



Patterns and Etiological Analysis of Zygomaticomaxillary Complex (ZMC) Fractures in a Military Tertiary Care Hospital, Karachi

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ABSTRACT

Objective: To evaluate the patterns and underlying causes of Zygomaticomaxillary Complex (ZMC) fractures in patients presenting to the Oral and Maxillofacial Surgery department at PNS Shifa Hospital, Karachi. **Methods:** 93 patients between the ages of 18 and 61 participated in a descriptive cross-sectional study that was carried out between April 2024 and April 2025. To determine fracture patterns and etiologies, patients received clinical and CT-based evaluations. SPSS v25 was used to examine information on age, gender, socioeconomic status, education, fracture type and site, and injury causation. To determine significance, the chi-square and Fisher's exact tests were used. **Results:** The average age was 35.69 ± 10.72 . The majority of patients were male (60.2%) and between the ages of 18 and 30 (37.6%). Road traffic incidents accounted for 29% of fractures, while falls accounted for 28%. The two anatomical areas most impacted were the zygomatico-frontal suture (22.6%) and the zygomatico-facial foramen (21.5%). The proportion of atypical (50.5%) and conventional (49.5%) fracture types was almost equal. Significant correlations between fracture patterns and age group and etiology were found by statistical analysis ($p < 0.05$). **Conclusion:** ZMC fractures commonly resulted from RTAs and falls, particularly in young males. Enhanced public safety and preventive strategies, including traffic regulations and helmet use, could mitigate these injuries.

INTRODUCTION

Second only to nasal bone fractures in incidence, zygomaticomaxillary complex (ZMC) fractures account for a substantial percentage of facial trauma cases worldwide. Because of the zygomatic bone's anatomical importance in face symmetry, ocular position, and mastication, these fractures can result in both cosmetic abnormalities and functional damage. The ZMC articulates with the frontal, temporal, sphenoid, and maxillary bones resulting in a tetrapod structure that is especially vulnerable to traumatic forces from frontal and lateral impact. [1].

Clinical signs like enophthalmos, infraorbital paresthesia, malar flattening and limited mouth opening can arise from injuries to the ZMC affecting the orbital floor, infraorbital nerve and zygomatic arch. In order to restore function and appearance these injuries frequently require surgical repair. [2].

The leading causes of ZMC fractures globally include road traffic accidents (RTAs), physical assaults, falls from height, sports-related trauma, and gunshot injuries [3–5]. However, due to socioeconomic and cultural factors, their

prevalence and etiology may vary across different regions. In countries like Pakistan, particularly big cities such as Karachi, the increase in motorcycle use without proper protection gear like helmets has led to a major increase in RTAs causing maxillofacial injuries [6].

While numerous studies have assessed the patterns and etiologies of ZMC fractures on a global level, there remains a lack of local data specifically pertaining to the Pakistani population. Understanding local trends is essential for devising targeted preventive strategies and resource allocation in trauma care settings. This study thus aimed to investigate the demographic profile, etiological factors, and anatomical distribution of ZMC fractures among patients reporting to a military tertiary care hospital in Karachi.

MATERIALS AND METHODS

A descriptive Cross sectional study was conducted on 93 patients over 1 year period who presented at the department of Oral & Maxillofacial Surgery, PNS Shifa Hospital, Karachi with ZMC fractures. After ethical

approval from the hospital's Ethical review committee, 93 patients fulfilling the inclusion criteria of ZMC fracture less than 2 weeks old and ranging from 18 to 61 years regardless of their gender were recruited using Non-probability consecutive sampling. Patients with Malunited or chronic fractures, Orbital fractures, Uncontrolled systemic illness and patients refusing treatment were excluded from the study. Informed consent was taken. CT scans with 3D reconstruction were used to assess fracture sites. Patterns were categorized as involving Zygomatico-Frontal Suture (ZFS), Zygomatico-Facial Foramen (ZFF), Infra-Orbital Foramen (IOF), Zygomatic Bone (ZB), Zygomatico-Maxillary Suture (ZMS), and Zygomatic Arch (ZA).

Data was entered and analyzed using SPSS version 25. Descriptive values included mean and standard deviation for continuous variables. Categorical variables were expressed as frequencies and percentages. Normality was assessed using Shapiro-Wilkes test. Chi-square and Fisher's exact tests were applied to identify associations between fracture patterns and demographic/etiological variables. p-values ≤ 0.05 were considered statistically significant.

RESULTS

A total 93 patients were recruited to conduct this study in Department of Oral & Maxillofacial Surgery, PNS Shifa Hospital, Karachi, Pakistan.

Mean ± Standard Deviation (SD) was calculated for age which was 35.69 ± 10.72 years. Tests of normality i.e., Shapiro-Wilk test was applied which showed that the data was normally distributed

Total study population was distributed in four age groups i.e., 18-30, 31-40, 41-50 and 51-60 years. Maximum patients i.e., 37.6% were recorded in the young age, 18-30 years, followed by 29% patients in 31-40 years age group, 23.7% patients in 41-50 years age group and 9.7% in 51-60 years age group (Table 2). As per gender distribution, a male dominance was recorded with 60.2% male patients and 39.8% female patients out of total study population

As per statistics of etiology of fractures, the most frequent etiology was "Road Traffic Accident (RTA)" observed in 29% patients. The 2nd most frequent etiology of fracture was "Falls" which was observed in 28% patients. Similarly, "Assault" was observed in 19.4% patients, "Sports" was observed in 16.1% and "Gun-Shot" was the least observed etiology observed in only 7.5% patients of the study population (Table - 6). As per statistics of type of fractures; 49.5% fractures were conventional while the remaining 50.5% fractures were atypical (Table 1).

The most important observation of the current study was patterns of fractures. Zygomatico-Frontal Suture (ZFS) was observed in 22.6% patients, Zygomatico-Facial Foramen (ZFF) was observed in 21.5% patients, Infra-Orbital Foramen (IOF) was observed in 17.2% patients, Zygomatic Bone (ZB) was observed in 14% patients, Zygomatico-Maxillary Suture (ZMS) was observed in another 14% patients and Zygomatic Arch (ZA) was observed in 10.8% patients.

Demographics

- Mean age: 35.69 ± 10.72 years

- Most patients (37.6%) were aged 18–30 years
- Gender distribution: 60.2% males, 39.8% females

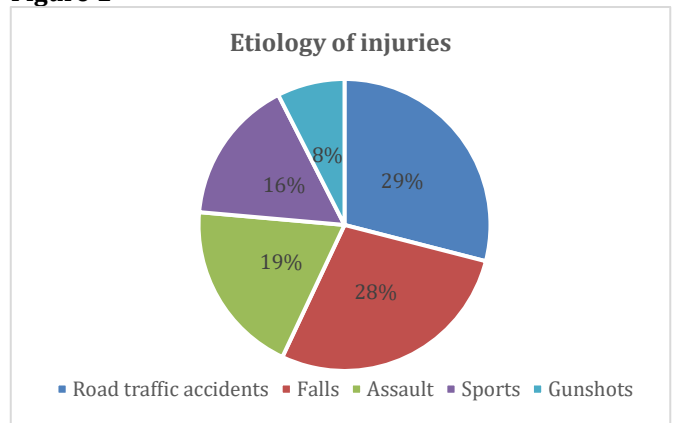
Socioeconomic and Educational Status

- 55.9% of patients were affording; 44.1% non-affording
- Education levels: Matric (33.3%), Intermediate (24.7%), Graduate (26.9%), Postgraduate (15.1%)

Etiology of Injuries

- Road Traffic Accidents: 29%
- Falls: 28%
- Assault: 19.4%
- Sports: 16.1%
- Gunshots: 7.5%

Figure 1



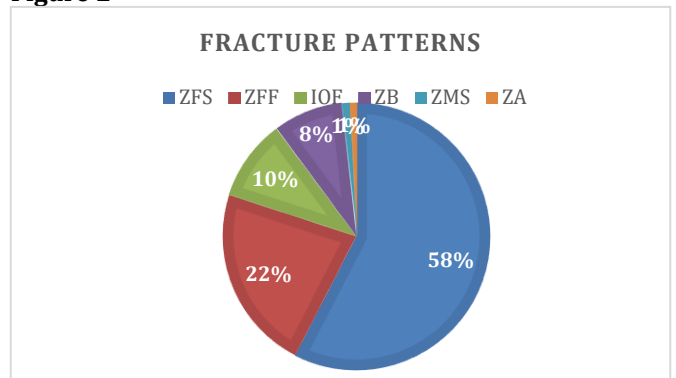
Fracture Types

- Conventional: 49.5%
- Atypical: 50.5%

Fracture Patterns

- ZFS: 22.6%
- ZFF: 21.5%
- IOF: 17.2%
- ZB: 14%
- ZMS: 14%
- ZA: 10.8%

Figure 2



Stratified Analysis

- Young adults (18–30 years) showed higher frequencies of ZFS and ZFF (p < 0.05)
- Males more commonly sustained ZFS and IOF fractures
- RTAs and falls were significantly associated with ZFS and ZFF involvement (p < 0.05)

Table 1
Frequency of ZMC Fracture Etiologies

Etiology	Frequency	Percentage (%)
Road Traffic accident	27	29.0
Falls	26	28.0
Assault	18	19.4
Sports	15	16.1
Gunshot	7	7.5

Table 2
Distribution of Fracture Patterns by Gender

Fracture pattern	Male (%)	Female (%)
ZFS	14.0	8.6
ZFF	12.9	8.6
IOF	11.8	5.4
ZB	9.7	4.4
ZMS	5.4	8.6
ZA	6.5	4.3

DISCUSSION

The results of this study conclude that ZMC fractures are predominantly observed in young males, particularly those aged 18–30 years. These results are in accordance with global literature, which often attributes higher fracture rates to increased physical activity, risky behavior, and occupational exposure in this age group [2,3].

The leading causes identified as RTAs and falls in this study are consistent with previously published findings. In many urban Pakistani settings, motorcycle-related trauma due to non-use of helmets has become a major concern. This is similar to a study carried out in UAE by Jaber et al. [4], where 64.2% of maxillofacial trauma was RTA-related, and supports findings from studies done in India and Europe [5,6,7].

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The most common fracture patterns involved the ZFS and ZFF regions, reflecting the structural vulnerability of the zygomatic bone's frontal and lateral processes. These findings are congruent with studies by Lerner et al. [1] and Dubron et al. [3], in which the Zygomaticofrontal suture shows a higher incidence of trauma.

From a clinical perspective, the near-equal distribution of conventional and atypical fractures highlights the variability of trauma mechanisms. This has implications for diagnostic accuracy and surgical planning. The routine uses of 3D CT scans, as employed in this study, allows for precise visualization of complex fracture patterns and aids in formulating tailored treatment plans.

The multifactorial nature of Facial trauma is highlighted through the statistical associations found between fracture types and demographic/etiological variables. For instance, young age and male gender were significantly associated with ZFS and IOF fractures, possibly as a result of higher kinetic impacts during car accidents and physical altercations.

The findings of this study demonstrate strong need for public health interventions that emphasize road safety, use of protective gear, and improved infrastructure to prevent falls and RTA-related injuries. Furthermore, education campaigns especially aimed for young males regarding helmet usage and safety protocols could play a key role in reducing the burden of ZMC fractures.

CONCLUSION

ZMC fractures are predominantly caused by RTAs and falls most commonly affecting the ZFS and ZFF sites. Targeted preventive strategies and improved diagnostic imaging can enhance patient outcomes and reduce healthcare burdens.