

# Functional and Radiological Outcome of Proximal 1/3<sup>rd</sup> Tibial Fractures Managed with Intramedullary Through Suprapatellar Approach

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## ABSTRACT

**Aim:** To evaluate the clinical and radiological outcome of proximal third tibia fractures managed by intramedullary nailing in knee semi-extended position via the suprapatellar approach.

**Methodology:** Our study consists of proximal one third tibial shaft fractures which were treated with nailing via suprapatellar approach. The study was done under Rajah Muthiah Medical College and hospital, Duration of the study from May 2019 to December 2021. The patients were followed at intervals of 1 and 6 months and 1 year. Patients were observed for affect in daily day to day activities, union, shortening. The functions were assessed using Lower Extremity Functional Scale (LEFS).

**Results:** In 20 patients of proximal 1/3<sup>rd</sup> fracture of tibia within the study with a mean follow-up of 1 year. On an average of 6-7 months the fractures united radiologically. At the top of 1 year, the typical LEFS was 86%. 4 patients had delayed union in that 1 patient had significant bone loss followed by bone grafting and transpositional gastrocnemius flap was done, one patient pre-operatively had anterior skin discolouration which was debrided. Eventually all the fractures were united. There were no post-operative knee pain seen.

**Conclusion:** Suprapatellar nailing performed with proper instrumentation, proper surgical technique is a viable option in management of proximal 1/3<sup>rd</sup> tibial fractures. Which has excellent radiological and clinical outcomes with lower complications on comparing to other management. This may be a viable option for proximal 1/3<sup>rd</sup> (extra-articular) tibia fractures thanks to its inbuilt advantages of placement, perfect nail entry and positioning.

**Keywords:** Proximal tibia, Suprapatellar approach, Semi-extended knee position.

## INTRODUCTION

Tibial fractures are one among the foremost common os longum fracture. Extra-articular proximal tibial fractures regard for 5 – 11% of all tibial fractures [1,2,3].

They are generally affected by high-energy injuries and are constantly related to severe soft tissue damage and comminution of bone. Nailing being the optimal management for lower limb shaft fractures, the patellar tendon pulls up the proximal fragment anteriorly in case of extra articular fracture (proximal tibia). Various methods have been tried and enforced like open reduction and plate fixation<sup>[4,5]</sup>, which allows an immediate view of the fracture and anatomical reduction but the disadvantage is poor axial stability and a high rate of postoperative infection<sup>[6,7]</sup>. In case of Minimally invasive plate osteosynthesis reduction and proper alignment of the fracture is burdensome.

Intramedullary nailing of extra-articular proximal fractures seems to be the simplest treatment choice. But high rates of malunion are reported for this system, which is grueling. In intramedullary nails, while infection rates were significantly lower compared to plates or external fixators<sup>[8]</sup>.

Several ways are employed for intra-medullary tibial nailing, including medial parapatellar, lateral parapatellar, and transpatellar incision. When using the infra-patellar approach, the knee is generally flexed a minimum of 90 degree.

Malreduction occurs due to sagittal dislocation of proximal tibia due to the pull of quadriceps muscle tendon. Bhandari et al. estimated the result of surgical ways within the operation of extra-articular proximal third tibial fractures with reference to rates of nonunion, malunion, infection, and implant failure<sup>[8]</sup>.

Augmented plate osteosynthesis with nailing, external fixators, and so-called blocking screws are developed to avoid malalignment during infrapatellar nailing.

Ricci et al. treated 12 successive cases with fractures of the proximal third of the tibial shaft using intramedullary nailing and blocking screws, and concluded that blocking screws are frequently effective in achieving and maintaining fracture alignment<sup>[9]</sup>. But the use of blocking screws is complex, breakage of screws were noted and screw placement is difficult<sup>[10]</sup>.

Matthews et al. used dynamic compression plate (four to six holed) which is applied anteriorly uncortically placed, followed by nailing via infra-patellar approach. Still, this system has the disadvantages of open procedures<sup>[11]</sup>.

The disadvantages of infra-patellar nailing led to the development of a semi-extended nailing fashion by Tornetta and Collins, who employed a parapatellar approach with lateral subluxation of the patella<sup>[12]</sup>.

Recent advance in nail design and reduction ways have expanded the suggestions for intramedullary nail obsession to further proximal tibia extra-articular also as some intra-articular fractures<sup>[20]</sup>.

Tornetta and Collins (1996) recorded 25 cases where partial medial parapatellar (1/3<sup>rd</sup>) arthrotomy was done with two-thirds of the retinaculum split, during a semi-extended position (15-degree bend of the knee joint)<sup>[12]</sup>. The patella is subluxed, the trochlear groove is used as a bed for the instruments and nail. The argument for this entry was that when the knee is maximally fraudulent to fifteen degrees, the pull of the patellar tendon on the proximal scrap is excluded, and therefore the fracture are frequently fluently dislocated and fixed.

As Sanders et al. reported, Dean Cole was the one who started suprapatellar approach employing a midline quadriceps tendon incision. This approach overcomes the issues of reduction in 90-degree flexion with posterior malalignment of the distal fragment<sup>[13]</sup>.

## AIM

To evaluate the clinical and radiological outcome of proximal third tibia fractures managed by intramedullary nailing in knee semi-extended position via the supra-patellar approach.

## MATERIALS AND METHODS

Our study consisted of proximal 1/3<sup>rd</sup> tibial shaft fracture which was managed with intramedullary nailing via supra-patellar approach. Persons who fulfilled the inclusion and exclusion criteria were admitted and studied in Rajah Muthiah Medical College and Hospital during May 2019 to October 2021. A total of 20 cases reported, evaluated and followed up between the intervals of 1 month, 6 months and 1 year. With each follow up of functional outcome and radiological union will be done. Routine preoperative evaluation was done. Open fractures were thoroughly washed by irrigation and temporarily immobilized as per the patients needs either calcaneal pin traction/ knee slab. Limb is elevated and appropriate analgesics and antibiotics were given. Approximately the nail length was measured in the unaffected leg from the tibial tuberosity to most prominent point of medial malleolus. The isthmus diameter measured.

### Inclusion Criteria

- Age  $\geq 20$  years (After physeal closure)
- Closed and open leg fractures
- Tibial Segmental fracture with proximal segment involvement
- Proximal 1/3<sup>rd</sup> tibial fracture
- Stiff knee.

### Exclusion Criteria Are

- Paediatric fractures before physeal closure
- Age  $> 70$  years
- Associated comorbidities

- Intra-articular extension fracture.

### Operative Techniques

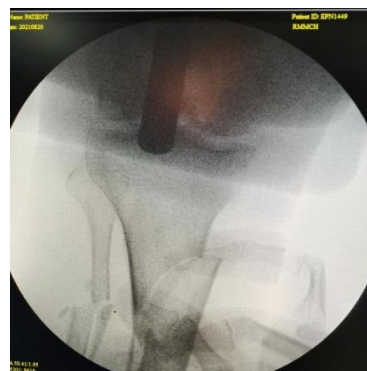


**Fig-1: Quadriceps Board (Knee in semi-extension)**

Pre-operatively, the patella is checked for its mobility. Patient is brought to the OT complex. Formerly, intramedullary tibial nailing is used only for extra articular fracture, but in recent times, we are using intramedullary nailing for both extra-articular and intra-articular fracture if the patella is not freely mobile then the ligament on the both the side of patella will be incised if needed, so that it will be freely movable. The knee is fixed in 20-30° flexion by using bump/bolster/quadriceps board Under the knee Joint (figure-1, 2). Tornique is applied over thigh, lower limb is painted and draped. In classical approach (infrapatellar) the knee will be flexed completely, so there is a chance of proximal segment getting displaced anteriorly, But in Suprapatellar approach, knee is fixed in 20 to 30 degree flexion which counteracts the pull of the patellar tendon 2.5cm sized Vertical Incision is made just above the base of patella. Quadriceps tendon is visualized and split. The Laxity of the Joint will be checked by introducing a finger between the patella & the femur. If necessary parapatellar ligaments can be incised the protective sleeve is placed which must be kept in position by an Assistant or by a k-wire (figure-3). In frontal plane, the entry point is located in straight line with the medullary canal (3mm medial of the tibial crest). In sagittal plane, the entry point should be located just distal the angle between tibial plateau and anterior tibial metaphysis. The Entry is made by using a straight awl, fracture site is reduced by using a clamp or by an assistant in both AP & lateral view, guide-wire inserted via the entry made serial reaming done. During reaming, fracture reduction is checked and kept in position. During reaming, the knee joint is protected by using the sleeve. After serial reaming, K wire and the protective sleeve removed following which insertion of nail is done. We augmented the classical infra-patellar Jig to Supra-patellar Jig by extending 5cms. Reduction clamp should be maintained until fixation. Fracture fixed proximally with one Antero-posterior screw, oblique screw, lateral screw. Fracture fixed distally without the aid of jig.



**Fig-2: Bolster (Knee in semi-extension)**



**Fig-3: Protective Sleeve placed**



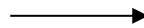
**Optimal Entry Point: AP View**



**Optimal Entry Point: Lateral View**



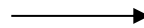
**Anteroposterior displacement**



**Held with clamp**



**Lateral displacement**



**Corrected by assistant**

**Case 1**  
**Pre op**



**Nail being introduced**



**One month post op**





**Six month post op**



**One year post op**



**Range of movements**



**Case 2  
Pre op**



**Anterior pull of proximal fragment**



**Calcaneal pin traction**



**Skin discoloration**



**Debridement done**



**Two weeks post op**



**one year post op**



**Range of movements**



**Healed anterior skin**

**LEFS SCORE (Lower extremity functional scale)**



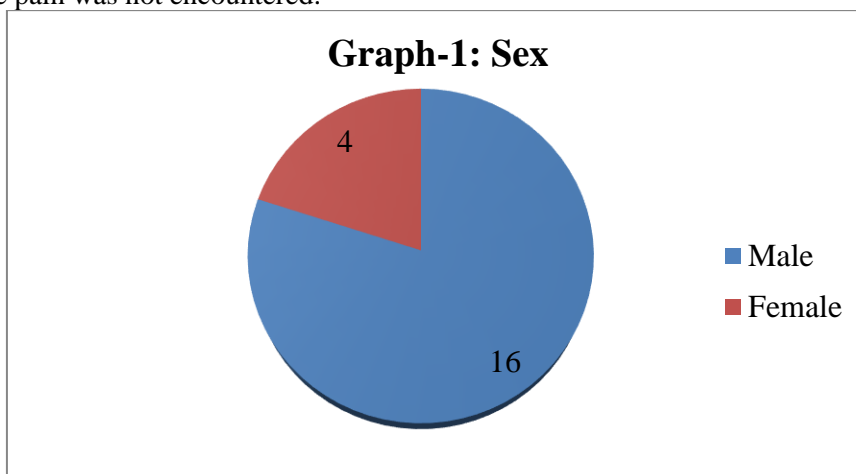
Activities	Extreme Difficulty or Unable to Perform Activity	Quite a Bit of Difficulty	Moderate Difficulty	A Little Bit of Difficulty	No Difficulty
a. Any of your usual work, housework, or school activities.	0	1	2	3	4
b. Your usual hobbies, recreational or sporting activities.	0	1	2	3	4
c. Getting into or out of the bath.	0	1	2	3	4
d. Walking between rooms.	0	1	2	3	4
e. Putting on your shoes or socks.	0	1	2	3	4
f. Squatting.	0	1	2	3	4
g. Lifting an object, like a bag of groceries from the floor.	0	1	2	3	4
h. Performing light activities around your home.	0	1	2	3	4
i. Performing heaving activities around your home.	0	1	2	3	4
j. Getting into or out of a car.	0	1	2	3	4
k. Walking 2 blocks.	0	1	2	3	4
l. Walking a mile.	0	1	2	3	4
m. Going up or down 10 stairs (about 1 flight of stairs).	0	1	2	3	4
n. Standing for 1 hour.	0	1	2	3	4
o. Sitting for 1 hour.	0	1	2	3	4
p. Running on even ground.	0	1	2	3	4
q. Running on uneven ground.	0	1	2	3	4
r. Making sharp turns while running fast.	0	1	2	3	4
s. Hopping.	0	1	2	3	4
t. Rolling over in bed.	0	1	2	3	4
Column Totals:					

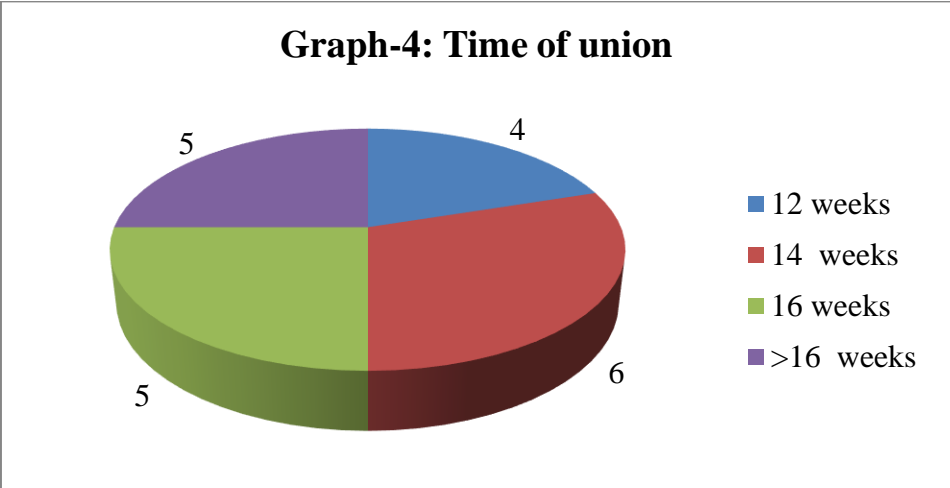
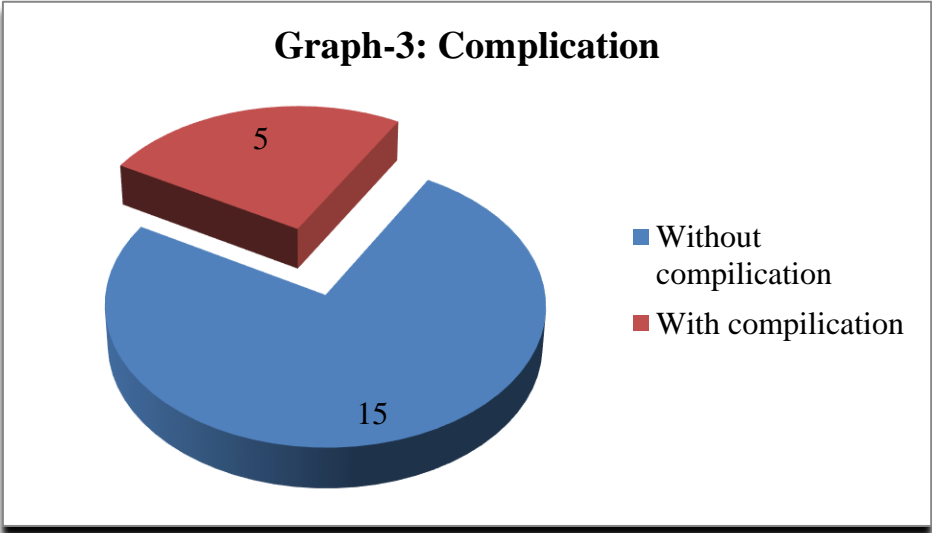
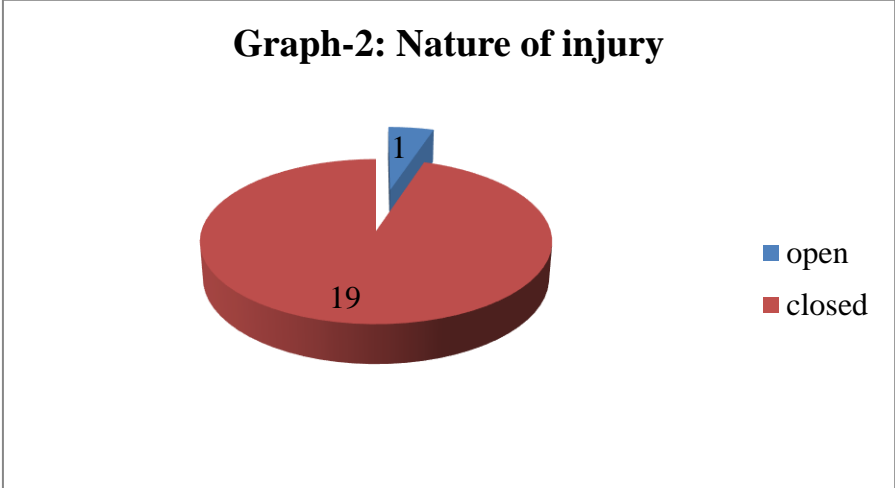
This scoring system is investigated under various daily activity performance such as house work, sports activity, outing shoes, squatting, running even ground and uneven ground etc. The maximum score is 80 for 20 related daily activities. Each activity got maximum 4 scores

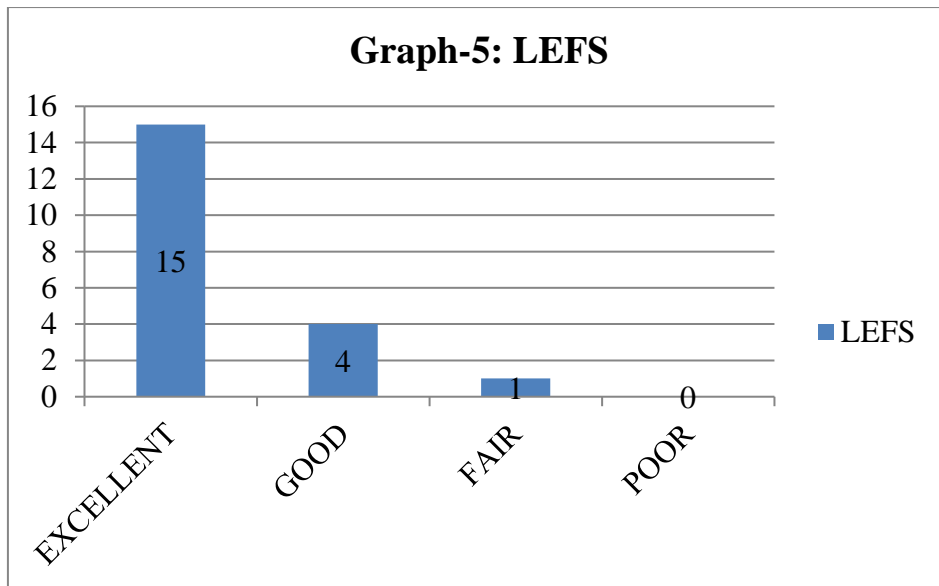
- Score between 70-80 indicate excellent functional outcome
- Score between 60-70 indicate good functional outcome
- Score between 40-60 indicates fair functional outcome
- Score < 40 indicates poor functional outcome

**RESULTS**

In our study a total of 20 cases of tibial fractures were treated with supra-patellar interlocking/ intramedullary nail. Average age of patients is around 40 years (20-60 years). Amidst 20 cases, 16 case were male and 4 were female. 19 cases were closed and 1 is a compound injury, compound injury was classified based on Gustilo Anderson system. The surgery was done to the patients on a mean average of 14 days (3-25 days). Initially immobilized with above knee slab in 18 cases and 2 cases were immobilized with calcaneal pin traction. The mean hospital stay was between 7-30 days, the cases were followed up for at intervals of 1, 6 and 12 months. On an average of 7 months, the fractures were radiologically united. Patients showed an average LEFS of 86% on a year of follow-up, 4 patients had delayed union and 1 patient had significant bone loss and skin discoloration for which (iliac) bone grafting and trans-positional gastrocnemius flap was kept. Eventually all the fractures were united. Post-operative knee pain was not encountered.







## DISCUSSION

There is no gold standard treatment for extra-articular proximal tibia fractures. The management of choice depends on the fracture location, morphology and other associated injuries. Intra-medullary/ Interlocking nailing is the ideal management. In this study we selected 20 patients with fracture tibia. All patients underwent intramedullary interlocking tibia nail via supra-patellar approach with semi-extended position of the knee. Of the 20 patients treated with supra-patellar approach, 15 excellent outcome with good range of movements with excellent LEFS score.

The main aim is to extend the advantages of the intra-medullary nailing for shaft (diaphyseal) fractures to the metaphyseal fractures like proximal tibia. Infra-patellar nailing of proximal tibia fractures is a demanding and challenging procedure, rendered difficulties in fracture reduction, and post-operatively malalignment is likely to occur frequently. This jeopardises restoration of the mechanical axis, knee joint function and joint congruency as described by Kurylo<sup>[14]</sup>. Matthews et al. states that, problematically, the ideal position for the correction of proximal tibial fractures (knee in extended position) does not occur with the optimal position for the usual infra-patellar approach, which is at least 90 deg of knee flexion<sup>[11]</sup>.

The notable advantage of supra-patellar approach was the extension of knee during the surgery which was very useful in the reduction of complex metaphyseal and diaphyseal tibia fractures. In the proximal oblique metaphyseal fracture with posterior cortical extension, the supra-patellar technique decreases the chance of perforating posterior cortex by placing the starting point in line with that of medullary canal. It also relaxes the pull of quadriceps muscle, thus preventing malreduction. This technique also helps to reduce Varus and Valgus deformity by using the femoral trochlear groove as a guide to the starting point. This maintains the mechanical axis of the lower limb. Additionally surgeon convenient assess through the tibial plateau safely.

Eventhough this approach is being criticized by many orthopedic surgeon because of joint involvement and articular cartilage damage over patellar trochlea surface, which can be prevented by using protective entry sleeve during entry and reaming procedures, not only fracture reduction post-operatively pain over anterior aspect of knee which is usually encounter in conventional approach.

Gaines et al also proposed that this approach was not associated with incidence of damage to the articular cartilage and ligaments around the knee joint<sup>[15]</sup>. In our study there is no patients suffering from post-operative complications like anterior knee pain, knee stiffness, ligament laxity, arthritic changes which may be decreased with use of entry sleeve<sup>[16]</sup>.

Establishing an proper anatomic entry point is pivotal in these kind of fracture patterns. Supra-patellar nailing with the semi extended position has lately been suggested as a secure and effective surgical fixation<sup>[17]</sup>.

A recent meta-analysis of RCT showed that supra-patellar approach has decreased fluoroscopic time and post-operative complications as said above. It is understood that low fluoroscopic time implies decreased procedure time and also several recent studies compared and shows supra-patellar approach has advantages over conventional approach for proximal 1/3<sup>rd</sup> tibial fractures<sup>[18,19]</sup>.

Since it is recently emerging technique long term follow up for functional and radiological outcome is needed to improve surgical technique. Now a days this technique has been used in intra articular proximal tibial fractures<sup>[20]</sup>.

## CONCLUSION

Reamed intramedullary interlocking nailing remains the ideal management of shaft fractures lower limb. In our study, we describe surgical techniques and ideas in supra-patellar approach. This approach appears to be an alternative and has an inherent additional advantage to routine conventional approach. Proper and specific instrumentation allows for nail insertion in a safe way. The semi-extended position of knee helps in preventing the disadvantage of classical approach. We had excellent outcome for proximal 1/3<sup>rd</sup> of tibial fracture nil post-operative anterior knee pain.

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