

Clinical and Functional Outcomes of Open Tibia-Fibula Fractures Managed with Ilizarov External Fixation: A 20 Case Study at CBMCHB Orthopedics Department

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Abstract

Background: The management of open tibia-fibula fractures, particularly those of higher Gustilo-Anderson grades, remains a significant challenge due to high rates of complications like infection and non-union. The Ilizarov external fixator (IEF) offers a versatile, minimally invasive technique allowing for early weight-bearing and excellent soft-tissue access. This study retrospectively evaluated the clinical and functional outcomes of open tibia-fibula fractures treated with IEF at our institution.

Methods: We retrospectively reviewed 20 consecutive patients with open tibia-fibula fractures treated definitively with the IEF at CBMCHB between [January 2023] and [January 2025]. The mean follow-up period was 24 months. Outcomes were assessed using the Association for the Study and Application of the Methods of Ilizarov (ASAMI) criteria for bone and functional results. Complications, time to union, and duration of external fixation were recorded.

Results: The mean time to radiologic union was 4.5 more or less 1.2 months (range, 3–7 months). According to the ASAMI criteria for bone results, 16 (80 %) cases achieved Excellent or Good outcomes. Functional results showed 15 (75%) patients had Excellent or Good outcomes. Pin-tract infection was the most common complication, observed in 4 (20%) cases, all of which were managed successfully with oral antibiotics and local wound care. No cases of deep infection or unacceptable malunion were recorded.

Conclusion: The use of the Ilizarov external fixator as a primary and definitive treatment for open tibia-fibula fractures, even in higher-grade injuries, yielded high rates of bone union and satisfactory functional outcomes. The ability to manage soft tissues and permit early weight-bearing makes the Ilizarov technique a valuable modality in this challenging patient population.

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Introduction

Open fractures of the tibia are common lower extremity injuries, frequently resulting from high-energy trauma, and are associated with considerable damage to the surrounding soft tissue envelope.¹ The exposed nature of the tibia (subcutaneous) makes it susceptible to infection and complex soft-tissue coverage issues, leading to high rates of non-union, delayed union, and chronic osteomyelitis.²

The immediate goals of treating an open fracture are rigorous debridement, infection control, and stable fixation to allow for soft-tissue reconstruction and early mobilization.³ While intramedullary nailing (IMN) is often the preferred choice for lower-grade open fractures, it can be contraindicated in cases of severe contamination or extensive soft-tissue injury (Gustilo-Anderson Grade IIIA and IIIB).⁴

The Ilizarov External Fixator (IEF), a circular ring fixator, provides a biologically friendly, stable, and minimally invasive solution. Its unique advantages include: i) Three-dimensional stability, ii) Preservation of fracture biology, iii) Easy access for soft-tissue care and dressing changes, and iv) The ability to accommodate early, protected

weight-bearing, which is believed to promote fracture healing.⁵

This study aims to retrospectively assess the clinical and functional outcomes of open tibia-fibula fractures treated definitively with the Ilizarov external fixator at our institution, CBMCHB, over a two-year period.

Methods

Study Design and Patient Selection

This was a retrospective single-center review of 20 consecutive patients with open fractures of the tibia and fibula treated with the Ilizarov external fixator between [January 2023] and [January 2025] at the Department of Orthopaedics, CBMCHB.

Inclusion Criteria

1. Age 18 years and above.
2. Diagnosis of Gustilo-Anderson Grade II, III or IIIB open fracture of the tibia and fibula.
3. Primary definitive fixation with the Ilizarov external fixator.

Exclusion Criteria

1. Pathological fractures
2. Prior ipsilateral surgery
3. Follow-up less than 24 months

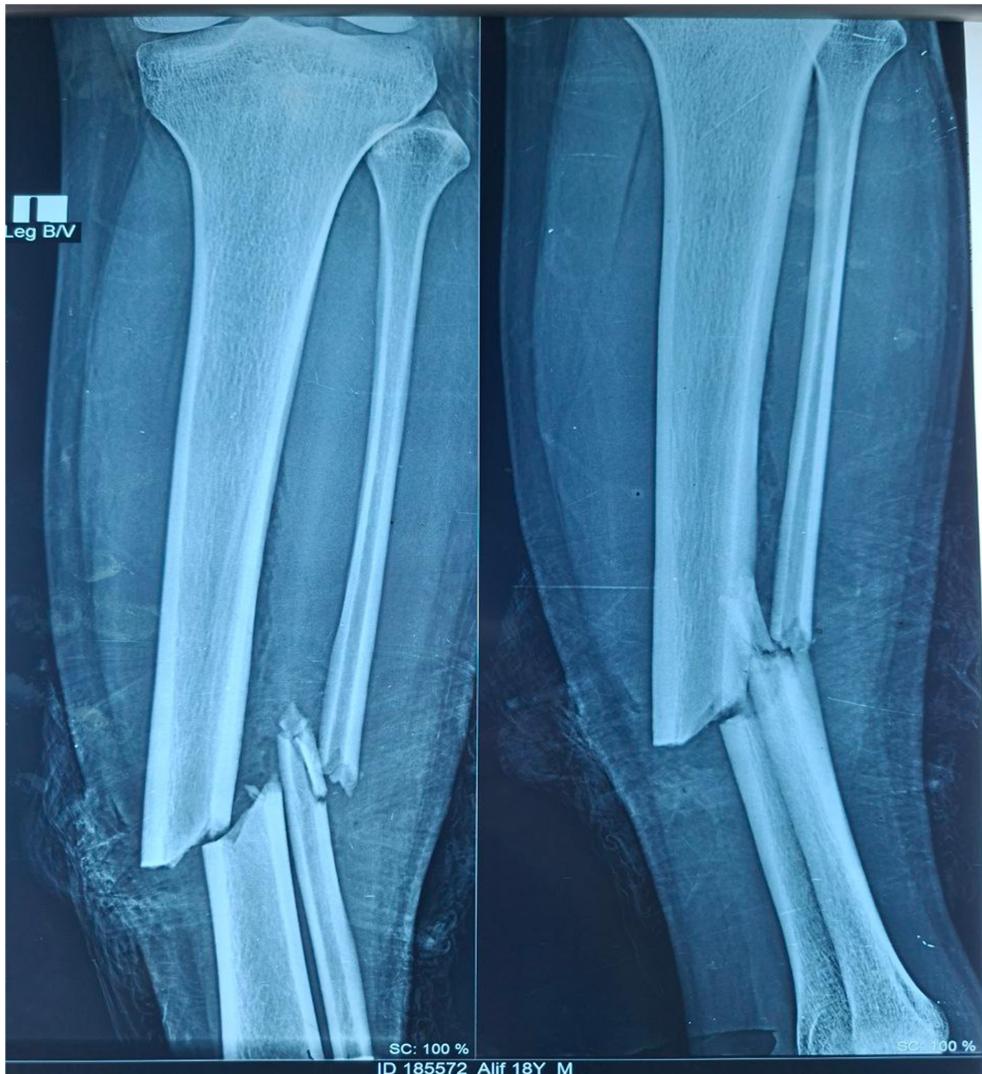


Figure 1. X-RAY showing fracture Tibia-Fibula

Surgical Technique and Postoperative Protocol

All patients underwent aggressive debridement and copious irrigation in the operating room as an emergency procedure, following standard ATLS (Advanced Trauma Life Support) protocols. The Gustilo-Anderson grading was confirmed intraoperatively. Primary stabilization was achieved using the Ilizarov external fixator. The frame was typically a three- or four-ring construct spanning the fracture site.⁶

Postoperatively, patients were encouraged to perform active and passive range-of-motion exercises of the knee and ankle (where applicable). All patients were started on prophylactic antibiotics and initiated early, protected weight-bearing as tolerated, typically within the first week.¹ Pin-tract care was meticulously taught to the patients or their caregivers. The fixator was typically removed after clinical and radiological evidence of union was confirmed.⁶



Figure 2. Photograph showing insertion of Ilizarove wire

Outcome Measures

The primary outcomes were assessed using the criteria established by the Association for the Study and Application of the Methods of Ilizarov (ASAMI):⁷

- Bone Result: Classified as Excellent, Good, Fair, or Poor, based on union, infection, deformity, and limb length discrepancy.
- Functional Result: Classified as Excellent, Good, Fair, or Poor, based on activity level, limp, stiffness, pain, and reflex sympathetic dystrophy (RSD).

Secondary outcome measures included

- Time to radiological union (defined as bridging callus on three out of four cortices on orthogonal radiographs).
- Duration of external fixation.
- Complications (pin-tract infection, non-union, malunion, deep infection, stiffness).

Statistical Analysis

Descriptive statistics were used to summarize the demographic data, injury characteristics, and outcome scores. Categorical data were presented as frequencies and percentages.

Continuous data were presented as means and standard deviations or median and range.

Results

Demographics and Injury Characteristics

The study included 20 patients (16 males, 4 females) with a mean age of 38.5 ± 11.2 years. Road traffic accidents accounted for 18 (90%) of the injuries. The fracture distribution according to the Gustilo-Anderson classification was: Grade II (5 cases, 25%), Grade IIIA (10 cases, 50%), and Grade IIIB (5 cases, 25%)

Table I: Table I: Distribution of fractures according to Gustilo-Anderson classification

Gustilo-Anderson grade	Frequency (n=20)	Percentage (%)
Grade I	5	25.0%
Grade IIIA	10	50.0%
Grade IIIB	5	25.0%

Bone and Functional Outcomes

Bony Union: The mean time to radiological union was 4.5 ± 1.2 months. All 20 patients achieved clinical and radiological union (100% union rate). The mean duration of external fixation was 5.1 ± 1.4 months.

Table IV: Complication and their management

Complication	Frequency (n=20)	Percentage	treatment
Pin tract infection	4	20.0	Oral antibiotics, local care
Ankle stiffness	2	10.0	physiotherapy
Non-union	0	0.0	N/A
Deep infection	0	0.0	N/A

Discussion

The use of the Ilizarov external fixator in open tibial fractures has been shown in the literature to be a reliable and versatile treatment option, particularly for high-energy injuries with significant soft-tissue damage.^{2,5} Our retrospective review of 20 cases at CBMCHB corroborates these findings, demonstrating a 100% union rate and a high proportion of patients (80% bone, 75%

Table II: Distribution of ASAMI bone results in the 20 patients treated with ilizarove external fixation

ASAMI bone result	Frequency (n=20)	Percentage (%)
Excellent	10	50.0 (%)
Good	6	30.0 (%)
Fair	3	15.0 (%)
Poor	1	5.0 (%)

Table III: Distribution of ASAMI functional results in the 20 patients treated with ilizarov external fixation

ASAMI funtional result	Frequency (n=20)	Percentage (%)
Excellent	8	40.0 (%)
Good	7	35.0 (%)
Fair	4	20.0 (%)
Poor	1	5.0 (%)

Complications

The most common complication was pin-tract infection, observed in 4 (20%) cases. All pin-tract infections were superficial (Grade I and II) and were successfully managed with local wound care and oral antibiotics without the need for premature frame removal.⁸

functional) achieving Excellent or Good outcomes according to the ASAMI criteria.

The mean union time of 4.5 months is comparable to or better than union times reported in other studies utilizing the IEF for open tibial fractures, which often cite a range of 4 to 8 months.^{6,9} The ability of the IEF to allow early weight-bearing (Wolff's Law) and provide a biologically sound environment

(minimal trauma to the soft tissue and periosteum) is a major contributor to this favorable union rate.¹⁰

Complication rates are critical in open fracture management. Our study's pin-tract infection rate of 20% is within the accepted range reported in the literature, where rates for circular fixators can be as high as 30% to 40%.⁸ Importantly, no case progressed to deep infection or required a change in the fixation strategy, highlighting the effectiveness of meticulous pin-tract care.¹

The high functional outcome score indicates that most patients were able to return to their normal daily activities with minimal residual disability. This is a significant advantage of the Ilizarov technique, which allows for dynamic, continuous adjustments to correct alignment and length, thereby optimizing the final functional result.²

Limitations of this study include its retrospective nature, the relatively small sample size (n=20), and the lack of a direct control group (e.g., comparing IEF with internal fixation or unilateral external fixation). Future prospective, randomized studies with larger cohorts would be beneficial to further solidify these findings.

Conclusion

The Ilizarov external fixator serves as a safe, effective, and definitive surgical modality for the management of Gustilo-Anderson Grade II, IIIA, and IIIB open tibia-fibula fractures. The technique provides a high rate of bone union and satisfactory functional outcomes with manageable complications. Based on the two-year follow-up of 20 cases at CBMCHB, we recommend the IEF as a preferred option, particularly in cases with compromised soft-tissue envelopes.

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