JCDS JOURNAL of CONTEMPORARY DENTAL SCIENCES OPEN ACCESS

Original Article

# Evaluation of Ophthalmic Complications Associated with Zygomaticomaxillary Complex Fracture

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**ARTICLE INFO.**

Received: 13 November, 2025
Accepted: 24 December, 2025

**Volume: Vol-14, Issue-1, January 2026**
DOI: https://doi.org/10.3329/jcds.v14i1.87402



**Publisher**: Sapporo Dental College, Dhaka, Bangladesh
**Web**: www.sdch.edu.bd
**E-mail**: jcds.sdc@gmail.com

**Scan QR code to access your article on JCDS BanglaJOL index.**

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**ABSTRACT**

**Background:** Zygomaticomaxillary complex (ZMC) is an important functional landmark of the midface. Due to its intrinsically prominent convexity it becomes most vulnerable to injury. ZMC fractures commonly destroy the integrity of the orbital skeleton, and are frequently complicated by injury to the eye. So the optimum ophthalmic evaluation of the patient who sustained ZMC fractures is mandatory to prevent any further ocular complications. This study was carried out to evaluate the ophthalmic complications associated with ZMC fractures to provide sufficient information for better treatment planning and management. **Method:** This observational type of study was conducted in Oral and Maxillofacial Surgery Department, Dhaka Dental College Hospital during the period between February2021 to January 2022. Twenty five patients who fulfilled the criteria were selected by purposive sampling. All the patients were observed by the same group of oral and maxillofacial surgeons and ophthalmologists. **Results:** Out of 25 patients mean age of the patients was 30.8±10.1 years. Majority 92% of the patients were male and 8% were female. Among all, 68% had fracture due to road traffic accident, 12% had fracture due to fall from one level to another and 12% of the patients had fracture due to assault. Besides, 4% said fall on a level surface and 4% said other different type of causes for fracture. Ninety-two percentage of the patients had developed Subconjunctival hemorrhage followed by 32% had Reduced visual acuity, 20% had developed Diplopia, 16% had developed Enophthalmos, 12% had Corneal injury and 4% had developed Loss of vision. **Conclusion:** All traumas to the face, particularly above the level of the mouth, require a careful eye examination. Considerable care should be taken in all patients who may have sustained eye injuries in association with ZMC fractures for the proper management to prevent any blinding complications.

**KEY WORDS:** *zygomaticomaxillary complex fracture, ophthalmic complications, trauma*

## INTRODUCTION:

Zygomatic complex is the term used for the structure formed by the zygomatic bone and parts of anatomically related neighboring bones [1]. An intact zygoma (or zygomatic bone) and its surrounding bony anatomy are essential for maintaining facial contour, such as cheek prominence, as well as orbital integrity [2]. The zygomatic region is a prominent portion of the face next only to the dorsum of the nose. This predisposes this bone to various traumas. Several studies had shown ZMC fractures to be the second most common facial fracture, after nasal bone or mandible fractures. A literature search showed ZMC fractures to account for approximately 15%-23.5% of maxillofacial fractures. Common causes of ZMC fractures are interpersonal violence (15%-64.5%), RTCs (13.9%-49%), as well as falls, occupational accidents, and sports-related injuries. Furthermore, ZMC fractures are more common in men than women, and most commonly occur in the third decade of life [2] .

The bony architecture of this bone is rather unique, it enables it to withstand blows with significant impact without being fractured. At the most, it gets disarticulated along its suture lines. Fracture and dislocation of this bone not only causes cosmetic defects but also disrupts ocular and mandibular functions [3]. The factors protecting the globe include the prominence of the orbital bones themselves, as well as natural reflexes such as blinking and head aversion [4, 5]. Cushioning of the contents of the orbit in the form of orbital fat and the extraocular muscles also protect the ocular structures from injury secondary to blunt external forces [6, 7].

Anatomically, the zygoma is attached to the frontal bone (via the frontozygomatic suture), the maxilla (via the zygomaticomaxillary

suture), the squamous part of the temporal bone (via the zygomaticotemporal suture), and the sphenoid bone (via the zygomaticosphenoid suture) [2] .

Fractures that involve the zygoma often occur at these four suture sites, leading to a "tetrapod" fracture pattern, known as a "zygomatic complex fracture" (ZMC). Furthermore, the zygoma is connected to the maxilla and sphenoid bone as part of the inferior orbital floor and forms the lateral orbital margin with the frontal bone. Thus, fractures of the zygomatic complex inevitability led to a certain degree of orbital defect. Ocular injuries can be divided into minor and major groups based on the possibility of causing permanent visual loss. Subconjunctival hemorrhage (SCH), periorbital ecchymosis, ptosis, crepitation, and laceration of the eyelids are considered minor injuries. Laceration of the sclera and cornea, ophthalmic infection, traumatic injury of the optic nerve, globe rupture, limitation of eye movements, enophthalmos, proptosis, blurred vision, diplopia, retinal hemorrhage, hyphema, and permanent visual loss are categorized as major injuries [8] .

Prompt recognition of ophthalmic complications is important in cases of midfacial fracture for several reasons. First, the management of ocular injury often takes precedence over the midfacial and orbital fracture. Second, fracture repair in the setting of occult ocular injury (e.g., ruptured globe and retinal detachment) may result in exacerbation of the injury, resulting in devastating visual loss. Third, recognition of the extent and possible irreversibility of the ophthalmic injury are crucial preoperatively from a medicolegal stand point so that the fracture repair is not later claimed to be the etiology of permanent visual compromise.

Zygomaticomaxillary complex fracture (ZMC) is frequently associated with ophthalmic complications which are challenging for the patients to maintain their quality of life. As a result, ocular impairments like subconjunctival hemorrhage, reduced visual acuity, corneal injury, diplopia, enophthalmos, loss of vision, etc. are created. Early diagnosis of ophthalmic injuries & complications is paramount not only in minimizing long-term complications of ZMC fractures but also from a medicolegal standpoint. The management of the ophthalmic injuries must be considered as the first priority. Repairing the fractures before treatment of ophthalmic injuries may further compromise visual outcomes, leading to visual loss. The objective of this study is to evaluate the ophthalmic complications following ZMC fracture.

The study was carried out in Dhaka Dental College & Hospital to evaluate the ophthalmic complications associated with ZMC fracture.

**RESULT:**

Majority 36% of the patients were aged between 30 to 40 years followed by in decreasing order 32% were 19 to 29 years, 20% were above 40 years and 12% were below or equal 18 years. Mean age of the patients was 30.8±10.1 years.

**Table 1: Age distribution of the patients (n=25)**

| Age group (years) | Frequency (n) | Percentage (%) |
|---|---|---|
| ≤18 | 3 | 12 |
| 19 to 29 | 8 | 32 |
| 30 to 40 | 9 | 36 |
| >40 | 5 | 20 |
| **Total** | **25** | **100** |
| **Mean±SD** | **30.8±10.1** | |

Table 1 shows the mean age of the participants was 30.8±10.1 years. The most affected group (36%) were between 30-40 years of age followed by (32%) were between 19-29 years. The least affected groups (12%) were <18 years. In addition, 20% were >40 years.

**Fig 1: Gender distribution of study population (n=25)**

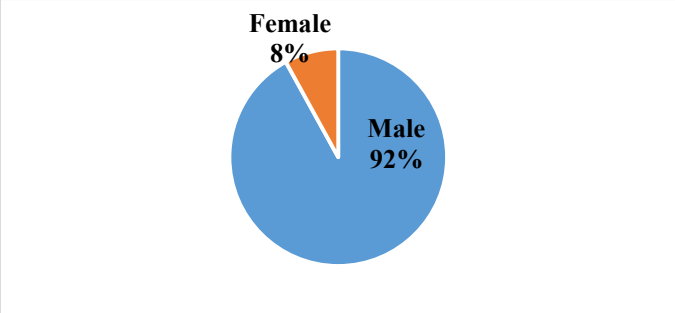


Figure 1 shows, majority (92%) of the patients were male and 8% were female.

**Table 2: Aetiology of the fracture among the study patients (n=25)**

| Aetiology | Frequency (n) | Percentage (%) |
|---|---|---|
| Road traffic accident | 17 | 68 |
| Fall from one level to another | 3 | 12 |
| Assault | 3 | 12 |
| Fall on a level surface | 1 | 4 |
| Others | 1 | 4 |
| **Total** | **25** | **100** |

Table 2 shows 68% had fracture due to road traffic accident, 12% had fracture due to fall from one level to another and 12% of the patients had fracture due to assault. Besides, 4% said fall on a level surface and 4% said other causes for fracture.

**Fig 2: Distribution of the study patients according to the site of fracture**

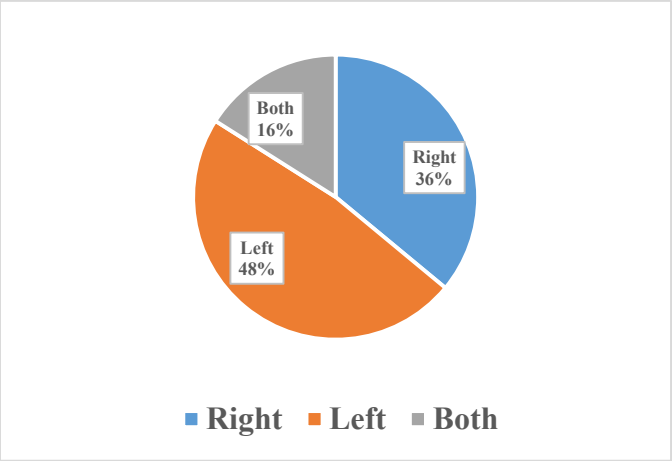


Figure 2 shows, majority (48%) had left sided fracture and 36% had right sided fracture. Besides, both sided fracture was observed in 16% cases.

**Table 3: Distribution of the study patients according to Ophthalmic complications after injury (n=25)**

| Ophthalmic complications | Frequency (n) | Percentage (%) |
|---|---|---|
| Subconjunctival hemorrhage | 23 | 92 |
| Reduced visual acuity | 8 | 32 |
| Diplopia | 5 | 20 |
| Enophthalmos | 4 | 16 |
| Corneal injury | 3 | 12 |
| Loss of vision | 1 | 4 |

*Multiple answers considered.

Table 3 shows, Ninety-two percentage of the patients (92%) had developed Subconjunctival hemorrhage followed by 32% had Reduced visual acuity, 20% had developed Diplopia, 16% had developed Enophthalmos, 12% had Corneal injury and 4% had developed Loss of vision.

**Table 4: Association of site of fracture with ophthalmic complication (n=25)**

| Ophthalmic complication | Right (n=9) | Left (n=12) | Both (n=4) | P value* |
|---|---|---|---|---|
| | n (%) | n (%) | n (%) | |
| Subconjunctival hemorrhage | 8 (88.9) | 11 (91.7) | 4 (100) | 1.00 |
| Reduced visual acuity | 2 (22.2) | 3 (25) | 3 (75) | 0.140 |
| Diplopia | 2 (22.2) | 1 (8.3) | 2 (50) | 0.192 |
| Enophthalmos | 2 (22.2) | 0 (0) | 2 (50) | 0.034 |
| Corneal injury | 0 (0) | 2 (16.7) | 1 (25) | 0.366 |
| Loss of vision | 0 (0) | 1 (8.3) | 0 (0) | 0.254 |

*p value was determined by Fisher Exact test. Percentage was expressed in column.

Table 4 shows, among the right sided fracture patients, 8 had subconjunctival hemorrhage, 2 had reduced visual acuity, 2 had diplopia and 2 had enophthalmos. Besides, among the left sided fracture patients, 11 had Subconjunctival hemorrhage, 3 had Reduced visual acuity, 1 had diplopia, 2 had corneal injury and 1 had loss of vision. However, all patients with both sided fractures had Subconjunctival hemorrhage followed by 3 had Reduced visual acuity, 2 had diplopia, 2 had enophthalmos and 1 had corneal injury. Complication was more common among the patients who had both sided fracture but no significant difference found except regarding Enophthalmos.

## DISCUSSION

The fracture pattern of any bone depends on several factors, including the direction and magnitude of the force. Because of the strong buttressing nature of the zygoma and the thin bones surrounding it, most injuries involving the zygoma are accompanied by disruption of adjacent articulating bones. This disruption occurs because when a force is applied to the body of the zygoma, it is distributed through its four processes to the adjacent articulating bones, many of which are weaker than the zygoma [9]. Zygoma fractures result in a range of deformities from cosmetic to functional disabilities. Cosmetic deformities are a loss of malar prominence (flattening), orbital dystopia, ectropion, enophthalmos, exophthalmos, and decreased anterior facial width. Functional deformities range from difficulty in the mouth opening (trismus), infra-orbital anesthesia, and diplopia. Zygomaticomaxillary complex fractures are frequently complicated by injury to the orbit and eye adnexae, which are the most serious negative outcomes of zygomatic complex fractures [10]. The ophthalmic opinion is necessary in most of the zygomatic complex fractures [11]. The current study aimed to evaluate the ophthalmic complications after a zygomaticomaxillary complex fracture. A total of 25 patients with zygomaticomaxillary complex fractures with or without other facial bone fracture were enrolled in this study.

In our study, majority 36% of the patients were aged between 30 to 40 years with the mean age of the patients being 30.8±10.1 years. Some privious studies conducted among 60 patients shows mean age of 34 years, among 96 patients with a mean age of 36 years and 148 patients reveals mean age of 36 years [10, 12, 13].

In a developing country like Bangladesh where a large group of young population are engaged in day today outdoor activities like driving cars, riding bikes for self employment, building constructions etc. this age group are more vulnerable to trauma which is reflected in this study.

In this study, male predominance (92%) was found among the study participants and that is consistent with another previous study 10. There were considerably more male than female patients (162/190, 85%) with these type fractures and the median age of 31 years (IQR 25-39) was also unveiled by another study [14]. In another study, it was also revealed that the higher frequency of ZMC fractures in the study was in males (83.5 %) 11. A previous study found that, a total number of 30 patients were included and all of them were males (100%) [15]. Again in a study, gender distribution of the patients was 88% male [12]. Previous other studies also revealed similar findings. In Bangladesh, according to cultural and socioeconomic characteristics males participate more in outdoor activities compared to females and that's why they are more prone to trauma.

The etiology of the trauma differs considerably according to the geographic location, culture, and socioeconomic status of the population. Ophthalmic injuries concerning maxillofacial trauma may be non-occupational domestic injuries, injuries in travel and sports, industrial hazards, assaults, self-inflicted injuries, and so on [16]. The current study revealed that more than half (68%) of the patients had a fracture due to road traffic accidents, fall from one level to another (12%), and assault (12%). Besides, 4% said to fall on a level surface and 4% said another different type of cause for fracture. The result was consistent with a previous study, which show a higher frequency of these fractures due to road traffic accidents [10]. In another study also observed about 64.17 % of patients had ZMC fracture due to road traffic accident, 14.9 % had ZMC fracture due to falls, about 19.4 % fractures were due to inter-personnel fights and only 1 patient had suffered firearm injury [11]. But in the other study, most common etiology of trauma was assault (56%), followed by falls (21%). Motor vehicle accidents (MVA) accounted for 16% of the injuries, with the remaining 7% sports related [12]. In a study, they also found assault was the most common mechanism of injury, and accounted for 125/190 cases (66%), followed by road traffic accidents (32/190, 17%), sports (23/190, 12%), and falls (10/190, 5%) [14]. Now-a-days in Bangladesh strict law is declared against physical assault and moreover female are more victim of assault and they do not easily went to a hospital due to various social bindings, assault is less

documented in our country. Recent studies indicated toward RTAs being the most frequent etiology in developing countries, whereas assault was the main cause in developed nations. Fall happens to be the most frequent cause of maxillofacial injuries in children and elderly individuals [17]. As Bangladesh is a developing country RTA most commonly happens.

The zygomaticomaxillary complex is crucial to the integrity of the orbit, as it forms most of its lateral wall and floor. So inevitably it leads to ophthalmic injuries at variable extent. Disregarding these symptoms may lead to delayed diagnosis and treatment and consequent development of a complication. In patients affected by maxillofacial trauma, computed tomography (CT) can clearly show extensive defects in the orbital wall, which can vary from a simple linear line in nondisplaced fractures to complete disruption of one or more of the walls with prolapse of soft tissue [18]. Facial fractures have been reported to increase the risk of developing an ocular injury by a factor of [6.7] when compared with major trauma in patients with no facial fractures [19]. Previous studies reported incidence of ocular injuries in facial fractures ranges from 2.7 to 90.6 % 9, [20]. The current study found that 92% of the patients had developed Subconjunctival hemorrhage followed by 32%had reduced visual acuity, 20% had developed Diplopia, 16% had developed Enophthalmos, 12% had Corneal injury and 4% had developed Loss of vision. Ophthalmic complications were found more among the patients those who had both-sided fractures.

In our study 92% of the patients had developed Subconjunctival hemorrhage. In some previous studies, they observed subconjunctival injury and hemorrhage were present in 86.56 %, 67.6%, 56.7% and 60.9% of the patients [11, 15, 21, 22]. As any minute bleeding under the conjunctiva is easily visible over the sclera, subconjunctival hemorrhage is easily evident on clinical examination of ocular injuries.

In our study, 32% patients had reduced visual acuity, where there is decreased visual acuity of 14% and 13.4% in previous studies [11, 21] We have got 20% patients developing Diplopia, whereas it is 20.89 %, 21% and 20% patients found developed diplopia in other studies [11, 14, 21] .

Our study reveals 16% had developed Enophthalmos. In some studies enophthalmous was found in 13.5% and 13.3% cases preoperatively 8, 15 . Enophthalmos was observed in 23.1% of men and 25% of women in separate study [22]. Fracture of the orbital walls with displacement leads to increase in the orbital volume, so inward displacement of eyeball occurs which is termed enophthalmous.

We have found 12% patients having Corneal injury. Different study shows corneal injury happening in 32.83 % and 2.27% cases [11, 14].

Current study shows 4% had developed Loss of vision. Blindness and sustained ophthalmic complications was evident in 8.1% and 2.94% cases with ZMC fractures [8, 21.]

An unidentified defect in the orbital floor can cause an impairment of eye movements by the soft tissue entrapment into the bone fragments. Impairment of eye movements or even diminished visual acuity is caused by injury to the extraocular muscles, intra-orbital or muscle hemorrhage, and edema. All patients require a thorough ophthalmologic examination that includes a careful ocular assessment of visual acuity of each eye, pupillary reactivity, and extraocular motility [23, 24].

In our study we have found that most of the ophthalmic complications resolve spontaneously over time. Because when periorbital oedema gradually subsides - subconjunctival hemorrhages, ecchymosis, diplopia improves significantly. Patients with ophthalmic complications like diplopia, enophthalmous, reduced visual acuity etc. are candidate for surgical exploration depending on the severity and persistence of the ocular sign symptoms. So, in our study we have found that most of the ophthalmic complications following ZMC fractures can be treated conservatively.

According to current findings, there has been a correlation between injuries caused by zygomatic fractures also affecting the eye. The maxillofacial surgeon must have a thorough knowledge of the various ophthalmic injuries that could occur in association with zygomatic complex fractures to prevent visual complications to the patient.

## CONCLUSION

The findings of this study will help to provide scientific data that would enable a doctor to an evidence-based decision. Moreover, the findings will be helpful to address different types of ophthalmic complications following Zygomaticomaxillary complex fractures. Early management of ocular injuries are of paramount importance from patient's point of view & if we can focus this issue earlier a lot of patients will be benefitted from this study.

Ophthalmic complications are commonly associated with ZMC fractures. In our study we have found various minor and major ophthalmic complications with variable prognosis. From our experience it has been suggested that all traumas to the face, particularly above the level of the mouth, requires a careful eye examination. Considerable care should be taken in all patients who may have sustained eye injuries in association with ZMC fractures for the proper management to preventary blinding complications. We recommend that ophthalmologic examination is mandatory in patients who have sustained ZMC fractures. Finally, it would be wise to educate the general public about the impact of maxillofacial trauma and how some accidents can be prevented.

## LIMITATION OF THE STUDY

In our study, sample size was small and it was done in a short duration of time. This is a limitation for statistical analysis of the result. Also the study was carried out in a single center. More over the study was done in Covid-19 pandemic situation which adversely influenced our study.

## RECOMMENDATION

A more extensive study is required including different centers in Bangladesh with the collaboration between maxillofacial surgeons and ophthalmologist is recommended with larger number of sample and longer duration of time to evaluate the ophthalmic complications which are associated with zygomaticomaxillary complex fracture.

**CONFLICT OF INTEREST:** The authors declare no conflict of interest.
**FUNDING:** This research received no external funding.
**DATA AVAILABILITY STATEMENT:** The data presented in this study are available on reasonable request from the corresponding author

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**How to Cite**

Islam A, Bhuiyan MRU, Tafhim S, Nath SK. Evaluation of Ophthalmic Complications Associated with Zygomaticomaxillary Complex Fracture. J. Contemp. Dent. Sci. [Internet]. [cited 2026 Feb. 10];14(1):18-22.
Available from:
https://www.banglajol.info/index.php/JCDS/article/view/87402

JCDS -ISSN: 2305-9664