International Journal of Multiphysics
Volume 18, No. 3, 2024
ISSN: 1750-9548

Setting A Classification and Management Protocol for Orbital Floor Fractures

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,

Abstract:

Background: Orbital floor fractures are among the most common maxillofacial injuries, frequently associated with zygomaticomaxillary fractures or occurring as isolated blow-out fractures. Clinical presentations vary from infraorbital hypoesthesia to enophthalmos, ocular motility restriction and diplopia. Management remains controversial regarding the optimal timing and surgical indications. Therefore, establishing a standardized classification and management algorithm is essential for improving outcomes.

Methods: This prospective study included patients with orbital floor fractures presenting to the Plastic Surgery Department. All patients were clinically evaluated for ocular motility, infraorbital nerve sensation, diplopia, and globe position. CT imaging was used to assess fracture type, displacement, size of defect, and herniation of orbital contents. Patients were classified based on fracture pattern, displacement, and defect size. Management ranged from conservative treatment to surgical reconstruction using cartilage grafts or titanium mesh according to the proposed protocol.

Results: Orbital floor fractures were most commonly associated with zygomaticomaxillary complex injuries. The clinical findings were diplopia, infraorbital hypoesthesia and enophthalmos. Displaced comminuted fractures and those with medium to large defects showed strong correlation with functional impairment. Surgical reconstruction demonstrated significant postoperative improvement in ocular motility, improvement of diplopia, and correction of enophthalmos. Conservative management was effective in minimally displaced fractures with small defect sizes.

Conclusion: The proposed classification and management protocol provides a systematic approach that helps identify patients who would benefit from surgical intervention and those suitable for conservative treatment. Applying this structured decision-making model enhances both functional and aesthetic outcomes while minimizing unnecessary surgical intervention.

Keywords: Orbital floor fractures; Infraorbital nerve; Surgical reconstruction; Titanium mesh.

Introduction:

The orbits are at the center of craniofacial region where eyes lie and protected with bony orbital walls that are formed by sharing of seven bones; zygoma, maxilla, frontal, ethmoidal, sphenoidal, lacrimal and palatine bones **(1).** Orbital fractures are one of the most common facial fractures, especially orbital floor and medial orbital wall fractures **(2).**

Road traffic accidents, assaults and falls are the most common causes of facial fractures **(3).** Orbital floor fractures usually occur in combination with zygomaticomaxillary complex fractures, and sometimes are pure orbital floor fractures **(4).** Usually, patients with orbital floor fractures complain of some or all of the following symptoms; periorbital edema, ecchymosis, hypoesthesia of infraorbital area, diplopia, enophthalmos, subconjunctival hemorrhage and limitation in ocular motility after trauma **(5, 6).**

The priority in the treatment is to restore the original volume and contour of the orbit to obtain normal function and aesthetics **(7).** There is a controversy in management protocols for orbital floor fractures regarding conservative or surgical management **(8).**

Methods:

This is analytical cross-sectional study that was held at Helwan and Ain shams university hospitals over a-24-months period.

Ethical approval was obtained from the ethical committee of the faculty of medicine at Helwan University. Informed consent was obtained from the study participants, addressing risks, benefits, compensations and withdrawal rights. Administrative approval was obtained from the conduction site.

Study population:

50 patients with orbital floor fractures were included in the study, either isolated or combined with zygomatico-maxillary complex fractures.

Inclusion criteria:

- Adult patients with orbital floor fractures (16-60 years).
- Both sexes.
- Unilateral or bilateral cases.

Exclusion criteria:

- Patients less than 16 or above 60 years.
- Patients unfit for surgery.
- Previous orbital fractures.
- Patients with ocular problems.
- Patients with skeletal deformities.
- Patients with congenital facial anomalies.
- Patients refused to included.

This study was conducted on patients presenting with orbital floor fractures to the Plastic, Reconstructive Surgery and Burns Department. All patients were clinically evaluated for ocular motility, diplopia, infraorbital nerve sensation, enophthalmos, and periorbital edema or ecchymosis following trauma.

Computed tomography (CT) scans were performed for all patients to assess the anatomical location of the fracture, pattern of displacement, defect size, and the presence of herniation of orbital tissues into the maxillary sinus. According to clinical and radiological findings, fractures were classified based on their site in relation to the infraorbital foramen, degree of displacement, presence of comminution, and defect size.

Management was determined according to the proposed classification protocol. Patients with non-displaced fractures and small defect size were treated conservatively. Conservative management included observation, anti-inflammatory medications, cold compresses, nasal decongestants, and avoidance of nose blowing. Patients with diplopia associated with limitation of ocular movement, significant enophthalmos, displaced fractures, or large-sized defects underwent surgical intervention.

Surgical management included reduction of herniated orbital contents and reconstruction of the orbital floor using either conchal cartilage grafts or titanium mesh, depending on the size and configuration of the defect. The approach to the orbital floor was performed according to each case requirement, and forced duction testing was repeated intraoperatively to ensure complete release of any muscle entrapment.

Postoperative follow-up was conducted at one week, three weeks, and three months to evaluate recovery of ocular motility, improvement of diplopia, infraorbital nerve sensation, and correction of enophthalmos.

Statistical analysis: was performed to correlate fracture pattern, displacement, and defect size with clinical presentation and outcomes.

Result:

Thirty four patients (68%) were due to Road Traffic Accident, twelve patients (24%) due to assaults and four patients (8%) due to fall from height. The right side was fractured in 28 patients (56%) while in 22 patients (44%) the fractures were on the left side (Table 1).

Table (1): Cause of trauma and side of fracture.

Cause			Side	
RTA	Assault	Fall	Right	Left
34	12	4	28	22

Isolated orbital floor fractures (blowout fractures) were found in 14 patients (28%) while in 36 patients (72%) floor fractures were associated with other facial fractures (table 2).

Table (2): Distribution of fracture among study group

Fracture	Number	%
Isolated orbital floor fracture	14	28%
Floor fracture associated with other facial fractures	36	72%

Symptoms and signs included infraorbital paresthesia (32 patients, 64%), limited ocular motility (27 patients, 54%), enophthalmos (20 patients, 40%) and diplopia (10 patients, 20%) (table 3).

There were symptoms and signs of associated fractures of periorbital bone as depressed malar eminence, limited mouth opening and malocclusion.

Table (3): Incidence of symptoms and signs in the study group.

Symptoms and signs	Number	%
Infraorbital paresthesia	32	64%
Enophthalmos	20	40%
Diplopia	10	20%
Limited ocular motility	27	54%

Orbital floor fractures were divided according to Anehosur et al 2020, by using the infra orbital foramen (IOF) as an anatomical landmark, into 3 categories: medial, above and lateral to IOF. There were thirty one fractures above IOF (62%), eleven fractures medial to IOF (22%) and eight fractures (16%) lateral to IOF (table 4).

Table (4): Anatomical distribution of orbital floor fractures in relation to IOF.

Site	Number	%
Above	31	62%
Medial	11	22%
Lateral	8	16%
Total	50	100%

In 12 patients (24%) the fractures were linear and were segmented or comminuted in 38 patients (76%) (table 5).

Table (5): Pattern of fractures among study group.

Fracture	Number	%
Linear	12	24%
Segmented/comminuted	38	76%

Displacement of orbital floor fractures presented in 37 patients (74%), while non-displaced fractures presented in 13 patients (26%) (table 6).

Table (6): Displacement of fractures among study group

Fracture	Number	%
Displaced	37	74%
Non displaced	13	26%

Orbital floor fracture resulted in different defect sizes. No defect occurred in 8 patients (16%), small sized defect (less than 0.5 cm) occurred in 15 patients (30%), medium sized defect (0.5-1 cm) occurred in 10 patients (20%) and large sized defect (more than 1 cm) occurred in 17 patients (34%) (table 7).

Table (7): Defect size of fractures among study group

Defect size	Number	%
No defect	8	16%
Small sized (less than 0.5 cm)	15	30%
Medium sized (0.5-1cm)	10	20%
Large sized (more than 1 cm)	17	34%
Total	50	100%

The etiology of trauma can give expectation about severity and fracture displacement. In our study, there were 34 patients caused by RTA, from which 25 patients had displaced fractures and only 9 had non displaced fractures.

Eight fractures out of twelve caused by assaults were displaced, while only four fractures were none displaced. All four patients caused by fall from height, in our study group, had displaced fractures (table 8).

Table (8): Relation between cause of trauma and fracture displacement.

Cause	Displaced	Non displaced	Total
RTA	25	9	34
Assault	8	4	12
FFH	4	0	4
Total	37	13	50

There was no significant relation between cause of trauma and defect size in our study group. All fractures caused by assaults and fall from height had defects of variable size (table 9).

Table (9): Relation between cause of trauma and defect size.

Cause	No defect	Small sized	Medium sized	Large sized	Total
RTA	8	10	5	11	34
Assault	0	4	3	5	12
FFH	0	1	2	1	4
Total	8	15	10	17	50

Twenty three patients with infraorbital paresthesia had their fractures above IOF, three were medial to IOF and six were lateral to IOF. Thirteen patients with enophthalmos had their fractures above IOF, four were medial to IOF and three were lateral to IOF. Seven patients with diplopia had their fractures above IOF, three were medial to IOF and no diplopia occurred in fractures lateral to IOF. Eighteen patients with limited ocular motility had their fractures above IOF, seven were medial to IOF and two were lateral to IOF (table 10).

Table (10): Relation between symptoms and signs and site .

Symptoms and signs	Above IOF	Medial IOF	Lateral IOF	Total
Infraorbital paresthesia	23	3	6	32
Enophthalmos	13	4	3	20
Diplopia	7	3	0	10
Limited ocular motility	18	7	2	27

Symptoms and signs occurred more frequent when comminution of fractures increased. Twenty three patients with infraorbital paresthesia had comminuted fractures while nine hadn't. Seventeen patients with enophthalmos had comminuted fractures while three patients hadn't. Eight patients out of ten with diplopia had comminuted fractures. Only two patients out of twenty seven patients with limited ocular motility had non comminuted fractures (table 11).

Table (11): Relation between comminuted fractures and associated symptoms and signs.

Symptoms and signs	Comminuted	Non comminuted	Total

Infraorbital paresthesia	23	9	32
Enophthalmos	17	3	20
Diplopia	8	2	10
Limited ocular motility	25	2	27

All patients with enophthalmos, diplopia and limited ocular motility had displaced fractures. Only four out of thirty two patients with infraorbital paresthesia had non displaced fractures (table 12).

Table (12): Relation of fracture displacement and associated symptoms and signs.

Symptoms and signs	Displaced	Non displaced	Total
Infraorbital paresthesia	28	4	32
Enophthalmos	20	0	20
Diplopia	10	0	10
Limited ocular motility	27	0	27

Incidence and severity of symptoms and signs increased with the increase in defect size. Half patients (50%) with paresthesia (16 out of 32) had large sized defects. 85% of patients with enophthalmos (17 out of 20) had medium and large sized defects. 80% of patients with diplopia (8 out of 10) had medium and large sized defects. About 92% of patients with limited ocular motility (25 out of 27) had medium and large sized defects. Fourteen cases hadn't significant associated symptoms and signs and more than 92% of them (13 out of 14) had no or small sized defect (Table 13).

Table (13): Relation between symptoms and signs and size of defect.

Symptoms and signs	No defect	Small sized defect	Medium sized defect	Large sized defect	Total
Infraorbital paresthesia	3	7	6	16	32
Enophthalmos	0	3	4	13	20
Diplopia	0	2	3	5	10
Limited ocular motility	0	2	8	17	27
No above symptoms and signs	5	8	1	0	14

Twenty nine displaced fractures were comminuted while eight were not comminuted. Nine non displaced fractures were comminuted while four were not comminuted (table 14).

Table (14): Incidence of displacement among comminuted fractures.

Fracture	Comminuted	Non comminuted	Total
Displaced	29	8	37
Non displaced	9	4	13

Total	38	12	50

Incidence of fracture displacement differed according to site of fracture in relation to inferior orbital foramen (IOF). About 67% (21 out of 31) of fractures above IOF were displaced, about 90% (10 out of 11) of fractures medial to IOF were displaced and 75% (6 out of 8) of fractures lateral to IOF were displaced (table 15).

Table (15): Incidence of fracture displacement in relation to site to IOF.

Fracture	Above	Medial	Lateral	Total
Displaced	21	10	6	37
Non displaced	10	1	2	13
Total	31	11	8	50

All medium and large sized defects had displaced fractures. 75% of fractures with no defect (6 out of 8) were non displaced fractures. Eight fractures with small sized defects were displaced fractures and seven were non displaced fractures (table 16).

Table (16): Relation between defect size and fracture displacement.

Defect size	Displaced	Non displaced	Total
No defect	2	6	8
Small sized defect	8	7	15
Medium sized defect	10	0	10
Large sized defect	17	0	17
Total	37	13	50

Fractures medial to inferior orbital foramen (IOF) had increased incidence (about 72%) to be medium and large sized defects in our study group (8 out of 11 fractures). Fractures that occurred above and lateral to inferior orbital foramen had no significant incidence with defect size (table 17).

Table (17): Relation between defect size and site in relation to IOF.

Defect size	Above IOF	Medial to IOF	Lateral to IOF	Total
No defect	4	1	3	8
Small sized defect	11	2	2	15
Medium sized defect	4	4	2	10
Large sized defect	12	4	1	17
Total	31	11	8	50

Frequent associated periorbital and facial fractures are inferior orbital rim fractures (IOR) (36 patients, 72%), zygomatico-maxillary buttress fractures (ZMB) (21 patients, 42%), lateral orbital rim fractures (LOR) (15 patients, 30%), naso-maxillary buttress fractures (NMB) (12 patients, 24%), zygomatic arch fractures (7 patients, 14%) and superior orbital rim fractures (SOR) (4 patients, 8%) (table 18).

Table (18): Incidence of associated periorbital and facial fractures among study group.

Fracture	Number	%
Inferior orbital rim	36	72%
Zygomatico-maxillary buttress	21	42%
Lateral orbital rim	15	30%
Naso-maxillary buttress	12	24%
Zygomatic arch	7	14%
Superior orbital rim	4	8%

We analyze all previous data including; fracture pattern, defect size, fracture displacement, associated facial fractures and associated symptoms and signs.

According to fractures analysis, orbital floor fractures were divided in two main types: type "I" (non-displaced fractures) and type "II" (displaced fractures).

Type "II" was further classified according to fracture characteristics into four subtypes" A, B, C and D" where "A" for linear fractures and "B" for comminuted fractures with small sized defect (<0.5cm) and "C" for comminuted fractures with medium sized defect (0.5-1 cm) and "D" for comminuted fractures with large sized defect (>1cm).

A "+" sign was added for any subtype with muscle entrapment or herniation of orbital contents in the maxillary sinus (Figure 1).

Proposed classification for orbital floor fractures

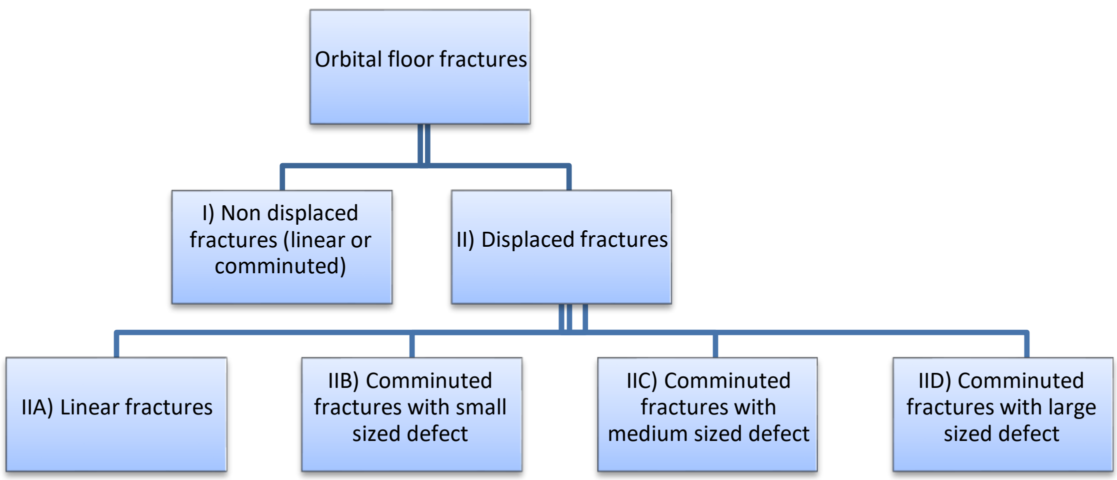

Figure (11): Proposed classification for orbital floor fractures

I- Non-displaced fractures.

II- Displaced fractures:
a) Linear fractures.
b) Comminuted fractures with small sized defect.
c) Comminuted fractures with medium sized defect.
d) Comminuted fractures with large sized defect.
A "+" sign was added for any subtype with muscle entrapment or herniation of orbital contents in the maxillary sinus.

Orbital floor fractures were managed according to associated symptoms, signs, fracture displacement, defect size, herniation of orbital content into maxillary sinus and muscle entrapment. Nineteen cases had conservative management (38%). Five cases underwent only open reduction without orbital floor reconstruction (10%). Two cases had conchal cartilage graft to reconstruct orbital floor (4%). Twenty four cases reconstructed with titanium mesh (48%) (table 19).

Table (19): Orbital floor management for study group

Floor management		Number	%
Conservative		19	38%
Open reduction without floor reconstruction		5	10%
Floor reconstruction	**Conchal cartilage graft**	2	4%
	Titanium mesh	24	48%

Associated facial bones fractures were managed according to fracture pattern and displacement either conservative or fixed with plates and screws (table 20).

Table (20): List of conservative and operative management for periorbital and facial bones fractures.

Fracture	No of conservative fractures	No of operative fractures	Total
Inferior orbital rim	14	22	36
Zygomatico-maxillary buttress	2	19	21
Lateral orbital rim	4	11	15
Naso-maxillary buttress	1	11	12
Zygomatic arch	2	5	7
Superior orbital rim	0	4	4

At the end of the study period, follow up of the patients showed improvement of symptoms and signs in 90% of the patients both clinically and radiologically. There were four cases of enophthalmos not fully corrected and one case with limited ocular motility not fully improved.

Enophthalmos and limited ocular motility improved within 6 weeks, while some patients with diplopia and infraorbital paresthesia improvement was delayed to 6 months (Table 21).

Table (21): Postoperative improvement of limited ocular motility, infraorbital paresthesia and diplopia

Symptoms and signs	1 week	2 weeks	6 weeks	6 weeks to 6 months	No improvement
Limited ocular motility	16	8	2	0	1

infraorbital paresthesia	5	5	17	5	0
Diplopia	4	4	1	1	0

Table (22): Postoperative improvement of enophthalmos.

Symptoms and signs	Nearly fully corrected	Partially corrected	Aesthetic satisfaction of patients
Enophthalmos	16	4	20

By retrograde analysis of orbital floor fracture management among study group, a management protocol was proposed for each type of the developed orbital floor fracture classification (table 23).

Type I was thirteen patients and had conservative management. Type IIA was five patients and three of them had conservative management and two patients had operative management. Type IIA+ was two patients and had operative management. Type IIB was three patients and one of them had conservative management while two had operative management. There were no patients in types IIB+ and IID. Type IIC was four patients and two of them had conservative management and two had operative management. Type IIC+ was six patients and had operative management. Type IID+ was seventeen patients and had operative management. There were five cases had only paresthesia and followed and improved within 6 weeks (table 23).

Table (23): Types of fractures with their management.

Type	No	%	Management
I	13	26%	Conservative
II A	5	10%	3 Conservative and 2 operative
II A+	2	4%	Operative
II B	3	6%	1 Conservative and 2 operative
II B+	0	0	--------------
II C	4	8%	2 Conservative and 2 operative
II C+	6	12%	Operative
II D	0	0	--------------
II D+	17	34%	Operative

Management of orbital floor fractures depending on the following factors:

1) Fracture displacement.

2) Muscle entrapment and herniation of orbital content into maxillary sinus.

3) Presence of associated symptoms and signs (Paresthesia, limited ocular motility, diplopia and enophthalmos).

4) Defect size (Diagram).

Discussion:

Orbital floor fractures commonly result from mid-face trauma caused by assaults, road accidents, sports injuries, or falls. These fractures may occur due to hydraulic forces that displace the globe and result in a decompressing fracture into an adjacent sinus, known as the hydraulic theory. Alternatively, the buckling theory suggests that fractures can occur from a direct force on the orbital rim, causing the orbital wall to buckle, or through a combination of these mechanisms **(9)**.

The study aimed to set a proposal for classification of orbital floor fractures.

Since various surgical approaches for management of orbital floor fractures represents conflict and may associated with complications, presenting a review of management of pure orbital floor fractures and proposing a protocol was highlighted as a main point of interest **(10)**.

Consequently, this study was conducted and aimed to setting a classification and management protocol for orbital floor fractures.

This analytical cross-sectional study was conducted at tertiary care hospital at Helwan and Ain shams university hospitals over a-24-months period from October 2022 till October 2024 and performed on a total of 50 patients with orbital floor fractures.

The study results provide detailed insights into the characteristics, types, symptoms, and management protocols for orbital floor fractures, based on a 24-month investigation across

50 patients aged 16 to 60 years, with a focus on developing a classification and management approach for these fractures.

Nolasco FP and Mathog RH (11) classified medial orbital wall fractures into four types; type one is confined to medial wall, type 2 extended to floor, type 3 extended to malar region and type 4 associated with complex mid face fractures. This differs from the study in including medial wall fractures with floor fractures and based on CT findings alone.

Lauer et al. (12) classified orbital floor fractures according to anatomical location into pure and impure fractures.

Pure fractures involve orbital floor only, while impure fractures involve inferior orbital rim or associated with zygomatico-maxillary complex fractures.

Jacquiery C et al. (13) classified orbital floor and medial wall fractures into five categories depending on its size, affection of bony ledge at the medial margin of the infraorbital fissure, extended fracture to posterior floor and associated roof fracture.

Beigi et al. (10) classified pure orbital floor fractures based on computed tomography findings into trap-door fractures in which a linear displaced fracture entrapping inferior rectus muscle and orbital soft tissues, floor fracture with incarcerated tissue without muscle entrapment and depressed floor fragment fractures in which a bone fragment is displaced downward into maxillary sinus.

Anehosur et al. (14) classify orbital floor fractures according to the anatomical site of fracture line into fracture line on the medial side of infraorbital foramen, fracture line on the lateral side of infraorbital foramen, fracture line passing through the infraorbital foramen and fracture line on both sides of infraorbital foramen.

Piombino et al. (15) grouped fractures by defect size:

small (1–2 cm^2), medium (2–2.5 cm^2), and large (2.5–4 cm^2).

The study aimed to find a proposed classification that explain the orbital floor fractures in a detailed method that explain fracture pattern, defect size, fracture displacement, associated facial fractures and associated symptoms and signs.

First we tried to classify fractures according to defect size into small (less than 0.5 cm), medium (0.5-1cm), large sized defects (more than 1 cm).

Then we tried to classify fractures according to their pattern into linear fractures and comminuted fractures and subdivided each type into 3 subtypes. Linear fractures divided into linear non displaced fractures, linear displaced fractures without muscle entrapment and linear displaced fractures with muscle entrapment. Comminuted fractures divided into comminuted non displaced fractures, comminuted displaced fractures (segmented fracture 2-3 segments) and comminuted displaced fractures (more than 3 segmented fractures).

These two trials were better to be integrated and refashioned to cover all aspects.

The proposed classification based on four main factors: fracture displacement, defect size, herniation of orbital content into maxillary sinus and muscle entrapment.

The proposed classification divided orbital floor fractures into two main types: type "I" (non-displaced fractures) and type "II" (displaced fractures). Type "II" was further classified according to fracture characteristics into four subtypes" A, B, C and D" where "A" for linear fractures and "B" for comminuted fractures with small sized defect (<0.5cm) and "C" for comminuted fractures with medium sized defect (0.5-1 cm) and "D" for comminuted fractures with large sized defect (>1cm).

A "+" sign was added for any subtype with muscle entrapment or herniation of orbital contents in the maxillary sinus.

Management of orbital floor fractures in the study group based on associated symptoms and signs, fracture displacement, defect size, herniation of orbital content into maxillary sinus and muscle entrapment. Conservative management applied in 38% of cases, while 62% required operative management. Orbital floor reconstruction with titanium mesh was in 48% of cases. Other treatment methods included open reduction only (10%) and orbital floor reconstruction with conchal cartilage graft (4%).

Postoperative results were promising, with 90% of patients experiencing significant improvement, although a few cases of enophthalmos and limited ocular motility not fully improved and were due to delayed intervention until patients became fit for surgery.

There were some trials to reach a specific management protocol for orbital floor fractures.

Reyes et al. (16) recommended immediate intervention for muscle entrapment or significant displacement.

Beigi et al. (10) preferred a cautious, delayed surgical approach for non-trap-door fractures, focusing on conservative treatment unless severe symptoms persisted, advocating a more cautious approach to avoid unnecessary surgeries.

Piombino et al. (15) based management primarily on defect size, using non-resorbable materials like titanium mesh for larger fractures and resorbable implants for smaller defects.

The study aimed to provide a proposed management protocol to help surgeons in the decision for each case to avoid unnecessary operations or the need for delayed, more complicated surgeries. So, we can achieve the best results for patients and reserve our resources.

By retrograde analysis of orbital floor fracture management among study group, **a management protocol was proposed** for each type of the developed orbital floor fracture classification.

All cases in type I had conservative management. Type II "A, B, C, D" cases had conservative or operative management according to associated symptoms and signs and defect size. All cases in type II, that had a "+" sign which means presence of muscle entrapment or herniation of orbital content into maxillary sinus, had operative management.

The study offers unique insights into orbital floor fracture management by providing a detailed classification, which helps predict outcomes and tailor surgical plans. Unlike other studies, the study establish specific correlations between trauma causes—such as road traffic accidents—and fracture characteristics, revealing that high-energy trauma often results in more complex, displaced fractures. The study emphasized associated facial fractures, like those in the inferior orbital rim and zygomatico-maxillary buttress, which frequently co-occur and complicate treatment. The proposed management protocol combines conservative and surgical interventions based on fracture type, displacement, and symptom severity, offering a flexible approach that adjusts to individual patient needs. Additionally, by linking symptoms like infraorbital paresthesia, diplopia, limited ocular motility and enophthalmos to treatment decisions, we provide a patient-centered framework that considers both anatomical and functional impacts, enhancing clinical decision-making beyond structural considerations alone.

CONCLUSION:

In conclusion, this study provides a proposal for classifying and managing orbital floor fractures, emphasizing the importance of a tailored approach based on fracture type, defect size, displacement, and muscle entrapment, herniation of orbital content into maxillary sinus and associated symptoms and signs. The developed classification and management protocol holds promise for improving patient outcomes by offering a structured pathway that considers both anatomical and clinical factors. Findings show that conservative management is often appropriate for non-displaced fractures, while displaced fractures, particularly those with muscle entrapment or significant defects, benefit from surgical intervention, commonly with titanium mesh reconstruction.

References:

1. Shutting, C., Jones, C., & Reifler, D. M. (2008). Anatomy of the orbit. Clinical Plastic Surgery, 35(2), 111–123.
2. Allareddy, V., Lee, M. K., & Nalliah, R. P. (2011). Epidemiology of facial fractures. Journal of Oral and Maxillofacial Surgery, 69(9), 2613–2618.
3. Heo, K., Cho, J., & Kim, H. (2018). Etiology and patterns of facial fractures. Archives of Plastic Surgery, 45(5), 437–444.
4. Gabrielli, M. A. C., Pereira Filho, V. A., & Gabrielli, M. F. R. (2011). Orbital floor fracture patterns. International Journal of Oral and Maxillofacial Surgery, 40(7), 701–706.
5. Mika, R., Kowalczuk, M., & Korchynska, S. (2011). Clinical features of orbital floor fractures. Medical Science Monitor, 17(4), CR209–CR214.
6. Bijan, A., Lee, W., & Park, J. (2014). Diplopia and infraorbital nerve injury in orbital floor fractures. Annals of Plastic Surgery, 72(5), 572–578.
7. Hammer, B., & Prein, J. (1995). Correction of posttraumatic enophthalmos. Clinical Plastic Surgery, 22(2), 233–243.
8. Felding, U. N. A. (2018). Conservative versus surgical treatment in orbital floor fractures. Journal of Cranio-Maxillo-Facial Surgery, 46(3), 412–418.
9. Palavalli MH, Huayllani MT, Gokun Y, Lu Y, Janis JE. Surgical Approaches to Orbital Fractures: A Practical and Systematic Review. Plast Reconstr Surg Glob Open. 2023 May 15;11(5):e4967.
10. Beigi, B., Khandwala, M., & Gupta, D. (2014). Management of pure orbital floor fractures: a proposed protocol to prevent unnecessary or early surgery. Orbit, 33(5), 336-342.
11. Nolasco FP and Mathog RH (1995). Medial orbital wall fractures: classification and clinical profile. Otolaryngology-Head and Neck Surgery, 112:549-56.
12. Lauer, S. A., Snyder, B., Rodriguez, E., & Adamo, A. (1996). Classification of orbital floor fractures. The Journal of Cranio-maxillofacial Trauma, 2(4), 6-11.
13. Jacquiery, C., Kunz, C., Hammer, B., & Prein, J. (2007). The orbital floor and medial wall: An anatomical study and classification of orbital wall defects for reconstructive surgery. Journal of Cranio-Maxillofacial Surgery, 35(2), 82–93. https://doi.org/10.1016/j.jcms.2006.10.007
14. Anehosur, V., Nathani, J., Nagraj, N., Nikhil, K. (2020). Clinical criteria for selective exploration of orbital floor in zygomaticomaxillary complex fractures. Craniomaxillofacial Trauma& Reconstruction,13(3):p 180-185.
15. Piombino, P., Troise, S., Maglitto, F., Barone, S., Sani, L., Committeri, U., ... & Califano, L. (2022). Management of orbital floor fractures: Our experience in 10 years. Indian Journal of Otolaryngology and Head & Neck Surgery, 74(4), 547-554.
16. Reyes, J. M., Vargas, M. F. G., Rosenvasser, J., Arocena, M. A., Medina, A. J., & Funes, J. (2013). Classification and epidemiology of orbital fractures diagnosed by computed tomography. Rev Argent Radiol, 77(2), 139-146.