**RESEARCH PAPER**

# Clinical Outcomes of Distal Tibial Fractures Managed with Expert Intramedullary Nailing: A Prospective Study

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**ABSTRACT**

**Objective:** The purpose of this study is to assess the functional results of ETNtreated distal third tibial fractures, with an emphasis on comorbidities, union rates, and functional recovery.

**Introduction:** The predominant bone accountable for bearing weight is the tibia and the most commonly fractured long bone, with distal tibial fractures presenting significant challenges due to instability, soft tissue injury, and limited blood supply. This study evaluates the outcomes of Expert Tibial Nailing (ETN) for distal third tibial fractures, aiming to assess radiological union, functional recovery, and complications. Given the complexities of treatment options, including ORIF and external fixation, the study explores ETN's effectiveness in providing enhanced stability and facilitating early mobilization.

**Materials and Methods:** Forty patients with distal third fractures of the tibia who received treatment at Chettinad Hospital and Research Institute using Expert Tibial Intramedullary Nails participated in this prospective study. Inclusion criteria included skeletally mature adults with extra-articular fractures (AO Classification 43-A1, 43-A2, 43-A3), while excluding certain conditions like pathological fractures and knee arthroplasty. Postoperative assessments included radiographic evaluation for fracture union and alignment, along with functional outcomes using AOFAS and HSS scores at 1, 3 and 6 months

**Results:** The study included 40 patients with distal tibial fractures, primarily aged 31-40 years, predominantly male (65%), and resulting from road traffic accidents (100%). The fractures were classified as AO types 43A1 (55%) and 43A2 (45%). 18.8 weeks was an average time to fracture union. Over the course of six months, functional outcomes as determined by AOFAS and HSS scores considerably improved. 60% of patients at 6-month follow-up had excellent outcomes, 20% good, and 20% fair. Complications included cellulitis, ankle stiffness, knee pain, valgus deformity, and delayed union. Most complications were minor and manageable, with excellent functional recovery

**Conclusion:** The study found that Expert Tibial Nailing is a successful approach for treating distal tibial fractures, with 80% of patients experiencing good to excellent functional outcomes. With an average union time of 18.8 weeks and minimal manageable complications, this technique ensures significant recovery and improved clinical outcomes over a 1-year follow-up.

**Keywords:** *distal tibia fractures, expert tibial nail, functional outcome,*
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## INTRODUCTION

With a yearly incidence of roughly two fractures per 1,000 people, the tibia is the most often broken long bone and the primary bone that bears weight in the leg. As a major load-bearing bone of the lower limb, fractures of the tibia can lead to prolonged morbidity and significant disability if not treated appropriately. Tibial fractures are more likely to result in open fractures than other long bones because to their subcutaneous anteromedial surface, which also frequently causes serious bone and soft tissue injuries. [1]

In the diaphysis, the distal tibia has a triangular morphology; in the metaphysis, it becomes more rounded. Fractures in the distal metaphyseal region, classified as AO types 43A1, 43A2, and 43A3, are particularly challenging since the region's restricted blood supply makes them vulnerable to delayed or non-union [2]. Muller defined distal tibial metaphyseal injuries as those occurring within a square extending 4 cm proximal to the tibial plafond, with non-articular fractures being those without extension into the plafond.The cause and prognosis of these fractures are different from those of pilon fractures, and surgical therapy is made more difficult by their close proximity to the ankle joint.

Ankle stiffness, non-union, as well as malunion have historically been linked to conservative treatment of distal tibial fractures [3]. Early approaches to treatment included immobilization using above-knee slabs, plaster casts, and functional braces. However, these methods often resulted in prolonged recovery times and complications. Notably, Sisk (1983) highlighted the drawbacks of prolonged immobilization, emphasizing the need for a treatment method that allows early mobilization and weight-bearing. Similarly, the Sarmiento-type patellar tendon-bearing brace, while widely used, has shown limitations, including an average union time of 5.7 months and residual shortening.

There are several choices available with modern surgical procedures, such as intramedullary nail placement, minimally invasive percutaneous plate osteosynthesis , open reduction of bone with internal fixation , and external fixation. Because of the potential for joint stiffness, pin tract infections, the failure to union, and malunion, external fixation is frequently saved for short-term stabilization. Even while ORIF achieves accurate reduction, it has been linked to a significant risk of complications, notably infections and late union, as well as intense harm to soft tissues . In contrast, the MIPO technique provides stable fixation while maintaining the blood flow and soft tissue integrity.[4]

Because of improvements in nail design and reduction procedures, intramedullary nailing—which is the gold-standard treatment for tibial diaphyseal fracture—is becoming more and more accepted for distal tibial [5]. The Expert Nail was specifically developed for metaphyseal fractures, offering enhanced biomechanical stability through multiple interlocking options in various planes. These features make the ETN particularly suitable for managing extra-articular tibial metaphyseal fractures[6].

Ultimately, the decision between conservative and surgical management must be tailored to the individual case, considering the specific fracture pattern and patient circumstances. There is still disagreement over whether technique is better for distal tibial fractures despite a large number of studies juxtaposing nail and plating. Therefore, clinical expertise and judgment remain critical in selecting the most appropriate treatment. The purpose of this study is to figure out the radiological union, functional results, and undesirable outcomes of employing Expert Nail for adult distal third fracture of tibia. [7]

## MATERIALS AND METHODS

After receiving institutional approval, this study, which involved 40 patients, was carried out in the Department of Orthopaedic Surgery at Chettinad Hospital and Research Institute from the month of July 2022 to May month of 2024 to examine the functional outcome of expert tibial intramedullary nailing for distal third shaft of tibia fractures.

**Inclusion criteria:**
Skeletally Mature Patients Age Above 18 Yrs.

Extraarticular Metaphyseal Fractures Of Distal Tibia.

Closed Fracture as well as open fracture with GA I and GA II grades

Fracture Pattern [ AO Classification 43-A1, 43-A2, 43-A3][8]

**Exclusion criteria:**
Skeletally Immature Patients below 18 Yrs.

Pathological Fractures.

Knee Arthroplasty.

Intra Articular Fracture of Distal Tibia.

Grade III Open Fractures.

## OPERATIVE PROCEDURE

The patient is placed on the surgical table in a supine posture, with the knee flexed at a 90° angle and supported by a pillow or bolster, or with the legs dangling off the edge or side of the surgical table. Usually, a closed technique with manually executed traction, manipulation, if needed reduction clamps under guidance of fluoroscopic imaging is used to reduce fractures. A vertical incision is made through the patella tendon. Using an awl, the entry point is established along the medullary canal axis, confirmed wih fluoroscopy. A guidewire with a ball tip is advanced to the distal fragment after being implanted. Guidewire is swapped out for a smooth one and sequentially reaming is done. The nail is introduced under

fluoroscopic guidance once the size of nail is established fluoroscopically. A jig is used for proximal locking, whereas a freehand method is used for distal locking.[figure 1]

**ASSESSMENT**

Anteroposterior as well as lateral postoperative X-rays were obtained in order for determining nail alignment, screw placement, reduction, and overall alignment. Four weeks, three months, and six months were the times for follow-ups (figure 2). During these visits, radiological assessments monitored fracture union and alignment, while clinical evaluations assessed knee and ankle ranges of movement, healing progress, returning to routine activity ,any discomfort in their knee, limb length, also if any deformities. Functional results were assessed at first month , third month and sixth month using the (AOFAS) score and (HSS) Knee Rating Scale. AOFAS assigns 40 points for pain, 50 points for function, and 10 points for alignment, for a total score of 100. The six components of the HSS scoring system include knee flexion deformity, range of motion, function, muscular strength, stability, and pain, with respective point allocations of 10, 18, 22, 10, 10, and 30.On radiographs, the finding of bridging callus across a minimum of 3 cortices indicated union of fracture . Radiographic assessments of malalignment included by drawing a line traversing the midpoints of the medial cortex and the lateral cortex was used to assess varus-valgus deformities on AP views and checking anterior-posterior angulations on lateral views using a vertical line through the anterior and posterior cortices.[9]

**RESULTS**

The study included 40 patients, as detailed in Table 1 and Table 2 . The majority (35%) were in 31-40 age range, with 40.25 ± 14.66 years as an mean age . The cohort consisted of 26 males (65%) and 14 females (35%). Injuries were predominantly on the right side (60%) compared to the left (40%). All cases (100%) resulted from road traffic accidents (RTA). Among these, 32 patients (80%) had closed injuries, while 8 (20%) suffered open injuries. Additionally, 36 patients (90%) had an associated fibula fracture.

The fractures were classified into 43 A1 and 43 A2 types, with 22 cases (55%) being 43 A1 fractures and 18 cases (45%) classified as 43 A2 fractures. Biplanar screw orientation was noted in 55% of cases, while 45% had triplanar screw orientation. The minimum follow-up period for all patients was 6months . The average fracture union time was 18.80 ± 3.58 weeks, with a range of 12 to 28 weeks.

The AOFAS scores improved significantly during the follow-up period. Preoperatively, the mean score was 0, increasing to 56.30 ± 8.11 at 1 month, 70.85 ± 6.71 at 3 months, 88.60 ± 6.26 at 6 months, and 90.23 ± 5.28 at 6months . Similarly, the HSS scores demonstrated significant improvement. The mean preoperative score was 0, which increased to 59.60 ± 7.37 at 1 month, 73.60 ± 5.54 at 3 months, 86.60 ± 6.62 at 6 months, and 89.46 ± 6.88 at 6months . The consistent increases in both AOFAS and HSS scores were statistically significant across all follow-up intervals.

60% of the participants had outstanding results, 20% had acceptable results, and another 20% had fair results, according to outcome evaluation. Complications were observed in 8 patients: 1 had cellulitis, 2 experienced ankle stiffness, 2 reported anterior knee pain, 1 developed valgus deformity, and 2 had delayed fracture union.

Overall, the study highlighted significant functional recovery and improved clinical outcomes over the follow-up period, with the majority of patients showing excellent to good results. Complications were minimal and manageable.

**DISCUSSION**

Fractures of tibia in distal shaft are a intricate orthopaedic challenge because of their instability, superficial location, limited soft tissue coverage, and poor blood supply. Usually injuries such like these are caused by higher energy axial and rotational forces, leading to significant management difficulties. Treatment strategies vary and include intramedullary nailing, plating, external fixation (such as AO or Ilizarov techniques), and conservative methods. Nonoperative approaches are considered for stable fractures or patients with severe comorbidities but carry risks such as delayed union, malunion, and joint stiffness. Locking plates, known for rigid fixation and anatomical alignment, often necessitate extensive dissection, which increases the likelihood of wound complications. Intramedullary nailing, while less invasive, presents technical challenges in distal fractures; however, its effectiveness improves with the use of blocking screws and multiplanar locking techniques[10]. ± 14.66

The age distribution in this study showed a mean of 40.25 years, which is consistent with findings from other studies like Memon et al., who reported a mean of 39 years, and Arora et al., who found an average of 42.3 years.Conversely, Wang et al. identified a higher mean age of 52.2 years in their study population[11][12]. In this study of 40 patients, males constituted the majority, with 26 men and 14 women. This male predominance is consistent with similar studies, including Nork et al., who reported a male-to-female ratio of 24:12, and Kachhap et al., who documented 18 males and 12 females among their 30 patients[13][14]. All injuries in this study were caused by road traffic accidents (RTA), similar to Kachhap et al., who attributed 93.3% of injuries to RTA, and Kiran et al., where RTAs accounted for 76.6% of cases[15].

Injury distribution in the current study revealed a predominance of right-sided fractures, with 24 cases compared to 16 on the left. This is consistent with studies like Kachhap et al. (17 right-sided versus 13 left-sided injuries) and Khalil et al. (12 right-sided compared to 9 left-sided fractures)[16]. However, Arora et al. observed a slightly different pattern, with a marginally higher number of left-sided injuries (13) compared to right-sided ones (12) among their patients. Closed fractures accounted for

the majority of cases (32 out of 40), a finding that aligns with the studies of Megas et al. and Nork et al., which found a higher prevalence of closed injuries compared to open fractures[17].

Fracture classification using the AO/OTA system in this study showed that the most common type was 43-A1, with 22 cases, followed by 43-A2, with 18 cases. Similarly, Megas et al. observed that 43-A1 and 43-A2 were the most frequent types in their study. Fibula fractures were a common associated injury, present in 90% (36 of 40) of cases in this study. These findings align with prior studies by Megas et al., who reported fibula fractures in all 18 patients, and Nork et al., where 35 out of 36 patients had concomitant fibula fractures.

Mean period required for union of this study was 18.80 ± 3.58 weeks, which closely matches the 18.2 weeks reported by Kiran et al. Shorter healing times were observed in studies such as those by Memon et al. and Megas et al. (16 weeks), while longer union durations were reported by Nork et al. (23.5 weeks). Fibula plating was performed in three cases but did not significantly affect healing outcomes. This observation is consistent with Khalil et al., who found no significant impact of fibula plating on fracture union. On the other hand, Renne Attal et al., documented delayed healing in patients with fibula plating (37.5%) compared to those without (4.8%)[18].

Dynamization, a subsequent technique used to promote bone repair, was not necessary for any of the patients in the present investigation. In contrast, findings by Megas et al. and Nork et al. reported cases where delayed healing necessitated dynamization. The mean of the study's follow-up length was six months, which is consistent with follow-up durations of Elsherbiny et al. and Khalil et al studies [19].

In our study, complications were observed in 8 patients: 1 with cellulitis, 2 with ankle stiffness, 2 with anterior knee pain, 1 with valgus deformity, and 2 with delayed fracture union. Comparing with other studies, pain in the anterior aspect of was the most frequent complication, reported in 3 out of 21 patients in Khalil S.A. et al. and 3 out of 30 in Kiran et al.

The AOFA score was used to assess functional outcomes, yielding a mean score of 88.60 ± 6.2, which is identical with the outcomes of Wang et al., who also reported an average AOFA score of 88.60. Additionally, the HSS Knee Rating Scale used , to measure knee functionality, with a mean score of 86.60 ± 6.2 in this study. This result was higher than the 82.3 mean score reported by Kachhap et al., highlighting excellent outcomes in the current study[20].

The study has several limitations. The result's generalizability is limited by the small sample size of 40 patients. Six months of following up is insufficient to assess long-term outcomes and complications. Being a single-center study, it may not reflect variations in surgical expertise and patient demographics. Additionally, the exclusion of severe cases, such as Grade III open fractures and intra-articular fractures, limits its applicability to complex injuries. Lastly, the lack of randomization restricts comparisons with alternative treatment methods.

## CONCLUSION

Distal tibial fractures are hard to address considering their inherent instability, minimal soft tissue coverage, superficial location, and limited blood supply. Nonoperative management is occasionally employed for stable fractures in patients with significant comorbidities but is often associated with complications like malunion, delayed union, and joint stiffness. Locking plate fixation offers stable alignment and better mechanical properties than traditional methods but requires significant soft tissue exposure, increasing risk of wound related complications and infections. Frequent hardware removal is another drawback. The Intramedullary Expert Nail provides a superior alternative with multidirectional locking options, ensuring better biomechanical stability while preserving soft tissue. It reduces complications such as valgus/varus deformities, infections, and irritation caused by hardware. Moreover, it allows for early weight-bearing, facilitating faster recovery and better functional outcomes, particularly in extra-articular fractures. However, to validate these results and improve distal tibial fracture treatment techniques, larger, multicentre trials with more extensive follow-up are necessary.

**Clinical message:**

The Intramedullary Expert Nail is recommended due to its enhanced stability and soft tissue preservation, allowing for quicker recovery and earlier weight-bearing. While locking plates are effective for fracture alignment, they come with a higher risk of wound complications, requiring careful consideration when selecting treatment options.

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**CONSENT**- The patient has given consent for their photo and details to be published in the case report.

**COMPETING INTERESTS**- Authors declare that there is no competing interest.

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**Table 1.** Demographic details of a study group.

| **Mean age (years)** | **40.25± 14.66** |
|---|---|
| Gender (n, %) | Male 26(65%) Female 14(35%) |
| Side (n, %) | Right 24 (62.5%) Left 16 (37.5%) |

**Table 2.** Study variables

| **Mechanism of injury (n, %)** | **Road traffic accident 40(100%)** |
|---|---|
| Type of injury | Open-8(20%) Closed-32(80%) |
| Classification (n, %) | 43 A1-22(55%) 46 A2-18(45%) |
| Follow-up | 1 Year |

| | |
|---|---|
| Associated injury | Fibula fracture-36(90%) |
| Time of union | 18 ± 3.58 weeks |
| HSS score | 86.60±6.62 |
| AOFAS Score | 88.60±6.26 |
| Complications | Total- 8(20%)<br>Cellulitis-1,<br>Ankle stiffness-2,<br>Anterior knee pain-2,<br>Valgus deformity-1<br>Delayed fracture union-2. |

**Figure 1-**Intra operative pictures

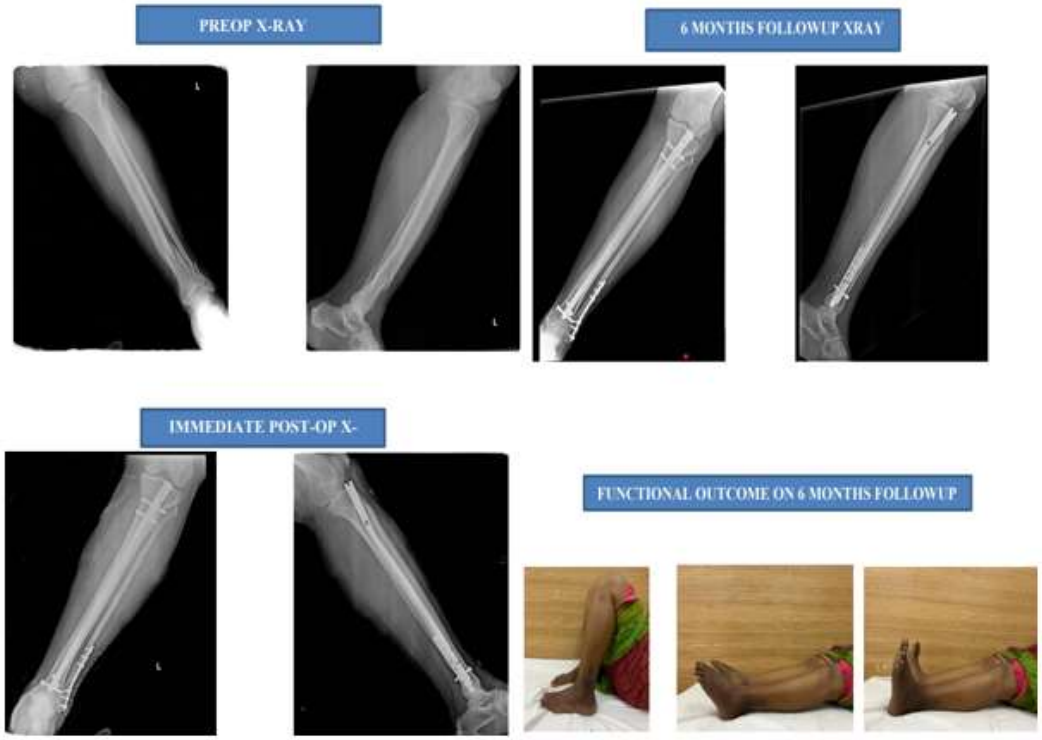


**Figure 2-**Distal 1/3rd tibia fracture fixed with expert tibial nail with good functional outcome