

## ORIGINAL RESEARCH

# Outcome Analysis after Proximal Fibular Osteotomy in Medial Compartment Osteoarthritis of Knee

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### ABSTRACT

**Background:** Knee osteoarthritis is a chronic progressive degenerative disease characterized by pain and disability. With increase in mean life expectancy, there is need to alleviate the symptoms for a better life. In developing nations with limited medical and financial resources procedures like total knee arthroplasty(TKA) is limited to a few. So a relatively new procedure proximal fibular osteotomy(pfo) with rapid relief of pain and shorter post-operative recovery time is being studied. **Aims and objective:** To study the effectiveness of PFO in treatment of osteoarthritis of medial compartment of knee. **Materials and method:** In this prospective observational study, 32 patients were selected by simple random sampling, subjected to PFO and followed up with functional parameters Numerical Pain Rating Scale(NRS) and Knee Society Score(KSS), radiological parameters tibio-femoral angle and ratio of medial to lateral joint space on post-operative day 2, at 3 months and 6 months and stride width analysis pre-operatively and post-operatively. **Result:** We observed that there was improvement in functional and radiological parameters after PFO in the immediate post-operative period with further improvement in these parameters and decrease in stride width at the end of 6 months. Also complication was significantly less with dysaesthesia along the distribution of superficial peroneal nerve noted in 4 patients and anesthesia along its distribution found in 1 patient. At 6 months of follow-up dysaesthesia persisted in 1 of the patients whereas the other patients were relieved at 6 months. **Conclusion:** We concluded that PFO can significantly improve the radiographic appearance and function of the affected knee and decrease knee varus as evidenced by decrease in stride width. It may be a viable treatment option for early medial compartment OA K.L. Grade 1,2.

**Key words:** (1) Proximal fibular osteotomy, (2) Total knee replacement, (3) High tibial osteotomy, (4) Stride width

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### INTRODUCTION

Osteoarthritis (OA) of the knee joint is a degenerative disease, which is chronic and progressive in nature and is accompanied by joint pain, stiffness and deformity. [1] The factors leading to the progression of OA are mechanical, structural, genetic and environmental. [2]

Medial compartment OA, also called unicompartmental arthritis affects only the medial aspect of knee and is the most common type of OA knee. [3] The risk of developing OA

substantially increases with each decade after the age of 45 years. [4] The reported prevalence of radiographic and symptomatic OA of knee in elderly patients above 60 years of age is 37% & 12% respectively [5]

As compared to High Tibial Osteotomy (HTO), Proximal Fibular Osteotomy procedure has relatively less complications. The possible complication is injury to the peroneal nerve, commonly superficial peroneal nerve (SPN) and rarely common peroneal nerve (CPN). [6]

Using stride width as a parameter to assess varus in patients of knee osteoarthritis, the effect of PFO on gait patterns of these patients can be studied. Decrease in stride width is associated with a decrease in knee varus and results in improved gait pattern. The changes in gait pattern after PFO to treat medial compartment osteoarthritis is still largely unknown which has been taken up in only one other Indian study by Biswas et al.<sup>[7]</sup>

#### **Aim Of Our Study**

To study the effectiveness of Proximal fibular osteotomy in the treatment of osteoarthritis of medial compartment of knee. Among all other parameters we have measured the stride width of the patients before and after the surgery which has been largely unexplored.

### **MATERIALS AND METHOD**

#### **STUDY DESIGN**

Prospective observational study

#### **SAMPLING METHOD**

Simple random sampling

#### **STUDY LOCATION**

The study was conducted in the outpatient and inpatient department of orthopaedics at R. G. Kar Medical College and Hospital

#### **SAMPLE SIZE**

32 patients

#### **ETHICAL CLEARANCE**

Ethical clearance for the study was obtained from the institutional ethical committee.

#### **STUDY DURATION**

The study was conducted from April 2020 to June 2021

#### **STUDY POPULATION**

All the patients presenting to the outpatient department of RG Kar Medical College and Hospital and presenting with OA knee

#### **INCLUSION CRITERIA**

1. Age above 45 years and below 75 years
2. Kellgren and Lawrence grade 1,2 in Xrays
3. Medial compartment OA knee
4. BMI less than 25
5. No history of previous injury or surgery to leg
6. Patients giving informed consent for the procedure

#### **EXCLUSION CRITERIA**

1. Kellgren and Lawrence grade 3,4 in Xrays
2. Varus deformity more than 18°
3. Fixed flexion deformity more than 15°

4. Arthritis due to traumatic or infectious causes
5. Non compliance to pre-operative and post-operative follow-up

#### **PREOPERATIVE CLINICAL EVALUATION**

- Degree of fixed flexion deformity
- Degree of valgus/varus

#### **FUNCTIONAL ASSESSMENT (PRE OPERATIVE & POST OPERATIVE)**

- KSS score
- NRS score

#### **RADIOLOGICAL ASSESSMENT (PRE OPERATIVE & POST OPERATIVE)**

- Ratio of medial to lateral joint space. In the figure, A is the medial joint space, B is the lateral joint space and A/B is the ratio of medial to lateral joint space. [Fig. 1]
- Tibiofemoral angle : In the figure,  $\alpha$  is the tibiofemoral angle. [Fig. 2]

**Stride width** ( Pre and post operative): Footprint of the patients were taken on a white sheet using dye applied to the sole and the distance between the medial-most borders of the two heels is calculated. Average of three such successive measurement is taken to estimate the stride width. [Table 1]

#### **OPERATIVE METHODOLOGY**

The choice of anaesthesia was left to the anaesthesiologist. The patient was placed in supine position with sand bag under the ipsilateral hip. Pneumatic tourniquet was applied. Dressing and draping was done. The procedure involves removing a 20mm piece of fibula six to nine cm below the fibular head, to relieve medial compartment pressure and realign the knee. The distance from fibular head tip should be closest to the knee joint, without damaging the common peroneal nerve. The formula is 6cm below knee joint in 5 feet tall, 7cm in 5.5 feet, and 8cm in six feet tall patients.<sup>[8]</sup>

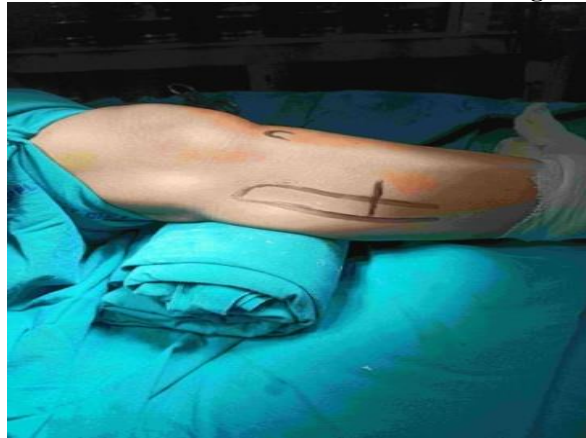
The patient was allowed early postoperative weight bearing and knee range of motion exercises. The patient was discharged on 3rd postoperative day and follow-up was done using functional parameters like Numerical Pain Rating Scale (NRS) and Knee Society Score (KSS), radiological parameters like tibio-femoral angle and ratio of medial to lateral joint space on the 2nd postoperative day, at 3 months and at 6 months and foot print analysis.

#### **STASTICAL ANALYSIS**

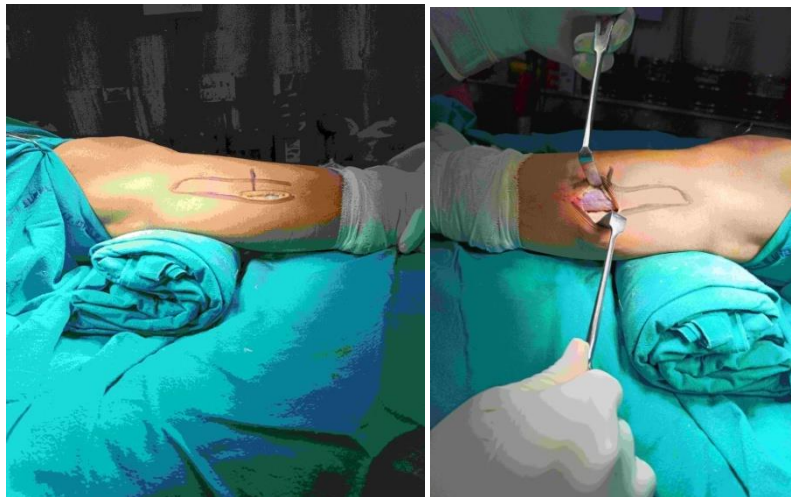
Statistical analysis was done using SPSS software (version 27.0). Data has been summarized as mean and standard deviation for numerical variables and count and percentages for categorical variables.

Two-sample t-tests for a difference in mean samples.  $p\text{-value} \leq 0.05$  was considered statistically significant.

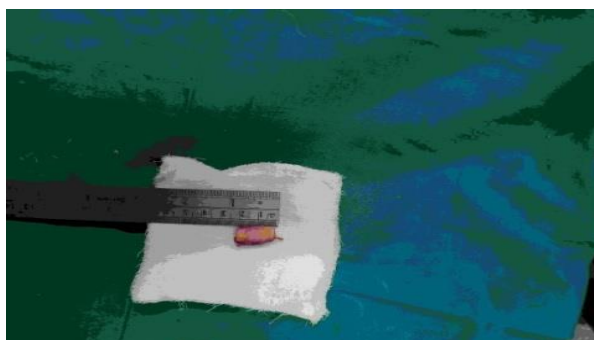
### Procedure And Instruments Skin Marking



### Incision and Dissection



### Osteotomized Part Of Fibula



### Instruments



**Radiological Assessment**

**Pre-operative X-ray      Post-Operative X-Ray Day2**



**Post-Operative X-Ray At 3 Months**

**Post-Operative X-Ray At 6 Months**



**RESULTS**

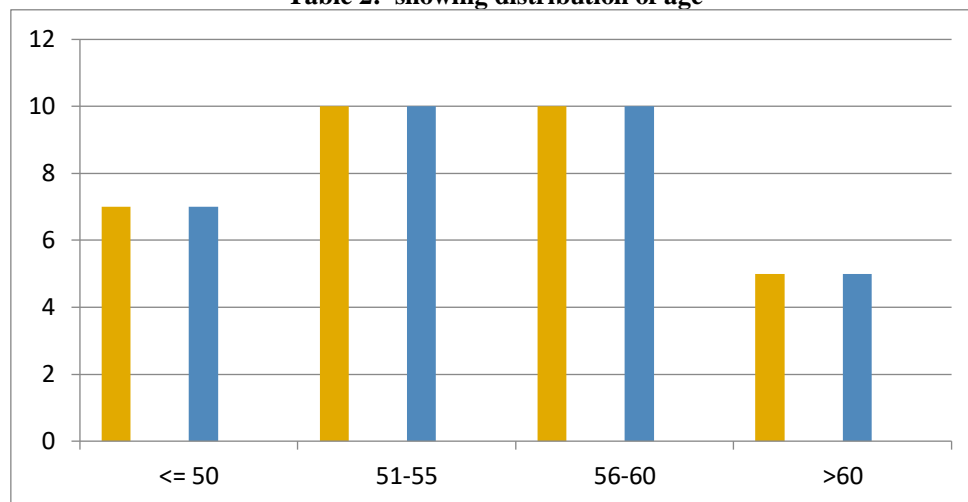
**Table 1: showing change in stride width in operated patients**

| Pre-operative stride width (inch) | Post-operative stride width (inch) at 6 months |
|-----------------------------------|--|
| 2                                 | 1  |
| 2.3                               | 1.3  |
| 2.6                               | 1.5  |
| 2.7                               | 1.4  |
| 2.1                               | 1.6  |
| 2.4                               | 1.2  |
| 2.8                               | 1.7  |
| 2.3                               | 1.8  |
| 2.7                               | 1.4  |
| 2.6                               | 1.5  |
| 2.8                               | 1.2  |
| 2.4                               | 1.3  |
| 2.6                               | 1.5  |
| 2.3                               | 1.4  |
| 2.6                               | 1.6  |
| 2.7                               | 1.2  |
| 2.1                               | 1.7  |
| 2.4                               | 1.8  |
| 2.3                               | 1.3  |
| 2.6                               | 1.5  |
| 2.7                               | 1.4  |

|     |     |
|-----|-----|
| 2.1 | 1.6 |
| 2.4 | 1   |

We found that , 7(22.1%) patients were ≤ 50 years old, 10(31.5%) patients were 51-55 years old, 10(31.5%) patients were 56-60 years old and 5(14.9%) patient was >60 years old [z= 0.85,p= 0.04].[Table 2]

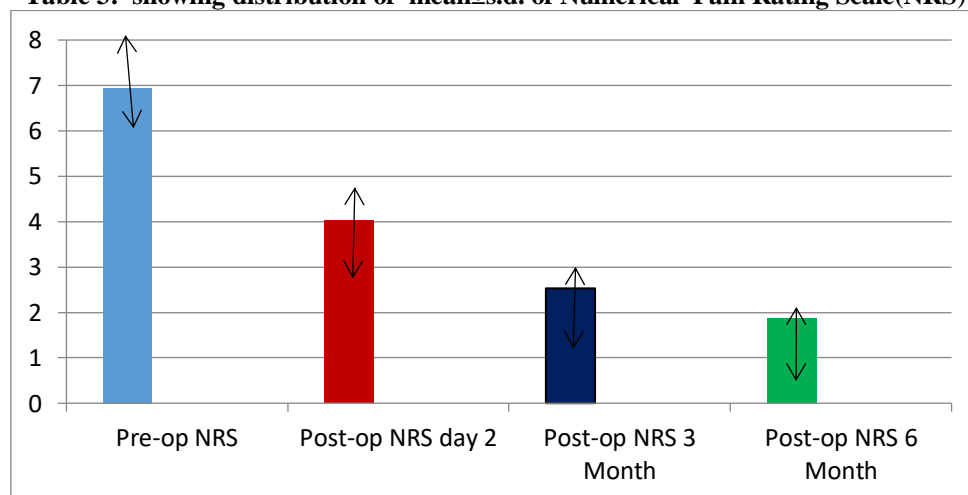
**Table 2: showing distribution of age**



The mean age (mean±s.d.) of patients was 55.31±4.95. In our study, 21(65.6%) patients were female and 11(34.4%) patients were male [z= 2.5,p= 0.01]. It was found that 12(37.5%) patients had Grade 1 and 20(62.5%) patients had Grade 2 [z=2,p= 0.045].

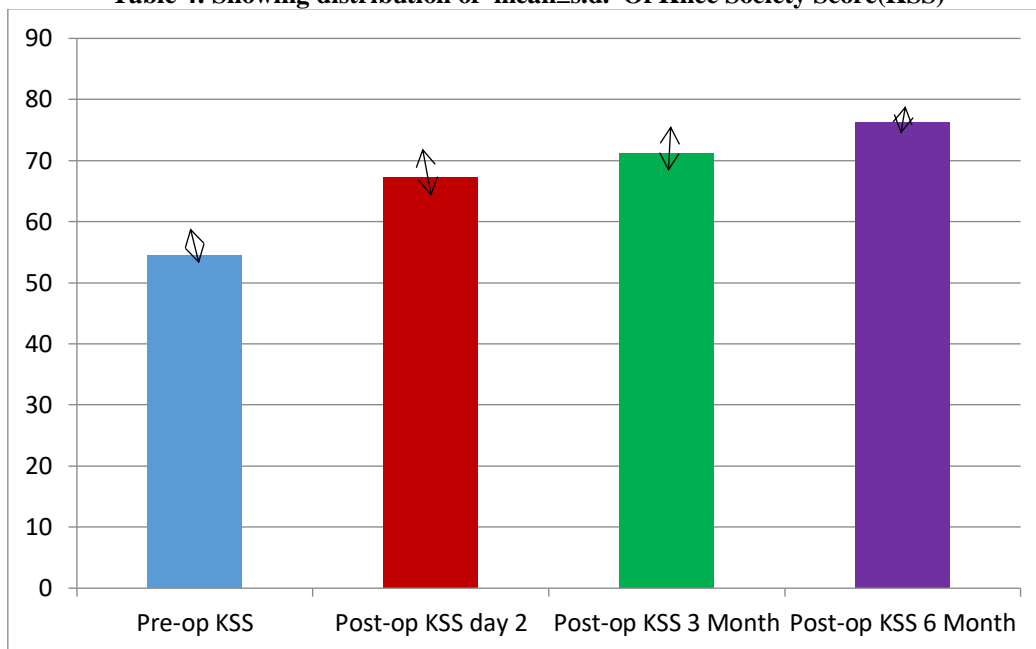
The mean pre-operative NRS (mean±s.d.) of patients was 6.94±0.97, the mean post-operative NRS (mean±s.d.) of patients was 4.03±0.92, at 3 months post-operative was 2.53±0.70 and at 6 months post-operative it was 1.97±0.78. [p< 0.0001]. [Table 3]

**Table 3: showing distribution of mean±s.d. of Numerical Pain Rating Scale(NRS)**



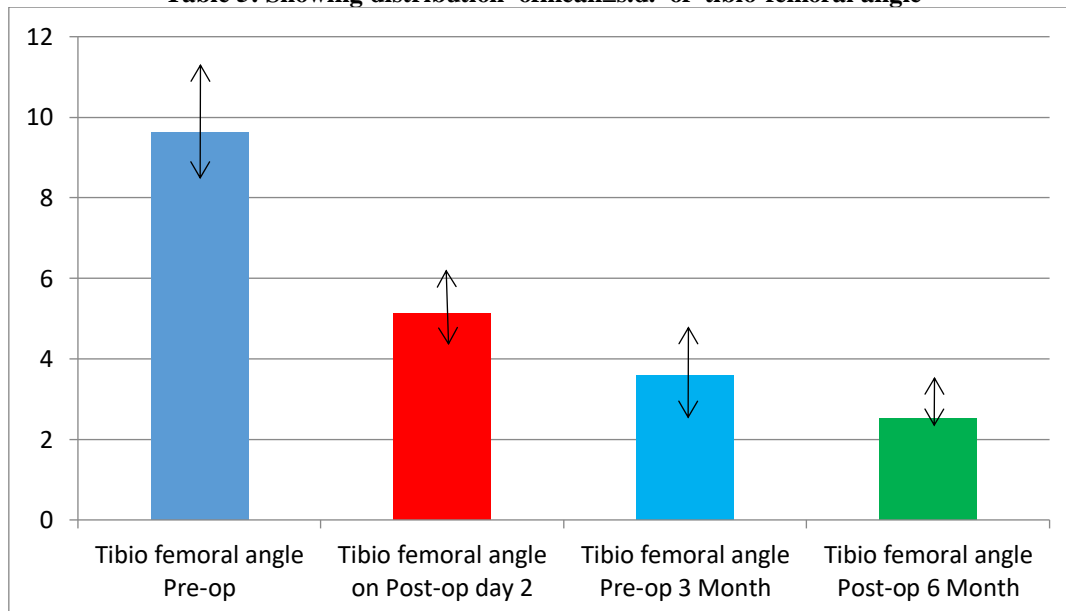
The mean pre-operative KSS (mean±s.d.) of patients was 54.5±2.14, the mean post-operative KSS (mean±s.d.) of patients was 67.25±2.68, at 3 months post-operative was 71.19±2.88 and at 6 months post-operative it was 76.22±2.13. [p< 0.0001]. [Table 4]

**Table 4: Showing distribution of mean±s.d. Of Knee Society Score(KSS)**



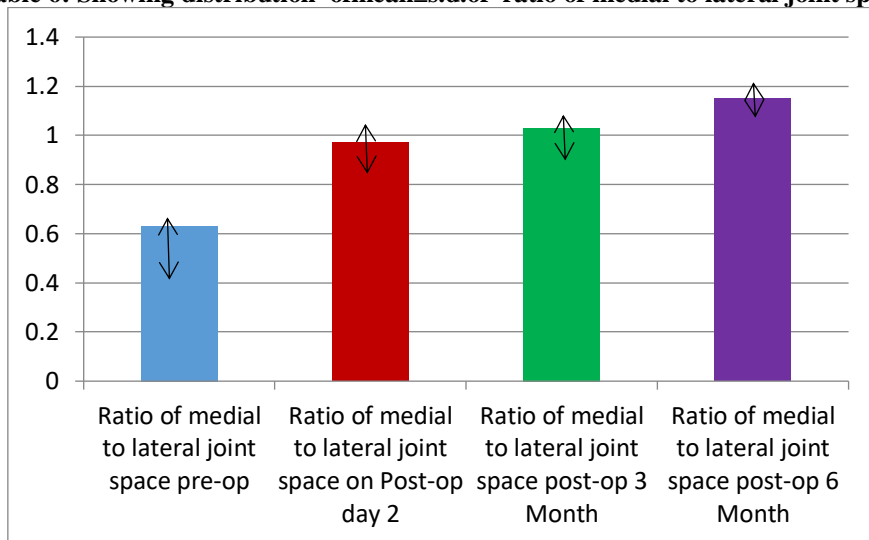
The meantibio-femoral angle pre-operatively (mean±s.d.) of patients was  $9.63 \pm 1.36$ , the mean tibio-femoral angle post-operatively (mean±s.d.) of patients was  $5.13 \pm 0.90$ , at 3 months post-operative was  $3.59 \pm 1.06$  and at 6 months post-operative it was  $2.53 \pm 0.50$ . [ $p < 0.0001$ ]. [Table 5]

**Table 5: Showing distribution of mean±s.d. of tibio-femoral angle**



The mean ratio of medial to lateral joint space pre-operatively (mean±s.d.) of patients were  $0.63 \pm 0.09$ , the mean ratio of medial to lateral joint space post-operatively (mean±s.d.) of patients was  $0.97 \pm 0.06$ , at 3 months post-operative was  $1.03 \pm 0.07$  and at 6 months post-operative it was  $1.15 \pm 0.05$ . [ $p = 0.02$ ]. [Table 6]

**Table 6: Showing distribution of mean±s.d. of ratio of medial to lateral joint space**



The mean pre-operative stride width (inch) (mean±s.d.) of patients was  $2.49 \pm 0.23$  and the mean postoperative stride width (inch) (mean±s.d.) of patients was  $1.45 \pm 0.21$ . [Table 7]

**Table 7: Showing distribution of mean±s.d. of stride width**

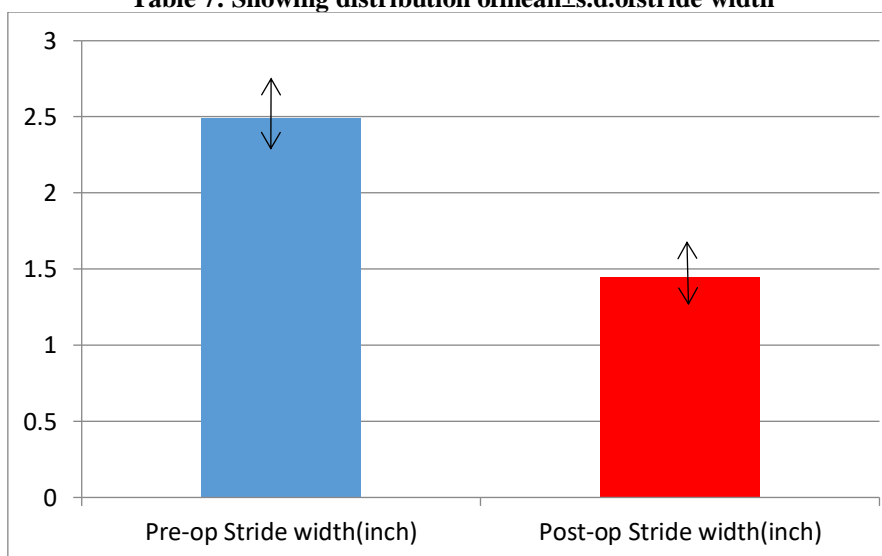


Fig 1: Ratio of medial to lateral joint space

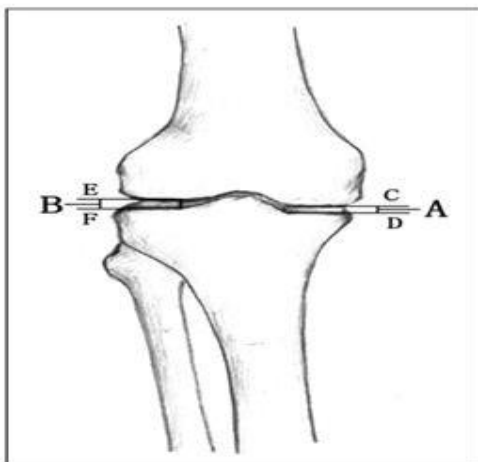
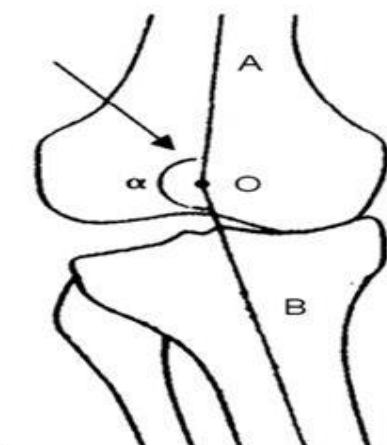


Fig 2: Tibiofemoral angle



## DISCUSSION

The mechanism of action of PFO is not exactly clear. A possible mechanism is fibula supports one-sixth of body weight, thus PFO may redistribute the load on both tibial plateau which relieves pain and improves joint space. It was named “Too many cortices theory”<sup>[9]</sup>. Another mechanism is that PFO corrects the non-uniform settlement due to lateral support to the osteoporotic tibia provided by the fibula-soft tissue complex causes load to shift further medially to the medial plateau, aggravating medial compartment osteoarthritis of knee, called the theory of “Non-uniform settlement”<sup>[10]</sup>.

This prospective observational study was conducted in the outpatient and inpatient department of orthopedics at R.G. Kar Medical College and Hospital from April 2020 to June 2021.

Patients having OA with Kellgren and Lawrence grade 1,2 were included in our study and the mean age of the patients was 55.31 years. Female population was higher than the male population. Numerical Rating Scale (NRS) was increased pre-operatively and decreased during 6 month of post-operative follow-up which was statistically significant.

**Wang X et al<sup>[11]</sup> (2017)** found that the preoperational NRS score was  $8.45 \pm 0.68$  points which improved to  $0.45 \pm 0.68$  post PFO at 4 months.

**Vashisht A et al<sup>[12]</sup> (2020)** found that post operative NRS score at 12 months was 8.45 (range 7-9) which was significantly lower than pre operative values of 0.45 (range 0-2).

So it was found that there was a significant reduction in pain of most patients in immediate post operative period as evidenced by a considerable reduction in mean NRS values and thereafter the pain gradually decreased over the next 6 months which is comparable to other similar studies.

We found that KSS was increased during 3 month and 6 month of post-operative follow-up which was statistically significant.

**Yang ZY et al<sup>[10]</sup> (2015)** found that mean KSS at final follow-up of 2 years was  $92.3 \pm 31.7$ , significantly higher than the mean preoperative score of  $45.0 \pm 21.3$  ( $p < .001$ )

**Liu B et al<sup>[13]</sup> (2018)** showed that the average preoperational KSS clinical and functional score were  $49.14 \pm 10.95$  points and  $44.97 \pm 17.71$  points, respectively which improved significantly 12 months post PFO.

**Subash Y et al<sup>[14]</sup> (2018)** reported a significant increase in modified oxford score from a pre operative score of 52.2 to 79 post operatively at 2 years.

So the KSS score gradually improved after PFO, similar to other comparable studies, suggesting functional improvement in these patients in the immediate post operative period (from day 2 post op) and that KSS can be considered as an independent factor for determining functional outcome of PFO.

Our study showed tibio-femoral angle was decreased during 6 month follow-up which was statistically significant.

**Matsui Y et al<sup>[15]</sup> (2005)** found that the knees with osteoarthritis were divided into three groups according to the femorotibial angle (Group 1,  $0^\circ$ - $9^\circ$  varus,  $n = 87$ ; Group 2,  $10^\circ$ - $19^\circ$  varus,  $n = 51$ ; Group 3,  $20^\circ$  or greater varus,  $n = 12$ ). Rotational deformities (external rotation of the tibia) existed in knees with osteoarthritis and were larger in knees with increased varus deformities (mean  $\pm$  standard deviation,  $-2.24^\circ \pm 4.19^\circ$  in Group 1;  $0.33^\circ \pm 4.14^\circ$  in Group 2; and  $5.33^\circ \pm 5.71^\circ$  in Group 3).

**Yang ZY et al<sup>[12]</sup> (2015)** found that at final follow-up of 2 years mean FTA was  $179.4^\circ \pm 1.8^\circ$  which was significantly smaller than that measured pre operatively  $182.7^\circ$



**Prakash L et al<sup>[16]</sup> (2018)** found the preoperative tibiofemoral angle was  $181^{\circ} \pm 1.9^{\circ}$  which changed to  $178^{\circ} \pm 2.0^{\circ}$  post operatively at 1 year.

So there exists some discrepancy in reporting of the tibio femoral angle. It has been reported as the acute angle in 1 study whereas in other two studies the obtuse angle has been taken. Nevertheless there is a correlation between tibiofemoral angle and rotational deformity of knee, which improved after PFO especially varusosteoarthritis of knee as evident from our study and other similar studies. The degree of varus was lesser in patients post operatively at 6 months as evidenced by pre and post operative X-rays.

In our study ratio of medial to lateral joint space was found increased during 6 month from pre-operative.

**Yang ZY et al<sup>[10]</sup> (2015)** found that at final follow-up of 2 years lateral joint space was  $6.9 \pm 0.7$  mm, which was significantly smaller than that measured preoperatively  $12.2 \pm 1.1$  mm, ( $p < .001$ ).

**Prakash L et al<sup>[16]</sup> (2018)** found that postoperatively at 12 months, the medial joint space widened from  $1.2 \pm 0.7$  mm to  $4.5 \pm 1.1$  mm, being statistically significant ( $p < .001$ ). Likewise the lateral joint space showed uniform reduction post operatively from  $7.2 \pm 1.2$  mm to  $5.2 \pm 1$  mm ( $p < .001$ ).

**Rai AK et al<sup>[17]</sup> (2019)** showed that mean preoperative medial joint space measurement on standard anteroposterior radiograph was  $1.45 \pm 0.28$  mm. The mean preoperative lateral joint space was  $8.86 \pm 1.27$  mm. Recorded levels of mean postoperative medial joint space at mean of 13.3 months improved to  $4.63 \pm 0.668$  mm, and mean postoperative lateral joint space at mean of 13.3 months was  $4.72 \pm 0.79$  mm.

So there was a gradual increase in medial joint space from post operative day 2 to 6 months post-operatively, which was comparable to the improvement seen in other studies. The better distribution of weight at the knee may be a cause of improvement of pain post operatively.

Stride width was measured in very few studies. It was found that stride width was more pre-operatively and decreased post-operatively. Only one such previous Indian study by **Biswas A et al<sup>[7]</sup> (2021)** found that pre-operative mean of stride width (meter) was  $0.16 \pm 0.04$  which was changed to  $0.14 \pm 0.04$  at 4 weeks follow up ( $p < 0.001$ ).

Our study shows a decrease in stride width, which is probably due to a better ground contact of the sole probably due to decrease in degrees of varus following PFO. The findings are consistent with the very limited available study. More studies comparing effect of PFO on gait

are required to understand the effects of PFO on gait biomechanics.

It was also found that the rate of complication was significantly less with dysaesthesia along the distribution of superficial peroneal nerve noted in 4 patients and anesthesia along its distribution found in 1 patient. At 6 months of follow up dysaesthesia persisted in 1 of the patients whereas the other patients were relieved from their complains at 6 months.

Proximal fibular osteotomy can be a useful procedure for treatment of patients with medial compartment OA of knee, but further studies are required to understand the exact mechanism of the procedure and long term follow up of the patients post-operatively is needed to find out the benefits of the procedure in the long run.

### Limitations of the Study

As the study was conducted during the Corona virus pandemic, only 32 patients could be included in the study. The patients were followed up for a period of 6 months post-operatively, so long term results couldn't be assessed.

### CONCLUSION

We concluded that proximal fibular osteotomy can significantly improve both the radiographic appearance and function of the affected knee joint and also achieve a decrease in knee varus as evidenced by a decrease in stride width. This procedure may be a viable treatment option for early medial compartment OA, K.L. grade 1,2.

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