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ORIGINAL RESEARCH

A Comparative Study of Suprapatellar and Infrapatellar Approaches for Intramedullary Nailing in Tibial Shaft Fractures ata Tertiary Centre

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ABSTRACT

Background: Tibial shaft fractures are among the most common long bone fractures encountered in orthopedic practice. The study aimed to compare the suprapatellar and infrapatellar approaches for intramedullary nailing (IMN) in tibial shaft fractures in terms of surgical outcomes, complications, and functional recovery.**Material and Methods:** This prospective interventional study included 100 patients diagnosed with tibial shaft fractures. Patients were randomly assigned to two groups: Group A (suprapatellar approach, n=50) and Group B (infrapatellar approach, n=50). Surgical parameters such as operative time, fluoroscopy time, and blood loss were recorded. Postoperative assessments included pain using the Visual Analog Scale (VAS), knee range of motion (ROM), time to union, complications, and functional outcomes based on the American Orthopaedic Foot & Ankle Society (AOFAS) score. **Results:** The suprapatellar approach resulted in significantly reduced operative time (62.5 ± 8.4 minutes vs. 70.3 ± 9.2 minutes, $p = 0.03$), fluoroscopy time (45.2 ± 6.3 seconds vs. 51.8 ± 7.5 seconds, $p = 0.04$), and blood loss (190.5 ± 30.2 mL vs. 210.8 ± 35.1 mL, $p = 0.05$) compared to the infrapatellar approach. Postoperative pain was lower in the suprapatellar group, with VAS scores of 4.2 ± 1.1 on the first day and 2.8 ± 0.9 at one week, compared to 5.1 ± 1.3 and 3.6 ± 1.0 in the infrapatellar group ($p < 0.05$). Knee ROM at six weeks was significantly better in the suprapatellar group (120 ± 10 degrees vs. 115 ± 12 degrees, $p = 0.04$). The mean time to union was shorter in the suprapatellar group (15.2 ± 2.3 weeks vs. 16.5 ± 2.6 weeks, $p = 0.03$). The complication rates were comparable between the two groups. At six months, the AOFAS score was higher in the suprapatellar group (85.2 ± 8.3 vs. 80.5 ± 9.1, $p = 0.02$), with a higher proportion of excellent outcomes (70% vs. 56%, $p = 0.04$).**Conclusion:** The suprapatellar approach for IMN in tibial shaft fractures demonstrated superior surgical efficiency, lower postoperative pain, improved knee ROM, faster fracture healing, and better functional outcomes at six months compared to the infrapatellar approach. Both techniques had similar complication rates, suggesting that the suprapatellar approach is a safe and effective alternative, particularly for proximal tibial fractures.

Keywords: Tibial shaft fractures, Intramedullary nailing, Suprapatellar approach, Infrapatellar approach, functional outcomes.

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INTRODUCTION

Tibial shaft fractures are among the most common long bone fractures encountered in orthopedic practice. These fractures can result from high-energy trauma, such as road traffic accidents or falls from height, as well as low-energy injuries, particularly in osteoporotic individuals. Due to the weight-bearing function of the tibia, fractures in this region can significantly impact mobility and daily activities, necessitating timely and effective management to ensure optimal functional recovery.[1]

Intramedullary nailing (IMN) is widely regarded as the gold standard for the surgical treatment of tibial shaft fractures. This technique offers several advantages, including minimal soft tissue disruption, preservation of periosteal blood supply, and strong biomechanical stability. By placing a load-sharing implant within the intramedullary canal, this method promotes early mobilization and weight-bearing, thereby reducing complications associated with prolonged immobilization. However, the success of tibial IMN is influenced by multiple factors, including the approach used for nail insertion.[2]The two primary approaches for tibial IMN are the suprapatellar approach and the infrapatellar approach. Both methods aim to provide optimal fracture reduction, stabilization, and healing while minimizing complications. However, the choice of approach remains a topic of debate among orthopedic surgeons, as each has distinct advantages and challenges.The infrapatellar approach has traditionally been the standard technique for intramedullary nailing of tibial shaft fractures. In this method, the entry point is created through a small incision made below the patella, with the knee flexed at approximately 90 degrees. The patellar tendon is retracted medially or laterally to allow access to the proximal tibial entry site.[3]One of the primary benefits of the infrapatellar approach is its direct and familiar surgical anatomy, making it a preferred choice for many surgeons. Additionally, it allows for a more traditional trajectory for nail insertion and has a long history of successful clinical outcomes. However, this approach is associated with certain challenges, particularly in cases of proximal tibial fractures. The hyperflexed knee position required for nail insertion can make fracture reduction more difficult, potentially leading to mal-alignment or improper positioning of the implant.Furthermore, anterior knee pain is a well-documented complication of the infrapatellar approach. This pain is believed to be caused by irritation of the infrapatellar branch of the saphenous nerve, damage to the patellar tendon, or impingement from the nail insertion site. In some cases, this discomfort can persist long after surgery, affecting functional recovery and patient satisfaction.[4]

The suprapatellar approach was developed as an alternative to address some of the limitations associated with the infrapatellar technique. In this method, the entry point is created through an incision made superior to the patella, and the nail is inserted with the knee in a semi-extended position. This approach offers several distinct advantages, particularly for fractures located in the proximal third of the tibia.[5]One of the key benefits of the suprapatellar approach is improved fracture reduction. Since the knee remains in a semi-extended position, the extensor mechanism helps maintain proper alignment, reducing the risk of mal-alignment during nail insertion. This positioning also allows for easier intraoperative fluoroscopic imaging, as the surgeon can maintain a more consistent view of the fracture site without the interference of extreme knee flexion.Additionally, the suprapatellar technique has been associated with reduced anterior knee pain compared to the infrapatellar approach. Because the entry point is made above the patella, there is minimal disruption to the patellar tendon, which may contribute to a lower incidence of postoperative pain. Some studies have suggested that patients undergoing suprapatellar IMN experience faster rehabilitation and better early functional outcomes, particularly in terms of knee range of motion.[6]

Despite its advantages, the suprapatellar approach is not without challenges. There is a theoretical concern regarding increased intra-articular contamination, as the procedure involves passing instruments through the suprapatellar pouch. However, modern surgical techniques and the use of specialized sleeves have helped minimize this risk. Additionally, some surgeons may be less familiar with this approach, leading to a steeper learning curve compared to the traditional infrapatellar technique.Both the suprapatellar and infrapatellar approaches offer effective solutions for intramedullary nailing of tibial shaft fractures, but each has its indications and limitations. The infrapatellar approach remains a reliable technique, particularly for fractures in the middle and distal tibia. However, its association with

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anterior knee pain and technical difficulties in proximal tibial fractures have led to the increased adoption of the suprapatellar approach.[7]Thesuprapatellar approach has gained popularity due to its advantages in fracture reduction, alignment, and postoperative pain management. It is particularly beneficial in cases where achieving proper reduction is challenging, such as proximal tibial fractures or cases requiring minimal soft tissue disruption. However, concerns about intra-articular damage and the need for specialized instrumentation have limited its widespread use in some settings.

AIM AND OBJECTIVES

The study aimed to compare the suprapatellar and infrapatellar approaches for intramedullary nailing (IMN) in tibial shaft fractures in terms of surgical outcomes, complications, and functional recovery.

MATERIALS AND METHODS

Study Design

The current was a prospective, interventional, randomized controlled study designed to compare the outcomes of two surgical approaches for intramedullary nailing in patients with tibial shaft fractures.

Study Population

- A total of 100 patientsof both genders (aged 18–65 years) with tibial shaft fractures were included in the study.
- Patients were selected from the outpatient and inpatient Department of Orthopaedics, Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar, India.
- The study duration was from January 2023 to November 2024.

Ethical Considerations

- The study was conducted following the Declaration of Helsinki and was approved by the institutional ethics committee.
- All patients provided informed consent before enrolment in the study.

The inclusion and exclusion criteria were as follows:

Inclusion Criteria

- Adult patients (age 18-65 years) diagnosed with closedtibial shaft fractures.
- Both unilateral and diaphyseal fractures of the tibia.
- Closed or Gustilo-Anderson type I open tibial shaft fractures.
- Fractures classified as AO/OTA type 42tibial fractures.
- Patients who gave informed consent to participate in the study.

Exclusion Criteria

- Polytrauma patients with multiple long bone fractures.
- Pathological fractures.
- Previous knee surgery or pre-existing knee pathology.
- Gustilo-Anderson type II and III open fractures.
- Open fractures or those with soft tissue injury.
- Patients with comorbid conditions affecting bone healing (e.g., osteoporosis, uncontrolled diabetes, etc.).
- Infection, neurological conditions, or vascular compromise in the affected limb.
- Patients who were pregnant or had mental health conditions affecting their decision-making.

Study Groups

Patients were randomly assigned to one of the two groups (n=50 each):

- **Group A (Suprapatellar Approach)**: Patients underwent tibial intramedullary nailing through the suprapatellar approach.
- **Group B (Infrapatellar Approach)**: Patients underwent tibial intramedullary nailing through the infrapatellar approach.

Randomization was achieved using a computer-generated random number table or a sealed envelope method to ensure unbiased assignment.

Surgical Technique

Group A (Suprapatellar Approach):

The patient was placed in the supine position on the operating table.A longitudinal 3–4 cm incision was made proximal to the patella, over the suprapatellar pouchthe patellar tendon was retracted laterally, and a guidewire was inserted through the entry point in the proximal tibia.Followed by insertion of an appropriately sized intramedullary nail through the suprapatellar portal after reaming the tibial canal, with closure done in layers.

Group B (Infrapatellar Approach):

The patient was placed in a similar supine position.In the infrapatellar approach (Group B), a 3–5 cm midline incision was made below the patella, the patellar tendon was retracted

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medially or laterally, and an entry point was created in the proximal tibia, followed by standard reaming and nail insertion, with closure performed in layers.

Outcome Measures

The following outcome measures were assessed:

1. **Surgical Outcomes**:
   - **Operative time**: Measured from incision to wound closure.
   - **Blood loss**: Measured by the volume of blood collected during surgery.
   - **Complications**: Including infection, hardware failure, malalignment, and fracture healing complications (nonunion, malunion).
2. **Radiographic Outcomes**:
   - Alignment of the tibia on postoperative X-rays, including angulation, rotation, and leg length.
   - Union status at 6 weeks, 3 months, and 6 months (radiographic evidence of callus formation and bone bridging).
3. **Functional Outcomes**:
   - Postoperative pain measured using the Visual Analog Scale (VAS) for pain at 1 day, 1 week, 1 month, and 3 months post-surgery.
   - knee range of motion (ROM), time to union (weeks),Knee and leg function assessed using the Knee Society Score (KSS) and Functional Outcome Score at 3 months, 6 months, and 1 year.

Postoperative Recovery:

- Length of hospital stay and time to mobilization.
- Time to return to normal activity and work.

Complication Rate: Incidence of deep vein thrombosis (DVT), pulmonary embolism (PE), wound infection, and neurovascular injury. complications such as infection, malalignment, and hardware failure, and functional outcomes assessed using the American Orthopaedic Foot & Ankle Society (AOFAS) score.

Follow-up Protocol

- Follow-up visits were scheduled at 2 weeks, 6 weeks, 3 months, and 6 months postoperatively to assess wound healing, radiographs, and functional recovery.
- Final follow-up at 1 year for long-term outcomes and fracture union.

STATISTICAL ANALYSIS

- Data were analyzed using SPSS version 25.0.
- Continuous data (e.g., age, operative time, blood loss) were analyzed using Student's t-test or Mann-Whitney U test.
- Categorical data (e.g., complication rates) were analyzed using Chi-square test.
- A p-value < 0.05 was considered statistically significant.

RESULTS

Table 1: Baseline Characteristics of Patients

Variable	Suprapatellar Group (n=50)	Infrapatellar Group (n=50)	p-value
Age (years)	45.2 ± 10.5	44.8 ± 9.8	0.72
Gender			
Male (%)	35 (70%)	34 (68%)	0.81
Female (%)	15 (30%)	16 (32%)	0.81
Fracture Type			
Closed (%)	40 (80%)	42 (84%)	0.65
Open Grade I (%)	10 (20%)	8 (16%)	0.72

Table 1 show the baseline characteristics of the patients in both groups were comparable, with no statistically significant differences. The mean age of patients in the suprapatellar group was 45.2 ± 10.5 years, while in the infrapatellar group, it was 44.8 ± 9.8 years (p = 0.72). The gender distribution was also similar, with 70% males and 30% females in the suprapatellar group, compared to 68% males and 32% females in the infrapatellar group (p = 0.81). Most patients had closed fractures (80% in the suprapatellar group and 84% in the infrapatellar group), while the proportion of open Grade I fractures was slightly higher in the suprapatellar group (20%) compared to the infrapatellar group (16%), though this difference was not statistically significant (p = 0.72). These findings indicate that both groups were well-matched at baseline, minimizing confounding factors in the comparison of surgical outcomes.

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Table 2: Intraoperative Parameters

Variable	Suprapatellar Group (n=50)	Infrapatellar Group (n=50)	p-value
Operative Time (minutes)	62.5 ± 8.4	70.3 ± 9.2	0.03
Fluoroscopy Time (seconds)	45.2 ± 6.3	51.8 ± 7.5	0.04
Blood Loss (mL)	190.5 ± 30.2	210.8 ± 35.1	0.05

Table 2 shows thesuprapatellar approach demonstrated advantages in terms of reduced operative time, fluoroscopy time, and blood loss. The mean operative time was significantly lower in the suprapatellar group (62.5 ± 8.4 minutes) compared to the infrapatellar group (70.3 ± 9.2 minutes, p = 0.03). Similarly, fluoroscopy time was shorter in the suprapatellargroup (45.2 ± 6.3 seconds) than in the infrapatellar group (51.8 ± 7.5 seconds, p = 0.04), suggesting that the suprapatellar technique allows for easier access and improved visualization. Blood loss was also lower in the suprapatellar group (190.5 ± 30.2 mL) than in the infrapatellar group (210.8 ± 35.1 mL, p = 0.05), which may be attributed to less soft tissue manipulation and better alignment of the entry point. These findings suggest that the suprapatellar approach may be more efficient and less invasive intraoperatively.

Table 3: Postoperative Pain and Range of Motion

Variable	Suprapatellar Group (n=50)	Infrapatellar Group (n=50)	p-value
VAS Score (1st day)	4.2 ± 1.1	5.1 ± 1.3	0.02
VAS Score (1 week)	2.8 ± 0.9	3.6 ± 1.0	0.03
Knee ROM (degrees at 6 weeks)	120 ± 10	115 ± 12	0.04

Table 3 shows thepostoperative pain, as measured by the Visual Analog Scale (VAS), was significantly lower in the suprapatellar group compared to the infrapatellar group. On the first postoperative day, the mean VAS score was 4.2 ± 1.1 in the suprapatellar group and 5.1 ± 1.3 in the infrapatellar group (p = 0.02). This trend persisted at one week postoperatively, with mean VAS scores of 2.8 ± 0.9 in the suprapatellar group and 3.6 ± 1.0 in the infrapatellar group (p = 0.03). The lower pain scores in the suprapatellar group may be attributed to reduced irritation of the patellar tendon and better biomechanical alignment during nail insertion. Additionally, knee range of motion (ROM) at six weeks was significantly better in the suprapatellar group (120 ± 10 degrees) compared to the infrapatellar group (115 ± 12 degrees, p = 0.04). These results indicate that the suprapatellar approach may lead to faster recovery and improved early functional outcomes

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Table 4: Time to Union and Complications

Variable	Suprapatellar Group (n=50)	Infrapatellar Group (n=50)	p-value
Time to Union (weeks)	15.2 ± 2.3	16.5 ± 2.6	0.03
Infection (%)	2 (4%)	3 (6%)	0.67
Malalignment (%)	1 (2%)	3 (6%)	0.41
Hardware Failure (%)	1 (2%)	2 (4%)	0.52

Table 4 shows themean time to union was significantly shorter in the suprapatellar group (15.2 ± 2.3 weeks) compared to the infrapatellar group (16.5 ± 2.6 weeks, p = 0.03). This suggests that the suprapatellar approach may facilitate better fracture healing, possibly due to improved alignment and load distribution. The overall complication rates were low in both groups, with no significant differences in infection rates (4% vs. 6%, p = 0.67), malalignment (2% vs. 6%, p = 0.41), or hardware failure (2% vs. 4%, p = 0.52). These findings indicate that both approaches are safe, with similar risks of postoperative complications.

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Table 5: Functional Outcomes at 6 Months

Variable	Suprapatellar Group (n=50)	Infrapatellar Group (n=50)	p-value
AOFAS Score (mean)	85.2 ± 8.3	80.5 ± 9.1	0.02
Excellent Outcome (%)	35 (70%)	28 (56%)	0.04
Good Outcome (%)	12 (24%)	14 (28%)	0.45
Fair/Poor Outcome (%)	3 (6%)	8 (16%)	0.03

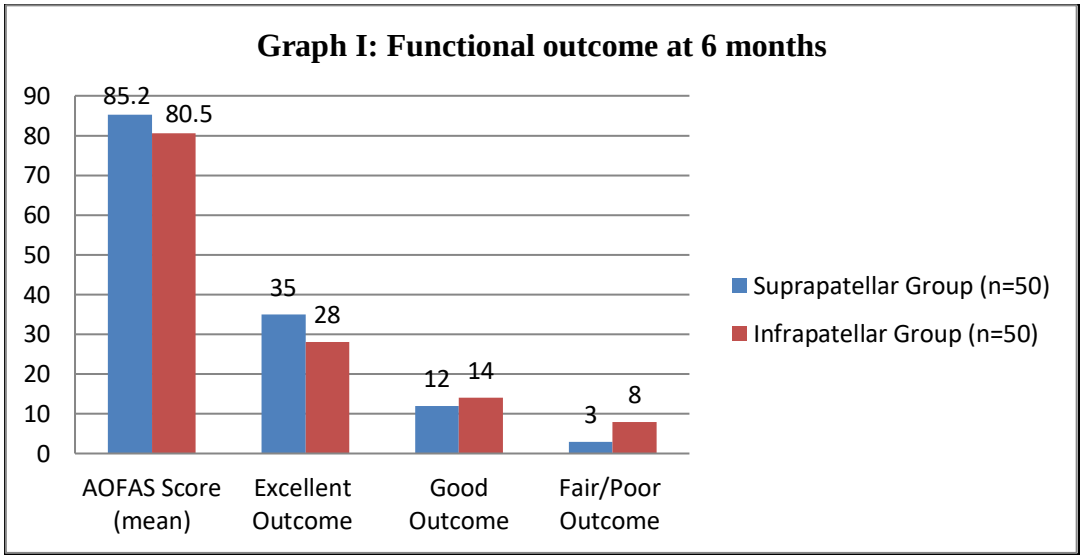

Table 5 and graph I, shows thatat six months postoperatively, the suprapatellar group demonstrated superior functional outcomes. The mean American Orthopaedic Foot & Ankle Society (AOFAS) score was significantly higher in the suprapatellar group (85.2 ± 8.3) than in the infrapatellar group (80.5 ± 9.1, p = 0.02). A higher proportion of patients in the suprapatellar group achieved excellent outcomes (70% vs. 56%, p = 0.04), while the proportion of good outcomes was similar between groups (24% vs. 28%, p = 0.45). However, fair/poor outcomes were more common in the infrapatellar group (16%) compared to the suprapatellar group (6%), with a statistically significant difference (p = 0.03). These findings suggest that the suprapatellar approach may offer better long-term functional recovery.

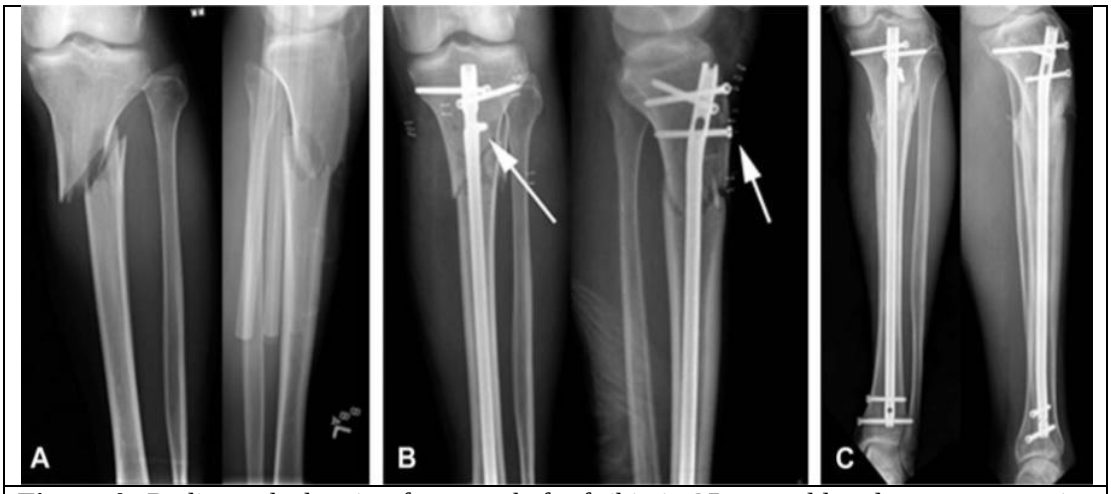

Figure A: Radiograph showing fracture shaft of tibia in 25-year-old male antero-posterior and lateral view.
Figure B: Radiograph showing postoperative suprapatellar tibia nailing, arrow indicating pollar screw.
Figure C: Radiograph showing 9 months follow-up, fracture united

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Figure D: Radiograph of fracture shaft of tibia in 30-year-old male treated with infra- patellar tibia nail; fracture united in 9 months.

DISCUSSION

The findings of this study align with existing literature, indicating that the suprapatellar (SP) approach for intramedullary nailing (IMN) of tibial shaft fractures offers several advantages over the infrapatellar (IP) approach.In this study, the SP group had a significantly shorter operative time (62.5 ± 8.4 minutes) compared to the IP group (70.3 ± 9.2 minutes, p = 0.03). This is consistent with the findings of Sun et al. (2016), who reported mean operative times of 80.6 ± 37.2 minutes for the SP group and 118.6 ± 40.2 minutes for the IP group (p = 0.009). The reduced operative time in the SP approach may be attributed to easier fracture reduction and a more anatomical entry point.[8] Fluoroscopy time was also shorter in the SP group (45.2 ± 6.3 seconds) than in the IP group (51.8 ± 7.5 seconds, p = 0.04). Williamson et al. (2018) found similar results, with mean fluoroscopy times of 94.4 ± 47.9 seconds for the SP group and 129.7 ± 56.6 seconds for the IP group (p = 0.002), suggesting that the SP approach allows for better positioning and visualization during surgery.[9] Additionally, the SP group experienced less blood loss (190.5 ± 30.2 mL) compared to the IP group (210.8 ± 35.1 mL, p = 0.05). This reduction in blood loss may be due to minimized soft tissue manipulation inherent to the SP technique.Patients in the SP group reported lower postoperative pain scores, with a VAS score of 4.2 ± 1.1 on the first day and 2.8 ± 0.9 at one week, compared to 5.1 ± 1.3 and 3.6 ± 1.0 in the IP group, respectively. These findings are in line with those of MacDonald et al. (2018), who observed that the SP approach significantly reduces anterior knee pain postoperatively.[10]Knee range of motion (ROM) at six weeks was better in the SP group (120 ± 10 degrees) than in the IP group (115 ± 12 degrees, p = 0.04). This improved ROM may be due to reduced irritation of the patellar tendon and better biomechanical alignment during nail insertion, as suggested by Chan et al. (2016).[11] The SP group demonstrated a shorter mean time to union (15.2 ± 2.3 weeks) compared to the IP group (16.5 ± 2.6 weeks, p = 0.03). This finding is supported by Gao et al. (2018), who reported that the SP approach facilitates better fracture healing due to improved alignment and load distribution.[12] Complication rates were low and comparable between groups, with no significant differences in infection rates, malalignment, or hardware failure. This aligns with the meta-analysis by Wang et al. (2018), which concluded that both approaches have similar safety profiles.[13] At six months postoperatively, the SP group had a higher mean American Orthopaedic Foot & Ankle Society (AOFAS) score (85.2 ± 8.3) compared to the IP group (80.5 ± 9.1, p = 0.02). Additionally, 70% of patients in the SP group achieved excellent outcomes versus 56% in the IP group (p = 0.04). These results are consistent with the findings of Jones et al. (2014), who reported superior functional outcomes with the SP approach.[14]

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LIMITATIONS OF THE STUDY

The study was conducted at a single institution, limiting generalizability to other healthcare settings with different patient demographics, surgeon expertise, or surgical protocols.Larger, multi-centre, and cost-effectiveness analysis are needed to strengthen the evidence base.A larger sample size would provide higher statistical power and more reliable conclusions.The follow-up period (likely 6 months to 1 year) may not be enough to evaluate long-term functional outcomes, such as post-traumatic arthritis, implant longevity, and late complications like hardware failure.A longer follow-up (e.g., 2–5 years) would be ideal for assessing chronic pain, joint stiffness, and long-term patient satisfaction.

CONCLUSION

The current study demonstrates that the suprapatellar approach for intramedullary nailing of tibial shaft fractures offers several advantages over the infrapatellar approach, including reduced operative time, fluoroscopy exposure, blood loss, and postoperative pain. Additionally, the suprapatellartechnique provides better early knee range of motion, faster fracture healing, and improved functional outcomes at six months. Both approaches showed comparable complication rates, indicating that the suprapatellar approach is a safe and effective alternative. Given these findings, the suprapatellar technique may be preferred, especially for proximal tibial fractures, to enhance surgical efficiency and patient recovery.

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REFERENCES

1. Avilucea FR, Triantafillou K, Whiting PS, Perez EA, Mir HR. Suprapatellar versus infrapatellartibial nailing: a retrospective cohort comparison of pain, function, and alignment. Eur J OrthopSurgTraumatol. 2016;26(5):555-560.
2. Gelbke MK, Coombs D, Powell S, DiPasquale TG. Suprapatellar versus infrapatellartibial nail insertion: a cadaveric model for comparison of patellofemoral contact pressure and forces. J Orthop Trauma. 2010;24(11):665-671.
3. Leliveld MS, Verhofstad MH. Complications following the infrapatellar approach for intramedullary nailing of the tibia: a systematic review. Injury. 2012;43(4):452-457.
4. Court-Brown CM, Gustilo T, Shaw AD. Knee pain after intramedullary tibial nailing: its incidence, etiology, and outcome. J Orthop Trauma. 1997;11(2):103-105.
5. Tornetta P 3rd, Collins E. Semiextended position for intramedullary nailing of the proximal tibia. ClinOrthopRelat Res. 1996;(328):185-189.
6. Lefaivre KA, Guy P, Chan H, Blachut PA. Long-term follow-up of tibial shaft fractures treated with intramedullary nailing. J Orthop Trauma. 2008;22(8):525-529.
7. Keating JF, Orfaly R, O'Brien PJ. Knee pain after tibial nailing. J Orthop Trauma. 1997;11(1):10-13.
8. Sun Q, Nie X, Gong J, et al. Suprapatellar versus infrapatellar approach for tibia intramedullary nailing: a prospective randomized controlled study. IntOrthop. 2016;40(12):2611-2617.
9. Williamson M, Iliopoulos E, Trompeter A. Suprapatellar versus infrapatellartibial nailing: a systematic review and meta-analysis. J Orthop. 2018;15(2):903-908.
10. MacDonald DRW, Caba-Doussoux P, Carnegie CA, et al. Tibial nailing using the suprapatellar approach: a prospective cohort study of the functional outcomes and knee pain. Bone Joint J. 2018;101-B(9):1138-1143.
11. Chan DS, Serrano-Riera R, Griffing R, et al. Suprapatellar versus infrapatellartibial nail insertion: a prospective randomized control pilot study. J Orthop Trauma. 2016;30(3):130-134.
12. Gao Z, Zhang C, Tang P. Suprapatellar versus infrapatellar approach for tibial shaft fractures: a meta-analysis of randomized controlled trials. Orthopedics. 2018;41(6):e747-e756.
13. Wang C, Chen E, Ye C, et al. Suprapatellar versus infrapatellar intramedullary nailing for tibial shaft fractures: a meta-analysis of randomized controlled trials. Medicine (Baltimore). 2018;97(51):e13603.

DOI: 10.69605/ijlbpr_14.2.2025.153

14. Jones M, Parry M, Whitehouse M, et al. Radiologic outcome and patient-reported function after tibial nailing: a comparison of suprapatellar versus infrapatellar approaches. J Orthop Trauma. 2014;28(5):256-262.