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ORIGINAL ARTICLE

Frequency of diplopia in zygomatic maxillary complex fractures in patients presenting to Ayub Teaching Hospital Abbottabad.

Ammara Saleem[1], Khurshid Alam[2], Muhammad Masood Khan[3], Bakhtawer Aziz[4], Jannat-ul-Mawa[5], Sidra Qadir[6]

ABSTRACT… Objective: To find out the incidence of diplopia in ZMC fracture patients reporting to the trauma center and maxillofacial outpatient department. **Study Design:** Cross Sectional study. **Setting:** Department of Trauma Center and Maxillofacial Outpatient, Ayub Teaching Hospital (ATH), Abbottabad. **Period:** December 2024 to May 2025. **Methods:** A total of 113 patients between the ages of 18–60 years with radiologically proven ZMC fractures were recruited using non-probability consecutive sampling. Data regarding age, gender, etiology of trauma, fracture pattern (unilateral/bilateral), and presence/direction of diplopia was obtained on a structured proforma. Diplopia was evaluated clinically by history and nine-gaze examination. Data were analyzed using SPSS version 22. Chi-square test was employed to evaluate associations, with $p < 0.05$ being statistically significant. **Results:** Of the 113 patients, diplopia occurred in 32.74% (n = 37). Horizontal diplopia was the most frequent (54.87%), followed by vertical (32.74%) and oblique (12.39%). Both-sided ZMC fractures were strongly related to diplopia (52.17%) than single-sided fractures (27.78%) ($p = 0.026$). No significant association was found with age, gender, cause of trauma, or direction of diplopia gaze. **Conclusion:** Diplopia is a relatively frequent ZMC fracture complication, especially in the case of bilateral trauma. Early detection can support ophthalmic referral and improved functional results.

Key words: Diplopia, Facial Trauma, Fracture Pattern, Orbital Injury, Zygomatic Maxillary Complex.

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INTRODUCTION

The Zygomatic bone is a strong buttress of lateral portion of middle third of facial skeleton lying between Zygomatic process of frontal bone and maxilla, and articulates with frontal, temporal, sphenoid and maxilla.[1] Zygomatic maxillary complex (ZMC) fractures are lateral midface fractures and second most common in facial region after nasal fractures.[2] The prominent convex shape of zygomatic bone makes it vulnerable to traumatic injury and the signs and symptoms exhibited by zygomatic maxillary complex fractures include flattening of cheek, swelling, paresthesia, limited mouth opening and difficulty in chewing.[3] The etiology of ZMC fractures include road traffic accident, assaults, falls and sports injuries.[4]

Panneerselvam et al. reported ZMC fractures accounting for 13%–40% of all facial fractures in cases of facial trauma, frequently resulting in functional deficits such as diplopia.[5]Shabbir et al. revealed a 25.9% occurrence of diplopia[6], whereas Khattak et al. observed a slightly elevated percentage of 28.9% in a tertiary care facility.[7] Likewise, Javed et al. reported diplopia in 26% of cases of ZMC fractures.[8] In a larger case series, Yamsani et al. had 22% of patients with visual disturbances.[9] Kambalimath et al. highlighted the importance of fracture severity in ocular complications, reporting that diplopia occurred in 31.5% of patients with complex ZMC fractures, particularly those involving the orbital floor and rim.[10]

Although a number of regional and global studies have published the incidence of diplopia among patients with ZMC fractures, most were postoperative series or did not employ standardized clinical examination in each direction of gaze. In addition, little localized data are available from northern parts of Pakistan, specifically Khyber Pakhtunkhwa (KPK), where trauma patterns and access to care may impact diagnosis and presentation.

1. BDS/ PGR OMFS/Oral & Maxillofacial Surgery, Ayub Teaching Hospital
2. BDS/FCPS/Assistant Professor/ Oral & Maxillofacial Surgery, Ayub Teaching Hospital
3. BDS, FCPS, CHPE, CHR, Associate Professor Oral and Maxillofacial Surgery, Khyber Medical University Institute of Dental Sciences, Kohat.
4. BDS/PGR OMFS/ Oral & Maxillofacial Surgery, Ayub Teaching Hospital
5. BDS/PGR OMFS/ Oral & Maxillofacial Surgery, Ayub Teaching Hospital
6. BDS/PGR OMFS/ Oral & Maxillofacial Surgery, Ayub Teaching Hospital
Correspondence Address:
Dr. Khurshid Alam
Department of Oral & Maxillofacial Surgery, Ayub Teaching Hospital
kurshid810@gmail.com

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The aim of the present study was to find out the incidence of diplopia in ZMC fracture patients reporting to the trauma center and maxillofacial outpatient department of Ayub Teaching Hospital, Abbottabad, and to assess its association with demographic and clinical factors such as age, gender, etiology, mechanism of trauma, and gaze of diplopia. This will assist in the direction of early diagnosis, referral, and management plans for ocular complications after mid-facial trauma.

METHODS

This was a cross-sectional study conducted at the Trauma Center and Maxillofacial Outpatient Department of Ayub Teaching Hospital (ATH), Abbottabad from December 2024 to May 2025. A sample size of 113 patients was calculated using the WHO sample size calculator, based on the following confidence level of 95%, absolute precision: 7% and expected frequency of diplopia in ZMC fractures of 17.4% (Khattak et al).Non-probability consecutive sampling was employed to recruit participants who met the inclusion criteria during the study period.

Inclusion Criteria

Patients aged between 18 and 60 years, both male and female genders, and with either unilateral or bilateral ZMC fractures confirmed radiographically.

Exclusion Criteria

Patients with non-displaced ZMC fractures, with pre-existing orbital pathologies and who declined to provide informed consent were excluded from the study.

Patients fulfilling the inclusion criteria were enrolled from the Department of Oral and Maxillofacial Surgery at ATH, Abbottabad, after obtaining ethical approval from the institutional review board (IRB) vide letter (Approval Code/Ref.No.RC-EA-2024/030) Written informed consent was taken from all participants after explaining the purpose and procedures of the study. Confidentiality and anonymity of data were maintained throughout the research process.

Demographic data, including age, gender, place of residence, educational level, and monthly income, were recorded using a structured data collection proforma. A thorough clinical assessment was conducted, including extraoral and intraoral examination, visual acuity testing, and evaluation for diplopia in all nine gaze positions (primary, left, right, up, down, up-left, up-right, down-left, down-right).

The diagnosis of ZMC fracture was confirmed through computed tomography (CT) scans of the face. Radiological findings were interpreted by a fellow of CPSP with a minimum of five years of clinical experience to ensure diagnostic accuracy. All data regarding the type and cause of trauma, pattern of fracture (unilateral or bilateral), presence and direction of diplopia (horizontal, vertical, or oblique), and other clinical findings were collected by the principal investigator.

Diplopiadefined as double vision of a single object observed in any of the horizontal, vertical, or oblique gazes, assessed clinically by history and physical examination. Zygomatic Maxillary Complex (ZMC) fracturedefined radiologically as a fracture involving one or more of the zygomatic arch, inferior orbital rim, anterior/posterior walls of the maxillary sinus, lateral orbital rim, frontozygomatic suture, and/or zygomaticomaxillary suture.

Data were analyzed using statistical package for social sciences (SPSS) version 22. Quantitative variables such as age were summarized as mean ± standard deviation or median (interquartile range), depending on the normality of distribution (assessed using the Shapiro-Wilk test). Categorical variables including gender, cause of trauma, trauma pattern, presence of diplopia, and direction of diplopia were presented as frequencies and percentages.

To assess associations between diplopia and demographic or clinical variables, stratification was performed based on age and gender to control for potential effect modifiers. Post-stratification comparisons were made using the Chi-square test or Fisher's exact test. A p-value < 0.05 was considered statistically significant.

RESULTS

113 patients with Zygomatic Maxillary Complex (ZMC) fractures were made part of the study. Majority of the patients (51.33%) belonged to the age group of 18–40 years, whereas 48.67%

belonged to 41–65 years of age. The sample had 56.64% males and 43.36% females.

Concerning the reason for trauma, Road Traffic Accidents (RTA) was the leading cause, with 61.95% of cases, followed by falls (23.89%) and assault (14.16%). The majority of patients (79.65%) had unilateral fractures of the ZMC, and 20.35% had bilateral fractures.

The total prevalence of diplopia among the study population was 32.74% (n = 37). Of the cases, horizontal diplopia occurred the most (54.87%), followed by vertical (32.74%), and oblique (12.39%) diplopia as shown in Table-I.

On bivariate analysis (Table-II), pattern of trauma was significantly correlated with diplopia presence (p = 0.026), with bilateral fractures presenting higher diplopia frequency (52.17%) than unilateral fractures (27.78%). The other variables like age, gender, reason of trauma, and direction of diplopia gaze did not present statistically significant association with diplopia presence (p > 0.05).

DISCUSSION

The purpose of this study was to establish the frequency and clinical presentation of diplopia in patients attending a tertiary care hospital with zygomatic maxillary complex (ZMC) fractures. Out of 113 patients, the overall prevalence of diplopia was 32.74%, and most frequently encountered was horizontal diplopia (54.87%). A significant association was found between the trauma pattern and presence of diplopia (p = 0.026), where bilateral fractures significantly contributed to the incidence of diplopia.

Table-I

Distribution of demographic and clinical variables among patients with zygomatic maxillary complex fractures (n=113)

Variables	Categories	n (%)
Age	18-40	58 (51.33%)
	41-65	55 (48.67%)
Gender	Male	64 (56.64%)
	Female	49 (43.36%)
Reason of Trauma	Road Traffic Accident	70 (61.95%)
	Fall	27 (23.89%)
	Assault	16 (14.16%)
Pattern of Trauma	Unilateral	90 (79.65%)
	Bilateral	23 (20.35%)
Presence of Diplopia	Yes	37 (32.74%)
	No	76 (67.26%)
Gaze of Diplopia	Horizontal	62 (54.87%)
	Vertical	37 (32.74%)
	Oblique	14 (12.39%)

TABLE-II

Association of demographic and clinical variables with presence of diplopia (n = 113)

Variables	Categories	Diplopia Presence		P-Value
		Yes	No	
Age	18-40	17 (29.31%)	41 (70.69%)	0.425
	41-65	20 (36.36%)	35 (63.64%)	
Gender	Male	23(35.94%)	41 (64.06%)	0.408
	Female	14 (28.57%)	35 (71.43%)	
Reason of Trauma	Road Traffic Accident	19 (27.14%)	51 (72.86%)	0.184
	Fall	10 (37.04%)	17 (62.96%)	
	Assault	8 (50%)	8 (50%)	
Pattern of Trauma	Unilateral	25 (27.78%)	65 (72.22%)	0.026
	Bilateral	12 (52.17%)	11 (47.83%)	
Gaze of diplopia	Horizontal	19 (30.65%)	43 (69.35%)	0.375
	Vertical	15 (40.54%)	22 (59.46%)	
	Oblique	3 (21.43%)	11 (78.57%)	

The incidence of diplopia in this research was relatively greater than in earlier study reports in comparable regional and global studies. For example, Starch-Jensen et al. reported that the incidence of diplopia was 29% in cases of ZMC fractures[11] and Rahman et al. reported a 17.4% rate of diplopia among ZMC fracture cases in Pakistan[12], a rate significantly lower than the 32.74% rate found in the present study's sample population. Likewise, Giudice et al. in a European population reported diplopia in about 21.2% of ZMC fracture patients who needed surgical management.[13] This difference may be due to differences in the severity of fractures, study inclusion criteria, or more sensitive diagnostic examinations in our study, e.g., diplopia testing in all nine directions of gaze. Additionally, Hashemi and Avval also conducted studies in an Iranian population that also documented 19% of cases with diplopia, pointing to variability in the prevalence as reported in different geographic and clinical environments.[14] Conversely, Siniscalchi et al. highlighted the value of orthoptic assessments and concluded that a majority of diplopia cases remain undiagnosed without extensive gaze analysis[15], perhaps explaining the greater prevalence in our report.

The prevalence of horizontal diplopia (54.87%) was greater than vertical (32.74%) and oblique (12.39%), which is in agreement with the literature. For example, Salma et al. described 56.2% horizontal diplopia due to medial and inferior rectus muscle involvement, which is the usual presentation in orbital floor and wall trauma with ZMC fracture.[16] Vertical diplopia represented 31.2%, while oblique diplopia was the least frequent at 12.5% as indicated in their results which aligns closely to our findings of 32.74% and 12.39%, respectively. This anatomical basis is consistent with our findings, particularly with bilateral fractures where there is a higher chance of orbital floor and wall violation. The significant association observed between bilateral ZMC fractures and presence of diplopia ($p = 0.026$) in our study is also supported by the results of Rizvi et al. and Manlove & Bailey, both of which reported greater ocular severity in complex bilateral fractures following increased bony displacement and muscle entrapment risk.[17,18] In addition, Obuekwe et al. also found that road traffic accidents were the most common reason for ZMC fractures, a finding corroborated in the present study with 61.95% of cases resulting from RTAs.[19]

Although age, gender, and trauma cause were not significantly associated with diplopia in the current analysis, this concurs with Javed et al. reporting no significant demographic associations.[20] Nevertheless, subtle variations in trauma biomechanics or in reporting bias may affect statistical results between studies. Generally, the general consensus of trends reinforces the validity of our results as well as highlighting the specific characteristics of our environment, for instance, greater severity of injury or late clinical presentation.

LIMITATIONS

This research contributes useful epidemiological information to the paucity of regional literature regarding ocular sequelae of ZMC fractures. However, a few limitations in this study were present. Firstly, it was a single-center tertiary care center study, so it may not be generalizable to other patient populations or care settings, particularly rural or resource-poor locations. Secondly, the cross-sectional study design limits the capacity to determine improvement or resolution of diplopia over time since follow-up data were not obtained to track long-term outcomes or healing after treatment. Furthermore, diplopia was assessed clinically without the implementation of advancedorthoptic instruments like Hess charts or synoptophore, which could have improved diagnostic accuracy, particularly in borderline or inconspicuous cases. Observer bias is also possible as clinical examination and history-taking were done by a single investigator without blinding, which could have affected the detection and classification of diplopia. Finally, though computed tomography (CT) scans were employed for radiographic verification of the fractures, the extent of entrapment of muscle or injury to soft tissue was not measured quantitatively, which might also have explained the occurrence and extent of diplopia.

CONCLUSION

The incidence of diplopia in ZMC fracture patients presenting at Ayub Teaching Hospital was significantly high at 32.74%, with the most frequent type being

horizontal diplopia. Bilateral fractures were found to be strongly correlated with an increased incidence of diplopia. These findings support the need for early and thorough ocular examinations in cases of ZMC trauma, in order to achieve an early diagnosis and prevent long-term sequelae.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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REFERENCES

1. Ali A. **Epidemiological study of zygomatic fractures: A five-year retrospective analysis in a single hospital experience.** Egypt J PlastReconstr Surg. 2020; 44(4):527-33.
2. Baraúna PKN, Gomes GN, Beneti IM. **Major clinical and surgical approaches to treating orbitozygomatic and zygomatic maxillary complex fractures: A systematic review.** MedNEXT J Med Health Sci. 2024; 5(S1):1-6.
3. Schneider M, Besmens IS, Luo Y, Giovanoli P, Lindenblatt N. **Surgical management of isolated orbital floor and zygomaticomaxillary complex fractures with focus on surgical approaches and complications.** J PlastSurg Hand Surg. 2020; 54(4):200-6.
4. Obimakinde O. **Zygomatic complex fractures in a Nigerian tertiary hospital: an update on pattern of presentation and care.** Niger Stethoscope. 2023; 5(1):62-76.
5. Panneerselvam E, Ravi P, Sasikala B. **Fractures of the zygomaticomaxillary complex. In: Oral and Maxillofacial Surgery for the Clinician.** Singapore: Springer; 2021; 1151-99.
6. Shabbir M, Shah R, Ahmad M, Issrani R, Khan Z, Alotha SN, et al. **Frequency of diplopia in zygomatic complex fractures—a cross-sectional descriptive study.** Int J Dent. 2023; 2023:e7631634.
7. Khattak JU, Rehman Y, Shah K, Zamir A, Sultana S. **Frequency of diplopia in patients with zygomaticomaxillary complex (ZMC) fractures reported to tertiary care hospital.** J Khyber Coll Dent. 2020; 10(3):68-71.
8. Javed A, Jamal M, Khan A, Khan TU, Ullah H, Sardar H, et al. **Frequency of trismus and diplopia in patients with zygomatic complex fractures.** J Khyber Coll Dent. 2021; 11(1):45-50.
9. Yamsani B, Gaddipati R, Vura N, Ramisetti S, Yamsani R. **Zygomaticomaxillary complex fractures: a review of 101 cases.** J Maxillofac Oral Surg. 2015; 15(4):417-24.
10. Kambalimath DH, Kambalimath HV, MVVS, Kumar VA, R TG, Deepak RM. **Retrospective analysis of management of zygomatic complex fractures.** Traumaxilla. 2023; 5(1-3):20-6.
11. Starch-Jensen T, Linnebjerg LB, Jensen JD. **Treatment of zygomatic complex fractures with surgical or nonsurgical intervention: A retrospective study.** Open Dent J. 2018; 12:377-87.
12. Rahman AU, Rehman MU, Munem A, Saleem M, Ahmed M, Ullah K. **Frequency of diplopia in zygomatic fractures.** Pak J Med Health Sci. 2023; 17(2):521-3.
13. Giudice GL, Siniscalchi EN, Ponte FD. **Is diplopia a predictor of zygomatic maxillary complex fractures surgical indication? 10-year single-center preliminary study.** Int J Oral Maxillofac Surg. 2023; 52:20-1.
14. Hashemi HM, Avval SK. **Prevalence of ocular complications in patients with zygomatic bone fractures in an Iranian population.** Front Dent. 2020; 17(9):1-4.
15. Siniscalchi EN, Lo Giudice G, Calvo A, Marino R, Bonavolontà P, Dell'AversanaOrabona G, et al. **Clinical significance of diplopia and the orthoptic examination in zygomatic maxillary complex fractures.** J Craniofac Surg. 2024; 35(5):1531-6.
16. Salma RG, Almutairi KM, Alalmai MI. **The clinical course of diplopia associated with zygomaticomaxillary complex fractures before and after surgery.** J Oral MaxillofacSurg Med Pathol. 2018; 30(3):191-6.
17. Rizvi A, Khan I, Snee D, Bruzual L. **Zygomatic complex fractures in the emergency department: Diagnosis and management.** Emerg Nurse. 2021; 29(6):20-4.
18. Manlove AE, Bailey JS. **Management of zygomatic complex fractures.** In: Manlove AE, Bailey JS, editors. Maxillofacial Trauma Management. Springer; 2022; 689-705.
19. Obuekwe O, Owotade F, Osaiyuwu O. **Etiology and pattern of zygomatic complex fractures: A retrospective study.** J Natl Med Assoc. 2005; 97(7):992-6.
20. Javed A, Jamal M, Khan A, Khan TU, Ullah H, Sardar H, et al. **Frequency of trismus and diplopia in patients with zygomatic complex fractures.** J Khyber Coll Dent. 2021; 11(1):45-50.

AUTHORSHIP AND CONTRIBUTION DECLARATION	
1	**Ammara Saleem:** Data collection, Literature review
2	**Khurshid Alam:** Data analysis, write up.
3	**Muhammad Masood Khan:** Data analysis, literature review.
4	**Bakhtawer Aziz:** Data collection.
5	**Jannat-ul-Mawa:** Literature review.
6	**Sidra Qadir:** Data analysis.