Avicenna J Dent Res. 2018 March;10(1):16-21

doi 10.34172/ajdr.2018.04

AJDR
Avicenna Journal of Dental Research

Original Article

Epidemiologic Study of Ocular Injuries in Patients With Maxillofacial Fracture in Hamadan

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Abstract

Background: Maxillofacial fractures are frequently complicated with injury to the eye and its adnexa. These injuries may result in loss of vision in one or both eyes or may compromise ocular function. This study aimed to evaluate ocular injuries in the patients with maxillofacial trauma.

Methods: Two hundred patients with maxillofacial fractures were examined by maxillofacial surgeons and suspected cases of ocular injuries were referred for ophthalmologic consult. Sixty-three patients were excluded from the study due to death and low Glasgow Coma Score (GCS). Patients' information including maxillofacial fractures and ocular injuries were recorded in check lists and analyzed with SPSS software version 16.0.

Results: out of 137 patients, 106 (77.4%) were males and 31 (22.6%) were females and their mean age was 34.1 ± 17.1. The age group with the highest rate of involvement were 21-40 years (46%). The most common cause of injury was motorcycle accident (32.1%), car accident (30.7%), and in the third place was falling down (13.9%). The incidence of right eye injuries was 5/9%. Right eye was also involved more frequently than left eye (38% and 32.1%, respectively), and in 41 cases (29.9%) both eyes were involved. The prevalence of minor ocular injury was 52.6%, moderate injury was 24.8%, and major injury was 22.6%. The most common ocular injuries were periorbital ecchymosis (83.9%) and subconjunctival hemorrhage (72.2%), and unfortunately 5 cases (3.6%) lost their vision.

Conclusions: The significant prevalence of ocular injuries due to maxillofacial trauma certifies the necessity of immediate ophthalmologic examination to prevent permanent vision loss. A multidisciplinary team composed of neurosurgeons, plastic, oral and maxillofacial, ENT and ophthalmic surgeons are suggested to improve management of maxillofacial trauma.

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Keywords: Ocular Injuries, Maxillofacial Fractures, Blindness

Received November 23, 2017
Accepted March 18, 2018
ePublished March 28, 2018

Citation: Eslami F, Zandi M, Seif Rabiei MA, Bigonah N, Sharifi S. Epidemiologic study of ocular injuries in patients with maxillofacial fracture in Hamadan. Avicenna J Dent Res. 2018;10(1):16-21. doi: 10.34172/ajdr.2018.04.

Background

The globe and adnexal structures are frequently injured during blunt facial trauma. Facial fractures have been reported to increase the risk of developing ocular injuries 6.7 times more when compared with major trauma in the patients with no facial fractures (1). The preliminary examination of the patients with maxillofacial trauma involving facial bone fracture should include a measurement of visual acuity, and all the patients diagnosed with even a little reduced visual acuity should be referred to ophthalmologists for anterior and posterior eye examination to explore if latent and potential ocular trauma and injuries could exist (2). The prevalence of ocular injuries in the patients with fractures of the middle third of the facial skeleton varies from 2.7% to 90.6%. This inconsistency in reports is associated with the factors such as examination skills of physician, referral (or lack of referral) to ophthalmologist, inclusion of minor injuries with major ones, and finally retrospective or prospective nature of the study (3). The prevalence of ocular injuries in maxillofacial trauma patients has been extensively investigated in different studies. In a study conducted in India, it was reported that 68.3% of the patients with maxillofacial fractures suffered from ocular injury. In this study, minor ocular injuries included swelling, bruising,

Highlights

- According to results of this study, the highest rate of ocular involvement (46%) in Patients with Maxillofacial Fracture was seen in the age group of 21-40 years old.
- The most common cause of injury was motorcycle accident (32.1%), followed by car accident (30.7%), and the next most common cause was falling down (13.9%).
- Of the studied patients, 68% had at least 1 associated non-ocular injury, most frequently caused by neurosurgical problems and 18.2% had 2 or more associated non-ocular injuries
- In 60.2% of the cases, visual impairment was mild to moderate, and in 3.6% of the cases, it was complete or nearly complete
- The prevalence of minor ocular injuries was 52.6%, and the prevalence of moderate and severe injuries was 24.8% and 22.6%, respectively and the most common ocular injuries were periorbital ecchymosis (83.9%) and subconjunctival hemorrhage (72.2%).

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and abrasion of eye lids, subconjunctival hemorrhage and superficial corneal abrasion without ocular sequel. Moderate ocular injuries were classified as: enophthalmos and injury and laceration of conjunctiva and eyelids with mild visual impairment requiring intervention. And severe ocular injuries included: retinal, optic nerve or vitreous injuries with permanent sequel. The prevalence of blindness was 6.45%, all due to optic neuropathy, which was caused in half of the cases by midfacial fracture and in the other half by frontal fracture (4). In another study in Italy with a larger sample size, 2.2% of the patients with facial bone fracture suffered from blindness or severe vision loss (5).

Objectives

Considering the absence of any research in this area among Iranian population and the strong possibility of prevalence of different ocular injuries in maxillofacial traumas in regional reports from neighboring countries, due to sociocultural and economic differences in these countries, the authors conducted an epidemiologic study to examine ocular injuries in maxillofacial fracture patients admitted to Besat hospital, Hamadan, Iran, from November 2014 to November 2015.

Methods

In this prospective cross-sectional study, 200 maxillofacial fracture patients with ocular injuries who were admitted to Besat hospital, Hamadan, Iran, during November 2014 to November 2015, were examined. In total, 63 patients were excluded because of death, discharge or long-term loss of consciousness. In the preliminary examination, the fracture type was determined by a maxillofacial surgeon based on diagnostic radiographic data. The cases with ocular injuries were referred to an ophthalmologist for complete ocular examination including visual acuity, pupillary reflex, slit lamp examination and fundoscopy. In the end, the collected data were entered into SPSS software version 16.0 and then were analyzed using descriptive analysis and chi-square tests for comparative statistics.

Results

In our study, 137 patients with ocular injury following a maxillofacial trauma were evaluated. Of these patients, 106 (77.4%) were male and 31 (22.6%) were female, namely, a male to female ratio of 3.5:1. Mean age of participants was 34.1±17.1 years with a range between 6 months and 76 years. Of all the patients who completed the study, 22.6% were in the age group of 0-20, 46% were in the age group of 21-40, 23.4% were in the age group of 41-60, and 8% were in the age group over 60. According to age group stratification, the highest rate of ocular involvement (46%) was seen in the age group of 21-40 years old (Table 1). The most common cause of injury was motorcycle accident (32.1%), followed by car accident (30.7%), and the next most common cause was falling down (13.9%). Among women, the most common cause of trauma was car accident (58%), but among men, the most common cause was motorcycle accident (41%). None of the women were injured in a motorcycle or work accident. Examination of 137 patients revealed 237 maxillofacial fractures including 67 zygomatic, 54 orbital, 40 nasal, 16 mandibular, 14 zygomaticomaxillary complex (ZMC), 13 frontal, 9 naso-orbitoethmoids (NOEs), 6 maxillary sinus, 6 LeFort I, 5 LeFort III, 4 LeFort II, and 3 dentoalveolar fractures. A summarized report of different fracture types and their frequencies with different levels of ocular injuries is provided in Table 2. Right eye injuries were more frequent than left eye injuries (38% and 32.1%, respectively), and in 41 cases (29.9%) both eyes were injured. Of the studied patients, 68% had at least 1 associated non-ocular injury, most frequently caused by neurosurgical problems and 18.2% had 2 or more associated non-ocular injuries. The time between trauma incidence and the first ocular examination was at least 4 hours and at most 12 days, with a mean of 2.82 ± 2.52 days. In 60.2% of the cases, visual impairment was mild to moderate, and in 3.6% of the cases, it was complete or nearly complete. The mean visual acuity of patients was 0.3 Log MAR. Double vision was diagnosed in 16 cases (11.7%).

Table 1. Demographic Characteristics of the Study Participants

		Male, No. (%)	Female, No. (%)	Total, No. (%)
Sex		106 (77.4)	31 (22.6)	137 (100)
Age group	0-20	26 (25)	6 (20)	31 (22.6)
	21-40	52 (49)	13 (43)	63 (46)
	41-60	21 (20)	8 (26)	32 (23.4)
	≥60	7 (6)	4 (11)	11 (8)
Age (mean± SD)		36.4 ± 17.32	33.7 ± 15.44	34.1 ± 17.1

The prevalence of minor ocular injuries was 52.6%, and the prevalence of moderate and severe injuries was 24.8% and 22.6%, respectively. The most common ocular injuries were periorbital ecchymosis (83.9%) and subconjunctival hemorrhage (72.2%). A summarized report of ocular injuries is provided in Table 3. The majority of patients (75.2%) were treated medically and 34 patients (24.8%) received surgical treatment, of which 16 cases (11.2%) had eyelid laceration, 14 cases (10.7%) had globe rupture and 4 cases had canalicular laceration (2.9%). Enucleation was performed in one case with open globe rupture. Thirteen patients had traumatic optic neuropathy (9.5%); one case with optic nerve avulsion and 12 cases with direct or indirect pressure on the nerve in the optic channel due to bone fracture and hematoma. Five cases (3.6%) had lost their sight. The analysis of eye injuries according to cause of accidents did not show any significant relationship between cause of accidents and severity of ocular injuries

Table 2. Severity of Ocular Injuries in Various Types of Maxillofacial Fractures in the Study Participants

Type of Fracture	Minor Ocular Injury, No. (%)	Moderate Ocular Injury, No. (%)	Major Ocular Injury, No. (%)	Frequency
Lefort	5 (3.85)	0 (0)	1 (2)	6
Lefort I	1 (0.77)	2 (3.5)	1 (2)	4
LEfort II	0 (0)	1 (1.75)	4 (8)	5
Zygoma	35 (26.92)	20 (35.1)	12 (24)	67
Zygomatiomaxillary	3 (2.3)	5 (8.77)	6 (12)	14
Nasal	25 (19.23)	9 (15.8)	6 (12)	40
Nasoorbitoethmoidal	6 (4.62)	1 (1.75)	2 (4)	9
Frontal	7 (5.38)	3 (5.28)	3 (6)	13
Maxillary sinus	2 (1.55)	2 (3.5)	2 (4)	6
Mandibular	12 (9.23)	2 (3.5)	2 (4)	16
Dentoalveolar	3 (2.3)	0 (0)	0 (0)	3
Orbital	31 (23.85)	12 (21.05)	11 (22)	54
Total	130 (100)	57 (100)	50 (100)	237

Table 3. Frequency of Ocular Injuries in Maxillofacial Fractures in the Study Participants

Type of Ocular Injury	Number	Percent
Periocular hematoma	115	83.9
Subconjunctival hemorrhage	99	72.2
Eyelid laceration	16	11.7
Globe rupture	14	10.2
Traumatic optic neuropathy	13	9.5
Corneal abrasion	10	7.3
Retinal hemorrhage	7	5.1
Iris damage	6	4.4
Ocular nerve damage	6	4.4
Blindness	5	3.6
Hyphema	4	2.9
Vitreous hemorrhage	4	2.9
Cataract	3	2.2
Canalicular laceration	4	2.9
Retrobulbar hemorrhage	3	2.2
Total	388	

Table 4. Severity of Ocular Injuries in Different Causes of Injuries

Cause of Injury	Minor	Moderate	Major	Total
Motor accident	25 (56.82)	11 (25)	8 (18.18)	44
Car accident	18 (42.87)	14 (33.33)	10 (23.8)	42
Falling down	13 (68.42)	3 (15.79)	3 (15.79)	19
Pedestrian accident	7 (50)	4 (28.57)	3 (21.43)	14
Violence	4 (57.15)	2 (28.57)	1 (14.28)	7
Occupational accident	3 (42.85)	0 (0)	4 (57.15)	7
Sport accident	1 (50)	0 (0)	1 (50)	2
Falling ground	1 (50)	0 (0)	1 (50)	2

P value = 0.548.

($P<0.05$). Regardless of the type of injuries, most ocular injuries were minor in all types (Table 4).

Discussion

Ocular injuries are unavoidable consequences of maxillofacial fractures. In this study, we examined 137 patients with ocular injury due to maxillofacial trauma to determine the frequency of different types of ocular injuries and their relation to the type of fractures among Iranian population. Our results are partly consistent and partly inconsistent with previous reports. The most important cause of any inconsistency between our results and other reports is the difference in the studied population. To be more specific, many similar studies have been performed by maxillofacial surgeons on the patients with maxillofacial fractures in order to determine the prevalence of different ocular injuries among these patients. However in our study, the entire population consisted of the patients with ocular injury following a maxillofacial fracture. Like most previous studies, we found men to be more susceptible to ocular injuries than women. This can be attributed to the typical lifestyle and occupation of men and being more active, community-dwelling, compared to women (3,4,6-8). In our study, the male-female ratio was 3.5:1; this ratio has been reported as low as 2:1 and as high as 14:1 in other studies (9,10).

A majority of previous studies have reported that people in the age range of 20-30 years have the highest prevalence of ocular injury, and our findings supported this subject (7,8).

The most common causes of injuries in our study were road accidents -especially motorcycle and car accidents and then falling down. This finding is consistent with the results of Mittal et al, Riaz et al, Septa et al, and Ansari et al (4,7,8,11), but it is not in agreement with the reports of Jamal et al, Roccia et al, Al-Qurainy et al and Holt

et al, in which physical conflict and work place trauma were the most common causes of maxillofacial fractures (3,5,6,12). This may be attributed to the cultural, social and economic differences between different countries. In Iran, high speed driving, insufficient attention to traffic rules and excessive and improper use of motorcycles are the main causes of high rates of road accidents (13). Our observations with regard to the incidence of associated non-ocular traumas among the study population were somewhat similar to other studies, as neurosurgery trauma had the highest association with ocular injuries (6,11). This result suggests that ocular injuries should be treated as part of the traumatic injury of the body as a whole and be viewed from a more comprehensive perspective.

In some studies, the orthopedic trauma was the most common trauma associated with ocular injuries (14-16). This difference may be due to variations in sampling technique or greater likelihood of association of eye damage and brain injury due to their anatomical proximity. Most patients in our study were treated exclusively with medical treatment and only 34 patients (24.8%) received surgical treatment (including 16 eyelid, 14 globe and 4 canalicular laceration). While the majority of studies have not specified the treatment methods, this part of our results is completely inconsistent with the reports of Rezaei et al and Roccia et al, where the percentage of patients receiving surgical treatment was as high as 85.5% and 42.5%, respectively. The cause of this difference can be the difference in the type of patient population, which we explained at the beginning of the discussion. To be more specific, in Roccia and colleagues' study, only patients with severe ocular injury were included (5). The study of Rezaei et al investigated the ocular injuries in the patients with orbital fractures (17). Our findings with regard to the frequency of types of ocular injuries is roughly similar to the results of previous studies. In many of the previous studies, such as those conducted by Jamal et al, Mittal et al, Al-Qurainy et al, Septa et al and Holt et al, minor eye injuries have been far more frequent than other injuries (3,4,6,11,12).

In a retrospective study in Hamadan, Iran, on 294 zygomatic fractures, Mohajerani et al revealed that periorbital ecchymosis was the most common ocular complication (58%) in the study population (18). This result is similar to our result, in which we revealed that 83.9% of our study participants with maxillofacial fracture had periorbital hematoma.

The most important major traumas in this study were globe rupture, optic neuropathy, retinal and vitreous hemorrhage, retrobulbar hemorrhage, blindness and hyphema. The prevalence of globe rupture in this study was 10.2% (14 patients), which is consistent with the reports of Jamal et al, Mittal et al and Amrith et al (3,4,19) but not with the results of Roccia et al (5) and Nagase et al (20). This difference can be attributed to larger sample size and the nature of populations of those studies, which assessed ocular injuries in middle third facial fractures or fractures in one or more orbital walls (5,20). Traumatic optic neuropathy was seen in 13 cases (9.5%), which is in agreement with the results of Jamal et al, Mittal et al, Ansari et al and Al-Qurainy et al (3,4,6,8), but not with the results of Roccia et al, Nagase et al and Amrith et al, for the same reasons as above-mentioned (5,19,20). The prevalence of retinal, vitreous and retrobulbar hemorrhage among our patients was 5.1%, 2.9% and 2.2%, respectively, which are consistent with the results of Mittal et al, Riaz et al, and Al-Qurainy et al, but are lower than the results reported by Nagase et al, Jamal et al and Ansari et al. The mentioned difference may be due to differences in the population and type of facial fractures, examination skills of the physician, use of more precise instruments, and faster referral to ophthalmologist (3,4,6-8,11,20). In our study, hyphema had a prevalence of 2.9%, which is in agreement with the results of Mittal et al, Jamal et al and Septa et al (3,4,11) and blindness had a prevalence of 3.6% which is consistent with the reports of Mittal et al, Septaet al and Amrith et al (4,11,19). In the study of Ansari et al, however, the prevalence of blindness among the patients with ocular injury was 37%. The greater prevalence of blindness in the reports of Roccia et al and Ansari et al can be attributed to the exclusion of records of mild ocular injuries from their results (5,8).

In our results, frequency of different types of ocular injuries varied with the type of maxillofacial fracture. In all cases except for one case, LeFort I fracture was associated with minor ocular injury and LeFort III and ZMC fractures were associated with major ocular injuries. Moreover, 62% of nasal fractures were associated with minor ocular injury. In contrast to previous studies, the prevalence of ocular injuries in the cases with mandibular and frontal fractures was significantly different, in the sense that none of the people with mandibular fractures had ocular injuries, but most of the cases with frontal fractures had such injuries. In our study, 30% of blindness cases were due to optic neuropathy, but in the study of Mittal et al, all cases of blindness were due to optic neuropathy (4). In the study of Roccia et al, blindness was mostly due to globe rupture, and in the study of Ansari et al, it was mostly due to retrobulbar hemorrhage (5,8).

All incidents of blindness in the present study were seen in the cases with orbital, frontal, LeFort III and ZMC fractures, but there was no statistically significant difference between these fractures and others in this respect. However, middle third facial fractures in the study of Roccia, LeFort III, LeFort II and NOE fractures in the study of Faryabi, and zygomatic fracture in the study of Septa et al and Ansari et al were more associated with the risk of blindness than any other fracture (5,8,11,21). In our study, the most frequent type of orbital wall fracture

was fracture in orbital floor (16.1%), and then in external wall (13.9%). In 8.8% of the cases, orbital fracture was of blow out type, and in 9.5% of the cases (13 patients), more than one orbital wall was fractured. We found a significant relationship between the types of ocular injury and the type of orbital fracture. Severe injuries such as retinal detachment, retinal hemorrhage and blindness were associated with the fracture of the external wall of the orbit, while vitreous hemorrhage was associated with orbital roof fracture; moderate injuries such as scleral rupture, enophthalmos, and conjunctival rupture were associated with blow out fracture; and mild injuries such as infraorbital nerve injury were associated with orbital floor fracture. In Rezaei and colleagues' study, the cases with internal orbital wall fracture and orbital floor fracture had a higher enophthalmos frequency than those with other fractures (17). In the study of Read and Sires, severe ocular injuries were associated with orbital roof and wall fractures and moderate ocular injuries were associated with orbital floor fractures, which are in agreement with our findings (22). In our study, optic nerve injury and retrobulbar hemorrhage had no significant relationship with any of the fractures. But in the study of Amirth, optic neuropathy was significantly more frequent in the cases with orbital roof fracture (19). This difference may be due to inclusion of a large number of mix fractures in our study, in contrast to evaluation of injuries in the isolated cases of orbital fractures in that study. Future works in this field are suggested to broaden the scope of research. Employing a single ophthalmologist for all eye examinations, comparing the ocular injuries before and after pharmacotherapy or surgical treatment, conducting follow-ups, and examining postoperative complications of maxillofacial surgeries are also suggested.

This study had some limitations. The inability to examine a larger number of patients due to time constraints, the occurrence of unforeseen events during patients' admission and before sufficient examinations, such as death or premature hospital discharge, were examples of limitations.

Conclusions

Considering the significant prevalence of severe ocular injuries in the patients with maxillofacial fracture, especially in the middle third of the facial skeleton, fast and efficient ophthalmologic examination of these patients is essential to prevent permanent visual sequel due to latent ocular injuries. In this regard, active participation of emergency medicine specialist, maxillofacial surgeon, ophthalmologist and neurologist in the framework of a trauma control team is highly recommended.

Authors' Contribution

FE and MZ conceptualized the study. NB and SS performed data collection. MASR contributed to primary and final analysis and all of the authors took part in the final draft.

Ethical Statement

Ethical approval was obtained from the ethical committee of Hamadan University of Medical Sciences. The ethical code number was: REF 3752.

Conflict of Interest Disclosures

The authors declare that they have no conflict of interests.

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