Surgical Decompression of the Orbit due to Frontal Bone and Roof of the Orbit Fractures - A Case Report

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Abstract

Trauma in the face region has a very varied etiology and can be associated with several important structures. Isolated fractures in the orbit region correspond to about 4 to 16% of all facial fractures and this incidence increases to 30 to 55% if we take into account fractures that expand to extraorbital regions. The present clinical report aims to describe the case of a male patient, 21-years-old, victim of a motorcycle accident with facial trauma and traumatic brain injury due to frontal collision. Clinical and imaging examinations showed multiple fractures in the face with herniation of brain mass to the orbital region and consequent extrusion of the eyeball. Surgical procedures were performed to reduce and fix fractures and multidisciplinary treatment aimed at preserving vision and brain integrity. Thus, the surgical approach and the multidisciplinary treatment led to an excellent prognosis attested by the one-year postoperative period.

Keywords: Decompression of the orbit, face trauma, roof of the orbit fracture

Introduction

The eyeball is housed by the orbital cavity, which is shaped like a pyramid with a quadrangular base formed by seven bones: maxillary, zygomatic, frontal, ethmoidal, lacrimal, palatal, and sphenoid.[1] Due to its anatomical position in the middle third of the face, the orbital cavity is considerably exposed to fractures and injuries; the most common causes of which are traffic accidents, sports accidents, and aggressions.

Fractures are directly associated with eye injuries that cause signs and symptoms such as diplopia, infraorbital and upper eyelid paresthesia, hematoma, enophthalmos, pain, crepitation, alteration of the orbital-eyelid groove, ecchymosis, and limitation of eye movements, and there may also be herniation of the brain tissues, which can result in sensory disturbances and lesions of the optic nerve and ophthalmic artery, leading to other complications such as amaurosis, dacryocystitis, epiphora, and restricted movement of the eyeball.[2,3]

The treatment of these fractures has, as its main objective, the reconstruction of the natural volume of the orbital cavity and its contour, the prevention of ophthalmic complications, the protection of intracranial structures and the reestablishment of the facial symmetry.[4] The management is performed surgically, and the choice of material takes into account several criteria such as biocompatibility and stabilization. If vicious consolidation occurs, the chances of sequelae are more severe and difficult to repair.[5,6]

Case Report

The present work aims to report the case of a 21-year-old male patient, victim of a motorcycle accident with face and head trauma due to frontal collision. On tomographic examination [Figures 1 and 2], fracture of the maxilla, mandibular symphysis, frontal and temporal bones, and the roof of the right orbit was diagnosed, which produced herniation of the brain tissue to the region of the orbital cavity with consequent compression and extrusion of the eyeball [Figure 3].

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Clinically, the patient had ophthalmoplegia, exophthalmos, eyelid ptosis, limitation of the eye movements, hematoma, cracking of the fractured bone segments, conjunctival ecchymosis, and infraorbital paresthesia, in addition to important temporary loss of vision in the right eye.

Due to the magnitude of the trauma, the patient was urgently operated by the neurosurgery team for drainage of subdural hematoma, being released to approach by the maxillofacial surgery team just 5 days after the accident. As the subdural hematoma was addressed by emergency craniotomy through bicoronal access a few days before by the neurosurgery team, we opted for the same surgical approach to treat fractures of the frontal bone and orbital roof. Besides that there was dura tear and damage in the frontal area and brain tissue herniation to orbital cavity, which further reinforced the indication for bicoronal access [Figures 4 and 5].

Surgical intervention was performed with the decompression of the orbit and brain tissue repositioning inwards into the skull, associated with the reconstruction of the orbital roof with titanium mesh [Figure 6], repositioning and rigid internal fixation of bone fragments with plates and screws [Figures 7, 8 and 9], freeing up space in the orbital cavity to the repositioning of the eyeball. Subsequently, a temporary tarsorrhaphy was performed [Figure 10] due to the need to protect the eyeball, aiming at preserving lesions in the corneas. During the transoperative, it was noticed that there was tearing of the dura mater, which was promptly solved by the neurosurgeon with suture and dura substitute glue [Figure 11].

Posteriorly, the patient was referred for ophthalmological treatment with topical medication with eye drops for 6 months, and after 1 year of follow-up, he has normal vision, without diplopia and without limitation of eye movements in both eyes [Figures 12 and 13].

Discussion

Trauma involving the face is of significant importance in modern society, as it has emotional and functional influences that involve people's lives and can cause permanent deformities, in addition to involving serious injuries.[7] In the present case, the patient suffered multiple face fractures after a motorcycle accident. The literature describes that traumatisms have a very varied etiology, and the predominance of one or another factor is due to characteristics of the study population, such as age, sex, social condition, and residential and urban location. Automobile accidents, physical aggressions, and sports trauma are the most common causes of facial trauma in young people up to the fourth decade of life.[8]

Fractures in the orbital region, when ocular trauma is present, may present the involvement of other bones of the face or even present themselves in an isolated way in the orbit. Isolated fractures of the orbital wall are responsible for 4%–16% of incidence of all facial fractures. In addition, if fractures that expand into extraorbital regions are incorporated, they become responsible for 30%–55% of all facial fractures.[7]

The classical literature presents three types of basic patterns for these fractures, classifying them as complex, linear, and blow out, the latter being the most common. In these fractures, the floor of the anterior medial orbit, medial wall, and the roof of the orbit are the walls most affected, respectively, coinciding with the present report, in which the patient suffered a fracture in multiple bones in the head region with the involvement of the entire face in the upper, middle, lower thirds, and especially in the region of the orbit roof.

In the literature, blunt trauma to the forehead shows that most isolated fractures are caused by falls. Even if surgical treatment is generally not required for nondisplaced or minimally displaced orbital roof fractures, significantly displaced fractures require an open approach.

The diagnosis of this patient was made based on clinical and imaging tests, as computed tomography (CT) and frontal teleradiography. Clinically, through simple eye tests conducted by our team together with the ophthalmologist, and the patient's own responses, the following changes were observed, such as those described in the literature: ophthalmoplegia, exophthalmos, eyelid ptosis, limitation of eye movements, hematoma, cracking of the fractured bone segments, conjunctival ecchymosis, and infraorbital paresthesia, in addition to important temporary loss of vision in the right eye. As imaging examinations, a CT was chosen due to its relevance for the diagnosis of these kinds of traumas, which allows the observation of bone tissues in several planes [Figures 1 and 2]. We understand that the magnetic resonance imaging (MRI) presents as one of its advantages, the ability to show soft-tissue herniation and a complete and detailed diagnosis is extremely important for choosing the appropriate treatment for orbital fractures. However, due to the cost of the examination, the patient's socioeconomic condition, and the fact that previous surgery had already been performed by the neurosurgery team, we chose not to expose the patient to another examination, and MRI was not indicated.

The patient had soft-tissue changes in the orbital region, and Bailey describes that the integrity of the orbital walls and the ligaments that suspend them determine the position of the globe. When injury occurs in the region of the walls and in the suspensory ligaments, there is then displacement of the soft tissues by the forces of gravity and scar retraction. This process alters the shape of the tissues in the orbit, which should have a conical shape and becomes spherical, causing the globe to recoil and depression, leading to enophthalmos.[9]

Orbital roof fractures that involve the eyeball require the evaluation and follow-up of an ophthalmologist in order to observe pupillary and visual field responses, in addition to a fundus examination. In more extensive traumas, in which the level of consciousness is reduced or null, the patient may not be able to report the symptoms, resulting in fatal injuries to his vision.[4] In addition, these fractures may extend to the internal region,

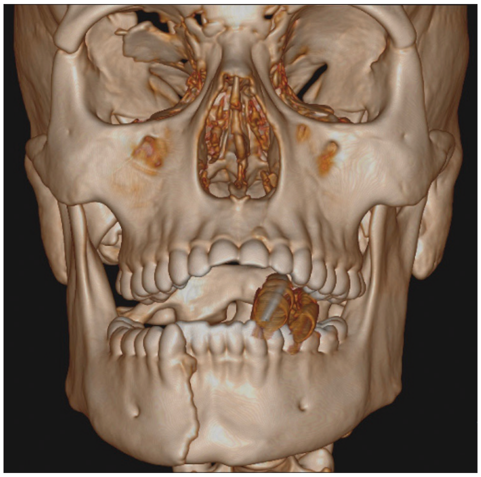

Figure 1: Preoperative computed tomography

Figure 3: Extrusion of the eyeball by orbit compression

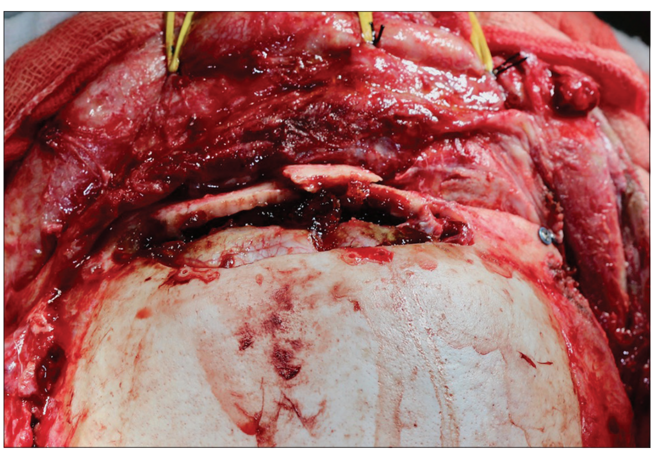

Figure 5: Bicoronal access for frontal fracture exposure

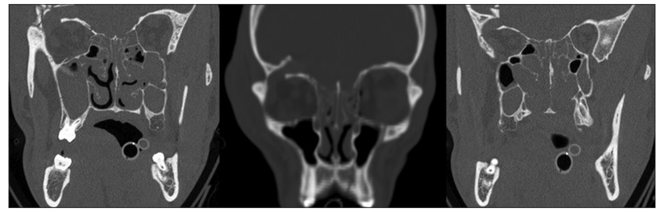

Figure 2: Noncontrast computed tomography coronal sections imaging

Figure 4: Bicoronal incision

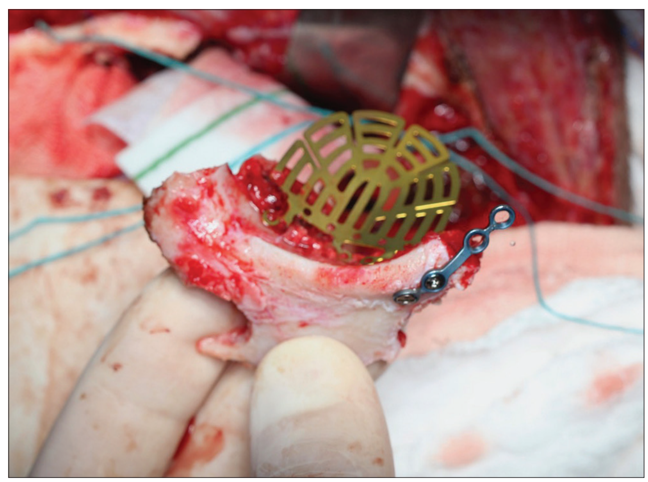

Figure 6: Reconstruction of the orbit roof with titanium mesh

occupying the posterior part of the orbital cavity, with involvement of the optic canal, and it is necessary, in addition to the presence of the maxillofacial surgeon, for reduction and subsequent rigid internal fixation and/or surgical reconstruction of the fractures, the presence of a neurosurgeon, if there is brain impairment, thus highlighting the need for a multidisciplinary approach.[10]

Orbital trauma can result in a wide variety of morphofunctional complications, and not all orbital fractures require surgical repair. However, bone disruption can cause several complications. Successful fracture management requires a detailed understanding of the associated anatomy and pathophysiology. Orbital trauma covers a wide variety of fracture patterns, with a wide variety of surgical approaches to the orbit, allowing the surgeon to access all areas of interest.[11] Regardless of the complexity of the fracture, the principles of atraumatic technique, anatomical reduction, and fixation stability are necessary requirements for all apply in all cases and have been carefully met in the present clinical case.

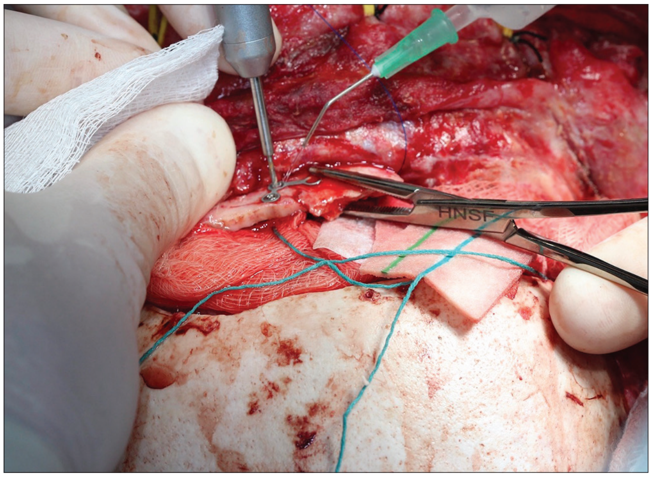

Figure 7: Repositioning of bone fragments for fixation

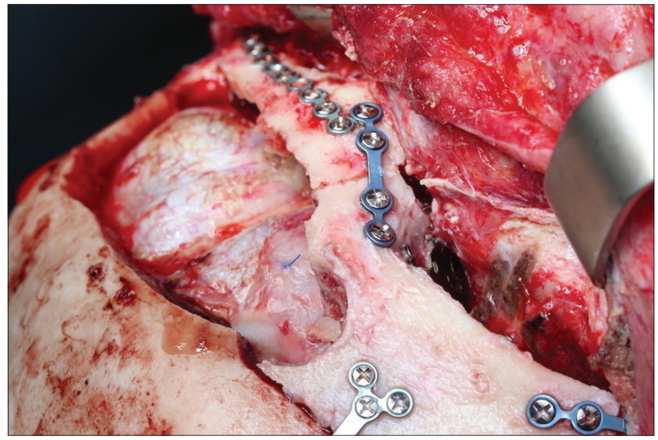

Figure 8: Initial fixation of bone fragments with plates and screws

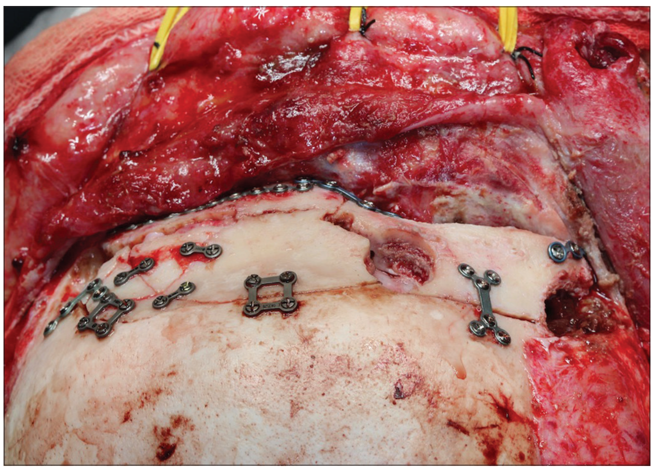

Figure 9: End of fixation of bone fragments with plates and screws

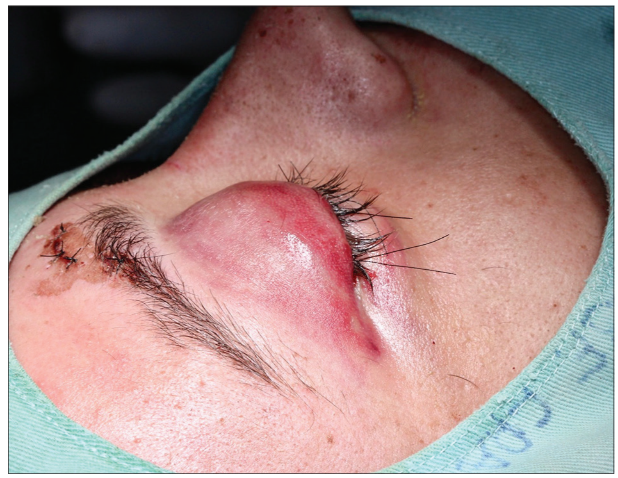

Figure 10: Tarsorrhaphy for eyeball maintenance

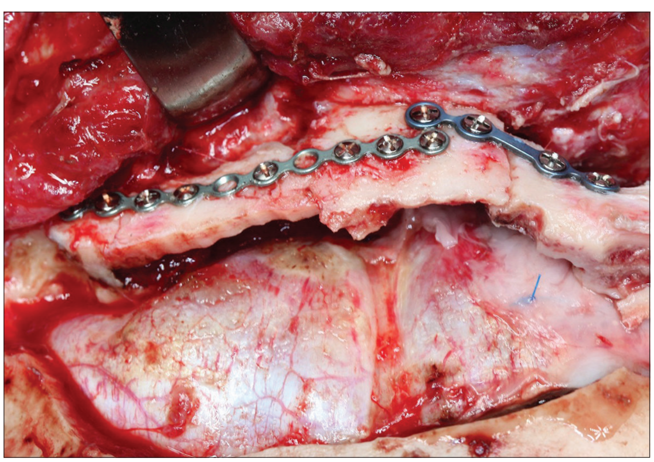

Figure 11: Torn dura mater with suture and dura substitute glue

Figure 12: Postoperative frontal radiography

The literature is clear in stating that the main objective of treating these traumas that involve fractures of the orbital cavity walls is, first, the initial reconstruction of the natural volume of the orbital cavity and its contour, to prevent the possibility of enophthalmos, thus ensuring that the eye mobility disorders do not also occur.[5]

If vicious consolidation occurs, the chances of sequelae are more severe and difficult to repair. For this reason, in the present report, the team opted first to perform surgical decompression of the orbit with the reconstruction of the bones that make up the skull-orbital structure for later ophthalmic treatment.

Figure 13: 1-year Follow-up

As in the treatment of other fractures, open reduction aims to protect intracranial structures, prevent postoperative inflammation, and restore frontal contour and symmetry. The option for bicoronal access to perform the procedure proves to be a great choice, as it allows great access to the structures of the orbital region such as the supraorbital rhyme, medial and lateral orbital wall, the upper surfaces of the nasal bone, the frontal sinus, the zygomatic arch, and the orbit roof.

Silva *et al.*[3] in a sample of 105 patients who had fractures in the facial region report that the most common postoperative complications are residual edema (5.7%), hypoesthesia in the area of infraorbital nerves and chin region (5.7%), malocclusion (4.7%), enophthalmos (0.9%), strabismus (0.9%), facial asymmetry (0.9%), ectropion (0.9%), and plate extrusion (0, 9%). The most prevalent complications reported in the literature on fractures in the orbit region are associated with eye injuries.

Nagase *et al.*[2] describe in their study a 20% incidence rate for this type of complication, 5% of which are more serious injuries. The authors also report the presence of diplopia, traumatic retinopathy, and eyeball puncture causing temporary visual deficit.

Andrews *et al.*[12] in a sample of 279 patients observed that 27.6% of patients had eye damage that could threaten visual acuity. Among these lesions, retrobulbar hematoma, ruptured eyeball, retinal shock, optic neuropathy, corneal abrasion/scar, and traumatic mydriasis stand out.

Regarding the ideal material choice for the treatment of orbital cavity fractures, multiple factors are considered such as biocompatibility, radiopacity of the material, possibility of molding, ease of handling, viability, stabilization, and fixation of the fractures. The choice is made taking also into account the size of the fracture, its degree of involvement in the orbital walls, its adaptation, and the possibility of restoring adequate volumes.[6] In addition to autogenous and allogeneic materials, alloplastic materials have gained a preference in orbital reconstructions due to their variety of shapes and sizes available, easy handling, satisfactory reduction in surgical time, and extinction of the morbidity of the donor area.[13]

In the present report, the material chosen for the reconstruction was titanium mesh, with relevant prominence in the literature for allowing a satisfactory anatomical correction, due to its thin thickness that allows adjustments and adaptations, allowing good osseointegration, biocompatibility, and biological inertia, in addition to corrosion resistance and radiopacity, thus allowing excellent results and correct postoperative follow-up.

Conclusion

Compression of the orbit due to face trauma with fracture of orbital cavity bones is a condition that requires multidisciplinary care, in the constant search to avoid permanent sequelae to the patient's vision. It is preferable, and in most cases extremely necessary, that the surgical decompression and rigid internal fixation and/or surgical reconstruction could be performed first for later ophthalmic follow-up. In the present case, the surgical approach, with reduction of the fracture of the frontal bone and reconstruction of the orbital cavity roof with titanium mesh and consequent decompression of the orbit, preceded by correct imaging tests, in addition to an accurate diagnosis, enabled an excellent recovery of the patient without complications. In the 1-year postoperative follow-up, we were able to observe a total absence of sequelae, with full recovery of vision and eye movements. The patient did not have any pain or esthetic complaints and declared that he was completely satisfied with the management of the case, thus demonstrating to our team the success of the treatment.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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