A Study on Assessing the Etiology and Different Treatment Modalities of Zygomaticomaxillary Complex Fracture

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ABSTRACT

Introduction: Fracture of the zygomatic complex is amongst the most frequent in maxillofacial trauma, due to its prominence which predisposes it to bear the brunt of facial injuries, the pattern of which may vary geographically. Fracture pattern ranges from simple to comminuted and from minimally displaced to severely displaced depending on the impact of injuries sustained by various modes. Study aimed to assess the etiology and different treatment modalities depending on severity of displacement of zygomatic fracture.

Material and methods: 46 patients with zygomaticomaxillary complex fracture reporting during November 2012 to April 2014 were included in the study. On the basis of radiographic evaluation severity of displacement was assessed and different treatment modalities were selected.

Results: Road traffic accident accounted as the leading cause of fracture (60.9%) followed by self-fall (28.3%), assault (6.5%). Open reduction and internal fixation was carried out in (73.9%), out of which 1-point fixation in (28.3%), 2-point fixation in (32.6%) and 3-point fixation in (13%).

Conclusion: This study on assessment of etiology and various treatment modalities of zygomatic bone fracture showed that the majority of the patients were young adult men. Road traffic accident was the leading factor causing zygomatic bone fracture. Our study showed that displacement at any of the fractured site on the occipitomental radiograph can be used as a criteria for to assign patient to either open reduction and fixation group or conservative management group.

Keywords: Etiology, Modalities of Zygomaticomaxillary, Complex Fracture

INTRODUCTION

Fracture of the zygomatic complex are among the most frequent in maxillofacial trauma, due to its prominence which predisposes it to bear the brunt of facial injuries, the pattern of which may vary geographically. Fracture pattern ranges from simple to comminuted and from minimally displaced to severely displaced depending on the impact of injuries sustained by various modes. Although a great volume of literature exists for the management of these injuries which include conservative management to routine exposure and fixation of at least one, two, three of the four articulations, depending on the degree of displacement.

Zygomatic bone contributes significantly to the strength and stability of the mid face. Zygoma is a strong buttress of lateral portion of middle third of facial skeleton[1] and it forms the cheek prominence, part of the lateral and inferior orbital rim and the orbital floor. Due to its prominent position it is frequently subjected to fracture and dislocation either alone or in combination with other structures of midface such as maxilla, nasoethmoidal and orbital area.[2]

zygomatic complex is important in the function of the globe, facial symmetry and also gives passage to infra orbital nerve that innervates the mid facial region. Fractures of zygomatic complex are among the most frequent in maxillofacial trauma and are involved in 42% of facial fractures and accounts for 64% of all middle third fracture.[1] They are the second most common fractures of the face after nasal injuries.[3]

The architectural pattern of the zygomatic bone allows it to withstand blows of great forces without fracturing. Traditionally referred to as a "tripod" fracture, a ZMC fracture actually involves disruption at four sites: the lateral orbital rim, the inferior orbital rim, the Zygomaticomaxillary buttress and the zygomatic arch. It may be separated from its four articulations, resulting in zygomatico-maxillary complex, zygomatic complex, or orbito zygomatic fracture depending on the severity of injury. Fractures of zygomatico-maxillary complex are one of the most common types of maxillofacial injuries to treat.[4]

The information about the incidence, etiology, age and gender concerning this type of fractures varies according to the social, economic, cultural and environmental factors.[1] Most of the cases indicate a predilection for males with a 4:1 proportion in relation to females. Variety of etiologies including aggressions, automobile accident, falls, industrial accidents and sports are important factors for this injury.

The diagnosis is made through clinical examination and adequate radiological evaluation. Plain radiograph commonly used is Occipito- mental or Water's view which can clearly demonstrates the bone discontinuity in the Zygomaticomaxillary buttress, Infraorbital rim and Frontozygomatic region. The submentovertex view more clearly detects fracture of the zygomatic arch.[5]

The treatment of the zygomatic complex fractures is controversial, as we can see in the different philosophies in literature. This treatment had varied from a simple observation, up to a surgical approach for an internal rigid fixation. Although it has been suggested that all displaced ZMC fractures require surgical intervention, conservative management is frequently employed in cases of minimal displacement, asymptomatic injury, and patient noncompliance.[6]

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Treatment options for the reduction of isolated zygomatic bone fracture ranges from closed reduction without fixation to open reduction and multiple point of exposure and fixation.[3] Study aimed to assess the etiology and different treatment modalities depending on severity of displacement of zygomatic fracture.

MATERIAL AND METHODS

Study was done in the Department of Oral and Maxillofacial surgery at V.S Dental College and hospital and Kempegowda institute of medical sciences, Bangalore. All patients who had sustained zygomaticomaxillary complex fracture reporting to the Department of Oral and Maxillofacial surgery at V.S Dental College and hospital and Kempegowda institute of medical sciences, Bangalore were included in the study. Study duration was from from November 2012 to April 2014 and 46 Patients were included in the study. Various inclusion and exclusion criteria was decided which are as follow.

Inclusion criteria

- Patients above the age of 15 years
- Zygomaticomaxillary complex fracture
- Displaced and undisplaced fracture of the zygomatic bone
- Fractures less than 5 weeks old
- Closed type of fractures

Exclusion criteria

- Orbital fractures, where additional procedure is required for reconstruction of orbital floor
- Fractures more than 5 weeks old
- Isolated zygomatic arch fracture
- Patients with systemic disorder where surgery is contraindicated.

The criteria used to determine the need of surgical correction consisted of both clinical and radiological assessement. Clinical assessment included detailed case history and physical examination of the patient. Malar asymmetry, neurological deficit of the infra orbital nerve was recorded, ocular changes, palpable step deformity at the infraorbital rim, tenderness at the fractured points, visible depression of the prominence of the cheek.

Radiological assessment was done using PNS or water's view which can clearly demonstrate the bone discontinuity in the Zygomaticomaxillary buttress region, Frontozygomatic region and Infraorbital rim. The SMV which can clearly detect fractures of the zygomatic arch and CT scan with its 3D applications for visualization of the orbit if the orbital portion of zygomatic fracture was suspected or in comminuted fracture of zygomatic bone and also to assess the degree of displacement.

Depending on the different patterns of zygomatic bone fracture which ranged from simple fracture to comminuted and from minimally displaced to severely displaced, treatment options were decided. Undisplaced zygomatic bone fracture were managed conservatively and were recalled for regular follow up while displaced and comminuted fractures of zygoma were surgically corrected. Most of the patients were treated on an in-patient basis. Varieties of surgical approaches were used depending on the degree of displacement of zygoma. Operative procedure involved open reduction and internal fixation using 1.5 mm stainless steel mini plates and screws with multiple points of exposure and fixation at 1-point, 2-point and 3-point fixation was done under general anesthesia.

STATISTICAL ANALYSIS

Microsoft office 2007 was used for the statistical analysis. Descriptive statistics like mean and percentages were used for the analysis.

RESULTS

During two years of study from November 2012 to October 2014 which included follow up period also, 46 patients with ZMC fracture were treated, of which 91.3% (n=42) male and 8.7% (n=4) females with Male: Female ratio of 11.5:1 (Table-1). In the population studied, road traffic accident was found to be the most common etiology of the zygomatic bone fracture accounting for 60.9% (n=28) of the cases followed by, accidental self fall representing 28.3% (n=13) of the cases, assault (inter personal violence) 6.5% (n=3) and work related injuries (construction workers) accounting for 4.35% (n=2) (table-2).

Data regarding clinical presentation during the initial examination of the patients were recorded and are displayed in Table. Patients presented with circumorbital ecchymosis and perioorbital edema which was the most common sign evident in 73.9% (n=34), subconjunctival ecchymosis in 71.7% (n=33), chemosis in 34.8% (n=16), flattening of the cheek was seen in 60.9% (n=28) and rest displayed in (Table 3).

Study showed that zygomatic bone was fractured at single process in 54.35% (n=25) and more than one process was involved in 44.65% (n=21). In patients with single process fracture infraorbital rim was most commonly involved accounting for 21.74% (n=10), followed by zygomatic maxillary buttress 17.39% (n=8) and frontozygomatic suture region 15.2% (n=7)

Gender	N	%
Male	42	91.3
Female	4	8.7
Total	46	100

Table-1: Gender distribution in study sample

Etiology	Number of Patients	%
RTA	28	60.9
Self-fall	13	28.3
Assault	3	6.5
Work related	2	4.3
Total	46	100

Table-2: Etiology of zygomatic bone fracture

Signs	Count	%
Periorbital Edema	34	73.9%
Sub-ecchymosis	33	71.7%
Chemosis	16	34.8%
Flatting of cheek	28	60.9%
Infra orbital Nerve paresthesia	32	69.6%
Step deformity	16	34.8%
Bony crepitations	14	30.4%
Diplopia	2	4.3%
Trismus	10	21.7%
Occlusal discrepancies	15	32.6%

Table-3: Signs, count & percentage

(Table 4a.)

When zygomatic bone was fractured at more than one process, fracture at two processes was found in 32.60% (n=15) of the patients. Three process fractures (tripod) were seen in 13.0% (n=6) of cases. In patients with two process fracture, the infraorbital rim and zygomatic buttress was the most common site of fractures accounting for 21.74% (n=10). Zygomatic arch fracture along with body fracture of zygoma was seen in 21.73% (n=10) (Table 4b).

Out of 46 patients, 26.1% (n=12) were diagnosed with undisplaced zygomatic fracture who did not require any surgical intervention and were managed conservatively with periodic follow ups. In 73.9% (n=34), open reduction and internal fixations were carried out under general anesthesia (Table 5).

Various surgical approaches were made to access the fractured ends such as subcilliary, Transconjunctival, lateral brow, intraoral maxillary vestibular incision or through existing laceration. (Table 6)

Depending on the severity of the injury, degree of displacement and stabilization required after reduction, fixation was done at either1-point, 2-point or 3-point. 1-point fixation was done in 28.3% (n=13) of the cases; 2-point fixation was done in 32.6% (n=15) of the cases and 3-point fixation in 13.1% (n=6) of the cases. (Table7)

In 1-point fixation cases ZMB was fixed in 53.8% (n=7) while in 2-point fixation IOR and ZMB was fixed in 66.6% (n=10) cases (Figure-5).

During the period of postoperative follow up period, no cases were encountered with incidence of mobility of fractured segments. Complications such as facial asymmetry, occlusal discrepancies, persistent infra orbital sensory nerve disturbance, sclera show (ectropion), entropion was encountered during post-operative follow up in few cases. (Table 8)

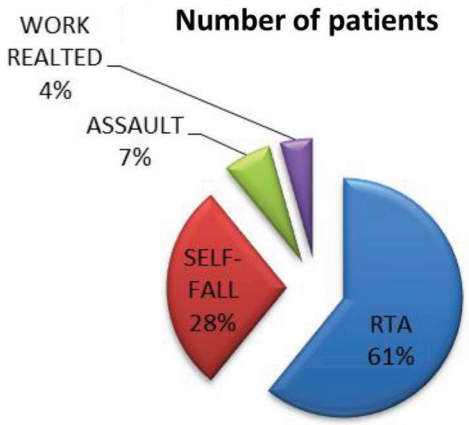

Figure-1: Etiology of ZMC fracture

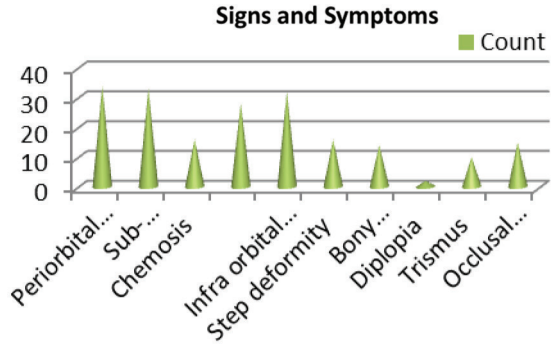

Figure-2: Clinical signs and symptoms

DISCUSSION

The zygomaticomaxillary complex functions as a buttress for the face and is the corner stone to a person's aesthetic appearance by both setting mid facial width and providing

Sites of fracture	Frequency	percentage
IOR	10	21.7
ZMB	8	17.4
FZ	7	15.2

Table-4a: Sites of fracture

Sites of fracture	Frequency	Percentage
IOR + ZMB	10	21.7
IOR+ FZ	4	8.7
FZ+ ZMB	1	2.2
IOR+ FZ+ ZMB	6	13.0

Table-4b: Two process and Three process fracture site

Treatment options	Frequency	Percentage
Conservative management	12	26.1
Open reduction and internal fixation	34	73.9

Table-5: Treatment Options

Surgical approach	Frequency	percentage
Lateral brow	12	26.1
Transconjunctival	14	30.4
Subcilliary	8	17.4
Maxillary vestibular (Keen's)	23	50
Existing laceration	4	8.7

Table-6: Surgical approaches

Fixation points	Frequency	Percentage
1-point	13	28.3
2-point	15	32.6
3-point	6	13.0

Table-7: Different point of fixation for ZMC fracture

ZMB	7	53.8
IOR	4	30.8
FZ	2	15.4

Table-7a: Fixation site for 1-point fixation

ZMB+IOR	10	66.6
FZ+ZMB	1	6.6
IOR+FZ	4	26.6

Table-7b: Fixation site for 2-point fixation

Postoperative complications	Frequency
Facial asymmetry	4
Ectropion (scleral show)	2
Intropion	1
Infraorbital nerve paresthesia	16
Occlusal discrepancy	6
Wound dehiscence	3

Table-8: Postoperative complications

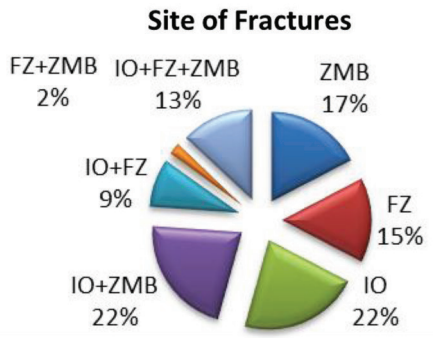

Figure-3: Sites of fracture

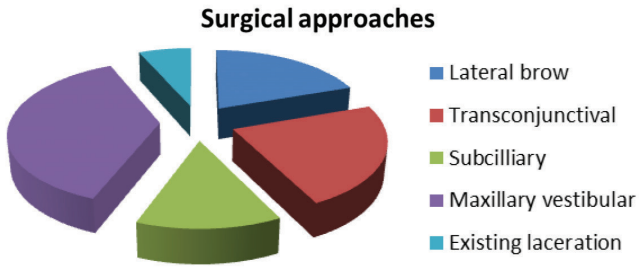

Figure-4: Surgical approaches

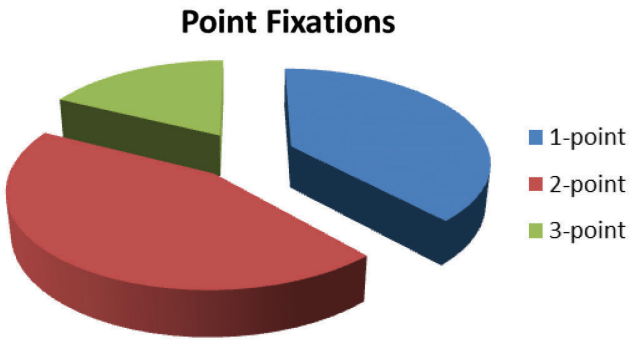

Figure-5: Point fixations

prominence to the cheek.[36] It can best be anatomically described as "tetrapod" as it maintains four points of articulation with the frontal bone, temporal bone, maxilla, grater wing of sphenoid, at the zygomatico frontal (ZF) suture, zygomatico temporal (ZT) suture, zygomaticomaxillary buttress (ZMB), and zygomatico sphenoid (ZS) suture respectively.[36] This tetrapod configuration lends itself to complex fractures. Due to the prominent, mid face location of the cheek fracture of the ZMC represent the second most common type of facial fracture after nasal bone fracture.[6] The majority of ZMC fractures are closed, displaced and non- comminuted. Although the typical resultant deformity is the mid face depression, with posterior positioning of the malar prominence, a range of displacements, including anterior positioning of zygoma may occur depending on the mechanism of trauma.[6]

Our study recorded that more males than female (11.5:1) sustained ZMC fracture. Similar findings were found in other studies however, the relative ration of male to female (11.5:1) is higher in the present study. Some of the reported male to female ratios is given below[1]:

Ozemene et al[54]	3.2:1
Ajabe HA et al	4.7:1
Chowdhury LCSR et al[2]	5.2:1
Kovacs FA et al	6.42:1
Sulliven STO et al	8.9:1
Bouguila J et al	9:1

The reasons could be greater social and economic involvement of young adult males. The age group most commonly involved in this study was from 3rd decade followed by 2nd and 4th, the lowest incidence was found in 7th decade. Studies reported by Chowdhury et al[2], Motamedi MH, Ozemene et al[54], AL Ahmad HE et al and Fasola et al showed that zygomatic bone fracture are common in 3rd decade.

The etiology of facial fractures has changed over decades and they continue to do so.[55] The developed countries show a striking reduction in broad category in road traffic accidents and increased influence of inter personal violence.[55] However, road traffic accident was the most common cause of the zygomatic bone fracture in present study. Similar high percentage of road traffic accidents were reported by Chowdhury and Menon 86.20%, Fasola et al 81.6%, Ozemene 81%. However, Kovacs et al 46.2%, Zingg et al[18] 29% reported interpersonal violence as the leading cause of zygomatic fracture. Interestingly Sulliven STO et al reported Sports injury as 27.5%. Gomes PP et al[56] reported accidental self fall as 21.83% as a most common cause of zygomatic fracture.

The zygomatic bone provides height, width and projection to the face and forms a part of the bony orbit. It also provides attachment to the suspensory ligament of lockwood which support the globe.[34] An inferiorly displaced fracture of the zygoma produces an antimongoloid slant and accentuation of the supratarsal fold of the upper eyelid and may result in disturbed ocular functions, orbital shape and facial esthetics.[34] Evaluation of a patient with a ZMC fracture included evaluation of bony injuries and status of surrounding soft tissues i.e eyelids, canthal ligament globe cranial nerve II to VI. Visual acuity was ascertained and ophthalmological consultation was obtained in doubtful case. However in our study none of the patient presented with altered visual acuity both pre and postoperatively.

Detailed history and close inspection, palpation of the orbital rim and the zygoma was done in orderly fashion. Tenderness, a step-off or discontinuity of the bony frame indicated possibility of fracture. As reported by Taicher et al[57] there may be paresthesia, over the cheek, lateral nose, upper lip and maxillary anterior teeth resulting from the injury to the infraorbital nerve, the reported incidence of which is about 30 to 80%. The infraorbital nerve involvement in our study compared to the reported incidence was 69.6%.

Intraorally ecchymosis in the buccal vestibule, tenderness or disruption in the zygomatic buttress was elicited. The range of mandibular movement was evaluated to rule out impingement of the zygoma or the arch or the coronoid process of mandible. In our study trismus was seen in 21.7% of the patient preoperatively.

In this study almost all the zygomatic bone fractures was diagnosed and confirmed using PNS and SMV view. Radiographic evaluation of ZMC fracture is complicated by difficulties in translating a three-dimensional rotation and displacement into two-dimensional imaging modalities. CT scans (Axial and coronal view) with 3D applications of the mid face helps to visualize and quantify malar eminence displacement in the anterior-posterior, medial-lateral, and

superior- inferior dimensions.[6]

This study showed isolated processes fracture in 54.35%, two processes fracture in 32.6% and tripod fracture in 13.1%. Zing et al[18] reported single process fracture in 31% cases and tripod fracture in 51% cases which is high as compared to this study. Isolated frontozygomatic fracture was found in 15.2% cases, isolated infraorbital rim fracture was seen in 21.7% and zygomaticomaxillary buttress in 17.4%. In the present study combination of IO and ZMB was seen in 21.7%while combination of FZ process and ZMB was fractured in 2.2% cases, however, Obuekwe et al[54] reported 38.8%.The time elapsed from trauma to first examination and surgical treatment varied in the study. Factors that influenced the treatment modalities included timing of presentation, age of the patient, function loss, aesthetic concern, finances and associated systemic disease.

According to Zachariades et al[24] the management of zygomatic complex fracture depends on the degree of displacement and the resultant esthetical and functional deficit. Management may therefore range from simple observation of resolving edema, diplopia and paresthesia to a more aggressive open reduction and internal fixation.

Pozatek et al[58] proposed criteria for selection of patients with zygomatic complex fracture for surgical intervention. Depending on the intensity of impact, the fractures of the zygomatic complex could be isolated, single and undisplaced as seen in low energy impact cases or they could be displaced and rotated at one or more points around vertical and horizontal axis as seen in medium and high velocity injuries. The fracture may be dislocated enbloc or comminuted which may be further aggravated by the pull of the attached muscle, thus making closed reduction of these fracture ineffective.

Although it has been suggested that all displaced ZMC fracture require surgical intervention, conservative management is frequently employed in cases of minimal displacement, asymptomatic injury, patient noncompliance, or medical contraindication to surgery.[6] No standard classification scheme currently exists to assist in the assessment of ZMC fracture severity and need for surgical treatment.

The decision to intervene surgically should be primarily based on displacement and rotation of the malar complex. As a general rule, non- displaced or minimal displaced fracture can usually be treated conservatively and regular follow up should be done to assess for any late displacement.[36] In the present study, 26.1% patients did not require any treatment and were followed up for variable period of time. All the patients in this category had undisplaced fracture at zygomatic buttress, infraorbital rim and frontozygomatic region. Similar results were reported by Larsen and Thompson et al and Ellis et al.[23] Gomes PP et al[56] reported a high number of zygomatic bone fracture (56.6%) that did not require any treatment. We did not encountered any case with late displacement or rotation during follow up. Persistent infra orbital nerve paresthesia was present in 16 patients during 6 months follow up.

In contrast, displaced fracture should be surgically reduced and stabilized. The degree of displacement can be easily checked by assessing the status of the normal articulation of the ZMC with the craniofacial skeleton on PNS radiograph and CT scan. Accurate reduction and fixation of displaced zygomatic fractures are necessary to ensure proper healing and prevent post-operative complications. The number of surgical approaches and sites of fixation necessary to ensure this varies based on the type of injury.[6] Not every articulation needs to be addressed to achieve an acceptable reduction however, at least one, two or three articulations out of four must be addressed intra operatively to reduce these fractured segments accurately.[36]

There are various treatment strategies for the treatment of zygomatic bone fracture as described in literatures, such as Temporal approach, Elevation with hook, External pin fixation, intra oral approach, Antral packing with gauge, Intraosseous wiring and bone plating.[24] All these procedures have their own advantage and disadvantages. The lack of directional control and factors like insufficient contact area, fracturing of bone in excessive tightening and healing by secondary intention were the problem areas in the management of ZMC fracture initially with wire osteosynthesis.[34] The development of monocortical miniplates and screws which consisted of plates which were malleable and miniaturized for maxillofacial fracture fixation resolved the problem associated with wire osteosynthesis. In our study for exposure of the fractured site we used lateral brow incision (26.1%) for the reduction and fixation of fractured ends at FZ area, subcilliary (17.4%) and transconjunctival (30.4%) approaches on and for exposure at infraorbital rim, intraoral maxillary vestibular (50%) approach was used for reduction and fixation of ZMB region. In few cases fractured site was reached through existing laceration.

In 2 patients with infraorbital rim fracture, were exposure was done via subcilliary approach had slightly more scleral show (ectropion). Some patients also complained of epiphora present on immediate postoperative follow up, which gradually subsided. While Patients who underwent transconjunctival approach had very minimal postoperative complaint, except for one case where moderate degree of entropion was evident.

One of the most controversial topics in maxillofacial trauma is how much fixation is enough to prevent post reduction displacement of the fractured ZMC.[3] Recommendations for fixation have varied from none to the placement of three or four bony plates at different locations. The reason for this disparity is multifactorial and includes many intangibles such as type of injury being treated i.e simple versus comminuted fractures, grossly displaced versus minimally displaced fractures, grossly displaced versus minimally displaced.

In our study 73.9% cases were treated by open reduction and internal fixation using minipplates. One-point fixation was done in 28.3% of cases in which fixation at ZMB was done in 7cases followed by 4cases at IOR margin and in 2 cases FZ was stabilized and fixed. Two-point fixation was done in 32.6% cases in which 10 cases were fixed at IOR and ZMB region, 4 cases at IOR and FZ and 1 case at FZ and ZMB region. Three-point fixation was carried out in 6 patients accounting for 13%. Different point of fixation in our study was based on severity of displacement. Fracture only at one process with minimal displacement was managed conservatively while moderate to severe displacement were operated. Fracture at two process and three processes were addressed and fixation was done accordingly depending on the sites involved.

Champy et al in his study reported satisfactory results with a single point fixation of the zygomatic complex fracture at the FZ

region. Ji Heui kim et al[46] concluded that one-point fixation at the ZMB through a gingivobuccal sulcus incision was effective for isolated fracture of zygoma without comminution of lateral orbital rim. Hwang suggested that one-point fixation of tripod fractures through a lateral brow incision can apply to cases with minimal or moderate displacement of the infraorbital rim.[35] However, because the ZMB plays a key role in withstanding contraction of the masseter muscle and supporting zygoma, rigid fixation at the ZMB is important in treatment of isolated zygomatic fracture. Further studies concluded that a single point of fixation failed to address the three dimensional rotation of zygoma.

Biomechanics of the facial skeleton was investigated and discussed by Rudderman and Mullen. According to them, fractured zygomatic segments has six possible direction of motion: translation across x, y, z axis and; rotation about x,y,z axis.[30] A miniplate applied across the FZ suture will resist translatory movement and also rotation along an axis perpendicular to the plane of miniplate because of the width of the plate. At the same time, it will offer little resistance to rotation along the linear axis of plate. To improve the stabilization, an additional plate is to be applied in a manner where the weak axis of both the plane doesn't coincide with a line connecting them.[19,30-40]

Paik-kwoon Lee et al stated that two point miniplate fixation at the infraorbital rim and frontozygomatic region provide significant amount of stability, provided the comminution of zygoma is not severe. Davidson et al stated that the two-point fixation using miniplate alone conferred a degree of stability comparable to most methods of three-point fixation regardless of the site in which the miniplates were applied.[27]

The masseter muscle has often been implicated as a primary cause of post reduction displacement of the fractured ZMC. It was assumed that because of the inferiorly directed pull i.e on the fractured zygoma it might cause movement even after surgical insertion of fixation device. However this contention was never proved.[23]

To determine whether there was any postsurgical displacement of the ZMC, Postoperative images were compared with those obtained at least 3 weeks after surgery. We din't found any evidence of displacement of fractured segments post stabilization and fixation regardless of the number of fixation device applied. There was neither any evidence of loosening of plates nor infection in the operated site.

Apart from this on clinical evaluation postoperatively there was no evidence of movement of fixed fractured segments. Ocular complication such as persistent subconjunctival ecchymosis, edema, circumorbital ecchymosis, epiphora, ectropion, intropion were evident postoperatively, but gradually subsided in 3 months follow up. Infraorbital nerve paresthesia was seen in 16 patients during a follow up period. None of the patient had Trismus after 3 month follow up. Mild occlusal discrepancy was seen in 6 patients, in which 4 patients had severely displaced mandibular fracture along with ZMC fracture. Wound healing was satisfactory in all cases except for 3 where wound dehiscence was seen on 7th and 9th day during post follow up. Infected site was then thoroughly irrigated with Betadine and antibacterial solution and resuturing was done.[41-50]

Based on our experience and the data generated from our study and other studies, a variety of methods can be used successfully to stabilize ZMC fracture. Treatment modalities for zygomatic bone fracture depends on various characteristics of the fracture and open reduction with internal fixation using miniplates is most stable and reliable modality providing three dimensional stability.[50-65]

CONCLUSION

Optimal management of ZMC fractures begin with accurate and expedient diagnosis followed by formulations of a treatment plan that account for proper reduction of fractured segments to restore facial balance. The conflicts which still persist in relation to the applied treatment modality concerns about the best way for surgical reduction of fractures, necessity to fix them or not after the reduction and lastly for the number of fixation points necessary so that the fractured ends are stabilized.

In our study fixation points were either 1-point, 2-point and 3-point depending on the displacement at the fractured sites. Two-point fixation being the most common,to determine whether there was any post-surgical change in the orientation of plates or displacement of ZMC, immediate post-operative images were compared with those obtained later after one month.There was no incidence of any change among the treated group.

Based on our experience and the data generated from our study, a variety of methods can be used successfully to stabilize ZMC fracture We conclude that treatment modalities for zygomatic bone fracture depends on the characteristics of the fracture and open reduction and internal fixation with miniplates is the most reliable modality providing three dimensional stability.

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