Improved Early Clinical Outcomes of RP/PS Mobile-Bearing Total Knee Arthroplasties

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Abstract The rotating-platform posterior-stabilized (RP/PS) prosthesis was developed to take advantage of the benefits of the traditional RP mobile-bearing system and the posterior-stabilized design. This nonconsecutive cohort study compared the clinical outcomes of TKAs performed using a RP/PS mobile system or a floating-platform (FP) system. The clinical outcomes of 93 TKAs with a RP/PS prosthesis were compared with the same number of TKAs with a FP mobile-bearing prosthesis at 6, 12, and 24 months after surgery. Clinical outcomes differed between the FP and RP/PS groups as a function of length of followup. In the FP group, most outcomes peaked at 12 months and then deteriorated, whereas in the RP/PS group, outcomes stabilized or continued to improve between 12 and 24 months. The RP/PS group had greater maximum flexion throughout followup and better clinical outcomes 24 months after surgery. Patient

satisfaction was superior in the RP/PS group. This study suggests the RP/PS prosthesis provides better functional outcomes, including greater maximum flexion and better patient satisfaction. We propose the RP/PS mobile-bearing system is a more attractive option than the FP mobile-bearing system for patient populations of elderly women similar to patients enrolled in our study.

Level of Evidence: Level III, therapeutic study. See Guidelines for Authors for a complete description of levels of evidence.

Introduction

Mobile-bearing systems have drawn considerable attention because they offer possible solutions to the limitations of fixed-bearing designs in TKA [9, 21]. Many mobile-bearing systems have been developed with the objective of realizing theoretical advantages, but whether these advantages translate into better clinical performances is debatable. The RP/PS design was developed for the traditional meniscal bearing or RP system [8, 14, 20, 22]. This design attempts to take advantage of the best prosthetic features of the mobile-bearing RP and the fixed-bearing system with a post-cam mechanism [8, 14, 20]. In the RP/PS design, rotation occurs between the tibia tray and the bottom surface of a polyethylene insert, and flexion-extension with anteroposterior (AP) translation occurs between the femoral component and the upper surface. This decoupling feature is expected to avoid multidirectional motions on the articulating surface, which are alleged to increase polyethylene wear [8, 9, 18]. Because greater flexion is expected from the obliged co-occurrence of more rotation and femoral rollback with the RP design and the post-cam mechanism, the RP/PS design has been

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adopted in several high-flexion TKA systems [12, 16, 32]. In addition, as this design is less dependent on the muscle function recovery because of greater prosthetic stability, it is expected patients with a RP/PS prosthesis would show faster recovery and better functional outcomes than those with other types of mobile-bearing prostheses. However, few studies have been conducted on the clinical outcomes of TKAs performed using this new mobile-bearing system. Moreover, clinical outcomes of the RP/PS design have not been investigated in a longitudinal manner.

We conducted this study to longitudinally compare a new RP/PS system (e.motion-PS®) and a mobile-bearing prosthesis (e.motion-FP®) from the same company (B. Braun Aesculap, Tuttlingen, Germany) with respect to early clinical outcomes. The RP/PS prosthesis allows only rotation at the site between the tibia tray and the bottom surface of the polyethylene insert and has a post-cam

mechanism at the site between the top surface of the polyethylene insert and the femoral component (Fig. 1). In contrast, the FP prosthesis has a greater contact area than the RP/PS prosthesis and allows multidirectional motion (AP and mediolateral translation, and rotation) at the site between the tibia tray and the bottom surface of the polyethylene insert (Fig. 2). We hypothesized TKAs conducted with the RP/PS system would show different temporal patterns in clinical outcomes and would have better clinical outcomes at final evaluations, including maximum flexion and patient satisfaction, than those with the FP system.

Materials and Methods

Four hundred thirty-five TKAs were performed by one surgeon (TKK) between February 2004 and November

Fig. 1A–B The photographs show the (A) femoral and (B) tibial components of the e.motion-PS® RP/PS prosthesis. The central peg on the tibial tray facilitates rotation of the bearing insert, and the post-cam mechanism provides controlled femoral rollback. (Courtesy of B. Braun Aesculap; printed with permission and copyright of B. Braun Aesculap.)

Fig. 2A–B The photographs show the (A) femoral and (B) tibial components of the e.motion-FP® prosthesis. The polyethylene insert can move multidirectionally on the top of the tibia tray, ie, rotate (up to 15 mm), move anteroposteriorly (4.5–8.0 mm), and translate

mediolaterally (2.0–4.0 mm). A hook-shaped peg on the surface of the tibial baseplate prevents bearing dislocation and interaction between the patella tendon and the polyethylene insert. (Courtesy of B. Braun Aesculap; printed with permission and copyright of B. Braun Aesculap.)

2005. During this period, one of two mobile-bearing systems (e.motion-FP[®] and e.motion-PS[®]) was implanted in 207 knees and a fixed-bearing system (Genesis II[®]; Smith & Nephew, Memphis, TN) was implanted in 228 knees. The selection between mobile-bearing and fixed-bearing systems was at the surgeon's discretion, which basically was random without applying any selection criteria. Of the 207 knees selected for mobile-bearing prostheses, 105 were implanted with the FP prostheses between February 2004 and November 2004 and 102 were implanted with the RP/PS prostheses between December 2004 and November 2005. We changed implant selection from the FP to the RP/PS prostheses because we believed the RP/PS design had better kinematic characteristics and would produce better clinical outcomes. Before this study was initiated, the operating surgeon (TKK) had performed more than 500 TKAs including more than 100 navigated TKAs with the

FP prosthesis. We excluded 21 knees (12 from the FP group and nine from the RP/PS group) from the analysis owing to periprosthetic infection (one in the RP/PS group), rheumatoid arthritis (two), death unrelated to surgery (two), serious medical problems unrelated to surgery (seven [including a cerebrovascular incident, Parkinson's disease, spine disease, and hip fracture]), and the absence of clinical outcome details during followup (nine [five in the FP group and four in the RP/PS group]). Clinical outcomes were evaluated at 6, 12, and 24 months after surgery, in a consecutive series of 93 TKAs conducted using the RP/PS system and in a consecutive series of 93 TKAs conducted using the FP system. The mean age was 68.7 years in the FP group and 68.2 years in the RP/PS group (Table 1). Eighty-nine knees (95.7%) in the FP group were in female patients and 88 knees (94.6%) in the RP/PS group were in female patients. This study was

Table 1. Demographics and preoperative clinical statuses in the FP and RP/PS groups*

Variable	FP (n = 93)	RP/PS (n = 93)	p Value
<i>Demographic data</i>			
Gender (female)	89 (95.7%)	88 (94.6%)	0.733
Age (years)	68.7 (6.0)	68.2 (5.1)	0.535
Height (cm)	151.7 (6.1)	153.1 (6.4)	0.145
Weight (kg)	59.9 (9.0)	62.1 (9.7)	0.098
Body mass index (kg/m ²)	26.0 (3.5)	26.5 (3.4)	0.349
Involved knee (right)	38 (40.9%)	44 (47.3%)	0.376
AKS patient category (Category A [†])	75 (80.6%)	64 (68.8%)	0.063
<i>Clinical status</i>			
Motion arc			
Flexion contracture	11.9 (7.6)	14.4 (7.9)	0.031
Further flexion	142.5 (13.6)	142.8 (14.0)	0.874
AKS score			
Pain	22.3 (5.7)	22.0 (6.1)	0.758
Knee	47.5 (9.6)	44.9 (10.9)	0.080
Function	51.5 (10.1)	56.3 (14.3)	0.008
PF score			
Anterior knee pain	12.2 (4.3)	11.5 (4.1)	0.232
Chair rising	3.1 (0.7)	3.0 (1.3)	0.469
Stair climbing	2.1 (0.4)	2.3 (0.8)	0.006
WOMAC score			
Pain	11.7 (4.6)	11.8 (4.4)	0.888
Stiffness	4.8 (2.1)	4.8 (2.1)	0.823
Function	42.5 (13.2)	41.1 (12.9)	0.501
SF-36 score			
Physical component summary	28.3 (6.7)	29.0 (7.0)	0.491
Mental component summary	40.4 (11.3)	40.5 (10.3)	0.944
Deformity severity (mechanical TFA)	Varus 11.6° (5.7°)	Varus 12.0° (5.6°)	0.664

* Data are presented as means, with standard deviations in parentheses; [†]Category A is defined as a unilateral condition or the opposite knee successfully replaced; FP = floating platform; RP/PS = rotating platform posterior stabilized; AKS = American Knee Society; PF = patellofemoral; TFA = tibiofemoral angle.

approved by the Institutional Review Board of our hospital and all patients provided informed consent concerning the use of medical records.

All surgeries were performed through the medial parapatellar approach using an image-free navigation system (OrthoPilot®; B. Braun Aesculap). The posterior cruciate ligament was preserved during TKAs performed with the FP system and resected in TKAs performed with the RP/PS system. The patella was resurfaced routinely and all implants were fixed with cement. After surgery, a compressive dressing was applied without immobilization for the first 24 hours. Knees then were placed in a continuous passive motion machine. All patients began walking with crutches or a walker and started active and passive range-of-motion exercises on the second postoperative day.

An independent investigator (KYG) prospectively collected all clinical information using a predesigned database. This included information on demographics, preoperative clinical status, and postoperative outcomes evaluated at 6, 12, and 24 months after surgery. Preoperative clinical status and postoperative outcomes were evaluated using knee motion arcs (flexion contracture and maximum flexion), American Knee Society (AKS) knee and function scores [15], patellofemoral scores as described by Feller et al. [11], WOMAC scores [5], and SF-36 scores [29]. An independent investigator (YGK) measured flexion contracture and maximum flexion to the nearest 5° using a goniometer with the patients supine. Patient satisfaction was evaluated at the 12- and 24-month followups using the grading system developed by the British Orthopaedic Association [1, 31], which is divided into four levels, ie, enthusiastic, satisfied, not committed, and disappointed.

We conducted statistical analyses using SPSS® for Windows® (Version 15.0; SPSS Inc, Chicago, IL), and *p* values < 0.05 were considered significant. The Kolmogorov-Smirnov test was used to confirm the clinical outcome scale scores were normally distributed. To control for possible confounders resulting from preoperative differences between the FP and RP/PS groups, they also were compared with respect to demographic data and preoperative clinical statuses. No preoperative differences were found between the two groups except for AKS patient

category (the FP group tended to have more patients in Category A, ie, unilateral condition or the opposite knee successfully replaced) (Table 1). Preoperatively, the RP/PS group had a greater mean flexion contracture (14.4° versus 11.9°; *p* = 0.031), a better mean AKS function score (56.3 versus 51.5; *p* = 0.008), and a higher stair-climbing score according to the patellofemoral scoring system (2.3 versus 2.1; *p* = 0.006). In addition, the RP/PS group had a marginally poorer AKS knee score (44.9 versus 47.5; *p* = 0.08). These differences are a result of the study design. The two groups were not established by randomization, but rather from two consecutive series treated at different times. We decided to use analysis of covariance to adjust for the effects of confounding factors on clinical outcomes.

Limb and prosthesis alignments in the coronal plane were investigated by measuring mechanical tibiofemoral angle, femoral component medial angle, and tibial component medial angle of whole standing legs in the AP view. Sagittal alignments were determined by measuring femoral component sagittal angle and tibial component posterior slope on 14-inch × 17-inch standard lateral views of knees. We found no major differences between the two study groups in terms of any radiographic parameter except tibial component posterior slope, which was smaller in the RP/PS group (3.2° versus 5.0°; *p* < 0.001) (Table 2). The difference in tibial component posterior slope was interpreted to originate from the different target values in navigation, which were set 3° for the FP type and 0° for the RP/PS type because the FP type is a cruciate-retaining type and the RP/PS type is a posterior-stabilized type.

We performed longitudinal comparisons of clinical outcomes in two steps. First, clinical outcomes were evaluated at 6, 12, and 24 months postoperatively. The statistical significance of the changes that occurred between two times was determined using the paired *t* test and chi square test or Fisher's exact test. Second, we compared clinical outcomes of the two groups at the same times. The statistical significance of differences between the two groups was determined using Student's *t* test for continuous variables and chi square or Fisher's exact test for categorical variables. To determine whether our sample

Table 2. Radiographic measurements in the FP and RP/PS groups*

Parameter	FP (n = 93)	RP/PS (n = 93)	<i>p</i> Value
Mechanical tibiofemoral angle	Varus 1.0° (3.0°)	Varus 1.7° (2.1°)	0.083
Femoral component medial angle	89.4° (2.1°)	89.0° (1.3°)	0.106
Tibial component medial angle	89.7° (1.9°)	89.3° (1.5°)	0.181
Femoral component sagittal angle	1.3° (3.2°)	2.0° (2.3°)	0.129
Tibial component posterior slope	5.0° (2.2°)	3.2° (1.6°)	< 0.001

* Data are presented as means, with standard deviations in parentheses; FP = floating platform; RP/PS = rotating platform posterior stabilized.

size had sufficient statistical power, we performed a priori power analysis using the two-sided hypothesis test at an alpha level of 0.05. Sixty-four knees were required to detect a 5° difference in motion arc and a 5% difference in outcome scales, which we considered to be clinically significant. Thus, the sample sizes used were regarded as adequate.

Results

Patients who had TKAs using the RP/PS prosthesis showed similar recovery patterns until 12 months but had different patterns after 12 months from patients with the FP prosthesis (Table 3, Fig. 3). In the FP group, many of the outcome scales peaked 12 months postoperatively and then deteriorated. Mean maximum flexion in this group was 133.4° (range, 105°–150°) at 12 months but 130.2° (range, 110°–150°) at 24 months. Likewise, AKS function, WOMAC pain and function, and the physical component of the SF-36 peaked at 12 months and then reduced. Additionally, in the FP group, only three patients (3.2%) were dissatisfied at 12 months, whereas nine (9.7%) were dissatisfied at 24 months (three disappointed; six uncommitted) ($p = 0.001$). In contrast, in the RP/PS group, outcome scales showed continued improvement at 12 months or remained at a constant level between 12 and 24 months. Mean maximum flexions were 136.8° (range, 110°–155°) and 135.4° (range, 105°–160°) at 12 and 24 months, respectively, which were not different ($p = 0.277$), whereas mean WOMAC pain and function scores were 2.3 and 15.8, respectively, at 12 months and improved to 2.1 ($p = 0.003$) and 13.4 ($p = 0.04$) at 24 months. Other outcome scales were at similar levels at 12 and 24 months.

Longitudinal comparisons revealed various results depending on the evaluation points, but the RP/PS group had better clinical outcomes including maximum flexion and patient satisfaction at 24 months (Table 4). Twenty-four months after surgery, the RP/PS group had a greater mean maximum flexion than the FP group (135.4° versus 130.2°; $p = 0.005$) and a better AKS function score (97.9 versus 94.0; $p = 0.038$) and also showed a tendency to have a better anterior knee pain score (14.5 versus 13.7; $p = 0.073$). Moreover, these differences in AKS function and anterior knee pain scores remained to have a statistical tendency after adjusting for preoperative differences between the two groups using analysis of covariance ($p = 0.081$ and 0.059, respectively). In addition, patient satisfaction was superior in the RP/PS group. Only one patient in the RP/PS group was dissatisfied (not committed), whereas nine patients (9.7%) were dissatisfied in the FP group ($p = 0.018$). No prosthesis-related complications

such as bearing dislocation occurred in either group, and no knee was revised for any reason.

Discussion

Various types of mobile-bearing TKA systems have been devised to take advantage of the dual-articulation concept, and the RP/PS prosthesis is the most recent of these systems. However, despite its theoretical advantages, few clinical studies have been done to compare the functional outcomes of the RP/PS prosthesis and other prostheses [8, 12, 24]. This study was conducted to longitudinally compare the clinical outcomes of TKAs performed using a RP/PS mobile-bearing system with those performed using a FP system. We hypothesized TKAs conducted with the RP/PS system would show different temporal patterns in clinical outcomes and they would have better clinical outcomes at final evaluations, including maximum flexion and patient satisfaction, than those with the FP system.

Several limitations should be noted when interpreting our findings. First, this study was not performed as a randomized, controlled study, but as a case-control study by using a control group that consisted of TKAs performed using a different prosthesis during a different time period. Accordingly, the RP/PS group differed from the FP group with respect to several demographic factors and preoperative clinical status. Although all surgeries were performed by one surgeon and all clinical data were collected by one clinical investigator using predesigned data collection sheets, some confounding factors arising from the study design, particularly, the different periods involved, may have affected results. However, we attempted to adjust for confounding effects arising from preoperative differences by controlling for preoperative differences using analysis of covariance. Second, this study does not address long-term outcomes, and thus, we were unable to investigate longevity-related issues such as wear and loosening, which are of real practical importance given the full-congruency design features of the FP prosthesis. Third, the characteristics of our study population should be considered carefully before extrapolating our findings to other populations. In particular, our study population had a large female dominance (approximately 95% were women) and a bias toward elderly subjects (approximately 68 years old). Accordingly, our findings more precisely concern elderly women whose physical activities and lifestyles differ markedly from those in other age groups.

Nevertheless, our study supports the first hypothesis that TKAs with the RP/PS prosthesis have different temporal patterns in clinical outcomes from those with the FP prosthesis. In particular, in the FP group, many of the outcome scales peaked at 12 months postoperatively and

Table 3. Temporal patterns of clinical outcomes in the FP and RP/PS groups*

Parameter	FP (n = 93)				RP/PS (n = 93)			
	Preoperative	6 months	12 months	24 months	Preoperative	6 months	12 months	24 months
<i>Motion arc</i>								
Flexion contracture	11.9 (7.6)	0.1 (0.8) [†]	0.0 (0.0)	0.0 (0.0)	14.4 (7.9)	0.3 (1.6) [†]	0.13 (1.1)	0.14 (1.2)
Further flexion	142.5 (13.6)	131.3 (9.4) [†]	133.4 (9.3) [†]	130.2 (9.9) [†]	142.8 (14.0)	134.0 (9.9) [†]	136.8 (9.5) [†]	135.4 (11.0)
<i>AKS score</i>								
Pain	22.3 (5.7)	47.6 (2.5) [†]	48.0 (3.3)	47.2 (5.5)	22.0 (6.1)	47.0 (4.8) [†]	47.7 (4.7)	48.1 (3.2)
Knee	47.5 (9.6)	95.1 (4.2) [†]	95.9 (4.6)	94.6 (6.2)	44.9 (10.9)	94.4 (6.2) [†]	95.5 (5.9)	95.1 (5.7)
Function	51.5 (10.1)	86.7 (13.5) [†]	95.7 (9.0) [†]	94.0 (13.7)	56.3 (14.3)	91.3 (10.9) [†]	96.3 (9.4) [†]	97.9 (7.0)
<i>PF score</i>								
Anterior knee pain	12.2 (4.3)	14.6 (1.4) [†]	14.6 (1.9)	13.7 (3.3)	11.5 (4.1)	13.5 (3.0) [†]	14.2 (2.5)	14.5 (1.7)
Chair rising	3.1 (0.7)	4.9 (0.5) [†]	4.9 (0.4)	5.0 (0.0)	3.0 (1.3)	5.0 (0.3) [†]	5.0 (0.2)	5.0 (0.2)
Stair climbing	2.1 (0.4)	4.3 (0.0) [†]	4.6 (0.9) [†]	4.7 (0.8)	2.3 (0.8)	4.3 (1.0) [†]	4.8 (0.6) [†]	4.8 (0.6)
<i>WOMAC score</i>								
Pain	11.7 (4.6)	3.3 (3.1) [†]	2.1 (2.8) [†]	2.7 (3.3) [†]	11.8 (4.4)	2.6 (3.0) [†]	2.3 (2.6) [†]	2.1 (3.6) [†]
Stiffness	4.8 (2.1)	2.4 (1.6) [†]	1.9 (1.7) [†]	1.7 (1.6)	4.8 (2.1)	2.3 (1.5) [†]	1.7 (1.4)	1.6 (1.6)
Function	42.5 (13.2)	19.9 (12.7) [†]	15.3 (9.6) [†]	16.7 (12.2) [†]	41.1 (12.9)	18.3 (8.1) [†]	15.8 (9.0) [†]	13.4 (10.6) [†]
<i>SF-36 score</i>								
Physical component summary	28.3 (6.7)	41.2 (7.4) [†]	44.5 (7.9) [†]	41.5 (9.5) [†]	29.0 (7.0)	41.7 (7.8) [†]	44.4 (8.6) [†]	43.9 (9.5)
Mental component summary	40.4 (11.3)	46.4 (10.9) [†]	49.4 (10.5) [†]	48.7 (10.4)	40.5 (10.3)	47.2 (10.8) [†]	47.5 (12.1)	49.1 (10.7)
<i>Patient satisfaction</i>								
Dissatisfied knee			3 (3.2%)	9 (9.7%) [†]			2 (2.2%)	1 (1.1%) [†]

* The statistical significances of changes from prior evaluations were determined using the paired t test and results are displayed using two p value cutoffs ([†]p < 0.05; [‡]p < 0.01); FP = floating platform; RP/PS = rotating platform posterior stabilized; AKS = American Knee Society; PF = patellofemoral.

Fig. 3A–L The graphs show comparative temporal patterns of the clinical outcomes for (A) maximum flexion; (B) pain, (C) knee, and (D) function scores of the AKS, (E) anterior knee pain, (F) chair rising, and (G) stair climbing of the patellofemoral scoring system, (H) pain, (I) stiffness, and (J) function of the WOMAC, and (K) physical component and (L) mental component summaries of the SF-

36 between the RP/PS and the FP groups. Values with a significant difference ($p < 0.05$) from the corresponding value in previous evaluations are marked with two symbols (□-s for the RP/PS group and △-s for the FP group), and times with a significant difference between the RP/PS and the FP groups are marked with two symbols († = $p < 0.05$ and ‡ = $p < 0.01$).

then deteriorated, whereas in the RP/PS group, outcome scales continued to improve between 12 and 24 months (Table 3; Fig. 3). The reasons for these differences are unclear. One possible explanation is the FP prosthesis,

which is less constraining and has more multidirectional motion, is more dependent on muscle function recovery and, thus, dependent on time lapsed postoperatively. Our elderly, female Korean patients typically live a sedentary

Table 4. Longitudinal comparisons of clinical outcomes in the FP and RP/PS groups*

Parameter	6 months			12 months			24 months		
	FP (n = 93)	RP/PS (n = 93)	p Value	FP (n = 93)	RP/PS (n = 93)	p Value	FP (n = 93)	RP/PS (n = 93)	p Value
<i>Motion arc</i>									
Flexion contracture	0.1 (0.8)	0.3 (1.6)	0.432	0.0 (0.0)	0.13 (1.1)	0.352	0.0 (0.0)	0.14 (1.2)	0.467
Maximum flexion	131.3 (9.4)	134.0 (9.9)	0.065	133.4 (9.3)	136.8 (9.5)	0.032	130.2 (9.9)	135.4 (11.0)	0.005
<i>AKS score</i>									
Pain score	47.6 (2.5)	47.0 (4.8)	0.289	48.0 (3.3)	47.7 (4.7)	0.634	47.2 (5.5)	48.1 (3.2)	0.271
Knee score	95.1 (4.2)	94.4 (6.2)	0.387	95.9 (4.6)	95.5 (5.9)	0.602	94.6 (6.2)	95.1 (5.7)	0.625
Function score	86.7 (13.5)	91.3 (10.9)	0.016 [†]	95.7 (9.0)	96.3 (9.4)	0.687	94.0 (13.7)	97.9 (7.0)	0.038 [†]
<i>PF score</i>									
Anterior knee pain	14.6 (1.4)	13.5 (3.0)	0.005 [†]	14.6 (1.9)	14.2 (2.5)	0.383	13.7 (3.3)	14.5 (1.7)	0.073 [†]
Chair rising	4.9 (0.5)	5.0 (0.3)	0.216	4.9 (0.4)	5.0 (0.2)	0.252	5.0 (0.0)	5.0 (0.2)	0.409
Stair climbing	4.3 (0.)	4.3 (1.0)	0.974	4.6 (0.9)	4.8 (0.6)	0.09 [†]	4.7 (0.8)	4.8 (0.6)	0.394
<i>WOMAC score</i>									
Pain	3.3 (3.1)	2.6 (3.0)	0.148	2.1 (2.8)	2.3 (2.6)	0.657	2.7 (3.3)	2.1 (3.6)	0.372
Stiffness	2.4 (1.6)	2.3 (1.5)	0.656	1.9 (1.7)	1.7 (1.4)	0.456	1.7 (1.6)	1.6 (1.6)	0.684
Function	19.9 (12.7)	18.3 (8.1)	0.342	15.3 (9.6)	15.8 (9.0)	0.771	16.7 (12.2)	13.4 (10.6)	0.105
<i>SF-36 score</i>									
Physical component summary	41.2 (7.4)	41.7 (7.8)	0.688	44.5 (7.9)	44.4 (8.6)	0.938	41.5 (9.5)	43.9 (9.5)	0.160
Mental component summary	46.4 (10.9)	47.2 (10.8)	0.590	49.4 (10.5)	47.5 (12.1)	0.319	48.7 (10.4)	49.1 (10.7)	0.865
<i>Patient satisfaction</i>									
Dissatisfied knee				3 (3.2%)	2 (2.2%)	0.650	9 (9.7%)	1 (1.1%)	0.018

* Data are presented as means, with standard deviations in parentheses; [†]the differences between the two groups remained significant or tended to be significant after adjusting for preoperative differences using analysis of covariance; FP = floating platform; RP/PS = rotating platform posterior stabilized; AKS = American Knee Society; PF = patellofemoral.

lifestyle, and their physical activities during the first year after surgery would be higher than their normal lifestyle because they were reminded of the necessity of physical activity during regular followups. However, when they return to their original sedentary lifestyle, their physical activities diminish, and subsequently, the muscle function deteriorates after 12 months when their motivation and interest in physical exercises would be diminishing. However, this study does not include any valid information regarding physical activity changes according to followup periods, and our interpretations are speculative. Nonetheless, the finding that the FP group outcomes tended to deteriorate after 12 months causes us to speculate the RP/PS prosthesis offers an advantage when patients return to daily activities after a 12-month rehabilitation period. In fact, several studies have reported patients with meniscal-bearing systems, which are similar to the FP prosthesis, have subjective instabilities [4, 13, 27].

This study also supports our second hypothesis that TKAs with the RP/PS prosthesis have better clinical outcomes including maximum flexion and patient satisfaction at final evaluations. At 24 months after surgery, the RP/PS group had greater maximum flexion and better AKS function score, anterior knee pain score, and patient satisfaction than the FP group (Table 4). Intuitively, RP/PS group knees should have had greater maximum flexion. The kinematic requirements for greater maximum flexion include the occurrence of posterior femoral rollback and tibial internal rotation with flexion [2, 8, 19, 22]. It is claimed the RP/PS prosthesis provides greater maximum flexion because it allows rotation at the interface between the tibial tray and the bottom surface of the polyethylene insert and femoral rollback at the interface between the femoral component and the top surface of the polyethylene [12, 16, 20]. This major difference we observed between prostheses in our study is remarkable, given that numerous studies that have compared maximum flexion for different prostheses in Korean patients typically have reported no major differences could be attached to prosthesis designs. This may just be a reiteration of previous findings that the preoperative maximum flexion may be the most important determinant of postoperative outcome [25, 26, 28]. Our longitudinal comparisons of maximum flexion show the RP/PS group had greater maximum flexion throughout followup. In particular, RP/PS group knees retained maximum flexion between 12 and 24 months (136.7° and 135.4° , respectively; $p = 0.277$), whereas the FP group had a decrease of 3.2° (133.4° and 130° at 12 and 24 months, respectively; $p = 0.028$) (Table 3). However, the reason for this temporal difference between the two groups is unclear, although we suspect motion of the polyethylene insert in the FP prosthesis may have reduced after 12 months, whereas the post-cam mechanism of the RP/PS

prosthesis assured femoral rollback even after 12 months. This explanation is supported by the findings of a recent study, which found polyethylene rotation in mobile-bearing systems reduces in vivo after implantation [30]. The reduced polyethylene rotation might affect maximum flexion adversely. Another explanation is patients with a RP/PS prosthesis tend to perform high-flexion activities because of its better stability. In addition, our finding of greater maximum flexion for the RP/PS prosthesis concurs with that of a previous study, which concluded TKAs with a RP/PS prosthesis allowed greater maximum flexion than TKAs with the rotating-platform design (both units also were from the same company) [12].

The patient satisfaction differences observed during our study were of particular interest. At 12 months, the two groups were similar in terms of the proportion of dissatisfied patients (3.2% and 2.2%; $p = 0.65$), but at 24 months, 9.7% in the FP group stated they were dissatisfied, whereas only 1.1% were dissatisfied in the RP/PS group. This extremely low prevalence of patient dissatisfaction in the RP/PS group was surprising, because previous studies typically have reported dissatisfaction levels greater than 10% [3, 10, 23]. In a previous study, we found the overall dissatisfaction level was 7.5% (33 of 438 knees), and approximately 49% of the dissatisfied patients said they were dissatisfied because of residual pain, vague knee symptoms, or inability to perform high-flexion activities [17]. In the current study, we did not attempt to identify the cause of patient dissatisfaction, but we suspect more patients in the FP group were disappointed because of perceived deteriorating outcomes in terms of maximum flexion, functional performances, and subtle subjective instabilities. In contrast, the extremely low prevalence of patient dissatisfaction in the RP/PS group suggests the RP/PS prosthesis has successfully achieved treatment goals in terms of pain relief, functional restoration, and patient satisfaction.

Our study showed the RP/PS prosthesis has several clear advantages over the FP prosthesis. However, requirements for an ideal knee prosthesis include the ability not only to achieve satisfactory functional outcomes but also to provide satisfactory longevity by decreasing wear, osteolysis, and loosening. The FP prosthesis has greater contact area throughout its motion arc than the RP/PS prosthesis and does not involve the post-cam mechanism, which is alleged to be a site of polyethylene wear and fracture. Unfortunately, our study does not provide information regarding the effects of prosthesis type on longevity, and therefore, we are limited in terms of being able to offer advice on this topic. However, as long as the RP/PS prosthesis incorporates either the RP type of mobile-bearing system or the posterior-stabilized type of fixed-bearing system, which have both been documented to accomplish satisfactory

endurance [6, 7, 9], we believe the RP/PS prosthesis is likely to provide better, more consistent functional outcomes and is the better option for Asian patients.

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