Case report

MULTIDISCIPLINARY MANAGEMENT OF AN OPEN DISTAL TIBIAL FRACTURE: A CASE REPORT

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Rezume Open fractures in orthopedic trauma present significant challenges due to the high risk of infection, non-union, and limb loss. This case report of a complicated Gustilo-Anderson Type IIIc high-energy trauma underscores the necessity for adaptable, evidence-based management protocols. It demonstrates that staged repair, prioritization of vascular status, early intervention, and the strategic use of external fixation contribute to improved outcomes in complex open fractures. A multidisciplinary approach, including early damage control, functional limb preservation, and adherence to BOA/BAPRAS guidelines, is essential for managing these injuries. Collaborative orthopedic-plastic management is a notable advancement that optimizes outcomes in high-energy limb trauma cases.

Key words: fracture, external fixation, osteosynthesis

INTRUDUCTION

An open fracture is a bone fracture where the broken bone and associated soft-tissue injuries are exposed to the external environment through a break in the skin. The energy involved in the injury directly correlates with trauma severity [1]. The Gustilo-Anderson classification (GAC), established as the standard in 1984, categorizes open fractures based on the extent of soft-tissue and skin damage [2]. Complications can include compartment syndrome (increased pressure within a muscle compartment), non-union (failure of bone healing), loss of function, neurovascular injury (damage to nerves or blood vessels), infection, osteomyelitis (bone infection), and amputation [1].

Understanding the epidemiology and mechanisms of open fractures is crucial for triage and treatment. Most are from traffic accidents; in patients under 65, tibial diaphysis fractures are most common. Gunshot wounds can cause complex bone and tissue injuries, sometimes exceeding those of high-velocity impacts. Since closure is not generally recommended, management must address the soft-tissue defect. Despite research efforts, data on best practices remains limited.

This case report presents the management of a gunshot-induced, open fracture of the distal tibia and associated foot injury. The study highlights the surgical decision-making process, the role of external fixation, and additional fundamental concepts of open fracture care.

CASE PRESENTATION

A male patient presented to the emergency department (ED) 30 minutes after being wounded by a gunshot injury to his right leg. The bullet had entered the posteromedial aspect of the lower leg, resulting in a fracture of the lower third of the tibia with active bleeding. X-rays were performed in the emergency department, confirming the findings below (Figure 1). It was a comminuted open distal tibial fracture with significant bone loss and displacement. Multiple bone fragments and foreign bodies/ bullet fragments were seen in the surrounding soft tissues.

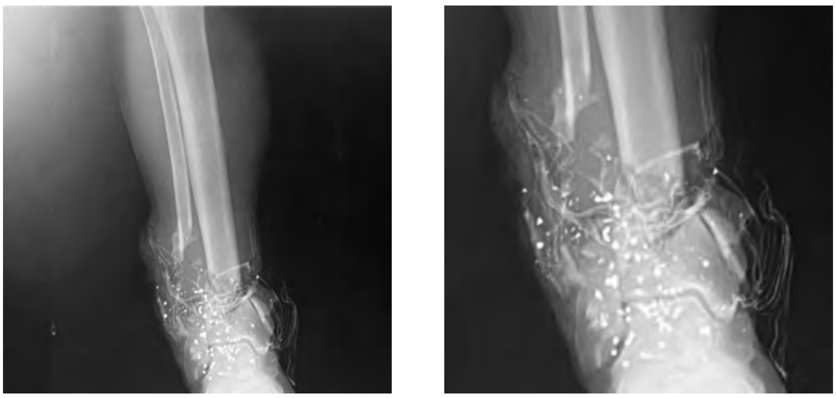

Figure 1. Preoperative plain radiographs. Anteroposterior (AP) view of the right lower leg/ankle

Initial Evaluation and Management

The Advanced Trauma Life Support (ATLS) protocol—a standardized approach for emergency care of trauma patients—should be immediately implemented at the scene or in the emergency room. Orthopedic evaluation and management should follow. On examination, the right leg showed extensive soft tissue injury and bone exposure. Emergency intraoperative findings confirmed damage to the arteria tibialis posterior (the posterior tibial artery), while the arteria dorsalis pedis (the dorsalis pedis artery) remained intact and became the foot's primary arterial blood supply. After administering a tetanus vaccine, the patient was taken to surgery for thorough irrigation (washing out the wound) and debridement (removal of damaged tissue). Given the extent of the bone defect, a 3-4 cm tibial shortening (surgically removing a bone segment to allow soft-tissue closure and alignment) was performed. Initial stabilization was achieved with external fixation (an external device that stabilizes the bone), as internal fixation (plates or rods placed inside the bone) is contraindicated when the wound is open and contaminated.

Postoperative Care and Plan

Postoperatively, the patient was placed on strict bed rest and started on broad-spectrum antibiotics. Vascular monitoring was performed routinely to assess perfusion via the remaining dorsalis pedis artery. The limb remained viable, though the vascular supply was tenuous due to the single-artery perfusion. Given the extensive bone loss and complexity of the injury, the orthopedic team recommended a 6-month observation period to monitor spontaneous bone regeneration and soft-tissue healing. If insufficient bone healing is observed, further interventions such as bone grafting and internal fixation will be considered at a later stage (Figure 2,3,4).

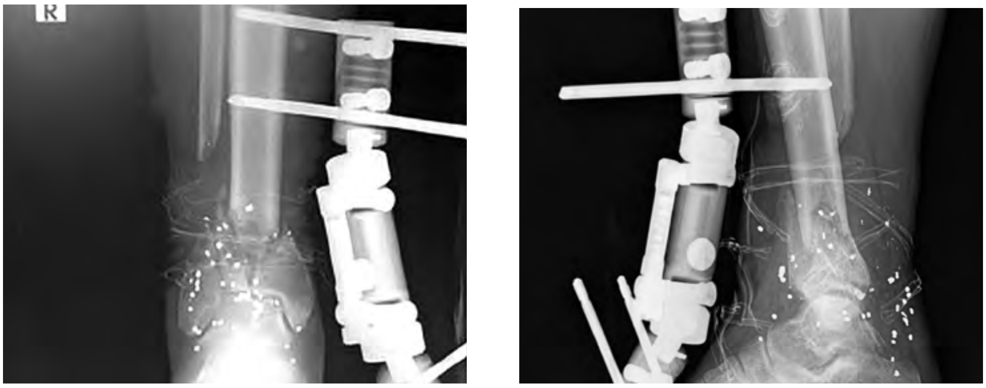

Figure 2. Postoperative plain radiographs. An external fixator was placed. 1 month post-op. Anteroposterior (AP) and Lateral views of the right lower leg/ankle (A and B)

Figure 3. Postoperative plain radiographs. 2 months post-op. Anteroposterior (AP) and Lateral views of the right lower leg/ankle (A-C)

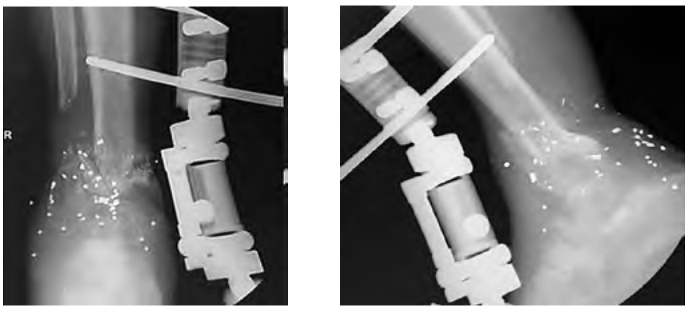

Figure 4. Postoperative plain radiographs. Latest post-op. Anteroposterior (AP) and Lateral views of the right lower leg/ankle(A-B)

DISCUSSION

Types of Open Fractures & Mechanisms

Open fractures may result from a variety of mechanisms of injury. Typical direct injuries include high-energy trauma such as car crashes, gunshot wounds, and high-impact falls. These injuries are frequently associated with varying degrees of contamination, soft-tissue compromise, and osseous involvement. High-velocity bullet-induced fractures have a known correlation with neurovascular injury due to the close proximity of vascular and neural structures to bone. According to Omer et al., approximately 69% of nerve injuries related to gunshot fractures demonstrate spontaneous recovery within three to nine months, while cases involving both arterial and nerve injury have a less favorable prognosis, often resulting in non-functional limbs. Visser et al. reported that only 7% of such combined injuries recover normal function.

In contrast, low-energy torsional injuries, including those from sports and falls from a standing height, are examples of indirect processes. However, there is a strong correlation between the amount of energy transferred at the time of damage and the severity of any open fracture [7].

Classification Systems

Gustilo and Anderson's classification system categorizes open fractures by severity and guides treatment. Type I fractures are clean wounds less than 1 cm long. Type II fractures are lacerations over 1 cm but without flaps, avulsions, or severe soft tissue damage. Type III fractures involve segmental bone injury with severe soft tissue damage or even amputation. For type I and II open fractures, primary wound closure is recommended, while for type III fractures, delayed primary closure is suggested, often using split-thickness skin grafts (transplanted skin layers) or suitable flaps (sections of tissue moved from another body part). The study found that more severe fracture types had worse prognoses and higher infection rates. Type IIIa fractures can be closed but have high contamination and soft tissue damage. Type IIIb fractures involve soft-tissue loss and require a tissue flap. Type IIIc fractures require vascular (blood vessel) repair due to arterial injury [10]. The present case is a Gustilo-Anderson type IIIc open fracture that required urgent surgery.

Treatment Principles

Effective management of open fractures requires understanding anatomy, injury mechanisms, the patient's physical state, and available surgical options. Treatment covers soft-tissue healing, reconstruction, final bone fixation, and initial wound cleaning (decontamination) [11].

Removing foreign objects within 6 hours during fracture reduction helps prevent infection. A wet-to-dry saline dressing after irrigation helps comfort and promote healing. Next, the limb should be reduced and put in a splint with padding. Pulses must be recorded both before and after reduction. However, formal debridement is not required for a gunshot fracture unless the wound is large and contaminated. Tetanus prophylaxis is a standard procedure after open fractures, given the disease's severity and the low morbidity of treatment.

Antibiotics are essential for open wounds, as gram-positive bacteria are present in most cases, and gram-negative bacteria in some. Giving antibiotics within 60 minutes reduces infection-related postoperative complications.

Surgical stabilization (external fixation vs internal)

Effective surgical care lays the foundation for rehabilitation and a return to activities. Early fracture stabilization, especially for intra-articular fractures, enhances healing, reduces pain, eases bed transfers, and prevents further damage. Hemodynamic state, fracture site, and soft-tissue damage influence the treatment option chosen.

Depending on the degree of soft-tissue cover, it is assessed whether to perform definitive surgery with internal or external fixation of the fracture, as this is the biggest predictor of infection risk later. External and internal devices such as ring fixators, external fixators, and monolateral rails, as well as extramedullary devices, such as intramedullary nails or ORF with plates, are examples of fixation types [11]. When GHOISS is greater than 9, external fixators are crucial because they aid in skeletal stabilization, facilitate less-invasive procedures, and reduce soft-tissue damage in open fracture treatment. To enable soft-tissue repair, external fixator pins should be inserted through undamaged skin rather than through the incision. To prevent interference, they should not be positioned along the lines of future surgical incisions. To reduce the risk of fracture, skin incisions may be performed if the patient's hemodynamic status permits. The limb's length can be preserved by applying temporary external fixation, which can subsequently be changed to internal fixation. Although internal fixation is advised for subsequent reduction loss, open wounds with articular fractures present a possibility for articular reconstruction on day 1 [12].

If there is no significant soft tissue involvement or extensive contamination, and the patient is stable, primary internal fixation can be performed for open fractures with a GHIOSS score of less than 9. The technique of choice is thorough debridement, with careful handling of the bone fragments to prevent devascularization [12].

Delayed vs primary closure.

The risk of nosocomial infection with gram-negative bacteria may increase with delayed wound closure. For wounds with significant tissue loss, Gopal et al. recommended early internal fracture fixation and flap covering [7]. In Type III injuries, Rajasekaran et al. reported outstanding results with a 3% deep infection rate following immediate primary skin closure, stringent inclusion and exclusion criteria, and tension-free closure after skeletal fixation. When the GHOISS skin score is 1 or 2, meaning there is no skin loss during debridement, and the overall score is less than 10, with no organic or sewage contamination and no farmyard injuries, primary closure can be performed in type IIIb fractures [12].

Risks and Complications

The severity of the injury, the treatment method, and each patient's individual traits all affect the incidence of complications [13]. Open wounds, diabetes, and peripheral vascular disease were identified as risk factors according to a large population-based study. These complications can be perioperative, early postoperative, or late postoperative [14]. Delaying surgery for swollen ankles can reduce wound complications like infection, blistering, and edge necrosis, as posttraumatic edema, fracture blisters, or abrasions decrease. Nonunion development is facilitated by excessive motion at the fracture site, influenced by factors like infection, obesity, diabetes, tobacco use, alcohol misuse, and old age. Complex regional pain syndrome results in 30% of open tibial fractures. Loss of reduction and malunion can lead to osteoarthritis and functional impairment [11,14]

Role of Multidisciplinary Management

Management of open fractures requires a multidisciplinary team approach. Imaging the wound in the ED allows different specialties within the multidisciplinary team to further assess the wound, minimizing repeated exposure or contamination of the injury. In cases of open fractures, patients with severe injuries are now sent straight to major trauma units via pre-hospital pathways, which provide orthopedic and plastic surgery experts as well as on-site trauma subspecialties[12]. Open injuries require the joint efforts of orthopedic and plastic surgeons to coordinate the course of treatment and surgical procedures, ensuring the patient receives the most feasible and effective care. Orthopedic hospitals that have implemented this approach have shown markedly lower rates of deep infections, fewer revision procedures, shorter hospital stays, lower overall expenditures, and better outcomes, with lower amputation and nonunion rates [11]. The effectiveness of structured interdisciplinary care in improving functional outcomes and quality of life for patients with open fractures is demonstrated by the success of orthoplastic centers.

Literature Review and Comparison

According to the protocols from the British Orthopaedic Association (BOA) and the British Association of Plastic Reconstructive and Aesthetic Surgeons (BAPRAS), treatment of open fractures must focus on early antibiotic prophylaxis, ortho-plastic input led by consultants, and early debridement with fracture fixation and soft tissue coverage within 72 hours [11]. Restoring as much anatomical alignment as feasible, reducing tamponade bleeding and edema at the fracture site, and reducing traction and pressure on the soft tissue and neurovascular systems are all objectives of reduction, according to the British Orthopaedic Association [11].

In our case, treatment adhered to all these principles as part of damage control orthopedics.

Conversion to final fixation following acute care may be managed with a "window period" in a cast or may involve ex-fix removal and internal fixation in a single procedure [12]. Given the circumstances of our case, the patient undergoes monthly imaging and bone regrowth follow-up after external fixation, with treatment not yet complete. Results are expected within 6 months, with next steps based on soft-tissue health and pin tract infections.

CONCLUSION

Open fracture management involves understanding anatomy, mechanisms of injury, patient physiology, and surgical procedures. It involves soft tissue healing, rebuilding, fixation, and initial wound decontamination. Complications are influenced by injury severity, treatment method, and patient traits. Collaboration between orthopedic and plastic surgeons is crucial for effective care and efficient treatment.

References:

1. *Alic, T., & Hassa, E. (2022). Open fractures from Gustilo and Anderson to the present: A bibliometric analysis with global productivity and research trends. Indian Journal of Orthopaedics, 56(12), 2119–2132. https://doi.org/10.1007/s43465-022-00743-z*
2. *Axelrod, D., Comeau-Gauthier, M., Prada, C., Bzovsky, S., Heels-Ansdell, D., Petrisor, B., Jeray, K., Bhandari, M., Schemitsch, E., & Sprague, S. (2022). Change in Gustilo-Anderson classification at time of surgery does not increase risk for surgical site infection in patients with open fractures: A secondary analysis of a multicenter, prospective randomized controlled trial. OTA International: The Open Access Journal of Orthopaedic Trauma, 6(1), Article e231. https://doi.org/10.1097/oi9.0000000000000231*
3. *Costa, F. C. D., Reis, J. M. D., Reis, S. P. D., Bartelega, L. A., Melo, N. F., & Araujo, C. D. M. (2022). Epidemiology of open fractures and degree of satisfaction of initial care. Acta Ortopedica Brasileira, 30(4), Article e245221. https://doi.org/10.1590/1413-785220223004e245221*
4. *Abghari, M., Monroy, A., Schubl, S., Davidovitch, R., & Egol, K. (2015). Outcomes following low-energy civilian gunshot wound trauma to the lower extremities: Results of a standard protocol at an urban trauma center. The Iowa Orthopaedic Journal, 35, 65–69.*

5. Maqungo, S., Kauta, N., Held, M., Mazibuko, T., Keel, M. J., Laubscher, M., & Ahmad, S. S. (2020). Gunshot injuries to the lower extremities: Issues, controversies and algorithm of management. Injury, 51(7), 1426–1431. https://doi.org/10.1016/j.injury.2020.05.024
6. Yim, G. H., & Hardwicke, J. T. (2018). The evolution and interpretation of the Gustilo and Anderson classification. Journal of Bone and Joint Surgery, 100(24), Article e152. https://doi.org/10.2106/jbjs.18.00342
7. Halawi, M. J., & Morwood, M. P. (2015). Acute management of open fractures: An evidence-based review. Orthopedics, 38(11), e1025–e1033. https://doi.org/10.3928/01477447-20151020-12
8. Sudduth, J. D., Moss, J. A., Spitler, C. A., Pham, V. H., Jones, L. C., Brown, J. T., & Bergin, P. F. (2020). Open fractures: Are we still treating the same types of infections? Surgical Infections, 21(9), 766–772. https://doi.org/10.1089/sur.2019.140
9. Khatri, J. P., Kumar, M., & Singh, C. M. (2020). Primary internal fixation in open fractures of tibia following high-velocity gunshot wounds: A single-centre experience. International Orthopaedics, 44(4), 685–691. https://doi.org/10.1007/s00264-019-04387-x
10. Trompeter, A. J., Furness, H., Kanakaris, N. K., & Costa, M. L. (2020). Classification of open fractures: The need to modernize. The Bone & Joint Journal, 102-B(11), 1431–1434. https://doi.org/10.1302/0301-620x.102b11.bjj-2020-0947
11. Davies, M., Dorrell, V., Grainger, C., Ahluwalia, A., Vasireddy, A., & Ahluwalia, R. (2022). Assessing and managing open fractures: A systematic approach. British Journal of Hospital Medicine, 83(12), 1–9. https://doi.org/10.12968/hmed.2021.0578
12. Dheenadhayalan, J., Nagashree, V., Devendra, A., Velmurugesan, P. S., & Rajasekaran, S. (2023). Management of open fractures: A narrative review. Journal of Clinical Orthopaedics and Trauma, 44, Article 102246. https://doi.org/10.1016/j.jcot.2023.102246
13. Elniel, A. R., & Giannoudis, P. V. (2018). Open fractures of the lower extremity. EFORT Open Reviews, 3(5), 316–325. https://doi.org/10.1302/2058-5241.3.170072
14. Ovaska, M. (2015). Complications in ankle fracture surgery. Acta Orthopaedica, 86(Suppl. 358), 1–35. https://doi.org/10.3109/17453674.2014.1002273

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რეზიუმე ღია მოტეხილობები, მათი მკურნალობა, გართულებების მართვა და პაციენტების ოპერაციის შემდგომი რეაბილიტაცია წარმოადგენს თანამედროვე ტრავმატოლოგია-ორთოპედიის აქტუალურ პრობლემას. დღემდე არ არსებობს ამ დაზიანებების მკურნალობის ერთიანი ალგორითმი. დავის საგანს წარმოადგენს ასევე ოსტეოსინთეზის მეთოდების შერჩევა და მათი შესრულების ოპტიმალური ვადები.

ნაშრომში მოცემულია თსსუ-ის ტრავმატოლოგიისა და ორთოპედიის თანამშრომლების და ამავე უნივერსიტეტის სტუდენტების მიერ, ს.ს. „ვიანი" - ივ.ბოკერიას საუნივერსიტეტო კლინიკაში ნამკურნალები პაციენტის (რომელსაც აღენიშნებოდა ქვედა კიდურის ძვლების ღია, ცეცხლნასროლი მოტეხილობა) საინტერესო შემთხვევის აღწერა.

მიღებულ შედეგებზე დაყრდნობით გამოტანილი დასკვნების საფუძველზე გაკეთებულია ამგვარი ტრავმული დაზიანებების მკურნალობის ტაქტიკის შემუშავების კიდევ ერთი მცდელობა.

საკვანძო სიტყვები: მოტეხილობა, გარეგანი ფიქსაცია, ოსტეოსინთეზი