

## Original Research Article

# A STUDY OF THE SUPRAPATELLAR APPROACH FOR INTRAMEDULLARY TIBIAL NAILING IN PROXIMAL 1/3RD TIBIAL FRACTURES

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Received : 06/09/2024  
Received in revised form : 24/10/2024  
Accepted : 09/11/2024

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DOI: 10.70034/ijmedph.2024.4.96

Source of Support: Nil,  
Conflict of Interest: None declared

Int J Med Pub Health  
2024; 14 (4): 506-511

### ABSTRACT

**Background:** Proximal one-third tibial fractures present unique challenges for surgical fixation. This study evaluates the efficacy and outcomes of the suprapatellar approach for intramedullary nailing in managing these fractures.

**Material and Methods:** Thirty patients with proximal one-third tibial fractures, treated between December 2020 and December 2022 at Prathima Institute of Medical Sciences, were retrospectively analyzed. Inclusion criteria were skeletally mature patients ( $\geq 20$  years) with closed or segmental fractures. Patients underwent intramedullary nailing through a suprapatellar approach. Outcomes assessed included clinical, functional, radiological results, and complications. The Lower Extremity Functional Scale (LEFS) measured functional recovery, and radiographic evaluations monitored fracture union.

**Results:** The study population had a mean age of 43.4 years ( $SD \pm 15.18$ ), with 70% males. Most injuries occurred on the right side (76.66%) due to road traffic accidents (73.33%). Radiological union was achieved in 73.33% of patients within 12-14 weeks. The average union time was 18.86 weeks ( $SD \pm 8.09$ ). LEFS scores indicated excellent functional outcomes in 80% of cases, with minimal complications, including proximal screw infection and nonunion in 6.66% and malunion in 3.33%.

**Conclusion:** The suprapatellar approach for intramedullary nailing in proximal tibial fractures is effective, providing high union rates and favorable functional outcomes with minimal complications. This approach demonstrates its value as a reliable option for managing proximal tibial fractures, particularly in terms of patient recovery and alignment maintenance.

**Key Words:** Suprapatellar approach, intramedullary nailing, proximal tibial fracture, fracture union, functional outcome, complications, Lower Extremity Functional Scale (LEFS).

## INTRODUCTION

Proximal tibial fractures, particularly those affecting the upper third of the tibia, represent a challenging aspect of orthopedic trauma.<sup>[1]</sup> These fractures are often associated with significant biomechanical forces due to their proximity to the knee joint and the unique stress distribution across the tibial plateau and shaft.<sup>[2]</sup> In managing these fractures, restoration of alignment and stability is crucial for ensuring effective weight-bearing and preventing complications such as malunion, joint stiffness, and

chronic pain.<sup>[3]</sup> Surgical intervention through intramedullary nailing has emerged as the standard approach for managing these fractures, favored for its minimally invasive technique, alignment control, and facilitation of early mobilization.<sup>[4]</sup> However, traditional methods like the infrapatellar approach have shown limitations, particularly in proximal tibial fractures where obtaining a lateralized entry point can be challenging due to interference from the patella and surrounding soft tissues.<sup>[5]</sup>

The infrapatellar approach, while widely used, may lead to less-than-ideal outcomes in certain proximal

tibial fractures.<sup>[6]</sup> Due to limited access to the optimal starting point, this approach often results in malalignment, varus or valgus deformities, and knee pain, all of which contribute to slower recovery and reduced patient satisfaction. Addressing these challenges, the suprapatellar approach has gained traction as an effective alternative.<sup>[7]</sup> This approach, which involves making an entry point through a small incision proximal to the patella, allows for easier access to the tibial canal, providing surgeons with better control over fracture reduction and alignment. By utilizing a suprapatellar entry point, the technique also minimizes the disruption to knee anatomy, as the knee joint does not need to be excessively manipulated or flexed during surgery. This is particularly beneficial in reducing postoperative knee pain, a common complaint among patients who undergo the infrapatellar approach.

The suprapatellar approach is not without its challenges. It requires careful patient positioning and surgical technique to achieve the desired entry point and avoid injury to surrounding structures, such as the patellofemoral joint.<sup>[7]</sup> Yet, its advantages have become apparent in recent literature, which highlights improvements in alignment control, minimized soft tissue irritation, and reduced operative time. Importantly, by minimizing disruption to the patellar tendon and reducing the need for extensive knee flexion during the procedure, this approach offers a potentially more comfortable postoperative experience for patients. Early mobilization, improved functional outcomes, and a shorter rehabilitation period are among the reported benefits, suggesting a promising alternative for the treatment of proximal one-third tibial fractures.

Despite the growing interest in the suprapatellar approach, research comparing its outcomes to traditional infrapatellar methods remains limited, especially in terms of long-term functional recovery, union rates, and complication frequencies. This study aims to evaluate the clinical, functional, and radiological outcomes of the suprapatellar approach for intramedullary nailing in patients with proximal one-third tibial fractures. Specifically, it seeks to analyze union rates, complication rates, and functional recovery profiles to determine the efficacy and potential advantages of this approach in orthopedic trauma care. By contributing to the evidence base on the suprapatellar approach, this study hopes to support improved clinical decision-making and enhance patient outcomes in the management of complex proximal tibial fractures.

## **MATERIALS AND METHODS**

### **Study Design and Setting**

This observational study was conducted at the Prathima Institute of Medical Sciences, Karimnagar, involving patients with proximal one-third tibial

fractures treated with intramedullary nailing via a suprapatellar approach. Data were collected over two years, from December 2020 to December 2022, after obtaining ethical clearance from the Institutional Ethical Committee.

### **Patient Selection and Inclusion Criteria**

A total of 30 patients with proximal one-third tibial fractures were included. Inclusion criteria involved skeletally mature individuals ( $\geq 20$  years) of both sexes with closed or segmental fractures of the proximal tibia, who consented to participate in the study. Exclusion criteria included patients with pediatric or intra-articular tibial fractures, compound fractures, those above 70 years, and those medically unfit for surgery.

### **Procedure**

Preoperative assessments included a thorough clinical, radiological, and functional evaluation. Patients were admitted through the emergency or outpatient departments, where a detailed history was taken to determine the injury's mechanism, time since occurrence, and any co-morbidities or prior surgeries. Clinical examinations focused on the fracture site and associated injuries, assessing both vascular and neurological functions of the affected limb, particularly the common peroneal nerve.

Patients underwent intramedullary nailing using a suprapatellar approach. The suprapatellar incision was made starting from the superior pole of the patella, allowing entry through the quadriceps tendon. Proper guide pin positioning was confirmed through fluoroscopic imaging, followed by reaming and nail insertion. Nail diameter and locking screw placement were selected based on intraoperative radiological assessments. Poller screws were inserted when necessary for fracture alignment. Following surgery, patients followed a postoperative protocol involving passive mobilization, quadriceps exercises, partial and full weight-bearing progression based on radiographic evidence of callus formation, and regular radiographic follow-ups.

### **Data Collection and Outcome Measures**

The primary outcomes assessed were clinical, functional, and radiological results, and complications post-surgery. Functional outcomes were evaluated using the Lower Extremity Functional Scale (LEFS), which assesses daily activities. Scores between 70-80 indicate excellent outcomes, 60-70 indicate good, 40-60 fair, and <40 poor. Radiological outcomes were based on evidence of union and assessed through monthly X-rays to evaluate callus formation and limb alignment. Additional complications, including infection, nonunion, and malunion, were documented.

### **Data Analysis**

Descriptive statistics, including frequency distributions, were used to summarize the demographic and clinical variables. The chi-square test and Fisher's exact test were applied to

determine statistical significance in outcome differences across demographic categories.

### Ethical Approval

Ethical approval for this study was obtained from the Institutional Ethical Committee at Prathima Institute of Medical Sciences, Karimnagar. All patients provided informed consent before participation, ensuring adherence to ethical standards in patient care and data confidentiality.

## RESULTS

### Demographics

The study included 30 patients, predominantly male (70%), with a mean age of 43.4 years (SD ± 15.18). The age distribution showed that the majority of participants fell into the 21-30 and 41-50-year age groups, each comprising 30% of the total population. The injuries predominantly involved the right side (76.66%), with road traffic accidents (RTA) as the most common cause (73.33%). [Table 1]

### Fracture and Surgery Characteristics

The average distance from the knee joint to the fracture site was 5.43 cm (SD ± 1.0). Based on the AO classification system, 50% of the fractures were categorized as type 2,3, while 80% were classified as stage 1 according to the Winquist classification. Most patients (80%) underwent closed reduction and internal fixation (CRIF), reflecting the preferred surgical approach in this cohort. [Table 2]

### Surgical Complications

Surgical complications were minimal, with a low incidence of immediate and delayed issues. Among the complications observed, 6.66% of patients experienced proximal screw infections, 6.66% experienced nonunion, and 3.33% had malunion. Mild hemarthrosis was noted as the most common immediate complication, though it was generally minimal and manageable. [Table 3]

### Functional and Radiological Outcomes

The average union time for fractures was 18.86 weeks (SD ± 8.09). Radiological union was achieved within 12-14 weeks in 73.33% of patients, while 23.33% demonstrated union at 15-16 weeks, with only one case extending beyond 17 weeks. Functional recovery, as assessed by the Lower Extremity Functional Scale (LEFS), showed positive outcomes: 80% of participants achieved an excellent score, 10% good, 6.66% fair, and 3.33% poor. [Tables 4 and 5]

### Overall Outcome and Follow-Up

The suprapatellar approach for intramedullary nailing in proximal one-third tibial fractures demonstrated favorable outcomes. High rates of fracture union and functional recovery were achieved, with minimal complication rates. Regular follow-ups confirmed successful radiological union and an absence of significant postoperative malalignment, supporting the suprapatellar approach as an effective option for proximal tibial fractures.

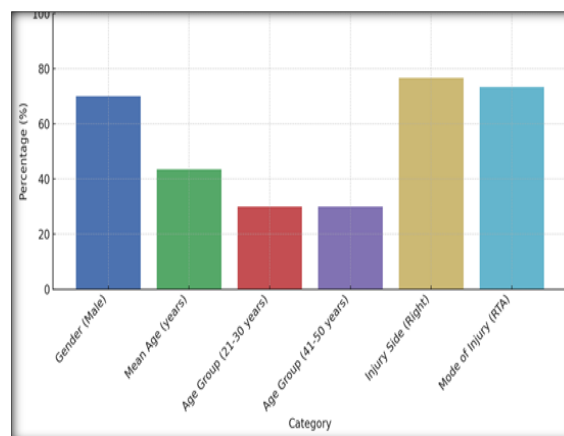


Figure 1: Demographics of Study Population

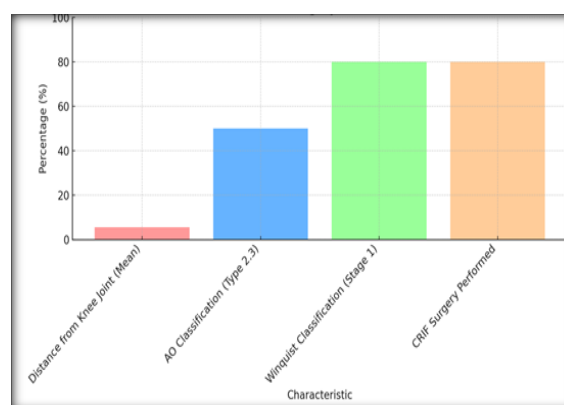


Figure 2: Fracture and Surgery Characteristics

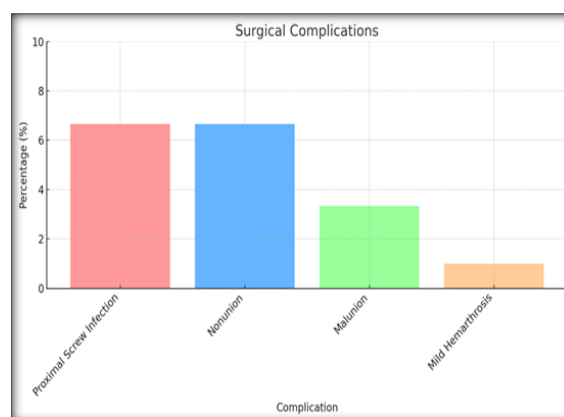


Figure 3: Surgical Complications

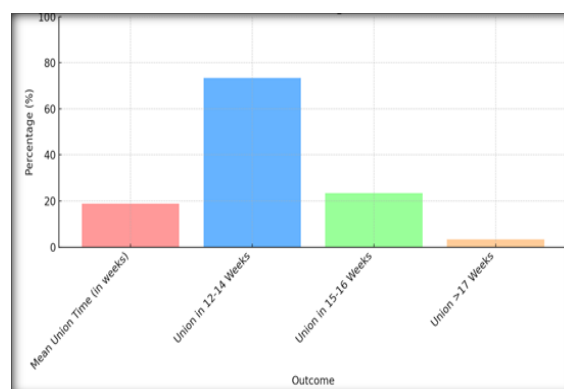
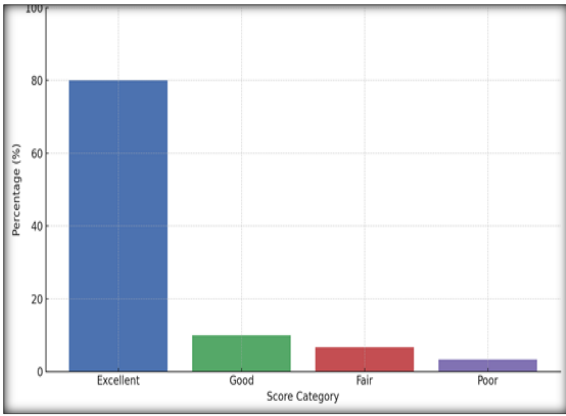


Figure 4: Functional and Radiological Outcomes



**Figure 5: Functional Score Distribution**



**Figure 8: AT Union**



**Figure 6: Pre OP X Ray**



**Figure 9: Extension**



**Figure 7: Post OP X Ray**



**Figure 10: Flexion**

**Table 1: Demographics of Study Population**

| Category                                | Percentage (%)    |
|---|-------------------|
| Gender (Male)                           | 70                |
| Mean Age (years)                        | 43.4 (SD ± 15.18) |
| Age Group (21-30 years)                 | 30                |
| Age Group (41-50 years)                 | 30                |
| Injury Side (Right)                     | 76.66             |
| Mode of Injury (Road Traffic Accidents) | 73.33             |

**Table 2: Fracture and Surgery Characteristics**

| Characteristic                              | Percentage (%)     |
|---|--------------------|
| Distance from Knee Joint to Fracture (Mean) | 5.43 cm (SD ± 1.0) |
| AO Classification (Type 2.3)                | 50                 |
| Winquist Classification (Stage 1)           | 80                 |
| CRIF Surgery Performed                      | 80                 |

**Table 3: Surgical Complications**

| Complication             | Percentage (%) |
|--------------------------|----------------|
| Proximal Screw Infection | 6.66           |
| Nonunion                 | 6.66           |
| Malunion                 | 3.33           |
| Mild Hemarthrosis        | Low            |

**Table 4: Functional and Radiological Outcomes**

| Outcome                       | Percentage (%)          |
|-------------------------------|-------------------------|
| Mean Union Time               | 18.86 weeks (SD ± 8.09) |
| Union Achieved in 12-14 Weeks | 73.33                   |
| Union Achieved in 15-16 Weeks | 23.33                   |
| Union >17 Weeks               | 3.33                    |

**Table 5: Functional Score Distribution (Lower Extremity Functional Scale - LEFS)**

| Score Category | Percentage (%) |
|----------------|----------------|
| Excellent      | 80             |
| Good           | 10             |
| Fair           | 6.66           |
| Poor           | 3.33           |

## DISCUSSION

This study aimed to evaluate the effectiveness of the suprapatellar approach for intramedullary nailing in proximal one-third tibial fractures, focusing on clinical, functional, and radiological outcomes. The findings support this approach as a viable option, offering high union rates, low complication incidences, and positive functional recovery, consistent with other literature indicating that the suprapatellar approach addresses limitations seen in traditional infrapatellar techniques (Jayaraju et al,<sup>[8]</sup> 2022; Joshi et al,<sup>[13]</sup> 2023).

One of the key findings was the high rate of union achieved in the suprapatellar group, with most patients achieving radiological union within 12-14 weeks. This aligns with prior studies, which report that the suprapatellar approach facilitates stable fracture fixation and favorable biomechanics for healing (Sagar et al,<sup>[9]</sup> 2023). The mean union time in our study was 18.86 weeks, which falls within an expected range for proximal tibial fractures, suggesting that this approach does not delay healing. These findings are further supported by Haubruck et al,<sup>[11]</sup> (2017), who observed that a proximal entry point, as seen in the suprapatellar approach,

enhances alignment control, which is critical in preventing malalignment in proximal fractures.

The low incidence of postoperative complications, including nonunion, malunion, and infections, was another significant finding. Only minor complications, such as mild hemarthrosis, were observed, posing minimal risk to long-term outcomes. Studies by Cheng et al,<sup>[12]</sup> (2021) and Wang et al,<sup>[14]</sup> (2024) similarly reported that the suprapatellar approach minimizes knee flexion requirements and reduces soft tissue disruption, potentially lowering the risk of complications. By bypassing the infrapatellar region, the suprapatellar approach reduces stress on the patellar tendon, which has been associated with decreased knee pain and less irritation (Ciminero et al,<sup>[10]</sup> 2023). This was reflected in our results, with minimal postoperative knee pain, suggesting improved patient comfort and a potentially shorter rehabilitation time.

Functional outcomes, assessed using the Lower Extremity Functional Scale (LEFS), were generally excellent, with 80% of patients achieving an "excellent" score. This high rate of functional success may be attributed to the reduced manipulation of the knee joint associated with the suprapatellar approach, which minimizes

postoperative pain and enhances mobility. Functional recovery is especially critical in tibial fractures, as it determines the patient's ability to regain mobility and resume daily activities. Our findings align with those of previous studies, which reported faster weight-bearing and fewer alignment issues with the suprapatellar approach compared to traditional methods (Jayaraju et al,<sup>[8]</sup> 2022; Sagar et al,<sup>[9]</sup> 2023).

Despite these advantages, the suprapatellar approach has certain limitations. It requires precise entry to avoid patellofemoral joint damage, and specialized training and instrumentation are necessary for proper technique (Haubruck et al,<sup>[11]</sup> 2017). There is also a small risk of patellofemoral cartilage injury at the entry point; however, none of our cases experienced this complication, likely due to careful patient positioning and surgical technique. Further research, as recommended by Joshi et al,<sup>[13]</sup> (2023), should focus on assessing potential cartilage degeneration in the knee over extended follow-up periods to better understand long-term outcomes.

Overall, the efficacy of the suprapatellar approach in managing proximal tibial fractures highlights its potential as a preferred method for complex fractures. Standardizing surgical protocols and enhancing specialized training could further broaden its use and improve outcomes across a wider patient population (Ciminero et al,<sup>[10]</sup> 2023; Wang et al,<sup>[14]</sup> 2024)

## CONCLUSION

Our study demonstrates that the suprapatellar approach for intramedullary nailing in proximal one-third tibial fractures yields high union rates, averaging 18.86 weeks, with most patients achieving radiological union within 12-14 weeks. Functional outcomes were favorable, with 80% of patients attaining excellent LEFS scores, indicating substantial mobility recovery. Complication rates were low, with only minor incidences of nonunion, malunion, and infection. The reduced postoperative knee pain and improved alignment observed suggest that the suprapatellar approach may offer significant advantages over traditional methods for challenging proximal tibial fractures. Further studies are warranted to assess its long-term effects on knee function and cartilage health.

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