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ORIGINAL ARTICLE

A Comparative Study of Intramedullary Interlocking Nailing Versus Distal Tibial Plating in Distal Tibial Fractures

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ABSTRACT

Background: *Distal tibial fractures are difficult to manage because of limited soft tissue coverage and a high risk of complications. Intramedullary interlocking nailing (IMIL) and distal tibial plating (DTP) are commonly used fixation methods; however, the optimal technique remains controversial. This study aimed to compare the clinical and functional outcomes of IMIL and DTP in the management of distal tibial fractures.* ***Methods & Materials:*** *This comparative study was conducted in the Department of Orthopedics, Shaheed Ziaur Rahman Medical College Hospital, Bogura, Bangladesh, from July to December 2025. Fifty patients with distal tibial fractures were equally allocated into two groups: IMIL (n=25) and DTP (n=25). Socio-demographic variables, fracture characteristics, operative parameters, time to union, functional outcomes (Johner and Wruhs criteria), and complications were recorded and analyzed.* ***Results:*** *Baseline characteristics were comparable between groups. IMIL showed significantly shorter operative time (68.4 vs 92.6 minutes), lower blood loss (120 vs 210 ml), shorter hospital stay (4.1 vs 6.3 days), and earlier partial weight bearing (4.5 vs 6.2 weeks) (p<0.001). Fracture union occurred earlier in the IMIL group (15.2 vs 17.6 weeks; p=0.01). Excellent functional outcomes were more frequent with IMIL (48% vs 32%), though not statistically significant. Infection rates were higher in the plating group, whereas mild malalignment was slightly higher with IMIL.* ***Conclusion:*** *IMIL provides better perioperative outcomes, faster recovery, and fewer wound complications compared to plating and may be considered the preferred treatment for most extra-articular distal tibial fractures.*

Keywords: *distal tibial fracture, intramedullary interlocking nail, distal tibial plating, functional outcome, fracture union.*

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INTRODUCTION

Distal tibial fractures represent a challenging subset of long bone injuries and account for a significant proportion of lower limb fractures encountered in orthopedic practice [1]. These fractures commonly occur as a result of road traffic accidents, falls from height, and sports-related trauma, particularly among young and economically active individuals [2]. Because the distal tibia has limited soft tissue coverage and relatively poor vascularity, fractures in this region are frequently associated with soft tissue damage, delayed healing, infection, and malalignment [3]. Achieving stable fixation while preserving the surrounding soft tissues remains a major concern in the management of these injuries [4].

Various surgical techniques have been developed to treat distal tibial fractures, among which intramedullary interlocking nailing (IMIL) and distal tibial plating (DTP) are the most commonly used methods [5]. Intramedullary interlocking nailing is a minimally invasive procedure that provides stable fixation through a load-sharing device placed within the medullary canal [6]. It preserves the fracture biology, minimizes soft tissue disruption, reduces blood loss, and often allows early mobilization and weight bearing. However, it may be associated with technical difficulties in maintaining alignment in very distal or intra-articular fractures and may occasionally cause anterior knee pain [7].

On the other hand, distal tibial plating, particularly with locking compression plates, allows direct visualization of the fracture site and provides accurate anatomical reduction, especially in metaphyseal and intra-articular fractures [8]. Despite these advantages, plating requires a larger surgical exposure and may increase the risk of soft tissue complications, infection, and delayed wound healing due to the subcutaneous location of the tibia [9]. The choice between these two techniques remains controversial and often depends on fracture pattern, soft tissue condition, surgeon experience, and available resources [10].

In developing countries, additional factors such as high patient load, limited healthcare resources, infection risk, and the need for early return to work further influence treatment

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decisions [11]. Therefore, selecting an optimal fixation method that ensures faster recovery with minimal complications is particularly important in this setting [12].

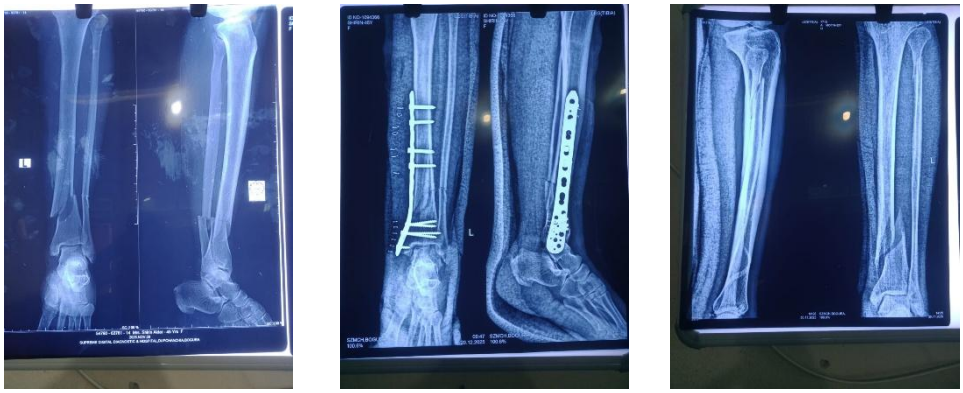
This study was conducted to compare the clinical, radiological, and functional outcomes of intramedullary interlocking nailing and distal tibial plating in the management of distal tibial fractures, with the aim of determining the more effective and practical treatment option for patients treated at Shaheed Ziaur Rahman Medical College Hospital, Bogura.

METHODS & MATERIALS

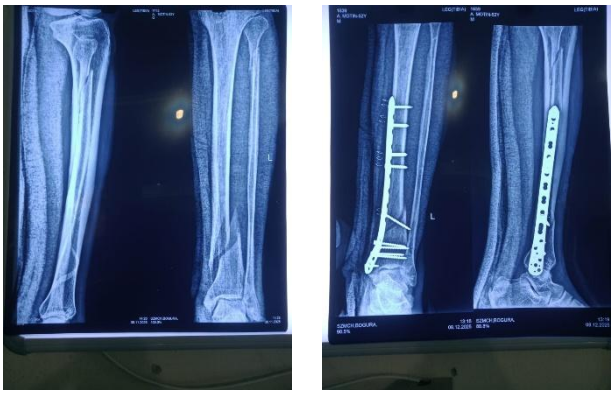
This comparative study was conducted in the Department of Orthopedics, Shaheed Ziaur Rahman Medical College Hospital, Bogura, Bangladesh, over a six-month period from July 2025 to December 2025. A total of 50 patients with distal tibial fractures who fulfilled the eligibility criteria were enrolled. Patients aged 18 years or above with closed or Gustilo–Anderson grade I–II open distal tibial fractures were included, while those with pathological fractures, polytrauma requiring staged procedures, severe open fractures (grade III), or associated neurovascular injuries were excluded. After admission, detailed history, clinical examination, and radiological evaluation were performed. The patients were allocated into two equal groups of 25 each according to the surgical procedure performed: Group I underwent intramedullary interlocking nailing (IMIL) and Group II underwent distal tibial plating (DTP) using open reduction and internal fixation techniques.

All operations were performed under regional or spinal anesthesia following standard aseptic precautions by experienced orthopedic surgeons. Preoperative prophylactic antibiotics were administered in all cases. Postoperatively, patients received routine analgesia, antibiotics, limb elevation, and physiotherapy. Early mobilization and progressive weight bearing were encouraged depending on fracture stability and clinical condition. Patients were followed up regularly at 2, 6, 12, and 24 weeks for clinical and radiological assessment. Operative time, intraoperative blood loss, hospital stay, time to weight bearing, and time to fracture union were recorded. Functional outcomes were evaluated using Johner and Wruhs criteria, and complications such as infection, delayed union, malalignment, and implant irritation were documented. Data were analyzed using standard statistical methods (SPSS), and a p value of <0.05 was considered statistically significant.

RESULT



a) Preoperative fracture view b) Postoperative plate fixation c) Early callus formation



d) Progressive fracture healing e) Complete fracture union

Figure – 1: Radiographic evaluation of distal tibial fracture before and after surgical management showing plating fixation and subsequent healing.

Figure 1 demonstrates the sequential radiographic evaluation of a distal tibial fracture managed with plating. The images show the preoperative fracture pattern, immediate postoperative fixation with plate and screws, and progressive healing during follow-up, culminating in complete fracture union with maintained alignment and stable implant position.

Table I presents the socio-demographic characteristics of the study population comprising 50 patients equally distributed between the IMIL (n=25) and DTP (n=25) groups. The mean age of the patients was comparable between the groups (36.8 ± 11.2 years in IMIL vs 38.5 ± 10.6 years in DTP; p=0.58), with most patients belonging to the 31–40 years age group (38%).

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Males predominated in both groups, accounting for 74% of the total sample. Road traffic accidents were the most common mode of injury (62%), followed by falls (30%).

Table – I: Socio-demographic Characteristics of the Study Population (*n* = 50)

Variables	IMIL (n=25)	DTP (n=25)	Total (n=50)	p value
Age (years), mean ± SD	36.8 ± 11.2	38.5 ± 10.6	37.7 ± 10.8	0.58
Age group				
18–30	8 (32%)	6 (24%)	14 (28%)	0.87
31–40	9 (36%)	10 (40%)	19 (38%)	
41–50	5 (20%)	6 (24%)	11 (22%)	
>50	3 (12%)	3 (12%)	6 (12%)	
Sex				
Male	19 (76%)	18 (72%)	37 (74%)	0.74
Female	6 (24%)	7 (28%)	13 (26%)	
Mode of injury				
Road traffic accident	15 (60%)	16 (64%)	31 (62%)	0.92
Fall	8 (32%)	7 (28%)	15 (30%)	
Others	2 (8%)	2 (8%)	4 (8%)	

Table II illustrates the fracture characteristics of the study population. The right side was slightly more commonly involved than the left (58% vs 42%), with similar distribution between the IMIL and DTP groups (p=0.78). Most fractures were extra-articular, accounting for 70% overall, with a higher proportion in the IMIL group (80%) compared to the DTP group (60%), while intra-articular fractures were relatively more frequent in the plating group; however, the difference was not statistically significant (p=0.11). The majority of injuries were closed fractures (86%), and only 14% were open grade I/II injuries. The mean time to surgery was comparable between groups (3.2 ± 1.1 days in IMIL vs 3.5 ± 1.4 days in DTP; p=0.41), indicating similar baseline fracture patterns and timing of intervention.

Table – II: Fracture Characteristics of the Patients (*n* = 50)

Variables	IMIL (n=25)	DTP (n=25)	Total (n=50)	p value
Side involved				
Right	14 (56%)	15 (60%)	29 (58%)	0.78
Left	11 (44%)	10 (40%)	21 (42%)	
Fracture type				
Extra-articular	20 (80%)	15 (60%)	35 (70%)	0.11
Intra-articular	5 (20%)	10 (40%)	15 (30%)	
Open/Closed fracture				
Closed	22 (88%)	21 (84%)	43 (86%)	0.68
Open (Grade I/II)	3 (12%)	4 (16%)	7 (14%)	
Time to surgery (days), mean ± SD	3.2 ± 1.1	3.5 ± 1.4	3.3 ± 1.2	0.41

Table III compares the operative and post-operative outcomes between the two groups. The IMIL group demonstrated significantly better perioperative parameters, with shorter operative time (68.4 ± 12.5 vs 92.6 ± 15.8 minutes) and lower intraoperative blood loss (120 ± 35 vs 210 ± 60 ml) compared to the DTP group (p<0.001). Patients treated with IMIL also had a shorter hospital stay (4.1 ± 1.3 vs 6.3 ± 1.8 days) and achieved partial weight bearing earlier (4.5 ± 1.0 vs 6.2 ± 1.4 weeks), both showing strong statistical significance. Additionally, fracture union occurred earlier in the IMIL group (15.2 ± 2.8 weeks) than in the plating group (17.6 ± 3.4 weeks) (p=0.01), indicating faster recovery with intramedullary nailing.

Table – III: Operative and Post-operative Outcomes (*n* = 50)

Variables	IMIL (n=25)	DTP (n=25)	p value
Operative time (min), mean ± SD	68.4 ± 12.5	92.6 ± 15.8	<0.001
Blood loss (ml), mean ± SD	120 ± 35	210 ± 60	<0.001
Hospital stay (days), mean ± SD	4.1 ± 1.3	6.3 ± 1.8	<0.001
Time to partial weight bearing (weeks)	4.5 ± 1.0	6.2 ± 1.4	<0.001
Time to union (weeks)	15.2 ± 2.8	17.6 ± 3.4	0.01

Table IV shows the functional outcomes and complications observed at the final follow-up. According to the Johner and Wruhs criteria, a higher proportion of patients in the IMIL group achieved excellent outcomes (48%) compared to the DTP group (32%), while good results were noted in 36% and 40% of patients, respectively; however, the overall functional outcome difference was not statistically significant (p=0.43). Regarding complications, superficial and deep infections were more frequent in the plating group (16% and 4%) compared to the IMIL group (4% and 0%). Delayed union and implant irritation were comparable between groups, whereas malalignment was slightly higher in the IMIL group (12% vs 4%).

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Table – IV: Functional Outcome and Complications at Final Follow-up (*n* = 50)

Variables	IMIL (n=25)	DTP (n=25)	p value
Functional outcome (Johner & Wruhs criteria)			
Excellent	12 (48%)	8 (32%)	0.43
Good	9 (36%)	10 (40%)	
Fair	3 (12%)	5 (20%)	
Poor	1 (4%)	2 (8%)	
Complications			
Superficial infection	1 (4%)	4 (16%)	0.29
Deep infection	0	1 (4%)	
Delayed union	2 (8%)	3 (12%)	
Malalignment	3 (12%)	1 (4%)	
Implant irritation	2 (8%)	3 (12%)	

DISCUSSION

Distal tibial fractures remain challenging because of limited soft tissue coverage and the risk of infection, delayed union, and malalignment. Selecting an appropriate fixation method is therefore essential, particularly in resource-limited settings like Bangladesh. In the present study, both groups were demographically comparable, with most patients aged 31–40 years (38%), predominantly male (74%), and road traffic accidents being the commonest cause of injury (62%). Similar demographic trends have been reported in regional trauma studies, reflecting the high involvement of young, working-age males in high-energy injuries.

Our findings demonstrated that intramedullary interlocking nailing (IMIL) offered superior perioperative advantages compared to distal tibial plating (DTP). Operative time was significantly shorter with IMIL (68.4 ± 12.5 minutes vs 92.6 ± 15.8 minutes), blood loss was nearly half (120 ml vs 210 ml), and hospital stay was reduced (4.1 vs 6.3 days). These results are consistent with Rahman et al., who reported shorter operative duration and less tissue disruption with intramedullary devices compared with plating techniques, and with Siddiki et al., who observed faster recovery and reduced hospitalization following interlocking nail fixation [13,14]. Rahman et al. further showed favorable outcomes of modified tibial nails in distal third fractures, supporting the efficiency of nail-based fixation [15].

Early rehabilitation is crucial for socioeconomically active patients. In our series, the IMIL group achieved partial weight bearing earlier (4.5 vs 6.2 weeks) and faster fracture union (15.2 vs 17.6 weeks; p=0.01). Similar trends were described by D'souza et al., who reported early union and quicker functional recovery with reamed interlocking nails, and by Shahid et al., who noted higher union rates and shorter healing time with intramedullary fixation compared to plating [16,17]. Systematic evidence by Elnewishy et al. and Kaya et al. also concluded that intramedullary nailing is associated with earlier mobilization and comparable or better radiological union than minimally invasive plating in extra-articular distal tibial fractures [18,19].

Functional outcomes in our study showed a higher proportion of excellent results in the IMIL group (48%) compared with DTP (32%), although the difference was not statistically significant. This observation aligns with the findings of Jose et al. and Nizar et al., who reported similar or slightly superior functional scores following intramedullary nailing compared to plating, suggesting that both techniques provide acceptable long-term function when properly indicated [20,21].

Regarding complications, superficial and deep infections were more frequent in the plating group (16% and 4%) compared to IMIL (4% and 0%). This may be attributed to greater soft tissue dissection and subcutaneous plate placement. Comparable higher wound-related complications with plating have been reported by Elnewishy et al. and Prabhat et al., emphasizing the soft tissue–friendly nature of intramedullary fixation [18,22]. However, malalignment was slightly higher in the IMIL group in our study (12% vs 4%), which is consistent with biomechanical concerns noted by Guran et al., who highlighted challenges in distal fragment control during nailing [23]. Careful technique and distal locking strategies may reduce this risk.

Overall, our results indicate that IMIL provides shorter surgery, less blood loss, earlier mobilization, faster union, and fewer infections, with comparable functional outcomes. These findings are in agreement with most contemporary literature and support the preferential use of intramedullary nailing for extra-articular distal tibial fractures, while plating may remain useful for selected intra-articular or very distal fractures requiring precise anatomical reduction.

In the context of Bangladeshi patients, where early return to activity and minimization of complications are crucial, IMIL appears to be a more practical and effective treatment option.

CONCLUSION

In conclusion, both intramedullary interlocking nailing and distal tibial plating provided satisfactory outcomes in the management of distal tibial fractures. However, IMIL demonstrated significant advantages in terms of shorter operative time, less blood loss, reduced hospital stay, earlier weight bearing, faster fracture union, and lower infection rates, with comparable functional outcomes. Therefore, IMIL may be considered the preferred treatment option for most extra-articular distal tibial fractures, while plating remains suitable for selected complex or intra-articular cases.

LIMITATIONS

This study has several limitations that should be considered while interpreting the findings. The sample size was relatively small (n=50) and conducted at a single center, which may limit the generalizability of the results. The follow-up period was short and focused mainly on early clinical and radiological outcomes, without long-term assessment of functional status or late complications. Additionally, allocation was not randomized, which may introduce selection bias and affect the comparability between the two treatment groups.

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CONFLICTS OF INTEREST

There are no conflicts of interest.

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