International Journal of Life Sciences, Biotechnology and Pharma Research Vol. 13, No. 12, December 2024 Online ISSN: 2250-3137
Print ISSN: 2977-0122

DOI: 10.69605/ijlbpr_13.12.2024.93

Original Research

Comparison of Outcome of Fixed Bearing vs. Mobile Bearing in case of total Knee Arthroplasty

Dr. Aditya Dabhi[1], Dr. Mukesh Chaudhari[2], Dr. Virag Shah[3], Dr. Ketas Mahajan[4]

[1]Assistant Professor, Department of Orthopedics, Parul Institute of Medical Sciences and Research, Waghodia, Vadodara, Gujarat, India
[2]First Year Resident, Department of Orthopedics, Parul Institute of Medical Sciences and Research, Waghodia, Vadodara, Gujarat, India
[3]Second Year Resident , Department of Orthopedics, Parul Institute of Medical Sciences and Research, Waghodia, Vadodara, Gujarat, India
[4]Associate Professor, Department of Orthopedics, Parul Institute of Medical Sciences and Research, Waghodia, Vadodara, Gujarat, India

Corresponding Author:
Dr.Ketas Mahajan
Associate Professor, Department of Orthopedics, Parul Institute of Medical Sciences and Research, Waghodia, Vadodara, Gujarat, India
Email: drketas0604@gmail.com

Received: 15 November, 2024 Accepted: 17 December, 2024

ABSTRACT

Background: It has been hypothesized that mobile-bearing total knee arthroplasty (TKA) may enhance outcomes by accommodating femorotibial rotational mismatches, potentially lowering contact stresses and reducing polyethylene wear. This study aimed to evaluate whether a difference exists between fixed-bearing and mobile-bearing designs of a modern TKA in terms of durability, range of motion (ROM), and functional outcomes at 5 years postoperatively.

Materials and Methods: This comparative analysis included 278 patients who underwent primary cemented TKA with one of three tibial components: all-polyethylene fixed-bearing, modular metal-backed fixed-bearing, or mobile-bearing. The median follow-up was 5 years (IQR: 3–8 years).

Results: No significant difference was observed in durability, assessed by survivorship free of revision for any cause, or in mean maximal ROM at ten years. Functional outcomes, as evaluated by Knee Society (KS) function scores and the prevalence of patellar tilt, also showed no significant differences between the groups.

Conclusion: This clinical study demonstrated that the mobile-bearing TKA design is reliable and durable but does not offer superior maximum knee flexion, functional outcomes, or durability at 5 years compared to posterior-stabilized fixed-bearing designs utilizing either all-polyethylene or modular metal-backed tibial components.

Key Words: Total knee arthroplasty, Range of motion, Fixed-bearing, Mobile-bearing

INTRODUCTION

It was hypothesized that incorporating a mobile-bearing design in total knee arthroplasty (TKA) might enhance longevity, improve range of motion (ROM), and optimize function while addressing femorotibial rotational incongruity. This concept was based on the premise that such a design could decrease contact stress and polyethylene wear, thereby mitigating debris-induced osteolysis through relative motion between the tibial tray and the bearing. These prosthetic devices have gained popularity among some orthopedic surgeons. However, it has been argued that the additional articulating surface might offset the benefits of reduced wear at the femorotibial interface [1-4].

Several studies have indicated no significant differences between fixed- and mobile-bearing TKA designs concerning pain, ROM, or functional outcomes. Nonetheless, randomized controlled trials (RCTs) directly comparing fixed- and mobile-bearing implants from the same manufacturer are limited. Although certain studies have investigated ROM and functional outcomes, many provide only mid-term follow-up data

DOI: 10.69605/ijlbpr_13.12.2024.93

or include varied implant designs, complicating the interpretation of results [5-8].

A prior study evaluated the outcomes of 240 primary TKAs with a mean follow-up period of five years, reporting four revisions: one in the all-polyethylene group due to patellar fracture, two in the modular metal-backed group due to aseptic loosening, and one in the mobile-bearing group due to infection [9]. That study found no significant differences in survivorship, functional outcomes, or maximum knee flexion across the groups. The objective of the present investigation was to assess survivorship, maximum knee flexion, and functional outcomes at a five-year follow-up.

MATERIAL AND METHODS

The study involving 278 patients who underwent primary unilateral total knee arthroplasty (TKA) for osteoarthritis (OA). Participants received a cemented, posterior-stabilized femoral component along with a patella, and one of three tibial components: all-polyethylene, modular-metal-backed, or mobile-bearing. Clinical and radiographic assessments were conducted at five years.

Inclusion criteria included a diagnosis of OA of the knee and an age between 20 and 85 years, while exclusion criteria encompassed: age outside the 20-85 year range, prior tibial osteotomy or patellectomy, retained implants, significant extra-articular deformities, tibial or femoral malunions requiring additional osteotomies, fixed varus/valgus deformities, flexion deformities greater than 20°, preoperative flexion less than 90°, osteomyelitis, previous knee infections, metastatic cancer, or major neurological or musculoskeletal disorders affecting gait or weight-bearing.

Randomization was performed using a computer program. A total of 460 patients were assessed for eligibility, and 182 were excluded before randomization due to refusal, inability to participate, or failure to meet inclusion criteria

(Figure 1).

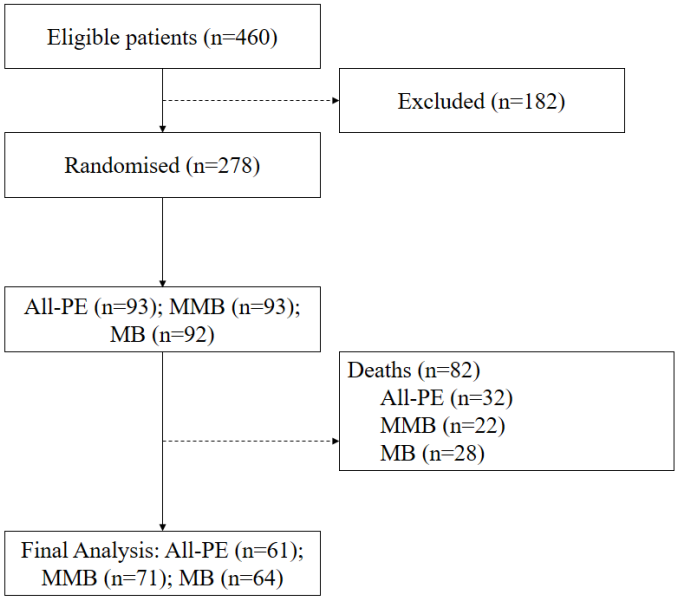

Figure 1: Flow of patients in the study

Each patient underwent tricompartmental TKA with a single cemented, posterior-stabilized femoral component and patella, along with one of the three tibial components as per the randomized group assignment. Experienced orthopedic surgeons performed all surgeries. Standard surgical procedures were followed [9]. Weight-bearing was initiated on the first postoperative day, and active knee movement was encouraged within 24 hours. Discharge criteria included the ability to walk with an aid, flex the knee ≥ 90°, and ascend stairs, with most patients being discharged on the fourth or fifth postoperative day.1

Range of motion analyses were performed by experienced physician assistants. Maximum active flexion was measured using a goniometer. The mean maximal ROM was calculated by subtracting maximum extension from maximum flexion. Knee Society (KS) knee and function scores were recorded pre- and postoperatively using a standardized questionnaire administered to all TKA patients at each follow-up [10]. Data on complications were collected from patient reports and medical record codes. Analysis of variance (ANOVA) was used to assess all postoperative data. A

DOI: 10.69605/ijlbpr_13.12.2024.93

two-tailed p-value of < 0.05 was considered statistically significant.

RESULTS

The outcomes of this study comparing All-polyethylene, Modular-metal-backed, and Mobile-bearing prostheses in total knee arthroplasty demonstrated no statistically significant differences across the evaluated parameters (Table 1). Revision rates for any reason were similar among the groups, with survival percentages of 93.5% for All-polyethylene, 95.8% for Modular-metal-backed, and 96.4% for Mobile-bearing prostheses (p = 0.91). These results suggest comparable durability among the three prosthesis designs.

In terms of knee flexion, the mean maximum flexion angles were 107° (SD: 18) for All-polyethylene, 112° (SD: 19) for Modular-metal-backed, and 108° (SD: 19) for Mobile-bearing groups, with no significant difference noted (p = 0.85). The median maximum knee flexion values followed a similar trend, ranging from 113° (41–138°) in the All-polyethylene group to 117° (42–141°) in the Modular-metal-backed group and 111° (39–133°) in the Mobile-bearing group.

Functional outcomes measured using the Knee Society Score (KSS) also showed no significant variation. The mean KSS function scores were 79.8 (SD: 22.3) for All-polyethylene, 58.4 (SD: 16.0) for Modular-metal-backed, and 62.3 (SD: 31.7) for Mobile-bearing prostheses (p = 0.23). Similarly, the mean KSS knee scores were 87.6 (SD: 6.2), 84.5 (SD: 17.6), and 81.9 (SD: 17.5) for All-polyethylene, Modular-metal-backed, and Mobile-bearing groups, respectively (p = 0.65).

Table 1: Comparison of results among study groups

Outcome	All-polyethylene (n = 61)	Modular-metalbacked (n = 71)	Mobile-bearing (n = 64)	p Value
Revision for any reason, %	93.5	95.8	96.4	0.91
Mean maximum knee flexion (SD)	107 (18)	112 (19)	108 (19)	0.85
Median maximum knee flexion (range)	113 (41 to 138)	117 (42 to 141)	111 (39 to 133)	
Flexion contracture > 5º, n (SD)	1 (8º)	1 (6º)	1 (7º)	-
Mean KSS, function (SD)	79.8 (22.3)	58.4 (16.0)	62.3 (31.7)	0.23
Median KSS, function (range)	88 (48 to 98)	54.5 (46 to 88)	65.0 (16 to 88)	
Mean KSS, knee (SD)	87.6 (6.2)	84.5 (17.6)	81.9 (17.5)	0.65
Median KSS, knee (range)	85 (82 to 93)	90 (60 to 94)	92 (61 to 95)	

Survival analysis (Table 2) further reinforced the similarity in outcomes, with no statistically significant differences between All-polyethylene and Mobile-bearing prostheses (p = 0.91) or between Modular-metal-backed and Mobile-bearing prostheses (p = 0.89). These findings suggest that all three prosthesis designs provide comparable clinical outcomes and survival rates, highlighting their efficacy in total knee arthroplasty.

Table 2: Survival (Knees) comparison results

Survival Comparison	p Value
All-polyethylene vs. mobile-bearing	0.91
Modular-metal-backed vs. mobile-bearing	0.89

DISCUSSION

In this study, no significant differences were observed between fixed- and mobile-bearing TKAs in terms of durability, mean maximal ROM, or function 5 years postoperatively. These findings align with results from other prospective studies, randomized controlled trials (RCTs), and meta-analyses that also reported comparable durability between these designs [11-14]. While some studies have suggested that mobile-bearing TKAs may offer superior flexion in the short term [15] our results support previous prospective studies indicating no significant outcome differences between fixed- and mobile-bearing designs. Kinematic studies have similarly shown no significant differences in anteroposterior femoral condylar translation or axial rotation between the two designs [11,16].

Regarding function, as measured by the Knee Society Score (KSS), no differences were observed between fixed- and mobile-bearing TKAs at the 5-year follow-up. These results are consistent with previous studies [6,8,17]. However, the present study uniquely compared devices with identical femoral components, isolating

DOI: 10.69605/ijlbpr_13.12.2024.93

the tibial components as the variable. Lädermann et al. [18] similarly found no differences in KSS or SF-12 scores after seven years. These findings confirm that mobile-bearing TKAs continue to provide functional outcomes comparable to fixed-bearing devices over the long term.

Radiographic assessment, specifically measuring patellar tilt and subluxation, did not reveal any differences between the groups. Some researchers have suggested that mobile-bearing TKAs could better accommodate rotational mismatch, potentially improving patellar tracking [3-8]. However, our study found no evidence to support this theory, as there were no significant differences in patellar tilt or subluxation between the groups.

This study has several limitations. First, function was evaluated using the KSS, which may lack sensitivity to detect small functional differences between similar TKA designs. Second, since this study focused on tibial components from a single manufacturer, the results may not be generalizable to all fixed- and mobile-bearing designs.

CONCLUSION

In conclusion, this comparative study demonstrated no significant differences in survivorship, range of motion (ROM), or function between fixed- and mobile-bearing total knee arthroplasties (TKAs) when the same femoral and patellar components were used. The anticipated benefits of mobile-bearing designs have not been substantiated by the findings, though ongoing monitoring may reveal potential differences in polyethylene wear or late failures over time.

REFERENCES

1. Hantouly AT, Ahmed AF, Alzobi O, Toubasi A, Salameh M, Elmhiregh A, et al. Mobile-bearing versus fixed-bearing total knee arthroplasty: a meta-analysis of randomized controlled trials. Eur J Orthop Surg Traumatol. 2022 Apr;32(3):481-495.
2. Teeter MG, Thoren J, Yuan X, et al. Migration of a cemented fixed-bearing, polished titanium tibial baseplate (Genesis II) at ten years: a radiostereometric analysis. Bone Joint J. 2016;98-B:616–21.
3. McGonagle L, Bethell L, Byrne N, Bolton-Maggs BG. The Rotaglide+ total knee replacement: a comparison of mobile versus fixed bearings. Knee Surg Sports Traumatol Arthrosc. 2014;22:1626–31.
4. Grupp TM, Kaddick C, Schwiesau J, Maas A, Stulberg SD. Fixed and mobile bearing total knee arthroplasty—influence on wear generation, corresponding wear areas, knee kinematics and particle composition. Clin Biomech (Bristol, Avon). 2009;24:210–7.
5. Ferguson KB, Bailey O, Anthony I, et al. A prospective randomised study comparing rotating platform and fixed bearing total knee arthroplasty in a cruciate substituting design--outcomes at two year follow-up. Knee. 2014;21:151–5.
6. Bistolfi A, Massazza G, Lee GC, et al. Comparison of fixed and mobile-bearing total knee arthroplasty at a mean follow-up of 116 months. J Bone Joint Surg Am. 2013;95-A:83.
7. Jawed A, Kumar V, Malhotra R, Yadav CS, Bhan S. A comparative analysis between fixed bearing total knee arthroplasty (PFC Sigma) and rotating platform total knee arthroplasty (PFC-RP) with minimum 3-year follow-up. Arch Orthop Trauma Surg. 2012;132:875–81.
8. Kim TK, Chang CB, Kang YG, et al. Early clinical outcomes of floating platform mobile-bearing TKA: longitudinal comparison with fixed-bearing TKA. Knee Surg Sports Traumatol Arthrosc. 2010;18:879–88.
9. Kalisvaart MM, Pagnano MW, Trousdale RT, Stuart MJ, Hanssen AD. Randomized clinical trial of rotating-platform and fixed-bearing total knee arthroplasty: no clinically detectable differences at five years. J Bone Joint Surg Am. 2012;94-A:481–9.
10. Insall JN, Dorr LD, Scott RD, Scott WN. Rationale of the Knee Society clinical rating system. Clin Orthop Relat Res. 1989;248:13–4.
11. Abdel MP, Tibbo ME, Stuart MJ, Trousdale RT, Hanssen AD, Pagnano MW. A randomized controlled trial of fixed- versus mobile-bearing total knee arthroplasty: A follow-up at a mean of ten years. Bone Joint J. 2018;100-B:925–9.
12. Namba RS, Inacio MC, Paxton EW, et al. Risk of revision for fixed versus mobile-bearing primary total knee replacements. J Bone Joint Surg Am. 2012;94-A:1929–35.
13. Carothers JT, Kim RH, Dennis DA, Southworth C. Mobile-bearing total knee arthroplasty: a meta-analysis. J Arthroplasty. 2011;26:537–42.
14. Smith H, Jan M, Mahomed NN, Davey JR, Gandhi R. Meta-analysis and systematic review of clinical outcomes comparing mobile bearing and fixed bearing total knee arthroplasty. J Arthroplasty. 2011;26:1205–13.
15. Aglietti P, Baldini A, Buzzi R, Lup D, De Luca L. Comparison of mobile-bearing and fixed-bearing total knee arthroplasty: a prospective randomized study. J Arthroplasty. 2005;20:145–153.
16. Harrington MA, Hopkinson WJ, Hsu P, Manion L. Fixed- vs. mobile-bearing total knee arthroplasty: does it make a difference? A prospective randomized study. J Arthroplasty. 2009;24(6 Suppl):24–27.
17. Woolson ST, Epstein NJ, Huddleston JI. Long-term comparison of mobile-bearing vs. fixed-bearing total knee arthroplasty. J Arthroplasty. 2011;26:1219–1223.
18. Lädermann A, Lübbeke A, Stern R, Riand N, Fritschy D. Fixed-bearing versus mobile-bearing total knee arthroplasty: a prospective randomised, clinical and radiological study with mid-term results at 7 years. Knee. 2008;15:206–210.