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Intramedullary nailing for distal tibial fracture through Suprapatellar Approach: A Prospective Study.

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KEYWORDS
Non-contrast computed tomography (NCCT), open reduction and internal fixation (ORIF), suprapatellar approach, distal tibia

ABSTRACT:

Background: Management of distal tibial is always a challenging task for orthopedic traumatologists with a conflicting study on treatment of choice. The suprapatellar approach for intramedullary nailing is one of the effective methods for the treatment of distal tibia fracture.

Aim: Treatment of both extra-articular and intraarticular fracture of the distal tibia with intramedullary nailing is discussed. The efficacy of the suprapatellar approach is analyzed and shared. **Method:** A prospective study about the functional outcome of intramedullary nailing through the supra patellar approach was carried out at Jawaharlal Institute of Medical Sciences (JNIMS) from March 2021 to March 2023 among 26 patients who satisfied the inclusion criteria. The Declaration of Helsinki was strictly followed. **Result:** Age range of the patients was 20-55 years. The most common cause of the fracture is road traffic accidents. Fibular plating was done for 4 patients with associated fibular fractures with associated syndesmotic injury. Partial Proximal fibulectomy was done for the remaining patients with no associated fibular fracture. The average time of healing was 25.8 weeks (Range 24-29 weeks). Partial weight bearing started around 6 weeks. Functional outcome was assessed using Johner and Ruh criteria with 22 patients (84.6 %) showing excellent results, 3 patients (7.7 %) being good and 1 patient (3.85%) showing poor results. **Conclusion:** Osteosynthesis with an intramedullary interlocking nail through a suprapatellar approach with combined fistulectomy for intact fibula and fibular plating for associated distal fibular fracture for syndesmotic injury is effective for distal tibia fracture with satisfactory results.

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Introduction:

Tibial fractures are notorious for malunion, non-union, and long-term dysfunction as well as their propensity for open injury. About 10 % of the distal end fracture of the tibia may be attributed to axial and rotational forces acting on the lower extremity [1,2]. Distal tibia fractures are associated with more extensive soft tissue injuries [3].

Intra articular distal tibial fracture comprises of less than 1 % of all lower extremities fracture and 3-10 % of all tibial fracture [4,5,6,7,8]. These fractures are caused by high-energy trauma and patients have concomitant injuries [4,5,6,9].

Conservative method, plate, and screw fixation, intramedullary nailing, and external fixator are commonly practiced therapeutic procedures for management. Due to extensive exposure and insult to the vascular supply risk of wound complication and delayed union are associated with open reduction and internal fixation (ORIF) plating even though stability and absolute reduction are achieved. Precontoured plate in minimally invasive plate osteosynthesis (MIPO) may lead to soft tissue and skin necrosis. Intramedullary nailing has become a reliable technique for closed or open tibial diaphyseal fracture. Early weight bearing is achievable with intramedullary nailing as it acts as an internal splint [10,11,12,13]. Advantages of intramedullary nailing include preservation of periosteal vascular integrity, small surgical wounds, provision of angular stability, and prevention of telescoping with the interlocking nail. Intramedullary nailing of the tibia through transtendinous, medial paratendinous, lateral paratendinous routes is associated with postoperative anterior knee pain, with a mean incidence of 47% after 2 years [14]. The suprapatellar approach in semi-extended knee position has emerged as a safe and beneficial technique for intramedullary nailing of tibial fracture. It renders easier access to the surgical entry point, better fluoroscopy, and better fracture handling by countering the deforming forces. Injuries to the tendon are rare so complications of chronic anterior knee pain are less [15].

In this paper, the functional outcome of using intramedullary nailing through the suprapatellar approach in distal tibia fractures is highlighted. Both extra-articular and intra-articular fractures are included.

Material and method:

This is a prospective study carried out from March 2021 to March 2023 at (JNIMS), a tertiary referral hospital in Imphal North Eastern India. Approval of the ethical committee of JNIMS was taken to carry out the study. Patients above 20 years who have epiphyseal fusions of distal tibia and fibula were included. Most of the fractures were due to road traffic accidents (92.3 %) and the remaining patients were due to fall from height. Heim's system of the square was used to define the distal end of the tibia. Extra-articular fracture types 43A and 43 C1 of Occupational therapy assistants (OTA) were included in the study. Polytrauma patients with fractures of another bone at a different site other than the leg and patients with head injuries were excluded. Written and informed consent of the patients was taken and the Declaration of Helsinki was strictly followed for the study. After clearance from other departments, routine preoperative blood and radiological investigations including non-contrast computed tomography (NCCT) of the fracture site with 3D reconstruction were performed with the consent of the patient (Figure 1). Pre-anaesthetic checkup was done to check the fitness of the patients before they were operated. All the patients underwent locked intramedullary nailing through the supra patellar approach. Postoperatively beta-lactam antibiotic and aminoglycosides with analgesics were given for 7 days. Patients were discharged after 10 days postoperatively after giving proper physiotherapy training. Follow-up was done weekly for the first month, twice monthly for the next 3 months, and after every 2 months thereafter. X-ray was taken in every visit to check the union and for any possible complications. The functional outcome was measured after 6 months using Johner and Ruh criteria.

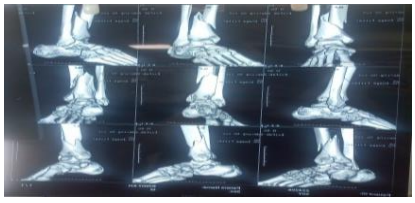

Fig 1. NCCT of fracture

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Surgical Technique:

With combined spinal and epidural anesthesia all the surgeries were conducted in the supine position. Under standard sterile precaution, the affected limb is shaved, prepared, and draped. Fracture, where the fibula was intact, partial fibulectomy of the proximal fibula, was carried out, and fibular plating with 3.5 mm with 1/3rd tubular plating for associated fibular fracture within 5 cm of the ankle. A tourniquet was used to provide a properly hemostatic field. A sterile towel or kidney tray was used as a bolster under the knee joint to flex the knee at 20-30®. A midline incision about 2 cm is made about 2 cm proximal to the superior pole of the patella. The Quadratus tendon was identified and split in full thickness to access the retro patellar space. K-wire is inserted through a protection sleeve of 12 mm at the anterior margin of the tibial plateau medial to the lateral tibial spine. The position was verified by true AP and lateral fluoroscopy. K wire was removed and the entry point was opened using awl as a prerequisite reduction of the fracture was done by external manipulation. A ball tip guidewire with a bend at the distal end was introduced into the canal and the fracture line was crossed. Augmentation of the trajectory was done by a poller screw and steaming pin acting as a poller screw whenever it was required. The distal end of the guidewire is placed at the level of the physical scar which was confirmed by anteroposterior and lateral view of the fluoroscopy. Serial reaming was started with 8mm with an increment of 0.5mm reamer size progressively. Adequacy of reaming was determined by the chattering sound. Nail size was determined pre-operatively with an X-ray from the normal leg by keeping the nail along the normal leg as shown in Figure 2 and the incision procedure is shown in Figure 3.

Fig 2. Measuring Nail Size

Fig 3. Incision

Nail lengths of 280mm,300mm, and 320mm were used depending on the length of the bone. The nail was mounted on the jig and introduced.2 locking bolts were placed orthogonally by the free hand and the fracture gap, if any, was reduced using the heel strike technique. Two Locking bolts were introduced proximally through the jig. Figure 4 shows different steps involved in the surgical process like the entry site, fibula plating, proximal Locking bolt, distal locking bolt, in addition with the post operative X-ray result at 6th month.

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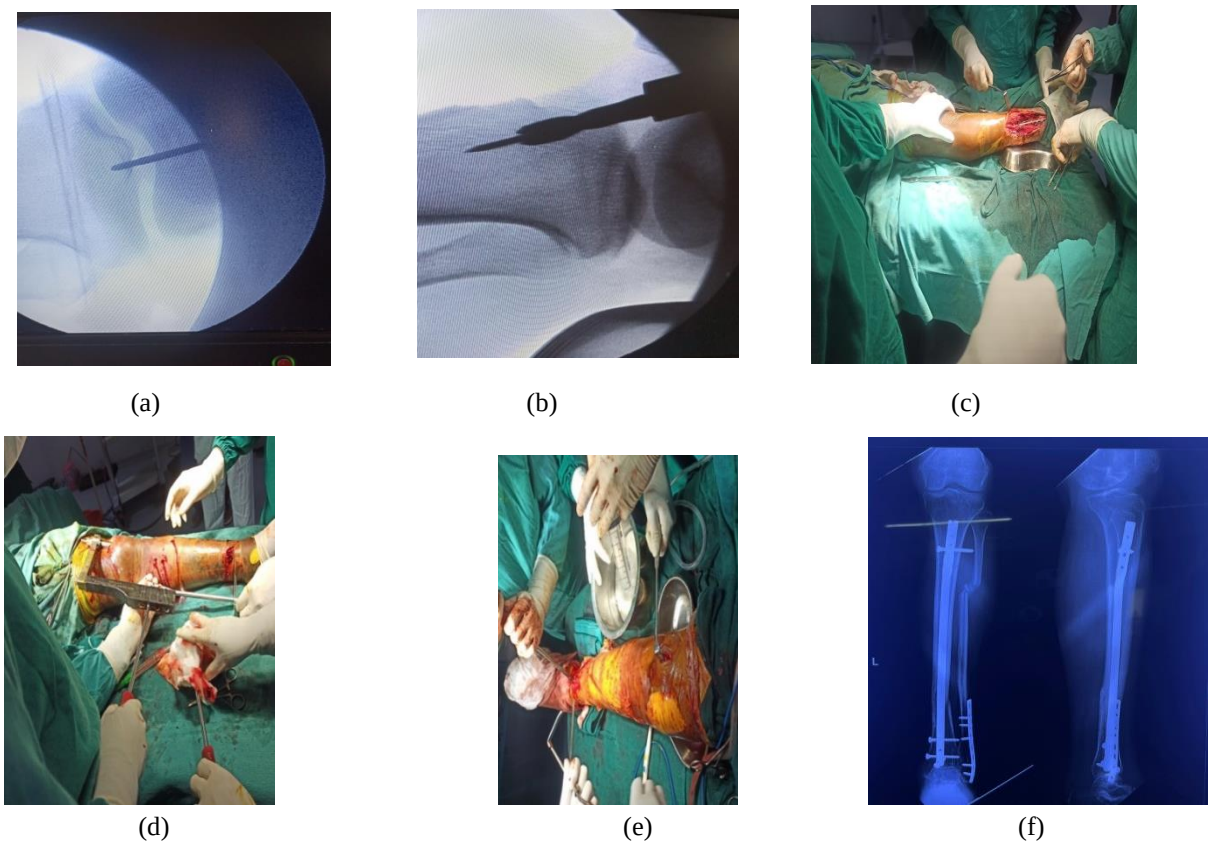

Fig 4. Surgical process (a) Entry site (b) Entry site (c) Fibula plating (d) Proximal Locking bolt (e) Distal locking bolt (f) X-ray at 6th month (post-operative).

Result:

The average time of injury to surgery was 3.6 days. The average time of operation was 129.15±18.35 minutes. 26 patients in the age range of 20-55 years were included. The average age of the patient was 38.7 years. 69% of the patients have a fracture on the left tibia. 80.8% of the fractures are due to road traffic accidents and the remaining are due to fall from height. All the fractures are closed 19 having grade I, 6 having grade 2, and 1 having grade 3 of Oestern and Tscherne classification. All the patients have fractures in the distal end of the tibia. 65.3% of the patients are male. The commonest fracture pattern is spiral 42.3 % followed by oblique 38.4 %. 69.2 % of the patients have associated fibular fractures of which 4 patients have fibular fractures within 5 cm of the angle joint which was fixed using a 3.5mm 1/3rd tubular plate. Partial fibulectomy of intact fibula at the proximal end was done for 8 patients. Reaming was done for all the patients. Partial weight bearing was started at 6 weeks (range 6-8 weeks). The average time of healing was 25.8 weeks (range 24-29 weeks). Dynamization was done for all the patients at 3 months. Full weight bearing was done for 96.1 % of the patients at 16 weeks except for 1 patient who had delayed union. For one patient belonging to OTA type C the union, partial weight bearing, and full weight bearing was delayed. 96.1% of the patients walked by a walker up to 3 months, with a pole from 3-5 months and without a pole after 5 months. Functional outcome was assessed was checked after a follow-up period of 12 months using Johner and Ruh criteria with 22 patients (84.6 %) showing excellent results, 3 patients (7.7 %) being good and 1 patient (3.85%) showing poor results.1 patients comprising 3.85% of the patients have limb shortening and anterior knee pain. Figure 5, 6 shows the clinical outcomes in serial follow-up visits in the OPD.

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Fig 5. Full weight bearing

Fig 6. Full Flexion

Table 1 shows the demography and fracture classification based on age, sex, etc. All the fractures are closed type and the location is distal tibia. Table 2 shows the result of this study using Johner and Wruh criteria.

Table 1. Demography and fracture classification

Classification according to:		**Number**	**Percentage**
Age(years)	20-35	10	38.5 %
36-40		10	38.5 %
41-55		6	23 %
Sex	Male	17	65.4 %
Female		9	34.6 %
Fracture classification	43A1.1	11	42.3%
(OTA)	43A1.2	10	38.4%
43A2.2		2	7.7%
43C1.1		3	11.6%
Associated Fibular Fracture		18	69.2%

Table 2. Result of the study using Johner and wruh criteria

Criteria	Excellent	Good	Fair	Poor
Non-union	None	None	None	None
NV injury	None	Minimal	Moderate	Severe
Deformity (In degree)				
Valgus/Varus	None	2-6	6-10	>10
Pro/Retrocurvatum(In degree)	0-5	6-10	11-20	>20
Rotation	0-5	6-10	11-20	>20

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Shortening	0-5mm	6-10mm	11-20mm	>20mm
Mobility				
Knee	Full	80%	75%	>75%
Ankle	>75%	>75%	50%	<50%
Subtalar	None	>50%	<50%	
Pain	None	Occasional	Moderate	Severe
Gait	Normal	Normal	Mild Limp	Significant
Strenous activity	Possible	Limited	Severe Restriction	Impossible
Result	84.6% (22)	7.7% (3)	nil	3.85% (1)

Discussion:

Intramedullary nailing through the suprapatellar approach has been described as a superior technique with fewer complications and better union for midshaft tibia fracture. But for distal tibia fracture, is still a matter inconclusive when compared to other techniques. The challenge increases more when the distal tibia fracture is complete intra-articular and has associated fibular fracture with syndesmotic injury. In our study, we have used the suprapatellar approach with the knee in semi extended position which was described for the first time by Tornettaet al[16]. Aided by fluoroscopy, anatomically better entry sites and better reduction of the fractures were achieved in our study. Instrumentation especially the introduction of the protective sleeve in the retropatellar space was not repeated twice which decreases the chances of patellofemoral joint injury. Anterior knee pain was documented significantly in only one patient during one year follow up which was corroborative to the findings published in the literature. Easier fluoroscopy and handling of the fracture site in a semi-extended position leads to easier reduction of the distal tibial fracture. Dynamization and the partial proximal fibulectomy may be the reason behind the

high union rates of the fractures in our study. The use of poller screw judiciously and plating of the associated fibula fracture within 5 cm of the ankle joint leads to better stability and less angular deformity which was also shown in the studies of Tyllianakis et al. Even though the purchase of distal screw was less in some cases there were significant union and less deformity with the use of modern tibial nail. Intra medullary nailing of the complete articular tibial fracture (OTA 43C1.1) was satisfactory with only one patient having poor and two showing good result in our study. The author opined the cautious use of intramedullary nailing for articular fracture distal tibial nailing.

In conclusion our study our 2 years of study and analysis of the study showed the osteosynhesis through intramedullary interlocking nail in distal tibial fracture including intra-articular fractures along with early dynamization, judicious use of poller screw, partial proximal fibulectomy and use of two distal imterlocking bolt in orthogonal fashion is a promising orthopedic management with favorable result. However further studies are still required in view of the poor result seen in one patient with complete articular fracture (OTA 43C1.1).

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