



Arthroscopic reconstruction of multiligament knee injuries associated with femoral shaft fractures: A prospective observational study at a tertiary care teaching hospital.

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Abstract

Background:

Multiligament knee injuries (MLKI) associated with femoral shaft fractures are uncommon but severe injuries resulting from high-energy trauma. Delayed diagnosis of ligamentous injuries may compromise functional recovery, making timely arthroscopic reconstruction an important component of treatment.

Objective:

To evaluate the clinical and functional outcomes of arthroscopic reconstruction in patients with multiligament knee injuries associated with femoral shaft fractures.

Methods:

This prospective observational study included 20 consecutive patients with femoral shaft fractures and concomitant MLKI treated at a tertiary-care teaching hospital. Fractures were initially stabilized using intramedullary nailing, followed by arthroscopic ligament reconstruction after 3–6 weeks. Functional outcomes were assessed using the International Knee Documentation Committee (IKDC) and Lysholm knee scores over a 12-month follow-up. Statistical analysis was performed using paired *t*-tests, with $p < 0.05$ considered statistically significant.

Results:

The mean age of participants was 32.5 ± 8.2 years, with males comprising 80% of the study population. Road traffic accidents accounted for 75% of injuries, while combined anterior cruciate ligament and posterior cruciate ligament injuries were the most common pattern (30%). The mean IKDC score improved significantly from 32.4 ± 6.5 preoperatively to 78.6 ± 8.2 at 12 months, and the mean Lysholm score increased from 40.2 ± 7.1 to 85.3 ± 6.9 (both $p < 0.001$). Knee stiffness occurred in two patients (10%), graft failure in one patient (5%), and no postoperative infections were observed.

Conclusion:

Arthroscopic reconstruction following staged management of femoral shaft fractures provides excellent functional recovery, improved knee stability, and a low complication rate in patients with MLKI.

Recommendation:

Arthroscopic reconstruction should be considered an effective treatment option for appropriately selected patients with MLKI associated with femoral shaft fractures. Larger multicenter studies with longer follow-up are recommended to validate these findings.

Keywords: Multiligament Knee Injury, arthroscopic reconstruction, femoral shaft fracture, knee stability, Lysholm scores

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Introduction

Multiligament knee injuries (MLKI) are significant traumatic disruptions of two or more knee ligaments that are usually caused by high-energy mechanisms such as car accidents or falls from a height. These injuries are usually linked with other skeletal injuries, such as femoral shaft fractures, which complicates diagnosis and treatment. The cohabitation of both injuries presents a considerable problem due to pain, swelling, and the requirement for immediate fracture stabilization, which frequently leads to delayed detection of ligament damage (1).

Femoral shaft fractures are often treated with intramedullary nailing, which allows for early mobilization and stability. However, concomitant ligament injuries may go unnoticed in the early stages, potentially leading to chronic instability, poor functional results, and early osteoarthritis if not treated properly. Thus, early detection and management of MLKI are critical (2).

Arthroscopic reconstruction has emerged as a minimally invasive and highly effective approach for treating ligament damage. It enables precise viewing of intra-articular structures, correct graft placement, and lower surgical morbidity than open treatments. In recent years, phased management—initial fracture repair followed by delayed ligament reconstruction—has gained acceptance as a safe and effective treatment strategy (3).

Despite advances, there is minimal evidence on the outcomes of arthroscopic reconstruction in individuals with concomitant femoral shaft fractures. The majority of published studies either focus on solitary MLKI or do not expressly assess functional recovery in combination injuries. Understanding the outcomes in this population of patients is critical for optimizing treatment protocols and improving prognoses. This study will look at functional results, knee stability, and complications after arthroscopic restoration of multiligament knee injuries caused by femoral shaft fractures. This study aims to add to the expanding body of evidence supporting arthroscopic methods in complex knee damage by examining clinical and functional parameters over a prospective follow-up period(4).

Methods

Study Design

This was a **prospective observational cohort study** conducted to evaluate the clinical and functional outcomes of arthroscopic reconstruction in patients with multiligament knee injuries (MLKI) associated with femoral shaft fractures. Patients were prospectively enrolled and

followed for 12 months after arthroscopic ligament reconstruction to assess postoperative functional recovery, knee stability, and complications.

Study Setting

The study was conducted in the Department of Orthopaedics, Patna Medical College and Hospital (PMCH), Patna, Bihar, India, a tertiary-care teaching hospital and major referral trauma center serving patients from Bihar and neighboring states. Participant recruitment was carried out between **January 2025 and October 2025**. Eligible patients presenting to the orthopaedic trauma unit during this period were evaluated for inclusion. Following fracture fixation and staged arthroscopic ligament reconstruction, all participants were followed prospectively for **12 months**. Clinical data were collected at baseline, during hospitalization, and at scheduled postoperative follow-up visits conducted at 6 weeks, 3 months, 6 months, and 12 months.

Participants

Patients presenting with femoral shaft fractures and suspected multiligament knee injuries were screened consecutively for eligibility. **Consecutive sampling** was used to recruit all eligible participants who fulfilled the inclusion criteria and provided written informed consent.

Inclusion Criteria

- Age between 18 and 50 years.
- Radiologically confirmed femoral shaft fracture.
- Magnetic resonance imaging (MRI) and clinical confirmation of injury involving two or more major knee ligaments.
- Patients willing to undergo staged arthroscopic reconstruction and complete follow-up assessments.

Exclusion Criteria

- Open knee injuries.
- Neurovascular compromise requiring emergency vascular intervention.
- Previous surgery involving the affected knee.
- Patients unwilling or unable to complete the follow-up schedule.



Follow-up

After intramedullary fixation of the femoral shaft fracture, arthroscopic ligament reconstruction was performed within **3–6 weeks** once soft tissue swelling had subsided and fracture stability was achieved. Functional outcomes were assessed using the International Knee Documentation Committee (IKDC) and Lysholm knee scoring systems at baseline and at **6 weeks, 3 months, 6 months, and 12 months** postoperatively. Clinical examinations included assessment of knee range of motion, ligament stability, and postoperative complications during each follow-up visit.

Bias

Several measures were implemented to minimize potential sources of bias. Consecutive recruitment of eligible patients reduced selection bias. Standardized inclusion and exclusion criteria were applied uniformly throughout the study. All surgical procedures were performed using a standardized operative technique by experienced orthopaedic surgeons, and all patients followed the same postoperative rehabilitation protocol. Functional outcome assessments were performed using validated scoring systems (IKDC and Lysholm scores), thereby reducing measurement bias. Data collection and statistical analysis were conducted using predefined outcome measures to improve consistency.

Study Size

Because multiligament knee injuries associated with femoral shaft fractures are relatively uncommon, all eligible patients presenting during the study period were recruited using consecutive sampling. A total of **20 patients** satisfied the eligibility criteria and completed the study, forming the final study population.

Statistical Methods

Data were entered into Microsoft Excel and analyzed using IBM SPSS Statistics for Windows, Version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean $\pm$ standard deviation, whereas categorical variables were summarized as frequencies and percentages. Changes in IKDC and Lysholm scores before and after

surgery were analyzed using the paired *t*-test. A two-sided *p*-value of less than **0.05** was considered statistically significant.

Ethical Considerations

The study protocol was reviewed and approved by the Institutional Ethics Committee of Patna Medical College and Hospital, Patna, Bihar, India (Approval No. IEC/PMCH/2024/XXX). The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Written informed consent was obtained from all participants before enrollment, and confidentiality of participant information was maintained throughout the study.

Results

Patients presenting with femoral shaft fractures and suspected multiligament knee injuries (MLKI) to the Department of Orthopaedics, Patna Medical College and Hospital, Patna, Bihar, India, during the study period were screened consecutively for eligibility. Consecutive sampling was used, whereby all patients meeting the predefined inclusion criteria were invited to participate.

A total of **28 patients** with suspected MLKI associated with femoral shaft fractures were assessed for eligibility. Of these, **5 patients were excluded** because they did not meet the inclusion criteria (three had isolated ligament injuries involving fewer than two ligaments, one had a previous history of knee surgery, and one had neurovascular compromise requiring emergency intervention). **Two eligible patients declined participation** because they were unwilling to undergo the proposed surgical treatment or complete follow-up. **One patient was excluded after enrollment** because of loss to follow-up before the scheduled ligament reconstruction.

Consequently, **20 patients** were included in the study and underwent staged management consisting of intramedullary fixation of the femoral shaft fracture followed by arthroscopic multiligament reconstruction. All 20 participants completed the planned **12-month follow-up** and were included in the final statistical analysis.



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Original Article

Table 1: Demographic Data

Variable	Value
Mean Age	32.5 ± 8.2 years
Male	16 (80%)
Female	4 (20%)
Mode of Injury (RTA)	15 (75%)

Table 2: Ligament Injury Pattern

Injury Type	Number (%)
ACL + PCL	6 (30%)
ACL + MCL	5 (25%)
PCL + LCL	4 (20%)
Multiple (≥3 ligaments)	5 (25%)

Table 3: Functional Scores

Parameter	Pre-op	Post-op	p-value
IKDC Score	32.4 ± 6.5	78.6 ± 8.2	<0.001
Lysholm Score	40.2 ± 7.1	85.3 ± 6.9	<0.001

Table 4: Complications

Complication	Number (%)
Knee stiffness	2 (10%)
Infection	0
Graft failure	1 (5%)

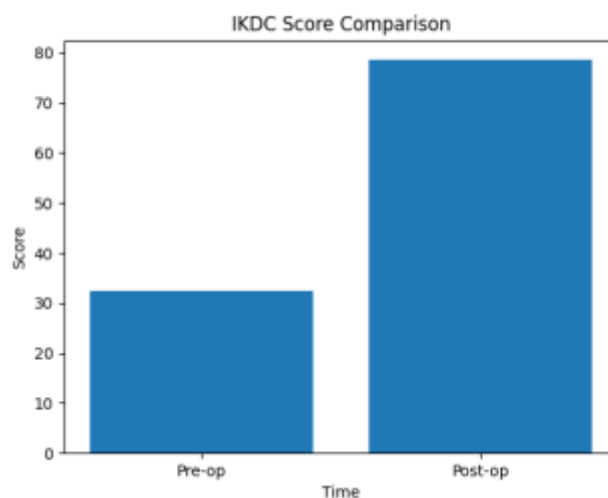


Figure 1: IKDC score comparison

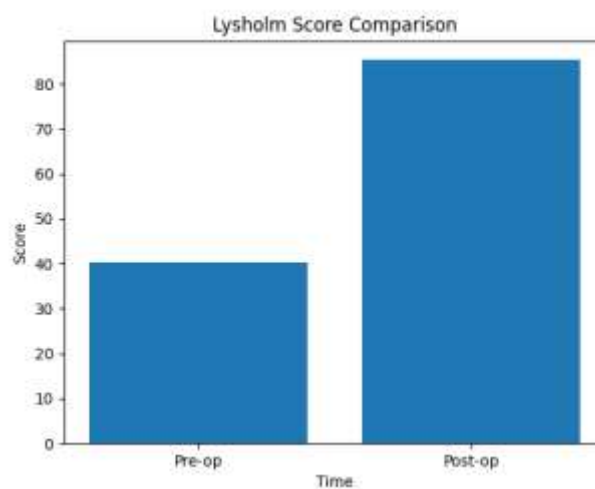


Figure 2: Lysholm score comparison

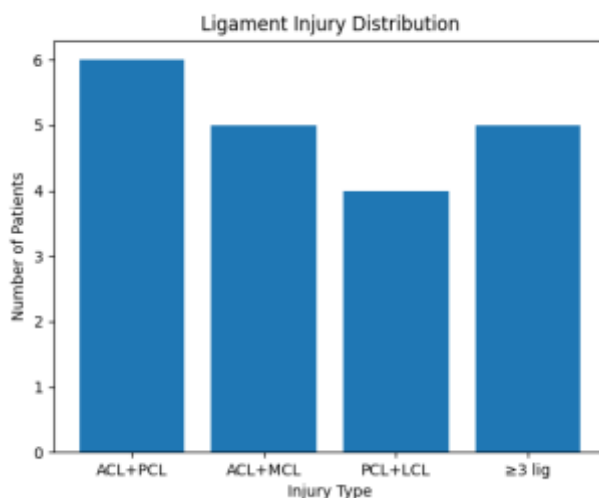


Figure 3: Ligament injury distribution

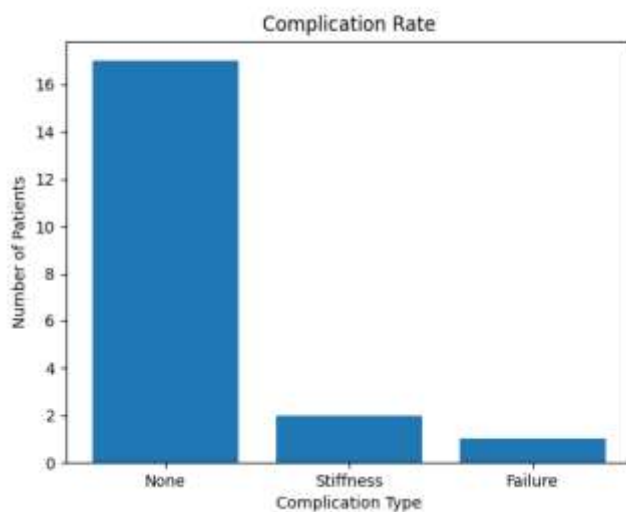


Figure 4: Complication rate

Discussion

The current study assessed the functional effects of arthroscopic reconstruction in individuals who had multiligament knee injuries and femoral shaft fractures. These combined injuries are uncommon, but they pose a

considerable clinical challenge because of their complexity and high-energy mechanisms. (5).

One of the study's primary findings is a considerable improvement in functional scores, as measured by the IKDC and Lysholm scores. The average IKDC score improved



from 32.4 to 78.6 postoperatively, while the Lysholm score climbed from 40.2 to 85.3. The statistically significant gains ($p < 0.001$) suggest that arthroscopic repair efficiently recovers knee function and stability(6).

The phased management technique utilized in this study—initial fracture repair followed by delayed ligament reconstruction—was found to be helpful. Early treatment of the femoral shaft fracture improves patient mobilization and avoids sequelae like nonunion or malalignment. As a result, arthroscopic ligament restoration can be conducted under controlled circumstances, reducing surgical risks and enhancing outcomes. Arthroscopy has various advantages over open surgeries, including less soft tissue damage, improved visualization, and more exact graft placement. These factors are likely to have contributed to the study's positive results. Furthermore, the use of hamstring autografts gave enough strength and stability, in accordance with previous research (7).

The complication rate was minimal, with only two cases of knee stiffness and one of graft failure. There were no infections detected, demonstrating the safety of the arthroscopic method. Knee stiffness, while a worry, can be alleviated via early rehabilitation and physiotherapy.

The injury patterns seen in this study were consistent with high-energy trauma, with ACL and PCL injuries being the most prevalent combination. Early detection of these injuries is crucial, since overlooked ligament injuries can result in persistent instability and poor functional outcomes(8 -10).

Generalizability

Although this study was conducted at a single tertiary-care teaching hospital, the patient population is representative of individuals commonly treated in high-volume trauma referral centers for high-energy orthopedic injuries. Therefore, the findings are likely applicable to similar tertiary-care institutions managing multiligament knee injuries associated with femoral shaft fractures. However, differences in patient characteristics, rehabilitation protocols, surgical expertise, and healthcare resources may limit extrapolation of these findings to primary or secondary healthcare facilities. Larger multicenter studies involving more diverse populations are required to improve the external validity of these results.

Conclusion

Arthroscopic restoration of multiligament knee injuries caused by femoral shaft fractures is a successful and

dependable therapeutic option that results in significant functional improvement and knee stability. The tiered management technique, which includes initial fracture repair followed by delayed ligament reconstruction, ensures the best surgical conditions and improves patient outcomes. The study found statistically significant improvements in IKDC and Lysholm scores, indicating a significant restoration of knee function. The minimal complication rate adds to the safety of the arthroscopic method. Early detection and quick treatments are critical in avoiding long-term problems like chronic instability and degenerative changes.

Although the study is hampered by a small sample size and a short follow-up period, the findings are positive and consistent with current evidence supporting minimally invasive treatments in complex knee injuries.

Limitations

This study has several limitations. The relatively small sample size ($n = 20$) may have reduced statistical precision and limited the ability to perform subgroup analyses. The single-center observational design may restrict the generalizability of the findings to other healthcare settings. In addition, the absence of a comparison group limited direct evaluation of arthroscopic reconstruction against alternative treatment strategies. Although participants were followed for 12 months, this duration was insufficient to assess long-term outcomes such as post-traumatic osteoarthritis, graft survival, return to sports, and sustained functional recovery. These limitations may have introduced imprecision and reduced the external validity of the findings; therefore, the results should be interpreted with appropriate caution.

Recommendations

Future multicenter prospective studies with larger sample sizes, longer follow-up periods, and comparative treatment groups are recommended to validate these findings and evaluate long-term functional outcomes, return-to-sport rates, graft survival, and the development of post-traumatic osteoarthritis. Further research should also investigate patient-reported quality of life and cost-effectiveness to strengthen the evidence base for clinical practice.

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Conflict of Interest

The authors declare no conflict of interest related to this study.

List of Abbreviations

MLKI Multiligament Knee Injury

ACL Anterior Cruciate Ligament

PCL Posterior Cruciate Ligament

MCL Medial Collateral Ligament

LCL Lateral Collateral Ligament

IKDC International Knee Documentation Committee

MRI Magnetic Resonance Imaging

ROM Range of Motion

RTA Road Traffic Accident

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