

An Observational Study Assessing the Promising Outcomes of Proximal Fibular Osteotomy in Treatment of Medial Compartment Knee Osteoarthritis

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Abstract

Aim: The purpose of this prospective study was to prove the promising outcomes of proximal fibular osteotomy in treatment of medial compartment knee osteoarthritis.

Material & Methods: A prospective observational study including 50 patients in Department of Orthopaedics for the period of 2 years. The following clinical parameters were used: VAS, KSS, KFS. The following radiological parameters were used: MJS, LJS, HKA Angle. post-operative physiotherapy protocol was followed. Discharge was planned based on patients comfort and mobility, that was usually on day 4 or 5. They were followed up at 6 weeks, 3 months, 6 months, 9 months and 12 months.

Results: In the present study, most of the patients belonged to 50-60 years age group. In the present study, there were 19 males and 31 females, with male to female ratio 2:3 approximately. The mean age of patients was 52.78 year (age range = 40-70 years). In this study patients included who has BMI>30 and most of patients lie in between 25 to 29.9 BMI i.e. most of them fall in overweight category. Osteochondral defect was found in all cases with various grade, 26 (52%) knees with grade 1, 15 (30%) knees with grade 2, 8 (16%) knees with grade 3 and 1 (2%) cases with grade 4. Average visual Analogue scale (VAS) score significantly decreased from 8.20 pre-operatively to 3.256 in 1 year of follow up. Knee society score improved from 45.25 pre-operatively to 71.77 in 12 month of follow up. Knee function score improved pre-operatively 49.50 to 75.55 in 12 month of follow up. Medial joint space increased from 1.62 pre-operatively to 3.56 in 12 month of follow up. Lateral joint space decreased from 6.68 pre-operatively to 5.38 in 12 months follow up. The correction of alignment Hip knee ankle angle (HKA) after PFO were seen after 12 months.

Conclusion: Proximal fibular osteotomy [PFO] is a simple, safe and affordable surgery to reduce pain and improve joint function and the medial compartment space in medial compartment osteoarthritis of knee joint. It may be a promising alternative surgery in most developing countries because of their financial and healthcare delivery limitations that may be used as an alternative surgery for patients of osteoarthritis knee who cannot undergo.

Keywords: PFO, Knee Osteoarthritis, Medial Compartment.

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Introduction

Osteoarthritis (OA) is a polyarticular chronic degenerative disease of multifactorial etiology, and the most common joint to be afflicted is the knee.¹ A community-based study that involved people above

40 years of age from five different states of India reported the prevalence of the condition to be 28.7% . [1] OA of the knee joint is associated with advanced age, higher body mass index (BMI),

female sex, and a sedentary lifestyle.¹ A study that included individuals above 60 years of age in the USA has estimated the prevalence of radiographic changes consistent with OA of the knee to be 37%. [2] The same study reported a prevalence of 12% for symptomatic OA of the knee. The lifetime risk of developing symptomatic knee OA has been reported to be 44.7%. [3]

The severity of OA of the knee is classified as per the Kellgren-Lawrence (KL) grading, which categorizes it into five grades. [4] An important feature of OA of the knee is the compartment-specific narrowing of the joint space, which is associated with clinical manifestations of the disease. Medial joint space narrowing is the most common type of narrowing. [5] Established operative treatment options for medial joint OA of the knee include high tibial osteotomy, unicompartmental knee arthroplasty, and total knee arthroplasty. Proximal fibular osteotomy (PFO) is a relatively new procedure for treating medial joint OA of the knee. Compared to other options, it is a simple, easy-to-do, and less invasive procedure, which requires only a small incision, limited dissection, and no internal fixation.

Proximal fibular osteotomy (PFO) is a surgical procedure for medial compartment knee osteoarthritis. In proximal fibular osteotomy 2-3 cm long section of fibula was resected 6 to 10 cm below the fibular head. Proximal fibular osteotomy can significantly improve both the radiographic appearance and function of the affected knee joint and also achieve long-term pain relief. It brings dramatic relief in pain and increase in medial compartment knee joint space after operation that lead to increase in joint function and mobility after PFO. This procedure may be an alternative treatment to high tibial osteotomy (HTO) for medial compartment knee osteoarthritis (OA). Proximal fibular osteotomy (PFO) is indicated in early-stage medial compartment knee osteoarthritis (OA). [6]

Mechanism of proximal fibular osteotomy is when a patient underwent to proximal fibular osteotomy, the muscle attached to the proximal fibula such as Soleus and Peroneus. Therefore lateral knee joint space become narrow to counteract knee varus deformity resulting from load bearing. Thereby reducing the pressure on medial compartment of knee and relieving the patients medial compartment knee pain. Thus, the purpose of this prospective study was to prove the promising outcomes of proximal fibular osteotomy in treatment of medial compartment knee osteoarthritis.

Materials & Methods

A prospective observational study including 50 patients in Department of Orthopaedics, MGM Medical College and Hospital, Jamshedpur,

Jharkhand, India for the period of 2 years. The following clinical parameters were used: VAS, KSS, KFS. The following radiological parameters were used: MJS, LJS, HKA Angle. post-operative physiotherapy protocol was followed. Discharge was planned based on patients comfort and mobility, that was usually on day 4 or 5. They were followed up at 6 weeks, 3 months, 6 months, 9 months and 12 months.

Inclusion Criteria: - 1. Patients with osteoarthritis of that confined mainly to the medial compartment with a varus deformity not exceeding 12 degrees. 2. Patients in the age group 40 to 70. 3. All patients has been treated conservatively for more than a year without success prior to the proximal fibular osteotomy.

Pre-operative data was collected that includes name, age, sex, any other comorbid conditions, Type of surgery proposed, choice of anaesthesia & written informed consent was obtained from the participants.

Post-operative data was collected which included duration of hospital stay(days)& any complications like - pulmonary complications, UTI, DVT, CVS complications, Prosthetic failure, wound infection (superficial/deep), pressure sores and others.

The functional outcome parameters were time taken to regain full weight bearing(wks.), relief of symptoms like pain which was assessed by VAS (visual analogue scale), Knee Society Score and Knee Function Score and return to normal daily activities (days). The patients were followed diligently and all the clinical as well as radiological parameters were observed and noted down. These parameters allowed us a comparison between the pre-operative and post-operative state.

The following clinical parameters were used:

1. VAS (Visual Analogue Scale)
2. Knee Society Score (KSS)
3. Knee Function Score (KFS)

The following radiological parameters were used:

1. Medial joint space (MJS)
2. Lateral joint space (LJS)
3. Hip-Knee-Ankle (HKA) Angle

Medial joint space was determined by a vertical line 'A' between two horizontal lines(C&D), that were drawn from the lowest point of the medial condyle of the femur and medial plateau of the tibia respectively. Lateral joint space was determined by a vertical line'B' between two horizontal line (E&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 was determined by ratio of A/B.

Operative procedure:

Procedure of Proximal Fibular Osteotomy

Under spinal anaesthesia with full aseptic and antiseptic precautions patient was lie down in supine position and bolster placed behind ipsilateral hip to keep the limb in internal rotation. Painting and drapping was done. An approximately five centimeter longitudinal incision was made over the posterolateral part of skin over the proximal part of the leg and fibula was exposed between the peroneus (longus and brevis) muscles and soleus muscle. Proximal fibular osteotomy was performed by removing approximately 1-2 cm length of fibula at a distance of 6-10cm below the fibular head with the help of a drill bit and corticotome. We need to be very cautious about common peroneal nerve injury.

Wound was closed in layer, dressing was done and crepe bandage applied.

Postoperative Care: - All participants had undergone a routine post-operative physiotherapy protocol. From day one, in-bed exercises and mobility was advised. Next day, out of bed mobility with the help of a walker was allowed with full weight bearing with the aid of a physiotherapist. The vacuum drain was usually not required in many cases but in few cases where it was required, it remained in place for 24 hours and was then removed. On days 3 wound dressings was changed. Discharge was planned based on patients comfort and mobility, that was usually on day 4 or 5. They were followed up at 6 weeks, 3 months, 6 months, 9 months and 12 months.

Results

Table 1: Patient details

Age (in years)	No. of cases (%)	
30-40	0	
40-50	16 (32)	
50-60	20 (40)	
60-70	14 (28)	
Sex		
Males	19 (38)	
Females	31 (62)	
Total	50	
BMI	Weight status	No. of patients (%)
Below 18.5	Under weight	0
18.5 -24.9	Normal	9 (18)
25.0-29.9	Overweight	28 (56)
30.0 and above	Obese	13 (26)
Side	No. of cases(%)	
Right	20 (40)	
Left	17 (34)	
Bilaletral	13 (26)	
Osteochondral defect grade	No. of knees (%)	
Grade 1	26 (52)	
Grade 2	15 (30)	
Grade 3	8 (16)	
Grade 4	1 (2)	

In the present study, most of the patients belonged to 50-60 years age group. In the present study, there were 19 males and 31 females, with male to female ratio 2:3 approximately. The mean age of patients was 52.78 year (age range = 40-70 years). In this study patients included who has BMI>30 and most

of patients lie in between 25 to 29.9 BMI i.e. most of them fall in overweight category. Osteochondral defect was found in all cases with various grade, 26 (52%) knees with grade 1, 15 (30%) knees with grade 2, 8 (16%) knees with grade 3 and 1 (2%) cases with grade 4.

Table 2: Average Visual Analogue Scale (VAS) score, Average Knee Society Score, Average knee function score, average Medial Joint Space, average Lateral Joint Space, average Hip Knee ankle angle (HKA)

Time	Avg. VAS score
Pre- op	8.20
1 mo follow up	5.62
2 mo follow up	4.54
6 mo follow up	3.82
12 mo follow up	3.256
Time	KSS score
Pre-op	45.25
12 mo follow up	71.77
Time	KSS score
Pre-op	45.25
12 mo follow up	71.77
Time	KFS score
Pre-op	49.50
12 mo follow up	75.55
Time	MJS
Pre op	1.62
12 months follow up	3.56
Time	LJS
Pre OP	6.68
12 months follow up	5.38
Time	HKA
Pre OP	169.21
12 months follow up	175.92

Average visual Analogue scale (VAS) score significantly decreased from 8.20 pre-operatively to 3.256 in 1 year of follow up. Knee society score improved from 45.25 pre-operatively to 71.77 in 12 month of follow up. Knee function score improved pre-operatively 49.50 to 75.55 in 12 month of follow up. Medial joint space increased from 1.62 pre-operatively to 3.56 in 12 month of follow up. Lateral joint space decreased from 6.68 pre-operatively to 5.38 in 12 months follow up. The correction of alignment Hip knee ankle angle (HKA) after PFO were seen after 12 months.

Discussion

Osteoarthritis is the most common cause of disability in the older population. Disability is caused by pain and limitations in mobility. Total knee arthroplasty (TKA), which aims to relieve pain and improve joint function and mobility, is the main surgical alternative in this patient population. However, TKA is expensive and complex, and some patients need a second knee revision after the first surgery. [7,8] Although high tibial osteotomy (HTO) is the first-choice treatment for young patients with osteoarthritis of the medial compartment of the knee, there are some potential disadvantages after surgery. [9,10]

Proximal fibular osteotomy is the new treatment option for medial compartment knee joint OA.

Although high tibial osteotomy and unicompartmental arthroplasty were previously the treatment options for medial compartmental arthritis, both have their advantages and disadvantages and are associated with major complications [11], which include infection, deep vein thrombosis (DVT), insufficient correction, intraarticular fractures, peroneal nerve injury, compartment syndrome, and knee stiffness. In contrast, late complications of this procedure include delayed union or nonunion, deformity recurrence, and internal fixation failure. [12] There is still insufficient and inconclusive evidence in the literature on PFO in medial compartment OA of the knee. A correctly performed fibular osteotomy (in terms of accurate height from the fibular head, the length of the fibular chunk removed, and peroneal nerve protection) is paramount for a good outcome. Performing fibular osteotomy at the level of about 4-7 cm distal to fibular head decreases the risk of peroneal nerve injury. [13] Yang et al. performed a study on 110 patients with medial compartment arthritis that were followed for over two years. [14] The mean age of patients was 51.68 year (age range = 40-70 years).

In the present study, most of the patients belonged to 50-60 years age group. In the present study, there were 19 males and 31 females, with male to female ratio 2:3 approximately. The mean age of patients

was 52.78 year (age range = 40-70 years). In this study patients included who has BMI>30 and most of patients lie in between 25 to 29.9 BMI i.e. most of them fall in overweight category. Osteochondral defect was found in all cases with various grade, 26 (52%) knees with grade 1, 15 (30%) knees with grade 2, 8 (16%) knees with grade 3 and 1 (2%) cases with grade 4. Average visual Analogue scale (VAS) score significantly decreased from 8.20 pre-operatively to 3.256 in 1 year of follow up. Based on these results, there was a significant improvement in the function of the knee and relieving pain. [14] In a study conducted by Wang et al. on PFO for medial compartment, OA pain relief was observed in all patients after PFO; the mean VAS scores improved dramatically from 8.02 ± 1.50 preoperatively to 2.74 ± 2.34 postoperatively. [15]

Knee society score improved from 45.25 pre-operatively to 71.77 in 12 month of follow up. Knee function score improved pre-operatively 49.50 to 75.55 in 12 month of follow up. Medial joint space increased from 1.62 pre-operatively to 3.56 in 12 month of follow up. Lateral joint space decreased from 6.68 pre-operatively to 5.38 in 12 months follow up. The correction of alignment Hip knee ankle angle (HKA) after PFO was seen after 12 months. The results in our study were comparable to the studies conducted by other authors such as Yang et al [15], Wang et al. [16] and Subash and Naidu. [16]

Due to the stress concentration in the medial compartment, cartilage was worn and degenerated under sustained pressure [17], leading to medial space narrowing in patients with knee osteoarthritis [KOA]. The stress concentration might be associated with the non-uniform-settlement of the tibial plateau and the support of the fibula. [18] Therefore, after removal of the cause (referring to the PFO), patients' clinical symptoms could be improved to a large extent. Moreover, advanced medial space narrowing was related to the severity of the disease. [19] For patients with knee osteoarthritis [KOA] of great severity, it is difficult to achieve an excellent-to-good result of clinical outcome, but there is more room for a significant improvement (KSS change >15).

In terms of functional evaluation, age, VAS score, KSS clinical and functional scores, HKA angle and settlement values were all independent factors affecting satisfactory functional outcome. For significant improvement of outcome, the results were similar. HKA angle reflected the changes in limb alignment [20] and patients with nearly normal HKA angles showed better outcomes in joint function, which might be because PFO could only partially correct the varus deformity of the tibial plateau. Studies have shown that patients with severe Knee osteoarthritis had varus deformity in the femoral condyle as well. [21] For these patients,

PFO was unable to fully improve their varus deformity and prognosis. In addition, settlement value was taken as a factor to reflect the degree of nonuniform- settlement of the tibial plateau.

The higher the settlement value the more significant the effect of lateral fibula support and the better the outcome of PFO. Such findings suggested that PFO in the treatment of Knee osteoarthritis was closely related to the non-uniform settlement theory. Patients with higher settlement value undergoing PFO operation could be expected to obtain better functional outcome. Of the factors associated with the outcome of PFO, medial joint space, HKA angle and settlement value were objective factors and could be measured directly on X-ray films. Therefore, these factors were not subject to subjective impact, and thus suitable for prediction of a patient's postoperative recovery.

The limitations of this study were as follows. First, the sample size was relatively small. Second, the follow-up time was short, making us unable to determine the relationship between study factors and long-term postoperative outcome of PFO.

Conclusion

Proximal fibular osteotomy [PFO] is a simple, safe and affordable surgery to reduce pain and improve joint function and the medial compartment space in medial compartment osteoarthritis of knee joint. Proximal fibular osteotomy [PFO] may be a promising alternative surgery in most developing countries because of their financial and healthcare delivery limitations. It may be used as an alternative surgery for patients of osteoarthritis knee who cannot undergo.

References

1. Pal CP, Singh P, Chaturvedi S, Pruthi KK, Vij A. Epidemiology of knee osteoarthritis in India and related factors. *Indian J Orthop.* 2016 Sep; 50(5):518-522.
2. Dillon CF, Rasch EK, Gu Q, Hirsch R. Prevalence of knee osteoarthritis in the United States: arthritis data from the Third National Health and Nutrition Examination Survey 1991-94. *J Rheumatol.* 2006 Nov;33(11):2271-9.
3. Murphy L, Schwartz TA, Helmick CG, Renner JB, Tudor G, Koch G, Dragomir A, Kalsbeek WD, Luta G, Jordan JM. Lifetime risk of symptomatic knee osteoarthritis. *Arthritis Rheum.* 2008 Sep 15;59(9):1207-13.
4. KELLGREN JH, LAWRENCE JS. Radiological assessment of osteo-arthritis. *Ann Rheum Dis.* 1957 Dec;16(4):494-502.
5. Neogi T, Felson D, Niu J, Nevitt M, Lewis CE, Aliabadi P, Sack B, Torner J, Bradley L, Zhang Y. Association between radiographic features of knee osteoarthritis and pain: results from two cohort studies. *BMJ.* 2009 Aug 21;339:b2844.

6. Prakash L. Proximal Fibular Osteotomy. Indian Academy of Orthopaedic Surgeons. Instructional course lectures. 2016.
7. Burnett RS, Bourne RB. Indications for patellar resurfacing in total knee arthroplasty. *JBJS*. 2003 Apr 1;85(4):728-45.
8. Zhang YZ. Innovations in orthopedics and traumatology in China. *Chinese medical journal*. 2015 Nov 5;128(21):2841-2.
9. Duivenvoorden T, Brouwer RW, Baan A, Bos PK, Reijman M, Bierma-Zeinstra SM, Verhaar JA. Comparison of closing-wedge and opening-wedge high tibial osteotomy for medial compartment osteoarthritis of the knee: a randomized controlled trial with a six-year follow-up. *JBJS*. 2014 Sep 3;96(17):1425-32.
10. LaPrade RF, Spiridonov SI, Nystrom LM, Jansson KS. Prospective outcomes of young and middle-aged adults with medial compartment osteoarthritis treated with a proximal tibial opening wedge osteotomy. *Arthroscopy: The Journal of Arthroscopic & Related Surgery*. 2012 Mar 1;28(3):354-64.
11. Hofmann S, Lobenhoffer P, Staubli A, Van Heerwaarden R. Osteotomies of the knee joint in patients with monocompartmental arthritis. *Der Orthopäde*. 2009 Aug;38:755-70.
12. Portner O. High tibial valgus osteotomy: closing, opening or combined? Patellar height as a determining factor. *Clinical Orthopaedics and Related Research*. 2014 Nov;472:3432-40.
13. Chen HW, Liu GD, Ou S, Zhao GS, Pan J, Wu LJ. Open Reduction and Internal Fixation of Posterolateral Tibial Plateau Fractures Through Fibula Osteotomy-Free Posterolateral Approach. *Journal of Orthopaedic Trauma*. 2014 Sep 1; 28(9):513-7.
14. Yang ZY, Chen W, Li CX, Wang J, Shao DC, Hou ZY, Gao SJ, Wang F, Li JD, Hao JD, Chen BC. Medial compartment decompression by fibular osteotomy to treat medial compartment knee osteoarthritis: a pilot study. *Orthopedics*. 2015 Dec 1;38(12):e1110-4.
15. Wang X, Wei L, Lv Z, Zhao B, Duan Z, Wu W, Zhang B, Wei X. Proximal fibular osteotomy: a new surgery for pain relief and improvement of joint function in patients with knee osteoarthritis. *Journal of International Medical Research*. 2017 Feb;45(1):282-9.
16. Subash Y, Naidu GK, Subash DY, Naidu DG. The role of proximal fibular osteotomy in the management of medial compartment osteoarthritis of the knee. *Int J Orthop Sci*. 2018;4(3.4):369-72.
17. Helminen HJ. Sports, loading of cartilage, osteoarthritis and its prevention. *Scandinavian journal of medicine & science in sports*. 2009 Apr;19(2):143-5.
18. Altman R, Asch E, Bloch D, Bole G, Borenstein D, Brandt K, Christy W, Cooke TD, Greenwald R, Hochberg M, Howell D. Development of criteria for the classification and reporting of osteoarthritis: classification of osteoarthritis of the knee. *Arthritis & Rheumatism: Official Journal of the American College of Rheumatology*. 1986 Aug;29(8): 10 39-49.
19. Hunter DJ, Buck R, Vignon E, Eckstein F, Brandt K, Mazzuca SA, Wyman BT, Otterness I, Le Graverand MH. Relation of regional articular cartilage morphometry and meniscal position by MRI to joint space width in knee radiographs. *Osteoarthritis and cartilage*. 2009 Sep 1;17(9):1170-6.
20. Anderson AS, Loeser RF. Why is osteoarthritis an age-related disease?. *Best practice & research Clinical rheumatology*. 2010 Feb 1;24 (1):15-26.
21. Tang WM, Zhu YH, Chiu KY. Axial alignment of the lower extremity in Chinese adults. *JBJS*. 2000 Nov 1;82(11):1603.