Original Research Article

Functional and Radiological Outcomes between Proximal Fibular Osteotomy Versus Medial Open Wedge High Tibial Osteotomy For Management of Medial Compartment Knee Osteoarthritis

ABSTRACT

Background: Osteoarthritis is the most common cause of disability in the older population. Disability is caused by pain and limitations in mobility.

Objectives: This work aims to compare the functional and radiological outcomes of proximal fibular osteotomy in medial compartment decompression, with medial opening wedge high tibial osteotomy.

Methods: This prospective randomized clinical trial was done on 32 patients suffering from manifestation of medial compartment osteoarthritis of the knee joint. Patients were allocated into two groups: The control group; 16 patients representing the standard HTO technique and the Case group; 16 patients representing the novel technique PFO. The average follow-up periodwas about 12 months after the operation. Operation time, clinical and radiological, postoperative clinical results, andcomplicationswerecomparedbetween thetwogroups.

Results: the operative duration was significantly longer among patients treated by HTO compared to patients treated by PFO (37.2± 4.8 minutes vs. 25.9± 6.4 minutes). The mean preoperative KSS score was 65.3± 3.5 and 67.2± 5.4 among PFO and HTO respectively. KSS scores at 3 months and 9 months were significantly higher among PFO than HTO. VAS, KSS, and radiological assessment were significantly improved postoperative among PFO and HTO.

Conclusion: Proximal fibular osteotomy might be a safe alternative treatment to high tibial osteotomy with better functional and radiological outcomes.

Keywords: Proximal Fibular Osteotomy, Medial compartment osteoarthritis, High Tibial Osteotomy.

Introduction

Osteoarthritis is one of the common types of disease compromising quality of life particularly in old age patients [(1)].Knee osteoarthritis (OA) is a chronic, slowly progressive degenerative disease with accompanying joint pain, stiffness, and deformity. Disability is due to pain and limitation in the range of motion (ROM) [(2)].Total Knee Replacement (TKR), is the main surgical intervention to relieve pain and improve ROM and function in patients with end-stage disease. However, TKR is not the best option for younger patients as they may need a second knee revision and there will be concerns about the longevity of more active patients in addition to the economic burden and complication of Arthroplasty [(3)].

Although high tibial osteotomy (HTO) is the first line of treatment in younger patients with medial compartment osteoarthritis of the knee, there are some potential complications after surgery. It was reported that proximal fibular osteotomy (PFO) improves the function of the knee joint and effectively relieves the pain, especially in medial compartment knee osteoarthritis. The novel technique is relatively safe, simple, and affordable, and may delay the need for TKR [3-5]

In the present study, we evaluated the short-term efficacy of PFO in comparison with HTO as regardsUNDER PEER REVIEWradiological and functional outcomes.

Aim of work

We aim to compare the functional and radiological outcomes of proximal fibular osteotomy (PFO) in medial compartment decompression, with medial opening wedge high tibial osteotomy (HTO), through a randomized clinical study (using the standard technique HTO as the control group to be compared with the novel technique; PFO as the case group).

Patients and methods

This prospective randomized clinical trial was done after approval by The Ethical and Research Committee of the Faculty of Medicine, Suez Canal University.

Patients who suffered from the manifestation of medial compartment osteoarthritis of the knee joint were allocated into two groups: The control group; 16 patients representing the standard HTO technique and the Case group; 16 patients representing the novel technique PFO. Subjects" allocation was randomized to avoid any bias.

Randomization of patients was done using computer-generated randomization by Random Allocation Software into 2 groups: group A (patients treated by PFO) and group B (patients treated by HTO).

Inclusion criteria:

Patients were eligible for inclusion if they met the following criteria:

- Middle age group ≤ 60 years with no difference in sex.
- Medial compartment knee osteoarthritis grade II, III (Kellgern & Lawrence classification).
- Patients already exhausted conservative measures
- Varus deformity grade I-II (FemoroTibial angle <15°)..
- Elder age group (> 60 years old).
- Severe Medial compartment knee osteoarthritis grade IV (Kellgern & Lawrence classification).
- The patient underwent any surgical intervention on the knee in the previous 6 months (e.g. arthroscopic debridement).
- Severe varus deformity (Femoro-Tibial angle >15°).
- Inflammatory joint disease e.g. Rheumatoid arthritis, Psoriatic arthritis, and gouty arthritis

Operative technique:

Proximal fibular osteotomy:

After preoperative evaluation and preparation of the patients, the operation was done under general or spinal anesthesia. A 3- to 5-cm lateral incision was made at the proximal third of the fibula to avoid injury to

the common fibular nerve and the tibial attachments of the soft tissue structures crossing the knee joint. The fascia was then incised parallel to the septum between the peroneus and soleus; the muscles were separated, and the fibula was exposed. A 2-cm section of the fibula was removed at the fibular neck 6 to 10 cm below the fibular head with an oscillating saw or using multiple drill holes at the proximal and the distal level of the osteotomy to avoid using the saw blades and prevent inadvertent injury to the common peroneal nerve.**(Figure 1)**

Medial Open wedge high tibial osteotomy:

A 5-cm vertical incision is made over the center between the medial aspect of the tibial tuberosity and the posteromedial aspect of the tibia below the joint line. After identifying the medial border of the patellar tendon, subperiosteal dissection is performed from the tibial tuberosity to the posteromedial aspect of the tibia. Two guide wires are inserted at a point 3.5-4 cm below the medial joint line and passed obliquely 1 cm below the lateral articular margin of the tibia towards the tip of the fibular head. After checking the appropriate location with a fluoroscope, a tibial osteotomy is performed immediately below the guide wires using an oscillating saw or an osteotome. Once the desired degree of correction is achieved, internal fixation of a metal plate is performed. **(Figure 2)**

Post-operative assessment:

Immediately after surgery, patients were placed in knee immobilizer, X-ray long film standing (AP and lateral views), Overnight stay for elevation, pain management, anti-coagulant, anti-inflammatory drugs, Broad spectrum antibiotic for 14 days post-operative.

Patients were assessed to evaluate functional and radiological assessment by using the Visual Analogue Scale of Pain (VAS) [(6)], Knee Society Score [(7)]. and Radiological assessment of medial joint space of the knee by mm[(8)].

Statistical Analysis

Data were collected, revised, coded, and entered into the Statistical Package for Social Science (IBM SPSS) version 23. The quantitative data were presented as mean, standard deviations, and ranges when their distribution was found parametric and median with inter-quartile range (IQR) when their distribution was found non-parametric. Also, qualitative variables were presented as numbers and percentages. The p-value was considered significant as the following: $P > 0.05$: Non-significant, $P < 0.05$: Significant, $P < 0.01$: Highly significant.

Results

The mean age was 43.8 ± 10.8 and 47 ± 13.3 years among groups A and B respectively. Females were more common among both groups (75% in both groups). The mean BMI was 30.8± 4.2 and 31.8± 4.7 Kg/m^2. Unemployed represented 50% and 56.3% among groups A and B respectively. No significant difference between the two groups regarding sociodemographic data. **(Table 1)**

Regarding preoperative evaluation, the mean HKA angle was 2.6 ± 0.7 and 3.0 ± 0.7 among groups A and B respectively. According to Kellgren- Lawrence grade, grade II was common among both groups (62.5% vs 43.8%). The mean KSS score was 65.3± 3.5 and 67.2± 5.4 while VAS was 7.8 ± 1.1 and 7.4 ± 0.9

among groups A and B respectively.

The mean radiological assessment score was 1.7± 0.4 and 1.9± 0.5 among groups A and B respectively. No statistically significant difference between the two studied groups regarding preoperative assessment of HKA angle, Kellgren- Lawrence grade, VAS, KSS score, and radiological data. **(Table 2)**

KSS scores at 3 months and 9 months were significantly higher among group A than B. No significant difference was found between both groups regarding KSS 6 months and 12 months. **(Figure 3)**

Radiological assessment at 3 months was significantly higher among group B than A. No significant difference was found between both groups regarding radiological assessment at 6 months, 9 months, and 12 months. When comparing changes from radiological assessment preoperative to postoperative, it showed a significant difference among both groups.**(Table 3)**

Discussion

Osteotomy offers an alternative surgical option to total knee replacement in reducing pain and improving function, especially in younger and more physically active people with Osteoarthritis of the knee [(8)].

Knee osteoarthritis (OA) is a chronic, slowly progressive degenerative disease with accompanying joint pain, stiffness, and deformity. Disability is due to pain and limitation in the range of motion[(9)].PFO and HTO both are common procedures. **(Table 4**) done for patients with osteoarthritis not responding to conservative management including physiotherapy [(10)].

The medial compartment of the tibiofemoral (TF) joint is often involved in the varus deformity of the lower limbs. Unbalanced load distribution between the medial and lateral compartments caused by varus deformity is the main cause of pain, which deteriorates the quality of life of these patients [(11)].

In the current study, the mean age was 43.8 ± 10.8 and 47 ± 13.3 years among PFO and HTO respectively. In an Egyptian study by Khalil *et al.*, (2021) conducted among patients with mean age (45.05 ± 6.35 years).Consistently[(12)], Datta *et al.*, (2022) agreed that the majority of the patients in the present study were more than 45 years of age. The most frequent age group was 46-50 years followed by 51-55 years [(13)].

This study agreed that high BMI was common among knee osteoarthritis the mean BMI was (30.8± 4.2 and 31.8± 4.7 Kg/m^2). Similarly, Mahadik *et al.*, (2021) agreed that high BMI was common among patients with osteoarthritis (20 (66.6%) patients were obese or overweight, and 22 (73.33%) patients were either obese or overweight among PFO and HTO groups) [(14)].

In this study, the operative duration was significantly longer among patients treated by HTO compared to patients treated by PFO (37.2± 4.8 minutes vs. 25.9± 6.4 minutes). Our results support a meta-analysis by Wu *et al.*, (2022), the pooled result showed that the difference was statistically significant between the PFO group and the HTO group with higher duration among group HTO (P<0.00001) [(15)].

In the current study, the mean preoperative KSS score was 65.3± 3.5 and 67.2± 5.4 among PFO and HTO respectively. KSS scores at 3 months and 9 months were significantly higher among PFO than HTO. No significant difference was found between both groups regarding KSS 6 months and 12 months. When comparing changes from KSS preoperative to postoperative, it showed a significant difference among both groups. Preoperative. Similar to our results, a meta-analysis by Sugianto *et al.*, (2021) included a total of 907 patients and 1012 knees and found that PFO successfully ameliorated patients' knee function [(16)].

The current study declared that VAS, KSS, and radiological assessment were significantly improved postoperative among PFO and HTO. Similarly, Zhang, (2015) found that the mean visual analogue scale scores significantly decreased from 8.02±1.50 preoperatively to 2.74± 2.34 postoperatively. The mean knee and function sub-scores of the American Knee Society score were 44.41±8.90 and 41.24±13.48, respectively. Postoperatively, they significantly improved to 69.02±11.12 and 67.63±13.65 [(17)].

The limitations of this study include its lack of a study group and the possibility of bias due to relatively small sample size and short-term follow-up. Further clinical trials and biomechanical studies are needed to validate these results.

Conclusion

Proximal fibular osteotomy might be a safe alternative treatment to high tibial osteotomy with better functional and radiological outcomes. PFO is preferred by shorter operative duration with no need for fixation, in addition to comparable postoperative complications between PFO and HTO.

Consent

Written consent was obtained from all patients after full explanation of hazards and benefits of the management procedure that was performed for each patient before getting them involved in the study (carried out by the researcher).

Ethical Approval

The patients have the right to refuse participation without affecting the medical care expected to be offered to the patient.

The patients have the right to withdraw from the study at any time.

Procedure expenses will be covered by National Health Insurance Authority.

Confidentiality of all data of all the study population is preserved.

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Legend of figures

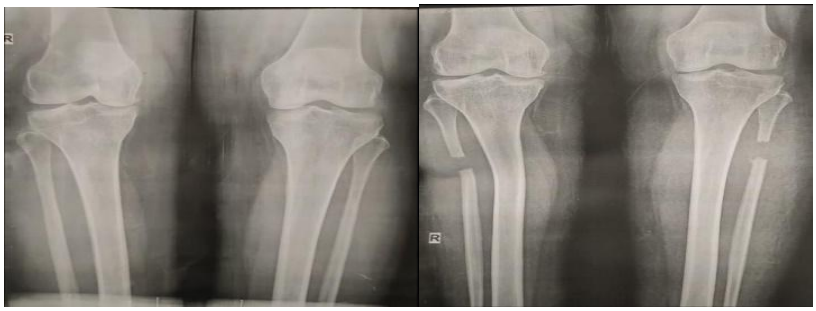

Figure 1: Preoperative and one-year postoperative standing X-ray of both knees (AP and lateral views) shows medial compartment knee osteoarthritis type 2 and also shows good improvement in the radiological assessment of the medial joint space of both knees.

Figure 2: One-year follow-up post-operative standing X-ray of both knees AP and lateral views by high tibial osteotomy.

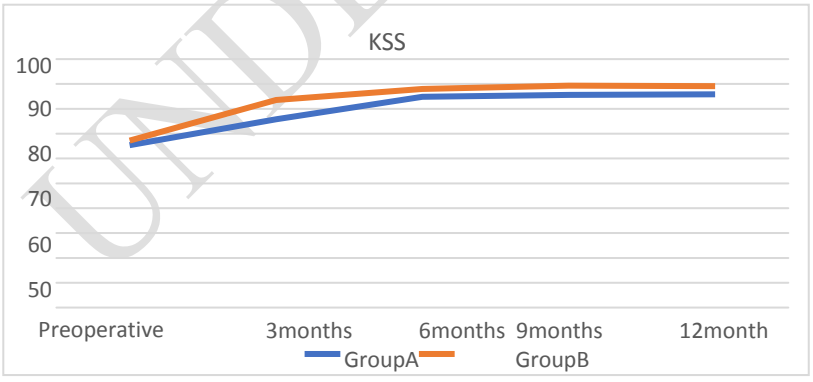

Figure 3. Comparing the KSS score between the two studied

Legend of Tables

Table 1. Sociodemographic data of the included groups.

Variable		Group A n= 16	Group B n= 16	P value
Age (years)	Mean ± SD	43.8 ± 10.8	47 ± 13.3	0.381
	Median (range)	48 (22, 56)	48.5 (20, 64)	
Gender	Male,NO (%)	4 (25)	4 (25)	>0.999
	Female,NO (%)	12 (75)	12 (75)	
Occupation	Employed, NO (%)	8 (50)	7 (43.7)	>0.999
	Unemployed, NO (%)	8 (50)	9 (56.3)	
BMI (Kg/m^2)	Mean ± SD	30.8± 4.2	31.8± 4.7	0.669
	Median (range)	32.1 (23.6, 34.9)	30.4 (26.3, 40.5)	

Table 2. Preoperative evaluation among the participants.

Variable		Group A n= 16	Group B n= 16	P value
HKA angle	Mean ± SD	2.6 ± 0.7	3.0 ± 0.7	0.089
	Median (range)	2.6 (1.4, 3.6)	3.2 (1.8, 4.2)	
Kellgren-Lawrence grade	I	4 (25)	5 (31.3)	0.643
	II	10 (62.5)	7 (43.8)	
	III	2 (12.5)	4 (25)	
KSS score	Mean ± SD	65.3± 3.5	67.2± 5.4	0.085
	Median (range)	64.5 (60, 72)	69.5 (53, 74)	
VAS score	Mean ± SD	7.8 ± 1.1	7.4 ± 0.9	0.300
	Median (range)	8 (5, 9)	7 (6, 9)	
Radiological assessment	Mean ± SD	1.7± 0.4	1.9±0.5	0.208
	Median (range)	1.8 (1.1, 2.2)	1.8 (1.2, 2.8)	

Table 3. Postoperative radiological assessment among the two studied groups.

Variable		Group A n= 16	Group B n= 16	P value
Radiological assessment preoperative	Mean ± SD	1.7± 0.4	1.9±0.5	0.208
Radiological assessment 3 months	Mean ± SD	2.5± 0.4	2.9± 0.7	**0.024***
Radiological assessment 6 months	Mean ± SD	3.7± 0.7	3.6± 0.9	0.931
Radiological assessment 9 months	Mean ± SD	3.9± 0.9	3.9± 0.8	0.881
Radiological assessment 12 months	Mean ± SD	4.2± 0.8	3.9± 0.9	0.405
P value (pre and postoperative)		**<0.001***	**<0.001***	