Associated maxillofacial bone fractures with zygomatic complex fracture: experience from a tertiary referral hospital in Riyadh, Kingdom of Saudi Arabia

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Background
The zygoma plays a fundamental role because the underlying bony structural design directly influences the facial contour. As a result of the intimate association of the zygomatic complex (ZC) with the rest of the facial skeleton, associated maxillofacial fractures are quite common.
Patients and methods
All cases diagnosed with ZC fracture over a 10-year period starting from December 2002 to December 2012 at Riyadh Dental Center at King Saud Medical City, Riyadh, Saudi Arabia, were studied. Patient's sex, age, etiology, and associated maxillofacial bone fracture were retrieved and recorded. Data were stored and statistically analyzed using SPSS. Results were presented as simple frequencies and percentages.
Results
Overall, 1487 patients presented with maxillofacial trauma and 306 cases were diagnosed with zygomatic bone fractures. There were 271 (88.6%) male patients and 35 (11.4%) female patients, with male : female ratio of 7.7 : 1. Patients in the age range of 21–30 years had the highest number of maxillofacial fracture. Ninety-six (31.4%) patients had associated maxillofacial bone fractures, whereas 231 (69.6%) patients did not have any associated fracture. Road traffic accident was the leading cause of the maxillofacial trauma [221 (72.2%)]. Mandibular fracture had the highest frequency of 35 (11.4%), whereas Le-Fort III and frontal bone fractures had the least number of cases [two (0.7%)].
Conclusion
Associated maxillofacial bone fracture with ZC fracture is quite common. Efforts should be made by the attending surgeon to identify these injuries.

Keywords:
associated fracture, mandibular, maxillofacial, orbital, zygomatic bone

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Introduction

In maintaining facial contour, the zygoma plays a fundamental role because the underlying bony structural design directly influences the facial contour [1]. When this prominent bone fractures and dislocates, it does not only cause aesthetic deficits but also disrupts ocular and mandibular functions. Because of its prominence, it is prone to various traumas; however, its bony architecture is unique as it enables it to resist significant impact without being fractured [2].

Trauma (most of the time road traffic accidents) has been the leading cause of zygomatic bone fracture followed by assault [3–6]. Male preponderance has been reported worldwide [3,4,7]. Third decade of life has been documented as peak age of maxillofacial trauma generally [7,8].

Because of its articulation with four pairs of bone in the caniomaxillofacial region, it is referred to as tetrapod fracture [9]. These bones are the frontal bone of the skull (zygomaticofrontal), the temporal bone of the skull (zygomaticotemporal), the sphenoid bone of the skull (zygomaticosphenoid), and the maxillary bone of the facial skeleton (zygomaticomaxillary) [10].

As a result of the intimate association of the zygomatic complex (ZC) with the rest of the facial skeleton, associated maxillofacial fractures are common. The management of these complex fractures will depend upon thorough evaluation and diagnosis of these associated fractures. The specific aim of the current study therefore is to find out the associated maxillofacial bone fractures with ZC fracture at

Riyadh Dental Centre, King Saud Medical City, Kingdom of Saudi Arabia.

Patients and methods

All patients with maxillofacial fractures presenting at Riyadh Dental Centre at King Saud Medical City, Riyadh, Saudi Arabia were reviewed retrospectively. All cases diagnosed with ZC fracture were included in this study over a 10-year period starting from December 2002 to December 2012. Patient's sex, age, etiology, and associated maxillofacial bone fracture were retrieved and recorded. The study was approved by the Ethical Committee of King Saud Medical City with protocol number GRP/43236002/38.

Inclusion criteria comprised all patients diagnosed clinically and radiographically with ZC fracture with associated maxillofacial fracture. Exclusions criteria included patients with other maxillofacial injuries or body injuries not associated with zygomatic bone involvement and patients under the care of other speciality such as neurosurgery and orthopedic.

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

Results

A total of 1487 patients overall presented with maxillofacial trauma and 306 cases were diagnosed with zygomatic bone fractures. There were 271 (88.6%) male patients and 35 (11.4%) female patients, with male : female ratio of 7.7 : 1 (Table 1). The patients with age ranged from 21–30 years had the highest number of maxillofacial fracture (Table 2). Of the 306 cases with zygomatic fractures, 96 (31.4%) had associated maxillofacial bone fractures, whereas 231 (69.6%) did not have any associated fracture. Road traffic accident was the leading cause of the maxillofacial trauma [221 (72.2%)] followed by assault [54 (17.6)]. Mandibular fracture had the highest frequency of 35 (11.4%) closely followed by Le-fort I fracture of the maxilla 20 (6.5%), and then Le-fort II fracture of the maxilla [15 (4.9%)]. Le-Fort III and frontal bone fractures had the least number of cases [two (0.7%)] each (Table 2). Other distribution of associated maxillofacial bone fracture is shown in Table 2 and Figure 1. The most common site of mandibular fracture was parasymphysis fracture which was diagnosed in 13 (4.2%) cases and the least affected site of the mandible was the coronoid process which was diagnosed in only one (0.3%) case (Fig. 2). Orbital fracture was diagnosed in nine (2.9%) cases. Three (1.0%) cases involved the infra-orbital rim, two (0.7%) cases involved the supra-orbital rim, one (0.3%) case affected the medial wall, and three (1.0%) cases were diagnosed with orbital floor fracture (Fig. 3).

Discussion

The incidence of maxillofacial trauma is rising at an alarming rate worldwide. In the UK, it has been

Table 1 Distribution of sex and etiology of zygomatic complex fracture

	Frequency	Percentage
Sex of patients		
Male	271	88.6
Female	35	11.4
Total	306	100.0
Etiology of zygomatic fracture		
RTA	221	72.2
Assault	54	17.6
Camel insult	4	1.3
Fall	17	5.6
Sports	10	3.3
Total	306	100.0

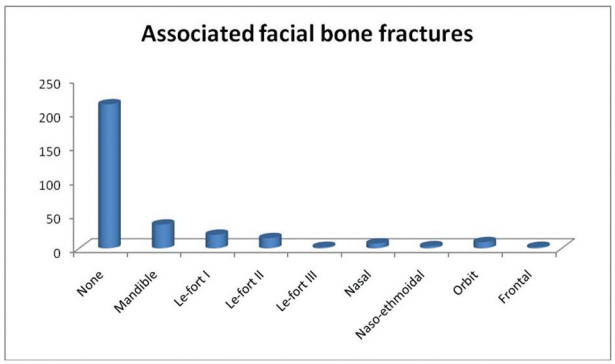
RTA, road traffic accident.

Table 2 Distribution of associated fractures with age group of patients

Associated fractures	Age group [*n* (%)]						Total [*n* (%)]
	0–10	11–20	21–30	31–40	41–50	>50	
Mandible	0 (0.0)	9 (1.3)	21 (6.9)	4 (1.3)	1 (0.3)	0 (0.0)	35 (11.4)
Le-Fort I	0 (0.0)	4 (1.3)	11 (3.6)	3 (1.0)	0 (0.0)	2 (0.7)	20 (6.5)
Le-Fort II	0 (0.0)	4 (1.3)	5 (1.6)	2 (0.7)	3 (1.0)	1 (0.3)	15 (4.9)
Le-Fort III	0 (0.0)	0 (0.0)	1 (0.3)	0 (0.0)	0 (0.0)	1 (0.3)	2 (0.7)
Nasal	0 (0.0)	3 (1.0)	3 (1.0)	1 (0.3)	0 (0.0)	0 (0.0)	7 (2.3)
NOE	1 (0.3)	2 (0.7)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	3 (1.0)
Orbital	1 (0.3)	3 (1.0)	4 (1.3)	0 (0.0)	1 (0.3)	0 (0.0)	9 (2.9)
Frontal	0 (0.0)	2 (0.7)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.7)
None	6 (2.0)	61 (19.9)	88 (28.8)	42 (13.7)	14 (4.6)	2 (0.7)	213 (69.6)
Total	8 (2.6)	88 (28.8)	133 (43.5)	52 (17.0)	19 (6.2)	6 (2.0)	306 (100.0)

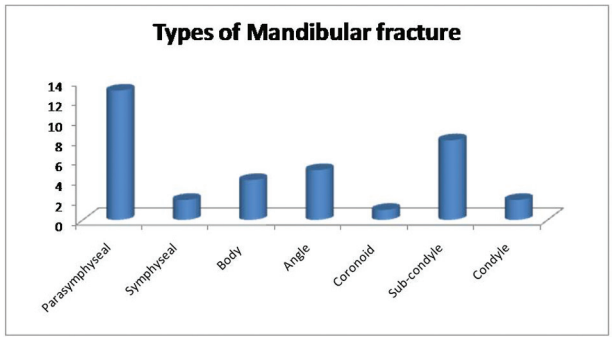
NOE, naso-orbito-ethmoidal.

Figure 1



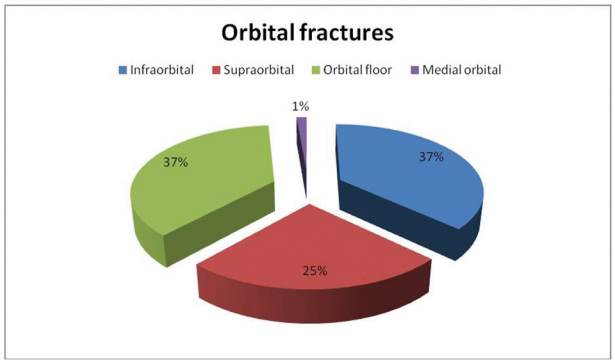
Graph showing associated facial bone fracture with zygomatic bone fracture.

Figure 2



Bar chart depicting types of mandibular fracture.

Figure 3



Pie chart showing types of orbital fractures.

reported that an increase of 28% was observed in 2011 as compared with 2010 [11]. Males are generally reported to be more predisposed to trauma, and the second to third decades of age was most vulnerable owing to high activities of this age bracket [3,7,8]. Our findings are in support of this position as most of the patients are males and in the second to third decade of life. In developed countries, there has been decrease in motor vehicular crashes owing to strict safety improvements such as airbags and seat belts; however, interpersonal violence continues to rise [12,13]. In Saudi Arabia, UAE, and other African countries, road traffic accidents still remain the main etiology of maxillofacial injuries [6,7,14–17]. This study has buttressed this finding, as 72.2% of the accidents were due to road traffic accident. It is also surprising that in Saudi Arabia, interpersonal violence may be on the increase as 17.6% of the incidents in this study were due to assault.

As a result of the intimate association of the ZC with the rest of the facial skeleton, associated maxillofacial fractures are common. In this study, the mandible was found to be associated with fracture zygoma in 35 (11.4%) patients followed by Le-fort I fracture in 20 (6.5%) cases. This is in agreement with the studies of Afzelius and Rosen [18], Ellis *et al.* [19], and Obuekwe *et al.* [7] who reported that mandibular fractures were most often associated with ZC fractures. On the contrary, Trindade *et al.* [20] reported that Le-fort II fractures were most often associated with zygomatic bone fractures followed by nasal bone fractures. In this study, the mandible was commonly fractured in the parasymphysis and subcondyle area and the least affected site of the mandible was the coronoid process, which was diagnosed in only one case.

The maxilla represents the bridge between the cranial base superiorly and the dental occlusal plane inferiorly. It is closely related to the zygomatic bone at the zygomaticomaxillary suture lines. Therefore, fracture of the zygoma may be associated with fractures of the maxilla to pose a life-threatening as well as disfiguring facial contour [21]. This study has shown Le-Fort I, II, and III are associated with ZC fracture. This was frequently seen with Le-Fort I and II as in 20 (6.5%) and 15 (4.9%) cases, respectively. We opined that because both fractures (Le-Fort I and II) involve the sub-zygomatic region at the buttress, they may be frequently associated with ZC fracture. It has been documented that Le-Fort I fractures caused by a high-velocity impact (i.e. impact from a fall from >1 story or a motor vehicle crash) occur higher on the lateral buttress (zygoma) than do those caused by a low-velocity impact (impact from a fall or an assault with a blunt weapon or closed fist) [22]. Therefore, as most of the causes of ZC fracture from this current study are road traffic crash related, then it sounds to reason why Le-Fort fractures are associated with ZC fractures.

The midface is frequently associated with orbital injuries; therefore, a thorough ophthalmological

examination is compulsory in all suspected ZC fractures [23]. In our study, orbital fracture was diagnosed in nine (2.9%) cases. Three cases involved the infra-orbital rim, two cases involved the supra-orbital rim, and one case affected the medial wall, whereas the orbital floor fracture was diagnosed in three cases. Orbital examination should note any lacerations: assess extraoccular motility, visual acuity, visual fields, and the pupillary light reflex. Diplopia, ophthalmoplegia, hypoglobus, enopthalmos, and proptosis must be accessed for all patients. The integrity of the optic nerve must be established even if the eye is closed. An ophthalmological review is essential in the presence of a through-and-through lid laceration. When there is concomitant naso-orbital-ethmoidal fractures with ZC fracture, then it predict a higher incidence of postoperative deformity [24]. Therefore, associated orbital injuries with ZC fracture should be identified and prompt management instituted to prevent blindness.

Conclusion

Associated maxillofacial bone fracture with ZC fracture is quite common. Efforts should be made by the attending surgeon to identify these injuries especially orbital injury. This will prevent permanent damage to vital structures in the head and neck region and improve the quality of life of patients following maxillofacial injuries.

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Conflicts of interest

There are no conflicts of interest.

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