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Extraocular Injuries Associated With Zygomaticomaxillary Complex Fracture

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ABSTRACT:
Background: *The zygomaticomaxillary complex (ZMC) fractures comprise various extraocular and intraocular consequences. In most cases, maxillofacial surgeons are often responsible for first ophthalmic assessments. Some ocular involvement of ZMC fracture needs immediate consultation of ophthalmologist whereas some ocular injury is simple extraocular involvements, which are not a cause of anxiousness for oral and maxillofacial surgeon, and they can continue the treatment in their field. In this study, it is to be observed that the common extraocular findings in relation to ZMC fracture.*
Objectives: *To observe the common extraocular findings in relation to the etiology of ZMC fracture. To determine the frequency of extraocular injuries in ZMC fracture. To determine the nature of extraocular injuries in patients who have sustained ZMC fracture.*
Methods: *This prospective observational study was conducted in dept. of oral and maxillofacial surgery of Dhaka Dental College Hospital. It was done between December, 2018 to November, 2019 over 50 patientswho were diagnosed with ZMC fracture.*
Result: *Among the 50 patients, Age range of the patient was 12 to 75 years. Out of 50 subjects 39 (78.0%)were male and rest of 11 (22.0%) patient were female patients. Rood traffic accident (RTA) is the most common cause of ZMC fracture. The common features of extraocular involvement were periorbital ecchymosis (91.4%) and subconjunctival haemorrhage (87.9%) followed by periorbital edema (65.5%), infraorbital nerve impairment (48.3%), eyelid injury (29.3%), restriction of extra ocular movement (20.7%),diplopia (15.5%) and Enophthalmos (8.6%).*
Conclusion: *According to this study subconjunctival ecchymosis and periorbital edema are the most common extraocular findings.*
Keywords: *Extraocular Injuries, Ocular Injuries, Ophthalmic Injuries, ZygomaticomaxillaryComplex (ZMC)*

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I. Introduction:

Injuries around the eye vary in severity. According to Le fort, the face resists the force mainly because of the face's elasticity, its periosteum and its soft tissues. Direct injury to the globe of the eye is relatively rare as compared to the frequency of orbital trauma. This is to be explained by the fact that a number of factors protect the globe from injury, including the prominence of the bones of the orbit and the natural reflexes of self-

protection such as blinking, protecting the eye with the hand and averting the head. Cushioning of the contents of the orbit in the form of orbital fat and the extraocular muscles protect the ocular structures from injury secondary to blunt external forces.[1] An important anatomical prominence at lower lateral aspect of eye is malar prominence of zygomaticomaxillary complex (ZMC) which is one of the most common reasons for trauma and ZMC fractures constituting 45% of all mid facial and 25% of all fractures of facial population. Other author also demonstrate that ZMC fractures are common facial injuries, representing themost common facial fracture[2] or the second in frequency after nasal fractures.[3] The incidence, cause, age, and gender predilection of zygomatic injuries vary, depending largely on the social, economic, political, and educational status of the population .Most studies indicate a male predilection, with a ratio of approximately 4:1 over female.[4] The causes of zygomatic injury in some studies, are mostly alterations, whereas in others, motor vehicle accidents account for a more substantial number.[5] These injuries often destroy the integrity of the orbital skeleton and are frequently complicated by injury to the eye, ranging between 2.7% and 90.6%.[6] Isolated orbital blowout fractures have associated eye injuries upto one third ofthe patients.[7] Blindness is an uncommon,[8] yet documented complication of facial trauma, with a reported incidence of fractures around 3%. the diagnosis of zygomatic fractures is primarily based on clinical and radiologic examination, although the history frequently raises a strong suggestion of the possibility that a fracture may exist and gives an indication about the nature, direction, and force of the blow. It should be stressed that the clinical examination is frequently difficult to perform adequately because of the nature of the patient's mental state and/or the amount of facial edema and pain.[9] performed ophthalmologic examinations in 363 patients who had sustained midfacial fractures. Minor or transient eye injuries, such as corneal abrasion, chemosis, mild impairment of accommodation and visual acuity, and orbital emphysema, were found in 63% of patients. Moderate injuries, such as enophthalmos, conjunctival abrasion, traumatic pupillary changes, iridodialysis, lens damage, macular edema, and moderate to severe impairment of accommodation and visual acuity, were noted in 16% of patients. Severe ophthalmic disorders, such as gross proptosis, retrobulbar hemorrhage, corneal laceration, hyphema, angle recession, severe reduction or loss of vision, visual field loss, choroidal tear involving the macula, and optic nerve injuries, were found in 12% of patients. One third of all patients with comminuted ZMC fractures suffereda severe ocular disorder.[8] The ocular consequences in ZMC fracture are eyelid injury, periorbital ecchymosis and edema, deformity of the orbital margin, abnormal nerve sensibility, subconjunctival ecchymosis, displacement of palpebral fissure, unequal papillary levels, diplopia, enophthalmos,[10] hyphema, vitreous hemorrhage, retinal hemorrhage, choroidal rupture, traumatic mydriasis, commotio retinae, reduced visual acuity, corneal abrasion, retinal detachment, corneal laceration, retinal tear, angle recession, canthal laceration etc. [11] In addition to this, most of the extraocular injuries caused by ZMC fracture need no immediate consultation of ophthalmologist and as general dentists and oral & maxillofacial surgeons are the first doctors who face this kind of injuries they have to understand the pattern and extensionof extraocular injuries caused by ZMC fracture are not vulnerable to eyes. That's why a careful and thorough ophthalmic examination should be done before reduction and fixation ZMC fracture. The objective of this study is to determine the incidence and types of extraocular injuries in patients who have sustained ZMC fracture and who are under the care of maxillofacial surgeon in Dhaka Dental College Hospital.

II. Materials and method:

This prospective observational study was conducted in dept. of oral and maxillofacial surgery of Dhaka Dental College Hospital. It was done between December 2018 to November 2019 over 50 patients who were diagnosed with ZMC fracture. After taking consent and proper history, all patients were examined by inspection and palpation. Eyelid injuries, periorbital ecchymosis and sub conjunctival hemorrhage was inspected and periorbital edema needs palpation for diagnosis. Diplopia was assessed by finger gaze at first then extraocular movements were evaluated to rule out any mechanical entrapment or paresis of extraocular muscle leading to restricted movement of eye ball. Computed tomography scan finding was correlated with any clinically noted entrapment. If mechanical entrapment was suspected, then eye was topically anesthetized and forced duction test was performed.

The post traumatic enophthalmos caused by orbital volume expansion was repeatedly confirmed using computed tomography imaging. The eyes were assessed for the presence of post traumatic position of eye ball. Incidence of enopthalmos is mainly attributed to the displacement of the zygoma.

When the altered sensitivity was suspected, examination was done for rule out any dysfunction of the infraorbital nerve. The areas tested for infraorbital nerve disturbance were lower eyelid, cheek, ala of the nose and upper lip. All the four sites were tested by questionnaire method regarding neurosensory disturbance. Tactile test was performed by using cotton wool. Pinprick test was performed by using sterile disposable 27-gauze syringe needle. Thermal test was performed by using ethylchloride soaked gauze. All the examination methods applied on the affected side. The unaffected contra lateral side was examined for comparison purposes. In the cases of bilateral ZMC fractures, the forehead region (frontal nerve) was examined to compare.

III. Result:

A total of 50 **(n=50)** patients with zygomaticomaxillary complex (ZMC) fracture admitted in Oral and Maxillofacial Surgery Department from December 2018 to November 2019 were selected for the study on the basis of inclusion and exclusion criteria. Findings were presented in Tables and Graphs.

Table 1 Age distribution of the study population (n=50)

Age (in years)	Number of patients	Percent (%)
0-20	4	8.0%
21-40	31	62.0%
41-60	13	26.0%
>60	2	4.0%
Mean ± SD		12.50±13.15
Range		(12-75) years

Table 1 shows the age distribution of the study patients. Age range of the patient was 12 to 75 years. The mean age of the patients was 12.50±13.15 years. Most of the patients (62%) belong to the age group of 21-40 years.

Fig 1: Distribution of the patients according to etiology of trauma

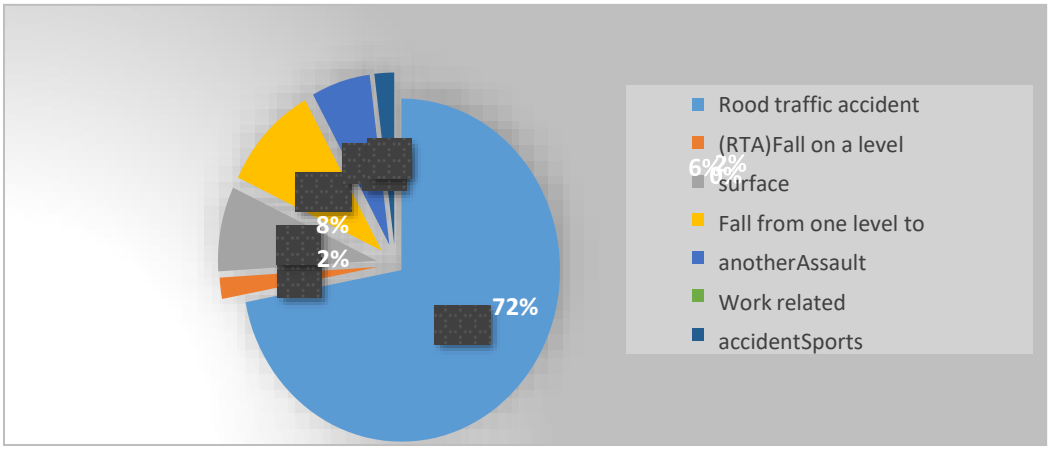


Figure 1 Pie diagram shows that, the rood traffic accident (RTA) is the most common cause of ZMC fracturewhich is accounting 72.0% (n=36) followed by assault and fall. No patient was found in sports injury in this injury.

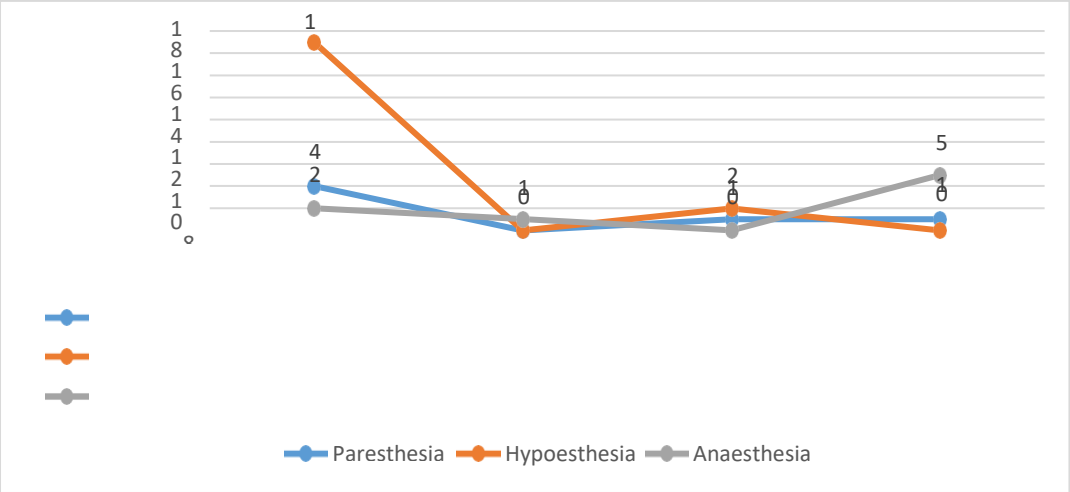
Table 2: Extraocular consequences in relation with time (of examination)

	Time (Days)			
Type of injuries / Symptoms	**1-3 Days (34 Patients)**	**4-10 Days (16 patients)**	**Total (%)**	***p*-value**
Eyelid injury	12	5	17 (29.3%)	0.030^{s}
Periorbital edema	36	2	38 (65.5%)	0.024^{s}
Periorbital ecchymosis	39	14	53 (91.4%)	0.006^{s}
Subconjunctival haemorrhage	37	14	51 (87.9%)	0.012^{s}
Restriction of extraocular movement.	5	7	12 (20.7%)	0.145
Enophthalmos	2	3	5 (8.6%)	0.208
Infraorbital nerve impairment	19	9	28 (48.3%)	0.015^{s}
Diplopia	7	2	9 (15.5%)	0.023^{s}

p-value < 0.05, s =significant

Table 2 shows periorbital ecchymosis (91.4%) and sub conjunctival haemorrhage (87.9%) are the more common feature of ZMC fracture in this study. The total side involvement was 58 as 8 patients had both side of

ZMC involvement (n = 50). 34 patients were examined in 1 to 3 days and rest of the patients were examined in 4 to 10 days.



IV. Discussion:

Ocular injuries commonly occur in patients with facial fractures. Injuries to the eye occur in majority of the patients who sustained midface trauma severe enough to cause a fracture. Zygomatic fractures are the most common facial fractures second only to nasal fractures and these fractures are also the most commonly occurring fractures of the orbit.[8]

The higher frequency of ZMC fractures in this study in males accounting 78% which is consistent with the other studies, the reasons being cultural and socioeconomic characteristic where males participate more in outdoor activities compared to females.[12] In this study the affected patients ranges from 12 to 75 years and the most affected groups is between 21 to 40 years which is accounting for 62% (31/50) (Table 1). These results are consistent with other studies.[13]

Classically, the main causes of facial fractures are road traffic accidents, followed by assault, self-fall, and sports injury.[14] However, some studies have identified assaults as the main cause.[15,16] According to present study, the most frequent etiologic factor was road traffic accident (72 %) followed by assault and accidental fall. (Fig 1)

In this study eyelid injury was observed in 29.3% cases where total side involvement were 58 among 50 patients (8 patient had both side involvement). In a study the authors found 80.5% of eyelid injury.[17] This result is not consistent with the present study may be due to some resions. The injuries to the eyelid are innocuous but may associated with underlying intraocular injury and probably the patient with intraocular severe injury was referred to eye hospital most of the time by them who first attend this kind of patient.[18]

Periorbital edema and bleeding into the loose connective tissue of the eyelids and periorbital areas is the most common sign following fracture of the orbital rim.[19] The ecchymosis may be in the inferior lid and infraorbital area only or around the entire orbital rim. In this study periorbital edema and ecchymosis was found in 38 (65.5%) and 53 (91.4%) sides out of 58 involved sides. Rajkumar et al. (2015) found 89.9 % periorbital edema and ecchymosis[13] which may be consistent with present study. Alamgir et al. (2013) found periorbital ecchymosis in 32.5% patient[20] which is much more less than present study.

In this study subconjunctival ecchymoses was found in 87.9% cases (51/58) which are consistent with Malik et al. (2016) who reported onjunctival ecchymoses of 86.56% individuals.[12] The result is also nearly similar with other studies like Amrith et al. (2000) reported 60-74% cases[21] and Wiesenbaugh (1970)[22] and Ellis et al. (1985)[10] reported 50-70% cases of subconjunctival hemorrhage as an ophthalmic consequence of ZMC fracture.

Diplopia, in this study is due to restriction of extra ocular movement was diagnosed in 20% cases (12/58) whereas transient diplopia was diagnosed in 15.5% (9/58) individuals (Table 2). The result is supported by Jamal et al. (2009) found symptomatic diplopia in 16% of the patients and restriction of extraocular movement occurred in 15% cases of ZMC fracture.[23] Kai Lund (1971) reported diplopia in six patients of a total of 62 patients (9.7%) with fractures of zygoma,[24]. But other author reported a little bit lower incidence like Ellis et al. (1985) who reported of 5.4%,[10] Alamgir et al. (2013) found 7.5% cases[20] and Nabeela Riaz et al. (2014) reported little bit higher incidence of diplopia (34%) than present study[11].

The post traumatic enopthalmos caused by orbital volume expansion was repeatedly confirmed using CT imaging. In this study 8.6% cases were reported as enopthalmos in which 2/40 fracture involved side were diagnosed in 1 to 3 days after trauma and 3/16 fracture involved side were diagnosed within 4 to 10 days. It is supported by Zingg et al. (1992) who reported 7% of involvement[25] and by Nabeela Riaz et al. (2014) who reported of 14% of enophthalmos after ZMC fracture.[11] But it is not consistent with Malik et al. (2016) who reported of only 4% ZMC fracture showed enopthalmos.[12]

Infraorbital nerve impairment is more common in fractures that are displaced than those that are not. In this study, hypoesthesia is more common and accounting for 67.86% (19/28) than paresthesia and anaesthesia were found as alteration of infraorbital nerve sensation. Almost similar result was reported by Jungell and Lindqvist (1987) who found 56% cases[26], Ellis et al. (1985) found 50% cases[10], Kai Lund (1971) reported sensory disturbances in the infraorbital region in 41 of the 62 patients that is 66% incidence of infraorbital nerve impairment in all ZMC fractures[24]. Saeed et al. (2020) reported a little bit higher incidence of infraorbital nerve disfunction (70%)[27] whereas Gaurav Mittal et al. (2017) reported a lower incidence 25% infraorbital nerve disfunction in ZMC fracture than present study.[17]

Limitations:

The study has certain limitations such as

- Prospective nature
- Small sample size
- Short study duration
- This was a single hospital based study located in the capital city which may not be representative of the whole population.

V. Conclusion

Ophthalmic consequences are the pathogmonic of ZMC fracture. Although there are some intraocular findings including the devastating loss of sight, the extraocular injuries are more common following ZMC fracture. According to this study subconjunctival ecchymosis and periorbital edema are the most common extraocular findings. These common extraocular findings also indicate a further careful evaluation for the diagnosis of ZMC fractures, excluding other important extraocular findings which need surgical intervention and other intraocular injuries that may present. Thus early decision can be made for the treatment of the fracture or the patient can be referred to the ophthalmologist. In such way, the patients unusual hospital delay, malunion of fractures and the facial deformity can be prevented

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Conception and design: DBD. Acquisition, analysis and interpretation of data: DBD, AHMB, SI. Manuscript drafting and revising it critically: DBD, SB, HIS. Approval of the final version of the manuscript: DBD, SBR, IAH. Guarantor accuracy and integrity of the work: DBD

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Conflict of Interest:

The authors declare no conflicts of interest.

Ethical Approval:

Ethical clearance for this study was granted by the Ethical committee of Dhaka Dental College (Ref:DDC/2018/1195) and obtained informed consent from all participating patients.

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