STEMedicine

ORIGINAL RESEARCH ARTICLE

Operative Outcome of Proximal Tibial Fractures Treated with Intramedullary Tibial Nailing Using the Suprapatellar Approach in Adults: A Prospective Study

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Abstract: Background: Proximal-third tibial fractures are challenging to stabilize because of metaphyseal flare and deforming forces around the knee. The suprapatellar approach permits intramedullary nail insertion with the knee in a semi-extended position and may facilitate alignment. This study evaluated clinical, radiological, and functional outcomes after suprapatellar intramedullary nailing in adults with proximal tibial fractures.**Materials and Methods**: This prospective study included 30 adults with proximal tibial metaphyseal or diaphyseal fractures treated at G K General Hospital, Bhuj, from April 2024 to September 2025. Patients aged >18 years who were medically fit for surgery were included; open, intra-condylar, pathological, peri-implant fractures and fractures with neurovascular deficits were excluded. All patients underwent suprapatellar intramedullary tibial nailing. Patients were followed for a minimum of 6 months and assessed clinically, radiologically, and functionally using the Lysholm Knee Scoring System.**Results**: The largest age group was 31–40 years (33.3%); 24 patients (80%) were male. Right-sided fractures accounted for 60%. Road traffic accidents were the most common mechanism (63.3%). AO/OTA type 42C was the most frequent (11/30, 36.7%). The mean final Lysholm score was 89.6. Excellent, good, fair, and poor outcomes were observed in 33.3%, 46.7%, 13.3%, and 6.7% of patients, respectively. The mean radiological union time was 14.8 weeks. Reported complications included anterior knee pain (6.7%), malalignment (3.3%), superficial infection (3.3%), delayed union (6.7%), and knee stiffness (6.7%).**Conclusion**: In this 30-patient prospective series, suprapatellar intramedullary nailing of proximal tibial fractures was associated with satisfactory fracture union and predominantly good to excellent functional outcomes at a minimum 6-month follow-up.

Keywords: Tibial fractures; Intramedullary nailing; Suprapatellar approach; Lysholm score; Fracture healing

Received:12.09.2026 | Revised:22.09.2026 | Accepted:25.10.2026 | Published:06.11.2026

Citation: Dr. Dhruvik Jitendrakumar Parmar *et al* (2026). Operative Outcome of Proximal Tibial Fractures Treated with Intramedullary Tibial Nailing Using the Suprapatellar Approachin Adults: A Prospective Study. STEMed, 7(2): 84-88.

INTRODUCTION

Proximal-third tibial fractures are among the most difficult tibial fractures to manage because of the metaphyseal flare, deforming muscular forces, and the proximity of the knee joint. Tibial fractures are common long-bone injuries and are frequently associated with high-energy mechanisms such as road traffic accidents and falls.[1,2] Intramedullary nailing is widely used for tibial shaft fractures because it preserves fracture biology and permits early mobilization.[3] However, proximal tibial fractures treated through the conventional infrapatellar approach may develop malalignment, particularly because maintaining reduction during nail insertion can be difficult.[4]

The suprapatellar technique permits nail insertion with the knee in a semi-extended position. This position reduces deforming forces on the proximal fragment and facilitates fluoroscopic visualization and fracture alignment.[4,5] Published reports have described satisfactory alignment and functional

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outcomes with suprapatellar tibial nailing.[6-9] The present study was undertaken to evaluate the operative, radiological, and functional outcomes of proximal tibial fractures treated with intramedullary tibial nailing using the suprapatellar approach in adults.

MATERIALS AND METHODS

Study Design and Setting

This prospective study was conducted in the Department of Orthopaedics, G K General Hospital, Bhuj, Gujarat, from April 2024 to September 2025. Thirty patients with proximal tibial metaphyseal or diaphyseal fractures were included. The study had Institutional Ethics Committee approval, and written informed consent was obtained from participants.

Participants

Patients aged >18 years with proximal tibial metaphyseal or diaphyseal fractures who were medically fit for surgery were eligible. Exclusion criteria were age <18 years, open fractures, fractures with intra-condylar extension, neurovascular deficit, pathological fractures, and peri-implant fractures.

Initial Assessment and Fracture Management

Patients were evaluated in the emergency department, stabilized according to Advanced Trauma Life Support principles, and assessed for associated systemic and skeletal injuries. Routine laboratory investigations and anteroposterior and lateral radiographs of the affected leg, including the knee and ankle, were obtained. Fractures were classified according to the AO/OTA system. The limb was initially immobilized in an above-knee posterior slab and treated with rest, ice, compression, and elevation. Surgery was deferred until soft-tissue swelling had subsided and the patient was fit for anaesthesia. According to the thesis protocol, operative treatment was generally performed within 1–2 weeks of injury.

Operative Technique

Displaced proximal-third tibial shaft fractures, metaphyseal and meta-diaphyseal fractures, fractures with unacceptable alignment after closed reduction, segmental or comminuted fractures, and unstable fractures associated with ipsilateral fibular fracture were indications for surgery. Intramedullary tibial nailing was performed through a suprapatellar approach with the knee maintained in a semi-extended position. A protective sleeve was used during nail insertion. Reduction and alignment were assessed fluoroscopically, followed by nail insertion and interlocking fixation according to the operative protocol.

Postoperative Care and Follow-up

Postoperatively, injectable antibiotics were administered for 48 hours. Limb elevation, quadriceps strengthening, and ankle and toe mobilization were started within 48 hours. Knee range-of-motion exercises were initiated as tolerated, and sutures were removed on postoperative day 14. Patients were mobilized non-weight-bearing with a walker or crutches for 6 weeks; partial weight bearing was initiated after radiological evidence of callus formation, and full weight bearing was permitted after clinical and radiological union, usually at 12–16 weeks. The minimum follow-up was 6 months.

Outcome Assessment

Clinical, radiological, and functional outcomes were assessed during follow-up. Functional assessment used the Lysholm Knee Scoring System, which evaluates limp, support, locking, instability, pain, swelling, stair climbing, and squatting, with a maximum score of 100. Scores of 95–100 were classified as excellent, 84–94 as good, 65–83 as fair, and <65 as poor.[10] The final Lysholm score at the last follow-up was used for analysis.Radiological union and postoperative complications were also recorded. The study protocol additionally included the Lower Extremity Functional Scale (LEFS)[11], although the thesis results presented for analysis were based on the Lysholm score.

STATISTICS

Categorical variables were summarized as frequencies and percentages, and the final Lysholm score and union time were summarized using mean values. The source thesis did not report inferential statistical testing, confidence intervals, or statistical software/version; therefore, these were not added or inferred for this manuscript.

RESULTS

Thirty adults were evaluated between April 2024 and September 2025, with a minimum postoperative follow-upof 6 months. The age distribution is shown in Table 1. The largest group was 31–40 years (10/30, 33.3%),followed by 41–50 years (8/30, 26.7%). Six patients each were in the 18–30 and 51–60 year groups (20% each).The thesis reported the youngest patient as 19 years and the oldest as 60 years.

Twenty-four patients (80%) were male and six (20%) were female. Right-sided fractures were present in 18 patients (60%) and left-sided fractures in 12 (40%). Road traffic accidents were the most common mechanism, accounting for 19 cases (63.3%), followed by falls from height in 9 (30%) and other mechanisms in 2 (6.7%).

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The AO/OTA distribution comprised 10 type 42A fractures (33.3%), 9 type 42B fractures (30.0%), and 11 type42C fractures (36.7%). Associated ipsilateral fibular fracture was the most frequent associated injury (12 cases,40%). Head injury was present in 3 cases (10%), chest injury in 2 (6.7%), and spine injury in 2 (6.7%); 11 patients (36.6%) had no recorded associated injury.

At final follow-up, the mean Lysholm score was 89.6. Ten patients (33.3%) had excellent scores, 14 (46.7%) had good scores, 4 (13.3%) had fair scores, and 2 (6.7%) had poor scores. Thus, 24 of 30 patients (80%) had good or excellent functional outcomes.

Radiological union occurred at a mean of 14.8 weeks. Eighteen patients united within 12–14 weeks, 10 within 15–18 weeks, and 2 after 18 weeks. Recorded postoperative complications included anterior knee pain in 2 patients (6.7%), malalignment in 1 (3.3%), superficial infection in 1 (3.3%), delayed union in 2 (6.7%), and knee stiffness in 2 (6.7%). No major implant-related failure was reported in the thesis.

Table1.Demographic and injury characteristics

Variable	No.ofpatients	Percentage
Age 18–30years	6	20.0
Age 31–40years	10	33.3
Age 41–50years	8	26.7
Age 51–60years	6	20.0
Male	24	80.0
Female	6	20.0
Right side	18	60.0
Left side	12	40.0
Road traffic accident	19	63.3
Fall from height	9	30.0
Other mechanism	2	6.7

Table2.AO/OTA classification and associated injuries

Variable	No.of cases	Percentage
AO/OTA42A	10	33.3
AO/OTA42B	9	30.0
AO/OTA42C	11	36.7
Ipsilateral fibula fracture	12	40.0
Head injury	3	10.0
Chest injury	2	6.7
Spine injury	2	6.7
None	11	36.6

Table3.Functional outcome at final follow-up

Lysholm score	Outcome	No.of patients	Percentage
95–100	Excellent	10	33.3
84–94	Good	14	46.7
65–83	Fair	4	13.3
<65	Poor	2	6.7
Total		30	100.0

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Table4.Radiological union and postoperative complications

Outcome	No. of patients	Percentage
Union12–14weeks	18	60.0
Union15–18weeks	10	33.3
Union>18weeks	2	6.7
Anterior knee pain	2	6.7
Malalignment	1	3.3
Superficial infection	1	3.3
Delayed union	2	6.7
Knee stiffness	2	6.7

DISCUSSION

The present prospective series evaluated 30 adults with proximal tibial fractures treated with suprapatellar intramedullary nailing. The study population was predominantly male (80%), with the largest age group being 31–40 years. Road traffic accidents accounted for nearly two-thirds of injuries, consistent with the high-energy mechanisms described for tibial fractures in epidemiological literature.[1,2]

Proximal tibial fractures are technically demanding for intramedullary fixation because the proximal fragment is influenced by deforming muscular forces and the metaphyseal flare can make maintenance of alignment difficult.[4,12] The semi-extended position used for suprapatellar nailing is intended to reduce these deforming forces and facilitate fluoroscopic control.[4,5] In the present study, AO/OTA type 42C fractures formed the largest group (36.7%), indicating that a substantial proportion of the treated fractures were comminuted.

Functional outcome was satisfactory in most patients. The mean final Lysholm score was 89.6, with 80% of patients achieving good or excellent outcomes. The Lysholm system provides a knee-specific assessment incorporating pain, instability, locking, swelling, support, limp, stair climbing, and squatting.[10] The findings in this series are in keeping with the thesis literature review, which describes favorable functional outcomes following suprapatellar tibial nailing.[6-9] Sanders et al. described the semi-extended suprapatellar technique with improved control of proximal tibial alignment.[6] Avilucea et al. reported lower malalignment with suprapatellar compared with infrapatellar nailing.[7] MacDonald et al. reported satisfactory outcomes and reduced anterior knee pain with the suprapatellar technique,[8] while Ryan et al. reported improved alignment without an increase in complications.[9]

The mean radiological union time in the present study was 14.8 weeks. Most fractures (28/30) united within 18 weeks. Intramedullary fixation preserves fracture biology and provides a load-sharing construct that can facilitate mobilization.[3] Earlier Indian reports have also described satisfactory results with intramedullary fixation of proximal tibial fractures.[13,14]

Complications were limited in this series. Anterior knee pain occurred in two patients (6.7%), and malalignment in one (3.3%). The low frequency of anterior knee pain is consistent with the rationale for avoiding direct violation of the patellar tendon used in the infrapatellar approach.[8] One superficial infection was reported and managed according to the clinical protocol. Delayed union occurred in two patients, while knee stiffness occurred in two. No deep infection or implant failure was reported.

This study has limitations. It was a single-centre prospective series with only 30 patients and no comparison group treated by the infrapatellar approach or another fixation method. The follow-up was limited to a minimum of 6 months, and the source thesis did not report inferential statistical testing, confidence intervals, or software details. The results therefore describe the observed outcomes in this selected cohort and should not be interpreted as evidence of superiority over alternative techniques. Larger comparative studies with longer follow-up and standardized statistical analysis are needed.

CONCLUSIONS

In this prospective series of 30 adults with proximal tibial fractures, suprapatellar intramedullary nailing resulted in a mean radiological union time of 14.8 weeks and a mean final Lysholm score of 89.6. Eighty percent of patients achieved good or excellent functional outcomes. The recorded complications were limited,with anterior knee pain in 6.7% and

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malalignment in 3.3%. Within the limitations of this single-centre, non-comparative study, suprapatellar intramedullary nailing provided satisfactory radiological and functional outcomes at a minimum 6-month follow-up.

What Was Already Known

Suprapatellar intramedullary nailing allows tibial nail insertion in a semi-extended position and has been described as a technique that can facilitate alignment in proximal tibial fractures.

What This Study Adds

In this 30-patient prospective series, the suprapatellar approach was associated with a mean union time of 14.8weeks and predominantly good or excellent Lysholm functional outcomes at a minimum 6-month follow-up.

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