Efficacy of two-point fixation in the management of zygomatic complex fractures – A prospective clinical study

ABSTRACT

Introduction: Anatomic disfigurement caused by zygomatic fracture warrants intervention to restore facial symmetry. It is most predictably restored to pre morbid condition by ORIF.

Aim: To evaluate the efficacy of 2 point fixation in Zygomaticomaxillary complex fractures.

Material and Method: 20 patients with established ZMC fractures were operated using two point fixation method and followed up for upto 3 months.

Results: 2 point fixation revealed satisfactory functional and esthetic results.

Conclusion: 2 point fixation offers efficient outcome as compared to other modalities of management of ZMC.

Keywords: Orbitozygomatic fracture, two-point fixation, zygomatic complex fracture

INTRODUCTION

Fractures of the facial bones have been recognized for a long time, and attempt to treat such fractures has been recorded as far back as 25–30 centuries BC. Zygomaticomaxillary complex (ZMC) fractures are common after maxillofacial injuries. The various causes of fractures are trauma due to road traffic accidents, assaults, falls, sports-related injuries, and the civilian warfare. The zygomatic arch, a laterally positioned element of the craniofacial skeleton comprised the zygoma and temporal bone, is susceptible to local trauma. Isolated zygomatic arch fractures comprise about 10% of all zygomatic fractures and result in noticeable depression at the arch fracture site. There may be impingement of the fractured arch on the coronoid process, resulting in limited mouth opening.

Precise repair of fracture of the orbital zygomatic complex requires four essential features: a thorough understanding of the regional anatomy, an accurate and precise diagnosis, an unimpeded exposure, and a rigid fixation of fracture to restore premorbid form. Although the zygomatic arch may be fractured in isolation, more commonly it is associated with complex orbital maxillary zygomatic and midface fractures. If the horizontal and vertical buttresses of the orbital ZMC and orbital floor are not properly aligned, a variety of sequelae can occur; including enophthalmos, diplopia, rotational zygomatic displacement, orbital dystopia, and midface widening. All of these conditions are difficult to address with revision.

Gaurav Mittal, Ritesh Garg, Siddharta Sharma, Vidhi Chhabra Rathi, Rakesh Ranjan, Gagan Khare
Department of Oral and Maxillofacial Surgery, Institute of Dental Studies and Technologies, Modinagar, TMU, Moradabad, Uttar Pradesh, India
Address for correspondence: Dr. Gaurav Mittal, Institute of Dental Studies and Technologies, NH 58, Kadrabad, Modinagar, Uttar Pradesh, India.
E-mail: drgauravmittal@rediffmail.com
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A comprehensive management should aim at achieving high-quality reduction and adequate and stable fixation of the fractured zygomatic complex fractures. Three-point fixation is associated with more extensive periosteal stripping, extreme retraction of bone edges, and requirement of expert assistance for the application of miniplate across the zygomaticomaxillary buttress. In addition, longer operative time, presence of more hardware, and increase in the cost of surgery are some disadvantages. After reviewing the advantages and limitations of various fixation techniques, a sincere effort has been made in the form of a prospective clinical study to manage ZMC fractures with this technique and its efficacy is evaluated in the larger interest of the patients.

MATERIALS AND METHODS

This study was conducted to evaluate the efficacy of two-point rigid internal fixation using conventional miniplates and screws for ZMC fractures. Fixation will be done at the frontozygomatic suture and zygomatic buttress region using lateral eyebrow and intraoral approach, respectively. After both clinical and radiological verification of fractures at the frontozygomatic, zygomatic buttress and infraorbital rim, miniplates will be applied at the two points as decided. Subsequently, both clinical and radiological assessment was performed for functional stability and alignment of fracture fragments respectively.

A prospective clinical study was carried out on twenty patients with confirmed clinical and radiographical diagnosis of ZMC fracture reported to the Department of Oral and Maxillofacial Surgery, Institute of Dental Studies and Technologies, Kadrabad, Modinagar, Uttar Pradesh, India. Patients with comminuted zygomatic fracture or compromising medical history were excluded from the study. Postoperatively, follow-up was recorded at the 1st, 3rd, and 6th weeks. An informed consent was taken from each of them. Patients were assessed clinically and radiographically at different intervals. All the data were analyzed by SPSS version 19 statistical package, and Shapiro–Wilk test was used for assessing the distribution of all parameters.

The following parameters were focused on:

- Vertical dystopia analysis: Vertical dystopia will be measured preoperatively and postoperatively. The area of reduction and fixation. The patients were usually

Surgical approach

Under general anesthesia, nasal intubation was done after standard painting and draping, local anesthesia was infused into the upper buccal sulcus in the region of the second molar tooth, and a horizontal incision was made in the buccal vestibule for a distance of approximately 4 cm over the zygomatic buttress. A Howarth’s periosteal elevator was passed supraperiosteally under the zygoma which helps in exposure of fracture site. At times, cautery was used during dissection to achieve a bloodless field. The fracture type, pattern, and displacement were assessed both in the zygomatic buttress reason and the infraorbital rim. Then, a local anesthesia with a vasoconstrictor was injected into the subcutaneous tissues over the lateral orbital rim to aid in hemostasis. Lateral eyebrow incision was placed, and then, the fracture site was visualized and assessed in the frontozygomatic region. Adequate exposure of the fracture segments was obtained. A Howarth's periosteal elevator was then placed under the zygomatic bone and manipulated in order to achieve anatomical reduction which was verified again by palpating the infraorbital margin and the frontozygomatic suture. Then, 1.5-mm stainless steel miniplate was placed along fracture line at the frontozygomatic suture region followed by 2.0-mm L-shaped stainless steel miniplate placed along fracture line at the zygomatic buttress region [Figure 1]. The area was irrigated with povidone-iodine and saline. Wound was closed in layers followed by application of an adhesive nonpressure bandage at the lateral eyebrow region. The intraoral incision was closed with resorbable sutures. Postoperatively, intravenous antibiotics were prescribed to a patient for 5 days. Submentovertex view was taken on the immediate postoperative day to check the adequacy of reduction and fixation. The patients were usually

Figure 1: L-shaped miniplate with 2 mm × 6 mm screw and four holes with gap miniplate with 1.5 mm × 6 mm screw and armamentarium for open reduction and internal fixation of zygomaticomaxillary complex fractures
Mittal, et al.: ZMC fracture: Two point fixation

RESULTS

In our study, all the patients were treated with open reduction and internal fixation under general anesthesia with two-point fixation using the stainless steel miniplate of size 2.0-mm thickness on zygomaticomaxillary buttress and 1.5-mm miniplate on frontozygomatic suture. This study was assessed by various clinical parameters such as vertical dystopia and malar height.

This study was conducted on twenty patients with clinical and radiographically confirmed diagnosis of frontozygomatic suture and zygomaticomaxillary buttress fractures who reported to the Department of Oral and Maxillofacial Surgery, Institute of Dental Studies and Technologies, Modinagar, Uttar Pradesh, India, and was assessed according to the set criteria. All the data were analyzed by IBM SPSS Statistics version 19 (IBM, Trialware, Stanford, California, USA) statistical package, and Shapiro–Wilk test was used for assessing the distribution of all the parameters.

Mean malar height
Preoperatively, mean malar height ± standard deviation of the patients recorded was 66.45 ± 4.67. Postoperatively, at the 1st week, value recorded was 69.55 ± 4.24, but in the 3rd and 6th weeks, it was the same, i.e. 69.10 ± 4.35 [Figure 2]. There was a significant increase in malar height postoperatively (P < 0.0001).

Mean vertical dystopia
Preoperatively, mean vertical dystopia ± standard deviation of patients recorded was 2.85 ± 1.27. At the 1st, 3rd, and 6th weeks postoperatively, 0.28 ± 0.55 value recorded was the same [Figure 3]. Postoperative resolution of vertical dystopia was statistically significant (P<0.0001).

DISCUSSION

Two-point fixation has been quoted by many authors in the English literature, but very few have applied it clinically and have highlighted its advantages. Two-point fixation has been used sporadically by few surgeons predominantly for fixation of the ZMC region at frontozygomatic suture and zygomatic buttress. The aim of this study was to examine the long-term results of primary repair of ZMC fractures and to develop the useful guidelines for treatment plan based on this experience. Thereby using various parameters at definite intervals, we intended to assess the efficacy and the stability of two-point fixation in the management of isolated unilateral displaced ZMC fractures.

Reduction and anatomically correct realignment of displaced fragments are most easily accomplished before the onset of early bone healing (fibrosis). Delay past the time that allows for osseous malunion means that a refracture or osteotomy will be needed for movement of the displaced skeletal segments. Configuration of soft tissue is dependent on the position of underlying or adjacent bone. The anatomically realigned facial skeleton returns the soft-tissue structures to their normal configuration and supports them during healing. Healing over untreated or incompletely reduced fractures may result in critical contracture with permanent thickening, shortening, and displacement of the soft-tissue structures. Delayed or secondary repair of both bony and soft-tissue defects is more challenging and its results are less satisfying than primary reconstruction owing to the consequences.
of allowing the natural healing process to proceed before repair is completed. Reoperation through scar tissue that has resulted from previous surgical approaches increases the risk of iatrogenic complications such as lid retraction or ectropion. The benefits of early, comprehensive surgical intervention may be outweighed by complicating factors including ocular and central nervous system injuries or an overall unstable medical condition in a patient with the multiple traumas. After 3 weeks of trauma, bone healing and resorption begin to take place and this period has been referred to as gray time zone.[4]

The surgical treatment of zygomatic fracture varies from surgeon to surgeon and also depending on the type of fracture and circumstance. The intraoral maxillary vestibular approach and lateral eyebrow were used in this particular study.

According to a study done by Ellis and Kittidumkerng who studied a variety of surgical approaches, the maxillary vestibular approach was used more frequently, either alone or in combination with other approaches. The next frequently used approach was through the lower eyelid. Complications associated with maxillary vestibular approach were not significant, and approximately 20% of those having lower eyelid approach had some amount of scleral show.[5]

In our study, the lateral brow incision was the second approach used after exposing the fracture site in zygomaticomaxillary buttress region. It provided a supportive role for maxillary vestibular approach in the management of ZMC fractures, by aiding in exposure, reduction, and stabilization of the displaced ZMC.

In a study conducted by Pozatek et al., the predominant approach was through the lateral eyebrow approach. In this study, various surgical approaches to the fractured zygomatic complex were discussed. According to their data many fractures were unstable after reduction. They concluded that the lateral eyebrow approach with internal wire fixation if necessary was used as the initial surgical approach in the management of zygomatic complex fractures.[6] Chuong and Kaban in their study recommended the lateral eyebrow approach for the initial access to the zygomatic complex fractures as it has the advantage of producing an inconspicuous scar and providing direct access to the zygomaticofrontal region for fracture reduction and fixation. No specific complications were reported and it provided a better long-term esthetic result.[7]

This was similar to our study where lateral eyebrow was the second prime approach in 100% of cases. Parasher in his study compared three-point fixation versus two-point fixation and found that in addition to longer operative time, the presence of more hardware and the increase in the cost of surgery are also some of the disadvantages associated with fixation across an additional point.[8]

In 1990, Davidson et al.[9] analyzed different methods of internal fixation of simple displaced fractures of the zygoma in an attempt to define the simplest method of achieving postreduction stability. In their report, the three-point fixation (frontozygomatic suture, inferior orbital rim, and zygomaticomaxillary buttress) using either miniplates alone or interfragmentary wiring conferred the greatest stability. In addition, they proposed 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.[10]

The results of study conducted by O’Hara et al. confirmed that the best site for rigid fixation is the zygomaticomaxillary buttress since this is the direct antagonist to pull of the masseter muscle along with the fact that fixation placed was deep and plates were rarely felt in that area, and therefore, a longer and stronger fixation plate could always be used in this site. The infraorbital rim though one of the points of fracture that requires reduction is the least important site for fracture fixation. Similarly, frontozygomatic suture line represents very thick bone which was ideal for rigid fixation.[11] Hence, we conducted a study on two-point fixation to further evaluate the treatment outcome in terms of esthetics, function, stability, and incidence of complication.

Vertical dystopia was measured as difference in the level of bony orbits while malar height was measured from vertex view comparing fractured site with normal site. According to Parashar et al., the mean vertical dystopia in Group 1, i.e. two-point fixation was 2.05 mm and in Group 2, i.e. three-point fixation was 0.81 mm, which was statistically significant, while the mean deficit in malar height in Group 1 patients was 3.74 mm while this parameter in Group 2 patients was 1.68 mm, which was also statistically significant.[8] A similar study was conducted by Rana et al. with average malar height in two-point fixation being $66.72 \pm 3.62$ mm with minimum and maximum value of 59 mm and 75 mm, respectively, while average malar height in three-point fixation being $68.26 \pm 3.76$ mm with minimum and maximum value of 60 mm and 74 mm, respectively. Average vertical dystopia in two-point fixation was $3.18 \pm 1.003$ mm with a range of 4 mm and in three-point fixation, average vertical dystopia was $2.36 \pm 1.102$ mm with a range of 3 mm.[12] In our study, preoperatively, mean
malar height was 66.45 ± 4.67 mm, while postoperatively, mean malar height was 69.10 ± 4.35 mm, which was significantly increased postoperatively. Preoperatively, mean vertical dystopia was 2.85 ± 1.27 mm, while postoperatively, mean vertical dystopia was 0.28 ± 0.55 mm, which was also statistically significant.

The management of facial trauma has undergone a revolution in last decade because of the introduction of improved surgical approaches and the plating systems.[7] Similarly management of ZMC fracture has evolved from multiple point fixation to single point fixation. Choice of fixation being single- or multiple-point fixation depends on the surgeon expertise. The disadvantage of doing single-point fixation is that it fails to address the three-dimensional rotation in ZMC fractures, and on the other hand, three-point fixation has complication of potential infection, scar, and nerve palsy.[8]

CONCLUSION

In our study, all twenty patients were treated with two-point fixation, and results were satisfactory in terms of both esthetics and function. This technique also served an additional advantage over the elimination of external scar at infraorbital rim and complication associated with it. Our study provides a basis for more research with larger samples and long follow-ups to further prove the efficacy of two-point fixation over single- and three-point fixation techniques.

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Conflicts of interest
There are no conflicts of interest.

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