Original Research Article

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Evaluation of Single Point Fixation in the Management of Tripod Fractures of Zygoma

I. Raja Kiran Kumar Goud[a], Baliram Chikte[a]

[a]Assistant Professor, Department of Plastic Surgery, Osmania General Hospital and Osmania Medical College, Hyderabad, Telangana.

Abstract

Aim: The aim of this study is to study the efficacy of single point (ZF) fixation in selected cases of Tripod fractures of zygoma in achieving anatomical reduction of the zygomatic bone complex in restoration of normal function & aesthetics. *Materials and Methods:* This prospective clinical study was conducted in the department of Plastic & Reconstructive Surgery, Gandhi Medical College & Hospital, Secunderabad, Andhra Pradesh. Total of 13 patients who reported in the Department of Plastic & Reconstructive Surgery with clinical and radiological evidence of unstable and displaced tripod fracture of zygoma. *Inclusion Criteria:* Displaced tripod fracture of zygoma as seen clinically and radiologically (3D CT). Tripod fracture of zygoma with or without associated maxillofacial fractures. Patients above 18 years of age. Presentation within 15 days of injury were included in the study. *Exclusion Criteria:* Associated fractures of maxilla, frontal bones which can destabilise mid facial skeleton. Bilateral displaced fractures of zygoma. Comminuted fractures of zygoma. Zygoma fractures with visual disturbances. Patients medically unfit for surgery to undergo general anaesthesia. Foreseeable missing opportunity of follow up examination were excluded in the study. *Results:* Road traffic accidents were the common cause of fracture zygoma. Most of the patients were between 18-25 yrs age group. Associated fractures were noticed in less than 23% (3cases) of patients in our group. 50% (7cases) of the fractures were compound. 3Dimensional computed Tomography was used to identify the pattern of fracture. Group 3 fracture was noted in 7% (1) patient. Group 4 fracture was noted in 53% (7) patients. Group 5 fracture was noted in 23% (3) patients. Group 6 fracture was noted in 15% (2) patients. Single point fixation done using 2 holed, 1.5 mm plate & 8mm screws in 23% (3) of patients. Single point fixation done using 3 holed, 1.5 mm plate & 8mm screws in 69% (9) of patients. Single point fixation done using 4 holed, 1.5 mm plate & 8mm screws in 7% (1) of patients. Malar symmetry obtained in 47% (6) of patients. Grade 2 malar symmetry obtained in 38% (5) of patients. Grade 3 malar symmetry obtained in 15% (2) of patients. Enophthalmos was noticed in 30% (4) of patients. All patients achieved >3cm mouth opening towards the end of 2 months. None of the patients developed clinical infra orbital step. 5 (38%) patients had radiologically detectable infra orbital step. None of the patients developed post operative infection. Dental occlusion was normal in all patients. *Conclusion:* It can be concluded that single point fixation has a definite place in the management of tripod fractures of zygoma with minimal to moderate displacement of infraorbital margin.

Keywords: Zygoma fractures; Enophthalmos.

Introduction

Fractures [1] of zygoma were noted as early as 1650 BC with Edwin Smith Papyrus. It is the modern era with prosperity for high velocity type injury that has made this region liable to injury & deformity. A displaced fracture zygoma cannot be treated as an isolated bone as it forms part of structure that houses the eyes & the maxillary sinus. Its malposition can also affect the normal unhindered excursion of the coronoid process of mandible. As with any other

Corresponding Author: Baliram Chikte, Assistant Professor, Department of Plastic Surgery, Osmania General Hospital and Osmania Medical College, Hyderabad.
E-mail: kiransurgeon@yahoo.co.in

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facial deformity, zygoma fractures demand restoration of form & function.

Little [2,3] was written about zygomatic fractures until 1751, when duVerney reported two cases. Before that time, in fact, fractures of the zygoma were thought to be "an ailment not to be treated" (Edwin Smith Papyrus, *ca*. 1650 BC), and consequently were largely ignored. At first, treatment consisted of reducing the body of the malar bone, which was approached via the (a) gingivobuccal sulcus; (b) maxillary antrum; (c) nose; or (d) skin over the malar prominence. Keen pioneered the *intraoral* approach. In 1906, Lothrop devised the *transantral* approach through the canine fossa. In 1931, Shea suggested a *nasal* approach that entered the antrum with a urethral sound to engage the antral surface of the zygoma. A number of *transcutaneous* approaches have been recommended over the years. Matas passed a suture around the medial arch for traction elevation. Roberts designed a corkscrew instrument that could be inserted into the malar bone for elevation. Kazanjian placed a screw into the malar bone, left it in place, and attached it to a transcutaneous wire for headcap traction. Gillies incised the temporal hair-bearing skin and passed a bone hook deep to the temporal fascia down to the body of the zygoma to elevate this segment. In 1950, Fryer reported stabilization of zygomatic fractures with transcutaneous Kirschner wires. In 1952, Anthony proposed using an inflatable antral balloon for the reduction of zygomatic fractures. The first published report of rigid fixation for the treatment of fractures of the midface was in 1973 by Michelet. Currently most plating systems designed for use in the craniofacial skeleton are composed of stainless steel & titanium of size 1.0, 1.5 mm and use screws 1.0, 1.5 in diameter. As technology has improved, self-drilling screws have been developed that allow insertion without the use of drill bits. Resorbable fixation systems have found widespread application in pediatric craniofacial surgery.

Anotomy

The zygoma [4,5] is a major buttress of the midfacial skeleton. It forms the malar eminence, giving prominence to the cheek, and forms the lateral and inferior portions of the orbit. The zygomatic bone has a quadrilateral shape with several processes that extend to reach the frontal bone, the maxilla, the temporal bone (zygomatic arch), and orbital processes. From a clinical standpoint, the zygoma has two faces: the lateral or malar surface and the more medial orbital surface. Zygoma meets the maxilla medially at the inferior orbital rim and inferiorly at the maxillary alveolus. The zygomatic bone articulates with the external angular process of the frontal bone superiorly, and with the greater wing of the sphenoid in the lateral orbit. In the inferior orbit, it articulates with the maxilla. The bone has its broadest [4] and strongest attachment with the frontal bone and then with the maxilla. Thinner and weaker attachments occur with the sphenoid and through the zygomatic arch. The bone furnishes attachments for the masseter, temporalis, zygomaticus major and minor, and the zygomatic head of the quadratus labii superiorus muscles. The temporal fascia attaches to the sharp superior border of the arch, while the masseter muscle and fascia attach to the inferior border of the arch. The broad attachment of the masseter produces the major deforming force on the zygomatic body and arch when fractured. The zygomaticotemporal and zygomaticofacial nerves pass through zygomaticotemporal and zygomatico facial foramena respectively, to innervate the soft tissues over the region of the zygomaticofrontal junction and malar eminence. In 1944, Ungley and Suggit coined the phrase **"zygomatic tripod"**, yet the zygoma is more properly called a **"tetrapod"** because of its attachment to the sphenoid.

Methods and Materials

This prospective clinical study was conducted in the department of Plastic & Reconstructive Surgery, Gandhi Medical College & Gandhi Hospital, Secunderabad, Andhra Pradesh. Total of 13 patients who reported in the Department of Plastic & Reconstructive Surgery with clinical and radiological evidence of unstable and displaced tripod fracture of zygoma.

Inclusion Criteria

Displaced tripod fracture of zygoma (with or without associated maxillofacial fractures) as seen clinically and radiologically (3D CT). Patients above 18 years of age. Presentation within 15 days of injury.

Exclusion Criteria

Associated fractures of maxilla, frontal bones which can destabilise mid facial skeleton. Bilateral displaced fractures of zygoma. Comminuted fractures of zygoma. Zygoma fractures with visual disturbances. Patients medically unfit for surgery or to undergo general anaesthesia. Foreseeable missing opportunity of follow up examination.

Investigations: Complete surgical profile for fitness for anesthesia: CBP, ESR, RBS, Blood urea, Serum creatinine, Viral screening, ECG & Chest X-ray depending on the requirement. *Radiographs*: Pre operative 3D-CT , Post operative Water's view skull. Patients were taken up for surgery under General Anestheisa .

Surgical Technique

Under aseptic conditions local infiltration with normal saline with 1:1,00,000 adrenaline was injected at the lateral portion of an upper eye brow. Incision (<1 cm) is made directly over the Z-F suture 8–10 mm above the lateral canthus. Palpating the frontal process of the zygoma between the thumb and index finger, the frontal process can be marked precisely in *eyebrow* skin. The incision should be short and not progress laterally out of eyelid skin, as it will make the scar noticeable. Alternately, the Z-F suture may be approached through a brow laceration, if one is already present. Fracture site is identified. Subperiosteal dissection is done. Zygoma is fully mobilised.

An elevator is passed deep to the frontal process of the zygoma to reach inner aspect and the fragments mobilized to get proper reduction. After the anatomical reduction at ZF region & rotational deformity correction is confirmed, the ZF suture region is stabilized with stainless steel plate of 1.5 mm size (2/3/4 holed plates) and screws (1.5 mm x 8mm) depending on the comminution at ZF.

Post-Operative Care

The surgical wound is left open with healex spray. The area over the malar bone is marked with methylene blue & the patient is advised not to apply pressure over the malar region and not to sleep over the area . The patient is advised liquid & semi solid diet for the first 2 weeks.

Follow Up

Patients were called on 5th day for suture removal and 2 weekly interval till the end of 3 months for follow-up and evaluated for the following parameters. All patients were evaluated clinically. Radiological aid (waters view of skull) was taken at the end of 3 months of follow up to assess the pattern of union & reduction.

Clinical Parameters

Pain at the operation site. Infra orbital nerve paresthesia. Step deformity of infra orbital margin. Mouth opening. Enophthalmos. Stability of zygomaticomaxillary complex. Malar symmetry.

Radiological Parameters

Haziness of the maxillary sinuses. Congruity of infra orbital margin.

Malar Asymmetry

Grading of malar asymmetry was done post operatively by clinical examination using the classification system proposed by Holmes and Mathews [6]. Each patient was assigned to one of the following grades.

Grade I: Excellent cosmetic result, no malar asymmetry,

Grade II: Good cosmetic result, malar asymmetry on careful inspection,

Grade III: Poor cosmetic result, noticeable malar asymmetry,

Grade IV: Gross malar asymmetry.

Haziness of Maxillary Sinus

This was assessed post operatively by checking for radio opacity of the maxillary sinus on affected side on Water's view radiograph.

Accuracy of Anatomic Reduction

This was assessed intra-operatively by palpation of the zygomaticomaxillary complex after reduction and fixation.

Post-Operative Stability of the Zygomaticomaxillary Complex

It was assessed clinically by extraoral examination and palpation and by radiographic examination on Water's View.

Results

This is a prospective study done to evaluate the efficacy of single point fixation in tripod fractures of zygoma between august 2012 and February 2014. 13 patients were evaluated.

All of the patients were male & they suffered injury in road traffic accident. All patients were aged between 18-38 yrs but majority were between 18 to 25 years age

Table 1: Shows side distribution of fratures

Fracture Side	Number of cases	Percentage
Right Side	7	54%
Left Side	6	46%

Table 1 shows 7 (54%) patients sustained fracture on right side and 6 (46%) patients suffered left side fracture

Table 2: Shows frequency of fractures

Fracture Type	Number of cases	Percentage
Isolated tripod fractures	10	77%
Associated Fractures	3	23%

Table 2 shows that all patients have isolated tripod fracture zygoma, except 3(23%) patients who have associated frontal, mandibular fractures. 10(77%) suffered isolated tripod fractures.

Table 3 shows frequency of compound fractures

Fracture Type	Number of cases	Percentage
Compound	7	53%
Simple	6	47%

Table 4: Shows type of miniplates (2 mm, stainless steel) used

Miniplate Type	Number of cases	Percentage
3 holed plate	9	69%
2 holed plate	3	23%
4 holed plate	1	7%

group. Figure 1 shows side distribution of fractures.

Table 3 shows 7 (53%) patients were classified as having Group 4 fracture (Medially rotated fractures), 3 (23%) patients were having Group 5 fracture (Laterally rotated fracture), 2 (15%) patients were having Group 6 fracture (Complex fracture) , 1 (7%) patient was having Group 3 (Undisplaced body fracture)fracture as per Knight and North classification. The rotation was noticed on 3D CT, apart from clinical evaluation. Fixation of zygoma in 8 patients was done within 7 days.

Table 4 shows 9 (69%) patients were treated with 3 holed, 1.5mm stainless steel plate & 2mm x 8mm stainless steel screws. In 3 (23%) patients we used 2 holed,1.5mm stainless steel plate. In 1 (8%) patient we used 4 holed, 1.5mm stainless steel plate.

Average operation time was 50 min. (Least time 40 mts. Longest time 80 mts.) There were no major immediate post op complications. There was no clinically detectable infra orbital step in any patient There was no enophthalmos in group III fractures. On post operative waters view x-rays only 5 (38%) patients were showing downward displacement of infra orbital margin, 6 (46%) patients did not show any displacement. 2 (15%) patients in fact had elevated infra orbital margin. There was no infraorbital step in any group III patients, with some lowering of infra orbital margin of around 2mm in group IV in 3 (23%) patients. 2mm of infra orbital margin displacement is observed in 1 (8%) patient with group VI fracture. 4 (30%) patients showed enophthalmos. 2 (15%) patients showed noticeable malar asymmetry. 6 (46%) patients showed no malar asymmetry. 5 (38%) patients were classified as having Grade 2 malar asymmetry detectable only on careful inspection.

6 (46%) patients developed infraorbital hypoesthesia. None of the patients had clinically detectable unstable zygomaticomaxillary complex. 5 (38%) patients have shown haziness of maxillary sinus in waters view on follow up. No patient developed any major late post operative complications and there were no visual disturbances. Patients were able to get full range of mouth opening towards the end of second month.

Discussion

Zygoma is one of the commonly fractured bone which can occur in isolation or as a part of panfacial fractures. Main cause of fractures is road traffic accidents & can occur with other causes like assaults, blows or fall from height. It is essential to treat these fractures and restore the pre-injury state as the zygomatic complex is closely associated with other

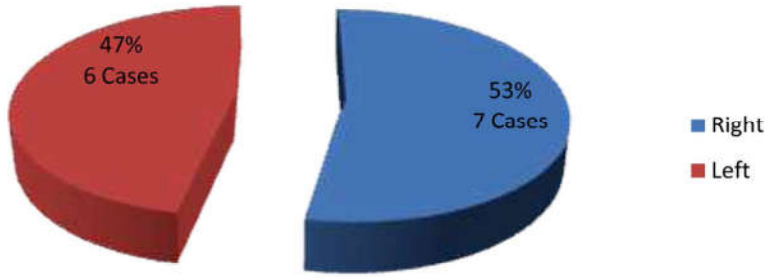

Fig. 1: Shows side distribution of fractures

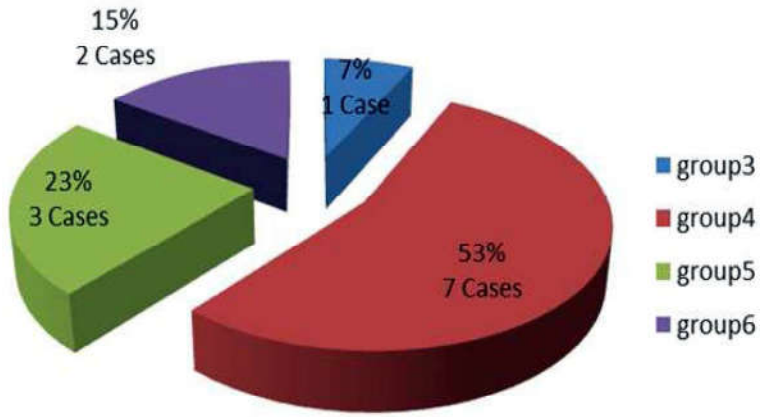

Fig. 2: Shows distribution of fractures by knight and north classification

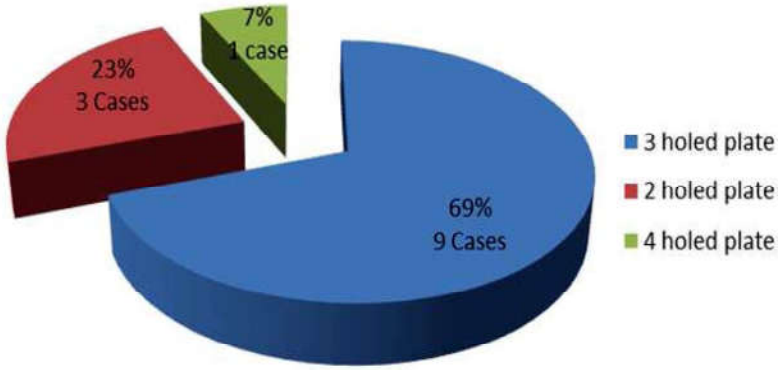

Fig. 3: Shows type of miniplates (2 mm, stainless steel) used

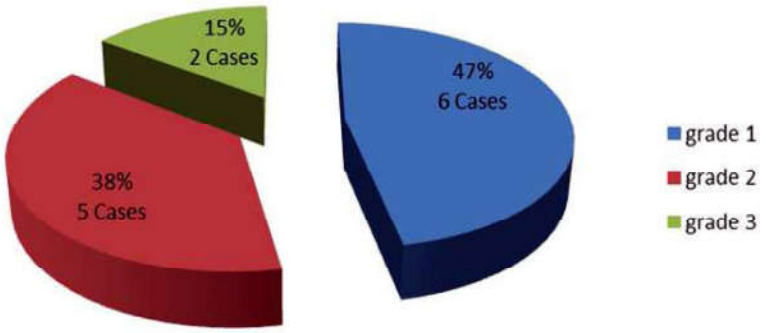

Fig. 4: Shows number of cases of malar symmetry

facial bones and trauma to this region can cause significant alteration in structure and function including ocular disturbances. Improper reduction could result in malar asymmetry, dystopia, enopthalmos,malocclusion, restricted mouth opening, infra orbital step deformity.

At first, treatment consisted of reducing the body of the malar bone, which was approached via the (a) gingivobuccal sulcus; (b) maxillary antrum; (c) nose; or (d) skin over the malar prominence. Today there is a paradigm shift in the management of zygomatic complex fractures from conservative to surgical. For unstable, displaced fractures of the zygomatic complex, open reduction and internal fixation using miniplates was found to efficiently stabilize the complex with minimal complications. However the precise stability of the complex with reference to the number of fixation points as well as the sites of rigid fixation still remain a topic of debate. In a tertiary center like ours where we have major work load with burns , compound limb trauma & facio maxillary trauma, with limited infrastructure resources & limited supply of implants, we wanted to assess whether the single point fixation would give satisfactory results in achieving the functional & aesthetic outcomes. Closed reduction, though have given reasonable results, there was an urge amongst us to improve upon the results, but with constraints of time, theater facility & implants which prevented us from using implants on all three buttresses as is the practice of-late. It is this reason that we have proceeded with the study of evaluation of single point fixation of tripod fracture zygoma.

This is a prospective study to evaluate the effectiveness of single point fixation in achieving optimal

functional & aesthetic outcomes done between august 2012 and February 2014. 13 patients were taken up for the study. All patients were the victims of road traffic accidents. Patients were evaluated medically and decided to take them up for single point fixation at zygomaticofrontal suture region as this is the major & main weight bearing buttress of the zygoma. As we are having major work load of faciomaxillary trauma, with limited resources we planned single point fixation with reasonably short operative time. (Average operative time is 53 min). Though >50% (7 cases) were having compound fractures, no patient developed post operative infections. Post operatively after 3 months, none of the operated patients showed infra orbital step. Radiologically too infra orbital step was not noticeable in many (6 cases) patients. Enophthalmos developed in around 30% (4) of cases . Mouth opening achieved in all patients was >3cm .Attaining mouth opening may be a factor related to the duration after surgery & adequacy of operative correction. Even group 6 patients have got Grade 1 malar asymmetry after single point fixation. Treatment of associated fractures simultaneously did not affect the outcome after single point fixation. Through single point fixation of frontozygomatic buttress using either 2,3 or 4 holed mini plates & screws malar symmetry achieved with most not having any noticeable asymmetry of malar bones on clinical examination. Infraorbital step was not noticed in many (11 cases) of the above patients. Patients operated beyond one week too developed good malar symmetry. Patients operated upon with group 6 fracture too were quiet satisfied with the eventual outcome of function & cosmesis. Associated fractures did not mandate any deviation from the procedure of single point fixation as the outcome even in them was quite satisfactory. The role of single point fixation perhaps does not give any scope for any argument in group 3 fractures as has been proved by near perfect outcomes in the study. Single point fixation in groups 4 & 5 has given fairly reasonable results with some amount of enophthalmos is the deterrant in perhaps declaring that this could suffice in all types of zygoma fractures. Our study correlates with other studies [6-13].

Conclusion

It can be concluded that single point fixation has a definite place in the management of tripod fractures of zygoma with minimal to moderate displacement of infraorbital margin, group 6 fractures where internal fixation is difficult and comminuted infraorbital margin fractures.

References

1. Selected readings in plastic surgery, facial fractures I, Upper two thirds p1-7.
2. Grabb and Smith's Plastic Surgery. Sixth edition by Charles H Thorne, pages 321,322.
3. Last's Anatomy-Regional and Applied tenth edition, 2006.
4. Neligan's Plastic surgery, 2nd edition, Volume 3, p64-68.
5. Peterson's Principles of Oral and Maxillo-facial Surgery. Second Edition p445-460.
6. Atul Parashar, Ramesh K. Sharma, Surinder Makkar. Rigid internal fixation of zygoma fractures: A comparison of two-point and three-point fixation. Indian J Plast Surg January-June 2007 Vol 40 Issue 1.
7. Balasubramanian Thiagarajan, Faciomaxillary Trauma an update; February 7, 2013.
8. Kim JH, Lee JH, Hong SM, Park CH. The effectiveness of 1-point fixation for zygomaticomaxillary complex fractures. Arch Otolaryngol head neck surgery. 2012;138(9):828-832.
9. Paulo Norberto Hasse, Cristiano Walter Gealh, Cassiano Costa Silva Pereira, Luiz Francisco Coradazzi, Osvaldo Magro Filho, Idelmo Rangel Garcia Junior; Clinical radiographic evaluation of surgical treatment of zygomatic fractures using 1.5 mm miniplates system; 2011.
10. Nyachhyon P, Kim PC; Intraoperative stereotactic navigation for reconstruction in zygomatic orbital trauma; Journal of Nepal Med Assoc; 2011 Jan-Mar; 51(181):37-40.
11. Hwang K., One-point fixation of tripod fractures of zygoma through a lateral brow incision, J Craniofac Surg. 2010 Jul;21(4):1042-4.
12. Suresh Menon, Ramen Sinha, Tapas Bandyopadhyay; Management of zygomatic complex fractures in a tertiary hospital: A retrospective study; Journal of maxillofacial and oral surgery; 2011 Apr-June; 10(2):138-141.
13. Seon Tae Kim; Comparison of 1-point fixation with 2-point fixation in treating tripod fractures of the zygoma; Journal of maxillofacial and oral surgery; 2011 Jun 12;69(11):2848-2852.