Section: Orthopaedics

Original Research Article

COMPARATIVE FUNCTIONAL AND RADIOLOGICAL OUTCOMES OF SUPRAPATELLAR VERSUS INFRAPATELLAR INTRAMEDULLARY NAILING FOR BOTH-BONE LEG FRACTURES: A PROSPECTIVE COMPARATIVE STUDY

Sudhakar. R.[1], G.Venkatesh[2]

[1]Assistant Professor, Department of Orthopaedics, Government Tiruvannamalai Medical College and Hospital, Tamilnadu, India.
[2]Assistant Professor, Department of Orthopaedics, Government Tiruvannamalai Medical College and Hospital, Tamilnadu, India.

Received : 04/01/2026
Received in revised form : 10/02/2026
Accepted : 25/02/2026

Keywords:
Fracture Fixation, Intramedullaryl; Lower Leg Fractures; Tibial Fractures; Treatment Outcome; Young Adult.

Corresponding Author:
Dr. Sudhakar. R.,
Email: sudhakarmsortho@gmail.com

DOI: 10.47009/jamp.2026.8.4.203

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

Int J Acad Med Pharm
2026; 8 (4); 1207-1211

ABSTRACT

Background: Suprapatellar and infrapatellar intramedullary nailing are widely used for the management of tibial shaft fractures; however, evidence comparing their outcomes in patients with both-bone leg fractures remains limited. This study compared the intraoperative, functional, radiological, and postoperative outcomes of the two approaches. **Materials and Methods:** This prospective comparative study included 50 patients with both-bone leg fractures treated at the Department of Orthopaedics, Government Tiruvannamalai Medical College and Hospital. Patients underwent suprapatellar (n=25) or infrapatellar (n=25) intramedullary interlocking nailing. Intraoperative parameters, functional outcomes, radiological outcomes, and postoperative complications were compared between the groups. **Results:** Baseline demographic and clinical characteristics were comparable between the groups ($p>0.05$). The suprapatellar group demonstrated significantly shorter operative time (74.8 ± 8.7 vs. 88.6 ± 10.5 minutes; $p<0.001$), reduced fluoroscopy time (44.2 ± 6.8 vs. 57.9 ± 8.5 seconds; $p<0.001$), and lower blood loss (112.5 ± 18.4 vs. 131.6 ± 21.8 mL; $p=0.002$). Functional outcomes were significantly better with lower VAS scores (1.8 ± 0.7 vs. 3.1 ± 0.9; $p<0.001$), higher Lysholm Knee Scores (91.8 ± 5.4 vs. 85.6 ± 6.2; $p=0.001$), greater knee flexion (128.6 ± 5.8° vs. 121.4 ± 7.3°; $p=0.001$), and higher LEFS scores (86.4 ± 5.7 vs. 80.3 ± 6.4; $p=0.003$). Fracture union time, malalignment, delayed union, and non-union were comparable between the groups ($p>0.05$). Anterior knee pain was less frequent with the suprapatellar approach (8.0% vs. 32.0%; $p=0.034$). **Conclusion:** Suprapatellar intramedullary nailing improved intraoperative efficiency, functional outcomes, and reduced anterior knee pain while achieving radiological outcomes and complication rates comparable to the infrapatellar approach in both-bone leg fractures.

INTRODUCTION

Fractures of the tibia and fibula (both-bone leg fractures) are among the most common long-bone injuries encountered in orthopaedic trauma practice, with an annual incidence of approximately 109 per 100,000 individuals. These fractures commonly affect young adults following high-energy trauma such as road traffic accidents and falls. Intramedullary nailing (IMN) has become the standard treatment because it preserves the extraosseous blood supply, requires minimal soft-tissue dissection, and allows early mobilisation compared with plate fixation.[1,2]

IMN has been performed through the infrapatellar (IP) approach, in which the knee is hyperflexed and the nail is inserted through a split in the patellar tendon. However, this position allows the pull of the quadriceps muscle to displace the proximal fracture fragment, leading to valgus and procurvatum deformities. The infrapatellar approach is also associated with a high incidence of anterior knee pain, reported in 10%–80% of patients, which may affect postoperative function and increase the risk of malalignment. To overcome these limitations, the suprapatellar (SP) approach was introduced. Performed with the knee in a semi-extended position (10°–30°), this technique reduces quadriceps tension on the proximal fragment and provides more

ISSN (O): 2687-5365; ISSN (P): 2753-6556

consistent access to the correct entry point for nail insertion.[2-4]

Over the past decade, several comparative studies have evaluated these two approaches. A retrospective study of 63 distal tibial fractures reported comparable functional recovery between the SP and IP groups, although the available evidence supporting either approach remained limited.[5] A systematic review including four studies and 586 patients found that the SP approach achieved better knee function, with a mean difference of 3.90 points, and superior ankle function, with a mean difference of 8.25 points, compared with the IP approach.6 In a series of 126 patients, the SP group had a significantly shorter operative time (75.86 ± 9.80 vs. 84.17 ± 10.47 minutes; $p<0.001$) and required fewer fluoroscopy exposures than the IP group.[7] A meta-analysis including 23 studies and 2,140 patients further demonstrated better coronal-plane alignment, shorter fluoroscopy time, and higher Lysholm Knee Scores with the SP approach, whereas operative time and blood loss were comparable between the two techniques.[8]

More recent studies have reported similar findings. A study involving 126 patients reported reduced hospital stay and fewer postoperative complications with the SP approach.[9] A randomized trial of 38 patients demonstrated significantly lower intraoperative blood loss with SP nailing, while operative time and fluoroscopy time were comparable between the two groups.[7]

Despite the growing evidence, most published studies have focused on isolated tibial shaft or distal tibial fractures. Evidence specifically evaluating patients with combined tibia-fibula (both-bone leg) fractures remains limited, and findings related to operative time, blood loss, and long-term functional recovery have not been consistent across different study populations. Therefore, the present prospective comparative study was undertaken to compare the intraoperative, functional, radiological, and postoperative outcomes of suprapatellar and infrapatellar intramedullary nailing in patients with both-bone leg fractures.

Aim

To compare the functional and radiological outcomes of suprapatellar and infrapatellar intramedullary nailing in patients with both-bone leg fractures.

Objectives

1. To compare the intraoperative outcomes between the suprapatellar and infrapatellar approaches.
2. To compare the functional outcomes following suprapatellar and infrapatellar intramedullary nailing.
3. To compare the radiological outcomes between the two approaches.
4. To compare the postoperative complications associated with the two surgical techniques.

MATERIALS AND METHODS

This prospective comparative study was conducted in the Department of Orthopaedics, Government Tiruvannamalai Medical College and Hospital. Institutional Ethics Committee approval was obtained before the commencement of the study, and written informed consent was obtained from all participants.

Sample size

All eligible patients who fulfilled the inclusion criteria during the study period were consecutively enrolled until the required sample size of 50 patients was achieved.

Study population

A total of 50 patients with both-bone leg fractures who fulfilled the eligibility criteria were enrolled and assigned to the suprapatellar (n=25) or infrapatellar (n=25) group.

Inclusion and Exclusion Criteria

Patients aged ≥18 years with acute both-bone leg fractures (tibial shaft fracture with associated fibular fracture) undergoing intramedullary interlocking nailing were included. Eligible patients had closed fractures or Gustilo-Anderson Grade I open fractures and provided written informed consent. Patients with Gustilo-Anderson Grade II or III open fractures, intra-articular fractures, pathological fractures, polytrauma, previous surgery or fracture of the affected limb, severe neurovascular injury, or those medically unfit for surgery were excluded.

Surgical Procedure

All patients underwent intramedullary interlocking nailing under spinal or general anaesthesia in the supine position with fluoroscopic guidance. Patients were treated using either the suprapatellar (n=25) or infrapatellar (n=25) approach. In the suprapatellar group, nail insertion was performed through a suprapatellar portal with the knee in a semi-extended position (15°–30° flexion) using a protective cannula. In the infrapatellar group, nailing was performed through a transpatellar tendon or paratendinous approach with the knee flexed to approximately 90°. Appropriate nail size was selected intraoperatively, and proximal and distal interlocking screws were inserted under fluoroscopic guidance. Postoperatively, all patients received standard antibiotics, analgesics, and a uniform rehabilitation protocol comprising early knee mobilization and progressive weight-bearing according to fracture stability and radiological healing.

Outcome Assessment

Baseline demographic and clinical characteristics, including age, sex, side of injury, and fracture type, were recorded. Intraoperative parameters included operative time, fluoroscopy time, and estimated blood loss. Functional outcomes were assessed at the final follow-up using the Visual Analogue Scale (VAS), Lysholm Knee Score, Lower Extremity Functional Scale (LEFS), and knee flexion measured with a goniometer. Radiological evaluation was

ISSN (O): 2687-5365; ISSN (P): 2753-6556

performed using standard anteroposterior and lateral radiographs. Fracture union was defined as bridging callus across at least three cortices with painless full weight-bearing. Coronal and sagittal malalignment were defined as angulation greater than 5°. Delayed union and non-union were also recorded. Postoperative complications, including anterior knee pain, superficial infection, knee stiffness, implant failure, and reoperation, were also recorded.

Statistical Analysis

Data were entered into Microsoft Excel and analysed using IBM SPSS Statistics for Windows, version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequencies and percentages. Comparisons between the two groups were performed using the independent Student's t-test for continuous variables and the Chi-square test or Fisher's exact test for categorical variables, as appropriate. A p-value <0.05 was considered statistically significant.

RESULTS

The mean age was 39.8 ± 11.2 years in the suprapatellar group and 41.6 ± 10.4 years in the infrapatellar group (p=0.561). There were no significant differences between the groups with respect to sex (p=0.733), side of fracture (p=0.777), or fracture type (p=0.684). [Table 1]

Table 1: Baseline demographic and clinical characteristics

Parameters	Variable	Suprapatellar (n=25)	Infrapatellar (n=25)	P value
Age (years)	mean ± SD	39.8 ± 11.2	41.6 ± 10.4	0.561
Sex	Male	20 (80.0%)	19 (76.0%)	0.733
	Female	5 (20.0%)	6 (24.0%)	
Side of fracture	Right	14 (56.0%)	13 (52.0%)	0.777
	Left	11 (44.0%)	12 (48.0%)	
Fracture type	Closed	22 (88.0%)	21 (84.0%)	0.684
	Open (Grade I)	3 (12.0%)	4 (16.0%)	

The mean operative time was 74.8 ± 8.7 minutes in the suprapatellar group and 88.6 ± 10.5 minutes in the infrapatellar group (p<0.001). The mean fluoroscopy time was 44.2 ± 6.8 seconds and 57.9 ± 8.5 seconds (p<0.001). Mean intraoperative blood loss was 112.5 ± 18.4 mL in the suprapatellar group and 131.6 ± 21.8 mL in the infrapatellar group (p=0.002). At the final follow-up, the mean VAS score was 1.8 ± 0.7 and 3.1 ± 0.9 (p<0.001), Lysholm Knee Score was 91.8 ± 5.4 and 85.6 ± 6.2 (p=0.001), knee flexion was 128.6 ± 5.8° and 121.4 ± 7.3° (p=0.001), and LEFS score was 86.4 ± 5.7 and 80.3 ± 6.4 (p=0.003) in the suprapatellar and infrapatellar groups. [Table 2]

Table 2: Comparison of intraoperative and functional outcomes

Parameters	Variable	Suprapatellar (n=25)	Infrapatellar (n=25)	P value
Intraoperative outcomes	Operative time (minutes)	74.8 ± 8.7	88.6 ± 10.5	<0.001
	Fluoroscopy time (seconds)	44.2 ± 6.8	57.9 ± 8.5	<0.001
	Blood loss (mL)	112.5 ± 18.4	131.6 ± 21.8	0.002
Functional outcomes at final follow-up	VAS score	1.8 ± 0.7	3.1 ± 0.9	<0.001
	Lysholm Knee Score	91.8 ± 5.4	85.6 ± 6.2	0.001
	Knee flexion (degrees)	128.6 ± 5.8	121.4 ± 7.3	0.001
	LEFS score	86.4 ± 5.7	80.3 ± 6.4	0.003

The mean fracture union time was 18.7 ± 2.1 weeks in the suprapatellar group and 19.6 ± 2.4 weeks in the infrapatellar group (p=0.271). Coronal malalignment was observed in 4.0% and 12.0% of patients (p=0.297), while sagittal malalignment occurred in 8.0% and 16.0%, respectively (p=0.384). Delayed union was noted in 4.0% of the suprapatellar group and 8.0% of the infrapatellar group (p=0.551). Non-union occurred in 0% and 4.0% of patients, respectively (p=0.312). [Table 3]

Table 3: Comparison of radiological outcomes

Variable	Suprapatellar	Infrapatellar	P value
Fracture union time (weeks)	18.7 ± 2.1	19.6 ± 2.4	0.271
Coronal malalignment (>5°)	1 (4.0%)	3 (12.0%)	0.297
Sagittal malalignment (>5°)	2 (8.0%)	4 (16.0%)	0.384
Delayed union	1 (4.0%)	2 (8.0%)	0.551
Non-union	0 (0.0%)	1 (4.0%)	0.312

Anterior knee pain occurred in 2 (8.0%) patients in the suprapatellar group and 8 (32.0%) patients in the infrapatellar group (p=0.034). Superficial infection was observed in 1 (4.0%) and 2 (8.0%) patients (p=0.551), knee stiffness in 1 (4.0%) and 3 (12.0%) patients (p=0.297), and implant failure and reoperation in 1 (4.0%) patient each in the infrapatellar group (p=0.312). Patients without postoperative complications were 21 (84.0%) in the suprapatellar group and 16 (64.0%) in the infrapatellar group (p=0.102). [Table 4]

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Table 4: Comparison of postoperative complications

Complication	Suprapatellar (n=25)	Infrapatellar (n=25)	P value
Anterior knee pain	2 (8.0%)	8 (32.0%)	0.034
Superficial infection	1 (4.0%)	2 (8.0%)	0.551
Knee stiffness	1 (4.0%)	3 (12.0%)	0.297
Implant failure	0 (0.0%)	1 (4.0%)	0.312
Reoperation	0 (0.0%)	1 (4.0%)	0.312
Patients without any complications	21 (84.0%)	16 (64.0%)	0.102

DISCUSSION

Intramedullary interlocking nailing is the preferred treatment for tibial shaft fractures, with the suprapatellar and infrapatellar approaches being the two most commonly used surgical techniques. The present study aimed to compare the functional and radiological outcomes of suprapatellar and infrapatellar intramedullary nailing in patients with both-bone leg fractures.

In our study, the baseline demographic and clinical characteristics were comparable between the suprapatellar and infrapatellar groups, with no significant differences in age, sex distribution, side of fracture, or fracture type. Similarly, Mubarak Ali et al. reported comparable baseline characteristics between the two groups, with a mean age of 38.96 ± 13.65 years in the suprapatellar group and 38.92 ± 13.56 years in the infrapatellar group, without significant differences in gender, smoking status, or diabetes.[10] Further, Sakale et al. found no significant differences in age (41.67 ± 16.17 vs. 36.80 ± 16.19 years; p=0.329), gender (*p*=0.802), fracture type (*p*=0.763), or AO fracture classification (*p*=0.205) between the two groups.[11] These findings indicate that the study groups were comparable at baseline, enabling a fair assessment of the functional and radiological outcomes following the two surgical approaches.

In our study, the suprapatellar approach was associated with shorter operative time, reduced fluoroscopy time, lower intraoperative blood loss, and better functional outcomes, including lower pain scores, higher Lysholm Knee Scores, greater knee flexion, and improved LEFS scores. Similarly, Singh et al. observed shorter operative time (72.4 ± 8.6 vs. 83.7 ± 9.4 minutes), lower fluoroscopy time (42.3 ± 6.5 vs. 55.2 ± 8.2 seconds), reduced blood loss (115 ± 22 vs. 130 ± 27 mL), lower VAS pain scores (2.6 ± 0.8 vs. 3.8 ± 1.1).[12] Kumar et al. also reported lower intraoperative blood loss with the suprapatellar approach (48.76 ± 12.75 vs. 63.89 ± 7.43 mL; *p*=0.002). They further observed shorter fluoroscopy time, lower postoperative pain, and better lower extremity functional scores in the suprapatellar group, while operative time and fracture healing were comparable between the two approaches.[13] Likewise, Singh A et al. demonstrated better functional recovery with the suprapatellar approach. Patients treated with the suprapatellar technique had significantly higher Lysholm Knee Scores (92.2 ± 5.35 vs. 87.95 ± 5.34; *p*=0.016), along with better LEFS scores and lower postoperative pain than those who underwent infrapatellar nailing.[14] The improved intraoperative and functional outcomes observed with the suprapatellar approach may be attributed to the semi-extended position, which facilitates fracture reduction, improves fluoroscopic visualization, and reduces manipulation of the patellar tendon.

Regarding radiological outcomes, no significant differences were observed between the suprapatellar and infrapatellar groups in fracture union time, coronal or sagittal malalignment, delayed union, or non-union. Similarly, Sakale et al. observed comparable RUST scores and fracture alignment throughout follow-up, with a mean union time of 19.27 weeks in the suprapatellar group and 20.13 weeks in the infrapatellar group (*p*=0.342).[11] Likewise, Singh et al. reported comparable fracture union times (17.3 ± 2.4 vs. 18.1 ± 3.1 weeks; p=0.28) and no significant differences in delayed union or infection between the two approaches.[12] In contrast, Mubarak Ali et al. demonstrated a shorter mean union time (19.0 vs. 24.4 weeks) and higher RUST scores at nine months (11.84 vs. 10.64) in the suprapatellar group.[10] These findings indicate that the choice of surgical approach has little influence on fracture healing, with both techniques providing comparable radiological outcomes despite differences in functional recovery.

With respect to postoperative complications, anterior knee pain was less frequent in the suprapatellar group, whereas superficial infection, knee stiffness, implant failure, reoperation, and overall postoperative complications were similar between the groups. Sakale et al., reported postoperative complications in 8% of the suprapatellar group compared with 27% of the infrapatellar group, with anterior knee pain occurring in 5% and 26.7% of patients.[11] Mubarak Ali et al. also found no cases of anterior knee pain in the suprapatellar group, whereas 16% of infrapatellar patients reported anterior knee pain during follow-up.[10] Similarly, Singh et al. observed anterior knee pain in 10% of patients treated with the suprapatellar approach compared with 30% in the infrapatellar group, while fracture union and infection rates remained comparable.[12] The lower incidence of anterior knee pain with the suprapatellar approach may be explained by reduced trauma to the patellar tendon and surrounding soft tissues during nail insertion.

Overall, the findings of the present study suggests that suprapatellar intramedullary nailing provides better intraoperative efficiency and functional recovery while maintaining radiological outcomes

ISSN (O): 2687-5365; ISSN (P): 2753-6556

and postoperative complication rates comparable to those of the infrapatellar approach.

Limitations

The study was conducted at a single centre with a relatively small sample size, which may limit the generalizability of the findings. The follow-up period was limited, preventing assessment of long-term functional outcomes. Patients with severe open fractures and polytrauma were excluded, restricting the applicability of the results to these populations.

CONCLUSION

The suprapatellar approach provided shorter operative and fluoroscopy times, lower blood loss, better functional outcomes, and less anterior knee pain than the infrapatellar approach. Radiological outcomes and overall complication rates were comparable between the two techniques. These findings suggest that suprapatellar intramedullary nailing is a safe and effective option for managing both-bone leg fractures.

REFERENCES

1. Lu Y, Wang G, Hu B, Ren C, Sun L, Wang Z, et al. Comparison of suprapatellar versus infrapatellar approaches of intramedullary nailing for distal tibia fractures. J Orthop Surg Res 2020;15:422. https://doi.org/10.1186/s13018-020-01960-8.
2. Yang CY, Tay ST, Kuo LT. Suprapatellar vs infrapatellar approaches for intramedullary nailing of distal tibial fractures: a systematic review and meta-analysis. J Orthop Traumatol 2023;24:14. https://doi.org/10.1186/s10195-023-00694-7.
3. Wu DH, Zhang Y, Xu D, Lou WG, Zhang JY. Evaluation of the effectiveness of suprapatellar versus infrapatellar approach in intramedullary nailing for the treatment of tibial fractures. Eur J Med Res 2025;30:599. https://doi.org/10.1186/s40001-025-02865-0.
4. Wang Z, Xiong X, Lu Z, Gao Y. A systematic review and meta-analysis comparing suprapatellar versus infrapatellar approach intramedullary nailing for tibal shaft fractures. Eur J Trauma Emerg Surg 2024;50:383–94. https://doi.org/10.1007/s00068-023-02384-9.
5. Sahni G, Singh S, Kavia A, Aggarwal HO, Chawla HKS. Suprapatellar versus infrapatellar approach for Intramedullary Nailing in tibial shaft fractures: A prospective interventional study. J Clin Diagn Res 2023. https://doi.org/10.7860/jcdr/2023/55398.17258.
6. Gao F, Wang X-H, Xia S-L, Zhou X-X, Wang M-H, Fu B-G, et al. Intramedullary nail fixation by suprapatellar and infrapatellar approaches for treatment of distal tibial fractures. Orthop Surg 2022;14:2350–60. https://doi.org/10.1111/os.13397.
7. Santhanam SS, Velayutham S, Krishnan P, Albert A, Ramanujam B. Comparison of efficacy of suprapatellar and infrapatellar approaches for intramedullary interlocking nailing of tibia in patients with tibial fracture. Cureus 2024;16:e74682. https://doi.org/10.7759/cureus.74682.
8. Gupta A, Ayaz A, Srivastava AK, Soni MK, Vatts A, Mall A et al. Comparative study of suprapatellar vs infrapatellar approach for proximal 1/3rd fracture of tibia managed by intramedullary interlocking nail. IJMPR 2025;6:130–4. https://doi.org/10.5281/ZENODO.17169767.
9. Agrawal A, Kelkar R, Mahajan P. Comparison of functional and radiological outcomes of intramedullary nailing of the tibia using suprapatellar and infrapatellar approaches. Cureus 2025;17:e92645. https://doi.org/10.7759/cureus.92645.
10. Mubarak HM, Jonnes SC, Pagadala N, Vijay N. A comparative study of functional and radiological outcome of Tibial Fractures treated with intramedullary and interlocking nailing through suprapatellar and infrapatellar approach n.d. https://doi.org/10.47009/jamp.2025.7.5.88.
11. Sakale HS, Sakarkar S, Agrawal AC, Gaurav P, Kar BK, Baghel A. Comparative analysis of suprapatellar and infrapatellar nailing in tibial fracture: A randomized clinical study. J Orthop Case Rep 2026;16:345–52. https://doi.org/10.13107/jocr.2026.v16.i03.6988.
12. Singh B, Bhanushali U, Gogia KK, Sharma R, Bhol A. A comparison of suprapatellar versus infrapatellar approach of intramedullary nailing in tibial shaft fracture. Int J Orthop Sci 2025;11:356–8. https://doi.org/10.22271/ortho.2025.v11.i4e.3869.
13. Kumar D, Kumar A, Sagar V, Kumar S, Pravina P. A comparative study of suprapatellar versus infrapatellar approach for intramedullary nailing in tibial shaft fractures. Eur J Cardiovasc Med 2025;15:863–8. https://doi.org/10.61336/ejcm/25-04-139.
14. Singh A, Gupta G, Singh N, Kala S, Sood S, Saini A, et al. A prospective study on the functional and radiological outcome of suprapatellar and infrapatellar intramedullary nailing for proximal tibia extra-articular fractures. Ind J Orthop Surg 2024;10:373–81. https://doi.org/10.18231/j.ijos.2024.061.

ISSN (O): 2687-5365; ISSN (P): 2753-6556