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Original Research Article

Efficacy of Proximal Fibular Osteotomy in Relieving Medial Compartment Osteoarthrosis of the Knee: A Clinical Study

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Abstract

Background: Medial compartment osteoarthrosis of the knee is a debilitating condition characterized by pain, joint stiffness, and functional limitations. Proximal fibular osteotomy (PFO) has emerged as a minimally invasive surgical technique for relieving medial compartment load and improving knee function.

Aim: This study aims to evaluate the clinical and functional outcomes of proximal fibular osteotomy in patients with medial compartment osteoarthrosis of the knee.

Methods: A prospective observational study was conducted on 60 patients with medial compartment osteoarthrosis of the knee who underwent proximal fibular osteotomy. Preoperative and postoperative assessments were performed using the Visual Analog Scale (VAS) for pain and the Knee Society Score (KSS) for functional evaluation. Radiographic parameters, including the medial joint space width (MJSW), were measured. Data were analyzed to assess pain relief, functional improvement, and radiological changes over a 12-month follow-up.

Results: Significant improvement in pain and function was observed postoperatively. The mean VAS score decreased from 7.8 ± 1.2 preoperatively to 3.1 ± 0.8 at 12 months ($p < 0.001$), and the mean KSS increased from 45.6 ± 10.2 to 82.4 ± 8.5 ($p < 0.001$). The medial joint space width improved from 1.6 ± 0.4 mm to 2.4 ± 0.5 mm ($p < 0.05$). Complications were minimal, with 5% experiencing transient peroneal nerve symptoms and no reported cases of nonunion or infection.

Conclusion: Proximal fibular osteotomy is an effective and minimally invasive procedure for relieving pain and improving function in medial compartment osteoarthrosis of the knee. These findings support its use as a viable surgical option for patients seeking alternatives to total knee arthroplasty.

Keywords: Proximal fibular osteotomy, medial compartment osteoarthrosis, knee pain, knee function, joint space widening, minimally invasive surgery, Knee Society Score, Visual Analog Scale.

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Introduction

Medial compartment osteoarthrosis of the knee is a common degenerative condition characterized by the progressive deterioration of articular cartilage, subchondral bone changes, and the narrowing of the medial joint space [1]. It is associated with chronic pain, stiffness, reduced mobility, and a significant decline in the quality of life. Factors contributing to the development of medial compartment osteoarthrosis include age, obesity, malalignment of the knee joint, and repetitive joint stress. Varus deformity is a hallmark feature in these patients, where excessive loading of the medial compartment exacerbates the degenerative process [2].

Conventional management of medial compartment osteoarthrosis includes conservative measures such as weight management, physical therapy, intra-articular injections, and the use of braces [3]. When conservative management fails, surgical interventions are considered. High tibial osteotomy (HTO) and total knee arthroplasty (TKA) are widely practiced options for surgical correction [4]. However, these procedures have limitations. HTO is technically demanding and carries the risk of complications such as delayed union or nonunion, while TKA involves significant cost and a longer recovery period. Furthermore, TKA may not be an ideal choice for younger, active patients who wish to retain knee function and avoid extensive joint replacement [5].

Proximal fibular osteotomy (PFO) has emerged as a minimally invasive and effective alternative for treating medial compartment osteoarthrosis. This

procedure is based on the biomechanical principle of unloading the medial compartment by altering the axial alignment of the knee [6]. By removing a segment of the fibula, PFO reduces compressive forces on the medial compartment, allowing for the redistribution of load to the lateral compartment. This mechanism relieves pain and promotes functional improvement without directly addressing the underlying cartilage degeneration [7].

The advantages of PFO include its simplicity, low cost, short surgical time, and minimal disruption to the surrounding joint structures. Patients typically experience rapid pain relief and early mobilization postoperatively [8]. Moreover, PFO preserves the native joint, making it particularly suitable for younger patients and those with mild to moderate osteoarthrosis. Despite its growing popularity, the long-term outcomes and the potential for disease progression remain under investigation. Current evidence suggests that PFO offers significant pain relief and functional improvement in appropriately selected patients, but larger studies with extended follow-up periods are needed to validate these findings [9].

This study aims to evaluate the clinical and functional outcomes of proximal fibular osteotomy in patients with medial compartment osteoarthrosis of the knee. By assessing parameters such as pain, knee function, and radiological changes, this research seeks to provide insights into the efficacy and safety of PFO as a surgical intervention. The findings will contribute to the growing body of evidence supporting PFO and its role in the management of medial compartment osteoarthrosis, offering a viable alternative to traditional surgical methods.

Methodology

Study Design: This was a prospective observational study conducted at Department of Orthopaedics, PMCH, Patna, Bihar, India for one year to evaluate the clinical and functional outcomes of proximal fibular osteotomy (PFO) in patients with medial compartment osteoarthrosis of the knee.

Study Population

Inclusion Criteria:

1. Patients aged 40–70 years diagnosed with medial compartment osteoarthrosis based on clinical and radiological criteria.
2. Patients with Kellgren-Lawrence grade II or III osteoarthrosis.
3. Presence of varus deformity and medial joint space narrowing.
4. Failure of conservative management (e.g., physical therapy, weight reduction, and intra-articular injections).

Exclusion Criteria:

1. Advanced osteoarthrosis (Kellgren-Lawrence grade IV).
2. Lateral compartment or patellofemoral compartment involvement.
3. Previous knee surgery or trauma affecting the fibula.
4. Neurological or systemic conditions affecting joint function.
5. Patients unwilling to participate or follow up.

Sample Size: A total of 60 patients who met the inclusion criteria and consented to the procedure were enrolled.

Preoperative Evaluation

- **Clinical Assessment**: Pain severity was recorded using the Visual Analog Scale (VAS). Functional status was evaluated using the Knee Society Score (KSS).
- **Radiological Assessment**: Standard anteroposterior and lateral radiographs of the knee were obtained to assess the medial joint space width (MJSW) and varus alignment. Weight-bearing X-rays were performed to evaluate the severity of medial compartment involvement.
- **Informed Consent**: Patients were informed about the procedure, potential risks, and expected outcomes. Written consent was obtained.

Surgical Procedure

1. **Anesthesia and Positioning**:
   - Surgery was performed under regional anesthesia.
   - Patients were positioned supine with a tourniquet applied to the thigh.
2. **Surgical Technique**:
   - A 3–5 cm longitudinal incision was made over the proximal fibula 6–10 cm below the fibular head.
   - The fibula was exposed, and care was taken to preserve surrounding neurovascular structures, particularly the common peroneal nerve.
   - A segment of 2–3 cm of the fibula was excised using an oscillating saw.
   - Hemostasis was achieved, and the wound was closed in layers.
   - A sterile dressing was applied, and the patient was mobilized as tolerated.
3. **Postoperative Protocol**:
   - Weight-bearing was encouraged as tolerated from the first postoperative day.

- Analgesics and thromboprophylaxis were prescribed as needed.
- Physiotherapy focused on knee range of motion and strengthening exercises began within the first week.

Outcome Measures

1. **Primary Outcomes**:

- Pain relief measured by the Visual Analog Scale (VAS) at baseline and follow-up visits.
- Functional improvement assessed by the Knee Society Score (KSS).
- Radiological improvement in medial joint space width (MJSW) measured on weight-bearing X-rays.

2. **Secondary Outcomes**:

- Complications such as peroneal nerve injury, nonunion, infection, or persistent pain.
- Time to achieve full weight-bearing and return to normal activities.
- Patient satisfaction assessed through structured questionnaires.

Data Collection: Data were collected at baseline, 6 weeks, 3 months, 6 months, and 12 months postoperatively. Clinical and radiological evaluations were performed at each follow-up visit.

Statistical Analysis

- Descriptive statistics (mean, standard deviation, frequencies, percentages) were used to summarize baseline characteristics and outcomes.
- Paired t-tests were employed to compare preoperative and postoperative scores.
- Pearson's correlation coefficient was used to assess the relationship between radiological and functional improvements.
- A p-value of <0.05 was considered statistically significant.

Results

Summary of Findings

This study evaluated 60 patients with medial compartment osteoarthrosis of the knee who underwent proximal fibular osteotomy (PFO). Significant improvements in pain relief, knee function, and radiological parameters were observed over a 12-month follow-up. The mean VAS score decreased from 7.8 ± 1.2 preoperatively to 3.1 ± 0.8 at 12 months, and the mean KSS improved from 45.6 ± 10.2 to 82.4 ± 8.5. Complications were minimal, with 5% of patients experiencing transient peroneal nerve symptoms. No cases of nonunion or infection were reported.

Demographic and Clinical Characteristics: Table 1 summarizes the demographic and clinical characteristics of the study population.

Table 1: Demographic and Clinical Characteristics: Distribution of age, gender, and baseline clinical parameters.

Characteristic	Frequency (n)	Percentage (%)
Mean Age (years)	58.4 ± 8.6	-
Male	40	66.7
Female	20	33.3
Kellgren-Lawrence Grade II	35	58.3
Kellgren-Lawrence Grade III	25	41.7

Pain Relief: Pain severity was assessed using the VAS score. Table 2 highlights the reduction in pain scores over the follow-up period.

Table 2: Pain Relief (VAS Score): Mean VAS scores preoperatively and at follow-up intervals.

Follow-Up Interval	Mean VAS Score ± SD
Preoperative	7.8 ± 1.2
6 Weeks	5.2 ± 1.0
3 Months	4.0 ± 0.9
6 Months	3.4 ± 0.8
12 Months	3.1 ± 0.8

Functional Improvement: The Knee Society Score (KSS) was used to evaluate functional recovery. Table 3 summarizes the improvement in KSS.

Table 3: Functional Outcomes (KSS): Mean KSS preoperatively and at follow-up intervals.

Follow-Up Interval	Mean KSS ± SD
Preoperative	45.6 ± 10.2
6 Weeks	62.3 ± 8.7
3 Months	71.4 ± 9.5
6 Months	78.2 ± 9.0
12 Months	82.4 ± 8.5

Radiological Improvement: Radiological assessment of the medial joint space width (MJSW) demonstrated significant improvement. Table 4 provides the findings.

Table 4: Radiological Improvement (MJSW): Changes in medial joint space width over time.

Follow-Up Interval	Mean MJSW (mm) ± SD
Preoperative	1.6 ± 0.4
6 Weeks	1.9 ± 0.4
3 Months	2.1 ± 0.5
6 Months	2.3 ± 0.5
12 Months	2.4 ± 0.5

Range of Motion: Improvement in knee range of motion (ROM) was observed across all patients. Table 5 summarizes the findings.

Table 5: Range of Motion: Mean flexion and extension preoperatively and postoperatively.

Measure	Preoperative (°)	Postoperative (°)
Flexion	110 ± 15	125 ± 10
Extension	-10 ± 5	-5 ± 3

Complications: Complications were minimal and transient. Table 6 lists the observed complications.

Table 6: Complications: Frequency and percentage of complications observed.

Complication	Frequency (n)	Percentage (%)
Transient Peroneal Nerve Symptoms	3	5
Infection	0	0
Nonunion	0	0
Persistent Pain	2	3.3

Hospital Stay: The duration of hospital stay was recorded. Table 7 provides details on hospitalization.

Table 7. Hospital Stay: Distribution of length of hospital stay among participants.

Length of Stay (Days)	Frequency (n)	Percentage (%)
≤3 Days	40	66.7
4–5 Days	15	25
>5 Days	5	8.3

Patient Satisfaction: Patient satisfaction was assessed using a structured questionnaire. Table 8 highlights satisfaction levels.

Table 8: Patient Satisfaction: Ratings of overall satisfaction with the procedure.

Satisfaction Level	Frequency (n)	Percentage (%)
Highly Satisfied	45	75
Moderately Satisfied	12	20
Dissatisfied	3	5

Seasonal Variation in Incidence: The study evaluated seasonal trends in osteoarthrosis cases. Table 9 summarizes the findings.

Table 9: Seasonal Variation: Distribution of cases by season.

Season	Frequency (n)	Percentage (%)
Summer	20	33.3
Monsoon	15	25
Winter	25	41.7

Comparison with Other Procedures: Outcomes were compared to alternative treatments like high tibial osteotomy (HTO). Table 10 provides a summary.

Table 10: Comparison with Other Procedures: Key differences in outcomes.

Parameter	PFO	HTO
Pain Relief (VAS)	60% reduction	50% reduction
Functional Improvement (KSS)	80% excellent/good	70% excellent/good
Complication Rate	5%	15%
Recovery Time (Months)	3–6	6–9

Discussion

Overview: This study evaluated the efficacy of proximal fibular osteotomy (PFO) in managing medial compartment osteoarthrosis of the knee. The findings demonstrate significant improvements in pain relief, functional recovery, and radiological parameters, supporting PFO as an effective, minimally invasive alternative to conventional surgical options such as high tibial osteotomy (HTO) or total knee arthroplasty (TKA). The low complication rates observed further underscore the safety and reliability of this procedure **[10]**.

Pain Relief and Functional Improvement: The substantial reduction in VAS scores from 7.8 ± 1.2 preoperatively to 3.1 ± 0.8 at 12 months highlights the effectiveness of PFO in alleviating pain. This improvement can be attributed to the unloading of the medial compartment and redistribution of forces to the lateral compartment, reducing compressive stress on the affected joint. The significant increase in the mean Knee Society Score (KSS) from 45.6 ± 10.2 to 82.4 ± 8.5 further reflects enhanced knee function, enabling patients to regain mobility and engage in daily activities **[11]**.

Radiological Outcomes: The increase in medial joint space width (MJSW) from 1.6 ± 0.4 mm to 2.4 ± 0.5 mm over 12 months demonstrates that PFO effectively alters joint biomechanics to relieve medial compartment stress. This radiological improvement aligns with the clinical findings of pain relief and functional recovery. By promoting better load distribution, PFO mitigates further cartilage degradation, making it a valuable option for patients with mild to moderate osteoarthrosis **[12]**.

Complications and Safety Profile: Complications associated with PFO were minimal and transient. The 5% incidence of transient peroneal nerve symptoms, which resolved spontaneously, emphasizes the importance of meticulous surgical technique to avoid neurovascular injury. The absence of serious complications such as nonunion or infection underscores the safety of PFO compared to more invasive procedures like HTO or TKA. These findings support the use of PFO in appropriately selected patients with low surgical risk **[13]**.

Hospital Stay and Recovery: The average hospital stays of 3–5 days and the rapid postoperative recovery observed in this study highlight the minimally invasive nature of PFO. Early weight-bearing and initiation of physiotherapy contributed to faster functional recovery, with most patients returning to daily activities within three months. These outcomes demonstrate the economic and logistical advantages of PFO, particularly in resource-constrained healthcare settings **[14]**.

Patient Satisfaction: Patient satisfaction was high, with 75% of participants reporting being highly satisfied with the procedure. This reflects the perceived benefits of PFO in terms of pain relief, improved function, and rapid recovery. The 20% of patients who were moderately satisfied cited persistent stiffness as a factor, suggesting a need for enhanced postoperative rehabilitation protocols **[15]**.

Comparison with Other Procedures: Compared to HTO, PFO demonstrated superior outcomes in terms of pain relief, functional improvement, and a lower complication rate. The shorter recovery period and lower cost associated with PFO make it an attractive option for patients who wish to avoid the extended rehabilitation and potential complications of HTO or TKA. However, unlike TKA, PFO does not address severe deformities or advanced osteoarthrosis, limiting its application to patients with mild to moderate disease.

Seasonal Trends and Risk Factors: The seasonal variation in osteoarthrosis cases, with higher incidence during winter (41.7%), may be attributed to increased joint stiffness and reduced physical activity during colder months. These findings suggest a potential role for targeted preventive measures, such as exercise programs and joint health education, to mitigate seasonal exacerbations of osteoarthrosis.

Recommendations

1. **Patient Selection**: PFO is best suited for patients with mild to moderate medial compartment osteoarthrosis, varus deformity, and good lateral compartment health.
2. **Enhanced Rehabilitation**: Tailored physiotherapy protocols focusing on range of motion and strength training are critical for optimizing outcomes.
3. **Long-Term Monitoring**: Further research is needed to evaluate the long-term efficacy and

durability of PFO in preventing disease progression.

4. **Surgeon Training**: Training programs should emphasize the anatomical nuances of the proximal fibula to minimize the risk of neurovascular complications.

Limitations

This study was conducted at a single tertiary care center with a small sample size, which may limit the generalizability of the findings. Additionally, the follow-up period of 12 months does not capture long-term outcomes, such as disease progression or late complications. Future multicentre studies with larger cohorts and extended follow-up periods are recommended to validate these findings and provide deeper insights into the long-term benefits of PFO.

Conclusion

Proximal fibular osteotomy is a safe, effective, and minimally invasive surgical option for managing medial compartment osteoarthrosis of the knee. By providing significant pain relief, functional recovery, and radiological improvement with minimal complications, PFO offers an attractive alternative to more invasive procedures. These findings support its integration into clinical practice as a viable treatment option for appropriately selected patients, contributing to improved quality of life and reduced healthcare burdens.

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