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ORIGINAL ARTICLE

Comparison of the clinical results of mobile-bearing and fixed-bearing prostheses used for total knee arthroplasty in patients with osteoarthritis

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Abstract

Background: The aim of this study was to investigate the changes in pain, function, stiffness and complications over time in patients with osteoarthritis who underwent total knee arthroplasty (TKA) with fixed or mobile-bearing.

Methods: This study is a prospective cohort type study performed with gonarthrosis patients that underwent TKA. Western Ontario and McMaster Universities Arthritis Index (WOMAC) and American Knee Society Score (AKSS) were used for clinical evaluation (pain, function and stiffness). The post-treatment measurements of patients were performed at the one-year follow-up.

Results: The study group consisted of 63 patients with a mean age of 63.57 ± 8.13 years. WOMAC and AKSS scores of the patients improved significantly in both groups over time. WOMAC pain score was found to be lower in the fixed-bearing group in the postoperative first year. The WOMAC function score was lower in the mobile-bearing group at 6 months and 1 year postoperatively. The AKSS pain score was significantly lower in the mobile-bearing group in the preoperative period and in the fixed-bearing group at postoperative third month. The AKSS function score was significantly lower in the fixed-bearing group in the third and sixth postoperative months. In the postoperative period, no significant difference was found between groups in terms of radiolucent area size, infection and complication development.

Conclusions: Significant clinical improvements were observed in both types of prostheses during the follow-up of patients. While there were differences in clinical outcomes between the groups during the follow-up period, the two groups were similar in terms of complications.

Keywords: Osteoarthritis, Knee, Arthroplasty, Replacement, Prostheses and Implants.

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INTRODUCTION

Osteoarthritis (OA) is the most common type of arthritis and is the main cause of chronic musculoskeletal pain and loss of mobility in the elderly (1). OA is particularly common in weight bearing joints such as the knee and the hip (2). Knee OA is a common degenerative condition caused by mechanical and chemical stress in the knee joint. Functional impairment inevitably occurs in affected joints, causing pain and reduced range of motion (3). Degenerative changes in the articular cartilage, muscles, bones, synovia and subchondral bone often progress during the development of the disease and include various abnormalities: osteophyte formation, synovial inflammation, degeneration of ligaments, dysfunctions in periarticular muscles and nerves, and bursitis (4,5).

Because of the continuous aging of the population and the increase in obesity levels, OA is becoming increasingly common worldwide (6). In population-based studies, the incidence of the disease has been reported to be 2-10 times higher in the population aged 65 years and older compared to the third decade of life (7). The estimated lifetime risk of developing symptomatic knee OA is approximately 40% in men and 47% in women, and this risk is higher in obese patients (8). In the Framingham OA survey; the prevalence of osteoarthritis has been reported to be 11% in women and 7% in men (9). In a study performed to evaluate the prevalence of osteoarthritis in Turkey, the prevalence of symptomatic knee OA was 14.8% in patients over 50 years of age (women: 22.5%, men: 8%) (10). Thus, it is evident that OA and OA-related knee pain has arguably become the most common cause of movement dependence and physical disability in the elderly (11,12).

In the advanced stages of the OA, surgical treatment options such as joint debridement, synovectomy, distal femoral/high tibial osteotomy are available (13). However, total knee arthroplasty (TKA) is the gold standard treatment for patients with severe end-stage symptomatic osteoarthritis that is unresponsive to conservative treatment, especially when OA leads to considerably impaired quality of life (14). TKA contributes significantly to pain control and functional recovery in patients with severe OA (15,16). Over the past 30 years, different prostheses have been designed with advances in biomedical engineering and surgical techniques (17). Nowadays, TKA is performed with knee prostheses that have mobile-bearing or fixed-bearing characteristics as both types seem to provide similarly successful clinical results (15,17). However, problems such as abrasion, osteolysis and loosening are known to affect some of the patients during long-term follow-up after TKA with fixed-bearing prostheses. This fact has caused further development and interest for the use of mobile-bearing knee prostheses. Mobile-bearing prostheses are reported to reduce the risk of loosening by reducing stress as a result of having a larger area and also its even distribution of weight to the surrounding soft tissues. They are also suggested to decrease risk for osteolysis by causing less microparticle formation than fixed bearing prostheses (18,19).

The aim of this study was to investigate the changes in pain, function, stiffness and complications over time in patients who underwent TKA with fixed or mobile-bearing prostheses for the treatment of OA.

MATERIALS AND METHODS

This study is a prospective cohort type study performed with gonarthrosis patients who underwent TKA at Necmettin Erbakan University, Meram Medical Faculty Orthopedics and Traumatology Department between 2017-2018.

In order to conduct the study, ethical committee approval (Date-no:16.06.2017- 2017/972) was obtained from the Ethics Committee of Meram Faculty of Medicine, and the study was conducted in accordance with the Helsinki Declaration (20).

Study group

The study group consisted of patients who applied to the orthopedics and traumatology department and were scheduled for TKA due to being diagnosed with OA that did not respond to conservative treatments.

Revision knee arthroplasty, bilateral knee arthroplasty in the same session, a constant varus of more than 20 degrees, skeletal development problems, rheumatic disease, secondary osteoarthritis, and Charcot's neuroarthropathy patients were excluded from the study.

Randomization

Each patient was assigned a number according to the order of admission to the hospital. The groups were determined by randomized selection. Patients were divided into two groups as fixed bearing and mobile bearing.

Evaluation of patients

TKA of OA patients who applied to the orthopedics and traumatology outpatient clinic were evaluated by an experienced specialist physician. Patients who were diagnosed with OA were informed about the aim and subject of the study. Informed consent was obtained from the patients who agreed to participate in the study. Afterwards, TKA operations were performed by the same group of specialists according to patient randomization.

Pain, function and stiffness of the knee joint were measured in the third postoperative month, sixth month and first year. Western Ontario and McMaster Universities Arthritis Index (WOMAC) and American Knee Society Score (AKSS) were used as clinical evaluation instruments. During the follow-up, radiographs of the patients were evaluated. In addition, complications such as superficial skin infection, serious discharge and anterior knee pain were evaluated and recorded in both groups.

WOMAC Index

The WOMAC index is a valid and reliable scale frequently used in the clinical evaluation of patients with hip and knee OA (21). The validity and reliability study of the Turkish version was conducted by Tüzün et al. (22). The WOMAC index consists of three different sections and 24 questions that assess pain (five questions), stiffness (two questions), and physical function (17 questions). The increase in the total score is associated with increased pain and stiffness and impairment of physical function (21,22).

AKSS

In addition to the WOMAC index, clinical evaluation of the patients was performed using the scoring system established by the American Knee Society. With this scoring system, pain, function, range of motion, flexion deformity and instability are evaluated. As the score obtained from the scale increases, pain and functional limitation decrease (23).

Statistical analysis

All data were evaluated by IBM SPSS (Version 15.0) statistical package program on a Windows OS computer. The variables were tested for normal distribution with the Shapiro Wilk and the Kolmogorov Smirnov (with Lilliefors correction) tests and normal distribution assumptions for the respective tests were not met in any analysis. The number, percentage, mean, standard deviation, median, minimum and maximum values of variables were used for the depiction of descriptive data. The Mann Whitney U, Kruskal Wallis and Chi Square tests were used to compare groups. Statistical significance level was accepted as $p \leq 0.05$.

RESULTS

The study group consisted of 63 patients (15 (23.8%) males and 48 (76.2%) females). The ages of the patients ranged from 47 to 87, with a mean of 63.57 ± 8.13 years. There was no statistically significant difference between the groups in terms of age, gender and affected extremity (localization). The comparison of groups in terms of descriptive characteristics is given in Table 1.

Table 1. Comparison of groups according to descriptive characteristics

	Fixed-bearing	Mobile-bearing	Overall	p
	Mean ± SD (Min–Max)	Mean ± SD (Min–Max)		
Age (years)	63.1±9.0 (47.0-87)	64.0±7.3 (51.0.-81.0)	63.57±8.13 (47.0-87.0)	0.65
	n (%)	**n (%)**		
Gender				
Male	9 (60.0)	6 (40.0)	15 (23.8)	0.41
Female	23 (47.9)	25 (52.1)	48 (76.2)	
Localization				
Right	11 (34.4)	10 (32.3)	21 (33.3)	0.86
Left	21 (65.6)	21 (67.7)	42 (66.7)	
Total	32 (50.8)	31 (49.2)	63 (100.0)	

WOMAC pain, function and stiffness scores of the patients decreased significantly over time. WOMAC pain score was found to be lower in the fixed-bearing group in the postoperative first year. The WOMAC function score was lower in the mobile-bearing group at 6 months and at 1 years postoperatively. The preoperative value of WOMAC stiffness score was lower in the mobile-bearing group, whereas the postoperative 1st year value was lower in the fixed-bearing group. The comparison of the WOMAC scores of the groups is given in Table 2.

Table 2. Comparison of the scores of the groups from the WOMAC Index

	Fixed-bearing	Mobile-bearing	p
	Mean±Sd (Min-Max)	Mean±Sd (Min-Max)	
WOMAC Pain			
Preoperative	17.7±1.8 (12-20)	17.1±2.2 (12-20)	0.37
Postoperative 6th month	3.2±0.9 (2-5)	3±0.7 (2-4)	0.32
Postoperative 1st year	2.3±0.7 (1-4)	2.6±0.7 (1-4)	**0.07**
p	**<0.01**	**<0.01**	
WOMAC Function			
Preoperative	53.1±5.2 (40-62)	54.8±5.6 (49-62)	0.18
Postoperative 6th month	15.2±3.6 (9-25)	11.4±2.7 (2-17)	**<0.01**
Postoperative 1st year	11±3.2 (5-18)	7.9±2.6 (4-18)	**<0.01**
p	**<0.01**	**<0.01**	
WOMAC Stiffness			
Preoperative	6.8±0.7 (6-8)	6.4±0.9 (5-8)	**0.03**
Postoperative 6th month	3.5±0.9 (2-6)	3.2±0.7 (2-4)	0.27
Postoperative 1st year	2±0.6 (1-3)	2.7±0.8 (1-4)	**<0.01**
p	**<0.01**	**<0.01**	

When the changes in the AKSS scores of the patients were examined, it was seen that there was a significant increase in the postoperative period in both groups compared to preoperative measurements. The AKSS pain score was significantly lower in the mobile-bearing group in the preoperative period, while in the fixed-bearing group it was lower in the postoperative third month. The AKSS function score was significantly lower in the fixed-bearing group in the third and sixth postoperative months. The comparison of groups in terms of AKSS scores is given in Table 3.

Table 3. Comparison of American Knee Society Scores (AKSS) of groups

	Fixed-bearing	Mobile-bearing	p
	Mean±Sd (Min-Max)	Mean±Sd (Min-Max)	
AKSS Pain Score			
Preoperative	51.8±6.7 (30-62)	48.0±5.7 (37-61)	**<0.01**
Postoperative 3th month	63.6±6.0 (51-76)	67.2±9.6 (45-83)	**0.02**
Postoperative 6th month	72.1±4.8 (62-86)	74.9±10.3 (54-93)	0.16
Postoperative 1st year	76.1±6.1 (65-98.9)	77.7±10.4 (56-98)	0.39
p	**<0,01**	**<0,01**	
AKSS Function Score			
Preoperative	30.3±8.6 (14-50)	28.0±6.7 (17-37)	0.33
Postoperative 3th month	59.3±7.0 (47-72)	62.6±6.7 (51-73)	**0.06**
Postoperative 6th month	63.4±10.2 (44-82)	69.7±5.2 (57-78)	**0.01**
Postoperative 1st year	70.3±7.8 (54-83)	73.3±4.4 (64-81)	0.11
p	**<0.01**	**<0.01**	

In the postoperative period, no significant difference was found between the fixed-bearing and mobile-bearing groups in terms of radiolucent area size, infection and complication development. The comparison of postoperative follow-up values of groups was given in Table 4.

Table 4. Comparison of postoperative follow-up values of groups

	Fixed-bearing n (%)	Mobile-bearing n (%)	p
Radiolucent area size			
<4 mm	30 (93.8)	29 (93.5)	0.97
5-6 mm	2 (6.3)	2 (6.5)	
Development of infection			
No	26 (81.3)	30 (96.8)	0.10
Serous discharge	4 (12.5)	0 (0.0)	
Superficial infection	2 (6.3)	1 (3.2)	
Development of complication			
No	29 (90.6)	29 (93.5)	0.67
Anterior knee pain	3 (9.4)	2 (6.5)	

DISCUSSION

In this study, we evaluated the clinical outcomes and complications of patients undergoing TKA with fixed-bearing and mobile-bearing prostheses. In both the fixed-bearing and mobile-bearing groups, it was found that pain, function and stiffness improved significantly. The clinical results showed variability between the two groups in the postoperative period, but the two groups were similar in terms of complications.

Knee pain

According to WOMAC index, pain was lower in the fixed-bearing group in the first postoperative year. According to AKSS, knee pain was significantly lower in fixed-bearing group at the preoperative period, while the mobile-bearing group had significantly lower values at postoperative third month. In a systematic review of 127 studies evaluating clinical outcomes with fixed and mobile-bearing prostheses in TKA, no significant difference was reported between the groups in terms of pain (24). In another systematic review, this time including 19 studies, no significant differences were found between the groups in terms of pain which was assessed via the AKSS and also visual analog scales (26). Furthermore, in a study from Turkey, by Atay et al., it was reported that there was no significant difference in postoperative pain scores between fixed and mobile-bearing groups (17). Despite finding various significant differences between groups, we are aware that there may be other parameters that influenced pain levels in patients, including baseline differences between patients (which are evident with preoperative measurements) and the lack of evaluation of the patients' daily life practices after surgery. However, the significant differences between pain levels at especially the postoperative third month may warrant further studies in order to assess whether the two procedures have different short-term pain outcomes.

Functional capacity and stiffness

Both groups showed significant improvement in function and stiffness over time, as measured by the WOMAC index. According to the WOMAC index, functional status of the patients was significantly better in the mobile-bearing group at 6 months and 1 year postoperatively. Further, stiffness of the knee joint was better in the fixed-bearing group at postoperative first year. When changes in the AKSS function score of the patients were examined, it was seen that there was a significant improvement in the postoperative period in both groups compared to preoperative measurements. AKSS function score was found to be significantly better in the mobile-bearing group in the third and sixth postoperative months. In a systematic review by Fransen et al., no significant difference was found between fixed and mobile bearing groups in terms of range of motion and function (24). In a study by Xu et al., the postoperative 1, 3, and 10 years of range of motion and functional scores (measured by AKSS and WOMAC) of both the fixed and mobile-bearing groups were found to have improved significantly (they were similar at baseline). In addition, range of motion and functional status were reported to be better in the fixed-bearing group compared to mobile-bearing in the sixth week (25). In another study, no significant difference was found between fixed and mobile-bearing in terms of AKSS and WOMAC functional scores (26). Returning to the study from Turkey by Atay et al., it was reported that there was no significant difference between the fixed and mobile-bearing groups in terms of function scores at 50 months of follow-up (17). In the study of Abdel et al., no significant difference was found between the fixed and mobile-bearing prosthesis groups observed for 10 years with tests of range of motion and AKSS (27). In their study, Emerson et al. reported that they did not find a significant difference in knee functional scores at 8-year follow-up between fixed and mobile-bearing (28).

In the study of Kim et al., fixed-bearing knee prostheses were applied to one knee and mobile-bearing knee prostheses to the other knees of the same patients due to concerns that factors related to patient characteristics might be effective on postoperative clinical changes. In this study, no difference was found between the groups in terms of WOMAC index, AKSS pain and function scores (27). Chiu et al., in a similarly designed study, reported that there was no significant difference between the two types of prostheses in terms of clinical results when the early results of the cases were compared (30). In contrast, we found some differences between groups; however, as mentioned before, some of these differences in pain, function and stiffness may be due to various factors. Even so, despite the overwhelming evidence in the literature and the fact that our results confirm prior findings at

longer duration of follow-up, we believe the short-term differences may again point to a short-term difference between the two prosthesis types. Therefore, our belief is that further studies are warranted to elucidate whether such a difference truly exists.

Complications in fixed-bearing and mobile-bearing groups

In the postoperative period, no significant difference was found between fixed-bearing and mobile-bearing groups in terms of radiolucent area size, infection and complication development. In the study of Hofstede et al., it was reported that there was no significant difference between two groups (fixed-bearing and mobile-bearing) when revision surgery, mortality and complication rates were examined (26). In another study, no difference was found between fixed and mobile-bearing groups in terms of patellar tilt and prosthesis survival (27). In the study by Kim et al., it was reported that osteolysis was not seen in both groups at 7.4 years of follow-up, and no significant difference was found between the groups in terms of complications (29). In a previous systematic review, no significant difference was found between the fixed and mobile-bearing groups in terms of complications such as insert wear, osteolysis and radiolucency (24). The results of this study support the literature in this regard.

Limitations

One of the limitations of the study is the relatively low sample size. In a larger sample, we could have obtained different results, especially with a multicenter study that may have contributed to the determination of actual differences in the short term. Another limitation is that the follow-up period of the patients was set at one year. In the long term, there may be other differences between groups, or the differences could diminish over time. Finally, the characteristics of the surgical team, postoperative care, and factors related to patient and treatment adherence are also likely to affect clinical outcomes. However, we could not control the effects of these factors during or after treatment.

Significant clinical improvements were observed with both types of prosthesis during the follow-up period. There were differences in clinical outcomes between the two groups, especially at short-term comparisons; but the two groups were similar with regard to complications. In the light of these results, both fixed-bearing and mobile-bearing type prostheses can be said to be beneficial in the treatment of OA. However, we further studies are necessary to evaluate the clinical effects of both types of prosthesis, particularly to compare short-term results.

Declarations

The authors received no financial support for the research and/or authorship of this article. There is no conflict of interest.

This study was approved by the clinical research ethics committee of the Necmettin Erbakan University Meram Faculty of Medicine (Date: 16.06.2017 number: 2017/972).

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