Zygomaticomaxillary Complex Fractures: A Review of 101 Cases

Bhasker Yamsani¹ · Rajasekhar Gaddipati¹ · Nandagopal Vura¹ · Sudhir Ramiseti¹ · Rajitha Yamsani²

Received: 15 April 2015 / Accepted: 18 September 2015 / Published online: 19 November 2015
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Abstract

Aim ZMC fractures are the common facial injuries. The main causes of fractures are trauma due to RTAs, assaults, falls, sports related injuries, and the civilian warfares. This study is to evaluate and review the etiology, incidence, clinical findings and treatment of ZMC fractures. A sincere effort has been put forward in the management of ZMC fractures and their efficacy is evaluated in the larger interest of the patients.

Materials and methods In this study 101 patients having displaced ZMC fractures with insignificant medical history were reviewed to evaluate the versatility of its management, with the main emphasis on post operative stability, restoration of mouth opening, wound healing, esthetic restoration of the prominence of cheek and the complications encountered.

Results A total of 101 patients were reviewed for the management of ZMC fractures. All the cases included were managed during the period from August 2007 to August 2009 in the Department of Oral and Maxillofacial Surgery, Mamata Dental College and Hospital, Khammam. The extremes of ages in this study ranged from 17 to 60 years with the mean of 43. RTA was the most common cause of injury. Seventy-eight patients (77 %) were managed with surgical treatment.

Conclusion Attention should be paid to improvement in automobile safety devices and compliance by motor

vehicle occupants in addition to the improvement of the rules and regulations in sporting activities.

Keywords Zygomaticomaxillary complex (ZMC) · Road traffic accident (RTA) · Infra orbital parasthesia (IOP) · Sub conjunctival haemorrhage (SCH) · Frontozygomatic (FZ)

Introduction

The face occupies the most prominent position in the human body rendering it vulnerable to injuries quite commonly. The prominence of the zygomatic region predisposes it to bearing the brunt of facial injuries. The zygoma, a major buttress of the facial skeleton, is the principle structure of the lateral mid face. The convexity on the outer surface of the zygomatic body forms the point of greatest prominence of the cheek. Injuries to the face, head and neck are relatively common and yet, in the overall trauma literature, the etiology of maxillofacial injuries has received relatively little attention [1].

The frequency of ZMC fractures is second only to nasal structure, function and fractures, which are the most common type of facial fractures. It has an important role in protecting the eye, and participates in the formation of orbital cavity, the maxillary sinus, the temporal fossa, and the zygomatic arch. The main causes of fractures are trauma due to RTAs, assaults, falls, sports related injuries, and the civilian warfares.

This study is to evaluate and review the etiology, incidence, clinical findings, and treatment of ZMC fractures. A sincere effort has been put forward in the management of ZMC fractures and their efficacy is evaluated in the larger interest of the patients.

✉ Bhasker Yamsani
drbhasysams@rediffmail.com

¹ Department of Oral and Maxillofacial Surgery, Mamata Dental College and Hospital, Khammam, India

² Gayatri Dental Hospital, Hyderabad, India

Materials and Methods

Source of Data

This study is a prospective clinical study involving 101 patients having displaced ZMC fractures with insignificant medical history to evaluate the versatility of various surgical approaches, its management, with the main emphasis on the wound healing, post operative stability, functional restoration in the form of mouth opening, esthetic restoration of the prominence of cheek and the complications encountered.

Inclusion Criteria

1. Patients reporting with zygomaticomaxillary complex fractures alone
2. Unilateral or bilateral
3. Above 15 years age

Exclusion Criteria

1. Patients suffering with uncontrolled systemic diseases
2. Orbital floor fractures
3. Patients not willing for the treatment

Results

A total of 101 patients were reviewed for the management of ZMC fractures. All the cases included were managed during the period from August 2007 to August 2009 in the Department of Oral and Maxillofacial Surgery, Mamata Dental College and Hospital, Khammam. The extremes of ages in this study ranged from 17 to 60 years with the mean of 43 (Table 1). The peak incidence was seen in the second, third and fourth decade of life. Out of the total 101 patients selected for the study 88 (87 %) were males and 13 (13 %) were females (Table 2).

According to the distribution of the cause of injury of the 101 patients selected for the study group RTA was the most common cause of injury with 77 (76 %) patients while 13 (13 %) patients of the study population reported history of Assault, Fall 9 (9 %) and others 2 (2 %) (Table 3). Isolated arch fracture has the least incidence in

Table 1 Age distribution of the study population

Mean	30.5
Range	43
Minimum	17
Maximum	60

Table 2 Gender distribution of the study population

Gender	Frequency	Percentage
Male	88	87.12
Female	13	12.87
Total	101	100.0

Table 3 Distribution of study population according to etiology

Etiology	Frequency	Percentage
Road traffic accident	77	76.23
Assault	13	12.87
Fall	9	8.91
Others	2	1.98
Total	101	100.0

Table 4 Distribution of type of fracture among study population

Type of fracture	Frequency	Percentage
(a)		
Zygomatic complex fracture	99	98.01
Zygomatic arch fracture	2	1.98
Total	101	100.0
(b)		
Unilateral	84	83.16
Bilateral	17	16.83
Total	101	100.0

the study with only 2 (2 %) of the total of 101 patients reporting arch fracture. Zygomatic complex fracture had the maximum with 99 (98 %) patients (Table 4a). Out of 101 patients who reported with zygomatic complex fractures patients had unilateral fracture and 17 (17 %) patients had bilateral fracture (Table 4b). Forty-six patients (45 %) were affected on the right side compared to 38 who were affected on the left side (38 %) (Table 7).

Majority of the patients were treated 7 days after their reporting. Among the preoperative clinical findings, isolated arch fractures are associated with the lowest signs and symptoms. SCH was a significant finding (100 %) seen in all the 101 patients. IOP was present in 22 (21.7 %) patients and diplopia in 10 (10 %) (Table 5). Restricted mandibular movements and reduced mouth opening was reported by 78 (77 %) patients (Table 6). Depression over the prominence of cheek could be appreciated in all the patients of the study (100 %). Step deformity was reported by all 78 (77 %) the patients (Table 7).

Resolution of SCH after 1 week was evident in 86 % of the cases and 100 % in 1 month. There was gradual improvement in the status of IOP with eventual restoration of normal sensation in 22 patients (22 %) out of which 22

Table 5 Distribution of status of presence of infraorbital nerve paresthesia, diplopia and subconjunctival hemorrhage

	Time of admission	Immediate postop	7th day	1st month	3rd month	6th month
IOP	22	22	22	12	6	0
Diplopia	10	10	8	4	0	0
SCH	101	101	86	0	0	0

IOP infra orbital parasthesia, *SCH* subconjunctival hemorrhage

Table 6 Distribution of restricted mandibular movements among the study population

Restricted mandibular movement	Frequency	Percentage
Yes	78	77.22
No	23	22.77
Total	101	100.0

Table 7 Distribution of site of fracture among the study population

	Frequency	Percentage
Right	46	45.54
Left	38	37.62

Table 8 Distribution of the type of management used among the study population

Type of treatment	Frequency	Percentage
Surgical	78	77.22
Non surgical	23	22.77
Total	101	100

(12 %) patients had pre-operative IOP. At the end of 1 month IOP completely resolved in 10 patients who had developed it post-operatively. For 6 patients it resolved by 3rd month and at sixth month follow up it was completely resolved in all the patients. Depression of cheek was corrected in 100 % of the cases. At the end of 1 month all the patients were stable with maintenance of cheek contour. There was a drastic improvement in the mouth opening at the immediate postoperative period. Significant limitation of mandibular movement was seen in 78 (77 %) patients. There was complete restoration of step deformity in all the patients (100 %) which was consistent at the end of 3rd month follow up period.

In 101 patients, 78 patients (77 %) were managed with surgical treatment (3 point fixation- Fz, infraorbital and Zygomatic buttress) (Table 8). The reduction and fixation obtained were stable according to the criteria used for this study. Uneventful recovery was achieved in all the individuals (100 %). Plate infection in the infra

Table 9 Post operative complications

IOP	22
Diplopia	10
Plate infections	1

orbital region was found in one patient (Table 9). In this study enophthalmos was not significant in many of the cases, however, mild degree of enophthalmos (Figs. 1a, b, 2a, b) was noted in few cases. It gradually improved in 2 weeks after stabilization and fixation of infraorbital fracture.

Discussion

The integrity of the zygoma is well established as critical in the maintenance of normal facial width and prominence of the cheek. Three principle buttresses need to be considered in midface fractures. The medial or nasomaxillary buttress reaches from the anterior maxillary alveolus to the frontal cranial attachment. The second is the pterygomaxillary, or posterior buttress, which connects the maxilla posteriorly to the sphenoid bone. The third is the lateral or zygomaticomaxillary buttress. This important buttress connects the lateral maxillary alveolus to the zygomatic process of the temporal bone. These buttresses help give the zygoma an intrinsic strength such that blows to the cheek usually result in fractures of the zygomatic complex at the suture lines, rarely of the zygomatic bone.

Fracture lines usually run through the infraorbital rim, involve the posterolateral orbit, and extend to the inferior orbital fissure. The fracture line then continues to the zygomatic sphenoid suture area and on to the frontozygomatic suture line [2].

Lothrop [3] was the first to describe an antrostomy approach in which he reached the fractured zygoma through the Highmore antrum below the inferior turbinate. He then was able to rotate the fractured zygoma upward and outward for a proper reduction. This transantral approach is known today as the Caldwell-Luc approach.

Gillies [3] described an original approach to reduce a depressed malar bone. He was the first to reach the malar bone through an incision made behind the hairline and over the temporal muscle. The Gillies method remains in use today to elevate the arch.

Fig. 1 **a** Pre-op, **b** Post-op **Fig. 2** **a** Pre-op, **b** Post-op

One can appreciate readily that the treatment of facial fractures has progressed. The ideal surgical approaches to treat the maxillofacial injuries are: Intra oral maxillary vestibular approach, and extra oral approaches like lateral eyebrow approach, infra orbital approach and reduction approaches like Gillies temporal approach were used in this particular study.

Lateral Eyebrow Approach

In a study conducted by Pozatek [4], the predominant approach was lateral eyebrow approach (Fig. 3a, b). In this study, various surgical approaches to the fractured zygomatic complex were discussed. The data illustrated that a

great many of the fractures were unstable after reduction. They concluded that the lateral eyebrow approach, with internal wire fixation if necessary was used as the initial surgical approach in the management of zygomatic complex fractures. This was similar to the present study, where the lateral eyebrow approach was the predominant approach used and none of the patients had esthetic concern.

Buccal Sulcus Approach, Gillies Temporal Approach

This transbuccal elevation, originally described by Keen [5], was recommended by Yanagisawa [6] as the standard

Fig. 3 **a** Lateral eyebrow approach, **b** Infra orbital approach

initial method for all types of zygomatic fractures except arch and rim fractures.

The upper buccal sulcus approach has been reviewed by Apfelberg et al. [7] and was reported as a fast, simple technique, virtually eliminating the need for open reduction. Balasubramaniam [8] also mentioned that less force was required for elevation than for the external approach and the technique could be performed within minutes, with minimum chance of hemorrhage. The buccal pad of fat was too small for a dehiscence to occur during the surgery.

Courtney [9] has done a retrospective study on 50 patients treated with upper buccal sulcus approach. He cited various advantages like no skin scar, closer and more precise application of force by the operator, minimal bleeding, simplified antral bone harvest if needed, and simple mucosal closure. He concluded that results of intra-oral approach are comparable to extraoral Gillie's temporal approach (Fig. 4a, b). According to him the upper buccal sulcus approach is a safe, rapid and effective technique for the reduction of zygomatic body and arch fractures.

Open Reduction and Fixation Approaches

In this current study open reduction was indicated in 78 % of cases, this was nearing the values reported by Robert Chuong and Kaban [10] (85.5 %), and higher than the values reported by Pozatek et al. [11] (58 %) and Wiesenbaugh [12] (64 %).

Robert Chuong and Kaban [10] in their study recommended the lateral eyebrow approach for the initial access to the zygomatic complex fractures as it has the advantages of producing an inconspicuous scar and providing direct

access to the zygomatico-frontal region for fracture reduction and fixation, and they restricted the use of Gillies temporal approach to the management of isolated arch fractures and occasionally to assist in the reduction of the ZMC fractures. They used lateral eyebrow approach predominantly to gain access to the zygomatico-frontal suture and for direct visualization and fixation of the fractured fragment.

Maxillary Vestibular Approach

According to a study done by Edward Ellis III and Winai Kittidumkerng [13], who studied a variety of surgical approaches, the maxillary vestibular approach (Fig. 4a, b) was used more frequently, either alone or in combination with other approaches. The next frequently used approach was through lower eyelid. Complications associated with maxillary vestibular approach were not significant and approximately 20 % of those having lower eyelid approach had some amount of sclera.

Infra orbital approach

Friedrich and Henning [14] studied the infraorbital approach (Fig. 3a, b). Follow up revealed sensory disturbances in 25.6 % (severe in 7.2 %). The patients reported impaired eye mobility was reported in 1 %, reduction of visual acuity in 3.9 %, an ectropion in 1 %, hypersensitivity of the affected eye in 6.8 %, and tear dropping in 5.8 %. The patients assessed their face as asymmetric following trauma in 2.2 % and reported that the maxillary sinus caused complaints in 3.7 %. They concluded that the rate of complaints following the zygomatic complex

Fig. 4 **a** Maxillary vestibular approach, **b** Gillies temporal approach

fractures (attributable to trauma) is in the range of other reports. The infraorbital approach is a safe technique and is a particularly preferred approach for training of young surgeons. In our experience infraorbital approach was used in combination with lateral eyebrow approach. IOP was observed postoperatively in 22 cases. This technique should be considered as a simple and useful alternative along with the more complicated procedures like Transconjunctival, Subciliary and Blepharoplasty approaches, which requires valuable operating skill and experienced surgeons, and these approaches may be considered as initial procedures required for most of the zygomatic complex fractures. The esthetic results were not superior to the infra orbital approach.

Delayed and Malformed ZMC Fractures

The various surgical approaches for the treatment of the fractures of ZMC may form the treatment of choice for different types of ZMC fractures. In a study conducted by Perino et al. [15] the temporal approach was used for all the delayed and malformed ZMC fractures, and they reported no major complications in ten patients who received temporal approach for osteotomy (9 cases) and zygomatic implant (1 case); of these, 3 patients needed an additional implant after osteotomy. There was no transient mydriasis as reported with zygomatic osteotomies. Although temporal flap procedures may seem radical in terms of the extent of the soft tissues dissection, they confer an advantage by providing the necessary exposure to perform meticulous and accurate surgery. Beyond this, benefits to the patient may include enhanced cosmesis, less danger to important anatomical structures, and the ability to perform secondary or ancillary procedures which enhance the post operative result and eliminate or minimize the need of secondary intervention. This was in accordance with our study where

we encountered a patient who reported with a complaint of pain and asymmetry, after 3 months post treatment. The ZMC was found to be laterally rotated, and was approached via an extended preauricular, temporal approach. Recon-touring of arch and zygomaticomaxillary buttress was performed. This approach has the advantage of providing a wide exposure to the ZMC. Though not used in our case but the temporal approach has also an added advantage of reconstruction of the depression over the zygoma region with temporalis flap and eliminates the need of a second procedure.

This was in contradiction to the study carried out by Richard et al. [16], who analysed 10 cases of delayed repair ZMC fractures from 21 days to 5 month post injury. They concluded that the lateral eyebrow and the infraciliary approach are the best approaches for the osteotomy of the malformed zygoma and a coronal approach can be used in cases of pan facial trauma.

The most important principle in treating fractures, especially those of the face, is proper reduction if the bone is not placed into the correct position, stabilization becomes superfluous. Recommendations in the literature for reduction of zygomatic complex fractures range from “closed reduction” technique to three or four point surgical exposure and fixation with miniplates or transosseous wires. Rigid fixation techniques have gained popularity because they offer greater, versatility in the treatment of ZMC fractures. Rohrich and Wattumull [17] retrospectively evaluated 85 patients treated with mini plates or wires. They arrived at the conclusion that mini plate fixation produced better malar projection as well as fewer ocular and infraorbital nerve complications.

A total of 101 patients were reviewed for the management of ZMC fractures. All the cases included were managed during the period from August 2007 to August 2009 in the Department of Oral and Maxillofacial Surgery,

Mamata Dental College and Hospital, Khammam. The extremes of ages in this study ranged from 17 to 60 years with the mean of 43. The peak incidence was seen in the second, third and fourth decades of life. Out of the 101 patients selected for the study 88 (87 %) were males and 13 (13 %) were females.

This observation was confirmed with the study carried out by Ellis et al. [13] who reported 80.2 % incidence of male predominance, and the study by Schnetler [18] also reported that the majority affected were males with a peak at 30 years of age. Age group of our study also conforms with the study of Adekeye [19], who found that out of 337 Nigerian patients with ZMC fractures, 80 % were between the age group of 21 and 40 years. Age group of our study was also similar with the work of Haider [20], Gomes Pereira et al. [21], Courtney [9], Esben Kaastad [22] and Ogden [23]. According to the distribution of the cause of injury of the 101 patients selected for the study, RTA was the most common cause of the injury in 77 (76 %) patients while 13 (13 %) patients of the study population reported history of Assault, Fall in 9 (9 %) and others 2 (2 %). This was contradicting with the study of Ellis et al. [13], where alleged assault was the major cause of zygomatico-orbital fractures amounting to 46.6 % of the entire sample, while motor vehicle accidents constituted only 13.3 %. This low figure of incidence of motor vehicle accidents in the study of Ellis et al. [50] may be attributed to the compulsory wearing of seat belts and head devices. The high incidence of zygoma fractures in the present study could be attributed to the increase in number of automobiles and lack of safety measures.

Out of 101 patients who reported with ZMC fractures 84 (83 %) patients had unilateral fracture and 17 (17 %) patients had bilateral fracture. Forty-six patients (45 %) were affected on the right side compared to 38 who were affected on the left side (38 %). The clinical signs and symptoms that were most helpful in the preoperative diagnosis were consistent with that of the other studies. Isolated arch fracture has the least incidence in the study with only 2 (2 %) of the total 101 patients reporting arch fracture. Zygomatic complex fracture has the maximum with 99 (98 %) patients. According to Row and Killey [24], limitation of mouth opening or lateral excursion resulted from mechanical obstruction by the zygomatic bone or arch impinging on coronoid process of the mandible.

SCH was a significant finding (100 %) which was seen in all the 101 patients., nearing approximately to a study done by Weisenbaug [23], who noted occurrence in 70.5 % of the patients. In the analysis of 2067 cases by Ellis et al. [13] SCH occurred variably ranging from a surprising 20 % in zygomatic arch fractures to 65 % in those zygomatic fractures which had multiple lines of fracture. IOP was present in 22 (21.7 %) patients and diplopia in 10

(10 %). According to Nordgaard [25] diplopia occurred in 8–22 % of malar fractures. Palpable step deformity of the orbital rim was found and depression over the cheek was noted in every patient. Ogden [23] found some form of palpable bony asymmetry of the zygomatic bone in 95 of the 105 cases studied.

Restricted mandibular movements and reduced mouth opening was reported by 78 (77 %) patients. Depression over the prominence of cheek could be appreciated in all the patients of the study (100 %). Step deformity was reported by all 78 (77 %) the patients. Isolated zygomatic arch fractures were not associated with IOP. But Ogden [23] noted that IOP was the most frequently reported symptom. Out of 101 patients, 23 (22.7 %) patients were managed with conservative treatment, 78 patients (77 %) were managed with surgical treatment. The reduction and fixation obtained were stable according to the criteria used for this study. Uneventful recovery was achieved in all the individuals (100 %).

Conclusion

Facial bones, especially of the middle third of the face are composed of a network of fragile bones which give way in case of force to a lesser extent than other parts of the body. ZMC fractures are the common facial injuries after maxillofacial trauma. Majority of the individuals were in their second, third and fourth decade of life and RTA was the leading cause of the fractures. It is imperative to educate people regarding the importance of restraints and use of protective headgears/use of seatbelts while travelling in motorized transport.

In light of the popularity of mini plates and screws, it would be inappropriate not to mention the time honored technique of closed reduction, which is often neglected. The ideal surgical approach to treat the maxillofacial injuries should provide maximum exposure of the fractured fragments, ensure less potential for injury to the facial structures, and allow for good cosmetic results. Combination of Lateral eyebrow and Infra orbital approaches are the simple, easy and effective approaches to be used in means of treating fractures of ZMC. Since the fractured zygomatic complex could lead to facial distortion and severe disability due to interference with vision and mastication, attention should be paid to improvement in automobile safety devices and compliance by motor vehicle occupants in addition to the improvement of the rules and regulations in sporting activities.

Compliance with Ethical Standards

Conflict of interest No conflict of interest.

Ethical Approval All procedures performed in this study involving human participants were in accordance with the ethical standards of the institution.

Informed Consent Informed consent was obtained from all individuals who are involved in this study.

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