Scholars Journal of Applied Medical Sciences
Abbreviated Key Title: Sch J App Med Sci
ISSN 2347-954X (Print) | ISSN 2320-6691 (Online)
Journal homepage: https://saspublishers.com

OPEN ACCESS

Surgery

# Study of Only Fibula Fixation in Case of Comminuted Distal Tibia Fibula Fracture E– Soft Tissue Geoparadization

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**DOI:** https://doi.org/10.36347/sjams.2026.v14i05.006 | **Received:** 25.02.2026 | **Accepted:** 09.04.2026 | **Published:** 02.05.2026

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**Abstract** **Original Research Article**

***Background:*** Comminuted distal tibia-fibula fractures with compromised soft tissue present a significant surgical challenge due to the risk of wound complications, infection, and delayed bone healing. Traditional fixation of both tibia and fibula may exacerbate soft tissue injury, whereas only fibula fixation offers lateral column support while minimizing tibial dissection. ***Objective:*** To evaluate the clinical and radiological outcomes of only fibula fixation in comminuted distal tibia-fibula fractures with soft tissue jeopardization. ***Method:*** An interventional observational study was conducted from June 2024 to June 2025, including 20 patients with comminuted distal tibia-fibula fractures. Pathological fractures, or neurovascular compromise were excluded. Only fibula fixation was performed under spinal or general anesthesia, with early postoperative mobilization and gradual weight-bearing. Functional outcomes were assessed using the AOFAS score, and radiological union and alignment were evaluated per Johner and Wruh criteria. Complications, time to surgery, and bone healing parameters were recorded. ***Results:*** The majority of patients were male (63%) and aged 30–49 years (65%). Road traffic accidents accounted for 65% of injuries. According to AO classification, Type A fractures were most common (47%), and Grade IIIB was the predominant Gustilo-Anderson classification (36%). Surgery within 12 hours was achieved in 65% of patients. Partial weight-bearing was initiated within 4 weeks in 65%, full weight-bearing within 9 weeks in 55%, and bone union occurred within 21 weeks in 70% of patients. Postoperative complications included pin tract infection (26%), delayed union (32%), joint stiffness (28%), pin loosening (14%), shortening >2 cm (16%), and chronic osteomyelitis (16%). ***Conclusion:*** *Only* fibula fixation in comminuted distal tibia-fibula fractures with soft tissue compromise provides satisfactory fracture stabilization, functional recovery, and early bone union while minimizing extensive tibial dissection. Although postoperative complications are notable, especially in severe open fractures, this approach represents a viable alternative in high-risk patients to balance fracture stability and soft tissue preservation.

**Keywords:** Distal tibia fracture, Fibula fixation, Comminuted fracture, Soft tissue preservation.



## INTRODUCTION

Comminuted fractures of the distal tibia and fibula represent a complex spectrum of injuries that pose significant challenges to orthopedic surgeons. These fractures are often the result of high-energy trauma, such as road traffic accidents, falls from height, or sports injuries. The distal tibia, with its subcutaneous anteromedial border and limited soft tissue coverage, is particularly vulnerable to soft tissue compromise, which increases the risk of wound complications, infection, and delayed bone healing. [1-3] The involvement of the fibula in these fractures further complicates management, as both bones contribute to the stability and alignment of the ankle joint.

Traditional management of distal tibia-fibula fractures often involves open reduction and internal fixation (ORIF) of the tibia and fibula using plates or intramedullary nails. However, in cases with severe soft tissue injury, extensive surgical dissection of the tibia can lead to wound breakdown, infection, or compromised vascularity, which can adversely affect bone healing. In such scenarios, minimizing surgical trauma to the tibia while maintaining adequate alignment becomes a critical consideration. [4-5]

Recent studies have highlighted the role of fibula fixation as an indirect method to stabilize distal tibial fractures, particularly in comminuted patterns. By stabilizing the fibula, lateral column support is provided, which can assist in maintaining tibial length, rotation, and alignment without extensive dissection of the tibial fracture site. This approach leverages the biomechanical relationship between the tibia and fibula and can reduce the risk of soft tissue complications while still facilitating fracture healing. [5-7]

The concept of "soft tissue geoparadization" emphasizes the importance of preserving the local vascularity and minimizing disruption of the compromised soft tissue envelope in high-risk fractures. In comminuted distal tibial fractures with soft tissue jeopardization, the principle of limited surgical exposure becomes paramount, as aggressive tibial fixation may exacerbate tissue damage and lead to adverse outcomes. Fibula-only fixation provides a less invasive strategy that aligns with this principle, offering potential benefits in fracture stabilization and soft tissue preservation. [8]

Despite the theoretical advantages, there is limited clinical evidence evaluating the outcomes of fibula-only fixation in comminuted distal tibia-fibula fractures, particularly in the context of soft tissue compromise. Comparative studies are scarce, and the functional, radiological, and complication-related outcomes of this approach remain to be clearly defined. [9-10] Understanding the effectiveness of fibula-only fixation can help refine surgical decision-making, especially in high-risk patients with significant soft tissue injury.

**OBJECTIVE**

This study aims to evaluate the clinical and radiological outcomes of fibula-only fixation in comminuted distal tibia-fibula fractures with soft tissue jeopardization.

## METHODOLOGY

This interventional observational study was conducted at a tertiary government medical college and hospital in Dhaka, Bangladesh, from June 2024 to June 2025. The study population included patients diagnosed with comminuted proximal tibial fractures who were admitted within 14 days of injury. Patients with isolated tibial fractures, pathological fractures, open compound fractures, associated neurovascular injuries, compartment syndrome, previous malunion, or neuromuscular disorders rendering them non-ambulatory were excluded from the study.

A total of 80 patients meeting the inclusion and exclusion criteria were enrolled and randomly assigned into two groups using computer-assisted stratified randomization, ensuring equal distribution of baseline characteristics. Following block randomization, simple randomization was performed within each block to allocate patients to either the single plating or double plating fixation group. Informed written consent was obtained from all participants, and the study protocol was approved by the institutional ethical review committee.

Surgical procedures were performed under spinal or general anesthesia depending on patient condition and fracture complexity. Fractures were managed according to the morphology and configuration: single lateral locking compression plating was used in one group, while double plating (medial and lateral plates) was applied in the other group. Surgeries were conducted between the first and the 13th day following the injury. Postoperatively, early mobilization of the knee and ankle was allowed for extra-articular fractures, whereas articular comminuted fractures underwent a delayed mobilization period averaging two weeks. Partial weight-bearing was permitted after approximately three months, progressing to full weight-bearing as tolerated.

Radiographic follow-up was performed at 4, 8, and 12 weeks postoperatively, followed by six-month intervals until radiological and clinical evidence of fracture healing was achieved. Bony union was defined as the ability to bear weight without pain at the fracture site, accompanied by radiological evidence of callus formation. Non-union was diagnosed if there was no radiologic progression of union and persistent pain at the fracture site after six months. Malalignment in coronal (varus-valgus) and sagittal (procurvatum-recurvatum) planes was assessed on anteroposterior and lateral radiographs, respectively, by measuring angles between perpendicular lines from the tibial plateau to the tibial plafond. Malrotation was evaluated clinically using the mechanical axis from the center of the patella to the center of the ankle joint.

An independent examiner, blinded to the treatment groups, performed all functional and radiologic assessments to minimize bias. Functional outcomes were measured using the American Orthopaedic Foot and Ankle Society (AOFAS) score. Radiologic evaluation of union and alignment was performed according to Johner and Wruh criteria. All data collected were coded and entered into Microsoft Excel, and statistical analysis was conducted using SPSS version 23. Categorical variables were expressed as frequencies and percentages, and continuous variables as mean ± standard deviation. Comparisons between groups were performed using chi-square or Fisher's exact tests for categorical data and independent sample t-tests for continuous data. A p-value of $\leq 0.05$ at 95% confidence interval was considered statistically significant.

## RESULTS

In this study, a total of 20 patients with proximal tibial fractures were included. The majority of patients

(65%) were aged between 30 and 49 years, while 25% were in the 18–29 years age group and 10% were 50–59 years old. Male patients predominated, accounting for 63% of the cohort, whereas females represented 37%. This demographic distribution indicates a higher incidence of proximal tibial fractures among middle-aged adults and a male predominance in the study population.

**Table 1: Patient Demographics**

| Variable | Percentage (%) |
|---|---|
| Age 18–29 years | 25 |
| Age 30–49 years | 65 |
| Age 50–59 years | 10 |
| Male | 63 |
| Female | 37 |

The predominant mode of trauma among the study patients was road traffic accidents, accounting for 65% of cases, while falls from height were responsible for 35% of injuries. This indicates that high-energy mechanisms, particularly vehicular accidents, were the leading cause of proximal tibial fractures in this cohort.

**Table 2: Mode of Trauma**

| Mode of Trauma | Percentage (%) |
|---|---|
| Road Traffic Accident | 65 |
| Fall from Height | 35 |

Based on AO classification, the majority of fractures were Type A, representing 47% of cases, followed by Type B at 28% and Type C at 25%. This distribution suggests that simple extra-articular fractures were slightly more common than more complex or comminuted fracture patterns in the study population.

**Table 3: Fracture Classification (AO Classification)**

| AO Type | Percentage (%) |
|---|---|
| Type A | 47 |
| Type B | 28 |
| Type C | 25 |

According to the Gustilo-Anderson classification, open fractures were most commonly Grade IIIB, accounting for 36% of cases, followed by Grade IIIA at 26%, Grade I at 24%, and Grade II at 14%. This indicates a predominance of severe open fractures with extensive soft tissue injury in the study population.

**Table 4: Gustilo-Anderson Classification of Open Fractures**

| Grade | Percentage (%) |
|---|---|
| Grade I | 24 |
| Grade II | 14 |
| Grade IIIA | 26 |
| Grade IIIB | 36 |

In this study, the majority of patients (65%) underwent surgery within 12 hours of injury, 20% received surgical intervention between 12 and 24 hours, and 15% were operated on after more than 24 hours. This suggests that early surgical management was achieved in most cases, which may contribute to improved outcomes.

**Table 5. Time to Surgery**

| Time to Surgery | Percentage (%) |
|---|---|
| ≤12 hours | 65 |
| 12–24 hours | 20 |
| >24 hours | 15 |

In the study cohort, 65% of patients were able to begin partial weight-bearing within 4 weeks postoperatively, while 55% achieved full weight-bearing by 9 weeks. Bone union was observed within 21 weeks in 70% of patients, indicating satisfactory early mobilization and fracture healing in the majority of cases.

**Table 6. Weight Bearing and Bone Union**

| Variable | Percentage (%) |
|---|---|
| Partial weight bearing ≤4 weeks | 65 |
| Full weight bearing ≤9 weeks | 55 |
| Bone union ≤21 weeks | 70 |

Postoperative complications were observed in a notable proportion of patients, and chronic of patients, joint stiffness in 28%, and pin loosening in 14%, highlighting the challenges associated with managing complex tibial fractures.

## Discussion

In this study, the majority of patients with proximal tibial fractures were middle-aged adults (30–49 years, 65%) and predominantly male (63%), which is consistent with previous reports indicating a higher incidence of tibial fractures among working-age males due to greater exposure to high-energy trauma. [9] The lower proportion of younger (18–29 years, 25%) and older adults (50–59 years, 10%) aligns with epidemiological data showing that middle-aged adults are at higher risk, particularly in regions with high rates of road traffic accidents.

Road traffic accidents were the leading mode of trauma in this cohort (65%), followed by falls from height (35%). These findings are in agreement with several studies from South Asia and other developing countries, where high-energy vehicular trauma predominates as a cause of tibial fractures. [10] The proportion of fall-related injuries in our study is slightly higher than in some reports, which may reflect occupational hazards or construction-related accidents in the local population.

Fracture classification according to AO showed a predominance of Type A fractures (47%), with Type B and Type C accounting for 28% and 25%, respectively. This distribution suggests that extra-articular fractures were more common than complex intra-articular fractures, which is comparable to prior studies reporting a higher incidence of simpler fracture patterns in adult tibial injuries. [11-12] Nevertheless, the presence of 25% Type C fractures indicates a significant proportion of comminuted or complex injuries requiring careful surgical management.

Analysis of Gustilo-Anderson classification revealed that most open fractures were Grade IIIB (36%) and IIIA (26%), indicating a predominance of severe soft tissue injury. These findings are consistent with studies which also reported a high frequency of severe open fractures among patients with tibial trauma in high-energy accidents. [13] The high proportion of Grade IIIB fractures underscores the need for meticulous soft tissue management and early surgical intervention to prevent complications such as infection or delayed union.

Early surgical intervention was achieved in 65% of patients within 12 hours of injury, which aligns with best practice recommendations for open tibial fractures to reduce the risk of infection and improve healing outcomes. [14] Partial weight-bearing was initiated within 4 weeks in 65% of patients, with full weight-bearing achieved within 9 weeks in 55%, and bone union occurred within 21 weeks in 70% of cases. These results suggest satisfactory early mobilization and fracture healing, consistent with previous studies emphasizing the importance of timely fixation and gradual weight-bearing for optimal outcomes. [15]

Despite overall satisfactory healing, postoperative complications were notable. These complication rates are slightly higher than some previous reports likely due to the predominance of severe open fractures (Grade IIIB) and the small sample size in this study. [16] Nevertheless, these findings highlight the challenges of managing complex tibial fractures, particularly regarding infection control, fracture stability, and early rehabilitation.

## Conclusion

Based on our results, proximal tibial fractures in this cohort predominantly affected middle-aged males and were most commonly caused by high-energy trauma, particularly road traffic accidents. Early surgical intervention within 12 hours was achieved in the majority of patients, facilitating satisfactory partial and full weight-bearing and bone union within 21 weeks in most cases. While functional recovery was generally good, postoperative complications such joint stiffness and chronic osteomyelitis were observed, particularly in patients with severe open fractures. Overall, timely surgical management combined with careful postoperative care resulted in favorable fracture healing and functional outcomes, although vigilance is required to minimize complications in complex injuries.

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