

Original Research Article

Functional outcomes of medial parapatellar versus patellar tendon splitting approaches in intramedullary nailing of tibial shaft fractures: a prospective comparative study

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ABSTRACT

Background: Anterior knee pain remains the most common complication following intramedullary nailing of tibial shaft fractures. The surgical approach used for nail insertion is an important factor influencing postoperative knee morbidity.

Methods: This prospective observational study included 42 patients with tibial shaft fractures treated with intramedullary interlocking nailing between April 2024 and March 2026. Patients were managed using either patellar tendon splitting or medial parapatellar approach. Functional outcomes were assessed using Visual Analog Scale (VAS) for pain and Lysholm Knee Score (LKS) at 6 weeks, 3 months, 6 months, and 1 year.

Results: Both groups were comparable in baseline characteristics. Fracture union was achieved in all patients by 6 months. While overall pain prevalence was similar at 1 year ($p=0.533$), VAS scores were significantly lower in the medial parapatellar group from 3 months onward ($p<0.001$). The medial parapatellar group demonstrated significantly better knee flexion, reduced extension lag, and higher Lysholm scores at all follow-up intervals ($p<0.001$).

Conclusions: Both approaches are effective for achieving fracture union; however, the medial parapatellar approach results in superior functional outcomes and lower pain severity. It may be preferred when feasible.

Keywords: Anterior knee pain, Gustilo Anderson classification, Lysholm knee score, Medial parapatellar approach, Patellar tendon splitting approach, Tibial shaft fractures, Visual analogue scale

INTRODUCTION

Tibial shaft fractures are among the most common long bone injuries in adults, accounting for approximately 37% of such fractures, with an incidence ranging from 17 to 21 per 100,000 population annually.^{1,2} The management of these fractures is influenced by several factors, including fracture morphology, the presence of open injury, and the status of surrounding soft tissues.

Intramedullary nailing (IMN) has emerged as the preferred method of fixation for displaced diaphyseal fractures of the tibia in adults. Acting as a load-sharing internal splint,

IMN provides adequate mechanical stability while allowing early mobilization and weight bearing. Compared to alternative methods such as plating or external fixation, IMN is associated with advantages including improved fracture healing rates, lower infection risk, better alignment, and earlier functional recovery.³⁻⁵

Despite these benefits, anterior knee pain remains the most frequently reported complication following tibial intramedullary nailing, with reported incidence rates as high as 86% in some series.⁶ This complication can adversely affect functional outcomes and patient satisfaction. The etiology of postoperative anterior knee

pain is multifactorial, with the surgical approach for nail entry being a major contributing factor. In addition, injury to the infrapatellar branch of the saphenous nerve has also been implicated in the development of persistent knee pain.^{7,8}

Two commonly employed approaches for infrapatellar nail insertion are the patellar tendon splitting approach and the medial parapatellar approach. Each technique has its own advantages and potential drawbacks, and there is currently no clear consensus regarding the optimal approach. The patellar tendon splitting approach has been associated with a higher likelihood of injury to the richly innervated infrapatellar fat pad, which may contribute to postoperative anterior knee pain.^{6,9}

More recently, the lateral parapatellar approach has been described as an alternative, offering improved access to the entry point and better control of deforming forces during nail insertion. However, this approach carries potential risks, including injury to the lateral retinaculum, lateral meniscus and lateral femoral condyle. It may also predispose to malalignment, including varus deformity and rotational errors, particularly in proximal tibial fractures or in obese patients where achieving an optimal entry point can be technically demanding.¹⁰ At present, no single factor reliably predicts the development of anterior knee pain following tibial nailing. Furthermore, there is limited high-quality comparative evidence evaluating the outcomes of patellar tendon splitting versus medial parapatellar approaches. In view of this lack of consensus and the paucity of regional data, the present study was undertaken to compare the functional outcomes and incidence of anterior knee pain between these two commonly used surgical approaches.

METHODS

Study design and setting

This prospective observational study was conducted in the Department of Orthopaedics at MES Medical College from April 2024 to March 2026.

Study population

A total of 42 patients with tibial shaft fractures were included. Both closed fractures and Gustilo-Anderson type I and II open fractures were enrolled.

Inclusion criteria

Adult patients with tibial shaft fractures, closed fractures and type I/II open fractures, and patients willing for follow-up.

Exclusion criteria

Type III open fractures, pathological fractures, and polytrauma patients unable to follow rehabilitation.

Surgical technique

All patients meeting the inclusion and exclusion criteria were enrolled in the study. A detailed general and local clinical examination was performed using a structured proforma. Radiographic evaluation included full-length tibial radiographs with the knee and ankle joints in anteroposterior and lateral views. All closed tibial shaft fractures were managed with closed reduction followed by intramedullary interlocking nailing after appropriate preoperative optimization. Open fractures classified as Gustilo-Anderson type I and II underwent thorough wound debridement prior to definitive fixation with intramedullary nailing. All procedures were performed by an experienced orthopaedic surgeon under either general or regional anaesthesia with image intensifier guidance, following standard operative protocols. Nail insertion was carried out using either the patellar tendon splitting approach or the medial parapatellar approach, with the choice of entry point determined by the operating surgeon's preference. Postoperatively, early mobilization with range of motion exercises for the knee and ankle was initiated as soon as tolerated. Serial monitoring for compartment syndrome was performed for the first 24 hours. Deep vein thrombosis prophylaxis was administered in patients identified as high risk.



Figure 1: Positioning of the patient.



Figure 2: Incision.



Figure 3: Medial parapatellar approach.



Figure 4: Guidewire passed under fluoroscopy guidance.

Patients were typically discharged on the fourth postoperative day following wound assessment. Suture removal was performed on the tenth postoperative day, and protected weight bearing was initiated as tolerated. Follow-up evaluations were conducted at 6 weeks, 3 months, 6 months, and 1 year. At each visit, patients underwent both clinical and radiographic assessment.

Table 1: Gender-wise distribution of patients undergoing medial parapatellar vs patellar tendon splitting approach.

Gender	Medial parapatellar, Count (n)	Medial parapatellar, Percent (%)	Patellar tendon splitting, Count (n)	Patellar tendon splitting, Percent (%)
Male	20	95.2	14	66.7
Female	1	4.8	7	33.3
Total	21	100.0	21	100.0

There was a slight predominance of right-sided involvement overall, with an equal distribution between the medial parapatellar and patellar tendon splitting groups, suggesting that the side of injury was comparable across both groups.

At 6 weeks postoperatively, mean VAS scores were comparable between the medial parapatellar and patellar tendon splitting groups, with no statistically significant

Functional outcomes were evaluated using the Visual Analog Scale (VAS) for anterior knee pain and the Lysholm Knee Score (LKS).

Postoperative protocol

Early mobilization and range of motion exercises were initiated. Patients were followed up at 6 weeks, 3 months, 6 months, and 1 year.

Outcome measures

The outcome measures included pain assessment using the Visual Analog Scale (VAS), functional assessment using the Lysholm Knee Score, knee range of motion, extension lag, and clinical and radiological assessment of fracture union.

Statistical analysis

All data were entered in Microsoft Excel sheet and analysis was done using SPSS software version 26. Appropriate statistical tests were performed. All quantitative variables expressed in mean and standard deviation. Qualitative variables were expressed in percentages. Probability value $p < 0.05$ was considered statistically significant. List variable wise statistical tests were used for data analysis. Student's t test was done for each outcome variables.

RESULTS

Socio demographic characteristics of patients

A total of 42 patients were included in the study. The mean age of patients was comparable between the two groups (35.23 ± 5.88 years for medial parapatellar and 34.42 ± 6.97 years for patellar tendon splitting), indicating that both groups were well matched in terms of age distribution. The gender-wise distribution of patients shows a predominance of males in both surgical approach groups (Table 1).

difference ($p = 0.480$). However, from 3 months onward, the medial parapatellar group demonstrated significantly lower pain scores, with statistically significant differences observed at 3 months ($p = 0.048$), 6 months ($p < 0.001$), and 1 year ($p < 0.001$). The reduction in pain was more pronounced over time, indicating superior long-term pain outcomes with the medial parapatellar approach compared to the patellar tendon splitting approach (Figure 5).

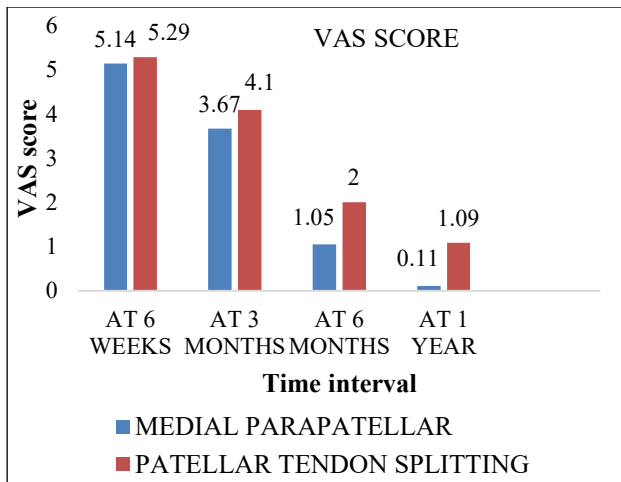


Figure 5: Comparison of medial parapatellar and patellar tendon splitting approaches based on pain severity (VAS score) at different time intervals.

Knee flexion was significantly greater in the medial parapatellar group at all follow-up intervals. At 6 weeks, 3 months, 6 months, and 1 year, the medial parapatellar group consistently demonstrated higher mean flexion compared to the patellar tendon splitting group, with all differences being statistically significant ($p < 0.001$). These findings indicate superior functional recovery of knee motion with the medial parapatellar approach (Figure 6).

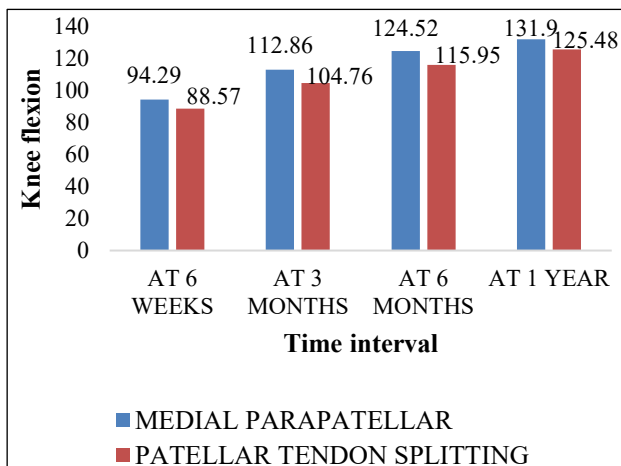


Figure 6: Comparison of medial parapatellar and patellar tendon splitting approaches based on knee flexion (degree) at different time intervals.

Lysholm knee scores were significantly higher in the medial parapatellar group at all follow-up intervals. At 6 weeks, 3 months, 6 months, and 1 year, the medial parapatellar group consistently demonstrated superior functional outcomes compared to the patellar tendon splitting group, with all differences being highly statistically significant ($p < 0.001$). These findings indicate better overall knee function with the medial parapatellar approach (Figure 7).

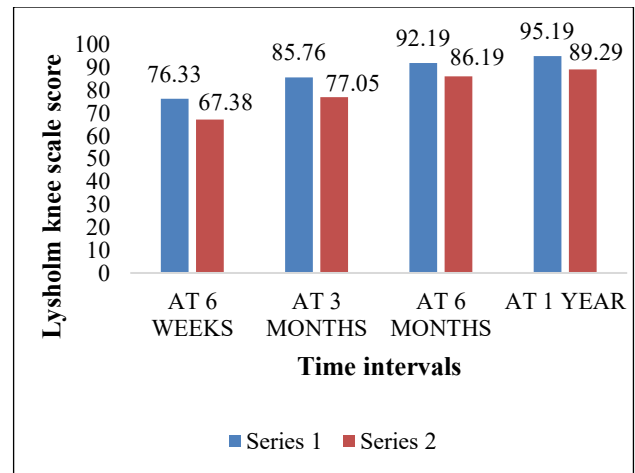


Figure 7: Comparison of medial parapatellar and patellar tendon splitting approaches based on Lysholm knee scale score at different time interval.

DISCUSSION

Intramedullary interlocking nailing is widely regarded as the standard treatment for displaced tibial shaft fractures due to its ability to provide stable fixation, preserve fracture biology, and allow early mobilization with high union rates.¹¹ However, knee-related complications particularly anterior knee pain, reduced range of motion, and extensor mechanism dysfunction remain important concerns, and these are influenced to a large extent by the surgical approach used for nail insertion.^{11,12} The present study compared the medial parapatellar (MPP) and patellar tendon splitting (PTS) approaches with respect to pain, knee motion, functional outcome, and fracture healing.

The PTS approach offers a direct and central entry into the tibial canal, facilitating accurate guidewire placement and alignment, especially in proximal fractures.¹³ It is technically straightforward and reproducible. However, splitting the patellar tendon may lead to tendon scarring, altered extensor mechanism mechanics, and increased postoperative anterior knee pain.^{11,12} In contrast, the MPP approach avoids direct tendon violation by retracting it laterally through a medial retinacular incision, thereby preserving extensor mechanism integrity.¹⁴ Despite this advantage, it may be technically more demanding and has been associated with a potential risk of valgus malalignment if the entry point is not accurately achieved.^{13,14}

In the present study, both approaches achieved satisfactory fracture stability and comparable union rates, consistent with previous reports.¹¹ However, differences were observed in knee-related outcomes and early functional recovery.

Anterior knee pain remains the most commonly reported complication after tibial nailing and significantly affects patient satisfaction.¹¹ In this study, patients treated with the PTS approach experienced higher pain levels in the early

postoperative period. This may be attributed to direct injury to the patellar tendon, disruption of the infrapatellar fat pad, and irritation of the infrapatellar branch of the saphenous nerve.^{11,12} Earlier studies by Court-Brown et al and Keating et al have similarly reported a high incidence of anterior knee pain associated with transpatellar approaches.^{11,12} Conversely, the MPP approach has been shown to reduce early postoperative pain by avoiding direct tendon trauma.^{14,15}

Although early pain relief was better with the MPP approach in our study, the difference between the groups decreased over time. This suggests that postoperative pain is multifactorial and influenced by factors such as rehabilitation, implant positioning, and soft tissue healing, rather than solely by the surgical approach.^{11,16}

Baseline demographic characteristics were comparable between groups, with most patients being young males injured in road traffic accidents, reflecting known epidemiological patterns.^{13,16} A higher proportion of high-energy injuries was observed in the PTS group, which may have contributed to greater soft tissue trauma and influenced early recovery; however, significant differences in outcomes persisted, indicating a true effect of the surgical approach.

Knee flexion was consistently better in the MPP group at all follow-up intervals, suggesting that preservation of the patellar tendon facilitates earlier and improved recovery of knee motion.¹⁷ Early stiffness in the PTS group may be related to tendon injury, pain-related quadriceps inhibition, and altered patellofemoral biomechanics.¹⁸ Although both groups achieved satisfactory flexion by one year, differences were more pronounced during the early and intermediate phases of recovery.

Extension lag was also significantly lower in the MPP group throughout follow-up. This finding supports the concept that tendon splitting may temporarily impair extensor mechanism function due to pain, scarring, or quadriceps inhibition.^{18,19} While extension lag improved in both groups over time, a small residual lag persisted in the PTS group.

Functional outcomes assessed using the Lysholm knee score were significantly better in the MPP group at all follow-up intervals. The greatest differences were observed in the early postoperative period, reflecting improved pain control and knee function.²⁰ However, by one year, both groups demonstrated good functional outcomes, indicating that long-term results may be comparable despite early differences.

Fracture union was achieved in all patients by six months, with no significant difference between the two approaches, confirming that the choice of entry technique does not adversely affect fracture healing when proper surgical principles are followed.²¹

Clinically, the MPP approach appears to offer advantages in terms of early pain relief, improved knee motion, reduced extension lag, and better early functional recovery. However, the PTS approach remains a reliable technique, particularly in situations where a central entry point is essential, such as in proximal tibial fractures. Therefore, the choice of approach should be individualized based on fracture characteristics, surgeon experience, and patient-specific functional demands rather than on a single outcome parameter.

CONCLUSION

Both medial parapatellar and patellar tendon splitting approaches were equally effective in achieving timely fracture union in proximal tibial fractures. Baseline characteristics were comparable between groups, although a higher proportion of high-energy injuries in the patellar tendon splitting group may have influenced early recovery. While pain prevalence was similar at one year, the medial parapatellar approach demonstrated significantly lower pain scores from three months onward, indicating better long-term pain outcomes. Pain location differed between approaches, reflecting soft tissue involvement and clinical relevance in daily activities. Functional outcomes consistently favored the medial parapatellar approach, with better knee flexion, reduced extension lag, and higher Lysholm scores at all follow-up intervals. Overall, the medial parapatellar approach offers superior functional recovery and may be preferred when optimal knee function and early mobilization are priorities.

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Ethical approval: The study was approved by the Institutional Ethics Committee (letter no IEC/MES/44/2024)

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