

**Original Research Article** 

# A PROSPECTIVE STUDY OF CLINICAL, FUNCTIONAL AND RADIOLOGICAL OUTCOME OF EXPERT TIBIAL NAIL FIXATION FOR DISTAL TIBIAL FRACTURES

M. Koteshwar Rao<sup>1</sup>, B. Sharukh<sup>2</sup>, S. Sai Bharath<sup>3</sup>

<sup>1</sup>Assistant Professor, Department of Orthopedics, Narayana Medical College and Hospital, Nellore, India. <sup>2</sup>Assistant Professor, Department of Orthopedics, Narayana Medical College and Hospital, Nellore, India. <sup>3</sup>Postgraduate, Department of Orthopedics, Narayana Medical College and Hospital, Nellore, India.

 Received
 : 07/03/2025

 Received in revised form : 06/05/2025

 Accepted
 : 23/05/2025

### **Corresponding Author:**

**Dr. M. Koteshwar Rao,** Assistant Professor, Department of Orthopedics, Narayana Medical College and hospital, Nellore, India. Email: koteee63@gmail.com

DOI: 10.70034/ijmedph.2025.2.276

Source of Support: Nil, Conflict of Interest: None declared

**Int J Med Pub Health** 2025; 15 (2); 1544-1551

#### ABSTRACT

**Background:** Distal third tibia fractures are common due to the bone's subcutaneous location and minimal muscle coverage, making them prone to complications such as delayed union, infection, and wound dehiscence. Various treatment methods exist, with interlocking nails and minimally invasive percutaneous plate osteosynthesis (MIPPO) being the most effective. Expert Tibia Nailing (ETN) has gained popularity due to its multi-axial locking system, providing superior stability. **Objective**: This study evaluates the clinical and radiological outcomes of extra-articular distal tibia fractures treated with ETN in comparison to plate osteosynthesis and external fixators.

**Materials and Methods**: A prospective study was conducted on 30 patients with extra-articular distal tibia fractures, assessing fracture healing, functional outcomes, and complications over a one-year follow-up period. Radiological evaluations included X-rays, CT, and MRI scans, while clinical assessments focused on joint mobility, weight-bearing ability, and complications.

**Results**: The results demonstrated an average fracture union time of four months, with early weight-bearing achieved in 80% of patients. Complications were minimal, with low rates of delayed union (3.33%) and infections (6.66%).

**Conclusion**: ETN offers excellent mechanical stability, early mobilization, and minimal soft tissue disruption, making it an effective primary treatment option for extra-articular distal tibia fractures. The study supports ETN as a superior alternative to traditional fixation methods

**Keywords:** Distal third tibia fracture, expert tibia nailing, tibio-fibular line, talar tilt.

### **INTRODUCTION**

Distal 1/3rd tibia fractures have high incidence, since the bone has little muscle tissue covering it and is subcutaneous,<sup>[1]</sup> Distal tibial metaphyseal fractures are the fractures which extend within approximately 4 cm from the tibial plafond Interlocking nails and minimal invasive percutaneous plate osteosynthesis (MIPPO) are the two most effective treatments for distal 1/3rd tibia fractures now accessible in orthopedic offices. The intramedullary nail saves extra osseous flow of blood and minimizes major soft tissue incision, allowing for load sharing.<sup>[2,3]</sup> Because there are more possibilities for angular locking, expert tibia nails are becoming increasingly popular.

The main objective of treating distal tibial fractures is to restore the normal or nearly normal alignment. Open fractures are much more common since subcutaneous nature of third of tibial surface along much of its length. Various methods of operative treatment are plate osteosynthesis, minimally invasive percutaneous plate osteosynthesis (MIPPO) and intra medullary nailing system.

The technique called as expert tibia nailing (ETN) allows early mobilization as well as continual maintenance of reduction. There is minimal to no disturbance of a fracture hematoma and a decreased risk of infection. Fractures that are below tibial tuberosity or three to four centimeters from the ankle joint may be aligned., fractures which are not stable can be stabilized, and their rotation and length can be controlled, because of the capability of nail locking at the proximal and distal ends.<sup>[4,5,6]</sup> Expert tibia nail provides extra stability in comparison to conventional intra medullary tibial nail due to multi-axial locking system.<sup>[7,8]</sup>

### **Objectives of The Study**

- 1. To assess the functional results of extra articular distal third of the tibia fractures treated using expert nailing
- 2. Main goal was to investigate fracture union using the radiological and clinical results.
- 3. Secondary goal was to look at the results, patient complaints, and postoperative problems.

### **MATERIALS AND METHODS**

This prospective observational study, conducted in Narayana General Hospital, aimed to evaluate the functional result of functional results of extra articular distal third of the tibia fractures treated using expert nailing. The time frame for this investigation was June 2022 to June 2024. Prior to surgery, the study participants had all the routine preoperative investigations. The study included a total of 30 patients have extra articular distal one third tibial fractures. All patients who underwent expert tibia nailing were included after giving their informed consent, using a simple sequential allocation method. There were two follow-up periods: three and six months. The study was carried out at the Narayana Medical College's Department of Orthopedics in Nellore, Andhra Pradesh.

### **Inclusion** Criteria

- 1. All distal 1/3rd tibial fractures that are extraarticular, AO (43-A) classification.
- 2. Patients of age > 18 years

#### **Exclusion Criteria**

- 1. Fracture of middle 1/3rd and proximal 1/3rd region of tibia.
- 2. Patients treated conservatively or any other method for other medical reasons.
- 3. Intra articular fractures
- 4. Pathological fractures.
- 5. Patients who either died before to the union of the fracture or were lost to follow-up.
- 6. People who have had neurovascular damage.

#### **Clinical Evaluation**

Every patient's complete medical history was obtained.

The patient's medical history was gathered since it provides a hint for analysing the injury's mechanism, which indirectly evaluates the velocity of the injury. The history of the patient's comorbidity was gathered because the effectiveness of the surgical operation is believed to be significantly influenced by it.

The examination revealed oedema, deformity observed on inspection & tenderness, abnormal movement, and crepitus felt during palpation. It is more crucial to assess the condition of the skin and look for any open wounds, bruising, or soft tissue swelling all the way around the ankle

Additionally, ipsilateral knee joint injury, distal tibiofibular injury, and syndesmotic injury were ruled out.

#### **Radiographic Evaluation**

Time to union, loss of reduction, and misalignment were all evaluated radiographically. AP & lateral images of the affected limb, consisting of the ankle and knee joints, comparisons were made during the radiographic evaluation

On both AP & Mortise views, this tibiofibular clear space should be smaller than 6 mm. Tibiofibular overlap of less than 10 mm is atypical and may indicate syndesmotic injury

Tibio-Fibular Line: Tibiofibular line is formed by the fibular medial aspect and the subchondral surface of distal tibia. It should be continuous, demonstrating that the articular surfaces of the distal fibula & talus are parallel to one another. Any disruption denotes shortening, rotation, & lateral malleolus lateral displacement as well as dislocation of the syndesmotic ligaments.

Talar Tilt: The superior joint space should not vary by more than 2 millimetres because this indicates a medial or lateral disturbance.

CT and / or MRI in patients with intraarticular injuries, hidden cartilaginous, ligamentous, tendon injuries

### Expert Tibia Nailing in Distal Tibia

- 1. PRINCIPLE: The nail serves like an internal splint by extending from one end to another end in the intramedullary canal. It enables the fragments opposing ends to be affected by the axial forces. In some cases, it also limits rotatory movement. It also restricts angulation and translation. In this, there is three places of contact seen between bone & the nail. The three sites are the entrance, the narrowest part of the intramedullary canal (Isthmus), & the cancellous bone at the other end (Three-point fixation)
- 2. INDICATIONS: Conventionally IMIL nailing is the gold standard for treating tibial fractures that occur between 5 cm just below knee and 5 cm above the ankle. The stability offered by IMIL nail rapidly declines as the line of fracture enters the tibia's metaphyseal zones. Recently, the metaphyseal region has been added to the indication of nailing. Currently, IMIL nailing is used to treat most of the type 1, type 2, and type 3A open and close tibial shaft/metaphyseal fractures.
- **3. Advantages:** Early fracture healing results from intramedullary nailing because it preserves the periosteal blood supply and fracture hematoma. Despite the fact that reamed nailing disturbs the endosteal blood flow, it enhances the periosteal blood flow. These are load-sharing devices as opposed to load bearing devices like plates. Consequently, the

possibility of periprosthetic osteopenia and fractures is present.

- 4. Disadvantages: There are a few issues in treatment of fracture tibia with traditional intramedullary interlocking nailing like trouble in controlling cracks of proximal and distal 1/third tibia and comminuted metaphyseal fractures
- Characteristics: Expert tibia nail is becoming 5. quite popular due to increased angular locking options. It provides extra stability in comparison to conventional intra medullary tibial nail due to multi-axial locking system with 5 proximal locking options and 4 distal locking options. Expert tibia nail contains multiple locking options at distal end of the nail. Despite short distal fragment these multiple locking options and their multidirectional alignment ensure more stability.



#### 6. Surgical Procedure

- a. Patients were kept nil by mouth (NBM) for 6–8 hours before surgery. Parts preparation done, suitable blood reserved. Nail length was predetermined by measuring from the tibial tubercle to the medial malleolus on the unaffected leg. IV antibiotics were administered one hour before surgery after obtaining written informed consent.
- b. Patients were placed in the supine position under spinal/epidural anesthesia in a sterile environment. The injured leg was scrubbed, painted and draped- The knee was fully flexed.
- c. The entry point was identified in the sagittal plane at the midpoint between the tibial articular surface and tibial tuberosity, just medial to the lateral tibial spine. The entry point was prepared using a bone awl, followed by the insertion of a guidewire. Surgical Approaches for Nailing includes Patellar Tendon Splitting Approach, Medial Para-Patellar Approach. Lateral Para-Patellar Approach
- d. Fracture reduction was achieved through traction and closed manipulation. If unsuccessful, an open reduction was performed.

- e. Sequential reaming was done up to one size larger than the required nail.
- f. The nail was inserted over the guidewire and advanced into the distal fragment using gentle hammer taps.
- g. Distal locking bolts (4.9 mm) were placed using the freehand method, while proximal bolts (dynamic and static) were secured with a jig.
- h. The wound was irrigated, hemostasis ensured, and soft tissues sutured using absorbable and non-absorbable materials.
- i. Postoperative Care NBM for 4–6 hours, with toe and ankle movements encouraged antibiotics for 5 days, followed by oral antibiotics for 7 days. Partial weight-bearing from day 1, progressing with toe-supported movements for 4–6 weeks. Full weight-bearing initiated after 6–8 weeks, with monthly follow-ups for up to a year.



- A. Instruments, scrubbing, draping, skin incision
- B. Entry point pictures including c arm pics
- C. Guide wire insertion and reaming
- D. Expert tibial nail with Jig and trocar

#### **Outcome Measures**

- 1) Knee Assessment
- a. Oxford Knee Score (OKS): A 12-item questionnaire assessing pain and function in total knee arthroplasty patients. Scores range from 0-60, with ≥35 considered satisfactory.
- b. Knee Range of Motion (ROM): Measured via goniometer at 1, 3, and 6 months post-op.
  2) Ankle Assessment: Ankle Range of Motion (ROM): Measured at 1, 3, and 6 months post-op using a goniometer. Normal ROM: Dorsiflexion 0-20°, Plantarflexion 0-40°

**3) AOFAS Ankle-Hindfoot Scale:** A standardized scoring system (0-100 points) incorporating pain, function, and alignment.

- 1. Pain (40 points): Ranges from none (40) to severe (0)
- 2. Function (50 points): Evaluates activity limitations, walking distance, gait abnormality, and joint motion
- 3. Alignment (10 points): Assesses foot positioning and stability

## RESULTS

### AGE DISTRIBUTION

13.33% (25–35 years),46.67% (36–45 years),33.3% (46–55 years),6.67% (≥56 years).Most patients (46.67%) were between 36–45 years.

Age group (in years)	Expet to	a nailing			Graph-1.4	oe Distri	bution	
	No. of petients(n)	Percentage %						
25-35	4	13.33	1					
36-45	14	46.67						
46-55	10	33.33	1					
254	2	6.67	ı					
Total	30	100	1					
Range	25 - ≥ 55 years			25.8	3-0		4.0	1.94

### GENDER DISTRIBUTION

Total patients: 30 (17 men, 13 women). Male-to-female ratio: 53:47



### SURGICAL APPROACH

Closed surgery: 22 patients, Open reduction & internal fixation: 8 patients

STATUS	Na	ling	n	. consider	recorden.
	No. of patients/n)	Percentage Phi		_	
Closed reduction	22	75			
Öpen reduction	8	25	0		
Total	30	100	a		
			4		
					1- 1
				Creat	lare .

### INJURY CAUSES

Road traffic accidents: 86.67%, Falls: 13.33%, No cases of ankle twisting in the nailing group.

Mode of injury	No. of patients (n)	Percentage (%)	Wode of injury
Road traffic accident	26	85.66	
Fail from height	2	6.66	i
Arikle twitt	2	6.66	
Total	30	100	Anitofication Affairings Article
			#168-010-0

# WEIGHT BEARING

Early weight-bearing: 80%, Delayed weight-bearing: 20%

Weight bearing	No. of patients(n)	Percentage (%)	18	Weight b	earing
Immediate	24	80	10 11		
Delayed	6	20	1		
Total	30	100		*Weight	bearing

### JOINT MOBILITY - KNEE

Full range: 22 patients, Normal: 6 patients, Near-normal: 2 patients

Knee ROM	No. of patients(n)	Percentage (%)	25		Knee ROM	
Full	22	73.33	15			
Normal	6	20	1			_
Near-normal	2	6.67		м	Normal	Nurvers
Total	30	100	1		Knee ROM	

### JOINT MOBILITY - ANKLE

Full range: 22 patients, Near-normal: 4 patients, Mid-range: 4 patients (26% had restricted motion)

Ankle ROM	No. of patients(n)	Percentage	Ankle ROM
Full range	22	73.33	2 · · · ·
Near- normal	4	13.33	-
Mid- range	4	13.33	
Total	30	100	# Anite FCM

### FRACTURE UNION

The nail group needed four to six months to unite. Average union duration was four months

months)	Union (in
Mean	Standard deviation (SD)
4.47	0.64

#### COMPLICATIONS ANKLE AND KNEE SCORE delayed union (3.33%), superficial infections (6.66%), wound dehiscence (3.33%) and Varus/valgus malunion (3.33%) Knee Score Complications of Percentage No. patients(n) Complications Ankle Score Delayed union 3.33 Mean SD Mean SD Non-union Ō Superficial 6.66 2 88.67 3.52 infection 48.86 4.98 Wound 3.33 dehiscence Varus\valgus 3.33 malunion 16.66 Total Cont

### CASE ILLUSTRATION

Case 1: A 44-year-old male who was hurt in an automobile accident sustained a closed fracture in his left lower extremity. The surgery involved a closed reduction & IMIL nailing with the application of apical and distal mediolateral locking bolts. His recovery from surgery was smooth and uneventful. At the follow-up, he had no problems, full ROM in both his knee and ankle, an outstanding ankle score, and a decent knee score.



**Case 2:** A 35-year-old man with a closed fracture who was hurt in an automobile accident to his left extremity underwent surgery that involved intramedullary nailing with apical and distal mediolateral locking bolts. His recovery from surgery was smooth and uneventful. He had outstanding ankle score, full knee score, no issues at follow-up, and nearly normal ankle and knee ranges of motion.



### DISCUSSION

The functional results of extra-articular distal 1/3rd of the tibia treated by using expert tibia nailing were evaluated in the results of the current study.

Expert tibia nail contains multiple locking options at distal end of the nail. Despite short distal fragment these multiple locking options and their multidirectional alignment ensure more stability. Gorczyca et al,<sup>[9]</sup> removed 1 cm from the tip of a routine interlocking tibia nail, which allowed placement of a greater number of distal locking screws in short distal fragment as compare to routine tibia nail. Attal et al,<sup>[10]</sup> also found that the modified locking options in expert tibia nail are able to provide more plains for screw fixation at both the ends of this implant and therefore providing more stability between the implant and fracture fragment.

Axial loading mechanisms with high or low energy cause distal tibia fractures. High energy fractures typically come with significant soft tissue injuries, distal tibial metaphyseal and articular fracture fragment comminution, and distal fibula fractures. Tibial Pilon fractures, which account for 10% of lower extremity fractures in adults, are more common in those who fall from a height or are involved in automobile accident. There is considerable controversy around the alternative course of treatment for these fractures

The distal tibia's vascular supply is precarious and there has been significant soft tissue injury, which is the cause of this. Distal tibia fractures may be challenging to treat because of their subcutaneous location, low vascularity, and minimal soft tissue. Treatment for these injuries depends on determining how serious the associated soft tissue injury is. Since closed and open fractures were a component of our investigation, we used the Tscherne classification of soft tissue injury to assess and rate the severity of soft tissue damage

Definitive fixation is indicated and carried out when the soft tissue damage has healed. The skin wrinkles indicator will become visible once the edema of limb has diminished

The fundamental guidelines for treating these fractures are as follows

- 1. Closed reduction & internal fixation of fracture of fibula to restore length and limb axis.
- 2. The distal tibia's articular surface anatomical reconstruction

Tibial diaphysis fracture rates (26 per 100,000 people per year). The rate of long bone fractures (per 100,000 people in a typical population) is the highest11 Professionals frequently agree that Expert nailing is the most popular technique since it maintains healthy organic circumstances, comprising healthy blood flow and soft tissues, as demonstrated by closed reduction & plaster application. In fracture cases, locking compression plate osteosynthesis is frequently used. Although 98% of cases end well, complications such

infections, wound dehiscence, mal union, & nonunion are frequently described

Mauffrey C. et al,<sup>[12]</sup> conducted a randomized pilot study to determine the outcome after intramedullary nailing or locking-plate placement revealed a balanced difference of,<sup>[13]</sup> points in the intramedullary nail's capacity rating record.

According to Charnley,<sup>[13]</sup> even though starting force may be sufficient to cause tibial fracture, the fibula is shielded by soft tissue and may have difficulties because of this. Macnab38 discovered that a Varus malunion could arise from a tibial fracture without a fibular fracture.

According to Macnab,<sup>[14]</sup> a Varus deformity may arise from a tibia fracture without a fibular fracture. According to Trueta et al. Additionally, issues like fractures have been seen during intramedullary canal reaming while nailing.

IMIL nailing may only maintain the configuration of the bone in cases of closed fractures of the tibial diaphysis without comminution; it may be desirable to use a plate that can both restore the configuration of the bone & apply compression on the shattered segments

It was discovered that open and closed fractures of the tibial diaphysis were commonly treated with intramedullary nailing (IMN). In order to address this problem, various nails & care technologies have been proposed, including locking screws holes at the tip of nails, multi - directional & point stable distally lock frameworks, and block screws to restrict the medullary cavity. However, problems with soft tissue (such as wound tissue necrosis and infection) and disruption of vascularity could affect the union of fracture

In our study, expert tibia nailing is used to treat the third of distal tibial fractures. To avoid issues related to soft tissue injury, the fracture repair was postponed for roughly two to three weeks. The

length and diameter of nails vary depending on the patient, while fibular fracture fixation is accomplished using a 1/3-tubular plate.

### Distribution by Age

In a group of 30 patients, according to the study's findings, the average age was  $45.67\pm7.66$  for the nailing group, which is comparable to Casstevens et al, Gupta et al and Arora et al,<sup>[15]</sup> where the average age of the patient was 48.4 years, 41.35 years and 45.2 years, respectively. This signifies that the middle age group involved in outdoor occupation has higher incidence of tibia fractures.

### **Distribution of sex**

Thirty patients were divided into 16 men and 14 women. In nailing, there are 53:47 men to females. 22 patients in the nailing group underwent closed surgery, whereas 8 underwent open reduction and fibular fixation.

Road traffic accidents were the most frequent cause of injury in the nailing group (86.67%), followed by falls from a height (6.66% occurrences), and injuries associated to twisting of the ankle (6.66% cases). This study was comparable to one that Mohammed et al,<sup>[16]</sup> previously described.

### Violence nature

In this study, road traffic accidents were the most frequent causes of fractures, followed by falls from a height and ankle twisting injuries. The outcomes were similar to those of research by Pawar et al., Roshan et al., and Kumar et al.<sup>[17]</sup> This research revealed that since industrialization and innovation have disrupted our lives, traffic accidents are the most frequent cause of harm. Additionally, Agrawal et al. observed that the most frequent cause of injuries was road traffic accidents.

#### Weight-bearing

In our study, the delayed weight-bearing was 20 percent in the nailing, which was statistically significant. The instantaneous weight bearing was 80 percent. According to Mukherjee et al,<sup>[18]</sup> the outcomes study was conducted.

### Ankle ROM

In our study, overall ankle score for nailing was excellent. The ankle joints' complete range of motion was available to the nailing group. The ankle's entire range of motion was 73.33%. The abnormal range of ankle motions was 26.67% in the nailing group.

This demonstrates that all patients had good ankle function restored. The outcomes are equivalent to the ankle function outcomes from the Badami et al,<sup>[19]</sup> trial.

### Knee ROM

The majority of patients had good knee function returned. Nailing group had a knee joint that can move fully to almost normally. The whole range of movements was used 73.33% of the time when nailing. Knee ROM was typical at 20.00 percent in the expert nailing group. Additionally, the near normal range of ankle movements was 6.67% for nailing. These outcomes are similar to how the knee performed in the trial by Gonsalves et al.<sup>[20]</sup> As a result, patients who had treatment in our study had good overall functional outcomes.

### Union time

The union took place in the nail category on average for four months. In this study, the union's interim period was  $4.47\pm0.64$  months for nailing group. In their investigation, Saied A et al. reported that the the nailing union took  $4.34\pm1.45$  months. Additionally, in the Vallier et al18. trial, all patients' tibial fracture union rates were 4.7 months, which falls in line with the results of the current study.

### Ankle score

In our study, the mean ankle score for the nailing group was  $88.67\pm3.52$ . The ankle scores ranged from good to excellent. The findings of this study were contrasted with those of Dutta et al.

### Knee Score

The average knee score in our study was 48.86±4.98. The knee scores ranged from good to outstanding. Results from the current study were compared to those from Baral et al

#### Complications

In the current study, nailing is advised as the preferred course of treatment for distal third tibial fractures. Complications such as delayed union, malunion, superficial infection and wound dehiscence, were observed (16.66%). Superficial infection was the most common complication identified (6.66%) of patients.

Expert tibia nail is a load-sharing implant. The union rate is higher because of the preservation of the fracture hematoma & the cambium layer of periosteum, which is required for bony healing. Loading can be carried out early using an expert nail and without having to open the fracture site. Theoretically, nailing has the benefits of minimally invasive surgery, a preserved fracture hematoma, and the potential for autograft material during reaming. With increased inertia & load-sharing device support, the biomechanics are improved. For the treatment of 1/3rd tibial fractures, nailing is a much simpler, quicker, more reliable, and more successful approach.

### **CONCLUSION**

### Summary

- 1. The various, multidirectional distal locking options available in distal tibia fractures allow ETN to provide good mechanical and rotational stability.
- 2. Therefore, as would be expected in the case of distal tibia fractures, therapy with ETN is linkedto a shorter hospital stay, early functional recovery, including weight bearing, and union within afair amount of time. As a result, it is a widely applicable primary treatment option for distal tibia fractures. Patients expressed greater satisfaction with nailing.
- 3. The nailing group experienced a small number of difficulties due to the very straightforward and quick operation approach.
- 4. There were no instances of non-union. The incidence of postoperative infection was quite low.
- 5. Since nails are load-sharing implants, instantaneous weight-bearing could be started.
- 6. According to the current study's findings, nailing is better in extra articular distal one third tibia fractures without comminution because it reduces implant-related problems and enables early weight bearing and fracture union.

### Conclusion

The goal of the study was to evaluate the functional outcome of treatment of extra articular distal 1/3rd tibial fractures using expert tibia nailing. The prospective trial included 30 individuals with extraarticular distal 1/3rd tibial fractures who were treated with expert tibia nail. The patients were evaluated radiologically & clinically during a standard follow-up of one year. for the presence of tenderness just at fracture site, the manner of injury, discomfort with movement of the ankle and knee joints, the knee score, the ankle score and the frequency and seriousness of sequelae.

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