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No difference in patient preference for medial pivot versus posterior-stabilized design in staged bilateral total knee arthroplasty: a prospective study

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Abstract

Purpose Medial pivot (MP) TKA has been shown to mimic normal knee kinematics with long-term survivorship comparable to most contemporary TKA. However, there are inadequate evidences to suggest its superiority in terms of patient preference and satisfaction. The aim of this study is to compare the MP with posterior-stabilized (PS) TKA in terms of patient preference and satisfaction.

Methods 46 patients with staged bilateral TKA were recruited. TKA with MP or PS design was performed at interval of 6–12 months. Patient preference, patient satisfaction score (0–100), Forgotten Joint Score (FJS), range of motion (ROM), Pain Score, Knee Society Score (KSS), Knee Function Score (KFS) and WOMAC Score were compared at up to 12 months.

Results The mean age was 70 and 69.6% were female. There was no difference in all preoperative parameters, operative time and length of stay between two knees. No difference was found in in range of motion and all outcome scores at 6 months and 12 months. Satisfaction score was similar for the two designs (82 vs 85, p = n.s.) at 1 year after the second TKA. Proportion of patients with preference on one design over another was not significantly different (28.9 vs 35.6%, p = n.s.).

Conclusions There is no evidence to support the superiority of MP TKA over PS TKA in terms of preference and satisfaction. The choice between MP TKA versus PS TKA maybe more a surgeon's preference than a patient's preference based on current evidence.

Keywords Medial pivot · Posterior-stabilized · Total knee arthroplasty · Patient preference · Satisfaction

Introduction

Total knee arthroplasty (TKA) is considered a successful surgery. Yet, there are still 10–20% of patients dissatisfied with the results of the surgery [6, 16]. Dissatisfaction could be due to residual pain, inadequate range of motion, inability to return to normal function, abnormal gait [7], etc. Kinematic problems due to conventional implant design have been postulated. These include mid-flexion instability [21], inadequate or delayed roll-back [4, 14], abnormal AP translation [4, 19] and kinematic conflict [8].

Medial pivot (MP) TKA has been introduced into market for more than 15 years with renewed interest in recent years [1, 15, 17, 18]. Long-term survivorship is comparable or even better than most contemporary TKA [2, 5, 9, 12, 15]. The prosthesis has been shown to mimic normal knee kinematics in terms of internal tibial rotation, consistent posterior translation of lateral femoral condyle and restricted AP translation of medial femoral condyle during knee flexion [13, 23]. However, there are inadequate evidences to show how much these kinematic advantages could translate into patient report outcome measures (PROM) such as patient preference, satisfaction or Forgotten Joint Score (FJS). Most studies used satisfaction scores and the results conflicted with each other [3, 10, 17, 18, 24]. These studies were either retrospective or involved independent group of patients for comparison. Only one study investigated on patient preference after MP TKA and it suggested its superiority over

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other designs [20]. That was also the only prospective study with comparison of MP TKA with other TKA designs on both knees of the same patients. FJS, as a newer PROM with higher sensitivity for good outcome, was not reported in in all but one study [22].

The aim of this study is to prospectively compare the MP TKA with posterior-stabilized (PS) TKA in terms of patient preference and satisfaction in a staged bilateral TKA setting. FJS is also compared as a secondary outcome. The null hypothesis is that there is no difference between both types of prosthesis in terms of patient preference and satisfaction.

Materials and methods

Patients with bilateral knee osteoarthritis scheduled for primary TKA from June 2016 to June 2018 were recruited prospectively. Staged bilateral TKA was performed with interval of 6–12 months. MP TKA was allocated at random to one knee and PS TKA was allocated to the contralateral knee. For allocation of the first TKA, random allocation number was generated and patients with single number would get MP TKA while patients with even number would get PS TKA. The remaining knee would receive design different from the first at an interval of 6–12 months. Patient with inflammatory arthritis, old periarticular fracture, previous osteotomy and surgical complications were excluded.

The primary outcome were patient preference and patient satisfaction score (0–100) at 1 year after the second knee surgery. The secondary outcomes were Forgotten Joint Score (FJS), range of motion (ROM), Pain Score, Knee Society Score (KSS), Knee Function Score (KFS) and WOMAC Score at 6 and 12 months after surgery of each knee. Comparability between two knees was assessed with pre-operative parameters including degree of deformity, range of motion (ROM), Pain Score, Knee Society Score (KSS), Knee Function Score (KFS) and WOMAC Score.

IRB approval was obtained from regional hospital research ethics committee (KWC-REC), IRB reference number: KW/EX-18–031(120–01).

Table 2 Baseline parameters

$n=46$	Medial Pivot	Posterior stabilized	p value
Alignment (°, varus)	13 ± 6	13 ± 7	n.s
ROM (°)	97 ± 15	100 ± 15	n.s
Knee Society Score	51 ± 19	44 ± 19	n.s
Pain Score	21 ± 14	17 ± 12	n.s
Function Score	49 ± 12	49 ± 12	n.s
WOMAC	49 ± 19	49 ± 23	n.s
Anesthesia (SA %) (*n*)	76.1 (11)	76.1 (11)	n.s

BMI body mass index, *ROM* range of motion, *WOMAC* Western Ontario and McMaster Universities Score, *SA* spinal anesthesia

Statistical analysis

All numerical parameters were assessed by Student *t* test while categorical parameters by Chi-square test. *P* value of < 0.05 was considered statistically significant.

Sample size calculation was based on patient preference and satisfaction score with type I error of 0.05 and power of 0.8. Using the result of patient preference from a previous study on MP TKA vs PS TKA (76.2 vs 9.5%) [20], a minimal size of 16 paired samples was required. Using the result of satisfaction score (0–100) of a previous study (mean difference of 2.5 ± 5.6) [3], the minimal size of 42 paired sample was required. Assuming attrition rate of 10%, a paired sample size of 46 was to be recruited. *P* value of 0.05 was considered statistically significant.

Results

During the study period, 53 patients received staged MP TKA and PS TKA. One patient with inflammatory arthritis, one with old periarticular fracture, one with previous osteotomy and four cases with surgical complications were excluded (Table 1); the remaining 46 patients were recruited into study. The mean age was 70 ± 7 and 69.6% were female. Mean BMI was 27.4 ± 4 kg/m^2. There was no difference in all preoperative parameters (Table 2).

Table 1 Excluded cases with surgical complications

Age	Sex	BMI	TKR design of affected side	Cause of exclusion
76	F	25.5	PS	Intraoperative partial MCL tear
75	F	22.9	PS	Crack tibial plateau fracture noticed post-operatively
56	F	28.8	PS	Patella fracture after a fall at 2 months
71	F	28.4	PS	Recurvatum at 6 months

PS Posterior-stabilized

The operative time and length of stay showed no difference between TKA designs (Table 3). There was also no significant difference in range of motion and all outcome scores at 6 months and 12 months. At 1 year after the second TKA, the satisfaction score was similar for the two designs (82 vs 85, p = n.s.). 35.5% patients had no preference for either design. Proportion of patients with preference on one design over another was not significantly different (35.6 vs 28.9%, p = n.s.). Forgotten Joint Score, being the more sensitive tool for patient report outcome and an indirect measure of patient satisfaction, was also found to be the same for both designs at 6 months (46 vs 51, p = n.s.) and 12 months (82 vs 85, p = n.s.) in the present study.

Discussion

The most significant finding of this study was that patients had no preference for either MP or PS design up to 12 months after staged bilateral TKA. Although medial pivot (MP) TKA has been introduced into market for more than 15 years and favorable long-term survival has been demonstrated [2, 5, 9, 15], there is little evidence whether the kinematic advantages could translate into clinical benefits, particularly in terms of patient preference or satisfaction.

There is only one study directly comparing patient preference between different TKA designs. Pritchett [20] compared patient preference between five types of TKA design in patient with staged bilateral TKA. MP TKA was shown to have higher preference over PS TKA (76.2 vs 9.5%), cruciate retaining (CR) TKA (76 vs 12%) and mobile-bearing (MB) TKA (61.4 vs 30.1%). The present study might be the second to report the result of patient preference with two different TKA designs performed on the same patients. In our study, 35.5% showed no preference on either MP TKA or PS TKA. Patient with preference on one design over another was not significantly different.

Table 3 Outcome

	Medial Pivot	Posterior stabilized	p value
OT duration (minutes)	79 ± 15	84 ± 16	n.s
Length of stay (days)	5.5 ± 1.8	5.8 ± 1.6	n.s
6 months post-operation			n.s
ROM (degree)	103 ± 14	105 ± 15	n.s
Knee Society Score	91 ± 7	91 ± 7	n.s
Pain Score	46 ± 5	47 ± 6	n.s
Function Score	57 ± 19	49 ± 17	n.s
WOMAC	20 ± 12	20 ± 14	n.s
Forgotten Joint Score	46 ± 26	51 ± 26	n.s
12 months post-operation			n.s
ROM (degree)	108 ± 12	110 ± 14	n.s
Knee Society Score	91 ± 11	90 ± 18	n.s
Pain Score	48 ± 3	47 ± 6	n.s
Function Score	58 ± 21	60 ± 22	n.s
WOMAC	19 ± 14	16 ± 12	n.s
Forgotten Joint Score	75 ± 24	82 ± 20	n.s
Satisfaction Score	82 ± 16	85 ± 15	n.s
Preference (%)	28.9	35.6	n.s

ROM range of motion, *WOMAC* Western Ontario and McMaster Universities Score

For patient satisfaction, evidences are scarce and conflicting. The present study might be the first to compare MP TKA with PS TKA in patient satisfaction and showed no difference in satisfaction score (82 vs 85, p = n.s.). Similarly, Nishitani [18] compared MP insert with symmetrical insert on two randomized groups and found no difference in satisfaction and other subsets of Knee Society Score a two years after surgery. The study did not mention whether the posterior cruciate ligament was retained or not. Kim [10] reported a lower proportion of patient being satisfied of MP TKA than mobile-bearing CR TKA (75 vs 93%) in patients with sequential bilateral TKA. Choi [3] retrospectively compared two groups of patients with MP TKA with rotating platform (RP) TKA using Knee Society Satisfaction Score (KSSS) and found inferior outcome in MP TKA. In contrast, Warth [24] used intraoperative sensor to compare TKA with MP kinematic pattern versus non-MP pattern and found superior satisfaction score in TKA with MP pattern. The study also found patient with PS TKA had lower chance of having MP pattern. Similarly Nishio [17] reported superior satisfaction score in MP kinematic pattern using CT-based navigation system. Our result echoed the findings by Nishitani, but had the advantage of comparison between different knees on the same patient.

Forgotten Joint Score (FJS) was also found to be the same for both designs at 6 months and 12 months in the present study. This was in contrast with a retrospective study on two groups of patients by Samy [22] which reported superior FJS in MP TKA than in PS TKA (59 vs 44) at 1 year. The FJS in his study was somehow quite low in both groups. There was no other study reporting FJS as the outcome. The present study might be the second in literature to compare such outcome between MP TKA and PS TKA.

There were no significant differences in other clinical results like the ROM, KSS, KFS and WOMAC. This was consistent with the findings in other comparative studies [1, 3, 18, 24]. Only one of these studies compared MP TKA with PS TKA [1]. The author somehow did not report p-value in the comparison of ROM and knee scores. In contrast, Kim [10, 11] reported inferior results in ROM, KSS and WOMAC in MP TKA but the comparison group was mobile-bear CR TKA. He speculated the reduced range and knee scores was due to the higher constrain in the medial compartment.

There are strength and limitations in the present study. First, patient-report outcome measures (PROM) were used as primary outcome. This is relevant since the kinematic difference in MP TKA might bring about subtle differences which only PROM could detect. Second, it is one of the few studies with comparison of different designs in bilateral TKA. The comparison made on the same patient is particularly important when the primary outcomes are PROM instead of objective clinical measurement. However, because the bilateral TKA were performed in staged manner, the sequence of performance might have affected the result. Also, function score and WOMAC score involved performance of both knees; it would not be easy for patients to chart separate scores for two knees. Another issue was that sample size calculation was not based on FJS which was a secondary outcome in our study. Based on previous study on FJS [22], a sample size of 33 was adequate for a test for an equivalence limit of 5. So the present study was adequately powered to conclude the equivalence between two TKA designs.

Based on the findings of the present study, the choice between MP and PS TKA is still open to surgeons' own preference. Both designs give comparable satisfactory clinical results. Since patient satisfaction is also affected by many other factors apart from implant design, the relative significance and the interplay between different factors may be the direction of future research.

Conclusion

Despite the theoretical advantage in kinematics, there is no evidence to support the superiority of MP TKA over PS TKA in terms of preference and satisfaction. The choice between MP TKA versus PS TKA maybe more a surgeon's preference than a patient's preference based on current evidence. More comparative researches on MP TKA in patients with bilateral TKA are required to resolve the conflicting evidences currently available.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no competing interests.

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