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Orbital Fractures

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Abstract:

This article attempts to review the role of Otolaryngologist in managing patients with orbital trauma. There is a high incidence of orbital injury in facio maxillary trauma. Trauma to orbit can be blunt / penetrating in nature. Commonest bony injury to orbit involves the floor and medial wall. Both these walls can be easily accessed by otolaryngologist. It is very important for otolaryngologist to be competent in handling these problems.

Introduction:

Location of orbit predisposes them to injury in facio maxillary trauma. Systemic evaluation of orbit is a must in patients with maxillo facial injuries. Knowledge of anatomy of this region is a must before one could venture into this area. Anatomically the orbit resembles a four sided pyramid, as one goes posterior it becomes three sided towards the apex [1]. The volume of orbit is about 30 ml. The four walls of the orbit are thinner than the rim. Hence any sudden increase in orbital pressure due to impact can cause fracture of these walls rather than the rim. Among the walls medial wall happens to be the thinnest and hence fractures easily. The inferior orbital wall is weakened by the presence of inferior orbital canal through which infraorbital vessels and nerve pass through.

The medial wall of the orbit is formed from anterior to posterior by:

1. Frontal process of maxilla

2. Lacrimal bone

3. Ethmoid bone

4. Lesser wing of sphenoid

The lateral wall of orbit is formed mainly by greater wing of sphenoid with minor contributions from zygoma and zygomatic process of maxilla anteriorly.

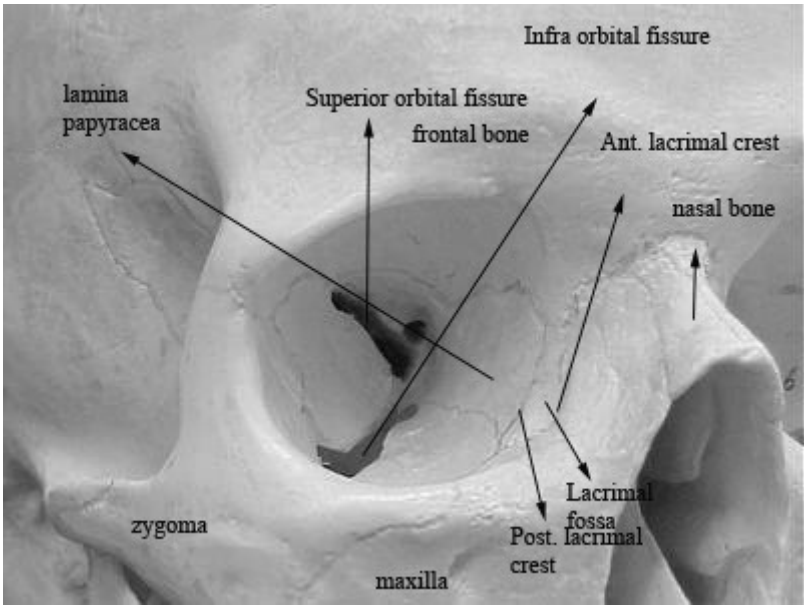


Figure showing bones forming the orbit

Orbital injuries are seen in nearly 70% of patients with maxillo facial trauma [2]. Penetrating injury to the globe is an indication for hospitalization [3]. This is usually caused by smaller high velocity travelling objects impacting the eye. Where as larger slow velocity objects are more prone to cause blow out fractures.

The role of otolaryngologist is important in all non penetrating injuries involving orbit.

Clinical examination of a patient with orbital trauma:

Examination should be performed with minimal manipulation till the integrity of the orbit is established.

Image of a patient with blow out fracture of inferior wall of orbit

Classification of fractures involving the orbit:

Fractures involving orbit may be classified according to the pattern of involvement of walls of the orbit, rim of the orbit, orbital fractures associated with fractures involving other facial bones.

1. Fractures limited to internal orbital skeleton. (Blow out and Blow in fractures). Orbital floor, medial wall, or roof can be involved. This type of fracture can be further classified into:

Trap door type of fracture – due to low velocity injuries
Medial blow out fractures – due to intermediate velocity injuries
Lateral blow out fractures – due to high velocity injuries

2. Fractures involving orbital rim / along with internal orbital skeleton. These fractures may be subclassified into:

Inferior rim fracture
Superior rim fracture
Lateral rim fracture
Rim fracture in association with fractures involving internal orbital skeleton

3. Fractures of orbit associated with other fractures of facial skeleton. These include:

zygomatico maxillary fracture

Naso-orbito-ethmoid fracture

Frontal sinus fracture

Lefort II

Lefort III

4. Orbital apex fractures : These fractures should be identified early because of potential threat to neurovascular structures at superior orbital fissure and optic canal. Optic canal injuries can lead to traumatic optic neuropathy.

Aims of therapy in orbital fractures:

1. To minimize / prevent early sequlae like diplopia, blindness etc

2. To prevent late complications like persistent diplopia and disfigurement due to globe malpositioning

Pathophysiology of orbital blow out fractures:

Most of the patients with fractures involving orbit give history of blung injury to the area. Penetrating injury is rather rare [4].

Two theories have been proposed to account for blow out fracture [4]. Hydraulic theory and Buckling theory.

Hydraulic theory:

This theory suggests that sudden increase in intraorbital pressure causes decompressing fracture into the adjacent sinus.

Buckling theory:

This theory suggests that posterior transmission of a direct orbital rim force causes a buckling and resultant fracture of orbital wall.

A combination of both mechanisms could be involved in classic blow out fractures.

Water House in 1999 [5] did a detailed study of these two mechanisms by applying force to the cadaveric orbit. He infact used fresh unfixed cadavers for the investigation. He described two types of fractures:

Type I: A small fracture confined to the floor of the orbit (actually mid medial floor) with herniation of orbital contents in to the maxillary sinus. This fracture was produced when force was applied directly to the globe (Hydraulic theory).

Type II: A large fracture involving the floor and medial wall with herniation of orbital contents. This type of fracture was caused by force applied to the orbital rim (Buckling theory).

In typical blow out fractures involving floor of the orbit, the medial extent of the fracture is limited by maxillo ethmoidal strut which is a strong bone and the lateral extent is limited by infraorbital neurovascular bundle. The medial wall in blow out fractures also receives additional support from bony septa present between ethmoidal air cells. In combined fractures involving both inferior and medial walls of orbit the stronger maxilloethmoidal bony struts are also fractured.

In children because of the elasticity of the bones green stick fractures are common. Green stick equivalent of blow out fracture is the trap door variant of blow out fracture. In these patient the intraorbital contents like muscle / fat can bet trapped between the fracture fragments when they snap back into position.

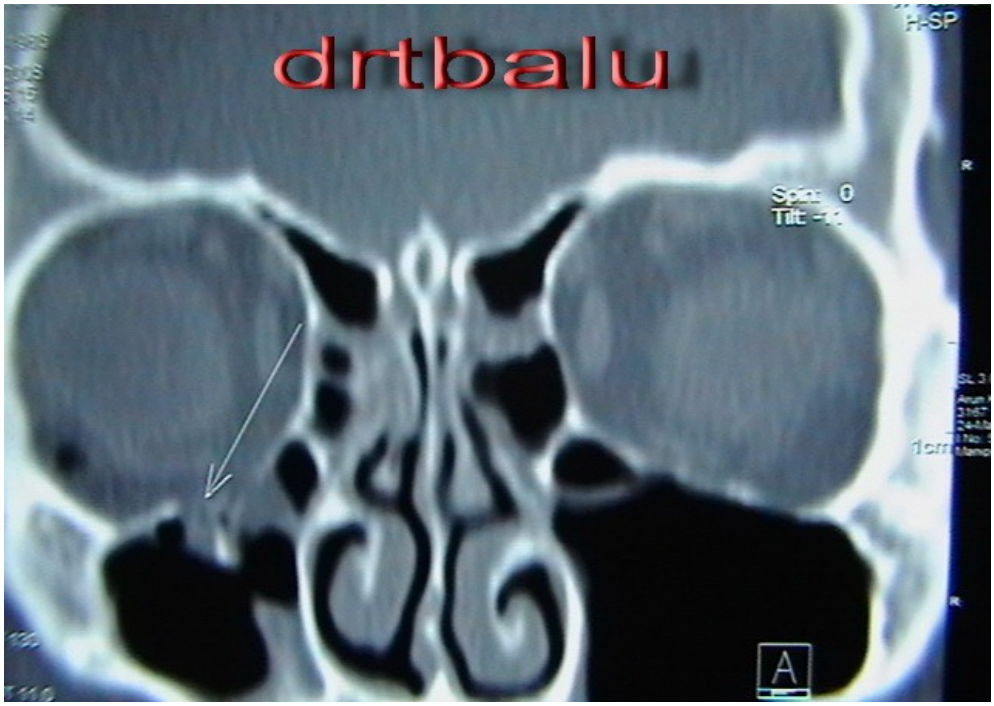
Classification of blow out fractures of orbit:

1. Orbito-zygomatic

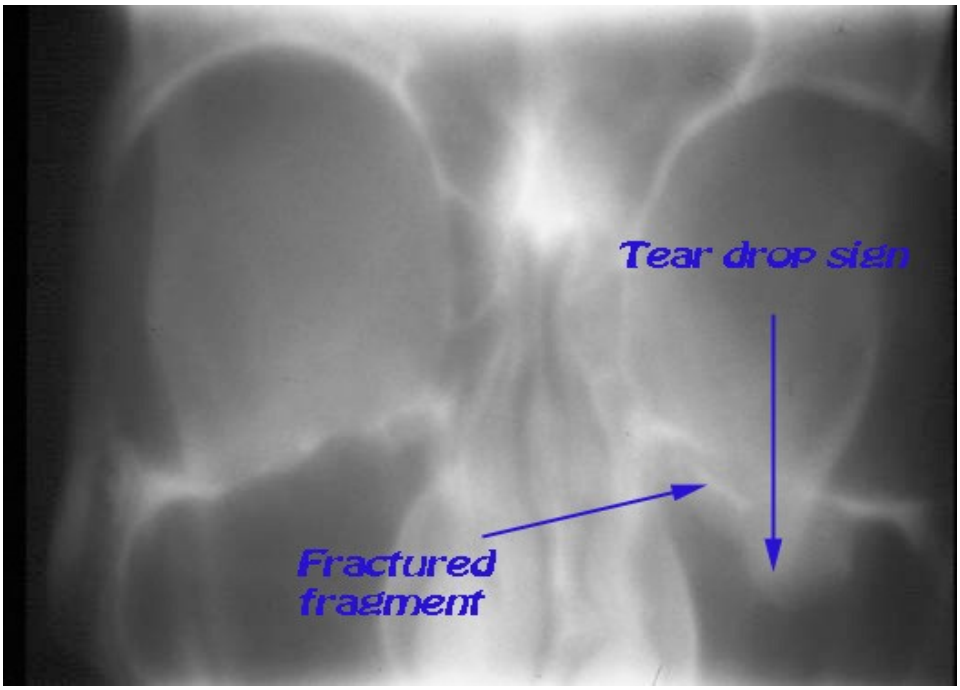
2. Naso – orbito – ethmoid

3. Internal blow out fracture

4. Complex fractures (Any of the above three in combination)



CT scan nose and sinuses showing blow out fracture of floor of orbit (Tear drop sign)



X-ray paranasal sinuses Water's view showing Tear drop sign

Clinical features of blow out fracture:

1. Intraocular pain

2. Numbness over certain areas of face

3. Diplopia

4. Inability to move the eye

5. Blindness

6. Epistaxis

On examination patients with blow out fracture may present with:

1. Enophthalmos

2. Orbital oedema

3. Hematoma

4. Globe displacement

5. Restricted ocular mobility

6. Infraorbital anesthesia due to entrapment of infraorbital nerve

Proptosis if present in these patients is rather sinister as it indicates retrobulbar / peribulbar hemorrhage.

Pupillary dysfunction associated with visual disturbances indicate injury to optic nerve and it is an emergency. Patient must be taken up for immediate optic nerve decompression to save vision. Hence a complete ophthalmological evaluation is a must in these patients.

Indications for surgical repair in these patients:[6]

1. Diplopia within 30 degrees of primary gaze

2. Extraocular muscle entrapment

3. Enophthalmos of more than 2mm

Management of blow out fracture:

Blow out fractures without acute enophthalmos / entrapment of intraocular muscles can be managed conservatively. Forced duction test should be performed in all these patients to rule out entrapment of intraocular muscles.

Aim of surgical repair include:

1. Release of entrapped orbital contents

2. Reconstruction of floor of the orbit

Approach is usually via caldwel Luc procedure. Entrapped inferior oblique muscle can be freed and the orbital contents reduced. Reconstruction of inferior wall of orbit is another important step that should be performed to prevent to further prolapse of orbital content into the maxillary sinus. Autologous bone graft or synthetic meshes can be used for the purpose.

Endoscopic decompression of the blow out fractures involving medial and inferior wall of orbit is being commonly performed these days.

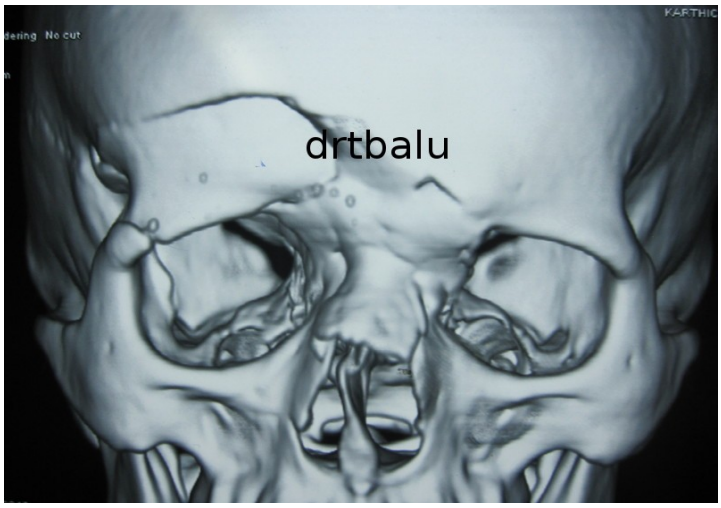
Fractures involving roof of the orbit:

These fractures are rather important because of their association with intracranial injury. Dural tears if any can cause CSF leak and penumocephalus. These fractures are commonly caused by trauma to forehead / frontal bone. These fractures are extensions of supraorbital rim fractures. Isolated non displaced fractures involving roof of frontal bone are commonly seen in children and they can be managed conservatively.

Signs:

Are rather similar to those of other orbital wall fractures but are minimal. Periorbital hematoma and oedema are common. These patients also have cosmetic deformity consisting of depression or flattening of supraorbital ridge. Subconjunctival hemorrhage and chemosis are also rather common. Ocular misalignment can also be seen. Proptosis / enophthalmos can also be seen.

Coronal CT scan image showing orbital roof fracture



Reformatted CT image showing anterior wall of frontal sinus fracture with involvement of superior orbital rim

Clinical photograph of a patient with fracture involving superior wall of orbit

Management:

Orbital roof fractures are managed conservatively most of the times [7]. If there are signs of muscle entrapment with associated levator dysfunction then surgery may be required. Superior wall of orbit can be accessed by superior lid crease approach or bicoronal approach. Bicoronal approach is cosmetically acceptable to the patient. In managing patients with large displaced fractures involving roof of the orbit a team approach with neurosurgeon is a must.

Fractures involving lateral wall of orbit:

The lateral wall of orbit happens to be the strongest of all orbital walls. Fractures involving this wall occurs following severe facial trauma. Fractures in this area usually occurs in the Sphenozygomatic suture line. Lateral orbital wall is formed anteriorly by the zygoma and posteriorly by sphenoid. Zygomatic bone consititues the midfacial prominence which make it highly susceptible to trauma.

These patients present with:

1. Significant midfacial deformity

2. Periorbital swelling

3. Ecchymosis

4. Displacement of lateral wall of orbit has a dramatic effect on the globe position and facial symmetry.

Management:

Repair of open globe injuries take precedence over fracture management. If intraocular pressure is high then it must be addressed by lateral canthotomy or cantholysis. Vision should be checked carefully in these patients. Exact management modality depends on the degree of displacement and comminution of the fracture, intracranial extension of sphenoid fracture. Non displaced or midly displaced fractures can be managed conservatively.

Indication for fracture repair involving lateral orbital wall:

1. Visual loss

2. Ocular motility disturbance

3. Enophthalmos

4. Flattening of malar eminence

Before attempting to repair these fractures any pre-existing corneal wounds need to be evaluated for possible leak during the procedure.

Fracture medial wall of orbit:

Also known as naso orbito ethmoidal fractures. They form a component of naso orbito ethmoidal fractures and hence the name. Isolated fractures involving the medial wall of orbit is rather rare. With increasing incidence of high velocity injury this type of fracture is becoming common. This type of fracture occurs when the force generated by blunt trauma exceeds the resistance offered by bony walls of orbit.

This fracture is difficult to diagnose without the aid of CT imaging. Signs and symptoms of this

condition may be masked by the presence of extensive periorbital trauma.

Clinical features of fractures involving medial wall of orbit include:

1. Periortbital oedema and ecchymosis

2. Subconjunctival hemorrhage

3. Subcutaneous emphysema

4. Epistaxis

5. CSF rhinorrhoea

6. Associated fractures of nasal bone

7. Restriction of abduction in the presence of entrapment of medial rectus muscle

8. Diplopia on medial / lateral gaze

9. Presence of enophthalmos

Management:

Almost 90% of these patients may be managed conservatively. Surgery is indicated only when there is entrapment of medial rectus muscle causing diplopia on horizontal gaze. Enophthalmos of more than 2 mm will cause cosmetic problems. Hence it is an indication for surgery. Even in the presence of enophthalmos it is prudent to wait till the fracture heals before putting material in the floor of the orbit to obviate cosmetic effects of enophthalmos. Defects involving medial wall of orbit can be repaired by using bone grafts or other inert materials.

Presence of concurrent ruptured globe is a contraindication for orbital surgery.

Anatomical landmarks to be respected when attempting to repair fractures involving medial wall of orbit:

1. Medial canthal tendon

2. Lacrimal sac

3. Trochlea

4. Anterior and posterior ethmoidal vessels

Administration of systemic steroids has been advocated with the hope it could cause rapid resolution of oedema associated with fractures of orbital wall. Resolution of oedema could also help in accurate clinical diagnosis of the condition.

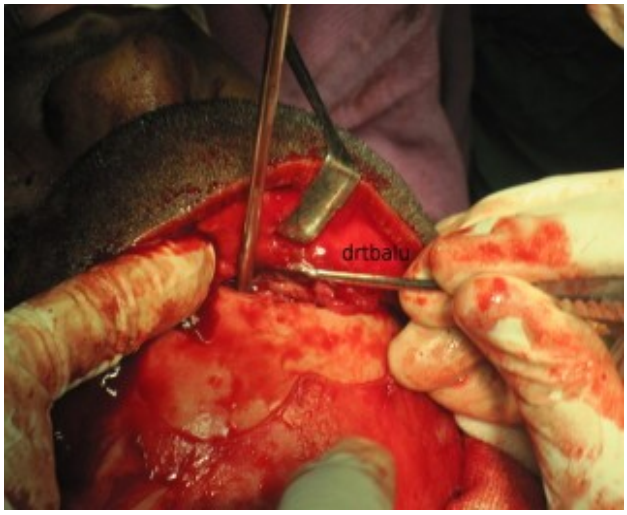


Image showing fracture involving roof of orbit

Conclusion:

Eventhough majority of fractures involving orbital walls may be managed conservatively, some of them may need surgical intervention and multispeciality approach. High degree of suspicion is a must in identifying potential threat to vision.
Surgical intervention is needed when there is:

1. Diplopia

2. Evidence of entrapment of orbital contents

3. Presence of orbital abscess

4. More than 2mm of enophthalmos causing cosmetic defects

5. Evidence of corneal tears and lacerations

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