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## A Retrospective Comparison of a Medial Pivot and Posterior-Stabilized Total Knee Arthroplasty With Respect to Patient-Reported and Radiographic Outcomes

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## ABSTRACT

**Background:** Medial pivot (MP) type total knee arthroplasty (TKA) implants are designed with a highly congruent medial tibiofemoral articulation. Compared with the cam-and-post design of the posterior-stabilized (PS) TKA, the MP-TKA design has been hypothesized to better replicate the natural kinematics of the knee. We compared the MP-TKA and PS-TKA designs, with our primary outcome measures being range of motion (ROM) and patient-reported satisfaction.

**Methods:** This study was a retrospective comparison between the 2 groups (76 MP-TKA vs 88 PS-TKA). ROM was collected preoperatively, 6 weeks, 6 months, and 1 year postoperatively. The Forgotten Joint Score-12 (FJS-12) scores were collected at a minimum of 1 year postoperatively.

**Results:** There was no statistically significant difference in age, gender, or body mass index between the groups. We found a statistical difference in preoperative ROM (MP = 120.3°, PS = 112.8°,  $P = .002$ ). There was no difference in  $\Delta$ ROM at 6 weeks (MP = -12.36, PS = -3.79,  $P = .066$ ), 6 months (MP = -4.23, PS = 2.73,  $P = .182$ ), or 1 year (MP = .17, PS = 3.31,  $P = .499$ ). Patients who underwent the MP-TKA scored significantly better than the PS-TKA on the FJS-12 score (MP = 59.72, PS = 44.77,  $P = .007$ ).

**Conclusion:** We found that patients who underwent the MP-TKA scored better on the FJS than those who underwent the PS-TKA; particularly with regard to deep knee flexion and stability of the prosthesis. The MP-TKA design may offer improved patient outcomes because of its highly congruent medial tibiofemoral articulation.

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Since the invention of the total knee arthroplasty (TKA) in the early 1950s, the design has undergone many revisions and modifications. Each new iteration aims to improve patient outcomes, knee function, and implant longevity. The posterior-stabilized TKA (PS-TKA) was developed in 1978 to address the issue of abnormal posterior-cruciate ligament morphology [1]. Advantages of the PS-TKA include simpler exposure, easier soft-tissue balancing, predictable restoration of knee kinematics, and

improved range of motion (ROM) [2]. The PS-TKA relies on a femoral cam that articulates with a tibial post, improving femoral rollback and increasing anteroposterior and translational stability of the knee [3–5]. It has been claimed that cam-post mechanism improves stair-climbing ability through the prevention of posterior tibial subluxation [2].

The medial pivot (MP-TKA) design was developed in the early 1990s to better mimic the natural kinematics of the knee, specifically more natural femoral rollback [6]. Kinematic studies showed that the medial compartment of the knee functioned like a ball-and-socket joint, with the lateral femoral condyle translating in an anteroposterior direction and rotating around the medial compartment in flexion [7–9]. The MP-TKA design features a deeper, highly conforming medial compartment and a less congruent lateral component to allow relative freedom of anteroposterior movement of the lateral condyle [7].

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The PS-TKA has shown good results with respect to the American Knee Society Score and survivorship at 10 years [3,4,6,10]. Similarly, the MP-TKA has also demonstrated excellent results regarding the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), Oxford Knee Score, and Short Form (SF)-12 scores [11–14]. In this study, we sought to compare the ROM and patient-reported outcomes (using the Forgotten Joint Score [FJS]) between the EVOLUTION Medial-Pivot (MicroPort, Arlington, TN) and the Zimmer Persona Posterior Stabilized (Zimmer, Warsaw, IN) Knee Systems.

## Materials and Methods

This study was approved by our institutional research ethics board. We used our prospectively collected institutional total joint registry and examined the electronic medical records of all patients who underwent a primary TKA from March 2014 to April 2017. Inclusion criteria included any patient undergoing a primary TKA with a diagnosis of osteoarthritis, rheumatoid arthritis, or posttraumatic arthritis. There were no specific criteria for implant selection, as the surgeon did not selectively use the MP-TKA design for specific preoperative conditions. The 2 groups represent 2 consecutive cohorts of patients as the primary surgeon gradually changed his practice and preference. All surgeries were performed by the senior author (DB). Standard surgical technique included a midline incision, medial parapatellar arthrotomy, subluxation (but not eversion) of the patella, intramedullary distal femur resection, extramedullary proximal tibia resection, and resurfacing of the patella depending on the intraoperative wear pattern. The patella was resurfaced in 90% of the patients. Patients received standard, weight-based doses of preoperative antibiotics and intravenous tranexamic acid, followed by 24 hours of postoperative antibiotics and 3 weeks of venous thromboembolism prophylaxis with low-molecular-weight heparin.

### Demographics

The mean age of all the patients in this study was 65.63 years (standard deviation [SD] 9.56). The mean age for the MP group was 64.4 years (10.5) and the mean age of the PS group was 66.7 years (8.61) (Table 1). There was no statistically significant difference in mean age between the 2 groups ( $P = .131$ ). Of the 164 patients, 101 were female and 63 were male. The male:female ratio of the MP group was 29:47 and 34:54, respectively ( $P = .85$ ).

### Range of Motion

The ROM was measured with the patient supine. It was recorded as the difference between the maximum active extension and flexion. ROM was measured at the preoperative consultation, and again at the 6-week, 6-month, and 1-year postoperative follow-up consultations. All ROM angles were measured by a trained Advanced Practice Physiotherapist using a standard 30-cm goniometer. The Advanced Practice Physiotherapist was blinded to the

**Table 1**  
Patient Demographics.

Variable	MP	PS	P Value
Gender (M:F)	29:47	34:54	.85
Age, y	64.4 ( $\pm 10.5$ ); range 26–87	66.7 ( $\pm 8.61$ ); range 47–86	.131
BMI, kg/m <sup>2</sup>	29.7 ( $\pm 5.24$ )	31.3 ( $\pm 8.20$ )	.137

BMI, body mass index; MP, medial pivot; PS, posterior-stabilized.

type of knee design used. The ROM was measured at each time point for both MP-TKA and PS-TKA groups and a mean flexion angle was obtained.

### Forgotten Joint Score

The FJS [15] is a validated measure of patient satisfaction after TKA. The score consists of 12 questions, each pertaining to the patient's ability to carry out daily activities. For each question, the patient is asked to answer as one of "Never," "Almost never," "Rarely/Seldom," "Sometimes," or "Mostly." Each response corresponds to a value (ie, "Never" = 1, "Mostly" = 5). The raw scores range from 12 to 60, with a higher raw score indicating a worse outcome. The raw score is then converted to a linearly scaled score of 100 using the following formula: Final score =  $100 - ((\text{sum}\{\text{item 1 to item 12}\} - 12)/48 * 100)$ . A high final score indicates a good outcome and a low final score indicates a poor outcome.

### Radiographic Analysis

Postoperative radiographs, taken at least 1 year after surgery, were available for 112 of 165 patients (68%). The radiographs were reviewed by 2 fellowship-trained orthopedic surgeons (JW and IV) using the Modern Knee Society Radiographic Evaluation System [16]. Any disagreements were reviewed with the senior surgeon (DB). The radiographic criteria for loosening included a wide (>2 mm) or progressive cement-bone or metal-cement lucent line, component migration, collapse of underlying trabecular bone with subsidence of the component, and cement mantle fractures. Nonprogressive lucent zones measuring 0–2 mm between cement and bone are considered normal and likely secondary to cement contraction. The standard radiographs included standing anteroposterior, lateral, and skyline views.

### Statistical Analysis

We performed a power calculation to detect a difference in mean ROM of 5° with a common SD of 10° [6]. A total of 62 patients were required to have a statistical power of 90%, with a 2-sided alpha set at 0.05. The independent *t* test was used to determine statistical significance in mean ROM between the 2 groups. The mean scores for ROM and FJS were calculated for both groups and analyzed for statistical significance using the independent *t* test. All statistical analysis was performed using SPSS, version 24 (IBM SPSS Statistics, Armonk, NY).

## Results

A total of 164 patients were included in this study; 76 patients in the MP-TKA group and 88 patients in the PS-TKA group. One hundred seventeen patients completed the FJS at their 1-year follow-up (57 MP vs 60 PS).

### Range of Motion (ROM)

There was a statistically significant difference in the mean preoperative flexion angle between the MP-TKA and the PS-TKA groups (MP-TKA 120.3° [SD 16.5] vs PS-TKA 112.8° [SD 15.6],  $P = .002$ ). There was no statistically significant difference in the mean flexion angle between the 2 groups at the 6-week (MP-TKA 105.9° vs PS-TKA 107.2°,  $P = .572$ ) or 6-month (MP-TKA 115.6° vs PS-TKA 114.8°;  $P = .726$ ) follow-up. At the 6-week, 6-month, and 1-year follow-up visits, there was no statistically significant difference in the change in ROM between the 2 groups (Table 2). We

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