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A study of functional outcome of proximal fibular osteotomy in medial compartmental osteoarthritis of knee

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Abstract

Objective: To evaluate the effectiveness of proximal fibular osteotomy (PFO) to produce symptomatic relief from pain and improvement of medial joint space and function in patients with medial compartmental osteoarthritis of the knee.

Materials and Methods: A prospective study from October 2019 to October 2021 at Rajah Muthiah Medical College, in 15 patients with clinical and radiological evidence of osteoarthritis of knee (Kellgren and Lawrence score 2 or more) who surgically managed with proximal fibular osteotomy were used in this study. Preoperative and Postoperative weight-bearing x-rays were obtained, to measure tibiofemoral angle, medial and lateral joint space of knee and to analyse the alignment of lower extremity. Pain relief was measured using a visual analogue scale and functional recovery was assessed by using the oxford knee score preoperatively and postoperatively.

Results: PFO provides short-term relieving from knee pain and improvement in walking postoperatively in almost all patients. Postoperative weight-bearing radiographs showed an increase in medial joint space and obvious correction of alignment of the lower extremity.

Conclusion: PFO is a technically easy and simple procedure in treating unicompartmental osteoarthritis of the knee, provides significant pain relief and functional restoration of the joint. PFO can emerge as an alternative for younger patients with medial compartmental arthritis and patients unable to undergo TKR due to comorbidities. This surgery delays the need for a TKR, even may obviate it. Care should be taken to avoid common peroneal nerve injury.

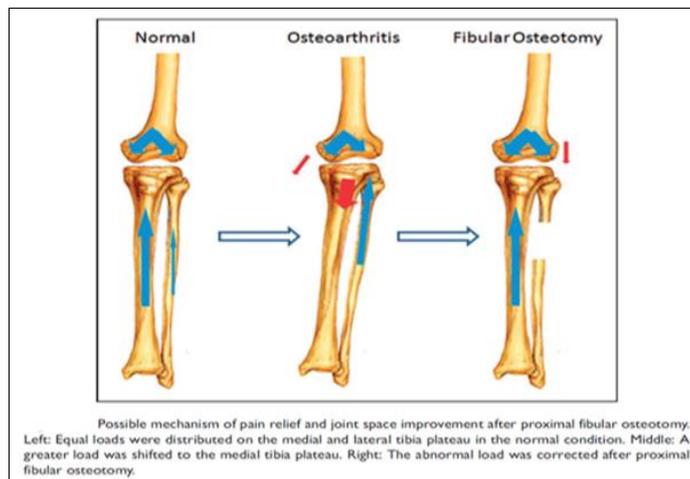
Keywords: proximal fibular osteotomy, medial compartmental osteoarthritis, medial joint space

Introduction

Knee joint Osteoarthritis (KOA) is a chronic, progressive and degenerative disease. The pathological characteristics of Knee Osteoarthritis include joint structure degradation and cartilage destruction and hyperplasia, with joint pain, dysfunction and joint deformity as the main clinical symptoms. Osteoarthritis is a common disease of joints with incidence of 30% in the population older than 60 years [1]. Due to certain precipitating factors like mechanical, structural, genetic, and environmental. osteoarthritis involving the medial compartment, more frequent and common than the lateral one resulting in varus deformity. Genu varus deformities, characterised by a tibiofemoral axis of less than 180° on scannogram and medial joint space narrowing, are more common in OA knee and affect 74% of patients with idiopathic OA [2]. Genu varum is more common in OA because of the fact that the mechanical axis, even in normal knees, passes a just medial to the centre of the joint that drives 60%-80% of body weight through the medial side of the knee joint [3]. In addition to various biomechanical alterations, the increased internal tibiofemoral rotations and peak knee joint adduction moment while weight bearing because of altered gait mechanics, are supposed to be the main culprits in the initiation and progression of medial compartment OA [4, 5]. High tibial osteotomy and total knee arthroplasty are the two surgical procedures used for treating knee OA [6]. High tibial osteotomy is comparatively difficult surgery and has occasional complications like neurovascular injury, fixation failure, iatrogenic fracture, loss of correction and non-union [7, 8]. Though total knee replacement corrects axis and alignment, relieving pain

and improves function, but it may not being the procedure of choice in young active patients or patients with moderate OA [9]. However there may be a need of second revision TKR after the first surgery in about 6 to 12 % of patients. The medial side of knee has only a single cortical support which is made up of fully cancellous bone, tends to collapse with advancing age., however, the lateral side of the knee is supported by three cortical support, one from the tibia and two from the fibula, making it rigid and un-collapsible. This leads to occurring and increasing varus deformity with age and causes medial compartment OA of the knee with a gradual reducing in medial joint space [10]. Hence, in proximal fibular

osteotomy, by removing 1 to 2 cm of fibula six to nine cm from the tip of the fibular head, to relieve compartment pressure on medial side of knee, and realign it. The PFO is characterised by a technically easy and simple procedure with minimal tissue damage, there is no need of internal fixation, less operating time, early weight bearing, few complications and definite effects The present study analysed the effectiveness of proximal fibular osteotomy (PFO) to produce symptomatic relieving of knee pain and improvement of joint space in medial compartment and function range of motion inpatient with medial compartmental osteoarthritis of the knee.



Materials and Methods:

A prospective study was conducted, with Institutional Ethics Board approval, in the department of Orthopaedics at Rajah Muthiah Medical College and Hospital, Annamalai University, Chidambaram during the period of one year OCTOBER 2019 to OCTOBER 2021.

Sample population: Fifteen patients, 9 male and 6 female patients, with the mean age of 55.33 years attending outpatient department (OPD) with clinical and radiological evidence of knee osteoarthritis who surgically managed with proximal fibular osteotomy will be used in this study.

The inclusion criteria

- OA mainly involving the medial side (compartment) of the knee
- Medial compartment OA with a Kellgren–Lawrence (KL) score of 2 or more points,
- A knee joint with varus deformity and medial space narrowing, and
- Those who gave consent for this procedure being briefed about the complete procedure.

The exclusion criteria

- Post-traumatic knee OA
- Inflammatory joint disease
- History of previous surgeries or fractures in the knee
- Patients who do not fit the inclusion criteria,

All patients were duly informed about the study that they were going to be a part of, its risks and advantages and all of them consented to it. All patients were thoroughly examined, routine blood investigations and weight-bearing radiographs were done, Kellgren–Lawrence (KL) score [11], preoperative femorotibial angle, joint spaces (medial and lateral) were measured and evaluated with the Visual analogue score (VAS) and the modified oxford knee score and the

preoperative values were documented in the patient case records and then anaesthetic fitness obtained, taken up for the procedure.

Surgical Technique

The length of the fibula to be removed is around 1.5 to 2cm, 6 to 9 cm from the head of fibula, the aim is to converting the knee joint as more balanced, by cutting fibular cortices, then unicortical support only on both side of knee. That leads to the correction of the mechanical axis.

The resection should be high enough to cause a mechanical axis correction, but not high to lead to lateral popliteal nerve damage.

The size of the segment of fibula to be removed from the fibular head depends on the height of the patient and length of fibula, for shorter patients -1.5 cm resected below 6 cm, for taller patients -2cm resected below 8 to 9 cm.

The fibula length is measured from tip of fibular head to tip of medial malleolus, resected segment should below 24% of length from head of fibula.

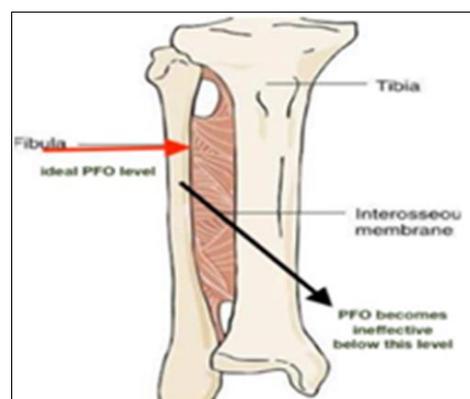


Fig 1: Optimal site for Osteotomy

All patients were operated on under spinal anaesthesia, with a tourniquet control. Crystalloids in the form of normal saline (NS) and dextrose normal saline (DNS) were used as maintenance fluid.



Fig 2: Operated under spinal anaesthesia

Armamentarium



Fig 3: Armamentarium

Positioning the Patient: patient in supine position, knee in 45 degrees of flexion, knee joint is free for flexion and extension



Fig 4: Positioning of Patient

The fibular head tip is marked with a skin marker, and the appropriate downward distance is measured.



Fig 5: Measuring of osteotomy level

A 4-8 cm lateral incision was made overlying the chosen site of osteotomy and dissection was carried out through the skin and subcutaneous tissues.



Fig 6: Skin incision at pre-planned osteotomy site

Through the plane between peroneus and soleus, fibular periosteum is reached, which is incised about 1.5 to 2 cm at pre-planned osteotomy site, periosteum elevated with a periosteal elevator.

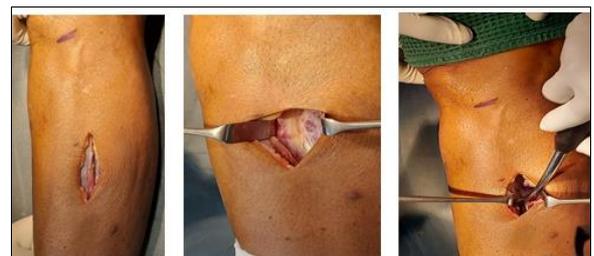


Fig 7: Fibular periosteum reached and elevated

Length of resected segment measured and confirmed with c arm



Fig 8: Intra op measuring of length of the fibula to be resected

A 1.5 to 2 cm of fibula was then resected with the help of an oscillating saw after placing a few drill holes and care must be taken not to overstretch the soft tissues too much to protect the nerve from damage.



Fig 9: Fibula resected with help of oscillating saw

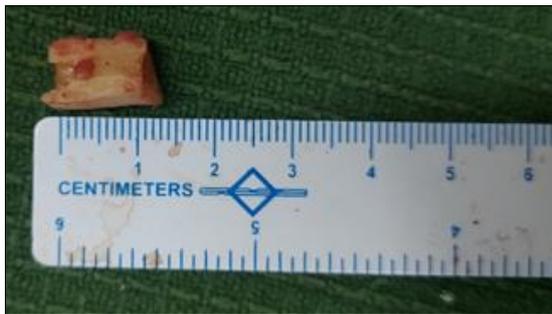


Fig 10: Resected segment of fibula

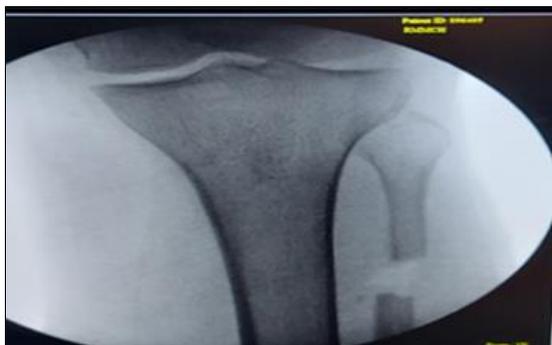


Fig 11: Intra op C arm Image

After attaining perfect haemostasis, a thorough wound wash was given and wound closed in layers and sterile dressing and compression bandage were applied.



Fig 12: Wound closed in layers

Postoperatively all patients are mobilised to stand and encouraged to walk on the same day of surgery as soon as the patient recovered from anaesthesia, and were discharged on the second postop day after wound inspection. Antibiotics given intravenously for two days and then five days orally.

Follow-up

Patients were followed on day 15 (suture removal) and, two, six and twelfth months from the date of surgery. They were then followed up annually thereafter.

Criteria of post-operative evaluation of results

1. Relieving of pain assessed by VAS [12,13].
2. Recovery of function by Modified Oxford knee score [13].
3. Radiologically evaluated by measuring lateral tibiofemoral angle, joint spaces (medial and lateral), under standard magnification.

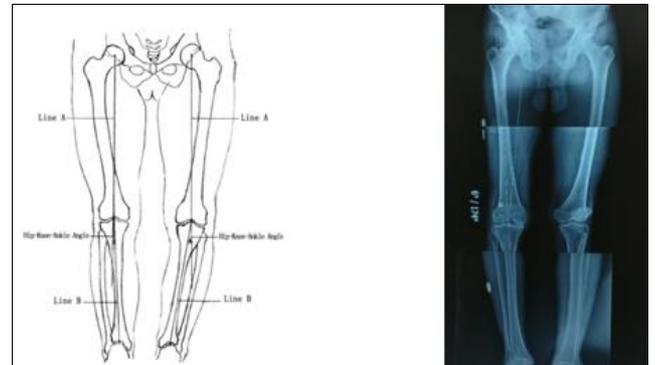


Fig 13: Measurement of the hip-knee-ankle angle

Measurement of the hip-knee-ankle angle. Line A was drawn from the center of the head of the femur to the center of the knee joint, and line B was drawn from the centre of the knee joint to the ankle joint. The hip-knee-ankle angle is the intersection angle a between these two lines.

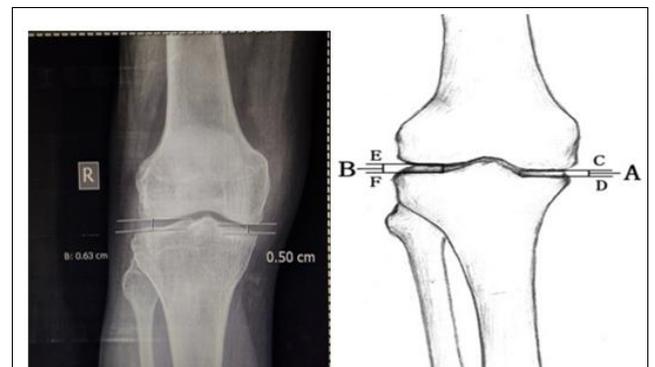


Fig 14: Measurement of knee joint space

Measurement of knee joint space. Medial and lateral joint space is determined by the vertical distance between lowermost point of the medial and lateral femoral condyle to corresponding tibial pleateaus.

Results

15 patients (9 Males and 6 Females) with medial compartment arthritis of the knee who presented between October 2019 to October 2021 were managed with PFO. The mean duration of follow up 10 months. Males are more commonly seen affected in our study, with right knee more commonly affected than left. The age of the patients, ranged from 42 to 70 years with the mean age being 57 years. Postoperatively 3 patients developed great toe drop, however, 2 patients recovered fully within 4-5 weeks, 1 patient have EHL weakness for upto 8 months. There were no complications such as superficial or deep infection or common peroneal nerve palsy or loss of sensation over the dorsum of the foot encountered in our study. None of our patients were lost to follow-up.

In all cases a 1.5 to 2 cm section of fibula was resected 6 to

9.5 cm below the fibular head. A total of 15 patients knees with a follow-up of more than 8 months were included in the study. In the AP and lateral standing X-rays, the Tibio femoral angle and the medial and lateral joint space were measured pre and postoperatively. In addition, the patients were evaluated on the basis of pre and post-operative Visual Analog Score, and knee scoring by the modified Oxford. The preoperative tibio femoral angle was $187.7 \pm 1.6^\circ$ which changed to $184.5 \pm 1.8^\circ$ post operatively, while the medial joint space widened from 2.5 ± 1.2 mm to 4.5 ± 0.9 mm, Likewise, the lateral joint space showed uniform reduction post operatively. From 6.2 ± 0.9 mm to 4.7 ± 0.7 mm. VAS score on a scale of one to ten, was averaged at 7.7 ± 1.1 Pre-operatively, which came down to 4.4 ± 1.3 post operatively. Mean Functional knee score was 69.4 ± 7.1 points at the end of a 6 months, compared to 54.2 ± 6.7 preoperatively.

Preoperative complaints

- Average VAS score 7.7 ± 1.1
- Average Modified Oxford score 54.2 ± 6.7

Pre-operative radiographs

- Average Tibio femoral angle $187.7 \pm 1.6^\circ$
- Average medial joint space 2.5 ± 1.2 mm.
- Average lateral Joint space 6.2 ± 0.9 mm.

Pre-operative clinical examination

- Range of movements 134.5 ± 9.2 degrees.

Post-operative complaints

- Average VAS score 4.4 ± 1.3
- Average Modified Oxford score 69.4 ± 7.1

Post-operative radiographs

- Average Tibio femoral angle $184.5 \pm 1.8^\circ$
- Average medial joint space 4.5 ± 0.9 mm.
- Average lateral Joint space 4.7 ± 0.7 mm.

Postoperative clinical examination

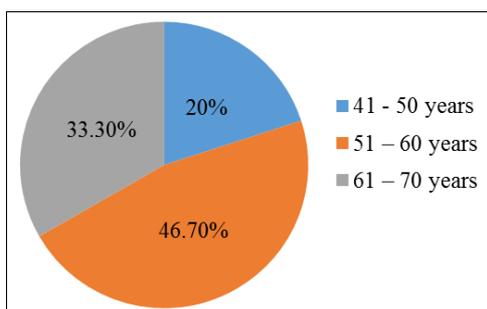
- Range of movements 137 ± 8.6 degrees

As seen by the above data, all patients had significantly relieved from pain and improving in functional range of motion. Though changes were not very significant in x-rays, but there was a definitive increasing in medial joint space.

Descriptive statistics

Table-1: Age distribution

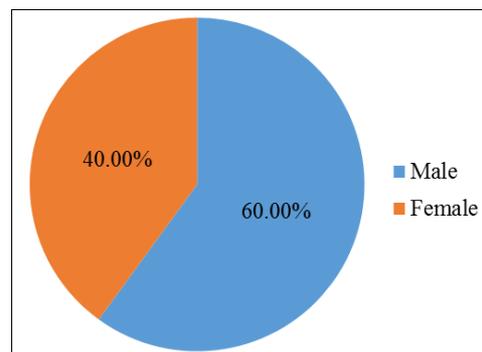
S. No	Category	Total No of Patients	Percentage
1	41 - 50 years	3	20%
2	51 – 60 years	7	46.7%
3	61 – 70 years	5	33.3%
	Total	15	100%
	Mean (Age)	57 years	
	Median (Age)	56 years	
	Mode (Age)	55 years	
	SD	7 years	



Graph 1: Age Distribution

Table-2: Gender Distribution

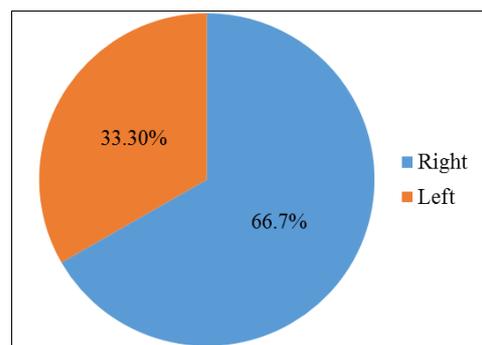
S. No	Category	Total No of Patients	Percentage
1	Male	9	60%
2	Female	6	40%
	Total	15	100%



Graph 2: Gender Distribution

Table 3: Side distribution

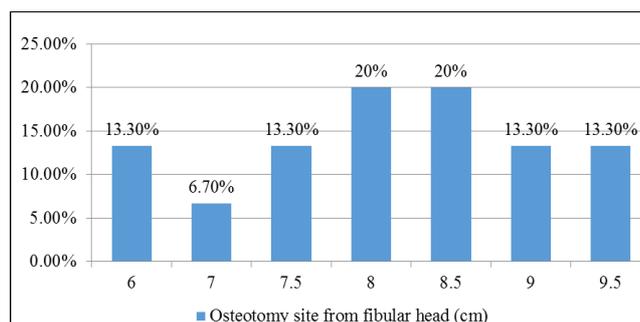
S. No	Side	Total No of Patients	Percentage
1	Right	10	66.7%
2	Left	5	33.3%
	Total	15	100%



Graph 3: Side distribution

Table 4: Osteotomy site from tip of fibular head (cm)

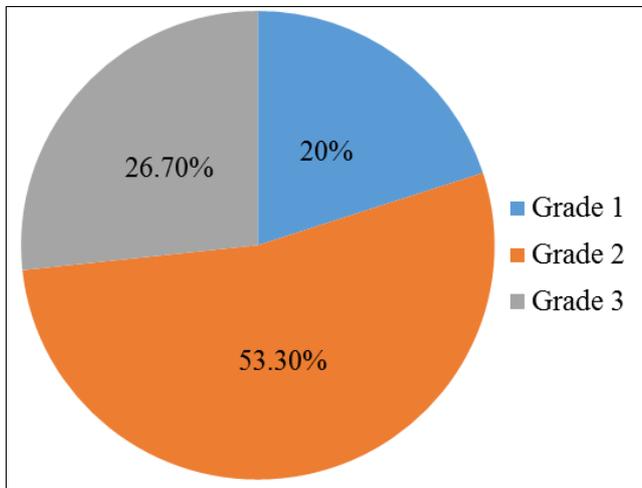
S. No	cm	Total No of Patients	Percentage
1	6	2	13.3%
2	7	1	6.7%
3	7.5	2	13.3%
4	8	3	20%
5	8.5	3	20%
6	9	2	13.3%
7	9.5	2	13.3%
	Total	15	100%
	Mean	8 cm	
	SD	1 cm	



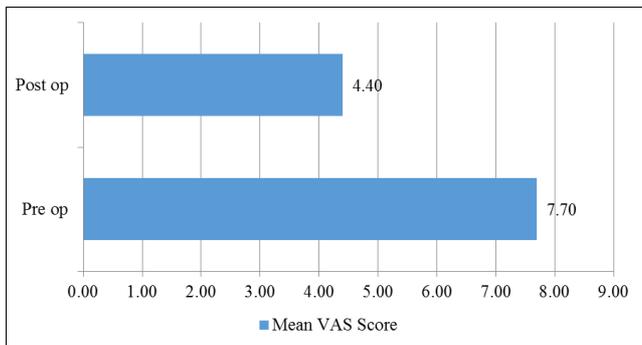
Graph 4: Osteotomy site from fibular head (cm)

Table 5: Kellgren Lawrence Grade

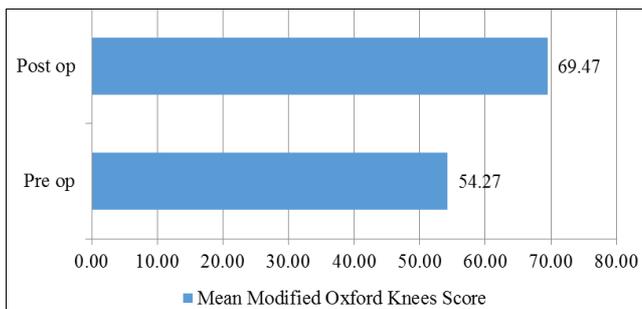
S. No	Category	Total No of Patients	Percentage
1	Grade 1	3	20%
2	Grade 2	8	53.3%
3	Grade 3	4	26.7%
	Total	15	100%



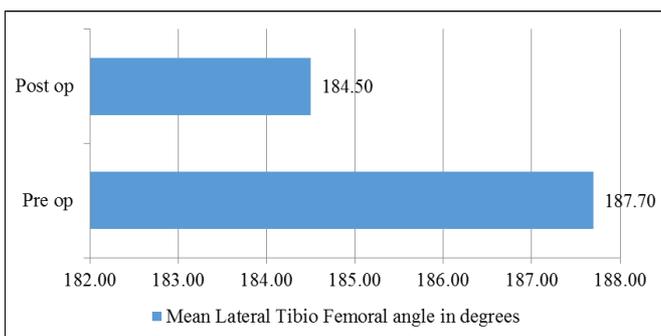
Graph 5: Kellgren Lawrence grading



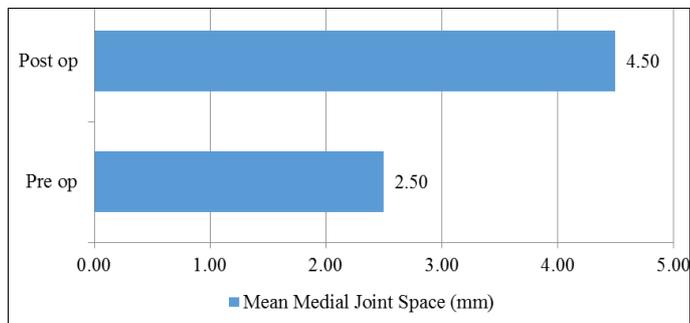
Graph 6: Pre-op and Post-op-Visual analog score



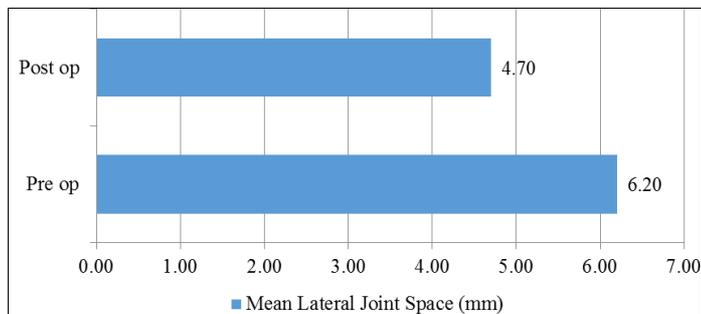
Graph 7: Pre-op and Post-op - Modified Oxford Knees score



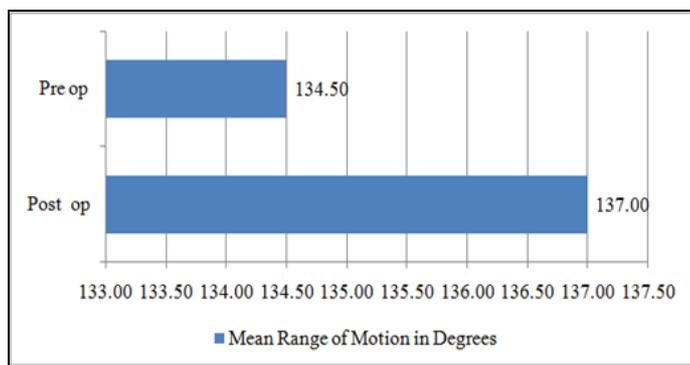
Graph 8: Pre-op and Post-op - Lateral Tibio Femoral angle in degrees



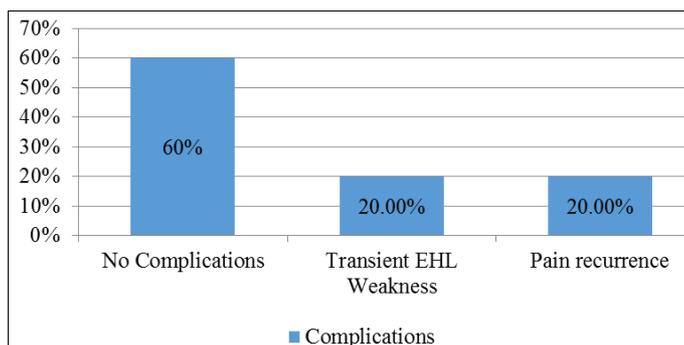
Graph 9: Pre-op and Post-op - Medial Joint Space (mm)



Graph 10: Pre-op and Post-op - Lateral Joint Space (mm)



Graph 11: Pre-op and Post-op - Range of Motion in Degrees



Graph 12: Complications

Table 6: Complications

S. No	Category	Total No of Patients	Percentage
1	No Complications	9	60%
2	Transient EHL Weakness	3	20%
3	Pain recurrence	3	20%
	Total	15	100%

Inferential statistics

Table 7: Evaluation of Pre-op and Post-op results

S. No	Component	Mean ± SD		p value
		Pre - op	Post - op	
1	Visual analog scale score	7.7 ± 1.1	4.4 ± 1.3	<0.001
2	Modified Oxford Knees score	54.2 ± 6.7	69.4 ± 7.1	
3	Lateral Tibio Femoral angle in degrees	187.7 ± 1.6	184.5 ± 1.8	
4	Medial Joint Space in mm	2.5 ± 1.2	4.5 ± 0.9	
5	Lateral Joint Space in mm	6.2 ± 0.9	4.7 ± 0.7	
6	Range of Motion in degrees	134.5 ± 9.2	137 ± 8.6	

Table 8: Comparison on Osteotomy site from fibular head in cm and Complications

S. No	Osteotomy site from fibular head in cm	Complications			p Value
		No complications	Transient EHL Weakness	Recurrence of pain	
1	6cm	0	2 (100%)	0	0.033
2	7cm	1(100%)	0	0	
3	7.5cm	2(100%)	0	0	
4	8cm	3(100%)	0	0	
5	8.5cm	2 (66.7%)	1 (33.3%)	0	
6	9cm	1 (50%)	0	1 (50%)	
7	9.5cm	0	0	2(100%)	

Fischer exact test was used as a statistical tool to compare the Osteotomy site from fibular head in cm and Complications. On comparison, it was found that the difference was statically significant with p value of <0.001. Most of the participants having osteotomy site above 9 cm had pain recurrence, in comparison the participants with 6cm had transient EHL weakness.

Discussion

In older population knee osteoarthritis is most common form of arthritis and also a leads to disability. Surgical methods for knee osteoarthritis include arthroscopic debridement, high tibial osteotomy (HTO), proximalfibular osteotomy and unicompartment or artificial total knee arthroplasty. TKA is very effective in relieving pain and improving kneefunction in late-stage of knee osteoarthritis and also it is more complex and expensive procedure, some of the patient may need second revision surgery. Though high tibial osteotomy and unicompartmental arthroplasty have both been described for treatment of medial compartmental arthritis, both of these are relatively major procedures [14]. Appropriate patient selection is key to successful HTO. Young patients with osteoarthritis of the medial compartment of the knee with varus deformity are the ideal candidate for HTO [15]. In elderly patients with severe osteoporosis there is risk of tibial plateau fracture and proximal necrosis with high tibial osteotomy so it is The HTO is technically demanding. Several complications can occur. In a study by Lee., *et al.* the parameters of surgical errors were defined by three separate factors [17]:

1. Correction error (under- and overcorrection).
2. Excessive changes in posterior slope
3. Occurance of lateral hinge fracture.

The goals of HTO are to reduce the knee pain and delay the replacement. To achieve these goals, appropriate patient selection, precise surgical planning, precise surgical techniques, and prevention of complications are essential.

PFO may be an alternative for patients of medial OA knee in developing countries (like India) due to their financial and healthcare delivery limitations. It may also constitute apromising alternative surgery for osteoarthritis of the medial compartment of the knee, especially for patients who can't undergo TKR because of certain comorbidities. Furthermore, these patients can still undergo TKA in the future if it becomes necessary.

PFO - Proximal Fibular Osteotomy in Medial Compartment Arthritis of the Knee with Varus Deformity with increasing age reduction of bone mass is a common occurrence. Just as in the vertebral column where there is a dorsal collapse due to a single cortical support, as opposed to stronger posterior support, in knee joints too, a gradual increasing varus occurs with age causing medial compartment arthritis [18]. Resecting a segment of fibula, loosens the lateral side allowing the upper tibia to settle into amore favourable lateral alignment, shifting the mechanical axis towards neutral or valgus.

Our study showed that proximal fibular osteotomy decreased the duration of surgery, decreased intra op bleeding and drainage volume after surgery while shortened the full weight-bearing time; decreased the pain VAS and FTA and increased the modified oxford score of the, knee joint; and decreased the incidence of complications [no risk of fracture or slope problems]. In our study 3 patients shows transient EHL weakness. No patients reported with wound infection or foot drop or loss of sensation over dorsum of foot. The optimal site for osteotomy 24% below the tip of fibular head, in our study fibula resected around 6cm (<24%) causes transient EHL weakness. Fibula resected above 9 cm causes recurrence of pain. This study also shows that PFO is a reliable, and safe alternative to both HTO and unicompartmental replacement and affordable surgery that does not require insertion of additional implants. As such, PFO is a suitable surgical option in most developing countries that lack financial and medical resources. Care should taken to avoid common peroneal nerve injury during procedure.

Our study was a short-term study with on small sample of patients. Our follow up does not allow for observing long term effects of PFO on progression of arthritis and its effect on hip and ankle. Large samples with long follow up are necessary to prove the efficacy of the procedure.

Conclusion

PFO is technically easy and simple procedure in treating unicompartmental osteoarthritis of knee, provides significant pain relief and functional restoration of joint. PFO can emerge as an alternative for younger patients with medial compartmental arthritis and patients unable to undergo TKR due to comorbidities. This surgery may defer the need for a TKR, even may obviate it. Care should be taken to avoid common peroneal nerve injury.

Case illustration
Case 1



Fig 1: Pre-op clinical images



Fig 2: Pre-Op X-Rays



Fig 3: Intra-Op Images



Fig 4: Post-op and follow up x-rays



Fig 5: Post-op Clinical Images



Fig 6: Case 2 – Pre-op images



Fig 7: Pre-op x-rays



Fig 8: Intra-op images

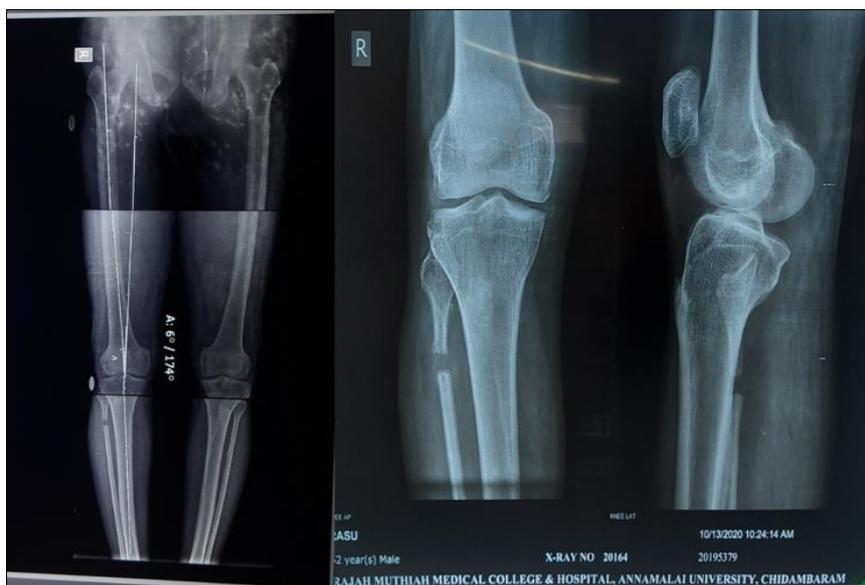


Fig 9: Post-op x-rays



Fig 10: Follow up x-rays



Fig 11: Post-op images

References

- Shiozaki H, *et al.* "Epidemiology of osteoarthritis of the knee in a rural Japanese population". *Knee*. 1999;6.3:183-188.
- Ahlbäck S. Osteoarthrosis of the knee: a radiographic investigation. *Acta Radiol*. 1968;277(suppl):7-72.3
- Ahlback S. Osteoarthrosis of the knee: a radiographic investigation. *Acta Radiol*. 1968;277(1):7-72.
- Annette WD, Robertsson O, Lidgren L. Surgery for knee osteoarthritis in younger patients. *Acta Orthopaedica*. 2010;81(2):161-4.
- Annette WD, Robertsson O, Lidgren L. Surgery for knee osteoarthritis in younger patients. *Acta Orthopaedica*. 2010;81(2):161-4.
- Sprenger TR, Doerzbacher JF. Tibial osteotomy for the treatment of varus gonarthrosis: survival and failure analysis to twenty-two years. *J Bone Joint Surg Am*. 2003;85:469-474.
- Aglietti P, Buzzi R, Vena LM, Baldini A, Mondaini A. A high tibial valgus osteotomy for medial gonarthrosis: a 10- to 21-year study. *J Knee Surg*. 2003;16:21-26.
- Hanssen AD, Stuart MJ, Scott RD, Scudery GR. Surgical options for the middle aged patient with osteoarthritis of the knee joint. *Joint Bone Spine*. 2000;67(6):504-508. Doi: 10.1016/S1297-
- Schnurr C, Jarrous M, Gudden I, Eysel P, Konig DP. Pre-operative arthritis severity as a predictor for total knee arthroplasty patients' satisfaction. *Int. Orthop*. 2013;37(7):1257-1261.
- Zhang Y, Li C, Li J, *et al.* The pathogenesis research of non-uniform settlement of the tibial plateau in knee degeneration and varus. *J Hebei Med Univ*. 2014;35(2):218-219.
- Kellgren JH and Lawrence JS. Radiological assessment of osteo-arthritis. *Ann Rheum Dis*. 1957;16:494-502.
- Huskisson E. "Measurement of pain". *Lancet*. 1974;304.7889:1127-1131.
- Prakash L. "Knee Scoring and Outcome Prediction in developing a surgical paradigm of total knee replacement". *Indian Academy of Orthopaedic Surgeons, Instructional course lectures*. 2016.
- Hofmann S, *et al.* "Osteotomies of the knee joint in patients with monocompartmental arthritis". *Orthopade*. 2009;38.8:755-769.
- Rossi R, Bonasia DE, Amendola A. The role of high tibial osteotomy in the varus knee. *J Am Acad Orthop Surg*. 2011;19:590-9.
- Zhang Y, Li C, Li J. The pathogenesis research of non-uniform settlement of the tibial plateau in knee degeneration and varus. *J Hebei Med Univ*. 2014;35(2):218-9.
- Kim JH, *et al.* "Leg length change after opening wedge

- and closing wedge high tibial osteotomy: A metaanalysis". PLoS One. 2017;12.7:e0181328.
18. Yang ZY, *et al.* "Medial Compartment Decompression by Fibular Osteotomy to Treat Medial Compartment Knee Osteoarthritis: A Pilot Study". Orthopedics. 2015;38.12:e1110-e1114.
 19. Wang F, *et al.* "Influence of knee lateral thrust gait to femorotibial angle and lateral joint space in the knee varus patients". Chinese Journal of Orthopaedics. 2005;25.9:517-519.