Promising results for early survivorship using the Persona® Knee with the ROSA® Knee System

An Automated Industry Report from the Australian Orthopaedic Association National Joint Replacement Registry

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Key Findings

The CPR for Persona Knee CR and PS bearings is 1.9 (95% CI, 1.6 – 2.2) at five years, compared to a CPR of 3.4 (95% CI, 3.4-3.5) for the same follow-up time with all other total knees. The revisions/100 observation years was 0.39 (95% CI, 0.14 – 0.86) for robotic assisted TKA using the Persona knee compared to 0.60 (95% CI, 0.52– 0.68) without robotic assistance for the same implants. This demonstrates a relative reduction in revisions of 35% when robotic assistance was used.

Introduction

The robotic age of arthroplasty is upon us, and the utilization of these robotic systems in total knee arthroplasty (TKA) continues to rise[1]. Compared to conventional instrumentation, multiple studies have confirmed improved accuracy and reliability with bone resections[2-7] using a robotic surgical assistant, and some have demonstrated improved early outcomes and implant survivorship[7-11]. A novel robotic orthopaedic surgical assistant (ROSA® Knee System, Zimmer Biomet, Warsaw, IN, USA) was recently introduced into the global market and little is known about its performance. As such, we reviewed an automated industry report[12] (AIRS) from the Australian Orthopaedic Association National Joint Replacement Registry (AOANJRR) in order to evaluate the one-year survivorship following TKA using the Persona® Knee (Zimmer Biomet, Warsaw, IN, USA) with the ROSA Knee System.

Methods

The AOANJRR is a national registry of joint replacement procedures that was established with the intent to "perform routine data collection, analysis, and reporting" of arthroplasty procedures performed in Australia[13]. In the latest report, there are over 1.6 million arthroplasty procedures in the registry, with nearly 850,000 TKA procedures[13]. The Automated Industry Report System (AIRS) (#3845) was generated from the AOANJRR on 18 March 2021[12]. Data provided was collected from 1 September 1999 to 16 March 2021 per the AOANJRR reporting process. The report provides survivorship information on the Persona Knee compared to all other TKA procedures in the registry. All robotic TKAs using the Persona Knee (n=2,179) were performed using the ROSA Knee System.

The first Persona Knee procedure was performed in Australia on 13 January 2013. Since then, 23,268 TKA procedures (20,024 patients) have been performed with either a Persona Cruciate Retaining (CR) or Posterior Stabilized (PS) implant. The mean follow-up time for the entire Persona Knee cohort was 1.77 ± 1.3 years (min 0.00, max 8.12).

Charts and data from the AIRS are provided; additional access to the remainder of the report is available upon request. Revisions of the implants systems (Persona Knee versus all others) are reported using the cumulative percent revision (CPR) rate[13]. Revisions per 100 observed component years for robotic and non-robotic cases are presented. This measure has been recommended by the European Federation of National Associations of Orthopaedics and Traumatology (EFORT) and introduced into the world of arthroplasty by the AOANJRR[13,14]. The calculation of risk is based on the number of days from the index procedure until the date of revision, death, or end of study.

The distribution of age, gender, ASA grade, body mass index, and diagnosis between procedures performed using the Persona Knee and all other total knee cases appears consistent between the groups (Tables 1 - 5).

Table 1. Primary Total Knee Replacement by Model and Age (All Diagnoses) (Table 5, AOANJRR, 18/03/2021)

	Persona CR & Persona PS		Other Total Knee	
Age	N	Col%	N	Col%
<55	1489	6.4	50623	6.8
55-64	6665	28.6	197076	26.4
65-74	9626	41.4	295659	39.5
≥75	5488	23.6	204372	27.3
TOTAL	**23268**	**100.0**	**747730**	**100.0**

Table 2. Primary Total Knee Replacement by Model and Gender (All Diagnoses) (Table 6, AOANJRR, 18/03/2021)

	Persona CR & Persona PS		Other Total Knee	
Gender	N	Col%	N	Col%
Male	10447	44.9	327220	43.8
Female	12821	55.1	420510	56.2
TOTAL	**23268**	**100.0**	**747730**	**100.0**

Table 3. Primary Total Knee Replacement by Model and ASA Grade (All Diagnoses) (Table 7, AOANJRR, 18/03/2021)

	Persona CR & Persona PS		Other Total Knee	
ASA Grade	N	Col%	N	Col%
1	1169	5.0	22343	5.9
2	12413	53.6	208474	54.9
3	9378	40.5	144985	38.2
4	212	0.9	4169	1.1
5	1	0.0	10	0.0
TOTAL	**23173**	**100.0**	**379981**	**100.0**

Note: The AOANJRR commenced collection of ASA data in 2013. 95 Persona CR & Persona PS procedures with no ASA Grade recorded are excluded from this table

Table 4. Primary Total Knee Replacement by Model and BMI (All Diagnoses) (Table 8, AOANJRR, 18/03/2021)

	Persona CR & Persona PS		Other Total Knee	
BMI	N	Col%	N	Col%
Underweight (<18.50)	43	0.2	593	0.2
Normal (18.50-24.99)	2155	9.5	30218	10.6
Pre Obese (25.00-29.99)	6862	30.3	89447	31.2
Obese Class 1 (30.00-34.99)	7102	31.4	87976	30.7
Obese Class 2 (35.00-39.99)	3966	17.5	48403	16.9
Obese Class 3 (≥40.00)	2498	11.0	29639	10.4
TOTAL	**22626**	**100.0**	**286276**	**100.0**

Note: The AOANJRR commenced collection of BMI data in 2015. 642 Persona CR & Persona PS procedures with no BMI recorded are excluded from this table

Table 5. Primary Total Knee Replacement by Model and Primary Diagnosis (Table 9, AOANJRR, 18/03/2021)

	Persona CR & Persona PS		Other Total Knee	
Primary Diagnosis	N	Col%	N	Col%
Osteoarthritis	22877	98.3	730650	97.7
Rheumatoid Arthritis	189	0.8	9227	1.2
Other Inflammatory Arthritis	122	0.5	3749	0.5
Osteonecrosis	72	0.3	2298	0.3
Tumour	1	0.0	938	0.1
Fracture	3	0.0	618	0.1
Chondrocalcinosis	.	.	18	0.0
Osteochondritis Dissecans	.	.	2	0.0
Other	4	0.0	230	0.0
TOTAL	**23268**	**100.0**	**747730**	**100.0**

Results

The cumulative percent revision (CPR) for Persona Knee CR and PS bearings is less than those reported for all other total knee implants (Table 6). For example, the CPR for Persona Knee CR and PS bearings is 1.9 (95% CI, 1.6 – 2.2) at five years, compared to a CPR of 3.4 (95% CI, 3.4-3.5) for the same follow-up time with all other total knees.

The primary reasons for revision included loosening, infection, instability, and pain (Figure 1). Interestingly, loosening appears to be less frequent (graphically) when the Persona knee was used. These indications for revision are consistent with those reported in the AOANJRR 2020 Annual report[13].

Table 6. Yearly Cumulative Percent Revision of Primary Total Knee Replacement by Model (All Diagnoses) (Table 11, AOANJRR, 18/03/2021)

CPR	1 Yr	2 Yrs	3 Yrs	4 Yrs	5 Yrs	6 Yrs
Persona CR & Persona PS	0.8 (0.7, 0.9)	1.3 (1.1, 1.5)	1.6 (1.4, 1.8)	1.9 (1.6, 2.2)	1.9 (1.6, 2.2)	1.9 (1.6, 2.2)
Other Total Knee	1.0 (1.0, 1.0)	2.0 (1.9, 2.0)	2.6 (2.6, 2.6)	3.1 (3.0, 3.1)	3.4 (3.4, 3.5)	3.8 (3.7, 3.8)
CPR	7 Yrs	8 Yrs	9 Yrs	10 Yrs	11 Yrs	12 Yrs
Persona CR & Persona PS	1.9 (1.6, 2.2)					
Other Total Knee	4.1 (4.0, 4.1)	4.4 (4.4, 4.5)	4.8 (4.7, 4.8)	5.1 (5.0, 5.1)	5.4 (5.4, 5.5)	5.8 (5.7, 5.9)
CPR	13 Yrs	14 Yrs	15 Yrs	16 Yrs	17 Yrs	18 Yrs	19 Yrs
Persona CR & Persona PS							
Other Total Knee	6.2 (6.1, 6.2)	6.5 (6.4, 6.6)	7.0 (6.9, 7.1)	7.4 (7.3, 7.5)	7.8 (7.7, 8.0)	8.2 (8.0, 8.3)	8.5 (8.3, 8.6)

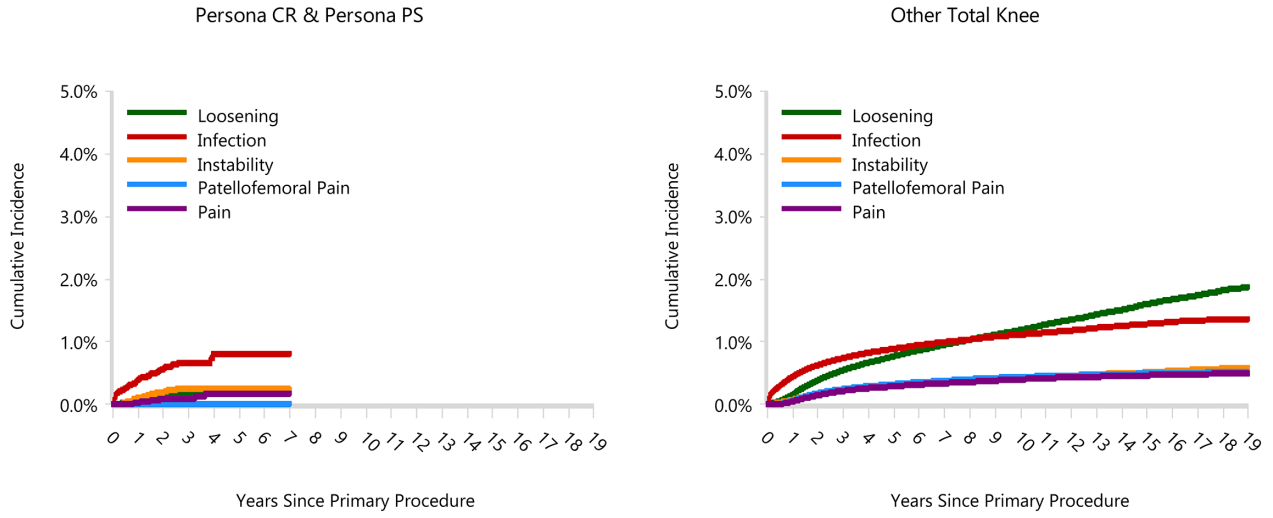

Figure 1. Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by Model (All Diagnoses) (Figure 2, AOANJRR, 18/03/2021)

The CPR for Persona Knee CR and PS bearings is 1.9 (95% CI, 1.6 – 2.2) at five years, compared to a CPR of 3.4 (95% CI, 3.4-3.5) for the same follow-up time with all other total knees. The revisions/100 observation years was 0.39 (95% CI, 0.14 – 0.86) for robotic assisted TKA using the Persona knee compared to 0.60 (95% CI, 0.52– 0.68) without robotic assistance for the same implants (Table 7). This demonstrates a relative reduction in revisions of 35% when robotic assistance was used.

Table 7. Revision Rates of Persona CR & Persona PS Primary Total Knee Replacement by Robotic Assistance (All Diagnoses) (Table 22, AOANJRR, 18/03/2021)

Robotic Assistance	N Revised	N Total	Obs. Years	Revisions/100 Obs. Yrs (95% CI)
Robotically Assisted	6	2179	1521	0.39 (0.14, 0.86)
Non-Robotic	237	21089	39650	0.60 (0.52, 0.68)
TOTAL	**243**	**23268**	**41171**	**0.59 (0.52, 0.67)**

Discussion & Conclusion

The Persona Knee was reported to have lower CPR rates compared to all other knee implant systems. Further, even though the ROSA Knee System has only been available in the Australian Market since 2019, the early revision rates are promising with a relative reduction of 35% compared to conventional instrumentation using the same implants. Thus, the combination of the Persona Knee with the ROSA Knee System may provide improved survivorship in patients undergoing primary TKA.

However, these results should be considered with some limitations. First, this is a novel robotic system in the Australian market and though early evaluations are promising, substantial follow-up is still needed to evaluate the differences in long-term survivorship between robotic and conventional TKA. Second, the data is limited to the Australian healthcare system and may not be generalizable to other populations.

A recent report by Macri[15] noted the benefits of medical technology in the Australian population, yet emphasized the challenges facing new technologies as they must "not only improve the health and well-being of citizens," but that they must also be cost effective. This is important when considering the high cost of robotic assistants. When using "cost per revision avoided" as a primary outcome, Yeroushalmi et al.[16] noted reduced costs in higher volume centers performing unicompartmental knee arthroplasty (UKA) given the reduced number of revisions in robotic cases compared to conventional UKA. Cool et al.[17] reported significantly lower costs in the 90-day episode of care following robotic TKA compared to conventional TKA in a US Medicare population. The reduction in the episode of care costs included lower index facility costs, fewer patients discharged to skilled nursing facilities, fewer post-acute care services, and a reduction in readmissions by 33%. The data presented in the current report corroborate these findings with a lower overall risk of revision in the robotic procedures, and though early, it should be noted that the cost benefits reported in the other studies were seen in the early phases by reducing immediate postoperative complications and healthcare utilization.

The survivorship reported within the AOANJRR of Persona Knee implants combined with early data from the ROSA Knee System is promising. Improved component positioning[2], personalized implant sizing[18], and the potential for fewer soft-tissue releases[19] should result in fewer early revisions associated with surgical errors, and may underlie the observed reduction in revision procedures. Further analysis of mid- and long-term survivorship is needed to evaluate the intra- and post-operative outcomes of this novel robotic orthopaedic surgical assistant.

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