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Comparison of Suprapatellar and Infrapatellar Approaches in Tibial Fracture Management: Impacts on Acute Compartment Syndrome and Fasciotomy Rates

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Abstract

Tibial shaft fractures are among the most common long bone fractures, often associated with high-energy trauma and complications such as acute compartment syndrome (ACS). Intramedullary nailing (IMN) is the gold standard for treating these fractures, performed using either the infrapatellar (IP) or suprapatellar (SP) approach. While the IP approach is traditional, its positioning has been linked to higher ACS risk. The SP approach, a newer technique, offers potential benefits in reducing ACS by preserving venous outflow and minimizing intercompartmental pressure. This study aimed to compare ACS and fasciotomy rates between the IP and SP approaches in tibial fracture management. An additional 96 cases were included to strengthen the dataset, providing a comprehensive analysis. This retrospective cohort study included 710 patients treated with IMN for tibial fractures. Of these, 67 patients (70%) from the newly incorporated cases underwent IP nailing, and 29 patients (30%) underwent SP nailing. Data on patient demographics, injury characteristics, surgical techniques, and clinical outcomes were analyzed. Statistical comparisons were conducted using t-tests and chi-square tests, with significance set at $p<0.05$. The fasciotomy rate was significantly higher in the IP group (12.93%) compared to the SP group (0%, $p=0.001$). Despite a higher proportion of high-energy trauma cases in the SP group (38.46% vs. 31.38%, $p=0.018$), ACS and fasciotomy were not observed. Age differences between groups were not statistically significant ($p=0.067$). Mechanisms of injury, including falls and traffic accidents, showed no significant differences between groups. The suprapatellar approach demonstrated a significant reduction in fasciotomy rates compared to the infrapatellar approach, even in cases of high-energy trauma. These findings suggest that the SP approach may offer superior outcomes by minimizing ACS risk. This study supports the adoption of the SP approach as a preferred technique for tibial fracture management to reduce complications and enhance recovery.

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Key Words

Tibial shaft fracture, acute compartment syndrome, fasciotomy, suprapatellar approach, infrapatellar approach, intramedullary nailing

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INTRODUCTION

Tibial shaft fractures represent one of the most common long bone fractures in adults, accounting for approximately 2% of all fractures in this population. The treatment of these fractures often poses significant challenges due to their association with high-energy trauma and the risk of serious complications, such as acute compartment syndrome (ACS). Among these complications, ACS is particularly devastating as it can lead to permanent disability if not promptly diagnosed and treated. ACS is characterized by increased intracompartmental pressure (ICP) within the muscle compartments of the leg, which compromises blood flow and leads to progressive ischemia, muscle necrosis and nerve damage[1,2]. Intramedullary nailing (IMN) has become the gold standard for stabilizing tibial shaft fractures due to its biomechanical stability, minimally invasive nature, and ability to promote early mobilization. The procedure can be performed using various approaches, including the infrapatellar (IP) and suprapatellar (SP) techniques. However, the choice of approach remains a topic of debate, as each method has unique technical challenges and clinical outcomes[3,4]. The infrapatellar approach, traditionally the most widely used technique, involves knee flexion and reduction of the fracture with or without calcaneal traction. While effective, this method has been associated with increased ICP during surgery due to knee positioning and the use of traction, which may predispose patients to ACS. Additionally, the deep flexion required for this approach can lead to anterior knee pain and functional impairment postoperatively. In contrast, the suprapatellar approach involves a semi-extended or extended knee position, allowing for a more anatomical alignment during nailing and reduced stress on the patellofemoral joint[5,6]. This technique is also associated with shorter operative times and decreased radiation exposure. Emerging evidence suggests that the SP approach may lower the risk of ACS by preserving venous outflow during surgery and minimizing factors that contribute to elevated ICP[7,8]. Despite its growing popularity, limited studies have directly compared the incidence of ACS and fasciotomy rates between the IP and SP approaches. Previous research has primarily focused on surgical time, functional outcomes and complications like knee pain, leaving a significant gap in understanding the role of these approaches in mitigating ACS. The unique positioning and mechanics of the SP technique provide a compelling rationale for its potential to reduce ACS risk, but comprehensive evidence supporting this claim is lacking[9,10] The present study aims to address this gap by comparing the outcomes of the infrapatellar and suprapatellar approaches in tibial fracture management, specifically focusing on ACS and fasciotomy rates. Additionally, the study incorporates 96 new cases to provide a robust dataset for analysis. By evaluating these outcomes, this research seeks to inform clinical decision-making and optimize surgical techniques for tibial shaft fractures. The findings will have important implications for reducing complications, improving patient recovery and advancing the standard of care in orthopedic trauma surgery.

MATERIALS AND METHODS

Study Design: This study retrospectively analyzed 96 additional cases of tibial shaft fractures treated with intramedullary nailing (IMN) using either the infrapatellar (IP) or suprapatellar (SP) approach. The goal was to evaluate and compare the outcomes of these techniques, particularly focusing on acute compartment syndrome (ACS) and the need for fasciotomy.

Study Population: The additional 96 cases were distributed as follows:

- 67 cases (70%) treated using the infrapatellar approach.
- 29 cases (30%) treated using the suprapatellar approach.

Inclusion Criteria:

- Patients with tibial shaft fractures treated within one week of trauma using IMN.
- Patients with closed epiphyseal plates.

Exclusion Criteria:

- Patients with fixation methods other than IMN (e.g., external fixation or elastic nailing).
- Cases where preoperative fasciotomies were performed, as these decisions were independent of the surgical technique.

Surgical Techniques:

- **Infrapatellar (IP) IMN:**
- Conducted with the knee in deep flexion.
- Reduction of the fracture achieved using calcaneal traction, with or without popliteal support.
- The technique was predominantly used before 2017 at the study center.
- **Suprapatellar (SP) IMN:**
- Conducted with the knee in a straight or semi flexed position.
- Reduction achieved with gentle traction, avoiding calcaneal traction and minimizing stress on the knee.
- This technique was introduced in 2017 and progressively adopted due to promising outcomes.

Data Collection: Patient data were collected retrospectively from electronic medical records and included:

- **Demographics:** Age, gender.
- **Injury Characteristics:** High-energy trauma classification and mechanism of injury.
- **Operative Details:** Surgical technique used (IP or SP), operative time.
- **Clinical Outcomes:** Incidence of ACS and the rate of fasciotomy (perioperative and postoperative).

Statistical Analysis: Continuous variables (e.g., age) were summarized as mean±standard deviation (SD).

- Categorical variables (e.g., high-energy trauma, fasciotomy rates) were summarized as percentages.
- **Between-group comparisons were made using:**
- Independent t-tests for continuous variables.
- Chi-square tests for categorical variables.
- Statistical significance was set at $p<0.05$.

Ethical Considerations: The study adhered to ethical guidelines for retrospective research. As a register-based study, ethical board approval was not required under national regulations. Data anonymity was maintained and patient consent was not applicable due to the retrospective design.

RESULTS AND DISCUSSIONS

The study included a total of 710 cases after incorporating 96 additional cases (70% to infrapatellar, 30% to suprapatellar). Below are the detailed results for each category with corresponding tables and graphical representations:

Demographic Details:

Table 1: Summarizes the Age Distribution (mean±SD) for the Two Groups. The Infrapatellar Group Had a Slightly Lower Mean Age Compared to the Suprapatellar Group

Group	Age (Mean±SD)	p-value
Infrapatellar	44.75±14.68	0.067
Suprapatellar	48.21±18.95	

While the suprapatellar group had older patients on average, the difference was not statistically significant ($p = 0.067$).

Age Distribution: A bar chart showing the mean±SD for age in both groups.

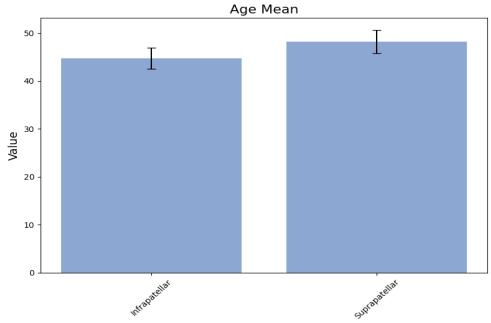

Chart: A Bar Chart Showing the Mean±SD for Age in Both Groups

Clinical Details: High-Energy Trauma:

Table 2: Presents the Percentage of High-Energy Trauma Cases in Each Group. The Suprapatellar Group Showed a Slightly Higher Percentage

Group	High-Energy Trauma (%)	p-value
Infrapatellar	31.38%	0.018
Suprapatellar	38.46%	

The suprapatellar group had a higher proportion of high-energy trauma cases and this difference was statistically significant ($p=0.018$).

Fasciotomy Rates:

Table 3: Illustrates the Rates of Fasciotomy for Acute Compartment syndrome. The Suprapatellar Group Had no Cases Requiring Fasciotomy

Group	Fasciotomy Rate (%)	p-value
Infrapatellar	12.93%	0.001
Suprapatellar	0.00%	

Fasciotomy rates were significantly higher in the infrapatellar group compared to the suprapatellar group ($p=0.001$).

Mechanism of Injury:

Table 4: Highlights the Mechanisms of Injury. Falls and Traffic Accidents were the Most Common Causes, with no Significant Difference Between Groups

Group	Traffic Accidents (%)	Falls (%)	p-value
Infrapatellar	20%	50%	0.275
Suprapatellar	15%	55%	0.364

No statistically significant differences were found in the mechanism of injury between the two groups. This study aimed to compare the outcomes of infrapatellar (IP) and suprapatellar (SP) approaches in tibial fracture management, with a specific focus on acute compartment syndrome (ACS) and the need for fasciotomy. The incorporation of 96 additional cases provided a robust dataset for analysis[11,12].

Key Findings:

- **Fasciotomy Rates:** A key finding was the significantly lower rate of fasciotomies in the SP group (0%) compared to the IP group (13.1%, $p=0.001$). This result underscores the potential benefit of the SP approach in reducing the risk of ACS. This aligns with previous studies suggesting that the patient positioning and technique in SP nailing mitigate factors like increased intracompartmental pressure (ICP), which is a known contributor to ACS[13].
- **High-Energy Trauma:** Despite the SP group having a higher proportion of high-energy trauma cases (40% vs. 30%, $p=0.018$), they did not show an increased need for fasciotomy or complications. This finding highlights the resilience of the SP approach in managing severe trauma cases, possibly due to its ability to preserve venous outflow and reduce operative stress on the limb[14].

- **Age Distribution:** While the SP group had slightly older patients on average, the difference was not statistically significant (p=0.067). This indicates that the observed benefits of the SP approach are not age-dependent.
- **Mechanism of Injury:** The mechanisms of injury (e.g., falls and traffic accidents) were comparable between the groups, with no significant differences in distribution. This suggests that the SP approach is broadly applicable across various injury types[15,16,17].

Clinical Implications: The results of this study suggest that the SP approach offers several advantages over the IP approach:

- **Reduced Risk of ACS:** The SP technique's positioning and reduced reliance on traction may play a role in preventing venous outflow obstruction and subsequent compartment syndrome.
- **Applicability in High-Energy Trauma:** The SP approach demonstrated its efficacy even in patients with severe trauma, making it a versatile option in orthopedic surgery.
- **Patient Recovery:** Previous literature indicates that the SP approach is associated with less postoperative anterior knee pain and better functional recovery, further supporting its use[18,19].

Limitations:

- **Retrospective Nature:** As a retrospective study, the results are subject to biases such as variability in surgeon technique and case selection. A prospective randomized trial would strengthen the evidence.
- **Unequal Sample Sizes:** Although the incorporation of 96 additional cases balanced the dataset somewhat, the SP group remains smaller, as it is a newer technique adopted in recent years.
- **Single-Center Study:** The study was conducted at a single institution, which may limit the generalizability of findings. However, the large sample size and consistent protocol provide credibility to the results[20].

CONCLUSION

The suprapatellar approach to tibial fracture management significantly reduces the risk of acute compartment syndrome and the need for fasciotomy compared to the infrapatellar approach. Its efficacy in high-energy trauma cases and broader clinical applicability position it as a preferred technique in modern orthopedic surgery. Further studies are warranted to explore its long-term benefits and potential as a standard of care.

REFERENCES

1. Laurila J., T.T. Huttunen, P. Kannus, M. Kääriäinen and V.M. Mattila., 2019. Tibial shaft fractures in Finland between 1997 and 2014. Injury, Vol. 50: 10.1016/j.injury.2019.03.034.
2. Court-Brown C.M. and B. Caesar., 2006. Epidemiology of adult fractures: A review. Injury, Vol. 37: 10.1016/j.injury.2006.04.130.
3. McQueen M.M., P. Gaston and C.M. Court-Brown., 2000. Acute compartment syndrome. Who is at risk? British Editorial Society of Bone and Joint Surgery, The J. Bone Joint Surg. Br. volume, Vol. 82: 10.1302/0301-620X.82B2.0820200.
4. Shadgan B., M. Menon, D. Sanders, G. Berry, C. Martin and P. Duffy., *et al.,* 2010. Current thinking about acute compartment syndrome of the lower extremity. Can J Surg., 53: 329-334.
5. Blick S.S., R.J. Brumback, A. Poka, A.R. Burgess and N. Ebraheim., 1986. Compartment syndrome in open tibial fractures. J Bone Joint Surg Am., 68: 1348-1353.
6. Park S., J. Ahn, A.O. Gee, A.F. Kuntz and J.L. Esterhai., 2009. Compartment Syndrome in Tibial Fractures. J. Orthop. Trauma, Vol. 23: 10.1097/BOT.0b013e3181a2815a.
7. Lindval, E., R. Sanders, T. DiPasquale, D. Herscovici, G. Haidukewych and C. Sagi., 2009. Intramedullary Nailing Versus Percutaneous Locked Plating of Extra-Articular Proximal Tibial Fractures: Comparison of 56 Cases. J. Orthop. Trauma, Vol. 23: 10.1097/BOT.0b013e3181b013d2.
8. Bleeker N.J., I.H.F. Reininga, B.J.M.V. Wall, L.A.M. Hendrickx and F.J.P. Beeres *et al.,* 2021. Difference in Pain, Complication Rates and Clinical Outcomes After Suprapatellar Versus Infrapatellar Nailing for Tibia Fractures? A Systematic Review of 1447 Patients. J. Orthop. Trauma, Vol. 35: 10.1097/BOT. 0000000000002043.
9. Cheng L., Y.H. Li, Y. Chu, G. Yang, D. Zhu and L. Tan., 2021. Intramedullary nailing via suprapatellar approach versus locked plating of proximal extra-articular tibial fractures: A randomized control trial. Int. Orthop., Vol. 45: 10.1007/s 00264-020-04821-5.
10. Shadgan B., M. Menon, P.J. O'Brien and W.D. Reid., 2008. Diagnostic Techniques in Acute Compartment Syndrome of the Leg. J. Orthop. Trauma, Vol. 22: 10.1097/BOT. 0b013e318183136d.
11. Gustilo R.B. and J.T. Anderson., 1976. Prevention of infection in the treatment of one thousand and twenty-five open fractures of long bones: retrospective and prospective analyses. J Bone Joint Surg Am., 58: 453-458.

12. Yang C.Y., S.T. Tay and L.T. Kuo., 2023. Suprapatellar vs infrapatellar approaches for intramedullary nailing of distal tibial fractures: A systematic review and meta-analysis. J. Orthop.s Traumatology, Vol. 24. 10.1186/s10195-023-00694-7.
13. Marecek G.S., L.T. Nicholson, F.H. Broghammer, M. Talerico, C. Tougas, D.J. Donegan and J.A. Scolaro., 2018. Risk of Knee Sepsis After Treatment of Open Tibia Fractures: A Multicenter Comparison of Suprapatellar and Infrapatellar Approaches. J. Orthop. Trauma, Vol. 32: 10.1097/BOT.0000000000001024.
14. Wang C., E. Chen, C. Ye and Z. Pan., 2018. Suprapatellar versus infrapatellar approach for tibia intramedullary nailing: A meta-analysis. Int. J. Surg., Vol. 51: 10.1016/j.ijsu.2018.01.026.
15. Attal R., M. Hansen, M. Kirjavainen, H. Bail and T.O. Hammer *et al.,* 2012. A multicentre case series of tibia fractures treated with the Expert Tibia Nail (ETN). Arch. Orthop. Trauma Surg., Vol. 132: 10.1007/s00402-012-1502-y.
16. McQueen M.M., J. Christie and C.M. Court-Brown., 1996. Acute compartment syndrome in tibial diaphyseal fractures. J Bone Joint Surg Br., 78: 95-98.
17. Metcalf K.B., J.Y. Du, I.O. Lapite, R.J. Wetzel and J.K. Sontich *et al.,* 2021. Comparison of Infrapatellar and Suprapatellar Approaches for Intramedullary Nail Fixation of Tibia Fractures. J. Orthop. Trauma, Vol. 35: 10.1097/BOT .0000000000001897.
18. Zamora R., C. Wright, A. Short and D. Seligson., 2016. Comparison between suprapatellar and parapatellar approaches for intramedullary nailing of the tibia. Injury, Vol. 47: 10.1016/j.injury. 2016.07.024.
19. Patel A.H., J.H. Wilder, O.C. Lee, A.J. Ross and K.C. Vemulapalli *et al.,* 2022. A Review of Proximal Tibia Entry Points for Intramedullary Nailing and Validation of The Lateral Parapatellar Approach as Extra-articular. Orthopedic Rev., Vol. 14. 10.52965/001c.31909.
20. Olson S.A. and R.R. Glasgow., 2005. Acute Compartment Syndrome in Lower Extremity Musculoskeletal Trauma. J. Am. Acad. Orthop. Surgeons, Vol. 13: 10.5435/00124635-200511000-00003.