Fractures of the Middle Third of Facial Skeleton (Part 2)

Isolated Orbital Floor Fractures

Introduction

The orbit is a complex bony cavity that houses and protects the eyeball, extraocular muscles, nerves, vessels, and supporting soft tissues. Because of its thin bony walls—especially the floor and medial wall—it is highly susceptible to fractures following facial trauma.

Among orbital injuries, isolated orbital floor fractures are commonly known as orbital blow-out fractures. These fractures are important because they may lead to diplopia, enophthalmos, restriction of eye movement, and functional visual problems.

Orbital Anatomy

The orbit is roughly pyramidal in shape with its apex located posteriorly at the optic foramen.

Although traditionally described as pyramidal, the rounded junctions between the walls make it resemble a cone.

The orbit has:

1. Roof
2. Floor
3. Medial wall
4. Lateral wall

Medial Wall

The medial wall is very thin and is closely related to the ethmoidal air cells. Because of this thinness, it may fracture easily.

Lateral Wall

The lateral wall is relatively thick and strong and is less commonly fractured.

Roof

The orbital roof is also relatively thick and provides protection to the cranial cavity.

Floor

The orbital floor is extremely thin, especially in the region of the infraorbital groove and infraorbital canal.

The orbital floor is formed mainly by:

- Orbital portion of the maxillary bone
- Part of the zygomatic bone

Posteriorly it includes:

- Orbital process of palatine bone
- Small part of ethmoid bone

Medially it is bounded by the lacrimal bone.

The eyeball normally protrudes slightly beyond the orbital rim and is supported by Lockwood's ligament.

The globe is relatively tough and filled with incompressible vitreous humor, while the remaining orbital cavity is largely filled with fat.

Mechanism of Injury

Orbital Blow-Out Fracture

When an object slightly larger than the orbital rim strikes the eye, the incompressible globe transmits a sudden hydraulic force to the orbital contents.

This causes a rapid rise in intraorbital pressure that fractures the weakest part of the orbit—usually the orbital floor.

This is called an orbital blow-out fracture.

Blow-In Fracture

In some cases, especially in children, trauma to the inferior orbital rim causes inward buckling of the orbital floor rather than outward displacement.

This is called a blow-in fracture.

Because both injuries may occur, the term isolated orbital floor fracture is preferred.

Pathophysiology

In blow-out fractures:

- Fragments of the orbital floor are displaced downward into the maxillary sinus
- They often remain attached to the orbital periosteum like a trap-door

This allows:

- Herniation of periorbital fat
- Entrapment of inferior rectus muscle
- Entrapment of inferior oblique muscle

These muscles share the same fascial sheath, so tethering causes restriction of eye movement.

If a large amount of orbital fat herniates through the defect, enophthalmos develops.

Additional Effects

The same hydraulic pressure may also cause:

1. Fracture of the medial orbital wall
2. Herniation through the inferior orbital fissure

Both contribute to immediate or delayed enophthalmos.

Fibrous tissue formation during healing may worsen muscle tethering and produce long-term diplopia.

Interference with inferior rectus and inferior oblique muscles mainly causes:

- Restriction of upward gaze
- Restriction of outward rotation
- Diplopia in these directions

Clinical Features

Possible findings include:

1. Periorbital ecchymosis

Bruising around the eye is very common.

2. Subconjunctival hemorrhage

Bleeding beneath the conjunctiva.

3. Diplopia

Double vision, especially on upward gaze.

4. Limitation of eye movement

Most commonly upward movement.

5. Globe retraction on upward gaze

6. Enophthalmos

Posterior displacement of the eyeball.

7. Surgical emphysema of eyelids

Air enters soft tissues from the maxillary sinus.

8. Infraorbital nerve paresthesia

Numbness of upper lip, cheek, and side of nose.

Imaging

Classical Radiographic Sign

A large orbital floor defect may show the classical “hanging drop sign” on occipitomental view (OMV), representing herniation of orbital contents into the maxillary sinus.

However, this sign is not fully reliable because:

- Blood clot

- Mucus retention cyst

may produce a similar appearance.

Plain Radiographs

They are generally not required unless other facial fractures are suspected.

CT Scan

CT is the investigation of choice.

Advantages:

- Excellent bone visualization
- Better assessment than plain radiographs
- More available than MRI
- Helps in treatment planning

CT can also predict the likelihood of enophthalmos.

Important CT Findings

Loss of the posteromedial bulge of the orbital floor is strongly associated with development of enophthalmos.

The posterior extent of the defect also helps predict surgical difficulty.

Treatment

Timing of Surgery

A decision to operate usually does not need to be made immediately.

Waiting 7–10 days allows:

- edema to subside

- more accurate ophthalmic assessment

All patients should ideally be assessed preoperatively and postoperatively by an ophthalmologist experienced in facial trauma.

Primary intervention is preferred when surgery is clearly indicated because delayed secondary correction of diplopia and enophthalmos usually gives inferior results.

Indications for Surgical Intervention

1. Significant restriction of eye movement (diplopia)

with CT evidence of muscle entrapment

2. Significant enophthalmos

3. Large blow-out defect

4. Significant orbital dystopia

It is often suggested that a defect larger than 1 cm × 1 cm is likely to produce significant enophthalmos.

However, the site of the defect is often more important than its size.

Defects involving the posteromedial bulge are more serious than similarly sized anterior defects.

Aims of Surgical Treatment

The objectives are:

- Release entrapped orbital tissues
- Restore orbital volume
- Prevent or correct enophthalmos
- Restore ocular motility
- Eliminate diplopia
- Support orbital contents
- Restore facial symmetry

Materials Used for Reconstruction

Various materials may be used to reconstruct the orbital floor:

1. Autogenous Bone Grafts

Examples:

- Calvarial bone
- Iliac bone

Advantages:

- Biocompatible
- Good integration

2. Titanium Mesh

Advantages:

- Strong

- Stable

- Useful for large defects

3. Porous Polyethylene Implants

Advantages:

- Easy to shape

- Good tissue compatibility

4. Resorbable Implants

Useful in selected cases where permanent material is not preferred.

Choice of material depends on:

- Size of defect

- Site of defect

- Surgeon preference

- Associated injuries

Conclusion

Orbital floor fractures require careful diagnosis because delayed treatment may lead to permanent diplopia and enophthalmos.

CT scan remains the gold standard for diagnosis and surgical planning.

Successful treatment depends on proper timing, ophthalmic assessment, restoration of orbital anatomy, and early release of entrapped tissues when indicated.