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Evaluating Clinical And Radiological Outcomes Of Suprapatellar Vs. Infrapatellar Nailing In Proximal Tibial Fractures: A Prospective Comparative Study

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Abstract:
Background: *Tibial shaft fractures are common, with proximal third fractures comprising a smaller but significant subset. The rise in high-velocity road traffic injuries has contributed to an increase in these fractures, predominantly affecting economically active adult males. These fractures often present with severe soft tissue injuries and bone comminution, posing challenges for treatment. Intramedullary nailing has been a successful method for tibial shaft fractures, but applying this technique to proximal third fractures presents difficulties due to deforming forces. The standard approach for intramedullary nailing in the tibia is infrapatellar, but this can lead to complications such as rotational deformities or malalignment. To address these challenges, the suprapatellar approach was introduced, offering potential advantages such as reduced postoperative knee pain and prevention of degenerative knee disorders. However, concerns remain regarding potential intra-articular injury.*
Material and Methods: *This study aimed to compare the clinical and radiological outcomes of suprapatellar and infrapatellar approaches for proximal third tibia fractures. Forty patients were divided into two groups, with one group undergoing suprapatellar nailing and the other infrapatellar nailing. Clinical outcomes were assessed using the Lower Extremity Functional Scale (LEFS) at 6 weeks, 3 months, 6 months, and 12 months, while radiological outcomes were evaluated based on time to union.*
Results: *The results showed that suprapatellar nailing had superior clinical outcomes at 3, 6, and 12 months compared to infrapatellar nailing. Radiologically, the average time to union was shorter in the suprapatellar group along with the number of delayed union and non-union cases. These findings support the use of the suprapatellar approach for proximal third tibia fractures.*
Conclusion: *This study provides evidence for the clinical and radiological advantages of the suprapatellar approach over the infrapatellar approach for proximal third tibia fractures. Larger prospective studies with longer follow-ups are needed to further validate these findings and establish treatment protocols.*
Keywords: *Tibia, Proximal third fractures, Suprapatellar technique, Infrapatellar technique, LEFS score.*

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I. Introduction

Tibial shaft fractures are the most frequently occurring fractures in long bones, typically found in the middle and distal thirds of the tibia shaft. Fractures in the proximal third of the tibia are less common, accounting for 9-11% of cases [(1)]. Unlike tibial shaft fractures, which often result from high-energy trauma, there has been a recent increase in proximal third tibia fractures, largely due to the rise in high-velocity road traffic injuries [(2)]. Proximal third tibia fractures are more common in economically active adult males, leading to job loss and a decrease in Disability Adjusted Life Years (DALYs), thereby straining both the economy and healthcare systems.

Proximal third tibia fractures are often associated with severe soft tissue injuries and bone comminution. Various surgical approaches have been proposed for treating these fractures, with intramedullary osteosynthesis being a successful method for tibial shaft fractures over recent decades. However, applying the benefits of intramedullary nailing to metaphyseal fractures like proximal third tibia fractures present a challenge. The complexity of proximal third tibia fractures arises from the deforming forces acting on the short proximal fracture segment. The proximal fragment tends to extend due to the pull of the quadriceps and extensor mechanism, while the distal fragment remains in flexion, resulting in anterior/procurvatum angulation.

The standard entry point for intramedullary nailing of the tibia is located centrally behind the tendon, between the tibial articular surface and the tibial tuberosity. This area can be accessed through various incisions, such as the medial parapatellar, lateral parapatellar, and trans patellar approaches, with the knee positioned in

either flexion or hyperflexion. In the infrapatellar approach, the knee must be flexed to at least 90 degrees, which can exacerbate the tendency for procurvatum angulation. To address this issue and reduce the risk of apex anterior deformity, there has been a need for alternative reduction methods or techniques during surgery.

The conical shape of the proximal metaphyseal region makes it challenging, as even a slight angulation during entry can lead to a coronal plane deformity, with valgus deformity being more common than varus. To maintain reduction and prevent these deformities, other techniques such as Poller screws and plates have been developed [(3).]

Tornetta et al [(4)] introduced a semi-extended approach to tibia intramedullary nailing, with the knee flexed at 15 degrees. This approach involved a medial parapatellar arthrotomy entry after laterally subluxating the patella. While this technique has shown satisfactory results, its extensive nature prompted further modifications. Dean Cole modified the semi-extended technique to a suprapatellar approach, which is a percutaneous method. The entry point is about 2.5 cm proximal to the superior pole of the patella, and the quadriceps tendon is split along the fibre line to access the suprapatellar pouch.

Various indications for Suprapatellar nailing have been illustrated such as proximal tibial fracture located entirely in the metaphysis, Fracture with a skin lesion or severe soft tissue damage in the infrapatellar region. Distance between the suprapatellar skin incision and the site of soft tissue trauma helps to prevent secondary trauma due to the surgical access, which favours fracture healing, Knee flexion deficit, Patella baja, Ossification in the patellar tendon, additional nerve and/or blood vessel damage or a two-stage surgical procedure after flap reconstruction.

Zhan et al. reported that suprapatellar approach may be effective in reducing the incidence of postoperative knee pain and prevent degenerative disorder of knee joint [(5)]. Besides, it can also decrease the risk of intraoperative second shifting. However, some studies showed that intraarticular injury may be the potential complication of this technique. Currently, the comparison of Suprapatellar and Infrapatellar approach for Proximal tibial intramedullary nail insertion is rarely reported, and most of them are retrospective studies. This study thus aims to provide a clearer picture regarding this ongoing debate.

Aim and Objectives

This study is aimed at assessing and comparing the clinico-radiological outcome of 40 patients in total managed with Intramedullary nailing for fracture of proximal shaft of tibia by Suprapatellar and conventional infrapatellar approaches.

Objectives:

- To compare the clinical outcome of both groups using LEFS (Lower Extremity Functional Scale) at 6 weeks, 3 months, 6 months and 12 months
- To compare the radiological outcome of both groups using time of union.

II. Materials and Methods

The study design is a Prospective Comparative study with 40 patients who meet the pre-defined inclusion and exclusion criteria were equally allocated to two groups of 20 patients each i.e. Group A – Patients managed with tibial intramedullary nailing by Suprapatellar approach and Group B- Patients managed with tibial intramedullary nailing by infrapatellar approach.

The patients are selected based on a set of pre-defined criteria's so as to maintain equal standards in both the groups participating in the study. Inclusion criteria for this study includes: Patients above the age of 18 years, patients providing written informed consent, patients with a diagnosis of extra-articular simple or segmental proximal 1/3rd tibial shaft fracture, patients without any known renal or cardiac disorders and patients with history of trauma less than 10 days. Furthermore, the exclusion criteria of this study include patients above the age of 60 years, patients not providing written informed consent, patients with intra-articular or middle and distal 1/3rd tibial fractures, patients with open injuries or pathological tibial fractures or associated contralateral tibial fractures, patients with known renal or cardiac disorders, patients with associated quadriceps injury or patellar fractures and fracture duration of more than 10 days.

Surgical technique:

In group A, the patients were managed with intramedullary nailing of tibia by the suprapatellar approach. In this approach, the patient was taken to the operating theatre and positioned supine on the table and spinal anaesthesia was administered. A bolster was placed under the hip of the affected limb to achieve neutral rotation of the knee. Open wounds were managed according to standard protocols. In this technique for semi-extended knee intramedullary nailing, the knee was flexed to approximately 15°. This position not only helps with fracture reduction and alignment of fragments but also allows for smooth intraoperative fluoroscopy.

A longitudinal incision of 3-5cm was made 2 cm above the patella (about 1-2 fingerbreadths). This incision was made large enough to accommodate the cannula. The quadriceps tendon was then longitudinally split along the incision line to access the patellofemoral joint. Using the surgeon's index finger, the patellofemoral joint was accessed directly under the proximal pole of the patella, followed by the insertion of the cannula. A specialized blunt tip cannula system with a blunt trocar was then inserted through the patellofemoral joint and advanced to the approximate starting point at the junction of the anterior cortex of the proximal tibia and the articular surface.

A starting pin was placed through the cannula to the desired starting point (medial to the lateral tibial spine), and a starting entry point was made with a 3.2-mm guide pin. Starting point is confirmed under image and entry point made. The guide gin is retrieved and guide wire is inserted into proximal fracture fragment and advanced across the fracture site. This is followed by reaming of the medullary canal followed by insertion of the nail adequate size and proper locking. Care is taken that the reamer is not be introduced across the fracture unless the fracture is reduced. This was followed by thorough wound wash and closure of wound in layers.

In group B, the patient was positioned supine, and spinal anaesthesia was administered. The knee was flexed to approximately 90 degrees. A 5 cm incision was made from the lower pole of the patella to the tibial tuberosity, first through the skin and then the patellar tendon and the superior and anterior surface of tibia are digitally palpated. Then using a curved awl, an entry point was made just medial to the lateral tibial spine, aligned with the tibial shaft on the anteroposterior (AP) view, and just anterior to the articular margin on the lateral view.

Both AP and lateral views were checked using imaging and traction was applied to achieve fracture reduction and restore tibial length. Suitable guide was selected and introduced under C-arm guidance after achieving reduction and passed across the fracture site into the distal fragment, followed by intramedullary reaming. An appropriately sized intramedullary tibial nail was inserted into the tibia over the guide wire under proper visualisation. Proper locking of the distal fragment was performed, and reduction was reassessed using C-arm visualisation followed by proximal locking with the limb in traction to maintain fracture reduction. The reduction was once again confirmed using the C-arm, and the position for locking was verified. Thorough wound wash was then given followed by closure of wound in layers.

Follow-up:

After surgery, rehabilitation began immediately, including quadriceps strengthening exercises, active assisted and active knee range of motion exercises, and ankle mobilization. Partial weight bearing with the assistance of crutches was permitted from the first postoperative day. Full weight bearing was allowed once clear clinical and radiological signs of union were observed. The patients were followed up at regular intervals after surgery – 6 weeks, 3 months, 6 months and 12 months. At each follow up, the patient was assessed clinico-radiologically.

Clinico-radiological assessment:

Under clinical assessment, the functional assessment was done using LEFS (Lower Extremity Functional Scale). It consists of a questionnaire with 20 questions regarding an individual's capacity to carry out daily activities. Each question is assigned a score ranging from 0 to 4 points based on the response. The LEFS score is the sum of all these points, with a maximum score of 80 and a minimum of 0. A lower score indicates a higher level of disability. The percentage of function is determined using the formula: (LEFS score) / 80 x 100.

The radiological assessment is done by evaluating the x-ray films at each specified visit and looking for progression of fracture union in Antero-posterior view and Lateral view.

Union is defined as pain free full weight bearing in the absence of motion or tenderness at fracture site with presence of more ≥3 bridging callus on two radiographic views. Non-union is absence of progressive fracture healing for three consecutive months extending beyond 6 months of injury and for which intervention is necessary to achieve union.

III. Results

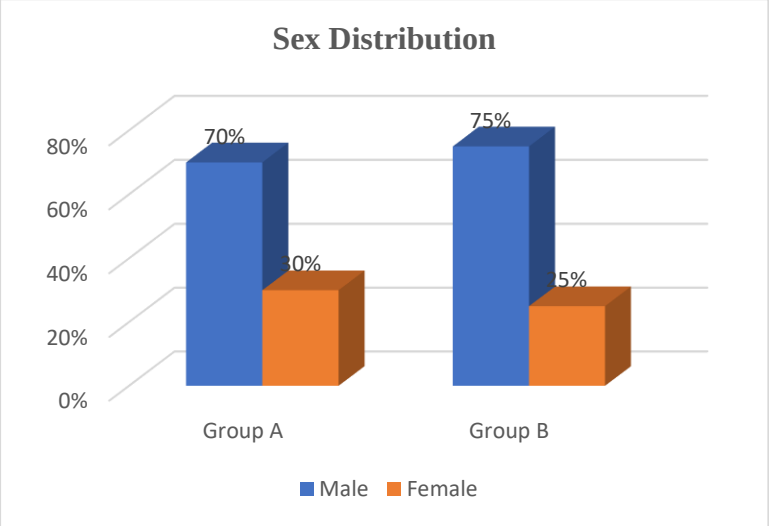
In this study, 40 patients meeting the pre-defined criteria were selected and divided randomly into two groups of 20 patients each: Group A- Suprapatellar group and Group B- Infrapatellar group.

This study had a male predominance with 14 males (70%) and 6 females (30%) in group A whereas 15 males (75%) and 5 females (25%) in group B. The average age of the patients in this study was found to be 39 years (Range: 18-60 years).

Table 1: Sex distribution of patients in this study

Sex	Group A	Percentage	Group B	Percentage
Male	14	70%	15	75%
Female	6	30%	5	25%

Graph 1: Sex distribution of patients in this study

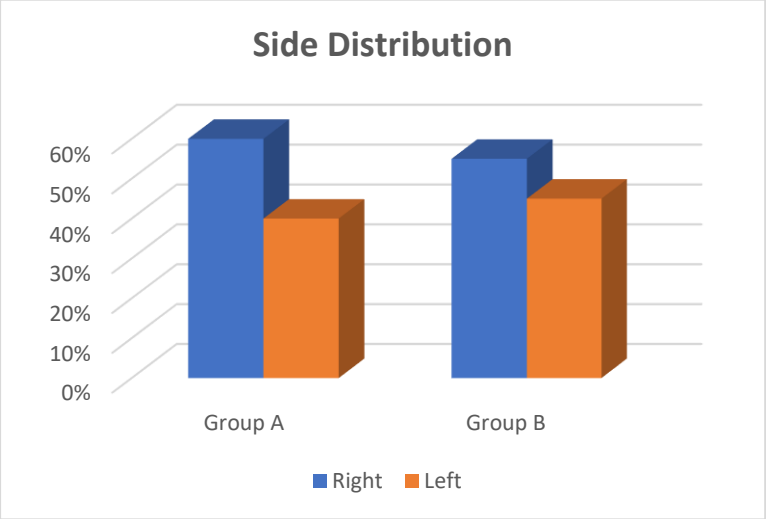


Furthermore, this study revealed that right sided tibial fractures were more common than left sided ones. There was an incidence of 12 (60%) right sided tibial fractures and 8 left sided tibial fractures in group A whereas there were 11 (55%) right sided tibial fractures and 9 (45%) left sided tibial fractures in group B.

Table 2: Side distribution of patients in this study

Side	Group A	Percentage	Group B	Percentage
Right	12	60%	11	55%
Left	8	40%	9	45%

Graph 2: Side distribution of patients in this study



Clinical assessment:

The Lower Extremity Functional Scale (LEFS) scores of both groups were assessed and compared at 6 weeks, 3 months, 6 months and 12 months

The scores of group A and group B at 6 weeks were obtained and documented. The mean of the scores in group A was found to be 1.55 ± 1.316 whereas the mean of scores in group B was found to be 1.2 ± 0.951. These scores were used to obtain the p-value which was found to be 0. 213.No statistically significant difference was found between suprapatellar and infrapatellar nailing at 6 weeks.

The mean of scores in group A at 3 months was found to be 14.9 ± 3.432 while that of group B was found to be 12.35 ± 2.183. Suprapatellar nailing showed a statistically significant advantage over infrapatellar nailing at 3 months, with a p-value of 0.002633475.

The mean of scores in group A at 6 months was found to be 37.5 ± 5.175 while that of group B was found to be 35.15 ± 3.631. Suprapatellar nailing also demonstrated a statistically significant advantage over infrapatellar nailing at 6 months, with a p-value of 0.035143962.

Similarly, the mean of scores in group A at 12 months was found to be 67.45 ± 4.358 while that of group B was found to be 62.6 ± 4.074 suprapatellar nailing showed a statistically significant advantage over infrapatellar nailing at 12 months, with a p-value of 0.001076931.

In summary, the data indicates that suprapatellar nailing may lead to better outcomes compared to infrapatellar nailing at 3 months, 6 months, and 12 months, suggesting that it could be a preferred technique for this type of procedure.

Radiological assessment:

The average time of radiological union was found to be 7.2 months in Group A and 7.8 months in group B. Furthermore, 1 patient showed delayed union in group A while there were 2 patients who showed delayed union and 1 patient who showed non-union in group B. This summarises the preference of Suprapatellar technique over infrapatellar technique while considering radiological outcomes as well.

Figure 1: Pre-operative X-ray film of patients depicting fracture of proximal third of tibia

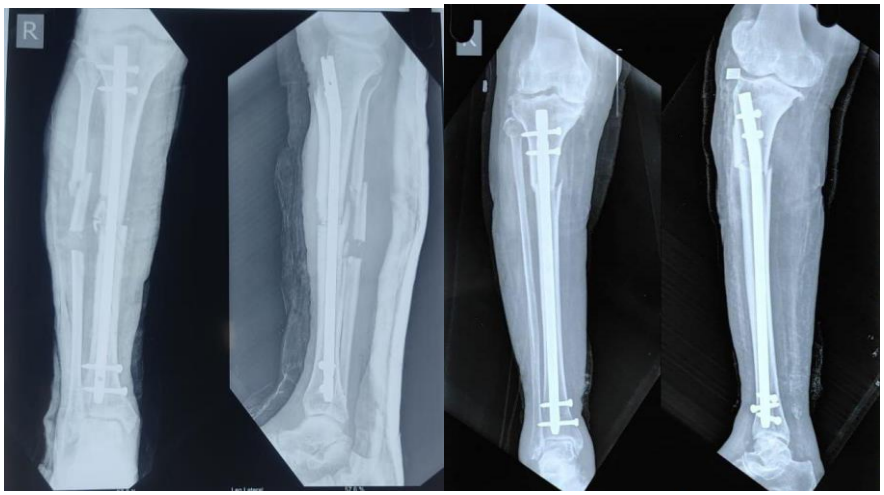


Figure 2: Post operative x-ray film of patients managed with suprapatellar (left) and infrapatellar tibial nailing (right) methods.

IV. Discussion

This study clearly provides evidence of superiority of Suprapatellar tibial nailing over Infrapatellar technique in proximal 1/3rd tibial shaft fractures. Many studies have also taken in recent past to come to the same conclusion citing clinical as well as radiological superiority of suprapatellar technique in such fractures.

Wang C. et al. in 2018 in their study concluded that for tibia IMN, suprapatellar approach might be superior to infrapatellar approach with shorter fluoroscopy time, less knee pain, better knee function recovery, and more accurate fracture reduction [6]. Yang L. et al in 2018 also came to the same conclusion and suggested

that Suprapatellar intramedullary nailing could significantly reduce total blood loss, postoperative knee pain, and fluoroscopy times compared to infrapatellar approach. Additionally, it was associated with an improved Lysholm knee score [7].

V. Conclusion

This prospective comparative study with all its results demonstrating the statistically significant clinical advantage as well as the radiological outcomes are most definitely suggestive of the fact that Suprapatellar technique of tibial intramedullary nailing is a better option as compared to Infrapatellar technique for proximal 1/3rd fracture of shaft of tibia. Due to the lack of prospective studies in relation to this topic, this study has a vast significance.

However, this study does bear a few drawbacks such as a small population in both the groups and not being able to consider the alignment of the bone after treatment. Henceforth, prospective studies or RCT's with a larger population, with wider variables and a longer follow up are needed before commenting on a final treatment protocol.

References

[1]. Court-Brown Cm, Bone … Jm-Tj Of, 1995. The Epidemiology Of Tibial Fractures. 1995 [Cited 1995].
[2]. Larsen P, Lund H, Laessoe U, Et Al. Restrictions In Quality Of Life After Intramedullary Nailing Of Tibial Shaft Fracture: A Retrospective Follow-Up Study Of 223 Cases. J Orthop Trauma 2014; 28:507–12.
[3]. Ricci Wm, O'boyle M, Trauma Jb-… Of Orthopaedic, 2001. Fractures Of The Proximal Third Of The Tibial Shaft Treated With Intramedullary Nails And Blocking Screws. 2001 [Cited 2001].
[4]. Tornetta P, Collins E. Semiextended Position Of Intramedullary Nailing Of The Proximal Tibia. Clin Orthop Relat Res [Internet]. 1996 Jul 1 [Cited 1996 Jul 1] ;(328):185–9.
[5]. Zhendong H, Li J, Hu Z, Orthopedics T. Comparison Of Therapeutic Effects Of Suprapatellar Approach And Infrapatellar Approach Intramedullary Nail For Tibial Shaft Fractures. J Pract Orthop. 2017;23(9):794–7.
[6]. Wang C, Chen E, Ye C, Pan Z. Suprapatellar Versus Infrapatellar Approach For Tibia Intramedullary Nailing: A Meta-Analysis. International Journal Of Surgery. 2018 Mar 1; 51:133-9.
[7]. Yang L, Sun Y, Li G. Comparison Of Suprapatellar And Infrapatellar Intramedullary Nailing For Tibial Shaft Fractures: A Systematic Review And Meta-Analysis. Journal Of Orthopaedic Surgery And Research. 2018 Dec;13(1):1-3.