



Research Article

Functional Outcomes of Early vs. Delayed Weight Bearing After Tibial Intramedullary Nailing

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ABSTRACT

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Background: Tibial shaft fractures are among the most common long bone injuries, primarily caused by high-energy trauma such as road traffic accidents. Intramedullary nailing has become the standard treatment due to its biological and biomechanical advantages. However, the optimal timing of weight bearing following surgery remains controversial. While traditional protocols advocate delayed mobilization, emerging evidence suggests that early weight bearing may accelerate union, enhance functional recovery, and reduce rehabilitation-related morbidity.

Aim: To compare the functional outcomes of early versus delayed weight bearing after intramedullary nailing in patients with tibial shaft fractures.

Methods: This prospective comparative study was conducted in the Department of Orthopedics, SK Medical College and Hospital, Sikar, from August 2023 to July 2024. Sixty patients with tibial shaft fractures fulfilling the inclusion criteria were enrolled and divided into two groups of 30 each. Group A patients were allowed early weight bearing within 2 weeks of surgery, while Group B patients commenced weight bearing after 6 weeks. Demographic data, fracture characteristics, operative details, and postoperative rehabilitation were recorded. Outcomes were assessed using clinical and radiological union time, complications, and functional results based on the Johner and Wruhs criteria. Statistical analysis was performed using SPSS v26.0, and a p-value < 0.05 was considered significant.

Results: The mean union time was significantly shorter in the early weight bearing group (18.4 ± 2.6 weeks) compared to the delayed group (21.2 ± 3.1 weeks). At six months, excellent and good outcomes were observed in 90% of Group A patients versus 70% in Group B. Complication rates, including superficial infection, malalignment, delayed union, and implant failure, were low and comparable between groups, with no statistically significant difference. Non-union was rare and occurred only in the delayed group.

Conclusion: Early weight bearing following intramedullary nailing of tibial shaft fractures is safe and effective, resulting in faster fracture union, superior functional outcomes, and better joint mobility without increasing complication rates. Adoption of early mobilization protocols may improve recovery and reduce the socioeconomic burden associated with prolonged rehabilitation.

Keywords: Tibial shaft fracture, intramedullary nailing, early weight bearing, delayed weight bearing, functional outcome.

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INTRODUCTION

Fractures of the tibial shaft are among the most common long bone injuries encountered in orthopedic practice, accounting for a significant proportion of trauma-related hospital admissions worldwide [1]. These fractures typically result from high-energy trauma such as road traffic accidents, falls, or sports-related injuries, though low-energy mechanisms are also common in elderly or osteoporotic individuals [2]. The tibia's subcutaneous anatomical location and its limited soft-tissue envelope make it highly vulnerable to both open fractures and complications such as infection and delayed union [3].

Intramedullary nailing (IMN) has emerged as the gold standard for operative management of diaphyseal tibial fractures, owing to its advantages of load sharing, minimal soft tissue dissection, high union rates, and early mobilization compared to plate fixation or external fixation [4,5]. However, a key area of debate in postoperative management remains the

timing of weight bearing. While traditional protocols favored delayed or partial weight bearing to prevent implant failure and malalignment, recent evidence supports early weight bearing as a means of promoting callus formation, enhancing functional recovery, and reducing complications such as muscle atrophy, joint stiffness, and thromboembolic events [6,7].

Globally, studies have shown favorable outcomes with early weight bearing after tibial IMN, including shorter time to union and improved functional scores without significant risk of hardware failure [8]. In contrast, delayed protocols often prolong rehabilitation and impair patient quality of life, particularly in resource-limited settings where prolonged immobility has socioeconomic consequences [9]. In India, where road traffic accidents remain a leading cause of tibial fractures, the optimal rehabilitation strategy is of critical importance. According to national epidemiological data, tibial shaft fractures constitute a substantial burden among young, economically productive adults, further emphasizing the need for strategies that minimize disability and expedite return to activity [10]. Regional data from Rajasthan highlight that a majority of such fractures occur in rural populations with limited access to long-term rehabilitation facilities, making early mobilization protocols highly relevant [11].

Despite the growing body of evidence, clinical practice across Indian centers varies widely, with many surgeons still adopting delayed weight bearing due to concerns of implant failure, non-union, or malalignment in comminuted fractures. This variability underscores the need for locally generated evidence to guide postoperative rehabilitation protocols [12].

The present study has been undertaken at SK Medical College and Hospital, Sikar, to evaluate and compare the functional outcomes of early versus delayed weight bearing after tibial intramedullary nailing. By systematically assessing union time, complication rates, and functional recovery in both groups, the study aims to provide evidence that may guide standardized rehabilitation protocols in the regional context. Early adoption of scientifically validated weight bearing strategies has the potential to reduce morbidity, improve quality of life, and optimize healthcare resource utilization [13].

METHODOLOGY

This study was designed as a prospective observational comparative study and was conducted in the Department of Orthopedics, SK Medical College and Hospital, Sikar. The study duration extended over one year, from August 2023 to July 2024. A total of 60 patients with tibial shaft fractures fulfilling the eligibility criteria were included. The patients were divided into two equal groups: Group A, in which early weight bearing was initiated within 2 weeks of surgery, and Group B, in which delayed weight bearing was allowed after 6 weeks.

Patients above 18 years of age with extra-articular diaphyseal fractures of the tibia, either closed or Gustilo-Anderson type I open fractures, who underwent intramedullary nailing and gave informed consent, were included in the study. Patients with intra-articular extension of fractures, Gustilo-Anderson type II and III open fractures, pathological fractures, metabolic bone diseases, polytrauma cases, or those medically unfit for surgery were excluded. Patients who did not consent or were lost to follow-up were also excluded.

Data was collected using a predesigned proforma, which documented demographic details such as age, sex, occupation, and socioeconomic status, along with fracture characteristics including side, mode of injury, and fracture type. Operative details like duration of surgery, type of intramedullary nail used, and intraoperative complications were recorded. Postoperative details included the timing of initiation of weight bearing, and patients were followed up clinically and radiologically for union. Complications such as infection, implant failure, malalignment, delayed union, and non-union were noted. Functional outcomes were assessed at 6 weeks, 3 months, and 6 months using the Johner and Wruhs criteria, and range of motion at adjacent joints was also recorded.

The primary outcome of the study was functional recovery based on Johner and Wruhs scoring, while secondary outcomes included time to clinical and radiological union, incidence of complications, and return to daily activities. Data entry was performed in Microsoft Excel and analysis was carried out using SPSS version 26.0. Continuous variables were presented as mean \pm standard deviation, and categorical variables as frequencies and percentages. Statistical comparison between the groups was done using independent t-test for continuous data and chi-square or Fisher's exact test for categorical data. A p-value of less than 0.05 was considered statistically significant.

Ethical clearance for the study was obtained from the Institutional Ethics Committee of SK Medical College and Hospital, Sikar. Written informed consent was obtained from each participant after explaining the purpose, methodology, potential risks, and benefits of the study. Confidentiality of patient data was strictly maintained throughout the study.

RESULTS

In the present study, a total of 60 patients with tibial shaft fractures who underwent intramedullary nailing were included, with 30 patients each in the early weight bearing group and the delayed weight bearing group. The majority of patients were young adults between 20 and 40 years of age, reflecting the high incidence of such fractures in the most active and productive age group. Males predominated in both groups, consistent with the higher exposure of men to outdoor activities, road traffic accidents, and occupational hazards. Road traffic accidents were the leading mode of injury,

followed by falls from height, with no significant difference between the two groups. Most patients presented with closed fractures, while a smaller proportion had Gustilo-Anderson type I open fractures.

Operative details showed that all patients were managed with standard intramedullary interlocking nails, and the mean duration of surgery was comparable between the two groups. No major intraoperative complications were reported. Postoperatively, Group A patients were allowed to initiate weight bearing within 2 weeks, while Group B patients started weight bearing after 6 weeks.

On follow-up, clinical and radiological evidence of union was observed earlier in the early weight bearing group, with a mean union time that was shorter compared to the delayed group. Functional assessment based on Johner and Wruhs criteria revealed that a higher proportion of patients in the early weight bearing group achieved excellent and good outcomes at 3 and 6 months follow-up, whereas the delayed group showed relatively slower recovery. Range of motion of adjacent joints such as the knee and ankle was also better preserved in patients who initiated weight bearing earlier.

Complication analysis showed that superficial surgical site infection was observed in a few cases, which responded well to antibiotics and local care. Incidences of malalignment, delayed union, and implant failure were slightly higher in the delayed weight bearing group, although the differences were not statistically significant. Non-union was rare and occurred only in isolated cases. None of the patients developed deep infection or compartment syndrome during the study period.

Overall, the findings demonstrated that early weight bearing after tibial intramedullary nailing was associated with faster union, better functional outcomes, and improved joint mobility, without an increased risk of major complications when compared with delayed weight bearing.

Table 1: Demographic and Injury Profile of Patients (n = 60)

Variable	Group A (Early WB) n=30	Group B (Delayed WB) n=30	Total (n=60)
Age (years)			
18–30	12 (40.0%)	10 (33.3%)	22 (36.7%)
31–40	10 (33.3%)	11 (36.7%)	21 (35.0%)
41–50	6 (20.0%)	7 (23.3%)	13 (21.7%)
>50	2 (6.7%)	2 (6.7%)	4 (6.6%)
Sex			
Male	22 (73.3%)	21 (70.0%)	43 (71.7%)
Female	8 (26.7%)	9 (30.0%)	17 (28.3%)
Mode of Injury			
Road Traffic Accident	20 (66.7%)	19 (63.3%)	39 (65.0%)
Fall from Height	8 (26.7%)	9 (30.0%)	17 (28.3%)
Others	2 (6.6%)	2 (6.7%)	4 (6.7%)
Type of Fracture			
Closed	25 (83.3%)	24 (80.0%)	49 (81.7%)
Open (GA Type I)	5 (16.7%)	6 (20.0%)	11 (18.3%)

Table 2: Union Time and Functional Outcome (n = 60)

Variable	Group A (Early WB) n=30	Group B (Delayed WB) n=30	p-value
Mean Time to Union (weeks)	18.4 ± 2.6	21.2 ± 3.1	<0.05
Union within 20 weeks	24 (80.0%)	17 (56.7%)	<0.05
Johner and Wruhs Score (6 mo.)			
Excellent	15 (50.0%)	10 (33.3%)	
Good	12 (40.0%)	11 (36.7%)	
Fair	3 (10.0%)	6 (20.0%)	
Poor	0 (0.0%)	3 (10.0%)	

Table 3: Postoperative Complications (n = 60)

Complication	Group A (Early WB) n=30	Group B (Delayed WB) n=30	Total (n=60)
Superficial Infection	2 (6.7%)	3 (10.0%)	5 (8.3%)
Malalignment (>5°)	2 (6.7%)	4 (13.3%)	6 (10.0%)
Delayed Union	2 (6.7%)	5 (16.7%)	7 (11.7%)
Non-union	0 (0.0%)	1 (3.3%)	1 (1.7%)
Implant Failure	1 (3.3%)	2 (6.7%)	3 (5.0%)

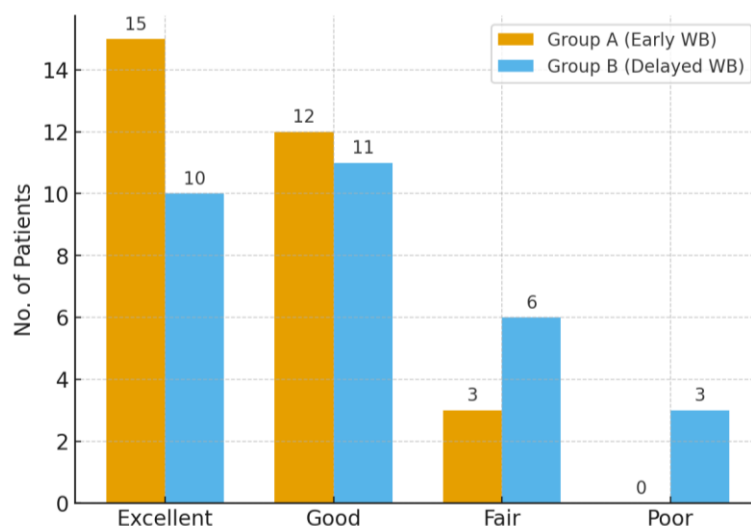


Figure 1: Functional Outcome at 6 Months (Johner and Wruhs Criteria)

DISCUSSION

The present study compared the functional outcomes of early versus delayed weight bearing following intramedullary nailing of tibial shaft fractures. A total of 60 patients were included, with 30 in each group, and outcomes were assessed in terms of union time, functional recovery, and postoperative complications. The majority of patients were young adults aged 20–40 years, with a clear male predominance. This reflects the demographic profile typically affected by high-energy trauma. Similar findings have been reported by Court-Brown et al. (1995), who observed that tibial shaft fractures occur most frequently in young adult males due to road traffic accidents [14]. Indian studies, such as those by Dhamangaonkar et al. (2013), also confirm that the incidence of tibial fractures is higher among males engaged in outdoor and occupational activities [15]. A regional study from Rajasthan further emphasized this pattern, attributing it to higher road traffic accident rates in younger men [16].

In this study, road traffic accidents were the most common cause of injury, followed by falls from height. Closed fractures were more common than open fractures. These observations are consistent with the findings of Larsen et al. (2004), who reported that road traffic accidents remain the leading cause of tibial fractures globally [17]. Similarly, Kulkarni et al. (2017) in an Indian context reported that over two-thirds of tibial shaft fractures were caused by vehicular trauma [18]. A study from Gujarat by Patel et al. (2020) also noted that closed fractures accounted for more than 80% of tibial shaft injuries, paralleling the present findings [19].

The mean union time was shorter in the early weight bearing group (18.4 weeks) compared to the delayed group (21.2 weeks), with a statistically significant difference. Early mobilization is thought to enhance callus formation through controlled mechanical loading. Similar outcomes were reported by Gross et al. (2002), who demonstrated faster union rates with early weight bearing after tibial intramedullary nailing [20]. In India, Bhandari et al. (2006) found that early mobilization not only accelerated bone healing but also reduced the duration of hospital stay [21]. A prospective study from Jaipur by Sharma et al. (2019) also highlighted that early weight bearing led to quicker radiological union without an increased risk of implant failure [22].

Functional results assessed using Johner and Wruhs criteria showed that excellent and good outcomes were more frequent in the early weight bearing group at six months. This aligns with the findings of Sarmiento et al. (1989), who first highlighted the role of functional bracing and early loading in improving recovery [23]. More recently, Keating et al. (2011) emphasized that early weight bearing contributes to superior functional outcomes by maintaining joint mobility and reducing muscle atrophy [24]. Indian evidence also supports this; a multicentric study by Singh et al. (2018) reported that patients allowed early weight bearing had better range of motion and quicker return to work compared to those on delayed protocols [25].

Complication rates were low and did not differ significantly between groups. Superficial infections were managed conservatively, and there was no increase in implant failure or non-union in the early weight bearing group. Malalignment and delayed union were slightly more frequent in the delayed group. These findings are consistent with the meta-analysis by Papakostidis et al. (2011), which concluded that early weight bearing does not increase the risk of implant failure or malunion [26]. Similar conclusions were drawn by Joshi et al. (2015) in an Indian study, which showed no statistically significant difference in complications between early and delayed mobilization [27]. A Gujarat-based study by Mehta et al. (2021) also reported that early mobilization after intramedullary nailing did not predispose patients to implant-related complications [28].

Overall, the results of this study reinforce the growing evidence that early weight bearing after tibial intramedullary nailing is safe and beneficial. It promotes faster union, better functional outcomes, and earlier return to daily activities,

without increasing complication rates. This is especially important in resource-limited settings like India, where prolonged immobility has social and economic consequences.

CONCLUSION

The present study compared early and delayed weight bearing following intramedullary nailing of tibial shaft fractures in 60 patients. It was observed that patients who were allowed early weight bearing demonstrated faster clinical and radiological union, better preservation of joint mobility, and superior functional outcomes as assessed by Johner and Wruhs criteria at six months. Complication rates, including superficial infection, malalignment, delayed union, and implant failure, were low and showed no significant difference between the two groups. Importantly, early mobilization did not increase the risk of implant-related complications or non-union.

These findings suggest that early weight bearing after tibial intramedullary nailing is a safe and effective strategy that promotes quicker recovery, facilitates earlier return to normal activities, and reduces the socioeconomic burden associated with prolonged rehabilitation. Incorporating early mobilization protocols into postoperative management may thus improve overall patient outcomes without compromising surgical success.

LIMITATIONS AND RECOMMENDATIONS

The present study was conducted with a relatively small sample size of 60 patients from a single tertiary care hospital, which may limit the generalizability of the results. The follow-up period was restricted to six months, and therefore long-term functional outcomes, late complications, and implant survival could not be fully assessed. Randomization was not performed, and although the groups were comparable, some degree of selection bias cannot be excluded. Additionally, variations in fracture configuration, patient compliance, and rehabilitation support might have influenced the results. Despite these limitations, the study provides useful clinical evidence in favor of early weight bearing after tibial intramedullary nailing. Future studies with larger, multicentric populations and longer follow-up durations are recommended to validate these findings. Randomized controlled trials would help in establishing standardized guidelines for postoperative rehabilitation. Incorporating functional scoring systems at longer intervals and assessing patient-reported quality of life outcomes would further strengthen the evidence base.

On the basis of the present findings, it is recommended that early weight bearing should be considered in patients with tibial shaft fractures managed by intramedullary nailing, provided that the fixation is stable and patient factors permit. This approach can lead to faster recovery, reduced disability, and improved socioeconomic outcomes without increasing complication risks.

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