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Functional outcomes of proximal fibular osteotomy in osteoarthritis knee grade II & III

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Abstract

Introduction: Osteoarthritis of the knee is a degenerative condition with a variety of treatment options like high tibial osteotomy (HTO), arthroscopic debridement, unicompartmental knee arthroplasty and total knee arthroplasty. This study was conducted with an aim to assess the outcomes of individuals with Grade II and III medial compartment osteoarthritis treated with a proximal fibular osteotomy (PFO) to alleviate discomfort, improve medial joint space and function of the knee joint.
Methodology: From November 2019 to October 2021, 25 Patients aged 45 to 65 years with knee OA of grade II or III (Kellgren-Lawrence classification) involving the medial compartment of the knee were included and underwent proximal fibular osteotomy and were followed up. Preoperatively as well as postoperatively, the entire lower extremity radiographs were obtained to assess the alignment of the lower extremity and the ratio of the knee joint space (medial/lateral compartment), knee pain was assessed using a visual analogy scale and knee ambulation activities were assessed using the American Knee Society score.
Results: All patients experienced alleviation from medial knee discomfort postoperatively. Postoperative weight-bearing lower limb radiographs revealed an average increase in medial knee joint space. The mean preoperative AKSS improved from 43.92 to 63.88 till the last follow-up.
Conclusion: PFO is a safe, simple and effective procedure that significantly decreases knee discomfort. It also enhances the joint's radiographic appearance and functional outcome in patients with medial compartment osteoarthritis of the knee.

Keywords: Osteoarthritis, knee pain, proximal fibular osteotomy, kellgren-lawrence classification

1. Introduction

Osteoarthritis (OA) Knee is a very common chronic condition causing fatigue, pain, functional limitations, increased healthcare utilization and high economic costs to society.

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The load of OA is projected to increase, due in part to population aging and obesity. It is commonly seen in 55-64yrs of age, predominantly more in females, particularly associated with obesity [1]. Pathologically, knee OA is characterized by structural changes in and around the knee joint. The primary structural changes include the formation of osteophytes and loss of cartilage [2-4]. Classical radiographic features in knee OA include osteophytes, subchondral bone sclerosis, decreased joint space, osteochondral bodies, cyst formation and bone deformity. The Kellgren and Lawrence system is a method to classify the severity of knee OA. This classification was proposed by Kellgren *et al*. in 1957 and later accepted by WHO in 1961[5].

Management of OA includes conservative or surgical methods. Conservative therapy incorporates patient education, the use of assistive devices example cane, frame, or wheeled walker. The pharmacological approach includes oral administration of paracetamol, diclofenac, NSAIDs [6]. HTO has been the surgical treatment of choice in young patients with OA of the medial compartment of the knee [7]. Joint replacement surgery can be done in patients with reduced function and persistent pain that are refractory to non-surgical therapies. Also, TKA is expensive and complex and may require a second revision [8]. PFO has emerged as a new surgical intervention to relieve pain and improve joint function for knee OA patients. The most striking findings in the study include medial pain relief along with the increase in the medial joint space. Postoperative ambulation was also improved compared with the preoperative state. Compared with HTO or TKA, PFO is a simple, fast, safe and affordable surgery that does not require any insertion of additional implants [9].

2. Materials and Methods

This was a prospective study recruiting patients with medial compartment OA presenting to the outdoor department of Orthopaedic Surgery. The study was conducted from the period of November 2019 to October 2021 on 25 patients (n = 25; mean age, 55.64 years; age range, 45–60 years; 17 female, 8 male) to assess the Functional outcomes of PFO in patients with medial compartment osteoarthritis of the knee. The study was approved by the Institutional Ethical Committee vide project no.46 Ref no. MMMCH/IEC/333. Every patient who agreed to participate in the study gave their informed and written agreement on an informed consent form (ICF). The inclusion criteria were Knee pain with functional limitations due to medial compartment osteoarthritis, age 45-65 years, grade II & III of Kellgren-Lawrence classification. The exclusion criteria were age less than 45 years or more than 65 years, Kellgren and Lawrence Grade 0, I and IV, both medial and lateral compartments of the knee involved, Genu valgus, acute trauma, inflammatory arthritis, crystal arthroplasty and malignant tumors, inflammatory joint disease or posttraumatic osteoarthritis of the knee, prior surgical intervention or fractures, around the knee. Before the procedure, each patient was given a thorough explanation of the procedure.

Anteroposterior and Lateral radiographs [Fig. 1a] & [Fig. 1b] of the knee joint that falls into grades II and III of the "Kellgren-Lawrence classification of osteoarthritis knee" were used to identify patients with osteoarthritis of the knee involving the medial compartment. The initial "Kellgren-Lawrence article" presented an X-Ray Antero-Posterior image of the knee.

A) **"KL classification Grade I":** The AP radiography view reveals a minor narrowing of the joint space, possibly due to the growth of osteophytes.
B) **"KL classification Grade II":** Reveals a slight reduction in joint space, possibly due to the establishment of an osteophyte
C) **"KL classification Grade III":** Reveals significant loss in joint space, mild osteophyte growth, sclerosis and minor bony end deformity.
D) **"KL classification Grade IV":** Demonstrate a significant loss in joint space, as well as a

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considerable osteophyte formation, sclerosis and obvious deformity at the bony ends.

VAS scores on a scale of 0 to 10 have been reported both pre and postoperatively for patients undergoing PFO.

To compute the medial joint space, a vertical line (A) was drawn in the center of two horizontal lines (C and D) taken from the bottommost point of the medial condyle of the femur and medial plateau of the tibia, respectively. To compute the lateral joint space, a vertical line (B) is drawn amid two horizontal lines (E and F) drawn from the bottommost point of lateral condyle of the femur and lateral plateau of the tibia, correspondingly. The medial/lateral ratio of the knee joint space is determined by the A/B ratio as shown in [Fig. 2].

The American Knee Society Score (AKSS) is an examiner-dependent criterion devised by the American Knee Society. The "clinical AKSS-knee score" and the "functional AKSS-function score" are the two components. The clinical AKSS is calculated based on a physical examination of the knee. It evaluates stability (25 points) and range of motion (25 points), pain (50 points). The functional AKSS is calculated by measuring walking distance (50 points) and assessing stair climbing and descending (50 points). Comorbidities and age have an impact on functional AKSS. Clinical AKSS, on the other hand, is unaffected by comorbidities or age. It is likewise unaffected by the presence of a functional AKSS.

All the patients were evaluated for age, sex, KL grade, VAS score for pain, Mean AKSS (functional and clinical) and Medial/Latera ratio before surgery.

All patients received an intravenous injection of Cefuroxime 1.5gm one hour before surgery. General surgical risks such as vascular and nerve injury, thrombosis/embolism, wound healing issues and early and late infections were also discussed with the patients.

The patient was positioned supine on the operation table with a pillow below the knee of the operative site and a sandbag under the ipsilateral hip after the administration of spinal anesthesia. Tourniquet was applied to the lower limb [Fig. 3a] before draping. The fibular head was marked with the help of a fluoroscope [Fig. 3b] & [Fig. 3c] to prevent damage to the superficial and deep peroneal nerve and tibial connection of soft tissue structures spanning the knee joint, a lateral incision of 3-5 cm was made in the proximal portion of the fibula [Fig. 3d]. The fibula was exposed by creating a plane between the peroneal and the soleus muscles [Fig. 3e]. Using several drill holes, two osteotomies were performed in the fibula [Fig. 3f] and approximately 2cm piece of the fibula was removed [Fig. 4a] from 6 to 10 cm below the fibular head. A sterile dressing was used after the wound was closed in layers [Fig. 4b]. The patient was allowed to walk as soon as the effects of the spinal anesthesia wore off or the pain was acceptable. A check radiograph of the operated extremity was done the next morning [Fig. 4c]. Patients were discharged after the stitches were removed. All these patients were called for follow-up at 6 weeks, 3 months and 6 months to record VAS scores for pain, AKSS (functional and clinical) and Weight-bearing anteroposterior and lateral radiographs of the affected knee were performed at each follow-up to evaluate the results of the knee joint space ratio (medial/lateral compartment).

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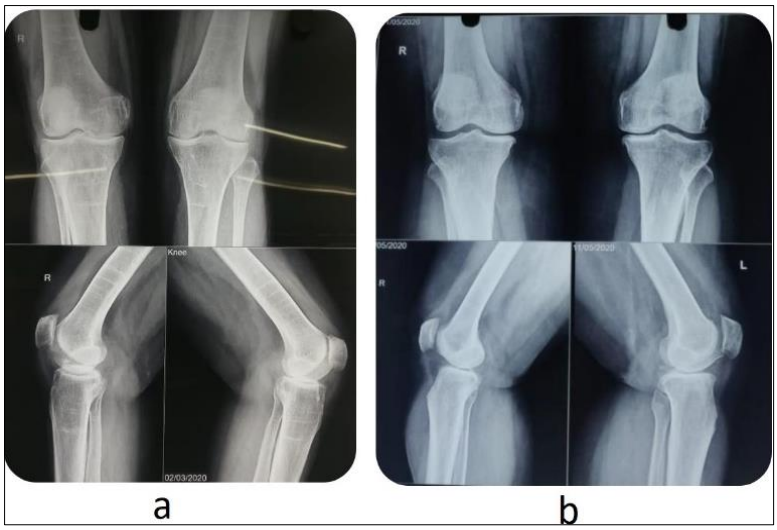

Fig 1(a) & 1(b): Anteroposterior and Lateral radiographs of the knee joint showing grades II&III OA

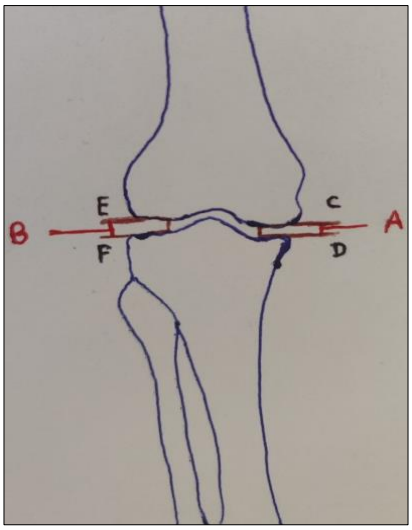

Fig 2: Showing medial/lateral ratio of the knee joint space

Fig 3: (a) Tourniquet applied in lower limb; (b): Draping of the surgical site; (c): fibular head marked with the help of a fluoroscope, (d) Lateral incision of 3-5 cm made in the proximal portion of the fibula; (e) fibula exposed; (f) *Osteotomies* performed Using several drill holes

Fig 4: (a): Approximately 2cm piece of fibula removed; (b): Wound closed; (c): Check radiograph of the operated extremity done the next morning

3. Results

Total 25 patients met the inclusion criteria who had undergone unilateral PFO. Out of the total 25 cases, there were 8 males (32%) and 17 females (68%). 2 Patients had both diabetes and hypertension while 1 patient had a history of Diabetes, hypertension along with a history of Cardiovascular complications i.e. history of Myocardial Infarction two times in the past,

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rest 2 pts. had an only history of Diabetes and one with history of Asthma. All wounds healed by primary intention. There was one case that had a superficial wound infection which was efficiently managed with antibiotics. The study population's average BMI was 28.9, patients were mostly of low socioeconomic status. During each visit, the American Knee Society Score, Visual Analogue Scale and Joint Space Ratio were evaluated and the results were noted in the respondent sheet. The results were analyzed using both functional and radiological criteria. In 15 cases, there was a radiological improvement (60 percent). Three patients (12%) exhibited radiological deterioration, while the other two-thirds (28%) had no discernible radiological improvement. On the practical side, 15 patients (60 percent) with x-ray improvement also had good functional scores, while 7 patients (28 percent) had good functional results short of any x-ray improvement. Three (12%) patients revealed deteriorating x-ray parameters. The Average walking distance was also improved especially the uphill and downhill walking in these patients Average of 19 (76%) patients showed continuous improvement till the last follow-up and 6 (24%) patients complained of recurrent interference.

The mean VAS score for pain at baseline was 7.64 ±0.89, which decreased to 4.32 ±0.61 at 6 weeks (p<0.001), 3.16 ±0.83 at 3 months (p<0.001) and 2.86 ± 1.12 at 6 months (p<0.001) [Tables 1]. The mean AKSS at baseline was 43.92 ±2.93, which increased to 48.52 ±4.56 at 6 weeks (p<0.001), 56.04 ±3.88 at 3 months (p<0.001) and 63.88 ± 6.41 at 6 months (p<0.001) [Table 2]. The mean joint space ratio at preop was 0.19 ±0.028 and postoperatively it improved to 0.52 ±0.068 (p<.0001) [Table 3].

Table 1: VAS Score

	Mean VAS score	SD	P-value
Preop	7.64	± 0.89	<0.001*
Follow up at 6 week	4.32	± 0.61	.001
Follow up at 3 months	3.16	± 0.83	.001
Follow up at 6 months	2.68	± 1.12	.001

*****statistically significant

Table 2: AKSS Score

	Mean AKSS Score	SD	p-value
Preop	43.92	2.93	<.001*
Follow up at 6 week	48.52	4.56	<.001*
Follow up at 3 months	56.04	3.88	<.001*
Follow up at 6 months	63.88	6.41	<.001*

*****statistically significant

Table 3: Medial/lateral Joint Space Ratio

	Mean medial/lateral Joint Space Ratio	SD	p-value
Preop	0.19	0.028	<.0001*
Postop	0.52	0.068	<.0001*

*****statistically significant

4. Discussion

The most prevalent cause of arthritis in adults is osteoarthritis of the knee joint, which is known to cause significant discomfort and loss of function [9]. The treatment option is determined by the patient's age, stage of the disease and bone quality. Arthroscopic debridement, high tibial osteotomy, PFO, unicompartmental knee arthroplasty and total knee arthroplasty are some of the treatment possibilities. In young patients with medial joint OA

and varus deformity of the knee, a high tibial osteotomy is also an option. Due to simultaneous osteoporosis producing a tibial plateau fracture in older individuals with medial joint OA, a high tibial osteotomy is not the best option [10]. Total knee arthroplasty offers effective pain relief and enhanced joint function. But, it is related to numerous complications and might necessitate revision [11]. High tibial osteotomy and unicompartmental knee arthroplasty are two commonly utilized treatments for young people with medial joint OA. Both, have several drawbacks. Deep vein thrombosis, infection, partial correction, non-union, internal fixation failure, peroneal nerve damage and recurrence are all common complications of high tibial osteotomy [12]. Unicompartmental knee arthroplasty is also linked to severe problems such as damage to the medial or lateral collateral ligaments, dislocation of the polyethylene bearing, degenerative arthritis in the other compartment, fracture of the medial proximal tibia and prosthesis dissociation [13, 14]. PFO is a relatively recent technique that has been demonstrated to be effective in treating knee OA in the medial joint. It is a less technically demanding and less expensive surgical alternative to HTO and TKA. In addition, if necessary, the patient can receive TKA in the future.

The precise method through which PFO delivers pain alleviation and varus alignment correction are currently unknown. Bone mass and density in load-bearing joints tend to diminish with age. The fibula supports the lateral condyle of the tibia, resulting in non-uniform tibial condyle settlement, with more settlement and cartilage degeneration on the medial side [15]. The support to the lateral side of the tibial plateau is diminished as a result of PFO, which may lead to varus deformity correction and lateral shift of the loading force. Pain alleviation and improved function are achieved by shifting the loading force to the less deteriorated cartilage in the lateral half. The hypothesis of non-uniform settlement was proposed by Dong *et al*. [16]. Prakash offered the "too many cortices" idea as the mechanism behind enhanced function after PFO [17]. Ground reaction vector adjustments have also been proposed as a possible explanation for PFO's success [18].

Patients in our study saw significant pain alleviation after 6 weeks, which continued to improve for six months. Several additional trials [9, 10, 17] have shown significant pain reduction following PFO, as we have. Two trials [9, 10] found that pain alleviation lasted longer than a year. Wang *et al*. conducted a retrospective study, which is likely to have a recollection bias [9].

Other studies have also observed improvements in the knee and functional subsets of the AKSS, as we have [9, 10]. Improvements in Oxford Knee Scores have been found in some studies [17, 19, 20]. The AKSS assigns a score of poor (60), fair (60-69), good (70-79), or excellent (>80) to the outcome [21]. Another study revealed an outstanding result in functional subgroups of the AKSS (72.06 ±7.30 and 87.90 ±7.08). However, in that study, patients had significantly higher preoperative clinical and functional scores (62.13 ±11.90 and 55.16 ±4.15) than in ours, which could explain the higher postoperative scores. In their investigation, Wang *et al*. reported that the AKSS outcome in the function subset was fair [9]. However, their study enrolled patients with a lower AKSS. The preoperative knee society score has been shown to influence outcomes, which could explain why our findings differ from other studies [12].

In previous studies, the outcome measurements of PFO at six weeks, three months and six months have been rarely reported. This has helped us in determining the change in scores over six months, i.e., improvements in VAS score, AKSS and mean joint space ratio can be shown as early as six weeks and continue to improve for the next six months. VAS score, Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) score and FTA at three months and one year were reported in a recent study by Huda *et al*. published in 2021 [22]. At three months, they reported a significant decrease in VAS and WOMAC ratings. However, when compared to the baseline, the reduction in VAS and WOMAC scores after six and twelve months was not significant. At no point throughout the follow-up, did they

report any significant differences in FTA. According to their findings, the benefits of PFO may not be long-lasting. This is in contrast to the improved radiological outcome reported in the current study as well as several previous investigations [9, 10, 12, 14]. Yang *et al*. found that the improvement in radiological outcomes lasts longer than a year [23]. This increases the chances of ongoing improvement even after 6 months. We are unable to comment on this idea because it is outside the scope of our research. In the literature, pain alleviation and improvements in functional knee scores have been documented after six months [9, 10]. A prospective study with a longer follow-up period on patients will be able to provide light on the long-term effects of PFO.

A potential complication of PFO has been noted to be an injury to the common peroneal nerve (CPN). CPN branches 8.2 cm below the head of the fibula, with the greatest risk of nerve damage occurring within the first 15 cm of the fibula [24]. CPN and superficial peroneal nerve damage were both documented in 1.8 percent of cases by Yang *et al*. [23]. They also discovered that 14.5 percent of their subjects experienced a four-week transitory weakness.

Our study was restricted by a shorter follow-up period, a small sample size and a lack of a reference group, which limited our ability to evaluate PFO compared to other available treatment options for medial joint OA of the knee. Another disadvantage is that we did not attempt to identify the factors that influence the outcomes in PFO cases. To establish the characteristics that regulate the outcomes of PFO in cases of medial joint OA of the knee, we advocate a prospective cohort study employing regression modeling.

5. Conclusion

In our study, we concluded that PFO is a convincing treatment modality for osteoarthritis involving the medial compartment of the knee joint. It is a simple, safe and minimally invasive surgical procedure providing relief from symptoms and improves functional and clinical outcomes, decreases knee joint discomfort and increases the joint space ratio.

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