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Orbital bone fractures: 10 years' experience at the Rome trauma centre: retrospective analysis of 543 patients

Paolo Priore, Danilo Di Giorgio *, Gloria Marchese, Marco Della Monaca, Valentina Terenzi, Andrea Battisti, Mariateresa Fadda, Valentino Valentini

Department of Oncological, Reconstructive Maxillo-Facial Surgery, "Sapienza University of Rome", Rome, Italy

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Abstract

Orbital fractures are among the most frequent facial traumas. This study retrospectively analysed patients treated in Umberto I Hospital Trauma-Centre, Sapienza University of Rome from 1 January 2010 to 31 December 2020. The inclusion criteria were as follows: diagnosis of pure/impure orbital bone fracture, complete clinical and radiological records, and a minimum 12-month follow up. Gender, age, aetiology, fracture type, treatment, and associated complications were analysed using IBM SPSS Statistics, and p values of <0.05 were considered significant. In total, 1393 patients presented with orbital trauma, 543 of whom met the inclusion criteria and underwent surgery (394 males (72.6%) and 149 females (27.4%); mean (range) age 39.2 (7–90) years). Assault (n = 165, 30.4%) was the most common cause of trauma, followed by road traffic accidents and sports-related incidents. Diplopia was the major symptom at diagnosis (n = 183, 33.6%). Open reduction and internal fixation via a sub-eyelid approach was the preferred treatment, achieving a significant reduction in the functional changes induced by fracture ($p < 0.05$). Our data will aid future studies of maxillofacial traumatology and suggest that education and prevention measures could reduce the incidence of this type of trauma.

Keywords: Orbital fractures; Maxillofacial; Surgery; Trauma; Epidemiology

Introduction

The epidemiology of maxillofacial fractures depends on the socioeconomic and demographic characteristics of the target population. The lifetime cumulative incidence of ocular injury in the general population is 14.4%, with 86% of all orbital bruising occurring in association with orbital fractures.[1] Orbital trauma is a frequent maxillofacial pathology. Forces can act on the orbital walls directly or indirectly, leading to different fracture patterns. Cramer et al divided orbital fractures into pure (confined to the orbital walls) and impure (extending to adjacent bone) types.[2] Typically these traumas are associated with complications of varying severity. Enophthalmos and diplopia are the most frequent complications[3] followed by optic nerve impairment. While retrobulbar haematoma is a severe complication that must be treated immediately, it is also rare. The main goal of orbital fracture treatment is to re-establish the pre-traumatic orbital volume by restoring the continuity of the bony walls through various reconstructive approaches.[4–6]

Policlinico Umberto I is the largest hospital in Rome; 138,934 patients were admitted in 2018, including 40,277 trauma patients admitted from 2016 to 2019. This retrospective study evaluated the epidemiology of orbital fractures in patients treated at our institution in 2010–2020, focusing on the associations among age, sex, aetiology, fracture site (mandibular or other facial areas), and surgical treatment.

Material and methods

The clinical charts of all patients admitted to the maxillofacial surgery trauma centre of Umberto I Hospital in Rome

* Corresponding author at: Viale del Policlinico 155, Rome, RM 00186, Italy.
E-mail address: danilo.digiorgio@uniroma1.it (D. Di Giorgio).

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for orbital trauma from January 2010 to March 2020 were retrospectively analysed. The inclusion criteria were as follows: diagnosis of pure/impure orbital bone fracture, complete clinical records, preoperative computed tomography (CT), and minimum 12-month follow up. Data on gender, age, trauma aetiology, fracture type, approach, reconstruction materials, hospitalisation, and complications were collected. For patients who underwent surgery, data on the surgical approach, hospitalisation, and complications were collected. All data were analysed using IBM SPSS Statistics for Windows version 27 (IBM Corp). P values of <0.05 were considered statistically significant.

Results

In the study period 1357 patients with orbital trauma were admitted to the emergency department. Of them, 543 met the inclusion criteria and were enrolled in the study. There were 394 males (72.6%) and 149 females (27.4%), with a mean (range) age of 39.2 (6–90) years. Patients were stratified into nine groups according to decade of life. There were 16 (2.95%), 47(8.66%), 127 (23.39%), 118 (21.73%), 83 (15.29%), 57 (10.5%), 41 (7.55%), 36 (6.63%), and 18 (3.31%) patients in the first to ninth decades of life, respectively (Fig. 1). The fractures were pure orbital fractures in 357 (65.74%), with blow-out fracture being the most common type (306; 85.7%). The remaining 186 (34.2%) patients had impure orbital fractures, and 118 (63.4%) showed involvement of the zygomatic complex. The most common aetiology was assault (n = 165; 30.4%), followed by road traffic accidents (RTAs) (n = 143; 26.3%), sports-related trauma (SRT; n = 123; 22.7%), accidental trauma (n = 79; 14.5%), and 'other' (n = 33; 6.1%; for example, struck by a horse) (Table 1). The main signs and symptoms at diagnosis were diplopia (n = 183; 33.6%), hypoaesthesia in the second trigeminal branch (HTB) dermatome (n = 145; 26.7%), enophthalmos (n = 94; 17.3%), and ocular movement limitation (OML) (n = 85; 15.7%). The mean (SD) time from diagnosis to surgery was 3 (4) days. The subpalpebral surgical approach was used most often (n = 353; 64.7%), followed by transconjunctival (n = 147; 27.1%) and subciliary (n = 43; 8.2%) approaches. The orbital wall was reconstructed using different implants, including bovine pericardium membrane (n = 237; 43.6%), decellularised heterologous bone graft (n = 123; 22.6%), dura mater membrane (n = 107; 19.8%), and titanium mesh (n = 76; 14%). Major postoperative complications occurred in 32 patients: 20, 5, and 7 developed diplopia, orbital haematoma, and reconstruction material-related problems, respectively. Nine patients underwent reoperation: three were treated for improper implant positioning, three for screw infections, two for haematoma drainage, and one for religious reasons (the patient was not cognisant of the origin of the swine bone allograft and asked for a replacement).

At the 12-month follow up, 43 patients (8%) complained of ongoing diplopia, 21 (4.3%) had residual enophthalmos, 18 (3.3%) had OML, and 80 (14.7%) ongoing HTB. Furthermore, 29 patients (5.7%) complained about the cosmetic outcome of the scar. Of these, 17 involved subpalpebral incisions and 12 subciliary incisions.

The independent *t* test revealed a significant reduction in the main symptoms and complications related to the fracture following surgical treatment ($p < 0.05$) (Table 2).

Discussion

Craniomaxillofacial trauma accounts for a significant percentage of all trauma cases. The orbital cavity is the main facial anatomical site, being involved in over 40% of all facial traumas, and this is generally followed by mandibular trauma.[7–9] Such injuries can occur in isolation, or in association with others including fractures and soft tissue injuries.[10] The epidemiology of craniofacial lesions varies widely among populations due to differences in socioeconomic conditions, laws, and behaviour. Traumatic pathology has negative economic effects that are directly proportional to the severity of the trauma.[11] Determining the specific aetiopathogenesis of such traumas is important to devise pre-

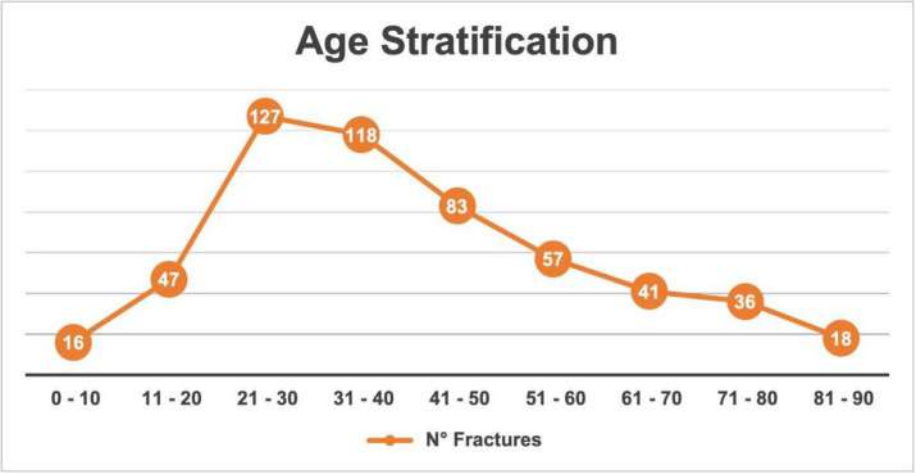

Fig. 1. Patients' age stratification of first to ninth decades of life.

Table 1
Patients' demographic and aetiopathological data.

Sex

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	man	394	72,6	72,6	72,6
	woman	149	27,4	27,4	100,0
	Total	543	100,0	100,0	

Type

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	pure	319	58,7	58,7	58,7
	impure	224	41,3	41,3	100,0
	Total	543	100,0	100,0	

Aetiology

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	assaults	165	30,4	30,4	30,4
	RTA	123	22,7	22,7	53,0
	SRT	143	26,3	26,3	79,4
	accidental trauma	79	14,5	14,5	93,9
	other	33	6,1	6,1	100,0
	Total	543	100,0	100,0	

vention strategies and efficiently allocate health resources for their treatment.

Descriptive research is the first step towards improving the treatment of, or preventing, this condition. Our retrospective study fully evaluated the epidemiology of orbital fractures treated in our trauma centre from January 2010 to March 2020. The onset of the COVID-19 epidemic changed professional and social habits, and from December 2019, cases of SARS-CoV-2 infection increased steadily such that on 11 March 2020, the Italian population was placed under lockdown to stop the spread of the virus. As COVID-19 changed the national health system and maxillofacial trauma epidemiology[12,13] we decided not to include the period following the outbreak of the pandemic, as it would have complicated the data analysis; moreover, we believe that other ongoing scientific studies are examining that period. We evaluated data on patients' age and gender, and on aetiology, symptoms, clinical findings, fracture type, treatment, complications, and follow up.

When orbital fracture is suspected, CT is the assessment of choice; it is superior to magnetic resonance imaging (MRI) and ultrasound (US) in terms of bone visualisation and analysis of the soft tissues involved.[14] Although some studies have shown the superiority of MRI for soft tissue trauma analysis, coronal CT is the most effective imaging modality for assessment of the orbital floor.[15,16] Orbital floor fractures can cause severe functional complications and obvious aesthetic imperfections. The main types are dysaesthesia (generally related to trauma of the infraorbital nerve passing through the floor of the orbit), diplopia (usually due to prolapse of the orbital contents following orbital floor fractures or, in the worst-case scenario, incarceration of the inferior rectus or inferior oblique muscle), enophthalmos, extraocular movement limitation, and ocular injuries.

Minimally displaced orbital fractures do not cause functional or aesthetic changes and, depending on the patient's age and performance status, do not normally require corrective surgery. We believe that early treatment leads to better results. Consistent with this view, several authors have recommended performing operations within two weeks of trauma.[17,18] Our indications for surgical treatment are persistent diplopia, increased orbital pressure, enophthalmos, visual deterioration, extraocular movement disorders, and hypoaesthesia of the infraorbital nerve, with surgery times ranging from one to seven days after injury.[19]

Open reduction and internal fixation is the surgical technique of choice for both pure and impure orbital fractures. Other techniques include computer-assisted 3-dimensional reconstruction and endoscopic repair, especially for fractures of the medial orbital wall.[20,21] Our analysis shows how social behaviours affect the epidemiology of maxillofacial trauma: assaults and RTAs were the two principal causes of trauma in

Table 2
Statistical analysis of the main complications recorded before and after operation. Independent *t* tests revealed a significant reduction in the main symptoms and complications related to the fracture following surgical treatment.

Diplopia Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
PostOp	Equal variances assumed	917,937	<,001	-10,496	541	<,001	-,23497	,02239	-,27895	-,19100
	Equal variances not assumed			-7,477	182,000	<,001	-,23497	,03143	-,29698	-,17296

HTB Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
PreOp2	Equal variances assumed	74,380	<,001	-22,092	541	<,001	-,85961	,03891	-,93605	-,78318
	Equal variances not assumed			-53,187	462,000	<,001	-,85961	,01616	-,89137	-,82785

Enophthalmos Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
PreOp3	Equal variances assumed	19,403	<,001	-11,344	541	<,001	-,86015	,07582	-1,00910	-,71121
	Equal variances not assumed			-56,608	521,000	<,001	-,86015	,01519	-,89000	-,83030

OML Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
PreOp4	Equal variances assumed	14,398	<,001	-11,072	541	<,001	-,87238	,07879	-1,02715	-,71761
	Equal variances not assumed			-59,850	524,000	<,001	-,87238	,01458	-,90102	-,84375

our patient cohort. Males were affected much more frequently than females; the male:female ratio was 2.6:1 in this study. The incidence of injuries was highest in the 21–40-year age group, which accounted for 45.12% of all treated fractures (Fig. 1). This can be explained by the high incidence of psychoactive substance abuse in these decades of life.[22] The Italian National Institute of Statistics has reported that psychoactive substance use is highest among those aged 18–24 years; this group also accounts for 17% of all binge drinkers.[23] In Italy men abuse psychotropic substances far more often than women.[22,23]

The reduction in RTAs seen in Italy can be explained by increasingly strict laws regarding alcohol consumption while driving, and the use of seat belts and motorcycle helmets, as well as a greater availability of safety equipment such as airbags. All these factors have significantly reduced the likelihood of traumatic maxillofacial road injuries.[24] However, due to these measures the relative proportion of trauma caused by interpersonal violence has increased, such that it is now the predominant cause. Alcohol and drug use are both important contributing factors.[18,25]

Conclusion

Our data can be considered reliable, as they are from the largest hospital in Rome with the most emergency room visits. Males are much more likely to experience orbital trauma, with assaults and traffic accidents being the main causes. The abuse of psychotropic substances by young people, together with stricter road regulations, explains the relative increase in orbital trauma cases caused by assault compared with RTAs, assault now being the main cause of such trauma. Open reduction and internal fixation is the treatment of choice due to the excellent efficacy and low complication rates. Our results agree with other studies and constitute important clinical information that will aid future investigations of these injuries. While road safety legislation has proven effective in reducing the incidence of facial trauma, there is a need for more effective social safety nets to reduce the abuse of alcohol and drugs, and associated physical violence, which is currently widespread among young people in Italy, especially in poorer communities. We believe that the continuous sharing of epidemiological data on trauma provides useful information for legislators. Interventions to address risky behaviours will reduce their negative impact on the population.

Ethics statement/confirmation of patient permission

This study and procedures were carried out in accordance with ethical principles of the World Medical Association's Declaration of Helsinki. Informed consent was obtained

from all participants before including them in the study. All procedures followed the ethical standards of our institutional review board.

Conflict of interest

All authors certify that they have no affiliations with or involvement in any organisation or entity with any financial interest in the subject matter or materials discussed in this manuscript.

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