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RESEARCH ARTICLE **OPEN ACCESS**

COMPARISON OF 1-POINT FIXATION WITH 2-POINT FIXATION IN TREATING TRIPOD FRACTURES OF THE ZYGOMA

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ABSTRACT

A ZMC fracture is also known as a tripod, tetrapod or quadripod fracture, trimalar fracture or malar fracture. They can account for approximately 40% of mid-face fractures. They are the second most common facial bone fracture after nasal bone injuries. For the reduction of ZMC fractures various surgical techniques including one, two and three point fixation have been used, these are based on the severity and the extent of the fracture, Several approaches are used namely lateral eyebrow, sub ciliary, intra oral incisions for fixation of ZMC fractures. At this time it remains unclear which treatment is best. This present study is aimed to compare the efficacy of one point versus two point fixation following repair of zygoma fractures in 10 patients and to compare the treatment outcomes of one point versus two point fixation.

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INTRODUCTION

The zygomaticomaxillary complex (ZMC) plays a key role in the structure, function, and aesthetic appearance of the facial skeleton. The fracture complex results from a direct blow to the malar eminence and results in three distinct fracture components that disrupt the anchoring of the zygoma[1]. In addition, the fracture components may result in impingement of the temporalis muscle, trismus (difficulty with mastication) and may compromise the infraorbital foramen/nerve resulting in hypesthesia within its sensory distribution. The etiology of zygomatic complex fractures includes road traffic accidents, assaults, falls, sports, and missile injuries. Earlier studies listed traffic accidents as the major etiological factor of maxillofacial injuries[2]. The relative contribution of these factors varies from region to region. The ZMC fractures present a challenging diagnostic and reconstructive task to the surgeon. However, surgical intervention is not usually taken up unless a functional or aesthetic impairment in the form of reduced mouth opening and depression of the cheek prominence is encountered. Although many surgical treatment modalities have been mentioned so far, every technique may have its own limitations. The zygomaticomaxillary buttress is one of the three vertical buttresses of the midface transferring masticatory forces to the cranium. The anteriorly projected zygomatic bone supports the globe from direct impact[3]. Zygomatic fractures result in zygomatic bone separation from four other neighbouring bones at its respective suture lines, and hence are known as tetrapod fractures. It articulates with the frontal bone superiorly at the zygomaticofrontal suture (FZ), orbital plate of greater wing of sphenoid bone medially at sphenozygomatic suture (SPZ), maxillary bone anteroinferiorly at the zygomaticomaxillary suture, and with the zygomatic process of the temporal bone posterolaterally at the zygomaticotemporal suture. The suture lines are anatomical areas of weakness. This tetrapod configuration then lends itself to complex fractures, as fractures here rarely occur in isolation. In addition, the zygoma serves as the attachment

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point for muscles of both mastication and facial animation, but among these, it is the masseter that provides the most significant intrinsic deforming force on the zygomatic body and arch, albeit a small one. The zygoma plays an integral role with the orbit, as it buttresses the orbit and forms the majority of the lateral orbital wall and floor. The cause is usually a direct blow to the Malar eminence of the cheek during assault[4]. The paired zygomas each have two attachments to the cranium, and two attachments to the maxilla, making up the orbital floors and lateral walls. These complexes are referred to as the ZMC. The upper and transverse maxillary bone has the zygomaticomaxillary and zygomaticotemporal sutures, while the lateral and vertical maxillary bone has the zygomaticomaxillary and frontozygomatic sutures.

The formerly used "tripod fracture" refers to these buttresses, but did not also incorporate the posterior relationship of the zygoma to the sphenoid bone at the ZS suture. There is an association of ZMC fractures with nasoorbito-ethmoid fractures (NOE) on the same side as the injury. Concomitant NOE fractures predict a higher incidence of post-operative deformity. Patterns of facial injury in children differ from those in adults, because of anatomic and physiologic characteristics at different stages of facial development, as well as the extent of paranasal sinus pneumatization and phase of dentition. The overall frequency of facial fractures in children is much lower than that in adults. There is a marked preponderance of boys in the worldwide pediatric population affected by facial fractures. In children, zygomatic complex fractures often are greenstick fractures involving the lateral wall and floor of the orbit. Fractures of the zygomatic complex appear commoner in young adult males. Common clinical features of zygomatic complex fractures include diplopia, enophthalmos, subconjunctival ecchymosis, flattening of the cheek, gagging of the occlusion, and sensory disturbances. Diagnosis of zygomatic complex fractures is usually clinical, with radiographic confirmation. Although isolated zygomatic complex fractures occur, several studies have shown that fractures of the zygomatic complex are often associated with other maxillofacial injuries.

Studies have shown that significant stability of fractured fragments can be achieved by application of mini plates across various points, depending upon the extent of injury[5]. Internal fixation and reductionprovides good post-operative aesthetics, form and function. Treatment of fractured zygomatic complex should be aimed at restoring the aesthetics, facial form and function. Three point of fixation is associated with extensive periosteal stripping, extreme retraction of bone edges and increased operating time. The approaches for FZ suture include lateral eyebrow incision, infra orbital rim can be approached via sub ciliary, sub tarsal, trans conjunctival or infra orbital incision[6]. Biomechanically the fractured zygomatic segment has six possible directions of motion: translation across x,y and z axis; rotation about x,y and z axis. Various Surgical approaches have been described for open reduction and fixation of managing zygomatic complex fractures[7]. Surgical choice for ZMC fractures is still challenging. Basically, four basic principles must be considered when undertaking the repair of a facial fracture: adequate exposure, proper reduction, stable fixation, and minimal complications. Treatment of facial fractures was attempted as early as 25—30 centuries BC. Zygomatic fracture were first documented in The Smith Paprrus[8]. Du Verney in 1751 recognized the importance of reduction of displaced zygoma for proper healing by closed reduction technique. In l906, Lothrop was the first to describe the Trans-antral approach for fractured zygoma. In l909, keen was the first to describe intraoral gingivobuccal sulcus incision to reduce the depressed zygomatic arch.

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[9]. The submentovertex view more clearly detects fracture of the zygomatic arch. 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. For the reduction of ZMC fractures various surgical techniques including one,two andthree point fixation have been used, these are based on the severity and the extent of the fracture, Several approaches are used namely lateral eyebrow, sub ciliary, intra oral incisions for fixation of ZMC fractures[10,11]. At this time it remains unclear which treatment is best.This present study is aimed to compare the efficacy of one point versus two point fixation following repair of zygoma fractures and compared the treatment outcomes of one point versus two point fixation.

AIMS AND OBJECTIVES

- The aim of this study is to compare one point fixation with two point fixation in zygomatic buttress and fronto-zygomatic region in zygomatic maxillary complex fractures (tripod fractures)
- This study is to be done to compare the postoperative outcome both clinically and radiographically to assess the alignment and approximation of fracture fragments.

SURGICAL ANATOMY AND CLASSIFICATION

Zygomatic bone has two attachments to the cranium and two to the maxilla, they create a large portion of the orbital floors and lateral orbital walls. The two major buttresses of the ZMC are the upper transverse maxillary (across the zygomaticomaxillary and zygomaticotemporal sutures) and the lateral vertical maxillary (across the zygomatico maxillary and frontozygomatic sutures).
Zygomatic bone maintains four points of articulation with the frontal bone, temporal bone, maxilla and greater wing of sphenoid. It presents a malar and a temporal surface four processes (frontosphenoidal, orbital, maxillary and temporal) and four borders. The malar surface is convex and perforated near its center by a small aperture, the zygomatical foramen, for the passage of zygomaticofacial nerve and vessels below this foramen a slight elevation which gives origin to the zygomaticus muscle.

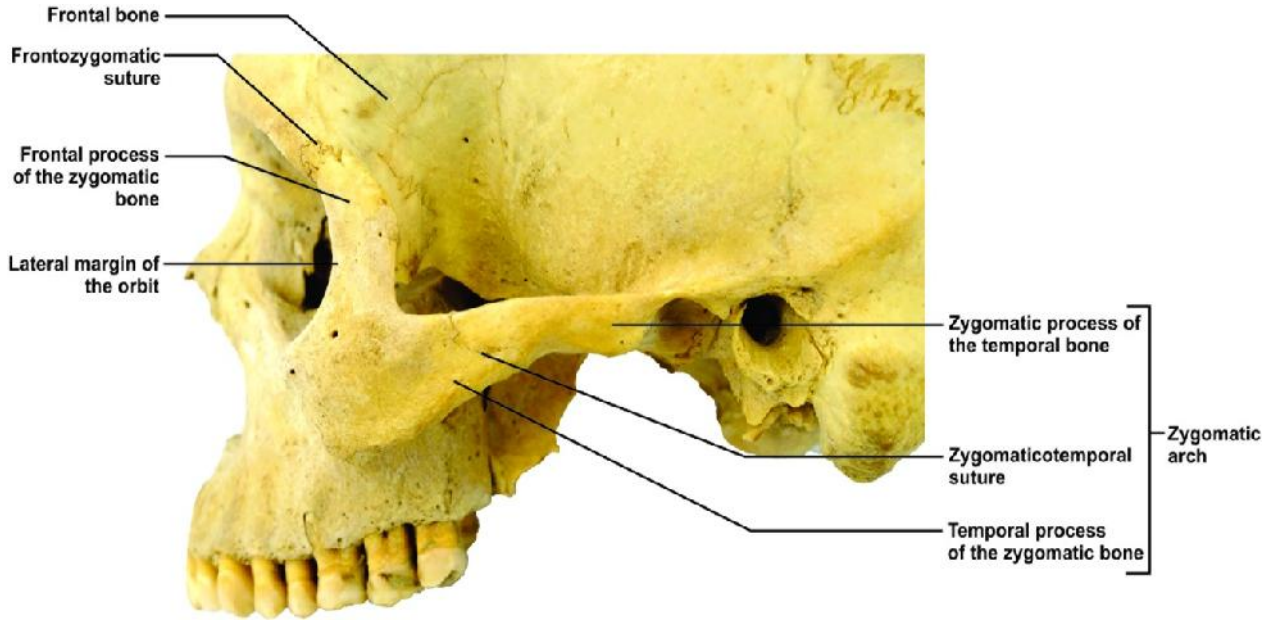
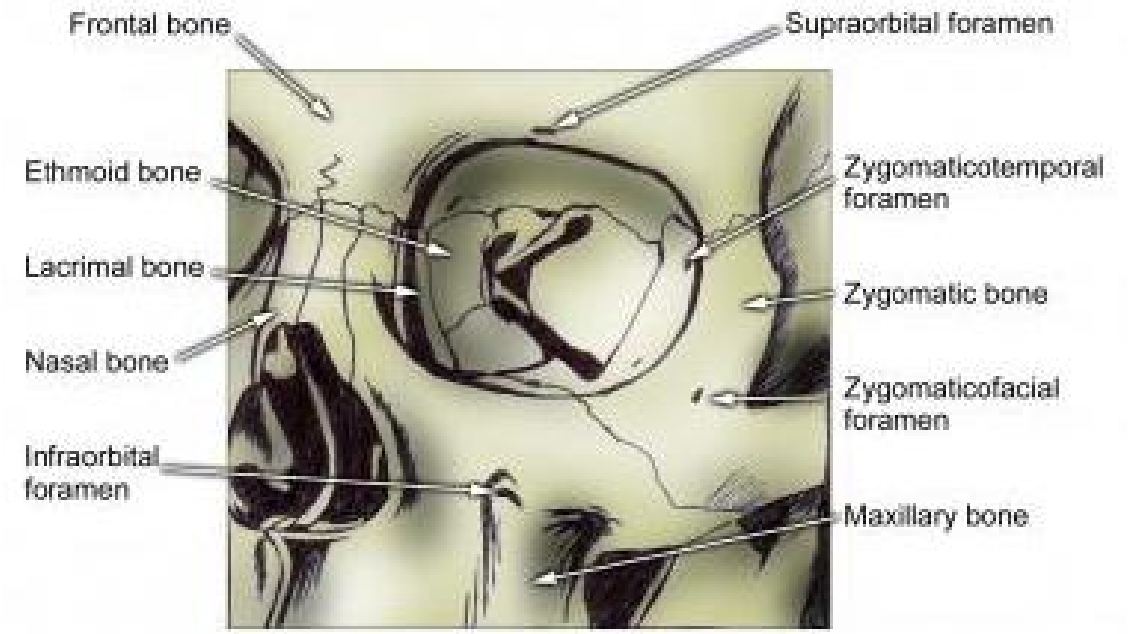


Fig. 1. Anatomic Boundaries of The Zygomatic Complex



The temporal surface, directed posteriorly and medially is concave presenting medially a rough triangular area for articulation with the maxilla and laterally a smooth concave surface the upper part of which forms the anterior boundary of the infratemporal fossa. Near the center of this surface is the zygomaticotemporal foramen for the transmission of the zygomaticotemporal nerve.

The orbital surface forms the lateral part and some of the inferior part of the bony orbit. The zygomatic nerve passes through zygomatic-orbital foramen on this surface. The lateral palpebral ligament attaches to a small protuberance called the orbital tubercle. Borders the anterosuperior or orbital border is a smooth, concave and forms a considerable part of the circumference of the orbit.

The anteroinferior or maxillary border is rough and beveled at the expense of its inner table to articulate with the maxilla, near the orbital margin it gives origin to quadratus labii superioris. The posterosuperior or temporal border curved like an italic letter f, is continuous above with the commencement of the temporal line, and below with the upper border of the zygomatic arch, the temporal fascia attached to it. The posteroinferior or zygomatic border affords attachment by its rough edge to the masseter.

CLASSIFICATION OF ZYGOMATIC COMPLEX FRACTURES

TYPES OF CLASSIFICATIONS:

- Shielderup classification
- Knight and North classification
- Rowe and Killey classification
- Spissel and schroll classification
- Henderson classification
- Ozyazgen classification
- Manson classification
- Fuji and Yamashiro classification
- Zingg classification

ROWE AND KILLEY CLASSIFICATION

Type I - No significant displacement
Type II - Fracture of zygomatic arch
Type III- Rotation around horizontal axis- inward or outward displacement
Type IV- Rotation around longitudinal axis-medial or lateral
Type V- Displacement of the complex block-medial/inferior/lateral Type VI- Displacement of orbitoantral partition
Type VII- Displacement of orbital rim segment
Type VIII- Complex comminuted fracture

SHIELDERUP CLASSIFICATION

Type 1 - Displaced zygomatic bone hinged on the maxillary and the frontal attachments
Type 2 - Displaced zygoma hinged on maxillary attachments.
Type 3- Displaced zygoma hinged on frontal attachments.

HENDERSON'S CLASSIFICATION

Type 1 -Non displaced fractures
Type 2- Isolated zygomatic arch fractures
Type 3- Zygomatic complex fractures but the frontozygomatic suture is undisplaced
Type 4 -Zygomatic complex fractures with displacement of the frontozygomatic suture
Type 5- Pure blow-out fractures
Type 6- Fractures of the orbital rim only
Type 7- Comminuted or multiple fractures

For practical use zygomatic fractures should be classified into 3 groups only:

UNDISPLACED FRACTURES: This diagnosis being based on both clinical and radiological examination and furthermore ensured by clinical re-examination when the traumatic edema has subsided

DISPLACED UNSTABLE FRACTURES: This diagnosis being based on radiological evidence of comminution; or wide seperation or displacement at the zygomaticofrontal suture.

C. DISPLACED POST REDUCTIVELY STABLE FRACTURES: this group comprising all other fractures.

VARIOUS TYPES OF SURGICAL APPROACHES:

- Extra oral approach
- Bicoronal or hemicoronal
- Gillies temporal approach
- Superolateral
- Supraorbital approach or lateral eyebrow
- Upper eyelid
- Lower eyelid
- Infraorbital
- Subtarsal
- Subciliary - lower blepheroplasty
- Transconjunctival
- Percutaneous
- Intraoral approach - Balasubramaniam or Keen's
- Transoral - maxillary vestibular
- Endoscopic transantral

MATERIALS AND METHODS

- This clinical study and design will be carried out on 10 patients presenting with zygomatico-maxillary complex fractures who reported at the department of Oral and maxillofacial Surgery, Sree Balaji Dental College and Hospital, Chennai.
- Patients with comminuted zygomatic complex fractures and undisplaced zygomatic complex fractures were excluded from the study.
- Institutional ethical committee clearance was taken for the study.
- Both male and female patients aged between 14-60 years were included in the study
- The patients were divided into two groups 1 and 2 with 5 patients in each group allocated randomly
- Two standardized surgical techniques were used to treat these patients.
- The surgical treatment planned in group I patients is one point fixation at zygomatic buttress and in group II patients-twopointfixation at frontozygomatic and zygomatic buttress
- Pre-operative assessment of the patients in Group I/II includes thorough history, clinical and radiological examinationand photographs.

STUDY PARAMETERS

The parameters to be assessed in both Groups I and Group II includes intraoperative time taken, unsightly scars, palpability of plates, clinical union at 4 weeks, radiographic union at 6 months, signs of wound infection or dehiscence and plate exposure and need for plate removal. Radiographic analysis includes digital PNS view, CT scan in all 3 planes (axial, coronal, sagittal and 3D reconstruction).

INCLUSION CRITERIA

- Fractures of zygomatico-maxillary complex
- Patients with isolated minimally displaced zygomatic bone fracture determined on clinical and radiographic findings
- Patients with isolated zygomatic bone fracture more than 15days old
- Age between 14 and 60 years

EXCLUSION CRITERIA

- Comminuted zygomatic bone fractures
- Gunshot injuries
- Medically unfit for surgery, who are unfit to undergo surgery under General Anesthesia
- Infected fractures
- Pathological fractures

ARMAMENTARIUM

- Bard parker handle no 3
- Bard parker blade no 15
- Howarths periosteal elevator
- Rowes zygomatic elevator
- Bone plates and screws
- Plate holding plier
- Plate bending plier
- Screw holder
- Screw driver
- Needle holder
- Suture materials
- Micromotor and handpiece
- 702 burs
- Artery forceps
- Suction tips
- Retractors
- Diathermy

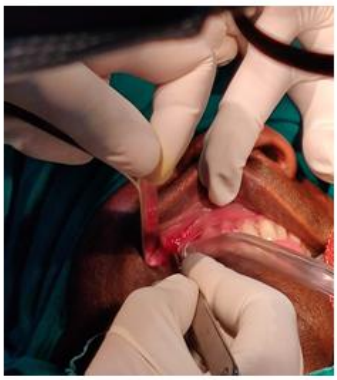
CASE REPORTS

GROUP 1: ONE POINT FIXATION

CASE 1

PRE OPERATIVE

INTRA OPERATIVE



POST OPERATIVE

CASE 2

PRE OPERATIVE

INTRA OPERATIVE


POST OPERATIVE


CASE 3

PRE OPERATIVE

INTRA OPERATIVE


POST OPERATIVE

CASE 4

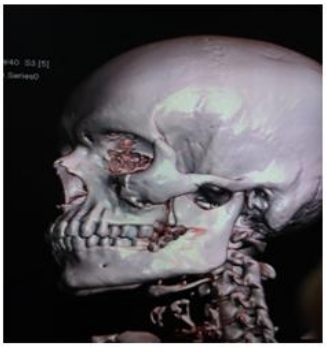
PRE OPERATIVE

INTRA OPERATIVE

POST OPERATIVE

CASE 5

PRE OPERATIVE




INTRA OPERATIVE

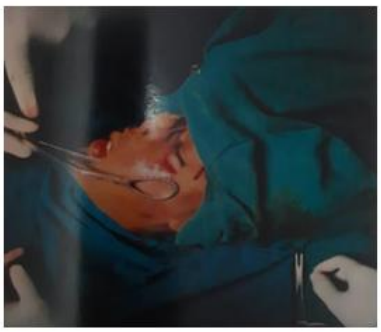

POST OPERATIVE


GROUP 2 : TWO POINT FIXATION

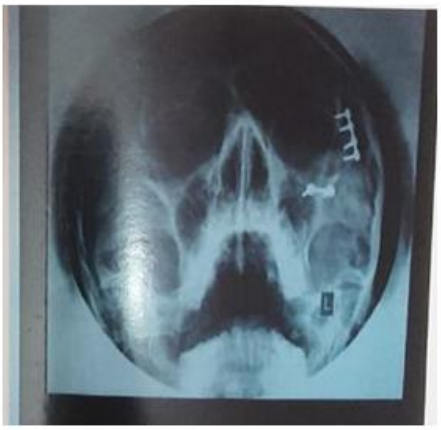
CASE 1

PRE OPERATIVE


INTRAOPERATIVE

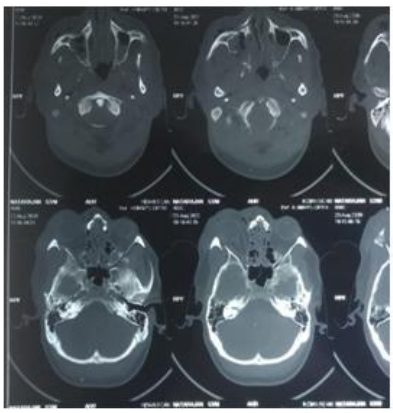



POSTOPERATIVE

CASE 2

PRE OPERATIVE

INTRAOPERATIVE




POST OPEARTIVE


CASE 3

INTRA OPERATIVE

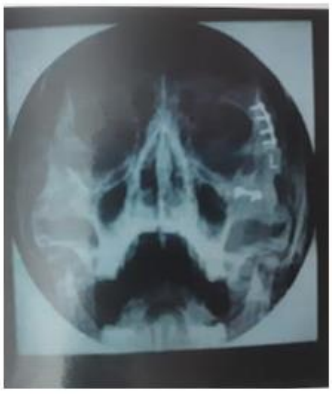
POST OPERATIVE

CASE 4

PRE OPERATIVE

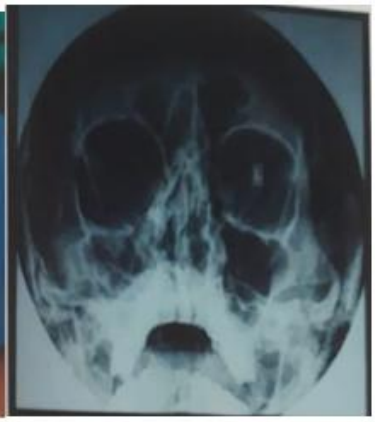
INTRAOPERATIVE

POST OPERATIVE

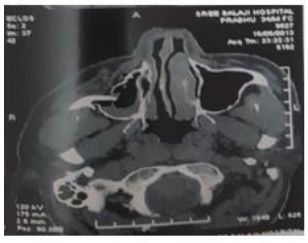



CASE 5

PRE OPERATIVE

INTRAOPERATIVE




POST OPERATIVE



RESULTS

The present study was conducted on ten patients, 5 in each group (Group 1 and Group 2) with zygomatico maxillary complex fractures. All of these patients had isolated and displaced zygomatic complex fractures without any other maxillofacial fractures. There was depression of malar eminence in all the patients and paraesthesia of infra orbital nerve in 50% of patients. There was diplopia in one patient and restricted mouth opening in 40% of the patients.The other symptoms seen were oedema, ecchymosis, subconjunctival haemorrhage in 70% of the patients.

All the patients were treated using open reduction and internal fixation. The age group of the patients varied from 18 to 60 years. Road traffic accident was the cause of fractures in nine of the patients except one. The highest incidence of fracture was seen between the age group of 20 and 40 years.

Table 1. Demographic Details of the Study Population

Sno	Age	Sex	Side	Orbital symptoms	Deprssion of malar eminence	Mouth opening	Clinical diplacement	Radiological displacement
1	33	M	LT	NO	YES	30MM	BUTTRESS REGION	FZ REGION AND BUTTRESS REGION
2	39	M	RT	NO	YES	20MM	FZ REGION	FZ REGION
3	32	M	LT	NO	YES	38MM	FZ REGION	FZ REGION
4	51	M	RT	NO	YES	20MM	FZ REGION AND BUTTRESS REGION	FZ REGION AND BUTTRESS REGION
5	36	M	RT	YES	YES	32MM	FZ REGION AND BUTTRESS REGION	FZ REGION AND BUTTRESS REGION
6	40	M	LT	NO	YES	28MM	FZ REGION AND BUTTRESS REGION	FZ REGION AND BUTTRESS REGION
7	26	M	LT	NO	YES	42MM	FZ REGION	FZ REGION
8	42	M	RT	NO	YES	25MM	FZ REGION	FZ REGION AND BUTTRESS REGION
9	28	M	LT	NO	YES	40MM	FZ REGION	FZ REGION
10	37	M	RT	NO	YES	35MM	FZ REGION AND BUTTRESS REGION	FZ REGION AND BUTTRESS REGION

Post-operatively patients were evaluated radio graphically by pre and postoperative radiographs (Digital Paranasal Sinus View) to assess the alignment and approximation of fracture fragments.However the reduction was very stable in all patients. Clinically the prominence of the malar eminence, infection, foreign body reaction, neurological deficit, palpability of the implant was considered.In Group I patientsthere was no incidence of wound infection or dehiscence, scars, foreign body reactions or palpability of plates in anypatients. Paraesthesia was present in one patient.

Table 2. Characteristics in Group I

S. No	Wound infection and dehiscence	Scar	Palpability of plates	Sign of clinical and radiological union
1	No	No	No	Yes
2	No	No	No	Yes
3	No	No	No	Yes
4	No	No	No	Yes
5	No	No	No	Yes

TABLE 3. Characteristics in Group 2

SNO	Wound infection and dehiscence	Scar	Palpability of plates	Sign of clinical and radiological union
1	No	No	No	yes
2	No	No	yes	yes
3	No	yes	No	yes
4	No	No	No	yes
5	No	No	yes	yes

In Group II patients, there was no paraesthesia in any patient there was no evidence of wound dehiscence or foreign body reactions. However, two patients complained of palpability of plates and mild scars in frontozygomatic region.It is seen that in terms of stability, it is definitely two-point fixation which is superior. However, it had its own disadvantages of implant palpability and unesthetic scars.

But the fixation at the ZM buttress was quicker, no scars, no implant palpability but fixation was inadequate in case of extensively comminuted or displaced fractures.On the basis of detailed pre-operative and post-operative observations, one point fixation at zygomatic buttress is a viable option for minimally displaced ZMC fracture and it is not feasible in patients with comminuted zygomatic fractures, incomplete reduction through buccogingival incision and fixation at zygomaticomaxillary buttrres, fractures with orbital complications. In such cases two- or three-point fixation is better alternative.

DISCUSSION

Zygomatico maxillary complex fractures are more common in the 2nd and 3rd decade of life. This study recorded that more males than females sustained zygomatic complex fractures. This is consistent with other reports[12]. Male patients 20–40year age group were most often involved, and road traffic accidents were the leading etiologic factor. Many studies have shown that young adult males were commonly affected. The role of road traffic accidents as an etiologic factor in zygomatic complex fractures has been identified by some studies. The key to management of facial trauma is to operate the cases as soon as clinical conditions permits with a special emphasis on function and aesthetics. The most important principle in the treatment of zygomaticomaxillary complex fractures is proper reduction[13]. The zygomaticomaxillary complex is an essential element of the facial configuration. The zygoma is a diamond-shaped bone located in the middle third of the face, and has relations with the orbit, the maxilla, and the temporal fossa. The four articulations of the zygoma include the fronto-zygomatic suture (FZS), infraorbital rim, zygomaticomaxillary buttress, and zygomaticotemporal suture. Because of its location, it is subjected to trauma more often than any other element of the face except the nose. Although some injuries will involve an isolated orbital rim or antral wall fracture, most injuries will include the zygomatic bone, and thus the term"zygomaticomaxillary. Despite the high frequency of the zygomaticomaxillary complex (ZMC) fractures, there is no consensus among surgeons regarding the best surgical management. Thus, the surgical treatment of these fractures remains challenging. Basically, four principles must be considered when undertaking the repair of a facial fracture: namely, adequate exposure, proper reduction, stable fixation, and minimal complications.

Eye injury is very common in mid face trauma; therefore a thorough Optholmological examination is mandatory in all suspected malar fractures[14]. An external examiantion should note any lacerations, assess extraoccular motility visual acuity, visual fields and the pupillary light reflex. The patient must be assessed for diplopia, opthalmoplegia, enopthalmos (sunken eye) and proptosis. The integrity of the optic nerve must be established even if the eye is closed by soft tissue swelling. This is accomplished by shining a light over the closed eye and getting the patient to confirm the presence or absence of light. An opthalmological review is essential in the presence of a through and through lid laceration. The technique of fixation at zygomaticomaxillary buttress has some advantages such as no palpability of the implant, shorter operating time, no facial scars, re-operating for an infected implant is also easier. On the contrary in case of extensively comminuted and malaligned fractures, one point fixation at zygomatic maxillary buttress area always resulted in poor stability as reported by **Chuong R and Kaban.** The present study recorded more fractures of the zygomatic bone than those of the arch alone and combined zygomatic bone and arch. Isolated fractures of the arch are uncommon. This was probably because of the predominant role of road traffic accidents, in which most impacts to the face were most likely frontal. Arch fractures are more likely to involve some form of lateral impact and were more often encountered in cases of falls, assaults, and sports injuries. As a result of the intimate association of the zygomatic complex with the rest of the facial skeleton, associated maxillofacial fractures are common. Although several signs and symptoms accompany zygomatic complex fractures, not all require active treatment. Circumorbital ecchymosis and subconjunctival ecchymosis were most frequently encountered in this study but were usually self-limiting[16].

Banks and Brown have summarized the indications for treatment 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. Flattening of the cheek was encountered among the patients in this study. This is usually seen in tripod fractures that are most often displaced in wards to a greater or lesser extent. Diplopia was observed. **Al-Qurainy et al**.reported diplopia in 17.4% of patients with mid-face fractures and found that zygomatic fractures were a principal risk factor in the development of diplopia. Limitation of mandibular movement occurred in patients and is usually a result of the fractured zygomatic complex impinging on the coronoid process of the mandible. Based on recent reports, the most significant types of chronic residual sequelae of zygomatic bone fracture are deformities resulting from mal reduction of the zygomatic prominence, enophthalmos, cheek anesthesia or dysesthesia, and trismus.

Earlier, **Ogden *et al*** had proposed that in some fractures of the zygomatic complex, clinical criteria alone were sufficient for postoperative assessment. **Pogrel et al.** evaluated the efficacy of a single radiograph to screen for mid-face fractures and concluded that a single 30° occipitomental radiograph (augmented with computed tomography (CT) scans when indicated) can identify all mid-face fractures requiring treatment. The transoral approach was the most common method of reduction. This is consistent with other reports. **McLoughlin et al.** found that the use of the bone plating was not significantly greater than the use of transosseous wiring among British oral and maxillofacial surgeons. However, **Tadj and Kimble**, in a study of 263 cases of fractured zygomatic complex, found that bone plating was the most frequently employed fixation. Two-point fixation methods were preferred to achieve stability against rotation with best esthetic outcome as the scars were well hidden intraorally and in the eyebrows[18]. This approach provided best result with minimal complications such as pain, palpability of implants, and mild facial asymmetry .However, opinions vary, and different combinations have been documented in the literature. Few cases were managed by more than two-point fixation, but no extra benefits were achieved from these approaches on reduction and stabilization point of view. Mixing wires with miniplates reduced the stability in proportion to the number of wires used. Minimal increases in stability were added using three-pointminiplate fixation when compared to two-point miniplate fixation, regardless of the application site. The authors concluded that a stable fixation can be achieved with a miniplate on the frontozygomatic suture line and a second buttress[19]. Acceptable stability can be achieved with single-point miniplate fixation at the frontozygomatic suture line or the infraorbital rim. These results do not take into account variables like fracture comminution rotatory forces of the masseter muscle or the type of skin incision necessary to apply the fixation.

Postoperative sinusitis was related directly to the severity of injury. Patients rarely complained of pain over titanium plates with cold exposure. Plate exposure was evidenced in few patients. The absence of infection, intraoral exposure of plates or wires was monitored conservatively. These wounds often granulate with appropriate oral hygiene. Persistent exposure for longer than 3 months, evidence of loose plates, or gross infection was indications for plate removal. Park *et al* recently reported on external suspension with Steinmann pin and Kirchner wire after closed reduction. The external pin can cause discomfort for patients and experience of reduction skill is necessary. Kim et al. reported reduction using a resorbable plate procedure, where there is a risk of breakage. Rinehart et al. proposed 3 point fixation to prevent masseter force. Ahn et al. reduced zygoma with wire and bone hook. Their methods are similar to our methods, however, we reduce with plates and screws which used in fixation, so additional hole of the fracture segment for reduction is not necessary. Uda et al. introduced closed reduction and internal fixation using a Carroll-Girard screw. This method used a special instrument and a small external incision on the malar eminence. A large bone hook can also be used to reduce the fracture through a small incision at the inferior margin of zygoma. The most common indication for surgery in ZMC fractures is displacement and rotation, and most displaced ZMC fractures should be treated surgically. If reduction is not performed properly, facial asymmetry will be prominent, as the result of lowering the malar prominent point. For this reason, precise anatomical reduction is very important. The need for one-point, two-point, three-point, or four-point fixation should be based on fracture stability, and applying the minimum amount of hardware to maintain fracture reduction throughout the process of healing. This approach has been termed functionally stable fixation (Bradley Strong and Gary, 2017). In the present study as far as the stability is concerned, two-point fixation was more stable compared to the one point fixation.

Rana et al., 2012, also concluded based on their study that open reduction and internal fixation using three-point fixation by miniplates is the best available method for the treatment of zygomatic bone fractures and precise reconstruction with rigid internal fixation at three points is superior to two-point fixation. Nasr et al., 2017, conducted a study in 40 patients with a duration of follow-up of 12 weeks; they concluded that apart from asymptomatic and clinically unnoticeable radiological difference, the two-point fixation modality for displaced ZMC fractures is almost as effective as three-point fixation and prevents post-reduction rotation or clinical displacement with a significantly lower cost. In this study two point fixation was effective in reducing displaced zygomatic fractures without any postoperative displacements and complications. 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. 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.

Studies have suggested that 1-point fixation is sufficient to maintain stability and to obtain a good outcome in selected cases. In cases of simple tripod fractures, many surgeons have used 1-point fixation through a lateral eyebrow incision. However, 1-point fixation in the FZ area through a lateral eyebrow incision usually leaves external scars, palpability of plates, and swelling resulting from severed muscle and soft tissue. Because the soft tissue overlying the FZ area is very thin, thin plates must be used to prevent visibility, sensibility, and palpability. One-point fixation in the ZM area does not leave external scars or palpability of plates or screws. In this study none of the group 1 patients complained of aesthetic problems related to external scars. However, one out of five patients in group 2 complained of external scars related to lateral eyebrow incisions. Manson showed that the ZM buttress is a good place for zygoma alignment and that the FZ suture has the best bone for fixation but the worst single-alignment guide. To reduce the chances of scarring, the more efficient approach is a buccogingival incision, not a lateral eyebrow incision. The less invasive management of zygomatic complex fractures avoids multiple surgical incisions, potential infections, additional scars, and nerve palsy. Taken together, our results show that a lateral eyebrow incision may cause problems in patients with zygomatic fractures. The advantage of 1-point fixation through a buccogingival incision is avoidance of external scars and palpability in the FZ area. However, this fixation is not feasible in patients with 1) comminuted zygomatic fractures; 2) incomplete or unsatisfactory reduction through a buccogingival incision; and 3) fractures combined with orbital complications.

In the study conducted by Rudderman and Mullen, plating the fractured zygoma must be done in a non-collinear manner in order to prevent translational and rotational forces acting on it. A miniplate applied over the frontozygomatic region resists the translation and rotational motion perpendicular to the plate. However, it will not resist the linear translation along the axis of the plate. To counteract this motion, a miniplate is applied onto the zygomaticomaxillary buttress, perpendicular to the axis of the frontozygomatic region. A third plate when applied onto the infraorbital rim will effectively counteract the forces and maintains the stability of the reduced zygoma.In this study two plates were placed in frontozygomatic and zygomaticomaxillary buttress region. Hwang et al. in the study of management of tripod fractures through lateral brow incision showed that one-point fixation stabilized the minimally displaced fractured zygoma. He also stated that patients having inferior orbital rim defect more than 7 mm, floor fractures, lateral orbital rim fractures, and ocular impairment would need more than 1-point fixation for treatment. Zingg M, LaedrachK et al. in their study on 813 patients with zygomatic fractures stated that 3-point fixation is not always necessary to obtain three-dimensional biomechanical stability. Alignment and adaptation of the fractured zygoma fragment in a stable anatomic position dictates the need of additional fixation point for stablility[20]. While fixing the frontozygomatic region, neglecting the three-dimensional rotational forces acting on the fractured zygoma during reduction may be the prime cause of postoperative facial asymmetry. To achieve better and predictable stabilization, recommendations were made to rigidly fix the fractured zygomatic complex at more than one point, i.e. 2, 3, and 4 points. Cadaveric study on fractured zygoma by Karlan et al. advocates 3-point fixation of zygomatic complex fracture. They stressed on the fact that a tripod fixation is a minimum requirement for stability of a tetrapod fracture. Even though literatures have shown 2-point fixation to be adequate for treating displaced zygomatic fractures, we undertook a prospective comparative study to compare 1-point fixation and 2-point fixation in

treating zygomaticomaxillary fractures. We aimed to find out the stability achieved from 1-point and 2-point fixation technique by evaluating various clinical and radiological parameters. Edward Ellis and Winai analysed various modalities for ZMC fractures. They used CT scan in their study for three-dimensional imaging of the zygomatic fractures and considered it as the gold standard for treatment planning of zygomaticomaxillary fractures. In CT coronal and axial scans, sphenozygomatic suture alignment, zygomatic arch alignment, and symmetry of malar prominence were compared with the opposite side. In our study CT scan (axial and coronal cuts) was used for diagnosis, treatment planning, and outcome of fixation techniques of ZMC fractures. The patients were evaluated for postoperative displacement of fractured zygoma. The evaluation was made by comparing CT scans done immediate and fifth postoperative week. There was no significant postoperative displacement at any point among all the patients in both groups. **Chakranarayan et al. (2009) recommended 2-point fixation with mini plates for rigid internal fixation of the fractured complex. Whereas, Ramesh Candamourty et al. stated 3-point fixation provides a better stability of displaced zygomaticomaxillary complex. Most studies stated the unacceptable postoperative scars in patientsundergoing infraorbital exploration. In this study, lateral brow incision was used to explore the frontozygomatic region.**

SUMMARY AND CONCLUSION

Single point fixation of the zygomaticomaxillary buttress is a viable option for the treatment of non-comminuted ZMC fractures. This technique, however, requires attention to important intraoperative details. After reduction and fixation of the ZM buttress, the FZ suture line must be palpated to establish adequate alignment. The orbital rim must also be evaluated for proper alignment. A significant palpable step-off, greater than 2 mm, indicates a need to surgically address the orbital rim. It is important to perform forced duction testing to rule out entrapment of the inferior rectus. If there is any concern for herniation or entrapment, the orbital floor should be explored and reconstructed when indicated. However, in most cases single-plate fixation proved to be a sufficient reduction technique with minimal associated morbidity. Single-point fixation has important implications beyond those of fracture management. The decreased operative time utilized with this technique may not only be more cost-effective but also subjects patients with multiple medical comorbidities, and an associated increased risk of anaesthesia, to decreased potential morbidity. With this in mind, single-point fixation may be of particular utility in patients in whom decreased operative time is of high priority. These patients should display uncomplicated mildly displaced non-comminuted ZMC fracture patterns in which plating of the zygomaticomaxillary buttress results in appropriate reduction without any further discernible step-off or deformity in other segments of the ZMC tetrapod. When there is extensive comminution, multiple approaches and fixation points are generally needed to provide adequate reduction and rigid fixation of the fracture fragments. It is the opinion of the authors that all displaced ZMC fractures require at least one-point fixation due to traction placed on fracture fragments by masticatory muscles. All necessary fracture sites should be visualized to ensure reduction. The zygomatic arch in most circumstances does not require fixation unless there is severe comminution or instability. In such cases, a coronal approach may be implemented and fixation of the zygomaticosphenoid suture may be considered for restoration of orbital volume and reduction of potential enophthalmos. In the prospective study, it is seen that in terms of stability, it is definitely two-point fixation which is superior. However it had its own disadvantages of longer operating time, implant palpability and unaesthetic scars. But the fixation at the ZM buttress was quicker, no scars, no implant palpability but fixation was inadequate in case of extensively comminuted or displaced fractures. On the basis of careful and detailed pre-operative and postoperative observations, we conclude that one point fixation at zygomatic buttress is a viable option for minimally displaced ZMC fracture and this one point fixation is not feasible in patients with comminuted zygomatic fractures, incomplete/unsatisfactory reduction through buccogingival incision and fixation at zygomaticomaxillary buttrres, fractures with orbital complications. In such cases two or three point fixation is better alternative. Therefore an individualistic approach is required for deciding the treatment plan for ZMC fractures based on extent and amount of displacement rather than fixed protocol.

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