



# Reduced patellofemoral and walking pain with mobile-bearing vs. fixed-bearing total knee replacements: a mid-term prospective analytic study

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**Objective:** Total knee replacement (TKR) is the standard treatment for advanced stage knee osteoarthritis. The introduction of the mobile-bearing (MB) design has given rise to a series of theoretical advantages compared to fixed-bearing (FB) implants, although current literature does not reveal significant differences between the designs. The aim of this study was to estimate the clinical results of 2 cemented total knee prosthetic designs: an MB and an FB design.

**Methods:** A series of patients with similar clinical and radiographic characteristics were treated consecutively with 100 FB followed by 94 MB implants. Patients were evaluated radiographically and clinically.

**Results:** Statistically significant differences were found in terms of pain at 5 years in favor of MB prostheses ( $p=0.006$ ). The “pain on ascending/descending stairs” category on the KSS score showed improvement at 5 years for the MB design ( $p=0.003$ ). MB implants showed better results in terms of ability to ascend/descend stairs at five years ( $p=0.002$ ). With regards to the patients’ ability to walk, there were differences at 1 year ( $p=0.020$ ) and at 5 years ( $p=0.021$ ) in favor of MB implants.

**Conclusion:** At a mean follow-up of 5 years, significant differences were observed in the MB prosthesis in terms of postoperative pain, ability to ascend/descend stairs, and patellofemoral pain.

**Keywords:** Total knee prosthesis; mobile-bearing; posterior-stabilized; patellofemoral pain; American Knee Society Score (KSS).

Mobile-bearing (MB) total knee replacement (TKR) was developed with 2 primary goals: to reduce contact pressures, thereby reducing long-term polyethylene wear, and to reproduce normal knee kinematics. Although these

goals were achieved, the long-term clinical results obtained with current MB knee arthroplasties remain similar to those of fixed-bearing (FB) designs.<sup>[1–9]</sup> Furthermore, the results of FB knee prostheses published in the

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literature are consistently good when the posterior cruciate ligament (PCL) is either resected or retained.<sup>[10-14]</sup>

The purpose of this study was to compare the clinical results of 2 types of cemented total knee arthroplasties (TKA): a posterior-stabilized FB design and a posterior cruciate ligament (PCL) preserving MB design.

## Patients and methods

From January 2002 to December 2003, 194 consecutive knees in 194 patients were treated with NexGen®. The 1<sup>st</sup> 100 consecutive knees implanted were MB, and the 2<sup>nd</sup> 94 knees were FB implants. Mean patient age was 67±7.2 years. The main indication for surgery was osteoarthritis. Patients with rheumatoid arthritis and post-traumatic osteoarthritis were excluded from the study.

Both groups were comparable with regards to deformity, knee mobility, demographics, and clinical characteristics (Table 1). All prostheses were implanted by the same surgical team consisting of 2 senior orthopedic consultants (JP and LG) using the same surgical technique. After surgery, all patients submitted to the same rehabilitation protocol supervised by the same doctor (BR).

The implants evaluated in this study were the NexGen® Legacy Knee Posterior Stabilized (LPS®) (Zimmer, Warsaw, Indiana, USA) and the Meniscal-Bearing Knee (MBK®).<sup>[15,16]</sup>

All procedures were performed via standard midline incision and medial parapatellar approach. The patella was resurfaced in all patients, and lateral retinaculum was released in 8% of FB patients and in 11% of MB patients (patellofemoral tracking was evaluated using the "no-thumb rule").

An accelerated physical therapy program was carried out in all patients: continuous passive motion began on the 1<sup>st</sup> postoperative day, and weight bearing was permitted 48 hours after the procedure. The postoperative physical therapy program included range of motion (ROM) and isometric exercises for the 1<sup>st</sup> 6 weeks and progressive resistive exercises thereafter for an additional 6 weeks.

All patients were discharged walking with crutches and with flexion ≥90°.

Follow-up evaluation was performed at 6 weeks, 3 months, 1 year, and every 2 years thereafter. All data were collected by 1 author of the study (MH) who was blinded to the procedure. Average follow-up was 5.4 years (range: 5.1–5.8 years). One patient died prior to the 1-year follow-up. Eighty-one percent of patients included in the study (n=157) completed the final follow-up (5 years): 82 from the FB group and 75 from the MB group.

Each knee was rated pre- and postoperatively according to the Knee Society Scoring System (KSS).<sup>[12]</sup> Patient satisfaction was evaluated using the British Orthopaedic Association (BOA) patient satisfaction outcome, which has 4 possible responses: enthusiastic, satisfied, noncommittal, and disappointed.<sup>[16]</sup> Muscle strength was measured according to the Medical Research Council (MRC) Scale, which distinguishes between Grade 0 (no movement is observed) and Grade 5 (muscle contracts normally against fully resistance).<sup>[16]</sup> Posteroanterior and mediolateral knee stability was measured clinically.

Preoperative standing anteroposterior (AP) radiographs in extension, posterioranterior (PA) standing radiographs in 30° of flexion, lateral views in 45° of flex-

**Table 1.** Demographic and clinical data.

Parameter	Preoperative		p
	MB (n=100)	FB (n=94)	
Sex	77 F, 23 M	89 F, 5 M	0.006*
Age	64.93±6.83 (62–70)	70.10±6.65 (67–75)	0.001**
Body mass index (%)			0.060
<25	5.0	15.1	
25–30	51.0	41.9	
>30	44.0	43.0	
Diagnosis: osteoarthritis (%)	100	100	
Knee			0.111
Left (%)	54.0	42.6	
Right (%)	46.0	57.4	
Varus deformity (%)	72 (2–20°)	72.3 (2–15°)	
Valgus deformity	23 (4–15°)	21.3 (4–18°)	
KSS score	40.6±10	38.7±10	

\*Chi-square test; \*\*T/student.

ion, and Merchant patella views were taken and repeated during follow-up. Alignment and presence of radiolucent lines were evaluated. An implant was defined as “loose” when there was a progression of radiolucency, a change in component position, and/or circumferential radiolucent lines with a thickness of  $>2$  mm in all zones.<sup>[6]</sup>

Data were assessed by means of a descriptive statistical analysis, Pearson’s chi-square test (for independent samples), McNemar’s test for paired samples and intra-group differences, and Student’s test for numerical dependent variables. Confidence intervals of 95% were accepted, as well as an alpha error of 0.05 in inferential estimations. SPSS software 12.5 statistical package was used (SPSS, Chicago, Illinois, USA).

## Results

Mean age was higher in the FB group ( $70.10 \pm 7.2$  years, mean difference of 5 years) ( $p=0.001$ ). In regards to gender, 84% of patients were female (91.5% female in the FB group vs. 77% in the MB group) ( $p=0.006$ ). Forty-six point six percent of patients were overweight and 43% were obese, with no statistically significant differences between the groups ( $p=0.06$ ). Preoperative physical examination of patients showed a mean flexion contracture of  $6^\circ$  ( $-4$ – $10^\circ$ ) in FB group and  $4^\circ$  ( $-3$ – $8^\circ$ ) in the MB group. Maximum flexion showed no differences ( $p=0.099$ ): patients in the FB group were able to flex their knee to  $100.4 \pm 20.5^\circ$ , whereas those in the MB group could flex their knee to  $102.5 \pm 18^\circ$ . Fifty percent of FB knees showed an extension lag as compared to 44% in the MB group; lag degrees differed between the groups:  $5.7 \pm 8.1^\circ$  for the FB group and  $3.8 \pm 4.9^\circ$  for the MB group ( $p=0.0475$ ).

Radiological angles were measured with the majority of patients (72.3% in the FB group vs. 72% in the MB group) presenting with varus malalignment  $<5^\circ$ .

Muscular strength was lower for the FB group ( $p=0.001$ ).

No statistically significant differences were observed in terms of medial-lateral ( $p=0.352$ ) or anterior-posterior ( $p=0.012$ ) stability.

Nine point three percent of all patients reported severe preoperative pain, most patients (74.3%) reported severe pain on walking, and 83% experienced severe pain on ascending/descending stairs. Additionally, 85.6% of patients complained of patellofemoral pain (anterior aspect of the knee), with no statistically significant differences between the groups.

In regards to function, 38.3% of patients were able to walk only at home, and 34.7% were able to walk only

400 m, with no statistically significant differences between the groups ( $p=0.124$ ). Furthermore, no differences were found ( $p=0.262$ ) regarding ability to ascend/descend stairs; most patients (68.2%) required the use of a banister. More than half of the patients (55.4%) did not require a cane.

KSS score for the MB group was  $79.6 \pm 17.86$  at 1 year postoperative and  $86.7 \pm 16.42$  at 5 years; for the FB group the score was  $8.19 \pm 15.50$  at 1 year and  $76.3 \pm 20.12$  at 5 years.

In short- and mid-term follow-ups, no differences were found in terms of resting pain: the MB group showed an improvement of 80% at 1 year and 84% at 5 years, and the FB group showed an improvement of 71% at 1 year and 70.7% at 5 years. In terms of pain on walking, statistically significant differences were observed ( $p=0.006$ ) at 5 years in favor of MB prostheses (Figure 1a, b). The “pain on ascending/descending stairs” category on the KSS score also showed improvement at 5 years for the MB design ( $p=0.003$ ) (Figure 1c, d). There was a significant reduction in both groups in postoperative patellofemoral pain as compared with the preoperative scores; however, at 5 years the MB knees obtained better results, with only 3% of patients presenting patellofemoral pain compared to 17% in the FB group ( $p=0.003$ ) (Figure 2).

With regards to patients’ ability to walk, there were differences at 1 year ( $p=0.020$ ) and at 5 years ( $p=0.021$ ) in favor of MB implants. Moreover, MB implants showed better results in terms of ability to ascend/descend stairs at 5 years ( $p=0.002$ ). For patients in both groups, use of a cane was less frequent at both 1 year and 5 years postoperatively than prior to surgery. ROM was similar for both designs:  $114.2 \pm 12^\circ$  at 1 year and  $114.6 \pm 11.2^\circ$  at 5 years in the FB group vs.  $113.3 \pm 11.4^\circ$  and  $117 \pm 10.4^\circ$  for the MB group.

According to the BOA patient satisfaction score, 89% of patients in the FB group reported being “satisfied” or “enthusiastic,” compared with 88% in the MB group.

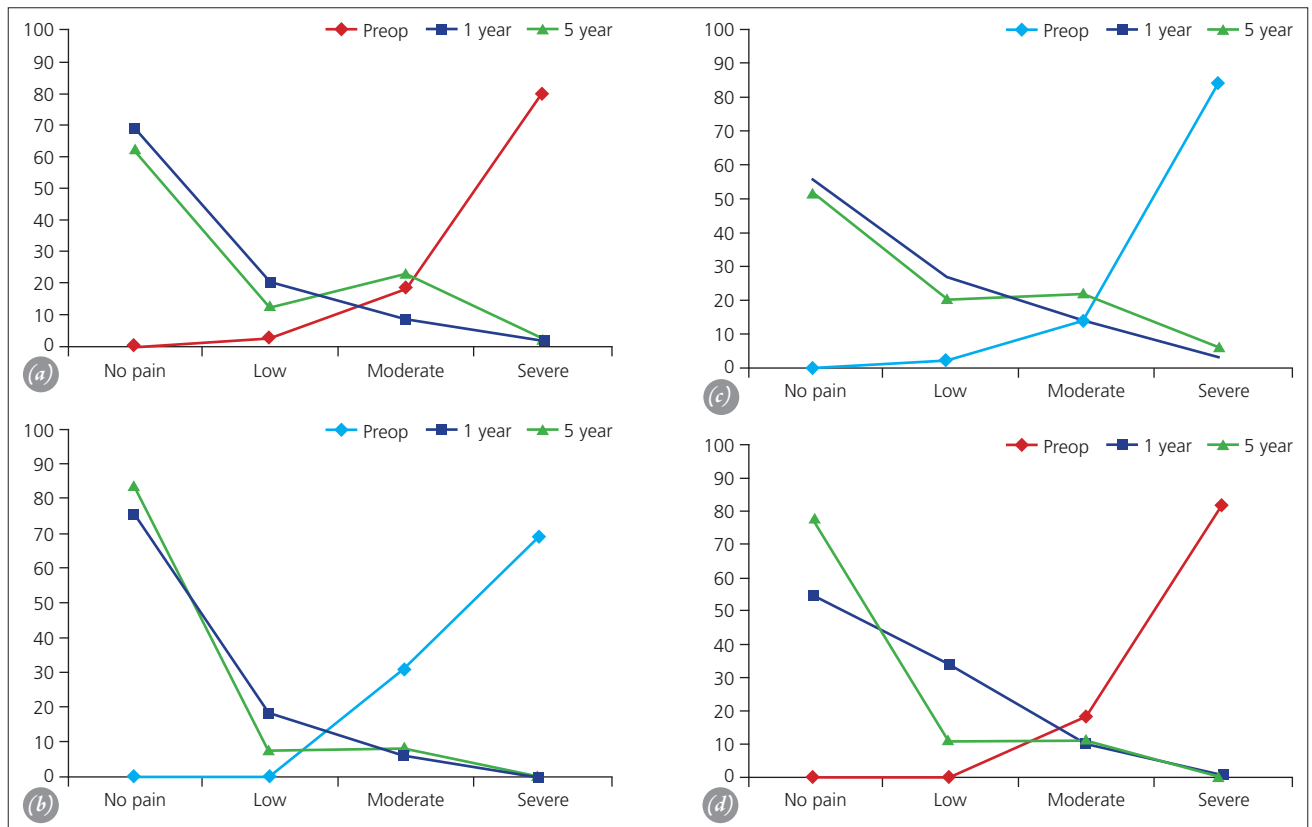
Clinically, medial-lateral and anterior-posterior stability were similar in both groups.

No differences were observed at 1 year ( $p=0.096$ ) or at 5 years ( $p=0.763$ ) in terms of muscular strength.

Similar values were measured for varus/valgus alignment at rest; the majority of patients had varus of  $<5^\circ$  (5% in the FB group and 10% in the MB group).

The number of physical therapy sessions prior to discharge was similar in both groups (26 for MBK® vs. 27 for LPS®).

The mean duration of hospital stay was  $11.8 \pm 2.6$



**Fig. 1.** (a) Walking knee pain LPS. (b) Walking knee pain MBK. (c) Knee pain up and down stairs LPS. (d) Knee pain up and down stairs MBK. [Color figure can be viewed in the online issue, which is available at [www.aott.org.tr](http://www.aott.org.tr)]

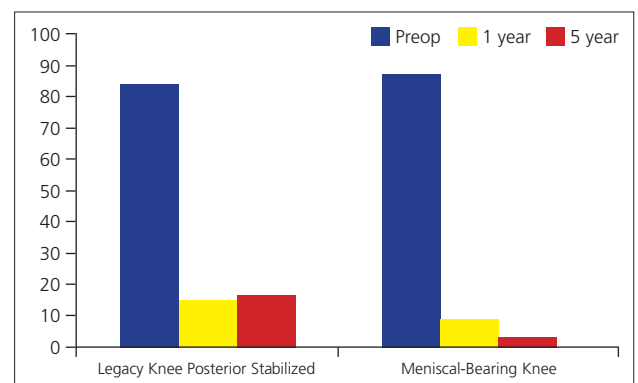
days in the FB group and  $125 \pm 2.9$  days in the MB group ( $p=0.105$ ); no relationship was found between gender, age, or body mass index (BMI) and hospital stay.

Seven patients (4 in the MB group, 3 in the FB group) suffered deep venous thrombosis, and 6 patients (3 in each group) developed superficial wound infection that was resolved with antibiotic therapy. One MB patient experienced a traumatic spin-out of the polyethylene bearing. In the late postoperative period, 1 FB patient sustained a periprosthetic femoral fracture that required internal fixation; another patient in the same group experienced a patellar fracture. One patient in the MB group required revision of the tibial insert due to stiffness. One patient in the FB group developed patellar clunk syndrome; another in the same group developed lateral peroneal nerve compression, leading to paresis but without sequelae. One other patient in the FB group required lateral retinacular release as a result of patellar dislocation. At 5 years, 2 patients (1 from each group) required revision for infection (2-stage for septic loosening).

### Discussion

Based on our results, we found less pain and better abil-

ity to ascend/descend stairs after MB implants than FB implants; however, the current literature does not reveal significant differences between the 2 designs, reporting similar clinical results and survival rates.<sup>[4,5,7,17,18]</sup> Silvestre-Muñoz et al. found no differences in KSS score comparing an MB vs. a posterior stabilized design, but they did report better results in the MB group for pain scores and subjective preference, although the difference did not reach statistical significance.<sup>[19]</sup> Li et al.<sup>[20]</sup>



**Fig. 2.** Femoro patellar pain. [Color figure can be viewed in the online issue, which is available at [www.aott.org.tr](http://www.aott.org.tr)]



published a meta-analysis of randomized controlled trials to compare the outcomes between both designs of prostheses; they concluded that clinical outcomes are similar with regard to knee function, postoperative knee function, complications, and prosthesis survivorship at short- and middle-term follow-up. Kim et al.<sup>[21]</sup> reported on a group of 174 patients who were undergoing simultaneous bilateral total knee arthroplasty; 1 knee was randomized to receive an FB implant and the other to receive an MB implant. At a follow-up of 5.6 years, there were no differences in knee motion, pain or function scores, or the prevalence of osteolysis between the 2 groups of knees. Additionally, authors such as Oh,<sup>[22]</sup> Wylde,<sup>[23]</sup> Wolhrab,<sup>[24]</sup> and Biau<sup>[5]</sup> found no differences in terms of ROM, KSS score, or radiolucent lines. More recently, Bistolfi<sup>[6]</sup> reported similar clinical results at a mean intermediate-term follow-up of nearly 10 years, and Gioe et al. reported similar results in a prospective randomized trial comparing MB with FB at a mean follow-up of 3.5 years.<sup>[25]</sup>

Mean age in our series was higher in FB design patients, with similar results to those of other studies<sup>[1,4,17,21]</sup> and with no gender-related differences, which could explain the difference in preoperative KSS scores between both groups if we assume that functional scores should be worse in older patients, though this hypothesis has not been proven in the current literature.<sup>[6]</sup> More recently, Kim et al.<sup>[26]</sup> found no superiority of MB total knee prosthesis over FB prosthesis in a population of patients younger than 51 years.

Mean length of hospital stay in our series was higher than that in the recent study by Aglietti et al.,<sup>[1]</sup> but similar to figures published in recent years, at the time when our prostheses were implanted.<sup>[8,11,16,27]</sup>

A detailed analysis of preoperative pain shows that in terms of resting pain in both prosthetic designs, severe and mild resting pain scored similarly in both groups. Similar studies<sup>[1,6,19]</sup> found a high proportion of preoperative severe resting pain. With regards to pain on ascending/descending stairs, values displayed by the FB and MB designs were similar.

Our overall analysis of both designs found that patellofemoral pain at 5 years was more severe in the FB group, and the ability to ascend/descend stairs was greater at 1 year and 5 years in the MB group.

A detailed analysis of postoperative pain revealed that abatement of severe pain at 5 years was greater in the MB group. This finding is not in agreement with those of authors such as Aglietti<sup>[1]</sup> who reported absence of pain for both groups.

Although the analysis of pain during walking did not reveal differences between the groups at 1 year, the MB group showed better results at 5 years, and the reduction of pain when ascending/descending stairs was also greater in the MB group. We believe that this can be attributed to 2 main factors, as has been described by others: firstly, preservation of the PCL, which increases the quadriceps lever arm,<sup>[9,13–15,28,29]</sup> and secondly, better patellar alignment resulting from a more efficient balancing of the extensor mechanism in the MB group.<sup>[30,31]</sup>

With regards to patellofemoral pain, patients in the MB group experienced less pain at 5 years, possibly because of greater instability and poorer patellar tracking in the FB group<sup>[14,15,32,33]</sup> and the improved quadriceps lever arm allowed by PCL preservation.

Patients' ability to walk and ascend/descend stairs improved significantly at 5 years in the MB group; this contrasts with the findings of other authors who have not found differences in these categories.<sup>[5,7,18,20,23,26,33]</sup>

ROM at 5 years was similar in both groups. Unlike other authors, we found no differences in terms of varus-valgus alignment, medial-lateral and anterior-posterior stability, muscular strength, or the use of a cane.<sup>[1,30,33]</sup>

Both the incidence of periprosthetic fracture and number of patellar fractures in our series are in line with those reported by other authors<sup>[30,34,35]</sup> and the literature.<sup>[35,36]</sup> We had only 1 case of patellar dislocation, although other authors had a higher incidence of patellar dislocations.<sup>[37]</sup> Our rates of revision for septic loosening coincide with those of other authors.<sup>[10,38]</sup> Only 1 patient experienced a patellar clunk syndrome, which was resolved with conservative treatment as proposed by Lonner.<sup>[33]</sup> We had 1 case of a lateral popliteal sciatic nerve compression, which has also been previously reported.<sup>[30,39]</sup>

The present study has 2 main limitations. First, it was not a randomized prospective study, although the groups were similar in demographic data and preoperative functional status. Second, different ages in both groups could interfere with the interpretation of the results.

Our clinical results show that walking pain, pain on ascending/descending stairs, and patellofemoral pain are lower in MB prostheses compared to FB designs.

**Conflicts of Interest:** No conflicts declared.

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