

Study of the functional outcome of medial compartment osteoarthritis of the knee treated with proximal fibular osteotomy



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ABSTRACT

Background: Knee osteoarthritis (OA) is a common painful and chronic condition that affects a large proportion of the population particularly older individuals. Increasing age and obesity are important predisposing factors for the development of knee OA. While in most of the cases, conservative approach is utilized, in patients not responding to conservative management surgical intervention is required. Proximal fibular osteotomy (PFO) is one of the important surgical procedures which is being increasingly used for managing knee OA not responding to conservative treatment. **Aims and Objectives:** The objectives of the study are as follows: To study the role of PFO in medial compartment OA of knee. To study the clinical and functional outcomes of OA of knee treated with PFO with respect to pain, disability, and range of movements. **Materials and Methods:** This was a prospective study conducted in the orthopedic division at Bharati Vidyapeeth Deemed College and Hospital, Sangli. Thirty patients with medial compartment knee OA and treated by PFO were included in this study on the basis of pre-defined inclusion and exclusion criteria. Body mass index (BMI) of all patients was determined. Pre-operative and post-operative visual analog scale index was analyzed to assess pain relief. Functional outcome was assessed by the Japanese Orthopaedic Association (JOA) score. $P < 0.05$ was taken as statistically significant. **Results:** Out of 30 studied cases, there were 18 (60%) females with a M: F ratio of 1:1.5. Fourteen (46.7%) of the participants had right side affected whereas 16 (53.3%) of the participants had left knee OA. The mean age of affected cases was found to be 71.27 ± 9.92 years. The median (IQR) of age (years) was 72.00 (64–80) and the age ranged from 52 to 90 years. Nine patients (30%) were obese ($BMI \geq 30$) and 13 (43.33%) patients were overweight ($BMI \geq 25$ but < 30). There was a significant reduction in pain at the time of final follow-up ($P < 0.0001$). Analysis of functional assessment showed that mean JOA scores at the time of final follow-up had significantly improved as compared to JOA scores at the time of presentation. Complications were seen in 4 (13.33%) patients. **Conclusion:** Proximal femoral osteotomy is effective in relieving pain and improving joint function in patients with medial compartment OA. It is an easy, safe, and cost-effective procedure with minimal complications.

Key words: Proximal fibular osteotomy; Knee osteoarthritis; Visual analog score; Functional outcome

INTRODUCTION

Knee osteoarthritis (OA) is a painful and chronic condition that affects a large proportion of population particularly older individuals. Symptomatic OA is one of the most common causes of compromised mobility in

elder individuals. OA of the knee joint affects about half of the population over the age of 60 years and mainly women, as it is mostly because of osteoporosis as a result of decreased bone mineral density.¹ Knee OA may in part be due to excessive loading of the articular cartilage. During walking, the forces transmitted across the knee joint

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are greater in the medial compartment compared to the lateral compartment, and increased medial compartment loading has been observed in patients with knee OA. The mechanics of gait, in particular, the knee adduction moment have been shown to be a contributing factor to the progression of medial compartment knee OA. Irrespective of the etiology or predisposing factors the main pathology in cases of OA is same and consist of degenerative process having multiple inflammatory components causing damage to articular cartilage of the joints.²

There are multiple options for the management of knee joint OA, both conservative and surgical. Conservative options for OA of the knee include analgesics, physiotherapy, intra-articular injections of steroid or platelet-rich plasma, and viscosity supplementation agents. Surgical options include high tibial osteotomy (HTO) and total knee arthroplasty (TKA) which can be done in intractable cases of OA of the knee. HTO is a technically demanding procedure and has specific problems associated with it, such as neurovascular injury, iatrogenic fracture, and non-union. Total knee replacement is an excellent procedure in terms of relief of pain, correction of deformity, and improvement of function but it is not a feasible option in young patients with mild-to-moderate OA.³

Proximal fibular osteotomy (PFO) is an excellent treatment option for medial compartment OA in comparison to HTO, as it is associated with fewer or none of the complications that are frequently encountered in a HTO.⁴ PFO works on the principle that it supports the lateral tibial plateau and by removing the wedge from the fibula, it weakens the support of lateral tibial plateau provided by the fibula leading to correction of varus deformity, shifting the loading force from the medial compartment more laterally causing the pain to decrease and improvement in function. When comparing a HTO to a PFO is a relatively simple surgical procedure.⁵

Ideal indications of PFO are predominantly medial compartment arthritis with varus knees and good lateral joint space in weight bearing films, at least 2 mm gap in AP stress Varus X-rays, a motivated patient who understands that this is a procedure that buys time and delays knee replacement surgery and patients with body mass index (BMI) <23.⁶ Compared with TKA or HTO, PFO is a simple, safe, fast, and affordable surgery that does not require insertion of additional implants. As such, PFO is a suitable surgical option for most of the patients who lack financial and medical resources.⁷ Complications related to removal of proximal fibula are few.⁸

In this background, the aim of this study is to evaluate the functional outcome of medial compartment OA of the knee treated with PFO.

Aims and objectives

The objectives of the study are as follows:

1. To study the role of PFO in medial compartment OA of knee
2. To study the clinical and functional outcomes of OA of knee treated with PFO with respect to pain, disability, and range of movements.

MATERIALS AND METHODS

This was a prospective study conducted in the orthopaedic division at Bharati Vidyapeeth Deemed College and Hospital, Sangli. Thirty patients with medial compartment knee OA treated by PFO were included in this study. The study duration was 18 months extending from June 2020 to December 2021. Institutional ethical committee approved the study (ethical committee letter no BV [DU]/MCH/2398/310) and written informed consent was obtained from all the participants of the study. Demographic details such as age and gender were noted in all the cases. BMI of all the cases was determined. The diagnosis of medial compartment of knee OA was made on the basis of history and clinical examination and was confirmed on the basis of weight bearing X-ray which was done in all the cases except in patients who were too frail. Patients with radiographic evidence of Kellgren Lawrence Grade II to IV OA of knee joint were included. In selected cases (In whom subchondral bone changes and chondrocalcinosis were suspected), computed tomography of knee was done. The degree of varus deformity was determined on the basis of imaging findings. Those patients not responding to conservative treatment and were having pain severe enough to hamper quality of life and daily activities were selected for surgical intervention. Sample size was calculated according to the previous reference studies, when PFO was done for knee OA. The minimum sample size necessary was found to be at least 25 patients as calculated by Open Epi-Version 3 online software, a 10% of difference could be determined between the group at 80% of power and 5% of significance ($\alpha=0.05$, $\beta=0.80$).

Informed written consent was obtained from all patients for surgery. All patients were electively posted for PFO after getting the anesthetic fitness for surgery and only ASA Grade I and II patients were selected for the surgery. PFO was done and after surgery, full weight bearing was allowed with quadriceps drill and knee range of motion exercises from day 1 if there was no significant pain. Full weight bearing X-ray was done on 2nd day after PFO.

Follow-up visits were scheduled at 1 month, 3 months, and 6 months. Follow-up X-ray was done during each follow-up visit. The functional outcome was assessed

using Japanese Orthopaedic Association (JOA) score for osteoarthritic knee.⁹ The other factors which were assessed during follow-up visits included range of motion, visual analog scale (VAS) scores, and complications.

Qualitative data were represented with percentages and quantitative data were represented as mean with SD. Paired t-test was used to compare the differences in outcome scores. The statistical analysis was done using SPSS 21.0 software and $P < 0.05$ was taken as statistically significant.

Inclusion criteria

The following criteria were included in the study:

1. Age more than 40 years
2. Patients gave written consent to be part of study
3. Patients having medial compartment OA and treated by PFO
4. Mild-to-moderate genu varus deformity ($< 15^\circ$)
5. ASA Grade I/II patients.

Exclusion criteria

The following criteria were excluded from the study:

1. Patients who refused consent to be part of study
2. Dynamic joint irritation
3. Varus deformity more than 15°
4. Tendon insecurity
5. ASA Grade III and IV patients.

RESULTS

Thirty cases of medial compartment knee treated by PFO were included in this study of which there were 18 (60%) females and 12 (40%) males with a M: F ratio of 1:1.5 (Figure 1). Fourteen (46.7%) of the participants had right side affected whereas 16 (53.3%) of the participants had left knee OA.

The analysis of the age group of the patients showed that the most common affected was 80 years or above (30%) followed by 70–79 years (26.67%) and 60–69 years (23.33%). Only 6 (20%) patients were below 59 years of age and there was no patient below 50 years of age. The mean age of affected cases was found to be 71.27 ± 9.92 years. The median (IQR) of age (years) was 72 (64–80) and the age ranged from 52 to 90 years (Table 1).

Overweight and obesity were found to be one of the important features in patients with knee OA. The analysis of BMI in patients showed that among 30 patients 9 (30.00%) patients were obese ($\text{BMI} \geq 30$) and 13 (43.33%) patients were overweight ($\text{BMI} \geq 25$ but < 30). Rest of the patients had $\text{BMI} < 25$ (Table 2).

At the time of presentation, all patients were having moderate pain. The mean VAS score at the time of

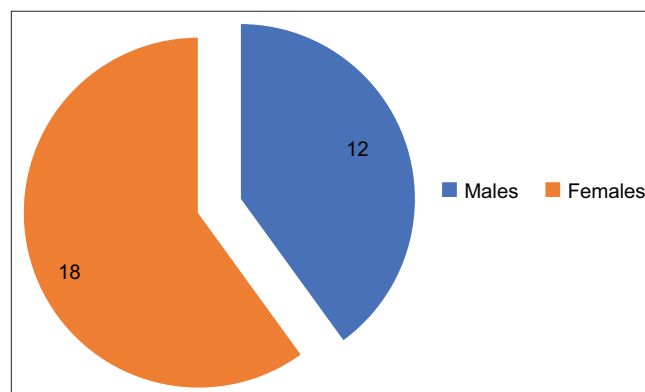


Figure 1: Gender Distribution of studied cases

Age	No of cases	Percentage
40–49 years	0	0.00
50–59 years	6	20.00
60–69 years	7	23.33
70–79 years	8	26.67
80 and above	9	30.00
Total	30	100
Mean age		71.27 ± 9.92 years

BMI	No of cases	Percentage
Normal (< 25)	8	26.67
25–30 (Overweight)	13	43.33
More than 30 (Obese)	9	30.00
Total	30	100.00

BMI: Body mass index

presentation was 5.1 ± 2.32 . The pain reduced gradually over a period of time and at the time of final follow-up visit, the pain had been reduced to considerable level as shown by mean VAS scores of 1.1 ± 0.68 . The difference in VAS score at the time of presentation and final follow-up was found to be statistically highly significant ($P < 0.0001$) (Table 3).

Patients were followed up for range of motion at 3 months and 6 months. At the time of 3-month follow-up, 4 (13.3%) had range of motion < 80 whereas 11 (36.7%) patients had ROM between 80 and 90. Nine (30%) patients had ROM between 90 and 100. Six (20%) patients were found to have ROM more than 100. At the time of final follow-up at 6 months, 2 (6.7%) had range of motion < 80 whereas 10 (33.3%) patients had ROM between 80 and 90. Eleven (36.7%) patients had ROM between 90 and 100. Seven (23.3%) patients were found to have ROM more than 100 (Table 4).

The patients were followed up for improvements in functional outcome for 6 months. The functional outcome was assessed by JOA score for osteoarthritic knee. Mean

pre-operative JOA was found to be 54.8 ± 11.8 . At the time of final follow-up visit (at 6 months), mean JOA score was found to be 89.2 ± 18.6 . The mean JOA scores at the time of final follow-up were found to be significantly improved as compared to JOA scores at the time of presentation and the difference was found to be statistically highly significant (Table 5).

Finally, the incidence of complication was assessed in studied cases. At the time of final follow-up, there was a significant improvement in all the cases as far as VAS scores, range of motion and joint function was concerned. There were no complications in majority of the cases. Only four patients were found to have complication out of which 3 (10%) patients were found to have extensor hallucis longus weakness and 1 (3.33%) patient was found to have dorsal numbness (Figure 2).

DISCUSSION

We studied 30 patients with knee OA who were treated by PFO. The analysis of gender distribution of studied

cases showed that there was a female predominance in the occurrence of OA knee. It is well established in various studies that knee OA is more common in females. Although the exact cause of female predominance in OA knee is not fully understood, various studies have suggested role of estrogen, body composition, and knee structure as the probable cause of OA in women. Several studies have examined role of estrogen in propensity to develop OA knee; however, the evidence is not found to be definitive. Some authors also suggested that women are more likely to have more pain as compared to men in similar degree of OA. Vashisht et al., conducted a prospective study to evaluate the efficacy of PFO.¹⁰ In this study, out of 38 patients there were 15 males and 23 females with a M: F ratio of 1:1.53. Similar female preponderance was also reported by the authors such as Vina et al.¹¹

In our study, majority of the affected patients were in their seventies or above. Fukui et al., conducted a study to explore the relationship between radiographic changes and symptoms or physical examination findings.¹² For this purpose, 106 OA knees in 68 subjects were followed up at 6-month intervals over 36 months. At each visit, knee radiographs were obtained, symptoms were assessed by a validated questionnaire, and the result of physical examination was recorded systematically using a specific chart. Correlations between the change of radiographs and clinical data were investigated in a longitudinal manner. The mean age of the patients in this study was found to be 71.1 years. Similar mean age of patients with knee OA was also reported by the authors such as Anderson and Loeser,¹³ and Dillon et al.¹⁴

In our study, 9 (30.00%) patients were obese (BMI ≥ 30) and 13 (43.33%) patients were overweight (BMI ≥ 25 but < 30). Rest of the patients had BMI < 25 . Roy et al., conducted a study to estimate the prevalence of knee OA among women in the age group of 46–65 years and the effect of age and BMI on knee OA.¹⁵ For this purpose, the

Table 3: Mean VAS score of the cases at presentation and during follow-up

Mean VAS score	Mean \pm SD	P-value
At presentation	5.1 \pm 2.32	P<0.0001
At 1 month	3.2 \pm 1.68	(Paired t-test)
At 3 months	2.4 \pm 1.24	Highly significant
Final follow-up (6 months)	1.1 \pm 0.68	

VAS: Visual analog scale

Table 4: Range of motion at presentation and during follow-up

Range of motion	Cases	Percentage	95% CI
At the time of 3-month follow-up			
<80	4	13.3	4.4–31.6
80–90	11	36.7	20.5–56.1
90–100	9	30.0	15.4–49.6
>100	6	20.0	8.4–39.1
At the time of 6-month follow-up			
<80	2	6.7	1.2–23.5
80–90	10	33.3	17.9–52.9
90–100	11	36.7	20.5–56.1
>100	7	23.3	10.6–42.7

Table 5: Functional outcome as assessed by JOA scores

Mean JOA score	Mean \pm SD	P-value
At presentation	54.8 \pm 11.8	P<0.0001
At 1 month	78.6 \pm 14.46	(Paired t test)
At 3 months	84.4 \pm 15.36	Highly significant
Final follow-up (6 months)	89.2 \pm 18.6	

JOA: Japanese Orthopaedic Association

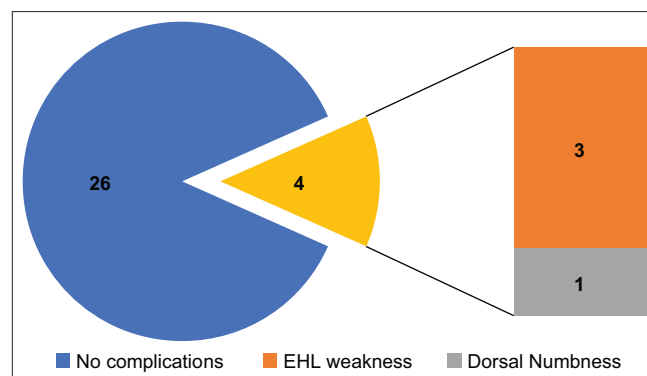


Figure 2: Complications in studied cases

authors undertook a cross-sectional study comprising of 100 patients with knee OA. The study found that patients affected with knee OA with BMI ≥ 25 were significantly more affected 45 (69.2%) compared with participants with normal BMI 20 (30.2%). The study concluded that advanced age and overweight were strongly associated with OA in our population. Therefore, weight reduction and preventive measures can decrease the burden and help in minimizing morbidity associated with OA. Similar positive correlation between Increased BMI and Knee OA has also been reported by the authors such as Anandacoomarasamy et al.,¹⁶ and Szoek et al.¹⁷

In our study, there was a significant improvement in functional outcome as well as VAS scores in patients who had undergone PFO for OA knee. The complications were seen only in 4 (13.33%) patients. Wang et al., conducted a prospective study to explore the effects of PFO as a new surgery for pain relief and improvement of medial joint space and function in patients with knee OA.¹⁸ In this study, the authors found that medial pain relief was observed in almost all patients after PFO. Most patients exhibited improved walking postoperatively. Weight-bearing lower extremity radiographs showed an average increase in the post-operative medial knee joint space.

In our study, there was a significant improvement in functional outcome of the cases as assessed by the difference in mean JOA scores at the time of presentation and final follow-up. There was a significant improvement in JOA scores at the time of final follow-up and the difference was found to be statistically highly significant. Zou et al., undertook a study in which 92 patients with KOA, including 40 patients with PFO (observation group) and 52 patients with HTO (control group), who were treated with osteotomy were included in the study. The median time of follow-up was 25 months. The functional outcome of the patients was assessed on the basis of JOA scores. The authors found that the pain VAS and femur-tibial angle significantly decreased and the JOA score of the knee joint significantly increased in the patients treated by PFO.¹⁹ Similar improvement in functional outcome in patients of knee OA treated by PFO was also reported by the authors such as Qin et al.²⁰

Limitations of the study

The follow-up period in our study was relatively short for assessing a chronic condition such as OA. It is important to know whether the excellent functional outcome as seen in short-term remain unchanged for a longer period of time. Therefore, a longer follow-up period would certainly help in determining long-term outcome.

CONCLUSION

PFO is relatively easy, safe, fast, and effective procedure for the management of knee OA not responding to conservative measures. It is effective in accomplishing pain relief along with functional recovery. Minimal post-operative rehabilitative measures and minimal complication rates make it an attractive treatment choice for managing Knee OA.

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Authors Contribution:

SG- Concept and design of the study, interpreted the results, prepared first draft of manuscript, and critical revision of the manuscript; **AI-** Statistically analyzed and interpreted, reviewed the literature, and manuscript preparation; **BP-** Design of the study, statistically analysed and interpreted, preparation of manuscript, and revision of the manuscript; and **RJ-** Concept and coordination of the overall study.

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