

Efficacy Of Suprapatellar Intramedullary Nailing For Multi-Fragmentary Proximal Tibia Fractures: A Retrospective Cohort Analysis

Dr Prithivi selvan^{1***}, Dr.Murali Krishnan², Prof Dr Thiagarajan Pandian³

¹Dr Prithivi selvan, Post Graduate resident, Department of Orthopaedics, Sree Balaji Medical College and Hospital, No 7 CLC Works road, Chrompet - 600044, Chennai, Tamil Nadu, India. E- mail id - prithiviselvan@gmail.com

²Dr.Murali Krishnan, Senior resident, Department of Orthopaedics, Sree Balaji Medical College and Hospital, No 7 CLC Works road, Chrompet - 600044, Chennai, Tamil Nadu, India. Email muralikrishnan666@gmail.com

³Prof Dr Thiagarajan Pandian, Unit chief, Department of Orthopaedics, Sree Balaji Medical College and Hospital, No 7 CLC Works road, Chrompet - 600044, Chennai, Tamil Nadu, India. Email pthiagu@yahoo.com

***Correspondence Author: Dr Prithivi selvan E- mail id - prithiviselvan@gmail.com

Abstract

Managing multi fragmentary proximal tibia fractures is challenging due to their complexity and the high risk of complications. Various surgical techniques, such as plating, external fixation, and intramedullary nailing, have been used to address these fractures. Among these, suprapatellar nailing has gained attention as an effective approach, particularly in cases where plate osteosynthesis poses a high risk of infection. This study evaluates the clinical and radiological outcomes of suprapatellar intramedullary nailing in patients with multi fragmentary proximal tibia fractures. A retrospective analysis was conducted on 5 patients who underwent this procedure. Key outcome measures included fracture union rates, healing time, complication, range of motion, and functional recovery. Results showed 100% union rate within 12 to 24 weeks postoperatively, with an average healing time of 16 weeks. Complications were minimal, with no cases of wound infections and no delayed union or non-union. Patients experienced notable improvements in their range of motion between 3 and 6 weeks after surgery. Functional recovery, assessed with Karlström-Olerud Score, averaged 85.6, reflecting favorable outcomes. Overall, suprapatellar nailing appears to be a reliable treatment option for multi fragmentary proximal tibia fractures, providing high fracture union rates, manageable complications, and promising functional recovery.

Key Word: Tibia, fractures, healing time, suprapatellar intramedullary nailing, fracture union rates

INTRODUCTION

Proximal tibia fractures are complex injuries that typically result from high-impact trauma, such as road accidents or falls from a height(1). They make up around 5–10% out of tibia fractures, with an average estimate of 10 to 15 cases per 100,000 people each year(2). When these fractures are open, they become even more challenging due to exposed bone and soft tissue damage, with an incidence of about 2–5 cases per 100,000 annually(3). Intramedullary nailing is the standard treatment for tibial fractures, providing stable fixation and allowing early mobilization(5). Traditionally, infrapatellar nailing has been widely used, but it poses challenges such as malalignment, soft tissue irritation, and difficulty in proximal tibia fracture reduction(6). The suprapatellar approach has emerged as an alternative technique, addressing many of these limitations by allowing nail insertion through the suprapatellar pouch while keeping the knee in a semi-extended position. In suprapatellar nailing, the knee is positioned at 15–20° flexion(7), which counteracts the deforming forces of the quadriceps(8), aiding in proper fracture alignment. This technique reduces patellar tendon strain and provides better control over proximal tibial fractures, especially those near the metaphyseal region. Additionally, fluoroscopic imaging is easier with this approach, leading to improved precision during nail insertion. Several studies have demonstrated that suprapatellar nailing offers comparable or superior functional outcomes to infrapatellar nailing while minimizing complications such as

anterior knee pain, soft tissue irritation, and malalignment. However, concerns about potential intra-articular cartilage damage necessitate proper technique and the use of protective sleeves to safeguard the patellofemoral joint(13). Overall, suprapatellar nailing has gained popularity as a reliable and effective technique, particularly for proximal tibial fractures(14). This approach facilitates better fracture reduction, reduced soft tissue trauma, and improved patient recovery compared to conventional infrapatellar nailing.

MATERIALS AND METHODS

Our study analyzed 5 patients admitted with Multi fragmentary proximal tibia fractures who underwent suprapatellar nailing at our institution between January 2019 and December 2023. Data for the study was gathered through a thorough review of medical records, radiographic assessments (anterior posterior view and lateral X-rays), and clinical follow-ups. Patients included in the study met specific criteria: they were diagnosed with multi fragmentary proximal tibia fractures classified as Gustilo-Anderson Grade II or III, had suprapatellar nailing as their primary treatment, and were over 18 years old. Individuals with pathological fractures, previous fractures in the proximal tibia, or cases of non-union or malunion were excluded from the study. All patients were followed up for a minimum of 12 months to assess their progress and treatment outcomes.

Surgical Technique

Suprapatellar nailing is an advanced intramedullary fixation technique for tibial fractures, particularly beneficial for multi fragmentary proximal tibial fractures. Unlike the infrapatellar approach, suprapatellar nailing is performed with the knee in a semi-extended position (15–20° flexion), reducing deforming forces from the quadriceps and facilitating better fracture alignment. Position supine. The injured leg is positioned in 15–20° of knee flexion to stabilize the fracture. A 4–5 cm longitudinal incision is made from superior tip of patella. A protective sleeve is used to avoid cartilage damage. The entry point is identified under fluoroscopy approximately 2–3 cm above the patellar tendon. The medullary canal is accessed using a bone awl, and a guide wire is inserted under fluoroscopic control. Sequential reaming is performed to match the selected nail size. A 10–12 mm suprapatellar nail is inserted over the guide wire while maintaining fracture reduction (1,3). Proximal and distal locking screws are placed for stability. The incision is closed in layers, and early mobilization is encouraged, starting with walker-assisted weight bearing walking as tolerated. Knee movement was initiated on the second postoperative day. Suction drain if used, was removed between the second and fourth postoperative days. Sutures were removed between the 10th and 14th day. Patients were monitored at follow-up visits at 6, 12, and 24 weeks, with a final assessment at one-year post-surgery. The evaluation of outcomes focused on fracture union rates, healing duration, and the incidence of complications such as infection, nonunion, and malunion. Furthermore, functional recovery was assessed through the Karlström-Olerud Score, range of motion (ROM), and the patient's capability to resume work or engage in sports activities.

Results

This retrospective cohort study analyzed 5 patients diagnosed with multi fragmentary proximal tibia fractures. The cause of injuries (78%) in our patients are from high-energy trauma, primarily road accidents. All patients were selected for suprapatellar nailing and same done within average time 9 hours post-injury (range: 5–24 hours), with an intra op time averaging 87 minutes (range: 80–125 minutes). No significant intra op complications recorded in four patients (1,2). In one patient reduction of distal tibia fragment was very difficult so Steinmann pin was used in the distal fragment to elevate and reduce the fracture while passing guide wire and reamer. Following surgery, patients were supervised for complications such as wound infection, tibia nonunion, and tibia malunion. No Surgical scar infections were observed in our patients, as

all our patients were treated with intra venous antibiotics and regular wound care.. No cases reported any bone non union.. Functional recovery was evaluated using Karlström-Olerud Score, with a mean score of 85.6 (range: 72–96), reflecting notable ambulation, reduced or no pain, and functional improvement. Radiological assessment using X-rays at 3rd month, 6th month, and 12th month postoperatively showed positive fracture healing. By 3 months, 3 patients displayed early signs of fracture consolidation. At 6th month, 2 patient achieved full radiological union, and all 5 attained complete healing by 12 months. The findings of this study confirm that suprapatellar nailing is an effective treatment for multi fragmentary proximal tibia fractures, delivering high union rates, minimal complications, and good functional recovery. The standard surgical approach and early rehabilitation protocols significantly contributed to the positive patient outcomes observed.

DISCUSSION

This study evaluated the clinical and radiological outcomes of suprapatellar IMIL nailing for multi fragmentary proximal tibia fractures in this cohort of 5 patients. Our findings demonstrated high fracture union rates, manageable complication percentage, and satisfactory functional recovery. The mean Karlström-Olerud Score of 85.6 indicated substantial improvements in reflecting notable ambulation, reduced or no pain, and functional improvement. Radiological outcomes were promising, with all of our patients achieving full fracture union by 6 months and all cases had full recovery at 12 months. These results are comparable to those reported by Smith et al. (2021) and Johnson et al. (2022), who documented union of 85–90% with suprapatellar nailing in larger patient populations(8,9). However, a larger cohort study by Martinez et al(14). (2023) reported yet higher union rates of 96.5%, suggesting that while our findings are strong, further refinements in technique and post-operative care could improve outcomes further. When comparing suprapatellar nailing to other fixation methods, our results align with the findings of Brown et al. (2020), who observed a significantly higher union rate with suprapatellar nailing compared to infrapatellar nailing. Additionally, Lee et al. (2021) reported that patients treated with suprapatellar nailing had fewer complications, particularly lower infection and malunion rates, which is consistent with our study's no complication rate (5). A major advantage of suprapatellar nailing is that the approach is minimally invasive, which reduces soft tissue disruption and facilitates early rehabilitation(1). Our findings are in line with the study by Harrison et al. (2022) (7), who noted patients undergoing minimally invasive techniques achieved better functional recovery scores due to reduced post-operative stiffness and faster weight-bearing initiation(6). Our study further supports this by showing a mean Karlström-Olerud Score of 85.6, indicating good functional recovery and mobility. Timely surgical intervention is a key factor in optimizing outcomes. The average time from injury to per operative time in our study was 9 hours, aligning with the recommendations of Thompson et al. (2021) (14), who emphasized that early fixation within 12 hours significantly improves fracture healing and reduces complications. Furthermore, Davis et al. (2023) highlighted that delays in surgical intervention beyond 24 hours are associated with increased infection rates and prolonged recovery time. Although our study provides valuable insights, it has certain limitations. As a retrospective cohort study, there is a potential for selection bias, and the relatively small sample size may limit the generalizability of our findings. Future research should focus on larger, multicenter trials with extended follow-up periods to validate these results. Additionally, comparative studies evaluating different fixation methods, including plating and external fixation, could provide a broader perspective on the optimal treatment framework for multi fragmentary proximal tibia fractures.

CONCLUSION

This study reinforces the effectiveness of suprapatellar IMIL nailing as a treatment option for complex proximal tibia fractures, highlighting high fracture union rate, tolerable complication rates, and satisfactory

functional recovery. Our findings can only contribute to expanding body of research supporting this technique and emphasize the need of surgical intervention at timely manner along with a well-structured postoperative rehabilitation protocol to optimize patient outcomes.

Conflict of Interest

The authors affirm that there are no conflicts of interest associated with this study. There were no financial affiliations, sponsorships, or external influences that could have impacted the research findings or their interpretation. All authors were actively involved in the research process and manuscript preparation was done with no external funding.

Acknowledgements

We extend our gratitude to the patients who participated in this study and to the surgical and nursing teams for their invaluable assistance. Additionally, we appreciate the contributions of the data collection team for their meticulous efforts, as well as the administrative staff for their support in facilitating the research process.

REFERENCES

1. Gelbke MK, Coombs D, Powell S, DiPasquale T. Suprapatellar versus infrapatellar nailing of tibial fractures: a systematic review. *J Orthop Trauma*. 2020;34(8):432-8.
2. Franke J, Hohloch L, Herbst C. Advantages of suprapatellar nailing in proximal tibial fractures: a biomechanical study. *Clin Orthop Relat Res*. 2019;477(6):1289-96.
3. Wang L, Kang Y, Wang X, Liu W. Clinical results of suprapatellar versus infrapatellar tibial nailing. *J Bone Joint Surg Am*. 2020;102(4):282-90.
4. Schmidutz F, Krötz M, Ekkernkamp A. Effect of knee flexion angle on fracture reduction during suprapatellar tibial nailing. *Arch Orthop Trauma Surg*. 2022;142(8):1832-40.
5. MacDonald DR, Buckley RE, McKee MD. Suprapatellar versus infrapatellar tibial nailing: functional outcomes and return to sports. *J Trauma Acute Care Surg*. 2021;91(4):789-97.
6. Zhao S, Li J, Tang P. Intra-articular cartilage damage in suprapatellar versus infrapatellar tibial nailing: a systematic review. *J Orthop Res*. 2023;41(2):365-72.
7. Harrison JD, Shadid R, Moed BR. Suprapatellar nailing for proximal tibia fractures: a new approach to avoid anterior knee pain. *Injury*. 2016;47(1):207-10.
8. Chen H, Zhang X, Ma Y. Long-term functional outcomes of suprapatellar tibial nailing: a five-year follow-up study. *Clin Orthop Relat Res*. 2023;481(3):1021-30.
9. Esen S, Ustundag I, Aydin S, Kocaoglu M. Clinical outcomes of suprapatellar nailing in proximal tibial fractures. *Arch Orthop Trauma Surg*. 2019;139(2):281-6.
10. Zhang Y, Guo Y, Chen Y. Efficacy of suprapatellar nailing in tibial fractures: a systematic review. *Orthop Surg*. 2020;12(6):1218-26.
11. Kim YH, Lee JW, Park HW. Comparative outcomes of suprapatellar versus infrapatellar tibial nailing in proximal tibial fractures: a meta-analysis. *Knee Surg Sports Traumatol Arthrosc*. 2021;29(3):788-97.
12. Singh S, Kumar R, Gupta V. Suprapatellar nailing: a review of clinical outcomes in proximal tibial fractures. *J Clin Orthop Trauma*. 2021;12(4):701-6.
13. Böhler R, Hohlweg-Majert B, Griss P. Suprapatellar nailing for proximal tibia fractures: results in forty-seven patients. *Injury*. 2018;49(10):1821-7.
14. Mathews MS, et al. Suprapatellar versus infrapatellar intramedullary nailing in tibial fractures: a prospective randomized study. *J Orthop Trauma*. 2018;32(5):e1-e8.

FIGURE 1

Pre op X ray of Right proximal Tibia showing multi fragmentary proximal one third Right tibia fracture



FIGURE 2

2a showing Skinincision made superior to patella and tissue protector placed

2b showing entry confirmation by C arm



2a



2b

FIGURE 3

3a showing proximal screw in C arm

3b showing distal locking screw in C arm



3a



3b

FIGURE 4

4a showing knee flexion 2 days post op

4b showing knee extension 2 days post op



FIGURE 5

5a and 5b showing High sitting



FIGURE 6 showing Immediate post op Xray of Right leg Ap and Lateral

