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Original Research

Early Revision Rates of Total Hip Arthroplasty Using the Intellijoint HIP Computer Navigation System: A Study From the Australian National Joint Replacement Registry of 1911 Procedures

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ABSTRACT

Background: Total hip arthroplasty (THA) is an effective treatment for symptomatic hip osteoarthritis. The aim of this study was to determine the revision outcome of commercially available navigation technologies.

Methods: Data from the Australian Orthopaedic Association National Joint Replacement Registry from January 2016 to December 2020 included all primary THA procedures performed for osteoarthritis. Procedures using the Intellijoint HIP navigation system were identified and compared to procedures using "other" computer navigation systems and to nonnavigated procedures. The cumulative percent revision (CPR) was compared between the 3 groups using Kaplan-Meier estimates of survivorship and hazard ratios from Cox proportional hazards models, adjusted for age and gender.

Results: There were 1911 procedures that used the Intellijoint system, 4081 used "other" computer navigation systems, and 160,661 were nonnavigated procedures. The all-cause 2-year CPR rate for the Intellijoint system was 1.8% (95% confidence interval [CI], 1.2-2.6), compared to 2.2% (95% CI, 1.8-2.8) for other navigated cases and 2.2% (95% CI, 2.1-2.3) for nonnavigated cases. A prosthesis analysis identified the Paragon/Acetabular Shell THAs combined with the Intellijoint system to have a higher (3.4%) rate of revision than nonnavigated THAs (hazard ratio = 2.00 [95% CI, 1.01-4.00], $P = .048$). When this combination was excluded, the Intellijoint group demonstrated a 2-year CPR of 1.3%. There was no statistical difference in the CPR between the 3 groups before or after excluding the Paragon/Acetabular Shell system.

Conclusions: The preliminary data presented demonstrate no statistical difference in all-cause revision rates when comparing the Intellijoint system with "other" navigation systems and "nonnavigated" approaches for primary THAs.

Level of evidence: III (National registry analysis).

Introduction

Total hip arthroplasty (THA) is a well-established method to treat hip pain and dysfunction due to end-stage osteoarthritis (OA) and other medical conditions. Acetabular prosthesis implantation angles have been shown to affect peri-articular muscle mechanical

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advantages, rates of dislocation, gait, limb lengths, impingement, noise generation, loosening, postoperative range of movement, liner wear, and overall revision rates [1,2]. Optimizing biomechanical and anatomical reconstruction of the joint is therefore critical to achieve function, longevity, and prevention of avoidable complications following the surgery [2-4]. Dislocation rates following primary THAs are acknowledged to occur in 1%-4% of cases, with "instability" accounting for approximately 23% of all revisions and remaining the most common reason for revision in the United States [5,6].

The Australian Orthopaedic Association National Joint Replacement Registry (AOANJRR) began collecting data on the use of computer-navigated total knee arthroplasty (TKA) in 2003 and has previously reported on the outcomes [7]. The use of computer navigation has steadily increased for TKAs, from 2.4% in 2003 to 33.2% in 2018. However, by comparison, the AOANJRR shows that <2% of THAs recorded to date have utilized navigation assistance [7,8].

The "safe zone" for acetabular cup placement was described by Lewinnek et al. (1978) and was claimed to be associated with a reduced dislocation risk [9]—although contemporary research has cast doubt upon this. Traditional freehand THA techniques rely on surgeon judgment to manually place acetabular components accurately. The use of computer navigation to reduce acetabular malposition has been in practice for more than 20 years, demonstrating improved attainment of target cup placement and variable reports of improvement in clinical outcomes, including reducing the rate of revision [8,10,11]. Computer tomography (CT)-based navigation has been shown to be highly accurate. However, it is burdened by the associated cost, the need for dedicated preoperative imaging, and incumbent radiation exposure risk—all of which have been linked to low levels of clinical utilization [12-15].

The Intellijoint HIP 3D mini-optical navigation tool (Intellijoint Surgical Inc., Waterloo, Canada) is an intraoperative, surgeon-controlled, "imageless" mini-navigation system tool that provides surgeons with real-time data on leg length, offset, and cup position [16]. The key features of this commercially-available system were intended to overcome some of the recognized barriers to uptake associated with imaging-based navigation. However, there remains a lack of independent research of the clinical outcomes as compared to other available navigation systems or to nonnavigated THAs.

Using data from a large national joint registry, the aim of this study was to determine if there were differences in the rates of all-cause revision between Intellijoint-navigated, other navigated, and nonnavigated THA procedures.

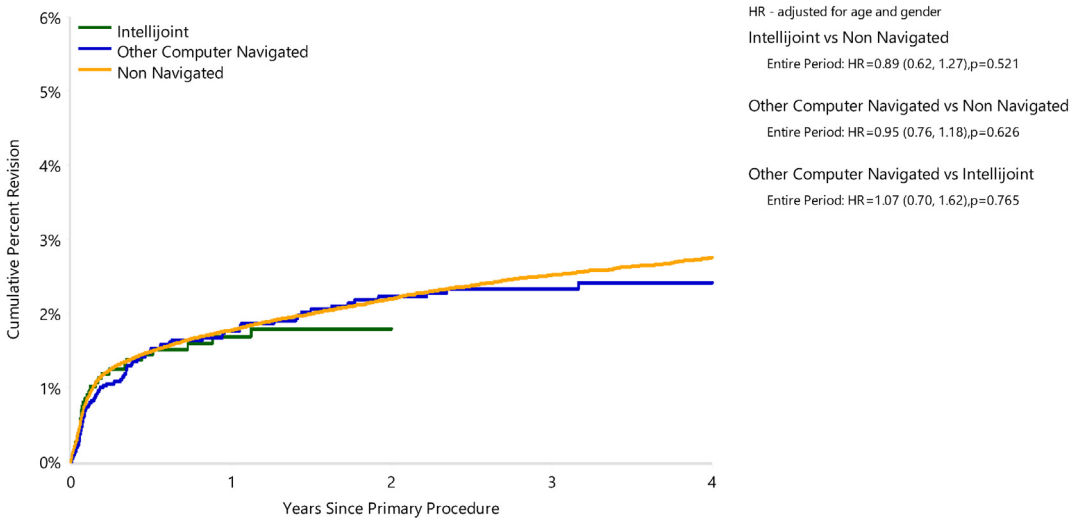
Material and methods

The AOANJRR commenced data collection on September 1, 1999, achieving complete national implementation by mid-2002. Since then, it has collected data on almost 100% of THAs and other joint replacements performed in Australia [17]. These data are externally validated against patient-level data provided by all Australian state and territory health departments. A sequential, multilevel matching process is used to identify any missing data which are subsequently obtained by follow-up with the relevant hospital. Each month, in addition to internal validation and data quality checks, all primary procedures are linked to any subsequent revision involving the same patient, joint, and side. Data are also matched biannually to the Australian National Death Index data to identify patients who have died. Information on the use and type of computer navigation for a procedure has been collected for THAs and TKAs and marked on the AOANJRR registration form as "computer-assisted".

Table 1
Summary of primary total conventional hip replacements since 2016 by model (primary diagnosis OA).

Variable	Intellijoint	Other computer navigated	Nonnavigated	Total
Age				
Mean ± SD	67.3 ± 10.9	69.1 ± 10.6	67.9 ± 10.7	68 ± 10.7
Age group, y				
<55	230 (12%)	380 (9.3%)	17,673 (11%)	18,283 (11%)
55-64	494 (25.9%)	847 (20.8%)	38,693 (24.1%)	40,034 (24%)
65-74	672 (35.2%)	1525 (37.4%)	58,724 (36.6%)	60,921 (36.6%)
≥75	515 (26.9%)	1329 (32.6%)	45,571 (28.4%)	47,415 (28.5%)
Gender				
Male	988 (51.7%)	1811 (44.4%)	74,915 (46.6%)	77,714 (46.6%)
Female	923 (48.3%)	2270 (55.6%)	85,746 (53.4%)	88,939 (53.4%)
Hospital setting				
Private hospital	1518 (79.4%)	3107 (76.1%)	113,747 (70.8%)	118,372 (71%)
Public hospital	393 (20.6%)	974 (23.9%)	46,914 (29.2%)	48,281 (29%)
ASA score[a]				
1	223 (11.7%)	352 (8.7%)	14,153 (8.8%)	14,728 (8.9%)
2	1005 (52.6%)	2066 (50.8%)	86,729 (54.1%)	89,800 (54%)
3	649 (34%)	1581 (38.9%)	57,132 (35.7%)	59,362 (35.7%)
4	33 (1.7%)	69 (1.7%)	2204 (1.4%)	2306 (1.4%)
5			3 (0%)	3 (0%)
BMI[b]				
Underweight (<18.50)	9 (0.5%)	32 (0.8%)	1077 (0.7%)	1118 (0.7%)
Normal (18.50-24.99)	367 (19.5%)	895 (22.8%)	31,804 (20.5%)	33,066 (20.6%)
Preobese (25.00-29.99)	702 (37.3%)	1487 (37.9%)	57,113 (36.9%)	59,302 (36.9%)
Obese class 1 (30.00-34.99)	475 (25.3%)	985 (25.1%)	39,510 (25.5%)	40,970 (25.5%)
Obese class 2 (35.00-39.99)	214 (11.4%)	358 (9.1%)	17,042 (11%)	17,614 (11%)
Obese class 3 (≥40.00)	113 (6%)	171 (4.4%)	8230 (5.3%)	8514 (5.3%)
Surgeon volume				
≤10	53 (68.8%)	119 (83.8%)	330 (33.1%)	502 (41.3%)
10-25	14 (18.2%)	9 (6.3%)	217 (21.8%)	240 (19.7%)
>25	10 (13%)	14 (9.9%)	450 (45.1%)	474 (39%)
Total	1911	4081	160,661	166,653

ASA, American Society of Anesthesiologists; BMI, body mass index (kg/m^2); SD, standard deviation.
[a] Excludes 454 procedures with an unknown ASA score.
[b] Excludes 6069 procedures with unknown BMI.



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs
Intellijoint®	1911	1037	342	2	1
Other Computer Navigated	4081	3027	2128	1294	648
Non Navigated	160661	126113	92158	59631	28901

Figure 1. Cumulative percent revision of primary total conventional hip replacements since 2016 by model (primary diagnosis OA).

The study period was from January 1, 2016, (when Intellijoint HIP THAs were first recorded by the AOANJRR) to 31 December 2020. The study population included all primary THA procedures for OA inserted using the Intellijoint Navigation System, "other" computer-navigated systems, or nonnavigated systems. Only THAs with modern bearing surfaces were included, and these were defined as ceramic-on-ceramic, metal-on-highly cross-linked polyethylene, and ceramic-on-highly cross-linked polyethylene. Metal-on-metal bearing surfaces were excluded because of their known high rate of revision. There were insufficient comparative numbers to permit subanalysis of dual-mobility or constrained liners. The indication for and type of revision performed for cases during the data collection period were recorded.

Descriptive data for the 3 groups (ie, Intellijoint-assisted, "other" navigated, and nonnavigated) including patient age at the time of surgery, gender, assigned American Society of Anesthesiology score, body mass index, and surgeon procedural volume were recorded (Table 1).

A prosthesis-specific analysis was also performed restricted to prosthesis combinations with over 100 procedures and with both Intellijoint and nonnavigated procedures. There were 3 prosthesis combinations identified, but only the Paragon/Acetabular Shell (Global) had enough revision procedures of the Intellijoint for a comparative analysis to be performed between the Intellijoint and nonnavigated groups. The other navigated group had too few revisions for a comparative analysis to be performed. A revision comparison was performed, and the analysis was repeated with the prosthesis combination excluded to account for a prosthesis effect.

The cumulative percent revision (CPR) was calculated for the Intellijoint-navigated, "other" navigated, and nonnavigated THAs over the same time period.

Statistical analysis

The AOANJRR uses Kaplan-Meier estimates of survivorship to describe the time to the first revision of an arthroplasty, with censoring at the time of death or closure of the database at the time of analysis. The unadjusted CPR rate with an accompanying 95% confidence interval (CI) was calculated with the use of unadjusted pointwise Greenwood estimates to allow for the same-time-matched comparison of navigated and nonnavigated THA procedures, as the former had a shorter follow-up in the registry. The unadjusted cumulative incidence functions of the reasons for revision of navigated and nonnavigated THAs were also calculated. The hazard ratio (HR) was calculated with the use of Cox proportional hazard models to make statistical comparisons of the revision rates between the groups. The assumption of proportional hazards was checked analytically for each model; if the interaction between the predictor and the log of the postoperative time was significant in the standard Cox model, then a time-varying model was used. For this study, the reported HRs pertain to the entire follow-up period. All tests were 2-tailed with significance set at

Table 2
Yearly CPR of primary total conventional hip replacements since 2016 by model (primary diagnosis OA).

CPR	1 y	2 y	3 y	4 y
Intellijoint	1.7 (1.2, 2.4)	1.8 (1.2, 2.6)		
Other computer navigated	1.8 (1.4, 2.2)	2.2 (1.8, 2.8)	2.3 (1.9, 2.9)	2.4 (1.9, 3.0)
Nonnavigated	1.8 (1.7, 1.8)	2.2 (2.1, 2.3)	2.5 (2.4, 2.6)	2.8 (2.7, 2.9)

Table 3
Revision diagnosis of primary total conventional hip replacements since 2016 by model (primary diagnosis OA).

Revision diagnosis	Intellijoint			Other computer navigated			Nonnavigated		
	Number	% Primaries revised	% Revisions	Number	% Primaries revised	% Revisions	Number	% Primaries revised	% Revisions
Infection	12	0.6	40.0	20	0.5	24.1	1081	0.7	30.2
Prosthesis dislocation/instability	4	0.2	13.3	10	0.2	12.0	865	0.5	24.2
Fracture	9	0.5	30.0	25	0.6	30.1	737	0.5	20.6
Loosening	4	0.2	13.3	18	0.4	21.7	515	0.3	14.4
Leg length discrepancy				4	0.1	4.8	79	0.0	2.2
Malposition				2	0.0	2.4	72	0.0	2.0
Pain	1	0.1	3.3				66	0.0	1.8
Implant breakage acetabular insert							28	0.0	0.8
Incorrect sizing				2	0.0	2.4	28	0.0	0.8
Implant breakage stem				1	0.0	1.2	14	0.0	0.4
Implant breakage acetabular							9	0.0	0.3
Lysis							8	0.0	0.2
Metal-related pathology							5	0.0	0.1
Heterotopic bone							4	0.0	0.1
Wear head							4	0.0	0.1
Tumor							3	0.0	0.1
Wear acetabular insert							2	0.0	0.1
Implant breakage head							1	0.0	0.0
Other				1	0.0	1.2	58	0.0	1.6
N Revision	30	1.6	100.0	83	2.0	100.0	3579	2.2	100.0
N Primary	1911			4081			160,661		

% 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.

0.05. A statistical analysis was performed using the SAS software version 9.4 (SAS Institute, Cary, NC).

Source of funding

The AOANJRR is approved by the Australian Federal Government as a federal quality assurance activity (QAA 3/2017) under Section 124X of the Health Insurance Act, 1973. All investigations were conducted in accordance with the ethical principles of research (The Helsinki Declaration II). The AOANJRR is funded by the Commonwealth of Australia Department of Health. The data of the AOANJRR are the intellectual property of the Australian Orthopaedic Association. The authors declare no relevant financial disclosures.

Results

There were 166,653 THA procedures performed for OA. Of these, 1911 were Intellijoint-assisted, 4081 used other computer navigation systems, and 160,661 were nonnavigated. Patient baseline demographics and surgeon procedural volume can be seen in Table 1. Mean patient age and age-group stratification for individuals undergoing THAs was comparable between the 3 groups, with a tendency of older patients undergoing “other” navigated THAs. A larger proportion of male patients were seen in the Intellijoint group (51.7%) than in the other navigated (44.4%) and nonnavigated groups (46.6%). The American Society of Anesthesiology and body mass index scores were similar among all 3 groups. The maximum follow-up duration for the Intellijoint group was 4.1

Table 4
Type of revision of primary total conventional hip replacements since 2016 by model (primary diagnosis OA).

Type of revision	Intellijoint			Other computer navigated			Nonnavigated		
	Number	% Primaries revised	% Revisions	Number	% Primaries revised	% Revisions	Number	% Primaries revised	% Revisions
Head/insert	12	0.6	40.0	17	0.4	20.5	1123	0.7	31.4
Femoral component	6	0.3	20.0	46	1.1	55.4	1060	0.7	29.6
Acetabular component	4	0.2	13.3	7	0.2	8.4	594	0.4	16.6
THR (femoral/acetabular)	4	0.2	13.3	7	0.2	8.4	335	0.2	9.4
Head only	3	0.2	10.0	3	0.1	3.6	232	0.1	6.5
Cement spacer	1	0.1	3.3				96	0.1	2.7
Minor components				2	0.0	2.4	57	0.0	1.6
Insert only							41	0.0	1.1
Removal of prostheses				1	0.0	1.2	22	0.0	0.6
Reinsertion of components							8	0.0	0.2
Head/neck/insert							6	0.0	0.2
Bipolar head and femoral							2	0.0	0.1
Cement only							1	0.0	0.0
Head/neck							1	0.0	0.0
Neck only							1	0.0	0.0
N Revision	30	1.6	100.0	83	2.0	100.0	3579	2.2	100.0
N Primary	1911			4081			160,661		

THR, total hip replacement.

Table 5
Revised number of Paragon/Acetabular Shell (Global) primary total conventional hip replacements since 2016 by navigation (primary diagnosis OA).

Navigation	N Revised	N Total
Intellijoint Paragon/Acetabular Shell (Global)	10	323
Other navigated Paragon/Acetabular Shell (Global)	2	24
Nonnavigated Paragon/Acetabular Shell (Global)	44	2824
Total	56	3171

years, which was slightly lower than the 5 years for each of the remaining groups. The mean follow-up duration was 1.2 years (±0.8) for the Intellijoint group, 2.2 years (±1.5) for the other navigated group, and 2.4 years (±1.4) for the nonnavigated group.

Of the 1911 Intellijoint THAs, 30 underwent subsequent revision. The CPR was 1.7% at 1 year (95% CI, 1.2%-2.4%) and 1.8% at 2 years (95% CI, 1.2%-2.6%) (Fig. 1) (Table 2). The unadjusted Intellijoint 2-year revision rate (1.8%) was lower than both the "other" navigated and nonnavigated THA rates at the same timepoint with a CPR of 2.2% (95% CI, 1.8%-2.8%) and 2.2% (95% CI, 2.1%-2.3%), respectively. Intellijoint CPRs are not yet available for 3- and 4-year timepoints due to the low current patient numbers. At 4 years, the "other" navigated and nonnavigated THA CPRs were 2.4% (95% CI, 1.9%-3.0%) and 2.8% (95% CI, 2.7%-2.9%), respectively. There was no statistical difference in the overall rate of revision when the 3 groups were compared (Fig. 1).

The reason for revision for the 3 THA groups are documented in Table 3, and the type of THA revision performed is shown in Table 4. There was a higher percentage of minor revisions (head/insert) (40%) for the Intellijoint THAs than that for "other" navigation and nonnavigated THAs (20.5% and 31.4%, respectively). Contrastingly, Intellijoint THA revisions had a lower percentage (20.0%) of femoral component revision than "other" navigation and nonnavigated revisions (55.4% and 29.6%, respectively). There were too few revisions with the Intellijoint system to undergo statistical comparison of individual reasons for a revision such as dislocation/instability or type of revision.

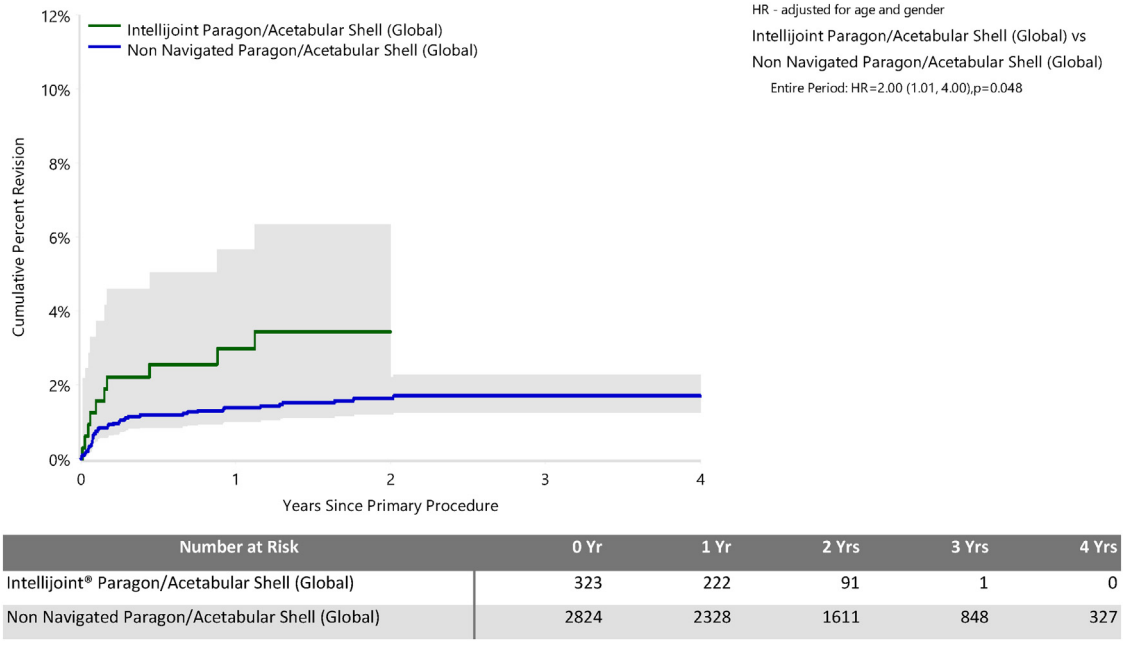
The prosthesis-specific analysis identified the Paragon/Acetabular Shell (Global) as having enough revision procedures of the Intellijoint for a comparative analysis to be performed between the Intellijoint and nonnavigated groups (Table 5). The Intellijoint Paragon/Acetabular Shell (Global) had a higher rate of revision than the nonnavigated Paragon/Acetabular Shell (Global) (HR = 2.00 [95% CI, 1.01-4.00], $P = .048$) (Fig. 2). When this prosthesis combination was excluded from the analysis, there was no statistical difference between the 3 groups (Fig. 3). The indication for an Intellijoint revision excluding Paragon implants is summarized in Table 6.

Discussion

To our knowledge, this study represents the largest reported-to-date analysis of the use of the Intellijoint-navigated system for THA with comparison to other computer-navigated and nonnavigated THAs. It represents data for all THAs in Australia during a 5-year period and demonstrates an all-cause Intellijoint 2-year CPR of 1.8%, which was not statistically different to that of "other" navigated and nonnavigated THAs (2.2%).

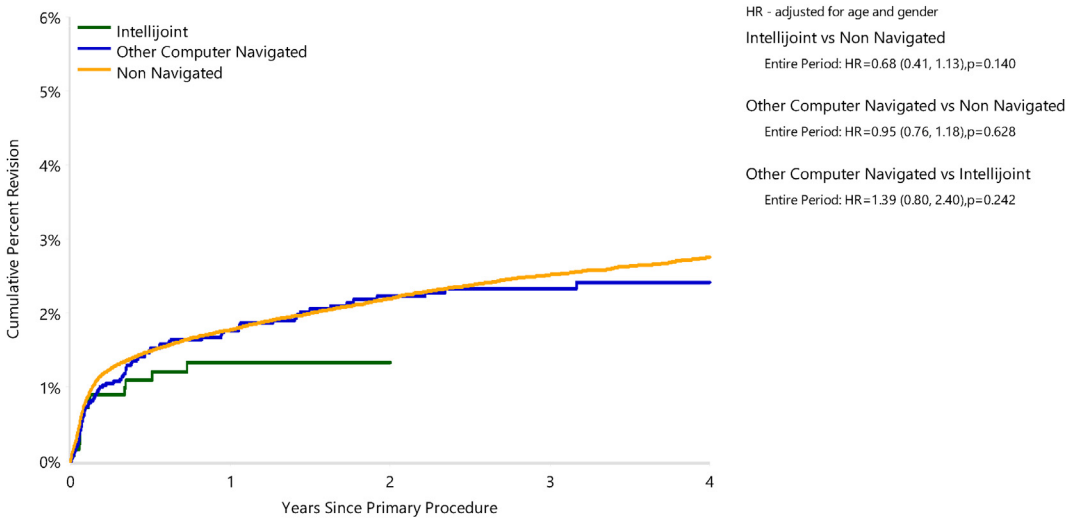
The Intellijoint navigation system has previously been demonstrated on a benchtop phantom model to accurately measure acetabular cup position and leg-length measurements within 1° and 1 mm, respectively [18]. A cadaveric study involving 3 surgeons and 12 hips demonstrated a mean absolute difference between postoperative CT and intraoperative Intellijoint measurements for inclination of 4.2° (standard deviation, 3.2°) and anteversion angle of 4.0° (standard deviation, 4.0°) [19]. A previous study has investigated the correlation between intraoperative Intellijoint navigation and postoperative CT measurements of cup inclination and anteversion when used for 53 revision THAs. The authors reported excellent agreement between navigation and CT measurements for inclination (r = 0.89) and anteversion (r = 0.93), with both measurements being within 10° in 86.8% of cases [20]. Authors of the aforementioned 3 studies all disclosed potential competing interests in the form of consultancy fees and/or stock options from Intellijoint Surgical.

The most common indications for revision noted in our registry analysis were infection, dislocation/instability, fracture, and



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs
Intellijoint® Paragon/Acetabular Shell (Global)	323	222	91	1	0
Non Navigated Paragon/Acetabular Shell (Global)	2824	2328	1611	848	327

Figure 2. Cumulative percent revision of Paragon/Acetabular Shell (Global) primary total conventional hip replacements since 2016 by navigation (primary diagnosis OA).



Number at Risk	0 Yr	1 Yr	2 Yrs	3 Yrs	4 Yrs
Intellijoint®	1265	649	213	1	1
Other Computer Navigated	4081	3027	2128	1294	648
Non Navigated	160661	126113	92158	59631	28901

Figure 3. Cumulative percent revision of primary total conventional hip replacements since 2016 by model (excluding Intellijoint Paragon femoral component, primary diagnosis OA).

loosening. The majority of these events occurred during the first year after implantation (Figs. 1 and 3). Agarwal et al. (2021) has previously demonstrated that compared with nonnavigation, the use of computer navigation was associated with a reduced rate of revision for dislocation following THAs [8]. However, there was no observed difference in all-cause revision [8]. Concerning the current study, the relative proportions of individual indications for revision were dissimilar between the 3 groups (Table 3). The Intellijoint group sample size did not permit a meaningful statistical comparison of subgroups. Further investigation with greater sample numbers is therefore required to better appreciate the potential underlying differences in the reason for revision, including implant-, technology-, or surgeon-specific factors. This will likely be possible in time as the registry record of navigated THAs grows, as does the mean follow-up period.

An analysis of implants used in conjunction with the Intellijoint system highlighted a statistical outlier combination in the Paragon femoral component with Acetabular Shell (Global) pairing, with a 2-year CPR nearly 3 times higher than the class at 3.4% (Table 5). The registry level data analyzed in the current study do not provide enough specific information to confidently elucidate the cause of this unexpected anomaly in an otherwise well-performing implant

Table 6
Type of revision of primary total conventional hip replacements since 2016 by model (excluding Intellijoint Paragon femoral component, primary diagnosis OA).

Type of revision	Intellijoint			Other computer navigated			Nonnavigated		
	Number	% Primaries revised	% Revisions	Number	% Primaries revised	% Revisions	Number	% Primaries revised	% Revisions
Head/insert	8	0.6	53.3	17	0.4	20.5	1123	0.7	31.4
Femoral component	3	0.2	20.0	46	1.1	55.4	1060	0.7	29.6
Acetabular component				7	0.2	8.4	594	0.4	16.6
THR (femoral/acetabular)	3	0.2	20.0	7	0.2	8.4	335	0.2	9.4
Head only				3	0.1	3.6	232	0.1	6.5
Cement spacer	1	0.1	6.7				96	0.1	2.7
Minor components				2	0.0	2.4	57	0.0	1.6
Insert only							41	0.0	1.1
Removal of prostheses				1	0.0	1.2	22	0.0	0.6
Reinsertion of components							8	0.0	0.2
Head/neck/insert							6	0.0	0.2
Bipolar head and femoral							2	0.0	0.1
Cement only							1	0.0	0.0
Head/neck							1	0.0	0.0
Neck only							1	0.0	0.0
N Revision	15	1.2	100.0	83	2.0	100.0	3579	2.2	100.0
N Primary	1265			4081			160,661		

THR, total hip replacement.
% 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.

combination. Whether this result relates to surgeon-, implant-, or technology-related considerations is not clear and provides an avenue for further investigation. The Paragon/Acetabular Shell (Global) made up 17% of the Intellijoint population yet accounted for 33% of the Intellijoint revisions described in this study. While no statistical difference was observed between the 3 groups with the Paragon/Acetabular Shell (Global) excluded, these early results warrant a longer follow-up duration with greater numbers to determine if a true clinical difference in rates of revision exists.

This study has several limitations. As the Intellijoint system has only been available for regulatory-approved use in Australia since 2016, our follow-up was limited to 2 years and represented 30 revisions out of 1911 THAs, compared to studies with other navigation systems approaching 10 years of follow-up with many more procedures [8]. Given that the majority of prosthetic hip dislocations and instability-related issues classically occur within the first 2 years of the index surgery, early results from this study may yield valuable clinical information. The AOANJRR does not record THA dislocation events treated successfully with closed reduction unless a revision procedure has been performed. Thus, it is likely that the results presented may underestimate the true numbers of dislocation/instability (although this bias is likely to affect all 3 groups in a similar fashion). Future research in this regard would require matching to local administrative data sets. While data are recorded by the AOANJRR on the use of navigation and the type used, it is possible that some cases were missed, and therefore, navigated cases are included in the nonnavigated group. However, we believe that because of the relative few numbers involved, this would make minimal difference to the outcomes. The Intellijoint group contained a slightly higher percentage of male patients (51.7% compared with 46.6% in the nonnavigated group), and almost 9% more Intellijoint THAs were performed in a private hospital setting than nonnavigated THAs. Given that public hospital THAs are often performed by a combination of training and consultant surgeons (in contrast to private hospitals where THAs are performed almost exclusively by consultant surgeons), there may be a bias secondary to surgeon experience; however, we were not able to analyze this. Previous studies have suggested that both surgeon operative volume (ie, number of cases per year) and extent of experience can have significant impact on patient outcomes following THA, including rates of dislocation and revision [21,22]. Surgeon volume represented one of the biggest between-group differences in our analysis with only 13% of Intellijoint and 10% of “other” navigated cases performed by surgeons completing more than 25 THAs per year, compared to 45% of nonnavigated cases. We could therefore propose the value of navigation options for hip arthroplasty may be even greater than what is shown by our raw data given that the navigation surgeons included in this analysis (Intellijoint and “other” navigation) performed comparatively far less cases per year than the nonnavigated group. While the absolute number of revised Intellijoint THAs was too small to permit a meaningful stratified subgroup analysis comparing surgeon volume, one would reasonably expect that as surgeon experience and annual case numbers increased—and as familiarity with the Intellijoint system itself increased—clinical outcomes may continue to improve. Finally, the AOANJRR also does not report radiological data to reflect final implant positioning. It is therefore impossible to comment if the Intellijoint navigated or “other” navigated THAs resulted in cup orientations in a more anatomical alignments than nonnavigated THAs or how far the definitive cup position differed from the intended target.

The preliminary data presented demonstrate no statistical difference when comparing the Intellijoint HIP THA navigation system to both “other” navigation systems and “nonnavigated” with respect to all-cause revision rates for primary THAs performed for OA. A subgroup analysis of prostheses revealed that the Paragon Acetabular Shell THAs combined with the Intellijoint system had a higher rate of revision than nonnavigated THAs. The reason for this remains unclear from the available registry-level data. The current cohort size included in the registry remains too small to permit further meaningful subgroup statistical comparisons by reason for revisions. Further follow-up with a larger sample size is required to determine if a clinical difference exists between rates of revision secondary to dislocation, instability, and prosthetic loosening.

Conflicts of interest

A. P. Kurmis is in the speakers' bureau of or gave paid presentations for Zimmer Biomet; is a paid consultant for Formus Labs and Zimmer Biomet; is in the editorial or governing board of The Open Orthopaedics Journal; and is a board member in RACS (SA). All other authors declare no potential conflicts of interest.

For full disclosure statements, refer to https://doi.org/10.1016/j.artd.2022.09.019.

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