Evaluation of fixed-bearing arthroplasty in primary total knee replacement

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Background
Fixed-bearing primary total knee replacement is a well-established method of treatment for advanced arthritic knee joint.
Aim of the study
This study evaluated the clinical, functional, and radiological outcomes after the use of fixed-bearing total knee arthroplasty in cases of primary total knee replacement.
Patients and method
This prospective study was conducted on 14 patients (six male and eight female) who attended Suez Canal University Hospitals between January 2012 and January 2013, and the mean age was 60 years (range 50–72 years) at the time of surgery. The patients included in the study had advanced unilateral knee osteoarthritis with severe pain and functional disability with failure of conservative measures. Preoperative clinical and radiological evaluation was carried out and the knee society clinical and functional rating system (KSS) was used to evaluate the patients preoperatively and postoperatively at 1-year follow-up. The scoring system combines a relatively objective knee score that is based on the clinical parameters and a functional score based on how patients perceive their knee function in relation to specific activities. Radiological evaluation was carried out to determine the alignment of the knee and the femoral and tibial component positions.
Results
There was significant difference between preoperative and postoperative clinical and functional scores. The mean postoperative clinical assessment score for pain was 44.9, for range of motion it was 115.9, and for stability it was 23.5. Postoperative mean knee society clinical assessment score was 90.7 and the mean functional assessment score for knee function was 87.5. According to the knee society clinical and functional score, 85% of patients had excellent results and 15% of patients had good results. As regards radiological results, all knees were well-aligned at 1 year postoperatively and no periprosthetic loosening or radiolucent line around either component was found.
Conclusion
Primary total knee arthroplasty using fixed-bearing prosthesis is an effective procedure with good clinical and functional results and early mobilization.

Keywords:
arthroplasty, bearing prosthesis, fixed

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Introduction

Total knee replacement (TKR) is a standard treatment method for advanced primary arthritis, with excellent long-term results [1]. In addition, it is a highly successful joint reconstruction procedure and is widely accepted for pain relief and for restoration of range of motion and function [2]. TKR has clinical and radiographic success rates greater than 90%; despite that, the problems related to the articular bearing surface have been one of the causes of failure [3,4]. The primary indications for TKR are severe pain, functional disability, and deformity [5]. Mandalia *et al.* [6] reported different factors that are linked to painful TKRs, including infection, aseptic loosening, and mechanical malalignment. However, many authors have reported that the cause of pain is not always known, with the incidence of unexplained pain following TKR varying from 4 to 13.1% [7,8]. Many authors have reported that fixed-bearing knee prosthesis has excellent long-term survival and good-to-excellent clinical results [9,10]. Consequently, the fixed-bearing TKR permits the so-called flat-on-flat (less conforming) geometrics, while allowing a greater degree of tibiofemoral rotation and translation, increased predicted contact stresses, and thus increased wear at the polyethylene insert and at the bearing surfaces [11,12].

Patients and methods

This prospective study was conducted on 14 patients (six male and eight female) who attended Suez Canal University Hospitals between January 2012 and January

2013 for advanced unilateral knee osteoarthritis with a follow-up of 1 year. The mean age was 60 years (range: 50–72 years) at the time of surgery.

The patients included in the study had severe pain and functional disability caused by severe arthritis with failure of conservative measures. We excluded patients with severe bilateral knee osteoarthritis that needs bilateral TKR and patients with sepsis and poor vascularity of the leg. Patients with preoperative range of movement less than 90° or with flexion contracture more than 10° that require extended soft tissue release were excluded from the study as it would affect the functional results of the study.

Preoperative clinical and radiological evaluations were carried out, including plain radiography of both knees to confirm the extent of osteoarthritis and determination of the mechanical axis and point of entry of the femoral and tibial medullary canal.

Operative procedure

Under anesthesia and tourniquet, the classic anterior midline approach with medial parapatellar arthrotomy of the joint was used to expose the joint. An incision was made with the knee in flexion, and the fascial layer was opened and reflected. Subsequently, with the knee in flexion, the vastus medialis was divided by means of 5 cm blunt dissection aligned with its muscle fibers with retraction of the patella and removal of osteophytes. Both the anterior and posterior cruciate ligaments, along with the menisci, were excised.

Femoral preparation was carried out by drilling a pilot hole of 8 mm to reach the femoral rotation of the femoral component, which is at 3° of external rotation in relation to the posterior condylar axis. A distal femoral cut that controls the extension gap and the valgus angle of the femoral component was made. Thereafter, a posterior femoral cut that controls the flexion gap was made and distal femoral cut was completed, and a tibial cut was performed at 90° in relation to the anatomical axis of the tibia. The tibial cut was performed in slight external rotation with a posterior slope of 7° using the extramedullary guide. Thereafter, the alignment and flexion and extension gaps were checked before trial insertion was applied.

After application of trial prosthesis, we checked the limb alignment, the stability of the joint in both flexion and extension, the range of motion, the patellar tracking, and the fitness of the prosthesis.

The femoral component was then cemented and applied, with the knee in 90° of flexion. The tibial component of the definitive prosthesis was applied after surface cementation of the tibia, with the knee flexed more than 120°, and then the polyethylene insert was applied with the knee extended until setting of cement.

Patellar resurfacing with removal of osteophytes and trimming of the facets was carried out. The tourniquet was released before closure and hemostasis was carried out, and then suction drain was inserted in all cases.

Antibiotic prophylaxis was carried out pre-operatively, followed by administration of antibiotics every 8 h for 3 days. Antithrombolytic prophylaxis was carried out for 10 days postoperatively. Postoperative DVT pump was applied and the patient was encouraged to perform static quadriceps and hamstringing exercises postoperatively. Flexion and extension exercises were performed, both active and assisted, as early as possible as the pain became tolerable and patients began walking with the help of a walker by the fourth postoperative day and with the help of cane after 2 weeks. The drain was removed after 48 h and the patient was discharged, and clinical follow-up was carried out. The last knee score at 1 year follow-up was used in data analysis.

The scoring system

The knee society clinical rating system (KSS) was used to evaluate the patients preoperatively and postoperatively at 1-year follow-up. The scoring system combines a relatively objective knee score that is based on the clinical parameters and a functional score based on how patients perceive their knee function in relation to specific activities [13,14].

The maximum knee clinical score is 100 points and the maximum functional score is also 100 points.

The knee clinical score evaluates pain, range of motion, and stability in the mediolateral and anteroposterior plane. It also offers deductions for flexion contractures, extension lag, and malalignment (Table 1).

The knee functional score considers only walking distance and stair climbing with deduction for walking aids. The maximum score is obtained if the patient can walk unlimited distance and go up and down stairs normally (Table 2).

Scores of 100–80 points were considered excellent results, 79–70 were considered good results, 69–60 were considered fair results, and scores less than 60 were considered poor results.

Radiological evaluation was carried out based on the knee society score (KSS), and the radiographs were evaluated for the alignment of the knee and the femoral

Table 1 The knee society clinical score

Objective scoring	Score
Pain	
None	50
Mild or occasional	
Stairs only	45
Walking and stairs	30
Moderate	
Occasional	20
Continuous	10
Severe	0
Range of motion (5° = 1 point)	25
Stability	
Anteroposterior	
<5 mm	10
5–10 mm	5
>10 mm	0
Mediolateral	
<5°	15
6–9°	10
10–14°	5
15°	0
Flexion contracture	
5–10°	−2
10–15°	−5
16–20°	−10
>20°	−15
Extension lag	
<10°	−5
10–20°	−10
20°	−15
Alignment	
0–4°	0
5–10°	3 points each degree
11–15°	3 points each degree

Table 2 Knee functional score

Objective scoring	Score
Walking (block = 100 m)	
Unlimited	50
>10 blocks	40
5–10 blocks	30
<5 blocks	20
Housebound	10
Unable	0
Stairs	
Normal, up and down	50
Normal, up; down with the support of the rail	40
Up and down with the support of the rail	30
Up with the support of the rail; unable to climb down	15
Unable	0
Functional deductions	
Cane	−5
Two canes	−10
Crutches or walker	−20

and tibial component positions. The position of the joint line was determined in AP films by calculating the distance between the tip of the fibular head and the distal margin of the lateral femoral condyle at 1 year postoperatively, and any radiolucent lines around the implant were recorded [15].

Statistical analysis

Data were analyzed using Statistical program of social sciences, version 16 (SPSS Inc., Chicago, IL) and were described as mean and SD, and comparison of quantitative parameters was carried out before and after the surgical procedure by means of *t*-test.

A 95% confidence interval was calculated and a *P* value less than 0.05 was considered significant.

Results

All patients were systematically followed up for 1 year and evaluated on the basis of the knee society scoring system. Clinical assessment for pain shows a statistically significant difference in the scores of preoperative pain (mean = 12.7) and postoperative pain (mean = 44.9). As regards range of motion, there was statistically highly significant difference in the grading of preoperative range of motion (mean = 94.7) and postoperative range of motion (mean = 115.9). There was statistically highly significant difference in the preoperative stability score (mean = 16.8) and postoperative stability score (mean 23.5).

There was statistically highly significant improvement in the KSS, from a preoperative mean score of 47.2 to a postoperative mean score of 90.7. As regards functional assessment score, there was also statistically highly significant difference with improvement, from a mean preoperative knee function score (KFS) of 35 to a mean postoperative KFS of 87.5.

As regards radiological results, all knees were well-aligned after the surgery and no significant differences were found in the immediate and 1-year postoperative alignment, position of the femoral and tibial components, and the shift of the joint line. No periprosthetic loosening or radiolucent line around either component was found.

Finally, 12 patients showed excellent results according to the knee society clinical and functional score and two patients showed good results.

Figures 1 and 2 show a 54-year-old female patient who underwent TKR with fixed-bearing NexGen LPS prosthesis in the left knee. The KSS preoperatively was 31 (poor) and postoperatively it was 94 (excellent), and no postoperative complications had occurred.

Figures 3 and 4 show a 58-year-old female patient who underwent TKR with fixed bearing NexGen LPS prosthesis in the left knee. The KSS preoperatively was 41 (poor) and postoperatively it was 97 (excellent).

Complications

Two patients had superficial infection and delayed wound healing, which was treated with multiple dressing and improved after 2 weeks.

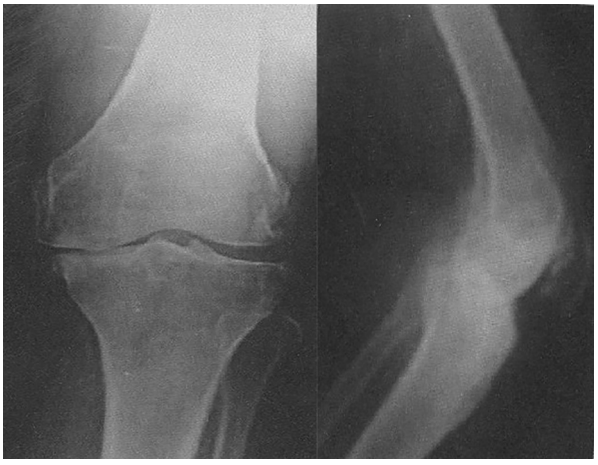
Discussion

During the early years of joint arthroplasty, the primary goal of knee replacement was to relieve the crippling pain associated with arthritis. In this respect, arthroplasty has been successful in solving pain symptoms, and studies have also shown that TKR restores knee function as well [16].

Figure 1

Preoperative radiograph of the left knee.

Figure 3



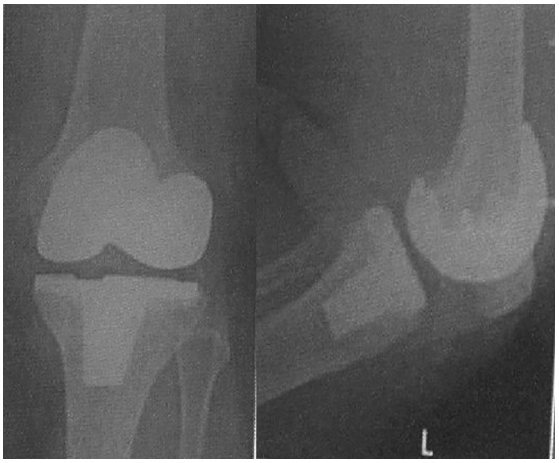
Preoperative radiograph of the left knee.

A positive outcome in TKR is influenced by the complex interaction between the soft tissue structure surrounding the joint and the geometry of the prosthetic design. A good implant design must achieve good results. In addition, continued use of a particular implant design requires addressing short-term and long-term problems that may arise and offering solutions comparable to those in published studies [17].

This was a randomized prospective study, which aimed to evaluate the results of the fixed-bearing design as regards clinical, functional, and radiological results of TKR at 1 year postoperatively. Evaluation of pain relief, range of movement, and improved function for all patients was carried out, but assessment of implant durability is outside the scope of our study because it requires longer follow-up. Patellar resurfacing was performed in all cases.

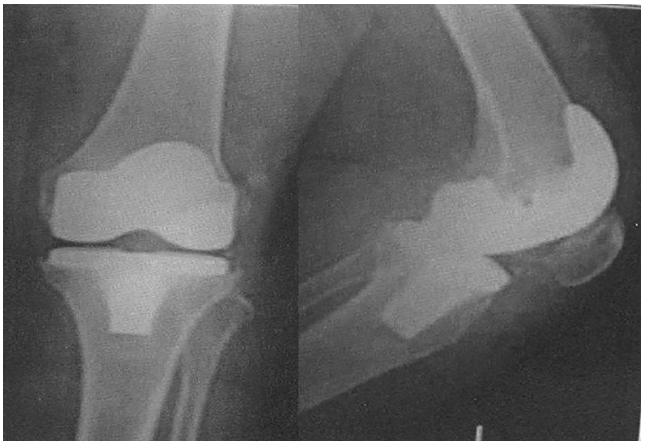
Ferguson *et al.* [18] stated that functional outcome and range of motion at 2 years of follow-up of fixed-bearing

Figure 2



Postoperative radiograph after 1 year.

Figure 4



Postoperative radiograph after 1 year.

TKR is more a factor of surgical technique and patient variables rather than tibial bearing design.

Staut *et al.* [19] found that excessive internal rotation of the femoral and tibial components individually, as well as the combined component rotation, was a factor in unexplained painful TKRs.

Gulcu *et al.* [20] evaluated the midterm results (average 53 months of follow-up) of 125 fixed-bearing arthroplasty in 86 patients with degenerative knee joint diseases. These results showed a significant improvement in knee pain scores based on the knee scoring system, from a mean of 14.3 points preoperatively to a mean of 43.2 points postoperatively.

Young-Hoo *et al.* [21] analyzed 116 primary TKRs with fixed-bearing arthroplasty, with a mean follow-up of 7.4 years. The results showed pain score improvements, with a mean of 0 points preoperatively to a mean of 48.1 points postoperatively. These results are comparable to the values for pain scores achieved in our study.

As regards range of movements, Woo *et al.* [22] evaluated the long-term clinical outcomes of TKR in 105 patients with osteoarthritis for a minimum of 8.5 years. The maximum flexion angle improved significantly from a preoperative mean of 110.5–130.4° postoperatively ($P > 0.05$).

Guclu *et al.* [20] reported midterm results of fixed-bearing TKR on 125 knees with an average of 4 years of follow-up, and the preoperative mean range of motion was 75.5° and it was measured as 93.2° at the last follow-up. Aggarwal and Agrawal *et al.* [23] showed that the mean postoperative range of motion was 110.5° (80–125°) in the fixed TKR and all patients were satisfied with the outcome of the procedure. Ferguson *et al.* [18] reported that the mean preoperative range of movements improved from 95.4° preoperatively to 108.8° at 1 year postoperatively. The differences of results from our study may be due to longer follow-up in other studies.

As regards the KSS, Woo *et al.* [22] reported in their study that the KSS mean improved significantly from 47.6 to 89.7 points at the last follow-up. In addition, Guclu *et al.* [20] found in their work a significant improvement in the KSS as the preoperative mean was 26.2 points and reached 87.1 points postoperatively ($P < 0.01$). Ferguson *et al.* [18] reported that the mean preoperative knee score was improved from 45.6 to 70.5 postoperatively. In the current study the better compared with the results of Ferguson *et al.* [18]; this may be due to the shorter follow-up and because patients with rheumatoid arthritis and severe knee deformities were excluded from our studies.

As regards the KFSs, Lamb *et al.* [24] reported that the postoperative mean of the KFS for fixed-bearing TKR was 88 points. In another study, Mahoney *et al.* [25] analyzed results of primary TKR with follow-up for 2 years using fixed-bearing arthroplasty, and they reported that postoperative KFS score was 83 points. Another study by Hanusch *et al.* [26] conducted on 50 patients with fixed-bearing arthroplasty reported that postoperative KFS was 76.4 points. All functional results were comparable to the results of our study; this may be due to nearly similar inclusion and exclusion criteria of patients selected in all studies.

Conclusion

Primary total knee arthroplasty using fixed-bearing prosthesis is an effective procedure for the treatment of advanced unilateral arthritic knee with good clinical, functional, and radiological results and early mobilization.

Acknowledgements

Conflicts of interest

There are no conflicts of interest.

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