

Functional and Radiological Outcomes of Suprapatellar Nailing for Extra-articular Proximal-third Tibial Fractures**Dr. Kunal Saoji¹, Dr. Vasant Gawande², Dr. Ashish Assudani³**¹Associate Professor, Dept. of Orthopaedics, DMMC, Nagpur¹Professor, Dept. of Orthopaedics, DMMC, Nagpur³Senior Resident, Dept. of Orthopaedics, DMMC, Nagpur

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Conflict of interest: Nil

Abstract:

Background: Extra-articular proximal-third tibial fractures are difficult to stabilize with intramedullary nails because the short proximal segment and deforming forces can compromise reduction. The semi-extended suprapatellar approach may facilitate reduction and alignment. This study assessed functional and radiological outcomes after suprapatellar nailing.

Methods: This prospective observational study included 40 adults with extra-articular proximal-third tibial fractures treated with suprapatellar intramedullary interlocking nailing at a tertiary care teaching hospital in Wardha, India, between February 2024 and January 2026. Patients were followed for nine months. Lower Extremity Functional Scale (LEFS), visual analogue scale (VAS) for pain, knee range of motion (ROM), radiographic union, alignment, and complications were recorded. Repeated-measures analysis of variance with Bonferroni-adjusted pairwise comparisons was used for serial outcomes.

Results: Mean age was 42.65 ± 14.56 years; 32 (80%) patients were male. Mean LEFS increased from 16.70 ± 4.84 postoperatively to 64.30 ± 7.53 at nine months ($F=626.393$, $p<0.001$). Mean VAS decreased from 7.45 ± 1.01 to 1.73 ± 0.88 ($F=335.589$, $p<0.001$), while mean knee ROM increased from $55.48 \pm 8.85^\circ$ to $115.80 \pm 7.65^\circ$ ($F=593.464$, $p<0.001$). All fractures united and all nails were recorded as acceptably aligned. Union was recorded between 18 and 28 weeks. Reported complications were infection in 3 (7.5%), anterior knee pain in 2 (5.0%), and screw backout in 1 (2.5%).

Conclusion: In this single-center cohort, suprapatellar nailing was associated with union in all cases, acceptable recorded alignment, and progressive improvement in pain, function, and knee motion through nine months. Comparative studies with longer follow-up are needed to determine relative effectiveness and late complications.

Keywords: tibial fracture; proximal tibia; intramedullary nailing; suprapatellar approach; LEFS; fracture union.

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Introduction

Extra-articular proximal-third tibial fractures are challenging to treat because the proximal fragment is short and the surrounding muscle forces can drive valgus and apex-anterior deformity. Intramedullary nailing is an established option for tibial shaft fractures, but maintaining reduction in proximal fractures can be difficult.^{1,2}

The suprapatellar approach permits nail insertion with the knee in a semi-extended position. This position can help maintain reduction and facilitate fluoroscopic assessment compared with the flexed-knee infrapatellar approach.^{3,4} Comparative evidence has evaluated alignment, knee symptoms, and other outcomes, although results depend on fracture pattern and study design.^{5,6} The present study describes functional and radiological outcomes in adults with extra-articular proximal-third tibial fractures treated using suprapatellar intramedullary nailing.

Materials and Methods**Study design and setting.**

This prospective observational study was conducted in the Department of Orthopaedics at Jawaharlal Nehru Medical College and Acharya Vinoba Bhave Rural Hospital, Sawangi (Meghe), Wardha, Maharashtra, India. Recruitment and follow-up were reported from February 2024 through January 2026. The Institutional Ethics Committee approved the study (DMIHER(DU)/IEC/2024/301). Written informed consent was obtained from participants.

Participants.

Adults older than 18 years with extra-articular proximal tibial fractures extending into the proximal diaphysis (AO/OTA 41-A1 to 41-A3) were eligible, including closed fractures and Gustilo-Anderson type I, II, or IIIA open fractures. Articular fractures

(41-B or 41-C), pathological fractures, fractures with infection, and proximal-third fractures associated with another injury in either limb were excluded. Forty eligible patients were included.

Surgical treatment.

After resuscitation and preoperative assessment, patients underwent suprapatellar intramedullary interlocking nailing in the supine, semi-extended position. Reduction and guidewire position were checked fluoroscopically in anteroposterior and lateral views. The medullary canal was sequentially reamed, and an appropriately sized nail was inserted and locked proximally and distally. Surgery was performed after the patient was fit for anesthesia, usually within six days of admission.

Postoperative care and follow-up.

Rehabilitation included ankle and knee motion, quadriceps strengthening, non-weight-bearing mobilization followed by progressive weight bearing as tolerated. Clinical and radiographic assessments were made postoperatively and at 3, 6, and 9 months. Anteroposterior and lateral radiographs were used to assess healing, shortening, angulation, displacement, and alignment. Fracture union was assessed radiographically; the operational criteria used to define union should be stated.

Outcomes.

The primary outcomes were serial LEFS (0-80) and VAS pain scores (0-10). Knee ROM, radiographic union and alignment, time to union, time to weight bearing, and complications were also recorded. The first score was recorded postoperatively and was not described as a preoperative baseline.

Statistical analysis.

Data were analyzed using SPSS version 21.0. Continuous variables were summarized as mean and standard deviation; categorical variables as frequency and percentage. Repeated-measures ANOVA and Bonferroni-adjusted pairwise comparisons were used for LEFS, VAS, and ROM. Statistical significance was set at $p < 0.05$. Degrees of freedom and assessment of ANOVA assumptions were not reported.

Results

Participant and fracture characteristics.

The cohort included 40 patients aged 18 to 72 years (mean 42.65 ± 14.56); 32 (80.0%) were male. Road traffic accidents accounted for 21 (52.5%) injuries and falls for 19 (47.5%). AO/OTA 41-A3 fractures accounted for 24 (60.0%) and 41-A2 fractures for 16 (40.0%). Thirty-three fractures (82.5%) were closed; seven (17.5%) were open (three type I, one type II, and three type IIIA).

Table 1:

Characteristic	n (%) or value
Age, years, mean $\pm$ SD	42.65 $\pm$ 14.56 (range 18-72)
Male	32 (80.0%)
Female	8 (20.0%)
Road traffic accident	21 (52.5%)
Fall	19 (47.5%)
AO/OTA 41-A2	16 (40.0%)
AO/OTA 41-A3	24 (60.0%)
Closed fracture	33 (82.5%)
Open fracture, type I / II / IIIA	3 (7.5%) / 1 (2.5%) / 3 (7.5%)

Serial clinical outcomes.

LEFS and knee ROM increased over follow-up, while VAS pain scores decreased. Repeated-measures ANOVA indicated differences across the reported time points for all three measures ($p < 0.001$); all Bonferroni-adjusted pairwise comparisons were also reported as significant ($p < 0.001$).

Table 2:

Outcome	Postoperative	3 months	6 months	9 months	ANOVA
LEFS, mean $\pm$ SD	16.70 $\pm$ 4.84	29.43 $\pm$ 5.45	53.75 $\pm$ 7.32	64.30 $\pm$ 7.53	F=626.393; $p < 0.001$
VAS, mean $\pm$ SD	7.45 $\pm$ 1.01	3.93 $\pm$ 0.89	2.58 $\pm$ 0.96	1.73 $\pm$ 0.88	F=335.589; $p < 0.001$
Knee ROM, degrees, mean $\pm$ SD	55.48 $\pm$ 8.85	80.78 $\pm$ 9.42	103.80 $\pm$ 7.77	115.80 $\pm$ 7.65	F=593.464; $p < 0.001$

Radiological outcomes and complications.

All 40 fractures were recorded as united, with union times ranging from 18 to 28 weeks. The most frequent recorded union time was 20 weeks (11 patients, 27.5%). Acceptable nail alignment was

recorded in all patients. Weight bearing was initiated between 6 and 10 weeks; 22 patients (55.0%) began at 8 or 9 weeks. Thirty-four patients had no recorded complication; the remaining six were recorded in one of the listed complication categories

Table 3:

Outcome	Finding
Radiographic union	40/40 (100%)
Acceptable nail alignment	40/40 (100%)
Time to union	18-28 weeks; most frequent: 20 weeks, 11 (27.5%)
Weight-bearing initiation	6-10 weeks; 8 or 9 weeks in 22 (55.0%)
No reported complication	34 (85.0%)
Infection	3 (7.5%)
Anterior knee pain	2 (5.0%)
Screw backout	1 (2.5%)

Discussion

In this prospective cohort of 40 adults with extra-articular proximal-third tibial fractures, suprapatellar nailing was followed by progressive improvement in LEFS, pain, and knee motion over nine months. All fractures were recorded as united and all nails as acceptably aligned. These findings describe outcomes in this cohort; because there was no comparator group, they do not establish superiority over infrapatellar nailing or plating.

The semi-extended position is intended to reduce the deforming effect of knee flexion and to facilitate control of proximal fracture alignment. Earlier clinical studies and reviews have examined these potential advantages and the safety profile of suprapatellar tibial nailing.^{3-6,8} The 100% acceptable alignment recorded here is encouraging, but the angular thresholds, measurement method, and use of independent radiographic assessment should be specified to support comparisons with other studies.

Functional recovery was reflected by an increase in mean LEFS from 16.70 to 64.30 at nine months, while mean VAS fell from 7.45 to 1.73. Mean knee ROM reached 115.80° at nine months. These serial trends support clinical improvement during follow-up. The first measurements are described only as postoperative, however, and should not be interpreted as preoperative baseline values. A prospective study comparing suprapatellar and infrapatellar approaches reported clinical and radiological outcomes at longer follow-up, underscoring the value of a direct comparison.⁷

All fractures united in this series, with recorded union times of 18-28 weeks. The reported complication categories included infection, anterior knee pain, and screw backout. Infection depth, management, and outcomes are not detailed, and the nine-month follow-up does not establish the absence of later knee symptoms or implant-related events.

The small, single-center cohort and absence of a comparator limit generalizability and causal interpretation.

The study did not specify reproducible radiographic definitions for union and alignment, infection severity, the full weight-bearing protocol, or the statistical degrees of freedom and assumptions. These details, along with confirmation of follow-up completeness, are needed for reproducibility and interpretation.

Limitations

This was a single-center observational study with 40 participants, no comparison group, and follow-up limited to nine months. The study did not define union and acceptable alignment using reproducible thresholds, detail infection severity, or assess longer-term knee symptoms. The serial statistical analysis did not include degrees of freedom or diagnostics for repeated-measures ANOVA assumptions. Accordingly, the findings should be interpreted as descriptive outcomes from this cohort.

Conclusion

Among 40 adults treated with suprapatellar intramedullary nailing for extra-articular proximal-third tibial fractures, all fractures were recorded as united and acceptably aligned. LEFS and knee ROM improved, and VAS pain decreased through nine months. Controlled comparative studies with explicit radiographic criteria and longer follow-up are needed to establish comparative effectiveness and late complications.

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