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Proximal Fibular Osteotomy in Treatment of Unicompartmental Osteoarthritis

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Abstract

Consider PFO as an alternative to high tibial osteotomy in some cases (HTO). Osteoarthritis in the medial compartment of the knee is treated surgically (KOA). There are various benefits of PFO over HTO. First and foremost, the surgical procedure is straightforward and straightforward. A smaller incision, little tissue dissection, and no internal fixation are some of the advantages of this procedure. In addition, the recuperation time after surgery is much quicker than it would be with HTO. In addition, HTO problems might have a negative impact on a patient's prognosis. The study's goal was to examine the functional and radiological outcomes of proximal fibular osteotomy treatment for medial compartment osteoarthritic knees. Methods: Our research comprised 20 patients with medial compartment knee osteoarthritis who had proximal fibular osteotomy between January 2018 and June 2019. Early findings of proximal fibular osteotomy for the treatment of medial compartment knee OA are shown in this research. Clinically, after three, six, nine, and twelve months after surgery, knee function was evaluated with KSS and radiographically, by measuring medial and lateral joint space. There was a substantial rise in KSS scores from 46.80 preoperatively to 82.05 at the 12th month postoperatively in this research (p 0.001). This research shows a considerable increase in medial joint space. In this research, the average lateral joint space change was 7.5 mm. Over the course of all planned follow-up visits, significant decrease was seen. All patients who underwent PFO reported feeling less discomfort in the midsection. Unicompartmental Osteoarthritis may benefit from PFO treatment. To determine whether the positive benefits of PFO are long-lasting, future studies will need to follow up for a longer length of time.

Key words: Proximal Fibular Osteotomy, Unicompartmental Osteoarthritis.

1. Introduction

In terms of OA, knee osteoarthritis (OA) is the most frequent. The medial compartment is a popular place to find it. An estimated 37 percent and 12 percent of the senior population over 60 years old had knee OA, and the lifetime risk of knee OA symptoms was determined to be around 44 percent [1].

Up to 34% of women and 31% of men over the age of 70 had radiological evidence of OA grade 3–4. Subjects under the age of 70 had a frequency of 27%, rising to 44% in those beyond the age of 80 [2].

More than 10,000 people in Sweden were investigated for the prevalence of radiographic OA (grade 2 Kellgren-Lawrence (KL)). 15.4% of patients had symptoms of OA, and 25.1% of them complained of regular knee discomfort [3].

Surgery for knee osteoarthritis (KOA) has so far focused mostly on arthroscopic techniques, total and unicompartmental arthroplasty (TKA and UKA) or high tibial osteotomy (HTO). Since recently, a new therapy for KOA, proximal fibular osteotomy (PFO), has been presented. More people in China and India than anywhere else are opting for this surgery [4].

Due to the fact that this process is less complicated, less costly and less time-consuming than other procedures like HTO, UKA, and TKA; it has been more popular in recent years. Helps to move the loading strain from the medial compartment further laterally for correcting a varus deformity in KOA. Since the pain is reduced and functional recovery is achieved, it serves as an aid [5].

In order to repair the varus deformity, the loading force from the medial compartment might be shifted more laterally due to the weakening of the lateral fibular support caused by PFO. Comparatively, PFO is a relatively low-risk investment [6].

The study's goal was to examine the functional and radiological outcomes of proximal fibular osteotomy treatment for medial compartment osteoarthritic knees.

2. Patients and Methods

Duration of the study: from January 2018 to June 2019.

Site of the study: Benha university Hospital and Naser Institute Hospital.

Gender of cases and side of the disease: Twenty patients, 8 males (Lift side =3, Right side =5) and 12 females (Lift side =2, Right side =10).

This study was approved by the ethical committee of Benha University Hospital and was conducted in accordance with Declaration of Helsinki.

The inclusion criteria:

Patients with moderate to severe symptoms of the knee over kellegran and Lawrence (KL grade) on radiographs [7]:

- Age > 40years
- Isolated medial compartment arthritis
- Medial joint space present on weight bearing x rays > 2 mm
- Bmi <32
- Varus < 10"
- Severe OA Knee

The exclusion criteria:

Patients with data not in the inclusion criteria or with:

- Rheumatoid arthritis
- Posttraumatic arthritis
- Congenital deformities of lower limb
- Joint infection
- History of ligament or meniscus injury.

Clinical evaluation:

On admission, all patients were evaluated clinically, radiologically and functionally.

Clinical data included gender, age, duration of symptoms and grading systems. The latter included Visual analogue scale (VAS) grading system: is a self-report measure by patient himself, which ranged preoperatively from 7 to 10 and after two months postoperatively from 3 to 5 and after four months from 3 to 7. The other grading system is Knee Society score (KSS score), which consisted of both clinical score and function score [8]. The clinical score of KSS major includes pain, stability and range of motion. In addition, the function score focuses on the activities of the patient.

Radiographic evaluation

- Plain x-ray (both knee AP view standing position, lat. view, skyline view, AP in 45^{o}).
- CT if needed and MRI if needed.

In this study, radiological factors included hip-knee-ankle angle (HKA angle), (9), KL grade (7), joint space width of both compartments. The HKA angle was measured on spliced images of total length lower extremities and all other measurements were made on weight-bearing AP radiographs. Briefly, the medial joint space was determined by a vertical line

(A) between two horizontal lines (C and D) that were drawn from the lowest point of the medial condyle of the femur and medial plateau of the tibia, respectively. The lateral joint space was determined by a vertical line (B) between two horizontal lines (E and F) that were drawn from the lowest point of the lateral condyle of the femur and lateral plateau of the tibia, respectively. The ratio of the knee joint space (medial/lateral) was determined by the ratio of A/B (Fig. 1).

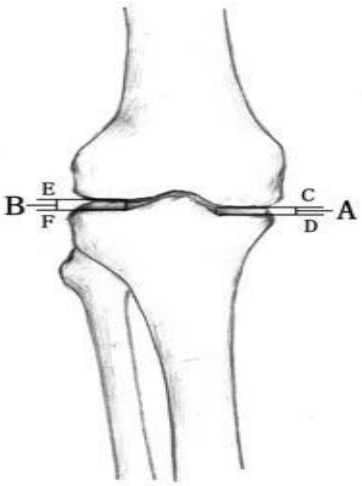

Fig. (1) Measurement of ratio of knee joint space. The medial joint space was determined by a vertical line (A) between two horizontal lines (C and D) that were drawn from the lowest point of the medial condyle of the femur and medial plateau of the tibia, respectively. The lateral joint space was determined by a vertical line (B) between two horizontal lines (E and F).

Surgical technique

After obtaining informed consent and anaesthetic fitness, the patients were taken up for the procedure. The surgery was performed with the patient in the supine position under spinal anaesthesia and tourniquet was inflated. The fibular head was marked and the osteotomy site was determined to be 7 to 9 cm from the head of fibula. The rationale behind choosing this level of osteotomy is that an osteotomy at a higher level would be likely to cause an injury to the common peroneal nerve while if it was done any lower down that the effect of the osteotomy on the medial compartment arthritis would be lost. A 5-8 cm lateral incision was made overlying the chosen site of osteotomy and dissection was carried out through the skin and subcutaneous tissues. The peroneus and soleus muscles were then separated to expose the periosteum of the fibula which was then incised and a 1.5 to 2 cm of fibula was then resected with the help of an oscillating saw after placing a few drill holes at the osteotomy site. (Figure 10) Curved homann retractors were placed behind the fibula prior to osteotomy and care was taken not to stretch the soft tissues too much in order to protect the nerve from potential damage. Occasionally after the osteotomy some of the fibulae tend to bleed quite profusely and in that situation bone wax was used to seal the cut ends of the bone. After ensuring heamostasis and giving wound wash, closure was done in layers and sterile dressing and compression bandage applied.

Postoperative care and follow up:

All patients were encouraged to stand and walk on the same evening of surgery and were discharged on the third postoperative day after the first wound inspection. Intravenous antibiotics for given for 3 days followed by oral antibiotics for a period of 5 days. The sutures were removed on the 12th postoperative day. Postoperative weight bearing X rays were then taken and the radiological parameters were evaluated and documented. Patients were reviewed at 1, 3, 6 months and at the end of the first year where the VAS and the knee society scores were evaluated and documented (fig. 2).

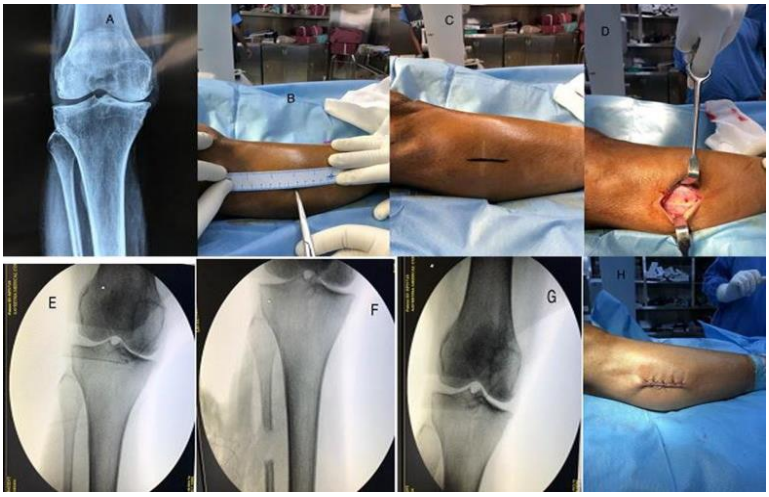

Fig. (2) Surgical procedure and follow up A: preoperative standing radiograph of knee showing decrease in medial joint space. B: marking a point 7-9cm from the head of fibula .C: Line of incision marked. D: Dissection carried out through perneus and soleus muscles. E: C-ARM image prior to osteotomy. F: Fibular osteotomy done .G: Post osteotomy c-arm image showing an increase in medial joint space. H: Wound closure.

Statistical analyses:

The data collected was analyzed using IBM SPSS (Version 22.0. Armonk, NY: IBM Corp). Chi square test was used in the comparison of categorical variables. A P value of less than 0.05 was considered to be statistically significant.

3. Results

A total of 20 patients (20 knees) were included in this study out of which 8 knees (Lift side =3, Right side =5) were of males and 12 knees (Lift side =2, Right side =10) were of females. There was a female predominance seen in our study with the right knee being more commonly affected. The age of the patients ranged from 44 to 66 years with the mean age being 56.6 years. The body mass index (BMI) of the patients ranged from 24 to 32 with the mean BMI being 28 Regarding the grade of osteoarthritis , there was 4 cases grade II, 14 cases grade III, 2 cases grade IV. Regarding side of knee ,there is 15 knees which were right ,5 knees which were left.

Average duration of the symptoms from 18 months to 58 months with mean 35.15 ±12.11. With average varus deformity from 5 degree to 10 degree (Tables 1, 2).

Table (1) Patients' demographic characteristics.

		-All patients (n= 20)		
		Mean ± SD	**Minimum**	**Maximum**
Age (years)		56.60 ± 6.30	44.00	66.00
BMI		28 ± 4.38	24	32
Gender	**Male**		40% (8)	
	Female		60% (12)	
Data is expressed as mean and standard deviation, Minimum, Maximum.				
	II		20% (4)	
	III		70% (14)	
Osteoarthritis grade	**IV**		10% (2)	
	Right		75% (15)	
Side	**Left**		25% (5)	
Data is expressed percentage and frequency.				

Table (2) Medical history of osteoarthritis in the studied patients.

	All patients (n= 20)		
	Mean ± SD	**Minimum**	**Maximum**
Duration of complain (months)	35.15 ± 12.11	18	58
Presence of neurovascular affection		0% (0)	
Presence of deformity		Genu varus (5-10°)14 cases	
Data is expressed as mean and standard deviation, Minimum, Maximum.			

Knee society score: is the sum of clinical knee score and function score which in totally show improvement from preoperative 28 to 70 with mean 46.80 ± 12.668 points and 3 months postoperatively was range from 36 to 79 points with

mean 54.35 ± 12.629 points after 12 months postoperative was range from range from 54 to 94 points with mean 82.05 ± 10.73 points (Table 3).

Table (3) preoperative and postoperative follow-up values of Knee Society score.

AKS score	All patients (n= 20)		
	Mean ± SD	**Minimum**	**Maximum**
Pre-operative	46.80 ± 12.668	28	70
3 months	54.35 ± 12.629	36	79
6 months	63.45 ± 13.736	42	87
9 months	73.75 ± 13.699	50	93
12 months	82.05 ± 10.738	54	94

Data is expressed as mean and standard deviation, Minimum, Maximum

A repeated measures ANOVA model was conducted to compare the Basal and follow-up values of AKS score of the studied patients. Complete data was available at all time points for all patients. Mauchly's test of sphericity indicated that the assumption of sphericity had been violated ($\chi 2$= 35.6, p= 0.001) with Huynh-Feldt epsilon of 0.634, therefore the Huynh-Feldt epsilon corrected test results were reported.

There was a significant variation in the AKS score throughout follow up period (F= 159.1, df 2.54, P= < 0.001). Comparisons of the follow-up levels were conducted for all cases within the model against the respective basal level. Significant statistical difference was considered when p value was 0.05

In this study, radiographs of the weight- bearing lower extremity showed an average increase in the medial knee joint space postoperatively compared with preoperatively (Table 4). And average decrease in the lateral knee joint space postoperatively compared with preoperatively (Table 5).

Table (4) preoperative and postoperative follow-up values of medial knee joint space.

medial joint space measured by mm.	All patients (n= 20)		
	Mean ± SD	**Minimum**	**Maximum**
preoperative	2.3+-0.8	5	2.1
3 months	3.8+-.5	2.3	4.3
6 months	4.2+-.6	3.6	4.8
9 months	6.5+-.7	5.8	7.2
12 months	7.2+-.1	6.1	7.6

Data is expressed as mean and standard deviation, Minimum, Maximum in mm

A repeated measures ANOVA model was conducted to compare the preoperative and follow-up values of medial joint space of the studied patients. Complete data was available at all time points for all patients. Mauchly's test of sphericity indicated that the assumption of sphericity had been violated ($\chi 2$= 26.91.4, p= 0.002) with Huynh-Feldt epsilon of 0.649, therefore the Huynh-Feldt epsilon corrected test results were reported.

There was a significant variation in the medial joint space throughout follow up period (F= 154.3, df 2.59, P= < 0.001). Comparisons of the follow-up levels were conducted for all cases within the model against the respective basal level. Significant statistical.

Table (5) Comparison of preoperative and postoperative follow-up values of lateral knee joint space.

Lateral knee joint space	All patients (n= 20)		
	Mean ± SD	**minimum**	**Maximum**
Preoperative	7.5 ± 0.958	7.1	7.8
3 months	7.2 ± 0.842	6.9	**7.5**
6 months	6.3 ± 1.035	5.8	**6.7**
9 months	5.7 ± 1.185	5.1	**6.2**
12 months	5.26 ± 1.386	4.9	**5.4**

Data is expressed as mean and standard deviation, minimum, maximum in mm.
P is significant when 0.05.

A repeated measures ANOVA model was conducted to compare the preoperative and follow-up values of lateral joint space of the studied patients. Complete data was available at all time points for all patients. Mauchly's test of sphericity indicated that the assumption of sphericity had been violated ($\chi 2$= 26.91.4, p= 0.002) with Huynh-Feldt epsilon of 0.649, therefore the Huynh-Feldt epsilon corrected test results were reported.

There was a significant variation in the lateral joint space throughout follow up period (F= 154.3, df 2.59, P= < 0.001). Comparisons of the follow-up levels were conducted for all cases within the model against the respective basal level. Significant statistical difference was considered when p value was 0.05.

4. Discussion

Twenty patients with medial compartment osteoarthritis received proximal fibular osteotomy for the purposes of our research. The average age of the patients included in the study was 56.6 years.

The same viewpoint was used in other trials, which comprised 47 patients with a mean age of 63.96 years (with a range of 48 – 78 years) [10].

Another research comprised 30 patients with medial compartment osteoarthritis, ranging in age from 42 to 54 years old, with a mean age of 48.4 [11].

The BMI of the individuals who took part in this research was on average 28 kilogrammes per square metre (range, 24. 32).

In accordance with a previous research, the mean BMI of the participants was 27.38 kg/m2 [12].

During the current study's history-taking, the average length of time that patients had been ill was 35.15 months. Fourteen patients were found to have genu varus deformity.

According to a different research, the average age of the patients was 59.458.82 years (ranging from 43 to 86 years) and the illness duration was 6.575.37 years (from 0.1 to 25 years) [13].

After proximal fibula osteotomy, a 51-year-old man's femoral abduction increased by 5° to 7°, femoral external rotation increased by 5° to 8°, and joint line translation increased by 2 to 5 mm distally. Increasing valgus, femoral external rotation, and distal translation of the knee in the kinematics of the knee may help alleviate knee discomfort and promote functional recovery early on [14].

For medial joint space alterations in this research, the mean preoperative value was 1.3 mm, and the following values were observed at 3-, 6-, 9- and 12-month follow-ups (p 0.001): (1.8,2.2,3.5,4.

When it comes to alterations in the lateral joint space, the mean value was 7.6mm. At 3-, 6-, 9-, and 12-month follow-up, a significant decrease was seen (7.2, 6.3, and 5.7 mm, respectively) (p 0.001).

After the procedure, Prakash and his colleague noticed a significant rise in the medial joint space (p 0.001). That's an increase of around one-and-a-half microns in width. Additionally, the postoperative decrease in the lateral joint gap was also consistent. It went down from 7.4 to 5.8 millimetres (P =.001). [15].

A two-year research of 110 patients indicated that proximal fibular osteotomy might dramatically enhance the radiographic look and function of the affected knee joint, as well as provide long-term relief from pain [16].

The preoperative American Knee Society score of 46.80 rose to 54.35, 63.45, 73.75, and 82.05 at the previously planned follow-up visits in this research (p 0.001).

American Knee Society score knee and function subscores averaged at 44.41 and 41.24 in a separate research project. After surgery, their scores improved dramatically, rising to 69.02 and 67.63 points, respectively [10].

Medial compartment arthritis affected 111 knees in 84 participants in a research by Bo Liu et al. There were 49.1410.95 and 44.9717.1 preoperative KSS (Knee society score) and functional scores of 67.7711.08 and 64.6613.12, respectively, after surgery. The clinical outcomes of 51 knees were good, whereas 77 knees showed a considerable improvement [13].

Wang et al. Proximal fibular osteotomy was performed on 47 patients with medial compartment osteoarthritis between January 2015 and May 2015. Only one of the 47 patients who received PFO surgery was able to be tracked for the whole 12-month period required. After PFO, all patients saw a significant reduction in discomfort. Mean visual analogue scale scores reduced from 8.02 preoperatively to 2.74 after surgery. There were 44.41 and 41.24 mean knee and function American Knee Society subscores prior to surgery. After surgery, their scores improved dramatically, rising to 69.02 and 67.63 points, respectively [10].

Preoperatively, the Knee score varied from 24 to 55 with a median of 43.5, and two months after surgery, it jumped from 40 to 67 with a median of 55. Additionally, the Function score, which varied from 20 to 60 before surgery with a median of 35, rose to 50 two months after surgery from 30 to 70 with a median of 50. As a result, the postoperative median Knee Society score increased from 83 to 105, which is the sum of the Knee Society score and the Knee Function Score [4].

According to Wang et al., the medial/lateral compartment knee joint space ratio increased considerably postoperatively from 0.40 preoperatively to 0.58. [10].

High tibial osteotomy (HTO) vs proximal fibula osteotomy, a comparative study For medial compartment knee osteoarthritis, proximal fibular osteotomy (PFO) is an alternate therapy to high tibial osteotomy (HTO) (KOA). PFO provides a number of benefits over HTO. To begin, the surgical procedure is straightforward and quick to carry out. A smaller incision, little tissue dissection, and no internal fixation are some of the advantages of this procedure. In addition, the recuperation time after surgery is much quicker than it would be with HTO. In addition, HTO problems might have a negative impact on a patient's prognosis. PFO, on the other hand, has a low risk of problems. Re-alignment of the lower extremities, via HTO, helps alleviate KOA symptoms. HTO, on the other hand, aims to rectify the alignment. [17].

Proximal fibula osteotomy coupled with arthroscopic debridement was reported to provide superior pain alleviation and an improved Knee Society Score than arthroscopic debridement alone. As a means of treating knee malalignment and disease, proximal fibula osteotomy coupled with arthroscopic debridement may be used to treat medial knee osteoarthritis with varus [18].

It was recently discovered that proximal fibular osteotomy had an impact on knee joint and ankle pressures

and tibia strain in a cadaveric investigation in Canada. Compression testing was carried out on 10 pairs of cadaver legs that were matched for length and weight, with the intact and proximal fibular osteotomized legs being evaluated at three different flexion angles of 0, 15, and 30 degrees. To monitor pressure, force, and contact area, sensors were implanted into the knees and ankles. Osteoarthritis patients with medial compartment knee osteoarthritis may benefit from proximal fibular osteotomy, which reduces knee discomfort and improves function [19].

The small sample size, short follow-up time, and lack of a control group all contributed to the study's drawbacks.

5. Conclusion

PFO looks to be an excellent treatment for Unicompartmental Osteoarthritis. Future investigations with terms to a longer duration of follow up is important to assess if the favourable benefits of PFO are maintained over a period of time.

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