Patterns of Zygomatic Complex Bone Fracture in Saudi Arabia

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Abstract

Introduction: Zygomatic bone (ZB), also known as the cheekbone, articulates with the maxilla, temporal sphenoid, and the frontal bones. It forms the prominence of the cheek and part of the orbit, and because of its prominence, it is susceptible to trauma. The aim of this study was to present the pattern of ZB fracture in a country in the Middle East. Patients and Methods: The medical records of all trauma cases admitted to the Department of Oral and Maxillofacial Surgery Ward, Riyadh Dental Centre, King Saud Medical City, Riyadh, Saudi Arabia, were reviewed and all cases with ZB fractures were included in this study from December 2002 to December 2012. Data were analyzed using SPSS version 16 (SPSS Inc., Chicago, IL, USA). The results were presented as simple frequencies and percentages. Results: A total of 1487 patients had maxillofacial trauma and 306 cases were diagnosed with ZB fractures during the study. There were 271 (88.6%) males and 35 (11.4%) females with male: female ratio of 7.7:1. Age group of 21–30 years has the highest number of fracture cases (133 [43.5%]). Road traffic accident (RTA) remained the leading etiology of zygomatic complex fracture (ZMCF; 221 [72.2%]). August has been observed to be associated with the highest cases of ZMCF (40 [13.1%]). The years 2005 and 2006 recorded the highest frequency of ZMCF cases (46 [15.0%] and 44 [14.4%], respectively). Conclusion: The results of this study showed that RTA is the leading cause of ZB fractures followed by assaults. The most commonly fractured site was the zygomaticomaxillary. Proper road traffic regulation is paramount to help reduce maxillofacial trauma.

Keywords: Etiology, maxillofacial, trauma, zygomatic bone

Introduction

The zygomatic bone (ZB) plays a key role in the structure, function, and esthetic appearance of the facial skeleton.[1] It provides standard cheek contour and separates the orbital contents from the temporal fossa and the maxillary antrum.[2]

The zygomatic complex fracture (ZMCF) formerly referred to as a tripod or trimalar fracture is now known as a quadripod or quadramalar fracture because it has four components: the zygomaticofrontal suture superiorly along the lateral orbital wall, zygomaticosphenoid suture inferiorly, zygomaticomaxillary suture separating the zygoma from the maxilla, and zygomaticotemporal at the zygomatic arch separating it from the temporal bone.[3]

Most zygomatico–orbito–maxillary complex fractures are caused by violent assaults, followed by motor vehicle accidents; the majority of patients affected and reported in the literature were young males in their third decade of life.[4,5] Abdullah et al.[6] have reported that the patterns of maxillofacial trauma in Saudi Arabia are poorly studied. Most middle-third facial fractures involved the zygomatic complex, and the incidence of such fractures differs significantly between male and female.[6] Successful management and treatment of ZMCF depends on the careful study of the pattern of fracture in any community. Saudi Arabia is peculiar because of restriction on female movement and driving and the introduction of new traffic regulations that may modify pattern and treatment of facial injuries. This treatment requires an accurate diagnosis, appropriate surgical exposure, and precise reduction to reconstitute the complex three-dimensional anatomy. The aim of the current study, therefore, is to find out the pattern of ZMCF in an Arabian community over a 10-year period.

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Patients and Methods
The medical records of all cases admitted to the Department of Oral and Maxillofacial Surgery Ward, Riyadh Dental Centre, King Saud Medical City, Riyadh, Saudi Arabia, were reviewed and all cases diagnosed with ZMCF were included in this study. The data studied were obtained retrospectively from clinical case sheets and surgical records over a 10-year period starting from December 2002 to December 2012. Patient’s gender, age, nationality, etiology, and site of ZMCF were recorded. Ethical committee approval of the institution was obtained for the study with protocol number GRP/43236002/38.

Inclusion criteria involve all patients diagnosed clinically and radiographically suffering from ZMCF that presented from December 2002 to December 2012. Exclusion criteria included patients with maxillofacial injuries or body injuries not associated with ZB involvement, patients admitted under other specialties such as neurosurgery and orthopedic because of the inaccurate maxillofacial diagnostic records in these departments, incomplete or unclear patient records, and cases in which computed tomography showed no evidence of fracture.

Data were stored and statistically analyzed using SPSS (ver. 16.0; SPSS Inc., Chicago, IL, USA). Results were presented as simple frequencies and percentages.

Results
A total number of 1487 patients were admitted for maxillofacial injuries, and of these, 306 cases were treated for ZMCF. This represents about 20.6% of the total maxillofacial trauma cases during the study. There were 271 (88.6%) male patients and 35 (11.4%) females with male: female ratio of 7.7:1. Of the 271 males, 233 (86%) patients were Saudis while 38 (14%) patients were non-Saudis. Of the 35 females, 30 (85.7%) patients were Saudis while only 5 (14.3%) patients were non-Saudis [Table 1]. Age group of 21–30 years had the highest number of fracture cases (133 [43.5%]), while patients >50 years of age had the least number of fractured cases [Table 2]. Road traffic accident (RTA) remained the leading etiology of ZMCF in the hospital (221 [72.2%]), followed by assault (54 [17.6%]). Least fractures were due to camel attack (4 [1.3%]) [Table 2].

August has been observed to be associated with the highest cases of ZMCF (40 [13.1%]) and closely followed by July (33 [10.8%]). February recorded the least number of ZMCF (17 [5.6%]) [Figure 1]. Throughout the study, 2005 and 2006 recorded the highest frequency of ZMCF cases (46 [15.0%] and 44 [14.4%], respectively). The year 2012 recorded the least cases (17 [5.2%]) [Figure 2].

ZMCF is the most common fracture pattern observed in the current study with 283 (92.5%) patients followed by isolated zygomatic arch fracture 20 (6.5%) [Table 3]. Only 2 (0.6%) cases of combined fracture were observed in the study. The left and right sides were affected equally in the current study (140 [45.8%] and 141 [46.1%], respectively). Only 25 (8.2%) cases occurred bilaterally [Figure 3].

| Table 1: Nationality and gender distribution of the studied patients |
|------------------|------------------|------------------|
| Gender          | Nationality      | Total (%)        |
|                 | Saudi (%)        | Non-Saudi (%)    |
| Male            | 233 (86.0)       | 38 (14.0)        | 271 (100.0) |
| Female          | 30 (85.7)        | 5 (14.3)         | 35 (100.0)  |
| Total           | 263 (86.0)       | 43 (14.0)        | 306 (100.0) |

Figure 1: Bar chart showing distribution of zygomatic complex fracture during the months of the year

Figure 2: Bar chart showing distribution of zygomatic complex fracture during the study years

Figure 3: Pie chart showing the laterality of the zygomatic complex fractures
The etiology of maxillofacial injuries varies from one country to another and even within the same country depending on the socioeconomic, cultural, and environmental factors.\cite{6,17} Within the same country, periodic verification of the etiology of maxillofacial injuries helps recommend ways to prevent maxillofacial injuries.\cite{17,18} Fights and assaults were the predominant cause of maxillofacial injuries reported in some studies;\cite{10,20} however, in this study, the most common cause of ZMCF was RTAs (72.2%). These figures match with the findings of other researches from different communities on the most common etiological factor of RTAs.\cite{12,16,21-23} On the contrary, Gomes et al.\cite{24} showed that falls were the main cause of injuries in their study. Similarly, falls have been reported as the main etiological cause of craniomaxillofacial injuries in females among Arabs in Israel.\cite{25} This current finding may be due to nonenforcement of road traffic laws as many drivers exceed the speed limit, do not use seat belts, and drive under the influence of psychoactive substances.\cite{26,27} Fastening of seat belts resulted in a decrease in the frequency of injury among car users as reported in the literature.\cite{28,29} Interpersonal violence was reported as the next most frequent cause of ZMCF in different studies.\cite{28,30-32} This is consistent with the findings of this study where assaults involved 54 (17.6%) cases. In contrast to our study, falls were reported more frequent than violence by a study in the United Arab Emirates.\cite{33} This could be explained by the presence of high sky buildings in the United Arab Emirates as compared with Saudi Arabia. Fall from height was the third highest cause of zygoma fractures in this study, followed by sport injuries. It was also surprising that camel assault was found to be a cause of ZMCF in Saudi Arabia. This

### Table 2: Etiology of Zygomatic bone fracture according to patient’s age group

| Age group (years) | RTA (%) | Assault (%) | Camel attack (%) | Fall (%) | Sports (%) | Total (%) |
|-------------------|---------|-------------|-----------------|---------|-----------|-----------|
| 0-10              | 6 (2.0) | 2 (0.6)     | 0 (0.0)         | 0 (0.0) | 0 (0.0)   | 8 (2.6)   |
| 11-20             | 60 (19.6)| 19 (6.2)    | 1 (0.3)         | 4 (1.3) | 4 (1.3)   | 88 (28.8) |
| 21-30             | 99 (32.3)| 21 (6.9)    | 2 (0.6)         | 8 (2.6) | 3 (1.0)   | 133 (43.5)|
| 31-40             | 38 (12.4)| 8 (2.6)     | 1 (0.3)         | 2 (0.6) | 3 (1.0)   | 52 (17.0) |
| 41-50             | 14 (4.6) | 5 (1.0)     | 0 (0.0)         | 2 (0.6) | 0 (0.0)   | 19 (6.2)  |
| >50               | 4 (1.3)  | 1 (0.3)     | 0 (0.0)         | 1 (0.3) | 0 (0.0)   | 6 (2.0)   |
| Total             | 221 (72.2)| 54 (17.6)  | 4 (1.3)         | 17 (5.6)| 10 (3.3)  | 306 (100.0)|

RTA: Road traffic accident

### Table 3: Pattern of zygomatic bone fracture and age group of patients

| Age group | ZMC (%) | Zygomatic arch (%) | Combine (%) | Bilateral (%) | Total (%) |
|-----------|---------|--------------------|-------------|--------------|-----------|
| 0-10      | 8 (2.6) | 0 (0.0)            | 0 (0.0)     | 0 (0.0)      | 8 (2.6)   |
| 11-20     | 85 (21.9)| 2 (0.6)            | 1 (0.3)     | 0 (0.0)      | 88 (28.7) |
| 21-30     | 122 (39.9)| 10 (3.3)           | 1 (0.3)     | 0 (0.0)      | 133 (43.5)|
| 31-40     | 47 (15.3)| 5 (1.6)            | 0 (0.0)     | 0 (0.0)      | 52 (17.0) |
| 41-50     | 16 (5.2) | 3 (1.0)            | 0 (0.0)     | 0 (0.0)      | 19 (6.2)  |
| >50       | 5 (1.6)  | 0 (0.0)            | 0 (0.0)     | 1 (0.3)      | 6 (2.0)   |
| Total     | 283 (92.5)| 20 (6.5)           | 2 (0.6)     | 1 (0.3)      | 306 (100.0)|

ZMC: Zygomaticomaxillary complex

**DISCUSSION**

Due to the morphologic prominence of the zygomatic region, ZMCF is the second most common mid-maxillofacial bone fractured.\cite{9} Overall, it represents 13% of all craniofacial fractures.\cite{7,8} However, ZMCF in this study represents 20.5% of the total number of maxillofacial trauma cases seen during the studied. This is far higher than that reported in the literature. The reason for this higher percentage is as a result of higher incidence of RTA in this region of the world.\cite{6}

The Saudi nationals represent the main group of patients affected as compared to non-Saudi citizens. This is not in agreement with a study done in the United Arab Emirates where the non-Emirates patients were higher than the Emirates.\cite{9} This may be due to the fact that the Riyadh Dental Centre has some restriction policy of accepting non-Saudi patients as compared to other Arab nations. Studies have shown that the peak incidences of maxillofacial fractures in rural children were found to be between the ages of 10 and 15 years.\cite{10,11} However, in the present study, the age group most frequently involved in ZMCF was found to be 21–30 years (43.5%) followed by 11–20 years (28.8%). This may be attributed to the fact that individuals in the third decade of life are more physically active in Saudi Arabia. This finding has been reported in other studies.\cite{12,13}

Males (88.6%) are affected with ZMCF more than females (11.4%) because women are not allowed to drive in Saudi Arabia and are therefore less susceptible to accidents, assaults, work, and sport injuries as found in other studies.\cite{13-16}
etiological factor has not been reported in previous studies from the region. However, in Northern Nigeria, camels are used for transportation and farming. These animals pull ploughs, assist in irrigation of farmlands, and transport agricultural produce. Maxillofacial injuries from camel aggregation have been reported in this part of Nigeria.

The monthly incidence of maxillofacial fractures from this study was fairly constant with seasonal variations, as reported in several studies. During this 10-year retrospective study, it appeared that August showed the highest month during which ZMCF was diagnosed, while February showed the lowest number of fracture diagnosed in the same period. This is in accordance with a study from an Indian community where most cases were diagnosed in August. This was however different from those reported in an country in Arab where the peak incidence reported was in January followed by May. This may be explained by the fact that August is the summer holiday at school and universities in Saudi Arabia and supported by the finding that the highest age group diagnosed with fractures are seen between 20 and 30 years. The highest incidence of fractures was reported during 2005 which declined during the following years. This could be related to the implementation of tough traffic regulation and the commencement of SAHER system. This system is an automated traffic control system in Saudi Arabia which is a complete and well-equipped network of digital cameras and online monitoring system linked with the National Information Center of the Ministry of Interior. It has a strong check on traffic flow through a satellite system and has special features such as auto vehicle location, variable message signs, closed-circuit TV, law enforcement system, and traffic management system. In addition, this system needs no human resource for its functioning and works even more than a traffic warden. If there is any case of traffic violation, it issues tickets to motorist. However, this finding needs further and detailed study to prove the effect of implementation of this system on the incidence of RTAs in the kingdom.

Zygomatic arch fracture often occurs as part of ZMCF, however, isolated zygomatic arch fractures are uncommon. This study is in tandem with the literature as zygomatic arch fractures are very few. Probably, this may be because most impacts to the face are likely to be frontal, while arch fractures are more likely to involve lateral impact. Therefore, isolated zygomatic arch fractures are expected more in cases of assaults, falls, missiles, and other injuries. The present study recorded fractures of the zygomaticomaxillary complex bone (92.8%) more than those of the zygomatic arch (7.2%). This is in agreement with a study from Medina, a community close to the center of the current study.

This study showed that both right and left sites of zygoma are equally affected by fractures. This is in tandem with previous studies, which showed no significant difference in both sides of ZB fracture. However, a few other studies have reported a higher right side predilection.

**Conclusion**

RTA is the most common cause of ZB fractures in Riyadh, Kingdom of Saudi Arabia, followed by assaults, while the most commonly fractured site was the zygomaticomaxillary fracture. These fractures frequently occurred in the age group of 21–30 years, which reflects the peak age of activities. Proper road traffic regulations should be advocated to reduce the incidence of maxillofacial injuries.

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**Conflicts of interest**

There are no conflicts of interest.

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