Review Article

Orbitofacial Trauma: Clinical Overview

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Abstract

This review article of orbitofacial trauma has following aims and objectives:

1) to understand the clinically relevant anatomy of orbit with regard to periorbital trauma , orbital fractures and other associated cranio maxillofacial injuries, different types of classification of cranio maxillofacial fractures
2) to explain how to assess and examine a patient after periorbital trauma, and
3) to understand the medical and surgical management of orbital fractures.

The article aims to summarize the evaluation and management of commonly encountered orbital fractures and other associated fracture of craniomaxillofacial region from the ophthalmologic perspective and to provide an overview for all practicing ophthalmologists and ophthalmologists in training. These fracture require multi disciplinary approaches involving ophthalmologist, dentalsurgeon, neurosurgeon and ENT surgeon .

Keywords : Orbitofacial, trauma, fracture, orbital floor.

Introduction

Orbitofacial trauma involves injury to the bones and soft tissues surrounding the eye (orbit) and face.The incidence of isolated orbital fractures ranges from 4 to 16% of facial injuries.[1] The orbit is especially susceptible to injury because of its very complex anatomical structure with hard and soft tissue. Blunt trauma in this facial region may cause an isolated orbital "blowout" fracture or a combined, orbital fracture and midface fracture.[2] Due to the proximity to critical structures such as the brain and optic nerve, diagnosis and treatment can be complex. In critically ill patients, especially in the ICU, these injuries often result from high-impact events and demand coordinated care across multiple specialties, including ophthalmology, neurosurgery, and maxillofacial surgery.

Early surgical intervention preferably within 7 to 12 days leads to better outcomes, including restored orbital volume, facial symmetry, and vision. Delayed treatment can result in complications such as diplopia, facial asymmetry, infraorbital numbness, and ocular dysfunction. Clinical diagnosis relies on imaging (CT scans) and physical examination, with open reduction and internal fixation (ORIF) using titanium plates or mesh being the standard of care.

Epidemiology

- **Age& Gender:** Primarily affects young adults (20–40 years) with a male-to-female ratio of 4:1[1]
- **Causes:**
- **Road Traffic Accidents (RTAs):** 40–60%[3]

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- **Interpersonal Violence:** 20–30%
- **Falls:** 10–15%
- Sports/Industrial Injuries: <10%
- **Trends:** More prevalent in urban and lower socioeconomic settings.

Anatomy of The Orbitofacial Region

The orbit is a bony cavity formed by seven bones: frontal, zygomatic, maxilla, sphenoid, ethmoid, lacrimal, and palatine.

Common Fracture Sites:

- **Zygomaticomaxillary Complex (ZMC)** – affects cheekbone and orbit
- **Orbital Floor ("Blowout")** – thin and prone to collapse
- **Frontal Bone/Supraorbital Rim**
- **Naso-Orbito-Ethmoid (NOE)** – affects facial contour and aesthetics

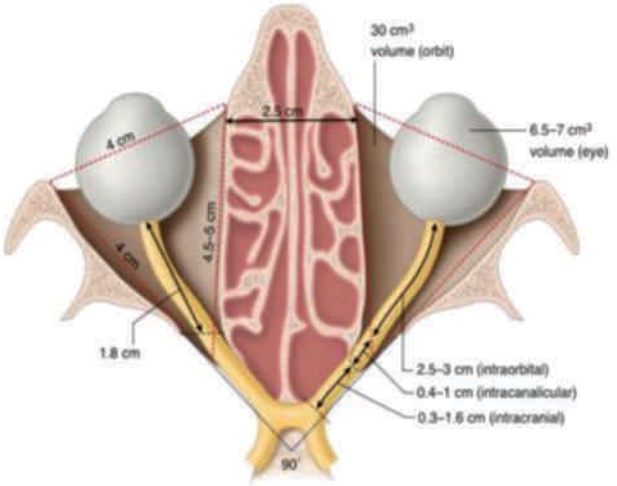

Figure 1-1A : Measurements of various orbital components

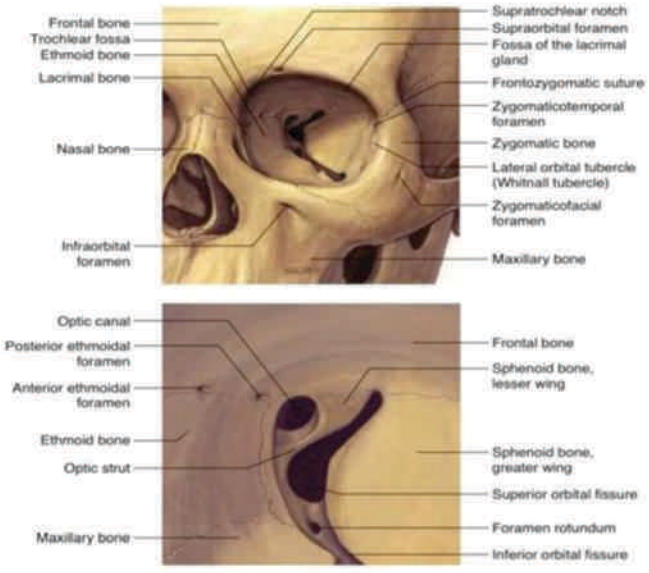

Figure 1-2A : Roof of Orbital Floor

Key Anatomical Areas:

- The roof of the orbit is composed of the orbital plate of the frontal bone and the lesser wing of the sphenoid bone (Fig 1-2A).
- It is located adjacent to the anterior cranial fossa and frontal sinus and includes the following important landmarks:
- The fossa of the lacrimal gland, which contains the orbital lobe of the lacrimal gland.
- The fossa for the trochlea of the superior oblique tendon, located 5 mm behind the super nasal orbital rim.
- The supraorbital notch, or foramen, which transmits the supraorbital vessels and the supraorbital branch of the frontal nerve.

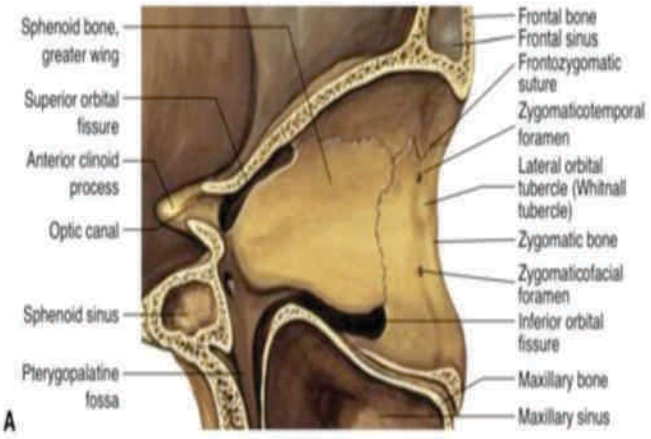

Figure 1.3A : Lateral Orbital Wall.

he lateral wall of the orbit is the thickest and strongest of the orbital walls. It is composed of the zygomatic bone and the greater wing of the sphenoid bone and is separated from the lesser wing (portion of the orbital roof) by the lesser wing (portion of the orbital roof) by the superior orbital fissure (Fig 1-3A). It is located adjacent to the middle cranial fossa and the temporal fossa and commonly extends anteriorly to the equator of the globe, helping to protect the posterior half of the eye while maximizing peripheral vision. Important landmarks include the following:

- the lateral orbital tubercle (Whitnall tubercle; see Figs 1-2A, 1-3A), with multiple attachments, including the lateral canthal tendon, the lateral horn of the levator aponeurosis, the check ligament of the lateral rectus, and the suspensory ligament of the globe (Lockwood ligament)

The frontozygomatic suture (see Figs 1-2A, 1-3A), located 1 cm above the lateral orbital tubercle Oculofacial Plastic and Orbital Surgery.

ORBITAL APEX

- VIEW OF ORBITAL APEX, RIGHT ORBIT .
- The ophthalmic artery enters the orbit through optic canal, whereas the superior and inferior divisions of the oculomotor nerve (cranial nerve [CN]Ill), abducens

nerve (CN VI), and the nasociliary nerve enter the muscle cone through the oculo-motor foramen. The trochlear nerve (CN IV), the frontal and lacrimal nerves, and the ophthalmic vein enter through the superior orbital fissure and thus lie within the periorbita but outside the muscle cone. Note that the presence of many nerves and arteries along the lateral side of the muscle cone. Note that the presence of many nerves and arteries along the lateral side of the optic nerve mandates a superonasal surgical approach to the optic nerve in the orbital apex.

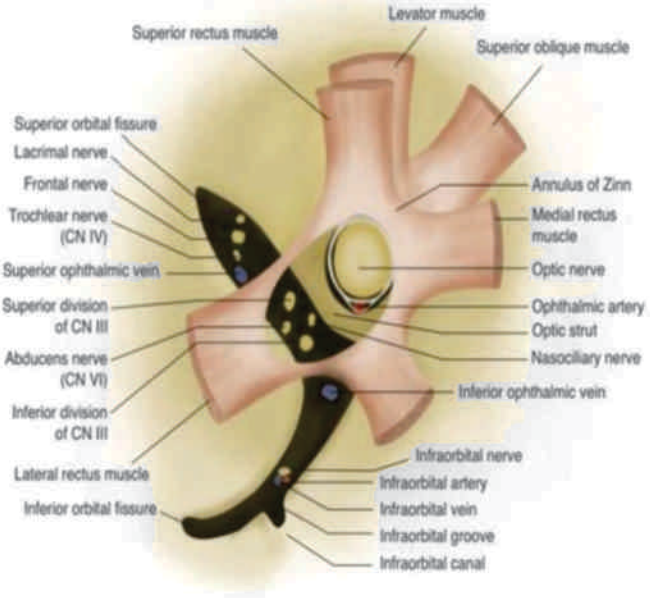

Figure 1.4 : Medial Wall of Orbit

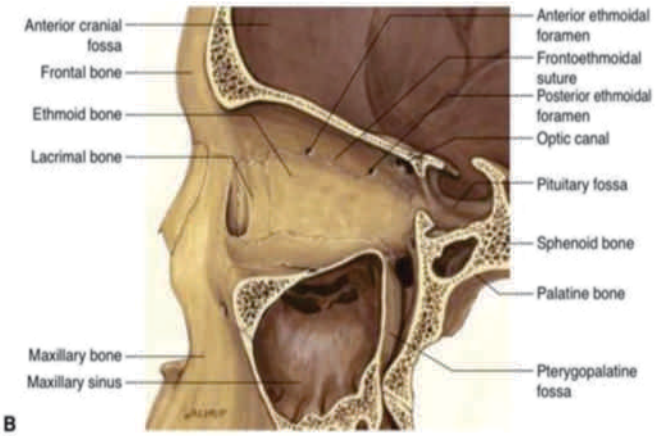

Figure 1.5 : Medial Wall (Left Side)
Internal View of Orbital Bones Floor of The Orbit

The anatomy of medial wall and orbital floor can be seen in figure 1.4, 1.5 and 1.6 respectively.

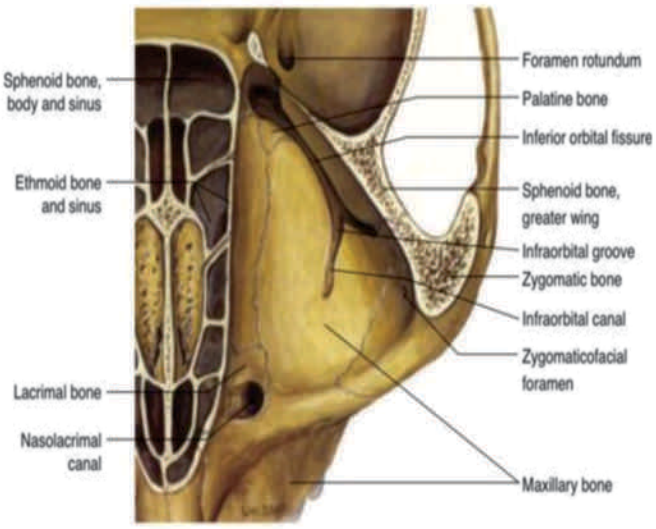

Figure 1.6 : Orbital Floor (Left Side)
Internal View of Orbital Bones

Classification of orbital fracture

- Pure/Simple Orbital Fractures

  These fractures are limited to the internal bony walls of the orbit (roof, floor, medial and lateral walls) and don't involve displacement of the orbital rim. They can be further categorized as:
- Linear fractures: Simple breaks in the bone.
- Blowout fractures: Fractures that occur due to trauma, typically involving the orbital floor or medial wall, where the bone is forced inward.
- Blow-in fractures: Less common, where the bone is displaced outward.

Complex Orbitofacial Fractures :

These fractures extend beyond the orbital walls and involve other parts of the craniofacial skeleton. Examples include:

- Zygomatico-maxillary complex (ZMC) fractures: Involve the lateral orbital wall and zygomatic bone.
- Naso-orbito-ethmoidal (NOE) fractures: Involve the medial wall, nasal bones, and ethmoid bone.
- Le Fort fractures (II and III): These are complex midface fractures that can involve the orbital walls and surrounding structures.
- Cranio-orbito-facial and panfacial fractures: Involve the entire craniofacial skeleton, including the orbit.

El Anwar and El Aassar classification ForFrontal Bone Fracture

Type 1: nondisplaced or asymptomatic displaced FS fractures (anterior and/or posterior table) with patent FSOT (radiologicallly and operatively) need conservative management

Type 2: isolated displaced anterior table fracture with symptomatic external depression and patent FSOT

(radiologically and operatively) that could need repair for cosmetic reason

Type 3: displaced anterior table fractures (with or without bone gap) with intact or asymptomatic displaced posterior table fractures and with obstructed FSOT

(a) FSOT could be cleaned operatively (could resume its patency operatively ± endoscopy) (needs repair without FS obliteration)

(b) FSOT could not be cleaned operatively and needs FS obliteration with anterior table repair.

Type 4 (a): symptomatic displaced posterior table fractures with duralinjury (needs cranialization and repair of the dura with repair of the anterior table fracture) or without dural injury (needs repair of fracture) (c) Displaced anterior table fractures with symptomatic displaced posterior table fractures (operatively detected, persistent CSF leak or significant neurological sequels). With obstruction of FSOT (needs FS obliteration and repair of anterior table fracture) or without obstructed FSOT (needs only repair of the anterior table).

Classification

The commonly used classification is as follows :

- **Le Fort type I**
  - horizontal maxillary fracture, separating the teeth from the upper face
  - fracture line passes through the alveolar ridge, lateral nose and inferior wall of the maxillary sinus
  - also known as a Guerin fracture
- **Le Fort type II**
  - pyramidal fracture, with the teeth at the pyramid base, and nasofrontal suture at its apex
  - fracture arch passes through the posterior alveolar ridge, lateral walls of maxillary sinuses, inferior orbital rim and nasal bones
  - uppermost fracture line can pass through the nasofrontal junction or the frontal process of the maxilla [3]
- **Le Fort type III**
  - craniofacial disjunction
  - transverse fracture line passes through nasofrontal suture, maxillo-frontal suture, orbital walls, and zygomatic arch/zygomaticofrontal suture
  - because of the involvement of the zygomatic arch, there is a risk of the temporalis muscle impingement
  - unsurprisingly type III fractures have the highest rate of CSF leak

A memory aid is:

- Le Fort I is a floating palate (horizontal)
- Le Fort II is a floating maxilla (pyramidal)
- Le Fort III is a floating face (transverse)
- Any combination is possible. For example, there may be type 2 on one side and contralateral type 3, or there may be unilateral type 1 and 2 fractures. It should be noted that Le Fort fractures are often associated with other facial fractures, neuromuscular injury and dental avulsion.

Markowitz and Manson classification of NOE based on MCT as a significant structure.

NOE Fractures

Type 1 fracture : Simple fracture with attachment of the MCT.

Type 2 fracture : Comminuted fracture with the MCT attachment intact on a large bane fragment .

Type 3 fracture : Grossly comminuted fracture with MCT attachment on a small fragment or MCT is Avulsed.

Zing classification of ZMC fractures

Type A (incomplete fracture)

A1: is isolated to zygomatic arch

A2: involves lateral wall fracture

A3: involve infra orbital rim

Type B (complete mono-fragment fracture) : All pillars of Malar bone are fractured

Type C (multi- fragment fracture) : Type B fracture with comminution , involving the body of zygoma

Burnsteine'sevidence based protocol for surgical management of orbital blowout fractures

Orbital floor repair indications Urgent (with in 24 hours): white eye ball fracture. Muscle entrapment with positive FDT and oculocardiac response

Early Repair(with in 2 weeks):persistent diplopia with positive FDT Enophthalmos> 2mm Fracture area >50 % of orbital floor (>2x2 cm)

Late Repair (>2 weeks): Late enophthalmos.

Clinical Presentation

Patients with orbitofacial trauma present with a range of symptoms, including [5]

- Periorbital swelling and bruising
- Diplopia (double vision) due to muscle entrapment or orbital volume changes
- Enophthalmos (sunken eye) or proptosis (protruding eye)
- Infraorbital numbness from nerve injury
- Restricted eye movement
- Facial asymmetry, such as flattening of the malar prominence

Associated injuries to the ocular globe, optic nerve, or intracranial structures may complicate the clinical picture.

Diagnostic Approach

Accurate diagnosis is critical for effective management.

Key diagnostic tools include :

- CT Scan (Maxillofacial, Axial + Coronal Views):The

gold standard for evaluating fracture extent, orbital volume, and muscle entrapment. The CT scan offers distinct advantages over other imaging modalities.[8] The size and morphology of the fracture can be determined, which aids in not only clinical assess ment but also surgical planning. A CT scan can determine whether the fracture involves the optic canal. A CT scan can also reliably demonstrate whether acute proptosis in a patient is secondary to orbital hemorrhage, a potential vision threatening emergency, or orbital emphysema. A CT scan can also help detect entrapment of the rectus muscles, recognized by displacement of the muscle into the fracture site, with or without bone displacement

- 3D Reconstruction : Facilitates preoperative planning for complex fractures.
- Ophthalmologic Evaluation : Assesses visual acuity, intraocular pressure, and fundoscopic findings to rule out globe or optic nerve injury.

Management

Initial management

Stabilization of airway, breathing, and circulation.

- Urgent ophthalmologic evaluation for globe injuries.
- Tetanus prophylaxis and antibiotics for open fractures.

Definitive Treatment

- Open Reduction and Internal Fixation (ORIF):The standard approach, utilizing titanium plates and screws for stability.

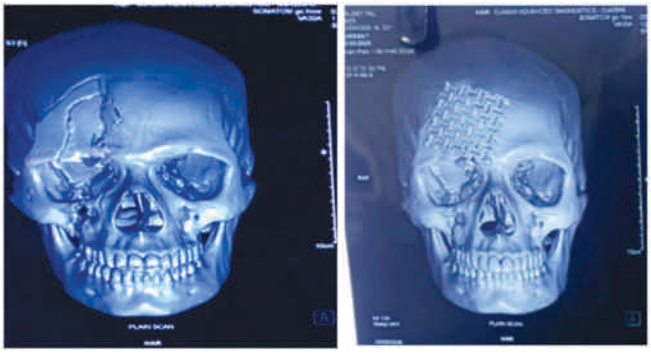

Figure 2 : Titanium mesh for reconstruction

Surgical approaches :

- Transconjunctival or sub ciliary for orbital floor access.
- Lateral brow for frontal bone fractures.
- Intraoral for MC fractures.
- Materials: Titanium mini-plates (1.5 mm, 2.0 mm) or mesh, and porous polyethylene implants for orbital reconstruction (Figure 2)
- Timing: Surgery is ideally performed within 7-10 days, unless globe injuries necessitate delay.

Complications

Orbital trauma can result in significant functional and cosmetic defects and hence can be significantly disabling.[7] Complications of orbitofacial trauma or its treatment include:

- Persistent diplopia
- Enophthalmos
- Infraorbital nerve paraesthesia
- Plate exposure or infection
- Orbital dystopia or malposition Timely and precise reconstruction minimizes these risks.

Prognosis

With early surgical intervention and multi disciplinary collaboration involving maxillofacial surgeons, ophthalmologists, and neurosurgeons, functional and cosmetic outcomes are favorable in over 85% of patients. Long-term follow-up is essential to monitor ocular and aesthetic results.

Epidemiological Profile

DEFINITION

Orbitofacial trauma refers to injuries affecting the orbital and facial bones and soft tissues, commonly managed with ORIF using titanium plates and screws.

DEMOGRAPHICS

- Age Group : Predominantly young adults (20-40 years).
- Gender : Males account for 75-90% of cases due to higher exposure to high-risk activities.
- Geography: Higher incidence in urban and semi-urban areas.

COMMON FRACTURE PATTERNS

- Zygomaticomaxillary complex (MC) fractures
- Orbital floor (blowout) fractures
- Naso-orbito-ethmoid (NOE) fractures
- Fronto-orbital fractures

Orbitofacial trauma may present with isolated bone fractures to complex facial fractures,isolated orbital wall fractures,naso- orbito-ethmoid (NOE) fractures, orbitomaxillary or orbitofrontal fractures. NOE fractures in 60% cases are associated with orbital fractures.

LINICAL FEATURES

- Periorbital swelling and ecchymosis
- Diplopia, enophthalmos, or proptosis
- Infraorbital numbness
- Restricted eye movement
- Facial asymmetry

DIAGNOSTIC MODALITIES

- CT Scan (Maxillofacial): Gold standard for fracture assessment.
- 3D Reconstruction: Enhances surgical planning.
- Ophthalmological Assessment: Evaluates visual function and eye movements

TREATMENT

- Surgical Approach : ORIF with titanium plates and screws.
- Approach Types : Transconjunctival, sub ciliary, lateral brow, intraoral (Figure 3).
- Timing : Within 7-10 days of injury.
- Materials : Titanium mini-plates and mesh.

Figure 3 : Intra oral approach

COMPLICATIONS

- Infection or plate exposure
- Persistent diplopia or enophthalmos
- Scarring or nerve damage

OUTCOMES

- Good recovery in >85% of cases with early intervention.
- Late reconstruction may lead to suboptimal results.

PREVENTION STRATEGIES

- Use of helmets and seatbelts.
- Public awareness campaigns on violence prevention.
- Workplace safety regulations.
- Protective gear for sports.

DISCUSSION

Orbitofacial trauma remains a significant public health challenge, particularly in regions with high rates of road traffic accidents and interpersonal violence. Advances in imaging (e.g., CT scans with 3D reconstruction) and biomaterials (e.g., titanium plates and porous polyethylene implants) have improved surgical outcomes.

However, challenges such as delayed presentation, limited access to specialized care in low-resource settings, and the complexity of managing associated ocular and intracranial injuries persist. Preventive measures, including stricter road safety regulations and public education, are critical to reducing the incidence of these injuries.

CONCLUSION

Orbitofacial trauma is a complex condition requiring prompt diagnosis, meticulous surgical intervention, and multi disciplinary care to achieve optimal functional and aesthetic outcomes. The epidemiological profile highlights the predominance of young males and road traffic accidents as key risk factors, emphasizing the need for targeted prevention strategies. Continued advancements in surgical techniques and public health initiatives will further enhance the management and prevention of orbitofacial trauma.

REFERENCES

1. Jatania H. Spectrum of ocular changes after zygomatico-maxillary-complex and Orbital Fractures. Dissertation MDS Oral and Maxillofacial surgery, Rajiv Gandhi University of Health Science, Bengaluru, 2012 pp 1-4, 30-54
2. Zhou HH, Liu Q, Yang RT, Li Z, Li ZB. Ocular trauma in patients with maxillofacial fractures. J Craniofac Surg. 2014;25:519–23.
3. Epidemiological Profile of Orbital Fracture in Orbital Trauma in a Tertiary Eye Care Centre in Kerala Authors Dr Awungshi Philamazan1, Dr V. Sahasranamam2, Dr Suresh Babu.
4. Oculofacial Plastic and Orbital Surgery AAO Major Revision Edition 2023–2024 BSCC Basic and Clinical Science Course 1996;40(3):264–268.
5. Bains RA, Rubin PA. Blunt orbital trauma. Int Ophthalmol Clin. 1995;35:37 46.