

Mueller Total Conventional Hip Investigation

Note: This analysis compares the Mueller acetabular prosthesis with all other total conventional hip prostheses.

This prosthesis has been identified as having a significantly higher rate of revision. For a detailed explanation of the process used by the Registry that results in identification of prostheses that have a higher than anticipated rate of revision please refer to the Prostheses with Higher than Anticipated Rates of Revision chapter of the most recent AOANJRR Annual Report, <https://aoanjrr.sahmri.com/annual-reports-2023>.

Note: Procedures using metal/metal prostheses with head size larger than 32mm are excluded from the comparator. Procedures using prostheses with no recorded use in 2022 are excluded from the comparator.

TABLE 1

Revision Rate of Primary Total Conventional Hip Replacement

The revision rate of the Mueller total conventional hip prosthesis is compared to all other total conventional hip prostheses.

Table 1: Revision Rates of Primary Total Conventional Hip Replacement

Component	N Revised	N Total	Obs. Years	Revisions/100 Obs. Yrs (95% CI)
Mueller	12	59	529	2.27 (1.17, 3.96)
Other Total Conventional Hip	17452	494136	3081437	0.57 (0.56, 0.57)
TOTAL	17464	494195	3081966	0.57 (0.56, 0.58)

Note: Prostheses no longer used in 2022 are excluded from the comparator. Procedures using metal/metal prostheses with head size larger than 32mm are excluded from the comparator.

TABLE 2

Yearly Cumulative Percent Revision of Primary Total Conventional Hip Replacement

The yearly cumulative percent revision of the Mueller total conventional hip prosthesis is compared to all other total conventional hip prostheses.

Table 2: Yearly Cumulative Percent Revision of Primary Total Conventional Hip Replacement

CPR	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs	8 Yrs
Mueller	1.8 (0.2, 11.8)	3.6 (0.9, 13.8)	12.1 (5.6, 25.1)	14.3 (7.0, 27.7)	14.3 (7.0, 27.7)	14.3 (7.0, 27.7)	14.3 (7.0, 27.7)	14.3 (7.0, 27.7)
Other Total Conventional Hip	1.7 (1.7, 1.8)	2.2 (2.1, 2.2)	2.5 (2.5, 2.6)	2.8 (2.7, 2.8)	3.1 (3.0, 3.1)	3.4 (3.3, 3.4)	3.6 (3.6, 3.7)	3.9 (3.9, 4.0)

CPR	9 Yrs	10 Yrs	11 Yrs	12 Yrs	13 Yrs	14 Yrs	15 Yrs
Mueller	23.4 (13.1, 39.9)	23.4 (13.1, 39.9)	23.4 (13.1, 39.9)	27.1 (15.6, 44.5)	30.9 (18.3, 49.2)	30.9 (18.3, 49.2)	30.9 (18.3, 49.2)
Other Total Conventional Hip	4.3 (4.2, 4.3)	4.6 (4.5, 4.7)	4.9 (4.8, 5.0)	5.3 (5.2, 5.4)	5.7 (5.6, 5.8)	6.1 (6.0, 6.2)	6.5 (6.4, 6.6)

CPR	16 Yrs	17 Yrs	18 Yrs	19 Yrs	20 Yrs	21 Yrs	22 Yrs
Mueller	30.9 (18.3, 49.2)	30.9 (18.3, 49.2)	30.9 (18.3, 49.2)	30.9 (18.3, 49.2)			
Other Total Conventional Hip	6.9 (6.8, 7.1)	7.3 (7.1, 7.4)	7.6 (7.4, 7.8)	8.2 (8.0, 8.5)	8.5 (8.2, 8.8)	8.9 (8.5, 9.3)	9.3 (8.8, 9.8)

Note: Prostheses no longer used in 2022 are excluded from the comparator. Procedures using metal/metal prostheses with head size larger than 32mm are excluded from the comparator.

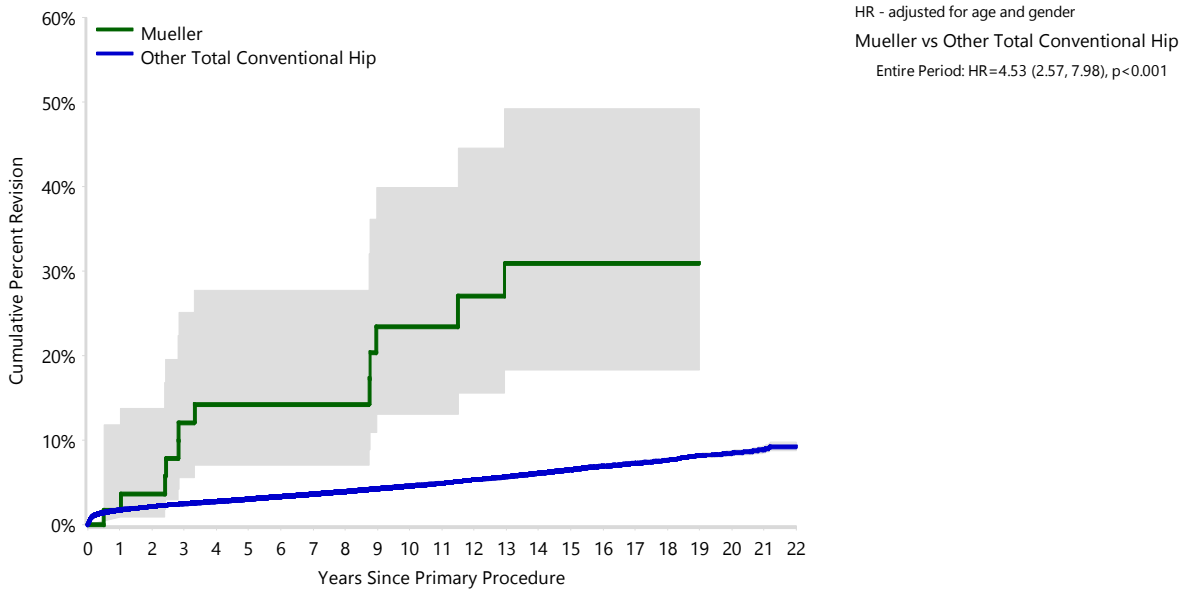
FIGURE 1

Yearly Cumulative Percent Revision of Primary Total Conventional Hip Replacement

The yearly cumulative percent revision of the Mueller total conventional hip prosthesis is compared to all other total conventional hip prostheses. In addition, hazard ratios are reported.

Hazard ratios are reported for specific time periods during which the hazard ratio is constant. This is done to enable more specific and valid comparisons of the risk of revision over time. The pattern of variation in risk has important implications with respect to the underlying reasons for any difference.

Figure 1: Cumulative Percent Revision of Primary Total Conventional Hip Replacement



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs	8 Yrs	9 Yrs	10 Yrs	11 Yrs
Mueller	59	53	48	41	37	35	32	30	28	25	25	22
Other Total Conventional Hip	494136	437492	388711	344215	299658	258063	219311	183514	151369	124924	102632	83483

Number at Risk	12 Yrs	13 Yrs	14 Yrs	15 Yrs	16 Yrs	17 Yrs	18 Yrs	19 Yrs	20 Yrs	21 Yrs	22 Yrs
Mueller	20	18	17	16	13	11	10	7	6	4	1
Other Total Conventional Hip	66659	51987	39538	29740	22330	16535	11402	7013	3737	1435	252

Note: Prostheses no longer used in 2022 are excluded from the comparator. Procedures using metal/metal prostheses with head size larger than 32mm are excluded from the comparator.

TABLE 3**Primary Diagnosis for Revised Primary Total Conventional Hip Replacement**

This table identifies the diagnosis of the primary procedure which was subsequently revised. This information is provided as there is a variation on outcome depending on the primary diagnosis. It is therefore important when considering the reasons for a higher than anticipated rate of revision that there is identification of the primary diagnosis. This information should be compared to the primary diagnosis for the revisions of all other total conventional hip prostheses.

Table 3: Primary Diagnosis for Revised Primary Total Conventional Hip Replacement

Primary Diagnosis	Mueller		Other Total Conventional Hip	
	Number	Percent	Number	Percent
Osteoarthritis	9	75.0	14432	82.7
Fractured Neck Of Femur			1291	7.4
Osteonecrosis	3	25.0	797	4.6
Developmental Dysplasia			279	1.6
Rheumatoid Arthritis			186	1.1
Failed Internal Fixation			147	0.8
Tumour			145	0.8
Other Inflammatory Arthritis			99	0.6
Fracture/Dislocation			46	0.3
Arthrodesis Takedown			16	0.1
Other			14	0.1
TOTAL	12	100.0	17452	100.0

Note: Prostheses no longer used in 2022 are excluded from the comparator. Procedures using metal/metal prostheses with head size larger than 32mm are excluded from the comparator.

TABLE 4

Reasons for Revision

This is reported in two ways: a percentage of primary procedures revised and as a percentage of all revision procedures.

% Primaries Revised: This shows the proportional contribution of each revision diagnosis as a percentage of the total number of primary procedures. This percentage can be used to approximate the risk of being revised for that diagnosis. Differing percentages between groups, with the same distribution of follow up time, may identify problems of concern.

% Revisions: The number of revisions for each diagnosis is expressed as a percentage of the total number of revisions. This shows the distribution of reasons for revision within a group but cannot be used as a comparison between groups.

Table 4: Primary Total Conventional Hip Replacement - Reason for Revision

Revision Diagnosis	Number	Mueller		Other Total Conventional Hip		
		% Primaries Revised	% Revisions	Number	% Primaries Revised	% Revisions
Prosthesis Dislocation/Instability				4021	0.8	23.0
Infection	1	1.7	8.3	4009	0.8	23.0
Fracture				3811	0.8	21.8
Loosening	10	16.9	83.3	3535	0.7	20.3
Pain				310	0.1	1.8
Leg Length Discrepancy				270	0.1	1.5
Malposition				244	0.0	1.4
Lysis	1	1.7	8.3	197	0.0	1.1
Implant Breakage Stem				168	0.0	1.0
Implant Breakage Acetabular Insert				120	0.0	0.7
Incorrect Sizing				102	0.0	0.6
Wear Acetabular Insert				102	0.0	0.6
Metal Related Pathology				79	0.0	0.5
Implant Breakage Acetabular				70	0.0	0.4
Wear Head				45	0.0	0.3
Tumour				41	0.0	0.2
Implant Breakage Head				32	0.0	0.2
Heterotopic Bone				26	0.0	0.1
Wear Acetabulum				9	0.0	0.1
Progression Of Disease				2	0.0	0.0
Osteonecrosis				1	0.0	0.0
Synovitis				1	0.0	0.0
Other				257	0.1	1.5
N Revision	12	20.3	100.0	17452	3.5	100.0
N Primary	59			494136		

Note: Prostheses no longer used in 2022 are excluded from the comparator. Procedures using metal/metal prostheses with head size larger than 32mm are excluded from the comparator.

FIGURE 2

Cumulative Incidence Revision Diagnosis of Primary Total Conventional Hip Replacement

This figure details the cumulative incidence of the most common reasons for revision. The five most common reasons for revision are included as long as each of these reasons account for more than 10 procedures or at least 5% of all revisions for the Mueller total conventional hip prosthesis. A comparative graph is provided of the cumulative incidence for the same reasons for revisions for all other total conventional hip prostheses.

Figure 2: Cumulative Incidence Revision Diagnosis for Primary Total Conventional Hip Replacement

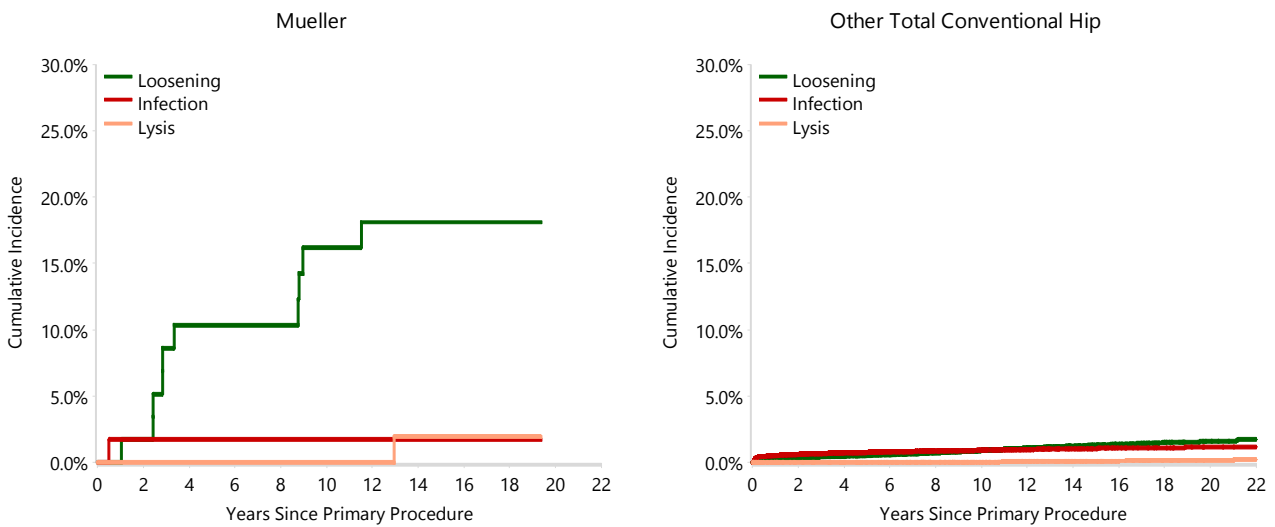


TABLE 5

Type of Revision Performed for Primary Total Conventional Hip Replacement

This analysis identifies the components used in the revision of the Mueller total conventional hip prosthesis and compares it to the components used in the revision of all other total conventional hip prostheses.

The reason this analysis is undertaken is to identify whether there is one or more components which are being replaced that differ from the components replaced for revisions of all other total conventional hip prostheses i.e. is there a difference in the type of revision undertaken for the Mueller total conventional hip prosthesis compared to all other total conventional hip prostheses.

Table 5: Primary Total Conventional Hip Replacement - Type of Revision

Type of Revision	Mueller		Other Total Conventional Hip	
	Number	Percent	Number	Percent
Femoral Component	1	8.3	5701	32.7
Acetabular Component	2	16.7	3314	19.0
THR (Femoral/Acetabular)	8	66.7	2031	11.6
Cement Spacer	1	8.3	619	3.5
Removal of Prostheses			95	0.5
Reinsertion of Components			27	0.2
Total Femoral			8	0.0
Bipolar Head and Femoral			5	0.0
Saddle			1	0.0
N Major	12	100.0	11801	67.6
Head/Insert			4324	24.8
Head Only			844	4.8
Minor Components			298	1.7
Insert Only			181	1.0
Bipolar Only			2	0.0
Cement Only			1	0.0
Head/Neck			1	0.0
N Minor			5651	32.4
TOTAL	12	100.0	17452	100.0

Note: Prostheses no longer used in 2022 are excluded from the comparator. Procedures using metal/metal prostheses with head size larger than 32mm are excluded from the comparator.

TABLE 6**Revision Rates of Mueller Primary Total Conventional Hip Replacement by Fixation**

This analysis is provided as some prostheses have more than one fixation option. Additionally there are prostheses where an alternative to the recommended approach to fixation was used e.g. a cementless prosthesis that has been cemented or vice-versa.

Table 6: Revised Number of Mueller Primary Total Conventional Hip Replacement by Fixation

Fixation	N Revised	N Total
Cemented	11	52
Reverse Hybrid (Femur Cementless)	1	7
TOTAL	12	59

TABLE 7**Revision Rates of Mueller Primary Total Conventional Hip Replacement by Bearing Surface**

This analysis is provided as some prostheses are combined with a variety of bearing surfaces. All bearing surfaces used with this prosthesis are listed.

Table 7: Revised Number of Mueller Primary Total Conventional Hip Replacement by Bearing Surface

Bearing Surface	N Revised	N Total
Ceramic/Ceramic	4	5
Ceramic/Non XLPE	2	10
Metal/Non XLPE	6	43
Unknown	0	1
TOTAL	12	59

TABLE 8**Revision Rates of Mueller Primary Total Conventional Hip Replacement by Approach**

This analysis is provided as some prostheses are used with a variety of surgical approaches. All surgical approaches used with this prosthesis are listed.

Table 8: Revised Number of Mueller Primary Total Conventional Hip Replacement by Approach

Approach	N Revised	N Total
Anterior	0	1
Lateral	0	3
Posterior	0	3
TOTAL	0	7

Note: Excludes 52 procedures with no approach recorded

TABLE 9

Revision Rates of Primary Total Conventional Hip Replacement by State

This enables a state by state variation to be identified for the Mueller total conventional hip prosthesis and provides the comparative data for each of the states for all other total conventional hip prostheses.

The purpose of this analysis is to determine if the higher than anticipated rate of revision has widespread distribution between states. If there is widespread distribution then the reason for the higher than anticipated rate of revision is unlikely to be surgeon specific. If the prosthesis has been used in only a small number of states it is not possible to distinguish if the higher than anticipated rate of revision is related to the prosthesis, surgeon, technique or patient.

Table 9: Revised Number of Primary Total Conventional Hip Replacement by State

Component	State	N Revised	N Total
Mueller	NSW	0	5
	VIC	0	3
	QLD	12	47
	TAS	0	4
Other Total Conventional Hip	NSW	4728	144765
	VIC	4348	128321
	QLD	3451	86927
	WA	2389	58888
	SA	1621	45638
	TAS	405	16379
	ACT/NT	510	13218
TOTAL		17464	494195

Note: Prostheses no longer used in 2022 are excluded from the comparator. Procedures using metal/metal prostheses with head size larger than 32mm are excluded from the comparator.

TABLE 10**Number of Revisions of Mueller Primary Total Conventional Hip Replacement by Year of Implant**

This analysis details the number of prostheses reported each year to the Registry for the Mueller total conventional hip prosthesis. It also provides the subsequent number of revisions of the primaries reported in that year.

Primary procedures performed in later years have had less follow up time therefore the number revised is expected to be less than the number revised in earlier years. For example, a primary procedure performed in 2022 has a maximum of one year to be revised, whereas a primary procedure performed in 2020 has a maximum of three years to be revised.

Table 10: Number of Revisions of Mueller Primary Total Conventional Hip Replacement by Year of Implant

Year of Implant	Number Revised	Total Number
2000	3	7
2001	4	21
2002	3	9
2003	2	3
2004	0	4
2005	0	3
2007	0	1
2008	0	2
2012	0	1
2014	0	1
2015	0	1
2017	0	1
2018	0	1
2019	0	3
2022	0	1
TOTAL	12	59

TABLE 11

Revision Rates of Mueller Primary Total Conventional Hip Replacement by Catalogue Number Range

Many prostheses have a number of catalogue ranges. The catalogue range is specific to particular design features; more than one catalogue range usually indicates a minor difference in design in a particular Mueller prosthesis.

This analysis has been undertaken to determine if the revision rate varies according to the catalogue number range.

Model	Catalogue Range	Catalogue Description	Cement	Material
Acetabular				
Mueller	561239015-561239040	UHMWPE + BIOLOX ACETABULAR CUP	YES	CERAMIC
Mueller	562050005-562250060	UHMWPE PROTRUDED ACETABULAR CUP	YES	NON CROSS-LINKED POLYETHYLENE
Mueller	562650010-562650060	UHMWPE ELEVATED RIM ACETABULAR CUP	YES	NON CROSS-LINKED POLYETHYLENE

Table 11: Revised Number of Mueller Primary Total Conventional Hip Replacement by Catalogue Number Range

Acetabular Range	N Revised	N Total
561239015-561239040	4	6
562050005-562250060	8	49
562650010-562650060	0	4
TOTAL	12	59

TABLE 12

Revision Rates of Mueller Primary Total Conventional Hip Replacement by Component

A prosthesis may be combined with multiple components. This analysis has been undertaken to determine if the revision rate varies according to the component with which it is combined.

Table 12: Revised Number of Mueller Primary Total Conventional Hip Replacement by Femoral Stem Component

Femoral Stem Component	N Revised	N Total
Friendly Hip	2	28
Furlong	0	1
H Moos	9	19
H-Max	0	5
Mallory-Head	0	1
Paragon	0	1
Revision Hip	0	3
Wagner	1	1
TOTAL	12	59