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Original Research Article

Comparison of Fixed-Bearing Prosthesis vs. Mobile-Bearing Prosthesis in Total Knee Arthroplasty among Indian Patients

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Abstract

Background: It has been claimed that mobile-bearing knee prostheses achieve more flexion in laboratory testing and may provide a better functional outcome in patients than traditional fixed-bearing knee prostheses.

Aim: To assess the mid-term clinical results of total knee arthroplasty (TKA) in Indian patients using a fixed- or mobile-bearing prosthesis.

Methods: 120 patients (50 men and 70 women) with arthritis of the knee with similar deformities and range of motion were randomly assigned to have TKA with a fixed- or mobile-bearing prosthesis. Patients with mediolateral instability and infective arthritis were not allowed to participate. Knee and functional ratings, range of motion, and the presence of flexion contracture were all evaluated by the Knee Society.

Results: The average duration of follow-up was 3.5 years (range, 1 - 4.6 years). The mid-term results of the two groups were comparable. At postoperative week 2, one patient with a mobile-bearing prosthesis experienced recurrent dislocation due to iatrogenic medial collateral ligament injury.

Conclusion: Long-term studies of functional and radiological outcomes are required to identify the indications for fixed-vs. mobile-bearing prosthesis.

Keywords: Fixed-Bearing Prosthesis, Mobile-Bearing Prosthesis, Total Knee Arthroplasty, Outcomes Comparison, India

Background

In the last 30 years, total knee arthroplasty (TKA) has become a successful and reproducible procedure for older, handicapped patients with knee osteoarthritis [1,2]. TKA indications were broadened to younger and more active patients based on initial success [3]. Long-term wear and loosening, on the other hand, became known causes of early and late implant failure [4,5]. The use of mobile-bearing polyethylene surfaces reflects efforts to reduce wear while coping with complex function and kinematics [6,7].

Laboratory results from a joint simulator and computerised simulation analyses utilising static and dynamic finite element models appear to indicate that mobile-bearing designs are beneficial in decreasing linear polyethylene wear caused by delamination and pitting [8]. Clinical trials, however, have not yet demonstrated superior results or greater knee function for mobile-bearing design series as compared to fixed-bearing designs [9,10]. As modern mobile-bearing knee designs enter the market, controlled prospective randomised trials are required to assess whether there is a clinical difference between the results of fixed-bearing and mobile-bearing designs [11]. Only a few trials have examined the clinical performance of current fixed-bearing and mobile-bearing TKAs, and the results are mixed [12].

Goodfellow *et al.* [13] and Buechel and Papas [14] conducted research on unicompartmental TKA implants, which resulted in the development of the mobile-bearing concept. Greater tibiofemoral congruency can be achieved due to its mobility at the tibia insert interface, reducing wear of the polyethylene insert without raising pressures at the bone-implant contact [3,8]. All theoretical evidence from laboratory testing and computer modelling suggests that mobile bearings aid to reduce linear polyethylene wear by minimising delamination and fatigue fractures [14,15]. Despite multiple prospective, randomised investigations, there is little clinical evidence to support the superiority of mobile bearings over fixed bearing designs [16].

This study aimed to compare the radiological and clinical outcomes of fixed and mobile bearings in the same TKA model. We examined the mid-term results of Indian patients who had TKA with a fixed-bearing or mobile-bearing prosthesis.

Materials and Methods

120 consecutive Indian patients (50 men and 70 women) aged 55 to 76 (mean, 63) years with knee arthritis and similar deformity and range of motion were randomly assigned to receive TKA with a fixed- or mobile- bearing prosthesis (Table 1). Patients with infective arthritis and mediolateral instability were not allowed to participate. Based on the state of the other joints and medical comorbidities, 74 (62%) and 22 (18%) patients were classified in groups B and C, respectively, by the Knee Society clinical rating system [8,9].

Antibiotic (intravenous cefazolin 2 g 1.5 hours before tourniquet inflation, followed by 1 g every 8 hours for 3 days) and anti-thrombotic (subcutaneous deltiparin or enoxaparin on the night before surgery until postoperative day 5) prophylaxis were provided. All procedures were carried out under regional anaesthesia (spinal or epidural) with tourniquet control via a medial parapatellar route. Although no patellas were replaced, all patients underwent patelloplasty. In 8 mobile- and 12 fixed-bearing prostheses, hybrid fixation was employed; the rest were completely affixed.

The rehabilitation includes the use of a knee immobiliser for two days, passive and active mobilisation, and walking with assistance beginning on day three. Patients were checked in at week 2 and 6, month 3

and 6, and biannually following that. The Knee Society knee and functional scores (maximum score, 100 each) were used to assess the performance of the replaced knee and overall function [8,9]. A goniometer was used to determine the flexion range and the existence of flexion contracture. The independent t-test was used to compare differences across groups. A p value of < 0.05 was regarded as significant.

Results

The average period of follow-up was 3.5 years (range, 1 - 4.6). One patient died on postoperative day 1 due to pulmonary embolism, and another (in the mobile-bearing group) experienced recurrent dislocation at postoperative week 2 due to iatrogenic medial collateral ligament injury.

The mean advancements in Knee Society knee and functional scores were 55 and 52, respectively, in range of motion was 13º and 13º, and in flexion deformity was 14º and 12º (Table 1). 93 percent of the patients got Knee Society knee scores of excellent or good. Only one patient in the mobile-bearing group needed assistance walking. The two groups had comparable mid-term outcomes in terms of range of motion, Knee Society knee and functional scores, and mortality rates. Immediately following surgery, one patient in the mobile-bearing group experienced popliteal artery thrombosis (distal pulses were absent). Following thrombectomy, the patient recovered. Two patients had superficial infections that were treated with antibiotics. Two patients (one from each of the fixed- and mobile-bearing groups) experienced an upper tibial tear that was repaired with lag screws and prolonged non-weight bearing.

Table 1: Comparison of fixed- and mobile-bearing total knee prostheses*

Variable	Fixed-bearing	Mobile-bearing	p value
No. of patients	60	60	-
Age	62 (57–76)	62 (55–75)	0.80
Male:female	20:40	30:30	1.00
Flexion contracture			
Preop	16º ± 1.9º (6º–20º)	12º ± 2.0º (5º–20º)	0.26
Final	1.7º ± 6.5º (0º–15º)	2.3º ± 6.3º (0º–10º)	0.95
Range of motion			
Preop	88.6º ± 15.5º (70º–100º)	89.0º ± 16º (70º–100º)	0.68
Final	100º ± 7.9º (75º–115º)	101º ± 7.8º (85º–115º)	0.79
Knee Society knee and functional scores			
Preop	36.4 ± 16.6 (0–60)	39.4 ± 21.5 (0–50)	0.39
Final	91.6 ± 11.5 (60–100)	91.3 ± 12.9 (55–100)	0.90

Discussion

With survival rates of 95 to 97 percent, the fixed-bearing prosthesis provides long-term fixation. The mobile-bearing prosthesis allows for a near-normal joint mechanism and nearly full femorotibial congruence, reducing polyethylene wear and osteolysis. Both prostheses had equivalent results; however, only one study found that mobile-bearing prostheses produced greater results after arthroplasty [12-14]. Long-term studies of both functional and radiological outcomes are required to evaluate whether fixed- or mobile-bearing prostheses are indicated [17, 18]. Both prosthetic designs have comparable kinematic patterns. With rates ranging from 1.1 percent to 9.3 percent, dislocation is a possible problem in mobile-bearing knees. Arterial problems are uncommon. There have only been a

few reports of popliteal artery thrombosis following TKA.

Several additional published studies on this topic exist, although they involve a shorter follow-up period than ours. Breeman *et al*. [19] conducted a randomised multicenter trial comparing 539 patients with a 5-year follow-up and discovered no differences in costs and OKS, SF-12, EuroQol, and EQ-5D scores between the two types of bearings. Ball *et al*. [20] presented a randomised, prospective, multicenter research comparing two Stryker® implants after two years in 69 patients in 2011. The IKS/SF-12 score did not change in this trial, however the IKS Stairs score was considerably higher in the mobile bearing group (44.9 ± 8.7 against 40.5 ± 11.3, P = 0.04).

Gioe *et al*. [21] assessed 312 knees after 2 years of follow-up in a level I randomised, prospective research. The researchers discovered no changes in radiologic complications, survival, range of motion, or IKS/WOMAC/SF-36 scores. Lädermann *et al*. [22] compared 52 fixed-bearing inserts against 52 mobile-bearing inserts in a prospective, randomised research. They discovered no major differences in IKS/SF-12 scores, clinical outcomes, or radiographic outcomes after 7 years of follow-up.

Aglietti *et al*. [23] enrolled 210 individuals in prospective randomised research that was examined after three years. The only clinical difference discovered was a slightly higher, but statistically significant, flexion angle in the fixed-bearing group versus the mobile-bearing group (112 versus 108, P = 0.025). They discovered no variations in radiography or IKS scores. Pagnamo *et al.* [24] compared 80 mobile-bearing cases to 160 fixed-bearing cases (all-PE tibial component or metal-backed baseplate) and discovered no differences in range of motion or patella-related complaints. In summary, the follow-up in other published randomised research is equal to or shorter than 7 years, and no significant differences in either kind of bearing were detected.

We discovered that the postoperative range of motion was the same as the preoperative value in this investigation. This verifies preoperative flexion's capacity to predict postoperative flexion [20]. The range of motion evaluated at the last follow-up (119° ± 12°) contains slightly higher flexion than that reported in comparable published research (110° to 116° [8-11]), most likely due to the use of the High-Flex implant. It is worth noting that Evans *et al*. [25] compared the range of motion of 100 patients with fixed bearings to 113 knees with movable bearings in a retrospective study.

They discovered that fixed-bearing knees had somewhat greater flexion than mobile-bearing knees (116 ± 15° versus 113 ± 11°), even though this difference was not substantial (P = 0.08). The IKS score in this investigation was noticeably smaller than that discussed in previous studies [8-11], most likely because the participants in our study were older. Our findings are consistent with Jacobs *et al*.'s evaluation of literature using the Cochrane database, which showed no evidence that one kind of bearing (fixed or mobile) was superior than the other in regard of functional outcome or range of motion [26].

Conclusion

Despite the widely acknowledged effectiveness of TKA surgeries, one out of every five patients is unsatisfied [23], lending validity to efforts to improve the implants. Despite its theoretical benefits, the mobile bearing design outperforms the fixed bearing design in clinical terms. It appears that the predicted advantage is insignificant in the short term. Longer term, its equivalent, if not superiority, must be proved. This randomised, single-center, single-surgeon study verifies this concept and begins to reveal differences between fixed and mobile bearings, with some evidence of mobile bearings being superior. This distinction between the two

groups was not clinically significant. Similarly, no significant changes in range of motion, subject satisfaction, or self-administered questionnaires were detected between the fixed bearing and mobile bearing groups. Overall, mobile bearing implants appear to have a little advantage over fixed bearing implants, however this finding is moderated by the inclusion of screw holes in the fixed bearing implant model employed in this investigation.

References

1. Crockarell JR, Guyton JL. Campbell's operative orthopaedics. Arthroplasty of ankle and knee. Philadelphia: Mosby; 2003:244.
2. Colizza WA, Insall JN, Scuderi GR. The posterior stabilized total knee prosthesis. Assessment of polyethylene damage and osteolysis after a ten-year-minimum follow-up. J Bone Joint Surg Am 1995; 77:1713–20.
3. Huang CH, Ma HM, Liau JJ, Ho FY, Cheng CK. Osteolysis in failed total knee arthroplasty: a comparison of mobile-bearing and fixed-bearing knees. J Bone Joint Surg Am 2002; 84:2224–9.
4. Engh GA. Failure of the polyethylene bearing surface of a total knee replacement within four years. A case report. J Bone Joint Surg Am 1988; 70:1093–6.
5. Buechel FF, Pappas MJ. New Jersey low contact stress knee replacement system. Ten-year evaluation of meniscal bearings. Orthop Clin North Am 1989; 20:147–77.
6. Huang CH, Ma HM, Liau JJ, Ho FY, Cheng CK. Late dislocation of rotating platform in New Jersey Low-Contact Stress knee prosthesis. Clin Orthop Relat Res 2002; 405:189–94.
7. Bert JM. Dislocation/subluxation of meniscal bearing elements after New Jersey low-contact stress total knee arthroplasty. Clin Orthop Relat Res 1990; 254:211–5.
8. Insall JN, Dorr LD, Scott RD, Scott WN. Rationale of the Knee Society clinical rating system. Clin Orthop Relat Res 1989; 248:13–4.
9. Ewald FC. The Knee Society total knee arthroplasty roentgenographic evaluation and scoring system. Clin Orthop Relat Res 1989; 248:9–12.
10. Keblish PA, Varma AK, Greenwald AS. Patellar resurfacing or retention in total knee arthroplasty. A prospective study of patients with bilateral replacements. J Bone Joint Surg Br 1994; 76:930–7.
11. Callaghan JJ, Squire MW, Goetz DD, Sullivan PM, Johnston RC. Cemented rotating-platform total knee replacement. A nine to twelve-year follow-up study. J Bone Joint Surg Am 2000; 82:705–11.
12. Kim YH, Koo HK, Kim JS. Comparison of fixed-bearing and mobile-bearing total knee arthroplasties. Clin Orthop Relat Res 2001; 392:101–15.
13. Goodfellow JW, O'Connor J. Clinical results of the Oxford knee: surface arthroplasty of the tibiofemoral joint with a meniscal bearing prosthesis. Clin Orthop 1986; 205:21.
14. Buechel FF, Pappas MJ. Long-term survivorship analysis of cruciate-sparing versus cruciate-sacrificing knee prostheses using meniscal bearings. Clin Orthop 1990; 260:162.
15. Chiu KY, Ng TP, Tang WM, Lam P. Bilateral total knee arthroplasty: one mobile-bearing and one fixed-bearing. J Orthop Surg (Hong Kong) 2001; 9:45–50.
16. Bhan S, Malhotra R, Kiran EK, Shukla S, Bijjawara M. A comparison of fixed-bearing and mobile-bearing total knee arthroplasty at a minimum follow-up of 4.5 years. J Bone Joint Surg Am 2005; 87:2290–6.
17. Insall JN, Hood RW, Flawn LB, Sullivan DJ. The total condylar knee prosthesis in gonarthrosis. A five to nine-year follow-up of the first one hundred consecutive replacements. J Bone Joint Surg Am 1983; 65:619–28.
18. Ranawat CS, Boachie-Adjei O.

Survivorship analysis and results of total condylar knee arthroplasty. Eight- to 11-year follow-up period. Clin Orthop Relat Res 1988; 226:6–13.
19. Breeman S, Campbell MK, Dakin H, Fiddian N, Fitzpatrick R, Grant A, Gray A, Johnston L, MacLennan GS, Morris RW, Murray DW. Five-year results of a randomised controlled trial comparing mobile and fixed bearings in total knee replacement. The bone & joint journal. 2013 Apr;95(4):486-92.
20. Ball ST, Sanchez HB, Mahoney OM, Schmalzried TP. Fixed versus rotating platform total knee arthroplasty: a prospective, randomized, single-blind study. The Journal of Arthroplasty. 2011 Jun 1;26(4):531-6.
21. Gioe TJ, Glynn J, Sembrano J, Suthers K, Santos ER, Singh J. Mobile and fixed-bearing (all-polyethylene tibial component) total knee arthroplasty designs: a prospective randomized trial. JBJS. 2009 Sep 1;91(9):2104-12.
22. Laedermann 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. The knee. 2008 Jun 1;15(3):206-10.
23. 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. The Journal of arthroplasty. 2005 Feb 1;20(2):145-53.
24. Pagnano MW, Trousdale RT, Stuart MJ, Hanssen AD, Jacofsky DJ. Rotating platform knees did not improve patellar tracking: a prospective, randomized study of 240 primary total knee arthroplasties. Clinical Orthopaedics and Related Research (1976-2007). 2004 Nov 1; 428:221-7.
25. Evans MC, Parsons EM, Scott RD, Thornhill TS, Zurakowski D. Comparative flexion after rotating-platform vs fixed-bearing total knee arthroplasty. J Arthroplasty 2006; 21:985–91.
26. Jacobs W, Anderson PG, van Limbeek J, Wymenga AA. Mobile bearing vs fixed bearing prostheses for total knee arthroplasty for post-operative functional status in patients with osteoarthritis and rheumatoid arthritis. Cochrane Database of Systematic Reviews. 2001(2).