Proximal Fibular Osteotomy (PFO) in Medial Compartment Osteoarthritis Knee Joint

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Abstract
Objective: To assess the effectiveness in our patients of proximal fibular osteotomy (PFO), a new surgical intervention which claims to provide substantial relief in medial compartment osteoarthritis (OA) of knee.
Method: A prospective analytical study was performed in DHQ Hospital, Rawalpindi on 25 consenting patients. A length of fibular segment 1.5 to 2 cm was resected at a distance of 6 to 9 cm from fibular head under local anesthesia, wound closed in layers and patient mobilized as soon as tolerated within few hours. Pre-operative and post-operative x-rays of knee were obtained. Pre-operative and post-operative VAS score for pain was recorded on each visit up to 6 months. Any complications and complaints were recorded.
Results: All opting patients were female with mean age of 47±4.2 years. The average pre-operative VAS score was 7.4±0.6, post-operative score was 4.4±1.1. Average improvement in VAS score was 3±1.2. The paired difference between pre and post-operative VAS scores was highly significant (8.1818E-12). Post treatment, 2 patients reported near complete relief, 3 very little reliefs and 80% of patients reported moderate relief. Post-operative complications included reversible temporary foot drop in all, one case of non-recovering common peroneal nerve injury, and mild ankle pain complaint in all patients. All patients expressed dislike of sawing procedure under local anesthesia although none complained of pain during operation. No patient opted for similar intervention in other limb.
Conclusion: The present protocol was not favored by the patients in our group, in spite of the fact that moderate alleviation of knee pain was reported by nearly all.
Keywords: medial compartment osteoarthritis, proximal fibular osteotomy, high tibial osteotomy, unicompartmental arthroplasty.

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Introduction
Osteoarthritis (OA) of knee joint is a major cause of disability with worldwide prevalence of disease of approximately 36% in people aged more than 65 years. It is anticipated that the prevalence will further increase substantially owing to increasing life expectancy. The need of the hour is not only to find new modalities of treatment of OA but also to apply fresh approaches to delay the progression of the debilitating effects of the disease. The management of OA of knee varies with stage of disease, with the socio-economic condition of individual patient and additionally with the health facility. Whereas multiple non-surgical and surgical treatment procedures are available, total knee replacement has become the fastest growing orthopedic surgery in the world. This pursuit is being driven not only by genuine indications but also by patient demand for quick relief, encouraged by self-serving industry.

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In this race of surgeries what has been lost is the knee preservation methods that delay or even abolish the need of arthroplasty, including drugs, platelet rich plasma and stem cell therapies, braces, physiotherapy and realignment osteotomies. Among the three compartments of knee the medial compartment shows early and predominant involvement as it bears approximately 70% of body weight the mechanical axis being more frequently medial to the center of the knee joint.\textsuperscript{4,5} This leads to a stress concentration in the medial compartment and degeneration of the cartilage and meniscus, increasing varus deformity and decreasing medial joint space which are the major pathological manifestations of knee OA.\textsuperscript{6,7} By shifting the load transmission from medial to lateral compartment the medial compartment can be unloaded, which can be facilitated by bracing, lateral wedge in-soles (nonsurgical), by osteotomy (surgical) or by joint distraction. This biomechanical approach has been used to reduce disease progression in osteoarthritis.\textsuperscript{8,9} It has been observed that symptomatic pain relief and cartilage regeneration are possible in OA if joints are distracted for prolonged periods of time. However, the mechanism by which cartilage growth might occur in the distracted joint space is not well known.\textsuperscript{10} It has been reported that cartilage regeneration is possible in OA joints that has been surgically pulled apart for a prolonged period of time.\textsuperscript{9} High tibial osteotomy or HTO is the gold standard for medial compartment OA with varus, and is known to correct the deformity producing remarkable results lasting even 15 years or longer. However, it has gradually fallen out of favour because not only is it technically more demanding than total knee replacement but certain disadvantages have been reported, including delayed time to full weight bearing and risks of non-union or delayed union, peroneal nerve paralysis and wound infection.\textsuperscript{11} Another good alternative for isolated medial compartment osteoarthritis is Uni-compartmental knee arthroplasty UKA. Although the procedure is less invasive but UKA has got even more high revision rate than TKA.\textsuperscript{12} High tibial osteotomy (HTO) revision rate is less than UKA and is more suitable for younger patient and delays requirement for TKA or UKA.\textsuperscript{12-14}

Recently a new concept of proximal fibular osteotomy PFO has been proposed for medial compartment OA of knee. The medial articular surface of proximal tibia is supported by single medial tibial cortex while lateral tibial articular surface is supported by 3 cortices; one lateral tibial & two fibular cortices. By resecting a small segment of fibula PFO redistributes the load on the tibia plateaus\textsuperscript{15}. This alteration in the kinematics of knee may increase valgus, femoral external rotation, and distal translation of the knee and thus help reduce knee pain and improve early functional recovery.\textsuperscript{16} This can be alternative treatment option for medial compartment OA which may delay or even abolish the need for TKA.\textsuperscript{17} Hence we conducted a preliminary study to investigate the above hypothesis as it has been reported to be simple, safe, fast and affordable surgery that does not require insertion of additional implants. Such a procedure can prove to be of immense benefit for our population.

**Material and Method**

The study was performed in DHQ Hospital, Rawalpindi as prospective interventional study between Jan. 2017 and July 2019. Patients for this surgery were selected by the following criteria:

- Medial compartment arthritis with significant compromise in daily life activities
- Candidates who would, otherwise, be suitable for HTO or uni-compartmental knee arthroplasty.
- Those patients who gave consent for this procedure.

A special consent was taken after explaining the experimental nature of this surgery to the patient.

A total of 25 patients were included in the study. All patients were females (as male patients refused to participate).

The surgery was performed under local anesthesia without a tourniquet. The tip of fibular head was marked with a skin marking pen and the appropriate distance (6 to 9 cm) measured. Skin, and subcutaneous tissue were cut. The incision was a little more than twice the length of the resected segment. The fibular periosteum was well anesthetized and was exposed by separating the peroneus and soleus muscles. The periosteum was incised in line of skin incision, and a 1.5 to 2 cm piece of fibula resected with a narrow blade oscillating saw.

The length of fibular segment resected was 1.5 to 2cm, and the distance from fibular head to the proximal cut was 6 to 9 cm. The concept was to remove the two fibular cortices, converting the knee to a more balanced joint, with unicortical support on either side, allowing correction of mechanical axis. The size of the resected segment and its distance from fibular head depends on the patient’s height. Shorter patients had a 1.5cm segment
resected 6 cm below fibular head, tall patients had a 2 cm resection, some 8 to 9 cm below the fibular head. The wound was washed, closed in layers and a light compression bandage given. The patient was mobilized as soon as tolerated which in most cases was within a few hours. All cases were performed as a day care surgery. Patients were followed up on day 15 (suture removal) and two, six months from the date of surgery.

1. Pain relief measured by VAS.
2. Satisfaction of patient was to be taken as the criteria of success of the treatment. Only left knees were operated initially. We hypothesized that if patient was satisfied with the treatment she would agree for the operation of right counter knee. After checking the data for normality Statistical analysis was performed using SPSS version 23.0. Student’s paired t-test was applied to determine the difference in the pre and post operative VAS scores

Results

25 patients were included in the study. All were females, 38 to 55 years, mean age of 47±4.2 years. The pre-operative VAS score ranged between 6 and 8, average of 7.4±0.6.

The post operative average score was 4.4±1.1. The paired difference between pre and post operative VAS scores was highly significant (p ≤ 0.05). Average improvement in VAS score was 3±1.2. 80% of patients reported postoperative pain at VAS score of 4 and 5 (10 patients each), 2 patients recorded 1 and 2 as post treatment VAS, 3 patients reported a little improvement at VAS-6. (Fig-1)

Intra-operative and post-operative delayed complications

1. In all patients PFO procedure was performed under local anesthesia. No pain at operation site was reported but there was apprehension among patients due to constant vibration of oscillating saw. 15 patients reported mild ankle pain during the procedure.
2. In 4 patients there was a moderate hemorrhage (200-300ml) that was controlled with packing.
3. Post operatively all the patients had foot drop and paresthesia. Foot drop continued for 2-4 months and then dorsiflexion was regained. However, paresthesia persisted in patients for up to 6 months.
4. Among the foot dorsiflexors, extensor hallucis longus function was last one to recover. In four patients it was never regained but they were able to extend the ankle.
5. One patient had complete common peroneal nerve injury that did not improve. NCS showed level of injury at the neck of fibula, above the surgical procedure site.
6. Post-operative swelling in operated leg and ankle persisted for 2-4 months.
7. All patients reported ankle pain of mild intensity in operated limb during follow up period. Thus knee pain was reduced in intensity but ankle pain became the concern of patients.
8. Postoperatively none of patient showed improvement in joint space as was expected before operation. However, none of the patient showed willingness for second procedure in the contralateral limb, even that patient also refused who had shown complete recovery.

Discussion

The purpose of this study was to find an alternative way to treat OA of knee joint which would be relatively easily available to our patient population. Total knee arthroplasty, unicompartmental arthroplasty, high tibial osteotomy undoubtedly have good results but they are expensive procedures available in only limited hospitals in a few larger cities of Pakistan. Moreover, the gold standard teaching is that TKR should be reserved as a last resort in management of knee OA, after exhausting all other methods of management. Unicompartmental arthroplasty and HTO for various reasons are less frequently procedures offered to patients demanding operative intervention for disabling disease. Similarly, platelet
rich plasma therapy and stem cell regeneration seem to be very fascinating new procedures. Both have shown early promising results and seem to delay the need of total knee replacement. However, their long term results are yet to come. They are costly and require special equipment and facilities.

In the above scenario PFO seemed to be an attractive option which is simple and can be readily done even in a remote area with the use of routinely used gadgets of orthopedic surgery.

This is a relatively recently introduced technique being performed in some Orthopedic centers in China, India, Indonesia which face somewhat similar limitations regarding nationwide health care facilities. They have reported promising results on the basis of which we were encouraged to try this option in our patients. Our initial experience however fell short of expectations. We have tried to analyze factors which could have contributed to these unsatisfactory results.

We observed that patients in our study were generally younger (47±) than those who were reported from other groups undergoing PFO, e.g. 63.9±7.5, 61.47±8.34 and 59.2.17,20 Also patients undergoing TKR in our own local hospitals were also significantly older. Thus Rahman et al and Amin et al reported mean age of the patients as 62±10 and 67.3±8.2 years in their studies of TKR performed in our region. It is possible that expectation of these younger patients with shorter period of disease was for quick and complete cure which did not materialize. The hypothesis was to arrest the disease process, allow for regeneration and provide longer period of relief. Our relatively naïve patients perhaps did not comprehend this scenario and were looking forward to total reversal of disease. Better communication and counselling may have better outcome. Older patients with severe disability suffering for longer periods may be satisfied with the relatively less dramatic relief. Follow-up time was also shorter in our study. We could only follow our patients for 6 months, whereas Yang et al after 2 years follow-up reported VAS score decreasing from 7 to 2. Wang et al following up patients for 12-18 months (mean 13.38 months) reported VAS improving from 8.02±1.50 - 2.74±2.34. A longer follow up might have documented further improvement in patient wellbeing in our study group.

A major cause of concern expressed by nearly all of our patients was distressful, although not painful, vibration they experienced during use of oscillation saw on bone. We operated under local anesthesia as described in detail by Chen et al working in Sichuan University who did not mention such feedback from their patients. Other groups such as Wang et al in Shanxi university operated under epidural or spinal anaesthesia. We realize now that spinal anesthesia would definitely improve patient comfort and subsequent compliance. Spinal anesthesia was not opted for in this study as it was not possible for us to spare the heavy trauma list for an experimental procedure. Although the original reported case series were done under spinal anesthesia they themselves encouraged to do it under local anesthesia. Thus an important cause of reluctance of patients to participate in the second procedure of PFO on contralateral limb was the apprehension of oscillating saw vibration perceived under local anesthesia.

Transient neuropraxia that lead to foot drop and cumbersome paresthesia were also the cause of reluctance in patients. The ankle joint pain though reported as mild also served to be a major source of misgiving in many patients. It may be because of shifting in alignment and changing musculoskeletal stresses in the lower limb. These phenomena may well have cleared up over time but we did not follow up after 6 months. We recommend future studies with larger sample size and longitudinal follow-up.

**Conclusion**

PFO procedure needs further evaluation and should better be performed under spinal anesthesia. At present we have abandoned this procedure because the desired results were not obtained. Also it is very difficult to pursue local population for an experimental procedure, as it is evident from non-participation of males in this study. But our results were not in favor of this hypothesis. Still we think that this concept needs large multicentric trials.

**Conflict of Interest**  None

**References**


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Authors Contribution
SR, OUR: Conceptualization of Project
SR: Data Collection
AIB: Literature Search
OUR: Statistical Analysis
AMM, MH, NQ: Drafting, Revision
OUR, SA: Writing of Manuscript