Management of isolated orbital blowout fractures

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INTRODUCTION

In facial and orbital trauma, fractures of the orbital floor and medial wall are common. Orbital floor fractures are described as either direct or indirect. Direct orbital fractures involve and extend from the orbital rim. Indirect orbital floor fractures are fractures of the orbital floor without involvement of the orbital rim. Indirect orbital floor fractures are also known as isolated blowout fractures.

Blowout fractures occur when a blow to the eye increases pressure in the orbit, causing the weak floor or lamina papyracea to 'blow out' into the maxillary sinus or ethmoid bone. Such fractures may result when a blunt object, which is of equal or greater diameter than the orbital aperture, strikes the eye. The globe usually does not rupture, and the resultant force is transmitted throughout the orbit causing a fracture of the orbital floor. There are two proposed mechanisms for orbital floor fractures. In 1957, Smith and Regan proposed that compression of the globe increases the hydraulic pressure, which if sufficient, results in fracture of the orbital floor.[1] In 1974, Fujino postulated that forces applied to the inferior orbital rim are transmitted posteriorly through the thin orbital floor and may result in buckling of bone and thus produces an indirect orbital floor fracture.[2] In either case, if the intra-orbital pressure is great enough at the time of injury, orbital contents can be forced into the fracture site and possibly into the maxillary sinus.[3] Additionally, the globe is surrounded by fat and as the medial wall and floor of the orbit are thin, force that is transmitted to the globe allows fractures of those areas of the orbit without significant globe injury. Peri-orbital fat and extra-ocular muscles can become entrapped in the fracture, leading to problems of ocular movement. When the medial wall (lamina papyracea) is fractured, the medial rectus becomes entrapped, leading to lateral gaze dysfunction, whereas a fracture of the floor of the orbit causes entrapment of inferior rectus muscle and affects upward gaze.

The vast majority of isolated orbital blowout fractures occur in males and the usual mechanism of injury is assault with a blunt object such as fists or balls. The age range most affected is teenagers to young adults.

CLINICAL SIGNS AND SYMPTOMS

Oedema and ecchymosis involving the peri-orbital region and eyelids is usually noted and is temporary. Patients may complain of increased swelling around the eye when blowing their nose and this is called orbital emphysema. As the injury involves a sinus, air may escape into the orbit or subcutaneous tissues. Unusually severe orbital oedema may be associated with more severe fractures and can cause proptosis.

With simple blowout fractures, there may be no morbidity at all, or the patient may complain of diplopia or hypoaesthesia of the cheek (distribution of the infra-orbital nerve) and gingiva of the upper teeth in the same side. Vertical diplopia may be caused by entrapment of the peri-muscular tissue surrounding the inferior rectus muscle in the fracture site. These result in limited upward gaze and may cause pain on attempting an upward gaze. Damage to the third nerve branch to the inferior rectus muscle also may cause limited vertical motility. Severe pain with limited horizontal and vertical movements can be indicative of more severe orbital hemorrhage or oedema.[4] It is important to check the patient's past ocular history to assess if there was diplopia or altered vision prior to their current injury.

Orbital oedema at initial presentation may mask enophthalmus (sunken eye appearance) and this may become more apparent 1-2 weeks post-injury once the oedema settles. Enophthalmos may result when large orbital floor fractures occur and orbital contents prolapse into the maxillary sinus. If a medial wall is also fractured, the enophthalmos may be compounded due to prolapse of orbital contents into the ethmoid sinus.

Fractures along the floor usually affect the infra-orbital groove and therefore the infra-orbital nerve. The resultant neuropraxia causes hypoaesthesia of the cheek, side of nose and possibly one half of the upper lip and the gingiva of the teeth on the affected side. This is usually temporary but can last up to six months or longer. In severe injuries, the hypoaesthesia may be permanent.

INVESTIGATIONS

Orbital assessment includes: history and clinical examination; orthoptic assessment (Hess chart and ocular motility studies); and ophthalmological investigations. Conventional plain X-rays, Occipitomental 10° or 30° may show the characteristic 'tear-drop' appearance in the maxillary antrum (see figure 1), although this may be masked by blood in the antrum. Orbital tomograms provide a more sensitive investigation for defining orbital floor fractures. Because of the complexity in the anatomy of the orbital and ethmoidal regions computed tomography (CT) is now recognised to be the best imaging technique for diagnosing fractures.[5] CT scanning in a coronal and axial plane with 3D reconstruction is usually performed.

TREATMENT

The aims of orbital floor fracture repair are to free incarcerated or prolapsed orbital tissues from the fracture and to repair the defect with an implant so as to restore the anatomical structure of the orbital floor and restore the pre-trauma orbital volume. An evidence-based analysis on the clinical recommendations for repair of orbital floor fractures was undertaken by Burnstine, in 2002 (see figure 2).[6] No prospective randomised clinical trials on the treatment of orbital floor fractures had been performed. Despite this, most recommendations were rated as most important to patient care (A) and had strong support for treatment (level I).

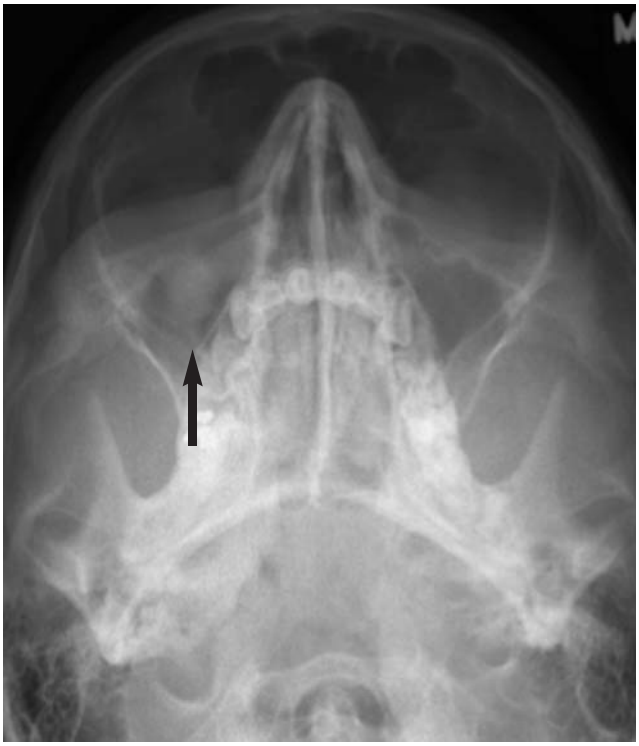

Figure 1 Teardrop sign noted on right floor of orbit fracture

Access to the orbital rim and then onto the orbital floor can be through one of the following incisons such as transconjuctival, lower blepharoplasty, lower eyelid (first crease), infraorbital, medial canthal or coronal flap. Some authors have advocated an endoscopic transantral approach for improved visualisation of fractures and to eliminate the need for eyelid incisions.[7] A transantral approach allows access to the orbital floor via the maxillary sinus and repair can be performed endoscopically and is useful for a trapdoor fracture of the orbital floor. The orbital floor bone fragments are repositioned and reconstruction undertaken with an implant. The ideal implant should be easy to insert and manipulate, inert, not prone to infection or extrusion, easily anchored to surrounding structures, and reasonably priced. The implant should not cause fibrous tissue formation. Most orbital floor defects can be repaired with synthetic implants composed of porous polyethylene, silicone, metallic rigid miniplates, Vicryl™ mesh, resorbable materials, or titanium mesh. Autogenous bone from the maxillary wall or the calvaria can be used, as can nasal septum or conchal cartilage. The choice of material is dependent on the surgeon's preference and expertise.

Intervention	Scenario	Rating
Immediate	Diplopia present with CT evidence of an entrapped muscle or peri-orbital tissue associated with a non-resolving oculocardiac reflex: bradycardia, heart block, nausea, vomiting or syncope	A:1*
	'White-eyed blow-out fracture'. Young patients (<18 yrs), history of peri-ocular trauma, little ecchymosis or oedema (white eye), marked extra-ocular motility vertical restriction, and CT examination revealing an orbital floor fracture with entrapped muscle or perimuscular soft tissue	A:1
	Early enophthalmos/hypoglobus causing facial asymmetry	A:1*
Within two weeks	Symptomatic diplopia with positive forced evidence of an entrapped muscle or perimuscular soft tissue on CT examination, and minimal clinical improvement over time	A:11
	Large floor fracture causing latent enophthalmus	B:11
	Significant hypo-ophthalmos	A:11
	Positive infra-orbital hypoaesthesia	C:111
Observation	Minimal diplopia (not in primary or downward gaze, good ocular motility, and no significant enophthalmos or hypo-ophthalmos	B:1

Figure 2 Clinical recommendations for repair of isolated orbital floor fractures by Burnstein, 2002[6]
** Recommendation based on case reports in which there is very compelling evidence that intervention is important to clinical outcome*

Case 1

An 18-year-old man presented to the emergency department following an injury at a rugby game. He had received blunt trauma to the left eye from an opponent's knee and presented with oedema, tenderness and ecchymosis of the left eye. There was subconjuctival haemorrhage with double vision and restricted movement of the globe in the upward gaze. Clinical examination revealed all bony margins around the left orbit to be intact. An Occipitomental radiograph (see figure 3) shows a teardrop sign of the left orbital floor and an orbital CT scan (figure 4 shows orbital contents have prolapsed into the left maxillary antrum through a fracture in the left floor of the orbit).

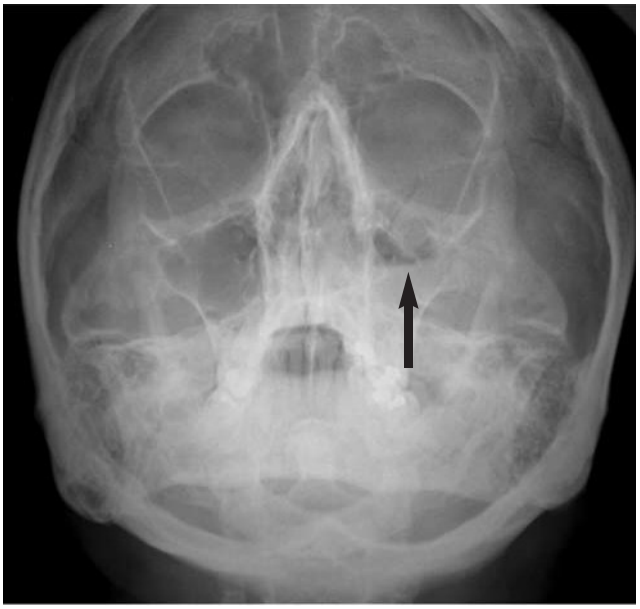

Figure 3 Occipitomental radiograph showing disruption at left infra-orbital floor with a teardrop sign

An orthoptic assessment confirmed restricted left eye movements and persistent diplopia. The patient underwent repair of the left orbital floor fracture with a titanium mesh via a transconjunctival approach with lateral canthotomy. Figure 5 shows the post-operative Occipitomental radiograph with titanium mesh in place. Post-operatively, the patient had full range of eye movements with no residual diplopia.

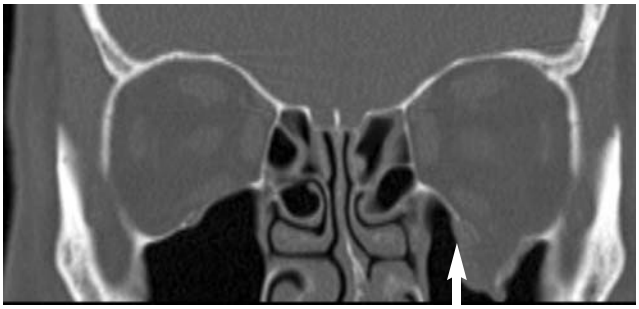

Figure 4 Coronal CT showing orbital tissue prolapse into the left maxillary antrum

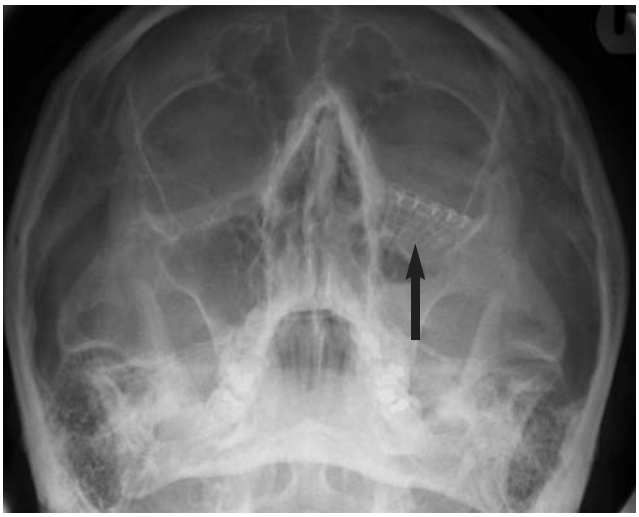

Figure 5 Post-operative Occipitomental radiograph with titanium mesh repair of the left orbital floor

Case 2

A 24-year semi-professional boxer was punched in the left eye during a sparring session. He presented with similar signs and symptoms as case 1. Figure 6 shows his pre-operative Occipitomental radiograph, hich raised a suspicion of a left orbital floor fracture, confirmed with an orbital CT scan (see figure 7).

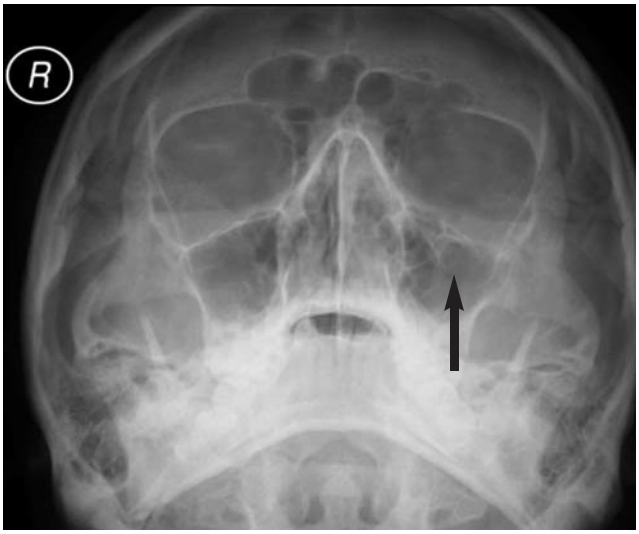

Figure 6 Fracture of left orbital floor

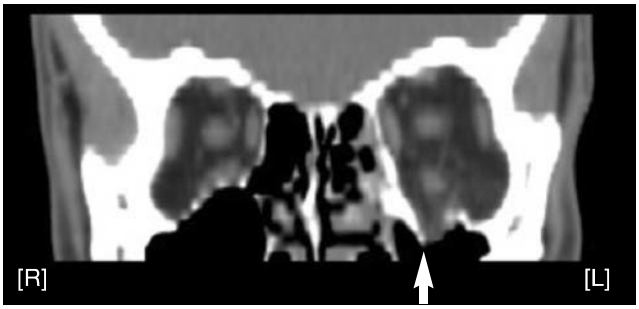

Figure 7 Orbital CT confirms fracture of the left orbital floor with herniation of contents into the left maxillary antrum

Case 2 was managed in a similar way to case 1.

COMPLICATIONS

Post-operative complications can include blindness, residual diplopia, enophthalmus, persistent altered sensation in the distribution of the infra-orbital nerve at the affected side and, occasionally, lower lid retraction or entropion. Implant infection, migration or extrusion is also known to occur particularly with implants such as silastic sheets.

CONCLUSION

The optimal timing for surgery has been debated in the literature and two weeks post-trauma is considered as appropriate, except for those cases with ocular-cardiac reflex or white-eyed blow out fracture. In 2008, Dal Canto and Linberg reported effective fracture repair up to 29 days post-trauma.[8] Patients with resolving diplopia and at low risk of enophthalmos can be observed for 3-4 weeks prior to considering surgery. CT scans of the orbit have also assisted in assessment and decision making on whether intervention is required.

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