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## Management of distal tibial metaphyseal fracture by expert tibial nail using suprapatellar approach

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### Abstract

**Background:** Distal tibial metaphyseal fractures are common lower limb injuries and results in extensive musculoskeletal damage due to paucity of soft tissue coverage. Fixation methods include open reduction and internal fixation (ORIF) with plates, minimally invasive percutaneous plate osteosynthesis (MIPPO) and intramedullary nailing. Extensive exposure for ORIF leads to wound complications, nonunion and infection. Intramedullary nailing is the preferred for diaphyseal tibial fracture however conventional nailing is less suited for distal tibial metaphysis due to diameter mismatch between the nail and the bone leading to very little nail effect and impaired stability. Expert tibial nail with multiplanar locking options at the proximal and distal end allows for secure stabilization of the metaphyseal fragments. Infrapatellar approach is traditionally used for tibial nailing however suprapatellar approach is emerging as an alternative as semi-extended positioning makes it technically easier to nail the proximal and distal fractures.

**Materials and Methods:** This is a prospective study conducted from February 2019 to February 2020. 14 patients fulfilling the inclusion criteria underwent intramedullary nailing using the suprapatellar approach. The functional outcomes were measured at 6 months using the Lysholm knee score and the SF-36 physical and mental score. The obtained data was analyzed using SPSSv16.

**Result:** The average time of fracture union was 17.8 weeks. The mean SF-36 physical and mental score were 42.4 and 44.5 respectively. The average Lysholm score was 84. The mean arc of motion in the involved knee was 110°. Secondary procedure in the form of dynamization was done in 2 cases. Anterior knee pain was observed in 3 patients.

**Conclusion:** Expert tibial nailing using suprapatellar approach appears to be a suitable fixation method for distal tibial metaphyseal injuries as it provides good functional and clinical outcome at the same time minimizing the violation of delicate soft tissue structures.

**Keywords:** Distal tibial metaphyseal fracture, expert tibial nailing and suprapatellar approach

### Introduction

Distal tibial fractures are common lower limb injuries and accounts for approximately 7% of all the tibial fractures. Due to its anatomy and paucity of soft tissue coverage distal tibial metaphyseal injuries poses significant challenge to management. Due to the superficial nature of distal tibia, compound injuries are very common which further complicates the management. Treatment is often complicated by contusion, infections, delayed-union and non-union, all pointing to secondary or revision surgeries [1]. The optimal method of fixation remains debatable. Treatment modality is dictated by the fracture displacement, comminution, intra-articular extension and injury to the soft-tissue envelope [2]. Soft-tissue management has been seen to play a vital role in the management alongside the bony reconstruction [3]. Treatment options include conservative methods, plate and screws fixation, intramedullary nails and external fixators. ORIF with plates achieves accurate reduction and absolute stability, however extensive exposure leads to devascularization of the fracture fragment and wound complications. MIPPO reduces the soft tissue problem but increases the risk of secondary skin necrosis due to prominence of precontoured and angular stable plates. Intramedullary nailing is the preferred means of fixation of diaphyseal tibial fracture however conventional nailing is less suited for distal tibial metaphysis due to diameter mismatch between the nail and the bone

leading to very little nail effect and impaired stability leading to high rates of primary and secondary malalignment, delayed union. Expert tibial nail with multiplanar locking options at the proximal and distal end allows for secure stabilization of the metaphyseal fragments. Infrapatellar approach is traditionally used for tibial nailing however, there is a risk of poor repositioning, suboptimal reaming and poor placement of the nail. Suprapatellar approach is emerging as an alternative as semi-extended positioning makes it technically easier to nail the proximal and distal fractures.

In this prospective study, we aimed to evaluate the functional and the radiographic outcome of expert tibial nailing in distal tibial metaphyseal fractures using the suprapatellar approach.

### Materials and Method

This is a prospective study conducted over a period of one year from February 2019 to February 2020 in department of orthopaedics RIMS, Imphal. With due approval from the institutional research ethics board and after obtaining written informed consent of the individual patients, 14 skeletally matured patients between 18-65 years with distal tibial metaphyseal fractures AO type 43-A1,A2 and A3 were included in the study. There were 9 patients with A1 type fracture, 3 patients with A2 type fracture and 2 patients with A3 type fracture. 11 patients out of the 14 had compound fractures of which 7 were Gustilo Anderson type I and 4 were type II injuries. All the 14 patients had concomitant fibular fractures. Fixation of the fibula was decided based on the distance of the fracture from the syndesmosis, those within 5cm from the syndesmosis were fixed. 9 patients had fibula fractures within 5cm from the syndesmosis and were fixed either with 3.5mm 1/3<sup>rd</sup> tubular plate or rush nail.

Patient with multiple injuries, skeletally immature patients, patients with preexisting comorbidities, compound fracture type III and those not willing to participate in the study were excluded from the study.

The injuries were assessed by antero-posterior, lateral view

X-rays and CT-scan with 3D reconstruction of the affected limb. Routine blood investigations were done in all patients to ensure the fitness of the patient to undergo planned surgery. Demographic data, radiographic parameters and complications were noted. The functional outcomes were measured at the end of follow-up at 6 months using the Lysholm knee score and the SF-36 physical and mental score. Clinically and radiologically, above five degrees of deformity in any plane was evaluated as malunion [4, 5]. The collected data was analyzed using SPSS software version 23.0.

### Surgical techniques

All the surgeries were conducted in spinal or epidural anesthesia with patient in supine position. Fixation of the fibula was done first either with 3.5mm 1/3<sup>rd</sup> tubular plate or rush nail in closed and compound fractures respectively. Once the fibula was fixed, the knee was flexed to 30° with bolster in the popliteal fossa. A 1.5-2cm longitudinal skin incision was made 1cm above the base of the patella. The quadriceps tendon was exposed by blunt dissection and a longitudinal midline split was performed in the tendon. 2.5mm protection sleeve was then introduced in the patella-femoral space. Long 2.5mm k wire was introduced at the anterior margin of the tibial plateau and 3mm medial to tibial crest. K-wire position was verified fluoroscopically in both AP and lateral view. Protection sleeve changed with 12mm sleeve and canal was opened with cannulated 8mm drill. The k-wire was then removed and a guide wire introduced crossing the fracture site after achieving closed reduction. The position of the guide wire was confirmed by AP and lateral view. Guide wire trajectory was adjusted by using Steinmann pin as a poller screw whenever necessary. Serial reaming was done and nail introduced mounted in a jig. Distal locking was done by free hand technique with at least 3 locking bolts. Fracture gap if any was closed with a back stroke technique. Proximal interlocking was done with the help of the jig at least 2 locking bolts were introduced through the jig.



a.



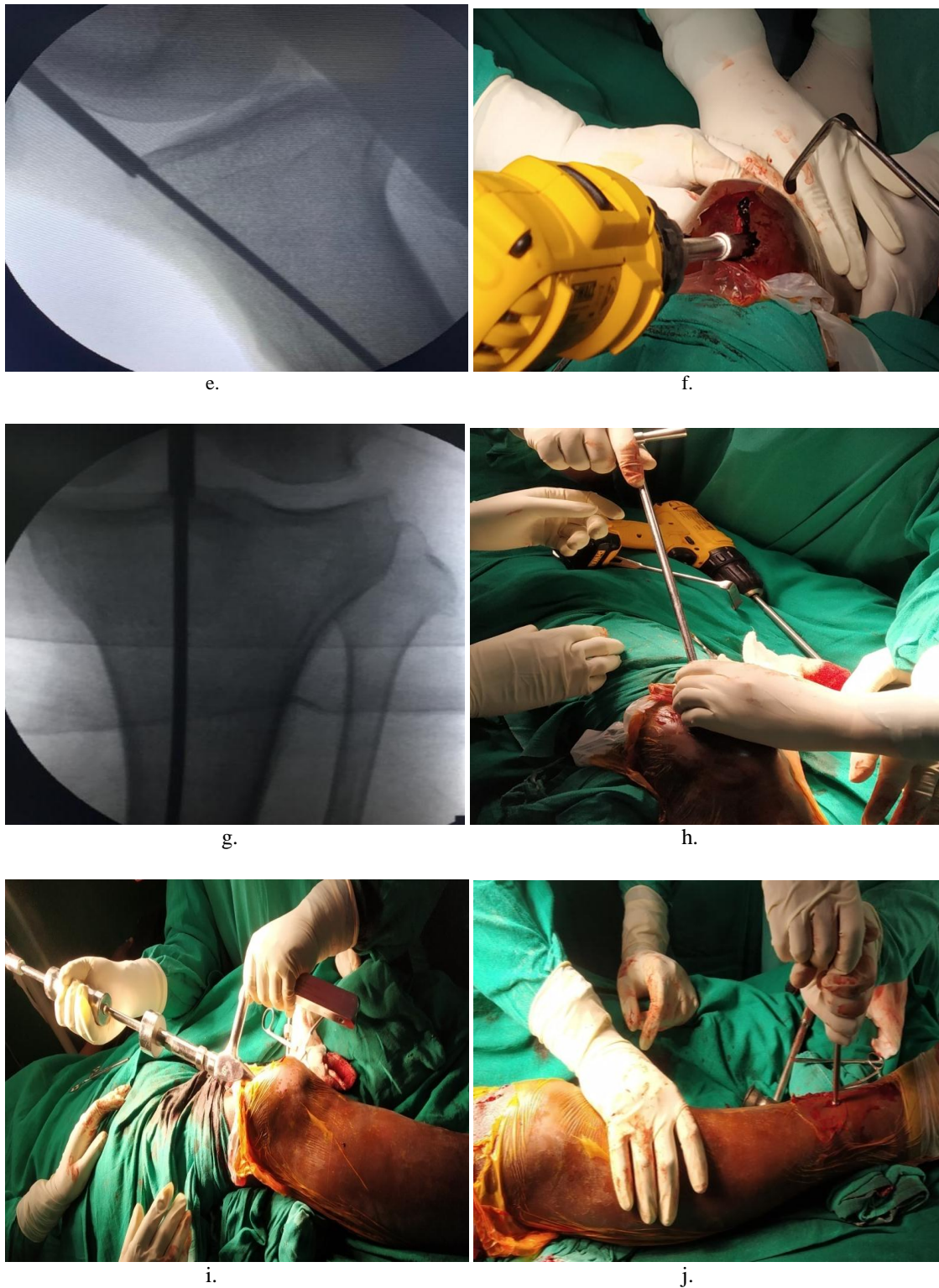
b.



c.



d.



**Fig 1:** Showing operative procedure. A- Preoperative x-ray. B- Incision for suprapatellar approach. C,D,E- Securing the entry point. F,G- Opening the canal. H- Reaming. I- Nail insertion. J- Distal locking

#### **Post-operative protocol:**

All the patients received 3<sup>rd</sup> generation cephalosporin injectable antibiotics for 3 days. All the patients were started on non weight bearing mobilization from 2<sup>nd</sup> day onwards including active range of motion exercises of the knee and the ankle joint. Wound inspection was done on the 2<sup>nd</sup> and the 5<sup>th</sup> day followed by suture removal on the 12<sup>th</sup> day. Follow-up was done on 1<sup>st</sup>, 3<sup>rd</sup> and the 6<sup>th</sup> month postoperatively. At each follow up patients were clinically, functionally and radio

graphically assessed. X-ray of the leg with ankle and the knee in AP and lateral view were taken during each visit. Fracture union, alignment, ankle and knee range of motion, soft tissue healing and associated complications were noted in each follow up. The functional outcomes were measured at 6 months postoperatively using the Lysholm knee score and the SF-36 physical and mental score.



**Fig 2:** A- Immediate Postoperative x-ray. B- X-ray at 6 months follow-up. C,D- Function at 6 months follow-up.

**Result**

8 out of 14 (57%) patients were between 20-40 years and 6 patients (43%) were between 40-60 years. 9 patients (64%) were males and 5 (36%) were females. Right limb was injured more commonly (57%). The commonest mode of injury was road traffic accident (50%). AO type A1 was the most type of injury accounting for 9 out of 14 cases (64%). Compound injury was present in 11 (79%) patients out of which 7 (64%) were Gustilo-Anderson Type I injury. Concomitant fibular fracture was present in all 14 (100%) patients out of which 9 (64%) fibular fracture were within 5cm from the syndesmosis which were fixed. 7 (78%) out of 9 fibular fractures were fixed with 3.5mm 1/3<sup>rd</sup> tubular plate and 2 (22%) were fixed with rush nail due to the presence of compound injury on the fibular side. The average time of union was 17.8 weeks. The average SF-36 physical score was 42.5 and the mental score was 44.5. The mean Lysholm score was 84. The mean arc of knee motion was 110° on the affected side. Dynamization was done in 2 cases, there were no secondary procedure apart from this. Long term complication in the form of anterior knee pain was seen in 3 patients. There was no incidence of malalignment on radiological measurement.

**Table 1:** Showing outcome of the patients based on Lysholm knee score

Outcome	No. of patients(n=14)	%
Excellent (>90)	2	14
Good (84-90)	9	64
Fair (65-83)	3	22

**Table 2:** Showing knee range of motion

Range (in degrees)	No. of patients(n=14)	%
90-99	2	14
100-109	4	28
110-119	7	50
>120	1	8

**Table 3:** Showing complications

Complications	No. of patients(n=14)	%
Malalignment (>5°)	0	0
Non-union	0	0
Infection	0	0
Anterior knee pain	3	22

**Discussion**

Distal tibial fractures are common injuries. Management of distal tibial metaphyseal fractures poses difficulty due to its anatomy and poor soft tissue coverage. Although intramedullary nailing of tibia shaft fractures is the gold standard, treatment becomes controversial as the fracture extends distally [4-7]. Expert tibial nailing with multiplanar locking options provides a viable option of fixation for distal metaphyseal fractures while avoiding the soft tissue concern associated with open reduction and internal fixation with plate.

The main objective of the present study was to evaluate the clinical and functional outcome of expert tibial nail for fixation of distal tibial metaphyseal fractures using the suprapatellar approach.

In the present study, the mean average age incidence was 40.2 years which was comparable to study conducted by Kumar YC *et al.* [8]. The average time of union was 17.8 which was comparable to study conducted by Im GI, Tae SK [9]. The mean SF-36 physical and mental scores were 42.5 and 44.5 respectively and the mean Lysholm knee score was 84 which was comparable to study done by Sanders RW *et al.* [10]. The mean arc of knee motion was 110° which was comparable with the finding of Sanders RW *et al.* [10]. Secondary procedure in the form of dynamization was done in 2 patients which was comparable to the findings of Badami RN *et al.* [11]. There was no incidence of malunion in our case series. Badami RN *et al.* reported 5.2% of malunion in their series.

### Conclusion

Expert tibial nailing using suprapatellar approach appears to be a suitable fixation method for distal tibial metaphyseal injuries as it provides good functional and clinical outcome at the same time minimizing the violation of delicate soft tissue structures.

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