

CASE REPORT

Staged Management of a Gustilo-Anderson Type IIIB Open Humeral Shaft Fracture Using the Ilizarov Method Followed by Definitive Internal Fixation: A Case Report

Shaikh Tanvir Ahmed Talukder^{1*}, Ekhlas Bhuiyan², Chowdhury Foyzur Rob³

Received: 24 August 2026
Accepted: 1 September 2026
Published Online: 3 October 2026

Published by:
Gopalganj Medical College, Gopalganj,
Bangladesh

*Corresponding Author

DOI: 10.5281/zenodo.23124057

Copyright © 2026 The Insight



This article is licensed under a Creative Commons Attribution 4.0 International License.



ABSTRACT

Background: Managing Gustilo-Anderson Type IIIB open humeral shaft fractures in resource-limited settings requires a staged external-to-internal fixation strategy to control infection and achieve soft-tissue coverage before definitive reconstruction. **Case Description:** A 15-year-old male presented with an infected Type IIIB open right humeral fracture three days after a stone-crusher injury. Treatment involved radical debridement and Ilizarov ring fixation using tensioned olive wires, followed by split-thickness skin grafting at one month. Although robust calluses were visible at 3.5 months prompting frame removal, premature heavy labor caused an acute closed refracture two days later. Results: Following 21 days of plaster immobilization, the closed refracture was definitively stabilized using an 8-hole plate and screws. Complete osseous union was achieved, allowing full recovery and return to work. Conclusion: Initial Ilizarov fixation for infection control and soft-tissue salvage, followed by plate osteosynthesis for mechanical failure, is an effective salvage protocol for severe open upper-extremity trauma.

Keywords: Humeral shaft fracture; Gustilo-Anderson Type IIIB; Ilizarov method; Refracture; Plate screw fixation.

(The Insight 2026; 9(3): 872-874)

1. Junior Consultant (Orthopedics), Al-Haramain Hospital Pvt Limited, Sylhet, Bangladesh (ORCID: 0009-0000-3837-3 126)
2. Consultant (Orthopedics), Al-Haramain Hospital Pvt Limited, Sylhet, Bangladesh
3. Chief Consultant (Orthopedics), Al-Haramain Hospital Pvt Limited, Sylhet, Bangladesh (ORCID: 0009-0004-2812-7422)

INTRODUCTION

High-energy Gustilo-Anderson Type IIIB open humeral shaft fractures present severe clinical challenges, characterized by extensive soft-tissue destruction, devitalization, and contamination that carry high risks of osteomyelitis and nonunion [1]. In resource-limited or remote settings, these difficulties are compounded by delayed presentation, limited microvascular capabilities, and high occupational demands. Preventing deep-seated infection, achieving structural stability, and reconstructing the soft-tissue envelope remain the cornerstones of managing severe open trauma [2]. Although immediate plate fixation is standard for closed or clean fractures, its placement in contaminated, soft-tissue-deficient beds is strictly contraindicated due to catastrophic hardware colonization risks. Consequently, external fixation serves as the primary bridging choice. Among available modalities, the Ilizarov circular frame offers superior multiplanar stability and controlled dynamic loading via thin tensioned wires [2, 3], stimulating local vascularity and osteogenesis without extensive subperiosteal stripping. However, prolonged frame retention on the upper extremity risks pin-tract sepsis, joint stiffness, and poor patient tolerance. Conversely, early frame removal leaves immature regenerate bone vulnerable to refracture, especially under premature physical stress. Once the soft-tissue bed has

successfully healed and infection is eradicated, converting a refracture to internal plate osteosynthesis provides the rigid stability required for final cortical union.

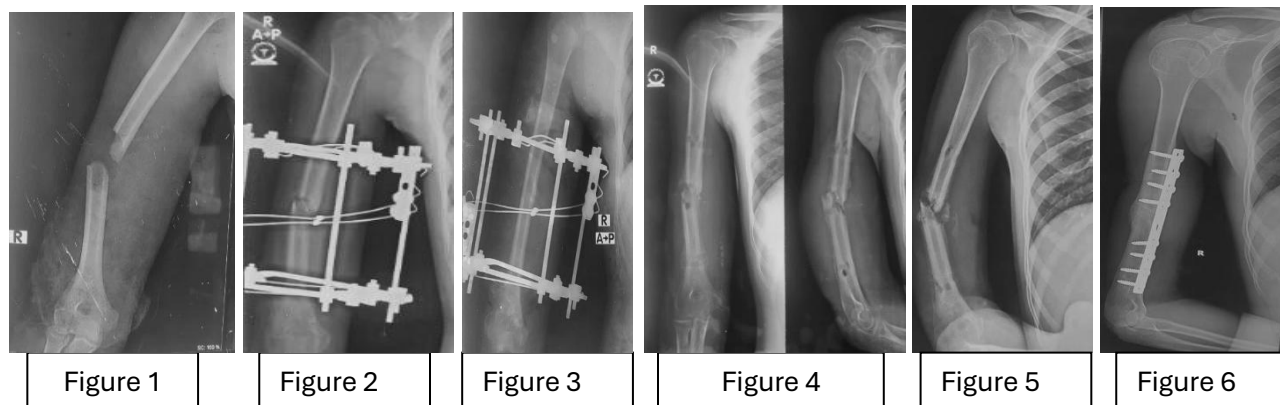
We report a case of a 15-year-old worker with an infected Type IIIB open humeral shaft fracture treated via a staged protocol, initial Ilizarov fixation and skin grafting for infection control and soft-tissue salvage, followed by internal plating for a subsequent refracture.

CASE PRESENTATION

A 15-year-old right-hand-dominant male laborer presented to our tertiary hospital three days after sustaining a severe occupational injury from an industrial stone crusher machine. Physical examination revealed a highly contaminated open wound over the right mid-shaft humerus with extensive soft tissue loss, muscle devitalization, direct bone exposure, and active purulent discharge consistent with early localized infection. Distal neurovascular examination confirmed intact radial, median, and ulnar nerve function with normal perfusion. Radiographs confirmed a displaced, comminuted mid-diaphyseal humeral shaft fracture, categorized as a Gustilo-Anderson Type IIIB open fracture. Given the delayed presentation and contamination, immediate internal fixation was contraindicated. The patient underwent urgent radical surgical debridement, followed by application of an Ilizarov

circular fixator. Two tensioned olive wires were placed obliquely through the humeral shaft and secured to circular rings using two-hole male posts. Tension stress applied across the bone ends achieved stable anatomical alignment while leaving the soft tissue bed open for serial wound care and

broad-spectrum antibiotic therapy. Infection was successfully eradicated, and a split-thickness skin graft (STSG) was performed at one month, achieving complete soft-tissue coverage.



From the left, *Figure 1*: Pre-op condition, *Figure 2*: Initial fixation with Ilizarov in-situ, *Figure 3*: Condition after 3 months, *Figure 4*: Ilizarov frame removal and bone union.

Figure 5: Re-fracture on the same site. *Figure 6*: Plate screw fixation and 1 month follow-up.



Figure 7: One month Follow-up after Plate-screw fixation, functional movement with soft tissue condition

Serial follow-ups at 1.5, 2, and 3 months demonstrated progressive soft-tissue maturation and stable frame positioning. Radiographs at 3.5 months revealed robust bridging calluses, prompting removal of the Ilizarov frame and temporary immobilization in a posterior plaster back slab for 21 days. Following slab removal, clinical examination showed no abnormal mobility, and the patient was discharged. However, two days later, he prematurely returned to heavy manual labor, resulting in an acute, closed refracture at the original fracture site under high mechanical torque. The patient returned immediately, displaying closed arm deformity with the overlying skin graft fully intact and free of infection signs. After 21 days of plaster immobilization to allow soft-tissue swelling to subside, he underwent Stage 2 open reduction and internal fixation (ORIF) via an anterolateral approach. Definitive rigid fixation was accomplished using a heavy 8-hole dynamic compression plate secured with four bicortical screws proximally and distally. The postoperative recovery was uneventful, with serial X-rays confirming complete osseous union and cortical remodeling, allowing the patient to achieve full functional range of motion and transition to a safer occupation.

DISCUSSION

Managing Gustilo-Anderson Type IIIB open humeral shaft fractures significant clinical dilemma, particularly when delayed presentation introduces active infection. In our case, the 3-day post-injury delay contraindicated immediate plate osteosynthesis. Implanting permanent metallic hardware within an acutely contaminated, soft-tissue-deficient field carries a high risk of bacterial colonization, glycoalkal biofilm formation, and chronic osteomyelitis [4, 5]. Initial plate fixation likely would have resulted in deep infection, cortical necrosis, and atrophic nonunion.

To avoid these complications, an Ilizarov circular fixator was selected over unilateral external frames. Humeral diaphyseal fractures are subject to complex multiplanar deforming forces driven by the shoulder girdle and arm musculature, which unilateral constructs often struggle to neutralize, leading to pin loosening or malunion. Conversely, the Ilizarov method utilizes thin tensioned transfixion wires mounted on circular rings, providing rigid multiplanar and torsional stability under beam loading while preserving native fracture biology [2, 3]. Combined with split-thickness skin grafting at one month, this approach successfully controlled infection and fostered robust callus formation by 3.5 months.

However, this case also highlights the vulnerability associated with early frame removal in the upper extremity. In global literature, the average time required in an Ilizarov frame for complete corticalized humeral union ranges from 4.5 to 8 months [6, 7]. Removing the frame at 3.5 months minimized patient intolerance, pin-tract sepsis, and joint stiffness, but left the immature regenerate bone fragile. When our adolescent patient prematurely resumed heavy manual labor, the unmodeled callus failed under mechanical torque [8].

Had the circular fixator remained in place for an additional 1 to 2 months, advanced primary cortical remodeling and haversian canalization would likely have prevented the refracture altogether, though at the expense of increased joint contracture and pin-site infection risks. Once the refracture occurred as a closed injury within a completely healed, uninfected soft-tissue bed, the biological landscape changed. Converting from external fixation to internal plate osteosynthesis is a well-established revision strategy for mechanical failure [9]. Achieving rigid internal compression with an 8-hole dynamic compression plate provided the absolute stability required for direct cortical healing, ultimately resulting in complete osseous union and full functional recovery.

CONCLUSION

Treating complex, infected Type IIIB open humeral fractures demands a flexible, staged strategy that prioritizes soft-tissue biology before final mechanics. Initial Ilizarov circular fixation reliably controls infection and enables soft-tissue reconstruction, though early frame removal risks refracture. Once soft tissues are fully healed and infection-free, converting to definitive plate-and-screw osteosynthesis serves as a highly effective salvage protocol to achieve predictable, absolute osseous union.

REFERENCES

1. Kim PH, Leopold SS: In brief: Gustilo-Anderson classification. [corrected]. *Clin Orthop Relat Res* 2012, 470(11):3270-3274.
2. Nieuwoudt L, Ferreira N, Marais L: Short-term results of grade III open tibia fractures treated with circular fixators. *SA Orthopaedic Journal* 2016, 15.
3. G GR, Mathew KC, J SGB, Zubair M, S KR, T AT, Mohamed ZH: ROLE OF ILIZAROV'S METHOD IN THE TREATMENT OF HUMERAL SHAFT NONUNION: A PROSPECTIVE STUDY. *J Surg Radiol* 2026, 5(5):175-177.
4. Seligson D, Mauffrey C, Roberts CS: *External Fixation in Orthopedic Traumatology*; 2012.
5. Huxman C, Armstrong A, Updegrove G, Lewis GS, Butler J: Dynamic Fracture Fixation Plates: A Systematic Review of Evolving Design Approaches. *Ann Biomed Eng* 2025, 53(6):1271-1290.
6. Kiran M, Jee R: Ilizarov's method for treatment of nonunion of diaphyseal fractures of the humerus. *Indian J Orthop* 2010, 44(4):444-447.
7. Anter M, Sanad E, Elkaramany M: Role of Ilizarov external fixator in treatment of humeral non-union ORIGINAL STUDY. *Acta Orthop Belg* 2020, 86:1-8.
8. Scaglione M, Fabbri L, Dell' Omo D, Goffi A, Guido G: The role of external fixation in the treatment of humeral shaft fractures: A retrospective case study review on 85 humeral fractures. *Injury* 2015, 46(2):265-269.
9. Ziveri G, Biase CF: A Case Report of Humeral Nail Breakage after 11 Years Secondary to Shaft Nonunion: Treatment with Autogenous Iliac Crest Bone Graft and Compression Plate. *J Orthop Case Rep* 2019, 10(1):89-92.