Orbital fractures in the emergency department: a review of early assessment and management

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ABSTRACT

Orbital fractures are a common, potentially vision-threatening presentation to an emergency department. Appropriate early management and referral by the emergency medicine practitioner has a significant role in preventing cosmetic and functional sequelae of orbital trauma. In this paper, we review the emergency, non-specialist management of traumatic injuries to the orbit.

INTRODUCTION

Facial trauma is a common presentation to emergency departments, either alone or in combination with other injuries.[1 2] Of all facial fracture presentations, 36.3% of these include trauma to the orbit.[3] Orbital fractures are a common consequence of medium and high forces directed towards the globe and surrounding bone, such as in physical assault, sports, motor vehicle accidents and mechanical falls.[4] The three most common patterns of fracture in this region are zygomatic complex, isolated orbital floor blowout and medial wall blowout.[5]

Due to the traumatic aetiology of orbital fractures, most patients will present acutely to a hospital emergency department. Consequently, emergency medicine practitioners are required to provide initial assessment and management of these injuries. The majority of orbital trauma cases do not require immediate surgical intervention and are reviewed subacutely in the specialist surgical outpatient clinic. However, there will be patients that present with vision-threatening conditions. Therefore, all patients with orbital trauma require rapid and accurate assessment, which can be difficult in the acute setting. Comprehensive examination and appropriate postinjury instruction by the emergency doctor, prior to discharge from the emergency department, is an essential component of quality care.

The aim of this paper is to discuss the presentation of orbital fractures in the acute setting, and describe best practice guidelines for early assessment and management by the emergency medicine practitioner.

METHODS

This project was designed as a comprehensive review of existing literature regarding initial presentation, diagnosis and management of orbital fractures. Research papers were obtained using a PubMed search, using a combination of the following search terms: trauma, fracture, orbit, zygomatic, maxillary fracture, head trauma, primary survey, maxillofacial, head injury, emergency assessment, emergency management, antibiotics and ocular trauma. Abstracts were narrowed for inclusion based on specific research questions pertaining to the subject of the paper. Full-text papers were incorporated only if their content yielded significance to the aims of the paper.

TRAUMA ASSESSMENT

Initial assessment

Initial assessment should be formally guided by ATLS principles.[6] With regard to particular head and neck trauma, primary survey with airway and cervical spine stabilisation and an assessment of mental state using the GCS are essential for the recognition of life-threatening injuries. Given that orbital fractures commonly occur in the context of significant force, close attention should be paid to the rest of the face and other body systems for concomitant injuries.[1]

Airway management can represent a unique challenge in patients with facial trauma. Maxillofacial trauma can complicate airway patency through decreased consciousness, presence of drug-induced or alcohol-induced respiratory depression, difficulties in maintaining or providing advanced airway support due to bone and soft tissue injuries of the upper aerodigestive tract and direct compromise via foreign bodies such as avulsed teeth. A low threshold should exist to place a definitive airway in cases where potential airway trauma, extensive maxillofacial injuries or progressive head and neck oedema are noted.

Cervical spine stabilisation and clearance is essential in the management of head and neck trauma, given the high incidence of spinal injuries in patients with facial fractures.[7 8]

History of trauma

Identifying the cause of trauma can provide critical information regarding both the magnitude and direction of force involved in causing injury, and help to determine the likelihood of additional head or bodily injuries. A high index of suspicion of intimate partner violence should be considered in cases where the patient history does not correlate with examination findings.[9] A history of loss of consciousness or unexpected changes in vital signs may reflect intracranial injury, or activation of the oculocardiac reflex.

The point of impact of force in the orbital area can predict the size, position and clinical significance of an isolated orbital fracture based on two theories of fracture propagation.[10] In trauma directed towards the globe, increased orbital pressure is disproportionately directed against the orbital floor, causing buckling and consequent fracture, usually small in size, with minimal herniation of orbital contents and no involvement of the medial wall or

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orbital roof. When the force is directed towards the lower orbital rim, fractures may be larger, more likely to involve the medial wall, commonly involve herniation of orbital contents into the maxilla, and can involve the orbital roof.

A history of penetrating eye injury with lid laceration must be treated with a high index of suspicion for underlying orbital or intracranial injury. Often, lid laceration is the only clinical sign of penetrating orbitocranial injury upon presentation, and during the acute assessment in the emergency department, patients may have a normal GCS.[11] As such, clinical consideration is essential to prevent delayed diagnosis and serious complications. A review of 56 case reports by Turbin *et al*[12] revealed that both upper and lower eyelid lacerations with a history of medium-force to high-force injury may present with a fracture of the orbit, or penetration of the object through the orbital fissures or optic canal. Eyelid injuries involving sharp objects should prompt a detailed neurological and radiographic examination with CT or MRI, to prevent missed diagnosis of occult orbital or intracranial injury.

Specific questions should be asked regarding symptoms of pain, paraesthesia and haemorrhage in the maxillofacial region. Most importantly, any visual changes should be clearly documented and followed up with a comprehensive ocular examination for vision-threatening injuries, described in this paper. In acute setting, early assessment of visual acuity and extraocular muscle movement is critical as clinical examination can become more difficult as swelling increases over time. Associated nausea and vomiting in children may be an indicator of trapdoor fracture, with entrapment of orbital contents within the fracture.[13 14] Immediate referral has been advocated in these cases, to prevent permanent loss of extraocular muscle movement; recently, this theory is in dispute, and range of eye movement has been shown to resolve irrespective of time to surgery.[15]

Given the significant association between maxillofacial trauma, alcohol consumption and use of other illicit drugs, a complete history should include recent use of such substances.[16–21]

Orbitofacial examination

Close examination of the maxillofacial structures occurs during the secondary trauma survey phase of assessment. A comprehensive examination of this region should include the globe, soft tissues and bony structures.

In known cases of orbital fracture, mild ocular injuries can exist even in visually asymptomatic patients.[22] In a retrospective study (n=410), 29.4% of orbital fractures also had significant intraocular sequelae.[23] Therefore, assessment of the globe for vision-threatening and non-vision-threatening injuries is paramount in early assessment (table 1).

A complete ocular examination should include visual acuity, eye movements, light reflexes and slit-lamp examination of the cornea and anterior segment. Fundoscopy may provide important findings regarding trauma to the posterior structures of the orbit; however, this may be difficult in the context of soft tissue oedema or severe orbital injury.[25] Visual assessment may be difficult in acute setting due to soft tissue swelling, but a basic level of acuity must be documented, whether the patient has full acuity, partial acuity, light perception only or none.

Soft tissues and the scalp should be thoroughly examined for any lacerations, bruising or swelling. Lacerations should be

Table 1 Vision-threatening ocular injuries

Diagnosis	Clinical signs	Initial management
Retrobulbar haemorrhage	Tense, proptosed globe Pupillary dilatation	Lateral canthotomy or cantholysis Medical adjunct therapy ▶ Mannitol ▶ Acetazolamide ▶ Dexamethasone URGENT ophthalmology referral
'White-eye' blowout (rectus muscle entrapment)	Paediatric/adolescent patient Bradycardia, nausea, syncope (oculocardiac reflex) Unilateral limited upward gaze Enophthalmos Hypoglobus Subconjunctival haemorrhage and periorbital bruising may be absent	Radiographic confirmation (CT) URGENT maxillofacial referral
Traumatic optic neuropathy	Loss of consciousness post-trauma Profound visual loss Relative afferent pupillary defect	Radiographic confirmation (CT/MRI) URGENT ophthalmology referral
Open and closed globe injuries	One or more of: ▶ Poor visual acuity ▶ Blood-stained tears ▶ Collapsed eye ▶ Prolapsed vitreous ▶ Hyphaema ▶ Presence of visible foreign body	URGENT ophthalmology referral
Loss of eyelid integrity	Complex eyelid laceration Loss of normal eyelid function Corneal desiccation and ulceration	Oculoplastic referral
Chemical injury	Severe pain Blepharospasm Watering Variable reduction in vision Ocular surface necrosis—abrasion, opacity, limbal ischaemia	Local anaesthetic drops pH evaluation Copious irrigation (Ringer's lactate) of at least 2 L URGENT ophthalmology referral

Adapted from Perry *et al*.[24]

evaluated closely with documentation of the location, depth, tissue loss and involvement of surrounding functional apparatus. A detailed anatomical understanding and examination of the eyelid is required in the management of lid lacerations. Complicated lid lacerations involving the lid margin, canaliculus, canthal tendons and levator muscles, or where there is significant loss of tissue and exposed orbital fat, require in-hospital referral to a specialist oculoplastic service.[26] In most cases, primary closure is the treatment of choice of lid lacerations, to correctly apposition the wound edges and restore normal lid function. Conservative management may be considered in cases where lacerations involve <25% of the lid, are superficial, and do not involve exposed vital structures.[27] Failure to restore normal anatomical structure of the lid following injury will often lead to scarring and subsequent ectropion, entropion and associated chronic corneal defects. Simple upper and lower lid lacerations are appropriate for primary closure management by the experienced emergency medicine physician. A 6-0 or 7-0 resorbable or non-resorbable suture has been suggested given the fine nature of the tissues and the need to avoid irritation of the eye by suture ends.[28] Given the highly aesthetic nature of the eyelid, as well as the potential complications of improper closure, restoration and repair, all lid lacerations should involve specialist surgical advice prior to commencing treatment.

Several clinical features may suggest bony fracture of the orbit or zygomatic complex, including periorbital ecchymosis, ptosis, hypertelorism, enophthalmos, exophthalmos, oronasal bleeding and facial asymmetry.[29 30] Loss of sensation over the upper lip, cheek, lateral nose and the lower eyelid may suggest involvement of the infraorbital nerve. Reduced eye movement is common in orbital fractures, particularly in upward gaze, and should be distinguished from muscle entrapment and true restriction (figures 1 and 2). A low clinical threshold should exist for radiographic confirmation of suspected orbital fracture, given the lack of pathognomonic clinical features.

Radiographic examination

Radiographic assessment is required for definitive diagnosis of orbital fractures. CT scanning is currently the gold standard, as it can provide rapid, detailed information regarding orbital fracture size, location and involved soft tissues, as well as to survey the remainder of the facial bones for additional injuries.[31 32] This is particularly important for adequate preoperative planning for surgical management, guiding access principles and in selecting treatment modality. Bony three-dimensional (3D) reconstruction can simplify the classification of multiple, complex or comminuted facial fractures, and can be easily produced by modern radiology software. 3D reconstruction can also be of future benefit to the surgeon, for surgical treatment planning.

Figure 1 True inferior rectus muscle entrapment in a 16-year-old man, who presented after sustaining a left orbital floor greenstick fracture.

Figure 2 Corresponding CT image, revealing inferior rectus entrapment within the fracture, and herniated orbital contents in the maxillary sinus.

More recently, cone-beam CT (CBCT) has been used successfully in the diagnosis of orbital floor fractures.[33] Initially designed for use in coronary angiography, CBCT differs from conventional CT imaging as it uses a cone-shaped source of ionising radiation, as opposed to a fan-shaped source and detector. This method allows the recording of multiple sequential planar images in a single rotation, rather than multiple individual image slices which then require stacking, to produce a 3D reconstruction. CBCT carries a number of benefits, including a rapid scan time, cheaper product cost, sharper images due to lower recording time and increased efficiency of radiation (translating to lower radiation dose).[34] Despite a major reduction in radiation dose, particularly important to the ocular lens, CBCT scans of the orbit tend to suffer low contrast resolution, making elucidation of herniated soft tissue orbital contents difficult. Additionally, CBCT is less suitable for patients with multiple injuries or who are unable to sit upright in the machine. CBCT is indicated for isolated bony orbital injuries in non-emergency cases only, who have had a thorough clinical assessment prior to examination to rule out any indications for conventional CT imaging.[35]

In smaller hospitals where CT scanners are not immediately available, plain radiographs can have a role in the diagnosis of orbital floor and zygomatic fractures, but are much less useful in determining inferior rectus involvement.[32] Views of the zygoma and orbital floor can be attained with submentovertex, occipitomental 30° and posteroanterior face views.[36] Features on plain films that should be assessed on these views include visualisation of the orbital floor and the classical 'trap-door' sign, prolapsing of orbital contents and air-fluid levels in the maxillary sinus.

Use of MRI has been suggested as a radiation-free method to assess both the bony and soft tissue structures in orbital trauma. MRI provides a high sensitivity method of diagnosing herniation and soft tissue entrapment, and is equally accurate for 3D bony reconstruction.[37 38]

EARLY MANAGEMENT AND REFERRAL

Management of traumatic lacerations should occur in line with established principles.[39] Rigorous wound cleaning and debridement of compromised tissues will help in preventing secondary infections. Facial aesthetics are an important factor to consider in wound closure, and specialist advice should be sought in complicated lacerations or avulsions.

All fractures involving the midface require referral to a maxillofacial unit. A referral should include all pertinent findings including aetiology, conscious state, cervical spine clearance, ocular and facial examination (particularly visual acuity), radiographic diagnosis, concomitant injuries and additional medical history.

DISCHARGE CARE

At present, consensus remains that in most cases, delayed treatment of orbital fractures is ideal practice.[40] Exceptions to this rule include: persistent oculocardiac reflex with bradycardia, heart block, nausea and vomiting; and 'white-eye' blowout fractures with entrapment in children and adolescents. Patients with these symptoms will require urgent inpatient management with surgical intervention as soon as possible.

In all other cases, within 3–7 days swelling and bruising will markedly reduce and allow for a more accurate clinical examination for orbital dystopia, diplopia and enophthalmos. Symptoms of diplopia can be due to soft tissue swelling in the acute phase and may resolve during the postinjury period. Therefore, uncomplicated cases of orbital fracture warrant referral to the maxillofacial outpatient clinic after discussion with the on-call maxillofacial trauma service.

Isolated cases of severe orbital infection after orbital fractures have been documented.[41 42] Given that orbital fractures frequently communicate with the underlying ethmoidal or maxillary sinuses antibiotic prophylaxis may be considered to prevent postseptal infections. Skin lacerations are another theoretical source of contamination, which can progress to periorbital infections. However, in a survey of 187 oral and maxillofacial surgeons, there was no consensus regarding prescription of systemic antibiotics upon initial diagnosis—only 47% stated this was part of their management.[43] Antibiotics should be prescribed on the advice of specialist services, and taking into account individual risk factors.

Patients with orbital blowout fractures should be informed to avoid blowing their nose and sneeze with an open mouth, which can risk pressurised air entering the orbital tissues and causing surgical emphysema.[44] Rarely, orbital emphysema can compress the optic nerve and lead to ischaemic neuropathy.[45] Cases of pneumomediastinum, a severe and life-threatening complication, have been documented to occur after orbital and zygomaticomaxillary complex fractures[46–49] (box 1).

CONCLUSION

In this review, we summarise the initial assessment and treatment of orbital fractures, a common presentation to emergency departments. While definitive management of orbital trauma is through specialist referral, diagnosis and treatment begins upon first contact with the hospital, often with non-specialist staff.

Box 1 Key learning points

History

Have a high index of suspicion of orbital fractures in patients with moderate-impact or high-impact facial trauma, and experiencing pain, lower lid and midface paraesthesia or change in visual acuity

Consider the nature of force/trauma in orbital fractures and which orbitofacial structures are likely to be affected

Examination

Follow the general principles of primary and secondary survey in all head and neck trauma cases

Clinical signs of orbital fractures:

- Periorbital ecchymosis
- Ptosis
- Hypertelorism
- Enophthalmos/exophthalmos
- Oronasal bleeding
- Facial asymmetry
- Loss of sensation
- Restriction of ocular motility with diplopia

Radiographs

CT is gold standard for orbital bony assessment

Consider MRI where radiation is a concern or CT contraindicated (eg, children)

Plain films—assess air-fluid levels, contour of orbital floor and herniation of orbital contents. Three views should be requested:

- Occipitomental 30°
- Submentovertex
- Posteroanterior face

Early management

Address life-threatening or vision-threatening injuries first—urgent referral required

Preoperative antibiotic cover

Patient education to reduce risk of surgical emphysema

It is important that the emergency medical practitioner be aware of red flag presentations and expected complications of orbital fractures, and provide prompt referral, and appropriate discharge precautions to prevent adverse secondary outcomes. This is particularly important as patients will not be exposed to specialist care for a number of days postinjury.

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