ORIGINAL ARTICLE

Proximal Fibular Osteotomy: Is it Really an Option for Medial Compartmental Osteoarthritis Knee? Our Experience at Tertiary Centre

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Abstract

Introduction The medial compartment is commonly involved in age-related osteoarthritis knee because weight-bearing axis passes close to the medial condyle and its large surface area. Various treatments have been proposed ranging from conservative to total knee arthroplasty which is an expensive and complex treatment. Recently, proximal fibular osteotomy (PFO) for medial compartment knee osteoarthritis became popular as a treatment modality. Although, the mechanism of PFO is not clear. So, we conducted a prospective study to assess the clinico-radiological outcome of proximal fibular osteotomy in medial compartment osteoarthritis knee.

Materials and methods We conducted a prospective study from November 2017 to November 2019 on 32 (47 knees) patients with degenerative medial compartmental osteoarthritis knee, varus deformity < 15 and Kellgren and Lawrence grade II and grade III (K–L Grade). We recorded the visual analogue score (VAS) and knee society score (KSS) pre-operatively and post-operatively of all patients. We got weight bearing antero-posterior and lateral radiograph of knee done. We assessed joint space ratio and lateral tibio-femoral angle (FTA) pre-operatively, post-operatively and at each follow-up.

Results Mean age was 48.4 (35–65) years and the mean follow-up was 18 months. Mean duration for unilateral PFO was 37 min and for bilateral, 55 min. The VAS was improved from 7.33 ± 0.72 to 7.13 ± 1.64 at 3 months and remained the same at final follow-up ($p > 0.05$). The mean pre-operative clinical and functional KSS was statistically insignificantly improved at 3 months and final follow-up ($p > 0.05$). The mean pre-operative lateral and mean pre-operative joint space ratio was also improved statistically insignificant ($p > 0.05$). Extensor hallucis longus (EHL) weakness was documented in five knees (10.6%) and paraesthesia was documented in seven (14.8%) knees.

Conclusion Although, PFO is a simple, less invasive and affordable procedure, we could not reproduce the favourable results in medial compartmental osteoarthritis knee. This procedure is also associated with reversible but noticeable complications. So, we would not consider PFO as an alternative option in the treatment of medial compartmental osteoarthritis knee.

Keywords Proximal fibular osteotomy · Medial compartmental osteoarthritis · Peroneal nerve palsy · VAS · Lateral FTA and KSS

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Introduction

Osteoarthritis of the knee is an age-related disease which shows degeneration and regeneration (osteophytes). Knee osteoarthritis is common in developing countries like India due to lifestyle (squatting and palthi posture) which subjects the knee joint to stresses. Its prevalence in India is about 28% [1]. It initially affects the medial compartment due to larger surface area and mechanical axis passes close to the medial compartment and leads to varus deformity. Depending on the severity, the spectrum of treatment extends from conservative (analgesic, glucosamine, diacerein, physiotherapy, viscosupplementation and intraarticular steroid injections) to surgical methods (total knee arthroplasty, unicompartmental knee arthroplasty, high tibial osteotomy, arthroscopic and autologous chondrocyte transplantation) [2]. Recently, Proximal fibular osteotomy (PFO) for medial compartment knee osteoarthritis became popular as a treatment modality, claiming that it is an easy, simple, affordable, without the need of an implant and with less complication in alleviating pain and disability. Most of the initial literature is from China and few from India regarding PFO and have shown promising results in medial compartment osteoarthritis knee. Although the mechanism of PFO is not clear, several theories have been given with or without evidence but none of them is accepted yet. So, we conducted a prospective study to assess the clinico-radiological outcome of proximal fibular osteotomy in the medial compartment osteoarthritis knee.

Materials and Methods

This current prospective study was conducted from November 2017 to November 2019 after approval by the institutional review board. After getting written consent, we

included 32 (47 knees) patients with degenerative medial compartmental osteoarthritis knee, varus deformity $< 15^\circ$ and Kellgren and Lawrence Grade II and Grade III (K–L Grade). We have excluded the patient with bi- or tri-compartmental osteoarthritis, flexion deformity, genu valgum, inflammatory arthritis, post-traumatic arthritis, previous knee surgery and body mass index > 30 . On admission, after explaining about the procedure, we examined the patients clinically and radiologically. Clinically, we recorded the visual analogue score (VAS) and knee society score (KSS) pre-operatively and post-operatively of all patients. Radiologically, we advised weight-bearing X-rays of knee antero-posterior and lateral views, standing scannogram. We assessed the joint space ratio and lateral tibio-femoral angle (FTA) pre-operatively, post-operatively and at each follow-up. The joint ratio is calculated as the ratio of medial joint space and lateral joint space (Fig. 1). We also documented the complications, if any.

Surgical Technique (Fig. 2)

We had operated all patients under spinal anaesthesia in the supine position with a tourniquet on. We marked the fibula head and fibula up to 10 cm from the head fibula after cleaning and draping. By keeping in mind the anatomy of superficial peroneal nerve (SPN) and deep peroneal nerve (DPN), we exposed the fibula with the posterolateral approach through the interval between peronei and soleus. We took out the fibula about 1.5–2 cm at the distance of 6–10 cm from fibular head. We did not use the oscillating saw, but weaken the fibular cortex with a drill and then osteotomised it with an osteotome. We used the Langenbeck retractor rather than bone lever in an attempt to avoid the overzealous stretching of the nerve. We rasped the cut ends and sealed them with bone wax. The wound was closed in layers after wound irrigation and hemostasis. Patients were

Fig. 1 **a** Pre-operative radiograph bilateral knee AP view (standing)—B/L medial compartmental osteoarthritis knee. **b** Post-operative radiograph bilateral knee AP view (standing)—B/L proximal fibular Osteotomy. **c** Radiograph bilateral knee AP view (standing)—at final follow-up

Fig. 2 Surgical technique. **a** Incision was given 6–10 cm below fibular head. **b** Exposing fibula after dissection between the peroneus longus and soleus muscle and retracting the tissue with hooks rather than

bone lever to avoid overzealous soft tissue stretching. **c** Weaken the bone with the help of a drill to avoid the use of oscillating saw

asked to stand and walk on the same evening of surgery and were discharged after the first wound inspection on the third post-operative day. Check X-ray and assessment were done on the next day of surgery and at every follow-up. The suture removal was done on the 14th post-operative day. Follow-up was done at 1, 3, 6, 12 months and then annually.

Statistical Analysis

Categorical variables were presented in number and percentage (%) and continuous variables were presented as mean $\pm$ SD and median. Quantitative variables were compared using the paired *t*-test between preoperative and post operative scores. A *p*-value of <0.05 was considered statistically significant. The data were entered in MS EXCEL spreadsheet and analysis was done using Statistical Package for Social Sciences (SPSS) version 20.0.

Results

We have done PFO on 47 knees (32 patients) in the current study. Fifteen patients had bilateral involvement and 17 patients unilateral. Female were more common than male (F:M—21:11). Among bilateral patients, bilateral PFO was done in nine patients and six patients underwent staged

PFO because of patient's apprehension or preference. Mean age was 48.4 (35–65) years and the mean follow-up was 18 months. Mean duration for unilateral PFO was 37 min and for bilateral, 55 min. Twenty nine knees (62%) were classified as KL grade II and 18 knees (38%), grade III. The mean pre-operative VAS was 7.33 ± 0.72 , which was improved to 7.13 ± 1.64 at 3 months and remained the same at final follow-up; this improvement was statistically insignificant ($p > 0.05$). The mean pre-operative clinical knee society score was 55.60 ± 4.29 which was insignificantly increased to 58.40 ± 7.33 at 3 months and remain unchanged at final follow-up ($p > 0.05$). The mean functional knee society score was 56.27 ± 3.99 which was increased to 57.47 ± 5.31 at 3 months and remained same at the final follow-up. This improvement was statistically insignificant ($p > 0.05$) (Table 1).

The mean pre-operative lateral FTA was 185.60 ± 2.53 , while it was decreased to 184.80 ± 1.97 at final follow-up which was statistically insignificant ($p > 0.05$). The mean pre-operative joint space ratio was 0.26 ± 0.04 mm and it was decreased to 0.25 ± 0.04 mm at final follow-up which was also statistically insignificant ($p > 0.05$) (Table 2). Post-operatively, extensor hallucis longus (EHL) weakness was documented in five knees (10.6%) and apart from EHL weakness patients, paraesthesia over the dorsum of the foot was documented in seven (14.8%) knees. All paresthesias

Table 1 The pre-operative and final follow-up value of mean VAS, clinical KSS and functional KSS

S. no	Score	Pre-operative value	Final follow-up value	<i>p</i> -value
1	VAS	7.33 ± 0.72	7.13 ± 1.64	> 0.05
2	Clinical KSS	55.60 ± 4.29	58.40 ± 7.33	> 0.05
3	Functional KSS	56.27 ± 3.99	57.47 ± 5.31	> 0.05

Table 2 The pre-operative, post-operative and final follow-up values of radiological parameters like Lateral FTA and joint space ratio

S. no	Parameters	Pre-operative value	Post-operative value	Final follow-up value	<i>p</i> -value
1	Lateral FTA	185.60 ± 2.53	184.80 ± 1.97	184.60 ± 1.80	> 0.05
2	Joint space ratio	0.26 ± 0.04	0.25 ± 0.04	0.25 ± 0.04	> 0.05

recovered within 4–6 weeks. All EHL had also regained grade five power within 6 months. There were no complications related to the wound. None of our patients was lost to follow-up.

Discussion

Medial compartmental osteoarthritis knee is due to excessive pressure over it and causes pain and disability. Recently, literature has shown that PFO redistributes the stresses in the medial and lateral compartment and relieves symptoms. Various concepts have been theorised to rationalise the PFO like dynamic fibular distalisation [3], ground reaction vector readjustment theory [4], non-uniform settlement [5], slip-page phenomenon, too many cortices [6], and competition of muscles [7]. None of these concepts was accepted yet. Despite the unclear mechanism of PFO, this procedure got admiration in developing countries like China and India. Some publication from China and few from India have shown promising results. In 2014, Yazdi et al. [8] gave the idea of fibulectomy first time when they were studying the joint reaction force across the cadaveric knees for other reason like nonunion of the tibia and fibular tumour resection. They have suggested that fibulectomy along with periarticular knee osteotomies can decompress the knee. Baldini T et al. [9] also conducted a biomechanical cadaveric study to determine the effect of PFO on knee joint, ankle joint and tibial strain and proposed that PFO decreases the pressure in the medial compartment and may reduce pain and improve knee function in medial compartment osteoarthritis. Yang et al. [10] in their retrospective study, included 110 patients with more than 2-year follow-up. The pre-operative KSS score was 45 ± 21.3 , while it was 92.3 ± 31.7 at final follow-up. Pre-operatively, the mean VAS score was seven which significantly decreased to two at the final follow-up. Pre-operatively, mean FTA and lateral joint space were $182.7^\circ \pm 2.0^\circ$ and 12.2 ± 1.1 mm, which were changed to $179.4^\circ \pm 1.8^\circ$ and 6.9 ± 0.7 mm, respectively, at final follow-up. They reckoned that PFO can significantly change the radiological appearance, clinical function of the knee in terms of pain relief and they considered PFO as an alternative method for medial compartment osteoarthritis knee. Wang et al. [11] followed 46 patients PFO retrospectively for more than a year. They noted that VAS significantly decreased from 8.02 ± 1.50 to 2.74 ± 2.34 at

final follow-up. Mean clinical and functional KSS was significantly improved from 44.41 ± 8.90 and 41.24 ± 13.48 to 69.02 ± 11.12 and 67.63 ± 13.65 , respectively. The ratio of the knee joint space was also significantly improved from 0.40 ± 0.28 to 0.58 ± 0.30 at final follow-up. But only eight patients got improvement in limb alignment out of 46. They suggested that PFO can be an alternative option for medial compartment osteoarthritis where financial and medical sources are limited.

Bo Liu et al. [12] also done a retrospective study on 111 knees with a follow-up of 1 year. They found that 51 knees came out with a satisfactory clinical outcome and 77 knees with significant improvement. Prakash et al. [6] conducted a retrospective study to assess the outcome of PFO on 149 knees. They found a significant reduction in pain and suggested that PFO is an easy, simple and less invasive procedure.

Aforementioned studies have shown encouraging results for PFO in medial compartmental osteoarthritis knee but all were retrospectively done and mostly from China. A prospective study with a large sample is yet to come with favourable results. We have conducted a prospective study on 47 knees to assess the result of PFO in patients with medial compartmental osteoarthritis but we found drastically opposite results to the previous studies. We could not achieve the significant change in the VAS, clinical and functional KSS, lateral FTA and joint space ratio at 3 months, 6 months, 1 year and at final follow-up from the pre-operative scores. All scores were remained almost the same from 3 months post-operative period to the final follow-up. Recently, Huda et al. [13] published a prospective study from India on 56 knees with medial compartmental osteoarthritis knee and they assessed the outcome of PFO with VAS and WOMAC scoring system and radiologically with FTA. They found a significantly improved score at 3 months except for FTA. Subsequently, their scores did not improve significantly until the final follow-up. They could not record any significant change in FTA from pre-operative to final follow-up.

Although, we could not comprehend the logic of this temporal change of scores in their study but certainly, their results substantiated our study. Most of the previous studies are from China and retrospective. Our results are different from these studies because we conducted a prospective study on different population sample, especially in stature and lifestyle.

Even after taking all precautions like the posterolateral approach, use of a drill and osteotome and resection 6–10 cm below the fibular head, we had a high rate of complication like EHL weakness (10.6%) and paraesthesia (14.8%) over dorsolateral foot and anterolateral aspect of leg. One patient of bilateral PFO developed EHL weakness bilaterally. All EHL weakness and paraesthesia recovered within 6 months and 4–6 weeks, respectively. Qiunt et al. [2] also reported SPN palsy in eight (12%) knees out of 67 and one (1.5%) knee with EHL weakness, all were reversible. Yang et al. [10] reported paraesthesia in 4 (3.6%) knees, out of these they have done osteotomy at fibular neck level in three knees (2.7%) and in one knee (0.9%) at 6 cm below the fibular head. They have also reported reversible weakness in the leg in 16 (14.5) knees but not specified EHL. Huda N et al. [13] mentioned paraesthesia in nine knees (16%) out of 56 but no EHL weakness. Prakash et al. [6] reported foot drop in one (1.1%) patient, EHL weakness in 8 (9%) patients and paraesthesia in seven (8%) patients. None of the preceding studies had reported the foot drop except Prakash et al. [6]. EHL weakness and paraesthesia were troublesome complications in our study until recovery. Paraesthesia was comparable with previous studies but EHL weakness is only comparable with Prakash et al. [6] and higher in incidence. Ogbemudia AO [14] reported that incidence of peroneal nerve involvement is higher (24%) in proximal (15 mm) fibular resection in comparison with distal fibular resection (3%); this study explains the higher incidence of EHL weakness and paraesthesia in our study. Wootton JR [15] observed in their anatomical study that motor branch for EHL consistently arises as single or multiple branches 9 cm below the proximal tibiofibular joint and this study explains the EHL weakness in our study because we have resected the fibula from 6–10 cm from fibular head.

Most of the previous studies on the role of PFO in medial compartmental osteoarthritis knee have shown favourable results were retrospective and weaker in evidence. We had limitations in our study like a small sample, short follow-up and lack of control group. Despite the simple, safe and less invasive procedure, we could not reproduce the favourable results in the current study. There are still numerous queries, for which double-blind randomised controls trials are required.

Conclusion

Although, PFO is a simple, less invasive and affordable procedure, we could not reproduce the favourable results in medial compartmental osteoarthritis knee. This procedure is also associated with reversible but noticeable complications.

So, we would not consider PFO as an alternative option in the treatment of medial compartmental osteoarthritis knee.

Compliance with Ethical Standards

Conflict of interest The authors have not received any funding for this work and have no conflict of interest, to declare.

Ethical standard statement We obtained the clearance from institutional ethical review board for this study and conformed to the ethical guidelines of the Helsinki declaration (as revised in Tokyo 2004). No studying advertising was made and no remuneration was offered.

Informed consent We obtained informed consent from all the participants included in this study for the procedure and use of data for publication.

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