

## Prospective Study of Surgical Management of Distal Tibial Fractures in Adults

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### Abstract

The incidence of tibial shaft fracture that too distal end fracture is on the rise due to increased rate of road traffic accident by two-wheeler users, specially due to the traffic scenario in cities of our country. High speed vehicles, bad roads and rapid industrialization has further compounded the problems. In this prospective study, we studied 20 patients that suffered a distal tibial fracture. They were managed by intramedullary nailing with or without fixation of the fibula. Results were based on radiological and functional outcomes categorized by excellent, good, fair and poor. We evaluated the rate of fracture union and post-operative complications. 65% of the patients had an excellent outcome, 25% had good, 5 had fair and 5 had a poor outcome. 6 patients suffered complication. The average time to union was 15 weeks. Our study concluded the excellent outcomes that could achieved by intramedullary nail with the distal locking screw.

**Keywords:** Distal tibial fractures; Controversial issues; Intramedullary nailing; Fixation of the fibula

### Introduction

The incidence of tibial shaft fractures especially those of the distal end are on the rise due to increased rate of road traffic accident by two wheeler users, partly due to the traffic scenario in the Indian Subcontinent. High speed vehicles, poor infrastructure and rapid industrialization has further compounded the problem.

Managing distal tibial fractures is a dreadful experience both for treating orthopaedic surgeons and patients. A major reason is the relative poor vascularity of the distal segment which delays the fracture healing. It is difficult to obtain a satisfactory reduction and rigid fixation due to the short distal segment resulting in instability at the fracture site. Conservative management of these fractures were highly unacceptable as it caused severe shortening, non-union, mal-union and ankle stiffness.

Closed intramedullary interlocking nailing is accepted by most surgeons, as the treatment of choice in distal diaphyseal fractures. There are many controversial issues in the management of fractures of distal tibial shaft with closed intramedullary nailing. Its role in distal third fractures is fairly established provided two distal locking screws are put at right angles to each other and the associated fibular fracture is fixed to avoid angulation when it is close to articular surface.

In this study, we evaluated the functional outcome of surgical management of distal one third tibial fracture using closed intramedullary interlocking nail versus plate fixation by minimally invasive technique. The fibula was not fixed in all the cases. The study aimed at highlighting the efficacy of each of these methods of treatment by analysing results using, arene ekland, bjorne thoresse criteria.

### Materials and Methods

Patients presenting to the emergency department or the outpatient clinic from May 2010 to April 2011 with distal tibial fractures were chosen in this study. Only those that were treated surgically were included. Patients history and physical examination was conducted, and were only selected if a written informed consent was taken. Any fracture pattern i.e. transverse, oblique or communitated patterns and all the types including closed or Gustillo Anderson's type 1 and type 2 compound fracture were included.

	Excellent	Good	Fair	Poor
<b>Tibial Mal Alignment and Shortening</b>				
i. Varus/valgus	2.5	5	10	>10
ii. Internal rotation	5	10	15	>15
iii. External rotation	10	15	20	>20
iv. Shortening	1 cm	2 cm	3 cm	>3 cm
<b>Range of Knee Motion</b>				
i. Flexion	>120	>90	<90	<60
ii. Extension lag	5	10	15	15
<b>Range of Ankle Motion</b>				
i. Dorsiflexion	>20	20	10	<10
ii. Plantar flexion	>30	30	20	<20
<b>Foot Motion as a Fraction of Normal</b>				
i. Range of motion	05-Jun	02-Mar	01-Mar	01-Mar
ii. Pain	none	sporadic	Significant	Severe
iii. Swelling				

	none	minor	Significant	Severe
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**Table 1:** Criteria for evaluation.

Those patients aged below 18 years, type 3 compound fractures or those with associated head injuries were excluded from our study. After preoperative radiographic assessment and planning the patients were either treated with an intramedullary nail or with distal tibial locking plate using the minimally invasive technique. Patients were followed up regularly at 3 weeks, 6 weeks and 6 months. At each follow up visits, they were also assessed for the radiological union and complications.

The functional outcomes of the patients were assessed and divided into 4 categories: excellent, good, fair and poor. These results were determined by the criteria defined in Table 1.

## Results

A total of 20 patients participated in this study. There were 13 males and 7 females. Age of the patients ranged from 27 to 52 years with the mean age being 39.5 years. Tibial fractures were commonly seen between the age group of 31 to 50 years. 6 patients were aged less than 30 years, were between 31 and 50 years and 6 were more than 50 years of age.

We classified the patients according to the type of fracture. 4 had a tibial fracture of the A1 type, 6 belonged to the A2 category, 7 were of the A3 type and 3 patients belonged to the C1 type of fracture. When taking the presence of open fracture, 14 had a closed fracture, while 6 had a compound fracture according to the Gustillo Anderson classification [1]. We also studied the time it took to convert the patient's ambulation to full weight bearing (Table 2).

Full weight bearing in weeks	Number of patients	%
7 weeks	8	40
8 weeks	11	55
10 weeks	1	5
Total	20	100
Mean ± SD: 7.70 ± 0.73		

**Table 2:** Full weight bearing in weeks.

In 55% cases of our study weight bearing started at 8 weeks, 40% at 7 weeks this one-week difference was because of mild pain. In one case, we delayed because of the loss of follow up regularly. The average time for union in all the patients was 15 weeks (Table 3). 2 cases presented with signs of delayed union where did dynamization was done at 20 weeks. The fractures successfully healed at 28 weeks.

Radiological weeks	union	Number of patients	%
<10 weeks		0	0.0
11-15 weeks		15	75.0
16-20 weeks		3	15.0
>20 weeks		2	10.0

Total	20	100.00
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**Table 3:** Radiological union (weeks).

Complications	Number of patients (n=20)	%
Absent	14	70.0
Present	6	30.0
Ankle stiffness	2	10.0
Delayed union + Ankle stiffness	2	10.0
Varus	2	10.0

**Table 4:** Complications.

Table 4 shows the rates of complication. Two of our patients suffered ankle stiffness of varying degrees. We had two delayed unions due to more distraction i.e. 4 mm to 5 mm at the fracture site, both of whom underwent dynamization at 3 months. Their fracture united after 5 months following which they suffered had ankle stiffness due to lack of physiotherapy. This could have been secondary to pain and hence were classified as fair and poor outcome as per our criteria. The outcomes of all the cases is depicted in Table 5.

Results	Number of patients (n=20)	%
Excellent	13	65.0
Good	5	25.0
Fair	1	5.0
Poor	1	5.0

**Table 5:** Results.



**Figure 1:** Weight bearing and ankle movements.

We had 13 patients with excellent results, 5 patients with good, 1 patient with fair and 1 patient with poor outcome. There had two delayed unions due to more distraction i.e. 4 to 5 mm at the fracture site both underwent dynamization at 3 months' fracture united after 5 months these two patients also had ankle stiffness due to lack of physiotherapy due to pain so both of them had fair and poor outcome as per our criteria (Figure 1).

## Discussion

Fractures of the distal tibia are among the most difficult fractures to treat effectively. The status of the soft tissue, the degree of comminution, articular damage sustained at the time of injury affect the long term clinical results. The goal of operative treatment is to obtain anatomical realignment of the joint and providing enough stability to allow early motion. This should be accomplished using techniques that minimize osseous and soft tissue devascularisation resulting from treatment.

The present study was undertaken to determine the outcome distal tibia fracture treated surgically. Our study revealed the average age of patients with such injuries to be 39.5 years. A few other studies on similar fractures conducted by Gaudinez et al. studied patients whose average age was 35 years while a study by Barbieri et al. and Kenneth Koval et al. had patients with ages averaging at 39 years [2-5]. The current study had a male preponderance of 65% while a study by Barbieri et al. revealed a population where 67% were male.

Our study correlates with the study conducted by Barbieri et al. in which they noted 75% due to high energy trauma in our study it is 70% due to RTA. The study Barbieri et al. showed 9% of A1, 9% of A2, 10% of A3, 16% of C1, 32% of C2, and 24% of C3 types of fractures. The current study had higher % of A2 30% and A3 35% patterns. This study also had 30% open fractures (type 1-20%, type 2-10%) comparable to Ovadia and Beals who also had 30% open fractures in his study [6].

In our study of 20 patients, 19 patients were fixed with IMIL nail which included open and closed fractures and AO types A1, A2. There was a single fracture belonging to the C1 type i.e. intraarticular extension one fracture which had severe that was treated with a distal locking plate by MIPPO technique. This case was the only case where the fibula was fixed. This is not comparable to other studies where majority were managed with external fixators [7].

The average duration of the operative time in the current study was 90 minutes which is comparable to the study conducted by Gaudinez et al. which was 86 min. In 55% cases in our study, weight bearing was started after 8 weeks. Barbieri et al. also reported similar outcome. In one case, we delayed by 2 weeks because of lack of compliance of patient and irregular follow up. The average time for fracture union in various studies conducted using various methods was 13-16 weeks. In our study, the average time for fracture union was 15 weeks which is comparable to studies conducted by Barbieri et al. and Gaudinez et al. that reported 14 weeks and 15 weeks respectively [8-10].

In a study that established open reduction with plate and screw fixation as the standard, Ruedi and Allgower achieved 74% acceptable results in 84 patients. Mast et al. reported 78% satisfactory results in 37 patients with a minimum follow-up interval of 6 months. Bourne and colleagues studied 42 patients with tibial plafond fractures, 62% of whom were victims of high energy trauma. Of the Ruedy type 3 fractures treated by open reduction and internal fixation, only 44% had

satisfactory results. The majority of these fractures were complicated by non-unions, infection and arthrodesis [11].

Ovadis and Beals studied 34 fractures with only 44% good to excellent results with numerous complications like superficial infections or skin loss and osteomyelitis. Teeny and Weiss studied 60 distal tibial fractures. They reported 50% poor results when ORIF was used. Mc Ferran et al. reported 52 tibial intraarticular fractures treated with ORIF 40% of the patients suffered some complication, with deep infection or osteomyelitis occurring in 43% of fractures, and a wound break down requiring soft tissue coverage in 62% of fractures [12-15].

For patients with distal fourth fractures, Johnson et al. modified the nail by cutting 1 cm of the distal nail. According to them, removal of 1 cm from the tip of nail allowed placement of two distal locking screws in distal fragment located 4 cm from tibiotalar joint [16]. The fixation strength achieved was comparable to that of standard nailing of tibial fractures located 5 cm from the distal locking screws. Twenty-six patients (80%) in their series recovered and achieved normal knee, ankle and subtalar joint movements. 4 patients suffered complications that included non-union, nail breakage, delayed union treated previously by an osteopath, and one segmental fracture with 50 antero-posterior angulations, which was supported with a patellar tendon bearing cast [17-20].

It is extremely difficult to make true comparisons between these studies because the method of classification, number of high energy injuries, and functional scoring system all differ. However, when critically analysing the outcomes of this study with respect to earlier studies, the comparison is favourable.

In our study, we had 13 patients with excellent results, 5 patients with good, 1 patients with fair and 1 patient with poor outcome. However, we excluded the C3 fractures, which formed a significant part of other similar studies. The patients in this study had a favourable outcome [21].

Three of our patients had ankle stiffness of varying degrees which was probably due to non-compliance of the patients to the physiotherapy regimen as advised. We had two delayed unions due to distraction of 4 mm to 5 mm at the fracture site. Both underwent a dynamization at 3 months following which the fracture united after 5 months [22]. These two patients also had ankle stiffness since they were unable to carry out physical therapy citing pain a cause. Hence, they suffered fair and poor outcome as per our criteria. 2 patients had various angulation of less than 2.5 degrees.

Drawbacks of our study included the small size of our study population. There are many other factors that determine the wound healing of distal tibia leg wounds such as diabetes and vascular disease. These were not taken into consideration [23-25].

## Summary

Twenty cases of fractures of distal one third tibial fracture treated surgically were studied from May 1st 2010 to April 30th 2011. 20 patients have underwent closed interlocking intramedullary nailing with distal tip locking with fibula fixation.

There were 13 males and 7 female patients, with a mean age 39.5 years. Most of the fractures were caused by road traffic accident. Transverse fractures being most common fracture pattern. There were 14 closed and 6 open fractures (GA type 4, GA type II 2). All the

patients were fixed with standard technique and followed up for an average of 10 to 12 months [26-29].

The average duration of surgery was 90 minutes. Two of our patients had ankle stiffness of varying degrees and 2 had two delayed union due to more distraction i.e. 4 mm to 5 mm at the fracture site. The latter underwent dynamization and also encountered delayed union followed by stiffness of the ankle [30-32].

## Conclusion

According to our study, 20 patients have undergone intramedullary nailing with fibula fixation. With newer systems that allow locking at the distal tip closed intramedullary nailing is a better technique for treating most of distal one third tibial fractures. The method is safe and effective in achieving solid union with minimal number of complications [33].

It does provide adequate stability and allows early motion as well as rapid union by preserving the blood supply to the distal fragment and skin over distal part of leg. Most of the complications following interlocking intramedullary nailing are preventable with meticulous care during preoperative, intraoperative and post-operative periods.

In our study, we recommend intramedullary nailing for distal one third fractures of the tibia with the newer distal tip locking system. We can consider fibula fixation when the fracture is close to articular surface.

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