

Ophthalmologic Injuries Associated with Maxillofacial Trauma: A Retrospective 13 Year Analysis

Priyanka Singh¹ and Pavan M Patil²

¹Department of Oral and Maxillofacial Surgery, School of Dental Sciences, Sharda University, Greater Noida, Uttar Pradesh, India

²Professor and Head of Department, Department of Oral and Maxillofacial Surgery, School of Dental Sciences, Sharda University, Greater Noida, Uttar Pradesh, India

*Corresponding author: Pavan M Patil, Professor and Head of Department, Department of Oral and Maxillofacial Surgery, School of Dental Sciences, Sharda University, Plot 32, 34 Knowledge Park 3, Greater Noida, Uttar Pradesh, India



ARTICLE INFO

Received:  December 03, 2020

Published:  December 10, 2020

Citation: Priyanka Singh, Pavan M Patil. Ophthalmologic Injuries Associated with Maxillofacial Trauma: A Retrospective 13 Year Analysis. Biomed J Sci & Tech Res 32(3)-2020. BJSTR. MS.ID.005256.

Keywords: Ocular injury; Maxillofacial trauma; Blindness; Midface fractures; Ophthalmic injury

Abstract

Objective: A study was designed to evaluate the incidence, mechanism of injury and treatment outcomes of ophthalmic injuries associated with maxillofacial trauma.

Material and Methods: 3708 patients who sustained maxillofacial trauma during the years from August 2006 to July 2019 and were included in this retrospective study. Patients' records were reviewed for gender, age, site of injury, aetiology of trauma, concomitant injuries, ophthalmic assessment and method of treatment. Minor and major ophthalmic injuries were recorded.

Results: Of the 103 patients, 81 were male with a median age of 38 years. Road traffic accident was the most common mechanism of injury (72/103, 70%). Common minor ophthalmic injuries included diplopia, enophthalmos, subconjunctival haemorrhage and restriction of the extraocular muscles, while major injuries included subretinal haemorrhage, retrobulbar haemorrhage, ruptured globe and detached retina. Most major ophthalmic injuries occurred in association with orbital fractures. Visual acuity was reduced in 15 patients, four of whom experienced persistent postoperative changes at eight weeks. Lack of vehicle drivability showed a highly significant association with major ophthalmic injury ($p=0.001$). The incidence of loss of vision was 0.97% (1/103).

Conclusion: Prompt assessment and treatment of ophthalmic injuries is of paramount importance in patients with fractures involving fractures of orbital walls.

Introduction

Ocular injuries very often are associated with maxillofacial trauma. Injuries to and around the eye may vary in presentation and severity. Careful ophthalmic examination must be a part of the initial assessment in all maxillofacial trauma patients [1]. Blindness is a potential complication from missed ophthalmic injuries, while certain ophthalmic injuries may be readily evident. In case such injuries are missed at first observation, the treating surgeon may face medicolegal consequences [2]. Ophthalmic injuries may range from certain minor ophthalmic injuries such as abrasions or lacerations to the eyelids or cornea to major injuries which may be potentially blinding. In all motor vehicular accidents, the injury tends to be severe, leading to fracture of the orbit or rupture/penetration of the globe by glass pieces [1].

An ophthalmologist must be a part of the treating team for ocular injury assessment and management. Maxillofacial surgeons may not be aware of many types of ocular injuries that may occur as well as their diagnosis, appropriate therapy or ultimate prognosis. Some ocular injuries may mandate concomitant surgical treatment with maxillofacial fracture repair, while in some cases, presence of an ocular injury may mandate a delay in ophthalmic injury repair secondary to repair of maxillofacial fractures [3]. The incidence of visual loss and blindness from maxillofacial fractures varies from 0.7 to 10.8% [4] and the causes reported in literature include retrobulbar haemorrhage, ruptured globe and traumatic optic neuropathy. Preoperative assessment of ophthalmic injuries is providing a safeguard to the maxillofacial surgeon. Ophthalmic

injury management must be given preference over facial fracture repair, as surgical treatment of the facial fractures in the presence of an untreated severe ophthalmic injury may exert pressure on the eye. This may eventually hamper the prognosis for the globe [5]. Recognition of an ophthalmic injury before operative intervention is important as it guards against a postoperative allegation from the patient alleging the surgical procedure to be the cause of any permanent visual disturbance.

The objective of this study was to determine the incidence and types of ocular and motility disorders in patients who had sustained maxillofacial injuries. Further, we aimed to evaluate mechanism of injury, facial fracture type and treatment outcomes of patients treated for ophthalmic injuries and maxillofacial bone fractures.

Methods

A retrospective study was designed to include surgical records of all patients admitted to the Department of Oral and Maxillofacial Surgery at School of Dental Sciences, Greater Noida, Uttar Pradesh, India who sustained a maxillofacial fracture during the years from August 2006 to July 2019. Excluded from the analysis were patients with maxillofacial fractures not associated with ophthalmic injuries, cranial bleeds that required craniotomy and pre-existing ophthalmic defects. The Institutional ethics committee approved the study. We reviewed patients' charts for data which were collected during this 13 year period. Our surgeons examined 3708 patients with maxillofacial fractures. Radiographs and computed tomography scans were utilized to confirm the diagnosis. An ophthalmologic examination by a consultant ophthalmologist was conducted in cases of zygomatico-maxillary, orbital, naso-orbito-ethmoidal, Lefort III, Lefort II, Lefort I and panfacial trauma cases when deemed necessary.

Patients' personal and clinical data, mechanism of injury and clinical ophthalmic signs were reviewed. All patients had signed informed consent letters as part of the presurgical protocol. Ophthalmic signs were divided into "minor" or "major" based on the chances of the injury leading to permanent loss of vision. Impairment of visual acuity was categorized as "mild" with readings of 6/12 or 20/40, "moderate" between 6/12 or 20/40 and 6/60 or 20/200 or "severe" with less than 6/60 or 20/200, following a careful assessment. Patients were grouped into four groups depending on the type of operative intervention that they required. Group I consisted of purely orbital fractures or naso-orbito-ethmoid (NOE) fractures; Group II included fractures of LeFort I, II and III levels; Group III were fractures of the of zygomatico-maxillary-complex [ZMC]; and Group IV included pan facial fractures (midface with mandible fractures). Fractures were either treated by open reduction and internal fixation with titanium miniplate and screw system under a general anaesthetic

or managed conservatively. Orbital defects were reconstructed with titanium mesh were indicated. Ophthalmic injuries were managed by specialist ophthalmologists.

Drivability criteria involved a measurement of visual acuity for each eye separately and without optical correction. In cases where optical correction was needed, vision was retested with appropriate corrective lenses. A standard visual acuity chart such as Snellen chart was used with five letters on the 6/12 line. Charts are placed six metres from the person tested. More than two errors in reading the letters of any line were regarded as a failure to read that line. In the case of a private vehicle driver, uncorrected vision (without eye glasses) must be a minimum of 6/12 to pass the drivability criteria. For commercial vehicle drivers, visual acuity in the driver's both eyes or better eye (with or without corrective lenses) must be 6/9 or better. 6/9 or 6/12 vision meant that the patient must be able to see clearly a letter or alphabet on the Snellen chart at a distance of 6 metres what a person with normal vision may see clearly at 9 or 12 metres respectively.

Data collected was recorded in Microsoft Excel and analysed using IBM SPSS Statistics for Windows (version 22.0, IBM Corp, Armonk NY, USA). The Kolmogorov-Smirnov test of normality with Lilliefors significance correction was used to test for normality of continuous variables in the study. Based on the outcome of the normality test, median and inter quartile range (IQR) for non-parametric data were derived. Descriptive data were reported as a number (%). Categorical data were analysed using the Chi square test to determine whether there was a significant difference between minor and major ophthalmic signs and other variables. Binary logistic regression was utilized to assess the significance of association between minor and major ophthalmic signs, the severity of visual impairment, and its association with the various locations of fractures. A probability value of < 0.05 was considered as statistically significant.

Results

The study sample consisted of 103 patients, of whom 81 were male (79%), with a median (IQR) age of 38 (18-59) years. The number of patients who had each type of fracture were Group I (n=13, 13%), Group II (n=32, 31%), Group III (n=42, 41%), and Group IV (n=16, 16%). Road traffic accident (RTA) was the most common mechanism of injury, and accounted for 72/103 cases (70%), followed by assaults (15/103, 15%), falls (13/103, 13%), and sports injuries 03/103, 5%). Most patients (90/103) were surgically treated within 2 weeks of the trauma. Those treated after this period were those with persistent diplopia or unaesthetic enophthalmos, or those in whom early orbital reconstruction was contraindicated because of persistent, severe, intra ocular injuries. Minor and major ophthalmic findings are outlined in Tables 1 & 2.

Table 1: Description of minor ophthalmic injuries.

	Group 1 (n=13)	Group 2 (n=32)	Group 3 (n=42)	Group 4 (n=16)	Total (%) (n=103)
Diplopia	2	13	6	2	23 (23%)
Enophthalmos	1	2	3	1	7 (7%)
Proptosis	1	2	0	0	3 (3%)
Corneal injury	1	1	0	1	3 (3%)
Subconjunctival haemorrhage	6	13	11	4	34 (34%)
Restriction of extraocular muscles	0	4	3	0	7 (7%)
Entrapment of muscle	0	2	2	0	4 (4%)
Epiphora	1	0	1	2	4 (4%)
Increased intraocular pressure	2	0	0	2	4 (4%)
Chemosis	1	0	0	0	1 (1%)
Conjunctival detachment	0	0	0	1	1 (1%)
Stereopsis	0	0	1	0	1 (1%)

Table 2: Description of major ophthalmic injuries.

	Group 1 (n=13)	Group 2 (n=32)	Group 3 (n=42)	Group 4 (n=16)	Total (%) (n=103)
Traumatic mydriasis	0	0	0	0	1 (1%)
Traumatic iritis	0	0	0	0	0 (0%)
Hyphaema	0	0	0	0	0 (0%)
Dislocated lens	0	0	0	1	1 (1%)
Comotio retinae	0	0	1	0	1 (1%)
Subretinal haemorrhage	0	1	1	0	2 (2%)
Vitreous haemorrhage	1	0	0	0	1 (1%)
Detached retina	0	1	1	0	2 (2%)
Ruptured choroid	1	0	0	0	0 (0%)
Ruptured globe	0	1	0	1	1 (1%)
Traumatic optic neuropathy	0	1	0	0	1 (1%)
Relative afferent papillary defect	0	0	1	0	1 (1%)
Retrobulbar haemorrhage	0	1	1	0	2 (2%)

Table 3 shows the association of minor and major ophthalmic signs and the various types of fracture using univariate logistic regression, with the reference group being orbital trauma. The regression model explained between 3.2% (Cox and Snell R2) and 5.6% (Nagelkerke RS2) of variance and correctly classified 80% of cases. Visual impairment severity is tabulated in Table 4. Impairment of visual acuity before and after operation for the various types of fractures is shown in Table 5. The association between severity of loss of vision and the various types of fracture using univariate logistic regression with the reference group being orbital trauma is tabulated in Table 6. The regression model explained between 1.6% (Cox and Snell R2) to 2.2% (Nagelkerke RS2) of variance and correctly classified 68 % of cases.

Table 3: Univariate logistic regression analysis for association between minor/major ophthalmic injuries and fracture groups (reference group: orbital trauma).

Association	UC	SE	p value	OR and 95% CI
Group 2	0.3	0.72	0.63	1.3 (0.34 to 3.4)

Group 3	0.72	0.52	0.15	2.1 (0.80 to 6.3)
Group 4	0.8	0.22	0.23	2.4 (0.90 to 7.8)
Constant	1.1	0.3	0	3.4

UC= Unstandardised coefficient, SE = Standard error, p < 0.05, OR= Odds ratio, CI = Confidence interval.

Table 4: Severity of visual impairment.

Variable	Minor ophthalmic injuries (n=92)	Major ophthalmic injuries (n=14)	OR (95% CI)	p value
Gender				
Female	18	2	0.38 (0.09 to 0.70)	0.01*
Male	74	12	3.7 (1.4 to 11.1)	
Pupillary Reaction				
Reactive	82	12	1.5 (0.3 to 4.2)	0.4
Not reactive	10	2	1.5 (0.6 to 4.2)	
Visual acuity				

Normal	82	9	2.0 (0.77 to 5.4)	0.17
Reduced	10	5	0.5 (0.2 to 1.2)	
Drivability				
Yes	83	9	13.5 (4.5 to 39.3)	0.001*
No	9	5	0.07 (0.03 to 0.20)	

Table 5: Comparison of preoperative and postoperative impairment of visual acuity.

Site of Fracture	Mild impairment		Moderate impairment		Severe impairment	
	Preop	Postop	Preop	Postop	Preop	Postop
Group 1	2	0	0	0	1	0
Group 2	2	0	2	0	1	1
Group 3	2	0	2	1	1	1
Group 4	1	0	1	1	0	0
Total	7	0	5	2	3	2

Table 6: Univariate logistic regression analysis for association between severity of visual impairment and types of fracture (reference group: orbital trauma).

Variable	UC	SE	p value	OR (95% CI)
Group 1	-0.04	0.53	0.54	0.85 (0.14 to 6.4)
Group 2	-0.03	1.03	0.12	0.95 (0.12 to 6.8)
Group 3	-0.56	0.62	0.4	0.54 (0.13 to 2.3)
Group 4	-0.03	1.01	0.1	0.95 (0.12 to 6.8)
Constant	-0.36	0.43	0.4	0.69

UC= Unstandardized coefficient, SE = Standard error, p < 0.05, OR= Odds ratio, CI = Confidence interval.

Discussion

This study retrospectively analysed data on patients’ personal and clinical details, mechanisms of injury and the preoperative ophthalmological injuries associated with maxillofacial fractures. Studies have indicated the association between ophthalmic injuries and midface fractures [6,7]. However, these studies failed to specify the type of fracture or the specific ophthalmic injuries sustained. Most of these studies have reported ocular injuries in patients with midface fractures in general [8], without specific categorization of maxillofacial fractures. However, our study has segregated ophthalmological injuries into those associated with the four different categories of fractures. The results indicated that there were considerably more male than female patients (81/103, 79%) with maxillofacial fractures and the median age was 38 years (IQR 18-59). These findings were consistent with the results of some previous studies [6,7]. The distribution of mechanism of injury was predominated by road traffic accidents, followed by a distant second by interpersonal violence or assault. This pattern is drastically different from similar studies on ocular injuries [5,9,10], where the predominant cause of injury was alcohol-related assault. This difference could be attributed to the fact that all these studies were

carried out western countries where there is a higher prevalence of alcohol-related interpersonal violence.

The reported incidence of ophthalmic injuries associated with maxillofacial fractures is very much dependent on the exact classification system used to quantify them. This study has segregated ophthalmic injuries into minor/temporary/reversible injuries and major/irreversible/permanent injuries. This classification was modified from those described previously [11,12]. Subconjunctival haemorrhage, diplopia, enophthalmos and restriction of extra ocular muscles, in decreasing order of frequency, were the commonest minor ophthalmic injuries associated with maxillofacial fractures. Further, entrapment of extra ocular muscles was observed only in Group 2 and 3. Subretinal haemorrhage, detached retina, ruptured globe and retrobulbar haemorrhage were the commonest major ophthalmic injuries associated with all maxillofacial fractures.

This study confirms the fact that the reported incidence of major ophthalmic injuries is low [13,14]. A majority of the major ophthalmic injuries were recorded in group 2 and 3. This finding seems to suggest that a greater degree of intraocular damage can result from these types of fractures than by any other maxillofacial fractures.

The univariate logistic regression analysis for ophthalmic injuries and types of fracture showed no statistically significant relation. However, findings from the study indicated that, fortunately, minor ophthalmic injuries are more likely than major ophthalmic injuries. Two patients experienced retrobulbar haemorrhage, one had traumatic optic neuropathy and one had a ruptured globe. Traumatic optic neuropathy can be a cause of severe permanent visual impairment, many times with concomitantly reduced visual acuity or a relative afferent papillary defect [15]. However, the patient in our study regained full vision following high dose steroid therapy with concomitant reduction of fractures and fixation.

Permanent loss of vision or blindness is an unfortunate complication associated with maxillofacial fractures, whose reported incidence varies between studies, 0.32%-9% [16] and 0.7-3% [7]. This devastating consequence may manifest as a result of direct injury to the globe, optic nerve injury, retinal oedema or detachment, vascular compromise to the eye, intracranial injury to the optic chiasm or brain and retrobulbar hemorrhage [16,17]. It would be prudent to think that patients on anticoagulants might be at an increased risk of a retrobulbar bleed. Therefore, a careful medical history must be sought at initial examination. Furthermore, literature review indicates that blindness is commonly observed with penetrating injury to the globe, an increased number of facial fractures, ZMC complex fracture, a Glasgow Coma Scale score less than or equal to 8 at examination and involvement of all three eye zones from injury [18]. Some uncommon causes of blindness reported in literature include optic nerve transaction, globe

luxation and retinal detachment [19]. Out of the two patients with retrobulbar haemorrhage in this study, one lost vision in the eye.

Reduced visual acuity was diagnosed in all patients who did not score 6/6 on visual assessment. Five patients with major ophthalmic injuries (5/14, 36%) and 10 out of 85 patients (10/85, 12%) with minor ophthalmic injuries experienced reduced visual acuity in our study. Twelve of these 15 patients needed orbital wall reconstruction. Similar percentage distributions were reported by other studies [11,20]. This finding reinforces the fact that greater intraocular damage may be expected from maxillofacial fractures that disrupt orbital walls than after other types of fracture. Four patients experienced persistent postoperative changes at 12 weeks, with preoperative ophthalmic injuries of commotio retinae, subretinal haemorrhage, globe rupture and retrobulbar haemorrhage.

Drivability relates to the patient's ability to drive independently, whether private (lesser than 6/12) or commercial vehicles (lesser than 6/9). There was a significant association of male gender with ocular injuries, a finding derived from the fact that maxillofacial fractures were also predominant in the male population in our study. Visual acuity and papillary reactivity did not differ significantly. However, the study found an OR of 0.07 (95% CI 0.03 to 0.20, $p = 0.001$) for those patients who had a major ophthalmological sign and inability to drive, which was statistically significant. No significant associations were observed in univariate logistic regression analysis between impairment of visual acuity and types of fracture. However, findings from the study reinforce the finding that visual impairment is a risk of any maxillofacial fracture that involves the orbit. Improvement in visual acuity within a week of the injury has been reported [20], a finding confirmed in our study. Fractures of the Le Fort III level and ZMC fractures, even when present as a part of panfacial fractures are associated with a higher proportion of major than minor ophthalmic injuries. This fact may be a result of high velocity being the main mechanism of trauma in such cases [4]. Similar observations have been reported in other studies on the subject [16,21,22].

The retrospective design of the study was a shortcoming which could be overcome by evaluating ophthalmic injuries with maxillofacial fractures in a prospective manner. The large sample size and availability of complete follow up records are the strengths of this study.

Conclusion

Ophthalmic injuries must be suspected in midface injuries and promptly evaluated by an ophthalmologist, particularly in case of ZMC and Le Fort II/ III fractures. Minor injuries are commoner than major injuries. However, a missed diagnosis of ophthalmic injury could lead to permanent alteration or loss of vision, thereby inviting medico legal consequences.

References

- Mittal G, Singh N, Suvarana S, Mittal SR (2012) A prospective study on ophthalmic injuries related to maxillofacial trauma in Indian population. *Natl J Maxillofac Surg* 3(2): 152-158.
- Dutton GN, Al-Qurainy (1997) Oral and Maxillofacial trauma. In: Fonseca RJ, Walker RV, editors. 2nd ed. Pennsylvania: W.B. Saunders Company.
- Holt GR, Holt JE (1983) Incidence of eye injuries in facial fractures: An analysis of 727 cases. *Otolaryngol Head Neck Surg* 91(3): 276-279.
- Magarakis M, Mundinger G, Kelamis J, Dorafshar AH, Bojovic B, et al. (2012) Ocular injury, visual impairment and blindness associated with facial fractures: a systematic literature review. *Plast Reconstr Surg* 129(1): 227-233.
- Jamal BT, Pfahler S, Lane K, Bilyk JR, Pribitkin EA, et al. (2009) Ophthalmic injuries in patients with zygomaticomaxillary complex fractures requiring surgical repair. *J Oral Maxillofac Surg* 67(5): 986-989.
- Zhou H, Liu Q, Yang R, Li Z, Li ZB (2014) Ocular trauma in patients with maxillofacial fractures. *J Craniofac Surg* 25(2): 519-523.
- Septa D, Newaskar V, Agrawal D, Tibra S (2014) Etiology, incidence and patterns of mid-face fractures and associated ocular injuries. *J Maxillofac Oral Surg* 13(2): 115-119.
- Patil SG, Kotwal I, Joshi U, Allurkar S, Thakur N, et al. (2016) Ophthalmological evaluation by a maxillofacial surgeon and an ophthalmologist in assessing the damage to the orbital contents in midfacial fractures: a prospective study. *J Maxillofac Oral Surg* 15(3): 328-335.
- Mellama P, Dewan M, Lee M, Smith SD, Harrison AR (2009) Incidence of ocular injury in visually asymptomatic orbital fractures. *Ophthal Plast Reconstr Surg* 25(4): 306-308.
- Johnson NR, Singh NR, Oztel M, Vangaveti VN, Rahmel BB, et al. (2018) Ophthalmological injuries associated with fractures of the orbitozygomaticomaxillary complex. *British Journal of Oral and Maxillofacial Surgery* 56(3): 221-226.
- Al-Qurainy I, Stassen L, Dutton G, Moos KF, El-Attar A (1991) The characteristics of midfacial fractures and the association with ocular injury: a prospective study. *Br J Oral Maxillofac Surg* 29: 291-301.
- Agrawal R, Shah M, Mireskandari K, Yong GK (2013) Controversies in ocular trauma classification and management: review. *Int Ophthalmol* 33(4): 435-445.
- Kloss F, Stigler R, Brandstatter A, Tuli T, Rasse M, et al. (2011) Complications related to mid-facial fractures: operative versus non-surgical treatment. *Int J Oral Maxillofac Surg* 40(1): 33-37.
- Karabekir H, Gocmen-Mas N, Emel E, Karacayli U, Koymen R, et al. (2012) Ocular and perocular injuries associated with an isolated orbital fracture depending on a blunt cranial trauma: anatomical and surgical aspects. *J Craniomaxillofac Surg* 40(7): e189-e193.
- Lee V, Ford R, Xing W, Bunce C, Foot B (2010) Surveillance of traumatic optic neuropathy in the UK. *Eye (Lond)* 24: 240-250.
- Ansari MH (2005) Blindness after facial fractures: a 19-year retrospective study. *J Oral Maxillofac Surg* 63(2): 229-237.
- Andrews BT, Jackson AS, Nazir N, Hromas A, Sokol JA, et al. (2016) Orbit fractures: identifying patient factors indicating high risk for ocular and periocular injury. *Laryngoscope* 126(suppl 4): S5-S11.
- Vaca EE, Mundinger GS, Kelamis JA, Dorafshar AH, Christy MR, et al. (2013) Facial fractures with concomitant open globe injury: mechanisms and fracture patterns associated with blindness. *Plastic and reconstructive surgery* 131(6): 1317-1328.
- Bossert RP, Giroto JA (2009) Blindness following facial fracture: treatment modalities and outcomes. *Craniofacial Trauma Reconstr* 2(3): 117-124.

20. Richards N, Brown N, Kidwell Jr E (2015) Visual acuity in orbital floor fractures: does surgical subspecialty management matter? J Craniofac Surg 26(5): 1668-1672.
21. Beogo R, Coulibaly TA, Dolo MT, Traore I, Ouattara B, et al. (2018) Facial fracture-associated blindness. Journal of Craniofacial Surgery 29(3): 751-753.
22. Rallis G, Stathopoulos P, Igoumenakis D, Krasadakis C, Mourouzis C, et al. (2015) Treating maxillofacial trauma for over half a century: how can we interpret the changing patterns in etiology and management? Oral Surg Oral Med Oral Pathol Oral Radiol 119(6): 614-618.

ISSN: 2574-1241

DOI: 10.26717/BJSTR.2020.32.005256

Pavan M Patil. Biomed J Sci & Tech Res



This work is licensed under Creative Commons Attribution 4.0 License

Submission Link: <https://biomedres.us/submit-manuscript.php>



Assets of Publishing with us

- Global archiving of articles
- Immediate, unrestricted online access
- Rigorous Peer Review Process
- Authors Retain Copyrights
- Unique DOI for all articles

<https://biomedres.us/>