

Outcomes of proximal fibular osteotomy in medial compartment knee osteoarthritis

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ABSTRACT

INTRODUCTION: Medial compartment knee osteoarthritis is the commonest form of osteoarthritis (OA) of the knee. Although total knee arthroplasty (TKA) is the Gold Standard treatment in the management of severe OA, it is costly and requires expertise. Proximal fibular osteotomy (PFO) on the other hand is a simple, safe, fast and affordable surgery that does not require insertion of additional implants and possibly delay the degenerative process thereby buying time for eventual replacement surgery. The purpose of this study is to study the early outcomes of proximal fibular osteotomy in medial compartment knee osteoarthritis in terms of pain relief and improvement in joint dynamics.

METHODS: This is a prospective observational study where 31 patients underwent the surgery and were followed-up with weight-bearing radiographs of the knee preoperatively and postoperatively to analyze the change in joint space dynamics. Knee pain was assessed using a visual analogue scale both pre-operatively and post-operatively.

RESULTS: Significant improvement in knee pain was observed postoperatively. The mean Visual Analogue Scale score (VAS) after the surgery decreased to (2.60 ± 0.96) from (8.80 ± 1.17) (p -value $< .05$). Joint dynamics were also improved significantly with an increase in medial joint space from an average of (2.14 ± 0.50) preoperatively to (4.13 ± 0.67) (P -value < 0.05). Most patients exhibited improved walking capacity immediately after the surgery.

CONCLUSION: PFO is an excellent, cost-effective, and safe surgery in relieving pain and improving joint function in patients with medial compartment arthritis of the knee provided the proper indications for surgery are met.

KEYWORDS: Medial compartment knee osteoarthritis, Medial joint space, Proximal fibular osteotomy, Visual analogue score.

INTRODUCTION

Osteoarthritis (OA) is a chronic degenerative disorder of multifactorial etiology and commonly involves large weight-bearing joints, like hip and knee joints, and ultimately leads to a joint failure.^{1,2} The prevalence rates of osteoarthritis of the knee were found to be high in Asia. According to the study done

by the global burden of diseases 2010, the incidence of knee osteoarthritis of the knee was found to be 3.8%.³ The involvement of the medial compartment of the knee is nearly 10 times more often than the lateral compartment because the medial compartment of a normal knee joint bears approximately 70% of body weight whereas the lateral and patella-femoral

compartment bears the remaining weight.⁴ The presentation of knee OA may vary according to the severity and there are different modalities available accordingly. Total knee replacement is the gold standard treatment for severe OA knee but in the initial stages of OA involving the unicompartments, biomechanical approaches like joint pressure unloading and mechanical axis alignment correction methods appear to be preventive and convenient means of treatment.⁴ There are shreds of evidence, that unloading the knee joint by bracing, osteotomy or joint distraction methods are effective in reducing pain and slowing down structural damage of the knee joint.⁵ Recent studies argue for the usefulness of a biomechanical approach to improve function and possibly reduce disease progression in osteoarthritis.^{6,7}

METHODS

This is a prospective observational study conducted at the National Academy of Medical Sciences, National Trauma Centre, Bir Hospital from August 2017 to September 2018. A total of 31 patients (19 female and 12 male) presenting with mild to moderate clinicoradiological features of OA knee like knee joint pain, difficulty in walking, associated genu varus of < 12 degrees, fixed flexion deformity of < 15 degrees, adequate lateral joint space with a minimum of 2mm of medial joint space, those not responding to conservative management, a motivated patient who understands that this is a procedure that buys time and delays knee replacement surgery were enrolled for the study after institutional board review approval. Patients with severe OA knee involving two or more compartments, Genu valgus, acute major trauma, inflammatory joint disease, malignant tumors, patella-femoral osteoarthritis were not included in the study.

Procedural details: The procedure was performed in the subarachnoid block. With the patient in the supine position, surface marking of the proximal fibula and the course of common peroneal nerve was done and an approximately

5cm longitudinal incision was made over the lateral skin of the proximal fibula and the fibula was exposed in the interval between the peroneus muscle and soleus muscle. The peroneal nerve when encountered was cautiously retracted with minimal force. The procedure was completed by removing a 2 to 3 cm length of the fibula at a site 6 to 10cm from the caput fibulae, hemostasis was achieved, and wound closure was done. Drains were not used. Full weight-bearing and free mobilization were allowed postoperatively.⁷

Fig 1: surface marking of the fibula



Fig 2: plane between the peroneal compartment and soleus.



Fig 3: osteotomy with saw

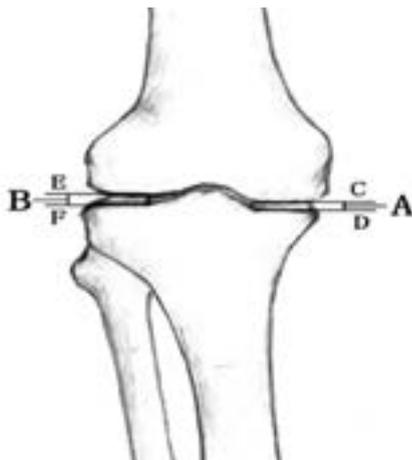


Fig 4: proximal fibular osteotomy



Knee pain was assessed both pre-operatively and post-operatively (preferably after 1 week follow up) by allowing the patient to fill in the VAS chart. The pre-operative and post-operative weight-bearing x-rays of knees in anterior-posterior and lateral views were taken. The measurements were done after magnification correction in x-ray as shown in the figure.

Fig 5: measurement of the lateral and medial joint space.



- A: medial joint space
- B: lateral joint space.
- C: horizontal line drawn from the lowest point of medial femoral condyle
- D: horizontal line drawn from the lowest point of lateral femoral condyle
- E: horizontal line drawn from the highest point of medial tibial plateau.
- F: horizontal line drawn from the highest point of lateral tibial plateau.

RESULTS

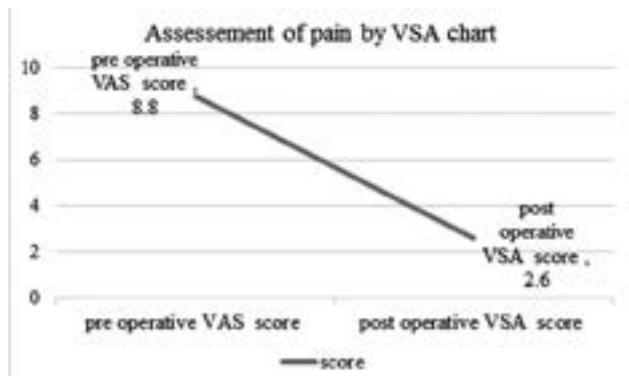
Data was entered in Statistical Package for the Social Sciences (SPSS) version 22 for Windows and analyzed using appropriate tools. The statistical significance of observations is tested by the Chi-squared test and t-test and the p-value ≤ 0.05 was considered significant.

There was a significant reduction of knee joint pain post-operatively as shown in the chart.

Table 1: Mean Pre and Post-operative VAS score

Sn	Average Preoperative VAS score	Average postoperative VAS score
1	8.80 ± 1.17	2.60 ± 0.96 (p-value < .05)

Fig 6: pie chart comparing preoperative and postoperative VAS scores.



Assessment of medial and lateral joint spaces: Significant improvement in joint space dynamics was observed as shown in the chart.

Table 2: Measurement of Mean medial and lateral joint spaces

Joint space (mm)	Preoperative	Postoperative
Medial joint space	2.14 ± 0.50	4.13 ± 0.67
Lateral joint space	6.02 ± 0.67	5.90 ± 0.82
Medial joint space / lateral joint space	0.39 ± 0.11	1.03 ± 0.22

Fig 7: bar diagram showing pre and post-operative medial and lateral joint space

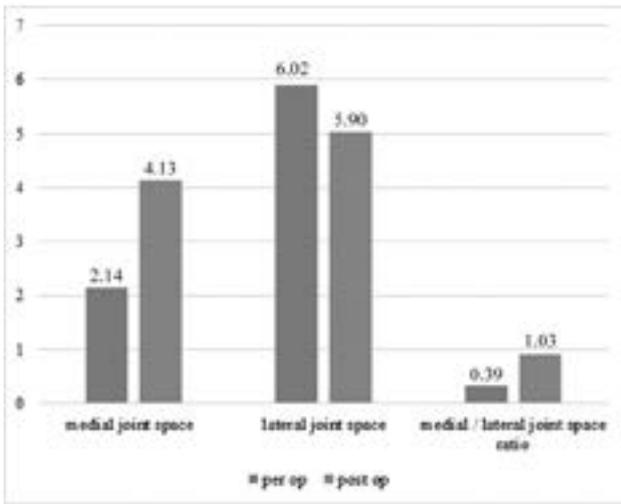


Fig 8: pre-operative medial compartment OA knee



Fig 9: immediate post-operative x-ray knee



DISCUSSION

Knee OA is one of the most common joint disorders, largely affecting the medial compartment. The medial compartment is predominantly loaded in a varus knee and the

neutral mechanical axis which passes slightly medial to the midpoint of the knee joint acts more medially.⁸ The knee joint can be visualized to be supported by four cortices. The medial cortex of the proximal tibia supporting the medial compartment and the lateral compartment being supported by the three cortices including the lateral cortex of the tibia and the two cortices of the fibula providing a fibular strut effect shifting the body-weight more medially thus loading the medial compartment maximally which further increases during walking, sportings, bending knee activities leading to cartilage and possibly meniscal damages with narrowing of joint spaces.^{4,8,9} Furthermore, as the patient ages, the medial cortex softens, and due to increased medial deviation of the bodyweight, the medial cortex collapses increasing the intraosseous pressure. Eventually, the medial tibial plateau slopes medially and lie lower than the lateral tibial plateau resulting in varus deformity.¹⁰ The varus loading of the knee joint causes the altered activity of the hamstrings quadriceps and gastrocnemius muscles and also increases the adduction moments of the knee joint in the midstance phase of the gait cycle, further compressing the medial compartment.^{11,12} Further, it has been shown that this injurious compression of the joint leading to the destruction of the proteoglycans and the collagen network of the cartilages resulted in the release of proinflammatory products like IL-1,6 and TNF alpha which causes synovitis and pain.^{13,14} But interestingly, movements in decompressed joints induces the expression of IL-10 which are a potent anti-inflammatory that reduces pain.^{14,15} Hence, if “loading” is a major cause in the development and progression of osteoarthritis, then “unloading” may be able to prevent progression. PFO is one of the noble procedures that unloads or distracts the medial compartment of the knee joint thus trying to nullify the injurious effect of loading and possibly help

in regeneration of the cartilages.^{16,17} Tiku and Sabaawy have also reported that cartilage regeneration is possible in OA joints that have been surgically pulled apart or distracted for a prolonged period.¹⁸

There are many other surgical options available for the management of medial compartment arthritis of the knee like High tibial osteotomy, Unicondylar knee replacement, and total knee arthroplasty.¹⁹ High tibial osteotomy and Unicondylar knee replacement have their disadvantages and are done in selected cases. Total knee arthroplasty is effective in relieving pain and improving joint functionality in the late stage but it is expensive, expertise dependent, and involves the use of complex implants. Such surgeries can be done only in tertiary hospitals and may not be feasible in hospitals having limited setup. Due to concerns over limited function and early failure of TKR in young and more active patients, treatment alternatives are being explored that would allow the delay or avoidance of arthroplasty in young patients with symptomatic early OA.^{20,21}

In this scenario, PFO can be an intermediate procedure, which is simple to perform, easily reproducible, gives good functional results, and is associated with a shorter recovery period and improves the quality of life.

In our study, most of the patients had early pain relief and improvement in joint functionality after the surgery and this was reflected by a decrease of VAS score to 2.6 ± 0.96 from 8.80 ± 1.17 also the medial joint opening increased to 4.13 ± 0.67 from 2.14 ± 0.50 . Significant varus deformity correction was reflected by a decrease in lateral joint space from 6.02 ± 0.676 to 5.90 ± 0.82 after surgery. Improved joint functionality was reflected by increased medial to lateral joint space ratio from 0.39 ± 0.11 to 1.03 ± 0.22 after surgery. In the study done by Yang et al and Wang et al, the authors found that VAS

score significantly reduced after the procedure and stated that PFO dramatically improves the function of the knee and gives good pain relief also they also stated that obvious correction of alignment of the knee joint was seen after PFO as found the increment in medial to lateral joint space ratio to from 0.40 ± 0.28 to 0.58 ± 0.30 .²¹ L Prakash et al also found an increment in medial joint space from 1.2mm pre-operatively to 4.5mm post-operatively and stated that PFO is also helpful in improving the biomechanical function of the knee.²² Similarly, decrement in lateral joint space was a significant finding in the study done by Yeshwant et al and stated that PFO possibly can give better varus correction.²³

Though PFO is a very safe and simple surgery it is not immune to the general complications of surgery. The complications are though few, consist of common peroneal nerve injury, wound infection, hematoma formation, anesthetic complications, injury to the lateral, and anterior compartment muscles. In our study, two patients had paresthesia in the dorsum of the foot lasting a few weeks but recovered completely at 3-4 months period. The majority of our patients after undergoing this simple, safe, and cost-effective procedure were able to ambulate with full weight-bearing on the same day of the surgery. Although our study shows promising results, a similar study on a larger sample is required to generalize the efficacy of the results and since osteoarthritis is a chronic condition, a longer duration of study is required to see the long term outcome.

CONCLUSION

PFO can act as a promising alternative method in the treatment of medial compartment knee osteoarthritis mostly, in developing countries because of their financial and healthcare delivery limitations. It may also constitute a promising alternative surgery for osteoarthritis of the

medial compartment of the knee, especially for patients who cannot undergo TKA because of certain medical comorbidities. Furthermore, these patients can still undergo TKA in the future if it becomes necessary.

REFERENCES

- 1) Silman AJ, Hochberg MC : Epidemiology of the rheumatic diseases. *International Journal of Epidemiology* 2002; 31(5): 1079–1080
- 2) Akinpelu AO, Alonge TO, Adekanla BA, Odole AC : Prevalence and pattern of symptomatic knee osteoarthritis in Nigeria. *Internet Journal of Allied Health Sciences and Practice* 2009; 7: 10.
- 3) Heidari B : Knee osteoarthritis prevalence, risk factors, pathogenesis, and features. *Caspian Journal of internal medicine* 2011; 2: 205.
- 4) Wang X, Lei Wei, Zhi Lv, Bin Zhao, Zhiqing Duan, Wenjin Wu, et al : 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; 45(1): 282-9.
- 5) Callaghan MJ et al : A randomized trial of a brace for patellofemoral osteoarthritis targeting knee pain and bone marrow lesions. *Annals of the rheumatic diseases* 2015; 74(6): 1164-70.
- 6) Altman RD, Lozada CJ, Hochberg MC : Management of limb joint osteoarthritis. In *Practical Rheumatology*, Hochberg MC, Silman AJ, Smolen JS, Weinblatt ME, Weisman MH (eds), London, Mosby Publications, 2004, pp 511-19.
- 7) Qin D, Chen W, Wang J, Ma W, Dong T, Zhang Y : Mechanism and influencing factors of proximal fibular osteotomy for treatment of medial compartment knee osteoarthritis: A prospective study. *Journal of International Medical Research* 2018; 46(8): 3114–3123
- 8) Tanamas S, Hanna FS, Cicuttini FM, Wluka AE, Berry P, Urquhart DM : Does knee malalignment increase the risk of development and progression of knee osteoarthritis? A systematic review. *Official Journal of the American College of Rheumatology* 2009 ;61(4): 459-467.
- 9) Koshino T, Wada S, Ara Y, Saito T. Regeneration of degenerated articular cartilage after high tibial valgus osteotomy for medial compartmental osteoarthritis of the knee. *The Knee*. 2003; 10: 229-236.
- 10) 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: 218-219.
- 11) Lewek MD, Ramsey DK, Snyder-Mackler L, Rudolph KS : Knee stabilization in patients with medial compartment knee osteoarthritis. *Arthritis Rheum* 2005; 52(9): 2845-2853.
- 12) Yang NH, Nayeb-Hashemi H, Canavan PK, Vaziri A : Effect of frontal plane tibiofemoral angle on the stress and strain at the knee cartilage during the stance phase of gait. *Journal of Orthopaedic Research*. 2010; 28(12): 1539-47.
- 13) Oliviero F, Ramonda R, Punzi L : New horizons in osteoarthritis. *Swiss medical weekly* 2010; 140(3738): 3.
- 14) Goldring MB et al : Roles of inflammatory and anabolic cytokines in cartilage metabolism: signals and multiple effectors converge upon MMP-13 regulation in osteoarthritis. *Eur Cell Mater* 2011; 21: 202-220.
- 15) Helmark IC, Mikkelsen UR, Børglum J : Exercise increases interleukin-10 levels both intraarticularly and peri-synovially in patients with knee osteoarthritis: a randomized controlled trial. *Arthritis research & therapy* 2010; 12(4): R126.
- 16) Lafeber FP, Intema F, Van Roermund PM, Marijnissen AC : Unloading joints to treat osteoarthritis, including joint distraction. *Current opinion in rheumatology* 2006; 18: 519-52.
- 17) Agneskirchner JD, Hurschler C, Wrann CD, Lobenhoffer P : The effects of valgus medial opening wedge high tibial osteotomy on articular cartilage pressure of the knee: a biomechanical study. *Arthroscopy Association of North America and the International Arthroscopy Association* 2007; 23: 852-861.
- 18) Tiku ML, Sabaawy HE : Cartilage regeneration for treatment of osteoarthritis: a paradigm for nonsurgical intervention. *Therapeutic advances in musculoskeletal disease* 2015; 7(3): 76-87.
- 19) Ringdahl E, Pandit S : Treatment of knee osteoarthritis. *American family physician* 2011; 83: 1287-1292.
- 20) Julin J, Jamsen E, Puolokka T, Knottinen YT, Moilanen T : Younger age increases the risk of early prosthesis failure following primary total knee replacement for osteoarthritis. *Acta Orthopædica* 2010; 81(4): 413-419.
- 21) Yang ZY, Chen W, Li CX, Wang J, Shao DC, Hou ZY, Gao, et al: Medial compartment decompression

- by fibular osteotomy to treat medial compartment knee osteoarthritis: a pilot study. Orthopedics 2015; 38(12): 1110-1114.*
- 22) Prakash L : *Proximal Fibular Osteotomy in medial compartment osteoarthritis of knee with varus deformity. Ec orthopedics 2019; 10: 315-321.*
- 23) Subash Y, Naidu GK : *The role of proximal fibular osteotomy in the management of medial compartment osteoarthritis of the knee. International Journal of Orthopaedics 2018; 4(3): 369-72.*

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