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OUTCOMES OF PROXIMAL FIBULAR OSTEOTMY

Orthopaedics

Dr Nibin Sanil Resident , Vydehi Institute of Medical Science and Research Centre (VIMS&RC), Bangalore.
Dr Alvin Sajan Resident, Navodaya medical college and research centre , Raichur.
Dr Hiranya Kumar Professor, vydehi institute of medical science and research centre (VIMS&RC), Bangalore.

KEYWORDS

INTRODUCTION

Osteoarthritis (OA) is a chronic disorder of synovial joint in which there is progressive softening of articular cartilage accompanied by growth of osteophyte, subchondral sclerosis and cyst formation[1] and it is the most common form of arthritis leading to joint dysfunction. Recent studies have demonstrated great interest in 'early osteoarthritis' and the need to understand the definition of early osteoarthritis is necessary as to develop new method of treatment to prevent progression and severe structural changes at an early stage before any irreversible change[2]. Early symptomatic knee OA (ESKOA) was defined in the presence of (I) two mandatory symptoms (knee pain in the absence of any recent trauma or injury and very short joint stiffness, lasting for less than 10 min at the start of movement) even in the absence of risk factors, or (II) knee pain, and 1 or 2 risk factors or (III) three or more risk factors in the presence of at least one mandatory symptom, with symptoms lasting less than 6 months without active inflammatory arthritis, generalized pain, Kellgren-Lawrence grade >0, any recent knee trauma or injury, and less than 40 years of age[3]. Commonly used non-pharmacological methods for medial compartment osteoarthritis are lateral wedge insoles, bracing.[4] High tibial osteotomy is a commonly accepted method of treatment for medial compartment osteoarthritis in young and active patients[5]. The complications of high tibial osteotomy are osteotomy site non-union, loss of correction angle and delayed weight bearing,

In this scenario, there is a need for a procedure which is simple to perform, gives good functional results, with a shorter recovery period. PFO is one such procedure. The theory behind it is that, there is an asymmetric load transmitted across both tibial plateaus leading to the development of a Varus deformity. PFO acts by weakening the support laterally and shifts the stress to the lateral compartment[6,7].

MATERIALS AND METHODS

This study obtained institutional review board approval (No. ECR/747/inst/KA/2015). All patients agreed to participate in this study and provided written informed consent.

Study population

From January 2019 to June 2020, patients with medial compartment knee osteoarthritis admitted in Orthopaedics ward from OPD of VIMS & RC, Bangalore. Inclusion Criteria were patients between 40-65 years of age and both sexes, patients with osteoarthritis involving only medial compartment of knee joint, medial compartment osteoarthritis with a Kellgren-Lawrence grade <3 points and BMI less than 30. The Exclusion criteria are post traumatic knee osteoarthritis and inflammatory joint disease.

Surgical procedure

Under spinal anesthesia, the patients were placed in the supine position with a lower limb tourniquet inflated. 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 a fretsaw. Following resection, the fibula ends were sealed with bone wax. After irrigation of the incision with a large volume of normal saline, the muscles, fascia, and skin were sutured separately

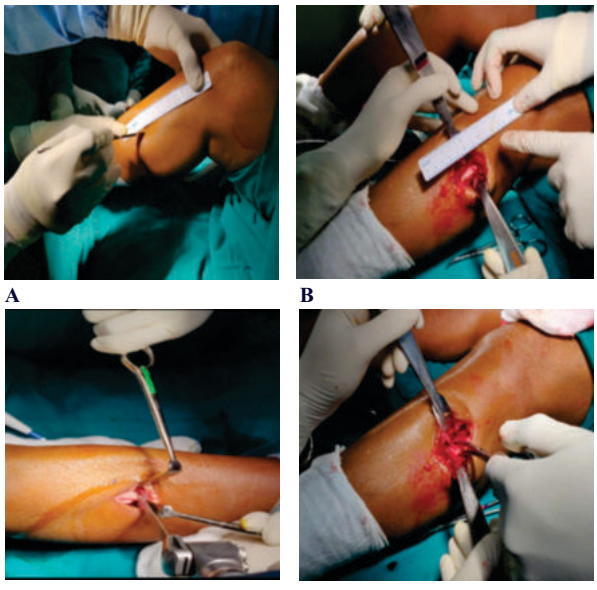


Figure 1. (a) Surface marking for PFO, (b) Measurement of fibular graft, (c) Osteotomy using bone saw, (d) Resected fibula and soft tissue closure

Postoperatively, the patients were ambulated as soon as pain could be tolerated. The patients were routinely ambulatory by the third postoperative day

Preoperative and postoperative weightbearing and bilateral scanogram were obtained in all patients to analyze the alignment of the lower extremity and the ratio of knee joint space (medial/ lateral compartment). 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.(figure2)

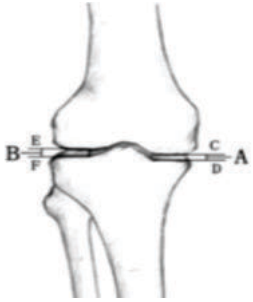


Figure 2: Measurement of knee joint space

The hip knee-ankle angle was measured based on a scanogram of lower limb. Line A was drawn from the center of the femur to the center of the knee, and line B was drawn from the center of the knee to the

center of the ankle. The hip-knee-ankle angle was the intersection angle a between lines A and B[6].(figure3)

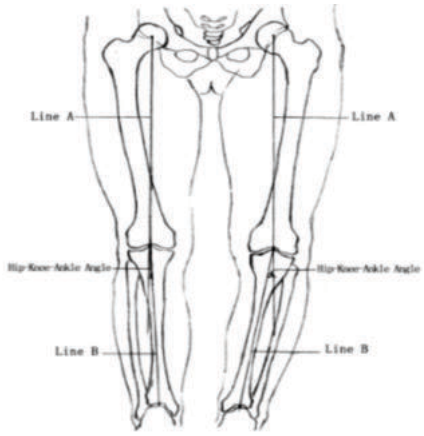


Figure 3: Hip Knee Ankle Angle
The patients are evaluated at 3, 6, 12 months by radiographs, pain scale and American Knee Society Score[8].

Statistical analyses
The statistical analysis was performed with excel 2011 and SPSS version 21 software package. The normal distribution of the measured variables was verified using the Shapiro-Wilk test, and the homogeneity of variances was verified using fisher's *f* test and Levene's test to ensure the condition has been met for parametric testing. The significance threshold was met at $p<0.05$.The descriptive analysis consisted of mean, median, and SD values. A comparative analysis was performed using the paired student *t* test or chi square test.

RESULTS
During the period from January 2019 to June 2020, 30 cases of medial compartment osteoarthritis (each knee considered as 1 patient) were treated for osteoarthritis with proximal fibular osteotomy in Vydehi Institute of Medical Sciences and Research Centre, Bangalore.

These patients were followed for a maximum of 1 year and some patients were followed up for a minimum period of 6 months. Data was collected based on detailed patient evaluation with respect to history, clinical examination and radiological assessment. The postoperative evaluation was done using both clinically and radiologically

Table1: Distribution of Cases according to Age

Descriptive Statistics	Min	Max	Mean	SD
Age(yrs)	45	62	52.9	5.8

Table 1 shows age distribution of patients. The average age was 52.9years±5.8 SD. Oldest patient was 62 years and youngest patient was 45 years. In this study , a maximum number of patients was found to be in the 5th decade of life with a mean (standard deviation (SD)) age of 52.9 (±5.8) years

Table:2 Distribution of Cases according to Sex

Sex	N	Percentage
Male	9	60
Female	6	40
Total	15	100

Table 2 shows sex distribution of patient. Most of the patient found to be 9 male patients (60%) and 6 female patien

Table:3 Distribution of Cases according to Complication

complication	patient		percentage	
	Right side	Left side	Right side	Left side
EHL weakness	6	6	40%	40%
Decrease sensation over dorsum of foot	4	3	26%	20%
Infection	0	0		

Table 6 shows 40% had EHL weakness and 4 patient had reduced sensation over dorsum of right foot and 3 patients had reduced sensation over dorsum of left foot.

Table: 4 Distribution of mean KSS according to follow-up

KSS	Pre Operative	Post Operative	3 Months	6 Months	12 Months	P Value
Right Knee	57.6±1.5	77.7±1.4	88.3±1	88.7±1	90±1.3	<0.001*
Left Knee	57.7±1.4	77.3±1.7	87.7±1.5	88.2±1.5	89.1±2.3	<0.001*

Note: * significant at 5% level of significance ($p<0.05$)

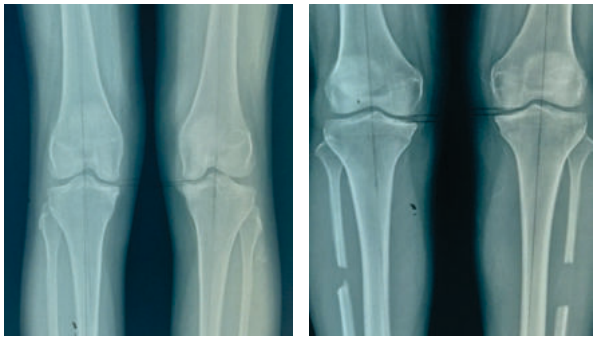
Table: 5 Distribution of mean MJS according to follow-up

MJS	Pre Operative	Post Operative	3 Months	6 Months	12 Months	P Value
Right Knee	1.2±0.4	2.1±0.2	2.2±0.2	2.2±0.2	2.2±0.2	<0.001*
Left Knee	1.1±0.4	2.2±0.3	2.2±0.3	2.2±0.3	2.2±0.3	<0.001*

Note: * significant at 5% level of significance ($p<0.05$)

Medial joint space was measured on plain AP X-ray of the knee after adjusting the magnification factor. The mean pre operative medial joint space of 30 patients was 1.2±0.4 SD on right knee and 1.1±0.4 SD on left side respectively and the mean post operative medial joint space was 2.1±0.2 SD on right side and 2.2±0.3 SD on left side respectively and there was no significant difference in follow up till 1 year with p value < 0.001.

Chi-square ($\chi 2$)test was used for association between two categorical variables. The difference of the means of analysis variables between two independent groups was tested by unpaired t test.



The measurement of medial joint space is done using anteroposterior weight bearing radiograph of the affected knees

Table:6 Distribution of mean VAS according to follow-up

VAS	Pre Operative	Post Operative	3 Months	6 Months	12 Months	P Value
Right Knee	6.3±0.6	4.9±0.5	4.3±0.5	4.3±0.5	4.3±0.5	<0.001*
Left Knee	6.3±0.6	5.7±0.7	4.2±0.4	4.2±0.4	4.2±0.4	<0.001*

Note: * significant at 5% level of significance ($p<0.05$)

Table:7 Distribution of mean HKAA according to follow-up

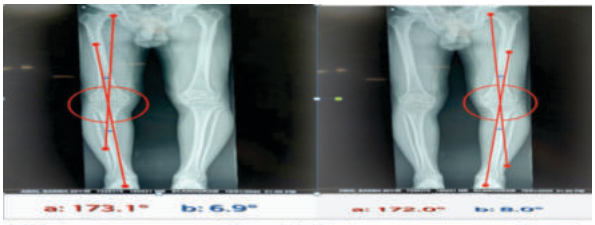
HKAA	Pre Operative	Post Operative	3 Months	6 Months	12 Months	P Value
Right Knee	6.5±1.7	3.7±1.7	3.1±1.5	3.1±1.4	2.9±1.4	<0.001*
Left Knee	6.3±2.1	4.1±1.7	3.3±1.4	3.2±1.2	3.1±1.3	<0.001*

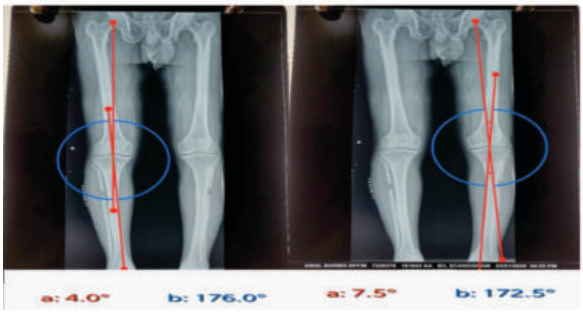
Note: * significant at 5% level of significance ($p<0.05$)

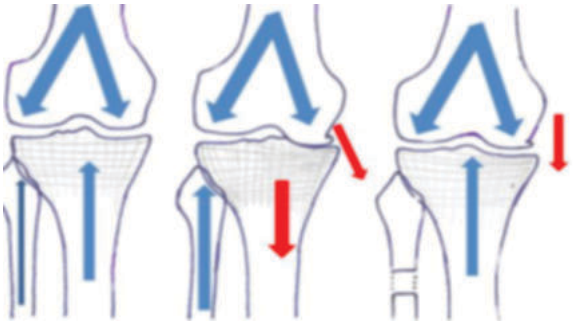
The mean (SD) pre operative hip knee ankle angle(HKAA) was 6.5±1.7 SD on right side and 6.2±2.1 SD on left side respectively, which decreased to 3.7±1.7 and 4.1±1.7 post operatively. No significant change in hip knee ankle angle till 12 months follow up. Chi-square ($\chi 2$)test was used for association between two categorical variables. The difference of the means of analysis variables between two independent groups was tested by unpaired t test.

DISCUSSION
PFO is considered as a new treatment of medial compartment knee

osteoarthritis with varus deformity which is simple to perform, gives good functional results, with a shorter recovery period. PFO relieves joint pain and improves joint space and works on the principle of non uniform settlement and redistribution of forces towards the lateral compartment as described by Wang et al. They stated lateral cortex is supported by fibula and tibia whereas the medial cortex has only one support it leads to shift of load from normal distribution to shift more to medial plateau, resulting in varus deformity. The tibia bears approximately 80% of the body weight and fibula bone bears only 15 to 20% (one-sixth) of the body weight. Recent studies have highlighted the importance of fibula in giving support to the lateral tibial condyle[9]. As age progresses, non-uniform settlement in the load-bearing joints and there is decrease in bone mass such as in the knees, hips, ankles, and spine[10,11].***Shanmugasundaram et al 2019***[12] stated the rationale behind proximal fibular osteotomy is that the lateral side "settles" down when fibula support is removed, leading to evenly distributing weight over the proximal tibia which result in correction of the deformity in a varus knee, thereby relieving symptoms. He also stated that "slippage phenomenon" and muscle imbalance following PFO help in correcting varus deformity of knee.







After PFO, distal fibula and tibio fibular syndesmosis become free from proximal fibular segment, leading to a relative increase of ROM of the proximal tibiofibular joint (PTFJ). The fibular head gets pulled distally by the muscle soleus and peroneus longus which attached to the proximal fibula, hence the tensile force is transmitted from the postero-lateral part of the fibular head to the lateral femoral condyle. To counteract the varus deformity the lateral joint space of the knee is therefore narrowed after weight bearing and it helps in reducing the pressure on the medial compartment of the knee and relieving the medial knee pain.

Wang et al 2015[10] conducted study on 47 patients who underwent proximal fibular osteotomy who were followed up for minimum 12 months, the mean visual analogue score significantly decreased from 8±1.5 SD pre operatively to 2.74±2.34 SD post operatively and the mean American knee society score were 44.41±8.90 and 41.24 ±13.48 respectively. Post operatively they significantly improved to 69.02± 11.12 and 67.63 ±13.65, respectively. In our study, The average knee society score pre operative was 57.6±1.5 SD on right and left side was 57.7±1.4 SD. The mean american knee society score post operative was 77.7±1.4SD and 77.3±1.7SD respectively.

In our study, analysis of the mean (SD) pre operative hip knee ankle angle(HKAA) was 6.5±1.7 SD on right side and 6.2±2.1 SD on left side respectively, which decreased to 3.7±1.7 and 4.1±1.7 post operatively. Radiograph parameters in wang et al study of the whole lower extremity showed bilateral genu varus (hip-knee-ankle angle: right knee 4.5° and 15.1°) and there was obvious correction of alignment (hip-knee-ankle angle: right knee of right knee 0.2° and left knee9.0°) after proximal fibular osteotomy. Our study and findings are in contrast to wang et al has similar results. This is further supported by study conducted by qin et al.

Qin et al 2015[11] conducted prospective study on Fifty-two patients (45 women and 7 men, mean age of 62.5 ±6.7 years with mainly medial compartment OA underwent PFO and were followed up for 36 months. The mean VAS score pre operatively was 6.03±1.45 to 3.17±1.59 post operatively and subsequent follow up shows improvement in VAs score and the mean HSS score with SD was 52.27±11.27 to 71.43±11.71 post operatively at 6 weeks and improvement of VAS score to 78.63±15.19 at the end of 36 months with p value <0.001.

Complications reported in our study were EHL weakness and numbness over dorsum of foot which recovered with time and with pregabalin supplements. No post operative complications were observed in wang et study. Qin et al study showed 8 of the 67 affected limbs presented with symptoms of superficial peroneal nerve injury. The symptoms of nerve injury had disappeared in 6 limbs at the 12-month follow-up and in the remaining 2 limbs at the 18-month follow-up

Limitations are inherent with all research studies. Our study had important limitations that must be considered while interpreting the results. Our sample size is 30, 15 per group, which is relatively small when compared to many prospective studies. Our duration of study is one and half year, owing to the fact that thesis had to completed in specific time frame. An increased sample size and longer follow up could show statistically significant values support the trend. Diagnosis of osteoarthritis of knee was based mainly on x ray findings Apart from this our operative technique and analysis of results are consistent with the standard literature.

Our results, in combination with the available literature, strongly support proximal fibular osteotomy as a new procedure for knee osteoarthrtis for pain relief and improvement of medial joint space.

CONCLUSION

The number of published studies of proximal fibular osteotomy for medial joint knee osteoarthritis had surfaced and the long term outcome studies of disease pathology are some of the parameters that need to be addressed. The surgical outcome of medial compartment OA depends on the tibiofibular joint osteo arthritis and preoperative knee function

In conclusion, proximal fibular osteotomy is safe and efficient technique. Short term one year follow up showed better functional outcome and pain relief.

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