

Comparison of Functional Outcome of Medial Pivot Total Knee Arthroplasty with Posterior Stabilizing (PS) Total Knee Arthroplasty - A Randomized Trial

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ABSTRACT

Background: Despite the wide acceptance of PS Total knee arthroplasty design as an answer to advance osteoarthritis of knee joint, still there are many shortcomings especially in terms of reproducing normal kinematics of the knee joint. Therefore, Medial Pivot TKA system is gaining popularity as it reproduces nearly a normal knee kinematics by pivoting medial condyle of femoral component with a concave medial part of tibial polyethylene insert like ball and socket mechanism.

Methods: A total of 70 patients were included in this study, half of whom underwent Medial Pivot TKR and the other half was managed by PS total knee design. Data was collected preoperatively and postoperatively at 6 months, 1 year and 2 years; from August 2016 till October 2018. Functional outcome was assessed in terms of Knee society score KSS, ROM and Forgotten Joint Score-12 FJS-12.

Results: In our study, male to female ratio was 13:22 and 11:24 in group-A (MP-TKA) and group-B (PS-TKA) respectively. The mean knee flexion at the end of our study was 119.4⁰ +/- 3.16 in group-A and 113.4⁰ +/- 2.47 in group-B. Similarly, FJS-12 was considerably better in group-A (60.08 +/- 16.72) with p-value <0.001 as compared to group-B. Knee society score was comparable in both groups with p-value of 0.180.

Conclusion: We have found better results in the group treated with Medial Pivot TKR in terms of Knee society score KSS, ROM and Forgotten Joint Score-12 FJS-12.

Keywords: Total knee arthroplasty, Medial pivot design, Knee society score.

INTRODUCTION

Knee osteoarthritis is the leading cause of functional disability, usually affecting the elder population¹. It is the pain that results in loss of daily life activity that affects the productivity². Therefore, the aim of treatment in such patients is pain relief and prevention of further disability³. In advance Osteoarthritis, the most common procedure is total knee replacement surgeries and the number of TKR surgeries is expected to increase by more than 600% by 2030². In USA, TKR is the most common orthopaedic surgery to be performed in the recent years for the management of severe osteoarthritis of the knee joint⁴.

Total knee arthroplasty is regarded as the most important procedure for the patients with advance Osteoarthritis to relieve not only pain but also to improve functional outcome [5]. That's why, TKA was done in 87% of patients suffering from advance osteoarthritis in USA in the year 2016⁶. In 1940, the predecessor design of total knee prosthesis was first used⁷. Since then a lot of progress has been made to improve the design, bearing surfaces, and kinematics of total knee prosthesis. The two most common designs that are used these days are either Cruciate retaining (CR) or Posterior stabilizing (PS) designs. Though biomechanics of these two designs are different; yet their preference by surgeons, longevity and durability are comparable⁸.

Those in favor of CR design advocates that there is preservation of bone stock, proprioception and PCL [9]. While on the other hand, it is very difficult to achieve

perfect balance between central pivot and PCL in CR designs [10]. Similarly there are pros and cons of PS TKA design, as well. In 2016, in USA 50% of surgeons preferred PS designs where as 42% preferred CR designs. But there are some disadvantages that are common in both designs. Two important short comings are:

- Reduced `femoral rollback` resulting in reduced range of flexion of the knee^{11,12}.
- Increased anterior sliding of femoral component on tibia during flexion i.e., "Paradoxical motion"¹³.

Because of these points in addition to other; 20% of patients remain dissatisfied postoperatively especially the younger age group requiring cycling or climbing as recreational activities^{14,15}. With the use of modern fluoroscopic investigations, there is a better understanding of knee kinematics during gait cycle and the cause of patient dissatisfaction. In a normal knee, during flexion, Medial femoral condyle pivots in the corresponding concave Tibial plateau like a "Ball and Socket joint". Whereas the lateral femoral condyle slides posteriorly and around the medial femoral condyle, over a convex lateral tibial plateau¹⁶.

Therefore modern TKA implants are being designed keeping in view this normal kinematics of knee joint. One such implant is called Medial Pivot TKA (MP-TKA) implant that was first launched in early 1990's¹⁷. In this implant the medial condyle's curvature is identical in both coronal and sagittal planes like a sphere; whereas lateral condyle is in cylindrical orientation. Also, the Polyethylene insert is asymmetrical with a concave medial compartment that is incongruent with medial femoral condyle of implant and it has anterior and posterior lips that mimic ACL and PCL

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respectively. On the other side, Lateral part of the insert is designed so that lateral condyle can move posteriorly during flexion in a curved path. Thus, almost a normal knee kinematics can be restored with MP-TKA.

In literature, limited work is done so far to check and authenticate the benefits of MP-TKA design. Better patient acceptance and better prognosis is demonstrated in studies by Schmidt et al and Hossain et al^{18,19}. Also there is better stability of implant, reduced polyethylene wear and decreased rate of loosening²⁰. But some authors are of the view that by increasing congruency of medial compartment of MP-TKS means more loading on the medial side that can result in early failure of implant and durability of implant is at risk²¹. So the objective of this study is to compare functional outcome of Medial Pivot total knee design with Posterior Stabilizing (PS) total knee design in our setting with cases operated by two surgeons in the same department.

MATERIALS AND METHODS

After getting approval from hospital’s ethical committee, a total of 70 patients were included in this study. All of them had advance osteoarthritis involving knee joint with either varus or neutral alignment of knee. All patients were aged between 60 and 80 years. Patients with secondary OA after inflammatory arthropathies were also included in this study as well. Patients with co morbidities like Diabetes, Ischemic heart disease, HTN etc.; valgus knee deformities, neglected traumatic fractures or patient with previous knee surgeries were excluded from this study. The duration of our study was 2 years (August 2016 till October 2018) in the Department of Orthopedic Surgery, Lahore General Hospital.

Record of patients who underwent TKA during our study period was obtained from the record room. Two groups were created (Group A and B) on the basis of prosthesis used (ADVANCE Medial-Pivot System (MicroPort Orthopedics) TKA prosthesis in group-A and Zimmer or Johnson & Johnson Posterior Stabilizing PS-TKA prosthesis in group-B). In each group not more than thirty five patients were included, intentionally to avoid bias. Pre-op series of radiographs included standard anterior-posterior and lateral weight-bearing radiographs of the knee joint, a long film radiographs of the lower extremity to calculate mechanical and anatomical axis of the limb, and a Skyline view of patellofemoral joint. All surgeries were

performed with a standard midline skin incision and a medial parapatellar capsulotomy. Intramedullary guiding device was used for distal femoral cut where as extramedullary guide was used for the tibial cut. PCL was resected in all cases. Posterior referencing was used to make anterior and posterior and chamfer cuts in all cases. The most obvious difference between two procedures was the removal of bone from distal femur to accommodate Post-cam mechanism in the case of PS-TKA prosthesis while no such removal of bone was required in MP-TKA. Intraoperative ROM, flexion extension gaps and patellofemoral tracking was checked with trial components. In all cases Patellar osteophytes were removed and denervation was done.

All patients followed an identical standard postoperative rehabilitation protocol including weight bearing as tolerated with crutches on postoperative day 1, and clinical improvements was assessed preoperatively and at 6-months, 1-year and 2-years after surgery using the Knee Society Score (KSS), Forgotten Joint Score-12 and range of motion of knee joint.

RESULTS

All statistical analyses were performed using SPSS version 20.0. A p-value ≤ 0.05 was taken as significant. In our study, there was thirteen males and twenty two females in Group-A, whereas, there was 11 males and 24 females in group-B (fig.1). The mean age of patients in group-A was 68.5 years with a range from 65 years to 73 years. In group-B the mean age was 68.6 years with a range of 65 years to 71 years.

At the time of final follow up, Forgotten Joint Score-12 was significantly higher in Group-A, who underwent Medial Pivot total knee arthroplasty in comparison to PS-TKA group (60.08 +/- 16.72 in Group-A vs. 47.60 +/- 20.9 in group-B). Similarly mean range of flexion was better in Group-A (119.4⁰) as compared to Group-B (113.4⁰) (Table.1 and 2).

But Knee Society Score was nearly comparable in both groups (89.2 +/- 1.72 and 88.8 +/- 2.59 in group-A and Group-B respectively) (Table.1 and 2). The probability value (p-value) was <0.001 with 95% confidence interval when FJS-12 and Range of motion was compared in the two groups but in the case of KSS p-value was >0.05 which was insignificant (Table 3).

Table 1: Descriptive Statistical Data of Group-A (MP-TKA)

	N	Minimum	Maximum	Mean	Std. Deviation
Age of patients	35	65.00	73.00	68.8571	2.66947
FJS12 score	35	35.00	80.00	60.0857	16.72682
KSS	35	87.00	92.00	89.2000	1.72865
Flexion in degrees	35	115.00	124.00	119.4000	3.16414
Valid N (list wise)	35				

Table.2 Descriptive Statistical Data of Group-B (PS-TKA)

	N	Minimum	Maximum	Mean	Std. Deviation
Age of patients	35	65.00	71.00	68.6000	2.08919
FJS12 score	35	23.00	74.00	47.6000	20.95541
KSS	35	85.00	92.00	88.8000	2.59864
Flexion in degrees	35	110.00	117.00	113.4286	2.47678
Valid N (listwise)	35				

Table.3 One sample t- test

	Df	Df	Sig. (2-tailed) (p-value)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
FJS12 score	4.416	34	.000	12.48571	6.7399	18.2316
KSS	1.369	34	.180	.40000	-.1938	.9938
Flexion	11.218	34	.000	6.00000	4.9131	7.0869

Fig.1 Distribution of Gender

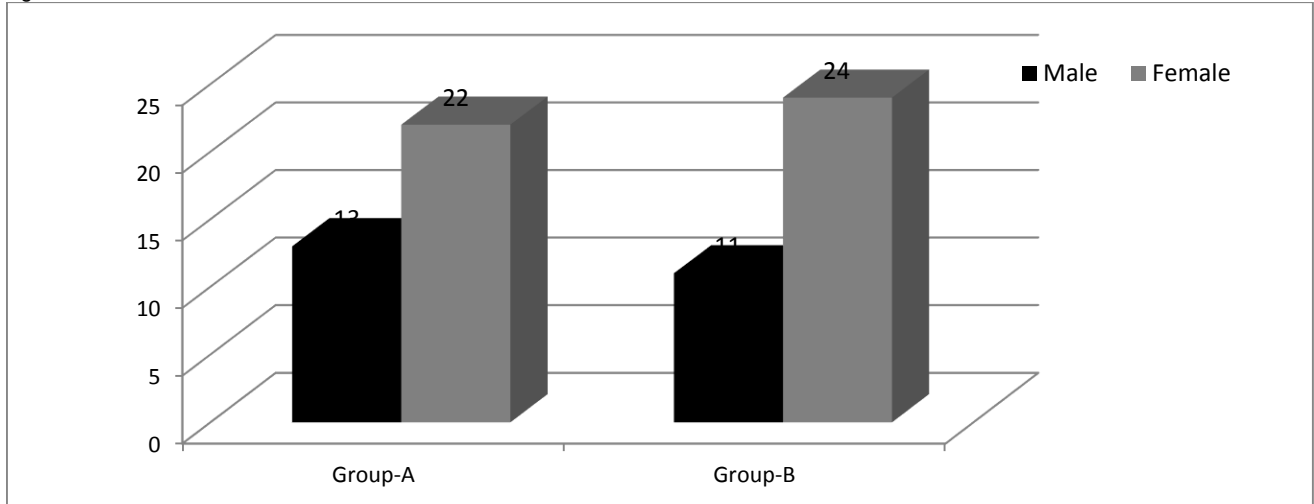
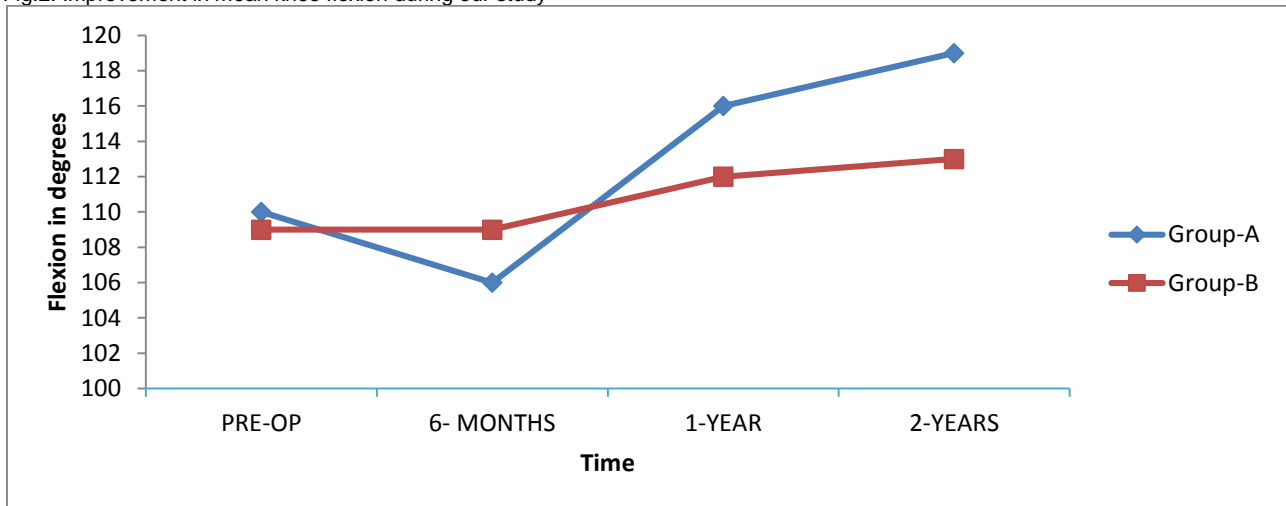


Fig.2: Improvement in mean knee flexion during our study



DISCUSSION

Theoretically MP-TKA seems to be a better option when it comes to the improvement of Range of motion, as its kinematics is like that of a normal knee. It has a medial congruent compartment with a concave PE insert and a less congruent lateral part of PE insert, allowing lateral condyle to move in anteroposterior direction during flexion and extension and also in arcuate plan around medial condyle of femoral component.. On one hand, there are studies which shows no significant difference in knee flexion e.g. Shakespeare et al [22]. In his study the mean knee flexion in MP-TKA group was 111° as compared to PS-TKA group which was 109° which is statistically not significant. But there are several studies which show

improvement in ROM after MP-TKA in comparison to PS-TKA. In a study by Cheng-Yu Fan et al²³, the mean knee flexion was 115.4°. In our study, we were able to achieve even better flexion of knee (119.4°) after MP-TKA. This increase of flexion is also documented by Macheras GA et al [24]. In his study, the mean knee flexion after MP-TKA was 120°.

The questionnaires, our study included were Knee society score (KSS) and Forgotten Joint Score-12 (FJS-12). The reason is that, these days patients are usually involved in high demand activities even after total knee arthroplasties and Knee society score includes all these parameters. Forgotten Joint Score-12 has been used in several studies [25]. Moreover this questionnaire is based on patient’s perception regarding awareness of artificial

knee while doing various activities. We got a better FJS-12 score in group-A(Mean= 60.08) as compared to group-B(Mean= 47.6) because MP- prosthesis restore normal knee kinematics especially during standing from sitting position, because one of the major cause of patient dissatisfaction after PS-TKA is mid-flexion instability that hampers patient to extend his knee from maximum flexed position of knee²⁶.

There are several studies in which the mean KSS was in excellent range after MP-TKA²⁷, and these scores are comparable to KSS in PS-TKA. This was the case in our study as well. Knee Society Score in group-A was 89.2 +/- 1.72 and 88.8 +/- 2.59 in group-B which is comparable. This can be because KSS does not include activities like squatting and kneeling and these positions can be better achieved by MP-TKA designs [28]. Scott et al pointed out that inability to perform these movements after traditional TKA results in higher rate of dissatisfaction among patients²⁹.

CONCLUSION

In summary, we have found MP-TKA a better choice than PS-TKA in terms of knee flexion and patient satisfaction. Efforts are being made to design prosthesis which mimics normal knee kinematics and MP-TKA is one such design. But a long term follow up is required to judge the survivorship, wear and tear, loosening etc. of this design.

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