Treatment of a Penetrating Intraorbital Injury by Rubber Projectile

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Abstract

Penetrating injuries caused by rubber projectiles are classified as low-velocity injuries. When the midface is affected, these can cause fractures, eye injuries, and even blindness. Unlike conventional projectiles, the removal of rubber projectiles involving the orbit and correction of associated fractures are mandatory for preventing infection and anophthalmic orbit syndrome, which is characterized by enophthalmos of the prosthesis, superior sulcus depression, and lower eyelid ptosis. This article aims to describe a case of penetrating injury by rubber projectile, associated with the removal and late reconstruction of the orbital walls, and to show the results obtained.

Keywords
- blindness
- orbital fractures
- eye injuries
- wounds
- penetrating

Injuries to the maxillofacial region caused by firearm projectiles represent a unique and challenging entity due to extensive tissue destruction, loss of the anatomical planes, and potentially fatal hemorrhages.[1] Several factors may influence the complexity of these injuries, such as the projectile's velocity, its profile, and format.[1]

Classically, high- and low-velocity projectiles (higher than 1,000 m/s and lower than 500 m/s, respectively) have been used by the military forces; however, these are still considered inappropriate for containing crowds and evacuating restricted areas. Due to these characteristics, very-low-velocity projectiles (lower than 100 m/s) were developed for controlling civilians without causing heavy damage or complex injuries.[2]

The very-low-velocity projectiles have a metal core covered with rubber, and owing to their cylindrical or round shape, drastically decrease the velocity.[2,3] Ideally, when using rubber projectiles, shooting should be aimed at the lower body from a minimum distance of 40 m from the target.[4] However, shots hitting the craniofacial region and even deaths have been reported.[3,5]

Although rare, facial injuries caused by rubber projectiles may be penetrating due to the low elasticity of the skin and bones of the midface.[4] Additionally, due to the low speed of these projectiles, these end up being lodged in regions without exit projectile orifices.[4] Given these circumstances, the removal of the projectile and correction of orbital fractures are essential for preventing the risk of infection and minimizing later problems associated with ocular rehabilitation, such as the anophthalmic orbit syndrome, characterized by enophthalmos of the prosthesis, depression of the superior orbital sulcus, and ptosis of the lower lid.[6]

The objective of this article is to report a case involving injury to the orbital region by rubber projectile associated with a loss of vision and late treatment of a large orbital floor defect.

Case Report

A 35-year-old male was hit by a rubber projectile in the right eye during a mass demonstration. At admission, the patient was conscious, hemodynamically stable, and received initial treatment in compliance with the Advanced Trauma Life Support (ATLS) guidelines. Antibiotic therapy was initiated with cefazolin (1 g, intravenous [I.V.]) in association with gentamicin (80 mg, I.V.).

Examination of the patient's face showed extensive injury to the lower eyelid and associated necrotic tissue, compatible

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Fig. 1 The three-dimensional (3D) reconstruction showing the rubber projectile trajectory across the entire orbital floor.

Fig. 3 Front view of the patient showing hypertrophic scarring of the entry projectile orifice in the right infrapalpebral region associated with enophthalmos, depression of the supraorbital sulcus, and change in the palpebral rima.

with an entry projectile orifice. No exit orifice was observed. Furthermore, the patient presented with blindness, whereas the movement of the remaining extrinsic muscles was preserved. A computed tomography (CT) scan showed the foreign body measuring approximately 5 × 3 cm lodged in the intraorbital region and across the entire right orbital floor, from the orbital margin to the sphenoid sinus, with an extensive defect in this region (►**Figs. 1** and **2**).

Initially, the case was handled solely by the ophthalmology team. With the patient under general anesthesia, only repair of the eye injuries and suturing of the lower eyelid (entry projectile orifice) were performed due to the large necrosis area and tissue loss. After 2 months, the patient was referred to the maxillofacial surgery service for orbital reconstruction. Upon clinical examination, it was possible to observe a hypertrophic scar in the infraorbital region associated with tissue retraction. In addition, the patient showed signs of very evident enophthalmos and a narrow palpebral aperture (►**Fig. 3**). The remainder of the ocular bulb was present, whereas eye movement was poorly preserved. To prevent infection and minimize both enophthalmos and depression of the palpebral sulcus, a new surgical procedure was scheduled. At this time, the ocular bulb was enucleated and the subciliary access was performed to remove the projectile and reconstruct the orbital floor defect (►**Figs. 4** and **5**). The titanium mesh implant was the material of choice because it allows a better adaptation to the orbital walls and reestablishes the content–container relationship more anatomically (►**Figs. 6** and **7**).

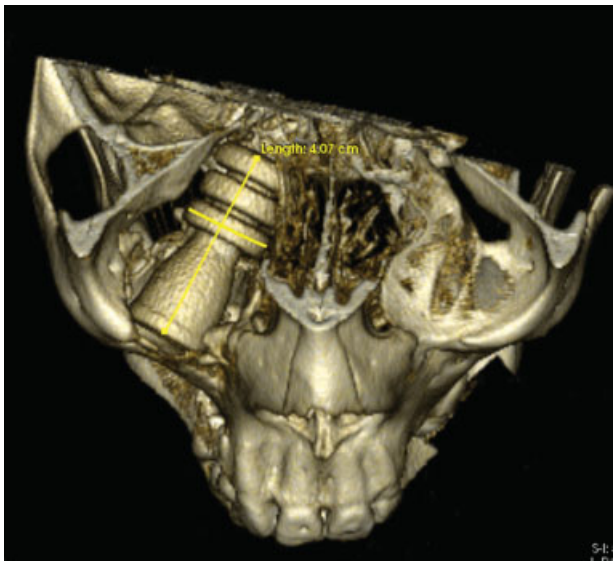

Fig. 2 Top view of three-dimensional (3D) reconstruction showing the anteroposterior dimension of the projectile and its extension toward the sphenoidal sinus.

Postoperative recovery was uneventful and the patient was encouraged to undergo ocular rehabilitation as soon as possible following the initial period. The movement of the extrinsic muscles was partially maintained because it was previously limited (►**Video 1**). A partial improvement was observed in ocular projection and palpebral rima; nevertheless, due to late reconstruction, the patient remained with visible signs of enophthalmos, change in the palpebral aperture, and depression of the palpebral sulcus (►**Fig. 8**).

Video 1

Shows the partially preserved and mildly restricted eye movement. Online content viewable at: https://www.thieme-connect.com/products/ejournals/html/doi/10.1055/s-0037-1603679.

Fig. 4 The rubber projectile being easily removed through the subciliary access.

Discussion

Facial trauma can cause eye disorders in 90% of patients sustaining injuries to their midface.[7] Among the many possible eye injuries, some cases may involve decreased visual acuity, and as demonstrated in this case report, blindness may occur in up to 39.7% of these individuals.[8]

The initial treatment of patients with these injuries should cover the basics of maintaining the airway and keeping the hemorrhage under control.[2] A CT scan should be performed to allow appropriate topographic diagnosis, and angiography can be used when vascular injuries are suspected or when the projectile reaches deeper regions and posterior to the coronal plane of the mandibular angles.[4]

Most of these projectiles are lodged in the maxillary and ethmoidal sinuses, thereby promoting sinusitis, injuries to the ocular bulb, and large defects in the orbital walls.[4,6] In the case reported here, the projectile reached the intraorbital region and was lodged within the orbital cone, causing eye injury and bone defects to the floor and medial wall. Another particularity in this case was that the projectile also reached deeper planes, all the way to the sphenoid sinus, thus constituting an increased risk of vascular injury.

The definitive treatment of such injuries consists of repair of ocular damage and removal of the projectiles lodged in the face, as these are not considered sterile and gradually

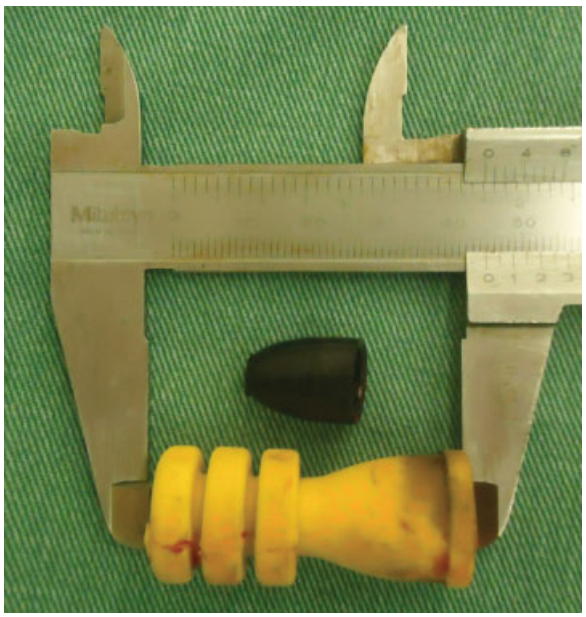

Fig. 5 Image showing projectile size, its outer yellow rubber coating, and the core.

Fig. 6 Postoperative coronal computed tomography (CT) showing the reconstruction of the orbital floor with a titanium mesh and the partial reestablishment of the orbital volume.

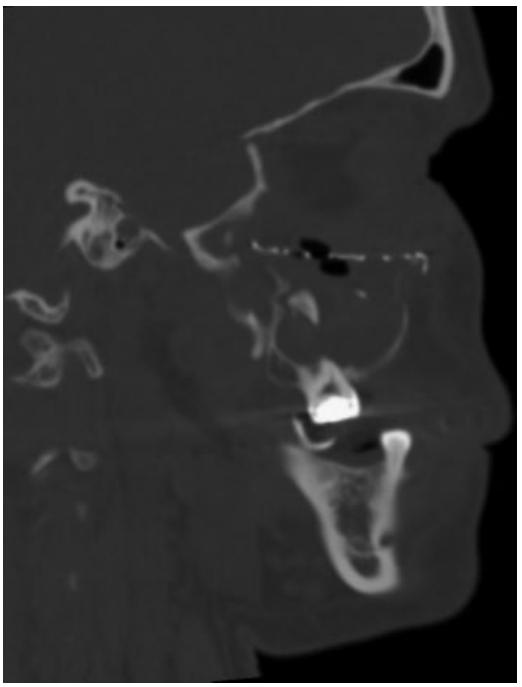

Fig. 7 Postoperative sagittal computed tomography (CT) showing the reconstruction of the orbital floor with a titanium mesh and anteroposterior dimension of the defect.

Fig. 8 Late postoperative photo showing the scarring resulting from improper healing of soft tissue, such as enophthalmos and depression of the palpebral sulcus.

disintegrate within the body, thus releasing toxic substances.[4] When the paranasal sinuses are affected, antibiotic therapy targeted against specific gram-positive and gram-negative microbes, such as *Streptococcus pneumoniae* and *Haemophilus influenzae*, respectively, is recommended due to the risk of sinusitis, meningitis, and chronic pain.[4]

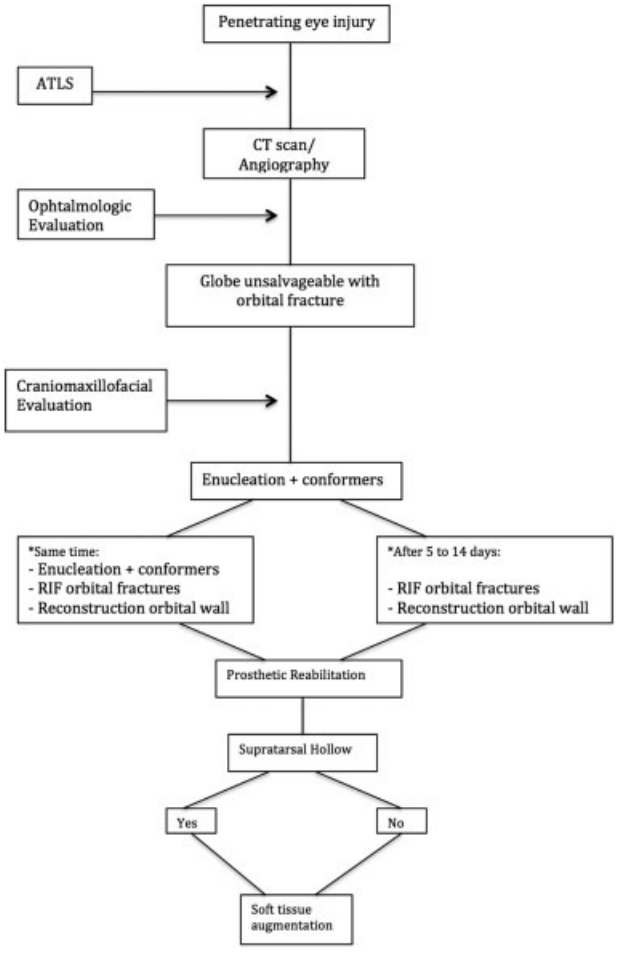

Fig. 9 Algorithm for penetrating eye injuries associated with facial fractures.

Associated with the removal of the projectile, repair of the eye injury and orbital reconstruction should always be performed within 2 weeks to avoid the anophthalmic orbit syndrome, which is characterized by enophthalmos of the prosthesis, superior sulcus depression, and lower eyelid ptosis.[6] Birgfeld and Gruss[6] reported that the appropriate reconstruction of the orbital walls is often overlooked due to the mistaken idea that it is unnecessary in the presence of anophthalmia.

In this case report, the patient was subjected to the initial repair of his eye injury and suturing of the soft tissue wounds. However, he was referred for the removal of the projectile and reconstruction of the orbital defect only after 2 months. Because of this, a larger scar retraction and shortening of soft tissue lining in the anophthalmic orbit were observed, as well as enophthalmos and depression of the superior orbital sulcus. Despite the late approach, the reconstruction of the orbital walls allowed a slight improvement in ocular projection and the prosthetic rehabilitation of the ocular bulb. Nonetheless, the scarring resulting from the inappropriate soft tissue healing compromised the cosmetic results and limited the functional outcomes.

Due to the factors discussed above, the authors propose a treatment algorithm for these types of lesions (►**Fig. 9**).

Conclusion

Facial injuries caused by rubber projectiles represent a high risk of ocular damage and can cause extensive fractures of the orbital walls. The repair of ocular damage, followed by removal of the projectile and reconstruction of orbital walls, is mandatory and should be performed as soon as possible to avoid complications and optimize the aesthetic and functional results.

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Competing Interests
None declared.

Ethical Approval
Not required.

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