

# NATIONAL JOINT REPLACEMENT REGISTRY



AOA

AUSTRALIAN  
ORTHOPAEDIC  
ASSOCIATION

Lay Summary  
Hip and Knee Replacement



SUPPLEMENTARY  
REPORT  
**2018**



# TABLE OF CONTENTS

- Introduction..... 2**
- A brief history of the Registry origins..... 3**
- The purpose of the Registry ..... 3**
  - Investigations of Prostheses with Higher than Anticipated Rates of Revision ..... 4*
  - How the Registry works ..... 4*
  - Who funds the Registry..... 5*
  - The format of the 2018 Annual Report for Hip, Knee and Shoulder Arthroplasty..... 5*
  - How the Registry presents the results..... 6*
    - Graphs ..... 6
    - Hazard Ratios..... 7
    - Tables ..... 8
- Ten and Fifteen Year Prosthesis Outcomes ..... 11**
- Hip Replacement..... 12**
  - Primary Partial Hip Replacement..... 12*
  - Primary Total Hip Replacement ..... 13*
- Knee Replacement ..... 17**
  - Primary Partial Knee Replacement..... 17*
  - Primary Total Knee Replacement..... 18*
- Hip and Knee Prostheses with a Higher than Anticipated Rate of Revision ..... 20**
- Conclusion ..... 21**

# Introduction

This summary is an explanation of the major findings of the Australian Orthopaedic Association National Joint Replacement Registry 2018 Annual Report for Hip, Knee and Shoulder Arthroplasty (replacement). This is the major clinical report produced by the Registry each year.

The Lay Summary is provided to ensure that a clear, concise and easily understood explanation of the published findings is available to all those who may be interested.

The Australian Orthopaedic Association (AOA) believes this is especially important because of the high level of community interest in the Registry and the need to ensure that reports are accessible to all.

The full version of the 2018 Annual Report on Hip, Knee and Shoulder Arthroplasty is available in the 'Publications' section of the Registry website.

This year's report involved the analysis of 1,355,938 primary and revision procedures (593,803 hip, 717,334 knee and 44,801 shoulder). This is the total number of hip, knee and shoulder replacement operations recorded by the Registry with a procedure date up to and including 31 December 2017. This is 118,362 additional hip, knee and shoulder procedures compared to the 2017 Annual Report.

In addition to Annual Report and this Lay Summary, there are a further 10 supplementary reports published by the Registry on the website:  
<https://aoanjrr.sahmri.com/annual-reports-2018>

## A brief history of the Registry origins

The AOA commenced the National Joint Replacement Registry in 1999. It was initially for hip and knee replacement only. This was a complex system to set up and therefore it took almost three years to fully implement the Registry across Australia. The Registry receives information from over 300 hospitals. Since mid-2002, the Registry has received information on almost all hip and knee replacements undertaken in Australia.

In November 2007, the Registry commenced national data collection on a number of additional types of joint replacement. This included shoulder joint replacement procedures, the analysis of which is presented along with hip and knee replacement in the main report. The other additional types of joint replacement that the Registry collects information on include elbow, wrist, ankle and spinal disc replacement. The analysis of these procedures is presented in the supplementary reports available on the Registry website.

## The purpose of the Registry

The AOA started the Registry to improve the results of joint replacement surgery in Australia. Generally, this type of surgery is very successful, but as with all areas of healthcare, there is always room for improvement. Since the Registry commenced data collection there has been improvement in the outcomes of this surgery.

One of the most serious consequences of a less than successful operation is the need to have a revision (redo) operation. The Registry provides information to assist surgeons keep the number of these operations to a minimum. It does this by identifying those things that work best and highlighting what can be improved.

Prior to establishing the Registry, Australian orthopaedic surgeons felt they had a lack of detailed information on the results of the many different procedures and types of joint replacement available. In particular, the surgeons required information to compare the impact of the many different factors known to influence the results for their patients.

Surgeons have a large choice of different types of artificial joints that they can use to replace damaged and painful joints. There are also different techniques, which can be used to put these artificial joints in place. Surgeons know that there is variation in the results depending on the patient, the nature of the patient's problem, which joint is being replaced, the way the operation is performed, and the type of artificial joint replacement used.

### Supplementary Reports

The Registry publishes data in addition to that included in the Annual Report, in the following Supplementary Reports:

#### 1. Demographics of Hip, Knee and Shoulder Arthroplasty

This report details the age and gender profile of people receiving hip, knee or shoulder replacement and includes information on the reasons for undergoing replacement surgery.

#### 2. Cement in Hip and Knee Arthroplasty

This report details the use of the different types of cement in hip and knee replacement surgery.

#### 3. Mortality of Hip and Knee Arthroplasty

This report details the risk of dying following the different types of hip and knee replacement surgery.

#### 4. Revision of Hip and Knee Arthroplasty

This report details the outcome of revisions of hip and knee replacements.

#### 5. Metal on Metal Bearing Surface in Total Conventional Hip Arthroplasty

This report details the outcome of metal on metal bearings when used with large (greater than 32 mm) femoral heads.

#### 6. Prosthesis Types No Longer Used

This report details the outcomes of classes of hip and knee replacement that are no longer used and therefore do not appear in the main report.

#### 7. Demographics and Outcomes of Elbow and Wrist Arthroplasty

This report details the age and gender profile of people receiving elbow and wrist surgery and includes information on the reasons for undergoing these different types of joint replacement as well as some early information on the outcome of these operations.

#### 8. Demographics and Outcomes of Ankle Arthroplasty

This report details the age and gender profile of people receiving ankle joint replacement and includes information on the reasons for undergoing ankle replacement as well as some early information on the outcome of this operation.

#### 9. Demographics of Spinal Disc Arthroplasty

This report details the age and gender profile of people receiving spinal disc replacement and includes information on the reasons for undergoing this operation.

#### 10. Analysis of State and Territory Health Data – All Arthroplasty 1993/1994 – 2016/2017

#### Investigations of Prostheses with Higher than Anticipated Rates of Revision

Each year the Registry identifies prostheses that have a higher than anticipated rate of revision. This is a series of reports providing detailed information on each of the prostheses identified in the 2018 Annual Report.

The Registry is able to compare all of these different factors simultaneously. In doing so, it provides information to assist surgeons decide the best type of artificial joint replacement to use in any particular situation. The Registry is able to detail the results for different classes (or categories) of artificial joints and different individual types of artificial joints in each of the classes. It can also determine if patient age, gender, weight, general health and/or the reason a joint replacement is performed, affects the result.

It is important to emphasise that this is not the only information that is used to determine what the best approach should be. When providing advice to patients, surgeons will also rely on their training and experience as well as information from medical journals, other registries elsewhere in the world, conferences and courses they may attend, as well as learning from other surgeons.

**The Registry provides information to assist in deciding the best type of artificial joint replacement to use in any particular situation.**

When surgeons interpret information from the Registry they use their knowledge and experience to put that information into context. The Registry does not decide or recommend the best joint replacement for a particular patient. This can only ever be decided by the surgeon in consultation with the patient. In this way, all factors can be carefully taken into consideration.

### How the Registry works

The Registry collects a small amount of confidential information on each joint replacement operation undertaken in Australia, with the exception of those people who choose not to have their information collected by the Registry. The information collected includes details of the patient including age, gender, weight, general health the reason for the surgery, the joint that was replaced and whether it was on the right or left side. Information on the type of artificial joint replacement and the individual components used in the operation are also collected.

**Currently the Registry monitors and has information on over 1.3 million joint replacement operations.**

As previously mentioned, if a problem occurs following a joint replacement one of the possible outcomes is that the operation is redone. This is referred to as a revision procedure. The Registry is notified about the revision, records this information and links it to the first (or primary) operation. By doing this it is able to determine how many initial primary procedures have been revised, the reason for the revision, how long after the original surgery, and which of the components (if any) were replaced is also recorded.

### Who funds the Registry

The Commonwealth Government, through the Department of Health, funds the Registry. The Government and the Department have been very supportive of the Registry. They provided the initial funding to establish the Registry and have maintained its core funding since the Registry commenced.

### The format of the 2018 Annual Report for Hip, Knee and Shoulder Arthroplasty

When the Registry prepares the Annual Report each year it updates important information that it has reported previously. This is done in the routine chapters. In addition to the updates of information in these chapters there is often new information presented. The reason that this new information is included is because it is an area of interest which has not previously been covered or because the Registry has sufficient new data to present. For the routine hip, knee and shoulder chapters in this report we are reporting for the first time on the effect of a patients American Society of Anaesthesiologists (ASA) score and their Body Mass Index (BMI) on the outcomes of their joint replacement surgery. The ASA score is method of assessing a patient's fitness before surgery. All patients having surgery performed in Australia have this done. It is an indication of their general health. BMI is the most often used measure of body fat in health care. It is calculated using a combination of weight and height. It is a more accurate measure of body fat than just assessing a patient's weight because it also considers how tall they are.

The Annual Report also includes one or more new chapters which are on topics of importance that have not previously been reported in any detail. This year, the two new chapters are on the outcomes of hip and knee replacement in patients aged 80 years or older. The focus of these chapters was to look at how death (both early and late) after surgery, revision and reasons for revision differed in this group compared to younger patients. This was done for both primary (initial) joint replacement as well as if an older patient required a revision (redo) operation. The information presented also looked closely at the surgery itself and what techniques and prostheses could be used to increase the chance of getting the best result possible.

The remainder of this year's Annual Report includes the routine chapters. They contain an additional year of information on the results that the Registry has previously reported as well as some new information as previously mentioned. As with previous reports, there is a section on the outcome of those devices that have reached 10 and 15 year outcomes as well as sections on Primary Hip Replacement, Primary Knee Replacement, Primary Shoulder Replacement and Prostheses with Higher than Anticipated Rates of Revision.

The Primary Hip, Knee and Shoulder chapters are each divided into three sections: Introduction, Partial and Total. In order to manage the size of the report there are decisions made each year to remove some information that was previously reported. The usual reason for deciding to remove this information is because it is no longer relevant. The removed data often reflects previous approaches to joint replacement surgery which are no longer used. This information, however, is not lost. When information is removed it is added into the one of the supplementary reports which are all available from the website. Therefore, anything we have reported previously is still available and based on the most recent data. A good example of this is metal on metal bearing primary total conventional hip replacement. Although common a number of years ago, procedures using this bearing surface are now rarely done. This section was moved out of the main report a number of years ago, but the information remains, is updated each year and is available in a supplementary report.

The section on Prostheses with Higher than Anticipated Rates of Revision includes hip, knee and shoulder procedures. These are the prostheses that, for whatever reason, have a higher rate of revision compared to all the other prostheses in the same class.

There are many reasons why an individual prosthesis may have a higher rate of revision. Only some of these are related to the prosthesis. Prostheses identified in the higher than anticipated rate of revision section, are prostheses that have been individually reviewed by a group of joint replacement specialists who believe that the particular prosthesis should be highlighted in the report. Identification

by the Registry also initiates a process whereby the Australian regulatory body, the Therapeutic Goods Administration (TGA), assesses each of the individually identified prostheses to determine if they are still safe to use.

The Registry lists individual prostheses that have been identified as having two or more times the rate of revision when compared to all other prostheses that are similar in design. This difference also has to be significant (likely to be true). Summary data is presented in this chapter but a complete analysis of each of these prostheses can be found in the Investigation reports published in the supplementary section on the website.

### How the Registry presents the results

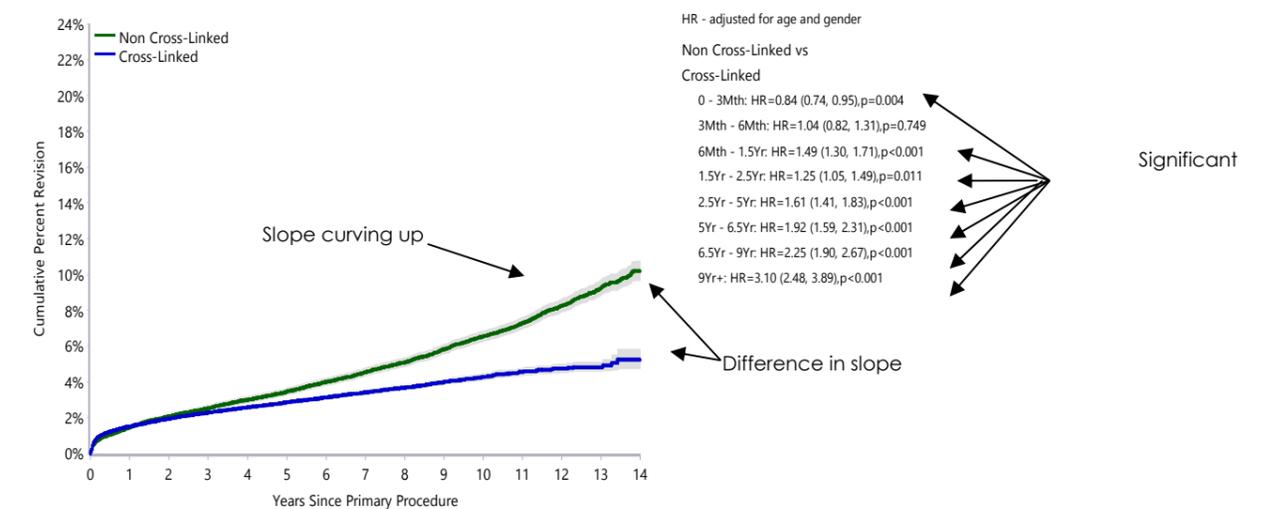
The fact that the Registry is a national database means it reports on the results of a very large number of operations, which improves the value of the information. Currently the Registry monitors and has information on over 1.3 million joint replacement operations.

The Registry presents the results in different ways. The clearest and most important way is by graphs and tables. We know the time until the redo (revision) operation and we can also calculate the percent of procedures that have been revised. This is known as the cumulative percent revision.

### GRAPHS

The graphs are used to look at and compare the difference between groups of interest. We plot the cumulative percent revision against the time (years) since the original surgery.

**Figure LS1 Example of a graph with Cumulative Percent Revision which compares the results of two different types of plastic commonly used in joint replacement surgery (cross-linked and non-cross-linked polyethylene).**



The lines on the graph represent the results for the factors being compared. The more the lines slope upwards the greater the number of revision (redo) operations that have been done. In general, the greater the difference in the slope of the lines the more important the difference. This graph shows that there are more revisions when non cross-linked polyethylene (the green line) is used compared to cross-linked polyethylene (the blue line).

The information on the right hand side of each of these graphs is important. This gives a measure of the amount of difference, how this is changing with time and how confident you can be that the difference is real. The most important information is the HR (hazard ratio) and the p (probability) value.

**HAZARD RATIOS**

The HR is an indication of the difference in the risk of revision. For example, if the HR=3, this means that there is a three times greater risk of being revised. If the HR=1, then this means that there is no difference. If the HR=0.5 then this means that that risk of revision is half.

The p value is a measure of the likelihood that a difference observed between groups being compared is real, rather than occurring by chance. In statistical terms, this is called significance. The difference is regarded as significant (in other words likely to be true) if a p value is smaller than 0.05. A p value of 0.05 means that there is a 1 in 20 chance that the difference is not true. A p value of 0.001 means that there is only a 1 in 1,000 chance that the difference is not true. In other words, it is more certain that the difference is real.

**Figure LS2 Example of a hazard ratio from a Registry graph**

HR adjusted for age and gender	
Non Cross-Linked vs Cross-Linked Polyethylene	
0-3Mth:	HR=0.84 (0.74, 0.95),p=0.004
3Mth-6Mth:	HR=1.04 (0.82, 1.31),p=0.749
6Mth-1.5Yr:	HR=1.49 (1.30, 1.71),p<0.001
1.5Yr-2.5Yr:	HR=1.25 (1.05, 1.49),p=0.011
2.5Yr - 5Yr:	HR=1.61 (1.41, 1.83),p<0.001
5Yr - 6.5Yr:	HR=1.92 (1.59, 2.31),p<0.001
6.5Yr - 9Yr:	HR=2.25 (1.90, 2.67),p<0.001
9Yr+:	HR=3.10 (2.48, 3.89),p<0.001

The hazard ratio (HR) has a number for each of the listed time periods. The time period is the number that is on the left. The values in the brackets after the HR number are the possible lower and upper limits of the HR. The reason that these numbers are given is because the HR number is an estimate and the numbers in the brackets indicate that there is a 95% degree of certainty that the actual HR falls within this range. For instance, the first entry in Table LS2 above referring to the 0-3 month period has a lower limit of 0.74 and an upper limit of 0.95. The HR value of 0.84 is the arithmetic mean (average) value of the upper and lower limit but because this is an estimate there is a possibility that the actual HR is not this figure but that is a 95% likelihood that it falls with the range identified by the numbers in the brackets

When the Registry compares two different factors, such as non cross-linked to cross-linked polyethylene, to see if there is a difference, it also takes into account whether that difference changes with time. That is why all the different time periods are listed. With this particular comparison it can be clearly seen that the difference between the two different polyethylenes is increasing as the time after the original operation increases.

The length of time after the initial operation when differences become evident, is an important piece of information in helping to determine why there is a difference. Using Figure LS2 as an example, the HRs have been divided into eight time periods, the time from the joint replacement to three months after the surgery, then three months following the surgery to six months and so on. There are many reasons why some things may differ soon after surgery and these reasons often change as the time after surgery increases. What can also happen as is the case in the example provided is that the extent of difference can vary with time; sometimes the difference is greatest early, and other times the difference may increase as time progresses which is what has occurred with this example. In some graphs the difference does not change with time but is the same from start to finish. When this occurs then instead of having a list of different time periods then only one HR will be given, and it will state that the HR is over the entire period.

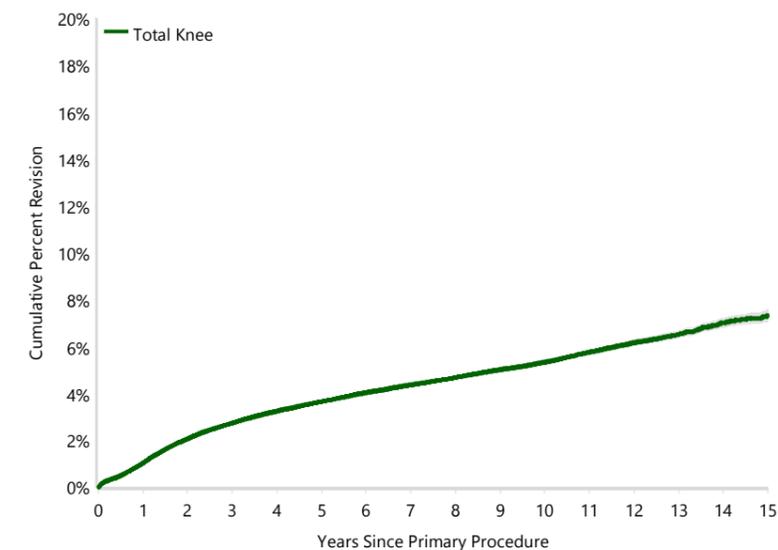
The Registry also reports data in cumulative percent revision tables which accompanies these graphs. These tables give the number of revisions as a percentage of the number of operations at particular

times i.e. 1 year, 3 years etc. The numbers are simply the values on the graph at these specific time points and are listed to provide the actual number for each year so that the number does not need to be read from the graph.

**TABLES**

**Figure LS3 Example of a table and corresponding graph**  
(KT12 Cumulative Percent Revision of Primary Total Knee Replacement (Primary Diagnosis OA) from the 2017 Registry Annual Report)

Knee Class	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	7 Yrs	10 Yrs	15 Yrs
Total Knee	17213	482373	1.0 (1.0, 1.1)	2.7 (2.7, 2.8)	3.6 (3.6, 3.7)	4.4 (4.3, 4.4)	5.3 (5.2, 5.4)	7.3 (7.1, 7.6)
<b>TOTAL</b>	<b>17213</b>	<b>482373</b>						



This Table shows the values in the brackets, as the lower and upper limits of the cumulative percentage. So, at 10 years the cumulative percentage is 5.3%, and is the calculated mean from the upper limit of 5.4 and the lower limit of 5.2.

On occasion, the Registry provides only cumulative percent revision tables and does not provide the graphs. This is usually when the results of a large number of different replacements in one category are being presented. The reason the graphs are not provided for each of the different replacements is simply a space issue. It would make the report too large.

When examining the tables, it can be seen that there is variation in the outcome of the different prostheses that are listed. It is important to understand that just because a prosthesis combination has a higher cumulative percent revision than other prosthesis combinations, it does not necessarily mean that the combination is not as good. It is possible that this difference in the number of revisions between the prostheses has occurred by chance rather than being a true difference. In reality, most but not all prostheses have equally good results.

## Primary Total and Revision Hip Replacement in Older Patients

The reason it was decided to look at this was because there is an increasing number of older people receiving hip replacement for the first time (i.e. a primary hip replacement) as well as an increasing number of older people who have had a hip replacement previously that are now requiring a redo (revision of that initial operation). The Registry has previously published some information on the outcome of joint replacement in older patients. However, the number of people in this age group (80 years and older) in the Registry has now increased to such an extent that it is possible to undertake a more detailed and comprehensive assessment. We have concentrated on patients who have osteoarthritis and who have had a total (rather than a partial) hip replacement to treat this. Where there is a sufficient number of patients for particular analyses we have looked at patients aged 80-89 and 90 years and older separately. In addition to assessing primary operations, we have also looked at revision operations. As the number of revision operations in this age group is much smaller, the information we are reporting includes all patients aged 80 years and older as a single group.

The overall assessment is that the results for older patients having either a primary or revision operation is very good. The number of people in this age group that had a primary total hip replacement for osteoarthritis was 4,406 (4,122 in those aged 80-89 years, and 284 in the  $\geq 90$  year age group). The risk of dying soon after the surgery is not higher in this older age group compared to younger patients. For patients aged 80-89 years the risk of dying in the first three months is 3 in 1000 patients and for those aged 90 or more it is 27 in 1000. Almost 80% of patients aged 80-89 are still alive five years after the operation and almost 60% of patients aged 90 years or older are still alive at this time. The risk of dying is less for patients who are in good health at the time of surgery. BMI does not have a big effect on the risk of dying although if patients are slightly heavier than normal then this reduces the risk. Some studies in the past have suggested that there may be an increased risk of dying if a cemented hip replacement is used. We could not find any evidence for this.

Older patients are less likely to be revised compared to younger patients however the difference is not great. One of the difficulties with assessing the revision risk in older patients is that understandably they may die sooner than younger patients. If they die they cannot be revised. There is a number of ways of assessing revision to determine if the revision rate is lower in this age group because some of the patients have died before they could be revised. There appears to be some truth to this. It was our conclusion that a major reason for the lower revision risk in older patients was that they did not live as long as younger patients.

There was a difference in reasons for requiring a revision of a primary total hip replacement in older patients compared to younger patients. Older patients have a higher rate of revision for fracture (mostly of the femoral bone). The risk of revision was not affected by the patients general health at the time of surgery, however heavier patients had a higher risk of revision.

The most important factor with respect to the devices used in those aged 80 years or older, that affected revision risk, was whether or not the femoral component was cemented. When a cementless femoral component was used this doubled the risk of early revision and the risk of later revision was increased by about 50%. Other device factors did not seem to have a major impact on the outcome of the procedure.

If older patients require a revision hip replacement they have almost four times the risk of dying in the first three months compared to those having a primary operation. However the success of revision operations in older patients is better than it is for younger patients.

## Primary Total and Revision Knee Replacement in Older Patients

The analysis for older patients having primary total knee replacement for osteoarthritis shows very similar results to those that were presented for primary total hip replacement. The number of people in this age group that had a primary total knee replacement for osteoarthritis was 5,577 (5,376 in those aged 80-89 years and 201 in those aged 90 years or older). The risk of dying soon after the surgery is less than with primary total hip replacement. For patients aged 80-89 years this is 6 in 1000 patients at 3 months and for those aged 90 or more years it is 16 in 1000. The long term survival is almost the same as primary total hip replacement with just over 80% of patients aged 80-89 still alive five years after the operation and almost 60% of patients aged 90 or older still alive at this time. The risk of dying is less for patients who are in good health at the time of surgery. BMI does not influence the risk of dying.

Older patients are less likely to need a revision operation. Due to the risk of death being higher in older patients, we assessed revision risk in a number of different ways as was explained in the section on hip replacement in older patients. As with primary total hip replacement it appears that a major reason for the lower risk of revision following a primary total knee replacement is because the patients did not live as long as younger patients.

There are differences in reasons for requiring a revision of a primary total knee replacement in older patients compared to younger patients. Most of the usual reasons for revision occur less often in older patients with the exception of infection. Consequently, infection is the most common reason for revision in older patients. However, this is not because it occurs more frequently but because the other reasons occur less frequently. The risk of needing a revision for infection is the same no matter the age of the patient.

If a revision operation is required, it is usually a less extensive operation compared to what is required when younger patients need a revision. A patients ASA score and BMI do not affect the risk of revision.

In patients aged 80 years or older the class of prosthesis used does have a small impact, with minimally stabilised knee replacements having a lower risk of revision. It also appears to be advantageous to use a patella prosthesis when undertaking a total knee replacement in this age group. However, these differences are quite small.

If older patients require a revision knee replacement they have over three times the risk of dying in the first three months compared to those having a primary operation. This risk is about half of that compared to a hip revision operation. The success of revision operations in older patients is better than it is for younger patients.

## Ten and Fifteen Year Prosthesis Outcomes

This chapter provides information on hip and knee prostheses that have the longest follow up in the Registry. This year, the Registry is reporting on the outcome of 81 different hip prostheses (combinations of femoral and acetabular prostheses with at least 10 years of follow up). Prostheses with 10 years of follow up data account for 63.9% of all primary total conventional hip procedures being undertaken in Australia. The percentage of hip procedures that have 10 years of follow up data and have been revised varies from 1.9% to 46.1%. The Registry has used a slightly different approach this year to identifying those devices that have the lowest revision rates. Two groups of devices have been identified. Those with what is referred to as a 'superior benchmark' and those with a 'non-inferior benchmark'. All of these devices have proven low revision rates at 10 years with the superior benchmark devices having a slightly lower revision rate than the non-inferior benchmark devices. Both of these groups of devices have what is regarded as low revision rates at 10 years. The Registry identified 14 hips with a superior benchmark and an additional 12 with a non-inferior benchmark. In other words, of the 81 different hip prosthesis combinations 26 (32.1%) are identified as having low revision rates at 10 years. This is regarded as an excellent result for these 26 different hip replacements.

A similar analysis was undertaken for primary total knee replacement. The Registry identified 60 total knee replacement combinations with data for 10 years or more. This group accounts for 84.3% of all the total knees reported to the Registry. The percentage of knee procedures that have 10 years of follow up data and have been revised varies from 3.0% to 13.3%. The Registry identified seven knees with a superior benchmark and an additional 19 with a non-inferior benchmark. In other words, of the 60 different knee prostheses combinations, 26 (43.3%) are regarded as having an excellent result.

The Registry also has a number of prostheses (47 hip and 35 knee) that have information that extends out to 15 years. Many of the devices have performed well. The percentage of hip procedures that have 15 years of follow up data and have been revised varies between 2.5% and 16.6%. Sixteen of the hip prostheses have a 15 year revision rate that is less than 6.5%, and six less than 5%. For knee replacements the percentage of procedures that have 15 years of data and have been revised varies between 4.4% to 14.3%. Seven of the knee prostheses have a percent revision of less than 6.5% and two with less than 5%.

## Hip Replacement

The Registry considers three different categories of hip replacement. These are primary partial, primary total and revision hip replacement. Each of these categories is divided into a number of different classes. These are described in the Annual Report at the start of the section on hip replacement.

There were 47,240 hip replacements reported to the Registry in 2017. This is an increase of 1.1% compared to the number undertaken in 2016.

Primary partial hips account for 15.1% of all hip replacements reported to the Registry since it commenced data collection. Primary total hips account for 73.7% and revision hips 11.2%.

Due to the staged introduction of the Registry, the first year that the Registry recorded complete national data was 2003. Since that time, the number of hip replacements reported to the Registry has increased each year. The number of hip replacements undertaken in 2017 was 77.6% more than undertaken in 2003.

However, there are differences in the rate of increase depending on the category of hip replacement. The number of primary partial hip replacements, which are almost always done for fractured neck of femur (broken hip), has increased by 29.4% since 2003. The number of primary total hips, which are most often done due to severe arthritis, has increased by 99.5% during the same time. The increase in revision hip replacement was the lowest of all categories and comparing 2003 to 2017 the number of revision hip procedures increased by 22.2%.

The proportion of hip procedures that are undertaken each year that are revision operations is called the revision burden. The aim of any intervention to improve the outcome of joint replacement is to reduce the revision burden. The revision burden has declined since 2003 with the exception of 2011. In that year, the Registry reported an increase in the revision burden. This was largely due to the high revision rate of large head metal on metal hip replacements and in particular the ASR XL prostheses. In 2012, the revision burden again declined and has continued to decrease since that time. In 2011, the revision burden was 12.6%, in 2012 it was 11.9%, in 2013 it was 10.7%, and in 2017 it had decreased to 8.9%. This is the lowest revision burden for hip replacement ever reported by the Registry.

The Registry data continues to show that in general Australian surgeons have increasingly used approaches to hip replacement and hip replacement prostheses that the Registry has identified as being associated with an improved result. This is particularly evident in recent years with increased use of prostheses known to have excellent outcomes over a long period and decreased use of those that are known to have a less satisfactory result. It is anticipated that the effect of these changes will have a progressively beneficial impact on the revision burden in coming years.

### Primary Partial Hip Replacement

Most partial hip replacements are used to treat broken hips. In particular, elderly patients with a broken hip involving a complete fracture at the base of the femoral head (ball of the hip joint) which is significantly displaced (moved out of position). This is commonly referred to as a subcapital fractured neck of femur.

The Registry has previously reported that the risk of further revision surgery following the treatment of broken hips with primary partial hip replacement is dependent on a number of factors. These include the age at the time of surgery, class of partial hip replacement, method of fixation and the type of prosthesis used.

There are three main classes of partial hip replacement: unipolar monoblock prostheses, unipolar modular prostheses and bipolar prostheses. Each has their place in the management of broken hips.

The use of partial hip replacement has been decreasing in recent years. The only type of partial hip replacement to show an increase in use is bipolar hips. This is a good outcome as these prostheses are reported by the Registry to have a lower rate of revision compared to other partial hip prostheses.

When the Registry first started collecting data, unipolar monoblock prostheses were the most common type of partial hip prostheses used. The use of these devices, however, has declined by over 85% since 2003. This is because of the three different types of partial hip replacement unipolar monoblock prostheses have the highest revision rate. They are now used mainly in very elderly patients who are almost certainly not very mobile. In this situation, a monoblock prosthesis runs a low risk of needing a revision.

Unipolar modular and bipolar replacement have a lower risk of revision in the 'younger' elderly population (below 85 years). Bipolar prostheses are revised less frequently than unipolar modular prostheses when individuals are less than 75 years of age.

The use of cement fixation reduces the risk of revision by approximately half, regardless of the class of partial hip replacement. Consequently, there has been a dramatic increase in recent years in the use of cement fixation when partial hips are used. However, the vast majority of partial hip replacements will do well, whether they are cemented or not.

### Primary Total Hip Replacement

There are two main classes of primary total hip replacement. The first and most common is total conventional hip replacement, which involves replacing the femoral head (ball of the hip joint) as well as the acetabulum (socket of the hip joint). The second is a total resurfacing hip replacement. Although the socket is replaced in a similar way to a conventional hip, it differs in that only the surface of the femoral head is replaced rather than the whole head.

Overall, resurfacing hip replacement has a higher rate of revision compared to primary total conventional hip replacement. In recent years, the use of total resurfacing hip replacement has continued to decline. In 2017, it was used in only 2.9% of all primary total hips.

Factors that affect the outcome of primary total resurfacing hip replacement include the type of prostheses used, as well as the gender and age of the patient. Women have a significantly higher rate of revision. This difference has resulted in this procedure now being done almost exclusively in males. Men have an age related rate of revision. Males over the age of 65 years have a much higher rate of revision in the first six months after surgery and consequently this surgery is almost never done in patients above this age.

It appears that there are a number of reasons for the difference in outcomes related to gender. The first relates to the size of the patient. Smaller femoral head sizes do not do as well in a resurfacing procedure and women on average have smaller femoral head sizes. It also appears that women still have a higher rate of revision following a resurfacing hip replacement when a larger head size is used, but the reason for this is not clear.

The Registry has identified many factors that affect the outcome of primary conventional hip replacement. These can be divided into patient and prosthesis factors.

Patients with osteoarthritis have better outcomes compared to patients having a total hip replacement for a different reason. Generally, it can be said that women have a slightly lower rate of revision compared to men. In the long term, the rate of revision decreases as the age at the time of the initial surgery increases. This is more apparent in women than men.

For the first time the Registry is reporting the impact of ASA score (see above in the elderly hip replacement section) and BMI (again see above) for all patients. The impact of ASA score and BMI is only seen in the first few years after surgery as the Registry only commenced collection of ASA data in 2012 and BMI data in 2015. The higher the ASA score the higher the risk of revision and this is due in part to an increased risk of revision for infection. There are six categories of BMI which include underweight, normal, pre-obese and then obese 1, 2, and 3. There revision rate is increased in patients with a BMI that is categorised as obese 1, 2, or 3. The most common reason for the increased revision rate is an increased rate of revision for infection.

As has been done in previous years, a number of important prosthesis characteristics that influence outcome have been highlighted again in this year's report. These include the method of fixation, the use of an exchangeable femoral neck, and the bearing surface of the hip prosthesis.

Primary total conventional hip replacements vary in the approach used to fix the prosthesis to bone. There are three main types of fixation, cemented, cementless and hybrid fixation.

Cemented fixation is when the femoral and acetabular prostheses are fixed to bone using a hard setting plastic called methyl methacrylate (bone cement). Cementless fixation is when the femoral and acetabular prostheses are fixed to bone using macro fixation initially, which is followed by bone ingrowth into the surface of the prostheses which gives a biological fixation. Macro fixation is achieved by shaping the bone and placing a slightly oversized prosthesis into the cavity produced by that shaping. Prostheses are designed to be specifically used with cemented or cementless fixation. The other main approach to fixation is hybrid fixation. This involves cementing the femoral component and using an acetabular component that is cementless. There is also an approach used which is termed 'reverse hybrid' where the acetabular component is cemented, and the femoral component is cementless. This method of fixation is rarely used in Australia.

For a number of years, the Registry has identified that there is an age related effect associated with the method of fixation. In general, older patients do better with hybrid or cement fixation and younger patients do better with hybrid or cementless fixation.

This year, the Registry is again highlighting the increased rate of revision associated with the use of an exchangeable femoral neck. The Registry has previously identified this class of prostheses as having a higher rate of revision compared to other conventional hip replacements. The neck is the part of the femoral component that protrudes outside of the femur. It is usual that the stem and neck are all one piece, i.e. the neck is fixed to the femoral stem. An exchangeable neck consists of the stem and neck as separate pieces, which are put together after the femoral stem is placed in position inside the femur. As the femoral head connects to the femoral component by the neck, the supposed advantage of an exchangeable neck is that it enables the surgeon to slightly vary the position of the head after the stem has been placed in position. This is not possible if the neck and stem are in one piece.

As the Registry has previously reported, our analysis shows that the use of an exchangeable neck is associated with twice the rate of revision. As in previous years, the Registry is also reporting that the rate of revision was higher regardless of the type of bearing surface used, and if the metals in the stem and the neck did not match. There is a much higher rate of revision if the stem and neck combination is titanium and cobalt chrome, compared to a titanium and titanium combination. All prostheses with exchangeable necks, on which the Registry has more than five years follow up, show an increased rate of revision. Those with a metal mismatch have a higher rate of revision.

For the last three years, the Registry has also reported the results of a number of different types of hip replacements that have special features. These included mini femoral stems, as well as constrained and dual mobility acetabular components. The Registry has reported the results of these devices again this year.

Mini stems are very short cementless femoral stems, where fixation to the bone is over a smaller area entirely in the top of the femur. This is in contrast to the standard femoral stem that usually extends almost half way down the length of the femur. Currently, mini femoral stems remain a relatively new technology and are not commonly used. They represent only 1.1% of all total conventional hip procedures. This analysis does not identify any difference in the overall revision rate compared to standard femoral stems. There is a difference in the reasons for revision, with the mini stems requiring revision because they have become loose at 10 years just over twice as often as the standard stem. The rate of revision also varies depending on the type of mini stem used.

As mentioned last year, a constrained acetabular prosthesis is a special prosthesis. Unlike normal acetabular prostheses, it has a mechanism to lock the femoral head inside the acetabular socket so that there is a reduced chance of dislocation. It is not surprising to find they are used in different types of clinical situations to usual acetabular prostheses. In particular, they have been used more commonly

in situations known to have a higher risk of dislocation. They do seem to have some beneficial effect because there is no difference in the rate of revision when a constrained acetabular prosthesis is used, when it would be expected that the risk of revision would be increased in the patient that it has been used in. However, younger patients (aged 70 years or less) do not do as well compared to older patients when a constrained cup is used. They have over three times the rate of revision. When total hip replacement is used to manage a broken hip (fractured neck of femur), a constrained acetabular prosthesis is associated with a lower risk of revision.

Another type of special acetabular prosthesis is the dual mobility acetabular prosthesis. The reason it is called dual mobility is because the femoral head articulates with a polyethylene liner, but unlike the common situation where the polyethylene liner is fixed to the acetabular shell, in the dual mobility the liner is designed to move or articulate with the metal shell i.e. there is dual mobility. The purpose of the dual mobility design is similar to the constrained acetabular prosthesis, in that it is designed to reduce the risk of dislocation. Similar to constrained acetabular prostheses the proportion of dual mobility acetabular prostheses used for unusual reasons is high compared to standard acetabular prostheses. At five years, there is no difference in the revision rate of dual mobility acetabular prostheses compared to standard acetabular prostheses. This is true for both the diagnoses of osteoarthritis and fractured neck of femur.

This year the Registry has again undertaken an extensive analysis on outcomes related to the use of different bearing surfaces used in primary total conventional hip replacement. The bearing surface is the articulating surface, and this varies depending on the material used to make the articulating surface on both the acetabular and femoral sides.

The acetabular articulating surface may be metal, ceramic or polyethylene. The polyethylene may be non cross-linked or cross-linked. Cross-linked (also referred to as XLPE) means that an additional manufacturing process has been used that increases the bonding of the molecules within the polyethylene. It has been shown in laboratory testing that increasing the cross-linking, increases the resistance to wear when this material is used in hip replacement.

The femoral articulating surface may be metal, ceramic, or a third option called ceramicised metal, which is available mainly from one company. Consequently, there are a number of possible combinations that make up the different bearing surfaces. These include metal on polyethylene (non cross-linked and cross-linked) ceramic on polyethylene (non cross-linked and cross-linked), ceramic on ceramic, and metal on metal. Ceramicised metal femoral heads have only been used in sufficient numbers to assess when combined with cross-linked polyethylene.

There are a small number of procedures where the bearing surface is ceramic on metal. Metal on metal bearings and ceramic on metal bearings are now rarely used. They have not been included in the main report. However, the information on these bearing surfaces is still available in two separate supplementary reports, which have been listed at the start of this summary. As the Registry has reported since 2008, large head metal on metal bearings continue to have a much higher rate of revision compared to other bearings. This is because they produce metal particles at a higher rate compared to other bearing surfaces. These particles cause an inflammatory reaction which can damage the bone and muscles around the joint replacement.

Although ceramicised metal on cross-linked polyethylene has the lowest reported cumulative percent revision at seven years, the Registry has explained that this result should be interpreted with caution. This is for a number of reasons; the Registry is not confident that this result is due to the bearing. While there is no doubt, that it is a perfectly satisfactory bearing, there is not enough evidence in the current data to suggest that it is the best. A complicating factor is that this bearing has only been used with a small number of different femoral stems and acetabular cups and shells from the same company. Many of these are well performing stems and acetabular components that are likely to be contributing in a major way to the lower revision rates seen with this bearing when compared to other bearings. In recent years, there has been increasing use of cross-linked polyethylene. The use of this material has been associated with a significant reduction in the rate of revision in primary total conventional hip replacement. This is due to a reduced rate of revision for dislocation, loosening and lysis. The reduced

rate of revision for dislocation is due to an increased use of larger head sizes (32mm or greater) in cross-linked polyethylene procedures.

These larger head sizes can be used because there is a lower rate of wear with this polyethylene. As mentioned earlier, when a larger head size is used, the hip replacement is more stable and so there is a lower rate of revision for dislocation. The reduced rate of revision for loosening and lysis is thought to be due to the lower wear rate. Loosening and lysis is most often due to an inflammatory reaction, that occurs following the production of small wear particles. Theoretically, a reduced wear rate means less particles and therefore less inflammation. The reduction in loosening is supportive of a lower wear rate for cross-linked polyethylene.

Cross-linked polyethylene has a lower rate of revision compared to non cross-linked, regardless of whether a metal, ceramic or ceramicised metal femoral head is used. In addition to the overall analysis of all prostheses, the Registry has also undertaken analyses on six different acetabular prostheses, each have been used in large numbers with both cross-linked and non cross-linked polyethylene. Five of the six prostheses have a lower rate of revision when cross-linked polyethylene is used. The remaining prosthesis does not show any difference. This is further evidence supporting a reduced revision rate when cross-linked polyethylene is used, but it does raise the question of whether this is true for all types of cross-linked polyethylene.

The Registry has undertaken a detailed analysis of ceramic on ceramic bearings. Although the Registry has information on three different ceramics, only one of these ceramics (mixed ceramic) is in current use. It is the best of the three ceramics. The revision rate of mixed ceramic varies with femoral head size. There is no difference in the revision rate when either 28 mm or 32 mm head sizes are used. Larger femoral head sizes 36 mm, 38 mm and 40 mm or more have a lower rate of revision compared to 32 mm heads. However, there is no difference in the revision rate of these larger head sizes when they are compared to each other.

## Knee Replacement

As with hips, the Registry considers three different categories of knee replacement: primary partial, primary total, and revision knee replacement. Each of these categories is further divided into a number of different classes. These are described in the Annual Report at the start of the section on knee replacement.

There were 63,294 knee replacements undertaken and reported to the Registry in 2017. This is an increase of 5.0% compared to the number reported in 2016.

Primary partial knee replacement accounts for 7.9% of all knee replacements reported to the Registry since it commenced data collection. Primary total knees account for 84.0% and revision knees 8.21%.

Since 2003 (which as previously mentioned was the first year that the Registry collected full national data), the number of knee replacements undertaken each year has increased. In 2017, there was a 123.5% increase in the number of knee replacements compared to 2003. However, the rate of change differs depending on the category of knee replacement. Primary total knee replacement has increased by 151.6% since 2003 and revision knees by 103.3%. However, primary partial knees have decreased by 8.4%. Almost all primary knee replacements, whether they are partial or total, are undertaken for osteoarthritis.

The proportion of knee procedures that are revision procedures, has been decreasing since the Registry was implemented. Between 2004 and 2017 the percentage of knee replacements that are revisions decreased from 8.8% in 2004 to 7.4%.

### Primary Partial Knee Replacement

A partial knee replacement is a replacement that only replaces part of the knee joint. The Registry identifies five classes of primary partial knee replacement. Most are used in small numbers and two are no longer used in Australia. The main report provides information on the three partial knee replacements that are still being used. The results of the two classes of partial knee replacement that are no longer used are available in the supplementary report on the AOANJRR website under the heading of 'Prosthesis Types No Longer Used'.

The most used partial knee replacement is the unicompartmental knee. This replaces the femoral and tibial joint surfaces on either the inner or outer side of the knee (most commonly the inner side of the knee), its use accounts for 92.9% of all primary partial knees. Other types of partial knee replacement are partial resurfacing and patella/trochlear knee replacements.

Partial resurfacing involves the use of special buttons to replace damaged areas of the knee joint surface. They account for 0.4% of all partial knee replacements. The Hemicap is the only partial resurfacing prosthesis currently available. Over the last few years, the Registry has reported that this prosthesis has a higher rate of revision compared to other partial knee replacements. These findings have been confirmed again this year.

Patella/trochlear prostheses replace the joint surfaces of the knee cap, both on the underside of the knee cap and on the top of the femur in the groove where the knee cap runs. This area of the femur is referred to as the trochlear. This is the second most used partial knee replacement and accounts for 6.3% of all partial knees. There are a range of different patella/trochlear prostheses available for use. Patella/trochlear replacement is used in relatively small numbers and generally in very special circumstances. Overall, almost half of the procedures have been revised at 15 years. Age is a risk factor for revision. The rate of revision in patients younger than 65 years of age is significantly higher than patients 65 aged years or older. Men have a slightly higher rate of revision compared to women. There is variation in the outcome depending on the type of patella/trochlear prosthesis used.

Primary unicompartmental knee replacement has a higher rate of revision than primary total knee replacement. Age is a major factor affecting the outcome of unicompartmental knee replacement.

The younger the patient, the more likely it is, that the procedure will be revised early. At 17 years following a unicompartmental knee replacement, 25.7% have been revised. Almost 39.4% of patients less than 55 years of age at the time of their surgery have been revised within 17 years.

Unicompartmental knee replacement may be undertaken on the medial (inner), or lateral (outer) side of the knee. Medial unicompartmental knee replacement is much more common and accounts for 94.7% of all unicompartmental knee replacements. There is no difference in the revision rate when medial and lateral unicompartmental knee replacements are compared. The revision rate of unicompartmental knee replacement varies depending on the type of prosthesis used.

### Primary Total Knee Replacement

A primary total knee involves the removal and replacement of the joint surface of the femur and the tibia on both the medial (inner) and lateral (outer) sides. A single femoral prosthesis and a single tibial prosthesis are used. The tibial prosthesis may be one component, but it is more commonly two that are put together at the time of surgery. Usually, a metal tray fits over the cut surface of the tibia, with a plastic insert that fits inside the tray to make the tibial prosthesis. This then articulates with the single femoral replacement. A primary total knee replacement may or may not, have the under surface of the patella replaced.

Primary total knee replacement has the lowest rate of revision compared to all other types of primary knee replacement. Men have a slightly higher rate of revision compared to women. The most important patient factor identified by the Registry that influences the rate of revision, is age at the time of surgery; the younger the patient the higher the subsequent rate of revision. Patients less than 55 years of age at the time of surgery, have a 15.8% chance of being revised at 17 years. The rate of revision declines as patients get older and in patients aged over 75 years, for those that live another 14 years only, 3.6% end up being revised.

There is only a small variation in the outcome of knee replacement related to the type of fixation used to hold the tibial and femoral components tightly to bone. Hybrid fixation has the lowest rate of revision, but the difference is not major. Cemented fixation has a lower rate of revision compared to cementless fixation, but again the difference is not very large. However, there are some differences depending on the intrinsic stability of the knee replacement (see below). Minimally stabilised knees do best, if at the very least the tibial component is cemented. Posterior stabilised knees do best when both the tibial and femoral components are cemented to the bone.

An important difference between hip and knee replacement is what keeps the artificial joint surfaces from moving out of position. This is referred to as the stability of the joint. An unstable joint is one where there are additional unnatural movements between the joint articulating surfaces. The very extreme example of this is when the articulating surfaces come apart. This is referred to as dislocation. There can also be lesser degrees of unnatural movement that can cause problems with the function of an artificial joint without the joint actually dislocating. In general, the stability of the joint is dependent on the shape of the joint as well as the soft tissues (muscles and ligaments) around the joint. If everything is working correctly, the combination of these factors allows normal movement and prevents unnatural movements between the joint surfaces. As the hip is a ball inside a socket joint, there is a lot of stability simply because of the shape. This is not the case with knee replacement, where two relatively flat surfaces articulate with each other. The stability of the knee joint is much more dependent on surrounding soft tissues and in particular ligaments that hold these joint surfaces in place and in the correct alignment. Quite often in patients receiving a knee replacement, one or more of these ligaments may already be damaged. In order to address this issue, primary total knee replacement can vary depending on the additional built-in stability that may be required. In certain circumstances, it is necessary to use a replacement that is designed to substitute for one or more of the damaged ligaments.

Most knee replacements used do not require any additional stabilising, other than substituting for the anterior cruciate ligament. These are referred to as minimally stabilised knee replacements. The next most common group is posterior stabilised. These have additional stability built into the knee replacement, so that the prosthesis substitutes for the posterior cruciate ligament as well. The vast

majority of knee replacements used, are either minimally or posterior stabilised prostheses. Minimally stabilised prostheses have a slightly better outcome than posterior stabilised prostheses. However, there is some difficulty in being too definite about this, as posterior stabilised prostheses may be used more often in difficult cases. If a case is more difficult, it has more potential to be revised.

Other important ligaments around the knee are the medial and lateral collateral ligaments. These can also be substituted by what is often referred to as constrained knee replacements. These are not often required in primary operations. There is one final group of knee replacement, when considering stability and these are hinged knees. These are used mostly when there is absolutely no ligament stability left in the knee. Their use is very rare for primary knee replacement.

Another general difference in the design of primary total knee replacement, is the way the tibial insert is designed to move on the surface of the tibial tray. It may either be fixed to the tray (fixed insert) or designed to move slightly in one or more specific directions (mobile insert). Mobile inserts either rotate, slide, or do both. For a number of years, the Registry has reported that in general, fixed inserts have a lower rate of revision. However, a number of prostheses with mobile inserts do have similar rates of revision as fixed inserts. This remains the current situation.

In previous reports, we provided information on the use of cross-linked polyethylene in total knee replacement. This year we have repeated and extended that analysis. Comparing the outcome of cross-linked to non cross-linked polyethylene across all knee replacements, there appears to be a benefit when cross-linked polyethylene is used. There is a lot of variation between the type of prostheses and the type of polyethylene used. As a consequence, any difference seen when comparing the overall result of cross-linked to non cross-linked may be in part due to the type of prostheses, rather than the type of polyethylene. To try and overcome this problem the Registry has undertaken analyses of specific designs of total knee replacement that have used both cross-linked and non cross-linked polyethylene. Only prostheses that had a minimum of 500 procedures, in at least one of the polyethylene groups, and a follow-up time of five or more years, were used in this analysis. 18 different primary total knee prostheses met this requirement.

The results of this analysis showed that for all prostheses tested there was no disadvantage to using cross-linked polyethylene, but for a number of specific types of prosthesis there was a clear benefit. This was, however, only for a small number of the prostheses (4 out of 18).

We have also done a follow up analysis on the outcome of computer navigation in primary total knee replacement. Computer navigation is computer-assisted surgery, which was first used over 14 years ago. It involves the use of intraoperative computer monitoring in an attempt to more accurately place the knee replacement prosthesis. It is known that accurate positioning of the prosthesis is a very important factor in determining the result of the operation. The current information from the Registry suggests that there may be a small advantage, particularly in younger patients, as there is a small reduction in the rate of revision for loosening in this group.

There is another technique, which surgeons are using in an attempt to improve the positioning of knee prostheses. This is known as Image Derived Instrumentation (IDI). This technique involves obtaining accurate images of the knee joint preoperatively, so that the instruments used to achieve the alignment can be specifically made for that patient. The Registry has looked at the ten different total knee prostheses where either the standard approach or IDI was used to determine the correct position of the knee prosthesis. For eight of these prostheses there was no difference in the subsequent revision rates when these two techniques were compared. For two of them, the revision rate was increased when IDI was used.

## Hip and Knee Prostheses with a Higher than Anticipated Rate of Revision

The Registry reports on the results of individual prostheses in the different classes. There is variation in the revision rates for different types of prostheses in each class. Many of these differences are not statistically significant.

The Registry, however, does identify individual prostheses that have a statistically significant higher rate of revision. The threshold for that identification is that the revision rate is more than twice that of all other prostheses in the same class and the difference is statistically significant. In other words, the revision rate of these devices lies outside the expected norm. They are often referred to as outliers. These outliers are identified in the final chapter of the 2018 Annual Report.

This information highlights to surgeons, orthopaedic companies and regulatory bodies worldwide, that something unexpected is happening with respect to the outcome of these prostheses. It enables consideration to be given as to the possible reasons for this difference and whether it is worthwhile or appropriate to continue to use these prostheses.

It is important to emphasise that there may be many reasons why the revision rate is twice that of other prostheses. Some of these may not necessarily be related, or specific to the identified prostheses. The data related to each of these prostheses have been carefully considered by an expert group of orthopaedic surgeons who have recommended these prostheses be identified and therefore be considered further as to whether or not they should continue to be used. When they undertake that consideration, all available data is reviewed and any subsequent investigation that they may request is undertaken and provided. The consequence of this process is that not all outliers are recommended for identification. One of the main reasons that an outlier is not identified is because it is a non-standard prosthesis that is used in unusual or complex clinical situations associated with a higher risk of revision. In this situation it is not fair to compare the results of these special devices to that of standard prostheses used in standard clinical situations.

This year, the Registry has identified 132 prostheses, or prosthesis combinations (77 hip, 46 knee, eight shoulder and one ankle replacement).

The identified prostheses are listed in one of three groups. There are those that have a higher rate of revision that are being identified for the first time and are still in use in Australia. The second group includes prostheses that are being re-identified but are also still used. This list identifies that the prosthesis continues to have a higher than anticipated rate of revision and it provides updated information on its continued use. Most prostheses that are identified for the first time or re-identified prostheses decline in use with time. This is usually evident only after the first year because almost a full year of use has occurred prior to the identification in a previous Annual Report.

The third group are prostheses that are identified but are no longer used in Australia. Most of these have been previously identified. However, occasionally there is a prosthesis in this group that is identified for the first time. These are prostheses that are no longer available for use in Australia, and that as time progresses the Registry is able to identify that this device has a revision rate that is subsequently identified to be higher than anticipated.

The Registry identification of prostheses with a higher than anticipated rate of revision has resulted in many of these prostheses being withdrawn from national and international markets. Only summary information is provided in the Annual Report. However, the full detailed analysis for each of these prostheses is available from the Registry website (Investigations of Prostheses with Higher than Anticipated Rates of Revision).

## Conclusion

The purpose of the Australian Orthopaedic Association National Joint Replacement Registry (AOANJRR) is to provide high quality independent data on the results of joint replacement in Australia.

The Registry provides this information to surgeons, and all other stakeholders to assist them to make informed judgments on the best approach to joint replacement surgery.

It is hoped that the information presented in this report is useful to people who are seeking additional information on joint replacement surgery, particularly those that are considering or have already undergone the operation. Registry information can be very complicated, as many factors interact to influence the outcome of the surgery. The intention of making this information available to everybody is to assist in promoting informed discussion about the outcome of joint replacement surgery, particularly between patients and their treating surgeons.



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