International Journal of Research in Medical Sciences
Agwulonu I et al. Int J Res Med Sci. 2025 May;13(5):1845-1850
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012
DOI: https://dx.doi.org/10.18203/2320-6012.ijrms20251279

Original Research Article

Prophylactic fibulotomy during external fixation for tibia fractures: a retrospective study on reducing nonunion incidence

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Received: 14 February 2025
Accepted: 24 March 2025

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ABSTRACT

Background: Tibial fractures are prevalent long bone injuries that can result in nonunion, especially when treated with external fixation. Prophylactic fibulotomy has been suggested to improve fracture healing. This study evaluates the effectiveness of prophylactic fibulotomy in reducing nonunion rates in patients undergoing external fixation for tibial fractures.
Methods: A retrospective cohort study was conducted at the National Orthopaedic Hospital, Igbobi, Lagos, Nigeria, analyzing patient records from January 2022 to December 2024. Associations between prophylactic fibulotomy and postoperative complications were assessed using chi-square tests, while t-tests compared time to union between fibulotomy and non-fibulotomy groups. A p value of less than 0.05 was considered statistically significant.
Results: The study included 60 patients, predominantly males (53.3%) aged 40 years and above (58.3%). Distal fractures were most common (36.7%). Union was achieved in 70.0% of cases, with a significant association between fibulotomy and union status (χ^2=18.367, p<0.005). The mean time to union was 15.8±1.4 weeks for patients who underwent fibulotomy, compared to 18.2±1.8 weeks for those who did not, indicating a significant difference (t=-5.179, p<0.05).
Conclusions: Prophylactic fibulotomy during external fixation of tibial fractures is associated with higher union rates and shorter time to union, suggesting it may be a beneficial adjunctive procedure in managing tibial fractures requiring external fixation.

Keywords: Fracture healing, External fixation, Nonunion, Prophylactic fibulotomy, Tibial fractures

INTRODUCTION

Tibial fractures are among the most common long bone fractures, accounting for a significant proportion of orthopedic injuries worldwide.[1] Their incidence varies depending on geographic location, population characteristics, and environmental factors.[2] In high-income countries, the annual incidence of tibial fractures ranges from 17 to 35 per 100,000 individuals, with higher rates observed in low- and middle-income settings where road traffic accidents and occupational hazards contribute significantly to trauma burden.[3,4] Studies suggest that tibia fractures are common in Nigeria, with road traffic accidents being the leading cause. In a study, the tibia was the most frequently fractured bone, accounting for 25% of cases.[5] Open tibia fractures are particularly concerning due to their high risk of infection, which complicates management and treatment.[6] Bone fractures in general are more prevalent in males (62.5%) than females.[7]

The mechanisms of injury leading to tibial fractures are diverse, including high-energy trauma such as motor vehicle collisions, falls from heights, and sports-related injuries, as well as low-energy mechanisms like simple falls in osteoporotic individuals.[8-10] Managing tibial fractures presents numerous challenges, particularly in

cases involving severe comminution, displacement, or associated soft tissue injury.[11] Complications such as nonunion, malunion, infection, and delayed healing remain prevalent, particularly in open fractures or those requiring prolonged external fixation.[12]

External fixation is a widely used technique for managing tibial fractures, particularly in cases of open fractures, comminuted fractures, and those with significant soft tissue injury.[13] It provides immediate stabilization while preserving blood supply and allowing for wound care, making it an essential option for fractures complicated by severe soft tissue damage or infection.[14] Despite its advantages, external fixation is not without complications, and its prolonged use has been associated with an increased risk of delayed healing and nonunion. The limited mechanical stability it provides, particularly in fractures with significant bone loss or complex patterns, can contribute to inadequate bone healing, leading to nonunion.[15]

Nonunion in tibial fractures occurs when there is a failure of bone healing within the expected timeframe, often due to factors such as poor blood supply, infection, and inadequate fracture stabilization.[16,17] While external fixation plays a crucial role in the acute management of tibial fractures, its extended application has been linked to an increased risk of nonunion.[13,18] This risk is particularly evident in cases where the fixator does not provide sufficient axial compression, leading to inadequate mechanical stimulation for callus formation.[19]

Furthermore, pin-site infections, a common complication of external fixation, can further compromise bone healing by introducing local infection, which contributes to nonunion and may necessitate additional interventions such as bone grafting or revision fixation.[20] Studies report nonunion rates ranging from 5 to 15% in tibial fractures managed with external fixation, emphasizing the need for strategies that enhance bone healing and reduce complications.[16,21] Given the challenges associated with nonunion in tibial fractures, particularly in cases managed with external fixation, adjunctive surgical techniques such as prophylactic fibulotomy have been explored to improve outcomes.

Prophylactic fibulotomy is performed to facilitate tibial alignment and prevent malunion, particularly in fractures with significant displacement or shortening.[22-24] An intact fibula can act as a tether, restricting tibial reduction and preventing proper alignment, thereby increasing the risk of nonunion.[25] The fibula carries 6-15% of the load of the lower extremity; hence, a healed fibula distracts a high percentage of the load as well as resists compression at the tibial nonunion site.[26] When a tibial fracture is accompanied by a fibular shaft fracture, the fibula typically heals within six weeks.[27] Consequently, by the time a tibial fracture exhibits delayed healing or nonunion, the fibula is often fully healed. In such scenarios, attempting to compress the tibial fracture can be challenging because the intact fibula absorbs a significant portion of the applied force, reducing the effective compression on the tibial fragments. This situation can hinder proper healing of the tibia. Therefore, performing a partial fibulectomy can facilitate better compression at the tibial fracture site, promoting more effective healing

By performing a fibulotomy, the mechanical hindrance posed by an intact fibula is eliminated, potentially allowing for more effective compression and stabilization of the tibial fracture site. This approach may reduce the risk of nonunion and improve overall healing outcomes. However, the efficacy of prophylactic fibulotomy in conjunction with external fixation has not been extensively studied. Therefore, this retrospective study aims to evaluate the effectiveness of prophylactic fibulotomy in reducing the incidence of nonunion in patients undergoing external fixation for tibia fractures.

METHODS

Study design

This retrospective cohort study analyzed patient records from the Department of Orthopaedics at the National Orthopaedic Hospital, Igbobi, Lagos, covering the period from January 2022 to December 2024. The exposure was the performance of prophylactic fibulotomy (intervention) during external fixation for tibial fractures, and the outcome was the incidence of nonunion in these fractures. The study included 60 patients.

Study setting

The research was conducted in the Department of Orthopaedics at the National Orthopaedic Hospital, Igbobi, Lagos, a leading tertiary center for orthopedic care in Nigeria. The hospital offers a wide range of services, including postgraduate training for orthopaedic surgeons and other medical professionals specializing in trauma management and reconstructive surgery. It features several subspecialties, such as spine surgery, arthroplasty, plastic and reconstructive surgery, physiotherapy, prosthetics, and orthotics, ensuring a comprehensive approach to orthopaedic care. Strategically situated within the Somolu Local Government Area, the hospital is easily accessible via the bustling Ikorodu Road, located between the Onipanu and Fadeyi bus stops. Its geographic coordinates are approximately 6.5312° N latitude and 3.3701° E longitude, facilitating convenient access for patients from Lagos and its surrounding states. The hospital's multidisciplinary services and cutting-edge facilities, including a dedicated pathology department and advanced diagnostic tools, make it an optimal location for conducting studies on rare and complex conditions like pigmented villonodular synovitis. Its central role in orthopaedic care across Nigeria ensures a broad patient base and robust data for research purposes.

Study population

This retrospective analysis focused on patients who sustained tibial fractures and underwent external fixation, specifically targeting those who received a prophylactic fibulotomy during the procedure. Eligible participants were adults aged 18 and older with acute tibial fractures managed with external fixation and concurrent prophylactic fibulotomy. Exclusion criteria encompassed individuals with pathological fractures, pre-existing conditions affecting bone healing (such as metabolic bone diseases), severe soft tissue damage, vascular or neurological compromise, a history of previous tibial fractures or surgeries, or incomplete medical records.

Data collection

Data were extracted from electronic medical records and surgical logs, encompassing demographic information such as age and gender; fracture characteristics including location, type (open or closed), and comminution level; surgical details like the use of prophylactic fibulotomy and type of external fixation applied; postoperative outcomes such as time to union, incidence of nonunion, complications (e.g., infection, malunion); and radiographic evaluations (X-rays, CT scans, etc.).

Outcome measures

The primary outcome was the incidence of nonunion. Secondary outcomes included the time to radiographic union, complication rates (such as infection and hardware failure), and functional outcomes assessed using a validated scoring system.

Statistical analysis

Descriptive statistics were used to summarize patient demographics and clinical characteristics. Associations between categorical variables, such as the presence of prophylactic fibulotomy and postoperative complications, were assessed using chi-square tests. Comparisons of continuous variables, like time to union, between the fibulotomy and non-fibulotomy groups were conducted using t-tests. A p value of less than 0.05 was considered statistically significant.

Ethical considerations

Ethical approval for the study was obtained from the hospital's ethical review committee. Patient confidentiality was maintained throughout the study. No identifiable information was included in the final dataset, and all patient data were anonymized prior to analysis.

RESULTS

The majority of the participants were aged 40 years and above (58.3%), with an age range between 28 and 56 years. Males constituted the highest proportion of the sample (53.3%). Among the different types of tibia fractures, distal fractures were the most common (36.7%) (Table 1). According to table 2, bilateral external fixation was the most common method used (36.7%). More participants underwent fibulotomy (58.3%) compared to those who did not. Union was achieved in 70.0 percent of cases, while 30.0 percent had nonunion (Table 1).

Table 1: Demographic, clinical, and surgical characteristics of the participants.

Variable	N (%)
Age (years)	
<40	25 (41.7)
≥40	35 (58.3)
Mean±SD	
Gender	
Female	28 (46.7)
Male	32 (53.3)
Type of tibia fracture	
Distal	22 (36.7)
Proximal	18 (30.0)
Shaft	20 (33.3)
External fixation	
Bilateral	10 (16.7)
Ring fixator	16 (26.7)
Unilateral	34 (56.7)
Fibulotomy	
No	25 (41.7)
Yes	35 (58.3)
Union status	
Non union	18 (30.0)
Union	42 (70.0)
Complications (40)	
Hardware failure	21 (52.5)
Infection	19 (47.5)

Table 2: Association between fibulotomy and union status.

	Fibulotomy		Pearson chi square	p value
	Yes	No		
Union status				
Union	10 (23.8)	32 (76.2	18.367	0.001
Non-union	15 (83.3)	3 (16.7)		

Table 2 revealed that there was association between fibulotomy and union status (χ^2 =18.367, p<0.005). As shown in Figure 1, the mean time to union was 15.8±1.4 weeks for patients who underwent fibulotomy, whereas those who did not undergo the procedure achieved union in 18.2±1.8 weeks. Analysis revealed a significant difference in mean time to union between patients who underwent fibulotomy and those who did not (t = -5.179, p<0.05).

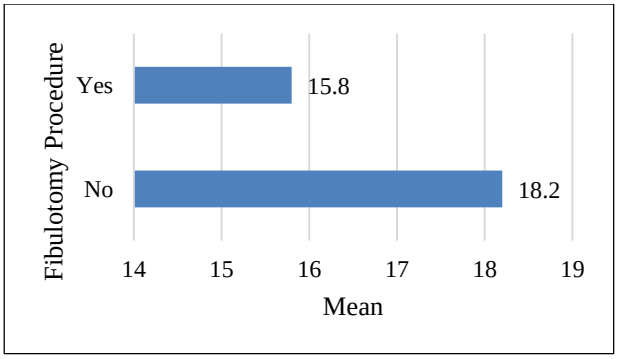

Figure 1: Time to union status in weeks.

DISCUSSION

Tibia fractures are complex injuries, especially when they involve open fractures, as they often present with significant soft tissue damage, compromised vascular supply, and a high risk of infection.[28,29] If not treated properly, these fractures can result in delayed union or nonunion, leading to prolonged disability.[30] In severe cases, inadequate healing may cause malalignment, joint instability, or post-traumatic arthritis, significantly affecting ankle joint function and overall mobility.[31]

Despite advancements in fracture management, nonunion remains a significant complication, leading to prolonged morbidity, increased healthcare costs, and a potential decline in patients' quality of life.[32] External fixation is frequently employed for tibia fractures, particularly in cases with severe soft tissue damage or comminuted fractures.[33] However, inadequate stabilization and limited bone healing potential can contribute to delayed union or nonunion. This study retrospectively evaluates the role of prophylactic fibulotomy during external fixation in reducing nonunion incidence and improving fracture healing outcomes.

The findings from this study suggest that prophylactic fibulotomy is associated with a higher rate of union and a shorter time to healing in tibia fractures managed with external fixation. The study sample also had a slight male predominance (53.3%), which is consistent with previous epidemiological reports showing higher incidences of tibia fractures in men, likely due to greater engagement in high-impact activities and sports-related injuries.[34,35]

Among patients who had fibulotomy, majority achieved union, while only few experienced nonunion. These findings strongly suggest that fibulotomy may play a critical role in enhancing fracture healing and reducing the risk of nonunion in tibial fractures. Fibulotomy has been proposed as a technique to improve tibial fracture healing by reducing stress on the primary fracture site, facilitating bone alignment, and enhancing callus formation.[36] The marked difference in union rates observed in this study aligns with previous research, which has indicated that fibulotomy may contribute to a more favorable biomechanical environment for bone healing, particularly in cases of external fixation.[37] By disrupting the intact fibula, which can act as a stress shield, fibulotomy allows for more uniform load distribution across the tibia, thereby promoting better fracture consolidation.[38]

The significantly higher nonunion rate in patients who did not undergo fibulotomy further hihlights the potential limitations of leaving the fibula intact in certain tibial fractures. Studies have suggested that an unbroken fibula may interfere with the compression and micromotion needed for optimal healing, particularly in cases where external fixation is employed.[39,40] This mechanical hindrance may explain the poor union outcomes observed in patients who did not receive fibulotomy in this study. While fibulotomy appears to enhance fracture healing, it is essential to consider patient selection and fracture characteristics. Some studies have cautioned that fibulotomy may increase the risk of additional complications, such as ankle instability or malalignment, if not performed appropriately.[41-43]

Our study demonstrated that patients who underwent fibulotomy experienced a shorter time to union compared to those who did not. This finding aligns with existing literature suggesting that fibulotomy, as an adjunctive procedure during external fixation, enhances fracture healing by improving mechanical stability and reducing interfragmentary strain.[44] The accelerated healing process in patients who underwent fibulotomy can be attributed to the release of tensile forces within the tibia-fibula complex, which facilitates axial loading and optimizes the biological environment for bone regeneration.[45-47] Conducted a study on exchange nailing for aseptic tibial shaft nonunion and emphasized the influence of a concomitant fibulotomy.[22] They found that performing a fibulotomy in conjunction with exchange nailing significantly reduced the time to union. Additionally, explored a simple approach to the management of aseptic non-union of the shaft of long bones and reported that incorporating fibulotomy into the treatment protocol resulted in a decreased time to union.[48] These studies support the notion that fibulotomy can be a valuable adjunct in the management of tibial fractures, particularly in cases of nonunion, by promoting a more rapid healing process.

CONCLUSION

Prophylactic fibulotomy during external fixation of tibial fractures is associated with higher union rates and shorter time to union, suggesting it may be a beneficial adjunctive procedure in managing tibial fractures requiring external fixation.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Agwulonu I, Idowu O, Igbinba B, Olusunmade O. Prophylactic fibulotomy during external fixation for tibia fractures: a retrospective study on reducing nonunion incidence. Int J Res Med Sci 2025;13:1845-50.