*Original Article*

# Surgical Management of Zygomatico-Maxillary Complex Fractures in Enam Medical College Hospital, Savar: A Retrospective Study of 70 Cases

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***Abstract***

***Background****: The incidence of maxillofacial injuries is on the rise due to motor vehicle accidents and increased incidence of violence in recent times. Zygomatic bone is closely associated with the maxilla, frontal, and temporal bones which are usually involved when a zygomatic bone fracture occurs.* ***Objective****: The aim of this retrospective study was to determine clinical presentations, the pattern of fractures, their management (open reduction and internal fixation), outcome and complications in a tertiary level hospital.* ***Materials and Methods****: This retrospective analysis of all operative cases (open reduction and internal fixation) of zygomatic complex fractures was carried out in the Maxillofacial Surgery Department, Enam Medical College & Hospital, Savar, Dhaka during the period of January 2018 to December 2021. Data were obtained from clinical notes and surgical records of the patients using standardized data collection form specifically designed to examine the variables and features of zygomatic complex fractures.* ***Results****: Seventy patients were allocated to surgical intervention. Two-point internal fixation was done in more than half (57.1%) of the cases. Six (8.6%) patients developed postoperative complications like paraesthesia, ectropion, scar, facial asymmetry. Twenty-five (35.7%) patients were found having limited mouth opening preoperatively and postoperative improvement occurred in 24 patients. All the patients had facial asymmetry preoperatively and postoperative improvement occurred in most cases. Only one patient had facial asymmetry in one year follow up.* ***Conclusion****:* There is no consensus on standard treatment of *zygomatic complex fractures, as made evident by the survey. Significant variability in fracture type warrants an individualized approach to management. A thorough review on zygomatic complex fracture management is provided.*

***Key words****: Zygomatic complex fractures; Open reduction internal fixation; Zygomaticomaxillary buttress*

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## Introduction

Fracture and dislocation of zygomatic bones not only causes cosmetic defects but also disrupts ocular and mandibular function. So zygomatic bone injuries should be properly diagnosed and adequately treated. A literature search showed ZMC fractures to account for approximately 15-23.5% of maxillofacial fractures.[1,2]

The etiology of zygomatic complex fractures primarily includes road traffic accidents, violent assaults, falls

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and sports injuries.[3,4] However, there is geographic and socio-demographic variation in the epidemiology of maxillofacial fractures due to socioeconomic, cultural and environmental factors. The main clinical features of zygomatic complex fractures include diplopia, enophthalmos, subconjunctival ecchymosis, extraocular muscle entrapment, cosmetic deformity with depression of the malar eminence, facial widening, malocclusion and neurosensory disturbances of the infraorbital nerve.[5] Diagnosis of zygomatic complex fractures is usually clinical, with confirmation by computed tomography (CT) scan. The zygoma articulates with four bones−frontal, sphenoid, maxillary and temporal. Fractures that involve the zygoma often occur at these four suture sites, leading to a "tetrapod" fracture pattern, known as a "zygomatic complex fracture" (ZMC).[6] Thus, fractures of the zygomatic complex inevitability lead to a certain degree of orbital defect. Indication for fixation of zygomatic fractures includes aesthetic defects (e.g., cheekbone flattening or a dimple) or functional defects (e.g., restrictive mouth opening, malocclusion or ophthalmic issues such as diplopia, restricted eye movements, enophthalmos and hypoglobus).

As surgical technique and technology have improved through the past century, management opinions have evolved.[7] Standard treatment mostly involves internal fixation with plates and screws but there is much debate regarding what qualifies as adequate fixation. Three-point fixation for treatment of ZMC fractures is traditionally recommended; but there are varying opinions on what is truly necessary for adequate reconstruction.[8,9] There is currently no widely accepted treatment protocol or guideline on the surgical management of ZMC fractures. A review of the literature shows that for ORIF of ZMC fractures, the number of fixation points used, their location, as well as the incisional access to these fixation points are variable.[5,6] A multidisciplinary survey by Farber et al[10] in 2016 involving otorhinolaryngology (ENT), plastic and oral and maxillofacial (OMF) surgeons, demonstrated variable treatment choices for ZMC fractures regarding the location and number of fixation points, surgical approaches, as well as the need for orbital floor exploration. Interestingly, across all three specialties, it was demonstrated that a greater number of fixation points were chosen by surgeons with less than 10 years experience.[11]

With regards to one-point fixation, there is variable support from the literature regarding its efficacy and there is no consensus regarding the optimum anatomical position for one point fixation between the zygomaticomaxillary (ZM) buttress, the infraorbital margin (IOM) and the frontozygomatic (FZ) region, as well as the optimum surgical access to these anatomical fixation points.[12,13] The ZM buttress has been quoted to be a popular choice for one-point fixation in some literature whilst others have quoted the FZ suture as their first choice; but beyond this, there is little consensus.[13] Some literature advocates the fixation of both the IOM and FZ suture for any displaced ZMC fractures and for cases with displacement greater than 5 mm, the use of Three-point fixation is recommended.[14]

## Materials and Methods

This observational study was conducted at Enam Medical College Hospital, Savar over a period of four years from January 2018 to December 2021. The target population of this study was all operative cases (ORIF) of zygomatic complex fractures, with and without other associated operative procedures (e.g., MUA nose, orbital floor exploration, orbital floor fixation or Le Fort fracture fixations) attending Maxillofacial Surgery Department of Enam Medical College Hospital. Our data set included demographic data (age, sex, relevant past medical history), aetiology (mechanism and impact of injury), treatment timeline (including presentation, referral pathway, clinical features (including head injury, eye signs, e.g., enopthalmus, hypoglobus, diplopia, restricted eye movements, infraorbital nerve paraesthesia, aesthetic deficits, e.g., cheek flattening, infraorbital rim deformity and functional deficits, e.g., restricted mouth opening and malocclusion), diagnosis, type of operation (ORIF, indirect reduction, with or without associated operative procedures, location and number of fixation points, and type of incision used for access), and outcomes and follow up.

All conservatively managed cases of ZMC fractures were excluded. Data were presented as number, percentage. Summarized data were presented in tables. The data were collected and conducted by the author and co-authors.

## Results

During the four years of study, 70 patients were operated for zygomaticomaxillary fracture. Of the operated cases, the mean age was 22 years, and range was 14−62 years. The majority (62, 88.5%) of cases were male and only eight (11%) were female. According to the investigation about social activity 24 (34.3%) of patients had some professional occupation and 46 (65.7%) were students. Road traffic accident was the most frequent (75%) etiological factor of maxillofacial fractures (Table I). The second most frequent cause of injuries was assault (15%) and by falls (8.6%).

Table I: Distribution of patients according to etiology (n=70)

| Etiology | Number | Percentage |
|---|---|---|
| RTA | 52 | 75 |
| Physical assault | 11 | 15 |
| Accidental fall | 6 | 8.6 |
| Sports injury | 1 | 1.4 |

In this study, 31.5% ZMC fractures were associated with Le Fort fracture, 17.1% were associated with orbital floor defect and 20% were isolated ZMC fracture (Table II).

Table II: Distribution of patients according to fracture site

| Sites of fractures | Number | Percentage |
|---|---|---|
| ZMC with Le Fort | 22 | 31.5 |
| ZMC only | 14 | 20 |
| ZMC with orbital floor | 12 | 17.1 |
| ZMC with mandible | 12 | 17.1 |
| ZMC with mandible with Le Fort | 10 | 14.3 |

Out of 70 patients, 42 (60%) had an associated head injury, 20 (28.6%) were with eye signs (diplopia, enopthalmus, hypoglobus, limitation of eye movements), 63 (90%) with flattening of malar prominence, 14 (20%) with infraorbital nerve numbness, 65 (93%) with restricted mouth opening and 44 (63%) with malocclusion. There were a total of 70 open reduction internal fixation (ORIF) of ZMC fractures (Table III). Of these, 24 (34.3%) cases were ORIF of ZMC fracture only, 18 (25.7%) were ORIF of Le Fort fractures, 12 cases (17.1%) ORIF of mandible, 10 (14.3%) were ORIF of Mandible and Le Fort fractures and six (8.6%) were ORIF with orbital floor exploration.

Table III: Distribution of operative cases of ZMC fractures (ZMC only, ZMC with associated operative procedures)

| Operation | Number | Percentage |
|---|---|---|
| ZMC only | 24 | 34.3 |
| ZMC+ Le Fort | 18 | 25.7 |
| ZMC+ Mandible | 12 | 17.1 |
| ZMC +Mandible+ Le Fort | 10 | 14.3 |
| ZMC+ Orbital floor repair | 6 | 8.6 |

Three anatomical points of fixation (plating) were used for ORIF of ZMC fractures−zygomaticomaxillary (ZM) buttress, frontozygomatic (FZ) suture and infraorbital margin (IOM). For FZ suture fixation, three types of incisions were used: upper blepharoplasty, lateral eyebrow, and existing scar. For IOM fixations, three types of incisions were used: subciliary, subtarsal and transconjunctival. In ZM buttress fixation, all accessed through an intra-oral buccal-sulcus incision.

Table IV shows out of 70 cases, 5 (7.1%) had one point fixation, 40 (57.1%) had two-point fixation and 25 (35.8%) had three-point fixations. Of the two-point fixations, 70% had fixation at the ZM buttress and FZ, and 30% had fixation at the ZM buttress and IOM. There was no significant correlation between the number of fixation points and the impact of injury.

Table IV: Distribution of patients according to points of fixations

| Points of fixations | Number | Percentage |
|---|---|---|
| Two point fixation | 40 | 57.1 |
| Three point fixation | 25 | 35.8 |
| One point fixation | 5 | 7.1 |

There were no immediate postoperative complications. The patient had an aesthetically satisfactory result and on subsequent outpatient follow-up the patient was pleased with their improved cheek contour from the bone graft. Another patient had delayed improvement of mouth opening, which subsequently resolved (Table V).

Table V: Distribution of patients according to postoperative complications (n=70)

| Complications | Number | Percentage |
|---|---|---|
| No | 65 | 92.85 |
| Infection | 1 | 1.4 |
| Malocclusion | 2 | 2.8 |
| Ectropion | 1 | 1.4 |
| Neural defect | 1 | 1.4 |
| Asymmetries | 1 | 1.4 |
| Nonunion | 0 | 0 |

Twenty (38%) patients were discharged after their first outpatient follow up consultation, 13 (25%) were discharged after their 2nd consultation, and 5 (9%) after their 3rd. All patients who attended follow up had satisfactory aesthetic and functional outcomes. A total of 65 patients (93%) out of 70 zygomatic complex fractures responded to the one year follow up examination. Satisfying facial contour and malar alignment was observed in 63 patients (97%).

All patients presented with an identical position of the eye globe without enophthalmos and normal ocular movement. A minor degree of ectropion was observed in one patient. Postoperative wound infection occurred in one patient. The osteosynthesis material had to be removed in one patient due to wound infection. A habitual dental occlusion was seen in all patients. Infraorbital neurosensory disturbances were described by 19 (41%) patients, which were rated as one on the visual analog scale by all patients. None of the patients were re-operated or needed secondary correction of the zygomatic complex or orbital floor.

## Discussion

The incidence of maxillofacial fractures varies with geographic regions, socioeconomic status, culture and era in the time. The majority of patients are in their third decade of life.[15] In this study majority of patients were in the age of 20-30 years (average 23 years).

The predominance of male population is a relatively consistent finding in most studies. In our study, the male to female ratio was 7.75:1, which corroborates with the worldwide data.[16] It is interesting to note that the cultural and socioeconomic characteristics of the studied population may influence the rates of facial fractures in women. In countries such as Greenland, Finland, and Austria, where women participate directly in social activities and consequently are more susceptible to traffic accidents and urban violence.[17,18]

Maxillofacial fractures are commonly caused by RTA, assaults, sports, industrial accidents and warfare.[19,20] In this study, RTA was the commonest cause in 52 (75%) cases, followed by inter-personal violence in 11 (15%), fall and accidental injuries in 6 (8.6%) and sports injuries in one (1.4%) cases. Analysis showed predominance of motor bike accidents. The incidence of non-wearing of the helmet and marked increase in the number of vehicles were significant findings in the category of RTAs. In RTA, the commonest fracture site was mandible and the zygomatic complex. In this study, among ZMC fractures isolated ZMC is 33%, ZMC with orbital floor is 33%, ZMC with mandible was 33%.

Currently, there is no consensus on ZMC fracture treatment regarding indications for surgery and the technique used. Our study demonstrates that there are significant variations within and between specialties in the treatment of ZMC fracture, confirming that management does not necessarily follow a clear standard. Most surgeons agree that conservative treatment of ZMC fractures is appropriate in situations with no displacement of the fracture segments. If this treatment option is chosen, patients should be placed on a soft, non-chew diet for approximately 2 to 6 weeks, with close monitoring for displacement.[6] If the ZMC fracture is displaced and/or the patient has enophthalmos, operative reduction and fixation is indicated. In the present study, a sequential surgical treatment strategy has been used exposing the zygomaticomaxillary buttress as the first approach, followed by either the frontozygomatical junction

and/or the infraorbital rim, when adequate anatomic alignment could not be achieved solely by the intraoral approach. Orbital floor exploration and/or repair is often required in the presences of eye signs (enopthalmus, hypoglobus, diplopia, restricted eye movements) or a significant defect with or without ocular muscular entrapment seen on CT imaging. Out of the 70 ZMC fracture patients included in our study, 8.6% (n=6) underwent orbital floor exploration or repair. Our proportion of ORIF ZMC fractures undergoing associated orbital floor exploration was lower in comparison to a study of 72 patients with ZMC fractures, where 30% of patients underwent orbital floor exploration.[21] Some centers carry out orbital floor exploration in cases of primary diplopia or evidence of comminuted ZMC fractures only.

Of the 70 cases that underwent ORIF, two-point fixations were the most popular (57.1%, n=40), followed by three-point fixations (35.8%, n=25) and one-point fixations (7.1%, n=5). Amid the cases of one-point fixation, (n=5) 100% had fixation at the ZM buttress. Some literature supports the ZM buttress as the first choice for one-point fixations, with it providing sufficient stability, without the need for fixation at the FZ site, whilst some studies advocate FZ suture as the first choice, claiming that greater stability and immobilization can be achieved at the FZ suture.[22,23] Of note, none of the literature reviewed advocated the IOM as the first choice location for one-point fixation. Our incidence of one-point fixations was 7.1%, which was lower compared to the literature, including Covington et al[24], who quoted that 30%-40% of ZMC fractures were adequately stabilized by one-point fixations, and Ellis and Kittidumkerng[7], who quoted 31%. A concern of one-point fixation can be that the zygoma may not be sufficiently stabilized against the rotational forces from the masseter upon mastication. Of the two-point fixations, the most common sites of fixation were ZM buttress and FZ suture followed by ZM buttress and IO rim. This was in keeping with a study of 210 surgically-managed ZMC fractures, in which similar anatomical locations for two-point fixations were used.[25] All ZM buttress fixations in our cohort were accessed via an intraoral buccal sulcus incision. For FZ access lateral eyebrow was the most common, for IOM access the most common incision was infraorbital.

1−3 years clinical and radiographic evaluation after open reduction of zygomatic complex fractures showed satisfying facial contour in 98% of the patients and anatomic alignment of the zygomatic complex. Minimal persistent flattering of the malar prominence was observed in one patient with a severely displace zygomatic complex fracture having three-point fixation and reconstruction of the orbital floor. All patients presented with a normal mandibular range of motion, habitual dental occlusion, normal ocular movement and identical position of the eye globe without enophthalmos.

Complications following surgical treatment of zygomatic complex fractures include diplopia, enophthalmos, extraocular muscle entrapment, facial asymmetry, persistent flattening of the malar prominence, neurosensory disturbances of the infraorbital nerve, malocclusion and limited mandible range of motion.[25,26] Complications of zygomatic complex fractures can occur from the initial trauma, from the surgical intervention, or from inaccurate surgical treatment. It has been reported that up to 5.5% of patients required a second procedure for zygomatic complex fractures within 4 weeks of initial repair due to inadequate reduction.[27] Persistent neurosensory disturbances due to infraorbital nerve injury after zygomatic complex fractures are a common clinical feature. In the present study, infraorbital neurosensory disturbances were described in one patient having surgical intervention after one year. Two patients had malocclusion due to associated unilateral intracapsular condylar fracture. Consequently, secondary correction of the zygomatic complex or orbital floor diplopia was not performed.

The main limitation of the study was nature of survey itself. ZMC fractures that were treated conservatively were not included in our data collection. There was insufficient documentation of alcohol and illicit drug use to determine their possible link to ZMC fracture aetiology.

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