

Research Article

Zygomatic complex fractures in a Nigerian tertiary hospital: An update on the pattern of presentation and care

Obimakinde OS^{1*}, Olajuyin OA², Akinbade AO³, Ojo KO⁴, Ibidun CO⁵ and Ogunsakin OT⁵

¹Associate Professor, Consultant, Oral and Maxillofacial Surgery, Ekiti State University Teaching Hospital, Ado-Ekiti, Nigeria

²Associate Professor/ Consultant Otorhinolaryngologist, Ekiti State University Teaching Hospital, Ado-Ekiti, Nigeria

³Consultant Oral and Maxillofacial Surgery, Federal Teaching Hospital, Ido-Ekiti, Nigeria

⁴Consultant Oral Medicine, Federal Teaching Hospital, Ido-Ekiti, Nigeria

⁵Senior Dental Officer, Ekiti State University Teaching Hospital, Ado-Ekiti, Nigeria

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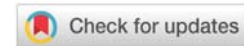
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*Corresponding author: Obimakinde OS, Associate Professor, Consultant, Oral and Maxillofacial Surgery, Ekiti State University Teaching Hospital, Ado-Ekiti, Nigeria, Tel: +2348030759320; E-mail: oobimakinde@gmail.com / obitade.obimakinde@eksu.edu.ng

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Abstract

Aim: The Zygomatic complex [ZMC], being one of the most commonly fractured bones in the facial skeleton, is largely underreported in the literature. This study was designed to evaluate the pattern of fractures, symptomatology, and treatment modalities at our institution.

Materials and methods: Information on patients' sociodemographics, the pattern of fractures, symptomatology, radiologic diagnosis, and treatment modalities were accessed from patients' records on our trauma register. Data collected was analyzed with SPSS 20 and the level of significance was set at $p < 0.05$.

Results: A total of 105 patients aged 19-66 years had ZMC fractures during the study period. A male preponderance was observed [M: F = 3.8:1] and road traffic crashes [RTC] accounted for the majority of fractures [79.0%]. There was a statistically significant relationship between RTC and fractures among the age groups [$X^2 = 33.61, df = 5, p = 0.001$]. Fractures at the zygomatico-frontal [ZF] and in combination with zygomaticomaxillary [ZM] sutures were the commonest finding on imaging [39.1% 28.6% respectively]. Subconjunctival and circumorbital ecchymosis [92.4% and 91.4% respectively] were the commonest symptomatology. Eighty four patients (80%) were managed via surgical intervention and the most commonly employed surgical modality was mini plates [1.0mm] fixation across either ZF [$n = 33, 39.3%$] or ZM [$n = 21, 25.0%$] suture lines.

Conclusion: This study revealed that RTC remains a major aetiology of ZMC fractures and mini plate osteosynthesis was the mainstay of surgical management. Enforcement of road safety regulations on speed and the use of protective measures by road users is imperative.

Introduction

The zygomatic [ZMC] complex plays a key role in the structure, function, and esthetic appearance of the facial skeleton [1]. It is responsible for the mid-facial contour and the protection of orbital contents [1-3]. The ZMC, being a major buttress of the facial skeleton is often predisposed to fracture because of its prominence [1-3]. ZMC fractures are among the

most frequently encountered in the maxillofacial region and some of the aetiologies include road traffic crashes, assaults, falls, sports, and missile injuries [2-4]. Although Road Traffic Crashes [RTC] are generally regarded as the major etiological factor of maxillofacial injuries in this part of the globe, some studies, however, revealed that injuries due to assault are more prevalent in some developed countries [5-7]. The relative contribution of these etiologic factors in different studies

is largely dependent on the sociocultural and geographic peculiarities of the populations studied [3,5-8].

ZMC fractures are commonly associated with a wide range of symptoms and those that have been described include diplopia, subconjunctival ecchymosis, flattening of the cheek, hooding of the globe, enophthalmous and sometimes sensory disturbance [2,7-10]. Management of ZMC fractures has received divergent opinions in the literature [3,10-12]. Some authors opined that undisplaced fractures or those with minimal displacement should be treated non-operatively, whereas fractures with functional or esthetic impairments in the form of diplopia, extraocular muscle entrapment, malocclusion, restricted mouth opening and/or depression of the malar prominence should necessitate surgical intervention [5-8,11-14].

Generally, there is a dearth of studies on ZMC fractures in sub-Saharan Africa probably due to the overriding influence of other facial injuries such as mid-face fractures of the Le Fort type and mandibular fractures. The previous efforts by Adekeye [8], Obuekwe and Owotade [3], from this environment only provided limited information mostly on the etiology and pattern of presentation. In order to scale up the existing information from these studies, the current study was therefore designed to evaluate the pattern of presentation and management modalities of ZMC fractures in our institution. We also aimed to compare our findings to similar works globally.

Materials and methods

Over a ten-year period [January 2010 to December 2019], the data of patients who sustained Zygomatic fractures were collected on individual proforma and added to our trauma register. Patients with other forms of maxillofacial injury without ZMC fractures were excluded from the study. The patients presented through either the Accident and emergency unit or the maxillofacial surgery clinic of our institution which is a major referral center in southwestern Nigeria. Ethical approval was obtained from our institution's ethical review committee.

Information on patients' sociodemographics [age, sex and occupation], aetiology, the pattern of fractures, clinical findings, and radiologic diagnosis were accessed from patients' individual records on our trauma register. Other data documented were the associated injuries, clinical presentation, and modality of definitive treatment.

Diagnosis of Zygomatic fractures was achieved through clinical and radiologic evaluation. All patients in this series had either plain radiographs [occipitomental or submentovertex] or Computerized Tomography Scans [CT scan] for radiologic evaluation. The diagnosis was confirmed by the presence of bony discontinuity during radiologic evaluation.

Data obtained were summarized in frequency tables and analyzed using SPSS statistical software package version 20. Descriptive statistics and a Chi-square test were carried out and the level of significance was set as $p < 0.05$.

Result

A total of 105 patients with zygomatic complex fractures were evaluated during the study period. There was a male preponderance of 83 to 22 [M: F = 3.8:1]. The age range of the subjects was 19-66 years with a mean age of 31 ± 12.6 years and those in the age group 21-30 years [46.7%] constituted the majority of the patient population (Figure 1). Regarding the aetiology of ZMC fractures (Table 1); road traffic crashes [RTC] accounted for the majority of fractures and there was a statistically significant relationship between RTC and fractures among the age groups [$X^2 = 33.61, df = 5, p = 0.001$]. However, the patient's gender did not have any statistically significant relationship with RTC [$X^2 = 3.02, df = 1, p = 0.13$].

Unilateral fracture [$n = 96, 91.4\%$] was the most common presentation and the right zygoma [$n = 55, 57.3\%$] was the more commonly affected side (Table 2). The Pattern of zygomatic complex fractures revealed that bony discontinuity occurred mostly along the suture lines of the articulation of the zygomatic bone with the frontal, temporal and maxillary bones (Table 3). Forty-one patients [39.1%] had isolated fracture involving the zygomatico-frontal [ZF] suture while fractures involving both zygomatico-frontal [ZF] and zygomaticomaxillary [ZM] sutures simultaneously was the next most prevalent [$n = 30,$

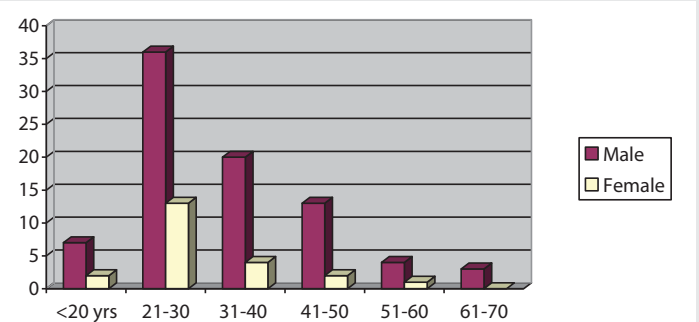


Figure 1: Age and sex distribution of the patients.

Table 1: Etiology of Zygomatic fractures.

Etiology	Frequency	Percentage
RTC	83	79.0
Assault	9	8.6
Gunshot	7	6.7
Fall	5	4.8
Sports	1	0.9
Total	105	100.0

Table 2: Pattern of fractures among the study population.

The pattern of fracture	Frequency [f]	Percentage [%]
[a] Zygomatic complex fracture	93	88.6
Zygomatic arch fracture	12	11.4
[b] Unilateral	98	93.3
Bilateral	7	6.7
[c] Right-sided	55	56.1
Left-sided	43	43.9

28.6%]. Fractures involving only the ZM suture line were the least encountered among the patients [$n = 20, 19.1\%$]. Two patients suffered a gross comminuted fracture of the zygomatic bone while there were two cases of fracture involving both the zygomatic bone and arch respectively.

The symptomatology of zygomatic fractures was presented in Table 4 and nearly all the patients, with the exception of those who had isolated Zygomatic arch fracture, presented with subconjunctival and circumorbital ecchymosis [92.4% and 91.4% respectively]. Flattening of the cheekbone was the third commonest symptom [67.6%] while sensory disturbance involving the infraorbital nerve [17.1%] was the least encountered among the subjects.

Of the 105 patients who sustained ZMC fractures in this series, the majority [$n = 84, 80\%$] were treated actively by surgical intervention. The commonest indication for surgery was aesthetic consideration [72.6%] followed by derangement of occlusion [63.1%] and restriction of mandibular excursion [20.2%] respectively (Figure 2). Persistent diplopia and enophthalmos were the least common indicators of operative treatments. The most commonly employed surgical modality was a one-point internal fixation with 1.0 mm mini plates and screws across either ZF [$n = 33, 39.3\%$] or ZM [$n = 21, 25.0\%$] suture lines (Figure 3). Only 7 patients [8.3%] had two points of fixation across both ZF and ZM suture lines simultaneously. Surgical access was achieved mostly via lateral eyebrow [$n = 41, 51.3\%$], subciliary [$n = 13, 16.3\%$] or a combination of both incisions [$n = 7, 8.8\%$]. Other treatment options were Gillies temporal lift [17.9%], use of transosseous wiring with or without front mandibular suspension [7.1%], and reduction via buccal sulcus approach [2.3%]. Regarding other associated maxillofacial injuries (Table 5): mandibular fracture [41.2%] was the commonest followed by Le Fort iii fracture of the maxilla [37.2%] (Images 1-5).

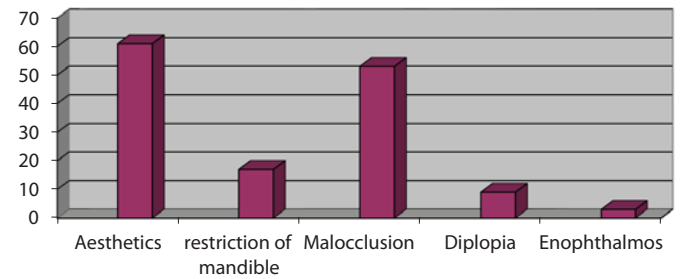


Figure 2: Indicators of surgical treatment of ZMC fractures.

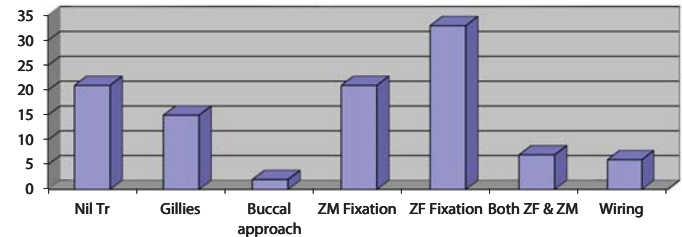


Figure 3: Treatment of ZMC fractures.

Table 5: Pattern of Associated maxillofacial fractures.

Fracture type	Frequency	Percentage
Mandible	21	41.2
Le Fort I	3	5.9
Le Fort II	19	37.2
Le Fort III	6	11.8
Nasoethmoidal fracture	2	3.9
Total	51	100

Table 3: Type/ bony site of Zygomaticomaxillary fractures.

Fracture site/ pattern	Frequency [f]	Percentage [%]
Zygomatic arch [V-shaped fracture]	10	9.5
Fracture at the ZF and ZM sutures	30	28.6
Fracture at ZF suture only	41	39.1
Fracture at ZM suture only	20	19.0
Comminuted fracture of the Zygomatic bone	02	1.9
A fracture involving both the Zygomatic bone and arch	02	1.9
Total fracture sites	105	100%

Table 4: Clinical features of Zygomaticomaxillary fractures.

Fracture type / symptomatology	Zygomatic arch	Zygomatic complex	%
Subconjunctival hemorrhage	93		92.4
Diplopia	0	32	30.5
Infraorbital paraesthesia	0	18	17.1
Flattening of the cheek	5	71	72.4
Restricted mandibular excursion	8	61	65.7
Circumorbital ecchymosis	6	90	91.4
Enophthalmos	0	21	20.0

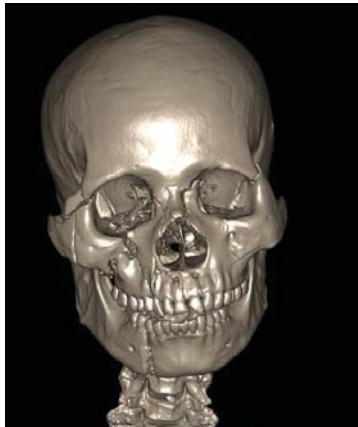


Image 1: One of the cases of ZMC fractures in our series.



Image 2: Occipitomental radiograph showing a 2-point fixation at both ZF and ZM with miniplate.



Image 3: One of our patients with left ZMC fracture showing flattening of the bone.



Image 4: Intraoperative picture of same patient with mini plate in situ.



Image 5: Postoperative picture of the same patient.

Discussion

The zygoma, being one of the buttresses of the facial skeleton, plays a critical role in the maintenance of normal facial width and prominence of the cheek. These buttresses help give the zygoma an intrinsic strength such that blows to the cheek usually result in fractures of the ZMC at the suture lines, and rarely of the body of the zygomatic bone itself [3]. The observed incidence in age is similar to previous reports where the majority of the patients were in the third decade of life [1,3,5-8,16]. The third decade marked the active phase whereby individuals are more likely to indulge in injury-prone

adventures such as reckless driving, violence, and the use of the automobile for commercial purposes. The observed male preponderance is also in agreement with the global trend in the literature. Also, in consonant with the studies cited, RTC was the commonest aetiology of ZMC in this study [3,7,8,16].

The pattern of fracture in this study showed that ZMC was involved in the majority of the fractures [82.9%]. Isolated fractures of the arch were quite uncommon in this series probably due to the fact that most road traffic crashes result in frontal impacts to the face, hence the zygoma is likely to be fractured at the suture lines. Zygomatic arch fractures are more likely to be caused by lateral impact which is more often associated with assault, sport, or missile injuries.

Several signs and symptoms are associated with ZMC fractures and most authors reported Circumorbital and subconjunctival ecchymosis as the most frequently encountered symptoms [2,3,8-10]. Although our findings were in agreement with this assertion, the cases of circumorbital and subconjunctival ecchymosis encountered were mostly usually self-limiting. Flattening of the cheek observed in 72.4% of our patients was the next most common symptom. This is usually seen in ZMC fractures that are most often displaced inwards to a greater extent. Diplopia observed in 30.5% of our patients is comparatively higher than figures from previous studies by Obuekwe, et al. [3] 9.7% and Al-Qurainy, et al. [17] 19.8%. Nevertheless, the presence or absence of diplopia depends largely on the inflammatory process around the extraocular muscles and most patients seen during the acute inflammatory period, as in our series, may present with diplopia. Limitation of mandibular movement occurred in 65.7% of our patients and this is usually caused by impaction of the fractured zygomatic complex on the coronoid process of the mandible [1,10].

There are divergent opinions in the literature regarding the radiographic examination of fractures of the zygomatic complex. A survey of British oral and maxillofacial surgeons [11] revealed that the majority of surgeons [93.3%] rely on two or more radiographic views for diagnostic purposes. Similarly, Obuekwe, et al. [3] reported that 73.1% of the cases in their study required two or more radiographs for the diagnosis of ZMC fractures. On the contrary, a single 30° occipitomeatal radiograph was found to be sufficient for 58 [55.2%] of our patients who had plain radiographs for ZMC fracture evaluation. Our observation is in agreement with Pogrel, et al. [18] who concluded that a single 30° occipitomeatal radiograph (augmented with CT scans when indicated) can identify all midface fractures requiring treatment. The advent of computerized tomography scan [CT scan] has simplified the diagnosis of ZMC fractures and laid to rest the debate about the number of views of plain radiographs required to make an accurate diagnosis. However, only 47 patients [44.8%] in our series were able to afford the cost of a CT scan.

Banks and Brown [10] summarized the indications for treatment of ZMC as follows: to restore the normal contour of the face both for cosmetic reasons and to establish skeletal protection for the globe of the eye, to correct diplopia, and to remove any interference with the range of movement of

the mandible. In agreement with other authors, aesthetic consideration was the commonest indicator of surgical treatment amongst our patients [3,8,17]. Malocclusion, Impairment of mandibular excursion, and persistent diplopia were other indicators of surgery that have also been reported in the literature [2,8,9,17-19].

Historically, treatment of ZMC fractures was done mostly via Gillies temporal lift, upper buccal sulcus approach, transosseous wiring, or front mandibular suspension [1-3,8,11,12,19,20]. However, the advent of osteosynthesis has significantly reduced the use of these traditional methods. Our surgical protocol is similar to recent reports where ZMC fractures were treated with miniplate osteosynthesis. The majority of our subjects [58.1%] had open reduction and internal fixation with 1.0mm miniplates at either ZF, ZM, or both. The availability of plating technology has popularized the use of miniplates in middle and low-income countries [22-24]. Tadj and Kimble [24], and several other authors have affirmed that bone plating was the most effective fixation method in the treatment of ZMC [13,14,15,22-24]. While the use of mini plates for the fixation of ZMC fractures is not debatable in the literature, the debate has however shifted to the relative merit of the number of fixation points employed.

Due to the contiguous anatomic relations of the zygoma with other bones of the facial skeleton, associated maxillofacial Fractures occur quite commonly with ZMC fractures. Fracture of the mandible [41.2%] was found to be the commonest in this study. Our observation was similar to figures reported by Obuekwe [3] Ellis, et al. [21] and Nam [25] These studies showed that mandibular fractures were most often associated with zygomatic complex fractures compared to the other bones of the facial skeleton.

Conclusion

Although ZMC fracture has been grossly underreported in the literature, it remains one of the commonest fractures of the facial skeleton and can be life-threatening when associated with concomitant injuries to the brain and other facial bones. It is therefore imperative to continue to educate the populace about associated morbidity and the importance of preventive measures such as restraints and the use of protective headgear/ use of seatbelts while commuting in motorized transport. The advent of mini plate osteosynthesis has revolutionized the management of ZMC fractures as the majority of the patients were treated with this modality. However, it would be inappropriate not to mention the time-honored technique of closed reduction by Gillies approach, which we employed in the management of some of our subjects with minimally displaced fractures.

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