

ORIGINAL RESEARCH

Short Term Follow-ups of Proximal Fibular Osteotomy (PFO) in Isolated Medial Compartment Knee Osteoarthritis (OA) patients: A prospective study

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ABSTRACT

Background: Proximal fibular osteotomy, which involves excising a proximal portion of the fibular bone, has been shown to be an effective treatment for knee osteoarthritis. This treatment is clinically validated by its immediate and explicit knee pain resorption and radiographically validated by joint space correction. This treatment reasoning is known as non-uniform settlement of the tibia plateau, and it is utilized to determine the origin of knee joint pain. **Aim:** To evaluate the efficacy of proximal fibular osteotomy (PFO) in isolated medial compartment knee osteoarthritis in terms of pain relief and knee ambulation activities. **Material and method:** This study is designed as a prospective observational study. Study was done between March 2021 to February 2022 in Chirayu Medical College And Hospital, Bhopal, where 20 patients with isolated medial compartment knee OA were operated. Knee pain was assessed using visual analogue scale (VAS), and knee ambulation activities were recorded using American Knee Society score (KSS) preoperatively and postoperatively and then at 3rd month and 12th months follow-up. **Results:** The mean age of patients was 58.6 years. Out of 20 patients, 12 were female and 8 were male. Postoperative weight-bearing x-rays of knee joint showed increase in medial joint space and Medio-Lateral joint space ratio (ML ratio) improved significantly postoperatively. Alignment of lower extremity got improved, measured by femorotibial and hip knee angle. In the final analysis, the mean \pm SD KSS was 90.25 ± 3.31 in females and 89 ± 1.85 in males postoperatively. Medial knee pain got relieved in almost all patients after PFO, pain assessed by VAS score was found significantly improved with Chi-square value = 25.85 and P value = 0.0000036 (<0.001) association is significant postoperatively. **Conclusion:** Our study demonstrates that PFO effectively relieves pain and improves joint function in patients with isolated medial compartment osteoarthritis knee. It can potentially become an alternative treatment method, especially for patients who cannot undergo total knee replacement because of medical comorbidities and in patients who wants to sit cross leg and squat and doesn't have access to western toilet.

Keywords: Proximal Fibular Osteotomy (PFO), Isolated Medial Compartment Knee Osteoarthritis, VAS score, American Knee Society score, ML ratio.

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INTRODUCTION

After the fifth decade, osteoarthritis of the knee is the most prevalent degenerative condition of the knee¹. Mechanical, structural, genetic, and environmental factors all have a role in the onset and progression of knee osteoarthritis². Idiopathic knee osteoarthritis (KOA) frequently has knee varus deviations, which is indicated by a mechanical femorotibial axis shorter than 180° on complete Anteroposterior radiographs and a constrained joint space³. Varus alignment increases the likelihood of medial progression of the

knee by four times⁴. Even in healthy knees, the medial compartment is said to bear 60-80% of the stress⁵. Although there are many other treatment methods, such as Analgesics, chondroprotective medications, intra-articular injections of steroids, Visco supplements, physical therapy, and operations such as high tibial osteotomy, arthroscopic lavage, autologous chondrocyte implantation, and total knee replacement are all options⁶. To address medial compartment involvement in knee OA before developing to pan arthritis, open wedge high tibial osteotomy (HTO) or

medial unicompartamental knee arthroplasty (UKA) may be recommended to avoid or postpone Total Knee Arthroplasty (TKA). These large procedures all have very specific indications, are expensive, and are relatively risky. As a result, many patients with knee OA remain untreated due to medical or non-medical constraints, such as contraindications for the aforementioned procedures, financial issues, and fear of major surgery, in our experience. Given these circumstances, alternative options to relieve symptoms and prevent the progression of knee OA are definitely needed⁷. Proximal Fibular Osteotomy, is an alternative to these aforementioned treatment modalities. PFO is based on the hypothesis of differential settlement (non-uniform settlement)—an entity that commences and facilitates the course of knee osteoarthritis⁸. The lateral portion of the tibial plateau is also supported by the fibula and accompanying soft tissues, whereas the medial side is only supported by the medial tibial cortex. This, in combination with the fact that the medial side experiences more axial strain, results in non-uniform settlement and tibial plateau degeneration^{9,10}. Proximal fibular osteotomy, which involves excising a proximal portion of the fibular bone, has been shown to be an effective treatment for knee osteoarthritis. This treatment is clinically validated by its immediate and explicit knee pain resorption and radiographically validated by joint space correction.

METHODOLOGY

It was the prospective observational study done between March2021 to February2022 in Chirayu Medical College And Hospital, Bhopal, where 20patients with isolated medial compartment knee OA were operated. Preoperative and postoperative weight-bearing radiographs were taken to analyse alignment of lower extremity and ratio of knee joint space(medial/lateral compartment). Knee pain was assessed using visual analogue scale (VAS), and knee ambulation activities were recorded using American Knee Society score preoperatively and postoperatively and then at 3rd month and 12thmonths follow-up.

RESULTS

Age distribution	Female	Male
50-54	1	2
55-59	8	4
60-64	2	0
65-69	1	2
Total	12	8
Age distribution	Female (%)	Male (%)
50-54	8%	25%
55-59	67%	50%
60-64	17%	0%
65-69	8%	25%
Total	100%	100%

SAMPLE SIZE ESTIMATION

A total of 20 patient with isolated medial compartment knee osteoarthritis, came to Chirayu medical college and hospital, Bhopal (MP), during the period of March 2021 to February 2022 were included in the study.

INCLUSION AND EXCLUSION CRITERIA

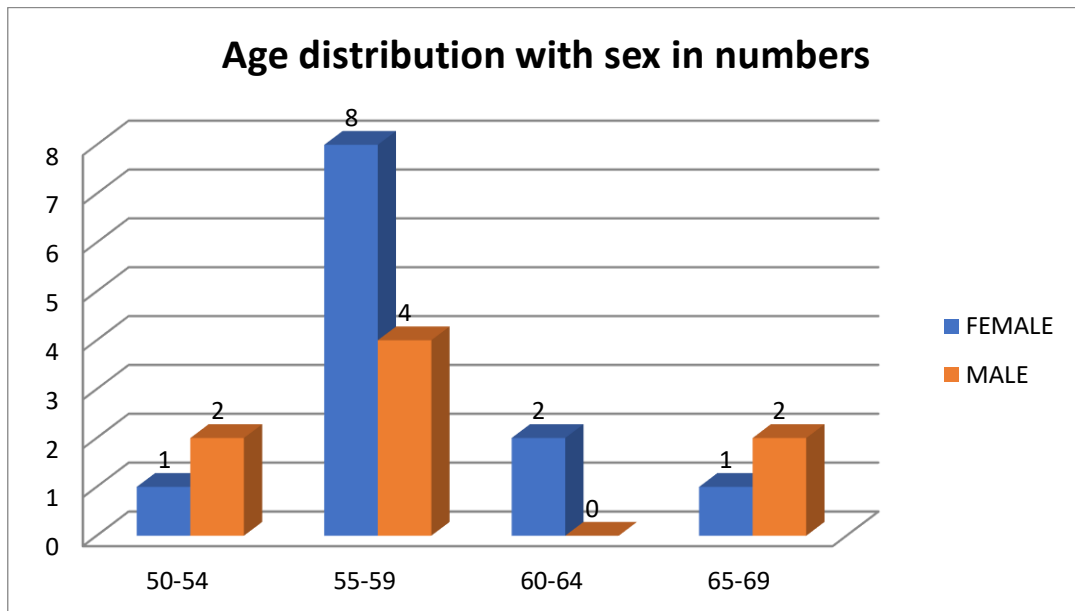
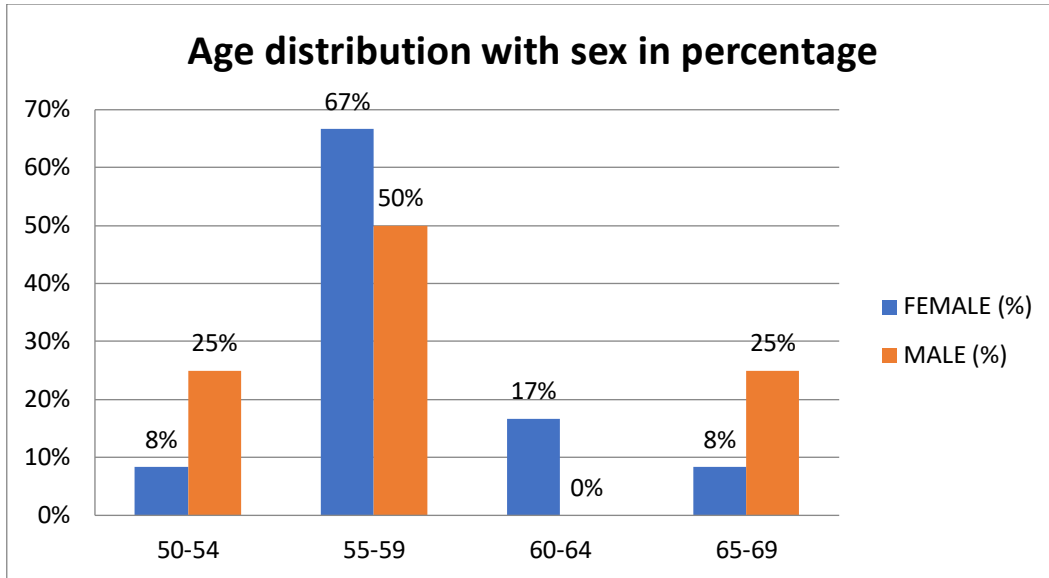
Patients with knee pain and difficulty in walking and squatting due to isolated medial compartment osteoarthritis, and theirweight-bearing X-ray shows isolated medial compartment OA knee were included in the study. Patientswith Lateral compartment OA knee, Inflammatory joint disease, septic knee disease, Patient not fit and not willing for surgery, Patient non-compliant for conservative support were excluded.

STUDY DESIGN

This study is designed as a prospective observationalstudy. Before starting the therapeutic procedure, consent was taken and thorough clinical examination and scoring or grading done.

SURGICAL TECHNIQUE

Under spinal anaesthesia and tourniquet control, Patients were placed supine on the operating table with a knee 90 degree flexion. Painting and draping were done from mid-thigh to the foot.Through fluoroscope, the fibular head was identified andmarkedpoint 8-10 cmdistal to head of fibula was marked over the skin with the help of a radio-opaque scale.A skin incision of approximately 4-5 cm given over the lateral aspect of the leg in line of fibular shaft and the bone was exposed.The plane between the peroneus muscles and soleus was developed to expose the fibula. Multiple drill holes were made over fibula in an interval of 2 cm and osteotomy was done.The radiographically stress view was taken both before and after osteotomy to note the changes in lateral joint space. Once the wound had been irrigated. Separate sutures were used to close the muscle, fascia, and skin, and sterile dressing was used.



Age wise difference in knee joint space					
Female patient	age	RMJS(cm)	RLJS	LMJS	LLJS
A	52	0.38	0.45	0.36	0.45
B	55	0.36	0.42	0.38	0.43
C	56	0.32	0.4	0.3	0.4
D	58	0.4	0.45	0.38	0.45
E	58	0.38	0.41	0.36	0.4
F	58	0.36	0.4	0.36	0.4
G	58	0.36	0.42	0.34	0.41
H	59	0.39	0.44	0.38	0.42
I	59	0.36	0.43	0.32	0.42
J	60	0.38	0.41	0.36	0.4
K	63	0.35	0.4	0.35	0.38
L	68	0.37	0.45	0.35	0.44
Mean	58.67	0.37	0.42	0.35	0.42
S.D.	3.98	0.02	0.02	0.02	0.02
Max	68.00	0.40	0.45	0.38	0.45
Min	52.00	0.32	0.40	0.30	0.38
Age wise difference in knee joint space					
Male patient	age	RMJS(cm)	RLJS	LMJS	LLJS
A	54	0.4	0.49	0.42	0.48
B	54	0.44	0.5	0.44	0.5
C	56	0.5	0.54	0.52	0.54
D	56	0.52	0.58	0.52	0.56
E	58	0.5	0.6	0.52	0.6
F	59	0.5	0.56	0.5	0.55
G	65	0.48	0.58	0.52	0.58
H	66	0.5	0.56	0.5	0.55
Mean	58.50	0.48	0.55	0.49	0.55
S.D.	4.66	0.04	0.04	0.04	0.04
Max	66.00	0.52	0.60	0.52	0.60
Min	54.00	0.40	0.49	0.42	0.48

Paired Samples T test Statistics

	Mean	N	Std. Deviation	T test value	P value
Pair 1 RMJS(cm) female	0.367	12	0.021	11.18	<0.001
RLJS female	0.423	12	0.020		
Pair 2 LMJS female	0.353	12	0.024	8.31	<0.001
LLJS female	0.417	12	0.022		
Pair 3 RMJS(cm)male	0.480	8	0.040	9.03	<0.001
RLJSmale	0.551	8	0.039		
Pair 4 LMJS male	0.493	8	0.040	8.47	<0.001
LLJS male	0.545	8	0.039		

P value<0.05 will be taken to be significant

PAIRED SAMPLES CORRELATIONS

	N	Correlation coefficient	P value
Pair 1 RMJS(cm) female & RLJS female	12	0.65	0.023
Pair 2 LMJS female & LLJS female	12	0.36	0.252
Pair 3 RMJS(cm)male & RLJSmale	8	0.84	0.009
Pair 4 LMJS male & LLJS male	8	0.90	0.002

P value<0.05 will be taken to be significant

Knee society score female		
	Preop	Postop
1	62	85
2	60	90
3	70	94
4	74	92
5	68	86

6	76	96
7	70	90
8	74	94
9	62	88
10	58	90
11	66	88
12	76	90
Mean	68	90
S.D.	6	3
Max	76	96
Min	58	85

Knee society score male		
	PREOP	POSTOP
1	78	88
2	68	90
3	60	86
4	74	90
5	74	88
6	72	92
7	68	90
8	70	88
Mean	71	89
S.D.	5	2
Max	78	92
Min	60	86

Paired Samples T test Statistics

	Mean	N	Std. Deviation	T test value	P value
Pair 1 KNEE SOCIETY SCORE female PREOP	68.00	12.00	6.38	14.95	<0.001
KNEE SOCIETY SCORE female POSTOP	90.25	12.00	3.31		
Pair 2 KNEE SOCIETY SCORE male PREOP	70.50	8.00	5.42	10.26	<0.001
KNEE SOCIETY SCORE male POSTOP	89.00	8.00	1.85		

P value<0.05 will be taken to be significant

Paired Samples Correlations

	N	Correlation	Sig.
Pair 1 KNEE SOCIETY SCORE female PREOP & KNEE SOCIETY SCORE female POSTOP	12	0.59	0.041
Pair 2 KNEE SOCIETY SCORE male PREOP & KNEE SOCIETY SCORE male POSTOP	8	0.34	0.408

P value<0.05 will be taken to be significant.

VAS

SCORE	PRE-OP	3MONTH	12month followup
<6	3	19	20

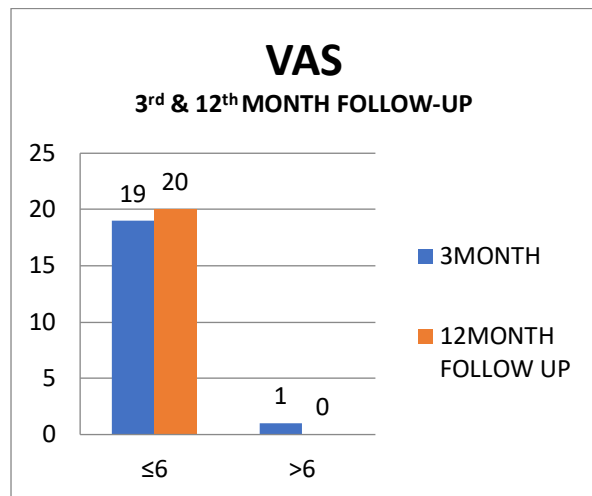
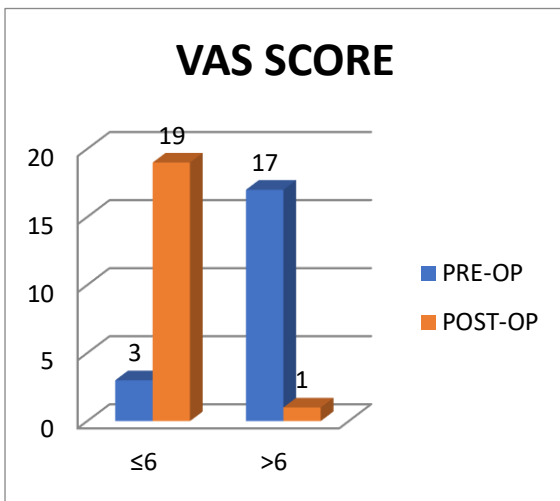
>6	17	1	0	
SCORE	PRE-OP	POST-OP	P Value	
≤6	3	19	<0.001	
>6	17	1		

Chisquare value= 25.85 and P value= 0.00000036 (<0.001) association is significant

Score	3month	12month follow up	P Value
≤6	19	20	1
>6	1	0	

The P value equals 1.0000

The association between rows (groups) and columns (outcomes) is considered to be not statistically significant.

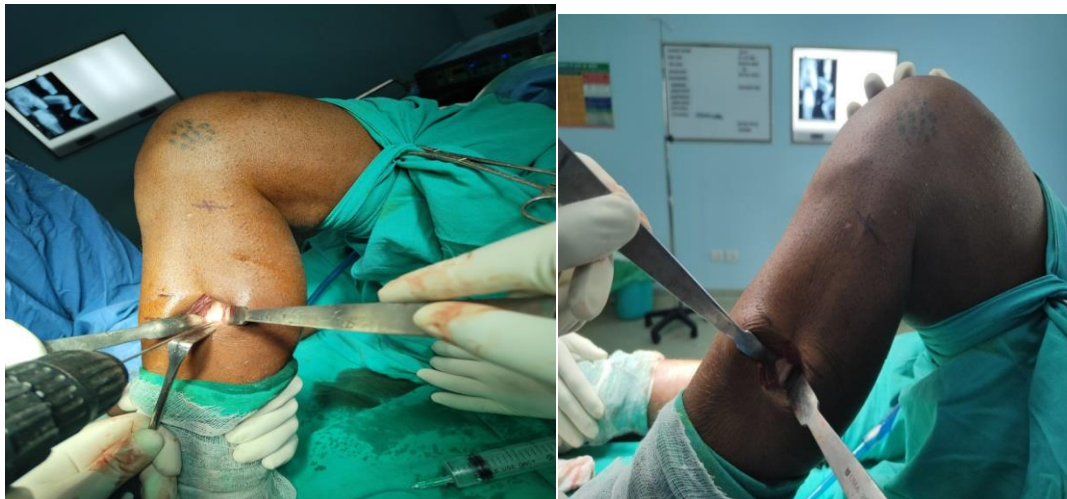


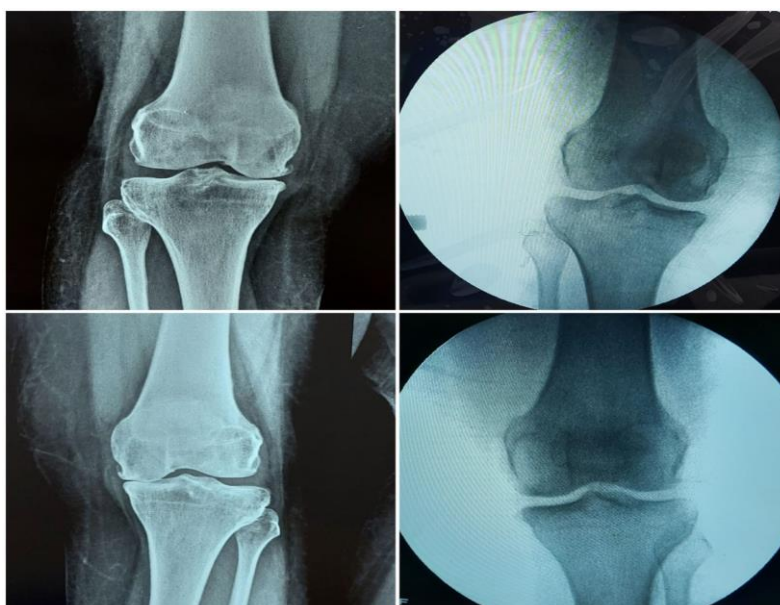
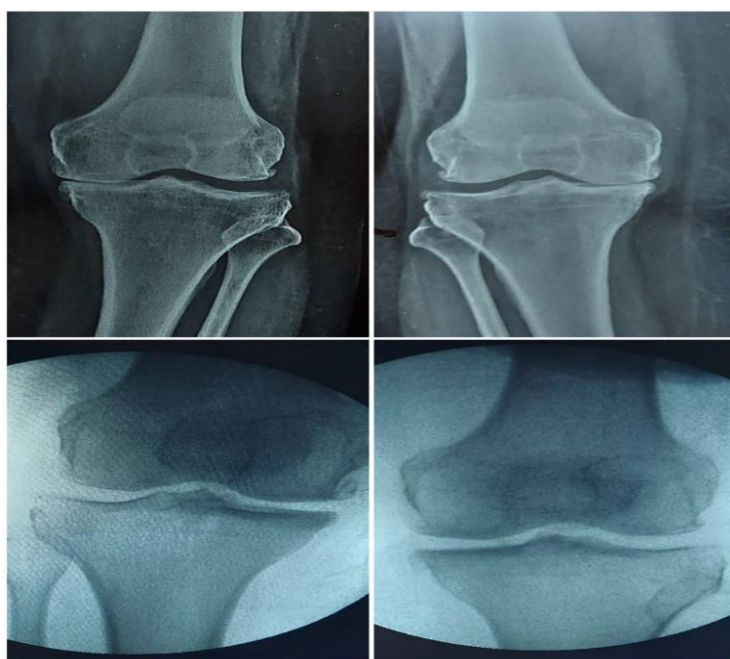
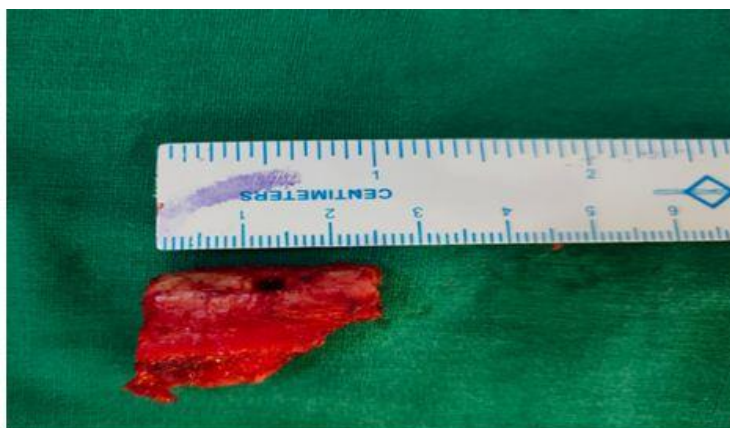
RESULTS

The mean age of patients was 58.6 years. Out of 20 patients, 12 were female and 8 were male. Postoperative weight-bearing x-rays of knee joint showed increase in medial joint space, ML ratio improved significantly postoperatively. Alignment of lower extremity got improved, measured by femorotibial and hip knee ankle angle. In the final

CLINICAL PICTURE

analysis, the mean± SD KSS was 90.25±3.31 in females and 89±1.85 in males postoperatively. Medial knee pain got relieved in almost all patients after PFO, pain assessed by VAS score was found significantly improved with Chi-square value = 25.85 and P value = 0.00000036 (<0.001) association is significant postoperatively.





DISCUSSION

OA knee is a debilitating chronic joint condition that causes functional impairment and physical disability. HTO, arthroscopic lavage, unicompartmental knee arthroplasty (UKA), and total knee arthroplasty (TKA) are all surgical treatments for this problem. A new procedure, proximal fibular osteotomy, has shown promising results in isolated medial compartment OA knees. HTO is used to treat OA-related knee varus deformities and seeks to improve the mechanical axis that runs from the hip's centre to the knee joint and to the tibiotalar joint's centre^{11,12}. Its drawbacks include infection, non-union, and common peroneal nerve damage¹³. The patella tendon's ability to function is hampered by osteotomies carried out close to the tibial tubercle¹⁴. Technically, owing of the distorted proximal tibial metaphysis and the imbalanced ligaments, transitioning HTO to TKR is more challenging¹⁵. The expense of TKR makes it an impractical surgical procedure for a single compartment involvement. Patients with TKR are unable to squat because their knees cannot fully flex,¹⁶ which is required for many of the day to day activities of common Indian population. PFO is an alternative approach suitable for these types of patients. According to biomechanics, the lateral compartment appears to be receiving more stress as seen by a drop in FTA and an increase in medial joint space. Patients are able to engage in all activities, including squatting, which is crucial for the majority of Indians' daily activities. Additionally, this is an inexpensive, implant-free procedure that may be performed in any setting. According to "the knee review article," peroneal nerve paresthesia was the most commonly reported consequence, followed by peroneal nerve palsy, fracture, and recurring deformity. The majority of cases healed before one year,^{14,17,18} in all cases with peroneal nerve paresthesia, which suggests that PFO is a relatively safe procedure. Yazdi et al.¹⁹ were the first to propose that fibulectomy reduces compartmental pressure on the medial side. Several ideas have been proposed to explain the logic behind PFO. The hypothesis of non-uniform settlement was proposed by Dong et al.¹⁴. Prakash L²⁰ offered the hypothesis of "too many cortices," while Huang et al.²¹ proposed the concept of muscular competition. The success of PFO was attributed by Xie et al. to ground response vector readjustment theory.

Wang et al.²³ studied 47 individuals with an average age of 63.96 years. They observed the patients for a year and found that the mean VAS score reduced from 8.02 pre-operatively to 2.74 at the final check-up. The vast majority of their patients were females (35 out of 47). Only eight patients had their lower limb alignment corrected.

Yang et al.⁸ studied 156 patients with a mean age of 59.2 years and a 49.1-month follow-up. The mean FTA, lateral joint space, and Knee Society Score (KSS) were all significantly improved at the last follow-up. Four patients experienced leg numbness,

and six experienced significant toe weakness that resolved in four weeks.

Zou et al.²⁴ conducted a prospective comparative study of PFO versus HTO and concluded that PFO has better short-term and long-term effects than HTO. In this study, we enrolled 42 patients with an average age of 58.30 years. The mean VAS score and WOMAC score improved significantly three months after surgery, but there was no significant improvement at six or twelve months. Similarly, at the 12-month follow-up, we found no statistically significant improvement in FTA.

Our study supports the safety and efficacy of proximal fibular osteotomy in the treatment of isolated medial compartment knee OA. This study is comparable to previous studies in that we recorded the VAS and knee society scores serially at 3 and 12 months of follow-up, and the results were compared to the preoperative values. This allowed us to determine the temporal change in scores at subsequent follow-up visits. Proximal fibular osteotomy lessens the lateral fibular support and rectifies the varus deformity, which can then shift the loading stress from the medial compartment more laterally, resulting in less pain and satisfactory functional recovery. In the final analysis, the mean \pm SD KSS was 90.25 ± 3.31 in females and 89 ± 1.85 in males. Pain levels decreased significantly from severe to mild, according to VAS scores. Pain assessed by VAS score was found significantly improved with Chi-square value = 25.85 and P value = 0.00000036 (<0.001) association is significant postoperatively. Although proximal fibular osteotomy is a simple procedure, there is a potential risk of peroneal nerve injury. In this investigation, 1 patient reported ipsilateral lower leg numbness due to superficial peroneal nerve damage. Based on this anatomical analysis and their clinical experience, we suggest a posterolateral approach via the space between the peroneus longus and brevis muscle and the soleus muscle at a position of 8-10 cm below the fibular head to reduce the risk of iatrogenic nerve injury.

This study's limitations include the lack of a control group for comparison. Moreover, bias may exist due to the small sample size.

CONCLUSIONS

Our study demonstrates that PFO effectively relieves pain and improves joint function in patients with isolated medial compartment osteoarthritis knee. It can potentially become an alternative treatment method, especially for patients who cannot undergo total knee replacement because of medical comorbidities and in patients who want to sit cross leg and squat and doesn't have access to western toilet.

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