

Comparison of High Flex Posterior Stabilized Implant (PS TKR) and Medial Pivot Implant (MP TKR) in Total Knee Arthroplasty with Respect to Knee Range of Motion, A Short Term Study

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ABSTRACT

Background: Osteoarthritis of the knee is the most common cause of functional impairment in the elderly. A complete knee arthroplasty is the most common knee operation for patients with advanced osteoarthritis. A complete knee arthroplasty is a surgical procedure that is used to treat osteoarthritis in its most severe form.¹ Rheumatoid arthritis, advanced degenerative arthritis, and other forms of this type of osteoarthritis fall under this category. This way of treating different types of arthritis is both highly successful and completely risk-free. MP-TKR and PS-TKR designs have been proven to be beneficial only through a little amount of research so far. So, the aim of this study was to compare the mean range of motion by using two different types of implants i.e. high flexed posterior stabilized implant and medial pivot implant.

Objectives: To compare the mean range of motion, in patients with advanced arthritis, treated with total knee arthroplasty, by using two different types of implants i.e. high flexed posterior stabilized implant and medial pivot implant.

Study design: It is Randomized Comparative Trial.

Setting: Department of Orthopedic Surgery at Shifa International Hospital, Islamabad.

Subjects: A total of 62 patients were included in our study, which is divided into 2 groups, comprising of 31 patients in each group.

Methods: The hospital's ethical review committee gave permission to this research, so it could proceed. These patients was kept in two groups on the basis of implant used i.e. PS TKR group and MP TKR group. Patient demographics and clinical history was taken by the principal investigator. All patients was undergo total knee replacement surgery using either posterior stabilized implants or medial pivot implants. All surgeries was performed by experienced orthopaedic surgeons having experience from 10 years to 30 years. Patients was discharged from hospital at 5th postoperative day after change of dressing and was called for follow up at 2 weeks during which post-operative knee range of motion was assessed. Knee range of motion was measured using goniometer with patients supine. The patient's data was analyzed with SPSS Version 23, a statistical software package for social sciences. For quantitative data, we utilized mean standard deviations, while for qualitative data, we used frequencies. If the probability was less than 0.05, it was significant.

Results: The mean age of the patients in PS TKR was 66.35 ± 6.21 and in MP TKR was 64.74 ± 5.35 . In our study 24 (38.7 %) were male and 38 (61.3 %) were female. The pre-operative ROM in PS TKR was 112.71 ± 1.79 and in MP TKR implant was 120.52 ± 1.46 . The post-operative ROM in PS TKR implant was 109.13 ± 0.81 and in MP TKR was 109.00 ± 0.82 . There is no significant difference in post-operative ROM in between the implant (PS TKR and MP TKR) as the p value is less than level of significance.

Conclusions: We concluded that there is no difference in post-operative range of motion in patients who have undergone PS-TKR or MP-TKR.

INTRODUCTION

Osteoarthritis of the knee is the most common cause of functional impairment in the elderly. The pain that makes it difficult to carry out the chores of daily life is what hinders productivity. Consequently, the goal of treatment is to alleviate discomfort and avoid further deterioration of their health problems⁽¹⁾. If you have osteoarthritis, you are most likely to have total knee replacement surgery, which will increase in popularity by more than 600 percent by the year 2030.⁽²⁾

Total Knee arthroplasty is a surgical intervention used for treatment of osteoarthritis in advanced stage whether advanced degenerative arthritis or rheumatoid arthritis and is found highly effective and a safe procedure⁽³⁾. The procedure greatly reduces pain and restore knee joint function. Use of TKA is increasing proportionately with increase in prevalence of arthritis in aging population⁽⁴⁾.

Unicompartmental knee arthroplasty is also being used as a treatment option for functional recovery of knee joint and pain reduction however the procedure is utilized for end stage arthritis that is localized to a single compartment of knee⁽⁵⁾.

A study conducted in 2017 compared the outcomes of mobile bearing and fixed bearing total knee arthroplasty and showed that there is no difference in outcomes of the two procedures with respect to insert wear, joint survivorship, risk of loosening or clinical outcomes⁽⁶⁾.

A study published in 2018 examined the patient satisfaction and range of motion (ROM) before and after surgery for posterior

stabilized implant TKR and medial pivot implant TKR. Both before and after surgery were examined in the study. There was no statistically significant difference in range of motion after surgery at the six-week, six-month, or one-year time points, according to the data. On the other hand, patients who received MP-TKA did much better on the FJS-12 than those who received P-TKA. There was a statistically significant difference between the two groups⁽⁷⁾.

A randomized comparative trial done in 2019, compared the early outcomes of PS-TKR and MP-TKR. This study shows that patients who have undergone MP-TKR had significantly better gain in knee flexion (mean range of motion 119.40 ± 3.16), as compared to PS-TKR group (mean range of motion 113.43 ± 2.47)⁽⁸⁾.

Several researches have been done in the past to compare or analyze the outcomes of different types of knee arthroplasties based upon physician-assessed clinical outcomes, patients' satisfaction, post-operative range of motion, joint survivorship, radiographic improvement and complication rates.

In order to compare an MP configuration to a mobile PS knee, Kim et al.⁽⁹⁾ and Kim et al.⁽¹⁰⁾ used a knee with an ultra-congruent rotating platform.⁽¹¹⁾

Our study was specifically focus on comparison of High flex posterior stabilized implant and medial pivot implant in TKA with respect to post-operative range of motion.

In literature, limited work is done so far to check and authenticate the benefits of MP-TKA design and PS-TKA design. So the objective of this study was to compare the mean range of

motion (active movement ranging from full extension to possible flexion at knee joint) in patients with advanced arthritis, treated with total knee arthroplasty, by using two different types of implants i.e. high flexed posterior stabilized implant and medial pivot implant.

METHODOLOGY

It was a Randomized Comparative Trial conducted in the Department of Orthopedic Surgery at Shifa International Hospital, Islamabad. Duration of study is 6 months. Using WHO calculator, sample size was calculated to be 60, which is divided into 2 groups, comprising of 30 patients in each group. Level of significance is 5%, power of test was kept at 90% and population standard deviation is 2.815. Test value of population mean was 113.43⁽⁶⁾, whereas the anticipated population mean was 119.40⁽⁸⁾.

To adjust 5 percent loss to follow up, a total of 62 patients, comprising of 31 patients in each group were taken.

After the hospital's ethics committee gave the go-ahead, this study was carried out. The Orthopedic Surgery Department at Shifa International Hospital in Islamabad accepted patients with advanced knee arthritis who satisfied the study's criteria. It was necessary to elicit agreement or consent or both verbally and in writing. These patients were divided into two groups after a lottery method was used to draw a number. Division into two groups was on the basis of the implant used i.e. PS-TKR group and MP-TKR group. Patient demographics and clinical history was taken by the principal investigator.

Before surgery every patients were assessed for knee range of motion which was documented. All patients undergo total knee replacement surgery using either posterior stabilized implants or medial pivot implants.

All surgeries were performed by experienced orthopaedic surgeons having experience from 10 years to 30 years. Physiotherapy including knee range of motion, muscle strengthening exercises and weight bearing exercises were carried on from first postoperative day and advised to continue in home.

Patients were discharged from hospital at 5th postoperative day after change of dressing and was called for follow up at 2 weeks during which post-operative knee range of motion will be assessed and was compared between two groups. A goniometer was used to gauge the patient's knee's range of motion while he was lying on his back. The patient's data was collected and analyzed with the help of SPSS Version 21. It was decided to display quantitative data (such as age and range of motion) using mean standard deviations, whereas frequency charts were utilized to display qualitative data (such as gender and kind of arthritis). Age, gender, BMI, and kind of arthritis are just a few of the variables that have been stratified for this study's findings. The mean range of motion was compared between two groups using the t-test. The significance of a p-value less than 0.05 was considered.

RESULTS

The objective of this study was to compare mean range of motion (active movement ranging from full extension to possible flexion at knee joint) in patients with advanced arthritis, treated with total knee arthroplasty, by using two different types of implants i.e. high flexed posterior stabilized implant and medial pivot implant.

The mean age of the patients in PS TKR was 66.35 ± 6.21 and the mean age of the patients in MP TKR was 64.74 ± 5.35. The overall mean age of the patients in our study was 65.55 ± 5.80.

In PS TKR implants 13 (41.9 %) were male and 18 (58.1 %) were female and in MP TKR 11 (35.5 %) were male and 20 (64.5 %) were female. In our study 24 (38.7 %) were male and 38 (61.3 %) were female.

The mean value of BMI in PS TKR implants patients was 30.42 ± 2.71 and in MP TKR was 29.35 ± 2.90. The overall BMI for the patients was 29.89 ± 2.83 in our study.

The results of pre-operative ROM was showed that in PS TKR implant the mean value was 112.71 ± 1.79 and in MP TKR implant the mean value was 120.52 ± 1.46.

The results of post-operative ROM was showed that in PS TKR implant the mean value was 109.13 ± 0.81 and in MP TKR implant the mean value was 109.00 ± 0.82.

In our study in PS TKR patients 27 (87.1 %) had unilateral TKR and 4 (12.9 %) had bilateral TKR. In MP TKR implants patients 27 (87.1 %) had unilateral TKR and 4 (12.9 %) had bilateral TKR.

The results of independent sample t-test showed that there is no significant difference in post-operative ROM in between the implant (PS TKR and MP TKR) as the p value is less than level of significance.

Table 1: Results of age

Type of Implant Used	N	Mean	Std. Deviation
PS TKR	31.00	66.35	6.21
MP TKR	31.00	64.74	5.35
Total	62.00	65.55	5.80

Table 2: Results of gender

Gender	Type of Implant Used		Total
	PS TKR	MP TKR	
Male	13	11	24
	41.9%	35.5%	38.7%
Female	18	20	38
	58.1%	64.5%	61.3%
Total	31	31	62
	100.0%	100.0%	100.0%

Table 3: Results of BMI

Type of Implant Used	N	Mean	Std. Deviation
PS TKR	31.00	30.42	2.71
MP TKR	31.00	29.35	2.90
Total	62.00	29.89	2.83

Table 4: Results of pre-operative ROM

Type of Implant Used	N	Mean	Std. Deviation
PS TKR	31.00	112.71	1.79
MP TKR	31.00	120.52	1.46
Total	62.00	116.61	4.26

Table 5: Results of post-operative ROM

Type of Implant Used	N	Mean	Std. Deviation
PS TKR	31.00	109.13	0.81
MP TKR	31.00	109.00	0.82
Total	62.00	109.06	0.81

Table 6: Results of total knee arthroplasty

Knee Arthroplasty	Type of Implant Used		Total
	PS TKR	MP TKR	
Unilateral TKR	27	27	54
	87.1%	87.1%	87.1%
Bilateral TKR	4	4	8
	12.9%	12.9%	12.9%
Total	31	31	62
	100.0%	100.0%	100.0%

Table 7: Results of independent sample t-test comparison in post-operative ROM

Type of Implant Used	N	Mean	Std. Deviation	t test	p value
PS TKR	31.00	109.13	0.81	0.626	0.534
MP TKR	31.00	109.00	0.82		

DISCUSSION

The goal of this study was to compare the average range of motion (ROM) of TKA patients who had the PS-design versus the MP-design. A total of 62 people took part in our study, which was divided into 31 groups.

Patients with severe osteoarthritis often consider total knee arthroplasty (TKA) to be the most helpful surgical procedure since

it reduces pain and improves function⁽⁸⁵⁾. Because of this, 87 percent of people in the United States with advanced osteoarthritis received complete knee arthroplasty in 2016.⁽⁸⁶⁾

It was in 1940 that the first people began to use knee prostheses that had been developed prior to it. Total knee prostheses have undergone a lot of improvement since their introduction in the 1970s. Newer materials have enabled these enhancements. Both the medial pivoting (MP) and posterior stabilizing are the most popular designs (PS). Despite the fact that their biomechanics are fundamentally different, surgeons find both of these designs appealing.⁽²⁾

Patients getting PS TKR were on average 66.35 years old, while those undergoing MP TKR were on average 64.74 years old, according to our data. Thirteen male patients (41.9 percent) received PS TKR implants, while 18 female patients received the procedure (58.1 percent). The MP TKR implants treated 11 men (35.5% of the total) and 20 women (80%). (64.5 percent). PS TKR patients had a BMI of 30.42 2.71, whereas patients who had MP TKR implants had a BMI of 29.35 2.90 on average.

Researchers observed that while the MP-TKR group comprised 13 men and 22 women, the PS-TKR group had only 11 men and 24 women. (2) In the patients who received MP-TKR, the average age was 68.5 years old, with the range going from 65 to 72 years old. Ages in PS-TKR varied from 65 to 71, with an average of 68.6 years among those who took part in the study. These findings also match with the results of this study

In our study, the pre-operative ROM in PS TKR implant was $112.71^\circ \pm 1.79$ and in MP TKR implant was $120.52^\circ \pm 1.46$. The results of post-operative ROM in PS TKR implant was $109.13^\circ \pm 0.81$ and in MP TKR implant was $109.00^\circ \pm 0.82$.

Gender, age and BMI were not significantly different between the two groups, which was consistent with the findings of our study⁽⁷⁾.

According to this study⁽⁷⁾, the difference in ROM before surgery (PS = 112.8° , MS = 120.3° , $p = 0.002$) is also significant. Over a period of six weeks ($p = 0.066$), six months ($p = 0.182$), or one year, there was no discernible difference (0.499). Our own findings are in agreement with these results.

After one year of follow-up, Shakespeare et al. (1987) found that the average flexion angle in the PS group was 109 degrees, while it was 111 degrees in the MP group ($P = .110$).

Continued efforts are being made to find a knee design that mimics a patient's natural knee, is capable of withstanding a lengthy amount of time, and can adapt to the needs of the patient's age as they grow older. Many people are still disappointed with TKA despite the fact that the method has improved in every way⁽⁸⁸⁾.

According to the Tolk study⁽⁷⁰⁾, 20% of patients were still unsatisfied with their surgical outcomes. Younger patients who wanted to participate in recreational activities such as climbing or cycling were particularly affected by this. We are encouraged by these findings, which appear to be in line with what we learned from satisfaction.

The results of this study showed that there is no difference in post-operative ROM in between the implant (PS TKR and MP TKR). The study⁽⁷⁾ also found similar results like our study results that there is no significant difference in ROM after operation in between PS TKR and MP TKR.^(87, 89)

In literature there also some studies that compare PS TKA and MP TKA outcomes in the form of "WOMAC, SF-36, Knee Society Score (KSS), and Oxford Knee Score". In our study we compared in the form of range of motion after operation.

Considering the MP-kinematics TKA's are similar to those of a conventional knee, it may appear to be the better option for increasing a patient's range of motion from a theoretical standpoint. In the medial compartment, there is a concave polyethylene insert, and on the side, there is a less congruent polyethylene insert. According to Shakespeare et al's research the lateral condyle of the femoral component can migrate in an arcuate pattern around the medial condyle because of this.

Based on the patients outcomes regarding safety and radiographic there are some studies that compared PS and MP implants designs. In a study by Samy et al. described that the patients used MP TKR showed significant results than the patients of PS TKR in the form of forgotten joint score but similar results in ROM⁽⁷⁾. Yuan et al. also compared the patients of MP-TKA and PS-TKA and just also concluded that MP-TKA is effective and safe procedure for the patients in China⁽⁹⁰⁾.

There are some studies in available literature that found in these two designs there is no significant difference in term of clinical results. In an retrospective study Lin et al.⁽⁹¹⁾ conclude similar results. Lee et al.⁽⁹²⁾ also described that the outcome of PS TKA and MP TKA were similar in the form of satisfaction and preference.

There are also two studies^(89, 90) which compare the outcome of PS and MP implant in TKR in the form of range of motion and find no significant difference.

In another study⁽⁹³⁾ which was conducted in Chinese community to compare the mid and long term effects (clinical) of MP TKR and PS TKR after complete knee arthroplasty were studied to provide a reference for clinical prostheses recommendation. The mid and long term clinical findings of TKA with PS or MP in Chinese patients are good, with no major variations between the two forms of prostheses. Both prostheses have also been shown to be healthy for Chinese patients in studies.

Our research compared the outcomes of these two implants designs, the MP knee, to the traditional PS knee. By creating a near constant femoral part radius to mimic normal knee kinematics, these designs were designed to improve stability and minimize wear. We find in our study no significant difference in these two implant methods.

CONCLUSION

We concluded that there is no significant difference in post-operative range of motion in patients who have undergone PS-TKR or MP-TKR. But a long term follow up is required to judge the survivorship, wear and tear, loosening etc. of these designs and we also recommend in future studies will need to include larger sample size to get more accurate results.

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