ORIGINAL ARTICLE

Retrospective analysis of 132 patients with orbital fracture

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ABSTRACT

BACKGROUND: The aim of this study was to evaluate the clinical and epidemiological features of 132 patients with orbital wall fracture who were treated at Şişli Etfal Teaching and Research Hospital, Istanbul, between 2005-2012.

METHODS: The medical records of the patients with a diagnosis of orbital fracture were reviewed and analyzed. The patients were evaluated by age, gender, etiology, symptoms, examination findings, fracture location, associated injuries, treatment, and complications.

RESULTS: The mean follow-up time was 9 (6-16) months. The male-to-female ratio was 5.3-1. The average age was 32 (6-82) years. The leading causes of orbital fractures were traffic accidents (36%) followed by assaults (32%). The most frequently affected orbital wall was the medial wall (33%). The main symptom was throbbing pain in the traumatized area (100%), and the main examination finding was periorbital edema and ecchymosis (100%). The most frequent associated injury was cerebral trauma (14%). Sixty-seven patients (50.1%) were managed with medical treatment, and 65 patients (49.9%) underwent surgical treatment. The most common complication in the late period was dermatomal sensory loss (11%).

CONCLUSION: This study makes clear that the frequency of orbital injuries may be decreased by preventing traffic accidents, by taking precautions in the event they occur, and by promulgating social and educational work against violence.

Key words: Epidemiology, demography, orbital fracture, trauma.

INTRODUCTION

Orbital fracture usually occurs as a result of blunt orbital and facial traumas and may involve ocular injuries. In general, patients are polytraumatized and their functional and cosmetic treatments are performed in different medical specialities such as ophthalmology, otorhinolaryngology, neurosurgery, and plastic and reconstructive surgery clinics.

Many epidemiological studies of orbital fracture have been described in the literature, with reports of variable diagnostic criteria, medical and surgical treatment modalities and complication rates, depending on whether the patient primarily consulted an ophthalmological or a maxillofacial surgery clinic.[1-4] These variations may also be explained by differences in the socioeconomic and cultural levels of the populations studied.

The purpose of this study was to investigate the epidemiological and demographic characteristics of patients with orbital fracture who were treated in the Ophthalmology and Plastic and Reconstructive Surgery Clinics of a tertiary healthcare institution, to which complicated cases were referred from surrounding areas.

MATERIALS AND METHODS

The records of 132 patients with orbital fractures were examined retrospectively, after Local Ethics Committee approval. These patients had been treated at Şişli Etfal Training and Research Hospital in the Second Ophthalmology Clinic and Plastic and Reconstructive Surgery Clinic from 2005 to 2012, and followed for at least six months.

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The patients were evaluated according to the involved side, age and sex distribution, trauma etiologies, symptoms, examination findings, fracture localizations, treatment time after the trauma, treatment procedure, and complications after treatment.

The orbital wall fractures were classified as isolated fractures involving one orbital wall or combined fractures involving more than one orbital wall. Isolated orbital fractures were classified as orbital floor, roof, medial, and lateral orbital wall fractures. In combined fractures, the affected walls were also evaluated together.

RESULTS

One hundred eleven patients were male (84%) and 21 were female (16%). The mean follow-up time was 9 (range, 6-16) months. The average age was 32 (±17, 6-82) years. The orbital fractures occurred most frequently in the 31-40 age range (n=32, 24.2%), followed by the age groups of 21-30 (n=29, 22%) and 11-20 (n=29, 22%) (Table 1).

The principal etiology of orbital bone fractures was traffic accidents (n=47, 35.6%), followed by assaults (n=42, 31.8%), falls (n=37, 28%), work accidents (n=3, 2.3%), and sports injuries (n=3, 2.3%) (Table 2).

With respect to the involved side, right orbital involvement occcurred in 66 patients (50%), left orbital involvement in 60 patients (45.5%) and bilateral orbital involvement in 6 patients (4.5%). The complaints included throbbing pain in the traumatized area (n=100, 75.8%), various degrees of vision loss (n=53, 40.1%), nose bleed (n=31, 23.5%), and diplopia (n=29, 22%). Ophthalmological examination findings were periorbital edema and ecchymosis (n=132, 100%), subconjuctival hemorrhage (n=79, 59.8%), decrease in vision (n=47, 35.6%), dermatomal sensory loss in the periorbital area (n=47, 36%), subcutaneous emphysema (n=45, 34.1%), bone fracture giving step sign at palpation (n=34, 25.8%), limitation of ocular movements (n=29, 22%), defects in light reflexes (n=21, 15.9%), corneal epithelial erosion (n=5, 3.8%), hyphema (n=5, 3.8%), traumatic uveitis (n=5, 3.8%), corneal perforation (n=3, 2.3%), and pupillary sphincter rupture (n=3, 2.3%) (Table 3).

Table 1. Distribution of orbital fractures according to age groups

Age (Year)	Male	Female	Total	%
0-10	8	2	10	7.6
11-20	26	3	29	22
21-30	24	5	29	22
31-40	21	11	32	24.2
41-50	10	0	10	7.6
51-60	17	0	17	12.9
>60	5	0	5	3.8
Total	111	21	132	100

Table 2. Etiology of orbital fractures

Reasons for orbital fracture	n	%
Traffic accident	47	35.6
Assault	42	31.8
Fall	37	28
Work accident	3	2.3
Sports injury	3	2.3

Table 3. Ophthalmological findings in patients with orbital fracture

Determined finding	n	%
Periorbital edema and ecchymosis	79	59.8
Decrease in vision	47	35.6
Dermatomal sensory loss in the periorbital area	47	35.6
Crepitation with palpation	45	34.1
Step in palpation	34	25.7
Limitation in globus movements	29	22
Defects in light reflexes	21	15.9
Corneal epithelial erosion	5	3.8
Hyphema	5	3.8
Traumatic uveitis	5	3.8
Corneal perforation	3	3.8
Pupil sphincter rupture	3	2.3

Table 4. Distribution of isolated wall fractures

Affected orbital wall	n	%
Medial wall	39	51.3
Lateral wall	21	27.6
Orbital floor	13	17.1
Orbital roof	3	3.9
Total isolated fractures	76	100

The orbital fractures were evaluated according to the number of walls involved, and fracture of one orbital wall was diagnosed in 76 patients (57.6%). Their distribution was 39 medial wall fractures (51.3%), 21 lateral wall fractures (27.6%), 13 orbital floor fractures (17.1%), and 3 orbital roof fractures (3.9%) (Table 4).

A combined wall fracture was identified in 56 patients

(42.4%). Their distribution was 21 lateral wall-floor fractures (37.5%), 8 medial wall-floor fractures (14.3%), 8 medial wall-roof fractures (14.3%), 8 lateral wall-roof fractures (14.3%), 5 lateral wall-floor-roof fractures (8.9%), 3 medial-floor-lateral fractures (5.4%), and 3 medial-floor-lateral-roof fractures (5.4%) (Table 5).

The distribution of combined and isolated fractures considered together was as follows: 61 medial wall fractures (33%), 53 lateral wall fractures (28.6%), 53 orbital floor fractures (28.6%), and 18 orbital roof fractures (9.7%) (Table 6).

Sixty-seven patients underwent conservative medical treatment. They were treated with the application of cold compresses, by keeping the patient's head elevated and by systemic/local antibiotics and anti-inflammatory agents.

Sixty-five patients received surgical treatment within the first day to three weeks (mean, 2 weeks) after the trauma. The surgical intervention consisted of open reduction of the fracture and fixation of titanium miniplates in 47 patients and bone graft (crista iliaca) in 12 patients. A closed reduction of the fracture was performed in 5 patients, while 1 patient underwent orbital decompression surgery.

In 44 patients (33.3%), the orbital fracture was accompanied by systemic injuries. The distribution of systemic injuries was cerebral trauma in 18 (13.6%), extremity fracture in 8 (6.1%), maxilla front wall fracture in 8 (6.1%), and nasal bone fracture in 5 (3.8%) patients. Two patients (1.5%) had an acute abdominal pathology, and 1 patient (0.8%) had a pelvic fracture (Table 7).

Table 5. Distribution of combined orbital wall fractures

Affected orbital walls	n	%
Lateral wall + Orbital floor	21	37.5
Medial wall + Orbital floor	8	14.3
Medial wall + Orbital roof	8	14.3
Lateral wall + Orbital roof	8	14.3
Lateral wall + Orbital floor + Orbital roof	5	8.9
Medial wall + Orbital floor + Lateral wall	3	5.4
Medial wall + Orbital floor + Lateral wall + Orbital roof	3	5.4
Total combined fractures	56	100

Table 6. Distribution of combined and isolated fractures evaluated together

Affected orbital walls	n	%
Medial wall	61	33
Lateral wall	53	28.6
Orbital floor	53	28.6
Orbital roof	18	9.7
Total fractured orbital walls	185	100

Table 7. Distribution of systemic injuries accompanying orbital fractures

Systemic injuries	n	%
Cerebral trauma	18	13.6
Maxilla front wall fracture	10	7.6
Extremity fracture	8	6.1
Nasal fracture	5	3.8
Acute abdomen	2	1.5
Pelvic fracture	1	0.8

Table 8. Late ophthalmological complications of orbital fractures

Complications	n	%
Dermatomal sensory loss	15	11.4
Enophthalmos	7	5.3
Hypoglobus	5	3.8
Irregularity on the lower eyelid	2	1.5
Diplopia	1	0.8
Optic atrophy	1	0.8
Phthisis bulbi	1	0.8
Lacrimal pump dysfunction	1	0.8

Ophthalmologic complications of the surgical treatments were early transitory periorbital edema, ecchymosis and subconjuctival hemorrhage. In the late period, dermatomal sensory loss in the periorbital area (n=15, 11.4%), enophthalmos (n=7, 5.3%), hypoglobus (n= 5, 3.8%), and diplopia (n=1, 0.8%) were observed. Cicatricial cutaneous shrinkage on the lower eyelids (n=2, 1.5%), epiphora due to orbicularis muscle weakness-lacrimal pump dysfunction (n=1, 0.8%), phthisis bulbi (n=1, 0.8%), and optic atrophy (n=1, 0.8%) were observed (Table 8).

DISCUSSION

This study investigated the epidemiological and demographic features of patients with orbital fractures who consulted the Ophthalmological and Plastic and Reconstructive Surgery Clinics of a tertiary healthcare institution located in the province of Istanbul to which complicated cases from surrounding areas were referred.

The etiology of orbital fractures varies according to the socioeconomic and cultural levels of the studied population, as well as to the country and geographical region in which the study is conducted. We believe that the findings of this study will help to determine the optimal protection and clinical management strategies of patients with orbital fractures.

Two mechanisms play a particular role in the occurrence of orbital wall fractures.The first mechanism is related to the "buckling theory". The buckling theory asserts that the forces that affect the orbital rim cause flexion movements rather than fracture, and this deformation secondarily creates fractures of thin walls of the orbita such as the medial wall. In contrast, the hydraulic theory suggests that the mechanism involved is an increase in the intraorbital pressure and subsequent formation of wall fractures. Biomechanical studies performed on cadavers have demonstrated that in the etiology of orbital blowout fractures, both mechanisms may play a role.[5]

In the literature, it is emphasized that the orbito-zygomatic area and the orbital floor are the most frequently affected orbital regions.[6] In our study, contrary to the literature, we found that medial wall fractures occurred more frequently than lateral wall fractures. We think that this difference may be due to the fact that medial wall fractures are probably underdiagnosed because of lack of symptoms. When they are suspected, the diagnosis is made by orbital computerized tomography (CT) examination.[7] The difference between our rates of medial wall fractures and those in the literature may be due to the systematic use of CT in all of our cases.

In 391 patients with orbital fracture reported by Hwang et al.,[8] the rate of isolated wall fractures was 47.1% and of combined multiple bone fractures was 52.9%. In our study, we found that the rate of isolated fractures was 57.6%.

Our study also shows that in the etiology of orbital fractures, the rates of falling and forensic incidents were higher in comparison with the literature. We think that this difference occurred because of the socioeconomic and cultural differences of the local population studied.[1-3] In the epidemiological literature, it has been reported that the principal etiology of orbital fractures was traffic accidents, followed by, in decreasing order of frequency, physical assault, sports injuries and falls.[9,10] In their review, Cruz and Eichenberger[11] indicated that the most common cause of orbital fractures in urban areas is traffic accidents. The study conducted by Shere et al.[3] on American soldiers determined that assault was the most frequent etiology, followed by traffic accidents. The etiology of orbital fractures in our cases was traffic accidents, assaults and falls, in order of decreasing frequency.

This study showed that orbital fractures occurred predominantly in male patients (84%) versus females (16%), and the mean age was 32 (6-82) years. Our results are similar to the previously published studies.[6,12-14]

Tan Başer et al.[15] reported that the ocular findings that accompany orbital fractures are periorbital ecchymosis (87.0%), periorbital paresthesia (33.3%), diplopia (12.96%), restricted eye movements (11.1%), and enophthalmos (7.4%). The ocular findings in our patients were edema and ecchymosis in the traumatized area (n=132, 100%), subconjuctival hemorrhage (n=79, 60%), decrease in vision (n=47, 36%), dermatomal sensory loss (n=47, 36%), subcutaneous crepitation at palpation (n=45, 34%), "bony step" sign at palpation (n=34, 26%), limitation in ocular movements (n=29, 22%), defects in light reflexes (n=21, 16%), corneal epithelial erosion (n=5, 4%), hyphema (n=5, 4%), traumatic uveitis (n=5, 4%), corneal perforation (n=3, 2%), and pupillary sphincter rupture (n=3, 2%). Gacto et al.[9] determined the rate of ocular damage accompanying orbital traumas to be 15.3%, and Jabaley et al.[16] detected a rate between 11% and 29%. The ocular pathologies in our patients were enophthalmos (n=7, 5.3%), corneal epithelial erosion (n=5, 4%), hyphema (n=5, 4%), traumatic uveitis (n=5, 4%), corneal perforation (n=3, 2%), and pupillary sphincter rupture (n=3, 2%). In our study, ocular involvement was detected in 23 patients (17%). These results were consistant with previous publications.[10,15,16]

Burm et al.[17] indicated in their study that the facial fractures most frequently associated with orbital fractures were nasal bone fractures folllowed by zygomatic and mandibular fractures. Gacto et al.[9] determined that the most frequent accompanying facial fracture was zygomatic fracture.[10,17] In our study, maxilla front wall fractures (n=8, 6%) and nasal bone fractures (n=8, 6%) were the most frequent accompanying facial fractures.

Martello and Vasconez,[18] who studied 621 patients with systemic injuries associated with orbital trauma, determined that extremity and pelvic traumas (33%) occurred most frequently, followed by chest traumas (7%) and intraabdominal traumas (5%). Gewalli et al.[19] reported soft tissue traumas in 19 (34%), extremity and pelvic traumas in 14 (25%), and chest traumas in 5 (9%) patients. The systemic traumas of our patients were cerebral traumas (n=18, 14%), extremity fractures (n=8, 6%), acute abdominal injuries (n=2, 2%), and pelvic fractures (n=2, 2%).

In our study, 67 patients were managed conservatively with cold applications, keeping the patient's head elevated, systemic and local antibiotherapy, and anti-inflammatory treatment. Orbital emphysema, which was determined in 45 patients (34%) in our study, was treated conservatively in accordance with the treatment protocol recommended in the study by Oba et al.[20] None of our patients developed the degree of compartment syndrome or optic neuropathy that would have necessitated surgical intervention.

Surgical intervention criteria for our patients with orbital

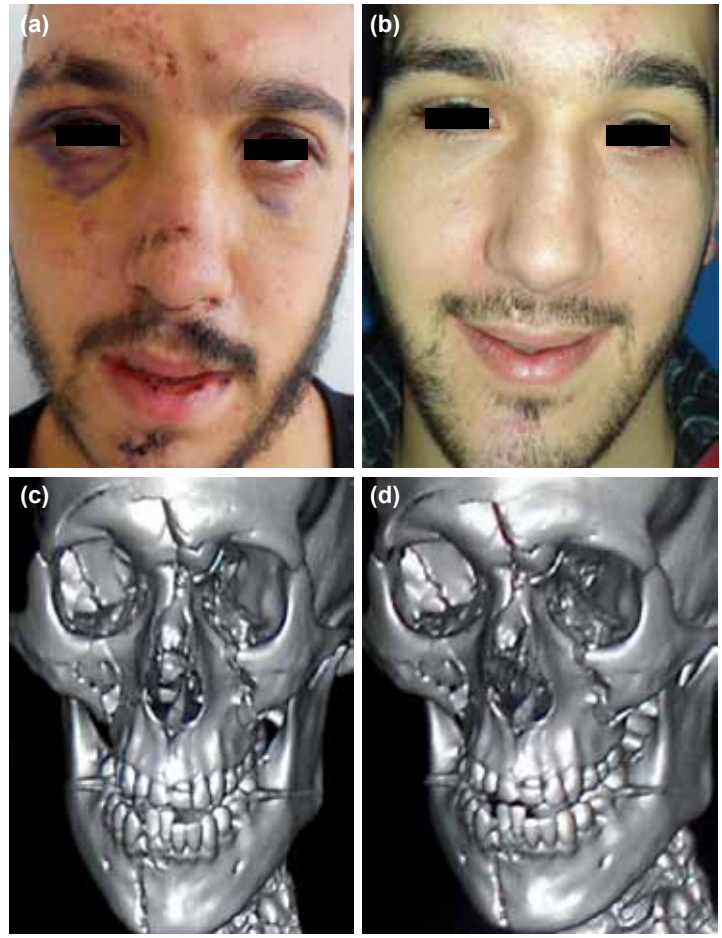

Figure 1. The photograph of the patient injured in a traffic accident with bilateral combined orbital fracture. **(a)** Pre-operative view of the patient. **(b)** Three months after bilateral orbital fracture reconstruction surgery via subciliary incision. **(c, d)** Pre-operative three-dimensional computed tomography scans.

traumas were permanent diplopia, apparent orbital wall defect, compression of soft tissue and/or extraocular muscles incarcerated in the fracture line, restricted eye movements, and optic nerve involvement.[21-23] Gazioğlu et al.[22] emphasized that early optic nerve decompression surgery provides recovery in 60% of patients in cases where the optic nerve is affected, and vision could partially be restored even in amaurotic patients. In our study, 47 patients with apparent orbital wall defect, compression of soft tissue and/or extraocular muscles in the fracture line, and restricted eye movements were treated with open surgery with the reduction-fixation of titanium miniplates. A bone graft (crista iliaca) was used in the surgical reconstruction in 12 patients, closed reduction of a zygomatic fracture was performed in 5 patients, and orbital decompression surgery for an apex fracture accompanied by a piece of free bone was performed in 1 patient.

The literature reports that surgical repair of orbital fractures can be performed using different routes such as transconjunctival, subtarsal, transcaruncular, and subciliary, but the two most preferred routes are subciliary and transconjunctival.[24] Each incision location has associated risks and benefits. Using a transconjunctival incision, De Riu et al.[25] observed canthal malposition in 3 of their 24 patients (12.5%), and Novelli et al.,[26] in their group of 56 patients, reported trichiasis in 2 patients (3.5%) and partial entropion in 2 patients (3.5%). Schmäl et al.[27] noticed cheloid formation at the lateral canthotomy site, necessitating surgical repair in 2 of 209 patients (1%), and Mullins et al.[28] reported conjunctival granuloma in 8 of 400 patients (2%). Using a subciliary incision, De Riu et al.[25] observed lagophthalmus in 5 of 23 (21.7%) and cutaneous scarring in 10 of 23 (43%) patients. In our study, the transcutaneous subciliary approach was the routinely used incision method during open reduction procedures of the orbital floor and lateral wall fractures. This approach gave us a large surgical field and facilitated surgical manipulations with a minimal rate of complications. This subciliary approach caused the formation of excessive scar tissue in the postoperative period, with a lower eyelid ectropion and a retraction of the lower eyelid in 2 (2%) of our

patients. We believe that the surgeon's preference and comfort play a pivotal role in influencing the decision regarding which incision to use.

In patients who required a surgical intervention, we observed that 15 (63%) had multiple and displaced fractures (Fig. 1). In our study, 67 patients underwent conservative medical treatment. A conservative approach was adopted when there was a stable fracture, no enophthalmos and no muscle-orbital soft tissue compression, and also when surgical intervention was refused by the patients.

In conclusion, we present the demographics, mechanism of injury, and associated injuries in one of the largest series of orbital fractures reported in the literature from our country. This study makes clear that the frequency of orbital injuries may be reduced significantly by preventing traffic accidents and assaults, by taking precautions in the event they occur, and also by promulgating social programs against violence. Although patients with orbital fractures are usually treated by a multitude of specialists, we believe that oculoplastic surgeons have a major role in the primary and secondary care of all orbital fractures because most complications of these fractures are related to the globe.

This study demonstrates important differences in the demographics and clinical presentation of patients that help to predict concomitant injuries and sequelae and facilitate a more accurate diagnosis in patients with orbital fracture.

Conflict of interest: None declared.

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KLİNİK ÇALIŞMA - *ÖZET*

Orbita kırığı saptanan 132 hastanın geriye dönük analizi

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AMAÇ: Bu çalışmada; 2005-2012 yılları arasında orbita kırığı tanısıyla İstanbul Şişli Etfal Eğitim ve Araştırma Hastanesi'nde tedavi edilen 132 hastanın klinik ve epidemiyolojik özellikleri değerlendirilmesi amaçlandı.
GEREÇ VE YÖNTEM: Orbita kırığı nedeniyle tedavi edilen hastalara ait kayıtlar geriye dönük olarak incelendi. Hastaların yaş ve cinsiyete göre dağılımları, travma etiyolojileri, semptomları, muayene bulguları, kırık lokalizasyonları, eşlik eden sistemik yaralanmalar, uygulanan tedavi prosedürü ve tedavi sonrası saptanan komplikasyonlar değerlendirildi.
BULGULAR: Ortalama takip süresi 9(6-16) ay olan hastaların erkek-kadın oranı 5.3-1 idi. Ortalama yaş 32 (6-82) yıl idi. En sık etiyolojik neden trafik kazaları (%36) ve darp (%32) olarak saptandı. En sık etkilenen duvar medial orbital duvardı (%33). Hastalarda en sık görülen semptom travma bölgesinde zonklayıcı ağrı (%100) ve saptanan bulgu ise periorbital ödem ve ekimozdu (%100). En sık eşlik eden sistemik yaralanma ise serebral travmaydı (%13.6). Hastaların %50.1'i tıbbi tedavi ile konservatif olarak takip edilirken, %49.9'una cerrahi tedavi uygulandı. Tedavi sonrası en sık gözlenen komplikasyonun dermatomal duyu kaybı (%11) olduğu görüldü.
TARTIŞMA: Bu çalışma orbital kırıklarının görülme sıklığının azaltılabilmesi için trafik kazalarını ve olası kaza durumunda yaralanmayı önleyiciyi tedbirlerin alınmasının, eğitim programlarının geliştirilmesinin önemini vurgulamaktadır.
Anahtar sözcükler: Epidemiyoloji, demografi, orbita kırığı, travma.

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