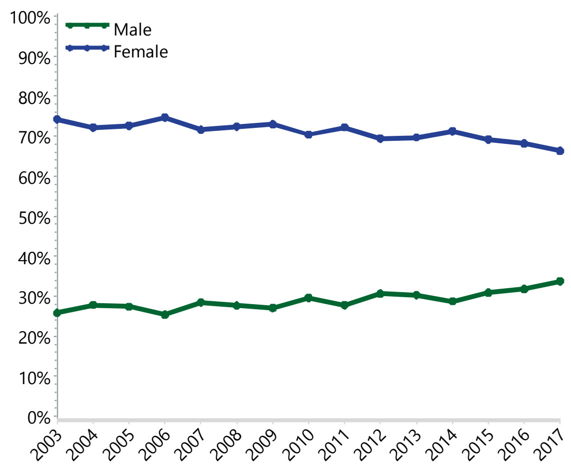
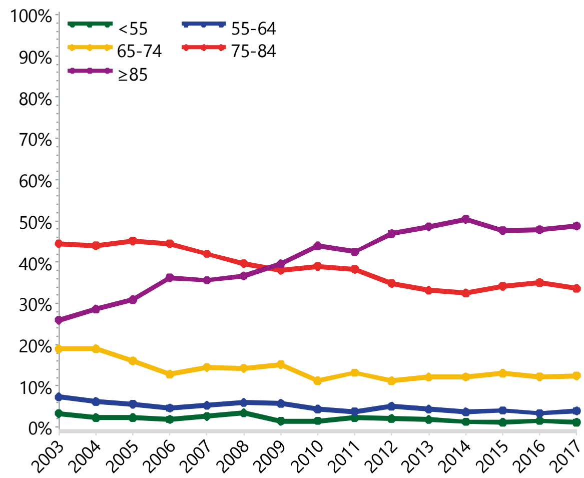


Figure HP19 Primary Bipolar Hip Replacement by Age



Overall, there have been 267 bipolar head and stem combinations recorded by the Registry. In 2017, there were nine different bipolar heads and 40 different femoral stem prostheses used.

In 2017, the UHR remains the most frequently used bipolar head (38.1%) (Table HP24). The Exeter V40 is the most frequently used femoral stem (35.5%). The 10 most used femoral stems account for 91.5% of all bipolar hip procedures (Table HP25).

The cumulative percent revision of bipolar head/stem prosthesis combinations with more than 100 procedures is detailed in Table HP26.

Table HP23 Age and Gender of Primary Bipolar Hip Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	6189	29.0%	17	101	82	79.8	10.8
Female	15142	71.0%	14	107	83	81.0	9.6
TOTAL	**21331**	**100.0%**	**14**	**107**	**82**	**80.6**	**10.0**

Table HP24 10 Most Used Bipolar Head Prostheses in Primary Bipolar Hip Replacement

2003		2014		2015		2016		2017	
N	Model	N	Model	N	Model	N	Model	N	Model
760	UHR	779	UHR	822	UHR	903	UHR	804	UHR
140	Hastings	208	Multipolar Bipolar	769	Multipolar Bipolar	672	Multipolar Bipolar	614	Multipolar Bipolar
115	Convene	115	Tandem	185	Self-Centering	215	Self-Centering	302	Tandem
91	Bipolar Head (Zimmer)	92	Self-Centering	113	Tandem	155	Tandem	270	Self-Centering
87	Self-Centering	64	Bipolar Head (Medacta)	69	Bipolar Head (Medacta)	90	Bipolar Head (Medacta)	79	Bipolar Head (Medacta)
59	Multipolar Bipolar	35	Hastings	18	Ringloc	24	Bipolar Head (Lima)	22	Ringloc
39	Bipolar Head (Mathys)	30	Bipolar Head (Lima)	16	Bipolar Head (Lima)	13	Ringloc	15	Bipolar Head (Lima)
19	Bipolar Head (Lima)	28	Ringloc	3	Bipolar Head (Mathys)	5	Bipolar Head (Implantcast)	4	Bipolar Head (Implantcast)
19	Ringloc	15	AcuMatch L-Series	2	Bipolar Head (Implantcast)	4	Bipolar Head (Mathys)	2	Bipolar Head (Mathys)
5	UHL	5	Gladiator	2	Hastings				
10 Most Used									
1334 (10) 99.5%		1371 (10) 99.3%		1999 (10) 100.0%		2081 (9) 100.0%		2112 (9) 100.0%	
Remainder									
7 (2) 0.5%		10 (4) 0.7%		1 (1) 0.0%		0 (0) 0%		0 (0) 0%	
TOTAL									
1341 (12) 100.0%		1381 (14) 100.0%		2000 (11) 100.0%		2081 (9) 100.0%		2112 (9) 100.0%	

Table HP25 10 Most Used Femoral Stem Prostheses in Primary Bipolar Hip Replacement

2003		2014		2015		2016		2017	
N	Model	N	Model	N	Model	N	Model	N	Model
630	Exeter V40	734	Exeter V40	783	Exeter V40	854	Exeter V40	750	Exeter V40
94	Elite Plus	171	CPT	670	CPT	610	CPT	566	CPT
75	Alloclassic	92	Corail	127	Corail	129	Corail	253	CPCS
65	CPCS	84	CPCS	78	CPCS	126	CPCS	160	Corail
61	C-Stem	39	Accolade I	35	Quadra-C	61	Quadra-C	70	C-Stem AMT
59	Omnifit	27	Quadra-C	27	C-Stem AMT	41	C-Stem AMT	58	Quadra-C
33	VerSys	26	X-Acta	26	X-Acta	23	H-Max	24	Paragon
26	ABGII	20	H-Max	24	Alloclassic	21	Summit	22	Spectron EF
25	CCA	16	Alloclassic	24	Summit	20	X-Acta	15	Accolade I
25	Spectron EF	13	C-Stem AMT	22	Accolade I	18	Accolade II	15	X-Acta
10 Most Used									
1093 (10) 81.5%		1222 (10) 88.5%		1816 (10) 90.8%		1903 (10) 91.4%		1933 (10) 91.5%	
Remainder									
248 (46) 18.5%		159 (39) 11.5%		184 (35) 9.2%		178 (30) 8.6%		179 (30) 8.5%	
TOTAL									
1341 (56) 100.0%		1381 (49) 100.0%		2000 (45) 100.0%		2081 (40) 100.0%		2112 (40) 100.0%	

Table HP26 Cumulative Percent Revision of Primary Bipolar Hip Replacement by Prosthesis Combination

Bipolar Head	Femoral Component	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Bipolar Head (Lima)	H-Max	5	101	3.4 (1.1, 10.1)	4.9 (1.8, 12.7)				
Bipolar Head (Medacta)	Quadra-C	7	265	3.2 (1.5, 6.6)	3.2 (1.5, 6.6)	3.2 (1.5, 6.6)			
Bipolar Head (Zimmer)	Alloclassic*	18	358	0.9 (0.3, 2.8)	2.0 (0.9, 4.3)	2.3 (1.1, 4.9)	2.8 (1.4, 5.4)	3.4 (1.7, 6.6)	6.8 (3.8, 12.1)
Centrax	Exeter*	7	200	2.1 (0.8, 5.5)	2.7 (1.1, 6.5)	2.7 (1.1, 6.5)	2.7 (1.1, 6.5)	2.7 (1.1, 6.5)	3.9 (1.7, 8.9)
Convene	CPCS*	16	347	2.2 (1.1, 4.6)	3.3 (1.8, 6.1)	3.3 (1.8, 6.1)	5.2 (3.1, 8.8)	5.9 (3.5, 9.8)	6.7 (4.0, 11.0)
Convene	Spectron EF*	8	123	2.6 (0.9, 8.0)	2.6 (0.9, 8.0)	3.8 (1.4, 10.1)	6.6 (2.9, 14.4)	6.6 (2.9, 14.4)	
Hastings	C-Stem*	10	208	2.5 (1.1, 5.9)	5.0 (2.6, 9.4)	5.7 (3.1, 10.4)	5.7 (3.1, 10.4)	5.7 (3.1, 10.4)	5.7 (3.1, 10.4)
Hastings	Charnley*	6	118	0.0 (0.0, 0.0)	3.6 (1.2, 10.8)	3.6 (1.2, 10.8)	6.5 (2.7, 15.0)		
Hastings	Corail*	18	361	3.3 (1.8, 5.8)	3.6 (2.1, 6.3)	4.0 (2.3, 6.8)	4.7 (2.7, 7.9)	4.7 (2.7, 7.9)	8.5 (4.7, 15.1)
Hastings	Elite Plus*	15	298	1.9 (0.8, 4.6)	3.3 (1.6, 6.5)	4.3 (2.3, 7.9)	5.4 (3.1, 9.5)	6.8 (4.0, 11.4)	6.8 (4.0, 11.4)
Hastings	Summit*	3	102	2.5 (0.6, 9.6)	2.5 (0.6, 9.6)	2.5 (0.6, 9.6)			
Multipolar Bipolar	Alloclassic	8	198	3.9 (1.9, 8.1)	3.9 (1.9, 8.1)	3.9 (1.9, 8.1)	5.1 (2.5, 10.4)		
Multipolar Bipolar	CPT	78	2543	2.8 (2.2, 3.6)	3.7 (2.9, 4.6)	3.9 (3.1, 5.0)	4.7 (3.5, 6.4)	5.7 (3.7, 8.5)	
Multipolar Bipolar	VerSys	4	246	0.7 (0.1, 4.6)	2.2 (0.7, 6.8)	2.2 (0.7, 6.8)	2.2 (0.7, 6.8)	2.2 (0.7, 6.8)	
Multipolar Bipolar	VerSys Heritage*	11	275	1.7 (0.6, 4.5)	3.2 (1.5, 6.7)	3.2 (1.5, 6.7)	4.0 (2.0, 7.9)	4.0 (2.0, 7.9)	
Ringloc	Mallory-Head	4	120	2.2 (0.6, 8.5)	2.2 (0.6, 8.5)	2.2 (0.6, 8.5)			
Self-Centering	C-Stem	3	113	0.0 (0.0, 0.0)	1.2 (0.2, 8.2)	1.2 (0.2, 8.2)	1.2 (0.2, 8.2)		
Self-Centering	C-Stem AMT	5	162	2.9 (1.1, 7.5)					
Self-Centering	Corail	29	707	4.0 (2.7, 5.9)	5.2 (3.5, 7.5)	5.2 (3.5, 7.5)	5.2 (3.5, 7.5)	6.7 (3.9, 11.5)	
Self-Centering	Elite Plus*	4	238	0.0 (0.0, 0.0)	0.6 (0.1, 3.9)	0.6 (0.1, 3.9)	1.3 (0.3, 5.2)	2.5 (0.8, 7.8)	2.5 (0.8, 7.8)
Tandem	Basis*	14	114	2.0 (0.5, 7.7)	7.5 (3.6, 15.1)	12.3 (7.0, 21.3)			
Tandem	CPCS	37	1499	1.7 (1.1, 2.6)	2.4 (1.6, 3.5)	3.0 (2.1, 4.3)	3.7 (2.6, 5.4)	4.7 (3.2, 6.9)	5.3 (3.6, 7.8)
Tandem	Spectron EF	8	185	2.4 (0.9, 6.4)	4.1 (1.8, 9.1)	5.0 (2.4, 10.4)	6.2 (3.1, 12.3)	6.2 (3.1, 12.3)	
UHR	ABGII*	20	177	4.3 (2.1, 8.9)	4.3 (2.1, 8.9)	5.1 (2.6, 10.0)	10.8 (6.5, 17.9)	13.4 (8.2, 21.4)	
UHR	Accolade I	17	328	3.0 (1.6, 5.7)	4.3 (2.4, 7.5)	4.8 (2.8, 8.2)	5.4 (3.2, 9.1)	6.4 (3.8, 10.8)	
UHR	Exeter V40	249	8711	2.0 (1.7, 2.4)	2.6 (2.2, 3.0)	3.2 (2.8, 3.6)	3.7 (3.2, 4.2)	4.2 (3.7, 4.9)	5.0 (4.3, 5.9)
UHR	Exeter*	11	205	1.6 (0.5, 4.9)	2.2 (0.8, 5.8)	3.5 (1.6, 7.6)	4.9 (2.5, 9.7)	4.9 (2.5, 9.7)	4.9 (2.5, 9.7)
UHR	GMRS	11	128	3.4 (1.3, 8.7)	4.8 (2.0, 11.5)	4.8 (2.0, 11.5)			
UHR	Omnifit	22	373	4.9 (3.1, 7.8)	5.3 (3.4, 8.3)	5.7 (3.6, 8.7)	6.1 (3.9, 9.3)	7.3 (4.8, 11.1)	7.3 (4.8, 11.1)
Other (238)		114	2528	3.0 (2.4, 3.8)	3.9 (3.1, 4.8)	4.7 (3.8, 5.7)	5.2 (4.3, 6.4)	5.9 (4.8, 7.2)	8.0 (6.4, 10.1)
TOTAL		**762**	**21331**						

Note: Only combinations with over 100 procedures have been listed
*denotes prosthesis combination with no recorded use in primary bipolar hip replacement in 2017

OUTCOME FOR FRACTURED NECK OF FEMUR

The cumulative percent revision at 10 years for primary bipolar hip replacement undertaken for fractured neck of femur is 6.3% (Table HP27 and Figure HP20).

The Registry has recorded 677 revisions of primary bipolar hip replacement procedures with a primary diagnosis of fractured neck of femur.

The main reasons for revision are fracture (24.8%), infection (20.7%), prosthesis dislocation (19.9%), and loosening (16.1%) (Table HP28).

The most frequent type of revision is of the acetabular component only (33.7%), followed by total hip replacement (femoral/acetabular) (23.5%), and bipolar head and femoral stem replacement (13.0%) (Table HP29).

Age is a risk factor for revision. Patients aged less than 75 years have a higher rate of revision compared to the two older age groups (Table HP30 and Figure HP21). There is no difference in outcome between males and females (Table HP31 and Figure HP22).

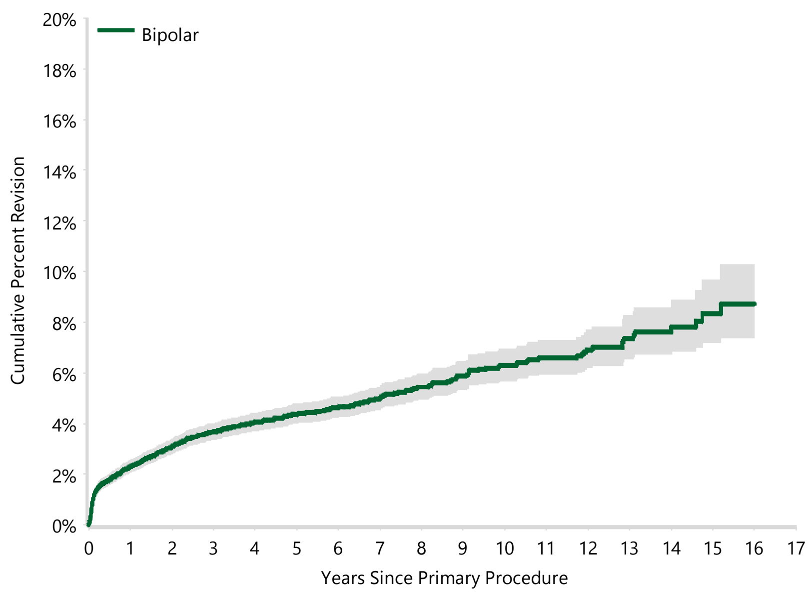
Cementless fixation has a higher rate of revision compared to cemented fixation.

Fixation is a risk factor for revision. Cementless fixation has a higher rate of revision compared to cemented fixation (Table HP32 and Figure HP23). The cumulative incidence of fracture for cementless fixation is higher than for cemented fixation (Figure HP24).

Table HP27 Cumulative Percent Revision of Primary Bipolar Hip Replacement (Primary Diagnosis Fractured NOF)

Hip Type	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Bipolar	677	19560	2.3 (2.1, 2.5)	3.1 (2.8, 3.4)	3.7 (3.4, 4.0)	4.4 (4.0, 4.8)	5.0 (4.6, 5.4)	6.3 (5.7, 6.9)
TOTAL	**677**	**19560**						

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



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Bipolar	19560	13497	10491	8117	5211	3394	1755

Data Period 1 September 1999 – 31 December 2017

Table HP28 Primary Bipolar Hip Replacement by Reason for Revision (Primary Diagnosis Fractured NOF)

Reason for Revision	Number	Percent
Fracture	168	24.8
Infection	140	20.7
Prosthesis Dislocation	135	19.9
Loosening	109	16.1
Chondrolysis/Acetab. Erosion	58	8.6
Pain	47	6.9
Lysis	4	0.6
Malposition	3	0.4
Other	13	1.9
TOTAL	**677**	**100.0**

Table HP29 Primary Bipolar Hip Replacement by Type of Revision (Primary Diagnosis Fractured NOF)

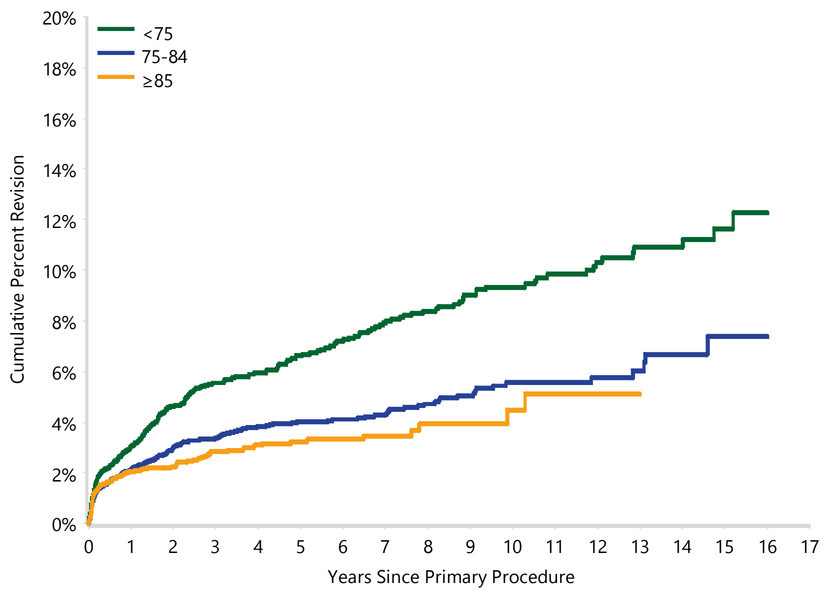
Type of Revision	Number	Percent
Acetabular Component	228	33.7
THR (Femoral/Acetabular)	159	23.5
Bipolar Head and Femoral	88	13.0
Bipolar Only	83	12.3
Femoral Component	38	5.6
Cement Spacer	33	4.9
Removal of Prostheses	18	2.7
Head Only	16	2.4
Minor Components	14	2.1
TOTAL	**677**	**100.0**

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

Table HP30 Cumulative Percent Revision of Primary Bipolar Hip Replacement by Age (Primary Diagnosis Fractured NOF)

Age	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<75	243	3874	3.1 (2.5, 3.7)	4.6 (4.0, 5.4)	5.6 (4.8, 6.4)	6.6 (5.8, 7.6)	7.9 (6.9, 9.1)	9.3 (8.1, 10.7)
75-84	256	7699	2.1 (1.8, 2.5)	3.0 (2.6, 3.4)	3.4 (3.0, 3.9)	4.0 (3.5, 4.6)	4.3 (3.7, 4.9)	5.6 (4.8, 6.5)
≥85	178	7987	2.1 (1.7, 2.4)	2.2 (1.9, 2.6)	2.8 (2.4, 3.3)	3.2 (2.7, 3.8)	3.5 (2.9, 4.2)	4.5 (3.3, 6.1)
TOTAL	**677**	**19560**						

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



HR - adjusted for gender

<75 vs ≥85

0 - 1Yr: HR=1.57 (1.23, 2.01),p<0.001

1Yr - 1.5Yr: HR=3.43 (1.96, 6.01),p<0.001

1.5Yr+: HR=2.41 (1.79, 3.23),p<0.001

75-84 vs ≥85

Entire Period: HR=1.19 (0.98, 1.45),p=0.073

<75 vs 75-84

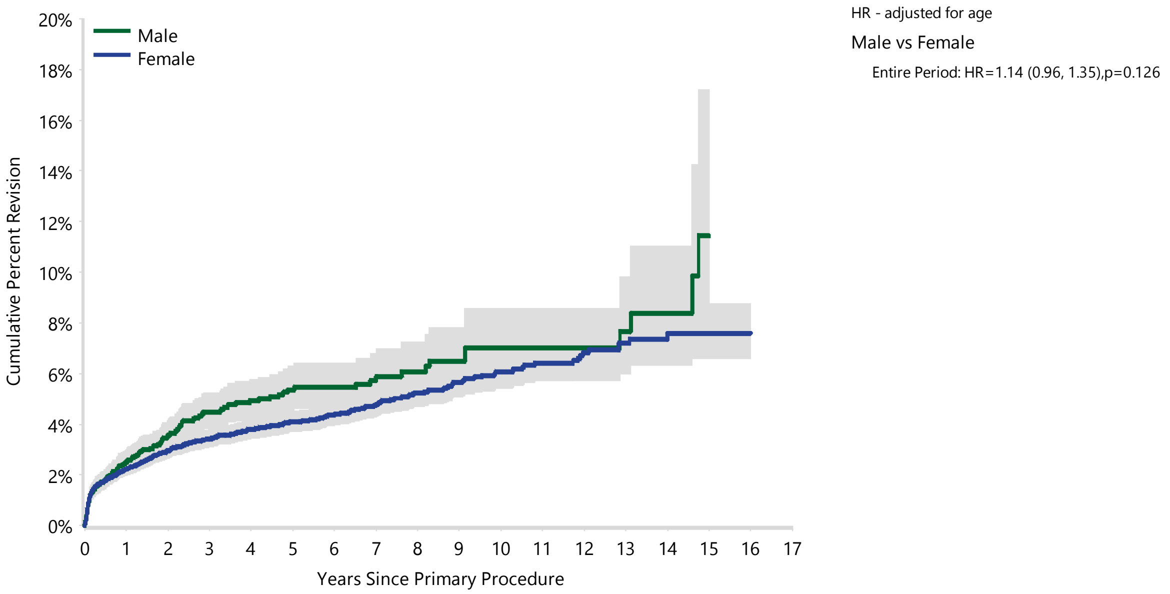
Entire Period: HR=1.65 (1.38, 1.97),p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<75	3874	2946	2445	2044	1574	1212	792
75-84	7699	5652	4529	3636	2466	1630	795
≥85	7987	4899	3517	2437	1171	552	168

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

Gender	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Male	191	5600	2.5 (2.1, 3.0)	3.5 (3.0, 4.2)	4.5 (3.8, 5.2)	5.4 (4.6, 6.3)	5.7 (4.8, 6.8)	7.0 (5.7, 8.6)
Female	486	13960	2.2 (2.0, 2.5)	3.0 (2.7, 3.3)	3.4 (3.1, 3.8)	4.1 (3.7, 4.5)	4.7 (4.3, 5.2)	6.1 (5.4, 6.8)
TOTAL	**677**	**19560**						

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

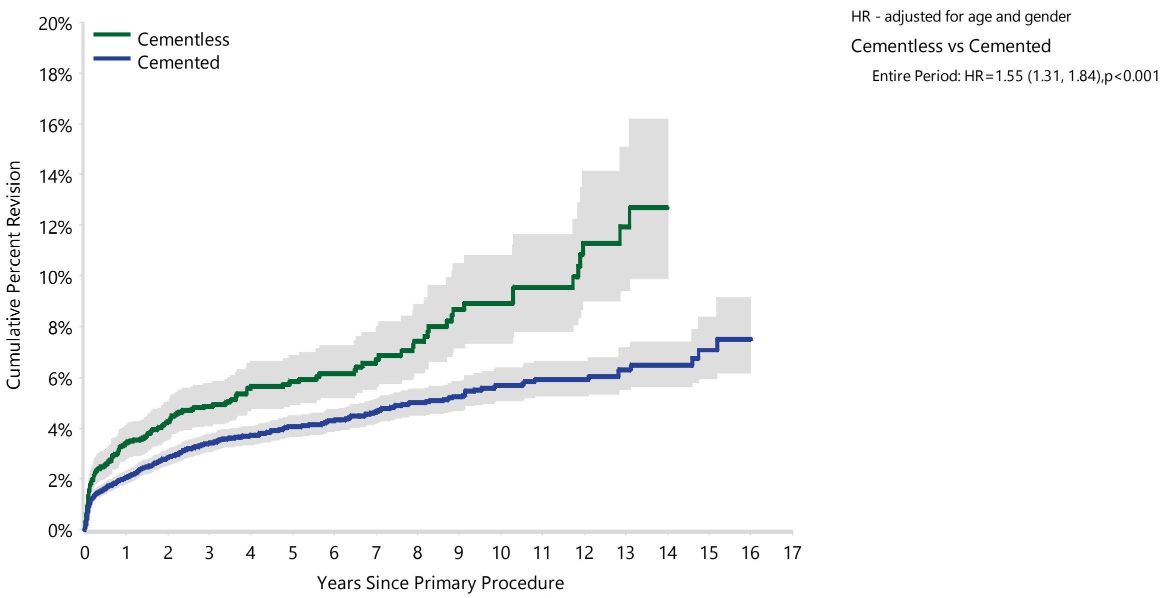


Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Male	5600	3353	2426	1719	1002	605	302
Female	13960	10144	8065	6398	4209	2789	1453

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

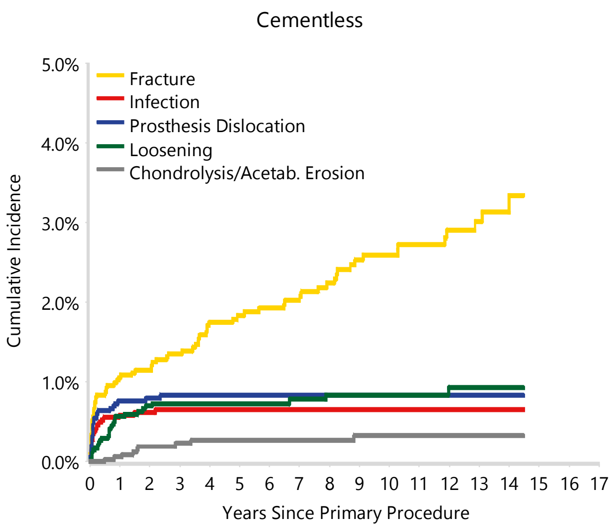
Femoral Fixation	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Cementless	176	3485	3.4 (2.8, 4.1)	4.2 (3.6, 5.1)	4.9 (4.1, 5.8)	5.8 (4.9, 6.9)	6.6 (5.5, 7.8)	8.9 (7.3, 10.8)
Cemented	501	16075	2.1 (1.8, 2.3)	2.8 (2.6, 3.1)	3.4 (3.1, 3.8)	4.1 (3.7, 4.5)	4.6 (4.2, 5.1)	5.7 (5.1, 6.4)
TOTAL	**677**	**19560**						

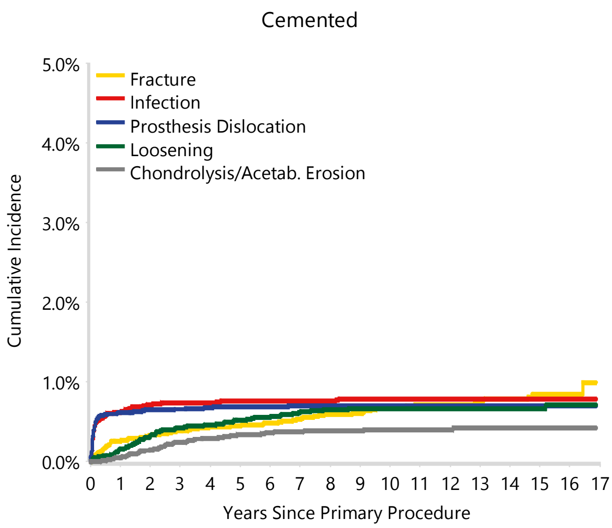
Figure HP23 Cumulative Percent Revision of Primary Bipolar Hip Replacement by Femoral Fixation (Primary Diagnosis Fractured NOF)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Cementless	3485	2456	1980	1577	991	612	318
Cemented	16075	11041	8511	6540	4220	2782	1437

Figure HP24 Cumulative Incidence Revision Diagnosis of Primary Bipolar Hip Replacement by Femoral Fixation (Primary Diagnosis Fractured NOF)





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 and Shoulder Arthroplasty' on the AOANJRR website:
https://aoanjrr.sahmri.com/annual-reports-2018

USE OF TOTAL HIP REPLACEMENT

The Registry has recorded 437,605 primary total hip replacement procedures. Of these, total conventional is the most common class (96.0%), followed by total resurfacing (4.0%) (Table HT1).

Table HT1 Primary Total Hip Replacement by Class

Total Hip Class	Number	Percent
Total Conventional	420260	96.0
Total Resurfacing	17345	4.0
TOTAL	**437605**	**100.0**

Osteoarthritis is the principal diagnosis for primary total hip replacement (88.7%).

Total conventional hip replacement (all bearing surfaces included) has a lower cumulative percent revision compared to total resurfacing at 17 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	17 Yrs
Total Conventional	19200	420260	1.7 (1.7, 1.8)	2.8 (2.7, 2.8)	3.8 (3.7, 3.8)	6.6 (6.5, 6.7)	9.7 (9.5, 9.9)	10.8 (10.5, 11.1)
Total Resurfacing	1656	17345	1.7 (1.5, 1.9)	3.3 (3.0, 3.5)	5.0 (4.7, 5.4)	9.6 (9.1, 10.1)	13.1 (12.4, 13.8)	13.7 (12.9, 14.5)
TOTAL	**20856**	**437605**						

PRIMARY TOTAL CONVENTIONAL HIP REPLACEMENT

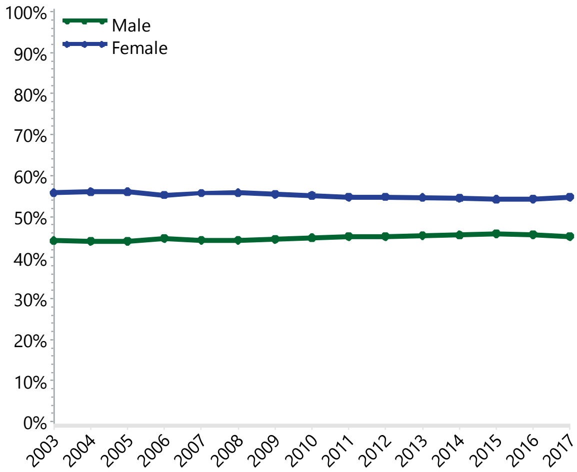
DEMOGRAPHICS

There have been 420,260 total conventional hip replacement procedures reported to the Registry. This is an additional 37,137 procedures compared to the previous report.

There was a small increase of 2.0% in primary total conventional hip replacement performed in 2017 compared to the previous year. There has been a 115.5% increase since 2003.

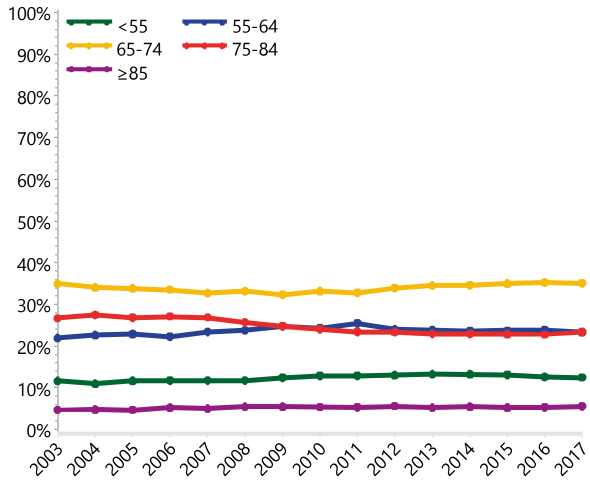
Total conventional hip replacement is more common in females (55.0%). This proportion has remained stable since 2003 (Figure HT1).

Figure HT1 Primary Total Conventional Hip Replacement by Gender



The mean age of patients is 67.7 years. There has been minimal change in the proportion of patients aged 55 to 64 years (21.9% in 2003 to 23.3% in 2017) and patients younger than 55 years (11.7% in 2003 to 12.5% in 2017) (Table HT3 and Figure HT2).

Figure HT2 Primary Total Conventional Hip Replacement by Age



The use of cementless fixation has increased from 51.3% in 2003 to 63.1% in 2017. Cemented fixation has declined from 13.9% to 3.2% and hybrid fixation from 34.8% to 33.6% over the same period (Figure HT3).

Figure HT3 Primary Total Conventional Hip Replacement by Fixation

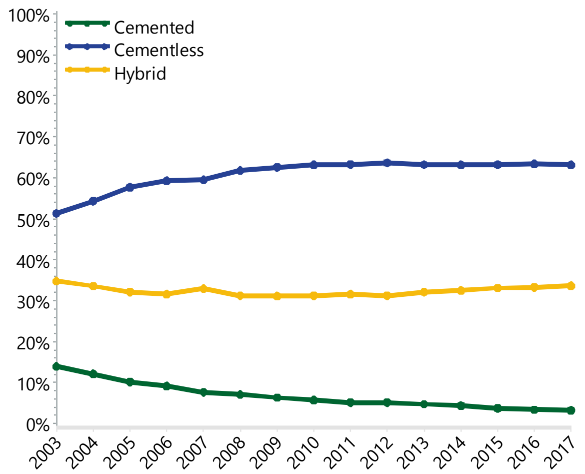


Table HT3 Age and Gender of Primary Total Conventional Hip Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	189189	45.0%	12	102	67	66.3	11.5
Female	231071	55.0%	11	101	70	68.9	11.4
TOTAL	**420260**	**100.0%**	**11**	**102**	**69**	**67.7**	**11.5**

The Exeter V40, Corail, Quadra-H, and Polarstem are the most used femoral stems for total conventional hip replacement (Table HT4). In 2017, 64.7% of 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 Tables HT5 and HT6, respectively. In 2017, the 10 most used cemented stems account for 92.9% of cemented stem procedures. The 10 most used cementless stems account for 72.0% of cementless stem procedures.

The Trident (Shell), Pinnacle, and R3 remain the most frequently used acetabular prostheses for total conventional hip replacement. In 2017, 79.5% of 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 Tables HT8 and HT9.

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

2003		2014		2015		2016		2017	
N	Model	N	Model	N	Model	N	Model	N	Model
3901	Exeter V40	7408	Exeter V40	7464	Exeter V40	7488	Exeter V40	7201	Exeter V40
1029	ABGII	5037	Corail	5420	Corail	5849	Corail	5318	Corail
1000	Synergy	2917	Quadra-H	2843	Quadra-H	2752	Quadra-H	1915	Quadra-H
819	Alloclassic	1565	CPT	1519	Polarstem	1822	Polarstem	1906	Polarstem
809	VerSys	1202	Polarstem	1303	CPT	1323	Accolade II	1811	Accolade II
780	Spectron EF	841	Anthology	905	Accolade II	1231	CPT	1570	Metafix
713	Secur-Fit Plus	727	CPCS	844	Taperloc	985	Taperloc	1212	CPT
618	Omnifit	716	Secur-Fit	814	CPCS	804	CPCS	1007	AMIStem H
565	C-Stem	715	Taperloc	779	Anthology	784	AMIStem H	1005	Taperloc
485	S-Rom	574	Synergy	579	Tri-Fit TS	783	Tri-Fit TS	852	C-Stem AMT
10 Most Used									
10719	(10) 62.8%	21702	(10) 67.3%	22470	(10) 66.1%	23821	(10) 66.0%	23797	(10) 64.7%
Remainder									
6354	(73) 37.2%	10540	(109) 32.7%	11533	(99) 33.9%	12260	(90) 34.0%	12992	(92) 35.3%
TOTAL									
17073	(83) 100.0%	32242	(119) 100.0%	34003	(109) 100.0%	36081	(100) 100.0%	36789	(102) 100.0%

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

2003		2014		2015		2016		2017	
N	Model	N	Model	N	Model	N	Model	N	Model
3901	Exeter V40	7408	Exeter V40	7464	Exeter V40	7488	Exeter V40	7201	Exeter V40
780	Spectron EF	1565	CPT	1303	CPT	1231	CPT	1212	CPT
565	C-Stem	727	CPCS	814	CPCS	804	CPCS	852	C-Stem AMT
477	CPT	382	C-Stem AMT	412	C-Stem AMT	619	C-Stem AMT	840	CPCS
445	Elite Plus	276	Spectron EF	332	MS 30	506	Short Exeter V40	550	Short Exeter V40
358	MS 30	237	MS 30	286	Quadra-C	412	Quadra-C	533	Quadra-C
338	Omnifit	189	Quadra-C	270	Evolve	369	Evolve	427	Evolve
321	Charnley	185	Omnifit	263	Short Exeter V40	353	MS 30	389	MS 30
245	CPCS	157	Evolve	241	Spectron EF	227	Taper Fit	301	Taper Fit
123	Exeter	123	Absolut	161	E2	181	Spectron EF	231	Absolut
10 Most Used									
7553 (10) 91.7%		11249 (10) 95.3%		11546 (10) 92.8%		12190 (10) 92.8%		12536 (10) 92.9%	
Remainder									
680 (26) 8.3%		559 (28) 4.7%		890 (24) 7.2%		939 (17) 7.2%		954 (21) 7.1%	
TOTAL									
8233 (36) 100.0%		11808 (38) 100.0%		12436 (34) 100.0%		13129 (27) 100.0%		13490 (31) 100.0%	

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

2003		2014		2015		2016		2017	
N	Model	N	Model	N	Model	N	Model	N	Model
1029	ABGII	5037	Corail	5420	Corail	5849	Corail	5318	Corail
980	Synergy	2917	Quadra-H	2843	Quadra-H	2752	Quadra-H	1915	Quadra-H
819	Alloclassic	1202	Polarstem	1519	Polarstem	1822	Polarstem	1906	Polarstem
739	VerSys	841	Anthology	905	Accolade II	1323	Accolade II	1811	Accolade II
713	Secur-Fit Plus	716	Secur-Fit	844	Taperloc	985	Taperloc	1570	Metafix
485	S-Rom	715	Taperloc	779	Anthology	784	AMIStem H	1007	AMIStem H
482	Secur-Fit	574	Synergy	579	Tri-Fit TS	783	Tri-Fit TS	1005	Taperloc
376	Corail	530	M/L Taper	565	Avenir	696	Anthology	790	Tri-Fit TS
334	Accolade I	523	Accolade II	551	Secur-Fit	642	Metafix	779	Paragon
334	Mallory-Head	478	Summit	474	Metafix	542	Paragon	667	Anthology
10 Most Used									
6291 (10) 71.2%		13533 (10) 66.2%		14479 (10) 67.1%		16178 (10) 70.5%		16768 (10) 72.0%	
Remainder									
2549 (47) 28.8%		6901 (81) 33.8%		7088 (75) 32.9%		6774 (71) 29.5%		6531 (69) 28.0%	
TOTAL									
8840 (57) 100.0%		20434 (91) 100.0%		21567 (85) 100.0%		22952 (81) 100.0%		23299 (79) 100.0%	

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

2003		2014		2015		2016		2017	
N	Model	N	Model	N	Model	N	Model	N	Model
3986	Trident (Shell)	7347	Trident (Shell)	7472	Trident (Shell)	7827	Trident (Shell)	7999	Trident (Shell)
1748	Reflection (Shell)	6159	Pinnacle	6616	Pinnacle	6922	Pinnacle	6505	Pinnacle
1524	Trilogy	3450	R3	3634	R3	3754	R3	3754	R3
955	Vitalock	2821	Versafitcup CC	3028	Versafitcup CC	2748	Versafitcup CC	2925	Trinity
907	Duraloc	1492	Continuum	1573	Trinity	1978	Trinity	2032	Versafitcup CC
827	ABGII	1321	Trinity	1359	Continuum	1318	Continuum	1378	Mpact
793	Allofit	1092	Trilogy	892	Trilogy	1133	Mpact	1271	Continuum
729	Mallory-Head	652	Exeter X3 Rimfit	768	Trident/Tritanium (Shell)	1101	Trident/Tritanium (Shell)	1232	Logical G
539	Contemporary	648	Trident/Tritanium (Shell)	634	Acetabular Shell (Global)	795	Logical G	1119	Trident/Tritanium (Shell)
537	Pinnacle	611	Allofit	608	Exeter X3 Rimfit	756	Acetabular Shell (Global)	1035	G7
10 Most Used									
12545	(10) 73.5%	25593	(10) 79.4%	26584	(10) 78.2%	28332	(10) 78.5%	29250	(10) 79.5%
Remainder									
4528	(69) 26.5%	6649	(77) 20.6%	7419	(67) 21.8%	7749	(69) 21.5%	7539	(68) 20.5%
TOTAL									
17073	(79) 100.0%	32242	(87) 100.0%	34003	(77) 100.0%	36081	(79) 100.0%	36789	(78) 100.0%

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

2003		2014		2015		2016		2017	
N	Model	N	Model	N	Model	N	Model	N	Model
539	Contemporary	652	Exeter X3 Rimfit	608	Exeter X3 Rimfit	537	Exeter X3 Rimfit	502	Exeter X3 Rimfit
256	Exeter	234	Contemporary	181	Contemporary	139	Contemporary	103	Marathon
251	Reflection (Cup)	135	Marathon	130	Marathon	118	Marathon	94	Contemporary
227	Exeter Contemporary	104	ZCA	104	ZCA	105	Exeter Contemporary	93	ZCA
199	Charnley Ogee	75	Reflection (Cup)	81	Reflection (Cup)	77	ZCA	66	Exeter Contemporary
149	Elite Plus LPW	59	Exeter Contemporary	52	Exeter Contemporary	65	Reflection (Cup)	64	Reflection (Cup)
130	Low Profile Cup	37	Brunswick	21	CCB	37	Muller	47	Avantage
110	Elite Plus Ogee	19	CCB	20	Low Profile Cup	24	Avantage	45	Novae E
102	Charnley	19	Low Profile Cup	17	Muller	17	Low Profile Cup	38	Muller
90	ZCA	12	Polarcup	12	Polarcup	15	Polarcup	26	Apricot
10 Most Used									
2053	(10) 85.4%	1346	(10) 94.7%	1226	(10) 96.2%	1134	(10) 92.8%	1078	(10) 90.3%
Remainder									
351	(16) 14.6%	75	(17) 5.3%	49	(14) 3.8%	88	(14) 7.2%	116	(21) 9.7%
TOTAL									
2404	(26) 100.0%	1421	(27) 100.0%	1275	(24) 100.0%	1222	(24) 100.0%	1194	(31) 100.0%

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

2003		2014		2015		2016		2017	
N	Model	N	Model	N	Model	N	Model	N	Model
3986	Trident (Shell)	7347	Trident (Shell)	7471	Trident (Shell)	7825	Trident (Shell)	7999	Trident (Shell)
1748	Reflection (Shell)	6159	Pinnacle	6616	Pinnacle	6922	Pinnacle	6505	Pinnacle
1524	Trilogy	3450	R3	3634	R3	3754	R3	3753	R3
955	Vitalock	2821	Versafitcup CC	3027	Versafitcup CC	2748	Versafitcup CC	2925	Trinity
907	Duraloc	1492	Continuum	1573	Trinity	1978	Trinity	2032	Versafitcup CC
827	ABGII	1321	Trinity	1359	Continuum	1318	Continuum	1378	Mpact
793	Allofit	1092	Trilogy	892	Trilogy	1133	Mpact	1270	Continuum
729	Mallory-Head	648	Trident/ Tritanium (Shell)	768	Trident/ Tritanium (Shell)	1101	Trident/ Tritanium (Shell)	1232	Logical G
537	Pinnacle	611	Allofit	634	Acetabular Shell (Global)	795	Logical G	1119	Trident/ Tritanium (Shell)
521	Fitmore	454	Acetabular Shell (Global)	539	G7	756	Acetabular Shell (Global)	1034	G7
10 Most Used									
12527	(10) 85.4%	25395	(10) 82.4%	26513	(10) 81.0%	28330	(10) 81.3%	29247	(10) 82.2%
Remainder									
2142	(43) 14.6%	5426	(55) 17.6%	6215	(52) 19.0%	6529	(53) 18.7%	6348	(48) 17.8%
TOTAL									
14669	(53) 100.0%	30821	(65) 100.0%	32728	(62) 100.0%	34859	(63) 100.0%	35595	(58) 100.0%

Note: Three shells have not been included because a cemented component was used

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 less than 3.9%) and has a much higher rate of revision than other bearing surfaces (29.7% at 15 years). In addition, metal/metal was also preferentially used in younger patients with cementless fixation and with particular femoral stem and acetabular prosthesis combinations.

For this year's report the Registry has excluded all metal/metal bearing surfaces (including those less than or equal to 32mm in diameter) from comparative analyses. Small head metal/metal has only been used in three procedures in 2017 and makes up a small proportion of all primary total conventional hip replacement procedures (1.4%).

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 (88.4%), followed by fractured neck of femur (4.5%), osteonecrosis (3.3%), developmental dysplasia (1.2%) and rheumatoid arthritis (1.0%) (Table HT10).

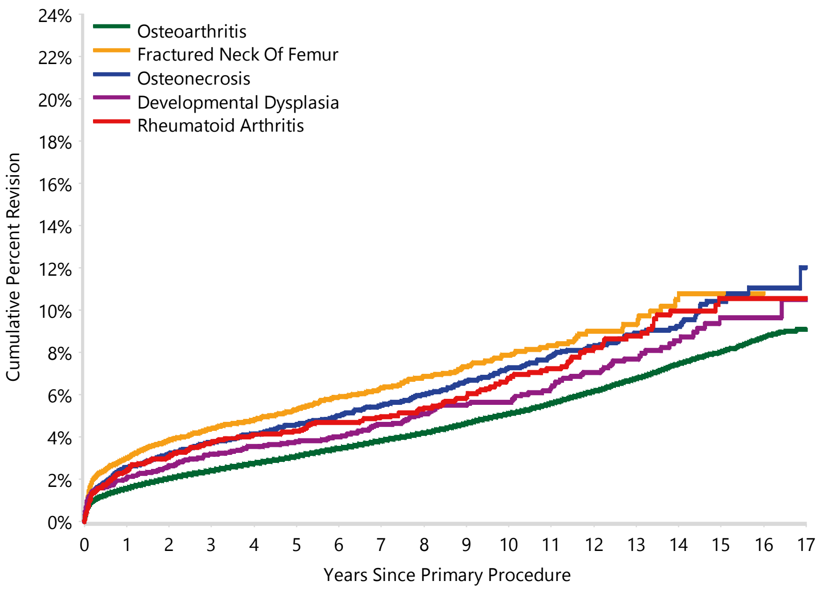
Osteoarthritis has a lower rate of revision compared to fractured neck of femur, osteonecrosis and rheumatoid arthritis. It also has a lower rate of revision compared to developmental dysplasia. However, this difference is only evident in the first two weeks (Figure HT4).

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	17 Yrs
Osteoarthritis	12907	351926	1.6 (1.5, 1.6)	2.4 (2.4, 2.5)	3.1 (3.0, 3.2)	5.1 (5.0, 5.2)	8.0 (7.8, 8.2)	9.1 (8.8, 9.4)
Fractured Neck Of Femur	865	17985	3.0 (2.8, 3.3)	4.4 (4.1, 4.7)	5.3 (4.9, 5.7)	7.9 (7.2, 8.6)	10.8 (9.3, 12.5)	
Osteonecrosis	680	12968	2.6 (2.3, 2.9)	3.7 (3.4, 4.1)	4.6 (4.2, 5.0)	7.3 (6.7, 7.9)	10.4 (9.3, 11.6)	12.0 (9.9, 14.5)
Developmental Dysplasia	235	4934	2.1 (1.7, 2.5)	3.2 (2.7, 3.7)	3.8 (3.2, 4.4)	5.6 (4.9, 6.5)	9.6 (8.1, 11.4)	10.5 (8.4, 13.0)
Rheumatoid Arthritis	218	3854	2.4 (2.0, 3.0)	3.7 (3.2, 4.4)	4.3 (3.7, 5.0)	6.8 (5.8, 7.9)	10.6 (8.9, 12.5)	10.6 (8.9, 12.5)
Tumour	120	2261	4.5 (3.6, 5.5)	7.3 (5.9, 9.1)	8.9 (7.1, 11.0)	13.5 (10.0, 18.0)		
Other (5)	256	4220	3.4 (2.9, 4.0)	4.9 (4.3, 5.7)	5.9 (5.2, 6.8)	8.6 (7.4, 9.9)	11.8 (9.8, 14.2)	
TOTAL	**15281**	**398148**						

Note: All procedures using metal/metal prostheses have been excluded
Only primary diagnoses with over 2000 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, 1.91),p<0.001

Osteonecrosis vs Osteoarthritis
0 - 6Mth: HR=1.44 (1.26, 1.64),p<0.001
6Mth - 9Mth: HR=2.63 (1.99, 3.47),p<0.001
9Mth+: HR=1.28 (1.16, 1.42),p<0.001

Developmental Dysplasia vs Osteoarthritis
0 - 2Wk: HR=1.97 (1.33, 2.90),p<0.001
2Wk - 1Mth: HR=1.41 (0.97, 2.07),p=0.074
1Mth+: HR=1.07 (0.92, 1.24),p=0.401

Rheumatoid Arthritis vs Osteoarthritis
Entire Period: HR=1.34 (1.17, 1.53),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Osteoarthritis	351926	311600	241193	179580	68937	12630	1453
Fractured Neck Of Femur	17985	14077	9377	5917	1352	165	12
Osteonecrosis	12968	11263	8645	6512	2645	543	76
Developmental Dysplasia	4934	4329	3373	2673	1281	333	40
Rheumatoid Arthritis	3854	3514	2881	2317	1110	277	48

Note: Only primary diagnoses with over 2500 procedures have been listed

PROSTHESIS TYPES

There are 3,064 different stem and acetabular combinations for primary total conventional hip replacement recorded by the Registry. This is an additional 220 prosthesis combinations since the previous report. All metal/metal prostheses are included in these combinations.

The cumulative percent revision of the 121 prosthesis combinations with more than 500 procedures is listed in Tables HT11 to HT13. Although the listed combinations are a small proportion of the possible combinations, they represent 82.3% 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 17.7% of all primary total conventional hip replacement procedures.

There are 10 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 5.7% (Table HT11).

There are 77 cementless total conventional stem and acetabular combinations listed. The Secur-Fit Plus/Trident (Shell) has the lowest 17 year cumulative percent revision of 4.5% (Table HT12).

There are 34 combinations of total conventional hip replacement prostheses with hybrid fixation. The Exeter/Vitalock has the lowest cumulative percent revision at 17 years (8.0%) (Table HT13).

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

Femoral Component	Acetabular Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
CPCS	Reflection (Cup)	69	955	1.5 (0.9, 2.6)	2.7 (1.8, 4.0)	3.4 (2.4, 5.0)	8.6 (6.4, 11.4)		
CPT	ZCA	38	951	0.7 (0.4, 1.6)	2.1 (1.3, 3.3)	2.8 (1.9, 4.2)	5.0 (3.5, 7.2)	7.9 (5.3, 11.6)	
Charnley	Charnley Ogee*	64	709	1.0 (0.5, 2.1)	3.0 (1.9, 4.5)	4.8 (3.4, 6.7)	8.7 (6.6, 11.3)	13.7 (10.5, 17.6)	
Charnley	Charnley*	41	591	0.5 (0.2, 1.6)	1.0 (0.5, 2.3)	2.2 (1.2, 3.8)	6.2 (4.4, 8.8)	11.1 (8.0, 15.3)	
Exeter V40	Contemporary	296	5513	1.7 (1.4, 2.1)	3.0 (2.5, 3.5)	3.6 (3.1, 4.2)	6.3 (5.5, 7.1)	9.8 (8.4, 11.4)	
Exeter V40	Exeter Contemporary	155	3350	1.4 (1.1, 1.9)	2.3 (1.9, 2.9)	3.1 (2.5, 3.8)	5.0 (4.2, 5.9)	9.9 (7.3, 13.3)	
Exeter V40	Exeter X3 Rimfit	79	3463	1.4 (1.1, 1.9)	2.4 (1.9, 3.0)	2.7 (2.2, 3.5)			
Exeter V40	Exeter*	96	1712	0.8 (0.5, 1.4)	1.9 (1.3, 2.7)	3.1 (2.4, 4.1)	5.0 (4.0, 6.3)	9.4 (7.4, 11.9)	
MS 30	Low Profile Cup	23	721	0.7 (0.3, 1.7)	0.9 (0.4, 1.9)	1.4 (0.7, 2.7)	2.9 (1.7, 4.8)	5.7 (3.5, 9.2)	
Spectron EF	Reflection (Cup)	123	1657	1.1 (0.7, 1.8)	1.8 (1.2, 2.5)	2.8 (2.1, 3.7)	7.3 (5.9, 9.0)	16.3 (13.2, 19.9)	
Other (486)		577	10146	1.8 (1.6, 2.1)	2.9 (2.5, 3.2)	4.0 (3.6, 4.4)	6.8 (6.2, 7.5)	11.5 (10.5, 12.6)	13.0 (11.7, 14.5)
TOTAL		**1561**	**29768**						

Note: Some cementless components have been cemented
Procedures using large head metal/metal prostheses have been included
* denotes prosthesis combination that has not been used in 2017
Only prostheses with over 500 procedures have been listed

Table HT12 Cumulative Percent Revision of Primary Total Conventional Hip Replacement with Cementless Fixation

Femoral Component	Acetabular Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
ABGII	ABGII	272	2974	1.8 (1.4, 2.4)	3.1 (2.5, 3.8)	4.2 (3.5, 5.0)	6.8 (5.9, 7.9)	11.5 (10.2, 13.0)	14.4 (11.7, 17.8)
ABGII	ABGII (Shell/Insert)	66	900	1.4 (0.8, 2.5)	2.3 (1.5, 3.5)	2.8 (1.9, 4.2)	6.7 (5.1, 8.7)		
ABGII	Trident (Shell)	224	2546	2.8 (2.3, 3.6)	4.4 (3.6, 5.2)	5.3 (4.4, 6.2)	9.0 (7.8, 10.3)	14.1 (12.0, 16.5)	
AMIStem H	Versafitcup CC	30	1832	1.1 (0.7, 1.8)	1.7 (1.0, 3.1)	3.5 (1.7, 7.2)			
Accolade I	Trident (Shell)	477	9288	1.7 (1.5, 2.0)	3.0 (2.7, 3.4)	3.8 (3.4, 4.2)	5.7 (5.2, 6.2)	7.5 (6.6, 8.5)	
Accolade I	Trident/Tritanium (Shell)*	30	756	1.3 (0.7, 2.4)	2.4 (1.5, 3.8)	3.6 (2.4, 5.2)			
Accolade II	Trident (Shell)	61	3738	1.5 (1.1, 1.9)	2.0 (1.6, 2.7)				
Accolade II	Trident/Tritanium (Shell)	25	878	3.0 (1.9, 4.6)					
Alloclassic	Allofit	301	5791	1.4 (1.2, 1.8)	2.3 (2.0, 2.7)	3.1 (2.7, 3.6)	5.4 (4.8, 6.1)	9.2 (7.9, 10.6)	
Alloclassic	Durom* MoM	95	621	1.3 (0.7, 2.6)	5.0 (3.5, 7.0)	7.1 (5.3, 9.4)	15.3 (12.5, 18.7)		
Alloclassic	Fitmore*	132	1883	3.3 (2.6, 4.2)	4.6 (3.8, 5.7)	5.6 (4.7, 6.8)	7.4 (6.3, 8.8)	9.0 (7.3, 11.0)	
Alloclassic	Trabecular Metal (Shell)	46	1065	2.4 (1.6, 3.5)	3.0 (2.1, 4.2)	4.1 (3.0, 5.5)	4.7 (3.5, 6.3)		
Alloclassic	Trilogy	17	955	0.6 (0.3, 1.4)	0.9 (0.4, 1.7)	1.1 (0.6, 2.1)	2.6 (1.6, 4.3)		
Anthology	R3	141	6110	1.7 (1.4, 2.1)	2.1 (1.8, 2.6)	2.4 (2.0, 2.9)			
Anthology	Reflection (Shell)	36	991	1.8 (1.2, 2.9)	2.1 (1.4, 3.3)	3.0 (2.1, 4.3)	4.3 (3.1, 5.9)		
Apex	Fin II*	46	1008	1.9 (1.2, 2.9)	2.5 (1.7, 3.7)	3.8 (2.7, 5.2)	5.7 (4.2, 7.7)		
Avenir	Continuum	31	1282	2.2 (1.5, 3.1)	2.4 (1.6, 3.4)	2.7 (1.8, 4.1)			
Avenir	Trilogy	8	624	1.0 (0.4, 2.1)	1.1 (0.5, 2.4)	1.4 (0.7, 2.7)			
C2	Delta-TT	17	691	1.2 (0.6, 2.4)	2.3 (1.4, 3.9)	3.2 (2.0, 5.3)			
CL2	C2	17	561	2.5 (1.5, 4.3)	2.8 (1.6, 4.7)	3.4 (1.9, 5.8)			
CLS	Allofit	56	866	1.5 (0.9, 2.6)	3.3 (2.3, 4.8)	3.7 (2.6, 5.3)	6.2 (4.7, 8.2)	10.5 (7.5, 14.6)	
CLS	Fitmore	50	815	2.0 (1.2, 3.2)	4.0 (2.8, 5.6)	4.5 (3.2, 6.2)	5.9 (4.4, 8.1)	9.2 (6.9, 12.3)	
Citation	Trident (Shell)*	54	1147	1.7 (1.1, 2.7)	2.5 (1.8, 3.6)	3.3 (2.4, 4.5)	4.3 (3.2, 5.6)	6.1 (4.5, 8.3)	
Citation	Vitalock*	49	555	0.5 (0.2, 1.7)	2.2 (1.2, 3.8)	2.8 (1.7, 4.5)	6.9 (5.0, 9.5)	10.9 (8.3, 14.4)	
Corail	ASR* MoM	1255	2901	2.2 (1.7, 2.8)	11.2 (10.1, 12.4)	27.0 (25.4, 28.7)	45.9 (44.0, 47.9)		
Corail	DeltaMotion	24	1183	1.0 (0.6, 1.8)	1.8 (1.1, 2.8)	2.4 (1.5, 3.8)			
Corail	Duraloc*	89	1433	1.4 (0.9, 2.2)	2.3 (1.6, 3.2)	2.9 (2.2, 4.0)	6.1 (4.8, 7.7)	10.8 (8.5, 13.7)	
Corail	Pinnacle	1337	42405	1.8 (1.7, 1.9)	2.7 (2.6, 2.9)	3.4 (3.2, 3.6)	5.6 (5.1, 6.1)		
Corail	Pinnacle* MoM	110	966	2.2 (1.4, 3.3)	3.7 (2.6, 5.1)	5.9 (4.6, 7.6)	12.8 (10.6, 15.4)		
Epoch	Trilogy*	45	1021	2.5 (1.7, 3.6)	3.4 (2.4, 4.7)	3.7 (2.7, 5.0)	4.4 (3.3, 5.9)		
F2L	SPH-Blind*	61	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)	11.4 (8.9, 14.6)	

Femoral Component	Acetabular Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
H-Max	Delta-TT	37	1203	1.7 (1.1, 2.6)	3.2 (2.3, 4.5)	4.0 (2.8, 5.7)			
M/L Taper	Allofit	18	742	1.7 (0.9, 2.9)	2.0 (1.2, 3.3)	2.2 (1.3, 3.7)			
M/L Taper	Continuum	38	1303	2.0 (1.3, 2.9)	2.9 (2.1, 4.0)	3.3 (2.4, 4.5)			
M/L Taper	Trilogy	25	833	1.3 (0.7, 2.4)	1.6 (0.9, 2.8)	3.1 (2.0, 4.7)	4.1 (2.7, 6.1)		
M/L Taper Kinectiv	Continuum	73	2168	2.1 (1.5, 2.8)	3.0 (2.4, 3.9)	3.6 (2.8, 4.5)			
Mallory-Head	Mallory-Head	177	3010	1.8 (1.4, 2.4)	2.3 (1.8, 2.9)	3.1 (2.6, 3.8)	5.2 (4.3, 6.1)	9.9 (8.3, 11.7)	10.8 (8.8, 13.1)
Metafix	Trinity	64	3680	1.7 (1.3, 2.2)	2.2 (1.7, 2.9)	2.3 (1.8, 3.1)			
MiniHip	Trinity	25	780	2.9 (1.9, 4.4)	3.5 (2.3, 5.1)	3.5 (2.3, 5.1)			
Nanos	R3	8	658	0.8 (0.3, 1.8)	1.1 (0.5, 2.2)	1.1 (0.5, 2.2)			
Natural Hip	Fitmore*	41	889	1.0 (0.5, 1.9)	1.6 (0.9, 2.7)	2.4 (1.6, 3.7)	4.6 (3.3, 6.3)	5.4 (3.9, 7.3)	
Omnifit	Secur-Fit*	63	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)	14.4 (11.3, 18.2)	
Omnifit	Trident (Shell)	78	1280	1.9 (1.3, 2.8)	3.2 (2.3, 4.3)	4.0 (3.1, 5.3)	5.5 (4.3, 7.0)	7.7 (6.1, 9.7)	
Origin	Logical G	18	933	1.9 (1.2, 3.1)	2.5 (1.5, 4.1)				
Paragon	Acetabular Shell (Global)	16	1345	1.1 (0.6, 1.8)	1.4 (0.8, 2.3)				
Polarstem	EP-Fit Plus	6	1363	0.3 (0.1, 0.9)	0.5 (0.2, 1.2)	0.8 (0.3, 2.3)			
Polarstem	R3	178	7337	1.9 (1.6, 2.2)	2.6 (2.2, 3.1)	3.2 (2.7, 3.7)			
Profemur L	Dynasty	37	1069	3.4 (2.5, 4.8)	4.2 (3.0, 6.0)				
Quadra-H	Mpact	46	2101	1.6 (1.1, 2.2)	2.8 (2.0, 4.0)	3.9 (2.7, 5.7)			
Quadra-H	Trident (Shell)	18	692	1.4 (0.7, 2.6)	2.3 (1.3, 4.0)	4.0 (2.2, 7.2)			
Quadra-H	Versafitcup CC	402	13928	1.8 (1.6, 2.0)	2.6 (2.4, 2.9)	3.1 (2.8, 3.5)	8.7 (5.9, 12.8)		
S-Rom	Duraloc Option*	33	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)	5.2 (3.7, 7.3)	
S-Rom	Pinnacle	169	3301	2.4 (2.0, 3.0)	3.9 (3.3, 4.6)	4.5 (3.8, 5.3)	6.2 (5.3, 7.3)		
SL-Plus	EP-Fit Plus	117	2300	1.7 (1.2, 2.3)	2.7 (2.1, 3.5)	3.5 (2.8, 4.3)	5.4 (4.5, 6.5)		
SL-Plus	R3	75	1656	2.3 (1.7, 3.2)	3.9 (3.1, 5.0)	4.3 (3.4, 5.4)			
Secur-Fit	DeltaMotion	25	783	0.8 (0.3, 1.7)	2.1 (1.3, 3.5)	2.6 (1.7, 4.0)			
Secur-Fit	Trident (Shell)	380	9642	1.8 (1.5, 2.1)	2.8 (2.5, 3.2)	3.4 (3.1, 3.8)	4.6 (4.1, 5.1)	6.0 (5.2, 6.9)	
Secur-Fit Plus	Trident (Shell)	190	5915	1.2 (1.0, 1.5)	1.9 (1.5, 2.3)	2.3 (2.0, 2.8)	3.4 (2.9, 3.9)	4.5 (3.8, 5.3)	4.5 (3.8, 5.3)
Summit	ASR* MoM	480	1118	1.2 (0.7, 2.0)	6.5 (5.2, 8.1)	19.8 (17.6, 22.3)	44.0 (41.0, 47.1)		
Summit	Pinnacle	118	4688	1.4 (1.1, 1.7)	2.0 (1.6, 2.5)	2.3 (1.9, 2.8)	3.3 (2.7, 4.1)		
Summit	Pinnacle* MoM	67	784	1.5 (0.9, 2.7)	2.2 (1.4, 3.5)	3.4 (2.3, 4.9)	8.6 (6.7, 10.9)		
Synergy	BHR* MoM	96	819	1.6 (0.9, 2.7)	3.1 (2.1, 4.5)	4.8 (3.6, 6.6)	12.1 (9.9, 14.8)		
Synergy	R3	118	4551	1.7 (1.4, 2.1)	2.3 (1.9, 2.8)	2.7 (2.3, 3.3)			

Femoral Component	Acetabular Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Synergy	Reflection (Shell)	350	7966	1.6 (1.3, 1.9)	2.4 (2.1, 2.7)	2.7 (2.4, 3.1)	4.0 (3.6, 4.5)	6.1 (5.4, 6.9)	
Taperloc	Exceed	57	2270	1.4 (1.0, 2.0)	2.3 (1.7, 3.0)	2.4 (1.9, 3.2)			
Taperloc	G7	24	1384	1.8 (1.2, 2.7)	2.0 (1.3, 3.0)				
Taperloc	M2a* MoM	64	512	1.8 (0.9, 3.4)	4.4 (2.9, 6.5)	7.4 (5.4, 10.1)	12.3 (9.6, 15.6)		
Taperloc	Mallory-Head	75	1939	1.8 (1.3, 2.5)	2.5 (1.9, 3.3)	3.0 (2.2, 3.9)	5.1 (3.9, 6.6)	8.5 (6.2, 11.5)	
Taperloc	Recap* MoM	50	500	2.4 (1.4, 4.2)	4.3 (2.8, 6.5)	6.2 (4.4, 8.8)	10.9 (8.3, 14.3)		
Taperloc	Regenerex	13	609	1.5 (0.8, 2.9)	2.1 (1.2, 3.6)	2.4 (1.4, 4.1)			
Taperloc Microplasty	G7	3	577	0.5 (0.2, 1.7)	0.5 (0.2, 1.7)				
Trabecular Metal	Continuum	44	684	5.1 (3.7, 7.1)	6.1 (4.5, 8.2)	6.5 (4.8, 8.6)			
Tri-Fit TS	Trinity	44	2842	1.2 (0.8, 1.7)	1.9 (1.4, 2.6)	2.7 (1.6, 4.6)			
Tri-Lock	DeltaMotion	10	805	0.6 (0.3, 1.5)	0.9 (0.4, 1.8)	1.4 (0.7, 2.5)			
Tri-Lock	Pinnacle	17	786	1.5 (0.8, 2.6)	2.3 (1.4, 3.8)	2.7 (1.6, 4.5)			
VerSys	Trilogy	229	4459	2.5 (2.1, 3.0)	3.4 (2.9, 3.9)	4.0 (3.4, 4.6)	5.1 (4.5, 5.9)	6.1 (5.4, 7.1)	
twinSys	RM Cup	31	1028	2.4 (1.6, 3.5)	3.0 (2.1, 4.4)	3.0 (2.1, 4.4)			
Other (1414)		3220	46100	2.3 (2.2, 2.5)	3.9 (3.8, 4.1)	5.4 (5.1, 5.6)	9.4 (9.0, 9.8)	13.3 (12.7, 13.9)	14.7 (13.9, 15.6)
TOTAL		**12669**	**252907**						

Note: Procedures using metal/metal prostheses have been included
MoM denotes metal/metal prostheses with head size larger than 32mm
* denotes prosthesis combination that has not been used in 2017
Only prostheses with over 500 procedures have been listed

Table HT13 Cumulative Percent Revision of Primary Total Conventional Hip Replacement with Hybrid Fixation

Femoral Component	Acetabular Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
C-Stem	Duraloc*	85	981	2.4 (1.6, 3.5)	3.1 (2.2, 4.4)	4.0 (2.9, 5.5)	7.3 (5.7, 9.3)	12.9 (10.3, 16.2)	
C-Stem	Pinnacle	30	862	1.6 (1.0, 2.8)	2.3 (1.5, 3.6)	2.8 (1.8, 4.2)	4.4 (2.9, 6.5)		
C-Stem AMT	Pinnacle	69	3025	1.3 (0.9, 1.8)	2.4 (1.8, 3.1)	3.1 (2.4, 4.1)	5.7 (3.6, 8.8)		
CPCS	R3	142	4667	2.1 (1.7, 2.6)	3.0 (2.5, 3.6)	3.4 (2.9, 4.1)			
CPCS	Reflection (Shell)	94	3019	0.9 (0.6, 1.3)	1.3 (0.9, 1.7)	1.7 (1.3, 2.3)	3.9 (3.1, 4.9)	6.2 (4.7, 8.4)	
CPT	Allofit	31	1252	1.1 (0.7, 1.9)	1.7 (1.1, 2.7)	2.9 (2.0, 4.2)	3.2 (2.2, 4.7)		
CPT	Continuum	112	2800	2.7 (2.2, 3.4)	3.8 (3.1, 4.6)	4.6 (3.8, 5.6)			
CPT	Trabecular Metal (Shell)	92	1846	2.6 (2.0, 3.5)	3.9 (3.1, 5.0)	5.0 (4.0, 6.3)	7.6 (6.0, 9.5)		
CPT	Trilogy	329	8152	1.8 (1.6, 2.2)	2.8 (2.4, 3.2)	3.6 (3.2, 4.0)	5.2 (4.6, 5.9)	6.5 (5.7, 7.5)	

Femoral Component	Acetabular Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
E2	C2	13	632	1.3 (0.7, 2.6)	2.0 (1.1, 3.5)	3.1 (1.6, 5.7)			
Elite Plus	Duraloc*	119	1078	2.0 (1.3, 3.0)	3.6 (2.7, 5.0)	5.4 (4.2, 7.0)	9.8 (8.1, 12.0)	15.8 (13.1, 18.8)	
Evolve	Logical G	9	1020	1.0 (0.5, 1.9)	1.0 (0.5, 1.9)				
Exeter	Vitalock*	74	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)	8.0 (6.4, 10.1)
Exeter V40	ABGII	42	1097	1.1 (0.6, 1.9)	1.4 (0.8, 2.3)	2.0 (1.3, 3.0)	3.5 (2.5, 4.9)	4.9 (3.6, 6.7)	
Exeter V40	Fixa	15	643	1.9 (1.1, 3.3)	2.3 (1.3, 3.8)	2.6 (1.6, 4.4)			
Exeter V40	Hemispherical	30	717	2.4 (1.5, 3.8)	3.4 (2.3, 5.0)	3.5 (2.4, 5.2)	4.9 (3.3, 7.3)		
Exeter V40	Mallory-Head	37	1457	0.6 (0.3, 1.2)	1.0 (0.6, 1.7)	1.2 (0.7, 1.9)	2.9 (2.0, 4.2)	4.6 (3.2, 6.5)	
Exeter V40	Pinnacle	46	1828	1.5 (1.1, 2.2)	2.2 (1.6, 3.0)	2.5 (1.8, 3.4)	5.1 (3.1, 8.1)		
Exeter V40	R3	54	1977	1.6 (1.1, 2.2)	2.5 (1.9, 3.4)	3.3 (2.5, 4.4)			
Exeter V40	Trident (Shell)	1544	57931	1.2 (1.1, 1.3)	1.9 (1.8, 2.0)	2.5 (2.3, 2.6)	4.1 (3.8, 4.3)	5.6 (5.1, 6.1)	
Exeter V40	Trident/Tritanium (Shell)	95	3884	1.6 (1.2, 2.0)	2.5 (2.0, 3.1)	3.2 (2.6, 4.0)			
Exeter V40	Trilogy*	20	605	1.7 (0.9, 3.1)	2.4 (1.4, 4.0)	2.6 (1.5, 4.2)	3.8 (2.4, 6.0)		
Exeter V40	Vitalock*	84	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)	5.2 (4.2, 6.5)	
MS 30	Allofit	62	1626	1.2 (0.8, 1.9)	1.7 (1.2, 2.5)	2.2 (1.6, 3.1)	4.1 (3.1, 5.5)	10.3 (6.6, 15.9)	
MS 30	Continuum	9	568	1.3 (0.6, 2.7)	1.6 (0.8, 3.3)	1.6 (0.8, 3.3)			
MS 30	Fitmore	24	702	0.7 (0.3, 1.7)	1.2 (0.6, 2.4)	1.9 (1.0, 3.5)	3.1 (1.8, 5.2)	6.5 (4.1, 10.2)	
Omnifit	Trident (Shell)	92	2843	1.8 (1.4, 2.3)	2.7 (2.2, 3.4)	3.0 (2.4, 3.7)	3.5 (2.8, 4.3)	4.6 (3.5, 6.0)	
Quadra-C	Mpact	6	603	1.0 (0.4, 2.5)	1.4 (0.6, 3.3)				
Quadra-C	Versafitcup CC	23	1082	1.9 (1.2, 3.0)	2.1 (1.3, 3.2)	2.5 (1.5, 4.1)			
Short Exeter V40	Trident (Shell)	14	899	1.5 (0.9, 2.7)					
Spectron EF	BHR* MoM	72	532	0.8 (0.3, 2.0)	2.9 (1.8, 4.8)	6.3 (4.5, 8.8)	16.0 (12.6, 20.0)		
Spectron EF	R3	55	1849	1.5 (1.0, 2.2)	2.6 (1.9, 3.5)	3.1 (2.4, 4.2)			
Spectron EF	Reflection (Shell)	299	5165	1.1 (0.8, 1.4)	1.9 (1.6, 2.4)	2.7 (2.3, 3.2)	5.6 (4.9, 6.4)	10.6 (9.2, 12.1)	12.9 (10.7, 15.6)
Taper Fit	Trinity	15	861	1.4 (0.7, 2.5)	2.1 (1.2, 3.8)	4.8 (2.1, 10.6)			
Other (962)		1133	18205	1.9 (1.7, 2.1)	3.2 (2.9, 3.5)	4.5 (4.2, 4.9)	8.0 (7.5, 8.5)	11.2 (10.5, 12.0)	12.0 (11.1, 12.9)
TOTAL		**4970**	**137585**						

Note: Procedures using metal/metal prostheses with head size larger than 32mm have been included
MoM denotes metal/metal prostheses with head size larger than 32mm
* denotes prosthesis combination that has not been used 2017
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 17 year cumulative percent revision of primary total conventional hip replacement undertaken for osteoarthritis is 9.1% (Table HT14 and Figure HT5).

Reason for Revision

The most common reasons for revision of primary total conventional hip replacement are loosening (25.0%), prosthesis dislocation (21.1%), fracture (20.3%), and infection (18.1%) (Table HT15).

The most common reason for revision varies with time. In the first five years, dislocation is the most frequent reason for revision. After seven 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 (33.1%), acetabular only (21.2%), head and insert (20.0%), total hip replacement (femoral/acetabular) (12.0%) 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 or older have a lower rate of revision than patients aged less than 55 years and 65 to 74 years after six months and for patients 55 to 64 years after two years (Table HT17 and Figure HT7).

Males have a higher rate of revision after 1.5 years. The cumulative percent revision at 17 years is 9.6% for males and 8.7% 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 or older have a higher rate of revision initially, compared to the younger age groups. However, this difference is no longer evident as time progresses (Table HT18 and Figure HT9).

For females, the rate of revision decreases with increasing age. After three months, females aged less than 55 years have almost twice the rate of revision compared to females aged 75 years or older (Table HT18 and Figure HT10).

ASA and BMI

ASA scores are an indication of co-morbidity 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 139,482 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 HT11). The difference in revision rate for each ASA score is partially due to an increase in revision for infection with increasing ASA score (Figure HT12).

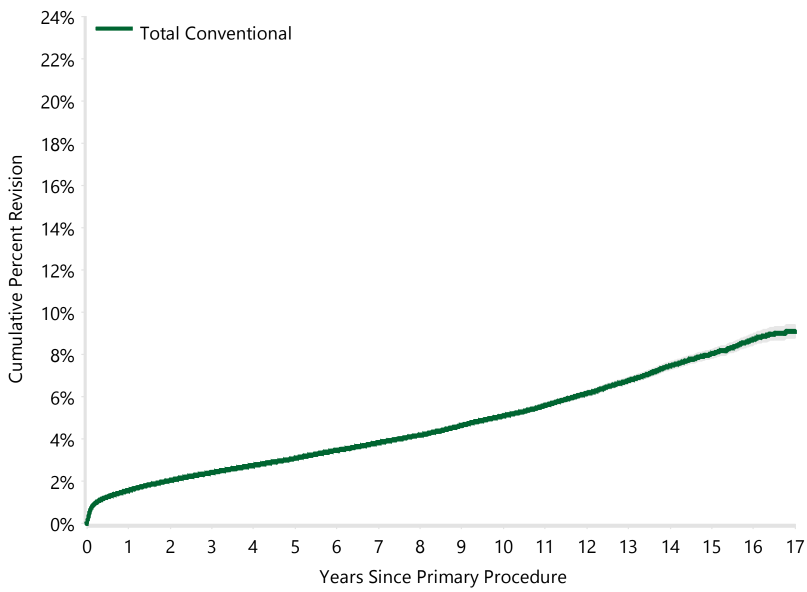
BMI data has been collected since 2015. The early revision outcomes are reported for 85,601 total conventional hip replacement procedures for osteoarthritis. When compared to patients in the normal BMI class, there is no difference in revision rate for patients in the underweight or pre-obese classes. The rate of revision increases for obese class 1, obese class 2, and obese class 3 (Table HT20 and Figure HT13). The most common reasons for revision are shown in Figure HT14. There is an increasing rate of revision for infection with increasing obesity classes with obese class 3 having 2% of revisions for infection.

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	17 Yrs
Total Conventional	12907	351926	1.6 (1.5, 1.6)	2.4 (2.4, 2.5)	3.1 (3.0, 3.2)	5.1 (5.0, 5.2)	8.0 (7.8, 8.2)	9.1 (8.8, 9.4)
TOTAL	**12907**	**351926**						

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	17 Yrs
Total Conventional	351926	311600	241193	179580	68937	12630	1453

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	3223	25.0
Prosthesis Dislocation	2720	21.1
Fracture	2626	20.3
Infection	2332	18.1
Lysis	278	2.2
Pain	241	1.9
Leg Length Discrepancy	202	1.6
Malposition	189	1.5
Instability	156	1.2
Implant Breakage Stem	136	1.1
Wear Acetabular Insert	114	0.9
Implant Breakage Acetabular Insert	112	0.9
Metal Related Pathology	107	0.8
Implant Breakage Acetabular	87	0.7
Incorrect Sizing	86	0.7
Implant Breakage Head	42	0.3
Other	256	2.0
TOTAL	**12907**	**100.0**

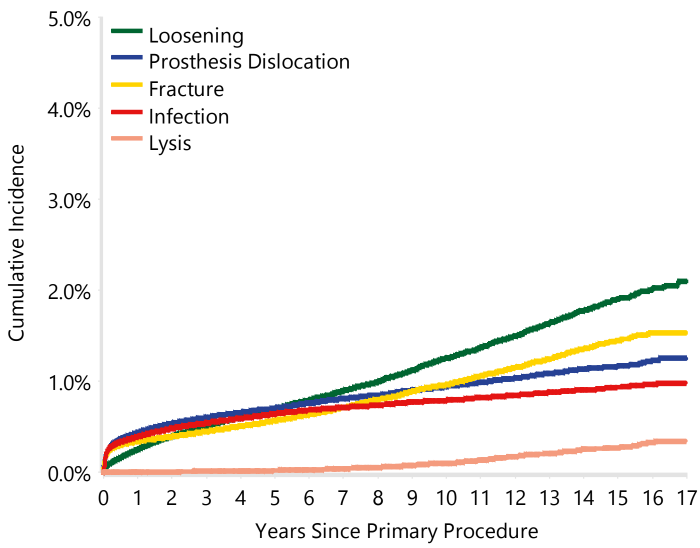
Note: All procedures using metal/metal prostheses have been excluded

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

Type of Revision	Number	Percent
Femoral Component	4266	33.1
Acetabular Component	2742	21.2
Head/Insert	2583	20.0
THR (Femoral/Acetabular)	1552	12.0
Head Only	620	4.8
Cement Spacer	556	4.3
Minor Components	226	1.8
Insert Only	143	1.1
Removal of Prostheses	84	0.7
Head/Neck/Insert	62	0.5
Head/Neck	48	0.4
Reinsertion of Components	12	0.1
Neck Only	5	0.0
Bipolar Only	3	0.0
Total Femoral	2	0.0
Saddle	1	0.0
Neck/Insert	1	0.0
Bipolar Head and Femoral	1	0.0
TOTAL	**12907**	**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)



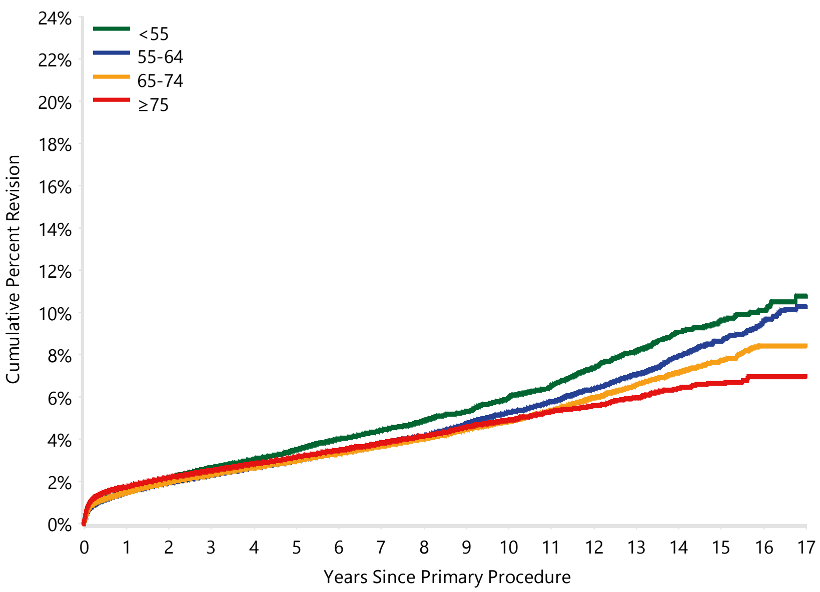
Note: All procedures using metal/metal prostheses have been excluded

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	17 Yrs
<55	1600	37294	1.5 (1.4, 1.7)	2.7 (2.5, 2.8)	3.5 (3.3, 3.7)	6.0 (5.6, 6.3)	9.6 (9.0, 10.3)	10.8 (9.8, 11.8)
55-64	3222	83441	1.5 (1.4, 1.6)	2.3 (2.2, 2.4)	3.0 (2.9, 3.1)	5.3 (5.1, 5.5)	8.7 (8.2, 9.1)	10.3 (9.6, 11.0)
65-74	4529	125674	1.5 (1.4, 1.5)	2.3 (2.2, 2.4)	3.0 (2.9, 3.1)	4.8 (4.7, 5.0)	7.7 (7.4, 8.1)	8.4 (8.0, 8.9)
≥75	3556	105517	1.8 (1.7, 1.8)	2.5 (2.4, 2.6)	3.1 (3.0, 3.3)	4.9 (4.7, 5.1)	6.6 (6.3, 7.0)	7.0 (6.5, 7.5)
TOTAL	**12907**	**351926**						

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=1.05 (0.86, 1.29),p=0.613
2Wk - 3Mth: HR=0.63 (0.55, 0.73),p<0.001
3Mth - 6Mth: HR=1.01 (0.81, 1.25),p=0.932
6Mth+: HR=1.43 (1.33, 1.54),p<0.001

55-64 vs ≥75
0 - 2Wk: HR=0.90 (0.76, 1.05),p=0.180
2Wk - 1Mth: HR=0.63 (0.55, 0.73),p<0.001
1Mth - 6Mth: HR=0.78 (0.70, 0.87),p<0.001
6Mth - 1.5Yr: HR=1.22 (1.10, 1.37),p<0.001
1.5Yr - 2Yr: HR=0.96 (0.79, 1.16),p=0.658
2Yr - 7Yr: HR=1.16 (1.07, 1.27),p<0.001
7Yr - 11Yr: HR=1.29 (1.15, 1.45),p<0.001
11Yr - 14.5Yr: HR=1.41 (1.21, 1.64),p<0.001
14.5Yr+: HR=1.82 (1.28, 2.59),p<0.001

65-74 vs ≥75
0 - 6Mth: HR=0.79 (0.73, 0.84),p<0.001
6Mth+: HR=1.11 (1.05, 1.18),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
<55	37294	33108	25504	18761	7700	1946	252
55-64	83441	74316	58142	44229	18302	3983	531
65-74	125674	111558	86836	65506	27052	5072	538
≥75	105517	92618	70711	51084	15883	1629	132

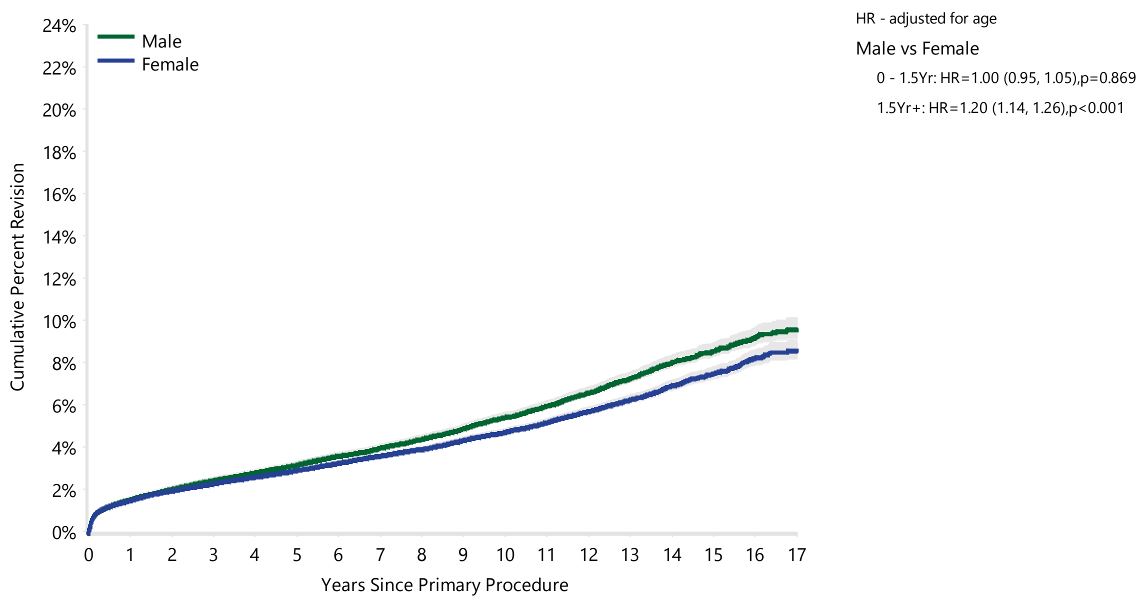
Note: All procedures using metal/metal prostheses have been excluded

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	17 Yrs
Male		**6127**	**160935**	**1.6 (1.5, 1.6)**	**2.5 (2.4, 2.6)**	**3.2 (3.1, 3.3)**	**5.5 (5.3, 5.7)**	**8.6 (8.3, 8.9)**	**9.6 (9.2, 10.1)**
	<55	809	20568	1.4 (1.2, 1.5)	2.4 (2.2, 2.7)	3.3 (3.0, 3.6)	5.7 (5.2, 6.1)	9.1 (8.3, 10.0)	10.5 (9.2, 12.0)
	55-64	1611	41460	1.5 (1.4, 1.6)	2.4 (2.2, 2.5)	3.0 (2.9, 3.2)	5.4 (5.1, 5.7)	8.9 (8.3, 9.5)	10.1 (9.3, 11.1)
	65-74	2137	57536	1.5 (1.4, 1.6)	2.3 (2.2, 2.5)	3.1 (2.9, 3.2)	5.2 (5.0, 5.5)	8.2 (7.7, 8.7)	8.9 (8.2, 9.5)
	≥75	1570	41371	1.9 (1.8, 2.1)	2.9 (2.7, 3.0)	3.6 (3.4, 3.8)	5.9 (5.6, 6.3)	8.2 (7.5, 9.0)	
Female		**6780**	**190991**	**1.6 (1.5, 1.6)**	**2.4 (2.3, 2.4)**	**3.0 (2.9, 3.1)**	**4.8 (4.7, 4.9)**	**7.6 (7.3, 7.8)**	**8.7 (8.2, 9.1)**
	<55	791	16726	1.7 (1.6, 2.0)	2.9 (2.7, 3.2)	3.8 (3.5, 4.1)	6.4 (5.9, 6.9)	10.2 (9.3, 11.2)	11.0 (9.9, 12.3)
	55-64	1611	41981	1.5 (1.3, 1.6)	2.3 (2.1, 2.4)	3.0 (2.8, 3.1)	5.2 (4.9, 5.5)	8.4 (7.9, 9.0)	10.4 (9.4, 11.6)
	65-74	2392	68138	1.5 (1.4, 1.6)	2.3 (2.2, 2.4)	2.9 (2.8, 3.1)	4.5 (4.3, 4.8)	7.4 (7.0, 7.8)	8.1 (7.6, 8.7)
	≥75	1986	64146	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, 6.3)	6.2 (5.6, 6.8)
TOTAL		**12907**	**351926**						

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

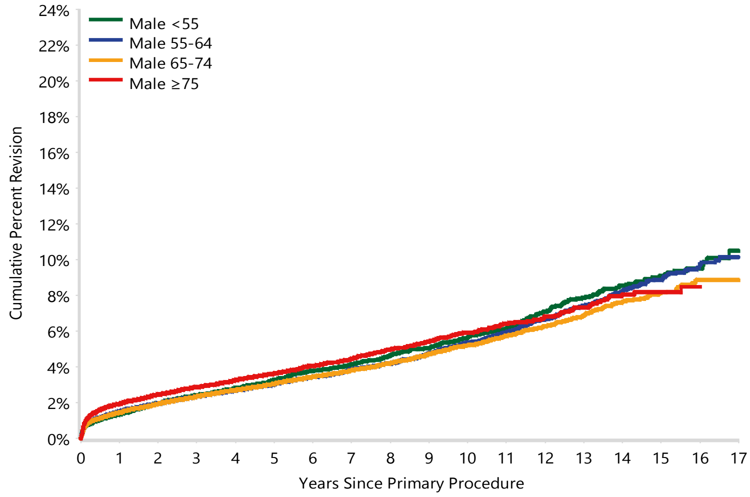
Figure HT8 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Gender (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Male	160935	141920	108362	79527	29809	5700	665
Female	190991	169680	132831	100053	39128	6930	788

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)

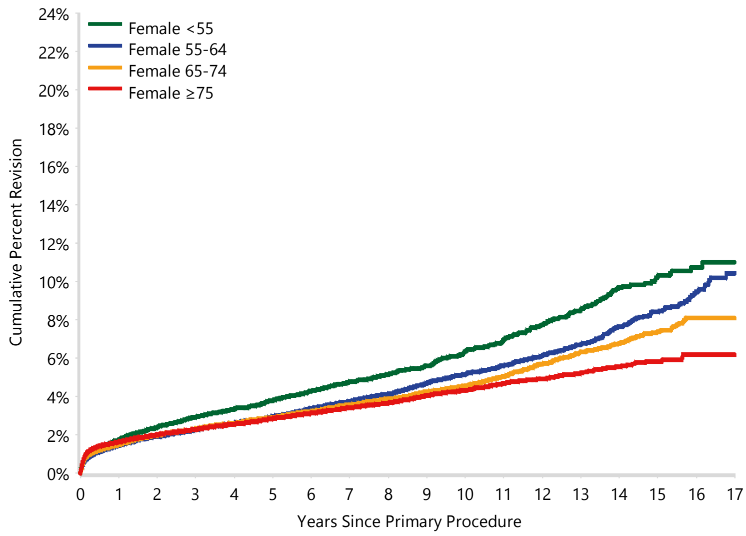


Male <55 vs Male ≥75
0 - 2Wk: HR=1.06 (0.80, 1.41),p=0.695
2Wk - 3Mth: HR=0.54 (0.44, 0.66),p<0.001
3Mth - 6Mth: HR=0.71 (0.51, 1.00),p=0.053
6Mth - 5.5Yr: HR=1.10 (0.98, 1.25),p=0.109
5.5Yr+: HR=1.06 (0.90, 1.24),p=0.480
Male 55-64 vs Male ≥75
0 - 2Wk: HR=0.88 (0.70, 1.12),p=0.301
2Wk - 1Mth: HR=0.66 (0.54, 0.81),p<0.001
1Mth - 9Mth: HR=0.76 (0.66, 0.87),p<0.001
9Mth - 1.5Yr: HR=1.09 (0.88, 1.34),p=0.446
1.5Yr - 2Yr: HR=0.76 (0.57, 0.99),p=0.043
2Yr - 7Yr: HR=0.95 (0.84, 1.07),p=0.407
7Yr - 11Yr: HR=0.99 (0.83, 1.17),p=0.887
11Yr+: HR=1.22 (0.99, 1.50),p=0.063
Male 65-74 vs Male ≥75
0 - 3Mth: HR=0.73 (0.65, 0.83),p<0.001
3Mth - 9Mth: HR=0.72 (0.60, 0.87),p<0.001
9Mth - 1.5Yr: HR=1.04 (0.85, 1.26),p=0.730
1.5Yr+: HR=0.94 (0.86, 1.03),p=0.171

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Male	<55	20568	18140	13768	9940	3995	1065	152
	55-64	41460	36734	28367	21305	8757	2009	250
	65-74	57536	51168	39718	29783	11985	2182	229
	≥75	41371	35878	26509	18499	5072	444	34

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=1.08 (0.80, 1.45),p=0.609
2Wk - 3Mth: HR=0.75 (0.62, 0.92),p=0.005
3Mth+: HR=1.76 (1.60, 1.94),p<0.001

Female 55-64 vs Female ≥75
0 - 2Wk: HR=0.93 (0.74, 1.15),p=0.492
2Wk - 1Mth: HR=0.59 (0.48, 0.73),p<0.001
1Mth - 3Mth: HR=0.76 (0.63, 0.91),p=0.003
3Mth - 6Mth: HR=1.16 (0.92, 1.47),p=0.206
6Mth - 1.5Yr: HR=1.39 (1.20, 1.62),p<0.001
1.5Yr - 5.5Yr: HR=1.25 (1.11, 1.41),p<0.001
5.5Yr+: HR=1.55 (1.39, 1.74),p<0.001

Female 65-74 vs Female ≥75
0 - 3Mth: HR=0.84 (0.76, 0.93),p<0.001
3Mth+: HR=1.20 (1.12, 1.30),p<0.001

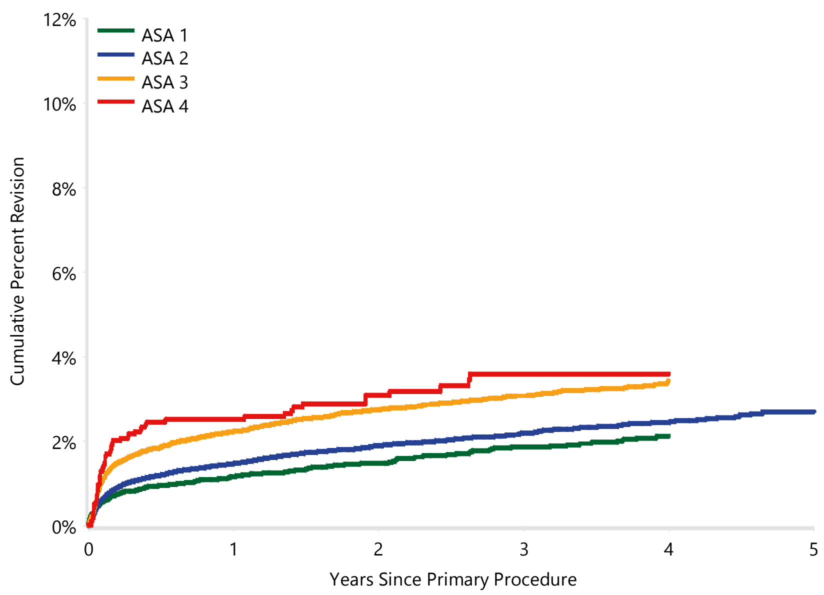
Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Female	<55	16726	14968	11736	8821	3705	881	100
	55-64	41981	37582	29775	22924	9545	1974	281
	65-74	68138	60390	47118	35723	15067	2890	309
	≥75	64146	56740	44202	32585	10811	1185	98

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
ASA 1	224	14242	1.2 (1.0, 1.4)	1.5 (1.3, 1.7)	1.9 (1.6, 2.2)	2.1 (1.8, 2.5)	
ASA 2	1454	77539	1.5 (1.4, 1.6)	1.9 (1.8, 2.0)	2.2 (2.1, 2.3)	2.4 (2.3, 2.6)	2.7 (2.5, 2.9)
ASA 3	1202	45692	2.2 (2.1, 2.4)	2.7 (2.6, 2.9)	3.1 (2.9, 3.2)	3.4 (3.2, 3.6)	
ASA 4	59	1998	2.5 (1.9, 3.3)	3.1 (2.4, 4.0)	3.6 (2.7, 4.7)	3.6 (2.7, 4.7)	
ASA 5	0	11	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)		
TOTAL	**2939**	**139482**					

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

Figure HT11 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by ASA Score (Primary Diagnosis OA)



HR - adjusted for age and gender

ASA 2 vs ASA 1

Entire Period: HR=1.23 (1.07, 1.42),p=0.004

ASA 3 vs ASA 1

Entire Period: HR=1.79 (1.54, 2.08),p<0.001

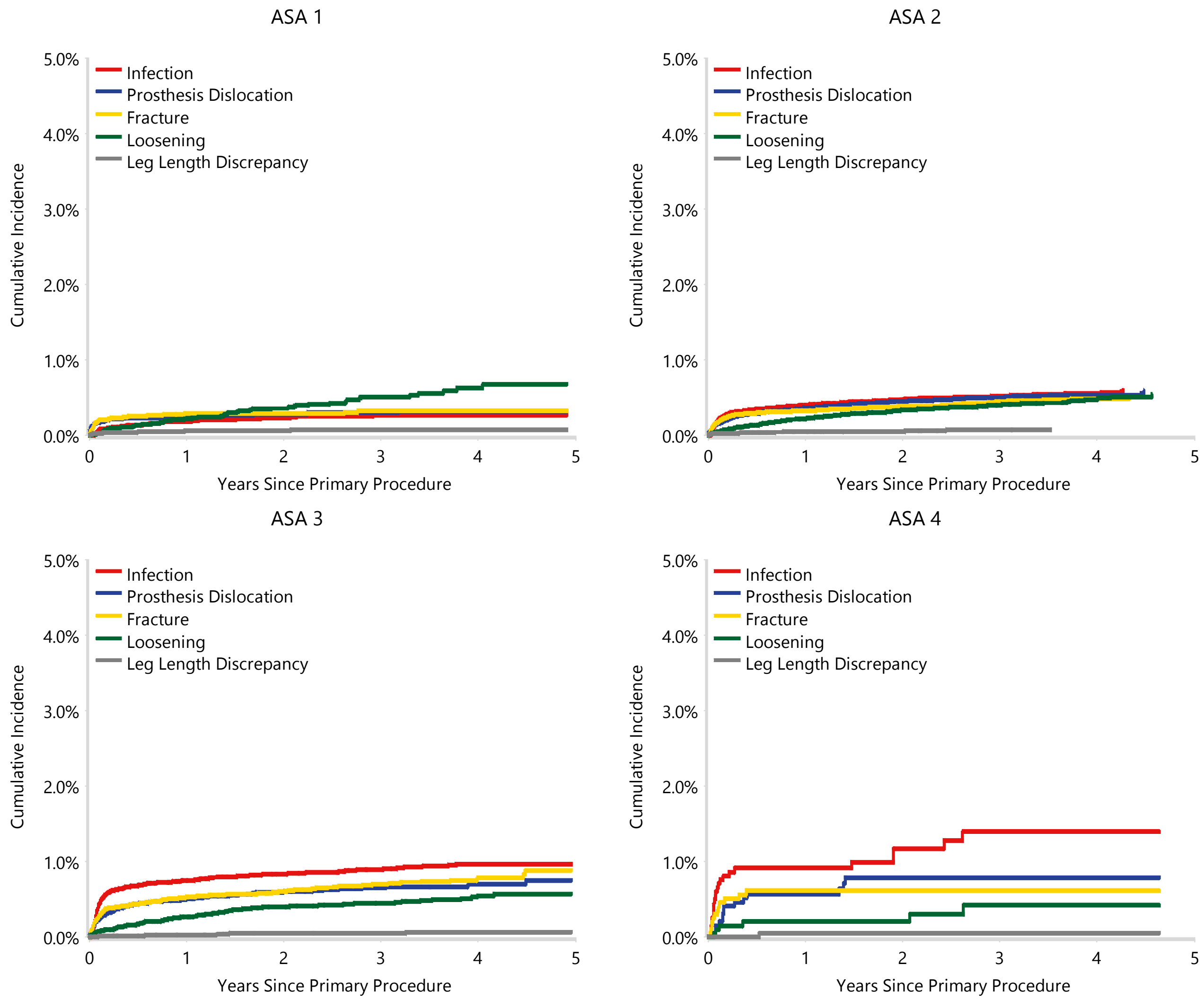
ASA 4 vs ASA 1

Entire Period: HR=2.05 (1.53, 2.74),p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
ASA 1	14242	11021	7957	4937	2040	14
ASA 2	77539	58977	41284	24742	9630	47
ASA 3	45692	33297	22572	13043	4856	26
ASA 4	1998	1448	955	558	218	0

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

Figure HT12 Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement by ASA Score (Primary Diagnosis OA)



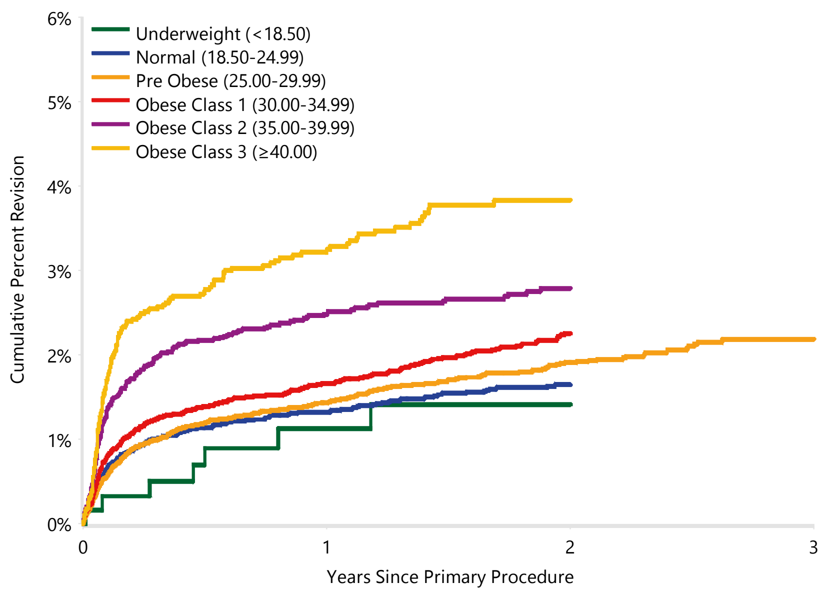
Note: All procedures using metal/metal prostheses have been excluded

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
Underweight (<18.50)	7	623	1.1 (0.5, 2.5)	1.4 (0.7, 3.0)	
Normal (18.50-24.99)	261	17931	1.3 (1.2, 1.5)	1.6 (1.4, 1.9)	
Pre Obese (25.00-29.99)	505	31810	1.4 (1.3, 1.6)	1.9 (1.7, 2.1)	2.2 (2.0, 2.4)
Obese Class 1 (30.00-34.99)	397	21578	1.7 (1.5, 1.9)	2.3 (2.0, 2.5)	
Obese Class 2 (35.00-39.99)	228	9151	2.5 (2.2, 2.8)	2.8 (2.4, 3.2)	
Obese Class 3 (≥40.00)	151	4508	3.2 (2.8, 3.8)	3.8 (3.3, 4.5)	
TOTAL	**1549**	**85601**			

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

Figure HT13 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=0.76 (0.36, 1.61),p=0.473

Pre Obese (25.00-29.99) vs Normal (18.50-24.99)
Entire Period: HR=1.10 (0.94, 1.27),p=0.231

Obese Class 1 (30.00-34.99) vs Normal (18.50-24.99)
Entire Period: HR=1.30 (1.11, 1.52),p=0.001

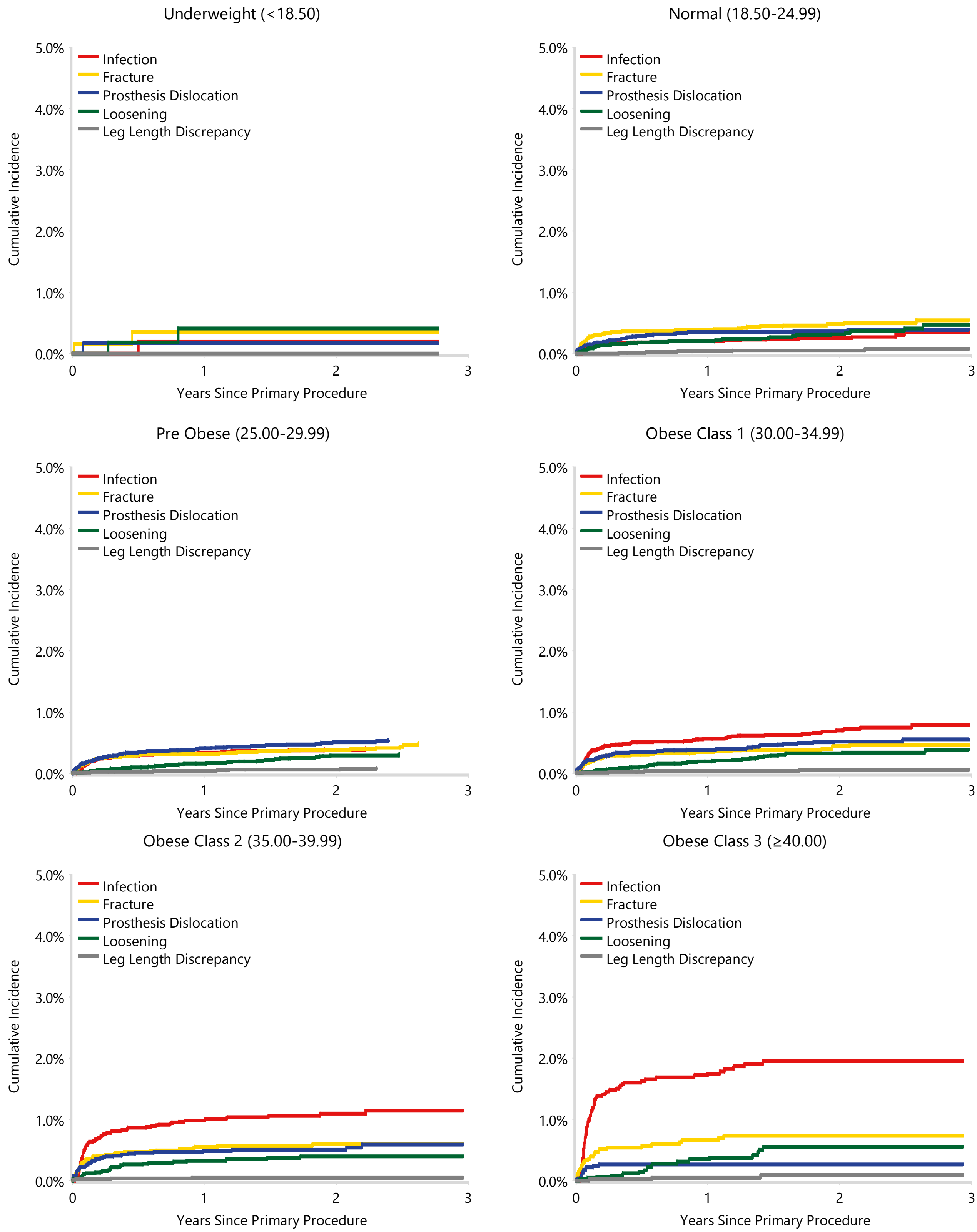
Obese Class 2 (35.00-39.99) vs Normal (18.50-24.99)
Entire Period: HR=1.81 (1.51, 2.17),p<0.001

Obese Class 3 (≥40.00) vs Normal (18.50-24.99)
Entire Period: HR=2.47 (2.02, 3.03),p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs
Underweight (<18.50)	623	387	183	0
Normal (18.50-24.99)	17931	11319	5230	19
Pre Obese (25.00-29.99)	31810	20038	9207	45
Obese Class 1 (30.00-34.99)	21578	13415	6091	25
Obese Class 2 (35.00-39.99)	9151	5592	2486	8
Obese Class 3 (≥40.00)	4508	2802	1277	5

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

Figure HT14 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

OUTCOME FOR OSTEOARTHRITIS - PROSTHESIS CHARACTERISTICS

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

Fixation

Modern bearing surfaces account for 97.2% of all primary total conventional hip procedures performed in 2017.

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 two weeks and after this time there is no difference (Table HT21 and Figure HT15).

The outcome with respect to fixation varies with age.

For patients aged less than 55 years and 55 to 64 years, there is no difference in the rate of revision when comparing fixation methods. The exception is a higher rate of revision in the first month for cementless fixation compared to hybrid fixation for patients aged 55 to 64 years. Cementless fixation has a higher rate of revision compared to hybrid fixation for all patients aged 65 years or older, and when compared to cemented fixation for patients aged 75 years or older (Table HT22, and Figures HT16 to HT19).

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 3,706 procedures using a mini stem prosthesis undertaken for osteoarthritis. This represents less than 1.1% of all total conventional hip procedures. There were 823 procedures recorded in 2017 using a mini stem prosthesis; an increase of 36.5% compared to 2016. The 10 year cumulative percent revision for total conventional hip replacement using a mini stem is 5.9% compared to 5.1% for other femoral stems. There is no difference in the overall rate of revision when a mini stem is used (Table HT23 and Figure HT20). The cumulative incidence of loosening for procedures using a mini stem is over twice that of other femoral stems at 10 years (2.5% compared to 1.2%) (Figure HT21). 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 total conventional hip replacement.

The Registry has recorded 10,074 procedures using femoral stems with exchangeable necks undertaken for osteoarthritis. There were 267 procedures reported in 2017; a 25.0% decrease compared to 2016. 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 2017, 0.8% of all procedures use a stem with an exchangeable neck.

Femoral stems with exchangeable necks have almost twice the rate of revision compared to fixed neck stems. The cumulative percent revision at 15 years is 12.4% for stems with exchangeable necks compared to 7.9% for fixed neck stems (Table HT26 and Figure HT22). The increase in the rate of revision is due to a higher cumulative incidence of loosening (2.7% at 15 years compared to 1.9% for fixed femoral neck stems), prosthesis dislocation (1.9% compared to 1.1%) and fracture (2.2% compared to 1.4%) (Figure HT23).

Of the revisions of femoral stems with exchangeable necks, 3.1% are for implant breakage of the femoral component compared to 0.9% for fixed neck stems (Table HT27). The higher rate of revision when using stems with exchangeable necks is evident for all bearing surfaces (Figure HT24).

The Registry has previously identified that the stem/neck metal combination has an effect on the rate of revision. There are five 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 HT25).

The reason for this difference is a higher cumulative incidence for each of the five main reasons for revision, with the exception of infection. At 15 years, the cumulative incidence of metal related pathology is 4.1% for titanium/cobalt chrome compared to 0.1% for titanium/titanium (Figure HT26).

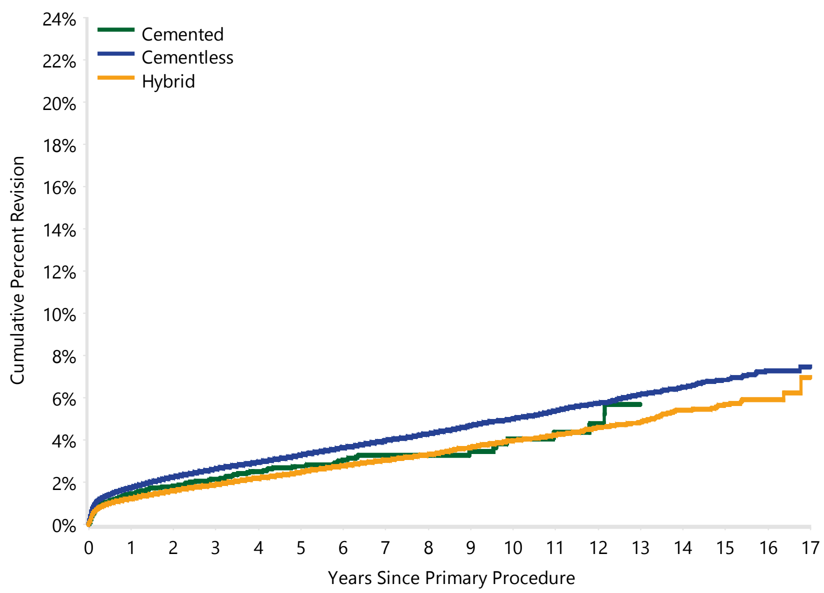
The Registry has information on 14 different exchangeable femoral neck prostheses that have been used in more than 60 procedures. The outcomes of each of these stems are detailed in Table HT29.

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	17 Yrs
Cemented	146	5667	1.5 (1.2, 1.8)	2.2 (1.8, 2.6)	2.8 (2.3, 3.3)	4.1 (3.2, 5.2)		
Cementless	6951	200398	1.8 (1.7, 1.8)	2.6 (2.6, 2.7)	3.3 (3.2, 3.4)	5.0 (4.9, 5.1)	6.8 (6.6, 7.1)	7.5 (7.0, 8.0)
Hybrid	2758	103430	1.2 (1.2, 1.3)	1.9 (1.8, 2.0)	2.5 (2.4, 2.6)	4.0 (3.8, 4.2)	5.7 (5.3, 6.1)	7.0 (5.5, 8.8)
TOTAL	**9855**	**309495**						

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

Figure HT15 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=1.10 (0.93, 1.30),p=0.269

Cementless vs Hybrid

0 - 2Wk: HR=2.12 (1.79, 2.52),p<0.001

2Wk - 1Mth: HR=1.46 (1.28, 1.66),p<0.001

1Mth - 1.5Yr: HR=1.30 (1.21, 1.40),p<0.001

1.5Yr+: HR=1.21 (1.13, 1.29),p<0.001

Cementless vs Cemented

0 - 2Wk: HR=1.94 (1.54, 2.45),p<0.001

2Wk+: HR=1.17 (0.99, 1.37),p=0.069

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Cemented	5667	4976	3563	2097	421	9	1
Cementless	200398	175228	131923	94426	30544	4238	274
Hybrid	103430	91037	68906	49937	16609	1599	61

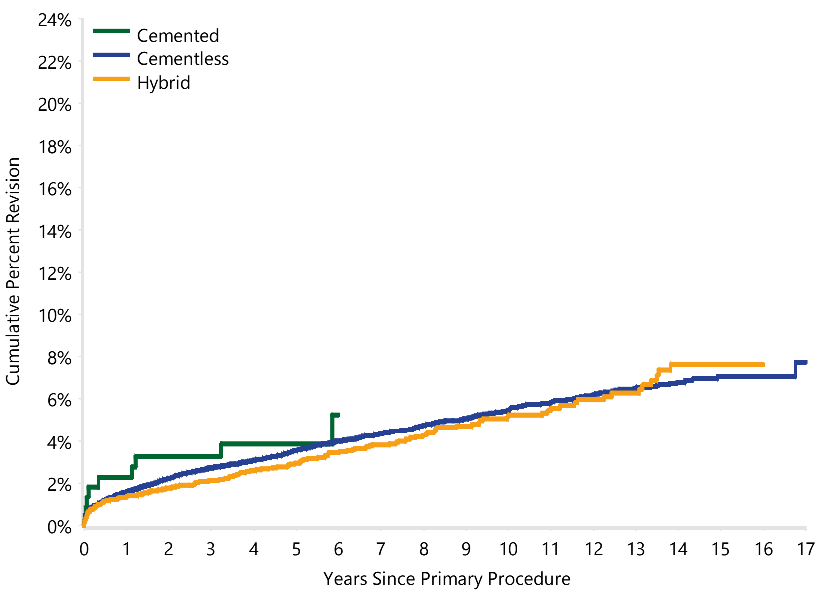
Note: Includes ceramic/ceramic and cross-linked polyethylene (XLPE) bearing surfaces

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	17 Yrs
<55		**1284**	**34767**	**1.6 (1.4, 1.7)**	**2.6 (2.5, 2.8)**	**3.5 (3.3, 3.7)**	**5.4 (5.1, 5.8)**	**7.2 (6.6, 7.8)**	**7.8 (6.6, 9.3)**
	Cemented	11	222	2.3 (1.0, 5.4)	3.3 (1.6, 6.7)	3.9 (1.9, 7.6)			
	Cementless	1077	28659	1.6 (1.5, 1.8)	2.7 (2.5, 2.9)	3.6 (3.3, 3.8)	5.4 (5.1, 5.8)	7.1 (6.5, 7.7)	7.8 (6.4, 9.4)
	Hybrid	196	5886	1.4 (1.1, 1.7)	2.1 (1.8, 2.6)	3.0 (2.5, 3.5)	5.2 (4.4, 6.2)	7.6 (6.2, 9.3)	
55-64		**2486**	**76505**	**1.5 (1.4, 1.6)**	**2.3 (2.2, 2.4)**	**2.9 (2.8, 3.0)**	**4.7 (4.5, 4.9)**	**6.5 (6.1, 6.9)**	**7.5 (6.6, 8.6)**
	Cemented	26	697	2.4 (1.5, 3.8)	3.6 (2.4, 5.4)	3.6 (2.4, 5.4)	4.6 (2.7, 7.7)		
	Cementless	1929	58432	1.6 (1.5, 1.7)	2.4 (2.2, 2.5)	3.0 (2.8, 3.2)	4.7 (4.5, 5.0)	6.4 (6.0, 6.9)	6.9 (6.3, 7.5)
	Hybrid	531	17376	1.2 (1.0, 1.4)	1.9 (1.7, 2.1)	2.6 (2.3, 2.9)	4.5 (4.1, 5.0)	6.8 (5.9, 7.8)	
65-74		**3324**	**110205**	**1.5 (1.4, 1.6)**	**2.3 (2.2, 2.4)**	**2.9 (2.8, 3.0)**	**4.3 (4.1, 4.5)**	**6.1 (5.8, 6.5)**	**6.8 (6.2, 7.4)**
	Cemented	46	1825	1.2 (0.8, 1.9)	1.8 (1.3, 2.6)	2.5 (1.8, 3.5)	4.1 (2.8, 6.0)		
	Cementless	2316	71621	1.7 (1.6, 1.8)	2.5 (2.4, 2.7)	3.1 (3.0, 3.3)	4.6 (4.3, 4.8)	6.5 (6.0, 6.9)	7.3 (6.6, 8.1)
	Hybrid	962	36759	1.1 (1.0, 1.2)	1.8 (1.7, 1.9)	2.4 (2.2, 2.6)	3.8 (3.5, 4.1)	5.5 (4.9, 6.1)	
≥75		**2761**	**88018**	**1.8 (1.7, 1.9)**	**2.5 (2.4, 2.6)**	**3.1 (3.0, 3.2)**	**4.7 (4.5, 5.0)**	**6.4 (5.9, 6.9)**	
	Cemented	63	2923	1.3 (1.0, 1.8)	1.9 (1.4, 2.5)	2.7 (2.1, 3.4)	2.8 (2.2, 3.7)		
	Cementless	1629	41686	2.3 (2.2, 2.4)	3.2 (3.0, 3.3)	3.8 (3.6, 4.0)	6.0 (5.6, 6.3)	8.6 (7.6, 9.6)	
	Hybrid	1069	43409	1.3 (1.2, 1.4)	2.0 (1.8, 2.1)	2.5 (2.3, 2.6)	3.7 (3.4, 4.0)	4.6 (4.1, 5.1)	
TOTAL		**9855**	**309495**						

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

Figure HT16 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=1.58 (0.86, 2.89),p=0.141

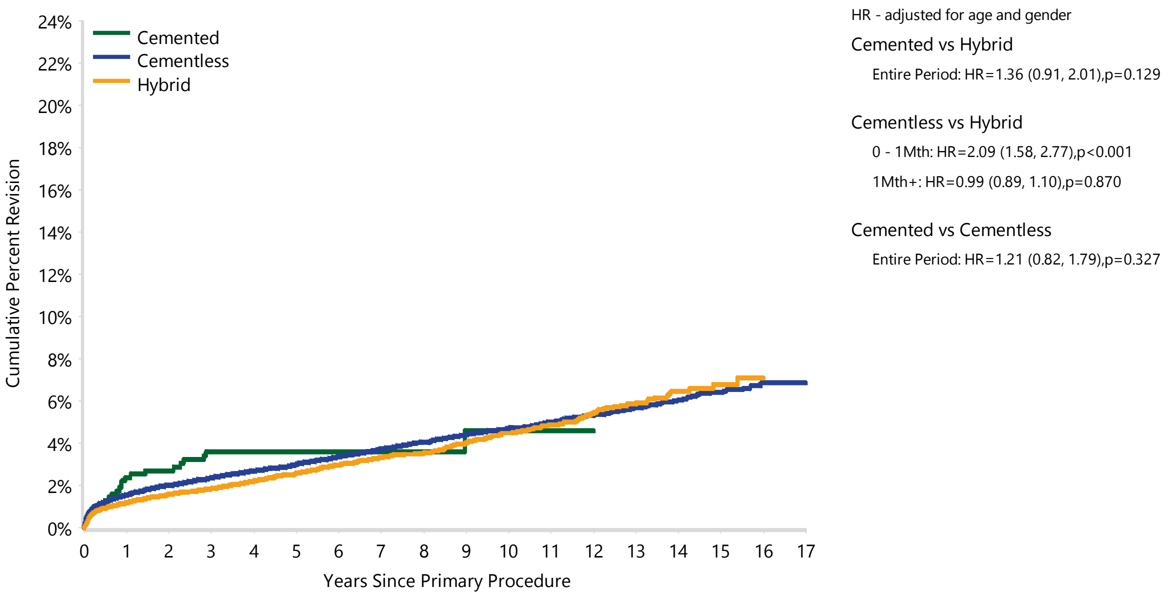
Cementless vs Hybrid
Entire Period: HR=1.10 (0.95, 1.29),p=0.200

Cemented vs Cementless
Entire Period: HR=1.43 (0.79, 2.58),p=0.240

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Cemented	222	200	166	101	19	3	1
Cementless	28659	25328	19305	13943	5080	1028	87
Hybrid	5886	5171	3829	2689	1013	188	6

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

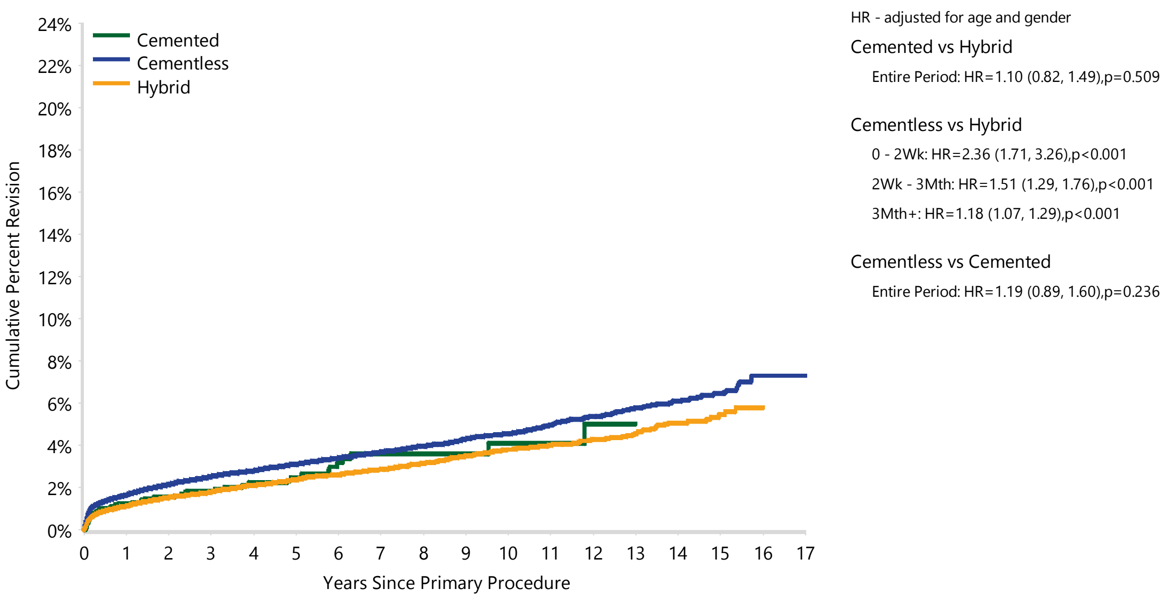
Figure HT17 Cumulative Percent Revision of Primary Total Conventional Hip Replacement in Patients Aged 55-64 Years by Fixation (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Cemented	697	626	489	314	81	1	0
Cementless	58432	51575	39513	29189	10445	1675	119
Hybrid	17376	15476	11968	8936	3365	411	15

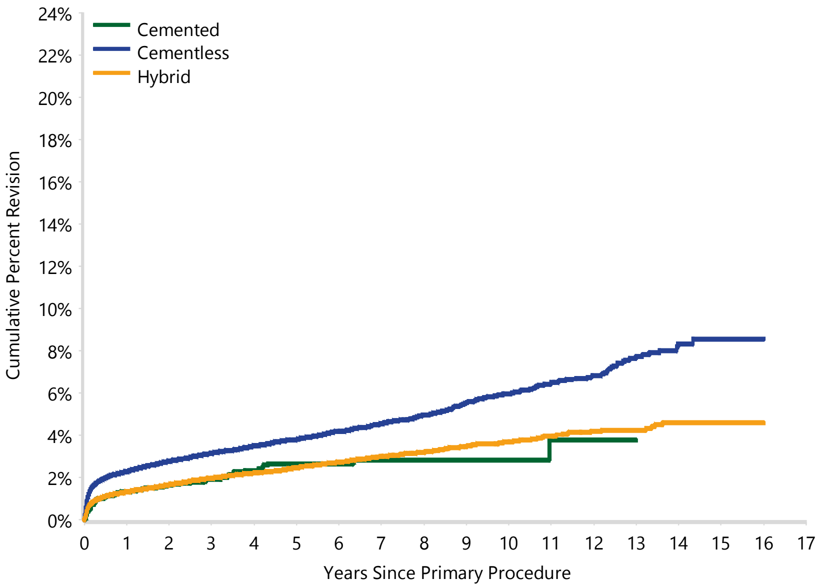
Note: Includes ceramic/ceramic and cross-linked polyethylene (XLPE) bearing surfaces

Figure HT18 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	17 Yrs
Cemented	1825	1632	1174	707	172	4	0
Cementless	71621	62480	46735	33309	10726	1311	64
Hybrid	36759	32589	25098	18731	7018	715	29

Figure HT19 Cumulative Percent Revision of Primary Total Conventional Hip Replacement in Patients Aged ≥75 Years by Fixation (Primary Diagnosis OA)



HR - adjusted for age and gender

Cemented vs Hybrid

Entire Period: HR=0.98 (0.76, 1.26),p=0.847

Cementless vs Hybrid

0 - 3Mth: HR=1.88 (1.66, 2.12),p<0.001

3Mth+: HR=1.46 (1.33, 1.62),p<0.001

Cementless vs Cemented

Entire Period: HR=1.67 (1.29, 2.14),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Cemented	1825	1632	1174	707	172	4	0
Cementless	71621	62480	46735	33309	10726	1311	64
Hybrid	36759	32589	25098	18731	7018	715	29

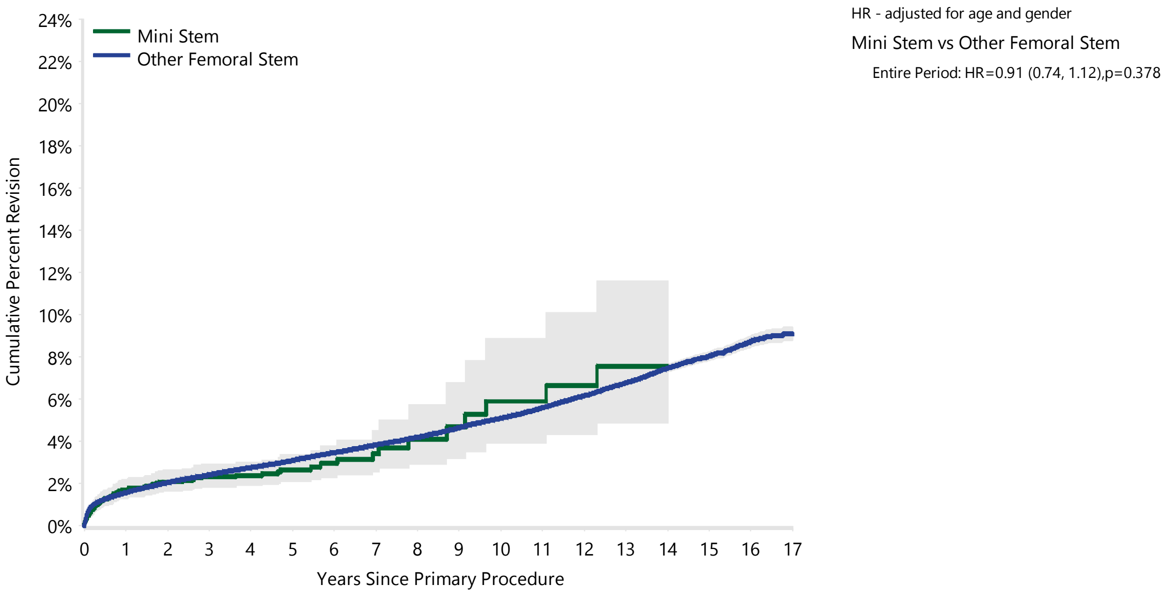
Note: Includes ceramic/ceramic and cross-linked polyethylene (XLPE) bearing surfaces

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	17 Yrs
Mini Stem	88	3706	1.7 (1.3, 2.2)	2.3 (1.8, 2.9)	2.7 (2.1, 3.4)	5.9 (3.9, 8.9)		
Other Femoral Stem	12819	348220	1.6 (1.5, 1.6)	2.4 (2.4, 2.5)	3.1 (3.0, 3.2)	5.1 (5.0, 5.2)	8.0 (7.8, 8.2)	9.1 (8.8, 9.4)
TOTAL	**12907**	**351926**						

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

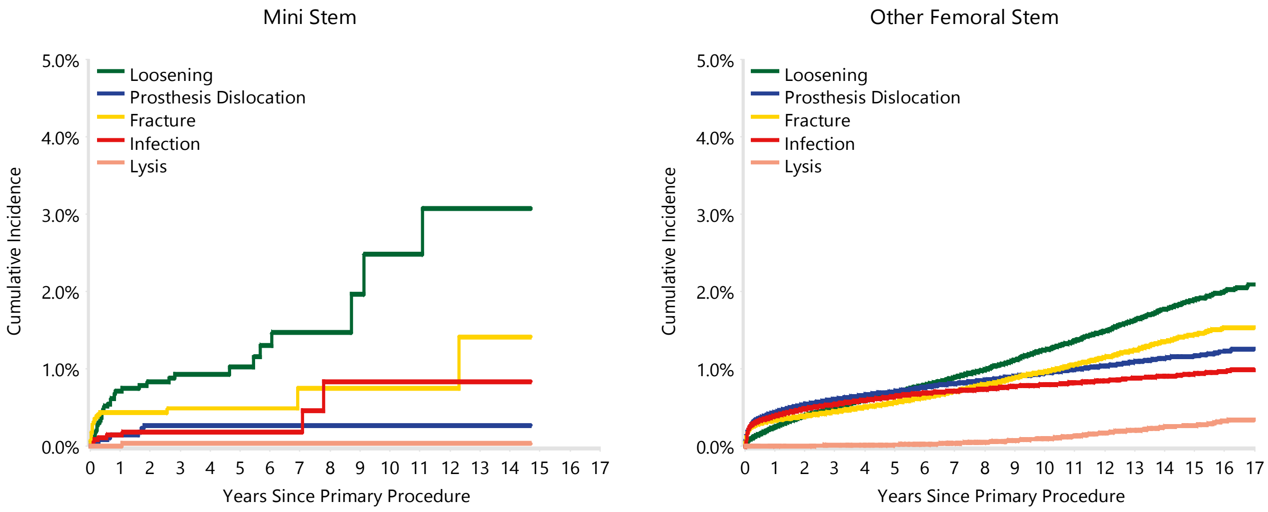
Figure HT20 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Stem Type (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Mini Stem	3706	2822	1763	908	144	26	1
Other Femoral Stem	348220	308778	239430	178672	68793	12604	1452

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

Figure HT21 Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement by Stem Type (Primary Diagnosis OA)



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

Table HT24 Primary Total Conventional Hip Replacement by Type of Revision and Stem Type (Primary Diagnosis OA)

Type of Revision	Mini Stem			Other Femoral Stem		
	Number	% Primaries Revised	% Revisions	Number	% Primaries Revised	% Revisions
Femoral Component	45	1.2	51.1	4221	1.2	32.9
Acetabular Component	18	0.5	20.5	2724	0.8	21.2
Head/Insert	11	0.3	12.5	2572	0.7	20.1
THR (Femoral/Acetabular)	4	0.1	4.5	1548	0.4	12.1
Head Only	6	0.2	6.8	614	0.2	4.8
Cement Spacer	2	0.1	2.3	554	0.2	4.3
Minor Components	2	0.1	2.3	224	0.1	1.7
Other				362	0.1	2.8
N Revision	**88**	**2.4**	**100.0**	**12819**	**3.7**	**100.0**
N Primary	**3706**			**348220**		

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 Stem Component (Primary Diagnosis OA)

Femoral Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 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)		
Mallory-Head	6	121	2.5 (0.8, 7.5)	5.8 (2.6, 12.6)				
Mayo*	7	96	2.1 (0.5, 8.1)	4.2 (1.6, 10.8)	4.2 (1.6, 10.8)	6.9 (3.1, 14.9)		
Metha	5	108	2.8 (0.9, 8.4)	4.7 (2.0, 10.9)	4.7 (2.0, 10.9)			
MiniHip	29	848	2.8 (1.9, 4.2)	3.3 (2.2, 4.8)	4.3 (2.8, 6.7)			
Nanos	8	668	0.8 (0.3, 1.8)	1.1 (0.5, 2.2)	1.1 (0.5, 2.2)			
Optimys	4	727	0.3 (0.1, 1.2)	1.2 (0.4, 3.5)				
Silent*	3	50	4.0 (1.0, 15.1)	6.0 (2.0, 17.5)	6.0 (2.0, 17.5)			
Taperloc Microplasty	13	945	1.4 (0.8, 2.5)	1.4 (0.8, 2.5)	2.0 (1.0, 4.0)			
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	**88**	**3706**						

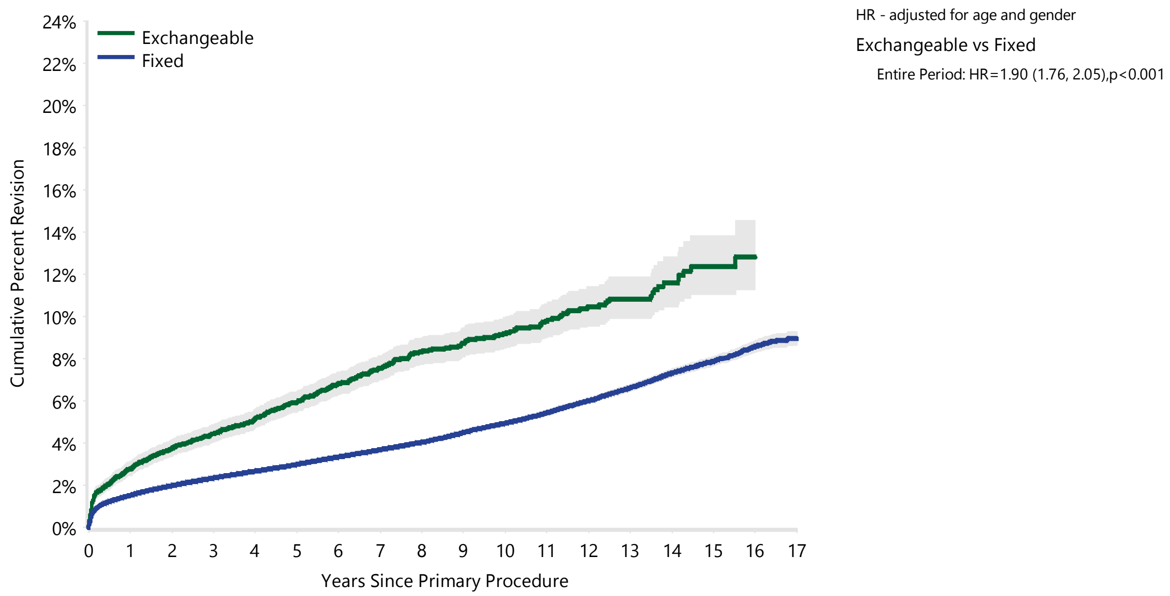
Note: All procedures using metal/metal prostheses have been excluded
* denotes mini stem with no recorded use in total conventional hip replacement in 2017
Only prostheses with over 50 procedures have been listed

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	17 Yrs
Exchangeable	735	10074	2.8 (2.5, 3.1)	4.5 (4.1, 4.9)	5.9 (5.5, 6.4)	9.2 (8.5, 9.9)	12.4 (11.0, 13.8)	
Fixed	12172	341852	1.5 (1.5, 1.6)	2.4 (2.3, 2.4)	3.0 (2.9, 3.1)	5.0 (4.8, 5.1)	7.9 (7.7, 8.1)	8.9 (8.6, 9.3)
TOTAL	**12907**	**351926**						

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

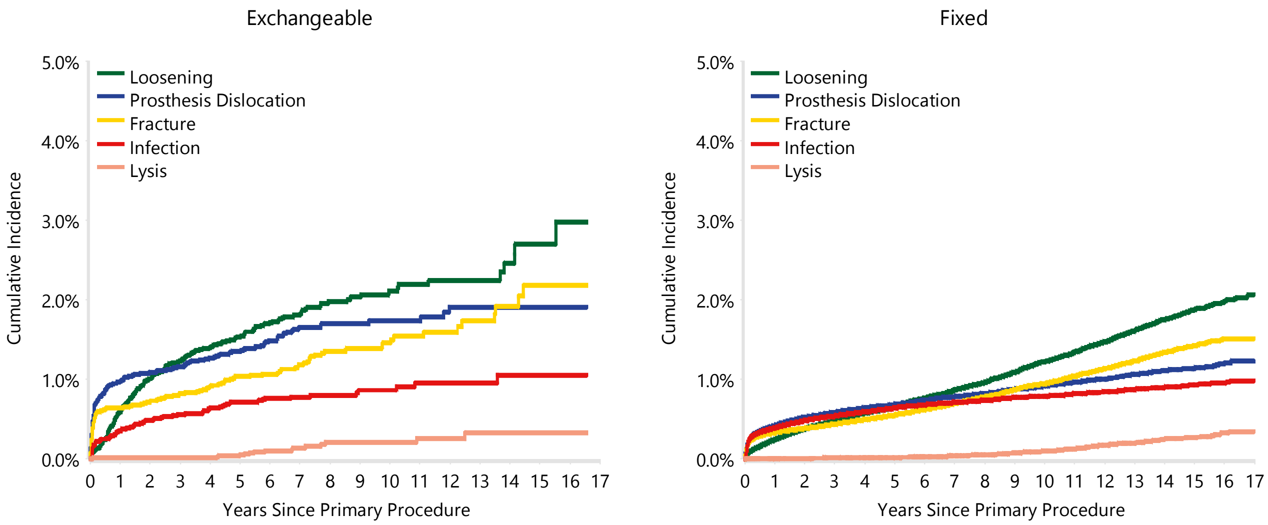
Figure HT22 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Type of Femoral Neck (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Exchangeable	10074	9454	8275	6680	1753	306	21
Fixed	341852	302146	232918	172900	67184	12324	1432

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

Figure HT23 Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement by Type of Femoral Neck (Primary Diagnosis OA)



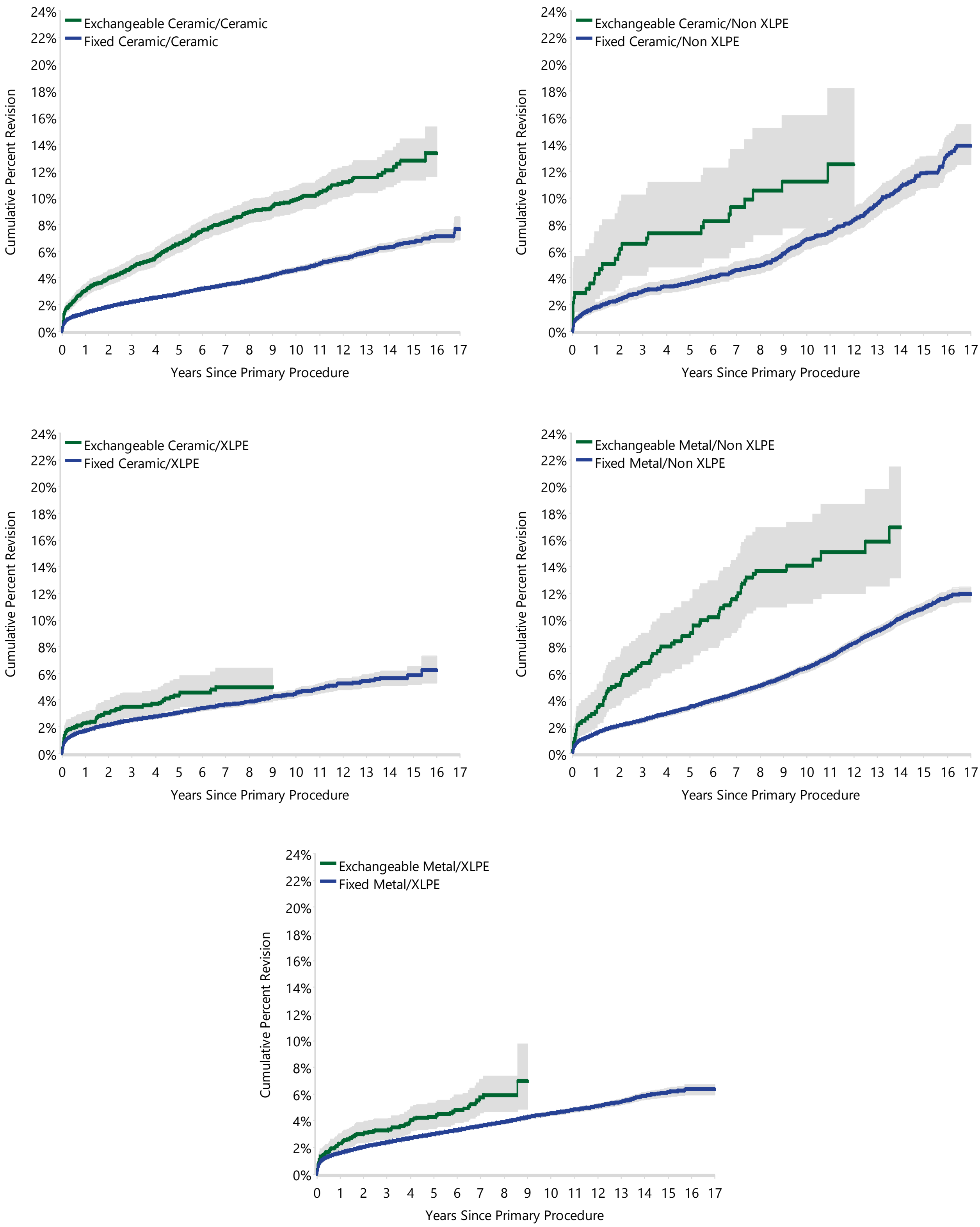
Note: All procedures using metal/metal prostheses have been excluded

Table HT27 Primary Total Conventional Hip Replacement by Reason for Revision and Type of Femoral Neck (Primary Diagnosis OA)

Revision Diagnosis	Exchangeable Number	Exchangeable % Primaries Revised	Exchangeable % Revisions	Fixed Number	Fixed % Primaries Revised	Fixed % Revisions
Loosening	184	1.8	25.0	3039	0.9	25.0
Prosthesis Dislocation	157	1.6	21.4	2563	0.7	21.1
Fracture	128	1.3	17.4	2498	0.7	20.5
Infection	78	0.8	10.6	2254	0.7	18.5
Lysis	15	0.1	2.0	263	0.1	2.2
Pain	17	0.2	2.3	224	0.1	1.8
Leg Length Discrepancy	9	0.1	1.2	193	0.1	1.6
Malposition	12	0.1	1.6	177	0.1	1.5
Instability	11	0.1	1.5	145	0.0	1.2
Wear Acetabular Insert				114	0.0	0.9
Implant Breakage Stem	23	0.2	3.1	113	0.0	0.9
Implant Breakage Acetabular Insert	12	0.1	1.6	100	0.0	0.8
Incorrect Sizing	4	0.0	0.5	82	0.0	0.7
Implant Breakage Acetabular	13	0.1	1.8	74	0.0	0.6
Metal Related Pathology	60	0.6	8.2	47	0.0	0.4
Wear Head	3	0.0	0.4	46	0.0	0.4
Implant Breakage Head	3	0.0	0.4	39	0.0	0.3
Heterotopic Bone				20	0.0	0.2
Tumour				14	0.0	0.1
Wear Acetabulum				14	0.0	0.1
Synovitis	1	0.0	0.1	2	0.0	0.0
Other	5	0.0	0.7	151	0.0	1.2
N Revision	**735**	**7.3**	**100.0**	**12172**	**3.6**	**100.0**
N Primary	**10074**			**341852**		

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

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



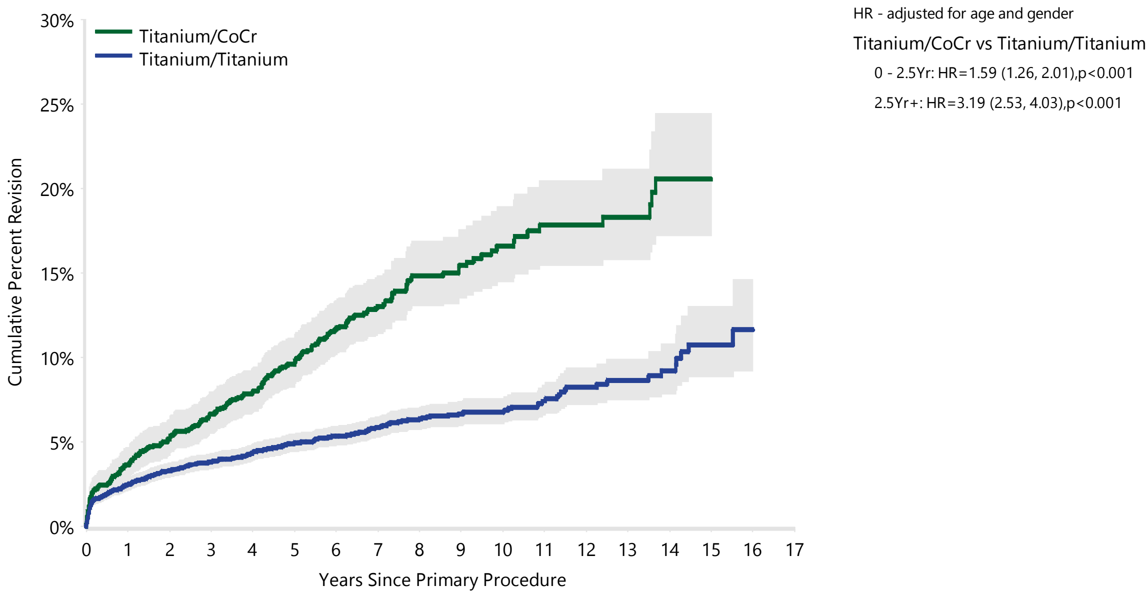
Note: All procedures using metal/metal prostheses have been excluded

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	17 Yrs
CoCr/CoCr	84	754	4.0 (2.8, 5.7)	5.8 (4.3, 7.7)	7.3 (5.6, 9.4)	11.9 (9.6, 14.6)	13.0 (10.6, 16.0)	
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	231	1675	3.7 (2.9, 4.7)	6.6 (5.5, 8.0)	9.6 (8.3, 11.1)	16.6 (14.5, 18.9)	20.6 (17.2, 24.5)	
Titanium/Titanium	416	7488	2.5 (2.2, 2.9)	3.8 (3.4, 4.3)	4.9 (4.4, 5.5)	6.8 (6.1, 7.5)	10.8 (8.9, 13.0)	
TOTAL	**735**	**10074**						

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

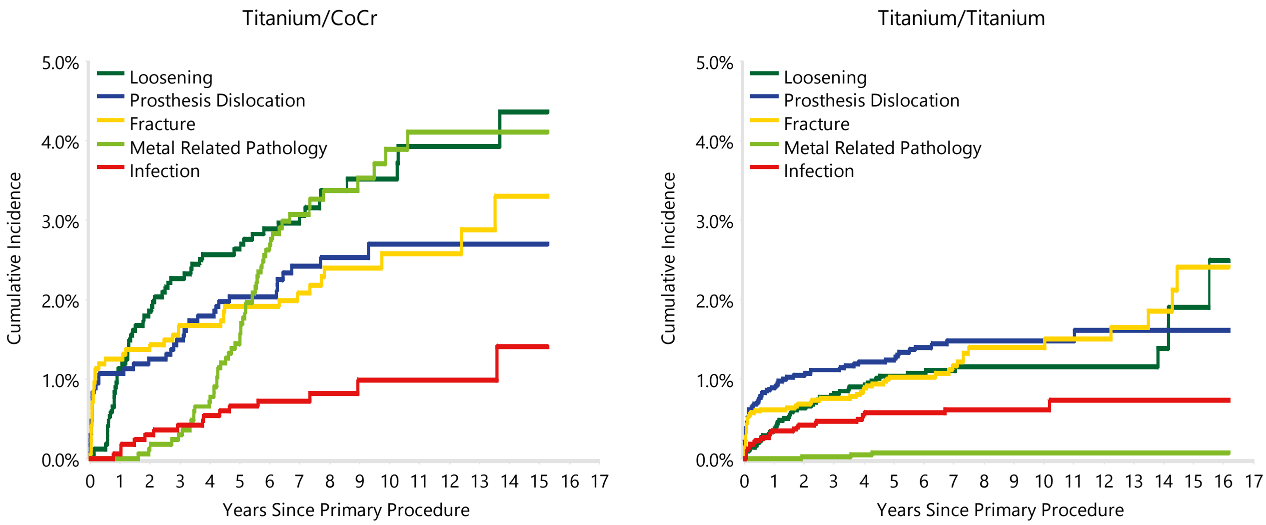
Figure HT25 Cumulative Percent Revision of Primary Total Conventional Hip Replacement Using an Exchangeable Femoral Neck by Stem/Neck Metal Combination (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Titanium/CoCr	1675	1600	1503	1319	310	54	0
Titanium/Titanium	7488	6997	5974	4650	1020	151	10

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

Figure HT26 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)

Femoral Neck	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
ABGII*	71	228	4.4 (2.4, 8.1)	11.1 (7.7, 16.0)	20.4 (15.6, 26.3)			
Adapter*	54	374	3.8 (2.2, 6.3)	7.6 (5.3, 10.8)	10.2 (7.5, 13.9)	16.7 (12.8, 21.5)		
Apex	150	2537	2.7 (2.1, 3.4)	4.0 (3.3, 4.9)	5.2 (4.4, 6.2)	7.4 (6.2, 8.7)		
F2L*	73	685	3.2 (2.1, 4.8)	5.4 (4.0, 7.4)	6.8 (5.2, 9.0)	8.6 (6.7, 11.1)	12.5 (9.9, 15.7)	
Femoral Neck (Amplitude)	20	548	0.9 (0.4, 2.2)	2.0 (1.1, 3.8)	4.3 (2.7, 6.8)			
H-Max*	1	71	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	1.9 (0.3, 12.6)			
M-Cor*	9	110	0.0 (0.0, 0.0)	2.8 (0.9, 8.4)	4.7 (2.0, 11.0)			
M/L Taper Kinectiv	114	2905	2.2 (1.7, 2.8)	3.2 (2.6, 3.9)	3.9 (3.3, 4.8)			
MBA*	61	630	2.1 (1.2, 3.5)	4.0 (2.7, 5.9)	6.1 (4.5, 8.3)	10.5 (8.0, 13.6)	14.6 (11.0, 19.3)	
MSA*	20	174	7.5 (4.4, 12.6)	9.9 (6.2, 15.4)	11.1 (7.2, 16.8)			
Margron*	77	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)	15.1 (12.3, 18.6)	
Metha*	12	84	10.7 (5.7, 19.6)	11.9 (6.6, 21.0)	11.9 (6.6, 21.0)			
Profemur	54	871	3.1 (2.1, 4.5)	4.8 (3.5, 6.4)	5.4 (4.1, 7.1)	6.8 (5.2, 8.9)		
R120*	7	178	1.1 (0.3, 4.4)	2.3 (0.9, 6.1)	2.3 (0.9, 6.1)			
Other (5)	12	136	2.2 (0.7, 6.8)	4.9 (2.2, 10.6)	7.2 (3.6, 14.1)			
TOTAL	**735**	**10074**						

Note: Only prostheses with over 60 procedures have been listed
* denotes exchangeable neck with no recorded use in total conventional hip replacement in 2017
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 three types of femoral head (metal, ceramic, and ceramicised metal) and four types of acetabular articular surface (XLPE, non XLPE, ceramic, and metal). Metal/metal bearing surface includes large head sizes (greater than 32mm) and head sizes 32mm or smaller.

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, eight 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 HT27).

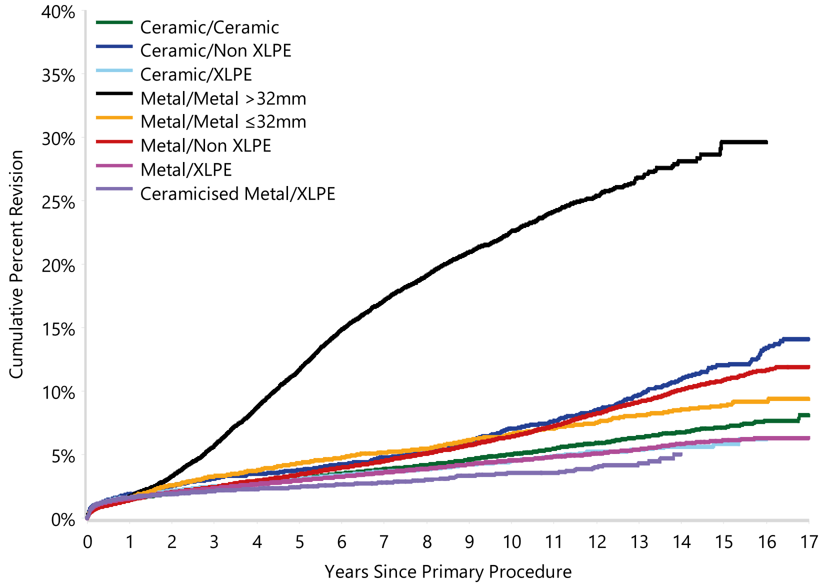
Detailed information on the analysis of metal/metal and metal/ceramic bearing surfaces is available in the supplementary reports 'Metal on Metal Bearing Surface Conventional Hip Arthroplasty' and 'Prosthesis Types No Longer Used' on the AOANJRR website: https://aoanjrr.sahmri.com/annual-reports-2018.

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	16 Yrs
Ceramic/Ceramic	3130	84474	1.5 (1.4, 1.6)	2.4 (2.3, 2.5)	3.1 (3.0, 3.2)	5.0 (4.8, 5.2)	7.2 (6.8, 7.5)	7.6 (7.2, 8.1)
Ceramic/Non XLPE	483	6793	1.9 (1.6, 2.3)	3.2 (2.7, 3.6)	3.8 (3.3, 4.3)	7.1 (6.4, 7.9)	12.1 (10.9, 13.3)	13.4 (12.1, 14.9)
Ceramic/XLPE	1631	61666	1.7 (1.6, 1.8)	2.5 (2.4, 2.6)	3.1 (2.9, 3.3)	4.5 (4.2, 4.8)	5.8 (5.2, 6.5)	6.2 (5.3, 7.3)
Ceramic/Metal	20	299	1.7 (0.7, 4.0)	3.7 (2.1, 6.6)	4.4 (2.6, 7.4)			
Metal/Metal >32mm	3119	14421	1.7 (1.5, 1.9)	5.7 (5.3, 6.1)	11.7 (11.2, 12.2)	22.6 (21.9, 23.4)	29.6 (27.7, 31.6)	29.6 (27.7, 31.6)
Metal/Metal ≤32mm	373	5146	1.6 (1.3, 2.0)	3.3 (2.9, 3.8)	4.4 (3.8, 5.0)	6.6 (5.9, 7.4)	8.9 (8.0, 9.9)	9.2 (8.2, 10.2)
Metal/Non XLPE	2497	34837	1.4 (1.3, 1.5)	2.5 (2.3, 2.6)	3.4 (3.3, 3.7)	6.4 (6.1, 6.7)	10.9 (10.4, 11.3)	11.7 (11.2, 12.2)
Metal/XLPE	4577	143028	1.6 (1.5, 1.6)	2.4 (2.3, 2.4)	3.0 (2.9, 3.1)	4.5 (4.4, 4.7)	6.1 (5.8, 6.5)	6.3 (5.9, 6.7)
Ceramicised Metal/Non XLPE	40	293	1.7 (0.7, 4.1)	3.8 (2.1, 6.8)	4.2 (2.4, 7.3)	12.7 (9.1, 17.7)		
Ceramicised Metal/XLPE	517	20327	1.6 (1.5, 1.8)	2.2 (2.0, 2.4)	2.5 (2.2, 2.7)	3.5 (3.2, 3.9)		
TOTAL	**16387**	**371284**						

Note: Excludes 200 procedures with unknown bearing surface, one procedure with ceramicised metal/ceramic bearing surface and eight procedures with metal/ceramic bearing surface

Figure HT27 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=1.02 (0.98, 1.07),p=0.347

Ceramic/Non XLPE vs Metal/XLPE
0 - 3Mth: HR=1.08 (0.86, 1.36),p=0.520
3Mth - 2Yr: HR=1.44 (1.16, 1.78),p<0.001
2Yr+: HR=1.97 (1.75, 2.21),p<0.001

Ceramic/XLPE vs Metal/XLPE
Entire Period: HR=1.01 (0.96, 1.07),p=0.665

Metal/Metal >32mm vs Metal/XLPE
0 - 2Wk: HR=1.30 (0.98, 1.73),p=0.068
2Wk - 1Mth: HR=0.49 (0.33, 0.72),p<0.001
1Mth - 3Mth: HR=0.86 (0.65, 1.14),p=0.298
3Mth - 9Mth: HR=1.13 (0.88, 1.45),p=0.345
9Mth - 1.5Yr: HR=2.63 (2.22, 3.12),p<0.001
1.5Yr - 2Yr: HR=4.26 (3.52, 5.17),p<0.001
2Yr - 2.5Yr: HR=6.00 (5.02, 7.16),p<0.001
2.5Yr - 6Yr: HR=9.61 (8.94, 10.33),p<0.001
6Yr - 6.5Yr: HR=8.40 (6.87, 10.26),p<0.001
6.5Yr - 8Yr: HR=7.96 (6.98, 9.06),p<0.001
8Yr - 9.5Yr: HR=5.30 (4.57, 6.15),p<0.001
9.5Yr+: HR=4.91 (4.26, 5.67),p<0.001

Metal/Metal ≤32mm vs Metal/XLPE
Entire Period: HR=1.35 (1.21, 1.50),p<0.001

Metal/Non XLPE vs Metal/XLPE
0 - 1Mth: HR=0.75 (0.64, 0.88),p<0.001
1Mth - 6Mth: HR=0.94 (0.81, 1.09),p=0.381
6Mth - 1.5Yr: HR=1.42 (1.24, 1.62),p<0.001
1.5Yr - 2.5Yr: HR=1.15 (0.97, 1.37),p=0.114
2.5Yr - 6Yr: HR=1.60 (1.45, 1.77),p<0.001
6Yr - 11Yr: HR=1.95 (1.78, 2.14),p<0.001
11Yr+: HR=2.49 (2.19, 2.84),p<0.001

Ceramicised Metal/XLPE vs Metal/XLPE
0 - 3Mth: HR=1.10 (0.96, 1.27),p=0.150
3Mth+: HR=0.67 (0.60, 0.76),p<0.001

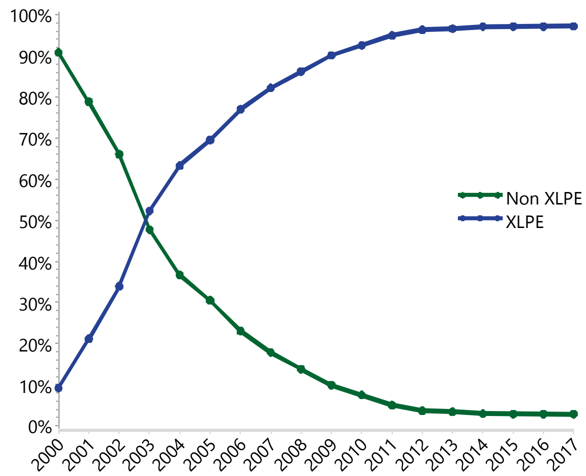
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Ceramic/Ceramic	84474	77231	62436	46826	17521	3296	241
Ceramic/Non XLPE	6793	6109	5073	4348	2988	1148	294
Ceramic/XLPE	61666	48568	29420	17839	4281	387	14
Metal/Metal >32mm	14421	14062	13217	11975	5535	134	18
Metal/Metal ≤32mm	5146	5022	4823	4560	3239	1012	78
Metal/Non XLPE	34837	33475	30998	28111	18122	5619	821
Metal/XLPE	143028	127659	99169	72445	22917	2163	81
Ceramicised Metal/XLPE	20327	17783	13367	9350	2855	0	0

Note: Only bearing surfaces with over 500 procedures have been listed

Cross-Linked Polyethylene (XLPE)

XLPE has been used in 225,021 procedures reported to the Registry. This includes 10,520 procedures that have XLPE with the addition of an antioxidant. In 2017, when polyethylene was used as a bearing surface in total conventional hip procedures, the proportion of XLPE was 97.2% (Figure HT28).

Figure HT28 Primary Total Conventional Hip Replacement by Polyethylene Type (Primary Diagnosis OA)



XLPE has a lower rate of revision compared to non XLPE after three months (Table HT31and Figure HT29). The difference increases with time and at 17 years the cumulative percent revision is 6.4% and 12.4%, respectively. The cumulative incidence of loosening, prosthesis dislocation and lysis at 17 years is 1.1%, 1.3% and 0.1% for XLPE, compared to 3.4%,1.7% and 0.7% for non XLPE bearings, respectively (Figure HT30).

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 less than 32mm and head sizes larger than 32mm (Figures HT31 and HT32).

The use of XLPE has been associated with an increased use of larger head sizes when compared to non XLPE. Head sizes of 32mm or larger have been used in 77.8% of XLPE procedures and in only 12.2% of non XLPE procedures. The Registry has previously shown that this increased use of larger head size with XLPE is the reason for reduced revision for dislocation.

The use of XLPE results in a reduced cumulative incidence of loosening for the most common head sizes of 32mm, and less than 32mm when compared to non XLPE (Figure HT33).

At 17 years the cumulative percent revision of total conventional hip replacement with XLPE is 6.4%.

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 HT34).

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 15 year follow up with an insert using both types of polyethylene. XLPE is used in 90.6% of Allofit Shell total conventional hip procedures. XLPE has a lower rate of revision than non XLPE (Table HT32 and Figure HT35).

The Duraloc Shell has a 15 year follow up with an insert using both types of polyethylene. XLPE is used in 36.4% of Duraloc Shell total conventional hip procedures. XLPE has a lower rate of revision compared to non XLPE (Table HT32 and Figure HT36).

The Mallory-Head Shell has a nine year follow up with an insert using both types of polyethylene. XLPE is used in 43.8% of Mallory-Head Shell total conventional hip procedures. XLPE has a lower rate of revision compared to non XLPE after 1.5 years (Table HT32 and Figure HT37).

The Reflection Cup has a 11 year follow up for both types of polyethylene. XLPE has been used in 52.5% of Reflection Cup total conventional hip procedures. After 1.5 years, XLPE has a lower rate of revision than non XLPE (Table HT32 and Figure HT38).

The Reflection Shell has a 15 year follow up with an insert using both types of polyethylene. XLPE is used in 83.8% of Reflection Shell total conventional hip procedures. XLPE has a lower rate of revision after one year compared to non XLPE (Table HT32 and Figure HT39).

The Vitalock Shell has a 14 year follow up with an insert using both types of polyethylene. XLPE is used in 22.7% of Vitalock Shell total conventional hip procedures. There is no difference in the rate of revision between XLPE and non XLPE (Table HT32 and Figure HT40).

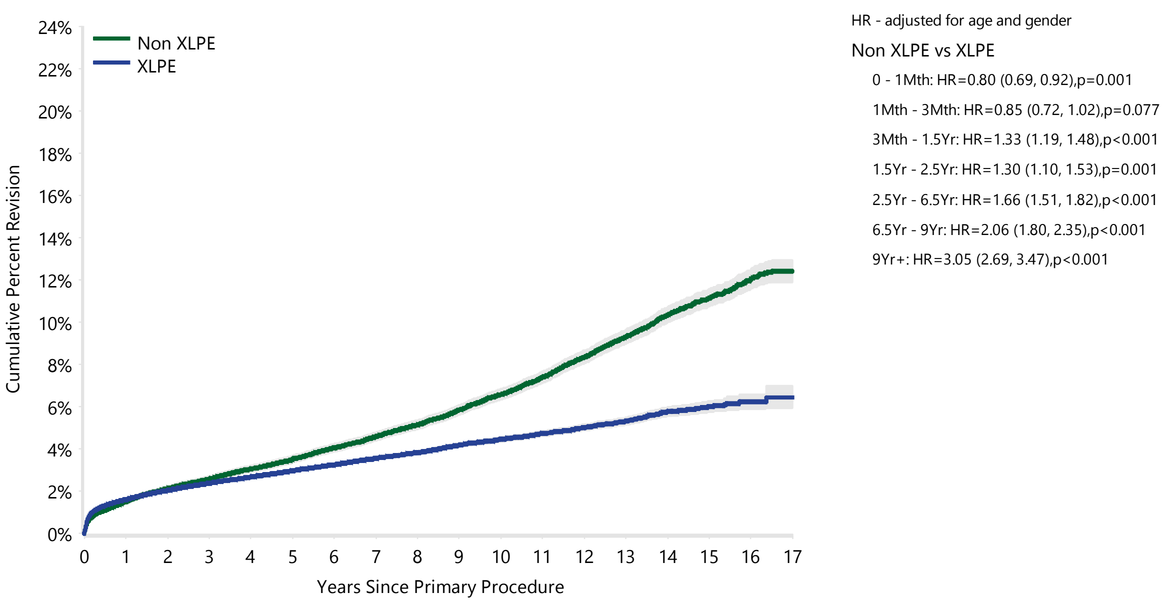
Prosthesis Specific (Antioxidant)

The Registry has performed a separate analysis of acetabular components that have both XLPE and XLPE with antioxidant. 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	17 Yrs
Non XLPE		**3020**	**41923**	**1.5 (1.4, 1.6)**	**2.6 (2.4, 2.7)**	**3.5 (3.3, 3.7)**	**6.6 (6.3, 6.9)**	**11.1 (10.7, 11.6)**	**12.4 (11.9, 13.0)**
	<32mm	2746	36801	1.5 (1.3, 1.6)	2.5 (2.3, 2.7)	3.4 (3.3, 3.6)	6.5 (6.2, 6.8)	11.1 (10.6, 11.5)	12.3 (11.8, 12.9)
	32mm	247	4815	1.6 (1.3, 2.0)	3.0 (2.5, 3.5)	3.8 (3.3, 4.4)	6.8 (5.9, 7.9)	10.6 (8.7, 13.0)	
	>32mm	27	307	3.6 (2.0, 6.4)	6.2 (3.9, 9.7)	8.5 (5.7, 12.5)			
XLPE		**6725**	**225021**	**1.6 (1.6, 1.7)**	**2.4 (2.3, 2.4)**	**3.0 (2.9, 3.0)**	**4.5 (4.3, 4.6)**	**6.0 (5.7, 6.3)**	**6.4 (5.9, 7.0)**
	<32mm	1974	49909	1.5 (1.4, 1.7)	2.4 (2.2, 2.5)	3.0 (2.9, 3.2)	4.5 (4.3, 4.7)	6.1 (5.7, 6.4)	6.5 (5.9, 7.1)
	32mm	2542	96108	1.6 (1.5, 1.7)	2.3 (2.2, 2.4)	2.8 (2.7, 2.9)	4.1 (3.9, 4.3)	5.3 (4.7, 5.9)	
	>32mm	2209	79004	1.7 (1.6, 1.8)	2.4 (2.3, 2.6)	3.1 (3.0, 3.3)	4.9 (4.6, 5.2)	6.8 (5.7, 7.9)	
TOTAL		**9745**	**266944**						

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



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Non XLPE	41923	39867	36337	32699	21274	6767	1115
XLPE	225021	194010	141956	99634	30053	2550	95

Figure HT30 Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement by Polyethylene Type (Primary Diagnosis OA)

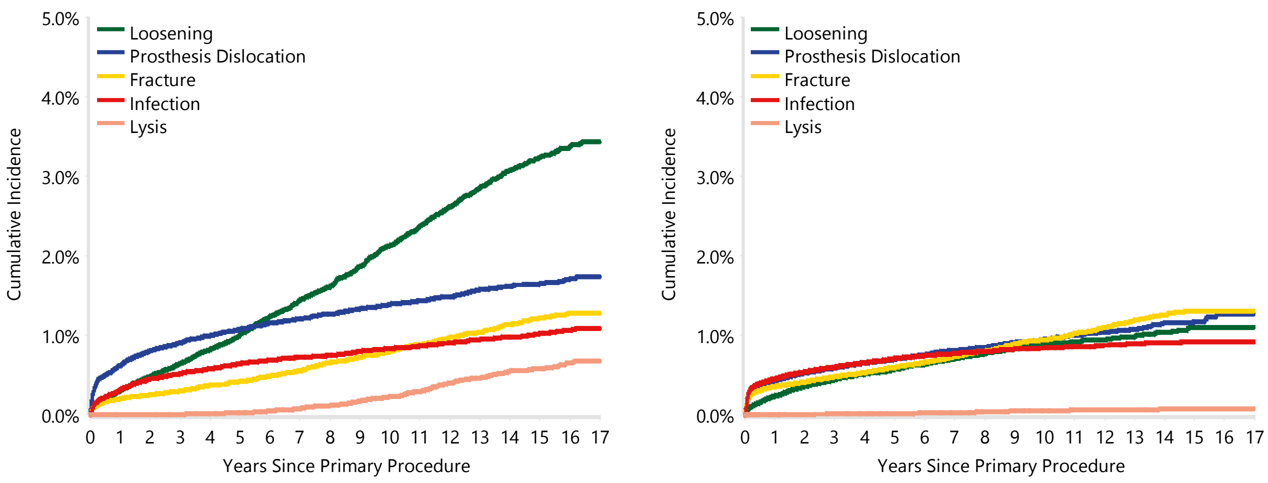
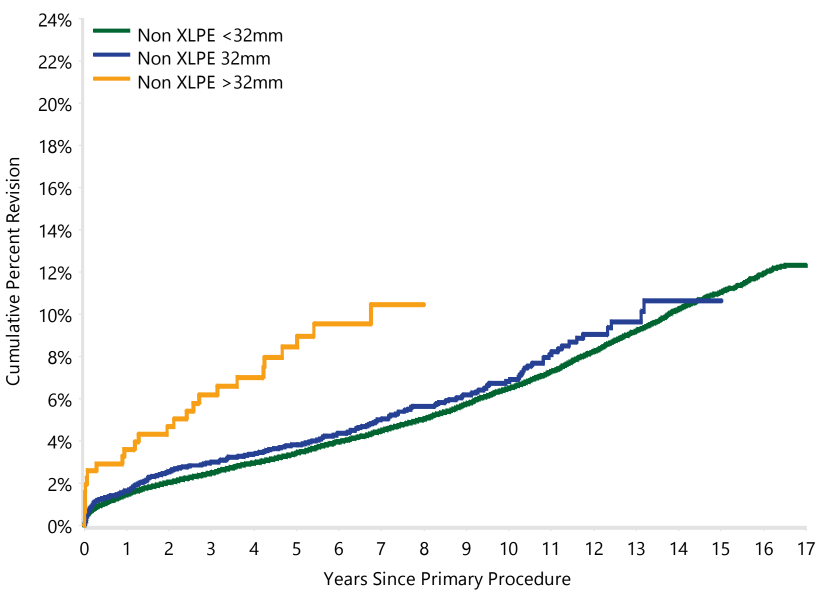


Figure HT31 Cumulative Percent Revision of Primary Total Conventional Hip Replacement using Non XLPE by Head Size (Primary Diagnosis OA)



HR - adjusted for age and gender

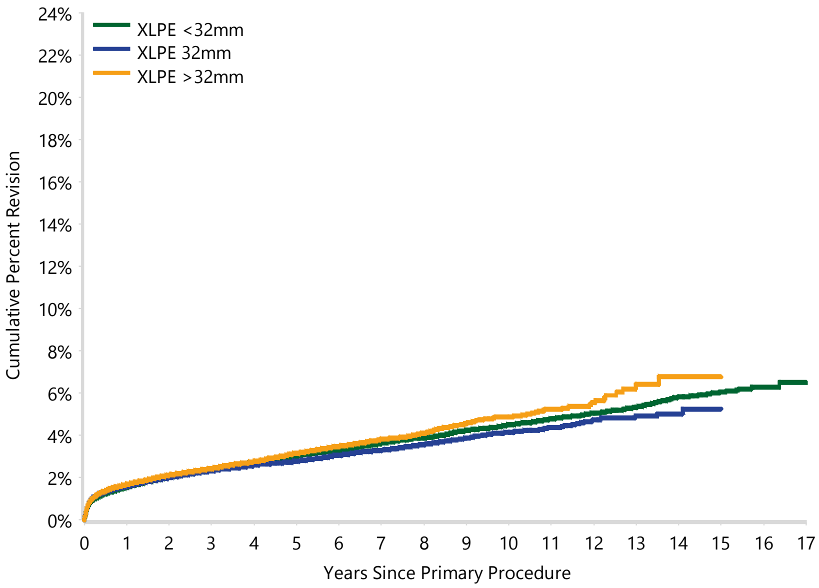
Non XLPE 32mm vs Non XLPE <32mm
Entire Period: HR=1.20 (1.05, 1.37),p=0.006

Non XLPE >32mm vs Non XLPE <32mm
Entire Period: HR=2.28 (1.56, 3.34),p<0.001

Non XLPE >32mm vs Non XLPE 32mm
Entire Period: HR=1.90 (1.28, 2.83),p=0.001

Number at Risk	0 Yr	1 Yrs	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Non XLPE	41923	39867	36337	32699	21274	6767	1115
XLPE	225021	194010	141956	99634	30053	2550	95

Figure HT32 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=0.92 (0.83, 1.02),p=0.124
- 3Mth+: HR=1.15 (1.06, 1.24),p<0.001

XLPE >32mm vs XLPE 32mm
- 0 - 3Mth: HR=0.99 (0.90, 1.08),p=0.783
- 3Mth+: HR=1.18 (1.10, 1.28),p<0.001

XLPE >32mm vs XLPE <32mm
- Entire Period: HR=1.05 (0.98, 1.11),p=0.168

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
XLPE	<32mm	49909	46694	41415	35215	18930	2426	94
	32mm	96108	82140	56947	36930	7671	83	1
	>32mm	79004	65176	43594	27489	3452	41	0

Figure HT33 Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement by Polyethylene Type and Head Size (Primary Diagnosis OA)

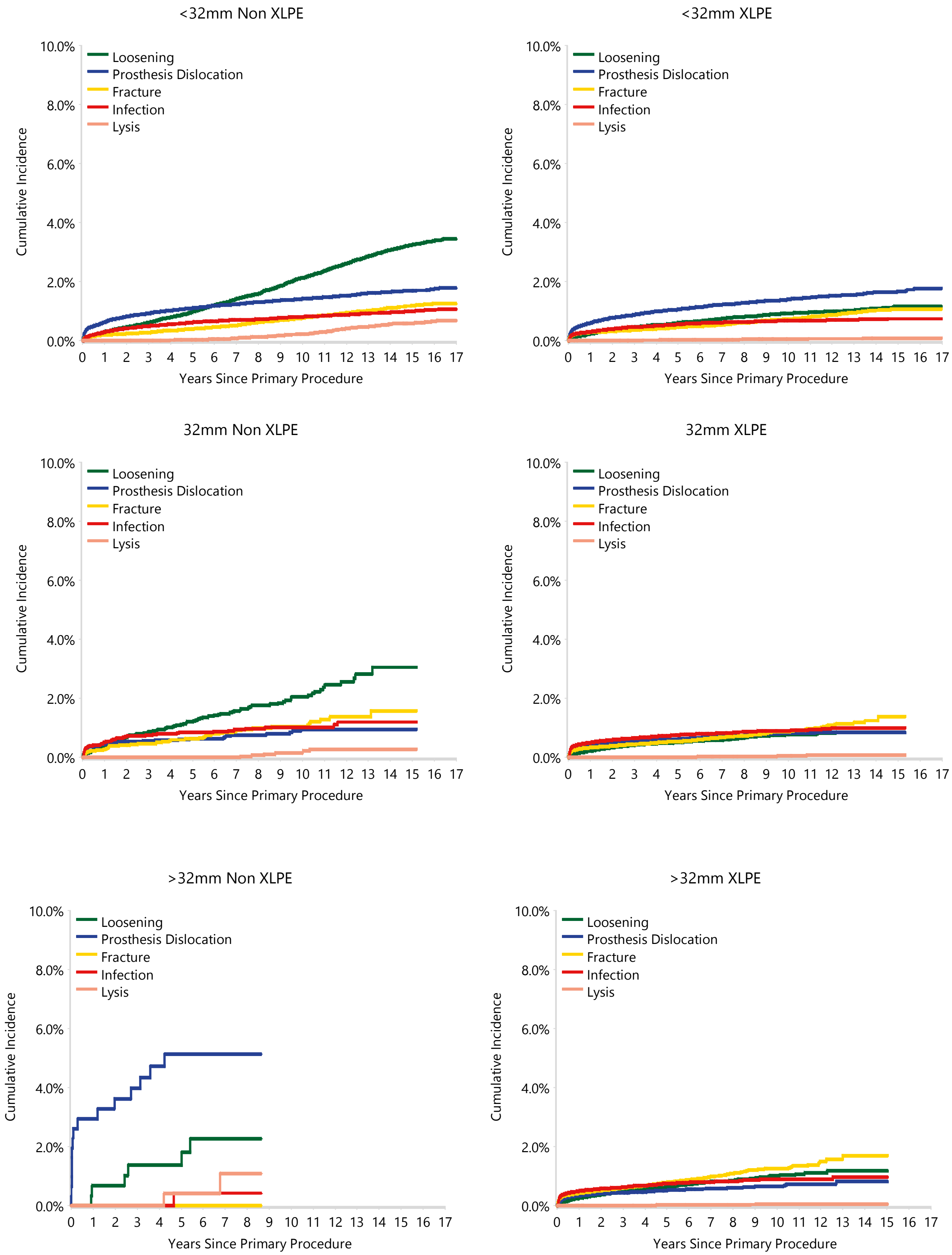


Figure HT34 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Head Surface and Polyethylene Type (Primary Diagnosis OA)

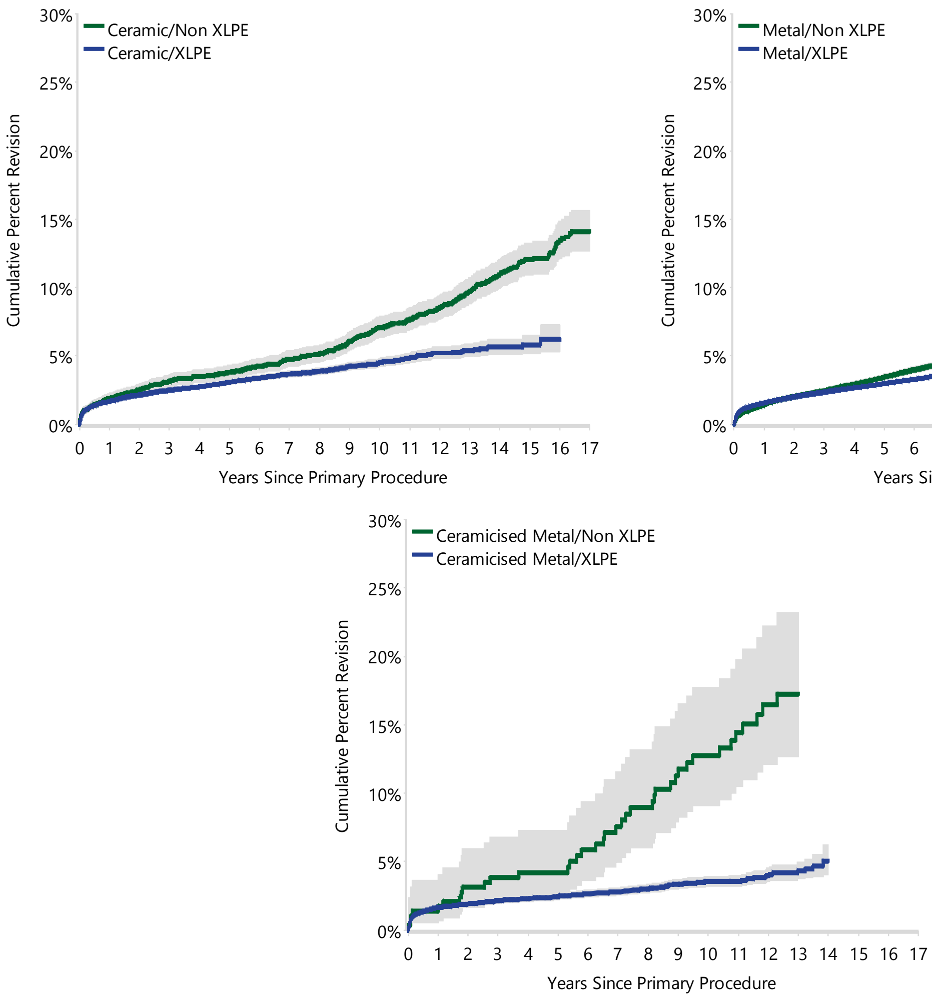
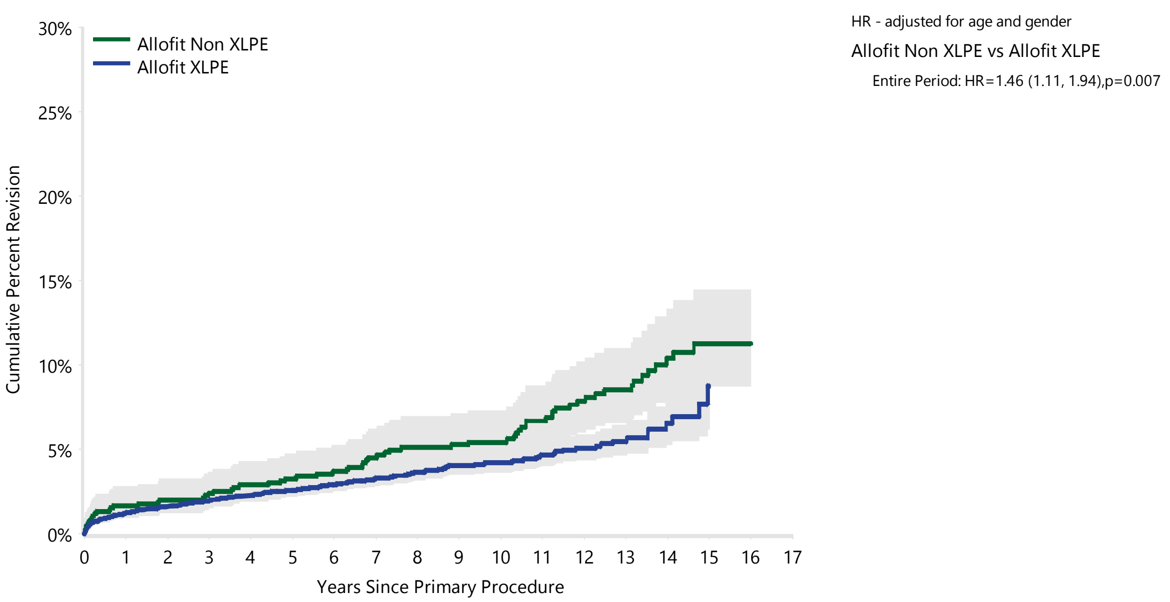


Table HT32 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Prosthesis Type and Polyethylene Type (Primary Diagnosis OA)

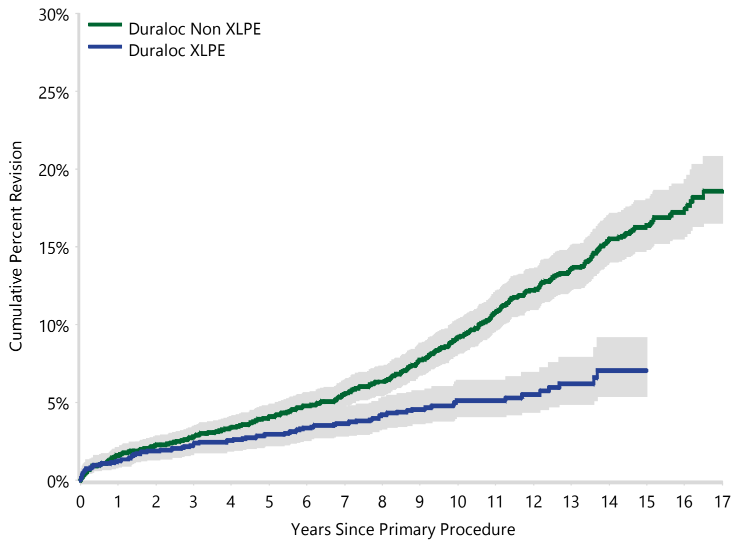
Acetabular Component	Polyethylene Type	N Revised	N Total	5 Yrs	9 Yrs	11 Yrs	14 Yrs	15 Yrs
Allofit		**337**	**9057**	**2.6 (2.3, 3.0)**	**4.2 (3.7, 4.7)**	**5.0 (4.4, 5.6)**	**7.6 (6.5, 8.9)**	**9.0 (7.4, 10.9)**
	Non XLPE	66	848	3.3 (2.3, 4.7)	5.3 (3.9, 7.1)	6.7 (5.1, 8.8)	10.4 (8.1, 13.3)	11.3 (8.7, 14.5)
	XLPE	271	8209	2.6 (2.2, 3.0)	4.1 (3.6, 4.6)	4.6 (4.0, 5.3)	6.5 (5.3, 8.1)	8.7 (6.2, 12.2)
Duraloc		**451**	**4711**	**3.7 (3.1, 4.2)**	**6.6 (5.9, 7.4)**	**9.0 (8.2, 10.0)**	**13.2 (12.0, 14.5)**	**14.0 (12.7, 15.4)**
	Non XLPE	369	2995	4.1 (3.4, 4.8)	7.7 (6.8, 8.8)	10.8 (9.6, 12.1)	15.4 (14.0, 17.1)	16.4 (14.8, 18.1)
	XLPE	82	1716	3.0 (2.2, 3.9)	4.6 (3.6, 5.8)	5.1 (4.1, 6.5)	7.1 (5.4, 9.2)	7.1 (5.4, 9.2)
Mallory-Head		**321**	**7278**	**2.5 (2.2, 3.0)**	**4.0 (3.5, 4.5)**	**4.9 (4.3, 5.6)**	**7.3 (6.4, 8.3)**	**8.4 (7.4, 9.6)**
	Non XLPE	256	4084	2.8 (2.3, 3.3)	4.4 (3.8, 5.1)	5.4 (4.7, 6.2)	7.8 (6.8, 8.8)	8.9 (7.8, 10.1)
	XLPE	65	3194	2.1 (1.7, 2.8)	2.5 (1.9, 3.2)			
Reflection (Cup)		**187**	**2270**	**3.0 (2.3, 3.8)**	**6.6 (5.5, 7.9)**	**9.0 (7.6, 10.7)**	**16.9 (14.4, 19.9)**	**18.7 (15.8, 22.0)**
	Non XLPE	153	1079	3.4 (2.4, 4.7)	9.5 (7.7, 11.6)	12.8 (10.6, 15.3)	21.7 (18.5, 25.4)	23.5 (20.0, 27.4)
	XLPE	34	1191	2.5 (1.7, 3.7)	2.7 (1.8, 3.9)	3.5 (2.4, 5.1)		
Reflection (Shell)		**638**	**14335**	**2.4 (2.1, 2.7)**	**4.0 (3.6, 4.3)**	**4.9 (4.5, 5.3)**	**7.1 (6.5, 7.8)**	**8.0 (7.2, 8.9)**
	Non XLPE	286	2322	4.3 (3.5, 5.2)	8.0 (6.9, 9.2)	11.0 (9.7, 12.5)	15.5 (13.8, 17.4)	16.7 (14.9, 18.7)
	XLPE	352	12013	2.0 (1.8, 2.3)	3.1 (2.8, 3.4)	3.3 (3.0, 3.7)	4.4 (3.8, 5.1)	4.8 (4.0, 5.8)
Vitalock		**271**	**4619**	**2.5 (2.1, 3.0)**	**4.1 (3.5, 4.7)**	**4.8 (4.2, 5.5)**	**6.7 (5.9, 7.6)**	**7.1 (6.3, 8.1)**
	Non XLPE	229	3569	2.6 (2.1, 3.1)	4.2 (3.6, 5.0)	5.1 (4.4, 5.9)	7.1 (6.2, 8.2)	7.6 (6.7, 8.7)
	XLPE	42	1050	2.4 (1.6, 3.5)	3.6 (2.6, 5.0)	3.9 (2.8, 5.3)	4.7 (3.5, 6.4)	
TOTAL		**2205**	**42270**					

Figure HT35 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	17 Yrs
Allofit	Non XLPE	848	828	793	738	545	144	5
	XLPE	8209	7658	6492	5147	1785	84	0

Figure HT36 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=1.33 (0.96, 1.86),p=0.091

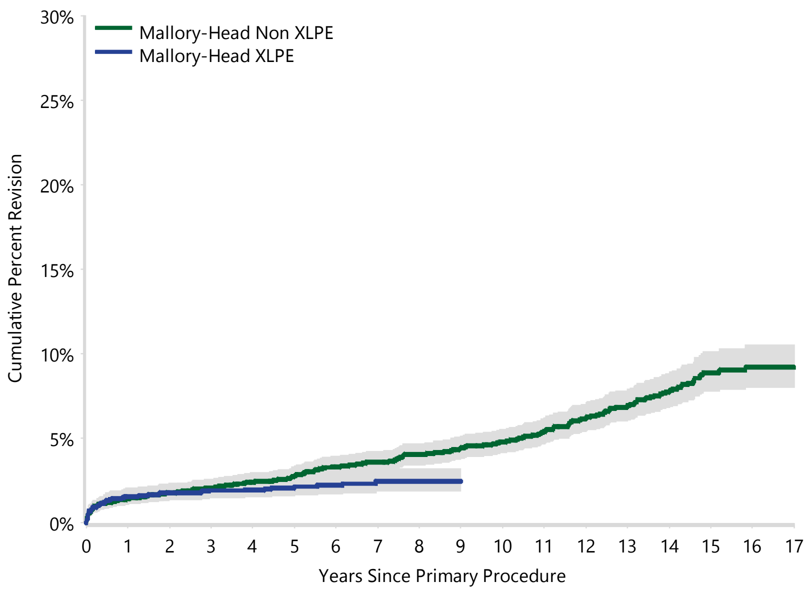
5Yr - 9Yr: HR=2.22 (1.38, 3.58),p<0.001

9Yr - 9.5Yr: HR=3.26 (0.75, 14.27),p=0.116

9.5Yr+: HR=4.11 (2.16, 7.81),p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Duraloc	Non XLPE	2995	2916	2745	2569	1939	731	83
	XLPE	1716	1668	1575	1460	763	91	0

Figure HT37 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 (0.48, 1.50),p=0.576

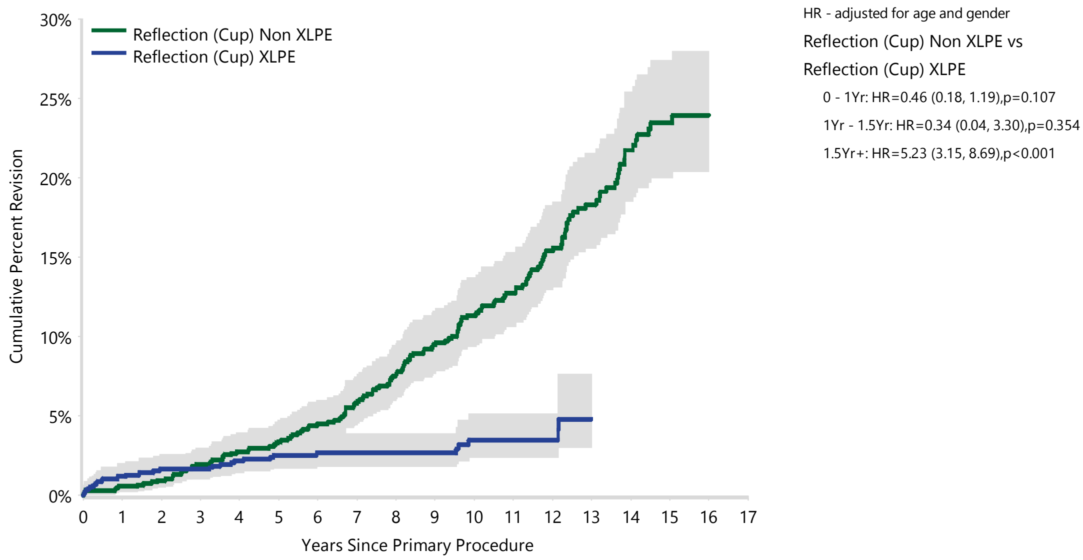
1Mth - 3Mth: HR=1.77 (0.73, 4.31),p=0.205

3Mth - 1.5Yr: HR=0.92 (0.52, 1.63),p=0.766

1.5Yr+: HR=2.75 (1.56, 4.85),p<0.001

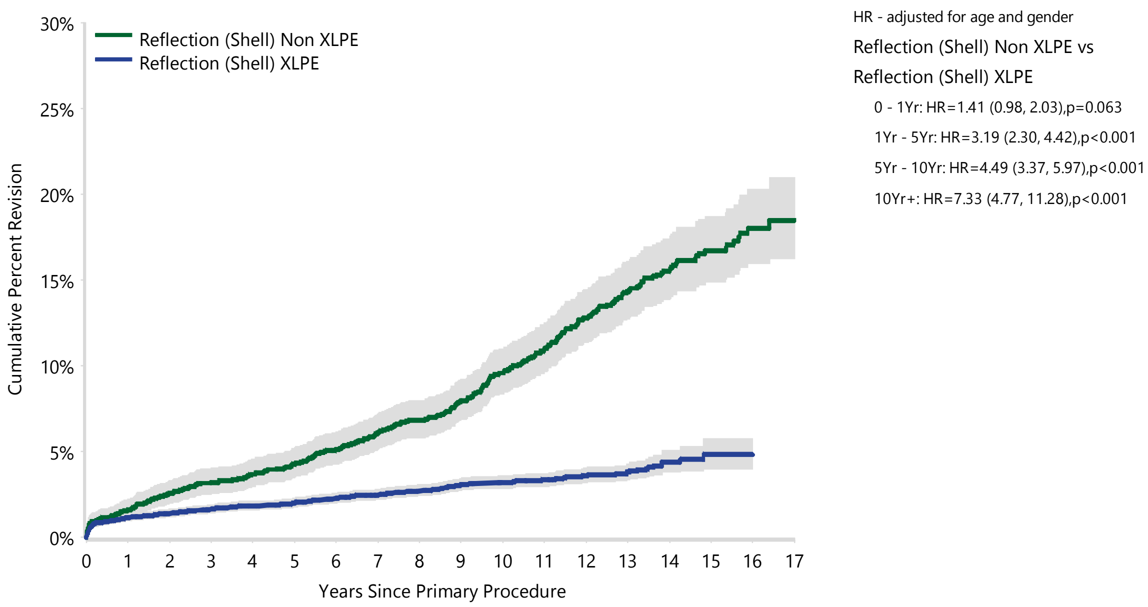
Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Mallory-Head	Non XLPE	4084	3977	3812	3620	2811	757	163
	XLPE	3194	2876	2223	1520	35	0	0

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



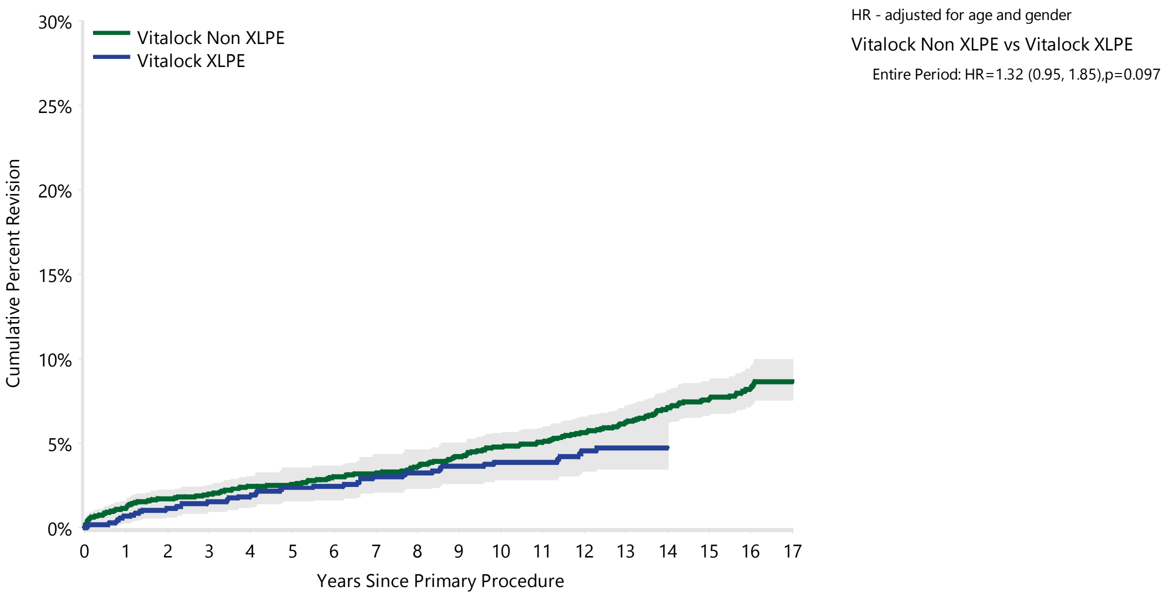
Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Reflection (Cup)	Non XLPE	1079	1052	975	895	590	166	22
	XLPE	1191	1125	971	793	313	0	0

Figure HT39 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	17 Yrs
Reflection (Shell)	Non XLPE	2322	2243	2117	1964	1456	533	89
	XLPE	12013	11625	10677	9363	5217	259	5

Figure HT40 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	17 Yrs
Vitalock	Non XLPE	3569	3479	3334	3165	2564	1376	319
	XLPE	1050	1032	985	936	731	0	0

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

Acetabular Component	Polyethylene Type	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
G7		**33**	**1939**	**1.6 (1.1, 2.3)**	**2.0 (1.4, 2.9)**	**2.2 (1.5, 3.2)**			
	XLPE	6	222	0.9 (0.2, 3.6)	2.6 (1.1, 6.2)	3.4 (1.5, 7.6)			
	XLPE + Antioxidant	27	1717	1.7 (1.1, 2.4)	1.8 (1.2, 2.7)	1.8 (1.2, 2.7)			
Ringloc		**126**	**5853**	**1.6 (1.3, 1.9)**	**1.9 (1.5, 2.3)**	**2.1 (1.7, 2.5)**	**2.2 (1.8, 2.6)**	**2.3 (1.9, 2.7)**	**2.3 (2.0, 2.8)**
	XLPE	65	3180	1.4 (1.0, 1.8)	1.7 (1.3, 2.2)	1.8 (1.4, 2.3)	1.9 (1.5, 2.4)	2.0 (1.6, 2.6)	2.2 (1.7, 2.8)
	XLPE + Antioxidant	61	2673	1.8 (1.4, 2.4)	2.1 (1.6, 2.7)	2.4 (1.9, 3.1)	2.5 (1.9, 3.2)	2.5 (1.9, 3.2)	2.5 (1.9, 3.2)
Trinity		**81**	**4797**	**1.5 (1.2, 1.9)**	**2.0 (1.5, 2.5)**	**2.3 (1.8, 2.9)**	**2.5 (1.9, 3.3)**	**2.8 (2.0, 4.0)**	**2.8 (2.0, 4.0)**
	XLPE	22	1039	1.6 (1.0, 2.6)	2.1 (1.3, 3.4)	2.7 (1.7, 4.3)	3.3 (2.0, 5.6)	3.3 (2.0, 5.6)	3.3 (2.0, 5.6)
	XLPE + Antioxidant	59	3758	1.5 (1.1, 2.0)	1.9 (1.5, 2.5)	2.1 (1.6, 2.8)	2.1 (1.6, 2.8)	2.9 (1.6, 5.3)	
TOTAL		**240**	**12589**						

Ceramic/Ceramic Bearings

Ceramic/ceramic bearings have been used in 84,474 primary total conventional hip replacement procedures undertaken for osteoarthritis. This is the second most common bearing reported to the Registry.

This year, the analysis has been restricted to procedures with mixed ceramic femoral head and mixed ceramic acetabular bearing surfaces. In 2017, mixed ceramic accounted for 97.6% of all procedures with ceramic/ceramic bearing surface (Figure HT41).

Head Size

To evaluate the effect of head size, an analysis was undertaken comparing four head size groups (≤28, 32, 36-38 and ≥40mm). Head sizes 36mm and 38mm have been combined in this analysis.

Mixed ceramic heads with head sizes 36 to 38mm, and 40mm or larger have a lower rate of revision than 32mm heads. There is no difference in the rate of revision between 28mm or smaller head sizes and 32mm head sizes. There is no difference in the rate of revision between 36 to 38mm and 40mm or larger head sizes (Table HT34 and Figure HT42).

At one year, the cumulative incidence of dislocation is 1.8% for head sizes 28mm or smaller compared to 0.4% for 32mm, 0.3% for 36 to 38mm, and 0.2% for head sizes 40mm or larger (Figure HT43).

Figure HT41 Primary Total Conventional Hip Replacement with Ceramic Femoral Head by Ceramic Type (Primary Diagnosis OA)

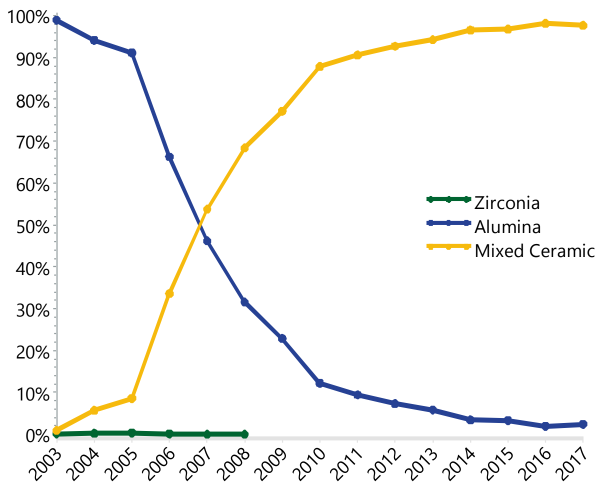
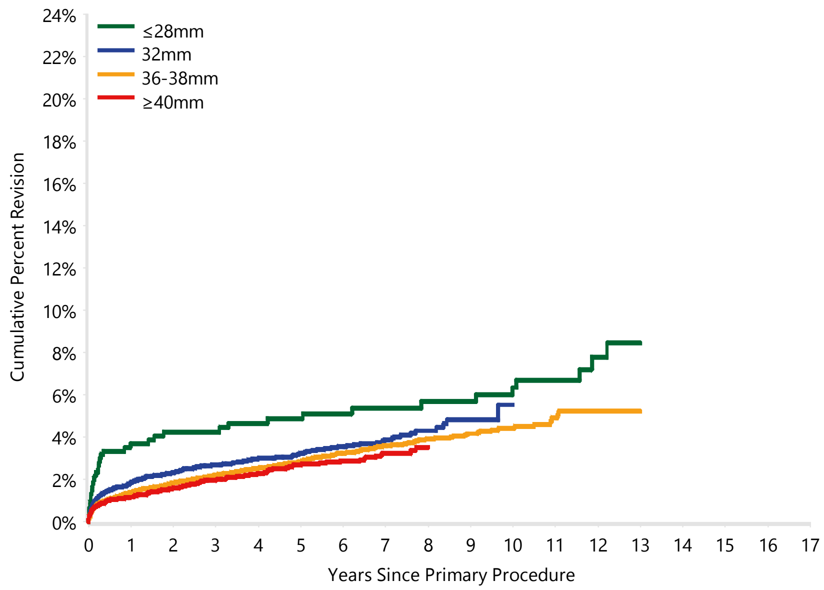


Table HT34 Cumulative Percent Revision of Mixed Ceramic/Mixed Ceramic Primary Total Conventional Hip Replacement by Head Size (Primary Diagnosis OA)

Head Size	N Revised	N Total	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
≤28mm	37	601	3.7 (2.4, 5.6)	4.2 (2.9, 6.2)	4.9 (3.4, 7.0)	6.3 (4.5, 8.9)	
32mm	284	9397	1.9 (1.6, 2.2)	2.7 (2.4, 3.0)	3.2 (2.8, 3.6)	5.5 (4.1, 7.4)	
36-38mm	962	36634	1.4 (1.3, 1.5)	2.2 (2.1, 2.4)	2.8 (2.7, 3.0)	4.4 (4.0, 4.8)	
≥40mm	161	6407	1.2 (0.9, 1.5)	2.0 (1.7, 2.4)	2.7 (2.3, 3.2)		
TOTAL	**1444**	**53039**					

Figure HT42 Cumulative Percent Revision of Mixed Ceramic/Mixed Ceramic Primary Total Conventional Hip Replacement by Head Size (Primary Diagnosis OA)



HR - adjusted for age and gender

≤28mm vs 32mm

Entire Period: HR=1.38 (0.97, 1.96),p=0.072

36-38mm vs 32mm

Entire Period: HR=0.84 (0.73, 0.97),p=0.014

≥40mm vs 32mm

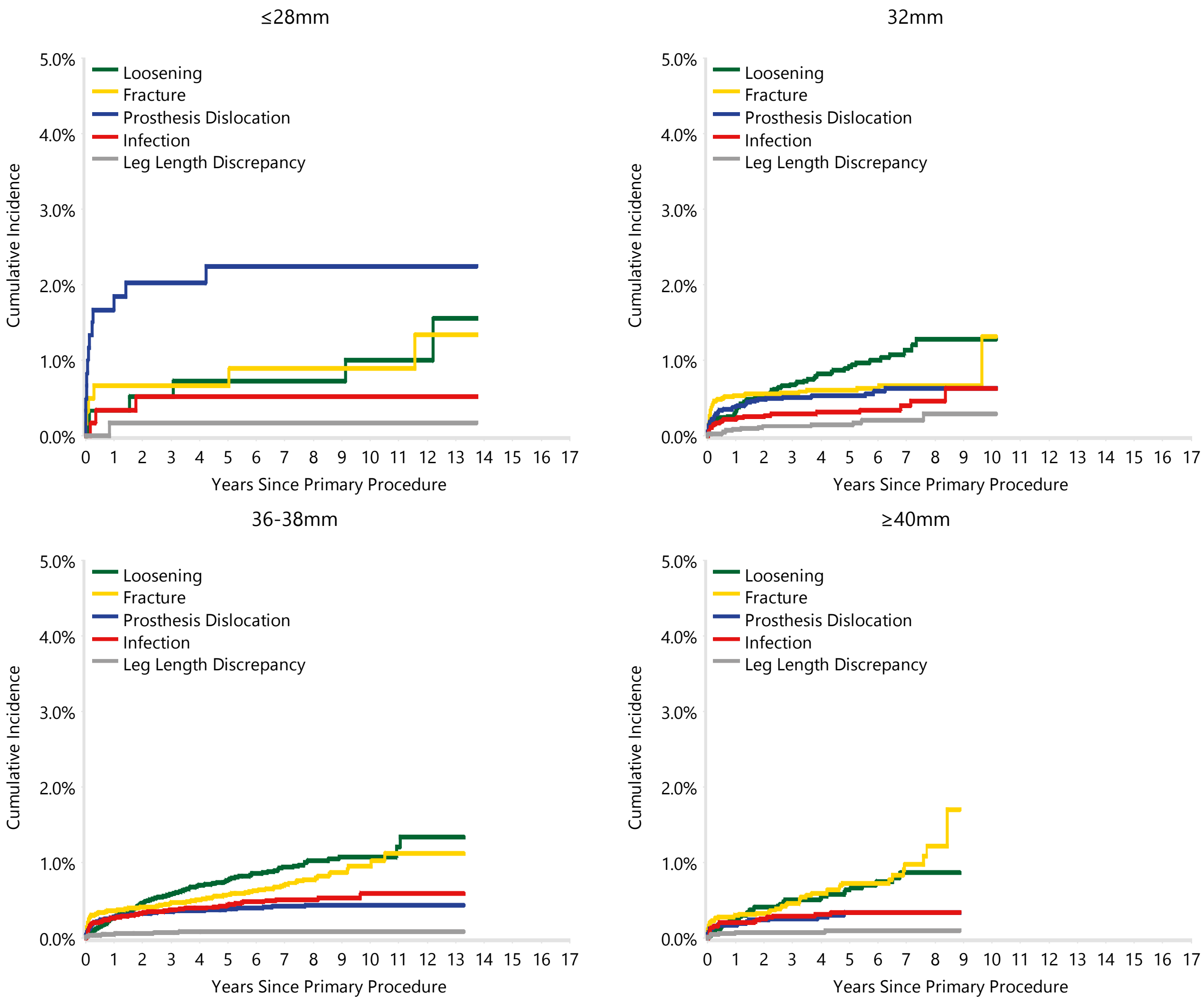
Entire Period: HR=0.76 (0.62, 0.93),p=0.007

36-38mm vs ≥40mm

Entire Period: HR=1.11 (0.93, 1.31),p=0.242

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
≤28mm	601	543	470	404	273	0	0
32mm	9397	8218	5927	3717	59	0	0
36-38mm	36634	32184	22807	13856	1168	0	0
≥40mm	6407	5933	4827	3064	0	0	0

Figure HT43 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 2,001 procedures using constrained acetabular prostheses for primary total conventional hip replacement. Of these, 792 procedures were constrained acetabular inserts and 1,209 procedures were constrained cups. There were 75 procedures reported in 2017. This is an increase of 13.6% compared to 2016.

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 HT44). When only those procedures with a diagnosis of osteoarthritis are included, there is no difference (Table HT37 and Figure HT45). Gender is not a risk factor for revision (Table HT38 and Figure HT46).

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 less than 70 years (Table HT39 and Figure HT47). There is no difference in the rate of revision according to fixation for constrained prostheses (Table HT40 and Figure HT48).

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 5,669 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 HT41).

When all diagnoses are included, dual mobility prostheses have a higher rate of revision compared to other acetabular prostheses (Table HT42 and Figure HT49).

For the diagnosis of osteoarthritis, there is no difference in the rate of revision when dual mobility prostheses are used (Table HT43 and Figure HT50).

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	794	39.7	351132	88.6
Fractured Neck Of Femur	696	34.8	17289	4.4
Osteonecrosis	79	3.9	12889	3.3
Developmental Dysplasia	21	1.0	4913	1.2
Rheumatoid Arthritis	22	1.1	3832	1.0
Tumour	226	11.3	2035	0.5
Failed Internal Fixation	114	5.7	1659	0.4
Other Inflammatory Arthritis	5	0.2	1681	0.4
Fracture/Dislocation	32	1.6	465	0.1
Arthrodesis Takedown	9	0.4	110	0.0
Other	3	0.1	142	0.0
TOTAL	**2001**	**100.0**	**396147**	**100.0**

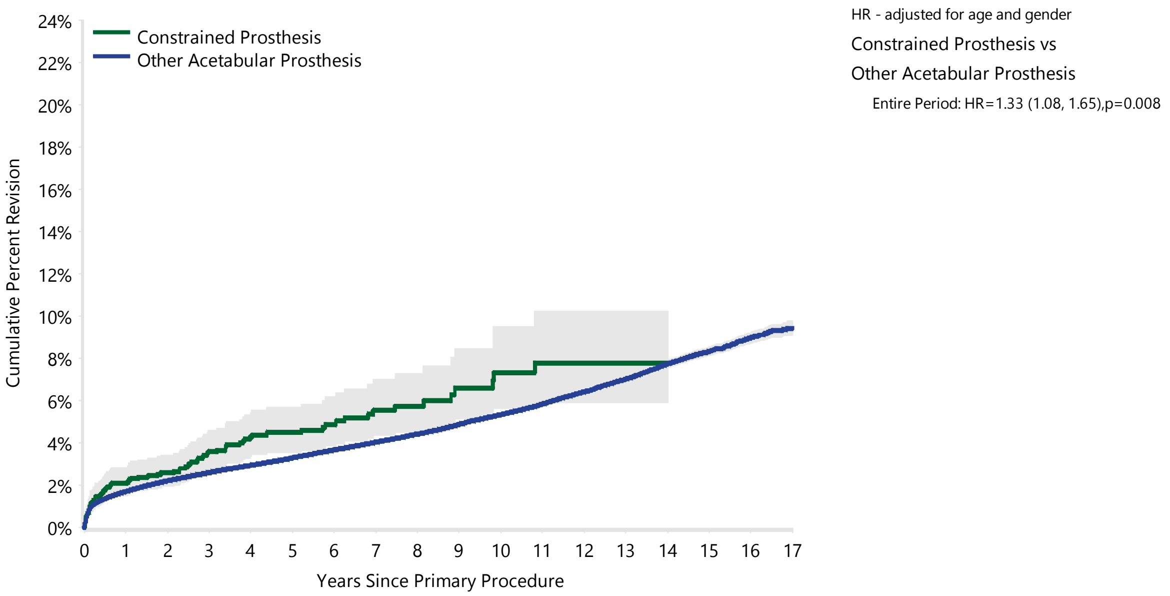
Note: All procedures using metal/metal prostheses have been excluded

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	17 Yrs
Constrained Prosthesis	84	2001	2.1 (1.5, 2.8)	3.6 (2.8, 4.6)	4.5 (3.5, 5.7)	7.3 (5.6, 9.5)		
Other Acetabular Prosthesis	15197	396147	1.7 (1.7, 1.7)	2.6 (2.6, 2.7)	3.3 (3.2, 3.4)	5.3 (5.2, 5.4)	8.3 (8.1, 8.5)	9.4 (9.1, 9.8)
TOTAL	**15281**	**398148**						

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

Figure HT44 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Acetabular Type (All Diagnoses)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Constrained Prosthesis	2001	1616	1198	804	237	26	3
Other Acetabular Prosthesis	396147	347784	267411	198366	75874	14097	1649

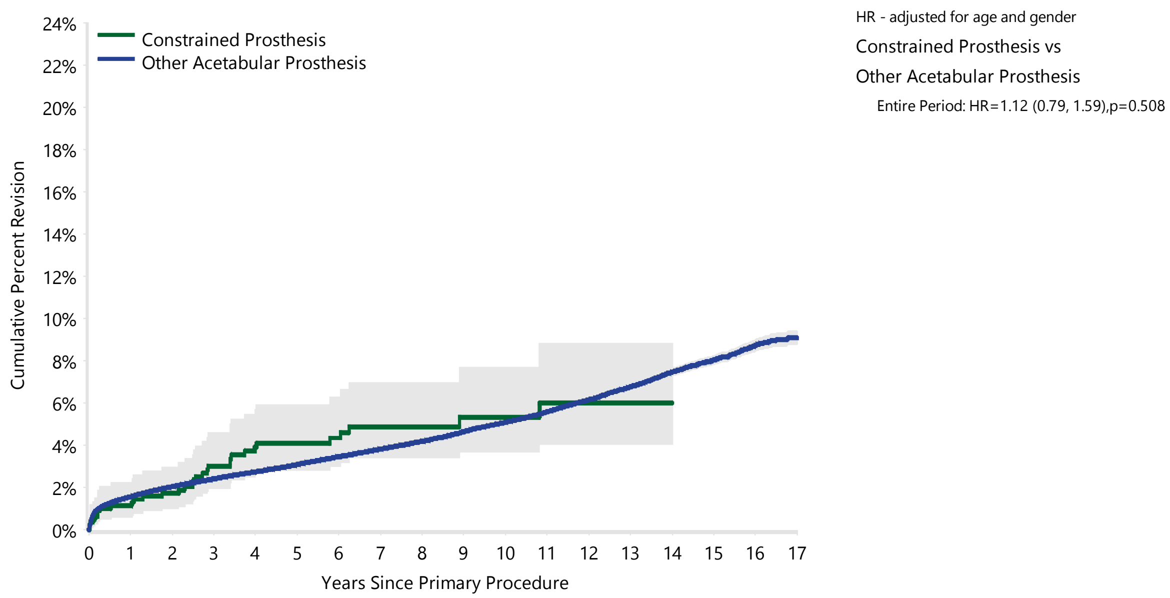
Note: All procedures using metal/metal prostheses have been excluded

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	17 Yrs
Constrained Prosthesis	32	794	1.2 (0.6, 2.2)	3.0 (2.0, 4.6)	4.1 (2.8, 5.9)	5.3 (3.7, 7.7)		
Other Acetabular Prosthesis	12875	351132	1.6 (1.5, 1.6)	2.4 (2.4, 2.5)	3.1 (3.0, 3.2)	5.1 (5.0, 5.2)	8.0 (7.8, 8.2)	9.1 (8.8, 9.4)
TOTAL	**12907**	**351926**						

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

Figure HT45 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	17 Yrs
Constrained Prosthesis	794	712	585	425	164	19	1
Other Acetabular Prosthesis	351132	310888	240608	179155	68773	12611	1452

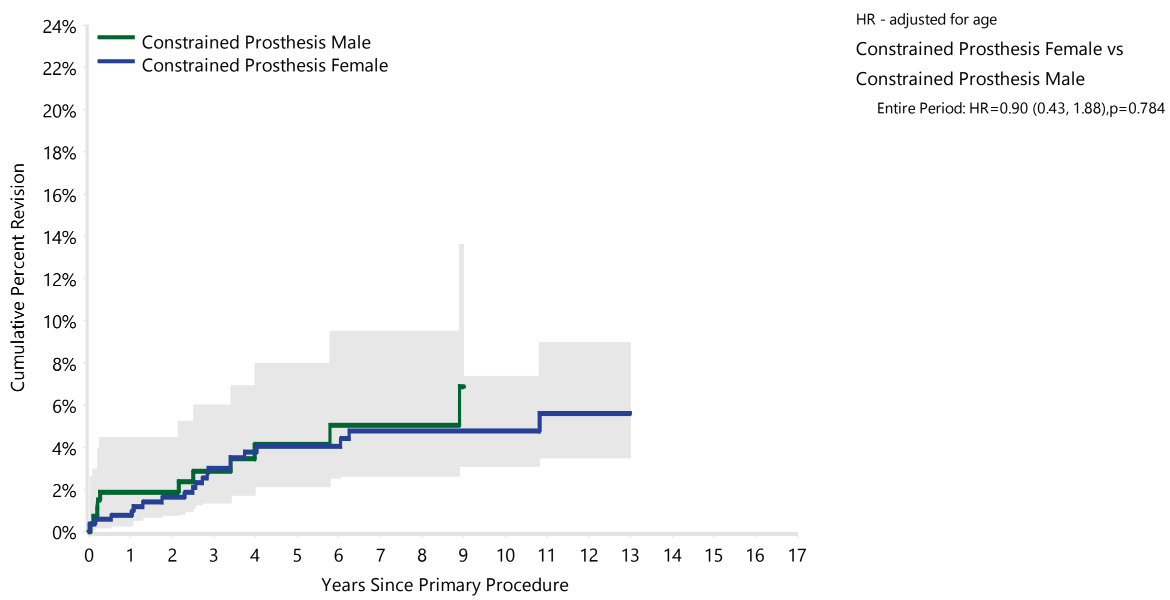
Note: All procedures using metal/metal prostheses have been excluded

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	17 Yrs
Constrained Prosthesis	Male	11	271	1.9 (0.8, 4.5)	2.9 (1.4, 6.0)	4.1 (2.1, 7.9)			
Constrained Prosthesis	Female	21	523	0.8 (0.3, 2.1)	3.0 (1.8, 5.1)	4.0 (2.6, 6.4)	4.8 (3.1, 7.4)		
TOTAL		**32**	**794**						

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

Figure HT46 **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	17 Yrs
Constrained Prosthesis	Male	271	233	173	119	34	1	0
	Female	523	479	412	306	130	18	1

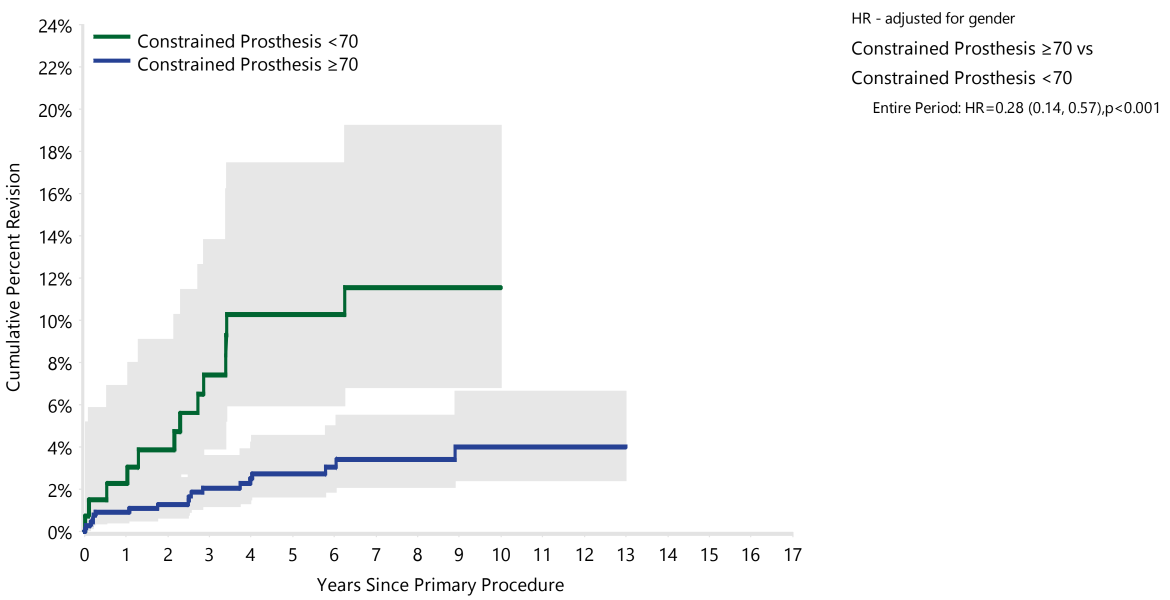
Note: All procedures using metal/metal prostheses have been excluded

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	17 Yrs
Constrained Prosthesis	<70	14	134	2.3 (0.7, 6.9)	7.4 (3.9, 13.8)	10.3 (5.9, 17.4)	11.6 (6.8, 19.2)		
Constrained Prosthesis	≥70	18	660	0.9 (0.4, 2.1)	2.1 (1.2, 3.6)	2.8 (1.7, 4.6)	4.0 (2.4, 6.6)		
TOTAL		**32**	**794**						

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

Figure HT47 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	17 Yrs
Constrained Prosthesis	<70	134	123	101	80	43	9	0
	≥70	660	589	484	345	121	10	1

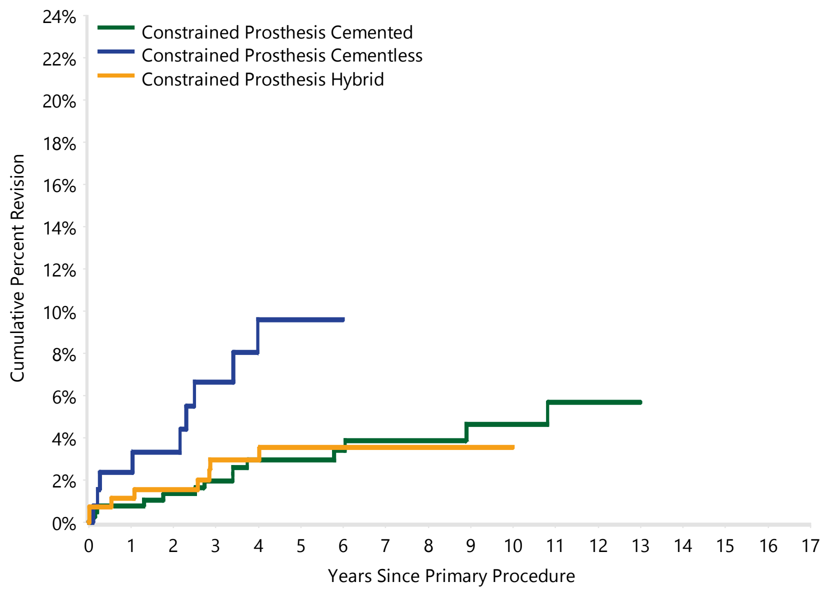
Note: All procedures using metal/metal prostheses have been excluded

Table HT40 Cumulative Percent Revision of Constrained Primary Total Conventional Hip Replacement by Fixation (Primary Diagnosis OA)

Acetabular Type	Fixation	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Constrained Prosthesis	Cemented	14	392	0.8 (0.3, 2.4)	2.0 (0.9, 4.1)	3.0 (1.6, 5.4)	4.7 (2.6, 8.2)		
	Cementless	10	132	2.4 (0.8, 7.2)	6.7 (3.2, 13.6)	9.6 (5.0, 18.0)			
	Hybrid	8	270	1.1 (0.4, 3.5)	3.0 (1.4, 6.2)	3.6 (1.8, 7.0)	3.6 (1.8, 7.0)		
TOTAL		**32**	**794**						

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

Figure HT48 Cumulative Percent Revision of Constrained Primary Total Conventional Hip Replacement by Fixation (Primary Diagnosis OA)



HR - adjusted for age and gender

Constrained Prosthesis Cementless vs
Constrained Prosthesis Cemented
Entire Period: HR=1.85 (0.75, 4.58),p=0.183

Constrained Prosthesis Hybrid vs
Constrained Prosthesis Cemented
Entire Period: HR=0.80 (0.33, 1.93),p=0.617

Constrained Prosthesis Cementless vs
Constrained Prosthesis Hybrid
Entire Period: HR=2.32 (0.88, 6.08),p=0.087

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Constrained Prosthesis	Cemented	392	362	314	240	103	9	0
	Cementless	132	104	74	50	16	1	0
	Hybrid	270	246	197	135	45	9	1

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

Table HT41 Primary Diagnosis of Primary Total Conventional Hip Replacement by Acetabular Mobility

Primary Diagnosis	Dual Mobility Prosthesis		Other Acetabular Prosthesis	
	N	Col%	N	Col%
Osteoarthritis	3630	64.0	348296	88.7
Fractured Neck Of Femur	1290	22.8	16695	4.3
Osteonecrosis	227	4.0	12741	3.2
Developmental Dysplasia	99	1.7	4835	1.2
Rheumatoid Arthritis	36	0.6	3818	1.0
Tumour	185	3.3	2076	0.5
Failed Internal Fixation	130	2.3	1643	0.4
Other Inflammatory Arthritis	20	0.4	1666	0.4
Fracture/Dislocation	37	0.7	460	0.1
Arthrodesis Takedown	7	0.1	112	0.0
Other	8	0.1	137	0.0
TOTAL	**5669**	**100.0**	**392479**	**100.0**

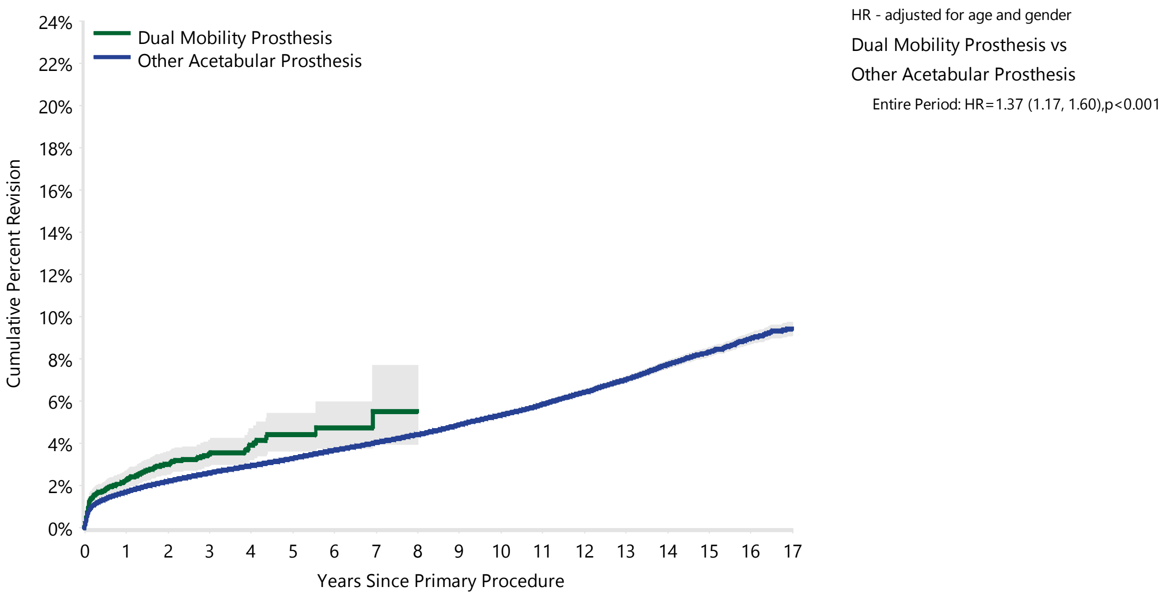
Note: All procedures using metal/metal prostheses have been excluded

Table HT42 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	17 Yrs
Dual Mobility Prosthesis	160	5669	2.3 (1.9, 2.7)	3.5 (3.0, 4.1)	4.4 (3.6, 5.4)			
Other Acetabular Prosthesis	15121	392479	1.7 (1.7, 1.7)	2.6 (2.5, 2.7)	3.3 (3.2, 3.4)	5.3 (5.2, 5.4)	8.3 (8.1, 8.5)	9.4 (9.1, 9.8)
TOTAL	**15281**	**398148**						

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

Figure HT49 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	17 Yrs
Dual Mobility Prosthesis	5669	3654	1430	411	13	0	0
Other Acetabular Prosthesis	392479	345746	267179	198759	76098	14123	1652

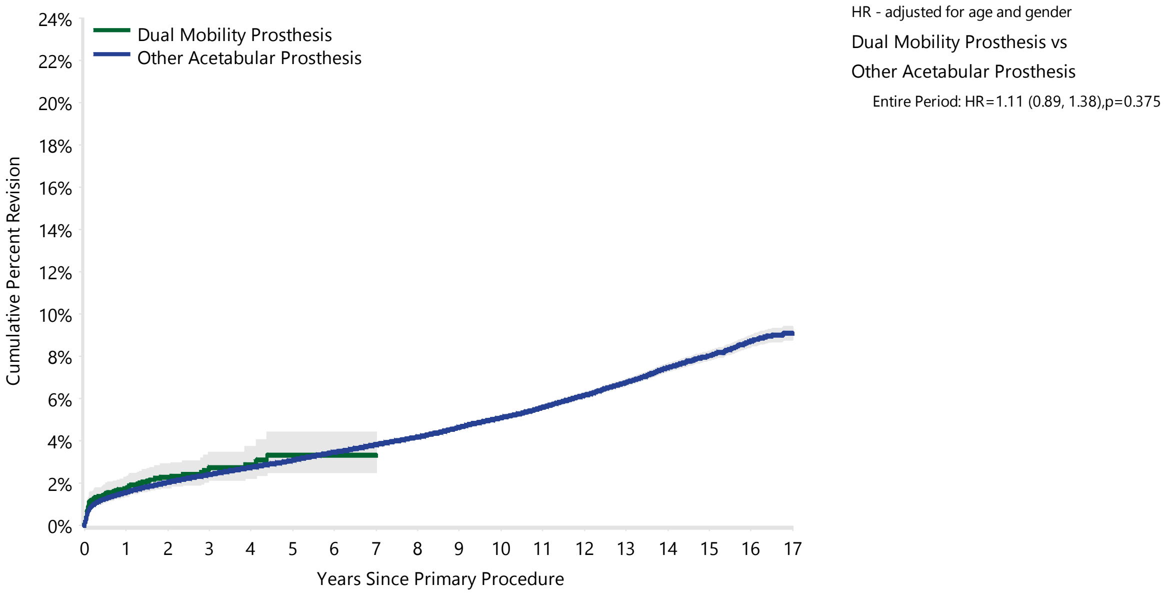
Note: All procedures using metal/metal prostheses have been excluded

Table HT43 **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	17 Yrs
Dual Mobility Prosthesis	78	3630	1.8 (1.4, 2.3)	2.7 (2.1, 3.5)	3.3 (2.5, 4.4)			
Other Acetabular Prosthesis	12829	348296	1.6 (1.5, 1.6)	2.4 (2.4, 2.5)	3.1 (3.0, 3.2)	5.1 (5.0, 5.2)	8.0 (7.8, 8.2)	9.1 (8.8, 9.4)
TOTAL	**12907**	**351926**						

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

Figure HT50 **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	17 Yrs
Dual Mobility Prosthesis	3630	2371	931	258	9	0	0
Other Acetabular Prosthesis	348296	309229	240262	179322	68928	12630	1453

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

OUTCOME FOR FRACTURED NECK OF FEMUR

There have been 17,985 total conventional hip replacement procedures recorded by the Registry with a diagnosis of fractured neck of femur.

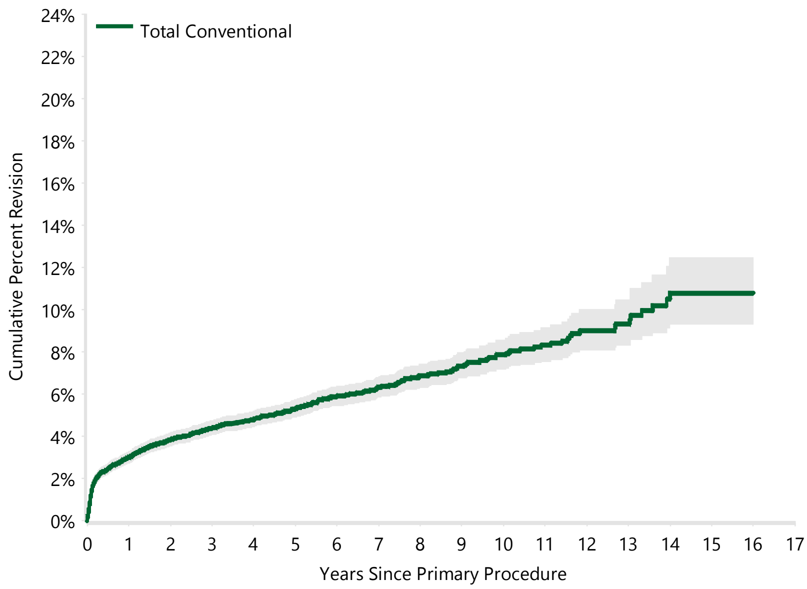
The cumulative percent revision of primary total conventional hip replacement for fractured neck of femur is 7.9% at 10 years (Table HT44 and Figure HT51).

Table HT44 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	865	17985	3.0 (2.8, 3.3)	3.8 (3.6, 4.2)	4.4 (4.1, 4.7)	5.3 (4.9, 5.7)	6.3 (5.9, 6.8)	7.9 (7.2, 8.6)
TOTAL	**865**	**17985**						

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

Figure HT51 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	17985	14077	11534	9377	5917	3539	1352

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

Reasons for Revision

Prosthesis dislocation is the most common reason for revision (32.5%), followed by fracture (27.4%), loosening (16.9%), and infection (16.1%) (Table HT45 and Figure HT52).

Type of Revision

Replacement of the femoral component only is the most common type of revision (37.0%), followed by head and insert (21.3%), acetabular only (19.5%), and total hip replacement (femoral/acetabular) (8.8%) (Table HT46).

Table HT45 Primary Total Conventional Hip Replacement by Reason for Revision (Primary Diagnosis Fractured NOF)

Reason for Revision	Number	Percent
Prosthesis Dislocation	281	32.5
Fracture	237	27.4
Loosening	146	16.9
Infection	139	16.1
Pain	9	1.0
Malposition	8	0.9
Implant Breakage Stem	7	0.8
Lysis	7	0.8
Instability	6	0.7
Leg Length Discrepancy	6	0.7
Implant Breakage Acetabular	4	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
Wear Acetabular Insert	1	0.1
Other	3	0.3
TOTAL	**865**	**100.0**

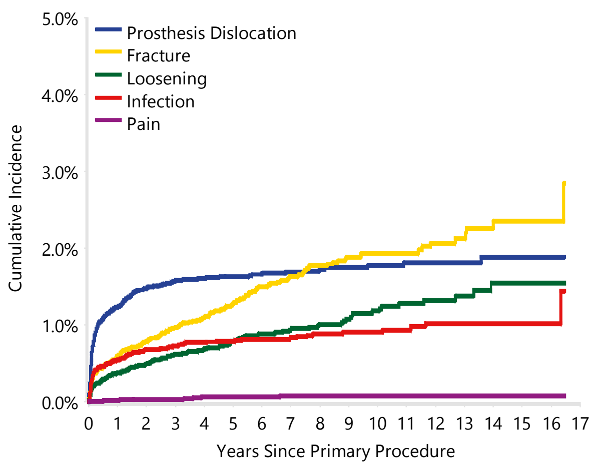
Note: All procedures using metal/metal prostheses have been excluded

Table HT46 Primary Total Conventional Hip Replacement Hip Replacement by Type of Revision (Primary Diagnosis Fractured NOF)

Type of Revision	Number	Percent
Femoral Component	320	37.0
Head/Insert	184	21.3
Acetabular Component	169	19.5
THR (Femoral/Acetabular)	76	8.8
Head Only	41	4.7
Cement Spacer	36	4.2
Minor Components	17	2.0
Insert Only	10	1.2
Removal of Prostheses	3	0.3
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	**865**	**100.0**

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

Figure HT52 Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement (Primary Diagnosis Fractured NOF)



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

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 8,152 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 HT47 and Figure HT53). The most common reasons for revision for each category show the difference in revision rate is partially due to an increase in revision for dislocation and infection with increasing ASA score (Figure HT54).

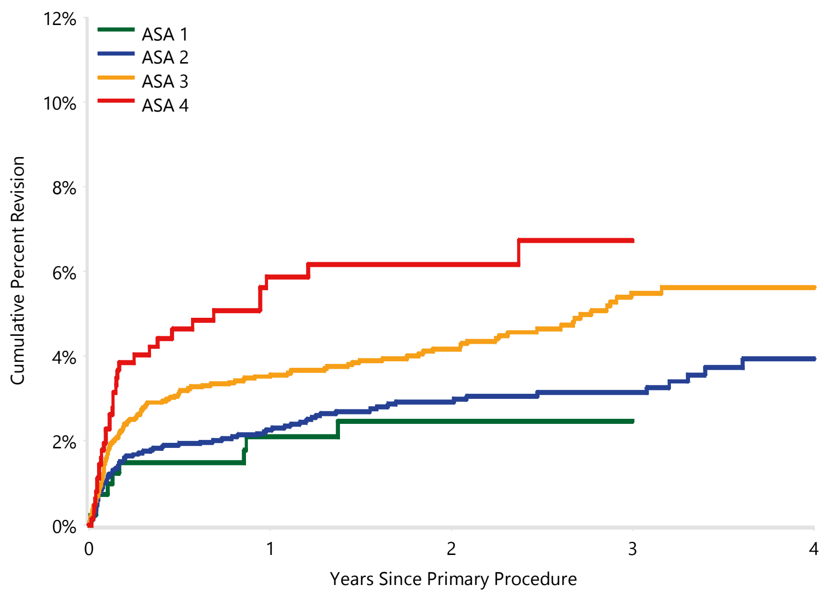
BMI data has been collected since 2015. The early revision outcomes are reported for 3,533 total conventional hip replacement procedures for fractured neck of femur. Patients who are underweight or obese class 2 have a higher rate of revision when compared to those with a normal BMI (Table HT48 and Figure HT55). The most common reasons for revision are shown in Figure HT56.

Table HT47 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
ASA 1	9	416	2.1 (1.0, 4.1)	2.5 (1.3, 4.7)	2.5 (1.3, 4.7)		
ASA 2	88	3132	2.3 (1.8, 2.9)	2.9 (2.3, 3.6)	3.1 (2.5, 3.9)	3.9 (3.1, 5.0)	
ASA 3	159	3940	3.6 (3.0, 4.2)	4.2 (3.5, 4.9)	5.5 (4.6, 6.5)	5.6 (4.7, 6.7)	
ASA 4	35	659	5.9 (4.2, 8.2)	6.2 (4.4, 8.6)	6.7 (4.7, 9.5)		
ASA 5	0	5	0.0 (0.0, 0.0)				
TOTAL	**291**	**8152**					

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

Figure HT53 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=1.50 (0.75, 2.99),p=0.248

ASA 3 vs ASA 1

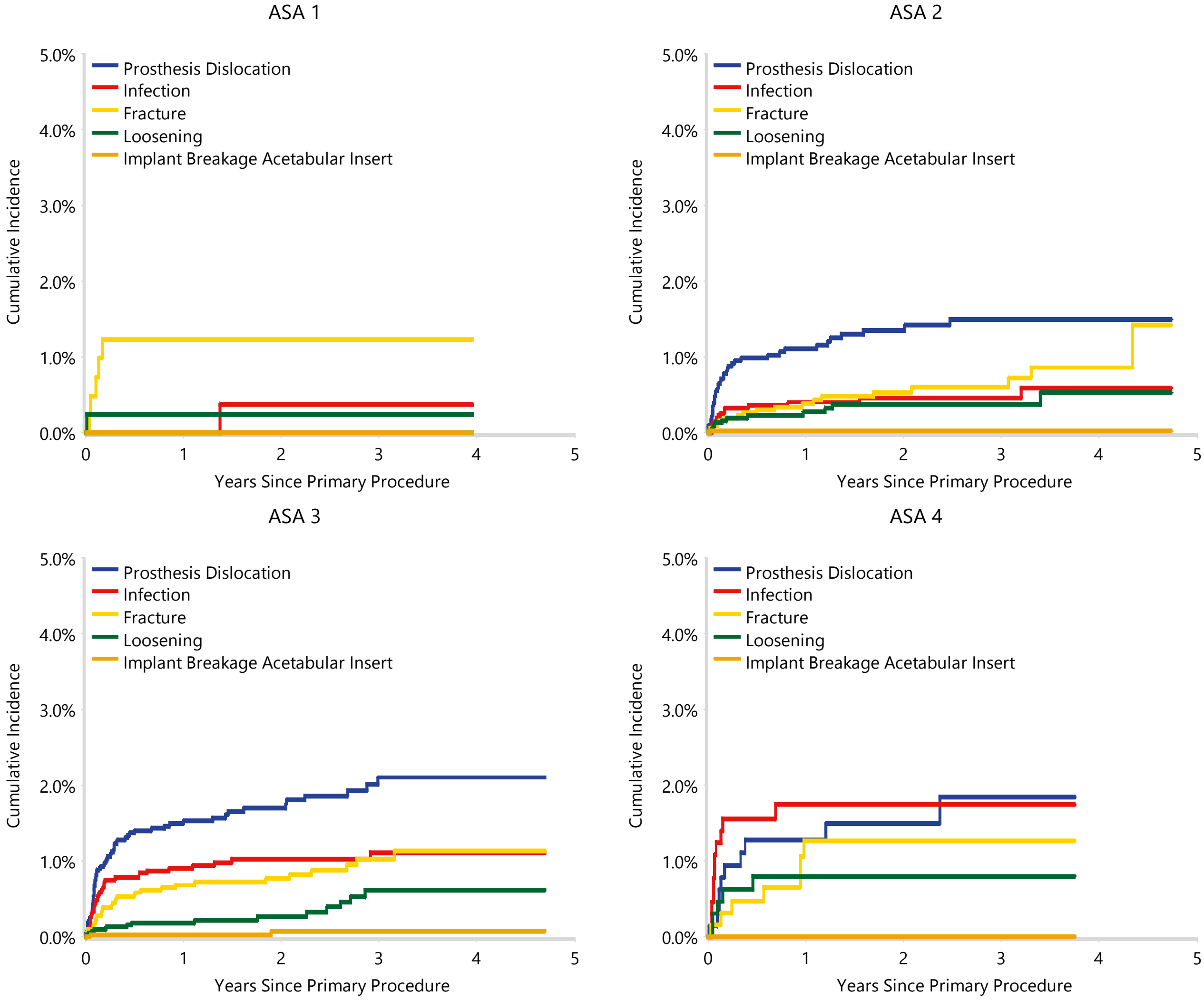
Entire Period: HR=2.29 (1.16, 4.53),p=0.017

ASA 4 vs ASA 1

Entire Period: HR=3.42 (1.62, 7.22),p=0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
ASA 1	416	304	199	118	39	0
ASA 2	3132	2188	1470	820	293	4
ASA 3	3940	2542	1604	864	275	6
ASA 4	659	352	205	101	30	0

Figure HT54 Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement by ASA Score (Primary Diagnosis Fractured NOF)



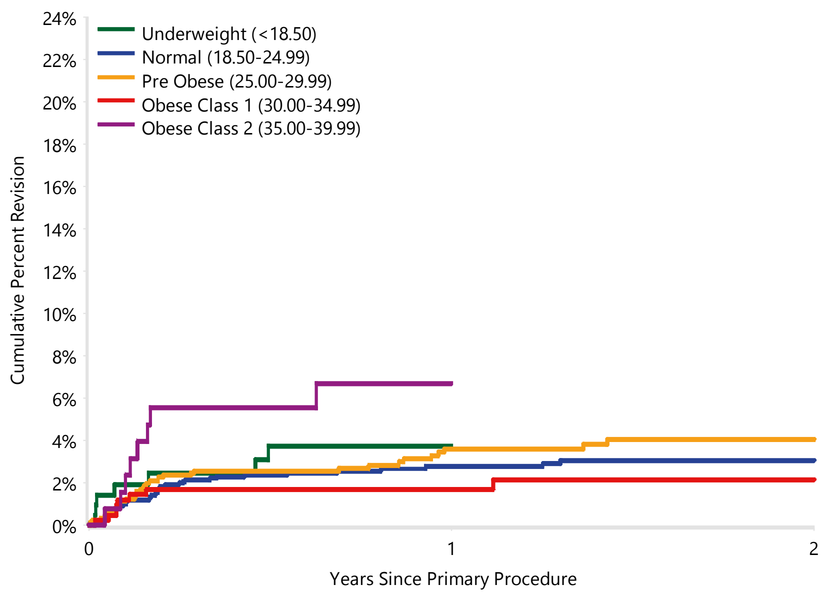
Note: All procedures using metal/metal prostheses have been excluded

Table HT48 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
Underweight (<18.50)	10	213	3.8 (1.8, 7.8)	
Normal (18.50-24.99)	40	1549	2.8 (2.0, 3.8)	3.1 (2.2, 4.2)
Pre Obese (25.00-29.99)	37	1166	3.6 (2.6, 5.0)	4.0 (2.9, 5.6)
Obese Class 1 (30.00-34.99)	9	428	1.7 (0.8, 3.5)	2.1 (1.1, 4.3)
Obese Class 2 (35.00-39.99)	8	134	6.7 (3.4, 13.0)	
Obese Class 3 (≥40.00)	3	43	4.7 (1.2, 17.5)	
TOTAL	**107**	**3533**		

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

Figure HT55 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=2.01 (1.00, 4.04),p=0.048

Pre Obese (25.00-29.99) vs Normal (18.50-24.99)
Entire Period: HR=1.20 (0.76, 1.88),p=0.431

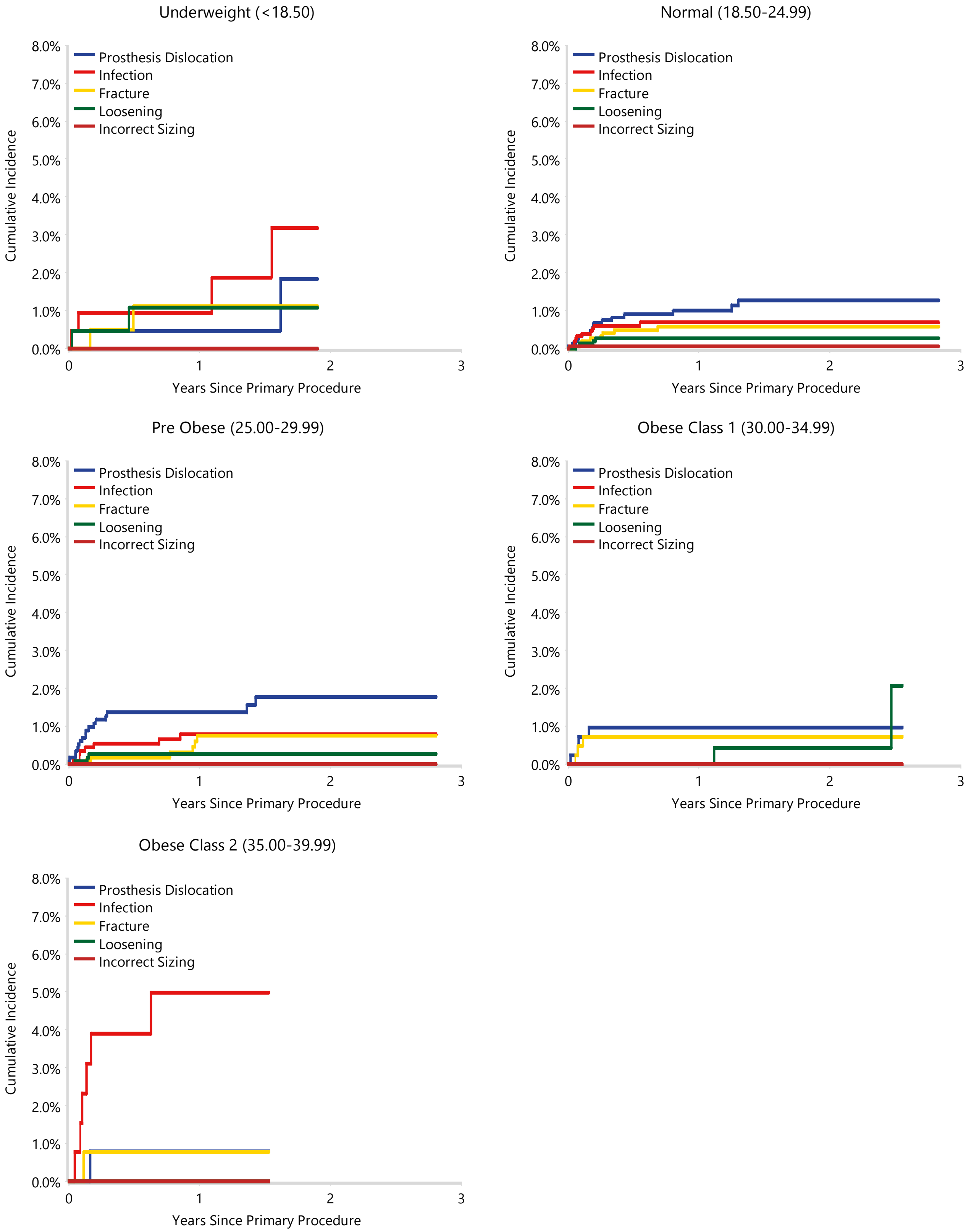
Obese Class 1 (30.00-34.99) vs Normal (18.50-24.99)
Entire Period: HR=0.76 (0.37, 1.57),p=0.454

Obese Class 2 (35.00-39.99) vs Normal (18.50-24.99)
Entire Period: HR=2.31 (1.08, 4.96),p=0.031

Number at Risk	0 Yr	1 Yr	2 Yrs
Underweight (<18.50)	213	103	37
Normal (18.50-24.99)	1549	832	325
Pre Obese (25.00-29.99)	1166	600	244
Obese Class 1 (30.00-34.99)	428	238	103
Obese Class 2 (35.00-39.99)	134	66	29

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

Figure HT56 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

Fixation

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

The Registry has recorded 933 procedures with cemented fixation, 5,237 with cementless fixation and 8,822 with hybrid fixation. Cemented fixation has a lower rate of revision at all time periods 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 three months only, with no difference after this time (Table HT49 and Figure HT57).

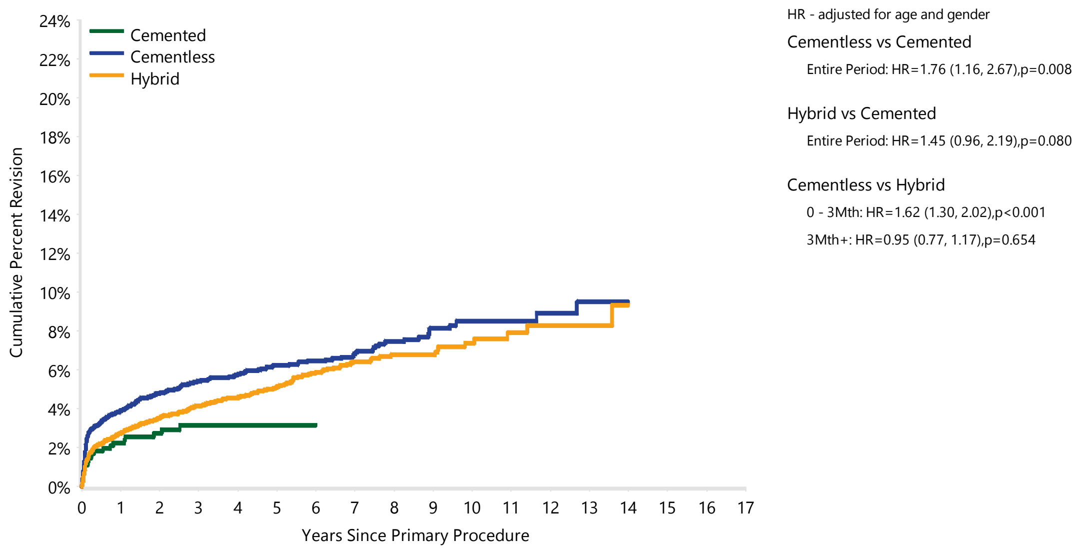
There are differences in outcome with respect to fixation and age. For patients aged less than 70 years, there is no difference in the rate of revision between the three different fixation methods (Table HT50 and Figure HT58). For patients aged 70 years or older, cementless fixation has a higher rate of revision than cemented fixation over the entire period, and for the first three months compared to hybrid fixation. Hybrid fixation has a higher rate of revision compared to cemented fixation (Table HT50 and Figure HT59).

Table HT49 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	24	933	2.2 (1.4, 3.5)	2.7 (1.8, 4.2)	3.2 (2.1, 4.7)	3.2 (2.1, 4.7)		
Cementless	302	5237	3.9 (3.4, 4.5)	4.8 (4.2, 5.4)	5.4 (4.8, 6.1)	6.3 (5.6, 7.0)	6.8 (6.0, 7.7)	8.5 (7.4, 9.8)
Hybrid	377	8822	2.7 (2.4, 3.1)	3.5 (3.1, 4.0)	4.1 (3.7, 4.6)	5.1 (4.6, 5.7)	6.4 (5.7, 7.2)	7.4 (6.4, 8.5)
TOTAL	**703**	**14992**						

Note: Includes ceramic/ceramic and XLPE

Figure HT57 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Fixation (Primary Diagnosis Fractured NOF)



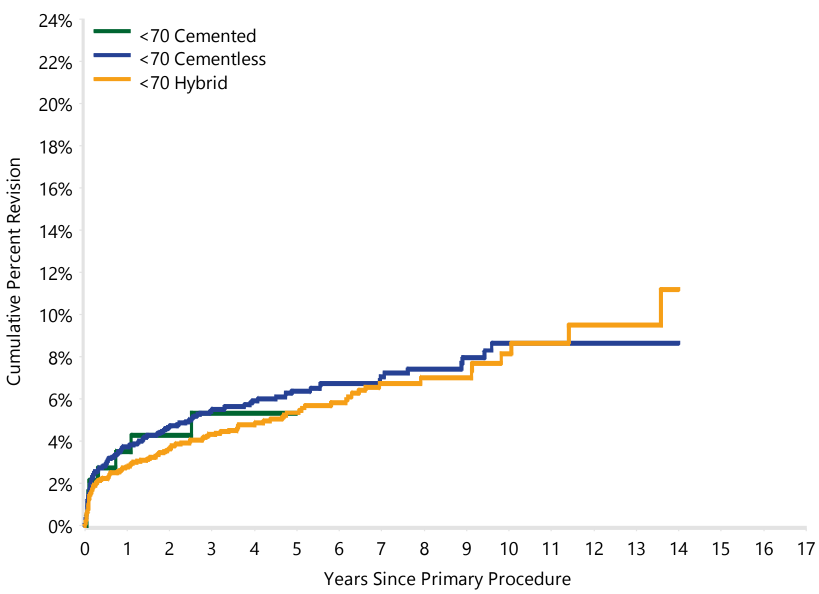
Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Cemented	933	656	502	382	160	39	7
Cementless	5237	4220	3571	2971	2015	1198	423
Hybrid	8822	6763	5342	4189	2403	1360	437

Table HT50 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	Cemented	8	197	3.5 (1.6, 7.7)	4.3 (2.0, 8.8)	5.3 (2.6, 10.7)	5.3 (2.6, 10.7)		
<70	Cementless	125	2085	3.7 (3.0, 4.6)	4.7 (3.8, 5.7)	5.5 (4.5, 6.6)	6.4 (5.3, 7.7)	7.1 (5.9, 8.5)	8.6 (7.0, 10.7)
<70	Hybrid	129	2737	2.8 (2.2, 3.5)	3.6 (2.9, 4.5)	4.3 (3.5, 5.2)	5.3 (4.4, 6.5)	6.7 (5.5, 8.2)	8.1 (6.4, 10.3)
≥70	Cemented	16	736	1.9 (1.1, 3.3)	2.4 (1.4, 3.9)	2.6 (1.6, 4.3)	2.6 (1.6, 4.3)		
≥70	Cementless	177	3152	4.0 (3.4, 4.8)	4.9 (4.1, 5.7)	5.4 (4.6, 6.3)	6.1 (5.2, 7.1)	6.6 (5.6, 7.7)	8.3 (6.9, 10.0)
≥70	Hybrid	248	6085	2.7 (2.3, 3.2)	3.5 (3.0, 4.0)	4.0 (3.5, 4.6)	5.0 (4.4, 5.8)	6.3 (5.4, 7.2)	6.9 (5.9, 8.1)
TOTAL		**703**	**14992**						

Note: Includes ceramic/ceramic and XLPE

Figure HT58 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=1.08 (0.53, 2.20),p=0.836

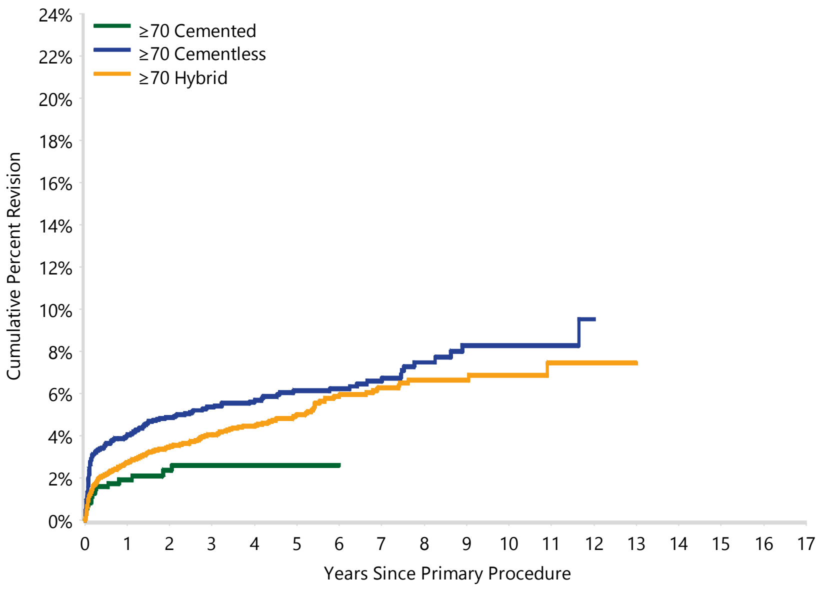
<70 Cementless vs <70 Hybrid
Entire Period: HR=1.13 (0.88, 1.44),p=0.339

<70 Cementless vs <70 Cemented
Entire Period: HR=1.05 (0.51, 2.14),p=0.901

Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<70	Cemented	197	127	96	76	41	10	2
	Cementless	2085	1749	1501	1271	903	567	240
	Hybrid	2737	2132	1719	1360	846	530	188

Note: Includes ceramic/ceramic and XLPE

Figure HT59 Cumulative Percent Revision of Primary Total Conventional Hip Replacement in Patients Aged ≥70 Years by Fixation (Primary Diagnosis Fractured NOF)



HR - adjusted for gender

≥70 Cementless vs ≥70 Cemented

Entire Period: HR=2.14 (1.28, 3.57),p=0.003

≥70 Hybrid vs ≥70 Cemented

Entire Period: HR=1.68 (1.01, 2.79),p=0.044

≥70 Cementless vs ≥70 Hybrid

0 - 3Mth: HR=1.82 (1.39, 2.39),p<0.001

3Mth+: HR=0.90 (0.68, 1.19),p=0.454

	Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
≥70	Cemented	736	529	406	306	119	29	5
	Cementless	3152	2471	2070	1700	1112	631	183
	Hybrid	6085	4631	3623	2829	1557	830	249

Note: Includes ceramic/ceramic and XLPE

Head Size

Head size 32mm used for fractured neck of femur in total conventional hip replacement has a lower rate of revision after six months compared to head sizes less than 32mm. There is no difference when head sizes larger then 32mm are compared to head sizes less than 32mm, or head size 32mm (Table HT51 and Figure HT60).

Constrained Acetabular Prostheses

When used for fractured neck of femur, constrained prostheses have a lower rate of revision compared to other acetabular prostheses (Table HT52 and Figure HT61).

Dual Mobility

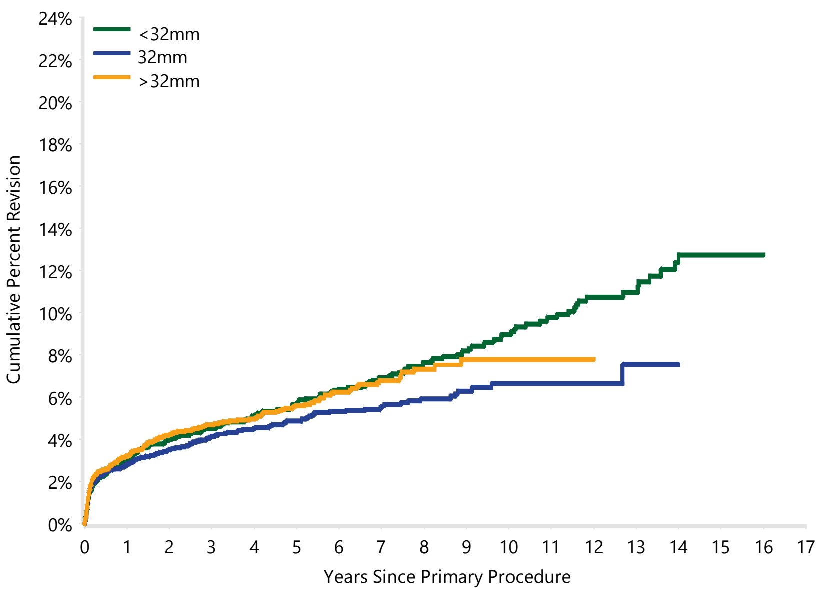
There is no difference in the rate of revision when dual mobility prostheses are used (Table HT53 and Figure HT62).

Table HT51 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	274	4681	3.1 (2.6, 3.6)	4.0 (3.5, 4.7)	4.5 (3.9, 5.2)	5.7 (5.0, 6.5)	6.9 (6.1, 7.9)	9.0 (7.8, 10.3)
32mm	323	7689	2.8 (2.5, 3.2)	3.5 (3.1, 3.9)	4.1 (3.7, 4.7)	4.9 (4.3, 5.5)	5.5 (4.9, 6.2)	6.6 (5.7, 7.7)
>32mm	268	5590	3.2 (2.8, 3.7)	4.2 (3.7, 4.8)	4.7 (4.1, 5.3)	5.6 (4.9, 6.4)	6.8 (5.9, 7.8)	7.8 (6.6, 9.1)
TOTAL	**865**	**17960**						

Note: All procedures using metal/metal prostheses have been excluded
Excludes 25 procedures with unknown head size

Figure HT60 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Head Size (Primary Diagnosis Fractured NOF)



HR - adjusted for age and gender
<32mm vs 32mm
0 - 1Mth: HR=0.92 (0.66, 1.30),p=0.650
1Mth - 6Mth: HR=1.08 (0.79, 1.46),p=0.628
6Mth+: HR=1.47 (1.19, 1.82),p<0.001

>32mm vs 32mm
Entire Period: HR=1.08 (0.92, 1.28),p=0.350

>32mm vs <32mm
Entire Period: HR=0.88 (0.74, 1.05),p=0.161

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<32mm	4681	3726	3078	2593	1793	1303	747
32mm	7689	6050	4990	4000	2420	1357	421
>32mm	5590	4280	3447	2769	1696	873	184

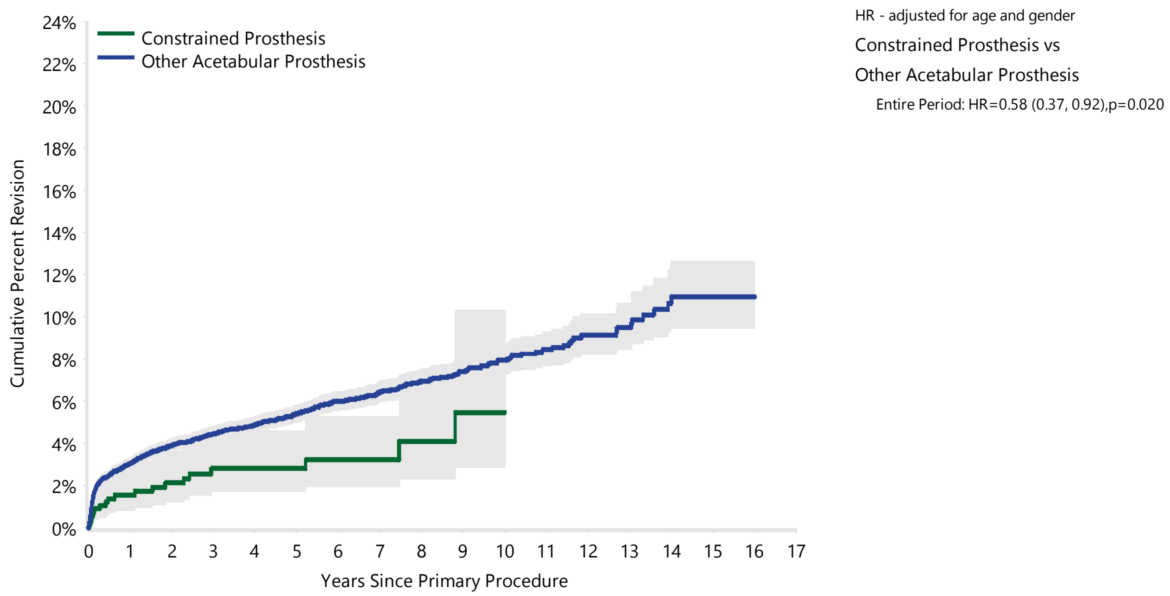
Note: All procedures using metal/metal prostheses have been excluded

Table HT52 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	19	696	1.6 (0.8, 2.9)	2.1 (1.2, 3.7)	2.8 (1.7, 4.6)	2.8 (1.7, 4.6)	3.2 (2.0, 5.3)	5.5 (2.9, 10.3)
Other Acetabular Prosthesis	846	17289	3.1 (2.8, 3.3)	3.9 (3.6, 4.2)	4.5 (4.1, 4.8)	5.4 (5.0, 5.8)	6.4 (6.0, 6.9)	8.0 (7.3, 8.7)
TOTAL	**865**	**17985**						

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

Figure HT61 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	696	551	484	393	252	144	47
Other Acetabular Prosthesis	17289	13526	11050	8984	5665	3395	1305

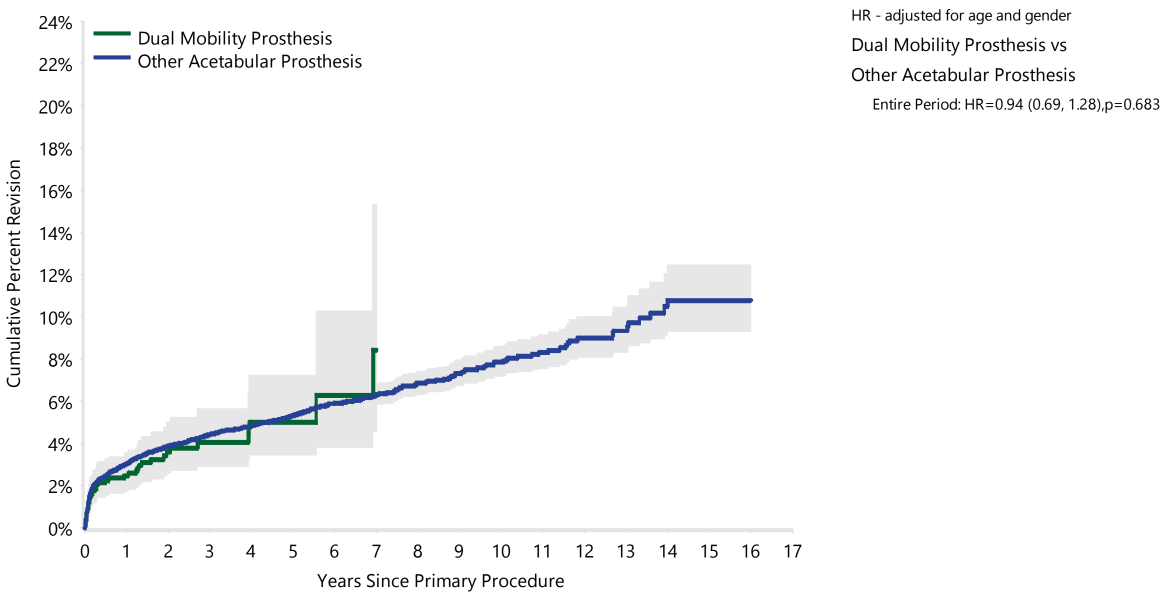
Note: All procedures using metal/metal prostheses have been excluded

Table HT53 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	43	1290	2.5 (1.7, 3.5)	3.6 (2.6, 5.0)	4.1 (2.9, 5.6)	5.0 (3.4, 7.2)	8.4 (4.6, 15.3)	
Other Acetabular Prosthesis	822	16695	3.0 (2.8, 3.3)	3.9 (3.6, 4.2)	4.4 (4.1, 4.8)	5.3 (4.9, 5.7)	6.3 (5.8, 6.8)	7.9 (7.2, 8.6)
TOTAL	**865**	**17985**						

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

Figure HT62 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Acetabular Mobility (Primary Diagnosis Fractured NOF)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Dual Mobility Prosthesis	1290	849	526	322	97	41	4
Other Acetabular Prosthesis	16695	13228	11008	9055	5820	3498	1348

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 total conventional hip replacement and in unipolar monoblock, unipolar modular and bipolar hip replacement procedures were compared.

Unipolar monoblock hip replacement has a higher rate of revision than total conventional hip replacement after three months. Unipolar modular hip replacement has a lower rate of revision than total conventional hip replacement for the first three months. From three 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 no difference in the rate of revision compared to total conventional hip replacement (Table HT54 and Figure HT63).

For patients under 70 years of age, unipolar monoblock has a higher rate of revision after three months compared to total conventional hip replacement. The use of unipolar monoblock components in patients aged less than 70 years may represent its use in those patients with significant comorbidities. Unipolar modular has a higher rate of revision than total conventional hip replacement after three months. There is no difference between bipolar and total conventional hip replacement in this age group (Table HT55 and Figure HT64).

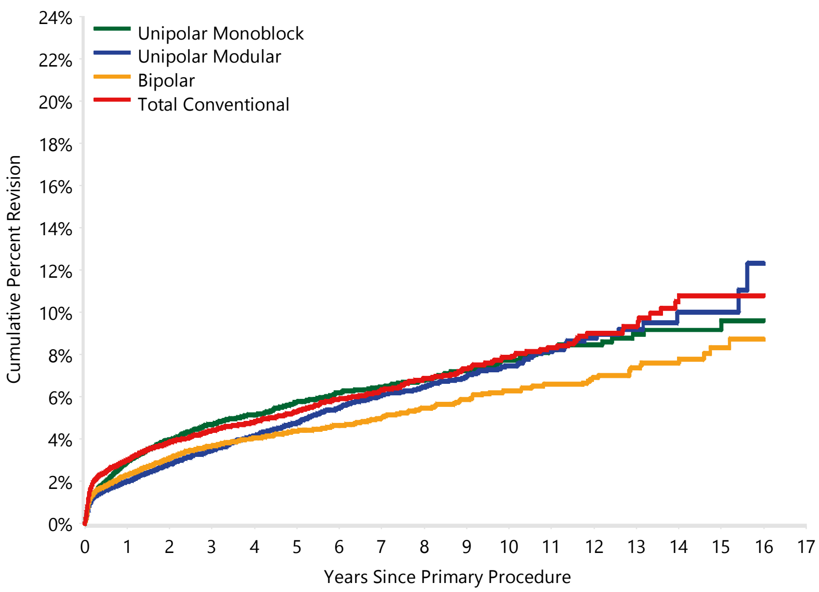
For patients aged 70 years or older, there are time dependent variations in the comparative rates of revision. Unipolar monoblock has a higher rate of revision compared to total conventional hip replacement between six months and 1.5 years. Unipolar modular has a lower rate of revision for the first 1.5 years. After 1.5 years there is no difference. Bipolar hip replacement has a lower rate of revision than total conventional hip replacement for the entire period (Figure HT65).

Table HT54 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	1052	27890	2.9 (2.7, 3.1)	4.0 (3.7, 4.3)	4.7 (4.4, 5.0)	5.8 (5.4, 6.1)	6.5 (6.0, 6.9)	7.8 (7.1, 8.5)
Unipolar Modular	1265	37687	2.0 (1.8, 2.1)	2.8 (2.6, 3.0)	3.5 (3.2, 3.7)	4.8 (4.5, 5.1)	6.1 (5.7, 6.5)	7.5 (6.9, 8.1)
Bipolar	677	19560	2.3 (2.1, 2.5)	3.1 (2.8, 3.4)	3.7 (3.4, 4.0)	4.4 (4.0, 4.8)	5.0 (4.6, 5.4)	6.3 (5.7, 6.9)
Total Conventional	865	17985	3.0 (2.8, 3.3)	3.8 (3.6, 4.2)	4.4 (4.1, 4.7)	5.3 (4.9, 5.7)	6.3 (5.9, 6.8)	7.9 (7.2, 8.6)
TOTAL	**3859**	**103122**						

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

Figure HT63 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=1.02 (0.88, 1.19),p=0.784
3Mth+: HR=1.74 (1.54, 1.96),p<0.001

Unipolar Modular vs Total Conventional
0 - 3Mth: HR=0.80 (0.70, 0.93),p=0.002
3Mth - 1.5Yr: HR=0.92 (0.79, 1.08),p=0.323
1.5Yr+: HR=1.65 (1.43, 1.89),p<0.001

Bipolar vs Total Conventional
0 - 3Mth: HR=0.91 (0.78, 1.07),p=0.245
3Mth - 1.5Yr: HR=0.93 (0.78, 1.12),p=0.469
1.5Yr+: HR=1.13 (0.95, 1.33),p=0.158

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Monoblock	27890	16917	13069	9943	5488	3010	1175
Unipolar Modular	37687	25581	19854	15238	8457	4331	1397
Bipolar	19560	13497	10491	8117	5211	3394	1755
Total Conventional	17985	14077	11534	9377	5917	3539	1352

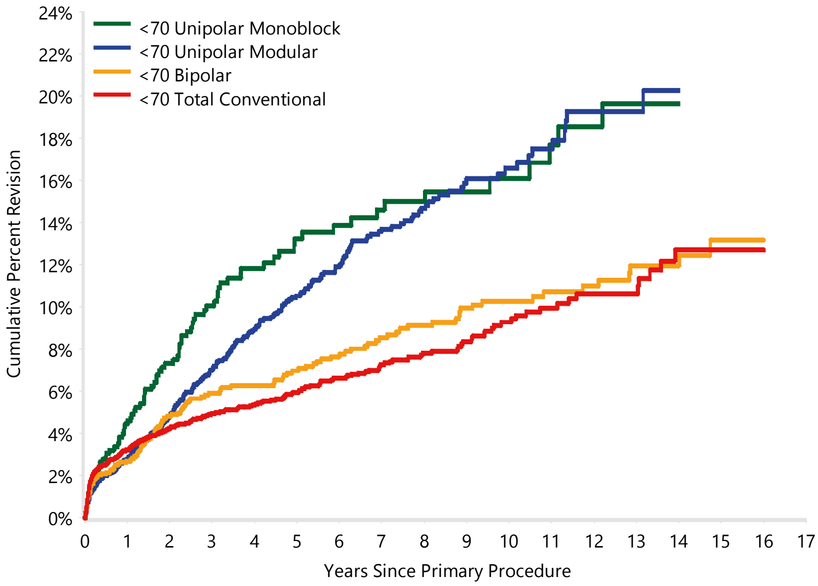
Note: All procedures using metal/metal prostheses have been excluded

Table HT55 Cumulative Percent Revision of Primary Hip Replacement by Class and Age (Primary Diagnosis Fractured NOF)

Age	Hip Class	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<70	Unipolar Monoblock	89	900	4.4 (3.2, 6.2)	7.3 (5.6, 9.6)	10.0 (7.9, 12.7)	13.2 (10.6, 16.4)	14.6 (11.8, 18.1)	16.1 (12.9, 20.0)
	Unipolar Modular	273	3045	2.8 (2.2, 3.5)	4.8 (4.0, 5.7)	7.0 (6.0, 8.1)	10.5 (9.2, 12.0)	13.7 (12.1, 15.5)	16.6 (14.5, 18.9)
<70	Bipolar	142	2093	2.7 (2.1, 3.5)	4.8 (3.9, 6.0)	5.9 (4.9, 7.2)	7.0 (5.8, 8.4)	8.6 (7.1, 10.2)	10.3 (8.6, 12.3)
	Total Conventional	326	5605	3.2 (2.8, 3.7)	4.2 (3.7, 4.8)	5.0 (4.4, 5.6)	6.0 (5.3, 6.7)	7.3 (6.5, 8.2)	9.3 (8.1, 10.6)
≥70	Unipolar Monoblock	963	26990	2.9 (2.6, 3.1)	3.8 (3.6, 4.1)	4.5 (4.2, 4.8)	5.4 (5.1, 5.8)	6.1 (5.7, 6.6)	7.4 (6.7, 8.1)
	Unipolar Modular	992	34642	1.9 (1.8, 2.1)	2.6 (2.4, 2.8)	3.1 (2.9, 3.3)	4.1 (3.8, 4.4)	5.0 (4.7, 5.4)	6.0 (5.5, 6.6)
≥70	Bipolar	535	17467	2.3 (2.0, 2.5)	2.9 (2.6, 3.1)	3.4 (3.1, 3.7)	4.0 (3.6, 4.4)	4.4 (4.0, 4.8)	5.5 (4.9, 6.2)
	Total Conventional	539	12380	2.9 (2.6, 3.2)	3.7 (3.3, 4.0)	4.1 (3.8, 4.5)	5.0 (4.5, 5.5)	5.8 (5.3, 6.4)	7.0 (6.2, 7.8)
TOTAL		**3859**	**103122**						

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

Figure HT64 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=0.99 (0.60, 1.65),p=0.982
3Mth+: HR=2.31 (1.78, 3.01),p<0.001

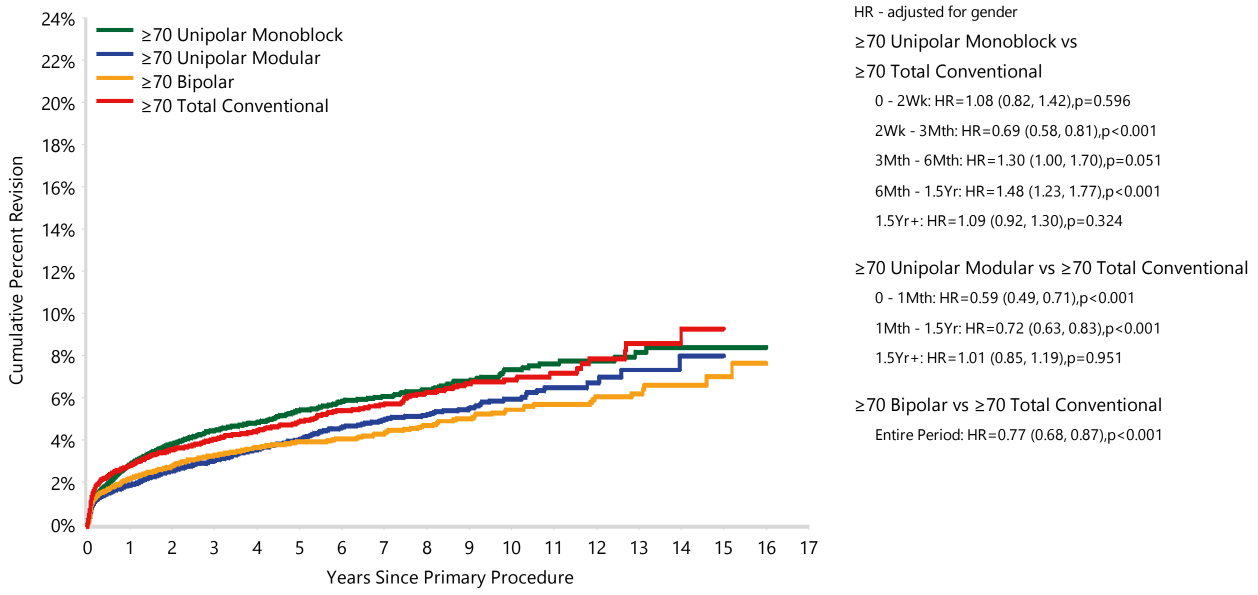
<70 Unipolar Modular vs <70 Total Conventional
0 - 3Mth: HR=0.73 (0.52, 1.02),p=0.066
3Mth - 3Yr: HR=1.71 (1.36, 2.17),p<0.001
3Yr+: HR=2.75 (2.12, 3.57),p<0.001

<70 Bipolar vs <70 Total Conventional
Entire Period: HR=1.10 (0.90, 1.34),p=0.353

	Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<70	Unipolar Monoblock	900	605	504	424	293	217	125
	Unipolar Modular	3045	2292	1919	1603	1100	723	314
	Bipolar	2093	1595	1314	1103	870	668	448
	Total Conventional	5605	4480	3735	3097	2105	1355	595

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

Figure HT65 Cumulative Percent Revision of Primary Hip Replacement in Patients Aged ≥70 Years by Class (Primary Diagnosis Fractured NOF)



	Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
≥70	Unipolar Monoblock	26990	16312	12565	9519	5195	2793	1050
	Unipolar Modular	34642	23289	17935	13635	7357	3608	1083
	Bipolar	17467	11902	9177	7014	4341	2726	1307
	Total Conventional	12380	9597	7799	6280	3812	2184	757

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

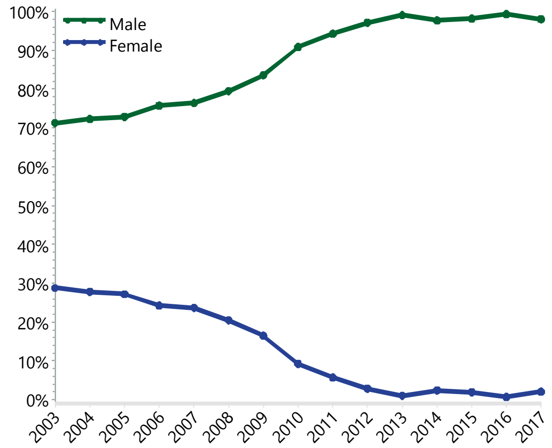
PRIMARY TOTAL RESURFACING HIP REPLACEMENT

DEMOGRAPHICS

There have been 17,345 total resurfacing hip replacement procedures reported to the Registry. This is an additional 395 procedures compared to the last report.

The use of total resurfacing hip replacement in Australia has been declining since 2005. In 2017, the number of total resurfacing procedures is 7.3% less than in 2016 and 78.7% less than 2005. Total resurfacing hip replacement represents 2.9% of all hip replacements performed in 2017.

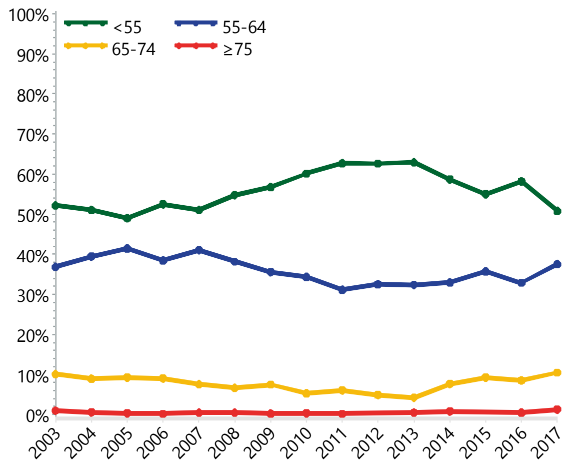
Figure HT66 Primary Total Resurfacing Hip Replacement by Gender



In 2017, 98.0% of total resurfacing hip replacements were undertaken in males (Table HT56 and Figure HT66).

There is a small increase in the proportion of patients aged 55 to 64 years receiving total resurfacing hip replacement in 2017 (Figure HT67).

Figure HT67 Primary Total Resurfacing Hip Replacement by Age



There were only two different types of resurfacing prostheses used in 2017, with the Adept the most commonly used, accounting for 68.1% of procedures (Table HT57).

Table HT56 Age and Gender of Primary Total Resurfacing Hip Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	13758	79.3%	13	82	54	53.4	9.0
Female	3587	20.7%	14	81	53	51.6	8.6
TOTAL	**17345**	**100.0%**	**13**	**82**	**54**	**53.0**	**9.0**

Table HT57 Most Used Resurfacing Heads in Primary Total Resurfacing Hip Replacement

2003		2014		2015		2016		2017	
N	Model	N	Model	N	Model	N	Model	N	Model
1359	BHR	286	BHR	196	Adept	258	Adept	267	Adept
58	Durom	94	Adept	171	BHR	165	BHR	125	BHR
43	ASR								
42	Cormet								
38	Cormet 2000 HAP								
7	Conserve Plus								
Most Used									
1547	(6) 100.0%	380	(2) 100.0%	367	(2) 100.0%	423	(2) 100.0%	392	(2) 100.0%

OUTCOME FOR ALL DIAGNOSES

Primary Diagnosis

The principal diagnosis for primary total resurfacing hip replacement is osteoarthritis (95.3%), followed by developmental dysplasia (2.3%) and osteonecrosis (1.6%) (Table HT58). 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 (Figure HT68).

Prosthesis Types

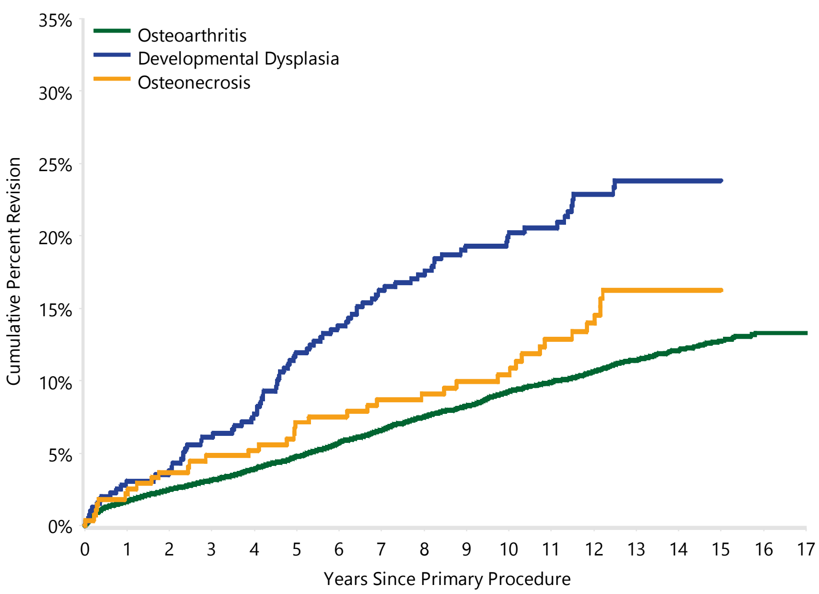
The cumulative percent revision of different total resurfacing hip prosthesis combinations with more than 100 procedures is listed in Table HT59. At 10 years, the prosthesis with the lowest cumulative percent revision is the Mitch TRH (5.4%).

Table HT58 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	17 Yrs
Osteoarthritis	1512	16537	1.7 (1.5, 1.9)	3.1 (2.9, 3.4)	4.8 (4.5, 5.1)	9.3 (8.8, 9.8)	12.7 (12.0, 13.4)	13.3 (12.5, 14.1)
Developmental Dysplasia	85	396	3.0 (1.7, 5.3)	6.1 (4.1, 9.0)	11.9 (9.1, 15.6)	20.3 (16.5, 24.7)	23.8 (19.7, 28.7)	
Osteonecrosis	38	277	2.2 (1.0, 4.8)	4.8 (2.8, 8.2)	7.1 (4.6, 11.0)	10.4 (7.2, 14.8)	16.3 (12.0, 21.8)	
Other (6)	21	135	2.3 (0.7, 6.9)	5.5 (2.7, 11.2)	9.7 (5.6, 16.5)	15.6 (10.1, 23.7)		
TOTAL	**1656**	**17345**						

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

Figure HT68 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement by Primary Diagnosis



HR - adjusted for age and gender

Developmental Dysplasia vs Osteoarthritis
Entire Period: HR=1.45 (1.16, 1.81),p=0.001

Osteonecrosis vs Osteoarthritis
Entire Period: HR=1.31 (0.94, 1.82),p=0.106

Developmental Dysplasia vs Osteonecrosis
Entire Period: HR=1.11 (0.75, 1.63),p=0.606

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Osteoarthritis	16537	15862	14809	13732	8684	1640	76
Developmental Dysplasia	396	382	362	331	255	58	4
Osteonecrosis	277	264	249	240	188	55	6

Table HT59 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	17 Yrs
ASR	ASR*	367	1168	3.4 (2.5, 4.6)	7.2 (5.9, 8.8)	15.4 (13.4, 17.6)	30.1 (27.5, 32.9)		
Adept	Adept	42	1473	1.0 (0.6, 1.7)	1.8 (1.2, 2.8)	2.6 (1.7, 3.8)	7.1 (5.0, 10.1)		
BHR	BHR	846	11504	1.4 (1.2, 1.6)	2.5 (2.2, 2.8)	3.5 (3.2, 3.8)	6.7 (6.3, 7.2)	10.0 (9.3, 10.7)	10.6 (9.8, 11.5)
Bionik	Bionik*	49	200	3.5 (1.7, 7.2)	12.0 (8.2, 17.4)	17.6 (13.0, 23.6)	25.5 (19.9, 32.4)		
Cormet	Cormet*	117	626	2.1 (1.2, 3.6)	5.6 (4.1, 7.7)	9.7 (7.6, 12.3)	17.4 (14.6, 20.8)		
Durom	Durom*	99	847	3.3 (2.3, 4.8)	5.6 (4.2, 7.3)	7.6 (6.0, 9.6)	11.0 (9.1, 13.4)		
Icon	Icon*	16	118	1.7 (0.4, 6.6)	4.2 (1.8, 9.9)	5.9 (2.9, 12.1)	11.9 (7.1, 19.8)		
Mitch TRH	Mitch TRH*	49	1024	1.2 (0.7, 2.1)	2.1 (1.4, 3.2)	2.6 (1.8, 3.8)	5.4 (4.0, 7.1)		
Recap	Recap*	28	196	5.1 (2.8, 9.3)	8.7 (5.5, 13.6)	10.2 (6.7, 15.4)	15.1 (10.6, 21.1)		
Other (9)		43	189	5.3 (2.9, 9.6)	7.4 (4.5, 12.2)	9.6 (6.1, 14.8)	17.5 (12.7, 23.9)		
TOTAL		**1656**	**17345**						

Note: Only combinations with over 100 procedures have been listed
* denotes prosthesis combinations with no reported use in primary total resurfacing hip replacement in 2017

OUTCOME FOR OSTEOARTHRITIS

The cumulative percent revision at 17 years for primary total resurfacing hip replacement undertaken for osteoarthritis is 13.3% (Table HT60 and Figure HT69).

Reasons for Revision

The main reasons for revision of primary total resurfacing hip replacement are metal related pathology (27.5%), loosening (24.3%) and fracture (18.3%) (Table HT61).

Metal related pathology is the most common reason for revision after seven years.

The five most common reasons for revision are shown in Figure HT70. 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 seven years.

Type of Revision

The most common type of revision for total resurfacing hip replacement is revision of both the femoral and acetabular components (71.0%). Femoral only revision is much less common (23.4%) and acetabular only revision is rarely undertaken (2.9%) (Table HT62).

Age and Gender

Patients aged 65 years or older have a higher rate of revision compared to patients aged less than 55 years, and patients aged 55 to 64 years, for the first six months only. After six months, patients aged 65 years or older have a lower rate of revision compared to patients aged less than 55 years, and patients aged 55 to 64 years (Table HT63 and Figure HT71).

Females have a higher rate of revision compared to males. After one year, the rate of revision is over three times higher for females compared to males (Table HT64 and Figure HT72). Males aged 65 years or older have a higher rate of revision compared to males aged less than 55 years, and 55 to 64 years, for the first six months only. After six months, the rate of revision for males aged 65 years or older is lower compared to males aged less than 55 years. After three months, females aged 65 years or older have a lower rate of revision compared to females aged less than 55 years (Figures HT73 and HT74).

Head Size

The rate of revision decreases as the femoral component head size increases. Femoral head sizes 44mm or less, and 45 to 49mm, have over twice the rate of revision compared to head sizes 55mm or larger. There is no difference for head sizes 50 to 54mm compared to 55mm or larger (Table HT65 and Figure HT75).

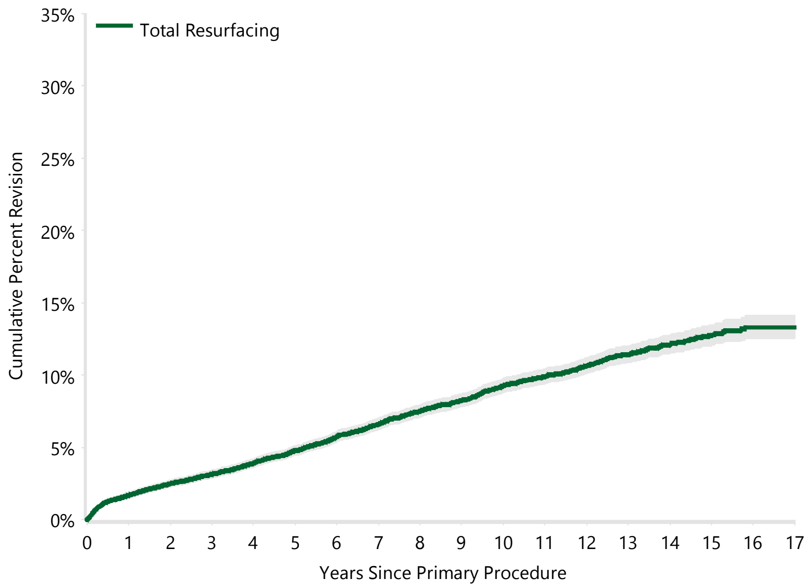
The reason for revision varies with head size. Head sizes less than 50mm have a higher cumulative incidence of metal related pathology, loosening, fracture, infection, and lysis compared to head sizes 50mm or larger (Figure HT76).

This effect of femoral component head size is evident in both males and females (Table HT66 and Figure HT77).

Table HT60 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	17 Yrs
Total Resurfacing	1512	16537	1.7 (1.5, 1.9)	3.1 (2.9, 3.4)	4.8 (4.5, 5.1)	9.3 (8.8, 9.8)	12.7 (12.0, 13.4)	13.3 (12.5, 14.1)
TOTAL	**1512**	**16537**						

Figure HT69 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	17 Yrs
Total Resurfacing	16537	15862	14809	13732	8684	1640	76

Table HT61 Primary Total Resurfacing Hip Replacement by Reason for Revision (Primary Diagnosis OA)

Reason for Revision	Number	Percent
Metal Related Pathology	416	27.5
Loosening	367	24.3
Fracture	276	18.3
Lysis	132	8.7
Infection	97	6.4
Pain	94	6.2
Osteonecrosis	40	2.6
Prosthesis Dislocation	21	1.4
Malposition	20	1.3
Other (12)	49	3.2
TOTAL	**1512**	**100.0**

Table HT62 Primary Total Resurfacing Hip Replacement by Type of Revision (Primary Diagnosis OA)

Type of Revision	Number	Percent
THR (Femoral/Acetabular)	1073	71.0
Femoral Component	354	23.4
Acetabular Component	44	2.9
Cement Spacer	31	2.1
Removal of Prostheses	10	0.7
TOTAL	**1512**	**100.0**

Figure HT70 Cumulative Incidence Revision Diagnosis of Primary Total Resurfacing Hip Replacement (Primary Diagnosis OA)

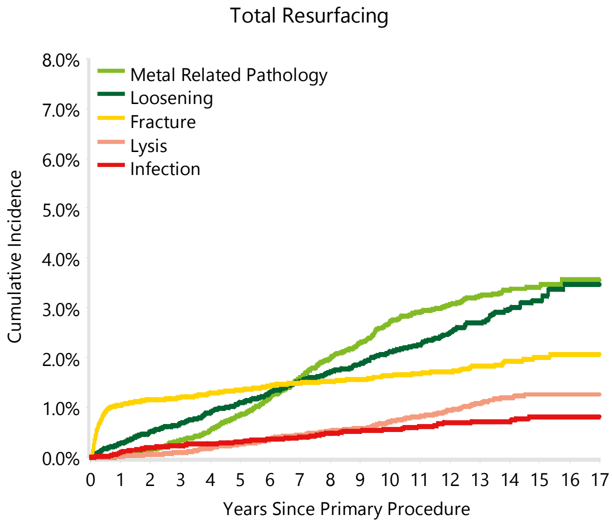
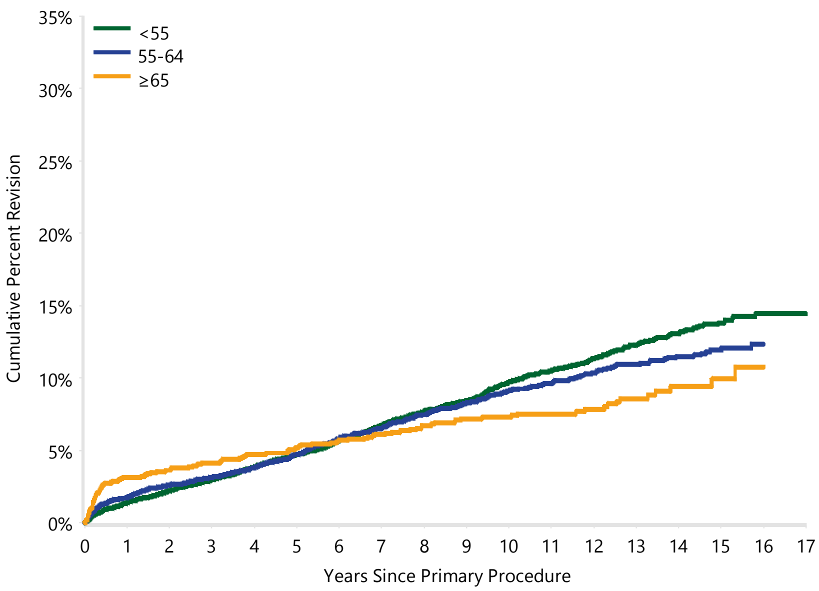


Table HT63 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement by Age (Primary Diagnosis OA)

Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
<55	833	8714	1.4 (1.2, 1.7)	3.0 (2.6, 3.4)	4.7 (4.3, 5.2)	9.7 (9.0, 10.4)	13.8 (12.8, 14.9)	14.4 (13.3, 15.7)
55-64	568	6336	1.8 (1.5, 2.1)	3.1 (2.7, 3.6)	4.7 (4.2, 5.3)	9.1 (8.4, 9.9)	11.9 (10.9, 13.0)	
≥65	111	1487	3.1 (2.4, 4.2)	4.1 (3.2, 5.3)	5.2 (4.2, 6.5)	7.3 (6.0, 8.8)	9.9 (8.0, 12.3)	
TOTAL	**1512**	**16537**						

Figure HT71 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement by Age (Primary Diagnosis OA)



HR - adjusted for gender

55-64 vs <55

0 - 5.5Yr: HR=1.07 (0.93, 1.24),p=0.358

5.5Yr+: HR=0.82 (0.70, 0.96),p=0.011

≥65 vs <55

0 - 6Mth: HR=2.97 (2.09, 4.23),p<0.001

6Mth+: HR=0.68 (0.53, 0.87),p=0.001

≥65 vs 55-64

0 - 6Mth: HR=2.45 (1.70, 3.52),p<0.001

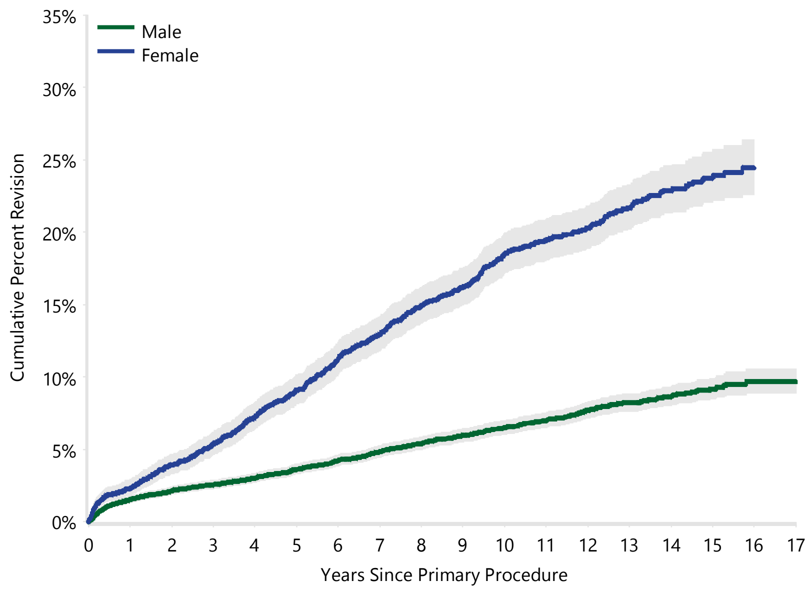
6Mth+: HR=0.75 (0.58, 0.96),p=0.022

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
<55	8714	8400	7816	7202	4381	881	51
55-64	6336	6072	5703	5322	3488	608	22
≥65	1487	1390	1290	1208	815	151	3

Table HT64 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	17 Yrs
Male		**842**	**13269**	**1.5 (1.3, 1.8)**	**2.6 (2.3, 2.9)**	**3.6 (3.3, 4.0)**	**6.5 (6.1, 7.0)**	**9.2 (8.5, 9.9)**	**9.7 (8.9, 10.6)**
	<55	433	6834	1.2 (1.0, 1.5)	2.4 (2.0, 2.7)	3.3 (2.9, 3.8)	6.5 (5.9, 7.2)	9.7 (8.7, 10.9)	
	55-64	318	5081	1.6 (1.3, 2.0)	2.5 (2.1, 3.0)	3.7 (3.2, 4.2)	6.5 (5.8, 7.3)	8.6 (7.6, 9.7)	
	≥65	91	1354	3.1 (2.3, 4.1)	3.9 (3.0, 5.1)	4.9 (3.8, 6.2)	6.6 (5.3, 8.2)	8.6 (6.9, 10.8)	
Female		**670**	**3268**	**2.3 (1.8, 2.9)**	**5.4 (4.7, 6.2)**	**9.1 (8.2, 10.2)**	**18.5 (17.1, 19.9)**	**23.8 (22.1, 25.5)**	
	<55	400	1880	2.1 (1.6, 2.9)	5.1 (4.2, 6.2)	9.3 (8.1, 10.7)	19.1 (17.3, 21.0)	24.9 (22.6, 27.3)	
	55-64	250	1255	2.4 (1.7, 3.4)	5.7 (4.5, 7.1)	8.9 (7.4, 10.6)	18.1 (16.0, 20.4)	22.6 (20.0, 25.4)	
	≥65	20	133	3.8 (1.6, 8.8)	6.0 (3.1, 11.7)	8.3 (4.7, 14.6)	13.2 (8.4, 20.5)		
TOTAL		**1512**	**16537**						

Figure HT72 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement by Gender (Primary Diagnosis OA)



HR - adjusted for age

Female vs Male

0 - 3Mth: HR=2.02 (1.41, 2.89),p<0.001

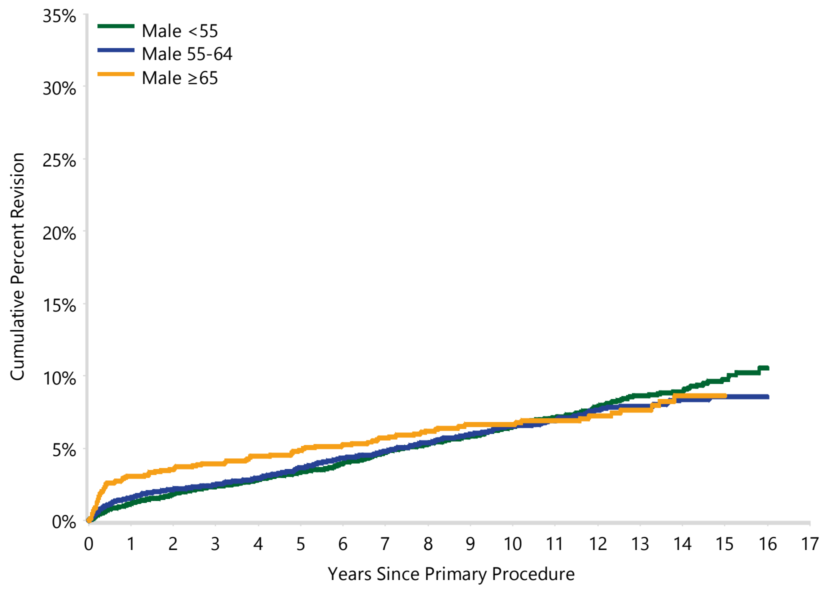
3Mth - 6Mth: HR=1.22 (0.71, 2.10),p=0.472

6Mth - 1Yr: HR=0.92 (0.51, 1.69),p=0.799

1Yr+: HR=3.20 (2.86, 3.58),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Male	12893	12276	11388	10384	5501	418	55
Female	3262	3180	3060	2914	1848	186	21

Figure HT73 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement in Males by Age (Primary Diagnosis OA)



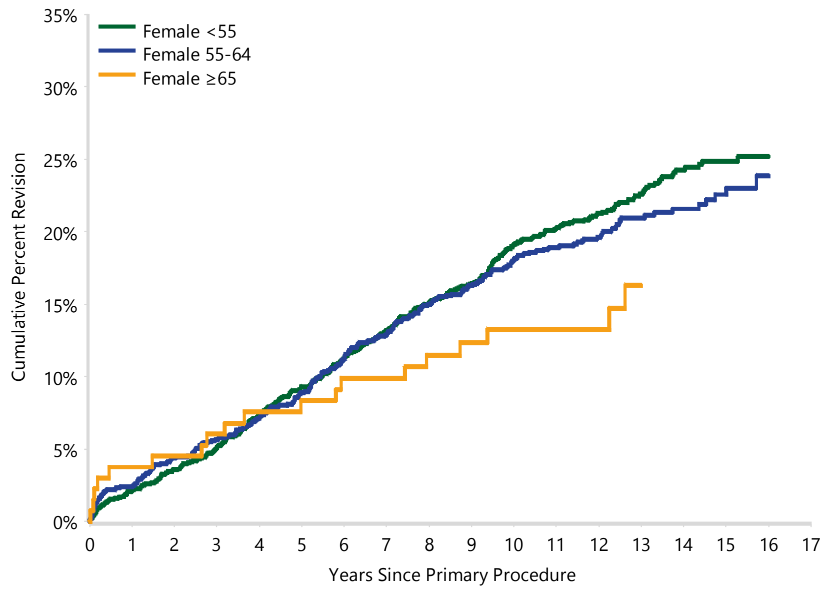
Male 55-64 vs Male <55
0 - 1Mth: HR=2.49 (1.14, 5.46),p=0.022
1Mth+: HR=0.93 (0.80, 1.08),p=0.340

Male ≥65 vs Male <55
0 - 6Mth: HR=2.96 (2.00, 4.38),p<0.001
6Mth+: HR=0.73 (0.55, 0.97),p=0.028

Male ≥65 vs Male 55-64
0 - 6Mth: HR=2.44 (1.63, 3.65),p<0.001
6Mth+: HR=0.80 (0.60, 1.07),p=0.128

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Male	<55	6834	6567	6046	5524	3178	612	35
	55-64	5081	4850	4529	4195	2654	434	17
	≥65	1354	1262	1167	1089	727	129	3

Figure HT74 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement in Females by Age (Primary Diagnosis OA)



Female 55-64 vs Female <55
Entire Period: HR=0.93 (0.79, 1.09),p=0.365

Female ≥65 vs Female <55
0 - 3Mth: HR=2.26 (0.81, 6.32),p=0.120
3Mth+: HR=0.59 (0.36, 0.98),p=0.040

Female ≥65 vs Female 55-64
Entire Period: HR=0.75 (0.48, 1.18),p=0.213

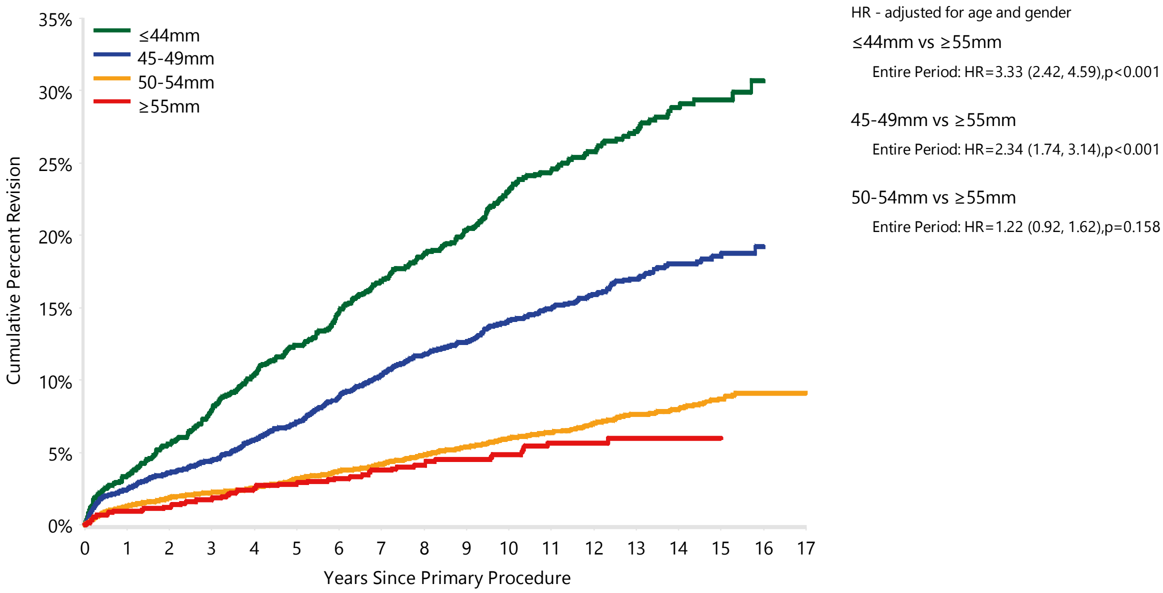
Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Female	<55	16726	14968	11736	8821	3705	881	100
	55-64	41981	37582	29775	22924	9545	1974	281
	65-74	68138	60390	47118	35723	15067	2890	309
	≥75	64146	56740	44202	32585	10811	1185	98

Table HT65 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	17 Yrs
≤44mm	310	1196	3.4 (2.5, 4.6)	8.0 (6.6, 9.6)	12.4 (10.7, 14.4)	23.0 (20.7, 25.6)	29.4 (26.5, 32.5)	
45-49mm	535	3758	2.4 (2.0, 3.0)	4.5 (3.9, 5.2)	7.1 (6.3, 8.0)	14.1 (13.0, 15.4)	18.5 (17.0, 20.2)	
50-54mm	614	10414	1.3 (1.1, 1.5)	2.2 (2.0, 2.5)	3.2 (2.9, 3.6)	6.0 (5.5, 6.5)	8.7 (7.9, 9.5)	9.1 (8.3, 10.0)
≥55mm	53	1168	0.9 (0.5, 1.7)	1.8 (1.1, 2.7)	2.8 (2.0, 4.0)	4.8 (3.7, 6.4)	6.0 (4.5, 7.9)	
TOTAL	**1512**	**16536**						

Note: Excludes one procedure with unknown head size

Figure HT75 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement by Head Size (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
≤44mm	1196	1153	1093	1032	738	163	7
45-49mm	3758	3606	3389	3179	2002	366	13
50-54mm	10414	9974	9272	8553	5417	1021	51
≥55mm	1168	1128	1054	967	527	90	5

Figure HT76 **Cumulative Incidence Revision Diagnosis of Primary Total Resurfacing Hip Replacement by Head Size (Primary Diagnosis OA)**

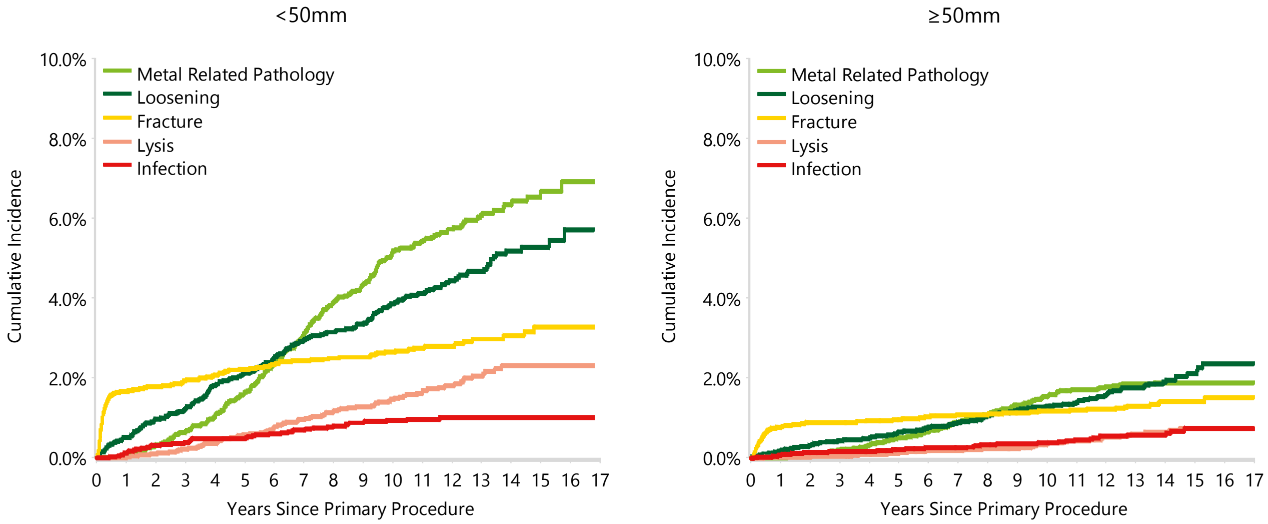
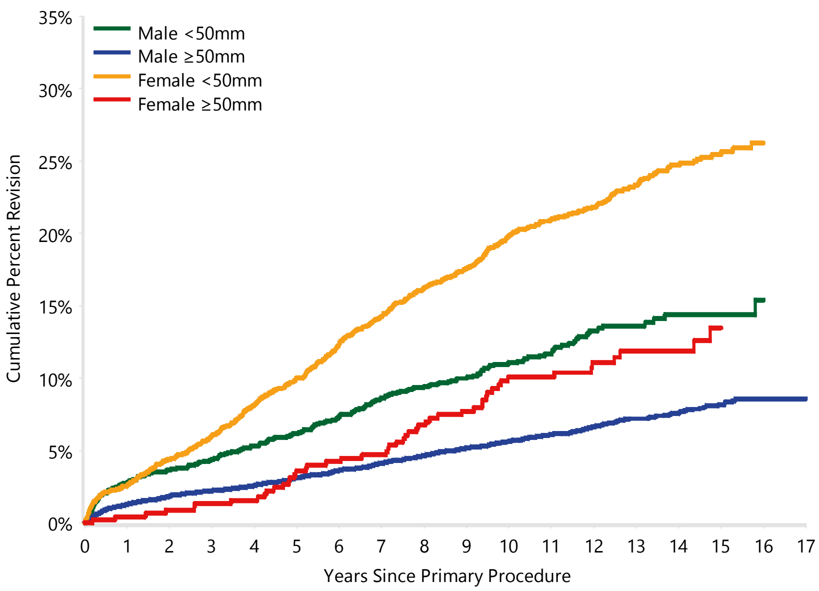


Table HT66 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement by Gender and Head Size (Primary Diagnosis OA)

Gender	Femoral Head Size	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Male		**842**	**13268**	**1.5 (1.3, 1.8)**	**2.6 (2.3, 2.9)**	**3.6 (3.3, 4.0)**	**6.5 (6.1, 7.0)**	**9.2 (8.5, 9.9)**	**9.7 (8.9, 10.6)**
	<50mm	225	2137	2.8 (2.2, 3.6)	4.4 (3.6, 5.3)	6.2 (5.2, 7.3)	11.1 (9.7, 12.6)	14.4 (12.5, 16.5)	
	≥50mm	617	11131	1.3 (1.1, 1.5)	2.2 (2.0, 2.5)	3.1 (2.8, 3.5)	5.6 (5.2, 6.1)	8.2 (7.4, 8.9)	8.6 (7.8, 9.5)
Female		**670**	**3268**	**2.3 (1.8, 2.9)**	**5.4 (4.7, 6.2)**	**9.1 (8.2, 10.2)**	**18.5 (17.1, 19.9)**	**23.8 (22.1, 25.5)**	
	<50mm	620	2817	2.6 (2.1, 3.3)	6.0 (5.2, 7.0)	10.0 (9.0, 11.2)	19.8 (18.4, 21.4)	25.5 (23.6, 27.4)	
	≥50mm	50	451	0.4 (0.1, 1.8)	1.3 (0.6, 2.9)	3.6 (2.2, 5.8)	10.1 (7.6, 13.4)	13.5 (10.1, 17.9)	
TOTAL		**1512**	**16536**						

Note: Excludes one male procedure with unknown head size

Figure HT77 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement by Gender and Head Size (Primary Diagnosis OA)



HR - adjusted for age

Male <50mm vs Male ≥50mm
Entire Period: HR=1.99 (1.71, 2.32),p<0.001

Male ≥50mm vs Female ≥50mm
0 - 7Yr: HR=0.90 (0.58, 1.40),p=0.651
7Yr - 9Yr: HR=0.33 (0.19, 0.57),p<0.001
9Yr+: HR=0.48 (0.29, 0.80),p=0.004

Male <50mm vs Female <50mm
0 - 6Mth: HR=0.77 (0.55, 1.08),p=0.130
6Mth+: HR=0.53 (0.45, 0.63),p<0.001

Female <50mm vs Female ≥50mm
0 - 4.5Yr: HR=4.04 (2.22, 7.35),p<0.001
4.5Yr - 5Yr: HR=0.82 (0.33, 2.05),p=0.675
5Yr+: HR=1.79 (1.27, 2.54),p=0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Male	<50mm	2137	2025	1857	1718	948	150	3
	≥50mm	11131	10653	9884	9089	5611	1025	52
Female	<50mm	2817	2734	2625	2493	1792	379	17
	≥50mm	451	449	442	431	333	86	4

Knee Replacement

Knee Replacement

CATEGORIES OF KNEE REPLACEMENT

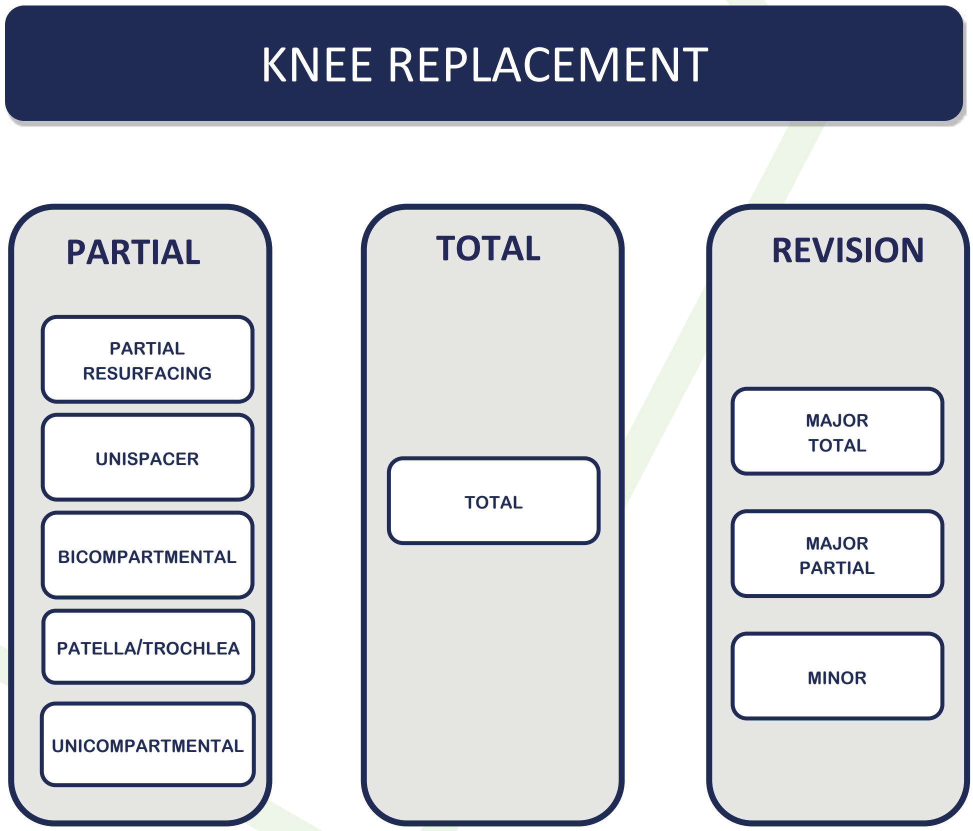
The Registry groups knee replacement into three broad categories: primary partial, primary total and revision knee replacement.

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-2018



USE OF KNEE REPLACEMENT

This report analyses 717,334 knee replacements with a procedure date up to and including 31 December 2017. This is an additional 63,854 knee procedures compared to the number reported last year. When considering all knee procedures currently recorded by the Registry, primary partial knee accounts for 7.9%, primary total knee 84.0% and revision knee replacement 8.1% (Table K1).

Table K1 Number of Knee Replacements

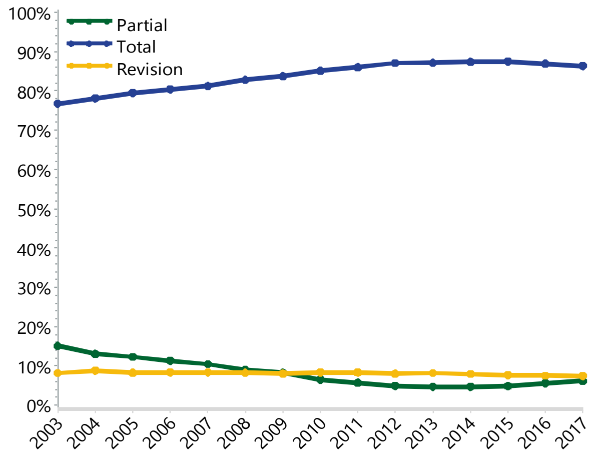
Knee Category	Number	Percent
Partial	56852	7.9
Total	602449	84.0
Revision	58033	8.1
TOTAL	**717334**	**100.0**

In 2017, the number of knee replacements undertaken has increased by 2,990 (5.0%) compared to 2016. During the last year, primary partial and primary total knee replacement has increased by 16.5% and 4.3%, respectively. There was an increase in revision knee replacement (4.1%).

Since 2003, the number of knee replacement procedures undertaken annually has increased by 123.5%. Primary total knee replacement has increased by 151.6% and revision knee replacement by 103.3%. Primary partial knee replacement has decreased by 8.4%.

In 2017, primary total knee replacement accounts for 86.4% of all knee replacement procedures. This has increased from 76.7% in 2003. Primary partial knee replacement decreased from 15.1% in 2003 to 6.2% in 2017. The proportion of revision knee procedures has declined from a peak of 8.8% in 2004 to 7.4% in 2017. This equates to 877 fewer revision procedures in 2017 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 269,717 and BMI data on 164,338 knee replacement procedures. Since its initial collection in 2012, ASA score has been recorded in 93.9% of procedures. BMI data has been recorded in 90.4% of procedures since 2015, when its collection commenced.

In 2017, ASA score is reported in 99.7% of knee replacement procedures and BMI data is reported in 95.4% of procedures.

BMI data is reported for 96.6% of primary partial knees, 95.7% of primary total knees and 90.3% of revision knee replacement procedures.

ASA score and BMI are both known to impact the outcome of knee replacement surgery. In the future, this data will be used to risk adjust in a range of analyses.

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 92.3% of procedures, patients have an ASA score of 2 or 3, 6.4% 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 (75.8% and 62.2%, respectively). For patients undergoing revision knee replacement surgery, there are a lower proportion with ASA scores 1 or 2 (49.3%) (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://apps.who.int/bmi/index.jsp?introPage=intro_3.html

For all knee replacements, the majority of procedures are undertaken in patients that are either pre-obese or obese class 1 (62.3%). There is almost no difference in BMI for patients when primary total and revision knee replacement are compared. However, for partial knee replacement, patients generally have a lower BMI, with 55.8% of procedures undertaken in patients in either the normal or pre-obese categories, compared to 41.7% for primary total knee and 41.2% for revision knee replacement (Table K3).

Table K2 ASA Score for Knee Replacement

ASA Score	Partial N	Partial Col%	Total N	Total Col%	Revision N	Revision Col%	TOTAL N	TOTAL Col%
ASA 1	2011	14.1	14443	6.2	848	4.1	17302	6.4
ASA 2	8783	61.7	131533	56.0	9327	45.2	149643	55.5
ASA 3	3374	23.7	86227	36.7	9690	47.0	99291	36.8
ASA 4	70	0.5	2625	1.1	767	3.7	3462	1.3
ASA 5	2	0.0	14	0.0	3	0.0	19	0.0
TOTAL	**14240**	**100.0**	**234842**	**100.0**	**20635**	**100.0**	**269717**	**100.0**

Table K3 BMI Category for Knee Replacement

BMI Category	Partial N	Partial Col%	Total N	Total Col%	Revision N	Revision Col%	TOTAL N	TOTAL Col%
Underweight	16	0.2	297	0.2	36	0.3	349	0.2
Normal	1331	14.3	15003	10.5	1269	10.8	17603	10.7
Pre Obese	3874	41.5	44703	31.2	3575	30.4	52152	31.7
Obese Class 1	2800	30.0	43899	30.6	3630	30.9	50329	30.6
Obese Class 2	957	10.3	24179	16.9	2026	17.2	27162	16.5
Obese Class 3	352	3.8	15164	10.6	1227	10.4	16743	10.2
TOTAL	**9330**	**100.0**	**143245**	**100.0**	**11763**	**100.0**	**164338**	**100.0**

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

Primary Partial Knee Replacement

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.

Detailed information on demographics of each class of primary partial 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-2018

USE OF PARTIAL KNEE REPLACEMENT

Unicompartmental knee replacement remains the most common class of primary partial knee replacement, accounting for 92.9% of all partial knee replacement procedures. The second most common class is patella/trochlea replacement (6.3%). Within the remaining three classes (partial resurfacing, unispacer and bicompartmental knee replacement) only small numbers of the three remaining partial knee 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-2018.

Osteoarthritis is the principal diagnosis for the five classes of partial knee replacement (99.0%). There is considerable variation in the outcome of primary partial knee replacement depending on the class (Table KP2).

Table KP1 Partial Knee Replacement by Class

Partial Knee Class	Number	Percent
Partial Resurfacing	240	0.4
Unispacer	40	0.1
Bicompartmental	165	0.3
Patella/Trochlear	3593	6.3
Unicompartmental	52814	92.9
TOTAL	**56852**	**100.0**

Table KP2 Cumulative Percent Revision of Primary Partial Knee Replacement by Class

Partial Knee Class	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Partial Resurfacing	80	240	5.9 (3.5, 9.7)	16.9 (12.7, 22.3)	25.4 (20.2, 31.8)	38.1 (31.6, 45.6)		
Unispacer	32	40	42.5 (29.0, 59.2)	67.5 (53.0, 81.2)	67.5 (53.0, 81.2)	77.5 (63.7, 88.8)		
Bicompartmental	26	165	6.1 (3.3, 11.0)	11.7 (7.6, 17.7)	14.2 (9.7, 20.6)			
Patella/Trochlear	700	3593	2.4 (1.9, 3.0)	8.5 (7.6, 9.6)	14.3 (13.0, 15.6)	28.6 (26.5, 30.7)	45.9 (41.8, 50.2)	
Unicompartmental	6626	52814	2.2 (2.1, 2.4)	5.7 (5.5, 5.9)	8.0 (7.8, 8.3)	14.7 (14.3, 15.0)	22.4 (21.8, 23.1)	25.6 (24.5, 26.8)
TOTAL	**7464**	**56852**						

PARTIAL RESURFACING

DEMOGRAPHICS

The Registry has recorded 240 partial resurfacing knee procedures. This is an additional two procedures compared to the number reported last year. The use of partial resurfacing knee replacement has decreased from a peak of 42 procedures in 2006.

The most common reason for undertaking a partial resurfacing procedure is osteoarthritis (89.2%). The mean age of patients with a partial resurfacing knee replacement is 50.4 years and 50.4% are males (Table KP3).

All recorded partial resurfacing procedures used the 'Hemicap' range of prostheses. Of the 240 procedures, 179 used one cap, 56 used two, and five used three caps. When a single cap was used, most (140) were implanted on the femoral articular surface. The remainder were used on the trochlear (14), tibial (13) and patellar (10) surfaces. There are two procedures where the positioning of the cap is unknown. When two caps were used, 53 were implanted on the patellar plus trochlear, one patellar plus femoral, and two used both devices on the femoral articular surface. In the five procedures where three caps were used, all were implanted on the patellar, trochlear and femoral articular surfaces.

There are 85 procedures that involve resurfacing of the patella/trochlear joint either on one side (27) or both sides (58). This is the same number of procedures that were reported in 2016. The five year cumulative percent revision for one side is 21.3% and 35.3% when both sides are resurfaced.

The main reasons for revision of a partial resurfacing are progression of disease (63.8%), loosening (11.3%) and pain (7.5%).

Most primary partial resurfacing replacements are revised to either a total knee replacement (58.8%) or unicompartmental knee replacement (23.8%). The remaining revisions are patellar resurfacing only (6.3%), patella/trochlear resurfacing (5.0%), additional partial resurfacing (5.0%), or removal of the prosthesis (1.3%).

The cumulative percent revision of partial resurfacing procedures undertaken for osteoarthritis is 6.1% at one year and 40.6% at 10 years (Table KP4 and Figure KP1).

The cumulative percent revision of partial resurfacing procedures undertaken for osteoarthritis is 40.6% at 10 years.

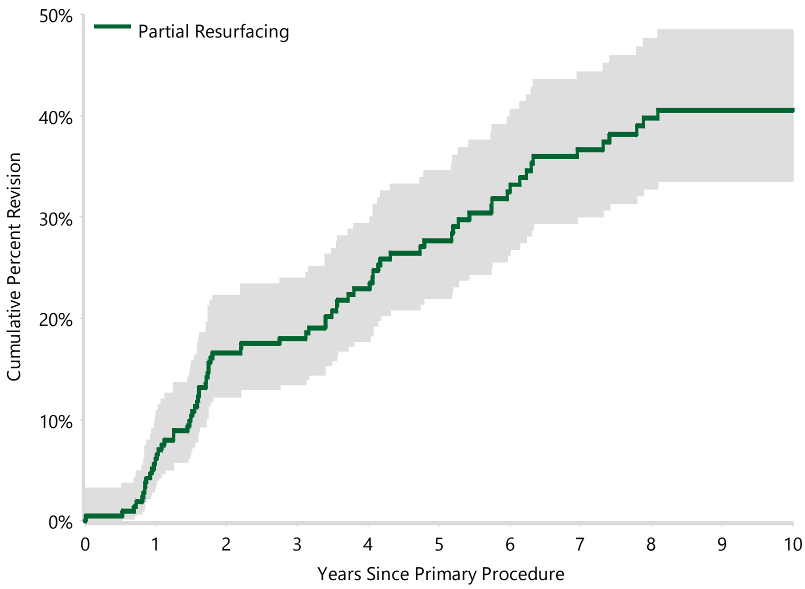
Table KP3 Age and Gender of Primary Partial Resurfacing Knee Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	121	50.4%	17	85	49	49.3	14.3
Female	119	49.6%	30	88	51	51.5	11.6
TOTAL	**240**	**100.0%**	**17**	**88**	**50**	**50.4**	**13.1**

Table KP4 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	7 Yrs	10 Yrs
Partial Resurfacing	76	214	6.1 (3.6, 10.3)	16.6 (12.2, 22.3)	18.0 (13.5, 23.9)	27.7 (22.0, 34.6)	36.7 (30.0, 44.3)	40.6 (33.5, 48.4)
TOTAL	**76**	**214**						

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	7 Yrs	10 Yrs
Partial Resurfacing	214	199	172	158	111	89	51

PATELLA/TROCHLEA

DEMOGRAPHICS

There have been 3,593 patella/trochlear knee replacements reported to the Registry. This is an additional 307 procedures compared to the previous report.

The principal diagnosis for patella/trochlear procedures is osteoarthritis (99.0%). This procedure is most frequently undertaken in females (76.8%). The mean age of patients is 58.7 years (Table KP5, Figures KP2 and KP3).

Figure KP2 Primary Patella/Trochlea Knee Replacement by Gender

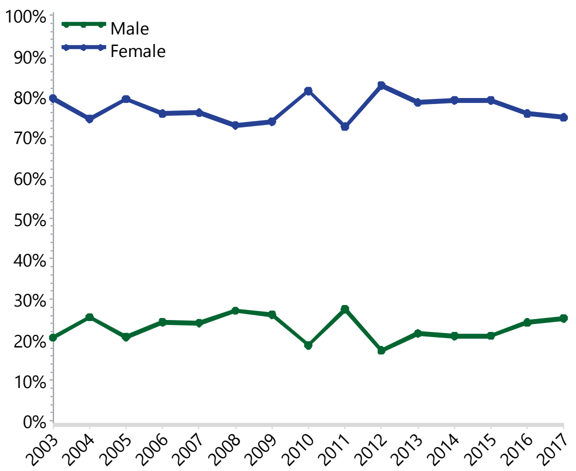
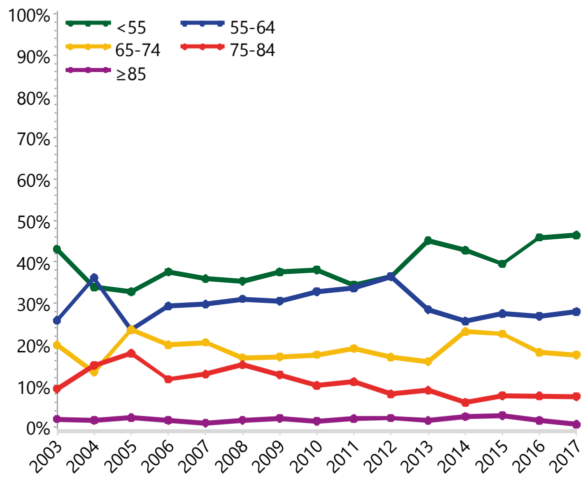


Figure KP3 Primary Patella/Trochlea Knee Replacement by Age



In 2017, the four most common resurfacing trochlear prostheses are the Gender Solutions, Restoris MCK, Journey and Avon. The Gender Solutions prosthesis was first reported in 2009 and since 2010 it has remained the most frequently used prosthesis in this class (Table KP6).

The outcomes of patella/trochlear prosthesis combinations with more than 20 procedures are presented in Table KP7.

Table KP5 Age and Gender of Primary Patella/Trochlea Knee Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	835	23.2%	25	95	60	60.6	13.1
Female	2758	76.8%	22	95	57	58.1	12.0
TOTAL	**3593**	**100.0%**	**22**	**95**	**58**	**58.7**	**12.3**

Table KP6 Most Used Resurfacing Trochlear Prostheses in Primary Patella/Trochlea Knee Replacement

2003		2014		2015		2016		2017	
N	Model	N	Model	N	Model	N	Model	N	Model
56	LCS	115	Gender Solutions	118	Gender Solutions	153	Gender Solutions	138	Gender Solutions
43	Avon	41	Avon	39	Journey	38	Journey	64	Restoris MCK
29	Lubinus	37	RBK	39	RBK	37	Restoris MCK	44	Journey
13	Themis	32	Journey	38	Avon	36	Avon	21	Avon
9	MOD III	7	Sigma HP	7	Sigma HP	34	RBK	20	RBK
1	RBK	1	HLS Kneetec	5	Restoris MCK	7	Sigma HP	10	Sigma HP
		1	Vanguard	2	Vanguard				
Most Used									
151	(6) 100.0%	234	(7) 100.0%	248	(7) 100.0%	305	(6) 100.0%	297	(6) 100.0%

Table KP7 Cumulative Percent Revision of Primary Patella/Trochlea Knee Replacement by Prosthesis Combination

Resurfacing Trochlear	Patella	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	13 Yrs	15 Yrs
Avon	Avon	62	378	1.1 (0.4, 2.9)	6.4 (4.3, 9.6)	11.7 (8.6, 15.9)	25.2 (19.7, 31.8)		
Avon	Kinemax Plus*	93	307	2.0 (0.9, 4.3)	4.9 (3.0, 8.0)	11.9 (8.7, 16.1)	22.8 (18.4, 28.1)	34.0 (28.1, 40.7)	
Avon	Triathlon	3	83	0.0 (0.0, 0.0)	1.4 (0.2, 9.8)	3.9 (0.9, 15.4)			
Gender Solutions	Natural Knee Flex	7	34	0.0 (0.0, 0.0)	17.4 (7.5, 37.2)	17.4 (7.5, 37.2)			
Gender Solutions	Nexgen	63	859	1.6 (0.9, 2.8)	6.1 (4.5, 8.3)	9.4 (7.0, 12.4)			
Journey	Genesis II	67	481	2.0 (1.0, 3.8)	7.9 (5.6, 10.9)	12.4 (9.4, 16.3)			
LCS	LCS*	168	395	3.5 (2.1, 5.9)	11.7 (8.9, 15.3)	20.9 (17.2, 25.3)	40.2 (35.4, 45.5)	50.6 (44.4, 57.1)	
Lubinus	Duracon*	26	77	2.6 (0.7, 10.0)	9.2 (4.5, 18.4)	16.0 (9.4, 26.4)	25.3 (16.6, 37.2)	36.5 (25.9, 49.9)	
Lubinus	Lubinus*	19	39	5.1 (1.3, 19.0)	18.1 (9.1, 34.3)	20.9 (11.0, 37.6)	35.0 (22.0, 52.7)	49.4 (33.7, 67.7)	57.9 (41.0, 75.8)
MOD III	MOD III*	23	63	4.8 (1.6, 14.0)	14.3 (7.7, 25.7)	17.5 (10.1, 29.4)	26.2 (16.9, 39.2)	38.4 (27.0, 52.6)	41.5 (29.4, 56.2)
RBK	RBK	94	497	3.3 (2.0, 5.3)	9.7 (7.3, 12.9)	16.0 (12.8, 19.9)	27.9 (22.7, 34.1)		
Restoris MCK	Restoris MCK	3	99	5.0 (1.3, 18.6)					
Sigma HP	PFC Sigma	24	117	4.5 (1.9, 10.4)	16.1 (10.3, 24.7)	21.3 (14.3, 31.0)			
Themis	Themis*	12	38	2.6 (0.4, 17.2)	2.6 (0.4, 17.2)	8.0 (2.6, 22.7)	18.8 (9.4, 35.4)	35.0 (21.4, 53.8)	
Vanguard	Series A*	11	41	4.9 (1.2, 18.1)	17.1 (8.5, 32.5)	25.6 (14.6, 42.6)			
Other (29)		25	85	3.8 (1.2, 11.3)	13.4 (7.4, 23.5)	16.4 (9.7, 27.2)	36.3 (24.9, 50.8)	50.1 (34.4, 68.1)	
TOTAL		**700**	**3593**						

Note: Only combinations with over 20 procedures have been listed
* denotes prosthesis combination with no reported use in patella/trochlear knee replacement in 2017

OUTCOME FOR OSTEOARTHRITIS

The Registry has recorded 691 revisions of primary patella/trochlear knee replacement for osteoarthritis.

The most common reason for revision is progression of disease (49.1%), followed by loosening (15.8%) and pain (12.2%) (Table KP8).

The main type of revision of a primary patella/trochlear knee replacement is to a total knee replacement (84.4%) (Table KP9).

The cumulative percent revision for primary patella/trochlear knee replacement undertaken for osteoarthritis is 14.3% at five years and 45.9% at 15 years (Table KP10 and Figure KP4).

Age and gender are risk factors for revision. Patients younger than 65 years of age have a higher rate of revision than patients aged 65 years or older between four and 10 years (Table KP11 and Figure KP5).

Males have a higher rate of revision than females (Table KP12 and Figure KP6).

Table KP8 Primary Patella/Trochlea Knee Replacement by Reason for Revision (Primary Diagnosis OA)

Reason for Revision	Number	Percent
Progression Of Disease	339	49.1
Loosening	109	15.8
Pain	84	12.2
Wear Patella	30	4.3
Implant Breakage Patella	29	4.2
Infection	18	2.6
Malalignment	16	2.3
Lysis	12	1.7
Other	54	7.8
TOTAL	**691**	**100.0**

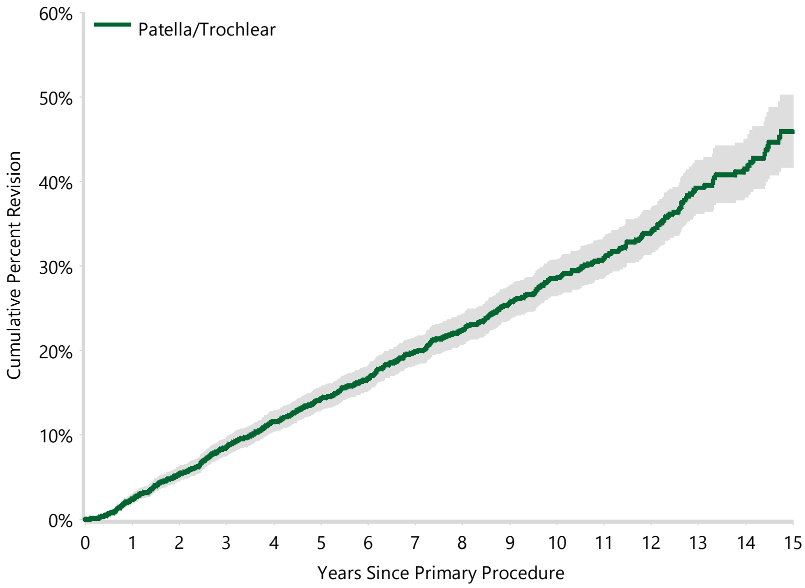
Table KP9 Primary Patella/Trochlea Knee Replacement by Type of Revision (Primary Diagnosis OA)

Type of Revision	Number	Percent
TKR (Tibial/Femoral)	583	84.4
Patella Only	65	9.4
Patella/Trochlear Resurfacing	25	3.6
UKR (Uni Tibial/Uni Femoral)	12	1.7
Removal of Prostheses	4	0.6
Cement Spacer	2	0.3
TOTAL	**691**	**100.0**

Table KP10 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	15 Yrs
Patella/Trochlear	691	3558	2.4 (1.9, 3.0)	8.5 (7.6, 9.6)	14.3 (13.0, 15.6)	28.5 (26.5, 30.7)	39.3 (36.2, 42.5)	45.9 (41.8, 50.2)
TOTAL	**691**	**3558**						

Figure KP4 Cumulative Percent Revision of Primary Patella/Trochlea Knee Replacement (Primary Diagnosis OA)

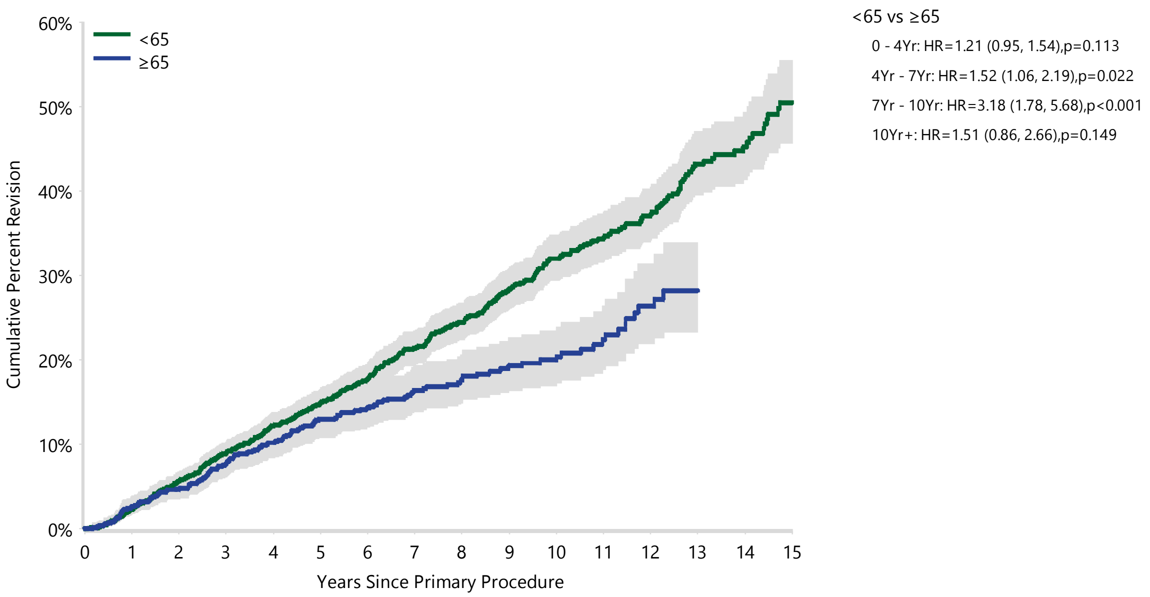


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	13 Yrs	15 Yrs
Patella/Trochlear	3558	3172	2435	1836	642	240	74

Table KP11 Cumulative Percent Revision of Primary Patella/Trochlea Knee Replacement by Age (Primary Diagnosis OA)

Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	13 Yrs	15 Yrs
<65	532	2461	2.3 (1.8, 3.0)	8.9 (7.8, 10.2)	14.8 (13.3, 16.5)	32.0 (29.4, 34.8)	43.2 (39.6, 47.0)	50.5 (45.7, 55.5)
≥65	159	1097	2.6 (1.8, 3.7)	7.6 (6.1, 9.5)	13.0 (10.9, 15.5)	20.0 (17.0, 23.4)	28.2 (23.3, 33.8)	
TOTAL	**691**	**3558**						

Figure KP5 Cumulative Percent Revision of Primary Patella/Trochlea Knee Replacement by Age (Primary Diagnosis OA)

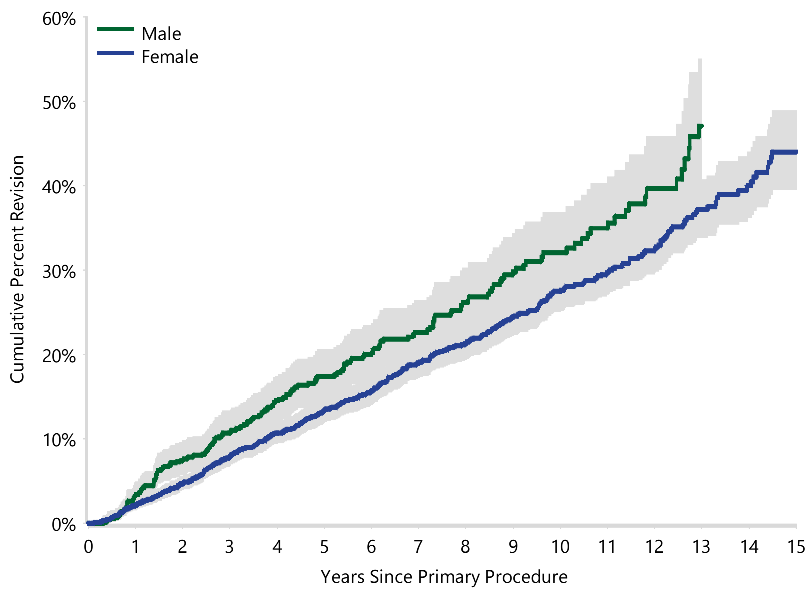


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	13 Yrs	15 Yrs
<65	2461	2187	1682	1273	449	183	59
≥65	1097	985	753	563	193	57	15

Table KP12 Cumulative Percent Revision of Primary Patella/Trochlea Knee Replacement by Gender (Primary Diagnosis OA)

Gender	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	13 Yrs	15 Yrs
Male	182	828	3.4 (2.3, 4.9)	10.7 (8.7, 13.3)	17.4 (14.7, 20.6)	32.0 (27.7, 36.8)	47.1 (39.8, 55.0)	
Female	509	2730	2.1 (1.6, 2.7)	7.9 (6.9, 9.0)	13.3 (11.9, 14.9)	27.5 (25.1, 30.0)	37.2 (33.8, 40.7)	44.0 (39.5, 48.8)
TOTAL	**691**	**3558**						

Figure KP6 Cumulative Percent Revision of Primary Patella/Trochlea Knee Replacement by Gender (Primary Diagnosis OA)



HR - adjusted for age

Male vs Female

Entire Period: HR=1.31 (1.11, 1.55),p=0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	13 Yrs	15 Yrs
Male	828	724	544	403	127	40	16
Female	2730	2448	1891	1433	515	200	58

UNICOMPARTMENTAL

DEMOGRAPHICS

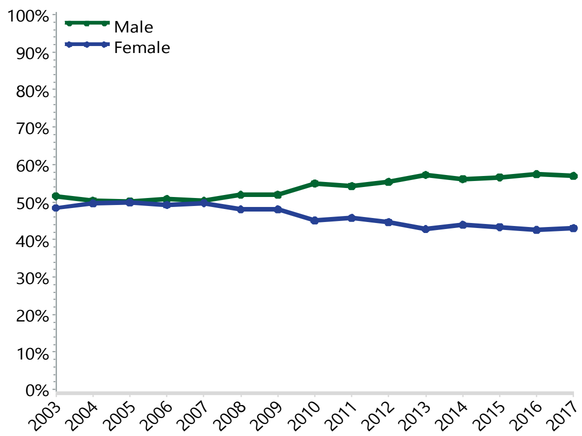
This year, the Registry is reporting on 52,814 primary unicompartmental knee procedures. This is an additional 3,641 procedures compared to the last report.

The use of unicompartmental knee replacement increased from 5.1% in 2016 to 5.7% of all knee procedures in 2017. Although the proportion of unicompartmental knee replacements has increased over the last three 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.

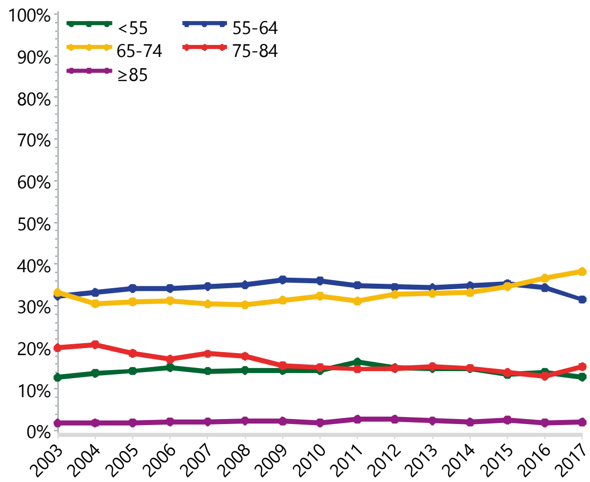
This procedure is undertaken more often in males (53.2%) (Table KP13). The proportion of males has increased from 50.3% in 2007 to 57.0% in 2017 (Figure KP7).

Figure KP7 Primary Unicompartmental Knee Replacement by Gender



Unicompartmental knee replacement is most frequently undertaken in patients aged between 55 and 74 years (66.5%). The age distribution has remained relatively stable since 2003 (Figure KP8). The mean age of patients is 65.3 years (Table KP13).

Figure KP8 Primary Unicompartmental Knee Replacement by Age



In 2017, the 10 most used tibial prostheses account for 98.0% of all unicompartmental procedures. The Restoris MCK, Oxford (cementless), and ZUK are the most used prostheses in 2017 (Table KP14).

The outcomes of unicompartmental knee prosthesis combinations with more than 200 procedures are presented in Table KP15.

Table KP13 Age and Gender of Primary Unicompartmental Knee Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	28094	53.2%	24	98	66	65.7	9.6
Female	24720	46.8%	25	95	64	64.8	10.2
TOTAL	**52814**	**100.0%**	**24**	**98**	**65**	**65.3**	**9.9**

Table KP14 10 Most Used Tibial Prostheses in Primary Unicompartmental Knee Replacement

2003		2014		2015		2016		2017	
N	Model	N	Model	N	Model	N	Model	N	Model
1366	Oxford (ctd)	674	ZUK	748	ZUK	783	Oxford (cless)	1017	Restoris MCK
444	Repicci II	639	Oxford (cless)	704	Oxford (cless)	740	ZUK	908	Oxford (cless)
373	Preservation Fixed	397	Oxford (ctd)	394	Oxford (ctd)	609	Restoris MCK	899	ZUK
353	M/G	130	Sigma HP	145	Restoris MCK	383	Oxford (ctd)	259	Oxford (ctd)
336	Allegretto Uni	97	Unix	129	Sigma HP	156	Sigma HP	172	Journey Uni (v2)
321	GRU	52	Journey Uni (v2)	113	Unix	136	Journey Uni (v2)	136	Sigma HP
275	Genesis	51	Freedom PKR/Active	54	Triathlon PKR	62	Unix	60	Triathlon PKR
260	Unix	47	Endo-Model Sled	48	Repicci II	40	Endo-Model Sled	38	Endo-Model Sled
121	Preservation Mobile	35	Repicci II	46	GRU	40	Triathlon PKR	27	Journey Uni All Poly
101	Endo-Model Sled	28	BalanSys Uni Fixed	40	Journey Uni (v2)	17	GMK-UNI	25	Repicci II
10 Most Used									
3950 (10)	96.1%	2150 (10)	94.8%	2421 (10)	94.7%	2966 (10)	97.2%	3541 (10)	98.0%
Remainder									
159 (7)	3.9%	119 (10)	5.2%	136 (10)	5.3%	85 (8)	2.8%	74 (8)	2.0%
TOTAL									
4109 (17)	100.0%	2269 (20)	100.0%	2557 (20)	100.0%	3051 (18)	100.0%	3615 (18)	100.0%

Table KP15 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement by Prosthesis Combination

Uni Femoral	Uni Tibial	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Allegretto Uni	Allegretto Uni*	350	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)	21.6 (19.5, 23.9)	24.8 (21.2, 28.9)
BalanSys Uni	BalanSys Uni Fixed	22	400	1.8 (0.9, 3.7)	2.9 (1.6, 5.1)	3.8 (2.3, 6.4)	7.4 (4.7, 11.5)		
Endo-Model Sled	Endo-Model Sled	168	1267	1.1 (0.7, 1.9)	4.8 (3.7, 6.1)	7.5 (6.1, 9.2)	14.7 (12.5, 17.1)		
Freedom PKR/Active	Freedom PKR/Active	341	1505	1.7 (1.1, 2.5)	7.7 (6.5, 9.2)	13.1 (11.4, 14.9)	26.4 (23.9, 29.0)		
GRU	GRU	279	2067	1.4 (0.9, 2.0)	4.6 (3.7, 5.6)	6.3 (5.3, 7.4)	13.6 (12.0, 15.3)		
Genesis	Genesis*	329	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)	23.3 (20.4, 26.5)	
Journey Uni	Journey Uni (v2)	18	496	3.8 (2.3, 6.3)	5.1 (3.2, 8.2)	5.1 (3.2, 8.2)			
Journey Uni	Journey Uni All Poly	19	270	1.2 (0.4, 3.6)	6.0 (3.6, 9.9)	8.0 (5.1, 12.5)			
M/G	M/G*	290	2135	1.6 (1.1, 2.2)	4.2 (3.4, 5.1)	6.4 (5.5, 7.6)	10.8 (9.5, 12.3)	17.0 (15.1, 19.1)	
Oxford (cless)	Oxford (cless)	297	5101	3.1 (2.6, 3.6)	5.1 (4.4, 5.8)	6.6 (5.8, 7.5)	13.5 (11.0, 16.6)		
Oxford (cless)	Oxford (ctd)	28	401	3.0 (1.7, 5.3)	6.9 (4.4, 10.7)	12.8 (8.3, 19.4)			
Oxford (ctd)	Oxford (ctd)	1979	13000	2.2 (2.0, 2.5)	5.8 (5.4, 6.2)	8.4 (7.9, 8.9)	14.8 (14.2, 15.5)	22.6 (21.5, 23.7)	26.0 (24.3, 27.9)
Preservation	Preservation Fixed*	413	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)	23.4 (21.1, 26.0)	
Preservation	Preservation Mobile*	131	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)	35.2 (30.5, 40.5)	
Repicci II	Repicci II	635	3072	1.7 (1.3, 2.2)	4.8 (4.0, 5.6)	7.9 (7.0, 8.9)	17.9 (16.5, 19.5)	29.3 (27.2, 31.6)	
Restoris MCK	Restoris MCK	17	1771	1.2 (0.7, 1.9)					
Sigma HP	Sigma HP	31	994	0.8 (0.4, 1.6)	2.8 (1.8, 4.2)	4.3 (3.0, 6.3)			
Triathlon PKR	Triathlon PKR	19	284	3.2 (1.6, 6.3)	7.7 (4.7, 12.4)	8.8 (5.4, 14.2)			
Uniglide	Uniglide	147	754	4.8 (3.5, 6.6)	10.7 (8.6, 13.1)	12.8 (10.6, 15.4)	19.8 (16.9, 23.0)		
Unix	Unix	448	3883	2.4 (2.0, 2.9)	5.3 (4.6, 6.0)	7.0 (6.2, 7.8)	12.0 (10.8, 13.2)	18.2 (16.2, 20.5)	
ZUK	ZUK	327	6785	1.5 (1.2, 1.8)	3.6 (3.2, 4.2)	4.9 (4.3, 5.5)	8.6 (7.5, 9.7)		
Other (37)		338	2012	3.7 (2.9, 4.6)	8.7 (7.5, 10.0)	11.3 (9.9, 12.8)	19.5 (17.5, 21.6)	25.3 (22.5, 28.5)	
TOTAL		**6626**	**52814**						

Note: Only combinations with over 200 procedures have been listed
* denotes prosthesis combination with no reported use in unicompartmental knee replacement in 2017

OUTCOME FOR OSTEOARTHRITIS

The Registry has recorded 6,548 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 8.0% at five years and 25.7% at 17 years (Table KP16 and Figure KP9).

The main reasons for revision are loosening (39.2%), progression of disease (32.3%) and pain (8.5%) (Table KP17 and Figure KP10). The main type of revision is to a total knee replacement (87.2%) (Table KP18).

Patient characteristics

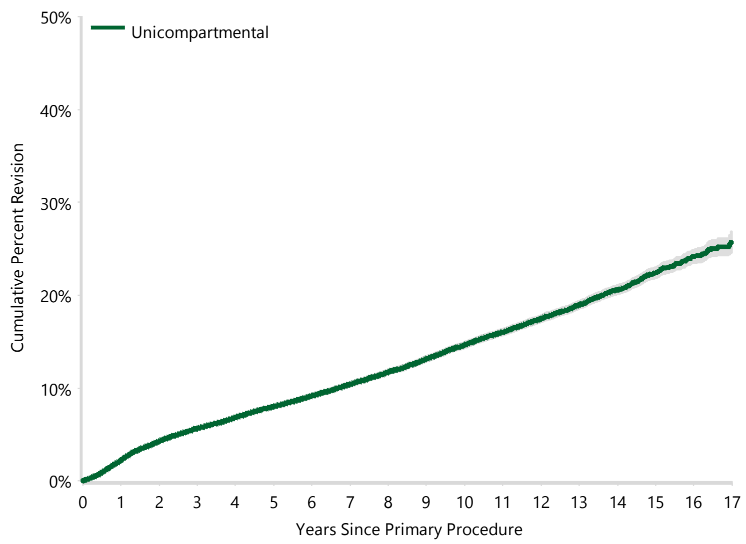
Age is a major factor affecting the outcome of primary unicompartmental knee replacement, with the rate of revision decreasing with increasing age (Table KP19 and Figure KP11).

Females have a higher rate of revision. The effect of age on the rate of revision is evident in both males and females (Table KP20 and Figure KP12).

Table KP16 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement (Primary Diagnosis OA)

Knee Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Unicompartmental	6548	52285	2.2 (2.1, 2.4)	5.6 (5.4, 5.9)	8.0 (7.8, 8.3)	14.6 (14.3, 15.0)	22.4 (21.8, 23.0)	25.7 (24.5, 26.9)
TOTAL	**6548**	**52285**						

Figure KP9 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	17 Yrs
Unicompartmental	52285	47402	39775	33886	18177	3376	274

Table KP17 Primary Unicompartmental Knee Replacement by Reason for Revision (Primary Diagnosis OA)

Reason for Revision	Number	Percent
Loosening	2566	39.2
Progression of Disease	2116	32.3
Pain	559	8.5
Infection	246	3.8
Lysis	177	2.7
Fracture	145	2.2
Bearing Dislocation	132	2.0
Wear Tibial Insert	103	1.6
Instability	74	1.1
Malalignment	69	1.1
Wear Tibial	50	0.8
Other (16)	311	4.7
TOTAL	**6548**	**100.0**

Table KP18 Primary Unicompartmental Knee Replacement by Type of Revision (Primary Diagnosis OA)

Type of Revision	Number	Percent
TKR (Tibial/Femoral)	5707	87.2
Uni Insert Only	391	6.0
Uni Tibial Component	216	3.3
Uni Femoral Component	71	1.1
UKR (Uni Tibial/Uni Femoral)	70	1.1
Cement Spacer	49	0.7
Patella/Trochlear Resurfacing	17	0.3
Removal of Prostheses	7	0.1
Reinsertion of Components	6	0.1
Patella Only	5	0.1
Femoral Component*	4	0.1
Tibial Component	3	0.0
Cement Only	2	0.0
TOTAL	**6548**	**100.0**

Note: *Bicompartmental Component

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

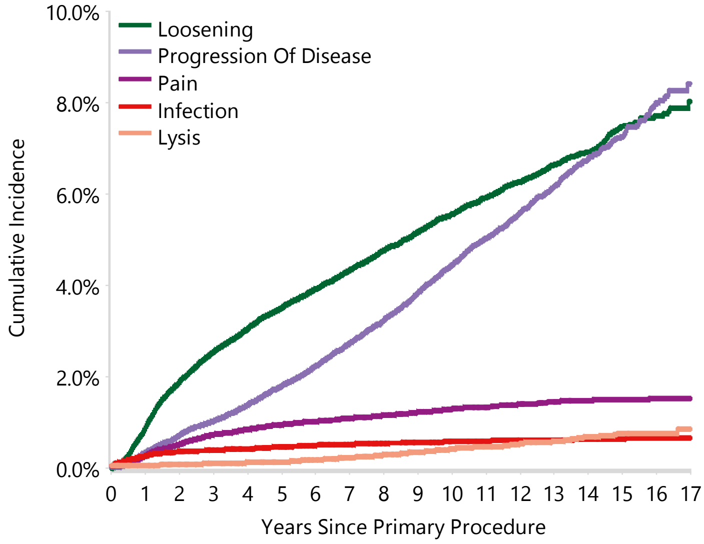
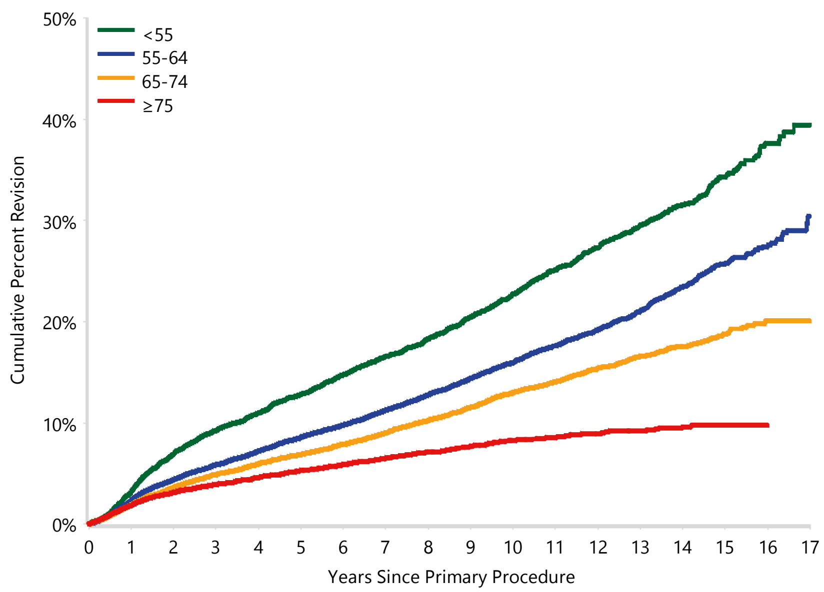


Table KP19 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement by Age (Primary Diagnosis OA)

Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
<55	1537	7433	3.2 (2.9, 3.7)	9.2 (8.6, 9.9)	12.8 (12.0, 13.6)	22.8 (21.7, 23.9)	34.3 (32.6, 36.2)	39.4 (36.6, 42.4)
55-64	2543	17642	2.4 (2.1, 2.6)	5.9 (5.5, 6.2)	8.6 (8.1, 9.0)	15.9 (15.3, 16.6)	25.7 (24.6, 26.8)	30.4 (28.0, 33.0)
65-74	1828	17142	1.9 (1.7, 2.1)	4.9 (4.5, 5.2)	6.9 (6.5, 7.3)	13.0 (12.4, 13.6)	18.8 (17.8, 19.8)	20.1 (18.9, 21.3)
≥75	640	10068	1.8 (1.6, 2.1)	3.9 (3.5, 4.3)	5.3 (4.8, 5.8)	8.3 (7.7, 9.0)	9.8 (8.9, 10.7)	
TOTAL	**6548**	**52285**						

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



<55 vs ≥75
0 - 6Mth: HR=1.35 (1.03, 1.78),p=0.030
6Mth - 1.5Yr: HR=2.37 (1.99, 2.82),p<0.001
1.5Yr - 10Yr: HR=3.23 (2.86, 3.65),p<0.001
10Yr+: HR=9.59 (6.41, 14.35),p<0.001

55-64 vs ≥75
0 - 6Mth: HR=1.12 (0.90, 1.41),p=0.313
6Mth - 1.5Yr: HR=1.46 (1.24, 1.72),p<0.001
1.5Yr - 2Yr: HR=1.72 (1.33, 2.21),p<0.001
2Yr - 3.5Yr: HR=2.11 (1.78, 2.49),p<0.001
3.5Yr - 4.5Yr: HR=2.32 (1.90, 2.84),p<0.001
4.5Yr - 10Yr: HR=2.28 (2.01, 2.60),p<0.001
10Yr - 10.5Yr: HR=8.09 (4.96, 13.18),p<0.001
10.5Yr+: HR=6.93 (4.65, 10.33),p<0.001

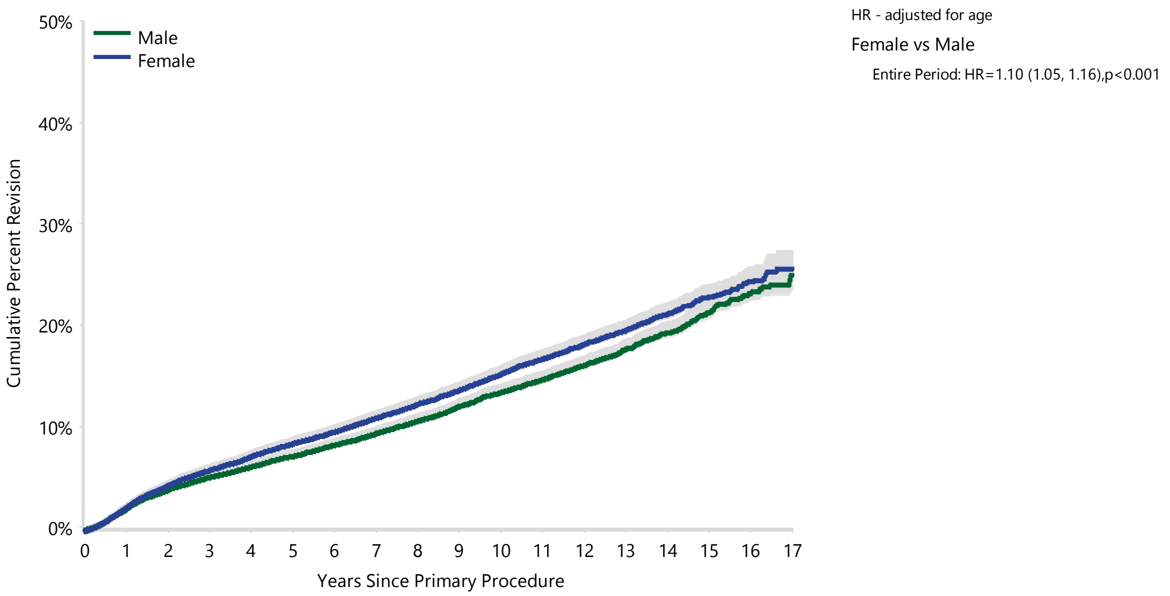
65-74 vs ≥75
0 - 1.5Yr: HR=1.09 (0.93, 1.27),p=0.280
1.5Yr - 2Yr: HR=1.58 (1.21, 2.05),p<0.001
2Yr - 10Yr: HR=1.78 (1.57, 2.01),p<0.001
10Yr+: HR=4.13 (2.76, 6.18),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
<55	7433	6740	5592	4767	2617	544	48
55-64	17642	16094	13611	11714	6504	1241	93
65-74	17142	15419	12859	11006	6058	1217	109
≥75	10068	9149	7713	6399	2998	374	24

Table KP20 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement by Gender and Age (Primary Diagnosis OA)

Gender	Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Male		**3167**	**27857**	**2.1 (1.9, 2.3)**	**5.3 (5.0, 5.5)**	**7.3 (7.0, 7.7)**	**13.7 (13.2, 14.2)**	**21.6 (20.7, 22.5)**	**25.3 (23.5, 27.3)**
	<55	672	3337	3.3 (2.7, 4.0)	9.1 (8.2, 10.2)	12.3 (11.1, 13.5)	22.5 (20.9, 24.3)	35.8 (32.9, 38.7)	
	55-64	1303	9462	2.3 (2.0, 2.7)	5.7 (5.2, 6.2)	8.4 (7.8, 9.0)	15.6 (14.7, 16.5)	25.2 (23.7, 26.8)	30.6 (27.0, 34.5)
	65-74	894	9643	1.7 (1.4, 2.0)	4.4 (4.0, 4.9)	6.0 (5.5, 6.5)	11.6 (10.8, 12.4)	17.2 (15.9, 18.5)	18.7 (17.1, 20.5)
	≥75	298	5415	1.7 (1.3, 2.0)	3.6 (3.1, 4.1)	4.7 (4.1, 5.4)	7.6 (6.7, 8.5)	9.1 (7.9, 10.6)	
Female		**3381**	**24428**	**2.4 (2.2, 2.6)**	**6.1 (5.8, 6.4)**	**8.7 (8.4, 9.1)**	**15.6 (15.1, 16.2)**	**23.3 (22.4, 24.2)**	**26.1 (24.7, 27.5)**
	<55	865	4096	3.2 (2.7, 3.8)	9.3 (8.4, 10.2)	13.2 (12.1, 14.3)	23.0 (21.5, 24.5)	33.3 (31.0, 35.6)	
	55-64	1240	8180	2.4 (2.1, 2.7)	6.1 (5.6, 6.6)	8.7 (8.1, 9.4)	16.2 (15.3, 17.2)	26.2 (24.7, 27.9)	
	65-74	934	7499	2.2 (1.9, 2.5)	5.5 (5.0, 6.0)	8.0 (7.3, 8.7)	14.7 (13.7, 15.7)	20.7 (19.3, 22.2)	21.8 (20.1, 23.5)
	≥75	342	4653	2.0 (1.6, 2.5)	4.2 (3.7, 4.9)	5.9 (5.2, 6.7)	9.1 (8.1, 10.1)	10.5 (9.3, 11.7)	
TOTAL		**6548**	**52285**						

Figure KP12 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	17 Yrs
Male	27857	25119	20793	17501	9037	1697	137
Female	24428	22283	18982	16385	9140	1679	137

OUTCOME BY PROSTHESIS CHARACTERISTICS

Fixation

Most unicompartmental knee replacements use cement fixation (80.8%), a smaller number use cementless fixation (17.6%) and few use hybrid fixation (1.6%). There are only five 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 six months, then after one year, a lower rate of revision. Both cementless and cement fixation have lower rates of revision compared to hybrid fixation (Table KP21 and Figure KP13).

The Oxford unicompartmental knee accounts for 55.0% of the cementless unicompartmental knees. When this prosthesis is used without cement there is a higher rate of revision for the first six months, then there is a lower rate of revision until seven years, after which there is no difference (Table KP22 and Figure KP14).

Bearing Mobility

Fixed bearings are used in 62.3% of unicompartmental knee replacements, while in 37.7% 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 nine months, and after this time there is no difference (Table KP23 and Figure KP15).

Comparison of Medial and Lateral Unicompartmental Knee Replacement

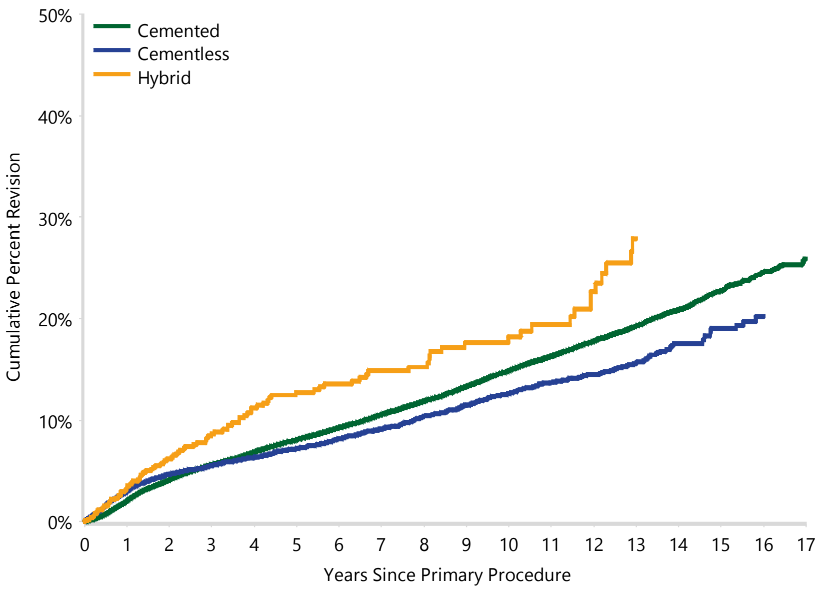
The Registry has recorded 2,116 lateral unicompartmental knee procedures undertaken for osteoarthritis. There is no difference in the rate of revision when lateral unicompartmental knee replacement is compared to medial unicompartmental knee replacement (Table KP24 and Figure KP16). The most common reason for revision of lateral unicompartmental knees is progression of disease, while loosening is the most common reason for revision for those placed medially (Table KP25 and Figure KP17).

The outcome of prosthesis combinations with more than 50 procedures used in lateral unicompartmental knee replacement is presented in Table KP26.

Table KP21 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	17 Yrs
Cemented	5631	42262	2.0 (1.9, 2.2)	5.6 (5.4, 5.8)	8.1 (7.8, 8.3)	14.9 (14.5, 15.3)	22.7 (22.1, 23.4)	25.9 (24.7, 27.2)
Cementless	815	9211	3.0 (2.7, 3.4)	5.5 (5.1, 6.1)	7.2 (6.6, 7.8)	12.7 (11.7, 13.6)	19.0 (17.2, 21.0)	
Hybrid	102	812	3.3 (2.2, 4.8)	8.6 (6.7, 11.1)	12.7 (10.2, 15.9)	18.2 (14.7, 22.3)		
TOTAL	**6548**	**52285**						

Figure KP13 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement by Fixation (Primary Diagnosis OA)



HR - adjusted for age and gender

Cemented vs Cementless

0 - 1Mth: HR=0.29 (0.18, 0.47),p<0.001

1Mth - 3Mth: HR=0.49 (0.34, 0.72),p<0.001

3Mth - 6Mth: HR=0.57 (0.44, 0.74),p<0.001

6Mth - 1Yr: HR=1.00 (0.83, 1.21),p=0.987

1Yr - 2Yr: HR=1.28 (1.07, 1.52),p=0.006

2Yr+: HR=1.45 (1.32, 1.60),p<0.001

Hybrid vs Cementless

Entire Period: HR=1.53 (1.24, 1.88),p<0.001

Hybrid vs Cemented

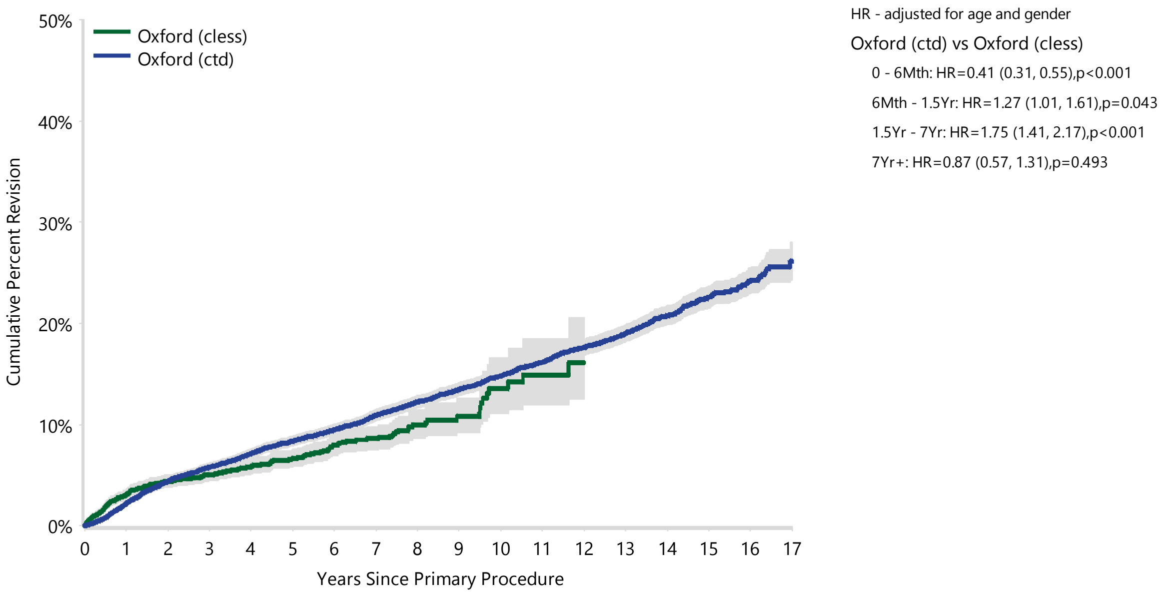
Entire Period: HR=1.30 (1.07, 1.59),p=0.007

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Cemented	42262	38689	33125	28771	16183	3055	246
Cementless	9211	8021	6217	4790	1849	308	26
Hybrid	812	692	433	325	145	13	2

Table KP22 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	17 Yrs
Oxford (cless)	296	5063	3.1 (2.6, 3.6)	5.1 (4.4, 5.8)	6.6 (5.8, 7.5)	13.6 (11.1, 16.6)		
Oxford (ctd)	1955	12846	2.2 (2.0, 2.5)	5.8 (5.4, 6.2)	8.4 (7.9, 8.9)	14.8 (14.1, 15.5)	22.6 (21.6, 23.7)	26.1 (24.3, 28.0)
TOTAL	**2251**	**17909**						

Figure KP14 Cumulative Percent Revision of Oxford/Oxford Primary Unicompartmental Knee Replacement by Fixation (Primary Diagnosis OA)



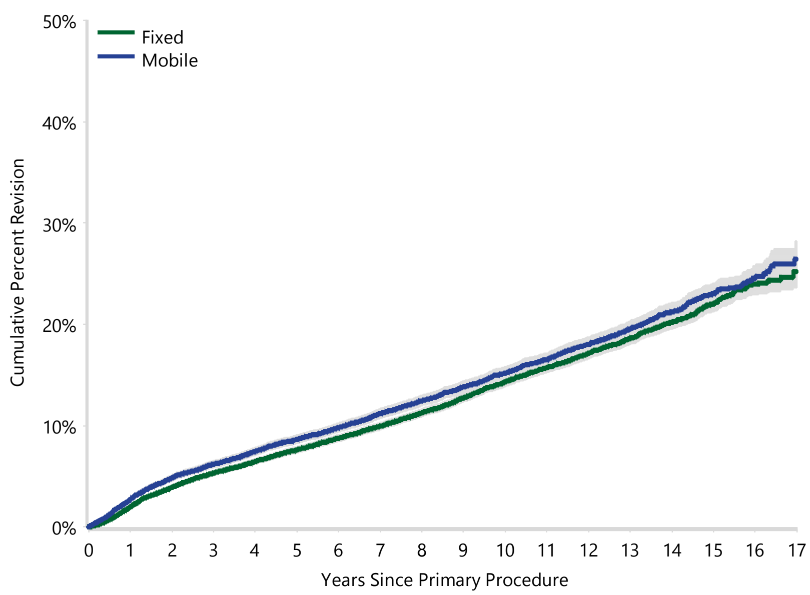
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Oxford (cless)	5063	4029	2553	1489	155	0	0
Oxford (ctd)	12846	12325	11105	9854	5844	1440	137

Table KP23 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement by Mobility (Primary Diagnosis OA)

Mobility	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Fixed	3947	32508	1.9 (1.8, 2.1)	5.3 (5.1, 5.6)	7.6 (7.3, 7.9)	14.3 (13.8, 14.8)	22.0 (21.2, 22.8)	25.2 (23.6, 26.9)
Mobile	2596	19708	2.7 (2.5, 2.9)	6.2 (5.9, 6.6)	8.6 (8.2, 9.1)	15.2 (14.6, 15.8)	23.1 (22.1, 24.1)	26.4 (24.7, 28.2)
TOTAL	**6543**	**52216**						

Note: Excludes 69 primary unicompartmental knee procedures with unknown/missing mobility

Figure KP15 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement by Mobility (Primary Diagnosis OA)



HR - adjusted for age and gender

Mobile vs Fixed

0 - 3Mth: HR=2.28 (1.71, 3.03),p<0.001

3Mth - 9Mth: HR=1.35 (1.15, 1.58),p<0.001

9Mth - 2Yr: HR=1.12 (1.00, 1.25),p=0.053

2Yr+: HR=1.03 (0.97, 1.09),p=0.377

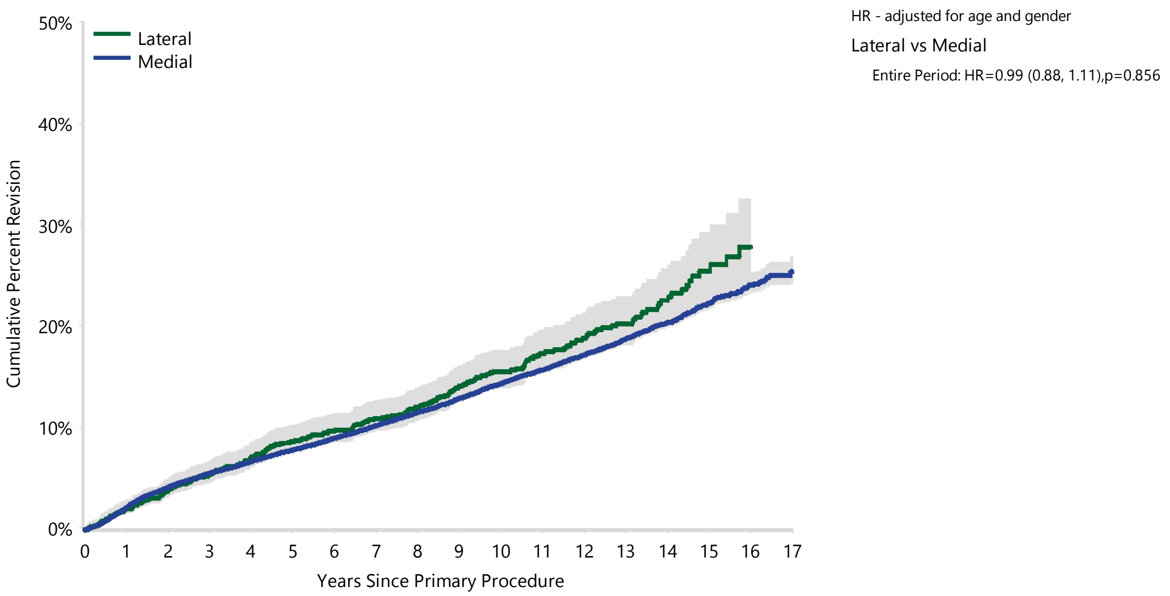
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Fixed	32508	29408	24811	21408	11466	1843	127
Mobile	19708	17964	14937	12454	6696	1532	147

Table KP24 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	17 Yrs
Lateral	302	2116	2.1 (1.5, 2.8)	5.5 (4.5, 6.6)	8.7 (7.5, 10.1)	15.6 (13.9, 17.5)	25.6 (22.4, 29.2)	
Medial	5660	46777	2.2 (2.1, 2.3)	5.6 (5.4, 5.8)	7.9 (7.7, 8.2)	14.5 (14.1, 14.9)	22.4 (21.7, 23.1)	25.5 (24.3, 26.9)
TOTAL	**5962**	**48893**						

Note: Excludes 3,392 primary unicompartmental knee procedures with unknown/missing position

Figure KP16 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	17 Yrs
Lateral	2116	1939	1676	1433	825	126	14
Medial	46777	42197	35052	29650	15503	2560	198

Table KP25 Reason for Revision of Primary Unicompartmental Knee Replacement by Position (Primary Diagnosis OA)

Revision Diagnosis	Lateral Number	Lateral % Primaries Revised	Lateral % Revisions	Medial Number	Medial % Primaries Revised	Medial % Revisions
Loosening	90	4.3	29.8	2241	4.8	39.6
Progression Of Disease	150	7.1	49.7	1769	3.8	31.3
Pain	20	0.9	6.6	499	1.1	8.8
Infection	11	0.5	3.6	223	0.5	3.9
Lysis	7	0.3	2.3	148	0.3	2.6
Fracture	3	0.1	1.0	130	0.3	2.3
Bearing Dislocation	5	0.2	1.7	126	0.3	2.2
Wear Tibial Insert	2	0.1	0.7	89	0.2	1.6
Instability	4	0.2	1.3	68	0.1	1.2
Malalignment	4	0.2	1.3	58	0.1	1.0
Other	6	0.3	2.0	309	0.7	5.5
N Revision	**302**	**14.3**	**100.0**	**5660**	**12.1**	**100.0**
N Primary	**2116**			**46777**		

Figure KP17 Cumulative Incidence Revision Diagnosis of Primary Unicompartmental Knee Replacement by Position (Primary Diagnosis OA)

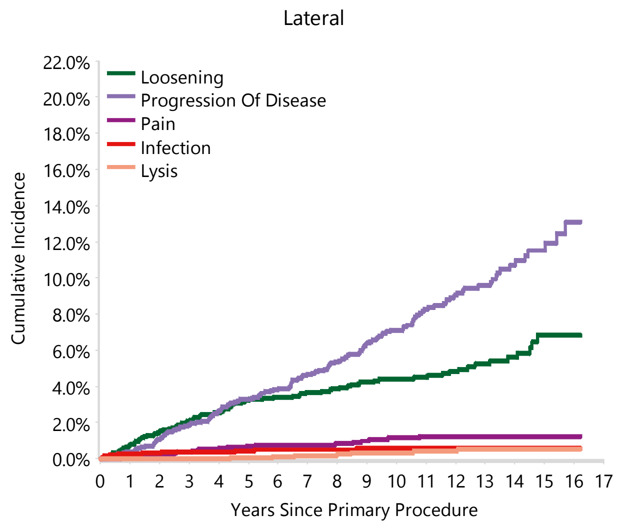


Table KP26 Cumulative Percent Revision of Lateral Primary Unicompartmental Knee Replacement by Prosthesis Combination (Primary Diagnosis OA)

Uni Femoral	Uni Tibial	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Endo-Model Sled	Endo-Model Sled	17	149	0.0 (0.0, 0.0)	3.8 (1.6, 8.9)	7.3 (3.8, 13.5)	13.9 (8.3, 22.8)		
Freedom PKR/Active	Freedom PKR/Active	26	151	0.7 (0.1, 4.6)	6.2 (3.3, 11.6)	10.1 (6.1, 16.5)	18.7 (12.5, 27.4)		
GRU	GRU	26	193	2.6 (1.1, 6.1)	4.2 (2.1, 8.2)	5.8 (3.3, 10.2)	13.4 (9.1, 19.5)		
Genesis	Genesis*	26	133	1.5 (0.4, 5.9)	6.0 (3.1, 11.7)	9.8 (5.8, 16.4)	17.3 (11.7, 25.1)		
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 (4.4, 22.9)	26.7 (13.2, 49.3)	
Oxford (cless)	Oxford (ctd)	3	60	1.9 (0.3, 12.6)	4.7 (1.2, 17.9)	4.7 (1.2, 17.9)			
Oxford (ctd)	Oxford (ctd)	32	162	6.3 (3.4, 11.4)	9.0 (5.4, 14.7)	12.9 (8.4, 19.5)	21.3 (14.9, 29.9)		
Preservation	Preservation Fixed*	16	149	0.0 (0.0, 0.0)	3.4 (1.4, 8.0)	6.8 (3.7, 12.3)	9.9 (6.0, 16.2)		
Repicci II	Repicci II	69	260	2.3 (1.1, 5.1)	7.0 (4.5, 11.0)	12.8 (9.2, 17.6)	21.5 (16.8, 27.4)	34.8 (27.9, 42.8)	
Restoris MCK	Restoris MCK	0	66	0.0 (0.0, 0.0)					
Unix	Unix	24	185	1.1 (0.3, 4.3)	3.9 (1.9, 8.0)	7.5 (4.4, 12.6)	12.5 (8.2, 18.8)		
ZUK	ZUK	11	214	0.9 (0.2, 3.7)	2.7 (1.1, 6.4)	5.9 (2.8, 11.9)			
Other (27)		42	340	3.7 (2.1, 6.4)	7.4 (5.0, 11.0)	9.1 (6.3, 13.0)	14.5 (10.5, 19.9)		
TOTAL		**302**	**2116**						

Note: Only combinations with over 50 procedures have been listed

*denotes prosthesis combinations with no recorded use in unicompartmental knee replacement in 2017

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 patellar 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 602,449 primary total knee replacement procedures reported to the Registry. This is an additional 55,042 procedures compared to the last report.

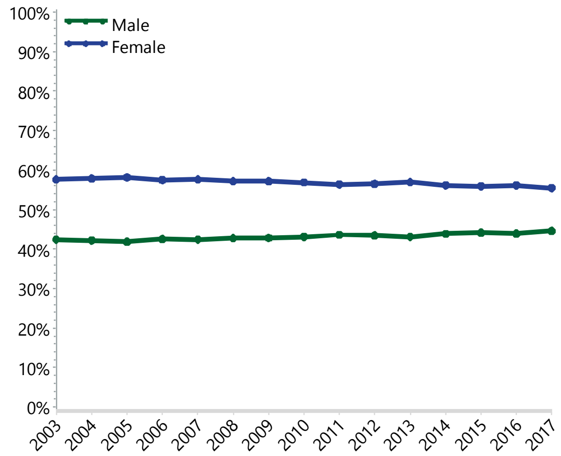
Primary total knee replacement continues to increase. In 2017, there were 4.3% more procedures than in 2016 and 151.6% more than in 2003. As a proportion of all knee replacement procedures, primary total knee replacement increased from 76.7% in 2003 to 86.4% in 2017.

Osteoarthritis is the most common diagnosis for primary total knee replacement (97.6%).

There have been 602,449 primary total knee replacement procedures reported to the Registry. This is an additional 55,042 procedures compared to the last report.

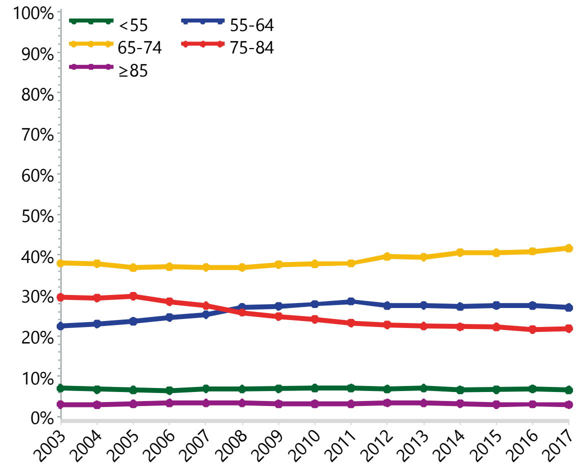
In 2017, primary total knee replacement remains more common in females (55.4%). This proportion has remained constant since 2003 (Figure KT1). The mean age of patients is 68.5 years (Table KT1).

Figure KT1 Primary Total Knee Replacement by Gender



There has been a decrease in the proportion of patients aged 75 to 84 years from 29.5% in 2003 to 21.8% in 2017. The proportion of patients aged less than 55 years remains small (6.6% in 2017) and there has been little change in that proportion since 2003 (Figure KT2).

Figure KT2 Primary Total Knee Replacement by Age



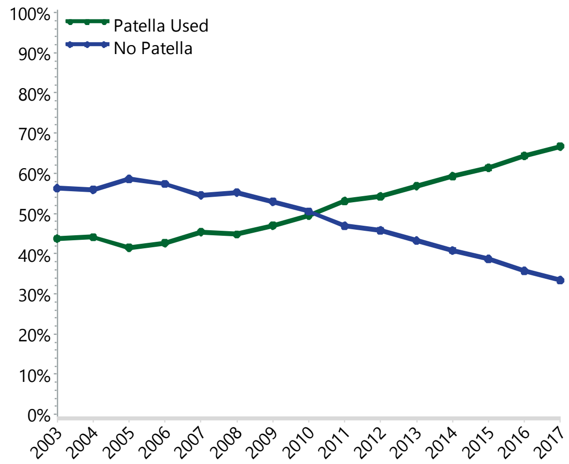
Detailed demographic information on primary total knee replacement is available in the supplementary report 'Demographics of Hip, Knee and Shoulder Arthroplasty' on the AOANJRR website: https://aoanjrr.sahmri.com/annual-reports-2018.

Table KT1 Age and Gender of Primary Total Knee Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	260968	43.3%	8	101	68	68.1	9.1
Female	341481	56.7%	8	103	69	68.8	9.4
TOTAL	**602449**	**100.0%**	**8**	**103**	**69**	**68.5**	**9.3**

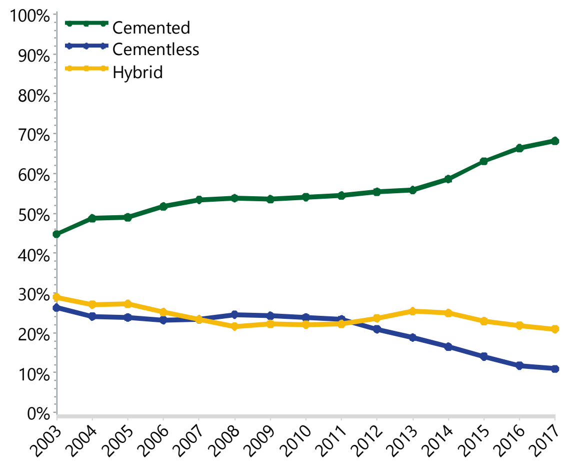
Patellar resurfacing at the time of the primary total knee replacement continues to increase from a low of 41.5% in 2005 to 66.6% in 2017 (Figure KT3).

Figure KT3 Primary Total Knee Replacement by Patella Usage



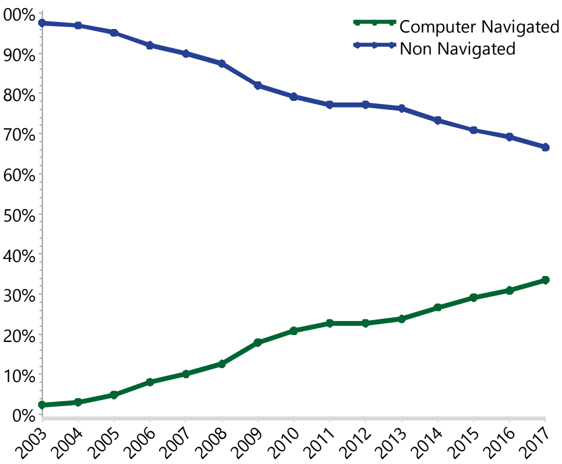
The most common method of fixation is cementing both femoral and tibial components. This has increased from 44.8% in 2003 to 68.1% in 2017. The use of cementless fixation continues to decrease from a peak of 26.3% in 2003 to 10.9% in 2017 (Figure KT4).

Figure KT4 Primary Total Knee Replacement by Fixation



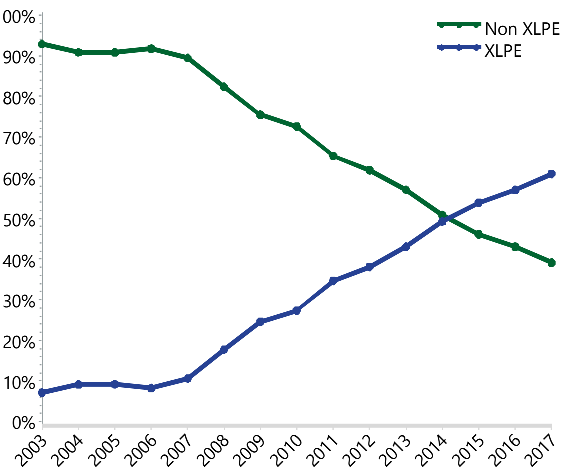
The proportion of primary total knee replacement procedures inserted with computer navigation has increased from 2.4% in 2003 to 33.5% in 2017 (Figure KT5).

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 60.9% in 2017 (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 2017, the most commonly used femoral prostheses were the Triathlon CR (19.1%), Nexgen CR Flex (12.0%) and Attune CR (5.8%) (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		2014		2015		2016		2017	
N	Model	N	Model	N	Model	N	Model	N	Model
3184	LCS CR	8093	Triathlon CR	8717	Triathlon CR	9520	Triathlon CR	10422	Triathlon CR
2846	Duracon	6388	Nexgen CR Flex	6345	Nexgen CR Flex	6470	Nexgen CR Flex	6575	Nexgen CR Flex
2150	Nexgen CR	3215	LCS CR	3326	Vanguard CR	2994	Nexgen LPS Flex	3148	Attune CR
1419	PFC Sigma CR	3004	Vanguard CR	3109	Nexgen LPS Flex	2857	Vanguard CR	2628	LCS CR
1354	Scorpio CR	2897	Nexgen LPS Flex	2926	LCS CR	2733	LCS CR	2613	Nexgen LPS Flex
1059	Genesis II CR	2286	PFC Sigma CR	2218	Attune CR	2484	Attune CR	2375	Vanguard CR
1002	Natural Knee II	2018	Legion Oxinium PS	2001	Legion Oxinium PS	1952	Legion Oxinium PS	2209	Persona
902	Nexgen LPS	1510	Genesis II CR	1456	PFC Sigma CR	1537	GMK Sphere Primary	1744	Evolution
883	Profix	1403	Genesis II Oxinium PS	1400	Genesis II CR	1481	Genesis II Oxinium PS	1563	Legion Oxinium PS
751	Scorpio PS	1255	Genesis II PS	1392	Genesis II Oxinium PS	1453	Evolution	1522	GMK Sphere Primary
10 Most Used									
15550 (10)	71.5%	32069 (10)	67.8%	32890 (10)	64.8%	33481 (10)	63.9%	34799 (10)	63.6%
Remainder									
6185 (47)	28.5%	15222 (73)	32.2%	17871 (76)	35.2%	18945 (70)	36.1%	19877 (71)	36.4%
TOTAL									
21735 (57)	100.0%	47291 (83)	100.0%	50761 (86)	100.0%	52426 (80)	100.0%	54676 (81)	100.0%

Table KT3 10 Most Used Femoral Prostheses in Cemented Primary Total Knee Replacement

2003		2014		2015		2016		2017	
N	Model	N	Model	N	Model	N	Model	N	Model
1213	Duracon	4056	Triathlon CR	4673	Triathlon CR	5394	Triathlon CR	5990	Triathlon CR
948	LCS CR	2547	Nexgen LPS Flex	2747	Nexgen CR Flex	3237	Nexgen CR Flex	3380	Nexgen CR Flex
824	Nexgen LPS	2361	Nexgen CR Flex	2746	Nexgen LPS Flex	2675	Nexgen LPS Flex	3148	Attune CR
761	Nexgen CR	2018	Legion Oxinium PS	2218	Attune CR	2483	Attune CR	2303	Nexgen LPS Flex
690	Nexgen LPS Flex	1403	Genesis II Oxinium PS	2001	Legion Oxinium PS	1952	Legion Oxinium PS	1917	Persona
642	Genesis II CR	1284	Vanguard CR	1391	Genesis II Oxinium PS	1536	GMK Sphere Primary	1737	Evolution
495	Profix	1226	Genesis II PS	1330	Vanguard CR	1481	Genesis II Oxinium PS	1562	Legion Oxinium PS
471	Genesis II Oxinium CR	1021	PFC Sigma CR	1189	Genesis II PS	1453	Evolution	1522	GMK Sphere Primary
471	PFC Sigma PS	945	Genesis II CR	1133	GMK Sphere Primary	1144	Vanguard CR	1422	Genesis II Oxinium PS
419	Genesis II PS	927	PFC Sigma PS	1089	Evolution	1047	Attune PS	1339	Attune PS
10 Most Used									
6934 (10)	71.3%	17788 (10)	64.2%	20517 (10)	64.1%	22402 (10)	64.4%	24320 (10)	65.3%
Remainder									
2795 (41)	28.7%	9929 (71)	35.8%	11498 (73)	35.9%	12359 (67)	35.6%	12922 (69)	34.7%
TOTAL									
9729 (51)	100.0%	27717 (81)	100.0%	32015 (83)	100.0%	34761 (77)	100.0%	37242 (79)	100.0%

Table KT4 10 Most Used Femoral Prostheses in Cementless Primary Total Knee Replacement

2003		2014		2015		2016		2017	
N	Model	N	Model	N	Model	N	Model	N	Model
1470	LCS CR	1662	Nexgen CR Flex	1565	Nexgen CR Flex	1360	Nexgen CR Flex	1349	Nexgen CR Flex
793	Nexgen CR	1616	Triathlon CR	1364	Triathlon CR	1245	LCS CR	1283	Triathlon CR
500	Natural Knee II	1426	LCS CR	1266	LCS CR	1223	Triathlon CR	1167	LCS CR
487	Active Knee	404	Vanguard CR	404	Vanguard CR	393	Scorpio NRG CR	272	Scorpio NRG CR
476	Duracon	384	RBK	360	Scorpio NRG CR	286	Vanguard CR	229	PFC Sigma CR
320	Scorpio CR	270	Score	347	RBK	265	RBK	216	Nexgen LPS Flex
314	PFC Sigma CR	248	Scorpio NRG CR	256	Score	227	Nexgen LPS Flex	203	Vanguard CR
303	RBK	237	PFC Sigma CR	242	Nexgen LPS Flex	168	Score	200	RBK
187	Profix	202	Nexgen LPS Flex	184	PFC Sigma CR	139	GMK Primary	157	Natural Knee Flex
181	Scorpio PS	176	GMK Primary	128	ACS	131	PFC Sigma CR	157	Score
10 Most Used									
5031 (10) 88.1%		6625 (10) 85.0%		6116 (10) 85.9%		5437 (10) 87.8%		5233 (10) 87.6%	
Remainder									
681 (14) 11.9%		1167 (22) 15.0%		1002 (20) 14.1%		757 (16) 12.2%		739 (15) 12.4%	
TOTAL									
5712 (24) 100.0%		7792 (32) 100.0%		7118 (30) 100.0%		6194 (26) 100.0%		5972 (25) 100.0%	

Table KT5 10 Most Used Femoral Prostheses in Hybrid Primary Total Knee Replacement

2003		2014		2015		2016		2017	
N	Model	N	Model	N	Model	N	Model	N	Model
1157	Duracon	2421	Triathlon CR	2680	Triathlon CR	2903	Triathlon CR	3149	Triathlon CR
766	LCS CR	2365	Nexgen CR Flex	2033	Nexgen CR Flex	1873	Nexgen CR Flex	1846	Nexgen CR Flex
764	PFC Sigma CR	1316	Vanguard CR	1592	Vanguard CR	1427	Vanguard CR	1191	Vanguard CR
737	Scorpio CR	1028	PFC Sigma CR	781	LCS CR	698	LCS CR	744	LCS CR
596	Nexgen CR	881	LCS CR	521	Genesis II CR	522	Genesis II CR	551	Apex Knee CR
364	Genesis II CR	505	Genesis II CR	393	Scorpio CR	449	Apex Knee CR	403	Legion CR
255	Maxim	378	Scorpio CR	370	Legion CR	382	PFC Sigma CR	386	Genesis II CR
247	Natural Knee II	290	Triathlon PS	365	PFC Sigma CR	377	BalanSys	316	BalanSys
204	AGC	287	Legion CR	324	Score	363	Scorpio CR	299	Scorpio CR
203	Scorpio PS	281	ACS	305	Natural Knee Flex	310	Legion CR	292	Persona
10 Most Used									
5293 (10) 84.1%		9752 (10) 82.8%		9364 (10) 80.5%		9304 (10) 81.1%		9177 (10) 80.1%	
Remainder									
1001 (27) 15.9%		2030 (34) 17.2%		2264 (37) 19.5%		2167 (34) 18.9%		2285 (30) 19.9%	
TOTAL									
6294 (37) 100.0%		11782 (44) 100.0%		11628 (47) 100.0%		11471 (44) 100.0%		11462 (40) 100.0%	

OUTCOME FOR ALL DIAGNOSES

Primary Diagnosis

The most common diagnosis for primary total knee replacement is osteoarthritis (97.6%), followed by rheumatoid arthritis (1.3%), 'other inflammatory arthritis' (0.5%) and osteonecrosis (0.3%).

Rheumatoid arthritis has a lower rate of revision compared to osteoarthritis after nine months. Osteonecrosis has a higher rate of revision compared to osteoarthritis.

There is no difference in the rate of revision between 'other inflammatory arthritis' and osteoarthritis (Table KT6 and Figure KT7).

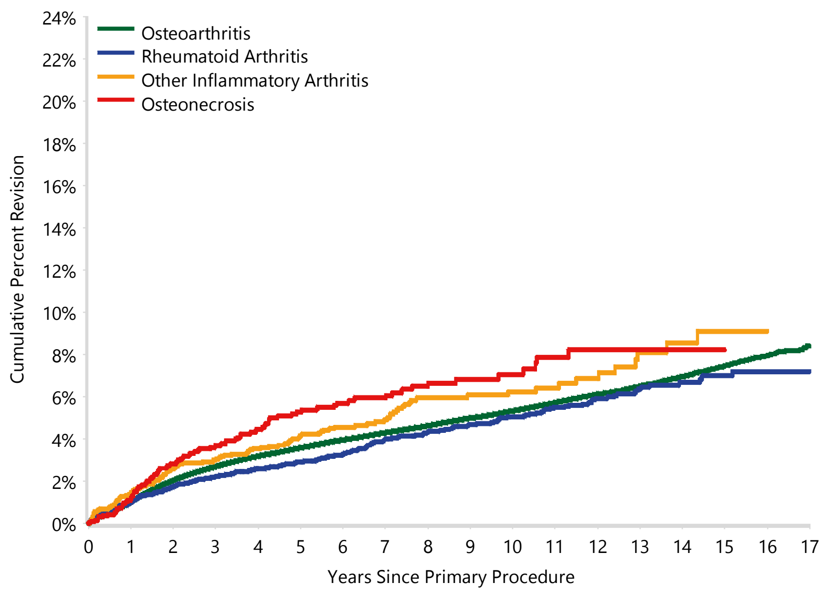
Rheumatoid arthritis has a lower rate of revision compared to osteoarthritis after nine months.

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	17 Yrs
Osteoarthritis	22205	588190	1.0 (1.0, 1.1)	2.7 (2.7, 2.7)	3.6 (3.5, 3.6)	5.3 (5.3, 5.4)	7.5 (7.3, 7.6)	8.4 (8.1, 8.7)
Rheumatoid Arthritis	309	8019	1.0 (0.8, 1.2)	2.2 (1.9, 2.6)	2.9 (2.5, 3.3)	5.1 (4.5, 5.7)	7.0 (6.1, 8.0)	7.2 (6.2, 8.4)
Other Inflammatory Arthritis	133	2993	1.5 (1.1, 2.0)	3.0 (2.4, 3.8)	4.2 (3.4, 5.1)	6.2 (5.2, 7.5)	9.1 (7.1, 11.7)	
Osteonecrosis	99	1928	1.1 (0.7, 1.8)	3.7 (2.9, 4.7)	5.3 (4.3, 6.6)	7.1 (5.7, 8.7)	8.2 (6.5, 10.3)	
Other (5)	134	1319	2.8 (2.0, 3.9)	8.1 (6.5, 10.0)	11.2 (9.2, 13.5)	18.0 (14.8, 21.8)		
TOTAL	**22880**	**602449**						

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=1.20 (0.87, 1.66),p=0.275
- 3Mth - 9Mth: HR=0.76 (0.53, 1.08),p=0.122
- 9Mth - 1.5Yr: HR=0.50 (0.36, 0.69),p<0.001
- 1.5Yr+: HR=0.73 (0.63, 0.84),p<0.001

Other Inflammatory Arthritis vs Osteoarthritis
- Entire Period: HR=1.05 (0.89, 1.25),p=0.541

Osteonecrosis vs Osteoarthritis
- Entire Period: HR=1.41 (1.16, 1.72),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Osteoarthritis	588190	524998	407381	306176	114290	17239	1695
Rheumatoid Arthritis	8019	7353	6058	4893	2286	476	63
Other Inflammatory Arthritis	2993	2639	1996	1488	572	121	18
Osteonecrosis	1928	1731	1311	972	389	61	3

PROSTHESIS TYPES

There have been 530 femoral and tibial prosthesis combinations used in primary total knee replacement reported to the Registry. In 2017, 194 femoral and tibial combinations were used. This is 75 more combinations than in 2016.

The cumulative percent revision of the 148 combinations with more than 400 procedures per combination are listed in Tables KT7 to KT9. Although the listed combinations are a small proportion of all possible combinations, they represent 96.6% of all primary total knee replacement procedures. The 'Other' group is the combined outcome of the remaining 382 prosthesis combinations with less than 400 procedures reported per combination.

There are 65 cemented femoral and tibial prosthesis combinations with more than 400 procedures. Of those combinations with a 17 year cumulative percent revision, the Genesis II CR/Genesis II and the Nexgen CR/Nexgen are the lowest at 5.9% (Table KT7).

There are 39 cementless femoral and tibial prosthesis combinations with more than 400 procedures. Of those combinations with a 17 year cumulative percent revision, the Nexgen CR/Nexgen is the lowest at 4.7% (Table KT8).

530 different femoral and tibial prosthesis combinations have been reported to the Registry. Outcomes at 17 years are being reported for the first time.

There are 44 combinations of primary total knee replacement using hybrid fixation with more than 400 procedures. The PFC Sigma CR/PFC Sigma has the lowest 17 year cumulative percent revision (5.6%) (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	17 Yrs
ACS	ACS Fixed	11	489	1.6 (0.8, 3.3)	2.7 (1.4, 5.2)				
ACS	ACS Mobile	14	669	0.9 (0.4, 2.1)	1.9 (1.0, 3.5)	4.3 (2.3, 8.1)			
AGC	AGC*	210	3497	0.5 (0.3, 0.9)	2.5 (2.0, 3.1)	3.7 (3.1, 4.4)	5.7 (4.9, 6.6)	8.7 (7.5, 10.2)	9.5 (7.9, 11.4)
Active Knee	Active Knee	59	2137	0.9 (0.6, 1.4)	2.5 (1.8, 3.4)	3.6 (2.7, 4.8)	4.9 (3.7, 6.5)		
Advance	Advance II	62	918	1.5 (0.9, 2.6)	4.3 (3.2, 5.9)	5.1 (3.9, 6.8)	7.6 (5.9, 9.9)	8.7 (6.6, 11.5)	
Apex Knee CR	Apex Knee	7	1675	0.3 (0.1, 0.8)	0.8 (0.3, 1.7)	0.8 (0.3, 1.7)			
Apex Knee PS	Apex Knee	42	2493	0.9 (0.6, 1.4)	2.6 (1.9, 3.6)				
Attune CR	Attune	109	8849	0.7 (0.6, 1.0)	2.3 (1.9, 2.9)				
Attune PS	Attune	37	4034	0.6 (0.4, 1.0)	1.3 (0.9, 1.8)				
BalanSys	BalanSys	34	1801	0.3 (0.1, 0.7)	1.4 (0.9, 2.2)	1.8 (1.2, 2.7)	4.4 (2.8, 7.0)		
Columbus	Columbus	12	752	0.9 (0.4, 2.2)	2.8 (1.5, 5.2)	2.8 (1.5, 5.2)			
Duracon	Duracon*	488	8967	1.0 (0.8, 1.2)	2.4 (2.1, 2.8)	3.3 (2.9, 3.7)	5.0 (4.6, 5.5)	7.4 (6.7, 8.2)	7.6 (6.8, 8.4)
E.Motion	E.Motion	30	642	2.4 (1.4, 4.0)	5.3 (3.7, 7.6)	5.6 (3.9, 8.0)			
Evolis	Evolis	16	876	0.2 (0.1, 1.0)	0.9 (0.4, 1.9)	1.7 (0.9, 3.0)			
Evolution	Evolution	69	4847	1.0 (0.7, 1.3)	2.4 (1.9, 3.2)	2.8 (2.0, 3.9)			
GMK Primary	GMK Primary	21	597	1.0 (0.5, 2.3)	2.8 (1.7, 4.5)	4.1 (2.3, 7.0)			
GMK Sphere Primary	GMK Primary	87	4937	1.4 (1.1, 1.8)	2.7 (2.1, 3.4)				

Femoral Component	Tibial Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Genesis II CR	Genesis II	507	14467	0.9 (0.8, 1.1)	2.4 (2.2, 2.7)	3.1 (2.8, 3.4)	4.3 (3.9, 4.7)	5.5 (4.9, 6.2)	5.9 (5.1, 6.7)
Genesis II CR	Profix Mobile*	38	490	1.7 (0.8, 3.3)	3.4 (2.1, 5.4)	5.4 (3.7, 7.8)	9.0 (6.4, 12.6)		
Genesis II Oxinium CR	Genesis II	389	8131	1.0 (0.8, 1.2)	2.8 (2.4, 3.2)	3.6 (3.2, 4.1)	6.2 (5.6, 6.9)	9.9 (8.4, 11.7)	
Genesis II Oxinium PS	Genesis II	911	17257	1.5 (1.3, 1.7)	3.8 (3.5, 4.1)	5.2 (4.9, 5.6)	7.7 (7.2, 8.3)		
Genesis II PS	Genesis II	629	16783	1.2 (1.0, 1.3)	2.8 (2.5, 3.1)	3.7 (3.4, 4.0)	5.1 (4.7, 5.5)	6.1 (5.3, 6.9)	
Journey Oxinium	Journey*	273	3032	1.4 (1.0, 1.9)	4.6 (3.9, 5.4)	6.5 (5.7, 7.4)	11.4 (10.0, 13.0)		
Kinemax Plus	Kinemax Plus*	117	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)	8.3 (6.9, 10.0)	9.1 (7.5, 11.1)
LCS CR	LCS	314	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)	9.3 (8.3, 10.4)	9.9 (8.8, 11.1)
LCS CR	MBT	412	11357	0.8 (0.7, 1.0)	2.5 (2.2, 2.8)	3.5 (3.1, 3.8)	5.3 (4.7, 5.9)	6.0 (5.3, 6.8)	
LCS PS	MBT*	39	492	1.4 (0.7, 3.0)	5.6 (3.9, 8.0)	7.1 (5.1, 9.8)			
Legion CR	Genesis II	33	1681	1.1 (0.7, 1.8)	2.2 (1.5, 3.2)	2.9 (2.0, 4.2)			
Legion Oxinium CR	Genesis II	80	3501	0.9 (0.6, 1.3)	2.6 (2.1, 3.4)	3.3 (2.6, 4.1)			
Legion Oxinium PS	Genesis II	347	11491	1.1 (0.9, 1.3)	3.1 (2.8, 3.5)	4.5 (4.0, 5.0)			
Legion PS	Genesis II	97	4505	1.0 (0.8, 1.4)	2.2 (1.8, 2.8)	2.7 (2.2, 3.3)			
MRK	MRK	8	459	0.9 (0.3, 2.4)	1.9 (0.9, 3.7)	1.9 (0.9, 3.7)			
Maxim	Maxim*	38	499	1.2 (0.5, 2.7)	2.6 (1.5, 4.5)	4.7 (3.2, 7.1)	6.5 (4.6, 9.2)	10.0 (7.0, 14.2)	
Natural Knee Flex	Natural Knee II	45	1775	1.2 (0.8, 1.9)	2.9 (2.2, 4.0)	3.4 (2.5, 4.6)			
Natural Knee II	Natural Knee II*	54	1754	0.5 (0.2, 0.9)	1.3 (0.8, 1.9)	1.9 (1.4, 2.7)	3.4 (2.5, 4.5)	4.8 (3.4, 6.9)	
Nexgen CR	Nexgen	128	3967	0.6 (0.4, 0.9)	1.5 (1.1, 1.9)	1.9 (1.5, 2.4)	3.0 (2.4, 3.6)	5.0 (4.1, 6.1)	5.9 (4.2, 8.3)
Nexgen CR Flex	Natural Knee II*	9	805	0.2 (0.1, 1.0)	0.8 (0.4, 1.8)	0.8 (0.4, 1.8)			
Nexgen CR Flex	Nexgen	386	22908	0.7 (0.6, 0.8)	1.5 (1.3, 1.7)	2.1 (1.8, 2.3)	2.9 (2.5, 3.2)		
Nexgen LCCK	Nexgen	34	805	2.1 (1.3, 3.4)	3.9 (2.7, 5.6)	5.2 (3.7, 7.4)	5.2 (3.7, 7.4)		
Nexgen LPS	Nexgen	257	5928	1.0 (0.8, 1.3)	2.3 (2.0, 2.8)	2.9 (2.5, 3.4)	4.7 (4.1, 5.3)	6.4 (5.6, 7.4)	6.8 (5.8, 7.9)
Nexgen LPS Flex	Nexgen	1112	32025	0.9 (0.8, 1.0)	2.3 (2.1, 2.4)	3.1 (2.9, 3.3)	5.2 (4.9, 5.6)	8.3 (6.8, 10.1)	
Nexgen RH	Nexgen	25	429	2.7 (1.5, 4.8)	4.6 (2.8, 7.3)	5.5 (3.5, 8.7)			
Optetrak-PS	Optetrak	184	2232	1.5 (1.1, 2.1)	4.6 (3.8, 5.6)	6.2 (5.3, 7.4)	9.6 (8.3, 11.2)		
Optetrak-PS	Optetrak RBK	45	856	1.3 (0.7, 2.4)	3.6 (2.5, 5.2)	4.7 (3.4, 6.6)	8.6 (6.2, 11.8)		
PFC Sigma CR	MBT	33	1163	0.9 (0.5, 1.6)	1.9 (1.3, 2.9)	2.3 (1.6, 3.4)	3.3 (2.3, 4.7)		
PFC Sigma CR	PFC Sigma	358	12657	0.8 (0.7, 1.0)	2.0 (1.7, 2.2)	2.4 (2.1, 2.7)	3.5 (3.1, 3.9)	5.7 (4.8, 6.8)	
PFC Sigma PS	MBT	260	6045	0.9 (0.7, 1.2)	2.7 (2.3, 3.2)	3.6 (3.1, 4.1)	5.1 (4.5, 5.8)	6.4 (5.4, 7.5)	
PFC Sigma PS	PFC Sigma	305	7833	1.2 (0.9, 1.4)	2.5 (2.2, 2.9)	3.3 (2.9, 3.7)	4.7 (4.2, 5.4)	7.3 (6.1, 8.7)	
Persona	Persona	17	2599	0.7 (0.4, 1.2)	1.4 (0.8, 2.5)				

Femoral Component	Tibial Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Profix	Profix*	151	3285	1.1 (0.8, 1.6)	2.6 (2.1, 3.2)	3.3 (2.7, 3.9)	4.8 (4.0, 5.6)	5.7 (4.6, 6.9)	
Profix Oxinium	Profix*	82	999	1.9 (1.2, 3.0)	5.0 (3.8, 6.5)	6.6 (5.2, 8.4)	8.1 (6.5, 10.0)		
RBK	RBK	96	2394	1.0 (0.7, 1.5)	2.7 (2.1, 3.4)	3.5 (2.8, 4.3)	5.5 (4.4, 6.9)		
SAIPH	SAIPH	19	1977	0.6 (0.3, 1.1)	1.6 (1.0, 2.6)	1.6 (1.0, 2.6)			
Score	Score	15	731	0.9 (0.4, 1.9)	1.4 (0.7, 2.7)	2.3 (1.3, 4.2)			
Scorpio CR	Series 7000	91	1799	0.8 (0.5, 1.4)	2.2 (1.6, 3.0)	2.9 (2.2, 3.8)	4.9 (3.9, 6.1)	6.5 (5.2, 8.1)	
Scorpio NRG CR	Series 7000	39	1668	0.7 (0.4, 1.2)	1.5 (1.0, 2.3)	2.2 (1.5, 3.2)			
Scorpio NRG PS	Series 7000	64	2596	0.6 (0.4, 1.0)	1.6 (1.2, 2.2)	2.3 (1.8, 3.0)	3.2 (2.4, 4.3)		
Scorpio PS	Scorpio*	33	511	1.2 (0.5, 2.6)	3.8 (2.4, 5.9)	4.4 (2.9, 6.6)	6.3 (4.5, 8.9)		
Scorpio PS	Scorpio+*	65	900	1.3 (0.8, 2.3)	4.2 (3.0, 5.7)	5.8 (4.5, 7.6)	7.4 (5.8, 9.4)	9.2 (6.9, 12.2)	
Scorpio PS	Series 7000	192	3233	1.1 (0.8, 1.5)	2.9 (2.3, 3.5)	4.0 (3.3, 4.7)	6.6 (5.7, 7.7)	9.6 (7.8, 11.8)	
Triathlon CR	Triathlon	778	37080	0.8 (0.7, 0.9)	2.0 (1.9, 2.2)	2.6 (2.4, 2.8)	4.0 (3.6, 4.4)		
Triathlon PS	Triathlon	253	7401	1.4 (1.2, 1.7)	3.0 (2.6, 3.4)	3.9 (3.4, 4.4)	5.5 (4.7, 6.4)		
Vanguard CR	Maxim	215	8888	0.7 (0.5, 0.9)	2.2 (1.9, 2.6)	2.8 (2.5, 3.3)	4.6 (3.5, 5.9)		
Vanguard CR	Vanguard	20	995	0.5 (0.2, 1.2)	1.4 (0.8, 2.3)	1.5 (0.9, 2.6)			
Vanguard PS	Maxim	218	4023	2.0 (1.6, 2.5)	4.5 (3.9, 5.3)	5.7 (5.0, 6.6)	7.6 (6.4, 9.0)		
Other (184)		592	8900	1.8 (1.5, 2.1)	4.5 (4.0, 5.0)	6.4 (5.8, 7.0)	9.2 (8.5, 10.0)	11.9 (10.8, 13.1)	14.4 (12.3, 17.0)
TOTAL		**11715**	**339251**						

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 2017

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	17 Yrs
ACS	ACS Fixed	29	692	1.7 (1.0, 3.1)	5.2 (3.6, 7.5)	5.2 (3.6, 7.5)			
Active Knee	Active Knee	439	4899	1.3 (1.1, 1.7)	4.0 (3.4, 4.5)	5.6 (5.0, 6.3)	9.5 (8.6, 10.4)	13.6 (12.0, 15.4)	
Advance	Advance	36	761	1.7 (1.0, 3.0)	4.7 (3.3, 6.7)	5.2 (3.7, 7.3)			
Advantim	Advantim*	62	1255	0.8 (0.4, 1.5)	2.7 (2.0, 3.8)	3.6 (2.7, 4.8)	5.4 (4.1, 7.0)	7.3 (5.3, 10.0)	
Columbus	Columbus	62	500	3.2 (2.0, 5.2)	7.7 (5.6, 10.4)	9.8 (7.4, 12.7)	13.7 (10.8, 17.3)		
Duracon	Duracon*	220	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)	8.4 (7.2, 9.8)	8.7 (7.4, 10.2)
GMK Primary	GMK Primary	24	886	1.3 (0.7, 2.3)	3.3 (2.2, 4.9)	3.6 (2.4, 5.4)			
Genesis II CR	Genesis II	28	611	1.5 (0.8, 2.9)	4.2 (2.8, 6.3)	4.7 (3.2, 7.0)	7.4 (4.8, 11.3)		
Genesis II CR	Profix Mobile*	38	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)	8.0 (5.7, 11.0)	11.3 (7.6, 16.4)
Genesis II PS	Genesis II	21	420	1.7 (0.8, 3.5)	3.4 (2.0, 5.7)	4.0 (2.5, 6.4)			
LCS CR	LCS	158	2352	1.4 (1.0, 2.0)	3.4 (2.7, 4.2)	4.3 (3.5, 5.2)	6.0 (5.1, 7.1)	7.1 (6.1, 8.4)	8.4 (7.1, 9.9)
LCS CR	MBT	327	8106	1.1 (0.9, 1.4)	3.3 (2.9, 3.8)	4.1 (3.6, 4.6)	5.3 (4.7, 6.0)	7.6 (6.0, 9.6)	
LCS CR	MBT Duofix	633	13451	1.3 (1.1, 1.5)	3.3 (3.0, 3.6)	4.1 (3.7, 4.5)	5.4 (4.9, 5.8)	7.6 (6.7, 8.5)	
LCS Duofix	MBT Duofix*	466	3650	1.6 (1.2, 2.1)	6.2 (5.5, 7.0)	10.1 (9.2, 11.2)	13.3 (12.2, 14.5)		
Maxim	Maxim*	41	612	1.6 (0.9, 3.0)	3.0 (1.9, 4.7)	3.2 (2.0, 4.9)	4.6 (3.1, 6.7)	8.3 (6.0, 11.4)	
Natural Knee Flex	Natural Knee II	31	1348	0.8 (0.4, 1.5)	2.0 (1.4, 3.0)	2.4 (1.6, 3.5)			
Natural Knee II	Natural Knee II*	236	2890	1.0 (0.7, 1.4)	2.2 (1.7, 2.8)	3.4 (2.8, 4.1)	7.0 (6.0, 8.1)	12.4 (10.8, 14.3)	
Nexgen CR	Nexgen	114	3421	0.6 (0.4, 0.9)	1.7 (1.3, 2.2)	2.2 (1.7, 2.7)	3.1 (2.5, 3.8)	4.3 (3.5, 5.3)	4.7 (3.7, 5.9)
Nexgen CR	Nexgen TM CR	43	690	1.3 (0.7, 2.5)	4.3 (3.0, 6.2)	6.2 (4.6, 8.4)	7.0 (5.2, 9.4)		
Nexgen CR Flex	Nexgen	225	7553	1.1 (0.9, 1.4)	2.6 (2.3, 3.0)	3.1 (2.7, 3.6)	4.1 (3.5, 4.7)		
Nexgen CR Flex	Nexgen TM CR	221	9562	0.6 (0.4, 0.8)	1.8 (1.6, 2.1)	2.4 (2.1, 2.7)	3.4 (2.9, 4.0)		
Nexgen LPS	Nexgen TM LPS	26	1184	0.8 (0.4, 1.5)	1.3 (0.8, 2.2)	2.4 (1.6, 3.6)	2.8 (1.9, 4.3)		
Nexgen LPS Flex	Nexgen	28	839	2.9 (1.9, 4.3)	4.0 (2.7, 5.8)	4.0 (2.7, 5.8)			
Nexgen LPS Flex	Nexgen TM LPS	34	980	1.3 (0.7, 2.2)	2.9 (2.0, 4.2)	4.1 (2.9, 5.7)			
PFC Sigma CR	AMK Duofix*	58	1911	0.7 (0.4, 1.2)	1.6 (1.1, 2.3)	2.3 (1.7, 3.1)	3.1 (2.3, 4.0)	4.4 (3.2, 6.1)	
PFC Sigma CR	MBT	63	994	2.3 (1.5, 3.5)	4.9 (3.7, 6.4)	5.5 (4.3, 7.2)	6.9 (5.3, 9.0)		
PFC Sigma CR	MBT Duofix	125	2778	1.1 (0.8, 1.6)	3.2 (2.6, 3.9)	4.0 (3.3, 4.9)	5.8 (4.7, 7.0)	8.4 (6.4, 11.0)	
Profix	Profix*	94	1488	1.1 (0.7, 1.8)	3.5 (2.6, 4.5)	4.6 (3.7, 5.9)	6.6 (5.4, 8.0)	7.4 (5.9, 9.3)	
RBK	RBK	301	6496	1.3 (1.1, 1.7)	3.2 (2.8, 3.6)	4.2 (3.7, 4.7)	5.6 (4.9, 6.3)	7.8 (6.3, 9.6)	
Score	Score	145	2034	1.6 (1.1, 2.3)	5.4 (4.4, 6.5)	7.4 (6.2, 8.9)			
Scorpio CR	Series 7000	213	3135	1.4 (1.0, 1.8)	3.4 (2.9, 4.1)	4.8 (4.1, 5.6)	7.5 (6.5, 8.6)	9.0 (7.7, 10.4)	
Scorpio NRG CR	Series 7000	81	2633	1.0 (0.6, 1.4)	2.8 (2.2, 3.6)	3.4 (2.7, 4.3)	4.9 (3.8, 6.3)		
Scorpio NRG PS	Series 7000	68	1116	1.3 (0.8, 2.2)	5.3 (4.0, 6.9)	6.6 (5.2, 8.4)	7.9 (6.1, 10.2)		
Scorpio PS	Series 7000	44	570	2.5 (1.5, 4.1)	5.3 (3.7, 7.5)	6.2 (4.5, 8.6)	7.7 (5.7, 10.2)		
Triathlon CR	Triathlon	392	14549	1.1 (0.9, 1.3)	2.3 (2.0, 2.5)	2.9 (2.6, 3.2)	4.0 (3.5, 4.5)		
Triathlon PS	Triathlon	54	1038	2.2 (1.4, 3.3)	3.9 (2.8, 5.3)	4.8 (3.7, 6.4)	6.6 (4.8, 9.0)		
Vanguard CR	Maxim	33	582	1.2 (0.6, 2.5)	3.8 (2.5, 5.8)	5.2 (3.7, 7.4)	6.1 (4.3, 8.6)		
Vanguard CR	Regenerex	64	1554	1.2 (0.8, 1.9)	3.9 (2.9, 5.1)	5.0 (3.9, 6.5)			
Vanguard CR	Vanguard	56	1315	1.4 (0.9, 2.2)	3.9 (2.9, 5.1)	4.6 (3.5, 5.9)			
Other (72)		571	5378	2.9 (2.5, 3.4)	7.6 (6.9, 8.3)	9.2 (8.4, 10.0)	11.8 (10.9, 12.8)	14.1 (12.8, 15.4)	
TOTAL		**5904**	**118276**						

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 2017

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	17 Yrs
ACS	ACS Fixed	41	926	1.9 (1.1, 3.0)	5.8 (4.3, 7.9)	5.8 (4.3, 7.9)			
AGC	AGC*	62	1644	0.6 (0.3, 1.1)	1.4 (0.9, 2.1)	2.0 (1.4, 2.8)	3.5 (2.6, 4.6)	5.5 (4.1, 7.3)	
Active Knee	Active Knee	109	2225	0.6 (0.3, 1.0)	2.6 (2.0, 3.4)	3.9 (3.1, 4.9)	6.6 (5.3, 8.1)		
Advance	Advance II	22	462	1.1 (0.5, 2.6)	2.7 (1.6, 4.7)	3.5 (2.1, 5.8)	5.7 (3.7, 8.8)		
Apex Knee CR	Apex Knee	14	1471	0.9 (0.5, 1.6)	1.2 (0.7, 2.2)				
BalanSys	BalanSys	14	1023	1.1 (0.6, 2.0)	2.2 (1.1, 4.4)				
Duracon	Duracon*	450	7963	1.2 (1.0, 1.5)	2.7 (2.4, 3.1)	3.5 (3.1, 3.9)	5.1 (4.6, 5.6)	7.2 (6.5, 7.9)	7.8 (6.9, 8.7)
GMK Primary	GMK Primary	16	512	0.6 (0.2, 2.0)	3.4 (2.0, 5.7)				
Genesis II CR	Genesis II	329	7661	0.9 (0.7, 1.1)	2.9 (2.6, 3.4)	4.0 (3.5, 4.5)	5.3 (4.7, 6.0)	6.7 (5.7, 7.7)	7.6 (6.1, 9.4)
Genesis II PS	Genesis II	61	707	1.7 (1.0, 3.0)	4.5 (3.2, 6.3)	5.4 (3.9, 7.3)	8.8 (6.8, 11.3)		
LCS CR	LCS	135	2363	1.0 (0.7, 1.5)	2.7 (2.1, 3.5)	3.8 (3.1, 4.6)	5.3 (4.4, 6.3)	6.6 (5.5, 7.8)	7.2 (6.0, 8.7)
LCS CR	MBT	269	9141	0.7 (0.6, 0.9)	2.2 (1.9, 2.5)	2.9 (2.6, 3.3)	4.2 (3.6, 4.8)	4.8 (4.1, 5.7)	
LCS CR	MBT Duofix	32	925	1.4 (0.8, 2.4)	3.4 (2.4, 4.8)	3.6 (2.5, 5.1)	4.9 (3.1, 7.6)		
LCS Duofix	MBT*	67	822	1.5 (0.8, 2.6)	5.5 (4.1, 7.3)	7.1 (5.5, 9.1)	8.7 (6.9, 10.9)		
Legion CR	Genesis II	64	1881	1.7 (1.2, 2.4)	4.2 (3.2, 5.4)	5.4 (4.1, 7.0)			
Maxim	Maxim*	109	1406	0.8 (0.4, 1.4)	2.7 (1.9, 3.7)	3.9 (3.0, 5.1)	6.3 (5.1, 7.8)	13.4 (10.3, 17.2)	
Natural Knee Flex	Natural Knee II	25	1805	0.4 (0.2, 0.8)	1.1 (0.7, 1.7)	1.6 (1.1, 2.5)			
Natural Knee II	Natural Knee II*	97	1966	1.2 (0.8, 1.8)	2.2 (1.6, 3.0)	2.6 (1.9, 3.4)	4.1 (3.2, 5.2)	8.5 (6.6, 10.8)	
Nexgen CR	Nexgen	130	4207	0.5 (0.4, 0.8)	1.7 (1.3, 2.1)	2.2 (1.8, 2.7)	3.2 (2.7, 3.9)	4.5 (3.7, 5.5)	
Nexgen CR Flex	Nexgen	370	18281	0.8 (0.6, 0.9)	1.8 (1.6, 2.0)	2.3 (2.0, 2.5)	3.0 (2.6, 3.4)		
Nexgen CR Flex	Nexgen TM CR	15	800	0.5 (0.2, 1.3)	1.3 (0.7, 2.4)	1.4 (0.8, 2.6)	2.0 (1.2, 3.4)		
Nexgen LPS	Nexgen	53	1006	0.5 (0.2, 1.2)	2.7 (1.9, 4.0)	4.2 (3.1, 5.7)	5.6 (4.3, 7.4)	6.9 (5.0, 9.5)	
Nexgen LPS Flex	Nexgen	45	894	2.4 (1.5, 3.6)	5.1 (3.7, 6.9)	6.1 (4.5, 8.2)			
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	7	409	2.1 (0.9, 4.7)					
Optetrak-CR	Optetrak*	32	415	1.5 (0.7, 3.2)	3.7 (2.2, 6.1)	4.5 (2.9, 7.1)	8.5 (5.9, 12.1)	11.7 (7.8, 17.5)	
PFC Sigma CR	MBT	186	3793	1.2 (0.9, 1.6)	3.1 (2.6, 3.8)	4.2 (3.5, 4.9)	5.3 (4.6, 6.2)	7.8 (6.2, 9.8)	
PFC Sigma CR	PFC Sigma	327	11035	0.6 (0.5, 0.8)	1.9 (1.6, 2.2)	2.5 (2.2, 2.8)	3.6 (3.1, 4.0)	5.6 (4.7, 6.7)	5.6 (4.7, 6.7)
PFC Sigma PS	MBT Duofix	143	2094	1.9 (1.4, 2.6)	4.8 (4.0, 5.9)	6.7 (5.6, 8.0)	8.6 (7.3, 10.1)		
Persona	Persona	3	465	0.6 (0.1, 2.3)					
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)	10.8 (8.2, 14.1)	
Profix	Profix*	34	769	0.8 (0.4, 1.7)	2.4 (1.5, 3.8)	3.8 (2.6, 5.4)	4.7 (3.4, 6.6)	4.7 (3.4, 6.6)	
RBK	RBK	54	1472	1.1 (0.7, 1.8)	2.9 (2.1, 3.9)	3.7 (2.8, 5.0)	4.8 (3.5, 6.4)		
Score	Score	35	1217	1.6 (1.0, 2.5)	4.1 (2.9, 5.7)	4.4 (3.1, 6.3)			
Scorpio CR	Scorpio+*	143	1893	1.0 (0.6, 1.6)	2.9 (2.2, 3.7)	4.4 (3.5, 5.4)	7.5 (6.4, 8.9)	8.9 (7.5, 10.5)	
Scorpio CR	Series 7000	249	6881	0.7 (0.5, 0.9)	2.0 (1.7, 2.4)	2.8 (2.4, 3.2)	4.2 (3.7, 4.8)	6.1 (5.3, 7.1)	6.3 (5.4, 7.4)
Scorpio NRG CR	Series 7000	26	794	0.4 (0.1, 1.2)	2.1 (1.3, 3.4)	2.9 (1.9, 4.4)			
Scorpio PS	Scorpio+*	46	905	1.0 (0.5, 1.9)	2.6 (1.7, 3.9)	3.4 (2.4, 4.8)	4.6 (3.4, 6.3)	6.4 (4.7, 8.8)	
Scorpio PS	Series 7000	89	1079	1.2 (0.7, 2.1)	4.4 (3.3, 5.8)	5.8 (4.5, 7.4)	7.4 (5.9, 9.2)	12.5 (9.5, 16.3)	
Triathlon CR	Triathlon	328	19821	0.6 (0.5, 0.8)	1.6 (1.4, 1.8)	2.1 (1.9, 2.4)	3.2 (2.7, 3.7)		
Triathlon PS	Triathlon	78	2438	1.7 (1.2, 2.3)	2.6 (2.0, 3.3)	3.7 (2.9, 4.6)	5.4 (3.8, 7.7)		
Vanguard CR	Maxim	221	8482	0.9 (0.7, 1.1)	2.4 (2.1, 2.8)	3.3 (2.8, 3.8)	4.8 (4.0, 5.7)		
Vanguard CR	Vanguard	79	2772	0.7 (0.4, 1.1)	2.2 (1.7, 2.8)	3.0 (2.3, 3.8)			
Vanguard PS	Maxim	24	627	1.5 (0.8, 2.8)	3.4 (2.2, 5.3)	4.6 (3.0, 6.9)			
Other (126)		556	6371	2.3 (1.9, 2.7)	5.9 (5.4, 6.6)	7.3 (6.7, 8.0)	10.6 (9.7, 11.5)	13.4 (12.2, 14.8)	15.0 (12.6, 17.8)
TOTAL		**5261**	**144922**						

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 2017

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 17 years, the cumulative percent revision of primary total knee replacement undertaken for osteoarthritis is 8.4% (Table KT10 and Figure KT8).

Reason for Revision

Loosening is the main reason for revision (25.3%), followed by infection (22.9%), patellofemoral pain (10.4%), pain (8.3%) and instability (7.8%) (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 six years.

Type of Revision

The most common types of revision are replacement of both the femoral and tibial prostheses (25.6%), insert only exchange (22.5%) and patella only replacement (20.2%) (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 less than 55 years have more than three times the rate of revision after six months and more than seven times after 10 years, compared to patients aged 75 years or older (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 a 17 year cumulative incidence of 1.7% 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, and Figures KT13 and KT14).

ASA and BMI

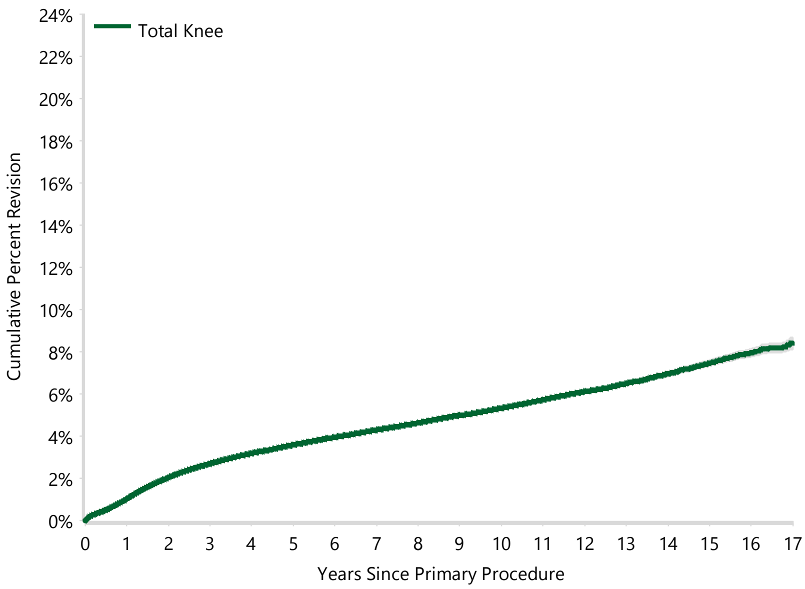
ASA scores are an indication of comorbidity and have been collected since 2012. The definitions for these scores can be found in the introductory chapter. The Registry can now report on the early outcome of 230,237 knee replacement procedures for osteoarthritis in relation to these scores. When compared to patients with an ASA score of 1, patients in all other ASA groups have a higher rate of revision. However, for patients with an ASA score of 4, this is only true for the first 1.5 years (Table KT15 and Figure KT15). The difference in revision rate for each ASA score is partially due to an increase in revision for infection with increasing ASA score (Figure KT16).

BMI data has been collected since 2015. The early revision outcomes are reported for 140,485 knee replacement procedures for osteoarthritis. When compared to patients with a normal BMI, there is no difference in revision rate for patients who are pre-obese, obese class 1 or obese class 2, but the revision rate is increased for patients in obese class 3 (Table KT16 and Figure KT17). The most common reasons for revision are shown in Figure KT18. The rate of revision for 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	17 Yrs
Total Knee	22205	588190	1.0 (1.0, 1.1)	2.7 (2.7, 2.7)	3.6 (3.5, 3.6)	5.3 (5.3, 5.4)	7.5 (7.3, 7.6)	8.4 (8.1, 8.7)
TOTAL	**22205**	**588190**						

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	17 Yrs
Total Knee	588190	524998	407381	306176	114290	17239	1695

Table KT11 Primary Total Knee Replacement by Reason for Revision (Primary Diagnosis OA)

Reason for Revision	Number	Percent
Loosening	5620	25.3
Infection	5085	22.9
Patellofemoral Pain	2304	10.4
Pain	1838	8.3
Instability	1734	7.8
Patella Erosion	1218	5.5
Arthrofibrosis	787	3.5
Fracture	649	2.9
Malalignment	487	2.2
Lysis	428	1.9
Wear Tibial Insert	391	1.8
Metal Related Pathology	327	1.5
Incorrect Sizing	260	1.2
Other	1077	4.9
TOTAL	**22205**	**100.0**

Table KT12 Primary Total Knee Replacement by Type of Revision (Primary Diagnosis OA)

Type of Revision	Number	Percent
TKR (Tibial/Femoral)	5684	25.6
Insert Only	4999	22.5
Patella Only	4489	20.2
Insert/Patella	2268	10.2
Tibial Component	2072	9.3
Femoral Component	1259	5.7
Cement Spacer	1244	5.6
Removal of Prostheses	117	0.5
Minor Components	45	0.2
Total Femoral	10	0.0
Cement Only	9	0.0
Reinsertion of Components	9	0.0
TOTAL	**22205**	**100.0**

Figure KT9 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement (Primary Diagnosis OA)

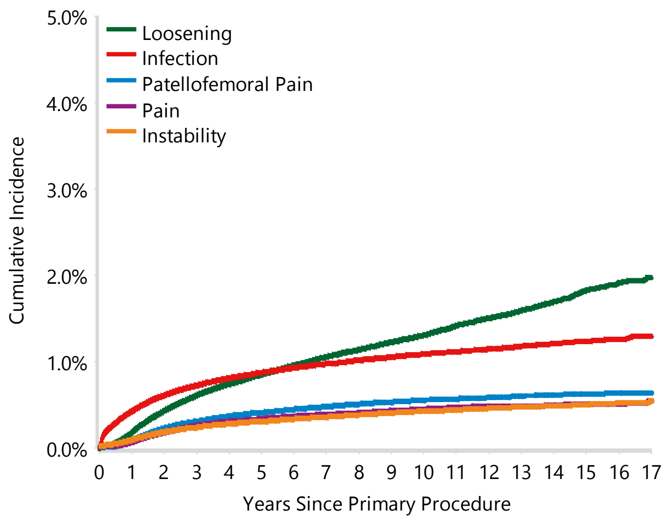
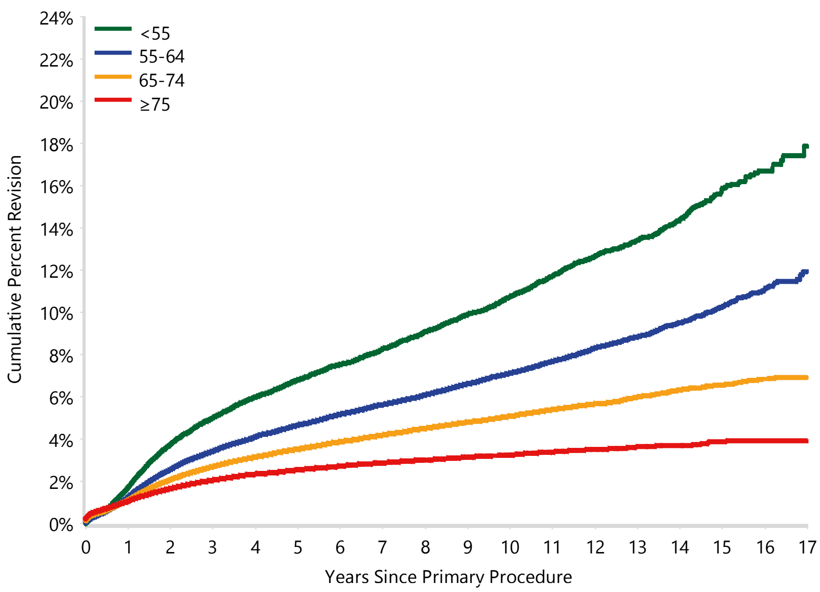


Table KT13 Cumulative Percent Revision of Primary Total Knee Replacement by Age (Primary Diagnosis OA)

Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
<55	3002	38759	1.7 (1.6, 1.9)	5.0 (4.8, 5.2)	6.8 (6.5, 7.1)	10.7 (10.3, 11.1)	15.8 (15.1, 16.6)	17.8 (16.4, 19.3)
55-64	7698	154902	1.2 (1.1, 1.3)	3.3 (3.2, 3.4)	4.5 (4.4, 4.7)	7.0 (6.8, 7.2)	10.1 (9.8, 10.4)	11.8 (11.1, 12.5)
65-74	7909	230281	1.0 (0.9, 1.0)	2.5 (2.5, 2.6)	3.3 (3.3, 3.4)	4.9 (4.7, 5.0)	6.3 (6.1, 6.5)	6.7 (6.4, 7.0)
≥75	3596	164248	0.8 (0.8, 0.9)	1.8 (1.7, 1.9)	2.3 (2.2, 2.4)	3.0 (2.9, 3.1)	3.6 (3.4, 3.8)	3.6 (3.4, 3.8)
TOTAL	**22205**	**588190**						

Figure KT10 Cumulative Percent Revision of Primary Total Knee Replacement by Age (Primary Diagnosis OA)



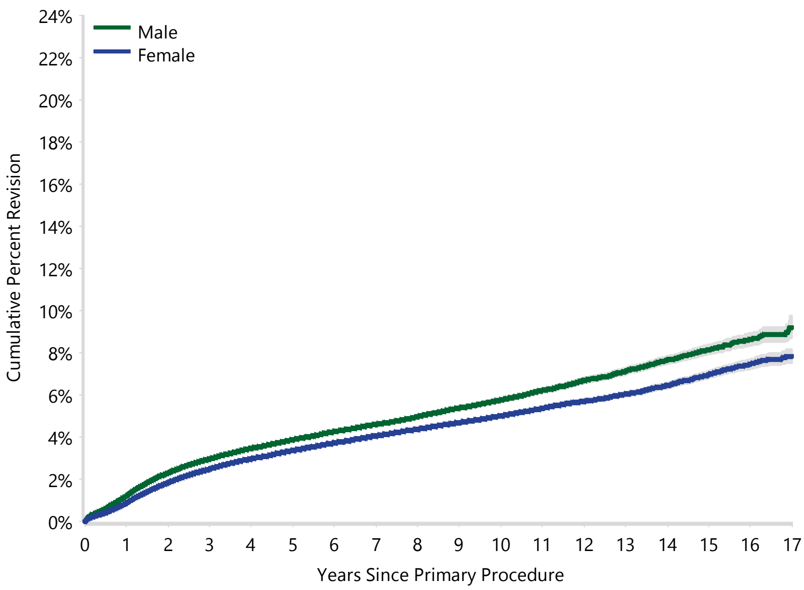
HR - adjusted for gender
<55 vs ≥75
0 - 6Mth: HR=1.39 (1.21, 1.60),p<0.001
6Mth - 2Yr: HR=3.38 (3.14, 3.65),p<0.001
2Yr - 2.5Yr: HR=3.13 (2.69, 3.64),p<0.001
2.5Yr - 4Yr: HR=3.42 (3.06, 3.83),p<0.001
4Yr - 6.5Yr: HR=4.58 (4.02, 5.22),p<0.001
6.5Yr - 10Yr: HR=6.21 (5.42, 7.13),p<0.001
10Yr+: HR=7.46 (6.32, 8.79),p<0.001
55-64 vs ≥75
0 - 3Mth: HR=0.95 (0.84, 1.07),p=0.379
3Mth - 6Mth: HR=1.42 (1.24, 1.64),p<0.001
6Mth - 9Mth: HR=1.92 (1.70, 2.16),p<0.001
9Mth - 4Yr: HR=2.19 (2.08, 2.31),p<0.001
4Yr - 4.5Yr: HR=3.32 (2.71, 4.08),p<0.001
4.5Yr - 6.5Yr: HR=3.00 (2.68, 3.35),p<0.001
6.5Yr - 7Yr: HR=3.53 (2.85, 4.38),p<0.001
7Yr - 7.5Yr: HR=3.17 (2.52, 3.98),p<0.001
7.5Yr - 10Yr: HR=3.69 (3.23, 4.21),p<0.001
10Yr - 11.5Yr: HR=3.86 (3.20, 4.64),p<0.001
11.5Yr+: HR=5.07 (4.28, 6.01),p<0.001
65-74 vs ≥75
0 - 6Mth: HR=0.98 (0.89, 1.07),p=0.664
6Mth - 2Yr: HR=1.57 (1.48, 1.66),p<0.001
2Yr - 4Yr: HR=1.53 (1.43, 1.64),p<0.001
4Yr - 4.5Yr: HR=2.38 (1.94, 2.92),p<0.001
4.5Yr+: HR=2.07 (1.89, 2.26),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
<55	38759	34599	26868	20575	8441	1586	169
55-64	154902	138336	107387	81547	31423	5440	556
65-74	230281	204843	158405	119190	46832	7531	766
≥75	164248	147220	114721	84864	27594	2682	204

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	17 Yrs
Male		**10362**	**256492**	**1.2 (1.2, 1.3)**	**3.0 (2.9, 3.0)**	**3.9 (3.8, 4.0)**	**5.8 (5.6, 5.9)**	**8.2 (7.9, 8.4)**	**9.2 (8.7, 9.8)**
	<55	1327	16633	2.1 (1.9, 2.3)	5.4 (5.0, 5.7)	6.9 (6.5, 7.4)	10.8 (10.2, 11.5)	16.1 (15.0, 17.3)	18.2 (15.9, 20.8)
	55-64	3754	70860	1.4 (1.3, 1.5)	3.6 (3.5, 3.8)	4.9 (4.7, 5.1)	7.5 (7.2, 7.8)	10.6 (10.2, 11.2)	12.5 (11.5, 13.6)
	65-74	3717	102753	1.1 (1.1, 1.2)	2.7 (2.6, 2.8)	3.6 (3.4, 3.7)	5.2 (5.0, 5.3)	6.8 (6.5, 7.1)	7.0 (6.6, 7.4)
	≥75	1564	66246	0.9 (0.9, 1.0)	2.0 (1.9, 2.1)	2.5 (2.4, 2.6)	3.3 (3.1, 3.5)	4.1 (3.7, 4.5)	4.1 (3.7, 4.5)
Female		**11843**	**331698**	**0.9 (0.9, 0.9)**	**2.5 (2.4, 2.6)**	**3.4 (3.3, 3.4)**	**5.0 (4.9, 5.1)**	**7.0 (6.8, 7.2)**	**7.8 (7.5, 8.2)**
	<55	1675	22126	1.5 (1.3, 1.6)	4.7 (4.4, 5.0)	6.7 (6.3, 7.0)	10.6 (10.1, 11.2)	15.6 (14.6, 16.7)	17.5 (15.9, 19.3)
	55-64	3944	84042	1.0 (1.0, 1.1)	3.1 (3.0, 3.2)	4.3 (4.1, 4.4)	6.6 (6.4, 6.8)	9.6 (9.2, 10.1)	11.2 (10.4, 12.1)
	65-74	4192	127528	0.8 (0.8, 0.9)	2.4 (2.3, 2.5)	3.2 (3.0, 3.3)	4.6 (4.5, 4.8)	6.0 (5.7, 6.3)	6.4 (6.1, 6.8)
	≥75	2032	98002	0.7 (0.7, 0.8)	1.7 (1.6, 1.8)	2.1 (2.0, 2.2)	2.8 (2.7, 2.9)	3.3 (3.1, 3.5)	3.4 (3.1, 3.6)
TOTAL		**22205**	**588190**						

Figure KT11 Cumulative Percent Revision of Primary Total Knee Replacement by Gender (Primary Diagnosis OA)



HR - adjusted for age

Male vs Female

0 - 9Mth: HR=1.41 (1.33, 1.50),p<0.001

9Mth - 1.5Yr: HR=1.16 (1.10, 1.23),p<0.001

1.5Yr+: HR=1.06 (1.02, 1.09),p=0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Male	256492	227418	174561	129684	46540	6878	659
Female	331698	297580	232820	176492	67750	10361	1036

Figure KT12 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by Gender (Primary Diagnosis OA)

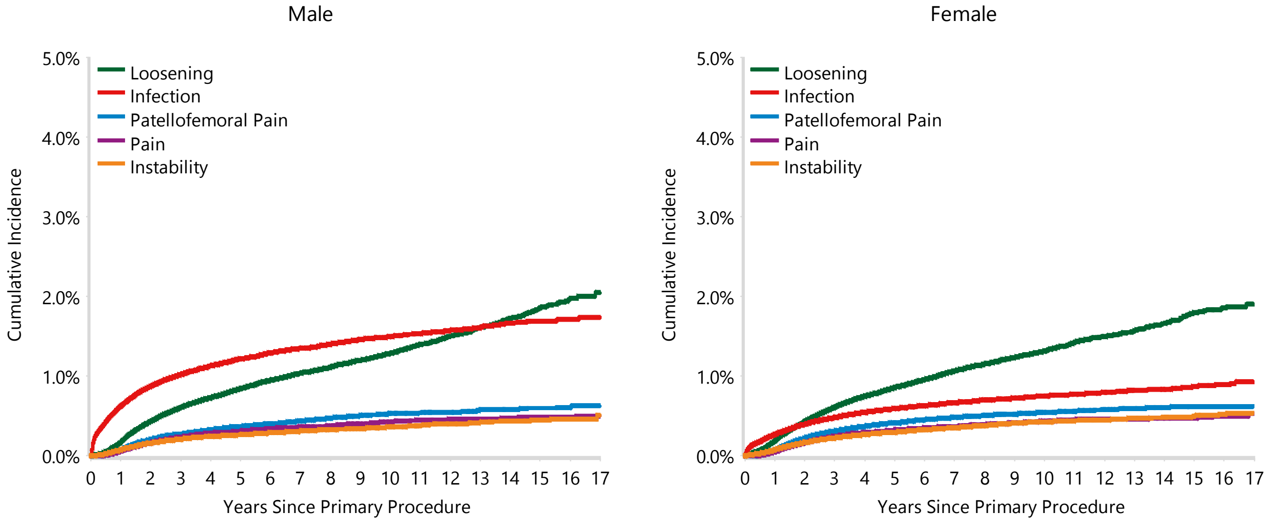
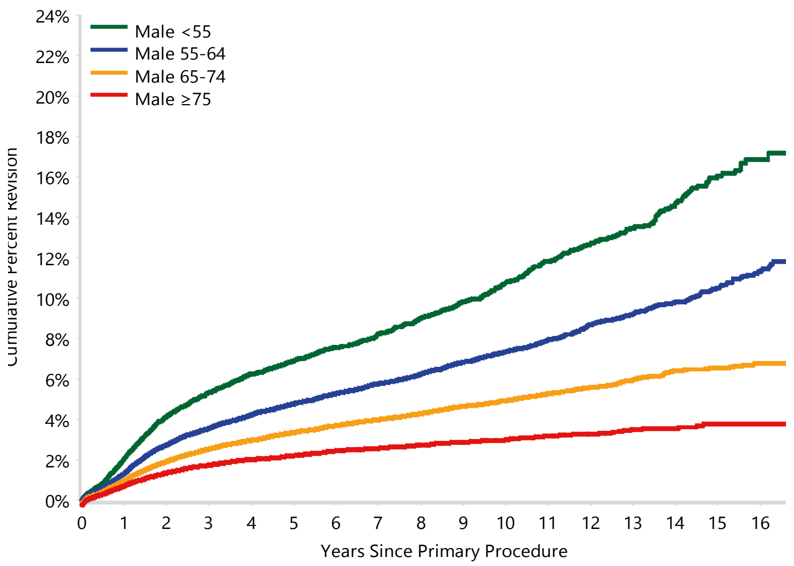


Figure KT13 Cumulative Percent Revision of Primary Total Knee Replacement in Males by Age (Primary Diagnosis OA)



Male <55 vs Male ≥75

- 0 - 6Mth: HR=1.61 (1.33, 1.95),p<0.001
- 6Mth - 1.5Yr: HR=3.03 (2.67, 3.44),p<0.001
- 1.5Yr - 2Yr: HR=3.57 (2.93, 4.34),p<0.001
- 2Yr - 2.5Yr: HR=2.70 (2.12, 3.44),p<0.001
- 2.5Yr - 3Yr: HR=4.06 (3.16, 5.23),p<0.001
- 3Yr - 3.5Yr: HR=2.90 (2.15, 3.91),p<0.001
- 3.5Yr - 7Yr: HR=3.68 (3.15, 4.31),p<0.001
- 7Yr - 10Yr: HR=5.11 (4.15, 6.29),p<0.001
- 10Yr+: HR=6.02 (4.81, 7.53),p<0.001

Male 55-64 vs Male ≥75

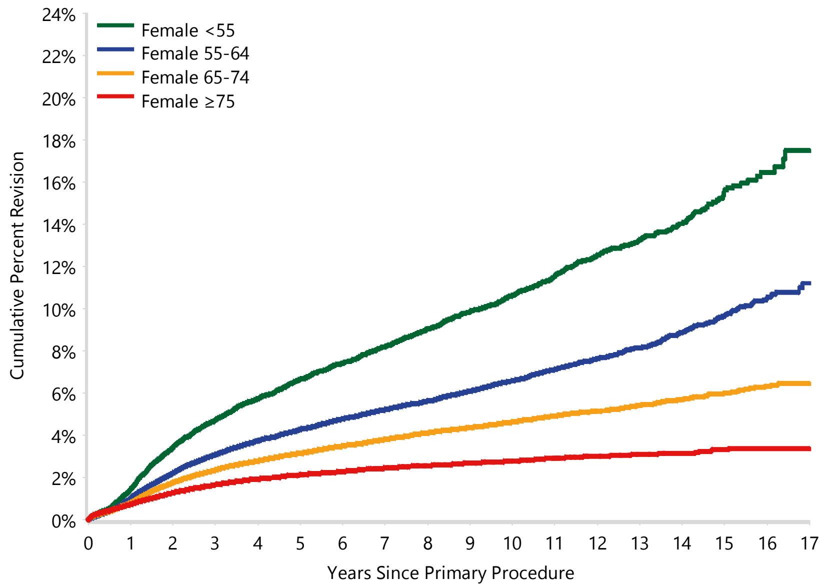
- 0 - 3Mth: HR=1.16 (0.99, 1.36),p=0.068
- 3Mth - 1Yr: HR=1.68 (1.50, 1.87),p<0.001
- 1Yr - 4Yr: HR=2.25 (2.08, 2.44),p<0.001
- 4Yr - 4.5Yr: HR=2.86 (2.25, 3.64),p<0.001
- 4.5Yr - 7Yr: HR=2.77 (2.41, 3.18),p<0.001
- 7Yr - 8.5Yr: HR=2.97 (2.42, 3.65),p<0.001
- 8.5Yr - 12Yr: HR=3.59 (3.02, 4.26),p<0.001
- 12Yr - 13Yr: HR=3.18 (2.12, 4.79),p<0.001
- 13Yr - 14.5Yr: HR=3.02 (2.03, 4.50),p<0.001
- 14.5Yr+: HR=6.93 (4.07, 11.79),p<0.001

Male 65-74 vs Male ≥75

- 0 - 6Mth: HR=1.08 (0.95, 1.22),p=0.238
- 6Mth - 1.5Yr: HR=1.40 (1.27, 1.54),p<0.001
- 1.5Yr - 2.5Yr: HR=1.56 (1.38, 1.75),p<0.001
- 2.5Yr+: HR=1.79 (1.63, 1.96),p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Male	<55	16633	14776	11482	8892	3674	712	79
	55-64	70860	62924	48530	36761	13989	2422	258
	65-74	102753	90952	69789	51868	19411	2940	266
	≥75	66246	58766	44760	32163	9466	804	56

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 (1.05, 1.58),p=0.013
- 6Mth - 1.5Yr: HR=3.48 (3.09, 3.93),p<0.001
- 1.5Yr - 3Yr: HR=3.36 (2.97, 3.80),p<0.001
- 3Yr - 4Yr: HR=3.78 (3.13, 4.57),p<0.001
- 4Yr - 6.5Yr: HR=5.42 (4.60, 6.37),p<0.001
- 6.5Yr - 7.5Yr: HR=5.75 (4.35, 7.59),p<0.001
- 7.5Yr+: HR=7.70 (6.52, 9.09),p<0.001

Female 55-64 vs Female ≥75
- 0 - 3Mth: HR=0.77 (0.64, 0.92),p=0.004
- 3Mth - 9Mth: HR=1.63 (1.42, 1.87),p<0.001
- 9Mth - 1Yr: HR=2.46 (2.08, 2.91),p<0.001
- 1Yr - 3Yr: HR=2.17 (2.00, 2.36),p<0.001
- 3Yr - 4Yr: HR=2.40 (2.07, 2.77),p<0.001
- 4Yr - 6.5Yr: HR=3.17 (2.77, 3.63),p<0.001
- 6.5Yr - 7.5Yr: HR=3.06 (2.44, 3.84),p<0.001
- 7.5Yr - 8.5Yr: HR=3.65 (2.86, 4.64),p<0.001
- 8.5Yr - 14Yr: HR=4.54 (3.87, 5.32),p<0.001
- 14Yr+: HR=5.54 (3.87, 7.93),p<0.001

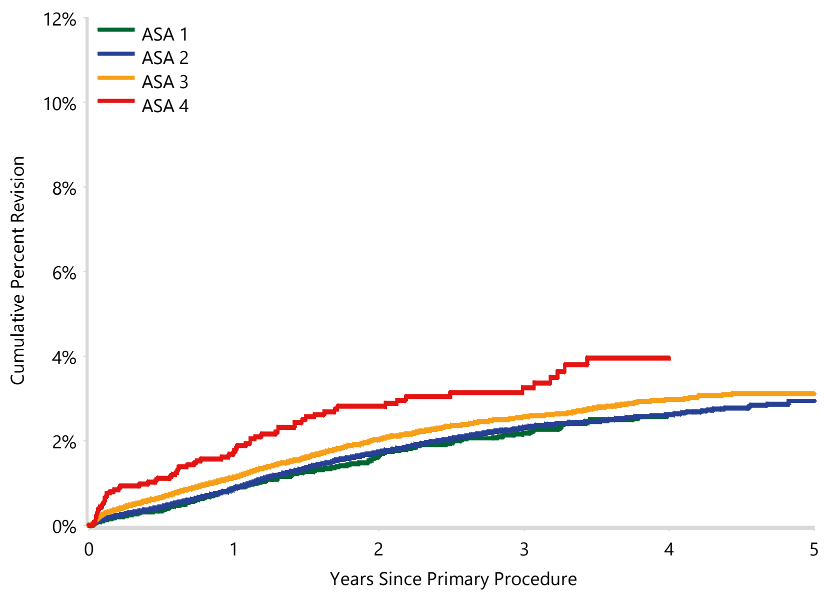
Female 65-74 vs Female ≥75
- 0 - 6Mth: HR=0.95 (0.84, 1.08),p=0.467
- 6Mth - 1Yr: HR=1.40 (1.22, 1.59),p<0.001
- 1Yr - 1.5Yr: HR=1.81 (1.61, 2.03),p<0.001
- 1.5Yr - 2Yr: HR=1.64 (1.44, 1.87),p<0.001
- 2Yr - 4Yr: HR=1.54 (1.40, 1.70),p<0.001
- 4Yr+: HR=2.17 (1.94, 2.43),p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Female	<55	22126	19823	15386	11683	4767	874	90
	55-64	84042	75412	58857	44786	17434	3018	298
	65-74	127528	113891	88616	67322	27421	4591	500
	≥75	98002	88454	69961	52701	18128	1878	148

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
ASA 1	242	14263	0.9 (0.7, 1.1)	1.7 (1.4, 1.9)	2.2 (1.9, 2.5)	2.6 (2.3, 3.0)	
ASA 2	2222	129546	0.9 (0.8, 0.9)	1.7 (1.7, 1.8)	2.3 (2.2, 2.4)	2.6 (2.5, 2.7)	2.9 (2.7, 3.2)
ASA 3	1602	83901	1.1 (1.1, 1.2)	2.0 (1.9, 2.2)	2.6 (2.4, 2.7)	3.0 (2.8, 3.1)	3.1 (2.9, 3.3)
ASA 4	70	2513	1.7 (1.3, 2.4)	2.8 (2.2, 3.6)	3.3 (2.5, 4.2)	3.9 (3.1, 5.1)	
ASA 5	0	14	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)		
TOTAL	**4136**	**230237**					

Figure KT15 Cumulative Percent Revision of Primary Total Knee Replacement by ASA Score (Primary Diagnosis OA)



HR - adjusted for age and gender

ASA 2 vs ASA 1

Entire Period: HR=1.24 (1.08, 1.41),p=0.001

ASA 3 vs ASA 1

0 - 6Mth: HR=2.02 (1.71, 2.39),p<0.001

6Mth+: HR=1.38 (1.20, 1.60),p<0.001

ASA 4 vs ASA 1

0 - 1.5Yr: HR=2.73 (2.03, 3.67),p<0.001

1.5Yr+: HR=1.43 (0.85, 2.42),p=0.177

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs
ASA 1	14263	10987	7926	4870	2095	21
ASA 2	129546	99152	70300	42403	17072	156
ASA 3	83901	62020	42055	24503	9387	81
ASA 4	2513	1889	1334	814	340	8

Figure KT16 **Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by ASA Score (Primary Diagnosis OA)**

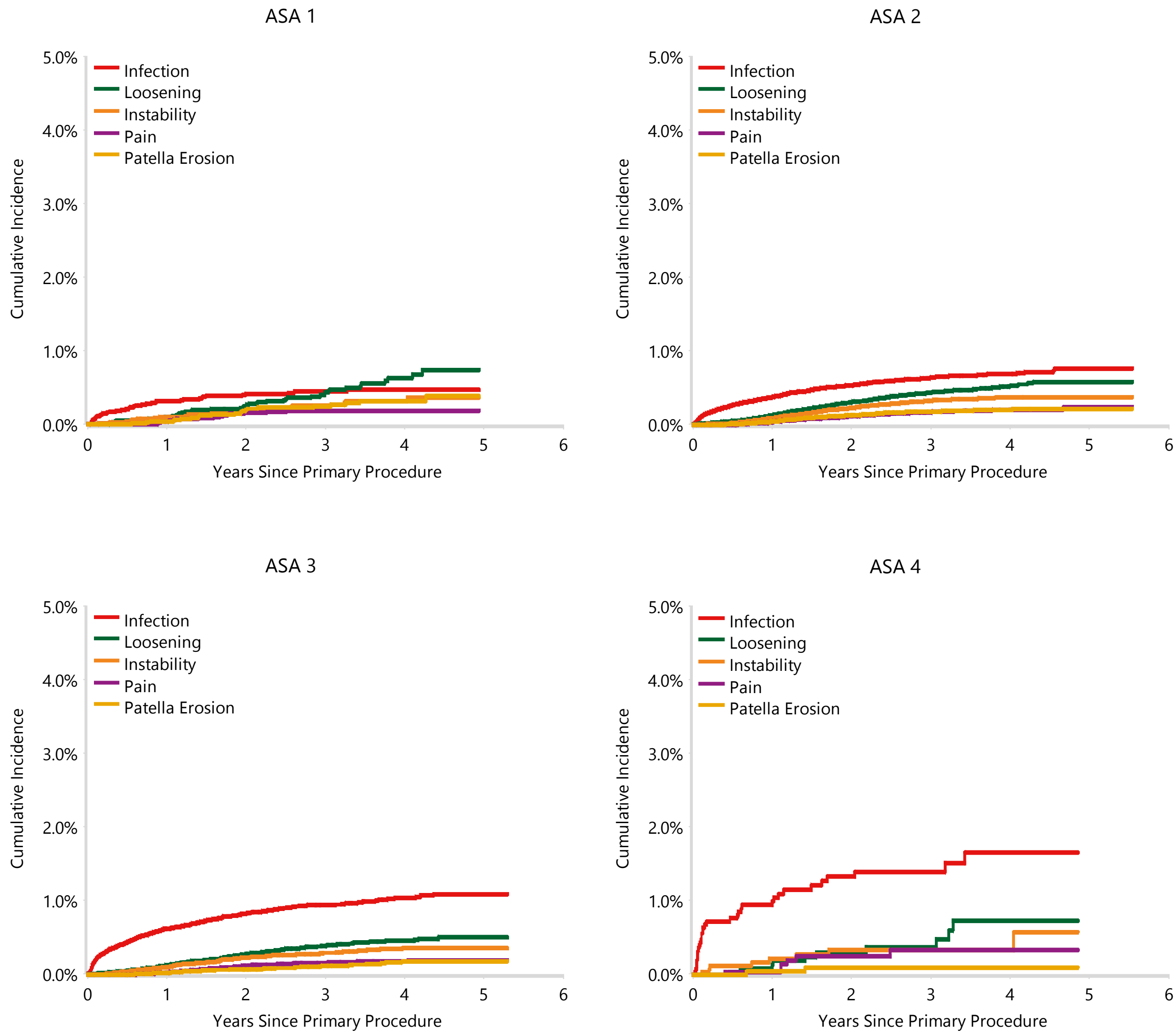
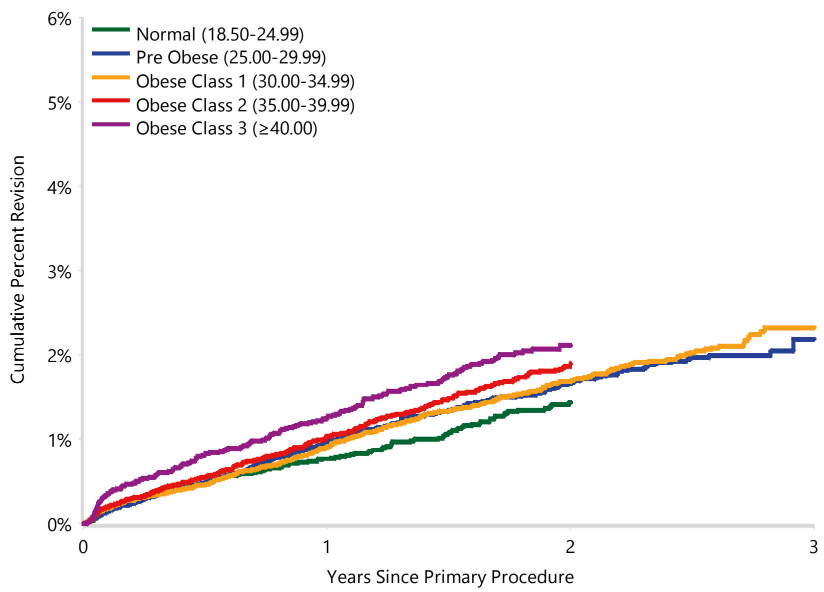


Table KT16 Cumulative Percent Revision of Primary Total Knee Replacement by BMI Category (Primary Diagnosis OA)

BMI Category	N Revised	N Total	1 Yr	2 Yrs	3 Yrs
Underweight (<18.50)	2	250	0.4 (0.1, 3.0)	1.4 (0.3, 6.0)	
Normal (18.50-24.99)	144	14494	0.8 (0.6, 0.9)	1.4 (1.2, 1.7)	
Pre Obese (25.00-29.99)	525	43812	1.0 (0.9, 1.1)	1.7 (1.5, 1.8)	2.2 (1.9, 2.6)
Obese Class 1 (30.00-34.99)	526	43181	0.9 (0.8, 1.0)	1.7 (1.5, 1.9)	2.3 (2.1, 2.6)
Obese Class 2 (35.00-39.99)	319	23795	1.0 (0.9, 1.2)	1.9 (1.7, 2.1)	
Obese Class 3 (≥40.00)	238	14953	1.3 (1.1, 1.5)	2.1 (1.8, 2.4)	
TOTAL	**1754**	**140485**			

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=1.12 (0.93, 1.35),p=0.233

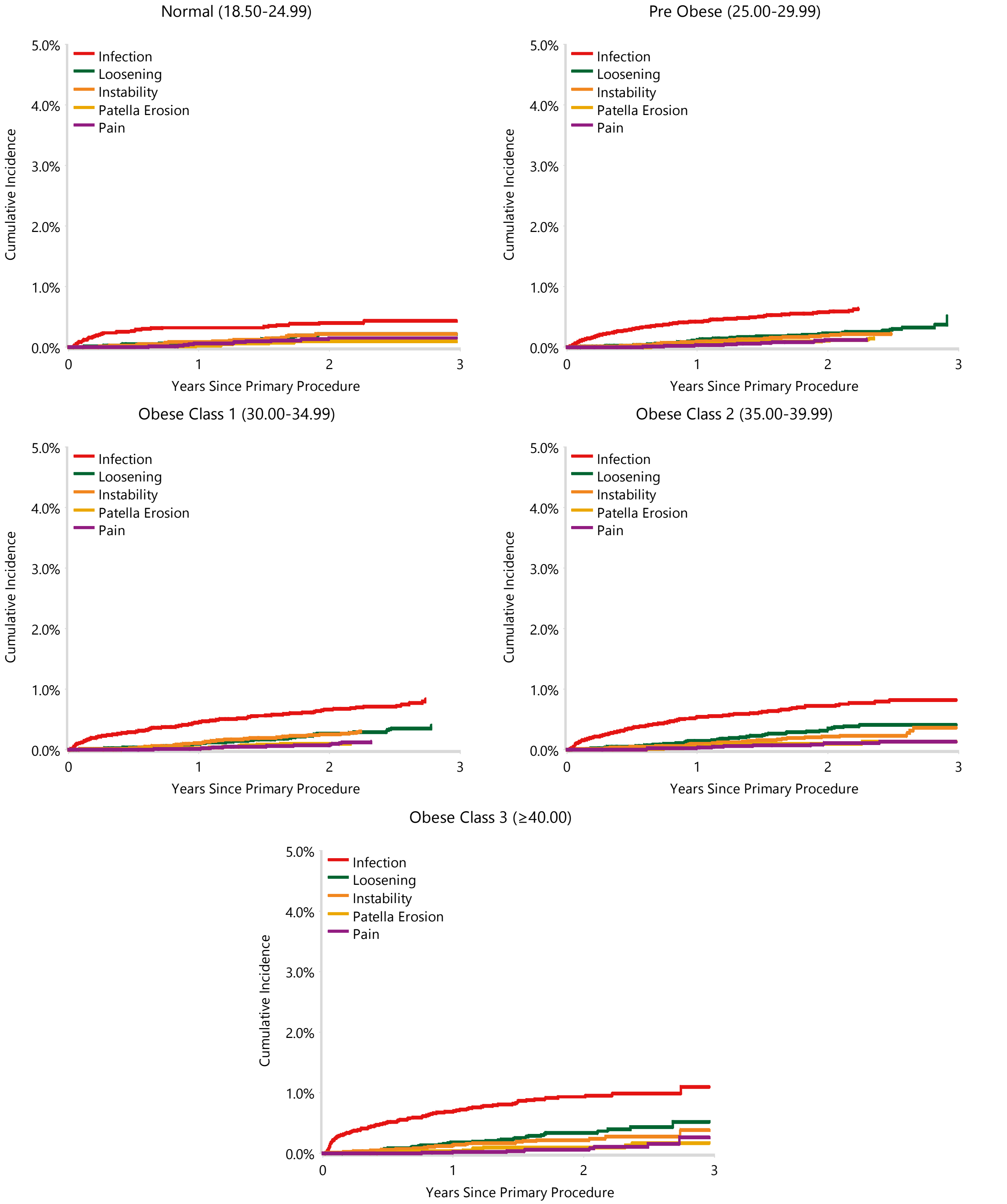
Obese Class 1 (30.00-34.99) vs
Normal (18.50-24.99)
Entire Period: HR=1.11 (0.93, 1.34),p=0.252

Obese Class 2 (35.00-39.99) vs
Normal (18.50-24.99)
Entire Period: HR=1.22 (1.00, 1.49),p=0.050

Obese Class 3 (≥40.00) vs Normal (18.50-24.99)
Entire Period: HR=1.45 (1.17, 1.79),p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs
Normal (18.50-24.99)	14494	9196	4331	13
Pre Obese (25.00-29.99)	43812	27419	12580	44
Obese Class 1 (30.00-34.99)	43181	26976	12381	44
Obese Class 2 (35.00-39.99)	23795	14817	6774	24
Obese Class 3 (≥40.00)	14953	9271	4099	11

Figure KT18 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by BMI Category (Primary Diagnosis OA)



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.

Mobile bearings include inserts that move in one of three ways: rotating, sliding, or both rotating and sliding. When those with rotating bearings are compared to those which rotate and slide, there is a higher rate of revision for the first 1.5 years. After this time, there is no difference until 2.5 years when rotating bearings then have a lower rate of revision. There is no difference in the revision rate between rotating and sliding bearings, or between sliding and those which rotate as well as slide (Table KT17 and Figure KT19). As there is little difference in the revision rate between these groups, in further analyses all types of mobile bearings are combined.

Fixed bearings include non-modular tibial prostheses, as well as those with fixed inserts that do not move relative to the baseplate.

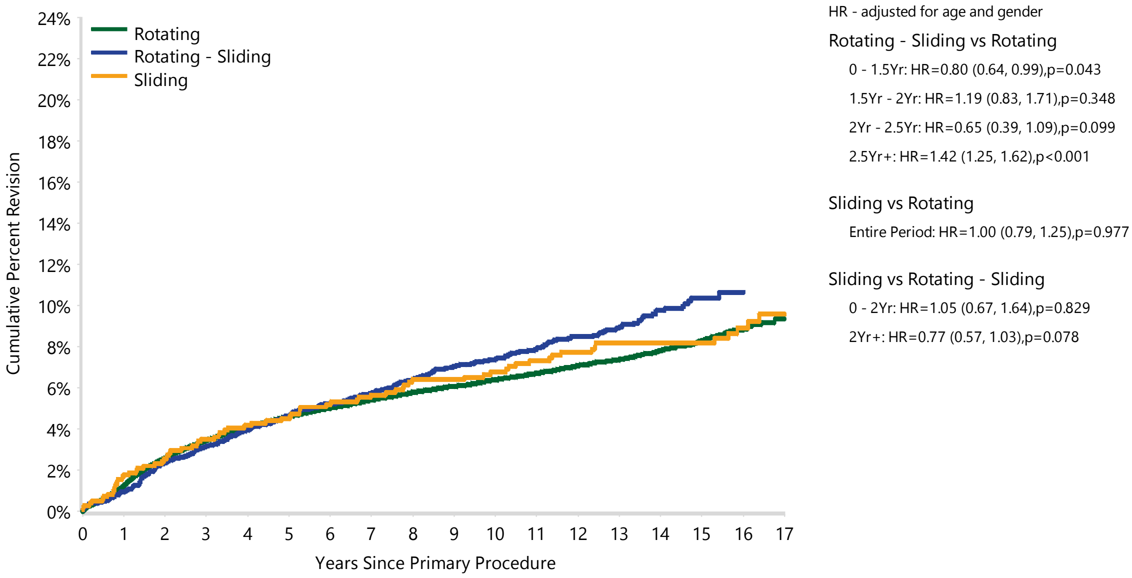
Fixed bearing prostheses have a lower rate of revision compared to mobile bearings in the first seven years. After this time, mobile bearings have a lower rate of revision (Table KT18 and Figure KT20).

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 KT19 and Table KT21).

Table KT17 Cumulative Percent Revision of Mobile Primary Total Knee Replacement (Primary Diagnosis OA)

Bearing Mobility	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Rotating	5734	114803	1.2 (1.2, 1.3)	3.4 (3.3, 3.5)	4.6 (4.4, 4.7)	6.3 (6.2, 6.5)	8.2 (7.9, 8.5)	9.3 (8.7, 9.9)
Rotating - Sliding	381	5252	0.9 (0.7, 1.2)	3.1 (2.6, 3.6)	4.6 (4.0, 5.2)	7.3 (6.6, 8.1)	10.3 (9.2, 11.5)	
Sliding	76	948	1.7 (1.0, 2.8)	3.4 (2.4, 4.8)	4.4 (3.3, 6.0)	6.7 (5.2, 8.5)	8.1 (6.4, 10.1)	9.5 (7.5, 11.9)
TOTAL	**6191**	**121003**						

Figure KT19 Cumulative Percent Revision of Mobile Primary Total Knee Replacement (Primary Diagnosis OA)



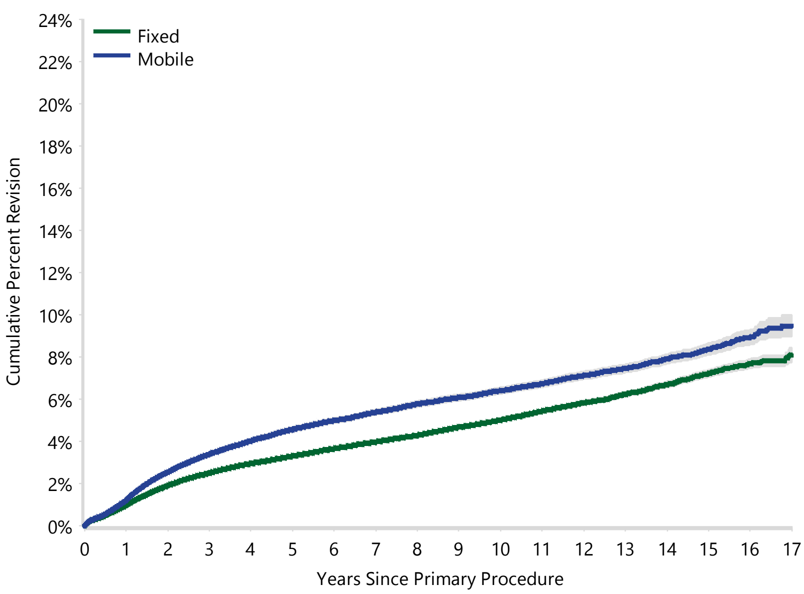
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Rotating	114803	105361	87089	69486	29096	4288	369
Rotating - Sliding	5252	4969	4491	4106	3023	497	4
Sliding	948	925	883	846	715	417	150

Table KT18 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	17 Yrs
Fixed	16007	467005	1.0 (1.0, 1.0)	2.5 (2.5, 2.6)	3.3 (3.3, 3.4)	5.0 (4.9, 5.1)	7.2 (7.0, 7.4)	8.1 (7.7, 8.4)
Mobile	6191	121003	1.2 (1.2, 1.3)	3.4 (3.3, 3.5)	4.6 (4.4, 4.7)	6.4 (6.2, 6.6)	8.4 (8.1, 8.7)	9.5 (9.0, 10.0)
TOTAL	**22198**	**588008**						

Note: Excludes 182 procedures with unknown bearing mobility

Figure KT20 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=1.21 (1.14, 1.29),p<0.001

1Yr - 1.5Yr: HR=1.50 (1.38, 1.62),p<0.001

1.5Yr - 2Yr: HR=1.27 (1.16, 1.40),p<0.001

2Yr - 2.5Yr: HR=1.36 (1.23, 1.51),p<0.001

2.5Yr - 3Yr: HR=1.48 (1.31, 1.67),p<0.001

3Yr - 3.5Yr: HR=1.30 (1.14, 1.48),p<0.001

3.5Yr - 4Yr: HR=1.45 (1.25, 1.68),p<0.001

4Yr - 5Yr: HR=1.51 (1.34, 1.69),p<0.001

5Yr - 7Yr: HR=1.21 (1.10, 1.33),p<0.001

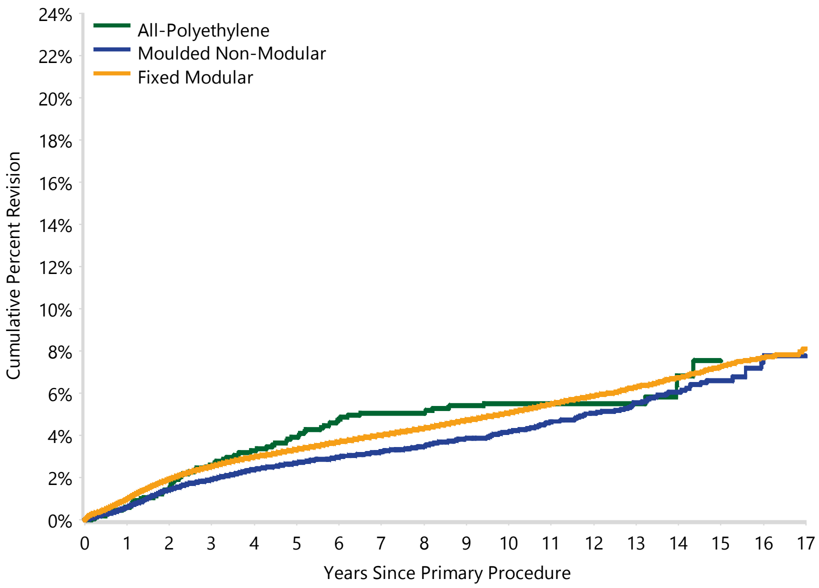
7Yr+: HR=0.92 (0.85, 1.00),p=0.039

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Fixed	467005	413569	314770	231617	81393	12028	1170
Mobile	121003	111255	92463	74438	32834	5202	523

Table KT19 Cumulative Percent Revision of Fixed Primary Total Knee Replacement by Bearing Type (Primary Diagnosis OA)

Fixed Bearing Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
All-Polyethylene	71	1640	0.6 (0.3, 1.1)	2.6 (1.9, 3.6)	3.9 (3.0, 5.1)	5.5 (4.4, 7.0)	7.5 (5.5, 10.3)	
Moulded Non-Modular	744	22516	0.6 (0.5, 0.7)	1.9 (1.8, 2.1)	2.7 (2.5, 2.9)	4.2 (3.9, 4.5)	6.6 (5.9, 7.4)	7.8 (6.6, 9.2)
Fixed Modular	15192	442849	1.0 (1.0, 1.0)	2.5 (2.5, 2.6)	3.3 (3.3, 3.4)	5.1 (5.0, 5.2)	7.3 (7.1, 7.5)	8.1 (7.7, 8.5)
TOTAL	**16007**	**467005**						

Figure KT21 Cumulative Percent Revision of Fixed Primary Total Knee Replacement by Bearing Type (Primary Diagnosis OA)



HR - adjusted for age and gender

All-Polyethylene vs Moulded Non-Modular
Entire Period: HR=1.47 (1.15, 1.88),p=0.001

All-Polyethylene vs Fixed Modular
Entire Period: HR=1.20 (0.95, 1.51),p=0.134

Fixed Modular vs Moulded Non-Modular
0 - 1Mth: HR=3.76 (2.08, 6.81),p<0.001
1Mth - 1.5Yr: HR=1.42 (1.24, 1.62),p<0.001
1.5Yr+: HR=1.13 (1.03, 1.23),p=0.007

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
All-Polyethylene	1640	1465	1174	1047	690	63	2
Moulded Non-Modular	22516	21352	18549	14690	5108	678	85
Fixed Modular	442849	390752	295047	215880	75595	11287	1083

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. The term 'medial pivot design' has been used to describe this design of prostheses. 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 2017, these accounted for 69.4% of the three prosthesis types. The use of posterior stabilised prostheses has declined from 32.9% in 2008 to 23.2% in 2017. Medial pivot design prostheses have been used in small numbers since the Registry began collecting data. In 2017, the use of medial pivot design prostheses increased, accounting for 7.4% (Figure KT22).

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 KT20). 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 KT20 and Figure KT23). 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 KT24).

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 seven prostheses (Table KT21). The Advance/Advance combination, 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 between these two groups (Table KT22 and Figure KT25).

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 three years. The Triathlon prosthesis with the condylar stabilising polyethylene has a higher rate of revision when compared to the cruciate retaining polyethylene design, but when compared to the posterior stabilised design there is a lower rate of revision for the first 1.5 years (Table KT23 and Figure KT26). 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 KT24 and Figure KT27).

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 three 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 KT25 and Figure KT28).

Fully Stabilised and Hinge Prostheses

Fully stabilised (large peg and box design) and hinge 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 97.6% of all primary knee replacements, fully stabilised prostheses are used in a higher proportion for rheumatoid arthritis and fracture, while hinge prostheses are used proportionally more for tumour, fracture and rheumatoid arthritis (Table KT26).

Fully stabilised prostheses have been used in 2,289 procedures and hinge prostheses in 1,511 primary total knee procedures. For these two knee designs, the rates of revision for all diagnoses are shown in Table KT27 and Figure KT29.

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 KT30). For both of these designs infection is the most common reason for revision, followed by loosening in fully stabilised prostheses and fracture in hinge prostheses (Table KT28 and Figure KT31).

Figure KT22 Primary Total Knee Replacement by Stability (Primary Diagnosis OA)

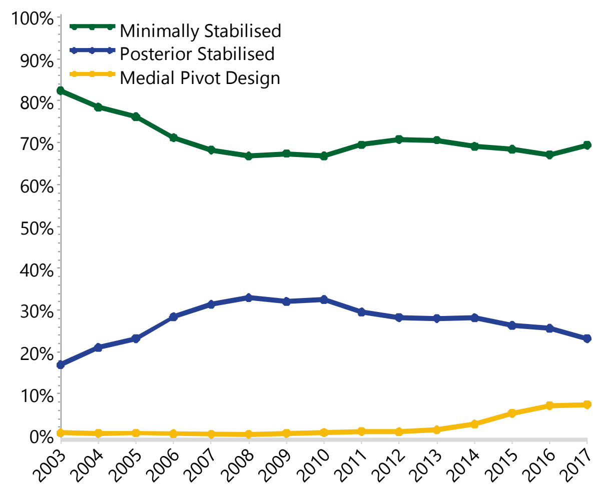
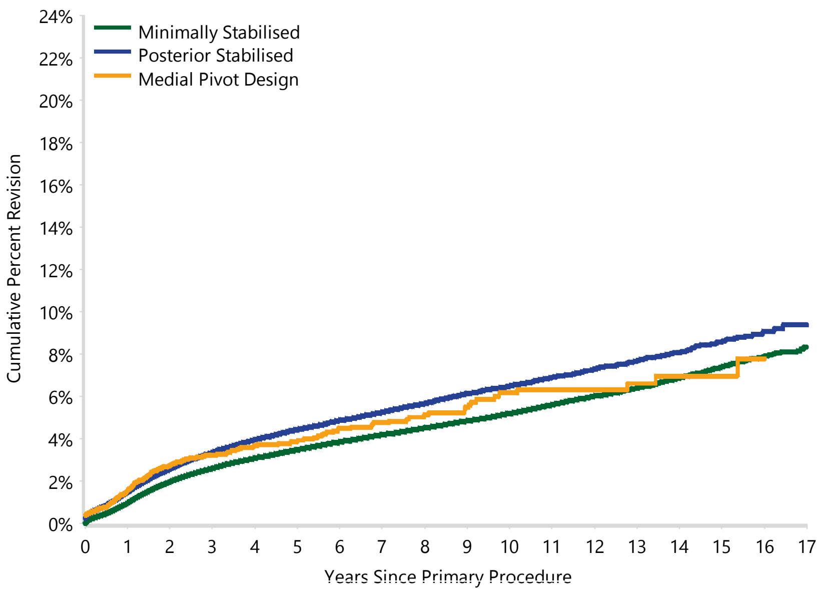


Table KT20 Cumulative Percent Revision of Primary Total Knee Replacement by Stability (Primary Diagnosis OA)

Stability	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Minimally Stabilised	15123	415537	0.9 (0.9, 1.0)	2.5 (2.5, 2.6)	3.4 (3.3, 3.4)	5.0 (4.9, 5.1)	7.2 (7.0, 7.3)	8.1 (7.8, 8.4)
Posterior Stabilised	6585	155198	1.2 (1.2, 1.3)	3.1 (3.0, 3.2)	4.1 (4.0, 4.2)	6.1 (6.0, 6.3)	8.2 (7.9, 8.6)	9.0 (8.3, 9.7)
Medial Pivot Design	326	14431	1.2 (1.0, 1.4)	2.8 (2.5, 3.2)	3.5 (3.1, 4.0)	5.8 (4.8, 6.9)	6.6 (5.3, 8.1)	
Fully Stabilised	108	2064	2.4 (1.8, 3.1)	4.8 (3.8, 5.9)	6.0 (4.9, 7.4)	9.3 (7.3, 11.7)		
Hinged	56	778	3.3 (2.2, 4.9)	6.0 (4.3, 8.2)	7.7 (5.7, 10.4)	14.4 (10.4, 19.8)		
TOTAL	**22198**	**588008**						

Note: Excludes 182 procedures with unknown stability

Figure KT23 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, 1.15),p=0.010

2Yr+: HR=1.23 (1.18, 1.28),p<0.001

Medial Pivot Design vs Minimally Stabilised

Entire Period: HR=1.12 (1.00, 1.25),p=0.041

Posterior Stabilised vs Medial Pivot Design

Entire Period: HR=1.08 (0.97, 1.21),p=0.177

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Minimally Stabilised	415537	372136	292406	221657	88252	14910	1506
Posterior Stabilised	155198	140083	109476	81422	25144	2148	180
Medial Pivot Design	14431	10297	3877	2026	623	137	6

Figure KT24 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by Stability (Primary Diagnosis OA)

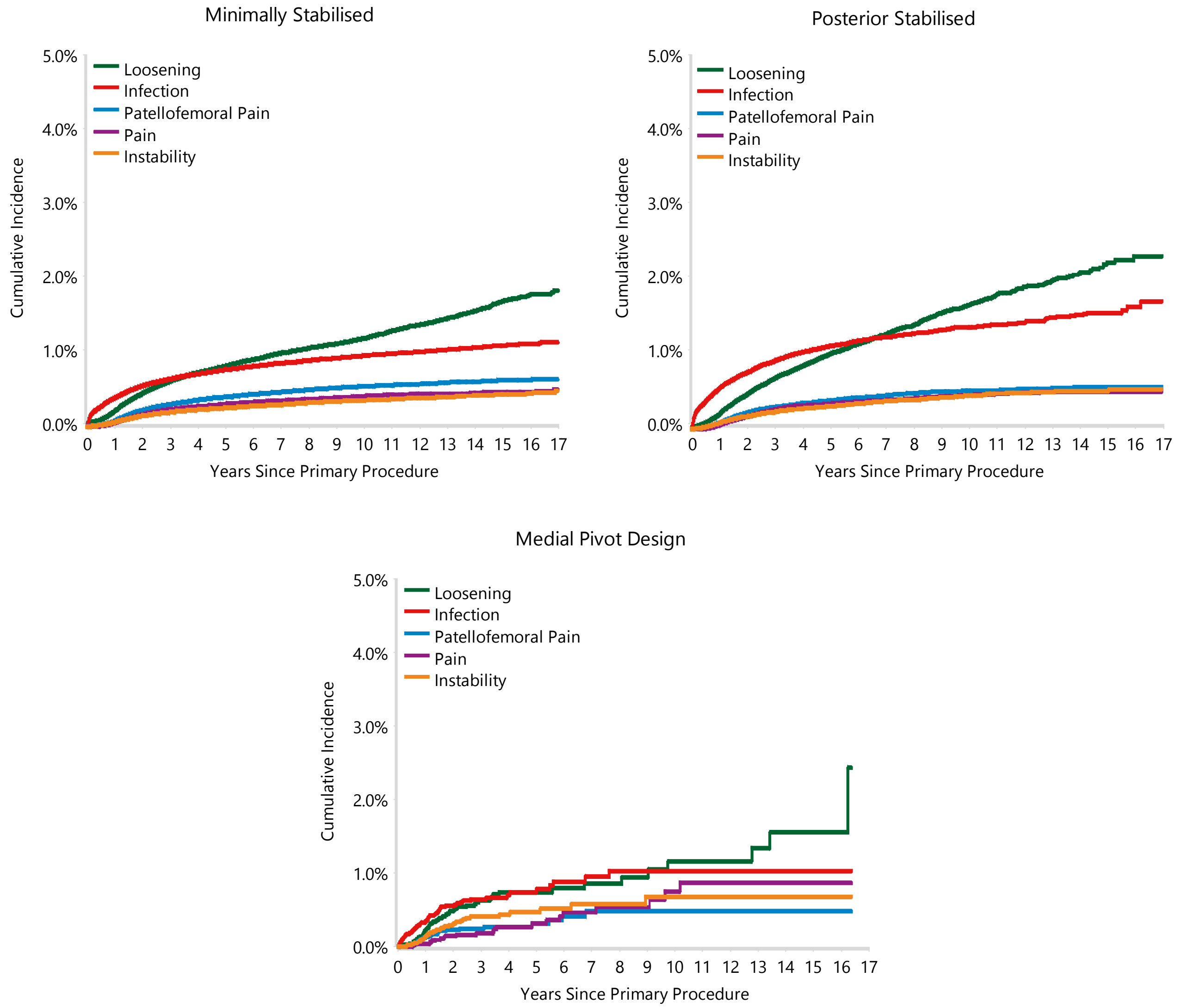


Table KT21 Cumulative Percent Revision of Primary Total Knee Replacement with Medial Pivot Design by Insert (Primary Diagnosis OA)

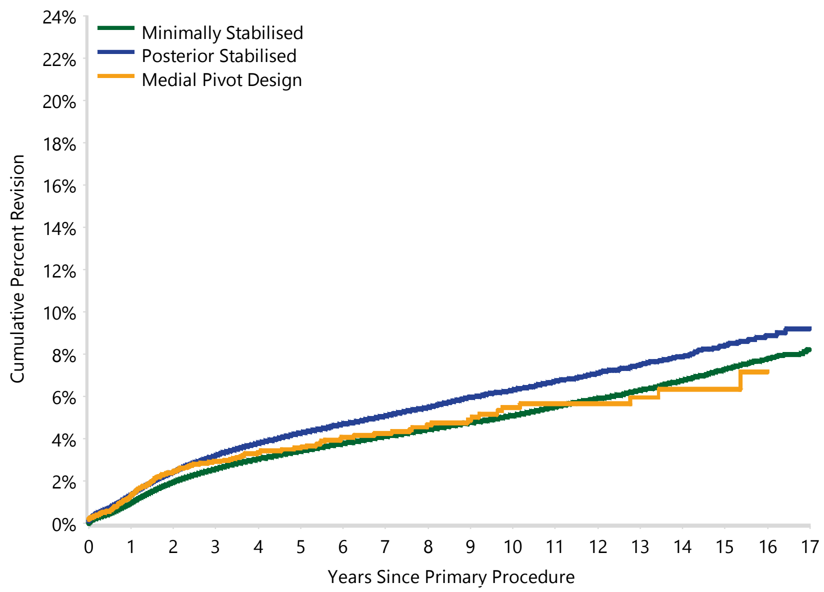
Insert	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Advance	24	638	1.2 (0.5, 2.4)	3.8 (2.5, 5.8)	4.4 (2.9, 6.7)			
Advance I	5	15	6.7 (1.0, 38.7)	13.3 (3.5, 43.6)	13.3 (3.5, 43.6)	35.0 (16.3, 64.9)	35.0 (16.3, 64.9)	35.0 (16.3, 64.9)
Advance II	111	1630	1.9 (1.3, 2.7)	4.4 (3.5, 5.5)	5.4 (4.4, 6.7)	7.7 (6.4, 9.3)	8.5 (6.9, 10.5)	
Evolution	68	4810	1.0 (0.7, 1.4)	2.4 (1.8, 3.1)	2.7 (2.0, 3.8)			
GMK Sphere Primary	87	4847	1.4 (1.1, 1.8)	2.7 (2.2, 3.4)				
MRK	12	546	0.9 (0.4, 2.2)	2.4 (1.3, 4.1)	2.4 (1.3, 4.1)			
SAIPH	19	1945	0.6 (0.3, 1.1)	1.6 (1.0, 2.7)	1.6 (1.0, 2.7)			
TOTAL	**326**	**14431**						

Table KT22 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	17 Yrs
Minimally Stabilised	15123	415537	0.9 (0.9, 1.0)	2.5 (2.5, 2.6)	3.4 (3.3, 3.4)	5.0 (4.9, 5.1)	7.2 (7.0, 7.3)	8.1 (7.8, 8.4)
Posterior Stabilised	6584	155163	1.2 (1.2, 1.3)	3.1 (3.0, 3.2)	4.1 (4.0, 4.2)	6.1 (6.0, 6.3)	8.2 (7.9, 8.6)	9.0 (8.4, 9.7)
Medial Pivot Design	286	13640	1.1 (1.0, 1.4)	2.7 (2.4, 3.1)	3.4 (2.9, 3.9)	5.3 (4.4, 6.4)	6.1 (4.9, 7.7)	
Fully Stabilised	108	2064	2.4 (1.8, 3.1)	4.8 (3.8, 5.9)	6.0 (4.9, 7.4)	9.3 (7.3, 11.7)		
Hinged	56	778	3.3 (2.2, 4.9)	6.0 (4.3, 8.2)	7.7 (5.7, 10.4)	14.4 (10.4, 19.8)		
TOTAL	**22157**	**587182**						

Note: Excludes 182 procedures with unknown stability

Figure KT25 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, 1.15),p=0.010
2Yr+: HR=1.23 (1.18, 1.28),p<0.001

Medial Pivot Design vs Minimally Stabilised
Entire Period: HR=1.08 (0.96, 1.21),p=0.209

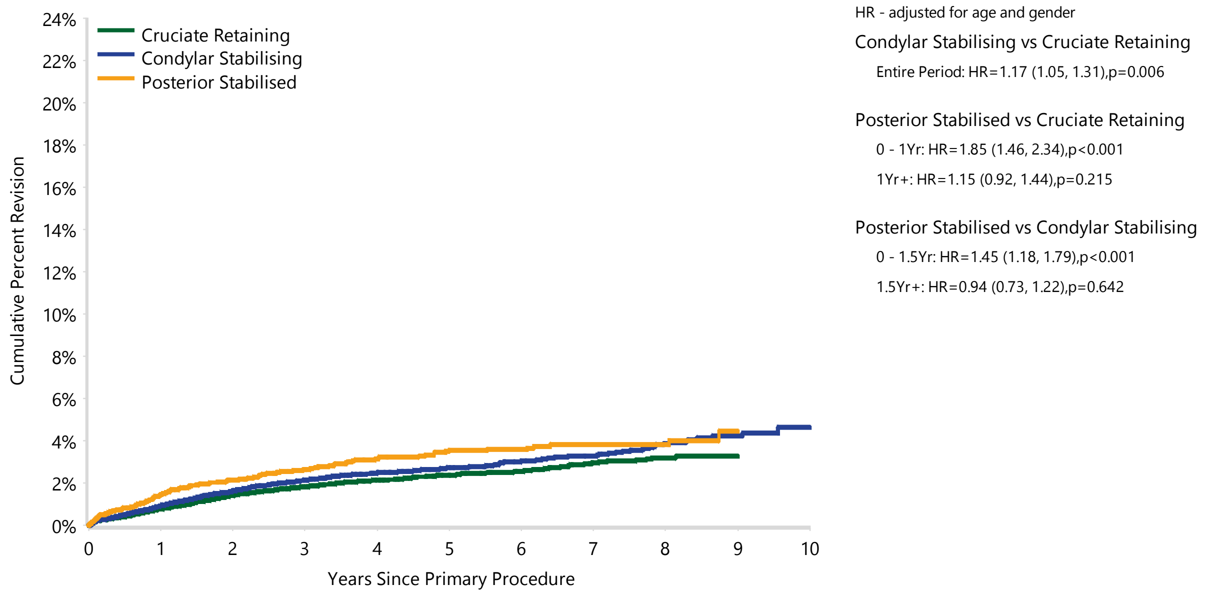
Posterior Stabilised vs Medial Pivot Design
Entire Period: HR=1.12 (1.00, 1.26),p=0.054

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Minimally Stabilised	415537	372136	292406	221657	88252	14910	1506
Posterior Stabilised	155163	140051	109446	81394	25119	2126	180
Medial Pivot Design	13640	9614	3398	1644	593	132	1

Table KT23 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	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Cruciate Retaining	560	29656	0.8 (0.7, 0.9)	1.4 (1.3, 1.6)	1.8 (1.7, 2.0)	2.4 (2.2, 2.6)	3.0 (2.7, 3.3)	
Condylar Stabilising	634	30346	0.9 (0.8, 1.1)	1.6 (1.5, 1.8)	2.1 (2.0, 2.3)	2.7 (2.5, 3.0)	3.3 (3.0, 3.6)	4.6 (3.9, 5.5)
Posterior Stabilised	182	6472	1.5 (1.2, 1.8)	2.2 (1.8, 2.6)	2.6 (2.2, 3.1)	3.5 (3.0, 4.1)	3.8 (3.3, 4.5)	
TOTAL	**1376**	**66474**						

Figure KT26 Cumulative Percent Revision of Triathlon/Triathlon Primary Total Knee Replacement with XLPE by Poly Shape (Primary Diagnosis OA)

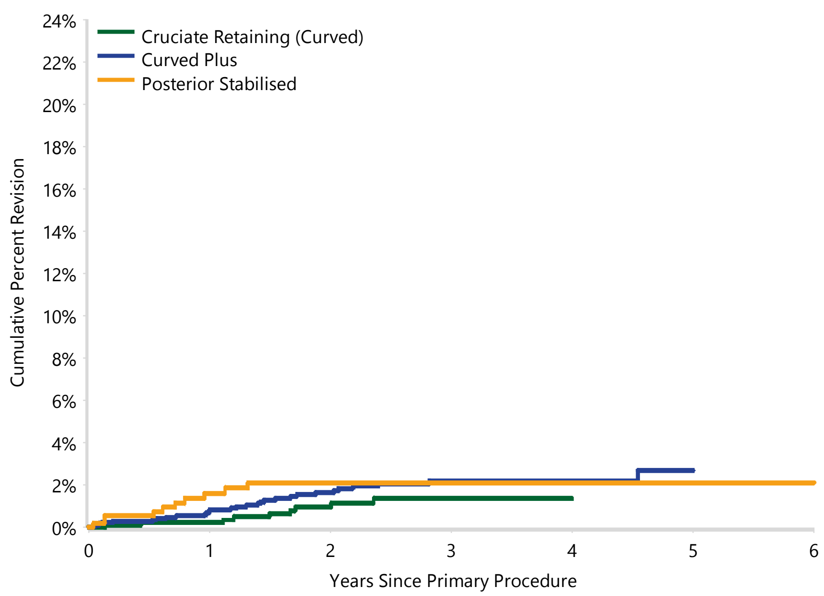


Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Cruciate Retaining	29656	24863	20745	16786	9333	3595	32
Condylar Stabilising	30346	24705	19461	15126	8310	3314	115
Posterior Stabilised	6472	5563	4696	3817	2192	828	31

Table KT24 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	4 Yrs	5 Yrs	6 Yrs
Cruciate Retaining (Curved)	9	943	0.2 (0.1, 0.9)	1.0 (0.5, 2.0)	1.4 (0.7, 2.6)	1.4 (0.7, 2.6)		
Curved Plus	29	1733	0.8 (0.5, 1.4)	1.6 (1.1, 2.5)	2.2 (1.5, 3.2)	2.2 (1.5, 3.2)	2.7 (1.7, 4.3)	
Posterior Stabilised	10	557	1.6 (0.8, 3.2)	2.1 (1.1, 3.9)	2.1 (1.1, 3.9)	2.1 (1.1, 3.9)	2.1 (1.1, 3.9)	2.1 (1.1, 3.9)
TOTAL	**48**	**3233**						

Figure KT27 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=1.77 (0.83, 3.74),p=0.137

Posterior Stabilised vs
Cruciate Retaining (Curved)
Entire Period: HR=1.95 (0.79, 4.82),p=0.149

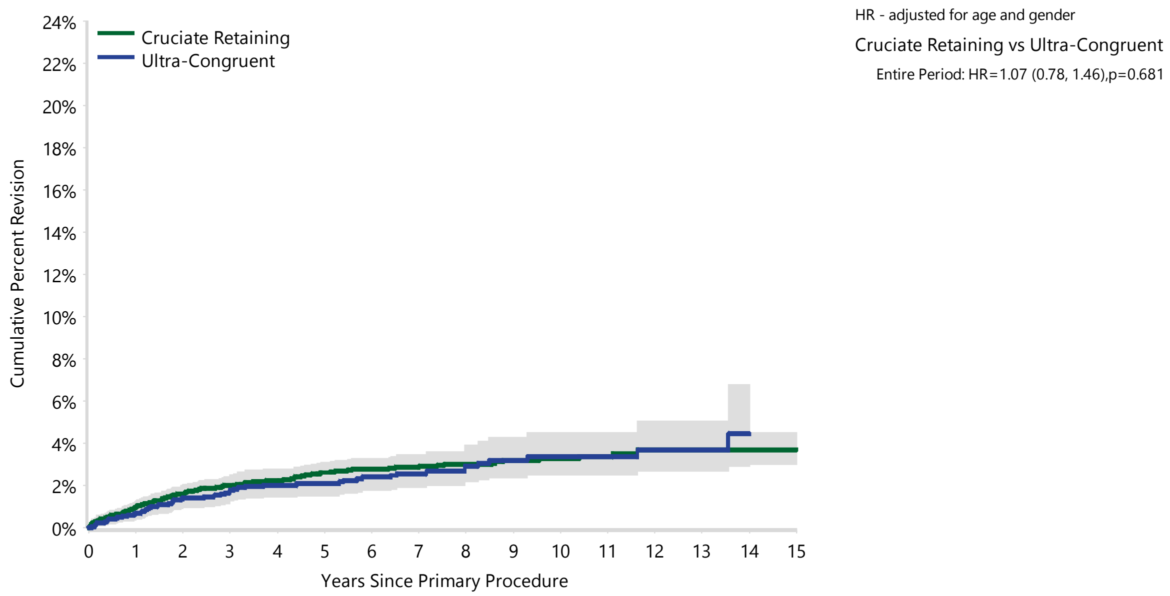
Curved Plus vs Posterior Stabilised
Entire Period: HR=0.91 (0.44, 1.87),p=0.791

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Cruciate Retaining (Curved)	943	779	545	400	144	6	5
Curved Plus	1733	1422	1008	613	306	133	34
Posterior Stabilised	557	429	294	194	170	139	46

Table KT25 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	15 Yrs
Cruciate Retaining	152	6062	1.0 (0.7, 1.3)	2.0 (1.7, 2.4)	2.6 (2.2, 3.1)	2.9 (2.5, 3.4)	3.3 (2.8, 3.9)	3.7 (3.0, 4.5)
Ultra-Congruent	52	2049	0.7 (0.4, 1.2)	1.8 (1.3, 2.5)	2.1 (1.5, 2.9)	2.6 (1.9, 3.5)	3.4 (2.5, 4.5)	
TOTAL	**204**	**8111**						

Figure KT28 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	15 Yrs
Cruciate Retaining	6062	5538	4449	3316	2254	947	40
Ultra-Congruent	2049	1892	1609	1382	1005	446	9

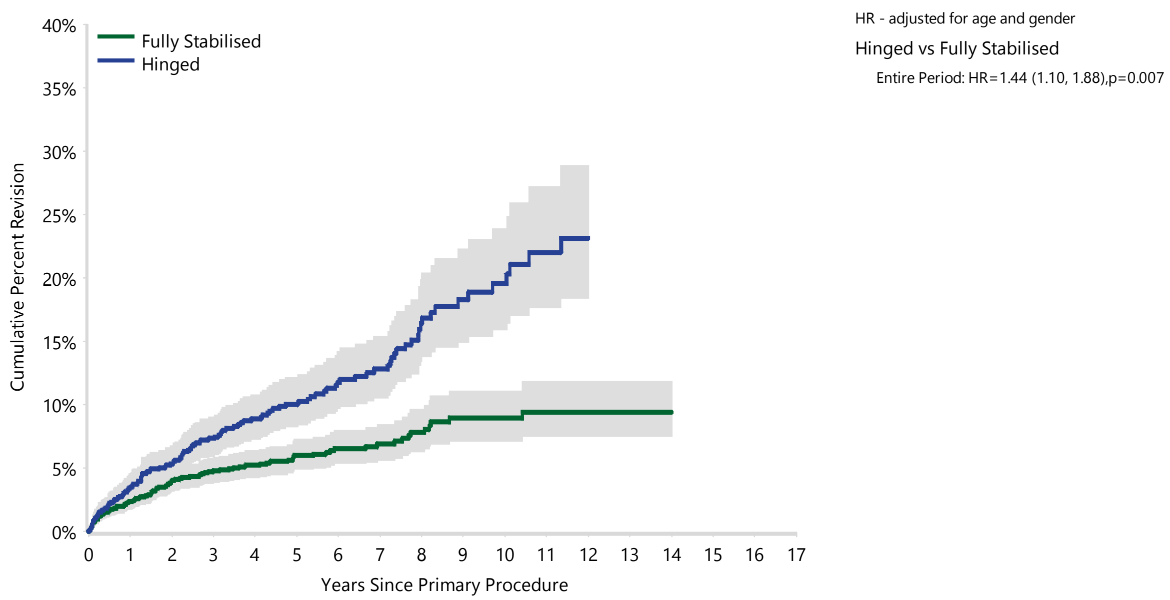
Table KT26 Primary Knee Replacement by Primary Diagnosis and Stability

	Fully Stabilised		Hinged		TOTAL	
Primary Diagnosis	N	Col%	N	Col%	N	Col%
Osteoarthritis	2064	90.2	778	51.5	2842	74.8
Tumour	7	0.3	478	31.6	485	12.8
Rheumatoid Arthritis	118	5.2	48	3.2	166	4.4
Fracture	33	1.4	121	8.0	154	4.1
Osteonecrosis	27	1.2	24	1.6	51	1.3
Other Inflammatory Arthritis	20	0.9	22	1.5	42	1.1
Other	20	0.9	40	2.6	60	1.6
TOTAL	**2289**	**100.0**	**1511**	**100.0**	**3800**	**100.0**

Table KT27 Cumulative Percent Revision of Primary Total Knee Replacement by Stability (All Diagnoses)

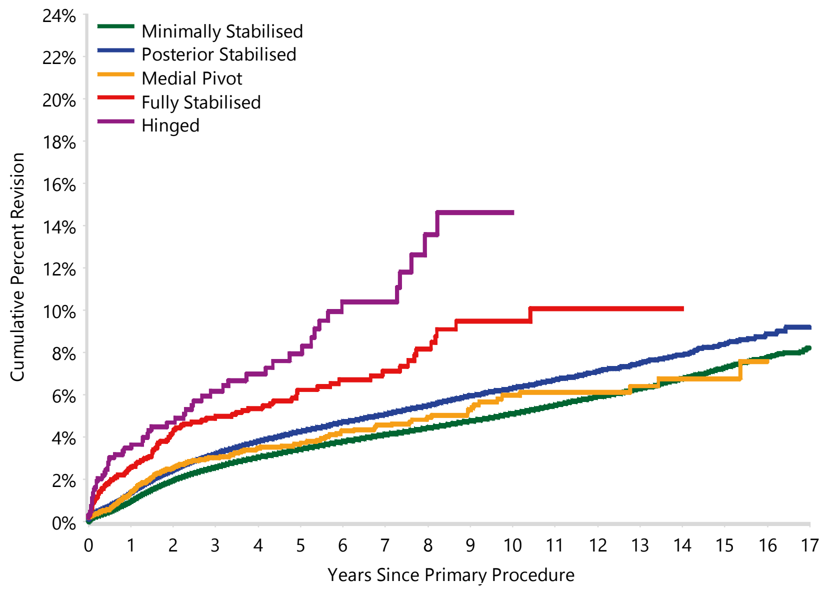
Stability	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Fully Stabilised	119	2289	2.4 (1.8, 3.1)	4.8 (3.9, 5.9)	6.0 (4.9, 7.3)	8.9 (7.2, 11.1)		
Hinged	137	1511	3.4 (2.6, 4.5)	7.3 (6.0, 9.0)	10.0 (8.3, 12.2)	19.5 (15.9, 23.9)		
TOTAL	**256**	**3800**						

Figure KT29 Cumulative Percent Revision of Primary Total Knee Replacement by Stability (All Diagnoses)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Fully Stabilised	2289	1900	1230	793	199	37	1
Hinged	1511	1144	717	476	108	14	2

Figure KT30 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, 1.15),p=0.010
2Yr+: HR=1.23 (1.18, 1.28),p<0.001

Medial Pivot vs Minimally Stabilised
Entire Period: HR=1.12 (1.00, 1.25),p=0.041

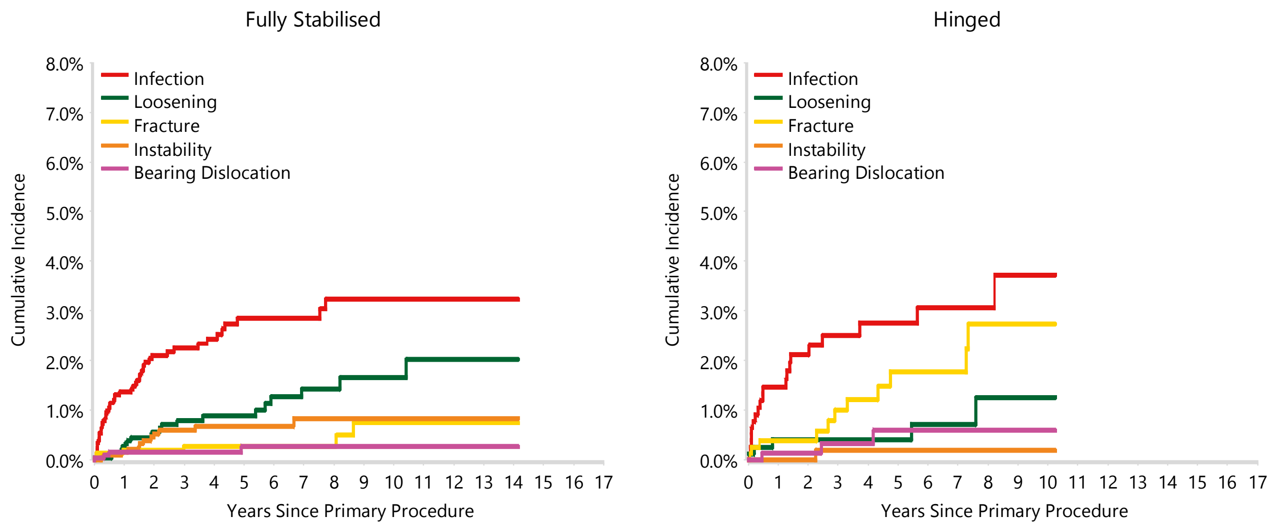
Fully Stabilised vs Minimally Stabilised
0 - 3Mth: HR=4.10 (2.74, 6.14),p<0.001
3Mth - 1.5Yr: HR=1.57 (1.11, 2.21),p=0.009
1.5Yr+: HR=1.68 (1.27, 2.21),p<0.001

Hinged vs Minimally Stabilised
0 - 6Mth: HR=5.90 (3.84, 9.06),p<0.001
6Mth - 1.5Yr: HR=1.35 (0.70, 2.60),p=0.364
1.5Yr+: HR=2.25 (1.53, 3.30),p<0.001

Table KT28 Revision Diagnosis of Primary Total Knee Replacement by Stability (Primary Diagnoses OA)

Revision Diagnosis	Fully Stabilised Number	Fully Stabilised % Primaries Revised	Fully Stabilised % Revisions	Hinged Number	Hinged % Primaries Revised	Hinged % Revisions
Infection	49	2.4	45.4	21	2.7	37.5
Loosening	20	1.0	18.5	5	0.6	8.9
Instability	13	0.6	12.0	1	0.1	1.8
Fracture	7	0.3	6.5	11	1.4	19.6
Bearing Dislocation	4	0.2	3.7	3	0.4	5.4
Patella Erosion	4	0.2	3.7	2	0.3	3.6
Other	11	0.5	10.2	13	1.7	23.2
N Revision	**108**	**5.2**	**100.0**	**56**	**7.2**	**100.0**
N Primary	**2064**			**778**		

Figure KT31 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by Bearing Mobility (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 KT29 and Figure KT32).

When resurfacing the patella, the rate of revision is lower for minimally stabilised compared to posterior stabilised prostheses within the first five years. Posterior stabilised without patellar resurfacing has the highest rate of revision (Table KT30 and Figure KT33).

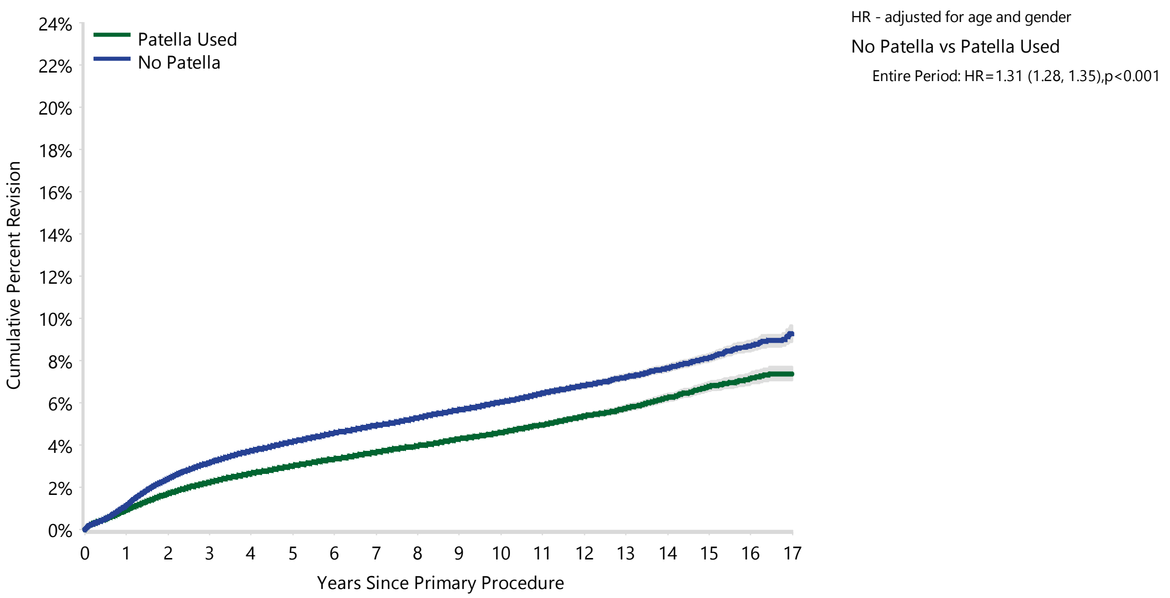
When the patella is resurfaced, there is no difference in the rate of revision for medial pivot design prostheses compared to minimally stabilised prostheses. When the patella is not resurfaced, medial pivot design prostheses have a higher rate of revision than minimally stabilised knee prostheses (Figure KT34).

Outcomes related to the use of patellar resurfacing vary depending on the type of prosthesis used.

Table KT29 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	17 Yrs
Patella Used	9385	311360	0.9 (0.9, 1.0)	2.2 (2.2, 2.3)	3.0 (3.0, 3.1)	4.6 (4.5, 4.7)	6.8 (6.6, 7.0)	7.4 (7.0, 7.7)
No Patella	12820	276830	1.1 (1.1, 1.2)	3.2 (3.1, 3.2)	4.2 (4.1, 4.2)	6.0 (5.9, 6.2)	8.1 (7.9, 8.3)	9.3 (8.9, 9.7)
TOTAL	**22205**	**588190**						

Figure KT32 Cumulative Percent Revision of Primary Total Knee Replacement by Patella Usage (Primary Diagnosis OA)

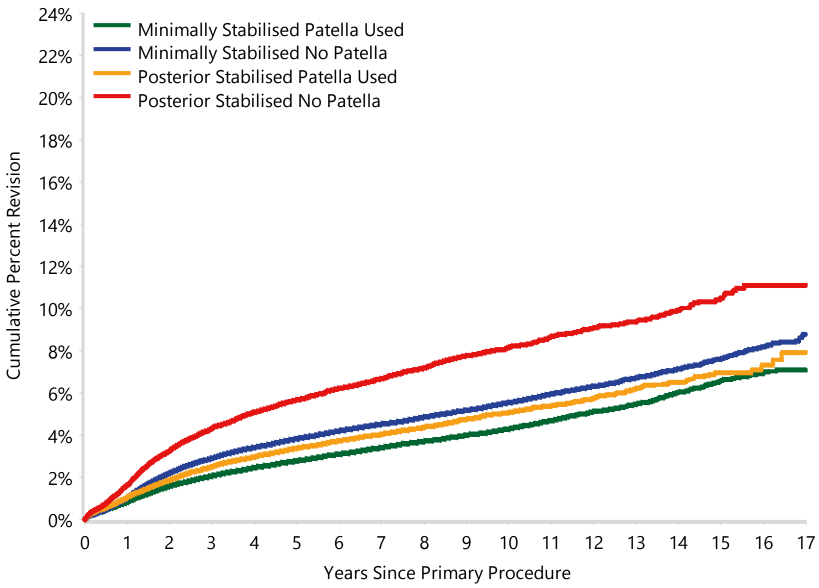


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Patella Used	311360	271213	200813	144126	49743	7294	551
No Patella	276830	253785	206568	162050	64547	9945	1144

Table KT30 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	17 Yrs
Minimally Stabilised	Patella Used	5543	191327	0.8 (0.8, 0.9)	2.1 (2.0, 2.1)	2.8 (2.7, 2.9)	4.3 (4.2, 4.4)	6.6 (6.3, 6.9)	7.1 (6.7, 7.5)
	No Patella	9580	224210	1.0 (1.0, 1.1)	2.9 (2.8, 3.0)	3.8 (3.7, 3.9)	5.5 (5.4, 5.7)	7.6 (7.4, 7.8)	8.8 (8.3, 9.2)
Posterior Stabilised	Patella Used	3636	110442	1.0 (1.0, 1.1)	2.5 (2.4, 2.6)	3.4 (3.3, 3.5)	5.1 (4.9, 5.3)	6.9 (6.5, 7.4)	7.9 (6.9, 9.1)
	No Patella	2949	44756	1.6 (1.5, 1.8)	4.3 (4.1, 4.5)	5.7 (5.5, 5.9)	8.1 (7.8, 8.5)	10.5 (9.9, 11.2)	11.1 (10.3, 12.0)
Medial Pivot Design	Patella Used	111	7691	0.9 (0.7, 1.2)	2.0 (1.6, 2.5)	2.6 (2.1, 3.2)	3.7 (2.6, 5.5)		
	No Patella	215	6740	1.5 (1.2, 1.8)	3.6 (3.1, 4.2)	4.3 (3.7, 5.1)	7.0 (5.8, 8.5)	8.0 (6.4, 9.9)	
TOTAL		**22034**	**585166**						

Figure KT33 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

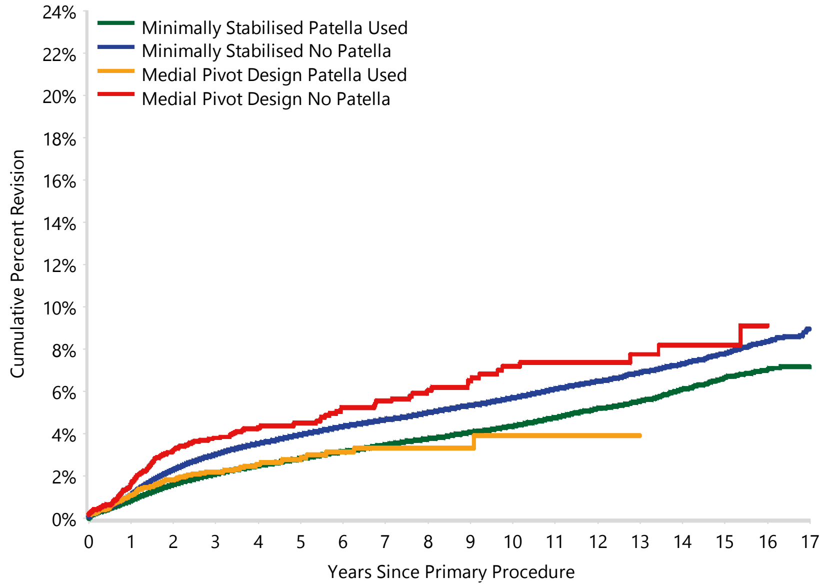
Minimally Stabilised Patella Used vs Posterior Stabilised Patella Used
0 - 2Yr: HR=0.84 (0.79, 0.88),p<0.001
2Yr - 2.5Yr: HR=0.72 (0.64, 0.81),p<0.001
2.5Yr - 3Yr: HR=0.84 (0.73, 0.96),p=0.010
3Yr - 3.5Yr: HR=0.81 (0.70, 0.94),p=0.004
3.5Yr - 5Yr: HR=0.86 (0.78, 0.96),p=0.005
5Yr+: HR=1.01 (0.94, 1.08),p=0.827

Minimally Stabilised No Patella vs Posterior Stabilised No Patella
Entire Period: HR=0.67 (0.64, 0.70),p<0.001

Posterior Stabilised Patella Used vs Posterior Stabilised No Patella
Entire Period: HR=0.61 (0.58, 0.64),p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Minimally Stabilised	Patella Used	191327	166537	124809	90887	34792	6008	456
	No Patella	224210	205599	167597	130770	53460	8902	1050
Posterior Stabilised	Patella Used	110442	98074	73348	51881	14694	1244	94
	No Patella	44756	42009	36128	29541	10450	904	86

Figure KT34 Cumulative Percent Revision of Primary Total Knee Replacement by Stability and Patella Usage (Primary Diagnosis OA)



HR - adjusted for age and gender

Minimally Stabilised Patella Used vs Minimally Stabilised No Patella
Entire Period: HR=0.78 (0.75, 0.81),p<0.001

Minimally Stabilised No Patella vs Medial Pivot Design No Patella
Entire Period: HR=0.79 (0.69, 0.90),p<0.001

Minimally Stabilised Patella Used vs Medial Pivot Design Patella Used
Entire Period: HR=1.06 (0.88, 1.28),p=0.537

Medial Pivot Design Patella Used vs Medial Pivot Design No Patella
Entire Period: HR=0.58 (0.46, 0.73),p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Minimally Stabilised	Patella Used	191327	166537	124809	90887	34792	6008	456
	No Patella	224210	205599	167597	130770	53460	8902	1050
Medial Pivot Design	Patella Used	7691	5096	1751	806	140	23	0
	No Patella	6740	5201	2126	1220	483	114	6

Fixation

The effect of fixation varies depending on implant 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 KT31 and Figure KT35).

When a posterior stabilised knee is used, cemented fixation has a lower rate of revision compared to cementless fixation within the first 1.5 years. After three 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 KT32 and Figure KT36).

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.

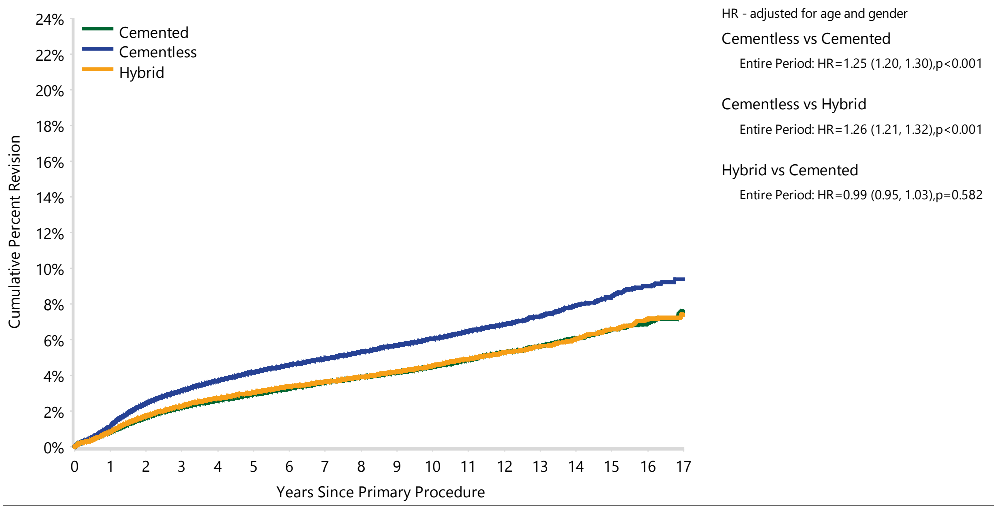
When a medial pivot design prosthesis is used there is no difference between cemented and hybrid fixation or between hybrid and cementless fixation. Cementless fixation has a higher rate of revision compared to cemented fixation (Table KT33 and Figure KT37).

Table KT31 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	17 Yrs
Cemented	5407	178279	0.8 (0.8, 0.9)	2.2 (2.1, 2.3)	2.9 (2.9, 3.0)	4.5 (4.4, 4.6)	6.6 (6.3, 6.9)	7.6 (7.0, 8.2)
Cementless	5230	107505	1.2 (1.1, 1.2)	3.2 (3.0, 3.3)	4.2 (4.1, 4.3)	6.0 (5.9, 6.2)	8.4 (8.1, 8.7)	9.4 (8.8, 10.0)
Hybrid	4284	129334	0.8 (0.8, 0.9)	2.3 (2.2, 2.4)	3.1 (2.9, 3.2)	4.5 (4.4, 4.7)	6.6 (6.3, 6.9)	7.4 (6.9, 7.9)
TOTAL	**14921**	**415118**						

Note: Excluding cementless Genesis Oxinium and Profix Oxinium femoral prostheses

Figure KT35 Cumulative Percent Revision of Minimally Stabilised Primary Total Knee Replacement by Fixation (Primary Diagnosis OA)

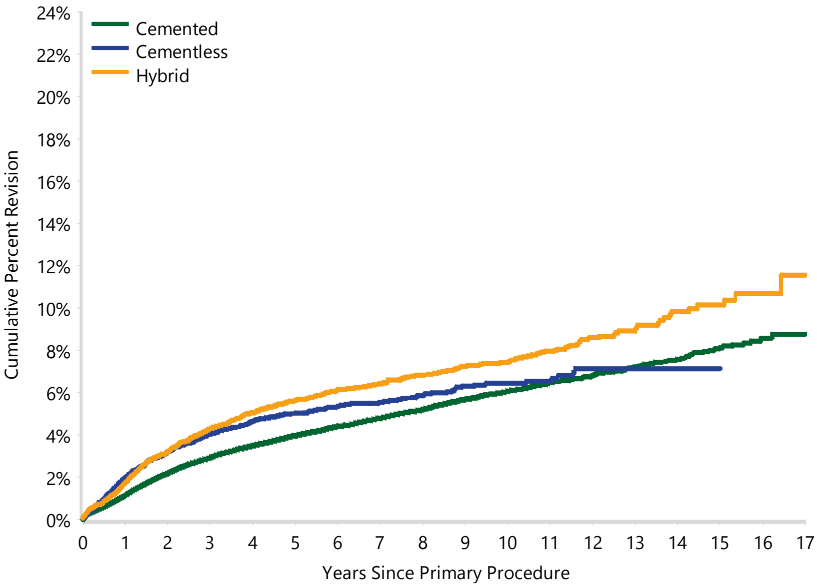


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Cemented	178279	154712	115525	85792	33424	5747	603
Cementless	107505	100277	84903	67594	26799	4049	408
Hybrid	129334	116790	91746	68051	27855	5086	495

Table KT32 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	17 Yrs
Cemented	5472	135641	1.1 (1.1, 1.2)	2.9 (2.8, 3.0)	3.9 (3.8, 4.0)	6.0 (5.8, 6.2)	8.1 (7.7, 8.5)	8.7 (8.0, 9.4)
Cementless	369	7433	1.9 (1.6, 2.3)	4.0 (3.5, 4.4)	5.0 (4.5, 5.5)	6.4 (5.7, 7.1)	7.1 (6.2, 8.1)	
Hybrid	744	12124	1.7 (1.5, 1.9)	4.2 (3.9, 4.6)	5.6 (5.1, 6.0)	7.3 (6.8, 7.9)	10.0 (9.0, 11.2)	11.5 (9.5, 13.9)
TOTAL	**6585**	**155198**						

Figure KT36 Cumulative Percent Revision of Posterior Stabilised Primary Total Knee Replacement by Fixation (Primary Diagnosis OA)



HR - adjusted for age and gender

Cementless vs Cemented

0 - 1.5Yr: HR=1.42 (1.22, 1.64),p<0.001

1.5Yr - 2.5Yr: HR=0.93 (0.71, 1.21),p=0.568

2.5Yr - 3Yr: HR=1.16 (0.77, 1.76),p=0.470

3Yr+: HR=0.75 (0.61, 0.91),p=0.004

Hybrid vs Cemented

0 - 1.5Yr: HR=1.49 (1.32, 1.68),p<0.001

1.5Yr+: HR=1.16 (1.05, 1.28),p=0.004

Hybrid vs Cementless

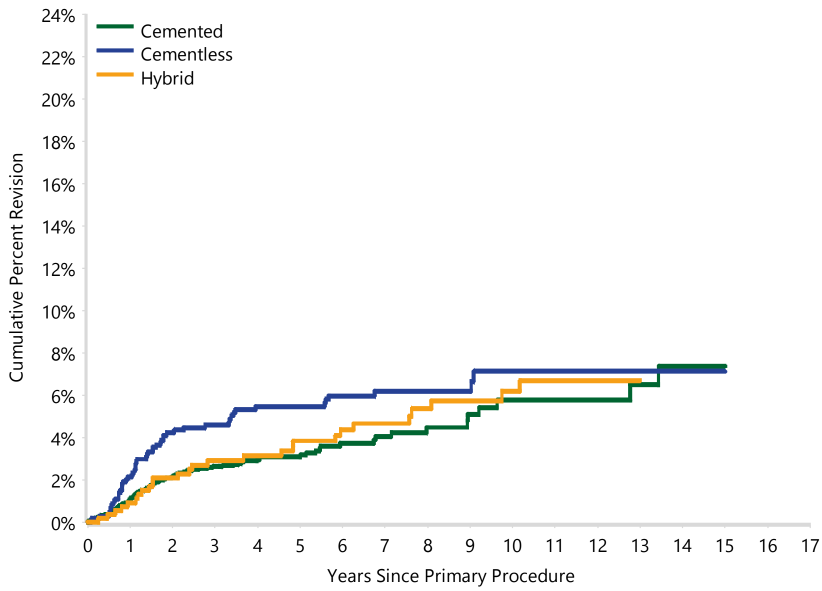
Entire Period: HR=1.23 (1.08, 1.39),p=0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Cemented	135641	122099	94396	69354	20910	1699	129
Cementless	7433	6784	5596	4461	1089	49	2
Hybrid	12124	11200	9484	7607	3145	400	49

Table KT33 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	17 Yrs
Cemented	243	12844	1.1 (0.9, 1.3)	2.6 (2.3, 3.0)	3.1 (2.6, 3.6)	5.8 (4.4, 7.6)	7.4 (5.1, 10.6)	
Cementless	56	1043	2.1 (1.4, 3.3)	4.6 (3.4, 6.2)	5.5 (4.2, 7.2)	7.1 (5.3, 9.5)	7.1 (5.3, 9.5)	
Hybrid	27	544	0.9 (0.4, 2.2)	2.9 (1.8, 4.8)	3.9 (2.5, 6.0)	6.2 (4.2, 9.1)		
TOTAL	**326**	**14431**						

Figure KT37 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=1.51 (1.12, 2.05),p=0.007

Cementless vs Hybrid

Entire Period: HR=1.20 (0.75, 1.90),p=0.446

Hybrid vs Cemented

Entire Period: HR=1.26 (0.84, 1.91),p=0.264

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Cemented	12844	8853	2719	1036	246	66	5
Cementless	1043	923	704	587	184	60	1
Hybrid	544	521	454	403	193	11	0

Computer Navigation

There have been 114,859 primary total knee replacement procedures reported to the Registry in which computer navigation was used. In 2017, computer navigation was used in 33.6% of all primary total knee replacement procedures.

Patients aged less than 65 years have a lower rate of revision when computer navigation is used. There is no difference in the rate of revision for the 65 years or older age group where computer navigation is used (Table KT34 and Figure KT38). However, there is a reduction in the rate of revision for navigated knee replacement for loosening in both age groups (Figure KT39).

Image Derived Instrumentation (IDI)

There have been 26,920 primary total knee replacement procedures undertaken using IDI since 2009. In 2017, IDI was used in 11.1% of all primary total knee replacement procedures.

There is a lower rate of revision in the first three months when IDI is used compared to when it is not. From three months to 1.5 years this is reversed and there is a higher rate of revision. After this time, there is no difference (Table KT35 and Figure KT40). When reasons for revision are compared, there is an increased cumulative incidence of loosening when IDI is used (Figure KT41).

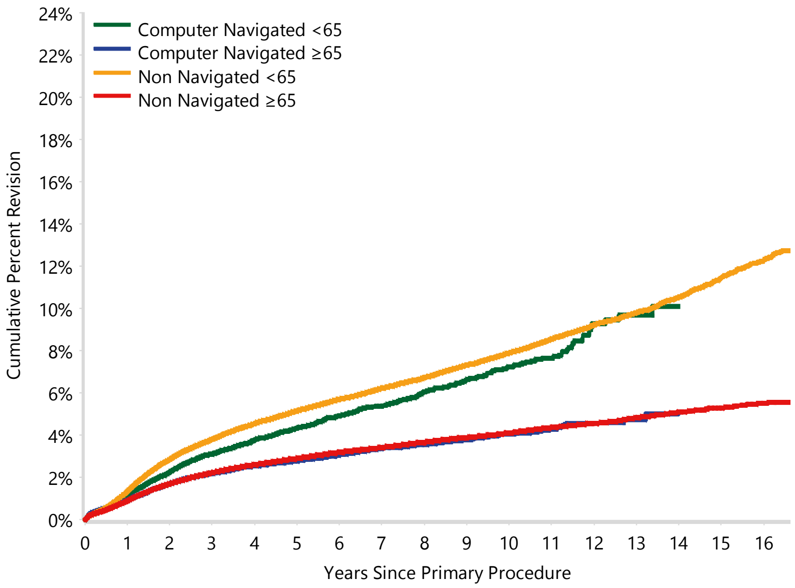
Where IDI is used for patients aged 65 years or older, there is a lower rate of revision in the first three months and a higher rate of revision after three months compared to when it is not used. There is no difference with IDI use for patients aged less than 65 years (Table KT36 and Figure KT42).

There are prosthesis specific differences in revision rates when IDI is used. There are 10 prostheses with over 500 procedures each with and without IDI, which have over three years follow up. There is no difference in the rate of revision for eight of these knee prostheses when IDI is used compared to when it is not used. The Genesis II PS and Legion PS (after 1.5 years) have a higher rate of revision when IDI is used (Tables KT37 and KT38).

Table KT34 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	17 Yrs
Computer Navigated		**3168**	**114859**	**1.0 (0.9, 1.0)**	**2.5 (2.4, 2.6)**	**3.3 (3.2, 3.5)**	**5.2 (5.0, 5.5)**		
	<65	1471	40390	1.1 (1.0, 1.2)	3.1 (2.9, 3.3)	4.3 (4.1, 4.6)	7.2 (6.7, 7.7)		
	≥65	1697	74469	0.9 (0.8, 1.0)	2.2 (2.1, 2.3)	2.8 (2.7, 2.9)	4.1 (3.8, 4.3)		
Non Navigated		**19037**	**473331**	**1.0 (1.0, 1.1)**	**2.7 (2.7, 2.8)**	**3.6 (3.6, 3.7)**	**5.4 (5.3, 5.4)**	**7.5 (7.3, 7.7)**	**8.4 (8.1, 8.7)**
	<65	9229	153271	1.3 (1.3, 1.4)	3.8 (3.7, 3.9)	5.1 (5.0, 5.3)	7.9 (7.7, 8.1)	11.5 (11.1, 11.8)	13.2 (12.6, 13.9)
	≥65	9808	320060	0.9 (0.9, 0.9)	2.2 (2.2, 2.3)	2.9 (2.8, 3.0)	4.1 (4.0, 4.2)	5.3 (5.1, 5.5)	5.6 (5.4, 5.8)
TOTAL		**22205**	**588190**						

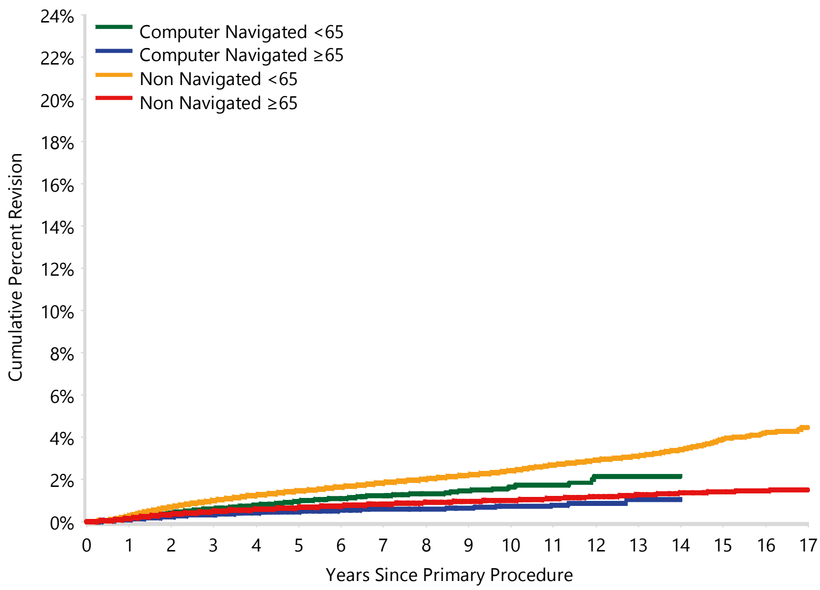
Figure KT38 Cumulative Percent Revision of Primary Total Knee Replacement by Computer Navigation and Age (Primary Diagnosis OA)



HR - adjusted for gender
Computer Navigated <65 vs Computer Navigated ≥65
0 - 3Mth: HR=1.03 (0.85, 1.24),p=0.773
3Mth - 1Yr: HR=1.38 (1.20, 1.58),p<0.001
1Yr - 2Yr: HR=1.41 (1.25, 1.59),p<0.001
2Yr - 2.5Yr: HR=1.86 (1.55, 2.24),p<0.001
2.5Yr - 3.5Yr: HR=1.52 (1.27, 1.82),p<0.001
3.5Yr - 5.5Yr: HR=2.06 (1.76, 2.42),p<0.001
5.5Yr+: HR=2.48 (2.11, 2.91),p<0.001
Computer Navigated <65 vs Non Navigated <65
Entire Period: HR=0.86 (0.81, 0.91),p<0.001
Computer Navigated ≥65 vs Non Navigated ≥65
0 - 1.5Yr: HR=1.00 (0.93, 1.07),p=0.948
1.5Yr+: HR=0.97 (0.91, 1.05),p=0.455
Non Navigated <65 vs Non Navigated ≥65
0 - 3Mth: HR=1.08 (0.97, 1.19),p=0.147
3Mth - 9Mth: HR=1.62 (1.49, 1.76),p<0.001
9Mth - 2Yr: HR=1.85 (1.76, 1.95),p<0.001
2Yr - 3Yr: HR=1.83 (1.70, 1.97),p<0.001
3Yr - 3.5Yr: HR=1.90 (1.69, 2.14),p<0.001
3.5Yr - 6.5Yr: HR=2.07 (1.94, 2.22),p<0.001
6.5Yr - 7Yr: HR=2.60 (2.13, 3.18),p<0.001
7Yr - 8Yr: HR=2.17 (1.87, 2.52),p<0.001
8Yr - 10.5Yr: HR=2.63 (2.35, 2.94),p<0.001
10.5Yr+: HR=3.19 (2.83, 3.61),p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Computer Navigated		**114859**	**95355**	**62928**	**39490**	**5495**	**3**	**0**
	<65	40390	33675	22446	14565	2106	0	0
	≥65	74469	61680	40482	24925	3389	3	0
Non Navigated		**473331**	**429643**	**344453**	**266686**	**108795**	**17236**	**1695**
	<65	153271	139260	111809	87557	37758	7026	725
	≥65	320060	290383	232644	179129	71037	10210	970

Figure KT39 Cumulative Percent Revision for Loosening of Primary Total Knee Replacement by Computer Navigation and Age (Primary Diagnosis OA)



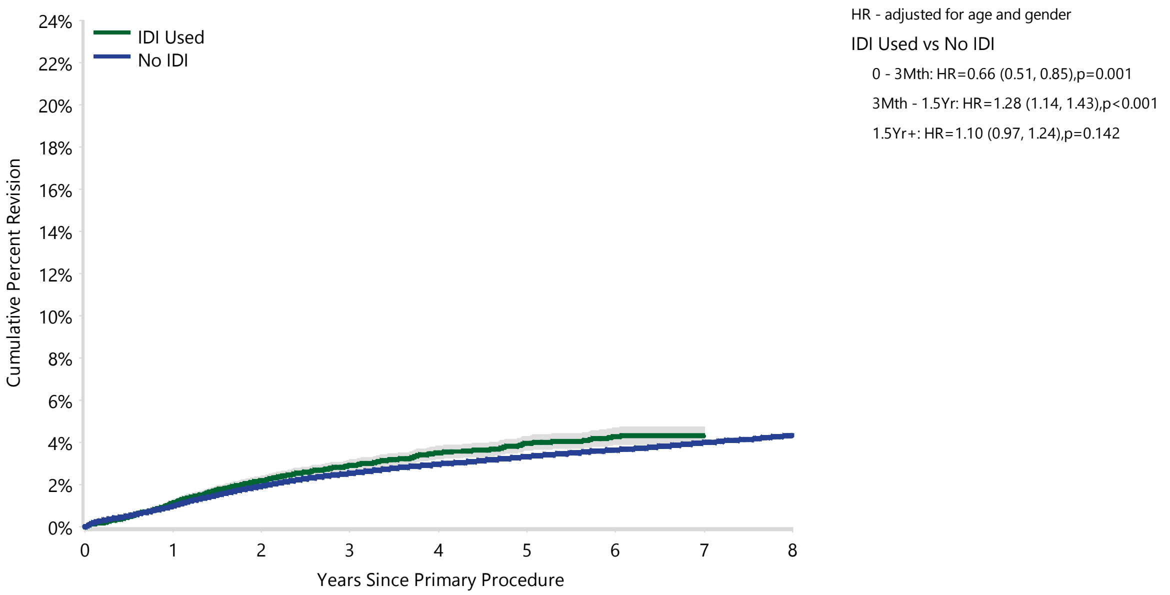
HR - adjusted for gender
Computer Navigated <65 vs Computer Navigated ≥65
0 - 2.5Yr: HR=1.71 (1.41, 2.08),p<0.001
2.5Yr+: HR=2.45 (1.99, 3.03),p<0.001
Computer Navigated <65 vs Non Navigated <65
Entire Period: HR=0.65 (0.57, 0.73),p<0.001
Computer Navigated ≥65 vs Non Navigated ≥65
Entire Period: HR=0.72 (0.63, 0.81),p<0.001
Non Navigated <65 vs Non Navigated ≥65
0 - 3Mth: HR=1.16 (0.84, 1.59),p=0.365
3Mth - 6Mth: HR=1.75 (1.31, 2.34),p<0.001
6Mth - 9Mth: HR=1.94 (1.54, 2.44),p<0.001
9Mth - 1.5Yr: HR=2.17 (1.92, 2.45),p<0.001
1.5Yr - 2Yr: HR=1.97 (1.66, 2.34),p<0.001
2Yr - 3Yr: HR=2.14 (1.86, 2.47),p<0.001
3Yr - 3.5Yr: HR=2.57 (2.04, 3.25),p<0.001
3.5Yr - 4Yr: HR=3.14 (2.41, 4.09),p<0.001
4Yr - 8.5Yr: HR=2.50 (2.24, 2.80),p<0.001
8.5Yr+: HR=3.36 (2.87, 3.93),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Computer Navigated	**114859**	**95355**	**62928**	**39490**	**5495**	**3**	**0**
<65	40390	33675	22446	14565	2106	0	0
≥65	74469	61680	40482	24925	3389	3	0
Non Navigated	**473331**	**429643**	**344453**	**266686**	**108795**	**17236**	**1695**
<65	153271	139260	111809	87557	37758	7026	725
≥65	320060	290383	232644	179129	71037	10210	970

Table KT35 Cumulative Percent Revision of Primary Total Knee Replacement since 2009 by IDI Usage (Primary Diagnosis OA)

IDI Usage	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs	8 Yrs
IDI Used	656	26920	1.1 (1.0, 1.3)	2.2 (2.0, 2.4)	2.9 (2.7, 3.2)	3.5 (3.2, 3.8)	3.9 (3.6, 4.3)	4.3 (3.9, 4.7)	4.3 (3.9, 4.7)	
No IDI	10043	369515	1.0 (1.0, 1.0)	1.9 (1.9, 2.0)	2.5 (2.5, 2.6)	3.0 (2.9, 3.0)	3.3 (3.3, 3.4)	3.7 (3.6, 3.7)	4.0 (3.9, 4.1)	4.3 (4.2, 4.4)
TOTAL	**10699**	**396435**								

Figure KT40 Cumulative Percent Revision of Primary Total Knee Replacement since 2009 by IDI Usage (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs	8 Yrs
IDI Used	26920	20643	15089	10673	7557	4736	2567	745	28
No IDI	369515	316581	266017	217815	173036	132101	94081	59158	27323

Figure KT41 Cumulative Percent Revision of Primary Total Knee Replacement since 2009 by IDI Usage (Primary Diagnosis OA)

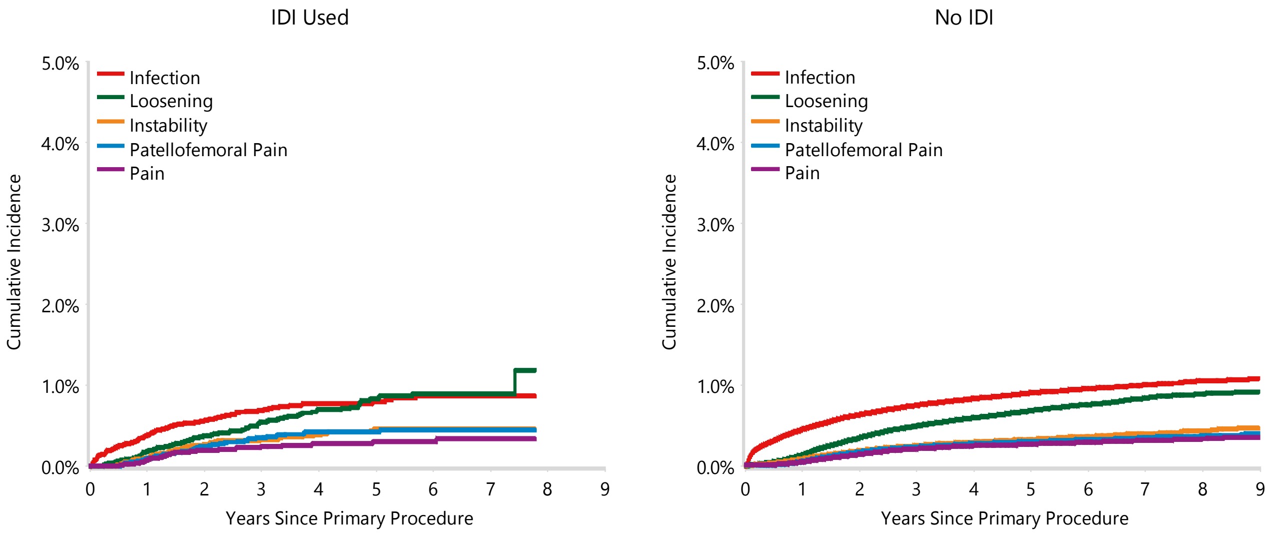
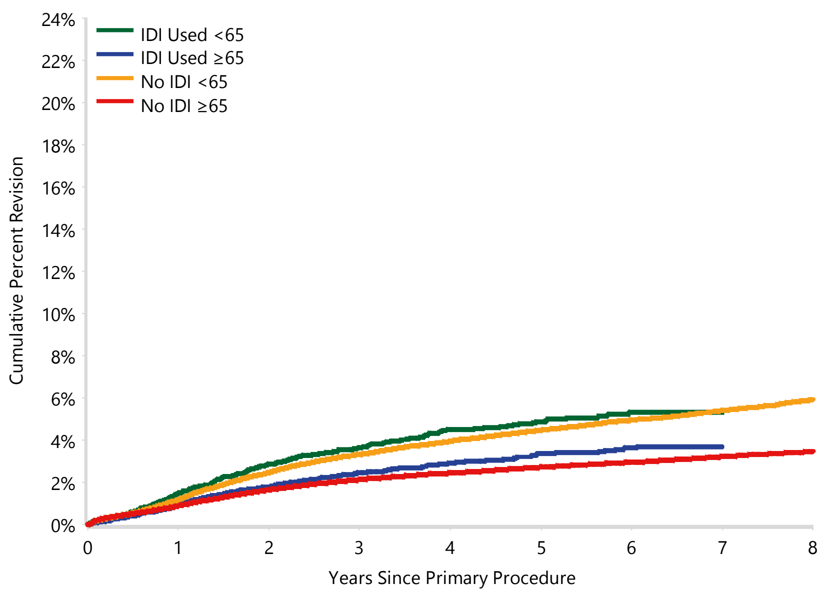


Table KT36 Cumulative Percent Revision of Primary Total Knee Replacement since 2009 by IDI Usage and Age (Primary Diagnosis OA)

IDI Usage	Age	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs	8 Yrs
IDI Used		**656**	**26920**	**1.1 (1.0, 1.3)**	**2.2 (2.0, 2.4)**	**2.9 (2.7, 3.2)**	**3.5 (3.2, 3.8)**	**3.9 (3.6, 4.3)**	**4.3 (3.9, 4.7)**	**4.3 (3.9, 4.7)**	
	<65	314	9974	1.5 (1.3, 1.8)	2.9 (2.5, 3.3)	3.7 (3.2, 4.1)	4.5 (4.0, 5.1)	4.9 (4.3, 5.5)	5.3 (4.7, 6.0)	5.3 (4.7, 6.0)	
	≥65	342	16946	0.9 (0.8, 1.1)	1.8 (1.6, 2.0)	2.5 (2.2, 2.8)	2.9 (2.6, 3.3)	3.4 (3.0, 3.8)	3.6 (3.2, 4.1)	3.7 (3.2, 4.2)	
No IDI		**10043**	**369515**	**1.0 (1.0, 1.0)**	**1.9 (1.9, 2.0)**	**2.5 (2.5, 2.6)**	**3.0 (2.9, 3.0)**	**3.3 (3.3, 3.4)**	**3.7 (3.6, 3.7)**	**4.0 (3.9, 4.1)**	**4.3 (4.2, 4.4)**
	<65	4634	125722	1.2 (1.1, 1.3)	2.5 (2.4, 2.6)	3.3 (3.2, 3.4)	4.0 (3.8, 4.1)	4.5 (4.3, 4.6)	5.0 (4.8, 5.1)	5.4 (5.2, 5.6)	5.9 (5.7, 6.1)
	≥65	5409	243793	0.9 (0.9, 0.9)	1.7 (1.6, 1.7)	2.1 (2.1, 2.2)	2.5 (2.4, 2.5)	2.7 (2.6, 2.8)	3.0 (2.9, 3.0)	3.2 (3.1, 3.3)	3.5 (3.4, 3.6)
TOTAL		**10699**	**396435**								

Figure KT42 Cumulative Percent Revision Diagnosis 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=1.50 (1.28, 1.74),p<0.001

IDI Used <65 vs No IDI <65

Entire Period: HR=1.09 (0.97, 1.22),p=0.135

IDI Used ≥65 vs No IDI ≥65

0 - 3Mth: HR=0.65 (0.56, 0.75),p<0.001

3Mth+: HR=1.28 (1.14, 1.43),p<0.001

No IDI <65 vs No IDI ≥65

0 - 3Mth: HR=0.89 (0.80, 1.00),p=0.047

3Mth - 1.5Yr: HR=1.69 (1.59, 1.80),p<0.001

1.5Yr - 2Yr: HR=1.60 (1.43, 1.79),p<0.001

2Yr+: HR=1.89 (1.77, 2.01),p<0.001

Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs	8 Yrs
IDI Used		**26920**	**20643**	**15089**	**10673**	**7557**	**4736**	**2567**	**745**	**28**
	<65	9974	7771	5788	4167	3034	1902	1060	323	12
	≥65	16946	12872	9301	6506	4523	2834	1507	422	16
No IDI		**369515**	**316581**	**266017**	**217815**	**173036**	**132101**	**94081**	**59158**	**27323**
	<65	125722	108275	91223	75310	60694	47012	34211	21738	10175
	≥65	243793	208306	174794	142505	112342	85089	59870	37420	17148

Table KT37 Cumulative Percent Revision of Primary Total Knee Replacement by Prosthesis Combination and IDI Usage since 2009 (Primary Diagnosis OA)

Prosthesis Combination	IDI Usage	N Revised	N Total	1 Yr	3 Yrs	4 Yrs	6 Yrs	7 Yrs	8 Yrs
Evolution	IDI Used	29	1872	1.3 (0.8, 2.1)	2.8 (1.9, 4.2)				
	No IDI	39	2939	0.8 (0.5, 1.2)	2.1 (1.5, 3.0)	2.1 (1.5, 3.0)			
GMK Primary	IDI Used	9	618	0.8 (0.3, 2.2)	2.4 (1.2, 4.7)	2.4 (1.2, 4.7)			
	No IDI	50	1324	1.1 (0.6, 1.8)	3.3 (2.5, 4.5)	3.8 (2.8, 5.0)	4.3 (3.1, 5.9)	5.9 (3.3, 10.3)	
Genesis II CR	IDI Used	32	1024	1.3 (0.8, 2.3)	3.2 (2.2, 4.7)	3.6 (2.5, 5.2)	4.2 (2.9, 6.1)		
	No IDI	360	12136	0.9 (0.8, 1.1)	2.4 (2.2, 2.8)	2.9 (2.6, 3.2)	3.8 (3.4, 4.3)	4.0 (3.6, 4.5)	4.4 (3.9, 4.9)
Genesis II PS	IDI Used	91	2236	1.6 (1.1, 2.2)	3.9 (3.1, 4.9)	4.7 (3.8, 5.9)	6.2 (5.0, 7.7)	6.2 (5.0, 7.7)	
	No IDI	790	21738	1.3 (1.1, 1.4)	3.0 (2.7, 3.2)	3.6 (3.3, 3.9)	4.5 (4.2, 4.8)	5.0 (4.6, 5.4)	5.5 (5.1, 6.0)
Legion CR	IDI Used	33	1330	1.2 (0.7, 2.1)	4.7 (3.2, 6.9)	5.1 (3.5, 7.4)			
	No IDI	137	5524	1.1 (0.9, 1.5)	2.8 (2.3, 3.3)	3.2 (2.7, 3.9)	3.8 (3.1, 4.6)	3.9 (3.2, 4.8)	3.9 (3.2, 4.8)
Legion PS	IDI Used	77	1759	1.5 (1.0, 2.2)	5.4 (4.2, 6.9)	7.0 (5.5, 8.9)	8.8 (6.8, 11.4)		
	No IDI	347	13788	1.0 (0.8, 1.2)	2.6 (2.3, 2.9)	2.9 (2.6, 3.3)	3.9 (3.4, 4.4)	4.0 (3.5, 4.6)	4.4 (3.7, 5.2)
Nexgen CR Flex	IDI Used	98	6034	0.7 (0.5, 0.9)	1.8 (1.4, 2.2)	2.1 (1.7, 2.6)	2.4 (1.9, 3.0)	2.4 (1.9, 3.0)	
	No IDI	810	41725	0.8 (0.7, 0.9)	1.9 (1.8, 2.1)	2.2 (2.0, 2.3)	2.7 (2.5, 2.9)	2.9 (2.7, 3.1)	3.0 (2.8, 3.2)
Nexgen LPS Flex	IDI Used	33	1815	1.3 (0.9, 2.0)	2.0 (1.4, 2.9)	2.5 (1.7, 3.7)	3.8 (1.9, 7.5)		
	No IDI	548	21321	0.9 (0.8, 1.1)	2.2 (2.0, 2.4)	2.6 (2.3, 2.8)	3.2 (3.0, 3.6)	3.6 (3.3, 4.0)	4.1 (3.7, 4.6)
Vanguard CR	IDI Used	101	3538	0.9 (0.6, 1.2)	2.7 (2.2, 3.4)	3.4 (2.8, 4.2)	4.1 (3.3, 5.1)	4.1 (3.3, 5.1)	
	No IDI	473	18890	0.8 (0.7, 1.0)	2.4 (2.2, 2.6)	2.8 (2.5, 3.1)	3.3 (3.0, 3.6)	3.7 (3.3, 4.1)	4.1 (3.6, 4.6)
Vanguard PS	IDI Used	49	909	2.0 (1.2, 3.2)	4.9 (3.6, 6.7)	6.1 (4.5, 8.1)	7.1 (5.4, 9.5)	7.1 (5.4, 9.5)	
	No IDI	146	3101	1.8 (1.3, 2.3)	4.1 (3.4, 4.9)	4.6 (3.9, 5.5)	5.6 (4.7, 6.6)	5.8 (4.9, 6.9)	6.1 (5.1, 7.3)
TOTAL		**4252**	**163621**						

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 KT38 Hazard Ratios of IDI Used vs No IDI in Primary Total Knee Replacement by Prosthesis Combination (Primary Diagnosis OA)

Prosthesis Combination	Hazard Ratio		P-Value
Evolution	Entire Period	1.53 (0.94, 2.48)	0.086
GMK Primary	Entire Period	0.70 (0.34, 1.44)	0.334
Genesis II CR	Entire Period	1.24 (0.86, 1.78)	0.251
Genesis II PS	Entire Period	1.29 (1.04, 1.60)	0.023
Legion CR	Entire Period	1.38 (0.94, 2.03)	0.095
Legion PS	0 - 1.5Yr	1.35 (0.93, 1.96)	0.117
	1.5Yr+	3.35 (2.40, 4.68)	<0.001
Nexgen CR Flex	Entire Period	0.88 (0.71, 1.09)	0.238
Nexgen LPS Flex	Entire Period	1.04 (0.73, 1.49)	0.807
Vanguard CR	Entire Period	1.12 (0.90, 1.39)	0.298
Vanguard PS	Entire Period	1.24 (0.90, 1.72)	0.191

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 16,828 procedures with the addition of an antioxidant. XLPE is now used more frequently (61.0% in 2017) than non XLPE.

It has previously been reported that when comparing all prostheses using XLPE to those using non XLPE, the XLPE group has a lower rate of revision. This year's analysis again confirms that finding. Prostheses using XLPE have a cumulative percent revision rate of 5.0% at 15 years, compared to 7.9% for non XLPE (Table KT39 and Figure KT43). The major reason for this difference is a reduced cumulative incidence for loosening (0.8% at 15 years for XLPE compared to 2.0% for non XLPE) (Figure KT44).

The overall difference between XLPE and non XLPE is more evident in younger patients. The 15 year cumulative percent revision rate for patients aged less than 65 years for XLPE is 7.2% and for non XLPE is 12.1%. For patients aged 65 years or older, the 15 year cumulative percent revision for XLPE is 3.5% and for non XLPE is 5.6% (Table KT40 and Figure KT45).

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 four of these prostheses. There was no difference in rate of revision for the remaining prostheses (Table KT41 and Table KT42).

Prosthesis Specific (Antioxidant)

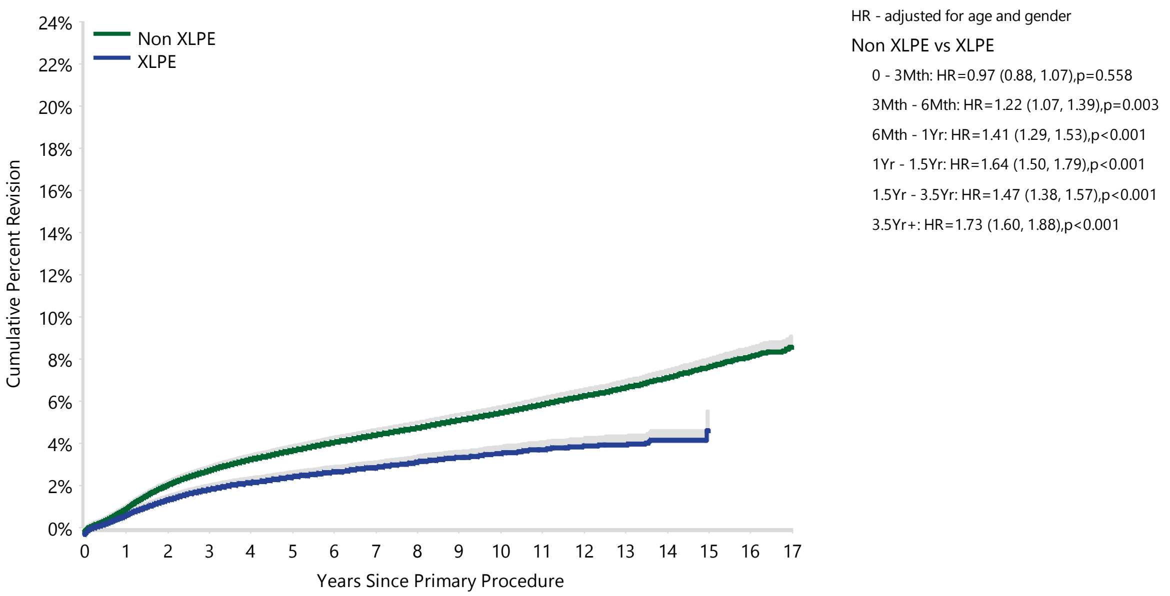
An analysis comparing the rate of revision of XLPE and XLPE with antioxidant has been undertaken. The follow up for XLPE with antioxidant is relatively short (five years). There are only a small number of prostheses that use this bearing. There is no difference in rates of revision when XLPE is compared to XLPE with antioxidant (Table KT43, Figures KT46 and KT47). The Attune was used in over 75% of these procedures. When the Attune is excluded from the analysis, the results are similar between XLPE and XLPE with antioxidant (Table KT44 and Figure KT48).

Table KT39 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	17 Yrs
Non XLPE	17995	392043	1.1 (1.1, 1.1)	2.9 (2.9, 3.0)	3.9 (3.8, 4.0)	5.7 (5.6, 5.8)	7.9 (7.8, 8.1)	8.9 (8.6, 9.2)
XLPE	4205	195969	0.9 (0.9, 1.0)	2.2 (2.1, 2.2)	2.8 (2.7, 2.8)	3.9 (3.7, 4.0)	5.0 (4.3, 5.7)	
TOTAL	**22200**	**588012**						

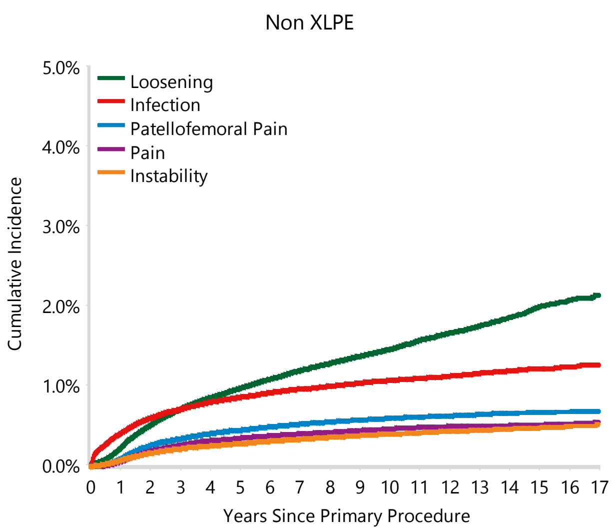
Note: Includes 16828 procedures using XLPE + antioxidant
Excludes 178 procedures with unknown polyethylene

Figure KT43 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	17 Yrs
Non XLPE	392043	364074	305438	246554	105500	16838	1693
XLPE	195969	160752	101795	59501	8727	392	0

Figure KT44 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by Polyethylene Type (Primary Diagnosis OA)



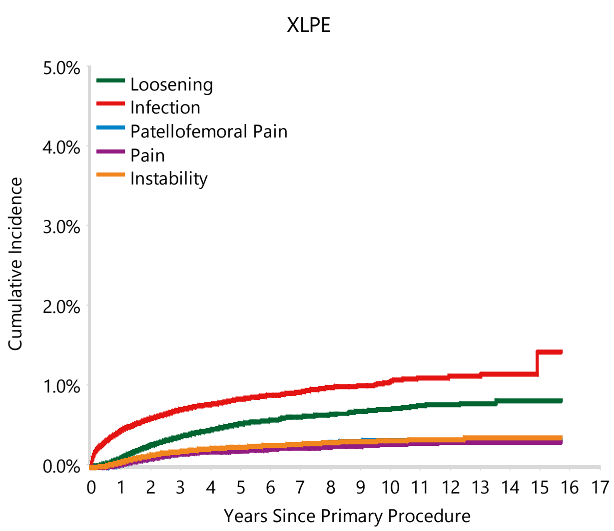
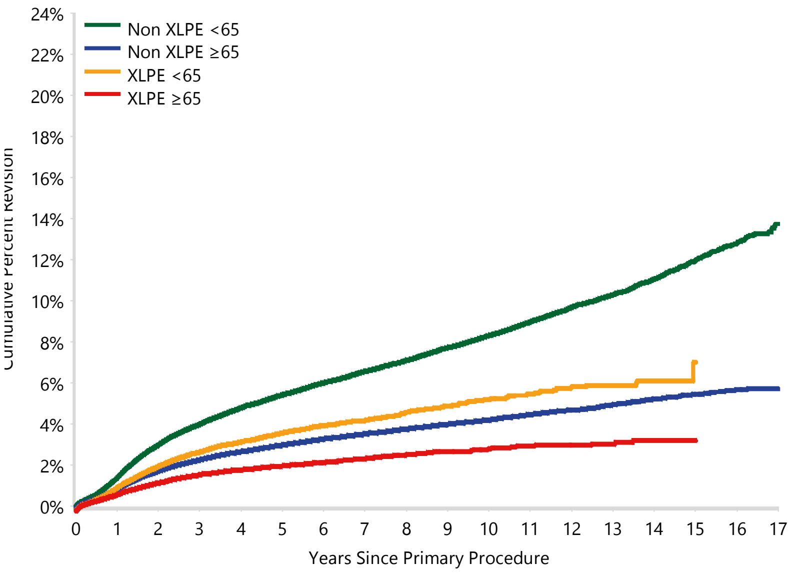


Table KT40 Cumulative Percent Revision of Primary Total Knee Replacement by Polyethylene Type and Age (Primary Diagnosis OA)

Polyethylene Type	Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Non XLPE		**17995**	**392043**	**1.1 (1.1, 1.1)**	**2.9 (2.9, 3.0)**	**3.9 (3.8, 4.0)**	**5.7 (5.6, 5.8)**	**7.9 (7.8, 8.1)**	**8.9 (8.6, 9.2)**
	<65	8746	127072	1.4 (1.3, 1.5)	4.0 (3.9, 4.1)	5.5 (5.3, 5.6)	8.4 (8.2, 8.6)	12.1 (11.7, 12.4)	13.8 (13.2, 14.5)
	≥65	9249	264971	0.9 (0.9, 1.0)	2.4 (2.3, 2.5)	3.1 (3.1, 3.2)	4.4 (4.3, 4.5)	5.6 (5.5, 5.8)	5.9 (5.7, 6.1)
XLPE		**4205**	**195969**	**0.9 (0.9, 1.0)**	**2.2 (2.1, 2.2)**	**2.8 (2.7, 2.8)**	**3.9 (3.7, 4.0)**	**5.0 (4.3, 5.7)**	
	<65	1951	66541	1.1 (1.0, 1.2)	2.9 (2.7, 3.0)	3.8 (3.6, 4.0)	5.4 (5.1, 5.8)	7.2 (6.0, 8.7)	
	≥65	2254	129428	0.8 (0.8, 0.9)	1.8 (1.7, 1.9)	2.2 (2.1, 2.3)	3.0 (2.9, 3.2)	3.5 (3.1, 3.8)	
TOTAL		**22200**	**588012**						

Figure KT45 Cumulative Percent Revision of Primary Total Knee Replacement by Polyethylene Type and Age (Primary Diagnosis OA)



Non XLPE <65 vs Non XLPE ≥65
0 - 3Mth: HR=1.07 (0.95, 1.20),p=0.278
3Mth - 9Mth: HR=1.57 (1.44, 1.71),p<0.001
9Mth - 3.5Yr: HR=1.82 (1.74, 1.89),p<0.001
3.5Yr - 6.5Yr: HR=2.08 (1.95, 2.22),p<0.001
6.5Yr - 7Yr: HR=2.71 (2.23, 3.29),p<0.001
7Yr - 8Yr: HR=2.16 (1.86, 2.51),p<0.001
8Yr - 10Yr: HR=2.74 (2.43, 3.10),p<0.001
10Yr - 10.5Yr: HR=2.31 (1.77, 3.02),p<0.001
10.5Yr+: HR=3.25 (2.88, 3.66),p<0.001
Non XLPE <65 vs XLPE <65
0 - 1Mth: HR=0.84 (0.71, 1.00),p=0.045
1Mth - 3Mth: HR=1.02 (0.86, 1.20),p=0.828
3Mth - 6Mth: HR=1.33 (1.15, 1.54),p<0.001
6Mth - 1Yr: HR=1.49 (1.35, 1.64),p<0.001
1Yr - 1.5Yr: HR=1.60 (1.45, 1.76),p<0.001
1.5Yr - 3.5Yr: HR=1.46 (1.35, 1.58),p<0.001
3.5Yr - 4Yr: HR=1.77 (1.53, 2.05),p<0.001
4Yr - 7Yr: HR=1.68 (1.53, 1.84),p<0.001
7Yr - 8Yr: HR=1.72 (1.47, 2.03),p<0.001
8Yr - 9.5Yr: HR=2.13 (1.83, 2.47),p<0.001
9.5Yr - 12Yr: HR=2.36 (2.04, 2.72),p<0.001
12Yr - 12.5Yr: HR=3.00 (1.96, 4.57),p<0.001
12.5Yr - 13.5Yr: HR=1.87 (1.42, 2.46),p<0.001
13.5Yr+: HR=3.29 (2.54, 4.27),p<0.001
Non XLPE ≥65 vs XLPE ≥65
0 - 3Mth: HR=0.90 (0.80, 1.00),p=0.057
3Mth - 1Yr: HR=1.37 (1.25, 1.51),p<0.001
1Yr - 1.5Yr: HR=1.61 (1.43, 1.81),p<0.001
1.5Yr+: HR=1.54 (1.44, 1.65),p<0.001
XLPE <65 vs XLPE ≥65
0 - 3Mth: HR=1.06 (0.94, 1.20),p=0.306
3Mth - 3Yr: HR=1.73 (1.61, 1.85),p<0.001
3Yr+: HR=2.02 (1.81, 2.26),p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
Non XLPE		**392043**	**364074**	**305438**	**246554**	**105500**	**16838**	**1693**
	<65	127072	118145	99254	81250	36669	6821	724
	≥65	264971	245929	206184	165304	68831	10017	969
XLPE		**195969**	**160752**	**101795**	**59501**	**8727**	**392**	**0**
	<65	66541	54742	34959	20838	3177	201	0
	≥65	129428	106010	66836	38663	5550	191	0

Table KT41 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	17 Yrs
Genesis II CR/Genesis II	Non XLPE	812	20596	0.9 (0.8, 1.1)	2.6 (2.4, 2.9)	3.4 (3.2, 3.7)	4.7 (4.4, 5.1)	6.0 (5.4, 6.5)	6.5 (5.8, 7.3)
	XLPE	30	1570	1.3 (0.8, 2.0)	2.3 (1.5, 3.4)	3.3 (2.1, 5.2)			
Genesis II Oxinium CR/Genesis II	Non XLPE	406	6315	1.2 (1.0, 1.5)	3.4 (3.0, 3.9)	4.4 (3.9, 4.9)	7.0 (6.3, 7.7)	10.6 (9.2, 12.3)	
	XLPE	36	1883	0.8 (0.4, 1.3)	2.8 (2.0, 4.0)	3.1 (2.1, 4.3)			
Genesis II Oxinium PS/Genesis II	Non XLPE	738	11607	1.6 (1.4, 1.8)	4.0 (3.6, 4.4)	5.4 (5.0, 5.9)	8.0 (7.4, 8.6)		
	XLPE	171	5302	1.5 (1.2, 1.9)	3.6 (3.1, 4.3)	5.0 (4.2, 5.8)			
Genesis II PS/Genesis II	Non XLPE	617	14550	1.2 (1.0, 1.4)	2.8 (2.6, 3.1)	3.7 (3.4, 4.0)	5.3 (4.9, 5.8)	6.5 (5.8, 7.4)	
	XLPE	79	2847	1.2 (0.9, 1.7)	3.2 (2.5, 4.1)	4.8 (3.7, 6.1)			
Legion CR/Genesis II	Non XLPE	57	1863	1.3 (0.9, 2.0)	3.1 (2.3, 4.1)	4.0 (3.1, 5.2)			
	XLPE	38	1667	1.6 (1.0, 2.4)	3.6 (2.5, 5.1)	4.5 (3.0, 6.7)			
Legion Oxinium CR/Genesis II	Non XLPE	44	1706	1.0 (0.6, 1.6)	2.3 (1.7, 3.2)	2.9 (2.2, 4.0)			
	XLPE	36	1751	0.8 (0.5, 1.5)	3.4 (2.4, 4.9)	4.2 (2.9, 6.0)			
Legion Oxinium PS/Genesis II	Non XLPE	211	4985	1.4 (1.1, 1.7)	3.6 (3.1, 4.2)	5.2 (4.5, 6.0)			
	XLPE	133	6361	0.9 (0.6, 1.1)	2.8 (2.3, 3.4)	3.6 (3.0, 4.4)			
Legion PS/Genesis II	Non XLPE	42	1984	0.9 (0.5, 1.4)	1.8 (1.2, 2.5)	2.0 (1.4, 2.8)			
	XLPE	53	2425	1.2 (0.8, 1.7)	2.9 (2.1, 3.8)	3.6 (2.7, 5.0)			
Natural Knee II/Natural Knee II	Non XLPE	266	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)	12.9 (11.4, 14.5)	
	XLPE	109	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)	4.0 (3.1, 5.0)	
Nexgen CR Flex/Nexgen	Non XLPE	95	4069	0.6 (0.4, 0.9)	1.7 (1.3, 2.2)	2.3 (1.8, 2.9)	3.4 (2.7, 4.2)		
	XLPE	860	43875	0.8 (0.7, 0.9)	1.8 (1.7, 1.9)	2.3 (2.1, 2.5)	3.0 (2.8, 3.3)		
Nexgen CR/Nexgen	Non XLPE	216	5902	0.5 (0.3, 0.7)	1.6 (1.3, 1.9)	2.0 (1.7, 2.4)	3.2 (2.7, 3.7)	5.1 (4.4, 5.9)	5.9 (4.8, 7.2)
	XLPE	146	5292	0.7 (0.5, 1.0)	1.7 (1.4, 2.1)	2.2 (1.8, 2.7)	3.1 (2.6, 3.6)	4.1 (3.2, 5.2)	
Nexgen LPS Flex/Nexgen	Non XLPE	667	14978	0.8 (0.7, 1.0)	2.3 (2.0, 2.5)	3.2 (2.9, 3.5)	5.3 (4.9, 5.8)	8.5 (6.9, 10.3)	
	XLPE	478	17788	1.0 (0.9, 1.2)	2.5 (2.2, 2.7)	3.2 (2.9, 3.5)	5.0 (4.5, 5.7)		
PFC Sigma CR/PFC Sigma	Non XLPE	632	20555	0.7 (0.6, 0.9)	1.9 (1.7, 2.1)	2.4 (2.2, 2.7)	3.5 (3.2, 3.9)	5.7 (5.1, 6.5)	5.9 (5.2, 6.7)
	XLPE	38	2676	0.6 (0.4, 1.0)	1.9 (1.4, 2.6)	2.4 (1.5, 3.8)			
PFC Sigma PS/PFC Sigma	Non XLPE	285	6975	1.1 (0.9, 1.4)	2.6 (2.2, 3.0)	3.3 (2.9, 3.8)	4.8 (4.2, 5.5)	7.4 (6.2, 8.9)	
	XLPE	10	557	1.6 (0.8, 3.2)	2.1 (1.1, 3.9)	2.1 (1.1, 3.9)			
Scorpio NRG PS/Series 7000	Non XLPE	18	503	0.6 (0.2, 1.8)	1.6 (0.8, 3.2)	3.1 (1.9, 5.1)	3.9 (2.4, 6.1)		
	XLPE	129	3397	0.9 (0.6, 1.2)	3.0 (2.4, 3.6)	3.8 (3.2, 4.6)			
Triathlon CR/Triathlon	Non XLPE	273	10139	0.7 (0.6, 0.9)	1.9 (1.7, 2.2)	2.5 (2.2, 2.8)	3.4 (3.0, 3.9)		
	XLPE	1192	59999	0.9 (0.8, 0.9)	2.0 (1.9, 2.1)	2.5 (2.4, 2.7)	4.0 (3.5, 4.6)		
Triathlon PS/Triathlon	Non XLPE	189	3841	1.7 (1.3, 2.2)	3.6 (3.1, 4.3)	4.5 (3.9, 5.3)	6.2 (5.3, 7.2)		
	XLPE	188	6623	1.5 (1.2, 1.8)	2.7 (2.3, 3.1)	3.6 (3.1, 4.2)			
Vanguard CR/Maxim	Non XLPE	451	17015	0.8 (0.7, 0.9)	2.4 (2.1, 2.6)	3.1 (2.8, 3.5)	4.6 (4.0, 5.3)		
	XLPE	9	684	1.0 (0.4, 2.3)	1.4 (0.7, 2.9)				
TOTAL		**9754**	**318721**						

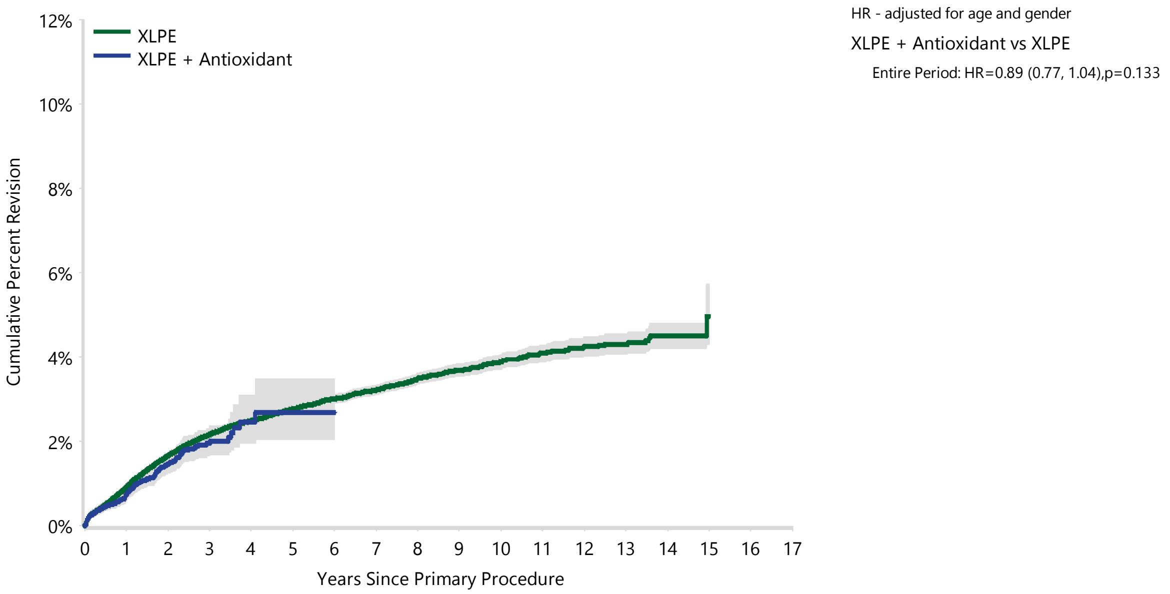
Table KT42 Hazard Ratios of XLPE vs Non XLPE in Primary Total Knee Replacement by Prosthesis Combination (Primary Diagnosis OA)

Model		Hazard Ratio	P-Value
Genesis II CR/Genesis II	Entire Period	0.99 (0.68, 1.42)	0.943
Genesis II Oxinium CR/Genesis II	Entire Period	0.81 (0.57, 1.15)	0.244
Genesis II Oxinium PS/Genesis II	Entire Period	0.91 (0.77, 1.08)	0.265
Genesis II PS/Genesis II	Entire Period	1.20 (0.95, 1.53)	0.126
Legion CR/Genesis II	Entire Period	1.10 (0.73, 1.67)	0.651
Legion Oxinium CR/Genesis II	Entire Period	1.20 (0.77, 1.89)	0.421
Legion Oxinium PS/Genesis II	Entire Period	0.68 (0.54, 0.85)	<0.001
Legion PS/Genesis II	Entire Period	1.50 (0.98, 2.28)	0.059
Natural Knee II/Natural Knee II	0 - 6Mth	1.79 (0.85, 3.75)	0.125
	6Mth - 3.5Yr	0.81 (0.55, 1.18)	0.270
	3.5Yr - 5.5Yr	0.45 (0.24, 0.85)	0.013
	5.5Yr+	0.13 (0.08, 0.21)	<0.001
Nexgen CR Flex/Nexgen	0 - 1.5Yr	0.99 (0.72, 1.37)	0.967
	1.5Yr+	0.80 (0.61, 1.07)	0.130
Nexgen CR/Nexgen	0 - 3Yr	0.99 (0.74, 1.34)	0.957
	3Yr - 4Yr	1.05 (0.50, 2.17)	0.902
	4Yr+	0.54 (0.38, 0.76)	<0.001
Nexgen LPS Flex/Nexgen	Entire Period	0.98 (0.87, 1.10)	0.721
PFC Sigma CR/PFC Sigma	Entire Period	0.87 (0.62, 1.21)	0.401
PFC Sigma PS/PFC Sigma	Entire Period	0.78 (0.41, 1.47)	0.444
Scorpio NRG PS/Series 7000	Entire Period	1.17 (0.71, 1.94)	0.531
Triathlon CR/Triathlon	Entire Period	1.08 (0.94, 1.24)	0.274
Triathlon PS/Triathlon	Entire Period	0.78 (0.63, 0.96)	0.016
Vanguard CR/Maxim	Entire Period	0.80 (0.41, 1.55)	0.508

Table KT43 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	17 Yrs
XLPE	4017	179141	0.9 (0.9, 1.0)	2.2 (2.1, 2.2)	2.8 (2.7, 2.9)	3.9 (3.7, 4.0)	5.0 (4.3, 5.7)	
XLPE + Antioxidant	188	16828	0.7 (0.6, 0.9)	2.0 (1.7, 2.3)	2.7 (2.1, 3.5)			
TOTAL	**4205**	**195969**						

Figure KT46 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	17 Yrs
XLPE	179141	150756	99621	59341	8727	392	0
XLPE + Antioxidant	16828	9996	2174	160	0	0	0

Figure KT47 Cumulative Incidence Revision Diagnosis of XLPE Primary Total Knee Replacement by Polyethylene Type (Primary Diagnosis OA)

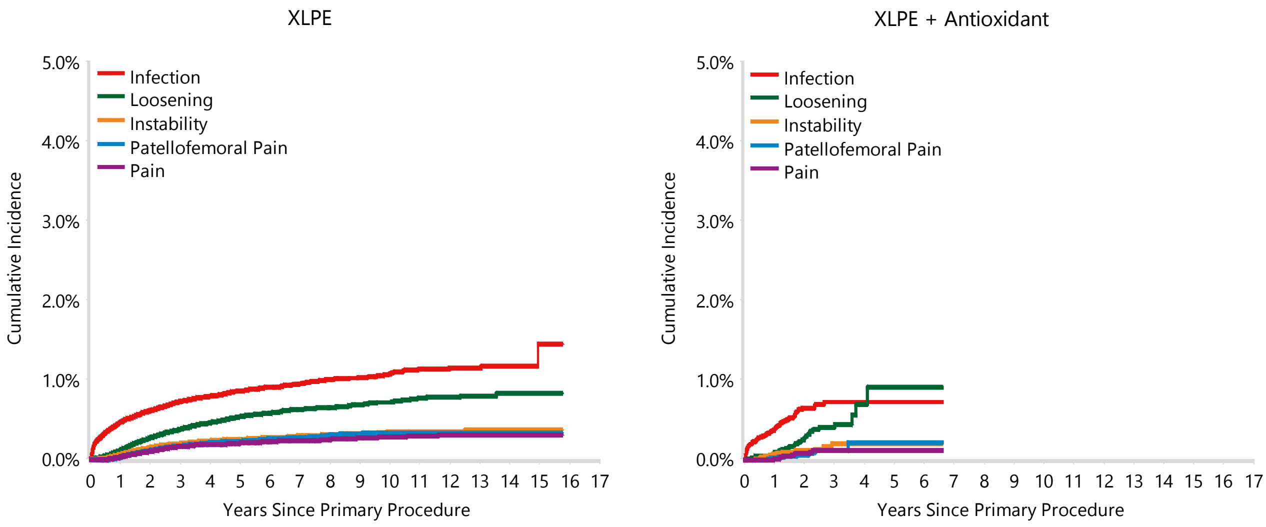
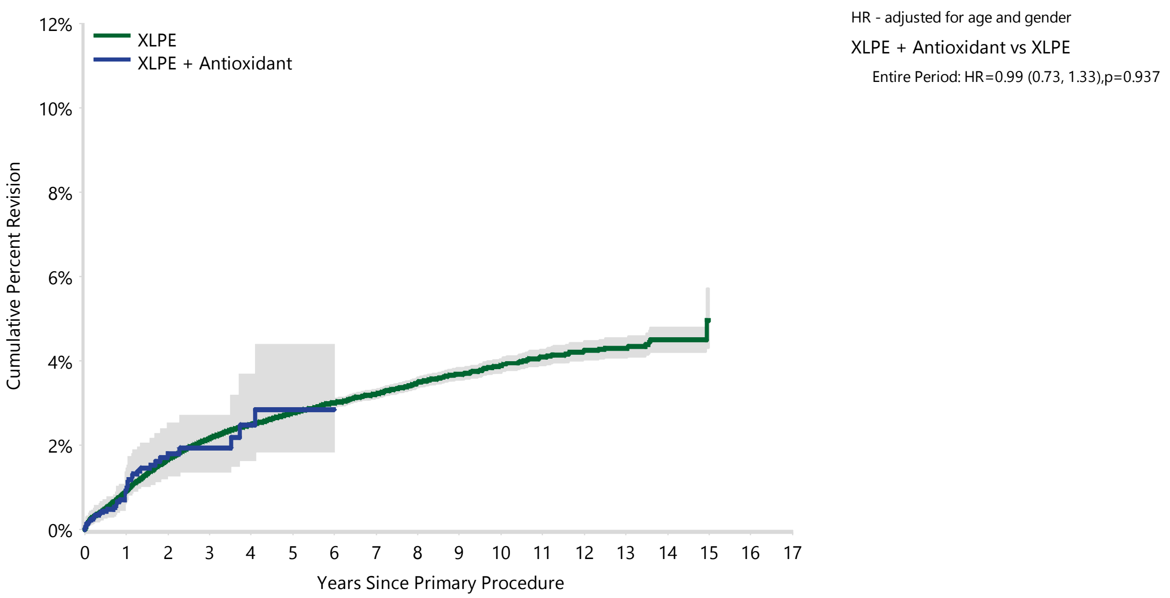


Table KT44 Cumulative Percent Revision of XLPE Primary Total Knee Replacement by Polyethylene Type (Primary Diagnosis OA, Excluding Attune)

Polyethylene Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
XLPE	4017	179141	0.9 (0.9, 1.0)	2.2 (2.1, 2.2)	2.8 (2.7, 2.9)	3.9 (3.7, 4.0)	5.0 (4.3, 5.7)	
XLPE + Antioxidant	188	16828	0.7 (0.6, 0.9)	2.0 (1.7, 2.3)	2.7 (2.1, 3.5)			
TOTAL	**4205**	**195969**						

Figure KT48 Cumulative Percent Revision of XLPE Primary Total Knee Replacement by Polyethylene Type (Primary Diagnosis OA, Excluding Attune)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	17 Yrs
XLPE	179141	150756	99621	59341	8727	392	0
XLPE + Antioxidant	4116	1819	555	160	0	0	0

Shoulder Replacement

Shoulder Replacement

CATEGORIES OF SHOULDER REPLACEMENT

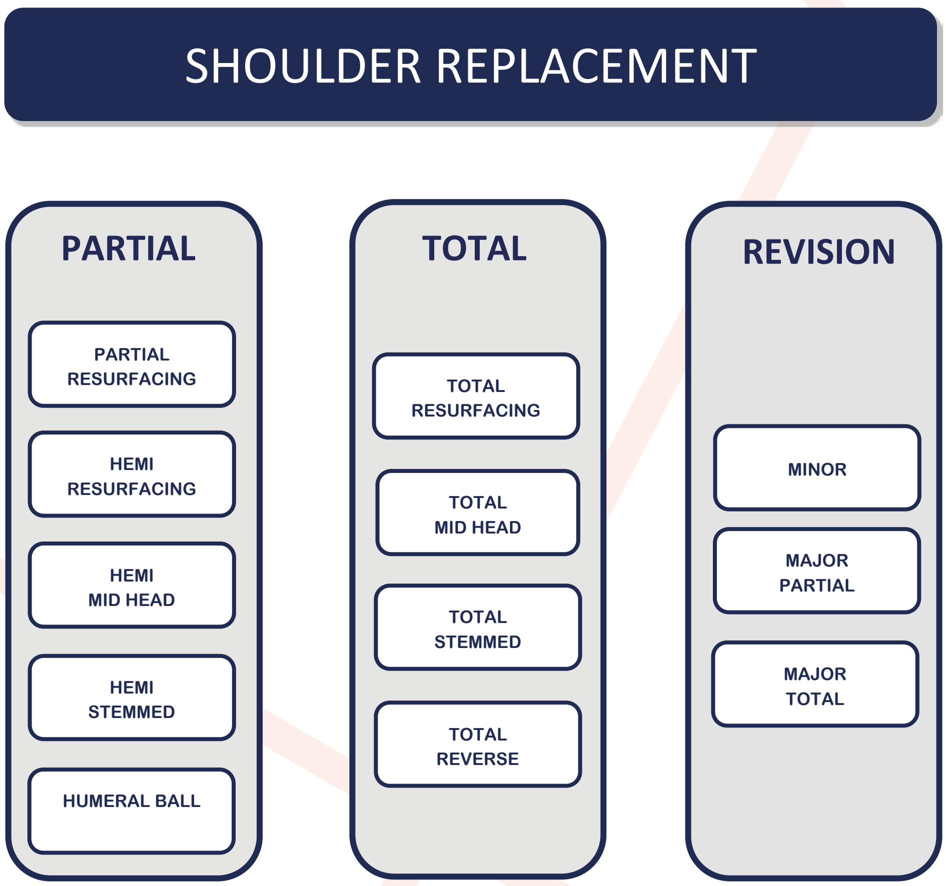
The Registry groups shoulder replacement into three broad categories: primary partial, primary total and revision shoulder replacement.

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 sub-categorised into classes depending on the type of prosthesis used. Partial shoulder classes include: partial resurfacing, hemi resurfacing, hemi mid head, hemi stemmed and humeral ball 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 sub-categorised into three classes: minor, major partial and major total shoulder replacement.



USE OF SHOULDER REPLACEMENT

This report is an analysis of 44,801 shoulder replacement procedures reported to the Registry with a procedure date up to and including 31 December 2017. This is an additional 6,536 shoulder procedures since the last report.

Registry shoulder data collection commenced in 2004 and full national collection was implemented by 2008.

The number of shoulder replacement procedures undertaken in 2017 increased by 576 (10.0%) compared to the previous year and by 141.4% since 2008.

Shoulder replacement procedures increased by 10.0% in 2017 and increased by 141.4% since 2008.

When considering all shoulder replacement procedures currently recorded by the Registry, primary total shoulder replacement is the most common category (75.5%), followed by primary partial (14.5%) and revision procedures (10.0%) (Table S1).

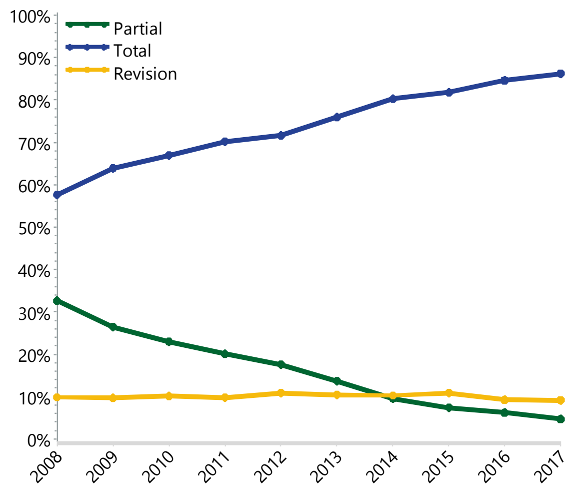
Table S1 Number of Shoulder Replacements

Shoulder Category	Number	Percent
Partial	6504	14.5
Total	33813	75.5
Revision	4484	10.0
TOTAL	**44801**	**100.0**

The proportion of total shoulder replacements has increased from 57.6% in 2008 to 86.2% in 2017. Since 2008, partial shoulder replacement has decreased from 32.6% to 4.7% in 2017. In 2008, the proportion of revision procedures was 9.8%. This peaked at 10.9% in 2012. In 2017, the proportion of revision procedures has declined to 9.1%. This equates to 113 less revision procedures in 2017 than would have been expected if the proportion of revision procedures had remained at the peak of 10.9% (Figure S1).

The proportion of revision procedures of 9.1% equates to 113 fewer revision procedures in 2017 than if the proportion of revision procedures had remained at 10.9%.

Figure S1 Proportion of Shoulder Replacement by Shoulder Category



ASA SCORE AND BMI

Data is 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 23,577 procedures and BMI data on 14,070 shoulder replacement procedures. Since its initial collection in 2012, ASA score has been recorded in 89.3% of procedures. BMI data has been recorded in 81.0% of procedures since 2015, when its collection commenced.

In 2017, ASA score is reported in 98.8% of procedures and BMI is reported in 91.2% of shoulder replacement procedures.

In 2017, the percentage of procedures with ASA score reported for primary partial shoulder is 97.3%, primary total shoulder 98.8% and revision shoulder replacement 99.3%. BMI data is reported for 87.9% of primary partial shoulder, 91.4% of primary total shoulder and 91.7% of revision shoulder replacements.

In the future, this data will be used to risk adjust in a range of analyses.

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 92.2% of procedures, patients have an ASA score of 2 or 3, 4.9% have a score of 1 and 2.9% have a score of 4. 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 (53.3%) compared to primary partial shoulder replacement (43.5%), or total shoulder replacement (45.7%) (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

http://apps.who.int/bmi/index.jsp?introPage=intro_3.html

For all shoulder replacements, the majority of procedures are undertaken in patients who are pre-obese or obese class 1 (61.6%). There is a slightly higher proportion of primary total shoulder replacement procedures where the patients are pre-obese or obese class 1 (62.0%), compared to partial shoulder replacement (58.9%), and revision shoulder replacement (59.1%) (Table S3).

Table S2 ASA Score for Shoulder Replacement

ASA Score	Partial N	Partial Col%	Total N	Total Col%	Revision N	Revision Col%	TOTAL N	TOTAL Col%
ASA 1	173	10.1	883	4.5	91	3.9	1147	4.9
ASA 2	735	42.7	9202	47.1	896	38.6	10833	45.9
ASA 3	748	43.5	8925	45.7	1237	53.3	10910	46.3
ASA 4	65	3.8	524	2.7	95	4.1	684	2.9
ASA 5	.	.	3	0.0	.	.	3	0.0
TOTAL	**1721**	**100.0**	**19537**	**100.0**	**2319**	**100.0**	**23577**	**100.0**

Table S3 BMI Category for Shoulder Replacement

BMI Category	Partial N	Partial Col%	Total N	Total Col%	Revision N	Revision Col%	TOTAL N	TOTAL Col%
Underweight	11	1.5	100	0.8	18	1.3	129	0.9
Normal	148	20.0	2019	16.8	257	19.2	2424	17.2
Pre Obese	260	35.2	4173	34.8	434	32.5	4867	34.6
Obese Class 1	175	23.7	3266	27.2	356	26.6	3797	27.0
Obese Class 2	88	11.9	1554	13.0	173	12.9	1815	12.9
Obese Class 3	57	7.7	882	7.4	99	7.4	1038	7.4
TOTAL	**739**	**100.0**	**11994**	**100.0**	**1337**	**100.0**	**14070**	**100.0**

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

Primary Partial Shoulder Replacement

CLASSES OF PARTIAL SHOULDER REPLACEMENT

The Registry sub-categorises 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.

There is a fifth class of partial shoulder replacement reported to the Registry. This is a spherical non-stemmed humeral head prosthesis referred to as the 'humeral ball'. It is used following partial resection of the humeral head. Only two procedures using this device have been reported to the Registry and this prosthesis is no longer used. Both of these procedures have been revised.

USE OF PARTIAL SHOULDER REPLACEMENT

There have been 6,504 primary partial shoulder replacements reported to the Registry up to 31 December 2017. This is an additional 313 procedures compared to the number reported last year.

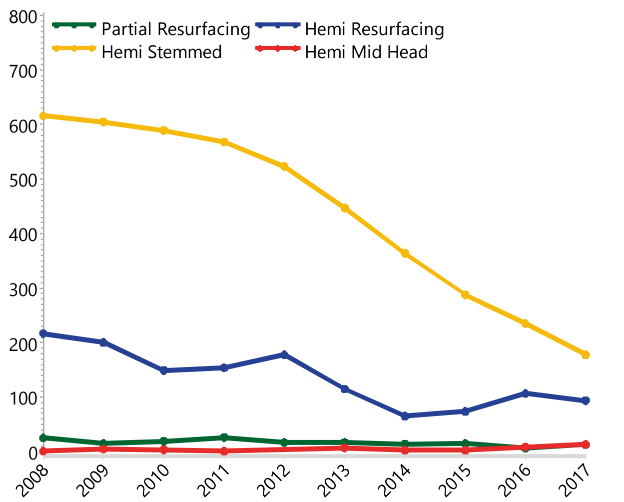
The most common class of primary partial shoulder replacement is hemi stemmed. This accounts for 73.5% of all partial shoulder replacements, followed by hemi resurfacing (23.1%), partial resurfacing (2.7%) and hemi mid head (0.7%) (Table SP1).

Table SP1 Primary Partial Shoulder Replacement by Class

Shoulder Class	Number	Percent
Partial Resurfacing	175	2.7
Hemi Resurfacing	1500	23.1
Hemi Stemmed	4783	73.5
Hemi Mid Head	46	0.7
TOTAL	**6504**	**100.0**

The use of the two main classes of partial shoulder replacement has declined over recent years. The number of hemi resurfacing procedures decreased from 178 in 2012 to 94 in 2017. The number of hemi stemmed procedures decreased from 616 in 2008 to 178 in 2017 (Figure SP1).

Figure SP1 Primary Partial Shoulder Replacement by Class



Primary partial shoulder replacement is more common in females (64.2%). However, 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 (72.6%), hemi mid head (47.8%), hemi resurfacing (42.9%) and partial resurfacing (22.9%) (Table SP2).

Most patients are aged 65 years or older (64.8%). The proportion of patients in this age group varies depending on the class of primary partial shoulder replacement: hemi stemmed (70.6%), hemi resurfacing (52.0%), hemi mid head (39.2%) and partial resurfacing (20.5%) (Table SP3).

Overall, males undergoing a partial shoulder replacement are younger (mean age 61.8 years) compared to females (71.5 years) (Table SP4).

The most common primary diagnosis for females is fracture (54.6%). For males the most common primary diagnosis is osteoarthritis (54.4%) (Table SP5).

The cumulative percent revision varies depending on class. Partial resurfacing and hemi mid head have only been used in small numbers (175 and 46 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 (16.4% compared to 11.3%, respectively) (Table SP6 and Figure SP2).

Table SP2 Primary Partial Shoulder Replacement by Gender and Class

Shoulder Class	Male		Female		TOTAL	
	N	Row%	N	Row%	N	Row%
Partial Resurfacing	135	77.1	40	22.9	175	100.0
Hemi Resurfacing	856	57.1	644	42.9	1500	100.0
Hemi Stemmed	1311	27.4	3472	72.6	4783	100.0
Hemi Mid Head	24	52.2	22	47.8	46	100.0
TOTAL	**2326**	**35.8**	**4178**	**64.2**	**6504**	**100.0**

Table SP3 Primary Partial Shoulder Replacement by Age and Class

Shoulder Class	<55		55-64		65-74		≥75		TOTAL	
	N	Row%	N	Row%	N	Row%	N	Row%	N	Row%
Partial Resurfacing	125	71.4	14	8.0	20	11.4	16	9.1	175	100.0
Hemi Resurfacing	309	20.6	411	27.4	465	31.0	315	21.0	1500	100.0
Hemi Stemmed	480	10.0	923	19.3	1436	30.0	1944	40.6	4783	100.0
Hemi Mid Head	16	34.8	12	26.1	13	28.3	5	10.9	46	100.0
TOTAL	**930**	**14.3**	**1360**	**20.9**	**1934**	**29.7**	**2280**	**35.1**	**6504**	**100.0**

Table SP4 Primary Partial Shoulder Replacement by Age and Gender

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	2326	35.8%	14	93	63	61.8	14.5
Female	4178	64.2%	13	101	73	71.5	11.3
TOTAL	**6504**	**100.0%**	**13**	**101**	**69**	**68.1**	**13.4**

Table SP5 Primary Partial Shoulder Replacement by Primary Diagnosis and Gender

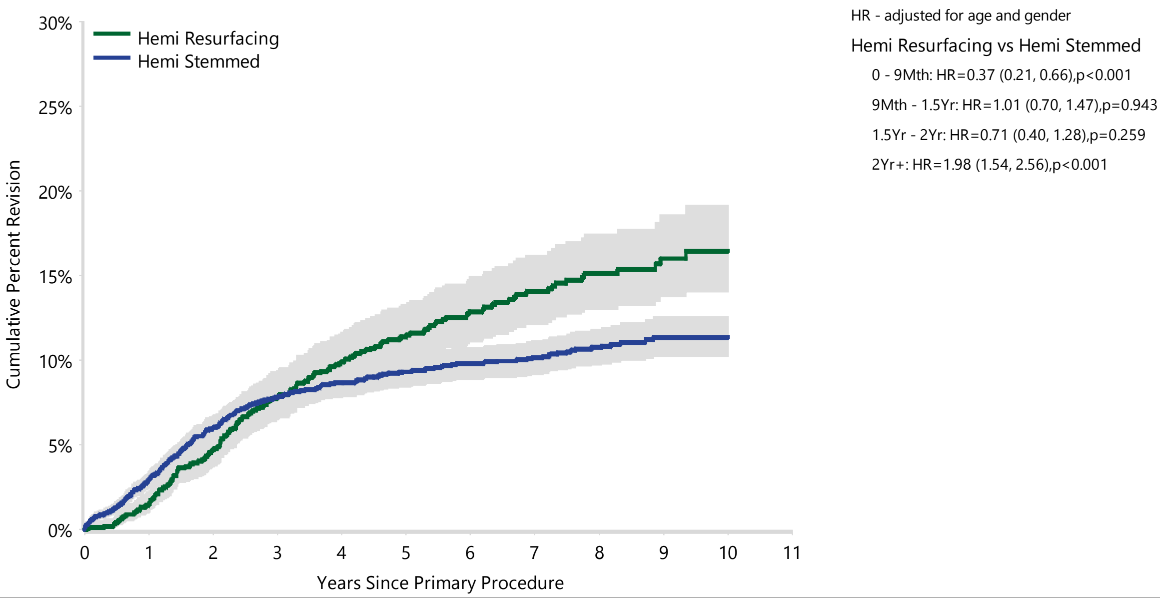
	Male		Female		TOTAL	
Primary Diagnosis	N	Col%	N	Col%	N	Col%
Fracture	643	27.6	2282	54.6	2925	45.0
Osteoarthritis	1266	54.4	1366	32.7	2632	40.5
Rotator Cuff Arthropathy	118	5.1	182	4.4	300	4.6
Osteonecrosis	85	3.7	114	2.7	199	3.1
Instability	108	4.6	58	1.4	166	2.6
Tumour	75	3.2	59	1.4	134	2.1
Rheumatoid Arthritis	19	0.8	101	2.4	120	1.8
Other Inflammatory Arthritis	10	0.4	16	0.4	26	0.4
Osteochondritis Dissecans	2	0.1	.	.	2	0.0
TOTAL	**2326**	**100.0**	**4178**	**100.0**	**6504**	**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 Category	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
Partial Resurfacing	7	175	0.6 (0.1, 4.2)	1.9 (0.6, 5.7)	1.9 (0.6, 5.7)	5.2 (2.3, 11.6)		
Hemi Resurfacing	174	1500	1.5 (1.0, 2.3)	7.8 (6.5, 9.4)	11.4 (9.7, 13.3)	14.0 (12.1, 16.2)	16.4 (14.1, 19.2)	
Hemi Stemmed	411	4783	2.9 (2.5, 3.5)	7.8 (7.0, 8.6)	9.3 (8.4, 10.2)	10.1 (9.2, 11.1)	11.3 (10.2, 12.6)	
Hemi Mid Head	5	46	2.5 (0.4, 16.5)	21.0 (9.0, 44.6)	21.0 (9.0, 44.6)	21.0 (9.0, 44.6)		
TOTAL	**597**	**6504**						

Figure SP2 Cumulative Percent Revision of Primary Partial Shoulder Replacement by Class (All Diagnoses)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
Hemi Resurfacing	1500	1378	1099	857	535	104	15
Hemi Stemmed	4783	4282	3305	2359	1369	186	21

PRIMARY PARTIAL RESURFACING SHOULDER REPLACEMENT

DEMOGRAPHICS AND OUTCOMES

There have been 175 primary partial resurfacing shoulder replacement procedures reported to the Registry. This is an additional 16 procedures compared to the previous report.

This procedure is undertaken more commonly in males (77.1%). The mean age for males is 39.8 years compared to 58.4 years for females (Table SP7).

The most common primary diagnosis for males is instability (54.8%), whereas the most common primary diagnosis for females is osteoarthritis (52.5%) (Table SP8).

The cumulative percent revision at seven years is 5.2% (Table SP6). Of the seven revisions, four were for glenoid erosion, two were for instability/dislocation and one was for loosening. All were revised to a total shoulder replacement.

Table SP7 Primary Partial Resurfacing Shoulder Replacement by Age and Gender

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	135	77.1%	14	87	37	39.8	17.7
Female	40	22.9%	17	88	61	58.4	18.7
TOTAL	**175**	**100.0%**	**14**	**88**	**42**	**44.0**	**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	74	54.8	13	32.5	87	49.7
Osteoarthritis	46	34.1	21	52.5	67	38.3
Fracture	9	6.7	2	5.0	11	6.3
Osteonecrosis	2	1.5	3	7.5	5	2.9
Osteochondritis Dissecans	2	1.5	.	.	2	1.1
Rotator Cuff Arthropathy	2	1.5	.	.	2	1.1
Rheumatoid Arthritis	.	.	1	2.5	1	0.6
TOTAL	**135**	**100.0**	**40**	**100.0**	**175**	**100.0**

Note: Instability includes instability, dislocation and Hill-Sachs Defect

PRIMARY HEMI RESURFACING SHOULDER REPLACEMENT

DEMOGRAPHICS

There have been 1,500 primary hemi resurfacing shoulder replacements reported to the Registry. This is an additional 95 procedures compared to the previous report. The use of primary hemi resurfacing has declined by 56.7% since 2008.

This procedure is more common in males (57.1%). The mean age is 61.1 years for males and 68.4 years for females (Table SP9).

Osteoarthritis is the most common primary diagnosis (87.5%). The range of diagnoses is similar for males and females (Table SP10).

The three most used prostheses in 2017 are the PyroTITAN, Copeland and Global CAP (Table SP11).

Table SP9 Primary Hemi Resurfacing Shoulder Replacement by Age and Gender

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	856	57.1%	19	90	62	61.1	12.0
Female	644	42.9%	27	93	69	68.4	11.3
TOTAL	**1500**	**100.0%**	**19**	**93**	**65**	**64.2**	**12.2**

Table SP10 Primary Hemi Resurfacing Shoulder Replacement by Primary Diagnosis and Gender

	Male		Female		TOTAL	
Primary Diagnosis	N	Col%	N	Col%	N	Col%
Osteoarthritis	756	88.3	557	86.5	1313	87.5
Rotator Cuff Arthropathy	49	5.7	34	5.3	83	5.5
Osteonecrosis	17	2.0	18	2.8	35	2.3
Rheumatoid Arthritis	8	0.9	19	3.0	27	1.8
Instability	13	1.5	5	0.8	18	1.2
Fracture	10	1.2	4	0.6	14	0.9
Other Inflammatory Arthritis	3	0.4	7	1.1	10	0.7
TOTAL	**856**	**100.0**	**644**	**100.0**	**1500**	**100.0**

Note: Instability includes instability and dislocation

Table SP11 Most Used Humeral Head Prostheses in Primary Hemi Resurfacing Shoulder Replacement

2008		2014		2015		2016		2017	
N	Model	N	Model	N	Model	N	Model	N	Model
124	Copeland	31	Copeland	27	Copeland	81	PyroTITAN	73	PyroTITAN
45	Global CAP	19	Global CAP	21	PyroTITAN	14	Copeland	13	Copeland
34	SMR	9	SMR	16	Global CAP	8	Global CAP	7	Global CAP
11	Aequalis	4	Aequalis	6	SMR	4	SMR	1	Aequalis
2	Epoca RH	1	Custom Made (Copeland)	4	Aequalis				
1	Buechel-Pappas	1	Epoca RH						
Most Used									
217	(6) 100.0%	65	(6) 100.0%	74	(5) 100.0%	107	(4) 100.0%	94	(4) 100.0%

OUTCOME FOR ALL DIAGNOSES

Reason for Revision

The main reasons for revision of hemi resurfacing shoulder replacement are glenoid erosion (24.1%), pain (23.6%), rotator cuff insufficiency (13.2%) and loosening (10.9%) (Table SP12 and Figure SP3). There were five reported humeral head breakages. All of them were reported in the PyroTITAN prosthesis. In addition, a further three breakages of this prosthesis were associated with loosening. This is two more head breakages of the PyroTITAN prosthesis than reported last year.

Glenoid erosion or pain are the reasons for 47.7% of all hemi resurfacing shoulder revisions.

Type of Revision

The most common type of revision is to a total shoulder replacement (89.7%) (Table SP13). Of these, 85 (54.5%) were revised to a total reverse shoulder and 71 (45.5%) to a total stemmed shoulder replacement.

OUTCOME FOR OSTEOARTHRITIS

Age and Gender

Patients aged 65 to 74 years have a lower rate of revision over the entire period compared to patients aged less than 55 years, whereas patients aged 75 years or older have a lower rate of revision after four 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 SP12 Primary Hemi Resurfacing Shoulder Replacement by Reason for Revision (All Diagnoses)

Reason for Revision	Number	Percent
Glenoid Erosion	42	24.1
Pain	41	23.6
Rotator Cuff Insufficiency	23	13.2
Loosening	19	10.9
Instability/Dislocation	17	9.8
Lysis	8	4.6
Infection	6	3.4
Implant Breakage Head	5	2.9
Metal Related Pathology	3	1.7
Wear Glenoid Insert	2	1.1
Malposition	2	1.1
Incorrect Sizing	2	1.1
Arthrofibrosis	1	0.6
Osteonecrosis	1	0.6
Implant Breakage Humeral	1	0.6
Fracture	1	0.6
TOTAL	**174**	**100.0**

Table SP13 Primary Hemi Resurfacing Shoulder Replacement by Type of Revision (All Diagnoses)

Type of Revision	Number	Percent
Humeral/Glenoid	156	89.7
Humeral Component	7	4.0
Glenoid Component	6	3.4
Cement Spacer	2	1.1
Removal of Prostheses	1	0.6
Reoperation	1	0.6
Head Only	1	0.6
TOTAL	**174**	**100.0**

Figure SP3 Cumulative Incidence Revision Diagnosis of Primary Hemi Resurfacing Shoulder Replacement (All Diagnoses)

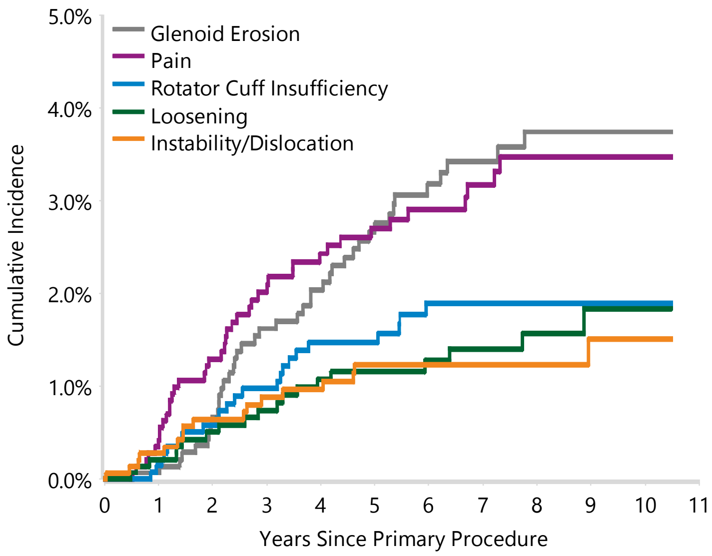
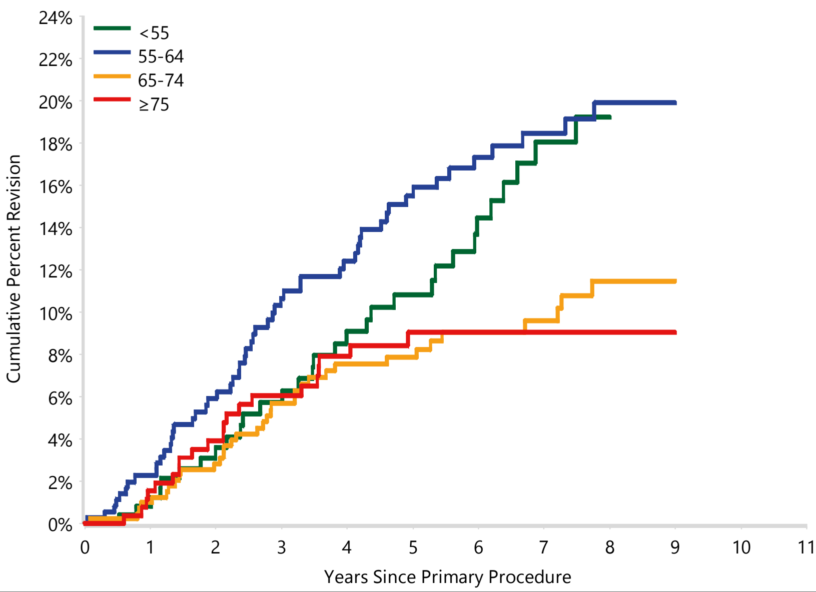


Table SP14 Cumulative Percent Revision of Primary Hemi Resurfacing Shoulder Replacement by Age (Primary Diagnosis OA)

Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
<55	34	255	0.8 (0.2, 3.3)	5.7 (3.3, 9.9)	10.8 (7.2, 16.2)	18.0 (12.8, 25.1)		
55-64	55	362	2.3 (1.1, 4.5)	10.7 (7.7, 14.6)	15.5 (11.8, 20.1)	18.5 (14.3, 23.6)		
65-74	36	419	1.0 (0.4, 2.6)	5.7 (3.7, 8.6)	7.9 (5.5, 11.2)	9.6 (6.8, 13.4)		
≥75	21	277	1.5 (0.6, 4.0)	6.1 (3.7, 9.9)	9.0 (6.0, 13.6)	9.0 (6.0, 13.6)		
TOTAL	**146**	**1313**						

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=1.21 (0.68, 2.14),p=0.512
2.5Yr - 3Yr: HR=1.79 (0.60, 5.33),p=0.296
3Yr+: HR=0.76 (0.42, 1.37),p=0.360

65-74 vs <55
Entire Period: HR=0.53 (0.33, 0.86),p=0.009

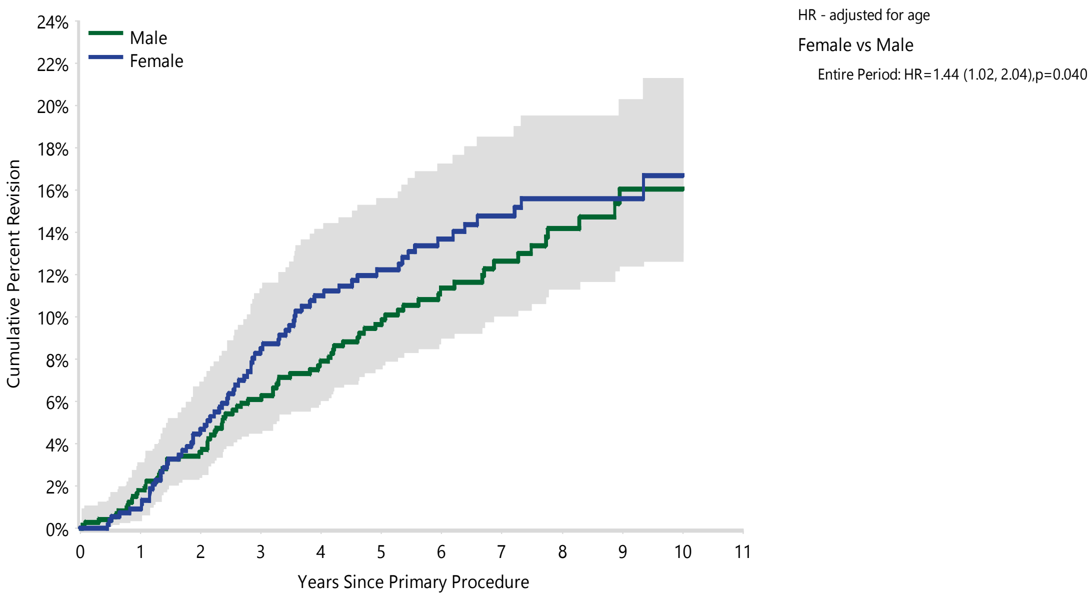
≥75 vs <55
0 - 1Yr: HR=0.84 (0.26, 2.72),p=0.772
1Yr - 3.5Yr: HR=0.53 (0.26, 1.08),p=0.079
3.5Yr - 4Yr: HR=1.17 (0.28, 4.88),p=0.833
4Yr+: HR=0.12 (0.03, 0.51),p=0.004

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
<55	255	229	172	140	81	20	3
55-64	362	333	259	206	130	26	5
65-74	419	387	316	248	157	37	3
≥75	277	255	210	149	96	13	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	11 Yrs
Male	77	756	1.8 (1.1, 3.1)	6.1 (4.5, 8.2)	9.7 (7.5, 12.3)	12.6 (10.0, 15.8)	16.1 (12.7, 20.3)	
Female	69	557	0.9 (0.4, 2.2)	8.5 (6.3, 11.3)	12.2 (9.6, 15.6)	14.8 (11.7, 18.5)	16.7 (13.0, 21.3)	
TOTAL	**146**	**1313**						

Figure SP5 Cumulative Percent Revision of Primary Hemi Resurfacing Shoulder Replacement by Gender (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
Male	756	685	538	416	254	54	7
Female	557	519	419	327	210	42	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	11 Yrs
Aequalis	12	79	1.3 (0.2, 8.9)	9.1 (4.5, 18.2)	12.4 (6.6, 22.7)	18.0 (10.0, 31.3)		
Copeland	55	543	1.5 (0.8, 3.0)	5.9 (4.1, 8.3)	9.0 (6.7, 11.9)	10.8 (8.3, 14.0)	12.6 (9.7, 16.4)	
Global CAP	30	212	0.5 (0.1, 3.4)	9.2 (5.9, 14.3)	12.8 (8.7, 18.5)	15.0 (10.5, 21.3)		
PyroTITAN	16	310	2.5 (1.2, 5.2)	5.4 (3.1, 9.1)	7.6 (4.6, 12.5)			
SMR	28	146	0.0 (0.0, 0.0)	7.2 (3.9, 12.9)	15.4 (10.2, 22.9)	22.3 (15.5, 31.3)		
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	**146**	**1313**						

Note: Only prostheses with over 50 procedures have been listed

PRIMARY HEMI MID HEAD SHOULDER REPLACEMENT

DEMOGRAPHICS AND OUTCOME

There have been 46 primary hemi mid head shoulder replacement procedures reported to the Registry. This is an additional 13 procedures compared to the previous report.

This procedure is undertaken more commonly in males (52.2%). The mean age is 53.4 years for males and 65.4 years for females (Table SP17).

Osteoarthritis is the most common primary diagnosis (60.9%) (Table SP18).

There have been no new revisions reported in 2017. Of the five revisions reported overall, there was one for each of the following reasons: fracture, pain, loosening, rotator cuff insufficiency and glenoid erosion (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 (21), the Eclipse (10) and the Affiniti (7).

Table SP17 Primary Hemi Mid Head Shoulder Replacement by Age and Gender

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	24	52.2%	24	83	53	53.4	14.0
Female	22	47.8%	30	85	66	65.4	11.6
TOTAL	**46**	**100.0%**	**24**	**85**	**61**	**59.2**	**14.1**

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	14	58.3	14	63.6	28	60.9
Osteonecrosis	7	29.2	5	22.7	12	26.1
Fracture	1	4.2	2	9.1	3	6.5
Rotator Cuff Arthropathy	2	8.3	.	.	2	4.3
Rheumatoid Arthritis	.	.	1	4.5	1	2.2
TOTAL	**24**	**100.0**	**22**	**100.0**	**46**	**100.0**

Table SP19 Primary Hemi Mid Head Shoulder Replacement by Reason for Revision

Reason for Revision	Number	Percent
Fracture	1	20.0
Pain	1	20.0
Loosening	1	20.0
Rotator Cuff Insufficiency	1	20.0
Glenoid Erosion	1	20.0
TOTAL	**5**	**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	3	60.0
Humeral Component	1	20.0
Glenoid Component	1	20.0
TOTAL	**5**	**100.0**

PRIMARY HEMI STEMMED SHOULDER REPLACEMENT

DEMOGRAPHICS

There have been 4,783 primary hemi stemmed shoulder replacement procedures reported to the Registry. This is an additional 189 procedures compared to the previous report.

This procedure is more common in females (72.6%). The mean age is 72.3 years for females and 64.7 years for males (Table SP21).

The most common primary diagnosis is fracture (60.6%), followed by osteoarthritis (25.6%) (Table SP22). In 2017, the number of primary hemi stemmed shoulder replacements undertaken for fracture decreased by 79.9% compared to 2008. In 2017, the number of primary hemi stemmed shoulder replacements undertaken for osteoarthritis decreased by 65.2% compared to 2008 (Figure SP6).

The most common humeral head prostheses used in 2017 are the Aequalis, Global Unite, Comprehensive and SMR. The 10 most used humeral head prostheses account for 87.1% of all primary hemi stemmed procedures in 2017. This has decreased from 98.2% in 2008 (Table SP23).

The most common humeral stem prostheses used in 2017 are the Aequalis Ascend, SMR and Comprehensive. The 10 most used humeral stem prostheses account for 93.3% of all primary hemi stemmed procedures in 2017. 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 Primary Hemi Stemmed Shoulder Replacement by Age and Gender

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	1311	27.4%	14	93	66	64.7	13.6
Female	3472	72.6%	13	101	74	72.3	11.0
TOTAL	**4783**	**100.0%**	**13**	**101**	**71**	**70.2**	**12.3**

Table SP22 Primary Hemi Stemmed Shoulder Replacement by Primary Diagnosis and Gender

	Male		Female		TOTAL	
Primary Diagnosis	N	Col%	N	Col%	N	Col%
Fracture	623	47.5	2274	65.5	2897	60.6
Osteoarthritis	450	34.3	774	22.3	1224	25.6
Rotator Cuff Arthropathy	65	5.0	148	4.3	213	4.5
Osteonecrosis	59	4.5	88	2.5	147	3.1
Tumour	75	5.7	59	1.7	134	2.8
Rheumatoid Arthritis	11	0.8	80	2.3	91	1.9
Instability	21	1.6	40	1.2	61	1.3
Other Inflammatory Arthritis	7	0.5	9	0.3	16	0.3
TOTAL	**1311**	**100.0**	**3472**	**100.0**	**4783**	**100.0**

Note: Instability includes instability and dislocation

Figure SP6 Primary Hemi Stemmed Shoulder Replacement by Primary Diagnosis

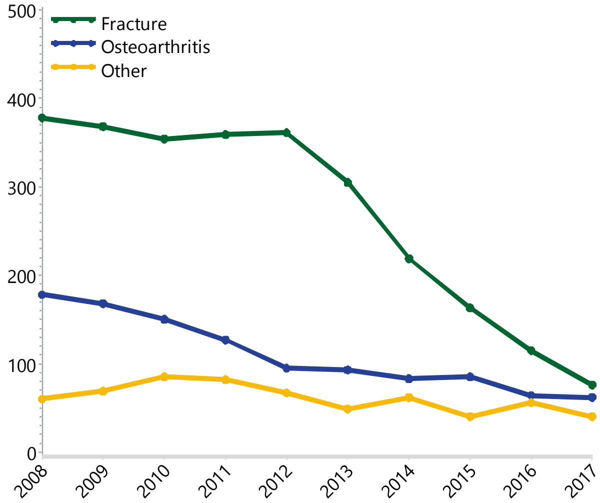


Table SP23 10 Most Used Humeral Head Prostheses in Primary Hemi Stemmed Shoulder Replacement

2008		2014		2015		2016		2017	
N	Model	N	Model	N	Model	N	Model	N	Model
197	Global Advantage	84	SMR	49	SMR	41	Aequalis	53	Aequalis
177	SMR	73	Aequalis	44	Aequalis	37	Global Unite	16	Global Unite
98	Aequalis	47	Global Advantage	38	Global Unite	31	SMR	15	Comprehensive
38	Bigliani/Flatow	31	Global AP	31	Global Advantage	20	Global AP	15	SMR
31	SMR CTA	30	Bigliani/Flatow	29	Bigliani/Flatow	16	Comprehensive	13	Equinoxe
22	Global Advantage CTA	25	Global Unite	26	Global AP	14	Bigliani/Flatow	12	Affinis
15	Bio-Modular	20	SMR CTA	10	SMR CTA	12	SMR CTA	9	Global AP
13	Solar	9	Global AP CTA	9	Bio-Modular	11	Bio-Modular	8	SMR CTA
8	Global AP	8	Bio-Modular	7	Ascend	11	Global Advantage	7	Bigliani/Flatow
6	Univers 3D	6	Delta Xtend	7	Global AP CTA	10	Global Advantage CTA	7	Global Advantage
10 Most Used									
605	(10) 98.2%	333	(10) 91.5%	250	(10) 86.8%	203	(10) 86.4%	155	(10) 87.1%
Remainder									
11	(4) 1.8%	31	(10) 8.5%	38	(11) 13.2%	32	(8) 13.6%	23	(6) 12.9%
TOTAL									
616	(14) 100.0%	364	(20) 100.0%	288	(21) 100.0%	235	(18) 100.0%	178	(16) 100.0%

Table SP24 10 Most Used Humeral Stem Prostheses in Primary Hemi Stemmed Shoulder Replacement

2008 N	2008 Model	2014 N	2014 Model	2015 N	2015 Model	2016 N	2016 Model	2017 N	2017 Model
207	SMR	105	SMR	60	SMR	43	SMR	43	Aequalis Ascend
138	Global FX	49	Aequalis	38	Global Unite	37	Global Unite	23	SMR
98	Aequalis	44	Global FX	33	Global AP	27	Aequalis Ascend	20	Comprehensive
81	Global Advantage	40	Global AP	31	Aequalis Ascend	27	Comprehensive	16	Global AP
26	Bigliani/Flatow TM	29	Aequalis Ascend	30	Global FX	25	Global AP	14	Global Unite
13	Solar	27	Bigliani/Flatow TM	22	Bigliani/Flatow TM	18	Aequalis	13	Aequalis
11	Bigliani/Flatow	25	Global Unite	18	Aequalis	12	Global Advantage	13	Equinoxe
11	Bio-Modular	12	Comprehensive	14	Comprehensive	11	Bigliani/Flatow TM	12	Affinis
8	Global AP	7	Global Advantage	5	Delta Xtend	9	Global FX	6	Bigliani/Flatow TM
6	Univers 3D	6	Delta Xtend	5	Equinoxe	8	Mutars	6	Global FX
10 Most Used									
599	(10) 97.2%	344	(10) 94.5%	256	(10) 88.9%	217	(10) 92.3%	166	(10) 93.3%
Remainder									
17	(7) 2.8%	20	(8) 5.5%	32	(10) 11.1%	18	(7) 7.7%	12	(4) 6.7%
TOTAL									
616	(17) 100.0%	364	(18) 100.0%	288	(20) 100.0%	235	(17) 100.0%	178	(14) 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).

There is no difference in the rate of revision when primary hemi stemmed shoulder replacement is performed for fracture or osteoarthritis.

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 (26.7%), whereas glenoid erosion occurs more frequently in procedures undertaken for osteoarthritis (31.1%) (Table SP26 and Figure SP8).

Type of Revision

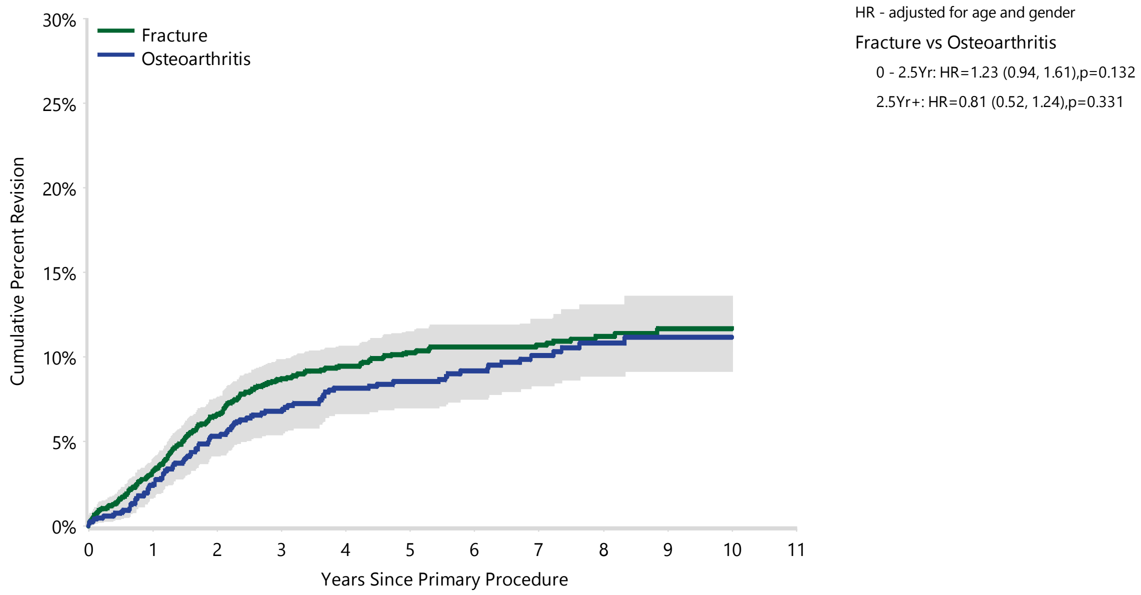
The most common type of revision is to a total shoulder replacement for both primary diagnoses (55.3% for osteoarthritis and 70.7% for fracture). Most were revised to a total reverse shoulder replacement (97.4% when used for fracture and 86.0% for osteoarthritis). Glenoid component only revision occurs more commonly in procedures undertaken for osteoarthritis (29.1% compared to 5.2% for fracture) (Table SP27).

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	11 Yrs
Fracture	270	2897	3.2 (2.7, 4.0)	8.7 (7.7, 9.9)	10.2 (9.1, 11.5)	10.7 (9.5, 12.0)	11.7 (10.3, 13.2)	
Osteoarthritis	103	1224	2.5 (1.7, 3.5)	6.8 (5.4, 8.4)	8.5 (7.0, 10.4)	10.1 (8.3, 12.2)	11.1 (9.1, 13.6)	
Rotator Cuff Arthropathy	13	213	1.9 (0.7, 5.1)	5.5 (3.0, 9.9)	6.9 (3.9, 11.9)	6.9 (3.9, 11.9)		
Osteonecrosis	8	147	1.4 (0.4, 5.7)	3.8 (1.6, 8.9)	4.9 (2.2, 10.8)	6.3 (3.0, 13.2)		
Tumour	9	134	4.7 (2.0, 11.0)					
Other (3)	8	168	2.5 (0.9, 6.4)	4.4 (2.1, 9.0)	4.4 (2.1, 9.0)	4.4 (2.1, 9.0)		
TOTAL	**411**	**4783**						

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	11 Yrs
Fracture	2897	2614	2030	1406	783	91	9
Osteoarthritis	1224	1112	877	660	427	70	6

Table SP26 Primary Hemi Stemmed Shoulder Replacement by Reason for Revision and Primary Diagnosis

Revision Diagnosis	Fracture Number	Fracture % Primaries Revised	Fracture % Revisions	Osteoarthritis Number	Osteoarthritis % Primaries Revised	Osteoarthritis % Revisions
Rotator Cuff Insufficiency	72	2.5	26.7	15	1.2	14.6
Instability/Dislocation	51	1.8	18.9	19	1.6	18.4
Glenoid Erosion	15	0.5	5.6	32	2.6	31.1
Infection	27	0.9	10.0	5	0.4	4.9
Pain	27	0.9	10.0	12	1.0	11.7
Fracture	24	0.8	8.9	4	0.3	3.9
Loosening	24	0.8	8.9	9	0.7	8.7
Arthrofibrosis	7	0.2	2.6	2	0.2	1.9
Malposition	7	0.2	2.6	1	0.1	1.0
Dissociation	3	0.1	1.1	1	0.1	1.0
Incorrect Sizing	2	0.1	0.7	1	0.1	1.0
Lysis	2	0.1	0.7			
Heterotopic Bone	1	0.0	0.4			
Osteonecrosis				1	0.1	1.0
Rotator Cuff Arthropathy	1	0.0	0.4			
Other	7	0.2	2.6	1	0.1	1.0
N Revision	**270**	**9.3**	**100.0**	**103**	**8.4**	**100.0**
N Primary	**2897**			**1224**		

Figure SP8 Cumulative Incidence Revision Diagnosis of Primary Hemi Stemmed Shoulder by Primary Diagnosis

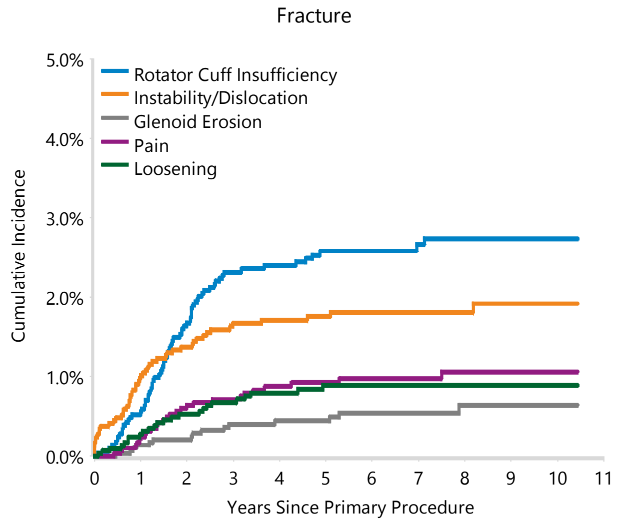


Table SP27 Primary Hemi Stemmed Shoulder Replacement by Type of Revision and Primary Diagnosis

Type of Revision	Fracture Number	Fracture % Primaries Revised	Fracture % Revisions	Osteoarthritis Number	Osteoarthritis % Primaries Revised	Osteoarthritis % Revisions
Humeral/Glenoid	191	6.6	70.7	57	4.7	55.3
Glenoid Component	14	0.5	5.2	30	2.5	29.1
Humeral Component	26	0.9	9.6	6	0.5	5.8
Head Only	16	0.6	5.9	3	0.2	2.9
Cement Spacer	11	0.4	4.1	1	0.1	1.0
Removal of Prostheses	6	0.2	2.2	1	0.1	1.0
Cement Only	4	0.1	1.5			
Reoperation	2	0.1	0.7	3	0.2	2.9
Head/Insert				1	0.1	1.0
Minor Components				1	0.1	1.0
N Revision	**270**	**9.3**	**100.0**	**103**	**8.4**	**100.0**
N Primary	**2897**			**1224**		

OUTCOME FOR FRACTURE

Age and Gender

The rate of revision is lower for patients aged 75 years or older compared to all other age groups (Table SP28 and Figure SP9).

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

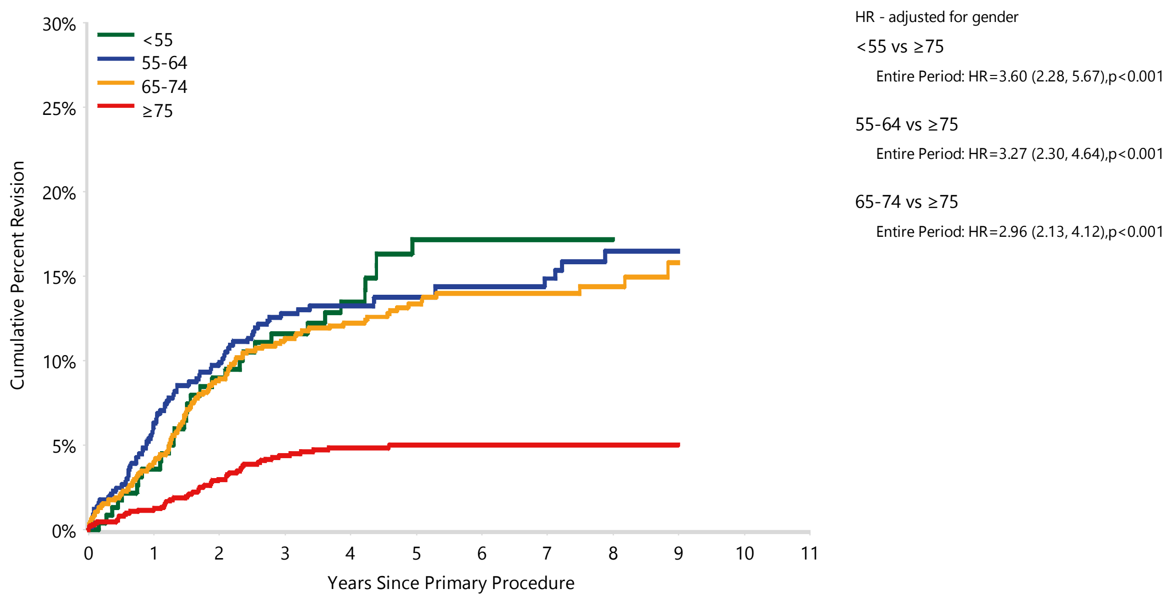
Cemented stem fixation for fracture has a lower rate of revision when a non-fracture stem is used.

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	11 Yrs
<55	32	233	3.6 (1.8, 7.0)	11.6 (7.9, 16.9)	17.2 (12.4, 23.6)	17.2 (12.4, 23.6)		
55-64	78	568	6.3 (4.6, 8.7)	12.8 (10.2, 15.9)	13.8 (11.1, 17.1)	14.9 (12.0, 18.4)		
65-74	107	848	4.0 (2.8, 5.5)	11.3 (9.3, 13.8)	13.3 (11.1, 16.0)	14.0 (11.6, 16.7)		
≥75	53	1248	1.2 (0.8, 2.1)	4.4 (3.3, 5.8)	5.0 (3.8, 6.5)	5.0 (3.8, 6.5)		
TOTAL	**270**	**2897**						

Figure SP9 Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Age (Primary Diagnosis Fracture)

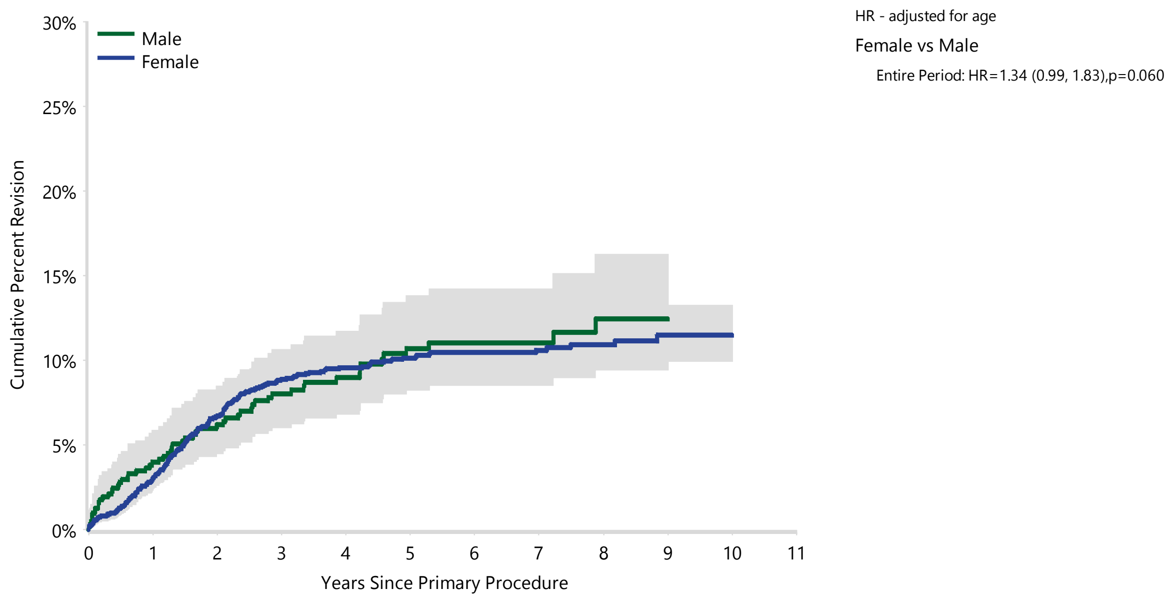


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
<55	233	204	153	99	59	10	0
55-64	568	507	400	292	177	15	0
65-74	848	773	602	433	240	35	6
≥75	1248	1130	875	582	307	31	3

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	11 Yrs
Male	58	623	4.0 (2.7, 5.9)	8.0 (6.1, 10.6)	10.7 (8.3, 13.8)	11.0 (8.5, 14.2)		
Female	212	2274	3.0 (2.4, 3.9)	8.9 (7.7, 10.2)	10.1 (8.9, 11.5)	10.6 (9.3, 12.1)	11.5 (9.9, 13.2)	
TOTAL	**270**	**2897**						

Figure SP10 Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Gender (Primary Diagnosis Fracture)

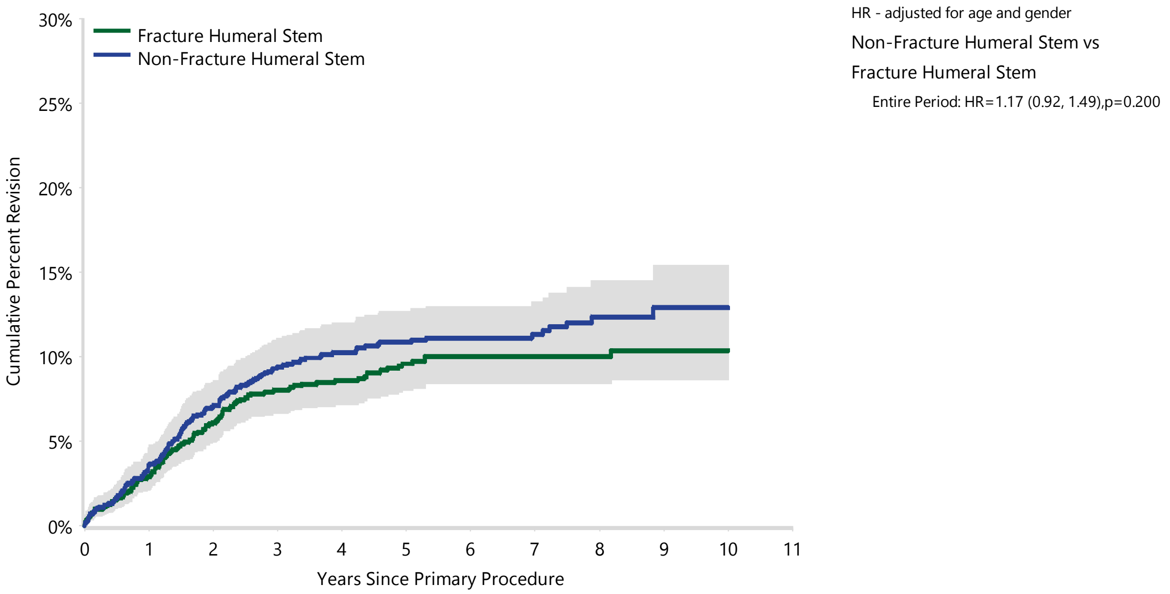


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
Male	623	542	421	278	150	18	1
Female	2274	2072	1609	1128	633	73	8

Table SP30 Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Stem Type (Primary Diagnosis Fracture)

Fracture	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
Fracture Humeral Stem	121	1425	2.9 (2.1, 3.9)	8.0 (6.6, 9.6)	9.6 (8.0, 11.4)	10.0 (8.4, 11.9)	10.4 (8.7, 12.4)	
Non-Fracture Humeral Stem	149	1472	3.6 (2.7, 4.7)	9.4 (7.9, 11.1)	10.9 (9.3, 12.7)	11.3 (9.7, 13.2)	12.9 (10.8, 15.4)	
TOTAL	**270**	**2897**						

Figure SP11 Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Stem Type (Primary Diagnosis Fracture)

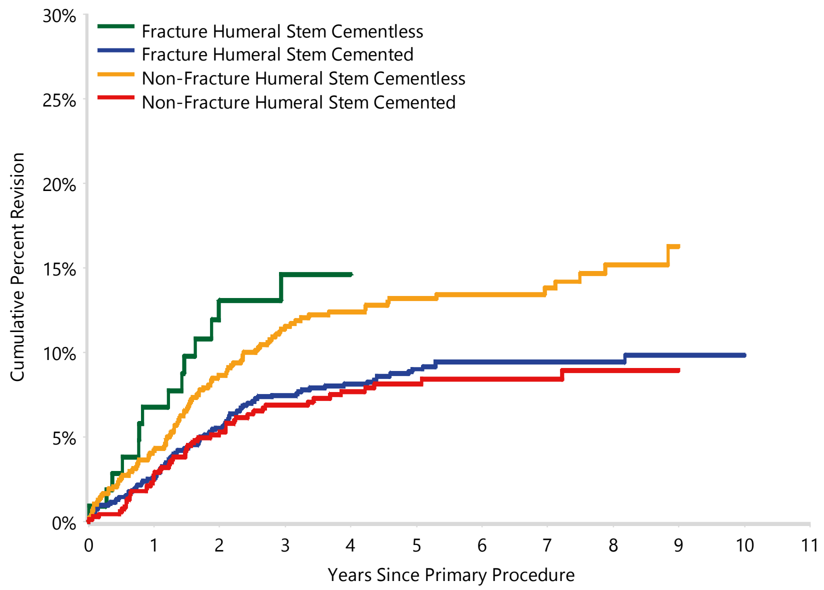


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
Fracture Humeral Stem	1425	1285	987	667	358	50	4
Non-Fracture Humeral Stem	1472	1329	1043	739	425	41	5

Table SP31 Yearly Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Stem Type and Humeral Fixation (Primary Diagnosis Fracture)

Fracture	Humeral Fixation	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
Fracture Humeral Stem	Cementless	15	106	6.8 (3.3, 13.7)	14.6 (8.9, 23.6)				
	Cemented	106	1319	2.6 (1.8, 3.6)	7.5 (6.1, 9.1)	9.0 (7.5, 10.9)	9.5 (7.8, 11.4)	9.8 (8.1, 11.9)	
Non-Fracture Humeral Stem	Cementless	98	780	4.2 (3.0, 5.9)	11.5 (9.4, 14.1)	13.2 (10.9, 16.0)	13.8 (11.4, 16.7)		
	Cemented	51	692	2.9 (1.9, 4.5)	6.9 (5.1, 9.2)	8.1 (6.2, 10.7)	8.4 (6.4, 11.0)		
TOTAL		**270**	**2897**						

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=1.61 (0.93, 2.77),p=0.088

Fracture Humeral Stem Cemented vs Non-Fracture Humeral Stem Cemented
Entire Period: HR=1.09 (0.78, 1.52),p=0.613

Fracture Humeral Stem Cementless vs Non-Fracture Humeral Stem Cementless
Entire Period: HR=1.08 (0.62, 1.86),p=0.787

Non-Fracture Humeral Stem Cementless vs Non-Fracture Humeral Stem Cemented
Entire Period: HR=1.62 (1.16, 2.28),p=0.005

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
Fracture Humeral Stem	Cementless	106	95	54	26	5	1	0
	Cemented	1319	1190	933	641	353	49	4
Non-Fracture Humeral Stem	Cementless	780	706	551	391	232	18	2
	Cemented	692	623	492	348	193	23	3

Table SP32 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	11 Yrs
Aequalis	Aequalis	30	441	2.6 (1.4, 4.6)	6.3 (4.4, 9.2)	7.3 (5.1, 10.4)	7.3 (5.1, 10.4)		
Affinis	Affinis	4	30	8.8 (2.3, 31.0)	14.5 (4.8, 39.1)	22.3 (8.6, 50.7)	22.3 (8.6, 50.7)		
Bigliani/Flatow	Bigliani/Flatow TM	8	291	1.4 (0.5, 3.8)	3.0 (1.5, 5.8)	3.0 (1.5, 5.8)	3.0 (1.5, 5.8)		
Bio-Modular	Comprehensive	4	75	2.7 (0.7, 10.4)	4.3 (1.4, 12.9)	7.0 (2.5, 18.4)	7.0 (2.5, 18.4)		
Comprehensive	Comprehensive	2	42	2.4 (0.3, 16.1)	6.3 (1.6, 23.9)	6.3 (1.6, 23.9)			
Global Advantage	Global Advantage	9	53	7.7 (2.9, 19.1)	15.7 (8.1, 28.9)	17.8 (9.7, 31.5)	17.8 (9.7, 31.5)		
Global Advantage	Global FX	52	692	2.2 (1.3, 3.7)	6.2 (4.6, 8.4)	8.1 (6.2, 10.6)	8.8 (6.8, 11.5)		
Global Unite	Global Unite	27	143	7.3 (4.0, 13.1)	23.6 (16.6, 32.8)				
SMR	SMR	106	872	4.0 (2.9, 5.6)	10.9 (9.0, 13.3)	12.7 (10.6, 15.3)	13.5 (11.2, 16.2)		
SMR CTA	SMR	4	36	3.1 (0.4, 20.2)	11.2 (3.7, 31.2)	16.2 (6.3, 38.1)	16.2 (6.3, 38.1)		
Solar	Solar	5	40	7.9 (2.6, 22.5)	10.5 (4.1, 25.7)	13.7 (5.9, 30.0)	13.7 (5.9, 30.0)		
Other (23)		19	182	2.3 (0.9, 6.1)	11.0 (6.9, 17.1)	12.1 (7.7, 18.6)	12.1 (7.7, 18.6)		
TOTAL		**270**	**2897**						

Note: Only combinations with over 30 procedures have been listed

Table SP33 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	11 Yrs
Aequalis	Aequalis	29	424	2.4 (1.3, 4.4)	6.4 (4.3, 9.3)	7.4 (5.1, 10.5)	7.4 (5.1, 10.5)		
Bio-Modular	Comprehensive	4	75	2.7 (0.7, 10.4)	4.3 (1.4, 12.9)	7.0 (2.5, 18.4)	7.0 (2.5, 18.4)		
Comprehensive	Comprehensive	2	37	2.8 (0.4, 18.1)	7.2 (1.8, 26.7)	7.2 (1.8, 26.7)			
Global Advantage	Global FX	52	692	2.2 (1.3, 3.7)	6.2 (4.6, 8.4)	8.1 (6.2, 10.6)	8.8 (6.8, 11.5)		
Global Unite	Global Unite	27	142	7.4 (4.0, 13.2)	23.7 (16.7, 32.9)				
Other (5)		7	55	4.3 (1.1, 16.0)	14.8 (6.9, 30.2)	18.6 (9.1, 35.9)			
TOTAL		**121**	**1425**						

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 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	11 Yrs
Bigliani/Flatow	Bigliani/Flatow TM	8	291	1.4 (0.5, 3.8)	3.0 (1.5, 5.8)	3.0 (1.5, 5.8)	3.0 (1.5, 5.8)		
Global Advantage	Global Advantage	9	53	7.7 (2.9, 19.1)	15.7 (8.1, 28.9)	17.8 (9.7, 31.5)	17.8 (9.7, 31.5)		
SMR	SMR	106	872	4.0 (2.9, 5.6)	10.9 (9.0, 13.3)	12.7 (10.6, 15.3)	13.5 (11.2, 16.2)		
SMR CTA	SMR	4	36	3.1 (0.4, 20.2)	11.2 (3.7, 31.2)	16.2 (6.3, 38.1)	16.2 (6.3, 38.1)		
Solar	Solar	5	40	7.9 (2.6, 22.5)	10.5 (4.1, 25.7)	13.7 (5.9, 30.0)	13.7 (5.9, 30.0)		
Other (25)		17	180	2.9 (1.2, 6.9)	9.7 (5.9, 15.6)	10.7 (6.6, 17.0)	10.7 (6.6, 17.0)		
TOTAL		**149**	**1472**						

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 or older compared to patients in the under 55 years and 55 to 64 years age groups (Table SP35 and Figure SP13).

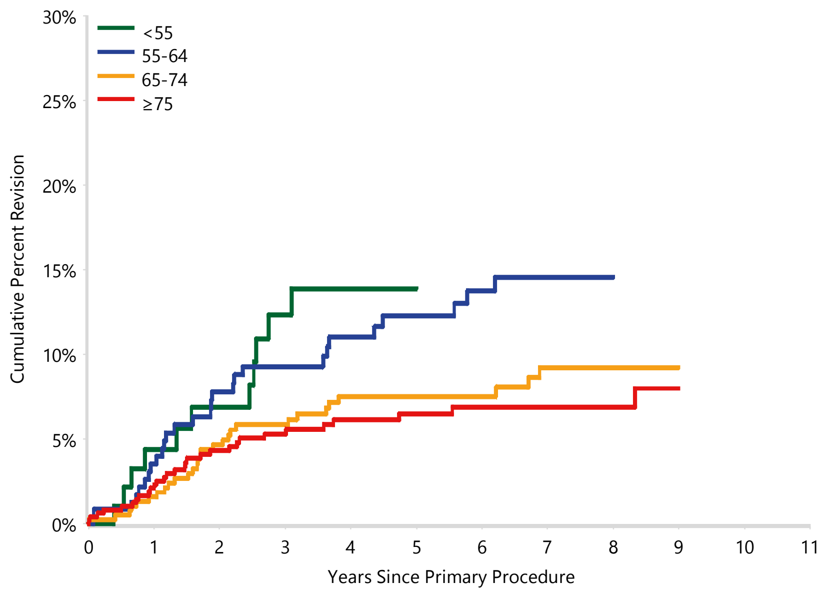
Gender is not a risk factor for revision (Table SP36 and Figure SP14).

The outcomes of the most used prosthesis combinations for osteoarthritis are listed in Table SP37.

Table SP35 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	11 Yrs
<55	16	104	4.4 (1.7, 11.3)	12.3 (6.8, 21.8)	13.9 (7.9, 23.8)			
55-64	28	237	3.5 (1.8, 6.9)	9.3 (6.1, 14.1)	12.3 (8.4, 17.7)	14.6 (10.2, 20.6)		
65-74	29	391	1.6 (0.7, 3.5)	5.8 (3.8, 8.8)	7.5 (5.2, 10.9)	9.2 (6.4, 13.2)		
≥75	30	492	2.3 (1.3, 4.1)	5.3 (3.6, 7.8)	6.5 (4.5, 9.3)	6.9 (4.8, 9.8)		
TOTAL	**103**	**1224**						

Figure SP13 Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Age (Primary Diagnosis OA)



HR - adjusted for gender

<55 vs ≥75

0 - 2.5Yr: HR=1.88 (0.81, 4.41),p=0.143

2.5Yr+: HR=7.41 (3.20, 17.18),p<0.001

55-64 vs ≥75

Entire Period: HR=2.12 (1.25, 3.60),p=0.005

65-74 vs ≥75

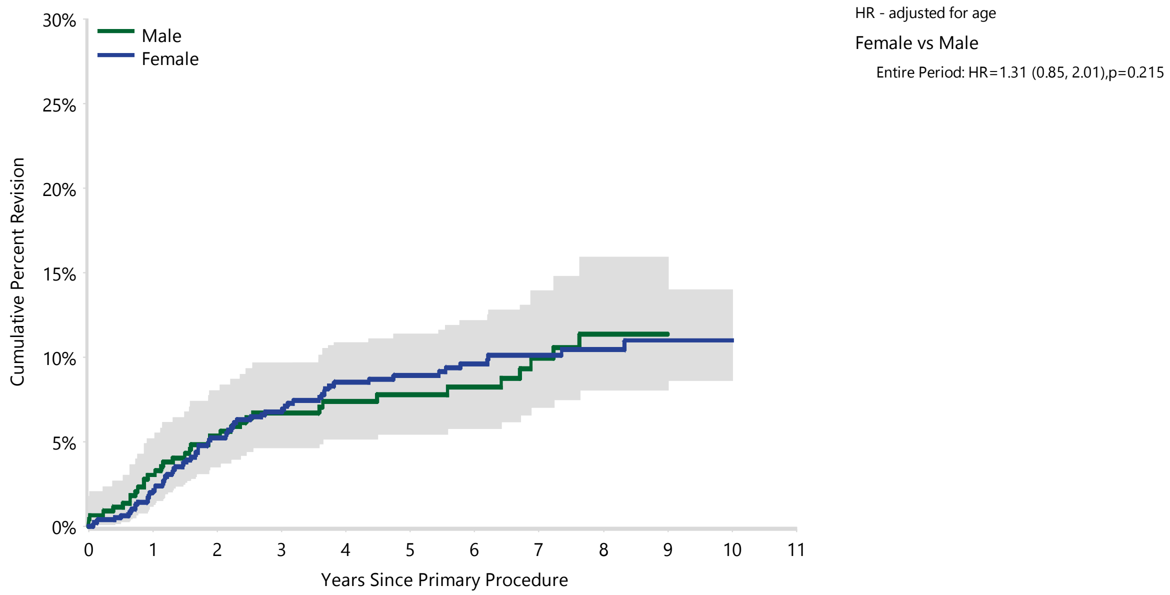
Entire Period: HR=1.21 (0.73, 2.03),p=0.457

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
<55	104	84	61	45	32	7	0
55-64	237	211	167	129	91	12	2
65-74	391	364	293	219	153	24	1
≥75	492	453	356	267	151	27	3

Table SP36 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	11 Yrs
Male	36	450	3.1 (1.8, 5.2)	6.7 (4.7, 9.7)	7.8 (5.5, 11.0)	9.9 (7.1, 13.9)		
Female	67	774	2.1 (1.3, 3.5)	6.8 (5.2, 8.9)	8.9 (7.0, 11.3)	10.1 (8.0, 12.8)	11.0 (8.6, 14.0)	
TOTAL	**103**	**1224**						

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	11 Yrs
Male	450	393	307	228	147	20	3
Female	774	719	570	432	280	50	3

Table SP37 **Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Humeral Head and Stem Prostheses (Primary Diagnosis OA)**

Humeral Head	Humeral Stem	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
Aequalis	Aequalis	10	138	1.5 (0.4, 5.7)	5.2 (2.5, 10.6)	6.1 (3.1, 11.8)	9.1 (4.8, 16.8)		
Aequalis	Aequalis Ascend	2	81	1.6 (0.2, 10.9)	5.9 (1.3, 24.4)				
Bigliani/Flatow	Bigliani/Flatow TM	3	53	3.8 (1.0, 14.5)	5.8 (1.9, 16.8)	5.8 (1.9, 16.8)	5.8 (1.9, 16.8)		
Delta Xtend	Delta Xtend	2	27	0.0 (0.0, 0.0)	8.9 (2.3, 31.2)	8.9 (2.3, 31.2)	8.9 (2.3, 31.2)		
Global AP	Global AP	8	163	0.6 (0.1, 4.5)	4.2 (1.9, 9.1)	6.2 (3.1, 12.2)			
Global AP CTA	Global AP	5	43	2.3 (0.3, 15.4)	12.6 (5.4, 27.6)	12.6 (5.4, 27.6)			
Global Advantage	Global Advantage	12	144	0.7 (0.1, 4.8)	5.0 (2.4, 10.2)	7.4 (4.0, 13.3)	8.2 (4.6, 14.4)		
Global Advantage	Global FX	4	31	3.2 (0.5, 20.8)	10.3 (3.4, 28.9)	10.3 (3.4, 28.9)	10.3 (3.4, 28.9)		
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	38	270	4.1 (2.3, 7.4)	8.8 (6.0, 13.0)	12.3 (8.8, 17.0)	15.0 (11.0, 20.2)		
SMR CTA	SMR	8	88	5.8 (2.5, 13.5)	9.9 (5.1, 18.9)	9.9 (5.1, 18.9)	9.9 (5.1, 18.9)		
Other (26)		10	147	2.9 (1.1, 7.6)	7.3 (3.9, 13.7)	8.6 (4.6, 15.5)			
TOTAL		**103**	**1224**						

Note: Only combinations with over 20 procedures have been listed

Primary Total Shoulder Replacement

CLASSES OF TOTAL SHOULDER REPLACEMENT

The Registry sub-categorises primary total shoulder replacement into four classes. These are defined by the type of prosthesis used. Due to the increasing variations of proximal humeral prostheses used in shoulder replacement, in this report the total conventional class has been renamed 'total stemmed'.

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 33,813 total shoulder replacements reported to the Registry. This is an additional 5,620 procedures compared to the previous report.

The two main classes of primary total shoulder replacement are total stemmed (37.1%) and total reverse (58.9%). Total mid head and total resurfacing shoulder replacements are used infrequently (3.3% and 0.7%, respectively) (Table ST1). The proportion of total reverse shoulder replacements has increased from 42.2% in 2009 to 73.6% in 2017 (Figure ST1).

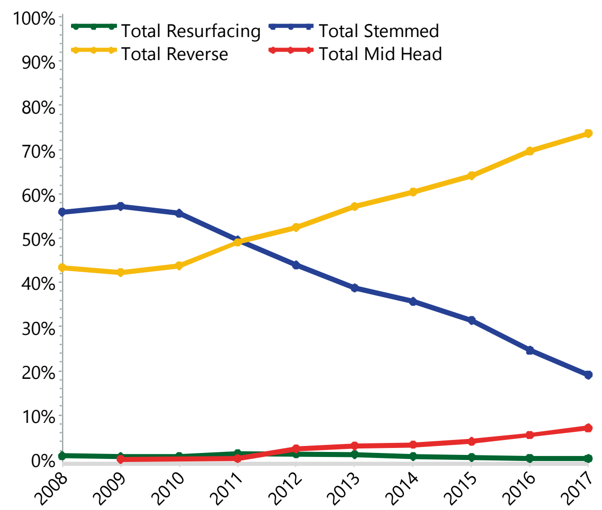
Table ST1 Primary Total Shoulder Replacement by Class

Shoulder Class	Number	Percent
Total Resurfacing	221	0.7
Total Stemmed	12535	37.1
Total Reverse	19929	58.9
Total Mid Head	1128	3.3
TOTAL	**33813**	**100.0**

Primary total shoulder replacement is more common in females (61.9%). However, 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 (65.0%), total stemmed (57.9%), total mid head (55.9%) and total resurfacing (39.4%) (Table ST2).

The mean age for total shoulder replacement is 73.5 years for females and 70.1 years for males (Table ST3).

Figure ST1 Proportion of Primary Total Shoulder Replacement by Class



Most patients are aged 65 years or older (82.3%). The proportion of patients in this age group varies depending on the class of shoulder replacement: total reverse (89.7%), total stemmed (72.3%), total mid head (65.6%) and total resurfacing (52.0%) (Table ST4).

The most common primary diagnoses are osteoarthritis (65.2%), rotator cuff arthropathy (20.5%) and fracture (9.4%). Rheumatoid arthritis and osteonecrosis account for 1.9% and 1.3%, respectively (Table ST5).

Only 221 total resurfacing shoulder replacements have been reported to the Registry, 16 of which have been revised. The cumulative percent revision at seven years is 7.0% (Table ST6).

Total mid head shoulder replacement has been used in 1,128 procedures. There have been 26 revisions and the five year cumulative percent revision is 4.2% (Table ST6).

At 10 years, the cumulative percent revision for total stemmed and total reverse shoulder replacement is 12.6% and 7.0%, respectively (Table ST6).

Total reverse shoulder replacement has a higher rate of revision compared to total stemmed in the first three months. However, after three 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 three months (Figure ST2).

An additional analysis has been undertaken with the SMR L2 prosthesis excluded from both total stemmed and total reverse shoulder procedures. This prosthesis has been identified as having a higher than anticipated rate of revision and has subsequently been withdrawn. After excluding the SMR L2 prosthesis from both total stemmed and reverse shoulder procedures, the 10 year cumulative percent revision for total stemmed and total reverse shoulder replacement is 10.0% and 6.8%, respectively. Total reverse shoulder replacement continues to have a higher rate of revision in the first three 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 Gender and Class

	Male		Female		TOTAL	
Shoulder Class	N	Row%	N	Row%	N	Row%
Total Resurfacing	134	60.6	87	39.4	221	100.0
Total Stemmed	5273	42.1	7262	57.9	12535	100.0
Total Reverse	6971	35.0	12958	65.0	19929	100.0
Total Mid Head	497	44.1	631	55.9	1128	100.0
TOTAL	**12875**	**38.1**	**20938**	**61.9**	**33813**	**100.0**

Table ST3 Primary Total Shoulder Replacement by Age and Gender

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	12875	38.1%	17	96	71	70.1	9.0
Female	20938	61.9%	13	102	74	73.5	8.5
TOTAL	**33813**	**100.0%**	**13**	**102**	**73**	**72.2**	**8.9**

Table ST4 Primary Total Shoulder Replacement by Age and Class

	<55		55-64		65-74		≥75		TOTAL	
Shoulder Class	N	Row%	N	Row%	N	Row%	N	Row%	N	Row%
Total Resurfacing	31	14.0	75	33.9	99	44.8	16	7.2	221	100.0
Total Stemmed	641	5.1	2827	22.6	5532	44.1	3535	28.2	12535	100.0
Total Reverse	273	1.4	1769	8.9	7422	37.2	10465	52.5	19929	100.0
Total Mid Head	95	8.4	293	26.0	502	44.5	238	21.1	1128	100.0
TOTAL	**1040**	**3.1**	**4964**	**14.7**	**13555**	**40.1**	**14254**	**42.2**	**33813**	**100.0**

Table ST5 Primary Total Shoulder Replacement by Primary Diagnosis and Gender

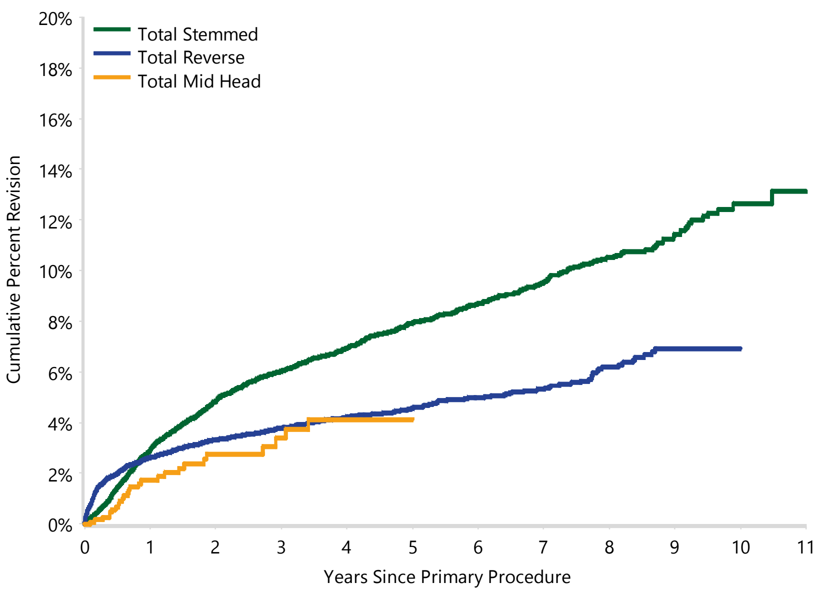
Primary Diagnosis	Male N	Male Col%	Female N	Female Col%	TOTAL N	TOTAL Col%
Osteoarthritis	8966	69.6	13088	62.5	22054	65.2
Rotator Cuff Arthropathy	2932	22.8	4000	19.1	6932	20.5
Fracture	515	4.0	2657	12.7	3172	9.4
Rheumatoid Arthritis	142	1.1	491	2.3	633	1.9
Osteonecrosis	96	0.7	353	1.7	449	1.3
Instability	97	0.8	170	0.8	267	0.8
Other Inflammatory Arthritis	48	0.4	108	0.5	156	0.5
Tumour	74	0.6	65	0.3	139	0.4
Other	5	0.0	6	0.0	11	0.0
TOTAL	**12875**	**100.0**	**20938**	**100.0**	**33813**	**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	11 Yrs
Total Resurfacing	16	221	1.9 (0.7, 4.9)	4.4 (2.3, 8.2)	6.2 (3.5, 10.7)	7.0 (4.1, 12.0)		
Total Stemmed	930	12535	2.9 (2.6, 3.2)	6.0 (5.6, 6.5)	8.0 (7.4, 8.5)	9.6 (8.9, 10.2)	12.6 (11.5, 13.8)	13.1 (11.7, 14.7)
Total Reverse	737	19929	2.6 (2.4, 2.9)	3.8 (3.5, 4.1)	4.6 (4.2, 5.0)	5.3 (4.9, 5.8)	7.0 (6.1, 7.9)	
Total Mid Head	26	1128	1.7 (1.1, 2.8)	3.4 (2.2, 5.2)	4.2 (2.7, 6.4)			
TOTAL	**1709**	**33813**						

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=0.33 (0.25, 0.43),p<0.001

3Mth+: HR=2.04 (1.81, 2.31),p<0.001

Total Mid Head vs Total Reverse

0 - 3Mth: HR=0.10 (0.02, 0.39),p=0.001

3Mth+: HR=1.16 (0.77, 1.75),p=0.484

Total Stemmed vs Total Mid Head

Entire Period: HR=1.89 (1.28, 2.79),p=0.001

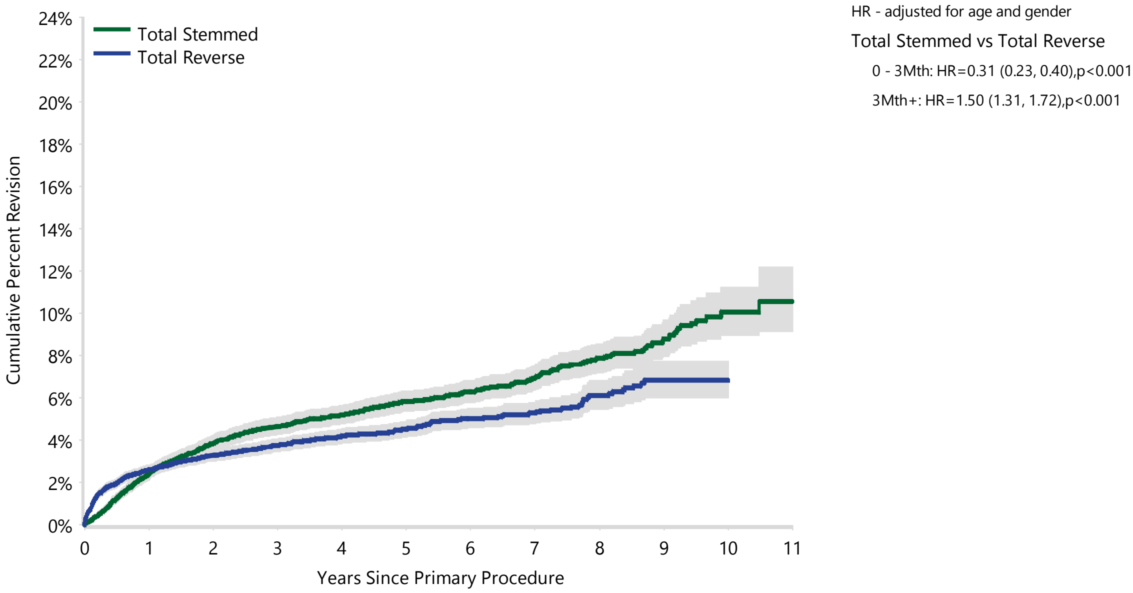
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
Total Stemmed	12535	11049	8111	5358	2960	375	62
Total Reverse	19929	15154	8652	4509	1953	207	37
Total Mid Head	1128	725	289	72	1	0	0

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	11 Yrs
Total Stemmed	647	11677	2.4 (2.1, 2.7)	4.7 (4.3, 5.1)	5.8 (5.4, 6.3)	7.0 (6.4, 7.6)	10.0 (8.9, 11.2)	10.5 (9.1, 12.2)
Total Reverse	670	18788	2.6 (2.4, 2.8)	3.8 (3.5, 4.1)	4.5 (4.1, 4.9)	5.3 (4.8, 5.8)	6.8 (6.0, 7.7)	
TOTAL	**1317**	**30465**						

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		1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
Total Stemmed	11677	10280	7462	4799	2738	375	62
Total Reverse	18788	14078	7649	3612	1695	207	37

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 221 primary total resurfacing shoulder replacements reported to the Registry. This is an additional 10 procedures compared to the previous report.

Primary total resurfacing shoulder replacement is undertaken more often in males (60.6%). The mean age is 62.3 years for males and 66.6 years for females (Table ST8).

Osteoarthritis is the most common primary diagnosis (95.9%) (Table ST9).

There are two different types of total resurfacing prosthesis combinations used in 2017. The Global CAP/Global Advantage combination has been used in eight of the 10 procedures reported in 2017 (Table ST10 and Table ST11).

The cumulative percent revision at seven years is 7.0% (Table ST6). There have been 16 revisions. The main reasons for revision are presented in Table ST12. The most common type of revision is to a total shoulder replacement (43.8%) (Table ST13).

Table ST8 Primary Total Resurfacing Shoulder Replacement by Age and Gender

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	134	60.6%	35	83	63	62.3	9.6
Female	87	39.4%	46	86	67	66.6	6.7
TOTAL	**221**	**100.0%**	**35**	**86**	**65**	**64.0**	**8.9**

Table ST9 Primary Total Resurfacing Shoulder Replacement by Primary Diagnosis and Gender

	Male		Female		TOTAL	
Primary Diagnosis	N	Col%	N	Col%	N	Col%
Osteoarthritis	130	97.0	82	94.3	212	95.9
Rheumatoid Arthritis	1	0.7	2	2.3	3	1.4
Fracture	1	0.7	1	1.1	2	0.9
Osteonecrosis	1	0.7	.	.	1	0.5
Rotator Cuff Arthropathy	.	.	1	1.1	1	0.5
Instability	1	0.7	.	.	1	0.5
Other Inflammatory Arthritis	.	.	1	1.1	1	0.5
TOTAL	**134**	**100.0**	**87**	**100.0**	**221**	**100.0**

Note: Instability includes instability and dislocation

Table ST10 Most Used Humeral Head Prostheses in Primary Total Resurfacing Shoulder Replacement

2008		2014		2015		2016		2017	
N	Model	N	Model	N	Model	N	Model	N	Model
5	SMR	17	Global CAP	12	Global CAP	9	Global CAP	8	Global CAP
4	Aequalis	6	Aequalis	4	Epoca RH	1	Epoca RH	2	Epoca RH
2	Copeland	1	Epoca RH	2	Aequalis	1	SMR		
1	Global CAP			1	SMR				
Most Used									
12 (4)	100.0%	24 (3)	100.0%	19 (4)	100.0%	11 (3)	100.0%	10 (2)	100.0%

Table ST11 Most Used Glenoid Prostheses in Primary Total Resurfacing Shoulder Replacement

2008		2014		2015		2016		2017	
N	Model	N	Model	N	Model	N	Model	N	Model
4	Aequalis	17	Global	12	Global	9	Global	8	Global
3	SMR L1	6	Aequalis	4	Epoca	1	Epoca	2	Epoca
2	Copeland	1	Epoca	2	Aequalis	1	SMR		
2	SMR			1	SMR				
1	Global								
Most Used									
12 (5)	100.0%	24 (3)	100.0%	19 (4)	100.0%	11 (3)	100.0%	10 (2)	100.0%

Table ST12 Primary Total Resurfacing Shoulder Replacement by Reason for Revision

Reason for Revision	Number	Percent
Loosening	6	37.5
Instability/Dislocation	2	12.5
Infection	2	12.5
Implant Breakage Glenoid Insert	2	12.5
Fracture	1	6.3
Implant Breakage Glenoid	1	6.3
Rotator Cuff Insufficiency	1	6.3
Wear Glenoid Insert	1	6.3
TOTAL	**16**	**100.0**

Table ST13 Primary Total Resurfacing Shoulder Replacement by Type of Revision

Type of Revision	Number	Percent
Humeral/Glenoid	7	43.8
Humeral Component	5	31.3
Insert Only	2	12.5
Head Only	1	6.3
Cement Spacer	1	6.3
TOTAL	**16**	**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 1,128 primary total mid head shoulder replacements reported to the Registry. This is an additional 395 procedures compared to the previous report. The use of primary mid head shoulder replacement has increased by 447.9% since its first full year of use in 2012.

Primary total mid head shoulder replacement is undertaken more often in females (55.9%). The mean age is 69.6 years for females and 64.9 years for males (Table ST14).

Osteoarthritis is the most common primary diagnosis (96.2%) (Table ST15).

The cumulative percent revision at five years is 4.2% (Table ST6). There have been 26 revisions in this class. The main reasons for revision are instability/dislocation (38.5%), loosening (26.9%), infection (11.5%) and rotator cuff insufficiency (11.5%) (Table ST16).

The most common types of revision involve replacement of the humeral and glenoid components (53.8%), replacement of the humeral component (15.4%), and replacement of the head only (15.4%). Of the 14 humeral/glenoid revisions, 12 have been revised to a total reverse requiring revision of the stem, and two have been revised to a total stemmed shoulder replacement (Table ST17).

The Affinis is the most used total mid head shoulder prosthesis in 2017 (Table ST18 and Table ST19).

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Table ST14 Primary Total Mid Head Shoulder Replacement by Age and Gender

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	497	44.1%	34	89	66	64.9	9.3
Female	631	55.9%	42	94	70	69.6	8.1
TOTAL	**1128**	**100.0%**	**34**	**94**	**68**	**67.5**	**9.0**

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	484	97.4	601	95.2	1085	96.2
Osteonecrosis	5	1.0	13	2.1	18	1.6
Rheumatoid Arthritis	2	0.4	6	1.0	8	0.7
Other Inflammatory Arthritis	.	.	6	1.0	6	0.5
Rotator Cuff Arthropathy	2	0.4	2	0.3	4	0.4
Instability	3	0.6	1	0.2	4	0.4
Fracture	1	0.2	2	0.3	3	0.3
TOTAL	**497**	**100.0**	**631**	**100.0**	**1128**	**100.0**

Table ST16 Primary Total Mid Head Shoulder Replacement by Reason for Revision

Reason for Revision	Number	Percent
Instability/Dislocation	10	38.5
Loosening	7	26.9
Infection	3	11.5
Rotator Cuff Insufficiency	3	11.5
Pain	1	3.8
Malposition	1	3.8
Incorrect Sizing	1	3.8
TOTAL	**26**	**100.0**

Table ST17 Primary Total Mid Head Shoulder Replacement by Type of Revision

Type of Revision	Number	Percent
Humeral/Glenoid	14	53.8
Humeral Component	4	15.4
Head Only	4	15.4
Removal of Prostheses	2	7.7
Cement Spacer	2	7.7
TOTAL	**26**	**100.0**

Table ST18 Most Used Humeral Stem Prostheses in Primary Total Mid Head Shoulder Replacement

2011		2014		2015		2016		2017	
N	Model	N	Model	N	Model	N	Model	N	Model
2	Simpliciti	61	Simpliciti	109	Affinis	218	Affinis	264	Affinis
2	TESS	52	Affinis	46	Sidus	19	Simpliciti	68	Simpliciti
1	Affinis	12	Sidus	11	Simpliciti	12	Sidus	27	SMR
				3	SMR	10	Comprehensive	22	Comprehensive
						10	SMR	8	Sidus
Most Used									
5	(3) 100.0%	125	(3) 100.0%	169	(4) 100.0%	269	(5) 100.0%	389	(5) 100.0%

Table ST19 Most Used Glenoid Prostheses in Primary Total Mid Head Shoulder Replacement

2011		2014		2015		2016		2017	
N	Model	N	Model	N	Model	N	Model	N	Model
2	Aequalis	61	Aequalis	109	Affinis	216	Affinis	264	Affinis
1	Affinis	52	Affinis	18	Anatomical Shoulder	19	Aequalis	68	Aequalis
1	Comprehensive	7	Bigliani/Flatow TM	15	Bigliani/Flatow	14	Comprehensive	20	Comprehensive
1	TESS	3	Bigliani/Flatow	12	Bigliani/Flatow TM	6	SMR L1	14	SMR L1
		2	Anatomical Shoulder	11	Aequalis	4	SMR	13	SMR
				3	SMR L1	3	Bigliani/Flatow	7	Anatomical Shoulder
				1	Global	2	Anatomical Shoulder	2	Custom Made (Comprehensive)
						2	Bigliani/Flatow TM	1	Bigliani/Flatow TM
						2	Global		
						1	Custom Made (Lima)		
Most Used									
5	(4) 100.0%	125	(5) 100.0%	169	(7) 100.0%	269	(10) 100.0%	389	(8) 100.0%

PRIMARY TOTAL STEMMED SHOULDER REPLACEMENT

DEMOGRAPHICS

There have been 12,535 total stemmed shoulder replacements reported to the Registry. This is an additional 1,067 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 19.1% in 2017.

The proportion of males has increased slightly from 38.7% in 2008 to 43.3% in 2017 (Figure ST4).

This procedure is most commonly undertaken in females (57.9%) (Table ST20). The mean age is 70.6 years for females and 67.2 years for males (Table ST20). In 2017, most procedures were undertaken in the 65 to 74 year age group, accounting for 48.2% of all procedures (Figure ST5).

Osteoarthritis is the most common primary diagnosis, accounting for 94.3% 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 19.1% in 2017.

Figure ST4 Proportion of Primary Total Stemmed Shoulder Replacement by Gender

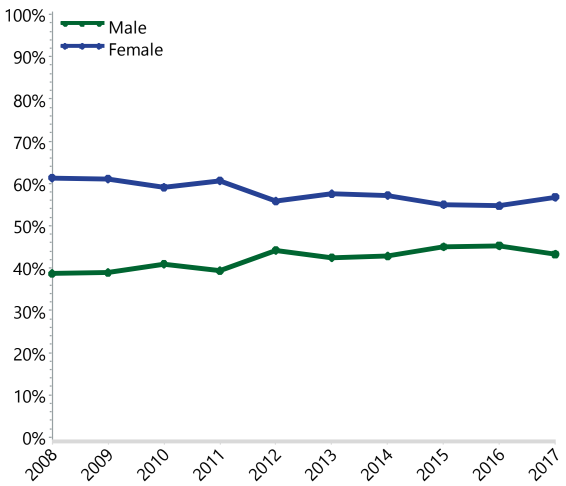


Figure ST5 Proportion of Primary Total Stemmed Shoulder Replacement by Age

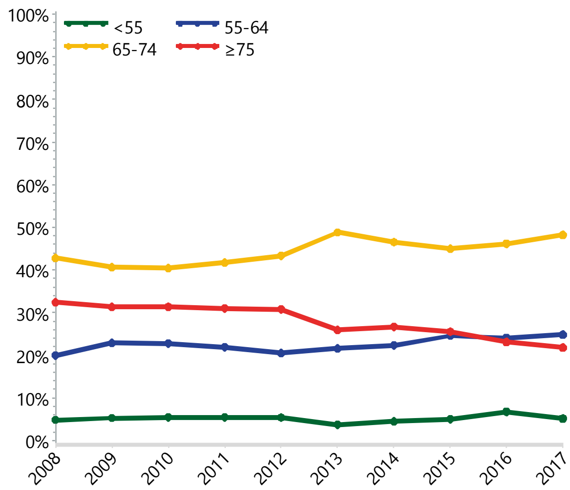


Table ST20 Primary Total Stemmed Shoulder Replacement by Age and Gender

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	5273	42.1%	21	93	67	67.2	8.9
Female	7262	57.9%	21	96	71	70.6	8.5
TOTAL	**12535**	**100.0%**	**21**	**96**	**70**	**69.2**	**8.8**

Table ST21 Primary Total Stemmed Shoulder Replacement by Primary Diagnosis and Gender

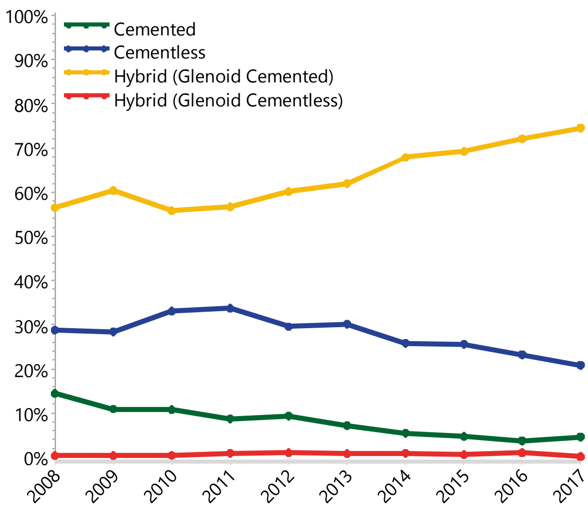
	Male		Female		TOTAL	
Primary Diagnosis	N	Col%	N	Col%	N	Col%
Osteoarthritis	5053	95.8	6762	93.1	11815	94.3
Rheumatoid Arthritis	59	1.1	168	2.3	227	1.8
Osteonecrosis	47	0.9	144	2.0	191	1.5
Fracture	29	0.5	89	1.2	118	0.9
Other Inflammatory Arthritis	23	0.4	51	0.7	74	0.6
Rotator Cuff Arthropathy	34	0.6	25	0.3	59	0.5
Instability	21	0.4	14	0.2	35	0.3
Tumour	4	0.1	6	0.1	10	0.1
Other	3	0.1	3	0.0	6	0.0
TOTAL	**5273**	**100.0**	**7262**	**100.0**	**12535**	**100.0**

Note: Instability includes dislocation

In 2017, 74.5% of procedures used hybrid fixation (cementless humerus and cemented glenoid). This has increased from a low of 55.8% in 2010. In 2017, cementless fixation was used in 20.8% 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 74.5% in 2017.

Figure ST6 Proportion of Primary Total Stemmed Shoulder Replacement by Fixation



The 10 most used humeral stem and glenoid prostheses are listed in Tables ST22 and ST23. The SMR, Global AP and Global Unite are the most commonly used humeral stem prostheses in 2017. The 10 most used humeral stem prostheses account for 97.8% of all primary total stemmed shoulder procedures.

The Global, Aequalis, and SMR L1 are the most commonly used glenoid prostheses in 2017. The 10 most used glenoid prostheses account for 98.5% of all primary total stemmed shoulder procedures.

Table ST22 10 Most Used Humeral Stem Prostheses in Primary Total Stemmed Shoulder Replacement

2008		2014		2015		2016		2017	
N	Model	N	Model	N	Model	N	Model	N	Model
298	SMR	389	Global AP	278	SMR	234	Global Unite	195	SMR
167	Aequalis	292	SMR	259	Global AP	229	SMR	176	Global AP
117	Global Advantage	146	Aequalis Ascend	203	Global Unite	186	Global AP	175	Global Unite
91	Global AP	145	Aequalis	120	Bigliani/Flatow TM	110	Bigliani/Flatow TM	129	Comprehensive
40	Bigliani/Flatow	132	Bigliani/Flatow TM	104	Aequalis	93	Comprehensive	118	Aequalis Ascend
37	Bigliani/Flatow TM	78	Global Advantage	81	Ascend	88	Aequalis	69	Equinoxe
32	Solar	44	Comprehensive	73	Comprehensive	84	Aequalis Ascend	68	Bigliani/Flatow TM
27	Affinis	32	Equinoxe	70	Aequalis Ascend	68	Ascend	49	Aequalis
11	Univers 3D	26	Turon	50	Global Advantage	45	Global Advantage	25	Global Advantage
10	Cofield 2	22	Ascend	46	Equinoxe	42	Equinoxe	20	Turon
10 Most Used									
830	(10) 97.9%	1306	(10) 97.4%	1284	(10) 97.0%	1179	(10) 97.7%	1024	(10) 97.8%
Remainder									
18	(7) 2.1%	35	(10) 2.6%	40	(4) 3.0%	28	(8) 2.3%	23	(5) 2.2%
TOTAL									
848	(17) 100.0%	1341	(20) 100.0%	1324	(14) 100.0%	1207	(18) 100.0%	1047	(15) 100.0%

Table ST23 10 Most Used Glenoid Prostheses in Primary Total Stemmed Shoulder Replacement

2008		2014		2015		2016		2017	
N	Model	N	Model	N	Model	N	Model	N	Model
237	SMR L1	481	Global	513	Global	467	Global	375	Global
209	Global	311	Aequalis	255	Aequalis	237	Aequalis	177	Aequalis
167	Aequalis	256	SMR L1	242	SMR L1	195	SMR L1	168	SMR L1
79	Bigliani/Flatow	94	Bigliani/Flatow TM	85	Bigliani/Flatow TM	94	Comprehensive	125	Comprehensive
57	SMR	44	Bigliani/Flatow	74	Comprehensive	85	Bigliani/Flatow TM	69	Equinoxe
32	Solar	44	Comprehensive	46	Equinoxe	42	Equinoxe	37	Bigliani/Flatow TM
27	Affinis	32	Equinoxe	37	Bigliani/Flatow	32	SMR	31	Bigliani/Flatow
11	Univers 3D	31	SMR	30	SMR	26	Bigliani/Flatow	23	SMR
10	Cofield 2	26	Turon	24	Turon	10	Turon	20	Turon
7	Promos	7	Anatomical Shoulder	9	Anatomical Shoulder	5	Affinis	6	Affinis
10 Most Used									
836	(10) 98.6%	1326	(10) 98.9%	1315	(10) 99.3%	1193	(10) 98.8%	1031	(10) 98.5%
Remainder									
12	(6) 1.4%	15	(6) 1.1%	9	(2) 0.7%	14	(7) 1.2%	16	(8) 1.5%
TOTAL									
848	(16) 100.0%	1341	(16) 100.0%	1324	(12) 100.0%	1207	(17) 100.0%	1047	(18) 100.0%

OUTCOME FOR ALL DIAGNOSES

Primary Diagnosis

The cumulative percent revision of primary total stemmed shoulder replacement for osteoarthritis is 13.1% at 11 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

Rotator cuff insufficiency is the most common reason for revision of primary total stemmed shoulder replacement. It accounts for 23.1% of all revisions, followed by instability/dislocation (22.9%) and loosening (16.8%) (Table ST25). The cumulative incidence of the five most common reasons for revision are presented in Figure ST8.

Type of Revision

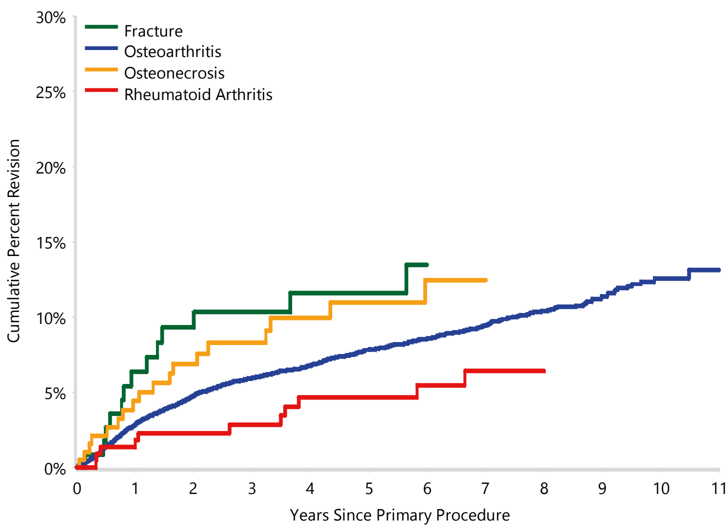
The most common type of revision is of the humeral component only (53.7%). This may include the revision of a humeral component (epiphysis and/or humeral stem) and additional minor components, such as the humeral head/glenosphere and/or removal of the glenoid component (Table ST26). Of the 499 humeral component revisions, 433 (86.8%) were revised to a total reverse shoulder replacement. The humeral stem was not revised in 414 (83.0%) 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	11 Yrs
Osteoarthritis	864	11815	2.9 (2.6, 3.2)	6.0 (5.5, 6.4)	7.8 (7.3, 8.4)	9.5 (8.8, 10.1)	12.6 (11.4, 13.8)	13.1 (11.6, 14.8)
Rheumatoid Arthritis	11	227	1.8 (0.7, 4.8)	2.9 (1.3, 6.3)	4.7 (2.4, 8.8)	6.4 (3.5, 11.5)		
Osteonecrosis	19	191	4.4 (2.2, 8.7)	8.3 (5.0, 13.6)	11.0 (6.9, 17.3)	12.5 (7.8, 19.6)		
Fracture	13	118	6.4 (3.1, 12.9)	10.3 (5.8, 17.9)	11.6 (6.7, 19.6)			
Other Inflammatory Arthritis	6	74	1.4 (0.2, 9.6)	3.0 (0.8, 11.4)	9.9 (4.1, 22.8)	9.9 (4.1, 22.8)		
Rotator Cuff Arthropathy	10	59	7.2 (2.8, 18.1)	15.6 (8.1, 29.0)	18.0 (9.7, 32.0)	18.0 (9.7, 32.0)		
Instability	6	35	8.8 (2.9, 25.0)	21.4 (10.0, 42.4)	21.4 (10.0, 42.4)	21.4 (10.0, 42.4)		
Other (2)	1	16	0.0 (0.0, 0.0)	10.0 (1.5, 52.7)	10.0 (1.5, 52.7)	10.0 (1.5, 52.7)		
TOTAL	**930**	**12535**						

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=1.44 (0.83, 2.50),p=0.190

Osteonecrosis vs Osteoarthritis

Entire Period: HR=1.21 (0.76, 1.91),p=0.424

Rheumatoid Arthritis vs Osteoarthritis

Entire Period: HR=0.50 (0.27, 0.91),p=0.022

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
Fracture	118	98	83	53	27	3	1
Osteoarthritis	11815	10429	7636	5018	2761	350	56
Osteonecrosis	191	161	116	78	46	6	1
Rheumatoid Arthritis	227	207	172	135	88	9	2

Table ST25 Primary Total Stemmed Shoulder Replacement by Reason for Revision

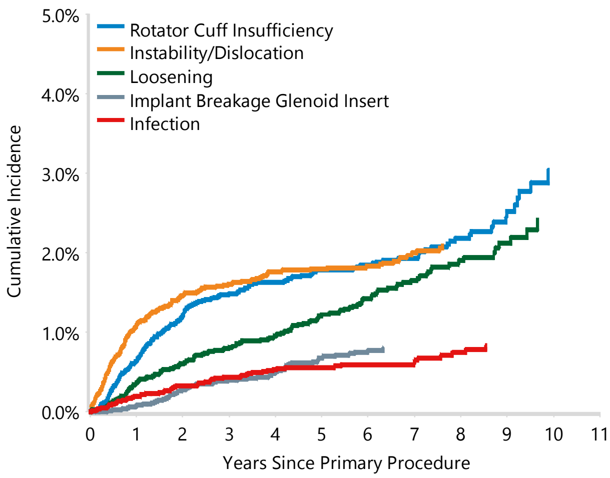
Reason for Revision	Number	Percent
Rotator Cuff Insufficiency	215	23.1
Instability/Dislocation	213	22.9
Loosening	156	16.8
Implant Breakage Glenoid Insert	69	7.4
Infection	67	7.2
Dissociation	30	3.2
Implant Breakage Glenoid	25	2.7
Fracture	23	2.5
Pain	19	2.0
Incorrect Sizing	17	1.8
Arthrofibrosis	16	1.7
Metal Related Pathology	13	1.4
Malposition	10	1.1
Wear Glenoid Insert	9	1.0
Lysis	7	0.8
Glenoid Erosion	3	0.3
Implant Breakage Head	1	0.1
Implant Breakage Humeral	1	0.1
Rotator Cuff Arthropathy	1	0.1
Progression Of Disease	1	0.1
Component Dissociation	1	0.1
Other	33	3.5
TOTAL	**930**	**100.0**

Table ST26 Primary Total Stemmed Shoulder Replacement by Type of Revision

Type of Revision	Number	Percent
Humeral Component	499	53.7
Humeral/Glenoid	186	20.0
Head Only	90	9.7
Glenoid Component	63	6.8
Cement Spacer	35	3.8
Head/Insert	32	3.4
Removal of Prostheses	12	1.3
Minor Components	6	0.6
Reoperation	4	0.4
Reinsertion of Components	1	0.1
Insert Only	1	0.1
Cup Only	1	0.1
TOTAL	**930**	**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

Age and Gender

There is no difference in the rate of revision between patients aged less than 55 years and patients aged 55 to 64 years. Patients aged 65 years or older have a lower rate of revision compared to patients aged less than 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).

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 ST29 and Figure ST11).

The fixation analysis was repeated excluding the SMR L2 prosthesis. The outcome of fixation remained the same, with cementless fixation of the glenoid being associated with a higher rate of revision when the SMR L2 was excluded (Table ST30 and Figure ST12).

The revision rate is increased if the glenoid is cementless.

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 71.1% of primary total stemmed shoulder replacements (the majority of which were cemented). These prostheses have a lower rate of revision compared to modular metal backed glenoid and non modular metal backed glenoid prostheses in the first two years. A modular metal backed glenoid has a higher rate of revision compared to a non modular metal backed glenoid (Table ST31 and Figure ST13).

When a modular metal backed glenoid was revised, 78.3% 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 (16 out of the total 401 procedures).

The above analysis was repeated excluding the SMR L2 prosthesis, and the results remained consistent (Table ST32 and Figure ST14).

Pegged and keeled all-polyethylene glenoid prostheses were also compared. The majority of all polyethylene glenoid prostheses are pegged (86.2%). There is no difference in the rate of revision between these prostheses (Table ST33 and Figure ST15).

The use of cross-linked polyethylene (XLPE) glenoids has increased from 11.1% in 2008 to 35.2% in 2017 (Figure ST16).

When the SMR L2 glenoid prosthesis is excluded, XLPE glenoids have a lower cumulative percent revision at seven years compared to non XLPE glenoids (2.9% compared to 8.1%) (Table ST34 and Figure ST17).

This is also the case when all-polyethylene glenoids are compared (Table ST35 and Figure ST18). However, it remains uncertain if these differences are due to the XLPE or the prosthesis it is used with.

Humeral Heads

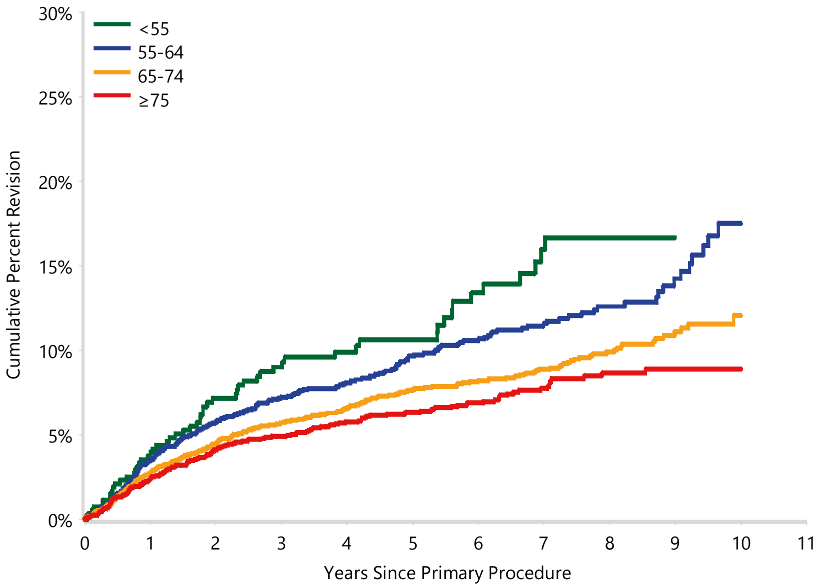
Humeral head sizes less than 44mm have the highest rate of revision. This decreases with increasing head size, with humeral heads larger than 50mm having the lowest rate of revision (Table ST36 and Figure ST19). The cumulative incidence for the most common reasons for revision is shown in Figure ST20. This remains the same when the SMR L2 prosthesis is excluded.

The outcomes of the most commonly used prosthesis combinations are listed in Table ST37. The most commonly used cementless prosthesis combinations are listed in Table ST38. The most commonly used prosthesis combinations with hybrid (glenoid cemented) fixation are listed in Table ST39.

Table 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	11 Yrs
<55	57	525	4.0 (2.6, 6.1)	9.0 (6.7, 12.1)	10.6 (8.0, 14.0)	16.0 (12.2, 20.8)		
55-64	237	2619	3.5 (2.8, 4.3)	7.2 (6.2, 8.3)	9.7 (8.4, 11.1)	11.6 (10.1, 13.2)	17.5 (14.4, 21.1)	
65-74	366	5284	2.7 (2.3, 3.2)	5.7 (5.1, 6.4)	7.7 (6.9, 8.5)	8.9 (8.0, 9.9)	12.0 (10.4, 14.0)	
≥75	204	3387	2.4 (1.9, 3.0)	4.9 (4.2, 5.7)	6.3 (5.5, 7.3)	7.7 (6.7, 8.9)	8.9 (7.6, 10.4)	
TOTAL	**864**	**11815**						

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=0.82 (0.61, 1.10),p=0.182

65-74 vs <55

Entire Period: HR=0.63 (0.47, 0.83),p=0.001

≥75 vs <55

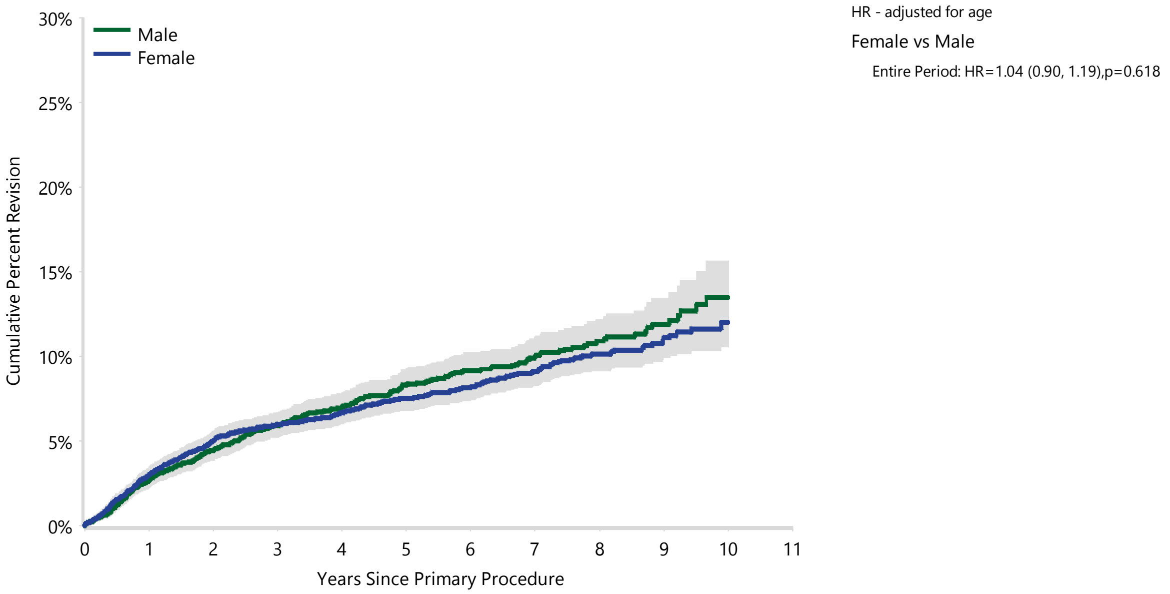
Entire Period: HR=0.53 (0.39, 0.71),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
<55	525	460	316	223	119	19	2
55-64	2619	2289	1636	1100	637	82	13
65-74	5284	4635	3377	2167	1199	153	25
≥75	3387	3045	2307	1528	806	96	16

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	11 Yrs
Male	374	5053	2.7 (2.3, 3.2)	5.9 (5.2, 6.7)	8.3 (7.5, 9.3)	10.0 (9.0, 11.1)	13.5 (11.6, 15.6)	
Female	490	6762	3.0 (2.6, 3.4)	6.0 (5.4, 6.6)	7.5 (6.8, 8.2)	9.1 (8.3, 10.0)	12.0 (10.6, 13.6)	
TOTAL	**864**	**11815**						

Figure ST10 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement by Gender (Primary Diagnosis OA)

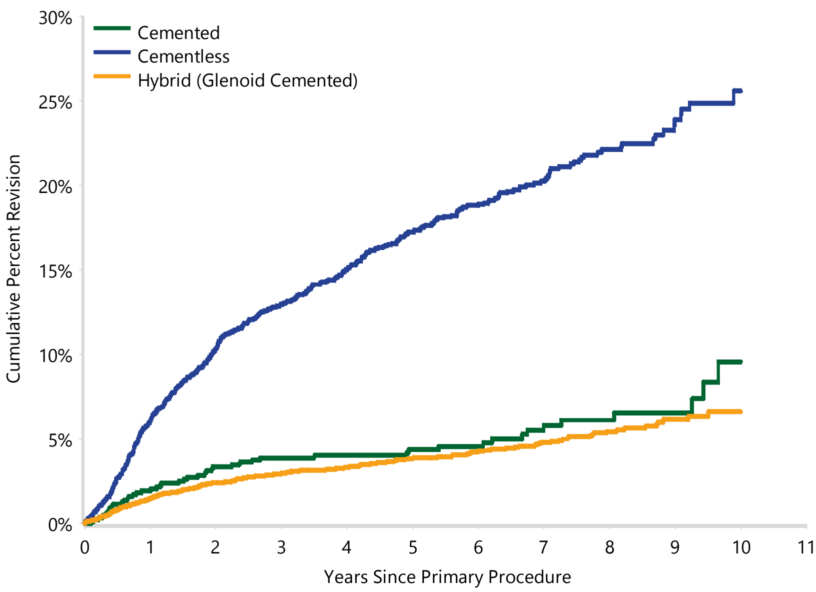


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
Male	5053	4451	3176	2034	1104	141	22
Female	6762	5978	4460	2984	1657	209	34

Table ST29 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	11 Yrs
Cemented	47	907	1.9 (1.2, 3.1)	3.9 (2.8, 5.4)	4.4 (3.2, 6.0)	5.8 (4.3, 7.9)	9.6 (6.3, 14.4)	
Cementless	539	3301	6.1 (5.3, 7.0)	12.9 (11.8, 14.2)	17.2 (15.8, 18.7)	20.2 (18.6, 22.0)	25.5 (22.8, 28.5)	
Hybrid (Glenoid Cemented)	270	7541	1.5 (1.2, 1.8)	3.0 (2.6, 3.4)	3.9 (3.4, 4.4)	4.8 (4.2, 5.5)	6.6 (5.5, 7.8)	
Hybrid (Glenoid Cementless)	8	66	9.2 (4.2, 19.3)	11.1 (5.4, 21.9)	13.8 (7.0, 26.4)	13.8 (7.0, 26.4)		
TOTAL	**864**	**11815**						

Figure ST11 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=1.24 (0.91, 1.69),p=0.169

Cementless vs Hybrid (Glenoid Cemented)
Entire Period: HR=4.54 (3.92, 5.25),p<0.001

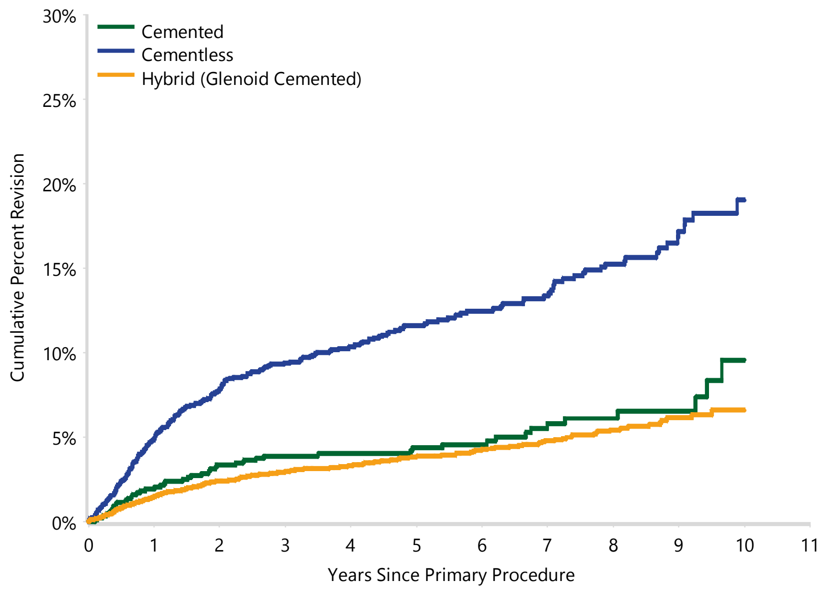
Cementless vs Cemented
Entire Period: HR=3.65 (2.71, 4.92),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
Cemented	907	839	706	545	335	48	6
Cementless	3301	2884	2100	1367	732	90	16
Hybrid (Glenoid Cemented)	7541	6648	4788	3080	1685	209	34

Table ST30 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	11 Yrs
Cemented	47	907	1.9 (1.2, 3.1)	3.9 (2.8, 5.4)	4.4 (3.2, 6.0)	5.8 (4.3, 7.9)	9.6 (6.3, 14.4)	
Cementless	275	2515	4.9 (4.1, 5.8)	9.4 (8.2, 10.7)	11.6 (10.3, 13.1)	13.4 (11.8, 15.2)	19.0 (16.2, 22.3)	
Hybrid (Glenoid Cemented)	270	7541	1.5 (1.2, 1.8)	3.0 (2.6, 3.4)	3.9 (3.4, 4.4)	4.8 (4.2, 5.5)	6.6 (5.5, 7.8)	
Hybrid (Glenoid Cementless)	5	53	7.6 (2.9, 19.0)	10.1 (4.3, 22.7)	10.1 (4.3, 22.7)	10.1 (4.3, 22.7)		
TOTAL	**597**	**11016**						

Figure ST12 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=1.25 (0.91, 1.70),p=0.162

Cementless vs Hybrid (Glenoid Cemented)
Entire Period: HR=3.08 (2.61, 3.65),p<0.001

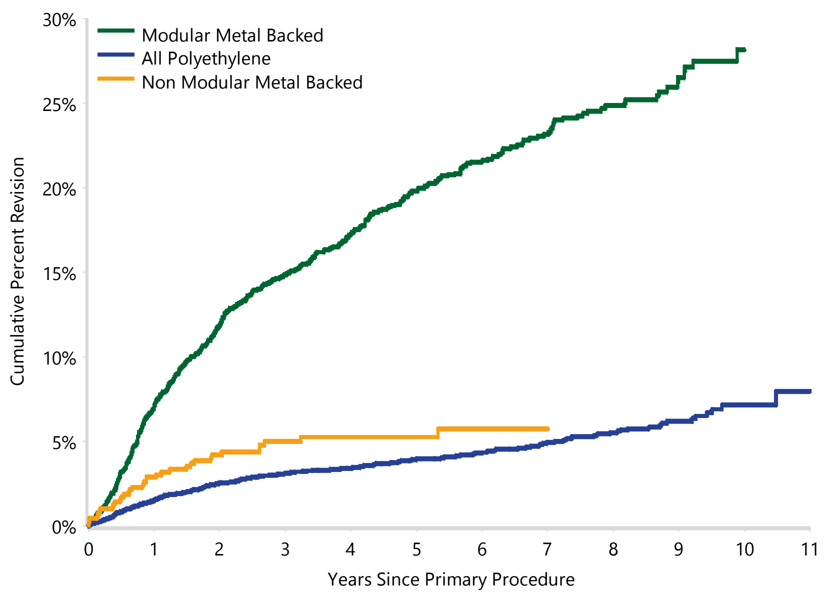
Cementless vs Cemented
Entire Period: HR=2.47 (1.81, 3.37),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
Cemented	907	839	706	545	335	48	6
Cementless	3301	2884	2100	1367	732	90	16
Hybrid (Glenoid Cemented)	7541	6648	4788	3080	1685	209	34

Table ST31 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement by Glenoid Type (Primary Diagnosis OA)

Glenoid Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
Modular Metal Backed	512	2687	7.0 (6.1, 8.1)	14.8 (13.5, 16.3)	19.8 (18.2, 21.5)	23.1 (21.3, 25.1)	28.1 (25.4, 31.1)	
All Polyethylene	316	8396	1.5 (1.3, 1.8)	3.1 (2.7, 3.5)	3.9 (3.5, 4.4)	4.9 (4.3, 5.6)	7.1 (6.0, 8.4)	7.9 (6.1, 10.2)
Non Modular Metal Backed	36	732	2.8 (1.8, 4.4)	5.0 (3.5, 7.0)	5.2 (3.7, 7.3)	5.7 (4.0, 8.0)		
TOTAL	**864**	**11815**						

Figure ST13 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=5.07 (4.41, 5.83),p<0.001

Non Modular Metal Backed vs All Polyethylene
0 - 2Yr: HR=1.72 (1.16, 2.53),p=0.006
2Yr+: HR=0.99 (0.49, 2.02),p=0.985

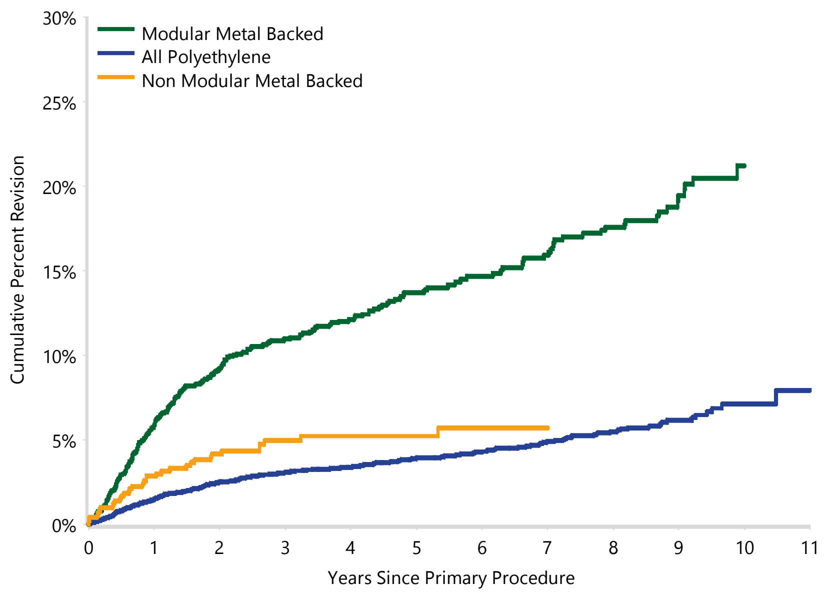
Modular Metal Backed vs
Non Modular Metal Backed
0 - 3Mth: HR=1.99 (1.13, 3.51),p=0.017
3Mth - 6Mth: HR=3.02 (1.82, 5.01),p<0.001
6Mth - 1Yr: HR=3.88 (2.49, 6.04),p<0.001
1Yr - 1.5Yr: HR=4.14 (2.51, 6.82),p<0.001
1.5Yr - 2Yr: HR=3.04 (1.81, 5.10),p<0.001
2Yr+: HR=3.73 (2.54, 5.48),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
Modular Metal Backed	2687	2326	1727	1155	666	93	16
All Polyethylene	8396	7462	5501	3635	2021	257	40
Non Modular Metal Backed	732	641	408	228	74	0	0

Table ST32 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	11 Yrs
Modular Metal Backed	245	1888	5.8 (4.8, 7.0)	11.0 (9.6, 12.6)	13.7 (12.0, 15.6)	15.9 (13.9, 18.2)	21.2 (18.2, 24.6)	
All Polyethylene	316	8396	1.5 (1.3, 1.8)	3.1 (2.7, 3.5)	3.9 (3.5, 4.4)	4.9 (4.3, 5.6)	7.1 (6.0, 8.4)	7.9 (6.1, 10.2)
Non Modular Metal Backed	36	732	2.8 (1.8, 4.4)	5.0 (3.5, 7.0)	5.2 (3.7, 7.3)	5.7 (4.0, 8.0)		
TOTAL	**597**	**11016**						

Figure ST14 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=3.50 (2.96, 4.14),p<0.001

Non Modular Metal Backed vs All Polyethylene

0 - 2Yr: HR=1.63 (1.10, 2.41),p=0.014

2Yr+: HR=1.13 (0.55, 2.30),p=0.742

Modular Metal Backed vs Non Modular Metal Backed

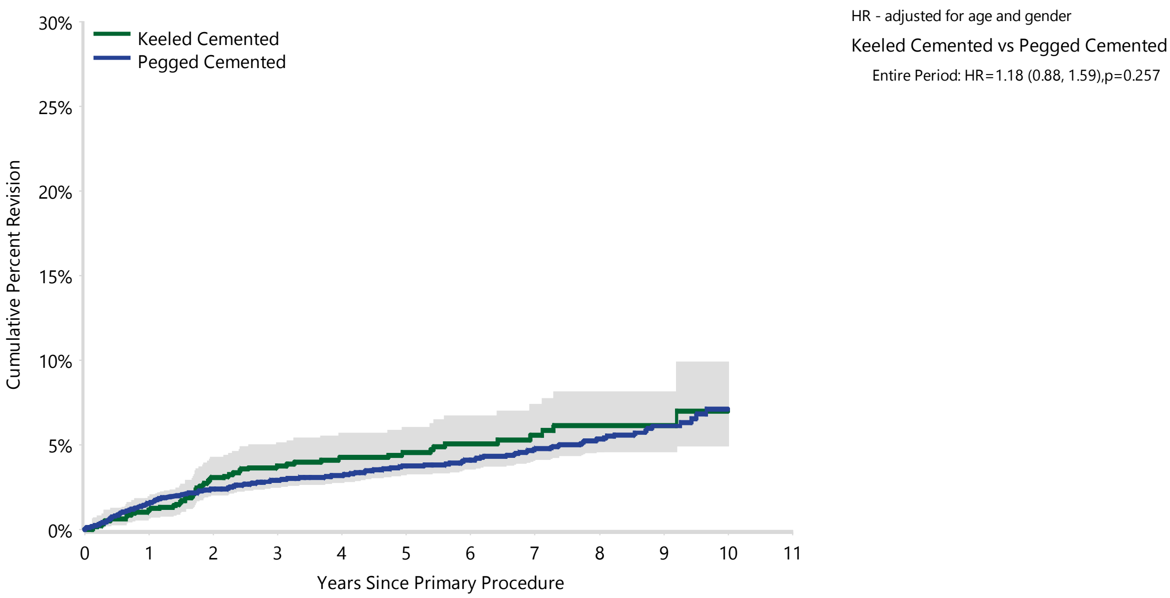
Entire Period: HR=2.38 (1.68, 3.38),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
Modular Metal Backed	1888	1611	1124	637	460	93	16
All Polyethylene	8396	7462	5501	3635	2021	257	40
Non Modular Metal Backed	732	641	408	228	74	0	0

Table ST33 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	11 Yrs
Keeled Cemented	54	1149	1.1 (0.7, 2.0)	3.8 (2.8, 5.1)	4.6 (3.4, 6.1)	5.6 (4.2, 7.4)	7.0 (5.0, 9.9)	
Pegged Cemented	259	7204	1.6 (1.3, 1.9)	2.9 (2.5, 3.4)	3.8 (3.3, 4.3)	4.8 (4.1, 5.5)	7.1 (5.9, 8.6)	
TOTAL	**313**	**8353**						

Figure ST15 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	11 Yrs
Keeled Cemented	1149	1095	880	604	353	58	9
Pegged Cemented	7204	6327	4591	3014	1664	199	31

Figure ST16 Proportion of Primary Total Stemmed Shoulder Replacement by Polyethylene Type (All Diagnoses)

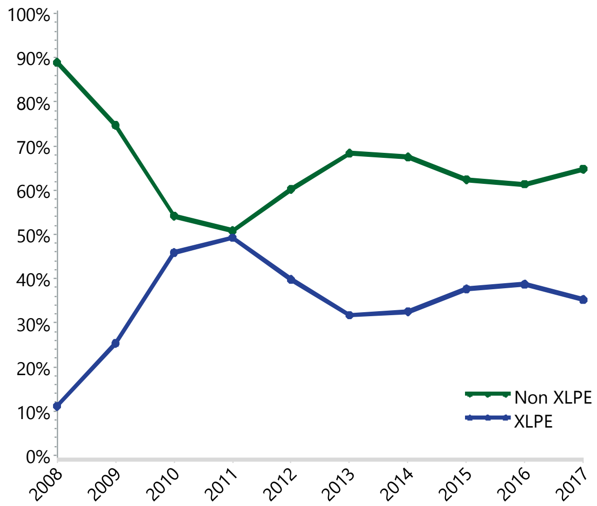
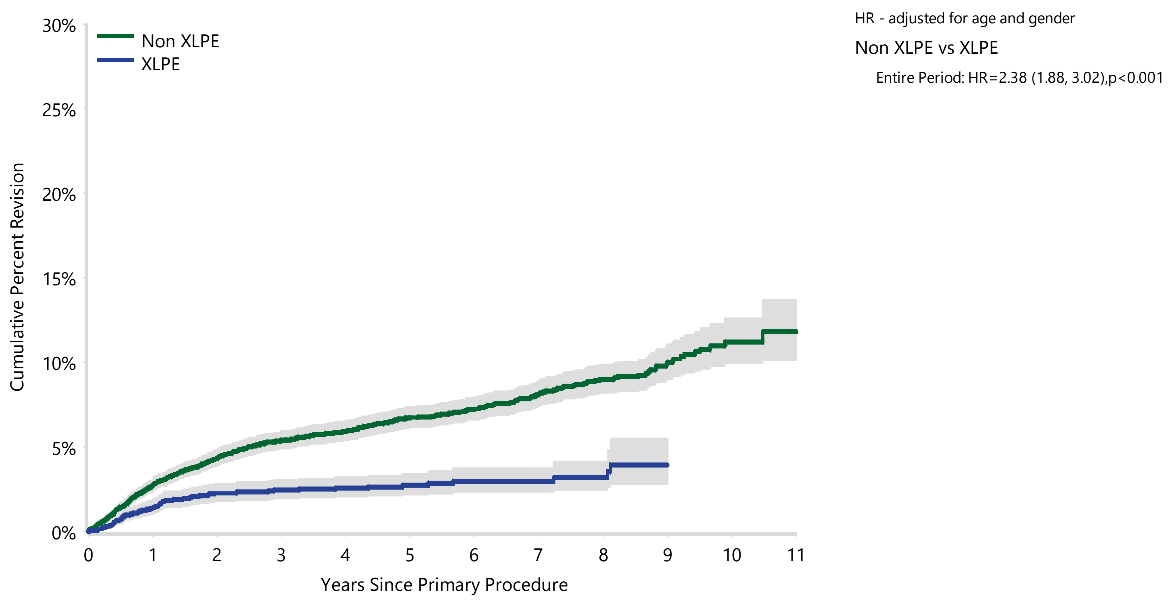


Table ST34 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement using All Types of Glenoid by Polyethylene Type (Primary Diagnosis OA, Excluding SMR L2)

Polyethylene Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
Non XLPE	504	7680	2.7 (2.4, 3.1)	5.4 (4.9, 5.9)	6.7 (6.1, 7.4)	8.1 (7.4, 8.9)	11.2 (9.9, 12.6)	11.8 (10.1, 13.7)
XLPE	79	3249	1.4 (1.0, 1.9)	2.4 (1.9, 3.1)	2.7 (2.2, 3.4)	2.9 (2.3, 3.7)		
TOTAL	**583**	**10929**						

Figure ST17 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement using All Types of Glenoid by Polyethylene Type (Primary Diagnosis OA, Excluding SMR L2)

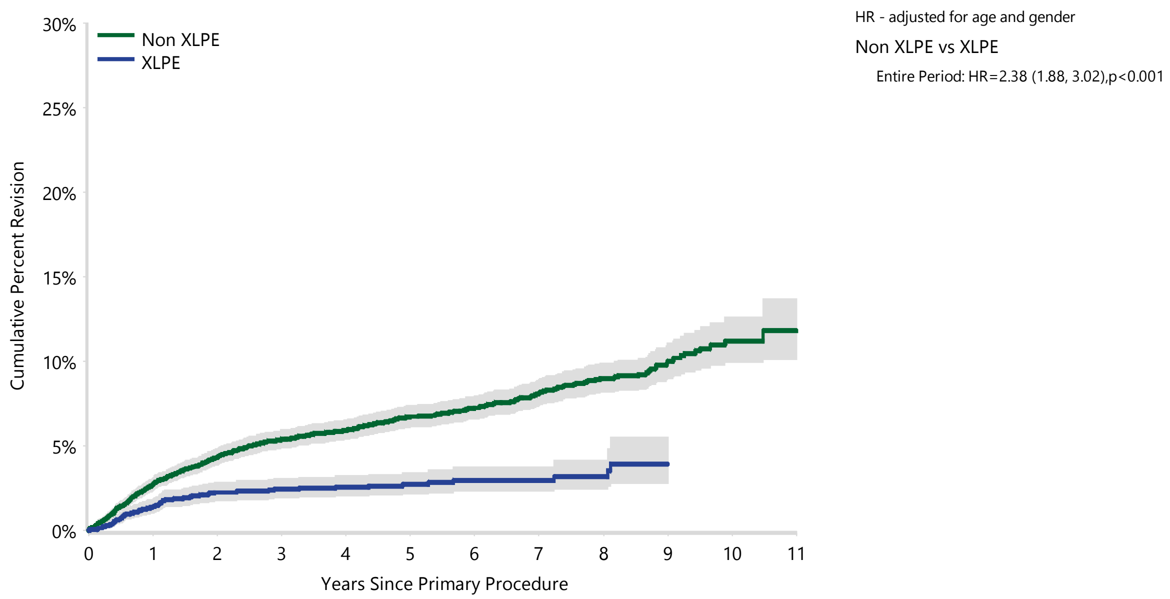


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
Non XLPE	7680	6796	5089	3384	2047	318	50
XLPE	3249	2837	1875	1060	457	25	6

Table ST35 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	11 Yrs
Non XLPE	237	5147	1.6 (1.2, 1.9)	3.4 (2.9, 4.0)	4.5 (3.9, 5.2)	5.8 (5.0, 6.6)	8.1 (6.8, 9.6)	
XLPE	79	3249	1.4 (1.0, 1.9)	2.4 (1.9, 3.1)	2.7 (2.2, 3.4)	2.9 (2.3, 3.7)		
TOTAL	**316**	**8396**						

Figure ST18 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement using All Polyethylene Glenoids by Polyethylene Type (Primary Diagnosis OA)



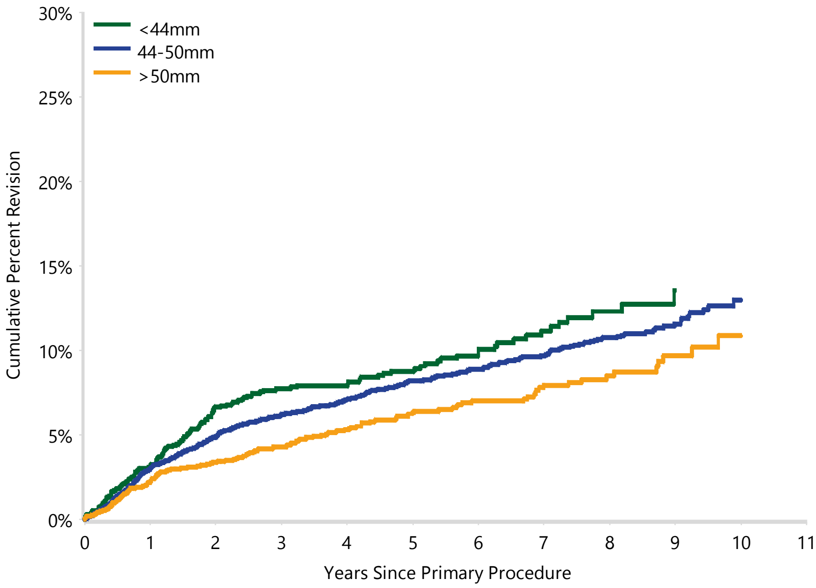
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
Non XLPE	5147	4625	3626	2575	1564	232	34
XLPE	3249	2837	1875	1060	457	25	6

Table ST36 Cumulative Percent Revision of Primary Total Stemmed Shoulder Replacement by Humeral Head Size (Primary Diagnosis OA)

Head Size	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
<44mm	134	1552	3.2 (2.4, 4.3)	7.7 (6.4, 9.3)	8.8 (7.3, 10.5)	11.1 (9.3, 13.3)		
44-50mm	571	7515	3.0 (2.6, 3.4)	6.2 (5.6, 6.8)	8.2 (7.5, 8.9)	9.7 (8.9, 10.5)	13.0 (11.5, 14.6)	
>50mm	158	2745	2.2 (1.7, 2.8)	4.3 (3.5, 5.2)	6.3 (5.3, 7.5)	7.9 (6.7, 9.4)	10.8 (8.6, 13.6)	
TOTAL	**863**	**11812**						

Note: Excludes three procedures with unknown humeral head size

Figure ST19 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=1.91 (1.46, 2.51),p<0.001

44-50mm vs >50mm

Entire Period: HR=1.54 (1.27, 1.87),p<0.001

<44mm vs 44-50mm

Entire Period: HR=1.24 (1.02, 1.51),p=0.029

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
<44mm	1552	1356	993	636	351	37	4
44-50mm	7515	6650	4875	3224	1762	223	36
>50mm	2745	2421	1766	1156	647	90	16

Figure ST20 Cumulative Incidence Revision Diagnosis of Primary Total Stemmed Shoulder Replacement by Humeral Head Size (Primary Diagnosis OA)

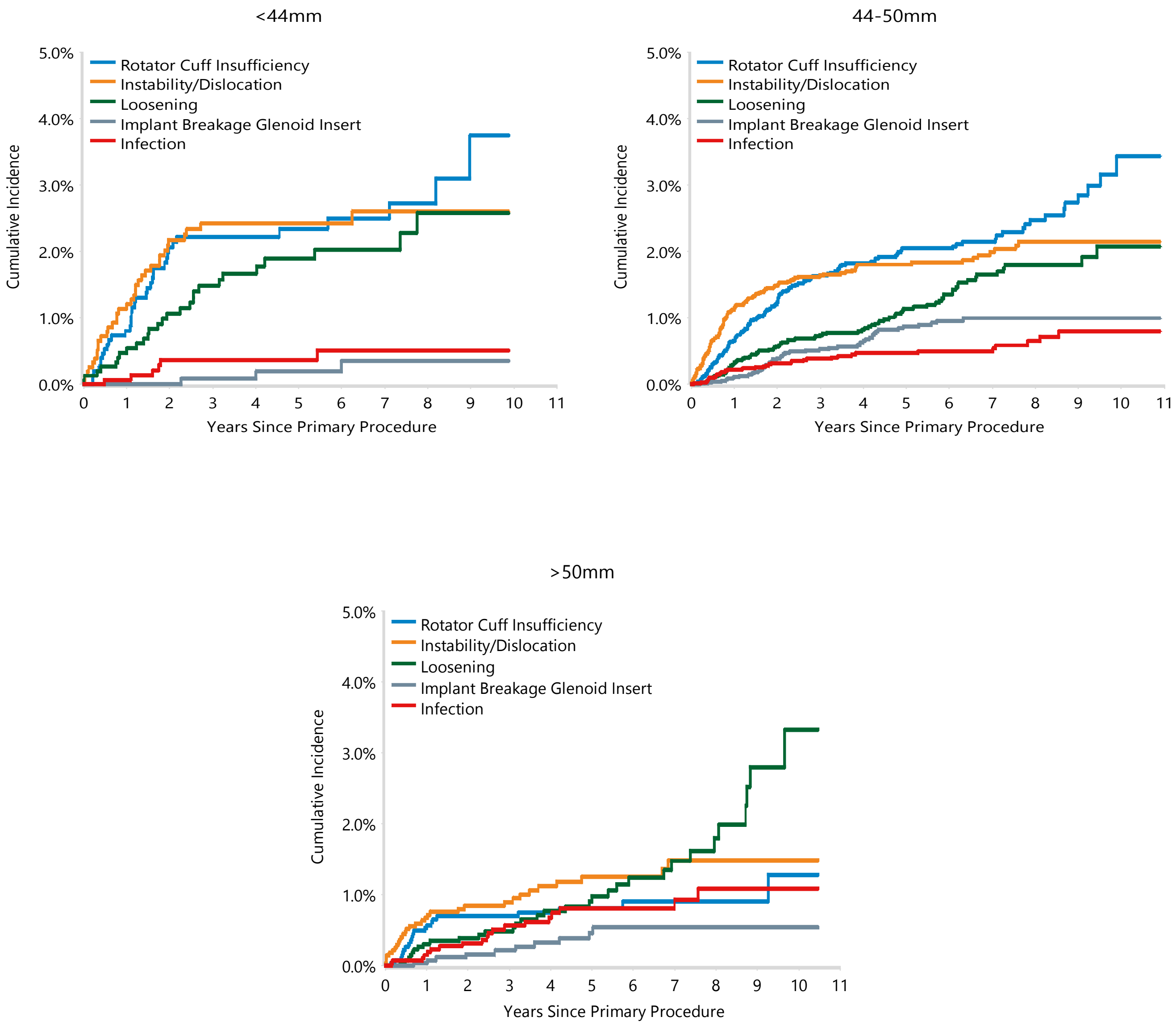


Table ST37 Cumulative Percent Revision of All Primary Total Stemmed Shoulder Replacement by Prosthesis Combination (Primary Diagnosis OA)

Humeral Stem	Glenoid	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
Aequalis	Aequalis	63	1675	1.5 (1.0, 2.2)	2.8 (2.1, 3.8)	3.5 (2.6, 4.5)	4.5 (3.4, 5.8)	5.1 (3.8, 6.8)	
Aequalis Ascend	Aequalis	4	388	0.3 (0.0, 2.3)	1.3 (0.4, 4.0)				
Affinis	Affinis	12	179	0.0 (0.0, 0.0)	1.8 (0.6, 5.5)	5.0 (2.5, 9.7)	5.7 (3.0, 10.7)		
Ascend	Aequalis	13	343	1.5 (0.6, 3.5)	3.3 (1.8, 6.1)	6.2 (3.2, 11.5)			
Bigliani/Flatow	Bigliani/Flatow	10	141	2.1 (0.7, 6.5)	3.6 (1.5, 8.4)	3.6 (1.5, 8.4)	5.4 (2.6, 11.0)		
Bigliani/Flatow TM	Bigliani/Flatow	24	397	2.1 (1.1, 4.1)	4.7 (3.0, 7.5)	5.9 (3.8, 9.0)	6.9 (4.6, 10.5)		
Bigliani/Flatow TM	Bigliani/Flatow TM	29	619	2.5 (1.5, 4.1)	4.7 (3.2, 6.8)	4.9 (3.4, 7.1)	5.4 (3.7, 7.9)		
Comprehensive	Comprehensive	17	378	4.6 (2.8, 7.5)	4.9 (3.0, 8.0)				
Epoca	Epoca	3	51	0.0 (0.0, 0.0)	4.4 (1.1, 16.6)	7.2 (2.4, 20.8)	7.2 (2.4, 20.8)		
Equinoxe	Equinoxe	14	222	3.2 (1.5, 7.1)	7.4 (4.0, 13.2)				
Global AP	Global	79	2585	1.5 (1.1, 2.0)	2.6 (2.0, 3.3)	3.0 (2.4, 3.8)	4.0 (3.1, 5.2)		
Global Advantage	Global	32	679	1.4 (0.7, 2.6)	3.7 (2.5, 5.5)	3.7 (2.5, 5.5)	4.8 (3.3, 7.0)	6.8 (4.6, 10.1)	
Global Unite	Global	6	590	0.8 (0.3, 2.0)					
SMR	SMR	18	422	1.7 (0.8, 3.6)	3.8 (2.3, 6.2)	4.1 (2.5, 6.6)	4.6 (2.9, 7.4)		
SMR	SMR L1	217	1806	5.6 (4.6, 6.8)	10.5 (9.1, 12.1)	12.9 (11.3, 14.8)	14.4 (12.5, 16.5)	19.2 (16.2, 22.5)	
SMR	SMR L2	266	798	9.7 (7.8, 12.0)	22.6 (19.8, 25.6)	30.2 (27.1, 33.6)	34.5 (31.1, 38.0)		
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)		
Turon	Turon	3	90	2.5 (0.6, 9.7)	4.0 (1.3, 12.1)				
Other (35)		48	283	4.4 (2.5, 7.6)	9.2 (6.2, 13.4)	15.2 (11.1, 20.5)	18.9 (14.2, 24.9)		
TOTAL		**864**	**11815**						

Note: Only combinations with over 50 procedures have been listed

Table ST38 Cumulative Percent Revision of Cementless Primary Total Stemmed Shoulder Replacement by Prosthesis Combination (Primary Diagnosis OA)

Humeral Stem	Glenoid	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
Bigliani/Flatow TM	Bigliani/Flatow TM	27	592	2.2 (1.3, 3.8)	4.5 (3.1, 6.7)	4.8 (3.3, 7.1)	5.3 (3.6, 7.9)		
Epoca	Epoca	3	37	0.0 (0.0, 0.0)	6.5 (1.7, 23.4)	10.7 (3.5, 30.0)			
Equinoxe	Equinoxe	4	31	9.9 (3.3, 27.7)	13.8 (5.4, 32.9)				
SMR	SMR L1	214	1775	5.6 (4.6, 6.8)	10.5 (9.1, 12.1)	13.0 (11.3, 14.9)	14.4 (12.5, 16.6)	19.3 (16.3, 22.7)	
SMR	SMR L2	263	785	9.6 (7.7, 11.9)	22.7 (19.9, 25.8)	30.3 (27.2, 33.7)	34.6 (31.3, 38.2)		
Univers 3D	Univers 3D	12	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)	48.1 (30.7, 69.0)	48.1 (30.7, 69.0)
Vaios	Vaios	11	24	16.7 (6.6, 38.5)	29.2 (15.1, 51.6)	42.2 (25.3, 64.3)			
Other (16)		5	31	7.2 (1.8, 26.0)	11.4 (3.8, 31.6)	18.8 (7.0, 45.0)	18.8 (7.0, 45.0)		
TOTAL		**539**	**3301**						

Note: Only combinations with over 10 procedures have been listed

Table ST39 Cumulative Percent Revision of Hybrid (Glenoid Cemented) Primary Total Stemmed Shoulder Replacement by Prosthesis Combination (Primary Diagnosis OA)

Humeral Stem	Glenoid	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
Aequalis	Aequalis	52	1467	1.3 (0.8, 2.1)	2.5 (1.8, 3.5)	3.2 (2.3, 4.3)	4.3 (3.2, 5.8)		
Aequalis Ascend	Aequalis	4	358	0.3 (0.0, 2.4)	1.4 (0.4, 4.3)				
Affinis	Affinis	12	175	0.0 (0.0, 0.0)	1.8 (0.6, 5.6)	5.0 (2.5, 9.8)	5.8 (3.0, 10.8)		
Ascend	Aequalis	11	326	1.5 (0.6, 3.6)	3.1 (1.6, 5.9)	4.7 (2.5, 8.7)			
Bigliani/Flatow	Bigliani/Flatow	8	120	2.5 (0.8, 7.5)	4.2 (1.8, 9.8)	4.2 (1.8, 9.8)	5.3 (2.4, 11.4)		
Bigliani/Flatow TM	Bigliani/Flatow	18	368	1.4 (0.6, 3.3)	3.6 (2.1, 6.3)	4.8 (2.9, 7.9)	5.4 (3.3, 8.8)		
Comprehensive	Comprehensive	17	371	4.7 (2.8, 7.6)	5.1 (3.1, 8.2)				
Equinoxe	Equinoxe	10	185	1.9 (0.6, 5.9)	6.0 (2.8, 12.6)				
Global AP	Global	72	2298	1.5 (1.1, 2.2)	2.8 (2.1, 3.6)	3.2 (2.5, 4.2)	4.2 (3.2, 5.5)		
Global Advantage	Global	24	559	1.3 (0.6, 2.7)	3.9 (2.5, 6.0)	3.9 (2.5, 6.0)	4.3 (2.8, 6.6)	5.6 (3.5, 8.8)	
Global Unite	Global	5	544	0.6 (0.2, 1.9)					
SMR	SMR	16	405	1.8 (0.9, 3.7)	3.4 (2.0, 5.8)	3.8 (2.2, 6.3)	4.3 (2.6, 7.1)		
Solar	Solar	4	114	0.9 (0.1, 6.1)	1.8 (0.4, 6.9)	2.7 (0.9, 8.1)	2.7 (0.9, 8.1)		
Turon	Turon	2	84	1.5 (0.2, 10.1)	3.2 (0.8, 12.2)				
Other (26)		15	167	1.2 (0.3, 4.8)	3.3 (1.4, 7.8)	8.6 (4.8, 15.1)	10.7 (6.3, 18.0)		
TOTAL		**270**	**7541**						

PRIMARY TOTAL REVERSE SHOULDER REPLACEMENT

DEMOGRAPHICS

There have been 19,929 primary total reverse shoulder replacement procedures reported to the Registry. This is an increase of 4,148 procedures compared to the previous report. Primary total reverse shoulder replacement has increased from 43.3% of all total shoulder replacements in 2008 to 73.6% in 2017.

The proportion of total reverse shoulder replacements for osteoarthritis declined from 57.9% in 2008 to 40.5% in 2013, and is 43.0% in 2017. 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 36.7% in 2017. The proportion of total reverse shoulder replacements for fracture has increased from 12.2% in 2008 to 15.5% in 2017 (Figure ST21).

Primary total reverse shoulder replacement is more commonly undertaken in females (65.0%) (Table ST40). There has been minimal change in gender distribution since 2008 (Figure ST22).

Figure ST21 Proportion of Primary Total Reverse Shoulder Replacement by Primary Diagnosis

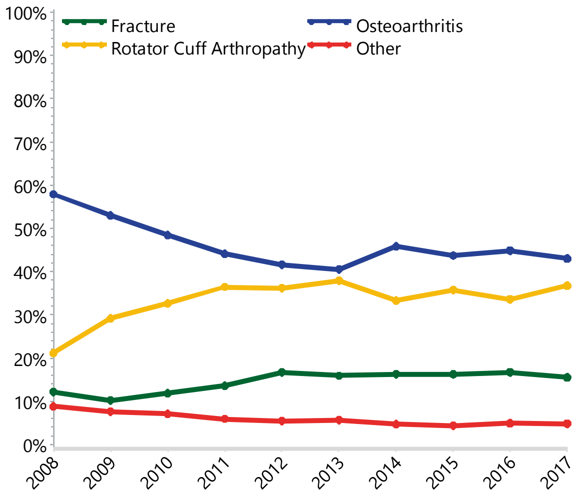
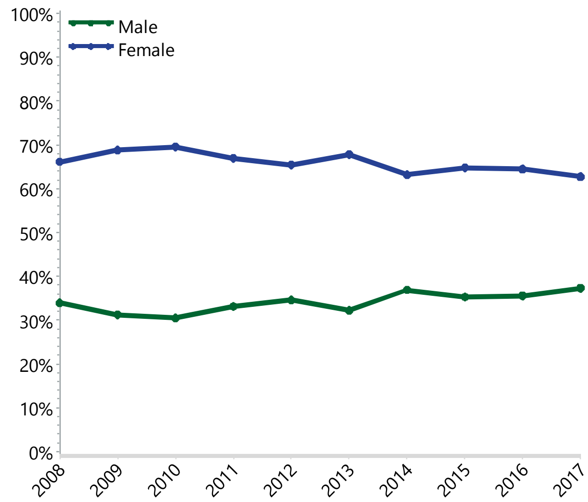


Figure ST22 Proportion of Primary Total Reverse Shoulder Replacement by Gender



The mean age is 75.4 years for females and 72.9 years for males. The proportion of patients aged 75 years or older has declined from 61.3% in 2010 to 46.9% in 2017 (Figure ST23).

The majority of procedures use cementless fixation (75.8%). Hybrid (humerus cemented) fixation is used in 22.7% of procedures. There has been little variation in the use of fixation since 2008 (Figure ST24).

The most common primary diagnoses are osteoarthritis (44.9%), rotator cuff arthropathy (34.5%) and fracture (15.3%).

The most common primary diagnoses are osteoarthritis (44.9%), rotator cuff arthropathy (34.5%) and fracture (15.3%) (Table ST41).

The most used humeral stems are the Delta Xtend, SMR and Aequalis (Table ST42). The most used glenoid prostheses are the Delta Xtend, SMR L1 and Aequalis (Table ST43).

Table ST40 Primary Total Reverse Shoulder Replacement by Age and Gender

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	6971	35.0%	17	96	73	72.9	8.1
Female	12958	65.0%	13	102	76	75.4	8.0
TOTAL	**19929**	**100.0%**	**13**	**102**	**75**	**74.5**	**8.1**

Figure ST23 Proportion of Primary Total Reverse Shoulder Replacement by Age

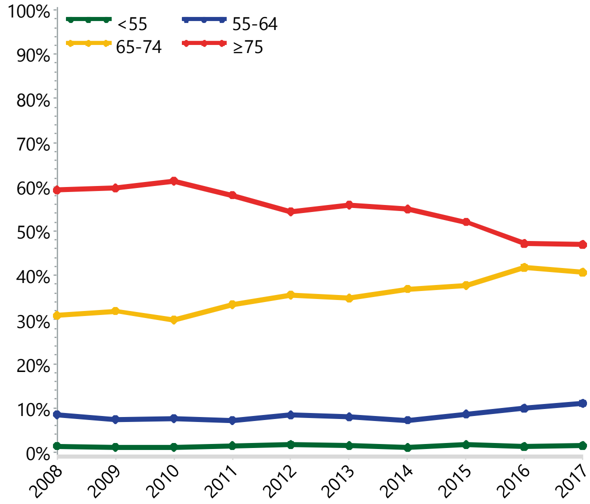


Figure ST24 Proportion of Primary Total Reverse Shoulder Replacement by Fixation

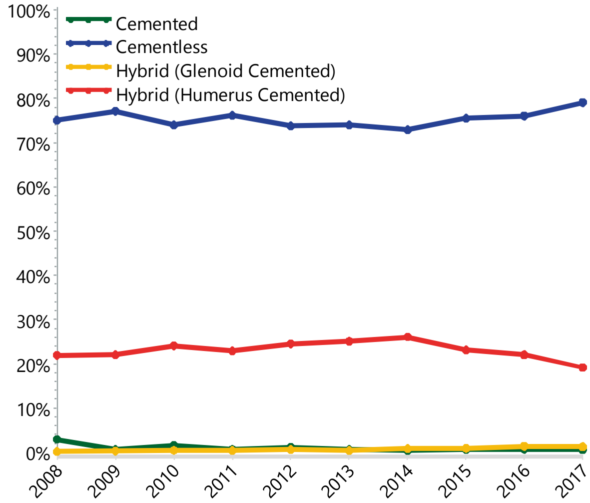


Table ST41 Primary Total Reverse Shoulder Replacement by Primary Diagnosis and Gender

	Male		Female		TOTAL	
Primary Diagnosis	N	Col%	N	Col%	N	Col%
Osteoarthritis	3299	47.3	5643	43.5	8942	44.9
Rotator Cuff Arthropathy	2896	41.5	3972	30.7	6868	34.5
Fracture	484	6.9	2565	19.8	3049	15.3
Rheumatoid Arthritis	80	1.1	315	2.4	395	2.0
Osteonecrosis	43	0.6	196	1.5	239	1.2
Instability	72	1.0	155	1.2	227	1.1
Tumour	70	1.0	59	0.5	129	0.6
Other Inflammatory Arthritis	25	0.4	50	0.4	75	0.4
Other	2	0.0	3	0.0	5	0.0
TOTAL	**6971**	**100.0**	**12958**	**100.0**	**19929**	**100.0**

Table ST42 10 Most Used Humeral Stem Prostheses in Primary Total Reverse Shoulder Replacement

2008		2014		2015		2016		2017	
N	Model	N	Model	N	Model	N	Model	N	Model
263	SMR	845	Delta Xtend	961	Delta Xtend	1027	Delta Xtend	1007	Delta Xtend
252	Delta Xtend	639	SMR	733	SMR	925	SMR	918	SMR
76	Aequalis	254	Aequalis	267	Aequalis	363	Aequalis	361	Aequalis
42	Trabecular Metal	141	Trabecular Metal	191	Trabecular Metal	208	Trabecular Metal	347	Comprehensive
21	Delta CTA	113	RSP	143	RSP	200	Comprehensive	338	RSP
2	Custom Made (Lima)	83	Aequalis Ascend	104	Comprehensive	179	RSP	306	Equinoxe
1	Generic Humeral Stem	80	Comprehensive	103	Equinoxe	171	Equinoxe	255	Affinis
1	Promos	45	Global Unite	67	Global Unite	110	Affinis	201	Trabecular Metal
		32	Equinoxe	47	Aequalis Ascend	104	Global Unite	158	Aequalis Ascend
		18	Anatomical Shoulder	44	Anatomical Shoulder	92	Aequalis Ascend	121	Global Unite
10 Most Used									
658	(8) 100.0%	2250	(10) 99.0%	2660	(10) 98.5%	3379	(10) 99.1%	4012	(10) 99.3%
Remainder									
0	(0) 0%	22	(4) 1.0%	40	(3) 1.5%	32	(3) 0.9%	29	(4) 0.7%
TOTAL									
658	(8) 100.0%	2272	(14) 100.0%	2700	(13) 100.0%	3411	(13) 100.0%	4041	(14) 100.0%

Table ST43 10 Most Used Glenoid Prostheses in Primary Total Reverse Shoulder Replacement

2008		2014		2015		2016		2017	
N	Model	N	Model	N	Model	N	Model	N	Model
264	SMR L1	890	Delta Xtend	1028	Delta Xtend	1131	Delta Xtend	1128	Delta Xtend
252	Delta Xtend	633	SMR L1	732	SMR L1	913	SMR L1	912	SMR L1
76	Aequalis	339	Aequalis	314	Aequalis	456	Aequalis	519	Aequalis
42	Trabecular Metal	150	Trabecular Metal	216	Trabecular Metal	233	Trabecular Metal	356	Comprehensive Reverse
21	Delta CTA	113	RSP	143	RSP	186	Comprehensive Reverse	339	RSP
1	Generic Metaglene	78	Comprehensive Reverse	103	Equinoxe	179	RSP	306	Equinoxe
1	Promos	32	Equinoxe	102	Comprehensive Reverse	167	Equinoxe	255	Affinis
1	SMR	11	Affinis	33	Affinis	110	Affinis	188	Trabecular Metal
		10	Anatomical Shoulder	19	Anatomical Shoulder	7	SMR Axioma	12	Custom Made (Comprehensive)
		9	Mets	6	Mets	6	Anatomical Shoulder	11	Mets
10 Most Used									
658 (8)	100.0%	2265 (10)	99.7%	2696 (10)	99.9%	3388 (10)	99.3%	4026 (10)	99.6%
Remainder									
0 (0)	0%	7 (4)	0.3%	4 (2)	0.1%	23 (8)	0.7%	15 (4)	0.4%
TOTAL									
658 (8)	100.0%	2272 (14)	100.0%	2700 (12)	100.0%	3411 (18)	100.0%	4041 (14)	100.0%

OUTCOME FOR ALL DIAGNOSES

Primary Diagnosis

Fracture has a higher rate of revision in the first three 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 ST44 and Figure ST25).

Reason for Revision

Instability/dislocation is the most common reason for revision (34.5%), followed by infection (19.9%), loosening (18.3%) and fracture (13.3%) (Table ST45 and Figure ST26).

Type of Revision

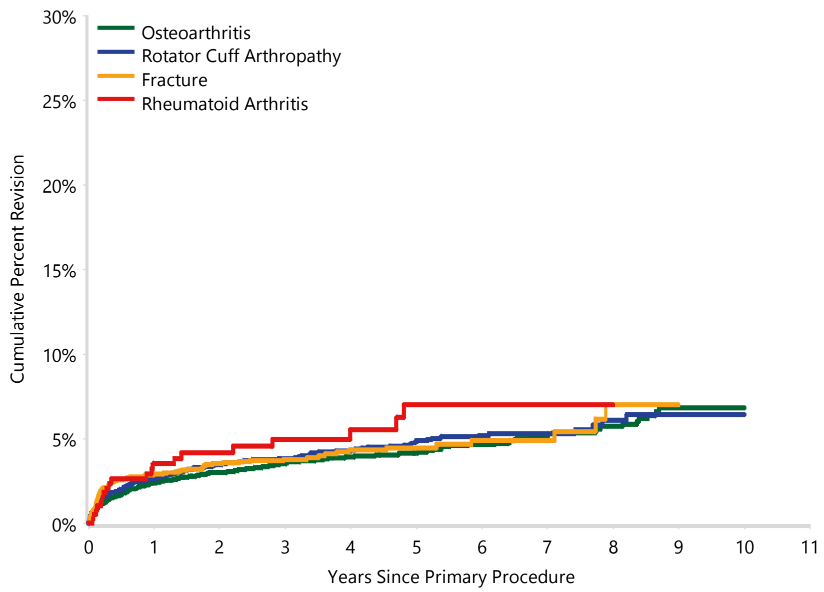
The four most common types of revision are: replacement of both cup (liner) and glenosphere (21.6%), humeral component only (20.8%), cup only (19.5%) and humeral head only (converted to a hemi arthroplasty) (15.1%) (Table ST46). When only the humeral component is revised, this may be associated with exchange of the epiphysis and/or humeral stem and additional minor components such as the liner.

Table ST44 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Primary Diagnosis

Primary Diagnosis	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
Osteoarthritis	315	8942	2.4 (2.1, 2.8)	3.6 (3.1, 4.0)	4.2 (3.7, 4.7)	5.2 (4.5, 5.9)	6.8 (5.7, 8.2)	
Rotator Cuff Arthropathy	255	6868	2.7 (2.3, 3.1)	3.8 (3.4, 4.4)	4.8 (4.2, 5.5)	5.3 (4.6, 6.1)	6.4 (5.2, 7.9)	
Fracture	111	3049	2.9 (2.4, 3.6)	3.8 (3.1, 4.6)	4.4 (3.6, 5.5)	4.9 (3.9, 6.2)		
Rheumatoid Arthritis	20	395	3.5 (2.1, 6.0)	5.0 (3.1, 7.9)	7.0 (4.4, 11.1)	7.0 (4.4, 11.1)		
Other (5)	36	675	3.7 (2.5, 5.6)	6.1 (4.2, 8.7)	6.5 (4.5, 9.3)	7.2 (5.0, 10.5)		
TOTAL	**737**	**19929**						

Note: Only primary diagnoses with over 300 procedures have been listed

Figure ST25 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=1.08 (0.92, 1.28),p=0.355

Fracture vs Osteoarthritis
0 - 3Mth: HR=1.82 (1.36, 2.44),p<0.001
3Mth+: HR=0.96 (0.71, 1.32),p=0.821

Rheumatoid Arthritis vs Osteoarthritis
Entire Period: HR=1.31 (0.83, 2.07),p=0.252

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
Osteoarthritis	8942	6929	4054	2217	1074	119	17
Rotator Cuff Arthropathy	6868	5162	2928	1471	533	54	14
Fracture	3049	2266	1198	550	203	20	2
Rheumatoid Arthritis	395	320	215	119	63	6	4

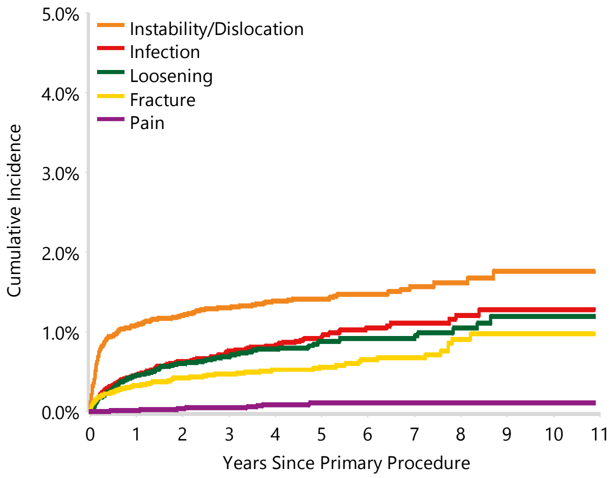
Table ST45 Primary Total Reverse Shoulder Replacement by Reason for Revision

Reason for Revision	Number	Percent
Instability/Dislocation	254	34.5
Infection	147	19.9
Loosening	135	18.3
Fracture	98	13.3
Pain	12	1.6
Lysis	10	1.4
Dissociation	7	0.9
Incorrect Sizing	7	0.9
Arthrofibrosis	7	0.9
Malposition	6	0.8
Implant Breakage Glenoid	5	0.7
Rotator Cuff Insufficiency	4	0.5
Metal Related Pathology	4	0.5
Wear Glenoid Insert	1	0.1
Post Operative Haematoma	1	0.1
Implant Breakage Head	1	0.1
Wear Humeral Cup	1	0.1
Synovitis	1	0.1
Other	36	4.9
TOTAL	**737**	**100.0**

Table ST46 Primary Total Reverse Shoulder Replacement by Type of Revision

Type of Revision	Number	Percent
Cup/Glenosphere	159	21.6
Humeral Component	153	20.8
Cup Only	144	19.5
Head Only	111	15.1
Glenoid Component	51	6.9
Cement Spacer	44	6.0
Humeral/Glenoid	43	5.8
Removal of Prostheses	16	2.2
Minor Components	6	0.8
Reoperation	4	0.5
Cement Only	3	0.4
Reinsertion of Components	2	0.3
Head/Insert	1	0.1
TOTAL	**737**	**100.0**

Figure ST26 Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement



OUTCOME FOR OSTEOARTHRITIS

Age and Gender

Age is not a risk factor for revision of total reverse shoulder replacement undertaken for osteoarthritis (Table ST47 and Figure ST27).

Males have a higher rate of revision compared to females in the first six months (Table ST48 and Figure ST28). The increase in the rate of revision is due to a higher cumulative incidence of instability/dislocation (2.4% for males at 10 years compared to 1.5% for females) and infection (1.8% compared to 0.8%) (Figure ST29).

Fixation

Fixation is not a risk factor for revision, with no difference between hybrid (humerus cemented) and cementless humeral stems (Table ST49 and Figure ST30). This is also the case when the SMR L2 prosthesis is excluded from the analysis (Table ST50 and Figure ST31).

Glenosphere Size

Glenosphere sizes smaller than 38mm have a higher rate of revision over the entire period compared to 38 to 40mm sizes, and in the first three months only when compared to sizes larger than 40mm (Table ST51 and Figure ST32). The cumulative incidence for the most common reasons for revision is presented in Figure ST33.

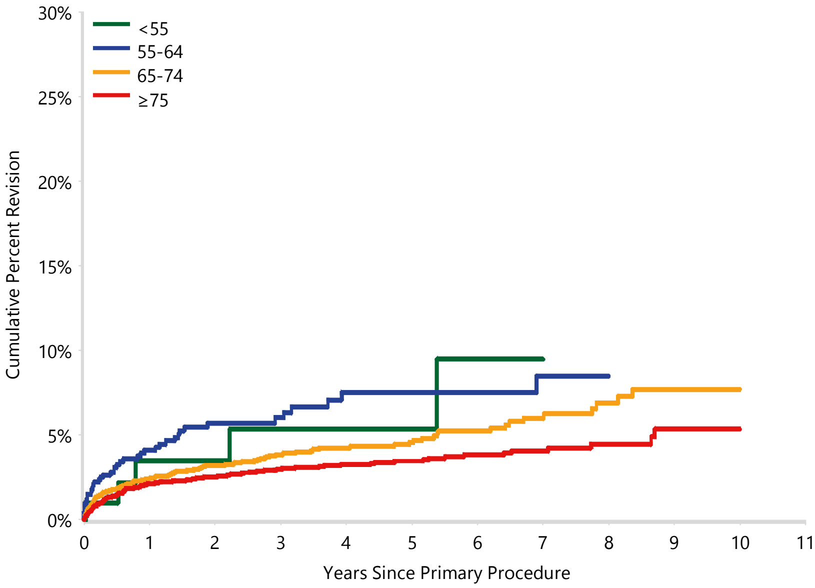
Glenosphere sizes smaller than 38mm have a higher rate of revision when used for osteoarthritis.

The outcomes of the most commonly used total reverse shoulder prostheses are listed in Table ST52. The outcomes for the most used prosthesis combinations using cementless fixation are listed in Table ST53. The most commonly used prosthesis combinations using hybrid (humerus cemented) fixation are listed in Table ST54.

Table ST47 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Age (Primary Diagnosis OA)

Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
<55	5	100	3.5 (1.1, 10.4)	5.4 (2.0, 14.1)	5.4 (2.0, 14.1)	9.5 (3.5, 24.5)		
55-64	44	730	4.1 (2.8, 5.9)	6.0 (4.4, 8.3)	7.5 (5.4, 10.3)	8.5 (5.9, 12.1)		
65-74	127	3369	2.4 (2.0, 3.0)	3.8 (3.2, 4.7)	4.5 (3.7, 5.5)	6.0 (4.8, 7.5)	7.7 (6.0, 9.9)	
≥75	139	4743	2.1 (1.7, 2.6)	3.0 (2.5, 3.5)	3.4 (2.9, 4.1)	4.1 (3.3, 4.9)	5.3 (4.0, 7.1)	
TOTAL	**315**	**8942**						

Figure ST27 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Age (Primary Diagnosis OA)



HR - adjusted for gender

55-64 vs <55

Entire Period: HR=1.26 (0.50, 3.17),p=0.627

65-74 vs <55

Entire Period: HR=0.81 (0.33, 1.97),p=0.636

≥75 vs <55

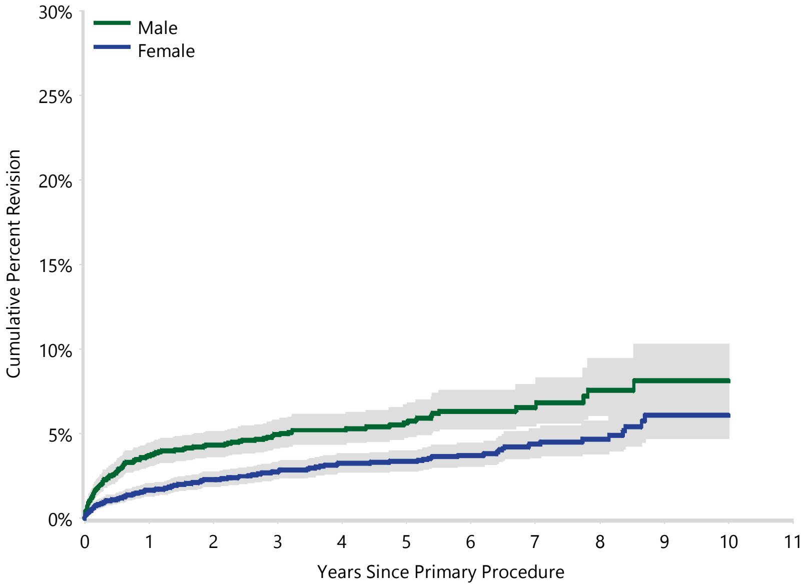
Entire Period: HR=0.64 (0.26, 1.56),p=0.324

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
<55	100	72	42	25	13	3	1
55-64	730	532	292	163	89	12	2
65-74	3369	2567	1423	769	388	51	5
≥75	4743	3758	2297	1260	584	53	9

Table ST48 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Gender (Primary Diagnosis OA)

Gender	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
Male	157	3299	3.7 (3.1, 4.5)	4.9 (4.2, 5.8)	5.6 (4.8, 6.7)	6.6 (5.5, 7.9)	8.1 (6.4, 10.3)	
Female	158	5643	1.6 (1.3, 2.0)	2.8 (2.3, 3.3)	3.3 (2.8, 4.0)	4.4 (3.6, 5.3)	6.1 (4.7, 7.8)	
TOTAL	**315**	**8942**						

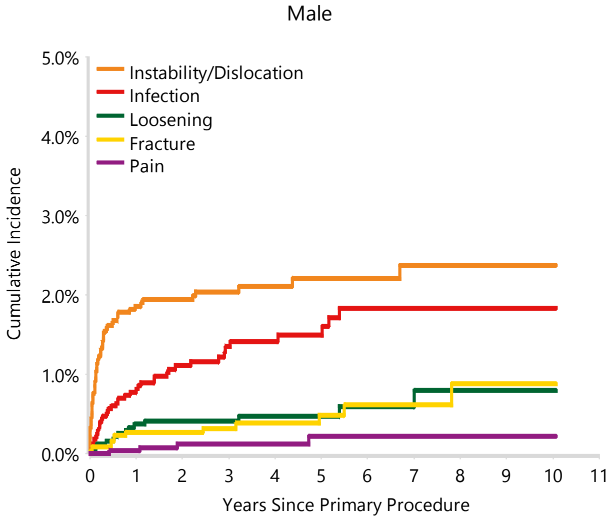
Figure ST28 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Gender (Primary Diagnosis OA)



HR - adjusted for age
Male vs Female
0 - 3Mth: HR=2.19 (1.51, 3.19),p<0.001
3Mth - 6Mth: HR=2.53 (1.32, 4.85),p=0.005
6Mth+: HR=1.26 (0.92, 1.72),p=0.153

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
Male	3299	2494	1421	754	349	44	4
Female	5643	4435	2633	1463	725	75	13

Figure ST29 Cumulative Incidence Revision Diagnosis of Total Reverse Shoulder by Gender (Primary Diagnosis OA)



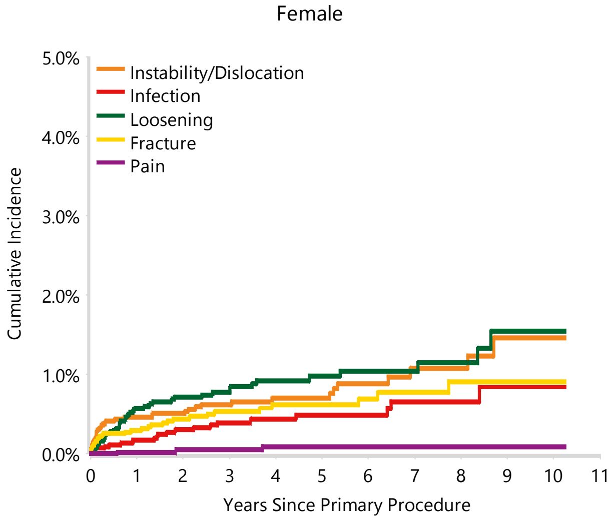
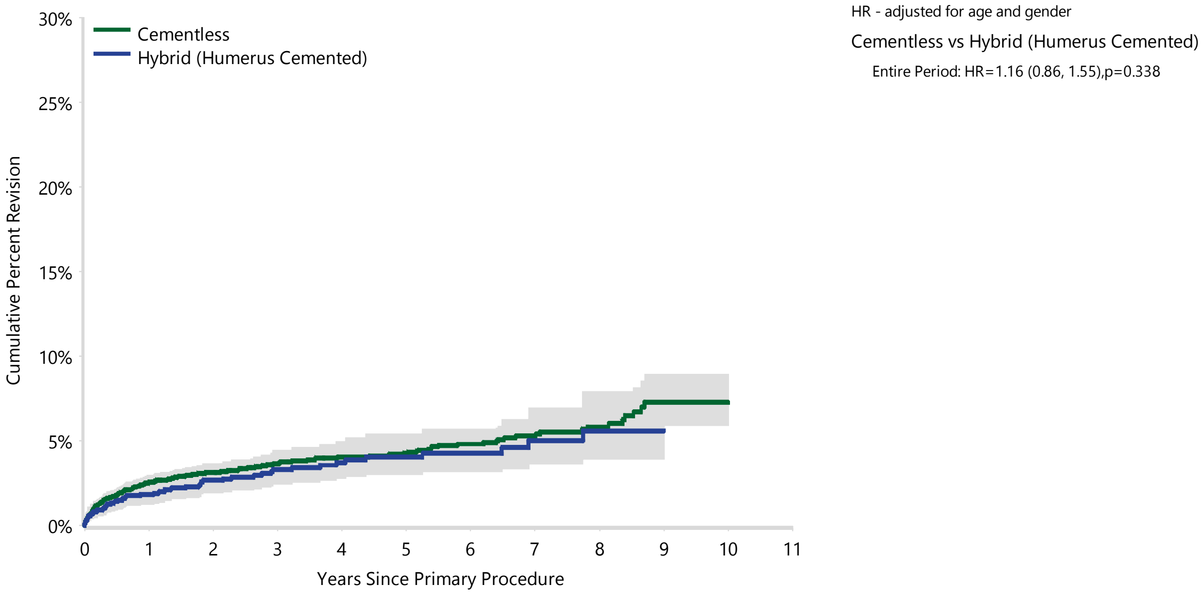


Table ST49 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Fixation (Primary Diagnosis OA)

Fixation	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
Cemented	1	82	1.4 (0.2, 9.3)	1.4 (0.2, 9.3)	1.4 (0.2, 9.3)	1.4 (0.2, 9.3)		
Cementless	259	7198	2.6 (2.2, 3.0)	3.6 (3.2, 4.2)	4.2 (3.7, 4.9)	5.3 (4.5, 6.1)	7.3 (5.9, 8.9)	
Hybrid (Glenoid Cemented)	2	64	3.2 (0.8, 12.2)	3.2 (0.8, 12.2)				
Hybrid (Humerus Cemented)	53	1598	1.8 (1.3, 2.6)	3.3 (2.4, 4.4)	4.0 (3.0, 5.4)	5.0 (3.6, 6.9)		
TOTAL	**315**	**8942**						

Figure ST30 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Fixation (Primary Diagnosis OA)

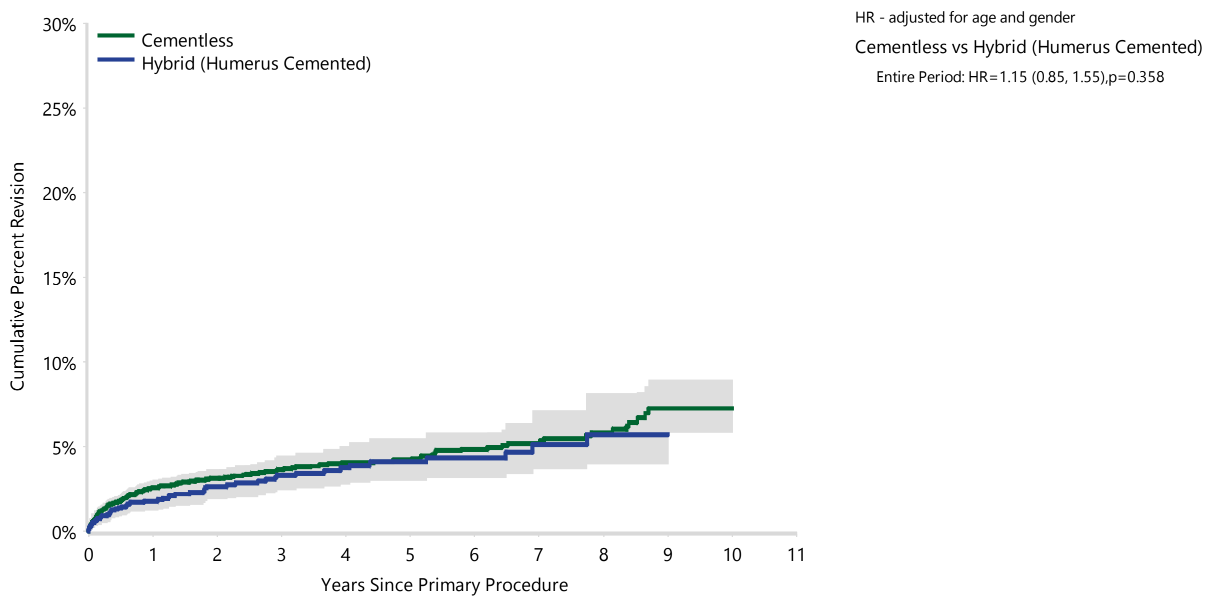


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
Cementless	7198	5495	3151	1711	824	81	17
Hybrid (Humerus Cemented)	1598	1322	835	458	222	32	0

Table ST50 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	11 Yrs
Cemented	1	82	1.4 (0.2, 9.3)	1.4 (0.2, 9.3)	1.4 (0.2, 9.3)	1.4 (0.2, 9.3)		
Cementless	237	6747	2.6 (2.2, 3.0)	3.6 (3.2, 4.2)	4.2 (3.7, 4.9)	5.2 (4.4, 6.1)	7.3 (5.9, 9.0)	
Hybrid (Glenoid Cemented)	2	62	3.3 (0.8, 12.6)	3.3 (0.8, 12.6)				
Hybrid (Humerus Cemented)	52	1569	1.8 (1.2, 2.6)	3.3 (2.4, 4.5)	4.1 (3.0, 5.5)	5.1 (3.7, 7.1)		
TOTAL	**292**	**8460**						

Figure ST31 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Fixation (Primary Diagnosis OA, excluding SMR L2)



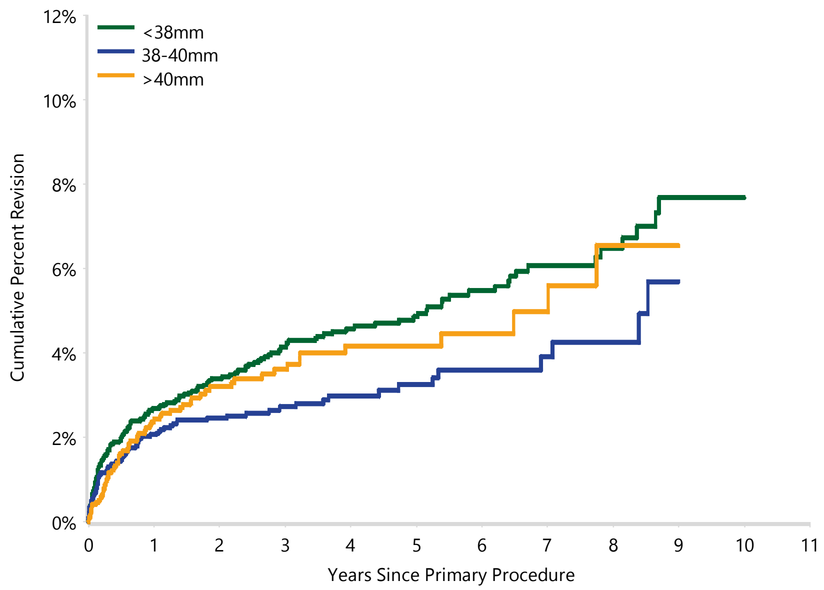
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
Cementless	6747	5063	2745	1343	705	81	17
Hybrid (Humerus Cemented)	1569	1295	809	434	209	32	0

Table ST51 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	11 Yrs
<38mm	163	3764	2.7 (2.2, 3.3)	4.1 (3.5, 4.9)	4.9 (4.1, 5.7)	6.1 (5.1, 7.2)	7.7 (6.2, 9.5)	
38-40mm	86	3208	2.1 (1.6, 2.6)	2.7 (2.2, 3.4)	3.3 (2.6, 4.1)	3.9 (2.9, 5.2)		
>40mm	65	1958	2.4 (1.8, 3.3)	3.6 (2.8, 4.7)	4.2 (3.2, 5.4)	5.0 (3.6, 6.8)		
TOTAL	**314**	**8930**						

Note: Excludes 12 procedures with unknown glenosphere size

Figure ST32 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=1.43 (1.10, 1.85),p=0.007

>40mm vs 38-40mm
0 - 3Mth: HR=0.58 (0.34, 1.01),p=0.053
3Mth - 1.5Yr: HR=1.29 (0.81, 2.03),p=0.280
1.5Yr+: HR=0.97 (0.55, 1.72),p=0.927

<38mm vs >40mm
0 - 3Mth: HR=2.39 (1.38, 4.13),p=0.001
3Mth+: HR=1.26 (0.88, 1.80),p=0.202

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs	8 Yrs	9 Yrs	10 Yrs	11 Yrs
<38mm	3764	3026	2453	1972	1535	1193	900	634	417	218	83	16
38-40mm	3208	2415	1762	1291	903	628	442	288	187	88	18	0
>40mm	1958	1480	1072	788	569	395	238	151	88	43	18	1

Figure ST33 Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement by Glenosphere Size (Primary Diagnosis OA)

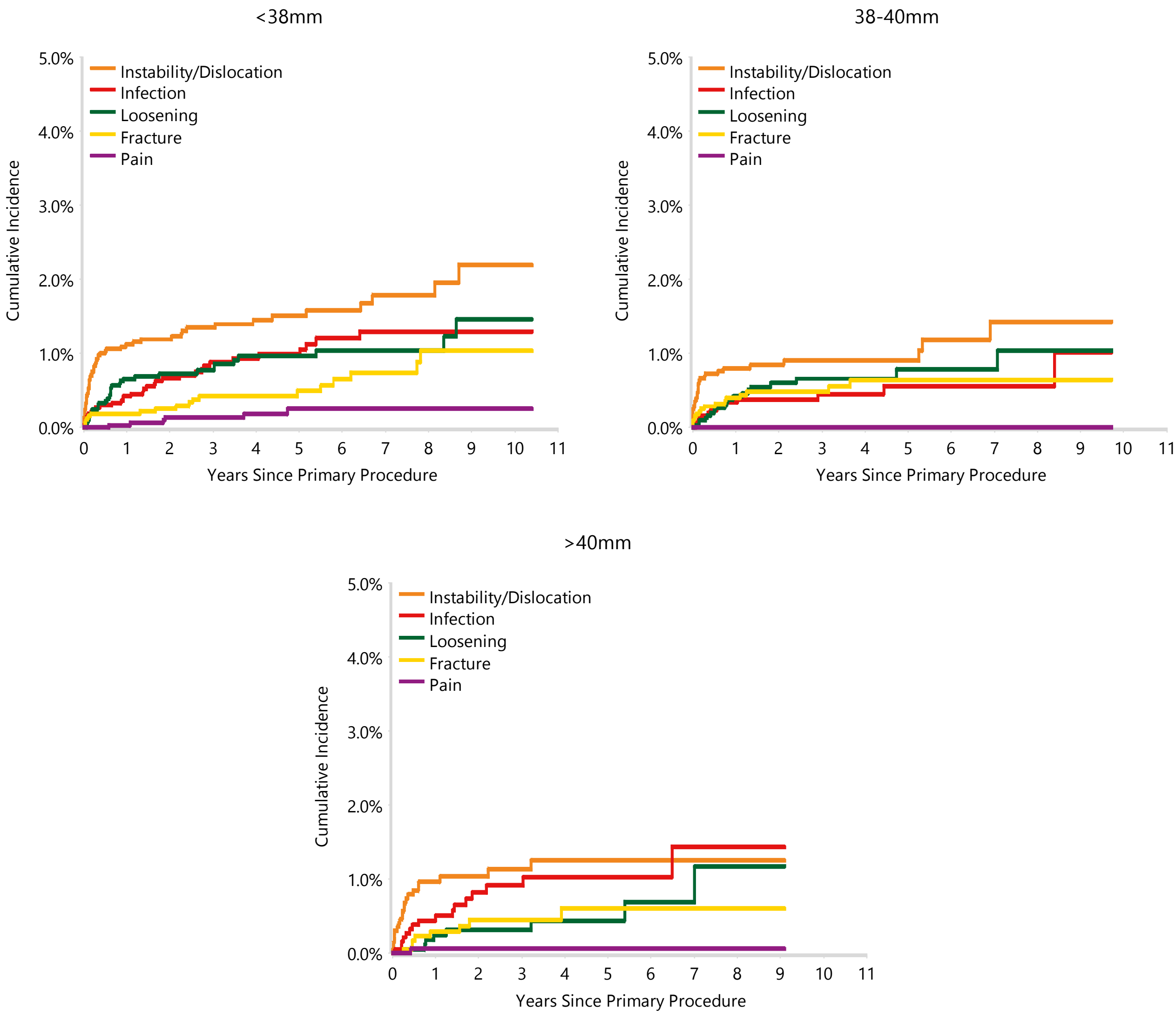


Table ST52 Cumulative Percent Revision of All Primary Total Reverse Shoulder Replacement by Prosthesis Combination (Primary Diagnosis OA)

Humeral Stem	Glenoid Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
Aequalis	Aequalis	52	1076	2.2 (1.5, 3.3)	4.2 (3.0, 5.7)	5.2 (3.9, 7.0)	7.2 (5.3, 9.8)		
Aequalis Ascend	Aequalis	4	177	2.2 (0.7, 6.8)	3.7 (1.3, 10.1)				
Affinis	Affinis	6	198	2.6 (1.0, 6.9)					
Comprehensive	Comprehensive Reverse	9	402	1.9 (0.9, 4.0)	2.8 (1.3, 6.2)				
Delta CTA	Delta CTA	7	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)	11.4 (5.6, 22.5)
Delta Xtend	Delta Xtend	85	2955	2.0 (1.6, 2.6)	2.7 (2.1, 3.4)	3.2 (2.5, 4.0)	4.0 (3.1, 5.2)		
Equinoxe	Equinoxe	9	351	2.5 (1.2, 5.3)					
Global Unite	Delta Xtend	4	134	0.9 (0.1, 6.5)					
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	10	365	2.5 (1.3, 5.0)	4.6 (2.2, 9.4)				
SMR	SMR L1	83	2092	3.2 (2.5, 4.1)	4.1 (3.3, 5.1)	4.5 (3.5, 5.6)	5.1 (3.9, 6.7)		
SMR	SMR L2	23	482	2.3 (1.3, 4.1)	3.6 (2.2, 5.7)	4.3 (2.8, 6.6)	5.5 (3.6, 8.3)		
Trabecular Metal	Trabecular Metal	17	507	2.1 (1.1, 3.8)	3.3 (1.9, 5.5)	4.3 (2.5, 7.1)	4.3 (2.5, 7.1)		
Other (21)		3	99	2.2 (0.6, 8.7)	4.2 (1.3, 13.0)	4.2 (1.3, 13.0)			
TOTAL		**315**	**8942**						

Note: Only combinations with over 25 procedures have been listed

Table ST53 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	11 Yrs
Aequalis	Aequalis	44	829	2.2 (1.4, 3.5)	4.6 (3.3, 6.5)	5.5 (4.0, 7.7)	8.3 (5.9, 11.6)		
Aequalis Ascend	Aequalis	4	156	2.5 (0.8, 7.8)					
Affinis	Affinis	5	126	3.3 (1.1, 10.1)					
Comprehensive	Comprehensive Reverse	9	377	2.1 (1.0, 4.3)	3.0 (1.4, 6.7)				
Delta CTA	Delta CTA	4	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	63	2052	2.4 (1.8, 3.2)	3.0 (2.3, 3.9)	3.5 (2.7, 4.6)	4.0 (3.0, 5.3)		
Equinoxe	Equinoxe	7	326	2.0 (0.8, 4.8)					
Global Unite	Delta Xtend	2	121	1.0 (0.1, 7.2)					
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	2	117						
SMR	SMR L1	78	2031	3.2 (2.5, 4.1)	3.9 (3.1, 5.0)	4.3 (3.4, 5.5)	5.0 (3.7, 6.6)		
SMR	SMR L2	22	451	2.2 (1.2, 4.1)	3.6 (2.2, 5.8)	4.4 (2.8, 6.7)	5.7 (3.7, 8.7)		
Trabecular Metal	Trabecular Metal	13	454	2.1 (1.1, 4.0)	2.7 (1.5, 4.9)	3.2 (1.8, 5.8)	3.2 (1.8, 5.8)		
Other (17)		3	85	2.6 (0.6, 10.0)	4.9 (1.5, 15.2)	4.9 (1.5, 15.2)			
TOTAL		**259**	**7198**						

Note: Only combinations with over 25 procedures have been listed.

Table ST54 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	11 Yrs
Aequalis	Aequalis	8	227	2.3 (1.0, 5.4)	2.9 (1.3, 6.4)	4.4 (2.2, 8.8)			
Affinis	Affinis	1	65	1.7 (0.2, 11.6)					
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	22	854	1.2 (0.7, 2.2)	2.1 (1.3, 3.4)	2.5 (1.6, 4.0)	4.1 (2.4, 6.9)		
RSP	RSP	5	207	1.6 (0.5, 4.8)	4.2 (1.6, 11.1)				
SMR	SMR L1	5	49	6.3 (2.1, 18.2)	11.4 (4.9, 25.4)	11.4 (4.9, 25.4)	11.4 (4.9, 25.4)		
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	46	2.2 (0.3, 14.4)	8.9 (2.9, 25.9)	13.7 (5.1, 33.9)	13.7 (5.1, 33.9)		
Other (12)		4	92	2.4 (0.6, 9.3)	6.6 (2.4, 17.2)				
TOTAL		**53**	**1598**						

Note: Only combinations with over 25 procedures have been listed.

OUTCOME FOR ROTATOR CUFF ARTHROPATHY

Age and Gender

For the diagnosis of rotator cuff arthropathy, patients aged 55 to 64 years have a higher rate of revision compared to those aged 75 years or older after three months (Table ST55 and Figure ST34).

Males have a higher rate of revision compared to females (Table ST56 and Figure ST35). 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 0.9% for females) and infection (2.5% compared to 0.5%) (Figure ST36).

Fixation

Fixation is not a risk factor for revision (Table ST57 and Figure ST37). This is also the case when the SMR L2 total reverse shoulder prosthesis is excluded from the analysis (Table ST58 and Figure ST38).

Glenosphere Size

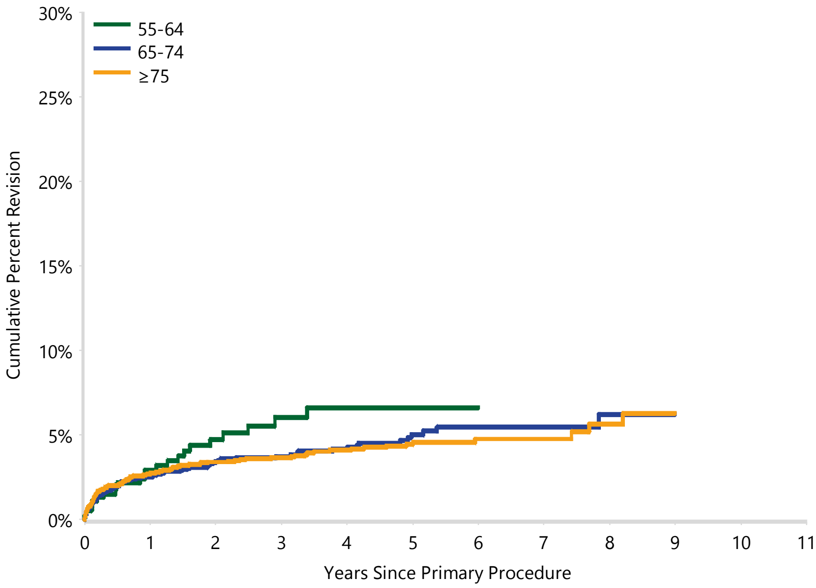
There is no difference in the rate of revision of the different glenosphere sizes for rotator cuff arthropathy (Table ST59 and Figure ST39). The cumulative incidence for the most common reasons for revision is shown in Figure ST40.

The outcomes of the most commonly used prosthesis combinations are listed in Table ST60. The most commonly used prosthesis combinations using cementless fixation for rotator cuff arthropathy are listed in Table ST61. The most commonly used prosthesis combinations using hybrid (humerus cemented) fixation for rotator cuff arthropathy are listed in Table ST62.

Table ST55 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	11 Yrs
<55	3	48	4.2 (1.1, 15.6)	4.2 (1.1, 15.6)	4.2 (1.1, 15.6)			
55-64	26	548	2.9 (1.7, 4.9)	6.0 (4.0, 9.2)	6.6 (4.4, 10.0)			
65-74	93	2587	2.5 (1.9, 3.2)	3.7 (3.0, 4.7)	5.0 (4.0, 6.3)	5.4 (4.3, 6.9)		
≥75	133	3685	2.7 (2.3, 3.3)	3.6 (3.0, 4.4)	4.5 (3.7, 5.4)	4.8 (3.9, 5.8)		
TOTAL	**255**	**6868**						

Figure ST34 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Age (Primary Diagnosis Rotator Cuff Arthropathy)



HR - adjusted for gender

55-64 vs ≥75

0 - 3Mth: HR=0.72 (0.33, 1.57),p=0.409

3Mth+: HR=1.76 (1.07, 2.89),p=0.026

65-74 vs ≥75

Entire Period: HR=0.96 (0.74, 1.26),p=0.787

55-64 vs 65-74

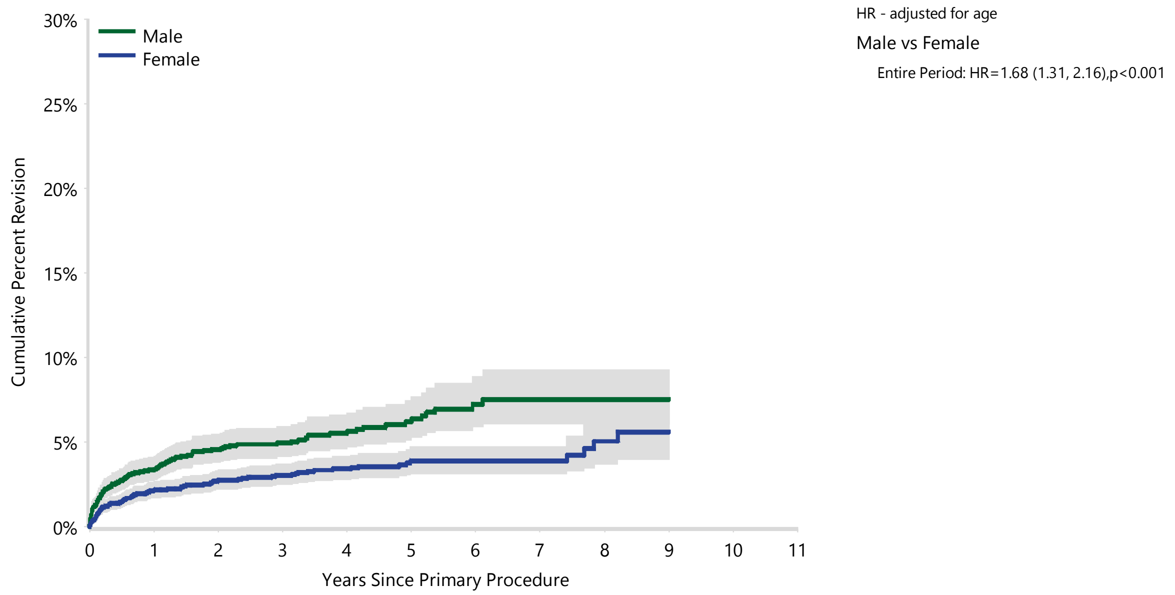
Entire Period: HR=1.32 (0.85, 2.04),p=0.214

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
55-64	548	379	184	97	30	3	0
65-74	2587	1921	1047	540	190	23	6
≥75	3685	2828	1683	825	310	27	8

Table ST56 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Gender (Primary Diagnosis Rotator Cuff Arthropathy)

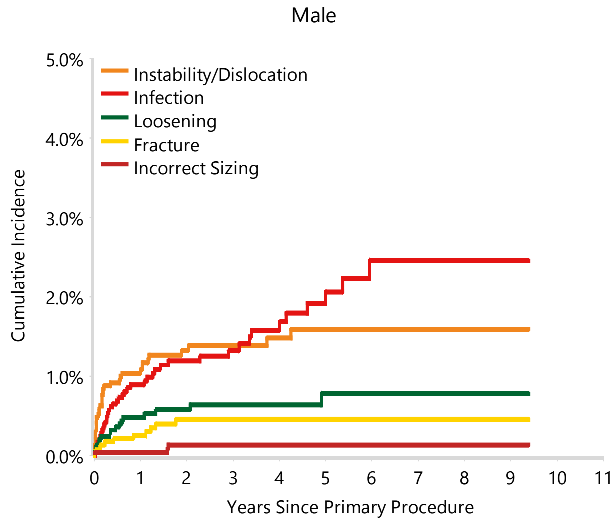
Gender	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
Male	138	2896	3.4 (2.8, 4.1)	5.0 (4.1, 5.9)	6.2 (5.2, 7.5)	7.5 (6.1, 9.3)		
Female	117	3972	2.1 (1.7, 2.7)	3.0 (2.5, 3.7)	3.9 (3.2, 4.7)	3.9 (3.2, 4.7)		
TOTAL	**255**	**6868**						

Figure ST35 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	11 Yrs
Male	2896	2119	1145	543	184	25	6
Female	3972	3043	1783	928	349	29	8

Figure ST36 Cumulative Incidence Revision Diagnosis of Total Reverse Shoulder by Gender (Primary Diagnosis Rotator Cuff Arthropathy)



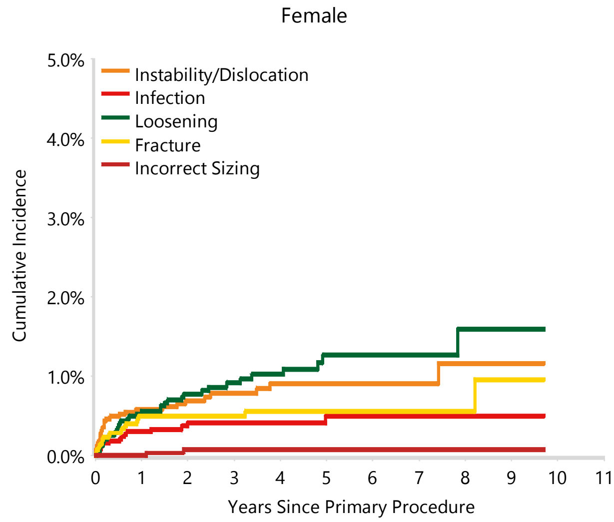
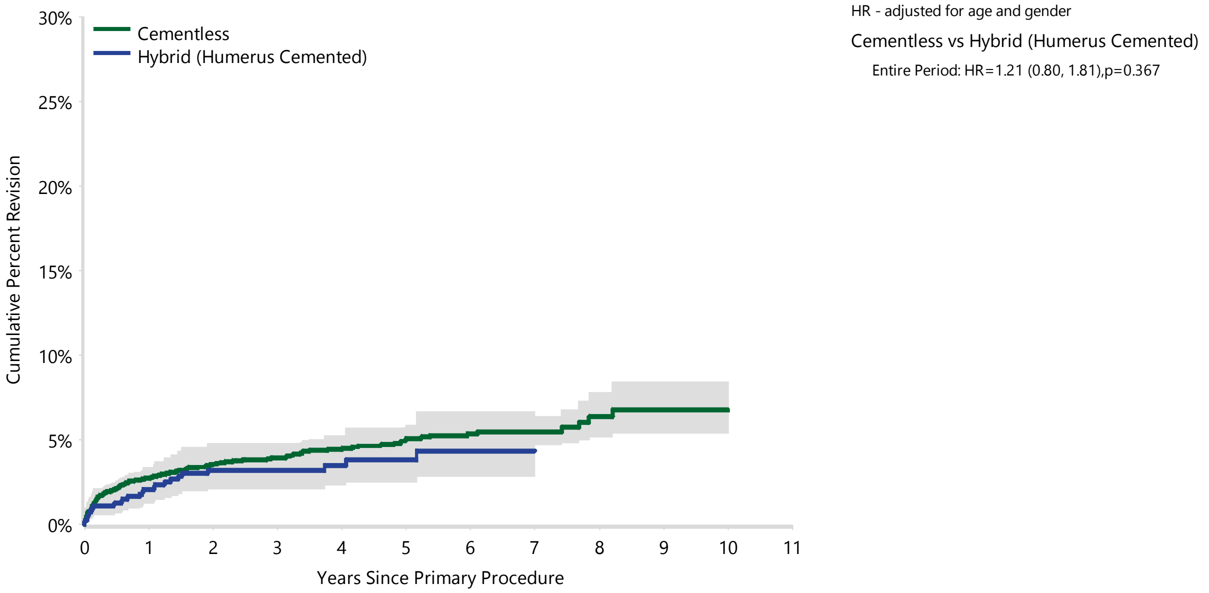


Table ST57 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Fixation (Primary Diagnosis Rotator Cuff Arthropathy)

Fixation	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
Cemented	0	14	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	228	5982	2.8 (2.4, 3.2)	4.0 (3.4, 4.5)	5.0 (4.3, 5.8)	5.5 (4.7, 6.4)	6.7 (5.4, 8.4)	
Hybrid (Glenoid Cemented)	1	52	2.1 (0.3, 13.9)	2.1 (0.3, 13.9)				
Hybrid (Humerus Cemented)	26	820	2.1 (1.3, 3.4)	3.2 (2.1, 4.8)	3.8 (2.5, 5.7)	4.3 (2.8, 6.7)		
TOTAL	**255**	**6868**						

Figure ST37 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Fixation (Primary Diagnosis Rotator Cuff Arthropathy)

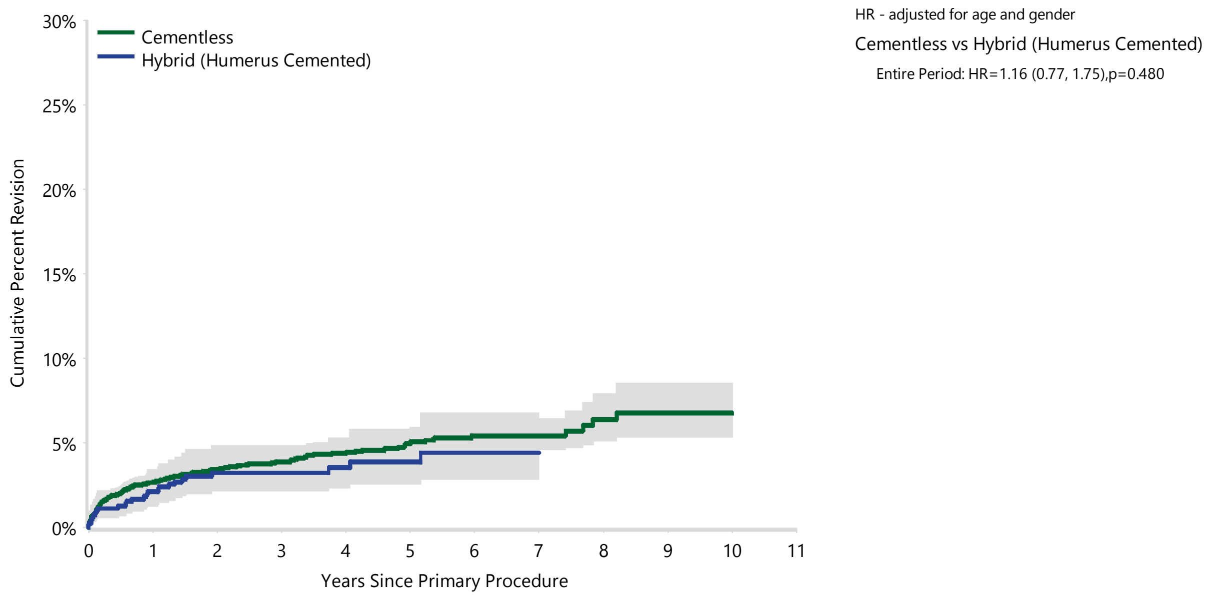


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
Cementless	5982	4432	2477	1269	464	51	13
Hybrid (Humerus Cemented)	820	681	427	191	64	3	1

Table ST58 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	11 Yrs
Cemented	0	14	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	205	5609	2.7 (2.3, 3.2)	3.9 (3.3, 4.5)	4.9 (4.2, 5.8)	5.4 (4.6, 6.4)	6.8 (5.3, 8.5)	
Hybrid (Glenoid Cemented)	1	52	2.1 (0.3, 13.9)	2.1 (0.3, 13.9)				
Hybrid (Humerus Cemented)	26	812	2.1 (1.3, 3.4)	3.2 (2.1, 4.8)	3.9 (2.6, 5.8)	4.4 (2.9, 6.8)		
TOTAL	**232**	**6487**						

Figure ST38 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Fixation (Primary Diagnosis Rotator Cuff Arthropathy, excluding SMR L2)



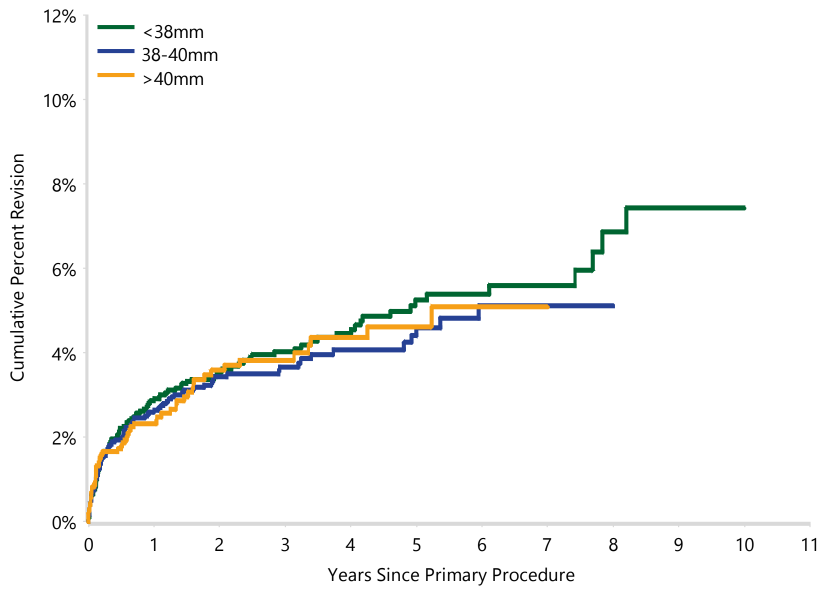
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
Cementless	5609	4079	2147	972	401	51	13
Hybrid (Humerus Cemented)	812	673	420	185	63	3	1

Table ST59 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	11 Yrs
<38mm	108	2595	2.9 (2.3, 3.7)	4.0 (3.3, 4.9)	5.2 (4.3, 6.4)	5.6 (4.5, 6.9)	7.4 (5.6, 9.9)	
38-40mm	92	2669	2.7 (2.1, 3.4)	3.7 (3.0, 4.6)	4.4 (3.5, 5.5)	5.1 (4.0, 6.6)		
>40mm	55	1597	2.3 (1.7, 3.2)	3.8 (2.9, 5.1)	4.6 (3.5, 6.2)	5.1 (3.7, 6.9)		
TOTAL	**255**	**6861**						

Note: Excludes seven procedures with unknown glenosphere size

Figure ST39 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Glenosphere Size (Primary Diagnosis Rotator Cuff Arthropathy)



HR - adjusted for age and gender

<38mm vs 38-40mm

Entire Period: HR=1.13 (0.86, 1.50),p=0.385

>40mm vs 38-40mm

Entire Period: HR=0.81 (0.57, 1.15),p=0.241

<38mm vs >40mm

Entire Period: HR=1.39 (0.99, 1.96),p=0.056

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
<38mm	2595	1998	1240	704	303	44	14
38-40mm	2669	1997	1073	528	172	8	0
>40mm	1597	1161	611	235	55	1	0

Figure ST40 **Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement by Glenosphere Size (Primary Diagnosis Rotator Cuff Arthropathy)**

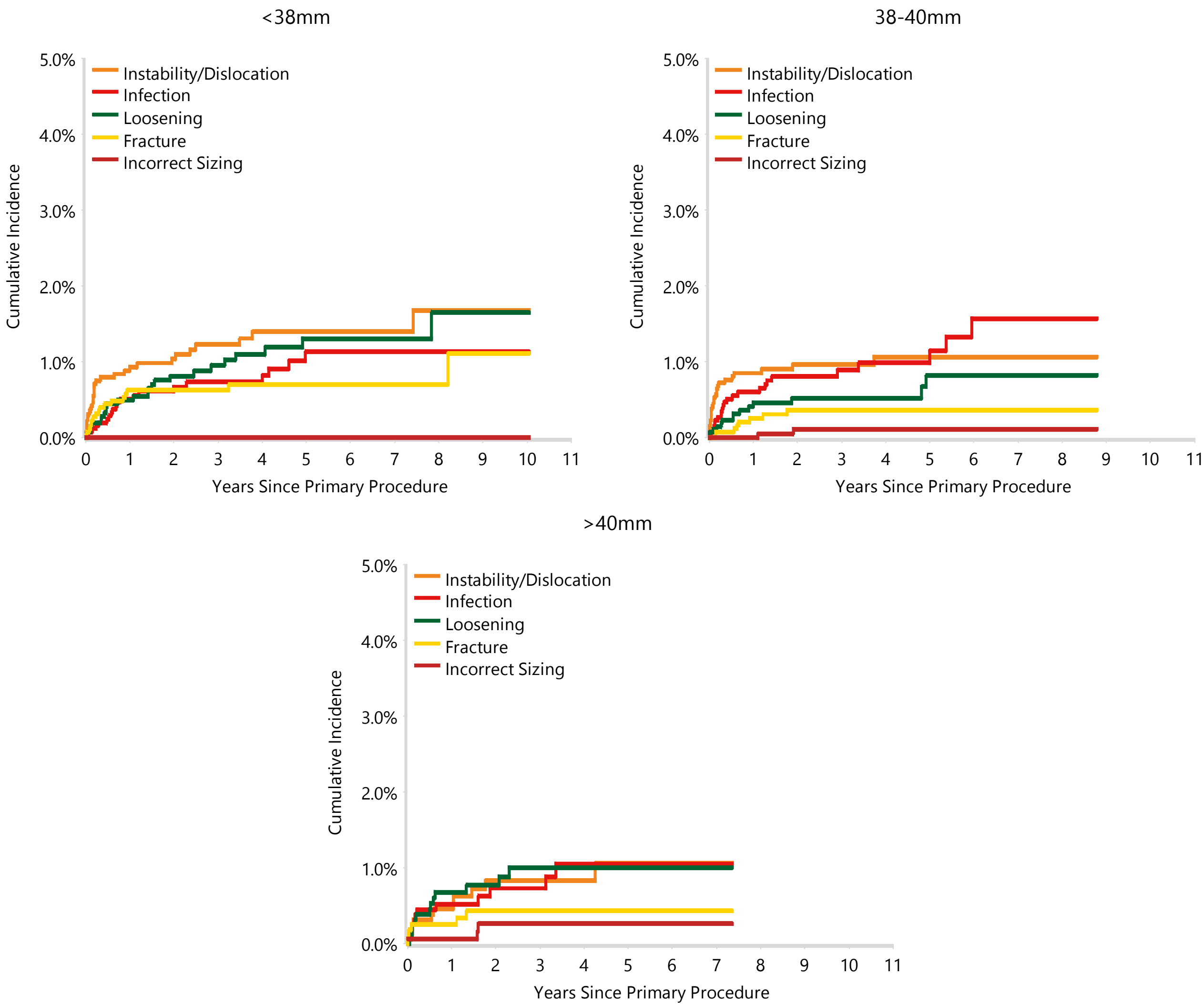


Table ST60 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Prosthesis Combination (Primary Diagnosis Rotator Cuff Arthropathy)

Humeral Stem	Glenoid Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
Aequalis	Aequalis	30	769	1.9 (1.1, 3.2)	3.6 (2.4, 5.3)	4.6 (3.1, 6.7)	5.0 (3.4, 7.3)		
Aequalis Ascend	Aequalis	4	173	2.0 (0.6, 6.1)					
Affinis	Affinis	3	122						
Anatomical Shoulder	Trabecular Metal	4	33	9.8 (3.3, 27.6)					
Comprehensive	Comprehensive Reverse	3	200	1.6 (0.5, 4.9)					
Delta Xtend	Delta Xtend	75	2405	2.1 (1.6, 2.7)	3.1 (2.5, 4.0)	3.8 (3.0, 4.9)	4.5 (3.4, 5.8)		
Equinoxe	Equinoxe	7	202	2.2 (0.8, 5.7)					
Global Unite	Delta Xtend	5	133	3.3 (1.2, 8.7)					
RSP	RSP	5	318	1.9 (0.7, 5.0)	1.9 (0.7, 5.0)				
SMR	SMR L1	70	1550	3.6 (2.7, 4.7)	4.8 (3.7, 6.1)	6.5 (4.9, 8.6)	6.5 (4.9, 8.6)		
SMR	SMR L2	23	381	3.9 (2.4, 6.5)	5.0 (3.2, 7.8)	5.9 (3.9, 8.9)	6.4 (4.3, 9.5)		
Trabecular Metal	Trabecular Metal	24	505	3.9 (2.5, 6.1)	4.7 (3.1, 7.0)	5.1 (3.4, 7.7)			
Other (15)		2	77	1.4 (0.2, 9.3)	1.4 (0.2, 9.3)	1.4 (0.2, 9.3)	1.4 (0.2, 9.3)	6.8 (1.4, 30.2)	
TOTAL		**255**	**6868**						

Note: Only combinations with over 25 procedures have been listed

Table ST61 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	11 Yrs
Aequalis	Aequalis	22	616	1.7 (0.9, 3.2)	3.2 (1.9, 5.1)	4.5 (2.9, 7.0)	4.5 (2.9, 7.0)		
Aequalis Ascend	Aequalis	4	156	2.2 (0.7, 6.7)					
Affinis	Affinis	3	92	3.1 (0.7, 12.6)					
Anatomical Shoulder	Trabecular Metal	3	30	10.9 (3.6, 30.3)					
Comprehensive	Comprehensive Reverse	3	196	1.6 (0.5, 5.0)					
Delta Xtend	Delta Xtend	67	2039	2.2 (1.6, 2.9)	3.4 (2.6, 4.4)	4.1 (3.2, 5.4)	4.9 (3.7, 6.5)		
Equinoxe	Equinoxe	7	196	2.2 (0.8, 5.9)					
Global Unite	Delta Xtend	4	122	3.6 (1.4, 9.5)					
RSP	RSP	2	130						
SMR	SMR L1	65	1494	3.4 (2.6, 4.5)	4.5 (3.5, 5.9)	6.3 (4.7, 8.5)	6.3 (4.7, 8.5)		
SMR	SMR L2	23	373	4.0 (2.5, 6.6)	5.1 (3.3, 7.9)	6.1 (4.0, 9.1)	6.5 (4.4, 9.7)		
Trabecular Metal	Trabecular Metal	23	468	4.0 (2.5, 6.3)	4.8 (3.2, 7.3)	5.3 (3.5, 8.0)			
Other (15)		2	70	1.5 (0.2, 10.3)	1.5 (0.2, 10.3)	1.5 (0.2, 10.3)	1.5 (0.2, 10.3)	8.1 (1.6, 35.3)	
TOTAL		**228**	**5982**						

Note: Only combinations with over 25 procedures have been listed

Table ST62 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	11 Yrs
Aequalis	Aequalis	8	149	2.8 (1.1, 7.3)	5.3 (2.6, 10.9)	5.3 (2.6, 10.9)			
Affinis	Affinis	0	25	0.0 (0.0, 0.0)					
Delta Xtend	Delta Xtend	8	356	1.7 (0.8, 3.8)	2.0 (1.0, 4.2)	2.5 (1.3, 5.1)			
RSP	RSP	3	170	1.2 (0.3, 4.9)					
SMR	SMR L1	4	33	10.0 (3.3, 28.0)	14.1 (5.5, 33.6)	14.1 (5.5, 33.6)			
Trabecular Metal	Trabecular Metal	1	33	3.0 (0.4, 19.6)	3.0 (0.4, 19.6)	3.0 (0.4, 19.6)			
Other (8)		2	54	0.0 (0.0, 0.0)	6.4 (1.6, 23.2)	6.4 (1.6, 23.2)			
TOTAL		**26**	**820**						

Note: Only combinations with over 25 procedures have been listed

OUTCOME FOR FRACTURE

Age and Gender

For the diagnosis of fracture, patients aged 55 to 74 years have a higher rate of revision compared to patients aged 75 years or older (Table ST63 and Figure ST41).

Males have a higher rate of revision than females in the first three months (Table ST64 and Figure ST42). The higher rate of revision for males is due to an increased incidence of instability/dislocation (Figure ST43).

Fixation

Cementless fixation has a higher rate of revision when used for the treatment of fracture compared to hybrid (humerus cemented) fixation (Table ST65 and Figure ST44). A similar result was observed when the SMR L2 prosthesis was excluded (Table ST66 and Figure ST45).

Cementless fixation has a higher rate of revision than hybrid (humerus cemented) fixation for fracture.

Glenosphere Size

Glenosphere size is not a risk factor for revision when undertaken for fracture (Table ST67, Figures ST46 and ST47).

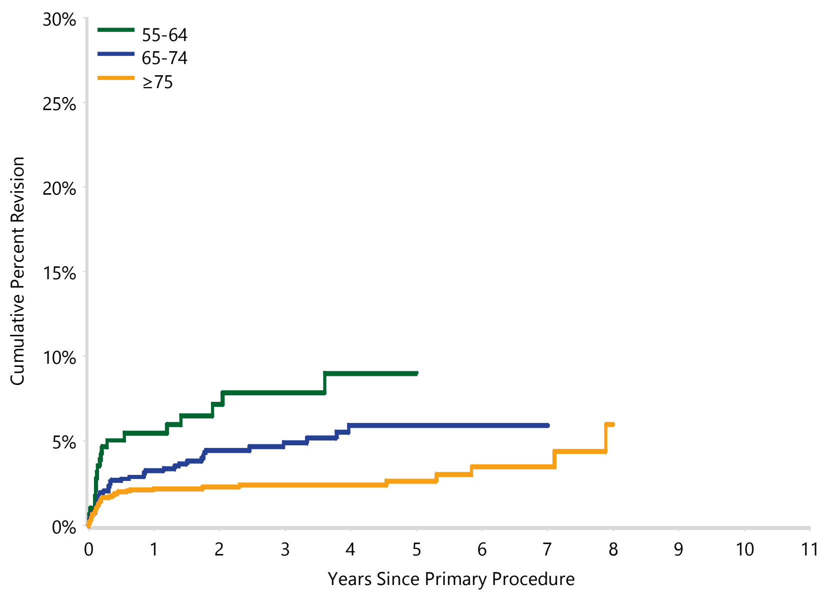
Glenosphere size is not a risk factor for revision when undertaken for fracture.

The outcomes of the most commonly used prosthesis combinations used in total reverse shoulder replacement for fracture are listed in Table ST68. The Cementless prosthesis combinations are listed Table ST69. The hybrid (humerus cemented) prosthesis combinations are listed in Table ST70.

Table ST63 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	11 Yrs
<55	3	33	6.3 (1.6, 22.8)	6.3 (1.6, 22.8)				
55-64	20	291	5.5 (3.3, 8.9)	7.9 (5.0, 12.2)	9.0 (5.7, 14.2)			
65-74	46	1051	3.3 (2.3, 4.6)	4.9 (3.6, 6.7)	5.9 (4.3, 8.1)	5.9 (4.3, 8.1)		
≥75	42	1674	2.2 (1.6, 3.0)	2.4 (1.7, 3.3)	2.7 (1.9, 3.7)	3.5 (2.3, 5.3)		
TOTAL	**111**	**3049**						

Figure ST41 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=2.54 (1.49, 4.35),p<0.001

65-74 vs ≥75

Entire Period: HR=1.69 (1.11, 2.56),p=0.014

55-64 vs 65-74

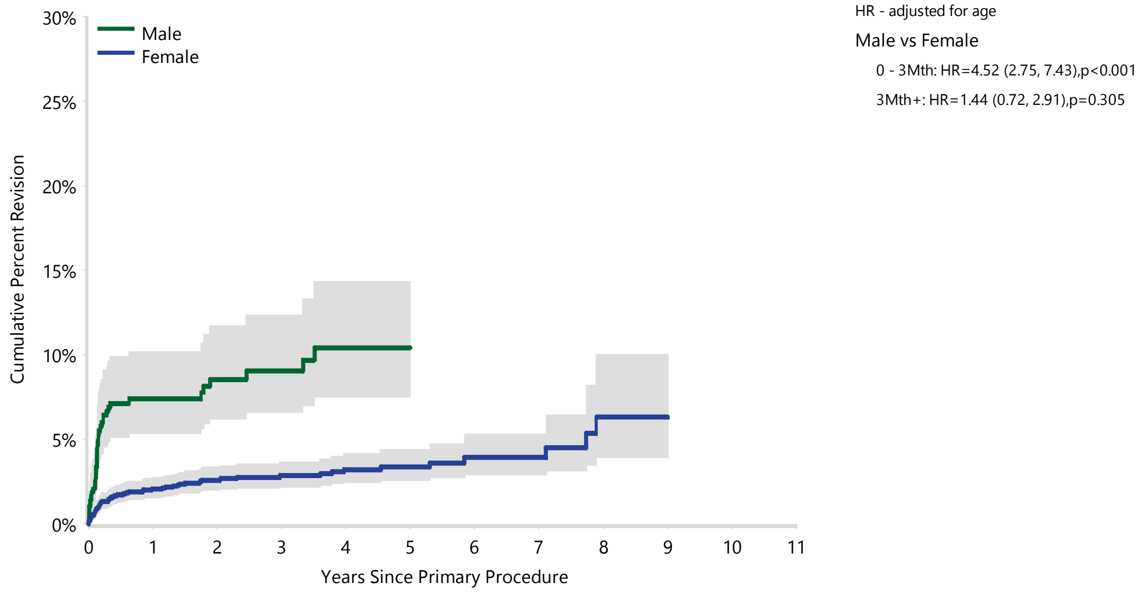
Entire Period: HR=1.51 (0.89, 2.55),p=0.124

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
55-64	291	194	100	60	28	2	0
65-74	1051	756	386	168	61	8	1
≥75	1674	1296	702	319	112	10	1

Table ST64 **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	11 Yrs
Male	40	484	7.4 (5.3, 10.2)	9.0 (6.6, 12.4)	10.4 (7.5, 14.3)			
Female	71	2565	2.1 (1.6, 2.7)	2.8 (2.2, 3.6)	3.4 (2.6, 4.4)	3.9 (2.9, 5.3)		
TOTAL	**111**	**3049**						

Figure ST42 **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	11 Yrs
Male	484	318	157	70	22	3	0
Female	2565	1948	1041	480	181	17	2

Figure ST43 **Cumulative Incidence Revision Diagnosis of Total Reverse Shoulder by Gender (Primary Diagnosis Fracture)**

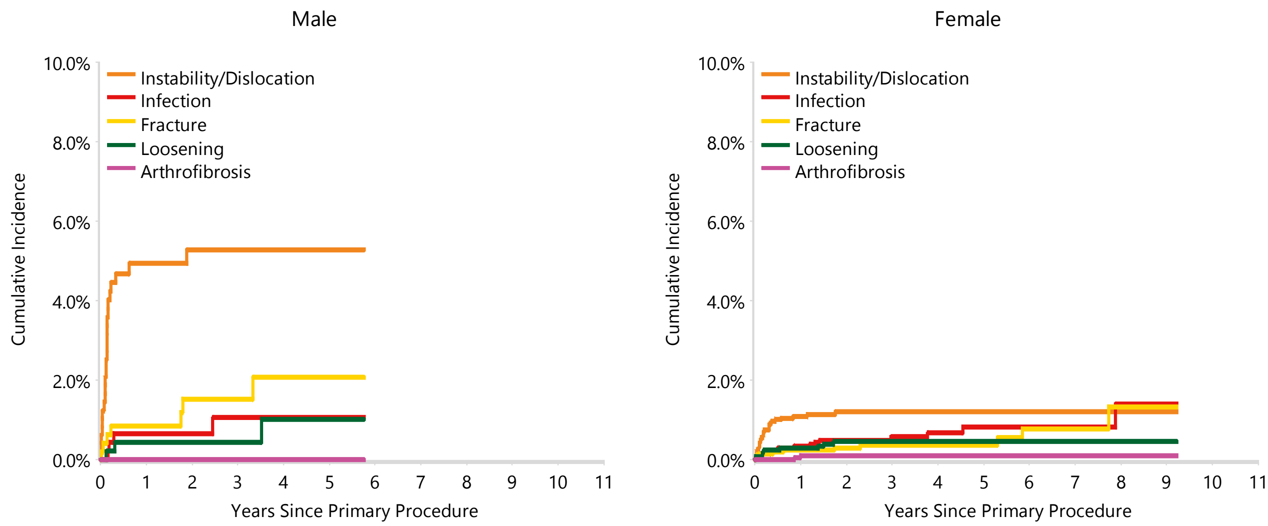
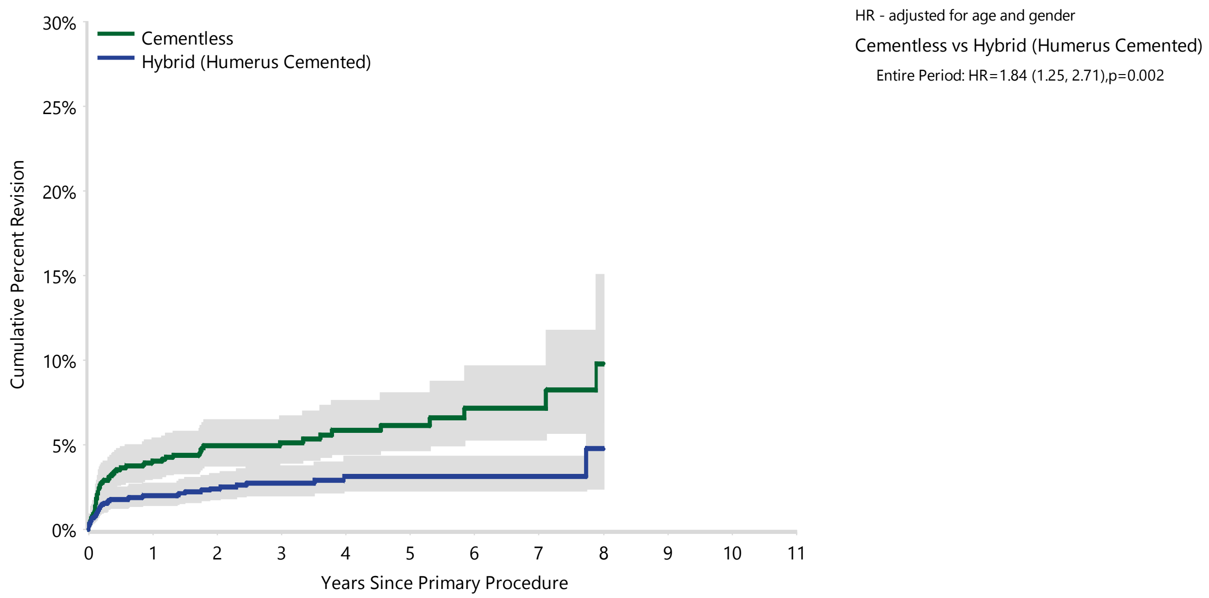


Table ST65 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Fixation (Primary Diagnosis Fracture)

Fixation	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
Cemented	4	46	9.3 (3.6, 22.9)	9.3 (3.6, 22.9)	9.3 (3.6, 22.9)			
Cementless	61	1170	4.1 (3.0, 5.4)	5.1 (3.9, 6.7)	6.2 (4.7, 8.1)	7.2 (5.3, 9.7)		
Hybrid (Glenoid Cemented)	1	31	3.7 (0.5, 23.5)	3.7 (0.5, 23.5)				
Hybrid (Humerus Cemented)	45	1802	2.0 (1.4, 2.8)	2.8 (2.0, 3.7)	3.2 (2.3, 4.3)	3.2 (2.3, 4.3)		
TOTAL	**111**	**3049**						

Figure ST44 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Fixation (Primary Diagnosis Fracture)

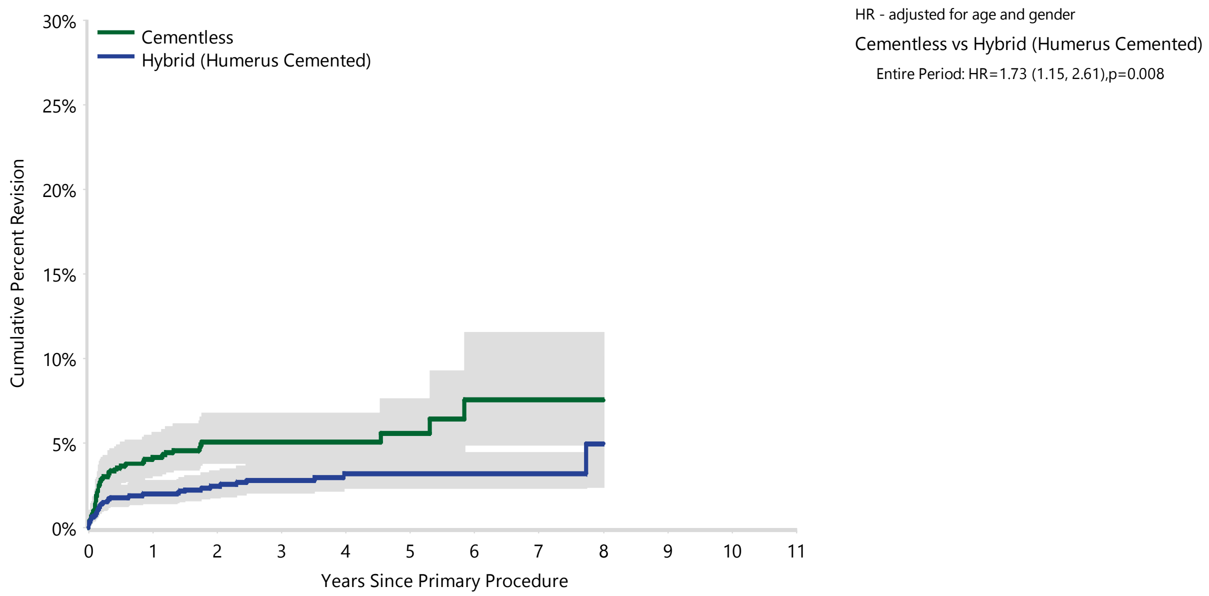


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
Cementless	1170	883	499	255	94	12	1
Hybrid (Humerus Cemented)	1802	1335	676	279	102	7	1

Table ST66 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	11 Yrs
Cemented	4	44	9.7 (3.8, 23.9)	9.7 (3.8, 23.9)	9.7 (3.8, 23.9)			
Cementless	49	1022	4.2 (3.1, 5.6)	5.1 (3.8, 6.8)	5.6 (4.1, 7.6)	7.6 (4.9, 11.5)		
Hybrid (Glenoid Cemented)	1	31	3.7 (0.5, 23.5)	3.7 (0.5, 23.5)				
Hybrid (Humerus Cemented)	44	1754	2.0 (1.4, 2.8)	2.8 (2.0, 3.8)	3.2 (2.3, 4.5)	3.2 (2.3, 4.5)		
TOTAL	**98**	**2851**						

Figure ST45 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Fixation (Primary Diagnosis Fracture, Excluding SMR L2)



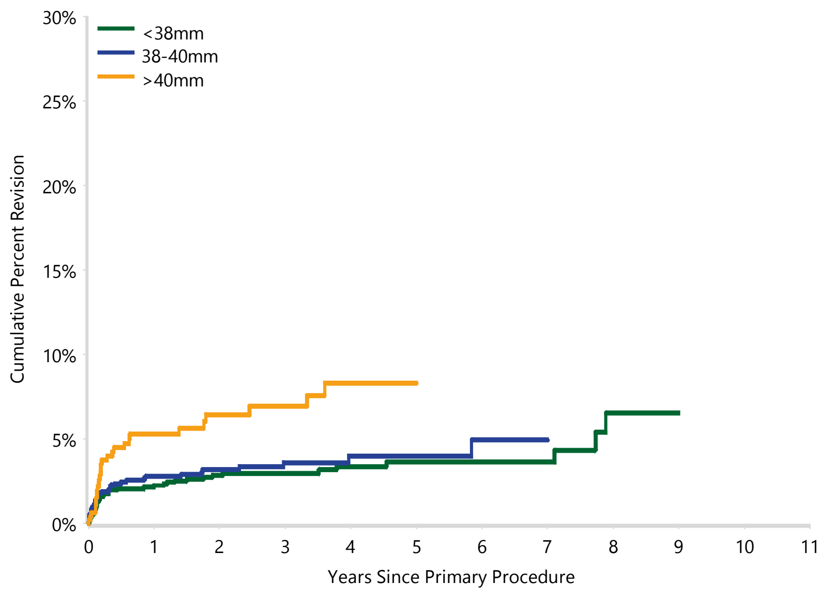
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
Cementless	1022	742	371	145	64	12	1
Hybrid (Humerus Cemented)	1754	1293	637	248	91	7	1

Table ST67 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Glenosphere Size (Primary Diagnosis Fracture)

Head Size	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
<38mm	43	1390	2.3 (1.6, 3.2)	3.0 (2.2, 4.1)	3.6 (2.6, 5.1)	3.6 (2.6, 5.1)		
38-40mm	38	1180	2.8 (2.0, 3.9)	3.6 (2.6, 5.0)	4.0 (2.8, 5.7)	4.9 (3.1, 7.9)		
>40mm	30	473	5.3 (3.5, 7.9)	6.9 (4.7, 10.1)	8.3 (5.6, 12.2)			
TOTAL	**111**	**3043**						

Note: Excludes six procedures with unknown glenosphere size

Figure ST46 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=1.16 (0.75, 1.80),p=0.500

>40mm vs <38mm

Entire Period: HR=1.62 (1.00, 2.65),p=0.051

>40mm vs 38-40mm

0 - 1Mth: HR=0.48 (0.14, 1.67),p=0.249

1Mth - 3Mth: HR=1.96 (0.97, 3.99),p=0.061

3Mth+: HR=1.58 (0.79, 3.19),p=0.199

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
<38mm	1390	1085	623	316	143	14	2
38-40mm	1180	868	411	162	50	3	0
>40mm	473	307	160	71	10	3	0

Figure ST47 **Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement by Glenosphere Size (Primary Diagnosis Fracture)**

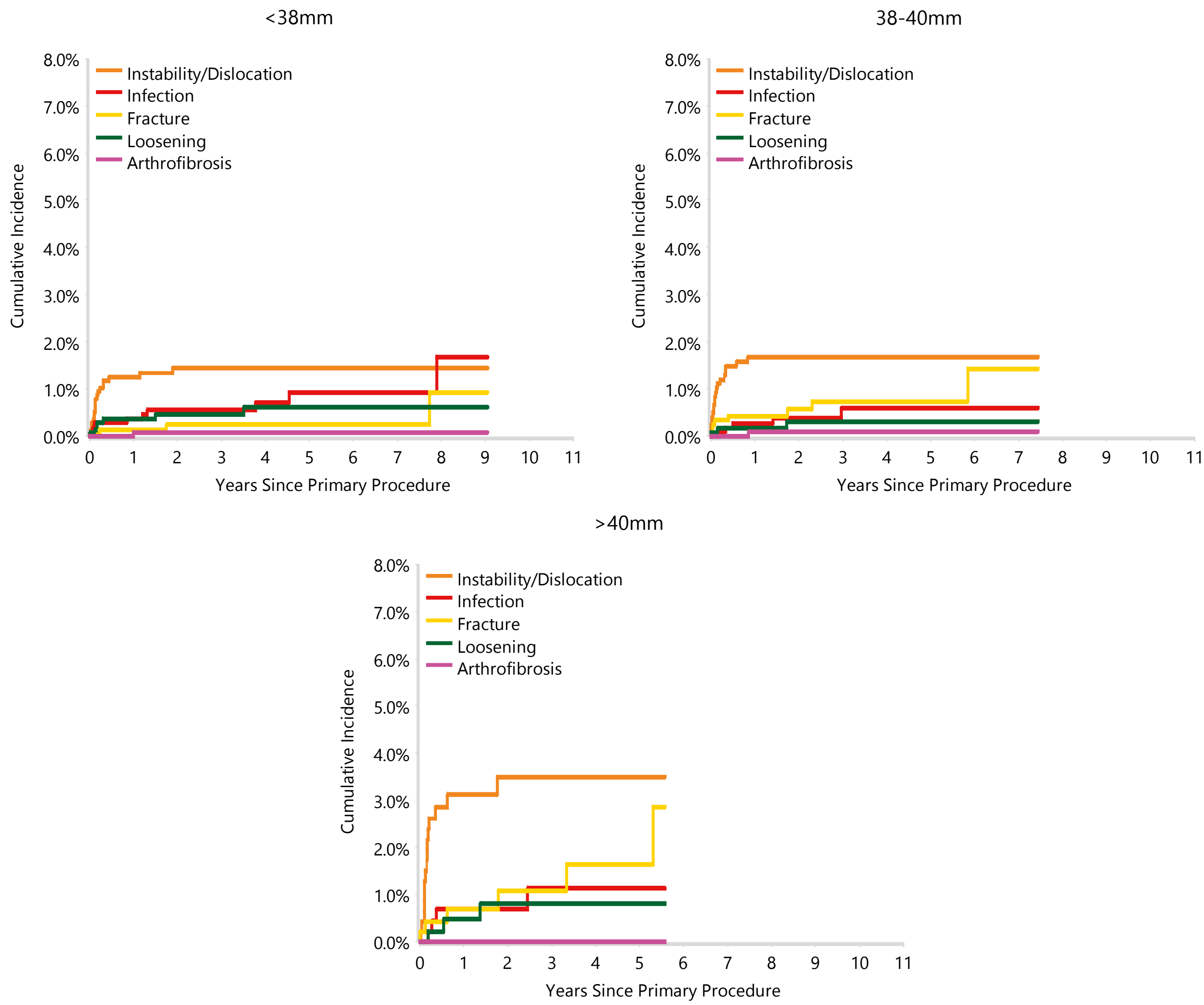


Table ST68 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Prosthesis Combination (Primary Diagnosis Fracture)

Humeral Stem	Glenoid Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	11 Yrs
Aequalis	Aequalis	13	490	1.9 (1.0, 3.7)	2.3 (1.2, 4.3)	3.9 (1.9, 7.6)			
Affinis	Affinis	3	84	2.6 (0.6, 10.0)					
Comprehensive	Comprehensive Reverse	1	130	0.9 (0.1, 6.0)					
Delta Xtend	Delta Xtend	30	859	2.9 (1.9, 4.3)	3.7 (2.5, 5.3)	4.0 (2.7, 5.9)	5.0 (3.1, 8.0)		
Equinoxe	Equinoxe	1	63	1.6 (0.2, 10.7)					
Global Unite	Delta Xtend	1	66	1.6 (0.2, 10.9)	1.6 (0.2, 10.9)				
RSP	RSP	5	101	2.0 (0.5, 7.9)					
SMR	SMR L1	42	812	4.7 (3.4, 6.5)	5.6 (4.2, 7.6)	5.6 (4.2, 7.6)	6.7 (4.5, 10.0)		
SMR	SMR L2	13	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	2	181	1.2 (0.3, 4.6)	1.2 (0.3, 4.6)				
Other (14)		0	65	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)				
TOTAL		**111**	**3049**						

Note: Only combinations with over 25 procedures have been listed

Table ST69 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	11 Yrs
Aequalis	Aequalis	2	37	2.7 (0.4, 17.7)	2.7 (0.4, 17.7)	10.2 (2.3, 39.5)			
Comprehensive	Comprehensive Reverse	1	25	4.5 (0.7, 28.1)					
Delta Xtend	Delta Xtend	4	147	1.4 (0.4, 5.5)	2.5 (0.8, 7.8)				
Global Unite	Delta Xtend	1	31	3.6 (0.5, 22.8)	3.6 (0.5, 22.8)				
SMR	SMR L1	40	695	5.2 (3.8, 7.2)	6.3 (4.6, 8.6)	6.3 (4.6, 8.6)	7.7 (5.0, 11.7)		
SMR	SMR L2	12	148	3.4 (1.4, 8.0)	4.9 (2.3, 9.9)	7.2 (3.9, 12.9)			
Trabecular Metal	Trabecular Metal	0	47	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)		
Other (10)		1	40	2.5 (0.4, 16.5)	2.5 (0.4, 16.5)				
TOTAL		**61**	**1170**						

Note: Only combinations with over 25 procedures have been listed

Table ST70 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	11 Yrs
Aequalis	Aequalis	11	447	1.9 (0.9, 3.7)	2.3 (1.2, 4.4)	3.0 (1.5, 5.8)			
Affinis	Affinis	3	80	2.7 (0.7, 10.4)					
Comprehensive	Comprehensive Reverse	0	96	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)				
Delta Xtend	Delta Xtend	23	693	2.8 (1.8, 4.4)	3.6 (2.3, 5.4)	4.0 (2.6, 6.2)	4.0 (2.6, 6.2)		
Equinoxe	Equinoxe	0	45	0.0 (0.0, 0.0)					
Global Unite	Delta Xtend	0	32	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)				
RSP	RSP	4	85	1.2 (0.2, 8.3)	9.3 (3.4, 23.9)				
SMR	SMR L1	1	109	1.0 (0.1, 6.7)	1.0 (0.1, 6.7)				
SMR	SMR L2	1	48	2.1 (0.3, 13.9)	2.1 (0.3, 13.9)	2.1 (0.3, 13.9)	2.1 (0.3, 13.9)		
Trabecular Metal	Trabecular Metal	2	123	1.7 (0.4, 6.8)	1.7 (0.4, 6.8)				
Other (11)		0	44	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)			
TOTAL		**45**	**1802**						

Note: Only combinations with over 25 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, 16 independent arthroplasty specialists together with the Chairperson of the AOANJRR Committee, AOANJRR Director, one Deputy Director, 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 the AOANJRR Director, 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-2018.

PRIMARY PARTIAL HIP REPLACEMENT

UNIPOLAR MODULAR

There are no newly identified unipolar prosthesis.

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	406	2.46	Entire Period: HR=2.14 (1.15, 3.98),p=0.016

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	17 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
Identified and No Longer Used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Unipolar Head (JRI)/Furlong LOL	.	.	.	.	.	12	18	10	13	10	8	7	34	16	4	.

BIPOLAR

There are no newly identified bipolar hip prostheses.

Table IP4 Revision Rate of Individual Bipolar Hip Prostheses Identified as having a Higher than Anticipated Rate of Revision

Bipolar/Femoral Stem	N Revised	N Total	Obs. Years	Revisions/100 Obs. Yrs	Hazard Ratio, P Value
Re-Identified and Still Used	.	.	.	.	
Bipolar Head (Medacta)/Quadra-H	6	61	131	4.58	Entire Period: HR=3.82 (1.71, 8.53),p=0.001
**Synergy	9	55	374	2.41	Entire Period: HR=2.62 (1.35, 5.06),p=0.004
Identified and No Longer Used	.	.	.	.	
Tandem/Basis	14	114	480	2.92	Entire Period: HR=2.58 (1.52, 4.39),p<0.001
UHR/ABGII	20	177	935	2.14	Entire Period: HR=2.57 (1.65, 4.01),p<0.001
UHR/Omnifit (cless)	7	40	241	2.90	Entire Period: HR=3.19 (1.51, 6.72),p=0.002

Note: All components have been compared to all other bipolar hip components
** Femoral Stem Component

Table IP5 Cumulative Percent Revision of Individual Bipolar Hip Prostheses Identified as having a Higher than Anticipated Rate of Revision

CPR	1 Yr	3 Yrs	5 Yrs	10 Yrs	17 Yrs
Re-Identified and Still Used					
Bipolar Head (Medacta)/Quadra-H	8.6 (3.3, 21.5)	12.0 (5.0, 27.1)			
**Synergy	7.4 (2.8, 18.6)	9.6 (4.1, 21.7)	12.3 (5.6, 25.6)	18.3 (9.4, 34.0)	
Identified and No Longer Used					
Tandem/Basis	2.0 (0.5, 7.7)	12.3 (7.0, 21.3)			
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)	

Note: ** Femoral Stem Component

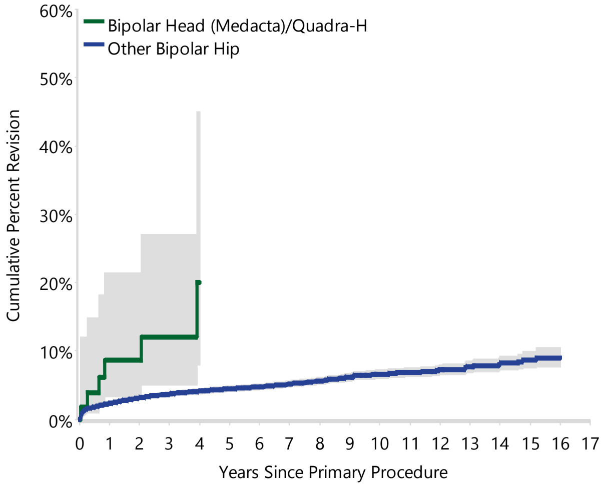
Table IP6 Yearly Usage of Individual Bipolar Hip Prostheses Identified as having a Higher than Anticipated Rate of Revision

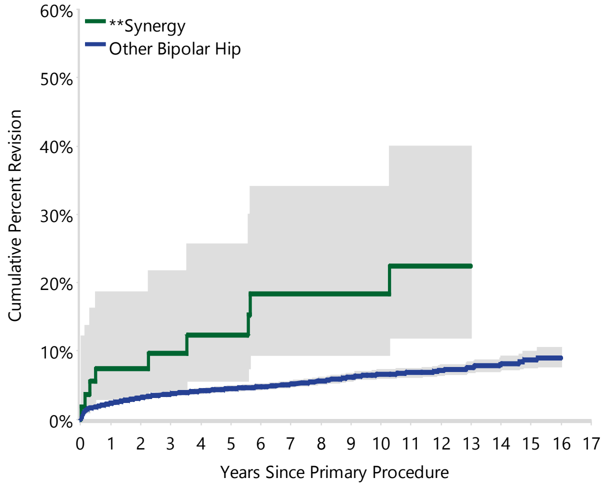
Year of Implant	≤2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Re-Identified and Still Used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bipolar Head (Medacta)/Quadra-H	.	.	.	.	.	.	.	10	7	5	6	3	11	8	7	4
**Synergy	12	13	9	10	3	2	1	1	.	1	.	2	.	.	.	1
Identified and No Longer Used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tandem/Basis	.	.	.	10	13	9	11	4	7	8	21	24	6	1	.	.
UHR/ABGII	25	25	36	34	10	15	20	7	5	.	.	.	.	.	.	.
UHR/Omnifit (cless)	11	10	7	5	4	1	2	.	.	.	.	.	.	.	.	.

Note: ** Femoral Stem Component

Figure IP1 Cumulative Percent Revision of Re-identified and still used Individual Bipolar Hip Prostheses

Re-identified and Still Used





PRIMARY TOTAL HIP REPLACEMENT

TOTAL CONVENTIONAL

Large head metal/metal bearings have been removed from the comparator group for all primary total conventional hip investigations.

The Metafix/Trinity, Taperloc Micropasty/Regenerex and HACTIV/Delta-TT (previously called Hyperion/Delta-TT) are no longer identified.

The Versafit DM acetabular component has been previously identified with the Quadra H femoral stem. This year only the acetabular component is identified. There have been 558 procedures implanted since 2011. The three year cumulative percent revision is 5.3%. The most common reasons for revision were fracture and infection. Of the 24 revisions there were 11 femoral only, six total hip replacements, and two acetabular only.

There are two primary total conventional hip combinations (MBA (exch neck)/ Pinnacle and Profemur TL/Dynasty) identified for the first time that are no longer used.

Table IP7 Revision Rate of Individual Total Conventional Hip Prostheses Identified as having a Higher than Anticipated Rate of Revision

Femoral Stem/Acetabular	N Revised	N Total	Obs. Years	Revisions/100 Obs. Yrs	Hazard Ratio, P Value
Newly Identified	.	.	.	.	
**Versafitcup DM	24	558	879	2.73	Entire Period: HR=2.24 (1.50, 3.35),p<0.001
Re-Identified and Still Used	.	.	.	.	
CPT/Fitmore	15	232	1062	1.41	Entire Period: HR=2.09 (1.26, 3.47),p=0.004
CPT/Low Profile Cup	11	139	735	1.50	Entire Period: HR=2.37 (1.31, 4.28),p=0.004
Corail/Trabecular Metal (Shell)	11	92	463	2.37	Entire Period: HR=3.57 (1.98, 6.43),p<0.001
Profemur L/Dynasty	37	1069	1890	1.96	Entire Period: HR=1.69 (1.23, 2.34),p=0.001
Taperloc/G7	24	1384	2173	1.10	0 - 2Wk: HR=2.32 (1.21, 4.47),p=0.011
	.	.	.	.	2Wk+: HR=0.65 (0.39, 1.08),p=0.099
Taperloc/Versafitcup CC	7	119	127	5.49	Entire Period: HR=3.36 (1.61, 7.04),p=0.001
*Apex	142	2467	14869	0.96	Entire Period: HR=1.48 (1.25, 1.74),p<0.001
*Emperion	44	507	2783	1.58	Entire Period: HR=2.31 (1.72, 3.11),p<0.001
*Excia (cless)	20	348	1311	1.53	Entire Period: HR=2.05 (1.32, 3.18),p=0.001
*Furlong Evolution	9	151	308	2.92	Entire Period: HR=2.87 (1.50, 5.52),p=0.001
*ML Taper Kinectiv	158	3457	17226	0.92	Entire Period: HR=1.36 (1.16, 1.59),p<0.001
*Novation	42	1085	3496	1.20	0 - 3Mth: HR=1.82 (1.19, 2.76),p=0.005
	.	.	.	.	3Mth+: HR=1.18 (0.76, 1.83),p=0.458
*Taper Fit	56	1219	4565	1.23	0 - 1Mth: HR=0.38 (0.12, 1.17),p=0.090
	.	.	.	.	1Mth - 6Mth: HR=0.92 (0.44, 1.93),p=0.824
	.	.	.	.	6Mth+: HR=2.46 (1.84, 3.28),p<0.001
*Trabecular Metal	110	1898	10280	1.07	0 - 1Mth: HR=2.61 (1.86, 3.66),p<0.001
	.	.	.	.	1Mth - 3Mth: HR=2.02 (1.26, 3.26),p=0.003
	.	.	.	.	3Mth+: HR=1.25 (0.97, 1.62),p=0.084
*UniSyn	49	466	3417	1.43	Entire Period: HR=2.31 (1.75, 3.06),p<0.001
**Continuum	386	10812	40201	0.96	0 - 3Mth: HR=1.68 (1.46, 1.94),p<0.001
	.	.	.	.	3Mth+: HR=0.99 (0.85, 1.14),p=0.853
**Delta-One-TT	8	109	319	2.50	Entire Period: HR=2.83 (1.41, 5.65),p=0.003
**Furlong	34	624	3162	1.08	0 - 3Mth: HR=2.17 (1.31, 3.61),p=0.002
	.	.	.	.	3Mth+: HR=1.31 (0.84, 2.06),p=0.238
**Procotyl L	56	1219	5440	1.03	Entire Period: HR=1.47 (1.13, 1.91),p=0.004
Identified and no longer used	.	.	.	.	
+MBA (exch neck)/Pinnacle	20	225	1406	1.42	Entire Period: HR=2.31 (1.49, 3.58),p<0.001

Femoral Stem/Acetabular	N Revised	N Total	Obs. Years	Revisions/100 Obs. Yrs	Hazard Ratio, P Value
Anatomic II/Duraloc Option	7	60	554	1.26	Entire Period: HR=2.17 (1.03, 4.54),p=0.040
Anca-Fit/Pinnacle	14	101	829	1.69	Entire Period: HR=2.94 (1.74, 4.97),p<0.001
F2L/Delta-PF	17	107	1022	1.66	Entire Period: HR=2.85 (1.77, 4.59),p<0.001
Friendly Hip/Cup (Exactech)	14	97	904	1.55	Entire Period: HR=2.71 (1.60, 4.58),p<0.001
H Moos/Mueller	9	19	141	6.37	Entire Period: HR=10.24 (5.33, 19.66),p<0.001
Secur-Fit Plus/Secur-Fit	25	197	2214	1.13	Entire Period: HR=1.91 (1.29, 2.83),p=0.001
Taperloc/M2a^{MoM}	65	515	5205	1.25	Entire Period: HR=2.13 (1.67, 2.71),p<0.001
*ABGII (exch neck)	75	246	1519	4.94	0 - 1Mth: HR=4.25 (2.03, 8.93),p<0.001
	.	.	.	.	1Mth - 2.5Yr: HR=3.67 (2.21, 6.09),p<0.001
	.	.	.	.	2.5Yr - 4Yr: HR=11.33 (6.56, 19.55),p<0.001
	.	.	.	.	4Yr - 4.5Yr: HR=33.19 (18.23, 60.43),p<0.001
	.	.	.	.	4.5Yr - 5Yr: HR=8.67 (2.79, 26.97),p<0.001
	.	.	.	.	5Yr - 6Yr: HR=27.67 (17.33, 44.17),p<0.001
	.	.	.	.	6Yr+: HR=7.20 (3.59, 14.40),p<0.001
*Adapter (cless)	131	744	5531	2.37	0 - 2Wk: HR=3.85 (1.92, 7.71),p<0.001
	.	.	.	.	2Wk - 1Mth: HR=1.70 (0.71, 4.08),p=0.237
	.	.	.	.	1Mth - 6Mth: HR=0.79 (0.30, 2.11),p=0.636
	.	.	.	.	6Mth - 3Yr: HR=3.72 (2.64, 5.24),p<0.001
	.	.	.	.	3Yr - 3.5Yr: HR=10.17 (5.74, 18.02),p<0.001
	.	.	.	.	3.5Yr+: HR=5.42 (4.27, 6.87),p<0.001
*Adapter (ctd)	31	148	1049	2.96	0 - 6Mth: HR=2.04 (0.77, 5.44),p=0.153
	.	.	.	.	6Mth+: HR=6.44 (4.41, 9.39),p<0.001
*BMHR VST	23	260	1710	1.35	Entire Period: HR=2.01 (1.33, 3.03),p<0.001
*CBH Stem	36	274	1824	1.97	Entire Period: HR=3.21 (2.32, 4.45),p<0.001
*Edinburgh	18	138	901	2.00	Entire Period: HR=3.39 (2.13, 5.37),p<0.001
*Elite Plus	245	2841	28851	0.85	0 - 1Mth: HR=0.27 (0.11, 0.64),p=0.003
	.	.	.	.	1Mth - 9Mth: HR=1.00 (0.67, 1.49),p=0.981
	.	.	.	.	9Mth+: HR=1.77 (1.55, 2.03),p<0.001
*K2	73	601	4083	1.79	Entire Period: HR=2.96 (2.35, 3.73),p<0.001
*LYDERIC II	15	164	1350	1.11	Entire Period: HR=1.92 (1.16, 3.19),p=0.011
*MSA	27	224	1278	2.11	Entire Period: HR=3.13 (2.15, 4.57),p<0.001
*Margron	109	688	7419	1.47	0 - 3Mth: HR=2.30 (1.45, 3.66),p<0.001
	.	.	.	.	3Mth - 6Mth: HR=5.38 (2.79, 10.37),p<0.001
	.	.	.	.	6Mth - 1Yr: HR=5.76 (3.34, 9.95),p<0.001
	.	.	.	.	1Yr - 1.5Yr: HR=2.13 (0.80, 5.67),p=0.132
	.	.	.	.	1.5Yr - 2Yr: HR=2.72 (1.02, 7.27),p=0.045
	.	.	.	.	2Yr - 5.5Yr: HR=3.23 (2.20, 4.75),p<0.001
	.	.	.	.	5.5Yr - 7Yr: HR=4.93 (3.01, 8.08),p<0.001
	.	.	.	.	7Yr+: HR=1.07 (0.68, 1.67),p=0.782
*Mayo	16	168	1554	1.03	Entire Period: HR=1.78 (1.09, 2.90),p=0.021
*Metha (exch neck)	14	88	564	2.48	Entire Period: HR=3.92 (2.32, 6.62),p<0.001
*Profemur Z	26	186	1735	1.50	Entire Period: HR=2.56 (1.74, 3.76),p<0.001
**2000 Plus	16	135	1048	1.53	Entire Period: HR=2.60 (1.59, 4.25),p<0.001
**ASR	1878	4421	32924	5.70	0 - 2Wk: HR=1.25 (0.77, 2.05),p=0.367
	.	.	.	.	2Wk - 1Mth: HR=0.22 (0.08, 0.59),p=0.002
	.	.	.	.	1Mth - 9Mth: HR=1.06 (0.78, 1.43),p=0.714
	.	.	.	.	9Mth - 1.5Yr: HR=3.52 (2.77, 4.48),p<0.001
	.	.	.	.	1.5Yr - 2Yr: HR=6.43 (4.98, 8.31),p<0.001
	.	.	.	.	2Yr - 2.5Yr: HR=11.44 (9.28, 14.10),p<0.001
	.	.	.	.	2.5Yr - 3Yr: HR=14.87 (12.20, 18.13),p<0.001

Femoral Stem/Acetabular	N Revised	N Total	Obs. Years	Revisions/100 Obs. Yrs	Hazard Ratio, P Value
	.	.	.	.	3Yr - 5Yr: HR=24.04 (21.93, 26.36),p<0.001
	.	.	.	.	5Yr - 6Yr: HR=26.39 (23.12, 30.12),p<0.001
	.	.	.	.	6Yr - 7Yr: HR=17.56 (14.89, 20.71),p<0.001
	.	.	.	.	7Yr - 8.5Yr: HR=13.27 (11.33, 15.54),p<0.001
	.	.	.	.	8.5Yr+: HR=6.58 (5.57, 7.76),p<0.001
**Adept	18	121	942	1.91	Entire Period: HR=3.09 (1.95, 4.90),p<0.001
**Artek	63	179	2126	2.96	0 - 1Yr: HR=1.57 (0.65, 3.78),p=0.311
	.	.	.	.	1Yr - 1.5Yr: HR=3.86 (0.96, 15.44),p=0.056
	.	.	.	.	1.5Yr - 3.5Yr: HR=6.39 (3.32, 12.29),p<0.001
	.	.	.	.	3.5Yr - 4Yr: HR=17.81 (7.37, 43.01),p<0.001
	.	.	.	.	4Yr - 4.5Yr: HR=3.57 (0.50, 25.42),p=0.203
	.	.	.	.	4.5Yr - 6Yr: HR=13.94 (7.89, 24.61),p<0.001
	.	.	.	.	6Yr+: HR=4.41 (3.06, 6.36),p<0.001
**BHR	393	2987	26048	1.51	0 - 2Wk: HR=0.81 (0.38, 1.70),p=0.571
	.	.	.	.	2Wk - 1Mth: HR=0.16 (0.04, 0.65),p=0.010
	.	.	.	.	1Mth - 1.5Yr: HR=0.92 (0.66, 1.27),p=0.596
	.	.	.	.	1.5Yr+: HR=3.68 (3.30, 4.10),p<0.001
**Bionik	134	608	4620	2.90	0 - 3Mth: HR=1.62 (0.90, 2.93),p=0.108
	.	.	.	.	3Mth - 3Yr: HR=4.03 (2.89, 5.62),p<0.001
	.	.	.	.	3Yr - 3.5Yr: HR=11.45 (6.30, 20.82),p<0.001
	.	.	.	.	3.5Yr - 4Yr: HR=7.98 (3.78, 16.83),p<0.001
	.	.	.	.	4Yr - 5Yr: HR=11.35 (7.28, 17.68),p<0.001
	.	.	.	.	5Yr+: HR=6.04 (4.57, 7.99),p<0.001
**Cormet	108	803	7098	1.52	0 - 1.5Yr: HR=1.09 (0.69, 1.74),p=0.704
	.	.	.	.	1.5Yr - 2Yr: HR=0.54 (0.08, 3.85),p=0.539
	.	.	.	.	2Yr+: HR=3.71 (3.01, 4.58),p<0.001
**DeltaLox	22	222	1140	1.93	Entire Period: HR=2.95 (1.94, 4.49),p<0.001
**Duraloc	536	5354	54987	0.97	0 - 3Mth: HR=0.82 (0.62, 1.09),p=0.179
	.	.	.	.	3Mth - 2.5Yr: HR=1.37 (1.11, 1.68),p=0.002
	.	.	.	.	2.5Yr - 3Yr: HR=1.80 (1.11, 2.92),p=0.016
	.	.	.	.	3Yr - 5.5Yr: HR=1.48 (1.15, 1.90),p=0.002
	.	.	.	.	5.5Yr+: HR=2.38 (2.12, 2.67),p<0.001
**Durom	169	1245	11720	1.44	0 - 1.5Yr: HR=0.74 (0.47, 1.15),p=0.181
	.	.	.	.	1.5Yr+: HR=3.41 (2.90, 4.00),p<0.001
**ExpanSys	12	71	680	1.76	Entire Period: HR=3.07 (1.74, 5.40),p<0.001
**Fin II	120	2025	13412	0.89	Entire Period: HR=1.46 (1.22, 1.75),p<0.001
**Hedrocel	11	46	512	2.15	Entire Period: HR=3.58 (1.99, 6.45),p<0.001
**Icon	85	401	3161	2.69	0 - 2.5Yr: HR=2.47 (1.65, 3.68),p<0.001
	.	.	.	.	2.5Yr+: HR=6.39 (4.97, 8.23),p<0.001
**Inter-Op	9	33	343	2.63	Entire Period: HR=4.47 (2.32, 8.58),p<0.001
**MBA	17	124	1040	1.63	Entire Period: HR=2.82 (1.75, 4.53),p<0.001
**Mitch TRH	98	731	5985	1.64	0 - 3Mth: HR=0.59 (0.25, 1.43),p=0.244
	.	.	.	.	3Mth+: HR=3.44 (2.81, 4.22),p<0.001
**Plasmacup	31	482	2588	1.20	Entire Period: HR=1.80 (1.26, 2.55),p=0.001
**SPH-Blind	115	952	10823	1.06	0 - 1Mth: HR=2.48 (1.52, 4.04),p<0.001
	.	.	.	.	1Mth+: HR=1.72 (1.41, 2.10),p<0.001
**seleXys (excluding seleXys PC)	45	391	2347	1.92	Entire Period: HR=3.01 (2.24, 4.03),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 Individual Total Conventional Hip Prostheses Identified as having a Higher than Anticipated Rate of Revision

CPR	1 Yr	3 Yrs	5 Yrs	10 Yrs	17 Yrs
Newly Identified					
**Versafitcup DM	4.4 (2.9, 6.6)	5.3 (3.5, 8.1)			
Re-Identified and Still Used					
CPT/Fitmore	4.0 (2.1, 7.5)	5.1 (2.9, 9.1)	6.3 (3.5, 11.2)		
CPT/Low Profile Cup	4.4 (2.0, 9.5)	6.0 (3.0, 11.6)	8.9 (5.0, 15.5)		
Corail/Trabecular Metal (Shell)	6.6 (3.0, 14.0)	10.4 (5.6, 19.2)	13.3 (7.5, 22.8)		
Profemur L/Dynasty	3.4 (2.5, 4.8)	4.2 (3.0, 6.0)			
Taperloc/G7	1.8 (1.2, 2.7)	2.0 (1.3, 3.0)			
Taperloc/Versafitcup CC	5.9 (2.9, 12.0)				
*Apex	2.3 (1.7, 2.9)	3.3 (2.7, 4.1)	4.9 (4.0, 5.9)	7.8 (6.5, 9.4)	
*Emperion	4.8 (3.2, 7.0)	5.9 (4.1, 8.4)	7.3 (5.2, 10.1)		
*Excia (cless)	4.2 (2.5, 6.9)	5.7 (3.6, 9.0)	6.3 (4.0, 9.8)		
*Furlong Evolution	4.1 (1.9, 9.0)	7.4 (3.8, 14.0)			
*ML Taper Kinectiv	2.4 (1.9, 2.9)	3.6 (3.0, 4.3)	4.5 (3.9, 5.3)		
*Novation	3.0 (2.1, 4.2)	4.0 (2.9, 5.4)	4.3 (3.1, 5.9)		
*Taper Fit	1.4 (0.8, 2.2)	2.8 (1.9, 4.2)	6.0 (4.2, 8.4)	12.2 (9.0, 16.4)	
*Trabecular Metal	3.4 (2.7, 4.4)	4.8 (3.9, 5.9)	5.5 (4.5, 6.6)	8.2 (6.2, 10.9)	
*UniSyn	3.2 (2.0, 5.3)	5.8 (4.0, 8.4)	6.6 (4.6, 9.4)	12.9 (9.6, 17.2)	
**Continuum	2.5 (2.2, 2.8)	3.4 (3.1, 3.8)	4.0 (3.6, 4.5)		
**Delta-One-TT	3.7 (1.4, 9.6)	7.2 (3.5, 14.6)			
**Furlong	3.5 (2.3, 5.3)	5.3 (3.7, 7.4)	5.6 (3.9, 7.8)		
**Procotyl L	3.2 (2.3, 4.3)	4.4 (3.3, 5.8)	4.9 (3.8, 6.4)		
Identified and no longer used					
+MBA (exch neck)/Pinnacle	2.2 (0.9, 5.3)	3.6 (1.8, 7.1)	7.3 (4.5, 11.9)		
+Profemur TL/Dynasty	3.6 (0.9, 13.5)	5.4 (1.8, 15.7)	7.1 (2.7, 17.9)		
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)	14.8 (9.0, 23.8)	
F2L/Delta-PF	5.6 (2.6, 12.1)	10.3 (5.9, 17.9)	12.3 (7.3, 20.2)	15.5 (9.8, 24.0)	
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)	
H Moos/Mueller	5.6 (0.8, 33.4)	33.3 (16.6, 59.6)	38.9 (20.8, 64.7)	46.5 (26.2, 72.4)	
Secur-Fit Plus/Secur-Fit	3.1 (1.4, 6.7)	7.3 (4.4, 11.9)	7.8 (4.8, 12.6)	10.1 (6.5, 15.3)	
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, 15.8)	
*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, 22.9)	
*Adapter (ctd)	4.1 (1.9, 8.9)	9.1 (5.4, 15.2)	17.0 (11.6, 24.5)	23.8 (17.1, 32.4)	
*BMHR VST	1.9 (0.8, 4.6)	4.6 (2.7, 8.0)	7.1 (4.5, 11.0)		
*CBH Stem	4.0 (2.3, 7.2)	7.4 (4.9, 11.3)	9.9 (6.8, 14.2)		
*Edinburgh	6.0 (3.1, 11.7)	9.6 (5.6, 16.4)	12.5 (7.7, 20.0)		
*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)	13.2 (11.5, 15.2)
*K2	5.2 (3.7, 7.3)	7.5 (5.7, 10.0)	9.8 (7.7, 12.6)		
*LYDERIC II	3.1 (1.3, 7.2)	5.7 (3.0, 10.6)	7.1 (4.0, 12.5)	12.2 (7.2, 20.2)	
*MSA	5.8 (3.4, 9.8)	9.5 (6.3, 14.1)	11.3 (7.8, 16.3)		
*Margron	5.8 (4.3, 7.9)	8.4 (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)	8.8 (5.3, 14.4)	
*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 (6.7, 15.8)	10.9 (7.2, 16.4)	12.2 (8.2, 18.0)	
**2000 Plus	3.0 (1.1, 7.8)	6.8 (3.6, 12.7)	9.2 (5.3, 15.7)	13.5 (8.4, 21.3)	
**ASR	1.9 (1.5, 2.3)	9.6 (8.8, 10.5)	24.4 (23.1, 25.7)	44.9 (43.3, 46.4)	
**Adept	4.1 (1.7, 9.6)	8.4 (4.6, 15.0)	9.3 (5.3, 16.2)		

CPR	1 Yr	3 Yrs	5 Yrs	10 Yrs	17 Yrs
**Artek	2.8 (1.2, 6.7)	8.0 (4.8, 13.1)	15.5 (10.9, 21.8)	24.5 (18.7, 31.7)	
**BHR	1.1 (0.8, 1.6)	3.2 (2.6, 3.9)	6.1 (5.3, 7.0)	14.2 (12.9, 15.7)	
**Bionik	3.6 (2.4, 5.5)	7.7 (5.8, 10.2)	14.5 (11.9, 17.6)	23.6 (20.2, 27.5)	
**Cormet	1.5 (0.9, 2.6)	3.5 (2.4, 5.0)	5.2 (3.8, 7.0)	14.8 (12.2, 18.0)	
**DeltaLox	5.9 (3.5, 9.9)	8.7 (5.6, 13.2)	9.7 (6.4, 14.4)		
**Duraloc	1.8 (1.5, 2.2)	3.0 (2.6, 3.5)	4.1 (3.6, 4.6)	8.5 (7.7, 9.3)	16.9 (15.1, 18.8)
**Durom	1.1 (0.7, 1.9)	3.6 (2.7, 4.8)	5.5 (4.3, 6.9)	13.3 (11.4, 15.4)	
**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)	
**Fin II	2.7 (2.1, 3.5)	3.6 (2.9, 4.5)	4.8 (3.9, 5.9)	7.6 (6.3, 9.2)	
**Hedrocel	4.3 (1.1, 16.3)	6.6 (2.2, 19.2)	6.6 (2.2, 19.2)	20.4 (10.7, 37.0)	
**Icon	3.0 (1.7, 5.3)	7.8 (5.5, 10.9)	12.7 (9.7, 16.4)	23.6 (19.3, 28.8)	
**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)	15.1 (12.4, 18.3)	
**Plasmacup	4.4 (2.9, 6.6)	5.6 (3.9, 8.1)	5.9 (4.1, 8.5)		
**SPH-Blind	3.8 (2.8, 5.2)	5.8 (4.5, 7.5)	7.3 (5.8, 9.2)	10.3 (8.5, 12.4)	
**seleXys (excluding seleXys PC)	4.6 (2.9, 7.2)	7.8 (5.5, 11.0)	10.7 (7.9, 14.3)	12.8 (9.5, 17.0)	

Note: * Femoral Component,
**Acetabular Component
+ Newly identified and no longer used

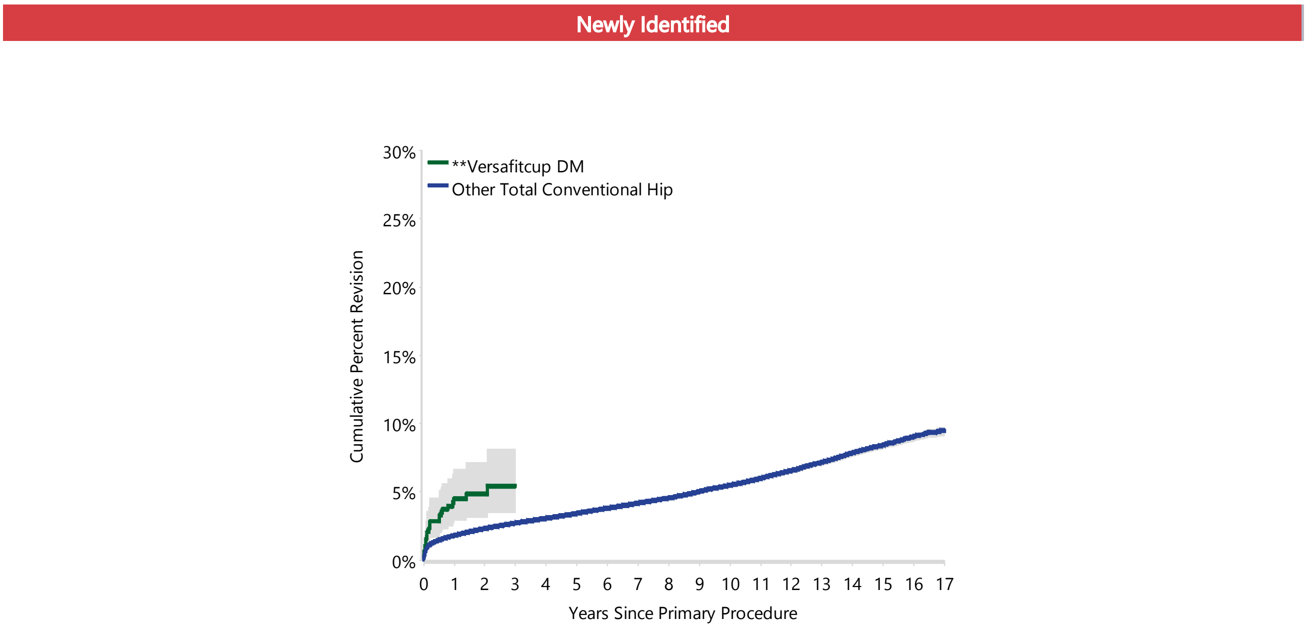
Table IP9 Yearly Usage of Individual Total Conventional Hip Prostheses Identified as having a Higher than Anticipated Rate of Revision

Year of Implant	≤2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Newly Identified	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
**Versafitcup DM	.	.	.	.	.	.	.	.	.	10	12	4	19	139	183	191
Re-Identified and Still Used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
CPT/Fitmore	.	.	19	6	6	4	16	12	15	24	14	30	30	22	18	16
CPT/Low Profile Cup	.	.	15	9	8	7	7	6	9	16	26	20	6	5	2	3
Corail/Trabecular Metal (Shell)	.	.	.	.	.	5	10	17	21	8	8	8	6	1	6	2
Profemur L/Dynasty	.	.	.	.	.	.	.	.	.	.	.	23	172	282	300	292
Taperloc/G7	.	.	.	.	.	.	.	.	.	.	.	19	147	334	414	470
Taperloc/Versafitcup CC	.	.	.	.	.	.	.	.	.	.	2	.	.	.	73	44
*Apex	.	.	.	75	247	223	265	197	169	190	219	246	188	193	168	87
*Emperion	.	.	.	1	13	21	26	65	87	72	44	53	38	41	34	12
*Excia (cless)	.	.	.	.	.	.	6	34	8	47	58	38	17	42	35	63
*Furlong Evolution	.	.	.	.	.	.	.	.	.	.	.	29	25	32	11	54
*ML Taper Kinectiv	.	.	.	.	.	.	36	341	647	576	515	384	345	256	199	158
*Novation	.	.	.	.	.	.	.	4	32	53	130	137	226	266	148	89
*Taper Fit	30	34	65	50	66	26	18	6	8	17	55	45	110	161	227	301
*Trabecular Metal	.	.	.	.	6	101	147	198	242	272	276	186	220	112	106	32
*UniSyn	1	14	41	74	33	37	46	48	36	22	19	23	27	23	17	5
**Continuum	.	.	.	.	.	.	.	175	1117	1245	1333	1502	1492	1359	1318	1271
**Delta-One-TT	.	.	.	.	.	.	.	.	4	7	7	15	37	13	12	14
**Furlong	27	4	.	.	.	4	7	61	90	85	73	76	64	66	12	55
**Procotyl L	.	.	.	.	.	.	8	32	268	342	67	26	121	104	110	141
Identified and no longer used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
+MBA (exch neck)/Pinnacle	.	.	.	.	.	24	45	9	43	46	14	44	.	.	.	.
+Profemur TL/Dynasty	.	.	.	.	.	.	.	.	.	29	27	.	.	.	.	.
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	.	.	.	.	.	.	.	.
H Moos/Mueller	19	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Secur-Fit Plus/Secur-Fit	101	27	21	26	22	.	.	.	.	.	.	.	.	.	.	.
Taperloc/M2a^{MoM}	18	79	113	74	38	43	76	49	23	2	.	.	.	.	.	.
*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	.	.	.	.	.	.
*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	.	.	.
*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	.	.	.	.	.	.	.
**2000 Plus	.	.	.	11	23	42	14	18	25	2	.	.	.	.	.	.
**ASR	.	.	84	584	958	1185	1180	430	.	.	.	.	.	.	.	.
**Adept	.	.	.	.	19	20	29	30	11	12	.	.	.	.	.	.

Year of Implant	≤2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
**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	.	.	.	.	.	.	.	.	.
**Fin II	.	.	.	39	128	175	251	269	318	286	205	247	101	6	.	.
**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

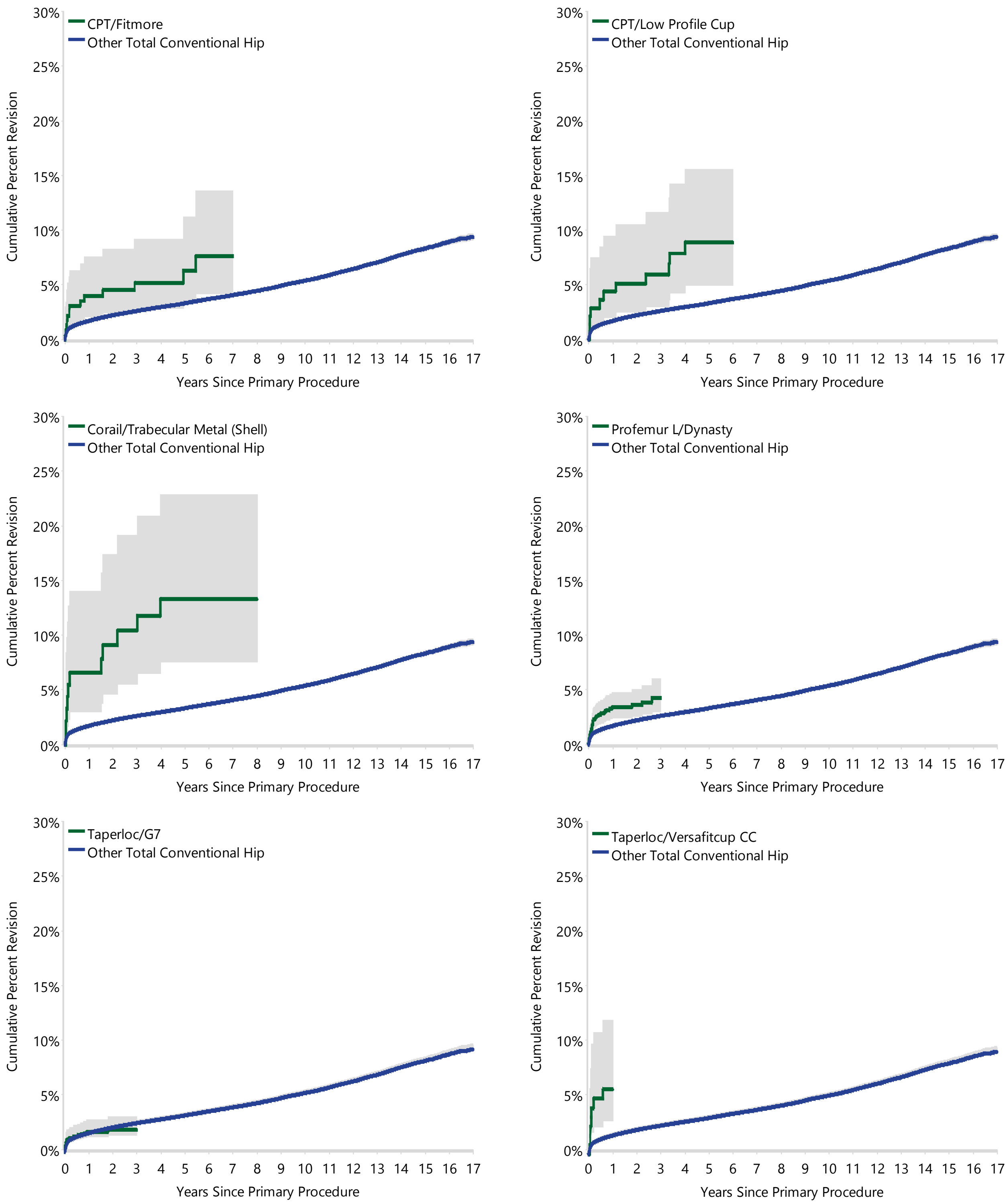
Figure IP2 Cumulative Percent Revision of Newly Identified Total Conventional Hip Prostheses

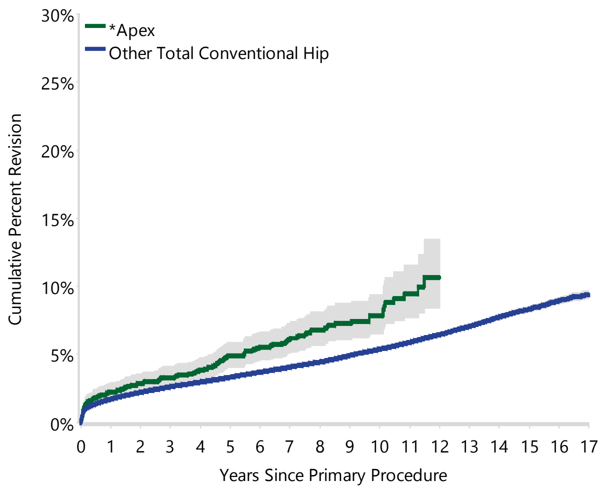


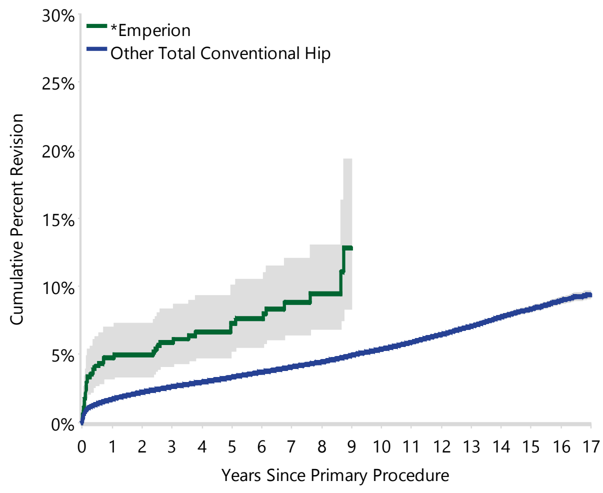
Note: **Acetabular Component

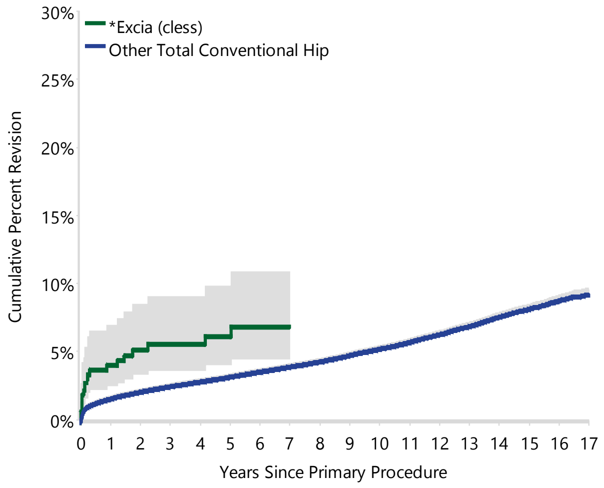
Figure IP3 Cumulative Percent Revision of Re-identified and Still Used Individual Total Conventional Hip Prostheses

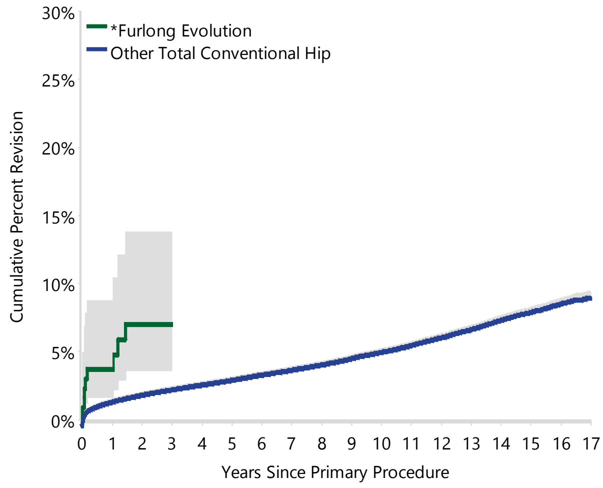
Re-identified and still used

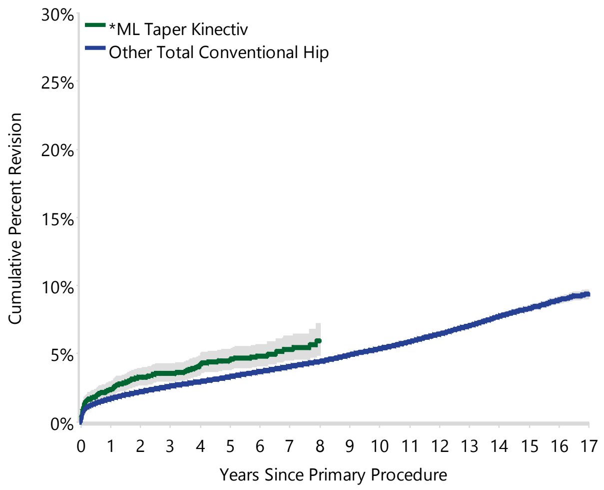


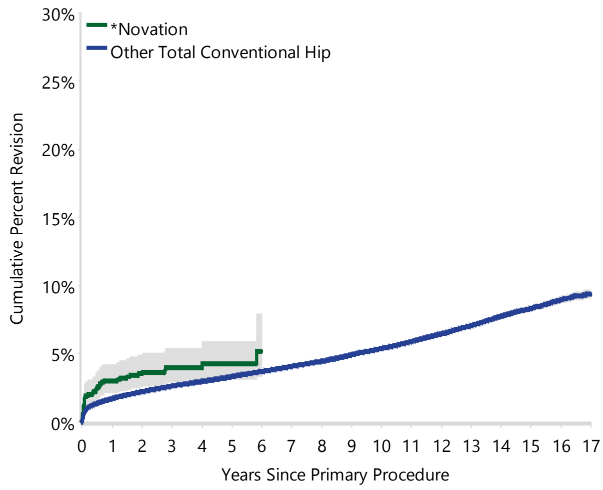

*Apex
Other Total Conventional Hip
Cumulative Percent Revision
Years Since Primary Procedure

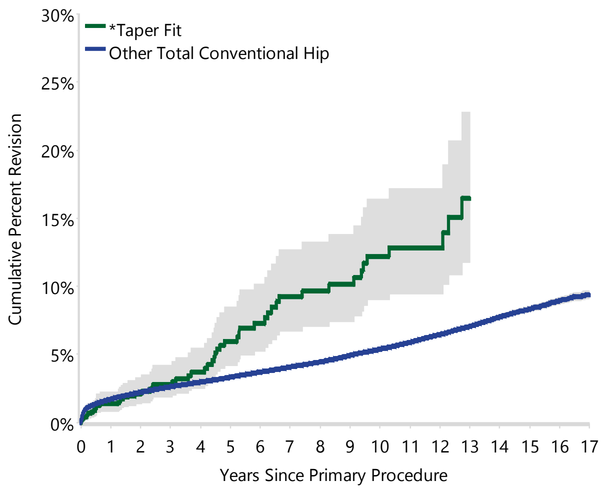

*Emperion
Other Total Conventional Hip
Cumulative Percent Revision
Years Since Primary Procedure

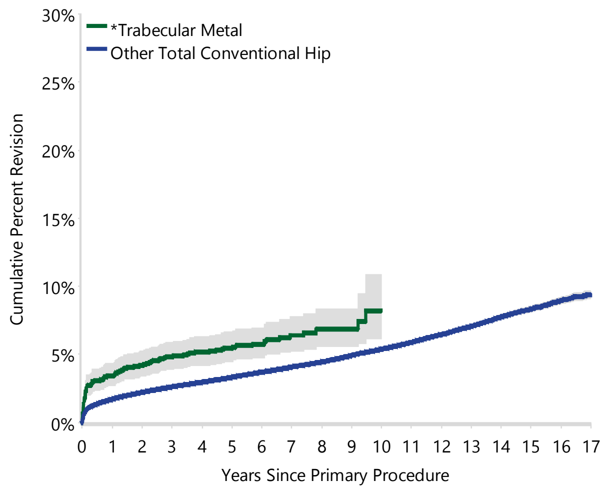

*Excia (cless)
Other Total Conventional Hip
Cumulative Percent Revision
Years Since Primary Procedure

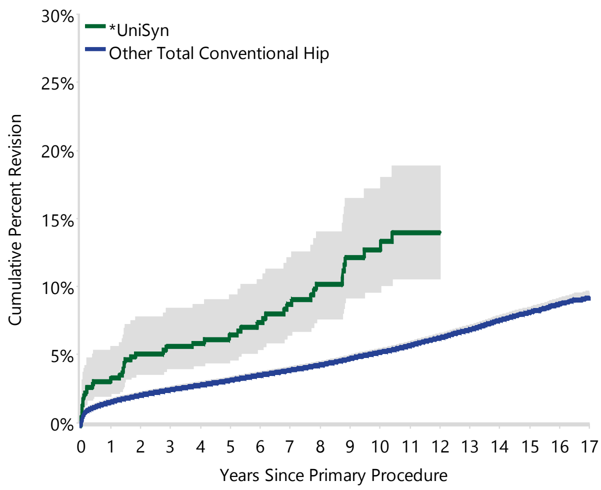

*Furlong Evolution
Other Total Conventional Hip
Cumulative Percent Revision
Years Since Primary Procedure

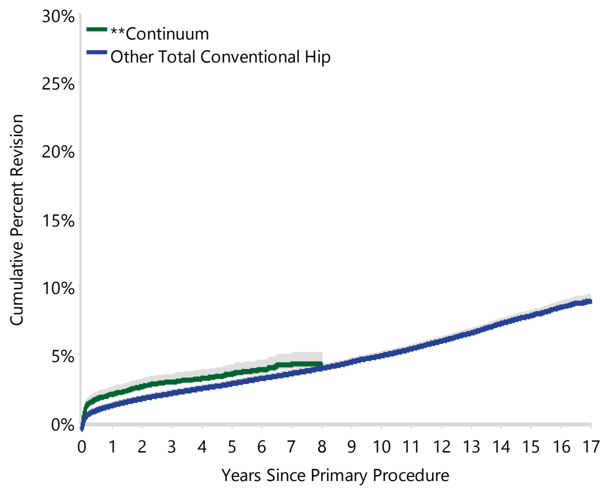

*ML Taper Kinectiv
Other Total Conventional Hip
Cumulative Percent Revision
Years Since Primary Procedure

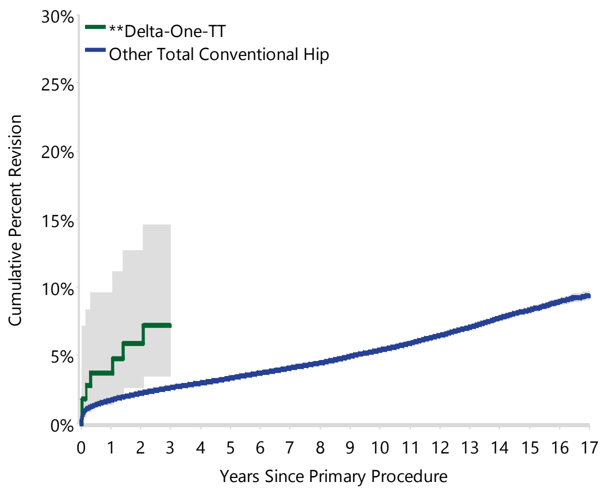

*Novation
Other Total Conventional Hip
Cumulative Percent Revision
Years Since Primary Procedure

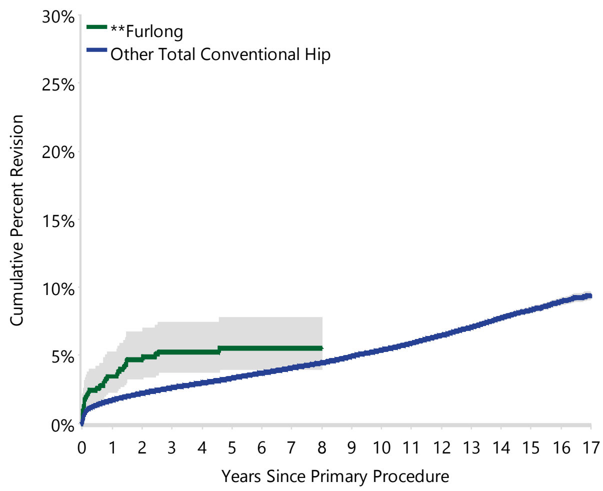

*Taper Fit
Other Total Conventional Hip
Cumulative Percent Revision
0%
5%
10%
15%
20%
25%
30%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
Years Since Primary Procedure

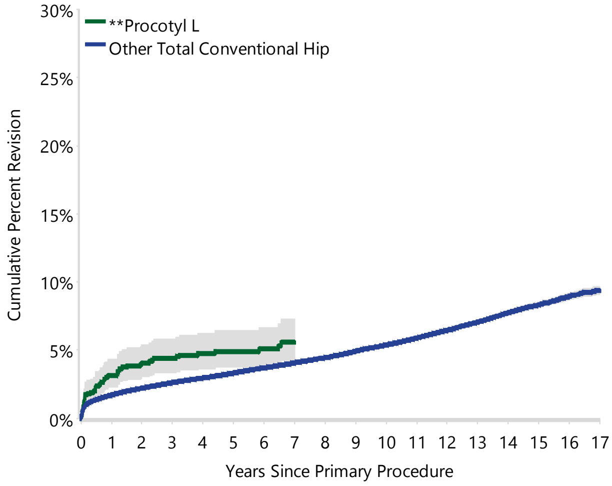

*Trabecular Metal
Other Total Conventional Hip
Cumulative Percent Revision
0%
5%
10%
15%
20%
25%
30%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
Years Since Primary Procedure


*UniSyn
Other Total Conventional Hip
Cumulative Percent Revision
0%
5%
10%
15%
20%
25%
30%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
Years Since Primary Procedure


**Continuum
Other Total Conventional Hip
Cumulative Percent Revision
0%
5%
10%
15%
20%
25%
30%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
Years Since Primary Procedure


**Delta-One-TT
Other Total Conventional Hip
Cumulative Percent Revision
0%
5%
10%
15%
20%
25%
30%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
Years Since Primary Procedure


**Furlong
Other Total Conventional Hip
Cumulative Percent Revision
0%
5%
10%
15%
20%
25%
30%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
Years Since Primary Procedure



Note: * Femoral Component,
**Acetabular Component

TOTAL RESURFACING

The Conserve Plus/Conserve Plus combination has been identified for the first time and is no longer used.

Table IP10 Revision Rate of Individual Total Resurfacing Hip Prostheses Identified as having a Higher than Anticipated Rate of Revision

Head/Acetabular	N Revised	N Total	Obs. Years	Revisions/100 Obs. Yrs	Hazard Ratio, P Value
Identified and No Longer Used	.	.	.	.	
+Conserve Plus/Conserve Plus	15	63	720	2.08	Entire Period: HR=1.83 (1.10, 3.04),p=0.019
ASR/ASR	367	1168	10939	3.35	0 - 3Mth: HR=1.75 (1.07, 2.87),p=0.025
	.	.	.	.	3Mth - 3Yr: HR=2.40 (1.84, 3.12),p<0.001
	.	.	.	.	3Yr - 4Yr: HR=4.99 (3.37, 7.40),p<0.001
	.	.	.	.	4Yr - 4.5Yr: HR=6.89 (4.34, 10.92),p<0.001
	.	.	.	.	4.5Yr - 5Yr: HR=9.28 (5.88, 14.63),p<0.001
	.	.	.	.	5Yr - 5.5Yr: HR=5.23 (3.07, 8.91),p<0.001
	.	.	.	.	5.5Yr - 6Yr: HR=7.15 (4.48, 11.42),p<0.001
	.	.	.	.	6Yr - 7.5Yr: HR=6.00 (4.42, 8.13),p<0.001
	.	.	.	.	7.5Yr - 9.5Yr: HR=3.56 (2.56, 4.97),p<0.001
	.	.	.	.	9.5Yr+: HR=3.05 (2.16, 4.31),p<0.001
Bionik/Bionik	49	200	1622	3.02	Entire Period: HR=3.26 (2.45, 4.33),p<0.001
Cormet/Cormet	117	626	6070	1.93	Entire Period: HR=1.91 (1.58, 2.31),p<0.001
Durom/Durom	99	847	8924	1.11	0 - 4.5Yr: HR=1.76 (1.36, 2.28),p<0.001
	.	.	.	.	4.5Yr+: HR=0.76 (0.55, 1.06),p=0.104
Recap/Recap	28	196	1755	1.60	0 - 6Mth: HR=2.43 (1.08, 5.46),p=0.032
	.	.	.	.	6Mth - 1.5Yr: HR=5.17 (2.53, 10.53),p<0.001
	.	.	.	.	1.5Yr+: HR=1.09 (0.64, 1.85),p=0.744
*Cormet 2000 HAP	23	95	1134	2.03	Entire Period: HR=2.28 (1.51, 3.43),p<0.001

Note: Components have been compared to all other total resurfacing hip components
*Head Component
+ Newly identified and no longer used

Table IP11 Cumulative Percent Revision of Individual Total Resurfacing Hip Prostheses Identified as having a Higher than Anticipated Rate of Revision

CPR	1 Yr	3 Yrs	5 Yrs	10 Yrs	17 Yrs
Identified and No Longer Used					
+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)	
ASR/ASR	3.4 (2.5, 4.6)	7.2 (5.9, 8.8)	15.4 (13.4, 17.6)	30.1 (27.5, 32.9)	
Bionik/Bionik	3.5 (1.7, 7.2)	12.0 (8.2, 17.4)	17.6 (13.0, 23.6)	25.5 (19.9, 32.4)	
Cormet/Cormet	2.1 (1.2, 3.6)	5.6 (4.1, 7.7)	9.7 (7.6, 12.3)	17.4 (14.6, 20.8)	
Durom/Durom	3.3 (2.3, 4.8)	5.6 (4.2, 7.3)	7.6 (6.0, 9.6)	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)	15.1 (10.6, 21.1)	
*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 Individual Total Resurfacing Hip Prostheses Identified as having a Higher than Anticipated Rate of Revision

Year of Implant	≤2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Identified and No Longer Used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
+Conserve Plus/Conserve Plus	8	7	18	15	11	3	.	1	.	.	.	.	.	.	.	.
ASR/ASR	.	43	165	302	258	176	133	91	.	.	.	.	.	.	.	.
Bionik/Bionik	.	.	.	12	33	33	46	54	20	2	.	.	.	.	.	.
Cormet/Cormet	62	42	50	85	74	76	94	75	50	10	4	4	.	.	.	.
Durom/Durom	.	58	166	207	143	105	88	46	24	10	.	.	.	.	.	.
Recap/Recap	.	.	27	14	10	42	46	38	16	3	.	.	.	.	.	.
*Cormet 2000 HAP	18	38	39	.	.	.	.	.	.	.	.	.	.	.	.	.

Note: * Head Component

PRIMARY PARTIAL KNEE REPLACEMENT

PATELLA/TROCHLEA

There are no newly identified patella/trochlear knee prostheses.

Table IP13 Revision Rate of Individual Patella/Trochlear Knee Prostheses Identified as having a Higher than Anticipated Rate of Revision

Patella/Trochlear	N Revised	N Total	Obs. Years	Revisions/100 Obs. Yrs	Hazard Ratio, P Value
Identified and No Longer Used	.	.	.	.	
**LCS	176	413	3493	5.04	Entire Period: HR=1.64 (1.38, 1.95),p<0.001
**Vanguard	12	45	229	5.23	Entire Period: HR=1.69 (0.95, 2.99),p=0.072

Note: Components have been compared to all other patella/trochlear knee components
** Trochlear Component

Table IP14 Cumulative Percent Revision of Individual Patella/Trochlear Knee Prostheses Identified as having a Higher than Anticipated Rate of Revision

CPR	1 Yr	3 Yrs	5 Yrs	10 Yrs	17 Yrs
Identified and No Longer Used					
**LCS	3.9 (2.4, 6.2)	11.9 (9.1, 15.4)	20.7 (17.1, 25.0)	40.6 (35.8, 45.8)	
**Vanguard	4.4 (1.1, 16.6)	17.8 (9.3, 32.4)	25.5 (14.9, 41.4)		

Note: ** Trochlear Component

Table IP15 Yearly Usage of Individual Patella/Trochlear Knee Prostheses Identified as having a Higher than Anticipated Rate of Revision

Year of Implant	≤2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Identified and No Longer Used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
**LCS	26	56	68	47	65	64	60	27	.	.	.	.	.	.	.	.
**Vanguard	.	.	.	.	.	4	5	2	1	13	3	14	1	2	.	.

Note: ** Trochlear Component

UNICOMPARTMENTAL

There are no newly identified unicompartmental knee prostheses.

Table IP16 Revision Rate of Individual Unicompartmental Knee Prostheses Identified as having a Higher than Anticipated Rate of Revision

Femoral/Tibial	N Revised	N Total	Obs. Years	Revisions/100 Obs. Yrs	Hazard Ratio, P Value
Re-Identified and Still Used	.	.	.	.	
GMK-UNI/GMK-UNI	25	124	414	6.04	Entire Period: HR=3.25 (2.20, 4.82),p<0.001
Uniglide/Uniglide	147	754	6424	2.29	0 - 1.5Yr: HR=1.97 (1.49, 2.59),p<0.001
	.	.	.	.	1.5Yr+: HR=1.12 (0.91, 1.37),p=0.277
Identified and No Longer Used	.	.	.	.	
Advance/Advance	16	37	287	5.57	Entire Period: HR=3.68 (2.25, 6.00),p<0.001
BalanSys Uni/BalanSys Uni Mobile	46	199	1859	2.47	0 - 6Mth: HR=4.27 (2.12, 8.58),p<0.001
	.	.	.	.	6Mth - 2Yr: HR=2.11 (1.25, 3.57),p=0.005
	.	.	.	.	2Yr+: HR=1.03 (0.69, 1.54),p=0.875
**Preservation Mobile	131	400	4248	3.08	0 - 1.5Yr: HR=2.23 (1.59, 3.12),p<0.001
	.	.	.	.	1.5Yr - 3Yr: HR=2.81 (1.92, 4.11),p<0.001
	.	.	.	.	3Yr+: HR=1.22 (0.96, 1.55),p=0.103

Note: Components have been compared to all other unicompartmental knee components
** Tibial Component

Table IP17 Cumulative Percent Revision of Individual Unicompartmental Knee Prostheses Identified as having a Higher than Anticipated Rate of Revision

CPR	1 Yr	3 Yrs	5 Yrs	10 Yrs	17 Yrs
Re-Identified and Still Used					
GMK-UNI/GMK-UNI	7.0 (3.5, 13.5)	20.1 (13.5, 29.3)			
Uniglide/Uniglide	4.8 (3.5, 6.6)	10.7 (8.6, 13.1)	12.8 (10.6, 15.4)	19.8 (16.9, 23.0)	
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)	21.8 (16.6, 28.3)	
**Preservation Mobile	5.3 (3.5, 7.9)	15.5 (12.3, 19.5)	19.1 (15.6, 23.3)	27.2 (23.1, 31.9)	

Note: ** Tibial Component

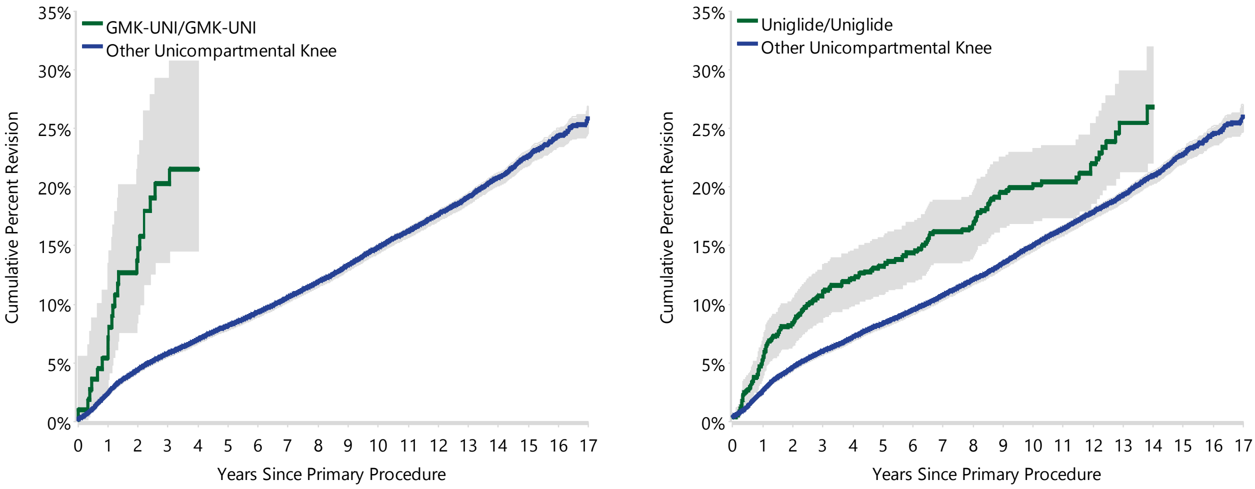
Table IP18 Yearly Usage of Individual Unicompartmental Knee Prostheses Identified as having a Higher than Anticipated Rate of Revision

Year of Implant	≤2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Re-Identified and Still Used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
GMK-UNI/GMK-UNI	.	.	.	.	.	.	5	10	2	.	21	22	16	19	17	12
Uniglide/Uniglide	.	80	66	123	84	107	93	61	30	38	25	22	9	5	8	3
Identified and No Longer Used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Advance/Advance	.	13	11	7	2	3	1	.	.	.	.	.	.	.	.	.
BalanSys Uni/BalanSys Uni Mobile	.	.	37	51	63	33	9	2	4	.	.	.	.	.	.	.
**Preservation Mobile	164	121	59	26	17	13	.	.	.	.	.	.	.	.	.	.

Note: ** Tibial Component

Figure IP4 Cumulative Percent Revision of Re-identified and Still Used Individual Unicompartmental Knee Prostheses

Re-identified and Still Used



PRIMARY TOTAL KNEE REPLACEMENT

The Score (cless)/Score (ctd) is no longer identified.

There are two total knee combinations identified for the first time which are still being used.

The Apex Knee CR (cless)/Apex Knee (cless) combination has been used in 362 procedures since 2012. The five year cumulative percent revision is 6.4%. Of the 22 revisions, 5 had both the femoral and tibial components revised, six were tibial component only and 11 were minor revisions. The most common reasons for revision were loosening (31.8%), infection (22.7%) and patella erosion (18.2%).

The Nexgen LPS Flex (cless)/Nexgen combination has been used in 1,600 procedures since 2010. The five year cumulative percent revision was 5.5%. This prosthesis combination had a higher rate of revision for the first nine months. There is no difference after this time. There were 37 major revisions including 15 total knee and 11 femoral component only, and 32 minor revisions (23 of which were insert only). The main reasons for revision were infection (29.0%), loosening (26.1%) and fracture (15.9%).

A further four combinations have been identified for the first time and are no longer used. These are: Evolis (cless)/Evolis (cless), PFC Sigma PS (ctd)/MBT (cless), Profix Oximium (ctd) / Profix (cless) and TC-Plus (cless) / TC-Plus (ctd).

Table IP19 Revision Rate of Individual Total Knee Prostheses Identified as having a Higher than Anticipated Rate of Revision

Femoral/Tibial	N Revised	N Total	Obs. Years	Revisions/ 100 Obs. Yrs	Hazard Ratio, P Value
Newly Identified	.	.	.	.	
Apex Knee CR (cless)/Apex Knee (cless)	22	362	1309	1.68	Entire Period: HR=1.99 (1.31, 3.02),p=0.001
Nexgen LPS Flex (cless)/Nexgen	69	1600	4993	1.38	0 - 9Mth: HR=2.91 (2.08, 4.08),p<0.001
	.	.	.	.	9Mth+: HR=1.18 (0.85, 1.65),p=0.318
Re-Identified and Still Used	.	.	.	.	
ACS (cless)/ACS Fixed	70	1616	4454	1.57	Entire Period: HR=1.75 (1.38, 2.21),p<0.001
Active Knee (cless)/Active Knee	544	7115	57069	0.95	0 - 3Yr: HR=1.21 (1.06, 1.37),p=0.003
	.	.	.	.	3Yr+: HR=1.86 (1.66, 2.09),p<0.001
Advance/Advance	44	844	4111	1.07	Entire Period: HR=1.46 (1.09, 1.97),p=0.011
Columbus/Columbus	100	1543	7549	1.32	Entire Period: HR=2.09 (1.72, 2.55),p<0.001
E.Motion/E.Motion	59	1061	3826	1.54	0 - 1.5Yr: HR=2.83 (2.11, 3.81),p<0.001
	.	.	.	.	1.5Yr+: HR=1.02 (0.62, 1.69),p=0.936
Optetrak-PS/Optetrak	204	2406	19127	1.07	Entire Period: HR=1.78 (1.55, 2.04),p<0.001
Optetrak-PS/Optetrak RBK	73	1039	6269	1.16	Entire Period: HR=1.87 (1.49, 2.36),p<0.001
Score (cless)/Score (cless)	145	2048	9288	1.56	0 - 1.5Yr: HR=1.55 (1.19, 2.04),p=0.001
	.	.	.	.	1.5Yr+: HR=2.19 (1.77, 2.69),p<0.001
Scorpio NRG PS (cless)/Series 7000 (cless)	71	1144	6582	1.08	Entire Period: HR=1.39 (1.10, 1.76),p=0.005
Trekking/Trekking	34	934	2893	1.18	0 - 1.5Yr: HR=1.89 (1.28, 2.80),p=0.001
	.	.	.	.	1.5Yr+: HR=0.80 (0.42, 1.54),p=0.504
Vanguard PS/Maxim	243	4667	23264	1.04	0 - 1.5Yr: HR=1.85 (1.56, 2.19),p<0.001
	.	.	.	.	1.5Yr+: HR=1.21 (1.00, 1.45),p=0.050
Vanguard PS/Regenerex	19	394	1652	1.15	0 - 6Mth: HR=4.19 (2.18, 8.06),p<0.001
	.	.	.	.	6Mth+: HR=0.93 (0.50, 1.73),p=0.826
**Legion Revision Tibial Baseplate	37	541	2485	1.49	0 - 3Mth: HR=6.09 (3.45, 10.74),p<0.001
	.	.	.	.	3Mth - 1.5Yr: HR=0.98 (0.47, 2.05),p=0.949
	.	.	.	.	1.5Yr+: HR=1.59 (1.00, 2.53),p=0.048
Identified and No Longer Used	.	.	.	.	
+Evolis (cless)/Evolis (cless)	8	87	499	1.60	Entire Period: HR=2.18 (1.09, 4.35),p=0.027

Femoral/Tibial	N Revised	N Total	Obs. Years	Revisions/ 100 Obs. Yrs	Hazard Ratio, P Value
+Evolis (cless)/Evolis (cless)	8	87	499	1.60	Entire Period: HR=2.18 (1.09, 4.35),p=0.027
+PFC Sigma PS (ctd)/MBT (cless)	23	316	1704	1.35	Entire Period: HR=1.77 (1.18, 2.67),p=0.006
+Profix Oxinium (ctd)/Profix (cless)	13	100	1006	1.29	Entire Period: HR=1.95 (1.13, 3.36),p=0.015
+TC-Plus (cless)/TC-Plus (ctd)	8	63	603	1.33	Entire Period: HR=2.62 (1.32, 5.24),p=0.006
ACS/ACS Mobile PC (cless)	26	131	541	4.81	Entire Period: HR=5.80 (3.95, 8.52),p<0.001
AMK/AMK	24	203	2335	1.03	Entire Period: HR=1.93 (1.29, 2.88),p=0.001
Buechel-Pappas/Buechel-Pappas	43	479	3621	1.19	Entire Period: HR=1.85 (1.37, 2.50),p<0.001
Eska RP/Eska RP	9	40	301	2.99	Entire Period: HR=5.50 (2.86, 10.58),p<0.001
Gemini MK II/Gemini MK II	7	21	199	3.52	Entire Period: HR=5.90 (2.81, 12.39),p<0.001
Genesis (ctd)/Genesis (ctd)	11	62	633	1.74	Entire Period: HR=3.45 (1.91, 6.23),p<0.001
Genesis II CR (cless)/Profix Mobile (ctd)	31	241	2393	1.30	Entire Period: HR=2.38 (1.68, 3.39),p<0.001
Genesis II Oxinium CR (cless)/Genesis II	47	110	869	5.41	0 - 1Yr: HR=10.11 (5.87, 17.42),p<0.001
	.	.	.	.	1Yr - 1.5Yr: HR=18.46 (10.21, 33.36),p<0.001
	.	.	.	.	1.5Yr - 2.5Yr: HR=20.94 (12.61, 34.76),p<0.001
	.	.	.	.	2.5Yr+: HR=2.69 (1.34, 5.37),p=0.005
Genesis II Oxinium CR (cless)/Profix Mobile	56	88	547	10.2	0 - 6Mth: HR=7.46 (2.80, 19.88),p<0.001
	.	.	.	.	6Mth - 9Mth: HR=46.83 (25.90, 84.68),p<0.001
	.	.	.	.	9Mth - 1.5Yr: HR=33.52 (21.83, 51.46),p<0.001
	.	.	.	.	1.5Yr - 2Yr: HR=27.65 (13.16, 58.06),p<0.001
	.	.	.	.	2Yr+: HR=6.16 (3.58, 10.62),p<0.001
Genesis II Oxinium PS (ctd)/Genesis II (cless)	17	56	326	5.22	0 - 1Yr: HR=16.44 (9.13, 29.60),p<0.001
	.	.	.	.	1Yr+: HR=3.30 (1.48, 7.34),p=0.003
Genesis II Oxinium PS (ctd)/Genesis II (keel)	61	269	2343	2.60	Entire Period: HR=4.42 (3.44, 5.68),p<0.001
HLS Noetos/HLS Noetos	36	294	2206	1.63	Entire Period: HR=2.64 (1.90, 3.66),p<0.001
IB II/IB II	35	199	2344	1.49	0 - 2Yr: HR=0.82 (0.26, 2.55),p=0.732
	.	.	.	.	2Yr - 2.5Yr: HR=4.61 (1.49, 14.31),p=0.008
	.	.	.	.	2.5Yr+: HR=4.26 (2.96, 6.14),p<0.001
Interax/Interax	11	52	499	2.20	0 - 3.5Yr: HR=1.45 (0.36, 5.79),p=0.600
	.	.	.	.	3.5Yr+: HR=7.91 (4.12, 15.21),p<0.001
Journey Oxinium/Journey	273	3033	21336	1.28	0 - 3Mth: HR=0.29 (0.09, 0.91),p=0.033
	.	.	.	.	3Mth - 1.5Yr: HR=1.95 (1.56, 2.44),p<0.001
	.	.	.	.	1.5Yr - 2Yr: HR=1.55 (1.01, 2.38),p=0.046
	.	.	.	.	2Yr - 2.5Yr: HR=2.04 (1.35, 3.08),p<0.001
	.	.	.	.	2.5Yr - 3Yr: HR=1.40 (0.79, 2.48),p=0.243
	.	.	.	.	3Yr+: HR=2.56 (2.16, 3.03),p<0.001
Optetrak-PS/Optetrak-PS	13	55	460	2.82	Entire Period: HR=5.44 (3.17, 9.33),p<0.001
Profix Oxinium (cless)/Profix	32	75	625	5.12	0 - 9Mth: HR=5.84 (2.19, 15.55),p<0.001
	.	.	.	.	9Mth - 2Yr: HR=23.12 (15.07, 35.49),p<0.001
	.	.	.	.	2Yr+: HR=2.83 (1.35, 5.95),p=0.005
Profix Oxinium (cless)/Profix Mobile	71	158	1207	5.88	0 - 9Mth: HR=3.09 (1.17, 8.22),p=0.023
	.	.	.	.	9Mth - 1.5Yr: HR=23.10 (16.03, 33.28),p<0.001
	.	.	.	.	1.5Yr - 2Yr: HR=15.76 (8.19, 30.32),p<0.001
	.	.	.	.	2Yr - 2.5Yr: HR=32.36 (19.13, 54.73),p<0.001
	.	.	.	.	2.5Yr - 3Yr: HR=20.83 (9.34, 46.46),p<0.001
	.	.	.	.	3Yr+: HR=2.54 (1.32, 4.88),p=0.005
Profix Oxinium (ctd)/Profix Mobile	28	228	2602	1.08	Entire Period: HR=1.70 (1.17, 2.46),p=0.005
Profix/Profix Mobile	105	1005	10509	1.00	0 - 1.5Yr: HR=2.53 (1.85, 3.45),p<0.001
	.	.	.	.	1.5Yr - 2.5Yr: HR=2.72 (1.77, 4.18),p<0.001

Femoral/Tibial	N Revised	N Total	Obs. Years	Revisions/ 100 Obs. Yrs	Hazard Ratio, P Value
	.	.	.	.	2.5Yr+: HR=1.27 (0.95, 1.71),p=0.112
Rotaglide Plus/Rotaglide Plus	73	631	6664	1.10	0 - 1.5Yr: HR=1.21 (0.69, 2.14),p=0.501
	.	.	.	.	1.5Yr - 2Yr: HR=3.01 (1.50, 6.03),p=0.001
	.	.	.	.	2Yr+: HR=2.20 (1.68, 2.89),p<0.001
SAL/SAL	13	56	667	1.95	0 - 8.5Yr: HR=1.43 (0.54, 3.81),p=0.474
	.	.	.	.	8.5Yr+: HR=8.52 (4.44, 16.33),p<0.001
Trac/Trac	25	138	1530	1.63	Entire Period: HR=2.85 (1.92, 4.21),p<0.001
*LCS Duofix	600	4866	41456	1.45	0 - 2Yr: HR=1.77 (1.53, 2.05),p<0.001
	.	.	.	.	2Yr - 3.5Yr: HR=3.64 (3.10, 4.27),p<0.001
	.	.	.	.	3.5Yr - 4Yr: HR=5.24 (3.95, 6.95),p<0.001
	.	.	.	.	4Yr - 5.5Yr: HR=4.37 (3.61, 5.30),p<0.001
	.	.	.	.	5.5Yr - 6.5Yr: HR=2.86 (2.10, 3.90),p<0.001
	.	.	.	.	6.5Yr+: HR=1.33 (1.04, 1.70),p=0.024
*LCS PS	60	638	3844	1.56	Entire Period: HR=2.41 (1.87, 3.10),p<0.001
*Renasys	15	121	1185	1.27	Entire Period: HR=2.33 (1.40, 3.85),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 Individual Total Knee Prostheses Identified as having a Higher than Anticipated Rate of Revision

CPR	1 Yr	3 Yrs	5 Yrs	10 Yrs	17 Yrs
Newly Identified					
Apex Knee CR (cless)/Apex Knee (cless)	2.8 (1.5, 5.1)	6.0 (3.9, 9.0)	6.4 (4.2, 9.5)		
Nexgen LPS Flex (cless)/Nexgen	2.7 (2.0, 3.6)	4.9 (3.8, 6.2)	5.5 (4.3, 7.0)		
Re-Identified and Still Used					
ACS (cless)/ACS Fixed	1.8 (1.2, 2.6)	5.5 (4.4, 7.0)	5.5 (4.4, 7.0)		
Active Knee (cless)/Active Knee	1.1 (0.9, 1.4)	3.5 (3.1, 4.0)	5.1 (4.6, 5.6)	8.7 (7.9, 9.5)	
Advance/Advance	1.9 (1.2, 3.1)	4.7 (3.4, 6.5)	5.3 (3.9, 7.3)	9.7 (6.1, 15.1)	
Columbus/Columbus	1.8 (1.2, 2.7)	5.8 (4.6, 7.3)	7.4 (5.9, 9.1)	10.9 (8.9, 13.4)	
E.Motion/E.Motion	2.8 (2.0, 4.1)	6.4 (4.9, 8.2)	6.5 (5.1, 8.4)		
Optetrak-PS/Optetrak	1.5 (1.1, 2.0)	4.7 (3.9, 5.7)	6.3 (5.4, 7.4)	9.7 (8.4, 11.2)	
Optetrak-PS/Optetrak RBK	1.9 (1.2, 3.0)	5.1 (3.8, 6.7)	6.4 (4.9, 8.2)	9.8 (7.7, 12.4)	
Score (cless)/Score (cless)	1.6 (1.1, 2.3)	5.3 (4.4, 6.5)	7.4 (6.2, 8.8)		
Scorpio NRG PS (cless)/Series 7000 (cless)	1.3 (0.8, 2.1)	5.4 (4.2, 7.0)	6.8 (5.3, 8.5)	8.0 (6.2, 10.2)	
Trekking/Trekking	2.4 (1.6, 3.7)	3.7 (2.5, 5.3)	4.8 (3.3, 6.9)		
Vanguard PS/Maxim	1.9 (1.5, 2.3)	4.4 (3.8, 5.1)	5.6 (4.9, 6.3)	7.3 (6.2, 8.5)	
Vanguard PS/Regenerex	3.5 (2.0, 5.9)	5.3 (3.3, 8.3)	5.3 (3.3, 8.3)		
**Legion Revision Tibial Baseplate	3.0 (1.8, 4.9)	5.1 (3.4, 7.4)	6.4 (4.4, 9.2)		
Identified and No Longer Used					
+Evolis (cless)/Evolis (cless)	2.3 (0.6, 8.9)	8.1 (3.9, 16.3)	9.6 (4.9, 18.3)		
+PFC Sigma PS (ctd)/MBT (cless)	2.2 (1.1, 4.6)	5.4 (3.4, 8.6)	7.3 (4.8, 10.8)		
+Profix Oxinium (ctd)/Profix (cless)	4.0 (1.5, 10.3)	8.0 (4.1, 15.4)	9.0 (4.8, 16.6)	11.3 (6.4, 19.4)	
+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)	
ACS/ACS Mobile PC (cless)	7.7 (4.2, 13.8)	19.3 (13.5, 27.2)	20.2 (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)	15.2 (9.9, 23.0)
Buechel-Pappas/Buechel-Pappas	1.9 (1.0, 3.6)	5.7 (3.9, 8.2)	7.9 (5.8, 10.7)	9.9 (7.4, 13.3)	
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)	
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)	13.1 (9.2, 18.6)	
Genesis II Oxinium CR (cless)/Genesis II	11.8 (7.0, 19.5)	38.9 (30.4, 48.7)	39.8 (31.3, 49.7)	42.8 (34.0, 52.7)	
Genesis II Oxinium CR (cless)/Profix Mobile	24.0 (16.3, 34.4)	52.8 (42.8, 63.5)	57.4 (47.4, 67.9)	61.1 (51.0, 71.3)	
Genesis II Oxinium PS (ctd)/Genesis II (cless)	19.6 (11.4, 32.7)	26.8 (17.1, 40.4)	30.4 (20.1, 44.2)		
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)	13.7 (9.8, 18.8)	
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 (5.7, 7.4)	11.4 (10.0, 13.0)	
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)	
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 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)	
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)	12.9 (12.0, 13.9)	
*LCS PS	2.1 (1.2, 3.5)	6.7 (5.0, 9.0)	8.7 (6.7, 11.2)		
*Renasys	2.5 (0.8, 7.5)	4.2 (1.8, 9.8)	8.5 (4.6, 15.1)	11.2 (6.7, 18.5)	

Note: * Femoral Component
** Tibial Component

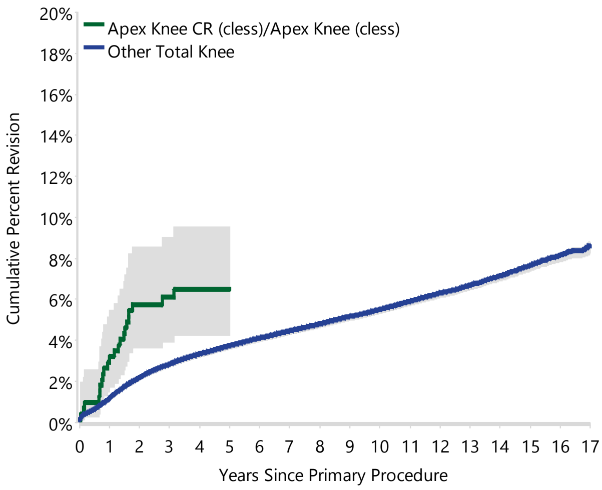
Table IP21 Yearly Usage of Individual Total Knee Prostheses Identified as having a Higher than Anticipated Rate of Revision

Year of Implant	≤2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Newly Identified	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Apex Knee CR (cless)/Apex Knee (cless)	.	.	.	.	.	.	.	.	.	.	69	83	118	78	11	3
Nexgen LPS Flex (cless)/Nexgen	.	.	.	.	.	.	.	.	73	78	149	312	238	280	225	245
Re-Identified and Still Used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
ACS (cless)/ACS Fixed	.	.	.	.	.	.	.	.	.	41	119	283	337	332	238	266
Active Knee (cless)/Active Knee	221	613	790	693	466	510	483	412	479	601	500	427	319	336	176	89
Advance/Advance	54	.	8	12	16	2	5	43	115	138	74	7	92	92	100	86
Columbus/Columbus	.	.	.	49	91	90	148	156	134	136	109	69	36	60	118	347
E.Motion/E.Motion	.	.	.	.	.	.	.	12	87	114	129	236	106	113	124	140
Optetrak-PS/Optetrak	126	130	155	252	253	216	168	202	198	202	200	151	115	30	3	5
Optetrak-PS/Optetrak RBK	.	.	.	1	81	173	166	119	82	40	37	50	100	56	46	88
Score (cless)/Score (cless)	.	.	.	1	.	11	135	212	187	204	196	238	273	262	170	159
Scorpio NRG PS (cless)/Series 7000 (cless)	.	.	.	.	.	76	185	171	166	114	67	71	76	72	77	69
Trekking/Trekking	.	.	.	.	.	.	.	.	35	102	133	107	108	106	129	214
Vanguard PS/Maxim	.	.	.	22	82	146	318	424	479	600	561	444	517	439	331	304
Vanguard PS/Regenerex	.	.	.	.	.	.	.	4	121	54	27	15	21	18	76	58
**Legion Revision Tibial Baseplate	.	.	.	.	16	33	48	40	56	47	63	54	47	38	50	49
Identified and No Longer Used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
+Evolis (cless)/Evolis (cless)	.	.	.	.	.	.	17	5	11	9	20	7	11	7	.	.
+PFC Sigma PS (ctd)/MBT (cless)	.	.	.	47	2	.	.	.	.	25	89	110	42	.	1	.
+Profix Oxinium (ctd)/Profix (cless)	5	5	29	17	15	8	10	8	2	.	1	.	.	.	.	.
+TC-Plus (cless)/TC-Plus (ctd)	.	1	27	27	5	3	.	.	.	.	.	.	.	.	.	.
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	.	.	.	.	.	.	.	.
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	.	.	.	.	.	.	.	.	.	.
Profix Oxinium (cless)/Profix	10	65	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Profix Oxinium (cless)/Profix Mobile	63	95	.	.	.	.	.	.	.	.	.	.	.	.	.	.
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	.	.	.	.	.	.	.	.	.
SAL/SAL	56	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Trac/Trac	128	9	1	.	.	.	.	.	.	.	.	.	.	.	.	.
*LCS Duofix	.	.	.	.	844	1636	1532	854	.	.	.	.	.	.	.	.
*LCS PS	.	.	.	.	.	.	8	157	203	109	51	69	39	2	.	.
*Renasys	.	.	.	51	53	3	14	.	.	.	.	.	.	.	.	.

Note: * Femoral Component ** Tibial Component

Figure IP5 Cumulative Percent Revision of Newly Identified Individual Total Knee Prostheses

Newly identified



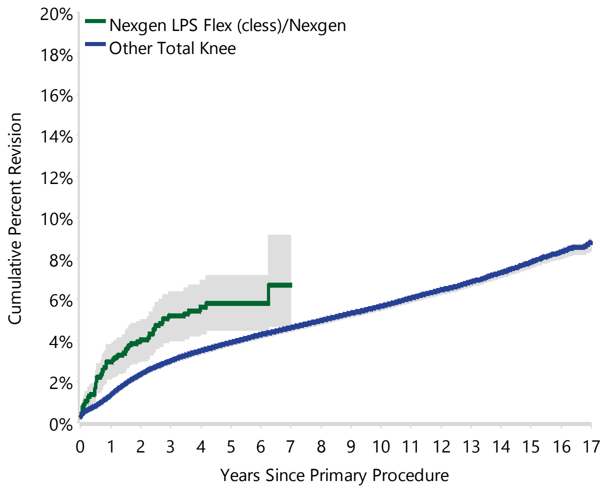
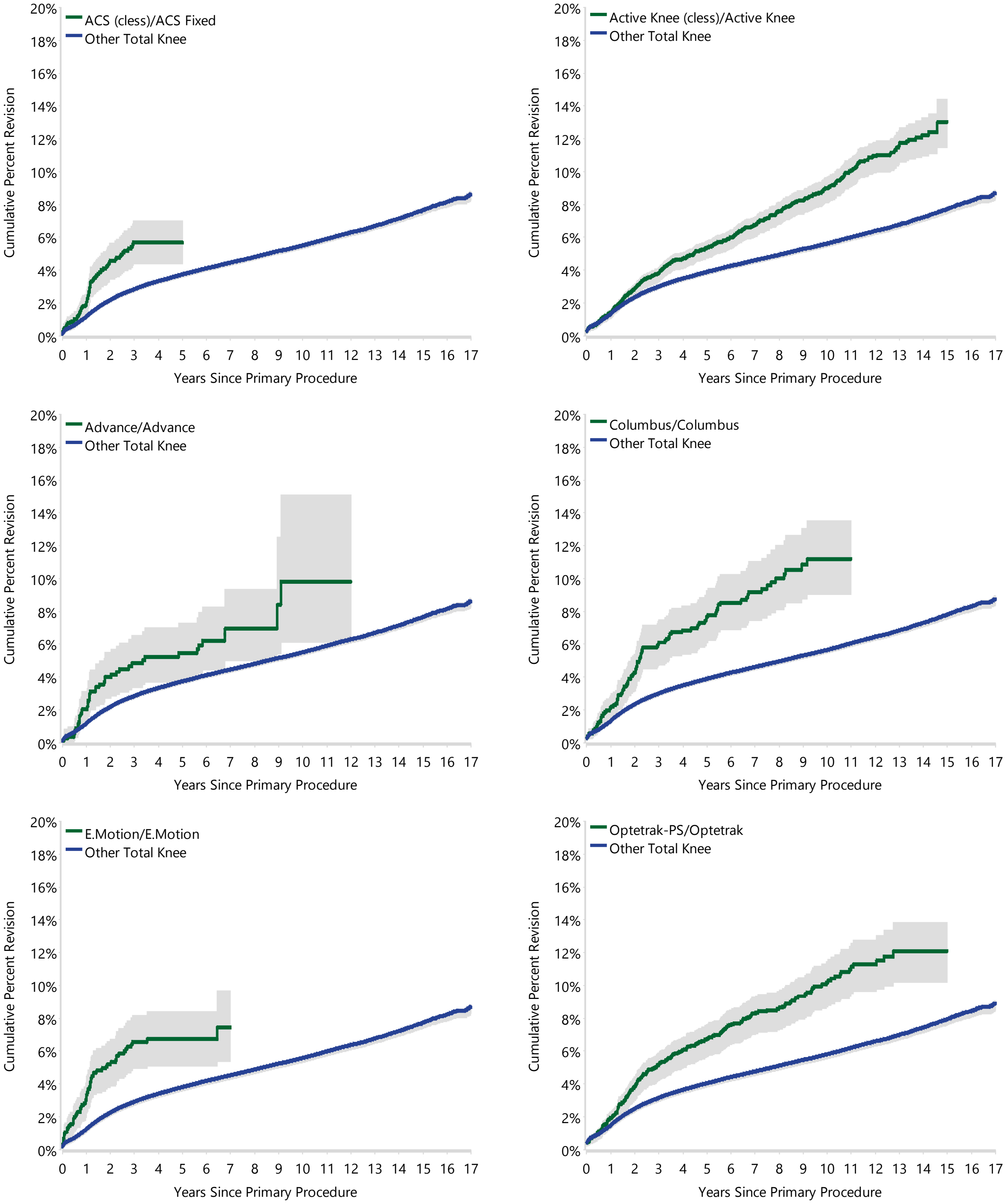
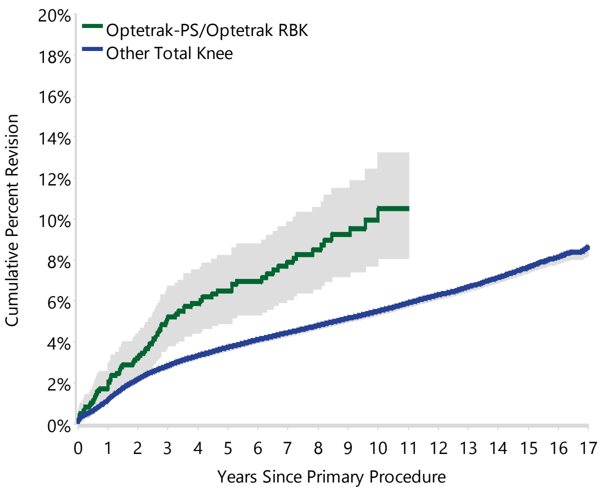
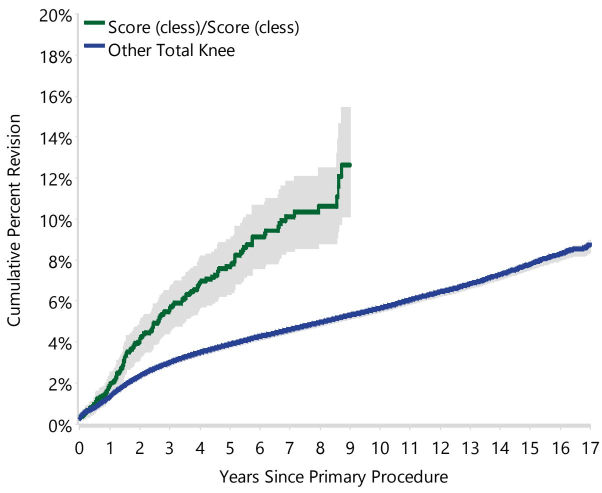


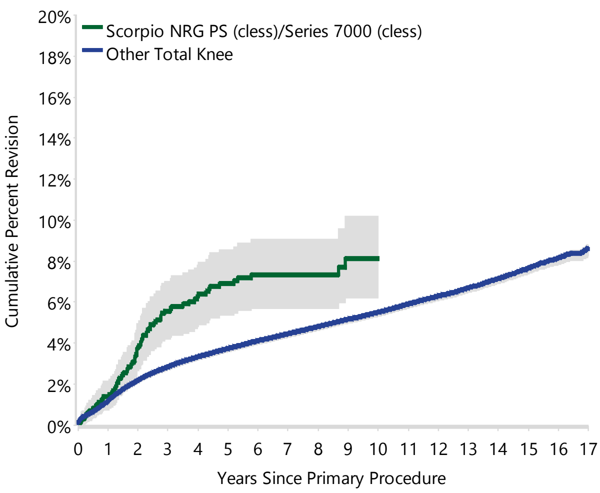
Figure IP6 Cumulative Percent Revision of Re-identified and Still Used Individual Total Knee Prostheses

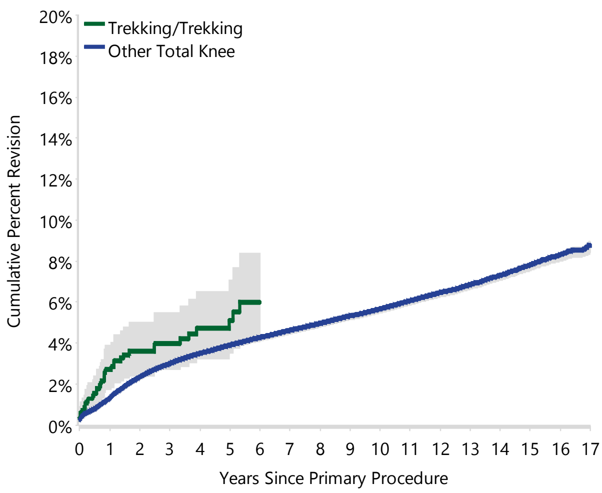
Re-identified and still used

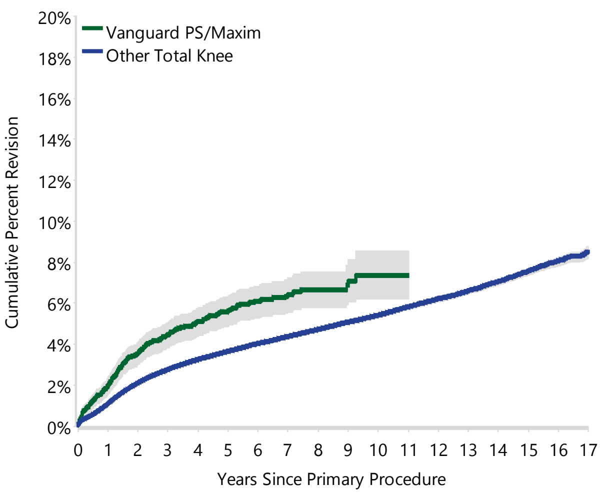


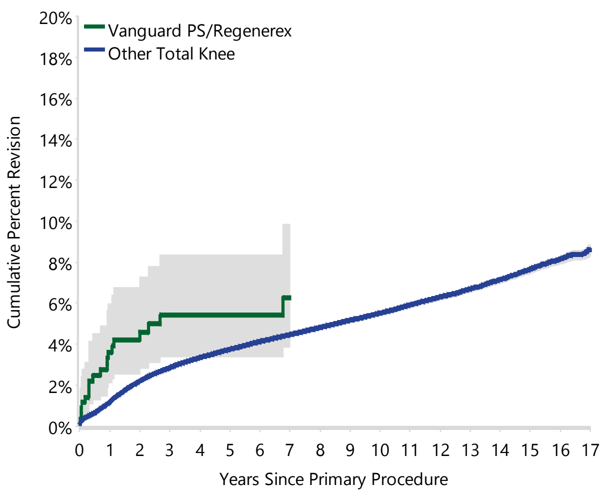

Optetrak-PS/Optetrak RBK
Other Total Knee
Cumulative Percent Revision
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
Years Since Primary Procedure

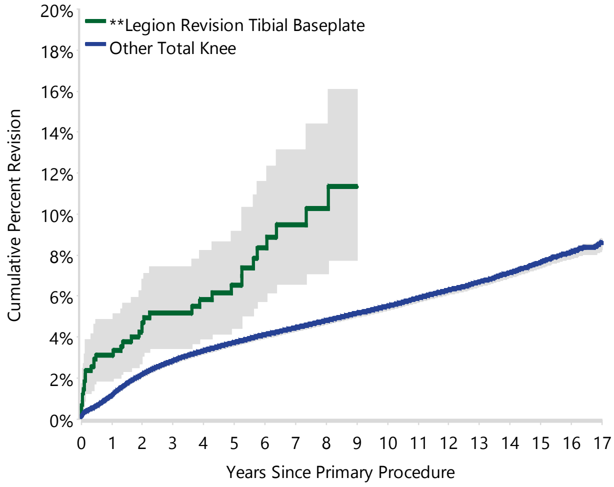

Score (cless)/Score (cless)
Other Total Knee
Cumulative Percent Revision
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
Years Since Primary Procedure


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
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
Years Since Primary Procedure


Vanguard PS/Maxim
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
Years Since Primary Procedure


Vanguard PS/Regenerex
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
Years Since Primary Procedure



Note: ** Tibial Component

PRIMARY PARTIAL SHOULDER REPLACEMENT

HEMI STEMMED

There are no newly identified hemi stemmed shoulder prostheses.

Table IP22 Revision Rate of Individual Hemi Stemmed Shoulder Prostheses Identified as having a Higher than Anticipated Rate of Revision

Humeral Stem/Head	N Revised	N Total	Obs. Years	Revisions/100 Obs. Yrs	Hazard Ratio, P Value
Re-Identified and Still Used	.	.	.	.	
Delta Xtend/Delta Xtend	12	65	282	4.26	Entire Period: HR=2.58 (1.45, 4.58),p=0.001
Global Unite/Global Unite	28	166	416	6.73	Entire Period: HR=2.33 (1.58, 3.44),p<0.001

Note: Components have been compared to all other hemi stemmed shoulder components

Table IP23 Cumulative Percent Revision of Individual Hemi Stemmed Shoulder Prostheses Identified as having a Higher than Anticipated Rate of Revision

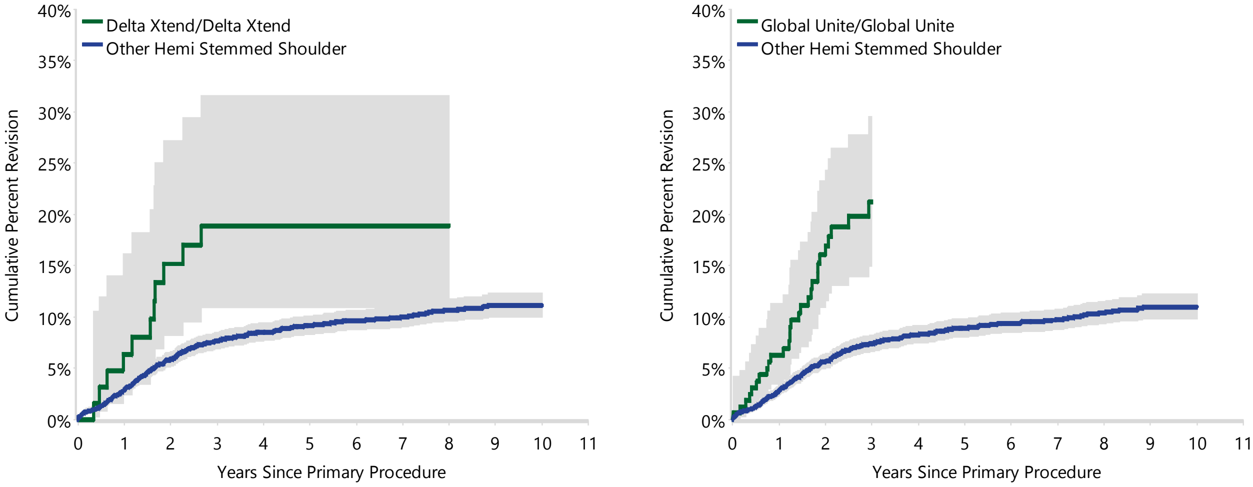
CPR	1 Yr	3 Yrs	5 Yrs	7 Yrs	11 Yrs
Re-Identified and Still Used					
Delta Xtend/Delta Xtend	6.4 (2.4, 16.1)	18.9 (10.9, 31.5)	18.9 (10.9, 31.5)	18.9 (10.9, 31.5)	
Global Unite/Global Unite	6.3 (3.4, 11.3)	21.2 (14.9, 29.5)			

Table IP24 Yearly Usage of Individual Hemi Stemmed Shoulder Prostheses Identified as having a Higher than Anticipated Rate of Revision

Year of Implant	≤2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Re-Identified and Still Used	.	.	.	.	.	.	.	.	.	.	.
Delta Xtend/Delta Xtend	2	5	9	9	5	10	7	6	5	4	3
Global Unite/Global Unite	.	.	.	.	.	15	37	25	38	37	14

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 Individual Total Stemmed Shoulder Prostheses Identified as having a Higher than Anticipated Rate of Revision

Humeral Stem/Glenoid	N Revised	N Total	Obs. Years	Revisions/100 Obs. Yrs	Hazard Ratio, P Value
Re-Identified and Still Used	.	.	.	.	
SMR/SMR L1	238	1937	8378	2.84	Entire Period: HR=1.95 (1.68, 2.26),p<0.001
Identified and No Longer Used	.	.	.	.	
SMR/SMR L2	282	856	4386	6.43	0 - 9Mth: HR=3.61 (2.69, 4.84),p<0.001
	.	.	.	.	9Mth - 1.5Yr: HR=5.48 (4.02, 7.47),p<0.001
	.	.	.	.	1.5Yr+: HR=7.23 (5.96, 8.76),p<0.001
Univers 3D/Univers 3D	14	34	247	5.66	Entire Period: HR=4.30 (2.53, 7.30),p<0.001
Vaios/Vaios	15	36	155	9.67	Entire Period: HR=5.88 (3.52, 9.79),p<0.001

Note: Components have been compared to all other total stemmed shoulder components

Table IP26 Cumulative Percent Revision of Individual Total Stemmed Shoulder Prostheses Identified as having a Higher than Anticipated Rate of Revision

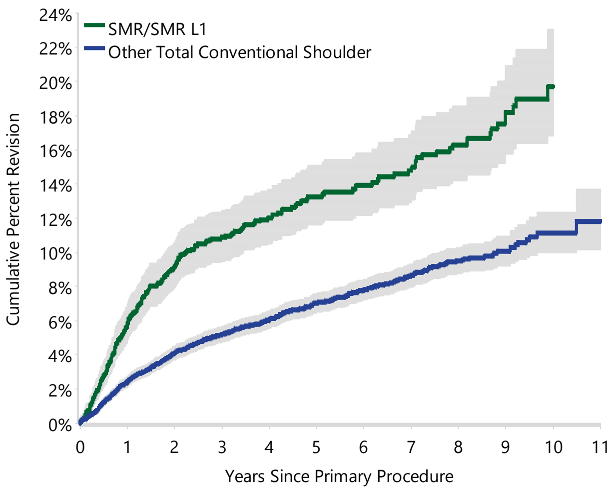
CPR	1 Yr	3 Yrs	5 Yrs	7 Yrs	11 Yrs
Re-Identified and Still Used					
SMR/SMR L1	5.8 (4.8, 6.9)	10.9 (9.5, 12.4)	13.2 (11.6, 15.1)	14.8 (12.9, 16.9)	
Identified and No Longer Used					
SMR/SMR L2	9.5 (7.7, 11.7)	22.2 (19.6, 25.2)	29.7 (26.8, 33.0)	34.2 (31.0, 37.7)	
Univers 3D/Univers 3D	5.9 (1.5, 21.5)	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)	39.4 (25.5, 57.3)		

Table IP27 Yearly Usage of Individual Total Stemmed Shoulder Prostheses Identified as having a Higher than Anticipated Rate of Revision

Year of Implant	≤2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Re-Identified and Still Used	.	.	.	.	.	.	.	.	.	.	.
SMR/SMR L1	135	237	247	.	.	157	301	255	242	195	168
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 Re-identified and still used Individual Total Stemmed Shoulder Prostheses



PRIMARY TOTAL REVERSE SHOULDER REPLACEMENT

There is one primary total reverse shoulder combination identified for the first time.

The Anatomical Shoulder/Trabecular Metal combination has been used in 60 procedures since 2013. The cumulative percent revision at three years is 10.1%. Of the five revisions, two were for loosening (40%), one was for infection (20.0%) and two were for disassociation of the glenosphere (40%). There have been three major revisions: humeral component only, glenoid component only and a cement spacer, and two minor revisions involving the glenosphere only.

Table IP28 Revision Rate of Individual Total Reverse Shoulder Prostheses Identified as having a Higher than Anticipated Rate of Revision

Humeral Stem/Glenoid	N Revised	N Total	Obs. Years	Revisions/ 100 Obs. Yrs	Hazard Ratio, P Value
Newly Identified	.	.	.	.	
Anatomical Shoulder/Trabecular Metal	5	60	114	4.38	Entire Period: HR=2.53 (1.05, 6.09),p=0.039
Re-Identified and Still Used	.	.	.	.	
SMR/SMR L1	206	4677	13891	1.48	Entire Period: HR=1.29 (1.09, 1.51),p=0.002

Note: Components have been compared to all other total reverse shoulder components

Table IP29 Cumulative Percent Revision of Individual Total Reverse Shoulder Prostheses Identified as having a Higher than Anticipated Rate of Revision

CPR	1 Yr	3 Yrs	5 Yrs	7 Yrs	11 Yrs
Newly Identified					
Anatomical Shoulder/Trabecular Metal	5.2 (1.7, 15.3)	10.1 (4.2, 23.1)			
Re-Identified and Still Used					
SMR/SMR L1	3.6 (3.0, 4.1)	4.6 (4.0, 5.3)	5.3 (4.6, 6.2)	6.0 (5.0, 7.2)	

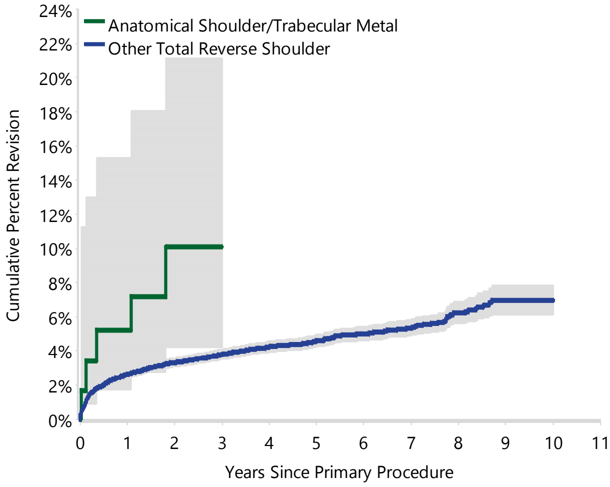
Table IP30 Yearly Usage of Individual Total Reverse Shoulder Prostheses Identified as having a Higher than Anticipated Rate of Revision

Year of Implant	≤2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Newly Identified	.	.	.	.	.	.	.	.	.	.	.
Anatomical Shoulder/Trabecular Metal	.	.	.	.	.	.	2	8	25	16	9
Re-Identified and Still Used	.	.	.	.	.	.	.	.	.	.	.
SMR/SMR L1	145	262	271	.	.	249	562	632	731	913	912

Note: The SMR L1 was not used in 2010 and 2011 due to the exclusive use of the SMR L2 in total reverse shoulder replacement

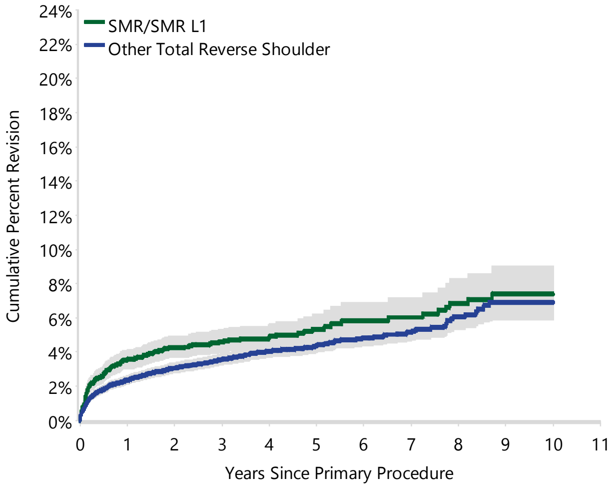
Newly Identified

Figure IP9 Cumulative Percent Revision of Newly Identified Total Reverse Shoulder Prostheses



Re-identified and Still Used

Figure IP10 Cumulative Percent Revision of Re-identified and Still Used Individual Total Reverse Shoulder Prostheses



PRIMARY TOTAL ANKLE REPLACEMENT

There are no newly identified total ankle prostheses.

Table IP31 Revision Rate of Individual Total Ankle Prostheses Identified as having a Higher than Anticipated Rate of Revision

Talar/Tibial Tray	N Revised	N Total	Obs. Years	Revisions/ 100 Obs. Yrs	Hazard Ratio, P Value
Identified and no longer used	.	.	.	.	
S.T.A.R/S.T.A.R	8	48	182	4.38	Entire Period: HR=2.13 (1.05, 4.32),p=0.037

Note: Components have been compared to all other ankle components

Table IP32 Cumulative Percent Revision of Individual Total Ankle Prostheses Identified as having a Higher than Anticipated Rate of Revision

CPR	1 Yr	3 Yrs	5 Yrs	7 Yrs	11 Yrs
Identified and no longer used					
S.T.A.R/S.T.A.R	4.2 (1.1, 15.8)	13.8 (6.4, 28.3)	16.8 (8.3, 32.3)		

Table IP33 Yearly Usage of Individual Total Ankle Prostheses Identified as having a Higher than Anticipated Rate of Revision

Year of Implant	≤2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Identified and no longer used	.	.	.	.	.	.	.	.	.	.	.
S.T.A.R/S.T.A.R	1	.	3	3	4	2	15	12	4	4	.

Appendices

Appendices

APPENDIX 1

PARTICIPATING HOSPITALS & COORDINATORS

VICTORIA

PUBLIC HOSPITALS		PRIVATE HOSPITALS	
Austin Health	Ross Kentish/Bev Murray	Beleura Private Hospital	Jean Leyland
Bairnsdale Regional Health Service	Sian Guns	Bellbird Private Hospital	Belinda Van Denberg
Ballarat Health Services	Bernie Anderson/Kellie Livingston	Cabrini Private Hospital, Brighton	Sandy Scherer
Bass Coast Regional Health	Michelle Nicholson/Andrea Crestani	Cabrini Private Hospital, Malvern	Sandy Scherer
Bendigo Health Care Group	Catherine Jensen/Shelly Sharp	Como Private Hospital	Gillian Wilson/Nicole Groves
Box Hill Hospital	Lisa Bingham	Cotham Private Hospital	Marianne Westley
Broadmeadows Hospital	Zoe Devenish	Epworth Hospital	Lynne Moyes
Cohuna District Hospital	Karyn Storm	Epworth Eastern Hospital	Linda Dennehy
Colac Area Health	Amanda Tout	Epworth Freemason Hospital	Claudia Nozzolillo
Dandenong Hospital	Karen Ferguson/Melanie Murray	Epworth Geelong	Christina King
Djerriwarrh Health Services	Kate Anderson/Judy Dehnert	Essendon Private Hospital	Elaine Jordan
East Grampians Health Service	Jane Smith/Jenny Sargent	Frankston Private Hospital	Tracey McIndoe
Echuca Regional Health	Kerryn Giorgianni	Geelong Private Hospital	Wilna Steyn
Goulburn Valley Health	Cara Disint	Glenferrie Private Hospital	Samantha Jervios
Hamilton Base Hospital	Rosalie Broadfoot	Holmesglen Private	Nicole Groves/Gillian Wilson
Kerang District Health	Margie Christian	John Fawkner Hospital	Belinda Emmett
Kyabram & District Health Services	Lynda Walker/Lee Fleming	Knox Private Hospital	Bronwyn Hawkins/Laura Tilley
Latrobe Regional Hospital	Simone Lovison	Linacre Private Hospital	Melissa Dillon/Denice Tyler
Maroondah Hospital	Benjamin Connelly	Maryvale Private Hospital	Glenda Chambers
Mildura Base Hospital	Kaylene Miles	Masada Private Hospital	Anna Bonato/Lisa Butler
Monash Medical Centre, Clayton	Jessica Cranston	Melbourne Private Hospital	Karen Grant/Tracey Perkins
Monash Medical Centre, Moorabbin	Carol Jackson/Lisa Mason	Mildura Private Hospital	Sue Malcolm
Northeast Health Wangaratta	Lynn Reid/Larissa Benci	Mitcham Private Hospital	Julie Nankivell/Joshie Lonthyil
Peninsula Health Service, Frankston	Donna Anderson	Northpark Private Hospital	Kath Morris
Portland Hospital	Julie Sealey	Peninsula Private Hospital	Ruth Honan
Sandringham & District Memorial	Jack Gaye	Ringwood Private Hospital	Carol Burns
Seymour District Memorial Hospital	Karen Lamaro	Shepparton Private Hospital	Niki Miller
South West Healthcare	Tony Kelly	St John of God Ballarat Hospital	Gitty Mathachan
St Vincent's Public Hospital	Shazeli Osman/Amanda Vary	St John of God Bendigo Hospital	Karen Rayner
Stawell Regional Health	Sue Campigli/Judy Body	St John of God Geelong Hospital	Colin Hay
Sunshine Hospital	Cassandra Mules	St John of God Warrnambool	Leanne McPherson/Gill Wheaton
Swan Hill District Hospital	Donna Hartland	St John of God Hospital, Berwick	Rebecca Jamieson
The Alfred	Caroline McMurray	St Vincent's Private East Melb	Jan Gammon
The Northern Hospital	Siew Perry	St Vincent's Private Fitzroy	Naomi Carter/Deanna Dellevirgini
The Royal Children's Hospital	Sonia Mouat	St Vincent's Private Kew	Joy Miller/Sue Zidziunas
The Royal Melbourne Hospital	Brychelyn Bennett	The Avenue Hospital	John Davidson
Uni Hospital Geelong Barwon Health	David Barber/Michelle Quinn	The Bays	Sharon Burton/Liz Kerr
West Gippsland Healthcare Group	Stefanie Backman/Bernie Norman	The Melbourne East Private	Jay Phillpotts
West Wimmera Health Service	Kim Stasinowsky/Christine Dufty	The Valley Private Hospital	Anthony Puzon
Western Hospital	Vicki Mahaljcek/Cassandra Mules	Wangaratta Private Hospital	Janet McKie
Williamstown Hospital	Paul Buso/Maureen Clark	Warringal Hospital	Marilyn Dey/Jodie Werkowski
Wimmera Health Care Group	Maree Markby	Waverley Private Hospital	Alfred Monleon
		Western Private Hospital	Sharryn McKinley

NEW SOUTH WALES

PUBLIC HOSPITALS

Albury Base Hospital	Laurel Rhodes
Armidale Hospital	Amber Prater
Bankstown/Lidcombe Hospital	Karen Och
Bathurst Base Hospital	Kylie Peers
Blacktown Hospital	June Tsang
Bowral and District Hospital	Barbara Wise
Broken Hill Health Service	Sue Beahl/Brock Roberts
Campbelltown Hospital	Susan Birch
Canterbury Hospital	Jenny Cubitt
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
Armidale Private Hospital	Katherine Latter
Baringa Private Hospital	K Hannaford/F Howson
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
Chris O'Brian Lifehouse	Fiona Strachan
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	Melissa McLean
Hawkesbury District Health Service	Sharon Garden/Elizabeth Jones
Holroyd Private Hospital	Christine Aldana
Hospital for Specialist Surgery	Hailey MacAllister
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	Yvonne Hart
Lake Macquarie Private Hospital	Vanessa Jones/Edward Miles
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
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 Darlinghurst	Fiona Crawford/ M Hofman
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	Lucy Richardson
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

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	Michelle Lanigan/Beth Keogh
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/Emily Currie
Redland Public Hospital	Sara Mackenzie
Rockhampton Base Hospital	Gabrielle Sellen
Royal Brisbane & Women's	Emma Babao/Anna Dowe
Sunshine Coast University Hospital	Sandy Colquist
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
Holy Spirit Northside Hospital	Lexie Shannon
John Flynn Hospital	Lynda Wise
Mater Health Services North Qld	Caitlin McKenzie/Anjela Hunt
Mater Misericordiae Bundaberg	Lauren Zunker
Mater Misericordiae Gladstone	Saroj Saini
Mater Misericordiae Mackay	Judith McDonald
Mater Misericordiae Rockhampton	Michelle Havik/Tim Harkin
Mater Misericordiae Private Hospital	J Jones / M Pfeiffer / 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, Ipswitch	Mel Grant
St Andrew's Hospital, Toowoomba	Jeff van Leeuwen
St Andrew's War Memorial Hospital	Kerrie Jenkins
St Stephen's Private Hospital	Wendy McLaughlan
St Vincent's Hospital, Toowoomba	Amanda Fitzgerald
Sunnybank Private Hospital	Francina Robinston
Sunshine Coast University Private	Tanya Prother
The Sunshine Coast Hospital	Phil Hall
Wesley Hospital	Carole Gregory/Kalpana Patel

WESTERN AUSTRALIA

PUBLIC HOSPITALS

Albany Regional Hospital	Jodie Hayton
Armadale Health Service	Eleri Griffiths/Deb Carkeek
Bunbury Regional Hospital	Anthea Amonini
Fremantle Hospital	Elsy Jiji
Fiona Stanley Hospital	Jarrod Duncan
Geraldton Hospital	Vicki Richards
Kalgoorlie Regional Hospital	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	D Crowley/J Holmes/P Villanova/E Yates
Mount Hospital	Jacqui McDonald
Peel Health Campus	Geraldine Keogh
South Perth Hospital	Deb Waters
St John of God Health Care Bunbury	Alison Hawkes
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	Renae Wauchope
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/VLawrence
North Eastern Community Hospital	Anne Sciacca
Parkwynd Private Hospital	Anna-Claire Naylor
Sportsmed SA	F Penning/S Smith/K Stapleton/S McAllister
St Andrew's Private Hospital	C McAllister/L White
Stirling District Hospital	Nick Clarke/Tanya Hanlon
The Memorial Hospital	E Carroll/J Ohlson
Western Hospital	Sharon Till

TASMANIA

PUBLIC HOSPITALS

Launceston General Hospital	E Davidson/M Postmus
North West Regional, Burnie Campus	B Kerr/ R 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

AUSTRALIAN CAPITAL TERRITORY

PUBLIC HOSPITALS

The Canberra Hospital	Helen Boyd/Jose Abraham
Calvary Health Care ACT	Fiona Carruthers

PRIVATE HOSPITALS

Calvary John James Memorial Hospital	Samjith Sreesan
The National Capital Private	M Liebhardt/G Palada
Calvary Health Care ACT	Rebecca Covington
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

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.

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 (31/12/2017) 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 1/1/2017 was revised on 1/7/2017. 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 1/1/2017 died without being revised on 1/4/2017. This procedure contributes 0.25 component years.
A primary procedure occurs on 1/1/2017 and has not been revised. This procedure contributes 1 component year (as observation time is censored at 31/12/2017).

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	Tumour	*Dominant diagnosis independent of prosthesis/surgery*
2	Infection	
3	Leg Length Discrepancy	*Surgical procedure*
4	Incorrect Sizing	
5	Malposition	
6	Metal Related Pathology	*Reaction to prosthesis*
7	Loosening	
8	Lysis	
9	Wear Hip Insert	*Wear and implant breakage*
10	Wear Acetabular Cup/Shell	
11	Wear Head	
12	Implant Breakage Head	
13	Implant Breakage Stem	
14	Implant Breakage Hip Insert	
15	Implant Breakage Acetabular Cup/Shell	
16	Prosthesis Dislocation	*Stability of prosthesis*
17	Instability	
18	Fracture (Femur/Acetabular/Neck/Periprosthetic)	*Fracture of bone*
19	Chondrolysis/Acetabular Erosion	*Progression of disease on non-operated part of joint*
20	Progression of Disease	
21	Synovitis	*New diseases occurring in association with joint replacement*
22	Osteonecrosis/AVN	
23	Heterotopic Bone	
24	Pain	*Pain*
25	Other	*Remaining diagnoses*

DIAGNOSIS HIERARCHY FOR REVISION KNEE REPLACEMENT

Rank	Diagnosis	Category
1	Tumour	*Dominant diagnosis independent of prosthesis/surgery*
2	Infection	
3	Incorrect Side	*Surgical procedure*
4	Incorrect Sizing	
5	Malalignment	
6	Metal Related Pathology	*Reaction to prosthesis*
7	Loosening	
8	Lysis	
9	Wear Knee Insert	*Wear and implant breakage*
10	Wear Tibial Tray	
11	Wear Femoral	
12	Wear Patella	
13	Implant Breakage Femoral	
14	Implant Breakage Knee Insert	
15	Implant Breakage Tibial Tray	
16	Implant Breakage Patella	
17	Bearing Dislocation	*Stability of prosthesis/knee*
18	Patellar Dislocation	
19	Prosthesis Dislocation	
20	Instability	
21	Patellar Maltracking	
22	Fracture (Femur/Tibia/Patella/Periprosthetic)	*Fracture of bone*
23	Progression of Disease	*Progression of disease on non-operated part of joint*
24	Patellar Erosion	
25	Synovitis	*New diseases occurring in association with joint replacement*
26	Arthrofibrosis	
27	Osteonecrosis/AVN	
28	Heterotopic Bone	
29	Patellofemoral Pain	*Pain*
30	Pain	
31	Other	*Remaining diagnoses*

DIAGNOSIS HIERARCHY FOR REVISION SHOULDER REPLACEMENT

Rank	Diagnosis	Category
1	Tumour	*Dominant diagnosis independent of prosthesis/surgery*
2	Infection	
3	Incorrect Side	*Surgical procedure*
4	Incorrect Sizing	
5	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, Mr Jake Platt

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 a joint replacement. This operation is very successful and most people do not require any further surgery following this procedure. However, a number of people who have a joint replacement may at some time in the future require another operation on that joint. This may occur due to a variety of reasons; the most common being that the joint replacement has worn out. Furthermore, differences between the many types of artificial joints available may affect the time at which they wear out and require replacing. In order to improve the success of this surgery, the Australian Orthopaedic Association has set up a National Joint Replacement Registry so that joint replacement and prostheses can be monitored.

The purpose of the Registry is to assess the performance of all joint replacement. If a joint replacement is identified as having a problem, the Registry can assist hospitals to locate those people that may be affected. To do this it is important to record information on every person having a joint replacement. More than 90,000 people have joint replacement surgery each year in Australia. It is also important to record details on any subsequent operations and the reason the surgery was performed. By analysing this information, it will be possible to identify the cause of any problems as well as determine which types of joint replacement have the best results. To be successful, the Registry needs to gather information on as many people having joint replacement surgery as possible. 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. This information is necessary to accurately link you to the artificial joint 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 artificial joint used. No other personal information is recorded. Hospitals and Government will from time to time provide information that enables the Registry to check the accuracy of its data.

Information - *how we will keep your information confidential*
Your personal information is confidential and cannot be used outside the Registry. Procedures are in place to protect your information and to keep it confidential. When your details have been entered into the Registry your record will be given a specific Registry number. In addition, you cannot be identified in any reports produced by the Registry.

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 Registry computer.

Risks and Benefits - *to you*
There are no risks to you by having your details in the Registry. Your information is protected and we are not allowed to identify you by law. The Registry produces general reports on a variety of factors that influence the success of joint replacement surgery. This will improve the quality of future joint replacement surgery.

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 Ms Cindy Turner, 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)

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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