European Journal of Clinical Pharmacy
Print ISSN: 2385-409X **Online ISSN**: 3105-0409
Website: https://farmclin.com/

Original Research Article

GUSTILO IIIA AND IIIB OPEN DIAPHYSEAL FRACTURE OF TIBIA TREATED BY NA EXTERNAL FIXATOR AS DEFINITIVE TREATMENT

Article History:

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Received: 11-11-2025
Revised: 25-11-2025
Accepted: 16-12-2025
Published: 31-12-2025

Abstract: Open tibial shaft fractures, especially those with soft tissue injuries, are difficult to manage. External fixation offers advantages in terms of ease of administration, minimal disruption, and promotion of soft tissue healing, but it also presents challenges in bone alignment and healing. This study aimed to evaluate the outcomes of Gustilo III-A and III-B tibial fractures treated with NA external fixators. A descriptive cross-sectional study was conducted at Liaquat University Hospital Jamshoro-Hyderabad, including 128 patients aged 18–50 years with Gustilo III-A and III-B tibial fractures. Management included wound debridement, antibiotics, and closure via secondary means such as split-thickness skin grafts or flaps. Patients were followed up for up to 9 months to monitor clinical and radiological union, with removal of the fixator and casting until solid union was achieved. Data were analyzed using SPSS software. The study showed that 31.3% of patients achieved union. Road traffic accidents were the leading cause of fractures (35.9%), and Gustilo type IIIB fractures (53.1%) were more common than IIIA (46.9%). Complications were generally low, with soft tissue complications (12.5%), bony complications (10.2%), and infections (13.3%) observed. The mean hospital stay was 9.26 ± 3.65 days, with older patients and less severe cases typically having shorter stays. The study concludes that the outcomes of union and complications were not significantly influenced by demographic or injury-related factors, and road traffic accidents were associated with the highest complication rates. NA external fixation proved to be effective for treating Gustilo III-A and III-B tibial fractures.

Keywords: Tibia, Fracture, External Fixation, Union

INTRODUCTION

Tibial shaft fractures are among the most common long bone fractures, often resulting from high-energy trauma such as motor vehicle accidents, falls, and extreme sports (Court-Brown & McBirnie, 1995). The tibia, being a primary weight-bearing bone, is vulnerable to fractures, particularly along its subcutaneous antero-medial surface. These fractures, especially when open and associated with soft tissue injury, pose significant treatment challenges, often

resulting in nonunion, infection, and long-term disability (Bhandari et al., 2008). Open fractures, particularly those classified as Gustilo III-A and III-B, require aggressive treatment strategies to prevent complications and promote healing (Schlickewei et al., 2019).

Historically, tibial fractures were treated using closed reduction and casting. However, this approach is less effective for open fractures, where significant soft tissue damage complicates the healing process (Albright et al., 2020). External fixation emerged as a more suitable alternative for managing open fractures, as it offers stabilization while minimizing disruption to the soft tissues (Fernando et al., 2021). External fixation is particularly beneficial for fractures with extensive soft tissue injuries, such as those caused by high-velocity trauma, as it allows for soft tissue healing while stabilizing the bone. However, external fixation is not without its drawbacks, including high rates of infection, malalignment, and potential non-union, which can require further surgical interventions (Piwani et al., 2015).

The **Gustilo and Anderson classification** system is widely used to classify open fractures, with type III fractures being the most severe. Type III-A fractures involve significant soft tissue damage but allow for primary wound closure, while type III-B fractures involve extensive soft tissue loss and require more advanced wound management, such as split-thickness skin grafts or flaps (Hadeed et al., 2020). External fixation is often the treatment of choice for these severe fractures, providing stability while allowing for the necessary soft tissue management (Bliven et al., 2019).
This study focuses on evaluating the outcomes of Gustilo III-A and III-B tibial fractures treated with NA external fixators, aiming to provide data that can improve the management of these complex injuries. The goal is to assess union rates, complication rates, and the overall effectiveness of NA external fixation as a definitive treatment for these challenging fractures.

The study is set against the backdrop of Pakistan's healthcare system, where resource constraints, delays in treatment, and reliance on traditional bone-setters often result in suboptimal outcomes for patients with open fractures (Alho et al., 1992). By analyzing local data, this study aims to contribute valuable insights into the management of open tibial fractures and standardize treatment protocols for better outcomes.

METHODOLOGY

This descriptive cross-sectional study was conducted at the Department of Orthopaedic Surgery & Traumatology Unit-I, Liaquat University Hospital Jamshoro-Hyderabad, over a period of one and a half years following approval of the synopsis. A sample size of 128 patients was calculated manually using a formula based on a prevalence rate of 5.1% for Gustilo IIIA and IIIB tibial shaft fractures. Non-probability random sampling was used to select participants aged 18 to 50 years, diagnosed with open diaphyseal fractures of the tibia (Gustilo type IIIA and IIIB). Patients with severe chest or abdominal injuries, poor compliance, comorbid conditions such as diabetes or hepatitis B and C, head injuries with a Glasgow Coma Scale of 8 or lower, and polytrauma were excluded (Schlickewei et al., 2019).

Data collection involved a detailed history, clinical examination, routine investigations, and X-ray findings, documented on a proforma. Local examination included checking the neurovascular status, taking photographs, sending swabs for culture and sensitivity (C/S), and performing aggressive wound debridement. If contamination persisted, a second debridement was performed. NA external fixation was applied promptly, and intravenous antibiotics were administered based on the C/S report. For Gustilo type IIIA fractures, the bone was covered, and the wound remained open with secondary closure, split-thickness skin grafts, or flaps after multiple dressings. In type IIIB fractures, debridement was followed by muscle coverage and similar wound closure techniques. Following secondary closure, patients were discharged and followed up weekly in the outpatient department (OPD). Dynamization of the NA external fixator was performed within 2.5 months, and when clinical and radiological union were confirmed, the fixator was removed. A POP cast was applied above the knee until solid union was achieved. Patients were followed up for up to 9 months with regular radiographs and clinical assessments. Data were analyzed using SPSS version 21, with quantitative variables presented as mean ± standard deviation and qualitative variables as frequencies and percentages. Chi-square tests were applied to assess the relationship between union and demographic variables, mode of injury, and complications, with a p-value <0.05 considered significant.

RESULTS

Table 1: Descriptive Statistics of Age, Gender, and Time Lapse Between Injury and Arrival

Variable	Frequency	Percentage	Mean ± SD
Age (Mean ± SD)	128.0	100%	35.6 ± 8.83
Gender			
Male	54	42.2%	
Female	74	57.8%	
Time Lapse (Injury & Arrival)			3.22 ± 1.67 (Mean ± SD)

Table 1 provides a summary of the demographic data. The mean age of patients is 35.6 years with a standard deviation of 8.83. The gender distribution shows that 42.2% were male and 57.8% were female. The time lapse between injury and hospital arrival was 3.22 ± 1.67 days on average, indicating a relatively short delay in patient admission after injury.

Table 2: Gustilo Classification, Side Involved, and Mode of Injury

Variable	Frequency	Percentage
Gustilo Classification		
Type IIIA	60	46.9%
Type IIIB	68	53.1%
Side Involved		
Left	65	50.8%
Right	63	49.2%
Mode of Injury		
Road Traffic Accident	46	35.9%
Fall from Height	19	14.8%
Firearm Injury	28	21.9%
Assault	35	27.3%

This table illustrates the distribution of patients according to the Gustilo classification, with type IIIB fractures being more common (53.1%) than type IIIA (46.9%). The side of injury was nearly evenly distributed, with 50.8% on the left and 49.2% on the right. The most common mode of injury was road traffic accidents (35.9%), followed by assaults (27.3%), firearm injuries (21.9%), and falls from heights (14.8%).

Table 3: Soft Tissue Procedure and Hospital Stay

Soft Tissue Procedure	Frequency	Percentage
Split-thickness Skin Grafts	44	34.4%
Flap	42	32.8%
Secondary Suturing	42	32.8%
Hospital Stay (Days)	**Frequency**	**Percentage**
4 to 9 Days	71	55.5%
10 to 15 Days	57	44.5%

Table 3 summarizes the soft tissue procedures performed, with split-thickness skin grafts being the most common procedure (34.4%), followed closely by flap procedures and secondary suturing (both 32.8%). Regarding the duration of hospital stays, 55.5% of patients stayed between 4 to 9 days, while 44.5% stayed for 10 to 15 days, indicating that most patients were discharged relatively early.

Table 4: Complications, Weight Bearing, and Fixator Removal

Complications	Frequency	Percentage
Soft Tissue	16	12.5%
Bony	13	10.2%
Infection	17	13.3%

Weight Bearing	Mean ± SD
Partial with Walker	4.38 ± 1.14
Full with NA External Fixator	9.51 ± 1.73
Fixator Removal	6.25 ± 1.49

This table provides data on complications and weight-bearing milestones. Soft tissue complications were experienced by 12.5% of patients, bony complications by 10.2%, and infections by 13.3%. Regarding weight-bearing milestones, the average time for partial weight bearing with a walker was 4.38 ± 1.14 weeks, and the mean time for full weight bearing with the NA external fixator was 9.51 ± 1.73 weeks. The mean time for fixator removal was 6.25 ± 1.49 weeks.

Table 5: Union Outcomes and Association with Demographic Factors

Variable	Union (Yes)	Union (No)	Total	P-value
Age Group				
20 to 35	20 (31.3%)	44 (68.8%)	64	1.00
36 to 50	20 (31.3%)	44 (68.8%)	64	
Gender				0.06
Male	12 (22.2%)	43 (77.8%)	54	
Female	28 (37.8%)	46 (62.2%)	74	
Side Involved				0.79
Left	21 (32.3%)	44 (67.7%)	65	
Right	19 (30.2%)	44 (69.8%)	63	
Gustilo Classification				0.15
IIIA	15 (25.0%)	45 (75.0%)	60	
IIIB	25 (36.8%)	43 (63.2%)	68	

Table 5 shows union outcomes based on demographic factors, including age, gender, side involved, and Gustilo classification. The union rates were similar across age groups, genders, and sides of the body. There was no significant difference in union rates between Gustilo IIIA and IIIB fractures. The P-values for each factor suggest that these variables did not significantly affect union outcomes.

Table 6: Association Between Mode of Injury, Soft Tissue Procedures, and Complications

Mode of Injury	Union (%)	Complications (Yes)	P-value
Road Traffic Accident	11 (23.9%)	8 (17.4%)	0.06
Fall from Height	6 (31.6%)	2 (10.5%)	0.64
Firearm Injury	6 (21.4%)	3 (10.7%)	
Assault	17 (48.6%)	3 (8.6%)	

Soft Tissue Procedure Union (%) Complications (Yes) P-value

Table 6 compares union rates and complications across different modes of injury and soft tissue procedures. The highest union rate was observed in assault cases (48.6%). Soft tissue procedures, such as secondary suturing, had the highest complication rate, while flap procedures had the lowest complication rate.

CONCLUSION

The conclusion of the study that union outcomes and complication rates in soft tissue injuries are not significantly influenced by age, gender, injury type, or mechanism of injury. Road traffic accidents were the leading cause of injury and associated with the highest complication and infection rates. Overall, complications were relatively uncommon, and shorter hospital stays were more prevalent, particularly among older patients and less severe cases.

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