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CLASSIFICATION OF ORBITAL DEFORMITIES DUE TO SEQUELAE OF MAXILLOFACIAL TRAUMA

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ABSTRACT

Objective: To classify orbital deformities due to sequelae of maxillofacial trauma.

Methods: A descriptive cross-sectional study with analysis, combining retrospective and prospective components, was conducted in patients diagnosed with orbital deformities due to post-traumatic sequelae at Military Central Hospital 108 from September 2018 to August 2019.

Results: The study included 35 patients, with a mean interval since trauma of 5 years; 82.9% had previously undergone surgery after trauma. Regarding the classification of orbital deformities, the most common deformed bony rim was the inferior orbital rim (85.7%); the most common deformed bony wall was the inferior wall (77.1%); the most common deformed orbital quadrant was the inferomedial quarter (65.7%); grade 3 enophthalmos was the most frequent degree of enophthalmos (73.3%); and the most common orbital deformity-related manifestations were ocular asymmetry (48.6%), hypoglobus (40%), and ptosis/eyelid drooping (34.3%).

Conclusion: Post-traumatic orbital deformities most commonly involve the inferior orbital rim, inferior wall, and inferomedial quarter of the orbit. Grade 3 enophthalmos predominates among orbital deformities.

Keywords: Orbital deformity, post-traumatic sequelae.

1. INTRODUCTION

Orbital deformity is a common sequela of maxillofacial trauma, affecting both function and aesthetics. It is characterized by posterior displacement of the globe within the orbit, distortion of the free orbital margins, displacement of the medial and lateral canthi, and/or functional impairment (diplopia, reduced visual acuity, blurred vision, limitation of ocular motility, strabismus) because fracture lines commonly pass through fissures and grooves within the orbit, especially in midfacial fractures causing injury to the orbital bones [1]. Post-traumatic orbital deformities can be classified in various ways, such as the Tessier classification [2] based on aesthetic aspects, the Manson and Gruss classification based on the pre-fracture location [3], [4], or classification according to anatomic location and characteristics of orbital fractures.1234

In addition to aesthetic concerns, functional disorders that impair quality of life are among the reasons why patients with post-traumatic orbital deformities require readmission for treatment. This indicates that accurate assessment of bony injury to the orbital walls, as well as classification of orbital deformities to select an appropriate treatment method, is highly necessary. Therefore, we conducted this study with the objective of classifying orbital deformities due to sequelae of maxillofacial trauma.

2. SUBJECTS AND METHODS

2.1. Study subjects

- Inclusion criteria:

Patients had a history of maxillofacial trauma more than 6 months earlier, had computed tomography (CT) images, and had or had not been treated for maxillofacial trauma at a lower-level facility. Patients were diagnosed with unilateral or bilateral post-traumatic orbital deformity based on the following signs:

+ Ocular findings: enophthalmos; asymmetry of the medial and lateral canthal angles; discontinuity of the orbital bony rims; protrusion or depression of the bony rims.

+ Associated functional signs (may or may not be present): reduced or lost vision, globe defect, strabismus, diplopia, ptosis.

Patients voluntarily agreed to participate and complied with the study procedures (for prospective cases) or had sufficient archived records in the medical records repository of Military Central Hospital 108 (for retrospective cases).

- Exclusion criteria:

Patients had congenital deformities causing facial/orbital abnormalities before trauma or had severe acute or chronic medical/surgical diseases requiring emergency intervention.

2.2. Study methods

- Study design: A descriptive cross-sectional study with analysis, combining retrospective and prospective components.

- Time and place of study: The study was conducted from September 2018 to August 2019 in patients definitively diagnosed with orbital deformity due to post-traumatic sequelae, who were examined and treated as inpatients in the Department of Maxillofacial and Plastic Surgery, Military Central Hospital 108, during the period from April 2015 to

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the end of June 2019.

- Sample size and sampling: Purposive sampling was used. The sample size formula applied in this study was that for a descriptive study, in which the variable described was the classification of types of orbital deformity. The currently used classifications mainly divide orbital deformities into 4–5 types. Because no prior study was available, we assumed these proportions were equal in the population of patients with post-traumatic orbital deformity sequelae. Therefore, p = 0.2. The sample size formula for this study was estimated as follows:

$$n = Z^2_{1-\alpha/2} \frac{p(1-p)}{d^2}$$

Where:

n: is the study sample size

$Z_{1-\alpha/2}$ = 1.96, with a confidence level of 95%

p: assumed to be 0.2

d: allowable error, d = 0.15

Substituting into the formula above yielded n = 27. Assuming a dropout rate of 10%, the sample size was: n = 27 × 110% = 30 patients. Thus, the minimum sample size for this study was 30 patients. In fact, we collected 35 patients who met the study criteria.

- Study variables:

Trauma-related factors: time and post-traumatic surgery

Classification of orbital deformity: according to deformed bony rim, bony wall, and orbital quadrant

Classification of orbit-related deformity: according to degree of enophthalmos, pattern of orbital deformity, and isolated/combined orbital deformity.

- Data processing: Data were processed using SPSS 20.0 software. The algorithms used included frequency counts, percentage calculation, mean values and standard deviation (SD), chi-square test, and t-test. At a 95% significance level, results were considered statistically significant when p < 0.05.

2.3. Research ethics

The study protocol was approved by the committee reviewing the Master of Medicine thesis proposal of the Department of Plastic and Aesthetic Surgery and was permitted for implementation by the Board of Directors of Military Central Hospital 108.

3. RESULTS

3.1. Trauma-related factors associated with orbital deformity

Table 1. Factors related to time since trauma (n=35)

Time		Male		Female		Overall	
		n	%	n	%	n	%
Years since trauma	< 3 years	2	8.0	3	30.0	5	14.3
	3 - < 5 years	7	28.0	3	30.0	10	28.6
	5 - < 10 years	14	56.0	3	30.0	18	51.4
	≥ 10 years	2	8.0	1	10.0	2	5.7
Mean years since trauma $\bar{X}$ ± SD (years)		5.40 ± 2.72		3.70 ± 1.49		4.91 ± 2.54	
Mean time to hospital visit after trauma $\bar{X}$ ± SD (months)		7.67 ± 3.83		15.83 ± 6.82		11.75 ± 6.78	

Comment: The mean time since trauma among the study patients was 5 years; the highest concentration was in the group with trauma duration from 5 to under 10 years (51.4%).

Table 2. Factors related to surgery after trauma (n=35)

Post-traumatic surgical factors			n	%
Surgery after trauma		Surgery performed	29	82.9
		No surgery	6	17.1
Indications for osteosynthesis	Yes	Zygomaticomaxillary complex	10	38.6
		Zygomaticomaxillary complex + maxilla	9	25.7
		Zygomaticomaxillary complex + maxilla + nasal bone	4	11.4
		Zygomaticomaxillary complex + maxilla + orbital bone	1	2.9
		Maxilla	2	5.7
		Frontal bone	2	5.7
		Frontal bone + nasal bone	1	2.9
	No	Conservative treatment (reduction, external fixation)	3	8.6
		No intervention	3	8.6
Surgical facility		Grade I hospital	25	75.8
		Grade II hospital	7	24.2

Comment: A total of 82.9% of patients underwent surgery after trauma; among these, 75.8% underwent intervention at grade I hospitals, and the main indication for osteosynthesis involved the zygomaticomaxillary complex.

3.2. Classification of orbital deformity according to the deformed bony rim, bony wall, and orbital quadrant

Table 3. Classification according to the location of the deformed bony rim * (n=35)

Classification of orbital deformity			Male		Female		Overall	
			n	%	n	%	n	%
According to the deformed bony rim	Inferior orbital rim	Unilateral	20	80.0	10	100	30	85.7
		Bilateral	0	0	0	0	0	0
	Lateral orbital rim	Unilateral	4	16.0	1	10.0	5	14.3
		Bilateral	0	0	0	0	0	0
	Superior orbital rim	Unilateral	2	8.0	3	30.0	5	14.3
		Bilateral	0	0	0	0	0	0
	Medial orbital rim	Unilateral	10	40.0	3	30.0	13	37.1
		Bilateral	0	0	0	0	0	0
According to the deformed bony wall	Superior wall (orbital roof)	Unilateral	3	12.0	3	30.0	6	17.1
		Bilateral	0	0	0	0	0	0
	Inferior wall (orbital floor)	Unilateral	18	72.0	9	90.0	27	77.1
		Bilateral	0	0	0	0	0	0
	Medial wall	Unilateral	19	76.0	3	30.0	22	62.9
		Bilateral	0	0	0	0	0	0
	Lateral wall	Unilateral	5	20.0	2	20.0	7	20.0
		Bilateral	0	0	0	0	0	0
According to the deformed orbital quadrant	Superolateral quarter	Unilateral	3	12.0	2	20.0	5	14.3
		Bilateral	0	0	0	0	0	0
	Superomedial quarter	Unilateral	5	20.0	1	10.0	6	17.1
		Bilateral	0	0	0	0	0	0
	Inferolateral quarter	Unilateral	6	24.0	3	30.0	9	25.7
		Bilateral	0	0	0	0	0	0
	Inferomedial quarter	Unilateral	17	68.0	6	60.0	23	65.7
		Bilateral	0	0	0	0	0	0

** One patient could have multiple combined deformed bony rims*

Comment: The most common deformed bony rim was the inferior orbital rim (85.7%); the most common deformed wall was the inferior wall (77.1%); and the most common deformed orbital quadrant was the inferomedial quarter (65.7%).

3.3. Classification of orbit-related deformity

Table 4. Classification according to degree of enophthalmos (n=30)

Grade of enophthalmos	Male		Female		Overall	
	n	%	n	%	n	%
Grade 1	0	0	1	14.3	1	3.3
Grade 2	3	13.0	0	0	3	10.0
Grade 3	16	69.6	6	85.7	22	73.3
Grade 4	4	17.4	0	0	4	13.3

Comment: The proportion of patients with grade 3 enophthalmos was the highest, whereas that with grade 1 enophthalmos was the lowest.

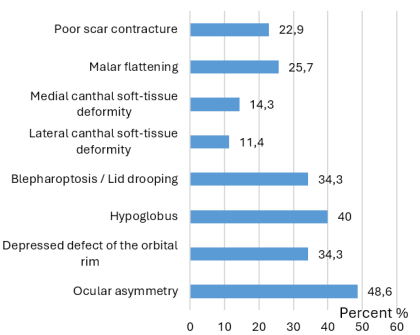


Figure 1. Classification according to orbital deformity (n=35)

Comment: Ocular asymmetry was the most common manifestation (48.6%), followed by hypoglobus (40%) and ptosis/eyelid drooping (34.3%). Soft-tissue deformity of the lateral or medial canthus was least frequent.

Table 5. Classification according to isolated/combined orbital deformity (n=35)

Manifestations of orbital deformity	Male		Female		Overall	
	n	%	n	%	n	%
Ocular asymmetry	1	4.0	1	10.0	2	5.7
Depressed defect of the orbital rim	1	4.0	0	0	1	2.9
Hypoglobus	4	16.0	1	10.0	5	14.3
Ptosis/eyelid drooping	1	4.0	1	10.0	2	5.7
Soft-tissue deformity of the lateral canthus	1	4.0	0	0	1	2.9
Ocular asymmetry + malar flattening	1	4.0	0	0	1	2.9
Ocular asymmetry + hypoglobus	0	0	3	30.0	3	8.6
Ocular asymmetry + soft-tissue deformity of the medial canthus	1	4.0	0	0	1	2.9
Ocular asymmetry + depressed defect of the orbital rim + ptosis/eyelid drooping + soft-tissue deformity of the medial canthus	0	0	1	10.0	1	2.9
Ocular asymmetry + malar flattening + depressed defect of the orbital rim + ptosis/eyelid drooping + soft-tissue deformity of the medial canthus	1	4.0	0	0	1	2.9
Depressed defect of the orbital rim + hypoglobus + ptosis/eyelid drooping	0	0	0	0	1	2.9
Malar flattening + depressed defect of the orbital rim + ptosis/eyelid drooping + soft-tissue deformity of the medial canthus	1	4.0	0	0	1	2.9
Retracting scar + ocular asymmetry + malar flattening + depressed defect of the orbital rim + hypoglobus	1	4.0	0	0	1	2.9
Retracting scar + ocular asymmetry + malar flattening + depressed defect of the orbital rim	1	4.0	0	0	1	2.9
Retracting scar + ocular asymmetry + hypoglobus + ptosis/eyelid drooping	0	0	1	10.0	1	2.9
Retracting scar + ocular asymmetry + malar flattening + depressed defect of the orbital rim + hypoglobus + ptosis/eyelid drooping	1	4.0	1	10.0	2	5.7
Retracting scar + ocular asymmetry + malar flattening + depressed defect of the orbital rim + ptosis/eyelid drooping + soft-tissue deformity of the lateral canthus	1	4.0	0	0	1	2.9
Retracting scar + ocular asymmetry + depressed defect of the orbital rim + hypoglobus + ptosis/eyelid drooping + soft-tissue deformity of the lateral canthus	0	0	0	0	1	2.9
Retracting scar + ocular asymmetry + malar flattening + depressed defect of the orbital rim + hypoglobus + ptosis/eyelid drooping + soft-tissue deformity of the medial and lateral canthus	1	4.0	0	0	1	2.9

Comment: The proportion of patients presenting with only one type of orbital deformity was low; combined manifestations predominated, among which ocular asymmetry was the most common.

4. DISCUSSION

4.1. Trauma-related factors associated with orbital deformity

The mean number of years since trauma among the study patients was 5 years, with the highest concentration in the 5–10-year range (51.4%). However, the mean time to hospital presentation after trauma for treatment of orbital deformity was much shorter, at approximately 12 months (Table 1). This is consistent with clinical practice because post-traumatic orbital deformities are usually detected around 6 months after intervention, when facial edema and bruising have subsided and the injuries have gradually stabilized [5]. Patients who underwent surgical treatment immediately after trauma often remained stable during this period before orbital deformities were identified, even in cases managed conservatively with reduction or external fixation[5].

A large proportion of patients underwent surgery immediately after trauma (82.9%). The main indications for osteosynthesis involved the zygomaticomaxillary complex (38.6%) and the zygomaticomaxillary complex together with the maxilla (25.7%). The study also recorded that 8.6% of patients were managed conservatively with reduction or external fixation, and 3 cases received no intervention after trauma. Most patients underwent surgery at large, reputable centers nationwide (grade I hospitals, 75.8%). One reason is that at some lower-level hospitals, imaging techniques—especially CT—have not yet been widely implemented, and hospitals may lack sufficient technical equipment for diagnosis as well as timely emergency surgery; therefore, patients are often referred to higher-level facilities for treatment. A second reason is the psychology of patients and their families, who often choose major centers for surgery because of concerns about trauma-related risks.

4.2. Classification of orbital deformity according to the deformed bony rim, bony wall, and orbital quadrant

According to the bony rim: The midface bony complex consists of 13 bones (6 paired bones and 1 unpaired bone) joined together into a strong unit by serrated sutures. Within the midface bony complex are natural cavities containing organs with important functions in the head and neck region, among which the orbit plays a particularly important role in human life. The midface is also closely related superiorly to the cranial vault, specifically the anterior and middle cranial fossae. When midfacial fractures occur, there are often associated injuries involving the cranial region, the globe and orbit, the ethmoid-maxillary system, and the oral cavity. In our study, according to the deformed bony rim, the detailed classification was as follows: deformity of the inferior orbital rim was the most common (85.7%), followed by the medial orbital rim (37.1%). The proportions of deformity of the lateral orbital rim and superior orbital rim were equal at 14.3%.

According to the bony wall: In the classification by bony wall deformity, the highest proportion was deformity of the inferior wall (77.1%) and the lowest was the superior wall (orbital roof) at 17.1%. Clinically, deformity of the inferior orbital wall may allow the globe and orbital contents to descend into the maxillary sinus, causing enophthalmos, limitation of ocular motility, and diplopia. This proportion was quite high in our study and corresponded to the manifestation of enophthalmos (85.7%).

According to the orbital quadrant: In the classification by deformed orbital quadrant, the inferomedial quarter was the most common location (65.7%). The remaining locations—including the superolateral quarter, superomedial quarter, and inferolateral quarter—had nearly similar proportions (ranging from 14% to 25%).

4.3. Classification of orbit-related deformity

According to the degree of enophthalmos: In maxillofacial trauma, when there is injury to the bones of the orbital walls (fractures of the zygoma, maxilla, nasoethmoidal-orbital complex, skull base fractures involving the orbital roof, etc.), if not managed correctly and promptly, post-traumatic enophthalmos can easily develop, mainly because of increased orbital cavity volume and partly because of reduced orbital soft-tissue volume (chiefly due to herniation and atrophy of orbital fat). Because the orbit is usually swollen after trauma, it is very difficult to detect or accurately assess injury to the orbital walls and to precisely predict the later risk of enophthalmos. Therefore, many patients treated at lower-level facilities (whether conservatively or surgically) often develop enophthalmos shortly after discharge. In our study, according to the degree of enophthalmos, the highest proportion of patients had grade 3 enophthalmos (73.3%), followed by grade 4 (13.3%), grade 2 (10%), and grade 1 (3.3%). According to the study by Ye L.X., enophthalmos accounted for up to 29.8% of indications for orbital reconstructive surgery [6].

According to orbital deformity: Most orbital deformities were combined deformities, whereas isolated deformity was seen in only a few patients. The highest proportion was ocular asymmetry (48.6%), due to orbital deformity; followed by hypoglobus (40%); and ptosis/eyelid drooping (34.3%), which narrows the palpebral fissure and makes it difficult for the patient to open the eye. The cause may be a tear of the levator palpebrae muscle or injury to the oculomotor nerve (distinguished from pseudoptosis, in which severe swelling makes the patient unable to open the eye). Pseudoptosis resolves when the eye swelling subsides. Malar flattening accounted for 25.7%, and the lowest proportions were seen in the groups with soft-tissue deformity of the medial or lateral canthus (14.3% and 11.4%, respectively).

5. CONCLUSION

The mean time since trauma among the study patients was 5 years, with the highest proportion in the 5–10-year group. Most patients had previously undergone surgery after maxillofacial trauma (82.9%).

Classification of orbital deformity showed that the most common bony rim location was the inferior orbital rim (85.7%); the most common wall location was the inferior wall (77.1%); and the most common orbital quadrant was the inferomedial quarter (65.7%).

According to the degree of enophthalmos, grade 3 was the most common (73.3%); according to the pattern of orbital deformity, ocular asymmetry was the most common manifestation (48.6%), followed by hypoglobus (40%) and ptosis/eyelid drooping (34.3%). Combined orbital deformities were more common than isolated lesions.

6. RECOMMENDATIONS

Orbital deformities should be classified early after trauma to select appropriate treatment methods, thereby helping restore function and aesthetics for the patient.

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