

Australian Orthopaedic Association National Joint Replacement Registry

2022 Revision of Hip and Knee
Arthroplasty Supplementary Report



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2022 Revision of Hip and Knee Arthroplasty Supplementary Report

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The Registry greatly appreciates the participation of all joint replacement patients throughout Australia. Their contribution allows ongoing improvements in arthroplasty outcomes to be achieved.

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Summary

This supplementary report provides demographic information and outcomes for revision hip and knee procedures.

There are separate sections for hip and knee replacement. Each section provides overall demographic and summary data. More detailed information, including types of revision, reasons for revision and outcomes are provided for the 1st revision where the primary procedure was captured by the Registry. These analyses are restricted to cases with a primary diagnosis of osteoarthritis and excluding those revised for infection.

For hip replacement overall, the most common reason for revision is loosening (35.5%), followed by infection, prosthesis dislocation and fracture. For knee replacement, the most common reason for revision is loosening (28.7%), followed by infection and progression of disease.

Revision Hip and Knee Replacement

Classes of Revision Procedures

The Registry defines revision of a joint replacement as any re-operation of any previous replacement procedure where one or more of the prosthetic components are replaced, removed, or one or more components are added.

Revisions are subcategorised into three classes: major total, major partial and minor.

Major total revision involves the insertion, removal and/or replacement of all major components.

Major partial revision involves the insertion, removal and/or replacement of one major component.

Minor revision involves the insertion, removal and/or replacement of any other component or implant including patella prostheses in knee replacement.

Major components are those that are fixed to bone. They involve the femoral prosthesis and the acetabular shell or cup in hip replacement and the femoral and tibial prostheses in either partial or total knee replacement. Although a patella prosthesis is fixed to bone, it is not considered a major component.

Different types of major partial and minor revisions are identified based on the specific prostheses or implants used in the revision. These are listed in Table R1 and Table R6.

If there is more than one revision, then subsequent revisions are identified in sequential order (i.e. 2nd, 3rd, 4th etc). The exception to this is a planned two-stage revision for infection, which is regarded as a single revision.

Approach to Analysis

The purpose of this analysis is to report the outcome of the 1st revision. To achieve this, it is necessary to have information on the primary procedure.

As the Registry has been collecting complete national data since 2003, the full history is not available for many of the revisions reported to the Registry. If the Registry does not have information on preceding procedures it is

unable to establish if a reported revision is the first for that joint, or a revision of a previous revision. It is also unable to determine the type of primary procedure that subsequently required revision.

To assist in the analysis, the Registry groups revision procedures into 'all revisions' and 'revisions of known primary procedures'.

The 'all revisions' group includes all revision procedures reported to the Registry regardless of whether the Registry has a full chronological history, including the primary procedure. Analysis of this group provides information on the entire revision burden as well as demographic data, the reasons for revision and the types of revision undertaken.

The second group, referred to as 'revisions of known primary procedures', is a subset of the 'all revisions' group. This group includes only the 1st revision of a primary procedure recorded in the Registry and is used to determine the outcome of the 1st revision. The number and proportion of revision procedures of known primary procedures continues to increase and will eventually approach 100%.

There are important differences between the two groups. The all revisions group covers the full spectrum of revisions including revisions of procedures undertaken prior to the implementation of the Registry.

As the 'revisions of known primary procedures' group are revisions of primary procedures recorded by the Registry, the primary procedure must have been undertaken since the Registry began collecting data.

First revisions for infection have been excluded from the analysis of the 'revisions of known primary procedures' group. Determining the outcome of these revisions is more complex than revisions undertaken for other reasons. There are many additional factors to consider, for instance: antibiotic treatment, adequacy of debridement, infective organism(s) and revision strategy, such as planned multi-staged procedures. The Registry does not have information on some of these factors and therefore meaningful interpretation of any analysis related to infection is difficult.

Revision Hip

DEMOGRAPHICS OF ALL REVISIONS

This report analyses 83,206 revisions of hip replacements with a procedure date up to and including 31 December 2021. This is an additional 4,067 procedures compared to the previous report.

Type of Revision

The majority of revisions recorded by the Registry are major revisions (81.3%) (Table R1). The most common types of major revision are acetabular component only (29.2%), total hip replacement (femoral/acetabular) (27.0%), and femoral component only (19.5%) (Table R1).

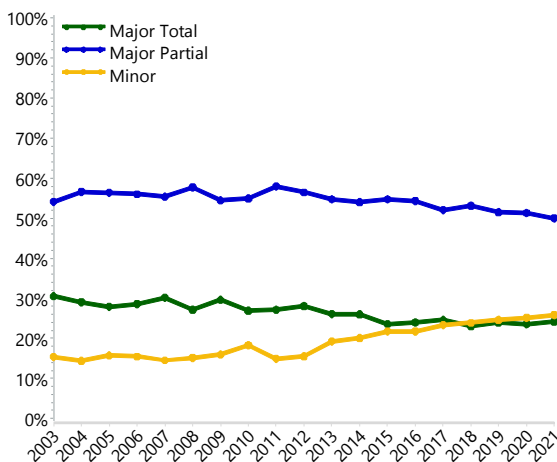
Minor revisions account for 18.7% of all hip replacement revision procedures. The most common type of minor revision is head and insert exchange, accounting for 13.4% of all revisions (Table R1).

Since 2003, the proportion of major partial revisions has remained unchanged. However, there has been a decrease in major total revisions (30.5% in 2003 to 24.2% in 2021) and an increase in minor revisions (15.4% in 2003 to 25.8% in 2020) (Figure R1).

Reason for Revision

The most common reasons for revision are loosening (34.5%), infection (18.1%), prosthesis dislocation (14.6%), and fracture (12.6%) (Table R2).

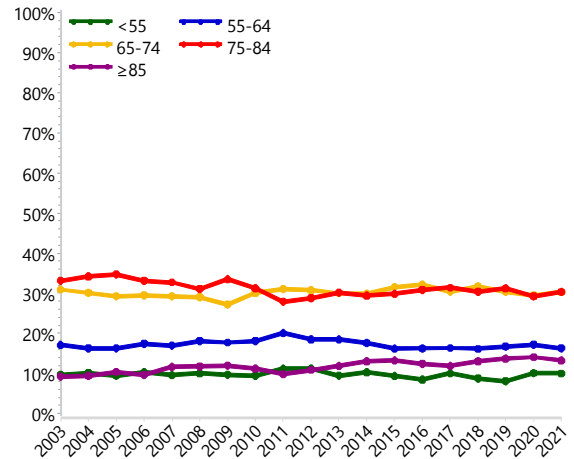
Figure R1 Revision Hip Replacement by Class



Age and Gender

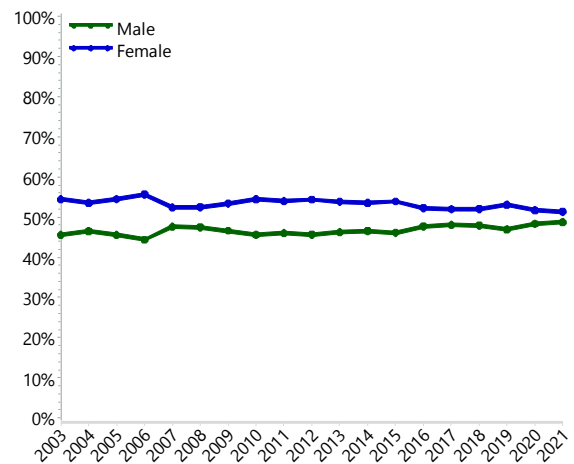
Age distribution of revision procedures has remained stable since 2003 (Figure R2).

Figure R2 Revision Hip Replacement by Age



Revision hip replacement is more common in females (53.4%). There has been little change in the proportion of females undergoing revisions since 2003 (Figure R3).

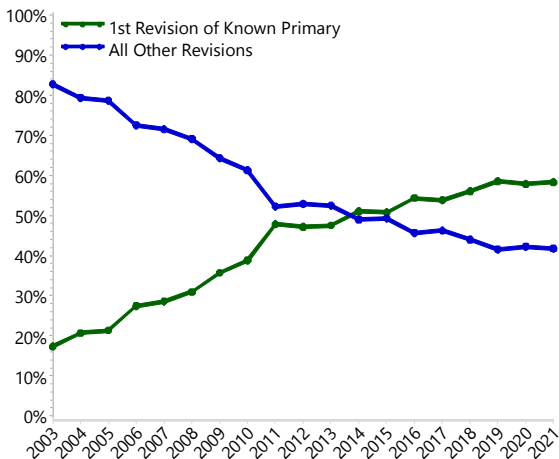
Figure R3 Revision Hip Replacement by Gender



DEMOGRAPHICS OF 1ST REVISIONS OF KNOWN PRIMARY PROCEDURES

There have been 33,982 1st revision procedures where the primary procedure has been recorded by the Registry. This includes revisions of all primary partial, total conventional and total resurfacing hip replacements. This is an additional 2,395 procedures compared to the previous report (Figure R4).

Figure R4 Revision Hip Replacement by Revision



Type of Revision

The '1st revisions of known primary procedures' group and the 'all revisions' group differ in the types of revisions recorded.

The '1st revisions of known primary procedures' group has a smaller proportion of major revisions (76.5%) compared to the 'all revisions' group (81.3%). There are less acetabular only and total hip replacement (acetabular /femoral) revisions, but more femoral only revisions (Table R1).

There are a higher proportion of minor revisions in the '1st revisions of known primary procedures' group (23.5%) compared to the 'all revisions' group (18.7%) (Table R1).

Reason for Revision

There are differences in the reasons for revision between the '1st revisions of known primary procedures' group and the 'all revisions' group. Loosening is the most common reason for revision in both groups, but the proportion is lower in the '1st revisions of known primary procedures' group (22.1% compared to 34.5%). Other diagnoses such as prosthesis dislocation, fracture, metal related pathology and pain are more common in the '1st revisions of known primary procedures' group (Table R2).

Table R1 Revision Hip Replacement by Type of Revision

Type of Revision	1 st Revision of Known Primary		All Revisions	
	Number	Percent	Number	Percent
Femoral Component	9092	26.8	16225	19.5
Acetabular Component	8547	25.2	24292	29.2
THR (Femoral/Acetabular)	6419	18.9	22477	27.0
Cement Spacer	1231	3.6	3136	3.8
Bipolar Head and Femoral	340	1.0	609	0.7
Removal of Prostheses	307	0.9	811	1.0
Reinsertion of Components	43	0.1	65	0.1
Saddle	2	0.0	5	0.0
Thrust Plate	1	0.0	2	0.0
N Major	25982	76.5	67622	81.3
Head/Insert	5379	15.8	11182	13.4
Head Only	1467	4.3	2169	2.6
Minor Components	529	1.6	1026	1.2
Insert Only	237	0.7	697	0.8
Bipolar Only	194	0.6	255	0.3
Head/Neck/Insert	120	0.4	150	0.2
Head/Neck	63	0.2	90	0.1
Neck Only	7	0.0	8	0.0
Cement Only	2	0.0	5	0.0
Incomplete	1	0.0	1	0.0
Neck/Insert	1	0.0	1	0.0
N Minor	8000	23.5	15584	18.7
TOTAL	33982	100.0	83206	100.0

**Table R2 Revision Hip Replacement by Reason for Revision**

Reason for Revision	1 st Revision of Known Primary		All Revisions	
	Number	Percent	Number	Percent
Loosening	7525	22.1	28693	34.5
Fracture	6429	18.9	10517	12.6
Infection	5905	17.4	15055	18.1
Prosthesis Dislocation	5819	17.1	12108	14.6
Metal Related Pathology	2758	8.1	3227	3.9
Lysis	1044	3.1	4676	5.6
Pain	1042	3.1	1604	1.9
Chondrolysis/Acetab. Erosion	437	1.3	554	0.7
Leg Length Discrepancy	390	1.1	476	0.6
Malposition	388	1.1	510	0.6
Instability	362	1.1	633	0.8
Implant Breakage Stem	345	1.0	853	1.0
Wear Acetabular Insert	210	0.6	1289	1.5
Implant Breakage Acetabular Insert	201	0.6	456	0.5
Implant Breakage Acetabular	178	0.5	675	0.8
Incorrect Sizing	165	0.5	198	0.2
Wear Head	89	0.3	106	0.1
Tumour	80	0.2	147	0.2
Implant Breakage Head	65	0.2	117	0.1
Osteonecrosis	53	0.2	128	0.2
Wear Acetabulum	40	0.1	337	0.4
Heterotopic Bone	39	0.1	76	0.1
Progression Of Disease	11	0.0	28	0.0
Synovitis	10	0.0	16	0.0
Other	397	1.2	727	0.9
TOTAL	33982	100.0	83206	100.0

OUTCOME OF 1ST REVISION OF KNOWN PRIMARY TOTAL CONVENTIONAL HIP REPLACEMENT

This analysis reports the outcome of the 1st revisions of known primary total conventional hip replacements.

There are 19,392 1st revisions of primary total conventional hip replacements undertaken for osteoarthritis, excluding all procedures with a 1st revision for infection.

Minor 1st revisions have a higher rate of 2nd revision when compared to major partial 1st revisions after the first month. Minor 1st revisions also have a higher rate of 2nd revision compared to major total 1st revisions. There is no difference in the rate of 2nd revision between major partial and major total 1st revisions (Table R3 and Figure R5).

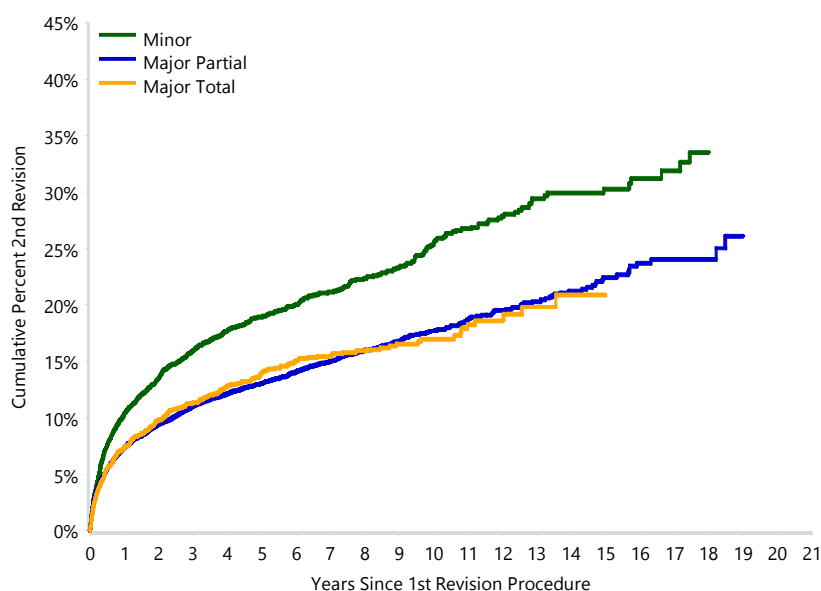
The outcome for the five most common types of 1st revision is detailed in Table R4 and Figure R6.

Table R3 Cumulative Percent 2nd Revision of Known Primary Total Conventional Hip Replacement by Class of 1st Revision (Primary Diagnosis OA, Excluding 1st Revision for Infection)

Class of 1 st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Minor	848	4325	10.4 (9.5, 11.4)	16.0 (14.9, 17.2)	19.0 (17.7, 20.3)	25.3 (23.6, 27.1)	30.3 (27.9, 32.8)	
Major Partial	1756	12842	7.4 (6.9, 7.8)	11.0 (10.5, 11.6)	13.1 (12.4, 13.7)	17.7 (16.9, 18.6)	22.5 (20.9, 24.1)	
Major Total	302	2225	7.4 (6.3, 8.6)	11.4 (10.1, 12.8)	14.0 (12.5, 15.7)	17.0 (15.1, 19.0)	20.9 (17.6, 24.6)	
TOTAL	2906	19392						

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

Figure R5 Cumulative Percent 2nd Revision of Known Primary Total Conventional Hip Replacement by Class of 1st Revision (Primary Diagnosis OA, Excluding 1st Revision for Infection)



HR - adjusted for age and gender

Minor vs Major Partial
 0 - 1Mth: HR=0.98 (0.77, 1.24), p=0.839
 1Mth - 3Mth: HR=1.45 (1.17, 1.80), p<0.001
 3Mth+: HR=1.58 (1.44, 1.74), p<0.001

Minor vs Major Total
 Entire Period: HR=1.47 (1.29, 1.67), p<0.001

Major Total vs Major Partial
 Entire Period: HR=1.00 (0.88, 1.13), p=0.996

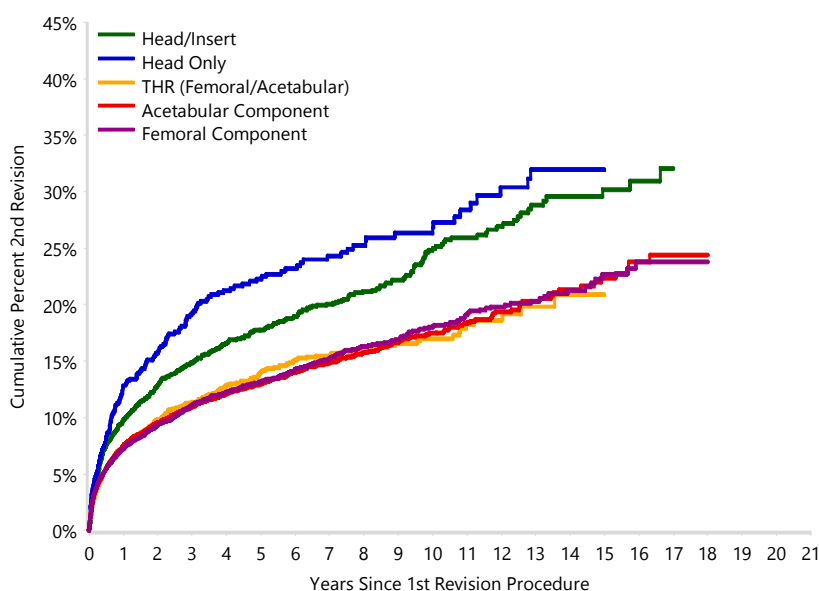
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Minor	4325	3524	2642	1895	682	191	10
Major Partial	12842	10689	8231	6163	2186	405	19
Major Total	2225	1846	1418	1038	353	46	1

Table R4 Cumulative Percent 2nd Revision of Known Primary Total Conventional Hip Replacement by Type of 1st Revision (Primary Diagnosis OA, Excluding 1st Revision for Infection)

Type of 1st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Head/Insert	548	2956	9.8 (8.7, 10.9)	14.9 (13.6, 16.3)	17.8 (16.3, 19.3)	24.8 (22.7, 27.1)	30.2 (27.1, 33.5)	
Head Only	174	749	12.8 (10.6, 15.5)	19.3 (16.5, 22.4)	22.3 (19.3, 25.7)	26.3 (22.9, 30.2)	31.9 (27.3, 37.2)	
THR (Femoral/Acetabular)	302	2225	7.4 (6.3, 8.6)	11.4 (10.1, 12.8)	14.0 (12.5, 15.7)	17.0 (15.1, 19.0)	20.9 (17.6, 24.6)	
Acetabular Component	885	6089	7.5 (6.9, 8.2)	11.0 (10.2, 11.8)	13.0 (12.1, 13.9)	17.5 (16.3, 18.6)	22.4 (20.2, 24.7)	
Femoral Component	869	6741	7.2 (6.6, 7.9)	11.1 (10.3, 11.9)	13.2 (12.3, 14.1)	18.0 (16.7, 19.4)	22.7 (20.5, 25.0)	
TOTAL	2778	18760						

Note: Only the outcome of the five most common types of revision have been listed

Figure R6 Cumulative Percent 2nd Revision of Known Primary Total Conventional Hip Replacement by Type of 1st Revision (Primary Diagnosis OA, Excluding 1st Revision for Infection)



HR - adjusted for age and gender
 Head/Insert vs THR (Femoral/Acetabular)
 Entire Period: HR=1.40 (1.22, 1.61), p<0.001
 Head Only vs THR (Femoral/Acetabular)
 Entire Period: HR=1.62 (1.34, 1.95), p<0.001
 Acetabular Component vs THR (Femoral/Acetabular)
 Entire Period: HR=0.98 (0.86, 1.11), p=0.706
 Femoral Component vs THR (Femoral/Acetabular)
 Entire Period: HR=1.03 (0.90, 1.17), p=0.710

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Head/Insert	2956	2427	1806	1268	441	114	2
Head Only	749	604	471	349	155	51	4
THR (Femoral/Acetabular)	2225	1846	1418	1038	353	46	1
Acetabular Component	6089	5277	4296	3403	1288	204	13
Femoral Component	6741	5403	3927	2755	896	199	6

OUTCOME OF 1ST REVISION OF KNOWN PRIMARY TOTAL RESURFACING HIP REPLACEMENT

There are 1,751 1st revisions of primary total resurfacing hip replacement undertaken for osteoarthritis, excluding procedures with a 1st revision for infection.

As most resurfacing prostheses are a combination of a solid metal acetabular component and a one-piece femoral component, the only possible revision is a major revision.

The most common type of major revision is femoral/acetabular (74.6%), followed by femoral only (23.1%) and acetabular only revisions (2.3%).

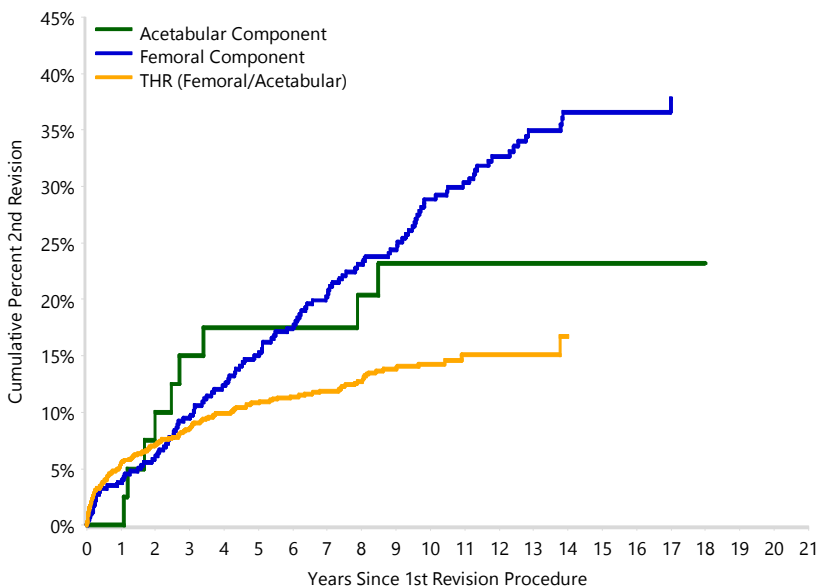
After 2 years, revising both the femoral and acetabular component has a lower rate of 2nd revision compared to revising only the femoral component. However, there is no difference when compared to revising the acetabular only (Table R5 and Figure R7).

Table R5 Cumulative Percent 2nd Revision of Known Primary Total Resurfacing Hip Replacement by Type of 1st Revision (Primary Diagnosis OA, Excluding 1st Revision for Infection)

Type of 1st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Acetabular Component	9	40	0.0 (0.0, 0.0)	15.0 (7.0, 30.4)	17.5 (8.8, 33.2)	23.2 (12.8, 39.9)	23.2 (12.8, 39.9)	
Femoral Component	117	405	3.7 (2.3, 6.1)	9.5 (6.9, 12.9)	15.0 (11.7, 19.1)	28.9 (24.3, 34.1)	36.6 (31.3, 42.4)	
THR (Femoral/Acetabular)	157	1306	5.4 (4.3, 6.8)	8.5 (7.1, 10.2)	10.8 (9.2, 12.8)	14.3 (12.2, 16.6)		
TOTAL	283	1751						

Note: Excluding revisions where no major femoral/acetabular components have been inserted

Figure R7 Cumulative Percent 2nd Revision of Known Primary Total Resurfacing Hip Replacement by Type of 1st Revision (Primary Diagnosis OA, Excluding 1st Revision for Infection)



HR - adjusted for age and gender

Acetabular Component vs THR (Femoral/Acetabular)
Entire Period: HR=1.48 (0.75, 2.93), p=0.259

Acetabular Component vs Femoral Component
Entire Period: HR=0.65 (0.33, 1.29), p=0.216

Femoral Component vs THR (Femoral/Acetabular)

- 0 - 3Mth: HR=0.67 (0.31, 1.44), p=0.309
- 3Mth - 6Mth: HR=1.68 (0.58, 4.93), p=0.341
- 6Mth - 2Yr: HR=0.83 (0.43, 1.62), p=0.592
- 2Yr - 5Yr: HR=2.38 (1.50, 3.80), p<0.001
- 5Yr - 5.5Yr: HR=7.61 (1.97, 29.47), p=0.003
- 5.5Yr - 6.5Yr: HR=6.23 (1.87, 20.72), p=0.002
- 6.5Yr - 10Yr: HR=3.66 (2.03, 6.60), p<0.001
- 10Yr+: HR=6.29 (1.83, 21.64), p=0.003

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Acetabular Component	40	40	34	33	25	16	0
Femoral Component	405	373	319	283	204	84	1
THR (Femoral/Acetabular)	1306	1173	990	859	332	26	2

Revision Knee

DEMOGRAPHICS OF ALL REVISIONS

There have been 78,373 revisions of knee replacements reported to the Registry with a procedure date up to and including 31 December 2021. This is an additional 5,174 procedures compared to the previous report.

Type of Revision

The majority of revision procedures are major revisions (64.0%). The most common major revisions are total knee replacement (TKR) (tibial and femoral) (47.2%) and tibial only (5.9%) (Table R6).

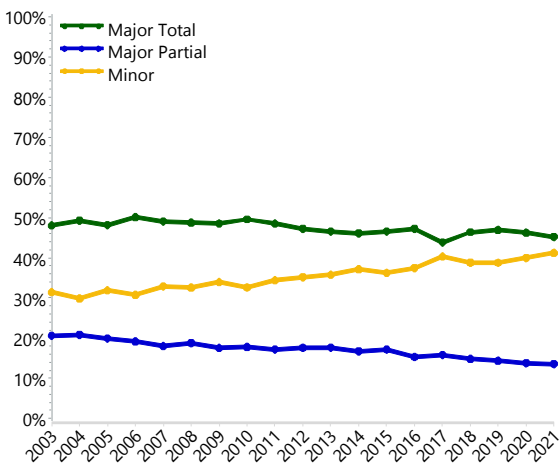
Minor revisions account for 36.0% of all revision knee procedures. The most common types of minor revision are insert only (17.0%), patella only (10.4%) and insert/patella (7.2%) (Table R6).

Since 2003, the proportion of major total revisions has remained unchanged. However, there has been a decrease in major partial revisions (20.6% in 2003 to 13.6% in 2021) and an increase in minor revisions (31.4% in 2003 to 41.2% in 2021) (Figure R8).

Reason for Revision

The most common reasons for revision are loosening (28.7%) and infection (25.1%) (Table R7).

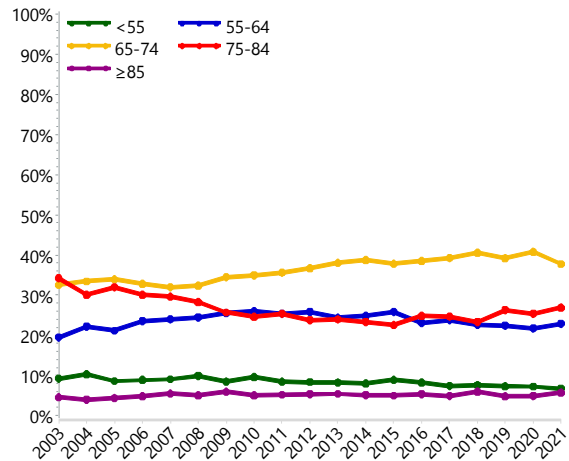
Figure R8 Revision Knee Replacement by Class



Age and Gender

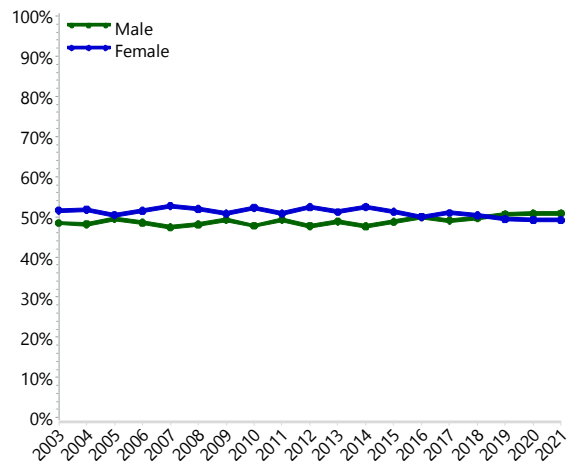
There has been an increase in the proportion of revisions undertaken in the 65-74 year age group from 32.5% in 2003 to 37.7% in 2021 and a decrease in the 75-84 year age group from 34.2% in 2003 to 26.9% in 2021 (Figure R9).

Figure R9 Revision Knee Replacement by Age



Revision knee replacement is slightly more common in females (51.0%). There has been little change in the gender proportion over the last 10 years (Figure R10).

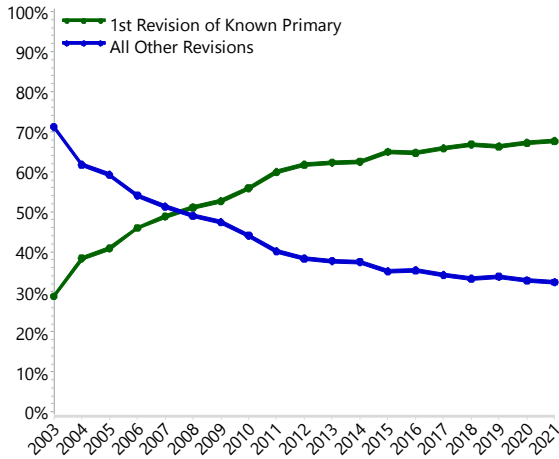
Figure R10 Revision Knee Replacement by Gender



DEMOGRAPHICS OF 1ST REVISIONS OF KNOWN PRIMARY PROCEDURES

There have been 44,167 1st revision procedures where the primary procedure has been recorded by the Registry. This includes revisions of primary partial and total knee replacement. This is an additional 3,498 procedures compared to the previous report (Figure R11).

Figure R11 Revision Knee Replacement by Revision



Type of Revision

Types of revision differ between the '1st revisions of known primary procedures' group and the 'all revisions' group.

The '1st revisions of known primary procedures' group has a smaller proportion of major revisions (57.2%) compared to the 'all revisions' group (64.0%), with less TKR (tibial/femoral)

revisions (41.4% compared to 47.2%) (Table R6). There is a higher proportion of minor revisions (42.8% compared to 36.0%) (Table R6).

Reason for Revision

There are differences in the reasons for revision between the '1st revisions of known primary procedures' group and the 'all revisions' group. Loosening is the most common reason for revision, but the proportion is less in the '1st revisions of known primary procedures' group (26.3% compared to 28.7%). Of the three most common reasons for revision, only progression of disease has a higher proportion in the '1st revisions of known primary procedures' group (9.0% compared to 6.4%) (Table R7).

**Table R6 Revision Knee Replacement by Type of Revision**

Type of Revision	1st Revision of Known Primary		All Revisions	
	Number	Percent	Number	Percent
TKR (Tibial/Femoral)	18275	41.4	37004	47.2
Tibial Component	2686	6.1	4645	5.9
Cement Spacer	1799	4.1	4144	5.3
Femoral Component	1734	3.9	3236	4.1
Uni Tibial Component	236	0.5	281	0.4
Removal of Prostheses	209	0.5	425	0.5
UKR (Uni Tibial/Uni Femoral)	143	0.3	198	0.3
Uni Femoral Component	85	0.2	111	0.1
Patella/Trochlear Resurfacing	55	0.1	92	0.1
Reinsertion of Components	23	0.1	36	0.0
N Major	25245	57.2	50172	64.0
Insert Only	8371	19.0	13306	17.0
Patella Only	6333	14.3	8155	10.4
Insert/Patella	3549	8.0	5615	7.2
Uni Insert Only	558	1.3	716	0.9
Minor Components	82	0.2	347	0.4
Cement Only	20	0.0	42	0.1
Partial Resurfacing	4	0.0	7	0.0
Unispacer	4	0.0	4	0.0
Uni Insert/Patella	1	0.0	1	0.0
Removal of Patella			8	0.0
N Minor	18922	42.8	28201	36.0
TOTAL	44167	100.0	78373	100.0

Table R7 Revision Knee Replacement by Reason for Revision

Reason for Revision	1st Revision of Known Primary		All Revisions	
	Number	Percent	Number	Percent
Loosening	11633	26.3	22459	28.7
Infection	8627	19.5	19637	25.1
Progression Of Disease	3957	9.0	5038	6.4
Pain	3469	7.9	4832	6.2
Instability	3129	7.1	4574	5.8
Patellofemoral Pain	2808	6.4	3612	4.6
Patella Erosion	2132	4.8	2405	3.1
Fracture	1393	3.2	2083	2.7
Arthrofibrosis	1228	2.8	1637	2.1
Lysis	953	2.2	2440	3.1
Wear Tibial Insert	845	1.9	2560	3.3
Malalignment	832	1.9	1182	1.5
Metal Related Pathology	421	1.0	636	0.8
Bearing Dislocation	386	0.9	584	0.7
Incorrect Sizing	369	0.8	482	0.6
Implant Breakage Tibial Insert	302	0.7	676	0.9
Patella Maltracking	256	0.6	389	0.5
Implant Breakage Patella	206	0.5	427	0.5
Implant Breakage Tibial	149	0.3	450	0.6
Prosthesis Dislocation	141	0.3	268	0.3
Synovitis	138	0.3	195	0.2
Osteonecrosis	109	0.2	133	0.2
Wear Patella	84	0.2	263	0.3
Wear Tibial	69	0.2	494	0.6
Implant Breakage Femoral	68	0.2	229	0.3
Tumour	34	0.1	68	0.1
Heterotopic Bone	17	0.0	41	0.1
Wear Femoral	8	0.0	20	0.0
Incorrect Side	3	0.0	3	0.0
Patella Dislocation	2	0.0	6	0.0
Other	399	0.9	550	0.7
TOTAL	44167	100.0	78373	100.0

OUTCOME OF 1ST REVISION OF KNOWN PRIMARY UNICOMPARTMENTAL KNEE REPLACEMENT

This analysis reports the outcome of the 1st revision of a known primary unicompartmental knee replacement (UKR).

There are 8,681 1st revisions of primary UKR that were undertaken for osteoarthritis, excluding all procedures with a 1st revision for infection.

For primary UKR, the lowest rate of 2nd revision occurs when it is revised to a TKR. Revision to another UKR has a 15 year cumulative percent revision of 53.7% compared to 17.4% when revised to a TKR (Table R8 and Figure R12).

Most UKR to UKR revisions are minor revisions where the insert is exchanged or major partial revisions where either the tibial or the femoral prosthesis only is revised. Revision to a TKR has a lower rate of 2nd revision compared to minor, major partial UKR, and major total UKR revision after 2 years (Table R9 and Figure R13).

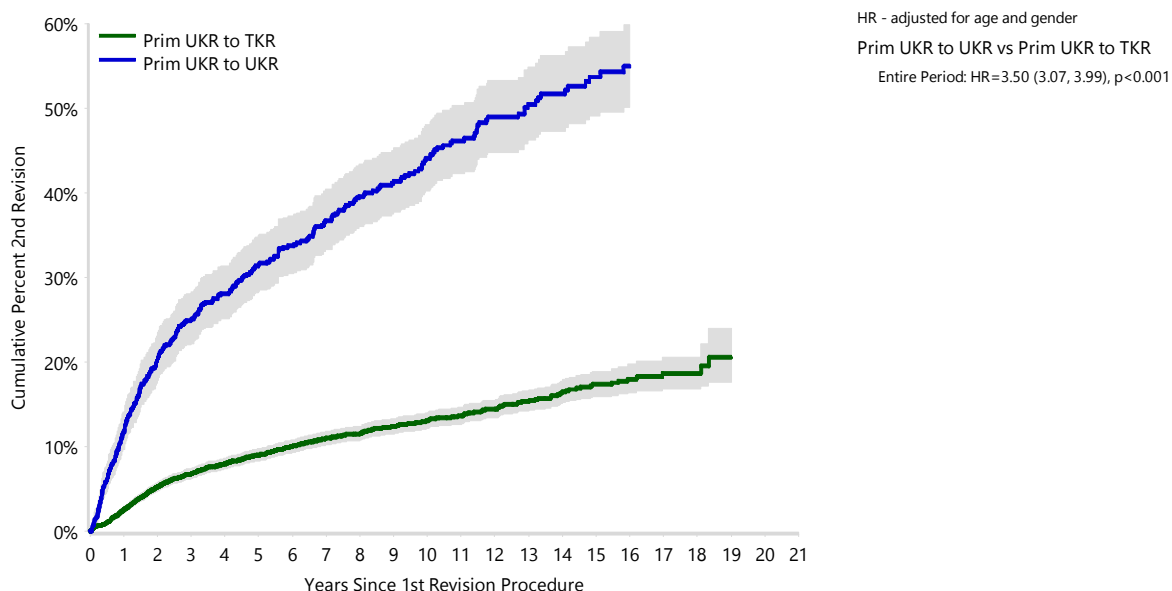
There is a difference in the outcome of revising a primary UKR to a TKR compared to revising a TKR to a TKR. The rate of 2nd revision of a UKR to TKR is lower than a TKR to TKR revision (Table R10 and Figure R14).

Table R8 Cumulative Percent 2nd Revision of Known Primary Unicompartmental Knee Replacement by Type of 1st Revision (Primary Diagnosis OA, Excluding 1st Revision for Infection)

Type of 1st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Prim UKR to TKR	807	7836	2.6 (2.2, 2.9)	6.8 (6.2, 7.4)	9.0 (8.4, 9.8)	13.1 (12.2, 14.0)	17.4 (15.9, 18.9)	
Prim UKR to UKR	338	845	11.7 (9.7, 14.1)	24.9 (22.1, 28.1)	31.5 (28.3, 35.0)	44.1 (40.2, 48.1)	53.7 (49.1, 58.5)	
TOTAL	1145	8681						

Note: Excluding patella/trochlea resurfacing and revisions where no femoral and tibial components have been inserted

Figure R12 Cumulative Percent 2nd Revision of Known Primary Unicompartmental Knee Replacement by Type of 1st Revision (Primary Diagnosis OA, Excluding 1st Revision for Infection)



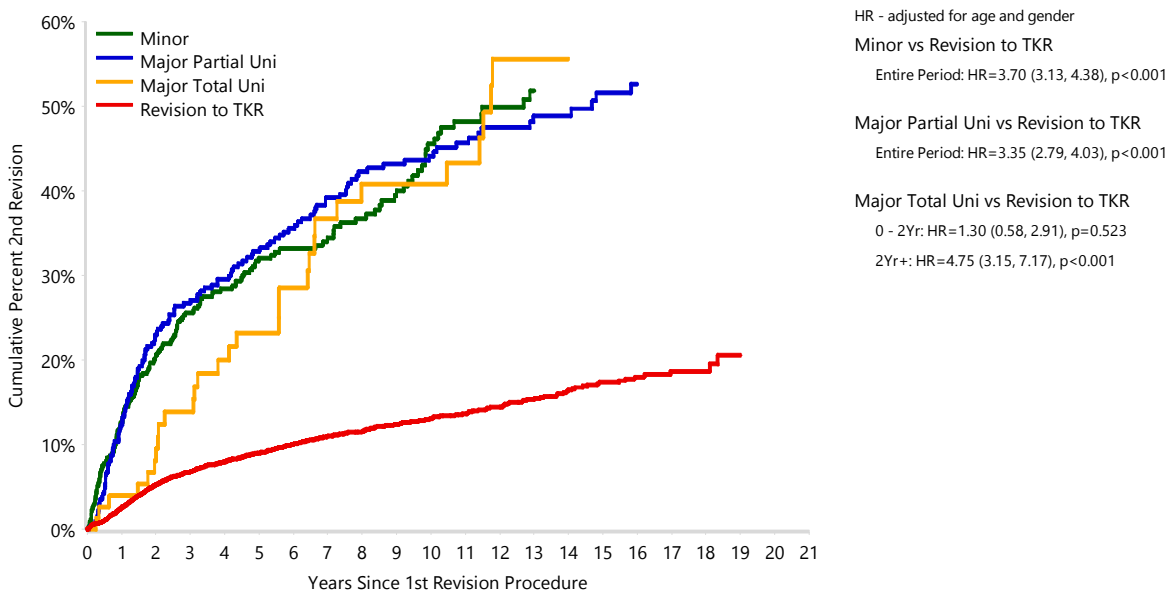
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Prim UKR to TKR	7836	7063	5636	4361	1928	503	5
Prim UKR to UKR	845	708	538	417	219	82	7

Table R9 Cumulative Percent 2nd Revision of Known Primary Unicompartmental Knee Replacement by Class of 1st Revision (Primary Diagnosis OA, Excluding 1st Revision for Infection)

Class of 1st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Minor	169	457	12.6 (9.9, 16.1)	25.6 (21.7, 30.1)	32.0 (27.6, 37.0)	45.5 (39.7, 51.8)		
Major Partial Uni	139	312	12.3 (9.1, 16.5)	26.7 (22.1, 32.1)	32.9 (27.8, 38.6)	44.1 (38.4, 50.2)	51.6 (45.1, 58.3)	
Major Total Uni	30	76	3.9 (1.3, 11.7)	13.9 (7.7, 24.3)	23.2 (14.9, 35.2)	40.9 (29.4, 54.7)		
Revision to TKR	807	7836	2.6 (2.2, 2.9)	6.8 (6.2, 7.4)	9.0 (8.4, 9.8)	13.1 (12.2, 14.0)	17.4 (15.9, 18.9)	
TOTAL	1145	8681						

Note: Excluding patella/trochlea resurfacing and revisions where no femoral and tibial components have been inserted

Figure R13 Cumulative Percent 2nd Revision of Known Primary Unicompartmental Knee Replacement by Class of 1st Revision (Primary Diagnosis OA, Excluding 1st Revision for Infection)



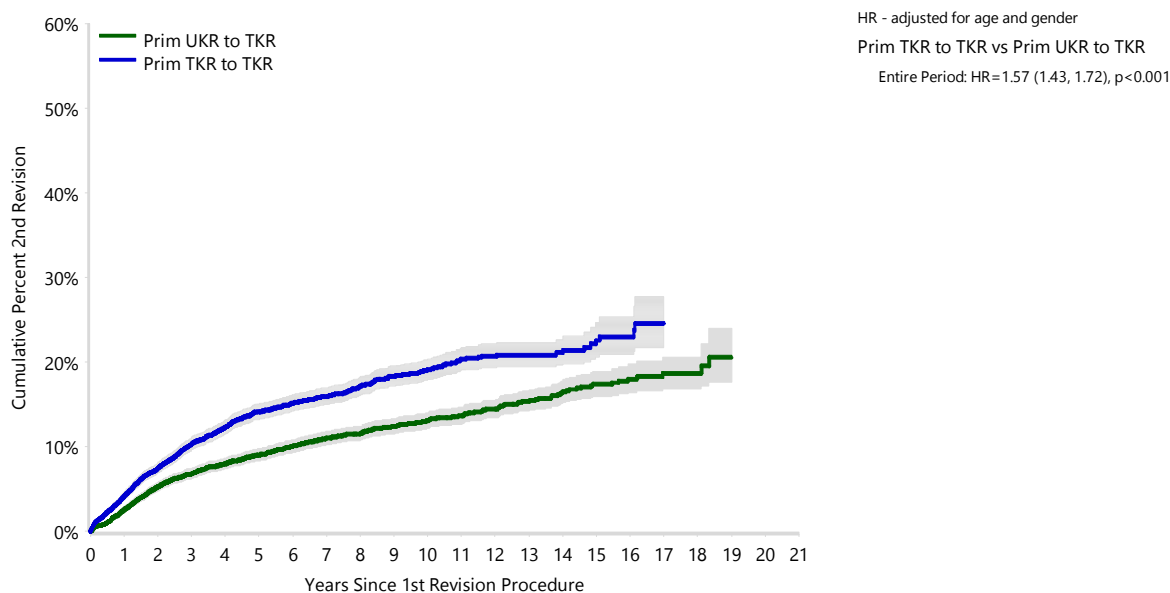
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Minor	457	371	270	195	86	24	3
Major Partial Uni	312	267	211	178	109	52	3
Major Total Uni	76	70	57	44	24	6	1
Revision to TKR	7836	7063	5636	4361	1928	503	5



Table R10 Cumulative Percent 2nd Revision of Known Primary Knee Replacement by Type of Primary (Primary Diagnosis OA, Excluding 1st Revision for Infection)

Type of Primary	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Prim UKR to TKR	807	7836	2.6 (2.2, 2.9)	6.8 (6.2, 7.4)	9.0 (8.4, 9.8)	13.1 (12.2, 14.0)	17.4 (15.9, 18.9)	
Prim TKR to TKR	1023	7760	4.1 (3.7, 4.6)	10.3 (9.6, 11.1)	14.1 (13.2, 15.0)	19.1 (17.9, 20.4)	22.6 (20.6, 24.7)	
TOTAL	1830	15596						

Figure R14 Cumulative Percent 2nd Revision of Known Primary Knee Replacement by Type of Primary (Primary Diagnosis OA, Excluding 1st Revision for Infection)



Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Prim UKR to TKR	7836	7063	5636	4361	1928	503	5
Prim TKR to TKR	7760	6686	4813	3439	1132	185	0

OUTCOME OF 1ST REVISION OF KNOWN PRIMARY TOTAL KNEE REPLACEMENT

This analysis examines the outcome of the 1st revision of known primary TKR.

There are 24,563 1st revisions of known primary TKR undertaken for osteoarthritis, excluding all procedures where the 1st revision was for infection.

Major partial revisions have a higher rate of 2nd revision compared to minor revisions and major total revisions (Table R11 and Figure R15).

Comparing the three types of major revision, TKR (femoral/tibial) revision has a lower rate of 2nd revision than revision of the femoral

component and the tibial component (Table R12 and Figure R16).

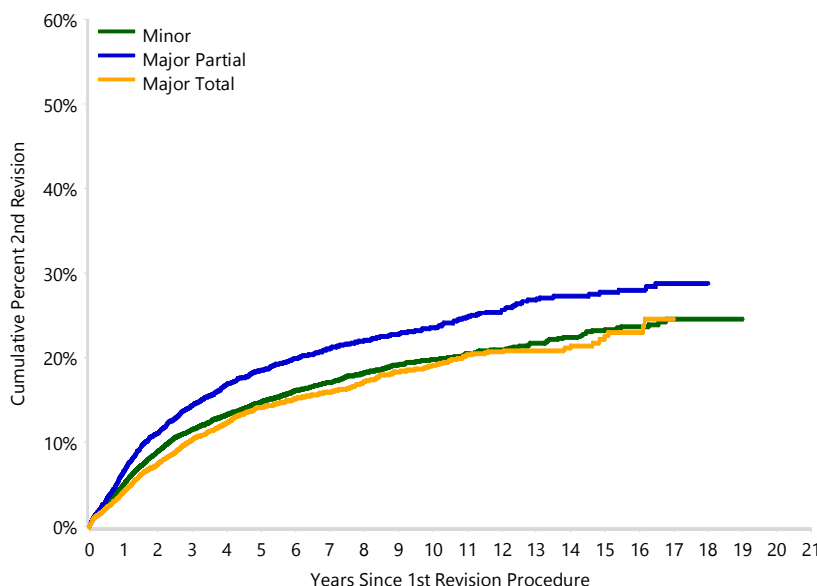
Revising the patella alone has the same rate of 2nd revision as revising the patella in combination with an insert exchange. At 15 years, the cumulative percent revision of the 1st revision of the patella only is 20.5% and 21.7% for a patella with an insert exchange. Revising the insert alone has the highest rate of 2nd revision of the three types of minor revision (Table R12 and Figure R17).

Table R11 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by Class of 1st Revision (Primary Diagnosis OA, Excluding 1st Revision for Infection)

Revision of Primary	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Minor	1963	13005	5.0 (4.6, 5.4)	11.5 (10.9, 12.1)	14.8 (14.1, 15.5)	19.8 (18.9, 20.6)	23.3 (22.0, 24.6)	
Major Partial	773	3798	6.6 (5.8, 7.4)	14.4 (13.2, 15.6)	18.5 (17.2, 19.9)	23.5 (22.0, 25.1)	27.7 (25.8, 29.8)	
Major Total	1023	7760	4.1 (3.7, 4.6)	10.3 (9.6, 11.1)	14.1 (13.2, 15.0)	19.1 (17.9, 20.4)	22.6 (20.6, 24.7)	
TOTAL	3759	24563						

Note: Excluding revisions where no femoral or tibial components have been inserted

Figure R15 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by Class of 1st Revision (Primary Diagnosis OA, Excluding 1st Revision for Infection)



HR - adjusted for age and gender

Minor vs Major Total
 0 - 1.5Yr: HR=1.15 (1.03, 1.29), p=0.015
 1.5Yr+: HR=0.98 (0.89, 1.09), p=0.759

Major Partial vs Major Total
 0 - 1.5Yr: HR=1.47 (1.28, 1.70), p<0.001
 1.5Yr+: HR=1.16 (1.02, 1.31), p=0.022

Major Partial vs Minor
 Entire Period: HR=1.22 (1.12, 1.33), p<0.001

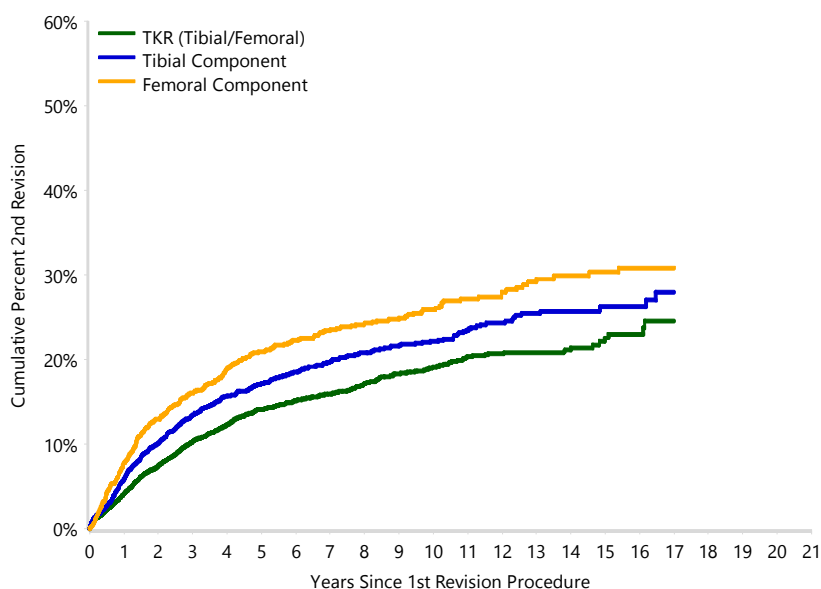
Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Minor	13005	11333	8652	6437	2462	519	10
Major Partial	3798	3347	2715	2149	979	285	8
Major Total	7760	6686	4813	3439	1132	185	0

Table R12 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by Type of 1st Revision (Primary Diagnosis OA, Excluding 1st Revision for Infection)

Type of 1st Revision	N Revised	N Total	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Insert/Patella	434	3347	3.7 (3.1, 4.5)	9.8 (8.7, 10.9)	12.9 (11.7, 14.3)	18.2 (16.5, 20.1)	21.7 (19.0, 24.7)	
Insert Only	685	3561	8.4 (7.5, 9.4)	15.7 (14.4, 17.0)	19.0 (17.6, 20.5)	25.2 (23.4, 27.1)	29.7 (27.2, 32.5)	
Patella Only	834	6058	3.6 (3.1, 4.1)	9.9 (9.2, 10.8)	13.2 (12.3, 14.2)	17.5 (16.4, 18.7)	20.5 (18.9, 22.3)	
TKR (Tibial/Femoral)	1023	7760	4.1 (3.7, 4.6)	10.3 (9.6, 11.1)	14.1 (13.2, 15.0)	19.1 (17.9, 20.4)	22.6 (20.6, 24.7)	
Tibial Component	470	2475	5.8 (5.0, 6.9)	13.4 (12.1, 14.9)	17.2 (15.6, 18.8)	22.2 (20.3, 24.1)	26.2 (23.7, 28.9)	
Femoral Component	301	1318	7.8 (6.5, 9.4)	16.1 (14.1, 18.3)	20.9 (18.7, 23.4)	25.9 (23.3, 28.7)	30.3 (27.1, 33.8)	
TOTAL	3747	24519						

Note: Only the outcomes of the six most common types of 1st revision have been listed

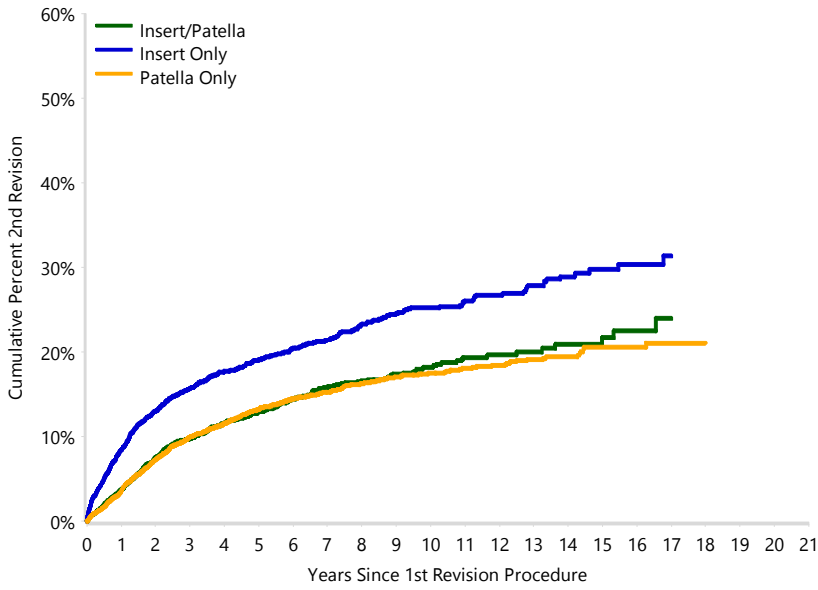
Figure R16 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by Type of 1st Revision (Primary Diagnosis OA, Excluding 1st Revision for Infection)



HR - adjusted for age and gender
 Tibial Component vs TKR (Tibial/Femoral)
 Entire Period: HR=1.21 (1.08, 1.35), p<0.001
 Femoral Component vs TKR (Tibial/Femoral)
 Entire Period: HR=1.42 (1.25, 1.62), p<0.001
 Femoral Component vs Tibial Component
 Entire Period: HR=1.18 (1.02, 1.36), p=0.027

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
TKR (Tibial/Femoral)	7760	6686	4813	3439	1132	185	0
Tibial Component	2475	2197	1785	1410	612	140	5
Femoral Component	1318	1146	927	738	367	145	3

Figure R17 Cumulative Percent 2nd Revision of Known Primary Total Knee Replacement by Type of 1st Revision (Primary Diagnosis OA, Excluding 1st Revision for Infection)



HR - adjusted for age and gender

Insert Only vs Insert/Patella
 0 - 3Mth: HR=3.02 (2.27, 4.02), p<0.001
 3Mth - 1.5Yr: HR=1.81 (1.52, 2.15), p<0.001
 1.5Yr+: HR=1.11 (0.95, 1.30), p=0.174

Insert Only vs Patella Only
 0 - 2Wk: HR=6.49 (3.13, 13.48), p<0.001
 2Wk - 6Mth: HR=2.45 (1.95, 3.08), p<0.001
 6Mth - 1.5Yr: HR=1.69 (1.41, 2.02), p<0.001
 1.5Yr - 2Yr: HR=0.86 (0.62, 1.20), p=0.371
 2Yr+: HR=1.17 (1.00, 1.36), p=0.043

Patella Only vs Insert/Patella
 Entire Period: HR=1.00 (0.89, 1.13), p=0.941

Number at Risk	0 Yr	1 Yr	3 Yrs	5 Yrs	10 Yrs	15 Yrs	20 Yrs
Insert/Patella	3347	2922	2186	1568	504	106	4
Insert Only	3561	2948	2128	1542	620	136	3
Patella Only	6058	5434	4315	3310	1331	275	3

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