NATIONAL JOINT REPLACEMENT REGISTRY

AOA
AUSTRALIAN
ORTHOPAEDIC
ASSOCIATION

Hip, Knee & Shoulder Arthroplasty

ANNUAL REPORT 2017

Director: Professor Stephen Graves
E: segraves@aoanjrr.org.au

Manager: Ms Cindy Turner
E: cturner@aoanjrr.org.au

AOANJRR
SAHMRI,
North Terrace
ADELAIDE SA 5000
T: +61 8 8128 4280

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AUSTRALIAN ORTHOPAEDIC ASSOCIATION
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2017 ANNUAL REPORT

HIP, KNEE & SHOULDER ARTHROPLASTY

September 1999 to December 2016

Preface

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It is my pleasure to present the Australian Orthopaedic Association National Joint Replacement Registry (AOANJRR) 2017 Annual Report. Joint replacement is widely regarded to be amongst the most successful interventions in modern surgical practice. In 2016, almost 115,000 Australians underwent hip, knee or shoulder replacement. However, even good operations can be made better. This was the reason that the AOA established the AOANJRR in 1999. Its sole purpose is to enhance the outcomes of joint replacement surgery. It has been very successful at achieving this.

Through quality analysis and reporting of accurate, validated data on almost every joint replacement procedure undertaken in Australia, the Registry has been able to provide information that has consistently reduced the risk of revision surgery over many years. In the last year, the benefit that AOANJRR has produced was independently assessed by the Australian Commission for Safety and Quality. Their report identified a financial benefit of over $600M for the period 2003-2014. Importantly, this reflects that many Australians have and continue to benefit because of the work of the Registry. This year the AOANJRR is reporting that there continues to be ongoing improvement. The current revision burden for hip, knee and shoulder replacement is now at its lowest level since the Registry began data collection.

Each year the Annual Report provides information on new and important themes. This year is no exception. For the first time, the AOANJRR has addressed the important issue of individual surgeon and hospital variation in outcomes and examined the role that prosthesis choice has in that variation.

An important AOANJRR function is to provide individual feedback to each surgeon. During the last year, the Registry has worked hard to improve this information by providing more detailed data to enable surgeons to more comprehensively assess their individual performance. In conjunction with this, the AOA has undertaken a focused campaign and developed strategies to assist surgeons in optimising the benefit of the information provided to them.

Another important AOA initiative developed in the last 12 months has been a two-year pilot study to assess the feasibility of the AOANJRR undertaking national collection of Patient Reported Outcome Measures (PROMs). If successful, it will enable the pre-operative severity of joint disease to be more accurately assessed as well as provide the patient's perspective on the results of their surgery. It has the potential to deliver new insights into the indications and outcomes of joint replacement surgery.

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

Ian Incoll

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 basic structure of the report is similar to last year. Previously reported analysis on the outcome of primary hip, knee and shoulder replacement has been updated and extended. For this report, the analysis has been undertaken on 1,237,576 (545,831 hip, 653,480 knee and 38,265 shoulder) joint replacement procedures. Each year a number of new topics are carefully selected for more detailed analysis. This year the AOANJRR has focused on individual surgeon and hospital variation in rate of revision and how this is affected by prosthesis choice.

As in previous years, in addition to the main report the Registry is publishing supplementary reports. These include a Lay Summary and 11 different reports on arthroplasty topics. The Registry also provides detailed analysis of all prostheses identified as having a higher than anticipated rate of revision. The supplementary reports are listed in the introduction and will be available on the AOANJRR website https://aoanjrr.sahmri.com/annual-reports-2017 from 1 October 2017.

Surgeon and Hospital Variation
Individual surgeon and hospital variation in the rate of revision were determined. Specifically, for surgeon variation, this was done for both revision for any reason as well as specific reasons for revision. To present variation data, funnel plots have been used for the first time. These are explained in the relevant chapter. There are many reasons why the rate of revision varies amongst surgeons. The Registry has on this occasion specifically focused on studying the impact of prosthesis choice. This was done for both primary total conventional hip replacement and primary total knee replacement. The results for both procedures were very similar. Outcomes are improved and surgeon variation is reduced when surgeons are consistent in their use of prosthesis combinations and when they choose to use devices that are known to have a lower rate of revision.

As with surgeon variation there are many factors that may influence hospital variation. This analysis included assessing the extent of individual hospital variation for primary total conventional hip replacement used in the management of osteoarthritis and fractured neck of femur, as well as primary total knee replacement for osteoarthritis. A comparison of the rate of revision in public and private hospital systems was also undertaken, and the impact of prosthesis choice on that comparison was studied. The initial higher rate of revision observed in private hospitals for primary total conventional hip (both diagnoses) and primary total knee replacement altered when the comparison was confined to prosthesis combinations that are known to have a lower rate of revision. For primary total conventional primary hip replacement with a primary diagnosis of osteoarthritis, the rate of revision in private hospitals was less in the first month and the same as for public hospitals after that time. When this procedure was performed for a primary diagnosis of fractured neck of femur, there was no difference in the rate of revision. For primary total knee replacement, the rate of revision was lower in private hospitals when procedures using only those prosthesis combinations with a lower rate of revision were considered.

10 and 15 Year Outcome Data
The Registry continues to highlight the 10 year and 15 year cumulative percent revision of prosthesis combinations used in primary total conventional hip and primary total knee replacement. These are important milestones to benchmark comparative prosthesis performance. Applying a more stringent benchmarking approach at 10 years (explained in the relevant chapter), 19.2% of hip prosthesis combinations and 16.1% of knee prosthesis combinations achieve a 10 year superiority benchmark.

Hip Replacement Data
In 2016, hip replacement increased by 3.7% and revision burden declined to 8.9%, which is 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 in the management of fractured neck of femur. Cement fixation of the femoral component is associated with the lowest rate of revision.

There have been a number of changes in the analysis of primary total conventional hip replacement. Non cross-linked polyethylene (non XLPE) has been excluded from the fixation analysis. Consequently, the outcome of cement fixation has improved compared to that previously reported by the Registry. The rate of revision of cross-linked polyethylene (XLPE) + antioxidant is included for the first time. The follow up period is short (maximum 4 years), but at this point in time there is no difference when compared to XLPE. To reflect current surgical practice the analysis of ceramic on ceramic bearings has been limited to mixed ceramic. A separate section on the outcome of primary total conventional hip replacement for fractured neck of femur has been included for the first time. In addition, primary total conventional hip replacement is compared to primary partial hip replacement, with an analysis and explanation of competing risks also included. This approach better addresses the high but variable mortality associated with the different prosthesis classes used in fractured neck of femur, and enables a more relevant comparison of the comparative revision incidence.

The data on total resurfacing hip replacement is similar to previous years.

Knee Replacement Data

In 2016, knee replacement increased by 3.5% and revision burden declined to 7.4%. As with hip replacement, this is the lowest knee revision burden reported by the Registry. The major change in the knee replacement analysis has been the inclusion of medial pivot knee replacement as a separate class of primary total knee replacement. The rate of revision of XLPE + antioxidant is also included for the first time.

Shoulder Replacement Data

In 2016, shoulder replacement increased by 11.1% and revision burden declined to its lowest level of 9.1%. The use of total reverse shoulder replacement continues to increase and in 2016 accounted for 69.3% of all total shoulder replacements. After 3 months, total reverse shoulder replacement has a lower rate of revision compared to total conventional shoulder replacement when the SMR L2 is excluded. In primary total conventional shoulder replacement, the use of cemented glenoid fixation continues to increase and its lower rate of revision is again highlighted. Larger head sizes are associated with a lower rate of revision. There is no difference related to fixation in total reverse shoulder replacement, but there are differences related to glenosphere size when used in the management of osteoarthritis.

Prostheses with Higher than Anticipated Rates of Revision

Each year, the AOANJRR identifies prostheses with higher than anticipated rates of revision. This year, six new prostheses have been identified: one acetabular prosthesis, four hip prosthesis combinations and one primary total knee prosthesis.

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

Professor Richard de Steiger
Mr Peter Lewis
Professor Ian Harris

DIRECTOR

Professor Stephen Graves

AOANJRR STAFF

Ms Cindy Turner (Manager)
Dr Sophia Rainbird
Ms Rychelle Brittain
Ms Grace O'Donohue

Assistant Deputy Directors

Mr James Stoney
Mr Bill Donnelly

Clinical Advisors

Professor Richard Page (Upper Limb Joint Replacement)
Mr Andrew Beischer (Ankle Replacement)

SOUTH AUSTRALIAN HEALTH AND MEDICAL RESEARCH INSTITUTE STAFF

Ms Liddy Griffith
Dr Mandy Anderson
Ms Michelle Lorimer
Ms Alana Cuthbert
Ms Andrea Peng
Ms Alesha Hatton
Ms Janey Barrow
Mr Robert Armitage
Many thanks to the Data Entry Team

AOANJRR COMMITTEE

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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 2017 Hip, Knee and Shoulder Arthroplasty Report is based on the analysis of 1,237,576 (545,831 hip, 653,480 knee and 38,265 shoulder) primary and revision procedures recorded by the Registry, with a procedure date up to and including 31 December 2016. Shoulder arthroplasty has been included in this report with hip and knee arthroplasty since 2016.

In addition, there are 12 supplementary reports that complete the AOANJRR Annual Report for 2017:

1. Lay Summary – Hip & Knee 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. Metal and Ceramic Bearing Surface in Total Conventional Hip Arthroplasty
8. The Outcome of Classes of Hip and Knee Prostheses No Longer Used
9. Demographics and Outcome of Elbow and Wrist Arthroplasty
10. Demographics and Outcome of Ankle Arthroplasty
11. Demographics of Spinal Disc Arthroplasty
12. Analysis of State and Territory Health Data – All Arthroplasty 1993/1994 – 2015/2016

In addition to the 12 supplementary reports, investigations of prostheses with higher than anticipated rates of revision are published on https://aoanjrr.sahmri.com/annual-reports-2017.

All hospitals, public and private, undertaking joint replacement submit their data to the Registry. Currently, there are 310 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 (256 in 2016). 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 2016, equating to 1,871 fewer hip revisions in 2016. The percentage of revision knee procedures has declined from a peak of 8.8% in 2004 to 7.4% in 2016, equating to 834 fewer knee revisions in 2016. Revision shoulder arthroplasty peaked at 10.8% in 2012 and 2015, and has declined to 9.1% in 2016.

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, Administration Officer, Research Coordinator and Prosthesis Library 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 202 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% of joint replacement procedures undertaken in Australia. On initial submission of forms from participating hospitals, the Registry's capture rate is 96.8%. 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. This year the Registry has provided cumulative incidence of revision for primary total conventional hip replacement compared to other types of primary hip arthroplasty used for the management of fractured neck of femur.

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 5 and 6 August 2017. Members of the AOA with expertise in shoulder surgery are invited to attend a separate workshop to review this section of the report. This second workshop was held in Adelaide on 12 August 2017. 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.

2017

Surgeon and Hospital Variation

This year, the Registry reports on the variation in rate of revision between surgeons and hospitals. The purpose is to provide insight into the role of surgeon and hospital related factors in the outcome of joint replacement surgery.

The Registry has previously reported on surgeon factors such as surgeon volume (number of procedures performed each year) and surgeon experience (time since qualification). This chapter further explores surgeon variation in the rate of revision for both primary total conventional hip and primary total knee replacement, the reasons for revision and the impact of prosthesis choice on the degree of surgeon variation. In addition, it also examines the impact of prosthesis choice on hospital variation.

Funnel plots (in addition to previously used graphs) are used to display variation in revision. 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.

The degree of variation expected is displayed on the graph as yellow (95% upper confidence limit) and red (99.7% upper confidence limit) lines which indicate the upper confidence limits around the average (or overall) revision rate for all procedures (indicated by the green line).

SURGEON VARIATION

Variation between surgeons should be interpreted within the limitations of the data. Firstly, some degree of random variation between surgeons is expected. For surgeons who undertake fewer procedures, more random variation is expected; this gives rise to the 'funnel' shape of the graph, with wider confidence limits to the left of the graph.

Secondly, the variation seen between surgeons may be due to factors unrelated to surgeon performance or surgeon preference. All funnel plots in this chapter are adjusted for differences in patient age and gender, but not for other factors that may also influence the outcome. For example, a higher proportion may be expected for surgeons performing more difficult procedures.

Due to the increased variation seen with low numbers, we have restricted the graphs to only include surgeons with at least 50 procedures recorded by the Registry.

This analysis is restricted to primary total conventional hip replacement and primary total knee replacement performed for osteoarthritis since 1 January 2003. The Registry contains data on 1,427 surgeons who have performed primary hip or knee replacement surgery, 1,010 (70.8%) of which contributed new procedures in 2016. The number of surgeons that have performed 50 or more total conventional hip replacements is 651 and 50 or more total knee replacements is 800.

TOTAL CONVENTIONAL HIP REPLACEMENT

Individual surgeon variation in revision for any reason following primary total conventional hip replacement, irrespective of prostheses used, was assessed. Overall, the proportion of primary procedures revised is 4.0%. The percentage of surgeons who are outliers (above the upper 99.7% confidence limit) is 7.4% (Figure SV1). This analysis was repeated excluding large head metal/metal prostheses, for which the overall proportion of procedures revised is 3.3% and the percentage of surgeon outliers is 6.8% (Figure SV2).

Figure SV1 Funnel Plot of Primary Total Conventional Hip Replacement by Surgeon (Primary Diagnosis OA, Revision for Any Reason)

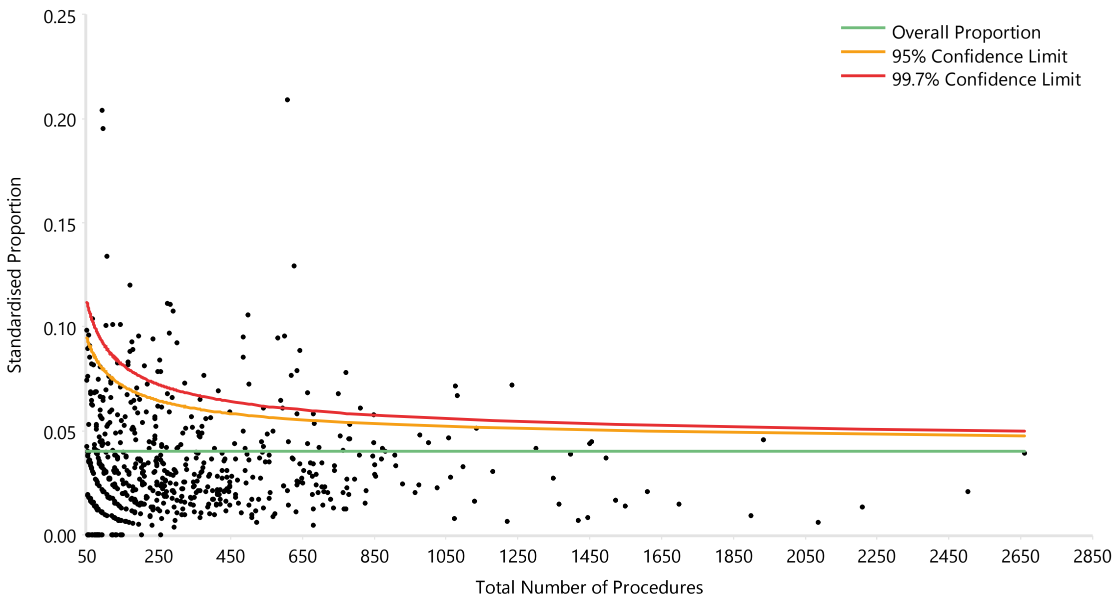
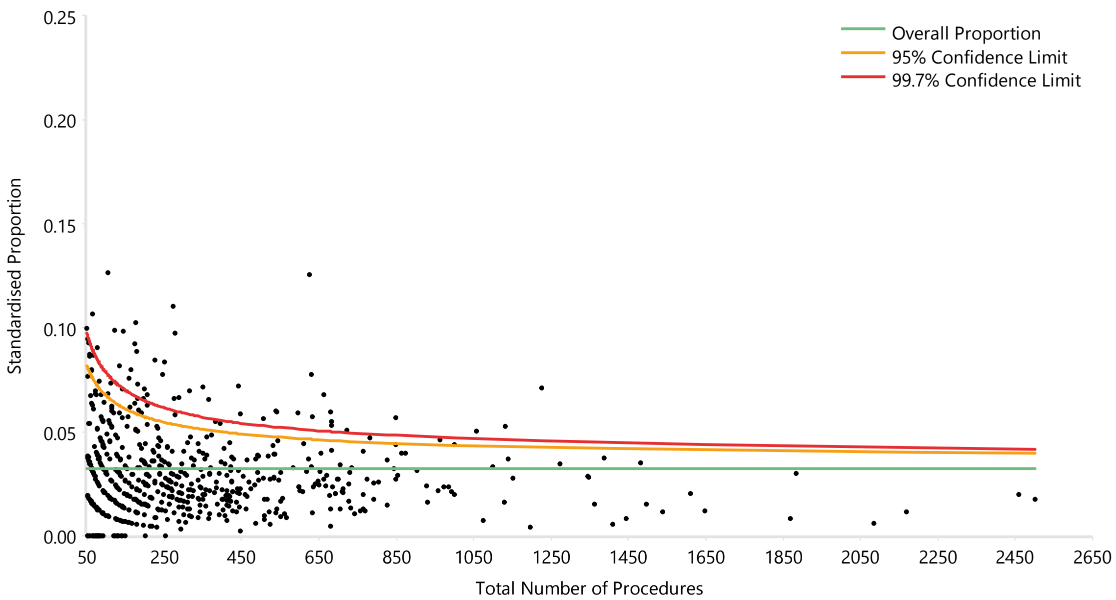


Figure SV2 Funnel Plot of Primary Total Conventional Hip Replacement by Surgeon (Primary Diagnosis OA, Excluding Large Head (>32mm) Metal/Metal, Revision for Any Reason)

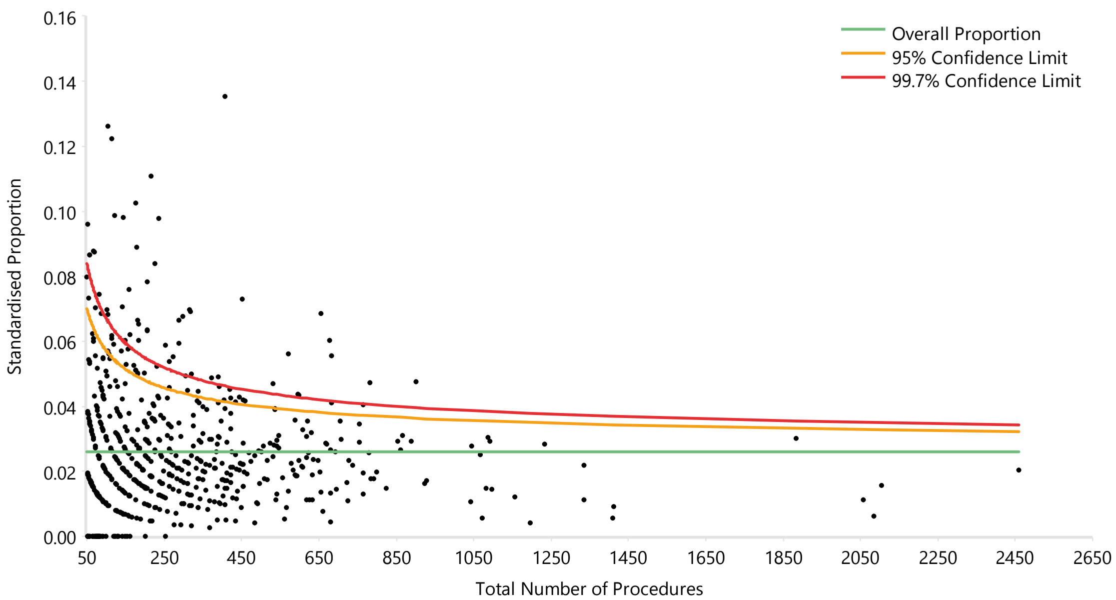


Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

The analysis excluding large head metal/metal prostheses was repeated but restricted to procedures performed from 2008 to 2016. This period was selected for several reasons, the most important being that 2008 was the first year the Registry could reliably link almost all procedures to specific surgeons. In addition, the outcomes during this period more accurately reflect current surgical practice. For this period, the overall proportion of procedures revised is 2.6% and the percentage of surgeon outliers is 7.9% (Figure SV3).

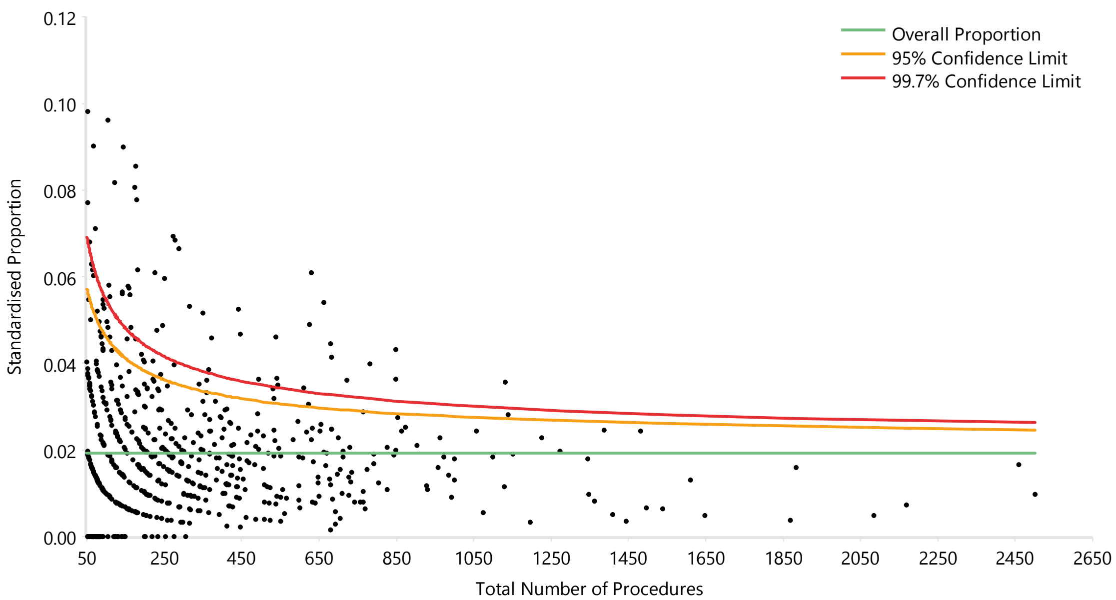
Further restricting the analysis to a shorter follow up time (two years) minimises the impact of revision for reasons such as implant wear, and focuses the analysis more on surgeon factors. The proportion of procedures revised for any reason within two years is 1.9% and the percentage of surgeon outliers is 7.4% (Figure SV4).

Figure SV3 Funnel Plot of Primary Total Conventional Hip Replacement by Surgeon performed from 1 January 2008 (Primary Diagnosis OA, Revision for Any Reason)



Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Figure SV4 Funnel Plot of Primary Total Conventional Hip Replacement by Surgeon (Primary Diagnosis OA, Revision for Any Reason Within 2 Years)



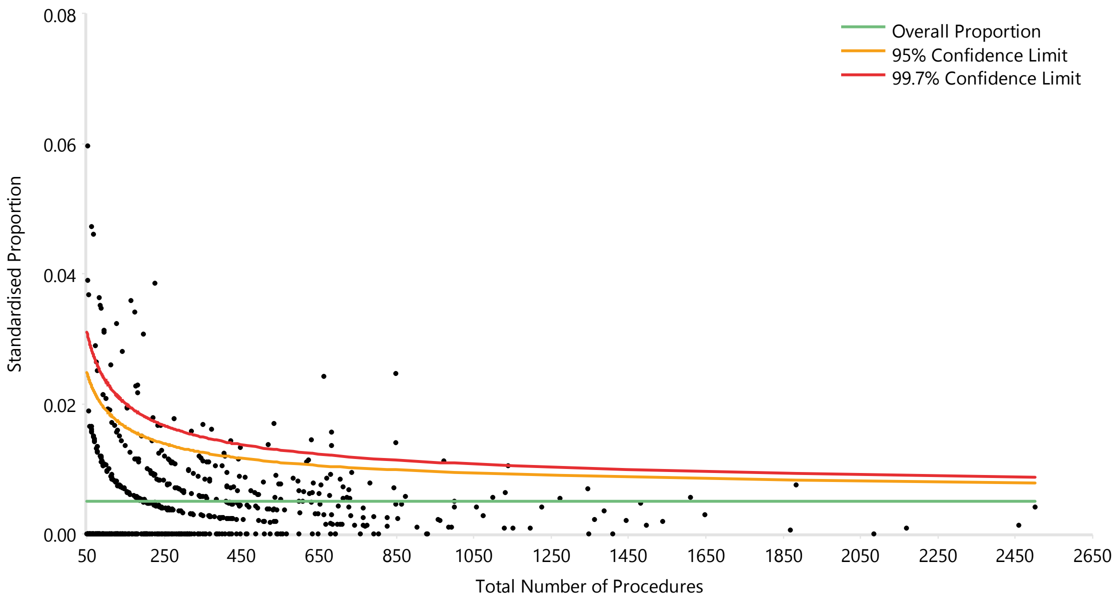
Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

An analysis was undertaken to determine the percentage of surgeon outliers for specific reasons for revision. The four most common reasons for revision of primary total conventional hip replacement are: dislocation, infection, fracture and loosening. Knowing the reason and timing of the revision has the potential to enable surgeons to identify modifiable factors, which may enable them to enhance the outcomes of their surgery.

The proportion of procedures revised within two years for dislocation, infection, fracture and loosening are 0.51%, 0.45%, 0.38% and 0.37%, respectively. The percentage of surgeon outliers for each of these revision diagnoses is 5.9%, 6.2%, 3.9%, and 5.4% respectively (Figures SV5 to SV8).

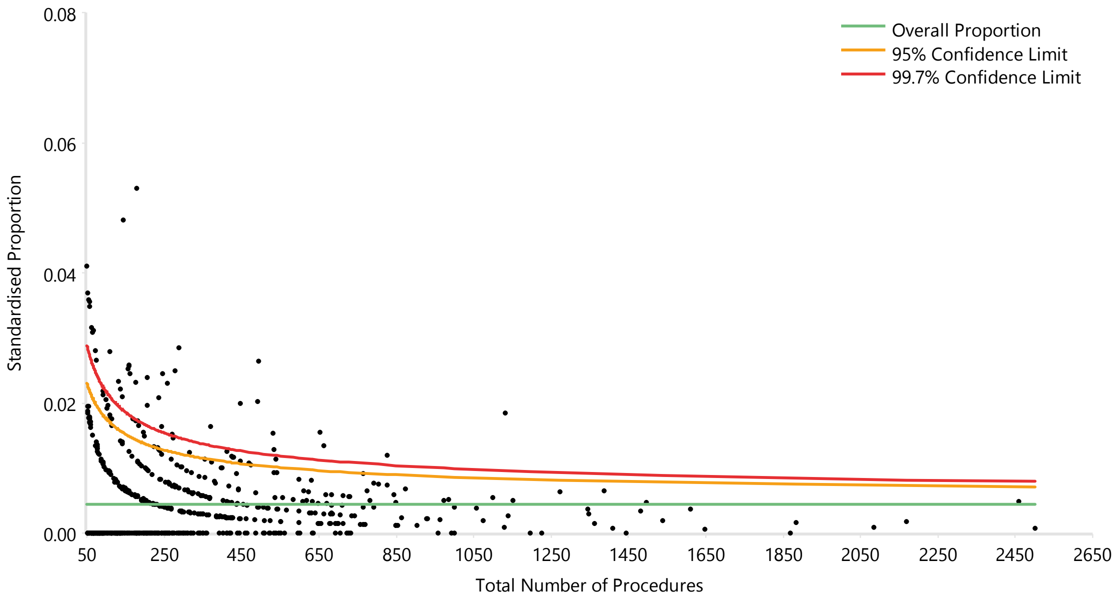
Of the 122 surgeon outliers in these four plots, 87.7% appear in one, 11.5% appear in two and 0.8% appear in three plots.

Figure SV5 Funnel Plot of Primary Total Conventional Hip Replacement by Surgeon (Primary Diagnosis OA, Revision for Prosthesis Dislocation Within 2 Years)



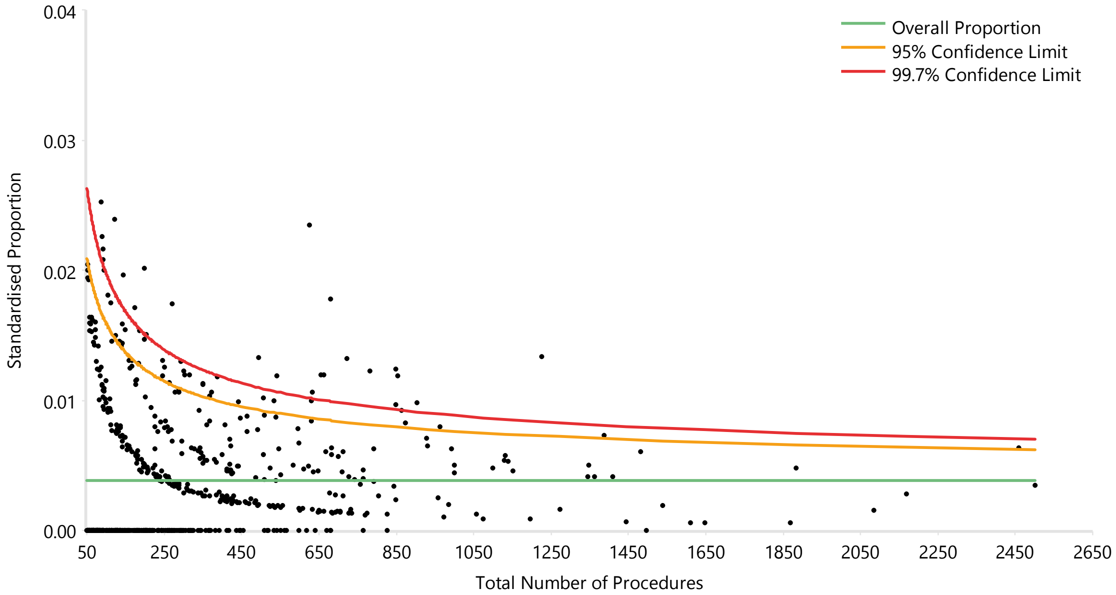
Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Figure SV6 Funnel Plot of Primary Total Conventional Hip Replacement by Surgeon (Primary Diagnosis OA, Revision for Infection Within 2 Years)



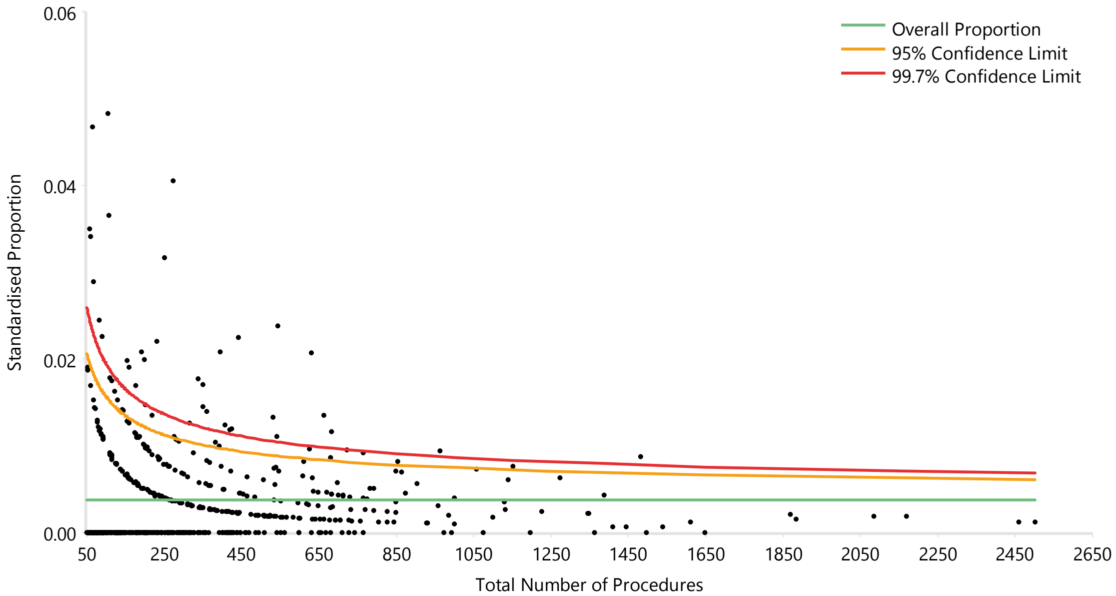
Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Figure SV7 **Funnel Plot of Primary Total Conventional Hip Replacement by Surgeon (Primary Diagnosis OA, Revision for Fracture Within 2 Years)**



Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Figure SV8 **Funnel Plot of Primary Total Conventional Hip Replacement by Surgeon (Primary Diagnosis OA, Revision for Loosening Within 2 Years)**



Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

PROTHESIS CHOICE

The effect of prosthesis choice on surgeon variation was explored. Two approaches were used. The first involved assessing the rate of revision based on the consistency of prosthesis combinations used by a surgeon. The second compared the extent of surgeon variation when only better performing prosthesis combinations were used.

Consistency of Prosthesis Use

This analysis is based on the proportion of procedures where a surgeon used up to two prosthesis combinations. As an example, a figure of 75% for a given surgeon means that they used two prostheses for 75% of all their procedures. In the remaining 25%, different prosthesis combinations were used. The Registry regards this as a measure of surgeon consistency in prosthesis choice.

Surgeons were then grouped according to consistency. Three surgeon groups were selected: when a surgeon used a maximum of two prosthesis combinations in more than 90%, 70 to 90% and less than 70% of their procedures.

Two prosthesis combinations were chosen, as surgeons will often use two different prosthesis combinations depending on the clinical indications. Due to limitations in surgeon specific data prior to 2008, and to provide more recent data, this analysis was restricted to procedures from 2008. The number of surgeons in each group is shown in Table SV1.

Table SV1 Number of Surgeons within each Prosthesis Consistency Group

Prosthesis Consistency Group	N Surgeons
>90%	224
70-90%	213
<70%	185

The cumulative percent revision decreases with increased surgeon consistency (less variability) in prosthesis choice (Table SV2 and Figure SV9). This indicates that surgeons who are more consistent in prosthesis choice have a lower rate of revision.

Surgeons who are more consistent in prosthesis choice have a lower rate of revision.

Use of Better Performing Prostheses

An analysis was undertaken to determine if the association between consistency and a lower rate of revision may be due to preferential selection of better performing prosthesis combinations by surgeons using fewer devices. The 10 prosthesis combinations with the lowest cumulative percent revision at five years and at least 1,000 procedures were chosen for this analysis. The number of prosthesis combinations (10) was chosen to focus on the effect of prosthesis choice and still provide enough data (procedure numbers) to preserve statistical power. There are many prosthesis combinations with a similar low rate of revision that were not included in this analysis.

Surgeons with greater consistency in prosthesis choice are more likely to use these 10 prosthesis combinations (30.8% compared to 25.3% and 17.4% for the other two surgeon groups) (Table SV3).

The cumulative percent revision for each surgeon group, restricted to procedures using these 10 prosthesis combinations, is provided in Table SV4 and Figure SV10. After six months, there is no difference in outcome between surgeon groups when these 10 prosthesis combinations are used.

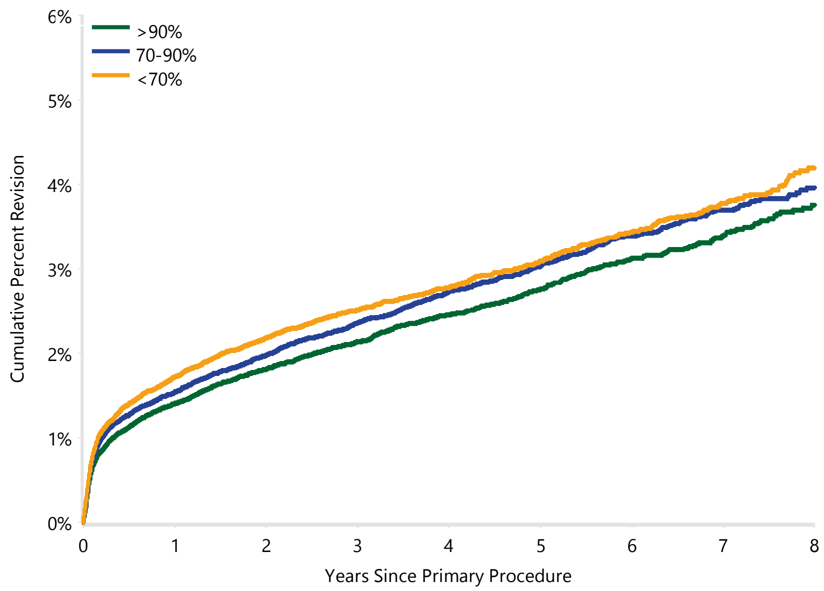
The role of prosthesis selection was also evaluated by determining the percentage of surgeon outliers when the 10 prosthesis combinations with the lowest five year cumulative percent revision were used, compared to when all other prosthesis combinations were used. The proportion of surgeon outliers when the 10 prosthesis combinations with the lowest five year cumulative percent revision were used is 1.7% and when all other prosthesis combinations were used the proportion of surgeon outliers is 7.8% (Figures SV11 and SV12).

Table SV2 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Prosthesis Consistency (Primary Diagnosis OA)

Prosthesis Consistency	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	6 Yrs	7 Yrs	8 Yrs
>90%	1424	60949	1.4 (1.3, 1.5)	2.1 (2.0, 2.3)	2.8 (2.6, 2.9)	3.1 (2.9, 3.3)	3.4 (3.2, 3.6)	3.8 (3.5, 4.0)
70-90%	1609	64522	1.5 (1.4, 1.6)	2.4 (2.2, 2.5)	3.0 (2.9, 3.2)	3.4 (3.2, 3.6)	3.7 (3.5, 3.9)	4.0 (3.7, 4.2)
<70%	1704	64170	1.7 (1.6, 1.8)	2.5 (2.4, 2.6)	3.1 (2.9, 3.3)	3.4 (3.3, 3.6)	3.8 (3.6, 4.0)	4.2 (3.9, 4.5)
TOTAL	**4737**	**189641**						

Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Figure SV9 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Prosthesis Consistency (Prosthesis Combinations) (Primary Diagnosis OA)



HR - adjusted for age and gender

70-90% vs >90%

Entire Period: HR=1.09 (1.02, 1.17),p=0.016

<70% vs >90%

0 - 1Mth: HR=1.18 (1.05, 1.34),p=0.006

1Mth - 3Mth: HR=1.24 (1.06, 1.44),p=0.006

3Mth - 6Mth: HR=1.31 (1.07, 1.61),p=0.009

6Mth+: HR=1.07 (0.98, 1.18),p=0.127

<70% vs 70-90%

Entire Period: HR=1.05 (0.98, 1.12),p=0.153

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	6 Yrs	7 Yrs	8 Yrs
>90%	60949	50942	33203	19336	12915	7534	3015
70-90%	64522	53034	33691	18692	12526	7416	3039
<70%	64170	53253	34693	19599	13221	7732	2956

Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Table SV3 Primary Total Conventional Hip Replacement by Prosthesis Consistency and Prosthesis Combination Used (Primary Diagnosis OA)

Prosthesis Consistency	10 Prosthesis Combinations with Lowest 5 Year CPR		Other Prosthesis Combinations		TOTAL	
	N	Row%	N	Row%	N	Row%
>90%	18752	30.8	42197	69.2	60949	100.0
70-90%	16331	25.3	48191	74.7	64522	100.0
<70%	11175	17.4	52995	82.6	64170	100.0
TOTAL	**46258**	**24.4**	**143383**	**75.6**	**189641**	**100.0**

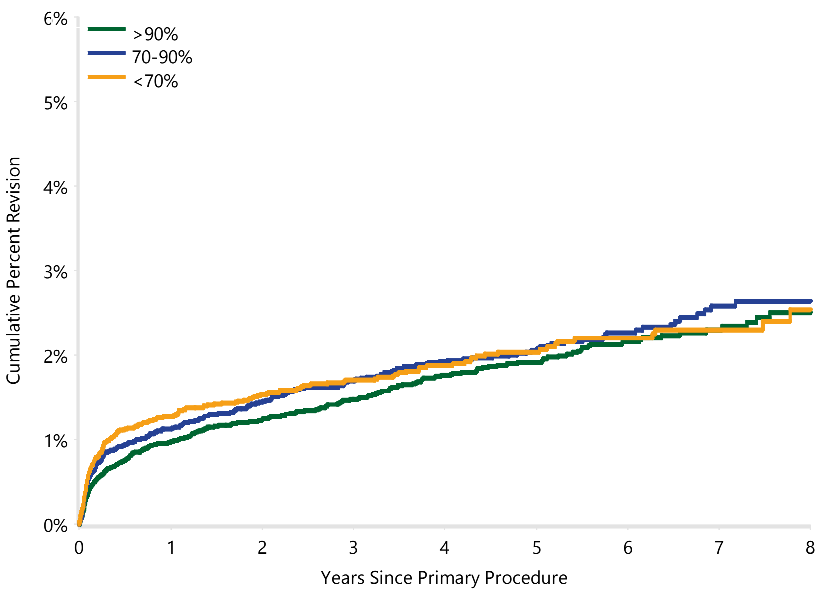
Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Table SV4 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Prosthesis Consistency, using the 10 Prosthesis Combinations with Lowest 5 Year CPR (Primary Diagnosis OA)

Prosthesis Consistency	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	6 Yrs	7 Yrs	8 Yrs
>90%	302	18752	1.0 (0.8, 1.1)	1.5 (1.3, 1.7)	1.9 (1.7, 2.2)	2.2 (1.9, 2.4)	2.3 (2.0, 2.6)	2.5 (2.2, 2.9)
70-90%	292	16331	1.1 (1.0, 1.3)	1.7 (1.5, 1.9)	2.1 (1.8, 2.3)	2.3 (2.0, 2.6)	2.6 (2.2, 3.0)	2.6 (2.3, 3.1)
<70%	200	11175	1.3 (1.1, 1.5)	1.7 (1.5, 2.0)	2.0 (1.8, 2.4)	2.2 (1.9, 2.6)	2.3 (2.0, 2.7)	2.5 (2.1, 3.1)
TOTAL	**794**	**46258**						

Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Figure SV10 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Prosthesis Consistency using the 10 Prosthesis Combinations with Lowest 5 Year CPR (Primary Diagnosis OA)



HR - adjusted for age and gender

70-90% vs >90%

Entire Period: HR=1.12 (0.95, 1.32),p=0.164

<70% vs >90%

0 - 6Mth: HR=1.42 (1.14, 1.78),p=0.002

6Mth+: HR=0.83 (0.64, 1.08),p=0.160

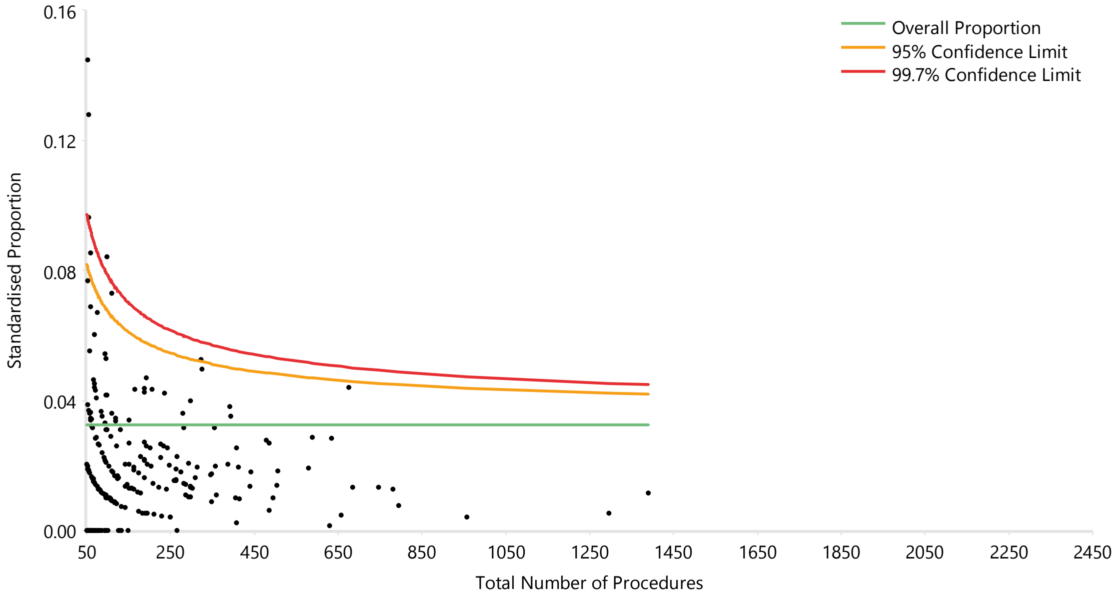
<70% vs 70-90%

Entire Period: HR=1.00 (0.83, 1.19),p=0.973

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	6 Yrs	7 Yrs	8 Yrs
>90%	18752	15789	10067	6005	4074	2472	1035
70-90%	16331	13696	9042	4980	3274	1902	726
<70%	11175	9655	6067	3303	2295	1343	525

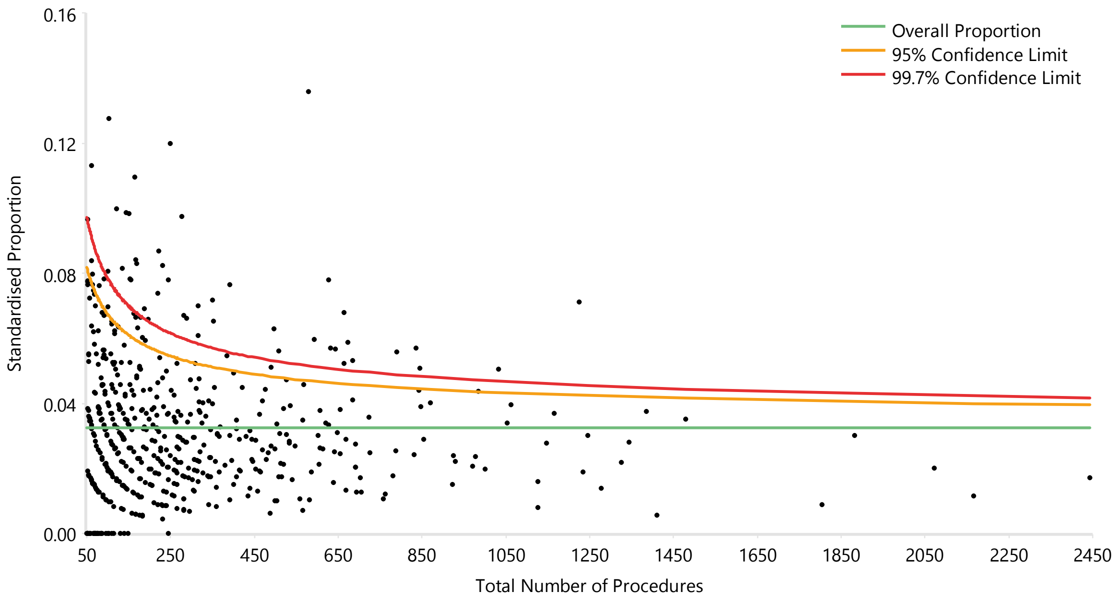
Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Figure SV11 Funnel Plot of Primary Total Conventional Hip Replacement by Surgeon (Primary Diagnosis OA, Revision for Any Reason, 10 Prosthesis Combinations with Lowest 5 Year CPR)



Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Figure SV12 Funnel Plot of Primary Total Conventional Hip Replacement by Surgeon (Primary Diagnosis OA, Revision for Any Reason, Excluding 10 Prosthesis Combinations with Lowest 5 Year CPR)



Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

PRIMARY TOTAL KNEE REPLACEMENT

This section provides a similar analysis to the previous section on hip replacement. More detailed explanation of the analysis is provided in that section.

Individual surgeon variation in revision for any reason following primary total knee replacement, irrespective of prostheses used, was assessed. Overall, the proportion of primary procedures revised is 3.7%. The percentage of surgeons who are outliers (above the upper 99.7% confidence limit) is 8.6% (Figure SV13).

Limiting this analysis to procedures undertaken between 2008 and 2016, the overall proportion of primary procedures revised is 2.8% and the percentage of surgeon outliers is 10.9% (Figure SV14). Further restricting the analysis to revisions performed within two years, the overall proportion revised is 1.8% and the percentage of surgeon outliers is 10.3% (Figure SV15).

The four most common reasons for revision are: infection, loosening, patellofemoral pain and pain. The proportion of procedures revised within two years for these four diagnoses are 0.55%, 0.38%, 0.20% and 0.15%, respectively. The percentage of surgeon outliers for each of these revision diagnoses is 5.9%, 5.8%, 5.0% and 4.4%, respectively.

Of the 128 surgeon outliers in these four funnel plots, 75.8% appear in one, 18.0% appear in two, 5.5% appear in three and 0.8% appear in all four funnel plots (Figures SV16 to SV19).

Figure SV13 Funnel Plot of Primary Total Knee Replacement by Surgeon (Primary Diagnosis OA, Revision for Any Reason)

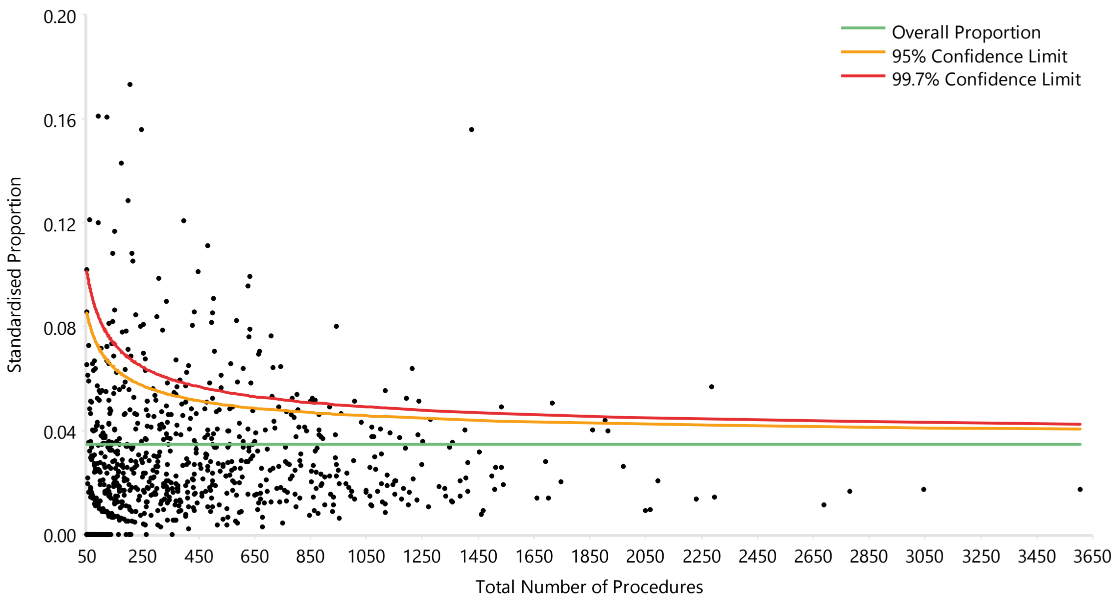


Figure SV14 Funnel Plot of Primary Total Knee Replacement by Surgeon performed from 1 January 2008 (Primary Diagnosis OA, Revision for Any Reason)

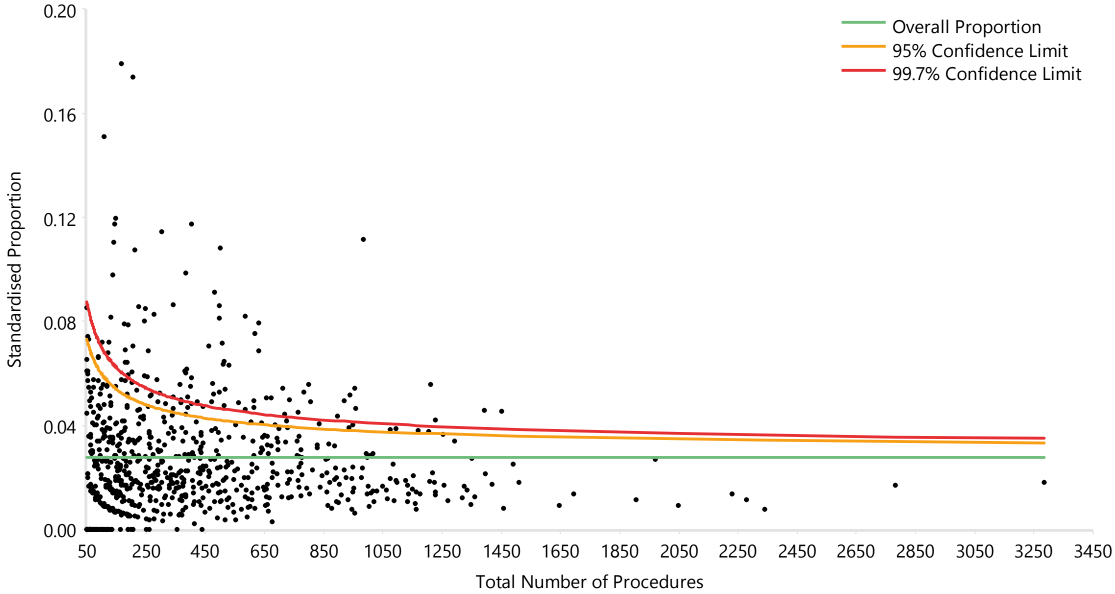


Figure SV15 Funnel Plot of Primary Total Knee Replacement by Surgeon (Primary Diagnosis OA, Revision for Any Reason Within 2 Years)

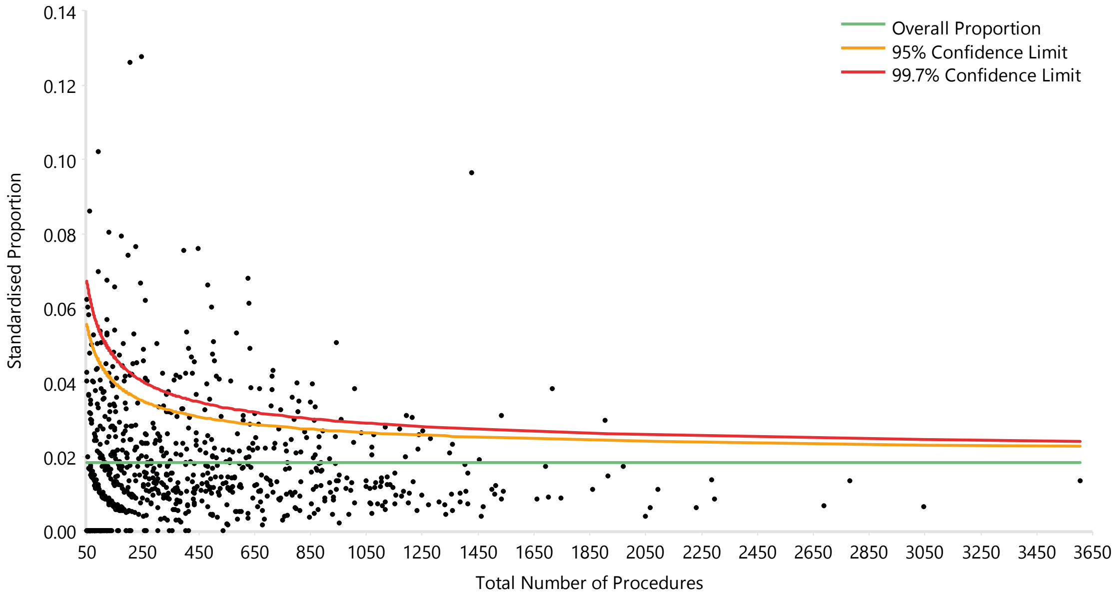


Figure SV16 Funnel Plot of Primary Total Knee Replacement by Surgeon (Primary Diagnosis OA, Revision for Infection Within 2 Years)

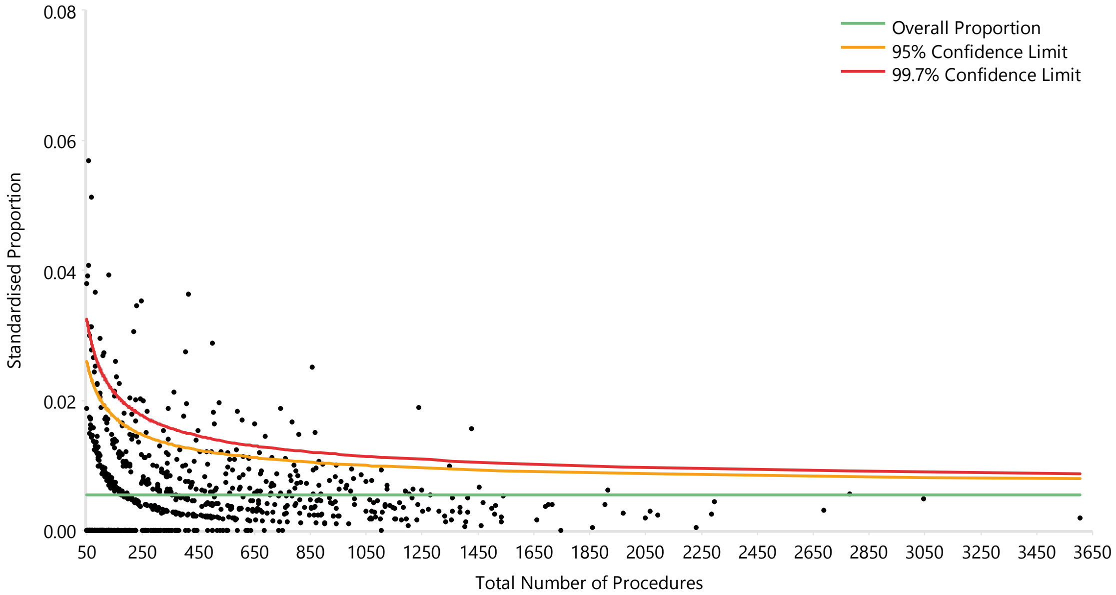


Figure SV17 Funnel Plot of Primary Total Knee Replacement by Surgeon (Primary Diagnosis OA, Revision for Loosening Within 2 Years)

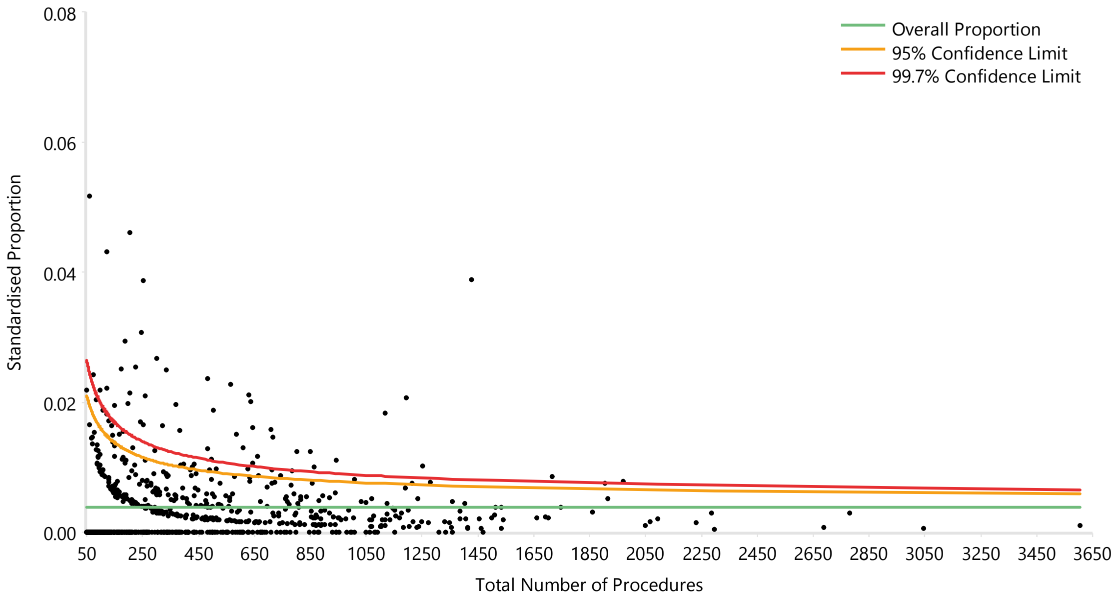


Figure SV18 Funnel Plot of Primary Total Knee Replacement by Surgeon (Primary Diagnosis OA, Revision for Patellofemoral Pain Within 2 Years)

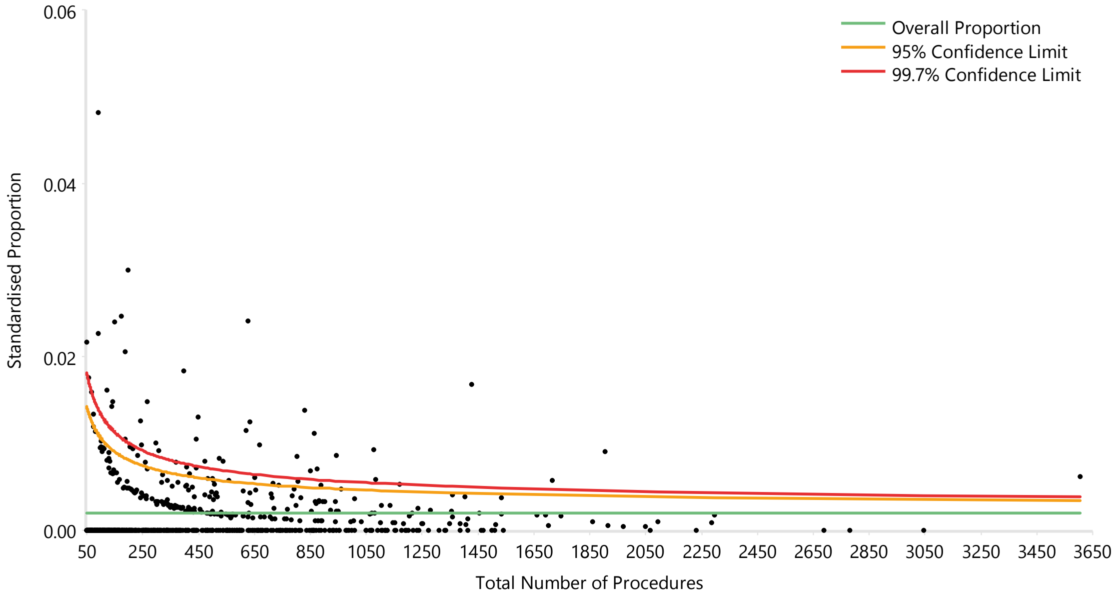
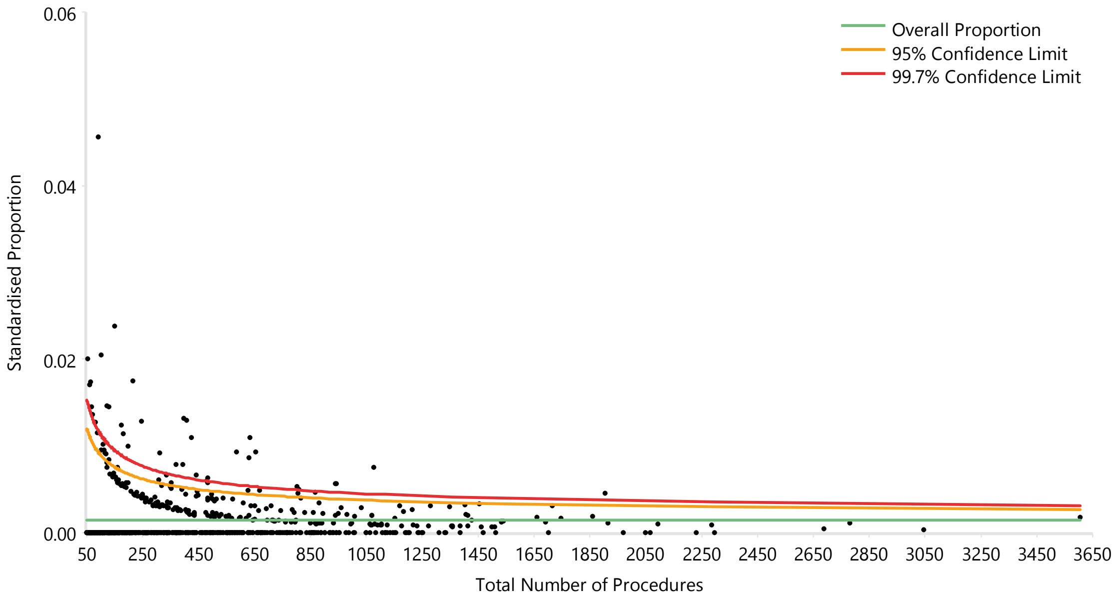


Figure SV19 Funnel Plot of Primary Total Knee Replacement by Surgeon (Primary Diagnosis OA, Revision for Pain Within 2 Years)



PROSTHESIS CHOICE

The effect of prosthesis choice on surgeon variation following primary total knee replacement, was explored. Two approaches were used. The first involved assessing the rate of revision based on the consistency of prosthesis combinations used by a surgeon. The second compared the extent of surgeon variation when only better performing prosthesis combinations were used.

Consistency of Prosthesis Use

Surgeons were divided into three groups based on the proportion of procedures in which they used their preferred knee prosthesis combination. Unlike in the hip analysis, the knee analysis was limited to one rather than two prosthesis combinations. The three groups were: >90%, 70-90% and <70%. The number of surgeons in each group is shown in Table SV5.

Table SV5 Number of Surgeons within each Prosthesis Consistency Group

Prosthesis Consistency	N Surgeons
>90%	197
70-90%	227
<70%	353

The group with least consistency (<70%) had the highest rate of revision compared to the other two groups (Table SV6 and Figure SV20).

The association between consistency and preferential selection of prostheses was examined. The 10 prosthesis combinations with the lowest cumulative percent revision at five years and used in at least 1,000 procedures, were chosen for this analysis. It should be noted that there are many other prosthesis combinations with a low rate of revision that were not included in the analysis. These 10 were chosen simply to test the effect of prosthesis choice.

Surgeons with less consistency were less likely to use the 10 prosthesis combinations with the lowest five year cumulative percent revision (26.6% compared to 41.7% and 45.7%) (Table SV7).

The rate of revision for the three surgeon groups when only these 10 prosthesis combinations were used is reduced for each group. However, the <70% group continues to have a higher rate of revision compared to the other two groups (Table SV8 and Figure SV21).

Use of Better Performing Prostheses

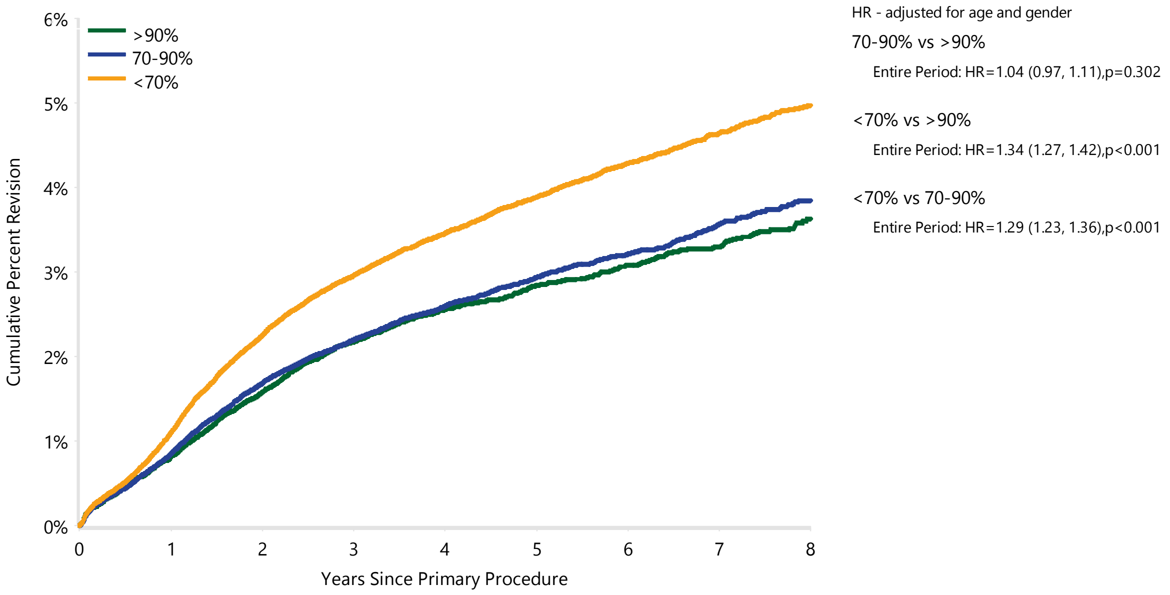
The role of prosthesis selection was also evaluated by determining the percentage of surgeon outliers when the 10 prosthesis combinations with the lowest five year cumulative percent revision were used, compared to when all other prosthesis combinations were used. The number of surgeon outliers when the 10 prosthesis combinations with the lowest five year cumulative percent revision were used, was 1.0% compared to 14.1% when all other prosthesis combinations were used (Figures SV22 and SV23). This indicates that the proportion of surgeon outliers is largely explained by prosthesis choice.

The proportion of surgeon outliers is largely explained by prosthesis choice.

Table SV6 Cumulative Percent Revision of Primary Total Knee Replacement by Prosthesis Consistency (Primary Diagnosis OA)

Prosthesis Consistency	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	6 Yrs	7 Yrs	8 Yrs
>90%	1492	68443	0.8 (0.7, 0.9)	2.2 (2.1, 2.3)	2.8 (2.7, 3.0)	3.1 (2.9, 3.2)	3.3 (3.1, 3.5)	3.6 (3.4, 3.9)
70-90%	1986	88276	0.9 (0.8, 0.9)	2.2 (2.1, 2.3)	2.9 (2.8, 3.1)	3.2 (3.1, 3.4)	3.6 (3.4, 3.8)	3.8 (3.6, 4.1)
<70%	5042	167545	1.1 (1.1, 1.2)	3.0 (2.9, 3.1)	3.9 (3.8, 4.0)	4.3 (4.2, 4.4)	4.6 (4.5, 4.8)	5.0 (4.8, 5.1)
TOTAL	**8520**	**324264**						

Figure SV20 Cumulative Percent Revision of Primary Total Knee Replacement by Prosthesis Consistency (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	6 Yrs	7 Yrs	8 Yrs
>90%	68443	57540	37701	22155	15275	9207	3895
70-90%	88276	73734	47761	27599	18759	11442	4843
<70%	167545	141131	92340	52646	35917	21351	8817

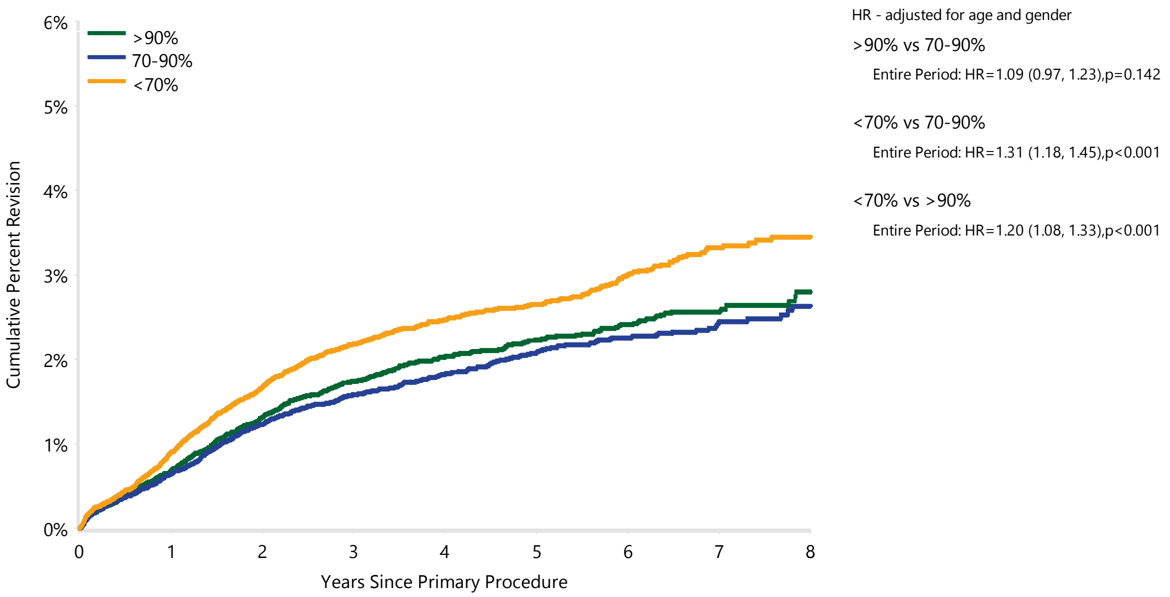
Table SV7 Primary Total Knee Replacement by Prosthesis Consistency and Prosthesis Used (Primary Diagnosis OA)

	10 Prosthesis Combinations with Lowest 5 Year CPR		Other Prostheses		TOTAL	
Prosthesis Consistency	N	Row%	N	Row%	N	Row%
>90%	31245	45.7	37198	54.3	68443	100.0
70-90%	36770	41.7	51506	58.3	88276	100.0
<70%	44638	26.6	122907	73.4	167545	100.0
TOTAL	**112653**	**34.7**	**211611**	**65.3**	**324264**	**100.0**

Table SV8 Cumulative Percent Revision of Primary Total Knee Replacement by Prosthesis Consistency using the 10 Prosthesis Combinations with Lowest 5 Year CPR (Primary Diagnosis OA)

Prosthesis Consistency	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	6 Yrs	7 Yrs	8 Yrs
>90%	526	31245	0.7 (0.6, 0.8)	1.7 (1.6, 1.9)	2.2 (2.0, 2.4)	2.4 (2.2, 2.6)	2.6 (2.3, 2.8)	2.8 (2.5, 3.1)
70-90%	570	36770	0.6 (0.6, 0.7)	1.6 (1.4, 1.7)	2.1 (1.9, 2.3)	2.3 (2.1, 2.5)	2.4 (2.2, 2.7)	2.6 (2.3, 2.9)
<70%	937	44638	0.9 (0.8, 1.0)	2.2 (2.0, 2.3)	2.7 (2.5, 2.8)	3.0 (2.8, 3.2)	3.3 (3.1, 3.6)	3.4 (3.2, 3.7)
TOTAL	**2033**	**112653**						

Figure SV21 Cumulative Percent Revision of Primary Total Knee Replacement by Prosthesis Consistency using the 10 Prosthesis Combinations with Lowest 5 Year CPR (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	6 Yrs	7 Yrs	8 Yrs
>90%	31245	25826	16493	9480	6426	3813	1526
70-90%	36770	30675	19528	10468	6655	3715	1467
<70%	44638	37775	24185	11929	7444	4186	1579

Figure SV22 Funnel Plot of Primary Total Knee Replacement by Surgeon (Primary Diagnosis OA, Revision for Any Reason, Excluding 10 Prosthesis Combinations with Lowest 5 Year CPR)

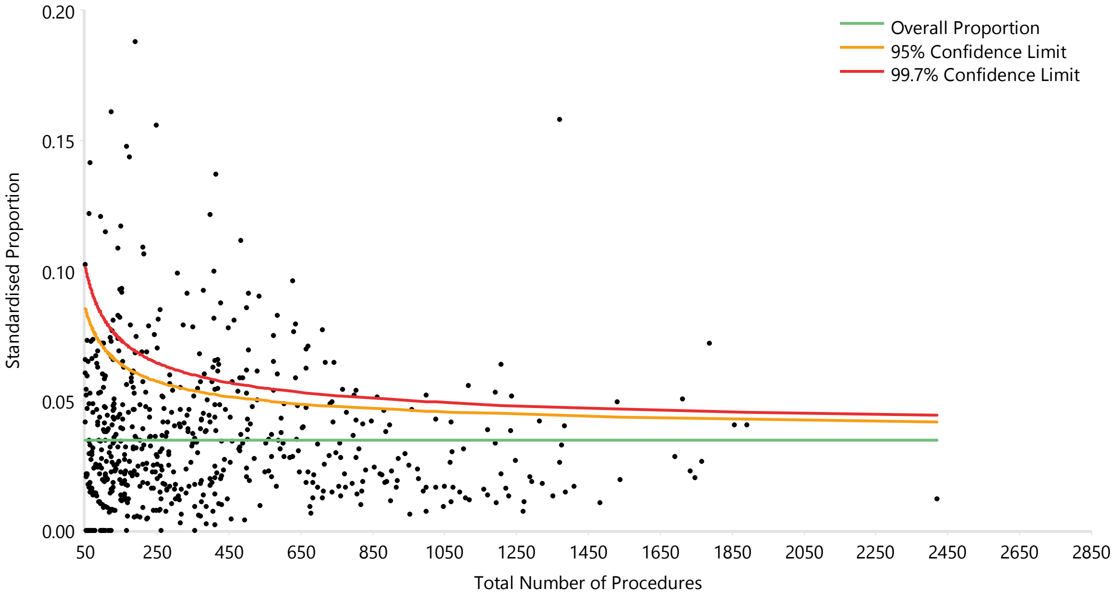
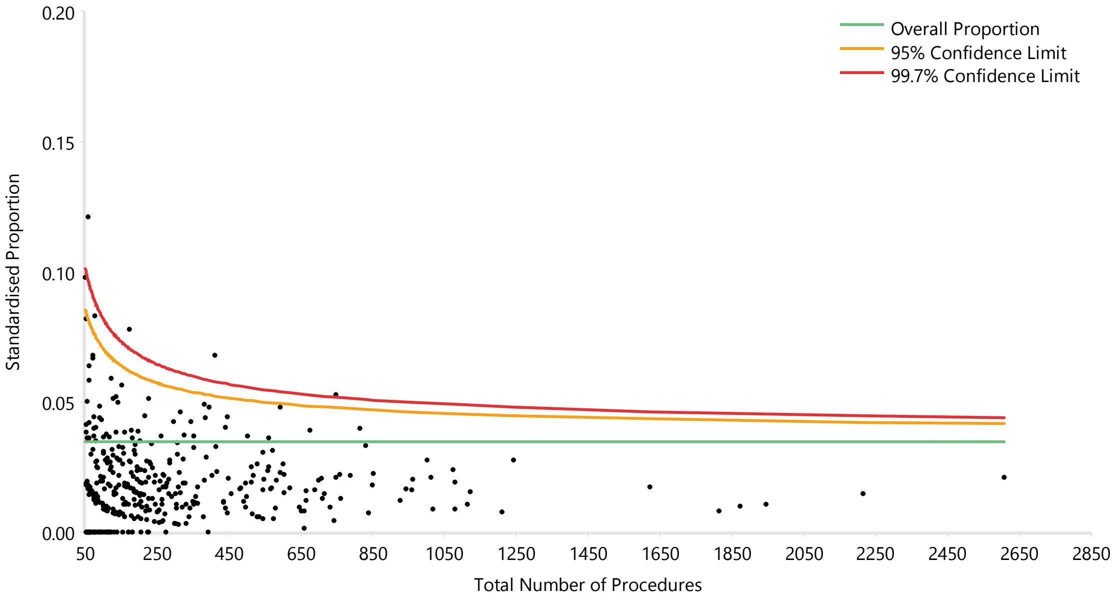


Figure SV23 Funnel Plot of Primary Total Knee Replacement by Surgeon (Primary Diagnosis OA, Revision for Any Reason, 10 Prosthesis Combinations with Lowest 5 Year CPR)



HOSPITAL VARIATION

The Registry assessed whether there was variation in revision for both primary total conventional hip and primary total knee replacement when individual hospitals were compared. Only hospitals with 50 or more procedures were included.

In addition, the rates of revision for public and private hospitals were also compared. There are many potential factors that may influence these rates. These include differences in patient characteristics, patient expectations, access to healthcare, prostheses used, and variation in surgeon experience and training. Many of these factors cannot be controlled for in this type of comparative analysis. One factor that can be controlled for is prosthesis choice. As this was identified as an important factor in surgeon variation, an analysis was undertaken to determine if prosthesis choice had an effect on the rate of revision in public and private hospitals.

PRIMARY TOTAL CONVENTIONAL HIP REPLACEMENT

Variation in revision between hospitals following primary total conventional hip replacement for osteoarthritis was assessed. The percentage of hospital outliers (above the upper 99.7% confidence limit) is 11.5% (Figure SV24).

The rate of revision following primary total conventional hip replacement (for osteoarthritis and fractured neck of femur separately) undertaken in public and private hospital groups was also compared.

For those procedures undertaken for osteoarthritis, private hospitals have a higher rate of revision after three months (Table SV9 and Figure SV25).

This difference was also evident when primary total conventional hip replacement was undertaken for fractured neck of femur (Table SV10 and Figure SV26).

Use of Better Performing Prostheses

The difference in the rate of revision between public and private hospitals was further explored by restricting the analysis to the 10 prosthesis combinations with the lowest cumulative percentage revision at five years and used in at least 1,000 procedures. The number of prosthesis combinations (10) was chosen to examine the effect of prosthesis choice. As mentioned previously in the section on surgeon variation, there are many other prosthesis combinations with a similar low rate of revision.

For procedures undertaken for osteoarthritis using only the 10 prosthesis combinations with the lowest cumulative percent revision at five years, there is a lower rate of revision in private hospitals in the first month, and no difference after that time (Table SV11 and Figure SV27).

For procedures undertaken for fractured neck of femur using only the 10 prosthesis combinations with the lowest cumulative percent revision at five years, there is no difference in the rate of revision between private and public hospitals (Table SV12 and Figure SV28).

These results suggest that the difference in the rate of revision between public and private hospitals is largely due to prosthesis choice.

The difference in rates of revision between public and private hospitals is largely due to prosthesis choice.

Figure SV24 **Funnel plot of Primary Total Conventional Hip Replacement by Hospital (Primary Diagnosis OA, Revision for Any Reason)**

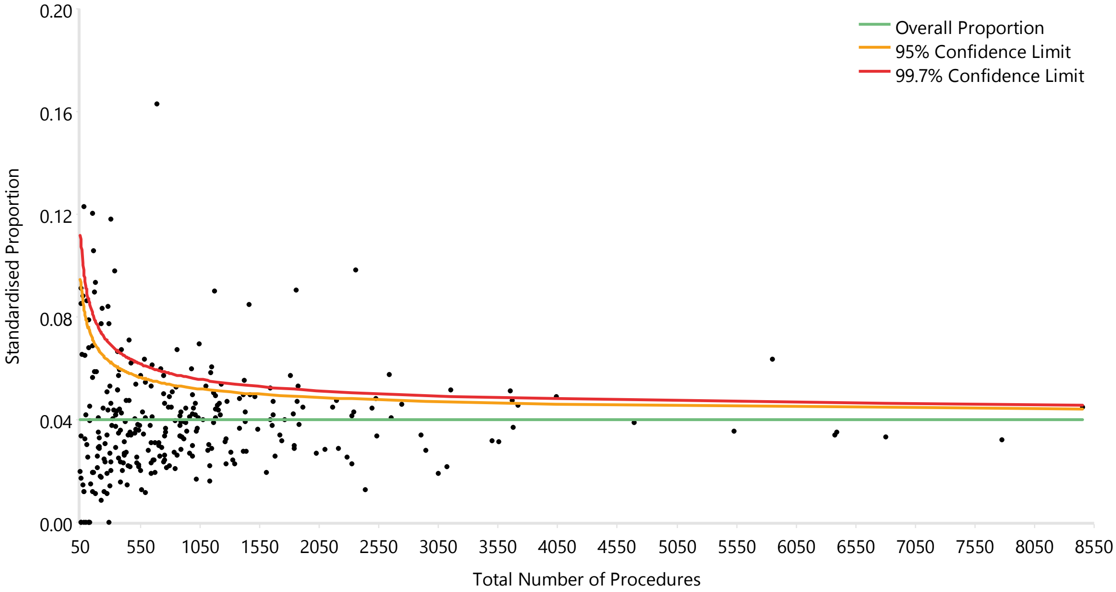
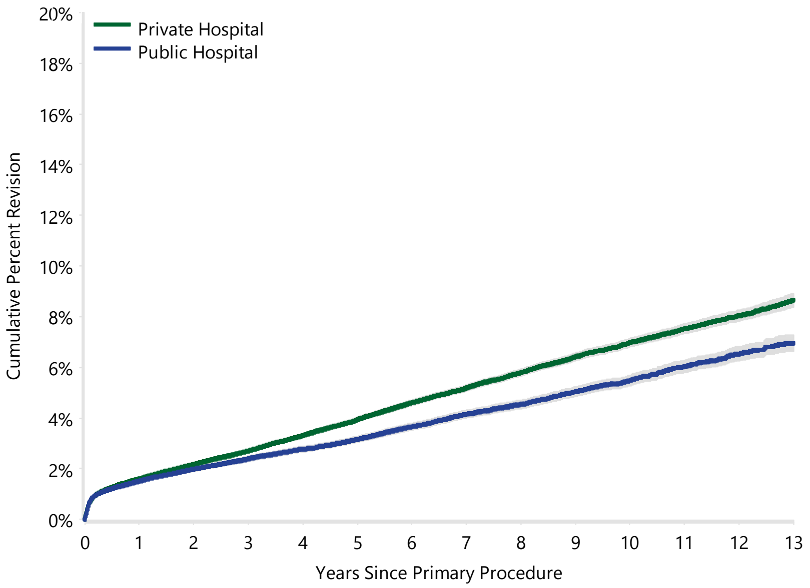


Table SV9 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Hospital Type (Primary Diagnosis OA)

Hospital Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Private Hospital	8910	210828	1.6 (1.5, 1.7)	2.7 (2.6, 2.8)	3.9 (3.8, 4.0)	5.2 (5.1, 5.3)	7.0 (6.8, 7.1)	8.7 (8.4, 8.9)
Public Hospital	3609	100931	1.5 (1.4, 1.6)	2.4 (2.3, 2.5)	3.2 (3.0, 3.3)	4.2 (4.0, 4.3)	5.5 (5.3, 5.7)	6.9 (6.6, 7.3)
TOTAL	**12519**	**311759**						

Figure SV25 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Hospital Type (Primary Diagnosis OA)



HR - adjusted for age and gender

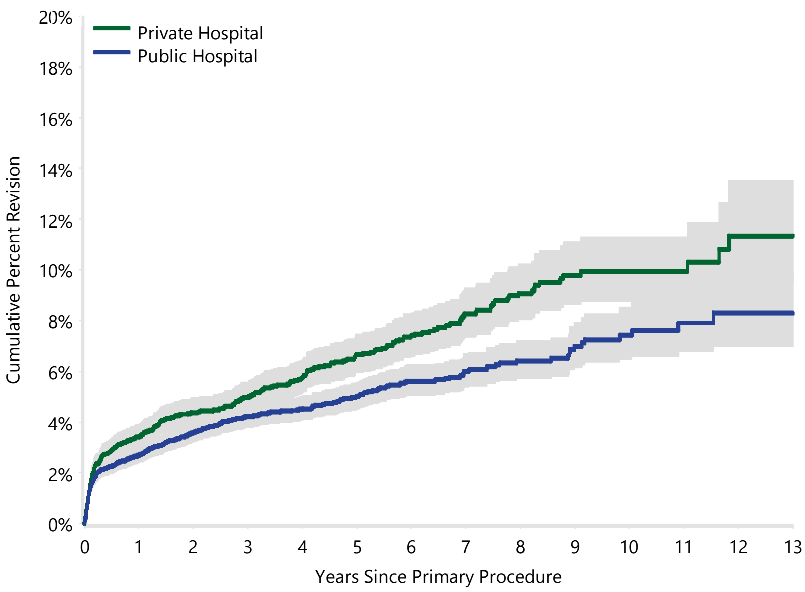
Private Hospital vs Public Hospital
0 - 2Wk: HR=1.07 (0.92, 1.23),p=0.385
2Wk - 1Mth: HR=0.89 (0.79, 1.00),p=0.053
1Mth - 3Mth: HR=1.10 (0.97, 1.24),p=0.128
3Mth+: HR=1.31 (1.25, 1.37),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Private Hospital	210828	184220	138555	99366	66029	29927	5808
Public Hospital	100931	88836	68381	50871	34854	16112	3098

Table SV10 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Hospital Type (Primary Diagnosis Fractured NOF)

Hospital Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Private Hospital	354	6118	3.4 (3.0, 3.9)	5.0 (4.4, 5.6)	6.7 (5.9, 7.5)	8.3 (7.3, 9.3)	9.9 (8.8, 11.3)	11.3 (9.5, 13.5)
Public Hospital	413	9484	2.7 (2.4, 3.1)	4.2 (3.8, 4.7)	5.0 (4.5, 5.6)	6.0 (5.4, 6.7)	7.4 (6.5, 8.5)	8.3 (7.0, 9.8)
TOTAL	**767**	**15602**						

Figure SV26 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Hospital Type (Primary Diagnosis Fractured NOF)



HR - adjusted for age and gender

Private Hospital vs Public Hospital

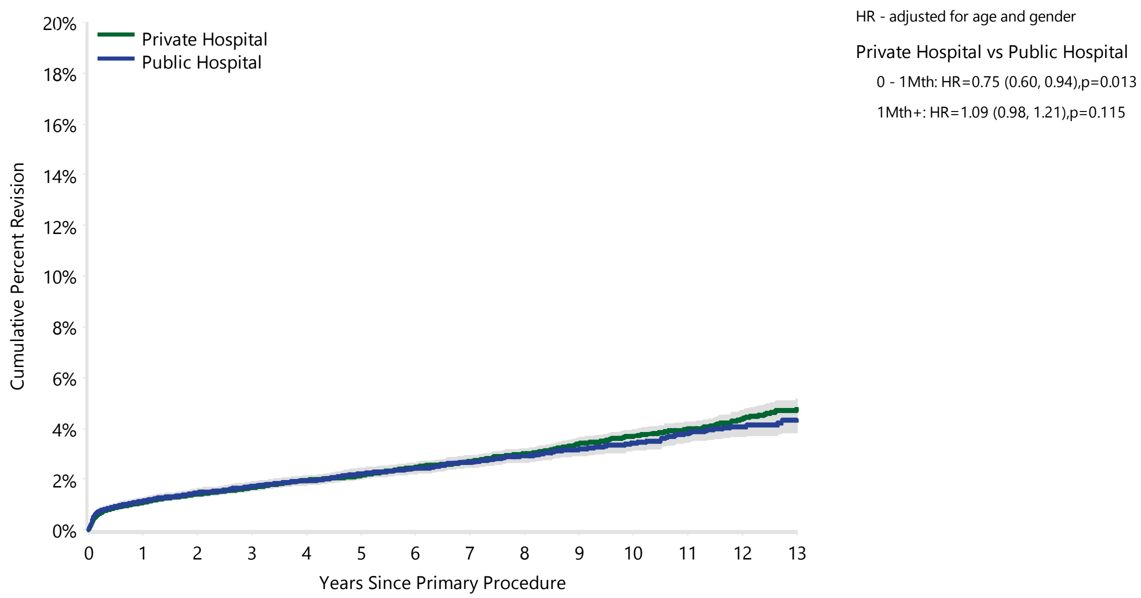
Entire Period: HR=1.40 (1.21, 1.61),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Private Hospital	6118	4752	3188	2040	1183	431	63
Public Hospital	9484	7467	4846	2975	1634	497	71

Table SV11 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Hospital Type using the 10 Prosthesis Combinations with Lowest 5 year CPR (Primary Diagnosis OA)

Hospital Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Private Hospital	1148	44909	1.1 (1.0, 1.2)	1.7 (1.6, 1.8)	2.1 (2.0, 2.3)	2.7 (2.5, 2.9)	3.7 (3.5, 3.9)	4.8 (4.4, 5.2)
Public Hospital	654	27522	1.1 (1.0, 1.3)	1.7 (1.6, 1.9)	2.2 (2.0, 2.4)	2.7 (2.5, 2.9)	3.4 (3.1, 3.7)	4.3 (3.8, 4.8)
TOTAL	**1802**	**72431**						

Figure SV27 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Hospital Type using the 10 Prosthesis Combinations with Lowest 5 year CPR (Primary Diagnosis OA)

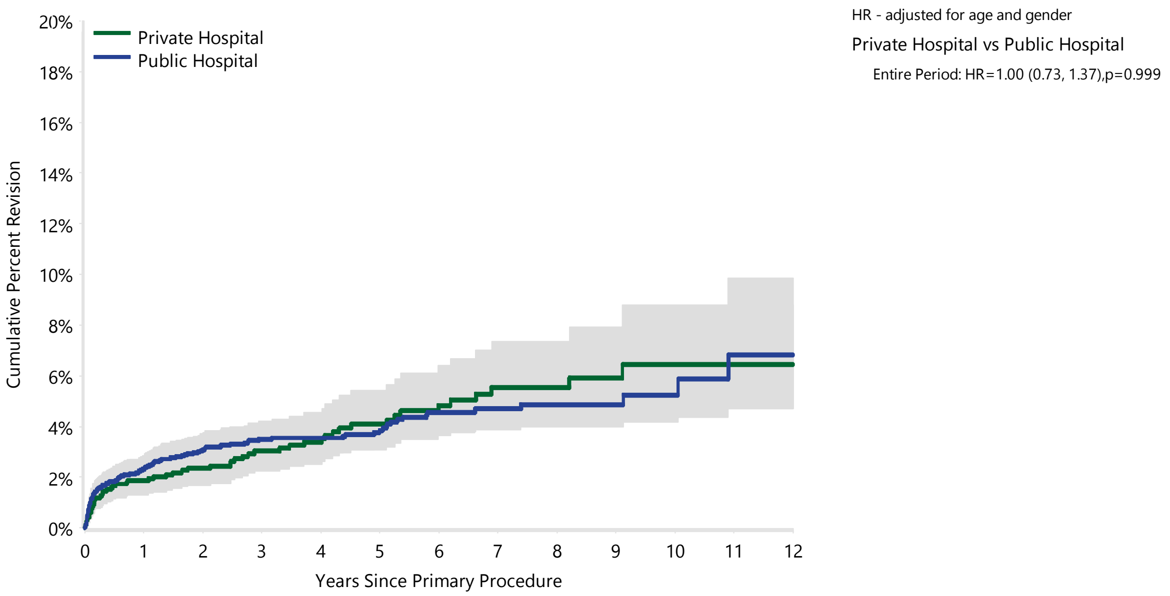


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Private Hospital	44909	40668	32326	24506	17536	9048	1671
Public Hospital	27522	24372	18710	14103	9953	4738	730

Table SV12 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Hospital Type using the 10 Prosthesis Combinations with Lowest 5 year CPR (Primary Diagnosis Fractured NOF)

Hospital Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Private Hospital	59	1634	1.9 (1.3, 2.7)	3.0 (2.2, 4.1)	4.1 (3.1, 5.4)	5.5 (4.2, 7.4)	6.4 (4.7, 8.8)	
Public Hospital	129	3688	2.3 (1.9, 2.9)	3.5 (2.9, 4.2)	3.8 (3.2, 4.6)	4.7 (3.9, 5.7)	5.2 (4.2, 6.6)	
TOTAL	**188**	**5322**						

Figure SV28 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Hospital Type using the 10 Prosthesis Combinations with Lowest 5 year CPR (Primary Diagnosis Fractured NOF)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Private Hospital	1634	1322	917	570	357	128	18
Public Hospital	3688	2927	1918	1191	631	158	19

PRIMARY TOTAL KNEE REPLACEMENT

Variation in revision between hospitals following primary total knee replacement for osteoarthritis was assessed. The percentage of hospital outliers (above the upper 99.7% confidence limit) is 15.2% (Figure SV29).

The rate of revision following primary total knee replacement for osteoarthritis, undertaken in public and private hospital groups, was also compared. Private hospitals have a higher rate of revision after four years (Table SV13 and Figure SV30).

Use of Better Performing Prostheses

The difference in the rate of revision was further explored by comparing the outcomes of all procedures performed using only the 10 prosthesis combinations with the lowest cumulative percentage revision at five years and used in at least 1,000 procedures. In this analysis, private hospitals have a lower rate of revision in the first three months and after 1.5 years (Table SV14 and Figure SV31).

As with primary total conventional hip replacement, it appears that the difference in rate of revision between private and public hospitals is largely due to prosthesis choice.

Figure SV29 Funnel plot of Primary Total Knee Replacement by Hospital (Primary Diagnosis OA, Revision for Any Reason)

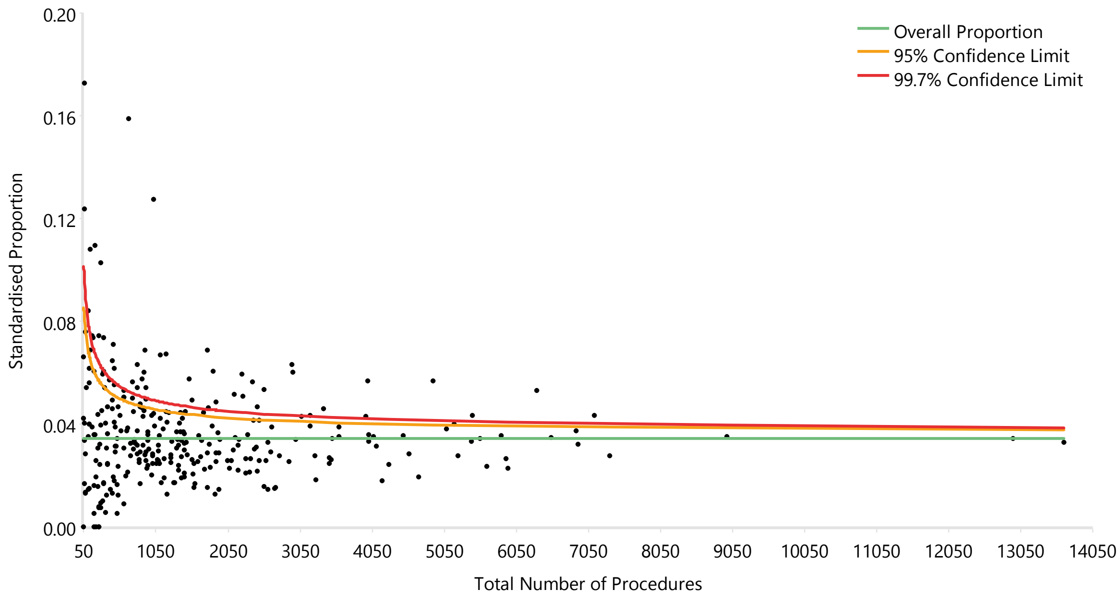
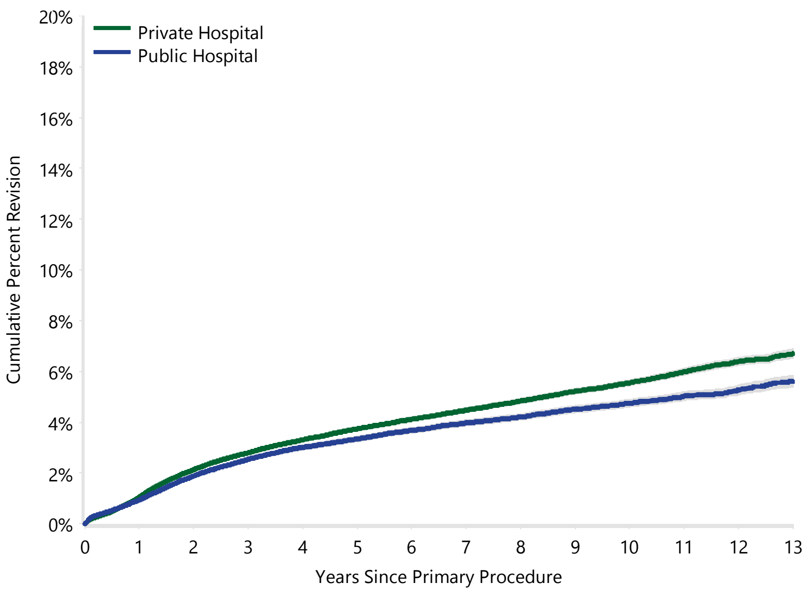


Table SV13 Cumulative Percent Revision of Primary Total Knee Replacement by Hospital Type (Primary Diagnosis OA)

Hospital Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Private Hospital	12111	338259	1.0 (1.0, 1.1)	2.8 (2.7, 2.9)	3.7 (3.7, 3.8)	4.5 (4.4, 4.6)	5.6 (5.4, 5.7)	6.7 (6.5, 6.9)
Public Hospital	5151	160642	0.9 (0.9, 1.0)	2.5 (2.5, 2.6)	3.3 (3.2, 3.4)	4.0 (3.9, 4.1)	4.7 (4.6, 4.9)	5.6 (5.4, 5.8)
TOTAL	**17262**	**498901**						

Figure SV30 Cumulative Percent Revision of Primary Total Knee Replacement by Hospital Type (Primary Diagnosis OA)



HR - adjusted for age and gender

Private Hospital vs Public Hospital

0 - 6Mth: HR=0.87 (0.80, 0.95),p=0.001

6Mth - 1Yr: HR=1.34 (1.22, 1.47),p<0.001

1Yr - 1.5Yr: HR=1.21 (1.11, 1.32),p<0.001

1.5Yr - 2.5Yr: HR=1.00 (0.93, 1.08),p=0.925

2.5Yr - 3Yr: HR=0.90 (0.79, 1.03),p=0.125

3Yr - 4Yr: HR=1.04 (0.93, 1.16),p=0.482

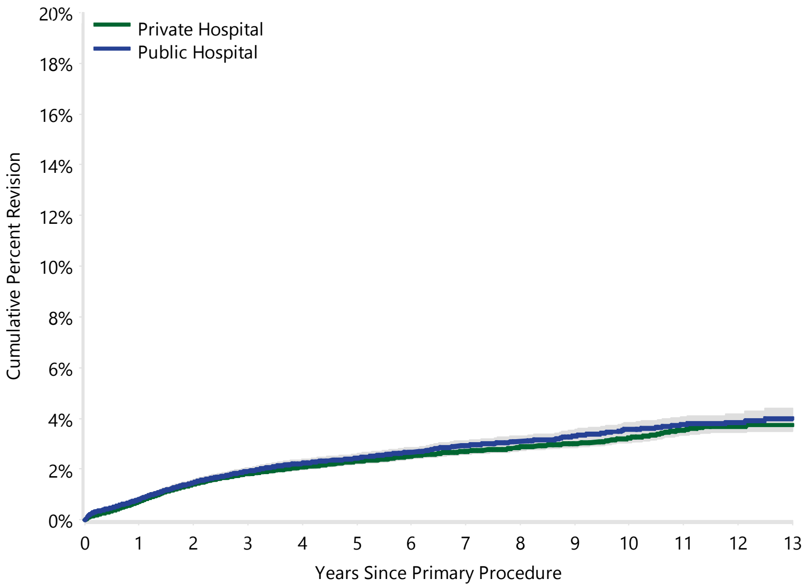
4Yr+: HR=1.24 (1.16, 1.33),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Private Hospital	338259	297471	222071	158463	104436	45000	8199
Public Hospital	160642	142391	108647	79446	53476	23973	4106

Table SV14 Cumulative Percent Revision of Primary Total Knee Replacement by Hospital Type using the 10 Prosthesis Combinations with Lowest 5 year CPR (Primary Diagnosis OA)

Hospital Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Private Hospital	2017	99701	0.7 (0.7, 0.8)	1.8 (1.7, 1.9)	2.3 (2.2, 2.4)	2.7 (2.6, 2.8)	3.2 (3.0, 3.4)	3.7 (3.5, 4.0)
Public Hospital	1131	53865	0.8 (0.7, 0.9)	1.9 (1.8, 2.1)	2.4 (2.3, 2.6)	2.9 (2.8, 3.1)	3.6 (3.3, 3.8)	4.0 (3.6, 4.4)
TOTAL	**3148**	**153566**						

Figure SV31 Cumulative Percent Revision of Primary Total Knee Replacement by Hospital Type using the 10 Prosthesis Combinations with Lowest 5 year CPR (Primary Diagnosis OA)



HR - adjusted for age and gender

Private Hospital vs Public Hospital

0 - 3Mth: HR=0.60 (0.50, 0.74),p<0.001

3Mth - 1.5Yr: HR=1.07 (0.95, 1.21),p=0.244

1.5Yr+: HR=0.89 (0.81, 0.99),p=0.033

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	13 Yrs
Private Hospital	99701	87030	62335	39921	22725	7667	1068
Public Hospital	53865	45733	32051	20045	11197	4344	722

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 9.9% and the number of individual combinations of femoral and tibial knee prostheses has increased by 21.7%.

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 78 femoral and acetabular combinations with 10 year outcome data. This is seven more than last year. These prosthesis combinations account for 61.8% of all primary total conventional hip procedures for osteoarthritis. Of these 78 combinations, 36 were not used in 2016. These 36 combinations account for 8.0% of all primary total conventional hip procedures.

The 10 year cumulative percent revision for the prosthesis combinations ranges from 1.9% to 45.8%. A commonly accepted benchmark standard is a 5% cumulative percent revision at 10 years. There are 35 (44.9%) hip prosthesis combinations with a 10 year cumulative rate of revision (for any reason) of less than 5.0%. These are indicated in bold text in Table TY1.

Recently, an international working group reviewed approaches to benchmarking hip and knee prostheses. An important recommendation was to use confidence intervals (CIs) rather than the rate of revision as used above. The reason for this is that data quality is inherently reflected in the CIs. To identify better performing prosthesis combinations, the following two approaches were recommended:

Superiority approach: the upper CI is less than, or equal to, the benchmark standard. If the benchmark is 5% at 10 years, then 15 (19.2%) hip prosthesis combinations would qualify for the superiority benchmark.

Non-inferiority approach: the permitted upper CI level is 20% above the benchmark standard. For the benchmark standard of 5% at 10 years, the accepted upper CI is 6% or less. Using this approach, an additional 11 prosthesis combinations can be benchmarked i.e. 26 (33.3%) prosthesis combinations would receive a non-inferiority benchmark.

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				1 Yr	5 Yrs	10 Yrs
				THR	Femoral	Acetabular	Other			
ABGII	ABGII	237	2755	31	116	60	30	1.7 (1.3, 2.3)	4.1 (3.4, 4.9)	6.9 (6.0, 8.0)
ABGII	ABGII (Shell/Insert)	57	841	11	32	10	4	1.4 (0.8, 2.5)	2.8 (1.9, 4.2)	6.5 (4.9, 8.7)
ABGII	Trident (Shell)	183	2383	9	111	23	40	2.6 (2.0, 3.3)	4.9 (4.1, 5.9)	8.5 (7.3, 10.0)
Accolade I	Trident (Shell)	413	8521	47	162	81	123	1.7 (1.4, 2.0)	3.8 (3.4, 4.2)	5.8 (5.2, 6.4)
Adapter	Bionik^{MoM}*	81	376	11	8	21	41	3.5 (2.0, 5.9)	15.3 (12.0, 19.5)	23.5 (19.3, 28.4)
Alloclassic	**Allofit**	**215**	**4914**	**24**	**83**	**43**	**65**	**1.2 (0.9, 1.5)**	**2.8 (2.3, 3.3)**	**4.9 (4.2, 5.6)**
Alloclassic	Durom^{MoM}*	80	547	21	12	37	10	1.3 (0.6, 2.7)	7.4 (5.5, 10.0)	16.3 (13.1, 20.2)
Alloclassic	Fitmore	118	1709	12	60	12	34	3.3 (2.5, 4.3)	5.8 (4.7, 7.0)	7.7 (6.4, 9.2)
Alloclassic	**Metasul***	**20**	**371**	**3**	**2**	**10**	**5**	**0.8 (0.3, 2.5)**	**3.6 (2.1, 6.1)**	**4.8 (3.0, 7.7)**
Alloclassic	**Trabecular Metal (Shell)**	**36**	**957**	**2**	**11**	**4**	**19**	**2.3 (1.5, 3.5)**	**3.7 (2.6, 5.2)**	**4.2 (3.0, 5.9)**
Alloclassic	**Trilogy**	**10**	**833**	**.**	**7**	**1**	**2**	**0.4 (0.1, 1.1)**	**0.5 (0.2, 1.4)**	**2.4 (1.2, 4.8)**
Anthology	**Reflection (Shell)**	**34**	**908**	**3**	**12**	**11**	**8**	**2.0 (1.3, 3.2)**	**3.2 (2.2, 4.6)**	**4.6 (3.2, 6.5)**
Apex	Fin II*	38	923	4	8	14	12	1.7 (1.1, 2.8)	3.6 (2.5, 5.1)	5.4 (3.9, 7.5)
C-Stem	Duraloc*	70	894	9	17	11	33	2.0 (1.3, 3.2)	3.8 (2.7, 5.3)	7.0 (5.4, 9.0)
C-Stem	Elite Plus LPW*	19	367	9	4	6	.	0.6 (0.1, 2.2)	2.7 (1.4, 5.0)	5.4 (3.3, 8.8)
C-Stem	**Pinnacle**	**24**	**760**	**1**	**10**	**5**	**8**	**1.7 (1.0, 3.0)**	**2.8 (1.8, 4.3)**	**4.0 (2.6, 6.2)**
CLS	Allofit	48	800	5	26	11	6	1.4 (0.8, 2.5)	3.9 (2.7, 5.5)	6.4 (4.7, 8.6)
CLS	Fitmore	46	712	5	21	7	13	2.0 (1.2, 3.3)	4.8 (3.4, 6.8)	6.2 (4.5, 8.5)
CPCS	Reflection (Cup)	51	716	18	2	20	11	0.6 (0.2, 1.5)	2.5 (1.5, 4.1)	8.8 (6.3, 12.2)
CPCS	**Reflection (Shell)**	**67**	**2616**	**6**	**27**	**10**	**24**	**0.8 (0.5, 1.2)**	**1.6 (1.2, 2.2)**	**3.6 (2.7, 4.7)**
CPT	**Allofit**	**21**	**1027**	**3**	**9**	**.**	**9**	**0.8 (0.4, 1.6)**	**2.7 (1.7, 4.1)**	**3.1 (1.9, 5.0)**
CPT	Trabecular Metal (Shell)	50	1275	4	22	8	16	1.7 (1.1, 2.6)	4.1 (3.0, 5.6)	6.5 (4.7, 9.0)
CPT	**Trilogy**	**246**	**6962**	**22**	**74**	**33**	**117**	**1.6 (1.3, 1.9)**	**3.2 (2.8, 3.7)**	**4.8 (4.1, 5.5)**
CPT	**ZCA**	**29**	**780**	**10**	**5**	**8**	**6**	**0.5 (0.2, 1.4)**	**2.4 (1.4, 3.8)**	**4.7 (3.1, 7.2)**
Charnley	Charnley Ogee*	54	630	31	7	4	12	1.1 (0.5, 2.3)	4.9 (3.5, 7.0)	8.1 (6.1, 10.8)
Charnley	Charnley*	39	563	30	6	3	.	0.5 (0.2, 1.7)	2.2 (1.3, 3.9)	6.5 (4.5, 9.4)
Charnley	Vitalock*	35	370	5	17	2	11	1.9 (0.9, 3.9)	4.4 (2.7, 7.1)	7.9 (5.5, 11.4)
Citation	**Trident (Shell)***	**42**	**1035**	**3**	**9**	**11**	**19**	**1.7 (1.1, 2.8)**	**3.2 (2.3, 4.5)**	**3.9 (2.9, 5.3)**
Citation	Vitalock*	34	508	2	5	11	16	0.4 (0.1, 1.6)	2.0 (1.1, 3.7)	5.0 (3.3, 7.4)
Corail	ASR^{MoM}*	1113	2653	196	37	837	43	2.0 (1.6, 2.7)	27.3 (25.6, 29.0)	45.8 (43.7, 48.0)
Corail	Duraloc*	64	1267	7	30	11	16	1.0 (0.6, 1.8)	2.5 (1.8, 3.6)	5.7 (4.3, 7.4)
Corail	Pinnacle	942	34210	82	314	155	391	1.6 (1.5, 1.8)	3.1 (2.9, 3.3)	5.2 (4.6, 5.8)
Corail	Pinnacle^{MoM}*	94	880	14	31	17	32	2.3 (1.5, 3.5)	6.1 (4.7, 8.0)	13.0 (10.4, 16.1)
Elite Plus	Duraloc*	97	953	14	57	6	20	1.6 (1.0, 2.6)	5.1 (3.9, 6.8)	8.8 (7.0, 10.9)
Epoch	**Trilogy***	**42**	**990**	**1**	**9**	**7**	**25**	**2.4 (1.6, 3.6)**	**3.6 (2.6, 4.9)**	**4.4 (3.2, 6.0)**
Exeter	Contemporary*	35	427	8	6	13	8	1.9 (1.0, 3.8)	4.2 (2.6, 6.6)	6.0 (4.0, 8.9)
Exeter	**Vitalock***	**58**	**1076**	**7**	**10**	**23**	**18**	**1.4 (0.8, 2.3)**	**2.3 (1.5, 3.4)**	**4.6 (3.4, 6.1)**
Exeter V40	**ABGII**	**34**	**973**	**8**	**12**	**8**	**6**	**0.8 (0.4, 1.7)**	**1.6 (1.0, 2.7)**	**3.4 (2.3, 4.8)**
Exeter V40	Contemporary	215	4398	48	38	98	31	1.4 (1.1, 1.8)	3.3 (2.8, 3.9)	5.8 (5.0, 6.7)
Exeter V40	**Exeter Contemporary**	**112**	**2821**	**32**	**28**	**31**	**21**	**1.4 (1.0, 1.9)**	**2.9 (2.3, 3.6)**	**4.5 (3.7, 5.5)**
Exeter V40	**Exeter***	**73**	**1526**	**12**	**14**	**30**	**17**	**0.9 (0.5, 1.5)**	**2.9 (2.1, 3.9)**	**4.5 (3.5, 5.8)**
Exeter V40	Hemispherical	24	655	6	5	1	12	1.8 (1.1, 3.2)	3.1 (2.0, 4.8)	5.0 (3.2, 7.8)
Exeter V40	**Mallory-Head**	**32**	**1347**	**3**	**20**	**2**	**7**	**0.5 (0.3, 1.1)**	**1.1 (0.6, 1.8)**	**2.8 (1.9, 4.2)**
Exeter V40	Pinnacle	31	1296	1	12	8	10	1.4 (0.9, 2.3)	2.3 (1.6, 3.5)	6.2 (3.1, 12.0)
Exeter V40	**Trident (Shell)**	**1083**	**45826**	**143**	**319**	**161**	**460**	**1.1 (1.0, 1.2)**	**2.3 (2.1, 2.4)**	**3.7 (3.5, 4.0)**
Exeter V40	**Trilogy***	**18**	**516**	**2**	**5**	**2**	**9**	**1.9 (1.0, 3.6)**	**2.5 (1.5, 4.3)**	**4.2 (2.5, 6.9)**
Exeter V40	**Vitalock***	**66**	**1795**	**14**	**19**	**19**	**14**	**0.8 (0.5, 1.4)**	**2.3 (1.7, 3.1)**	**3.2 (2.5, 4.2)**

Femoral Stem	Acetabular Component	N Revised	N Total	Type of Revision THR	Femoral	Acetabular	Other	1 Yr	5 Yrs	10 Yrs
F2L	SPH-Blind*	53	571	6	19	15	13	2.8 (1.7, 4.5)	6.1 (4.4, 8.4)	7.6 (5.7, 10.2)
M/L Taper	**Trilogy**	**20**	**686**	**.**	**4**	**6**	**10**	**1.3 (0.7, 2.5)**	**2.8 (1.7, 4.6)**	**4.2 (2.6, 6.6)**
MS 30	**Allofit**	**49**	**1473**	**8**	**16**	**14**	**11**	**1.2 (0.7, 1.9)**	**2.2 (1.5, 3.1)**	**3.5 (2.6, 4.9)**
MS 30	**Fitmore**	**19**	**572**	**1**	**4**	**7**	**7**	**0.4 (0.1, 1.4)**	**1.5 (0.7, 3.2)**	**2.8 (1.5, 5.1)**
MS 30	**Low Profile Cup**	**14**	**594**	**5**	**2**	**6**	**1**	**0.3 (0.1, 1.4)**	**1.0 (0.4, 2.3)**	**2.4 (1.3, 4.4)**
Mallory-Head	**Mallory-Head**	**156**	**2863**	**13**	**13**	**50**	**80**	**1.8 (1.4, 2.4)**	**3.0 (2.4, 3.7)**	**4.9 (4.1, 5.9)**
Mallory-Head	Recap MoM*	26	395	6	.	18	2	1.0 (0.4, 2.7)	2.6 (1.4, 4.7)	6.8 (4.4, 10.4)
Meridian	Vitalock*	29	354	2	2	12	13	0.9 (0.3, 2.6)	3.5 (2.0, 6.1)	6.4 (4.2, 9.6)
Natural Hip	**Allofit***	**10**	**529**	**.**	**3**	**3**	**4**	**0.8 (0.3, 2.0)**	**1.1 (0.5, 2.5)**	**1.9 (1.0, 3.6)**
Natural Hip	**Fitmore***	**35**	**882**	**2**	**5**	**11**	**17**	**0.5 (0.2, 1.2)**	**2.0 (1.3, 3.2)**	**4.1 (2.9, 5.9)**
Omnifit	Secur-Fit*	77	716	7	21	17	32	2.4 (1.5, 3.8)	6.2 (4.6, 8.2)	9.9 (7.9, 12.5)
Omnifit	**Trident (Shell)**	**134**	**3613**	**12**	**31**	**22**	**69**	**1.7 (1.3, 2.2)**	**3.1 (2.5, 3.7)**	**3.9 (3.3, 4.7)**
S-Rom	**Duraloc Option***	**25**	**523**	**4**	**9**	**5**	**7**	**1.7 (0.9, 3.3)**	**3.3 (2.1, 5.2)**	**4.6 (3.1, 6.8)**
S-Rom	Pinnacle	97	2249	8	58	8	23	2.1 (1.6, 2.8)	3.9 (3.1, 4.8)	5.2 (4.2, 6.4)
SL-Plus	EP-Fit Plus	102	2062	5	45	20	32	1.6 (1.1, 2.2)	3.5 (2.8, 4.4)	5.6 (4.6, 6.9)
Secur-Fit	**Trident (Shell)**	**303**	**8524**	**22**	**128**	**56**	**97**	**1.6 (1.3, 1.9)**	**3.3 (2.9, 3.7)**	**4.4 (3.9, 5.0)**
Secur-Fit Plus	**Trident (Shell)**	**155**	**5333**	**12**	**40**	**35**	**68**	**1.1 (0.9, 1.4)**	**2.2 (1.8, 2.6)**	**3.1 (2.6, 3.7)**
Spectron EF	BHR MoM*	45	430	9	.	32	4	0.9 (0.4, 2.5)	6.0 (4.1, 8.8)	13.9 (10.2, 18.8)
Spectron EF	Reflection (Cup)	104	1398	36	10	49	9	1.0 (0.6, 1.7)	2.8 (2.1, 3.9)	7.2 (5.7, 9.0)
Spectron EF	Reflection (Shell)	243	4584	52	79	37	75	1.0 (0.7, 1.3)	2.7 (2.2, 3.2)	5.5 (4.7, 6.3)
Stability	Duraloc*	44	374	1	9	13	21	0.5 (0.1, 2.1)	2.2 (1.1, 4.3)	8.9 (6.3, 12.5)
Summit	ASR MoM*	426	1041	14	6	384	22	1.1 (0.6, 1.9)	19.6 (17.3, 22.2)	44.0 (40.8, 47.4)
Summit	**Pinnacle**	**90**	**4115**	**6**	**19**	**14**	**51**	**1.1 (0.9, 1.5)**	**2.0 (1.6, 2.5)**	**3.1 (2.4, 4.1)**
Summit	Pinnacle MoM*	59	730	3	5	10	41	1.4 (0.7, 2.5)	3.4 (2.3, 5.0)	9.0 (6.9, 11.5)
Synergy	BHR MoM*	73	698	4	5	46	18	1.4 (0.8, 2.6)	4.8 (3.4, 6.7)	12.3 (9.8, 15.5)
Synergy	**Reflection (Shell)**	**299**	**7314**	**26**	**61**	**99**	**113**	**1.5 (1.3, 1.8)**	**2.6 (2.3, 3.0)**	**3.9 (3.4, 4.4)**
Synergy	**Trident (Shell)***	**13**	**438**	**.**	**3**	**4**	**6**	**0.9 (0.3, 2.4)**	**1.9 (0.9, 3.7)**	**4.5 (2.5, 8.2)**
Taperloc	M2a MoM*	54	471	11	2	38	3	1.5 (0.7, 3.1)	6.9 (4.9, 9.6)	12.2 (9.4, 15.8)
Taperloc	Mallory-Head	69	1657	6	15	24	24	1.9 (1.3, 2.7)	3.1 (2.3, 4.2)	5.6 (4.3, 7.3)
Taperloc	Recap MoM*	40	456	10	5	20	5	2.0 (1.0, 3.8)	5.6 (3.8, 8.2)	9.7 (7.2, 13.0)
VerSys	**Trilogy**	**203**	**4363**	**13**	**71**	**36**	**83**	**2.5 (2.1, 3.0)**	**3.7 (3.2, 4.4)**	**4.9 (4.2, 5.6)**
TOTAL		**9596**	**209670**	**1243**	**2541**	**3017**	**2795**			

Note: Only combinations with over 350 procedures have been listed
MoM denotes metal/metal prosthesis combinations used with head size larger than 32mm
* denotes prosthesis combinations with no reported use in primary total conventional hip replacement in 2016

KNEE REPLACEMENT

Individual femoral and tibial prosthesis combinations are reported. 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 separated as to whether they are minimally or posteriorly stabilised.

There are 56 total knee replacement combinations with 10 year outcome data; 10 more than last year. These prosthesis combinations account for 84.8% of all primary total knee replacement procedures for osteoarthritis. Of these 56 prosthesis combinations, 18 were not used in 2016. These 18 account for 10.6% of all primary total knee procedures.

The 10 year cumulative percent revision ranges from 3.0% to 13.1%. There are 16 knee prosthesis combinations (28.6%) with a 10 year cumulative percent revision (for any reason) of less than 5.0%. These are indicated in bold text in Table TY2.

Applying the recommendations of the international benchmarking working group, nine (16.1%) knee prosthesis combinations would qualify for a superiority benchmark and 25 (44.6%) would qualify for a non-inferiority benchmark.

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	1 Yr	5 Yrs	10 Yrs
AGC	**AGC**	**245**	**5026**	**90**	**5**	**25**	**125**	**0.5 (0.4, 0.8)**	**3.1 (2.7, 3.7)**	**4.9 (4.3, 5.7)**
Active Knee	Active Knee	527	8533	148	25	36	318	1.1 (0.9, 1.3)	4.9 (4.4, 5.4)	8.0 (7.3, 8.8)
Advance	Advance	33	741	9	1	8	15	2.1 (1.2, 3.5)	4.6 (3.2, 6.6)	8.0 (4.9, 13.0)
Advance	Advance II	96	1596	32	2	13	49	1.6 (1.1, 2.3)	4.9 (3.9, 6.1)	6.9 (5.7, 8.5)
Advantim	**Advantim***	**61**	**1454**	**28**	**3**	**3**	**27**	**0.7 (0.4, 1.3)**	**3.1 (2.3, 4.1)**	**4.7 (3.6, 6.2)**
BalanSys	**BalanSys**	**33**	**2277**	**8**	**3**	**3**	**19**	**0.4 (0.2, 0.8)**	**2.3 (1.5, 3.4)**	**4.3 (2.7, 7.0)**
Columbus	Columbus	90	1174	27	4	5	54	1.9 (1.2, 2.9)	7.6 (6.1, 9.4)	11.6 (9.1, 14.6)
Duracon	Duracon*	1044	19830	251	29	67	697	1.1 (1.0, 1.3)	3.4 (3.2, 3.7)	5.0 (4.7, 5.3)
Genesis II CR	**Genesis II**	**760**	**20944**	**144**	**49**	**49**	**518**	**0.9 (0.8, 1.1)**	**3.4 (3.2, 3.7)**	**4.7 (4.3, 5.0)**
Genesis II CR	Profix Mobile*	100	1209	38	9	7	46	1.9 (1.3, 2.9)	5.4 (4.2, 6.9)	7.9 (6.4, 9.7)
Genesis II Oxinium CR (ct	Genesis II	354	7468	60	23	22	249	1.0 (0.8, 1.3)	3.7 (3.3, 4.2)	6.2 (5.6, 7.0)
Genesis II Oxinium PS (ct	Genesis II	785	15524	92	26	129	538	1.5 (1.4, 1.8)	5.3 (4.9, 5.7)	7.6 (7.0, 8.2)
Genesis II PS	Genesis II	631	16463	96	26	45	464	1.3 (1.1, 1.4)	3.8 (3.5, 4.1)	5.3 (4.8, 5.8)
Journey Oxinium	Journey*	243	2975	37	5	26	175	1.4 (1.0, 1.9)	6.5 (5.6, 7.5)	11.1 (9.5, 12.9)
Kinemax Plus	**Kinemax Plus***	**112**	**1815**	**64**	**3**	**5**	**40**	**0.9 (0.6, 1.5)**	**3.2 (2.4, 4.1)**	**4.7 (3.8, 5.8)**
LCS CR	LCS	554	8301	221	23	84	226	1.1 (0.9, 1.3)	4.4 (4.0, 4.9)	6.2 (5.7, 6.8)
LCS CR	MBT	879	25962	282	41	118	438	0.9 (0.8, 1.0)	3.5 (3.3, 3.8)	5.0 (4.6, 5.3)
LCS CR	MBT Duofix	605	13412	164	26	38	377	1.3 (1.1, 1.5)	4.1 (3.8, 4.5)	5.4 (5.0, 5.9)
LCS Duofix	MBT Duofix*	445	3605	323	27	7	88	1.6 (1.2, 2.1)	10.2 (9.2, 11.2)	13.1 (12.0, 14.3)
LCS Duofix	MBT*	126	1170	88	10	2	26	1.1 (0.6, 1.9)	7.9 (6.5, 9.7)	12.2 (10.2, 14.5)
MBK (Zimmer)	Nexgen*	30	448	16	1	1	12	0.9 (0.3, 2.4)	4.1 (2.6, 6.5)	5.9 (4.0, 8.6)
Maxim	Maxim*	172	2447	53	15	12	92	1.1 (0.7, 1.6)	4.0 (3.3, 4.8)	6.0 (5.1, 7.1)
Natural Knee II	Natural Knee II*	357	6443	144	8	58	147	0.9 (0.7, 1.2)	2.8 (2.4, 3.2)	5.3 (4.7, 6.0)
Nexgen CR	**Nexgen**	**332**	**10977**	**103**	**14**	**31**	**184**	**0.5 (0.4, 0.7)**	**2.1 (1.8, 2.3)**	**3.1 (2.7, 3.4)**
Nexgen CR	Nexgen TM CR	43	793	14	3	8	18	1.3 (0.7, 2.4)	5.4 (3.9, 7.3)	6.1 (4.5, 8.2)
Nexgen CR Flex	**Nexgen**	**795**	**42126**	**159**	**59**	**89**	**488**	**0.8 (0.7, 0.9)**	**2.3 (2.1, 2.4)**	**3.1 (2.8, 3.3)**

Femoral Component	Tibial Component	N Revised	N Total	Type of Revision TKR	Femoral	Tibial	Other	1 Yr	5 Yrs	10 Yrs
Nexgen CR Flex	**Nexgen TM CR**	**211**	**9571**	**60**	**18**	**22**	**111**	**0.5 (0.4, 0.7)**	**2.3 (2.0, 2.7)**	**3.3 (2.8, 3.9)**
Nexgen LPS	Nexgen	289	6591	69	19	32	169	1.0 (0.8, 1.2)	3.2 (2.8, 3.7)	5.1 (4.5, 5.7)
Nexgen LPS	**Nexgen TM LPS**	**26**	**1116**	**6**	**2**	**5**	**13**	**0.8 (0.4, 1.6)**	**2.7 (1.8, 4.0)**	**3.3 (2.1, 4.9)**
Nexgen LPS Flex	Nexgen	979	30278	239	51	166	523	0.9 (0.8, 1.1)	3.2 (3.0, 3.5)	5.1 (4.8, 5.5)
Nexgen LPS Flex	**Nexgen TM LPS**	**41**	**1432**	**21**	**.**	**4**	**16**	**1.0 (0.6, 1.7)**	**3.0 (2.2, 4.1)**	**3.6 (2.6, 4.9)**
Optetrak-CR	Optetrak	41	966	10	6	4	21	1.5 (0.8, 2.6)	5.4 (3.8, 7.7)	8.2 (5.9, 11.3)
Optetrak-PS	Optetrak	191	2729	67	4	26	94	1.4 (1.0, 1.9)	6.3 (5.4, 7.4)	9.9 (8.5, 11.5)
Optetrak-PS	Optetrak-RBK	68	939	16	2	3	47	2.0 (1.2, 3.1)	6.8 (5.2, 8.8)	10.9 (8.3, 14.4)
PFC Sigma CR	**AMK Duofix***	**53**	**1890**	**17**	**.**	**1**	**35**	**0.7 (0.4, 1.2)**	**2.3 (1.7, 3.1)**	**3.0 (2.2, 4.0)**
PFC Sigma CR	MBT	257	5742	38	30	42	147	1.4 (1.1, 1.7)	4.1 (3.6, 4.7)	5.2 (4.6, 5.9)
PFC Sigma CR	MBT Duofix	115	2544	14	16	3	82	1.2 (0.9, 1.7)	4.3 (3.5, 5.2)	5.7 (4.6, 7.1)
PFC Sigma CR	**PFC Sigma**	**599**	**22644**	**124**	**45**	**53**	**377**	**0.7 (0.6, 0.9)**	**2.4 (2.2, 2.6)**	**3.5 (3.2, 3.8)**
PFC Sigma PS	**MBT**	**241**	**6161**	**70**	**12**	**19**	**140**	**0.9 (0.7, 1.2)**	**3.6 (3.1, 4.1)**	**4.9 (4.2, 5.6)**
PFC Sigma PS	MBT Duofix	131	1886	19	4	4	104	1.8 (1.2, 2.5)	6.9 (5.8, 8.3)	8.9 (7.5, 10.5)
PFC Sigma PS	**PFC Sigma**	**263**	**7317**	**82**	**8**	**22**	**151**	**1.2 (0.9, 1.5)**	**3.2 (2.8, 3.7)**	**4.7 (4.1, 5.4)**
Profix	Profix Mobile*	102	986	32	6	5	59	2.3 (1.6, 3.5)	8.2 (6.6, 10.1)	9.8 (8.0, 11.9)
Profix	Profix*	259	5370	55	13	18	173	1.0 (0.8, 1.4)	3.7 (3.2, 4.3)	5.1 (4.6, 5.8)
Profix Oxinium (ctd)	Profix*	92	1049	20	4	14	54	2.1 (1.4, 3.2)	7.0 (5.6, 8.7)	8.5 (7.0, 10.5)
RBK	RBK	410	9783	152	11	35	212	1.3 (1.1, 1.5)	4.0 (3.6, 4.4)	5.6 (5.0, 6.2)
Rocc	Rocc*	37	575	12	1	2	22	1.7 (0.9, 3.2)	5.2 (3.6, 7.3)	6.9 (5.0, 9.4)
Rotaglide Plus	Rotaglide Plus*	70	616	30	1	5	34	0.8 (0.3, 2.0)	5.8 (4.1, 8.0)	11.0 (8.7, 14.0)
Scorpio CR	Scorpio+*	162	2448	36	10	24	92	0.9 (0.6, 1.4)	4.2 (3.5, 5.1)	6.7 (5.7, 7.8)
Scorpio CR	Series 7000	502	11261	121	26	42	313	0.9 (0.7, 1.1)	3.4 (3.0, 3.8)	5.2 (4.8, 5.8)
Scorpio PS	Scorpio	31	524	8	.	9	14	1.2 (0.5, 2.6)	4.5 (3.0, 6.7)	6.2 (4.3, 8.7)
Scorpio PS	Scorpio+*	133	2036	34	12	9	78	1.4 (1.0, 2.1)	5.0 (4.1, 6.0)	6.5 (5.5, 7.7)
Scorpio PS	Series 7000	304	4679	102	8	60	134	1.3 (1.0, 1.7)	4.7 (4.1, 5.4)	6.9 (6.1, 7.8)
Triathlon CR	**Triathlon**	**1174**	**59826**	**181**	**55**	**67**	**871**	**0.8 (0.8, 0.9)**	**2.5 (2.3, 2.6)**	**3.7 (3.3, 4.0)**
Triathlon PS	Triathlon	323	9547	51	20	39	213	1.5 (1.3, 1.8)	4.0 (3.6, 4.5)	5.0 (4.3, 5.8)
Vanguard CR	**Maxim**	**394**	**15727**	**81**	**18**	**34**	**261**	**0.8 (0.7, 1.0)**	**3.3 (3.0, 3.7)**	**4.8 (4.2, 5.7)**
Vanguard PS	Maxim	210	4251	48	7	44	111	1.8 (1.4, 2.2)	5.5 (4.8, 6.4)	7.3 (6.0, 8.8)
TOTAL		**17160**	**453197**	**4506**	**849**	**1704**	**10101**			

Note: Only combinations with over 350 procedures have been listed
* denotes prosthesis combinations with no reported use in primary total knee procedures in 2016

FIFTEEN YEAR OUTCOMES

This year, the Registry is reporting 15 year outcomes for 36 hip prosthesis and 24 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 35.8% of all primary total conventional hip replacement procedures for osteoarthritis. Of the 36 combinations, 17 had no reported use in 2016.

The 15 year cumulative percent revision ranges from 3.2% to 17.0%. There are 13 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 39.2% of all primary total knee replacement procedures for osteoarthritis. Of the 24 combinations, nine had no reported use in 2016.

The 15 year cumulative percent revision ranges from 4.4% to 11.5%. Eight of the combinations have a cumulative percent revision of less than 6.5% and one 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	Femoral	Acetabular	Other	5 Yrs	10 Yrs	15 Yrs
ABGII	ABGII	237	2755	31	116	60	30	4.1 (3.4, 4.9)	6.9 (6.0, 8.0)	11.6 (10.1, 13.2)
Alloclassic	Allofit	215	4914	24	83	43	65	2.8 (2.3, 3.3)	4.9 (4.2, 5.6)	8.3 (6.7, 10.2)
Alloclassic	Fitmore	118	1709	12	60	12	34	5.8 (4.7, 7.0)	7.7 (6.4, 9.2)	10.1 (7.3, 13.9)
C-Stem	Duraloc*	70	894	9	17	11	33	3.8 (2.7, 5.3)	7.0 (5.4, 9.0)	12.4 (9.3, 16.3)
CLS	Fitmore	46	712	5	21	7	13	4.8 (3.4, 6.8)	6.2 (4.5, 8.5)	10.2 (7.4, 14.1)
CPT	**Trilogy**	**246**	**6962**	**22**	**74**	**33**	**117**	**3.2 (2.8, 3.7)**	**4.8 (4.1, 5.5)**	**5.9 (5.0, 6.9)**
CPT	ZCA	29	780	10	5	8	6	2.4 (1.4, 3.8)	4.7 (3.1, 7.2)	7.3 (4.6, 11.3)
Charnley	Charnley Ogee*	54	630	31	7	4	12	4.9 (3.5, 7.0)	8.1 (6.1, 10.8)	13.4 (9.8, 18.2)
Charnley	Charnley*	39	563	30	6	3	.	2.2 (1.3, 3.9)	6.5 (4.5, 9.4)	11.6 (8.3, 16.2)
Charnley	Vitalock*	35	370	5	17	2	11	4.4 (2.7, 7.1)	7.9 (5.5, 11.4)	11.7 (8.4, 16.1)
Citation	**Trident (Shell)***	**42**	**1035**	**3**	**9**	**11**	**19**	**3.2 (2.3, 4.5)**	**3.9 (2.9, 5.3)**	**4.9 (3.5, 6.8)**
Citation	Vitalock*	34	508	2	5	11	16	2.0 (1.1, 3.7)	5.0 (3.3, 7.4)	10.0 (7.0, 14.2)
Elite Plus	Duraloc*	97	953	14	57	6	20	5.1 (3.9, 6.8)	8.8 (7.0, 10.9)	14.8 (11.9, 18.3)
Exeter	Contemporary*	35	427	8	6	13	8	4.2 (2.6, 6.6)	6.0 (4.0, 8.9)	12.1 (8.6, 16.8)
Exeter	Vitalock*	58	1076	7	10	23	18	2.3 (1.5, 3.4)	4.6 (3.4, 6.1)	6.6 (5.1, 8.5)
Exeter V40	**ABGII**	**34**	**973**	**8**	**12**	**8**	**6**	**1.6 (1.0, 2.7)**	**3.4 (2.3, 4.8)**	**4.7 (3.3, 6.6)**
Exeter V40	Contemporary	215	4398	48	38	98	31	3.3 (2.8, 3.9)	5.8 (5.0, 6.7)	8.4 (7.1, 9.9)
Exeter V40	Exeter*	73	1526	12	14	30	17	2.9 (2.1, 3.9)	4.5 (3.5, 5.8)	8.1 (6.1, 10.7)
Exeter V40	**Trident (Shell)**	**1083**	**45826**	**143**	**319**	**161**	**460**	**2.3 (2.1, 2.4)**	**3.7 (3.5, 4.0)**	**5.0 (4.4, 5.6)**
Exeter V40	**Vitalock***	**66**	**1795**	**14**	**19**	**19**	**14**	**2.3 (1.7, 3.1)**	**3.2 (2.5, 4.2)**	**4.6 (3.6, 5.9)**
F2L	SPH-Blind*	53	571	6	19	15	13	6.1 (4.4, 8.4)	7.6 (5.7, 10.2)	11.7 (8.7, 15.7)
MS 30	Fitmore	19	572	1	4	7	7	1.5 (0.7, 3.2)	2.8 (1.5, 5.1)	6.5 (3.9, 10.9)
MS 30	**Low Profile Cup**	**14**	**594**	**5**	**2**	**6**	**1**	**1.0 (0.4, 2.3)**	**2.4 (1.3, 4.4)**	**3.2 (1.8, 5.8)**
Mallory-Head	Mallory-Head	156	2863	13	13	50	80	3.0 (2.4, 3.7)	4.9 (4.1, 5.9)	10.3 (8.5, 12.5)
Meridian	Vitalock*	29	354	2	2	12	13	3.5 (2.0, 6.1)	6.4 (4.2, 9.6)	9.9 (6.9, 14.1)
Natural Hip	**Fitmore***	**35**	**882**	**2**	**5**	**11**	**17**	**2.0 (1.3, 3.2)**	**4.1 (2.9, 5.9)**	**4.9 (3.5, 6.9)**

Femoral Stem	Acetabular Component	N Revised	N Total	Type of Revision: THR	Femoral	Acetabular	Other	5 Yrs	10 Yrs	15 Yrs
Omnifit	Secur-Fit*	77	716	7	21	17	32	6.2 (4.6, 8.2)	9.9 (7.9, 12.5)	13.2 (10.6, 16.5)
Omnifit	**Trident (Shell)**	**134**	**3613**	**12**	**31**	**22**	**69**	**3.1 (2.5, 3.7)**	**3.9 (3.3, 4.7)**	**5.8 (4.7, 7.3)**
S-Rom	**Duraloc Option***	**25**	**523**	**4**	**9**	**5**	**7**	**3.3 (2.1, 5.2)**	**4.6 (3.1, 6.8)**	**5.2 (3.5, 7.8)**
Secur-Fit	**Trident (Shell)**	**303**	**8524**	**22**	**128**	**56**	**97**	**3.3 (2.9, 3.7)**	**4.4 (3.9, 5.0)**	**5.5 (4.6, 6.6)**
Secur-Fit Plus	**Trident (Shell)**	**155**	**5333**	**12**	**40**	**35**	**68**	**2.2 (1.8, 2.6)**	**3.1 (2.6, 3.7)**	**4.4 (3.5, 5.4)**
Spectron EF	Reflection (Cup)	104	1398	36	10	49	9	2.8 (2.1, 3.9)	7.2 (5.7, 9.0)	17.0 (13.4, 21.5)
Spectron EF	Reflection (Shell)	243	4584	52	79	37	75	2.7 (2.2, 3.2)	5.5 (4.7, 6.3)	10.7 (9.1, 12.7)
Stability	Duraloc*	44	374	1	9	13	21	2.2 (1.1, 4.3)	8.9 (6.3, 12.5)	14.6 (10.9, 19.6)
Synergy	**Reflection (Shell)**	**299**	**7314**	**26**	**61**	**99**	**113**	**2.6 (2.3, 3.0)**	**3.9 (3.4, 4.4)**	**6.4 (5.4, 7.5)**
VerSys	**Trilogy**	**203**	**4363**	**13**	**71**	**36**	**83**	**3.7 (3.2, 4.4)**	**4.9 (4.2, 5.6)**	**5.4 (4.7, 6.2)**
TOTAL		**4719**	**121384**	**652**	**1399**	**1033**	**1635**			

Note: Only combinations with over 350 procedures have been listed

* denotes prosthesis combinations with no reported use in primary total conventional hip procedures in 2016

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	245	5026	90	5	25	125	3.1 (2.7, 3.7)	4.9 (4.3, 5.7)	7.4 (6.4, 8.6)
Advance	Advance II	96	1596	32	2	13	49	4.9 (3.9, 6.1)	6.9 (5.7, 8.5)	7.8 (6.2, 9.7)
Advantim	**Advantim***	**61**	**1454**	**28**	**3**	**3**	**27**	**3.1 (2.3, 4.1)**	**4.7 (3.6, 6.2)**	**6.4 (4.7, 8.8)**
Duracon	Duracon*	1044	19830	251	29	67	697	3.4 (3.2, 3.7)	5.0 (4.7, 5.3)	7.1 (6.6, 7.6)
Genesis II CR	**Genesis II**	**760**	**20944**	**144**	**49**	**49**	**518**	**3.4 (3.2, 3.7)**	**4.7 (4.3, 5.0)**	**5.8 (5.2, 6.4)**
Genesis II CR	Profix Mobile*	100	1209	38	9	7	46	5.4 (4.2, 6.9)	7.9 (6.4, 9.7)	11.2 (9.1, 13.8)
Genesis II Oxinium CR (ct	Genesis II	354	7468	60	23	22	249	3.7 (3.3, 4.2)	6.2 (5.6, 7.0)	11.0 (8.5, 14.3)
Genesis II PS	Genesis II	631	16463	96	26	45	464	3.8 (3.5, 4.1)	5.3 (4.8, 5.8)	6.6 (5.7, 7.7)
Kinemax Plus	Kinemax Plus*	112	1815	64	3	5	40	3.2 (2.4, 4.1)	4.7 (3.8, 5.8)	8.5 (7.0, 10.4)
LCS CR	LCS	554	8301	221	23	84	226	4.4 (4.0, 4.9)	6.2 (5.7, 6.8)	7.8 (7.2, 8.5)
LCS CR	**MBT**	**879**	**25962**	**282**	**41**	**118**	**438**	**3.5 (3.3, 3.8)**	**5.0 (4.6, 5.3)**	**6.1 (5.4, 6.8)**
LCS CR	MBT Duofix	605	13412	164	26	38	377	4.1 (3.8, 4.5)	5.4 (5.0, 5.9)	7.2 (6.3, 8.2)
MBK (Zimmer)	Nexgen*	30	448	16	1	1	12	4.1 (2.6, 6.5)	5.9 (4.0, 8.6)	8.0 (5.5, 11.5)
Maxim	Maxim*	172	2447	53	15	12	92	4.0 (3.3, 4.8)	6.0 (5.1, 7.1)	11.1 (8.9, 13.9)
Natural Knee II	Natural Knee II*	357	6443	144	8	58	147	2.8 (2.4, 3.2)	5.3 (4.7, 6.0)	10.6 (9.1, 12.2)
Nexgen CR	**Nexgen**	**332**	**10977**	**103**	**14**	**31**	**184**	**2.1 (1.8, 2.3)**	**3.1 (2.7, 3.4)**	**4.4 (3.9, 5.0)**
Nexgen LPS	**Nexgen**	**289**	**6591**	**69**	**19**	**32**	**169**	**3.2 (2.8, 3.7)**	**5.1 (4.5, 5.7)**	**6.3 (5.5, 7.3)**
PFC Sigma CR	**MBT**	**257**	**5742**	**38**	**30**	**42**	**147**	**4.1 (3.6, 4.7)**	**5.2 (4.6, 5.9)**	**6.1 (5.2, 7.2)**
PFC Sigma CR	**PFC Sigma**	**599**	**22644**	**124**	**45**	**53**	**377**	**2.4 (2.2, 2.6)**	**3.5 (3.2, 3.8)**	**5.1 (4.5, 5.9)**
PFC Sigma PS	PFC Sigma	263	7317	82	8	22	151	3.2 (2.8, 3.7)	4.7 (4.1, 5.4)	7.3 (5.9, 8.9)
Profix	**Profix***	**259**	**5370**	**55**	**13**	**18**	**173**	**3.7 (3.2, 4.3)**	**5.1 (4.6, 5.8)**	**5.5 (4.8, 6.2)**
Scorpio CR	Series 7000	502	11261	121	26	42	313	3.4 (3.0, 3.8)	5.2 (4.8, 5.8)	6.7 (6.1, 7.4)
Scorpio PS	Scorpio+*	133	2036	34	12	9	78	5.0 (4.1, 6.0)	6.5 (5.5, 7.7)	8.5 (6.9, 10.5)
Scorpio PS	Series 7000	304	4679	102	8	60	134	4.7 (4.1, 5.4)	6.9 (6.1, 7.8)	11.5 (9.4, 14.1)
TOTAL		**8938**	**209435**	**2411**	**438**	**856**	**5233**			

Note: Only combinations with over 350 procedures have been listed

* denotes prosthesis combinations with no reported use in primary total knee procedures in 2016

Hip Replacement

Hip Replacement

CATEGORIES OF HIP REPLACEMENT

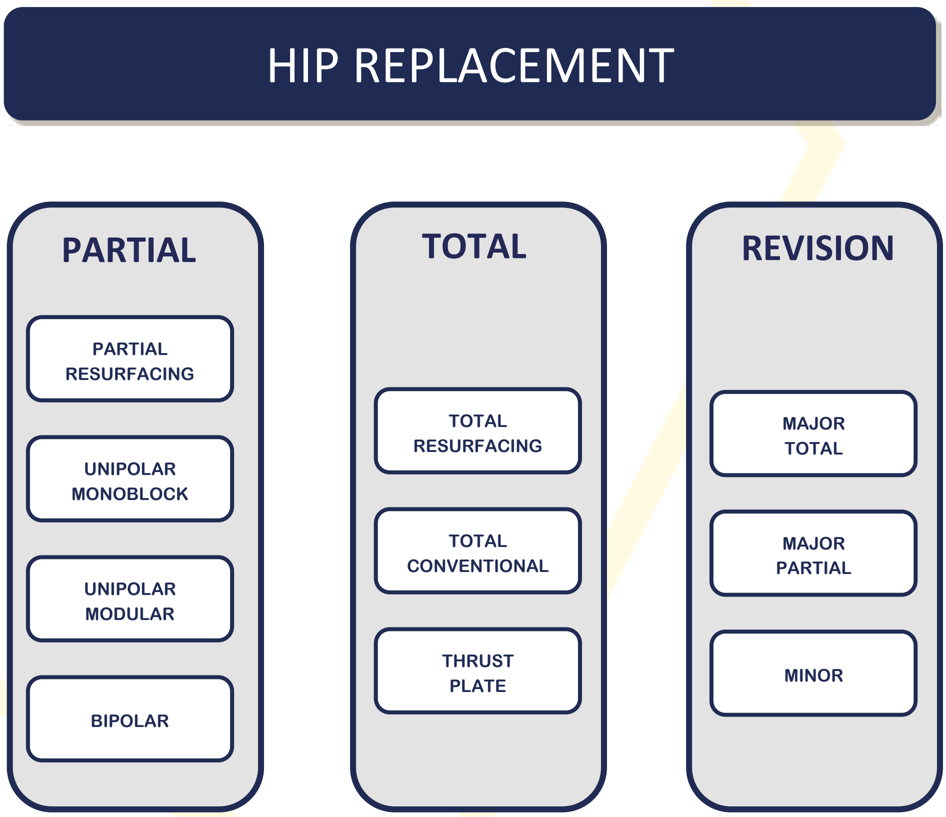
The Registry groups hip replacement into three broad categories: primary partial, primary total and revision hip replacement.

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: resurfacing, conventional, and thrust plate. Definitions for each of these 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://aoanjrr.sahmri.com/annual-reports-2017



USE OF HIP REPLACEMENT

This report analyses 545,831 hip replacements reported to the Registry with a procedure date up to and including 31 December 2016. This is an additional 47,171 hip procedures compared to the number reported last year. When considering all hip procedures currently recorded by the Registry, primary partial hip accounts for 15.3%, primary total hip 73.3% and revision hip replacement 11.4% (Table H1).

Table H1 Number of Hip Replacements

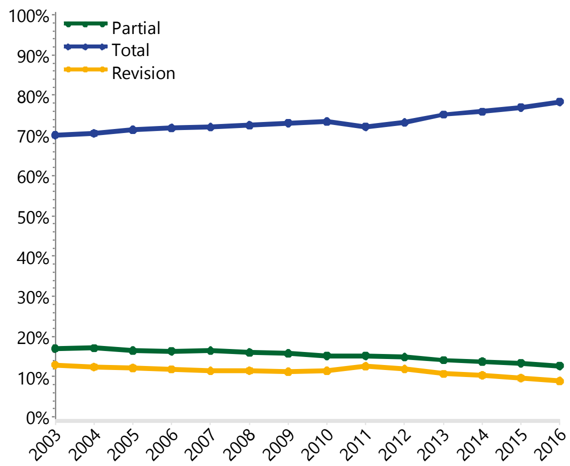
Hip Category	Number	Percent
Partial	83389	15.3
Total	400331	73.3
Revision	62111	11.4
TOTAL	**545831**	**100.0**

The number of hip replacement procedures undertaken in 2016 is 73.7% higher than the number undertaken in 2003. The corresponding increase in primary total hip replacement is 94.4%, primary partial 30.1%, and revision hip replacement 19.4%.

The number of hip replacements undertaken in 2016 increased by 1,639 (3.7%) compared to 2015. During this time, the use of primary total hip replacement increased by 5.6% accounting for 78.4% of all hip replacement procedures in 2016. Primary partial hip replacement decreased by 1.5% accounting for 12.7% of hip procedures in 2016.

The proportion of revision hip procedures has declined from a peak of 12.9% in 2003 to 8.9% in 2016. This equates to 1,871 fewer revision procedures in 2016 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 in 2015.

There is ASA score data on 158,657 hip replacement procedures and BMI data on 72,892 hip replacement procedures.

In 2016, the ASA score is reported in 99.4% of hip replacement procedures and BMI in 84.2% of hip replacement procedures.

There is no variation in reporting of ASA based on procedure type. However, there is some variation in the reporting of BMI. The Registry has BMI recorded for 47.5% of primary partial hip, 90.6% of primary total hip, and 80.6% 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 (https://www.asahq.org/resources/clinical-information/asa-physical-status-classification-system):

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

Overall, in 85.7% of procedures, patients have an ASA score of 2 or 3, 8.7% have a score of 1, and 5.6% have a score of 4. Very few procedures were recorded where patients have a 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 (85.8%), compared to those undergoing primary total hip replacement (35.1%). 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 those having a partial hip replacement (57.4% have an ASA score of 3 or 4) (Table H2).

BMI

BMI for adults is classified by the World Health Organisation into six main categories (http://apps.who.int/bmi/index.jsp?introPage=intro_3.html):

1.	Underweight	<18.50
2.	Normal	18.50 - 24.99
3.	Pre-obese	25.00 - 29.99
4.	Obese Class 1	30.00 - 34.99
5.	Obese Class 2	35.00 - 39.99
6.	Obese Class 3	≥40.00

For all hip replacement, the majority of procedures are undertaken in patients who are normal or pre-obese (60.8%). There is a similar proportion of primary total and revision hip replacement procedures where the patients are normal or pre-obese in 59.5% of primary total hip procedures and in 60.4% of revision hip replacement procedures.

In partial hip replacement procedures, patients generally have a lower BMI, with most being normal or underweight (59.6%) (Table H3).

There is a gender difference with a higher proportion of males in the normal and pre-obese categories, which is most apparent in primary total and revision hip replacement procedures (Figure H2).

Table H2 ASA Score by Hip Category

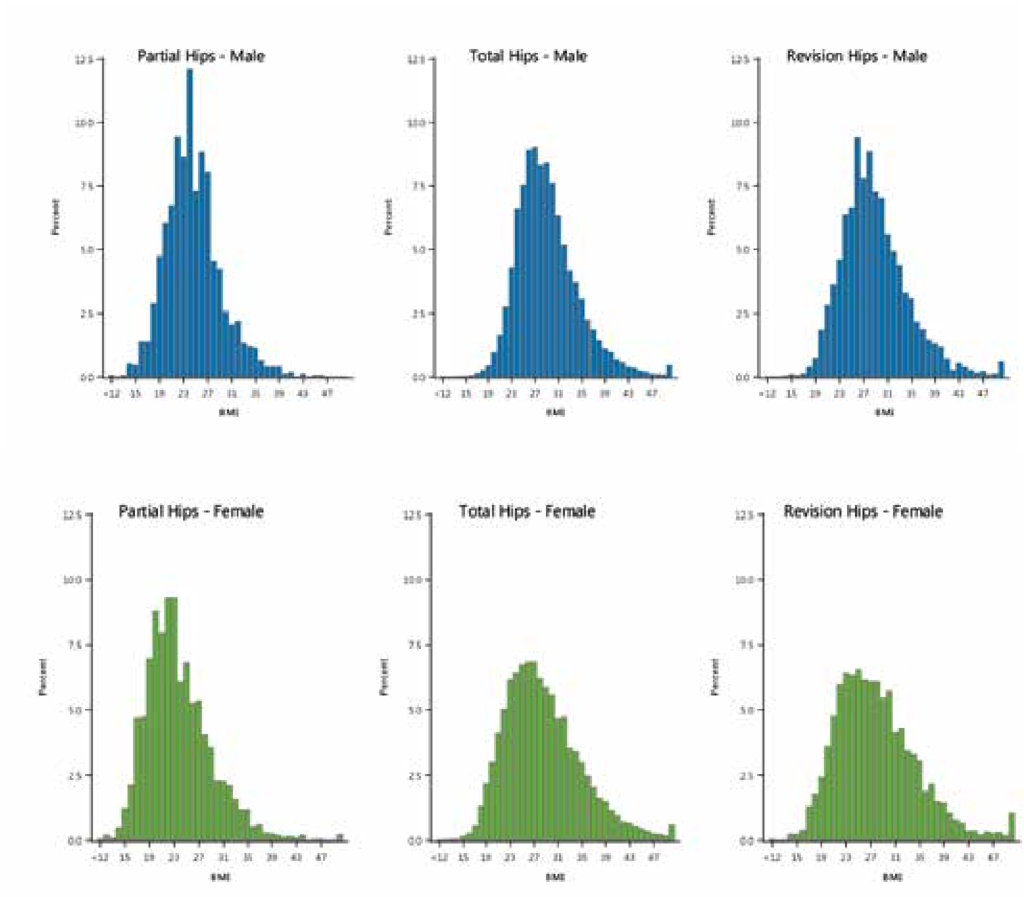
	Partial		Total		Revision		TOTAL	
ASA Score	N	Col%	N	Col%	N	Col%	N	Col%
1	90	0.4	12957	10.6	774	5.0	13821	8.7
2	2829	13.5	66304	54.3	5850	37.6	74983	47.3
3	12754	60.8	40471	33.1	7715	49.7	60940	38.4
4	5219	24.9	2399	2.0	1190	7.7	8808	5.6
5	84	0.4	12	0.0	9	0.1	105	0.1
TOTAL	**20976**	**100.0**	**122143**	**100.0**	**15538**	**100.0**	**158657**	**100.0**

Table H3 BMI Category for Hip Replacement by Hip Category

	Partial		Total		Revision		TOTAL	
BMI Category	N	Col%	N	Col%	N	Col%	N	Col%
Underweight	501	9.6	659	1.1	118	1.8	1278	1.8
Normal	2619	50.0	13728	22.5	1669	25.5	18016	24.7
Pre-obese	1434	27.4	22609	37.0	2280	34.9	26323	36.1
Obese Class 1	488	9.3	14849	24.3	1496	22.9	16833	23.1
Obese Class 2	148	2.8	6189	10.1	647	9.9	6984	9.6
Obese Class 3	45	0.9	3089	5.1	324	5.0	3458	4.7
TOTAL	**5235**	**100.0**	**61123**	**100.0**	**6534**	**100.0**	**72892**	**100.0**

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

Figure H2 BMI Distribution by Gender and Hip Category



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.

There is a fifth class of partial hip replacement that has been reported to the Registry. It involves the use of a prosthesis referred to by the manufacturer as an 'acetabular buffer'. This is a polycarbonate urethane insert. Five procedures using this device have been reported to the Registry, four of which have been revised.

USE OF PARTIAL HIP REPLACEMENT

The most common class of primary partial hip replacement is unipolar modular. This accounts for 43.3% of all partial hip procedures, followed by unipolar monoblock (33.7%) and bipolar (23.0%) (Table HP1).

Table HP1 Primary Partial Hip Replacement by Class

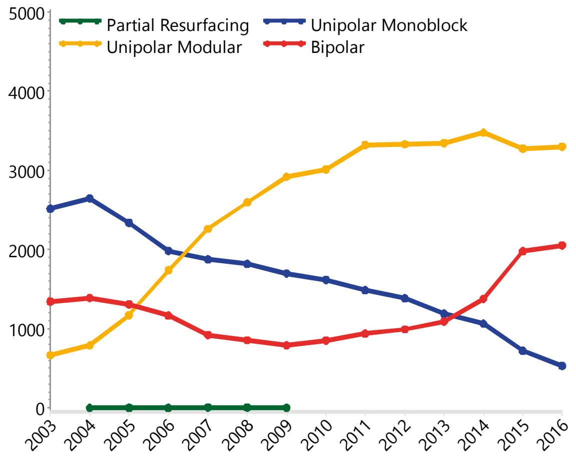
Partial Hip Class	Number	Percent
Unipolar Monoblock	28122	33.7
Unipolar Modular	36090	43.3
Bipolar	19163	23.0
TOTAL	**83375**	**100.0**

Note: Excludes 14 partial resurfacing procedures.

There is a slight increase in the use of bipolar and unipolar modular partial hip replacements in 2016. 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-2017.

Figure HP1 Primary Partial Hip Replacement by Class



Detailed information on Partial Resurfacing Hip Replacement is available in the supplementary report 'Outcomes of Classes No Longer Used Hip and Knee Arthroplasty' on the AOANJRR website https://aoanjrr.sahmri.com/annual-reports-2017.

Fractured neck of femur is the principal diagnosis for the three main classes of primary partial hip replacement: unipolar monoblock (97.6%), unipolar modular (95.0%) and bipolar (91.3%). A comparative analysis of partial hip replacement with 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, 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).

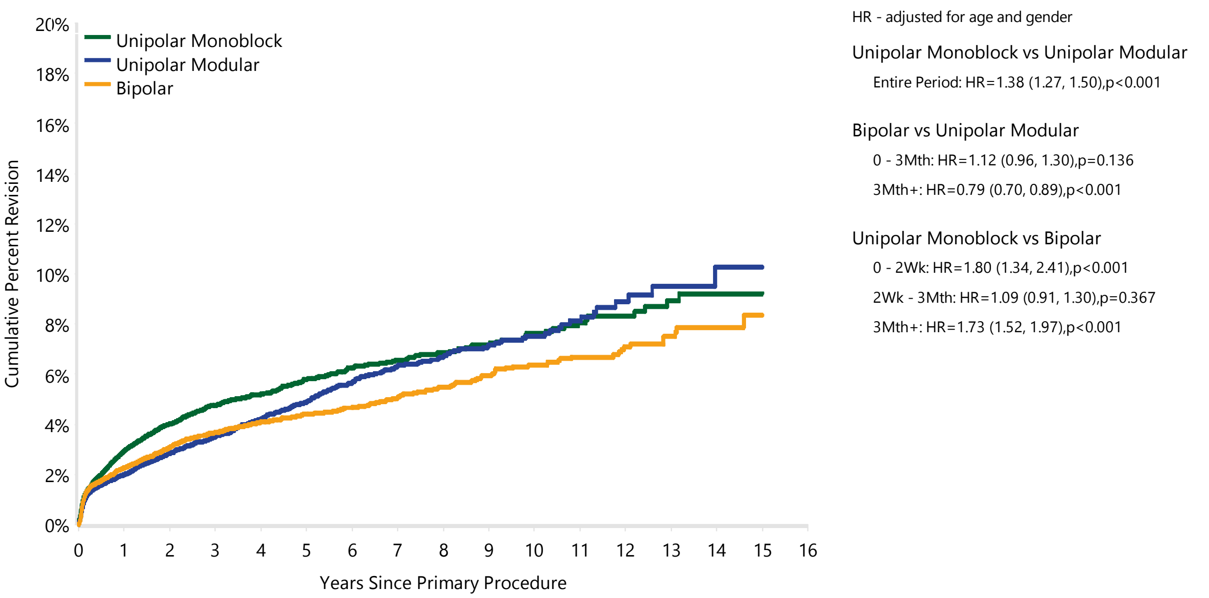
Table HP2 Cumulative Percent Mortality of Primary Partial Hip Replacement by Class (Primary Diagnosis Fractured NOF)

Hip Class	N Deceased	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Monoblock	22668	26769	36.5 (36.0, 37.1)	49.6 (48.9, 50.2)	60.3 (59.7, 60.9)	76.2 (75.6, 76.7)	85.4 (84.9, 85.9)	92.8 (92.4, 93.2)
Unipolar Modular	19082	33253	23.9 (23.4, 24.3)	34.2 (33.7, 34.8)	43.6 (43.1, 44.2)	59.4 (58.8, 60.1)	70.8 (70.2, 71.5)	81.4 (80.7, 82.1)
Bipolar	10011	17060	21.0 (20.4, 21.7)	30.6 (29.9, 31.4)	38.9 (38.1, 39.7)	53.4 (52.5, 54.2)	64.9 (64.0, 65.8)	77.0 (76.1, 77.8)
TOTAL	**51761**	**77082**						

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	1034	27453	2.9 (2.7, 3.2)	4.0 (3.7, 4.3)	4.8 (4.4, 5.1)	5.8 (5.4, 6.2)	6.5 (6.1, 7.0)	7.6 (7.0, 8.3)
Unipolar Modular	1149	34286	2.0 (1.8, 2.2)	2.8 (2.6, 3.0)	3.5 (3.3, 3.7)	4.9 (4.6, 5.2)	6.3 (5.9, 6.8)	7.5 (6.9, 8.2)
Bipolar	606	17486	2.3 (2.0, 2.5)	3.1 (2.8, 3.4)	3.7 (3.4, 4.0)	4.4 (4.0, 4.8)	5.0 (4.6, 5.5)	6.4 (5.7, 7.0)
TOTAL	**2789**	**79225**						

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

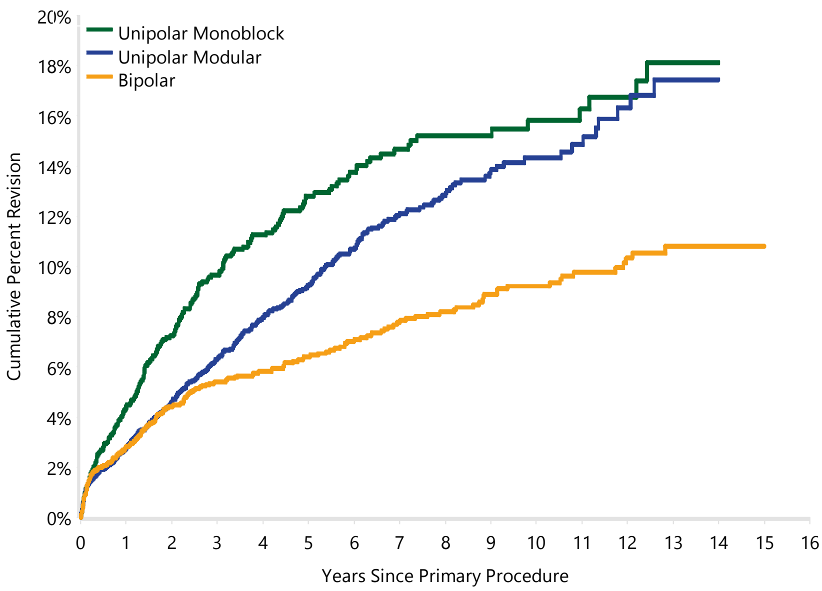


Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Monoblock	27453	16627	12742	9621	5235	2828	1045
Unipolar Modular	34286	23221	17936	13572	7314	3598	1015
Bipolar	17486	12050	9300	7415	4866	3191	1598

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	218	2377	4.4 (3.6, 5.4)	7.2 (6.1, 8.5)	9.6 (8.3, 11.2)	12.8 (11.2, 14.7)	14.7 (12.8, 16.8)	15.8 (13.7, 18.2)
Unipolar Modular	428	5629	2.7 (2.3, 3.2)	4.6 (4.0, 5.2)	6.3 (5.6, 7.1)	9.2 (8.3, 10.3)	12.1 (10.9, 13.4)	14.3 (12.9, 16.0)
Bipolar	213	3528	2.8 (2.3, 3.4)	4.4 (3.7, 5.2)	5.4 (4.6, 6.3)	6.4 (5.5, 7.4)	7.8 (6.7, 9.0)	9.2 (8.0, 10.6)
TOTAL	**859**	**11534**						

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



HR - adjusted for age and gender

Unipolar Monoblock vs Bipolar
Entire Period: HR=1.86 (1.54, 2.26),p<0.001

Unipolar Modular vs Bipolar
0 - 2.5Yr: HR=1.11 (0.91, 1.35),p=0.298
2.5Yr+: HR=2.21 (1.73, 2.81),p<0.001

Unipolar Monoblock vs Unipolar Modular
Entire Period: HR=1.32 (1.12, 1.56),p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Monoblock	2377	1613	1315	1071	723	497	237
Unipolar Modular	5629	4274	3525	2882	1918	1153	434
Bipolar	3528	2701	2211	1919	1479	1150	719

UNIPOLAR MONOBLOCK

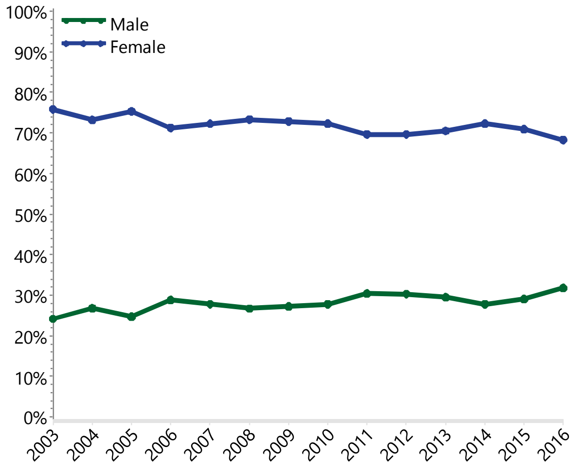
DEMOGRAPHICS

The Registry has recorded 28,122 unipolar monoblock procedures. This is an additional 590 procedures compared to the previous report.

The use of monoblock hip replacement in Australia continues to decline. The number of procedures reported in 2016 has declined by 26.4% compared to 2015 and by 79.0% compared to 2003.

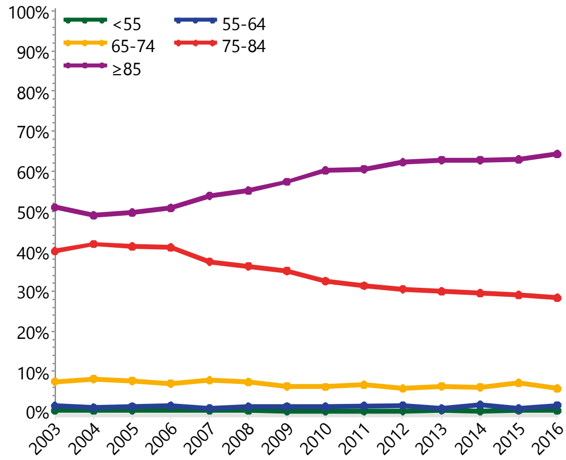
Fractured neck of femur is the principal diagnosis for primary unipolar monoblock hip replacement (97.6%).

Figure HP4 Primary Unipolar Monoblock Hip Replacement by Gender



The majority of patients are female (73.1%) 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 64.3% in 2016. The mean age of patients is 84.5 years (Table HP5, Figures HP4 and HP5).

Figure HP5 Primary Unipolar Monoblock Hip Replacement by Age



The three types of unipolar monoblock prostheses are: the Austin-Moore Type, Thompson Type, and Exeter Trauma Stem (ETS). In 2016, the use of the Austin-Moore Type decreased by 42.5% compared to 2015, and by 91.1% compared to 2003. The Thompson Type decreased by 48.2% compared to 2015, and by 80.8% compared to 2003. In 2016, the use of the ETS increased by 16.2% compared to 2015, and accounted for 47.4% of all 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	7558	26.9%	32	107	84	83.4	7.8
Female	20564	73.1%	16	108	86	84.9	7.1
TOTAL	**28122**	**100.0%**	**16**	**108**	**85**	**84.5**	**7.3**

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

2003		2013		2014		2015		2016	
N	Model	N	Model	N	Model	N	Model	N	Model
1988	Austin-Moore Type	616	Austin-Moore Type	512	Austin-Moore Type	308	Austin-Moore Type	251	ETS
526	Thompson Type	322	Thompson Type	283	ETS	216	ETS	177	Austin-Moore Type
		252	ETS	268	Thompson Type	195	Thompson Type	101	Thompson Type
Most Used									
2514 (2)	100.0%	1190 (3)	100.0%	1063 (3)	100.0%	719 (3)	100.0%	529 (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 7.6% (Table HP7 and Figure HP6).

The main reason for revision is loosening (43.5%), followed by fracture (19.7%), and prosthesis dislocation (11.3%) (Table HP8). The majority of unipolar monoblock hip replacements are revised to a total hip replacement (60.3%). Revision to another unipolar hip replacement (femoral component only) has occurred in 18.4% of revisions (Table HP9).

Age and femoral stem fixation are risk factors 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 HP11 and Figure HP8).

In the first 1.5 years, cementless fixation has a higher rate of revision compared to cemented fixation, with no difference after this time (Table HP12 and Figure HP9).

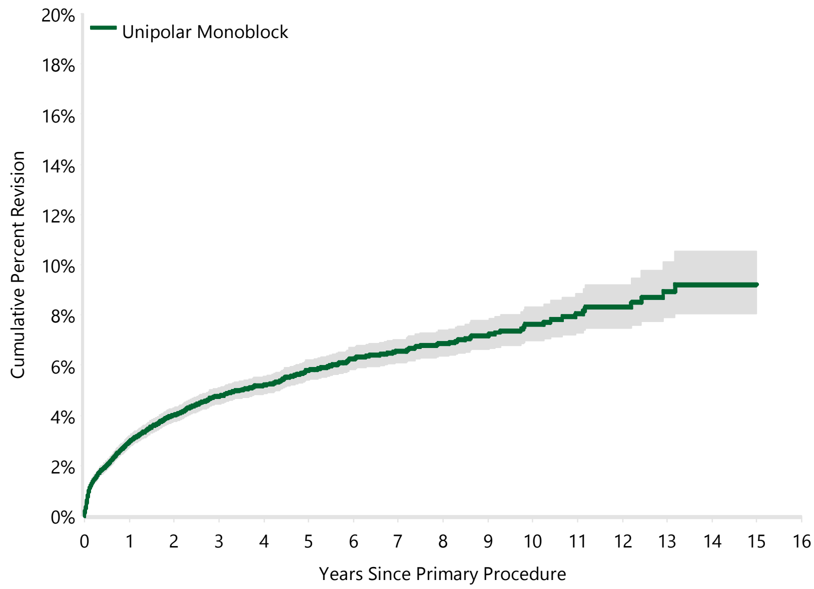
The Thompson Type prosthesis, though designed to be cemented, has been inserted without cement in 574 procedures. This has the highest rate of revision.

The Thompson Type cemented and Austin Moore Type cementless have a higher rate of revision compared to the 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 Class	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Monoblock	1034	27453	2.9 (2.7, 3.2)	4.0 (3.7, 4.3)	4.8 (4.4, 5.1)	5.8 (5.4, 6.2)	6.5 (6.1, 7.0)	7.6 (7.0, 8.3)
TOTAL	**1034**	**27453**						

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	27453	16627	12742	9621	5235	2828	1045

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

Reason for Revision	Number	Percent
Loosening	450	43.5
Fracture	204	19.7
Prosthesis Dislocation	117	11.3
Infection	109	10.5
Pain	76	7.4
Chondrolysis/Acetab. Erosion	44	4.3
Malposition	12	1.2
Lysis	9	0.9
Other	13	1.3
TOTAL	**1034**	**100.0**

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

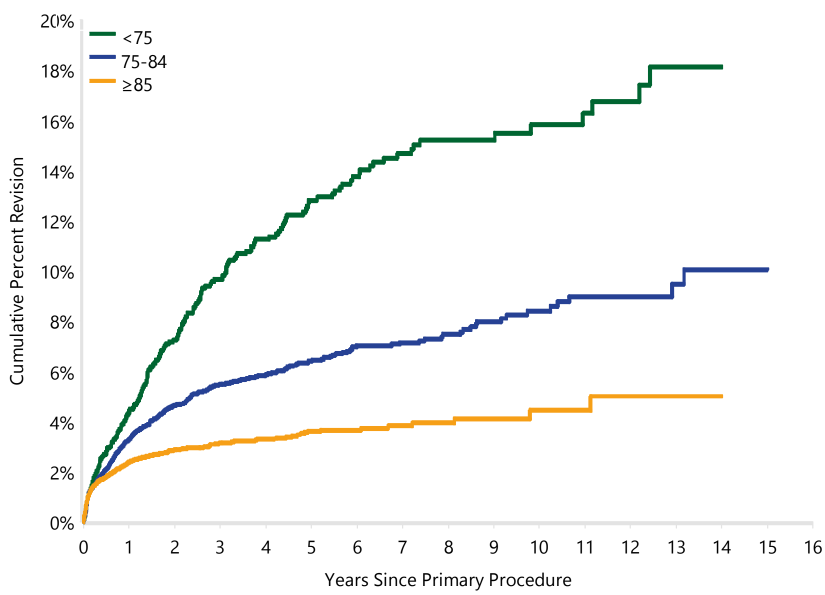
Type of Revision	Number	Percent
THR (Femoral/Acetabular)	623	60.3
Femoral Component	190	18.4
Bipolar Head and Femoral	98	9.5
Removal of Prostheses	54	5.2
Cement Spacer	43	4.2
Minor Components	17	1.6
Reinsertion of Components	6	0.6
Incomplete	1	0.1
Bipolar Only	1	0.1
Insert Only	1	0.1
TOTAL	**1034**	**100.0**

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	218	2377	4.4 (3.6, 5.4)	7.2 (6.1, 8.5)	9.6 (8.3, 11.2)	12.8 (11.2, 14.7)	14.7 (12.8, 16.8)	15.8 (13.7, 18.2)
75-84	467	10291	3.3 (2.9, 3.7)	4.6 (4.2, 5.1)	5.5 (5.0, 6.0)	6.4 (5.8, 7.1)	7.1 (6.5, 7.9)	8.4 (7.4, 9.5)
≥85	349	14785	2.4 (2.1, 2.7)	2.9 (2.6, 3.2)	3.1 (2.8, 3.5)	3.6 (3.2, 4.1)	3.8 (3.3, 4.3)	4.4 (3.6, 5.4)
TOTAL	**1034**	**27453**						

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=1.20 (0.85, 1.69),p=0.307
3Mth - 1Yr: HR=3.08 (2.19, 4.31),p<0.001
1Yr - 2Yr: HR=5.34 (3.71, 7.70),p<0.001
2Yr+: HR=6.84 (5.05, 9.26),p<0.001

75-84 vs ≥85
0 - 3Mth: HR=1.01 (0.81, 1.25),p=0.957
3Mth+: HR=2.34 (1.93, 2.82),p<0.001

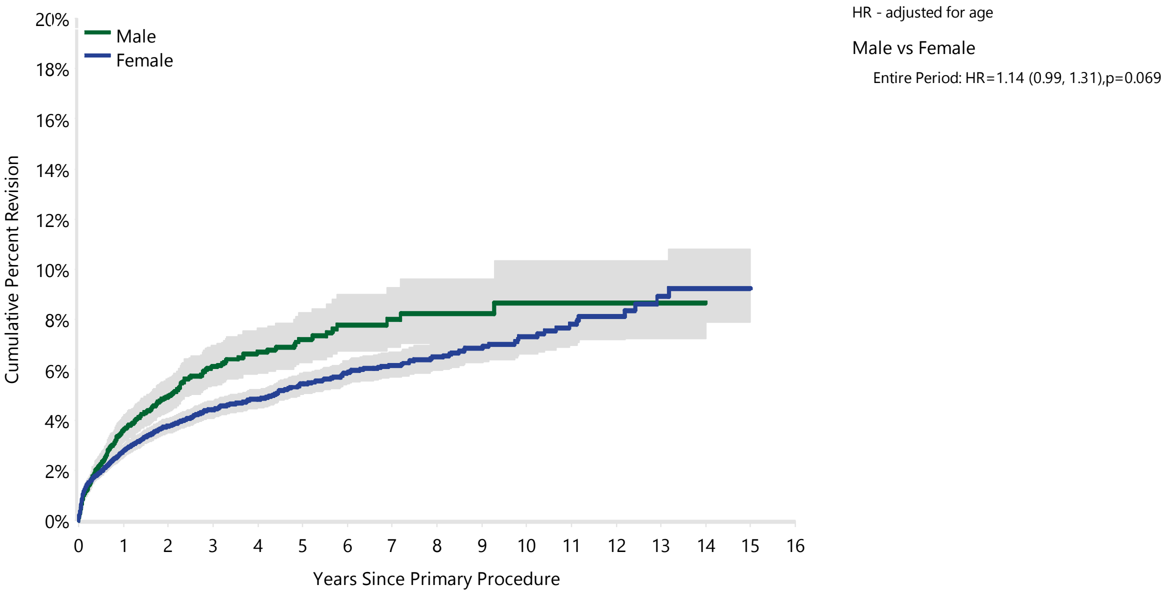
<75 vs 75-84
0 - 1Yr: HR=1.26 (0.99, 1.60),p=0.059
1Yr - 1.5Yr: HR=2.63 (1.69, 4.08),p<0.001
1.5Yr+: HR=2.66 (2.08, 3.41),p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<75	2377	1613	1315	1071	723	497	237
75-84	10291	6682	5306	4162	2497	1417	542
≥85	14785	8332	6121	4388	2015	914	266

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	268	7378	3.6 (3.1, 4.2)	4.9 (4.3, 5.7)	6.1 (5.4, 7.0)	7.2 (6.3, 8.3)	8.0 (6.9, 9.3)	8.7 (7.3, 10.3)
Female	766	20075	2.7 (2.5, 3.0)	3.8 (3.5, 4.1)	4.4 (4.1, 4.8)	5.4 (5.0, 5.9)	6.2 (5.7, 6.7)	7.3 (6.6, 8.1)
TOTAL	**1034**	**27453**						

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

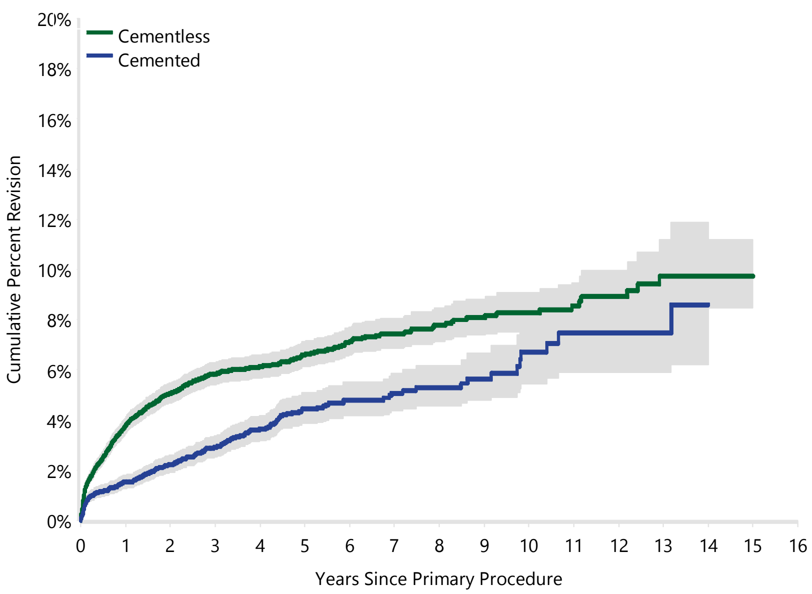


Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Male	7378	3482	2372	1651	795	415	155
Female	20075	13145	10370	7970	4440	2413	890

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		**776**	**17454**	**3.8 (3.5, 4.1)**	**5.1 (4.7, 5.5)**	**5.8 (5.4, 6.3)**	**6.6 (6.1, 7.1)**	**7.4 (6.8, 8.0)**	**8.3 (7.5, 9.1)**
	Austin-Moore	728	16880	3.7 (3.4, 4.0)	5.0 (4.6, 5.4)	5.7 (5.3, 6.2)	6.4 (5.9, 6.9)	7.2 (6.6, 7.8)	8.0 (7.3, 8.8)
	Thompson	48	574	6.6 (4.7, 9.3)	7.5 (5.4, 10.5)	9.4 (6.9, 12.8)	12.3 (9.0, 16.6)	13.0 (9.5, 17.6)	
Cemented		**258**	**9999**	**1.5 (1.3, 1.8)**	**2.2 (1.9, 2.6)**	**2.9 (2.5, 3.4)**	**4.4 (3.9, 5.1)**	**5.1 (4.4, 5.9)**	**6.7 (5.4, 8.2)**
	Austin-Moore	18	935	1.4 (0.7, 2.6)	2.1 (1.2, 3.6)	3.0 (1.8, 5.0)	4.0 (2.4, 6.8)	4.0 (2.4, 6.8)	
	ETS	62	2960	1.4 (1.0, 2.0)	1.9 (1.4, 2.5)	2.4 (1.8, 3.2)	3.3 (2.5, 4.4)	4.4 (3.2, 6.2)	
	Thompson	178	6104	1.6 (1.3, 2.0)	2.4 (2.0, 2.9)	3.1 (2.6, 3.7)	5.0 (4.2, 5.9)	5.5 (4.6, 6.5)	7.5 (5.9, 9.5)
TOTAL		**1034**	**27453**						

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=1.91 (1.50, 2.43),p<0.001

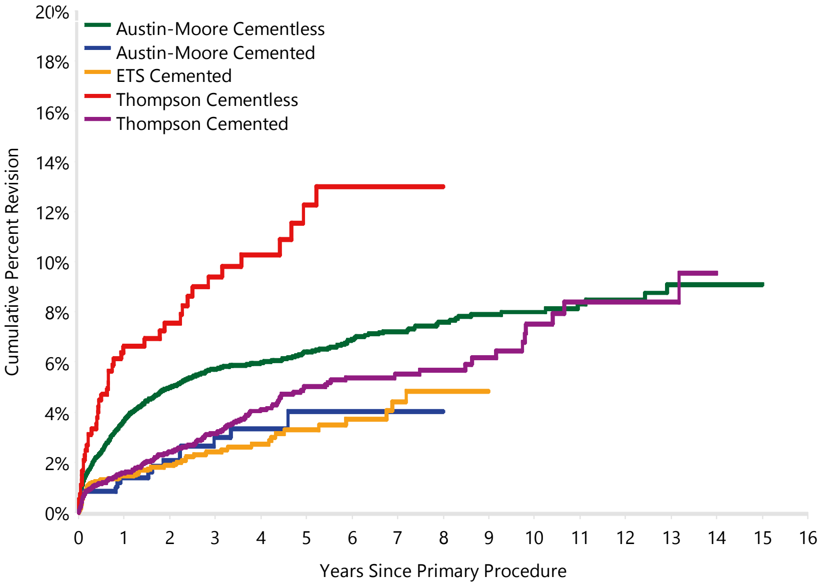
3Mth - 9Mth: HR=4.43 (2.89, 6.79),p<0.001

9Mth - 1.5Yr: HR=2.49 (1.72, 3.60),p<0.001

1.5Yr+: HR=0.99 (0.78, 1.25),p=0.904

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Cementless	17454	10317	7863	5991	3312	1847	743
Cemented	9999	6310	4879	3630	1923	981	302

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=2.21 (1.70, 2.87),p<0.001

Austin-Moore Cemented vs ETS Cemented

Entire Period: HR=1.13 (0.67, 1.90),p=0.656

Thompson Cementless vs ETS Cemented

Entire Period: HR=3.87 (2.65, 5.64),p<0.001

Thompson Cemented vs ETS Cemented

Entire Period: HR=1.38 (1.03, 1.84),p=0.028

Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Austin-Moore	Cementless	16880	9957	7581	5772	3192	1772	716
	Cemented	935	505	382	282	126	58	16
ETS	Cemented	2960	1837	1407	1043	541	257	38
Thompson	Cementless	574	360	282	219	120	75	27
	Cemented	6104	3968	3090	2305	1256	666	248

UNIPOLAR MODULAR

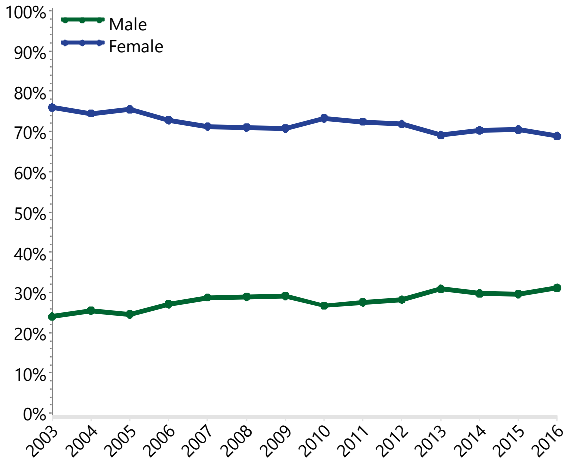
DEMOGRAPHICS

There have been 36,090 unipolar modular procedures reported to the Registry. This is an additional 3,399 procedures compared to the previous report.

In 2016, the number of unipolar modular procedures increased by 0.8% compared to 2015, and increased by 395.7% since 2003.

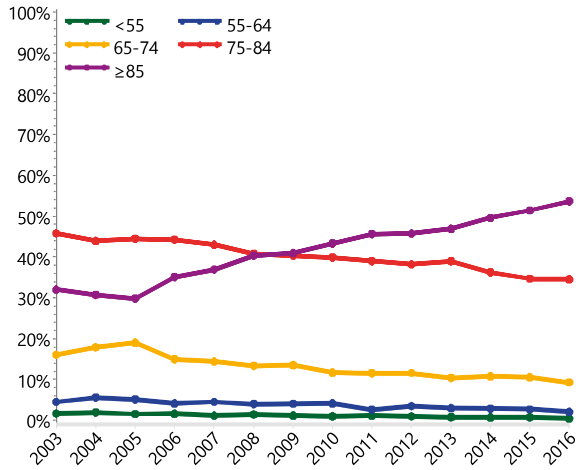
Fractured neck of femur is the principal diagnosis for primary unipolar modular hip replacement (95.0%).

Figure HP11 Primary Unipolar Modular Hip Replacement by Gender



The majority of patients are female (71.4%) and aged 75 years or older (83.1%). The proportion of patients aged 85 years or older has increased from 32.0% in 2003 to 53.6% in 2016. The mean age of patients is 82.0 years (Table HP13, Figures HP11 and HP12).

Figure HP12 Primary Unipolar Modular Hip Replacement by Age



Overall, there have been 219 unipolar modular head and stem combinations. The 10 most frequently used unipolar modular head prostheses and femoral stems are listed in Tables HP14 and HP15.

In 2016, 19 different unipolar modular head prostheses were used. The Unitrax head is the most frequently used (61.8%). The 10 most used unipolar modular head prostheses account for 99.1% of all primary unipolar modular hip procedures.

There were 37 different stem prostheses used in 2016, eight less than in 2015. The most frequently used stem in 2016 is the Exeter V40 (61.0%). 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/steam 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	10332	28.6%	19	106	83	80.9	9.5
Female	25758	71.4%	18	108	84	82.5	8.5
TOTAL	**36090**	**100.0%**	**18**	**108**	**83**	**82.0**	**8.9**

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

2003		2013		2014		2015		2016	
N	Model	N	Model	N	Model	N	Model	N	Model
193	Unitrax	1476	Unitrax	1612	Unitrax	1871	Unitrax	2041	Unitrax
142	Unipolar Head (Zimmer)	959	Unipolar Head (S&N)	958	Unipolar Head (S&N)	831	Unipolar Head (S&N)	645	Unipolar Head (S&N)
127	Unipolar Head (S&N)	551	VerSys	523	VerSys	201	Cathcart	246	Cathcart
75	VerSys	127	Cathcart	162	Cathcart	167	VerSys	164	VerSys
64	Unipolar Head (Mathys)	71	Unipolar Head (Corin)	58	Pharo	61	Unipolar Head (Corin)	63	Unipolar Head (Corin)
46	Elite	52	Metasul	52	Unipolar Head (Corin)	39	Unipolar Head (Lima)	49	Unipolar Head (Signature)
16	Ultima	28	Unipolar Head (Zimmer)	38	Unipolar Head (JRI)	21	Unipolar Head (JRI)	25	Endo II
1	Metasul	27	Pharo	25	Unipolar Head (Lima)	19	FMP	16	Endo Head
1	Optimom	17	Unipolar Head (Lima)	15	Unipolar Head (Zimmer)	18	Pharo	12	BioBall
1	Unipolar Head (Sulzer)	8	FMP	14	FMP	14	Unipolar Head (Mathys)	9	Unipolar Head (Lima)
10 Most Used									
666 (10)	100.0%	3316 (10)	99.2%	3457 (10)	99.5%	3242 (10)	99.0%	3270 (10)	99.1%
Remainder									
0 (0)	0%	27 (7)	0.8%	18 (7)	0.5%	32 (11)	1.0%	31 (9)	0.9%
TOTAL									
666 (10)	100.0%	3343 (17)	100.0%	3475 (17)	100.0%	3274 (21)	100.0%	3301 (19)	100.0%

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

2003		2013		2014		2015		2016	
N	Model	N	Model	N	Model	N	Model	N	Model
180	Exeter V40	1438	Exeter V40	1558	Exeter V40	1831	Exeter V40	2013	Exeter V40
111	Alloclassic	572	CPT	566	CPCS	528	CPCS	504	CPCS
91	CPT	518	CPCS	485	CPT	192	Spectron EF	137	C-Stem AMT
70	Spectron EF	181	SL-Plus	189	Spectron EF	149	CPT	133	CPT
49	Fullfix	178	Spectron EF	122	SL-Plus	107	C-Stem AMT	111	Corail
38	SL-Plus	83	Corail	88	C-Stem AMT	96	Corail	90	Spectron EF
33	Elite Plus	69	Metafix	74	Corail	67	SL-Plus	53	Metafix
18	Basis	55	Basis	57	Pharo	59	Metafix	30	Short Exeter V40
15	CCA	45	C-Stem AMT	52	Metafix	35	H-Max	26	E2
15	Thompson Modular Stem	42	Alloclassic	44	Omnifit	24	Absolut	25	Sirius
10 Most Used									
620 (10)	93.1%	3181 (10)	95.2%	3235 (10)	93.1%	3088 (10)	94.3%	3122 (10)	94.6%
Remainder									
46 (13)	6.9%	162 (26)	4.8%	240 (35)	6.9%	186 (35)	5.7%	179 (27)	5.4%
TOTAL									
666 (23)	100.0%	3343 (36)	100.0%	3475 (45)	100.0%	3274 (45)	100.0%	3301 (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
Cathcart	C-Stem AMT	6	426	1.5 (0.6, 3.5)	1.5 (0.6, 3.5)	1.5 (0.6, 3.5)			
Cathcart	Corail	78	1360	3.4 (2.5, 4.7)	4.8 (3.6, 6.2)	6.1 (4.7, 7.9)	7.9 (6.1, 10.0)	10.7 (8.3, 13.8)	
Endo II	Taperloc*	7	102	5.1 (2.2, 11.9)	5.1 (2.2, 11.9)	5.1 (2.2, 11.9)			
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, 7.6)	8.8 (5.0, 15.2)	
Metasul	CPT*	4	215	1.6 (0.5, 4.9)	1.6 (0.5, 4.9)	2.4 (0.9, 6.6)			
Pharo	Pharo	6	141	3.1 (1.2, 8.1)	5.5 (2.4, 11.9)				
U2	E2*	3	232	0.0 (0.0, 0.0)	0.7 (0.1, 4.9)	1.5 (0.4, 5.9)	2.6 (0.8, 8.2)		
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	14	459	2.1 (1.1, 4.2)	3.0 (1.6, 5.7)	3.0 (1.6, 5.7)	7.8 (4.1, 14.6)		
Unipolar Head (Corin)	Taper Fit	18	316	2.2 (1.0, 4.8)	3.5 (1.8, 6.7)	5.6 (3.3, 9.6)	7.1 (4.3, 11.7)	8.0 (4.9, 13.1)	
Unipolar Head (Corin)	Tri-Fit*	8	288	1.5 (0.6, 4.0)	2.1 (0.9, 5.0)	2.7 (1.2, 5.9)	2.7 (1.2, 5.9)	4.8 (2.2, 10.0)	
Unipolar Head (JRI)	Furlong LOL	10	131	6.4 (3.1, 13.0)	9.9 (5.4, 17.7)	9.9 (5.4, 17.7)			
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)	2.7 (1.1, 6.5)	2.7 (1.1, 6.5)	2.7 (1.1, 6.5)	6.1 (2.9, 12.4)	6.1 (2.9, 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)	Basis	26	578	2.0 (1.1, 3.7)	2.0 (1.1, 3.7)	3.1 (1.8, 5.3)	6.8 (4.5, 10.4)	7.9 (5.3, 11.9)	7.9 (5.3, 11.9)
Unipolar Head (S&N)	CPCS	113	4626	1.7 (1.4, 2.2)	2.2 (1.8, 2.7)	2.8 (2.2, 3.4)	3.8 (3.1, 4.7)	4.9 (3.8, 6.3)	6.6 (3.8, 11.4)
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	44	1039	2.3 (1.5, 3.5)	3.3 (2.3, 4.8)	4.4 (3.1, 6.1)	5.1 (3.6, 7.1)	6.6 (4.6, 9.6)	
Unipolar Head (S&N)	Spectron EF	96	2851	1.6 (1.1, 2.1)	2.5 (1.9, 3.2)	2.9 (2.2, 3.7)	4.1 (3.3, 5.2)	5.9 (4.6, 7.4)	7.6 (5.8, 9.9)
Unipolar Head (Zimmer)	Alloclassic*	60	1084	3.2 (2.3, 4.5)	4.1 (3.0, 5.6)	4.4 (3.2, 5.9)	6.0 (4.5, 7.8)	8.1 (6.2, 10.7)	8.1 (6.2, 10.7)
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, 11.7)	7.2 (3.7, 13.8)	9.1 (4.7, 17.0)
Unitrax	Accolade I*	8	130	0.8 (0.1, 5.6)	5.0 (2.1, 11.6)	6.2 (2.8, 13.3)	6.2 (2.8, 13.3)		
Unitrax	Exeter V40	440	14097	1.9 (1.6, 2.1)	2.7 (2.4, 3.0)	3.4 (3.1, 3.8)	5.1 (4.6, 5.7)	6.4 (5.7, 7.2)	8.2 (7.0, 9.5)
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	142	4254	1.9 (1.5, 2.4)	3.0 (2.4, 3.6)	3.5 (2.9, 4.3)	4.7 (3.9, 5.6)	5.9 (4.8, 7.2)	6.5 (5.2, 8.1)
VerSys	VerSys	5	168	3.2 (1.2, 8.5)	3.2 (1.2, 8.5)	3.2 (1.2, 8.5)			
Other (192)		89	1803	3.5 (2.6, 4.5)	4.7 (3.7, 6.0)	5.4 (4.2, 6.8)	7.2 (5.7, 9.1)	9.2 (7.2, 11.7)	9.9 (7.6, 12.7)
TOTAL		**1244**	**36090**						

Note: Only combinations with over 100 procedures have been listed
*denotes prosthesis combination with no recorded use in primary unipolar modular hip replacement in 2016

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 1,149 revisions of primary unipolar modular hip replacement for a diagnosis of fractured neck of femur.

The main reasons for revision are: prosthesis dislocation (19.9%), infection (19.1%), fracture (16.5%), chondrolysis/acetabular erosion (14.3%), loosening (12.6%), and pain (12.4%) (Table HP18).

Most revisions are acetabular only (45.0%), followed by total hip replacement (femoral/acetabular) (17.8%) (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).

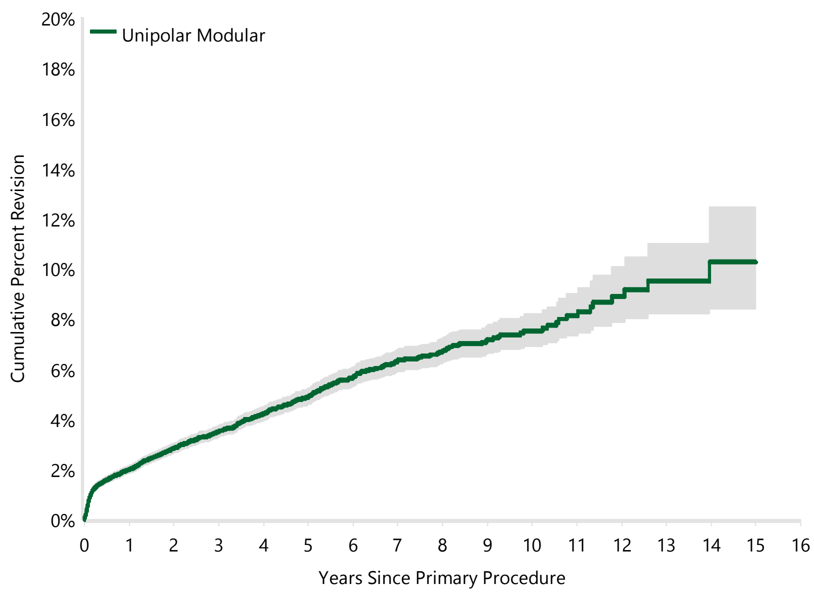
Cementless fixation has a higher rate of revision compared to cemented fixation (Table HP22 and Figure HP16). The cumulative incidence for loosening and fracture is higher for cementless compared to cemented fixation (Figure HP17).

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

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

Hip Class	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Modular	1149	34286	2.0 (1.8, 2.2)	2.8 (2.6, 3.0)	3.5 (3.3, 3.7)	4.9 (4.6, 5.2)	6.3 (5.9, 6.8)	7.5 (6.9, 8.2)
TOTAL	**1149**	**34286**						

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	34286	23221	17936	13572	7314	3598	1015

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

Reason for Revision	Number	Percent
Prosthesis Dislocation	229	19.9
Infection	220	19.1
Fracture	190	16.5
Chondrolysis/Acetab. Erosion	164	14.3
Loosening	145	12.6
Pain	142	12.4
Lysis	15	1.3
Malposition	3	0.3
Other	41	3.6
TOTAL	**1149**	**100.0**

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

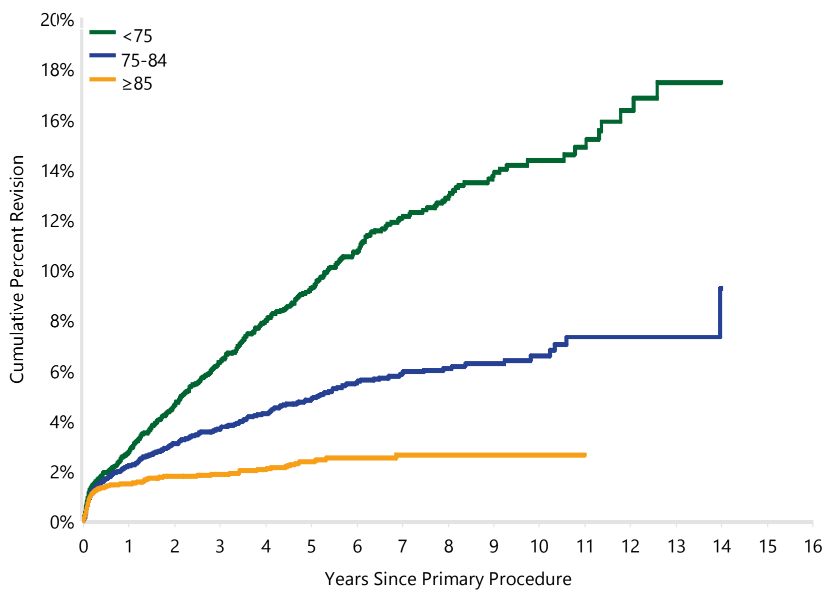
Type of Revision	Number	Percent
Acetabular Component	517	45.0
THR (Femoral/Acetabular)	205	17.8
Head Only	136	11.8
Femoral Component	126	11.0
Cement Spacer	48	4.2
Minor Components	39	3.4
Bipolar Head and Femoral	37	3.2
Removal of Prostheses	28	2.4
Bipolar Only	8	0.7
Reinsertion of Components	4	0.3
Cement Only	1	0.1
TOTAL	**1149**	**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	428	5629	2.7 (2.3, 3.2)	4.6 (4.0, 5.2)	6.3 (5.6, 7.1)	9.2 (8.3, 10.3)	12.1 (10.9, 13.4)	14.3 (12.9, 16.0)
75-84	482	13492	2.2 (1.9, 2.5)	3.1 (2.8, 3.4)	3.6 (3.3, 4.0)	4.8 (4.4, 5.3)	5.9 (5.3, 6.5)	6.6 (5.8, 7.4)
≥85	239	15165	1.5 (1.3, 1.7)	1.8 (1.5, 2.0)	1.9 (1.6, 2.1)	2.3 (2.0, 2.7)	2.6 (2.2, 3.1)	2.6 (2.2, 3.1)
TOTAL	**1149**	**34286**						

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 (0.96, 1.64),p=0.096
3Mth - 9Mth: HR=3.58 (2.35, 5.47),p<0.001
9Mth - 1.5Yr: HR=6.72 (4.62, 9.78),p<0.001
1.5Yr - 2Yr: HR=6.58 (4.01, 10.80),p<0.001
2Yr+: HR=9.21 (6.88, 12.33),p<0.001

75-84 vs ≥85
0 - 3Mth: HR=1.09 (0.87, 1.35),p=0.461
3Mth+: HR=3.25 (2.54, 4.16),p<0.001

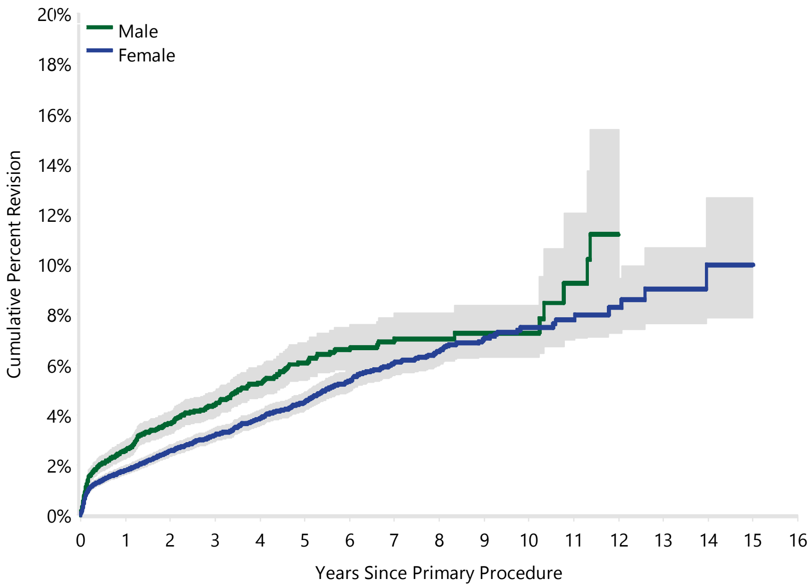
<75 vs 75-84
0 - 3Mth: HR=1.16 (0.89, 1.51),p=0.285
3Mth - 9Mth: HR=1.10 (0.75, 1.61),p=0.615
9Mth - 1.5Yr: HR=2.07 (1.49, 2.87),p<0.001
1.5Yr - 2Yr: HR=2.03 (1.28, 3.20),p=0.002
2Yr - 2.5Yr: HR=2.98 (1.80, 4.94),p<0.001
2.5Yr+: HR=2.81 (2.24, 3.52),p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<75	5629	4274	3525	2882	1918	1153	434
75-84	13492	9754	7834	6160	3459	1743	476
≥85	15165	9193	6577	4530	1937	702	105

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	347	9801	2.6 (2.2, 2.9)	3.6 (3.2, 4.1)	4.4 (3.9, 4.9)	6.1 (5.4, 6.8)	7.0 (6.1, 8.0)	7.2 (6.3, 8.3)
Female	802	24485	1.8 (1.6, 2.0)	2.5 (2.3, 2.8)	3.2 (2.9, 3.4)	4.5 (4.2, 4.9)	6.1 (5.6, 6.6)	7.5 (6.7, 8.3)
TOTAL	**1149**	**34286**						

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=1.37 (1.18, 1.61),p<0.001

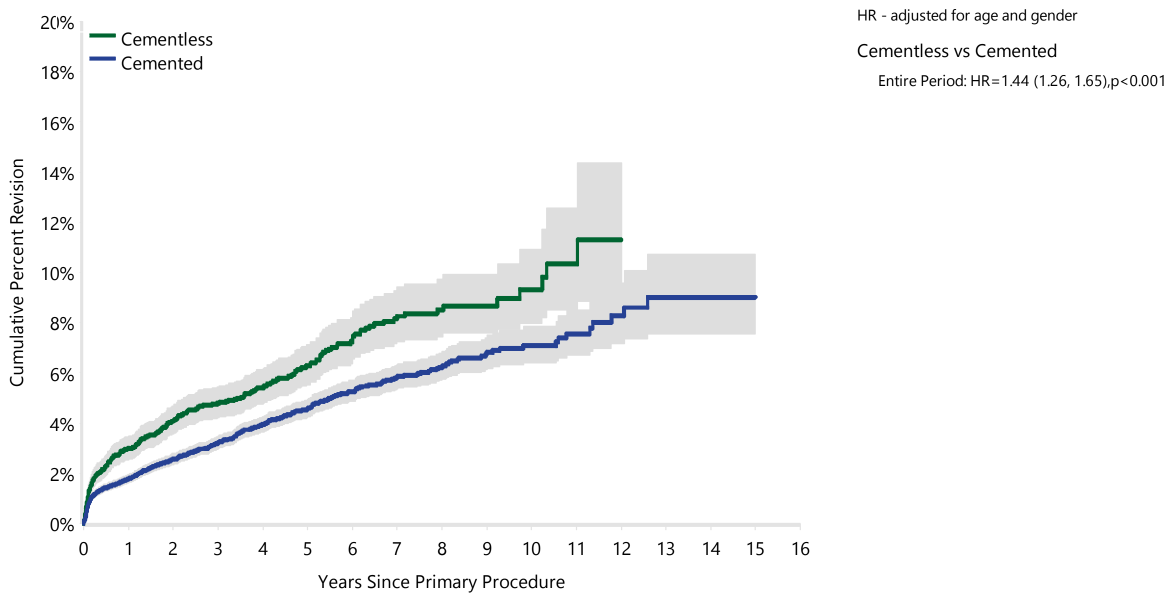
1.5Yr+: HR=0.91 (0.73, 1.14),p=0.404

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Male	9801	5725	4147	2964	1431	712	181
Female	24485	17496	13789	10608	5883	2886	834

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

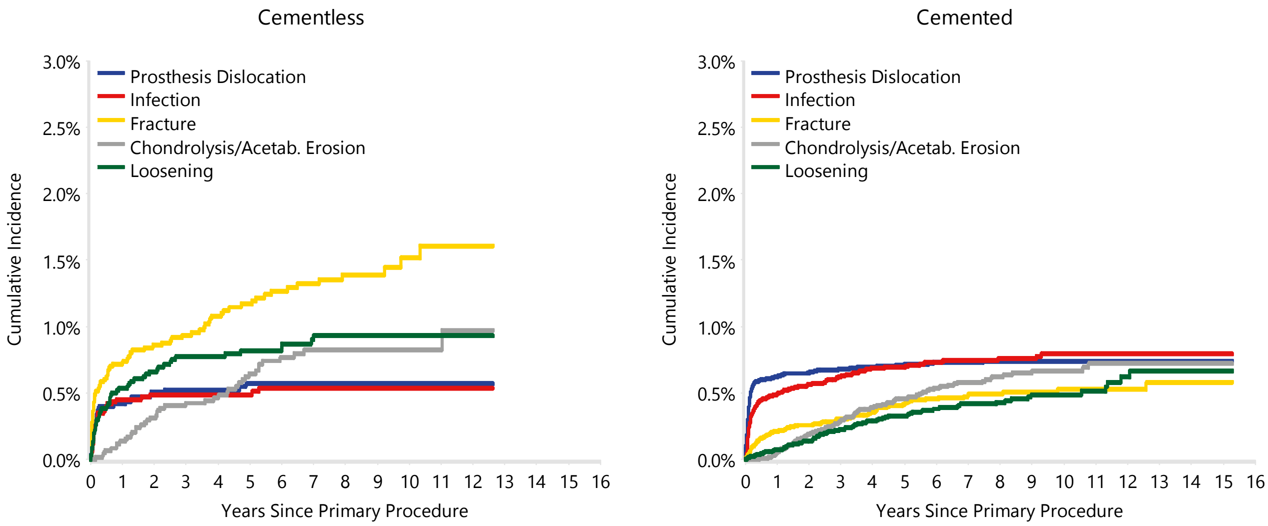
Femoral Fixation	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Cementless	296	6022	3.0 (2.5, 3.5)	4.1 (3.6, 4.7)	4.8 (4.2, 5.5)	6.3 (5.5, 7.1)	8.3 (7.2, 9.4)	9.3 (7.9, 10.9)
Cemented	853	28264	1.8 (1.6, 1.9)	2.6 (2.4, 2.8)	3.2 (2.9, 3.4)	4.6 (4.2, 4.9)	5.8 (5.4, 6.3)	7.1 (6.4, 7.8)
TOTAL	**1149**	**34286**						

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	6022	4345	3528	2756	1651	887	217
Cemented	28264	18876	14408	10816	5663	2711	798

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



BIPOLAR

DEMOGRAPHICS

There have been 19,163 bipolar hip replacement procedures reported to the Registry. This is an additional 2,120 procedures compared to the previous report.

Since 2010, there has been an increase in the number of bipolar procedures undertaken each year, with 3.8% more procedures in 2016 compared to 2015. The total number of bipolar procedures has increased by 53.1% since 2003.

Fractured neck of femur is the principal diagnosis for bipolar hip replacement (91.3%).

The majority of patients are female (71.5%) and aged 75 years or older (78.0%). The proportion of patients aged 85 years or older has increased from 26.0% in 2003 to 47.9% in 2016. The mean age of patients is 80.4 years (Table HP23, Figures HP18 and HP19).

Figure HP18 Primary Bipolar Hip Replacement by Gender

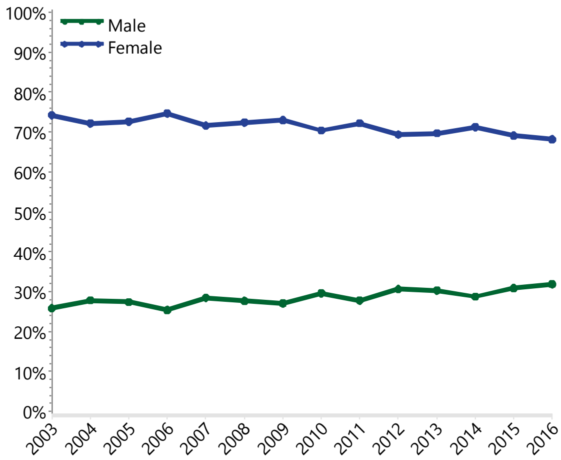
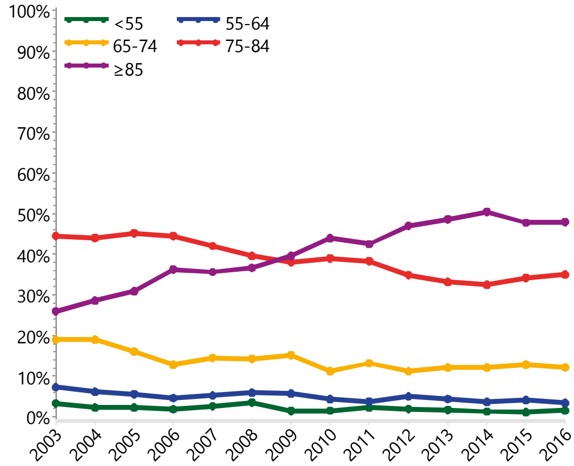


Figure HP19 Primary Bipolar Hip Replacement by Age



Overall, there have been 261 bipolar head and stem combinations. In 2016, there were nine different bipolar head and 40 different stem prostheses used.

In 2016, the UHR remains the most frequently used bipolar head (43.5%) and the Exeter V40 the most frequently used femoral stem (41.2%). The 10 most used femoral stems account for 91.4% of all bipolar hip procedures (Tables HP24 and 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	5462	28.5%	17	101	82	79.6	10.9
Female	13701	71.5%	14	107	82	80.8	9.6
TOTAL	**19163**	**100.0%**	**14**	**107**	**82**	**80.4**	**10.0**

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

2003		2013		2014		2015		2016	
N	Model	N	Model	N	Model	N	Model	N	Model
760	UHR	596	UHR	779	UHR	815	UHR	894	UHR
140	Hastings	155	Tandem	207	Multipolar Bipolar	759	Multipolar Bipolar	661	Multipolar Bipolar
115	Convene	130	Multipolar Bipolar	115	Tandem	179	Self-Centering	212	Self-Centering
91	Bipolar Head (Zimmer)	46	Bipolar Head (Lima)	91	Self-Centering	113	Tandem	154	Tandem
87	Self-Centering	38	Hastings	63	Bipolar Head (Medacta)	69	Bipolar Head (Medacta)	88	Bipolar Head (Medacta)
59	Multipolar Bipolar	35	Self-Centering	35	Hastings	18	Ringloc	23	Bipolar Head (Lima)
39	Bipolar Head (Mathys)	34	Bipolar Head (Medacta)	30	Bipolar Head (Lima)	16	Bipolar Head (Lima)	12	Ringloc
19	Bipolar Head (Lima)	22	Ringloc	28	Ringloc	3	Bipolar Head (Mathys)	5	Bipolar Head (Implantcast)
19	Ringloc	8	Moonstone	15	AcuMatch L-Series	2	Bipolar Head (Implantcast)	4	Bipolar Head (Mathys)
5	UHL	8	Pharo	5	Gladiator	2	Hastings		
10 Most Used									
1334 (10)	99.5%	1072 (10)	98.2%	1368 (10)	99.3%	1976 (10)	99.9%	2053 (9)	100.0%
Remainder									
7 (2)	0.5%	20 (7)	1.8%	9 (4)	0.7%	1 (1)	0.1%	0 (0)	0%
TOTAL									
1341 (12)	100.0%	1092 (17)	100.0%	1377 (14)	100.0%	1977 (11)	100.0%	2053 (9)	100.0%

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

2003		2013		2014		2015		2016	
N	Model	N	Model	N	Model	N	Model	N	Model
630	Exeter V40	577	Exeter V40	734	Exeter V40	777	Exeter V40	845	Exeter V40
94	Elite Plus	116	CPCS	170	CPT	662	CPT	600	CPT
75	Alloclassic	106	CPT	91	Corail	124	Corail	127	Corail
65	CPCS	55	Corail	84	CPCS	78	CPCS	125	CPCS
61	C-Stem	28	Quadra-C	39	Accolade I	35	Quadra-C	60	Quadra-C
59	Omnifit	26	C2	27	Quadra-C	26	C-Stem AMT	40	C-Stem AMT
33	VerSys	24	Basis	25	X-Acta	26	X-Acta	22	H-Max
26	ABGII	19	H-Max	20	H-Max	23	Alloclassic	21	Summit
25	CCA	15	Accolade I	16	Alloclassic	22	Accolade I	19	X-Acta
25	Spectron EF	14	Alloclassic	13	C-Stem AMT	22	Summit	18	Accolade II
10 Most Used									
1093 (10)	81.5%	980 (10)	89.7%	1219 (10)	88.5%	1795 (10)	90.8%	1877 (10)	91.4%
Remainder									
248 (46)	18.5%	112 (33)	10.3%	158 (39)	11.5%	182 (35)	9.2%	176 (30)	8.6%
TOTAL									
1341 (56)	100.0%	1092 (43)	100.0%	1377 (49)	100.0%	1977 (45)	100.0%	2053 (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 (Medacta)	Quadra-C	6	206	3.7 (1.7, 8.2)	3.7 (1.7, 8.2)	3.7 (1.7, 8.2)			
Bipolar Head (Zimmer)	Alloclassic*	17	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)	2.8 (1.2, 6.5)	2.8 (1.2, 6.5)	2.8 (1.2, 6.5)	2.8 (1.2, 6.5)	3.9 (1.7, 9.0)
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, 10.3)	5.7 (3.1, 10.3)	5.7 (3.1, 10.3)	
Hastings	Charnley*	6	118	0.0 (0.0, 0.0)	3.6 (1.2, 10.8)	3.6 (1.2, 10.8)	6.6 (2.8, 15.3)		
Hastings	Corail*	17	361	3.3 (1.8, 5.8)	3.6 (2.1, 6.3)	4.0 (2.3, 6.8)	4.7 (2.7, 8.0)	4.7 (2.7, 8.0)	
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	190	4.1 (2.0, 8.4)	4.1 (2.0, 8.4)	4.1 (2.0, 8.4)	5.3 (2.6, 10.9)		
Multipolar Bipolar	CPT	60	1958	2.8 (2.1, 3.7)	3.8 (2.9, 5.1)	4.4 (3.2, 5.9)	5.3 (3.7, 7.6)	6.5 (4.1, 10.2)	
Multipolar Bipolar	VerSys	3	237	0.0 (0.0, 0.0)	1.7 (0.4, 6.6)	1.7 (0.4, 6.6)	1.7 (0.4, 6.6)	1.7 (0.4, 6.6)	
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	113	2.2 (0.6, 8.5)	2.2 (0.6, 8.5)	2.2 (0.6, 8.5)			
Self-Centering	C-Stem*	3	111	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	Corail	21	540	3.6 (2.3, 5.8)	4.9 (3.1, 7.7)	4.9 (3.1, 7.7)	4.9 (3.1, 7.7)	6.7 (3.6, 12.3)	
Self-Centering	Elite Plus*	3	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*	13	114	2.0 (0.5, 7.7)	7.5 (3.7, 15.2)	12.5 (7.1, 21.5)			
Tandem	CPCS	31	1245	1.8 (1.1, 2.8)	2.4 (1.6, 3.6)	2.9 (2.0, 4.3)	3.1 (2.1, 4.6)	4.3 (2.8, 6.4)	4.9 (3.2, 7.5)
Tandem	Spectron EF	7	163	2.7 (1.0, 7.1)	3.7 (1.5, 8.6)	4.6 (2.1, 10.0)	5.8 (2.8, 12.1)		
UHR	ABGII*	20	177	4.4 (2.1, 8.9)	4.4 (2.1, 8.9)	5.1 (2.6, 10.1)	10.9 (6.5, 18.0)	13.5 (8.3, 21.6)	
UHR	Accolade I	16	313	2.8 (1.4, 5.5)	4.2 (2.3, 7.4)	4.7 (2.7, 8.2)	5.4 (3.1, 9.4)	6.7 (3.8, 11.9)	
UHR	Exeter V40	223	7946	1.9 (1.6, 2.3)	2.5 (2.2, 3.0)	3.1 (2.7, 3.6)	3.7 (3.2, 4.2)	4.3 (3.7, 5.0)	5.0 (4.2, 5.9)
UHR	Exeter*	10	205	1.6 (0.5, 4.9)	2.2 (0.8, 5.8)	3.5 (1.6, 7.7)	4.9 (2.5, 9.7)	4.9 (2.5, 9.7)	4.9 (2.5, 9.7)
UHR	GMRS	10	117	3.7 (1.4, 9.6)	5.2 (2.2, 12.4)	5.2 (2.2, 12.4)			
UHR	Omnifit	22	372	4.9 (3.1, 7.8)	5.3 (3.4, 8.3)	5.7 (3.6, 8.7)	6.1 (4.0, 9.3)	7.3 (4.8, 11.1)	7.3 (4.8, 11.1)
Other (234)		116	2528	3.2 (2.5, 4.0)	4.0 (3.3, 5.0)	4.9 (4.0, 5.9)	5.6 (4.6, 6.8)	6.2 (5.1, 7.6)	8.2 (6.6, 10.3)
TOTAL		**686**	**19163**						

Note: Only combinations with over 100 procedures have been listed
*denotes prosthesis combination with no recorded use in primary bipolar hip replacement in 2016

OUTCOME FOR FRACTURED NECK OF FEMUR

The cumulative percent revision at 10 years for bipolar hip replacement undertaken for fractured neck of femur is 6.4% (Table HP27 and Figure HP20).

The Registry has recorded 606 revisions of primary bipolar hip replacement procedures with a primary diagnosis of fractured neck of femur.

The main reasons for revision are fracture (24.9%), infection (21.0%), prosthesis dislocation (18.3%), and loosening (16.7%) (Table HP28). The most frequent type of revision is acetabular only (34.7%), followed by total hip replacement (femoral/acetabular) (22.8%), and bipolar head and femoral (12.9%) (Table HP29).

Age and femoral stem fixation are risk factors 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).

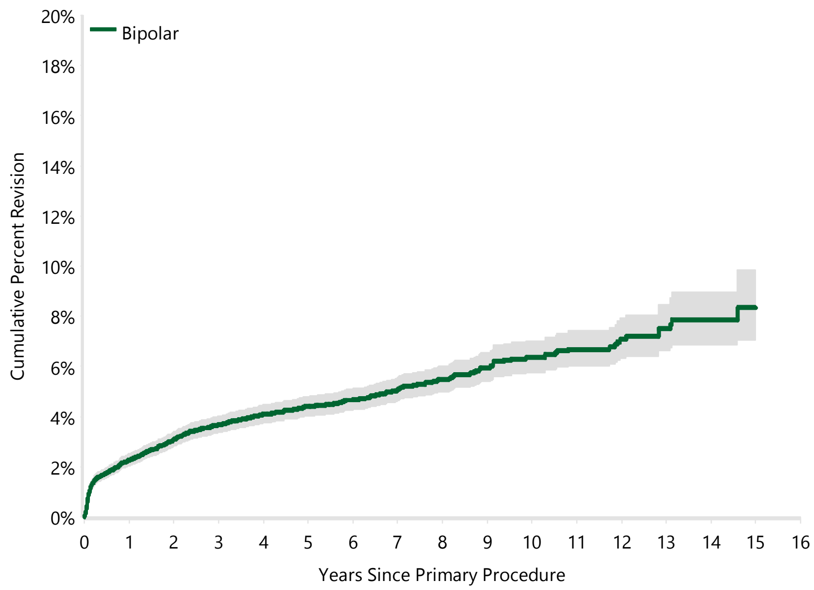
Cementless fixation has a higher rate of revision compared to cemented fixation (Table HP32 and Figure HP23). The cumulative incidence of fracture for cementless fixation is higher than for cemented fixation (Figure HP24).

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

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

Hip Class	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Bipolar	606	17486	2.3 (2.0, 2.5)	3.1 (2.8, 3.4)	3.7 (3.4, 4.0)	4.4 (4.0, 4.8)	5.0 (4.6, 5.5)	6.4 (5.7, 7.0)
TOTAL	**606**	**17486**						

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	17486	12050	9300	7415	4866	3191	1598

Table HP28 Primary Bipolar Hip Replacement by Reason for Revision

Reason for Revision	Number	Percent
Fracture	151	24.9
Infection	127	21.0
Prosthesis Dislocation	111	18.3
Loosening	101	16.7
Chondrolysis/Acetab. Erosion	48	7.9
Pain	45	7.4
Malposition	3	0.5
Lysis	2	0.3
Other	18	3.0
TOTAL	**606**	**100.0**

Table HP29 Primary Bipolar Hip Replacement by Type of Revision

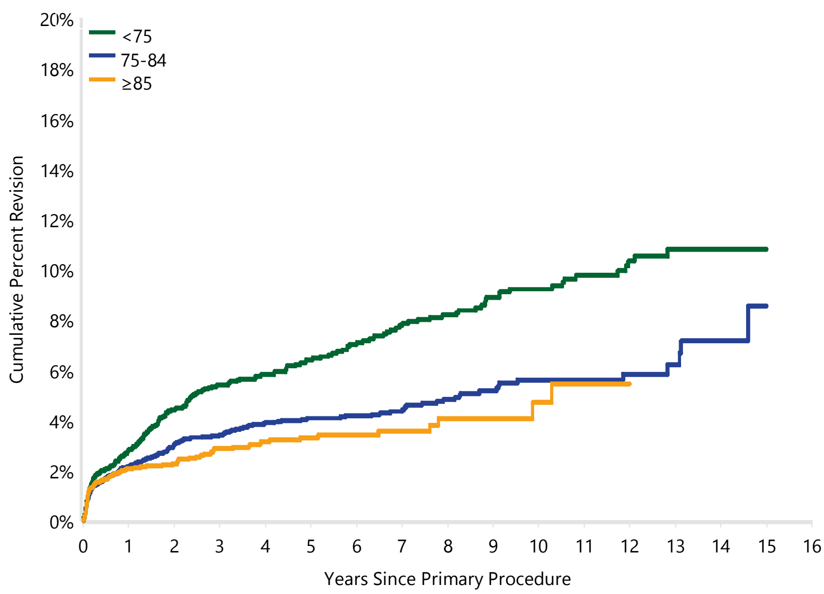
Type of Revision	Number	Percent
Acetabular Component	210	34.7
THR (Femoral/Acetabular)	138	22.8
Bipolar Head and Femoral	78	12.9
Bipolar Only	72	11.9
Femoral Component	35	5.8
Cement Spacer	32	5.3
Removal of Prostheses	15	2.5
Head Only	14	2.3
Minor Components	12	2.0
TOTAL	**606**	**100.0**

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	213	3528	2.8 (2.3, 3.4)	4.4 (3.7, 5.2)	5.4 (4.6, 6.3)	6.4 (5.5, 7.4)	7.8 (6.7, 9.0)	9.2 (8.0, 10.6)
75-84	236	6987	2.2 (1.8, 2.5)	3.0 (2.6, 3.5)	3.4 (2.9, 3.9)	4.1 (3.6, 4.7)	4.3 (3.8, 5.0)	5.6 (4.8, 6.5)
≥85	157	6971	2.1 (1.7, 2.5)	2.2 (1.9, 2.7)	2.9 (2.4, 3.4)	3.3 (2.8, 3.9)	3.6 (2.9, 4.3)	4.7 (3.4, 6.5)
TOTAL	**606**	**17486**						

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=1.43 (1.10, 1.87),p=0.008

1Yr - 1.5Yr: HR=3.73 (2.07, 6.73),p<0.001

1.5Yr+: HR=2.28 (1.68, 3.11),p<0.001

75-84 vs ≥85

Entire Period: HR=1.19 (0.97, 1.46),p=0.096

<75 vs 75-84

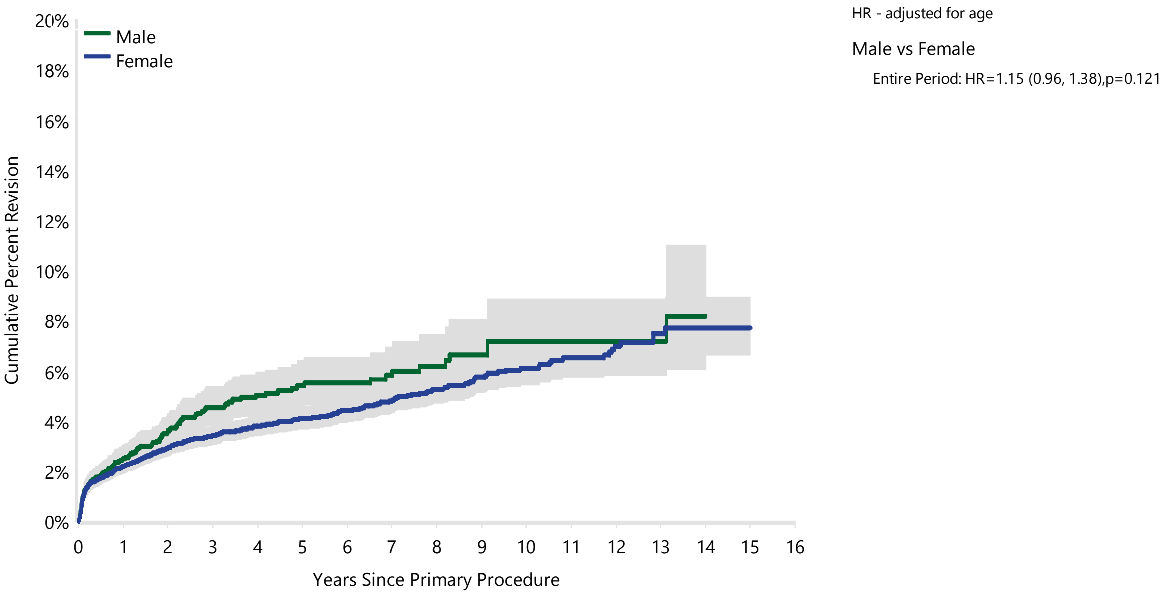
Entire Period: HR=1.57 (1.31, 1.90),p<0.001

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<75	3528	2701	2211	1919	1479	1150	719
75-84	6987	5102	4078	3380	2324	1539	733
≥85	6971	4247	3011	2116	1063	502	146

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	168	4905	2.5 (2.1, 3.0)	3.6 (3.0, 4.2)	4.5 (3.8, 5.4)	5.4 (4.6, 6.4)	5.8 (4.9, 6.9)	7.2 (5.8, 8.8)
Female	438	12581	2.2 (1.9, 2.5)	2.9 (2.6, 3.3)	3.4 (3.1, 3.8)	4.1 (3.7, 4.5)	4.8 (4.3, 5.3)	6.1 (5.4, 6.8)
TOTAL	**606**	**17486**						

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

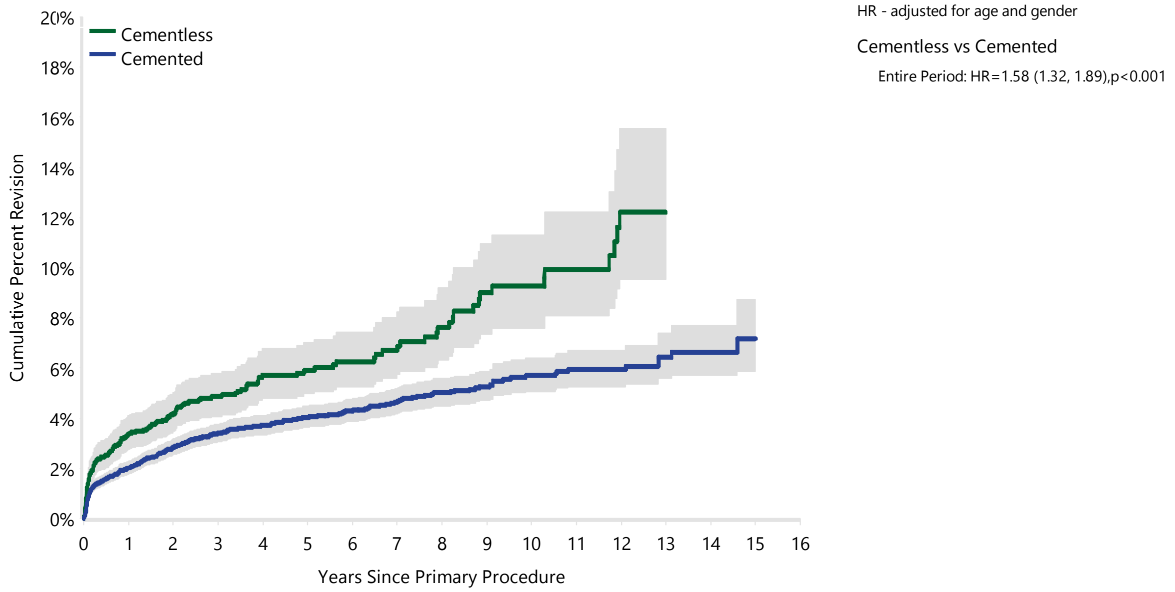


Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Male	4905	2950	2111	1569	913	565	276
Female	12581	9100	7189	5846	3953	2626	1322

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

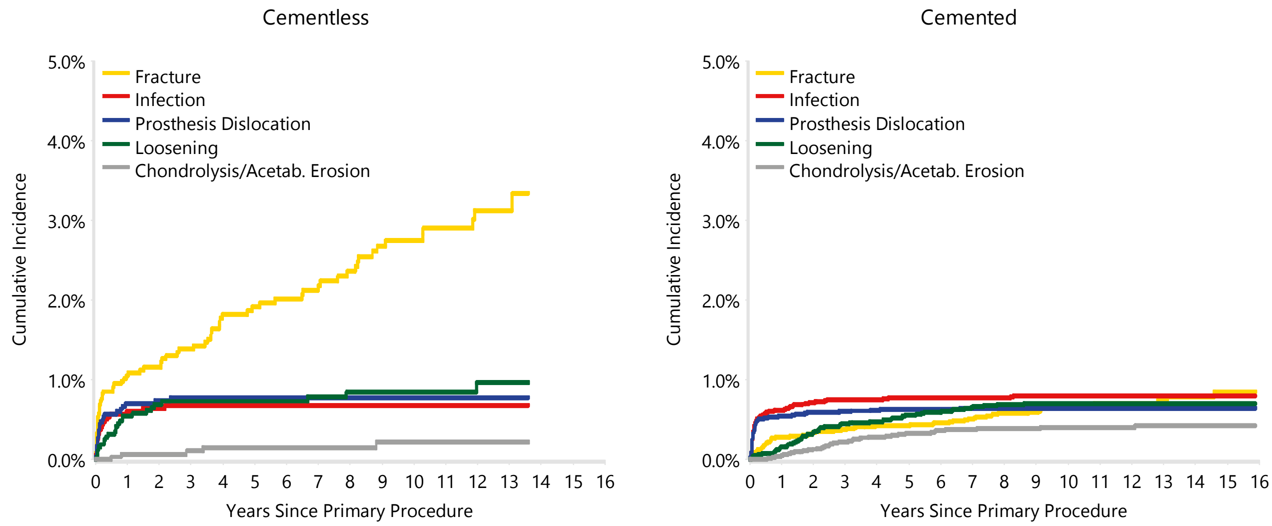
Femoral Fixation	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Cementless	162	3192	3.3 (2.7, 4.1)	4.2 (3.5, 5.0)	4.9 (4.1, 5.8)	5.9 (5.0, 7.0)	6.7 (5.6, 8.0)	9.3 (7.6, 11.3)
Cemented	444	14294	2.0 (1.8, 2.3)	2.8 (2.5, 3.1)	3.4 (3.1, 3.8)	4.0 (3.6, 4.5)	4.6 (4.2, 5.2)	5.7 (5.1, 6.4)
TOTAL	**606**	**17486**						

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	3192	2273	1794	1428	889	563	281
Cemented	14294	9777	7506	5987	3977	2628	1317

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

The Registry sub-categorises primary total hip replacement into three classes. These are defined by the type of femoral prosthesis used. A total hip procedure replaces both the femoral and acetabular articular surfaces.

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.

Thrust plate involves acetabular replacement combined with resection of the femoral head and replacement with a femoral component that has a lateral fixation plate and femoral head prosthesis.

USE OF TOTAL HIP REPLACEMENT

The Registry has recorded 400,331 primary total hip replacement procedures. Of these, total conventional is the most common class (95.8%) followed by total resurfacing (4.2%) (Table HT1). Previously, the Registry has included the thrust plate in primary total hip replacement, but as there has been no use for four years and the use of the thrust plate is less than 0.1% of all primary total hip replacements, it has been excluded from further analysis.

Table HT1 Primary Total Hip Replacement by Class

Total Hip Class	Number	Percent
Total Conventional	383123	95.8
Total Resurfacing	16950	4.2
TOTAL	**400073**	**100.0**

Note: Excludes 258 thrust plate procedures

Detailed information on Thrust Plate is available in the supplementary report 'Outcome of Classes No Longer Used - Hip and Knee Arthroplasty' on the AOANJRR website:
https://aoanjrr.sahmri.com/annual-reports-2017.

Osteoarthritis is the principal diagnosis for primary total hip replacement (88.8%).

Total conventional hip replacement (all bearing surfaces included) has a lower cumulative percent revision compared to total resurfacing at 16 years (Table HT2).

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-2017.

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	16 Yrs
Total Conventional	17003	383123	1.7 (1.6, 1.7)	2.8 (2.7, 2.8)	3.8 (3.7, 3.9)	6.6 (6.5, 6.8)	9.8 (9.5, 10.0)	10.4 (10.0, 10.7)
Total Resurfacing	1565	16950	1.7 (1.5, 1.9)	3.3 (3.0, 3.6)	5.1 (4.8, 5.4)	9.8 (9.3, 10.3)	13.5 (12.7, 14.3)	14.2 (13.0, 15.5)
TOTAL	**18568**	**400073**						

PRIMARY TOTAL CONVENTIONAL HIP REPLACEMENT

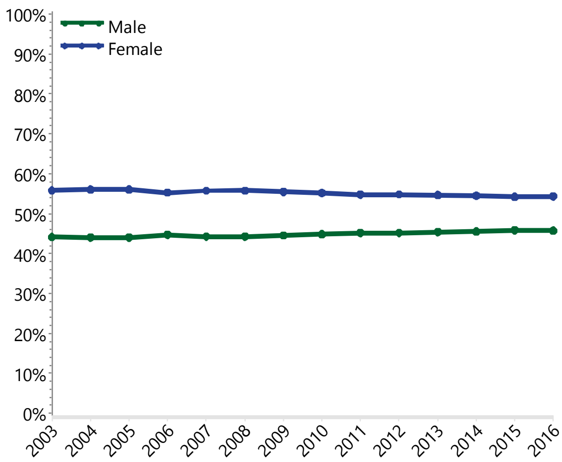
DEMOGRAPHICS

There have been 383,123 total conventional hip replacement procedures reported to the Registry. This is an additional 36,341 procedures compared to the previous report.

Primary total conventional hip replacement continues to increase. In 2016, there were 5.5% more procedures than in 2015 and 109.7% more than in 2003.

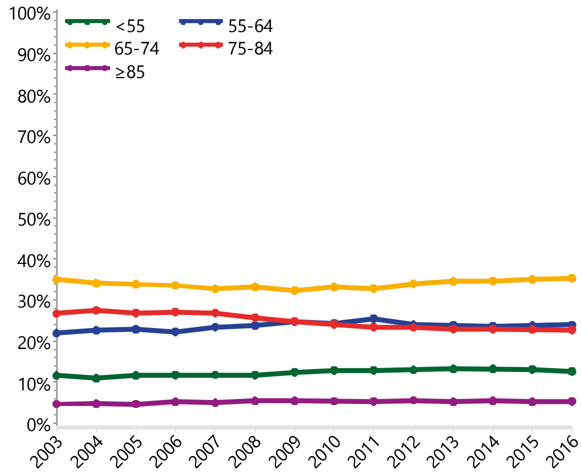
Total conventional hip replacement is more common in females (55.0%). This proportion has remained stable since 2003 (Figure HT1).

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 24.0% in 2016) and younger than 55 years (11.7% in 2003 to 12.6% in 2016) (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 63.4% in 2016. Cemented fixation has declined from 13.9% to 3.4% and hybrid fixation from 34.8% to 33.2% over the same period (Figure HT3).

Figure HT3 Primary Total Conventional Hip Replacement by Fixation

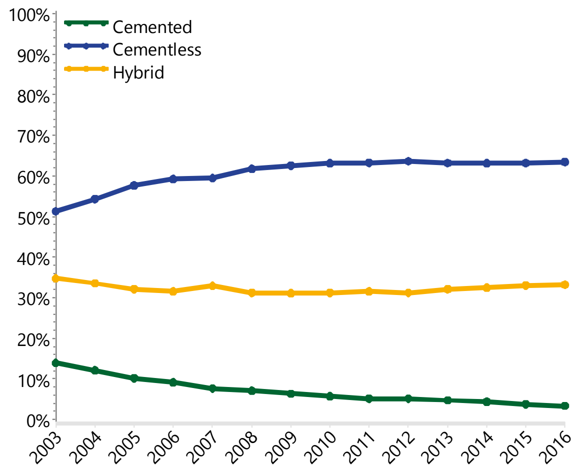


Table HT3 Age and Gender of Primary Total Conventional Hip Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	172435	45.0%	13	102	67	66.3	11.5
Female	210688	55.0%	11	101	70	68.9	11.4
TOTAL	**383123**	**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 2016, 66.0% of total conventional hip replacements used stems in the 10 most used femoral component list. Seven of these are cementless. The 10 most used cemented and cementless stems are listed in Tables HT5 and HT6, respectively. In 2016, the 10 most used cemented stems accounted for 92.8% of cemented stem procedures. The ten most used cementless stems accounted for 70.5% of cementless stem procedures.

The Trident (Shell), Pinnacle, and R3 remain the most frequently used acetabular prostheses for total conventional hip replacement. In 2016, 78.5% 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		2013		2014		2015		2016	
N	Model	N	Model	N	Model	N	Model	N	Model
3901	Exeter V40	6932	Exeter V40	7406	Exeter V40	7455	Exeter V40	7419	Exeter V40
1029	ABGII	4668	Corail	5036	Corail	5411	Corail	5815	Corail
1000	Synergy	2259	Quadra-H	2916	Quadra-H	2828	Quadra-H	2736	Quadra-H
819	Alloclassic	1462	CPT	1565	CPT	1517	Polarstem	1813	Polarstem
809	VerSys	1048	Polarstem	1201	Polarstem	1295	CPT	1315	Accolade II
780	Spectron EF	813	Secur-Fit	841	Anthology	905	Accolade II	1216	CPT
713	Secur-Fit Plus	785	CPCS	726	CPCS	842	Taperloc	982	Taperloc
618	Omnifit	765	Accolade I	716	Secur-Fit	811	CPCS	790	CPCS
565	C-Stem	731	Synergy	715	Taperloc	778	Anthology	780	Tri-Fit TS
485	S-Rom	643	Anthology	574	Synergy	579	Tri-Fit TS	779	AMIStem H
10 Most Used									
10719 (10)	62.8%	20106 (10)	68.0%	21696 (10)	67.3%	22421 (10)	66.1%	23645 (10)	66.0%
Remainder									
6354 (73)	37.2%	9463 (109)	32.0%	10539 (109)	32.7%	11521 (98)	33.9%	12160 (91)	34.0%
TOTAL									
17073 (83)	100.0%	29569 (119)	100.0%	32235 (119)	100.0%	33942 (108)	100.0%	35805 (101)	100.0%

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

2003		2013		2014		2015		2016	
N	Model	N	Model	N	Model	N	Model	N	Model
3901	Exeter V40	6932	Exeter V40	7406	Exeter V40	7455	Exeter V40	7419	Exeter V40
780	Spectron EF	1462	CPT	1565	CPT	1295	CPT	1216	CPT
565	C-Stem	785	CPCS	726	CPCS	811	CPCS	790	CPCS
477	CPT	327	C-Stem AMT	381	C-Stem AMT	412	C-Stem AMT	612	C-Stem AMT
445	Elite Plus	317	Spectron EF	276	Spectron EF	332	MS 30	506	Short Exeter V40
358	MS 30	246	Omnifit	237	MS 30	286	Quadra-C	409	Quadra-C
338	Omnifit	165	MS 30	189	Quadra-C	271	Evolve	363	Evolve
321	Charnley	118	Quadra-C	185	Omnifit	263	Short Exeter V40	352	MS 30
245	CPCS	106	C-Stem	157	Evolve	241	Spectron EF	224	Taper Fit
123	Exeter	74	Absolut	123	Absolut	161	Taper Fit	180	Spectron EF
10 Most Used									
7553 (10)	91.7%	10532 (10)	97.2%	11245 (10)	95.3%	11527 (10)	92.9%	12071 (10)	92.8%
Remainder									
680 (26)	8.3%	305 (29)	2.8%	558 (28)	4.7%	885 (24)	7.1%	931 (17)	7.2%
TOTAL									
8233 (36)	100.0%	10837 (39)	100.0%	11803 (38)	100.0%	12412 (34)	100.0%	13002 (27)	100.0%

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

2003		2013		2014		2015		2016	
N	Model	N	Model	N	Model	N	Model	N	Model
1029	ABGII	4668	Corail	5036	Corail	5411	Corail	5815	Corail
980	Synergy	2259	Quadra-H	2916	Quadra-H	2828	Quadra-H	2736	Quadra-H
819	Alloclassic	1048	Polarstem	1201	Polarstem	1517	Polarstem	1813	Polarstem
739	VerSys	813	Secur-Fit	841	Anthology	905	Accolade II	1315	Accolade II
713	Secur-Fit Plus	765	Accolade I	716	Secur-Fit	842	Taperloc	982	Taperloc
485	S-Rom	731	Synergy	715	Taperloc	778	Anthology	780	Tri-Fit TS
482	Secur-Fit	643	Anthology	574	Synergy	579	Tri-Fit TS	779	AMIStem H
376	Corail	609	Taperloc	530	M/L Taper	565	Avenir	687	Anthology
334	Accolade I	448	Alloclassic	523	Accolade II	551	Secur-Fit	638	Metafix
334	Mallory-Head	433	Summit	477	Summit	474	Metafix	537	Paragon
10 Most Used									
6291 (10)	71.2%	12417 (10)	66.3%	13529 (10)	66.2%	14450 (10)	67.1%	16082 (10)	70.5%
Remainder									
2549 (47)	28.8%	6315 (82)	33.7%	6903 (81)	33.8%	7080 (74)	32.9%	6721 (72)	29.5%
TOTAL									
8840 (57)	100.0%	18732 (92)	100.0%	20432 (91)	100.0%	21530 (84)	100.0%	22803 (82)	100.0%

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

2003		2013		2014		2015		2016	
N	Model	N	Model	N	Model	N	Model	N	Model
3986	Trident (Shell)	7020	Trident (Shell)	7346	Trident (Shell)	7463	Trident (Shell)	7762	Trident (Shell)
1748	Reflection (Shell)	5653	Pinnacle	6157	Pinnacle	6606	Pinnacle	6882	Pinnacle
1524	Trilogy	3340	R3	3448	R3	3632	R3	3717	R3
955	Vitalock	2133	Versafitcup CC	2820	Versafitcup CC	3014	Versafitcup CC	2731	Versafitcup CC
907	Duraloc	1502	Continuum	1492	Continuum	1573	Trinity	1969	Trinity
827	ABGII	1022	Trilogy	1322	Trinity	1359	Continuum	1297	Continuum
793	Allofit	778	Trinity	1092	Trilogy	884	Trilogy	1123	Mpact
729	Mallory-Head	644	Allofit	652	Exeter X3 Rimfit	768	Trident/Tritanium (Shell)	1093	Trident/Tritanium (Shell)
539	Contemporary	630	Trident/Tritanium (Shell)	648	Trident/Tritanium (Shell)	633	Acetabular Shell (Global)	786	Logical G
537	Pinnacle	563	Delta-TT	611	Allofit	608	Exeter X3 Rimfit	746	Acetabular Shell (Global)
10 Most Used									
12545 (10)	73.5%	23285 (10)	78.7%	25588 (10)	79.4%	26540 (10)	78.2%	28106 (10)	78.5%
Remainder									
4528 (69)	26.5%	6284 (69)	21.3%	6647 (77)	20.6%	7402 (67)	21.8%	7699 (68)	21.5%
TOTAL									
17073 (79)	100.0%	29569 (79)	100.0%	32235 (87)	100.0%	33942 (77)	100.0%	35805 (78)	100.0%

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

2003		2013		2014		2015		2016	
N	Model	N	Model	N	Model	N	Model	N	Model
539	Contemporary	544	Exeter X3 Rimfit	652	Exeter X3 Rimfit	608	Exeter X3 Rimfit	535	Exeter X3 Rimfit
256	Exeter	222	Contemporary	234	Contemporary	181	Contemporary	138	Contemporary
251	Reflection (Cup)	130	Marathon	135	Marathon	130	Marathon	116	Marathon
227	Exeter Contemporary	111	Brunswick	103	ZCA	104	ZCA	104	Exeter Contemporary
199	Charnley Ogee	108	Exeter Contemporary	75	Reflection (Cup)	81	Reflection (Cup)	76	ZCA
149	Elite Plus LPW	97	ZCA	58	Exeter Contemporary	52	Exeter Contemporary	65	Reflection (Cup)
130	Low Profile Cup	82	Reflection (Cup)	37	Brunswick	21	CCB	36	Muller
110	Elite Plus Ogee	28	Low Profile Cup	19	CCB	20	Low Profile Cup	24	Avantage
102	Charnley	19	CCB	19	Low Profile Cup	17	Muller	17	Low Profile Cup
90	ZCA	12	Durasul	12	Polarcup	12	Polarcup	15	Polarcup
10 Most Used									
2053 (10)	85.4%	1353 (10)	97.3%	1344 (10)	94.7%	1226 (10)	96.2%	1126 (10)	92.8%
Remainder									
351 (16)	14.6%	37 (11)	2.7%	75 (17)	5.3%	49 (14)	3.8%	87 (14)	7.2%
TOTAL									
2404 (26)	100.0%	1390 (21)	100.0%	1419 (27)	100.0%	1275 (24)	100.0%	1213 (24)	100.0%

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

2003		2013		2014		2015		2016	
N	Model	N	Model	N	Model	N	Model	N	Model
3986	Trident (Shell)	7020	Trident (Shell)	7346	Trident (Shell)	7462	Trident (Shell)	7760	Trident (Shell)
1748	Reflection (Shell)	5653	Pinnacle	6157	Pinnacle	6606	Pinnacle	6882	Pinnacle
1524	Trilogy	3340	R3	3448	R3	3632	R3	3717	R3
955	Vitalock	2133	Versafitcup CC	2820	Versafitcup CC	3013	Versafitcup CC	2731	Versafitcup CC
907	Duraloc	1502	Continuum	1492	Continuum	1573	Trinity	1969	Trinity
827	ABGII	1022	Trilogy	1322	Trinity	1359	Continuum	1297	Continuum
793	Allofit	778	Trinity	1092	Trilogy	884	Trilogy	1123	Mpact
729	Mallory-Head	644	Allofit	648	Trident/Tritanium (Shell)	768	Trident/Tritanium (Shell)	1093	Trident/Tritanium (Shell)
537	Pinnacle	629	Trident/Tritanium (Shell)	611	Allofit	633	Acetabular Shell (Global)	786	Logical G
521	Fitmore	563	Delta-TT	454	Acetabular Shell (Global)	538	G7	746	Acetabular Shell (Global)
10 Most Used									
12527 (10)	85.4%	23284 (10)	82.6%	25390 (10)	82.4%	26468 (10)	81.0%	28104 (10)	81.2%
Remainder									
2142 (43)	14.6%	4895 (54)	17.4%	5426 (55)	17.6%	6199 (52)	19.0%	6488 (52)	18.8%
TOTAL									
14669 (53)	100.0%	28179 (64)	100.0%	30816 (65)	100.0%	32667 (62)	100.0%	34592 (62)	100.0%

OUTCOME FOR ALL DIAGNOSES

Since 2014, the Registry has excluded large head metal/metal bearings from many analyses of primary total conventional hip replacement outcomes. It is a bearing that is no longer used; it accounts for an increasingly small proportion of procedures (currently 4.3%) and it has a much higher revision rate than any other bearing used (30.0% at 15 years). In addition, it was also preferentially used in younger patients with cementless fixation and with particular femoral stem and acetabular prosthesis combinations.

Consequently, in specific analyses it has 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. The Registry clearly identifies whether large head metal/metal bearings are excluded in any analyses.

Osteoarthritis is the principal diagnosis (88.5%), followed by fractured neck of femur (4.3%), osteonecrosis (3.3%), developmental dysplasia (1.2%) and rheumatoid arthritis (1.0%) (Table HT10).

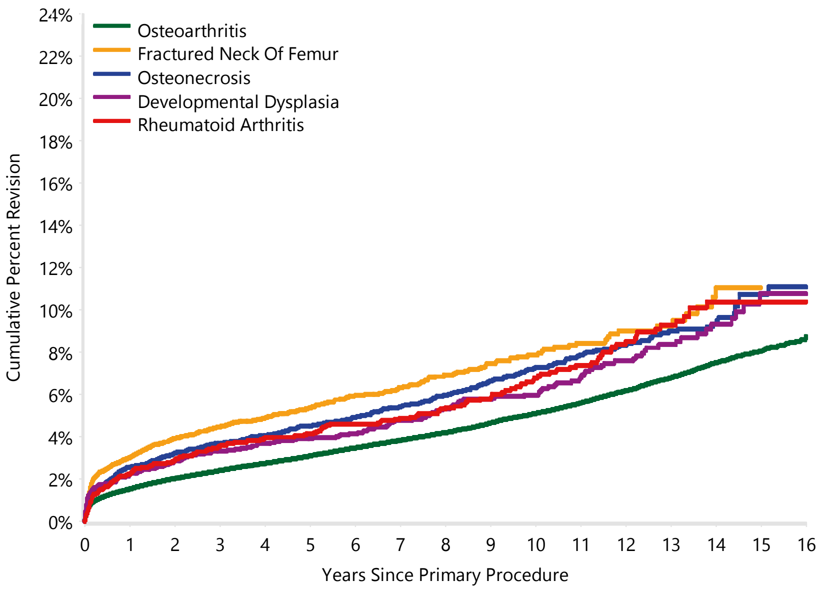
Osteoarthritis has a lower rate of revision compared to fractured neck of femur, osteonecrosis and rheumatoid arthritis. It also has a lower rate of revision compared to developmental dysplasia. However, this difference is only evident in the first month (Figure HT4).

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	16 Yrs
Osteoarthritis	11610	324627	1.5 (1.5, 1.6)	2.4 (2.4, 2.5)	3.1 (3.0, 3.2)	5.1 (5.0, 5.2)	8.1 (7.8, 8.3)	8.8 (8.4, 9.1)
Fractured Neck Of Femur	763	15865	3.0 (2.8, 3.3)	4.5 (4.1, 4.8)	5.4 (5.0, 5.8)	7.9 (7.2, 8.6)	11.1 (9.3, 13.2)	
Osteonecrosis	623	12051	2.6 (2.3, 2.9)	3.7 (3.4, 4.1)	4.5 (4.1, 4.9)	7.3 (6.6, 8.0)	10.8 (9.5, 12.2)	11.1 (9.7, 12.7)
Developmental Dysplasia	228	4556	2.2 (1.8, 2.7)	3.3 (2.8, 3.9)	3.9 (3.4, 4.6)	6.0 (5.2, 6.9)	10.8 (8.9, 13.1)	10.8 (8.9, 13.1)
Rheumatoid Arthritis	205	3733	2.2 (1.8, 2.8)	3.5 (3.0, 4.2)	4.2 (3.5, 4.9)	6.8 (5.8, 7.9)	10.4 (8.7, 12.3)	10.4 (8.7, 12.3)
Tumour	103	2077	4.0 (3.2, 5.1)	6.6 (5.2, 8.3)	8.3 (6.5, 10.5)	13.4 (9.7, 18.4)		
Other (5)	232	3915	3.4 (2.9, 4.0)	4.8 (4.2, 5.6)	5.9 (5.1, 6.7)	8.4 (7.2, 9.7)	11.0 (9.1, 13.3)	
TOTAL	**13764**	**366824**						

Note: Only primary diagnoses with over 2,000 procedures have been listed
All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

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
0 - 2Wk: HR=1.58 (1.22, 2.04),p<0.001
2Wk - 3Mth: HR=2.44 (2.15, 2.77),p<0.001
3Mth - 1.5Yr: HR=1.87 (1.61, 2.16),p<0.001
1.5Yr+: HR=1.42 (1.25, 1.62),p<0.001

Osteonecrosis vs Osteoarthritis
0 - 6Mth: HR=1.50 (1.31, 1.72),p<0.001
6Mth - 9Mth: HR=2.66 (2.00, 3.54),p<0.001
9Mth - 1.5Yr: HR=1.29 (0.99, 1.68),p=0.059
1.5Yr+: HR=1.25 (1.11, 1.40),p<0.001

Developmental Dysplasia vs Osteoarthritis
0 - 2Wk: HR=2.29 (1.57, 3.34),p<0.001
2Wk - 1Mth: HR=1.62 (1.10, 2.37),p=0.014
1Mth+: HR=1.11 (0.96, 1.30),p=0.170

Rheumatoid Arthritis vs Osteoarthritis
Entire Period: HR=1.34 (1.16, 1.53),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Osteoarthritis	324627	285535	219001	162111	61303	6575	1649
Fractured Neck Of Femur	15865	12450	8199	5149	1120	91	17
Osteonecrosis	12051	10463	8045	6051	2435	322	87
Developmental Dysplasia	4556	3994	3138	2459	1212	181	45
Rheumatoid Arthritis	3733	3367	2769	2201	1039	156	57

Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

PROSTHESIS TYPES

There are 2,844 different stem and acetabular combinations for primary total conventional hip replacement recorded by the Registry. This is an additional 157 prosthesis combinations since the previous report. Metal/metal prostheses with head size larger than 32mm are included in these combinations.

The cumulative percent revision of the 115 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 81.5% 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 18.5% 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 5.3% (Table HT11).

There are 74 cementless total conventional stem and acetabular combinations listed. The Secur-Fit Plus/Trident (Shell) has the lowest 16 year cumulative percent revision of 4.6% (Table HT12).

There are 31 combinations of total conventional hip replacement prostheses with hybrid fixation. The Exeter/Vitalock has the lowest cumulative percent revision at 16 years (7.3%) (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	16 Yrs
CPCS	Reflection (Cup)	60	918	1.2 (0.7, 2.2)	2.3 (1.5, 3.7)	3.2 (2.1, 4.7)	8.7 (6.4, 11.8)		
CPT	ZCA	37	915	0.8 (0.4, 1.6)	2.2 (1.4, 3.5)	3.0 (2.0, 4.4)	5.1 (3.5, 7.4)	8.5 (5.5, 12.9)	
Charnley	Charnley Ogee*	59	709	1.0 (0.5, 2.1)	3.0 (1.9, 4.5)	4.8 (3.4, 6.7)	8.1 (6.1, 10.6)	13.0 (9.7, 17.4)	
Charnley	Charnley*	39	591	0.5 (0.2, 1.6)	1.0 (0.5, 2.3)	2.2 (1.2, 3.8)	6.3 (4.4, 9.0)	11.1 (7.9, 15.5)	
Exeter V40	Contemporary	272	5428	1.7 (1.4, 2.1)	2.9 (2.5, 3.4)	3.6 (3.1, 4.1)	6.3 (5.5, 7.2)	9.2 (7.8, 10.8)	
Exeter V40	Exeter Contemporary	136	3289	1.4 (1.0, 1.9)	2.3 (1.8, 2.9)	3.0 (2.4, 3.7)	4.7 (3.9, 5.7)		
Exeter V40	Exeter X3 Rimfit	64	3027	1.4 (1.0, 1.9)	2.4 (1.9, 3.1)	2.7 (2.1, 3.5)			
Exeter V40	Exeter*	88	1712	0.8 (0.5, 1.4)	1.9 (1.3, 2.7)	3.1 (2.4, 4.1)	4.9 (3.9, 6.2)	8.5 (6.6, 10.9)	
MS 30	Low Profile Cup	20	715	0.6 (0.2, 1.5)	0.7 (0.3, 1.8)	1.1 (0.5, 2.3)	2.6 (1.5, 4.6)	5.3 (3.0, 9.2)	
Spectron EF	Reflection (Cup)	113	1654	1.0 (0.7, 1.7)	1.6 (1.1, 2.4)	2.7 (2.0, 3.6)	7.1 (5.7, 8.8)	16.5 (13.1, 20.6)	
Other (458)		518	9603	1.7 (1.4, 2.0)	2.7 (2.4, 3.1)	3.9 (3.5, 4.3)	6.7 (6.0, 7.4)	10.9 (9.9, 12.1)	11.8 (10.4, 13.3)
TOTAL		**1406**	**28561**						

Note: In the 'Other' group, there are some cementless components that have been inserted with cement
Only combinations with over 500 procedures have been listed
Procedures using metal/metal prostheses with head size larger than 32mm have been included
* denotes prosthesis combinations with no reported use in primary total conventional hip replacement in 2016

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	16 Yrs
ABGII	ABGII	253	2968	1.8 (1.4, 2.4)	3.1 (2.5, 3.8)	4.2 (3.5, 5.0)	6.8 (5.9, 7.9)	11.4 (10.1, 13.0)	12.2 (10.5, 14.2)
ABGII	ABGII (Shell/Insert)	62	894	1.5 (0.9, 2.5)	2.3 (1.5, 3.5)	2.9 (2.0, 4.2)	6.8 (5.1, 8.9)		
ABGII	Trident (Shell)	201	2514	2.8 (2.2, 3.5)	4.3 (3.6, 5.2)	5.3 (4.4, 6.2)	8.9 (7.7, 10.3)		
AMIStem H	Versafitcup CC	17	1164	1.0 (0.6, 2.0)	2.4 (1.1, 5.3)	3.5 (1.5, 7.8)			
Accolade I	Trident (Shell)	451	9248	1.7 (1.5, 2.0)	3.0 (2.7, 3.4)	3.8 (3.4, 4.2)	5.8 (5.3, 6.4)		
Accolade I	Trident/ Tritanium (Shell)*	26	756	1.3 (0.7, 2.4)	2.4 (1.5, 3.8)	3.7 (2.4, 5.5)			
Accolade II	Trident (Shell)	36	2408	1.4 (0.9, 2.0)	2.1 (1.5, 3.0)				
Alloclassic	Allofit	268	5700	1.4 (1.2, 1.8)	2.3 (1.9, 2.7)	3.0 (2.6, 3.5)	5.3 (4.7, 6.0)	8.8 (7.3, 10.5)	
Alloclassic	Durom^{MoM}*	86	621	1.3 (0.7, 2.6)	5.0 (3.5, 7.0)	7.1 (5.3, 9.4)	15.4 (12.5, 19.0)		
Alloclassic	Fitmore	131	1883	3.3 (2.6, 4.2)	4.7 (3.8, 5.8)	5.7 (4.7, 6.9)	7.6 (6.4, 9.1)	10.1 (7.6, 13.3)	
Alloclassic	Trabecular Metal (Shell)	41	1064	2.4 (1.6, 3.5)	3.0 (2.1, 4.2)	3.8 (2.8, 5.2)	4.3 (3.1, 5.8)		
Alloclassic	Trilogy	17	943	0.6 (0.3, 1.4)	0.9 (0.4, 1.8)	1.2 (0.6, 2.1)	3.0 (1.8, 5.2)		
Anthology	R3	118	5441	1.7 (1.4, 2.1)	2.0 (1.7, 2.5)	2.3 (1.9, 2.8)			
Anthology	Reflection (Shell)	35	990	1.8 (1.2, 2.9)	2.2 (1.4, 3.3)	3.0 (2.1, 4.4)	4.4 (3.1, 6.1)		
Apex	Fin II*	43	1008	1.9 (1.2, 2.9)	2.5 (1.7, 3.7)	3.8 (2.8, 5.3)	5.6 (4.1, 7.6)		
Avenir	Continuum	23	1114	2.0 (1.3, 3.0)	2.1 (1.4, 3.2)	2.1 (1.4, 3.2)			
Avenir	Trilogy	6	601	0.8 (0.3, 2.0)	1.0 (0.5, 2.3)	1.0 (0.5, 2.3)			
C2	Delta-TT	12	604	1.1 (0.5, 2.3)	2.0 (1.1, 3.7)	3.0 (1.6, 5.5)			
CLS	Allofit	53	860	1.5 (0.9, 2.6)	3.4 (2.4, 4.9)	3.8 (2.7, 5.4)	6.5 (4.9, 8.6)		
CLS	Fitmore	49	775	2.1 (1.3, 3.4)	4.2 (3.0, 6.0)	4.7 (3.4, 6.6)	6.0 (4.4, 8.2)	9.9 (7.3, 13.4)	
Citation	Trident (Shell)*	48	1147	1.7 (1.1, 2.7)	2.5 (1.7, 3.5)	3.2 (2.3, 4.4)	4.0 (3.0, 5.3)	5.1 (3.7, 7.0)	
Citation	Vitalock*	46	555	0.5 (0.2, 1.7)	2.2 (1.2, 3.8)	2.8 (1.7, 4.5)	6.7 (4.8, 9.3)	11.6 (8.5, 15.6)	
Corail	ASR^{MoM}*	1205	2901	2.2 (1.7, 2.8)	11.1 (10.0, 12.4)	26.9 (25.3, 28.6)	45.6 (43.6, 47.7)		
Corail	DeltaMotion	21	1046	1.1 (0.6, 2.0)	1.8 (1.1, 2.9)	2.8 (1.7, 4.7)			
Corail	Duraloc*	78	1433	1.4 (0.9, 2.2)	2.3 (1.6, 3.2)	3.0 (2.2, 4.0)	6.2 (4.8, 7.9)		
Corail	Pinnacle	1082	37501	1.8 (1.6, 1.9)	2.7 (2.5, 2.8)	3.3 (3.1, 3.5)	5.3 (4.8, 5.9)		
Corail	Pinnacle^{MoM}*	102	966	2.2 (1.4, 3.3)	3.7 (2.6, 5.1)	5.9 (4.6, 7.6)	12.9 (10.5, 15.9)		
Epoch	Trilogy*	43	1021	2.5 (1.7, 3.6)	3.4 (2.4, 4.7)	3.7 (2.7, 5.0)	4.2 (3.2, 5.7)		
F2L	SPH-Blind*	56	615	3.1 (2.0, 4.8)	4.9 (3.5, 7.0)	6.1 (4.5, 8.3)	7.6 (5.7, 10.0)	11.3 (8.5, 15.1)	
H-Max	Delta-TT	27	1039	1.6 (1.0, 2.6)	3.0 (2.0, 4.3)	3.3 (2.2, 5.0)			
M/L Taper	Allofit	17	684	1.9 (1.1, 3.3)	2.3 (1.3, 3.8)	2.5 (1.5, 4.2)			
M/L Taper	Continuum	33	1141	2.2 (1.5, 3.2)	3.0 (2.1, 4.3)	3.4 (2.4, 4.9)			
M/L Taper	Trilogy	24	769	1.4 (0.8, 2.6)	1.8 (1.0, 3.0)	3.2 (2.1, 5.0)	4.4 (2.9, 6.7)		
M/L Taper Kinectiv	Continuum	60	2046	1.9 (1.4, 2.6)	2.9 (2.3, 3.8)	3.3 (2.6, 4.3)			
Mallory-Head	Mallory-Head	169	2970	1.8 (1.4, 2.4)	2.3 (1.8, 2.9)	3.1 (2.5, 3.8)	5.1 (4.3, 6.1)	10.6 (8.8, 12.7)	11.0 (9.1, 13.2)
Metafix	Trinity	43	2147	1.9 (1.4, 2.6)	2.4 (1.8, 3.2)	2.4 (1.8, 3.2)			
MiniHip	Trinity	17	683	2.3 (1.4, 3.8)	2.7 (1.7, 4.3)				
Nanos	R3	7	657	0.8 (0.3, 1.8)	1.1 (0.5, 2.3)	1.1 (0.5, 2.3)			
Natural Hip	Fitmore*	40	889	1.0 (0.5, 1.9)	1.6 (0.9, 2.7)	2.4 (1.6, 3.7)	4.7 (3.4, 6.4)	5.4 (3.9, 7.4)	
Omnifit	Secur-Fit*	62	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)	14.8 (11.5, 18.9)	
Omnifit	Trident (Shell)	76	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)	8.2 (6.4, 10.6)	
Origin	Logical G	7	583	1.3 (0.6, 2.8)					

Femoral Component	Acetabular Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Paragon	Acetabular Shell (Global)	7	744	0.7 (0.3, 1.6)					
Polarstem	EP-Fit Plus	3	1029	0.3 (0.1, 0.9)	0.3 (0.1, 0.9)				
Polarstem	R3	129	5821	1.8 (1.5, 2.2)	2.5 (2.1, 3.0)	2.9 (2.4, 3.5)			
Profemur L	Dynasty	22	770	3.1 (2.0, 4.7)					
Quadra-H	Mpact	27	1476	1.6 (1.0, 2.5)	2.6 (1.6, 4.0)	3.4 (2.1, 5.6)			
Quadra-H	Trident (Shell)	11	564	1.3 (0.6, 2.7)	2.3 (1.2, 4.5)	2.8 (1.5, 5.3)			
Quadra-H	Versafitcup CC	325	12882	1.8 (1.6, 2.0)	2.6 (2.3, 2.9)	3.0 (2.7, 3.4)			
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)	5.3 (3.8, 7.5)	
S-Rom	Pinnacle	146	3181	2.3 (1.9, 2.9)	3.6 (3.0, 4.4)	4.2 (3.5, 5.0)	6.0 (5.0, 7.1)		
SL-Plus	EP-Fit Plus	110	2288	1.7 (1.2, 2.3)	2.7 (2.1, 3.5)	3.5 (2.8, 4.3)	5.5 (4.5, 6.6)		
SL-Plus	R3	61	1565	2.1 (1.5, 2.9)	3.6 (2.7, 4.7)	3.9 (3.0, 5.1)			
Secur-Fit	DeltaMotion	21	761	0.7 (0.3, 1.6)	2.1 (1.3, 3.4)	2.5 (1.6, 4.0)			
Secur-Fit	Trident (Shell)	333	9228	1.7 (1.4, 2.0)	2.7 (2.4, 3.1)	3.3 (3.0, 3.7)	4.4 (3.9, 5.0)	5.6 (4.8, 6.6)	
Secur-Fit Plus	Trident (Shell)	181	5778	1.2 (1.0, 1.5)	1.9 (1.6, 2.3)	2.3 (2.0, 2.8)	3.4 (2.9, 4.0)	4.6 (3.8, 5.6)	4.6 (3.8, 5.6)
Summit	ASR^{MoM}*	456	1118	1.2 (0.7, 2.0)	6.5 (5.2, 8.1)	19.7 (17.5, 22.2)	43.9 (40.7, 47.1)		
Summit	Pinnacle	97	4377	1.2 (0.9, 1.6)	1.9 (1.5, 2.3)	2.1 (1.7, 2.6)	3.1 (2.4, 4.0)		
Summit	Pinnacle^{MoM}*	62	784	1.5 (0.9, 2.7)	2.2 (1.4, 3.5)	3.4 (2.3, 4.9)	8.8 (6.8, 11.2)		
Synergy	BHR^{MoM}*	85	819	1.6 (0.9, 2.7)	3.1 (2.1, 4.5)	4.8 (3.6, 6.6)	12.4 (10.0, 15.3)		
Synergy	R3	104	4266	1.6 (1.3, 2.1)	2.3 (1.8, 2.8)	2.7 (2.2, 3.2)			
Synergy	Reflection (Shell)	336	7922	1.6 (1.3, 1.9)	2.4 (2.1, 2.8)	2.7 (2.4, 3.1)	4.0 (3.6, 4.5)	6.6 (5.7, 7.6)	6.6 (5.7, 7.6)
Taperloc	Exceed	55	2203	1.5 (1.0, 2.1)	2.4 (1.8, 3.1)	2.6 (2.0, 3.4)			
Taperloc	G7	20	911	2.4 (1.5, 3.7)					
Taperloc	M2a^{MoM}*	58	512	1.8 (0.9, 3.4)	4.4 (2.9, 6.5)	7.4 (5.4, 10.1)	12.2 (9.5, 15.6)		
Taperloc	Mallory-Head	71	1779	1.9 (1.3, 2.7)	2.6 (2.0, 3.5)	3.1 (2.3, 4.1)	5.2 (4.0, 6.8)		
Taperloc	Recap^{MoM}*	47	500	2.4 (1.4, 4.2)	4.3 (2.8, 6.5)	6.2 (4.4, 8.8)	10.9 (8.2, 14.4)		
Taperloc	Regenerex	13	571	1.6 (0.8, 3.1)	2.3 (1.3, 4.0)	2.7 (1.5, 4.7)			
Trabecular Metal	Continuum	42	680	5.0 (3.6, 7.0)	6.1 (4.5, 8.2)	6.3 (4.6, 8.4)			
Tri-Fit TS	Trinity	22	2059	1.1 (0.7, 1.7)	1.2 (0.8, 1.8)				
Tri-Lock	DeltaMotion	8	801	0.6 (0.3, 1.5)	0.8 (0.3, 1.7)	1.2 (0.6, 2.4)			
Tri-Lock	Pinnacle	14	675	1.5 (0.8, 2.8)	2.4 (1.4, 4.0)	2.4 (1.4, 4.0)			
VerSys	Trilogy	212	4423	2.5 (2.1, 3.0)	3.3 (2.8, 3.9)	3.8 (3.3, 4.4)	4.9 (4.3, 5.6)	6.0 (5.1, 7.1)	
twinSys	RM Cup	27	884	2.6 (1.7, 3.9)	3.3 (2.2, 4.9)				
Other (1356)		2876	43320	2.3 (2.2, 2.4)	3.9 (3.7, 4.1)	5.4 (5.2, 5.6)	9.4 (9.0, 9.7)	13.1 (12.4, 13.8)	14.0 (12.9, 15.1)
TOTAL		**11205**	**229494**						

Note: Only combinations with over 500 procedures have been listed
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 combinations with no reported use in primary total conventional hip replacement in 2016

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	16 Yrs
C-Stem	Duraloc*	78	981	2.4 (1.6, 3.5)	3.1 (2.2, 4.4)	4.0 (2.9, 5.5)	7.3 (5.7, 9.4)	12.3 (9.4, 15.9)	
C-Stem	Pinnacle	27	840	1.7 (1.0, 2.9)	2.3 (1.4, 3.6)	2.8 (1.8, 4.3)	4.3 (2.8, 6.4)		
C-Stem AMT	Pinnacle	44	2267	1.0 (0.7, 1.5)	2.1 (1.5, 3.0)	2.7 (2.0, 3.8)			
CPCS	R3	112	3905	2.1 (1.7, 2.6)	2.9 (2.4, 3.6)	3.4 (2.8, 4.2)			
CPCS	Reflection (Shell)	86	2985	0.9 (0.6, 1.3)	1.3 (0.9, 1.7)	1.7 (1.3, 2.2)	4.0 (3.1, 5.0)		
CPT	Allofit	27	1138	1.2 (0.7, 2.0)	1.7 (1.1, 2.7)	3.0 (2.0, 4.4)	3.4 (2.2, 5.2)		
CPT	Continuum	97	2521	2.9 (2.3, 3.7)	3.9 (3.2, 4.8)	4.5 (3.7, 5.6)			
CPT	Trabecular Metal (Shell)	76	1612	2.5 (1.8, 3.4)	3.8 (2.9, 5.0)	5.0 (3.9, 6.4)	7.3 (5.6, 9.5)		
CPT	Trilogy	295	7786	1.8 (1.5, 2.1)	2.7 (2.3, 3.1)	3.5 (3.0, 3.9)	5.1 (4.5, 5.8)	6.4 (5.4, 7.4)	
E2	C2	11	521	1.4 (0.7, 2.9)	1.9 (1.0, 3.7)	3.3 (1.6, 6.6)			
Elite Plus	Duraloc*	116	1078	2.0 (1.3, 3.0)	3.6 (2.7, 5.0)	5.4 (4.2, 7.0)	9.7 (7.9, 11.8)	15.8 (13.0, 19.2)	
Evolve	Logical G	4	653	0.7 (0.3, 1.8)					
Exeter	Vitalock*	69	1218	1.6 (1.0, 2.5)	2.3 (1.6, 3.4)	2.5 (1.8, 3.6)	4.8 (3.6, 6.2)	6.9 (5.5, 8.8)	7.3 (5.7, 9.4)
Exeter V40	ABGII	42	1093	1.1 (0.6, 1.9)	1.4 (0.8, 2.3)	2.0 (1.3, 3.1)	3.6 (2.6, 5.0)	5.2 (3.8, 7.1)	
Exeter V40	Fixa	13	590	1.9 (1.0, 3.4)	2.4 (1.4, 4.1)				
Exeter V40	Hemispherical	27	709	2.1 (1.3, 3.5)	3.2 (2.1, 4.8)	3.3 (2.2, 5.0)	5.1 (3.3, 7.7)		
Exeter V40	Mallory-Head	36	1413	0.6 (0.3, 1.2)	1.0 (0.6, 1.7)	1.1 (0.7, 1.9)	3.0 (2.1, 4.4)		
Exeter V40	Pinnacle	43	1625	1.6 (1.1, 2.4)	2.3 (1.7, 3.2)	2.7 (2.0, 3.8)	6.0 (3.3, 10.9)		
Exeter V40	R3	47	1765	1.4 (0.9, 2.1)	2.5 (1.8, 3.4)	3.4 (2.5, 4.6)			
Exeter V40	Trident (Shell)	1344	52552	1.2 (1.1, 1.3)	1.9 (1.8, 2.0)	2.5 (2.3, 2.6)	4.1 (3.8, 4.4)	5.7 (5.0, 6.5)	
Exeter V40	Trident/ Tritanium (Shell)	67	3314	1.5 (1.1, 1.9)	2.1 (1.6, 2.7)	2.7 (2.1, 3.6)			
Exeter V40	Trilogy*	20	605	1.7 (0.9, 3.1)	2.4 (1.4, 4.0)	2.6 (1.6, 4.2)	4.0 (2.5, 6.5)		
Exeter V40	Vitalock*	76	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)	4.9 (3.9, 6.2)	
MS 30	Allofit	53	1568	1.2 (0.7, 1.8)	1.7 (1.2, 2.5)	2.2 (1.6, 3.2)	3.9 (2.8, 5.2)		
MS 30	Fitmore	21	662	0.5 (0.1, 1.4)	1.0 (0.5, 2.3)	1.5 (0.7, 3.0)	3.0 (1.7, 5.2)	6.4 (3.9, 10.4)	
Omnifit	Trident (Shell)	90	2764	1.8 (1.4, 2.4)	2.8 (2.2, 3.5)	3.1 (2.5, 3.8)	3.6 (2.9, 4.5)	4.7 (3.5, 6.3)	
Quadra-C	Versafitcup CC	22	924	2.2 (1.4, 3.4)	2.4 (1.5, 3.7)	3.2 (1.8, 5.6)			
Spectron EF	BHR^{MoM}*	58	532	0.8 (0.3, 2.0)	2.9 (1.8, 4.8)	6.3 (4.5, 8.8)	14.3 (11.0, 18.6)		
Spectron EF	R3	46	1676	1.5 (1.0, 2.2)	2.4 (1.8, 3.4)	3.0 (2.2, 4.1)			
Spectron EF	Reflection (Shell)	278	5149	1.1 (0.8, 1.4)	1.9 (1.6, 2.4)	2.7 (2.3, 3.2)	5.7 (5.0, 6.5)	10.9 (9.4, 12.8)	13.3 (10.7, 16.5)
Taper Fit	Trinity	10	577	1.6 (0.8, 3.1)	1.9 (1.0, 3.7)				
Other (915)		1057	18086	1.8 (1.6, 2.0)	3.1 (2.9, 3.4)	4.4 (4.1, 4.8)	7.9 (7.4, 8.5)	11.3 (10.5, 12.2)	11.6 (10.7, 12.6)
TOTAL		**4392**	**125068**						

Note: Only combinations with over 500 procedures have been listed
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 combinations with no reported use in primary total conventional hip replacement in 2016

OUTCOME FOR OSTEOARTHRITIS - PATIENT CHARACTERISTICS

The following analyses have been undertaken excluding all procedures using large head metal/metal bearing surface. The 16 year cumulative percent revision of primary total conventional hip replacement undertaken for osteoarthritis is 8.8% (Table HT14 and Figure HT5).

Reason for Revision

The most common reasons for revision of primary total conventional hip replacement are: loosening (25.6%), prosthesis dislocation (21.6%), fracture (19.5%), and infection (17.7%) (Table HT15).

The most common reason for revision varies with time. In the first six 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.

Previously, the Registry has reported loosening/lysis as a single diagnosis. This included the diagnoses of loosening or lysis, as well as loosening and lysis combined. Loosening and lysis are now 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 (32.7%), acetabular only (21.6%), head and insert (19.7%), total hip replacement (femoral/acetabular) (11.9%) and head only (4.9%) (Table HT16).

Age and Gender

There is a difference in the rate of revision with respect to age and this varies with time. After two years, patients aged 75 years or older have a lower rate of revision than all other age groups (Table HT17 and Figure HT7).

Males have a higher rate of revision after 1.5 years. The cumulative percent revision at 16 years is 9.2% for males and 8.4% 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).

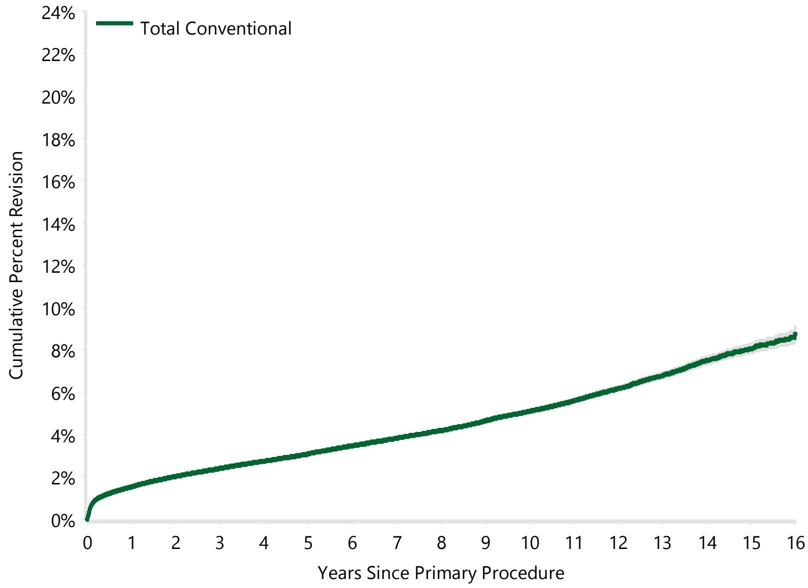
For females, the rate of revision decreases with increasing age. After three months, females aged less than 55 years have almost twice the rate of revision compared to females aged 75 years or older (Table HT18 and Figure HT10).

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	16 Yrs
Total Conventional	11610	324627	1.5 (1.5, 1.6)	2.4 (2.4, 2.5)	3.1 (3.0, 3.2)	5.1 (5.0, 5.2)	8.1 (7.8, 8.3)	8.8 (8.4, 9.1)
TOTAL	**11610**	**324627**						

Note: All procedures using metal/metal prostheses with head size larger than 32mm 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	16 Yrs
Total Conventional	324627	285535	219001	162111	61303	6575	1649

Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Table HT15 Primary Total Conventional Hip Replacement by Reason for Revision (Primary Diagnosis OA)

Reason for Revision	Number	Percent
Loosening	2975	25.6
Prosthesis Dislocation	2506	21.6
Fracture	2265	19.5
Infection	2055	17.7
Lysis	266	2.3
Pain	219	1.9
Leg Length Discrepancy	169	1.5
Malposition	154	1.3
Instability	125	1.1
Implant Breakage Stem	119	1.0
Metal Related Pathology	118	1.0
Implant Breakage Acetabular Insert	102	0.9
Wear Acetabular Insert	98	0.8
Incorrect Sizing	90	0.8
Implant Breakage Acetabular	76	0.7
Implant Breakage Head	39	0.3
Other	234	2.0
TOTAL	**11610**	**100.0**

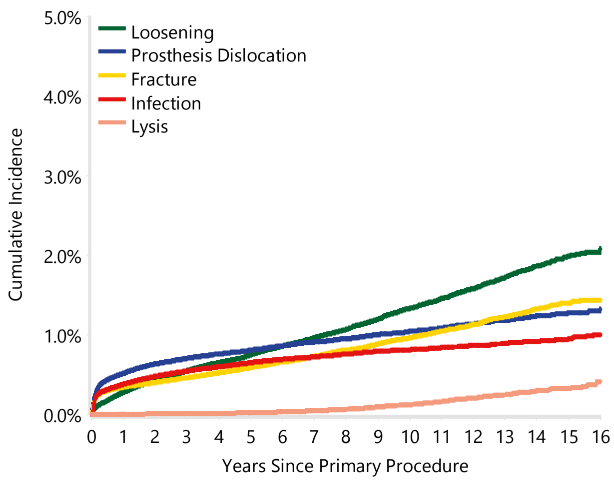
Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

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

Type of Revision	Number	Percent
Femoral Component	3801	32.7
Acetabular Component	2511	21.6
Head/Insert	2284	19.7
THR (Femoral/Acetabular)	1378	11.9
Head Only	565	4.9
Cement Spacer	519	4.5
Minor Components	209	1.8
Insert Only	138	1.2
Removal of Prostheses	69	0.6
Head/Neck/Insert	64	0.6
Head/Neck	49	0.4
Reinsertion of Components	10	0.1
Neck Only	5	0.0
Bipolar Only	3	0.0
Total Femoral	2	0.0
Neck/Insert	1	0.0
Saddle	1	0.0
Bipolar Head and Femoral	1	0.0
TOTAL	**11610**	**100.0**

Note: All procedures using metal/metal prostheses with head size larger than 32mm 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)



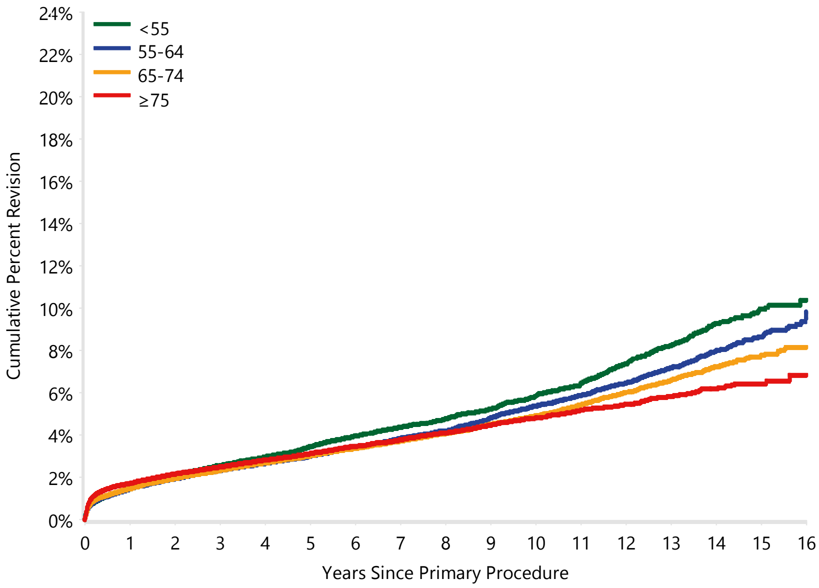
Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

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	16 Yrs
<55	1437	34607	1.5 (1.3, 1.6)	2.6 (2.4, 2.7)	3.5 (3.2, 3.7)	5.8 (5.5, 6.2)	9.9 (9.2, 10.7)	10.4 (9.5, 11.3)
55-64	2912	77367	1.5 (1.4, 1.5)	2.3 (2.2, 2.5)	3.0 (2.9, 3.2)	5.4 (5.2, 5.6)	8.7 (8.2, 9.1)	9.8 (9.0, 10.7)
65-74	4085	115632	1.5 (1.4, 1.5)	2.3 (2.2, 2.4)	3.0 (2.9, 3.1)	4.9 (4.7, 5.1)	7.8 (7.4, 8.2)	8.2 (7.7, 8.7)
≥75	3176	97021	1.7 (1.6, 1.8)	2.5 (2.4, 2.6)	3.1 (3.0, 3.2)	4.8 (4.6, 5.0)	6.4 (6.0, 6.9)	6.8 (6.1, 7.6)
TOTAL	**11610**	**324627**						

Note: All procedures using metal/metal prostheses with head size larger than 32mm 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=1.00 (0.81, 1.23),p=0.971
- 2Wk - 3Mth: HR=0.61 (0.53, 0.72),p<0.001
- 3Mth - 9Mth: HR=1.06 (0.89, 1.28),p=0.504
- 9Mth - 1.5Yr: HR=1.42 (1.18, 1.71),p<0.001
- 1.5Yr - 5.5Yr: HR=1.45 (1.30, 1.62),p<0.001
- 5.5Yr - 7.5Yr: HR=1.26 (1.02, 1.54),p=0.029
- 7.5Yr+: HR=1.63 (1.42, 1.87),p<0.001

55-64 vs ≥75

- 0 - 3Mth: HR=0.73 (0.66, 0.80),p<0.001
- 3Mth - 6Mth: HR=0.83 (0.69, 1.00),p=0.056
- 6Mth - 9Mth: HR=1.30 (1.05, 1.59),p=0.014
- 9Mth - 1.5Yr: HR=1.24 (1.07, 1.45),p=0.004
- 1.5Yr - 2Yr: HR=1.03 (0.83, 1.27),p=0.819
- 2Yr - 7Yr: HR=1.18 (1.08, 1.29),p<0.001
- 7Yr+: HR=1.42 (1.28, 1.58),p<0.001

65-74 vs≥ 75

- 0 - 6Mth: HR=0.79 (0.73, 0.85),p<0.001
- 6Mth - 1.5Yr: HR=1.17 (1.03, 1.32),p=0.012
- 1.5Yr - 2Yr: HR=1.00 (0.82, 1.21),p=0.989
- 2Yr+: HR=1.14 (1.06, 1.23),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
<55	34607	30486	23056	16938	7220	1086	294
55-64	77367	68303	53041	40079	16448	2165	581
65-74	115632	101898	78673	59021	23965	2516	614
≥75	97021	84848	64231	46073	13670	808	160

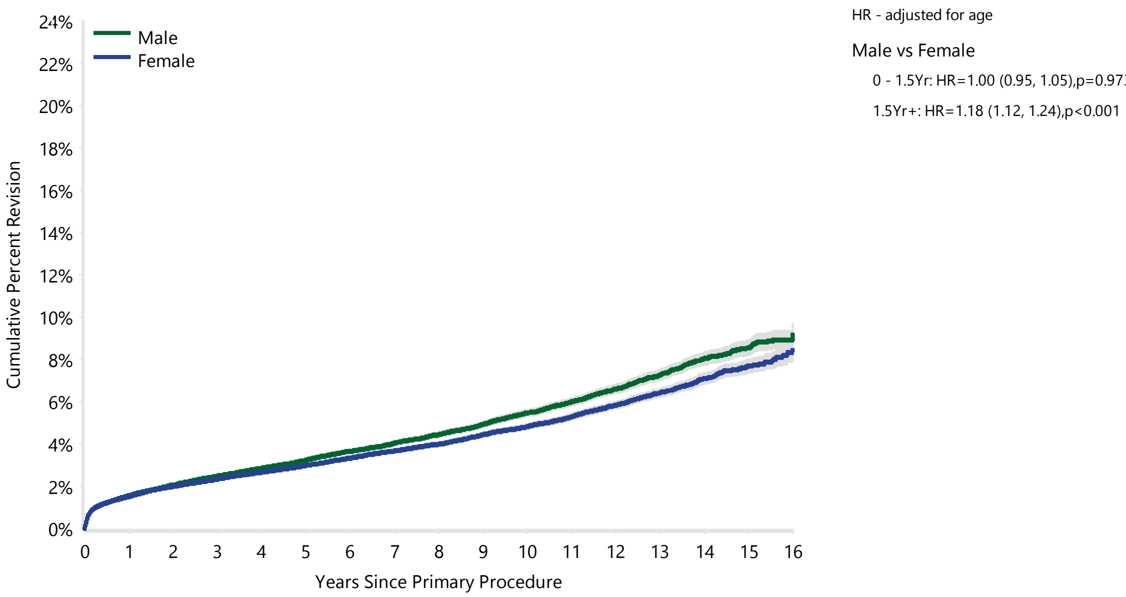
Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

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	16 Yrs
Male		**5500**	**148490**	**1.6 (1.5, 1.6)**	**2.5 (2.4, 2.6)**	**3.2 (3.1, 3.3)**	**5.5 (5.3, 5.6)**	**8.6 (8.2, 8.9)**	**9.2 (8.6, 9.7)**
	<55	721	18942	1.3 (1.2, 1.5)	2.4 (2.1, 2.6)	3.2 (3.0, 3.6)	5.5 (5.0, 6.0)	9.2 (8.3, 10.2)	9.5 (8.5, 10.6)
	55-64	1456	38297	1.5 (1.4, 1.6)	2.4 (2.2, 2.5)	3.1 (2.9, 3.3)	5.5 (5.1, 5.8)	9.0 (8.3, 9.7)	10.1 (9.0, 11.4)
	65-74	1916	53264	1.4 (1.3, 1.5)	2.3 (2.2, 2.5)	3.1 (2.9, 3.2)	5.2 (4.9, 5.5)	8.1 (7.5, 8.7)	8.3 (7.7, 9.1)
	≥75	1407	37987	1.9 (1.8, 2.1)	2.9 (2.7, 3.1)	3.6 (3.4, 3.9)	5.8 (5.5, 6.2)	7.4 (6.8, 8.2)	
Female		**6110**	**176137**	**1.5 (1.5, 1.6)**	**2.3 (2.3, 2.4)**	**3.0 (2.9, 3.1)**	**4.8 (4.7, 5.0)**	**7.7 (7.4, 8.0)**	**8.4 (7.9, 9.0)**
	<55	716	15665	1.6 (1.4, 1.8)	2.8 (2.5, 3.1)	3.7 (3.4, 4.0)	6.3 (5.8, 6.8)	10.8 (9.7, 12.0)	11.4 (9.8, 13.2)
	55-64	1456	39070	1.4 (1.3, 1.5)	2.3 (2.2, 2.5)	3.0 (2.8, 3.2)	5.3 (5.0, 5.6)	8.4 (7.7, 9.0)	9.5 (8.4, 10.8)
	65-74	2169	62368	1.5 (1.4, 1.6)	2.3 (2.2, 2.5)	3.0 (2.8, 3.1)	4.6 (4.4, 4.9)	7.5 (7.0, 8.1)	8.0 (7.4, 8.7)
	≥75	1769	59034	1.6 (1.5, 1.7)	2.2 (2.1, 2.4)	2.8 (2.7, 2.9)	4.2 (4.0, 4.5)	5.9 (5.4, 6.4)	6.4 (5.5, 7.4)
TOTAL		**11610**	**324627**						

Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

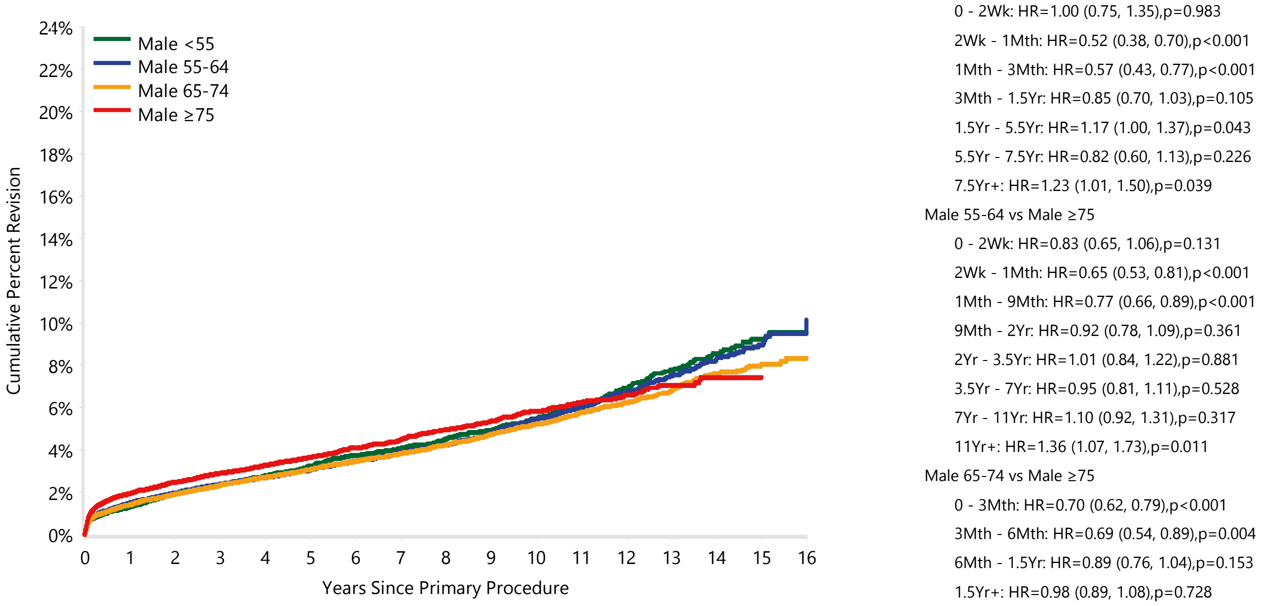
Figure HT8 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Gender (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Male	148490	129963	98290	71737	26937	3079	760
Female	176137	155572	120711	90374	34366	3496	889

Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

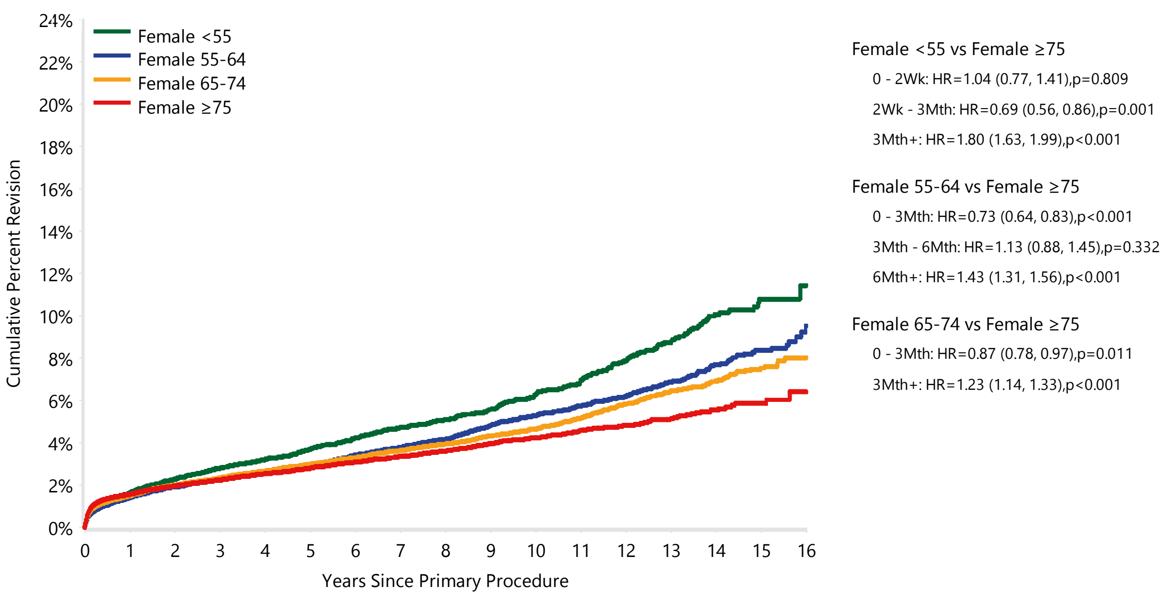
Figure HT9 Cumulative Percent Revision of Primary Total Conventional Hip Replacement in Males by Age (Primary Diagnosis OA)



Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Male	<55	18942	16614	12366	8892	3821	630	179
	55-64	38297	33589	25777	19233	8003	1116	277
	65-74	53264	47000	36193	26983	10762	1120	267
	≥75	37987	32760	23954	16629	4351	213	37

Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

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



Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Female	<55	15665	13872	10690	8046	3399	456	115
	55-64	39070	34714	27264	20846	8445	1049	304
	65-74	62368	54898	42480	32038	13203	1396	347
	≥75	59034	52088	40277	29444	9319	595	123

Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

OUTCOME FOR OSTEOARTHRITIS - PROSTHESIS CHARACTERISTICS

These analyses have been undertaken excluding all procedures using large head metal/metal bearing surface.

Fixation

This year the Registry has performed an analysis of the effect of fixation, to reflect the modern use of bearing surfaces. This analysis is restricted to ceramic/ceramic and all femoral head materials used in combination with XLPE. Metal/metal, ceramic/metal, metal/ceramic, and non XLPE have been excluded. Modern bearing surfaces account for 97.3% of all primary total conventional hip procedures performed in 2016.

The outcome with respect to fixation varies with age.

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 1.5 years and after this time there is no difference (Table HT19 and Figure HT11).

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 in 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 HT20 and Figures HT12 to HT15).

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 2,877 procedures using a mini stem prosthesis undertaken for osteoarthritis. This represents less than 1.0% of all total conventional hip procedures. There were 597 procedures recorded in 2016 using a mini stem prosthesis; an increase of 33.9% compared to 2015. The 10 year cumulative percent revision for total conventional hip replacement using a mini stem is 6.2% 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 HT21 and Figure HT16). The cumulative incidence of loosening for procedures using a mini stem is over twice that of other femoral stems at 10 years (2.7% compared to 1.3%) (Figure HT17). The types of revision are presented in Table HT22.

The Registry has information on 11 different mini stem prostheses. Rates of revision vary depending on the type of prosthesis (Table HT23).

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 10,114 procedures using femoral stems with exchangeable necks undertaken for osteoarthritis. There were 355 procedures reported in 2016, a 23.0% decrease compared to 2015. The proportion of procedures using exchangeable necks peaked in 2010 at 6.6% of all primary total conventional hip procedures. This proportion continues to decrease, with 1.1% of all procedures using a stem with an exchangeable neck in 2016.

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 12.0% for stems with exchangeable necks compared to 7.9% for fixed neck stems (Table HT24 and Figure HT18). The increase in the rate of revision is due to a higher cumulative incidence of loosening (2.5% at 15 years compared to 1.9% for fixed femoral neck), dislocation (1.8% compared to 1.1%) and fracture (2.3% compared to 1.3%) (Figure HT19).

Of the revisions of femoral stems with exchangeable necks, 2.9% are for implant breakage of the femoral component compared to 0.9% for fixed neck stems (Table HT25). The higher rate of revision when using stems with exchangeable necks is evident for all bearing surfaces (Figure HT20).

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 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 HT26 and Figure HT21).

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 10 years, the cumulative incidence of metal related pathology is 3.6% for titanium/cobalt chrome compared to 0.2% for titanium/titanium (Figure HT22).

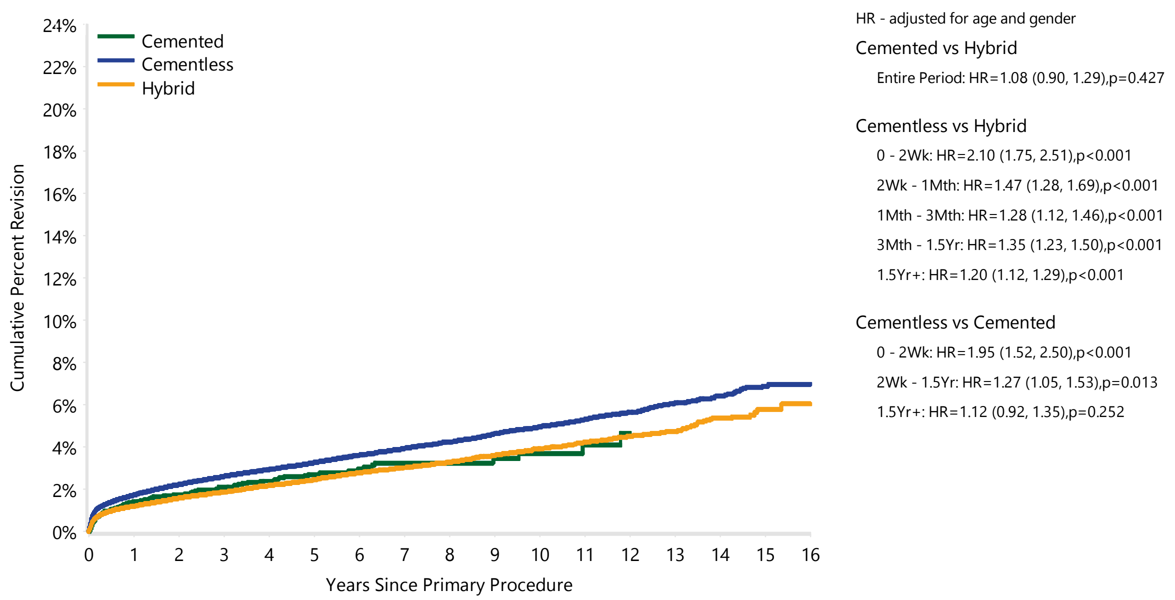
The Registry has information on 14 different exchangeable femoral neck prostheses that have been used in more than 60 procedures. The outcomes of each of these stems are detailed in Table HT27.

Table HT19 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	16 Yrs
Cemented	121	5130	1.4 (1.1, 1.8)	2.1 (1.7, 2.6)	2.7 (2.2, 3.3)	3.7 (2.9, 4.7)		
Cementless	5955	179366	1.7 (1.7, 1.8)	2.6 (2.5, 2.7)	3.3 (3.2, 3.4)	4.9 (4.8, 5.1)	6.9 (6.5, 7.2)	7.0 (6.6, 7.4)
Hybrid	2383	93309	1.2 (1.1, 1.3)	1.9 (1.8, 2.0)	2.5 (2.4, 2.6)	3.9 (3.7, 4.1)	5.8 (5.2, 6.4)	6.0 (5.3, 6.9)
TOTAL	**8459**	**277805**						

Note: Includes procedures using ceramic/ceramic and XLPE prostheses

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



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Cemented	5130	4430	2882	1542	343	3	1
Cementless	179366	155056	114408	79927	24810	1605	288
Hybrid	93309	81380	60725	43554	13186	605	68

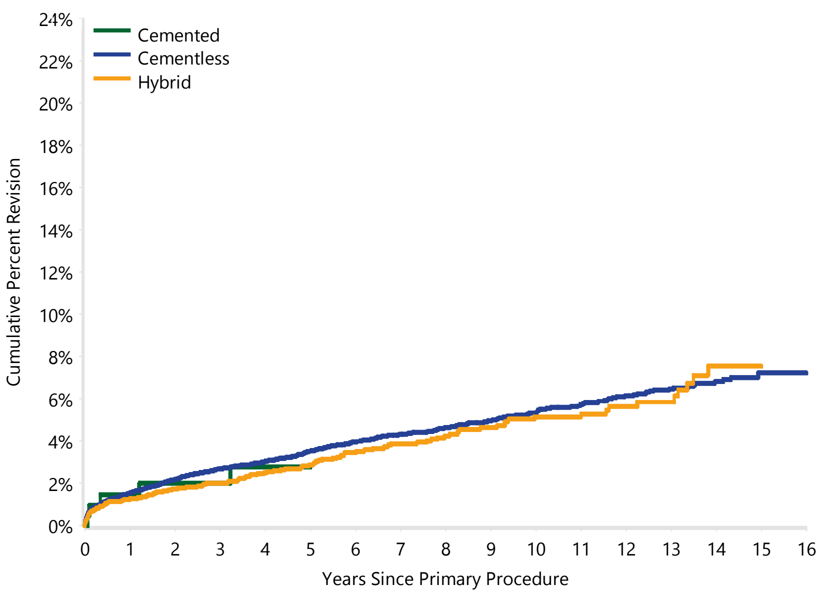
Note: Includes procedures using ceramic/ceramic and XLPE prostheses

Table HT20 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	16 Yrs
<55		**1087**	**31201**	**1.5 (1.4, 1.6)**	**2.6 (2.4, 2.8)**	**3.4 (3.2, 3.7)**	**5.3 (4.9, 5.7)**	**7.3 (6.6, 8.0)**	**7.3 (6.6, 8.0)**
	Cemented	5	209	1.5 (0.5, 4.4)	2.0 (0.8, 5.2)	2.8 (1.1, 6.6)			
	Cementless	919	25741	1.5 (1.4, 1.7)	2.7 (2.5, 2.9)	3.5 (3.3, 3.8)	5.3 (5.0, 5.8)	7.2 (6.5, 8.1)	7.2 (6.5, 8.1)
	Hybrid	163	5251	1.3 (1.0, 1.6)	2.0 (1.7, 2.5)	2.9 (2.4, 3.5)	5.2 (4.3, 6.2)	7.5 (5.9, 9.7)	
55-64		**2135**	**68842**	**1.5 (1.4, 1.6)**	**2.3 (2.1, 2.4)**	**2.9 (2.7, 3.0)**	**4.7 (4.5, 4.9)**	**6.6 (6.1, 7.1)**	**6.7 (6.1, 7.3)**
	Cemented	24	644	2.4 (1.5, 4.0)	3.7 (2.4, 5.6)	3.7 (2.4, 5.6)	4.8 (2.7, 8.5)		
	Cementless	1662	52487	1.5 (1.4, 1.7)	2.4 (2.2, 2.5)	3.0 (2.8, 3.2)	4.7 (4.5, 5.0)	6.4 (5.9, 7.0)	6.6 (6.0, 7.2)
	Hybrid	449	15711	1.1 (1.0, 1.3)	1.8 (1.6, 2.0)	2.5 (2.2, 2.8)	4.5 (4.0, 5.0)	7.0 (5.7, 8.4)	
65-74		**2860**	**98689**	**1.5 (1.4, 1.5)**	**2.3 (2.2, 2.4)**	**2.9 (2.7, 3.0)**	**4.3 (4.1, 4.4)**	**6.2 (5.7, 6.7)**	**6.5 (5.9, 7.3)**
	Cemented	41	1672	1.2 (0.8, 1.9)	1.9 (1.4, 2.8)	2.7 (1.9, 3.8)	4.6 (3.0, 6.9)		
	Cementless	1982	63823	1.6 (1.5, 1.7)	2.5 (2.4, 2.6)	3.1 (3.0, 3.3)	4.5 (4.3, 4.8)	6.5 (5.9, 7.1)	6.7 (6.0, 7.5)
	Hybrid	837	33194	1.1 (1.0, 1.2)	1.8 (1.7, 2.0)	2.4 (2.2, 2.6)	3.7 (3.5, 4.0)	5.6 (4.8, 6.6)	
≥75		**2377**	**79073**	**1.7 (1.7, 1.8)**	**2.5 (2.4, 2.6)**	**3.1 (2.9, 3.2)**	**4.6 (4.4, 4.8)**	**6.2 (5.5, 6.8)**	
	Cemented	51	2605	1.2 (0.9, 1.8)	1.8 (1.3, 2.4)	2.5 (1.9, 3.4)	2.7 (2.0, 3.7)		
	Cementless	1392	37315	2.3 (2.1, 2.4)	3.1 (2.9, 3.3)	3.7 (3.5, 4.0)	5.8 (5.4, 6.2)	8.3 (7.1, 9.7)	
	Hybrid	934	39153	1.3 (1.2, 1.4)	1.9 (1.8, 2.1)	2.4 (2.3, 2.6)	3.6 (3.4, 3.9)	4.4 (3.9, 5.0)	
TOTAL		**8459**	**277805**						

Note: Includes procedures using ceramic/ceramic and XLPE prostheses

Figure HT12 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=0.85 (0.35, 2.06),p=0.715

Cementless vs Hybrid

Entire Period: HR=1.13 (0.96, 1.33),p=0.155

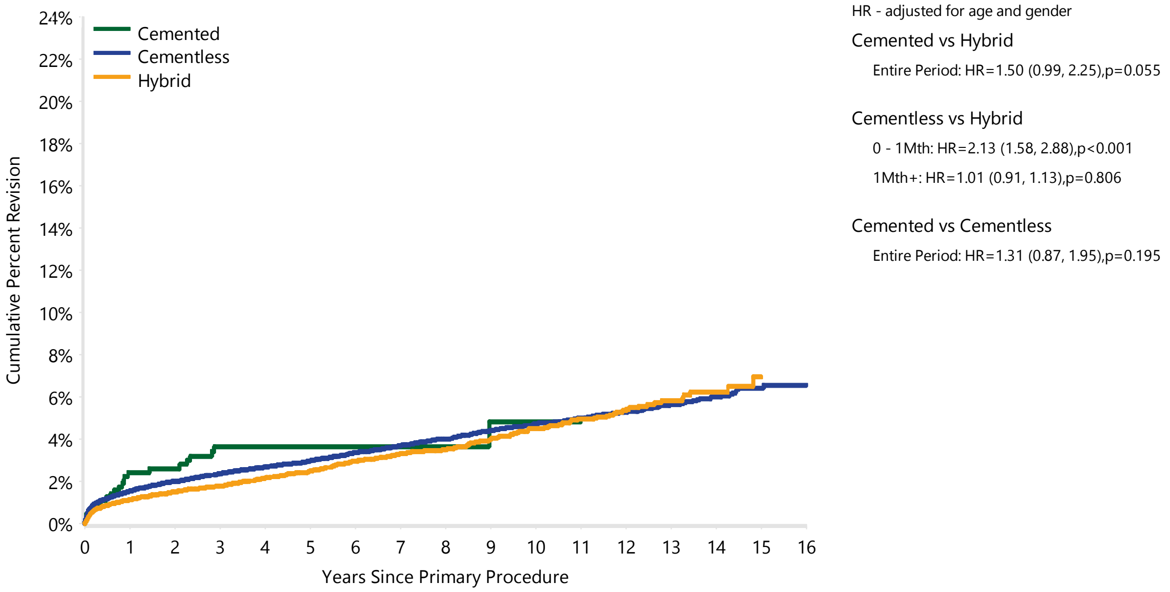
Cementless vs Cemented

Entire Period: HR=1.33 (0.55, 3.21),p=0.522

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Cemented	209	185	139	67	16	2	1
Cementless	25741	22454	16622	11718	4268	408	88
Hybrid	5251	4559	3254	2281	812	79	6

Note: Includes procedures using ceramic/ceramic and XLPE prostheses

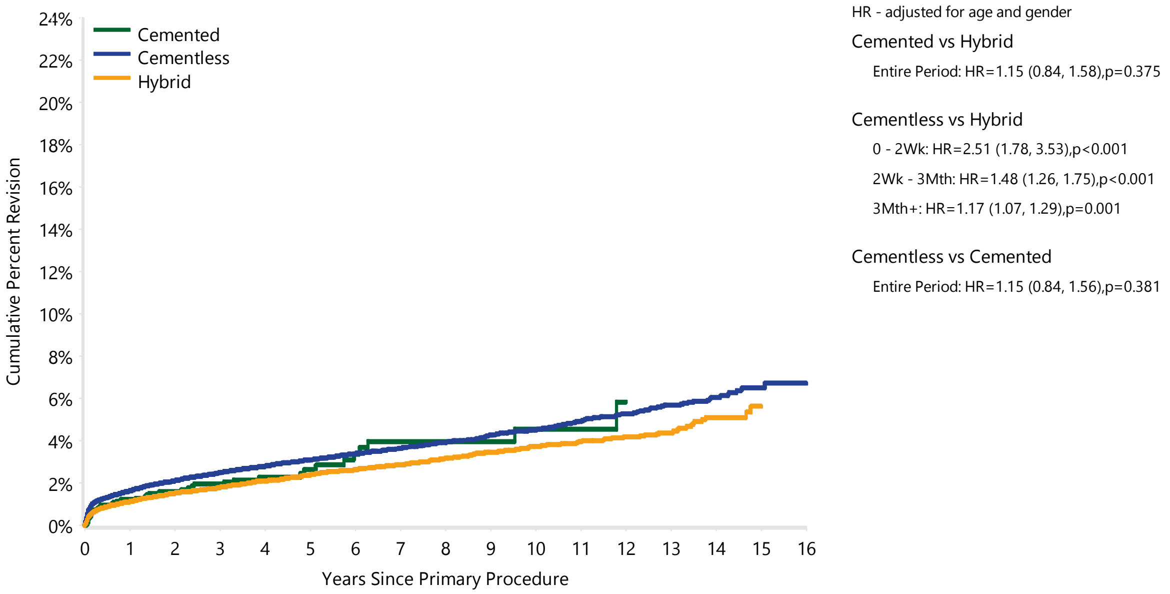
Figure HT13 Cumulative Percent Revision of Primary Total Conventional Hip Replacement in Patients Aged 55-64 Years by Fixation (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Cemented	644	572	412	236	64	0	0
Cementless	52487	45739	34419	24829	8540	667	123
Hybrid	15711	13784	10526	7760	2641	151	15

Note: Includes procedures using ceramic/ceramic and XLPE prostheses

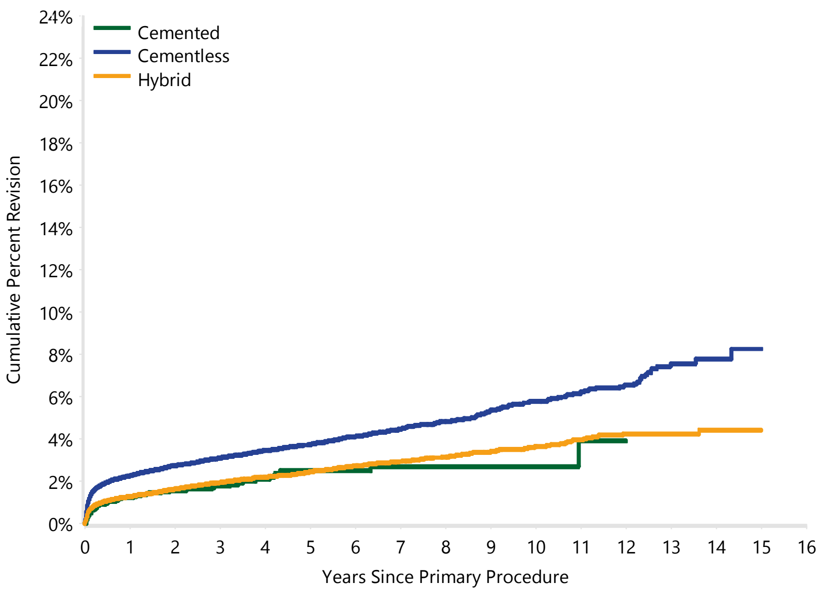
Figure HT14 Cumulative Percent Revision of Primary Total Conventional Hip Replacement in Patients Aged 65-74 Years by Fixation (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Cemented	1672	1447	949	508	145	0	0
Cementless	63823	55010	40334	28082	8604	460	73
Hybrid	33194	29173	22161	16347	5605	262	34

Note: Includes procedures using ceramic/ceramic and XLPE prostheses

Figure HT15 **Cumulative Percent Revision of Primary Total Conventional Hip Replacement in Patients Aged ≥75 Years by Fixation (Primary Diagnosis OA)**



HR - adjusted for age and gender

Cemented vs Hybrid

Entire Period: HR=0.93 (0.70, 1.23),p=0.613

Cementless vs Hybrid

0 - 3Mth: HR=1.89 (1.66, 2.16),p<0.001

3Mth+: HR=1.43 (1.28, 1.59),p<0.001

Cementless vs Cemented

Entire Period: HR=1.73 (1.31, 2.29),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Cemented	2605	2226	1382	731	118	1	0
Cementless	37315	31853	23033	15298	3398	70	4
Hybrid	39153	33864	24784	17166	4128	113	13

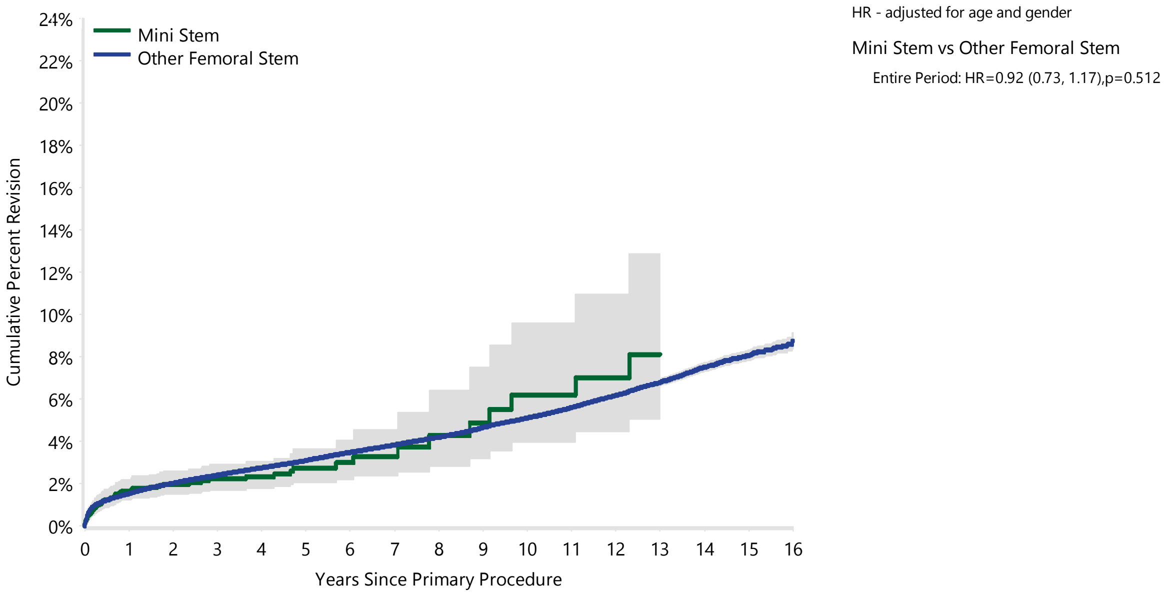
Note: Includes procedures using ceramic/ceramic and XLPE prostheses

Table HT21 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	16 Yrs
Mini Stem	68	2877	1.6 (1.2, 2.2)	2.2 (1.7, 2.9)	2.7 (2.1, 3.7)	6.2 (4.0, 9.6)		
Other Femoral Stem	11542	321750	1.5 (1.5, 1.6)	2.4 (2.4, 2.5)	3.1 (3.0, 3.2)	5.1 (5.0, 5.2)	8.1 (7.8, 8.3)	8.8 (8.4, 9.1)
TOTAL	**11610**	**324627**						

Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

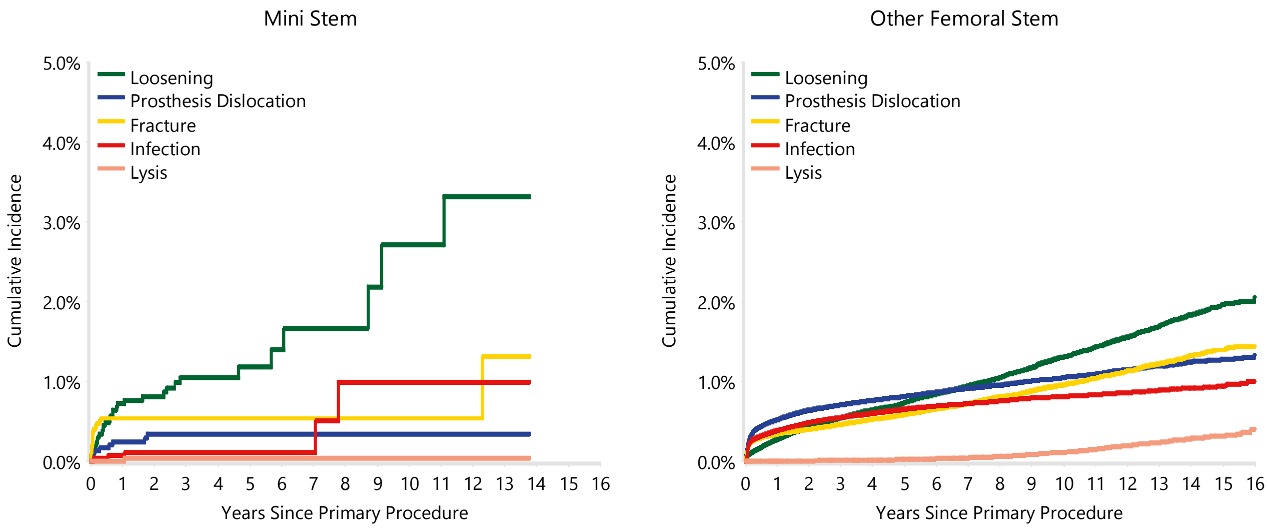
Figure HT16 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Stem Type (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Mini Stem	2877	2232	1339	576	137	3	1
Other Femoral Stem	321750	283303	217662	161535	61166	6572	1648

Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Figure HT17 Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement by Stem Type (Primary Diagnosis OA)



Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Table HT22 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	36	1.3	52.9	3765	1.2	32.6
Acetabular Component	14	0.5	20.6	2497	0.8	21.6
Head/Insert	7	0.2	10.3	2277	0.7	19.7
THR (Femoral/Acetabular)	3	0.1	4.4	1375	0.4	11.9
Head Only	5	0.2	7.4	560	0.2	4.9
Cement Spacer	2	0.1	2.9	517	0.2	4.5
Minor Components	1	0.0	1.5	208	0.1	1.8
Insert Only				138	0.0	1.2
Removal of Prostheses				69	0.0	0.6
Head/Neck/Insert				64	0.0	0.6
Head/Neck				49	0.0	0.4
Reinsertion of Components				10	0.0	0.1
Neck Only				5	0.0	0.0
Bipolar Only				3	0.0	0.0
Total Femoral				2	0.0	0.0
Bipolar Head and Femoral				1	0.0	0.0
Neck/Insert				1	0.0	0.0
Saddle				1	0.0	0.0
N Revision	**68**	**2.4**	**100.0**	**11542**	**3.6**	**100.0**
N Primary	**2877**			**321750**		

Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Table HT23 Cumulative Percent Revision of Primary Total Conventional Hip Replacement using a Mini Stem by Femoral Stem (Primary Diagnosis OA)

Femoral Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
C.F.P.*	10	124	4.0 (1.7, 9.4)	4.0 (1.7, 9.4)	4.9 (2.2, 10.5)	7.7 (4.1, 14.2)		
Mallory-Head	5	114	2.7 (0.9, 8.1)	5.5 (2.3, 13.1)				
Mayo*	7	96	2.1 (0.5, 8.1)	4.2 (1.6, 10.8)	4.2 (1.6, 10.8)	7.3 (3.3, 16.0)		
Metha	5	106	2.8 (0.9, 8.6)	4.8 (2.0, 11.1)				
MiniHip	19	742	2.1 (1.3, 3.5)	2.5 (1.5, 3.9)	4.7 (2.3, 9.4)			
Nanos	7	664	0.8 (0.3, 1.8)	1.1 (0.5, 2.3)	1.1 (0.5, 2.3)			
Optimys	1	412	0.3 (0.0, 2.0)					
Silent*	3	50	4.0 (1.0, 15.1)	6.0 (2.0, 17.5)	6.0 (2.0, 17.5)			
Taperloc Microplasty	8	552	1.4 (0.7, 3.0)	1.4 (0.7, 3.0)	2.2 (0.9, 4.9)			
Other (2)	3	17	5.9 (0.9, 35.0)	5.9 (0.9, 35.0)	5.9 (0.9, 35.0)	29.4 (10.0, 68.5)		
TOTAL	**68**	**2877**						

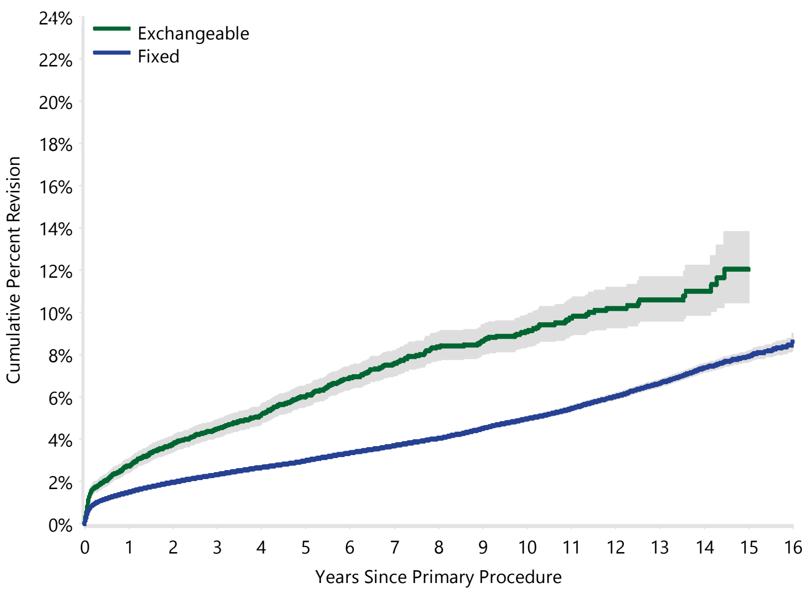
Note: Only prostheses with over 50 procedures have been listed
All procedures using metal/metal prostheses with head size larger than 32mm have been excluded
* denotes prostheses with no reported use in primary total conventional hip replacement in 2016

Table HT24 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	16 Yrs
Exchangeable	691	10114	2.7 (2.4, 3.1)	4.5 (4.1, 4.9)	6.0 (5.6, 6.5)	9.1 (8.4, 9.9)	12.0 (10.5, 13.8)	
Fixed	10919	314513	1.5 (1.5, 1.5)	2.3 (2.3, 2.4)	3.0 (2.9, 3.1)	5.0 (4.9, 5.1)	7.9 (7.7, 8.2)	8.6 (8.2, 9.0)
TOTAL	**11610**	**324627**						

Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Figure HT18 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Type of Femoral Neck (Primary Diagnosis OA)



HR - adjusted for age and gender

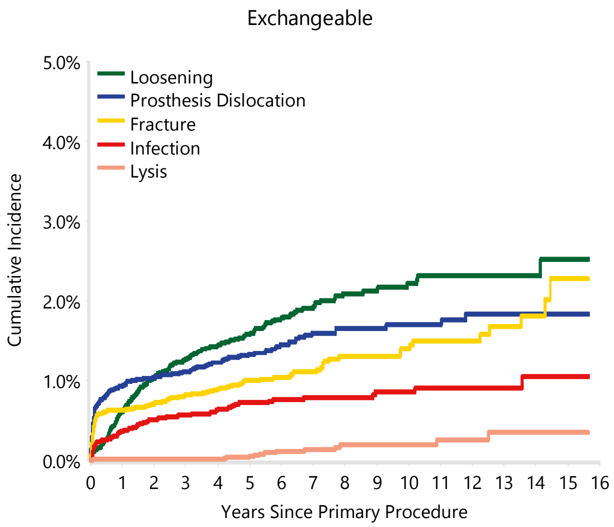
Exchangeable vs Fixed

Entire Period: HR=1.91 (1.77, 2.07),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Exchangeable	10114	9407	8004	6117	1466	103	23
Fixed	314513	276128	210997	155994	59837	6472	1626

Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Figure HT19 Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement by Type of Femoral Neck (Primary Diagnosis OA)



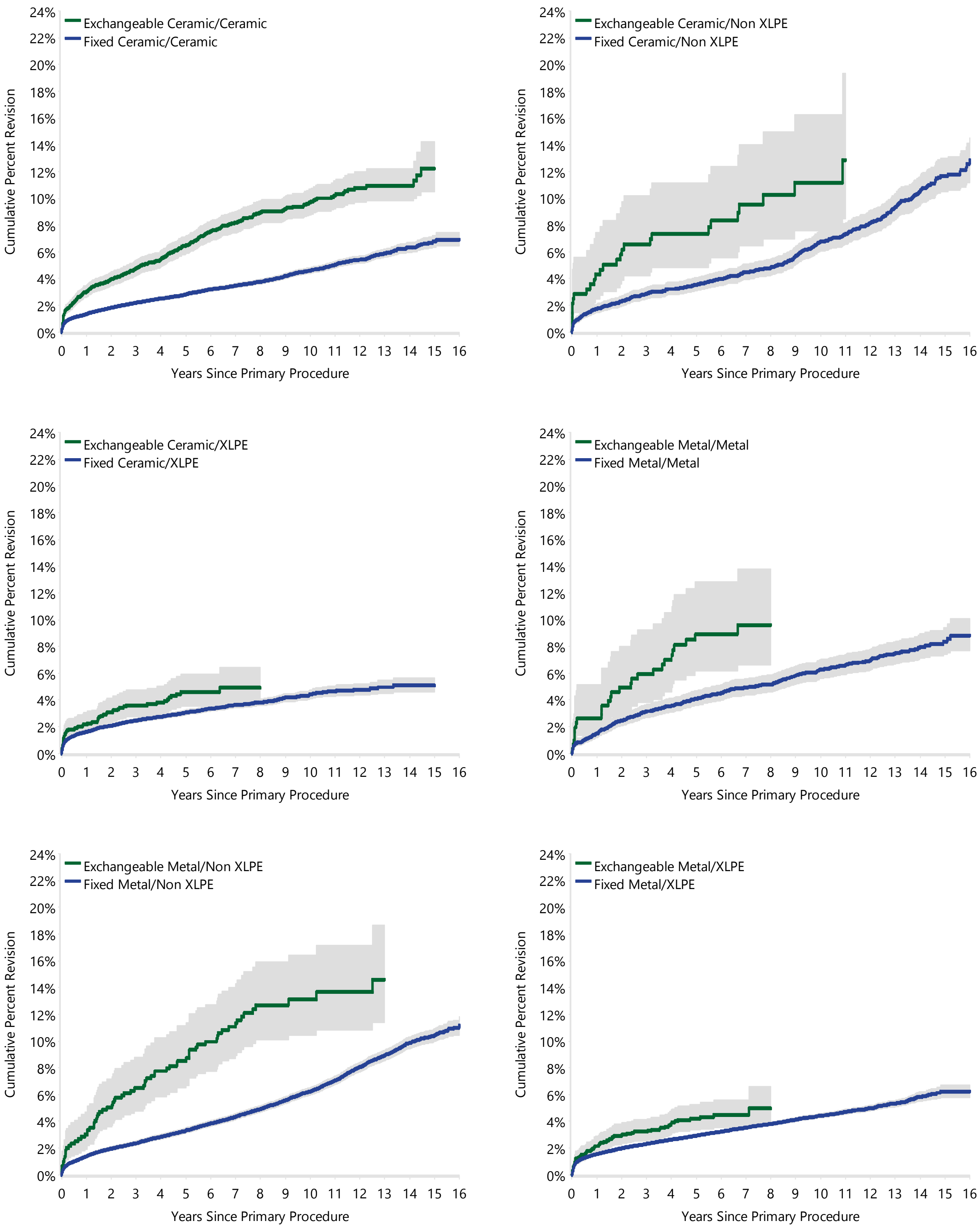
Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Table HT25 Primary Total Conventional Hip Replacement by Reason for Revision and Type of Femoral Neck (Primary Diagnosis OA)

Reason for Revision	Exchangeable Number	Exchangeable % Primaries Revised	Exchangeable % Revisions	Fixed Number	Fixed % Primaries Revised	Fixed % Revisions
Loosening	179	1.8	25.9	2796	0.9	25.6
Prosthesis Dislocation	147	1.5	21.3	2359	0.8	21.6
Fracture	117	1.2	16.9	2148	0.7	19.7
Infection	75	0.7	10.9	1980	0.6	18.1
Lysis	13	0.1	1.9	253	0.1	2.3
Pain	17	0.2	2.5	202	0.1	1.8
Leg Length Discrepancy	7	0.1	1.0	162	0.1	1.5
Malposition	9	0.1	1.3	145	0.0	1.3
Instability	11	0.1	1.6	114	0.0	1.0
Implant Breakage Stem	20	0.2	2.9	99	0.0	0.9
Wear Acetabular Insert				98	0.0	0.9
Implant Breakage Acetabular Insert	10	0.1	1.4	92	0.0	0.8
Incorrect Sizing	7	0.1	1.0	83	0.0	0.8
Implant Breakage Acetabular	11	0.1	1.6	65	0.0	0.6
Metal Related Pathology	57	0.6	8.2	61	0.0	0.6
Wear Head	2	0.0	0.3	39	0.0	0.4
Implant Breakage Head	3	0.0	0.4	36	0.0	0.3
Heterotopic Bone				18	0.0	0.2
Tumour				14	0.0	0.1
Wear Acetabulum				13	0.0	0.1
Synovitis	1	0.0	0.1	2	0.0	0.0
Other	5	0.0	0.7	140	0.0	1.3
N Revision	**691**	**6.8**	**100.0**	**10919**	**3.5**	**100.0**
N Primary	**10114**			**314513**		

Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Figure HT20 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Bearing Surface and Type of Femoral Neck (Primary Diagnosis OA)



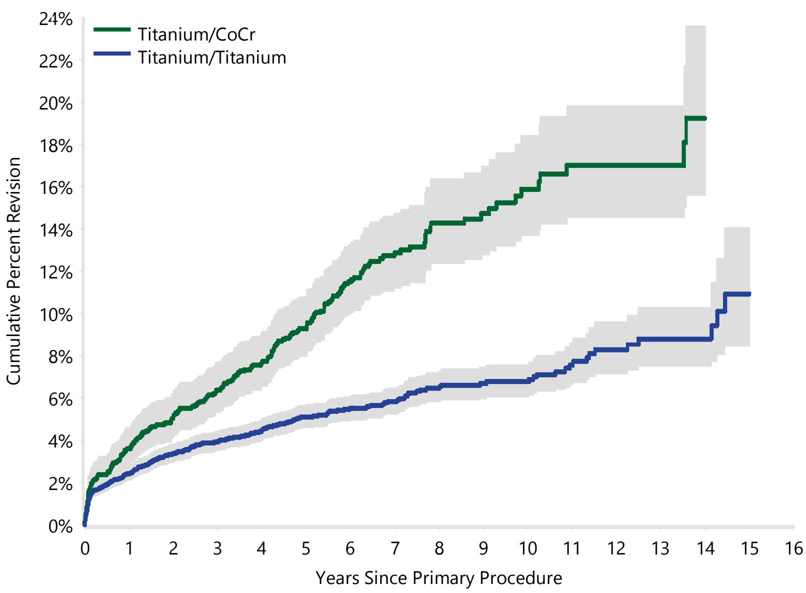
Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Table HT26 Cumulative Percent Revision of Primary Total Conventional Hip Replacement Using an Exchangeable Femoral Neck by Stem/Neck Metal Combination (Primary Diagnosis OA)

Stem/Neck Metal Combination	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
CoCr/CoCr	83	763	4.1 (2.9, 5.8)	5.9 (4.4, 7.8)	7.5 (5.8, 9.7)	12.1 (9.8, 14.8)		
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	206	1680	3.6 (2.8, 4.6)	6.4 (5.3, 7.7)	9.3 (7.9, 10.8)	15.9 (13.7, 18.4)		
Titanium/Titanium	398	7514	2.4 (2.1, 2.8)	3.9 (3.5, 4.4)	5.1 (4.6, 5.7)	6.8 (6.1, 7.6)	10.9 (8.5, 14.0)	
TOTAL	**691**	**10114**						

Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Figure HT21 Cumulative Percent Revision of Primary Total Conventional Hip Replacement Using an Exchangeable Femoral Neck by Stem/Neck Metal Combination (Primary Diagnosis OA)



HR - adjusted for age and gender

Titanium/CoCr vs Titanium/Titanium

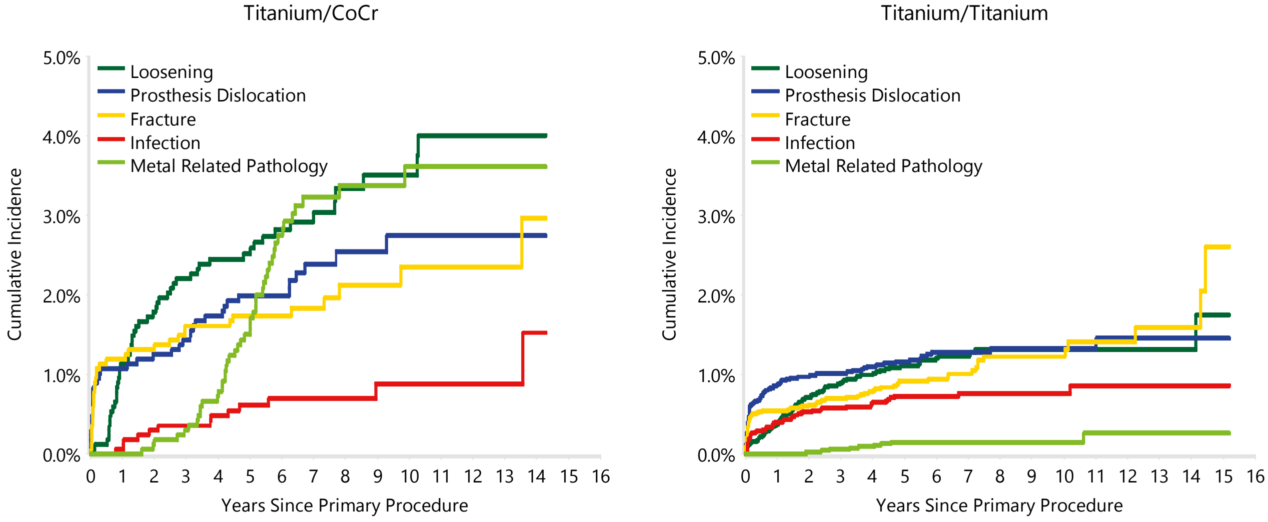
0 - 2.5Yr: HR=1.51 (1.19, 1.91),p<0.001

2.5Yr+: HR=3.10 (2.40, 3.99),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Titanium/CoCr	1680	1607	1501	1204	251	16	0
Titanium/Titanium	7514	6935	5716	4224	828	51	10

Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Figure HT22 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 with head size larger than 32mm have been excluded

Table HT27 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	16 Yrs
ABGII*	66	228	4.0 (2.1, 7.5)	10.2 (6.9, 15.0)	19.5 (14.8, 25.3)			
Adapter*	48	374	3.8 (2.2, 6.3)	7.3 (5.1, 10.5)	10.0 (7.3, 13.6)			
Apex	136	2466	2.8 (2.2, 3.5)	4.1 (3.4, 5.0)	5.3 (4.4, 6.3)	7.3 (6.1, 8.8)		
F2L*	69	687	3.2 (2.1, 4.8)	5.4 (4.0, 7.4)	6.8 (5.1, 9.0)	8.6 (6.7, 11.0)	12.6 (9.7, 16.4)	
Femoral Neck (Amplitude)	17	510	1.0 (0.4, 2.3)	2.2 (1.2, 4.1)	4.4 (2.6, 7.2)			
H-Max*	1	71	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	2.2 (0.3, 14.7)			
M-Cor*	8	110	0.0 (0.0, 0.0)	2.8 (0.9, 8.4)	4.7 (2.0, 11.0)			
M/L Taper Kinectiv	118	2993	2.1 (1.6, 2.6)	3.4 (2.8, 4.1)	4.4 (3.7, 5.3)			
MBA*	54	630	2.1 (1.2, 3.5)	4.0 (2.7, 5.9)	5.8 (4.2, 8.1)	9.9 (7.4, 13.0)		
MSA*	17	174	7.5 (4.4, 12.6)	9.3 (5.8, 14.7)	9.9 (6.3, 15.5)			
Margron*	76	552	5.3 (3.7, 7.5)	7.3 (5.4, 9.9)	9.4 (7.2, 12.2)	14.0 (11.3, 17.3)		
Metha*	11	84	10.7 (5.7, 19.6)	11.9 (6.6, 21.0)	11.9 (6.6, 21.0)			
Profemur*	54	934	3.1 (2.2, 4.5)	4.7 (3.5, 6.2)	5.2 (4.0, 6.9)	6.4 (4.8, 8.5)		
R120*	7	178	1.1 (0.3, 4.4)	2.3 (0.9, 6.1)	2.3 (0.9, 6.1)			
Other (5)	9	123	1.7 (0.4, 6.5)	4.7 (2.0, 10.9)	7.1 (3.4, 14.3)			
TOTAL	**691**	**10114**						

Note: Only Femoral Neck Prostheses with over 60 procedures have been listed
All procedures using metal/metal prostheses with head size larger than 32mm have been excluded
* denotes prostheses with no reported use in primary total conventional hip replacement in 2016

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 only includes 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 nine bearing surfaces, seven 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. 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 combination of femoral and acetabular prostheses.

Ceramic/XLPE has a lower rate of revision after three years compared to metal/XLPE (Table HT28 and Figure HT23).

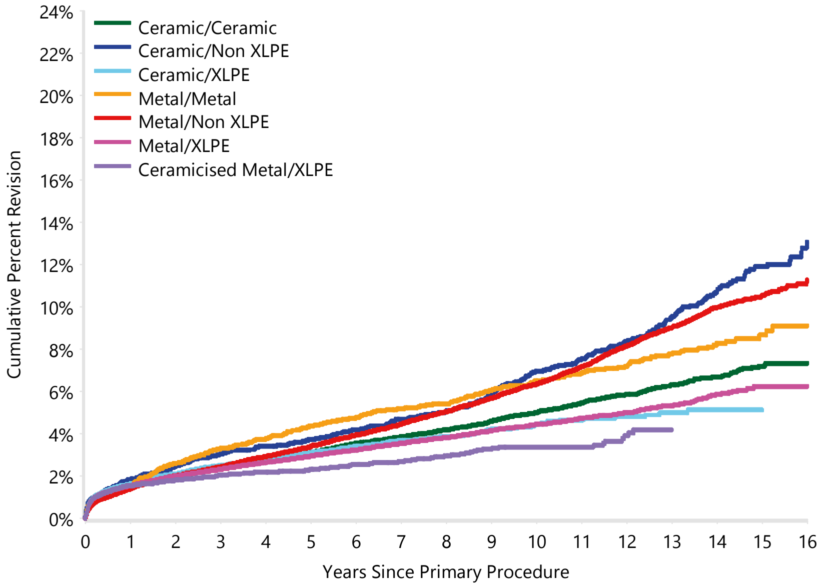
Detailed information on the analysis of metal/metal and metal and ceramic bearing surfaces are available in the supplementary reports 'Metal on Metal Bearing Surface Conventional Hip Arthroplasty' and 'Metal and Ceramic Bearing Surface in Total Conventional Hip Arthroplasty' on the AOANJRR website: https://aoanjrr.sahmri.com/annual-reports-2017.

Table HT28 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	2758	78674	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, 7.7)	7.3 (6.9, 7.8)
Ceramic/Non XLPE	429	6288	1.8 (1.5, 2.2)	3.0 (2.6, 3.5)	3.7 (3.3, 4.3)	7.0 (6.2, 7.8)	11.9 (10.7, 13.2)	13.1 (11.6, 14.7)
Ceramic/XLPE	1276	49627	1.6 (1.5, 1.8)	2.5 (2.3, 2.7)	3.1 (2.9, 3.3)	4.5 (4.1, 4.8)	5.1 (4.6, 5.7)	
Ceramic/Metal	18	299	1.7 (0.7, 4.0)	3.7 (2.1, 6.6)	4.4 (2.6, 7.4)			
Metal/Metal	347	5146	1.6 (1.3, 1.9)	3.3 (2.9, 3.9)	4.4 (3.8, 5.0)	6.5 (5.8, 7.2)	8.7 (7.7, 9.7)	9.1 (8.0, 10.4)
Metal/Non XLPE	2310	34593	1.4 (1.3, 1.5)	2.4 (2.3, 2.6)	3.4 (3.2, 3.6)	6.3 (6.1, 6.6)	10.5 (10.1, 11.0)	11.3 (10.7, 11.9)
Metal/XLPE	3999	131327	1.6 (1.5, 1.6)	2.3 (2.2, 2.4)	2.9 (2.8, 3.1)	4.4 (4.3, 4.6)	6.3 (5.8, 6.7)	6.3 (5.8, 6.7)
Ceramicised Metal/Non XLPE	36	290	1.7 (0.7, 4.1)	3.9 (2.2, 6.9)	4.3 (2.4, 7.4)	12.5 (8.9, 17.5)		
Ceramicised Metal/XLPE	426	18177	1.6 (1.4, 1.7)	2.0 (1.8, 2.3)	2.3 (2.1, 2.6)	3.4 (3.0, 3.8)		
TOTAL	**11599**	**324421**						

Note: Excludes 197 procedures with unknown bearing surface, one procedure with ceramicised metal/ceramic bearing surface and eight procedures with metal/ceramic bearing surface
All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Figure HT23 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=1.04 (0.99, 1.09),p=0.165
Ceramic/Non XLPE vs Metal/XLPE	0 - 3Yr: HR=1.30 (1.12, 1.51),p<0.001
	3Yr - 5Yr: HR=1.03 (0.73, 1.47),p=0.853
	5Yr - 9Yr: HR=1.66 (1.33, 2.08),p<0.001
	9Yr+: HR=2.83 (2.34, 3.43),p<0.001
Ceramic/XLPE vs Metal/XLPE	0 - 3Yr: HR=1.07 (1.00, 1.15),p=0.046
	3Yr+: HR=0.83 (0.72, 0.95),p=0.006
Metal/Metal vs Metal/XLPE	Entire Period: HR=1.36 (1.21, 1.52),p<0.001
Metal/Non XLPE vs Metal/XLPE	0 - 1Mth: HR=0.76 (0.64, 0.89),p=0.001
	1Mth - 6Mth: HR=0.98 (0.84, 1.14),p=0.762
	6Mth - 1Yr: HR=1.36 (1.13, 1.64),p=0.001
	1Yr - 5Yr: HR=1.37 (1.26, 1.50),p<0.001
	5Yr - 7Yr: HR=1.67 (1.45, 1.91),p<0.001
	7Yr - 9Yr: HR=1.90 (1.64, 2.21),p<0.001
	9Yr+: HR=2.46 (2.18, 2.77),p<0.001
Ceramicised Metal/XLPE vs Metal/XLPE	0 - 1Yr: HR=1.03 (0.91, 1.17),p=0.627
	1Yr+: HR=0.56 (0.47, 0.66),p<0.001

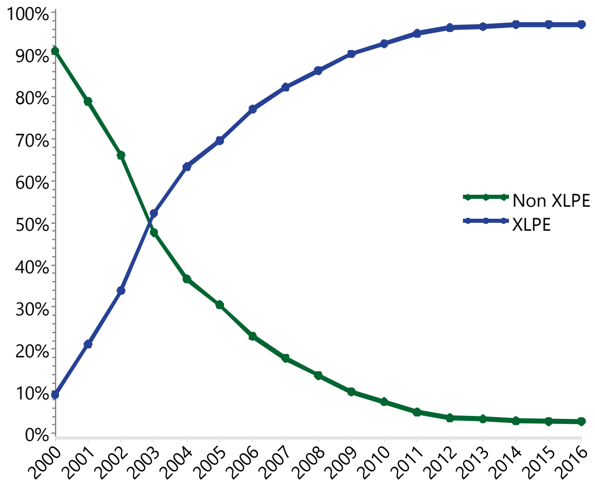
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Ceramic/Ceramic	78674	70863	55391	40220	14612	1355	254
Ceramic/Non XLPE	6288	5678	4808	4179	2835	779	317
Ceramic/XLPE	49627	38561	23126	14232	3208	137	17
Metal/Metal	5146	5023	4779	4500	2907	478	82
Metal/Non XLPE	34593	33199	30698	27752	17001	3096	891
Metal/XLPE	131327	115680	88000	62862	18396	721	86
Ceramicised Metal/XLPE	18177	15762	11498	7709	2123	0	0

Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Cross-linked Polyethylene

XLPE has been used in 199,131 procedures reported to the Registry. This includes 7,245 procedures that have XLPE with the addition of an antioxidant. When polyethylene was used as a bearing surface in total conventional hip procedures, the proportion of XLPE was 97.1% in 2016 (Figure HT24).

Figure HT24 Primary Total Conventional Hip Replacement by Polyethylene Type (Primary Diagnosis OA)



XLPE has a lower rate of revision compared to non XLPE after six months (Table HT29 and Figure HT25). The difference increases with time and at 16 years the cumulative percent revision is 6.2% and 11.7%, respectively. The cumulative incidence of loosening and prosthesis dislocation at 16 years is 1.1% and 1.3% for XLPE, compared to 3.3% and 1.7% for non XLPE bearings, respectively (Figure HT26).

Rates of revision vary depending on head size. This is most evident for non XLPE where the rate of revision increases with larger head size. For XLPE, 32mm head size has the lowest rate of revision. There is no difference between head sizes less than 32mm and greater than 32mm (Table HT29, Figures HT27 and HT28).

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 greater have been used in 75.9% of XLPE procedures and in only 12.0% 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.

Reduced cumulative incidence of loosening when XLPE is used, is evident for the most common head sizes of 32mm and less than 32mm when compared to non XLPE (Figure HT29).

At 16 years the cumulative percent revision of total conventional hip replacement with XLPE is 6.2%.

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 HT30).

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 14 year follow up with an insert using both types of polyethylene. XLPE is used in 90.2% of Allofit Shell total conventional hip procedures. XLPE has a lower rate of revision than non XLPE (Table HT30 and Figure HT31).

The Duraloc Shell has a 14 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 HT30 and Figure HT32).

The Mallory-Head Shell has an eight year follow up with an insert using both types of polyethylene. XLPE is used in 41.9% of Mallory-Head Shell total conventional hip procedures. XLPE has a lower rate of revision compared to non XLPE after 1.5 years (Table HT30 and Figure HT33).

The Reflection Cup has a 12 year follow up for both types of polyethylene. XLPE has been used in 51.9% of Reflection Cup total conventional hip procedures. After one year, XLPE has a lower rate of revision than non XLPE (Table HT30 and Figure HT34).

The Reflection Shell has a 15 year follow up with an insert using both types of polyethylene. XLPE is used in 83.7% of Reflection Shell total conventional hip procedures. XLPE has a lower rate of revision after one year compared to non XLPE (Table HT30 and Figure HT35).

The Vitalock Shell has a 13 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 HT30 and Figure HT36).

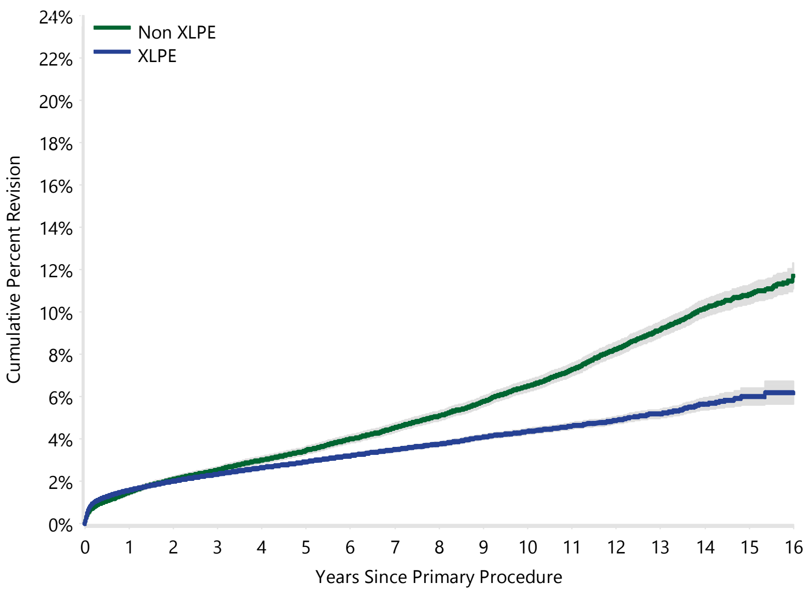
Prosthesis Specific (Antioxidant)

For the first time, 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 HT31).

Table HT29 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	16 Yrs
Non XLPE		**2775**	**41171**	**1.5 (1.4, 1.6)**	**2.5 (2.4, 2.7)**	**3.5 (3.3, 3.7)**	**6.5 (6.2, 6.8)**	**10.8 (10.4, 11.3)**	**11.7 (11.1, 12.3)**
	<32mm	2538	36230	1.4 (1.3, 1.6)	2.5 (2.3, 2.6)	3.4 (3.2, 3.6)	6.4 (6.2, 6.7)	10.8 (10.3, 11.3)	11.6 (11.1, 12.3)
	32mm	213	4642	1.6 (1.3, 2.0)	3.0 (2.5, 3.5)	3.8 (3.2, 4.4)	6.3 (5.4, 7.4)		
	>32mm	24	299	3.7 (2.1, 6.6)	6.0 (3.8, 9.5)	8.6 (5.7, 12.8)			
XLPE		**5701**	**199131**	**1.6 (1.5, 1.6)**	**2.3 (2.3, 2.4)**	**2.9 (2.8, 3.0)**	**4.4 (4.2, 4.5)**	**6.0 (5.6, 6.4)**	**6.2 (5.7, 6.7)**
	<32mm	1817	48001	1.5 (1.4, 1.7)	2.4 (2.2, 2.5)	3.0 (2.8, 3.2)	4.4 (4.2, 4.7)	6.0 (5.6, 6.5)	6.2 (5.7, 6.8)
	32mm	2089	84157	1.5 (1.4, 1.6)	2.3 (2.1, 2.4)	2.7 (2.6, 2.8)	4.0 (3.8, 4.3)		
	>32mm	1795	66973	1.7 (1.6, 1.8)	2.4 (2.3, 2.6)	3.1 (3.0, 3.3)	4.7 (4.3, 5.0)		
TOTAL		**8476**	**240302**						

Figure HT25 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Polyethylene Type (Primary Diagnosis OA)



HR - adjusted for age and gender

Non XLPE vs XLPE

0 - 3Mth: HR=0.82 (0.73, 0.91),p<0.001

3Mth - 6Mth: HR=1.02 (0.82, 1.28),p=0.849

6Mth - 1.5Yr: HR=1.45 (1.27, 1.65),p<0.001

1.5Yr - 2.5Yr: HR=1.31 (1.11, 1.55),p=0.001

2.5Yr - 6.5Yr: HR=1.65 (1.50, 1.81),p<0.001

6.5Yr - 9Yr: HR=2.15 (1.86, 2.49),p<0.001

9Yr+: HR=3.02 (2.60, 3.51),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Non XLPE	41171	39158	35763	32170	19988	3875	1208
XLPE	199131	170003	122624	84803	23727	858	103

Figure HT26 Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement by Polyethylene Type (Primary Diagnosis OA)

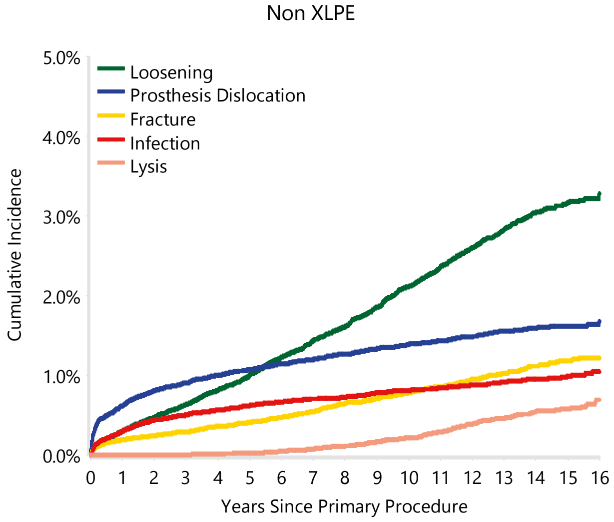
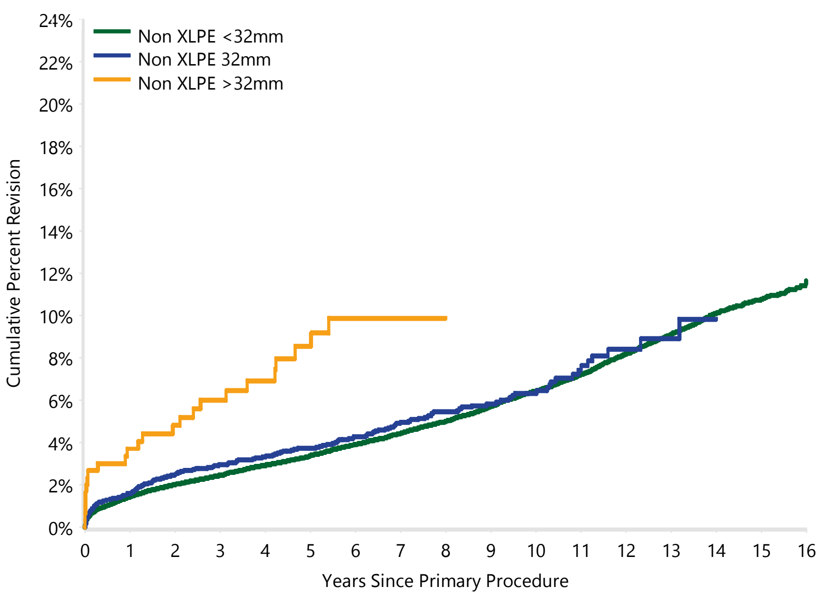


Figure HT27 Cumulative Percent Revision of Primary Total Conventional Hip Replacement using Non XLPE by Head Size (Primary Diagnosis OA)



HR - adjusted for age and gender

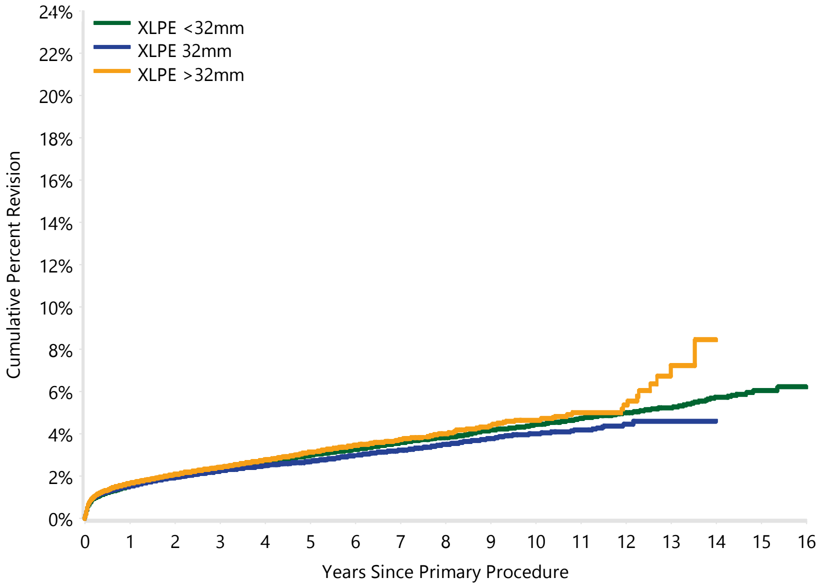
Non XLPE 32mm vs Non XLPE <32mm
Entire Period: HR=1.16 (1.00, 1.33),p=0.045

Non XLPE >32mm vs Non XLPE <32mm
Entire Period: HR=2.28 (1.52, 3.41),p<0.001

Non XLPE >32mm vs Non XLPE 32mm
Entire Period: HR=1.97 (1.29, 3.01),p=0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Non XLPE	<32mm	36230	34626	32033	29272	19222	3864	1205
	32mm	4642	4256	3510	2750	746	11	3
	>32mm	299	276	220	148	20	0	0

Figure HT28 **Cumulative Percent Revision of Primary Total Conventional Hip Replacement using XLPE by Head Size (Primary Diagnosis OA)**



HR - adjusted for age and gender

XLPE <32mm vs XLPE 32mm
0 - 1Mth: HR=0.94 (0.82, 1.08),p=0.398
1Mth+: HR=1.13 (1.05, 1.21),p=0.001

XLPE >32mm vs XLPE 32mm
0 - 3Mth: HR=1.05 (0.95, 1.15),p=0.334
3Mth+: HR=1.16 (1.07, 1.26),p<0.001

XLPE >32mm vs XLPE <32mm
Entire Period: HR=1.04 (0.97, 1.11),p=0.278

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
XLPE	<32mm	48001	44954	39391	33101	16632	849	102
	32mm	84157	70357	47241	29945	5075	2	1
	>32mm	66973	54692	35992	21757	2020	7	0

Figure HT29 Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement by Polyethylene Type and Head Size (Primary Diagnosis OA)

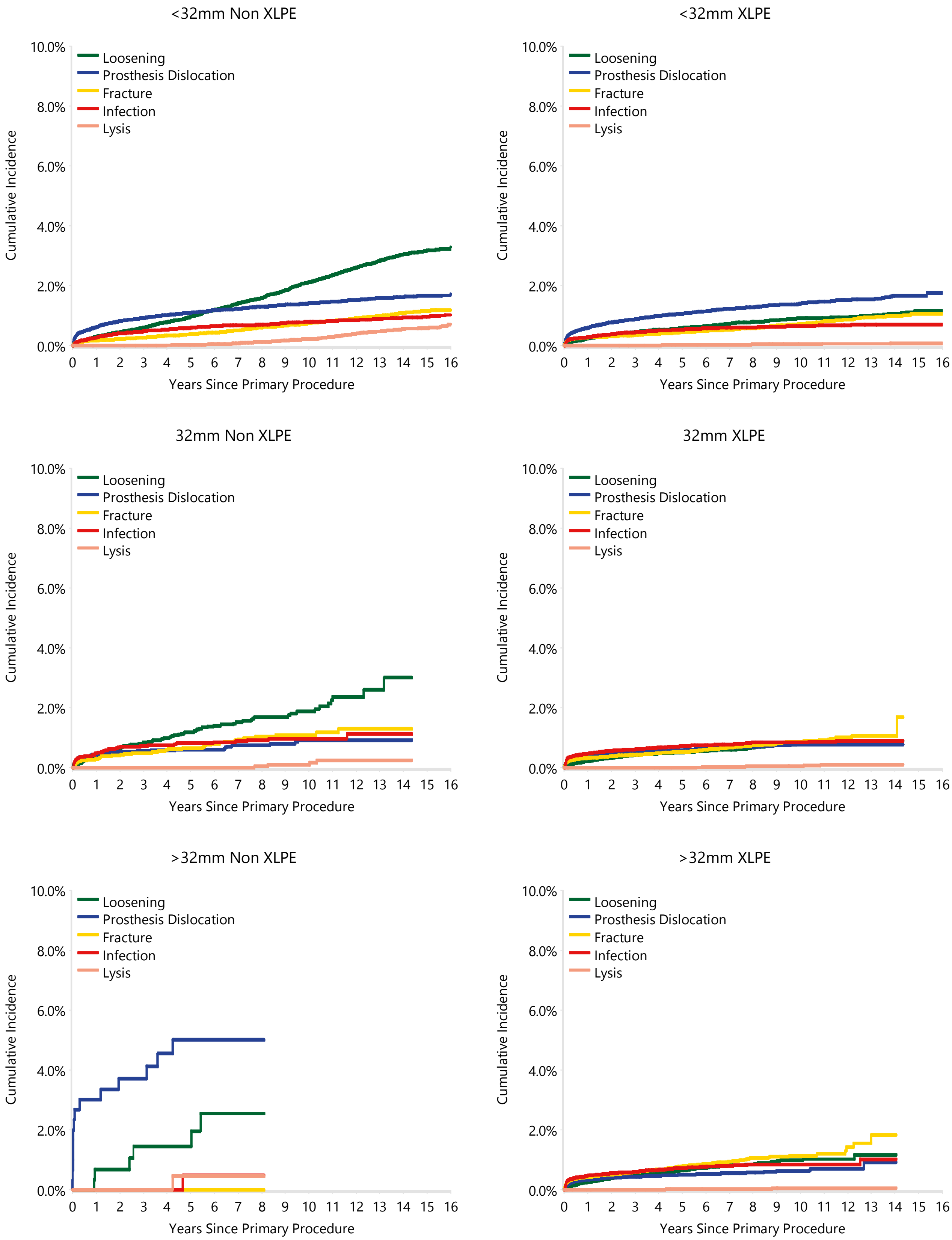


Figure HT30 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Head Surface and Polyethylene Type (Primary Diagnosis OA)

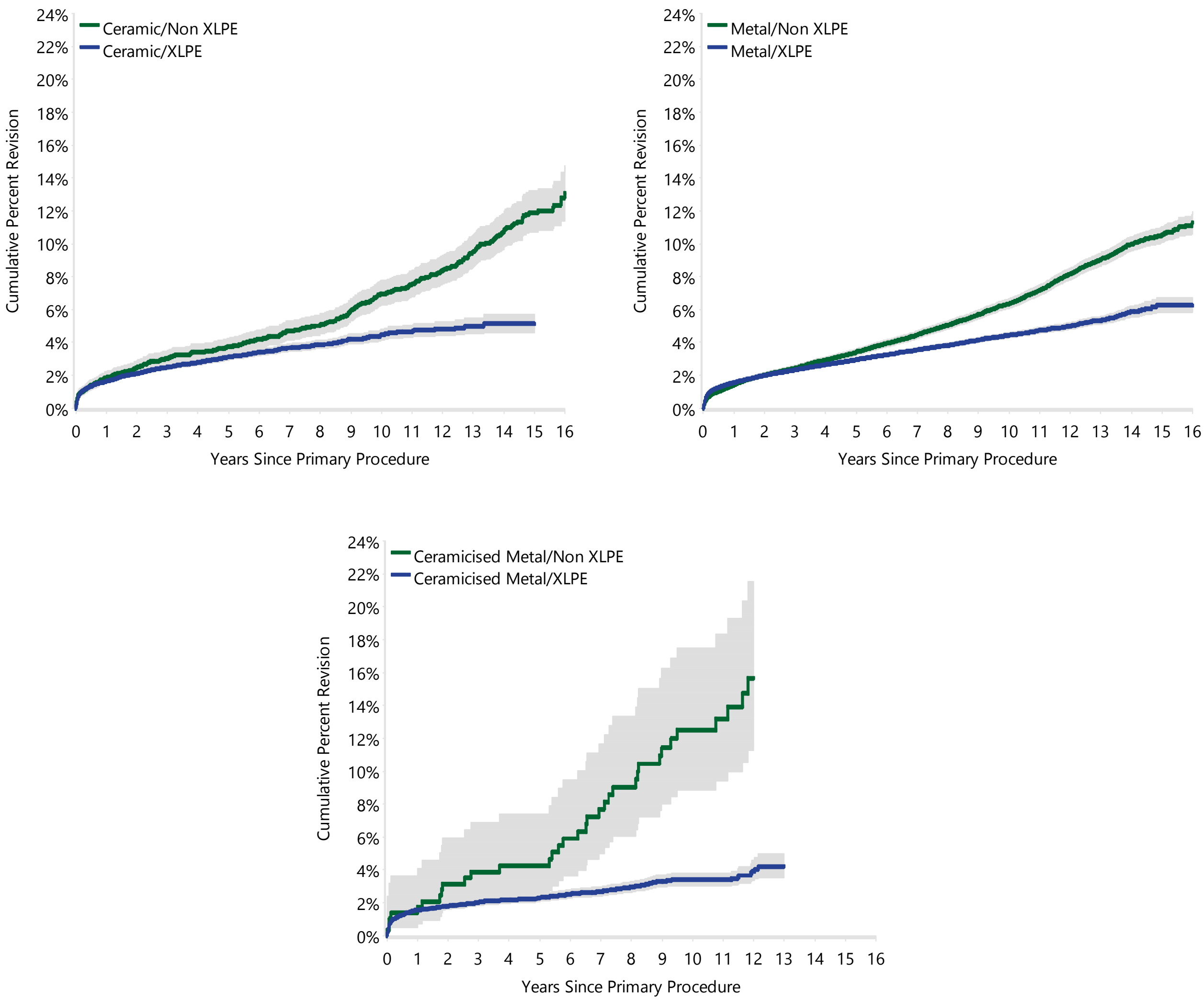
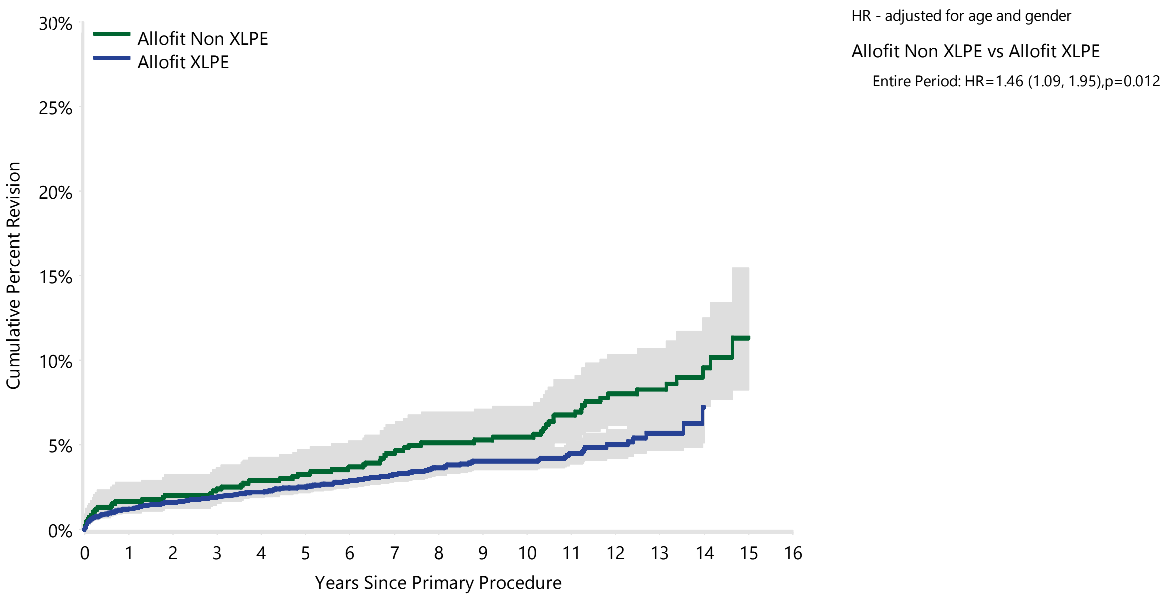


Table HT30 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Prosthesis Type and Polyethylene Type (Primary Diagnosis OA)

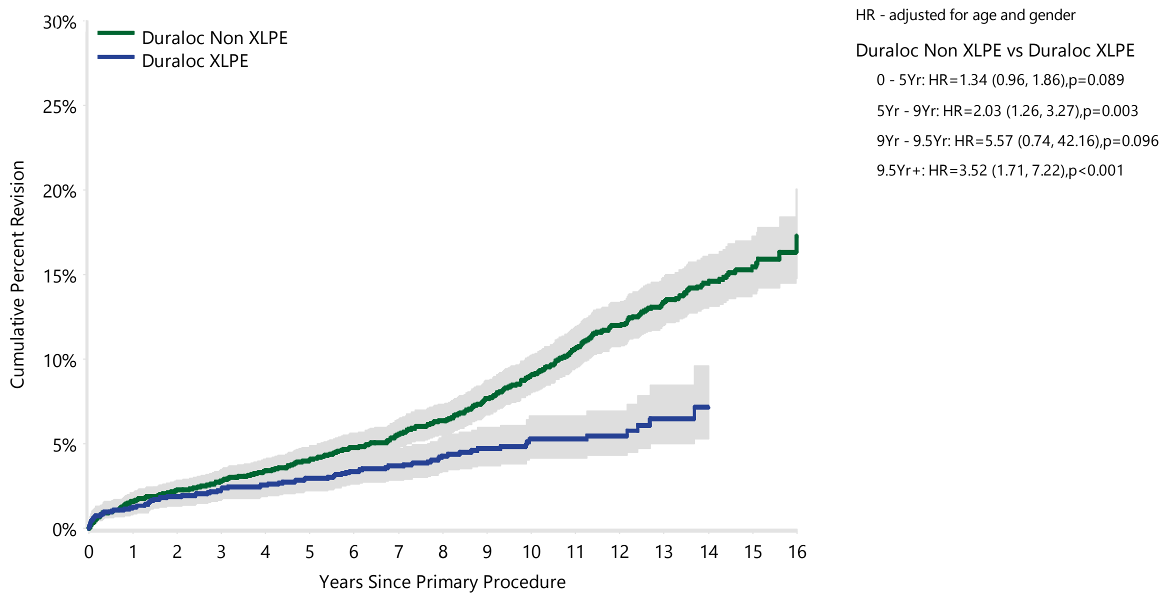
Acetabular Component	Polyethylene Type	N Revised	N Total	5 Yrs	8 Yrs	12 Yrs	13 Yrs	14 Yrs	15 Yrs
Allofit		**300**	**8693**	**2.6 (2.3, 3.0)**	**3.9 (3.4, 4.4)**	**5.7 (5.0, 6.6)**	**6.2 (5.4, 7.3)**	**7.6 (6.2, 9.3)**	**8.8 (6.8, 11.5)**
	Non XLPE	61	848	3.3 (2.3, 4.7)	5.1 (3.8, 6.9)	8.0 (6.2, 10.4)	8.3 (6.4, 10.7)	9.6 (7.3, 12.5)	11.3 (8.2, 15.5)
	XLPE	239	7845	2.5 (2.2, 2.9)	3.7 (3.2, 4.2)	5.0 (4.2, 5.9)	5.7 (4.7, 7.0)	7.2 (5.1, 10.2)	
Duraloc		**418**	**4710**	**3.7 (3.2, 4.2)**	**5.6 (5.0, 6.4)**	**10.2 (9.2, 11.3)**	**11.5 (10.4, 12.7)**	**12.6 (11.4, 13.9)**	**13.6 (12.2, 15.1)**
	Non XLPE	339	2994	4.1 (3.4, 4.8)	6.3 (5.5, 7.3)	12.0 (10.7, 13.4)	13.4 (12.0, 14.8)	14.5 (13.0, 16.1)	15.5 (13.9, 17.3)
	XLPE	79	1716	3.0 (2.2, 3.9)	4.3 (3.4, 5.5)	5.5 (4.3, 6.9)	6.5 (5.0, 8.5)	7.1 (5.3, 9.6)	
Mallory-Head		**307**	**7030**	**2.6 (2.2, 3.0)**	**3.7 (3.2, 4.2)**	**6.0 (5.2, 6.8)**	**6.8 (5.9, 7.7)**	**7.9 (6.9, 9.0)**	**9.2 (7.9, 10.6)**
	Non XLPE	246	4084	2.7 (2.3, 3.3)	4.0 (3.4, 4.6)	6.2 (5.5, 7.2)	7.1 (6.2, 8.1)	8.2 (7.1, 9.4)	9.5 (8.2, 11.0)
	XLPE	61	2946	2.3 (1.8, 3.0)	2.4 (1.9, 3.2)				
Reflection (Cup)		**169**	**2244**	**2.8 (2.2, 3.6)**	**5.4 (4.4, 6.6)**	**11.1 (9.3, 13.2)**	**13.8 (11.6, 16.4)**	**17.6 (14.6, 21.1)**	**18.7 (15.4, 22.5)**
	Non XLPE	142	1079	3.3 (2.3, 4.6)	7.5 (6.0, 9.5)	15.4 (12.9, 18.3)	18.1 (15.3, 21.4)	21.8 (18.4, 25.7)	22.7 (19.1, 26.9)
	XLPE	27	1165	2.3 (1.5, 3.4)	2.4 (1.6, 3.6)	2.7 (1.8, 4.2)			
Reflection (Shell)		**601**	**14241**	**2.4 (2.1, 2.7)**	**3.5 (3.2, 3.8)**	**5.8 (5.3, 6.3)**	**6.7 (6.0, 7.3)**	**7.8 (6.9, 8.7)**	**9.0 (7.8, 10.2)**
	Non XLPE	270	2322	4.3 (3.5, 5.2)	6.8 (5.8, 8.0)	12.6 (11.1, 14.3)	14.3 (12.7, 16.1)	15.6 (13.9, 17.6)	16.7 (14.8, 18.8)
	XLPE	331	11919	2.0 (1.8, 2.3)	2.7 (2.4, 3.1)	3.6 (3.2, 4.1)	3.8 (3.3, 4.3)	4.5 (3.7, 5.5)	6.3 (4.0, 9.8)
Vitalock		**250**	**4619**	**2.5 (2.1, 3.0)**	**3.5 (3.0, 4.1)**	**5.3 (4.7, 6.1)**	**5.8 (5.1, 6.6)**	**6.6 (5.8, 7.5)**	**7.2 (6.3, 8.2)**
	Non XLPE	209	3569	2.6 (2.1, 3.1)	3.6 (3.0, 4.2)	5.5 (4.8, 6.4)	6.0 (5.2, 6.9)	6.9 (6.0, 7.9)	7.5 (6.5, 8.6)
	XLPE	41	1050	2.4 (1.6, 3.5)	3.3 (2.3, 4.6)	4.7 (3.5, 6.5)	4.7 (3.5, 6.5)		
TOTAL		**2045**	**41537**						

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



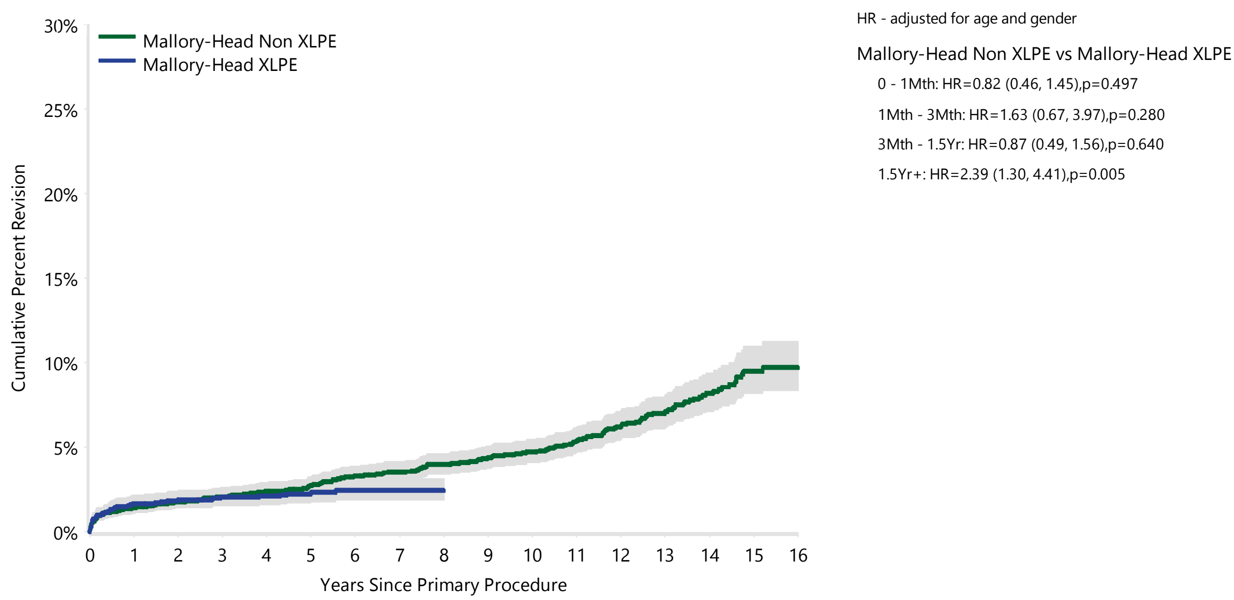
Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Allofit	Non XLPE	848	828	793	738	526	55	7
	XLPE	7845	7236	5981	4643	1416	21	0

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



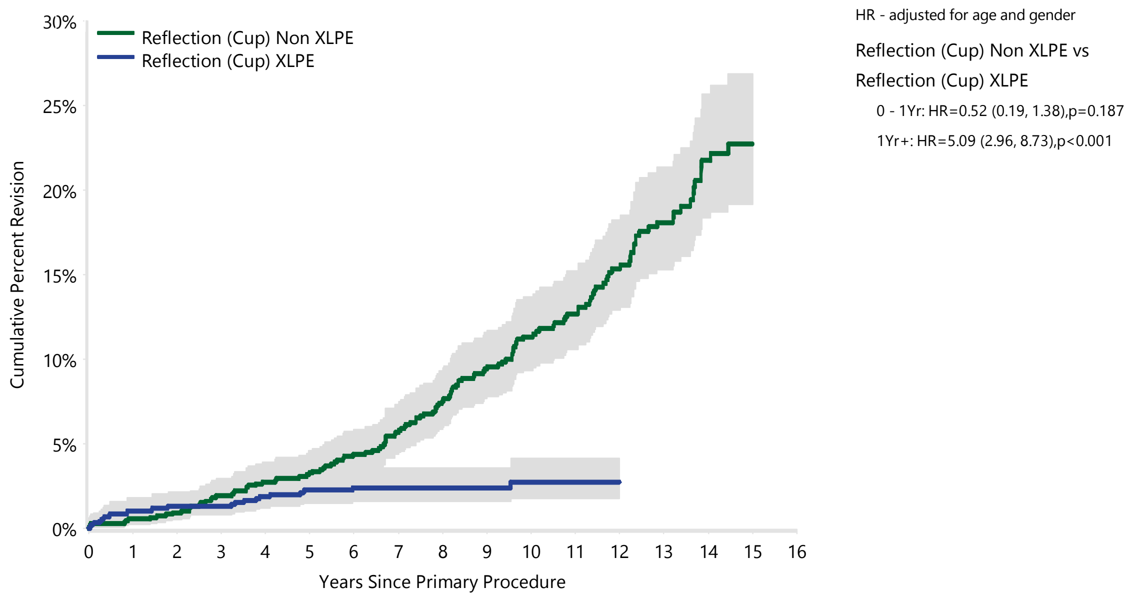
Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Duraloc	Non XLPE	2994	2915	2743	2567	1905	398	90
	XLPE	1716	1668	1575	1445	643	16	0

Figure HT33 Cumulative Percent Revision of Mallory-Head Primary Total Conventional Hip Replacement by Polyethylene Type (Primary Diagnosis OA)



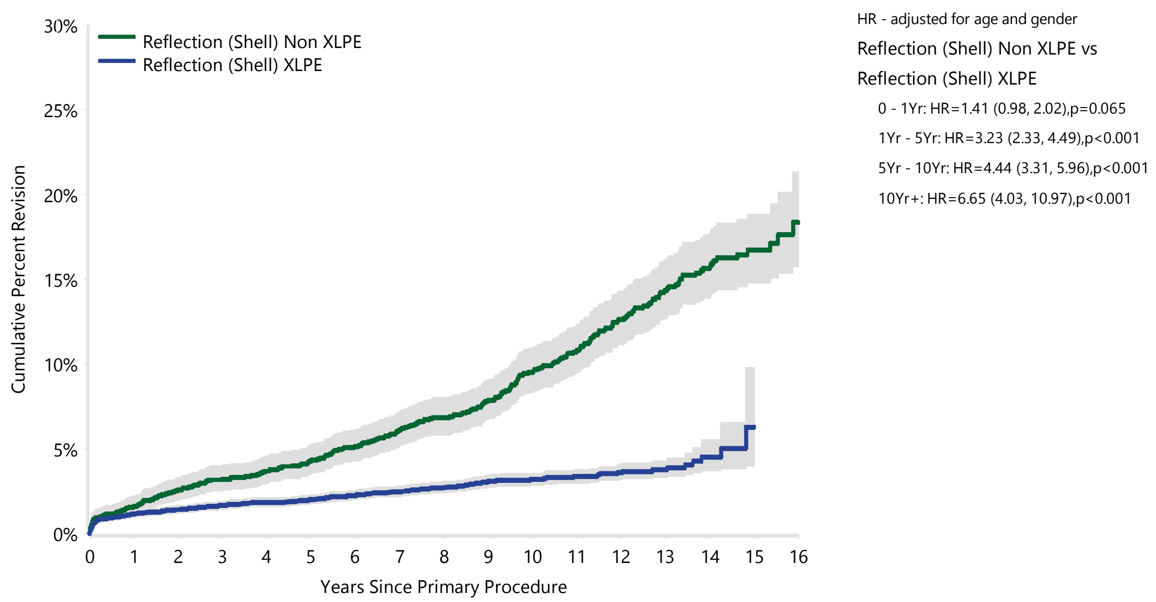
Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Mallory-Head	Non XLPE	4084	3976	3810	3618	2592	468	177
	XLPE	2946	2585	1908	1131	10	0	0

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



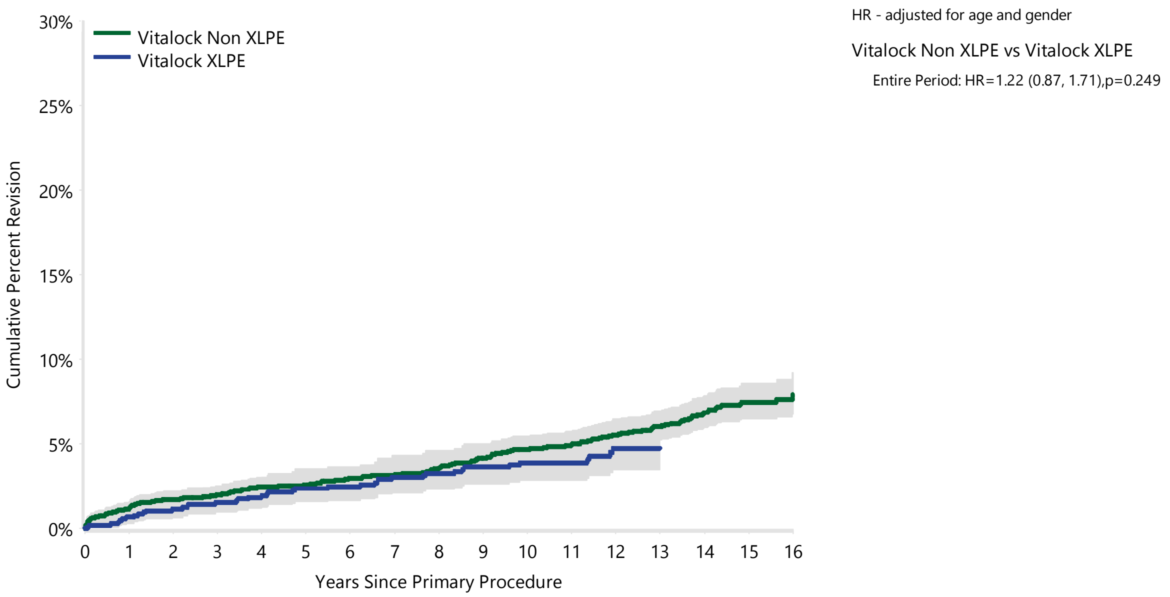
Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Reflection (Cup)	Non XLPE	1079	1052	975	895	564	85	26
	XLPE	1165	1096	926	744	254	0	0

Figure HT35 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	16 Yrs
Reflection (Shell)	Non XLPE	2322	2243	2116	1964	1399	298	97
	XLPE	11919	11455	10286	9019	4091	60	6

Figure HT36 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	16 Yrs
Vitalock	Non XLPE	3569	3477	3331	3162	2564	851	340
	XLPE	1050	1032	985	936	687	0	0

Table HT31 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		**21**	**1236**	**1.7 (1.1, 2.7)**	**2.3 (1.4, 3.6)**				
	XLPE	3	196	1.0 (0.3, 4.0)	2.1 (0.6, 6.8)				
	XLPE + Antioxidant	18	1040	1.9 (1.1, 3.0)	2.2 (1.3, 3.7)				
Ringloc		**121**	**5518**	**1.6 (1.3, 2.0)**	**2.0 (1.6, 2.4)**	**2.2 (1.8, 2.6)**	**2.3 (1.9, 2.8)**	**2.4 (2.0, 2.9)**	**2.6 (2.1, 3.1)**
	XLPE	63	3091	1.4 (1.0, 1.9)	1.7 (1.3, 2.3)	1.8 (1.4, 2.4)	2.0 (1.5, 2.6)	2.2 (1.7, 2.8)	2.3 (1.8, 3.0)
	XLPE + Antioxidant	58	2427	2.0 (1.5, 2.6)	2.3 (1.7, 3.0)	2.6 (2.0, 3.4)	2.7 (2.1, 3.5)	2.7 (2.1, 3.5)	2.7 (2.1, 3.5)
Trinity		**47**	**2815**	**1.6 (1.2, 2.2)**	**1.9 (1.4, 2.6)**	**2.2 (1.6, 3.0)**	**2.6 (1.7, 4.0)**	**2.6 (1.7, 4.0)**	
	XLPE	13	718	1.4 (0.7, 2.7)	2.1 (1.1, 3.9)	2.6 (1.4, 5.0)	3.3 (1.7, 6.3)	3.3 (1.7, 6.3)	
	XLPE + Antioxidant	34	2097	1.7 (1.2, 2.4)	1.9 (1.3, 2.6)	2.0 (1.4, 2.9)	2.0 (1.4, 2.9)		
TOTAL		**189**	**9569**						

Ceramic/Ceramic Bearing

Ceramic/ceramic bearings have been used in 78,674 primary total conventional hip replacement procedures undertaken for osteoarthritis. This is the second most common bearing reported to the Registry.

This year, analysis has been restricted to procedures with mixed ceramic femoral head and mixed ceramic acetabular bearing surfaces. In 2016, mixed ceramic accounted for 92.0% of all procedures with ceramic/ceramic bearing surface (Figure HT37).

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. After 1.5 years there is no difference in the rate of revision between 28mm or smaller and 32mm head sizes. There is no difference in the rate of revision between 36 to 38mm and 40mm or larger head sizes (Table HT32 and Figure HT38).

At one year, the cumulative incidence of revision for dislocation is 2.0% for head sizes 28mm or smaller compared to 0.4% for 32mm, 0.3% for 36 to 38mm, and 0.1% for head sizes 40mm or larger (Figure HT39).

Figure HT37 Primary Total Conventional Hip Replacement with Ceramic Femoral Head by Ceramic Type (Primary Diagnosis OA)

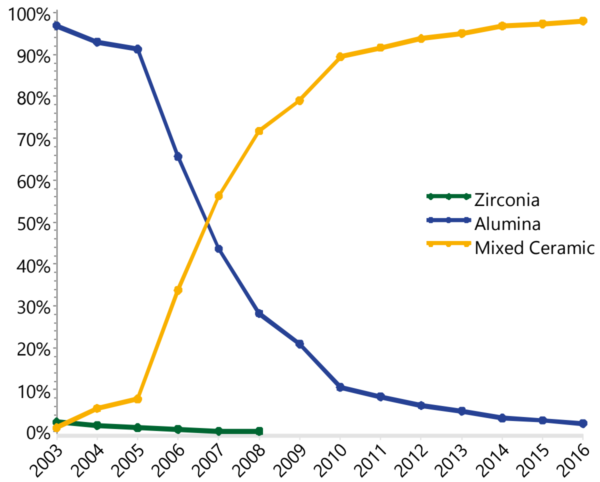
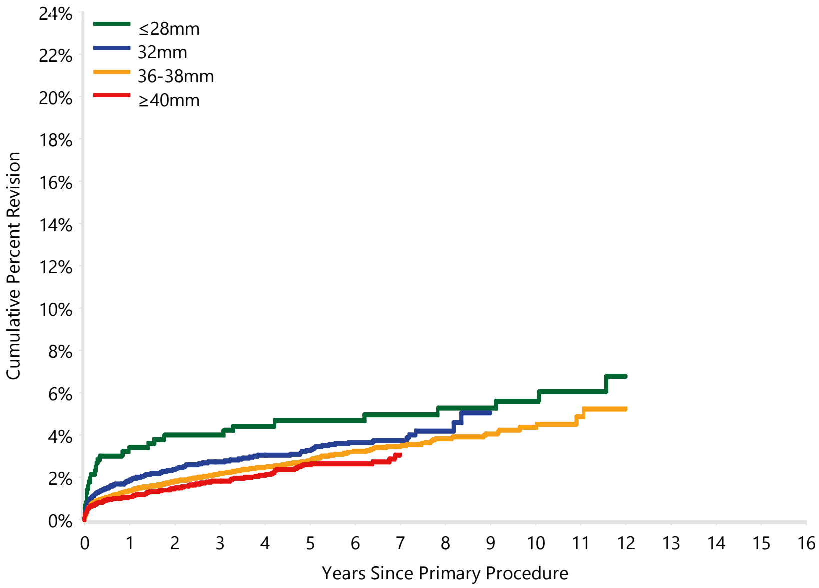


Table HT32 Cumulative Percent Revision of Mixed Ceramic/Mixed Ceramic Primary Total Conventional Hip Replacement by Head Size (Primary Diagnosis OA)

Head Size	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
≤28mm	30	564	3.4 (2.2, 5.3)	4.0 (2.6, 6.0)	4.7 (3.2, 6.9)	5.6 (3.9, 8.1)		
32mm	242	8384	1.9 (1.6, 2.2)	2.7 (2.4, 3.1)	3.3 (2.9, 3.7)			
36-38mm	792	32734	1.4 (1.2, 1.5)	2.2 (2.0, 2.4)	2.8 (2.6, 3.0)	4.4 (3.9, 4.9)		
≥40mm	129	6027	1.1 (0.8, 1.4)	1.8 (1.5, 2.2)	2.6 (2.2, 3.1)			
TOTAL	**1193**	**47709**						

Figure HT38 Cumulative Percent Revision of Mixed Ceramic/Mixed Ceramic Primary Total Conventional Hip Replacement by Head Size (Primary Diagnosis OA)



HR - adjusted for age and gender

≤28mm vs 32mm
0 - 2Wk: HR=2.18 (0.80, 5.94),p=0.126
2Wk - 1.5Yr: HR=1.79 (1.08, 2.98),p=0.024
1.5Yr+: HR=0.69 (0.36, 1.34),p=0.277

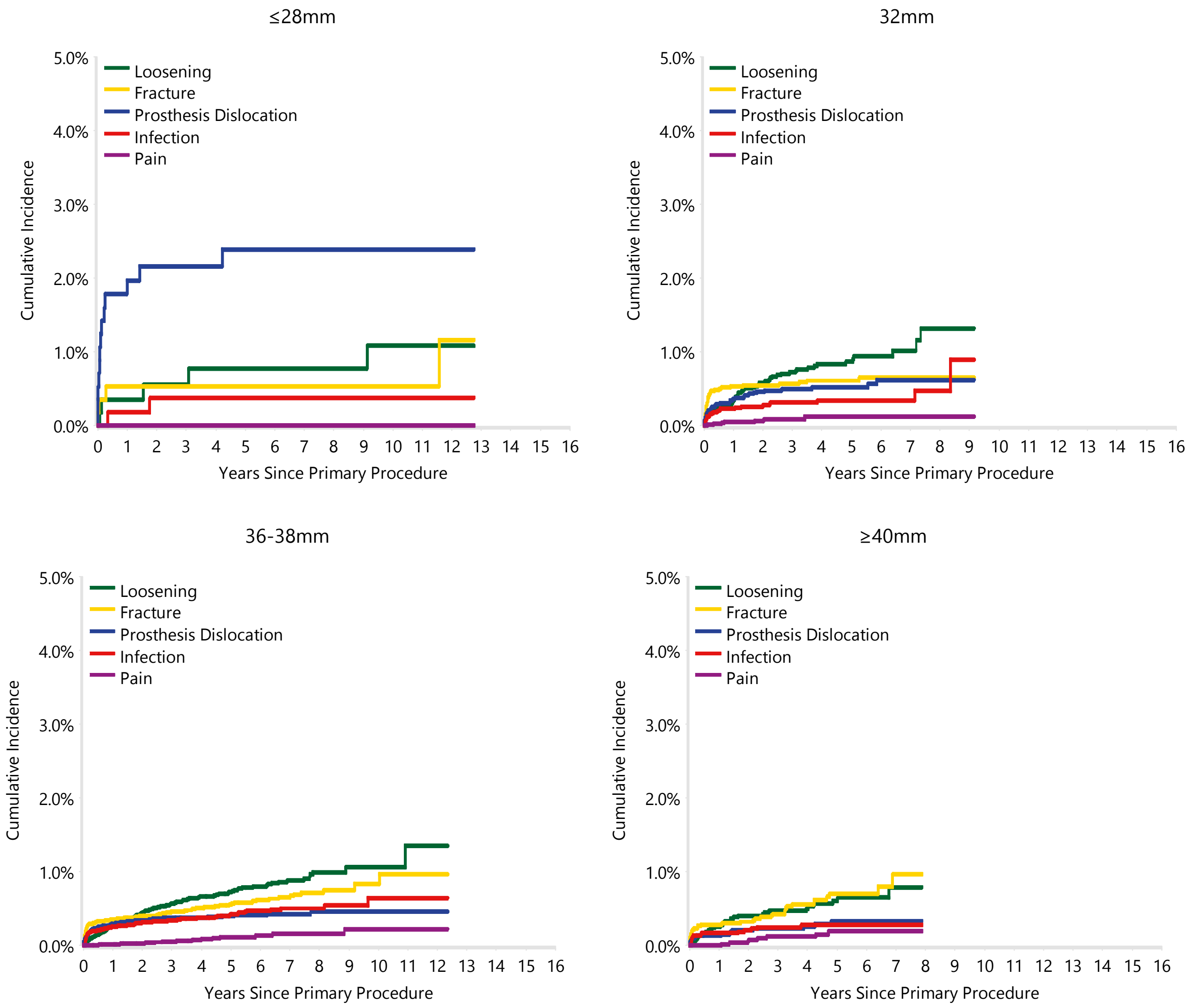
36-38mm vs 32mm
Entire Period: HR=0.81 (0.69, 0.95),p=0.008

≥40mm vs 32mm
Entire Period: HR=0.69 (0.55, 0.87),p=0.001

36-38mm vs ≥40mm
Entire Period: HR=1.17 (0.97, 1.41),p=0.100

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
≤28mm	564	518	434	371	218	0	0
32mm	8384	7136	4832	2625	2	0	0
36-38mm	32734	27885	18461	10330	631	0	0
≥40mm	6027	5482	4047	2144	0	0	0

Figure HT39 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 1,923 procedures used for primary total conventional hip replacement. Of these, 725 procedures using constrained acetabular inserts and 1,198 procedures using constrained cups. There were 64 procedures reported in 2016. This is an increase of 3.1% compared to 2015.

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 HT33).

When all diagnoses are included, there is no difference in the rate of revision for constrained prostheses compared to other acetabular prostheses (Table HT34 and Figure HT40). This is also true when only those procedures with a diagnosis of osteoarthritis are included (Table HT35 and Figure HT41). Gender is not a risk factor for revision (Table HT36 and Figure HT42).

However, there is a difference in outcome with respect to age. Constrained prosthesis have a higher rate of revision if they are used in patients aged less than 70 years (Table HT37 and Figure HT43). There is no difference in the rate of revision related to fixation (Table HT38 and Figure HT44).

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 3,948 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 HT39).

When all diagnoses are included, dual mobility prostheses have a higher rate of revision compared to other acetabular prostheses (Table HT40 and Figure HT45).

For the diagnosis of osteoarthritis, there is no difference in the rate of revision when dual mobility prostheses are used (Table HT41 and Figure HT46).

Table HT33 Primary Total Conventional Hip Replacement by Primary Diagnosis and Acetabular Type

	Constrained Prosthesis		Other Acetabular Prosthesis	
Diagnosis	N	Col%	N	Col%
Osteoarthritis	765	39.8	323862	88.8
Fractured Neck Of Femur	678	35.3	15187	4.2
Osteonecrosis	73	3.8	11978	3.3
Developmental Dysplasia	19	1.0	4537	1.2
Rheumatoid Arthritis	22	1.1	3711	1.0
Tumour	214	11.1	1863	0.5
Failed Internal Fixation	108	5.6	1515	0.4
Other Inflammatory Arthritis	5	0.3	1589	0.4
Fracture/Dislocation	28	1.5	413	0.1
Arthrodesis Takedown	8	0.4	109	0.0
Other	3	0.2	137	0.0
TOTAL	**1923**	**100.0**	**364901**	**100.0**

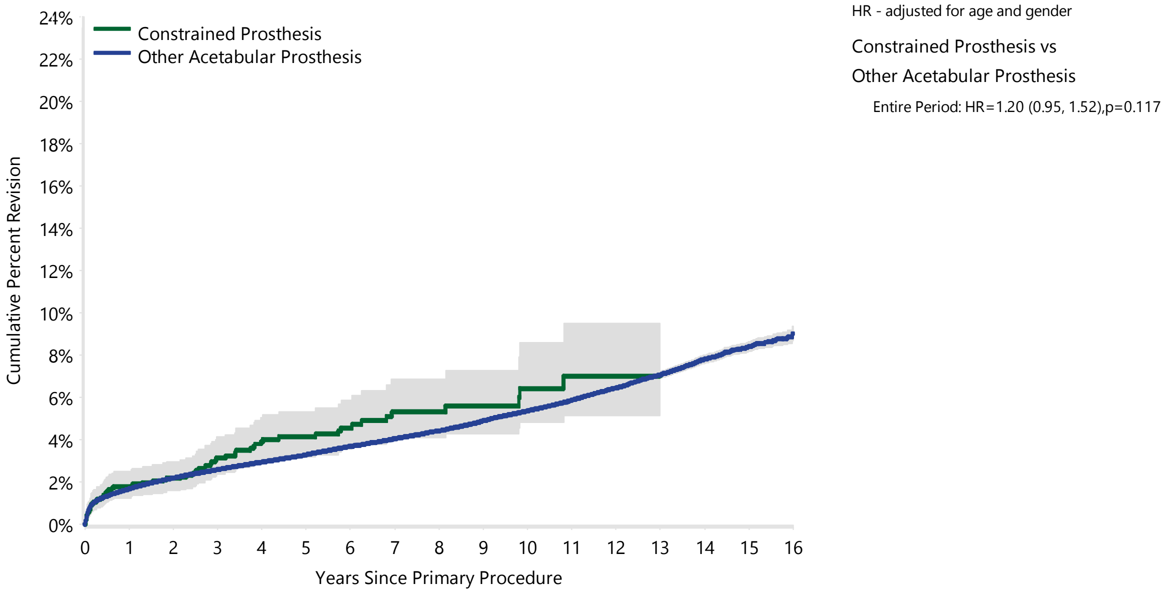
Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Table HT34 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	16 Yrs
Constrained Prosthesis	71	1923	1.8 (1.3, 2.5)	3.1 (2.4, 4.1)	4.1 (3.2, 5.3)	6.4 (4.8, 8.6)		
Other Acetabular Prosthesis	13693	364901	1.7 (1.6, 1.7)	2.6 (2.5, 2.7)	3.3 (3.2, 3.4)	5.4 (5.3, 5.5)	8.4 (8.2, 8.6)	9.0 (8.7, 9.4)
TOTAL	**13764**	**366824**						

Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Figure HT40 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	16 Yrs
Constrained Prosthesis	1923	1560	1140	736	209	14	4
Other Acetabular Prosthesis	364901	318535	242906	179211	67627	7405	1881

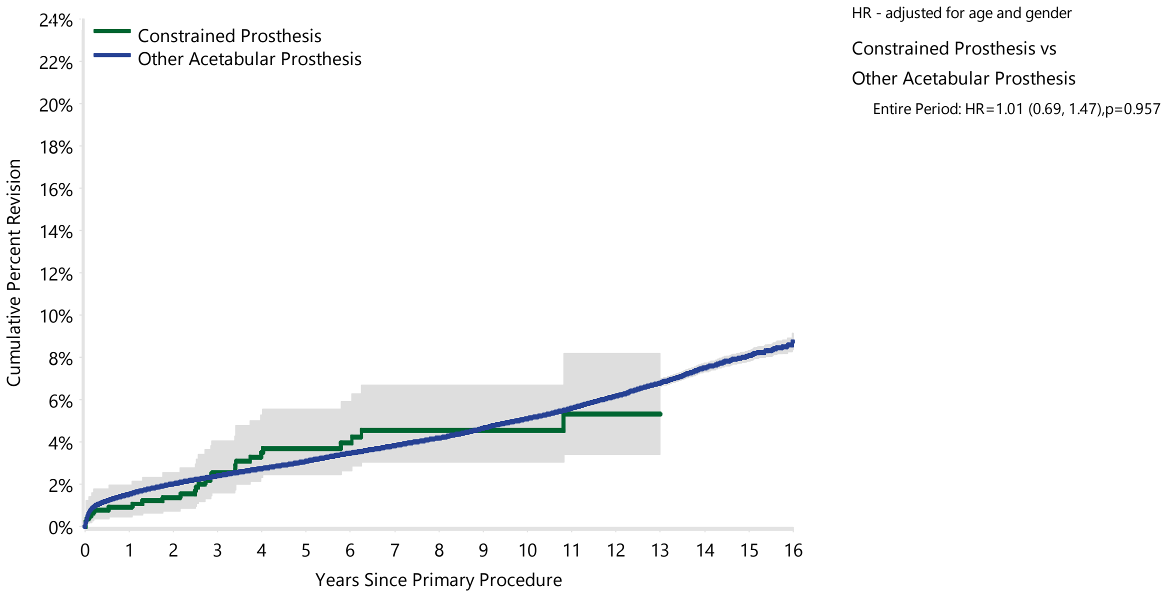
Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Table HT35 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	16 Yrs
Constrained Prosthesis	27	765	0.9 (0.4, 1.9)	2.5 (1.6, 4.1)	3.7 (2.5, 5.5)	4.5 (3.1, 6.7)		
Other Acetabular Prosthesis	11583	323862	1.5 (1.5, 1.6)	2.4 (2.4, 2.5)	3.1 (3.0, 3.2)	5.1 (5.0, 5.2)	8.1 (7.8, 8.3)	8.8 (8.4, 9.1)
TOTAL	**11610**	**324627**						

Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Figure HT41 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Acetabular Type (Primary Diagnosis OA)



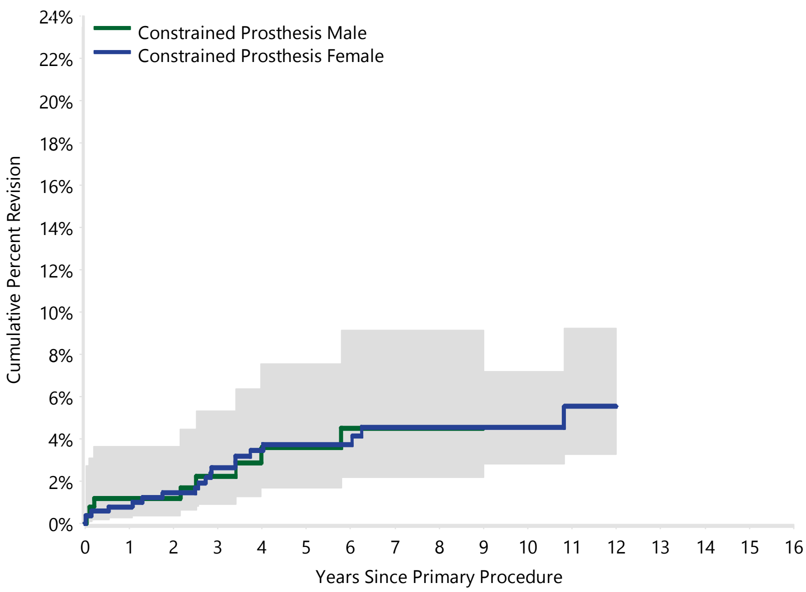
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Constrained Prosthesis	765	695	560	402	153	9	2
Other Acetabular Prosthesis	323862	284840	218441	161709	61150	6566	1647

Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Table HT36 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	16 Yrs
Constrained Prosthesis	Male	8	256	1.2 (0.4, 3.6)	2.2 (0.9, 5.3)	3.6 (1.7, 7.5)			
	Female	19	509	0.8 (0.3, 2.1)	2.7 (1.5, 4.6)	3.7 (2.3, 6.1)	4.5 (2.8, 7.2)		
TOTAL		**27**	**765**						

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



HR - adjusted for age

Constrained Prosthesis Female vs Constrained Prosthesis Male

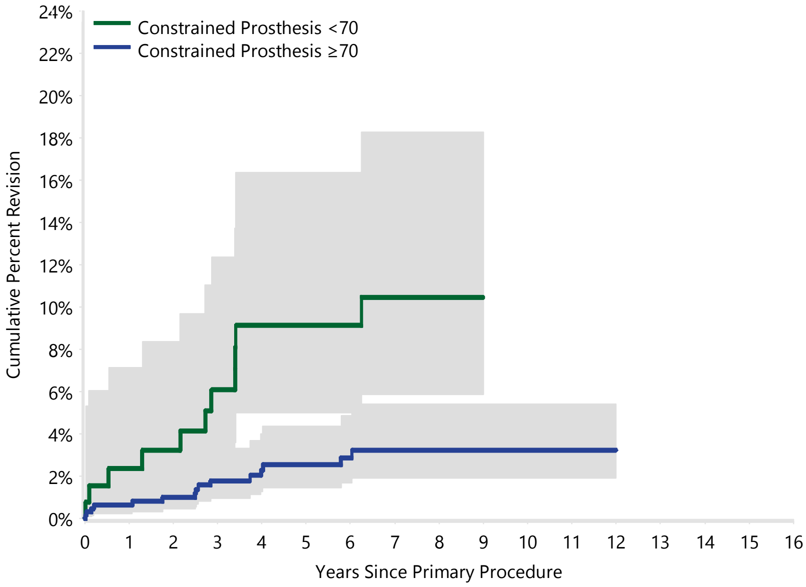
Entire Period: HR=1.11 (0.49, 2.55),p=0.800

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Constrained Prosthesis	Male	256	225	163	114	33	0	0
	Female	509	470	397	288	120	9	2

Table HT37 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	16 Yrs
Constrained Prosthesis	<70	12	130	2.4 (0.8, 7.1)	6.1 (2.9, 12.4)	9.1 (5.0, 16.4)			
	≥70	15	635	0.6 (0.2, 1.7)	1.8 (1.0, 3.3)	2.5 (1.5, 4.4)	3.2 (1.9, 5.4)		
TOTAL		**27**	**765**						

Figure HT43 Cumulative Percent Revision of Constrained Primary Total Conventional Hip Replacement by Age (Primary Diagnosis OA)



HR - adjusted for gender

Constrained Prosthesis <70 vs Constrained Prosthesis ≥70

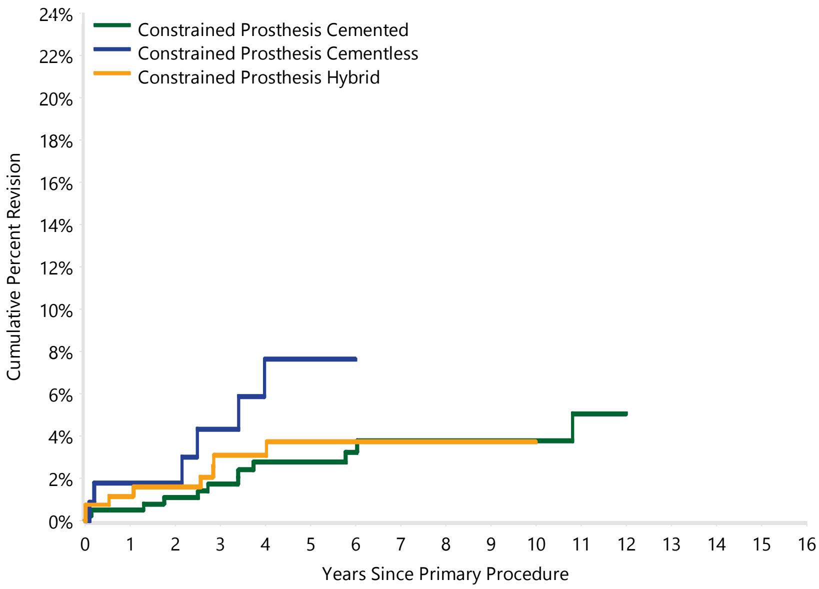
Entire Period: HR=3.71 (1.73, 7.95),p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Constrained Prosthesis	<70	130	117	95	73	38	5	0
	≥70	635	578	465	329	115	4	2

Table HT38 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	16 Yrs
Constrained Prosthesis	Cemented	12	388	0.5 (0.1, 2.1)	1.7 (0.8, 3.8)	2.8 (1.4, 5.3)	3.8 (2.1, 6.8)		
	Cementless	7	112	1.8 (0.5, 7.0)	4.3 (1.6, 11.3)	7.6 (3.4, 16.6)			
	Hybrid	8	265	1.2 (0.4, 3.6)	3.1 (1.5, 6.4)	3.7 (1.9, 7.4)	3.7 (1.9, 7.4)		
TOTAL		**27**	**765**						

Figure HT44 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=1.67 (0.59, 4.70),p=0.329

Constrained Prosthesis Hybrid vs Constrained Prosthesis Cemented
Entire Period: HR=0.96 (0.39, 2.37),p=0.921

Constrained Prosthesis Cementless vs Constrained Prosthesis Hybrid
Entire Period: HR=1.75 (0.61, 5.04),p=0.300

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Constrained Prosthesis	Cemented	388	363	306	229	97	4	0
	Cementless	112	95	69	45	14	1	0
	Hybrid	265	237	185	128	42	4	2

Table HT39 Primary Diagnosis of Primary Total Conventional Hip Replacement by Acetabular Mobility

Diagnosis	Dual Mobility Prosthesis N	Dual Mobility Prosthesis Col%	Other Acetabular Prosthesis N	Other Acetabular Prosthesis Col%
Osteoarthritis	2467	62.5	322160	88.8
Fractured Neck Of Femur	954	24.2	14911	4.1
Osteonecrosis	153	3.9	11898	3.3
Developmental Dysplasia	62	1.6	4494	1.2
Rheumatoid Arthritis	24	0.6	3709	1.0
Tumour	137	3.5	1940	0.5
Failed Internal Fixation	94	2.4	1529	0.4
Other Inflammatory Arthritis	15	0.4	1579	0.4
Fracture/Dislocation	31	0.8	410	0.1
Arthrodesis Takedown	7	0.2	110	0.0
Other	4	0.1	136	0.0
TOTAL	**3948**	**100.0**	**362876**	**100.0**

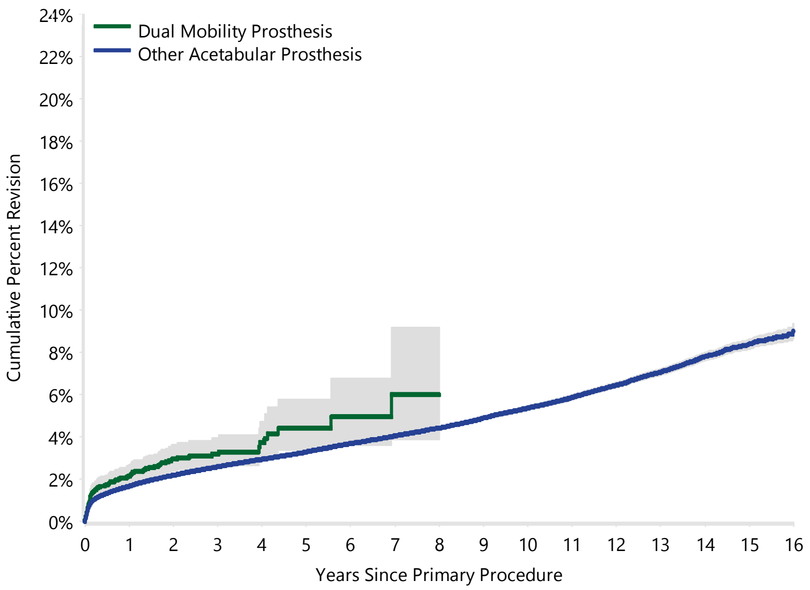
Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Table HT40 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	16 Yrs
Dual Mobility Prosthesis	104	3948	2.2 (1.7, 2.7)	3.2 (2.6, 3.9)	4.4 (3.4, 5.8)			
Other Acetabular Prosthesis	13660	362876	1.7 (1.6, 1.7)	2.6 (2.5, 2.6)	3.3 (3.2, 3.4)	5.4 (5.3, 5.5)	8.4 (8.2, 8.6)	9.0 (8.7, 9.4)
TOTAL	**13764**	**366824**						

Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Figure HT45 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Acetabular Mobility (All Diagnoses)



HR - adjusted for age and gender

Dual Mobility Prosthesis vs
Other Acetabular Prosthesis
Entire Period: HR=1.33 (1.09, 1.61),p=0.004

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Dual Mobility Prosthesis	3948	2450	882	256	5	0	0
Other Acetabular Prosthesis	362876	317645	243164	179691	67831	7419	1885

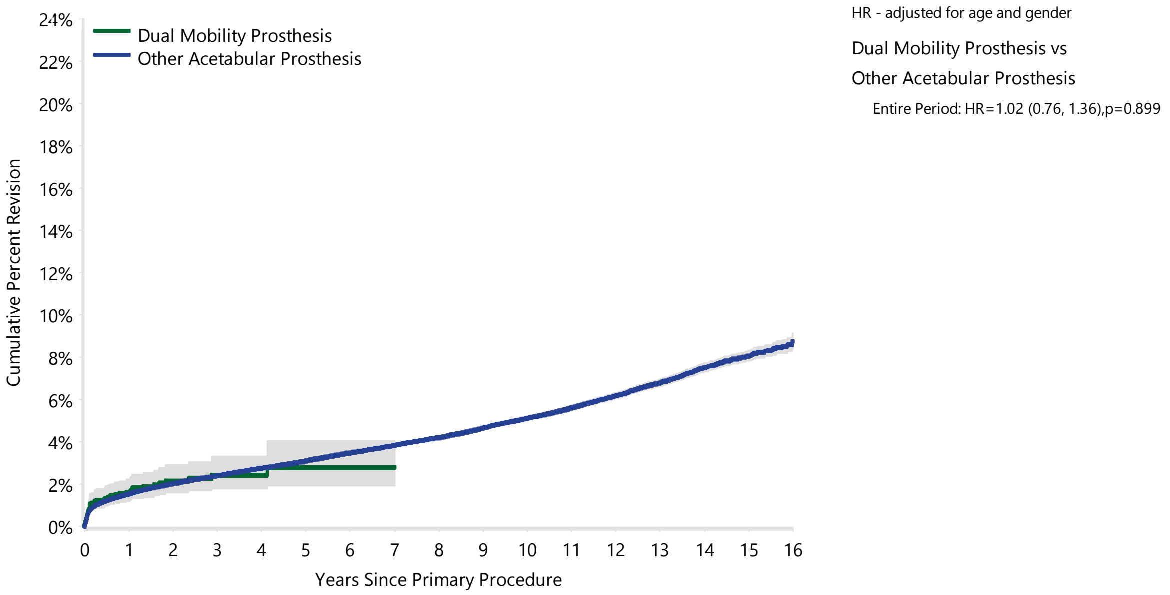
Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Table HT41 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	16 Yrs
Dual Mobility Prosthesis	47	2467	1.6 (1.2, 2.2)	2.4 (1.8, 3.3)	2.8 (1.9, 4.1)			
Other Acetabular Prosthesis	11563	322160	1.5 (1.5, 1.6)	2.4 (2.4, 2.5)	3.1 (3.0, 3.2)	5.1 (5.0, 5.2)	8.1 (7.8, 8.3)	8.8 (8.4, 9.1)
TOTAL	**11610**	**324627**						

Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Figure HT46 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	16 Yrs
Dual Mobility Prosthesis	2467	1573	556	151	4	0	0
Other Acetabular Prosthesis	322160	283962	218445	161960	61299	6575	1649

Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

OUTCOME FOR FRACTURED NECK OF FEMUR

This year, the Registry has undertaken a separate analysis of the outcome of primary total conventional hip replacement for fractured neck of femur.

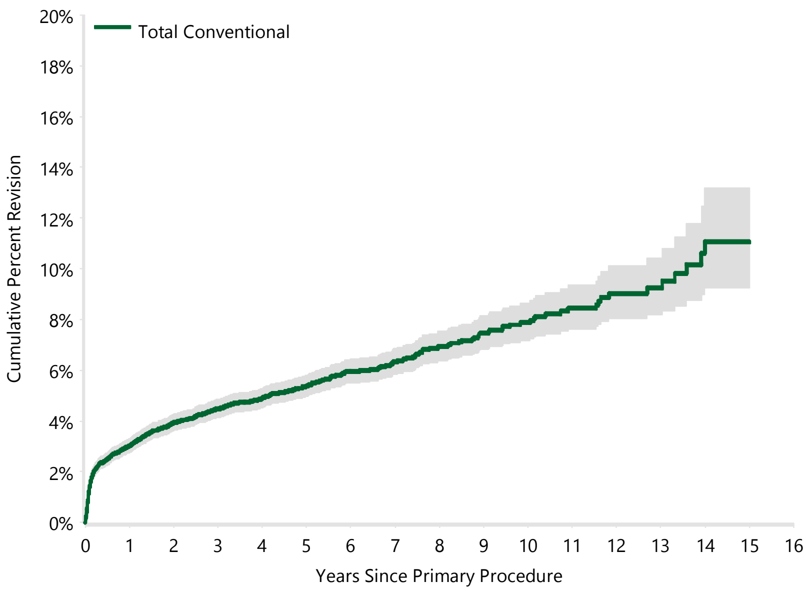
There have been 15,865 total conventional hip replacement procedures recorded by the Registry for a diagnosis of fractured neck of femur. The cumulative percent revision of primary total conventional hip replacement at 10 years for fractured neck of femur is 7.9% (Table HT42 and Figure HT47).

Table HT42 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	763	15865	3.0 (2.8, 3.3)	3.9 (3.6, 4.3)	4.5 (4.1, 4.8)	5.4 (5.0, 5.8)	6.3 (5.9, 6.9)	7.9 (7.2, 8.6)
TOTAL	**763**	**15865**						

Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Figure HT47 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	15865	12450	10172	8199	5149	2952	1120

Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Reasons for Revision

Prosthesis dislocation (32.9%) is the most common reason for revision, followed by fracture (27.1%), loosening (16.6%), and infection (16.0%) (Table HT43 and Figure HT48).

Type of Revision

Replacement of the femoral component only is the most common type of revision (35.6%), followed by head and insert (21.0%), acetabular only (20.4%), and total hip replacement (femoral/acetabular) (8.4%) (Table HT44).

Table HT43 Primary Total Conventional Hip Replacement by Reason for Revision (Primary Diagnosis Fractured NOF)

Reason for Revision	Number	Percent
Prosthesis Dislocation	251	32.9
Fracture	207	27.1
Loosening	127	16.6
Infection	122	16.0
Pain	9	1.2
Malposition	7	0.9
Implant Breakage Stem	7	0.9
Lysis	6	0.8
Implant Breakage Acetabular	5	0.7
Leg Length Discrepancy	5	0.7
Metal Related Pathology	3	0.4
Incorrect Sizing	3	0.4
Instability	3	0.4
Implant Breakage Acetabular Insert	3	0.4
Heterotopic Bone	2	0.3
Wear Acetabular Insert	1	0.1
Other	2	0.3
TOTAL	**763**	**100.0**

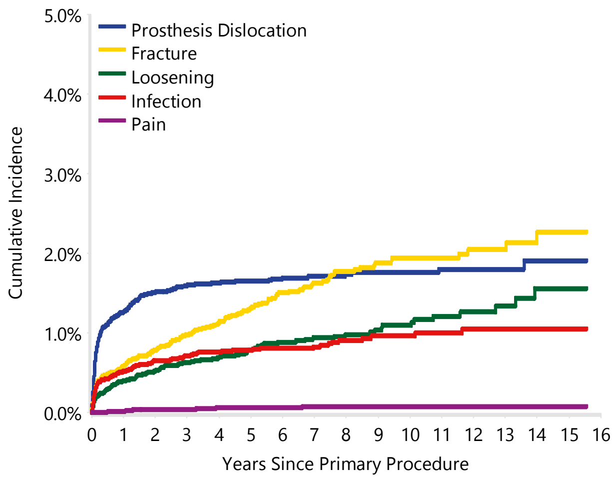
Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Table HT44 Primary Total Conventional Hip Replacement Hip Replacement by Type of Revision (Primary Diagnosis Fractured NOF)

Type of Revision	Number	Percent
Femoral Component	272	35.6
Head/Insert	160	21.0
Acetabular Component	156	20.4
THR (Femoral/Acetabular)	64	8.4
Head Only	38	5.0
Cement Spacer	34	4.5
Minor Components	17	2.2
Insert Only	10	1.3
Removal of Prostheses	3	0.4
Head/Neck/Insert	3	0.4
Reinsertion of Components	2	0.3
Head/Neck	2	0.3
Total Femoral	1	0.1
Neck Only	1	0.1
TOTAL	**763**	**100.0**

Note: Femoral heads are usually replaced when the acetabular component and/or femoral stem is revised
All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Figure HT48 Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement (Primary Diagnosis Fractured NOF)



Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Fixation

The analysis for fractured neck of femur and fixation has been performed on modern bearing surfaces and restricted to ceramic/ceramic and all femoral head materials used in combination with XLPE.

The Registry has recorded 764 procedures with cemented fixation, 4,670 with cementless fixation and 7,436 with hybrid fixation. Cemented fixation has a lower rate of revision for all time periods compared to cementless fixation and compared to hybrid fixation after 3 months. Cementless fixation has a higher rate of revision than hybrid fixation for the first three months only, and then there is no difference after this time (Table HT45 and Figure HT49).

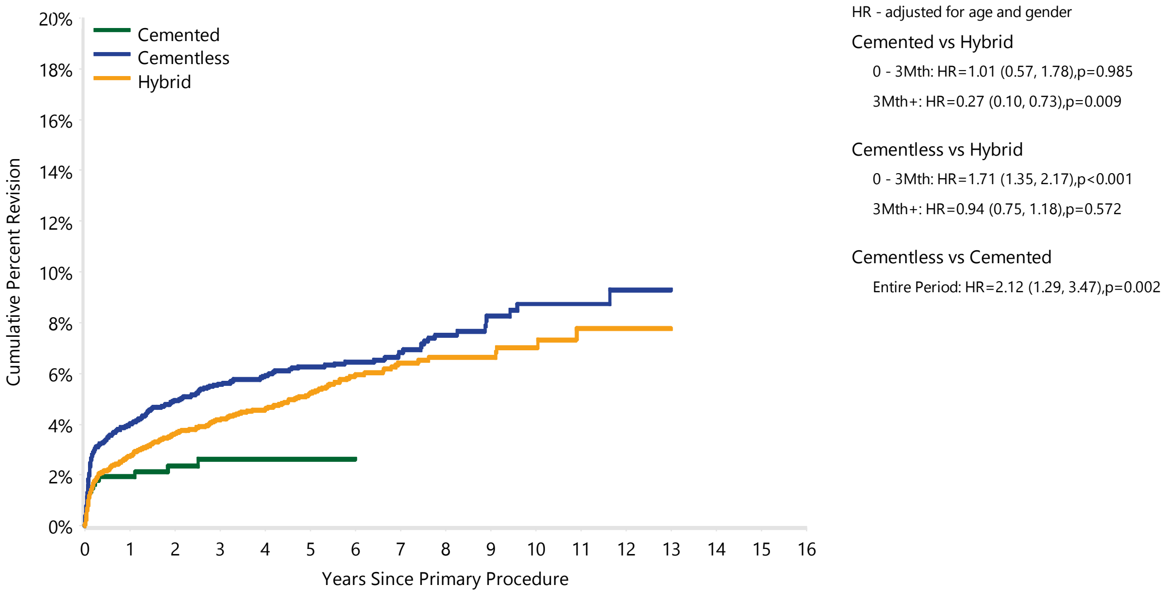
There are differences in outcome with respect to fixation and age. For patients aged less than 70 years, there is no difference in the rate for revision between the three different fixation methods (Table HT46 and Figure HT50). For patients aged 70 years or older, cementless fixation has a higher rate of revision than cemented fixation for all time periods, and for the first three months compared to hybrid fixation. Hybrid fixation has a higher rate of revision compared to cemented fixation after one month (Table HT46 and Figure HT51).

Table HT45 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	17	764	1.9 (1.1, 3.2)	2.3 (1.4, 3.8)	2.6 (1.6, 4.3)	2.6 (1.6, 4.3)		
Cementless	269	4670	4.0 (3.5, 4.6)	4.9 (4.3, 5.6)	5.6 (4.9, 6.3)	6.3 (5.5, 7.1)	6.8 (6.0, 7.8)	8.7 (7.4, 10.3)
Hybrid	314	7436	2.7 (2.4, 3.1)	3.6 (3.2, 4.1)	4.2 (3.7, 4.7)	5.2 (4.6, 5.9)	6.4 (5.6, 7.3)	7.0 (6.1, 8.1)
TOTAL	**600**	**12870**						

Note: Includes procedures using ceramic/ceramic and XLPE prostheses

Figure HT49 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	764	548	411	280	97	28	3
Cementless	4670	3778	3139	2600	1701	930	321
Hybrid	7436	5659	4474	3455	1994	1071	316

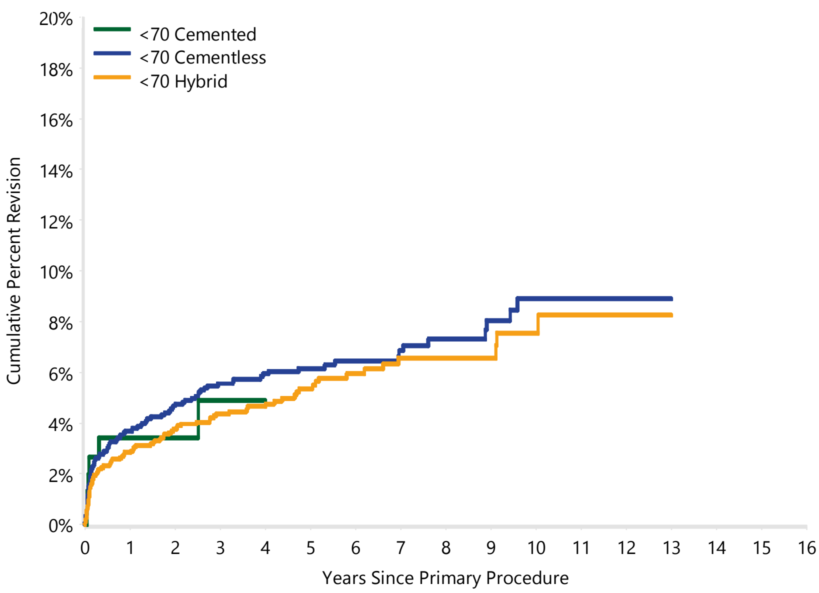
Note: Includes procedures using ceramic/ceramic and XLPE prostheses

Table HT46 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	6	159	3.4 (1.4, 8.0)	3.4 (1.4, 8.0)	4.9 (2.1, 11.1)			
	Cementless	108	1862	3.7 (2.9, 4.7)	4.7 (3.8, 5.8)	5.6 (4.5, 6.8)	6.2 (5.1, 7.5)	6.8 (5.6, 8.4)	8.9 (7.0, 11.3)
	Hybrid	105	2291	2.8 (2.2, 3.6)	3.8 (3.0, 4.7)	4.4 (3.5, 5.4)	5.4 (4.3, 6.6)	6.6 (5.3, 8.2)	7.5 (5.8, 9.8)
≥70	Cemented	11	605	1.6 (0.8, 3.0)	2.1 (1.1, 3.7)	2.1 (1.1, 3.7)	2.1 (1.1, 3.7)		
	Cementless	161	2808	4.2 (3.5, 5.1)	5.1 (4.3, 6.0)	5.6 (4.7, 6.5)	6.3 (5.4, 7.4)	6.8 (5.7, 8.0)	8.4 (6.8, 10.3)
	Hybrid	209	5145	2.7 (2.3, 3.2)	3.6 (3.1, 4.2)	4.1 (3.5, 4.7)	5.2 (4.4, 6.0)	6.4 (5.4, 7.5)	6.7 (5.7, 7.9)
TOTAL		**600**	**12870**						

Note: Includes procedures using ceramic/ceramic and XLPE prostheses

Figure HT50 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=1.04 (0.46, 2.37),p=0.923

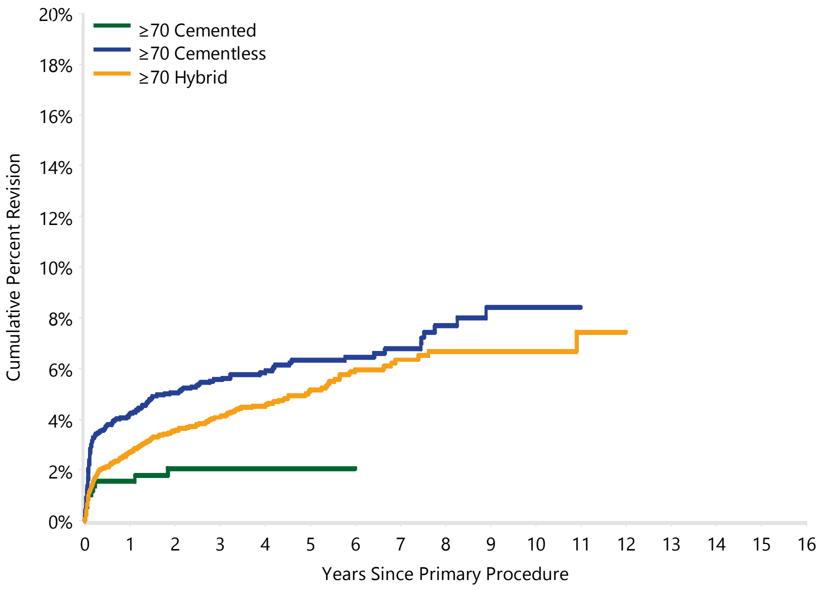
<70 Cementless vs <70 Hybrid
Entire Period: HR=1.14 (0.87, 1.49),p=0.348

<70 Cementless vs <70 Cemented
Entire Period: HR=1.09 (0.48, 2.49),p=0.833

Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<70	Cemented	159	104	79	57	20	8	1
	Cementless	1862	1542	1306	1085	749	447	188
	Hybrid	2291	1777	1416	1125	699	394	135

Note: Includes procedures using ceramic/ceramic and XLPE prostheses

Figure HT51 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=2.67 (1.45, 4.92),p=0.001

≥70 Hybrid vs ≥70 Cemented
0 - 1Mth: HR=1.23 (0.62, 2.44),p=0.552
1Mth+: HR=2.50 (1.34, 4.67),p=0.004

≥70 Cementless vs ≥70 Hybrid
0 - 3Mth: HR=1.92 (1.44, 2.56),p<0.001
3Mth+: HR=0.88 (0.66, 1.19),p=0.420

Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
≥70 years	Cemented	605	444	332	223	77	20	2
	Cementless	2808	2236	1833	1515	952	483	133
	Hybrid	5145	3882	3058	2330	1295	677	181

Note: Includes procedures using ceramic/ceramic and XLPE prostheses

Head Size

Head size 32mm has a lower rate of revision after three months compared to head sizes less than 32mm. There is no difference when 36mm or larger head sizes are compared to head sizes both less than 32mm or 32mm (Table HT47 and Figure HT52).

Constrained Acetabular Prostheses

When used for fractured neck of femur, constrained prostheses have a lower rate of revision compared to other acetabular prostheses (Table HT48 and Figure HT53).

Dual Mobility

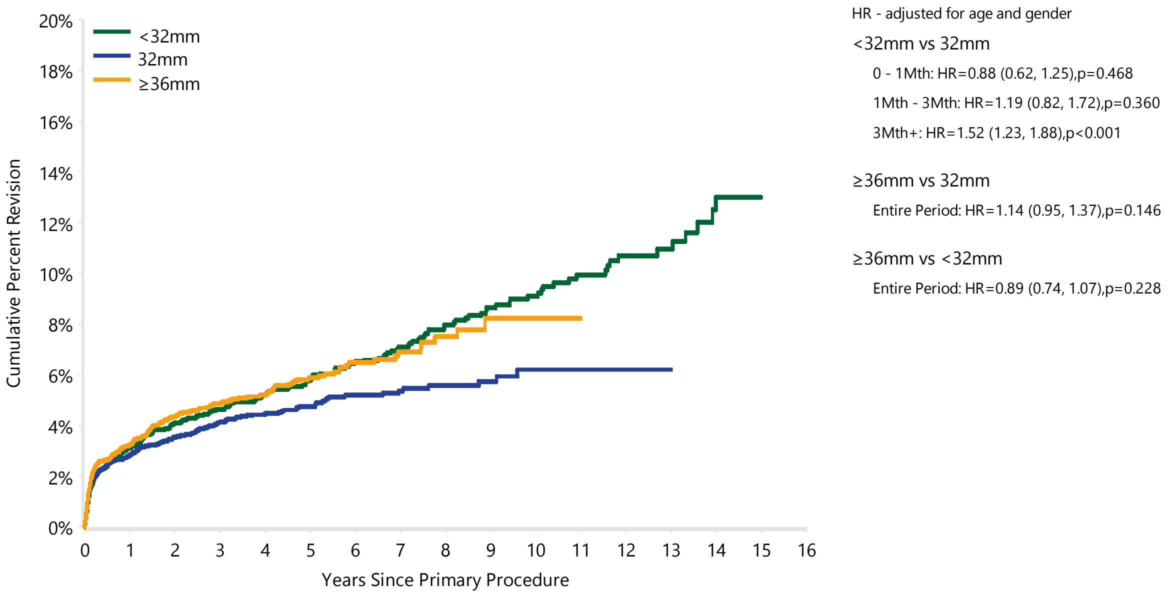
There is no difference in the rate of revision when dual mobility prostheses are used (Table HT49 and Figure HT54).

Table HT47 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	255	4290	3.1 (2.6, 3.7)	4.1 (3.5, 4.8)	4.6 (4.0, 5.4)	5.8 (5.0, 6.7)	7.1 (6.2, 8.1)	9.1 (7.9, 10.5)
32mm	274	6736	2.8 (2.4, 3.3)	3.5 (3.1, 4.0)	4.1 (3.6, 4.7)	4.7 (4.2, 5.4)	5.4 (4.7, 6.1)	6.2 (5.2, 7.3)
≥36mm	234	4813	3.2 (2.7, 3.8)	4.3 (3.8, 5.0)	4.8 (4.2, 5.6)	5.9 (5.1, 6.7)	6.9 (5.9, 8.0)	8.2 (6.8, 9.9)
TOTAL	**763**	**15839**						

Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded
Excludes 26 procedures with unknown head size

Figure HT52 Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Head Size (Primary Diagnosis Fractured NOF)



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<32mm	4290	3406	2841	2415	1734	1260	713
32mm	6736	5347	4334	3415	2050	1075	302
≥36mm	4813	3677	2980	2357	1357	612	105

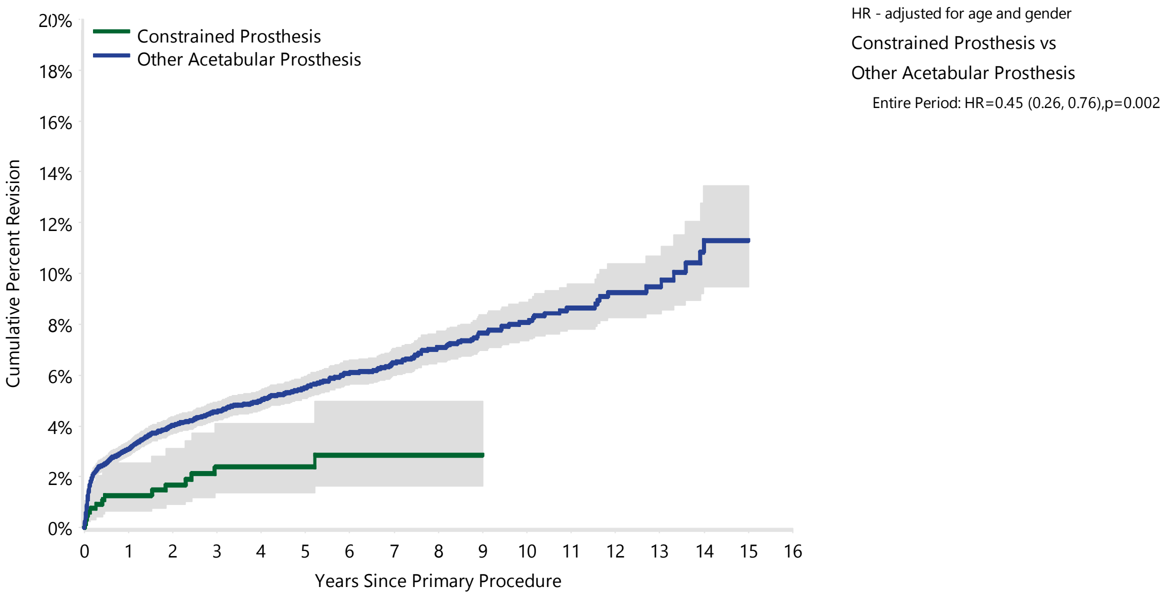
Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Table HT48 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	14	678	1.3 (0.6, 2.5)	1.7 (0.9, 3.1)	2.4 (1.4, 4.1)	2.4 (1.4, 4.1)	2.9 (1.6, 5.0)	
Other Acetabular Prosthesis	749	15187	3.1 (2.8, 3.4)	4.0 (3.7, 4.4)	4.6 (4.2, 4.9)	5.5 (5.1, 6.0)	6.5 (6.0, 7.0)	8.1 (7.3, 8.9)
TOTAL	**763**	**15865**						

Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Figure HT53 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	678	540	471	373	224	111	34
Other Acetabular Prosthesis	15187	11910	9701	7826	4925	2841	1086

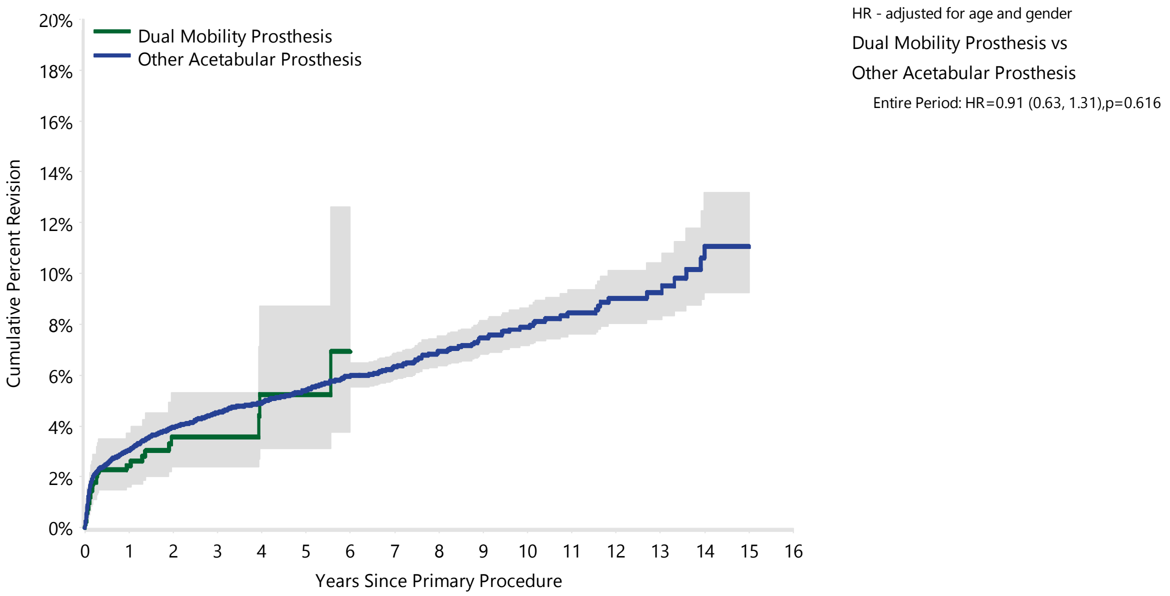
Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Table HT49 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	30	954	2.4 (1.6, 3.7)	3.6 (2.4, 5.3)	3.6 (2.4, 5.3)	5.2 (3.1, 8.7)		
Other Acetabular Prosthesis	733	14911	3.1 (2.8, 3.3)	4.0 (3.6, 4.3)	4.5 (4.2, 4.9)	5.4 (5.0, 5.9)	6.3 (5.8, 6.9)	7.9 (7.2, 8.6)
TOTAL	**763**	**15865**						

Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Figure HT54 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	954	565	353	209	67	32	1
Other Acetabular Prosthesis	14911	11885	9819	7990	5082	2920	1119

Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

OUTCOME OF TOTAL CONVENTIONAL COMPARED TO PARTIAL HIP REPLACEMENT

The rate of revision of total conventional hip replacement was compared to unipolar monoblock, unipolar modular and bipolar hip replacement for fractured neck of femur.

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 it has a higher rate of revision. Bipolar hip replacement has a lower rate of revision for the first two weeks compared to total conventional hip replacement, but after this time there is no difference (Table HT50 and Figure HT55).

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 those aged less than 70 years may represent its use in patients with significant co-morbidities. Unipolar modular has a lower rate of revision than total conventional hip replacement for the first three moths, but after this time it is higher. There is no difference between bipolar and total conventional hip replacement in this age group (Table HT51 and Figure HT56).

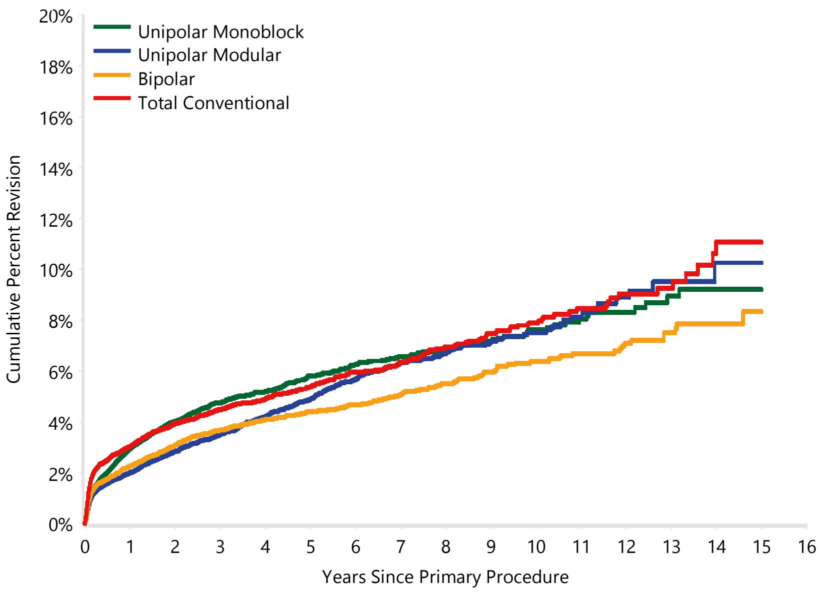
For patients aged 70 years or older, there are time dependent variations in the comparative rates of revision. Unipolar monoblock has a higher rate of revision compared to total conventional hip replacement between three months and one year. Unipolar modular has a lower rate of revision for the first 1.5 years. After 1.5 years there is no difference. Bipolar hip replacement has a lower rate of revision than total conventional hip replacement for the entire period (Table HT51 and Figure HT57).

Table HT50 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	1034	27453	2.9 (2.7, 3.2)	4.0 (3.7, 4.3)	4.8 (4.4, 5.1)	5.8 (5.4, 6.2)	6.5 (6.1, 7.0)	7.6 (7.0, 8.3)
Unipolar Modular	1149	34286	2.0 (1.8, 2.2)	2.8 (2.6, 3.0)	3.5 (3.3, 3.7)	4.9 (4.6, 5.2)	6.3 (5.9, 6.8)	7.5 (6.9, 8.2)
Bipolar	606	17486	2.3 (2.0, 2.5)	3.1 (2.8, 3.4)	3.7 (3.4, 4.0)	4.4 (4.0, 4.8)	5.0 (4.6, 5.5)	6.4 (5.7, 7.0)
Total Conventional	763	15865	3.0 (2.8, 3.3)	3.9 (3.6, 4.3)	4.5 (4.1, 4.8)	5.4 (5.0, 5.8)	6.3 (5.9, 6.9)	7.9 (7.2, 8.6)
TOTAL	**3552**	**95090**						

Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Figure HT55 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=0.99 (0.85, 1.15),p=0.887
3Mth+: HR=1.75 (1.55, 1.98),p<0.001

Unipolar Modular vs Total Conventional
0 - 3Mth: HR=0.77 (0.66, 0.89),p<0.001
3Mth - 1.5Yr: HR=0.94 (0.80, 1.10),p=0.447
1.5Yr+: HR=1.69 (1.46, 1.95),p<0.001

Bipolar vs Total Conventional
0 - 2Wk: HR=0.61 (0.42, 0.88),p=0.007
2Wk - 1Mth: HR=0.93 (0.73, 1.19),p=0.573
1Mth - 1.5Yr: HR=0.92 (0.79, 1.07),p=0.264
1.5Yr+: HR=1.16 (0.98, 1.38),p=0.089

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Monoblock	27453	16627	12742	9621	5235	2828	1045
Unipolar Modular	34286	23221	17936	13572	7314	3598	1015
Bipolar	17486	12050	9300	7415	4866	3191	1598
Total Conventional	15865	12450	10172	8199	5149	2952	1120

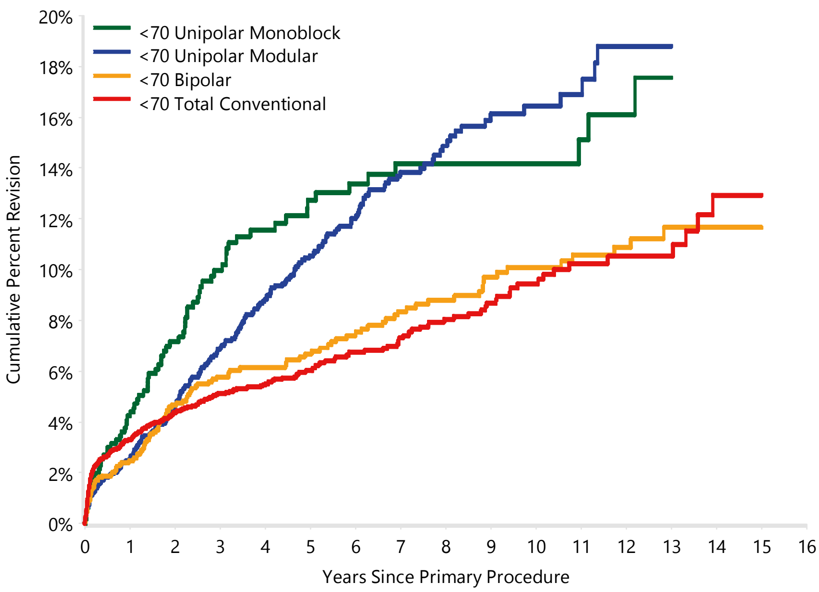
Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Table HT51 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		**734**	**10575**	**3.0 (2.7, 3.4)**	**4.7 (4.3, 5.1)**	**6.1 (5.6, 6.6)**	**7.8 (7.2, 8.5)**	**9.7 (9.0, 10.5)**	**11.7 (10.8, 12.7)**
	Unipolar Monoblock	81	886	4.2 (3.0, 6.0)	7.1 (5.4, 9.4)	10.0 (7.8, 12.7)	12.7 (10.2, 15.9)	14.2 (11.3, 17.6)	14.2 (11.3, 17.6)
	Unipolar Modular	243	2845	2.5 (2.0, 3.2)	4.6 (3.8, 5.5)	6.9 (5.9, 8.1)	10.6 (9.2, 12.1)	13.8 (12.1, 15.8)	16.4 (14.3, 18.9)
	Bipolar	123	1909	2.5 (1.8, 3.3)	4.7 (3.7, 5.8)	5.8 (4.7, 7.1)	6.7 (5.5, 8.2)	8.4 (6.9, 10.1)	10.1 (8.4, 12.2)
	Total Conventional	287	4935	3.3 (2.8, 3.8)	4.4 (3.8, 5.0)	5.1 (4.5, 5.8)	6.0 (5.3, 6.8)	7.3 (6.4, 8.3)	9.4 (8.2, 10.9)
≥70		**2818**	**84515**	**2.4 (2.3, 2.5)**	**3.2 (3.1, 3.3)**	**3.7 (3.6, 3.9)**	**4.6 (4.5, 4.8)**	**5.4 (5.2, 5.7)**	**6.5 (6.1, 6.8)**
	Unipolar Monoblock	953	26567	2.9 (2.7, 3.1)	3.9 (3.6, 4.2)	4.5 (4.2, 4.9)	5.5 (5.1, 5.9)	6.2 (5.7, 6.7)	7.4 (6.7, 8.1)
	Unipolar Modular	906	31441	1.9 (1.8, 2.1)	2.6 (2.5, 2.9)	3.1 (2.9, 3.3)	4.2 (3.9, 4.5)	5.2 (4.8, 5.7)	6.1 (5.5, 6.7)
	Bipolar	483	15577	2.2 (2.0, 2.5)	2.8 (2.6, 3.2)	3.4 (3.0, 3.7)	4.0 (3.7, 4.5)	4.4 (4.0, 4.9)	5.6 (5.0, 6.3)
	Total Conventional	476	10930	2.9 (2.6, 3.2)	3.7 (3.4, 4.1)	4.2 (3.8, 4.6)	5.1 (4.6, 5.6)	5.8 (5.3, 6.5)	6.9 (6.1, 7.8)
TOTAL		**3552**	**95090**						

Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Figure HT56 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=0.93 (0.55, 1.56),p=0.781
3Mth+: HR=2.19 (1.65, 2.89),p<0.001

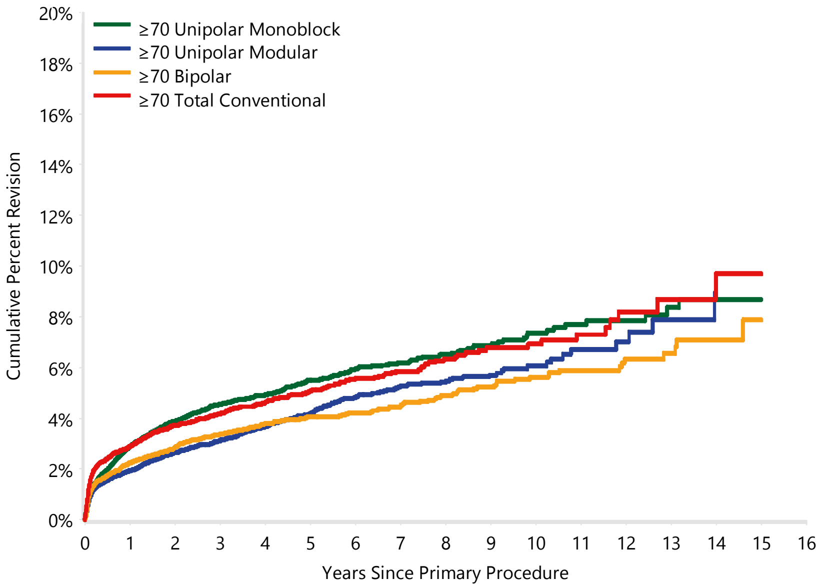
<70 Unipolar Modular vs <70 Total Conventional
0 - 3Mth: HR=0.64 (0.45, 0.93),p=0.018
3Mth - 3Yr: HR=1.65 (1.29, 2.10),p<0.001
3Yr+: HR=2.91 (2.19, 3.86),p<0.001

<70 Bipolar vs <70 Total Conventional
Entire Period: HR=1.05 (0.85, 1.29),p=0.681

	Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
<70	Unipolar Monoblock	886	597	494	410	282	202	108
	Unipolar Modular	2845	2158	1767	1447	990	604	234
	Bipolar	1909	1453	1188	1039	814	638	407
	Total Conventional	4935	3934	3266	2696	1814	1120	506

Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Figure HT57 Cumulative Percent Revision of Primary Hip Replacement in Patients Aged ≥70 Years by Class (Primary Diagnosis Fractured NOF)



HR - adjusted for gender

≥70 Unipolar Monoblock vs
≥70 Total Conventional

0 - 2Wk: HR=1.13 (0.85, 1.50),p=0.392
2Wk - 3Mth: HR=0.68 (0.57, 0.81),p<0.001
3Mth - 6Mth: HR=1.38 (1.05, 1.83),p=0.022
6Mth - 1Yr: HR=1.72 (1.36, 2.18),p<0.001
1Yr+: HR=1.12 (0.96, 1.31),p=0.163

≥70 Unipolar Modular vs ≥70 Total Conventional

0 - 3Mth: HR=0.64 (0.55, 0.75),p<0.001
3Mth - 1.5Yr: HR=0.76 (0.63, 0.91),p=0.002
1.5Yr+: HR=1.03 (0.87, 1.22),p=0.749

≥70 Bipolar vs ≥70 Total Conventional

Entire Period: HR=0.77 (0.68, 0.88),p<0.001

	Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
≥70	Unipolar Monoblock	26567	16030	12248	9211	4953	2626	937
	Unipolar Modular	31441	21063	16169	12125	6324	2994	781
	Bipolar	15577	10597	8112	6376	4052	2553	1191
	Total Conventional	10930	8516	6906	5503	3335	1832	614

Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Competing Risk

The Registry typically presents the outcomes of joint replacement in terms of Kaplan-Meier estimates of the survival of the primary procedure. Using the Kaplan-Meier method, observations are censored at the close of the database or at the time of death if a revision has not occurred. These patients are then assumed to have the same chance of revision in the future as those whose follow up is not censored. However, if a patient dies they cannot be revised. Death is therefore a competing risk to revision. In the presence of a competing risk, such as death, Kaplan-Meier is known to overestimate the probability of revision. This is especially so if the incidence of the competing risk is high.

As there is a higher incidence of mortality with patients undergoing joint replacement for fractured neck of femur, the Registry has for the first time, estimated the probability of revision in the presence of competing risks using cumulative incidence. This analysis can be compared to the traditional Kaplan-Meier method.

In order to further investigate the impact of the competing risk of death, the cumulative incidence graphs of mortality and revision are provided for patients under 70 years and 70 years or older.

For patients aged less than 70 years of age the cumulative incidence of mortality at 10 years for unipolar monoblock is 70.0%, for unipolar modular 52.2%, for bipolar 47.7% and for total conventional hip 26.0% (Table HT52 and Figure HT58). The cumulative incidence of revision for unipolar monoblock at 10 years is 9.0%, for unipolar modular 11.2%, bipolar 7.6%, and total conventional 8.4% (Table HT53 and Figure HT59).

For patients aged 70 years or older the cumulative incidence of mortality at 10 years for unipolar monoblock is 90.2%, for unipolar modular 81.6%, for bipolar 78.4% and for total conventional hip 64.8% (Table HT54 and Figure HT60). The cumulative incidence of revision for unipolar monblock at 10 years is 3.7%, for unipolar modular 3.5%, bipolar 3.6% and total conventional 5.4% (Table HT55 and Figure HT61).

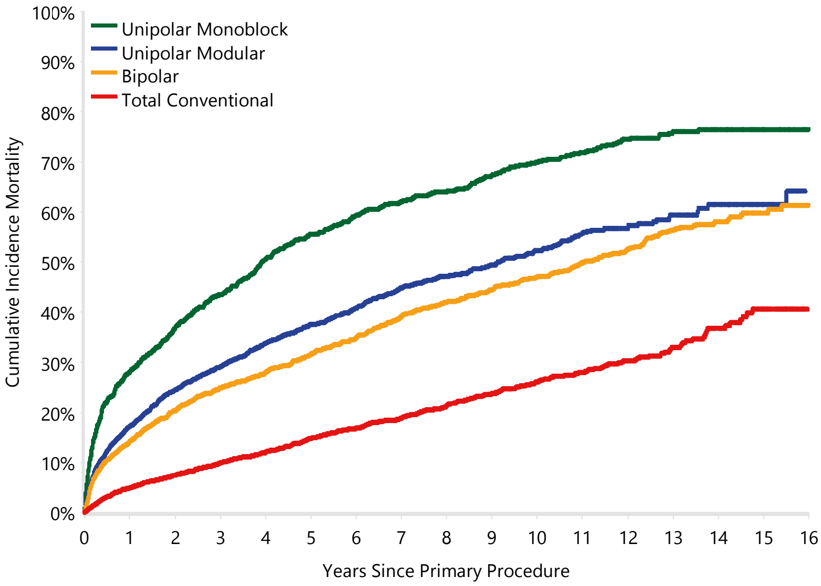
When compared to the Kaplan-Meier estimates of revision it can be seen that there is a lower risk of revision for patients when the competing risk approach is used. This is because of the high mortality of patients with a diagnosis of fractured neck of femur.

Table HT52 Cumulative Incidence Mortality of Primary Hip Replacement in Patients Aged <70 Years by Class (Primary Diagnosis Fractured NOF)

Hip Class	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Monoblock	28.0	36.8	43.5	55.5	62.0	70.0
Unipolar Modular	17.2	24.4	29.1	37.5	44.8	52.2
Bipolar	14.2	20.3	24.8	31.6	39.1	47.0
Total Conventional	4.9	7.4	9.9	14.8	18.8	26.0

Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Figure HT58 Cumulative Incidence Mortality of Primary Hip Replacement in Patients Aged <70 Years by Class (Primary Diagnosis Fractured NOF)



Number at Risk	0 Yr	1 Yrs	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Monoblock	886	597	494	410	282	202	108
Unipolar Modular	2845	2158	1767	1447	990	604	234
Bipolar	1909	1453	1188	1039	814	638	407
Total Conventional	4935	3934	3266	2696	1814	1120	506

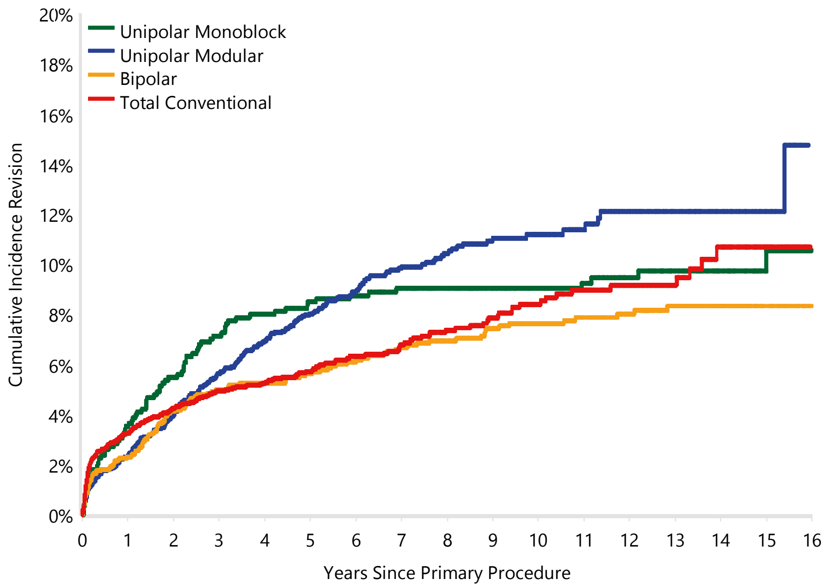
Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Table HT53 Cumulative Incidence Revision of Primary Hip Replacement in Patients Aged <70 Years by Class (Primary Diagnosis Fractured NOF)

Hip Class	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Monoblock	3.5 (2.4, 4.9)	5.5 (4.1, 7.1)	7.1 (5.6, 9.0)	8.5 (6.7, 10.5)	9.0 (7.2, 11.1)	9.0 (7.2, 11.1)
Unipolar Modular	2.3 (1.8, 2.9)	4.0 (3.3, 4.7)	5.6 (4.8, 6.5)	8.0 (7.0, 9.2)	9.9 (8.7, 11.2)	11.2 (9.8, 12.7)
Bipolar	2.3 (1.7, 3.1)	4.1 (3.3, 5.1)	5.0 (4.0, 6.1)	5.6 (4.6, 6.8)	6.7 (5.5, 8.0)	7.6 (6.4, 9.1)
Total Conventional	3.2 (2.8, 3.8)	4.2 (3.7, 4.8)	4.9 (4.3, 5.6)	5.7 (5.0, 6.5)	6.8 (6.0, 7.7)	8.4 (7.3, 9.6)

Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Figure HT59 Cumulative Incidence Revision of Primary Hip Replacement in Patients Aged <70 Years by Class (Primary Diagnosis Fractured NOF)



Number at Risk	0 Yr	1 Yrs	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Monoblock	886	597	494	410	282	202	108
Unipolar Modular	2845	2158	1767	1447	990	604	234
Bipolar	1909	1453	1188	1039	814	638	407
Total Conventional	4935	3934	3266	2696	1814	1120	506

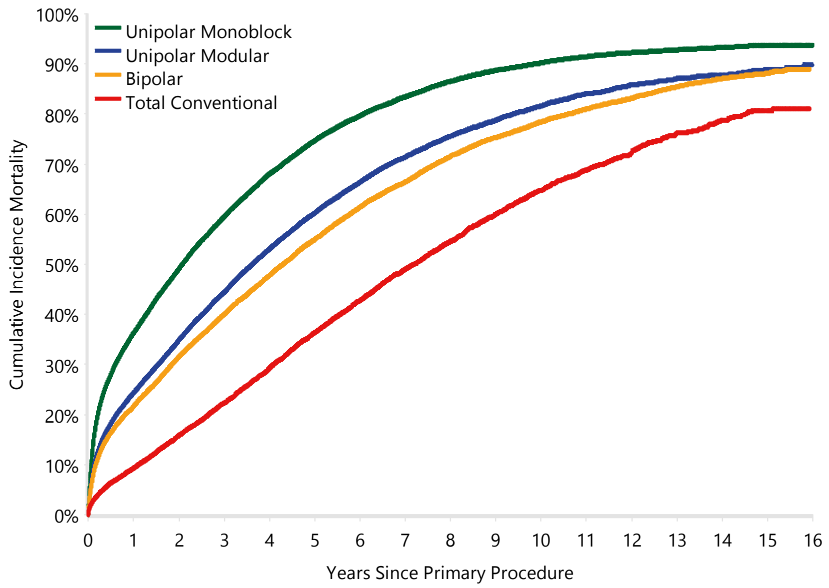
Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Table HT54 Cumulative Incidence Mortality of Primary Hip Replacement in Patients Aged ≥ 70 Years by Class (Primary Diagnosis Fractured NOF)

Hip Class	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Monoblock	36.3	49.1	59.5	74.7	83.4	90.2
Unipolar Modular	24.3	34.8	44.4	60.2	71.4	81.6
Bipolar	21.6	31.5	40.0	54.9	66.4	78.4
Total Conventional	9.3	15.8	22.3	36.3	48.9	64.8

Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Figure HT60 Cumulative Incidence Mortality of Primary Hip Replacement in Patients Aged ≥ 70 Years by Class (Primary Diagnosis Fractured NOF)



Number at Risk	0 Yr	1 Yrs	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Monoblock	26567	16030	12248	9211	4953	2626	937
Unipolar Modular	31441	21063	16169	12125	6324	2994	781
Bipolar	15577	10597	8112	6376	4052	2553	1191
Total Conventional	10930	8516	6906	5503	3335	1832	614

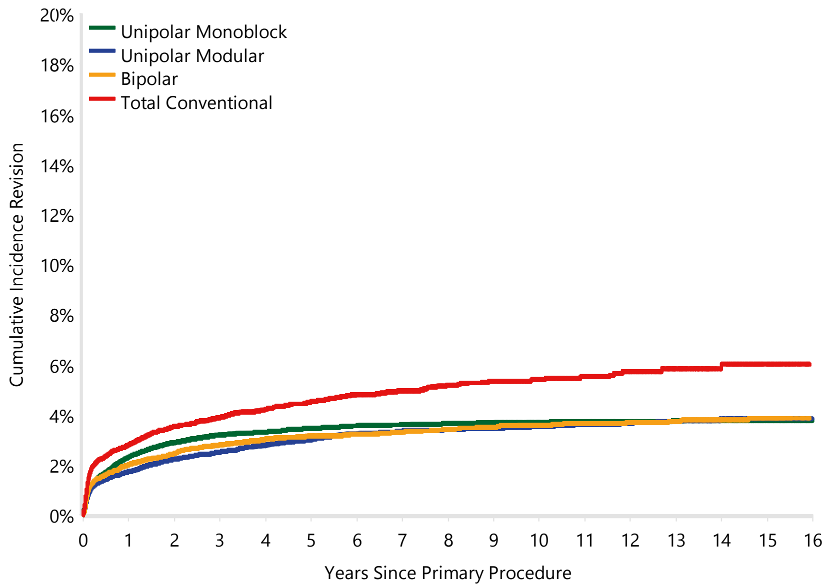
Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Table HT55 Cumulative Incidence Revision of Primary Hip Replacement in Patients Aged ≥ 70 Years by Class (Primary Diagnosis Fractured NOF)

Hip Class	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Monoblock	2.3 (2.1, 2.5)	2.9 (2.7, 3.1)	3.2 (3.0, 3.4)	3.5 (3.2, 3.7)	3.6 (3.4, 3.8)	3.7 (3.5, 3.9)
Unipolar Modular	1.7 (1.6, 1.9)	2.2 (2.1, 2.4)	2.5 (2.3, 2.7)	3.0 (2.8, 3.2)	3.3 (3.1, 3.6)	3.5 (3.3, 3.8)
Bipolar	2.0 (1.8, 2.2)	2.4 (2.2, 2.7)	2.8 (2.5, 3.1)	3.1 (2.8, 3.4)	3.3 (3.0, 3.6)	3.6 (3.3, 3.9)
Total Conventional	2.8 (2.5, 3.1)	3.5 (3.2, 3.9)	3.9 (3.5, 4.3)	4.5 (4.1, 4.9)	4.9 (4.5, 5.4)	5.4 (4.9, 5.9)

Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

Figure HT61 Cumulative Incidence Revision of Primary Hip Replacement in Patients Aged ≥ 70 Years by Class (Primary Diagnosis Fractured NOF)



Number at Risk	0 Yr	1 Yrs	2 Yrs	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Unipolar Monoblock	26567	16030	12248	9211	4953	2626	937
Unipolar Modular	31441	21063	16169	12125	6324	2994	781
Bipolar	15577	10597	8112	6376	4052	2553	1191
Total Conventional	10930	8516	6906	5503	3335	1832	614

Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

PRIMARY TOTAL RESURFACING HIP REPLACEMENT

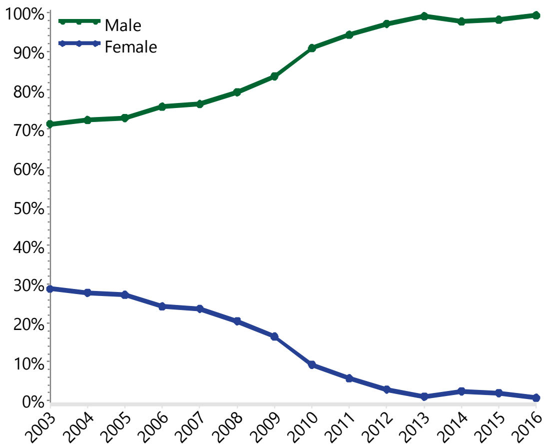
DEMOGRAPHICS

There have been 16,950 total resurfacing hip replacement procedures reported to the Registry. This is an additional 429 procedures compared to the last report.

The use of total resurfacing hip replacement in Australia has been declining since 2005. In 2016, the number of total resurfacing procedures was 15.0% greater than in 2015 and 77.0% less than in 2005. Total resurfacing hip replacement represents 2.5% of all hip replacements performed in 2016.

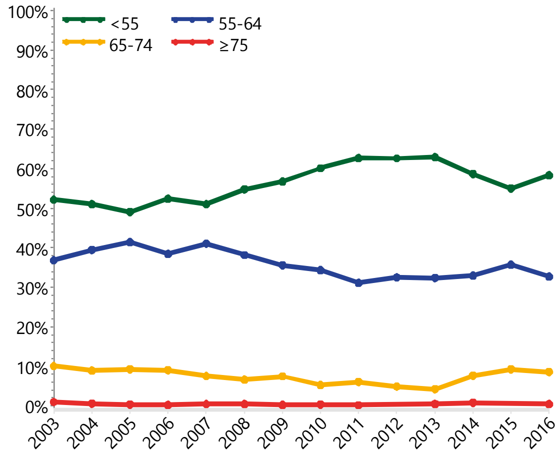
In 2016, 99.3% of total resurfacing hip replacements were undertaken in males (Figure HT62).

Figure HT62 Primary Total Resurfacing Hip Replacement by Gender



There was a small increase in the proportion of patients aged less than 55 years receiving total resurfacing hip replacement in 2016 (Figure HT63).

Figure HT63 Primary Total Resurfacing Hip Replacement by Age



There were only two different types of resurfacing prostheses used in 2016, with the Adept the most commonly used, accounting for 61.1% 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	13371	78.9%	13	93	54	53.4	9.0
Female	3579	21.1%	14	81	53	51.6	8.6
TOTAL	**16950**	**100.0%**	**13**	**93**	**54**	**53.0**	**8.9**

Table HT57 Most Used Resurfacing Heads in Primary Total Resurfacing Hip Replacement

2003		2013		2014		2015		2016	
N	Model	N	Model	N	Model	N	Model	N	Model
1359	BHR	267	BHR	286	BHR	196	Adept	258	Adept
58	Durom	126	Adept	94	Adept	171	BHR	164	BHR
43	ASR	5	Icon						
42	Cormet	4	Cormet						
38	Cormet 2000 HAP								
7	Conserve Plus								
Most Used									
1547 (6)	100.0%	402 (4)	100.0%	380 (2)	100.0%	367 (2)	100.0%	422 (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 HT64).

Prosthesis Types

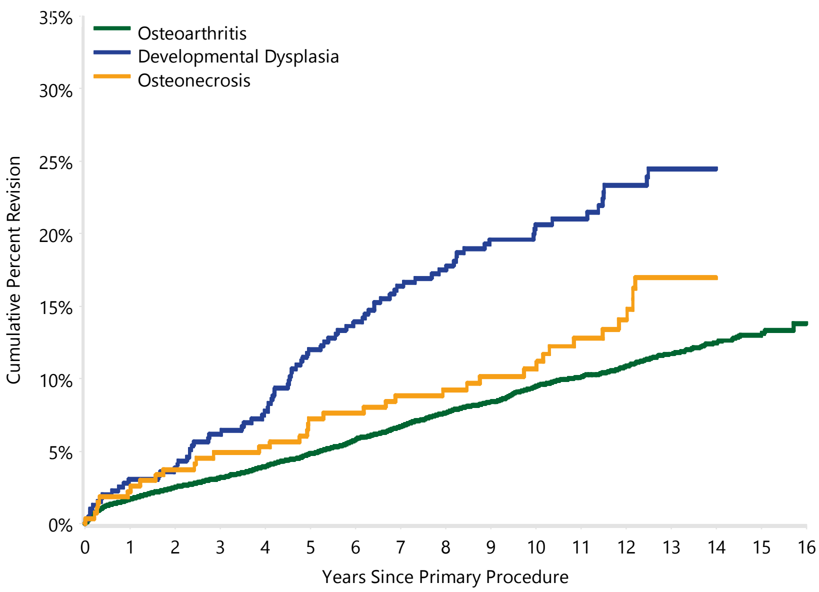
The cumulative percent revision of different total resurfacing hip prosthesis combinations with more than 100 procedures is listed in Table HT59. At 10 years, the prosthesis with the lowest cumulative percent revision is the Mitch TRH (5.6%).

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	16 Yrs
Osteoarthritis	1424	16155	1.7 (1.5, 1.9)	3.2 (2.9, 3.5)	4.8 (4.5, 5.2)	9.5 (9.0, 10.0)	13.0 (12.2, 13.8)	13.8 (12.5, 15.2)
Developmental Dysplasia	84	394	3.1 (1.7, 5.3)	6.2 (4.2, 9.1)	12.0 (9.1, 15.7)	20.7 (16.8, 25.2)		
Osteonecrosis	37	270	2.2 (1.0, 4.9)	4.9 (2.9, 8.3)	7.2 (4.7, 11.1)	10.7 (7.4, 15.2)		
Other (6)	20	131	2.3 (0.8, 7.0)	5.6 (2.7, 11.4)	9.9 (5.7, 16.8)	16.3 (10.5, 24.8)		
TOTAL	**1565**	**16950**						

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

Figure HT64 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=1.49 (1.19, 1.87),p<0.001

Osteonecrosis vs Osteoarthritis
Entire Period: HR=1.33 (0.96, 1.86),p=0.088

Developmental Dysplasia vs Osteonecrosis
Entire Period: HR=1.12 (0.76, 1.65),p=0.573

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Osteoarthritis	16155	15456	14448	13298	7349	604	76
Developmental Dysplasia	394	378	357	330	225	17	4
Osteonecrosis	270	258	246	237	171	22	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	16 Yrs
ASR	ASR*	356	1168	3.4 (2.5, 4.6)	7.2 (5.9, 8.8)	15.3 (13.4, 17.5)	30.4 (27.8, 33.3)		
Adept	Adept	36	1206	0.9 (0.5, 1.7)	1.8 (1.1, 2.9)	2.7 (1.8, 4.2)	7.5 (5.1, 11.1)		
BHR	BHR	797	11377	1.4 (1.2, 1.6)	2.5 (2.2, 2.8)	3.5 (3.2, 3.9)	6.9 (6.4, 7.4)	10.2 (9.5, 11.1)	11.0 (9.8, 12.4)
Bionik	Bionik*	47	200	3.5 (1.7, 7.2)	12.0 (8.2, 17.4)	17.1 (12.5, 23.1)			
Cormet	Cormet*	113	626	2.1 (1.2, 3.6)	5.6 (4.1, 7.7)	9.5 (7.5, 12.1)	17.7 (14.7, 21.3)		
Durom	Durom*	93	847	3.2 (2.2, 4.6)	5.4 (4.1, 7.2)	7.5 (5.9, 9.5)	10.9 (8.9, 13.3)		
Icon	Icon*	13	118	1.7 (0.4, 6.6)	4.2 (1.8, 9.9)	5.9 (2.9, 12.1)	11.6 (6.6, 19.9)		
Mitch TRH	Mitch TRH*	46	1024	1.2 (0.7, 2.1)	2.1 (1.4, 3.2)	2.6 (1.8, 3.8)	5.6 (4.1, 7.5)		
Recap	Recap*	27	195	5.1 (2.8, 9.3)	8.7 (5.5, 13.7)	10.3 (6.8, 15.5)	15.8 (10.9, 22.6)		
Other (9)		37	189	5.3 (2.9, 9.6)	7.4 (4.5, 12.2)	9.6 (6.1, 14.8)	16.6 (11.9, 22.9)		
TOTAL		**1565**	**16950**						

Note: Only combinations with over 100 procedures have been listed
* denotes prosthesis combinations with no reported use in primary total resurfacing hip replacement in 2016

OUTCOME FOR OSTEOARTHRITIS

The cumulative percent revision at 16 years for primary total resurfacing hip replacement undertaken for osteoarthritis is 13.8% (Table HT60 and Figure HT65).

Reasons for Revision

The main reasons for revision of primary total resurfacing hip replacement are metal related pathology (28.1%), loosening (23.4%) and fracture (18.7%) (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 HT66. 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 (70.2%). Femoral only revision is much less common (23.9%) and acetabular only revision is rarely undertaken (3.0%) (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 HT67).

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 HT68). 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 (Table HT64, Figures HT69 and HT70).

Head Size

The rate of revision decreases as the femoral component head size increases. Femoral head sizes of 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 HT71).

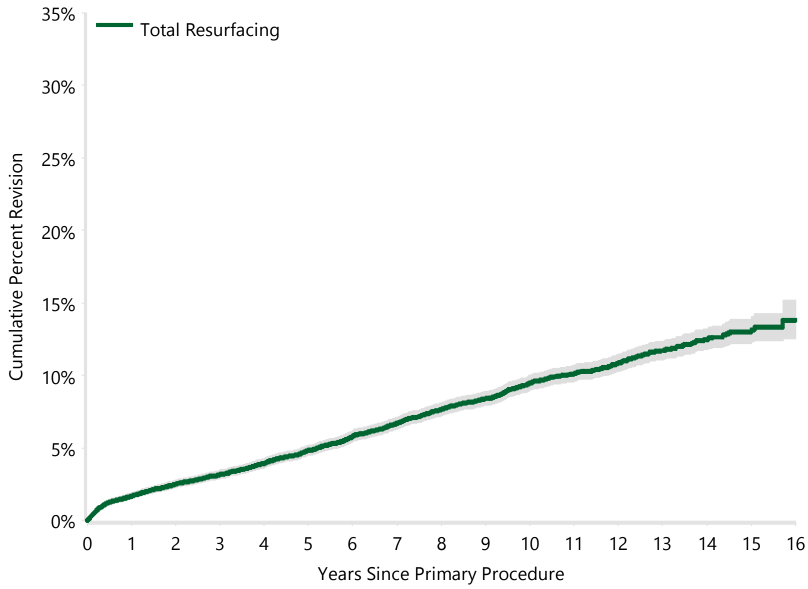
The reason for revision varies with head size. Head sizes less than 50mm have a higher cumulative incidence of metal related pathology, loosening, fracture, infection, and lysis compared to head sizes 50mm or larger (Figure HT72).

This effect of femoral component head size is evident in both males and females (Table HT66 and Figure HT73).

Table HT60 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement (Primary Diagnosis OA)

Hip Class	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Total Resurfacing	1424	16155	1.7 (1.5, 1.9)	3.2 (2.9, 3.5)	4.8 (4.5, 5.2)	9.5 (9.0, 10.0)	13.0 (12.2, 13.8)	13.8 (12.5, 15.2)
TOTAL	**1424**	**16155**						

Figure HT65 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	16 Yrs
Total Resurfacing	16155	15456	14448	13298	7349	604	76

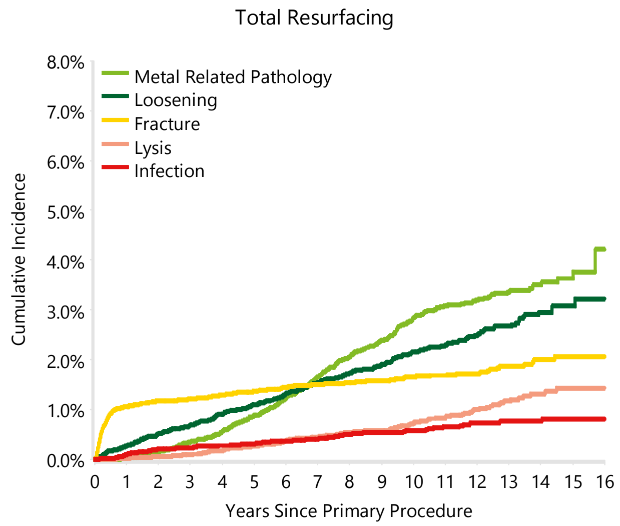
Table HT61 Primary Total Resurfacing Hip Replacement by Reason for Revision (Primary Diagnosis OA)

Reason for Revision	Number	Percent
Metal Related Pathology	400	28.1
Loosening	333	23.4
Fracture	266	18.7
Lysis	125	8.8
Infection	93	6.5
Pain	89	6.3
Osteonecrosis	36	2.5
Malposition	20	1.4
Prosthesis Dislocation	20	1.4
Other	42	2.9
TOTAL	**1424**	**100.0**

Table HT62 Primary Total Resurfacing Hip Replacement by Type of Revision (Primary Diagnosis OA)

Type of Revision	Number	Percent
THR (Femoral/Acetabular)	1000	70.2
Femoral Component	341	23.9
Acetabular Component	43	3.0
Cement Spacer	30	2.1
Removal of Prostheses	10	0.7
TOTAL	**1424**	**100.0**

Figure HT66 Cumulative Incidence Revision Diagnosis of Primary Total Resurfacing Hip Replacement (Primary Diagnosis OA)

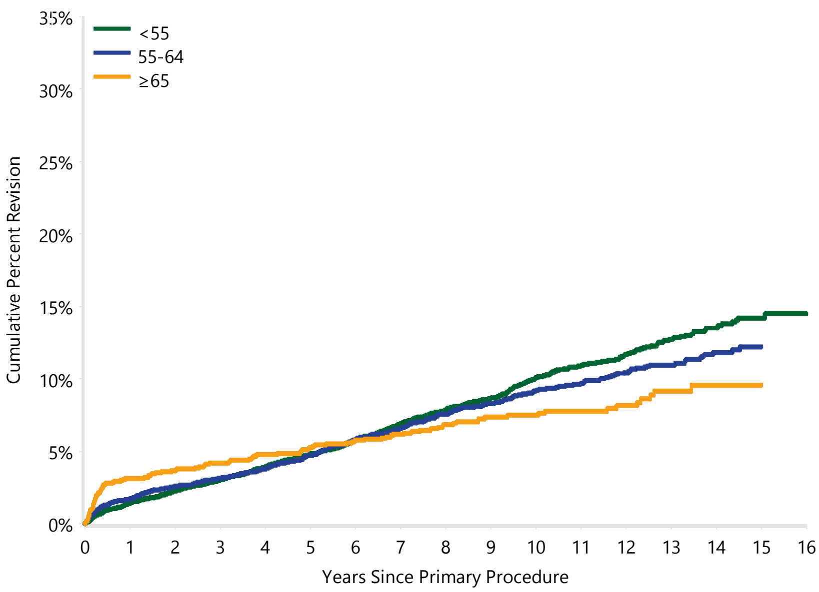


Data Period 1 September 1999 – 31 December 2016

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	16 Yrs
<55	783	8522	1.4 (1.2, 1.7)	3.0 (2.7, 3.4)	4.8 (4.4, 5.3)	10.1 (9.4, 10.8)	14.2 (13.1, 15.4)	14.5 (13.2, 15.8)
55-64	535	6189	1.7 (1.4, 2.1)	3.1 (2.7, 3.6)	4.7 (4.2, 5.3)	9.2 (8.4, 10.0)	12.2 (11.0, 13.5)	
≥65	106	1444	3.1 (2.4, 4.2)	4.2 (3.2, 5.4)	5.3 (4.2, 6.6)	7.5 (6.2, 9.1)	9.6 (7.7, 11.8)	
TOTAL	**1424**	**16155**						

Figure HT67 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement by Age (Primary Diagnosis OA)



HR - adjusted for gender

55-64 vs <55
0 - 1.5Yr: HR=1.28 (1.02, 1.61),p=0.030
1.5Yr+: HR=0.86 (0.76, 0.97),p=0.017

≥65 vs <55
0 - 6Mth: HR=3.34 (2.33, 4.81),p<0.001
6Mth+: HR=0.66 (0.51, 0.85),p=0.001

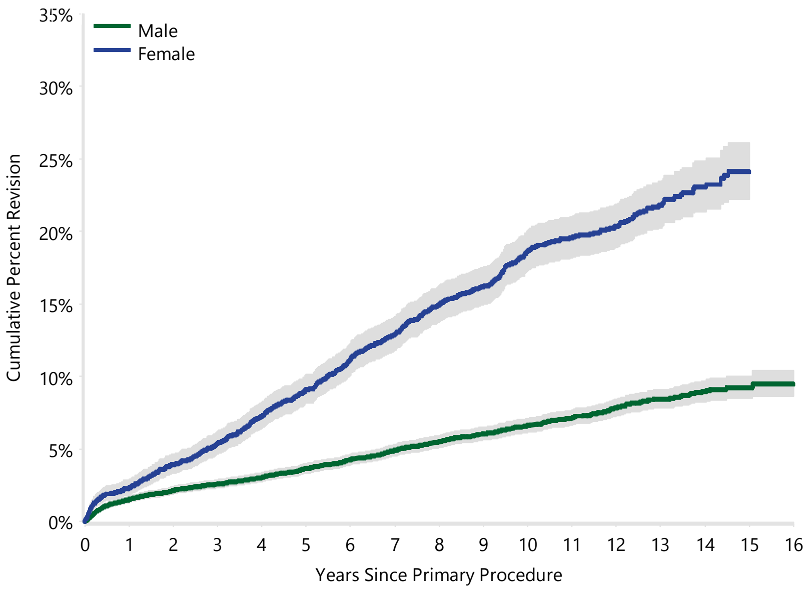
≥65 vs 55-64
0 - 6Mth: HR=2.58 (1.79, 3.72),p<0.001
6Mth+: HR=0.74 (0.57, 0.95),p=0.020

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
<55	8522	8161	7606	6929	3716	332	51
55-64	6189	5940	5581	5182	2917	225	22
≥65	1444	1355	1261	1187	716	47	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	16 Yrs
Male		**785**	**12893**	**1.5 (1.3, 1.8)**	**2.6 (2.3, 2.9)**	**3.7 (3.3, 4.0)**	**6.6 (6.1, 7.1)**	**9.2 (8.5, 10.1)**	**9.5 (8.6, 10.4)**
	<55	402	6647	1.2 (1.0, 1.5)	2.4 (2.1, 2.8)	3.4 (3.0, 3.9)	6.7 (6.0, 7.4)	9.9 (8.8, 11.2)	
	55-64	296	4935	1.6 (1.2, 1.9)	2.5 (2.1, 2.9)	3.6 (3.1, 4.2)	6.5 (5.8, 7.4)	8.6 (7.5, 9.8)	
	≥65	87	1311	3.1 (2.3, 4.2)	4.0 (3.0, 5.2)	4.9 (3.9, 6.3)	6.8 (5.5, 8.4)		
Female		**639**	**3262**	**2.3 (1.8, 2.9)**	**5.4 (4.7, 6.2)**	**9.1 (8.2, 10.1)**	**18.6 (17.3, 20.1)**	**24.1 (22.2, 26.2)**	
	<55	381	1875	2.1 (1.6, 2.9)	5.1 (4.2, 6.2)	9.3 (8.1, 10.8)	19.4 (17.6, 21.4)	25.3 (22.8, 28.0)	
	55-64	239	1254	2.4 (1.7, 3.4)	5.7 (4.5, 7.1)	8.8 (7.4, 10.5)	18.0 (15.9, 20.3)	23.1 (20.1, 26.4)	
	≥65	19	133	3.8 (1.6, 8.8)	6.0 (3.1, 11.7)	8.4 (4.7, 14.6)	13.5 (8.6, 20.9)		
TOTAL		**1424**	**16155**						

Figure HT68 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement by Gender (Primary Diagnosis OA)



HR - adjusted for age

Female vs Male

0 - 3Mth: HR=2.06 (1.43, 2.95),p<0.001

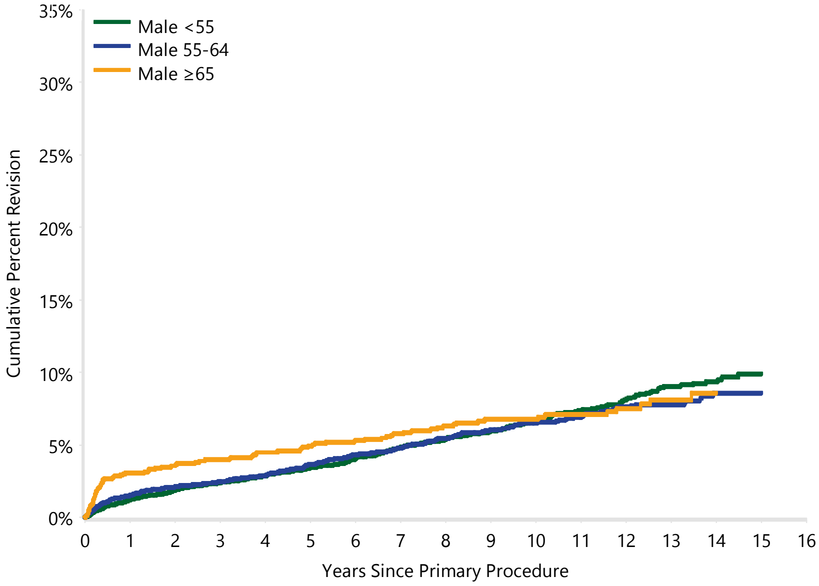
3Mth - 6Mth: HR=1.21 (0.70, 2.08),p=0.492

6Mth - 1Yr: HR=0.93 (0.51, 1.70),p=0.814

1Yr+: HR=3.19 (2.84, 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 HT69 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement in Males by Age (Primary Diagnosis OA)



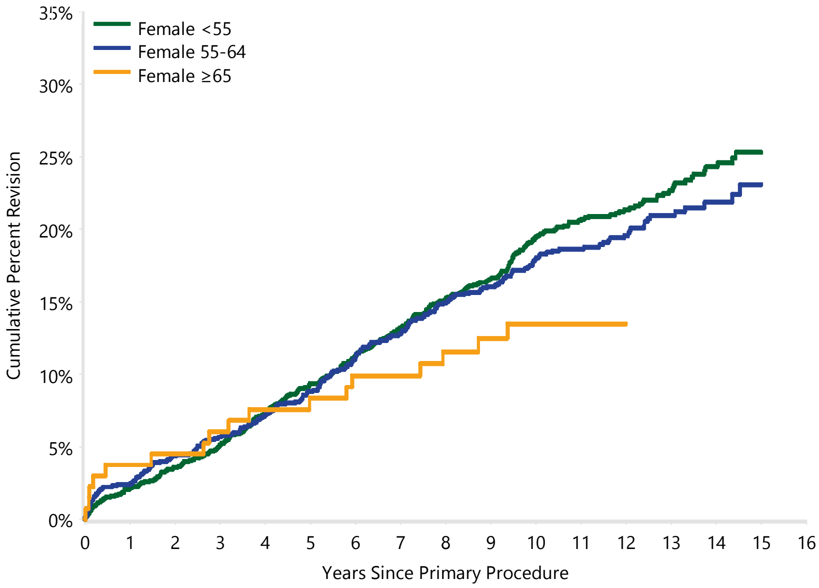
Male 55-64 vs Male <55
0 - 1Mth: HR=2.35 (1.06, 5.21),p=0.036
1Mth+: HR=0.93 (0.80, 1.08),p=0.331

Male ≥65 vs Male <55
0 - 6Mth: HR=3.08 (2.08, 4.56),p<0.001
6Mth+: HR=0.72 (0.54, 0.96),p=0.027

Male ≥65 vs Male 55-64
0 - 6Mth: HR=2.62 (1.74, 3.95),p<0.001
6Mth+: HR=0.79 (0.58, 1.06),p=0.115

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Male	<55	6647	6330	5839	5258	2679	227	35
	55-64	4935	4719	4410	4058	2187	152	17
	≥65	1311	1227	1139	1068	635	39	3

Figure HT70 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=0.388

Female ≥65 vs Female <55
0 - 3Mth: HR=2.26 (0.81, 6.31),p=0.120
3Mth+: HR=0.58 (0.35, 0.98),p=0.040

Female ≥65 vs Female 55-64
Entire Period: HR=0.74 (0.47, 1.19),p=0.212

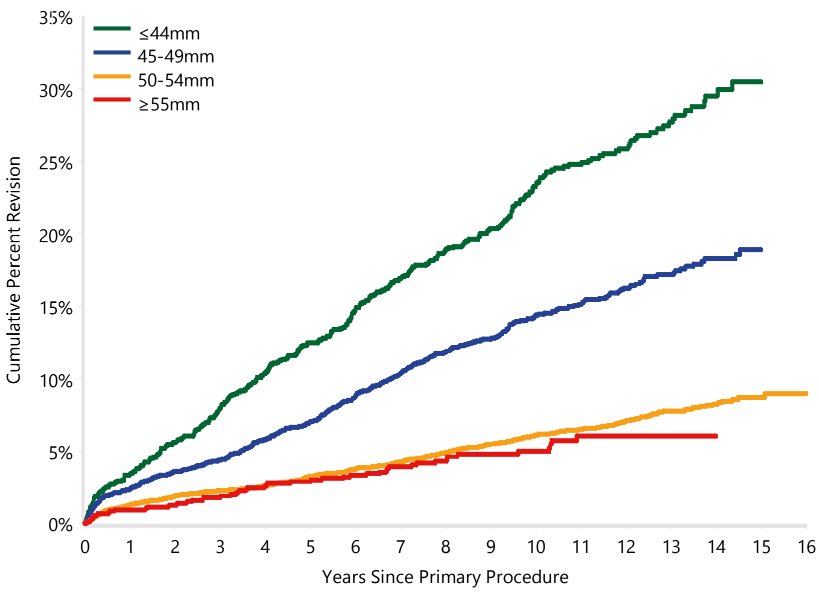
Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Female	<55	1875	1831	1767	1671	1037	105	16
	55-64	1254	1221	1171	1124	730	73	5
	≥65	133	128	122	119	81	8	0

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	16 Yrs
≤44mm	299	1196	3.4 (2.5, 4.6)	8.0 (6.6, 9.7)	12.4 (10.7, 14.5)	23.3 (20.9, 25.9)	30.5 (27.2, 34.0)	
45-49mm	505	3699	2.4 (1.9, 2.9)	4.4 (3.8, 5.1)	7.0 (6.2, 7.9)	14.4 (13.2, 15.7)	18.9 (17.1, 20.9)	
50-54mm	569	10117	1.3 (1.1, 1.6)	2.3 (2.0, 2.6)	3.3 (2.9, 3.6)	6.1 (5.6, 6.6)	8.7 (7.8, 9.6)	9.0 (8.0, 10.1)
≥55mm	51	1142	1.0 (0.5, 1.7)	1.8 (1.2, 2.8)	2.9 (2.0, 4.1)	5.0 (3.7, 6.6)		
TOTAL	**1424**	**16154**						

Note: Excludes one procedure with unknown head size

Figure HT71 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement by Head Size (Primary Diagnosis OA)



HR - adjusted for age and gender

≤44mm vs ≥55mm

Entire Period: HR=3.28 (2.36, 4.55),p<0.001

45-49mm vs ≥55mm

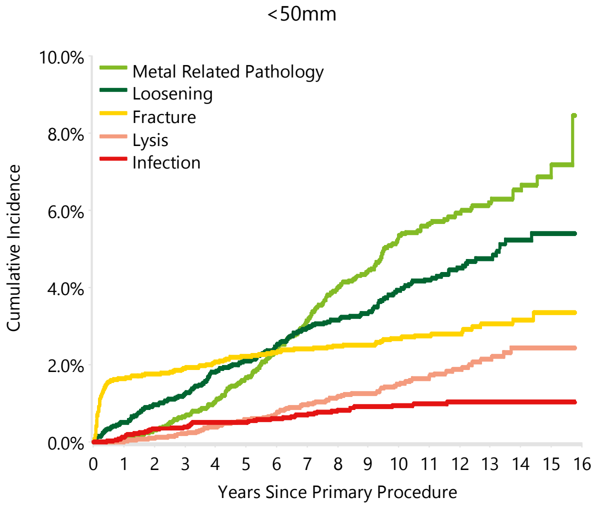
Entire Period: HR=2.27 (1.68, 3.07),p<0.001

50-54mm vs ≥55mm

Entire Period: HR=1.17 (0.88, 1.56),p=0.281

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
≤44mm	1196	1153	1092	1030	633	71	7
45-49mm	3699	3548	3335	3093	1661	154	13
50-54mm	10117	9652	9009	8243	4636	349	51
≥55mm	1142	1102	1011	931	419	30	5

Figure HT72 Cumulative Incidence Revision Diagnosis of Primary Total Resurfacing Hip Replacement by Head Size (Primary Diagnosis OA)



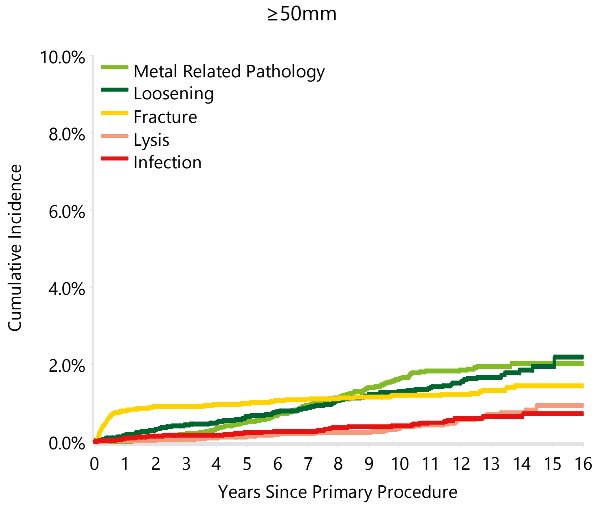
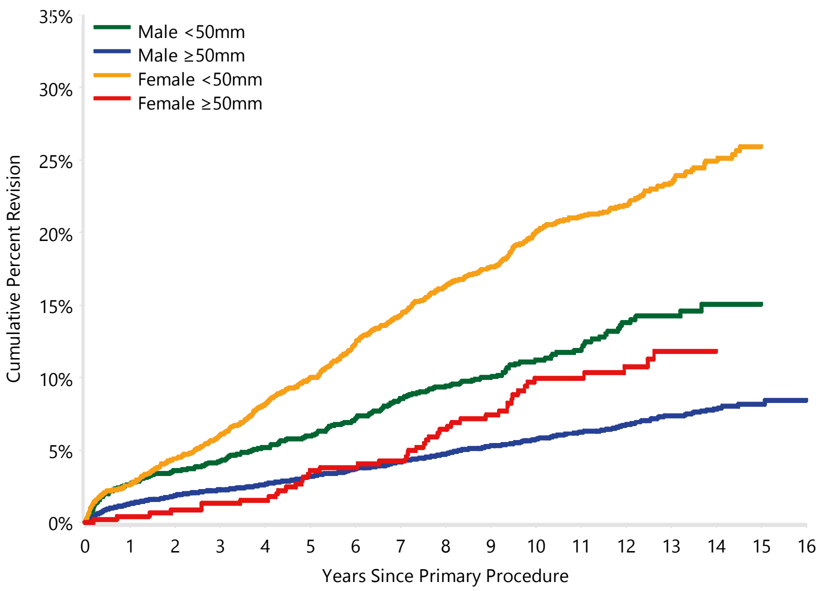


Table HT66 Cumulative Percent Revision of Primary Total Resurfacing Hip Replacement by Gender and Head Size (Primary Diagnosis OA)

Gender	Head Size	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Male		**785**	**12892**	**1.5 (1.3, 1.8)**	**2.6 (2.3, 2.9)**	**3.7 (3.3, 4.0)**	**6.6 (6.1, 7.1)**	**9.2 (8.5, 10.1)**	**9.5 (8.6, 10.4)**
	<50mm	211	2084	2.7 (2.1, 3.5)	4.3 (3.5, 5.2)	6.0 (5.0, 7.1)	11.2 (9.8, 12.9)	15.1 (12.9, 17.6)	
	≥50mm	574	10808	1.3 (1.1, 1.5)	2.3 (2.0, 2.6)	3.2 (2.9, 3.6)	5.7 (5.3, 6.3)	8.2 (7.4, 9.0)	8.5 (7.5, 9.5)
Female		**639**	**3262**	**2.3 (1.8, 2.9)**	**5.4 (4.7, 6.2)**	**9.1 (8.2, 10.1)**	**18.6 (17.3, 20.1)**	**24.1 (22.2, 26.2)**	
	<50mm	593	2811	2.6 (2.1, 3.3)	6.0 (5.2, 7.0)	10.0 (8.9, 11.2)	20.0 (18.5, 21.6)	25.9 (23.9, 28.2)	
	≥50mm	46	451	0.4 (0.1, 1.8)	1.3 (0.6, 2.9)	3.6 (2.2, 5.8)	10.0 (7.4, 13.3)		
TOTAL		**1424**	**16154**						

Note: Excludes one male procedure with unknown head size

Figure HT73 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=2.01 (1.72, 2.35),p<0.001

Male ≥50mm vs Female ≥50mm

0 - 3Yr: HR=1.69 (0.75, 3.79),p=0.204

3Yr - 4.5Yr: HR=0.60 (0.24, 1.47),p=0.260

4.5Yr - 5Yr: HR=0.23 (0.09, 0.60),p=0.002

5Yr+: HR=0.51 (0.35, 0.74),p<0.001

Male <50mm vs Female <50mm

Entire Period: HR=0.57 (0.49, 0.67),p<0.001

Female <50mm vs Female ≥50mm

0 - 4.5Yr: HR=4.01 (2.20, 7.30),p<0.001

4.5Yr - 5Yr: HR=0.81 (0.32, 2.03),p=0.658

5Yr+: HR=1.90 (1.31, 2.75),p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Male	<50mm	2084	1970	1808	1636	746	68	3
	≥50mm	10808	10305	9579	8747	4755	350	52
Female	<50mm	2811	2731	2619	2487	1548	157	17
	≥50mm	451	449	441	427	300	29	4

Knee Replacement

Knee Replacement

CATEGORIES OF KNEE REPLACEMENT

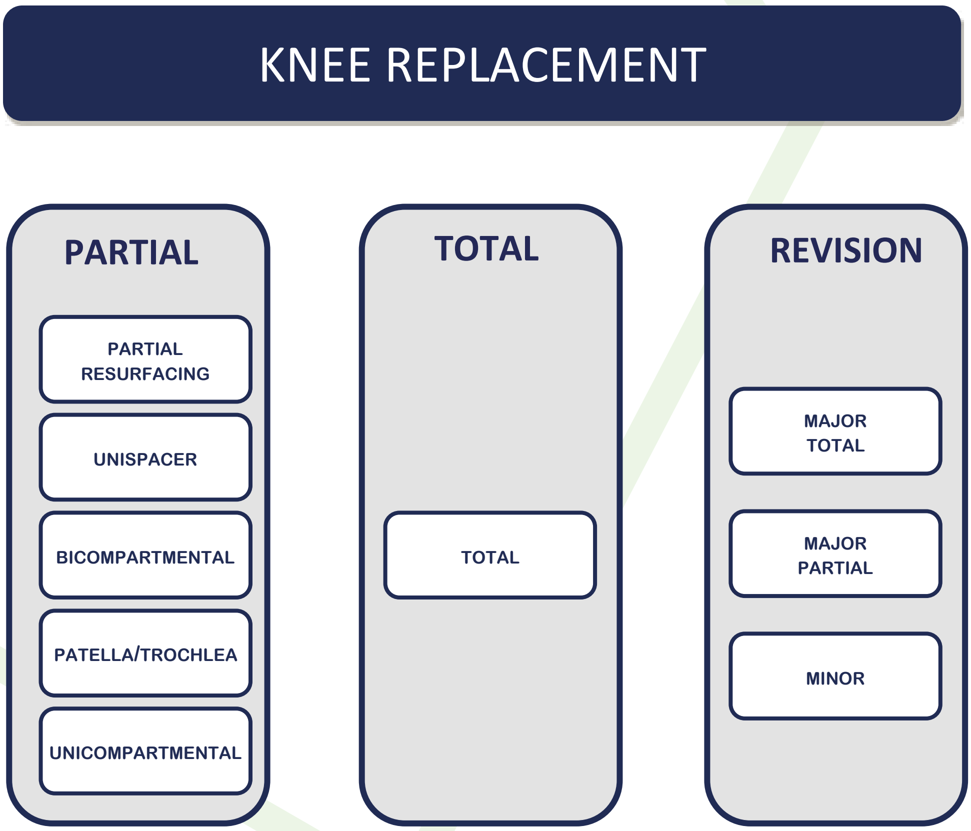
The Registry groups knee replacement into three broad categories: primary partial, primary total and revision knee replacement.

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-2017



USE OF KNEE REPLACEMENT

This report analyses 653,480 knee replacements with a procedure date up to and including 31 December 2016. This is an additional 60,903 knee procedures compared to the number reported last year. When considering all knee procedures currently recorded by the Registry, primary partial knee accounts for 8.1%, primary total knee 83.8% and revision knee replacement 8.1% (Table K1).

Table K1 Number of Knee Replacements

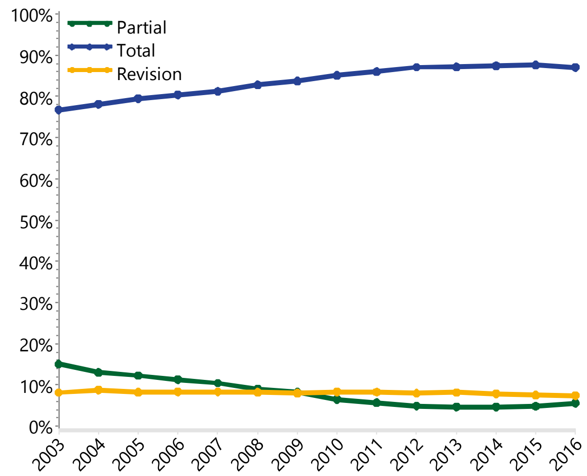
Knee Category	Number	Percent
Partial	52902	8.1
Total	547407	83.8
Revision	53171	8.1
TOTAL	**653480**	**100.0**

In 2016, the number of knee replacements undertaken increased by 2,020 (3.5%) compared to 2015. During the last year, primary partial and primary total knee replacement increased by 18.8% and 2.8%, respectively. There was a slight increase in revision knee replacement (1.6%).

Since 2003, the number of knee replacement procedures undertaken annually has increased by 111.5%. Primary total knee replacement has increased by 139.8% and revision knee replacement by 92.1%. Primary partial knee replacement has decreased by 22.0%.

In 2016, primary total knee replacement accounts for 87.0% of all knee replacement procedures. This has increased from 76.7% in 2003. Primary partial knee replacement decreased from 15.1% in 2003 to 5.6% in 2016. The proportion of revision knee procedures has declined from a peak of 8.8% in 2004 to 7.4% in 2016. This equates to 834 fewer revision procedures in 2016 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 in 2015.

There is ASA score data on 206,077 and BMI data on 103,566 knee replacement procedures.

In 2016, the ASA score is reported in 99.3% of knee replacement procedures and BMI is reported in 92.3% of procedures.

BMI is reported for 93.1% of primary partial knees, 92.7% of primary total knees and 87.5% of revision knee replacements.

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

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

Overall, in 92.2% of procedures, patients have an ASA score of 2 or 3, 6.5% have a score of 1 and 1.3% have a score of 4. Very few procedures were recorded where patients have a 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 (76.1% and 62.7%, respectively). For patients undergoing revision knee replacement surgery, there are a lower proportion with ASA scores 1 or 2 (50.8%) (Table K2).

BMI

BMI for adults is classified by the World Health Organisation into six main categories (http://apps.who.int/bmi/index.jsp?introPage=intro_3.html):

1. Underweight <18.50
2. Normal 18.50 - 24.99
3. Pre-obese 25.00 - 29.99
4. Obese Class 1 30.00 - 34.99
5. Obese Class 2 35.00 - 39.99
6. Obese Class 3 ≥40.00

For all knee replacements, the majority of procedures are undertaken in patients that are either pre-obese or obese class 1 (62.3%). There is almost no difference in BMI for patients when primary total and revision knee replacement are compared. For partial knee replacement, 55.6% of procedures were in either normal or pre-obese patients compared to 41.8% for primary total knee and 41.3% for revision knee replacement (Table K3).

There is a gender difference with a higher proportion of males in the normal and pre-obese categories, which is most apparent in primary partial knee replacement (Figure K2).

Table K2 ASA Score by Knee Category

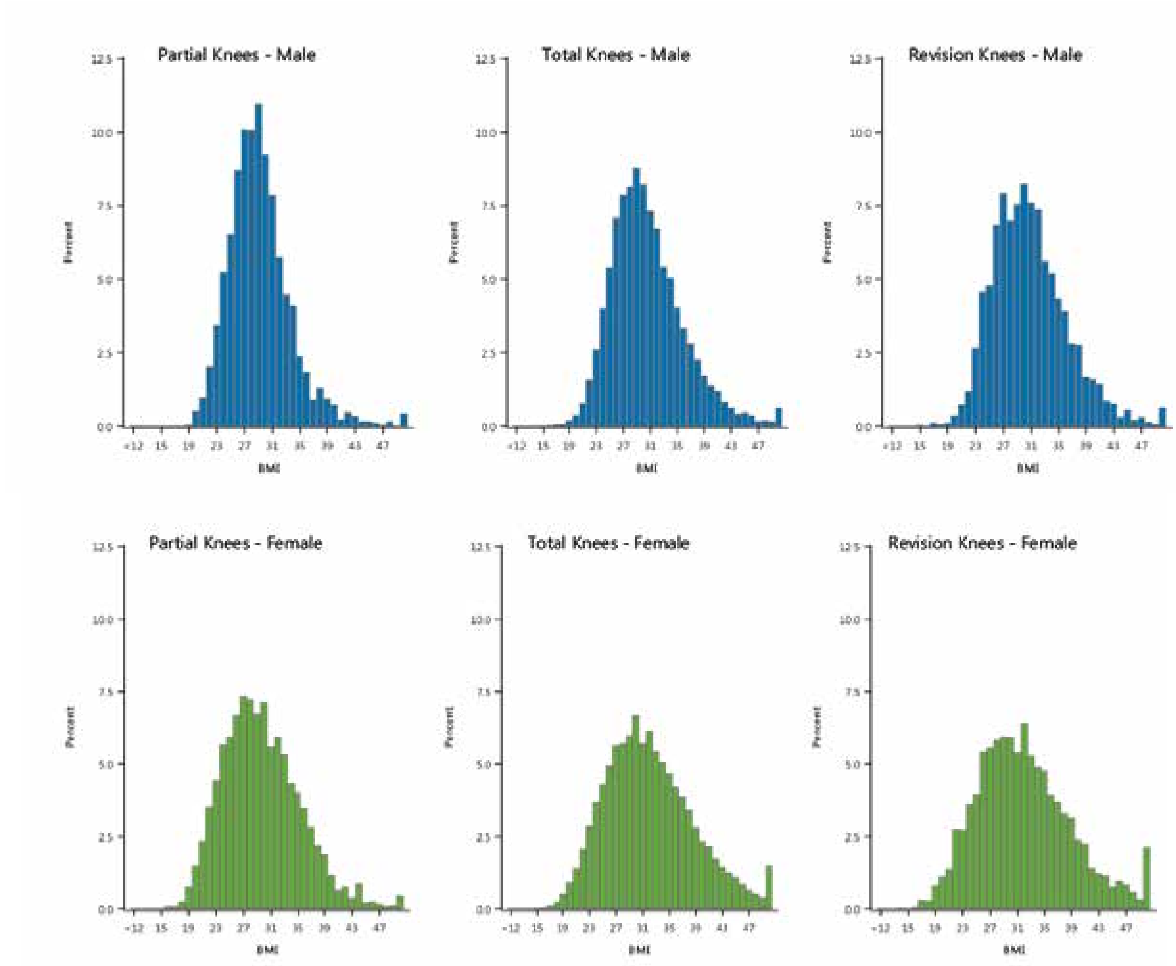
	Partial		Total		Revision		TOTAL	
ASA Score	N	Col%	N	Col%	N	Col%	N	Col%
1	1482	14.4	11240	6.2	668	4.2	13390	6.5
2	6367	61.7	101706	56.5	7363	46.6	115436	56.0
3	2415	23.4	64927	36.1	7215	45.6	74557	36.2
4	47	0.5	2068	1.1	565	3.6	2680	1.3
5	1	0.0	11	0.0	2	0.0	14	0.0
TOTAL	**10312**	**100.0**	**179952**	**100.0**	**15813**	**100.0**	**206077**	**100.0**

Table K3 BMI Category for Knee Replacement by Knee Category

	Partial		Total		Revision		TOTAL	
BMI Category	N	Col%	N	Col%	N	Col%	N	Col%
Underweight	8	0.1	192	0.2	26	0.4	226	0.2
Normal	827	15.0	9643	10.6	818	11.0	11288	10.9
Pre-obese	2242	40.6	28311	31.2	2248	30.3	32801	31.7
Obese Class 1	1653	29.9	27720	30.6	2288	30.8	31661	30.6
Obese Class 2	582	10.5	15234	16.8	1270	17.1	17086	16.5
Obese Class 3	210	3.8	9526	10.5	768	10.4	10504	10.1
TOTAL	**5522**	**100.0**	**90626**	**100.0**	**7418**	**100.0**	**103566**	**100.0**

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

Figure K2 BMI Distribution by Gender and Knee Category



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

Primary Partial Knee Replacement

CLASSES OF PARTIAL KNEE REPLACEMENT

The Registry sub-categorises partial knee replacement into five classes. These are defined by the type of prostheses used.

1. **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.
2. **Unispacer** involves the use of a medial or lateral femorotibial compartment articular spacer.
3. **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.
4. **Patella/trochlea** involves the use of a trochlear prosthesis to replace the femoral trochlear articular surface and on most occasions a patellar prosthesis.
5. **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-2017

USE OF PARTIAL KNEE REPLACEMENT

Unicompartmental knee replacement remains the most common primary partial knee replacement, accounting for 93.0% of all partial knee replacement procedures. The second most common is patella/trochlea replacement (6.2%). Only small numbers of the three remaining partial knee procedures have been reported (partial resurfacing, unispacer and bicompartmental knee replacement) (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. Neither of these classes of partial knee replacement are presented in detail in this report.

Detailed information on unispacer and bicompartmental knee replacement is available in the supplementary report 'Outcomes of Classes No Longer Used - Hip and Knee Arthroplasty' on the AOANJRR website: https://aoanjrr.sahmri.com/annual-reports-2017.

Osteoarthritis is the principal diagnosis for the five classes of partial knee replacement (98.9%). 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	238	0.4
Unispacer	40	0.1
Bicompartmental	165	0.3
Patella/Trochlea	3286	6.2
Unicompartmental	49173	93.0
TOTAL	**52902**	**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	16 Yrs
Partial Resurfacing	70	238	5.5 (3.3, 9.3)	17.0 (12.7, 22.5)	25.0 (19.6, 31.5)			
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	24	165	6.1 (3.3, 11.0)	11.7 (7.6, 17.7)	14.2 (9.7, 20.6)			
Patella/Trochlear	604	3286	2.5 (2.0, 3.1)	8.6 (7.6, 9.7)	14.5 (13.2, 16.0)	27.7 (25.5, 30.0)	44.5 (39.6, 49.8)	
Unicompartmental	5964	49173	2.2 (2.1, 2.4)	5.7 (5.5, 5.9)	8.1 (7.8, 8.4)	14.7 (14.3, 15.1)	22.1 (21.4, 22.9)	23.4 (22.4, 24.4)
TOTAL	**6694**	**52902**						

PARTIAL RESURFACING

DEMOGRAPHICS

The Registry has recorded 238 partial resurfacing knee procedures. This is an additional 14 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 (88.7%). The mean age of patients with partial resurfacing knee replacement was 50.4 years and 50.8% were males (Table KP3).

All recorded partial resurfacing procedures used the 'Hemicap' range of prostheses.

Of the 238 procedures, 177 used one cap, 56 used two, and five used three caps. When a single cap was used, most (138) were implanted on the femoral articular surface. The remainder were used on the trochlear (14), tibial (13) and patellar surfaces (10). 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 where both devices were used on the femoral articular surface. The five procedures using three caps were all 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 six more patella/trochlear procedures than reported last year. The five year cumulative percent revision for one side is 22.4% and 35.5% when both sides were resurfaced.

The main reasons for revision of a partial resurfacing are progression of disease (60.0%), loosening (12.9%) and pain (8.6%).

Most primary partial resurfacing replacements are revised to either a total knee replacement (54.3%) or unicompartmental knee replacement (25.7%). The remaining revisions are patellar resurfacing only (7.1%), patella/trochlear resurfacing (5.7%), partial resurfacing (5.7%), or removal of the prosthesis (1.4%).

The cumulative percent revision of partial resurfacing procedures undertaken for osteoarthritis is 5.8% at one year and 38.7% at nine years (Table KP4 and Figure KP1).

The cumulative percent revision of partial resurfacing procedures undertaken for osteoarthritis is 38.7% at nine years.

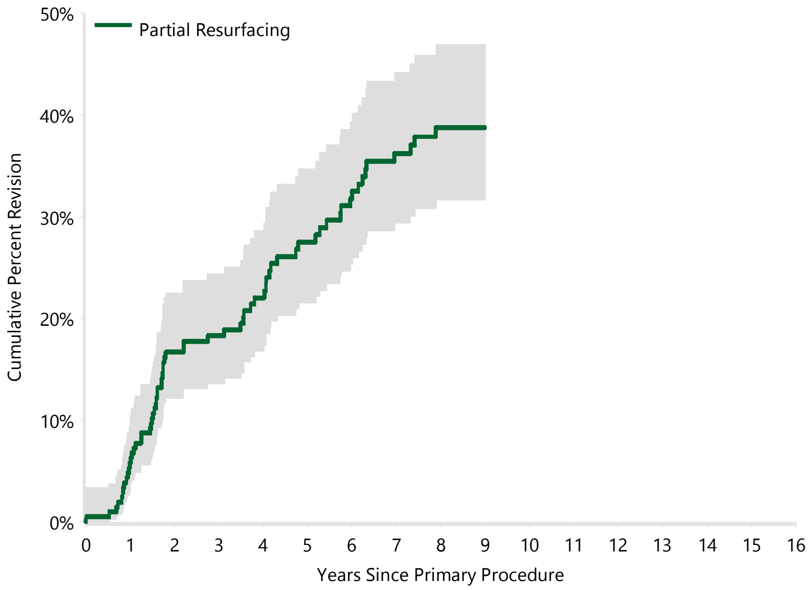
Table KP3 Age and Gender of Primary Partial Resurfacing Knee Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	121	50.8%	17	85	49	49.3	14.3
Female	117	49.2%	30	88	51	51.5	11.7
TOTAL	**238**	**100.0%**	**17**	**88**	**50**	**50.4**	**13.1**

Table KP4 Cumulative Percent Revision of Primary Partial Resurfacing Knee Replacement (Primary Diagnosis OA)

Knee Class	N Revised	N Total	1 Yr	2 Yrs	3 Yrs	5 Yrs	7 Yrs	9 Yrs
Partial Resurfacing	67	211	5.8 (3.3, 10.0)	16.6 (12.2, 22.5)	18.3 (13.6, 24.3)	27.5 (21.5, 34.7)	36.2 (29.3, 44.1)	38.7 (31.6, 46.9)
TOTAL	**67**	**211**						

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	9 Yrs
Partial Resurfacing	211	194	162	144	103	83	52

PATELLA/TROCHLEA

DEMOGRAPHICS

There have been 3,286 patella/trochlear knee replacements reported to the Registry. This is an additional 305 procedures compared to the previous report.

The principal diagnosis for patella/trochlear procedures is osteoarthritis (98.9%). This procedure is most frequently undertaken in females (76.9%). The mean age of patients is 58.9 years (Table KP5, Figures KP2 and KP3).

Figure KP2 Primary Patella/Trochlea Knee Replacement by Gender

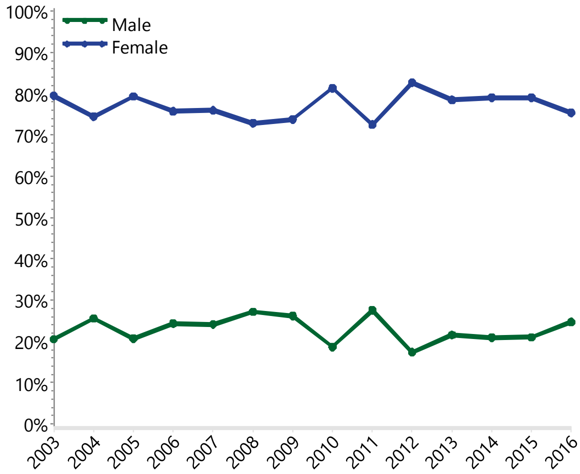
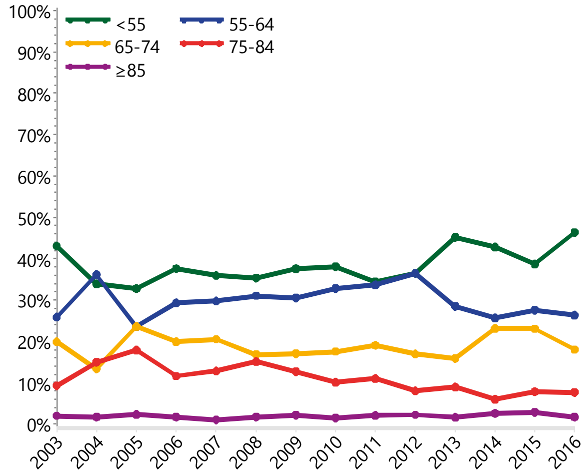


Figure KP3 Primary Patella/Trochlea Knee Replacement by Age



In 2016, the four most common resurfacing trochlear prostheses were the Gender Solutions, Journey, Restoris MCK 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	759	23.1%	25	95	60	60.9	13.2
Female	2527	76.9%	22	95	57	58.3	12.0
TOTAL	**3286**	**100.0%**	**22**	**95**	**58**	**58.9**	**12.3**

Table KP6 Most Used Resurfacing Trochlear Prostheses in Primary Patella/Trochlea Knee Replacement

2003		2013		2014		2015		2016	
N	Model	N	Model	N	Model	N	Model	N	Model
56	LCS	94	Gender Solutions	115	Gender Solutions	115	Gender Solutions	150	Gender Solutions
43	Avon	47	RBK	41	Avon	39	RBK	38	Journey
29	Lubinus	42	Journey	37	RBK	38	Journey	37	Restoris MCK
13	Themis	26	Avon	32	Journey	37	Avon	35	Avon
9	MOD III	20	Sigma HP	7	Sigma HP	7	Sigma HP	34	RBK
1	RBK	14	Vanguard	1	HLS Kneetec	5	Restoris MCK	6	Sigma HP
		3	HLS Kneetec	1	Vanguard	2	Vanguard		
Most Used									
151	(6) 100.0%	246	(7) 100.0%	234	(7) 100.0%	243	(7) 100.0%	300	(6) 100.0%

Table KP7 Cumulative Percent Revision of Primary Patella/Trochlea Knee Replacement by Prosthesis Combination

Resurfacing Trochlea	Patella	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	13 Yrs	14 Yrs
Avon	Avon	57	363	1.2 (0.4, 3.1)	6.9 (4.6, 10.4)	12.5 (9.2, 16.9)	25.1 (19.3, 32.3)		
Avon	Kinemax Plus*	83	307	2.0 (0.9, 4.3)	4.9 (3.0, 8.0)	11.9 (8.7, 16.1)	22.9 (18.4, 28.3)	31.7 (25.8, 38.5)	34.4 (27.8, 42.1)
Avon	Triathlon	1	76	0.0 (0.0, 0.0)	1.8 (0.2, 11.8)				
Gender Solutions	Natural Knee Flex	5	33	0.0 (0.0, 0.0)	12.6 (4.2, 34.6)	12.6 (4.2, 34.6)			
Gender Solutions	Nexgen	42	719	1.5 (0.8, 2.8)	5.2 (3.6, 7.6)	7.6 (5.3, 10.9)			
Journey	Genesis II	54	436	2.2 (1.2, 4.2)	8.1 (5.7, 11.4)	12.8 (9.6, 16.9)			
LCS	LCS*	150	395	3.5 (2.1, 5.9)	11.7 (8.9, 15.3)	20.9 (17.2, 25.3)	37.8 (32.9, 43.3)		
Lubinus	Duracon*	24	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)	36.9 (25.6, 51.3)	
Lubinus	Lubinus*	19	39	5.1 (1.3, 19.0)	18.1 (9.1, 34.3)	20.9 (11.0, 37.6)	35.2 (22.1, 52.9)	49.9 (34.1, 68.3)	59.0 (41.7, 77.1)
MOD III	MOD III*	22	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)	39.8 (27.9, 54.5)	39.8 (27.9, 54.5)
RBK	RBK	81	477	3.5 (2.2, 5.6)	10.3 (7.7, 13.7)	17.0 (13.5, 21.3)	26.2 (20.9, 32.6)		
Restoris MCK	Restoris MCK	0	37	0.0 (0.0, 0.0)					
Sigma HP	PFC Sigma	20	108	4.8 (2.0, 11.1)	15.6 (9.7, 24.6)				
Themis	Themis*	11	38	2.6 (0.4, 17.2)	2.6 (0.4, 17.2)	8.0 (2.6, 22.7)	18.9 (9.5, 35.6)	36.1 (20.4, 58.4)	
Vanguard	Series A*	11	41	4.9 (1.2, 18.1)	17.3 (8.6, 32.9)	30.3 (17.0, 50.5)			
Other (26)		24	77	4.0 (1.3, 12.0)	13.8 (7.7, 24.2)	16.9 (10.0, 27.9)	38.7 (26.5, 54.1)	47.5 (32.8, 64.8)	
TOTAL		**604**	**3286**						

Note: Only combinations with over 20 procedures have been listed
* denotes prosthesis combination with no reported use in patella/trochlear knee replacement in 2016

OUTCOME FOR OSTEOARTHRITIS

The Registry has recorded 595 revisions of primary patella/trochlear knee replacement for osteoarthritis.

The most common reason for revision is progression of disease (47.9%), followed by loosening (16.5%) and pain (12.3%) (Table KP8).

The main type of revision of a primary patella/trochlear knee replacement is to a total knee replacement (84.7%) (Table KP9).

The cumulative percent revision for primary patella/trochlear knee replacement undertaken for osteoarthritis is 14.5% at five years and 41.0% at 14 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 (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	285	47.9
Loosening	98	16.5
Pain	73	12.3
Implant Breakage Patella	23	3.9
Wear Patella	19	3.2
Infection	16	2.7
Malalignment	15	2.5
Lysis	10	1.7
Other	56	9.4
TOTAL	**595**	**100.0**

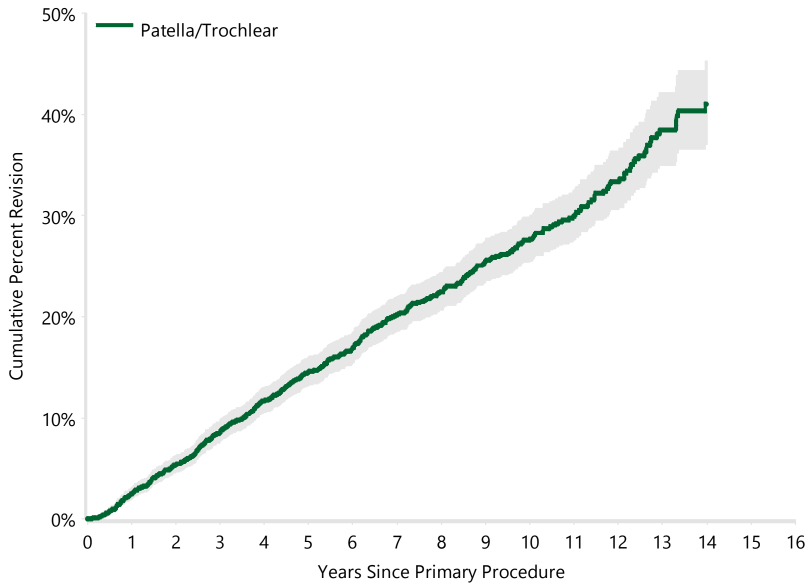
Table KP9 Primary Patella/Trochlea Knee Replacement by Type of Revision (Primary Diagnosis OA)

Type of Revision	Number	Percent
TKR (Tibial/Femoral)	504	84.7
Patella Only	56	9.4
Patella/Trochlea Resurfacing	24	4.0
UKR (Uni Tibial/Uni Femoral)	7	1.2
Removal of Prostheses	2	0.3
Cement Spacer	2	0.3
TOTAL	**595**	**100.0**

Table KP10 Cumulative Percent Revision of Primary Patella/Trochlea Knee Replacement (Primary Diagnosis OA)

Knee Class	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	13 Yrs	14 Yrs
Patella/Trochlear	595	3251	2.5 (2.0, 3.1)	8.6 (7.6, 9.7)	14.5 (13.2, 16.0)	27.6 (25.4, 29.9)	38.5 (35.0, 42.2)	41.0 (37.0, 45.2)
TOTAL	**595**	**3251**						

Figure KP4 Cumulative Percent Revision of Primary Patella/Trochlea Knee Replacement (Primary Diagnosis OA)

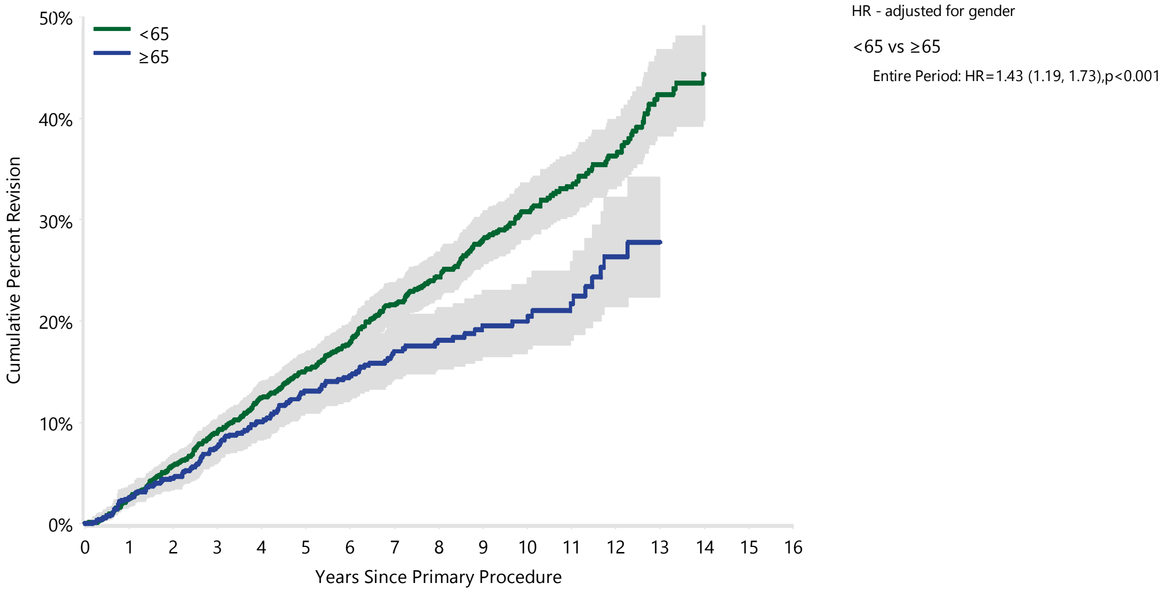


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	13 Yrs	14 Yrs
Patella/Trochlear	3251	2874	2220	1650	524	153	83

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	14 Yrs
<65	453	2231	2.5 (1.9, 3.3)	9.0 (7.8, 10.4)	15.2 (13.5, 16.9)	30.7 (28.0, 33.7)	42.4 (38.2, 46.7)	44.3 (39.8, 49.1)
≥65	142	1020	2.5 (1.7, 3.7)	7.5 (6.0, 9.5)	13.1 (10.9, 15.7)	19.9 (16.8, 23.6)	27.8 (22.3, 34.2)	
TOTAL	**595**	**3251**						

Figure KP5 Cumulative Percent Revision of Primary Patella/Trochlea Knee Replacement by Age (Primary Diagnosis OA)

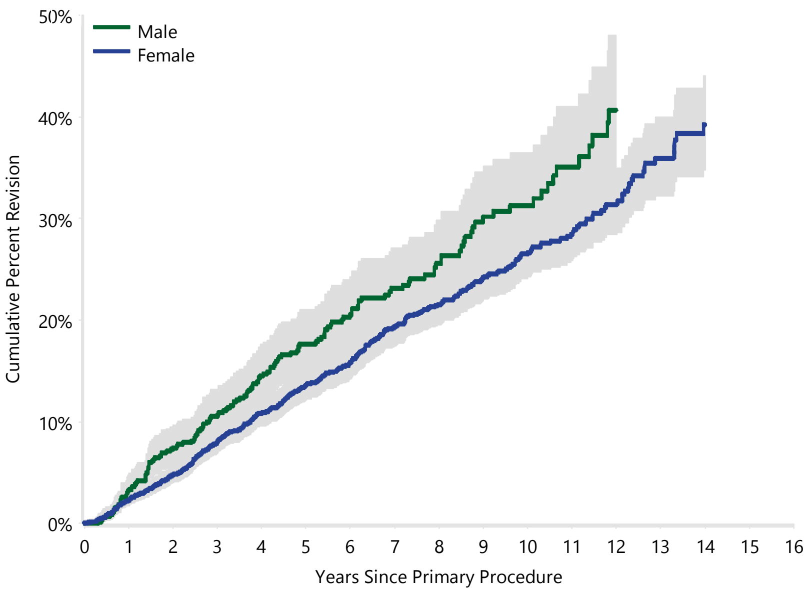


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	13 Yrs	14 Yrs
<65	2231	1965	1534	1134	370	113	65
≥65	1020	909	686	516	154	40	18

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	14 Yrs
Male	159	752	3.3 (2.2, 4.9)	10.5 (8.4, 13.2)	17.6 (14.7, 21.0)	31.3 (26.7, 36.4)		
Female	436	2499	2.2 (1.7, 2.9)	8.0 (6.9, 9.2)	13.6 (12.1, 15.2)	26.5 (24.1, 29.1)	35.9 (32.2, 39.9)	39.2 (34.8, 44.0)
TOTAL	**595**	**3251**						

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=1.32 (1.10, 1.58),p=0.002

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	13 Yrs	14 Yrs
Male	752	653	502	373	105	29	18
Female	2499	2221	1718	1277	419	124	65

UNICOMPARTMENTAL

DEMOGRAPHICS

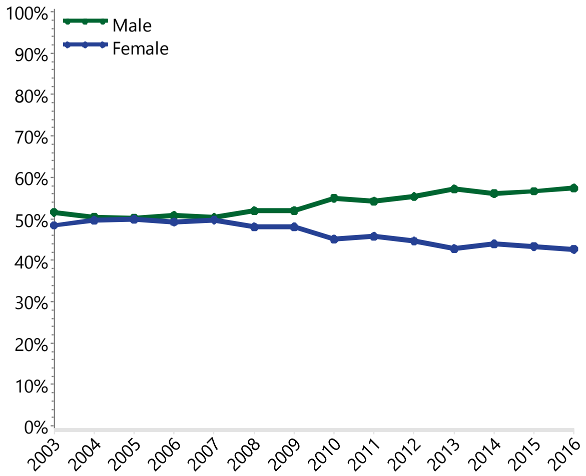
This year, the Registry is reporting on 49,173 primary unicompartmental knee procedures. This is an additional 3,079 procedures compared to the last report.

The use of unicompartmental knee replacement increased from 4.4% of all knee replacements in 2015 to 5.1% in 2016. Although the proportion of unicompartmental knee replacement has increased slightly over the last two years, it is still considerably less than it was in 2003 (14.5%).

Osteoarthritis is the principal diagnosis, accounting for 99.0% of primary unicompartmental knee replacement procedures.

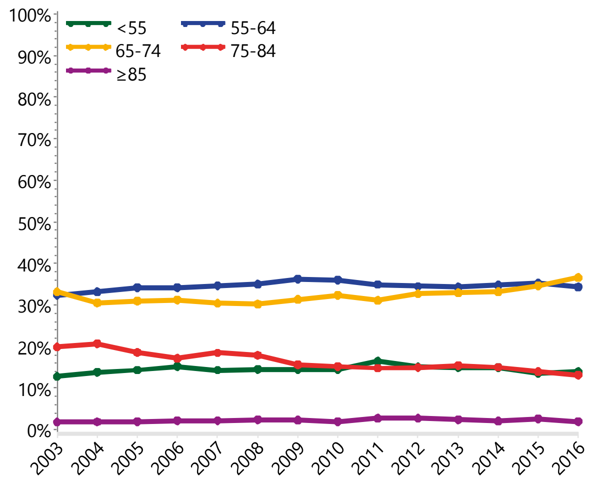
This procedure is undertaken more often in males (52.9%) (Table KP13). The proportion of males has increased from 50.3% in 2007 to 57.4% in 2016 (Figure KP7).

Figure KP7 Primary Unicompartmental Knee Replacement by Gender



Unicompartmental knee replacement is most frequently undertaken in patients aged between 55 and 74 years (66.2%). The age distribution has remained relatively stable since 2003 (Figure KP8). The mean age of patients is 65.2 years (Table KP13).

Figure KP8 Primary Unicompartmental Knee Replacement by Age



In 2016, the 10 most used tibial prostheses accounted for 97.3% of all unicompartmental procedures. The Oxford (cementless), ZUK and Restoris MCK were the most used prostheses in 2016 (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	26020	52.9%	24	98	65	65.7	9.6
Female	23153	47.1%	25	95	64	64.7	10.2
TOTAL	**49173**	**100.0%**	**24**	**98**	**65**	**65.2**	**9.9**

Table KP14 10 Most Used Tibial Prostheses in Primary Unicompartmental Knee Replacement

2003		2013		2014		2015		2016	
N	Model	N	Model	N	Model	N	Model	N	Model
1366	Oxford (ctd)	579	ZUK	674	ZUK	745	ZUK	780	Oxford (cless)
444	Repicci II	483	Oxford (cless)	639	Oxford (cless)	704	Oxford (cless)	730	ZUK
373	Preservation Fixed	398	Oxford (ctd)	397	Oxford (ctd)	394	Oxford (ctd)	607	Restoris MCK
353	M/G	167	Unix	130	Sigma HP	145	Restoris MCK	379	Oxford (ctd)
336	Allegretto Uni	96	Sigma HP	97	Unix	128	Sigma HP	156	Sigma HP
321	GRU	68	Repicci II	52	Journey Uni	113	Unix	133	Journey Uni
275	Genesis	64	Journey Uni	51	Freedom PKR/Active	54	Triathlon PKR	62	Unix
260	Unix	63	Freedom PKR/Active	47	Endo-Model Sled	46	GRU	40	Endo-Model Sled
121	Preservation Mobile	37	Endo-Model Sled	35	Repicci II	46	Repicci II	40	Triathlon PKR
101	Endo-Model Sled	36	BalanSys Uni Fixed	28	BalanSys Uni Fixed	41	Journey Uni	18	GMK-UNI
10 Most Used									
3950 (10)	96.1%	1991 (10)	93.1%	2150 (10)	94.8%	2416 (10)	94.7%	2945 (10)	97.3%
Remainder									
159 (7)	3.9%	147 (10)	6.9%	119 (10)	5.2%	136 (10)	5.3%	83 (8)	2.7%
TOTAL									
4109 (17)	100.0%	2138 (20)	100.0%	2269 (20)	100.0%	2552 (20)	100.0%	3028 (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	16 Yrs
Allegretto Uni	Allegretto Uni*	324	2035	3.2 (2.5, 4.0)	5.8 (4.9, 6.9)	8.1 (6.9, 9.3)	14.5 (13.0, 16.3)	21.4 (19.0, 24.0)	23.5 (20.3, 27.1)
BalanSys Uni	BalanSys Uni Fixed	21	388	1.8 (0.9, 3.8)	3.0 (1.7, 5.3)	4.0 (2.4, 6.8)	8.1 (5.2, 12.7)		
Endo-Model Sled	Endo-Model Sled	153	1229	1.1 (0.6, 1.9)	4.8 (3.7, 6.2)	7.6 (6.2, 9.3)	14.4 (12.2, 16.9)		
Freedom PKR/Active	Freedom PKR/Active	296	1500	1.7 (1.1, 2.5)	7.4 (6.2, 8.9)	12.8 (11.1, 14.7)	24.8 (22.3, 27.6)		
GRU	GRU	252	2050	1.4 (1.0, 2.0)	4.4 (3.6, 5.4)	6.1 (5.1, 7.3)	13.1 (11.5, 14.8)		
Genesis	Genesis*	309	1864	2.7 (2.0, 3.5)	8.3 (7.1, 9.6)	11.0 (9.6, 12.5)	16.3 (14.6, 18.1)		
Journey	Journey	18	243	1.3 (0.4, 4.0)	6.3 (3.8, 10.4)	8.7 (5.6, 13.6)			
Journey	Journey Uni	10	322	3.5 (1.8, 7.0)	4.9 (2.6, 9.2)				
M/G	M/G*	258	2135	1.6 (1.1, 2.2)	4.2 (3.4, 5.1)	6.4 (5.5, 7.6)	10.7 (9.4, 12.1)	15.5 (13.6, 17.6)	
Oxford (cless)	Oxford (cless)	236	4209	3.1 (2.6, 3.7)	5.1 (4.4, 5.9)	6.8 (5.9, 7.8)	13.2 (10.3, 16.7)		
Oxford (cless)	Oxford (ctd)	21	329	3.5 (1.9, 6.5)	7.9 (4.9, 12.8)	11.4 (7.1, 18.1)			
Oxford (ctd)	Oxford (ctd)	1807	12811	2.2 (1.9, 2.4)	5.8 (5.4, 6.2)	8.4 (7.9, 8.9)	14.7 (14.0, 15.4)	22.4 (21.2, 23.6)	23.1 (21.7, 24.7)
Preservation	Preservation Fixed*	382	2318	2.4 (1.9, 3.1)	7.1 (6.1, 8.2)	9.5 (8.4, 10.8)	15.6 (14.1, 17.2)	22.8 (19.8, 26.1)	
Preservation	Preservation Mobile*	126	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)		
Repicci II	Repicci II	572	3045	1.7 (1.3, 2.2)	4.8 (4.1, 5.6)	7.9 (7.0, 8.9)	17.7 (16.2, 19.3)	28.6 (26.2, 31.2)	
Restoris MCK	Restoris MCK	5	752	0.8 (0.3, 1.9)					
Sigma HP	Sigma HP	27	857	0.9 (0.4, 1.9)	3.0 (1.9, 4.7)	4.4 (3.0, 6.6)			
Triathlon PKR	Triathlon PKR	16	224	3.0 (1.4, 6.6)	7.8 (4.5, 13.3)	9.5 (5.4, 16.4)			
Uniglide	Uniglide	137	751	4.9 (3.5, 6.7)	10.6 (8.6, 13.1)	12.8 (10.6, 15.5)	19.8 (16.9, 23.2)		
Unix	Unix	411	3862	2.4 (2.0, 2.9)	5.3 (4.6, 6.1)	7.0 (6.2, 7.9)	12.1 (10.9, 13.3)	18.6 (16.1, 21.4)	
ZUK	ZUK	275	5921	1.4 (1.1, 1.7)	3.6 (3.1, 4.2)	4.9 (4.3, 5.6)	8.9 (7.6, 10.3)		
Other (36)		308	1928	3.8 (3.0, 4.8)	8.6 (7.4, 9.9)	11.1 (9.8, 12.7)	19.7 (17.7, 22.0)	24.1 (21.3, 27.1)	
TOTAL		**5964**	**49173**						

Note: Only combinations with over 200 procedures have been listed
* denotes prosthesis combination with no reported use in unicompartmental knee replacement in 2016

OUTCOME FOR OSTEOARTHRITIS

The Registry has recorded 5,894 revisions of primary unicompartmental knee replacements.

The cumulative percent revision at 16 years for primary unicompartmental knee replacement undertaken for osteoarthritis is 23.4% (Table KP16 and Figure KP9).

The main reasons for revision are loosening (39.9%), progression of disease (31.3%) and pain (8.9%) (Table KP17 and Figure KP10). The main type of revision is to a total knee replacement (87.0%) (Table KP18).

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).

Comparison of Medial and Lateral Unicompartmental Knee Replacement

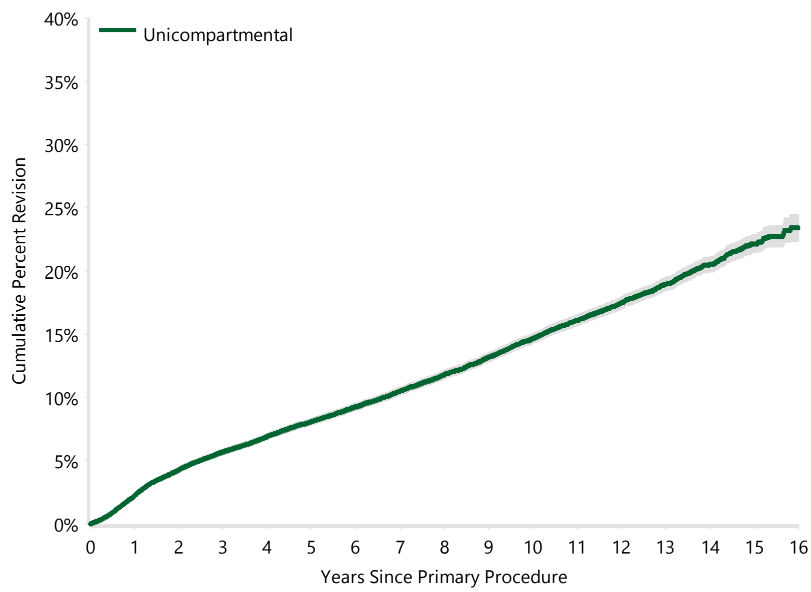
The Registry has recorded 1,992 lateral unicompartmental knee procedures undertaken for osteoarthritis. There is no difference in the rate of revision when compared to medial unicompartmental knee replacement (Table KP21 and Figure KP13).

The outcome of prosthesis combinations with more than 50 procedures used in lateral unicompartmental knee replacement is presented in Table KP22.

Table KP16 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement (Primary Diagnosis OA)

Knee Class	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Unicompartmental	5894	48661	2.2 (2.1, 2.4)	5.7 (5.5, 5.9)	8.1 (7.8, 8.4)	14.6 (14.3, 15.0)	22.1 (21.4, 22.9)	23.4 (22.4, 24.5)
TOTAL	**5894**	**48661**						

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	16 Yrs
Unicompartmental	48661	44448	37673	31992	15639	1471	291

Table KP17 **Primary Unicompartmental Knee Replacement by Reason for Revision (Primary Diagnosis OA)**

Reason for Revision	Number	Percent
Loosening	2352	39.9
Progression Of Disease	1844	31.3
Pain	524	8.9
Infection	232	3.9
Lysis	147	2.5
Fracture	136	2.3
Bearing Dislocation	117	2.0
Wear Tibial Insert	83	1.4
Malalignment	66	1.1
Instability	62	1.1
Wear Tibial	48	0.8
Other	283	4.8
TOTAL	**5894**	**100.0**

Table KP18 **Primary Unicompartmental Knee Replacement by Type of Revision (Primary Diagnosis OA)**

Type of Revision	Number	Percent
TKR (Tibial/Femoral)	5126	87.0
Uni Insert Only	343	5.8
Uni Tibial Component	207	3.5
Uni Femoral Component	69	1.2
UKR (Uni Tibial/Uni Femoral)	64	1.1
Cement Spacer	50	0.8
Patella/Trochlear Resurfacing	10	0.2
Removal of Prostheses	7	0.1
Reinsertion of Components	6	0.1
Patella Only	5	0.1
Femoral Component*	4	0.1
Cement Only	2	0.0
Tibial Component	1	0.0
TOTAL	**5894**	**100.0**

Note: *Bicompartmental Component

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

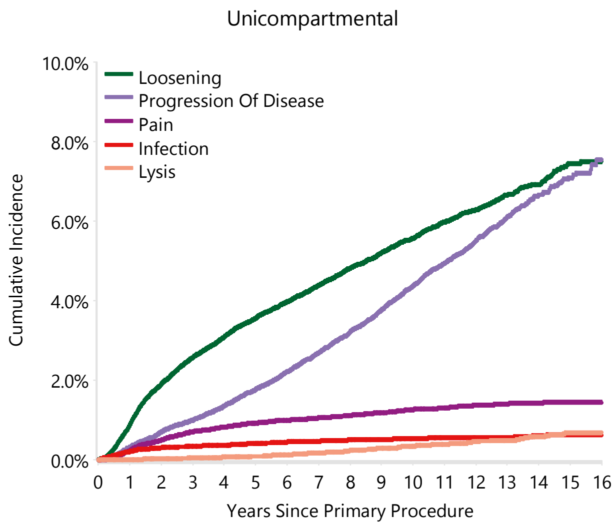
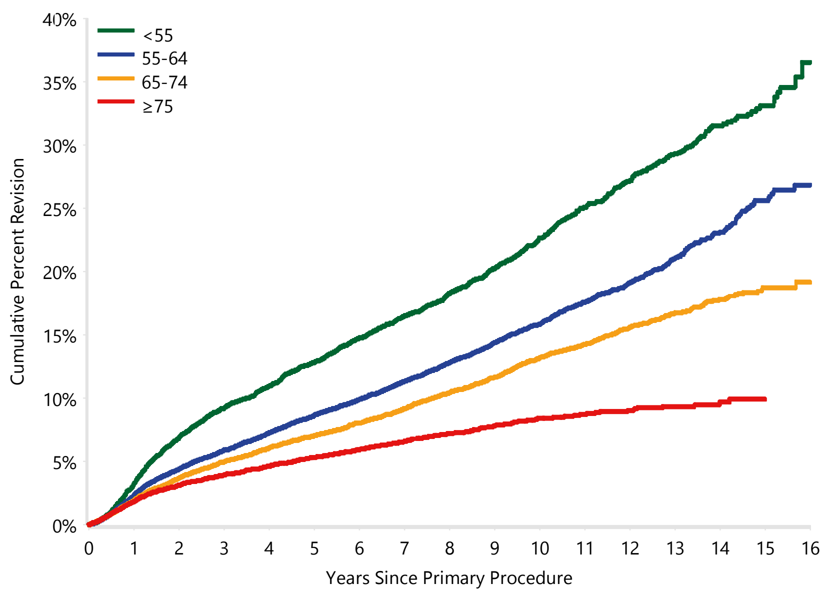


Table KP19 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement by Age (Primary Diagnosis OA)

Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
<55	1361	6964	3.2 (2.8, 3.7)	9.2 (8.5, 9.9)	12.8 (12.0, 13.7)	22.7 (21.5, 23.9)	33.1 (31.2, 35.2)	36.5 (33.1, 40.2)
55-64	2255	16499	2.3 (2.1, 2.6)	5.9 (5.5, 6.3)	8.6 (8.2, 9.1)	15.8 (15.1, 16.5)	25.6 (24.3, 27.0)	26.9 (25.2, 28.6)
65-74	1670	15759	1.9 (1.7, 2.2)	5.0 (4.6, 5.3)	7.0 (6.6, 7.5)	13.2 (12.5, 13.8)	18.7 (17.7, 19.9)	19.2 (17.8, 20.6)
≥75	608	9439	1.8 (1.6, 2.1)	3.9 (3.5, 4.4)	5.3 (4.9, 5.9)	8.4 (7.7, 9.1)	9.9 (8.9, 11.0)	
TOTAL	**5894**	**48661**						

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



HR - adjusted for gender

<55 vs ≥75
- 0 - 6Mth: HR=1.39 (1.04, 1.87),p=0.028
- 6Mth - 1Yr: HR=2.02 (1.60, 2.55),p<0.001
- 1Yr - 2Yr: HR=3.04 (2.48, 3.73),p<0.001
- 2Yr - 4.5Yr: HR=2.86 (2.41, 3.38),p<0.001
- 4.5Yr - 6Yr: HR=3.07 (2.44, 3.87),p<0.001
- 6Yr - 8Yr: HR=3.04 (2.44, 3.77),p<0.001
- 8Yr - 9Yr: HR=3.56 (2.59, 4.91),p<0.001
- 9Yr - 10Yr: HR=5.07 (3.69, 6.99),p<0.001
- 10Yr+: HR=7.06 (5.23, 9.52),p<0.001

55-64 vs ≥75
- 0 - 1Yr: HR=1.28 (1.07, 1.54),p=0.008
- 1Yr - 1.5Yr: HR=1.75 (1.39, 2.21),p<0.001
- 1.5Yr - 4Yr: HR=1.83 (1.57, 2.13),p<0.001
- 4Yr - 7Yr: HR=2.13 (1.81, 2.50),p<0.001
- 7Yr - 10Yr: HR=2.69 (2.19, 3.31),p<0.001
- 10Yr+: HR=5.37 (4.05, 7.13),p<0.001

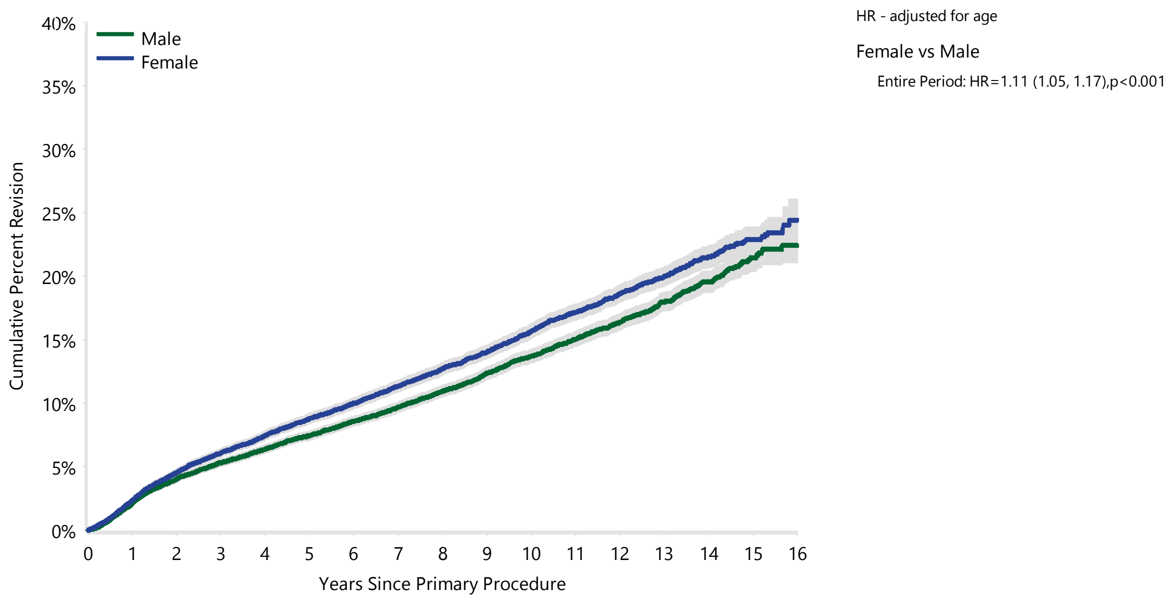
65-74 vs ≥75
- 0 - 6Mth: HR=1.15 (0.90, 1.48),p=0.272
- 6Mth - 1Yr: HR=1.01 (0.80, 1.27),p=0.933
- 1Yr - 2Yr: HR=1.46 (1.20, 1.79),p<0.001
- 2Yr - 5Yr: HR=1.52 (1.30, 1.78),p<0.001
- 5Yr - 7Yr: HR=1.67 (1.36, 2.04),p<0.001
- 7Yr - 9Yr: HR=2.10 (1.66, 2.66),p<0.001
- 9Yr+: HR=3.06 (2.37, 3.95),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
<55	6964	6326	5288	4495	2243	249	48
55-64	16499	15082	12869	11049	5558	531	99
65-74	15759	14334	12153	10364	5251	550	116
≥75	9439	8706	7363	6084	2587	141	28

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	16 Yrs
Male		**2839**	**25794**	**2.1 (1.9, 2.3)**	**5.3 (5.0, 5.6)**	**7.5 (7.1, 7.8)**	**13.7 (13.2, 14.2)**	**21.5 (20.4, 22.6)**	**22.4 (21.1, 23.8)**
	<55	581	3098	3.2 (2.6, 3.9)	9.0 (8.0, 10.2)	12.3 (11.1, 13.6)	21.9 (20.2, 23.8)	34.2 (31.0, 37.6)	
	55-64	1161	8815	2.3 (2.0, 2.7)	5.8 (5.3, 6.4)	8.6 (8.0, 9.2)	15.6 (14.7, 16.6)	25.3 (23.5, 27.3)	27.1 (24.7, 29.7)
	65-74	814	8823	1.7 (1.5, 2.1)	4.5 (4.1, 5.0)	6.1 (5.6, 6.7)	11.7 (10.9, 12.6)	17.2 (15.7, 18.8)	17.2 (15.7, 18.8)
	≥75	283	5058	1.6 (1.3, 2.0)	3.6 (3.1, 4.2)	4.8 (4.2, 5.4)	7.8 (6.9, 8.8)	9.5 (8.0, 11.4)	
Female		**3055**	**22867**	**2.4 (2.2, 2.6)**	**6.1 (5.8, 6.4)**	**8.8 (8.4, 9.2)**	**15.6 (15.1, 16.2)**	**22.9 (21.9, 23.9)**	**24.4 (22.9, 26.0)**
	<55	780	3866	3.2 (2.7, 3.9)	9.3 (8.4, 10.3)	13.2 (12.2, 14.4)	23.2 (21.7, 24.9)	32.4 (30.0, 35.0)	
	55-64	1094	7684	2.3 (2.0, 2.7)	6.0 (5.4, 6.5)	8.7 (8.1, 9.4)	16.0 (15.1, 17.0)	25.9 (24.0, 27.9)	
	65-74	856	6936	2.2 (1.9, 2.6)	5.5 (5.0, 6.1)	8.1 (7.5, 8.8)	14.9 (13.9, 15.9)	20.6 (19.0, 22.3)	21.4 (19.2, 23.7)
	≥75	325	4381	2.0 (1.7, 2.5)	4.3 (3.7, 5.0)	6.0 (5.3, 6.8)	9.1 (8.1, 10.1)	10.4 (9.2, 11.9)	
TOTAL		**5894**	**48661**						

Figure KP12 Cumulative Percent Revision of Primary Unicompartmental Knee Replacement by Gender (Primary Diagnosis OA)



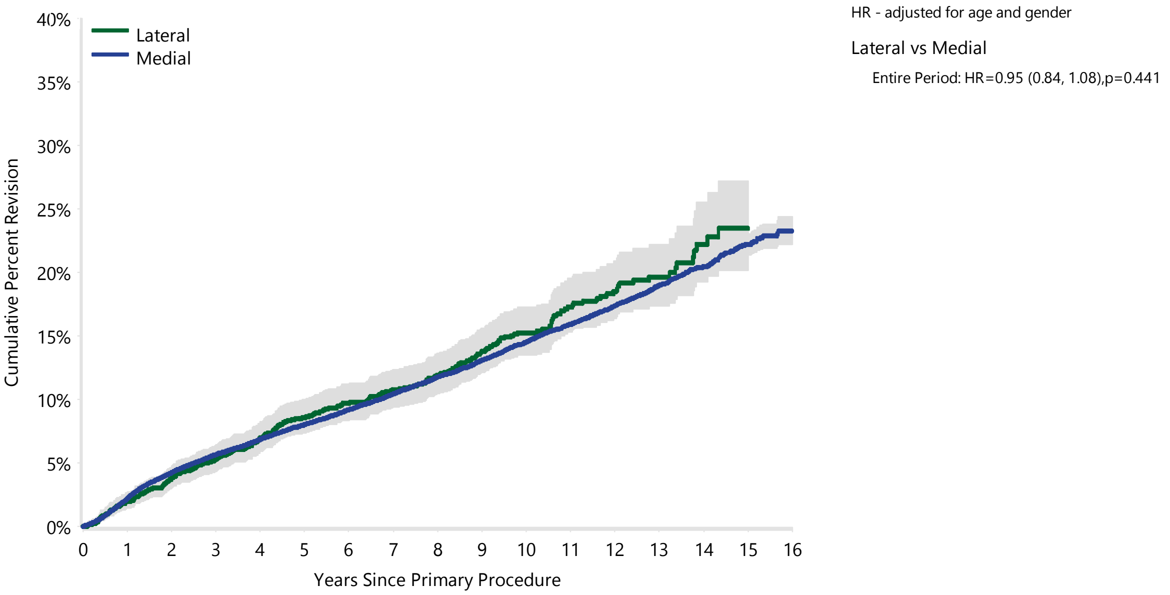
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Male	25794	23424	19615	16451	7787	743	148
Female	22867	21024	18058	15541	7852	728	143

Table KP21 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	16 Yrs
Lateral	265	1992	2.0 (1.5, 2.8)	5.3 (4.4, 6.4)	8.6 (7.4, 10.0)	15.3 (13.5, 17.3)	23.5 (20.2, 27.2)	
Medial	5080	43298	2.2 (2.1, 2.4)	5.7 (5.4, 5.9)	8.0 (7.8, 8.3)	14.5 (14.1, 14.9)	22.2 (21.4, 23.1)	23.3 (22.2, 24.4)
TOTAL	**5345**	**45290**						

Note: Excludes 3,371 primary unicompartmental knee procedures with unknown/missing position

Figure KP13 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	16 Yrs
Lateral	1992	1855	1605	1383	710	59	14
Medial	43298	39332	33052	27872	13207	1098	212

Table KP22 Cumulative Percent Revision of Lateral Primary Unicompartmental Knee Replacement by Prosthesis Combination (Primary Diagnosis OA)

Femoral Component	Tibial Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Endo-Model Sled	Endo-Model Sled	16	141	0.0 (0.0, 0.0)	3.9 (1.6, 9.2)	7.5 (4.0, 13.9)			
Freedom PKR/Active	Freedom PKR/Active	20	150	0.7 (0.1, 4.7)	5.8 (2.9, 11.2)	9.9 (5.9, 16.5)			
GRU	GRU	23	193	2.6 (1.1, 6.2)	4.2 (2.1, 8.3)	5.3 (2.9, 9.7)	12.8 (8.5, 19.0)		
Genesis	Genesis	24	137	1.5 (0.4, 5.7)	5.8 (3.0, 11.3)	9.6 (5.7, 15.9)	17.0 (11.5, 24.8)		
M/G	M/G	8	54	1.9 (0.3, 12.4)	3.7 (0.9, 14.1)	3.7 (0.9, 14.1)	10.9 (4.6, 24.3)		
Oxford (cless)	Oxford (ctd)	2	51	2.1 (0.3, 13.9)	2.1 (0.3, 13.9)	2.1 (0.3, 13.9)			
Oxford (ctd)	Oxford (ctd)	30	158	6.4 (3.5, 11.6)	9.1 (5.5, 14.9)	13.1 (8.5, 19.8)	21.7 (15.2, 30.5)		
Preservation	Preservation Fixed	16	149	0.0 (0.0, 0.0)	3.4 (1.4, 8.0)	6.8 (3.7, 12.3)	10.0 (6.0, 16.4)		
Repicci II	Repicci II	62	258	2.3 (1.1, 5.1)	7.1 (4.5, 11.0)	12.8 (9.2, 17.6)	20.9 (16.2, 26.8)		
Unix	Unix	21	184	1.1 (0.3, 4.4)	3.4 (1.6, 7.5)	7.2 (4.1, 12.3)	11.7 (7.5, 18.1)		
ZUK	ZUK	8	176	0.0 (0.0, 0.0)	2.1 (0.7, 6.3)	5.8 (2.6, 13.0)			
Other (28)		35	341	3.5 (1.9, 6.2)	6.8 (4.4, 10.3)	8.6 (5.8, 12.6)	13.9 (9.8, 19.6)		
TOTAL		**265**	**1992**						

Note: Only combinations with over 50 procedures have been listed.

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 sub-divides these systems into the specific prosthesis types. The initial characteristic used is fixation. Further sub-division is based on mobility, stability and flexion capacity. However, this further system sub-division is not uniformly applied to all knee systems at this time.

High use prosthesis systems are sub-divided. 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 sub-divided. 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 sub-divided.

DEMOGRAPHICS

There have been 547,407 primary total knee replacement procedures reported to the Registry. This is an additional 52,836 procedures compared to the last report.

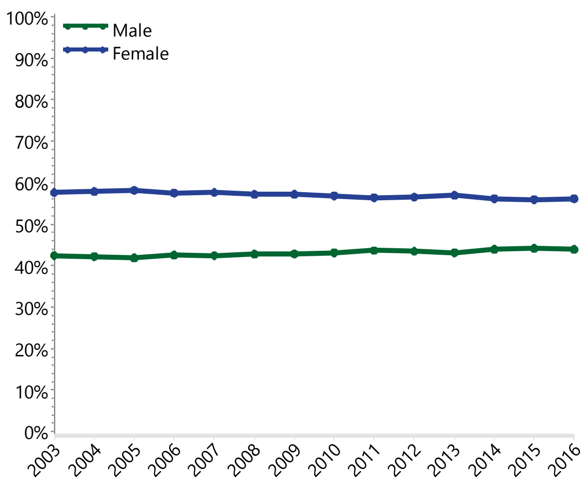
Primary total knee replacement continues to increase. In 2016, there were 2.8% more procedures than 2015 and 139.8% more than in 2003. As a proportion of all knee replacement procedures, primary total knee replacement increased from 76.7% in 2003 to 87.0% in 2016.

Osteoarthritis is the most common diagnosis for primary total knee replacement (97.6%).

There have been 547,407 primary total knee replacement procedures reported to the Registry. This is an additional 52,836 procedures compared to the last report.

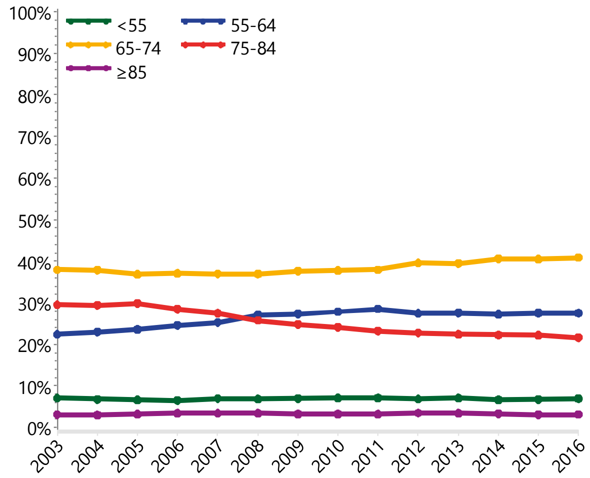
In 2016, primary total knee replacement remains more common in females (56.1%). This proportion has remained constant since 2003 (Figure KT1). The mean age of patients is 68.5 years (Table KT1).

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 21.6% in 2016. The proportion of patients aged less than 55 years remains small (6.9% in 2016) and there has been little change in that proportion since 2003 (Figure KT2).

Figure KT2 Primary Total Knee Replacement by Age



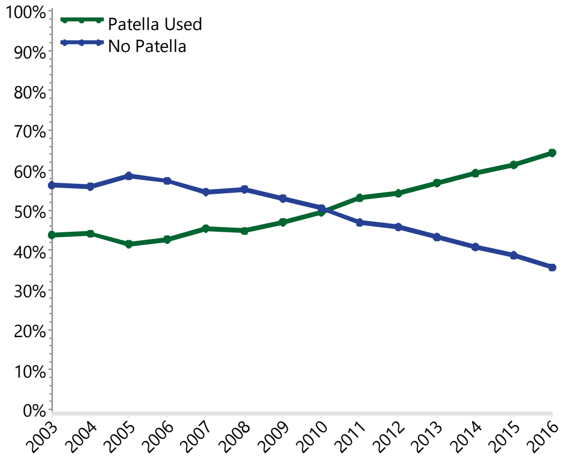
Detailed demographic information on primary total knee replacement is available in the supplementary report 'Demographics of Hip, Knee and Shoulder Arthroplasty' on the AOANJRR website: https://aoanjrr.sahmri.com/annual-reports-2017.

Table KT1 Age and Gender of Primary Total Knee Replacement

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Female	310950	56.8%	8	103	69	68.8	9.4
Male	236457	43.2%	8	101	68	68.2	9.2
TOTAL	**547407**	**100.0%**	**8**	**103**	**69**	**68.5**	**9.3**

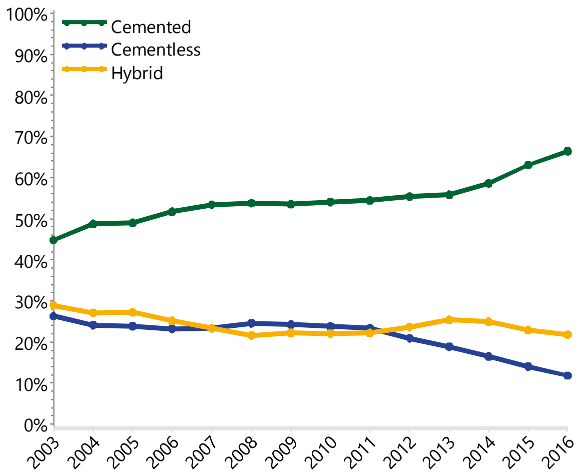
Patellar resurfacing at the time of the primary total knee replacement continues to increase from a low of 41.5% in 2005 to 64.4% in 2016 (Figure KT3).

Figure KT3 Primary Total Knee Replacement by Patella Usage



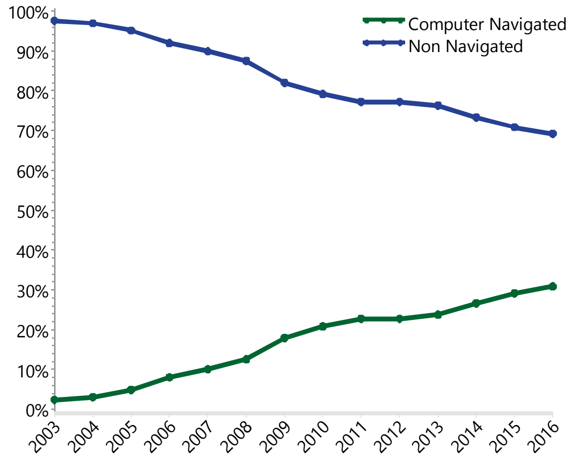
The most common method of fixation is cementing both femoral and tibial components. This has increased from 44.8% in 2003 to 66.4% in 2016. The use of cementless fixation continues to decrease from a peak of 26.3% in 2003 to 11.8% in 2016 (Figure KT4).

Figure KT4 Primary Total Knee Replacement by Fixation



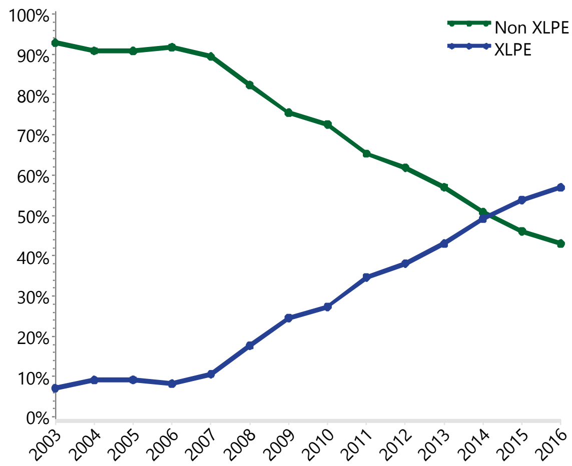
The proportion of primary total knee replacement procedures inserted with computer navigation has increased from 2.4% in 2003 to 30.8% in 2016 (Figure KT5).

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 57.0% in 2016 (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 2016, the most commonly used femoral prostheses were the Triathlon CR (18.2%), Nexgen CR Flex (12.3%) and Nexgen LPS Flex (5.7%) (Table KT2). The most used prostheses are also reported based on fixation (cemented, cementless and hybrid) (Tables KT3 to KT5).

Table KT2 10 Most Used Femoral Prostheses in Primary Total Knee Replacement

2003		2013		2014		2015		2016	
N	Model	N	Model	N	Model	N	Model	N	Model
3184	LCS CR	7407	Triathlon CR	8091	Triathlon CR	8703	Triathlon CR	9467	Triathlon CR
2847	Duracon	6179	Nexgen CR Flex	6382	Nexgen CR Flex	6337	Nexgen CR Flex	6416	Nexgen CR Flex
2150	Nexgen CR	3259	LCS CR	3216	LCS CR	3327	Vanguard CR	2971	Nexgen LPS Flex
1419	PFC Sigma CR	2814	Nexgen LPS Flex	3004	Vanguard CR	3106	Nexgen LPS Flex	2836	Vanguard CR
1354	Scorpio CR	2698	PFC Sigma CR	2896	Nexgen LPS Flex	2925	LCS CR	2721	LCS CR
1058	Genesis II CR	2653	Vanguard CR	2286	PFC Sigma CR	2216	Attune CR	2476	Attune CR
1002	Natural Knee II	1598	Genesis II CR	2018	Legion Oxinium PS	2000	Legion Oxinium PS	1949	Legion Oxinium PS
902	Nexgen LPS	1537	Genesis II Oxinium PS	1510	Genesis II CR	1455	PFC Sigma CR	1534	GMK Sphere Primary
883	Profix	1388	Legion Oxinium PS	1404	Genesis II Oxinium PS	1397	Genesis II CR	1475	Genesis II Oxinium PS
751	Scorpio PS	1292	PFC Sigma PS	1254	Genesis II PS	1390	Genesis II Oxinium PS	1451	Evolution
10 Most Used									
15550 (10)	71.5%	30825 (10)	69.3%	32061 (10)	67.8%	32856 (10)	64.8%	33296 (10)	63.9%
Remainder									
6184 (47)	28.5%	13668 (74)	30.7%	15221 (71)	32.2%	17849 (75)	35.2%	18830 (69)	36.1%
TOTAL									
21734 (57)	100.0%	44493 (84)	100.0%	47282 (81)	100.0%	50705 (85)	100.0%	52126 (79)	100.0%

Table KT3 10 Most Used Femoral Prostheses in Cemented Primary Total Knee Replacement

2003		2013		2014		2015		2016	
N	Model	N	Model	N	Model	N	Model	N	Model
1212	Duracon	3390	Triathlon CR	4033	Triathlon CR	4644	Triathlon CR	5367	Triathlon CR
933	LCS CR	2388	Nexgen LPS Flex	2540	Nexgen LPS Flex	2741	Nexgen LPS Flex	3163	Nexgen CR Flex
826	Nexgen LPS	2254	Nexgen CR Flex	2345	Nexgen CR Flex	2718	Nexgen CR Flex	2652	Nexgen LPS Flex
760	Nexgen CR	1537	Genesis II Oxinium PS	2018	Legion Oxinium PS	2216	Attune CR	2476	Attune CR
693	Nexgen LPS Flex	1386	Legion Oxinium PS	1404	Genesis II Oxinium PS	2000	Legion Oxinium PS	1949	Legion Oxinium PS
644	Genesis II CR	1206	Genesis II PS	1276	Vanguard CR	1390	Genesis II Oxinium PS	1533	GMK Sphere Primary
494	Profix	1167	Vanguard CR	1225	Genesis II PS	1327	Vanguard CR	1475	Genesis II Oxinium PS
471	Genesis II Oxinium CR	1089	PFC Sigma PS	1017	PFC Sigma CR	1189	Genesis II PS	1451	Evolution
471	PFC Sigma PS	1088	PFC Sigma CR	941	Genesis II CR	1133	GMK Sphere Primary	1134	Vanguard CR
418	Genesis II PS	996	Genesis II CR	927	PFC Sigma PS	1088	Evolution	1047	Attune PS
10 Most Used									
6922 (10)	71.8%	16501 (10)	66.6%	17726 (10)	64.2%	20446 (10)	64.1%	22247 (10)	64.5%
Remainder									
2718 (38)	28.2%	8267 (68)	33.4%	9891 (67)	35.8%	11434 (72)	35.9%	12261 (65)	35.5%
TOTAL									
9640 (48)	100.0%	24768 (78)	100.0%	27617 (77)	100.0%	31880 (82)	100.0%	34508 (75)	100.0%

Table KT4 10 Most Used Femoral Prostheses in Cementless Primary Total Knee Replacement

2003		2013		2014		2015		2016	
N	Model	N	Model	N	Model	N	Model	N	Model
1490	LCS CR	1739	Triathlon CR	1687	Nexgen CR Flex	1590	Nexgen CR Flex	1373	Nexgen CR Flex
810	Nexgen CR	1732	Nexgen CR Flex	1626	Triathlon CR	1373	Triathlon CR	1238	LCS CR
519	Natural Knee II	1472	LCS CR	1427	LCS CR	1273	LCS CR	1228	Triathlon CR
488	Active Knee	440	RBK	410	Vanguard CR	410	Vanguard CR	394	Scorpio NRG CR
484	Duracon	413	Vanguard CR	385	RBK	360	Scorpio NRG CR	287	Vanguard CR
318	Scorpio CR	354	PFC Sigma CR	252	Score	347	RBK	264	RBK
313	PFC Sigma CR	249	ACS	247	Scorpio NRG CR	249	Score	226	Nexgen LPS Flex
304	RBK	248	Nexgen LPS Flex	237	PFC Sigma CR	245	Nexgen LPS Flex	152	Score
188	Profix	238	Score	210	Nexgen LPS Flex	184	PFC Sigma CR	138	GMK Primary
182	Scorpio PS	233	Active Knee	176	GMK Primary	143	Natural Knee Flex	131	PFC Sigma CR
10 Most Used									
5096 (10)	87.8%	7118 (10)	84.4%	6657 (10)	84.7%	6174 (10)	85.8%	5431 (10)	87.5%
Remainder									
705 (17)	12.2%	1318 (26)	15.6%	1198 (24)	15.3%	1019 (22)	14.2%	776 (17)	12.5%
TOTAL									
5801 (27)	100.0%	8436 (36)	100.0%	7855 (34)	100.0%	7193 (32)	100.0%	6207 (27)	100.0%

Table KT5 10 Most Used Femoral Prostheses in Hybrid Primary Total Knee Replacement

2003		2013		2014		2015		2016	
N	Model	N	Model	N	Model	N	Model	N	Model
1151	Duracon	2278	Triathlon CR	2432	Triathlon CR	2686	Triathlon CR	2872	Triathlon CR
765	PFC Sigma CR	2193	Nexgen CR Flex	2350	Nexgen CR Flex	2029	Nexgen CR Flex	1880	Nexgen CR Flex
761	LCS CR	1256	PFC Sigma CR	1318	Vanguard CR	1590	Vanguard CR	1415	Vanguard CR
742	Scorpio CR	1073	Vanguard CR	1032	PFC Sigma CR	777	LCS CR	698	LCS CR
580	Nexgen CR	893	LCS CR	881	LCS CR	520	Genesis II CR	513	Genesis II CR
360	Genesis II CR	547	Genesis II CR	509	Genesis II CR	391	Scorpio CR	447	Apex Knee CR
276	Maxim	352	Scorpio CR	382	Scorpio CR	377	Legion CR	376	BalanSys
232	Natural Knee II	321	Triathlon PS	294	Triathlon PS	367	PFC Sigma CR	375	PFC Sigma CR
205	AGC	203	PFC Sigma PS	288	Legion CR	337	Score	363	Scorpio CR
204	Scorpio PS	194	Active Knee	283	ACS	294	Natural Knee Flex	312	Score
10 Most Used									
5276 (10)	83.8%	9310 (10)	82.5%	9769 (10)	82.7%	9368 (10)	80.5%	9251 (10)	81.1%
Remainder									
1017 (26)	16.2%	1979 (34)	17.5%	2041 (33)	17.3%	2264 (34)	19.5%	2160 (31)	18.9%
TOTAL									
6293 (36)	100.0%	11289 (44)	100.0%	11810 (43)	100.0%	11632 (44)	100.0%	11411 (41)	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 (1.4%), '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).

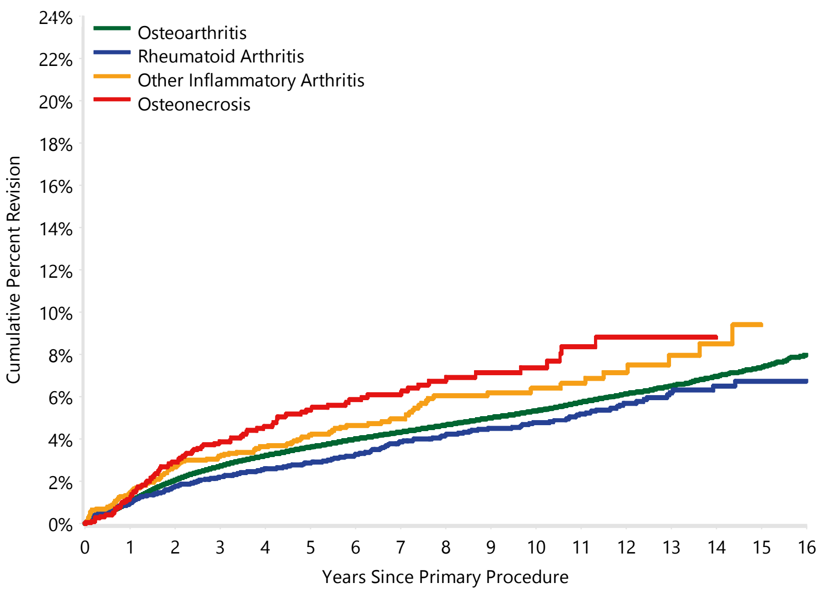
Rheumatoid arthritis has a lower rate of revision compared to osteoarthritis.

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	16 Yrs
Osteoarthritis	19627	534202	1.0 (1.0, 1.1)	2.7 (2.7, 2.8)	3.6 (3.6, 3.7)	5.3 (5.2, 5.4)	7.4 (7.2, 7.6)	8.0 (7.7, 8.3)
Rheumatoid Arthritis	272	7542	1.0 (0.8, 1.2)	2.2 (1.9, 2.6)	2.9 (2.5, 3.3)	4.8 (4.2, 5.5)	6.7 (5.7, 7.9)	6.7 (5.7, 7.9)
Other Inflammatory Arthritis	119	2705	1.5 (1.1, 2.0)	3.2 (2.5, 4.0)	4.2 (3.4, 5.1)	6.4 (5.2, 7.8)	9.4 (7.0, 12.6)	
Osteonecrosis	92	1777	1.2 (0.8, 1.8)	3.9 (3.0, 5.0)	5.4 (4.3, 6.7)	7.4 (5.9, 9.2)		
Other (5)	116	1181	2.6 (1.8, 3.8)	8.2 (6.5, 10.2)	11.0 (8.9, 13.4)	17.5 (14.2, 21.4)		
TOTAL	**20226**	**547407**						

Note: Only primary diagnoses with over 1,000 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 - 9Mth: HR=0.92 (0.71, 1.18),p=0.496
9Mth - 1.5Yr: HR=0.49 (0.36, 0.69),p<0.001
1.5Yr+: HR=0.70 (0.60, 0.81),p<0.001

Other Inflammatory Arthritis vs Osteoarthritis
Entire Period: HR=1.06 (0.89, 1.27),p=0.498

Osteonecrosis vs Osteoarthritis
Entire Period: HR=1.47 (1.19, 1.80),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Osteoarthritis	534202	474281	363321	268621	93358	7947	1861
Rheumatoid Arthritis	7542	6898	5641	4459	1956	229	68
Other Inflammatory Arthritis	2705	2375	1804	1314	470	71	20
Osteonecrosis	1777	1581	1181	869	326	26	3

PROSTHESIS TYPES

There have been 516 femoral and tibial prosthesis combinations used in primary total knee replacement reported to the Registry. In 2016, 119 femoral and tibial combinations were used. This is eight less than in 2015.

The cumulative percent revision of the 144 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 96.4% of all primary total knee replacement. The 'Other' group is the combined outcome of the remaining 372 prosthesis combinations with less than 400 procedures reported per combination.

There are 63 cemented femoral and tibial prosthesis combinations with more than 400 procedures. Of those with a 16 year cumulative percent revision, the Nexgen CR/Nexgen is the lowest at 5.1% (Table KT7).

There are 39 cementless femoral and tibial prosthesis combinations with more than 400 procedures. Of those with a 16 year cumulative percent revision, the Nexgen CR/Nexgen is the lowest at 4.4% (Table KT8).

516 different femoral and tibial prosthesis combinations have been reported to the Registry. Outcomes at 16 years are being reported for the first time.

There are 42 combinations of primary total knee replacement using hybrid fixation and with more than 400 procedures. The PFC Sigma CR/PFC Sigma has the lowest 16 year cumulative percent revision (4.8%) (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	16 Yrs
ACS	ACS Mobile	12	533	1.0 (0.4, 2.4)	1.9 (0.9, 3.9)				
AGC	AGC	195	3497	0.5 (0.3, 0.9)	2.5 (2.0, 3.0)	3.6 (3.0, 4.3)	5.6 (4.8, 6.5)	8.8 (7.4, 10.4)	9.6 (7.6, 12.1)
Active Knee	Active Knee	48	1698	0.9 (0.5, 1.5)	2.4 (1.7, 3.4)	3.7 (2.7, 5.0)	4.8 (3.4, 6.6)		
Advance	Advance II	56	918	1.5 (0.9, 2.6)	4.2 (3.1, 5.7)	4.8 (3.6, 6.4)	7.1 (5.4, 9.4)		
Apex Knee CR	Apex Knee	3	1016	0.1 (0.0, 0.7)	0.7 (0.2, 2.2)				
Apex Knee PS	Apex Knee	25	1953	0.7 (0.4, 1.2)	3.4 (1.9, 5.9)				
Attune CR	Attune	49	5691	0.6 (0.4, 0.9)	2.1 (1.4, 3.1)				
Attune PS	Attune	18	2693	0.4 (0.2, 0.8)	1.1 (0.6, 1.9)				
BalanSys	BalanSys	27	1636	0.3 (0.1, 0.7)	1.6 (1.0, 2.5)	2.1 (1.3, 3.2)	4.2 (2.5, 7.0)		
Columbus	Columbus	8	403	0.8 (0.3, 2.5)	2.5 (1.2, 5.4)	2.5 (1.2, 5.4)			
Duracon	Duracon*	453	8968	1.0 (0.8, 1.2)	2.4 (2.1, 2.8)	3.3 (2.9, 3.7)	4.9 (4.4, 5.4)	7.0 (6.3, 7.9)	7.2 (6.4, 8.2)
E.Motion	E.Motion	23	519	2.0 (1.1, 3.7)	4.9 (3.2, 7.4)	5.4 (3.6, 8.1)			
Evolis	Evolis	14	797	0.3 (0.1, 1.1)	1.0 (0.5, 2.1)	1.6 (0.9, 3.0)			
Evolution	Evolution	32	3107	0.7 (0.4, 1.2)	2.3 (1.5, 3.5)				
GMK Primary	GMK Primary	17	587	1.1 (0.5, 2.3)	2.8 (1.7, 4.7)	5.1 (2.6, 9.8)			
GMK Sphere Primary	GMK Primary	49	3417	1.2 (0.8, 1.7)	2.7 (2.0, 3.7)				
Genesis II CR	Genesis II	466	13669	0.9 (0.8, 1.1)	2.4 (2.1, 2.7)	3.1 (2.8, 3.4)	4.3 (3.9, 4.7)	5.6 (4.9, 6.5)	6.0 (5.0, 7.1)
Genesis II CR	Profix Mobile*	35	490	1.7 (0.8, 3.3)	3.4 (2.1, 5.4)	5.4 (3.7, 8.0)	9.0 (6.3, 12.9)		
Genesis II Oxinium CR	Genesis II	347	7488	1.0 (0.8, 1.3)	2.8 (2.4, 3.2)	3.7 (3.2, 4.2)	6.1 (5.5, 6.9)	10.9 (8.3, 14.2)	
Genesis II Oxinium PS	Genesis II	785	15823	1.5 (1.3, 1.7)	3.8 (3.5, 4.1)	5.2 (4.8, 5.6)	7.5 (6.9, 8.1)		
Genesis II PS	Genesis II	571	15816	1.2 (1.1, 1.4)	2.8 (2.6, 3.1)	3.7 (3.4, 4.0)	5.0 (4.5, 5.5)	6.2 (5.2, 7.3)	
Journey Oxinium	Journey*	245	3032	1.4 (1.0, 1.9)	4.6 (3.9, 5.4)	6.4 (5.6, 7.4)	10.9 (9.4, 12.7)		
Kinemax Plus	Kinemax Plus*	111	1826	0.9 (0.6, 1.5)	2.4 (1.8, 3.3)	3.1 (2.4, 4.0)	4.6 (3.7, 5.7)	8.5 (6.9, 10.4)	9.3 (7.2, 12.0)
LCS CR	LCS	299	3939	1.0 (0.7, 1.4)	3.8 (3.2, 4.4)	5.0 (4.4, 5.8)	7.2 (6.4, 8.1)	9.1 (8.1, 10.2)	9.4 (8.2, 10.8)

Femoral Component	Tibial Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
LCS CR	MBT	364	10638	0.8 (0.7, 1.0)	2.5 (2.2, 2.8)	3.4 (3.0, 3.8)	5.2 (4.7, 5.9)		
LCS PS	MBT*	36	492	1.4 (0.7, 3.0)	5.6 (3.9, 8.1)	7.3 (5.2, 10.2)			
Legion CR	Genesis II	29	1266	1.5 (0.9, 2.4)	2.4 (1.6, 3.6)	3.3 (2.2, 4.9)			
Legion Oxinium CR	Genesis II	59	2696	0.8 (0.5, 1.3)	2.4 (1.8, 3.2)	3.1 (2.3, 4.0)			
Legion Oxinium PS	Genesis II	261	9937	1.1 (0.9, 1.3)	3.3 (2.9, 3.7)	4.3 (3.7, 4.9)			
Legion PS	Genesis II	73	3939	1.0 (0.7, 1.3)	2.1 (1.7, 2.7)	2.6 (2.0, 3.3)			
MRK	MRK	7	430	0.7 (0.2, 2.2)	1.8 (0.9, 3.7)	1.8 (0.9, 3.7)			
Maxim	Maxim*	37	498	1.2 (0.5, 2.7)	2.6 (1.5, 4.5)	4.8 (3.2, 7.1)	6.5 (4.6, 9.2)		
Natural Knee Flex	Natural Knee II	33	1449	1.1 (0.7, 1.9)	2.8 (1.9, 4.0)	3.2 (2.2, 4.5)			
Natural Knee II	Natural Knee II*	49	1754	0.5 (0.2, 0.9)	1.3 (0.8, 2.0)	1.9 (1.3, 2.7)	3.4 (2.5, 4.5)	4.1 (3.0, 5.7)	
Nexgen CR	Nexgen	119	3853	0.6 (0.4, 0.8)	1.4 (1.1, 1.9)	1.9 (1.5, 2.4)	2.9 (2.4, 3.6)	5.1 (4.0, 6.4)	5.1 (4.0, 6.4)
Nexgen CR Flex	Natural Knee II	8	804	0.2 (0.1, 1.0)	0.7 (0.3, 1.8)	0.7 (0.3, 1.8)			
Nexgen CR Flex	Nexgen	315	19517	0.7 (0.6, 0.8)	1.5 (1.3, 1.7)	2.1 (1.8, 2.3)	2.8 (2.4, 3.2)		
Nexgen LCCK	Nexgen	29	706	2.0 (1.1, 3.4)	3.6 (2.4, 5.5)	5.2 (3.5, 7.7)	5.2 (3.5, 7.7)		
Nexgen LPS	Nexgen	239	5776	1.0 (0.8, 1.3)	2.3 (2.0, 2.8)	3.0 (2.5, 3.5)	4.8 (4.2, 5.5)	6.0 (5.2, 7.0)	6.0 (5.2, 7.0)
Nexgen LPS Flex	Nexgen	956	29701	0.9 (0.8, 1.0)	2.3 (2.1, 2.5)	3.1 (2.9, 3.4)	5.0 (4.7, 5.4)		
Optetrak-PS	Optetrak	178	2603	1.5 (1.1, 2.0)	4.6 (3.8, 5.5)	6.3 (5.4, 7.4)	9.8 (8.3, 11.4)		
Optetrak-PS	Optetrak-RBK	43	768	1.5 (0.8, 2.6)	3.9 (2.7, 5.7)	5.1 (3.6, 7.2)	10.0 (6.8, 14.5)		
PFC Sigma CR	MBT	28	1153	0.9 (0.5, 1.6)	1.7 (1.1, 2.6)	2.1 (1.4, 3.2)	3.0 (2.0, 4.3)		
PFC Sigma CR	PFC Sigma	318	12226	0.8 (0.7, 1.0)	2.0 (1.7, 2.2)	2.4 (2.1, 2.7)	3.4 (3.0, 3.9)	5.7 (4.6, 7.1)	
PFC Sigma PS	MBT	231	5971	0.9 (0.7, 1.2)	2.7 (2.3, 3.1)	3.5 (3.0, 4.0)	4.8 (4.2, 5.5)		
PFC Sigma PS	PFC Sigma	274	7600	1.2 (0.9, 1.4)	2.5 (2.2, 2.9)	3.2 (2.8, 3.6)	4.7 (4.1, 5.4)	7.2 (5.9, 8.8)	
Persona	Persona	6	821	0.5 (0.2, 1.5)	1.5 (0.6, 3.5)				
Profix	Profix*	142	3285	1.1 (0.8, 1.5)	2.6 (2.1, 3.2)	3.2 (2.6, 3.9)	4.7 (4.0, 5.5)	4.9 (4.2, 5.9)	
Profix Oxinium	Profix*	81	999	1.9 (1.2, 3.0)	5.0 (3.8, 6.5)	6.6 (5.2, 8.4)	8.0 (6.5, 10.0)		
RBK	RBK	91	2290	1.0 (0.7, 1.5)	2.8 (2.1, 3.6)	3.6 (2.9, 4.5)	5.9 (4.7, 7.5)		
SAIPH	SAIPH	11	1333	0.5 (0.2, 1.2)	1.6 (0.8, 3.1)				
Score	Score	12	628	0.9 (0.4, 2.1)	1.5 (0.8, 3.1)	1.9 (1.0, 3.6)			
Scorpio CR	Series 7000	88	1793	0.8 (0.5, 1.4)	2.2 (1.6, 3.0)	2.9 (2.2, 3.8)	4.9 (3.9, 6.1)	6.4 (5.1, 7.9)	
Scorpio NRG CR	Series 7000	37	1579	0.7 (0.4, 1.3)	1.7 (1.2, 2.6)	2.4 (1.7, 3.5)			
Scorpio NRG PS	Series 7000	61	2592	0.6 (0.4, 1.0)	1.6 (1.2, 2.2)	2.4 (1.8, 3.1)			
Scorpio PS	Scorpio	31	511	1.2 (0.5, 2.6)	3.8 (2.4, 5.9)	4.4 (2.9, 6.6)	6.4 (4.5, 9.0)		
Scorpio PS	Scorpio+*	60	900	1.2 (0.7, 2.2)	4.0 (2.9, 5.5)	5.6 (4.3, 7.4)	7.0 (5.4, 9.0)		
Scorpio PS	Series 7000	184	3225	1.1 (0.8, 1.5)	2.9 (2.4, 3.5)	4.0 (3.4, 4.8)	6.8 (5.8, 7.9)	10.9 (8.3, 14.3)	
Triathlon CR	Triathlon	607	31060	0.8 (0.7, 0.9)	2.0 (1.8, 2.2)	2.5 (2.3, 2.7)	3.9 (3.4, 4.5)		
Triathlon PS	Triathlon	219	6676	1.4 (1.2, 1.7)	3.1 (2.6, 3.6)	4.0 (3.4, 4.5)	5.1 (4.3, 6.0)		
Vanguard CR	Maxim	178	7915	0.6 (0.5, 0.8)	2.2 (1.9, 2.7)	2.9 (2.5, 3.4)	4.3 (3.5, 5.3)		
Vanguard CR	Vanguard	16	983	0.5 (0.2, 1.2)	1.2 (0.7, 2.2)	1.4 (0.8, 2.6)			
Vanguard PS	Maxim	193	3751	1.9 (1.5, 2.4)	4.5 (3.8, 5.3)	5.7 (4.9, 6.6)	7.5 (6.1, 9.3)		
Other (181)		540	8182	1.7 (1.4, 2.0)	4.4 (3.9, 4.9)	6.2 (5.7, 6.9)	9.1 (8.3, 9.9)	11.6 (10.4, 13.0)	12.5 (10.8, 14.4)
TOTAL		**10131**	**301816**						

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 2016

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	16 Yrs
ACS	ACS Fixed	26	575	1.7 (0.9, 3.3)	6.0 (4.1, 8.7)				
Active Knee	Active Knee	403	4899	1.3 (1.0, 1.7)	3.9 (3.4, 4.5)	5.6 (4.9, 6.2)	9.3 (8.4, 10.3)		
Advance	Advance	28	672	1.8 (1.0, 3.2)	4.6 (3.1, 6.7)	4.8 (3.3, 7.1)			
Advantim	Advantim*	59	1255	0.7 (0.4, 1.4)	2.7 (2.0, 3.8)	3.6 (2.7, 4.8)	5.2 (3.9, 6.9)	7.6 (5.4, 10.7)	
Columbus	Columbus	58	500	3.2 (2.0, 5.2)	7.7 (5.6, 10.4)	9.9 (7.5, 12.9)	13.5 (10.4, 17.3)		
Duracon	Duracon*	206	3539	1.1 (0.8, 1.4)	2.7 (2.2, 3.3)	3.7 (3.1, 4.4)	5.5 (4.8, 6.3)	8.3 (6.9, 9.9)	9.2 (7.1, 11.8)
GMK Primary	GMK Primary	19	747	1.4 (0.7, 2.6)	3.2 (2.1, 5.0)				
Genesis II CR	Genesis II	25	561	1.3 (0.6, 2.8)	4.4 (2.8, 6.7)	5.0 (3.3, 7.6)			
Genesis II CR	Profix Mobile*	35	505	1.4 (0.7, 2.9)	2.0 (1.1, 3.7)	3.0 (1.8, 4.9)	4.6 (3.1, 6.9)	8.1 (5.8, 11.3)	10.2 (6.9, 14.9)
Genesis II PS	Genesis II	19	420	1.7 (0.8, 3.5)	3.5 (2.1, 5.8)	4.1 (2.5, 6.6)			
LCS CR	LCS	149	2348	1.4 (1.0, 2.0)	3.3 (2.7, 4.2)	4.3 (3.5, 5.2)	5.9 (5.0, 7.0)	6.9 (5.9, 8.1)	7.9 (6.5, 9.6)
LCS CR	MBT	300	7580	1.1 (0.9, 1.4)	3.4 (3.0, 3.9)	4.3 (3.8, 4.8)	5.5 (4.8, 6.2)		
LCS CR	MBT Duofix	587	12806	1.3 (1.1, 1.5)	3.3 (3.0, 3.6)	4.1 (3.8, 4.5)	5.4 (5.0, 5.9)	7.2 (6.4, 8.2)	
LCS Duofix	MBT Duofix*	449	3649	1.6 (1.2, 2.1)	6.2 (5.5, 7.0)	10.1 (9.2, 11.2)	13.0 (11.9, 14.2)		
Maxim	Maxim*	39	612	1.6 (0.9, 3.0)	3.0 (1.9, 4.7)	3.3 (2.2, 5.1)	4.8 (3.3, 6.9)	8.4 (5.8, 12.2)	
Natural Knee Flex	Natural Knee II	29	1193	0.9 (0.5, 1.6)	2.2 (1.4, 3.3)	2.6 (1.7, 3.8)			
Natural Knee II	Natural Knee II*	227	2890	1.0 (0.7, 1.4)	2.2 (1.7, 2.8)	3.4 (2.8, 4.2)	7.1 (6.1, 8.2)	13.4 (11.5, 15.7)	
Nexgen CR	Nexgen	109	3402	0.6 (0.4, 0.9)	1.7 (1.3, 2.2)	2.2 (1.7, 2.7)	3.1 (2.5, 3.8)	4.4 (3.5, 5.4)	4.4 (3.5, 5.4)
Nexgen CR	Nexgen TM CR	40	676	1.4 (0.7, 2.6)	4.4 (3.1, 6.4)	6.1 (4.5, 8.3)	6.7 (4.9, 9.1)		
Nexgen CR Flex	Nexgen	194	6886	1.1 (0.9, 1.4)	2.5 (2.1, 2.9)	3.1 (2.6, 3.6)	4.2 (3.5, 4.9)		
Nexgen CR Flex	Nexgen TM CR	201	8870	0.6 (0.4, 0.8)	1.9 (1.6, 2.2)	2.4 (2.1, 2.8)	3.6 (3.0, 4.3)		
Nexgen LPS	Nexgen TM LPS	24	1099	0.9 (0.4, 1.6)	1.4 (0.8, 2.4)	2.5 (1.6, 3.7)	3.1 (2.0, 4.8)		
Nexgen LPS Flex	Nexgen	20	670	2.7 (1.6, 4.3)	3.7 (2.4, 5.7)				
Nexgen LPS Flex	Nexgen TM LPS	28	931	1.2 (0.7, 2.2)	2.6 (1.7, 4.0)	3.7 (2.6, 5.4)			
PFC Sigma CR	AMK Duofix*	54	1911	0.7 (0.4, 1.2)	1.5 (1.1, 2.2)	2.3 (1.7, 3.1)	3.0 (2.3, 4.1)		
PFC Sigma CR	MBT	62	994	2.3 (1.5, 3.5)	4.9 (3.7, 6.4)	5.7 (4.4, 7.4)	7.3 (5.6, 9.6)		
PFC Sigma CR	MBT Duofix	113	2548	1.2 (0.8, 1.7)	3.3 (2.7, 4.1)	4.2 (3.4, 5.1)	5.6 (4.6, 7.0)		
Profix	Profix*	88	1488	1.1 (0.7, 1.8)	3.5 (2.6, 4.5)	4.6 (3.6, 5.8)	6.2 (5.1, 7.7)	6.8 (5.4, 8.4)	
RBK	RBK	280	6293	1.4 (1.1, 1.7)	3.2 (2.8, 3.7)	4.2 (3.7, 4.8)	5.6 (4.9, 6.3)		
Score	Score	111	1877	1.5 (1.0, 2.2)	5.4 (4.3, 6.6)	7.3 (6.0, 8.9)			
Scorpio CR	Series 7000	200	3135	1.3 (1.0, 1.8)	3.4 (2.8, 4.1)	4.7 (4.0, 5.5)	7.4 (6.4, 8.5)	8.8 (7.5, 10.4)	
Scorpio NRG CR	Series 7000	60	2362	1.0 (0.6, 1.5)	2.3 (1.7, 3.2)	2.9 (2.2, 3.8)			
Scorpio NRG PS	Series 7000	66	1046	1.4 (0.8, 2.3)	5.7 (4.4, 7.4)	7.2 (5.7, 9.1)			
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	333	13263	1.1 (0.9, 1.3)	2.2 (1.9, 2.5)	2.9 (2.6, 3.2)	3.7 (3.3, 4.2)		
Triathlon PS	Triathlon	46	1008	2.1 (1.4, 3.2)	3.8 (2.7, 5.1)	4.8 (3.6, 6.3)			
Vanguard CR	Maxim	32	581	1.2 (0.6, 2.5)	3.8 (2.5, 5.8)	5.3 (3.7, 7.5)	6.1 (4.3, 8.6)		
Vanguard CR	Regenerex	54	1386	1.1 (0.7, 1.9)	3.8 (2.8, 5.1)	5.2 (3.9, 6.9)			
Vanguard CR	Vanguard	42	1277	1.3 (0.8, 2.1)	3.6 (2.7, 4.9)	3.8 (2.8, 5.1)			
Other (72)		541	5243	2.8 (2.4, 3.3)	7.6 (6.9, 8.3)	9.2 (8.4, 10.1)	11.9 (10.9, 12.9)	14.3 (12.8, 15.9)	
TOTAL		**5400**	**112267**						

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 2016

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	16 Yrs
ACS	ACS Fixed	36	777	1.7 (1.0, 2.9)	7.4 (5.2, 10.5)				
AGC	AGC	58	1644	0.6 (0.3, 1.1)	1.4 (0.9, 2.1)	2.0 (1.4, 2.9)	3.4 (2.6, 4.6)	5.2 (3.8, 7.0)	
Active Knee	Active Knee	91	2136	0.5 (0.3, 1.0)	2.6 (2.0, 3.5)	3.7 (2.9, 4.7)	6.1 (4.9, 7.7)		
Advance	Advance II	21	453	1.1 (0.5, 2.7)	2.6 (1.4, 4.6)	3.5 (2.1, 5.8)	5.8 (3.7, 9.0)		
Apex Knee CR	Apex Knee	9	916	1.0 (0.5, 2.2)	1.8 (0.9, 3.9)				
BalanSys	BalanSys	6	702	0.8 (0.3, 2.0)	0.8 (0.3, 2.0)				
Duracon	Duracon*	421	7963	1.2 (1.0, 1.5)	2.7 (2.4, 3.1)	3.5 (3.1, 3.9)	4.9 (4.5, 5.5)	6.8 (6.1, 7.6)	7.3 (6.4, 8.4)
GMK Primary	GMK Primary	11	439	0.5 (0.1, 2.0)	3.5 (1.9, 6.4)				
Genesis II CR	Genesis II	289	7265	0.9 (0.7, 1.1)	2.9 (2.5, 3.3)	3.9 (3.5, 4.5)	5.2 (4.6, 5.8)	6.0 (5.2, 6.9)	6.0 (5.2, 6.9)
Genesis II PS	Genesis II	57	705	1.7 (1.0, 3.0)	4.5 (3.2, 6.3)	5.4 (4.0, 7.4)	8.7 (6.7, 11.2)		
LCS CR	LCS	133	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)	6.8 (5.7, 8.2)	7.2 (5.9, 8.8)
LCS CR	MBT	242	8432	0.7 (0.6, 1.0)	2.2 (1.9, 2.6)	3.0 (2.6, 3.4)	4.2 (3.6, 4.8)		
LCS CR	MBT Duofix	29	889	1.5 (0.9, 2.6)	3.7 (2.5, 5.3)	3.9 (2.7, 5.6)			
LCS Duofix	MBT*	67	822	1.5 (0.8, 2.6)	5.5 (4.1, 7.3)	7.1 (5.5, 9.1)	9.3 (7.0, 12.2)		
Legion CR	Genesis II	46	1474	1.4 (0.9, 2.2)	4.2 (3.1, 5.7)	5.3 (3.8, 7.3)			
Maxim	Maxim*	99	1407	0.8 (0.4, 1.4)	2.7 (1.9, 3.7)	3.9 (3.0, 5.1)	6.3 (5.1, 7.9)		
Natural Knee Flex	Natural Knee II	20	1687	0.4 (0.2, 0.8)	1.0 (0.6, 1.8)	1.7 (1.0, 2.8)			
Natural Knee II	Natural Knee II*	92	1966	1.2 (0.8, 1.8)	2.2 (1.6, 2.9)	2.5 (1.9, 3.3)	4.1 (3.2, 5.2)	9.8 (7.2, 13.2)	
Nexgen CR	Nexgen	114	4111	0.4 (0.3, 0.7)	1.5 (1.2, 2.0)	2.1 (1.7, 2.6)	3.1 (2.5, 3.8)	3.9 (3.2, 4.8)	
Nexgen CR Flex	Nexgen	303	16425	0.8 (0.6, 0.9)	1.8 (1.6, 2.0)	2.2 (1.9, 2.5)	2.8 (2.4, 3.2)		
Nexgen CR Flex	Nexgen TM CR	14	779	0.5 (0.2, 1.4)	1.3 (0.7, 2.5)	1.5 (0.8, 2.6)	1.9 (1.1, 3.2)		
Nexgen LPS	Nexgen	50	990	0.4 (0.2, 1.1)	2.6 (1.7, 3.8)	4.1 (3.0, 5.6)	5.6 (4.2, 7.5)		
Nexgen LPS Flex	Nexgen	35	803	2.1 (1.3, 3.4)	5.0 (3.5, 7.0)	5.3 (3.8, 7.3)			
Nexgen LPS Flex	Nexgen TM LPS	13	503	0.6 (0.2, 1.8)	1.8 (0.9, 3.5)	2.0 (1.1, 3.7)	2.7 (1.6, 4.7)		
Optetrak-CR	Optetrak	34	666	1.7 (0.9, 3.1)	3.6 (2.3, 5.7)	4.5 (3.0, 6.9)	8.7 (6.1, 12.4)		
PFC Sigma CR	MBT	170	3671	1.3 (0.9, 1.7)	3.2 (2.7, 3.9)	4.3 (3.6, 5.0)	5.4 (4.6, 6.3)	6.2 (5.1, 7.4)	
PFC Sigma CR	PFC Sigma	295	10858	0.6 (0.5, 0.8)	1.9 (1.6, 2.2)	2.4 (2.1, 2.8)	3.6 (3.1, 4.1)	4.8 (4.0, 5.6)	4.8 (4.0, 5.6)
PFC Sigma PS	MBT Duofix	131	1921	1.8 (1.3, 2.5)	5.0 (4.0, 6.1)	6.9 (5.7, 8.2)	8.5 (7.2, 10.1)		
Profix	Profix Mobile*	56	592	1.9 (1.0, 3.4)	5.7 (4.1, 7.9)	7.4 (5.6, 9.9)	9.3 (7.1, 12.0)		
Profix	Profix*	35	769	0.8 (0.4, 1.7)	2.5 (1.6, 3.9)	3.9 (2.7, 5.6)	4.9 (3.5, 6.8)		
RBK	RBK	45	1370	1.0 (0.6, 1.7)	2.7 (1.9, 3.8)	3.6 (2.6, 4.9)	4.9 (3.5, 6.8)		
Score	Score	24	943	1.9 (1.1, 3.1)	4.0 (2.5, 6.2)				
Scorpio CR	Scorpio+*	135	1893	1.0 (0.6, 1.6)	2.8 (2.2, 3.7)	4.4 (3.5, 5.4)	7.3 (6.1, 8.6)		
Scorpio CR	Series 7000	227	6580	0.7 (0.5, 1.0)	2.0 (1.7, 2.4)	2.8 (2.4, 3.3)	4.2 (3.7, 4.9)	5.9 (5.0, 6.9)	5.9 (5.0, 6.9)
Scorpio NRG CR	Series 7000	23	787	0.4 (0.1, 1.2)	1.9 (1.2, 3.3)	2.8 (1.7, 4.4)			
Scorpio PS	Scorpio+*	43	905	1.0 (0.5, 1.9)	2.6 (1.7, 3.9)	3.4 (2.4, 4.8)	4.4 (3.2, 6.1)	6.8 (4.7, 9.6)	
Scorpio PS	Series 7000	86	1072	1.1 (0.6, 2.0)	4.3 (3.2, 5.7)	5.7 (4.4, 7.3)	7.3 (5.8, 9.1)	14.1 (10.2, 19.5)	
Triathlon CR	Triathlon	264	16633	0.6 (0.5, 0.8)	1.6 (1.4, 1.9)	2.1 (1.9, 2.4)	3.2 (2.6, 3.9)		
Triathlon PS	Triathlon	65	2239	1.5 (1.1, 2.2)	2.5 (1.9, 3.3)	3.5 (2.7, 4.5)			
Vanguard CR	Maxim	192	7447	0.9 (0.7, 1.2)	2.6 (2.2, 3.0)	3.6 (3.1, 4.2)	5.4 (4.2, 6.8)		
Vanguard CR	Vanguard	65	2607	0.6 (0.4, 1.0)	2.2 (1.7, 2.9)	2.8 (2.1, 3.6)			
Vanguard PS	Maxim	21	587	1.5 (0.8, 3.0)	3.5 (2.2, 5.6)	4.6 (2.9, 7.1)			
Other (119)		528	6133	2.2 (1.9, 2.7)	6.0 (5.4, 6.7)	7.4 (6.7, 8.1)	10.8 (9.9, 11.8)	13.7 (12.3, 15.2)	13.7 (12.3, 15.2)
TOTAL		**4695**	**133324**						

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 2016

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 16 years, the cumulative percent revision of primary total knee replacement undertaken for osteoarthritis is 8.0% (Table KT10 and Figure KT8).

Reason for Revision

Loosening is the main reason for revision (25.9%), followed by infection (22.5%), patellofemoral pain (10.9%), pain (8.6%) and instability (7.3%) (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.

Previously, the Registry has reported loosening/lysis as a single diagnosis. This included the diagnoses of loosening or lysis, as well as loosening and lysis combined. Loosening and lysis are now considered 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 (Table KT11).

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 three years.

Type of Revision

The most common types of revision are replacement of both the femoral and tibial prostheses (25.6%), insert only exchange (21.6%) and patella only replacement (20.7%) (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. Those aged less than 55 years have more than three times the rate of revision after nine months and more than eight times after 9.5 years compared to those 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 16 year cumulative incidence of 1.7% compared to 0.9% for females (Figure KT12).

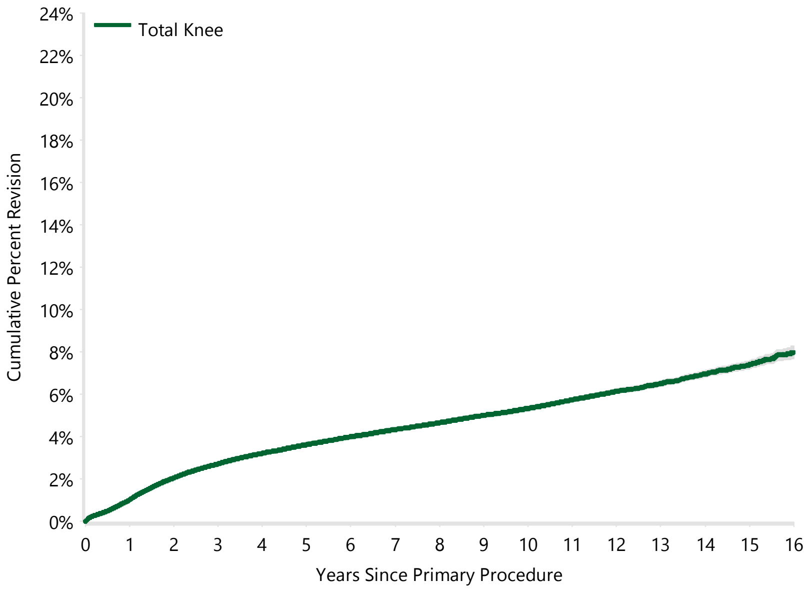
Males have a higher rate of revision which is largely due to an increased incidence of infection.

Age related differences in the rate of revision are evident for both males and females (Table KT14, Figures KT13 and KT14).

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	16 Yrs
Total Knee	19627	534202	1.0 (1.0, 1.1)	2.7 (2.7, 2.8)	3.6 (3.6, 3.7)	5.3 (5.2, 5.4)	7.4 (7.2, 7.6)	8.0 (7.7, 8.3)
TOTAL	**19627**	**534202**						

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	16 Yrs
Total Knee	534202	474281	363321	268621	93358	7947	1861

Table KT11 Primary Total Knee Replacement by Reason for Revision (Primary Diagnosis OA)

Reason for Revision	Number	Percent
Loosening	5074	25.9
Infection	4412	22.5
Patellofemoral Pain	2143	10.9
Pain	1694	8.6
Instability	1429	7.3
Patella Erosion	992	5.1
Arthrofibrosis	689	3.5
Fracture	541	2.8
Malalignment	428	2.2
Lysis	389	2.0
Wear Tibial Insert	331	1.7
Metal Related Pathology	304	1.5
Incorrect Sizing	239	1.2
Other	962	4.9
TOTAL	**19627**	**100.0**

Table KT12 Primary Total Knee Replacement by Type of Revision (Primary Diagnosis OA)

Type of Revision	Number	Percent
TKR (Tibial/Femoral)	5034	25.6
Insert Only	4245	21.6
Patella Only	4060	20.7
Insert/Patella	1970	10.0
Tibial Component	1904	9.7
Femoral Component	1145	5.8
Cement Spacer	1102	5.6
Removal of Prostheses	102	0.5
Minor Components	39	0.2
Cement Only	9	0.0
Reinsertion of Components	9	0.0
Total Femoral	8	0.0
TOTAL	**19627**	**100.0**

Figure KT9 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement (Primary Diagnosis OA)

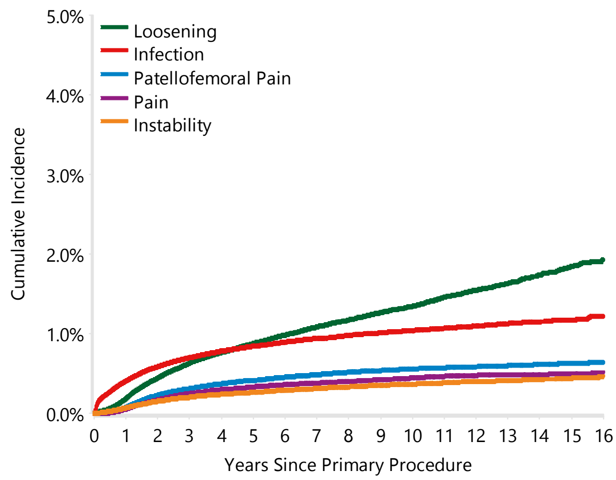
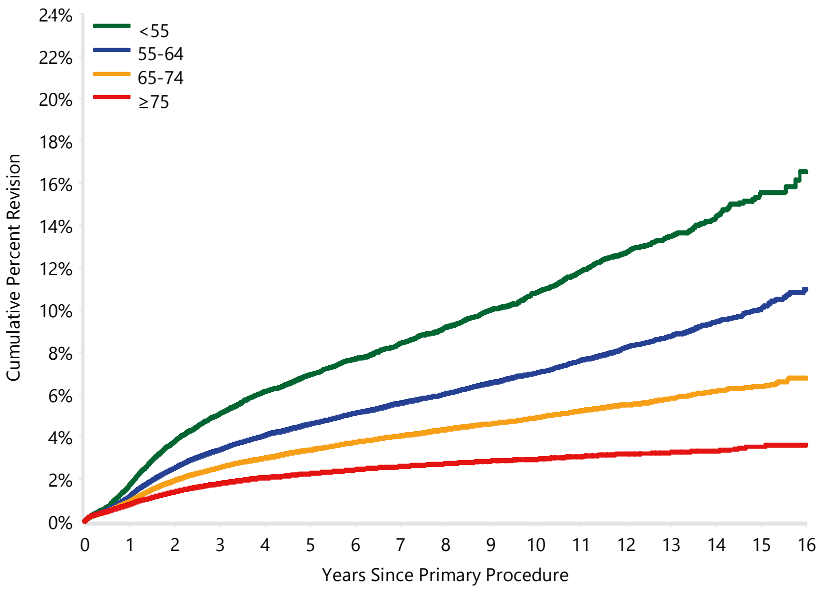


Table KT13 Cumulative Percent Revision of Primary Total Knee Replacement by Age (Primary Diagnosis OA)

Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
<55	2645	35261	1.7 (1.6, 1.9)	5.1 (4.8, 5.3)	6.9 (6.6, 7.2)	10.8 (10.4, 11.3)	15.6 (14.7, 16.5)	16.5 (15.2, 18.0)
55-64	6738	140352	1.2 (1.1, 1.3)	3.4 (3.3, 3.5)	4.6 (4.5, 4.7)	7.0 (6.8, 7.2)	10.0 (9.6, 10.4)	11.0 (10.4, 11.6)
65-74	7027	207745	0.9 (0.9, 1.0)	2.5 (2.5, 2.6)	3.4 (3.3, 3.5)	4.9 (4.8, 5.0)	6.4 (6.2, 6.6)	6.8 (6.4, 7.1)
≥75	3217	150844	0.8 (0.8, 0.8)	1.8 (1.7, 1.9)	2.3 (2.2, 2.3)	2.9 (2.8, 3.0)	3.5 (3.3, 3.8)	3.6 (3.3, 3.9)
TOTAL	**19627**	**534202**						

Figure KT10 Cumulative Percent Revision of Primary Total Knee Replacement by Age (Primary Diagnosis OA)



HR - adjusted for gender

<55 vs ≥75
- 0 - 6Mth: HR=1.45 (1.25, 1.68),p<0.001
- 6Mth - 9Mth: HR=2.90 (2.44, 3.46),p<0.001
- 9Mth - 2Yr: HR=3.50 (3.21, 3.81),p<0.001
- 2Yr - 2.5Yr: HR=3.31 (2.83, 3.87),p<0.001
- 2.5Yr - 6.5Yr: HR=3.87 (3.53, 4.23),p<0.001
- 6.5Yr - 9.5Yr: HR=6.83 (5.69, 8.19),p<0.001
- 9.5Yr+: HR=8.55 (7.01, 10.42),p<0.001

55 – 64 vs ≥75
- 0 - 3Mth: HR=0.98 (0.87, 1.12),p=0.808
- 3Mth - 9Mth: HR=1.63 (1.47, 1.80),p<0.001
- 9Mth - 4Yr: HR=2.26 (2.14, 2.38),p<0.001
- 4Yr - 6.5Yr: HR=2.67 (2.40, 2.98),p<0.001
- 6.5Yr - 7Yr: HR=4.40 (3.43, 5.63),p<0.001
- 7Yr - 10Yr: HR=4.16 (3.54, 4.88),p<0.001
- 10Yr+: HR=5.13 (4.26, 6.16),p<0.001

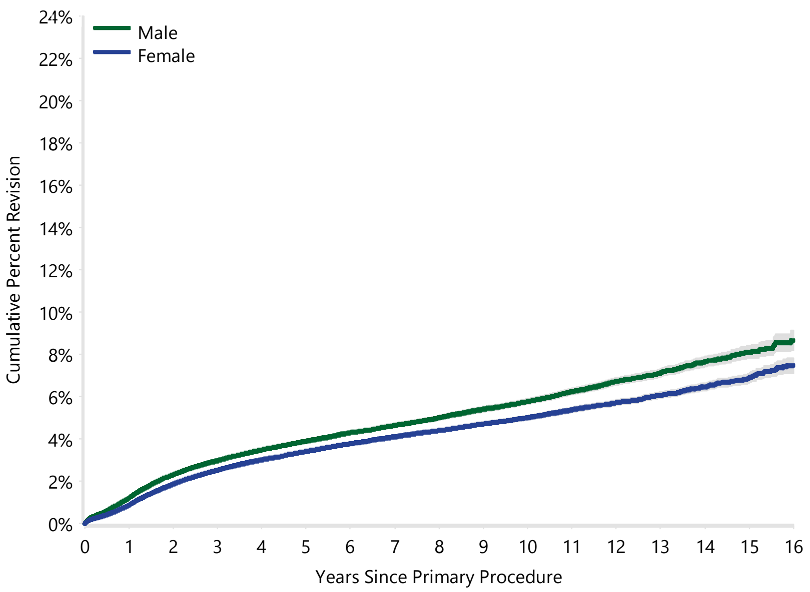
65 – 74 vs ≥75
- 0 - 6Mth: HR=1.02 (0.92, 1.12),p=0.754
- 6Mth - 1Yr: HR=1.41 (1.29, 1.54),p<0.001
- 1Yr - 2Yr: HR=1.67 (1.56, 1.80),p<0.001
- 2Yr - 4Yr: HR=1.58 (1.46, 1.69),p<0.001
- 4Yr - 4.5Yr: HR=2.12 (1.78, 2.53),p<0.001
- 4.5Yr - 6.5Yr: HR=1.77 (1.58, 1.99),p<0.001
- 6.5Yr+: HR=2.52 (2.18, 2.92),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
<55	35261	31196	24006	18023	6857	713	176
55-64	140352	124342	95282	70916	25349	2429	583
65-74	207745	184009	140271	104000	38391	3529	845
≥75	150844	134734	103762	75682	22761	1276	257

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	16 Yrs
Male		**9138**	**232351**	**1.2 (1.2, 1.3)**	**3.0 (2.9, 3.1)**	**3.9 (3.8, 4.0)**	**5.8 (5.6, 5.9)**	**8.1 (7.8, 8.4)**	**8.7 (8.2, 9.1)**
	<55	1156	15121	2.1 (1.8, 2.3)	5.4 (5.0, 5.8)	7.0 (6.6, 7.5)	10.8 (10.2, 11.5)	15.3 (14.0, 16.6)	15.8 (14.2, 17.5)
	55-64	3283	64030	1.4 (1.3, 1.5)	3.7 (3.5, 3.9)	4.9 (4.7, 5.1)	7.5 (7.2, 7.8)	10.7 (10.2, 11.4)	11.7 (10.7, 12.7)
	65-74	3303	92546	1.1 (1.1, 1.2)	2.7 (2.6, 2.9)	3.6 (3.5, 3.7)	5.2 (5.0, 5.4)	6.9 (6.5, 7.3)	7.2 (6.7, 7.8)
	≥75	1396	60654	0.9 (0.9, 1.0)	2.0 (1.9, 2.1)	2.5 (2.3, 2.6)	3.3 (3.1, 3.4)	4.1 (3.6, 4.7)	4.1 (3.6, 4.7)
Female		**10489**	**301851**	**0.9 (0.8, 0.9)**	**2.5 (2.5, 2.6)**	**3.4 (3.3, 3.5)**	**5.0 (4.9, 5.1)**	**6.9 (6.7, 7.1)**	**7.5 (7.1, 7.8)**
	<55	1489	20140	1.5 (1.3, 1.7)	4.8 (4.5, 5.2)	6.9 (6.5, 7.3)	10.8 (10.2, 11.4)	15.8 (14.6, 17.2)	17.2 (15.1, 19.5)
	55-64	3455	76322	1.0 (1.0, 1.1)	3.1 (3.0, 3.3)	4.4 (4.2, 4.5)	6.6 (6.4, 6.9)	9.4 (8.9, 9.9)	10.4 (9.6, 11.2)
	65-74	3724	115199	0.8 (0.7, 0.8)	2.4 (2.3, 2.5)	3.2 (3.1, 3.3)	4.6 (4.5, 4.8)	6.0 (5.7, 6.3)	6.4 (6.0, 6.9)
	≥75	1821	90190	0.7 (0.7, 0.8)	1.7 (1.6, 1.8)	2.1 (2.0, 2.2)	2.7 (2.6, 2.9)	3.2 (3.0, 3.5)	3.3 (3.0, 3.7)
TOTAL		**19627**	**534202**						

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 (1.32, 1.50),p<0.001

9Mth - 1.5Yr: HR=1.15 (1.08, 1.23),p<0.001

1.5Yr - 2.5Yr: HR=1.04 (0.97, 1.11),p=0.282

2.5Yr - 3.5Yr: HR=0.95 (0.87, 1.04),p=0.278

3.5Yr+: HR=1.10 (1.04, 1.15),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Male	232351	205147	155298	113552	37977	3156	737
Female	301851	269134	208023	155069	55381	4791	1124

Figure KT12 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by Gender (Primary Diagnosis OA)

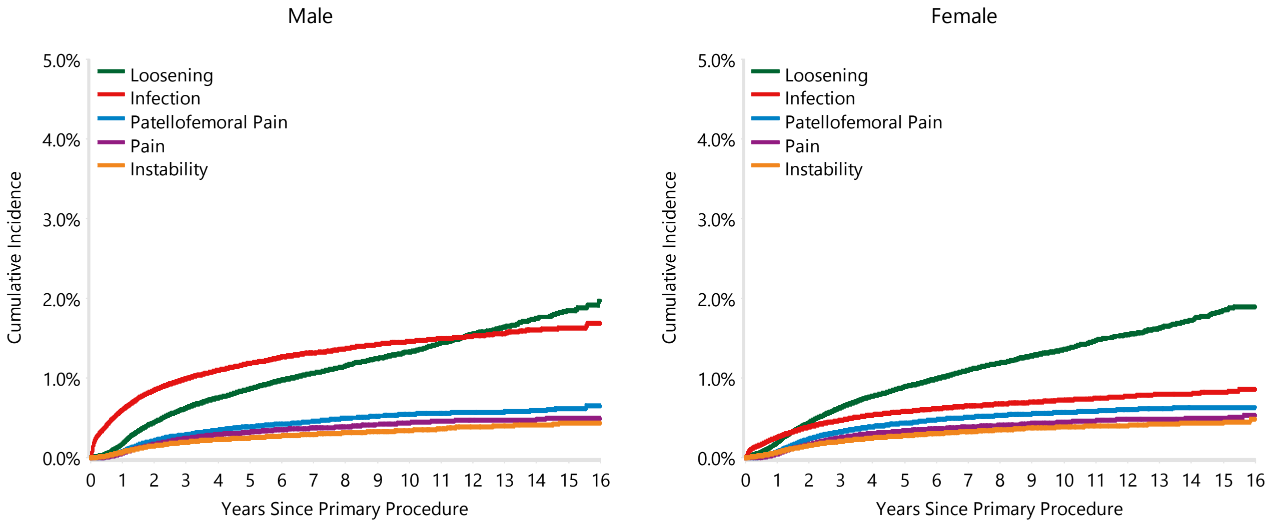
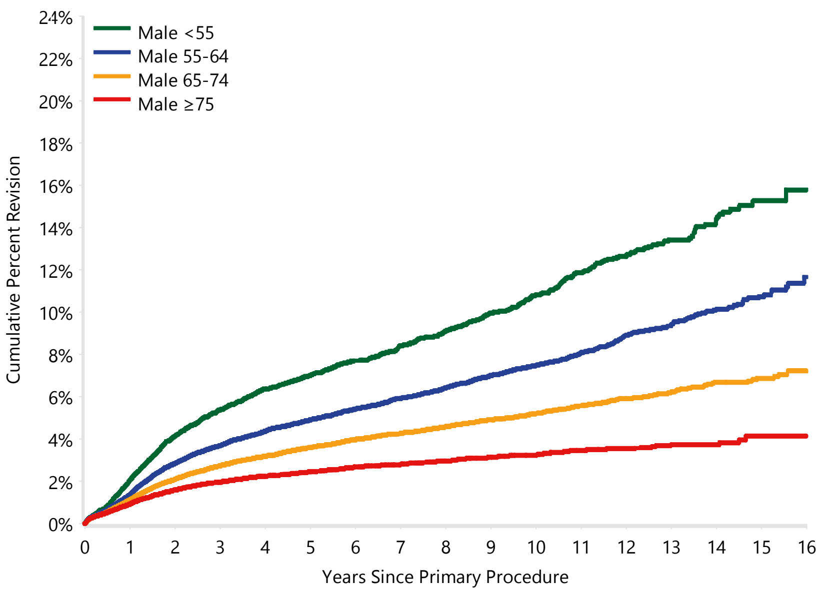


Figure KT13 Cumulative Percent Revision of Primary Total Knee Replacement in Males by Age (Primary Diagnosis OA)



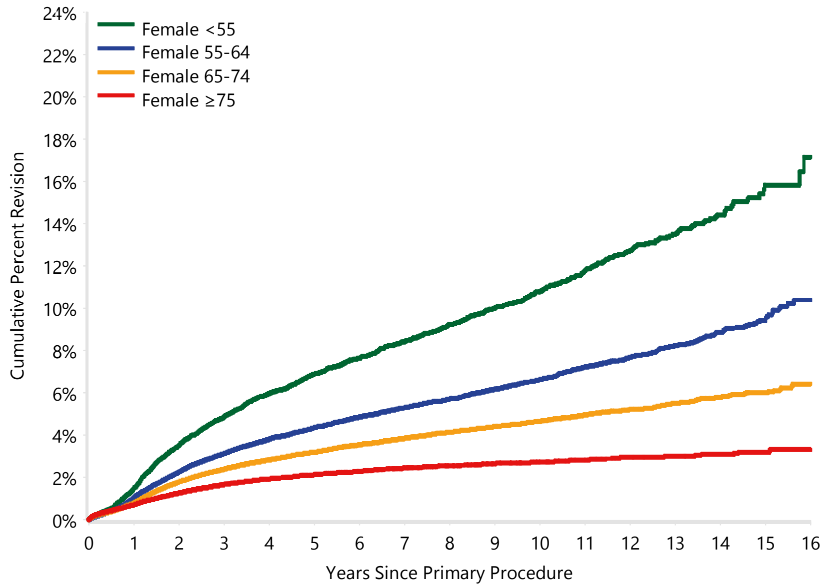
Male <55 vs Male ≥75
- 0 - 9Mth: HR=1.98 (1.68, 2.33),p<0.001
- 9Mth - 1Yr: HR=3.22 (2.53, 4.11),p<0.001
- 1Yr - 1.5Yr: HR=2.73 (2.25, 3.31),p<0.001
- 1.5Yr - 2Yr: HR=3.81 (3.09, 4.71),p<0.001
- 2Yr - 2.5Yr: HR=3.02 (2.35, 3.89),p<0.001
- 2.5Yr - 3Yr: HR=4.20 (3.22, 5.49),p<0.001
- 3Yr - 3.5Yr: HR=3.13 (2.29, 4.28),p<0.001
- 3.5Yr - 9.5Yr: HR=4.02 (3.47, 4.66),p<0.001
- 9.5Yr+: HR=5.61 (4.41, 7.15),p<0.001

Male 55 – 64 vs Male ≥75
- 0 - 9Mth: HR=1.43 (1.27, 1.61),p<0.001
- 9Mth - 1Yr: HR=1.81 (1.50, 2.17),p<0.001
- 1Yr - 1.5Yr: HR=2.11 (1.84, 2.42),p<0.001
- 1.5Yr - 4Yr: HR=2.38 (2.14, 2.65),p<0.001
- 4Yr - 7Yr: HR=2.78 (2.42, 3.20),p<0.001
- 7Yr - 12Yr: HR=3.25 (2.79, 3.80),p<0.001
- 12Yr+: HR=3.82 (2.75, 5.31),p<0.001

Male 65-74 vs Male ≥75
- 0 - 6Mth: HR=1.15 (1.01, 1.31),p=0.038
- 6Mth - 1.5Yr: HR=1.35 (1.22, 1.50),p<0.001
- 1.5Yr - 2.5Yr: HR=1.61 (1.41, 1.83),p<0.001
- 2.5Yr+: HR=1.84 (1.67, 2.04),p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Male	<55	15121	13330	10310	7826	3021	330	83
	55-64	64030	56510	42995	32029	11241	1092	271
	65-74	92546	81664	61645	45106	15900	1355	305
	≥75	60654	53643	40348	28591	7815	379	78

Figure KT14 Cumulative Percent Revision of Primary Total Knee Replacement in Females by Age (Primary Diagnosis OA)



Female <55 vs Female ≥75
- 0 - 9Mth: HR=1.68 (1.42, 1.99),p<0.001
- 9Mth - 2Yr: HR=3.64 (3.25, 4.09),p<0.001
- 2Yr - 4Yr: HR=3.84 (3.39, 4.36),p<0.001
- 4Yr - 7Yr: HR=5.85 (4.94, 6.92),p<0.001
- 7Yr+: HR=7.17 (6.02, 8.54),p<0.001

Female 55-64 vs Female ≥75
- 0 - 3Mth: HR=0.83 (0.69, 1.00),p=0.053
- 3Mth - 9Mth: HR=1.46 (1.26, 1.70),p<0.001
- 9Mth - 4Yr: HR=2.31 (2.14, 2.49),p<0.001
- 4Yr+: HR=3.66 (3.24, 4.14),p<0.001

Female 65-74 vs Female ≥75
- 0 - 9Mth: HR=1.01 (0.90, 1.13),p=0.872
- 9Mth - 4Yr: HR=1.67 (1.54, 1.80),p<0.001
- 4Yr - 7.5Yr: HR=2.32 (2.02, 2.66),p<0.001
- 7.5Yr+: HR=2.16 (1.84, 2.54),p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Female	<55	20140	17866	13696	10197	3836	383	93
	55-64	76322	67832	52287	38887	14108	1337	312
	65-74	115199	102345	78626	58894	22491	2174	540
	≥75	90190	81091	63414	47091	14946	897	179

OUTCOME FOR OSTEOARTHRITIS - PROSTHESIS CHARACTERISTICS

Fixed and Mobile Bearing

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. Fixed bearings include non-modular tibial prostheses, as well as fixed inserts that do not move relative to the baseplate.

Fixed bearing prostheses have a lower rate of revision compared to rotating, and rotating-sliding after two years. Rotating prostheses have a lower rate of revision than fixed bearings after eight years. This finding is being reported for the first time. There is no difference between fixed and sliding prostheses. However, the number of procedures where a sliding prosthesis has been used is small (Table KT15 and Figure KT15).

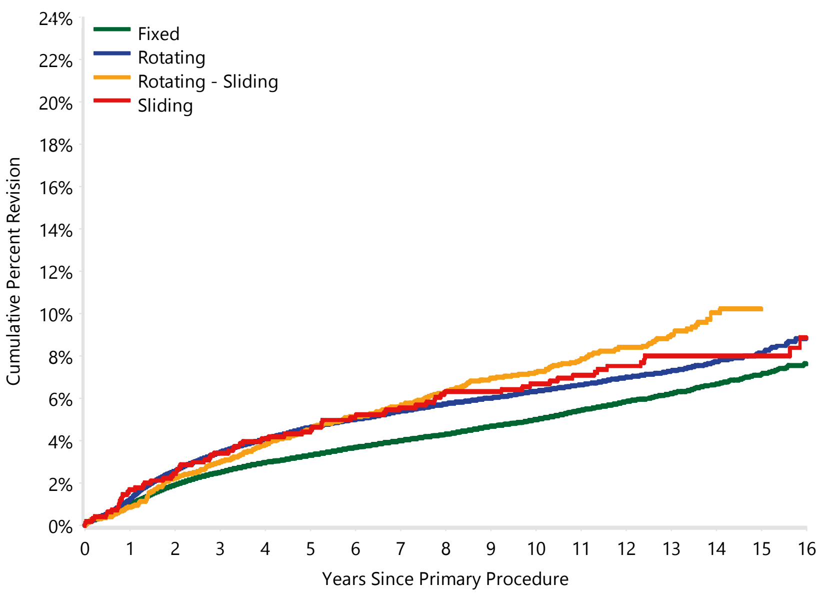
Moulded non-modular tibial prostheses have the lowest rate of revision. However, this only includes a limited number of prosthesis types. There is no difference when comparing all-polyethylene to fixed modular tibial prostheses (Table KT16 and Figure KT16).

Table KT15 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	16 Yrs
Fixed	13968	420701	1.0 (0.9, 1.0)	2.5 (2.5, 2.6)	3.3 (3.3, 3.4)	5.0 (4.9, 5.1)	7.1 (6.9, 7.3)	7.6 (7.3, 8.0)
Rotating	5223	107325	1.2 (1.2, 1.3)	3.5 (3.3, 3.6)	4.6 (4.5, 4.8)	6.3 (6.2, 6.5)	8.2 (7.8, 8.5)	8.8 (8.3, 9.5)
Rotating - Sliding	358	5052	0.9 (0.6, 1.2)	3.0 (2.6, 3.5)	4.5 (3.9, 5.1)	7.2 (6.5, 8.0)	10.2 (9.1, 11.5)	
Sliding	72	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)	8.0 (6.4, 10.1)	8.9 (6.9, 11.3)
TOTAL	**19621**	**534026**						

Note: Excludes 176 procedures with unknown bearing mobility

Figure KT15 Cumulative Percent Revision of Primary Total Knee Replacement by Bearing Mobility (Primary Diagnosis OA)



HR - adjusted for age and gender

Rotating vs Fixed
- 0 - 1Yr: HR=1.23 (1.16, 1.31),p<0.001
- 1Yr - 1.5Yr: HR=1.50 (1.38, 1.63),p<0.001
- 1.5Yr - 2Yr: HR=1.28 (1.16, 1.42),p<0.001
- 2Yr - 2.5Yr: HR=1.40 (1.25, 1.56),p<0.001
- 2.5Yr - 3Yr: HR=1.50 (1.32, 1.70),p<0.001
- 3Yr - 5Yr: HR=1.41 (1.31, 1.53),p<0.001
- 5Yr - 8Yr: HR=1.09 (1.00, 1.20),p=0.060
- 8Yr+: HR=0.81 (0.73, 0.91),p<0.001

Rotating - Sliding vs Fixed
- 0 - 2Yr: HR=1.12 (0.93, 1.35),p=0.242
- 2Yr+: HR=1.53 (1.34, 1.73),p<0.001

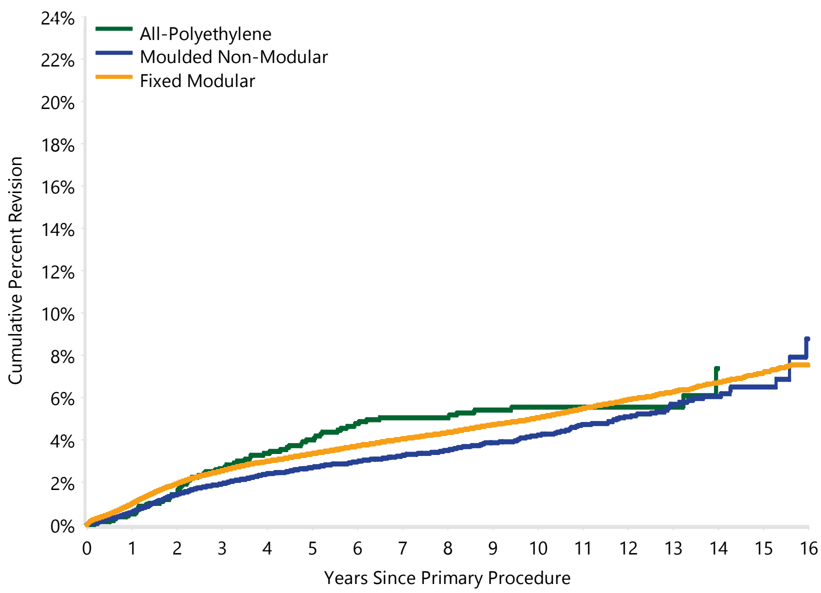
Sliding vs Fixed
- Entire Period: HR=1.13 (0.89, 1.42),p=0.314

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Fixed	420701	369794	277613	200607	66495	5504	1288
Rotating	107325	98632	80271	63006	23505	1980	402
Rotating - Sliding	5052	4764	4419	4046	2592	118	6
Sliding	948	925	883	846	711	340	163

Table KT16 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	16 Yrs
All-Polyethylene	66	1496	0.5 (0.2, 1.0)	2.7 (1.9, 3.7)	4.0 (3.0, 5.3)	5.5 (4.3, 7.0)		
Moulded Non-Modular	675	21645	0.6 (0.5, 0.7)	1.9 (1.8, 2.1)	2.7 (2.5, 3.0)	4.2 (3.9, 4.6)	6.5 (5.7, 7.4)	8.8 (6.6, 11.6)
Fixed Modular	13227	397560	1.0 (1.0, 1.0)	2.5 (2.5, 2.6)	3.4 (3.3, 3.4)	5.0 (4.9, 5.1)	7.2 (6.9, 7.4)	7.5 (7.3, 7.8)
TOTAL	**13968**	**420701**						

Figure KT16 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=1.49 (1.16, 1.92),p=0.002

Fixed Modular vs Moulded Non-Modular
0 - 2Wk: HR=2.50 (1.03, 6.06),p=0.043
2Wk - 1Mth: HR=5.23 (2.17, 12.63),p<0.001
1Mth - 1.5Yr: HR=1.44 (1.25, 1.65),p<0.001
1.5Yr+: HR=1.11 (1.02, 1.22),p=0.021

All-Polyethylene vs Fixed Modular
Entire Period: HR=1.22 (0.95, 1.55),p=0.114

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
All-Polyethylene	1496	1333	1128	1030	630	24	2
Moulded Non-Modular	21645	20469	17098	12830	4033	344	95
Fixed Modular	397560	347992	259387	186747	61832	5136	1191

Stability

Stability refers to particular prosthetic features intended to substitute for the intrinsic stability of knee ligaments. This year, the Registry has expanded the classification to include the medial pivot designs separately. The three major categories are now: minimally stabilised, medial pivot and posterior stabilised.

Medial pivot primary total knee replacement is included as a separate category for the first time.

The Registry defines minimally stabilised prostheses as those that have a flat or dished tibial articulation, regardless of congruency. Medial pivot prostheses are minimally stabilised, but have a ball-and-socket medial portion of the articulation. Posterior stabilised prostheses provide additional posterior stability, most commonly using a peg and box design, or less frequently, a cam and groove.

Comparing minimally stabilised, posterior stabilised and medial pivot primary total knee replacement, the use of minimally stabilised prostheses has remained relatively constant over the last 10 years. In 2016, these accounted for 67.4% of the three prosthesis types. The use of posterior stabilised prostheses has declined from 32.9% in 2008 to 25.6% in 2016. Medial pivot total knee replacements have been used in small numbers since the Registry began collecting data. In 2016 this has increased, accounting for 7.0% (Figure KT17).

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 KT17). They are usually used in complex clinical situations and have therefore been excluded from any comparative outcome analysis for primary total knee replacement.

Posterior stabilised and medial pivot prostheses have a higher rate of revision compared to minimally stabilised (Table KT17 and Figure KT18). 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 prostheses. Posterior stabilised also have a higher cumulative incidence of loosening compared to minimally stabilised prostheses. Medial pivot prostheses have a higher cumulative incidence of revision for pain and instability compared to minimally stabilised prostheses (Figure KT19).

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 group. This group only contains five prostheses. One of these, the Advance, is identified as a prosthesis with a higher than anticipated rate of revision (Table KT18). When the Advance is excluded from the analysis comparing minimally stabilised and medial pivot prostheses, there is no difference between these two groups. However, the follow up for the medial pivot group is only four years when the Advance is excluded (Table KT19 and Figure KT20).

Figure KT17 Primary Total Knee Replacement by Stability (Primary Diagnosis OA)

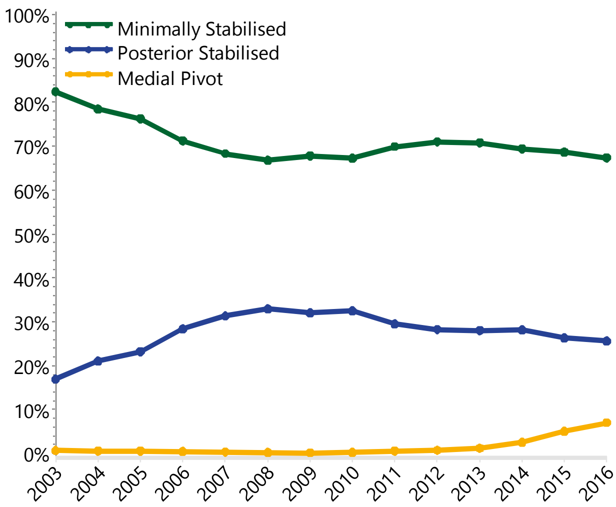
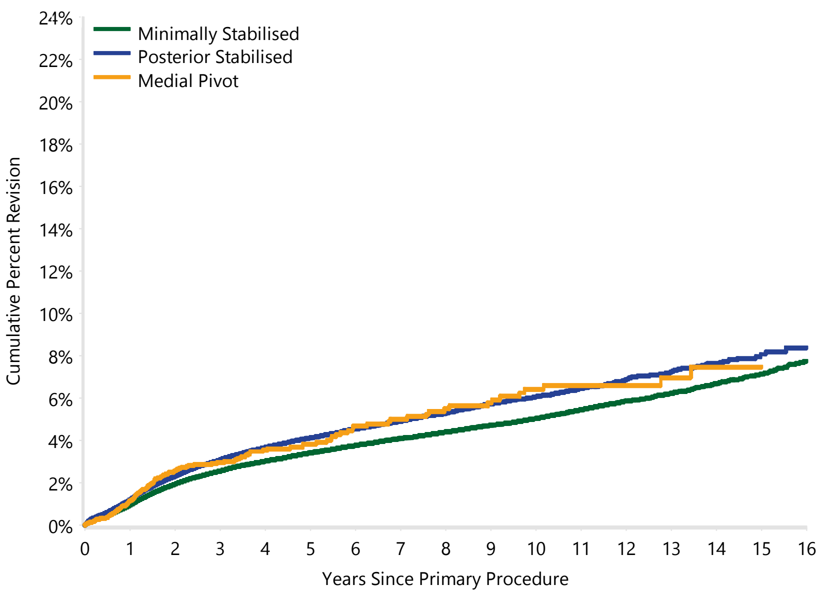


Table KT17 Cumulative Percent Revision of Primary Total Knee Replacement by Stability (Primary Diagnosis OA)

Stability	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Minimally Stabilised	13511	379445	0.9 (0.9, 1.0)	2.6 (2.5, 2.6)	3.4 (3.3, 3.5)	5.0 (4.9, 5.1)	7.1 (6.9, 7.3)	7.7 (7.4, 8.1)
Posterior Stabilised	5786	142780	1.2 (1.2, 1.3)	3.1 (3.0, 3.2)	4.1 (4.0, 4.2)	6.1 (5.9, 6.3)	8.1 (7.6, 8.6)	8.4 (7.8, 9.1)
Medial Pivot	200	9390	1.2 (0.9, 1.4)	3.0 (2.5, 3.5)	3.8 (3.2, 4.6)	6.4 (5.3, 7.8)	7.5 (5.9, 9.5)	
Fully Stabilised	83	1777	2.3 (1.7, 3.2)	4.4 (3.5, 5.6)	5.8 (4.6, 7.3)	7.8 (6.0, 10.2)		
Hinged	41	634	2.5 (1.5, 4.1)	5.4 (3.7, 7.8)	7.1 (5.0, 10.0)			
TOTAL	**19621**	**534026**						

Note: Excludes 176 procedures with unknown stability

Figure KT18 Cumulative Percent Revision of Primary Total Knee Replacement by Stability (Primary Diagnosis OA)



HR - adjusted for age and gender

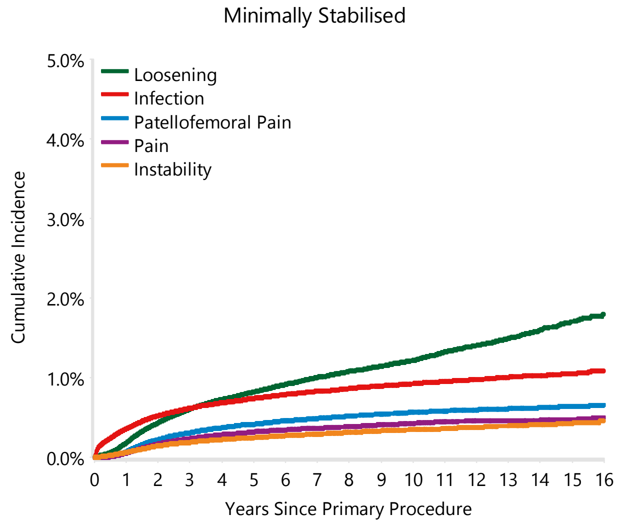
Posterior Stabilised vs Minimally Stabilised
0 - 1Yr: HR=1.28 (1.21, 1.36),p<0.001
1Yr - 2Yr: HR=1.09 (1.02, 1.16),p=0.010
2Yr - 2.5Yr: HR=1.32 (1.19, 1.47),p<0.001
2.5Yr+: HR=1.19 (1.14, 1.25),p<0.001

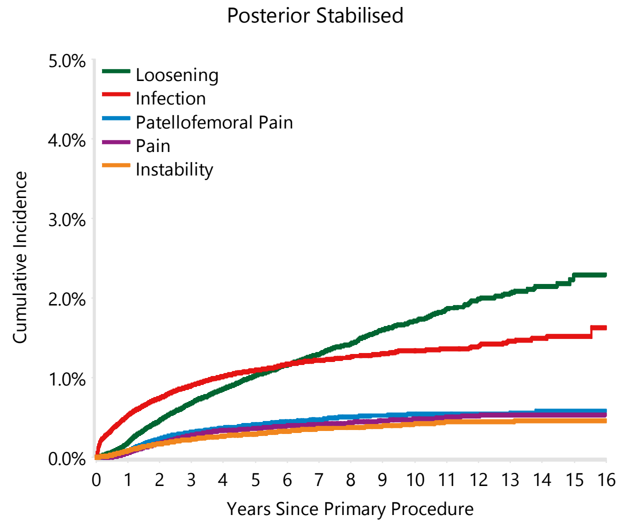
Medial Pivot vs Minimally Stabilised
Entire Period: HR=1.19 (1.04, 1.37),p=0.013

Posterior Stabilised vs Medial Pivot
Entire Period: HR=1.01 (0.88, 1.16),p=0.902

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Minimally Stabilised	379445	339252	262727	195578	73965	6970	1655
Posterior Stabilised	142780	127197	97163	70937	18639	875	196
Medial Pivot	9390	5727	2047	1191	531	77	7

Figure KT19 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by Stability (Primary Diagnosis OA)





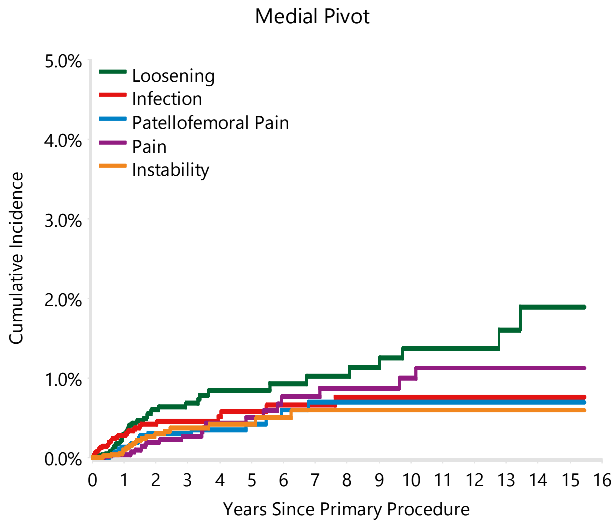


Table KT18 Cumulative Percent Revision of Primary Total Knee Replacement with Medial Pivot by Insert (Primary Diagnosis OA)

Insert Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
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	103	1610	1.9 (1.3, 2.7)	4.3 (3.4, 5.5)	5.3 (4.3, 6.5)	7.5 (6.2, 9.2)	8.6 (6.8, 10.8)	
Evolution	31	3087	0.7 (0.4, 1.2)	2.2 (1.5, 3.4)				
GMK Sphere Primary	50	3361	1.2 (0.9, 1.8)	2.7 (2.0, 3.7)				
SAIPH	11	1317	0.6 (0.2, 1.2)	1.6 (0.8, 3.1)				
TOTAL	**200**	**9390**						

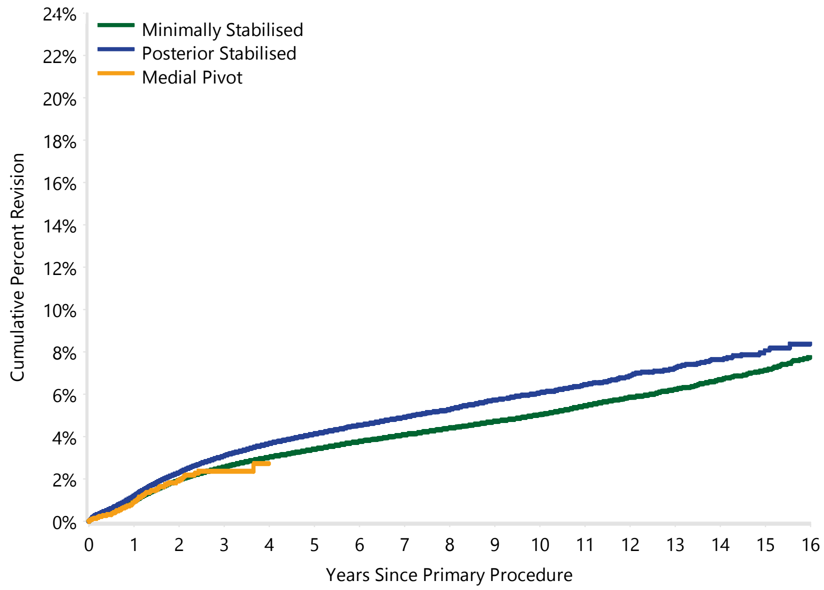
Note: See 2017 Annual Report Erratum #2 for corrected Table KT18

Table KT19 Cumulative Percent Revision of Primary Total Knee Replacement by Stability (Primary Diagnosis OA, Excluding Advance)

Stability	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Minimally Stabilised	13511	379445	0.9 (0.9, 1.0)	2.6 (2.5, 2.6)	3.4 (3.3, 3.5)	5.0 (4.9, 5.1)	7.1 (6.9, 7.3)	7.7 (7.4, 8.1)
Posterior Stabilised	5786	142780	1.2 (1.2, 1.3)	3.1 (3.0, 3.2)	4.1 (4.0, 4.2)	6.1 (5.9, 6.3)	8.1 (7.6, 8.6)	8.4 (7.8, 9.1)
Medial Pivot	92	7765	0.9 (0.7, 1.2)	2.4 (1.9, 3.0)				
Fully Stabilised	83	1777	2.3 (1.7, 3.2)	4.4 (3.5, 5.6)	5.8 (4.6, 7.3)	7.8 (6.0, 10.2)		
Hinged	41	634	2.5 (1.5, 4.1)	5.4 (3.7, 7.8)	7.1 (5.0, 10.0)			
TOTAL	**19513**	**532401**						

Note: Excludes 176 procedures with unknown stability

Figure KT20 Cumulative Percent Revision of Primary Total Knee Replacement by Stability (Primary Diagnosis OA, Excluding Advance)



HR - adjusted for age and gender

Posterior Stabilised vs Minimally Stabilised
- 0 - 1Yr: HR=1.28 (1.21, 1.36),p<0.001
- 1Yr - 2Yr: HR=1.09 (1.02, 1.16),p=0.008
- 2Yr - 2.5Yr: HR=1.32 (1.18, 1.47),p<0.001
- 2.5Yr+: HR=1.19 (1.14, 1.25),p<0.001

Medial Pivot vs Minimally Stabilised
- Entire Period: HR=0.94 (0.77, 1.15),p=0.556

Posterior Stabilised vs Medial Pivot
- Entire Period: HR=1.28 (1.04, 1.58),p=0.017

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Minimally Stabilised	379445	339252	262727	195578	73965	6970	1655
Posterior Stabilised	142780	127197	97163	70937	18639	875	196
Medial Pivot	7765	4168	611	26	0	0	0

Patellar Resurfacing

Resurfacing the patella has a lower rate of revision compared to procedures without patellar resurfacing (Table KT20 and Figure KT21).

When resurfacing the patella, the rate of revision is lower for minimally stabilised compared to posterior stabilised prostheses within the first 3.5 years. Posterior stabilised without patellar resurfacing has the highest rate of revision (Table KT21 and Figure KT22).

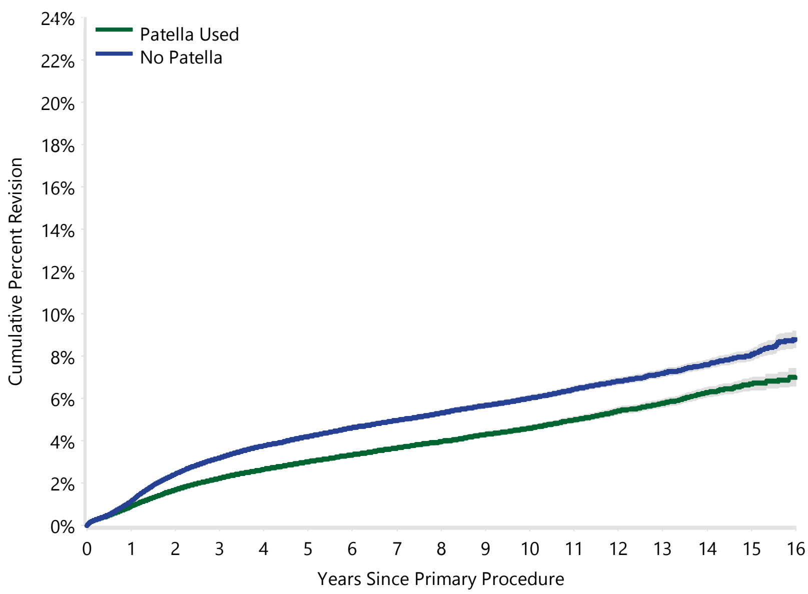
When the patella is resurfaced, there is no difference in the rate of revision of medial pivot prostheses compared to minimally stabilised prostheses. When the patella is not resurfaced, medial pivot knees have a higher rate of revision than minimally stabilised knees (Table KT21 and Figure KT23).

Outcomes related to the use of patellar resurfacing vary depending on the type of prosthesis used.

Table KT20 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	16 Yrs
Patella Used	8058	275454	0.9 (0.9, 0.9)	2.2 (2.2, 2.3)	3.0 (2.9, 3.1)	4.6 (4.5, 4.7)	6.7 (6.4, 7.0)	7.0 (6.6, 7.4)
No Patella	11569	258748	1.1 (1.1, 1.2)	3.2 (3.1, 3.3)	4.2 (4.1, 4.3)	6.0 (5.9, 6.1)	8.0 (7.8, 8.3)	8.8 (8.4, 9.2)
TOTAL	**19627**	**534202**						

Figure KT21 Cumulative Percent Revision of Primary Total Knee Replacement by Patella Usage (Primary Diagnosis OA)



HR - adjusted for age and gender

No Patella vs Patella Used

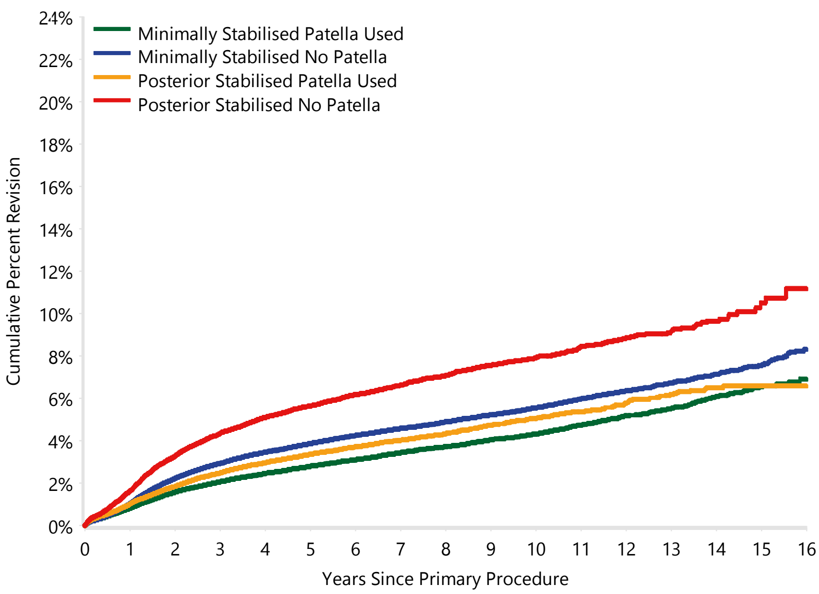
Entire Period: HR=1.33 (1.29, 1.36),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Patella Used	275454	238631	174642	123650	40127	3194	599
No Patella	258748	235650	188679	144971	53231	4753	1262

Table KT21 **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	16 Yrs
Minimally Stabilised	Patella Used	4821	169427	0.8 (0.8, 0.9)	2.1 (2.0, 2.1)	2.8 (2.7, 2.9)	4.3 (4.2, 4.5)	6.5 (6.2, 6.9)	6.9 (6.4, 7.4)
	No Patella	8690	210018	1.0 (1.0, 1.1)	2.9 (2.9, 3.0)	3.9 (3.8, 4.0)	5.6 (5.4, 5.7)	7.5 (7.3, 7.8)	8.3 (7.9, 8.7)
Posterior Stabilised	Patella Used	3114	99747	1.0 (1.0, 1.1)	2.5 (2.4, 2.6)	3.4 (3.2, 3.5)	5.1 (4.9, 5.3)	6.6 (6.1, 7.0)	6.6 (6.1, 7.0)
	No Patella	2672	43033	1.6 (1.5, 1.8)	4.3 (4.2, 4.6)	5.7 (5.4, 5.9)	7.9 (7.6, 8.2)	10.5 (9.6, 11.5)	11.2 (9.9, 12.6)
Medial Pivot	Patella Used	56	4715	0.9 (0.7, 1.3)	1.8 (1.3, 2.4)	2.5 (1.7, 3.5)	3.2 (2.1, 4.9)		
	No Patella	144	4675	1.4 (1.0, 1.8)	4.0 (3.3, 4.9)	5.0 (4.1, 6.0)	8.0 (6.5, 9.8)	9.3 (7.3, 11.7)	
TOTAL		**19497**	**531615**						

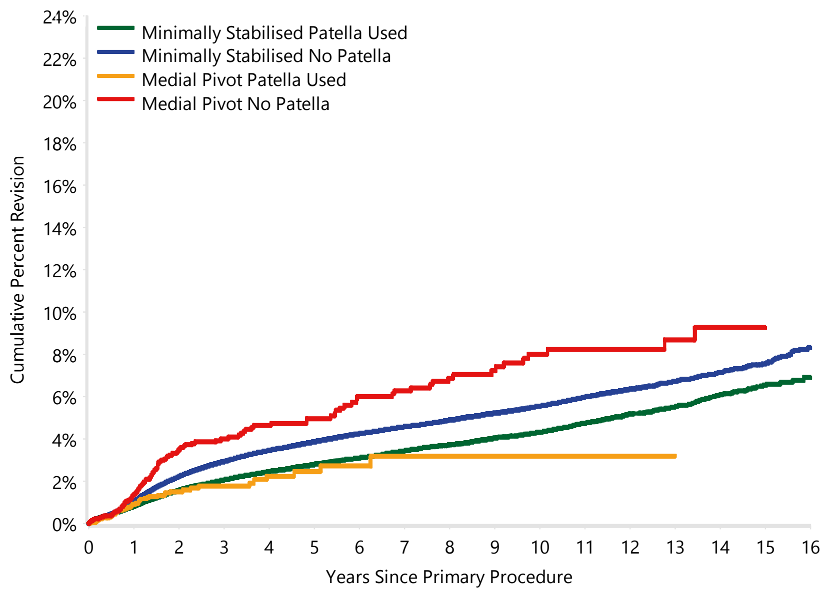
Figure KT22 **Cumulative Percent Revision of Primary Total Knee Replacement by Stability and Patella Usage (Primary Diagnosis OA)**



HR - adjusted for age and gender
Minimally Stabilised Patella Used vs
Minimally Stabilised No Patella
Entire Period: HR=0.78 (0.75, 0.80),p<0.001
Minimally Stabilised No Patella vs
Posterior Stabilised No Patella
0 - 1.5Yr: HR=0.64 (0.60, 0.68),p<0.001
1.5Yr - 2Yr: HR=0.72 (0.63, 0.82),p<0.001
2Yr - 3.5Yr: HR=0.67 (0.61, 0.73),p<0.001
3.5Yr - 4Yr: HR=0.57 (0.47, 0.69),p<0.001
4Yr+: HR=0.78 (0.72, 0.85),p<0.001
Minimally Stabilised Patella Used vs
Posterior Stabilised Patella Used
0 - 2Yr: HR=0.82 (0.78, 0.87),p<0.001
2Yr - 2.5Yr: HR=0.74 (0.65, 0.83),p<0.001
2.5Yr - 3Yr: HR=0.86 (0.75, 0.99),p=0.035
3Yr - 3.5Yr: HR=0.80 (0.69, 0.94),p=0.005
3.5Yr - 4Yr: HR=0.91 (0.77, 1.08),p=0.296
4Yr - 4.5Yr: HR=0.88 (0.73, 1.06),p=0.169
4.5Yr+: HR=1.05 (0.97, 1.13),p=0.216
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	16 Yrs
Minimally Stabilised	Patella Used	169427	147740	109628	78942	29172	2703	496
	No Patella	210018	191512	153099	116636	44793	4267	1159
Posterior Stabilised	Patella Used	99747	86914	63411	43856	10755	474	102
	No Patella	43033	40283	33752	27081	7884	401	94

Figure KT23 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=0.77 (0.75, 0.80),p<0.001

Minimally Stabilised No Patella vs
Medial Pivot No Patella
Entire Period: HR=0.72 (0.61, 0.85),p<0.001

Minimally Stabilised Patella Used vs
Medial Pivot Patella Used
Entire Period: HR=1.13 (0.87, 1.47),p=0.360

Medial Pivot Patella Used vs
Medial Pivot No Patella
Entire Period: HR=0.49 (0.36, 0.67),p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Minimally Stabilised	Patella Used	169427	147740	109628	78942	29172	2703	496
	No Patella	210018	191512	153099	116636	44793	4267	1159
Medial Pivot	Patella Used	4715	2738	863	396	103	5	0
	No Patella	4675	2989	1184	795	428	72	7

Fixation

The effect of fixation varies depending on implant stability.

With a minimally stabilised prosthesis, there is no difference between cemented and hybrid fixation and both have a lower rate of revision compared to cementless fixation (Table KT22 and Figure KT24).

When a posterior stabilised knee is used, cemented fixation has a lower rate of revision compared to hybrid fixation and when compared to cementless fixation within the first 1.5 years. Hybrid fixation has a higher rate of revision compared to both cemented and cementless fixation (Table KT23 and Figure KT25).

Cementing the tibial component gives the best outcome for minimally stabilised and medial pivot prostheses. Cementing both tibial and femoral components gives the best outcome for posterior stabilised prostheses.

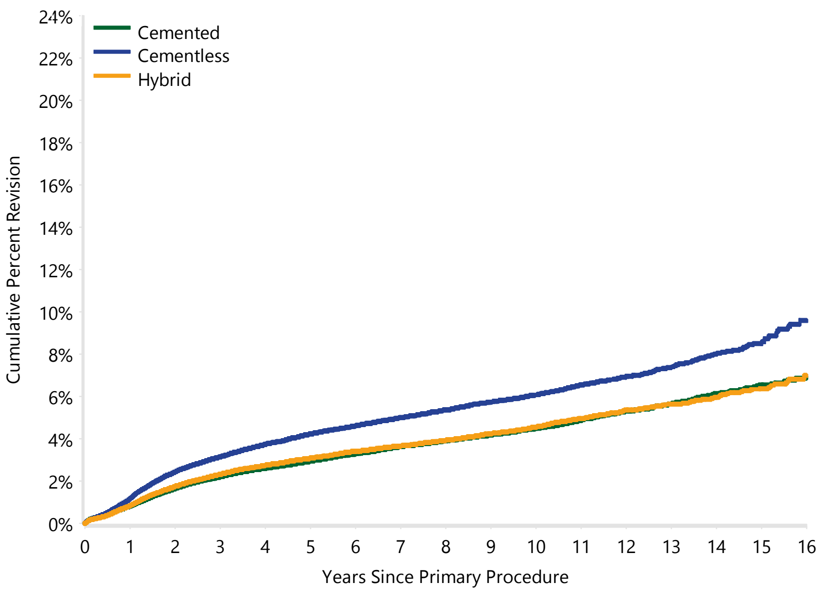
When a medial pivot prosthesis is used there is a similar outcome to minimally stabilised prostheses with respect to fixation. There is no difference between cemented and hybrid fixation and both have a lower rate of revision compared to cementless fixation (Table KT24 and Figure KT26).

Table KT22 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	16 Yrs
Cemented	4712	157680	0.8 (0.8, 0.9)	2.2 (2.1, 2.3)	2.9 (2.9, 3.0)	4.5 (4.3, 4.6)	6.5 (6.2, 6.9)	6.9 (6.5, 7.3)
Cementless	4795	102625	1.2 (1.1, 1.2)	3.2 (3.0, 3.3)	4.2 (4.1, 4.4)	6.1 (5.9, 6.3)	8.5 (8.1, 8.9)	9.6 (8.9, 10.3)
Hybrid	3804	118721	0.8 (0.8, 0.9)	2.3 (2.2, 2.4)	3.1 (3.0, 3.2)	4.6 (4.4, 4.7)	6.4 (6.1, 6.7)	7.0 (6.4, 7.6)
TOTAL	**13311**	**379026**						

Note: Excluding cementless Genesis Oxinium and Profix Oxinium femoral prostheses

Figure KT24 Cumulative Percent Revision of Minimally Stabilised Primary Total Knee Replacement by Fixation (Primary Diagnosis OA)



HR - adjusted for age and gender

Cementless vs Cemented

Entire Period: HR=1.26 (1.21, 1.32),p<0.001

Hybrid vs Cemented

Entire Period: HR=0.99 (0.95, 1.04),p=0.775

Cementless vs Hybrid

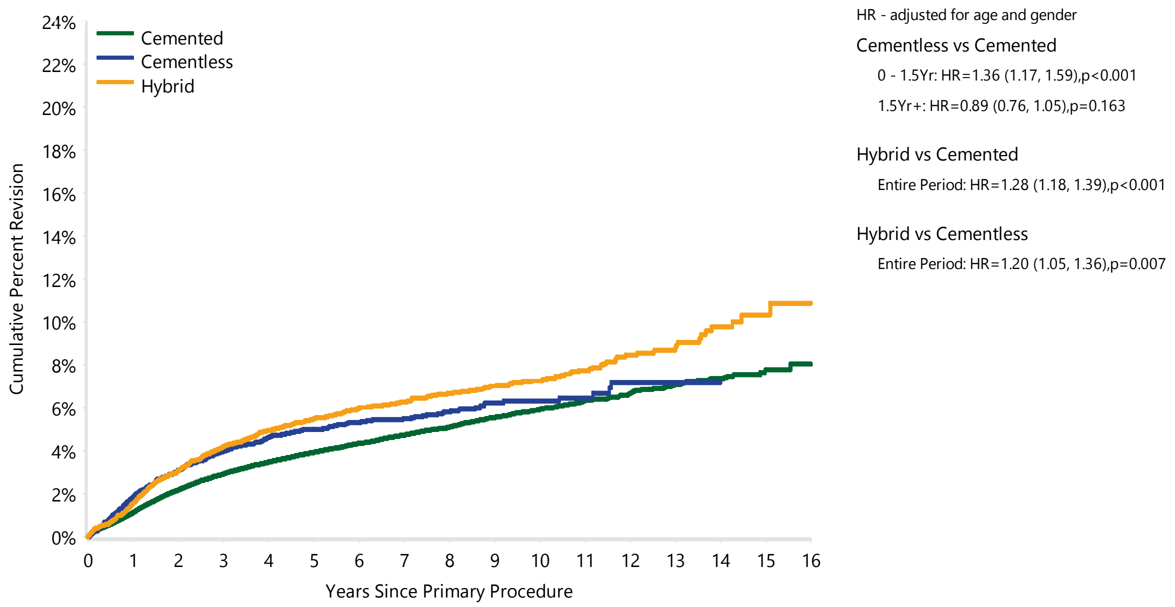
Entire Period: HR=1.27 (1.22, 1.33),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Cemented	157680	137324	102690	75175	27902	2835	658
Cementless	102625	95177	78385	60395	22089	1754	451
Hybrid	118721	106395	81421	59789	23799	2381	546

Table KT23 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	16 Yrs
Cemented	4774	124375	1.1 (1.1, 1.2)	2.9 (2.8, 3.0)	3.9 (3.8, 4.1)	5.9 (5.8, 6.1)	7.8 (7.3, 8.3)	8.0 (7.3, 8.8)
Cementless	337	6947	1.9 (1.6, 2.2)	4.0 (3.5, 4.5)	5.0 (4.5, 5.6)	6.3 (5.6, 7.1)		
Hybrid	675	11458	1.6 (1.4, 1.8)	4.2 (3.8, 4.6)	5.5 (5.1, 6.0)	7.3 (6.7, 7.9)	10.3 (9.0, 11.8)	10.9 (9.3, 12.8)
TOTAL	**5786**	**142780**						

Figure KT25 Cumulative Percent Revision of Posterior Stabilised Primary Total Knee Replacement by Fixation (Primary Diagnosis OA)

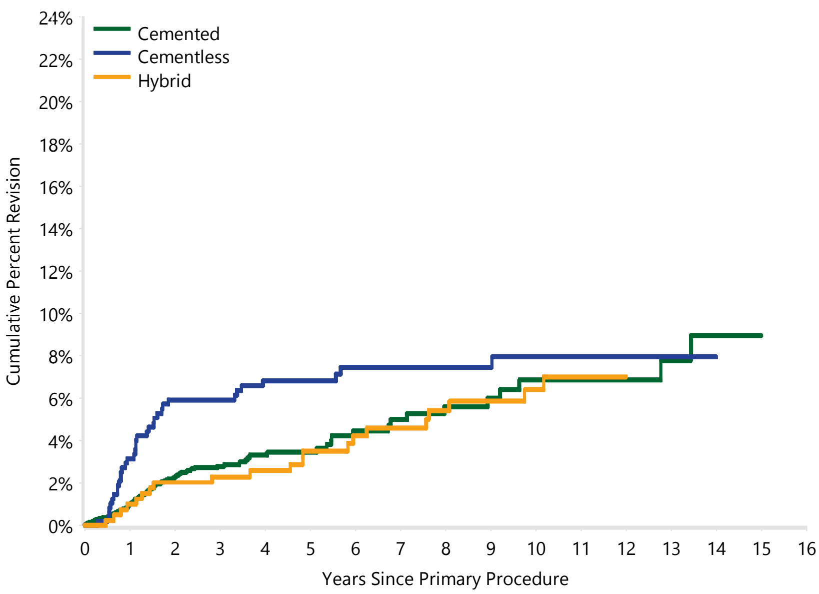


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Cemented	124375	110276	83217	59991	15594	689	140
Cementless	6947	6351	5132	3930	769	12	2
Hybrid	11458	10570	8814	7016	2276	174	54

Table KT24 Cumulative Percent Revision of Medial Pivot Primary Total Knee Replacement by Fixation (Primary Diagnosis OA)

Fixation	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Cemented	144	8497	1.0 (0.8, 1.3)	2.8 (2.3, 3.4)	3.4 (2.8, 4.3)	6.9 (5.0, 9.3)	9.0 (6.0, 13.3)	
Cementless	35	483	3.2 (1.9, 5.2)	5.9 (4.1, 8.5)	6.8 (4.9, 9.5)	7.9 (5.7, 11.0)		
Hybrid	21	410	1.0 (0.4, 2.7)	2.3 (1.2, 4.4)	3.5 (2.1, 6.0)	6.4 (4.1, 9.9)		
TOTAL	**200**	**9390**						

Figure KT26 Cumulative Percent Revision of Medial Pivot Primary Total Knee Replacement by Fixation (Primary Diagnosis OA)



HR - adjusted for age and gender

Cementless vs Cemented
- 0 - 6Mth: HR=0.56 (0.08, 4.10),p=0.567
- 6Mth - 2Yr: HR=3.11 (2.01, 4.79),p<0.001
- 2Yr+: HR=0.43 (0.19, 0.98),p=0.043

Hybrid vs Cemented
- Entire Period: HR=0.95 (0.58, 1.54),p=0.822

Cementless vs Hybrid
- 0 - 9Mth: HR=2.91 (1.25, 6.80),p=0.013
- 9Mth - 2Yr: HR=2.76 (1.40, 5.44),p=0.003
- 2Yr+: HR=0.46 (0.19, 1.09),p=0.078

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Cemented	8497	4881	1263	547	197	42	6
Cementless	483	456	428	343	176	31	1
Hybrid	410	390	356	301	158	4	0

Computer Navigation

There have been 96,730 primary total knee replacement procedures reported to the Registry in which computer navigation was used. In 2016, computer navigation was used in 30.8% 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 (Table KT25 and Figure KT27). However, there is a reduction in the rate of revision for navigated knee replacement due to loosening in both age groups (Figure KT28).

Image Derived Instrumentation (IDI)

There have been 20,931 primary total knee replacement procedures undertaken using IDI since 2009. In 2016, IDI was used in 10.4% of all primary total knee replacement procedures.

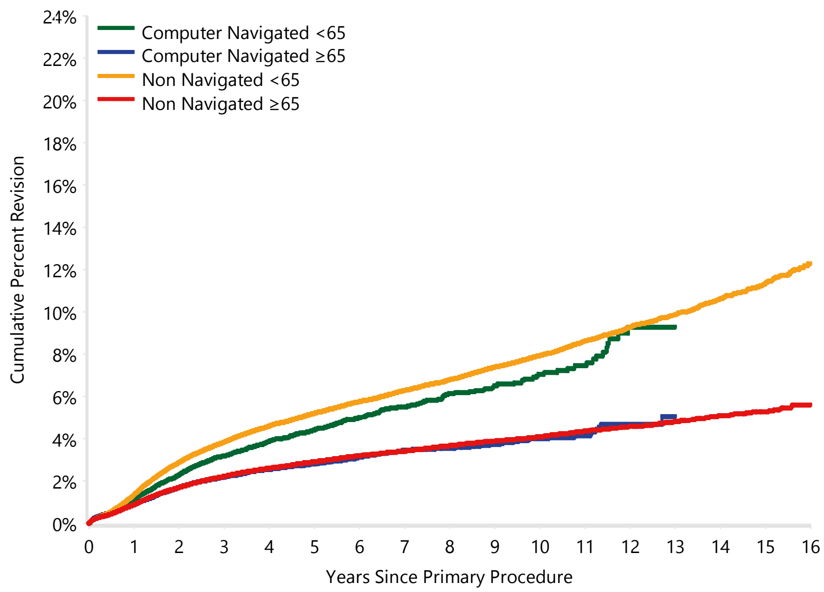
There is a lower rate of revision in the first three months when IDI is used compared to non IDI. From three months to 1.5 years this is reversed and there is a higher rate of revision. After this time, there is no difference in the rate of revision between IDI and non IDI (Table KT26 and Figure KT29).

The difference is age dependent and there is no difference in patients aged less than 65 years. However, there is an increased rate of revision for patients aged 65 years or older after three months (Table KT27 and Figure KT30).

Table KT25 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	16 Yrs
Computer Navigated		**2582**	**96730**	**1.0 (0.9, 1.0)**	**2.6 (2.4, 2.7)**	**3.4 (3.3, 3.5)**	**5.1 (4.8, 5.4)**		
	<65	1195	34089	1.1 (1.0, 1.2)	3.2 (3.0, 3.4)	4.4 (4.2, 4.7)	7.1 (6.5, 7.7)		
	≥65	1387	62641	0.9 (0.8, 1.0)	2.2 (2.1, 2.3)	2.8 (2.7, 3.0)	4.0 (3.7, 4.3)		
Non Navigated		**17045**	**437472**	**1.0 (1.0, 1.1)**	**2.8 (2.7, 2.8)**	**3.7 (3.6, 3.7)**	**5.4 (5.3, 5.5)**	**7.4 (7.2, 7.6)**	**8.0 (7.7, 8.3)**
	<65	8188	141524	1.4 (1.3, 1.4)	3.8 (3.7, 3.9)	5.2 (5.1, 5.3)	7.9 (7.7, 8.1)	11.3 (11.0, 11.7)	12.3 (11.7, 12.9)
	≥65	8857	295948	0.9 (0.8, 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 (5.3, 5.9)
TOTAL		**19627**	**534202**						

Figure KT27 Cumulative Percent Revision of Primary Total Knee Replacement by Computer Navigation and Age (Primary Diagnosis OA)



HR - adjusted for gender

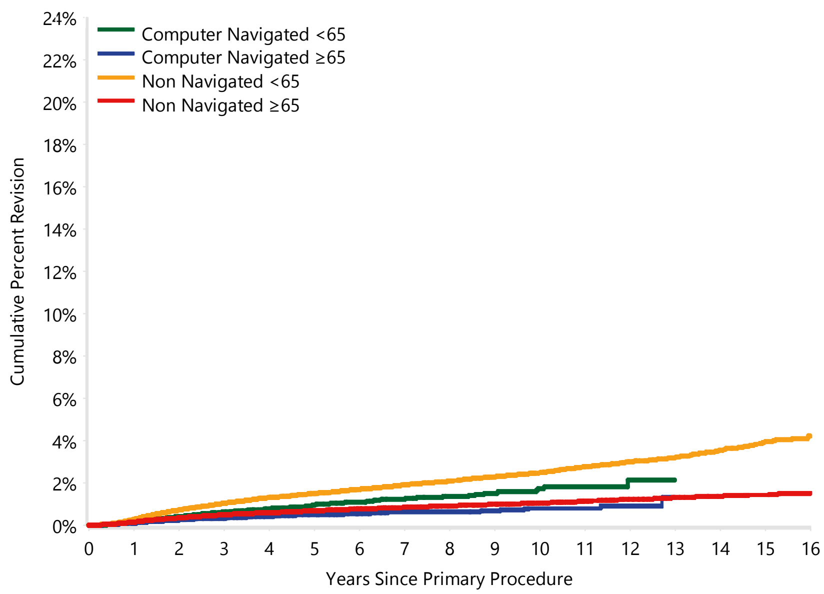
Computer Navigated <65 vs Computer Navigated ≥65
- 0 - 3Mth: HR=1.10 (0.90, 1.35),p=0.367
- 3Mth - 9Mth: HR=1.26 (1.06, 1.50),p=0.010
- 9Mth - 1Yr: HR=1.54 (1.23, 1.92),p<0.001
- 1Yr - 2Yr: HR=1.44 (1.26, 1.63),p<0.001
- 2Yr - 2.5Yr: HR=1.98 (1.64, 2.40),p<0.001
- 2.5Yr - 3.5Yr: HR=1.60 (1.33, 1.93),p<0.001
- 3.5Yr+: HR=2.08 (1.82, 2.37),p<0.001

Computer Navigated ≥65 vs Non Navigated ≥65
- Entire Period: HR=0.99 (0.93, 1.05),p=0.698

Computer Navigated <65 vs Non Navigated <65
- Entire Period: HR=0.85 (0.80, 0.91),p<0.001

Non Navigated ≥65 vs Non Navigated <65
- 0 - 2Wk: HR=0.95 (0.75, 1.20),p=0.679
- 2Wk - 1Mth: HR=0.98 (0.83, 1.17),p=0.850
- 1Mth - 3Mth: HR=0.89 (0.77, 1.03),p=0.103
- 3Mth - 9Mth: HR=0.61 (0.56, 0.67),p<0.001
- 9Mth - 1.5Yr: HR=0.54 (0.50, 0.57),p<0.001
- 1.5Yr - 3Yr: HR=0.53 (0.50, 0.56),p<0.001
- 3Yr - 3.5Yr: HR=0.51 (0.45, 0.58),p<0.001
- 3.5Yr - 4.5Yr: HR=0.49 (0.44, 0.55),p<0.001
- 4.5Yr - 5Yr: HR=0.48 (0.40, 0.56),p<0.001
- 5Yr - 6.5Yr: HR=0.48 (0.43, 0.54),p<0.001
- 6.5Yr - 7Yr: HR=0.37 (0.29, 0.46),p<0.001
- 7Yr - 11Yr: HR=0.41 (0.37, 0.45),p<0.001
- 11Yr+: HR=0.33 (0.28, 0.39),p<0.001

Figure KT28 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=1.64 (1.33, 2.02),p<0.001
- 2.5Yr+: HR=2.47 (1.95, 3.12),p<0.001

Computer Navigated ≥65 vs Non Navigated ≥65
- Entire Period: HR=0.73 (0.64, 0.83),p<0.001

Computer Navigated <65 vs Non Navigated <65
- Entire Period: HR=0.63 (0.55, 0.72),p<0.001

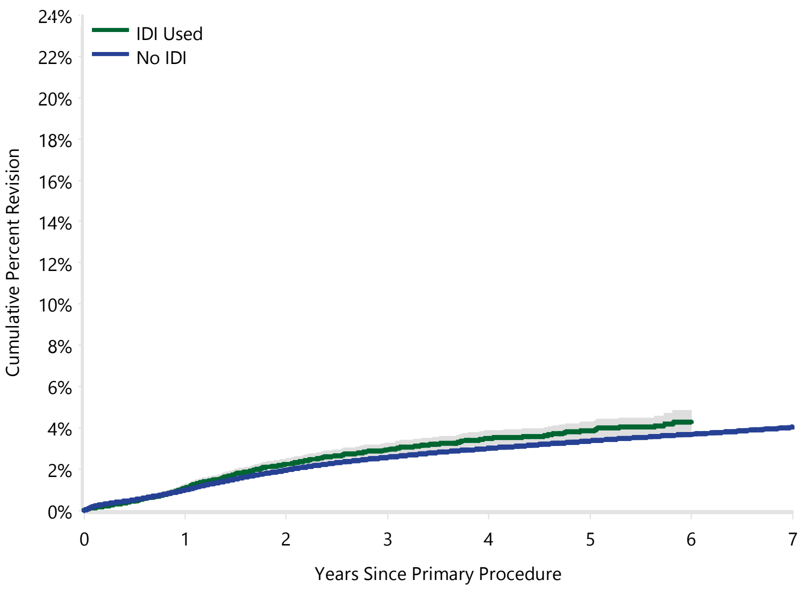
Non Navigated <65 vs Non Navigated ≥65
- 0 - 1Mth: HR=0.82 (0.49, 1.35),p=0.426
- 1Mth - 6Mth: HR=1.75 (1.37, 2.25),p<0.001
- 6Mth - 9Mth: HR=1.90 (1.50, 2.41),p<0.001
- 9Mth - 1.5Yr: HR=2.18 (1.92, 2.47),p<0.001
- 1.5Yr - 2Yr: HR=2.00 (1.67, 2.39),p<0.001
- 2Yr - 3Yr: HR=2.16 (1.87, 2.50),p<0.001
- 3Yr+: HR=2.74 (2.51, 2.99),p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Computer Navigated		**96730**	**79680**	**51117**	**30907**	**3363**	**0**	**0**
	<65	34089	28102	18327	11418	1284	0	0
	≥65	62641	51578	32790	19489	2079	0	0
Non Navigated		**437472**	**394601**	**312204**	**237714**	**89995**	**7947**	**1861**
	<65	141524	127436	100961	77521	30922	3142	759
	≥65	295948	267165	211243	160193	59073	4805	1102

Table KT26 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
IDI Used	474	20931	1.1 (0.9, 1.3)	2.2 (2.0, 2.5)	2.9 (2.7, 3.2)	3.5 (3.2, 3.8)	3.9 (3.5, 4.3)	4.3 (3.8, 4.8)
No IDI	8263	321519	1.0 (0.9, 1.0)	1.9 (1.9, 2.0)	2.6 (2.5, 2.6)	3.0 (2.9, 3.1)	3.4 (3.3, 3.4)	3.7 (3.6, 3.8)
TOTAL	**8737**	**342450**						

Figure KT29 Cumulative Percent Revision of Primary Total Knee Replacement since 2009 by IDI Usage (Primary Diagnosis OA)



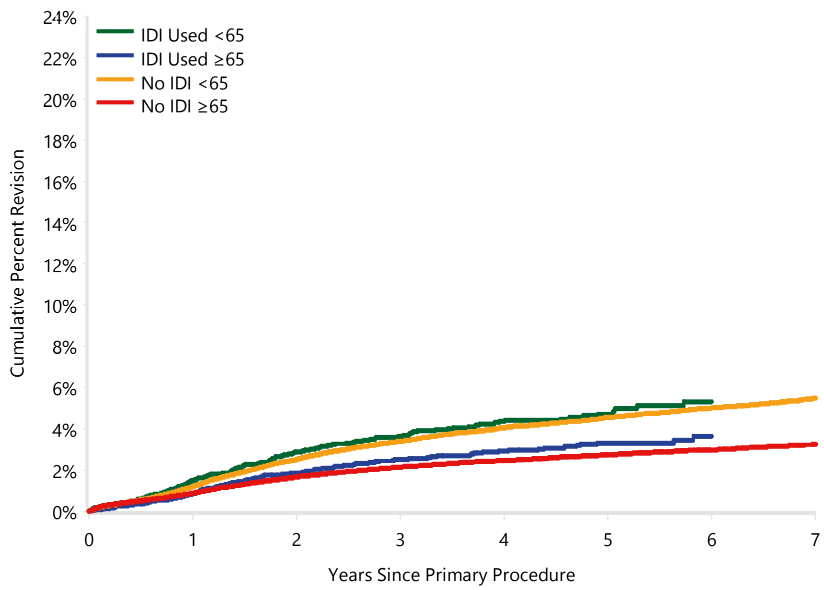
HR - adjusted for age and gender
IDI Used vs No IDI
0 - 3Mth: HR=0.65 (0.48, 0.87),p=0.003
3Mth - 1.5Yr: HR=1.26 (1.10, 1.43),p<0.001
1.5Yr+: HR=1.09 (0.94, 1.27),p=0.242

Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
IDI Used	20931	15350	10842	7685	4819	2608	751
No IDI	321519	271171	222122	176743	135375	96671	61075

Table KT27 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
IDI Used		**474**	**20931**	**1.1 (0.9, 1.3)**	**2.2 (2.0, 2.5)**	**2.9 (2.7, 3.2)**	**3.5 (3.2, 3.8)**	**3.9 (3.5, 4.3)**	**4.3 (3.8, 4.8)**
	<65	230	7890	1.5 (1.2, 1.8)	2.9 (2.5, 3.3)	3.6 (3.2, 4.2)	4.4 (3.8, 5.0)	4.7 (4.1, 5.4)	5.3 (4.5, 6.2)
	≥65	244	13041	0.8 (0.7, 1.0)	1.9 (1.6, 2.1)	2.5 (2.2, 2.9)	2.9 (2.5, 3.3)	3.3 (2.9, 3.8)	3.6 (3.0, 4.3)
No IDI		**8263**	**321519**	**1.0 (0.9, 1.0)**	**1.9 (1.9, 2.0)**	**2.6 (2.5, 2.6)**	**3.0 (2.9, 3.1)**	**3.4 (3.3, 3.4)**	**3.7 (3.6, 3.8)**
	<65	3812	109761	1.2 (1.1, 1.3)	2.5 (2.4, 2.6)	3.4 (3.3, 3.5)	4.0 (3.9, 4.2)	4.5 (4.4, 4.7)	5.0 (4.8, 5.2)
	≥65	4451	211758	0.9 (0.8, 0.9)	1.7 (1.6, 1.7)	2.1 (2.1, 2.2)	2.5 (2.4, 2.5)	2.7 (2.7, 2.8)	3.0 (2.9, 3.1)
TOTAL		**8737**	**342450**						

Figure KT30 Cumulative Percent Revision of Primary Total Knee Replacement since 2009 by IDI Usage and Age (Primary Diagnosis OA)



HR - adjusted for gender

IDI Used <65 vs IDI Used ≥65
Entire Period: HR=1.50 (1.25, 1.80),p<0.001

IDI Used ≥65 vs No IDI ≥65
0 - 3Mth: HR=0.65 (0.55, 0.77),p<0.001
3Mth - 1.5Yr: HR=1.22 (1.06, 1.40),p=0.004
1.5Yr+: HR=1.31 (1.15, 1.51),p<0.001

IDI Used <65 vs No IDI <65
Entire Period: HR=1.08 (0.95, 1.24),p=0.239

No IDI <65 vs No IDI ≥65
0 - 3Mth: HR=0.90 (0.79, 1.02),p=0.093
3Mth - 2Yr: HR=1.68 (1.58, 1.78),p<0.001
2Yr+: HR=1.89 (1.76, 2.03),p<0.001

Number at Risk		0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
IDI Used		**20931**	**15350**	**10842**	**7685**	**4819**	**2608**	**751**
	<65	7890	5881	4213	3073	1925	1066	326
	≥65	13041	9469	6629	4612	2894	1542	425
No IDI		**321519**	**271171**	**222122**	**176743**	**135375**	**96671**	**61075**
	<65	109761	92770	76352	61429	47580	34657	22020
	≥65	211758	178401	145770	115314	87795	62014	39055

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 10,091 procedures that have used XLPE with the addition of an antioxidant. XLPE is now used more frequently (57.0% in 2016) 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 3.7% at 10 years, compared to 5.7% for non XLPE (Table KT28 and Figure KT31). The major reason for this difference is a reduced cumulative incidence for loosening (0.7% at 10 years for XLPE compared to 1.5% for non XLPE) (Figure KT32).

The overall difference between XLPE and non XLPE is more evident in younger patients. The 10 year cumulative percent revision rate for those aged less than 65 years for XLPE is 5.2% and for non XLPE is 8.4%. For those aged 65 years or older the 10 year cumulative percent revision for XLPE is 2.9% and for non XLPE is 4.4% (Table KT29 and Figure KT33).

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 16 prosthesis combinations in this analysis. The rate of revision was lower when XLPE was used for three of these prostheses. There was no difference in rate of revision for the remaining prostheses (Tables KT30 and KT31).

Prosthesis Specific (Antioxidant)

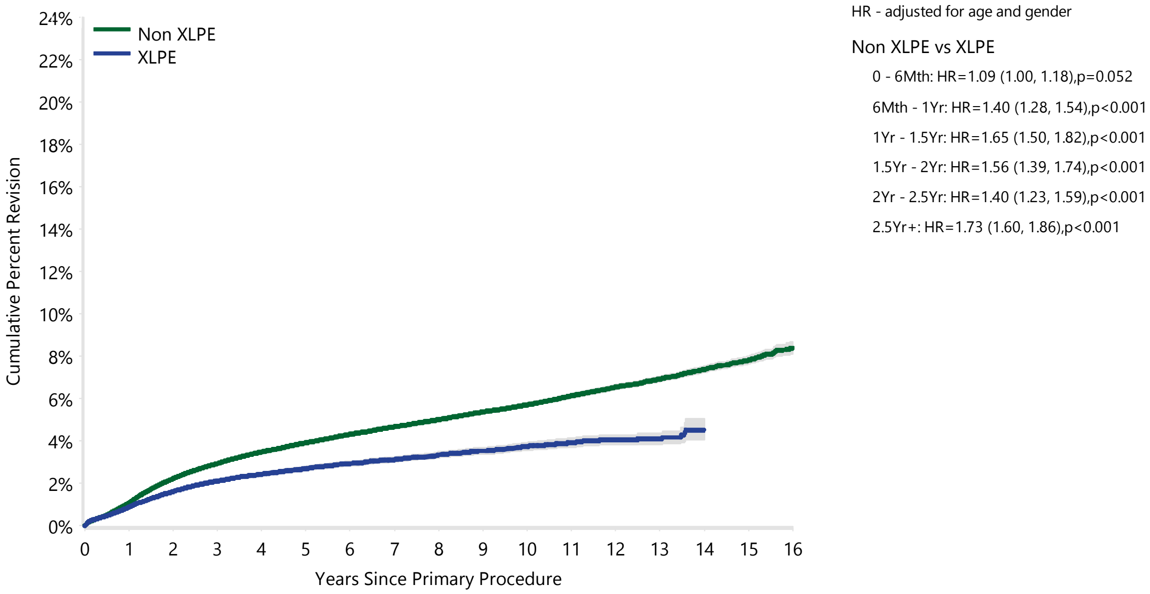
For the first time, an analysis comparing the rate of revision of XLPE and XLPE + antioxidant has been undertaken. The follow up for XLPE + antioxidant is relatively short (five years). XLPE + antioxidant has a lower rate of revision (Table KT32 and Figure KT34). However, there are only a small number of prostheses that use this bearing. The Attune was used in over 80% of these procedures. When the Attune is excluded from the analysis, there is no difference between XLPE and XLPE + antioxidant (Figure KT35).

Table KT28 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	16 Yrs
Non XLPE	16332	370987	1.1 (1.0, 1.1)	2.9 (2.9, 3.0)	3.9 (3.8, 4.0)	5.7 (5.6, 5.8)	7.8 (7.6, 8.0)	8.4 (8.1, 8.7)
XLPE	3290	163042	0.9 (0.8, 0.9)	2.1 (2.0, 2.2)	2.7 (2.6, 2.8)	3.7 (3.5, 3.9)		
TOTAL	**19622**	**534029**						

Note: Includes 10,091 procedures using XLPE + Antioxidant
Excludes 173 procedures with unknown bearing surface

Figure KT31 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	16 Yrs
Non XLPE	370987	342318	283174	223427	86828	7941	1859
XLPE	163042	131797	80012	45078	6475	1	0

Figure KT32 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by Polyethylene Type (Primary Diagnosis OA)

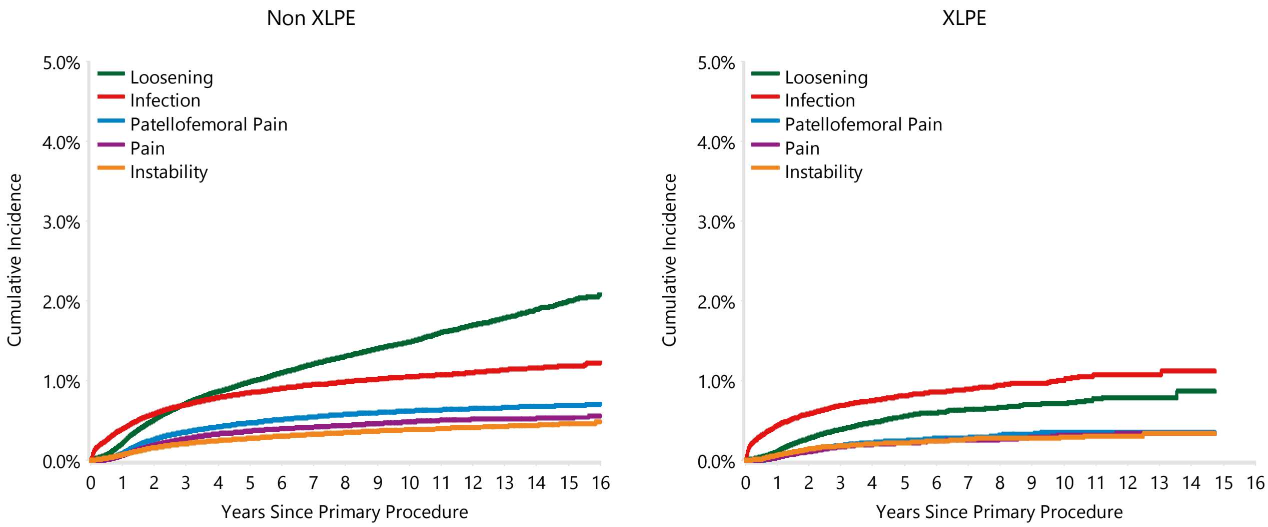
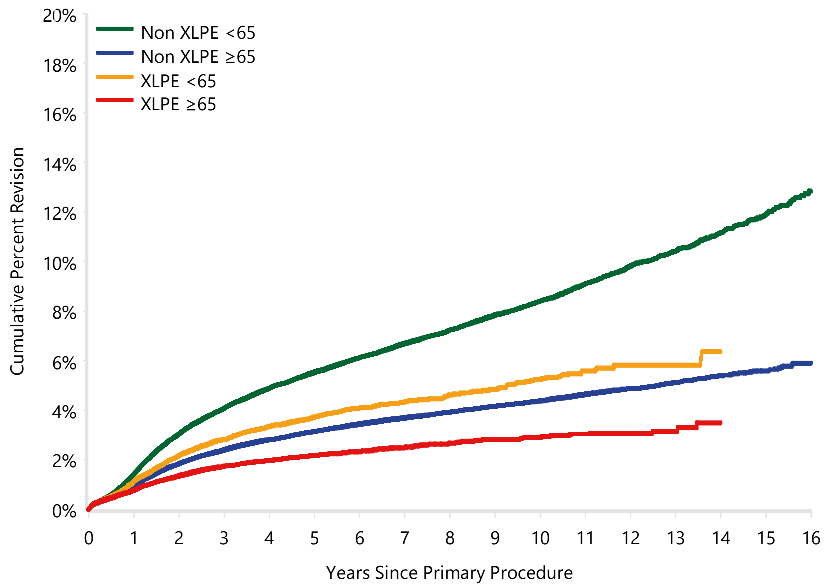


Table KT29 Cumulative Percent Revision of Primary Total Knee Replacement by Polyethylene Type and Age (Primary Diagnosis OA)

Polyethylene Type	Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Non XLPE	<65	7851	120129	1.4 (1.3, 1.5)	4.1 (3.9, 4.2)	5.5 (5.4, 5.7)	8.4 (8.2, 8.6)	11.9 (11.5, 12.3)	12.8 (12.3, 13.4)
	≥65	8481	250858	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 (5.4, 5.8)	5.9 (5.6, 6.2)
XLPE	<65	1529	55436	1.1 (1.0, 1.2)	2.8 (2.7, 3.0)	3.7 (3.5, 3.9)	5.2 (4.9, 5.6)		
	≥65	1761	107606	0.8 (0.7, 0.8)	1.7 (1.7, 1.8)	2.2 (2.1, 2.3)	2.9 (2.7, 3.1)		
TOTAL		**19622**	**534029**						

Figure KT33 Cumulative Percent Revision of Primary Total Knee Replacement by Polyethylene Type and Age (Primary Diagnosis OA)



HR - adjusted for gender

Non XLPE <65 vs Non XLPE ≥65
- 0 - 3Mth: HR=1.07 (0.94, 1.20),p=0.301
- 3Mth - 9Mth: HR=1.60 (1.46, 1.75),p<0.001
- 9Mth - 2Yr: HR=1.83 (1.73, 1.93),p<0.001
- 2Yr - 3.5Yr: HR=1.85 (1.73, 1.98),p<0.001
- 3.5Yr - 4Yr: HR=2.21 (1.91, 2.55),p<0.001
- 4Yr - 6.5Yr: HR=2.01 (1.86, 2.18),p<0.001
- 6.5Yr+: HR=2.69 (2.49, 2.90),p<0.001

Non XLPE ≥65 vs XLPE ≥65
- 0 - 3Mth: HR=0.95 (0.83, 1.07),p=0.382
- 3Mth - 6Mth: HR=1.23 (1.02, 1.48),p=0.027
- 6Mth - 2Yr: HR=1.54 (1.42, 1.67),p<0.001
- 2Yr+: HR=1.59 (1.45, 1.74),p<0.001

Non XLPE <65 vs XLPE <65
- 0 - 9Mth: HR=1.16 (1.07, 1.27),p<0.001
- 9Mth - 1Yr: HR=1.58 (1.40, 1.78),p<0.001
- 1Yr - 1.5Yr: HR=1.57 (1.43, 1.72),p<0.001
- 1.5Yr - 2.5Yr: HR=1.54 (1.41, 1.67),p<0.001
- 2.5Yr - 3.5Yr: HR=1.59 (1.44, 1.76),p<0.001
- 3.5Yr - 6.5Yr: HR=1.75 (1.61, 1.90),p<0.001
- 6.5Yr+: HR=2.29 (2.09, 2.51),p<0.001

XLPE <65 vs XLPE ≥65
- 0 - 3Mth: HR=1.03 (0.90, 1.17),p=0.687
- 3Mth - 1Yr: HR=1.70 (1.52, 1.90),p<0.001
- 1Yr - 1.5Yr: HR=1.83 (1.59, 2.10),p<0.001
- 1.5Yr+: HR=1.88 (1.71, 2.06),p<0.001

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	16 Yrs
Non XLPE	<65	120129	110707	91679	73219	29865	3141	758
	≥65	250858	231611	191495	150208	56963	4800	1101
XLPE	<65	55436	44784	27572	15690	2326	0	0
	≥65	107606	87013	52440	29388	4149	1	0

Table KT30 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	4 Yr	5 Yrs	8 Yrs	10 Yrs	12 Yrs	14 Yrs
Genesis II CR/Genesis II	Non XLPE	739	19793	3.0 (2.8, 3.3)	3.4 (3.1, 3.7)	4.4 (4.1, 4.7)	4.7 (4.3, 5.0)	5.1 (4.7, 5.6)	5.6 (5.1, 6.1)
	XLPE	20	1144	2.6 (1.5, 4.3)					
Genesis II Oxinium CR/Genesis II	Non XLPE	368	6171	3.8 (3.4, 4.3)	4.3 (3.8, 4.9)	5.8 (5.2, 6.5)	6.8 (6.1, 7.6)	8.2 (7.3, 9.2)	8.9 (7.8, 10.2)
	XLPE	30	1402	3.9 (2.6, 5.8)	3.9 (2.6, 5.8)				
Genesis II Oxinium PS/Genesis II	Non XLPE	662	11256	4.9 (4.5, 5.3)	5.4 (5.0, 5.9)	6.9 (6.4, 7.4)	7.7 (7.1, 8.4)	8.3 (7.6, 9.1)	
	XLPE	122	4265	3.9 (3.2, 4.7)	4.9 (3.9, 6.1)				
Genesis II PS/Genesis II	Non XLPE	571	14287	3.3 (3.0, 3.6)	3.7 (3.4, 4.1)	4.7 (4.3, 5.1)	5.2 (4.8, 5.7)	5.6 (5.1, 6.3)	6.2 (5.5, 7.0)
	XLPE	60	2166	4.3 (3.2, 5.6)	4.3 (3.2, 5.6)				
Legion CR/Genesis II	Non XLPE	44	1610	3.6 (2.6, 4.9)	3.7 (2.7, 5.1)				
	XLPE	30	1102	5.0 (3.2, 7.5)					
Legion Oxinium CR/Genesis II	Non XLPE	39	1499	2.8 (2.0, 3.9)	3.1 (2.2, 4.3)	3.4 (2.4, 4.9)			
	XLPE	20	1158	3.0 (1.9, 4.7)	3.0 (1.9, 4.7)				
Legion Oxinium PS/Genesis II	Non XLPE	173	4776	4.2 (3.6, 4.9)	4.9 (4.2, 5.8)	6.1 (4.9, 7.7)			
	XLPE	86	5036	3.1 (2.4, 3.9)	3.2 (2.5, 4.1)				
Legion PS/Genesis II	Non XLPE	34	1941	1.8 (1.2, 2.5)	2.0 (1.4, 2.9)				
	XLPE	37	1906	3.2 (2.3, 4.6)	3.2 (2.3, 4.6)				
Natural Knee II/Natural Knee II	Non XLPE	252	2865	2.4 (1.9, 3.1)	3.0 (2.5, 3.8)	4.9 (4.1, 5.8)	7.0 (6.1, 8.1)	9.8 (8.6, 11.2)	12.0 (10.6, 13.6)
	XLPE	105	3576	2.2 (1.8, 2.8)	2.5 (2.1, 3.1)	2.9 (2.4, 3.6)	3.3 (2.7, 4.0)	3.7 (3.0, 4.6)	4.6 (3.0, 6.9)
Nexgen CR Flex/Nexgen	Non XLPE	84	3733	2.1 (1.7, 2.7)	2.4 (1.9, 3.0)	2.7 (2.2, 3.4)	3.2 (2.5, 4.1)	3.2 (2.5, 4.1)	
	XLPE	711	38386	2.0 (1.9, 2.2)	2.3 (2.1, 2.4)	2.7 (2.5, 2.9)	3.0 (2.8, 3.3)	3.3 (3.0, 3.7)	
Nexgen CR/Nexgen	Non XLPE	199	5890	1.8 (1.5, 2.2)	2.0 (1.7, 2.4)	2.7 (2.3, 3.2)	3.1 (2.7, 3.7)	3.7 (3.2, 4.3)	4.3 (3.7, 5.0)
	XLPE	133	5081	1.9 (1.6, 2.3)	2.1 (1.7, 2.5)	2.6 (2.1, 3.1)	2.9 (2.5, 3.5)	3.2 (2.7, 3.9)	3.6 (3.0, 4.4)
Nexgen LPS Flex/Nexgen	Non XLPE	590	14815	2.7 (2.4, 3.0)	3.1 (2.9, 3.5)	4.4 (4.0, 4.8)	5.1 (4.7, 5.6)	5.9 (5.3, 6.5)	6.1 (5.4, 6.9)
	XLPE	388	15444	2.9 (2.6, 3.3)	3.3 (3.0, 3.7)	4.3 (3.8, 4.8)	4.6 (4.0, 5.2)		
PFC Sigma CR/PFC Sigma	Non XLPE	575	20412	2.2 (2.0, 2.4)	2.4 (2.2, 2.7)	3.0 (2.8, 3.3)	3.5 (3.2, 3.9)	4.2 (3.8, 4.6)	5.2 (4.5, 5.9)
	XLPE	24	2223	1.6 (1.1, 2.4)	1.6 (1.1, 2.4)				
Scorpio NRG PS/Series 7000	Non XLPE	18	504	2.4 (1.4, 4.2)	3.1 (1.9, 5.0)	3.1 (1.9, 5.0)			
	XLPE	124	3322	3.5 (2.9, 4.3)	4.0 (3.3, 4.8)	4.4 (3.7, 5.3)			
Triathlon CR/Triathlon	Non XLPE	253	9618	2.3 (2.0, 2.6)	2.5 (2.2, 2.8)	3.1 (2.7, 3.5)	3.5 (3.1, 4.0)		
	XLPE	921	50201	2.3 (2.1, 2.4)	2.5 (2.3, 2.7)	3.4 (3.0, 3.7)			
Triathlon PS/Triathlon	Non XLPE	174	3753	4.2 (3.6, 4.9)	4.6 (4.0, 5.4)	5.2 (4.5, 6.1)	5.8 (4.9, 6.8)		
	XLPE	149	5794	3.1 (2.6, 3.7)	3.5 (3.0, 4.2)	3.7 (3.1, 4.4)			
TOTAL		**7735**	**265129**						

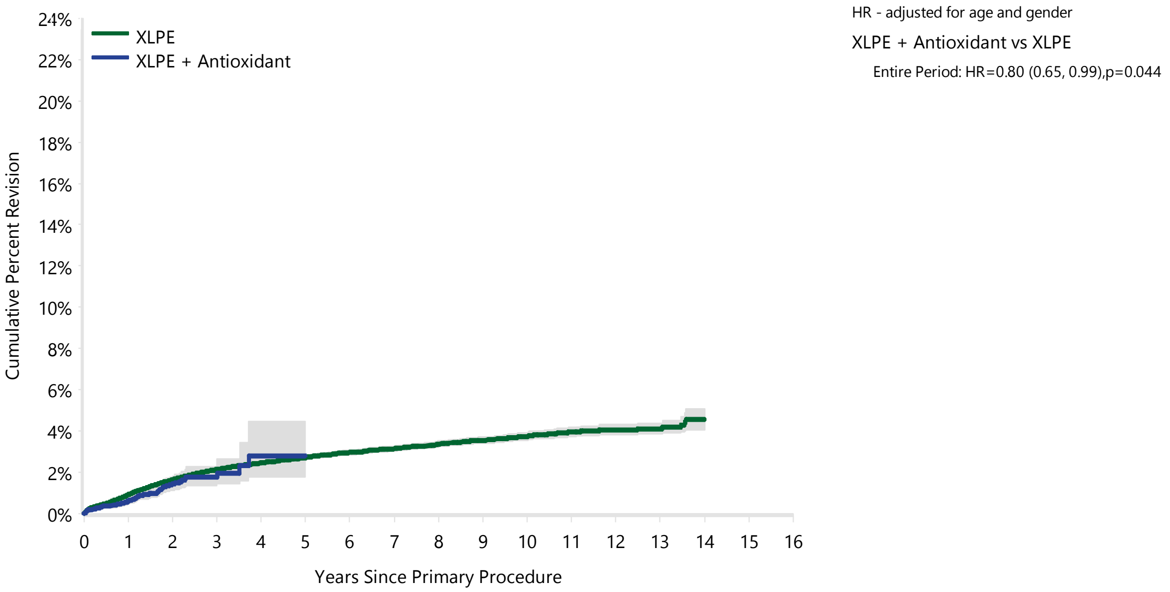
Table KT31 Hazard Ratios of XLPE vs Non XLPE in Primary Total Knee Replacement by Prosthesis Combination (Primary Diagnosis OA)

Femoral/Tibial Combination	Hazard Ratio		p-value
Genesis II CR/Genesis II	Entire Period	1.00 (0.64, 1.57)	0.994
Genesis II Oxinium CR/Genesis II	Entire Period	1.01 (0.69, 1.48)	0.950
Genesis II Oxinium PS/Genesis II	Entire Period	0.87 (0.71, 1.06)	0.177
Genesis II PS/Genesis II	Entire Period	1.26 (0.96, 1.65)	0.098
Legion CR/Genesis II	Entire Period	1.50 (0.93, 2.40)	0.094
Legion Oxinium CR/Genesis II	Entire Period	0.96 (0.55, 1.68)	0.894
Legion Oxinium PS/Genesis II	Entire Period	0.65 (0.50, 0.84)	0.001
Legion PS/Genesis II	Entire Period	1.58 (0.98, 2.56)	0.061
Natural Knee II/Natural Knee II	0-3.5Yr	0.98 (0.70, 1.37)	0.908
	3.5Yr – 9 Yr	0.26 (0.17, 0.41)	<0.001
	9Yr+	0.11 (0.04, 0.27)	<0.001
Nexgen CR Flex/Nexgen	Entire Period	0.88 (0.70, 1.11)	0.275
Nexgen CR/Nexgen	Entire Period	0.79 (0.63, 0.98)	0.35
Nexgen LPS Flex/Nexgen	0-6Mth	1.37 (1.00, 1.88)	0.050
	6Mth – 1.5Yr	0.81 (0.62, 1.06)	0.119
	1.5Yr – 2Yr	1.13 (0.75, 1.71)	0.558
	2Yr – 2.5Yr	1.51 (0.98, 2.32)	0.059
	2.5Yr+	0.87 (0.70, 1.09)	0.222
PFC Sigma CR/PFC Sigma	Entire Period	0.80 (0.53, 1.20)	0.278
Scorpio NRG PS/Series 7000	Entire Period	1.32 (0.78, 2.23)	0.306
Triathlon CR/Triathlon	Entire Period	1.02 (0.88, 1.18)	0.796
Triathlon PS/Triathlon	Entire Period	0.72 (0.57, 0.90)	0.003

Table KT32 Cumulative Percent Revision of XLPE Primary Total Knee Replacement by Polyethylene Type (Primary Diagnosis OA)

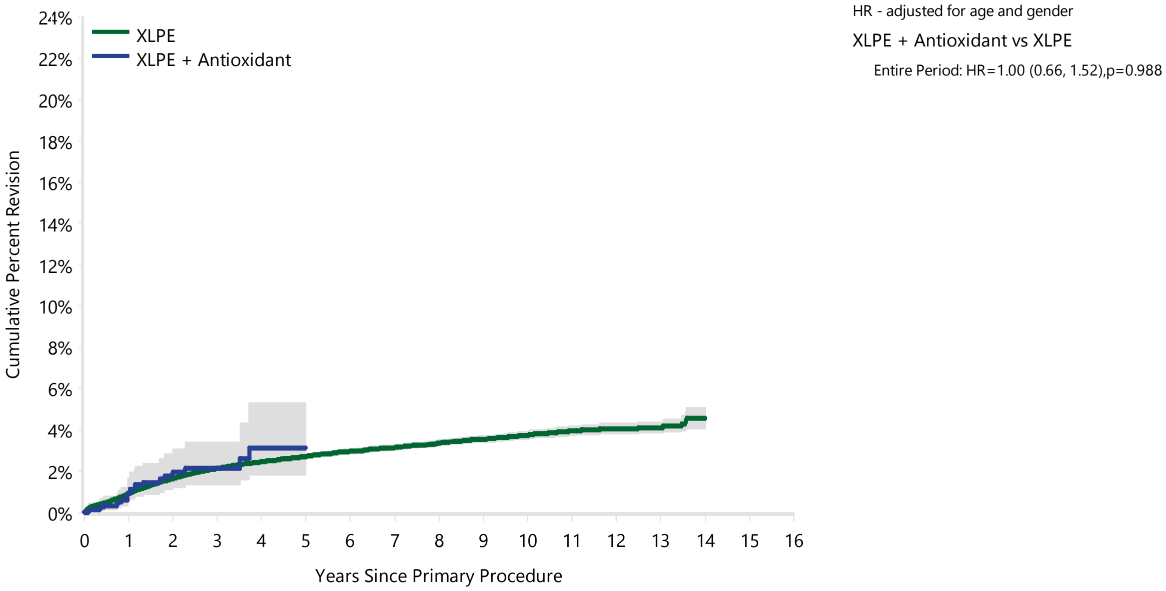
Polyethylene Type	N Revised	N Total	1 Yr	3 Yrs	4 Yrs	5 Yrs	7 Yrs	10 Yrs
XLPE	3202	152951	0.9 (0.9, 1.0)	2.1 (2.0, 2.2)	2.4 (2.4, 2.5)	2.7 (2.6, 2.8)	3.1 (3.0, 3.3)	3.7 (3.5, 3.9)
XLPE + Antioxidant	88	10091	0.6 (0.4, 0.8)	1.8 (1.4, 2.3)	2.8 (1.7, 4.5)	2.8 (1.7, 4.5)		
TOTAL	**3290**	**163042**						

Figure KT34 Cumulative Percent Revision of XLPE Primary Total Knee Replacement by Polyethylene Type (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	4 Yrs	5 Yrs	7 Yrs	10 Yrs
XLPE	152951	126087	79503	60736	44971	21951	6475
XLPE + Antioxidant	10091	5710	509	161	107	0	0

Figure KT35 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	4 Yrs	5 Yrs	7 Yrs	10 Yrs
XLPE	152951	126087	79503	60736	44971	21951	6475
XLPE + Antioxidant	1838	969	279	161	107	0	0

Shoulder Replacement

Shoulder Replacement

CATEGORIES OF SHOULDER REPLACEMENT

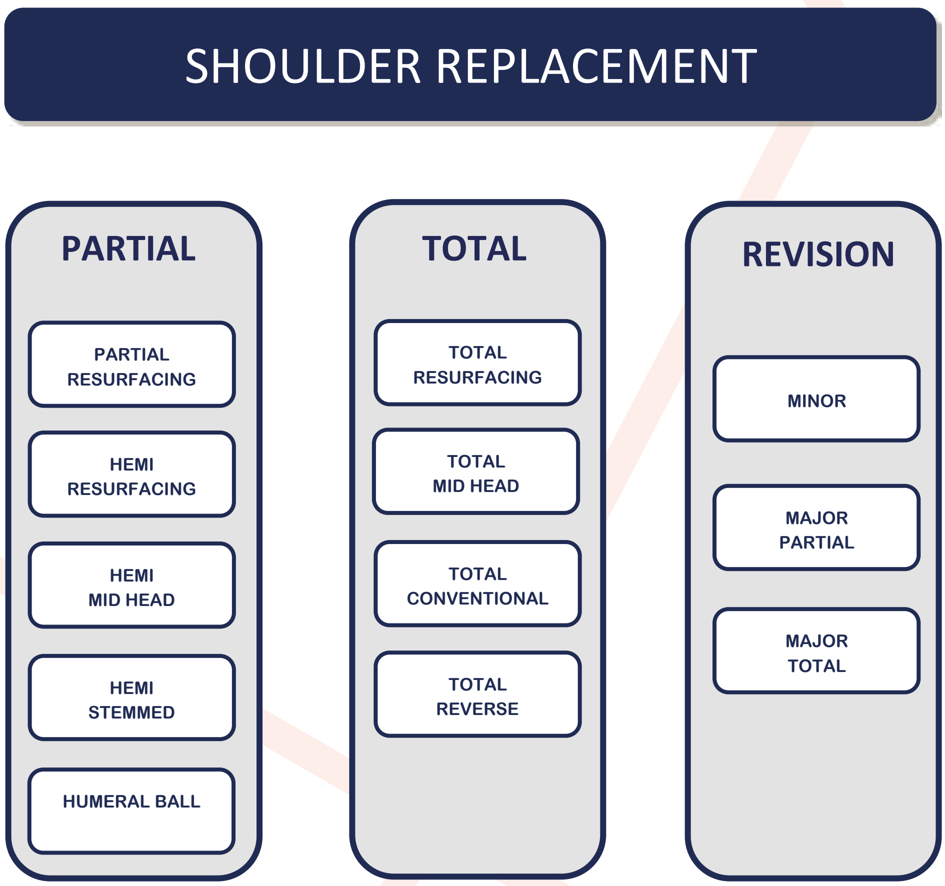
The Registry groups shoulder replacement into three broad categories: primary partial, primary total and revision shoulder replacement.

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 conventional 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 38,265 shoulder replacement procedures reported to the Registry with a procedure date up to and including 31 December 2016. This is an additional 5,859 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 2016 increased by 569 (11.1%) compared to the previous year and by 115.5% since 2008.

Shoulder replacement procedures increased by 11.1% in 2016 and increased by 115.5% since 2008.

When considering all shoulder replacement procedures currently recorded by the Registry, primary total shoulder replacement is the most common category (73.7%), followed by primary partial (16.2%) and revision procedures (10.1%) (Table S1).

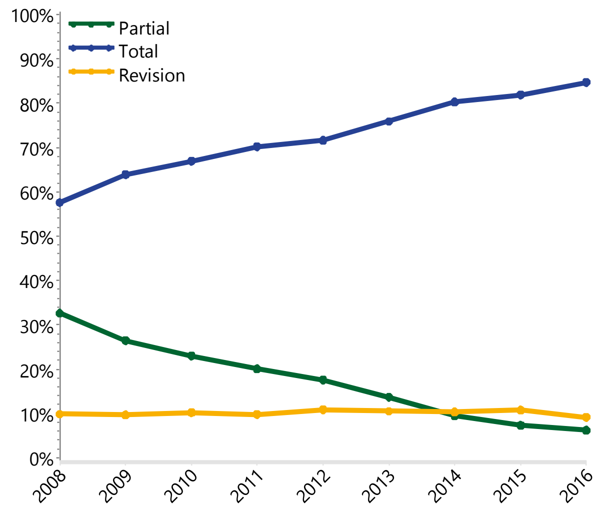
Table S1 Number of Shoulder Replacements

Shoulder Category	Number	Percent
Partial	6191	16.2
Total	28193	73.7
Revision	3881	10.1
TOTAL	**38265**	**100.0**

The proportion of total shoulder replacements has increased from 57.6% in 2008 to 84.7% in 2016. Since 2008, partial shoulder replacement has decreased from 32.6% to 6.2% in 2016. In 2008, the proportion of revision procedures was 9.8%. This peaked at 10.8% in 2012 and 2015. In 2016, the proportion of revision procedures has declined to 9.1%. This equates to 96 less revision procedures in 2016 than would have been expected if the proportion of revision procedures had remained at the peak of 10.8% (Figure S1).

The proportion of revision procedures of 9.1% equates to 96 fewer revision procedures in 2016 than if the proportion of revision procedures had remained at 10.8%.

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 17,146 procedures and BMI data on 8,153 shoulder replacement procedures.

In 2016, the ASA score is reported in 97.4% of procedures and BMI is reported in 80.6% of shoulder replacement procedures.

In 2016, the percentage of procedures where the ASA score was reported for primary partial shoulders is 95.7%, primary total shoulder 97.5% and revision shoulder replacement 97.3%. There is some variation in reporting of BMI based on procedure type. BMI is reported for 67.3% of primary partial shoulders, 81.8% of primary total shoulders and 79.3% 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 (https://www.asahq.org/resources/clinical-information/asa-physical-status-classification-system):

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

Overall, in 92.0% of procedures, patients have an ASA score of 2 or 3, 5.1% have a score of 1 and 2.9% have a score of 4. In three procedures, patients have a 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 (53.2%) compared to primary partial shoulder replacement (43.8%), or total shoulder replacement (45.4%) (Table S1).

BMI

BMI for adults is classified by the World Health Organisation into six main categories (http://apps.who.int/bmi/index.jsp?introPage=intro_3.html):

1.	Underweight	<18.50
2.	Normal	18.50 - 24.99
3.	Pre-obese	25.00 - 29.99
4.	Obese Class 1	30.00 - 34.99
5.	Obese Class 2	35.00 - 39.99
6.	Obese Class 3	≥40.00

For all shoulder replacements, the majority of procedures are undertaken in patients who are pre-obese or obese class 1 (61.3%). There is a higher proportion of primary total shoulder replacement procedures where the patients are pre-obese or obese class 1 (61.8%), compared to partial shoulder replacement (59.2%), and revision shoulder replacement (58.1%) (Table S2).

There is a gender difference, with a higher proportion of females in obese categories for all procedure groups (Figure S2).

Table S2 ASA Score by Shoulder Category

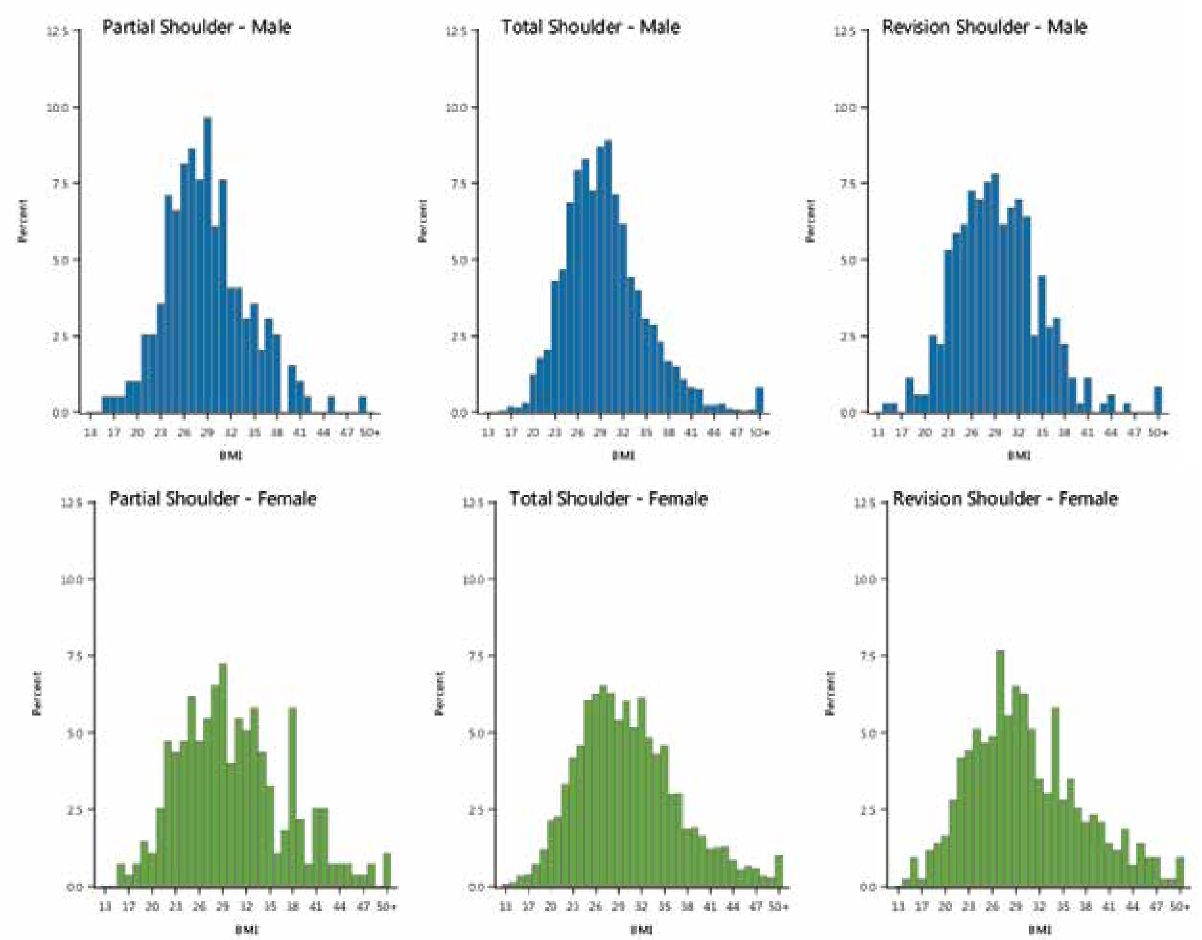
ASA Score	Partial N	Partial Col%	Total N	Total Col%	Revision N	Revision Col%	TOTAL N	TOTAL Col%
1	133	9.4	669	4.8	68	3.9	870	5.1
2	608	42.8	6592	47.1	675	39.1	7875	45.9
3	622	43.8	6355	45.4	919	53.2	7896	46.1
4	57	4.0	379	2.7	66	3.8	502	2.9
5	.	.	3	0.0	.	.	3	0.0
TOTAL	**1420**	**100.0**	**13998**	**100.0**	**1728**	**100.0**	**17146**	**100.0**

Table S3 BMI Category for Shoulder Replacement by Shoulder Category

BMI Category	Partial N	Partial Col%	Total N	Total Col%	Revision N	Revision Col%	TOTAL N	TOTAL Col%
Underweight	6	1.3	58	0.8	10	1.3	74	0.9
Normal	89	18.8	1144	16.6	152	19.2	1385	17.0
Pre-obese	163	34.5	2331	33.8	254	32.2	2748	33.7
Obese Class 1	117	24.7	1932	28.0	205	25.9	2254	27.6
Obese Class 2	61	12.9	907	13.2	106	13.4	1074	13.2
Obese Class 3	37	7.8	518	7.5	63	8.0	618	7.6
TOTAL	**473**	**100.0**	**6890**	**100.0**	**790**	**100.0**	**8153**	**100.0**

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

Figure S2 BMI Distribution by Gender and Shoulder Category



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

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 prosthesis 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 cone stemmed humeral head prosthesis.
Hemi stemmed involves the resection of the humeral head and replacement with a stemmed humeral prosthesis and humeral head prosthesis.

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. Both of these procedures have now been revised.

USE OF PARTIAL SHOULDER REPLACEMENT

There have been 6,191 primary partial shoulder replacements reported to the Registry up to 31 December 2016. This is an additional 379 procedures compared to the number reported last year.

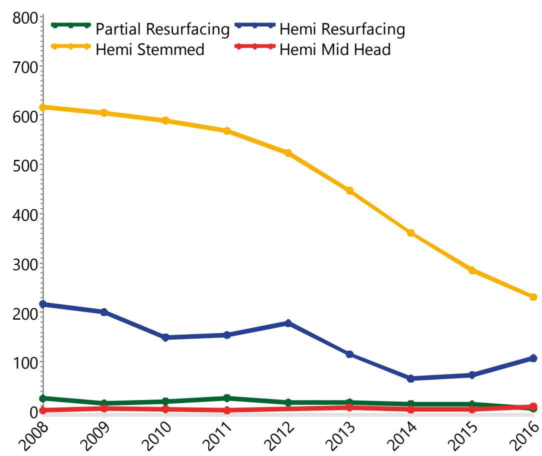
The most common class of primary partial shoulder replacement is hemi stemmed. This accounts for 74.2% of all partial shoulder replacements, followed by hemi resurfacing (22.7%), partial resurfacing (2.6%) and hemi mid head (0.5%) (Table SP1).

Table SP1 Primary Partial Shoulder Replacement by Class

Shoulder Class	Number	Percent
Partial Resurfacing	159	2.6
Hemi Resurfacing	1405	22.7
Hemi Stemmed	4594	74.2
Hemi Mid Head	33	0.5
TOTAL	**6191**	**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 107 in 2016. The number of hemi stemmed procedures decreased from 523 in 2012 to 231 in 2016 (Figure SP1).

Figure SP1 Primary Partial Shoulder Replacement by Class



Primary partial shoulder replacement is more common in females (65.0%). 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 (73.3%), hemi mid head (54.5%), hemi resurfacing (43.3%) and partial resurfacing (21.4%) (Table SP2).

Most patients are aged 65 years or older (65.6%). The proportion of patients in this age group varies depending on the class of primary partial shoulder replacement: hemi stemmed (71.3%), hemi resurfacing (52.4%), hemi mid head (48.5%) and partial resurfacing (21.4%) (Table SP3).

Overall, males undergoing a partial shoulder replacement are younger (mean age 62.2 years compared to 71.7 years for females) (Table SP4).

The most common primary diagnoses are fracture (45.8%) and osteoarthritis (39.9%) (Table SP5).

The five year cumulative percent revision varies depending on class. Partial resurfacing and hemi mid head have only been used in small numbers (159 and 33, respectively). This makes any assessment of comparative performance difficult. However, there is a clear difference in the two more commonly used classes. These devices have longer follow up and the cumulative percent revision at nine years for hemi resurfacing is greater than for hemi stemmed replacement (15.1% compared to 10.5%) (Table SP6 and Figure SP2).

When the diagnosis of osteoarthritis is considered, hemi resurfacing has a higher rate of revision compared to hemi stemmed after 2.5 years (Table SP7 and Figure SP3).

Table SP2 Primary Partial Shoulder Replacement by Gender and Class

	Male		Female	
Shoulder Class	N	Row%	N	Row%
Partial Resurfacing	125	78.6	34	21.4
Hemi Resurfacing	796	56.7	609	43.3
Hemi Stemmed	1228	26.7	3366	73.3
Hemi Mid Head	15	45.5	18	54.5
TOTAL	**2164**	**35.0**	**4027**	**65.0**

Table SP3 Primary Partial Shoulder Replacement by Age and Class

	<55		55-64		65-74		≥75	
Shoulder Class	N	Row%	N	Row%	N	Row%	N	Row%
Partial Resurfacing	111	69.8	14	8.8	18	11.3	16	10.1
Hemi Resurfacing	281	20.0	387	27.5	436	31.0	301	21.4
Hemi Stemmed	432	9.4	886	19.3	1388	30.2	1888	41.1
Hemi Mid Head	9	27.3	8	24.2	11	33.3	5	15.2
TOTAL	**833**	**13.5**	**1295**	**20.9**	**1853**	**29.9**	**2210**	**35.7**

Table SP4 Primary Partial Shoulder Replacement by Age and Gender

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	2164	35.0%	14	93	64	62.2	14.5
Female	4027	65.0%	13	101	73	71.7	11.2
TOTAL	**6191**	**100.0%**	**13**	**101**	**70**	**68.4**	**13.2**

Table SP5 Primary Partial Shoulder Replacement by Primary Diagnosis and Gender

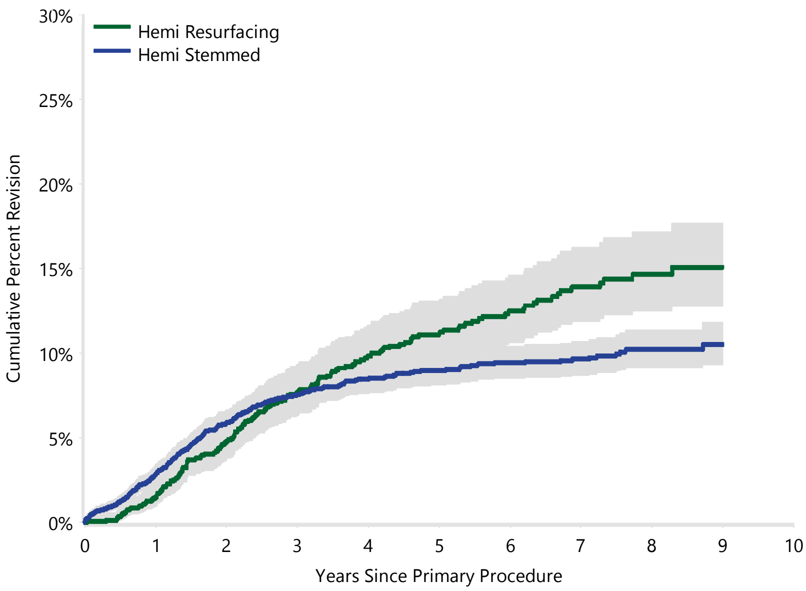
	Male		Female		TOTAL	
Primary Diagnosis	N	Col%	N	Col%	N	Col%
Fracture	615	28.4	2222	55.2	2837	45.8
Osteoarthritis	1165	53.8	1304	32.4	2469	39.9
Rotator Cuff Arthropathy	114	5.3	176	4.4	290	4.7
Osteonecrosis	72	3.3	107	2.7	179	2.9
Instability	98	4.5	56	1.4	154	2.5
Tumour	70	3.2	56	1.4	126	2.0
Rheumatoid Arthritis	18	0.8	91	2.3	109	1.8
Other Inflammatory Arthritis	10	0.5	15	0.4	25	0.4
Osteochondritis Dissecans	2	0.1	.	.	2	0.0
TOTAL	**2164**	**100.0**	**4027**	**100.0**	**6191**	**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	9 Yrs	10 Yrs
Partial Resurfacing	6	159	0.6 (0.1, 4.5)	1.3 (0.3, 5.2)	1.3 (0.3, 5.2)	5.5 (2.2, 13.8)		
Hemi Resurfacing	152	1405	1.5 (1.0, 2.3)	7.7 (6.3, 9.3)	11.1 (9.4, 13.1)	13.9 (11.9, 16.2)	15.1 (12.8, 17.7)	
Hemi Stemmed	364	4594	2.9 (2.4, 3.4)	7.6 (6.8, 8.4)	9.0 (8.1, 10.0)	9.7 (8.7, 10.7)	10.5 (9.3, 11.8)	
Hemi Mid Head	5	33	3.8 (0.6, 24.3)	24.0 (10.6, 48.9)	24.0 (10.6, 48.9)			
TOTAL	**527**	**6191**						

Figure SP2 Cumulative Percent Revision of Primary Partial Shoulder Replacement by Class (All Diagnoses)



HR - adjusted for age and gender

Hemi Resurfacing vs Hemi Stemmed

0 - 1Yr: HR=0.48 (0.30, 0.77),p=0.002

1Yr - 1.5Yr: HR=1.16 (0.75, 1.80),p=0.509

1.5Yr - 2Yr: HR=0.75 (0.41, 1.39),p=0.368

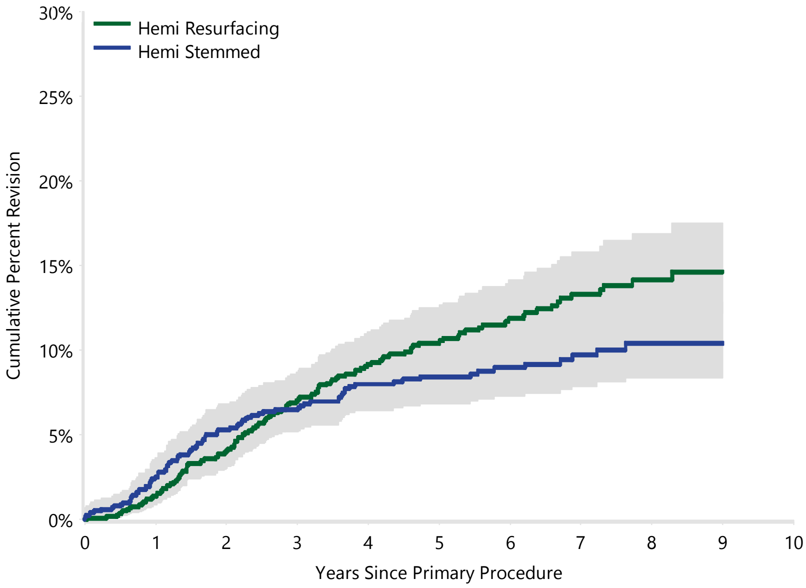
2Yr+: HR=2.04 (1.54, 2.70),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Hemi Resurfacing	1405	1271	1044	715	418	105	17
Hemi Stemmed	4594	4059	3031	1986	1012	204	23

Table SP7 Cumulative Percent Revision of Primary Partial Shoulder Replacement by Class (Primary Diagnosis OA)

Shoulder Class	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Hemi Resurfacing	125	1225	1.4 (0.8, 2.2)	7.0 (5.6, 8.7)	10.4 (8.7, 12.5)	13.3 (11.2, 15.8)	14.6 (12.2, 17.5)	
Hemi Stemmed	91	1161	2.5 (1.7, 3.6)	6.5 (5.2, 8.2)	8.4 (6.8, 10.4)	9.7 (7.9, 11.9)	10.4 (8.4, 12.9)	
TOTAL	**216**	**2386**						

Figure SP3 Cumulative Percent Revision of Primary Partial Shoulder Replacement by Class (Primary Diagnosis OA)



HR - adjusted for age and gender

Hemi Resurfacing vs Hemi Stemmed

0 - 2.5Yr: HR=0.80 (0.56, 1.14),p=0.220

2.5Yr+: HR=2.04 (1.27, 3.26),p=0.003

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Hemi Resurfacing	1225	1106	909	616	365	97	14
Hemi Stemmed	1161	1049	806	582	321	74	6

PRIMARY PARTIAL RESURFACING SHOULDER REPLACEMENT

DEMOGRAPHICS AND OUTCOMES

There have been 159 primary partial resurfacing shoulder replacement procedures reported to the Registry. This is an additional 10 procedures compared to the previous report.

This procedure is undertaken more commonly in males (78.6%). The mean age for males is 40.2 years compared to 60.1 years for females (Table SP8).

The most common primary diagnosis is instability (48.4%), followed by osteoarthritis (39.6%) (Table SP9).

The cumulative percent revision at seven years is 5.5% (Table SP6). Of the six revisions, four were for glenoid erosion and two were for instability/dislocation. All were revised to a total conventional shoulder replacement.

Table SP8 Primary Partial Resurfacing Shoulder Replacement by Age and Gender

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	125	78.6%	14	87	37	40.2	18.0
Female	34	21.4%	17	88	64	60.1	18.5
TOTAL	**159**	**100.0%**	**14**	**88**	**43**	**44.5**	**19.8**

Table SP9 Primary Partial Resurfacing Shoulder Replacement by Primary Diagnosis and Gender

	Male		Female		TOTAL	
Primary Diagnosis	N	Col%	N	Col%	N	Col%
Instability	65	52.0	12	35.3	77	48.4
Osteoarthritis	45	36.0	18	52.9	63	39.6
Fracture	8	6.4	2	5.9	10	6.3
Osteonecrosis	2	1.6	2	5.9	4	2.5
Osteochondritis Dissecans	2	1.6	.	.	2	1.3
Rotator Cuff Arthropathy	2	1.6	.	.	2	1.3
Tumour	1	0.8	.	.	1	0.6
TOTAL	**125**	**100.0**	**34**	**100.0**	**159**	**100.0**

Note: Instability includes instability, dislocation and Hill-Sachs Defect

PRIMARY HEMI RESURFACING SHOULDER REPLACEMENT

DEMOGRAPHICS

There have been 1,405 primary hemi resurfacing shoulder replacements reported to the Registry. This is an additional 113 procedures compared to the previous report. The use of primary hemi resurfacing has declined by 50.7% since 2008.

This procedure is more common in males (56.7%). The mean age is 61.3 years for males and 68.5 years for females (Table SP10).

Osteoarthritis is the most common primary diagnosis (87.2%). The range of diagnoses is similar for males and females (Table SP11).

The three most used prostheses in 2016 were the PyroTITAN, Copeland and Global CAP (Table SP12).

Table SP10 Primary Hemi Resurfacing Shoulder Replacement by Age and Gender

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	796	56.7%	19	90	62	61.3	12.0
Female	609	43.3%	27	93	70	68.5	11.2
TOTAL	**1405**	**100.0%**	**19**	**93**	**65**	**64.4**	**12.2**

Table SP11 Primary Hemi Resurfacing Shoulder Replacement by Primary Diagnosis and Gender

	Male		Female		TOTAL	
Primary Diagnosis	N	Col%	N	Col%	N	Col%
Osteoarthritis	698	87.7	527	86.5	1225	87.2
Rotator Cuff Arthropathy	49	6.2	34	5.6	83	5.9
Osteonecrosis	16	2.0	17	2.8	33	2.3
Rheumatoid Arthritis	7	0.9	16	2.6	23	1.6
Instability	13	1.6	5	0.8	18	1.3
Fracture	10	1.3	4	0.7	14	1.0
Other Inflammatory Arthritis	3	0.4	6	1.0	9	0.6
TOTAL	**796**	**100.0**	**609**	**100.0**	**1405**	**100.0**

Note: Instability includes instability and dislocation

Table SP12 Most Used Humeral Head Prostheses in Primary Hemi Resurfacing Shoulder Replacement

2008		2013		2014		2015		2016	
N	Model	N	Model	N	Model	N	Model	N	Model
124	Copeland	35	Copeland	31	Copeland	26	Copeland	81	PyroTITAN
45	Global CAP	33	PyroTITAN	19	Global CAP	21	PyroTITAN	14	Copeland
34	SMR	19	Global CAP	9	SMR	16	Global CAP	8	Global CAP
11	Aequalis	14	Aequalis	4	Aequalis	6	SMR	4	SMR
2	Epoca RH	14	SMR	1	Custom Made (Copeland)	4	Aequalis		
1	Buechel-Pappas			1	Epoca RH				
Most Used									
217 (6)	100.0%	115 (5)	100.0%	65 (6)	100.0%	73 (5)	100.0%	107 (4)	100.0%

OUTCOME FOR ALL DIAGNOSES

Reason for Revision

The main reasons for revision of hemi resurfacing shoulder replacement are glenoid erosion (25.7%), pain (23.7%), rotator cuff insufficiency (13.8%) and loosening (11.2%) (Table SP13 and Figure SP4). There were three 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.

Type of Revision

The most common type of revision is to a total shoulder replacement (90.1%). Of these, 72 (52.6%) were revised to a total reverse shoulder and 65 (47.5%) to a total conventional shoulder replacement (Table SP14).

OUTCOME FOR OSTEOARTHRITIS

Age and Gender

Patients aged 75 years or older have a lower rate of revision after 3.5 years compared to patients aged less than 55 years (Table SP15 and Figure SP5).

Gender is not a risk factor for revision (Table SP16 and Figure SP6).

The outcomes of the most commonly used prostheses are listed in Table SP17.

Glenoid erosion or pain are the reasons for 49% of all hemi resurfacing shoulder revisions.

Table SP13 Primary Hemi Resurfacing Shoulder Replacement by Reason for Revision

Reason for Revision	Number	Percent
Glenoid Erosion	39	25.7
Pain	36	23.7
Rotator Cuff Insufficiency	21	13.8
Loosening	17	11.2
Instability/Dislocation	16	10.5
Lysis	5	3.3
Infection	4	2.6
Implant Breakage Head	3	2.0
Malposition	2	1.3
Incorrect Sizing	2	1.3
Fracture	2	1.3
Metal Related Pathology	2	1.3
Arthrofibrosis	1	0.7
Osteonecrosis	1	0.7
Implant Breakage Humeral	1	0.7
TOTAL	**152**	**100.0**

Table SP14 Primary Hemi Resurfacing Shoulder Replacement by Type of Revision

Type of Revision	Number	Percent
Humeral/Glenoid	137	90.1
Glenoid Component	6	3.9
Humeral Component	6	3.9
Removal of Prostheses	1	0.7
Reoperation	1	0.7
Head Only	1	0.7
TOTAL	**152**	**100.0**

Figure SP4 Cumulative Incidence Revision Diagnosis of Primary Hemi Resurfacing Shoulder Replacement (All Diagnoses)

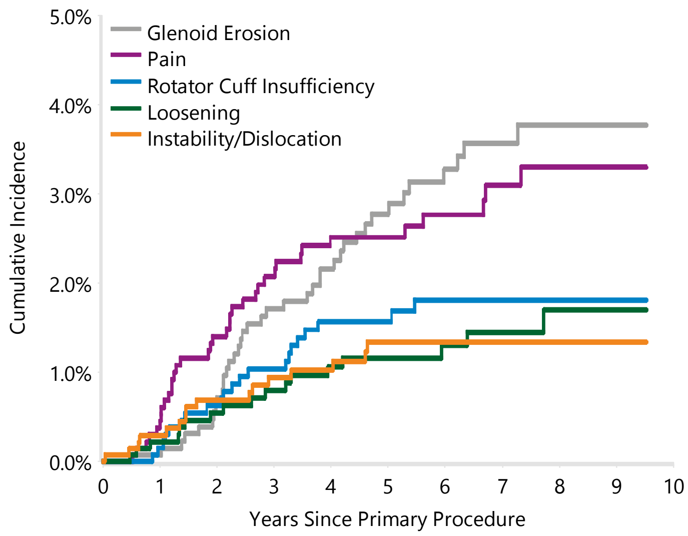
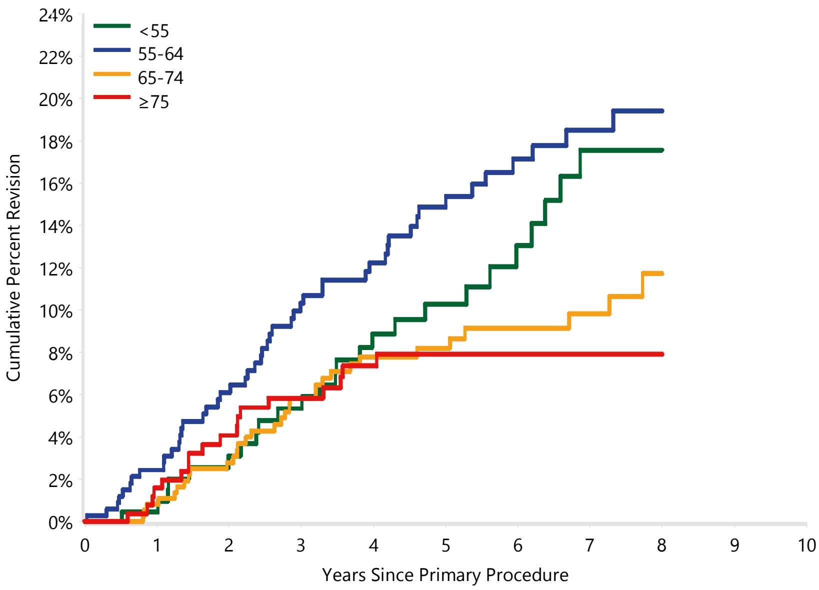


Table SP15 Cumulative Percent Revision of Primary Hemi Resurfacing Shoulder Replacement by Age (Primary Diagnosis OA)

Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
<55	26	231	0.5 (0.1, 3.3)	5.3 (2.9, 9.7)	10.3 (6.6, 15.9)	17.6 (11.9, 25.5)		
55-64	49	341	2.4 (1.2, 4.8)	10.3 (7.4, 14.4)	14.9 (11.2, 19.6)	18.5 (14.1, 24.1)		
65-74	32	390	0.8 (0.3, 2.5)	5.8 (3.8, 8.9)	8.2 (5.7, 11.8)	9.8 (6.9, 13.9)		
≥75	18	263	1.6 (0.6, 4.2)	5.8 (3.5, 9.7)	7.9 (5.0, 12.3)	7.9 (5.0, 12.3)		
TOTAL	**125**	**1225**						

Figure SP5 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=1.35 (0.73, 2.49),p=0.345

2.5Yr+: HR=1.04 (0.57, 1.89),p=0.897

65-74 vs <55

Entire Period: HR=0.61 (0.36, 1.04),p=0.070

≥75 vs <55

0 - 1.5Yr: HR=0.83 (0.34, 2.03),p=0.682

1.5Yr - 3.5Yr: HR=0.47 (0.19, 1.14),p=0.093

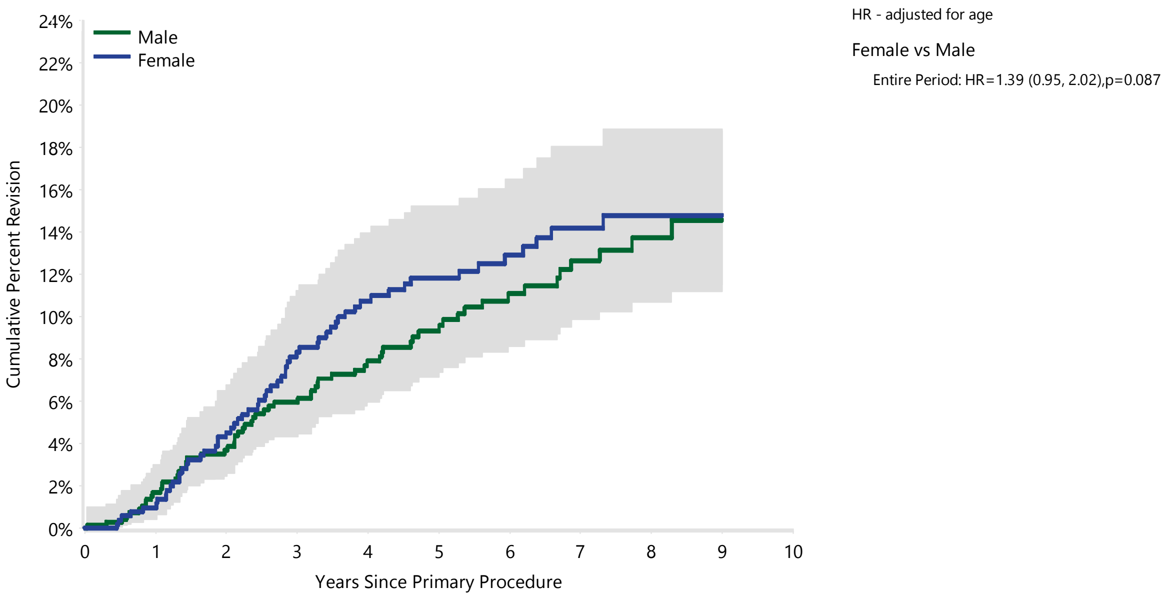
3.5Yr+: HR=0.24 (0.07, 0.82),p=0.023

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
<55	231	196	167	115	59	21	3
55-64	341	304	246	165	103	26	6
65-74	390	359	300	203	123	37	4
≥75	263	247	196	133	80	13	1

Table SP16 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	9 Yrs	10 Yrs
Male	65	698	1.7 (0.9, 3.0)	6.0 (4.3, 8.2)	9.3 (7.1, 12.1)	12.6 (9.9, 16.2)	14.6 (11.2, 18.8)	
Female	60	527	1.0 (0.4, 2.3)	8.3 (6.1, 11.2)	11.8 (9.1, 15.2)	14.2 (11.1, 18.1)	14.8 (11.5, 18.9)	
TOTAL	**125**	**1225**						

Figure SP6 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	9 Yrs	10 Yrs
Male	698	613	513	331	198	55	8
Female	527	493	396	285	167	42	6

Table SP17 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	9 Yrs	10 Yrs
Aequalis	10	78	1.3 (0.2, 8.9)	9.4 (4.6, 18.7)	11.1 (5.7, 21.1)	19.4 (9.8, 36.2)		
Copeland	50	531	1.5 (0.8, 3.0)	5.9 (4.1, 8.3)	9.1 (6.9, 12.2)	10.7 (8.1, 14.0)	11.7 (8.9, 15.4)	
Global CAP	25	205	0.5 (0.1, 3.5)	8.8 (5.5, 14.0)	12.1 (8.1, 18.1)	13.8 (9.3, 20.1)		
PyroTITAN	12	242	2.4 (1.0, 5.8)	5.8 (3.1, 10.6)				
SMR	23	146	0.0 (0.0, 0.0)	6.7 (3.5, 12.5)	13.8 (8.8, 21.3)	22.1 (14.9, 32.0)		
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	**125**	**1225**						

Note: Only prostheses with over 50 procedures have been listed

PRIMARY HEMI MID HEAD SHOULDER REPLACEMENT

DEMOGRAPHICS AND OUTCOME

There have been 33 primary hemi mid head shoulder replacement procedures reported to the Registry. This is an additional nine procedures compared to the previous report.

This procedure is undertaken more commonly in females (54.5%). The mean age is 65.3 years for females and 59.1 years for males (Table SP18).

Osteoarthritis is the most common primary diagnosis (60.6%) (Table SP19).

There have been an additional two revisions reported in 2016. 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 SP20).

The most common type of revision is to a total shoulder replacement (Table SP21).

The most common humeral head and stem prosthesis combinations are the Affinis (11), the Eclipse (10) and the Affiniti (7).

Table SP18 Primary Hemi Mid Head Shoulder Replacement by Age and Gender

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	15	45.5%	44	83	59	59.1	12.1
Female	18	54.5%	30	85	66	65.3	12.8
TOTAL	**33**	**100.0%**	**30**	**85**	**64**	**62.5**	**12.7**

Table SP19 Primary Hemi Mid Head Shoulder Replacement by Primary Diagnosis and Gender

	Male		Female		TOTAL	
Primary Diagnosis	N	Col%	N	Col%	N	Col%
Osteoarthritis	9	60.0	11	61.1	20	60.6
Osteonecrosis	4	26.7	4	22.2	8	24.2
Fracture	.	.	2	11.1	2	6.1
Rotator Cuff Arthropathy	2	13.3	.	.	2	6.1
Rheumatoid Arthritis	.	.	1	5.6	1	3.0
TOTAL	**15**	**100.0**	**18**	**100.0**	**33**	**100.0**

Table SP20 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**

Table SP21 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 4,594 primary hemi stemmed shoulder replacement procedures reported to the Registry. This is an additional 249 procedures compared to the previous report.

This procedure is more common in females (73.3%). The mean age is 72.4 years for females and 65.1 years for males (Table SP22).

The most common primary diagnosis is fracture (61.2%), followed by osteoarthritis (25.3%) (Table SP23). In 2016, the number of primary hemi stemmed shoulder replacements undertaken for fracture decreased by 70.4% compared to 2008. In 2016, the number of primary hemi stemmed shoulder replacements undertaken for osteoarthritis decreased by 64.6% compared to 2008 (Figure SP7).

The most common humeral head prostheses used in 2016 were the Aequalis, Global Unite and SMR. The 10 most used humeral head prostheses accounted for 86.1% of all primary hemi stemmed procedures in 2016. This has decreased from 98.2% in 2008 (Table SP24).

The most common humeral stem prostheses used in 2016 were the SMR, Global Unite and Aequalis Ascend. The 10 most used stem prostheses accounted for 92.2% of all primary hemi stemmed procedures in 2016. This has decreased from 97.2% in 2008 (Table SP25).

There has been a major decline in the use of primary hemi stemmed shoulder replacement for the management of osteoarthritis and fracture.

Table SP22 Primary Hemi Stemmed Shoulder Replacement by Age and Gender

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	1228	26.7%	14	93	66	65.1	13.5
Female	3366	73.3%	13	101	74	72.4	10.9
TOTAL	**4594**	**100.0%**	**13**	**101**	**72**	**70.4**	**12.1**

Table SP23 Primary Hemi Stemmed Shoulder Replacement by Primary Diagnosis and Gender

	Male		Female		TOTAL	
Primary Diagnosis	N	Col%	N	Col%	N	Col%
Fracture	597	48.6	2214	65.8	2811	61.2
Osteoarthritis	413	33.6	748	22.2	1161	25.3
Rotator Cuff Arthropathy	61	5.0	142	4.2	203	4.4
Osteonecrosis	50	4.1	84	2.5	134	2.9
Tumour	69	5.6	56	1.7	125	2.7
Rheumatoid Arthritis	11	0.9	74	2.2	85	1.9
Instability	20	1.6	39	1.2	59	1.3
Other Inflammatory Arthritis	7	0.6	9	0.3	16	0.3
TOTAL	**1228**	**100.0**	**3366**	**100.0**	**4594**	**100.0**

Note: Instability includes instability and dislocation

Figure SP7 Primary Hemi Stemmed Shoulder Replacement by Primary Diagnosis

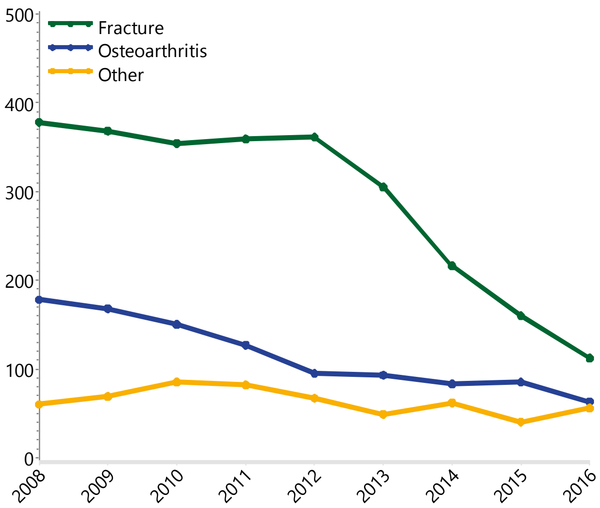


Table SP24 10 Most Used Humeral Head Prostheses in Primary Hemi Stemmed Shoulder Replacement

2008		2013		2014		2015		2016	
N	Model	N	Model	N	Model	N	Model	N	Model
197	Global Advantage	109	SMR	83	SMR	47	SMR	40	Aequalis
177	SMR	71	Global Advantage	73	Aequalis	44	Aequalis	35	Global Unite
98	Aequalis	64	Aequalis	47	Global Advantage	38	Global Unite	31	SMR
38	Bigliani/Flatow	37	Global Unite	31	Global AP	31	Global Advantage	20	Global AP
31	SMR CTA	33	Bigliani/Flatow	29	Bigliani/Flatow	28	Bigliani/Flatow	15	Comprehensive
22	Global Advantage CTA	26	Global AP	25	Global Unite	26	Global AP	14	Bigliani/Flatow
15	Bio-Modular	19	SMR CTA	20	SMR CTA	10	SMR CTA	12	SMR CTA
13	Solar	16	Global AP CTA	9	Global AP CTA	9	Bio-Modular	11	Bio-Modular
8	Global AP	14	Comprehensive	7	Bio-Modular	7	Ascend	11	Global Advantage
6	Univers 3D	12	Bio-Modular	6	Delta Xtend	7	Global AP CTA	10	Global Advantage CTA
10 Most Used									
605 (10)	98.2%	401 (10)	89.7%	330 (10)	91.4%	247 (10)	86.7%	199 (10)	86.1%
Remainder									
11 (4)	1.8%	46 (14)	10.3%	31 (10)	8.6%	38 (11)	13.3%	32 (8)	13.9%
TOTAL									
616 (14)	100.0%	447 (24)	100.0%	361 (20)	100.0%	285 (21)	100.0%	231 (18)	100.0%

Table SP25 10 Most Used Humeral Stem Prostheses in Primary Hemi Stemmed Shoulder Replacement

2008		2013		2014		2015		2016	
N	Model	N	Model	N	Model	N	Model	N	Model
207	SMR	128	SMR	104	SMR	58	SMR	43	SMR
138	Global FX	66	Global FX	49	Aequalis	38	Global Unite	35	Global Unite
98	Aequalis	64	Aequalis	44	Global FX	33	Global AP	27	Aequalis Ascend
81	Global Advantage	42	Global AP	40	Global AP	31	Aequalis Ascend	26	Comprehensive
26	Bigliani/Flatow TM	37	Global Unite	29	Aequalis Ascend	30	Global FX	25	Global AP
13	Solar	27	Bigliani/Flatow TM	26	Bigliani/Flatow TM	21	Bigliani/Flatow TM	17	Aequalis
11	Bigliani/Flatow	26	Comprehensive	25	Global Unite	18	Aequalis	12	Global Advantage
11	Bio-Modular	15	Global Advantage	11	Comprehensive	14	Comprehensive	11	Bigliani/Flatow TM
8	Global AP	7	Delta Xtend	7	Global Advantage	5	Delta Xtend	9	Global FX
6	Univers 3D	4	Ascend	6	Delta Xtend	5	Equinoxe	8	Mutars
10 Most Used									
599 (10)	97.2%	416 (10)	93.1%	341 (10)	94.5%	253 (10)	88.8%	213 (10)	92.2%
Remainder									
17 (7)	2.8%	31 (13)	6.9%	20 (8)	5.5%	32 (10)	11.2%	18 (7)	7.8%
TOTAL									
616 (17)	100.0%	447 (23)	100.0%	361 (18)	100.0%	285 (20)	100.0%	231 (17)	100.0%

OUTCOME FOR ALL DIAGNOSES

Primary Diagnosis

There is no difference in the rate of revision when primary hemi stemmed shoulder replacement is performed for fracture or osteoarthritis (Table SP26 and Figure SP8).

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 primary diagnosis. Rotator cuff insufficiency occurs more frequently in hemi stemmed shoulder replacement undertaken for fracture (27.0%), whereas glenoid erosion occurs more frequently in procedures undertaken for osteoarthritis (28.6%) (Table SP27 and Figure SP9).

Type of Revision

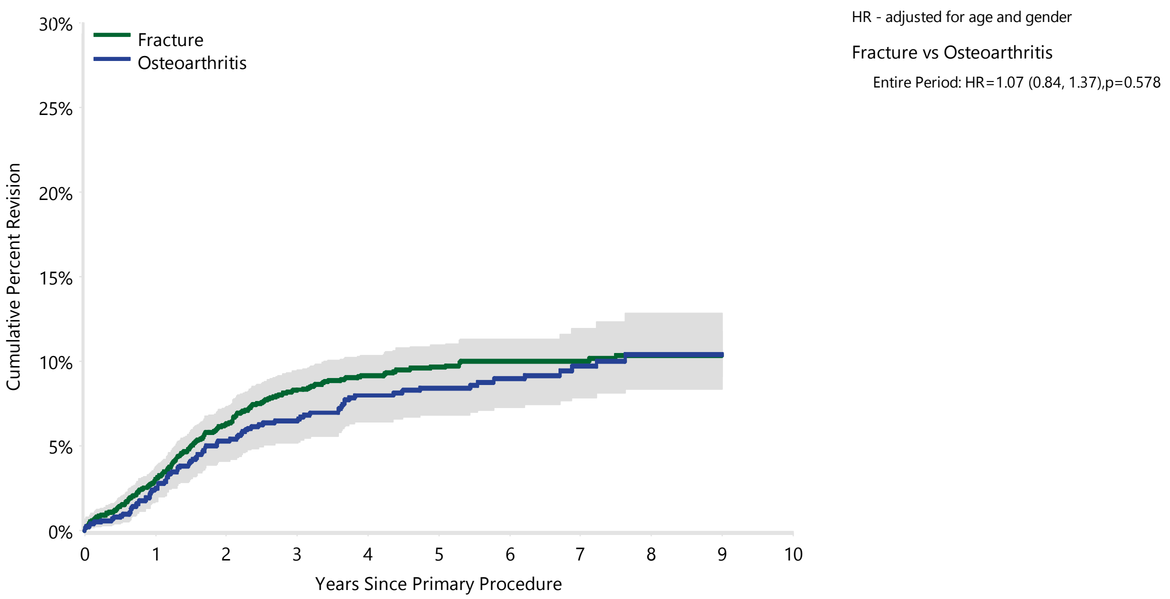
The most common type of revision is to a total shoulder replacement for both primary diagnoses (71.7% for osteoarthritis and 54.9% for fracture). Most were revised to a total reverse shoulder replacement (97.1% when used for fracture and 84.0% for osteoarthritis). Glenoid component only revision occurs more commonly in procedures undertaken for osteoarthritis (28.6% compared to 4.6% for fracture) (Table SP28).

Table SP26 Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Primary Diagnosis

Primary Diagnosis	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Fracture	237	2811	3.0 (2.5, 3.8)	8.3 (7.3, 9.5)	9.7 (8.5, 11.0)	10.0 (8.8, 11.3)	10.4 (9.1, 11.8)	
Osteoarthritis	91	1161	2.5 (1.7, 3.6)	6.5 (5.2, 8.2)	8.4 (6.8, 10.4)	9.7 (7.9, 11.9)	10.4 (8.4, 12.9)	
Rotator Cuff Arthropathy	12	203	2.1 (0.8, 5.5)	5.8 (3.2, 10.6)	7.4 (4.2, 12.9)			
Osteonecrosis	7	134	1.6 (0.4, 6.2)	4.1 (1.7, 9.7)	5.3 (2.4, 11.6)			
Tumour	9	125	5.3 (2.2, 12.3)					
Other (4)	8	160	2.6 (1.0, 6.8)	4.6 (2.2, 9.5)	4.6 (2.2, 9.5)	4.6 (2.2, 9.5)		
TOTAL	**364**	**4594**						

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

Figure SP8 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	9 Yrs	10 Yrs
Fracture	2811	2505	1871	1159	582	103	10
Osteoarthritis	1161	1049	806	582	321	74	6

Table SP27 Primary Hemi Stemmed Shoulder Replacement by Reason for Revision and Primary Diagnosis

Reason for Revision	Fracture			Osteoarthritis		
	Number	% Primaries Revised	% Revisions	Number	% Primaries Revised	% Revisions
Rotator Cuff Insufficiency	64	2.3	27.0	13	1.1	14.3
Instability/Dislocation	46	1.6	19.4	17	1.5	18.7
Glenoid Erosion	11	0.4	4.6	26	2.2	28.6
Pain	25	0.9	10.5	11	0.9	12.1
Fracture	22	0.8	9.3	4	0.3	4.4
Loosening	21	0.7	8.9	9	0.8	9.9
Infection	20	0.7	8.4	4	0.3	4.4
Arthrofibrosis	7	0.2	3.0	2	0.2	2.2
Malposition	7	0.2	3.0	1	0.1	1.1
Dissociation	3	0.1	1.3	1	0.1	1.1
Lysis	2	0.1	0.8			
Heterotopic Bone	1	0.0	0.4			
Incorrect Sizing	1	0.0	0.4	1	0.1	1.1
Osteonecrosis				1	0.1	1.1
Other	7	0.2	3.0	1	0.1	1.1
N Revision	**237**	**8.4**	**100.0**	**91**	**7.8**	**100.0**
N Primary	**2811**			**1161**		

Figure SP9 Cumulative Incidence Revision Diagnosis of Primary Hemi Stemmed Shoulder by Primary Diagnosis

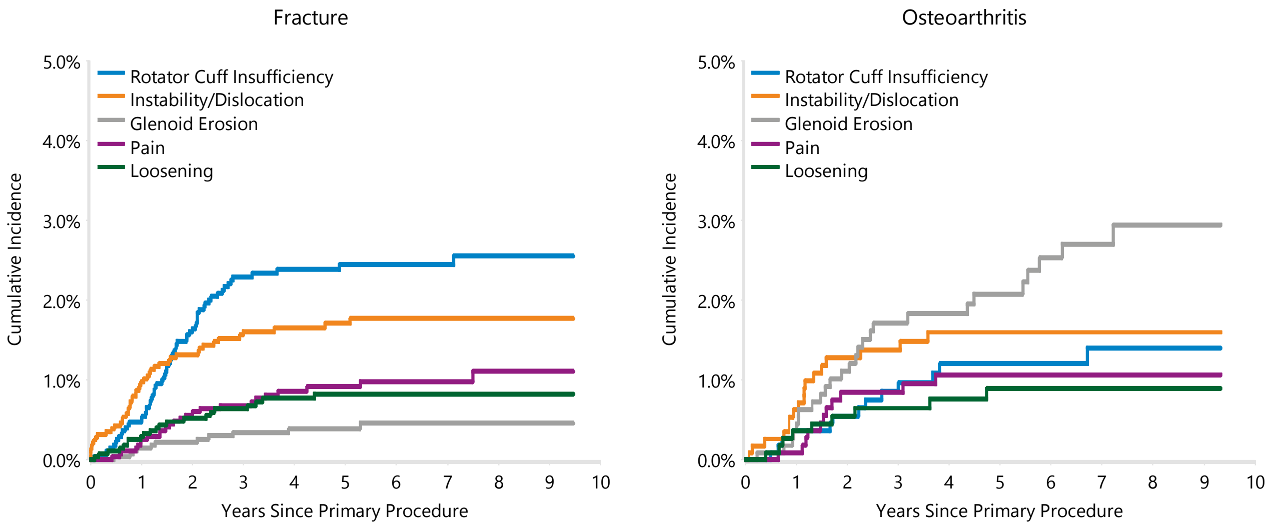


Table SP28 Primary Hemi Stemmed Shoulder Replacement by Type of Revision and Primary Diagnosis

Type of Revision	Fracture			Osteoarthritis		
	Number	% Primaries Revised	% Revisions	Number	% Primaries Revised	% Revisions
Humeral/Glenoid	170	6.0	71.7	50	4.3	54.9
Glenoid Component	11	0.4	4.6	26	2.2	28.6
Humeral Component	24	0.9	10.1	6	0.5	6.6
Head Only	14	0.5	5.9	3	0.3	3.3
Cement Spacer	7	0.2	3.0	1	0.1	1.1
Removal of Prostheses	5	0.2	2.1	1	0.1	1.1
Cement Only	4	0.1	1.7			
Reoperation	2	0.1	0.8	2	0.2	2.2
Head/Insert				1	0.1	1.1
Minor Components				1	0.1	1.1
N Revision	**237**	**8.4**	**100.0**	**91**	**7.8**	**100.0**
N Primary	**2811**			**1161**		

OUTCOME FOR FRACTURE

Age and Gender

The rate of revision is lower for those aged 75 years or older compared to all other age groups (Table SP29 and Figure SP10).

Females have a higher rate of revision compared to males (Table SP30 and Figure SP11).

Humeral Stem

There is no difference in the rate of revision for fracture humeral stems compared to non fracture humeral stems (Table SP31 and Figure SP12).

The use of cement for stem fixation in fracture hemiarthroplasty has a lower rate of revision when a non-fracture stem is used (Table SP32 and Figure SP13).

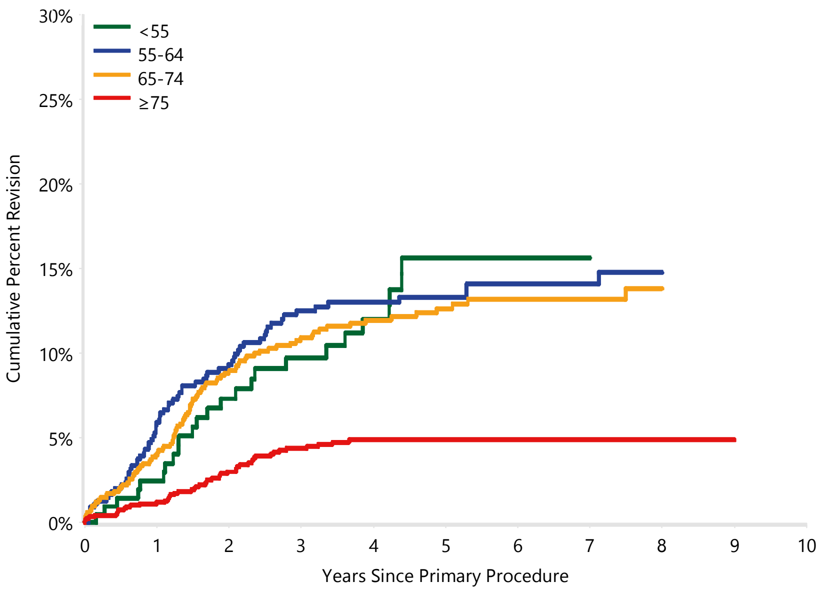
Cemented stem fixation for fracture has a lower rate of revision when a non-fracture stem is used.

The outcomes for the most used prosthesis combinations in the treatment of fracture are listed in Table SP33. The outcomes for individual fracture stems are presented separately in Table SP34 and non fracture humeral stems in Table SP35.

Table SP29 **Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Age (Primary Diagnosis Fracture)**

Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
<55	25	214	2.4 (1.0, 5.8)	9.7 (6.2, 15.0)	15.6 (10.7, 22.5)	15.6 (10.7, 22.5)		
55-64	68	549	5.9 (4.2, 8.3)	12.5 (9.9, 15.8)	13.3 (10.6, 16.7)	14.1 (11.2, 17.6)		
65-74	94	825	4.0 (2.8, 5.6)	10.9 (8.9, 13.4)	12.6 (10.4, 15.4)	13.2 (10.8, 16.0)		
≥75	50	1223	1.2 (0.7, 2.0)	4.4 (3.3, 5.8)	4.9 (3.7, 6.4)	4.9 (3.7, 6.4)	4.9 (3.7, 6.4)	
TOTAL	**237**	**2811**						

Figure SP10 **Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Age (Primary Diagnosis Fracture)**



HR - adjusted for gender

<55 vs ≥75
0 - 1.5Yr: HR=2.51 (1.28, 4.94),p=0.007
1.5Yr+: HR=4.39 (2.35, 8.21),p<0.001

55-64 vs ≥75
Entire Period: HR=3.15 (2.19, 4.55),p<0.001

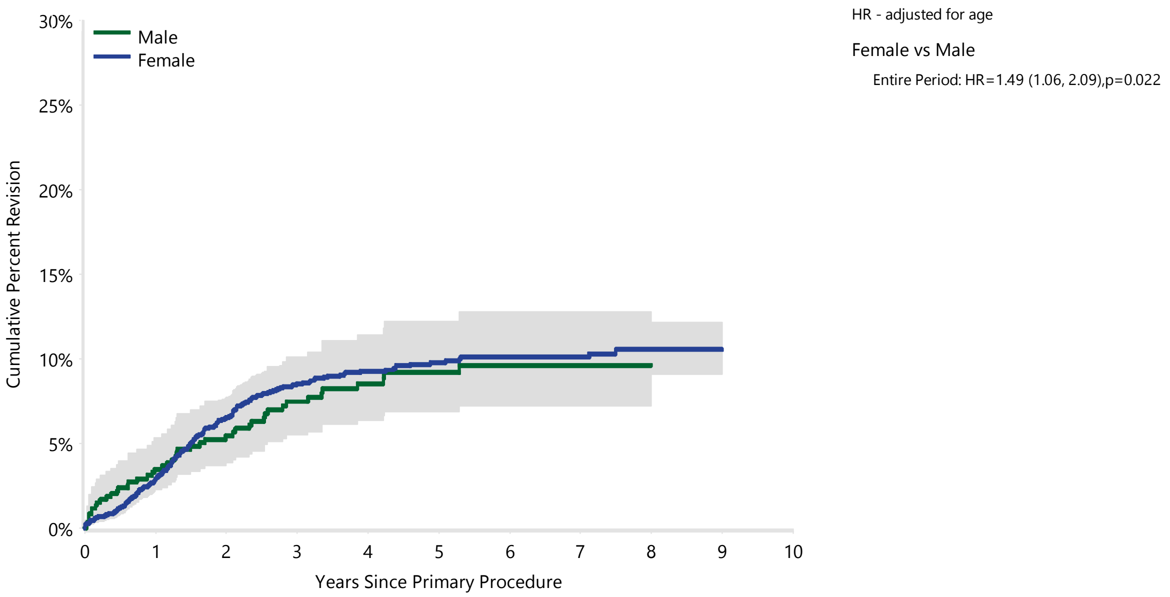
65-74 vs ≥75
Entire Period: HR=2.84 (2.01, 4.00),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
<55	214	186	139	76	44	10	0
55-64	549	479	363	248	134	16	0
65-74	825	738	552	348	177	37	7
≥75	1223	1102	817	487	227	40	3

Table SP30 Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Gender (Primary Diagnosis Fracture)

Gender	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Male	46	597	3.5 (2.3, 5.4)	7.5 (5.5, 10.1)	9.2 (6.9, 12.2)	9.6 (7.2, 12.8)		
Female	191	2214	2.9 (2.3, 3.7)	8.5 (7.4, 9.9)	9.8 (8.5, 11.2)	10.1 (8.8, 11.6)	10.6 (9.1, 12.2)	
TOTAL	**237**	**2811**						

Figure SP11 Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Gender (Primary Diagnosis Fracture)

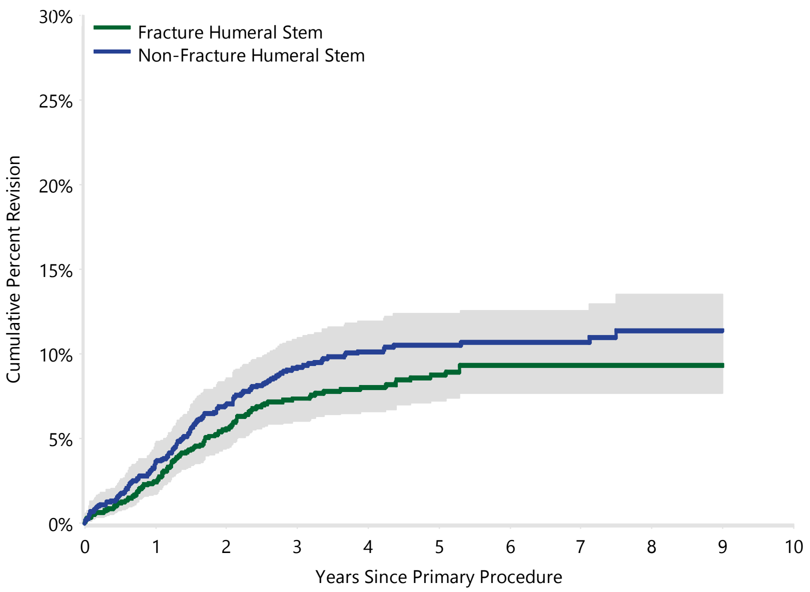


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Male	597	509	381	225	119	19	1
Female	2214	1996	1490	934	463	84	9

Table SP31 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	9 Yrs	10 Yrs
Fracture Humeral Stem	103	1369	2.4 (1.7, 3.4)	7.4 (6.0, 9.0)	8.8 (7.2, 10.6)	9.3 (7.7, 11.3)	9.3 (7.7, 11.3)	
Non-Fracture Humeral Stem	134	1442	3.6 (2.7, 4.7)	9.2 (7.8, 11.0)	10.5 (8.9, 12.4)	10.7 (9.0, 12.6)	11.4 (9.5, 13.5)	
TOTAL	**237**	**2811**						

Figure SP12 Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Stem Type (Primary Diagnosis Fracture)



HR - adjusted for age and gender

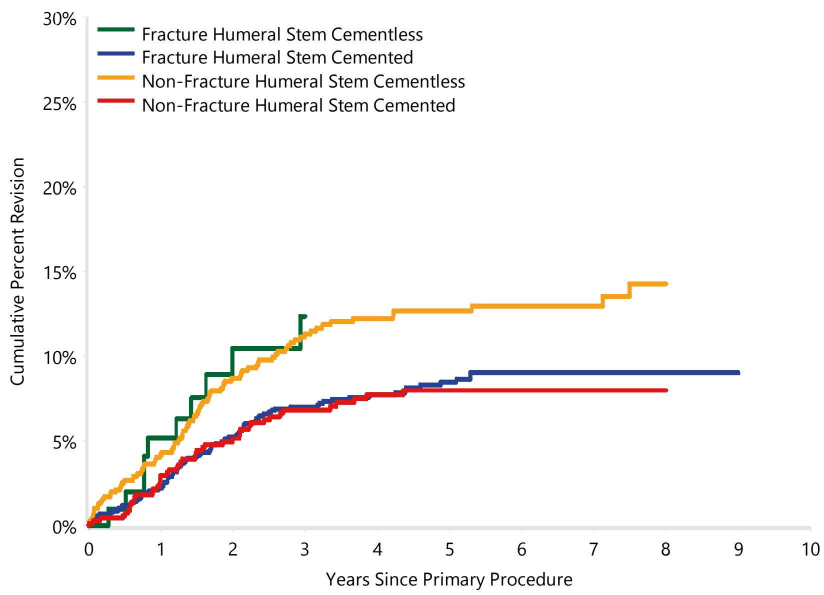
Non-Fracture Humeral Stem vs Fracture Humeral Stem
Entire Period: HR=1.22 (0.94, 1.57),p=0.136

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Fracture Humeral Stem	1369	1222	901	546	278	59	4
Non-Fracture Humeral Stem	1442	1283	970	613	304	44	6

Table SP32 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	9 Yrs	10 Yrs
Fracture Humeral Stem	Cementless	10	101	5.2 (2.2, 12.0)	12.4 (6.7, 22.2)				
	Cemented	93	1268	2.2 (1.5, 3.2)	7.0 (5.7, 8.7)	8.5 (6.9, 10.4)	9.0 (7.4, 11.0)	9.0 (7.4, 11.0)	
Non-Fracture Humeral Stem	Cementless	88	761	4.2 (3.0, 5.9)	11.3 (9.2, 13.9)	12.7 (10.4, 15.5)	13.0 (10.6, 15.8)		
	Cemented	46	681	3.0 (1.9, 4.6)	6.8 (5.1, 9.2)	8.0 (6.0, 10.6)	8.0 (6.0, 10.6)		
TOTAL		**237**	**2811**						

Figure SP13 Cumulative Percent Revisionof 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=1.31 (0.68, 2.53),p=0.419

Fracture Humeral Stem Cemented vs
Non-Fracture Humeral Stem Cemented
Entire Period: HR=1.08 (0.76, 1.53),p=0.677

Fracture Humeral Stem Cementless vs
Non-Fracture Humeral Stem Cementless
Entire Period: HR=0.86 (0.45, 1.67),p=0.664

Non-Fracture Humeral Stem Cementless vs
Non-Fracture Humeral Stem Cemented
Entire Period: HR=1.63 (1.14, 2.34),p=0.007

Number at Risk		0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Fracture Humeral Stem	Cementless	101	86	45	14	3	1	0
	Cemented	1268	1136	856	532	275	58	4
Non-Fracture Humeral Stem	Cementless	761	679	505	326	165	19	3
	Cemented	681	604	465	287	139	25	3

Table SP33 Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Humeral Head and Stem (Primary Diagnosis Fracture)

Humeral Head	Humeral Stem	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Aequalis	Aequalis	28	429	2.6 (1.5, 4.7)	6.5 (4.5, 9.5)	7.2 (5.0, 10.3)	7.2 (5.0, 10.3)		
Bigliani/Flatow	Bigliani/Flatow TM	8	284	1.5 (0.6, 3.9)	3.1 (1.6, 6.1)	3.1 (1.6, 6.1)	3.1 (1.6, 6.1)		
Bio-Modular	Comprehensive	3	70	1.6 (0.2, 10.7)	3.5 (0.9, 13.3)	7.1 (2.1, 21.9)	7.1 (2.1, 21.9)		
Comprehensive	Comprehensive	0	34	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)				
Global Advantage	Global Advantage	9	53	7.7 (2.9, 19.1)	15.9 (8.3, 29.3)	18.2 (9.9, 32.1)	18.2 (9.9, 32.1)		
Global Advantage	Global FX	49	685	2.1 (1.3, 3.5)	6.2 (4.6, 8.5)	7.8 (5.9, 10.4)	8.7 (6.6, 11.4)	8.7 (6.6, 11.4)	
Global Unite	Global Unite	19	129	5.2 (2.4, 11.2)					
SMR	SMR	97	858	4.0 (2.8, 5.5)	10.9 (8.9, 13.3)	12.6 (10.4, 15.3)	12.9 (10.6, 15.6)		
SMR CTA	SMR	2	33	3.3 (0.5, 21.4)	7.4 (1.9, 26.5)	7.4 (1.9, 26.5)	7.4 (1.9, 26.5)		
Solar	Solar	5	40	7.9 (2.6, 22.5)	10.5 (4.1, 25.7)	14.3 (6.1, 31.3)	14.3 (6.1, 31.3)		
Other (24)		17	196	2.8 (1.2, 6.7)	10.1 (6.3, 16.0)	11.0 (6.9, 17.2)	11.0 (6.9, 17.2)		
TOTAL		**237**	**2811**						

Note: Only combinations with over 30 procedures have been listed

Table SP34 Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Humeral Head and Fracture Stem (Primary Diagnosis Fracture)

Humeral Head	Fracture Stem	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Aequalis	Aequalis	27	412	2.5 (1.3, 4.6)	6.6 (4.5, 9.6)	7.3 (5.0, 10.4)	7.3 (5.0, 10.4)		
Bio-Modular	Comprehensive	3	70	1.6 (0.2, 10.7)	3.5 (0.9, 13.3)	7.1 (2.1, 21.9)	7.1 (2.1, 21.9)		
Comprehensive	Comprehensive	0	30	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)				
Global Advantage	Global FX	49	685	2.1 (1.3, 3.5)	6.2 (4.6, 8.5)	7.8 (5.9, 10.4)	8.7 (6.6, 11.4)	8.7 (6.6, 11.4)	
Global Unite	Global Unite	19	128	5.2 (2.4, 11.2)					
Other (5)		5	44	2.6 (0.4, 17.2)	10.7 (4.2, 26.2)	16.7 (6.8, 37.9)	16.7 (6.8, 37.9)		
TOTAL		**103**	**1369**						

Note: Only combinations with over 30 procedures have been listed

Table SP35 Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Humeral Head and Non Fracture Stem (Primary Diagnosis Fracture)

Humeral Head	Non Fracture Stem	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Bigliani/Flatow	Bigliani/Flatow TM	8	284	1.5 (0.6, 3.9)	3.1 (1.6, 6.1)	3.1 (1.6, 6.1)	3.1 (1.6, 6.1)		
Global Advantage	Global Advantage	9	53	7.7 (2.9, 19.1)	15.9 (8.3, 29.3)	18.2 (9.9, 32.1)	18.2 (9.9, 32.1)		
SMR	SMR	97	858	4.0 (2.8, 5.5)	10.9 (8.9, 13.3)	12.6 (10.4, 15.3)	12.9 (10.6, 15.6)		
SMR CTA	SMR	2	33	3.3 (0.5, 21.4)	7.4 (1.9, 26.5)	7.4 (1.9, 26.5)	7.4 (1.9, 26.5)		
Solar	Solar	5	40	7.9 (2.6, 22.5)	10.5 (4.1, 25.7)	14.3 (6.1, 31.3)	14.3 (6.1, 31.3)		
Other (25)		13	174	3.2 (1.3, 7.5)	9.1 (5.4, 15.3)	9.1 (5.4, 15.3)	9.1 (5.4, 15.3)		
TOTAL		**134**	**1442**						

Note: Only combinations with over 30 procedures have been listed

OUTCOME FOR OSTEOARTHRITIS

Age and Gender

The rate of revision is lower for those aged 75 years or older compared to patients aged less than 55 years and 55 to 64 years (Table SP36 and Figure SP14).

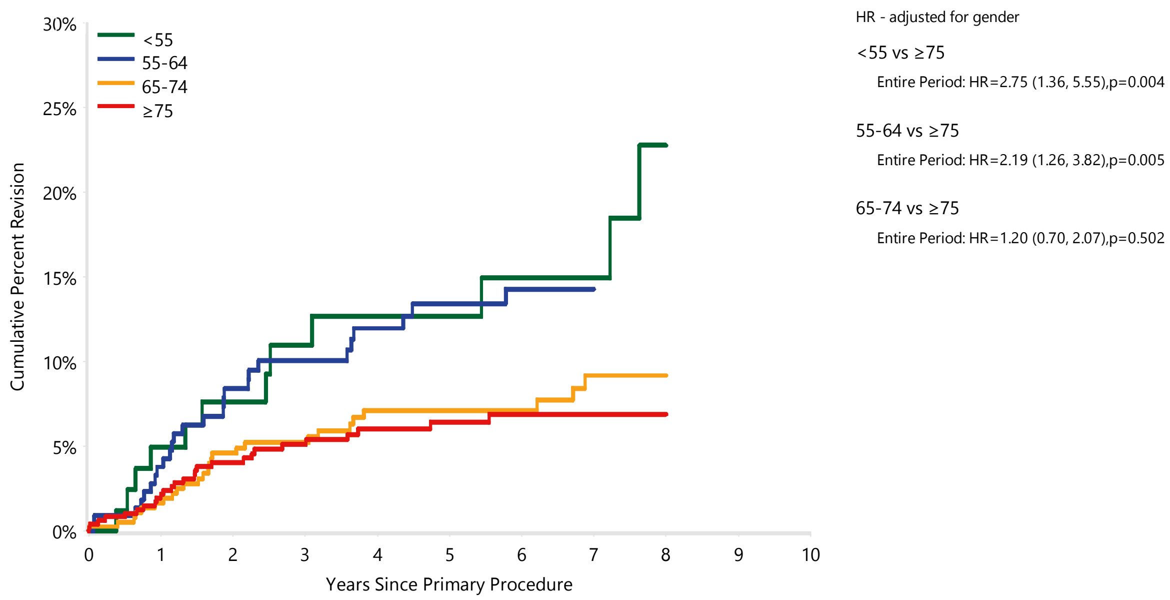
Gender is not a risk factor for revision (Table SP37 and Figure SP15).

The outcomes of the most used prosthesis combinations for osteoarthritis are listed in Table SP38.

Table SP36 Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Age (Primary Diagnosis OA)

Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
<55	12	88	4.9 (1.9, 12.6)	10.9 (5.6, 20.9)	12.7 (6.7, 23.2)	14.9 (8.2, 26.4)		
55-64	26	223	3.8 (1.9, 7.4)	10.1 (6.6, 15.2)	13.4 (9.2, 19.3)	14.3 (9.9, 20.4)		
65-74	26	374	1.7 (0.7, 3.7)	5.2 (3.3, 8.2)	7.1 (4.8, 10.6)	9.2 (6.2, 13.5)		
≥75	27	476	2.2 (1.2, 4.0)	5.1 (3.4, 7.7)	6.4 (4.4, 9.4)	6.9 (4.7, 10.0)		
TOTAL	**91**	**1161**						

Figure SP14 Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Age (Primary Diagnosis OA)

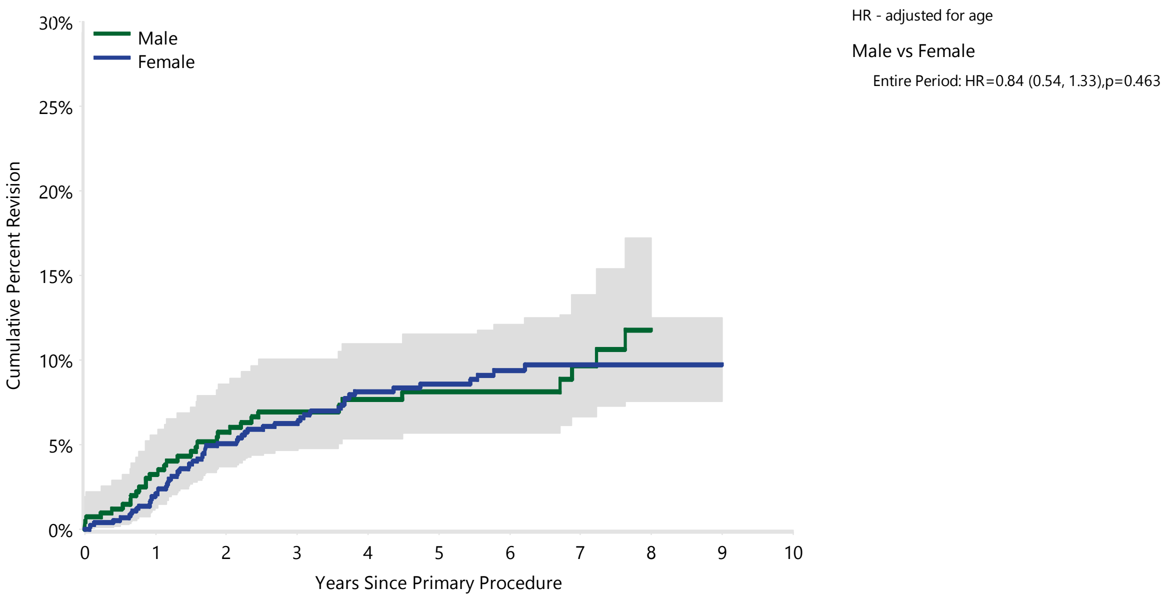


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
<55	88	76	51	41	28	7	0
55-64	223	197	156	113	59	12	2
65-74	374	347	270	193	116	24	1
≥75	476	429	329	235	118	31	3

Table SP37 Cumulative Percent Revision of Primary Hemi Stemmed Shoulder Replacement by Gender (Primary Diagnosis OA)

Gender	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Male	33	413	3.3 (1.9, 5.6)	7.0 (4.8, 10.1)	8.1 (5.7, 11.5)	9.7 (6.7, 13.9)		
Female	58	748	2.1 (1.3, 3.5)	6.3 (4.7, 8.4)	8.6 (6.6, 11.1)	9.7 (7.5, 12.5)	9.7 (7.5, 12.5)	
TOTAL	**91**	**1161**						

Figure SP15 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	9 Yrs	10 Yrs
Male	413	373	280	193	105	20	3
Female	748	676	526	389	216	54	3

Table SP38 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	9 Yrs	10 Yrs
Aequalis	Aequalis	9	138	1.5 (0.4, 5.8)	5.3 (2.5, 10.7)	6.2 (3.2, 12.1)	8.3 (4.1, 16.4)		
Aequalis	Aequalis Ascend	1	53	2.4 (0.3, 15.7)					
Bigliani/Flatow	Bigliani/Flatow TM	3	52	3.9 (1.0, 14.8)	5.9 (1.9, 17.3)	5.9 (1.9, 17.3)	5.9 (1.9, 17.3)		
Delta Xtend	Delta Xtend	1	26	0.0 (0.0, 0.0)	5.0 (0.7, 30.5)	5.0 (0.7, 30.5)	5.0 (0.7, 30.5)		
Global AP	Global AP	7	155	0.7 (0.1, 4.8)	3.8 (1.6, 9.0)	6.4 (3.0, 13.3)			
Global AP CTA	Global AP	5	40	2.5 (0.4, 16.5)	13.2 (5.7, 28.9)	13.2 (5.7, 28.9)			
Global Advantage	Global Advantage	11	144	0.7 (0.1, 4.8)	5.1 (2.4, 10.3)	7.4 (4.1, 13.4)	8.3 (4.7, 14.6)		
Global Advantage	Global FX	4	31	3.3 (0.5, 21.4)	10.8 (3.6, 30.1)	10.8 (3.6, 30.1)	10.8 (3.6, 30.1)		
Global Advantage CTA	Global Advantage	1	39	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	4.0 (0.6, 25.2)	4.0 (0.6, 25.2)	
SMR	SMR	34	269	4.2 (2.4, 7.5)	8.6 (5.7, 12.7)	12.2 (8.7, 17.0)	14.1 (10.2, 19.4)		
SMR CTA	SMR	6	85	4.9 (1.8, 12.4)	7.7 (3.5, 16.3)	7.7 (3.5, 16.3)	7.7 (3.5, 16.3)		
Other (25)		9	129	3.3 (1.2, 8.5)	7.2 (3.7, 14.0)	8.7 (4.5, 16.2)			
TOTAL		**91**	**1161**						

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.

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 cone stemmed humeral head prosthesis.
Total conventional involves glenoid replacement combined with resection of the humeral head and replacement with a stemmed humeral prosthesis and humeral head prosthesis.
Total reverse involves glenoid replacement with a glenoid head prosthesis combined with resection of the humeral head and replacement with a stemmed humeral prosthesis and humeral cup prosthesis.

USE OF TOTAL SHOULDER REPLACEMENT

There have been 28,193 total shoulder replacements reported to the Registry. This is an additional 4,941 procedures compared to the previous report.

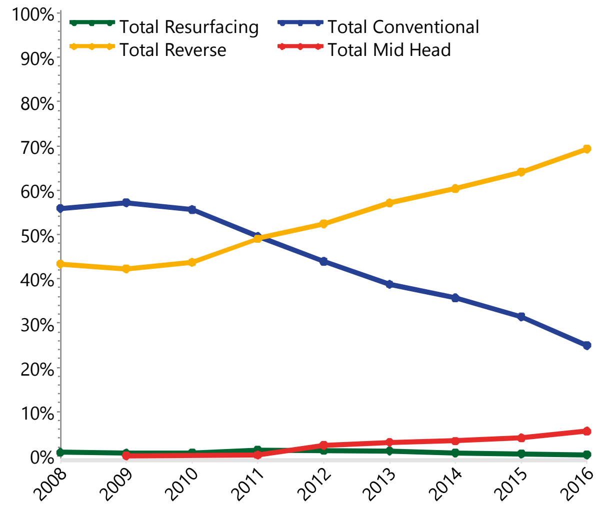
The two main classes of primary total shoulder replacement are total conventional (40.7%) and total reverse (56.0%). Total mid head and total resurfacing shoulder replacement are used infrequently (2.6% and 0.7%, respectively) (Table ST1). The proportion of total reverse shoulder replacements has increased from 42.2% in 2009 to 69.3% in 2016 (Figure ST1).

Table ST1 Primary Total Shoulder Replacement by Class

Shoulder Class	N	Percent
Total Resurfacing	211	0.7
Total Conventional	11468	40.7
Total Reverse	15781	56.0
Total Mid Head	733	2.6
TOTAL	**28193**	**100.0**

Primary total shoulder replacement is more common in females (62.1%). 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 (65.6%), total conventional (58.1%), total mid head (55.1%), and total resurfacing (39.3%) (Table ST2).

Figure ST1 Proportion of Primary Total Shoulder Replacement by Class



Most patients are aged 65 years or older (82.2%). The proportion of patients in this age group varies depending on the class of shoulder replacement: total reverse (90.3%), total conventional (72.5%), total mid head (66.5%) and total resurfacing (51.7%) (Table ST3).

The mean age for total shoulder replacement is 73.5 years for females and 70.1 years for males (Table ST4).

The most common primary diagnoses are osteoarthritis (67.0%), rotator cuff arthropathy (19.2%) and fracture (8.8%). Rheumatoid arthritis and osteonecrosis account for 2.0% and 1.3%, respectively (Table ST5).

Only 211 total resurfacing shoulder replacements have been reported to the Registry, 15 of which have been revised. The cumulative percent revision at five years is 6.9% (Table ST6).

Total mid head shoulder replacement has been used in 733 procedures. There have been 11 revisions and the three year cumulative percent revision is 2.1% (Table ST6).

At nine years, the cumulative percent revision for total conventional and total reverse shoulder replacement is 11.3% and 7.0%, respectively. Total reverse shoulder replacement has a higher rate of revision compared to total conventional in the first three months. However, after three months, total reverse shoulder replacement has a lower rate of revision (Table ST6 and Figure ST2).

An additional analysis has been undertaken with both the SMR L2 total conventional and the SMR L2 total reverse shoulder prostheses excluded. These prostheses have been withdrawn.

After excluding the SMR L2 prosthesis from both total conventional and reverse shoulder procedures, the nine year cumulative percent revision for total conventional and total reverse shoulder replacement is 8.6% and 6.9%, respectively. The total reverse shoulder replacement continues to have a higher rate of revision in the first three months. After this time, total conventional shoulder replacement has a higher rate of revision (Table ST7 and Figure ST3).

Table ST2 Primary Total Shoulder Replacement by Gender and Class

	Male		Female	
Shoulder Class	N	Row%	N	Row%
Total Resurfacing	128	60.7	83	39.3
Total Conventional	4806	41.9	6662	58.1
Total Reverse	5434	34.4	10347	65.6
Total Mid Head	329	44.9	404	55.1
TOTAL	**10697**	**37.9**	**17496**	**62.1**

Table ST3 Primary Total Shoulder Replacement by Age and Class

	<55		55-64		65-74		≥75	
Shoulder Class	N	Row%	N	Row%	N	Row%	N	Row%
Total Resurfacing	31	14.7	71	33.6	93	44.1	16	7.6
Total Conventional	587	5.1	2565	22.4	5017	43.7	3299	28.8
Total Reverse	213	1.3	1311	8.3	5748	36.4	8509	53.9
Total Mid Head	57	7.8	189	25.8	326	44.5	161	22.0
TOTAL	**888**	**3.1**	**4136**	**14.7**	**11184**	**39.7**	**11985**	**42.5**

Table ST4 Primary Total Shoulder Replacement by Age and Gender

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	10697	37.9%	21	96	71	70.1	9.1
Female	17496	62.1%	14	102	74	73.5	8.5
TOTAL	**28193**	**100.0%**	**14**	**102**	**73**	**72.2**	**8.9**

Table ST5 Primary Total Shoulder Replacement by Primary Diagnosis and Gender

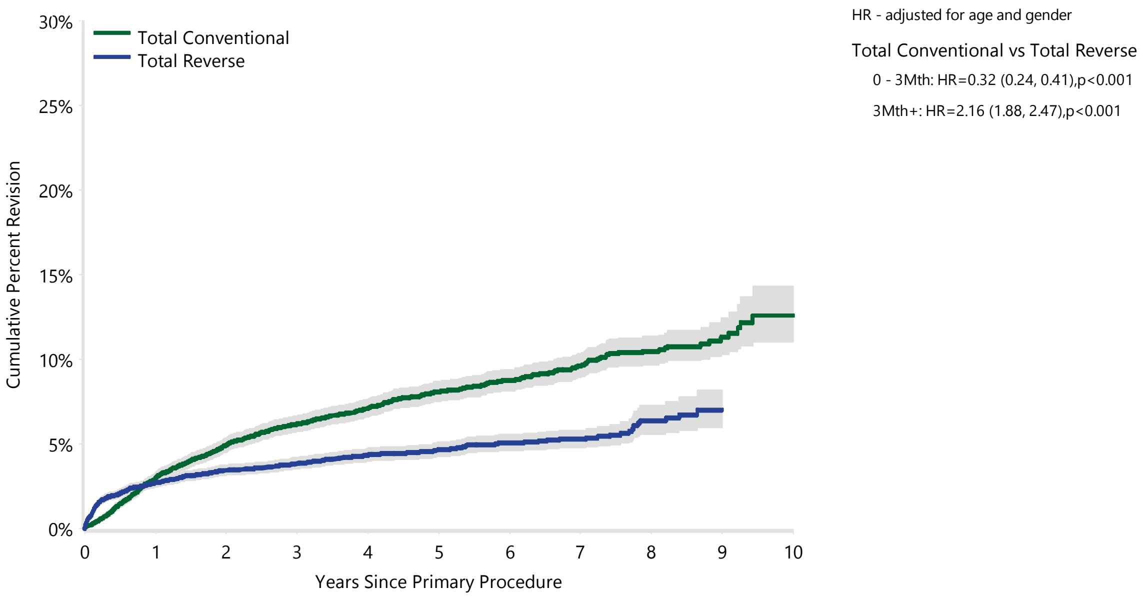
	Male		Female		TOTAL	
Primary Diagnosis	N	Col%	N	Col%	N	Col%
Osteoarthritis	7670	71.7	11213	64.1	18883	67.0
Rotator Cuff Arthropathy	2259	21.1	3163	18.1	5422	19.2
Fracture	383	3.6	2095	12.0	2478	8.8
Rheumatoid Arthritis	119	1.1	441	2.5	560	2.0
Osteonecrosis	78	0.7	286	1.6	364	1.3
Instability	85	0.8	143	0.8	228	0.8
Other Inflammatory Arthritis	40	0.4	89	0.5	129	0.5
Tumour	56	0.5	59	0.3	115	0.4
Other	7	0.1	7	0.0	14	0.0
TOTAL	**10697**	**100.0**	**17496**	**100.0**	**28193**	**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	9 Yrs	10 Yrs
Total Resurfacing	15	211	2.0 (0.7, 5.1)	4.7 (2.5, 8.9)	6.9 (3.9, 11.9)			
Total Conventional	802	11468	3.0 (2.7, 3.3)	6.2 (5.7, 6.7)	8.1 (7.5, 8.7)	9.6 (8.9, 10.4)	11.3 (10.3, 12.4)	12.6 (11.0, 14.3)
Total Reverse	582	15781	2.7 (2.5, 3.0)	3.9 (3.5, 4.2)	4.7 (4.3, 5.1)	5.3 (4.8, 5.8)	7.0 (6.0, 8.2)	
Total Mid Head	11	733	1.6 (0.8, 3.1)	2.1 (1.2, 3.8)				
TOTAL	**1410**	**28193**						

Figure ST2 Cumulative Percent Revision of Primary Total Shoulder Replacement by Class (All Prostheses)



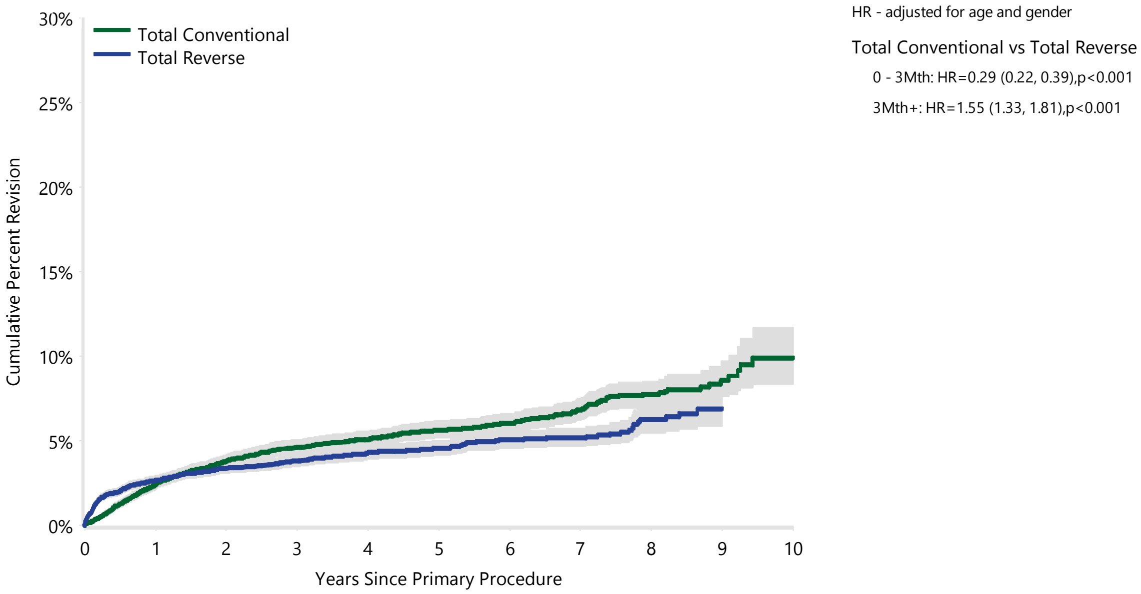
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Total Conventional	11468	9869	6870	4263	2020	403	68
Total Reverse	15781	11856	6643	3268	1295	227	38

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	9 Yrs	10 Yrs
Total Conventional	537	10610	2.4 (2.1, 2.7)	4.6 (4.2, 5.1)	5.6 (5.2, 6.2)	6.8 (6.2, 7.5)	8.6 (7.6, 9.7)	9.9 (8.4, 11.7)
Total Reverse	521	14641	2.7 (2.4, 3.0)	3.8 (3.5, 4.2)	4.6 (4.2, 5.0)	5.2 (4.6, 5.7)	6.9 (5.8, 8.1)	
TOTAL	**1058**	**25251**						

Note: The SMR L2 total reverse shoulder prosthesis and the SMR L2 total conventional shoulder prosthesis have both been excluded

Figure ST3 Cumulative Percent Revision of Primary Total Shoulder Replacement by Class (excluding SMR L2)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Total Conventional	10610	9100	6221	3795	1997	403	68
Total Reverse	14641	10781	5640	2571	1271	227	38

Note: The SMR L2 total reverse shoulder prosthesis and the SMR L2 total conventional shoulder prosthesis have both been excluded

PRIMARY TOTAL RESURFACING SHOULDER REPLACEMENT

DEMOGRAPHICS AND OUTCOME

There have been 211 primary total resurfacing shoulder replacements reported to the Registry. This is an additional 13 procedures compared to the previous report.

Primary total resurfacing shoulder replacement is undertaken more often in males (60.7%). The mean age is 62.1 years for males and 66.5 years for females (Table ST8).

Osteoarthritis is the most common primary diagnosis (95.7%) (Table ST9).

There were three different types of total resurfacing prosthesis combinations used in 2016. The Global CAP/Global Advantage combination was used in nine of the 11 procedures reported in 2016 (Tables ST10 and ST11).

The cumulative percent revision at five years is 6.9% (Table ST6). There have been 15 revisions. The main reasons for revision are presented in Table ST12. The most common type of revision is to a total shoulder replacement (40.0%) (Table ST13).

Table ST8 Primary Total Resurfacing Shoulder Replacement by Age and Gender

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	128	60.7%	35	83	63	62.1	9.7
Female	83	39.3%	46	86	67	66.5	6.8
TOTAL	**211**	**100.0%**	**35**	**86**	**65**	**63.8**	**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	124	96.9	78	94.0	202	95.7
Rheumatoid Arthritis	1	0.8	2	2.4	3	1.4
Fracture	1	0.8	1	1.2	2	0.9
Other Inflammatory Arthritis	.	.	1	1.2	1	0.5
Instability	1	0.8	.	.	1	0.5
Rotator Cuff Arthropathy	.	.	1	1.2	1	0.5
Osteonecrosis	1	0.8	.	.	1	0.5
TOTAL	**128**	**100.0**	**83**	**100.0**	**211**	**100.0**

Note: Instability includes instability and dislocation

Table ST10 Most Used Humeral Head Prostheses in Primary Total Resurfacing Shoulder Replacement

2008		2013		2014		2015		2016	
N	Model	N	Model	N	Model	N	Model	N	Model
5	SMR	27	Global CAP	17	Global CAP	12	Global CAP	9	Global CAP
4	Aequalis	5	Aequalis	6	Aequalis	4	Epoca RH	1	Epoca RH
2	Copeland	3	Epoca RH	1	Epoca RH	2	Aequalis	1	SMR
1	Global CAP	1	SMR			1	SMR		
Most Used									
12 (4)	100.0%	36 (4)	100.0%	24 (3)	100.0%	19 (4)	100.0%	11 (3)	100.0%

Table ST11 Most Used Glenoid Prostheses in Primary Total Resurfacing Shoulder Replacement

2008		2013		2014		2015		2016	
N	Model	N	Model	N	Model	N	Model	N	Model
4	Aequalis	27	Global Advantage	17	Global Advantage	12	Global Advantage	9	Global Advantage
3	SMR L1	5	Aequalis	6	Aequalis	4	Epoca	1	Epoca
2	Copeland	3	Epoca	1	Epoca	2	Aequalis	1	SMR
2	SMR	1	SMR L1			1	SMR		
1	Global Advantage								
Most Used									
12 (5)	100.0%	36 (4)	100.0%	24 (3)	100.0%	19 (4)	100.0%	11 (3)	100.0%

Table ST12 Primary Total Resurfacing Shoulder Replacement by Reason for Revision

Reason for Revision	Number	Percent
Loosening	5	33.3
Instability/Dislocation	2	13.3
Infection	2	13.3
Implant Breakage Glenoid Insert	2	13.3
Wear Glenoid Insert	1	6.7
Fracture	1	6.7
Implant Breakage Glenoid	1	6.7
Rotator Cuff Insufficiency	1	6.7
TOTAL	**15**	**100.0**

Table ST13 Primary Total Resurfacing Shoulder Replacement by Type of Revision

Type of Revision	Number	Percent
Humeral/Glenoid	6	40.0
Humeral Component	5	33.3
Insert Only	2	13.3
Cement Spacer	1	6.7
Head Only	1	6.7
TOTAL	**15**	**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 733 primary total mid head shoulder replacements reported to the Registry. This is an additional 271 procedures compared to the previous report. The use of primary mid head shoulder replacement has increased by 273.2% since its first full year of use in 2012.

Primary total mid head shoulder replacement is undertaken more often in females (55.1%). The mean age is 69.8 years for females and 65.3 years for males (Table ST14).

Osteoarthritis is the most common primary diagnosis (95.8%) (Table ST15).

The cumulative percent revision at three years is 2.1% (Table ST6). There have been 11 revisions in this class. The main reasons for revision are instability/dislocation, loosening, and infection (Table ST16). The most common types of revision involve replacement of the humeral component only and replacement of the humeral component and glenoid. The latter were all revised to a total reverse shoulder replacement (Table ST17).

The Affinis is the most used total mid head shoulder prosthesis in 2016 (Tables ST18 and ST19).

Table ST14 Primary Total Mid Head Shoulder Replacement by Age and Gender

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	329	44.9%	37	89	66	65.3	9.4
Female	404	55.1%	45	94	70	69.8	8.0
TOTAL	**733**	**100.0%**	**37**	**94**	**68**	**67.8**	**8.9**

Table ST15 Primary Total Mid Head Shoulder Replacement by Primary Diagnosis and Gender

	Male		Female		TOTAL	
Primary Diagnosis	N	Col%	N	Col%	N	Col%
Osteoarthritis	317	96.4	385	95.3	702	95.8
Osteonecrosis	5	1.5	9	2.2	14	1.9
Rheumatoid Arthritis	1	0.3	3	0.7	4	0.5
Other Inflammatory Arthritis	.	.	4	1.0	4	0.5
Rotator Cuff Arthropathy	2	0.6	1	0.2	3	0.4
Fracture	1	0.3	2	0.5	3	0.4
Instability	2	0.6	.	.	2	0.3
Other	1	0.3	.	.	1	0.1
TOTAL	**329**	**100.0**	**404**	**100.0**	**733**	**100.0**

Table ST16 Primary Total Mid Head Shoulder Replacement by Reason for Revision

Reason for Revision	Number	Percent
Instability/Dislocation	4	36.4
Loosening	3	27.3
Infection	2	18.2
Pain	1	9.1
Malposition	1	9.1
TOTAL	**11**	**100.0**

Table ST17 Primary Total Mid Head Shoulder Replacement by Type of Revision

Type of Revision	Number	Percent
Humeral Component	3	27.3
Humeral/Glenoid	3	27.3
Removal of Prostheses	2	18.2
Head Only	1	9.1
Cement Spacer	1	9.1
Cup Only	1	9.1
TOTAL	**11**	**100.0**

Table ST18 Most Used Humeral Stem Prostheses in Primary Total Mid Head Shoulder Replacement

2011		2013		2014		2015		2016	
N	Model	N	Model	N	Model	N	Model	N	Model
2	Simpliciti	60	Affinis	61	Simpliciti	108	Affinis	217	Affinis
2	TESS	36	Simpliciti	52	Affinis	45	Sidus	18	Simpliciti
1	Affinis	3	Sidus	12	Sidus	11	Simpliciti	12	Sidus
						3	SMR	10	SMR
								8	Comprehensive
Most Used									
5 (3)	100.0%	99 (3)	100.0%	125 (3)	100.0%	167 (4)	100.0%	265 (5)	100.0%

Table ST19 Most Used Glenoid Prostheses in Primary Total Mid Head Shoulder Replacement

2011		2013		2014		2015		2016	
N	Model	N	Model	N	Model	N	Model	N	Model
2	Aequalis	60	Affinis	61	Aequalis	108	Affinis	215	Affinis
1	Affinis	36	Aequalis	52	Affinis	18	Anatomical Shoulder	18	Aequalis
1	Comprehensive	2	Bigliani/Flatow TM	7	Bigliani/Flatow TM	15	Bigliani/Flatow	12	Comprehensive
1	TESS	1	Bigliani/Flatow	3	Bigliani/Flatow	11	Aequalis	6	SMR L1
				2	Anatomical Shoulder	11	Bigliani/Flatow TM	4	SMR
						3	SMR L1	3	Bigliani/Flatow
						1	Global	2	Anatomical Shoulder
								2	Bigliani/Flatow TM
								2	Global
								1	Custom Made (Lima)
Most Used									
5 (4)	100.0%	99 (4)	100.0%	125 (5)	100.0%	167 (7)	100.0%	265 (10)	100.0%

PRIMARY TOTAL CONVENTIONAL SHOULDER REPLACEMENT

DEMOGRAPHICS

There have been 11,468 total conventional shoulder replacements reported to the Registry. This is an additional 1,238 procedures compared to the previous report.

The use of total conventional shoulder replacement has declined from 55.9% of all total shoulder replacements in 2008 to 24.9% in 2016.

The use of total conventional shoulder replacement has declined from 55.9% of all total shoulder replacements in 2008 to 24.9% in 2016.

This procedure is most commonly undertaken in females (58.1%) (Table ST20). The proportion of males has increased slightly from 38.7% in 2008 to 45.1% in 2016 (Figure ST4).

Figure ST4 Proportion of Primary Total Conventional Shoulder Replacement by Gender

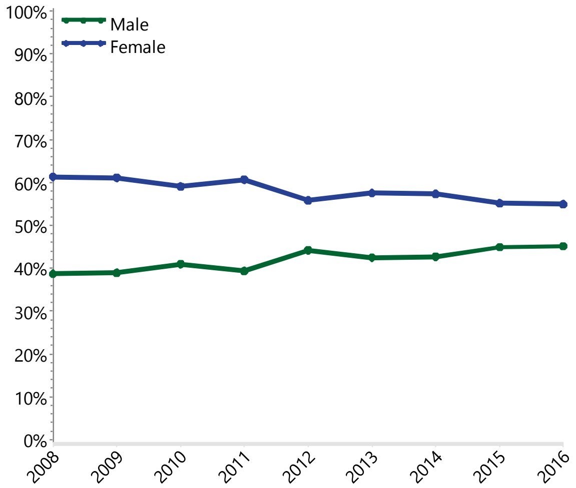
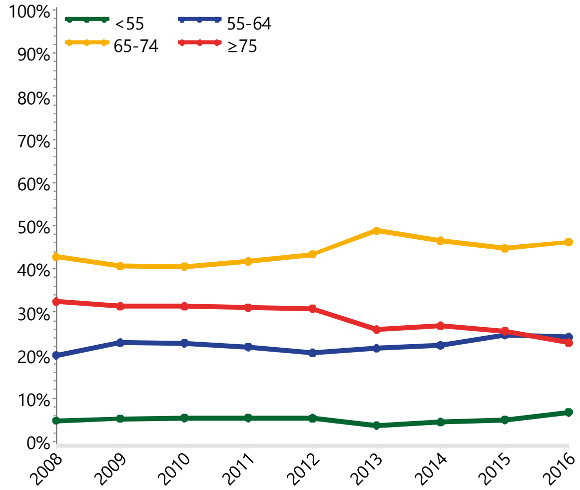


Figure ST5 Proportion of Primary Total Conventional Shoulder Replacement by Age



The mean age is 70.7 years for females and 67.2 years for males (Table ST20). In 2016, most procedures were undertaken in the 65 to 74 year age group, which accounted for 46.2% of all patients (Figure ST5).

Osteoarthritis is the most common primary diagnosis, accounting for 94.2% of all procedures (Table ST21).

Table ST20 Primary Total Conventional Shoulder Replacement by Age and Gender

Gender	Number	Percent	Minimum	Maximum	Median	Mean	Std Dev
Male	4806	41.9%	21	93	67	67.2	9.0
Female	6662	58.1%	21	96	71	70.7	8.5
TOTAL	**11468**	**100.0%**	**21**	**96**	**70**	**69.2**	**8.9**

In 2016, 72.1% of procedures used hybrid fixation (cementless humerus and cemented glenoid). This has increased from a low of 55.8% in 2010. In 2016, cementless fiaxtion was used in 23.2% 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 72.1% in 2016.

The 10 most used humeral stem and glenoid prostheses are listed in Tables ST22 and ST23. The Global Unite, SMR, and Global AP are the most commonly used humeral stem prostheses in 2016. The 10 most used humeral stem prostheses accounted for 97.7% of all primary total conventional shoulder procedures.

The Global Advantage, Aequalis, and SMR L1 are the most commonly used glenoid prostheses in 2016. The 10 most used glenoid prostheses account for 98.4% of all primary total conventional shoulder procedures.

Figure ST6 Proportion of Primary Total Conventional Shoulder Replacement by Fixation

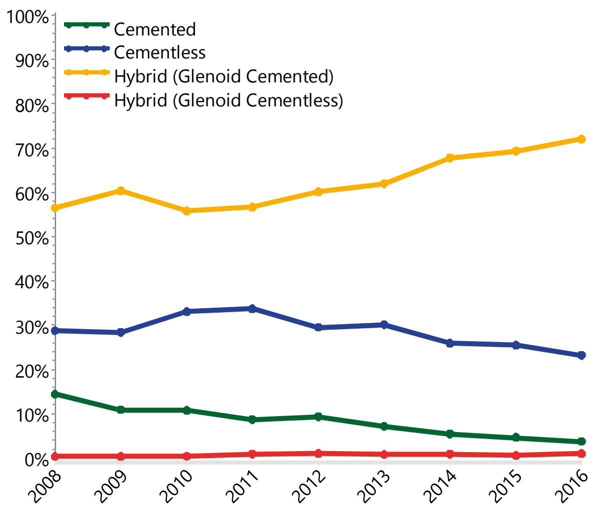


Table ST21 Primary Total Conventional Shoulder Replacement by Primary Diagnosis and Gender

	Male		Female		TOTAL	
Primary Diagnosis	N	Col%	N	Col%	N	Col%
Osteoarthritis	4603	95.8	6202	93.1	10805	94.2
Rheumatoid Arthritis	53	1.1	159	2.4	212	1.8
Osteonecrosis	41	0.9	129	1.9	170	1.5
Fracture	26	0.5	82	1.2	108	0.9
Other Inflammatory Arthritis	23	0.5	44	0.7	67	0.6
Rotator Cuff Arthropathy	32	0.7	23	0.3	55	0.5
Instability	20	0.4	14	0.2	34	0.3
Tumour	4	0.1	6	0.1	10	0.1
Other	4	0.1	3	0.0	7	0.1
TOTAL	**4806**	**100.0**	**6662**	**100.0**	**11468**	**100.0**

Note: Instability includes dislocation

Table ST22 10 Most Used Humeral Stem Prostheses in Primary Total Conventional Shoulder Replacement

2008		2013		2014		2015		2016	
N	Model	N	Model	N	Model	N	Model	N	Model
298	SMR	373	Global AP	388	Global AP	275	SMR	233	Global Unite
167	Aequalis	334	SMR	292	SMR	258	Global AP	228	SMR
117	Global Advantage	192	Aequalis	146	Aequalis Ascend	202	Global Unite	185	Global AP
91	Global AP	120	Bigliani/Flatow TM	145	Aequalis	119	Bigliani/Flatow TM	109	Bigliani/Flatow TM
40	Bigliani/Flatow	103	Ascend	132	Bigliani/Flatow TM	104	Aequalis	91	Comprehensive
37	Bigliani/Flatow TM	51	Global Advantage	77	Global Advantage	81	Ascend	88	Aequalis
32	Solar	26	Equinoxe	44	Comprehensive	72	Comprehensive	84	Aequalis Ascend
27	Affinis	21	Comprehensive	32	Equinoxe	68	Aequalis Ascend	67	Ascend
11	Univers 3D	13	Solar	26	Turon	50	Global Advantage	45	Global Advantage
10	Cofield 2	7	Epoca	22	Ascend	45	Equinoxe	41	Equinoxe
10 Most Used									
830 (10)	97.9%	1240 (10)	98.3%	1304 (10)	97.5%	1274 (10)	97.0%	1171 (10)	97.7%
Remainder									
18 (7)	2.1%	22 (8)	1.7%	34 (9)	2.5%	40 (4)	3.0%	28 (8)	2.3%
TOTAL									
848 (17)	100.0%	1262 (18)	100.0%	1338 (19)	100.0%	1314 (14)	100.0%	1199 (18)	100.0%

Table ST23 10 Most Used Glenoid Prostheses in Primary Total Conventional Shoulder Replacement

2008		2013		2014		2015		2016	
N	Model	N	Model	N	Model	N	Model	N	Model
237	SMR L1	367	Global Advantage	397	Global Advantage	458	Global Advantage	421	Global Advantage
167	Aequalis	301	SMR L1	311	Aequalis	253	Aequalis	236	Aequalis
157	Global	295	Aequalis	256	SMR L1	239	SMR L1	194	SMR L1
79	Bigliani/Flatow	81	Bigliani/Flatow TM	94	Bigliani/Flatow TM	85	Bigliani/Flatow TM	92	Comprehensive
57	SMR	61	Global	81	Global	73	Comprehensive	84	Bigliani/Flatow TM
52	Global Advantage	40	Bigliani/Flatow	44	Bigliani/Flatow	53	Global	44	Global
32	Solar	33	SMR	44	Comprehensive	45	Equinoxe	41	Equinoxe
27	Affinis	26	Equinoxe	32	Equinoxe	36	Bigliani/Flatow	32	SMR
11	Univers 3D	20	Comprehensive	31	SMR	30	SMR	26	Bigliani/Flatow
10	Cofield 2	13	Solar	26	Turon	24	Turon	10	Turon
10 Most Used									
829 (10)	97.8%	1237 (10)	98.0%	1316 (10)	98.4%	1296 (10)	98.6%	1180 (10)	98.4%
Remainder									
19 (7)	2.2%	25 (7)	2.0%	22 (7)	1.6%	18 (3)	1.4%	19 (8)	1.6%
TOTAL									
848 (17)	100.0%	1262 (17)	100.0%	1338 (17)	100.0%	1314 (13)	100.0%	1199 (18)	100.0%

OUTCOME FOR ALL DIAGNOSES

Primary Diagnosis

The cumulative percent revision of primary total conventional shoulder replacement for osteoarthritis is 12.7% at 10 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

Instability/dislocation is the most common reason for revision of primary total conventional shoulder replacement. This accounts for 24.2% of all revisions, followed by rotator cuff insufficiency (22.6%), and loosening (16.5%) (Table ST25). The cumulative incidence of the five most common reasons for revision are presented in Figure ST8.

Type of Revision

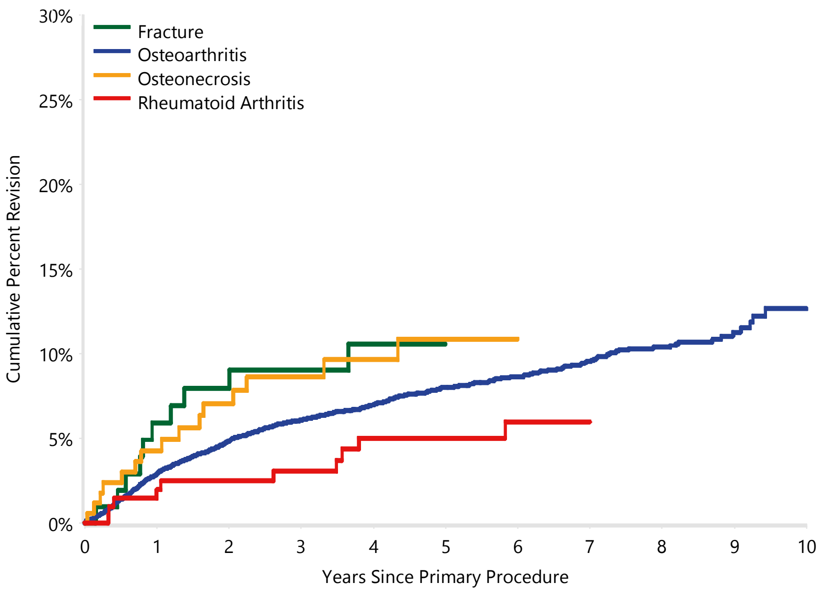
The most common type of revision is of the humeral component only (55.4%). This may include the revision of a humeral component (epiphysis and/or humeral stem) and additional minor components, such as the humeral head and/or removal of the glenoid component (Table ST26). Of the 444 humeral component revisions, 384 (86.5%) were revised to a total reverse shoulder replacement. The humeral stem was not revised in 367 (82.7%) procedures.

Table ST24 Cumulative Percent Revision of Primary Total Conventional Shoulder Replacement by Primary Diagnosis

Primary Diagnosis	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Osteoarthritis	745	10805	2.9 (2.6, 3.3)	6.1 (5.6, 6.6)	8.0 (7.4, 8.6)	9.6 (8.8, 10.3)	11.3 (10.2, 12.5)	12.7 (11.0, 14.5)
Rheumatoid Arthritis	10	212	2.0 (0.7, 5.2)	3.1 (1.4, 6.7)	5.0 (2.6, 9.5)	6.0 (3.2, 11.0)		
Osteonecrosis	16	170	4.3 (2.1, 8.8)	8.7 (5.1, 14.5)	10.9 (6.6, 17.7)			
Fracture	11	108	5.9 (2.7, 12.7)	9.0 (4.8, 16.7)	10.6 (5.8, 18.9)			
Other Inflammatory Arthritis	5	67	1.5 (0.2, 10.4)	3.4 (0.9, 13.1)	9.4 (3.4, 24.3)	9.4 (3.4, 24.3)		
Rotator Cuff Arthropathy	9	55	7.6 (2.9, 19.1)	17.0 (8.8, 31.3)	19.5 (10.6, 34.4)	19.5 (10.6, 34.4)		
Other (4)	6	51	6.4 (2.1, 18.5)	16.4 (7.5, 33.8)	16.4 (7.5, 33.8)			
TOTAL	**802**	**11468**						

Note: Only primary diagnoses with over 30 procedures have been listed

Figure ST7 Cumulative Percent Revision of Primary Total Conventional Shoulder Replacement by Primary Diagnosis



HR - adjusted for age and gender

Fracture vs Osteoarthritis
Entire Period: HR=1.39 (0.76, 2.52),p=0.282

Osteonecrosis vs Osteoarthritis
Entire Period: HR=1.20 (0.73, 1.98),p=0.472

Rheumatoid Arthritis vs Osteoarthritis
Entire Period: HR=0.52 (0.28, 0.97),p=0.038

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Fracture	108	94	67	42	17	3	1
Osteoarthritis	10805	9301	6455	3985	1884	378	62
Osteonecrosis	170	145	94	59	34	6	1
Rheumatoid Arthritis	212	192	157	117	59	9	2

Table ST25 Primary Total Conventional Shoulder Replacement by Reason for Revision

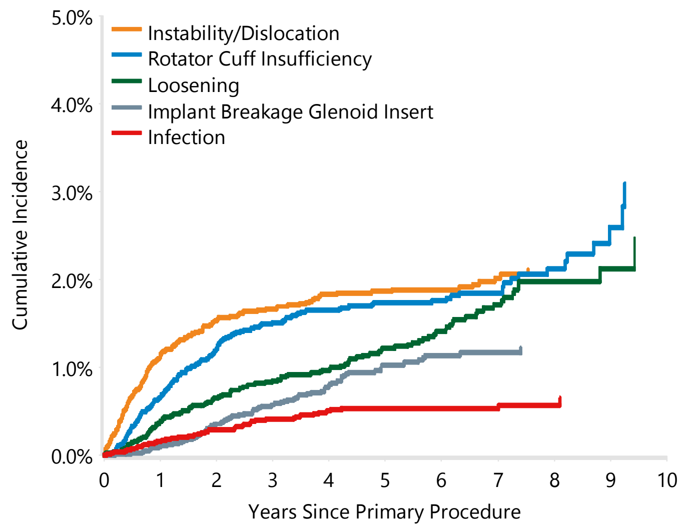
Reason for Revision	Number	Percent
Instability/Dislocation	194	24.2
Rotator Cuff Insufficiency	181	22.6
Loosening	132	16.5
Implant Breakage Glenoid Insert	88	11.0
Infection	50	6.2
Dissociation	29	3.6
Fracture	20	2.5
Incorrect Sizing	16	2.0
Pain	15	1.9
Arthrofibrosis	13	1.6
Metal Related Pathology	11	1.4
Wear Glenoid Insert	9	1.1
Malposition	8	1.0
Lysis	4	0.5
Other	32	4.0
TOTAL	**802**	**100.0**

Table ST26 Primary Total Conventional Shoulder Replacement by Type of Revision

Type of Revision	Number	Percent
Humeral Component	444	55.4
Humeral/Glenoid	141	17.6
Head Only	83	10.3
Glenoid Component	59	7.4
Head/Insert	31	3.9
Cement Spacer	24	3.0
Removal of Prostheses	11	1.4
Minor Components	5	0.6
Reoperation	3	0.4
Reinsertion of Components	1	0.1
TOTAL	**802**	**100.0**

Note: Humeral heads are replaced when the humeral component is revised

Figure ST8 Cumulative Incidence Revision Diagnosis of Primary Total Conventional Shoulder Replacement



OUTCOME FOR OSTEOARTHRITIS

Age and Gender

There is no difference in the rate of revision between patients aged less than 55 years compared to those aged 55 to 64 years. Patients aged 65 to 74 years and 75 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 fixation (glenoid cemented). There is no difference between cemented and hybrid fixation (glenoid cemented) (Table ST29 and Figure ST11).

The fixation analysis was repeated excluding the SMR L2 prosthesis as it has been withdrawn. 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 rate of revision is increased if the glenoid is not cemented.

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 70.7% of primary total conventional shoulder replacements. These prostheses have a lower rate of revision compared to modular and non modular metal backed glenoid prostheses. 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, 78.4% retained the metal glenoid component and replaced the modular insert with a glenosphere. The humeral stem was also revised in only a small number of these revisions (15 out of the total 360 procedures).

The above analysis was repeated excluding the SMR L2 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 (84.9%). 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 38.6% in 2016 (Figure ST16). XLPE glenoids have a lower cumulative percent revision at seven years compared to non XLPE glenoids (2.6% compared to 11.4%) (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

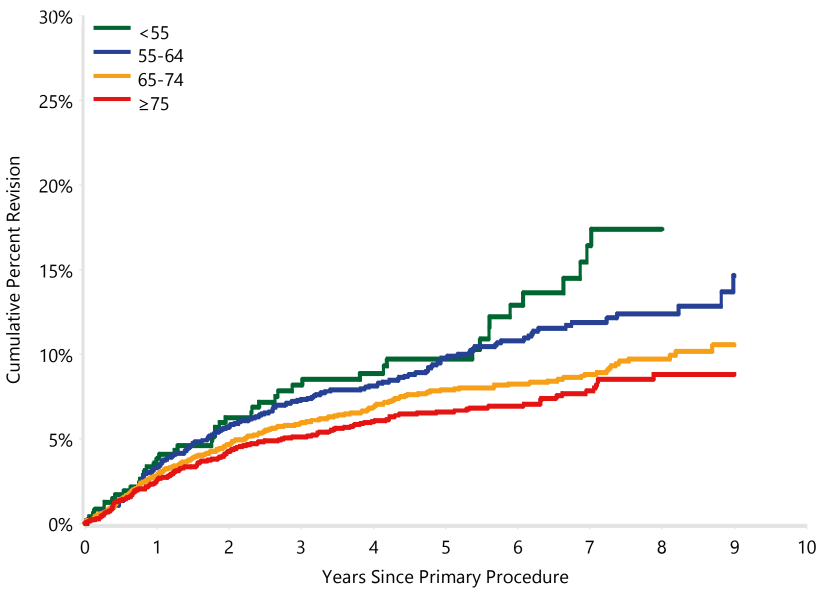
Humeral head sizes less than 44 mm have the highest rate of revision. This decreases with increasing head size, with humeral heads larger than 50mm having the lowest rate of revision (Table ST36 and Figure ST19). A comparison of revision diagnoses is shown in Figure ST20.

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 Conventional Shoulder Replacement by Age (Primary Diagnosis OA)

Age	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
<55	46	481	3.9 (2.4, 6.1)	8.2 (5.8, 11.4)	9.7 (7.1, 13.3)	16.4 (11.9, 22.3)		
55-64	200	2377	3.3 (2.7, 4.2)	7.3 (6.3, 8.6)	9.8 (8.5, 11.3)	11.9 (10.3, 13.8)	14.6 (11.8, 18.2)	
65-74	314	4786	2.9 (2.4, 3.4)	5.9 (5.3, 6.7)	7.9 (7.0, 8.8)	8.8 (7.8, 10.0)	10.6 (9.1, 12.2)	
≥75	185	3161	2.5 (2.0, 3.2)	5.1 (4.4, 6.0)	6.6 (5.7, 7.7)	7.9 (6.7, 9.2)	8.8 (7.4, 10.5)	
TOTAL	**745**	**10805**						

Figure ST9 Cumulative Percent Revision of Primary Total Conventional Shoulder Replacement by Age (Primary Diagnosis OA)



HR - adjusted for gender

55-64 vs <55

Entire Period: HR=0.85 (0.62, 1.18),p=0.338

65-74 vs <55

Entire Period: HR=0.66 (0.49, 0.91),p=0.010

≥75 vs <55

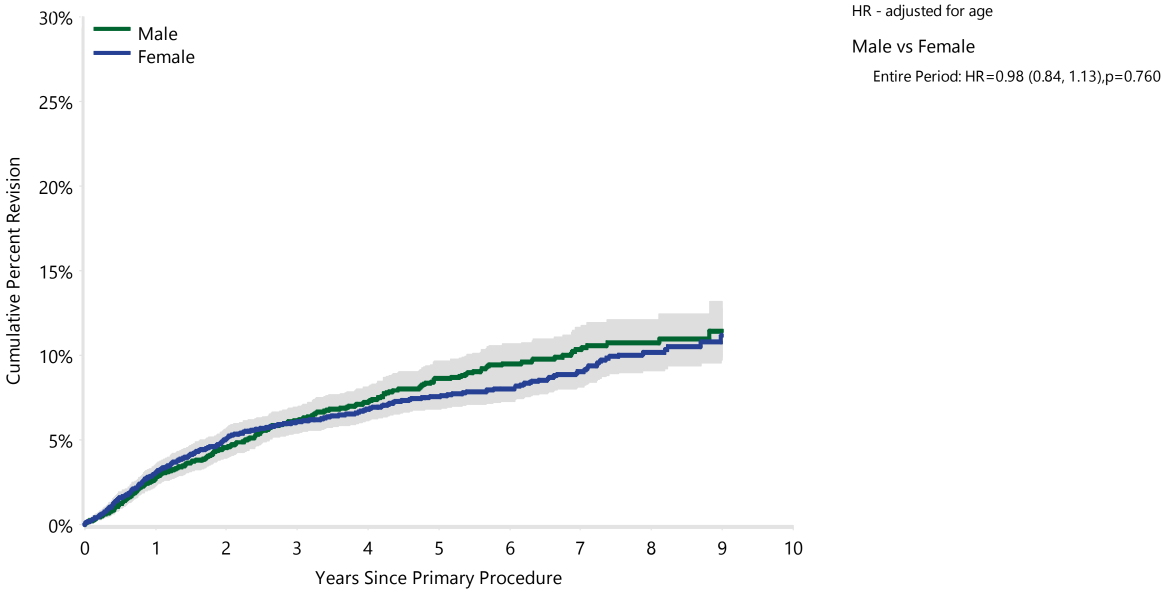
Entire Period: HR=0.57 (0.41, 0.79),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
<55	481	391	269	173	85	19	2
55-64	2377	2025	1383	892	433	89	14
65-74	4786	4103	2827	1707	815	162	27
≥75	3161	2782	1976	1213	551	108	19

Table ST28 Cumulative Percent Revision of Primary Total Conventional Shoulder Replacement by Gender (Primary Diagnosis OA)

Gender	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Male	321	4603	2.7 (2.3, 3.3)	6.1 (5.4, 6.9)	8.6 (7.7, 9.7)	10.3 (9.2, 11.6)	11.4 (9.9, 13.2)	
Female	424	6202	3.0 (2.6, 3.5)	6.1 (5.5, 6.8)	7.6 (6.9, 8.4)	9.1 (8.2, 10.0)	11.2 (9.7, 12.8)	
TOTAL	**745**	**10805**						

Figure ST10 Cumulative Percent Revision of Primary Total Conventional Shoulder Replacement by Gender (Primary Diagnosis OA)

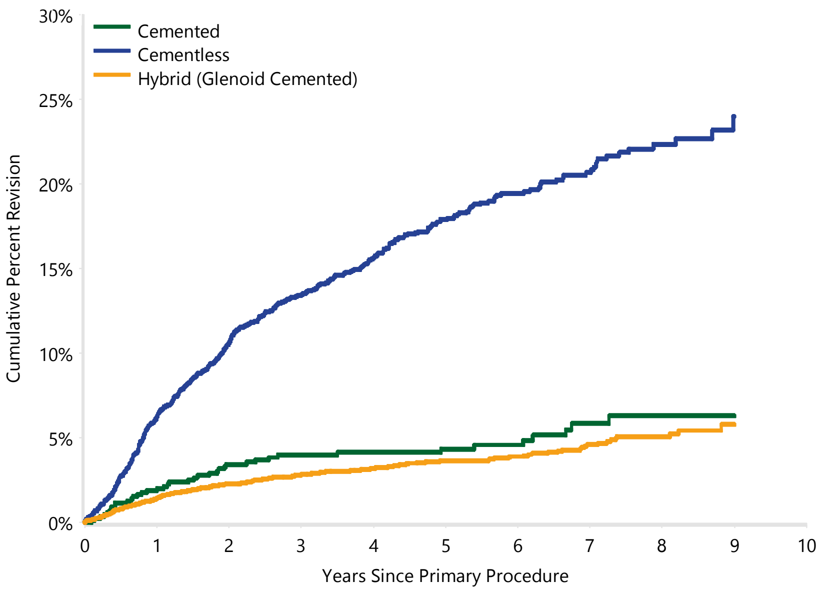


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Male	4603	3925	2661	1576	742	155	24
Female	6202	5376	3794	2409	1142	223	38

Table ST29 Cumulative Percent Revision of Primary Total Conventional Shoulder Replacement by Fixation (Primary Diagnosis OA)

Fixation	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Cemented	42	862	1.9 (1.2, 3.1)	4.0 (2.8, 5.6)	4.4 (3.1, 6.1)	5.8 (4.2, 8.1)	6.3 (4.5, 8.8)	
Cementless	482	3094	6.2 (5.4, 7.1)	13.4 (12.2, 14.8)	17.9 (16.4, 19.6)	20.7 (18.9, 22.6)	24.0 (21.3, 27.0)	
Hybrid (Glenoid Cemented)	213	6784	1.4 (1.2, 1.8)	2.8 (2.4, 3.3)	3.7 (3.2, 4.2)	4.6 (3.9, 5.4)	5.8 (4.7, 7.1)	
Hybrid (Glenoid Cementless)	8	65	9.6 (4.4, 20.1)	11.7 (5.7, 23.2)	15.2 (7.6, 29.4)			
TOTAL	**745**	**10805**						

Figure ST11 Cumulative Percent Revision of Primary Total Conventional Shoulder Replacement by Fixation (Primary Diagnosis OA)



HR - adjusted for age and gender

Cemented vs Hybrid (Glenoid Cemented)
Entire Period: HR=1.34 (0.96, 1.87),p=0.083

Cementless vs Hybrid (Glenoid Cemented)
0 - 6Mth: HR=3.35 (2.41, 4.66),p<0.001
6Mth+: HR=5.53 (4.62, 6.63),p<0.001

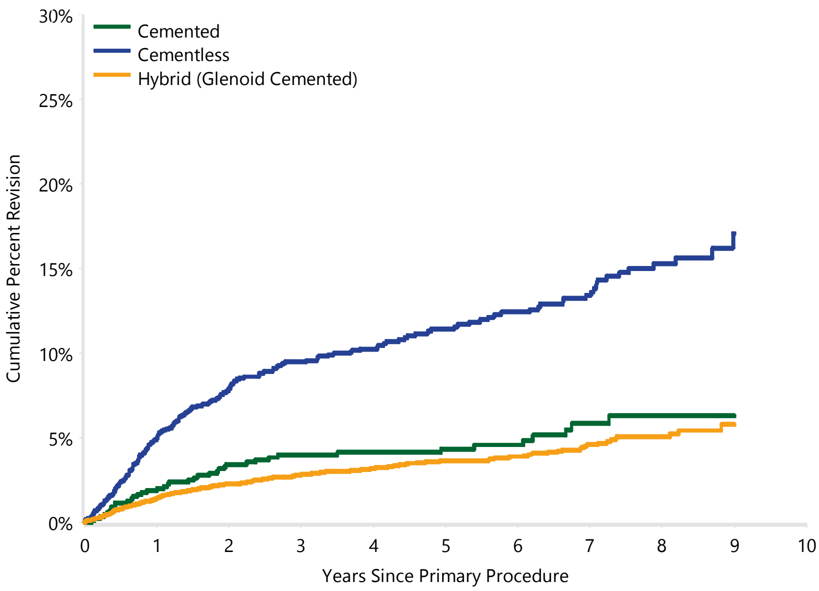
Cementless vs Cemented
Entire Period: HR=3.75 (2.74, 5.15),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Cemented	862	797	647	456	241	52	6
Cementless	3094	2634	1809	1092	500	96	18
Hybrid (Glenoid Cemented)	6784	5821	3964	2420	1138	227	38

Table ST30 Cumulative Percent Revision of Primary Total Conventional Shoulder Replacement by Fixation (Primary Diagnosis OA, excluding SMR L2)

Fixation	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Cemented	42	862	1.9 (1.2, 3.1)	4.0 (2.8, 5.6)	4.4 (3.1, 6.1)	5.8 (4.2, 8.1)	6.3 (4.5, 8.8)	
Cementless	234	2308	5.0 (4.1, 6.0)	9.5 (8.3, 10.9)	11.4 (10.0, 13.1)	13.4 (11.7, 15.4)	17.1 (14.3, 20.3)	
Hybrid (Glenoid Cemented)	213	6784	1.4 (1.2, 1.8)	2.8 (2.4, 3.3)	3.7 (3.2, 4.2)	4.6 (3.9, 5.4)	5.8 (4.7, 7.1)	
Hybrid (Glenoid Cementless)	5	52	7.9 (3.1, 19.8)	10.9 (4.6, 24.6)	10.9 (4.6, 24.6)			
TOTAL	**494**	**10006**						

Figure ST12 Cumulative Percent Revision of Primary Total Conventional Shoulder Replacement by Fixation (Primary Diagnosis OA, excluding SMR L2)



HR - adjusted for age and gender

Cemented vs Hybrid (Glenoid Cemented)
Entire Period: HR=1.33 (0.96, 1.85),p=0.090

Cementless vs Hybrid (Glenoid Cemented)
Entire Period: HR=3.29 (2.74, 3.97),p<0.001

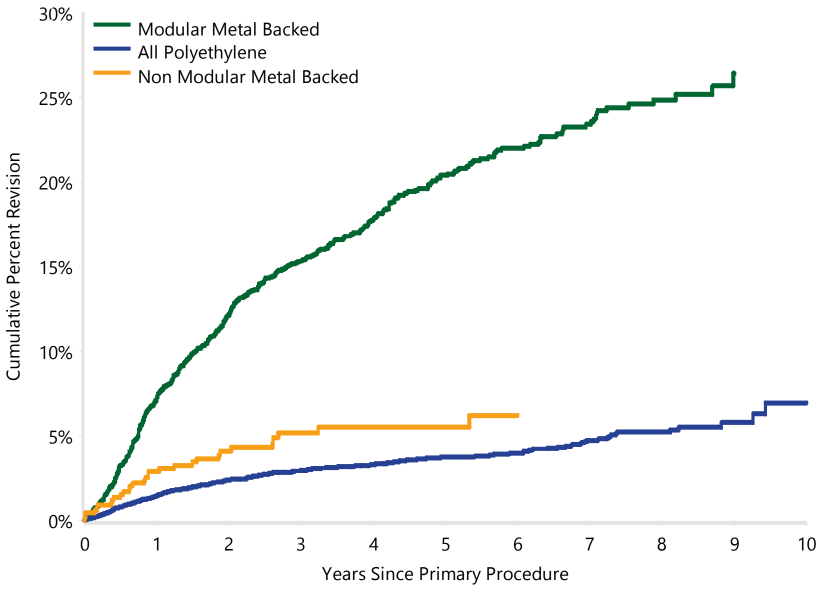
Cementless vs Cemented
Entire Period: HR=2.47 (1.78, 3.44),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Cemented	862	797	647	456	241	52	6
Cementless	2308	1930	1217	666	481	96	18
Hybrid (Glenoid Cemented)	6784	5821	3964	2420	1138	227	38

Table ST31 Cumulative Percent Revision of Primary Total Conventional Shoulder Replacement by Glenoid Type (Primary Diagnosis OA)

Glenoid Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Modular Metal Backed	459	2509	7.2 (6.2, 8.3)	15.3 (13.9, 16.9)	20.4 (18.7, 22.3)	23.4 (21.4, 25.5)	26.4 (23.6, 29.4)	
All Polyethylene	255	7634	1.5 (1.2, 1.8)	3.0 (2.6, 3.4)	3.8 (3.3, 4.3)	4.7 (4.1, 5.5)	5.8 (4.8, 6.9)	7.0 (5.3, 9.2)
Non Modular Metal Backed	31	662	2.9 (1.8, 4.6)	5.2 (3.6, 7.5)	5.5 (3.8, 7.9)			
TOTAL	**745**	**10805**						

Figure ST13 Cumulative Percent Revision of Primary Total Conventional Shoulder Replacement by Glenoid Type (Primary Diagnosis OA)



HR - adjusted for age and gender

Modular Metal Backed vs All Polyethylene

Entire Period: HR=5.48 (4.70, 6.39),p<0.001

Non Modular Metal Backed vs All Polyethylene

Entire Period: HR=1.64 (1.13, 2.39),p=0.009

Modular Metal Backed vs
Non Modular Metal Backed

0 - 3Mth: HR=1.87 (1.04, 3.37),p=0.037

3Mth - 9Mth: HR=3.29 (2.09, 5.18),p<0.001

9Mth - 1Yr: HR=3.62 (2.02, 6.51),p<0.001

1Yr - 2Yr: HR=3.58 (2.28, 5.62),p<0.001

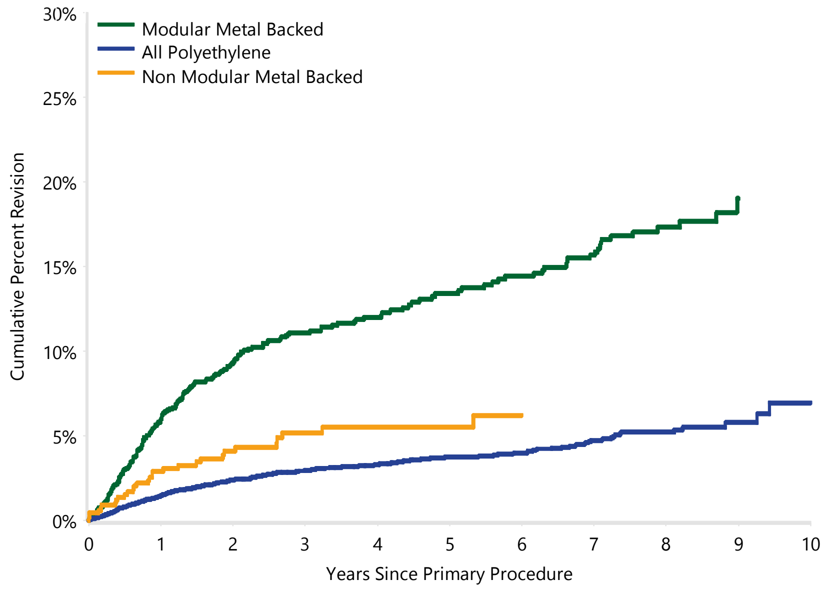
2Yr+: HR=3.73 (2.44, 5.69),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Modular Metal Backed	2509	2143	1514	947	480	99	18
All Polyethylene	7634	6616	4631	2882	1379	279	44
Non Modular Metal Backed	662	542	310	156	25	0	0

Table ST32 Cumulative Percent Revision of Primary Total Conventional 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	9 Yrs	10 Yrs
Modular Metal Backed	208	1710	6.0 (4.9, 7.2)	11.1 (9.6, 12.8)	13.4 (11.6, 15.5)	15.7 (13.6, 18.1)	19.0 (16.1, 22.4)	
All Polyethylene	255	7634	1.5 (1.2, 1.8)	3.0 (2.6, 3.4)	3.8 (3.3, 4.3)	4.7 (4.1, 5.5)	5.8 (4.8, 6.9)	7.0 (5.3, 9.2)
Non Modular Metal Backed	31	662	2.9 (1.8, 4.6)	5.2 (3.6, 7.5)	5.5 (3.8, 7.9)			
TOTAL	**494**	**10006**						

Figure ST14 Cumulative Percent Revision of Primary Total Conventional 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=3.69 (3.07, 4.43),p<0.001

Non Modular Metal Backed vs All Polyethylene

Entire Period: HR=1.65 (1.13, 2.39),p=0.009

Modular Metal Backed vs Non Modular Metal Backed

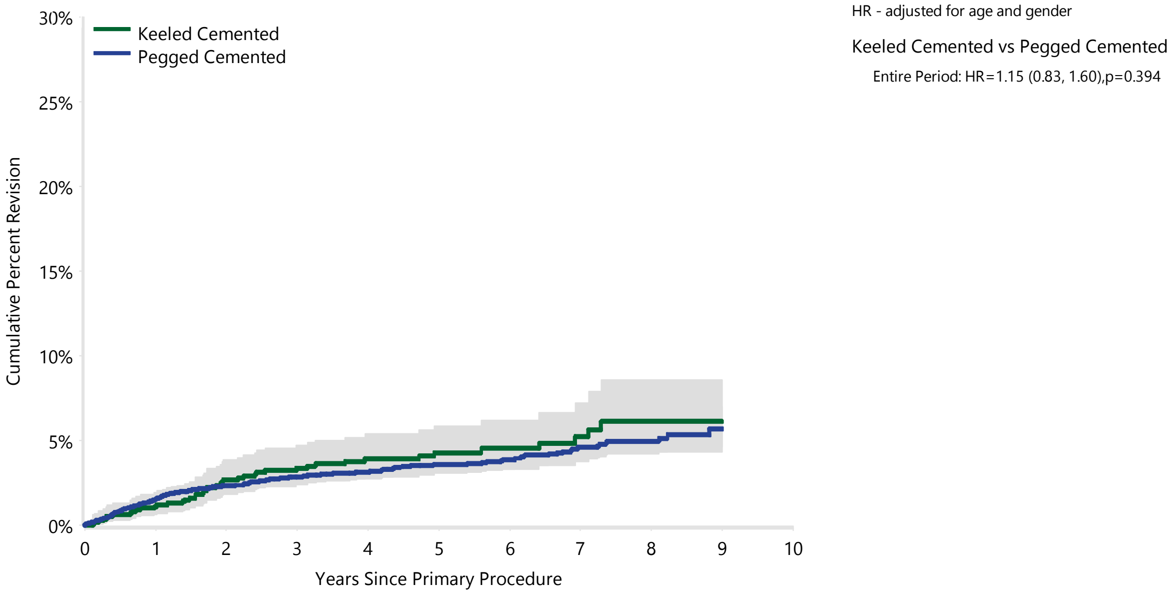
Entire Period: HR=2.24 (1.54, 3.27),p<0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Modular Metal Backed	1710	1428	911	513	461	99	18
All Polyethylene	7634	6616	4631	2882	1379	279	44
Non Modular Metal Backed	662	542	310	156	25	0	0

Table ST33 Cumulative Percent Revision of All Polyethylene Cemented Primary Total Conventional Shoulder Replacement by Glenoid Design (Primary Diagnosis OA)

Glenoid Design	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Keeled Cemented	44	1115	1.1 (0.6, 2.0)	3.4 (2.4, 4.7)	4.3 (3.1, 5.9)	5.2 (3.8, 7.3)	6.1 (4.3, 8.6)	
Pegged Cemented	208	6478	1.5 (1.3, 1.9)	2.9 (2.5, 3.4)	3.6 (3.1, 4.2)	4.6 (3.9, 5.4)	5.7 (4.6, 7.0)	
TOTAL	**252**	**7593**						

Figure ST15 Cumulative Percent Revision of All Polyethylene Cemented Primary Total Conventional Shoulder Replacement by Glenoid Design (Primary Diagnosis OA)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Keeled Cemented	1115	1015	762	494	231	62	9
Pegged Cemented	6478	5565	3841	2376	1146	217	35

Figure ST16 Proportion of Primary Total Conventional Shoulder Replacement by Polyethylene Type (All Diagnoses)

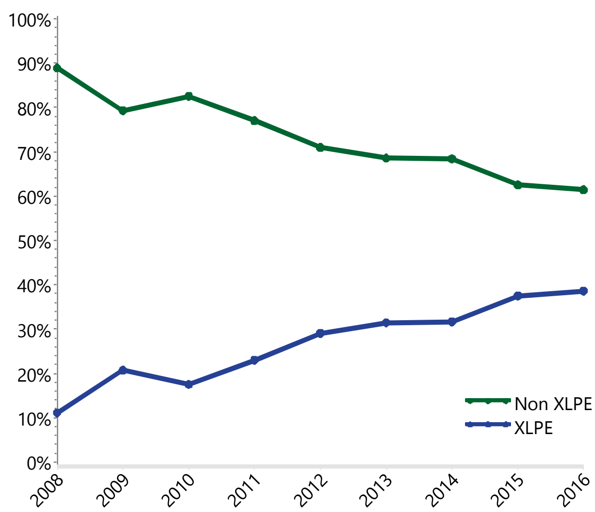
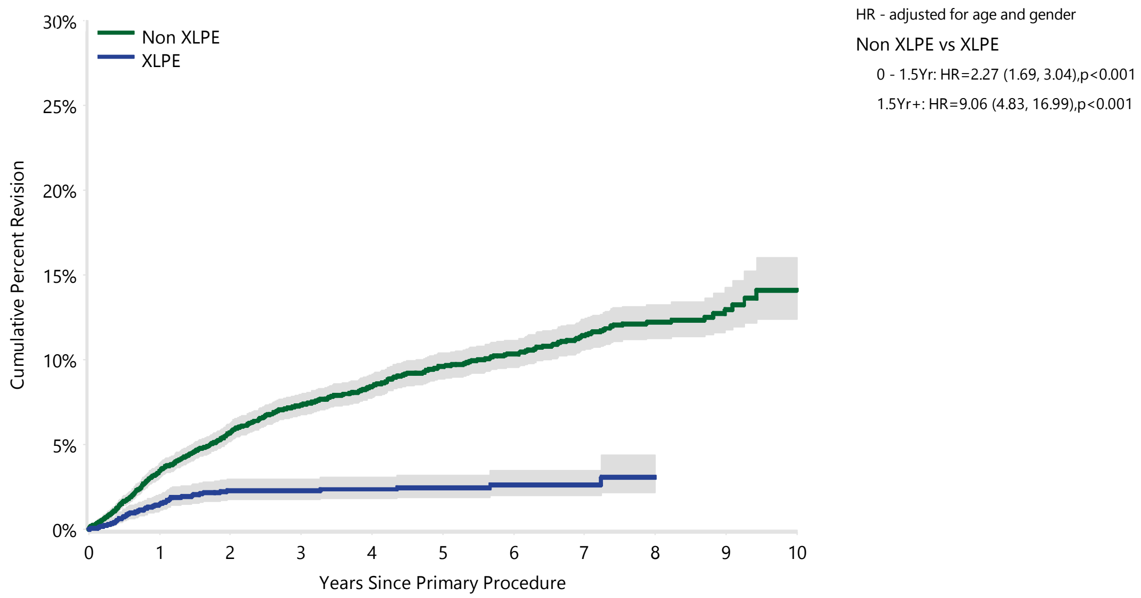


Table ST34 Cumulative Percent Revision of Primary Total Conventional Shoulder Replacement using All Types of Glenoid by Polyethylene Type (Primary Diagnosis OA)

Polyethylene Type	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Non XLPE	671	7868	3.4 (3.0, 3.9)	7.3 (6.7, 8.0)	9.6 (8.9, 10.4)	11.4 (10.6, 12.4)	13.0 (11.8, 14.3)	14.1 (12.4, 16.0)
XLPE	62	2855	1.5 (1.1, 2.0)	2.3 (1.8, 3.0)	2.5 (1.9, 3.2)	2.6 (2.0, 3.5)		
TOTAL	**733**	**10723**						

Note: Excludes 82 procedures with unknown bearing surface, most of which are customised prostheses where the type of polyethylene used has not been defined

Figure ST17 Cumulative Percent Revision of Primary Total Conventional Shoulder Replacement using All Types of Glenoid by Polyethylene Type (Primary Diagnosis OA)



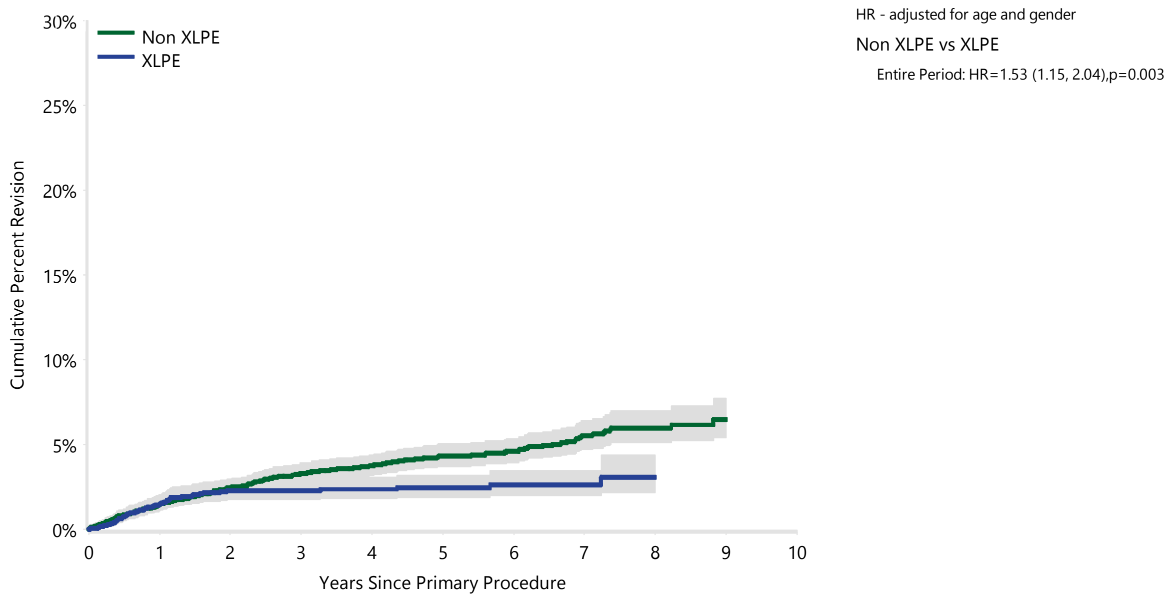
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Non XLPE	7868	6861	4927	3197	1557	343	56
XLPE	2855	2363	1465	733	276	27	6

Table ST35 Cumulative Percent Revision of Primary Total Conventional 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	9 Yrs	10 Yrs
Non XLPE	193	4767	1.5 (1.2, 1.9)	3.3 (2.8, 3.9)	4.3 (3.7, 5.0)	5.5 (4.7, 6.4)	6.5 (5.4, 7.7)	
XLPE	62	2855	1.5 (1.1, 2.0)	2.3 (1.8, 3.0)	2.5 (1.9, 3.2)	2.6 (2.0, 3.5)		
TOTAL	**255**	**7622**						

Note: Excludes 12 procedures with unknown bearing surface most of which are customised prostheses where the type of polyethylene used has not been defined

Figure ST18 Cumulative Percent Revision of Primary Total Conventional Shoulder Replacement using All Polyethylene Glenoids by Polyethylene Type (Primary Diagnosis OA)



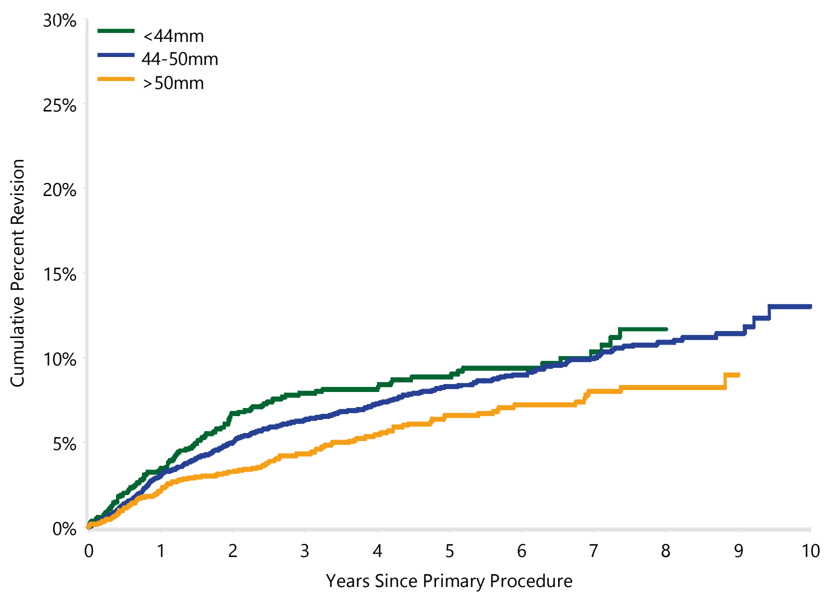
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Non XLPE	4767	4243	3166	2149	1103	252	38
XLPE	2855	2363	1465	733	276	27	6

Table ST36 Cumulative Percent Revision of Primary Total Conventional Shoulder Replacement by Humeral Head Size (Primary Diagnosis OA)

Head Size	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
<44mm	115	1417	3.5 (2.6, 4.6)	7.9 (6.5, 9.6)	8.9 (7.3, 10.7)	10.4 (8.5, 12.6)		
44-50mm	496	6891	3.1 (2.7, 3.5)	6.4 (5.8, 7.0)	8.3 (7.6, 9.1)	10.0 (9.1, 10.9)	11.5 (10.3, 12.8)	13.0 (11.0, 15.4)
>50mm	133	2493	2.1 (1.6, 2.8)	4.3 (3.5, 5.3)	6.6 (5.5, 7.9)	8.0 (6.6, 9.7)	9.0 (7.1, 11.4)	
TOTAL	**744**	**10801**						

Note: Excludes four procedures with unknown humeral head size

Figure ST19 Cumulative Percent Revision of Primary Total Conventional Shoulder Replacement by Humeral Head Size (Primary Diagnosis OA)



HR - adjusted for age and gender

<44mm vs >50mm

Entire Period: HR=1.97 (1.47, 2.64),p<0.001

44-50mm vs >50mm

Entire Period: HR=1.60 (1.29, 1.98),p<0.001

<44mm vs 44-50mm

Entire Period: HR=1.24 (1.00, 1.53),p=0.049

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
<44mm	1417	1220	823	517	232	38	4
44-50mm	6891	5941	4146	2542	1218	239	40
>50mm	2493	2137	1484	924	433	101	18

Figure ST20 Cumulative Incidence Revision Diagnosis of Primary Total Conventional Shoulder Replacement by Humeral Head Size (Primary Diagnosis OA)

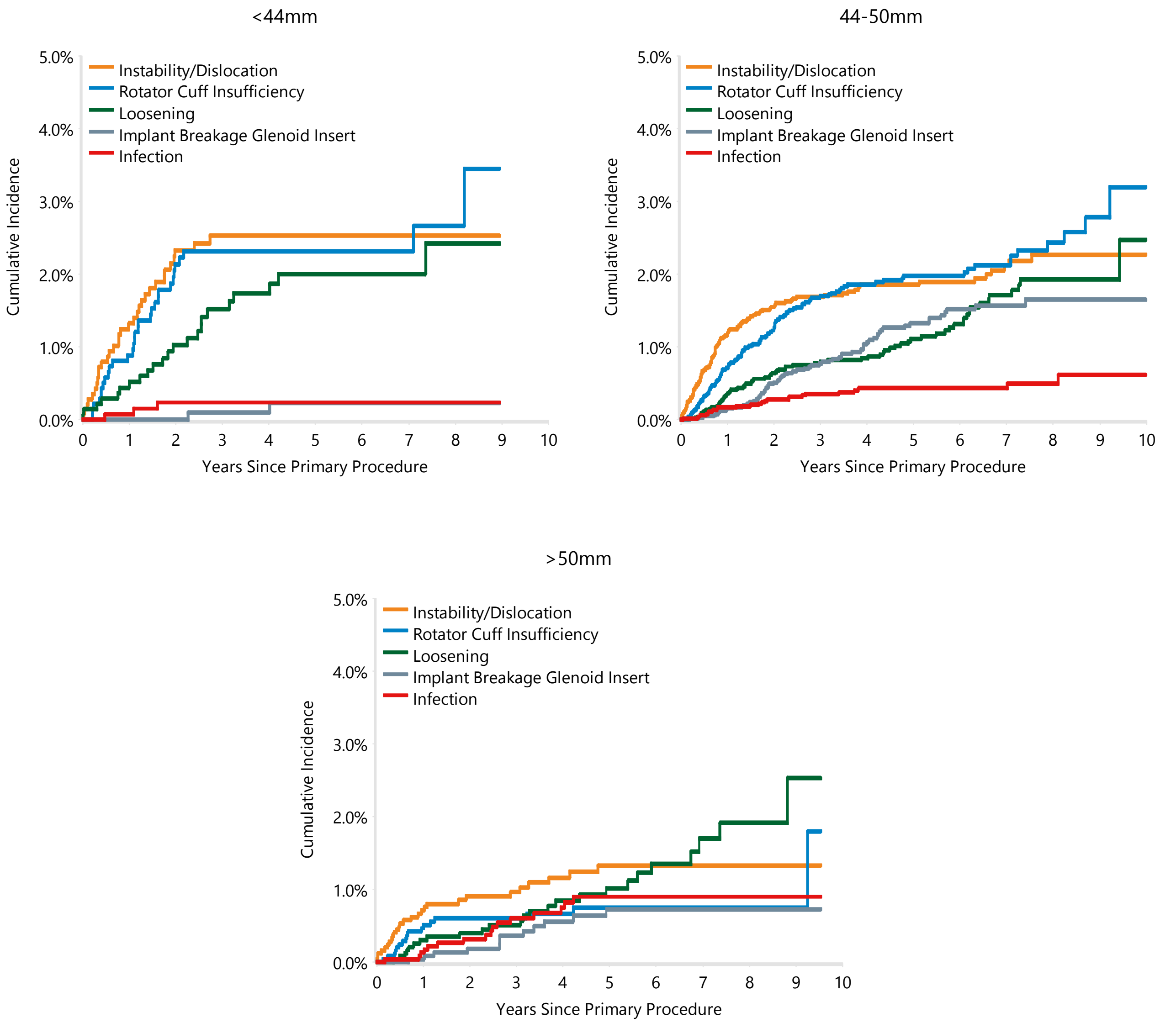


Table ST37 Cumulative Percent Revision of All Primary Total Conventional Shoulder Replacement by Prosthesis Combination (Primary Diagnosis OA)

Humeral Stem	Glenoid	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Aequalis	Aequalis	52	1630	1.4 (0.9, 2.1)	2.6 (1.9, 3.6)	3.3 (2.5, 4.3)	4.2 (3.1, 5.7)	4.2 (3.1, 5.7)	
Aequalis Ascend	Aequalis	2	276	0.4 (0.1, 3.0)					
Affinis	Affinis	11	173	0.0 (0.0, 0.0)	1.8 (0.6, 5.5)	5.1 (2.6, 10.0)	6.2 (3.2, 11.7)		
Ascend	Aequalis	10	331	1.6 (0.7, 3.8)	3.6 (1.9, 7.0)				
Bigliani/Flatow	Bigliani/Flatow	9	141	2.1 (0.7, 6.5)	3.6 (1.5, 8.5)	3.6 (1.5, 8.5)	5.6 (2.7, 11.5)		
Bigliani/ Flatow TM	Bigliani/ Flatow	22	365	2.2 (1.1, 4.4)	5.2 (3.3, 8.3)	6.5 (4.2, 9.9)	7.1 (4.6, 10.9)		
Bigliani/Flatow TM	Bigliani/Flatow TM	26	583	2.5 (1.5, 4.2)	5.0 (3.3, 7.4)	5.3 (3.6, 7.8)			
Comprehensive	Comprehensive	12	257	4.5 (2.5, 8.3)	5.1 (2.9, 9.2)				
Epoca	Epoca	3	50	0.0 (0.0, 0.0)	4.8 (1.2, 17.7)	7.9 (2.6, 22.9)	7.9 (2.6, 22.9)		
Equinoxe	Equinoxe	6	155	3.0 (1.1, 7.8)					
Global AP	Global	22	439	1.2 (0.5, 2.8)	3.7 (2.2, 6.1)	4.3 (2.7, 6.8)	6.6 (4.2, 10.4)		
Global AP	Global Advantage	46	1977	1.6 (1.2, 2.3)	2.3 (1.7, 3.1)	2.5 (1.8, 3.3)	2.7 (2.0, 3.7)		
Global Advantage	Global	21	495	1.7 (0.8, 3.3)	3.4 (2.1, 5.5)	3.4 (2.1, 5.5)	4.9 (3.2, 7.7)	4.9 (3.2, 7.7)	
Global Advantage	Global Advantage	3	158	0.0 (0.0, 0.0)	2.3 (0.6, 9.2)	2.3 (0.6, 9.2)			
Global Unite	Global Advantage	0	404	0.0 (0.0, 0.0)					
SMR	SMR	16	398	1.8 (0.9, 3.8)	3.8 (2.3, 6.4)	4.2 (2.5, 6.8)	4.2 (2.5, 6.8)		
SMR	SMR L1	183	1648	5.7 (4.6, 6.9)	10.6 (9.1, 12.3)	12.4 (10.7, 14.4)	13.9 (12.0, 16.2)	17.4 (14.4, 20.9)	
SMR	SMR L2	250	798	9.7 (7.8, 12.0)	22.6 (19.8, 25.6)	30.2 (27.1, 33.6)			
Solar	Solar	6	169	0.6 (0.1, 4.1)	2.4 (0.9, 6.2)	3.2 (1.3, 7.5)	3.2 (1.3, 7.5)		
Turon	Turon	1	70	1.5 (0.2, 10.0)	1.5 (0.2, 10.0)				
Other (35)		44	288	4.4 (2.5, 7.6)	9.1 (6.1, 13.4)	15.5 (11.3, 21.1)	19.6 (14.7, 26.0)		
TOTAL		**745**	**10805**						

Note: Only combinations with over 50 procedures have been listed

Table ST38 Cumulative Percent Revision of Cementless Primary Total Conventional Shoulder Replacement by Prosthesis Combination (Primary Diagnosis OA)

Humeral Stem	Glenoid	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Bigliani/ Flatow TM	Bigliani/ Flatow TM	24	556	2.3 (1.3, 4.0)	4.8 (3.2, 7.3)	5.2 (3.4, 7.8)			
Epoca	Epoca	3	36	0.0 (0.0, 0.0)	7.1 (1.8, 25.7)	12.6 (4.1, 35.1)			
Equinoxe	Equinoxe	3	27	12.0 (4.0, 32.8)					
SMR	SMR L1	180	1618	5.6 (4.6, 6.9)	10.6 (9.0, 12.3)	12.4 (10.6, 14.4)	13.9 (11.9, 16.2)	17.4 (14.4, 21.0)	
SMR	SMR L2	247	785	9.6 (7.7, 11.9)	22.7 (19.9, 25.8)	30.3 (27.2, 33.7)			
Univers 3D	Univers 3D	11	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)	39.4 (23.5, 60.9)	45.5 (27.8, 67.7)
Vaios	Vaios	11	24	16.7 (6.6, 38.5)	29.2 (15.1, 51.6)	44.3 (26.4, 67.3)			
Other (14)		3	22	5.3 (0.8, 31.9)	5.3 (0.8, 31.9)	17.1 (4.1, 57.1)	17.1 (4.1, 57.1)		
TOTAL		**482**	**3094**						

Note: Only combinations with over 10 procedures have been listed

Table ST39 Cumulative Percent Revision of Hybrid (Glenoid Cemented) Primary Total Conventional Shoulder Replacement by Prosthesis Combination (Primary Diagnosis OA)

Humeral Stem	Glenoid	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Aequalis	Aequalis	41	1423	1.2 (0.8, 2.0)	2.3 (1.6, 3.2)	2.9 (2.1, 4.0)	4.0 (2.9, 5.7)		
Aequalis Ascend	Aequalis	2	265	0.4 (0.1, 3.1)					
Affinis	Affinis	11	171	0.0 (0.0, 0.0)	1.8 (0.6, 5.6)	5.2 (2.6, 10.1)	6.2 (3.2, 11.8)		
Ascend	Aequalis	9	314	1.7 (0.7, 4.0)	3.3 (1.6, 6.6)				
Bigliani/Flatow	Bigliani/Flatow	7	120	2.5 (0.8, 7.6)	4.3 (1.8, 9.9)	4.3 (1.8, 9.9)	5.4 (2.5, 11.7)		
Bigliani/Flatow TM	Bigliani/Flatow	16	337	1.5 (0.6, 3.6)	4.0 (2.3, 7.0)	5.4 (3.3, 8.8)	5.4 (3.3, 8.8)		
Comprehensive	Comprehensive	12	250	4.7 (2.5, 8.6)	5.3 (2.9, 9.4)				
Equinoxe	Equinoxe	3	125	0.8 (0.1, 5.8)					
Global AP	Global	21	385	1.3 (0.6, 3.1)	4.3 (2.6, 7.0)	5.0 (3.1, 7.9)	7.8 (4.9, 12.2)		
Global AP	Global Advantage	42	1748	1.7 (1.2, 2.4)	2.4 (1.8, 3.3)	2.6 (1.9, 3.5)	2.9 (2.0, 4.0)		
Global Advantage	Global	14	404	1.5 (0.7, 3.4)	3.5 (2.0, 5.9)	3.5 (2.0, 5.9)	4.0 (2.3, 6.7)	4.0 (2.3, 6.7)	
Global Advantage	Global Advantage	3	133	0.0 (0.0, 0.0)	2.8 (0.7, 11.1)				
Global Unite	Global Advantage	0	370	0.0 (0.0, 0.0)					
SMR	SMR	14	382	1.9 (0.9, 4.0)	3.4 (1.9, 5.9)	3.8 (2.2, 6.4)	3.8 (2.2, 6.4)		
Solar	Solar	4	114	0.9 (0.1, 6.1)	1.8 (0.4, 6.9)	2.9 (0.9, 8.8)	2.9 (0.9, 8.8)		
Turon	Turon	0	64	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)				
Other (26)		14	179	1.7 (0.6, 5.3)	4.0 (1.8, 8.8)	9.5 (5.5, 16.4)	11.9 (7.1, 19.6)		
TOTAL		**213**	**6784**						

Note: Only combinations with over 50 procedures have been listed

PRIMARY TOTAL REVERSE SHOULDER REPLACEMENT

DEMOGRAPHICS

There have been 15,781 primary total reverse shoulder replacement procedures reported to the Registry. This is an increase of 3,419 procedures compared to the previous report. Primary total reverse shoulder replacement has increased from 43.3% of all total shoulder replacements in 2008 to 69.3% in 2016.

The proportion of total reverse shoulder replacements for osteoarthritis declined from 57.8% in 2008 to 40.6% in 2013, increasing to 45.1% in 2016. 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 21.0% in 2008 to 37.9% in 2013, and is 33.9% in 2016. The proportion of total reverse shoulder replacements for fracture has increased from 12.0% in 2008 to 16.0% in 2016 (Figure ST21).

Figure ST21 Proportion of Primary Total Reverse Shoulder Replacement by Primary Diagnosis

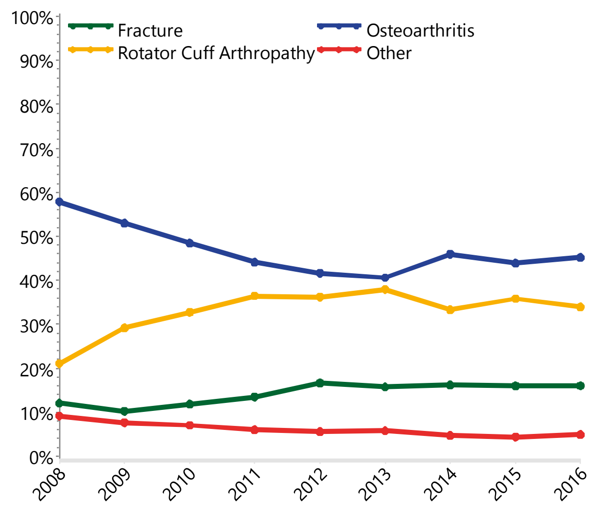
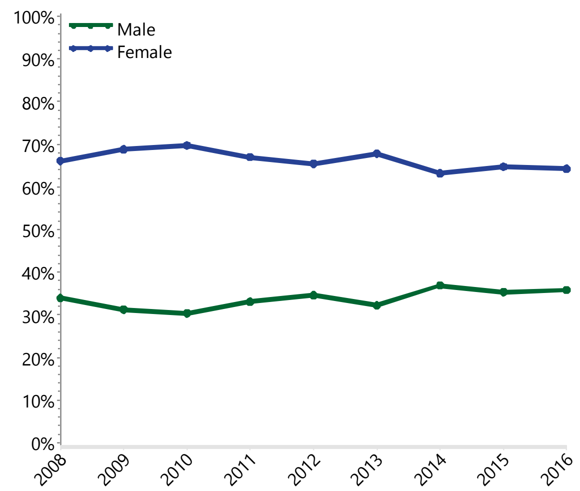


Figure ST22 Proportion of Primary Total Reverse Shoulder Replacement by Gender



Primary total reverse shoulder replacement is most commonly undertaken in females (65.6%) (Table ST40). There has been minimal change in gender distribution since 2008 (Figure ST22). The mean age is 75.6 years for females and 73.1 years for males. The proportion of patients aged 75 years or older has declined from 61.4% in 2010 to 47.0% in 2016 (Figure ST23).

The most common primary diagnoses are osteoarthritis (45.5%), rotator cuff arthropathy (34.0%) and fracture (15.0%) (Table ST41).

The most common primary diagnoses are osteoarthritis (45.5%), rotator cuff arthropathy (34.0%) and fracture (15.0%).

The majority of procedures use cementless fixation (75.1%). Hybrid fixation (humerus cemented) is used in 23.4% of procedures. There has been little variation in the use of fixation since 2008 (Figure ST24).

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	5434	34.4%	24	96	74	73.1	8.1
Female	10347	65.6%	14	102	76	75.6	7.9
TOTAL	**15781**	**100.0%**	**14**	**102**	**75**	**74.7**	**8.1**

Figure ST23 Proportion of Primary Total Reverse Shoulder Replacement by Age

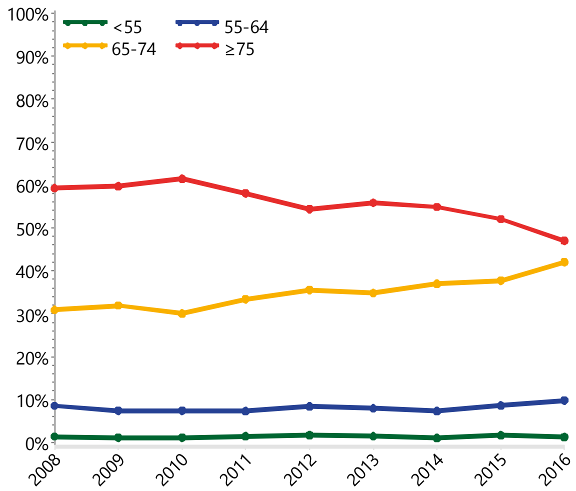


Figure ST24 Proportion of Primary Total Reverse Shoulder Replacement by Fixation

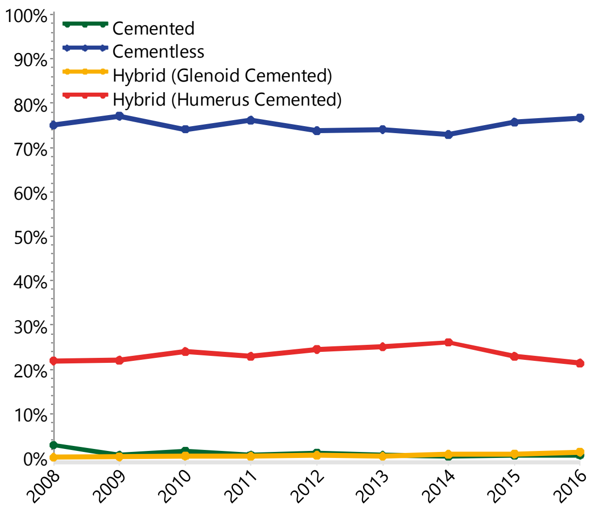


Table ST41 Primary Total Reverse Shoulder Replacement by Primary Diagnosis and Gender

	Male		Female		TOTAL	
Primary Diagnosis	N	Col%	N	Col%	N	Col%
Osteoarthritis	2626	48.3	4548	44.0	7174	45.5
Rotator Cuff Arthropathy	2225	40.9	3138	30.3	5363	34.0
Fracture	355	6.5	2010	19.4	2365	15.0
Rheumatoid Arthritis	64	1.2	277	2.7	341	2.2
Instability	62	1.1	129	1.2	191	1.2
Osteonecrosis	31	0.6	148	1.4	179	1.1
Tumour	52	1.0	53	0.5	105	0.7
Other Inflammatory Arthritis	17	0.3	40	0.4	57	0.4
Other	2	0.0	4	0.0	6	0.0
TOTAL	**5434**	**100.0**	**10347**	**100.0**	**15781**	**100.0**

Note: Instability includes instability and dislocation

Table ST42 10 Most Used Humeral Stem Prostheses in Primary Total Reverse Shoulder Replacement

2008		2013		2014		2015		2016	
N	Model	N	Model	N	Model	N	Model	N	Model
262	SMR	713	Delta Xtend	845	Delta Xtend	959	Delta Xtend	1017	Delta Xtend
252	Delta Xtend	567	SMR	633	SMR	729	SMR	909	SMR
76	Aequalis	308	Aequalis	253	Aequalis	265	Aequalis	358	Aequalis
42	Trabecular Metal	142	Trabecular Metal	141	Trabecular Metal	191	Trabecular Metal	205	Trabecular Metal
21	Delta CTA	38	RSP	113	RSP	142	RSP	192	Comprehensive
2	Custom Made (Lima)	36	Comprehensive	83	Aequalis Ascend	103	Comprehensive	176	RSP
1	Generic Humeral Stem	14	Equinoxe	80	Comprehensive	103	Equinoxe	168	Equinoxe
1	Promos	13	Global Unite	45	Global Unite	67	Global Unite	104	Global Unite
		12	Affinis	32	Equinoxe	46	Aequalis Ascend	92	Aequalis Ascend
		7	Vaios	18	Anatomical Shoulder	44	Anatomical Shoulder	79	Affinis
10 Most Used									
657 (8)	100.0%	1850 (10)	99.4%	2243 (10)	99.1%	2649 (10)	98.7%	3300 (10)	99.0%
Remainder									
0 (0)	0%	11 (3)	0.6%	21 (4)	0.9%	35 (3)	1.3%	32 (3)	1.0%
TOTAL									
657 (8)	100.0%	1861 (13)	100.0%	2264 (14)	100.0%	2684 (13)	100.0%	3332 (13)	100.0%

Table ST43 10 Most Used Glenoid Prostheses in Primary Total Reverse Shoulder Replacement

2008		2013		2014		2015		2016	
N	Model	N	Model	N	Model	N	Model	N	Model
263	SMR L1	726	Delta Xtend	890	Delta Xtend	1026	Delta Xtend	1121	Delta Xtend
252	Delta Xtend	562	SMR L1	628	SMR L1	728	SMR L1	897	SMR L1
76	Aequalis	313	Aequalis	338	Aequalis	311	Aequalis	451	Aequalis
42	Trabecular Metal	144	Trabecular Metal	150	Trabecular Metal	216	Trabecular Metal	231	Trabecular Metal
21	Delta CTA	38	RSP	113	RSP	142	RSP	178	Comprehensive Reverse
1	Generic Metaglene	36	Comprehensive Reverse	78	Comprehensive Reverse	103	Equinoxe	176	RSP
1	Promos	14	Equinoxe	32	Equinoxe	101	Comprehensive Reverse	164	Equinoxe
1	SMR	12	Affinis	10	Affinis	28	Affinis	79	Affinis
		7	Vaios	10	Anatomical Shoulder	19	Anatomical Shoulder	7	SMR Axioma
		6	Mets	9	Mets	6	Mets	6	Anatomical Shoulder
10 Most Used									
657 (8)	100.0%	1858 (10)	99.8%	2258 (10)	99.7%	2680 (10)	99.9%	3310 (10)	99.3%
Remainder									
0 (0)	0%	3 (2)	0.2%	6 (3)	0.3%	4 (2)	0.1%	22 (8)	0.7%
TOTAL									
657 (8)	100.0%	1861 (12)	100.0%	2264 (13)	100.0%	2684 (12)	100.0%	3332 (18)	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 (35.4%), followed by infection (19.1%), loosening (18.2%) and fracture (13.7%) (Table ST45 and Figure ST26).

Type of Revision

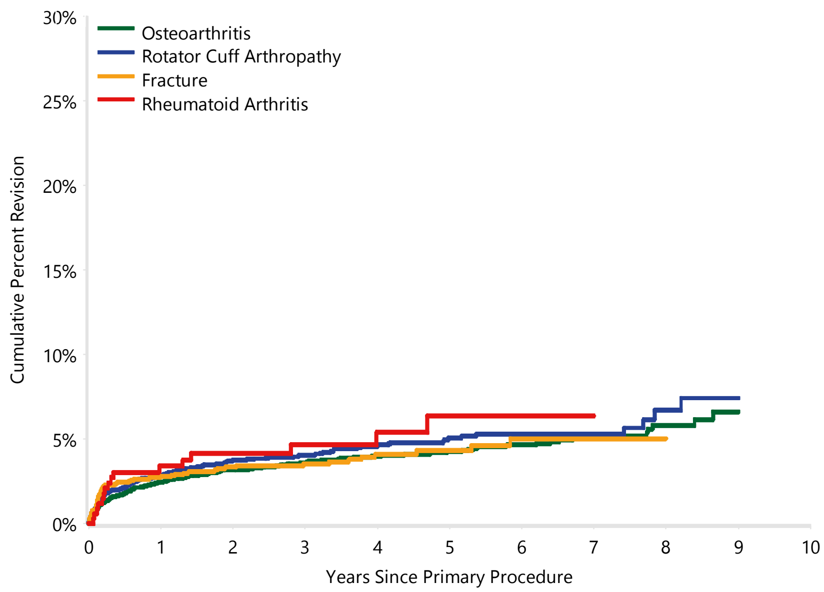
The four most common types of revision are: replacement of both cup (liner) and glenosphere (23.2%), cup only (20.1%), humeral component only (20.1%), and humeral head only (converted to a hemi arthroplasty, 16.0%) (Table ST46). When only the humeral component is revised, this may be associated with 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	9 Yrs	10 Yrs
Osteoarthritis	249	7174	2.5 (2.1, 2.9)	3.6 (3.1, 4.1)	4.3 (3.7, 4.9)	5.1 (4.4, 5.9)	6.6 (5.2, 8.3)	
Rotator Cuff Arthropathy	207	5363	2.9 (2.4, 3.4)	4.0 (3.5, 4.7)	5.1 (4.3, 5.9)	5.3 (4.5, 6.2)	7.4 (5.4, 10.1)	
Fracture	80	2365	2.8 (2.2, 3.6)	3.5 (2.8, 4.4)	4.3 (3.4, 5.5)	5.0 (3.8, 6.7)		
Rheumatoid Arthritis	16	341	3.4 (1.9, 6.1)	4.7 (2.8, 7.8)	6.4 (3.7, 10.7)	6.4 (3.7, 10.7)		
Other (5)	30	538	3.6 (2.3, 5.7)	6.2 (4.1, 9.2)	6.7 (4.5, 10.0)	7.6 (5.0, 11.6)		
TOTAL	**582**	**15781**						

Note: Only primary diagnoses with over 200 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=1.13 (0.94, 1.36),p=0.186

Fracture vs Osteoarthritis
0 - 3Mth: HR=1.86 (1.35, 2.55),p<0.001
3Mth+: HR=0.74 (0.50, 1.12),p=0.154

Rheumatoid Arthritis vs Osteoarthritis
Entire Period: HR=1.27 (0.76, 2.12),p=0.359

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Osteoarthritis	7174	5438	3122	1684	740	133	17
Rotator Cuff Arthropathy	5363	4051	2255	1008	327	58	15
Fracture	2365	1721	877	362	122	20	2
Rheumatoid Arthritis	341	271	179	89	45	6	4

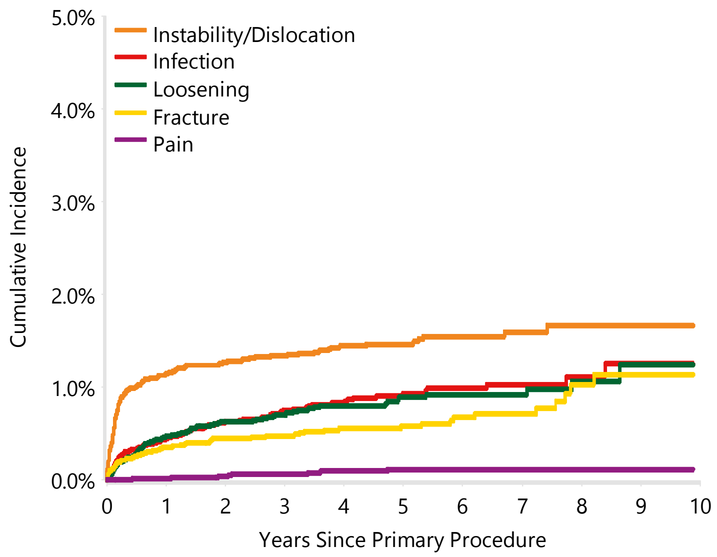
Table ST45 Primary Total Reverse Shoulder Replacement by Reason for Revision

Reason for Revision	Number	Percent
Instability/Dislocation	206	35.4
Infection	111	19.1
Loosening	106	18.2
Fracture	80	13.7
Dissociation	12	2.1
Pain	10	1.7
Lysis	8	1.4
Incorrect Sizing	7	1.2
Malposition	6	1.0
Arthrofibrosis	3	0.5
Rotator Cuff Insufficiency	2	0.3
Other	31	5.3
TOTAL	**582**	**100.0**

Table ST46 Primary Total Reverse Shoulder Replacement by Type of Revision

Type of Revision	Number	Percent
Cup/Glenosphere	135	23.2
Cup Only	117	20.1
Humeral Component	117	20.1
Humeral Head Only	93	16.0
Glenoid Component	36	6.2
Humeral/Glenoid	31	5.3
Cement Spacer	24	4.1
Removal of Prostheses	12	2.1
Glenosphere Only	5	0.9
Minor Components	5	0.9
Cement Only	3	0.5
Reoperation	2	0.3
Head/Insert	1	0.2
Reinsertion of Components	1	0.2
TOTAL	**582**	**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 (Table ST48 and Figure ST28).

Fixation

Fixation is not a risk factor for revision (Table ST49 and Figure ST29), with no difference between hybrid (humerus cemented) and cementless humeral stems. This is also the case when the SMR L2 prosthesis is excluded from the analysis (Table ST50 and Figure ST30).

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 ST31). The most common reason for revision is instability/dislocation (Figure ST32).

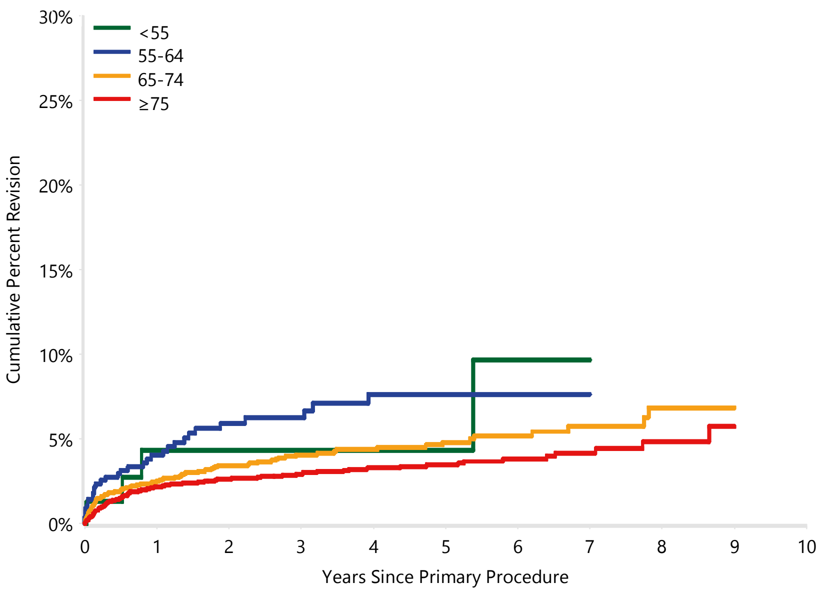
Glenosphere sizes smaller than 38mm have a higher rate of revision when used for osteoarthritis.

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	9 Yrs	10 Yrs
<55	4	77	4.3 (1.4, 12.9)	4.3 (1.4, 12.9)	4.3 (1.4, 12.9)	9.7 (3.0, 28.9)		
55-64	33	555	4.0 (2.7, 6.1)	6.3 (4.4, 9.0)	7.6 (5.3, 10.9)	7.6 (5.3, 10.9)		
65-74	98	2648	2.5 (2.0, 3.2)	4.1 (3.3, 5.0)	4.8 (3.9, 6.0)	5.7 (4.5, 7.3)	6.8 (5.1, 9.2)	
≥75	114	3894	2.2 (1.8, 2.7)	2.9 (2.4, 3.6)	3.5 (2.8, 4.2)	4.2 (3.3, 5.2)	5.7 (3.9, 8.4)	
TOTAL	**249**	**7174**						

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=1.22 (0.43, 3.44),p=0.710

65-74 vs <55

Entire Period: HR=0.79 (0.29, 2.16),p=0.649

≥75 vs <55

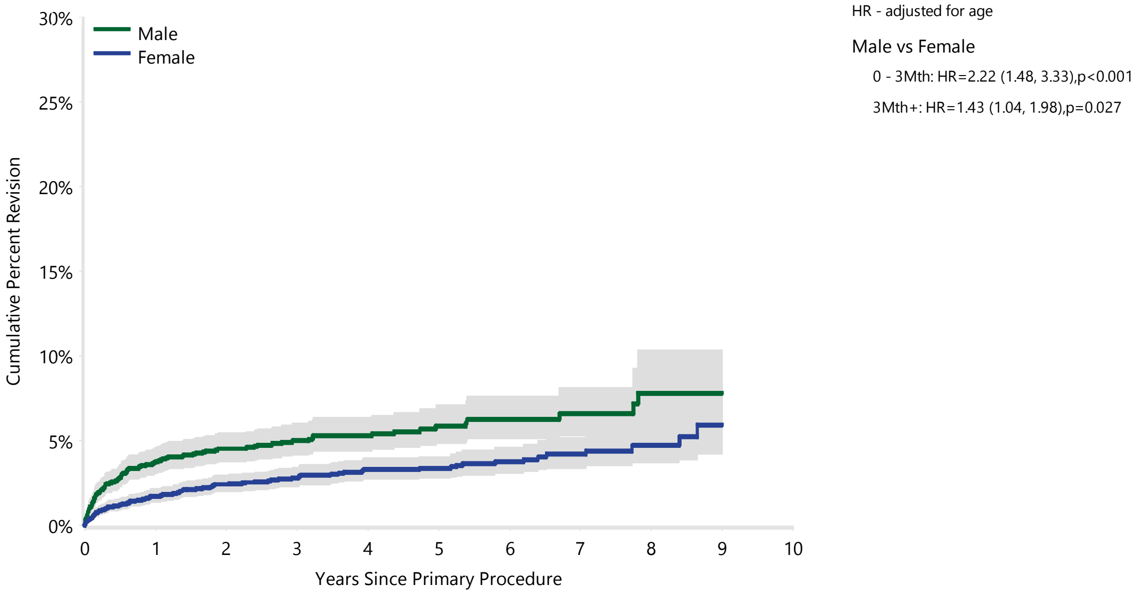
Entire Period: HR=0.63 (0.23, 1.72),p=0.371

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
<55	77	55	35	19	10	3	1
55-64	555	403	227	122	57	14	2
65-74	2648	1913	1061	575	278	52	5
≥75	3894	3067	1799	968	395	64	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	9 Yrs	10 Yrs
Male	124	2626	3.8 (3.1, 4.6)	5.0 (4.1, 6.0)	5.9 (4.8, 7.1)	6.6 (5.3, 8.1)	7.8 (5.9, 10.3)	
Female	125	4548	1.7 (1.4, 2.2)	2.8 (2.3, 3.4)	3.4 (2.8, 4.1)	4.2 (3.4, 5.2)	5.9 (4.2, 8.4)	
TOTAL	**249**	**7174**						

Figure ST28 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Gender (Primary Diagnosis OA)

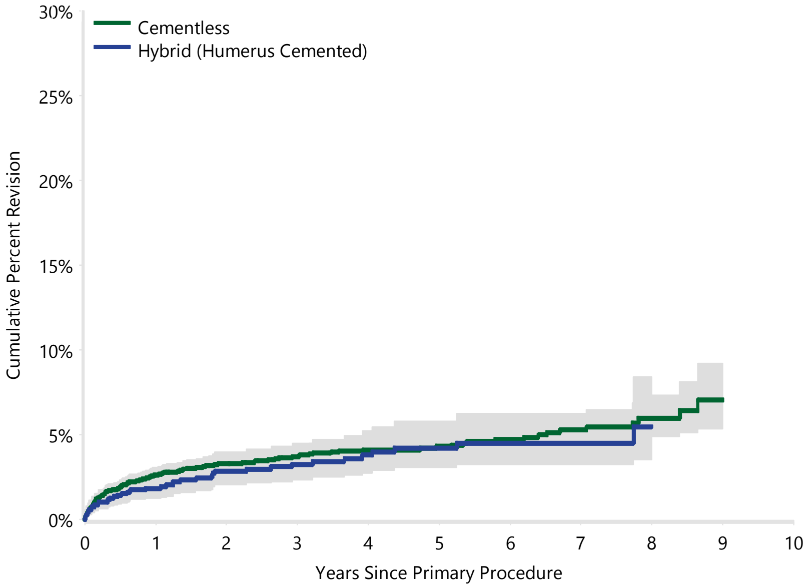


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Male	2626	1942	1063	554	244	50	4
Female	4548	3496	2059	1130	496	83	13

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	9 Yrs	10 Yrs
Cemented	1	72	1.6 (0.2, 10.7)	1.6 (0.2, 10.7)	1.6 (0.2, 10.7)	1.6 (0.2, 10.7)		
Cementless	203	5692	2.6 (2.2, 3.1)	3.7 (3.2, 4.3)	4.3 (3.7, 5.0)	5.3 (4.4, 6.3)	7.0 (5.4, 9.2)	
Hybrid (Glenoid Cemented)	1	45	2.3 (0.3, 15.4)	2.3 (0.3, 15.4)				
Hybrid (Humerus Cemented)	44	1365	1.9 (1.2, 2.8)	3.3 (2.4, 4.5)	4.2 (3.1, 5.8)	4.5 (3.3, 6.2)		
TOTAL	**249**	**7174**						

Figure ST29 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Fixation (Primary Diagnosis OA)



HR - adjusted for age and gender

Cementless vs Hybrid (Humerus Cemented)

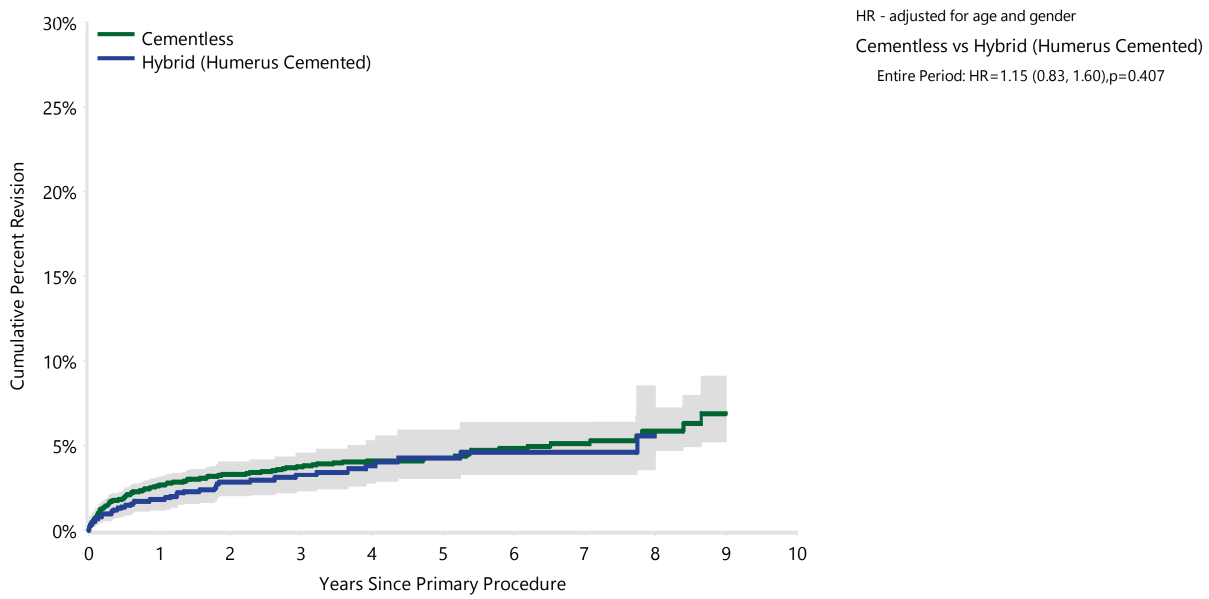
Entire Period: HR=1.15 (0.83, 1.59),p=0.405

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Cementless	5692	4270	2416	1300	565	94	17
Hybrid (Humerus Cemented)	1365	1086	648	345	158	33	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	9 Yrs	10 Yrs
Cemented	1	72	1.6 (0.2, 10.7)	1.6 (0.2, 10.7)	1.6 (0.2, 10.7)	1.6 (0.2, 10.7)		
Cementless	183	5241	2.7 (2.2, 3.2)	3.7 (3.2, 4.4)	4.3 (3.7, 5.0)	5.1 (4.3, 6.1)	6.9 (5.2, 9.1)	
Hybrid (Glenoid Cemented)	1	43	2.4 (0.3, 16.1)	2.4 (0.3, 16.1)				
Hybrid (Humerus Cemented)	43	1337	1.8 (1.2, 2.7)	3.3 (2.4, 4.6)	4.3 (3.1, 5.9)	4.6 (3.3, 6.4)		
TOTAL	**228**	**6693**						

Figure ST30 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Fixation (Primary Diagnosis OA, excluding SMR L2)



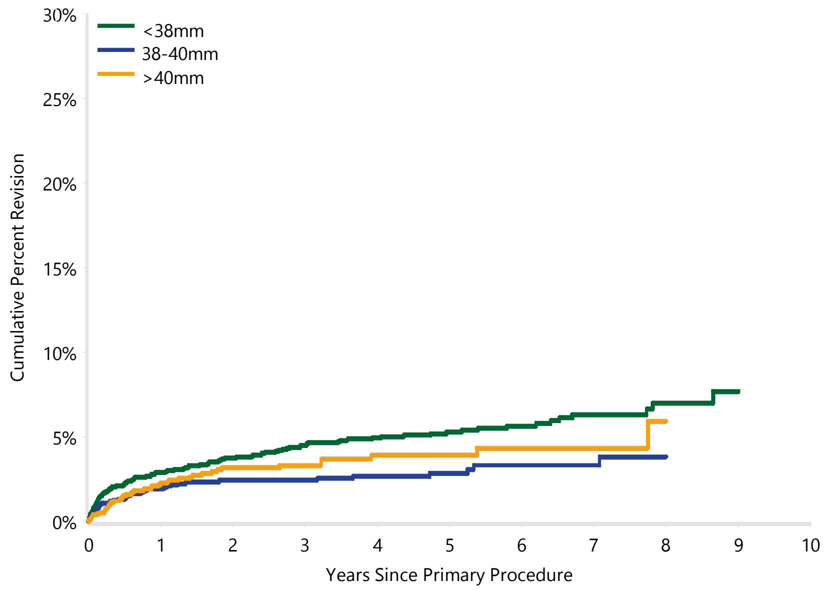
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Cementless	5241	3838	2009	1004	550	94	17
Hybrid (Humerus Cemented)	1337	1060	623	326	158	33	0

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	9 Yrs	10 Yrs
<38mm	142	3160	2.9 (2.4, 3.6)	4.5 (3.8, 5.4)	5.3 (4.4, 6.3)	6.3 (5.2, 7.6)	7.7 (5.9, 10.0)	
38-40mm	60	2478	2.0 (1.5, 2.6)	2.4 (1.9, 3.2)	2.9 (2.1, 3.8)	3.3 (2.4, 4.6)		
>40mm	46	1528	2.3 (1.6, 3.2)	3.3 (2.4, 4.5)	3.9 (2.9, 5.3)	4.4 (3.1, 6.1)		
TOTAL	**248**	**7166**						

Note: Excludes 8 procedures with unknown head size

Figure ST31 **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=1.66 (1.22, 2.24),p=0.001

>40mm vs 38-40mm

0 - 3Mth: HR=0.54 (0.28, 1.02),p=0.058

3Mth+: HR=1.21 (0.77, 1.90),p=0.411

<38mm vs >40mm

0 - 3Mth: HR=3.07 (1.63, 5.78),p<0.001

3Mth+: HR=1.38 (0.91, 2.08),p=0.129

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
<38mm	3160	2522	1589	961	442	92	16
38-40mm	2478	1809	934	467	199	21	0
>40mm	1528	1104	598	255	98	20	1

Figure ST32 **Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement by Glenosphere Size (Primary Diagnosis OA)**

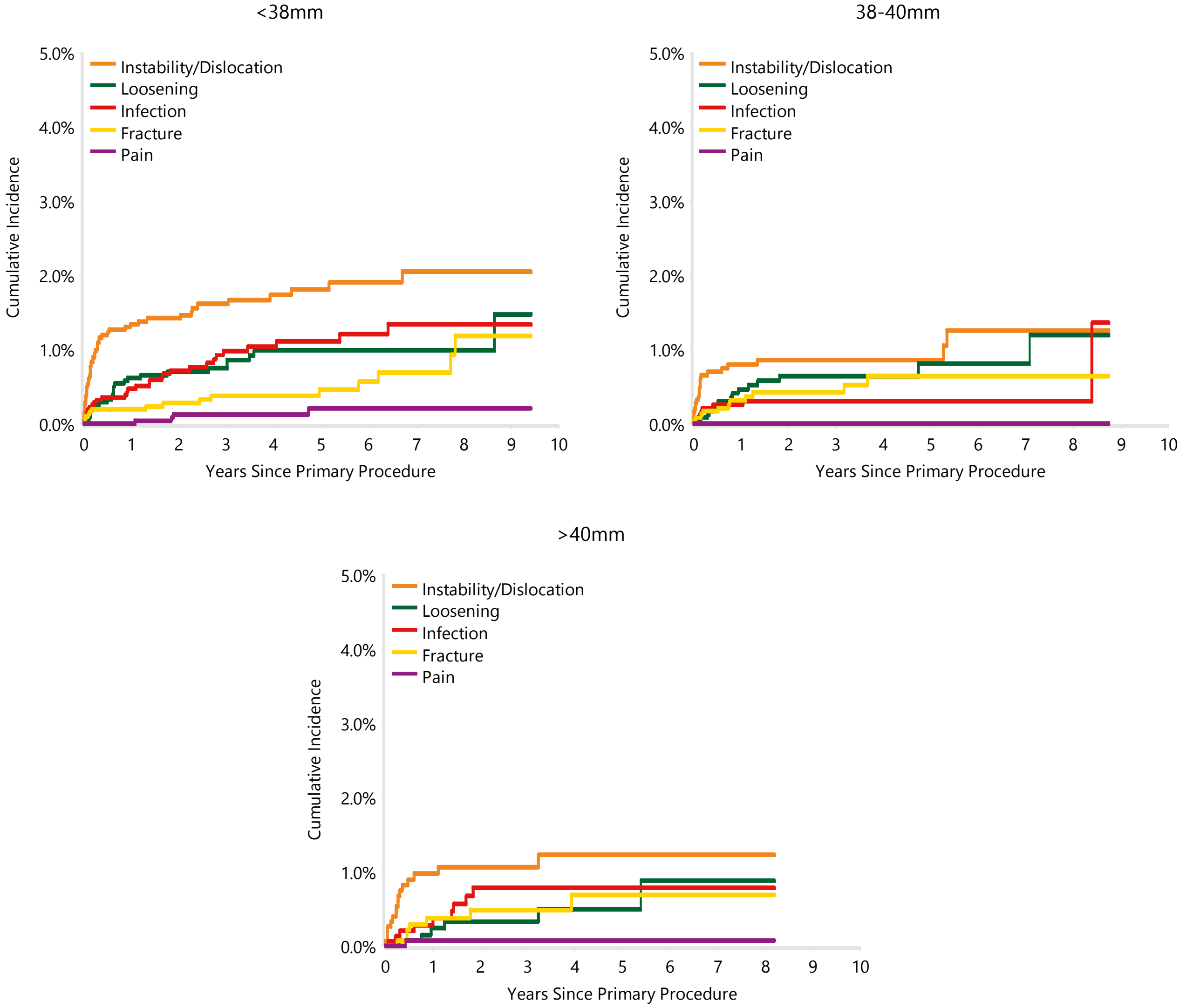


Table ST52 Cumulative Percent Revision of All Primary Total Reverse Shoulder Replacement by Prosthesis Combination (Primary Diagnosis OA)

Humeral Stem	Glenoid Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Aequalis	Aequalis	43	953	2.3 (1.5, 3.5)	4.4 (3.2, 6.2)	5.7 (4.2, 7.8)	6.7 (4.8, 9.3)		
Aequalis Ascend	Aequalis	3	108	2.4 (0.6, 9.5)					
Affinis	Affinis	3	81	2.6 (0.7, 10.1)	5.6 (1.7, 17.9)				
Comprehensive	Comprehensive Reverse	5	220	2.7 (1.1, 6.4)					
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	63	2513	1.9 (1.4, 2.6)	2.4 (1.8, 3.1)	2.8 (2.1, 3.7)	3.3 (2.5, 4.4)		
Equinoxe	Equinoxe	3	179	1.4 (0.3, 5.5)					
Global Unite	Delta Xtend	2	91	0.0 (0.0, 0.0)					
Promos	Promos	2	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	7	221	3.7 (1.8, 7.6)					
SMR	SMR L1	73	1705	3.5 (2.7, 4.5)	4.7 (3.6, 5.9)	5.1 (4.0, 6.7)	5.9 (4.4, 7.8)	7.0 (5.0, 9.6)	
SMR	SMR L2	21	481	2.3 (1.3, 4.1)	3.4 (2.1, 5.5)	4.1 (2.6, 6.4)			
Trabecular Metal	Trabecular Metal	14	444	1.7 (0.8, 3.5)	3.2 (1.8, 5.8)	4.5 (2.5, 8.0)	4.5 (2.5, 8.0)		
Other (18)		3	74	3.0 (0.8, 11.6)	5.7 (1.8, 17.5)				
TOTAL		**249**	**7174**						

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	9 Yrs	10 Yrs
Aequalis	Aequalis	36	730	2.5 (1.5, 3.9)	5.1 (3.6, 7.2)	6.2 (4.4, 8.6)	7.5 (5.2, 10.8)		
Aequalis Ascend	Aequalis	3	93	2.8 (0.7, 11.2)					
Affinis	Affinis	2	50	2.0 (0.3, 13.4)	6.7 (1.5, 26.6)				
Comprehensive	Comprehensive Reverse	5	206	2.9 (1.2, 6.8)					
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	45	1713	2.3 (1.6, 3.1)	2.6 (1.9, 3.5)	2.9 (2.1, 4.1)	3.5 (2.5, 5.1)		
Equinoxe	Equinoxe	2	164	0.6 (0.1, 4.3)					
Global Unite	Delta Xtend	0	83	0.0 (0.0, 0.0)					
Promos	Promos	2	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)		
SMR	SMR L1	68	1654	3.4 (2.6, 4.5)	4.4 (3.4, 5.7)	4.9 (3.7, 6.4)	5.7 (4.2, 7.6)	6.8 (4.8, 9.5)	
SMR	SMR L2	20	451	2.2 (1.2, 4.1)	3.4 (2.1, 5.5)	4.2 (2.6, 6.6)			
Trabecular Metal	Trabecular Metal	11	393	1.9 (0.9, 3.9)	2.7 (1.4, 5.2)	3.4 (1.8, 6.5)			
Other (16)		5	82	5.2 (2.0, 13.3)	7.3 (3.0, 17.2)				
TOTAL		**203**	**5692**						

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	9 Yrs	10 Yrs
Aequalis	Aequalis	7	203	2.0 (0.8, 5.3)	2.7 (1.1, 6.5)	4.6 (2.2, 9.8)			
Affinis	Affinis	1	29	4.2 (0.6, 26.1)					
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	18	759	1.2 (0.6, 2.4)	2.1 (1.2, 3.5)	2.6 (1.6, 4.3)	3.1 (1.8, 5.2)		
RSP	RSP	3	167	2.2 (0.7, 6.8)					
SMR	SMR L1	5	46	6.9 (2.3, 19.9)	12.6 (5.4, 27.8)	12.6 (5.4, 27.8)	12.6 (5.4, 27.8)		
SMR	SMR L2	1	28	3.6 (0.5, 22.8)	3.6 (0.5, 22.8)	3.6 (0.5, 22.8)			
Trabecular Metal	Trabecular Metal	3	44	0.0 (0.0, 0.0)	8.4 (2.2, 29.9)	13.8 (4.6, 37.4)	13.8 (4.6, 37.4)		
Other (10)		3	60	1.9 (0.3, 12.6)					
TOTAL		**44**	**1365**						

Note: Only combinations with over 25 procedures have been listed.

OUTCOME FOR ROTATOR CUFF ARTHROPATHY

Age and Gender

Age is not a risk factor for revision of total reverse shoulder replacement undertaken for rotator cuff arthropathy (Table ST55 and Figure ST33).

Males have a higher rate of revision compared to females (Table ST56 and Figure ST34).

Fixation

Fixation is not a risk factor for revision (Table ST57 and Figure ST35). This is also the case when the SMR L2 total reverse shoulder prosthesis is excluded from the analysis (Table ST58 and Figure ST36).

Glenosphere Size

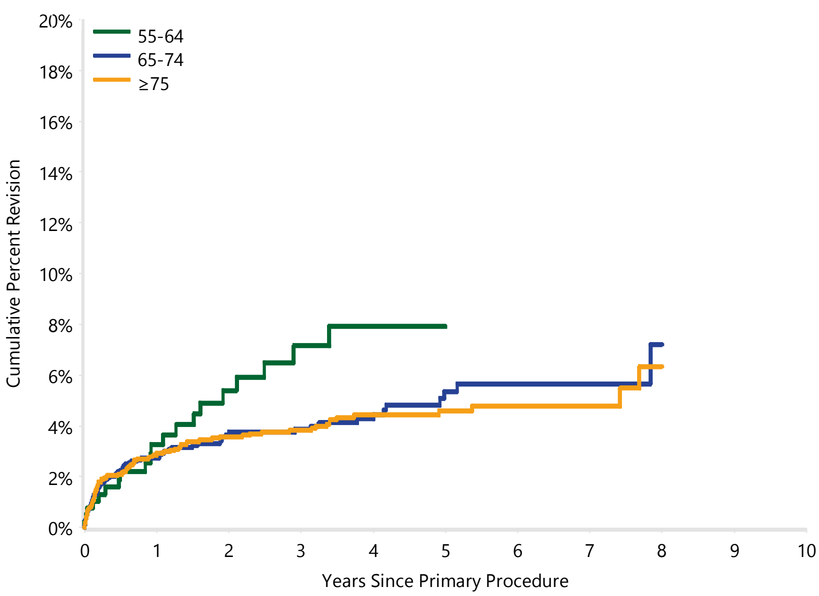
There is no difference in the rate of revision of the different glenosphere sizes for rotator cuff arthropathy (Table ST59 and Figure ST37). Instability/dislocation is the most common reason for early revision for glenosphere sizes 40mm or less (Figure ST38).

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	9 Yrs	10 Yrs
<55	1	37	2.7 (0.4, 17.7)	2.7 (0.4, 17.7)	2.7 (0.4, 17.7)			
55-64	20	392	3.3 (1.8, 5.9)	7.2 (4.5, 11.2)	7.9 (5.0, 12.3)			
65-74	75	1985	2.7 (2.1, 3.6)	3.9 (3.0, 4.9)	5.4 (4.1, 7.0)	5.7 (4.3, 7.4)		
≥75	111	2949	2.9 (2.4, 3.6)	3.8 (3.1, 4.6)	4.6 (3.7, 5.6)	4.8 (3.9, 5.9)		
TOTAL	**207**	**5363**						

Figure ST33 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Age (Primary Diagnosis Rotator Cuff Arthropathy)



HR - adjusted for gender

55-64 vs ≥75

Entire Period: HR=1.32 (0.82, 2.14),p=0.250

65-74 vs ≥75

Entire Period: HR=0.98 (0.73, 1.32),p=0.907

55-64 vs 65-74

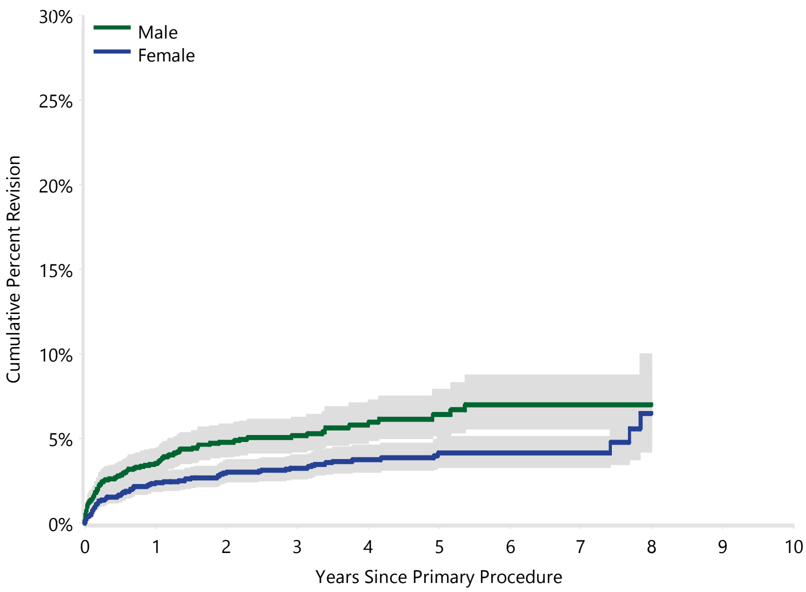
Entire Period: HR=1.35 (0.82, 2.21),p=0.235

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
55-64	392	266	138	64	22	3	1
65-74	1985	1459	807	347	122	24	6
≥75	2949	2300	1298	592	181	30	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	9 Yrs	10 Yrs
Male	107	2225	3.6 (2.8, 4.4)	5.2 (4.2, 6.3)	6.4 (5.2, 7.9)	7.0 (5.6, 8.8)		
Female	100	3138	2.4 (1.9, 3.0)	3.3 (2.6, 4.0)	4.1 (3.3, 5.1)	4.1 (3.3, 5.1)		
TOTAL	**207**	**5363**						

Figure ST34 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Gender (Primary Diagnosis Rotator Cuff Arthropathy)



HR - adjusted for age

Male vs Female

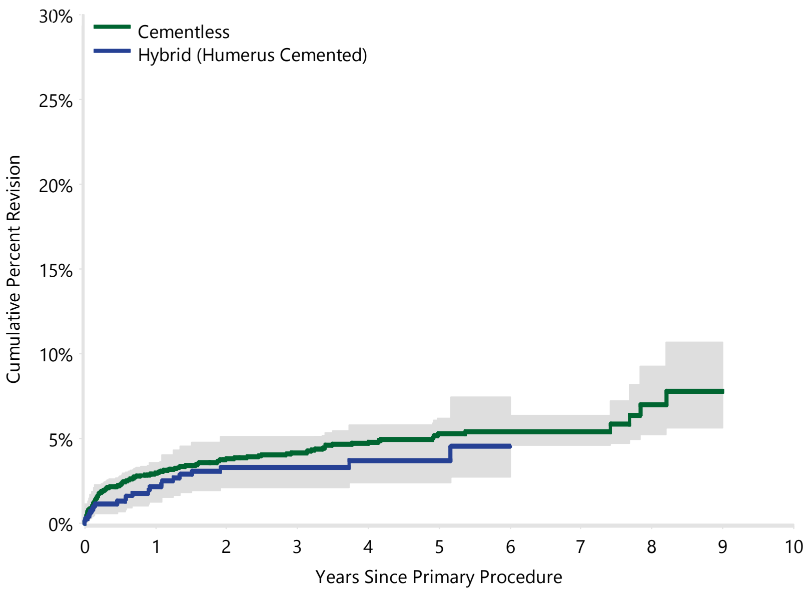
Entire Period: HR=1.57 (1.19, 2.07),p=0.001

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Male	2225	1632	851	355	116	26	6
Female	3138	2419	1404	653	211	32	9

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	9 Yrs	10 Yrs
Cemented	0	13	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)			
Cementless	184	4608	3.0 (2.5, 3.5)	4.2 (3.6, 4.9)	5.3 (4.5, 6.2)	5.4 (4.6, 6.4)	7.8 (5.6, 10.7)	
Hybrid (Glenoid Cemented)	1	36	3.0 (0.4, 19.6)	3.0 (0.4, 19.6)				
Hybrid (Humerus Cemented)	22	706	2.1 (1.3, 3.6)	3.3 (2.1, 5.1)	3.7 (2.4, 5.8)			
TOTAL	**207**	**5363**						

Figure ST35 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Fixation (Primary Diagnosis Rotator Cuff Arthropathy)



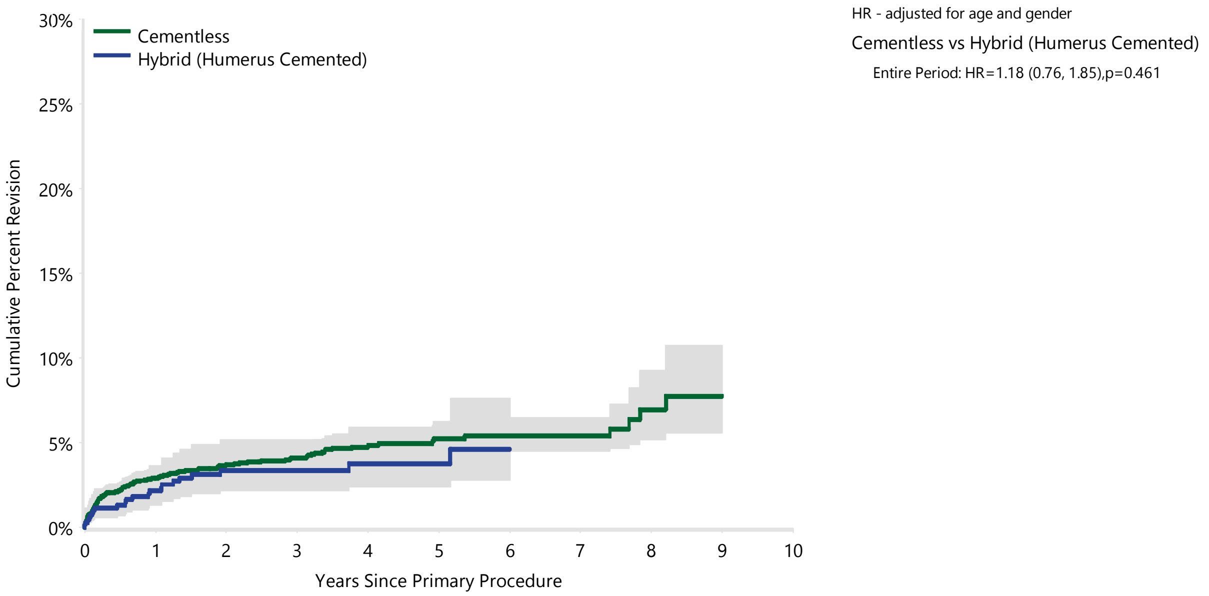
HR - adjusted for age and gender
Cementless vs Hybrid (Humerus Cemented)
Entire Period: HR=1.23 (0.79, 1.92),p=0.353

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Cementless	4608	3470	1920	876	290	55	14
Hybrid (Humerus Cemented)	706	550	317	126	35	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	9 Yrs	10 Yrs
Cemented	0	13	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)			
Cementless	163	4235	2.9 (2.4, 3.5)	4.1 (3.5, 4.9)	5.2 (4.4, 6.2)	5.4 (4.5, 6.5)	7.8 (5.6, 10.7)	
Hybrid (Glenoid Cemented)	1	36	3.0 (0.4, 19.6)	3.0 (0.4, 19.6)				
Hybrid (Humerus Cemented)	22	698	2.2 (1.3, 3.7)	3.4 (2.2, 5.2)	3.8 (2.4, 5.9)			
TOTAL	**186**	**4982**						

Figure ST36 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Fixation (Primary Diagnosis Rotator Cuff Arthropathy, excluding SMR L2)



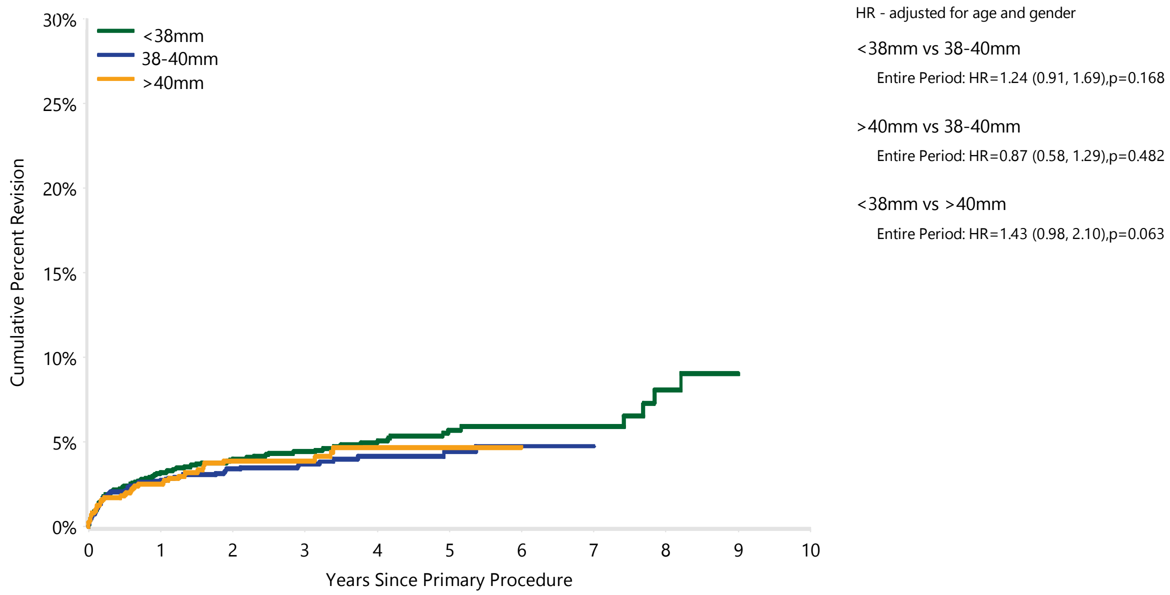
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Cementless	4235	3117	1590	656	285	55	14
Hybrid (Humerus Cemented)	698	542	310	121	35	3	1

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	9 Yrs	10 Yrs
<38mm	95	2082	3.2 (2.5, 4.1)	4.4 (3.6, 5.5)	5.7 (4.6, 7.1)	5.9 (4.7, 7.4)	9.0 (6.2, 13.0)	
38-40mm	70	2072	2.7 (2.1, 3.6)	3.7 (2.9, 4.8)	4.4 (3.4, 5.7)	4.8 (3.6, 6.3)		
>40mm	42	1204	2.5 (1.7, 3.6)	3.9 (2.8, 5.3)	4.7 (3.4, 6.4)			
TOTAL	**207**	**5358**						

Note: Excludes five procedures with unknown glenosphere size

Figure ST37 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Glenosphere Size (Primary Diagnosis Rotator Cuff Arthropathy)



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
<38mm	2082	1637	1288	1011	745	525	324	198	103	47	15
38-40mm	2072	1544	1106	806	554	346	189	95	31	9	0
>40mm	1204	866	628	434	247	133	58	31	9	1	0

Figure ST38 Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement by Glenosphere Size (Primary Diagnosis Rotator Cuff Arthropathy)

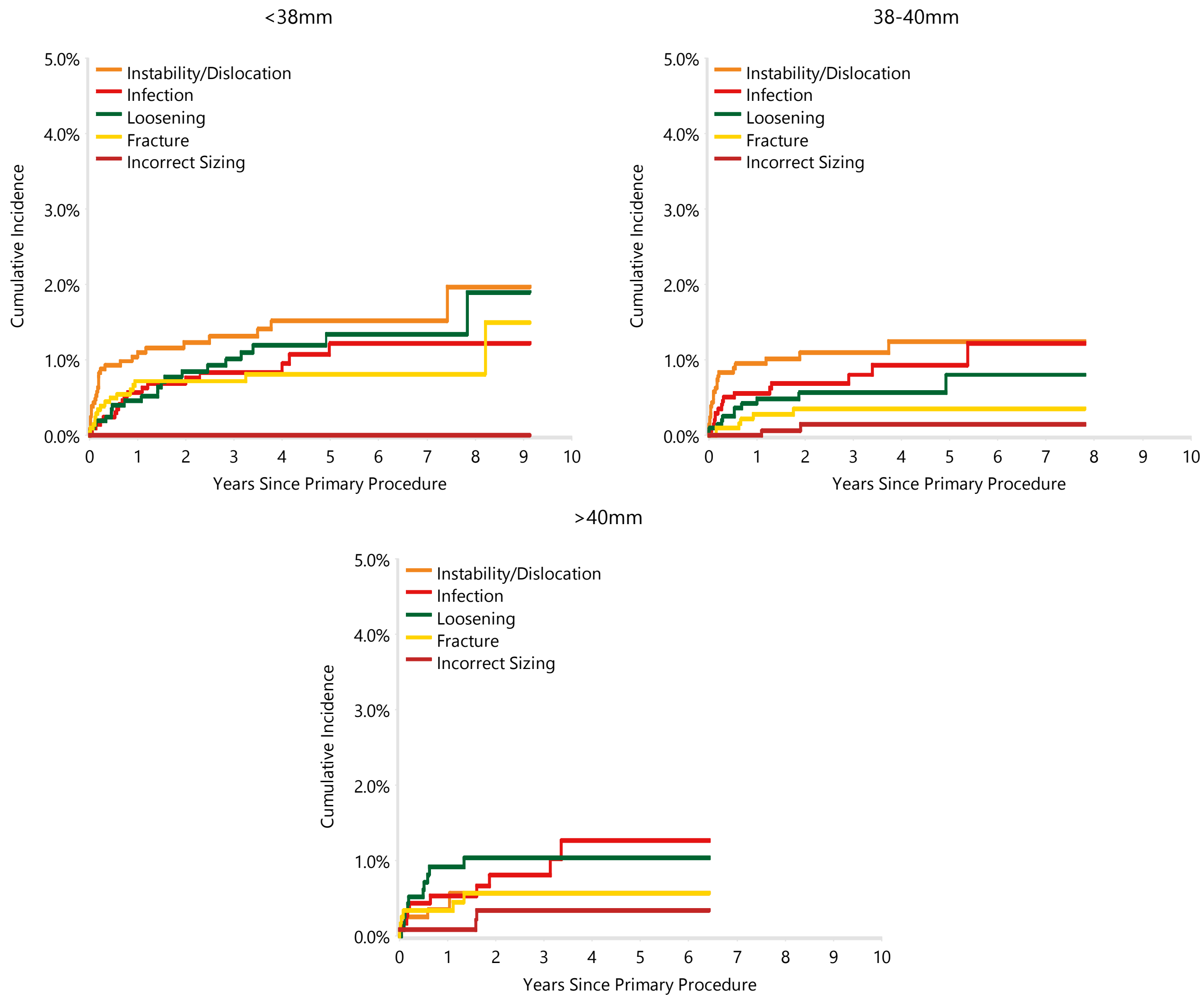


Table ST60 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Prosthesis Combination (Primary Diagnosis Rotator Cuff Arthropathy)

Humeral Stem	Glenoid Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Aequalis	Aequalis	26	660	1.8 (1.0, 3.3)	3.7 (2.4, 5.7)	4.6 (3.1, 7.0)	5.2 (3.4, 8.0)		
Aequalis Ascend	Aequalis	2	97	2.4 (0.6, 9.4)					
Affinis	Affinis	2	42	7.3 (1.7, 28.0)					
Anatomical Shoulder	Trabecular Metal	3	26	7.7 (2.0, 27.4)					
Comprehensive	Comprehensive Reverse	2	100	2.1 (0.5, 8.1)	2.1 (0.5, 8.1)				
Delta Xtend	Delta Xtend	65	2021	2.2 (1.7, 3.0)	3.4 (2.6, 4.4)	4.2 (3.2, 5.5)	4.5 (3.4, 5.9)		
Equinoxe	Equinoxe	2	91	1.1 (0.2, 7.6)					
Global Unite	Delta Xtend	2	81	2.6 (0.7, 10.2)					
RSP	RSP	3	172	2.5 (0.8, 7.7)					
SMR	SMR L1	58	1206	4.1 (3.1, 5.4)	5.1 (3.9, 6.7)	7.4 (5.2, 10.3)	7.4 (5.2, 10.3)		
SMR	SMR L2	21	381	3.7 (2.2, 6.2)	4.8 (3.0, 7.5)	5.8 (3.8, 8.8)			
Trabecular Metal	Trabecular Metal	19	426	3.9 (2.4, 6.4)	4.6 (2.9, 7.3)	5.2 (3.3, 8.2)			
Other (12)		2	60	1.7 (0.2, 11.2)	1.7 (0.2, 11.2)	1.7 (0.2, 11.2)	1.7 (0.2, 11.2)	8.7 (1.8, 37.4)	
TOTAL		**207**	**5363**						

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	9 Yrs	10 Yrs
Aequalis	Aequalis	19	522	1.7 (0.8, 3.3)	3.4 (2.0, 5.6)	4.6 (2.8, 7.4)	4.6 (2.8, 7.4)		
Aequalis Ascend	Aequalis	2	90	2.6 (0.6, 10.0)					
Affinis	Affinis	2	35	8.6 (2.0, 32.3)					
Comprehensive	Comprehensive Reverse	2	99	2.1 (0.5, 8.1)	2.1 (0.5, 8.1)				
Delta Xtend	Delta Xtend	58	1684	2.4 (1.7, 3.3)	3.8 (2.9, 5.0)	4.6 (3.4, 6.1)	4.9 (3.7, 6.7)		
Equinoxe	Equinoxe	2	91	1.1 (0.2, 7.6)					
Global Unite	Delta Xtend	2	71	3.0 (0.8, 11.6)					
SMR	SMR L1	53	1166	3.8 (2.8, 5.1)	4.8 (3.6, 6.3)	7.1 (4.9, 10.1)	7.1 (4.9, 10.1)		
SMR	SMR L2	21	373	3.8 (2.2, 6.3)	4.9 (3.1, 7.6)	5.9 (3.9, 8.9)			
Trabecular Metal	Trabecular Metal	18	394	4.0 (2.4, 6.6)	4.7 (2.9, 7.5)	5.4 (3.3, 8.5)			
Other (14)		5	83	5.1 (1.9, 13.0)	5.1 (1.9, 13.0)	5.1 (1.9, 13.0)	5.1 (1.9, 13.0)		
TOTAL		**184**	**4608**						

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	9 Yrs	10 Yrs
Aequalis	Aequalis	7	134	2.5 (0.8, 7.5)	5.3 (2.4, 11.5)				
Delta Xtend	Delta Xtend	7	327	1.5 (0.6, 3.7)	1.9 (0.9, 4.2)	2.6 (1.2, 5.8)			
RSP	RSP	2	150	1.9 (0.4, 7.5)					
SMR	SMR L1	4	29	11.6 (3.9, 32.0)	16.8 (6.6, 39.4)	16.8 (6.6, 39.4)	16.8 (6.6, 39.4)		
Trabecular Metal	Trabecular Metal	1	28	3.6 (0.5, 22.8)	3.6 (0.5, 22.8)	3.6 (0.5, 22.8)			
Other (8)		1	38	0.0 (0.0, 0.0)	3.4 (0.5, 22.1)	3.4 (0.5, 22.1)			
TOTAL		**22**	**706**						

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 64 years have a higher rate of revision compared to those aged 75 years or older (Table ST63 and Figure ST39).

Males have a higher rate of revision than females over the entire period (Table ST64 and Figure ST40).

Fixation

Cementless fixation has a higher rate of revision for fracture than hybrid (humerus cemented) fixation (Table ST65 and Figure ST41). A similar result was observed when the SMR L2 prosthesis was excluded (Table ST66 and Figure ST42).

Glenosphere Size

Glenosphere sizes larger than 40mm have a higher rate of revision. This is in contrast to osteoarthritis (Table ST67 and Figure ST43).

Glenosphere sizes larger than 40mm have a higher rate of revision.

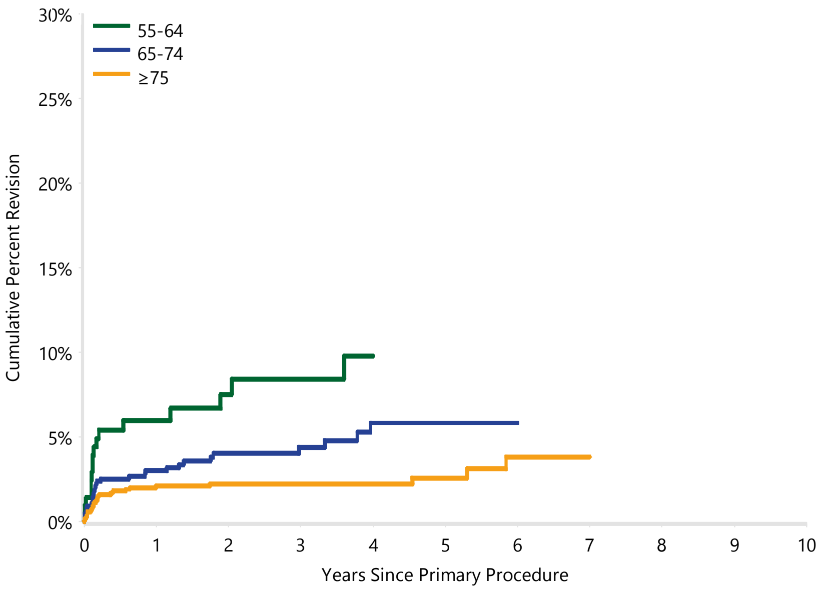
The reasons for revision and cumulative incidence revision diagnoses are shown in Table ST68 and Figure ST44. The larger glenospheres have a higher cumulative incidence of revision for instability/dislocation.

The outcomes of the most commonly used prosthesis combinations are listed in Table ST69. The cementless prosthesis combinations used in total reverse shoulder replacement for fracture are listed in Table ST70. The hybrid (humerus cemented) prosthesis combinations used in total reverse shoulder replacement for fracture are listed in Table ST71.

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	9 Yrs	10 Yrs
<55	2	21	9.8 (2.5, 33.8)	9.8 (2.5, 33.8)				
55-64	16	207	6.0 (3.4, 10.3)	8.4 (5.1, 13.8)				
65-74	31	775	3.0 (2.0, 4.5)	4.4 (3.0, 6.4)	5.8 (3.9, 8.6)			
≥75	31	1362	2.1 (1.4, 3.1)	2.2 (1.5, 3.2)	2.6 (1.7, 3.9)	3.8 (2.3, 6.5)		
TOTAL	**80**	**2365**						

Figure ST39 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=2.91 (1.59, 5.35),p<0.001

65-74 vs ≥75

Entire Period: HR=1.64 (0.99, 2.70),p=0.052

55-64 vs 65-74

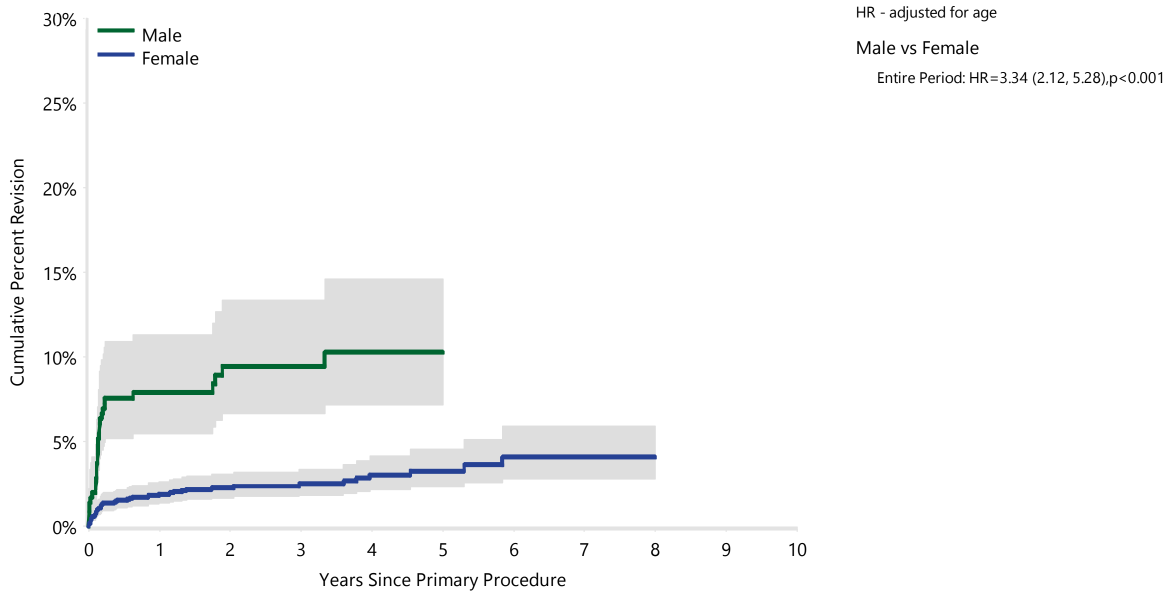
Entire Period: HR=1.78 (0.97, 3.25),p=0.062

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
55-64	207	141	80	38	18	2	0
65-74	775	561	266	104	37	8	1
≥75	1362	1003	524	217	65	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	9 Yrs	10 Yrs
Male	31	355	7.9 (5.5, 11.3)	9.5 (6.6, 13.4)	10.3 (7.2, 14.6)			
Female	49	2010	1.9 (1.4, 2.6)	2.5 (1.8, 3.4)	3.3 (2.4, 4.5)	4.1 (2.8, 5.9)		
TOTAL	**80**	**2365**						

Figure ST40 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Gender (Primary Diagnosis Fracture)

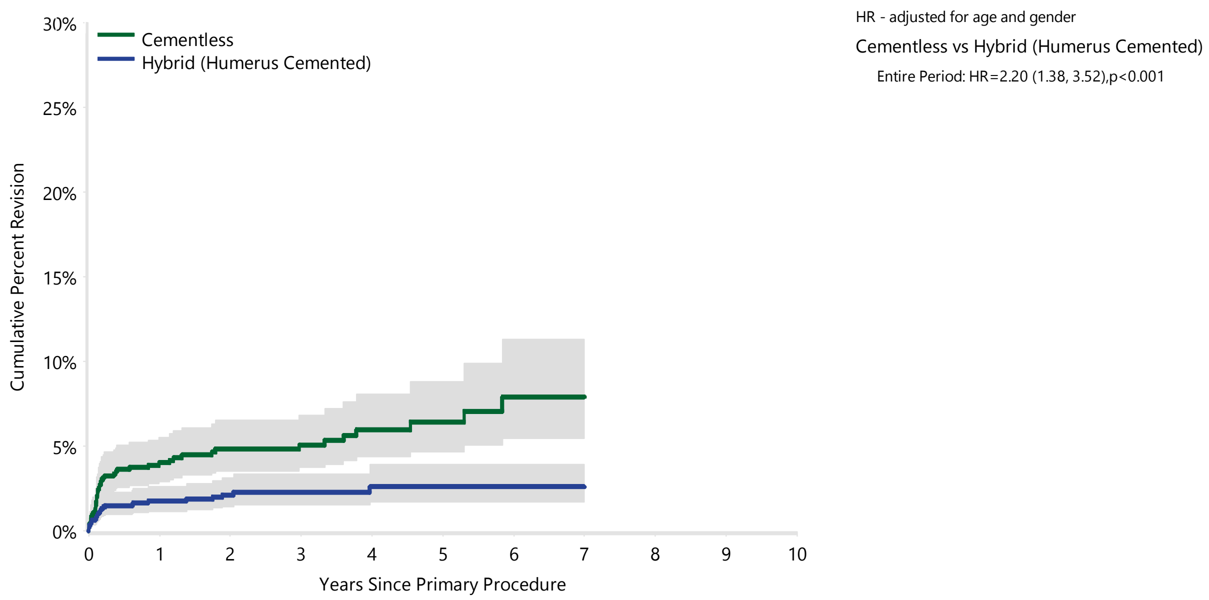


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Male	355	240	119	41	16	3	0
Female	2010	1481	758	321	106	17	2

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	9 Yrs	10 Yrs
Cemented	3	35	9.4 (3.1, 26.3)	9.4 (3.1, 26.3)	9.4 (3.1, 26.3)			
Cementless	48	940	4.0 (2.9, 5.5)	5.1 (3.7, 6.9)	6.4 (4.7, 8.8)	7.9 (5.5, 11.3)		
Hybrid (Glenoid Cemented)	1	20	5.6 (0.8, 33.4)	5.6 (0.8, 33.4)				
Hybrid (Humerus Cemented)	28	1370	1.8 (1.2, 2.7)	2.3 (1.6, 3.3)	2.6 (1.7, 3.9)	2.6 (1.7, 3.9)		
TOTAL	**80**	**2365**						

Figure ST41 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Fixation (Primary Diagnosis Fracture)

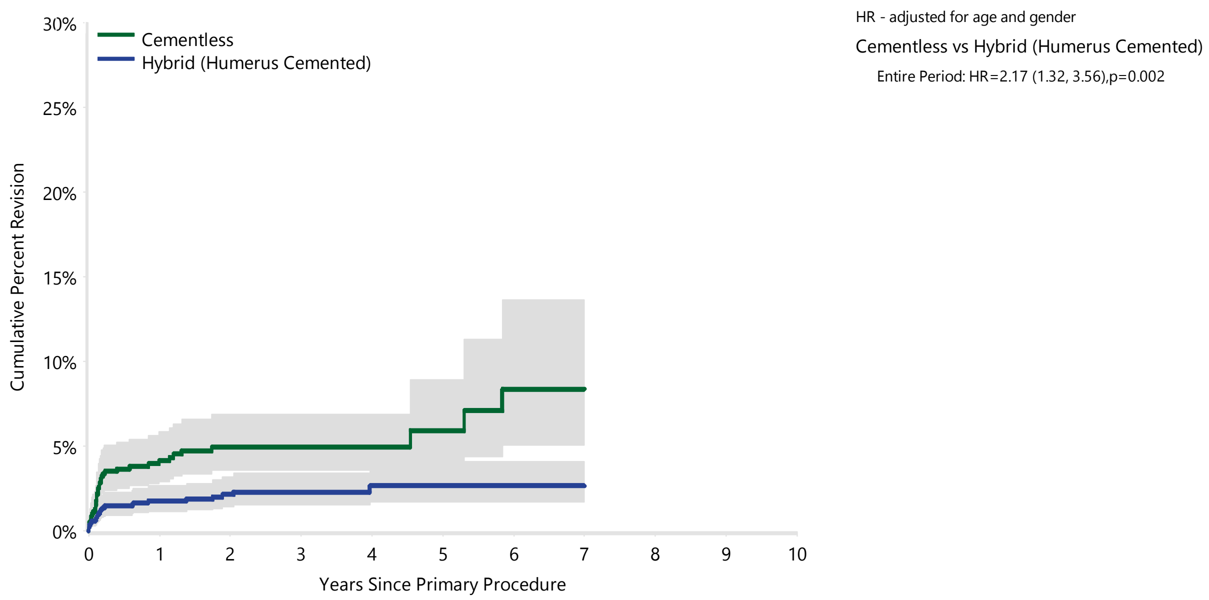


Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Cementless	940	677	385	172	61	12	1
Hybrid (Humerus Cemented)	1370	1008	472	181	55	7	1

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	9 Yrs	10 Yrs
Cemented	3	33	10.0 (3.3, 27.9)	10.0 (3.3, 27.9)	10.0 (3.3, 27.9)			
Cementless	38	792	4.2 (2.9, 5.9)	5.0 (3.6, 6.9)	5.9 (3.9, 9.0)	8.4 (5.1, 13.7)		
Hybrid (Glenoid Cemented)	1	20	5.6 (0.8, 33.4)	5.6 (0.8, 33.4)				
Hybrid (Humerus Cemented)	27	1322	1.8 (1.2, 2.7)	2.3 (1.6, 3.4)	2.7 (1.7, 4.1)	2.7 (1.7, 4.1)		
TOTAL	**69**	**2167**						

Figure ST42 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Fixation (Primary Diagnosis Fracture, excluding SMR L2)



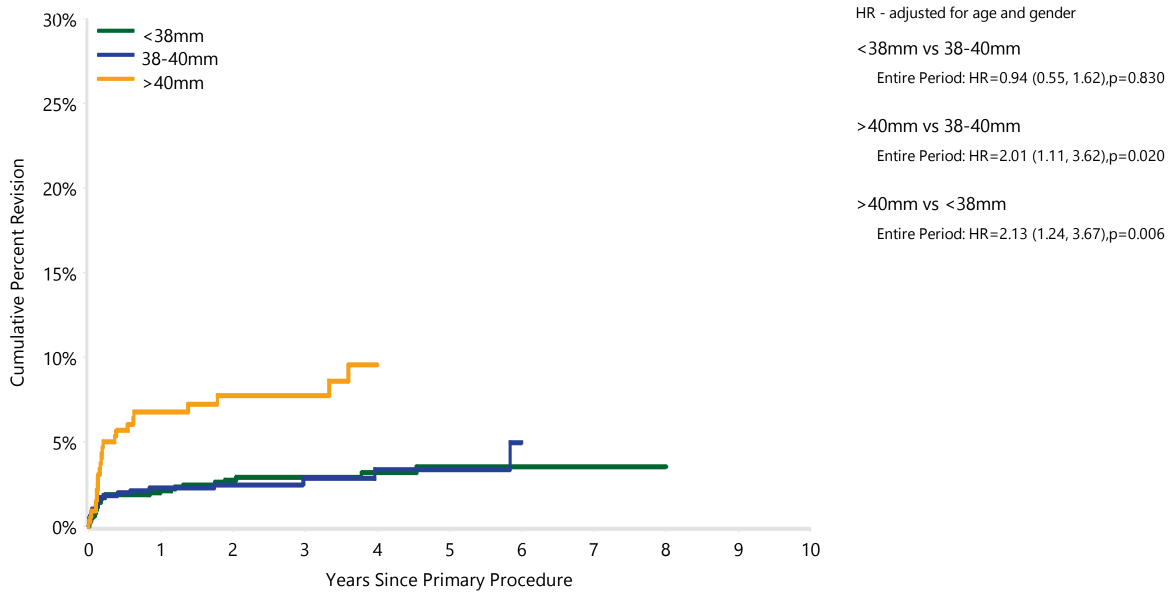
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Cementless	792	536	257	87	60	12	1
Hybrid (Humerus Cemented)	1322	966	433	158	54	7	1

Table ST67 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Glenosphere Size (Primary Diagnosis Fracture)

Glenosphere Size	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
<38mm	31	1142	2.1 (1.4, 3.1)	2.9 (2.0, 4.2)	3.5 (2.4, 5.2)	3.5 (2.4, 5.2)		
38-40mm	23	886	2.3 (1.5, 3.5)	2.8 (1.8, 4.5)	3.4 (2.1, 5.6)			
>40mm	26	331	6.8 (4.5, 10.2)	7.7 (5.2, 11.5)				
TOTAL	**80**	**2359**						

Note: Excludes six procedures with unknown glenosphere size

Figure ST43 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Glenosphere Size (Primary Diagnosis Fracture)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
<38mm	1142	861	484	226	83	14	2
38-40mm	886	628	271	101	33	3	0
>40mm	331	226	119	34	6	3	0

Table ST68 Revision Diagnosis of Primary Total Reverse Shoulder Replacement by Glenosphere Size (Primary Diagnosis Fracture)

Revision Diagnosis	<38mm			38-40mm			>40mm		
	Number	% Primaries Revised	% Revisions	Number	% Primaries Revised	% Revisions	Number	% Primaries Revised	% Revisions
Instability/Dislocation	14	1.2	45.2	12	1.4	52.2	13	3.9	50.0
Infection	9	0.8	29.0	2	0.2	8.7	2	0.6	7.7
Fracture	3	0.3	9.7	6	0.7	26.1	6	1.8	23.1
Loosening	3	0.3	9.7	1	0.1	4.3	3	0.9	11.5
Arthrofibrosis	1	0.1	3.2						
Implant Breakage Glenoid							1	0.3	3.8
Malposition				1	0.1	4.3			
Pain	1	0.1	3.2				1	0.3	3.8
Other				1	0.1	4.3			
N Revision	**31**	**2.7**	**100.0**	**23**	**2.6**	**100.0**	**26**	**7.9**	**100.0**
N Primary	**1142**			**886**			**331**		

Note: Excludes six procedures with unknown glenosphere size

Figure ST44 Cumulative Incidence Revision Diagnosis of Primary Total Reverse Shoulder Replacement by Glenosphere Size (Primary Diagnosis Fracture)

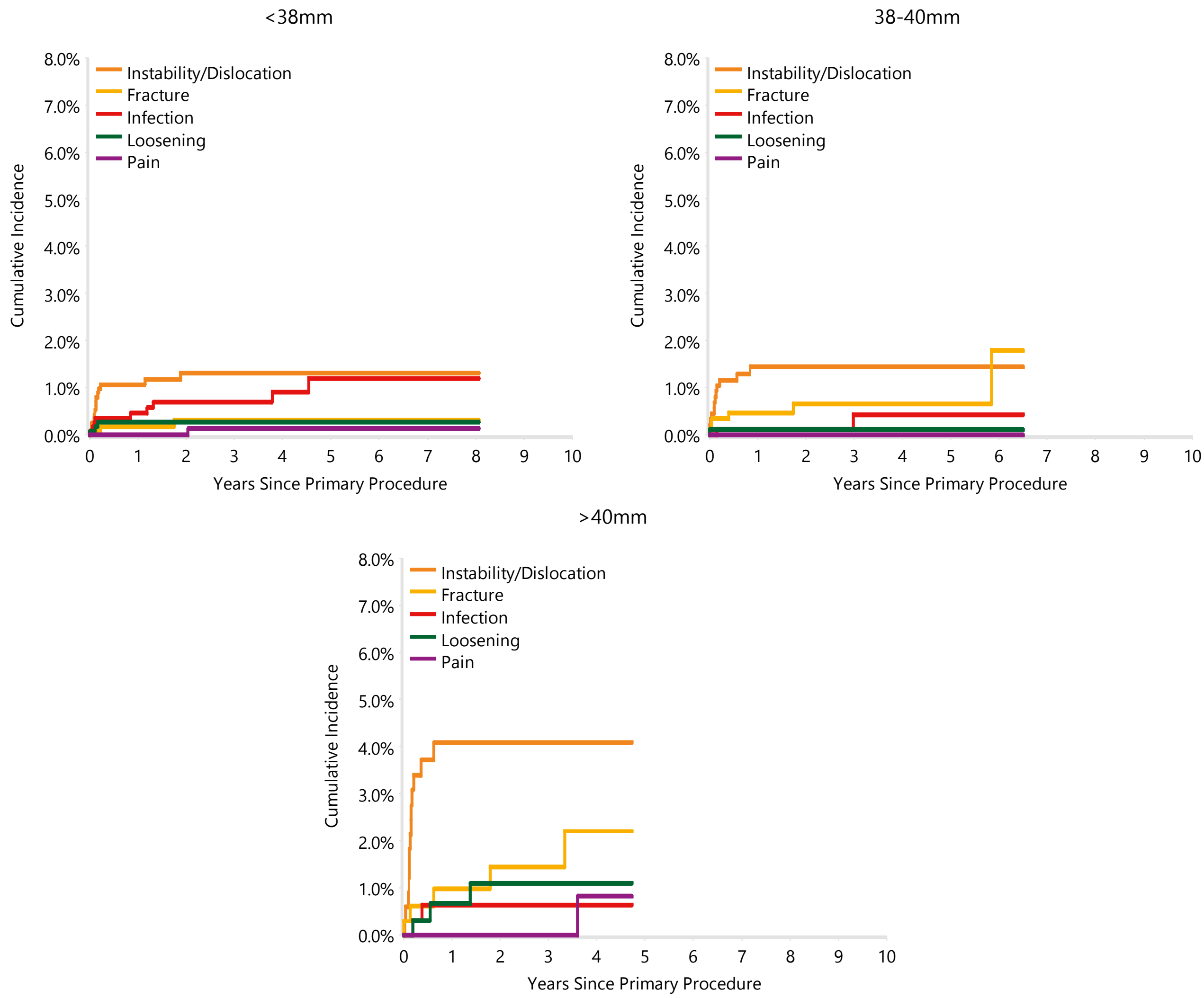


Table ST69 Cumulative Percent Revision of Primary Total Reverse Shoulder Replacement by Prosthesis Combination (Primary Diagnosis Fracture)

Humeral Stem	Glenoid Component	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	9 Yrs	10 Yrs
Aequalis	Aequalis	9	370	2.0 (1.0, 4.2)	2.5 (1.2, 5.0)	4.2 (1.7, 10.4)			
Comprehensive	Comprehensive Reverse	0	85	0.0 (0.0, 0.0)					
Delta Xtend	Delta Xtend	22	701	2.7 (1.7, 4.2)	3.1 (2.0, 4.8)	3.7 (2.3, 5.8)			
RSP	RSP	4	67	3.1 (0.8, 11.7)					
SMR	SMR L1	32	648	4.6 (3.2, 6.6)	5.3 (3.7, 7.5)	5.3 (3.7, 7.5)	6.7 (4.1, 10.8)		
SMR	SMR L2	11	198	3.0 (1.4, 6.7)	4.2 (2.1, 8.2)	5.9 (3.3, 10.5)			
Trabecular Metal	Trabecular Metal	0	153	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)				
Other (13)		2	143	1.4 (0.4, 5.6)					
TOTAL		**80**	**2365**						

Note: Only combinations with over 50 procedures have been listed

Table ST70 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	9 Yrs	10 Yrs
Delta Xtend	Delta Xtend	3	115	0.9 (0.1, 6.0)	2.3 (0.6, 9.5)				
SMR	SMR L1	31	544	5.3 (3.7, 7.6)	6.1 (4.3, 8.7)	6.1 (4.3, 8.7)	8.0 (4.7, 13.3)		
SMR	SMR L2	10	148	3.4 (1.4, 8.0)	4.9 (2.3, 9.9)	7.2 (3.9, 12.9)			
Other (13)		4	133	2.3 (0.8, 7.0)	2.3 (0.8, 7.0)				
TOTAL		**48**	**940**						

Note: Only combinations with over 50 procedures have been listed

Table ST71 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	9 Yrs	10 Yrs
Aequalis	Aequalis	7	339	1.9 (0.8, 4.1)	2.4 (1.1, 5.1)				
Comprehensive	Comprehensive Reverse	0	68	0.0 (0.0, 0.0)					
Delta Xtend	Delta Xtend	17	568	2.8 (1.7, 4.5)	3.0 (1.9, 4.9)	3.7 (2.2, 6.3)			
RSP	RSP	3	57	1.8 (0.3, 12.2)					
SMR	SMR L1	0	97	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)		
Trabecular Metal	Trabecular Metal	0	104	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)				
Other (12)		1	137	0.7 (0.1, 5.1)	0.7 (0.1, 5.1)				
TOTAL		**28**	**1370**						

Note: Only combinations with over 50 procedures have been listed.

Prostheses with Higher Than Anticipated Rates of Revision

Prostheses with Higher Than Anticipated Rates of Revision

INTRODUCTION

A unique and important function of registries is that they are able to provide population based data on the comparative outcome of individual prostheses in a community. Outcome data are necessary to enable an evidence-based approach to prosthesis selection. For many prostheses, the only source of outcome data are Registry reports.

It is evident from Registry data that most prostheses have similar outcomes. However, a number have a rate of revision that is statistically higher than other prostheses in the same class. The Registry identifies these as 'prostheses with a higher than anticipated rate of revision'.

The Registry has developed a standardised three-stage approach to identify prostheses that are outliers with respect to rate of revision. The comparator group includes all other prostheses within the same class regardless of their rate of revision. This is a more pragmatic approach than comparing to a select group of prostheses with the lowest rate of revision.

Stage 1

The first stage is a screening test to identify prostheses that differ significantly from the combined revisions per 100 observed component years of all other prostheses in the same class. It is an automated analysis that identifies prostheses based on set criteria. These include:

1. the revision rate (per 100 component years) exceeds twice that for the group, and
2. the Poisson probability of observing that number of revisions, given the rate of the group is significant ($p<0.05$), and

either:

3. there are at least 10 primary procedures for that component,

or

4. the proportion revised is at least 75% and there have been at least two revisions.

The Registry has the capacity to assess the outcome of individual prostheses or combinations of prostheses used in a procedure. It is apparent from previous reports that individual prostheses that perform well in one combination may not perform well in another. Therefore, the outcome of an individual prosthesis is partly dependent on the combination of the different prostheses used.

Consequently, the Registry undertakes two different analyses in Stage 1. The first assesses the outcome of all combinations. The second assesses all individual prostheses regardless of the combination. Both analyses are reviewed to determine if a higher revision rate is identified with a single combination, multiple combinations, or uniformly with all combinations. If prostheses are identified in a single combination, that combination progresses to Stage 2. An individual prosthesis progresses to Stage 2 if it is identified in multiple combinations or uniformly across all combinations.

If a prosthesis is identified in more than two combinations with 10 or more procedures in Stage 1, an additional analysis of the individual prosthesis is undertaken for review at Stage 2, regardless of whether the individual prosthesis was identified in Stage 1. The purpose of this is to simplify the reporting of an individual prosthesis and to avoid identifying the same prosthesis in multiple combinations when it may be more appropriate to identify it individually.

A prosthesis or combination may also be brought to the attention of the Registry by the Therapeutic Goods Administration (TGA) or a member of the AOA. A further investigation may then be undertaken as outlined in Stage 2.

Stage 2

In Stage 2, the AOANJRR Director and Deputy Directors in conjunction with SAHMRI staff, review the identified prostheses and undertake further investigation. This includes examining the impact of confounders and calculating age and gender adjusted hazard ratios. In addition, all prostheses identified in previous reports are re-analysed as part of the Stage 2 analysis. This is not dependent on re-identification in Stage 1. If there is a significant difference compared to the combined hazard rate of all other prostheses in the same class, then the prosthesis or prosthesis combination progresses to Stage 3. The possible exception to this is the presence of confounding factors, such as use in complex primary procedures.

Stage 3
The final stage involves review by a panel of independent orthopaedic surgeons from the Australian Orthopaedic Association 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 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, 19 independent arthroplasty specialists together with the Chairperson of the AOANJRR Committee, AOANJRR Director, three Deputy Directors, two assistant Deputy Directors and SAHMRI Registry staff attended the two day Hip and Knee Surgeon Review Workshop.

The Shoulder Chapter was reviewed at a weekend workshop under the leadership of Professor Richard Page, together with the AOANJRR Director, one Deputy Director 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://aoanjrr.sahmri.com/annual-reports-2017.

PRIMARY PARTIAL HIP REPLACEMENT

UNIPOLAR MODULAR

There are no newly identified unipolar modular prostheses.

Table IP1 Revision Rate of Individual Unipolar Modular Hip Prostheses Identified as having a Higher than Anticipated Rate of Revision

Head/Femoral	N Revised	N Total	Obs. Years	Revisions/100 Obs. Yrs	Hazard Ratio, P Value
Re-Identified and Still Used	.	.	.	.	
Unipolar Head (JRI)/Furlong LOL	10	131	358	2.79	Entire Period: HR=2.29 (1.23, 4.26),p=0.009

Note: All components have been compared to all other unipolar modular hip components

Table IP2 Cumulative Percent Revision of Individual Unipolar Modular Hip Prostheses Identified as having a Higher than Anticipated Rate of Revision

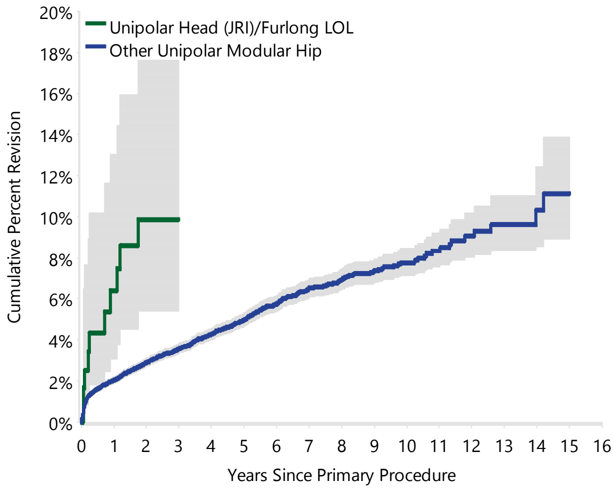
CPR	1 Yr	3 Yrs	5 Yrs	10 Yrs	16 Yrs
Re-Identified and Still Used					
Unipolar Head (JRI)/Furlong LOL	6.4 (3.1, 13.0)	9.9 (5.4, 17.7)			

Table IP3 Yearly Usage of Individual 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
Re-Identified and Still Used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Unipolar Head (JRI)/Furlong LOL	.	.	.	.	.	12	18	10	13	10	8	7	34	16	3

Figure IP1 Cumulative Percent Revision of Re-identified and still used Individual Unipolar Modular Hip Prostheses

Re-identified and still used



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	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	57	111	5.39	Entire Period: HR=4.28 (1.91, 9.57),p<0.001
Identified and no longer used	.	.	.	.	
Tandem/Basis	13	114	438	2.97	Entire Period: HR=2.53 (1.46, 4.40),p<0.001
UHR/ABGII	20	177	897	2.23	Entire Period: HR=2.63 (1.68, 4.10),p<0.001
UHR/Omnifit (cless)	7	40	232	3.02	0 - 3Mth: HR=4.51 (1.44, 14.09),p=0.009
	.	.	.	.	3Mth - 6Mth: HR=8.98 (1.24, 65.01),p=0.029
	.	.	.	.	6Mth+: HR=2.21 (0.71, 6.88),p=0.172
**Synergy	9	54	358	2.51	Entire Period: HR=2.74 (1.42, 5.30),p=0.002

Note: All components have been compared to all other bipolar hip components
** Femoral 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	16 Yrs
Re-Identified and Still Used					
Bipolar Head (Medacta)/Quadra-H	8.9 (3.4, 22.2)	12.7 (5.3, 28.8)			
Identified and no longer used					
Tandem/Basis	2.0 (0.5, 7.7)	12.5 (7.1, 21.5)			
UHR/ABGII	4.4 (2.1, 8.9)	5.1 (2.6, 10.1)	10.9 (6.5, 18.0)		
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)	
**Synergy	7.5 (2.9, 18.7)	9.7 (4.1, 21.8)	12.3 (5.7, 25.7)	18.4 (9.4, 34.1)	

Note: ** Femoral Component

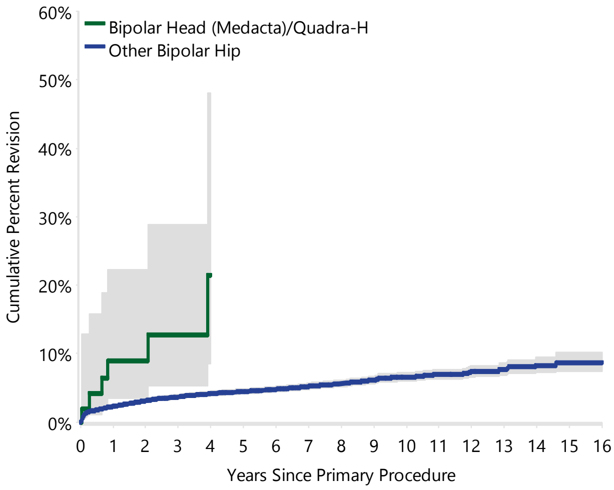
Table IP6 Yearly Usage of Individual Bipolar Hip Prostheses Identified as having a Higher than Anticipated Rate of Revision

Year of Implant	≤2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Re-Identified and Still Used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bipolar Head (Medacta)/Quadra-H	.	.	.	.	.	.	.	10	7	5	6	3	11	8	7
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	.	.	.	.	.	.	.	.
**Synergy	12	13	9	10	3	2	1	1	.	1	.	2	.	.	.

Note: ** Femoral Component

Figure IP2 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 Furlong femoral stem is no longer identified. There have been an additional three procedures and one further revision since the previous report.

There are four primary total conventional hip combinations and one acetabular prosthesis identified for the first time.

The Quadra-H/Versafitcup DM combination has been used in 283 procedures since 2012. The cumulative percent revision at one year was 4.2%. Of the 10 revisions, four were femoral only, two acetabular only and four were minor revisions. The main reasons for revision were fracture (30.0%), infection (30.0%) and loosening (20.0%).

The Taperloc/G7 combination has been used in 911 procedures since 2013. The cumulative percent revision at one year was 2.4%. This combination has a higher rate of revision in the first two weeks only and after this time there is no difference when compared to other total conventional hip procedures. The main reasons for revision were dislocation (50.0%), fracture (20.0%), infection (15.0%) and loosening (10.0%).

Of the 20 revisions, five were femoral only, two were acetabular only, and nine were head/insert.

The Taperloc/Versafitcup CC combination has been used in 75 procedures. Of the four revisions, three were femoral only and one was revision of the head only. The reasons for revision were fracture (50.0%), infection (25.0%) and pain (25.0%).

The Delta-One-TT acetabular component has been used in 95 procedures since 2010. The cumulative percent revision at three years was 7.3%. Of the six revisions, four were acetabular only and two were femoral only. The reasons for revision were loosening (50.0%), dislocation (33.3%) and fracture (16.7%).

The Hyperion/Delta-TT combination has been identified for the first time and is no longer used.

The Continuum acetabular component remains identified because of its higher than anticipated rate of revision in the first three months. However, after 2.5 years it has a lower rate of revision than other total conventional hip prostheses.

Table IP7 Revision Rate of Individual Total Conventional Hip Prostheses Identified as having a Higher than Anticipated Rate of Revision

Femoral/Acetabular	N Revised	N Total	Obs. Years	Revisions/100 Obs. Yrs	Hazard Ratio, P Value
Newly Identified	.	.	.	.	
Quadra-H/Versafitcup DM	10	283	282	3.55	Entire Period: HR=2.20 (1.18, 4.08),p=0.012
Taperloc/G7	20	911	1084	1.85	0 - 2Wk: HR=3.15 (1.57, 6.31),p=0.001
	.	.	.	.	2Wk+: HR=0.91 (0.52, 1.61),p=0.754
Taperloc/Versafitcup CC	4	75	21	18.7	Entire Period: HR=5.78 (2.17, 15.40),p<0.001
**Delta-One-TT	6	95	232	2.58	Entire Period: HR=2.65 (1.19, 5.89),p=0.017
Re-Identified and Still Used	.	.	.	.	
CPT/Fitmore	13	216	912	1.43	Entire Period: HR=2.06 (1.19, 3.54),p=0.009
CPT/Low Profile Cup	11	136	657	1.67	Entire Period: HR=2.59 (1.44, 4.67),p=0.001
Corail/Trabecular Metal (Shell)	11	90	399	2.76	Entire Period: HR=3.95 (2.19, 7.13),p<0.001
Metafix/Trinity	43	2147	4622	0.93	0 - 2Wk: HR=1.82 (1.00, 3.29),p=0.048
	.	.	.	.	2Wk - 1.5Yr: HR=0.90 (0.62, 1.31),p=0.582
	.	.	.	.	1.5Yr+: HR=0.44 (0.16, 1.16),p=0.097
Profemur L/Dynasty	22	770	999	2.20	Entire Period: HR=1.60 (1.05, 2.43),p=0.027
Taperloc Microplasty/Regenerex	4	48	201	1.99	Entire Period: HR=2.81 (1.06, 7.49),p=0.038
*Apex	126	2380	12838	0.98	Entire Period: HR=1.48 (1.24, 1.76),p<0.001
*Emperion	38	494	2350	1.62	Entire Period: HR=2.27 (1.65, 3.12),p<0.001
*Excia (cless)	20	285	1031	1.94	Entire Period: HR=2.57 (1.66, 3.99),p<0.001
*Furlong Evolution	6	91	187	3.21	Entire Period: HR=3.06 (1.37, 6.81),p=0.006
*ML Taper Kinectiv	133	3298	14208	0.94	Entire Period: HR=1.31 (1.10, 1.55),p=0.002
*Novation	35	996	2526	1.39	Entire Period: HR=1.49 (1.07, 2.08),p=0.017
*Taper Fit	50	915	3697	1.35	0 - 1Mth: HR=0.50 (0.16, 1.56),p=0.234
	.	.	.	.	1Mth - 3Mth: HR=1.35 (0.56, 3.26),p=0.498
	.	.	.	.	3Mth - 6Mth: HR=0.52 (0.07, 3.71),p=0.516
	.	.	.	.	6Mth+: HR=2.69 (1.98, 3.65),p<0.001
*Trabecular Metal	101	1866	8654	1.17	0 - 3Mth: HR=2.38 (1.80, 3.16),p<0.001
	.	.	.	.	3Mth+: HR=1.30 (0.99, 1.71),p=0.060
*UniSyn	45	462	3081	1.46	Entire Period: HR=2.33 (1.74, 3.12),p<0.001
**Continuum	322	9520	30945	1.04	0 - 3Mth: HR=1.72 (1.48, 2.00),p<0.001
	.	.	.	.	3Mth - 1.5Yr: HR=1.06 (0.84, 1.33),p=0.621
	.	.	.	.	1.5Yr - 2.5Yr: HR=1.30 (0.94, 1.80),p=0.109
	.	.	.	.	2.5Yr+: HR=0.67 (0.47, 0.96),p=0.028
**Furlong	30	568	2654	1.13	Entire Period: HR=1.61 (1.13, 2.30),p=0.009
**Plasmacup	30	482	2153	1.39	Entire Period: HR=1.96 (1.37, 2.80),p<0.001
**Procotyl L	52	1076	4426	1.17	Entire Period: HR=1.62 (1.24, 2.13),p<0.001
Identified and no longer used	.	.	.	.	
+Hyperion/Delta-TT	8	128	453	1.77	Entire Period: HR=2.24 (1.12, 4.48),p=0.022
Anatomic II/Duraloc Option	7	60	514	1.36	Entire Period: HR=2.35 (1.12, 4.92),p=0.023
Anca-Fit/Pinnacle	14	101	775	1.81	Entire Period: HR=3.14 (1.86, 5.30),p<0.001
F2L/Delta-PF	17	107	957	1.78	Entire Period: HR=3.07 (1.91, 4.93),p<0.001
Friendly Hip/Cup (Exactech)	14	97	853	1.64	Entire Period: HR=2.88 (1.71, 4.87),p<0.001
H Moos/Mueller	9	19	139	6.47	Entire Period: HR=10.39 (5.41, 19.95),p<0.001
Secur-Fit Plus/Secur-Fit	23	197	2100	1.10	Entire Period: HR=1.86 (1.23, 2.79),p=0.003
Taperloc/M2a MoM	59	515	4844	1.22	Entire Period: HR=2.08 (1.61, 2.69),p<0.001
*ABGII (exch neck)	70	246	1384	5.06	0 - 1Mth: HR=3.68 (1.65, 8.21),p=0.001
	.	.	.	.	1Mth - 2.5Yr: HR=3.45 (2.04, 5.82),p<0.001
	.	.	.	.	2.5Yr - 4Yr: HR=11.15 (6.46, 19.26),p<0.001
	.	.	.	.	4Yr - 4.5Yr: HR=32.93 (18.07, 60.01),p<0.001

Femoral/Acetabular	N Revised	N Total	Obs. Years	Revisions/100 Obs. Yrs	Hazard Ratio, P Value
	.	.	.	.	4.5Yr+: HR=17.04 (11.58, 25.10),p<0.001
*Adapter (cless)	115	744	5088	2.26	0 - 2Wk: HR=3.88 (1.93, 7.78),p<0.001
	.	.	.	.	2Wk - 1Mth: HR=1.73 (0.72, 4.16),p=0.222
	.	.	.	.	1Mth - 6Mth: HR=0.82 (0.31, 2.18),p=0.687
	.	.	.	.	6Mth - 3Yr: HR=3.59 (2.53, 5.08),p<0.001
	.	.	.	.	3Yr - 3.5Yr: HR=9.86 (5.56, 17.48),p<0.001
	.	.	.	.	3.5Yr+: HR=5.06 (3.87, 6.63),p<0.001
*Adapter (ctd)	30	148	987	3.04	0 - 6Mth: HR=2.19 (0.82, 5.83),p=0.118
	.	.	.	.	6Mth+: HR=5.29 (3.60, 7.76),p<0.001
*BMHR VST	21	260	1482	1.42	Entire Period: HR=2.02 (1.32, 3.10),p=0.001
*CBH Stem	35	274	1634	2.14	Entire Period: HR=3.40 (2.44, 4.73),p<0.001
*Edinburgh	18	138	842	2.14	Entire Period: HR=3.61 (2.27, 5.72),p<0.001
*Elite Plus	235	2841	27751	0.85	0 - 1Mth: HR=0.27 (0.11, 0.65),p=0.003
	.	.	.	.	1Mth - 9Mth: HR=1.02 (0.68, 1.53),p=0.916
	.	.	.	.	9Mth+: HR=1.77 (1.54, 2.03),p<0.001
*K2	67	601	3624	1.85	Entire Period: HR=2.96 (2.33, 3.77),p<0.001
*LYDERIC II	15	164	1306	1.15	Entire Period: HR=2.00 (1.20, 3.31),p=0.007
*MSA	23	224	1092	2.11	Entire Period: HR=2.94 (1.95, 4.43),p<0.001
*Margron	102	688	7024	1.45	0 - 3Mth: HR=2.35 (1.48, 3.74),p<0.001
	.	.	.	.	3Mth - 1Yr: HR=5.70 (3.74, 8.67),p<0.001
	.	.	.	.	1Yr - 2Yr: HR=2.37 (1.18, 4.74),p=0.015
	.	.	.	.	2Yr - 4Yr: HR=2.96 (1.75, 5.01),p<0.001
	.	.	.	.	4Yr - 7Yr: HR=4.10 (2.80, 5.99),p<0.001
	.	.	.	.	7Yr+: HR=0.84 (0.49, 1.45),p=0.528
*Mayo	16	168	1446	1.11	Entire Period: HR=1.91 (1.17, 3.12),p=0.009
*Metha (exch neck)	13	88	488	2.67	Entire Period: HR=4.01 (2.33, 6.91),p<0.001
*Profemur Z	26	186	1636	1.59	Entire Period: HR=2.74 (1.86, 4.02),p<0.001
**2000 Plus	16	135	971	1.65	Entire Period: HR=2.78 (1.70, 4.54),p<0.001
**ASR	1801	4421	31051	5.80	0 - 1.5Yr: HR=1.47 (1.24, 1.75),p<0.001
	.	.	.	.	1.5Yr - 2Yr: HR=6.26 (4.83, 8.10),p<0.001
	.	.	.	.	2Yr - 3Yr: HR=13.09 (11.32, 15.13),p<0.001
	.	.	.	.	3Yr - 5Yr: HR=23.69 (21.57, 26.02),p<0.001
	.	.	.	.	5Yr - 5.5Yr: HR=27.93 (23.32, 33.45),p<0.001
	.	.	.	.	5.5Yr - 6Yr: HR=23.26 (18.98, 28.50),p<0.001
	.	.	.	.	6Yr - 7Yr: HR=17.28 (14.57, 20.50),p<0.001
	.	.	.	.	7Yr - 8.5Yr: HR=13.60 (11.56, 15.99),p<0.001
	.	.	.	.	8.5Yr+: HR=6.84 (5.56, 8.43),p<0.001
**Adept	17	121	856	1.99	Entire Period: HR=3.18 (1.97, 5.11),p<0.001
**Artek	63	179	2016	3.13	0 - 1.5Yr: HR=1.93 (0.92, 4.04),p=0.083
	.	.	.	.	1.5Yr+: HR=6.32 (4.85, 8.22),p<0.001
**BHR	347	2987	23928	1.45	0 - 2Wk: HR=0.81 (0.39, 1.71),p=0.584
	.	.	.	.	2Wk - 1Mth: HR=0.17 (0.04, 0.66),p=0.010
	.	.	.	.	1Mth - 1.5Yr: HR=0.93 (0.67, 1.29),p=0.664
	.	.	.	.	1.5Yr+: HR=3.60 (3.21, 4.05),p<0.001
**Bionik	117	608	4290	2.73	0 - 3Mth: HR=1.66 (0.92, 2.99),p=0.094
	.	.	.	.	3Mth+: HR=5.59 (4.62, 6.77),p<0.001
**Cormet	96	803	6557	1.46	0 - 1.5Yr: HR=1.05 (0.65, 1.69),p=0.845
	.	.	.	.	1.5Yr - 2Yr: HR=0.53 (0.08, 3.80),p=0.531
	.	.	.	.	2Yr+: HR=3.68 (2.94, 4.61),p<0.001
**DeltaLox	22	222	965	2.28	Entire Period: HR=3.27 (2.15, 4.97),p<0.001

Femoral/Acetabular	N Revised	N Total	Obs. Years	Revisions/100 Obs. Yrs	Hazard Ratio, P Value
**Duraloc	500	5354	52320	0.96	0 - 3Mth: HR=0.84 (0.63, 1.11),p=0.227
	.	.	.	.	3Mth - 9Mth: HR=1.36 (0.95, 1.95),p=0.096
	.	.	.	.	9Mth - 2Yr: HR=1.58 (1.20, 2.07),p<0.001
	.	.	.	.	2Yr - 2.5Yr: HR=0.76 (0.38, 1.53),p=0.445
	.	.	.	.	2.5Yr - 3Yr: HR=1.80 (1.11, 2.92),p=0.017
	.	.	.	.	3Yr - 5.5Yr: HR=1.47 (1.14, 1.89),p=0.002
	.	.	.	.	5.5Yr+: HR=2.35 (2.08, 2.66),p<0.001
**Durom	148	1245	10842	1.37	0 - 1.5Yr: HR=0.75 (0.48, 1.17),p=0.204
	.	.	.	.	1.5Yr+: HR=3.29 (2.76, 3.92),p<0.001
**ExpanSys	11	71	636	1.73	Entire Period: HR=3.02 (1.67, 5.46),p<0.001
**Fin II	110	2025	11808	0.93	Entire Period: HR=1.47 (1.22, 1.77),p<0.001
**Hedrocel	9	46	489	1.84	Entire Period: HR=3.04 (1.58, 5.84),p<0.001
**Icon	75	401	2911	2.58	0 - 2.5Yr: HR=2.50 (1.68, 3.73),p<0.001
	.	.	.	.	2.5Yr+: HR=6.17 (4.68, 8.13),p<0.001
**Inter-Op	9	33	334	2.70	Entire Period: HR=4.57 (2.38, 8.79),p<0.001
**MBA	17	124	1008	1.69	Entire Period: HR=2.91 (1.81, 4.69),p<0.001
**Mitch TRH	86	732	5457	1.58	0 - 3Mth: HR=0.61 (0.25, 1.46),p=0.262
	.	.	.	.	3Mth+: HR=3.30 (2.65, 4.11),p<0.001
**SPH-Blind	107	952	10266	1.04	0 - 1Mth: HR=2.51 (1.54, 4.10),p<0.001
	.	.	.	.	1Mth+: HR=1.68 (1.37, 2.07),p<0.001
**seleXys (excluding seleXys PC)	42	391	2050	2.05	Entire Period: HR=3.08 (2.28, 4.17),p<0.001

Note: All components have been compared to all other total conventional hip components, excluding metal/metal bearings with head size larger than 32mm
* Femoral 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	16 Yrs
Newly Identified					
Quadra-H/Versafitcup DM	4.2 (2.2, 7.9)				
Taperloc/G7	2.4 (1.5, 3.7)				
Taperloc/Versafitcup CC					
**Delta-One-TT	3.2 (1.0, 9.6)	7.3 (3.3, 15.8)			
Re-Identified and Still Used					
CPT/Fitmore	4.3 (2.3, 8.1)	4.9 (2.6, 8.9)	6.1 (3.3, 11.3)		
CPT/Low Profile Cup	4.5 (2.0, 9.7)	6.1 (3.1, 11.9)	9.3 (5.2, 16.3)		
Corail/Trabecular Metal (Shell)	6.7 (3.1, 14.3)	10.7 (5.7, 19.6)	13.9 (7.8, 23.8)		
Metafix/Trinity	1.9 (1.4, 2.6)	2.4 (1.8, 3.2)	2.4 (1.8, 3.2)		
Profemur L/Dynasty	3.1 (2.0, 4.7)				
Taperloc Microplasty/Regenerex	8.5 (3.3, 21.1)	8.5 (3.3, 21.1)	8.5 (3.3, 21.1)		
*Apex	2.3 (1.8, 3.0)	3.4 (2.7, 4.2)	5.0 (4.1, 6.1)	8.1 (6.6, 9.8)	
*Emperion	4.7 (3.2, 7.0)	5.7 (3.9, 8.2)	7.3 (5.2, 10.2)		
*Excia (cless)	5.0 (3.0, 8.3)	6.9 (4.4, 10.7)	7.6 (4.9, 11.8)		
*Furlong Evolution	4.5 (1.7, 11.6)	7.3 (3.3, 15.5)			
*ML Taper Kinectiv	2.2 (1.7, 2.8)	3.5 (2.9, 4.2)	4.5 (3.8, 5.4)		
*Novation	2.8 (1.9, 4.0)	3.9 (2.8, 5.5)	4.4 (3.0, 6.4)		
*Taper Fit	1.5 (0.9, 2.6)	3.0 (2.0, 4.7)	6.4 (4.4, 9.2)	13.0 (9.6, 17.5)	
*Trabecular Metal	3.4 (2.7, 4.3)	4.8 (3.9, 5.9)	5.4 (4.5, 6.6)		

CPR	1 Yr	3 Yrs	5 Yrs	10 Yrs	16 Yrs
*UniSyn	3.3 (2.0, 5.4)	5.9 (4.1, 8.6)	6.8 (4.8, 9.7)	13.1 (9.6, 17.7)	
**Continuum	2.5 (2.2, 2.9)	3.4 (3.1, 3.8)	3.9 (3.5, 4.4)		
**Furlong	3.4 (2.2, 5.2)	5.1 (3.6, 7.4)	5.5 (3.8, 7.9)		
**Plasmacup	4.4 (2.9, 6.7)	5.8 (4.0, 8.4)	6.2 (4.3, 8.9)		
**Procotyl L	3.4 (2.4, 4.7)	4.7 (3.6, 6.3)	5.3 (4.1, 7.0)		
Identified and no longer used					
+Hyperion/Delta-TT	3.2 (1.2, 8.2)	5.6 (2.7, 11.3)			
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)		
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)	14.2 (8.3, 23.8)	
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)	12.3 (9.6, 15.8)	
*ABGII (exch neck)	4.1 (2.2, 7.5)	10.3 (7.1, 14.9)	19.7 (15.2, 25.3)		
*Adapter (cless)	3.2 (2.2, 4.8)	6.7 (5.1, 8.8)	11.4 (9.3, 14.0)	17.9 (15.0, 21.2)	
*Adapter (ctd)	4.1 (1.9, 8.9)	9.1 (5.4, 15.2)	17.0 (11.6, 24.5)		
*BMHR VST	1.9 (0.8, 4.6)	4.6 (2.7, 8.0)	6.8 (4.3, 10.8)		
*CBH Stem	4.0 (2.3, 7.2)	7.5 (4.9, 11.3)	10.0 (6.9, 14.4)		
*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)	7.6 (6.6, 8.8)	13.2 (11.3, 15.4)
*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)	12.3 (7.3, 20.5)	
*MSA	5.8 (3.4, 9.8)	9.0 (5.9, 13.6)	10.6 (7.1, 15.5)		
*Margron	5.8 (4.3, 7.9)	8.4 (6.5, 10.8)	10.2 (8.2, 12.8)	14.9 (12.4, 17.9)	
*Mayo	3.0 (1.3, 7.0)	6.6 (3.7, 11.6)	6.6 (3.7, 11.6)	9.0 (5.4, 14.9)	
*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)		
**ASR	1.9 (1.5, 2.3)	9.6 (8.7, 10.5)	24.2 (23.0, 25.6)	44.8 (43.1, 46.4)	
**Adept	4.1 (1.7, 9.6)	8.4 (4.6, 15.0)	9.3 (5.3, 16.2)		
**Artek	2.8 (1.2, 6.7)	8.0 (4.8, 13.1)	15.6 (11.0, 21.9)	24.7 (18.9, 32.0)	
**BHR	1.1 (0.8, 1.6)	3.2 (2.6, 3.9)	6.1 (5.2, 7.0)	14.1 (12.6, 15.6)	
**Bionik	3.6 (2.4, 5.5)	7.6 (5.7, 10.0)	14.1 (11.5, 17.3)	21.5 (18.2, 25.3)	
**Cormet	1.4 (0.8, 2.5)	3.4 (2.3, 4.9)	5.1 (3.7, 6.9)	15.4 (12.4, 19.0)	
**DeltaLox	5.9 (3.5, 9.9)	8.7 (5.6, 13.3)	9.8 (6.5, 14.7)		
**Duraloc	1.8 (1.5, 2.2)	3.0 (2.6, 3.5)	4.1 (3.6, 4.6)	8.5 (7.7, 9.4)	16.0 (13.9, 18.5)
**Durom	1.1 (0.7, 1.9)	3.6 (2.7, 4.8)	5.5 (4.3, 6.9)	12.7 (10.8, 14.9)	
**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)	7.2 (5.8, 9.0)	
**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 (18.8, 29.3)	
**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, 25.4)	
**Mitch TRH	1.5 (0.8, 2.7)	4.6 (3.3, 6.4)	7.4 (5.7, 9.6)		
**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)	11.1 (8.2, 14.9)		

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
Newly Identified	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Quadra-H/Versafitcup DM	.	.	.	.	.	.	.	.	.	.	1	1	15	120	146
Taperloc/G7	.	.	.	.	.	.	.	.	.	.	.	19	147	333	412
Taperloc/Versafitcup CC	.	.	.	.	.	.	.	.	.	.	2	.	.	.	73
**Delta-One-TT	.	.	.	.	.	.	.	.	4	7	7	15	37	13	12
Re-Identified and Still Used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
CPT/Fitmore	.	.	19	6	6	4	16	12	15	24	14	30	30	22	18
CPT/Low Profile Cup	.	.	15	9	8	7	7	6	9	16	26	20	6	5	2
Corail/Trabecular Metal (Shell)	.	.	.	.	.	5	10	17	21	8	8	8	6	1	6
Metafix/Trinity	.	.	.	.	.	.	.	.	52	114	224	293	360	470	634
Profemur L/Dynasty	.	.	.	.	.	.	.	.	.	.	.	23	172	280	295
Taperloc Microplasty/Regenerex	.	.	.	.	.	.	.	.	12	14	12	2	3	3	2
*Apex	.	.	.	75	247	223	265	197	169	190	219	246	188	193	168
*Emperion	.	.	.	1	13	21	26	65	87	72	44	53	38	41	33
*Excia (cless)	.	.	.	.	.	.	6	34	8	47	58	38	17	42	35
*Furlong Evolution	.	.	.	.	.	.	.	.	.	.	.	29	23	29	10
*ML Taper Kinectiv	.	.	.	.	.	.	36	341	647	576	515	384	345	256	198
*Novation	.	.	.	.	.	.	.	4	32	53	130	137	227	265	148
*Taper Fit	30	34	65	50	66	26	18	6	8	17	55	45	110	161	224
*Trabecular Metal	.	.	.	.	6	101	147	198	242	272	276	186	220	112	106
*UniSyn	1	14	41	74	33	37	46	48	36	23	19	23	27	23	17
**Continuum	.	.	.	.	.	.	.	175	1117	1245	1333	1502	1492	1359	1297
**Furlong	27	4	.	.	.	4	7	61	90	84	73	76	64	66	12
**Plasmacup	.	.	.	10	16	13	7	54	60	59	77	70	44	51	21
**Procotyl L	.	.	.	.	.	.	8	32	268	342	67	26	121	103	109
Identified and no longer used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
+Hyperion/Delta-TT	.	.	.	.	.	.	.	.	2	7	44	60	15	.	.
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	.	.	.	.	.

Year of Implant	≤2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
**ASR	.	.	84	584	958	1186	1179	430	.	.	.	.	.	.	.
**Adept	.	.	.	.	19	20	29	30	11	12	.	.	.	.	.
**Artek	179	.	.	.	.	.	.	.	.	.	.	.	.	.	.
**BHR	39	66	127	288	550	581	476	404	276	134	27	13	5	1	.
**Bionik	.	.	.	11	147	136	138	134	38	4	.	.	.	.	.
**Cormet	9	53	74	103	114	73	129	124	93	26	4	1	.	.	.
**DeltaLox	.	.	.	.	.	.	.	.	32	86	72	24	8	.	.
**Duraloc	2147	907	631	448	301	253	293	187	82	84	18	3	.	.	.
**Durom	.	5	79	265	322	257	218	85	13	1	.	.	.	.	.
**ExpanSys	.	1	7	24	30	8	1	.	.	.	.	.	.	.	.
**Fin II	.	.	.	39	128	175	251	269	318	287	205	247	100	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	274	164	130	82	37	.	.	.	.	.
**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 IP3 Cumulative Percent Revision of Newly Identified Individual Total Conventional Hip Prostheses

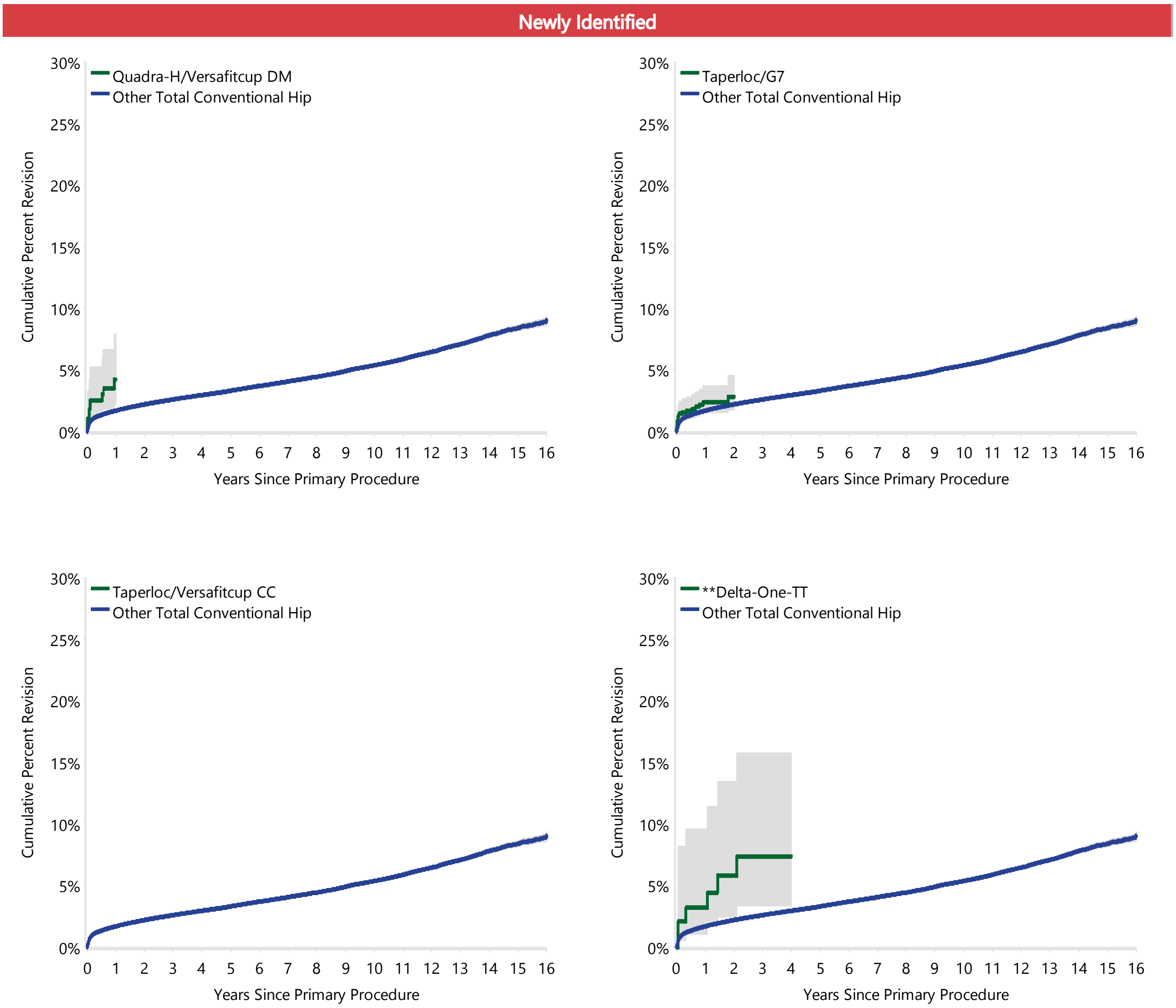
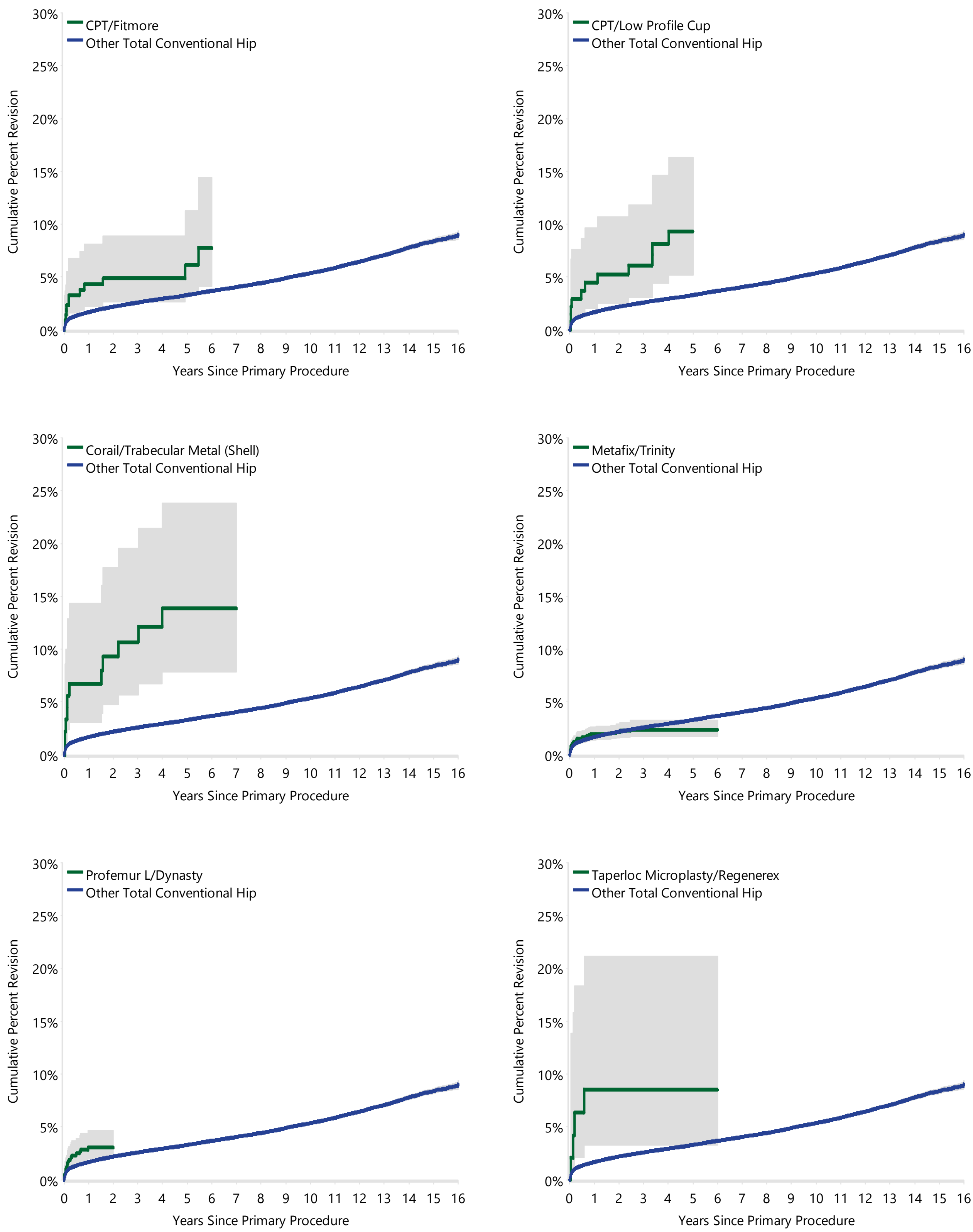
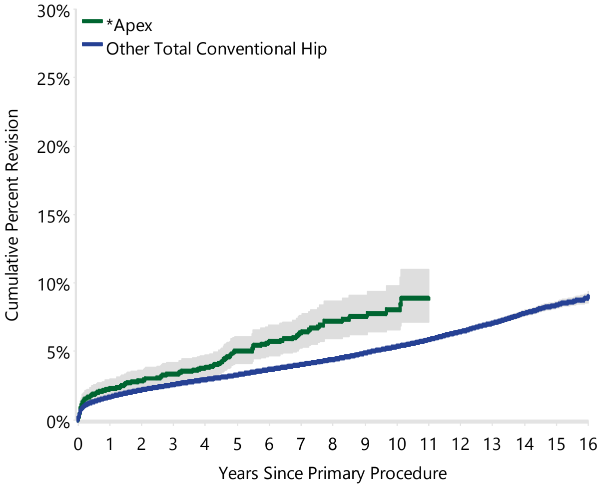
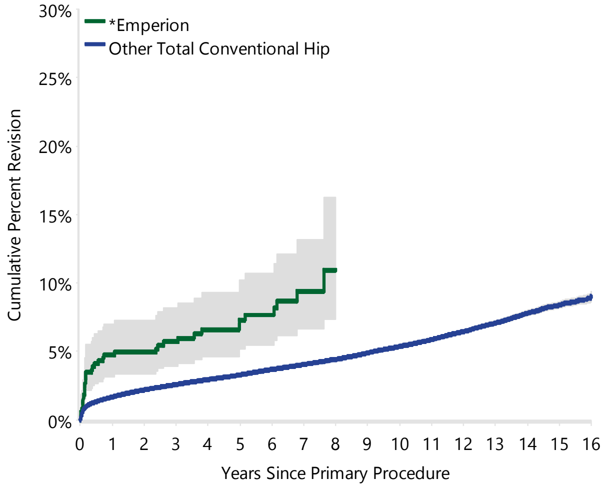


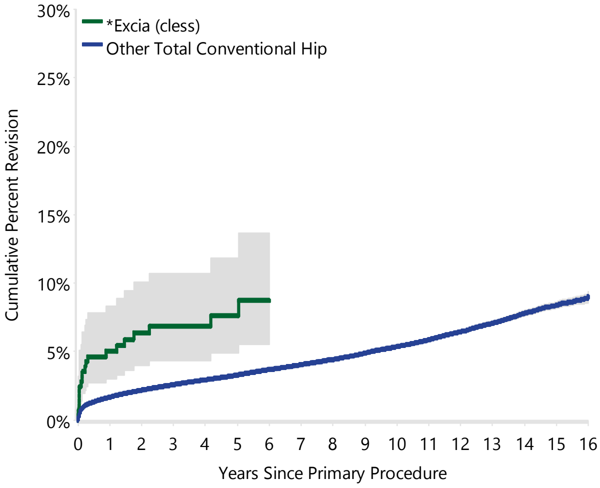
Figure IP4 Cumulative Percent Revision of Re-identified and still used Individual Total Conventional Hip Prostheses

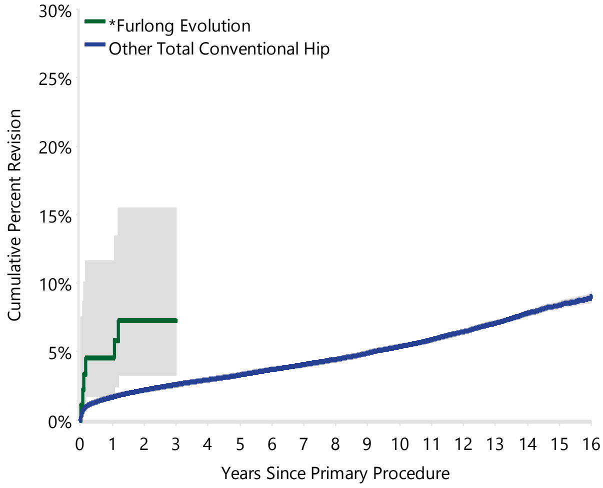
Re-identified and still used

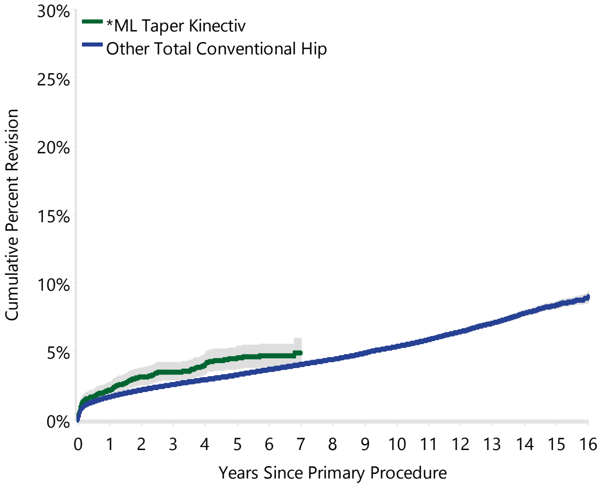


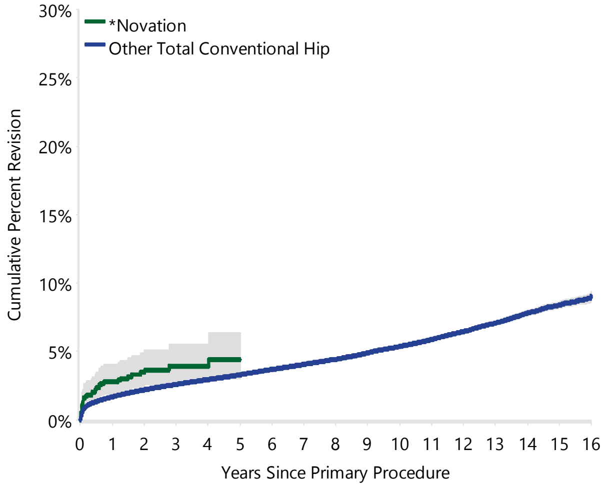

*Apex
Other Total Conventional Hip
Cumulative Percent Revision
30%
25%
20%
15%
10%
5%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Years Since Primary Procedure

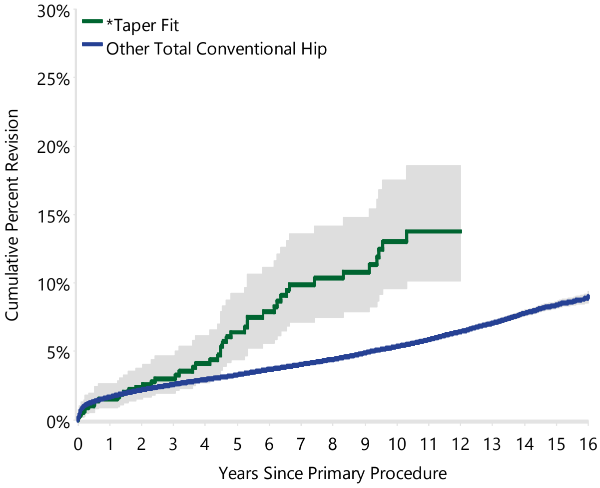

*Emperion
Other Total Conventional Hip
Cumulative Percent Revision
30%
25%
20%
15%
10%
5%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Years Since Primary Procedure

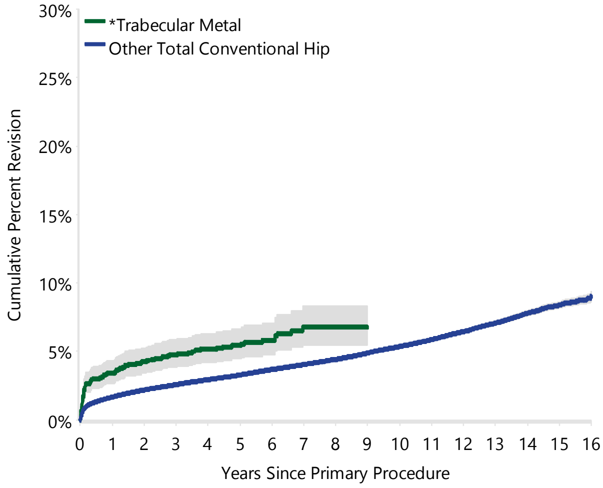

*Excia (cless)
Other Total Conventional Hip
Cumulative Percent Revision
30%
25%
20%
15%
10%
5%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Years Since Primary Procedure

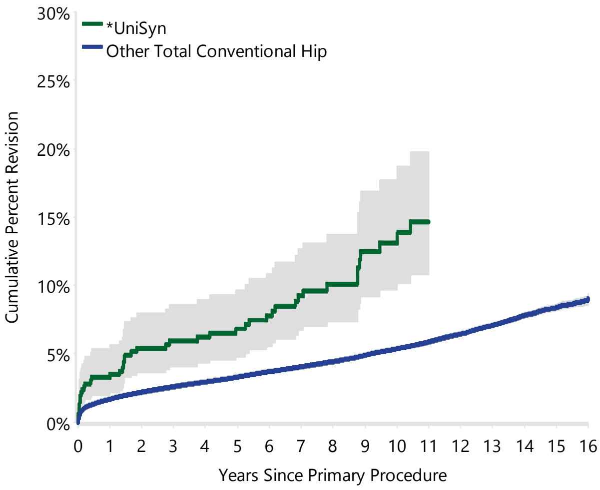

*Furlong Evolution
Other Total Conventional Hip
Cumulative Percent Revision
30%
25%
20%
15%
10%
5%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Years Since Primary Procedure

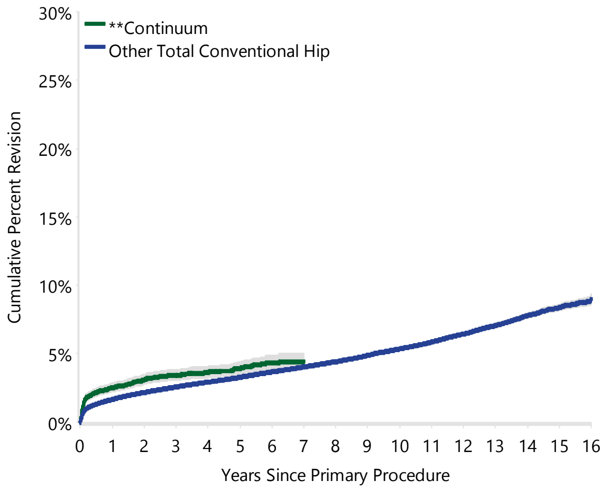

*ML Taper Kinectiv
Other Total Conventional Hip
Cumulative Percent Revision
30%
25%
20%
15%
10%
5%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Years Since Primary Procedure

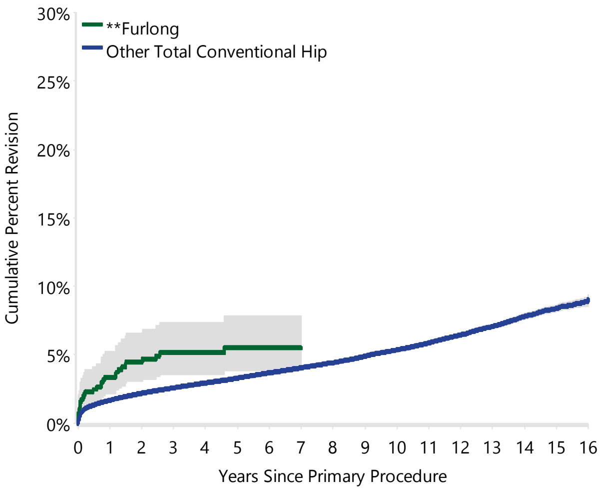

*Novation
Other Total Conventional Hip
Cumulative Percent Revision
30%
25%
20%
15%
10%
5%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Years Since Primary Procedure

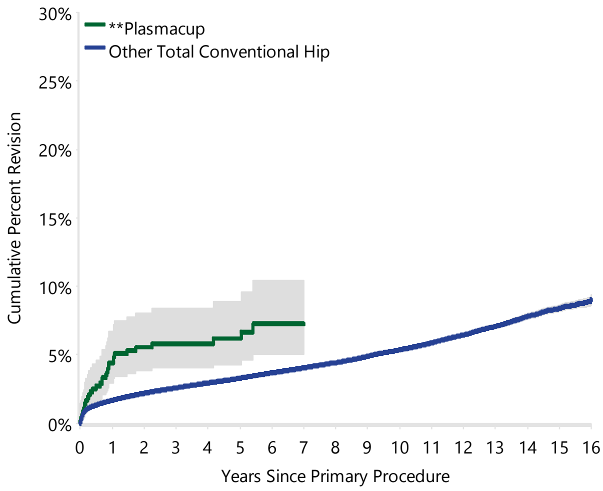

*Taper Fit
Other Total Conventional Hip
Cumulative Percent Revision
30%
25%
20%
15%
10%
5%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Years Since Primary Procedure

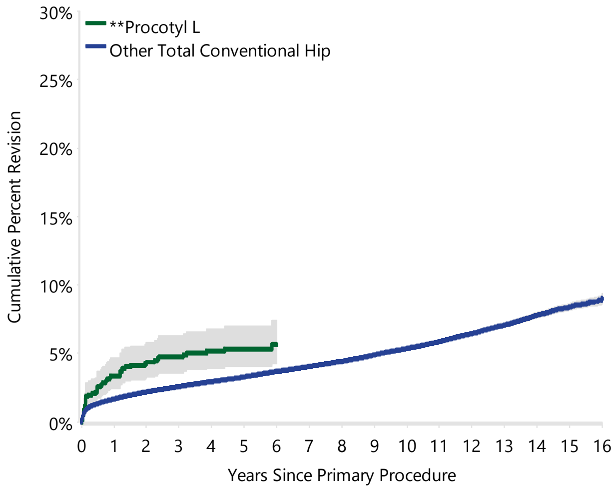

*Trabecular Metal
Other Total Conventional Hip
Cumulative Percent Revision
30%
25%
20%
15%
10%
5%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Years Since Primary Procedure


*UniSyn
Other Total Conventional Hip
Cumulative Percent Revision
30%
25%
20%
15%
10%
5%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Years Since Primary Procedure


**Continuum
Other Total Conventional Hip
Cumulative Percent Revision
30%
25%
20%
15%
10%
5%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Years Since Primary Procedure


**Furlong
Other Total Conventional Hip
Cumulative Percent Revision
30%
25%
20%
15%
10%
5%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Years Since Primary Procedure


**Plasmacup
Other Total Conventional Hip
Cumulative Percent Revision
30%
25%
20%
15%
10%
5%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Years Since Primary Procedure



Note: * Femoral Component, **Acetabular Component

TOTAL RESURFACING

There are no newly identified total resurfacing hip prostheses.

Table IP10 Revision Rate of Individual Total Resurfacing Hip Prostheses Identified as having a Higher than Anticipated Rate of Revision

Head/Acetabular	N Revised	N Total	Obs. Years	Revisions/100 Obs. Yrs	Hazard Ratio, P Value
Identified and no longer used	.	.	.	.	
ASR/ASR	356	1168	10182	3.50	0 - 3Mth: HR=1.78 (1.08, 2.92),p=0.022
	.	.	.	.	3Mth - 6Mth: HR=2.21 (1.19, 4.09),p=0.011
	.	.	.	.	6Mth - 4Yr: HR=3.03 (2.40, 3.82),p<0.001
	.	.	.	.	4Yr - 4.5Yr: HR=6.74 (4.25, 10.69),p<0.001
	.	.	.	.	4.5Yr - 5Yr: HR=8.99 (5.66, 14.26),p<0.001
	.	.	.	.	5Yr - 6Yr: HR=6.29 (4.42, 8.96),p<0.001
	.	.	.	.	6Yr - 9.5Yr: HR=4.71 (3.75, 5.90),p<0.001
	.	.	.	.	9.5Yr+: HR=3.69 (2.49, 5.46),p<0.001
Bionik/Bionik	47	200	1480	3.18	Entire Period: HR=3.33 (2.49, 4.46),p<0.001
Cormet/Cormet	113	626	5578	2.03	Entire Period: HR=1.95 (1.61, 2.37),p<0.001
Durom/Durom	93	847	8219	1.13	0 - 4.5Yr: HR=1.72 (1.32, 2.23),p<0.001
	.	.	.	.	4.5Yr+: HR=0.73 (0.51, 1.04),p=0.082
Recap/Recap	27	195	1585	1.70	Entire Period: HR=1.73 (1.18, 2.54),p=0.004
*Cormet 2000 HAP	23	95	1068	2.15	Entire Period: HR=2.33 (1.55, 3.52),p<0.001

Note: Components have been compared to all other total resurfacing hip components
* Head Component

Table IP11 Cumulative Percent Revision of Individual Total Resurfacing Hip Prostheses Identified as having a Higher than Anticipated Rate of Revision

CPR	1 Yr	3 Yrs	5 Yrs	10 Yrs	16 Yrs
Identified and no longer used					
ASR/ASR	3.4 (2.5, 4.6)	7.2 (5.9, 8.8)	15.3 (13.4, 17.5)	30.4 (27.8, 33.3)	
Bionik/Bionik	3.5 (1.7, 7.2)	12.0 (8.2, 17.4)	17.1 (12.5, 23.1)		
Cormet/Cormet	2.1 (1.2, 3.6)	5.6 (4.1, 7.7)	9.5 (7.5, 12.1)	17.7 (14.7, 21.3)	
Durom/Durom	3.2 (2.2, 4.6)	5.4 (4.1, 7.2)	7.5 (5.9, 9.5)	10.9 (8.9, 13.3)	
Recap/Recap	5.1 (2.8, 9.3)	8.7 (5.5, 13.7)	10.3 (6.8, 15.5)	15.8 (10.9, 22.6)	
*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
Identified and no longer used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
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	9	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	158	413	3292	4.80	Entire Period: HR=1.62 (1.35, 1.95),p<0.001
**Vanguard	12	45	197	6.08	Entire Period: HR=1.98 (1.11, 3.51),p=0.019

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	16 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)	38.4 (33.5, 43.7)	
**Vanguard	4.4 (1.1, 16.6)	18.0 (9.4, 32.8)	29.2 (16.9, 47.5)		

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
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	19	113	322	5.89	Entire Period: HR=3.13 (2.00, 4.91),p<0.001
Uniglide/Uniglide	137	751	5897	2.32	0 - 1.5Yr: HR=1.99 (1.51, 2.63),p<0.001
	.	.	.	.	1.5Yr+: HR=1.13 (0.91, 1.40),p=0.276
Identified and no longer used	.	.	.	.	
Advance/Advance	16	37	275	5.81	Entire Period: HR=3.84 (2.35, 6.27),p<0.001
BalanSys Uni/BalanSys Uni Mobile	44	199	1726	2.55	0 - 6Mth: HR=4.37 (2.17, 8.78),p<0.001
	.	.	.	.	6Mth - 2Yr: HR=2.09 (1.24, 3.54),p=0.006
	.	.	.	.	2Yr+: HR=1.06 (0.70, 1.61),p=0.795
**Preservation Mobile	126	400	4027	3.13	0 - 1.5Yr: HR=2.24 (1.60, 3.14),p<0.001
	.	.	.	.	1.5Yr - 3Yr: HR=2.80 (1.91, 4.10),p<0.001
	.	.	.	.	3Yr+: HR=1.26 (0.98, 1.62),p=0.066

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	16 Yrs
Re-Identified and Still Used					
GMK-UNI/GMK-UNI	7.8 (4.0, 15.1)	17.4 (11.0, 27.0)			
Uniglide/Uniglide	4.9 (3.5, 6.7)	10.6 (8.6, 13.1)	12.8 (10.6, 15.5)	19.8 (16.9, 23.2)	
Identified and no longer used					
Advance/Advance	10.8 (4.2, 26.3)	27.0 (15.6, 44.4)	32.9 (20.2, 50.6)	41.6 (27.5, 59.4)	
BalanSys Uni/BalanSys Uni Mobile	7.0 (4.2, 11.6)	13.1 (9.1, 18.6)	14.6 (10.4, 20.4)	21.4 (16.2, 27.9)	
**Preservation Mobile	5.3 (3.5, 7.9)	15.5 (12.3, 19.5)	19.1 (15.6, 23.3)	27.2 (23.1, 31.9)	

Note: ** Tibial Component

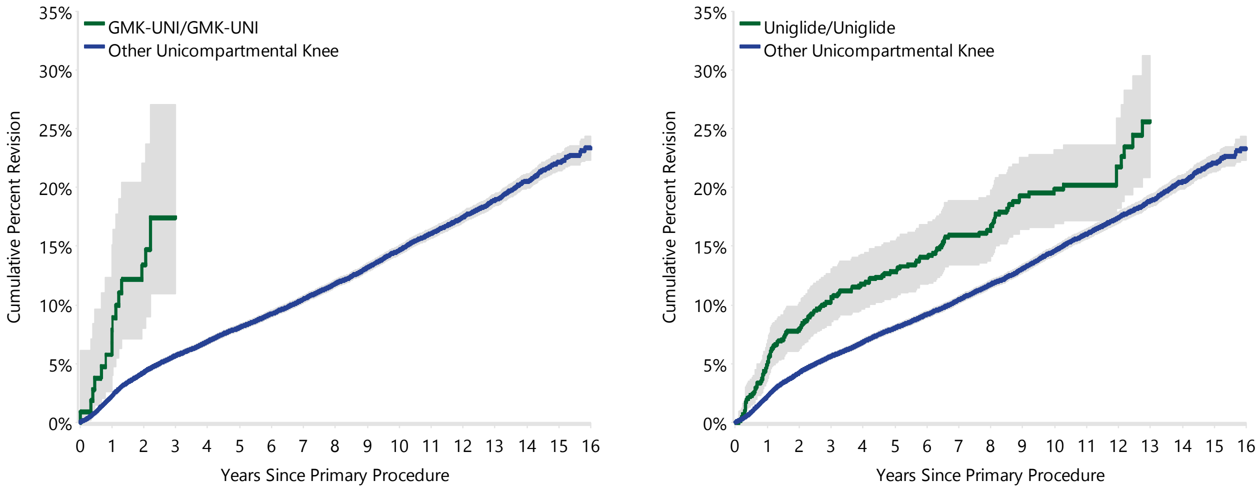
Table IP18 Yearly Usage of Individual Unicompartmental Knee Prostheses Identified as having a Higher than Anticipated Rate of Revision

Year of Implant	≤2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Re-Identified and Still Used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
GMK-UNI/GMK-UNI	.	.	.	.	.	.	5	10	2	.	21	22	16	19	18
Uniglide/Uniglide	.	80	66	123	84	107	93	61	30	38	25	22	9	5	8
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 IP5 Cumulative Percent Revision of Re-identified and still used Individual Unicompartmental Knee Prostheses

Re-identified and still used



PRIMARY TOTAL KNEE REPLACEMENT

The GMK Primary (cementless)/GMK Primary (cementless) combination is no longer identified. There have been an additional 139 procedures and no further revisions.

There is one tibial prosthesis identified for the first time.

The Legion Revision Tibial Baseplate has been used in 492 primary procedures since 2006. The cumulative percent revision at five years was 6.5%. This prosthesis had a higher rate of revision in the first three months compared to other total knee procedures, with there being no difference after this time. There were four major and 21 minor revisions, 16 of which were for insert only. The main reasons for revision were infection (34.4%), bearing dislocation (12.5%) and loosening (9.4%).

The bearing dislocation occurred when a degree of prosthetic constraint was used (both posterior and fully stabilised).

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	.	.	.	.	
**Legion Revision Tibial Baseplate	32	492	2087	1.53	0 - 3Mth: HR=6.25 (3.46, 11.31),p<0.001
	.	.	.	.	3Mth - 1.5Yr: HR=0.91 (0.41, 2.03),p=0.819
	.	.	.	.	1.5Yr+: HR=1.56 (0.94, 2.60),p=0.083
Re-Identified and Still Used	.	.	.	.	
ACS (cless)/ACS Fixed	62	1350	3061	2.03	Entire Period: HR=2.09 (1.63, 2.69),p<0.001
Active Knee (cless)/Active Knee	490	7024	51498	0.95	0 - 3Yr: HR=1.19 (1.04, 1.35),p=0.008
	.	.	.	.	3Yr+: HR=1.83 (1.62, 2.07),p<0.001
Advance/Advance	36	755	3416	1.05	Entire Period: HR=1.41 (1.02, 1.95),p=0.039
Columbus/Columbus	92	1194	6481	1.42	Entire Period: HR=2.21 (1.80, 2.71),p<0.001
E.Motion/E.Motion	48	921	2943	1.63	0 - 1.5Yr: HR=2.66 (1.91, 3.69),p<0.001
	.	.	.	.	1.5Yr+: HR=1.07 (0.61, 1.89),p=0.813
Optetrak-PS/Optetrak	197	2778	17715	1.11	Entire Period: HR=1.77 (1.54, 2.03),p<0.001
Optetrak-PS/Optetrak-RBK	70	951	5470	1.28	Entire Period: HR=2.00 (1.58, 2.53),p<0.001
Score (cless)/Score (cless)	108	1836	7467	1.45	Entire Period: HR=1.66 (1.38, 2.01),p<0.001
Scorpio NRG PS (cless)/Series 7000 (cless)	69	1074	5622	1.23	Entire Period: HR=1.52 (1.20, 1.92),p<0.001
Trekking/Trekking	29	720	2118	1.37	0 - 1.5Yr: HR=1.96 (1.28, 3.01),p=0.002
	.	.	.	.	1.5Yr+: HR=0.97 (0.48, 1.93),p=0.924
Vanguard PS/Maxim	215	4355	19309	1.11	0 - 1.5Yr: HR=1.79 (1.50, 2.15),p<0.001
	.	.	.	.	1.5Yr+: HR=1.26 (1.03, 1.54),p=0.026
Vanguard PS/Regenerex	13	334	1318	0.99	0 - 1Yr: HR=2.66 (1.38, 5.11),p=0.003
	.	.	.	.	1Yr+: HR=0.55 (0.21, 1.47),p=0.231
Identified and no longer used	.	.	.	.	
ACS/ACS Mobile PC (cless)	25	131	445	5.62	Entire Period: HR=6.15 (4.16, 9.11),p<0.001
AMK/AMK	24	203	2273	1.06	Entire Period: HR=1.97 (1.32, 2.94),p<0.001
Buechel-Pappas/Buechel-Pappas	38	479	3243	1.17	Entire Period: HR=1.74 (1.26, 2.39),p<0.001
Eska RP/Eska RP	8	40	282	2.83	Entire Period: HR=5.15 (2.58, 10.27),p<0.001
Gemini MK II/Gemini MK II	7	21	193	3.63	Entire Period: HR=6.08 (2.90, 12.74),p<0.001
Genesis (ctd)/Genesis (ctd)	10	62	610	1.64	Entire Period: HR=3.21 (1.73, 5.97),p<0.001
Genesis II CR (cless)/Profix Mobile (ctd)	30	241	2249	1.33	Entire Period: HR=2.42 (1.69, 3.46),p<0.001
Genesis II Oxinium CR (cless)/Genesis II	45	110	831	5.42	0 - 1Yr: HR=10.25 (5.95, 17.67),p<0.001
	.	.	.	.	1Yr - 1.5Yr: HR=18.20 (10.07, 32.90),p<0.001
	.	.	.	.	1.5Yr - 2.5Yr: HR=20.90 (12.59, 34.71),p<0.001
	.	.	.	.	2.5Yr+: HR=2.14 (0.96, 4.76),p=0.062
Genesis II Oxinium CR (cless)/Profix Mobile	56	88	523	10.7	0 - 6Mth: HR=7.65 (2.87, 20.40),p<0.001
	.	.	.	.	6Mth - 9Mth: HR=46.94 (25.95, 84.90),p<0.001

Femoral/Tibial	N Revised	N Total	Obs. Years	Revisions/100 Obs. Yrs	Hazard Ratio, P Value
	.	.	.	.	9Mth - 1.5Yr: HR=32.85 (21.39, 50.43),p<0.001
	.	.	.	.	1.5Yr - 2Yr: HR=27.14 (12.92, 57.00),p<0.001
	.	.	.	.	2Yr+: HR=6.60 (3.83, 11.38),p<0.001
Genesis II Oxinium PS (ctd)/Genesis II (cless)	17	56	289	5.89	0 – 1Yr: HR=16.61 (9.23, 29.91),p<0.001
	.	.	.	.	1Yr+: HR=3.56 (1.60, 7.92),p=0.001
Genesis II Oxinium PS (ctd)/Genesis II (keel)	59	269	2183	2.70	Entire Period: HR=4.50 (3.49, 5.81),p<0.001
HLS Noetos/HLS Noetos	35	294	2000	1.75	Entire Period: HR=2.71 (1.95, 3.78),p<0.001
IB II/IB II	33	199	2245	1.47	0 - 2Yr: HR=0.82 (0.26, 2.53),p=0.724
	.	.	.	.	2Yr - 2.5Yr: HR=4.60 (1.48, 14.27),p=0.008
	.	.	.	.	2.5Yr+: HR=4.20 (2.88, 6.13),p<0.001
Interax/Interax	11	52	492	2.24	0 - 3.5Yr: HR=1.43 (0.36, 5.73),p=0.610
	.	.	.	.	3.5Yr+: HR=8.12 (4.22, 15.59),p<0.001
Journey Oxinium/Journey	245	3033	18884	1.30	0 - 3Mth: HR=0.30 (0.10, 0.93),p=0.037
	.	.	.	.	3Mth - 1.5Yr: HR=1.93 (1.54, 2.41),p<0.001
	.	.	.	.	1.5Yr - 2Yr: HR=1.52 (0.99, 2.33),p=0.057
	.	.	.	.	2Yr - 2.5Yr: HR=2.03 (1.35, 3.07),p<0.001
	.	.	.	.	2.5Yr - 3Yr: HR=1.38 (0.78, 2.43),p=0.271
	.	.	.	.	3Yr+: HR=2.47 (2.04, 2.99),p<0.001
Optetrak-PS/Optetrak-PS	13	55	433	3.00	Entire Period: HR=5.60 (3.25, 9.64),p<0.001
Profix Oxinium (cless)/Profix	32	75	596	5.37	Entire Period: HR=8.19 (5.79, 11.58),p<0.001
Profix Oxinium (cless)/Profix Mobile	71	158	1160	6.12	Entire Period: HR=9.92 (7.86, 12.53),p<0.001
Profix Oxinium (ctd)/Profix Mobile	25	228	2475	1.01	Entire Period: HR=1.57 (1.06, 2.33),p=0.024
Profix/Profix Mobile	105	1005	9932	1.06	0 - 2.5Yr: HR=2.53 (1.96, 3.26),p<0.001
	.	.	.	.	2.5Yr+: HR=1.41 (1.05, 1.89),p=0.021
Rotaglide Plus/Rotaglide Plus	72	631	6341	1.14	0 - 1.5Yr: HR=1.21 (0.69, 2.13),p=0.507
	.	.	.	.	1.5Yr - 2Yr: HR=2.96 (1.48, 5.92),p=0.002
	.	.	.	.	2Yr+: HR=2.32 (1.77, 3.05),p<0.001
SAL/SAL	13	56	643	2.02	0 - 8.5Yr: HR=1.42 (0.53, 3.79),p=0.481
	.	.	.	.	8.5Yr+: HR=9.58 (4.98, 18.43),p<0.001
Trac/Trac	24	138	1486	1.62	Entire Period: HR=2.81 (1.88, 4.19),p<0.001
*LCS Duofix	582	4866	38026	1.53	0 - 2Yr: HR=1.76 (1.52, 2.04),p<0.001
	.	.	.	.	2Yr - 3.5Yr: HR=3.59 (3.06, 4.22),p<0.001
	.	.	.	.	3.5Yr - 4Yr: HR=4.88 (3.64, 6.53),p<0.001
	.	.	.	.	4Yr - 4.5Yr: HR=4.03 (2.86, 5.66),p<0.001
	.	.	.	.	4.5Yr - 5.5Yr: HR=4.50 (3.55, 5.69),p<0.001
	.	.	.	.	5.5Yr - 6.5Yr: HR=2.85 (2.09, 3.89),p<0.001
	.	.	.	.	6.5Yr+: HR=1.45 (1.10, 1.92),p=0.009
*LCS PS	55	638	3332	1.65	Entire Period: HR=2.38 (1.83, 3.10),p<0.001
*Renasys	15	121	1105	1.36	Entire Period: HR=2.44 (1.47, 4.04),p<0.001

Note: Components have been compared to all other total knee components
* Femoral Component
** 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	16 Yrs
Newly Identified					
**Legion Revision Tibial Baseplate	3.1 (1.9, 5.1)	4.9 (3.2, 7.4)	6.5 (4.4, 9.5)		
Re-Identified and Still Used					
ACS (cless)/ACS Fixed	1.7 (1.1, 2.6)	6.6 (5.1, 8.5)			
Active Knee (cless)/Active Knee	1.1 (0.9, 1.4)	3.5 (3.1, 4.0)	5.0 (4.5, 5.6)	8.4 (7.7, 9.3)	
Advance/Advance	2.0 (1.2, 3.4)	4.6 (3.2, 6.5)	5.0 (3.6, 7.1)	8.4 (5.3, 13.2)	
Columbus/Columbus	1.9 (1.3, 2.9)	6.0 (4.7, 7.6)	7.7 (6.2, 9.5)	11.6 (9.2, 14.7)	
E.Motion/E.Motion	2.5 (1.7, 3.8)	6.1 (4.6, 8.1)	6.3 (4.8, 8.4)		
Optetrak-PS/Optetrak	1.5 (1.1, 2.0)	4.7 (3.9, 5.6)	6.4 (5.5, 7.5)	9.9 (8.5, 11.4)	
Optetrak-PS/Optetrak-RBK	2.1 (1.3, 3.2)	5.4 (4.1, 7.2)	6.8 (5.2, 8.8)	11.1 (8.4, 14.5)	
Score (cless)/Score (cless)	1.5 (1.0, 2.2)	5.2 (4.2, 6.5)	7.2 (5.9, 8.8)		
Scorpio NRG PS (cless)/Series 7000 (cless)	1.3 (0.8, 2.3)	5.8 (4.5, 7.5)	7.3 (5.8, 9.2)		
Trekking/Trekking	2.4 (1.5, 3.9)	4.0 (2.7, 5.9)	5.8 (3.8, 8.8)		
Vanguard PS/Maxim	1.8 (1.5, 2.3)	4.4 (3.8, 5.1)	5.5 (4.8, 6.3)	7.2 (6.0, 8.7)	
Vanguard PS/Regenerex	3.0 (1.6, 5.7)	4.7 (2.7, 8.0)	4.7 (2.7, 8.0)		
Identified and no longer used					
ACS/ACS Mobile PC (cless)	7.7 (4.2, 13.8)	18.6 (12.9, 26.5)			
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)	13.2 (8.9, 19.4)
Buechel-Pappas/Buechel-Pappas	1.9 (1.0, 3.6)	5.5 (3.8, 8.0)	7.7 (5.6, 10.5)		
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)	9.5 (6.3, 14.0)	12.6 (8.7, 18.0)	
Genesis II Oxinium CR (cless)/Genesis II	11.9 (7.1, 19.7)	39.2 (30.7, 49.1)	40.2 (31.6, 50.1)	41.2 (32.5, 51.2)	
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)	14.5 (10.8, 19.3)	18.7 (14.5, 23.9)	22.3 (17.7, 27.8)	
HLS Noetos/HLS Noetos	3.4 (1.8, 6.2)	8.6 (5.9, 12.4)	10.8 (7.7, 14.9)		
IB II/IB II	0.0 (0.0, 0.0)	3.6 (1.7, 7.3)	7.8 (4.8, 12.7)	15.4 (10.9, 21.5)	
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)	6.4 (5.6, 7.4)	10.9 (9.4, 12.7)	
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	1.8 (0.7, 4.6)	6.3 (3.8, 10.4)	8.6 (5.5, 13.1)	10.9 (7.4, 15.8)	
Profix/Profix Mobile	2.3 (1.5, 3.4)	6.4 (5.0, 8.1)	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)	10.9 (8.6, 13.8)	
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)	9.6 (8.8, 10.5)	12.9 (11.9, 13.9)	
*LCS PS	2.1 (1.2, 3.5)	6.7 (5.0, 9.0)	8.8 (6.7, 11.3)		
*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
Newly Identified	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
**Legion Revision Tibial Baseplate	.	.	.	.	16	33	48	40	56	47	63	54	47	38	50
Re-Identified and Still Used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
ACS (cless)/ACS Fixed	.	.	.	.	.	.	.	.	.	41	119	283	337	332	238
Active Knee (cless)/Active Knee	221	613	790	693	466	510	483	412	479	601	500	427	318	335	176
Advance/Advance	54	.	8	12	16	2	5	43	115	138	74	7	92	91	98
Columbus/Columbus	.	.	.	49	91	90	148	156	134	136	108	69	36	60	117
E.Motion/E.Motion	.	.	.	.	.	.	.	12	87	114	129	236	106	113	124
Optetrak-PS/Optetrak	126	130	155	252	253	216	168	202	198	202	200	151	117	202	206
Optetrak-PS/Optetrak-RBK	.	.	.	1	81	173	166	119	82	40	37	50	100	56	46
Score (cless)/Score (cless)	.	.	.	1	.	11	135	212	187	204	195	238	252	249	152
Scorpio NRG PS (cless)/Series 7000 (cless)	.	.	.	.	.	76	185	171	166	114	67	71	76	72	76
Trekking/Trekking	.	.	.	.	.	.	.	.	35	102	133	107	108	106	129
Vanguard PS/Maxim	.	.	.	22	82	146	318	424	479	600	561	444	516	439	324
Vanguard PS/Regenerex	.	.	.	.	.	.	.	4	121	54	27	15	21	18	74
Identified and no longer used	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
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	.	.	.	.	843	1636	1532	854	1	.	.	.	.	.	.
*LCS PS	.	.	.	.	.	.	8	157	203	109	51	69	39	2	.
*Renasys	.	.	.	51	53	3	14	.	.	.	.	.	.	.	.

Note: * Femoral Component
** Tibial Component

Figure IP6 Cumulative Percent Revision of Newly Identified Individual Total Knee Prostheses

Newly identified

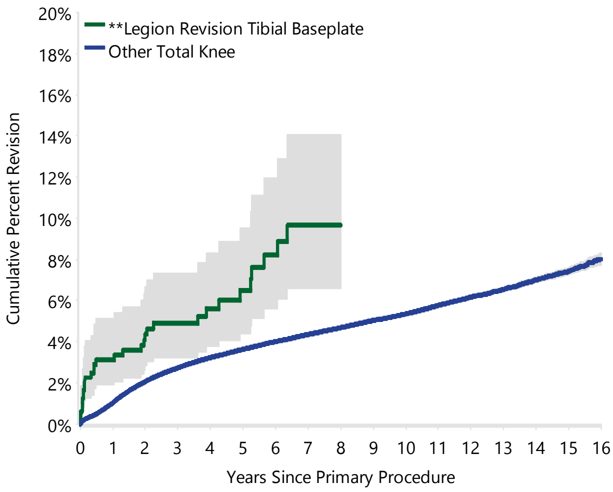
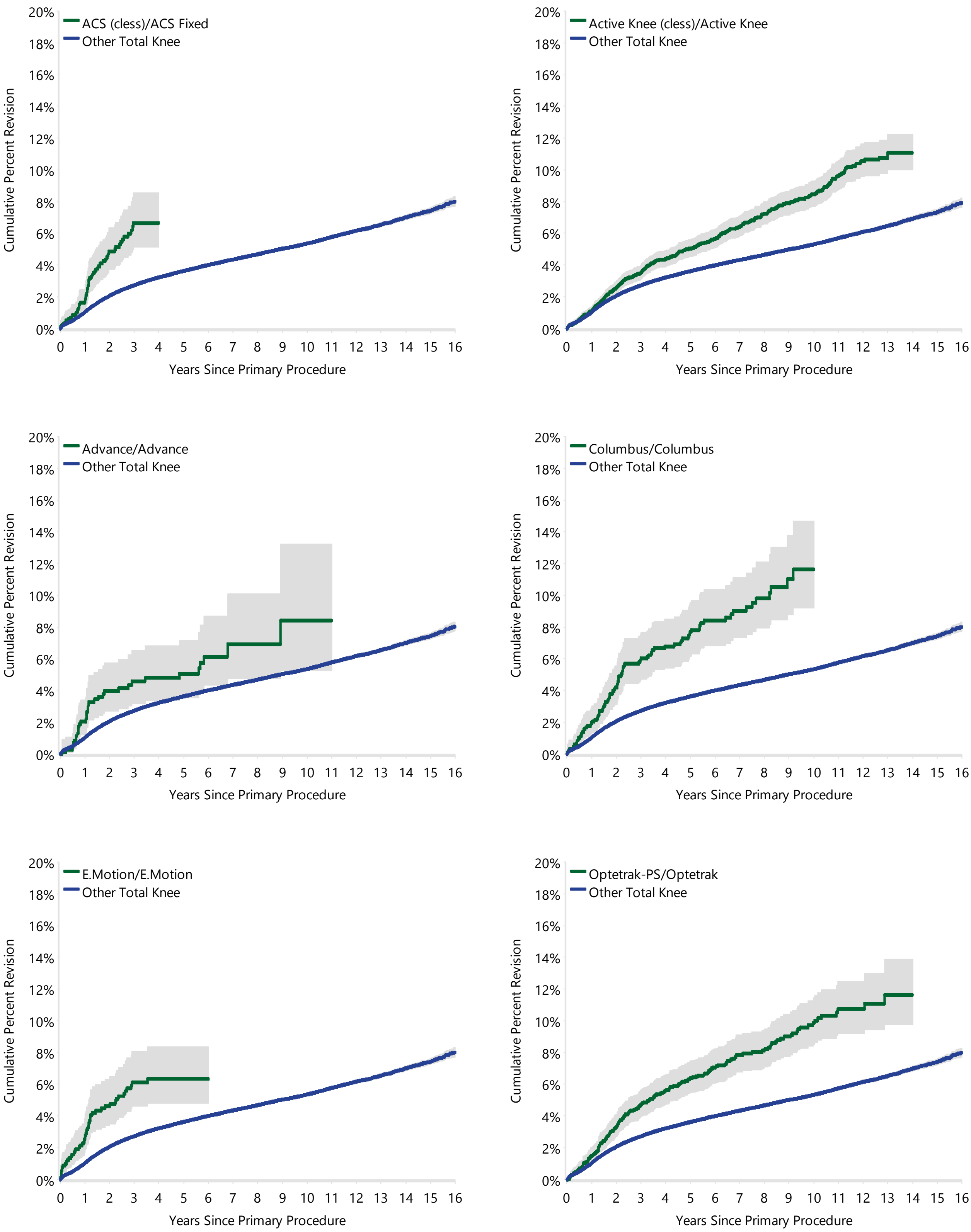
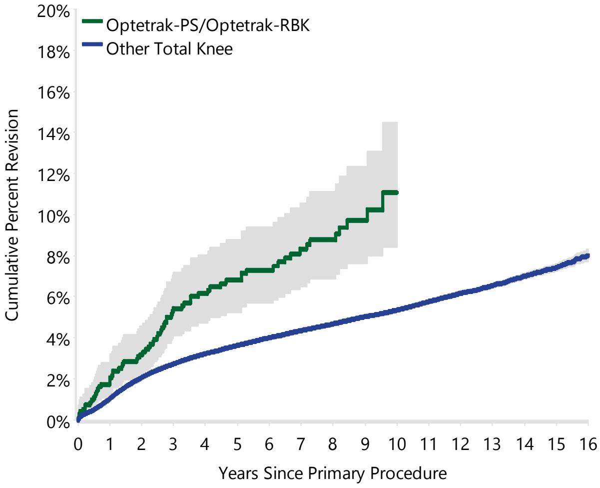
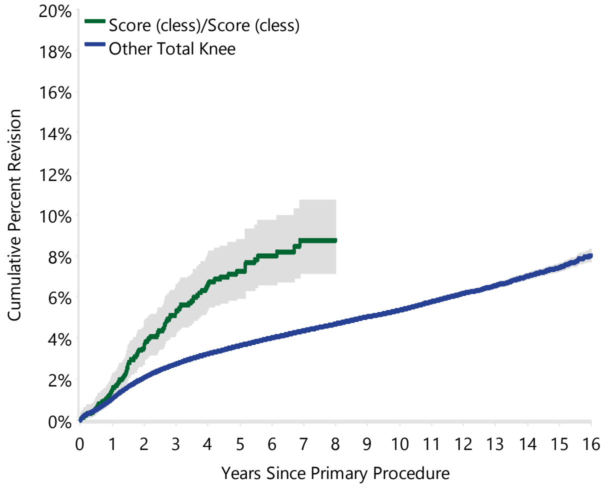


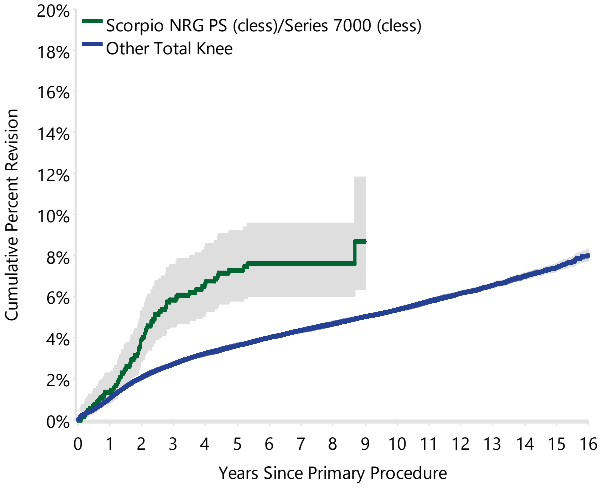
Figure IP7 Cumulative Percent Revision of Re-identified and still used Individual Total Knee Prostheses

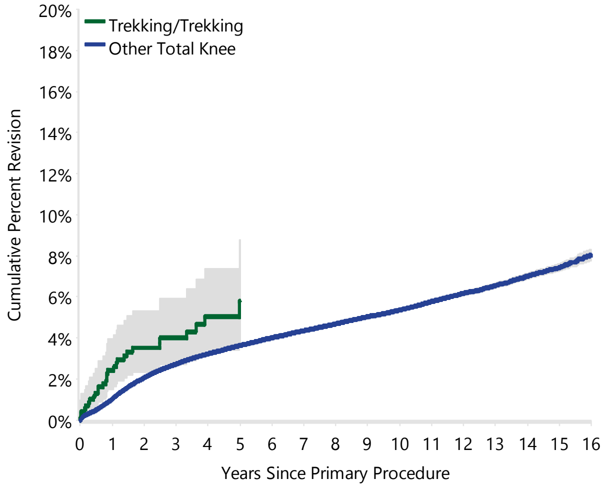
Re-identified and still used

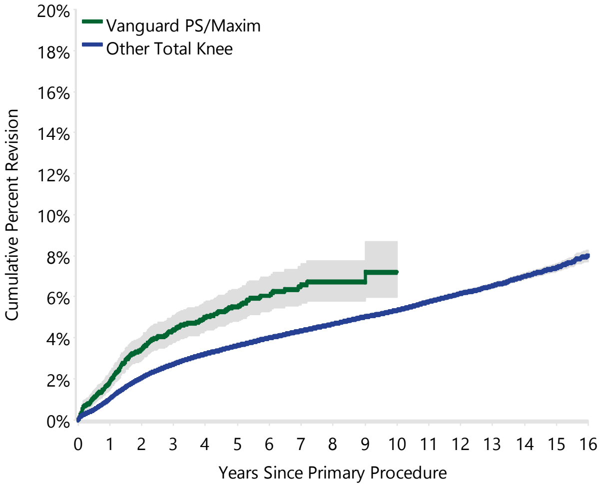


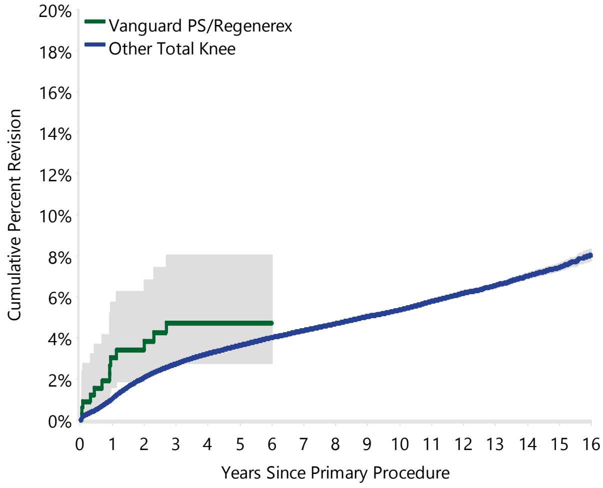

Optetrak-PS/Optetrak-RBK
Other Total Knee
Cumulative Percent Revision
Years Since Primary Procedure
0% 2% 4% 6% 8% 10% 12% 14% 16% 18% 20%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16


Score (cless)/Score (cless)
Other Total Knee
Cumulative Percent Revision
Years Since Primary Procedure
0% 2% 4% 6% 8% 10% 12% 14% 16% 18% 20%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16


Scorpio NRG PS (cless)/Series 7000 (cless)
Other Total Knee
Cumulative Percent Revision
Years Since Primary Procedure
0% 2% 4% 6% 8% 10% 12% 14% 16% 18% 20%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16


Trekking/Trekking
Other Total Knee
Cumulative Percent Revision
Years Since Primary Procedure
0% 2% 4% 6% 8% 10% 12% 14% 16% 18% 20%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16


Vanguard PS/Maxim
Other Total Knee
Cumulative Percent Revision
Years Since Primary Procedure
0% 2% 4% 6% 8% 10% 12% 14% 16% 18% 20%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16


Vanguard PS/Regenerex
Other Total Knee
Cumulative Percent Revision
Years Since Primary Procedure
0% 2% 4% 6% 8% 10% 12% 14% 16% 18% 20%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

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	9	62	242	3.71	Entire Period: HR=2.15 (1.11, 4.17),p=0.023
Global Unite/Global Unite	20	150	291	6.88	Entire Period: HR=2.23 (1.41, 3.52),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

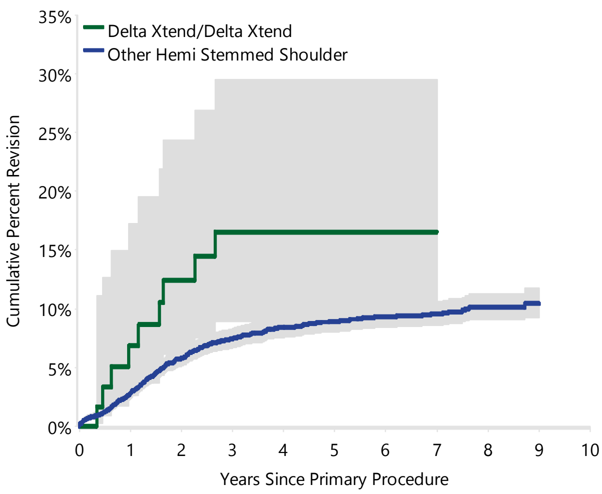
CPR	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Re-Identified and Still Used					
Delta Xtend/Delta Xtend	6.9 (2.6, 17.2)	16.5 (8.9, 29.5)	16.5 (8.9, 29.5)	16.5 (8.9, 29.5)	
Global Unite/Global Unite	4.5 (2.0, 9.7)				

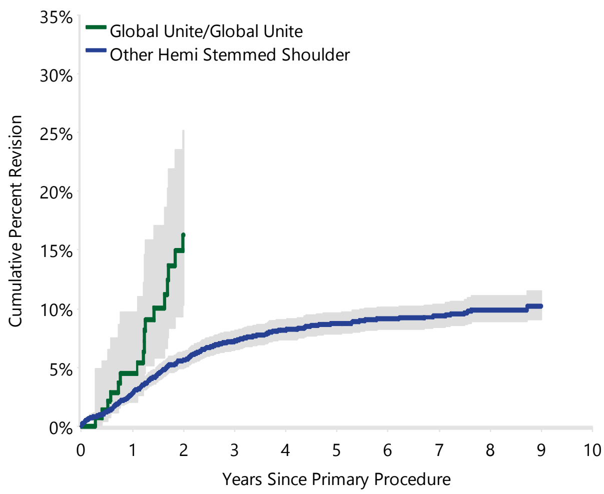
Table IP24 Yearly Usage of Individual Hemi Stemmed Shoulder Prostheses Identified as having a Higher than Anticipated Rate of Revision

Year of Implant	≤2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Re-Identified and Still Used	.	.	.	.	.	.	.	.	.	.
Delta Xtend/Delta Xtend	2	5	9	9	5	10	7	6	5	4
Global Unite/Global Unite	.	.	.	.	.	15	37	25	38	35

Figure IP8 Cumulative Percent Revision of Re-Identified and Still Used Hemi Stemmed Shoulder Prostheses

Re-Identified and still used





PRIMARY TOTAL SHOULDER REPLACEMENT

TOTAL CONVENTIONAL

There are no newly identified total conventional shoulder prostheses.

Table IP25 Revision Rate of Individual Total Conventional 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	199	1765	6888	2.89	0 - 1.5Yr: HR=2.39 (1.95, 2.95),p<0.001
	.	.	.	.	1.5Yr+: HR=1.37 (1.06, 1.78),p=0.016
Identified and no longer used	.	.	.	.	
SMR/SMR L2	264	856	3873	6.82	0 - 6Mth: HR=3.11 (2.12, 4.55),p<0.001
	.	.	.	.	6Mth - 1.5Yr: HR=5.19 (3.99, 6.76),p<0.001
	.	.	.	.	1.5Yr+: HR=8.01 (6.47, 9.91),p<0.001
Univers 3D/Univers 3D	12	34	232	5.18	Entire Period: HR=3.83 (2.16, 6.79),p<0.001
Vaios/Vaios	15	36	136	11.0	Entire Period: HR=6.21 (3.73, 10.37),p<0.001

Note: Components have been compared to all other total conventional shoulder components

Table IP26 Cumulative Percent Revision of Individual Total Conventional Shoulder Prostheses Identified as having a Higher than Anticipated Rate of Revision

CPR	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Re-Identified and Still Used					
SMR/SMR L1	5.8 (4.8, 7.0)	10.8 (9.4, 12.5)	12.7 (10.9, 14.6)	14.2 (12.3, 16.5)	
Identified and no longer used					
SMR/SMR L2	9.5 (7.7, 11.7)	22.2 (19.6, 25.2)	29.8 (26.8, 33.0)		
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)	41.6 (26.6, 60.7)		

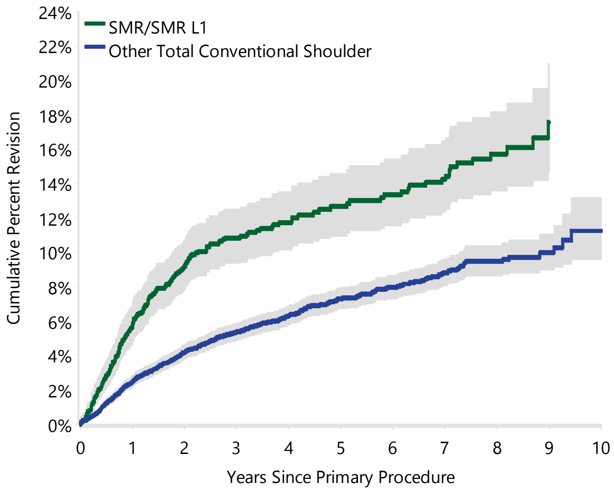
Table IP27 Yearly Usage of Individual Total Conventional Shoulder Prostheses Identified as having a Higher than Anticipated Rate of Revision

Year of Implant	≤2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Re-Identified and Still Used	.	.	.	.	.	.	.	.	.	.
SMR/SMR L1	135	237	247	.	.	157	301	255	239	194
Identified and no longer used	.	.	.	.	.	.	.	.	.	.
SMR/SMR L2	.	.	43	343	336	134	.	.	.	.
Univers 3D/Univers 3D	23	11	.	.	.	.	.	.	.	.
Vaios/Vaios	.	.	.	.	16	17	2	1	.	.

Note: The SMR L1 was not used in 2010 and 2011 due to the exclusive use of the SMR L2 in total conventional shoulder replacement

Figure IP9 Cumulative Percent Revision of Re-identified and still used Individual Total Conventional Shoulder Prostheses

Re-identified and still used



PRIMARY TOTAL REVERSE SHOULDER REPLACEMENT

There are no newly identified total reverse shoulder prostheses.

Table IP28 Revision Rate of Individual Total Reverse Shoulder Prostheses Identified as having a Higher than Anticipated Rate of Revision

Humeral Stem/Glenoid	N Revised	N Total	Obs. Years	Revisions/100 Obs. Yrs	Hazard Ratio, P Value
Re-Identified and Still Used	.	.	.	.	
SMR/SMR L1	172	3739	10224	1.68	Entire Period: HR=1.40 (1.17, 1.68),p<0.001

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	10 Yrs
Re-Identified and Still Used					
SMR/SMR L1	3.8 (3.2, 4.5)	4.9 (4.2, 5.7)	5.8 (4.9, 7.0)	6.6 (5.4, 8.0)	

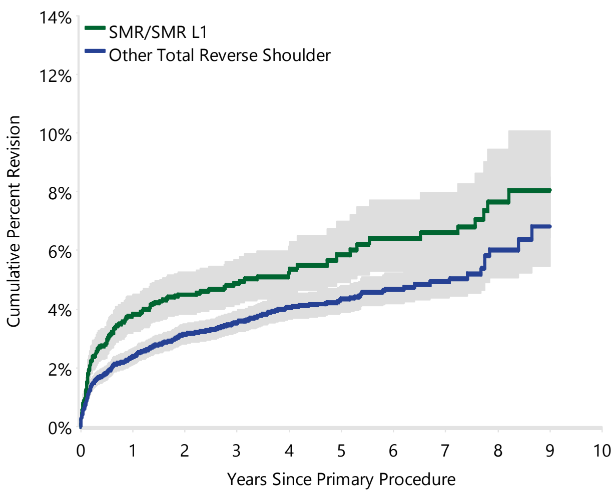
Table IP30 Yearly Usage of Individual Total Reverse Shoulder Prostheses Identified as having a Higher than Anticipated Rate of Revision

Year of Implant	≤2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Re-Identified and Still Used	.	.	.	.	.	.	.	.	.	.
SMR/SMR L1	145	261	271	.	.	249	562	627	727	897

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

Figure IP10 Cumulative Percent Revision of Re-identified and still used Individual Total Reverse Shoulder Prostheses

Re-identified and still used



PRIMARY TOTAL ANKLE REPLACEMENT

There are no newly identified total ankle prosthesis.

Table IP1 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
Re-Identified and Still Used	.	.	.	.	
S.T.A.R/S.T.A.R	7	48	145	4.83	Entire Period: HR=2.28 (1.07, 4.88),p=0.033

Note: Components have been compared to all other ankle components

Table IP2 Cumulative Percent Revision of Individual Total Ankle Prostheses Identified as having a Higher than Anticipated Rate of Revision

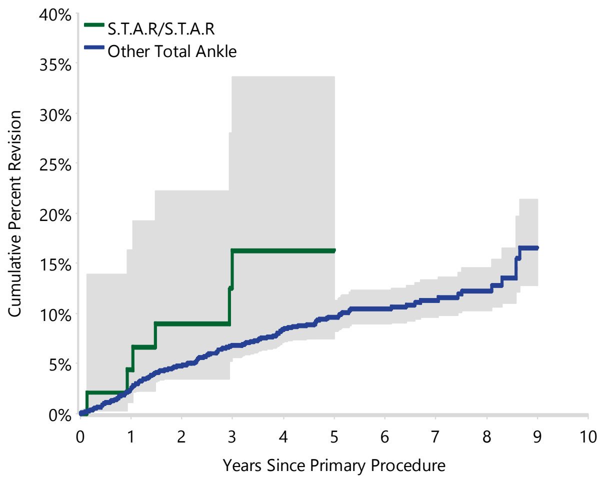
CPR	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs
Re-Identified and Still Used					
S.T.A.R/S.T.A.R	4.4 (1.1, 16.4)	16.3 (7.4, 33.6)	16.3 (7.4, 33.6)		

Table IP3 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
Re-Identified and Still Used	.	.	.	.	.	.	.	.	.	.
S.T.A.R/S.T.A.R	1	.	3	3	4	2	15	12	4	4

Figure IP1 Cumulative Percent Revision of Re-identified and still used Individual Total Ankle Prostheses

Re-Identified and still used



Appendices

Appendices

APPENDIX 1

PARTICIPATING HOSPITALS & COORDINATORS

VICTORIA

PUBLIC HOSPITALS

Austin Health	Ross Kentish/Bev Murray
Bairnsdale Regional Health Service	Sian Guns
Ballarat Health Services	Bernie Anderson/Kellie Livingston
Bass Coast Regional Health	Debbie Rogers/Simonne Liberman
Bendigo Health Care Group	Catherine Jensen/Shelly Sharp
Box Hill Hospital	Lisa Bingham
Cohuna District Hospital	Karyn Storm
Colac Area Health	Amanda Tout
Dandenong Hospital	Karen Ferguson/Melanie Murray
Djerriwarrh Health Services	Kate Anderson/Judy Dehnert
East Grampians Health Service	Jane Smith/Jenny Sargent
Echuca Regional Health	Kerryn Giorgianni
Goulburn Valley Health	Cara Disint
Hamilton Base Hospital	Rosalie Broadfoot
Kerang District Health	Margie Christian
Kyabram & District Health Services	Lynda Walker
Latrobe Regional Hospital	Simone Lovison
Maroondah Hospital	Satish Singh
Mildura Base Hospital	Katrina Allen
Monash Medical Centre, Clayton	Jessica Cranston
Monash Medical Centre, Moorabbin	Carol Jackson/Lisa Mason
Northeast Health Wangaratta	Lynn Reid/Larissa Benci
Peninsula Health Service, Frankston	Donna Anderson
Portland Hospital	Julie Sealey
Sandringham & District Memorial	Rebecca Harouche/Trang Le
Seymour District Memorial Hospital	Karen Lamaro
South West Healthcare	Tony Kelly
St Vincent's Public Hospital	Shazeli Osman/Ridwaan Khan
Stawell Regional Health	Sue Campigli/Judy Body
Sunshine Hospital	Cassandra Mules
Swan Hill District Hospital	Helen Wilkins
The Alfred	Caroline McMurray
The Northern Hospital	Siew Perry
The Royal Children's Hospital	Sonia Mouat
The Royal Melbourne Hospital	Brychelyn Bennett
Uni Hospital Geelong Barwon Health	David Barber/Michelle Quinn
West Gippsland Healthcare Group	Stefanie Backman/Bernie Norman
West Wimmera Health Service	Sharon Sanderson/Christine Dufty
Western Hospital	Vicki Mahaljcek/Cassandra Mules
Williamstown Hospital	Paul Buso/Maureen Clark
Wimmera Health Care Group	Maree Markby

PRIVATE HOSPITALS

Beleura Private Hospital	Jean Leyland
Bellbird Private Hospital	Belinda Van Denberg
Cabrini Private Hospital, Brighton	Sandy Scherer
Cabrini Private Hospital, Malvern	Sandy Scherer
Como Private Hospital	Gillian Wilson/Nicole Groves
Cotham Private Hospital	Marianne Westley
Epworth Hospital	Lynne Moyes
Epworth Eastern Hospital	Kylie Longley/Janine Cope
Epworth Freemason Hospital	Claudia Nozzolillo
Epworth Geelong	Dianne Buttigieg/Julia Castro
Essendon Private Hospital	Elaine Jordan
Frankston Private Hospital	Tracey McIndoe
Geelong Private Hospital	Wilna Steyn
Glenferrie Private Hospital	Samantha Jervios
John Fawkner Hospital	Belinda Emmett
Knox Private Hospital	Bronwyn Hawkins/Laura Tilley
Linacre Private Hospital	Melissa Dillon/Denice Tyler
Maryvale Private Hospital	Glenda Chambers
Masada Private Hospital	Anna Bonato/Lisa Butler
Melbourne Private Hospital	Karen Grant/Tracey Perkins
Mildura Private Hospital	Sue Malcolm
Mitcham Private Hospital	Julie Nankivell/Joshie Lonthyil
Northpark Private Hospital	Kath Morris
Peninsula Private Hospital	Ruth Honan
Ringwood Private Hospital	Carol Burns
Shepparton Private Hospital	Niki Miller
St John of God Ballarat Hospital	Gitty Mathachan
St John of God Bendigo Hospital	Margaret Brown/Alanna Sheehan
St John of God Geelong Hospital	Colin Hay
St John of God Warrnambool	Leanne McPherson/Gill Wheaton
St John of God Hospital, Berwick	Rebecca Jamieson
St Vincent's Private East Melb	Jan Gammon
St Vincent's Private Fitzroy	Naomi Carter/Deanna Dellevirgini
St Vincent's Private Kew	Joy Miller/Sue Zidziunas
The Avenue Hospital	John Davidson
The Bays	Romany Goonan
The Melbourne East Private	Jay Phillpotts
The Valley Private Hospital	Anthony Puzon
Wangaratta Private Hospital	Janet McKie
Warringal Hospital	Marilyn Dey/Jodie Werkowski
Waverley Private Hospital	Alfred Monleon
Western Private Hospital	Abbie Grech

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/L Black/A Baker
Sutherland Hospital	Sara Hogan
Tamworth Base Hospital	David Marsh
The Children's Hospital Westmead	Ariella Galstaun
The Prince of Wales Hospital	F O'Brien/L Robertson/C Noema
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	Karla Hannaford
Bathurst Private Hospital	Diane Carter
Berkeley Vale Private Hospital	Michelle Turner
Brisbane Waters Private Hospital	Adele Ryan
Calvary Health Care Riverina	Annette Somerville
Campbelltown Private Hospital	Yvonne Quinn
Dalcross Adventist Hospital	Anne Carroll/Kerrie Legg
Delmar Private Hospital	Cathy Byrne
Dubbo Private Hospital	Sallie Cross/Kim Troth
Dudley Private Hospital	Michele Englart/Pam Fullgrabe
East Sydney Private	Dane Browne/Jane Telfer
Forster Private Hospital	Margaret Parish
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	Tanja Radic
Lake Macquarie Private Hospital	Edward Miles/Fiona Lindsay
Lingard Private Hospital	Nicole Garland/Ian Jones
Maitland Private Hospital	Martine Mead/Joanne Chalmers
Macquarie University Hospital	Julie Guthrie
Mayo Private Hospital	Janet Hickman
National Day Surgery Sydney	Stephanie Schofield/Kerry Gardner
Nepean Private Hospital	Lauren Bradford
Newcastle Private Hospital	Darren Fogarty
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	Robbie Bentley
St Vincent's Private Darlinghurst	Fiona Crawford/ Vivien Law
St Vincent's Private Lismore	Janelle Hospers
Strathfield Private Hospital	John Mati
Sydney Adventist Hospital	Jill Parker/Melissa Ng
Sydney Private Hospital	Margaret Haughton
Sydney South West Private	Lucy Richardson
Tamara Private Hospital	Kris Wall
The Mater Hospital	Namor Guerrero
The Prince of Wales Private	Ellaine Perez/Paula Civit Diez
Toronto Private Hospital	Stephanie Keys
Waratah Private Hospital	Kim Bassot
Warners Bay Private Hospital	Annette Harrison
Westmead Private Hospital	Katrina Teren
Wollongong Private Hospital	Kim Dyer/Mandy Holmes

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	Elaine Loots
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	Craig Steains
Nambour General Hospital	Fiona Tognolini
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
Caboolture Private Hospital	Dee Ireland
Cairns Private Hospital	Louisa Smit
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	Paula Archer
Mater Health Services North Qld	Jo Humphreys/Anjela Hunt
Mater Misericordiae Bundaberg	Catherine Hackney
Mater Misericordiae Gladstone	Saroj Saini
Mater Misericordiae Mackay	Judith McDonald
Mater Misericordiae Rockhampton	Michelle Havik/Tim Harkin
Mater Misericordiae Private Hospital	Justine Jones
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 Simmers
St Vincent's Hospital, Toowoomba	Judy Plotecki
Sunnybank Private Hospital	Francina Robinston
Sunshine Coast University Private	Tanya Prothero
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	Nicolle Turton
South Perth Hospital	Deb Waters
St John of God Health Care Bunbury	Alison Hawkes
St John of God Health Care Geraldton	Teresa Wood
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	Andy Sullivan
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 Lewington
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	Brooke Drechsler
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/M Odgaard
St Andrew’s Private Hospital	H Crosby/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	Rebecca Covington

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

NORTHERN TERRITORY

PUBLIC HOSPITALS

Alice Springs Hospital	Debra Mullan
Royal Darwin Hospital	Tanya Anderson/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.

Confidence Interval: A set of values for a summary measure, such as a rate or rate ratio, constructed so the set has a specified probability of including the true value of the measure. The specified probability is called the confidence interval, the end points are called lower and upper confidence limits; 95% confidence intervals are most common.

Cox Model or Proportional Hazards Model: A statistical model that relates the hazard for an individual at any time *t* to an (unspecified) baseline hazard and a set of predictor variables, such as treatment type, age, gender etc. The Cox model produces hazard ratios that allow comparisons between groups of the rate of the event of interest. The main assumption of a Cox model is that the ratio of hazards between groups that we wish to compare does not vary over time. If the hazard for prosthesis Model A is twice that of prosthesis Model B at three years, it will also be twice at four years, and so on. This is referred to as the 'proportional hazards assumption'. If the hazard ratio is not proportional over the entire time of observation, then a time varying model is used, which estimates a separate hazard ratio within each pre-defined time period. Within each time period, the hazards are proportional. The Registry uses a set algorithm which iteratively chooses time points until the assumption of proportional hazards is met for each time period. The time points are selected based on where the greatest change in hazard occurs between the two comparison groups, weighted by the number of events in that time period.

Cumulative Incidence Function: An estimator of the actual probability of revision in the presence of a competing risk. In these circumstances, the Kaplan-Meier estimate, which treats competing risks as censored, overestimates the true probability. In the competing risks paradigm, patients who have already had a revision or died are excluded from the set at risk of being revised. Under Kaplan-Meier only patients who have already been revised are excluded from the risk set; dead patients are analysed as though they are still at risk of revision.

Cumulative Percent Revision: Otherwise known as the 'cumulative failure rate'. This is defined as 100 x [1- S(*t*)] where S(*t*) is the survivorship probability estimated by the Kaplan-Meier method (see survival curve, below). The cumulative percent revision gives the percent of procedures revised up until time *t*, and allows for right censoring due to death (but see Cumulative Incidence Function above) or closure of the database for analysis.

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 (31/12/2016) 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 1/1/2016 was revised on 1/7/2016. 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 1/1/2016 died without being revised on 1/4/2016. This procedure contributes 0.25 component years.
A primary procedure occurs on 1/1/2016 and has not been revised. This procedure contributes 1 component year (as observation time is censored at 31/12/2016).

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.

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.

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, Mr Ian Harris
Assistant Deputy Director, Mr James Stoney
Assistant Deputy Director, Bill Donnelly
Manager, Ms Cindy Turner
Research Coordinator, Dr Sophia Rainbird
Administration Assistant, Ms Rychelle Brittain
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 2017. An amendment was approved in 2017 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) or alternatively the Australian Government, Office of the Privacy Commissioner on 1300 363 992

APPENDIX 6

IMPLEMENTATION OF NATIONAL JOINT REPLACEMENT REGISTRY FOR HIP, KNEE & SHOULDER

The Registry was implemented in a staged manner on a state-by-state basis. The table below shows the commencement date for each state. Implementation was completed nationally by mid 2002, therefore 2003 was the first year of complete national data. National data collection on shoulder replacement commenced in November 2007.

State/Territory	Commencement Date
South Australia	September 1999
Queensland	April 2000
Western Australia	April 2000
Victoria	July 2000
Tasmania	September 2000
Northern Territory	October 2000
Australian Capital Territory	May 2001
New South Wales	June 2001

APPENDIX 7

ICD-10-AM CODES

HIP REPLACEMENT

PARTIAL HIP REPLACEMENT

49315-00	Partial arthroplasty (excludes Austin-Moore)
47522-00	Austin-Moore

PRIMARY TOTAL HIP REPLACEMENT

49318-00	Total arthroplasty of hip unilateral
49319-00	Total arthroplasty of hip bilateral
90607-00 [1489]	Resurfacing of hip, unilateral
90607-01 [1489]	Resurfacing of hip, bilateral

REVISION HIP REPLACEMENT

49312-00	Excision arthroplasty of hip (removal of prosthesis without replacement)
49324-00	Revision of total arthroplasty of hip
49327-00	Revision of total arthroplasty with bone graft to acetabulum
49330-00	Revision of total arthroplasty with bone graft to femur
49333-00	Revision of total arthroplasty with bone graft to acetabulum and femur
49339-00	Revision of total arthroplasty of hip with anatomic specific allograft to acetabulum
49342-00	Revision of total arthroplasty of hip with anatomic specific allograft to femur
49345-00	Revision of total arthroplasty with anatomic specific allograft to acetabulum & femur
49346-00	Revision of partial arthroplasty hip replacement

KNEE REPLACEMENT

PARTIAL KNEE REPLACEMENT

Patellofemoral Knee Replacement

49534-01	Total replacement arthroplasty of patellofemoral joint of knee

Unicompartmental Knee Replacement

49517-00	Hemi arthroplasty of knee

PRIMARY TOTAL KNEE REPLACEMENT

49518-00	Total arthroplasty of knee unilateral
49519-00	Total arthroplasty of knee bilateral
49521-00	Total arthroplasty of knee with bone graft to femur unilateral
49521-01	Total arthroplasty of knee with bone graft to femur bilateral
49521-02	Total arthroplasty of knee with bone graft to tibia unilateral
49521-03	Total arthroplasty of knee with bone graft to tibia bilateral
49524-00	Total arthroplasty of knee with bone graft to femur and tibia unilateral
49524-01	Total arthroplasty of knee with bone graft to femur and tibia bilateral

REVISION KNEE REPLACEMENT

49512-00	Arthrodesis with removal of prosthesis
49515-00	Removal-prostheses from knee
49527-00	Revision of total arthroplasty of knee excluding patellar resurfacing
49530-00	Revision of total arthroplasty of knee with bone graft to femur
49530-01	Revision of total arthroplasty of knee with bone graft to tibia
49533-00	Revision of total arthroplasty of knee with bone graft to femur and tibia
49554-00	Revision of total arthroplasty of knee with anatomic specific allograft
90562-00	Patellar resurfacing

SHOULDER REPLACEMENT

PARTIAL SHOULDER REPLACEMENT

48915-00	Hemiarthroplasty of shoulder

TOTAL SHOULDER REPLACEMENT

48918-00	Total arthroplasty of shoulder

REVISION SHOULDER REPLACEMENT

48921-00	Revision of total joint replacement of shoulder
48924-00	Revision of total joint replacement of shoulder with bone graft
48927-00	Removal of shoulder prosthesis
48942-00	Arthrodesis and removal of shoulder prosthesis

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