

# Comparison of Fixed-Bearing and Mobile Bearing Total Knee Arthroplasty in and around Kanchipuram Population

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## Abstract

**Aim and Background:** The aim of the present study was to analyze the functional and radiological outcome between mobile bearing total knee arthroplasty and fixed bearing total knee arthroplasty in and around Kanchipuram population. Total knee arthroplasty has grown on a significant high rise during the past 40 years, due to the change in lifestyle and increase in medical ailments. This has led to advanced degenerative joint disease of the knee which has deprived the function of the normal knee. Various factors have changed the modality of treatment in degenerative Osteo arthritis of the knee joint. During this course of treatment conservative management could not play a role beyond preservation of the knee joint. **Materials and Methods:** This is a Prospective comparative study. The study was carried out during the period of one year. It included a total of thirty patients, who underwent Total knee arthroplasty in our department of orthopaedics at Meenakshi Medical College Hospital and Research Institute, Kanchipuram. In the present study was divided into two groups each group consist of fifteen patients. Group-I as a Mobile bearing system and Group-II as a Fixed Bearing system. **Results:** In our study the mobile bearing and fixed bearing prosthesis showed a significant difference in the functional outcome and restoration of joint line with a minimal change in the radiological outcomes also. **Conclusion:** During this course of treatment conservative management could not play a role beyond preservation of the knee joint. Considering this fact, a new evolution of total knee arthroplasty will be evolved, there by relieving the pain, improvement in the function of the knee joint as well as leading a good quality of life.

**Keywords:** Total knee arthroplasty, Mobile Bearing, Fixed Bearing.

## I. INTRODUCTION

Total knee arthroplasty has grown on a significant high rise during the past 40 years, due to the change in lifestyle and increase in medical ailments. This has led to advanced degenerative joint disease of the knee which has deprived the function of the normal knee 1.

Various factors have changed the modality of treatment in degenerative Osteo arthritis of the knee joint. During this course of treatment conservative management could not play a role beyond preservation of the knee joint. Considering this fact, a new evolution of total knee arthroplasty has been evolved, there by relieving the pain, improvement in the function of the knee joint as well as leading a good quality of life<sup>2</sup>.

In view of this successful joint replacement surgery multiple factors play a role in modifying the outcome of the surgery. Hence those factors had to be dealt in detail during the course of multiple researches.

Several research studies have been made in total knee arthroplasty. In most of these studies two categories of devices have been consistently used to maintain the normal anatomical and kinematic function of the knee joint 2. Namely; a) Fixed bearing knee prosthesis b) Mobile bearing knee prosthesis.

Theoretical studies of these implants have shown various disadvantages such as contact stress, polyethylene wear, and the risk of implant loosening. Hence the need to study the longevity of those implants have a pivotal role in the development of prosthesis.<sup>5</sup> Fixed bearing prosthesis are designed with polyethylene tibial insert locked with tibial tray and mobile bearing

prosthesis are designed to facilitate the movement of the insert relative to the tray<sup>3,4</sup>.

Our study helps to analyze and compare the outcome of both the prosthesis functionally and radiologically.

## II. Materials and Methods

After due registration and permission from the ethical committee, the study was carried out during the period between August 2019 – September 2021. The follow up period was on an average 12 months. It included a total of thirty patients, who underwent Total knee arthroplasty in our department of orthopaedics and traumatology at Meenakshi Medical College Hospital and Research Institute. Fifteen patients were treated with mobile bearing system and another fifteen treated with fixed bearing system. All the thirty patients were on regular follow-up after surgery.

### Inclusion criteria

Patients suffering from primary osteoarthritis with severe pain, disability and mild deformity were selected for the treatment of Total Knee Arthroplasty with Mobile bearing prosthesis and fixed bearing prosthesis.

### Exclusion criteria

Patients with following criteria were excluded from the study to avoid problems in assessing the functional outcome. They are as follows:

Need for replacement of patella.

Patients who had undergone or needed ipsilateral total hip replacement surgery.

TKR needed for other indications like post-traumatic or post-septic sequelae

Patients with inflammatory polyarthritis causing disability.

### Preoperative check-list

Includes routine investigations like Complete blood count, Erythrocyte Sedimentation Rate, Random blood sugar, Blood urea, Serum creatinine, Rheumatoid factor, Chest X-ray, ECG, Blood Borne Virus Sampling (BBVS), C-Reactive Protein, ASO titre. Plain antero-posterior radiograph of both knees in standing position. Plain lateral radiograph of both knees.

Informed consent was obtained from all the patients and prophylactic antibiotics given preoperatively after test dose. Patients were evaluated for foci of sepsis from all the respective departments and assessment was obtained. Patients were operated under spinal / epidural / general anaesthesia, based on assessment by our anaesthetist.

### Surgical technique

Patient in supine position, under tourniquet control, a midline skin incision was made by a medial parapatellar approach for the eversion of the patella. Anterior Cruciate Ligament, Posterior Cruciate Ligament and both the menisci were removed to perform a posterior cruciate substituting Total Knee Arthroplasty. Ligament balancing was done before the bone resection. With 5° of valgus to anatomical axis, a distal femoral cut was made perpendicularly in the sagittal plane followed by anteroposterior cut, Chamfer cut, Femoral notch cut and Tibial notch cut. Sizing was done after the tibial cut which was taken at 90° to the long axis and posterior sloping at less than 5°. Trial implants were inserted after checking the flexion and extension gaps. Stability of the joint was checked and found to be satisfactory.

Then the original implants of required size were fixed with cement. Patelloplasty was done. Wound closed in layers with drain in situ.

### Management protocol

### Postoperative rehabilitation

Intravenous antibiotics were given in the next 48 hrs postoperatively and then changed to oral antibiotics. On the first postoperative day the patient was made to ambulate with the help of walker and long knee brace. Passive ankle exercises are advised to prevent deep vein thrombosis.

On the second postoperative day the wound was inspected and epidural catheter and drain was removed. DVT prophylaxis was given in the form of low molecular weight heparin for three days from the second post-operative day, followed by Tablet Ecospirin 150 mg for next 4 weeks. Ambulation with support (walker or crutches) was started from fourth post operative day. By fifteenth postoperative day, patients were advised to climb stairs with support. Patients were advised to discontinue crutches use by 6 weeks. Patient will be asked for a review for every 1 month, 3 months, 6 months and 1 year.

### Survivorship Analysis

Survivorship analysis for mobile bearing in designer series had a 10 year survival rate of 98% 5,6. In designer series for fixed bearing posterior stabilized survivorship analysis showed 96.4% in 10 years follow-up<sup>7</sup>. For mobile bearing, individual authors have reported a survivorship ranging from 95% to 100% in 11 to 12 year follow up. Durable long-term fixation has also been documented for many designs of fixed bearing total knee replacement by individual authors<sup>8</sup>.

The clinical results are influenced by surgical technique. The goal of primary total knee arthroplasty is to re-establish the normal mechanical axis with stable prosthesis that is well fixed. This is achieved by both the bone resection and the soft tissue balance.

## III. Results

After applying the inclusion and exclusion criteria, A total of 30 patients had undergone total knee replacement out of which fifteen were treated using mobile bearing prosthesis and the remaining fifteen patients with the fixed bearing prosthesis between the years 2019 and 2021. (Table 1.1)

### Age Distribution

Majority of the age groups falls between 55 to 65 years, 65 to 75 years (33.33% each) (Table.1.1)

**Table 1.1:** Age Distribution of Patients

AGE GROUP	NUMBERS	PERCENTAGE
45-55	4	13.3%
55-65	10	33.33%
65-75	10	33.33%
75-85	6	20%

Of the 30 patients male constitute upto thirteen patients and females constitute seventeen patients (Table 1.2)

**Table 1.2:** Sex Distribution of the patients

Patient Sex	Total No of Patients	Percentage
Male	13	43.3%
Female	17	56.6%
Total	30	100%

Among these 30 patients, 15 patients had Mobile bearing prosthesis and 15 patients had Fixed bearing prosthesis (Table 1.3, 1.4)

**Table 1.3:** Patient Demographic Data

Variables	Mobile Bearing	Fixed Bearing
Number of patients operated	15	15

Number of knees operated	15	15
Mean age (in years)	57 years (45-71 years)	60.46 years (45-73 years)

**Table 1.4.** Distribution of patients who underwent Mobile bearing prosthesis TKA and Fixed bearing prosthesis TKA

SEX	MOBILE BEARING PROSTHESIS		FIXED BEARING PROSTHESIS	
	RIGHT	LEFT	RIGHT	LEFT
Male	4	2	3	4
Female	5	4	5	3
Total	15		15	
Percentage	50 %		50 %	
Grand Total	30			

Pre-and post-operative American knee society grading for Functional outcome of mobile bearing prosthesis: (Table 1.5)

**Table 1.5:** Functional outcome of American knee society score in mobile bearing group

Grade	Preoperative mean American knee society grading Mobile Bearing Prosthesis		Postoperative mean American knee society grading Mobile Bearing Prosthesis	
	Number of knees	%	Number of knees	%
	Excellent	00	0.0	06
Good	00	0.0	08	53.3
Fair	00	0.0	01	6.66
Poor	30	100	00	0.0

Pre-and post-operative for Oxford knee Score for subjective outcome of mobile bearing prosthesis (Table 1.6)

**Table 1.6:** Functional outcome of Oxford knee score in mobile bearing group

Score	Preoperative mean Oxford knee Score Mobile Bearing Prosthesis		Postoperative mean Oxford knee Score Mobile Bearing Prosthesis	
	Number of knees	%	Number of knees	%
0-19	25	83.3	00	0.0
20-29	05	16.6	00	0.0
30-39	00	0.0	15	100
40-48	00	0.0	00	0.0

Pre-and post-operative American knee society grading for Functional outcome of Fixed bearing prosthesis (Table 1.7)

**Table 1.7:** Functional outcome of American knee society score in fixed bearing group

Grade	Preoperative mean American knee society grading Fixed Bearing Prosthesis		Postoperative mean American knee society grading Fixed Bearing Prosthesis	
	Number of knees	%	Number of knees	%
Excellent	00	0.0	04	26.6
Good	00	0.0	11	73.3
Fair	00	0.0	00	0.0
Poor	30	100	00	0.0

Pre-and post-operative for Oxford knee Score for subjective outcome of Fixed bearing prosthesis (Table 1.8)

**Table 1.8:** Functional outcome of Oxford knee score in fixed bearing group

Score	Preoperative mean Oxford knee Score Fixed bearing prosthesis		Postoperative mean Oxford knee Score Fixed bearing prosthesis	
	Number of knees	%	Number of knees	%
0-19	25	83.3	00	0.0
20-29	05	16.6	00	0.0
30-39	00	0.0	15	100
40-48	00	0.0	00	0.0

#### RANGE OF MOVEMENT

The mean preoperative range of movement in the Mobile bearing group was  $65.50^{\circ} \pm 10.4^{\circ}$ . This showed an improvement to a mean flexion of  $100.26^{\circ} \pm 13.9^{\circ}$  post operatively. The mean preoperative range of movement in the Fixed bearing group was  $70.68^{\circ} \pm 5.0^{\circ}$ . This showed an improvement to a mean flexion of  $110.2^{\circ} \pm 14.8^{\circ}$  post operatively (Table 1.9)

**Table 1.9** Range of movements

TYPE OF FIXATION	MEAN	
	Pre-Operative ROM	Post-Operative ROM
Mobile bearing System	$65.50^{\circ} \pm 10.4^{\circ}$	$100.26^{\circ} \pm 13.9^{\circ}$
Fixed bearing System	$70.68^{\circ} \pm 5.0^{\circ}$	$110.2^{\circ} \pm 14.8^{\circ}$

#### RADIOGRAPHIC RESULTS

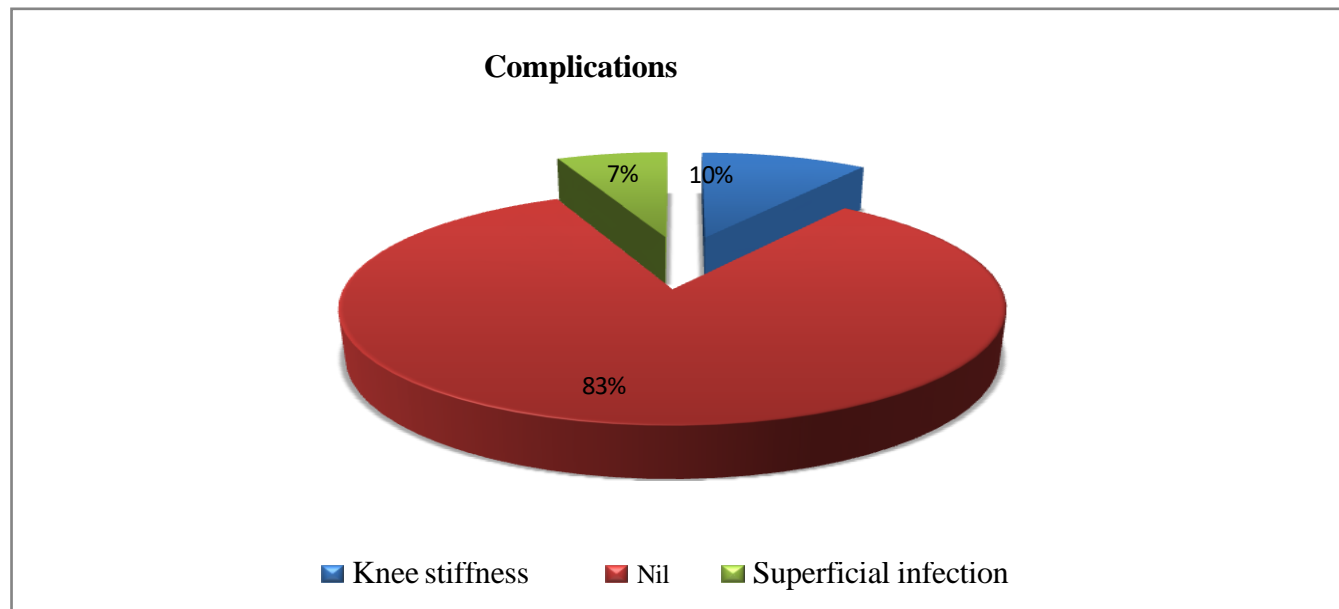
The mean change in joint line was calculated using the Figgie et al method was  $3.63 \pm 1.74$ mm in the mobile bearing group and  $2.28 \pm 0.94$  mm in the fixed bearing group and. This difference was found to be significant

The change in the joint line for each patient was correlated with the post-operative range of movement. The fixed bearing group showed significant correlation indicating that any significant alteration in the joint line affected the post-operative range of

movement. Conversely, in the mobile bearing group the change in the joint line did not show any correlation with the post-operative range of movement.

## COMPLICATIONS

Out of 30 patients, two patients in mobile bearing group developed superficial infections who are treated conservatively with intra venous antibiotics and were recovered in two weeks. Three patients in fixed bearing group developed knee stiffness and was instigated physiotherapy and gradually achieved full range of movements.



Multiple studies over the past decade owing to primary osteoarthritis of the knee had led to some increased lifestyle modifications but still a complete remedy has not been achieved by conservative management. This has led to a series of surgical management for osteoarthritic knee. Better results have been obtained by total knee replacements.

The use of total knee prosthesis for osteoarthritic knee has played a significant role in improvement of the quality of the patient's life. Hence the need for detailed study of this prosthesis has played a pivotal role in the outcome of management of osteoarthritic knee.

We have considered two types of prosthesis; one is mobile bearing prosthesis which has a polyethylene insert which can be fixed to the tibial plateau and has a freedom of rotation and allows the femoral roll back antero posteriorly. This kind of prosthesis is more like that of a natural knee. Another one is of fixed bearing prosthesis which has a posterior post there by allowing femoral condyle in only antero posterior movement.

However, studies comparing outcomes of mobile bearing prosthesis and fixed bearing prosthesis of total knee arthroplasty designs have found no difference in survivorship, clinical functions (rotation, flexion and extension), or patient preference 28,29.

Our sample size consists of thirty patients, of which four are aged from 45 to 55 years (13.3%), Ten are aged from 55-65 years (33.33%), another ten are from 65 -75 years (33.33%) and six are aged from 75 -85 (20%).

Out of thirty patients thirteen were male (43.3%) and seventeen were females (56.6%).

Those patients who were operated with mobile bearing and fixed bearing prosthesis has a subsequent follow up for one month, three months, six months and one year

Their improvements were studied using an objective and subjective scoring systems such as American knee scoring system and an oxford knee scoring system. The follow-up results for mobile bearing knee based on American knee society showed an excellent score of 40%, Good score of 53.3%, And a fair score of 6.66%.

Similarly, oxford knee score for mobile bearing showed a significant increase of 100% from preoperative to postoperative score which has showed a good functional outcome for mobile bearing knee.

The follow-up results for Fixed bearing knee based on American knee society showed an excellent score of 26.6%, and a Good score of 73.3%.

Similarly, oxford knee score for fixed bearing showed a significant increase of 100% from preoperative to postoperative score which has showed a good functional outcome for mobile bearing knee.

The mean preoperative range of movements in mobile bearing Total knee arthroplasty patients were  $65.50^{\circ} \pm 10.4^{\circ}$  which has significantly improved postoperatively with a mean range of movements of  $100.26^{\circ} \pm 13.9^{\circ}$

The mean preoperative range of movements in fixed bearing Total knee arthroplasty patients were  $70.68^{\circ} \pm 5.0^{\circ}$  which has significantly improved postoperatively with a mean range of movements of  $110.2^{\circ} \pm 14.8^{\circ}$ . This showed minimal change in the functional outcome between mobile and fixed bearing.

The mean change in the joint line was calculated using Figgie et.al, method and there was a difference preoperatively ( $2.17 \pm 0.72$ ) and postoperatively ( $3.67 \pm 0.22$ ) which was significant. But, there was an insignificant difference postoperatively between the mobile bearing ( $2.85 \pm 0.22$ ) and fixed bearing prosthesis ( $3.02 \pm 1.24$ ) in our study.

In our study the mobile bearing and fixed bearing prosthesis showed a significant difference in the functional outcome and restoration of joint line with a minimal change in the radiological outcomes also.

Postoperatively, we have encountered complications of superficial infections in two patients treated with mobile bearing total knee arthroplasty who were started on antibiotics and recovered in two weeks and postoperative knee stiffness in three patients treated with fixed bearing total knee arthroplasty for whom physiotherapy of continuous passive mobilization was instigated and attained significant improvement in the range of movements.

#### IV. Statistical Analysis

The collected data were analysed with IBM.SPSS statistics software 23.0 Version. To describe about the data descriptive statistics frequency analysis, percentage analysis was used for categorical variables and the mean & S.D were used for continuous variables. To find the significant difference between the bivariate samples in Independent groups the unpaired sample t -test was used. In the above statistical tool, the probability [P]-value  $> .05$  found to nil significant in between both mobile and fixed bearing total knee arthroplasty.

Our study of mobile bearing and fixed bearing total knee arthroplasty did not show much significant changes in the functional outcome, range of movements and radiological outcome. Hence, large sample size and a long -term study might show some significant changes between mobile bearings and fixed bearing prosthesis in total knee arthroplasty.

## V. Discussion

Multiple studies over the past decade owing to primary osteoarthritis of the knee had led to some increased lifestyle modifications but still a complete remedy has not been achieved by conservative management. This has led to a series of surgical management for osteoarthritic knee. Better results have been obtained by total knee replacements<sup>9,10</sup>.

The use of total knee prosthesis for osteoarthritic knee has played a significant role in improvement of the quality of the patient's life. Hence the need for detailed study of this prosthesis has played a pivotal role in the outcome of management of osteoarthritic knee.

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However, studies comparing outcomes of mobile bearing prosthesis and fixed bearing prosthesis of total knee arthroplasty designs have found no difference in survivorship, clinical functions (rotation, flexion and extension), or patient preference<sup>11,12</sup>.

Our sample size consists of thirty patients, of which four are aged from 45 to 55 years (13.3%), Ten are aged from 55-65 years (33.33%), another ten are from 65 -75 years (33.33%) and six are aged from 75 -85 (20%).

Out of thirty patients thirteen were male (43.3%) and seventeen were females (56.6%).

Those patients who were operated with mobile bearing and fixed bearing prosthesis has a subsequent follow up for one month, three months, six months and one year

Their improvements were studied using an objective and subjective scoring systems such as American knee scoring system and an oxford knee scoring system. The follow-up results for mobile bearing knee based on American knee society showed an excellent score of 40%, Good score of 53.3%, And a fair score of 6.66%.

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Our study of mobile bearing and fixed bearing total knee arthroplasty did not show much significant change in the functional outcome, range of movements and radiological outcome<sup>13</sup>. Hence, large sample size and a long -term study might show some significant changes between mobile bearings and fixed bearing prosthesis in total knee arthroplasty.

## VI. Conclusion

Patients treated with mobile bearing system did not show significant changes in comparison to fixed bearing system clinically and radiologically. Our study had a limited sample size and a short-term follow-up; hence there was not much significant difference functionally and radiologically between both the prosthesis. For a better outcome, a larger sample size with a longer period of follow-up might show a significant change.

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