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Surgical Outcome of Blowout Fractures of Floor of Orbit: A Case Series of 5 Patients

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Abstract

Purpose: To report the surgical outcome of traumatic blow out fractures of the floor of the orbit.

Materials and methods: Five patients who sustained orbital floor blowout fracture following trauma underwent surgical repair via trans-conjunctival or subciliary approaches. One patient had sustained bilateral blowout fracture. Three patients presented with symptoms early following the fracture with enophthalmos, entrapment of inferior rectus muscle or orbital fat, whereas two presented after a month with features of oculo-cardiac reflex.

Results: All patients underwent orbital floor repair with Titanium mesh with or without screws and orbital plate. Post-operative surgical results were excellent with restoration of orbital floor and release of orbital fat and/or muscle and repositioning of the globe. Three patients developed cicatricial entropion and trichiasis. One patient complained of transient numbness in the distribution of the infra orbital nerve.

Conclusions: Surgical intervention for blow out fractures is indicated in cases with entrapment of orbital fat or muscle for restoration of structure and function. Surgical outcome is excellent with low incidence of complications.

Keywords: Blowout fracture; Orbital floor; Titanium mesh

Introduction

Orbital floor fractures were reported initially by MacKenzie in Paris in 1844 [1]. In 1957, Smith and Regan described inferior rectus entrapment with decreased ocular movements in orbital floor fractures and used the term blowout fractures [2]. Different mechanisms have been proposed for blowout fractures, a 'hydraulic' one due to increase in the intraorbital pressure [2] or by direct transmission of pressure posteriorly through the orbital rim leading to buckling of the orbital floor [3]. A 'pure' blow out fracture does not involve the rim, whereas an 'impure' fracture may involve the rim or adjacent orbital wall.

Clinical features depend on the severity of trauma and the interval between injury and examination. In the acute phase, the patient may present with periocular ecchymosis, oedema and rarely subcutaneous emphysema. Infraorbital nerve anaesthesia may occur along the lower lid, cheek, side of nose, upper lip, upper teeth if the fracture involves the infraorbital canal [4,5]. Diplopia may occur in the acute phase due to oedema and haemorrhage into the orbit impairing mobility of the inferior rectus and inferior oblique. Diplopia may also occur due to entrapment within the fracture of the inferior rectus or inferior oblique muscle, or adjacent connective tissue and fat or due to direct injury to the muscle fibres [6,7]. Enophthalmos may manifest later following resolution of oedema, if the fracture is severe due to sinking of orbital contents into maxillary antrum with resultant reduction in the orbital volume. Entrapment of muscle or fat, if not corrected, can lead to progressive diplopia and enophthalmos. Although the eyeball is generally spared in blowout fractures, these may be associated with injuries to the eyelid, cornea, globe or optic nerve [8,9].

Surgical management is indicated if there is herniation of the orbital contents into the maxillary sinus or muscle entrapment. Other indications for surgery are enophthalmos of greater than 2 mm, persistent, significant diplopia in the primary position or oculocardiac reflex.

Oculocardiac reflex is a vasovagal response triggered by traction on the extraocular muscles, mainly medial rectus, manipulation of the globe in strabismus surgeries or even direct pressure on the globe. The affterent limb is the ophthalmic division of the Trigeminal nerve and efferent is the Vagus nerve that leads to bradycardia. This may manifest as dizziness, nausea, hypotension and even syncope and has been reported in orbital wall fractures with entrapment of extraocular muscles [10].

The aim of this case series was to report the surgical outcome of traumatic blow out fractures of the floor of the orbit in five consecutive patients.

Materials and Methods

This is a retrospective review of case notes and observational study of clinical features and surgical outcome of blow out fractures of the orbital floor on patients who attended Canadian Specialist Hospital, Dubai from January 2012 to December 2014. All surgeries were performed by a single Maxillo-facial surgeon (YKAS). Being a retrospective study, this did not require Ethics Committee approval or informed consent. The study adhered to the tenets of the Declaration of Helsinki. This included six eyes of five patients, one with bilateral fracture of the orbital floor.

Case 1

A 28 year old healthy lady presented with dizziness on upgaze following a fall on her face four weeks ago. She was initially treated conservatively with antibiotics for right sided periorbital ecchymosis and swelling with intact globe. Visual acuity was normal in both eyes. Ocular movements showed restriction of upgaze in the right eye and associated diplopia. CT scan of orbit showed fracture floor of right orbit with herniation of retrobulbar fat into right antrum. She underwent orbital floor repair via the trans-conjunctival route and reconstruction with titanium mesh four weeks following the injury. Post operatively, the globe was well placed with no evidence of enophthalmos, ocular movements were full and there was no diplopia.

Post-operative complications included cicatricial entropion of nasal part of right lower lid with trichiasis causing recurrent lower corneal epithelial abrasions, that was managed conservatively with lubricants and epilation.

Case 2

A 33 year old lady presented to the emergency room with history of having sustained injury to the left side of face following a fall. On examination, there was swelling and ecchymosis over left side of face with facial asymmetry due to enophthalmos of left intact globe of 3mm.She also suffered from diplopia on upgaze dut to mild restriction of elevation. CT orbit showed left sided zygomatico-maxillary fracture involving floor of orbit with entrapment of fat and inferior rectus. Surgery was performed on the same day via a sub-ciliary approach with release of orbital fat and inferior rectus and orbital floor reconstruction with Titanium mesh and screws. (Figure 1) Post-operatively, she was noticed to have good facial symmetry, no enophthalmos, full extraocular movements and no diplopia. The lower eyelid position was normal.

Case 3

A 31 year old male presented with history of dizziness on upgaze of 2 weeks duration following an assault on right side of face one month back. Visual acuity was normal in both eyes. Facial asymmetry due to right sided enophthalmos, infraorbital anaesthesia and mild restriction of upgaze was observed. CT scan orbit confirmed a blowout fracture orbit with depression of orbital floor, herniation of orbital fat and inferior rectus associated with enophthalmos. (Figure 2) The orbital floor was repaired via trans-conjunctival approach, with release of orbital fat and inferior rectus followed by reconstruction of orbital floor with Titanium mesh. Postoperatively, extraocular movements were full with no diplopia. Eyeball position returned to normal, with symmetric exophthalmometry values. Infraorbital nerve anaesthesia resolved by 8 weeks. Lower lid cicatricial entropion with trichiasis developed by 4 weeks and remains persistent at 12 weeks.

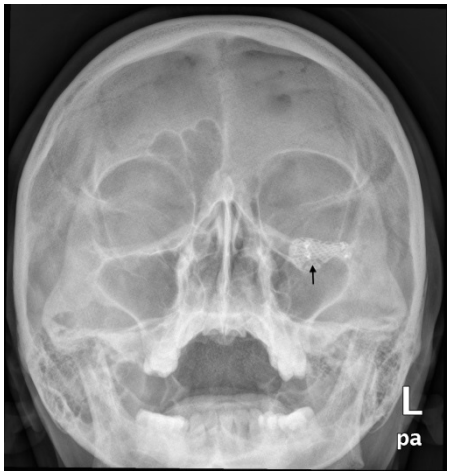

Figure 1: Postoperative X-ray orbit of patient 2, shows the Titanium mesh with screws *in-situ* orbital floor left side (Black arrow).

Figure 2: CT scan of orbit in patient 3, showing fracture floor of orbit right side with incarceration of inferior rectus in coronal view (white arrow, left panel) and sagittal view (arrowhead, right panel).

Case 4

A 30 year old Australian male presented to the emergency room with history of injury left side of face with a blunt object following an assault. On examination, he had bruising over left cheek with mild enophthalmos. Visual acuity was normal both eyes. Except for a prominent area of subconjunctival haemorrhage in the temporal area, the left eye was within normal limits. Ocular movements showed mild limitation of elevation in the left eye with diplopia in upgaze, all other movements were within normal limits. CT scan of the orbit revealed a tripod fracture of left zygoma involving inferior margin and floor of the orbit and fronto-zygomatic suture with depression and separation of fracture fragments. He underwent surgery by 2 weeks via a sub-ciliary approach with release of orbital fat and orbital floor reconstruction was performed with a titanium mesh and inferior orbital rim plate was placed. Post-operatively facial symmetry was restored with normal values on exophthalmometry. Ocular movements were full with no diplopia and lid position was normal.

Case 5

A 22 year old male was admitted in the hospital with multiple injuries involving the lower limbs, abdomen chest and head and neck sustained in a bomb blast in Afghanistan. Visual acuity was 6/9 in both eyes. Right eye showed corneal abrasion with few corneal foreign bodies. Left eye showed commotio retinae in the temporal paramacular area and a lamellar macular hole. Ocular movements showed restriction of upgaze both eyes. Exophthalmometry showed equal values on both sides of 17 mm. CT scan orbit showed fracture floor of orbit both sides, with entrapment of fat and inferior rectus muscle and herniation into the maxillary sinus on the left side (Figure 3). After stabilisation of his general condition, surgery was performed by trans-conjunctival approach both eyes with additional lateral canthotomy in the left eye, by 2 weeks. Release of orbital fat and inferior rectus and reconstruction of orbital floor with Titanium mesh both eyes was done. Postoperatively, extraocular movements were full and there was no diplopia, globe position was normal. Lower lid entropion developed in the right eye by 2 weeks but resolved by 2 months.

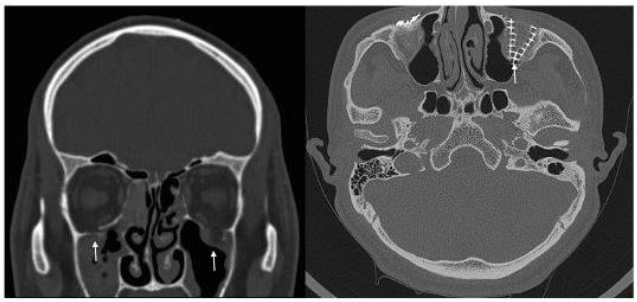

Figure 3: CT scan orbit in coronal view in patient 5 showing fracture floor of orbit both sides with incarceration of inferior rectus in coronal view both sides (white arrows, left panel). Right panel shows post-operative CT orbit, axial view with intact Titanium mesh, better visible on the left side (white arrow).

Results

Etiology of fracture: Blowout fracture was sustained following a fall in 2 patients, assault in 2 patients and bomb blast in one patient.

The indications for surgery were diplopia with restriction of upgaze in 3 patients and Oculo-cardiac reflex in 2 patients (patients 1 and 3). All patients had evidence of fracture of the orbital floor with entrapment of orbital fat with/without inferior rectus muscle.

The timing of surgery was within 24 hours in patient number 2 who had evidence of tripod fracture with fracture of orbital floor. Two patients underwent surgery by 2 weeks, after subsidence of acute inflammation and oedema. The two patients who presented with oculocardiac reflex had surgery after 4 weeks.

Surgical approach in patient number 2 and 4 were by a subciliary incision as they had 'impure' blowout fractures. The other 3 patients underwent surgery by the trans-conjunctival route, including the patient with bilateral fracture.

Surgical procedure Titanium mesh was used to bridge the fracture gap, orbital plate or fixation screws were used for further stabilization of the implant in impure fractures.

Post-operative results: Globe position was normal in all patients including patient 5 with bilateral floor fracture. Infra-orbital nerve anesthesia that was present pre-operatively in patient 3 persisted post-operative, but resolved by 2 months. Extraocular movements were normal in all patients; no one had diplopia post operatively. Lid position was normal in patients 2 and 4 who underwent surgery via subciliary approach. Three out of the four eyes that had surgery done via transconjunctival approach developed entropion and trichiasis. Patient 1 has mild entropion on the nasal lid margin with trichiasis of a few lashes 2 years hence. Patient 4, who had bilateral orbital floor repair, developed entropion in the right eye by 2 weeks that resolved by 3 months. However, patient 3 has persistent entropion in the third month that may necessitate lid surgery. Dizziness on upgaze disappeared post operatively in patients 1 and 3.

Discussion

All the patients in our case series had fracture of the orbital floor with incarceration of orbital fat with or without inferior rectus muscle. Diplopia and enophthalmos resolved post operatively and the globe position returned to normal. Trans-conjunctival approach provides good cosmesis, but it may result in cicatricial entropion.

The approach to a patient with suspected blowout fractures includes detailed history and general examination to rule out associated injuries and head injury. Once the patient has been stabilized, examination of eyes to rule out globe injuries, testing extraocular movements and diplopia charting are necessary. Forced generation and forced duction tests help to differentiate between muscle entrapment and paresis. Diplopia scoring systems have been suggested to assess the extent of the same [11]. Hess charting provides a reproducible record for assessment of extraocular motility defects.

Orbital imaging in suspected cases by X-ray, CT scan or MRI help to confirm the diagnosis. Coronal and axial CT scans are adequate for visualization of orbital fractures [12]. MRI may be rarely indicated in the later stages for diagnosis of muscular fibrosis.

An initial period of conservative management with observation has been advocated for adults and children with isolated orbital floor

fractures to allow spontaneous improvement of motility [13-15]. Surgical management is indicated in large fractures more than half the orbital floor with herniation of the orbital contents into the maxillary sinus or muscle entrapment. Other indications for surgery are enophthalmos of greater than 2 mm, persistent, significant diplopia in the primary position or oculocardiac reflex.

The primary aim of surgical repair is to minimize orbital soft tissue damage and to restore a full field of functional binocular single vision. There are two schools of thought regarding timing of surgical management of orbital floor fracture, early surgery within days 16,17 or following a period of observation within 2 weeks [18,19]. Repair in 1-2 weeks following injury has been reported to be the optimal period for surgery as it allows resorption of orbital oedema and haemorrhage and precludes onset of fibrosis [5].

Various surgical approaches to the orbital floor have been tried. Trans-conjunctival approach anterior to the orbital septum allows good cosmesis and lower risk of ectropion due to minimal disturbance of the intraorbital connective tissue framework [20]. Transcutaneous approaches via the subciliary or sub tarsal route provide wider access to the orbital floor and medial wall and are the approach of choice in impure fractures [20]. However, there is higher incidence of postoperative lower lid malposition and visible scarring compared with the transconjunctival approach. Transantral endoscopic approach in isolation or combined with orbital approach has been reported to be a safe procedure, offering good visualization and surgical access with excellent postoperative eyelid position and good clinical results [21].

The aim of surgical repair is to restore the pre-injury orbital anatomy and can be a challenging task. This includes release of entrapped orbital fat and muscle and restoration of the orbital contour with an implant that is bio-inert and bio-compatible. It may be either alloplastic or autogenous bone graft, depending on the clinical situation and surgeon's preference [22]. Alloplastic materials include non-absorbable material such as Silastic, Medpore, Titanium mesh or absorbable polymers. Titanium mesh is a metallic substance that is highly biocompatible, with good osteo-integration and mechanical properties making it a good substitute for bone [23,24].

Post-operative complications include limitation of extra ocular movements with diplopia, infra-orbital nerve anaesthesia, lid malposition with entropion and trichiasis, in transconjunctival approach or ectropion in subciliary approach. The most dreaded complication is loss of vision that may occur in 1/1500 cases [25].

Three of the patients in our series underwent surgery by 2 weeks after the fracture, as they presented initially to our institution. The other 2 patients were seen elsewhere initially, but presented with dizziness due to Oculo-cardiac reflex by 4 weeks of injury. We did not note any difference in post-operative outcome based on timing of surgery. Surgery helped to restore normal globe position and anatomy with resolution of enophthalmos in all patients. Extraocular movements returned to normal and there was no diplopia post operatively in all patients. Three out of the four eyes that had surgery via the trans-conjunctival approach developed entropion and trichiasis, but one patient recovered after a course of topical steroids. The patients who underwent surgery via the sub ciliary approach did not have significant external scarring. Titanium mesh was used for reconstruction of the orbital floor in all patients as per the surgeon's preference with excellent post-operative results.

This is a small case-series with 5 patients who presented to the hospital; however the results are consistent with other reports [26]. Our series showed good results post-operatively. Entropion may be encountered in procedures via transconjunctival approach. It may resolve within 2-3 months on topical use of steroids. Persistent entropion may necessitate lid surgery for relief of trichiasis. Best results are seen in patients who present with initial ocular motility restriction and diplopia and the improvement in eye motility postoperatively is equally gratifying for the surgeon as well.

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