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CLINICAL AND IMAGING CHARACTERISTICS OF POST-TRAUMATIC ORBITAL DEFORMITIES AT 108 MILITARY CENTRAL HOSPITAL

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ABSTRACT

Objective: To evaluate the clinical and imaging characteristics of post-traumatic orbital deformities at Military Central Hospital 108 from September 2018 to August 2019.

Methods: A descriptive cross-sectional study with analysis, combining retrospective and prospective data. Patients had a history of maxillofacial trauma more than 6 months earlier and were diagnosed with post-traumatic orbital deformities.

Results: Among the 35 study patients, the mean age was 30 years, with the youngest aged 17 years and the oldest aged 50 years. The male-to-female ratio was 2.5:1. The main cause of trauma was traffic accidents (91.4%). The most common subjective symptoms were diplopia (42.9%) and blurred vision (31.4%); the most common physical sign was enophthalmos (85.7%); the most common associated injury was maxillofacial fracture (91.4%). The most common sites of bony deformity on computed tomography were the inferior orbital rim (82.9%) and the orbital floor (85.7%). Computed tomography detected more lesions than conventional radiography ($p < 0.05$).

Conclusion: The most common manifestations of post-traumatic orbital deformities were diplopia, blurred vision, and enophthalmos. The most common bony deformity involved the inferior orbital rim. Computed tomography provided clearer images and detected more lesions than conventional radiography.

Keywords: Post-traumatic orbital deformities, clinical characteristics, imaging characteristics.

1. INTRODUCTION

Post-traumatic orbital deformity following maxillofacial injury is a condition characterized by a sunken orbit, distortion of the free orbital margins, displacement of the medial and lateral canthi, and/or functional impairment (diplopia, decreased visual acuity, blurred vision, limitation of ocular motility, strabismus), because fracture lines often pass through the fissures and grooves within the orbit, particularly in midfacial fractures that injure the orbital bones. This injury accounts for a considerable proportion of maxillofacial trauma, with an estimated prevalence of 10–20% according to previous studies [1], [2], and is most commonly seen in motor vehicle-related trauma. Orbital deformities usually become progressively evident after surgery or 6 months after trauma, when edema has subsided and the lesions have gradually stabilized [3].

The clinical manifestations of post-traumatic orbital deformity are diverse, including enophthalmos and exophthalmos associated with structural changes in the orbital walls, bony rims, and orbital angles, which can be clearly identified on computed tomography (CT) or radiographs. In addition to aesthetic concerns, associated functional disturbances are also among the reasons why patients require readmission for treatment. Accurate evaluation of clinical and imaging characteristics helps identify the risk of post-traumatic orbital deformity, select appropriate subsequent treatment methods, and predict long-term outcomes for patients. Therefore, we conducted this study with the objective of evaluating the clinical and imaging characteristics of post-traumatic orbital deformities at Military Central Hospital 108.

2. STUDY SUBJECTS AND METHODS

2.1. Study subjects

- Inclusion criteria:

Patients with a history of maxillofacial trauma more than 6 months earlier, with 320-slice computed tomography (CT-320) images, who had or had not been treated at lower-level facilities. Patients were diagnosed with unilateral or bilateral post-traumatic orbital deformities based on the following signs:

+ Ocular signs: atrophic enophthalmos; asymmetry of the medial and lateral canthi; discontinuity of the orbital bony margins; protrusion or depression of the bony margins.

+ 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 process (for prospective cases) or had sufficient records stored in the Medical Records Archive of Military Central Hospital 108 (for retrospective cases).

- Exclusion criteria:

Patients with congenital anomalies causing facial/orbital deformity before trauma; or severe acute or chronic medical/surgical diseases requiring emergency intervention.

2.2. Study methods

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- Study design: Analytical descriptive cross-sectional study 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 post-traumatic orbital deformities who were examined and treated as inpatients at the Department of Maxillofacial Surgery and Plastic Surgery, Military Central Hospital 108, during the period from April 2015 to 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. Current classifications mainly divide orbital deformities into 4–5 types. Because no previous study was available, we assumed these proportions to be equal in the population of patients with post-traumatic orbital deformities. Therefore, p = 0.2. The estimated sample size formula was 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, corresponding to a 95% confidence level

p: assumed p = 0.2

d: allowable error, d = 0.15

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

- Study variables:

Epidemiological characteristics: age, sex, cause of trauma.

Clinical characteristics: subjective symptoms, physical signs, associated systemic manifestations.

Orbital imaging characteristics: on conventional radiographs and computed tomography.

- Data analysis: After collection, data were processed using SPSS 20.0 software. Statistical methods included frequency counts, percentage calculations, mean values and standard deviations (SD), chi-square test, and t-test. At a significance level of 95%, results were considered statistically significant when p < 0.05.

2.3. Research ethics

The study was approved by the Council reviewing the master's thesis proposal in medicine 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. Epidemiological characteristics of patients with post-traumatic orbital deformities

Table 1. Epidemiological characteristics (n = 35)

Characteristics		n	%
Age group	< 20 years	3	8.6
	20 - < 30 years	17	48.6
	30 - < 40 years	12	34.3
	40 - < 50 years	1	2.8
	≥ 50 years	2	5.7
Sex	Male	25	71.4
	Female	10	28,6
Cause of trauma	Traffic accident	32	91.4
	Occupational accident	3	8.6

Comment: Among the 35 study patients, the mean age was 30 years, with the youngest aged 17 years and the oldest aged 50 years. The proportion of male patients was 2.5 times that of female patients. The main cause of trauma was traffic accidents, accounting for 91.4%.

3.2. Clinical characteristics of patients with post-traumatic orbital deformities

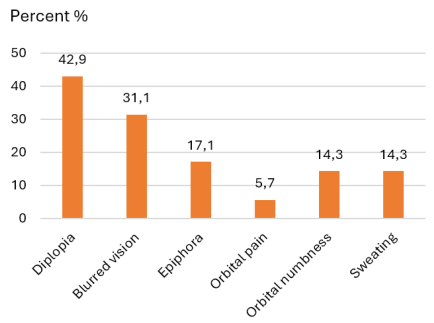


Figure 1. Subjective orbital symptoms (n = 35)

Comment: The most common subjective symptoms were diplopia (42.9%) and blurred vision (31.4%); the least common was orbital pain (5.7%).

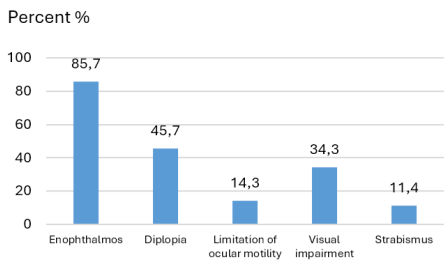


Figure 2. Physical signs of orbital deformity (n = 35)

Comment: The most common physical sign on examination was enophthalmos (85.7%), while strabismus was the least common (11.4%).

Table 2. Distribution of associated systemic manifestations in orbital deformity

Associated systemic manifestations	n	%
Maxillofacial soft-tissue deformity	10	28,6
Maxillofacial fracture	32	91,4
Traumatic brain injury	6	17,1
Thoracoabdominal trauma	1	2,9
Limb trauma	2	5,7

** One patient could have more than one associated systemic manifestation*

Comment: The most common associated injury was maxillofacial fracture (91.4%); the least common was thoracoabdominal trauma (2.9%).

3.3. Imaging characteristics of post-traumatic orbital deformities

Table 3. CT scan images* (n = 35)

CT-detected bony deformities	n	%
Lateral rim	7	20.0
Superior rim	9	25.7
Medial rim	12	34.3
Inferior rim	29	82.9
Maxillary bone	6	17.1
Zygomatic arch	5	14.3
Frontal bone	3	8.6
Nasal bone	5	14.3
Orbital roof	5	14.3
Orbital floor	30	85.7
Medial orbital wall	12	34.3
Lateral orbital wall	3	8.6
Mean bony deformity score $\bar{X}$ ± SD (points)	3,94 ± 1.73	

** One patient could have multiple findings on computed tomography*

Comment: The most common sites of bony deformity on CT were the inferior orbital rim (82.9%) and the orbital floor (85.7%).

Table 4. Agreement in bony deformity images between CT and radiography (n = 25)

Images of bony deformity by site	CT-320		Conventional radiography	
	n	%	n	%
Lateral rim	6	24.0	5	20.0
Superior rim	4	16.0	6	24.0
Medial rim	7	28.0	2	8.0
Inferior rim	23	92.0	20	80.0
Maxillary bone	4	16.0	3	12.0
Zygomatic arch	4	16.0	2	8.0
Frontal bone	3	12.0	0	0
Nasal bone	2	8.0	3	12.0
Orbital roof	2	8.0	0	0
Orbital floor	23	92.0	0	0
Medial orbital wall	14	56.0	0	0
Lateral orbital wall	3	12.0	0	0
Mean bony deformity score $\bar{X}$ ± SD (points)	2.78 ± 1.07		1.64 ± 1.25	
p	< 0.05			

** One patient could have multiple findings on both CT and conventional radiography*

Comment: On both 320-slice CT and conventional radiography, the most common bony deformity was at the inferior orbital rim. However, CT provided clearer results and detected more lesions than conventional radiographs; the difference was statistically significant ($p < 0.05$).

4. DISCUSSION

4.1. Epidemiological characteristics of patients with post-traumatic orbital deformities

Most patients in this study were relatively young, with a mean age of 30 years, the youngest being 17 years and the oldest 50 years. This is consistent with reality because trauma often occurs due to collisions, traffic accidents, or domestic accidents, in which the age group from 20 to under 40 years is of working age and therefore more likely to experience trauma than other groups. Compared with some other domestic authors, we found similar mean ages, such as those reported by Pham Thi Hai Ha (19 to 45 years) [4] and Pham Thi Thu Hoai (16 to 55 years) [5].

Regarding sex distribution, male patients predominated; our results were similar to those of authors such as Pham Thi Hai Ha [4] and Pham Thi Thu Hoai [5]. Considering environmental and epidemiological factors, Vietnam is a country in which motorcycles are widely used as the main means of transportation. A large proportion of these users are men, because in addition to commuting (to work or school), many men use motorcycles as their main means of carrying passengers or goods as a primary occupation (freelance labor). This partly explains why men often have a higher risk of trauma. In addition, alcohol consumption among men is often more difficult to control, especially during lunch breaks or after work. This is also one of the major risk factors increasing traffic accident-related trauma in men.

4.2. Clinical characteristics of patients with post-traumatic orbital deformities

The most common general subjective orbital symptom was diplopia (42.9%); followed by blurred vision (31.4%), tearing (17.1%), orbital numbness (14.3%), sweating retention (14.3%), and the least common was orbital pain (5.7%), which may have been due to globe hemorrhage or an intraorbital foreign body at the time of injury. These symptoms could occur alone or in combination. It can be seen that diplopia was the most troublesome symptom leading patients to seek hospital admission.

Traffic accidents are among the common causes of trauma-related visual impairment. The optic nerve transmits light signals from the eye to the brain, so when it is injured, visual acuity may be severely reduced and can even lead to complete loss of vision. This may result from head trauma causing compression and injury to the optic nerve or the vessels supplying the eye, or from direct impact to the eye causing contusion of the globe or intraocular tissues. Blurred vision may also result from optic nerve injury leading to optic nerve disruption.

All patients in this study were referred for ophthalmologic examination in order to accurately assess the lesions. Among them, enophthalmos was present in 85.7% of the study patients, higher than the other symptom groups. Clinically, enophthalmos can usually be detected when the difference is approximately 2–3 mm, and a difference of about 5 mm confirms the diagnosis of enophthalmos deformity. The main mechanism of this phenomenon is deficiency of the soft tissues around the orbit after trauma (muscle atrophy), leading to changes in the dimensions of the orbital bones after impact/fracture [6]. In addition, fat atrophy and scar contracture are less important causes of the mismatch

between peri-orbital soft-tissue volume and orbital size [7].

In our study, 42.9% of patients subjectively perceived diplopia, and after examination this proportion was 45.7%, with grade 2 diplopia accounting for 33.3%, grade 1 for 22.2%, and 3.7% of patients having grade 3 diplopia. Diplopia is often an early sign and the main reason patients seek medical attention because it causes substantial discomfort (patients may feel uncomfortable when walking in traffic and seeing moving vehicles, when going down stairs or curbs, or when reading books, depending on the muscle involved).

Trauma following traffic accidents often leaves severe consequences. In the survey of 35 patients admitted with orbital deformity, 91.4% had associated maxillofacial fractures; 28.6% had maxillofacial soft-tissue deformities and 17.1% had traumatic brain injury. There were 2/35 patients with associated limb trauma and 1/35 patient with associated thoracoabdominal trauma. This is understandable because, from the initial patient selection stage, we purposively selected patients with orbital deformity 6 months after trauma who had or had not received intervention at lower-level facilities; thus, patients admitted after the trauma period all had orbital deformity, and therefore fracture/fissure of the maxillofacial bones was difficult to avoid. Maxillofacial trauma accompanied by brain, thoracic, abdominal, or limb injury makes the condition more severe and worsens the prognosis.

4.3. Imaging characteristics of post-traumatic orbital deformities

All patients underwent CT, and 25/35 (71.4%) cases underwent both conventional radiography and CT at the time of the study. The purpose of imaging in trauma is to determine the number and location of fractures, especially in functional maxillofacial regions and areas at risk of leaving aesthetic sequelae, thereby providing a basis for clinicians to plan appropriate management. However, classic conventional radiographs are relatively sensitive for skull vault fractures but are less effective for the maxillofacial bones [8]. With axial and coronal sections, CT offers many advantages, allowing accurate diagnosis of fracture lines, providing details of fracture length and displacement deformities of bony, cartilaginous, and muscular components, and detecting associated lesions, especially skull base fractures and intracranial hematomas.8

The CT scanner used in this study was a CT-320 machine with a gantry rotation speed of 350 milliseconds/360 degrees and a wide coverage of 16 cm. The most common sites of bony deformity on CT were the inferior orbital rim (82.9%) and the orbital floor (85.7%). When comparing CT with conventional radiography, the mean number of bony deformities on CT-320 was 2.78 points, higher than that on conventional radiography at 1.64 points, and the difference in lesions detected was statistically significant ($p < 0.05$). In some typical findings such as deformity of the inferior orbital rim and orbital floor, the detection rates on conventional radiography and CT were quite similar; however, for other lesions such as the nasal bone, frontal bone, and the superior/inferior/medial/lateral orbital walls, detection on radiography was much less frequent. This shows that, although conventional radiography remains a simple, classic, and routine diagnostic method, computed tomography is essential to avoid missed lesions, allow timely intervention, and accurately predict post-traumatic orbital deformity. In addition, the maxillofacial skeleton has a special structure, serving as the supporting framework for the soft tissues covering the exterior and creating the distinctive shape of each face; only the mandible is a mobile bone, whereas the remaining bones are connected by immobile serrated sutures. The maxillofacial bony complex is arranged in overlapping layers from top to bottom and front to back, making the diagnosis of fractures on clinical examination and radiography difficult to achieve accurately.

5. CONCLUSION

Post-traumatic orbital deformities are common in young people, occur more often in men than in women, and are mainly caused by traffic accidents. The most common subjective symptoms are diplopia and blurred vision. The most common physical sign is enophthalmos.

On both CT and conventional radiography, the most common bony deformity is at the inferior orbital rim. CT provides clearer images and detects more lesions than conventional radiography, with a statistically significant difference.

6. RECOMMENDATIONS

Patients after maxillofacial trauma should be monitored and evaluated early (ophthalmologic examination and periodic postoperative follow-up) in order to promptly detect orbital deformities for timely intervention, thereby avoiding severe impacts on both function and aesthetics.

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