The Egyptian Journal of Hospital Medicine (October 2025) Vol. 101, Page 5602-5609

Management of Orbital Floor Fractures: Review Article

Saeed Mohamad Elsheikh[1]**, Amr Magdy Mahmoud**[2]**,**
Dina Farouk El Naggar[1]**, Barakat Abdel Raheem Mahmoud**[1]
[1]Plastic surgery Department, Faculty of Medicine, Helwan University, Egypt
[2]Plastic surgery Department, Faculty of Medicine, Ain Shams University, Egypt
***Corresponding author:** Saeed Mohamad Elsheikh, **Email:** drsaeedelsheikh@gmail.com, **Mobile:** 01065493933

ABSTRACT

Background: Orbital fractures represent one of the most common patterns of facial fractures, particularly those involving the orbital floor and medial orbital wall. These fractures typically result from road traffic accidents, assaults, or falls and are frequently associated with zygomaticomaxillary complex injuries. Patients often present with periorbital edema, ecchymosis, infraorbital nerve hypoesthesia, diplopia, enophthalmos and limitation of ocular motility. Accurate diagnosis and timely decision-making are crucial for restoring proper orbital volume, globe position and functional ocular alignment. However, controversy persists regarding the indications for conservative versus surgical management and the optimal timing of intervention.

Objective: This article aimed to throw the light on establishing the fracture patterns, clinical assessment and treatment principles of orbital fracture and its appropriate management.

Methods: A systematic search was conducted using PubMed, Google Scholar, and Scopus, with keywords including Orbital fractures; Blow-out fracture, Zygomaticomaxillary complex. Diplopia, Enophthalmos, Infraorbital nerve and Ocular motility. The writers evaluated relevant literature references as well. Documents written in languages other than English have been ignored. Papers that were not regarded as significant scientific research included dissertations, oral presentations, conference abstracts and unpublished manuscripts were excluded.

Conclusion: Effective management of orbital floor fractures depends on accurate assessment and timely decision-making. Small, non-displaced fractures may be treated conservatively, while larger or symptomatic ones require surgical repair to restore function and appearance. A multidisciplinary approach ensures the best functional and aesthetic outcomes.

Keywords: Orbital fractures; Blow-out fracture; Zygomaticomaxillary complex; Diplopia; Enophthalmos; Infraorbital nerve; Ocular motility.

INTRODUCTION

Because of the orbit's important anatomical location and delicate bone makeup within the craniofacial skeleton, orbital fractures are among the most common injuries seen in maxillofacial trauma. The seven bones that make up the orbital cavity provide a stiff framework that shields the globe and permits coordinated eye movements. However, the orbital floor and medial wall are particularly susceptible to trauma due to their thinness, particularly in the areas that cover the maxillary and ethmoid sinuses. These delicate osseous structures may be disrupted by blunt force applied to the orbital rim or globe, resulting in different patterns of orbital wall fractures [(1)].

The direction and severity of the traumatic impact have a major influence on the cause and pattern of orbital fractures. The pathophysiology of blow-out fractures is explained by two generally accepted theories: The hydraulic theory, which holds that abrupt stress on the globe raises intraorbital pressure and disrupts bone and the buckling theory, which holds that force transmission along the orbital rim resulting in a fracture in the floor or medial wall. Periorbital edema, ecchymosis, infraorbital nerve hypoesthesia, diplopia from inferior rectus muscle entrapment, and enophthalmos from increased orbital volume are among the usual clinical presentations [(2)]. Delaying treatment can lead to ischemia and long-term motility impairment, so it's imperative to detect the presence of muscular entrapment.

Depending on the defect size, degree of displacement, orbital contents herniation and existence of functional impairment, several management approaches are used for orbital fractures. Larger defects and cases involving diplopia, muscle entrapment, or enophthalmos frequently require surgical reconstruction to restore orbital volume and function, whereas tiny, non-displaced fractures can be treated conservatively [(3)]. Although a variety of surgical techniques and implant materials, such as porous polyethylene and titanium mesh, are employed, there is still disagreement over the best time or method. Therefore, directing effective and customized care of orbital fractures requires knowledge of the anatomical basis, fracture classification, clinical evaluation, and evidence-based therapeutic techniques.

Incidence: Orbital floor fractures are frequent. It is believed that 30–40% of all facial fractures affect the orbit and 10% of all face fractures are isolated orbital wall fractures, the majority of which involve the orbital floor. The orbital floor is prone to fracture due to its anatomy [(4)].

Types of orbital fractures: Comparisons between studies are challenging due to the duplication and

Received: 11/06/2025
Accepted: 13/08/2025

potential confusion of fracture categorization methods. Numerous kinds of orbital fractures can result from trauma, depending on where the impact occurred on the facial skeleton. The zygomatico-orbital, naso-orbito-ethmoid and internal orbital (linear or pure blowout) fracture patterns are all well-described. Blowout fractures with little displacement of the bone fragment are referred to as trapdoor fractures. Complex or mixed orbital fractures are the result of various combinations of these fundamental patterns [5].

CLASSIFICATION OF ORBITAL FLOOR FRACTURES

Nolasco *et al.* [6] divided fractures of the medial orbital wall into four categories: **Type 1** is restricted to the medial orbital wall. **Type 2** reached the floor of the orbit. **Type 3** reached the malar region and orbital floor. **Type 4** is linked to intricate fractures of the midface.

Lauer *et al.* [7] divided orbital floor fractures into pure and impure fractures based on their anatomical location. An impure fracture involves the inferior orbital rim or is linked to zygomatico-maxillary complex fractures, whereas a pure fracture solely affects the orbital floor.

Jacquiery *et al.* [8] classified orbital walls defects into 5 categories:

I: A single, 1-2 cm^2 defect in zones 1 and 2 of the orbital floor or medial wall.

II: Within zones 1 and 2 (bony ledge preserved at the medial boundary of the infraorbital fissure), a defect of the orbital floor and/or medial wall that is greater than 2 cm^2.

III: A defect in zones 1 and 2 (missing bony ledge medial to the infraorbital fissure) of the orbital floor and/or medial wall, greater than 2 cm^2.

IV: A defect that extends into the posterior third (zone 3) and affects the entire orbital floor and medial wall (missing bony ledge medial to the infraorbital fissure).

V: Defect extending to the orbital roof, same as IV.

Beigi *et al*. [9] based on CT results, pure orbital floor fractures were categorized as follows:

1) Trap-door fracture: A linearly displaced orbital floor fracture that traps the orbital soft tissues and inferior rectus muscle.

2) A floor fracture without muscle entrapment that has incarcerated tissue

3) Fractures of the depressed floor fragment: These include the displacement of a bone fragment downward into the maxillary sinus.

Anehosur *et al.* [10] stated that orbital floor fractures can be divided into the following categories based on the anatomical location of the fracture line:

1) Fracture line on the medial side of the infraorbital foramen.

2) The infraorbital foramen's lateral side has a fracture line.

3) A fracture line that goes through the foramen infraorbital.

4) The infraorbital foramen has a fracture line on both sides.

SYMPTOMS AND SIGNS OF ORBITAL FLOOR FRACTURE

When orbital trauma first manifests, it is frequently accompanied by edema and a periorbital hemorrhage, which essentially prevents the eye from opening without manual assistance. Pure blow-out fractures leave the orbital rims and malar prominence intact, while other zygomatico-orbital fractures cause the zygomatic bone to dislocate, which frequently flattens the cheek contour to varied degrees. However, the swelling may cover up the flattening. Due to its proximity to the masseter and temporalis muscles as well as the coronoid process of the jaw, a dislocation of the zygoma may impact the ability to open the mouth and occlusion. The infra-orbital nerve passes via the infra-orbital foramen and enters the cheek after traveling over the orbital floor in the infra-orbital groove. As a result, this nerve is frequently impacted by orbital floor fractures, resulting in varied degrees of compromised sensitivity on the ipsilateral side of the face in the cheek, nose, lower eyelid, upper lip and gums and teeth [11].

An expansion of the bony orbit may cause the eye globe to shift, resulting in either hypophthalmos or enophthalmos. According to the Hertel exopthalmometer, a 0.8–1 ml increase in bony orbital volume is equivalent to 1 mm. Consequently, enophthalmos ($\geq$ 2 mm) will become clinically apparent with a 1.5–2 ml increase in the bony orbital volume. Hematoma and oedema can temporarily mask and compensate for ophthalmos. Similarly, exophthalmos can be caused by a decrease in orbital volume, an enlargement of soft tissues inside the orbit, or both. The so-called "retraction syndrome," which is an entrapment of the inferior rectus muscle that causes the superior rectus muscle to pull strongly inward on the eye bulb in response to the imprisoned antagonist, may be the cause of a "sunken eye" in the acute stage [12].

Since the two eyes are no longer aligned with the same visual axis, diplopia could be brought on by displacement of the eye globe. When the enophthalmos is $\geq$ 5 mm, diplopia may develop. In certain situations, ocular mobility might not be affected. Temporary paresis, in which the eye of the wounded orbit does not exhibit typical motility, can also result in diplopia. Pupil paralysis, weakening of the inferior and medial recti, and weakness of the inferior oblique muscles can all result from an orbital floor fracture that affects the inferior branch of the third cranial nerve (oculomotor nerve). Mechanical inhibition of an extraocular eye muscle's movement is another factor contributing to diplopia. Restrictions in vertical eye movement may result from swelling or entrapment of the inferior rectus muscle in orbital floor fractures [13].

One example is the "orbital floor trap door" fracture that happens to kids and teenagers. The characteristics of the juvenile, elastic skeletal bone define the fracture. The inferior rectus muscle and orbital soft tissue get firmly lodged in the fracture, causing ischemia. If treatment is delayed, fibrosis and permanent diplopia may result. Acute "orbital floor trap door" fracture symptoms and indicators can be deceptive and frequently confused with those of brain injury. The disease is also known as the "white-eyed" blow-out fracture, and the typical "black eye" may not be present. The patient has bradycardia, syncope (oculocardiac reflex), discomfort, nausea, and occasionally vomiting. If severe consequences, such persistent diplopia, are to be avoided in these situations, immediate surgery to remove the trapped tissue is necessary [14].

DIAGNOSTIC METHODS

When it comes to facial fractures, a comprehensive clinical assessment is crucial. Both an ophthalmologist and an oral and maxillofacial surgeon must be consulted if there is any suspicion that the trauma is related to vision, occlusion and/or mouth opening [15]. Making an informed decision regarding whether or not to operate requires the use of trustworthy diagnostic techniques that accurately depict the anatomy and functioning following a facial trauma. Nonetheless, the widely used phrase "orbital floor exploration" suggests that the surgical procedure is being performed for diagnostic reasons, which begs the question of whether standard pre-operative diagnostic techniques are enough [16]. There are high expectations placed on the accuracy of diagnostic techniques in order to distinguish between patients who require immediate surgical intervention and those who do not, particularly when it comes to assessing eye mobility in situations when diplopia is present [15].

I. Imaging

Radiographic evaluation of the orbital fractures includes a number of imaging modalities:

1. Plain radiograph: Plain radiographs show Caldwell's and Waters' viewpoints. Since the displacement of the fracture pieces in a blowout fracture varies, the radiographic findings on the waters' view cover a range of findings, leading to various relationships between the fractured orbital floor and intact orbital rim. These findings include a fracture fragment hanging from the sinus roof, known as a trap door, a total absence of the orbital floor and a greater space (more than 2 mm) between the perceptible orbital rim and floor than on the non-injured side [17].

In the maxillary sinus, avulsed fragments may or may not be visible. If the x-ray beam meets avulsed or displaced fracture fragments tangentially, the fragments may show accentuation of their outlines. This phenomenon is commonly referred to as the bright light sign. On the waterways' view, soft tissue abnormalities may also be observed in addition to osseous abnormalities. These include soft tissue herniation into the superior portion of the neighboring maxillary sinus and intraorbital air. Because it shows the exact fracture location, the Caldwell's view is significant [16].

2. Computed tomography: Imaging methods have advanced quickly and CT scans offer more precise information on the skeletal structures than standard X-ray pictures. It is possible to anticipate the probability of developing enophthalmos and compute the volume of the bony orbital volume. Since the fracture is frequently not sufficiently visible on simple film studies, CT is particularly crucial in the assessment of blowout fractures. Blowout fractures are not best shown by axial CT scans. A noticeable osseous fragment and/or soft tissue mass in the maxillary sinus is the most frequent observation on axial CT sections. Both the direct coronal projection and the direct oblique sagittal projection must be examined in order to perform an adequate CT evaluation. The direct coronal projection is the most effective way to show orbital damage, particularly the lateral and medial extent of floor fractures. It is not the greatest way to show the anterior and posterior boundaries of the fracture or the inferior rectus muscle displacement. On the other hand, the direct oblique sagittal projection clearly shows the condition of the inferior rectus muscle as well as the anterior and posterior extent of the fracture. Planning procedures like facial reconstructive surgery has benefited from the use of three-dimensional (3D) CT, which gives patients more information without exposing them to extra radiation. With accurate computations and reduced radiation exposure, cone beam computed tomography (CBCT) appears to be appropriate for computer-assisted planning in the treatment of orbital trauma [18].

3. Magnetic resonance Imaging (MRI): One benefit of MRI is its ability to accurately depict the condition of the soft tissues. This is crucial because it makes it possible to see the soft tissues that are trapped in orbital floor fractures. CT must be used in conjunction with MRI since it is not enough to evaluate the bone structures [19].

II. Tests of functionality

Vision and the ability to open the mouth are two vital abilities that are at danger in orbital floor fractures. Although it is prevalent, disturbed sensibility in the infra-orbital nerve's distribution area has historically been dismissed as a secondary issue. The next section describes the methods utilized to evaluate these functions [19].

1) Methods of assessing affected eye motility and diplopia: Determining whether or not soft tissue entrapment is the source of diplopia in conjunction with an orbital floor fracture is crucial. Because entrapment results in limited eye mobility, the doctor can only speculate as to whether entrapment is present because CT and MRI scans only produce motionless images. A functional test is the sole way to demonstrate eye motility. To determine whether diplopia is present and whether eye motility is impacted, several tests are available such as the forced generation test and the forced duction test (Figure 1). Nonetheless, ocular motility is frequently assessed by asking the patient to focus and track the movement of a penlight in the nine cardinal directions of gaze while the examiner watches the eyes [20].

The examiner uses forceps to grasp the conjunctiva near the attachment of the inferior rectus muscle and attempts to move the globe through a full range of motion. Because of potential significant discomfort. This should be performed under sedation or anesthesia [20].

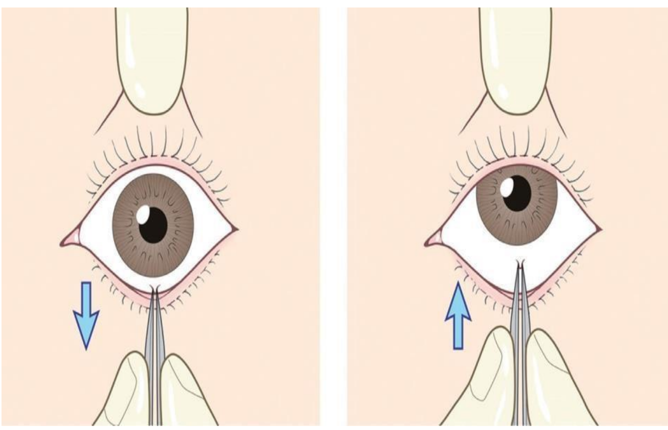

Figure (1): Forced duction test performed to evaluate extraocular muscle entrapment.

2) Sensibility: In clinical practice the sensibility in the distribution area of the infra-orbital nerve is normally tested bilaterally and the injured side is compared with the uninjured. Generally, cotton wool and a needle are used to test for blunt and sharp touch. Two-point discrimination tests by means of a specific device, as well as cold sensation may also be tested [21].

3) Ophthalmologic assessment: Include Hess charts (Lees screen), binocular field of vision, Hertel measurements, Electromyography, the prism and alternate cover test [21].

INDICATIONS AND TIMING OF SURGERY

The primary concern when evaluating a patient with a suspected blowout fracture is whether surgery is necessary. Numerous criteria determine when surgery is indicated. For this reason, a comprehensive evaluation is necessary. The majority of surgeons will concur that apparent enophthalmos, big deformities and indications of muscular entrapment are unequivocal evidence that surgery is necessary [22].

A more difficult and controversial question is when to operate. The problem arises from many factors:

Immediately following trauma, oedema may hide crucial indications and symptoms.

Diplopia could go away quickly once the damage has healed. If left untreated, more complex motility issues could develop. If left untreated, initially asymptomatic patients may develop late diplopia. If left untreated, initially asymptomatic patients may develop enophthalmos [22]. Indications of when to operate or simply observe have been examined in recent suggestions.

Early intervention

The so-called "white eyed" blow-out fracture is a sign of this. Children exhibit this entity. Children's bones are different because they are softer and more pliable. The bending and cracking give the defects the appearance of a trapdoor. After that, orbital tissue may become trapped and potentially experience ischemia and necrosis, which could cause permanent enophthalmos and diplopia [23].

Even though it is extremely uncommon, bradycardia, heart block, nausea, vomiting, and syncope are all signs of orbital soft tissue entrapment linked to the oculocardiac reflex [24]. Via the reticular pathway to the visceral motor pathway, the soft tissue entrapment from damaged trigeminal pathways (afferent limb) may cause an increase in vagal tone. Since these symptoms have the potential to be lethal, they should be addressed very away [23]. Treatment should be started right away if there is severe facial asymmetry brought on by major orbital floor fractures, such as globe herniation [25].

Observation with possible intervention

Many surgeons have embraced this more conservative strategy for situations that don't need to be treated right away. It gives time for the early hemorrhage and oedema to go away, improving the clinical assessment of the fracture. The majority of researches recommend using a 2-week observation frame. Additionally, keep in mind that orbital fibrosis develops shortly after damage and advances considerably over a few months. It may be the primary cause of late correction's typically inadequate symptom relief and will complicate surgical repair. This period of time is also appropriate for ruling out any diplopia brought on by motor nerve palsy, oedema or bleeding. The problem occurs when the patient has only mild enophthalmos vision during this time, yet visually incapacitating diplopia continues. Here, CT imaging could be useful in determining whether surgery is necessary [26].

The use of CT in the treatment of orbital fractures has grown significantly. Primarily as a preoperative evaluation, but also as a diagnostic tool. According to a lot of studies, CT axial assessments can be used to predict late enophthalmos, which will help determine when surgery is necessary. According to volumetric measurement, 0.89 mm of enophthalmos occurs with every 1 cm^3 increase in orbital capacity. According to current guidelines, if more than half of the orbital floor is depressed, surgery should be done within two weeks [27].

Late intervention: Anything done after the two-week window is referred to as late intervention. These patients include individuals who were given surgery but declined, or those who, in the early phases, showed quick remission of irritating diplopia but did not attain the desired overall outcomes. [27].

Objectives of surgery: Reducing fractures with fixation, relieving trapped muscles, containing any herniated orbital tissues and restoring the proper orbital volume are the primary goals of surgical treatment. In essence, the goal is to attempt to reconstruct the orbit's delicate architecture in order to restore both its functionality and appearance. [28].

Management protocol for orbital floor fractures:
There is a controversial in management of orbital floor fractures regarding timing and indications. **Beigi *et al.*** [9] set a proposed management protocol according to type of fracture as follow (Figure 2):

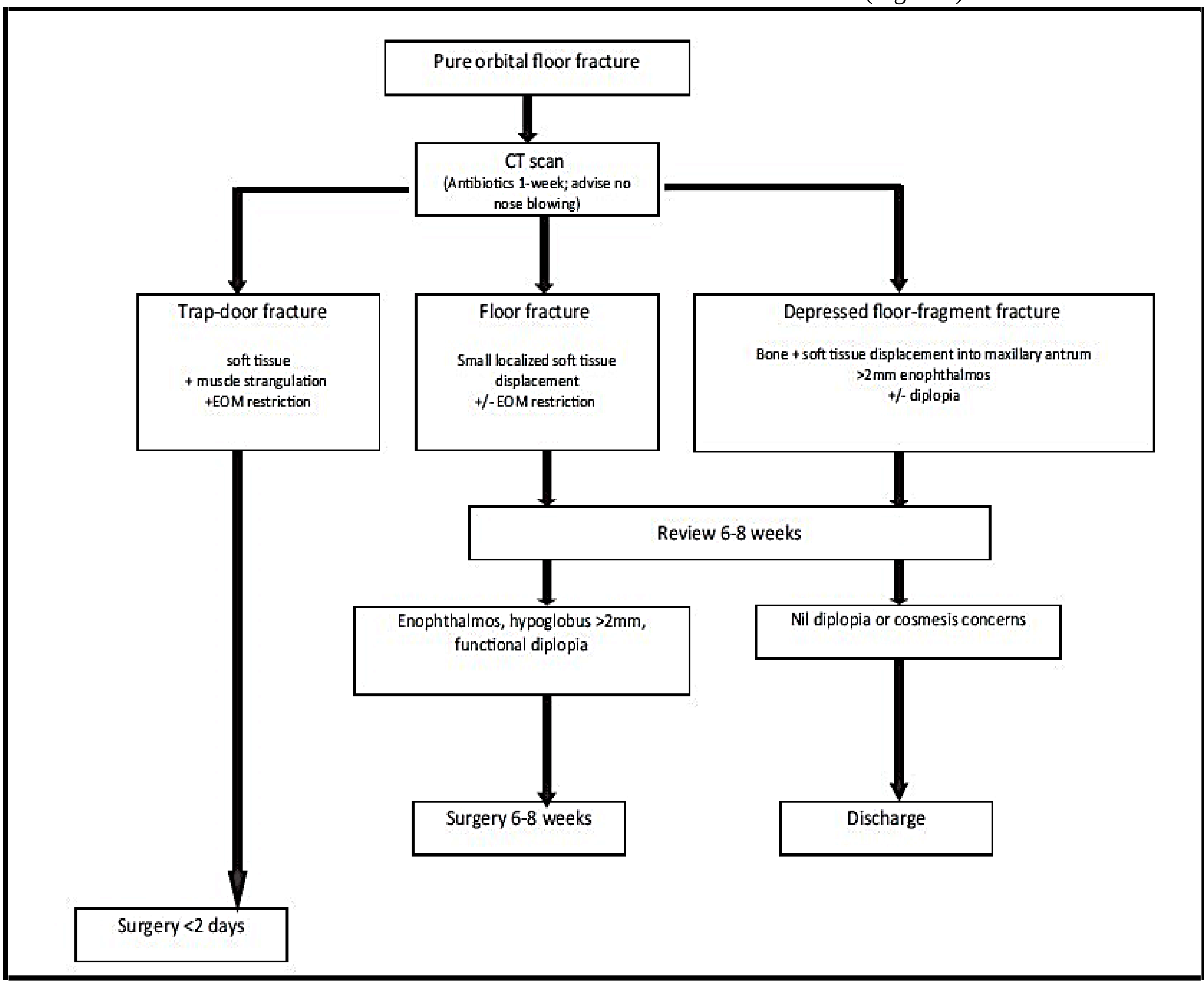

Figure (2): Proposed fracture management protocol. EOM: Extraocular muscle motility [9].

Surgical approaches to the orbital floor:

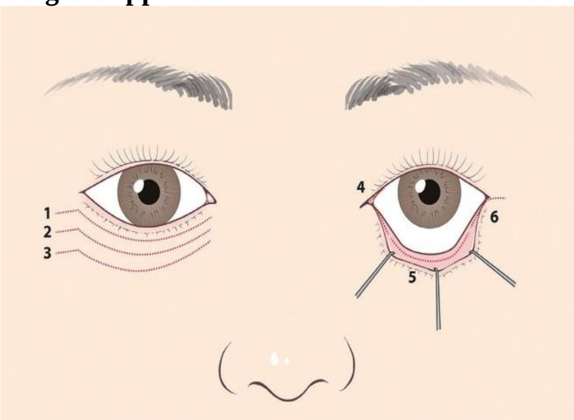

Figure (3): Types of accesses used to expose the orbital floor: (1) Subciliary, (2) Subtarsal, (3) Infraorbital, (4) Transcaruncular, (5) Tranconjuctival and (6) Transconjunctival with lateral canthotomy [29].

Orbital fractures that require surgical intervention pose challenging problems to the trauma surgeon. Many options have been described to gain access to the subperiosteal plane of the orbit [29]. In general, the options can be divided into the following categories:

The Transconjunctival approach (Also known as conjunctival or the inferior fornix approach):

I. History: In order to remove herniated fat pads during cosmetic blepharoplasty, Bourguet first reported the transconjunctival incision in 1924. Tenzel and Miller repaired and investigated orbital floor fractures using this incision almost fifty years later. In order to address maxillofacial trauma and abnormalities, Tessier popularized the transconjunctival incision as a method of accessing the orbital floor and maxilla. For better lateral exposure, Converse and associates modified the transconjunctival retroseptal incision by adding a lateral canthotomy. Many writers employed lateral canthotomy to improve orbital access and facilitate osteosynthesis plate installation. Others concur that a lateral canthotomy is not required in order to expose the orbital floor [17].

II. Different Routes: Retro-septal and pre-septal are the two approaches for the transconjunctival approach and they differ in how the course of dissection relates to the orbital septum. Although Tessier expanded on the transconjunctival pre-septal incision, Tenzel and Miller created the transconjunctival retro-septal incision. By cutting through the conjunctiva at a level halfway between the fornix and the inferior margin of the tarsal plate, the retro-septal approach is used. The preseptal technique creates the dissection plane between the orbital septum and the orbicularis muscle by making an incision through the conjunctiva beneath the tarsus [30].

The maintenance of septal integrity, which prevents inferior palpebral retraction is the basis for the retroseptal approach's benefit over the preseptal procedure. Due to the direct access to the orbital floor, many authors employ the retroseptal technique in blepharoplasty procedures and in the repair of orbital fractures. However, with fracture relocation, the benefit of direct orbital fat exposure in a lower-lid blepharoplasty is a drawback. Furthermore, the disruption of the intraorbital connective tissue framework, which may affect eye movements and contribute to the development of an enophthalmos, is the primary drawback of the retroseptal approach [31].

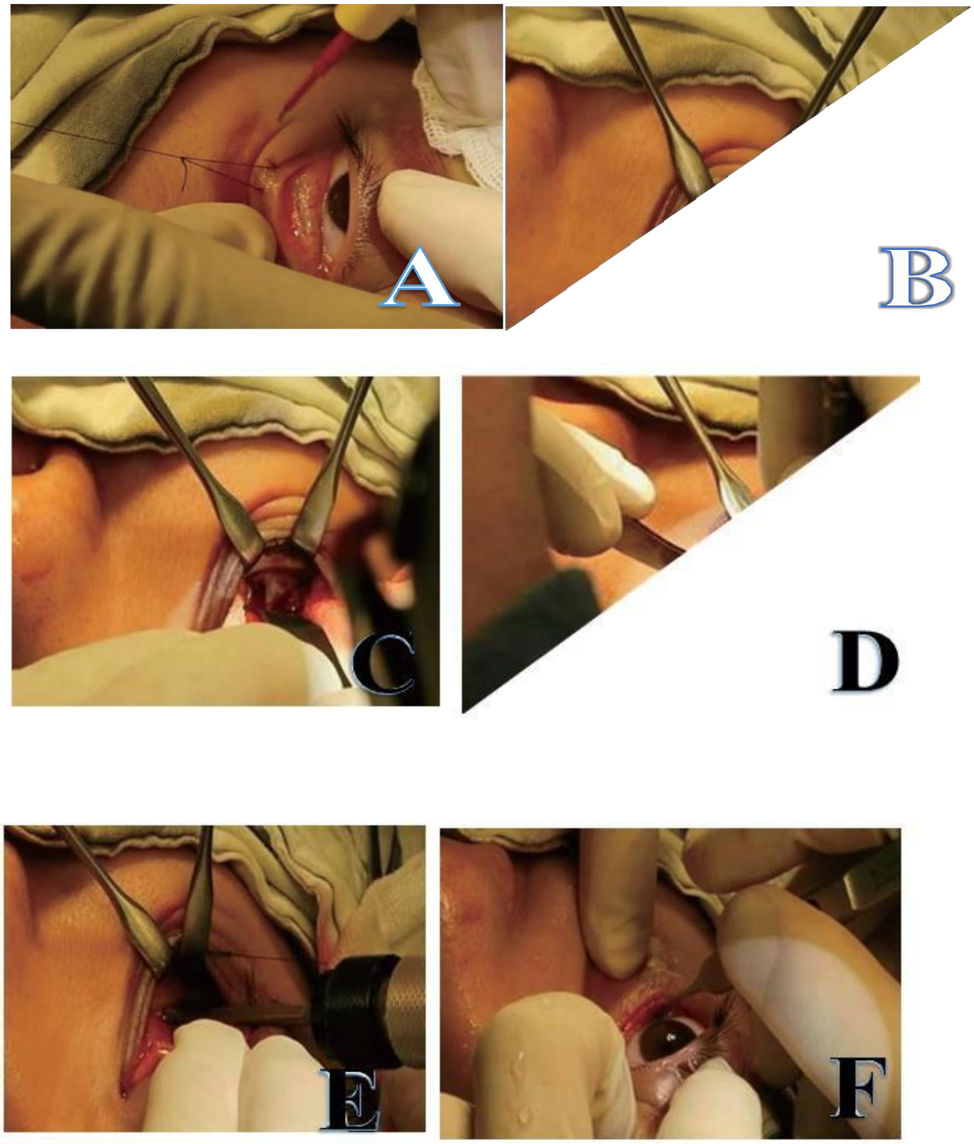

Figure (4): The author's favored method for accessing the orbital floor is transconjunctival. (A) Transconjunctival incision 1 mm below the tarsal plate's inferior edge. (B) Subperiosteal dissection is performed posteriorly following pre-septal dissection and arcus marginalis release. (C) To release an impinged or herniated tissue, the fracture borders are identified using a periosteal elevator and a tiny bendable retractor. In order to prevent intraoperative bleeding, gentle manipulation is necessary. (D) Determining the posterior shelf. To expose the posterior shelf, the elevator is positioned in the maxillary sinus and swept upward. (E) Typically, an implant is fastened with a single screw. (F) Following implant insertion, the forced duction test is conducted once more [(31)].

III. Advantages & disadvantages: Because the scar is concealed in the conjunctiva, the transconjunctival approach has the primary benefit over other methods in terms of producing outstanding esthetic results. Only the lateral extension, which heals with a subtle scar, is evident if a canthotomy is done in addition to the approach. Additionally, this method is quick and doesn't need dissecting muscles or skin [(32)].

When not utilized in conjunction with a lateral canthotomy, the transconjunctival approach's primary drawback is the restricted access to the orbital floor and infraorbital rim [(33)].

The Subciliary Approach (Also Known as Infraciliary Approach or Blepharoplasty)

Converse established the subciliary incision as a treatment for orbital floor fractures in 1944. Traditionally, it was defined as a linear cutaneous incision that was softly curved and positioned in a skin crease about 2 mm below (and parallel to) the lower eyelid's gray line. The surgeon has three choices after the skin is cut [(34)]:

I. Skin only flap: Initially, the skin and muscle are separated until the orbital rim is reached. After that, the bone is cut through the muscle and periosteum.

II. Skin muscle flap (non-stepped): The alternative is to cut through muscle at the same level as the skin incision and then dissect from the orbital rim to just in front of the orbital septum.

III. Skin muscle flap (stepped): A mixture of these is the third option, where a few millimeters of subcutaneous dissection is made toward the rim, followed by a step-incision made through the muscle at a lower level and a follow-up to the rim along the orbital septum [35].

Conflicts of interest: None.
Competing interests: None.

REFERENCES

1. **Allareddy V, Lee K, Nalliah P (2011):** Epidemiology of facial fractures. J Oral Maxillofac Surg., 69 (9): 2613–2618.
2. **Mika R, Kowalczuk M, Korchynska S (2011):** Clinical features of orbital floor fractures. Med Sci Monit., 17 (4): CR209–CR214.
3. **Singh N, Patel A, Lee J (2022):** Current decision algorithms in orbital floor fracture management. Plast Reconstr Surg., 150 (4): 789–799.
4. **Committeri U, Arena A, Carraturo E *et al.* (2023):** Incidence of orbital side effects in zygomaticomaxillary complex and isolated orbital walls fractures. J Clin Med., 12 (3): 845.
5. **Fernandez de Grado G, Keller L, Idoux-Gillet Y *et al.* (2018):** Bone substitutes: characteristics and clinical use. J Tissue Eng., 9: 2041731418776819.
6. **Nolasco P, Mathog H (1995):** Medial orbital wall fractures: classification and clinical profile. Otolaryngol Head Neck Surg., 112: 549–556.
7. **Lauer A, Snyder B, Rodriguez E (1996):** Classification of orbital floor fractures. J Craniomaxillofac Trauma, 2 (4): 6–11.
8. **Jacquiery C, Kunz C, Hammer B (2007):** The orbital floor and medial wall: anatomical study and classification. J Craniomaxillofac Surg., 35 (2): 82–93.
9. **Beigi B, Khandwala M, Gupta D (2014):** Management of pure orbital floor fractures. Orbit, 33 (5): 336–342.
10. **Anehosur V, Nathani J, Nagraj N (2020):** Criteria for selective exploration of orbital floor. Craniomaxillofac Trauma Reconstr., 13 (3): 180–185.
11. **Nakajima Y, Iwasawa M, Mishima Y *et al.* (2020):** Compensatory overaction and postoperative diplopia. J Craniofac Surg., 31 (7): e730–e732.
12. **Osaki T, Murakami H, Tamura R *et al.* (2020):** Orbital morphology and eyelid relationship. J Craniofac Surg., 31 (7): 1875–1878.
13. **Rossin J, Szypko C, Giese I *et al.* (2021):** Risk of ocular injury in orbital fractures. JAMA Ophthalmol., 139 (1): 77–83.
14. **Sergi M (2020):** Head and Neck. In: Pathology of Childhood and Adolescence, Pp: 1167–1241. Springer.
15. **Düzgün S, Sirkeci K (2020):** Comparison of graft materials in blow-out fractures. Ulus Travma Acil Cerrahi Derg., 26 (4): 538–544.
16. **Archer-Arroyo K, Mirvis E (2020):** Radiological evaluation of craniofacial skeleton. In: Facial Trauma Surgery, Pp: 16–31. Elsevier.
17. **Harold Lee B, Grecco G, Moorthy M (2019):** Midfacial fractures. In: Oculofacial, Orbital, and Lacrimal Surgery, Pp: 635–647. Springer.
18. **Hudecki A, Wolany W, Likus W *et al.* (2021):** Orbital reconstruction materials & challenges. Eur J Pharmacol., 892: 173766.
19. **Kyllonen M, Monson L (2020):** Ethnic facial aging by forensic artists. Forensic Sci Int., 313: 110353.
20. **Sultanova N, Alieva S (2020):** Orbital proportion indices & microlipografting. Kazan Med J., 101 (1): 139–144.
21. **Tandon R, Aljadeff L, Ji S *et al.* (2020):** Anatomic variability of the human orbit. J Oral Maxillofac Surg., 78 (5): 782–796.
22. **Vaanmugil J, Jimson S, Bhanumurthy L *et al.* (2021):** Conchal cartilage in orbital floor reconstruction. Cureus, 13 (2): e13047.
23. **Roselló G, Granado Q, Garcia A *et al.* (2020):** Facial fractures: highlights for reporting. Insights Imaging, 11 (1): 1–15.
24. **Sahoo A, Lenka P, Rathor K *et al.* (2019):** Endoscopic approach to maxillofacial trauma. Indian J Public Health Res Dev., 10 (11): 1–6.
25. **Lofrese G, Mongardi L, De Bonis P *et al.* (2020):** Spontaneous repositioning of orbital roof fracture. J Craniofac Surg., 31 (3): e263–e266.
26. **Luibil N, Lopez J, Patel C (2021):** Anatomy, head and neck, orbit. **In:** StatPearls. StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK539843/
27. **Oliver D, Saba S, Gupta N *et al.* (2020):** Alloplastic reconstruction of orbital floor fractures. Eur J Plast Surg., 43 (2): 109–116.
28. **Bevans E, Moe S (2017):** Advances in orbital fracture reconstruction. Facial Plast Surg Clin North Am., 25 (4): 513–535.
29. **Cornelius P, Stiebler T, Mayer P *et al.* (2021):** Prediction of surface area in orbital fractures. J Craniomaxillofac Surg., 49 (7): 598–612.
30. **Bastos M, Taparello C, Tres R *et al.* (2021):** Orbital blowout fracture with globe displacement. J Oral Maxillofac Surg., 79 (1): 204.e1.
31. **Chai G, Zhang D, Hua W *et al.* (2021):** Pediatric trapdoor fractures & 3D printing. Bioact Mater., 6 (2): 559–567.
32. **Insalaco F, Karp E, Zavala H *et al.* (2020):** Rib grafting in cleft rhinoplasty. Int J Pediatr Otorhinolaryngol., 138: 110264.
33. **Karaji G, Jahanmard F, Mirzaei H *et al.* (2020):** Silk coating for infection prevention & bone regeneration. Biomed Mater., 15 (6): 065016.
34. **Schlittler F, Vig N, Burkhard P *et al.* (2020):** Limitations of non-patient-specific titanium implants. Br J Oral Maxillofac Surg., 58 (9): e80–e85.
35. **Murdzheva M, Kostianev S, Sarafian-Ozanian S *et al.* (2020):** Jubilee scientific conference. Folia Medica, 62 (3): 1–162.