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Cranial floor fracture: A growing orbital roof fracture with encephalocele – Case Report

Yuchen You[a,*], Javier Romero[a], Graal Diaz[a], James Herman[b], Alan Siu[c], Robin Evans[b]

[a] Graduate Medical Education, Community Memorial Health System, Ventura, CA, USA
[b] Department of General Surgery, Ventura County Medical Center, Ventura, CA, USA
[c] Ventura County Neuroscience Center, Ventura County Medical Center, Ventura, CA, USA

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ABSTRACT

Orbital roof fractures are among the rarest of craniofacial fractures. The mechanism of injury is typically a high-impact blunt force vector directly to the orbit or forehead. Most patients are males between 20 and 40 years old, involved in motor vehicle accidents. Although most orbital roof fractures are managed conservatively, there is a significant risk of ophthalmologic and neurologic complications. Detailed craniofacial examination and high-resolution CT imaging is necessary for diagnosis. A multidisciplinary team approach is required for these challenging fractures.

1. Background

Orbital roof fractures are among the rarest of craniofacial fractures [1]. The mechanism of injury is typically a high-impact blunt force vector directly to the orbit or forehead. Most patients are males between 20 and 40 years old, involved in motor vehicle accidents [2]. Although most orbital roof fractures are managed conservatively [3], there is a significant risk of ophthalmologic [4] and neurologic [5] complications. Detailed craniofacial examination and high-resolution CT imaging is necessary for diagnosis. A multidisciplinary team approach is required for these challenging fractures.

A challenging aspect of these orbital roof fractures is their “growing” nature [6]. An encephalocele can develop secondary to hematoma or swelling in the context of a dural tear and the inferior displacement of brain tissue. The orbital roof (anterior cranial base) is required for the separation of the cranium and orbit. Without a clear separation, intracranial pressure will progressively displace the fracture, creating a larger defect. MRI is required to confirm the encephalocele. This type of “growing” fracture is also seen in the pediatric population [7]. The Aim of this case report is to highlight the importance of clinical vigilance and multi-disciplinary treatment approach for such patients. This case report is in line with SCARE criteria [8]. Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request

2. Case report

A 47-year-old male presented at level two County Medical Center as a Tier 2 trauma after his horse fell on him. He was brought in by ambulance with no recollection of the event. He was otherwise lucid. He sustained multiple injuries, including femoral neck fracture, c-spine fracture, t-spine fracture, and multiple rib fractures with flail chest. An epidural hematoma was discovered and proved stable over time via serial CT imaging. Craniofacial injuries included an incomplete LeFort III type fracture pattern with his frontal bone involved (Fig. 1). His midface remained stable through the integrity of the pterygoid plates.

During his in patient observation period, this patient developed progressive left sided proptosis, worsening ability for downward gaze, and radiographic evidence of cranial floor fracture progression with enlarging herniation causing mass effect within left orbit. His original CT showed a 17 × 15 mm defect with 5 mm of displacement (Fig. 2). However, in 4 h, the displacement became 8 mm (Fig. 3). In 16 h from the original scan, it became 10 mm, followed

* Corresponding author.
E-mail address: yyou1@cmhshealth.org (Y. You).

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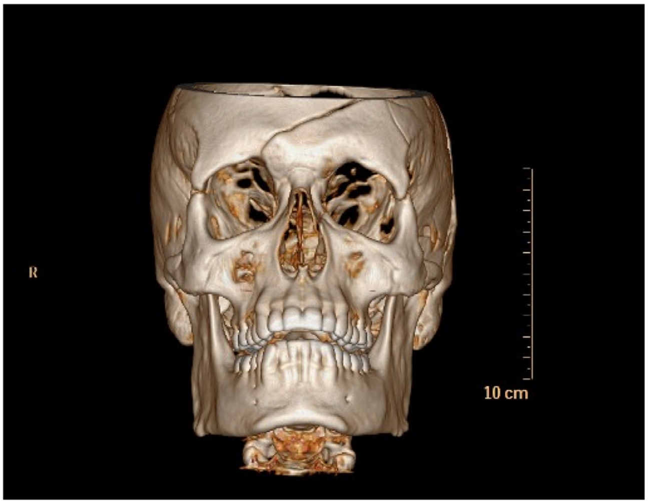

Fig. 1. 3D maxillofacial reconstruction showing multiple left-sided calvarial fractures involving the left inferior parietal, temporal, and frontal bones, bifrontal hemorrhagic contusion, and small extra-axial hemorrhage.

Fig. 2. Initial coronal CT scan showing left greater than right bifrontal hemorrhagic contusion; intraparenchymal hematoma in the left anterior frontal lobe; comminuted fracture of the squamous portion of the left temporal bone and greater wing of sphenoid bone with adjacent epidural hematoma; and focal defect along the left orbital roof.

by 12 mm at 36 h (Fig. 4). This progressive worsening prompted confirmation of encephalocele with MRI (Fig. 5).

He was brought to the operating room post-injury day 3 for his orbital roof fracture and encephalocele. A multidisciplinary approach was used. A trauma surgeon, plastic surgeon and a neurosurgeon were involved in this operation. Coronal approach was used to gain access for a frontal craniotomy. The orbital floor was approached superiorly and plated with a contoured titanium mesh plate. Care was taken to ensure the plate did not encroach on the orbital nerve. Post-operative CT was performed and confirmed adequate plate placement (Fig. 6). Patient's remaining inpatient recovery period was relatively unremarkable. Following discharge, he followed up in the outpatient trauma, neurosurgery, and plastic surgery clinics. Now, patient is doing well and his left eye function continues to steadily improve.

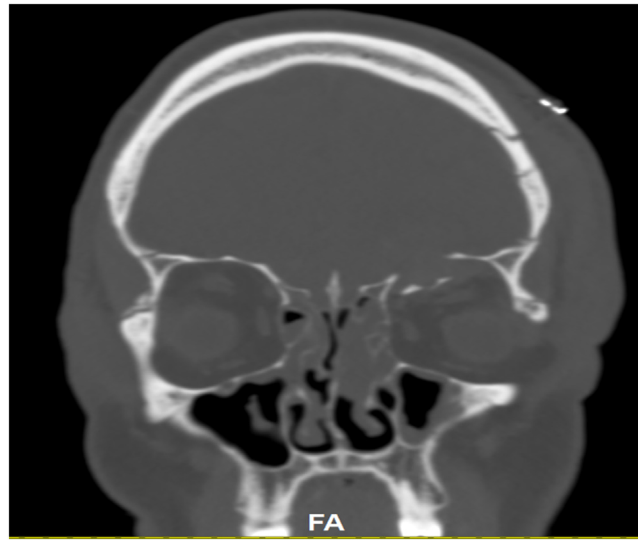

Fig. 3. CT scan four hours after the presentation. Focal defect along the left orbital roof again noted. There is now a small (10 mm) parenchymal herniation of the left anterior inferior frontal lobe with hemorrhagic contusion through the left anterior cranial fossa defect into the superior orbit. There is opacification of the right frontal sinus; and near-complete opacification of ethmoid air cells and sphenoid sinuses.

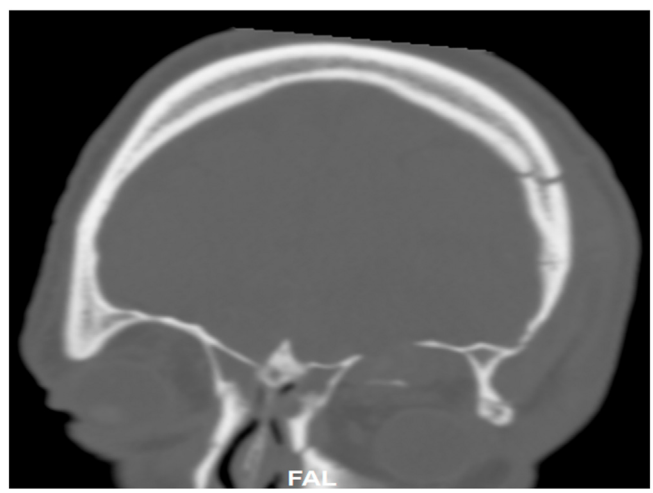

Fig. 4. CT scan 16 h after presentation. Interval progression of parenchymal herniation of left anterior inferior frontal lobe with hemorrhagic contusion through left anterior cranial fossa defect into superior orbit. Now measuring (1.2 cm).

3. Discussion

Orbital fractures can be classified as blow-in or blow-out fractures [8]. Blow-out fractures increase orbital volume and therefore protect the globe from increased pressure and subsequent neurologic damage. The fracture, in fact, protects the globe. However, blow-in fractures reduce orbital volume [9]. Blow-in fractures are typically associated with high-energy impact to the orbit or forehead [10]. Orbital roof fractures are an example of blow-in fractures that reduce the orbital volume and subsequently have the potential to increase intra-orbital pressure.

A growing encephalocele can complicate the treatment of orbital roof fractures. Growing skull fractures (GSF) are fractures that become increasingly displaced over time secondary to brain swelling. Gupta et al. found that this occurs more frequently in pediatric trauma patients under the age of five [11]. This is secondary to a lack of frontal sinus development and the increased ratio of the cranial vault's volume to the face. However, GSF can occur in

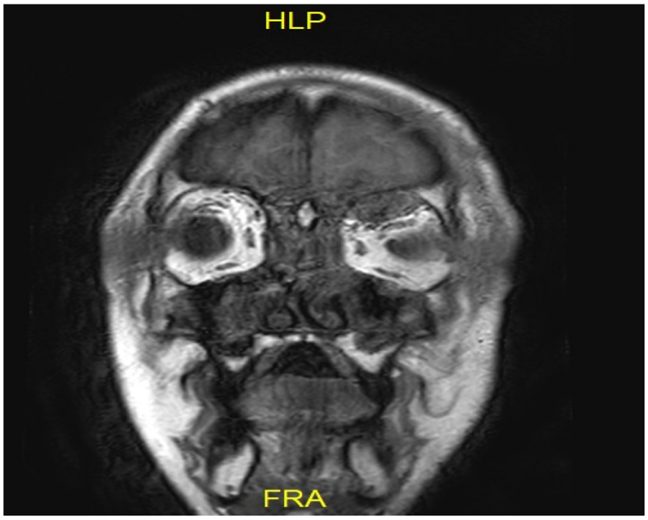

Fig. 5. MRI showing traumatic left orbital encephalocele appears to be contiguous with a left frontal hemorrhagic contusion.

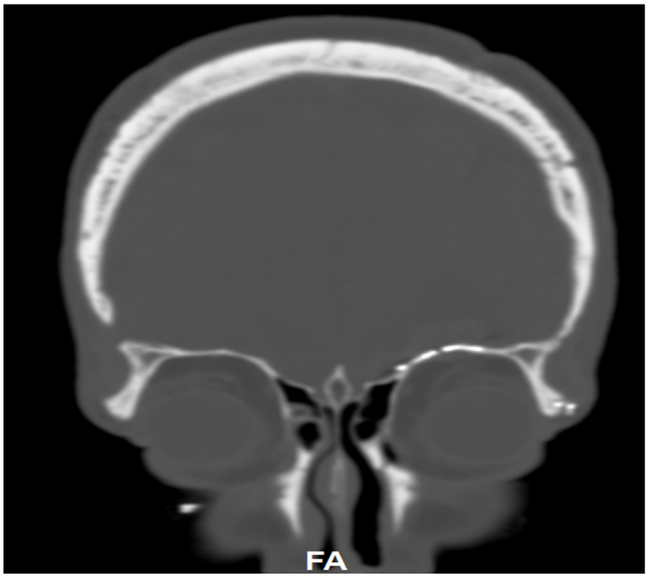

Fig. 6. Post-operative CT scan. Cranioplasty mesh is now positioned over a left orbital roof fracture and elevation of fracture fragments. Intra-orbital extra coronal hematoma is stable.

adults as well [12]. Adequate imaging is a critical component in recognizing GSF in the context of orbital trauma [13].

The management of orbital roof fractures includes Advanced Trauma and Life Support (ATLS) protocols [14]. It is important to recognize the relative high incidence of C-spine injuries with craniofacial trauma [15]. Findings on clinical examination related to an orbital roof fracture may include worsening exophthalmos. This is secondary to a gradual reduction in orbital volume. Surgical indications include cerebrospinal fluid leak (as evidenced by blot or beta-2 transferrin test) or progressive fracture displacement.

4. Conclusions

Although rare, orbital roof fractures can become progressively worse secondary to brain swelling. Having a high suspicion is required for appropriate surgical care.

Declaration of Competing Interest

The authors report no declarations of interest.

Funding

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Ethical approval

Single case reports are exempt by Ventura County's Internal Review Board. They require that the patient sign a consent for publication and that the patient to be de-identified. The consent is included with this application, and patient was de-identified.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images.

Author contribution

Yuchen You DO - Writing the manuscript.
Javier Romero MD - Study concept.
Graal Diaz PhD - Method and design.
James Herman MD - Revising the article critically for important intellectual content.
Alan Siu MD - Revising the article critically for important intellectual content.
Robin Evans MD - Study concept.

Registration of research studies

Not applicable.

Guarantor

Yuchen You DO.

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