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Case Report

Management of Gunshot-Induced Mandibular Fracture in a Young Patient Using External Fixation: A Case Report

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Abstract: The management of gunshot wounds to the face represents a significantly complex challenge due to the need for meticulous surgical interventions. This study aims to report the efficacy of external fixators in treating comminuted mandibular fractures caused by gunshot trauma in a 16-year-old patient. The patient presented to an Oral and Maxillofacial Surgery and Traumatology service with edema, malocclusion, mandibular mobility, spontaneous pain, oral mucosal laceration, paresthesia in the mandibular region, and multiple entry and exit gunshot wounds on the face. Facial computed tomography revealed a frontal sinus fracture, comminuted mandibular body fracture, left zygomatic arch fracture, and right zygoma fracture, in addition to fragments consistent with firearm projectiles adjacent to the right and left mandible, glabella region, and soft tissues on the left side of the face. Given the patient's clinical complaints, the proposed treatment involved surgical removal of the projectiles under general anesthesia and the use of an external fixator for mandibular fracture stabilization. The patient progressed without complications or clinical complaints, with follow-up over six months showing bone consolidation, satisfactory occlusion, and no clinical or imaging signs of infection. It is concluded that the use of external fixators in comminuted mandibular fractures is an effective approach, ensuring good recovery, preserving aesthetic and functional outcomes, and minimizing the risk of infections and other complications.

Keywords: Gunshot Wounds; Bone Fixation Techniques; External Fixators; Maxillomandibular Fractures.

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1. Introduction

The management of gunshot wounds, particularly in facial areas, poses a significant challenge in emergency settings, reflecting the rising incidence of civil violence in various regions worldwide. Craniofacial injuries caused by firearm projectiles are most common among victims aged 12 to 29 years, representing 59.4% of cases. This age group highlights the vulnerability of young individuals to gun violence in Brazil, revealing a concerning pattern of homicides within this population. Facial injuries resulting from gunshot wounds can lead to complex complications, requiring a timely and meticulous surgical approach to optimize clinical outcomes. Early and appropriate interventions that not only aim to restore facial structures but also preserve function and aesthetics are crucial for a favorable prognosis [1].

Experimental studies investigating the mechanisms of maxillofacial fractures caused by projectile injuries are limited. In contrast, an extensive body of literature supports various treatment modalities, underscoring the need to tailor treatments to individual patient

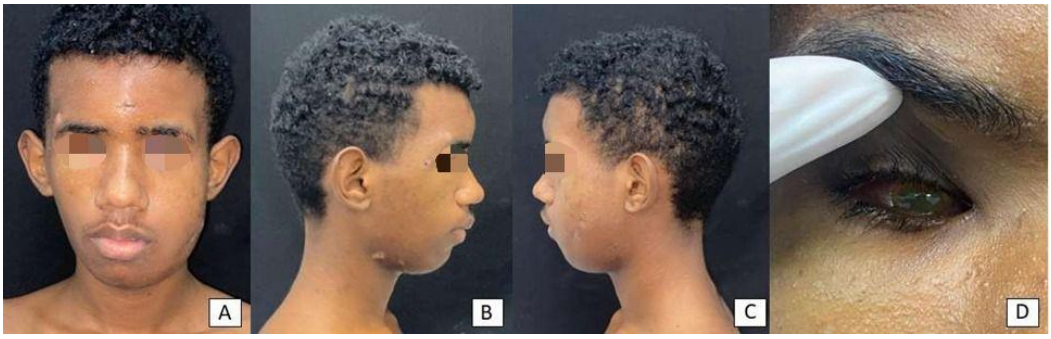
needs [2]. In cases of comminuted mandibular fractures caused by high-energy trauma, such as gunshot wounds, external fixation is considered a form of closed reduction that provides semi-rigid fixation for fractured segments. External fixators are primarily indicated in cases of significant bone loss due to tumor resections, infections leading to multiple bone sequestrations, comminution, and trauma involving substance loss [2, 3].

The timing of intervention in maxillofacial gunshot injuries remains a subject of debate. While not all maxillofacial gunshot injuries can be comprehensively treated immediately, options for early fixation do exist [4, 5]. This study aims to present a clinical case illustrating the use of external fixation for the treatment of a comminuted mandibular fracture caused by a firearm injury.

2. Case Report

A 16-year-old male patient presented to an Oral and Maxillofacial Surgery and Traumatology service with a history of facial trauma caused by gunshot wounds. At the time of trauma, the patient was eupneic in room air, alert, and oriented. Clinical examination revealed bilateral mandibular edema, blindness in the right eye, and extensive oral mucosal lacerations, with entry wounds observed on the face, left mandibular region, and right malar region. A projectile was palpable and lodged in the glabella region (Figures 1A to 1D).

Figure 1. A. Clinical images in frontal view and left profile (item B) and right profile (item C) showing gunshot wounds in the glabella region, left malar region, bilateral mandibular body region, and right supraorbital region. D. The patient presented with blindness in the right eye following the trauma.



Computed tomography (CT) revealed a comminuted fracture of the left mandible, with hyperdense artifacts of shapes consistent with firearm projectiles (PAF) located in the glabella region, left mandibular body, and left malar region (Figures 2A to 2F). The patient underwent hemostasis maneuvers and removal of the projectile from the glabella region in an outpatient setting and was admitted for elective surgical management. After multidisciplinary evaluation and clinical stabilization, maxillomandibular fixation was performed, followed by a planned surgery for projectile removal and fracture fixation using an external fixator.

Given the patient's clinical complaints, the proposed treatment included surgical removal of the projectile and fixation of the comminuted mandibular fracture using an external fixator. This approach aimed to preserve the periosteum, thereby promoting improved vascularization in the affected area. Maxillomandibular fixation was maintained, and the fracture was stabilized using a pneumatic drill and four 3 mm Schanz pins connected to a size 150 external fixator (Figures 3A to 3F).

Figure 2. A. 3D reconstruction performed in the emergency room showing projectiles lodged in the face and a comminuted fracture of the left mandibular body. B. Axial slice showing bone and dental fragments in the left mandibular region. C. CT image revealing a projectile lodged in the left mandibular ramus region. D. CT scan showing a fracture in the alveolar region of the left maxilla, with a dental element displaced buccally and positioned horizontally after the trauma. E. Axial slice demonstrating the presence of hemossinus in the maxillary sinus, with a projectile lodged in the left zygomatic arch region and in the frontal sinus region (F).

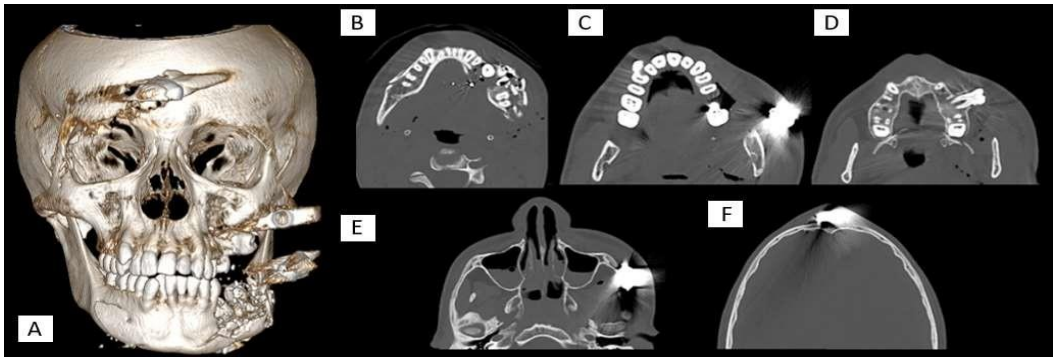


Figura 3. A. Fixation of a No. 3 Schanz pin in the mental region. B. Removal of a projectile from the left malar region. C. Final positioning of a 150 wrist fixator after reduction.

The patient progressed without complications or clinical complaints. A postoperative computed tomography (CT) scan was requested, which showed the Schanz pins in position and the absence of projectiles (Figures 4A to 4F). The external fixator was removed after 8 weeks, and the patient remained under clinical and imaging follow-up for 7 months. Follow-up revealed bone consolidation, patent maxillary sinuses, satisfactory mouth opening and occlusion, and no signs of infection (Figures 5A to 5G).

3. Discussion

The use of external fixation provides better control of existing infections, as internal fixation treatment requires extensive periosteal removal, which can impair blood supply, leading to pseudoarthrosis or bone necrosis [6, 7]. In such cases, external fixation techniques can be employed until sufficient bone volume is achieved for internal fixation. Antibiotic therapy should be implemented to minimize the risk of postoperative complications [8, 9]. In the present case, the decision to use an external fixator was based on the patient's infection status, opting for a less invasive approach to preserve the periosteum, blood supply, and bone architecture [10].

Additionally, the use of external fixators in facial trauma, especially in adolescents, has proven to be an effective approach in managing complex fractures, including those caused by gunshot wounds. External fixators not only stabilize fractures in craniofacial trauma but also provide better visualization and improved surgical access to the affected

areas. They enable continuous monitoring of the affected region, facilitating early detection of infections and minimizing complications associated with internal fixation methods. Studies have shown that patients treated with external fixators achieve positive outcomes in terms of bone consolidation and mandibular function preservation [11], with significantly lower infection rates [12].

Figure 4. A. 3D reconstruction showing five Schanz pins in position, stabilizing the fractured segments. B. Axial slice demonstrating a Schanz pin positioned in the posterior region of the mandibular ramus and in the anterior mandibular region (C). D. Axial slice after the removal of bone fragments and a dental element. E. Image showing a patent maxillary sinus following projectile removal, with the aligned fracture of the left zygomatic arch. F. Frontal sinus appearance after projectile removal from the region.

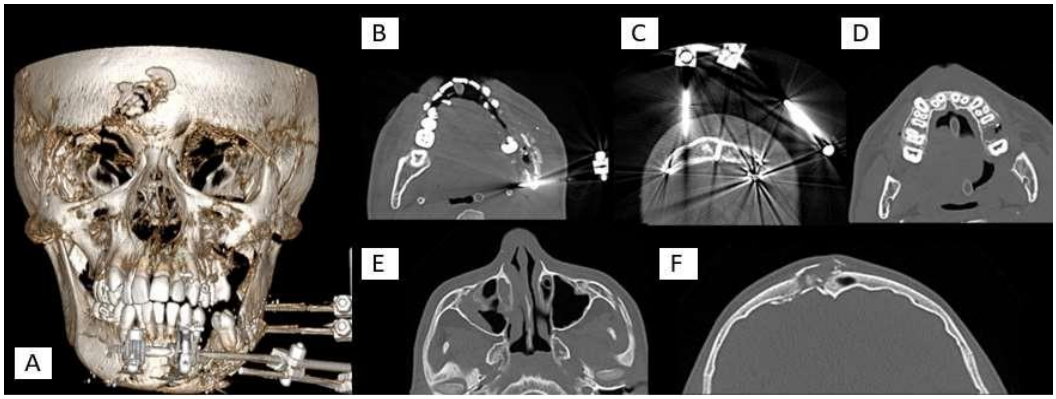
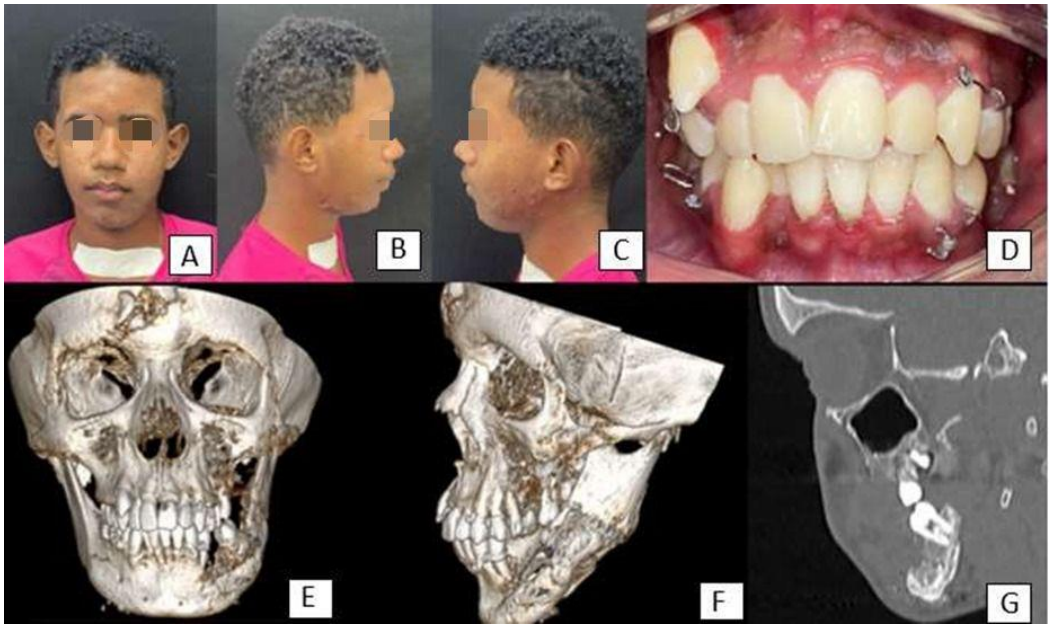


Figure 5. A. Patient in frontal view and right profile (B) and left profile (C) photographs, showing good healing with a satisfactory postoperative facial pattern. D. Stable postoperative occlusion. E. 3D reconstruction displaying bone neoformation in the left mandibular body in frontal view and profile view (F). G. Bone consolidation with preservation of an adjacent dental element.



Furthermore, the severity of these injuries is increasing, underscoring the need for effective surgical approaches [13]. The literature supports the idea that external fixation can be particularly advantageous in pediatric populations, where facial fractures often

exhibit unique characteristics requiring adaptive solutions [14]. It also highlights the importance of a multidisciplinary approach, including fracture stabilization, removal of foreign bodies, functional rehabilitation, and long-term aesthetic improvement [15].

4. Conclusion

In summary, this case report demonstrates the efficacy of external fixators in stabilizing comminuted mandibular fractures. This less invasive approach optimized recovery by preserving vascularization, promoting good bone consolidation, achieving functional and aesthetic outcomes, reducing the risk of infections, and enabling safe, clear, and effective clinical follow-up.

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Research Ethics Committee Approval: We declare that the patient approved the study by signing the informed consent form, and that the study followed the ethical guidelines established by the Declaration of Helsinki.

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Conflicts of Interest: The authors declare no conflicts of interest.

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