

Buechel-Pappas/Buechel-Pappas Total Knee Investigation

Note: This analysis compares the Buechel-Pappas/Buechel-Pappas femoral/tibial combination with all other total knee prostheses.

This combination 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-2022>.

Note: Procedures using prostheses with no recorded use in 2021 are excluded from the comparator.

TABLE 1

Revision Rate of Primary Total Knee Replacement

The revision rate of the Buechel-Pappas/Buechel-Pappas total knee combination is compared to all other total knee prostheses.

Table 1: Revision Rates of Primary Total Knee Replacement

Component	N Revised	N Total	Obs. Years	Revisions/100 Obs. Yrs (95% CI)
Buechel-Pappas/Buechel-Pappas	53	479	5018	1.06 (0.79, 1.38)
Other Total Knee	26061	727695	4729125	0.55 (0.54, 0.56)
TOTAL	26114	728174	4734143	0.55 (0.54, 0.56)

Note: Prostheses no longer used in 2021 are excluded from the comparator.

TABLE 2

Yearly Cumulative Percent Revision of Primary Total Knee Replacement

The yearly cumulative percent revision of the Buechel-Pappas/Buechel-Pappas total knee combination is compared to all other total knee prostheses.

Table 2: Yearly Cumulative Percent Revision of Primary Total Knee Replacement

CPR	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs
Buechel-Pappas/Buechel-Pappas	1.9 (1.0, 3.6)	4.2 (2.7, 6.4)	5.7 (3.9, 8.2)	6.5 (4.6, 9.2)	7.9 (5.8, 10.7)	8.1 (6.0, 11.0)	8.6 (6.3, 11.5)
Other Total Knee	1.0 (1.0, 1.0)	1.9 (1.9, 1.9)	2.5 (2.4, 2.5)	2.9 (2.9, 2.9)	3.2 (3.2, 3.3)	3.6 (3.5, 3.6)	3.9 (3.8, 3.9)

CPR	8 Yrs	9 Yrs	10 Yrs	11 Yrs	12 Yrs	13 Yrs	14 Yrs
Buechel-Pappas/Buechel-Pappas	9.0 (6.7, 12.0)	10.0 (7.6, 13.1)	10.5 (8.0, 13.7)	10.8 (8.2, 14.0)	11.9 (9.2, 15.4)	12.4 (9.6, 16.1)	12.4 (9.6, 16.1)
Other Total Knee	4.2 (4.1, 4.2)	4.5 (4.4, 4.5)	4.8 (4.7, 4.8)	5.1 (5.0, 5.2)	5.4 (5.3, 5.5)	5.7 (5.7, 5.8)	6.1 (6.0, 6.1)

CPR	15 Yrs	16 Yrs	17 Yrs	18 Yrs	19 Yrs	20 Yrs	21 Yrs
Buechel-Pappas/Buechel-Pappas							
Other Total Knee	6.4 (6.3, 6.6)	6.9 (6.7, 7.0)	7.3 (7.1, 7.4)	7.6 (7.4, 7.8)	7.9 (7.7, 8.1)	8.2 (7.9, 8.4)	8.2 (8.0, 8.5)

Note: Prostheses no longer used in 2021 are excluded from the comparator.

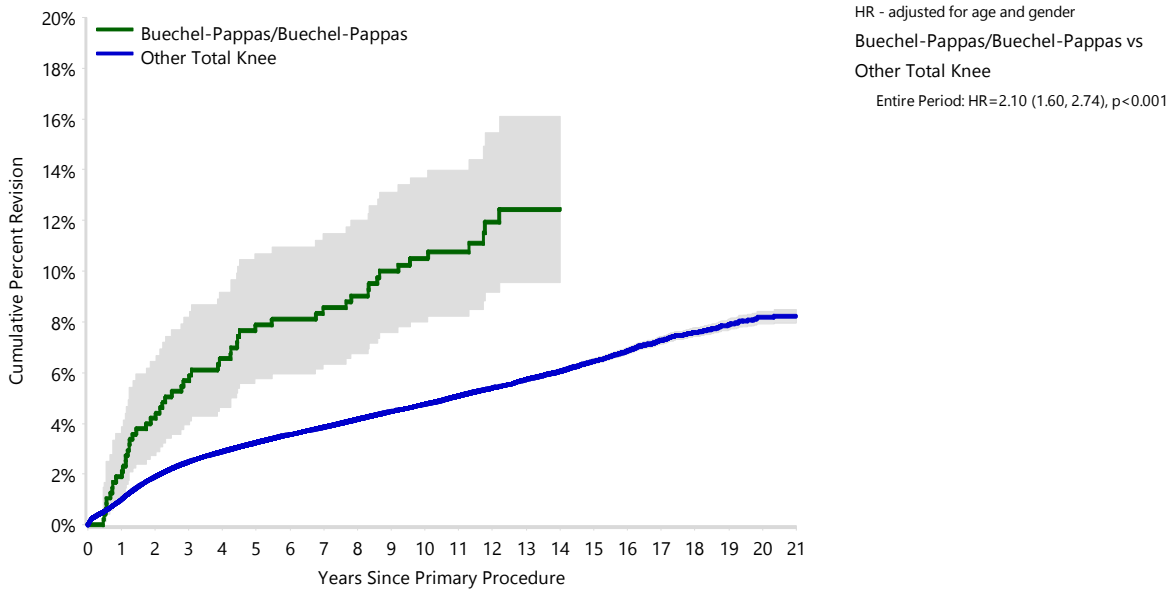
FIGURE 1

Yearly Cumulative Percent Revision of Primary Total Knee Replacement

The yearly cumulative percent revision of the Buechel-Pappas/Buechel-Pappas total knee combination is compared to all other total knee 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 Knee 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
Buechel-Pappas/Buechel-Pappas	479	467	454	443	430	412	406	399	380	367	350
Other Total Knee	727695	657528	592760	527219	464041	403691	347132	293768	245752	202649	163502

Number at Risk	11 Yrs	12 Yrs	13 Yrs	14 Yrs	15 Yrs	16 Yrs	17 Yrs	18 Yrs	19 Yrs	20 Yrs	21 Yrs
Buechel-Pappas/Buechel-Pappas	299	187	109	58	25	1	0	0	0	0	0
Other Total Knee	128843	99109	75527	56481	41660	29601	19593	11953	6490	2687	605

Note: Prostheses no longer used in 2021 are excluded from the comparator.

TABLE 3**Primary Diagnosis for Revised Primary Total Knee 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 knee prostheses.

Table 3: Primary Diagnosis for Revised Primary Total Knee Replacement

Primary Diagnosis	Buechel-Pappas/Buechel-Pappas		Other Total Knee	
	Number	Percent	Number	Percent
Osteoarthritis	53	100.0	25251	96.9
Rheumatoid Arthritis			331	1.3
Other Inflammatory Arthritis			161	0.6
Tumour			151	0.6
Osteonecrosis			98	0.4
Fracture			49	0.2
Other			19	0.1
Chondrocalcinosis			1	0.0
TOTAL	53	100.0	26061	100.0

Note: Prostheses no longer used in 2021 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 Knee Replacement - Reason for Revision (Follow-up Limited to 16.2 Years)

Revision Diagnosis	Buechel-Pappas/Buechel-Pappas			Other Total Knee		
	Number	% Primaries Revised	% Revisions	Number	% Primaries Revised	% Revisions
Infection	2	0.4	3.8	6954	1.0	26.9
Loosening	12	2.5	22.6	5786	0.8	22.4
Instability	5	1.0	9.4	2472	0.3	9.6
Pain	6	1.3	11.3	2057	0.3	7.9
Patellofemoral Pain	6	1.3	11.3	2045	0.3	7.9
Patella Erosion	13	2.7	24.5	1677	0.2	6.5
Arthrofibrosis				995	0.1	3.8
Fracture	2	0.4	3.8	930	0.1	3.6
Malalignment	2	0.4	3.8	601	0.1	2.3
Wear Tibial Insert				351	0.0	1.4
Lysis	2	0.4	3.8	335	0.0	1.3
Incorrect Sizing				258	0.0	1.0
Patella Maltracking				181	0.0	0.7
Bearing Dislocation	1	0.2	1.9	152	0.0	0.6
Implant Breakage Tibial Insert				147	0.0	0.6
Implant Breakage Patella				133	0.0	0.5
Metal Related Pathology	2	0.4	3.8	116	0.0	0.4
Prosthesis Dislocation				79	0.0	0.3
Synovitis				78	0.0	0.3
Osteonecrosis				58	0.0	0.2
Implant Breakage Tibial				42	0.0	0.2
Implant Breakage Femoral				38	0.0	0.1
Wear Patella				31	0.0	0.1
Tumour				27	0.0	0.1
Heterotopic Bone				15	0.0	0.1
Wear Tibial				12	0.0	0.0
Progression Of Disease				6	0.0	0.0
Patella Dislocation				2	0.0	0.0
Wear Femoral				2	0.0	0.0
Incorrect Side				1	0.0	0.0
Other				301	0.0	1.2
N Revision	53	11.1	100.0	25882	3.6	100.0
N Primary	479			727695		

Note: This table is restricted to revisions within 16.2 years for all groups to allow a time-matched comparison of revisions.

Note: Prostheses no longer used in 2021 are excluded from the comparator.

FIGURE 2

Cumulative Incidence Revision Diagnosis of Primary Total Knee 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 Buechel-Pappas/Buechel-Pappas total knee combination. A comparative graph is provided of the cumulative incidence for the same reasons for revisions for all other total knee prostheses.

Figure 2: Cumulative Incidence Revision Diagnosis for Primary Total Knee Replacement

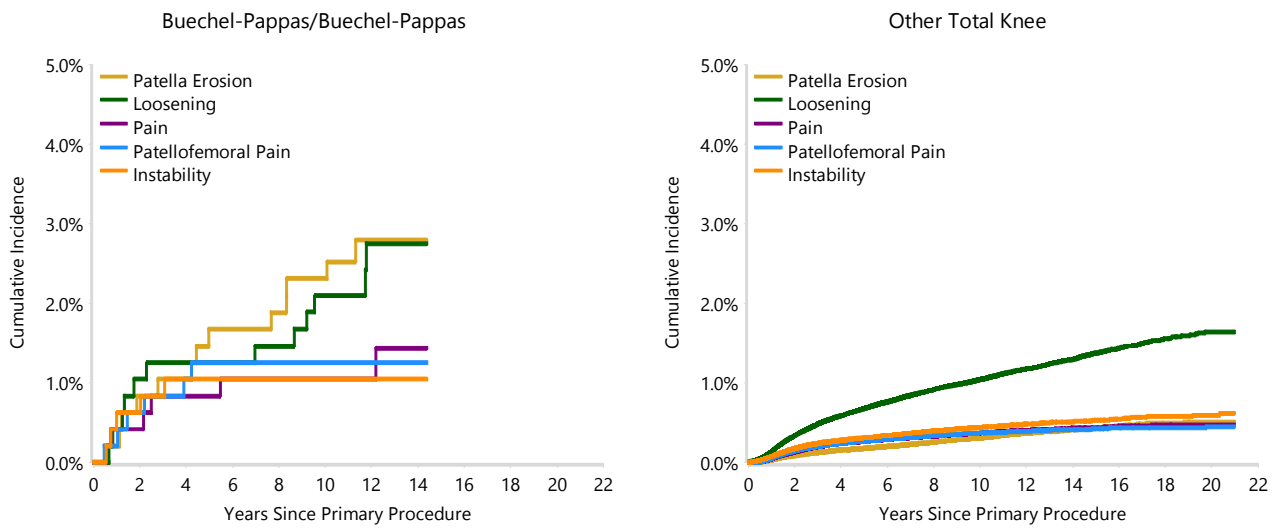


TABLE 5

Type of Revision Performed for Primary Total Knee Replacement

This analysis identifies the components used in the revision of the Buechel-Pappas/Buechel-Pappas total knee combination and compares it to the components used in the revision of all other total knee 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 knee prostheses i.e. is there a difference in the type of revision undertaken for the Buechel-Pappas/Buechel-Pappas total knee combination compared to all other total knee prostheses.

Table 5: Primary Total Knee Replacement - Type of Revision (Follow-up Limited to 16.2 Years)

Type of Revision	Buechel-Pappas/Buechel-Pappas		Other Total Knee	
	Number	Percent	Number	Percent
TKR (Tibial/Femoral)	18	34.0	6342	24.5
Tibial Component	2	3.8	2095	8.1
Cement Spacer	1	1.9	1353	5.2
Femoral Component	2	3.8	1311	5.1
Removal of Prostheses			149	0.6
Total Femoral			20	0.1
Reinsertion of Components			11	0.0
N Major	23	43.4	11281	43.6
Insert Only	5	9.4	7089	27.4
Patella Only	24	45.3	4768	18.4
Insert/Patella	1	1.9	2671	10.3
Minor Components			59	0.2
Cement Only			14	0.1
N Minor	30	56.6	14601	56.4
TOTAL	53	100.0	25882	100.0

Note: This table is restricted to revisions within 16.2 years for all groups to allow a time-matched comparison of revisions.

Note: Prostheses no longer used in 2021 are excluded from the comparator.

TABLE 6**Revision Rates of Buechel-Pappas/Buechel-Pappas Primary Total Knee 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 Buechel-Pappas/Buechel-Pappas Primary Total Knee Replacement by Fixation

Fixation	N Revised	N Total
Cemented	0	7
Cementless	45	300
Hybrid (Tibial Cemented)	8	170
Hybrid (Tibial Cementless)	0	2
TOTAL	53	479

TABLE 7**Revision Rates of Buechel-Pappas/Buechel-Pappas Primary Total Knee 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 combination are listed.

Table 7: Revised Number of Buechel-Pappas/Buechel-Pappas Primary Total Knee Replacement by Bearing Surface

Bearing Surface	N Revised	N Total
Non XLPE	53	479
TOTAL	53	479

TABLE 8**Revision Rates of Buechel-Pappas/Buechel-Pappas Primary Total Knee Replacement by Bearing Mobility**

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

Table 8: Revised Number of Buechel-Pappas/Buechel-Pappas Primary Total Knee Replacement by Bearing Mobility

Bearing Mobility	N Revised	N Total
Rotating	53	479
TOTAL	53	479

TABLE 9**Revision Rates of Buechel-Pappas/Buechel-Pappas Primary Total Knee Replacement by Stability**

This analysis is provided as some prostheses are combined with a variety of stabilities. All stabilities used with this combination are listed.

Table 9: Revised Number of Buechel-Pappas/Buechel-Pappas Primary Total Knee Replacement by Stability

Stability	N Revised	N Total
Minimally Stabilised	53	479
TOTAL	53	479

TABLE 10

Revision Rates of Primary Total Knee Replacement by State

This enables a state by state variation to be identified for the Buechel-Pappas/Buechel-Pappas total knee combination and provides the comparative data for each of the states for all other total knee 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 10: Revised Number of Primary Total Knee Replacement by State

Component	State	N Revised	N Total
Buechel-Pappas/Buechel-Pappas	NSW	9	170
	VIC	40	280
	QLD	0	4
	WA	0	2
	SA	4	23
Other Total Knee	NSW	7722	253121
	VIC	5553	144487
	QLD	5690	153171
	WA	3235	77905
	SA	2837	63440
	TAS	418	16885
	ACT/NT	606	18686
TOTAL		26114	728174

Note: Prostheses no longer used in 2021 are excluded from the comparator.

TABLE 11**Number of Revisions of Buechel-Pappas/Buechel-Pappas Primary Total Knee Replacement by Year of Implant**

This analysis details the number of prostheses reported each year to the Registry for the Buechel-Pappas/Buechel-Pappas total knee combination. 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 2021 has a maximum of one year to be revised, whereas a primary procedure performed in 2019 has a maximum of three years to be revised.

Table 11: Number of Revisions of Buechel-Pappas/Buechel-Pappas Primary Total Knee Replacement by Year of Implant

Year of Implant	Number Revised	Total Number
2005	0	1
2006	3	39
2007	4	51
2008	14	84
2009	11	100
2010	18	148
2011	3	44
2012	0	4
2014	0	7
2015	0	1
TOTAL	53	479

TABLE 12

Revision Rates of Buechel-Pappas/Buechel-Pappas Primary Total Knee 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 Buechel-Pappas/Buechel-Pappas 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	Coating	Fixation
Femoral						
Buechel-Pappas	04311001-04312006	FEMORAL ALLOY MIN. STAB	NO	METAL	TIN	BEADED
Buechel-Pappas	04311204-04314006	FEMORAL COMPONENT W/OUT BIOCOAT	YES	METAL		
Buechel-Pappas	04311301-04312306	NARROW FEMORAL ALLOY MIN. STAB.	NO	METAL	TIN	BEADED
Tibial						
Buechel-Pappas	04220003-04220003	TIBIAL BASEPLATE BEADED TITANIUM	NO			
Buechel-Pappas	04220005-04220005	UNIVERSAL TIBIAL COMPONENT	YES		TIN	
Buechel-Pappas	04320001-04320006	TYPE 1 FIXED SUBLAXATION	NO		TIN	BEADED
Buechel-Pappas	04320012-04320016	TYPE 2 REMOVAL SUBLAXATION ROTATING PLATFORM	NO		TIN	BEADED
Buechel-Pappas	04320021-04320026	TYPE 3 ROTATING PLATFORM	NO		TIN	BEADED
Buechel-Pappas	04320061-04320066	TYPE 0 STD TIBIAL COMPONENT	NO		TIN	BEADED
Buechel-Pappas	04320101-04320116	REVISION MODULAR ROTATING PLATFORM TIBIAL	NO		TIN	BEADED
Buechel-Pappas	04320463-04320464	TIBIAL COMPONENT W/O BIOCOAT	YES			

Table 12: Revised Number of Buechel-Pappas/Buechel-Pappas Primary Total Knee Replacement by Catalogue Number Range

Femoral Range	Tibial Range	N Revised	N Total
04311001-04312006	04220003-04220003	0	1
	04220005-04220005	0	6
	04320001-04320006	26	148
	04320012-04320016	3	21
	04320021-04320026	16	141
	04320061-04320066	1	59
	04320101-04320116	1	1
04311204-04314006	04320463-04320464	0	1
04311301-04312306	04220003-04220003	0	2
	04220005-04220005	1	3
	04320001-04320006	2	8
	04320012-04320016	0	2
	04320021-04320026	0	5
	04320061-04320066	3	80
	04320463-04320464	0	1
TOTAL		53	479