Original Article

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Orthopaedics Section

Evaluation of Medial Compartment Decompression by Fibular Osteotomy to Treat Medial Compartment Knee Osteoarthritis: A Retrospective Study

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ABSTRACT

Introduction: Osteoarthritis (OA) of the knee is a debilitating old age disease causing pain and restriction in movement. Proximal Fibular Osteotomy (PFO) can be a novel surgical technique which may provide an increase in the joint space and balance the load bearing of the knee joint. The present study was conducted to determine the outcomes of this surgical technique in patients with OA of the knee. The findings may motivate many practicing orthopaedicians to undertake this surgical technique and thereby, impart better quality of life to such patients.

Aim: To assess the outcome in terms of medial joint space, lateral joint space, tibiofemoral angle and range of movement of medial compartment decompression by fibular osteotomy in medial compartment knee OA.

Materials and Methods: This retrospective study was conducted in the Postgraduate Department of Orthopaedics, Government Medical College, Jammu, India, from November 2018 to October 2019, on 30 adult patients (both genders) aged 40-60 years who had moderate to severe symptomatic medial compartment knee OA. Patients who had rheumatoid arthritis, post-traumatic arthritis, congenital lower extremities defects, infections in joints, presence of ligament/meniscus injury, and those with abnormality in the lateral compartment were excluded. Preoperatively and postoperatively, medial joint space, lateral joint space, tibiofemoral angle and range of movement were assessed and compared. The p-value <0.05 was taken as statistically significant.

Results: A total of 30 patients were enrolled in the study, 18 (60%) were males, and 12 (40%) were females. Compared to preoperative values, postoperatively there was a significant increase in medial joint space (1.3±0.7 vs 5.2±0.9 mm, p-value <0.01), significant decrease in lateral joint space (6.9±0.3 mm vs 5.7±0.2 mm, p-value <0.01), significant decrease in tibiofemoral angle (180.7±1.02 vs 178.13±0.97, p-value <0.01) and significant increase in range of movement (135.36±1.06 degrees vs 137.6±1.02 degrees postoperatively, p-value <0.01). The median duration of follow-up for the patients were six months.

Conclusion: Proximal fibular osteotomy can be suitably applied in the clinical practice for OA of the knee joint and it can give prolonged beneficial outcomes for the patients.

Keywords: Chronic degenerative disease, Knee joint, Pain, Range of movement

INTRODUCTION

The Osteoarthritis (OA) of the knee joint is a chronic, progressive degenerative disease often related to pain, stiffness as well as deformity [1]. Knee OA is a common joint disease. It affects nearly 30% of the population more than 60 years of age [2]. Knee OA is categorised into primary or secondary. Mechanical, structural, genetic, and environmental factors are involved in its development and advancement. [3].

Knee varus deformities are commonly found in patients having knee OA, 74% of patients with idiopathic OA are affected by this. In these deformities, mechanical femorotibial axis of <180° as well as narrow medial joint space are present on full-leg standing AP radiographs [4].

The medial compartment of normal knees bears 60-80% of total load, but the reason behind uneven distribution of load is still not clear [5].

Management options are {pain-relieving medications, physiotherapy exercises, steroid injections, Platelet-Rich Plasma (PRP) injections in the affected joints} [6]. Surgical options, which are the main treatment options, consist of high tibial osteotomy and total knee arthroplasty [7].

High tibial osteotomy, a surgical option, is a technically demanding procedure leading to complications comprising iatrogenic fracture, non union, and neurovascular injury. Total knee arthroplasty can result in correction of alignment of the lower extremity, provides pain relief, and improve function significantly. But, it may not be choice for treatment in case of young age, active patients or patients with moderate OA [8].

As reported in the previous researches, the fibula-soft tissue complex gives lateral support to the osteoporotic tibia, which may cause non uniform settlement as well as plateau degeneration bilaterally [9,10]. Thus, there is a medial shift in the load towards medial plateau from normal distribution. This subsequently causes knee varus, exaggerating the medial compartment knee OA advancement [11].

Proximal Fibular Osteotomy (PFO) results in improvement of joint space by removing the support of fibula and rebalancing the load on both (medial and lateral) sides of the tibial plateau. It is a safe, easy, fast, and affordable surgery, in which insertion of additional implants is not required [11]. The aim of the present retrospective study was to assess the outcome of medial compartment decompression by fibular osteotomy which was used to treat medial compartment knee OA.

MATERIALS AND METHODS

This retrospective study was conducted in the Postgraduate Department of Orthopaedics, Government Medical College, Jammu, India, from November 2018 to October 2019. The study included of 30 adult patients (both genders) aged 40 to 60 years with medial compartment OA, satisfying the inclusion criteria.

After obtaining an approval from the Hospital Ethics Committee (IEC/GMC/2019/807), a written, informed consent was taken from the patients for their inclusion in the present study. All the patients were

explained in detail the available methods of treatment, with the final treatment decision left for the patient to decide. The complications of surgery and anaesthesia were also explained to the patient.

Inclusion and Exclusion criteria: Any patient who had symptomatic osteoarthritis of the medial compartment of the knee (of moderate or severe nature) with surgical indication and providing written consent for undergoing surgery were included in the study. Patients with rheumatoid arthritis, post-traumatic arthritis, congenital lower extremities defects, infections in joints, presence of ligament/meniscus injury, and those with abnormality in the lateral compartment were excluded from the study.

The severity of the patients were graded as per the International Knee Documentation Committee (IKDC) score [12] which classified OA into four categories:

- Minimal (Grade A): no reduction in joint space;
- Mild (Grade B): reduced joint space but still more than 4 mm; presence of small osteophytes, femoral condyle flattening or slight sclerosis;
- Moderate (Grade C): 2 to 4 mm joint space;
- Severe (Grade D): <2 mm joint space.

Clinical evaluation of the patients was done and details regarding gender, age, knee involved, and grading system [12] were noted. The latter included two patients operated for bilateral PFO were regarded as two independent participation.

Study Procedure

Preoperative planning: All the patients were admitted on Outpatient Department (OPD) basis. A detailed history, especially with reference to pain, loss of function and crepitation was taken. Detailed examination was done. The examination included findings on inspection and palpation, intermalleolar distance with ankles touching, testing for lateral ligaments with varus or valgus stress, testing for menisci and cruciate ligaments and patellofemoral joint examination by patellofemoral compression test (Zohlen test). Complete neurovascular status assessment was done [10-13].

Radiographic imaging was performed on patients, which included: (1) weight bearing AP and lateral radiographs; (2) axial views of patellofemoral joint; (3) whole standing radiograph to assess the alignment; and (4) measurement of mechanical tibiofemoral angle.

Operative procedure: All the patients were given intravenous injection of Cefuroxime 1.5 g + sulbactam 750 mg 1 hour before surgery. Patients were explained about surgical risks including vessel and nerve injuries, wound healing complications, thrombosis or embolism, and early/late infections.

Anaesthesia: The spinal anaesthesia was given to all patients before surgery.

Position and draping: The patient was placed supine on table for surgery. The knee was flexed and laid across the opposite limb, to make fibular head prominent during surgery. A standard orthopaedic draping set was deployed, and if both knees were being operated at the same time, we prepared and draped them together beforehand and then performed the surgery one after the another.

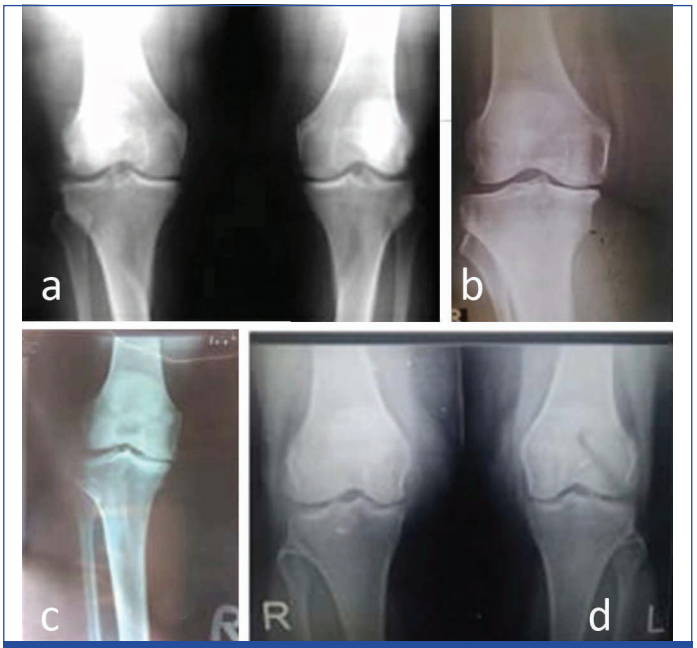
Incision: The fibular head was marked. A 3-5 cm lateral incision was made in the proximal one-third part of fibula-thereby preventing the common fibular nerve injury.

Steps of procedure: The incision to fascia was given along the septum between two muscles (soleus and peroneus), then separation of the muscle was done, and two Hohmann retractors for exposing the fibula. The periosteum was split and 2 cm section of the fibula is removed 6-10 cm below the fibular head by using an oscillating/fret saw. Following resection, for sealing the fibula, bone wax was utilised. The normal saline was used in large amount for irrigation of incision. Thereafter, suturing of muscles, fascia, and skin was done separately with nylon.

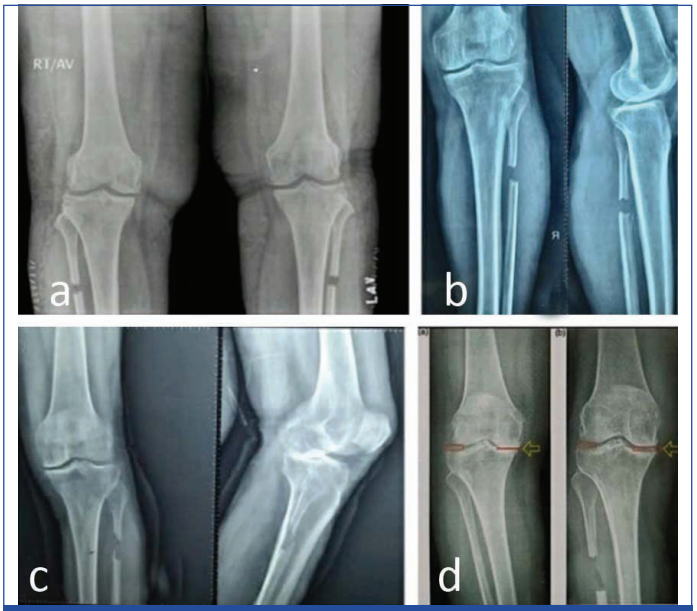
Postoperatively: The patient was allowed to ambulate as soon as the effect of spinal anaesthesia weared-off or pain was tolerated. Orals were allowed after 4 hours of surgery. The patient was discharged after 24 hours. The pressure bandage was removed on 4th day and sutures in 12-14 days.

The patients were advised physiotherapy which comprised of 30 minutes of Quadriceps stretch, Quadriceps tense and Hamstring stretch as part of early rehabilitation for one month. The later rehabilitation comprised of Quadriceps strengthening, Quadriceps strengthening step down exercise and Quadriceps strengthening minisquat exercise for 30 minutes for three months.

Follow-up: Patients were followed-up at one, three, and six months postoperatively and annually after that. At each follow-up, weight-bearing AP as well as lateral radiographs of the affected knee were taken. The representative preoperative and postoperative case images are shown in [Table/Fig-1,2].



[Table/Fig-1]: Preoperative radiographs of knee joint showing medial joint space narrowing on a stress view with varus alignment. a) Anteroposterior (AP) view of both knee with medial compartment Osteoarthritis (OA); b) AP view with medial compartment Osteoarthritis (OA); c) AP view with medial joint narrowing on stress view; d) AP view both knee with medial joint narrowing on stress view.



[Table/Fig-2]: Postoperative radiographs showing obvious improvement in alignment and joint space ratio both medial and lateral compartment after Proximal Fibular Osteotomy (PFO). a) AP view after rectification of joint after Proximal Fibular Osteotomy (PFO); b) AP and lateral views after PFO with improved joint space; c) AP and lateral views showing improved joint space after PFO; d) AD view immediate postoperative radiograph showing opening of medial joint after PFO.

Criteria of evaluation of result: Functional relief was measured by IKDC score. For radiological assessment, both the joint spaces (lateral and medial) and the tibiofemoral angle were measured. Clinical improvement was assessed by range of movement.

STATISTICAL ANALYSIS

Data was compiled and represented as mean, standard deviation (for continuous parameters); absolute numbers and relative frequency (percentage) for categorical parameters. By using paired t-test, quantitative variables were compared between preoperative and postoperative. The p-value <0.05 was considered statistically significant. The data was entered in MS Excel spreadsheet; Statistical Package for Social Sciences (SPSS) version 21.0 was used for analysis.

RESULTS

Out of total 30 patients, 33% patients were in the age group of 51-55 years, 33% in 56-60 years, 27% of 46-50 years age, and two patients were of 41-45 years; with an overall mean age of 51.7±5.2 years. Males constituted 60% of the study population [Table/Fig-3].

Demographic characteristics	Frequency (n)	Percentage (%)
Age (years)		
41-45	2	7
46-50	8	27
51-55	10	33
56-60	10	33
Gender		
Male	18	60
Female	12	40

[Table/Fig-3]: Demographic characteristics.

Right and left knee were involved in 53% and 47% of the patients, respectively. Grade 2 OA was present in 77% patients and Grade 3 in 23% patients [Table/Fig-4].

Osteoarthritis	Frequency (n)	Percentage (%)
Knee involved		
Right	16	53
Left	14	47
Grade of osteoarthritis		
Grade 2 (Grade B)	23	77
Grade 3 (Grade C)	7	23

[Table/Fig-4]: Characteristics of OA.

As compared to preoperatively, postoperatively, patients had more range of movement (137.6±1.02 vs 135.36±1.06, p-value <0.01), lesser tibiofemoral angle (178.13±0.97 vs 180.7±1.02, p-value <0.01), greater medial joint space (5.2±0.9 vs 1.3±0.7, p-value <0.01), lesser Lateral joint space (5.7±0.2 vs 6.9±0.3, p-value <0.01) and more IKDC score (73.5±5.2 vs 45.7±6.6, p-value <0.01) [Table/Fig-5]. The median duration of follow-up for the patients was six months (4-7 months).

Outcome	Preoperative	Postoperative	p-value
Clinical outcome			
Range of movement	135.36±1.06	137.6±1.02	<0.01*
Tibio femoral angle	180.7±1.02°	178.13±0.97°	<0.01*
Medial joint space	1.3±0.7 mm	5.2±0.9 mm	<0.01*
Lateral joint space	6.9±0.3 mm	5.7±0.2 mm	<0.01*
IKDC score	45.7±6.6	73.5±5.2	<0.01*

[Table/Fig-5]: Comparison of pre and postoperative outcomes.
*p-value<0.05 was considered as statistically significant; p-value by two-tailed t-test

No significant complications were seen after the procedure with only one patient having foot drop and another patient having Extensor Hallucis Longus (EHL) weakness i.e., peroneal nerve injury which got recovered spontaneously.

DISCUSSION

The present study holds strength in showing a significant improvement in the joint space after fibular osteotomy with clear cut improvement in the range of motion. The present study results can inspire other practicing orthopaediacians to undertake this surgical procedure for providing better outcomes to patients with OA. However, future studies need to be conducted on a larger sample size and wider regional variation population groups to see if the outcomes vary. Also, one needs to compare the experience of the operating surgeon in association with the final outcomes for the patients.

Recently, PFO has come out as a novel procedure for providing pain relief and improving joint function. PFO results in weakening of the lateral fibular support and corrects varus deformity; this can shift the loading force from the medial compartment more laterally, resulting in reduced pain as well as satisfactory functional recovery [7].

In the present study, total 30 knee joints were evaluated. Twelve patients were females, while 18 were males. The mean age was 52.7±4.6 years. The right knee and left knee were operated in 16 and 14 patients, respectively. Out of this, one patient was operated bilaterally. In a similar study by Yang ZY et al., including total 110 patients, 76 were females; right and left knees were operated in 62 and 48 patients, respectively; the mean age was 59.2 years [11]. In study by Ahmed M et al., including 60 patients, 73.3% were females; mean age was 51.8±4.1 years [13].

In the present study, there was significant difference in preoperative and postoperative functional status of patients. This study is in accordance with study done by Yang ZY et al., (2015) that included 150 patients who had medial compartment arthritis; follow-up was done for more than two years [11]. The preoperative and postoperative Knee Society Score (KSS) was 45±21.3 and 92.3±31.7, respectively; while the preoperative and postoperative IKDC score was 45.7±6.6 and 73.5±5.2 respectively. It reported that PFO can result in significant improvement in radiographic appearance as well as knee joint function and provide pain relief for long term [11].

The findings of the present study were supported by previous stuides like Ahmed M et al., where the Oxford Knee Score (OSS) was used to assess the functional outcome where they found that OSS improved from preoperative levels of 20.82±1.97 to postoperative levels of 35.92±3.50 (p<0.00000001) [13]. Similarly, Liu B et al., showed the efficacy of PFO procedure with significant improvements in the clinical and functional KSS scores from preoperative levels of 49.14±10.95 and 44.97±17.1 to postoperative levels of p 67.77±11.08 and 64.66±13.12 respectively (p<0.05) [14]. The findings are also supported indirectly in the studies by Wang X et al.,[15] and Subash Y et al., [16].

Though other studies being compared did not use IKDC score as was used in the present study, but they used some other functional score. It must be stressed here that even IKDC score is a valid functional score that can be used in children, adolescents and adult population [17]. IKDC score assesses both the knee symptoms and the functional activity as a single scoring system and any increase in the IKDC represents the improvement in the patient condition of the knee [17], as was seen in the present study after PFO.

Similar results were reported by Ahmed M et al., including 60 patients where preoperative and postoperative mean medial joint space on standard AP radiograph were 1.45±0.28 mm and 4.63±0.668 mm, respectively; thus medial joint space was improved. The mean preoperative and postoperative lateral joint space was 8.86±1.27 mm and 4.72±0.79 mm respectively; thus lateral joint

space was improved. The mean preoperative Visual Analog Scale (VAS) for pain measurement was 7.90±0.79, which improved to 2.32±0.792, postoperatively. The mean postoperative Oxford knee score was 35.92±3.509 that was improved significantly compared to preoperative score (20.82±1.97) [13].

Liu B et al., included 84 patients who had medial compartment knee OA (n=111 knees). The mean preoperative VAS score was 7.08±1.41. The average preoperative KSS and functional scores were 49.14±10.95 and 44.97±17.1 while postoperatively it was 67.77±11.08 and 64.66±13.12, respectively. Significant improvement was present in 77 knees and satisfactory clinical outcome in 51 knees [14].

Similar study was done by Wang X et al., significant reduction in mean VAS scores was noted from preoperatively to postoperatively (8.02±1.50 vs 2.74±2.34). The mean knee sub-score (69.02±11.12 vs 44.41±8.90) and function subscores of the American KSS (67.63±13.65 vs 41.24±13.48) showed improvement postoperatively than preoperative levels [15].

In another study by Subash Y et al., a significant difference was present in VAS score with the mean preoperative VAS score decreasing from 6.9 to a value of 2.1 in the postoperatively [16]. The modified oxford score postoperatively showed significant increased from preoperative score (79 vs 52.2).

The present study is also consistent with another study including similar study population by Wang X et al., who concluded that an increase in the proximal curve of the fibula was observed among patients who had medial compartment knee OA; this change was positively correlated with age and settlement of the medial tibial plateau [15]. This anatomical adaptation of the fibula with higher fibular axial load and the pulling from the peroneus longus was noted.

In terms of safety, in the present study, PFO showed minimal complications. Among other studies, in study by Yang ZY et al., peroneal nerve injury was observed in 4 patients (3.6%) [11]. Ahmed M et al., reported that loss of dorsiflexion of the great toe and superficial wound infection were present in 3 (5.0%) patients each [13]. Because of this, posterolateral approach is recommended through the space between the soleus and peroneus muscles (brevis and longus) for decreasing the relative risk of iatrogenic nerve injury.

Limitation(s)

The study had a small sample size. Also, proximal fibular osteotomy was not compared to any other approach in the study.

CONCLUSION(S)

Authors assessed functional scoring using IKDC score which increased significantly postoperatively. Range of movement also increased postoperatively. Postoperatively, tibiofemoral angle and lateral joint space decreased and medial joint space increased. Thus, with the present study we can conclude that for early medial compartment OA of the knee, PFO is an easy and simple procedure and causes significant reduction in pain, improves the radiographic appearance, and results in restoration of function.

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