



Original Article

Comparative Study Between Intra Medullary Nail Fixation and Plate Fixation in Distal Tibia Fracture

Mohammad Khaza Ahamed¹, Mohammed Mahfoozur Rahman², Golam Sarwar³, Debashis Chakrabarty⁴

Abstract

Background: Distal tibial fractures are among the most commonly encountered long bone injuries. A variety of treatment approaches have been explored for the management of displaced fractures in this region. The two commonly used methods include plate fixation and intramedullary nailing. The aim of our research was to assess and compare the effectiveness of intramedullary nailing and plate fixation in the treatment of distal tibial fractures. **Materials and Methods:** This prospective comparative study included 60 patients aged >18 years with extra-articular distal tibial fractures who underwent surgical fixation with either intramedullary nailing or plate fixation at Eastern Medical College Hospital, Cumilla, Bangladesh, from January to December 2025. Patients were divided into two groups: intramedullary nailing (n=30) and plate fixation (n=30). After obtaining informed written consent, data were collected through face-to-face interviews using a pretested structured questionnaire that included sociodemographic data, clinical findings, and pre- and postoperative outcomes. Follow-up assessments were performed at 4, 8, 12, and 24 weeks postoperatively, and complications were recorded each visit. Data was analyzed using SPSS version 25.0. Ethical approval was obtained from the Review Board of Eastern Medical College. **Results:** Most patients were in the 31-50 years age group in both the nail fixation (53.3%) and plate fixation (60%) groups, with comparable mean ages (38.59±12.7 vs 37.86±11.2 years). Males were slightly more common in both groups. Motorcycle accidents were the most frequent cause of injury, and AO Type A fractures were the predominant fracture pattern. Nail fixation showed significantly faster fracture union (20.1 vs 22.8 weeks, $p=0.01$) and earlier weight-bearing (15.1 vs 16.3 weeks, $p=0.01$) compared to plate fixation. The overall complication rate was higher in the plate fixation group (46.7%) than in the nail fixation group (23.3%), with infections occurring only in the plate fixation group. **Conclusion:** The findings of this study suggest that both intramedullary nailing and plate fixation are safe and effective for the treatment of distal tibial fractures. However, intramedullary nailing may be considered a preferable option due to its shorter operative time, reduced hospital stays, earlier full weight-bearing, and lower infection rate.

Keywords: Distal tibia fracture, Intramedullary nailing, Plate fixation, Fracture management, Postoperative outcomes.

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Introduction

The tibia is a key weight-bearing bone of the lower limb, articulating proximally with the femur at the knee joint and distally with the ankle¹. Fractures of the distal tibia can occur due to both high- and low-energy trauma and are frequently seen in road traffic accidents and sports-related injuries, representing approximately 37.8% of all tibial fractures^{1,2}. Distal tibial fractures are commonly defined as extra-articular fractures occurring within 4 to 12 cm of the tibial plafond, corresponding to AO classifications 42A1 and 43A1. Fractures of the distal tibia are further classified based on their morphology and the extent of comminution. Type 43-A1 represents simple, non-comminuted extra-articular fractures, 43-A2 denotes wedge fractures, and 43-A3 includes comminuted extra-articular fractures. Fractures with

simple intra-articular extension without depression of the articular surface are categorized as 43-B1 and are often managed similarly to 43-A fractures³⁻⁵. The overall annual incidence of tibial fractures is approximately 51.7 per 100,000 population, while diaphyseal and distal tibial fractures occur at rates of 15.7 and 9.1 per 100,000 population per year, respectively⁶.

Management of distal tibial fractures is often difficult because of their distinct anatomical features, including minimal soft tissue coverage and limited blood supply, particularly along the anteromedial surface where the bone lies close to the skin⁷. Various treatment options are available for tibial shaft fractures, such as closed reduction with

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casting, functional bracing, open reduction and internal fixation using plates and screws, external fixation, and intramedullary nailing. Among these, intramedullary nailing (IMN) and plate fixation are currently the most widely used approaches for treating distal tibial fractures⁸. IMN is a minimally invasive technique that requires small incisions, allows relatively easy implant removal, preserves extraosseous blood supply, and results in less soft tissue disruption³. It promotes earlier fracture union and weight-bearing while lowering the risk of several complications⁹⁻¹¹. However, it is associated with certain drawbacks, particularly anterior knee pain and the risk of malunion¹². Plate fixation may be carried out using either open reduction and internal fixation (ORIF) or minimally invasive percutaneous plate osteosynthesis (MIPO). The ORIF technique involves wider surgical exposure and greater soft tissue dissection, which may increase the likelihood of wound-related complications and delayed fracture union¹³.

Both intramedullary nailing (IMN) and minimally invasive percutaneous plate osteosynthesis (MIPO) have their respective advantages and limitations, as discussed earlier. However, only a limited number of studies have directly compared MIPO with IMN. Despite the reported success of these techniques and their favorable outcomes, including lower rates of infection and malunion, the optimal treatment approach remains a subject of ongoing debate^{14,15}. The aim of our research was to assess and compare the results of intramedullary nailing and plate fixation, focusing on factors such as surgical duration, length of hospital stay, time to fracture union, infection rates, and complications related to healing, including non-union and malunion.

Materials and Methods

Study Design: This prospective comparative study involved 60 patients with either gender with age of >18 years and who underwent surgical fixation of extraarticular distal tibia fractures using either intramedullary nail fixation or plate fixation. The research was conducted from January 2025 to December 2025 at Eastern Medical College Hospital in Cumilla, Bangladesh. Patients were categorized into two distinct groups: the intramedullary nailing group, which comprised 30 individuals who underwent intramedullary nailing, and plate fixation group, consisting of 25 individuals who received plate fixation surgery. **Data Collection Procedure:** After obtaining informed written consent, data was collected through face-to-face interviews using a pre-tested structured questionnaire. The questionnaire included sections on sociodemographic characteristics, clinical examination findings related to the fracture, and preoperative and postoperative outcomes. Follow-up assessments were conducted at 4, 8, 12, and 24

weeks postoperatively. Any complications were recorded during each follow-up visit. **Inclusion Criteria:** Patients diagnosed with an extra-articular distal tibia fracture of either sex, aged 18 years or older, who are medically fit to undergo surgical intervention, are willing to provide informed consent and participate in the study were included. **Exclusion Criteria:** Patients with proximal or distal intra-articular tibial fractures, those presenting with open distal tibia fractures or pathological fractures, unfit for surgery and/or anaesthesia, and those unwilling to participate in the study were excluded from the study. **Statistical Analysis:** Collected data were entered into Microsoft Excel and analyzed using SPSS version 25.0. Descriptive statistical methods, including frequencies, percentages, means, and standard deviations, were applied to summarize the data. The Chi-square test was applied to assess associations between categorical variables, and a p-value of <0.05 was considered statistically significant. The findings were presented through tables, figures, and narrative descriptions. **Ethical Consideration:** Ethical permission was taken from the IERB of Eastern Medical College. Written informed consent was obtained from all participants, and strict measures were taken to ensure the confidentiality and anonymity of the data.

Results

The majority of cases in the study belonged to the 31-50 years age group in nail fixation groups (53.3%) and plate fixation group (60%). The mean age was 38.59 ± 12.7 and 37.86 ± 11.2 years in nail fixation and plate fixation group respectively with not statistically significant (Table-I). Figure-1 illustrates the sex distribution by fixation method. In the nail fixation group, there were 16 males and 14 females, while in the plate fixation group, males were 18 and females were 12 in number. Overall, males were more frequent in both groups.

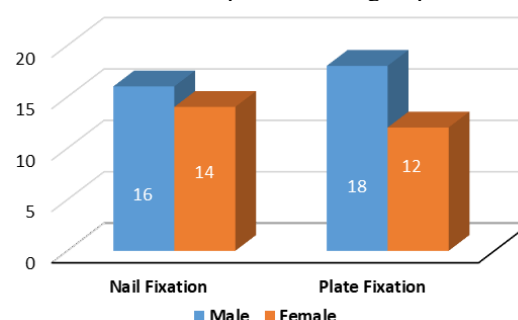


Figure-1: Gender distribution of the study participants (n=60)

Motorcycle accidents were the most common cause of fractures in both groups (66.7% in nail fixation and 63.3% in plate fixation), followed by falls (20.0% and 23.3%) and other vehicle accidents (13.3% in both groups). There was no statistically significant difference in the etiology of fractures

between the two groups ($p=0.95$) (Table-II). Table-III demonstrated that the majority of fractures in both groups were AO Type A (70.0% in nail fixation and 73.3% in plate fixation), followed by Type B (20.0% and 23.3%) and Type C (10.0% and 3.3%). There was no statistically significant difference in the distribution of AO fracture types between the two groups ($p = 0.57$). Among the patients with tibial fractures, nail fixation was performed in 13 left-sided and 16 right-sided tibial fractures, while plate fixation was done in 17 left-sided and 14 right-sided fractures, showing slightly higher nail fixation on the right side and plate fixation on the left side (Figure-2).

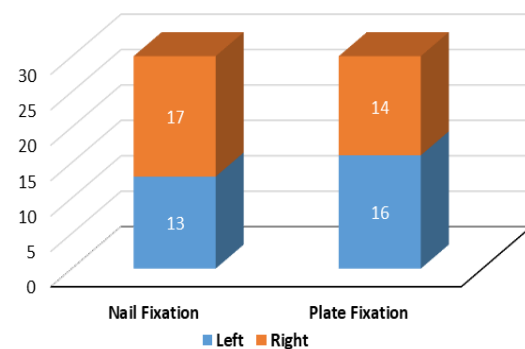


Figure-2: Fracture site distribution of study participants (n=60)

Table-I: Age distribution of the study cases (n=60)

Age distribution	Nail Fixation n (%)	Plate Fixation n (%)	Total (%)	p-value
18-30 years	9 (30)	8 (26.7)	17 (28.3)	*p=0.86 ^{ns}
31-50 years	16 (53.3)	18 (60)	34 (56.7)	
>50 years	5 (16.7)	4 (13.3)	9 (15)	
Total	30 (100)	30 (100)	60 (100)	
Mean±SD	38.59±12.7	37.86±11.2		**p=0.82 ^{ns}

ns=non-significant; p-value obtained from χ^2 test and **t-test

Table-II: Etiology of Fractures among the Study Cases (n = 60)

Etiology	Nail Fixation n=30	Plate Fixation n=30	Total (%)	p-value
Motorcycle	20 (66.7)	19 (63.3)	39 (65.0)	p=0.95 ^{ns}
Fall	6 (20.0)	7 (23.3)	13 (21.7)	
Other vehicle	4 (13.3)	4 (13.3)	8 (13.3)	
Total	30 (100)	30 (100)	60 (100)	

ns=non-significant; p-value obtained from χ^2 test

Table-III: Distribution of Fractures According to the AO Classification (n=60)

AO Type	Nail Fixation n=30	Plate Fixation n=30	Total (%)	p-value
Type A	21 (70.0)	22 (73.3)	43 (71.7)	p=0.57 ^{ns}
Type B	6 (20.0)	7 (23.3)	13 (21.7)	
Type C	3 (10.0)	1 (3.3)	4 (6.7)	
Total	30 (100)	30 (100)	60 (100)	

ns=non-significant; p-value obtained from χ^2 test

Table-IV: Comparison of Operative and Postoperative Outcomes between Nail Fixation and Plate Fixation Groups (n = 60)

Parameters	Nail Fixation n=30	Plate Fixation n=30	p-value
Duration of surgery (mins)	61.7±4.3	63.4±3.02	p=0.09 ^{ns}
Fracture union time (weeks)	20.1±1.32	22.8±1.12	p=0.01 ^s
Weight bearing start (weeks)	15.1±0.66	16.3±0.89	p=0.01 ^s
Duration of hospital stay (days)	4.5±0.5	4.7±0.5	p=0.23 ^{ns}

ns=non-significant; s=significant; p-value obtained from 't'-test

Table-IV shows that nail fixation showed faster fracture union (20.1 vs 22.8 weeks, $p=0.01$) and earlier weight bearing (15.1 vs 16.3 weeks, $p=0.01$) than plate fixation, while there was no difference in

surgery duration and hospital stay between groups ($p>0.05$). Table-V describes that complications were observed in both groups but were higher in the plate fixation group than in the nail fixation group

(46.7% vs 23.3%). Infection occurred only in the plate fixation group in 4 (13.3%) cases. Malunion was found in 2 (6.7%) patients in the nail fixation group and 5 (16.7%) in the plate fixation group. Non-union occurred in 2 (6.7%) cases in the nail fixation group and 3 (10%) cases in the plate fixation group. Implant-related pain was reported in 3 (10%) patients in the nail fixation group and 2 (6.7%) patients in the plate fixation group.

Table-V: Complications Observed in Nail Fixation and Plate Fixation Groups (n = 60)

Complications	Nail Fixation n (%)	Plate Fixation n (%)
Infection	0 (0.0%)	4 (13.3%)
Malunion	2 (6.7%)	5 (16.7%)
Non-union	2 (6.7%)	3 (10%)
Implant-related pain	3 (10%)	2 (6.7%)
Total complications	7 (23.3%)	14 (46.7%)

Discussion

Distal tibial fractures have long been regarded as difficult to manage due to the compromised blood supply to both the bone and overlying skin. Moreover, the severity of injury often leads to rapid post-traumatic swelling, which can delay early internal fixation. The primary objective in treating these fractures is to achieve proper restoration of length, alignment, and rotational stability while maintaining the integrity of the surrounding soft tissues¹⁶. These days, plate fixation and intramedullary nailing are regarded as the cornerstones of tibial shaft fracture care¹⁷. In this study, 60 patients were enrolled during the study period. The majority of cases in the study belonged to the 31-50 years age group in nail fixation groups (53.3%) and plate fixation group (60%). The mean age was 38.59±12.7 and 37.86±11.2 years in nail fixation and plate fixation group respectively with not statistically significant. Nath, et al.¹⁶ showed the mean age of the patients in the intramedullary nailing group was 36.4±13.1 and in the plating group was 38.6±15.1 with no statistical difference of age between the groups. Besides, males were more frequent in both groups of this study. Male predominance was also observed in other studies^{16,18,19}. The higher incidence of distal tibial fractures in males may be attributed to higher exposure to trauma from occupational, sports, and risk-taking activities.

Regarding the etiology of the fractures, motorcycle accidents were the most common cause of fractures in both groups (66.7% in nail fixation and 63.3% in plate fixation), followed by falls (20.0% and 23.3%) and other vehicle accidents (13.3% in both groups). Gok, et al.¹⁹ reported motorcycle and bicycle collisions were the most common causes of fracture

followed by fall in both groups. Motorcycle accidents were the most common cause, likely due to higher motorcycle use and risk-taking behavior among young males. We classified the fractures according to the AO (Arbeitsgemeinschaft für Osteosynthesefragen) classification system, which categorizes fractures based on the fracture line. The majority of fractures in both groups were AO Type A (70.0% in nail fixation and 73.3% in plate fixation), followed by Type B (20.0% and 23.3%) and Type C (10.0% and 3.3%). A similar observation was also observed by Gok, et al.¹⁹.

Among the patients with tibial fractures, nail fixation was performed in 13 left-sided and 16 right-sided tibial fractures, while plate fixation was done in 17 left-sided and 14 right-sided fractures, showing slightly higher nail fixation on the right side and plate fixation on the left side. Regarding fracture site distribution, Gok et al.¹⁹ reported that among patients treated with intramedullary nailing, 12 (48%) had fractures on the right side and 13 (52%) on the left side. Among those treated with plating, 15 patients (55.5%) had right-sided fractures, while 12 patients (44.4%) had left-sided fractures. This findings are very similar to our study. Tibial fractures were more commonly observed on the right side, possibly due to the dominant limb being more exposed to trauma during activities such as walking, driving, and road traffic accidents.

In this study, regarding the surgical procedure nail fixation showed significantly faster fracture union (20.1 vs 22.8 weeks) and earlier weight bearing (15.1 vs 16.3 weeks) than plate fixation. Patil, et al.¹⁸ also reported meantime for fracture union was significantly shorter in nailing group as compared to plating (19.20 vs. 23.8 weeks). Another meta-analysis found that patients treated with intramedullary nailing achieved union earlier than those treated with plate fixation¹⁷. This meta-analysis¹⁷ also found that intramedullary nailing conferred a 1.71-week shorter time to partial weight bearing and a 2.61-week shorter time to full weight bearing. In this study, there was no significant difference in the duration of surgery between the two groups (61.7 ± 4.3 vs 63.4 ± 3.02 minutes). A similar finding was reported by Nath et al. However, studies by Daolagupu, et al.²⁰, Guo, et al.²¹, and Janssen, et al.²² reported a significantly longer operative time in the locking compression plate group compared with the intramedullary nailing group.

Mean duration of hospital stay was comparable in both nailing and plating group, respectively (4.5±0.5 vs 4.7±0.5 days). This finding is comparable with the finding by Patil, et al.¹⁸. Similarly, Yu et al.²³, in their meta-analysis, concluded that for the treatment of distal tibial fractures, intramedullary nailing and

plating are comparable with respect to hospital stay. Regarding complications malunion was found in 6.7% patients in the nail fixation group and 16.7% in the plate fixation group. Non-union occurred in 6.7% cases in the nail fixation group and 10% cases in the plate fixation group. Infection occurred only in the plate fixation group in 13.3% cases. Implant-related pain was reported in 10% patients in the nail fixation group and 6.7% patients in the plate fixation group. Nath, et al.¹⁷ reported that the rates of nonunion and delayed union were 5% and 8.2 in the intramedullary nailing group, and 4.3% and 11% in the plate fixation group. It was also reported in that study that, 15.4% of patients developed malunion in intramedullary group, which was higher than 10.3% in the plate fixation group.

In the study by Daolagupu, et al.²⁰ observed that complication rate was comparable among the two groups in regards with delayed union, malalignment, joint stiffness. However, a higher rate of infection was found in plating patients (4 vs 2). Nath et al.¹⁷ also reported that the intramedullary nailing group was associated with a significantly lower risk of wound infection compared to plate fixation (6.5% vs 15.2%). Superficial infection subsided with intravenous antibiotics and continued dressing and healed eventually. Most important postoperative complication in nailing group was anterior knee pain (10%). Rahman, et al.²⁴ reported the Incidence of anterior knee pain in nailing cases was 30%.

Limitations

This study was conducted using a non-randomized design, which may introduce potential bias. Additionally, the relatively short follow-up period and the small sample size may have contributed to the lack of a statistically significant difference in functional outcomes was observed between the groups.

Conclusion and Recommendations

The findings of this study suggest that both intramedullary nailing and plate fixation are safe and effective methods for the treatment of distal tibial fractures. However, intramedullary nailing may be considered a preferable surgical option due to its advantages in terms of shorter operative time, reduced hospital stays, earlier full weight-bearing, and a lower rate of infection. Further research is required to better understand the advantages and disadvantages of different treatment options for distal tibial fractures. Addressing this issue will require well-designed randomized controlled trials with larger sample sizes to compare outcomes between the two techniques.

Conflict of interest

The authors declared that they have no conflicts of interest.

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