

**A comparison of two point versus three point fixation of displaced Zygomaticomaxillary complex fractures – A randomised prospective clinical trial**

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**Type of Publication:** Case Report

**Conflicts of Interest:** Nil

**Abstract**

**Introduction:** The Zygomaticomaxillary complex (ZMC) functions as the principle buttress of the face and is the cornerstone to an individual’s aesthetic appearance. Road traffic accidents, assaults and falls are the common causes leading to fracture of the zygomatic bone. ZMC fracture presents a challenging diagnostic and reconstructive task to the oral and maxillofacial

surgeon. However, surgical intervention is not usually taken up unless a functional or aesthetic impairment such as infra orbital paresthesia, visual and ocular disturbances, malar flattening, deranged occlusion and restricted mouth opening is noted. Treatment modality is based on the type and severity of the fracture. Numerous methods have been advocated for the treatment of ZMC fracture; one of the debatable topic is the amount of

fixation required to accurately stabilize and prevent the displacement of ZMC post operatively.

**Aim And Objectives:** The purpose of this study to compare and assess the advantages, efficacy and aesthetic consideration in two point mini plate fixation versus three point mini plate fixation for the displaced zygomatic complex fractures.

**Methods:** The study included 2 groups of 10 patients each with zygomatico-maxillary complex fracture referred to Department of Oral and Maxillofacial Surgery, P.M.N.M. Dental College and Hospital, Bagalkot.

Preoperative, anaesthetic premedications and other routine preparations for general anesthesia was done. After administration of general anesthesia, preparation of surgical site was done followed by, reduction of fracture sites. open reduction and internal fixation (ORIF) with Two Point Miniplates Fixation was done by using frontozygomatic approach and zygomaticomaxillary buttress fixation. Three Point Miniplates Fixation was done using fronto zygomatic approach, zygomaticomaxillary buttress and Infraorbital approach depending upon the clinical situations.

Patients were discharged from the hospital after 5 days following surgery. All the patients were put on post op medications for 7 days. Patients were recalled for review at regular intervals of 1 week, 1 month and 3 months respectively to examine infra orbital nerve status, wound healing, facial symmetry, esthetic, stability and functional evaluation.

**Results:** All patients maintained better stability at fracture sites resulting in decreased incidence of dystopia, enophthalmos and paresthesia of infraorbital region without any complications in the three point fixation group as compared to two point fixation group.

**Conclusion:** We conclude that with limited period of

follow up three point miniplate fixation yields promising results in management of isolated and minimally displaced ZMC fractures in terms of postoperative stability, aesthetics, resolution of infraorbital paresthesia, less operative time and prevents post reduction rotation or clinical displacement in comparison to two point mini plate fixation.

**Keywords:** two point fixation; three point fixation; zygomaticomaxillary complex, frontozygomatic suture; zygomaticomaxillary buttress; infraorbital rim.

### **Introduction**

The face occupies the most prominent position in the human body rendering it vulnerable to injuries quite commonly. The prominence of the Zygomatico-Maxillary Complex (ZMC) region predisposes it to bearing the brunt of the facial injuries. Because of its position, it is the second most common mid-facial bone fractured after the nasal bones and overall represents 13% of all craniofacial fractures<sup>1</sup>

However, ZMC is very vulnerable to injury because of its intrinsically prominent convexity. When blunt trauma to the ZMC results in fractures of all four suture lines, it is referred to as a tetrapod fracture<sup>2</sup>.

The fracture of the ZMC can result in restricted mouth opening due to impingement on the coronoid process. Disruption of the zygomatic position also carries psychological, aesthetic and functional significance, causing impairment of ocular and mandibular function. Therefore, for both cosmetic and functional reasons, it is mandatory that ZMC injury is properly diagnosed and adequately managed<sup>3</sup>.

### **Materials and Methods**

In this study, twenty patients reporting with the minimally displaced zygomatico-maxillary complex fracture operated in Department of Oral and Maxillofacial Surgery were considered.

### Inclusion Criteria

- Fracture of the ZMC as evidenced on radiography [Waters view, Sub-mento vertex view, Paranasal sinus (PNS) view and Computed tomography (CT) Scan of Face with or without 3D reconstruction]
- Medically fit patient for Surgery under general anesthesia

### Exclusion Criteria

- Medically compromised patients for surgical procedure under general anesthesia
- Associated fractures of the other facial bones
- Bilateral displaced fracture of ZMC

### Study Method

It includes following four steps:

- Pre-operative preparation of the patients
- Surgical procedure
- Post-operative care and assessment
- Follow up of the Patients.

### Operative Technique

General anaesthesia was administered and nasoendotracheal intubation was done. The surgical site was scrubbed with Cetremide 2% followed by 70% ethyl alcohol and painted with 5% povidone iodine. Draping of the patient was done keeping the surgical site exposed.

The incision was marked, Local anaesthesia i.e 2% lignocaine with adrenaline (1:80,000) was injected into subcutaneous tissue

The following incisions were used-

1. Lateral eyebrow incision for FZ suture region
2. Infraorbital incision for infraorbital rim region exposure
3. Maxillary vestibular incision for exposure of zygomatico-maxillary buttress region exposure

After obtaining informed consent, all patients underwent ORIF of the fractured segments at two point and three

point respectively using titanium miniplates of 1.5 mm with 1.5 x 6 mm or 1.5 x 8 mm screws under general anesthesia for the same.

ORIF with Two Point Miniplates Fixation was done by using zygomaticofrontal approach and zygomaticomaxillary buttress fixation and Three Point Miniplates Fixation was done using frontozygomatic approach, zygomaticomaxillary buttress and Infraorbital approach, depending upon the clinical situations

Postoperatively, all patients were kept on a standard drug regimen for 5 days. Pressure bandage was removed after 48 hours; alternate skin sutures were removed on 5th postoperative day.

### Follow up of patients

The patients were followed up on 1<sup>st</sup> week, 1<sup>st</sup> Month and 3<sup>rd</sup> Month postoperatively. Radiological evaluation was done post operatively with PNS X-ray at 3rd Month.

### Parameters for Evaluation

#### Clinical Parameters:

#### Facial Symmetry<sup>4</sup>.

#### Surgeon's evaluation score

-1 points: marked asymmetry of the face

0 points: mild asymmetry

1 points: no asymmetry

#### Self-evaluation score

-1 points: not pleased with appearance

0 points: not fully pleased with appearance

1 points: pleased with appearance

#### Limited Mouth Opening

According to Maxillofacial injury severity score<sup>5</sup>.

0- mouth opening range more than 3.7cm

1 - mouth opening range 2-3.7cm

2 - mouth opening range less than 2 cm

Photographs - Aesthetic Assessment

Proposed by Holmes and Mathews<sup>6</sup>.

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.

Radiographic Evidence Of Healing<sup>7</sup>.

0 points: no evidence of osteosynthesis or union

1 points: osteogenesis (external & internal callus)

2 points: union

Complications<sup>4</sup>

0 points: without complication

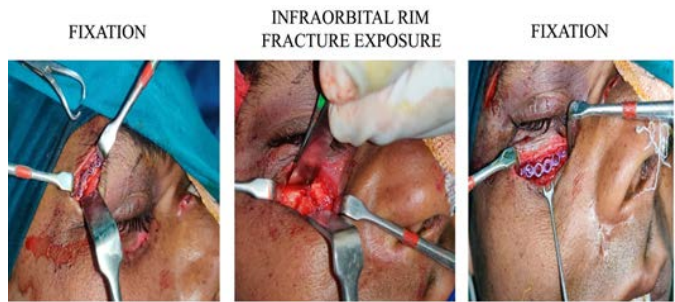
-1 points: soft tissue infection

-2 points: trismus 3 months after treatment

-3 points: mobile fracture fragments 6 weeks after treatment

-5 points: bone infection

Globe abnormalities (dystopia and enophthalmos) were recorded by the same investigator.



F-Z FIXATION                      MAXILLARY BUTTRESS FIXATION



POST OP PROFILE                      POST OP OCCLUSION

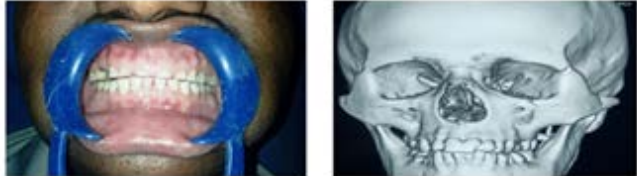


POST OP X-RAY PNS

CASE: POINT FIXATION  
LEFT SIDE ZYGOMATICOMAXILLARY COMPLEX FRACTURE  
TREATMENT - OPEN REDUCTION AND INTERNAL FIXATAION

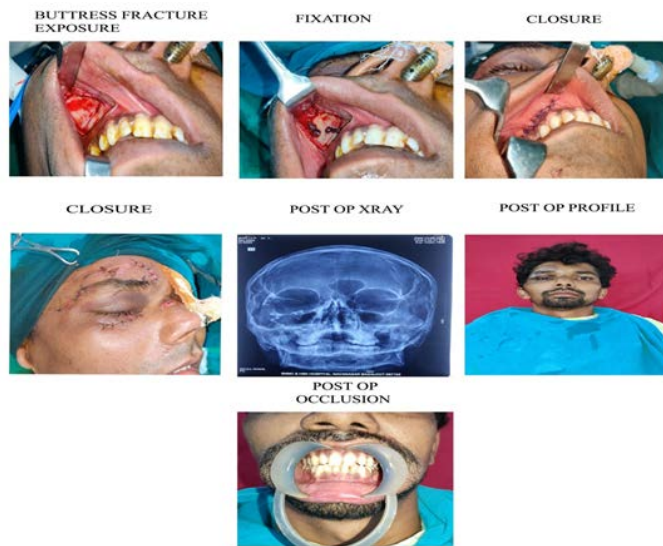


PRE OP PROFILE                      PRE OP PROFILE



PRE OP OCCLUSION                      3D CT RECONSTRUCTION

**CASE: 1 POINT FIXATION  
RIGHT SIDE ZYGOMATICOMAXILLARY COMPLEX FRACTURE  
TREATMENT - OPEN REDUCTION AND INTERNAL FIXATAION**



**Results**

After clinical and radiographic examinations, 20 patients with minimally displaced unilateral ZMC fractures were selected and divided into two groups of two-point fixation and three-point fixation. Age group range of patients in our study was (18-55 years). The mean age group for two point foixation was 28.2+/-9.03 years while mean age group in three point fixation was 36.3+/-9.88 years. The most common etiological factor was road traffic accidents (RTA) with 65% incidence followed by fall (20%) and assault (10%). 60% of the patients had fracture on the right, while 40% of the patients were having fracture on the left side. Estimation IT-DF interval of patients is summarized in Table 1.

Table 1: Comparison of two groups (2 points and 3 points) with pain scores at different treatment time points by Mann-Whitney U test.

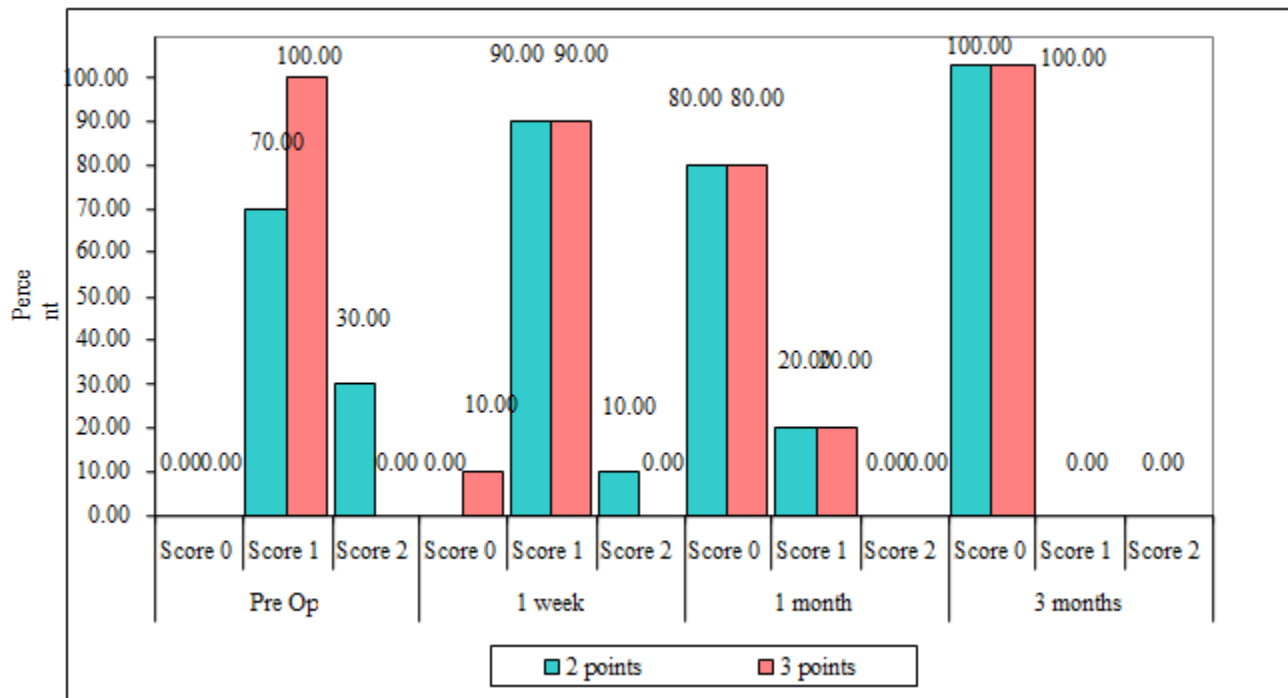
| Treatment time | 2 points group |    | 3 points group |    | Total |    | Z-value | p-value |
|----------------|----------------|----|----------------|----|-------|----|---------|---------|
|                | Yes            | No | Yes            | No | Yes   | No |         |         |
| 1 week         | 10             | 0  | 9              | 1  | 19    | 1  | -0.3780 | 0.7055  |
| 1 month        | 5              | 5  | 4              | 6  | 9     | 11 | -0.3780 | 0.7055  |
| 3 month        | 1              | 9  | 0              | 10 | 1     | 19 | -0.3780 | 0.7055  |

In this study, about 95% of patients in both the groups had pain upon palpation over the operated sites at 1st week of post operatively.

Comparison of the inter incisal mouth opening in this study among the two groups is shown in figure 1.

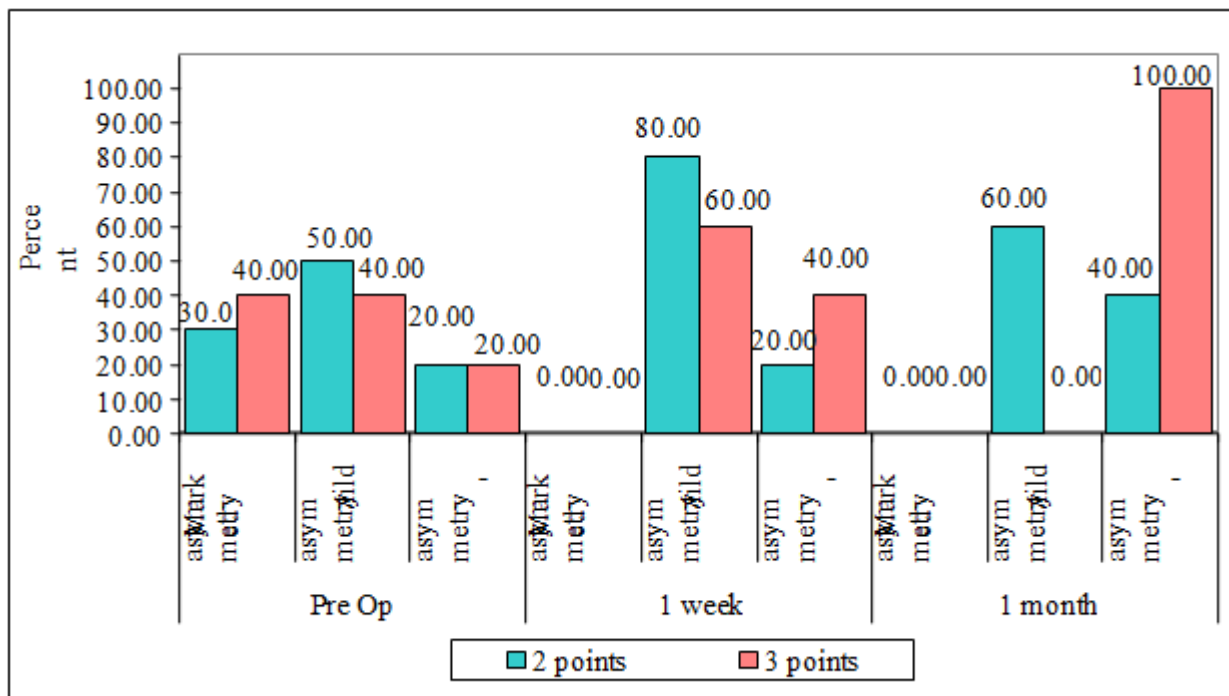
By the end of three month post op, 100% patients had good mouth opening in both the groups.

Figure 1: Comparison of two groups (2 points and 3 points) with Inter-incisal opening scores at different treatment time points



In this study, 30% of the patients in the two point group and 40% of the patients in the three point group had marked asymmetry preoperatively. By the end of third month of post op, 40% patients in the two point group and 100% of the patients in the three point group had no asymmetry shown in figure 2.

Figure: 2 Comparison of two groups (2 points and 3 points) with Facial symmetry (Surgeon's evaluation) at different treatment time points.



In our study, we found that none of the patients in either group had any fracture displacement at the end of the third month post operatively.

## Discussion

The management of ZMC fractures is debated, as demonstrated by the varied and often paradoxical treatment philosophies described in the literature. The zygoma is a four-sided pyramid with the malar eminence as its apex.

In 1909, Keen classified zygomatic fractures as those of the arch, the body, or the sutural disjunction<sup>8</sup>. He was the first to describe an intraoral approach to the zygomatic arch via a gingivobuccal sulcus incision.

In 1751, du Verney<sup>9</sup> elicited the anatomy, type of fractures observed, and approach to reduction in two cases. Recognizing the importance of reduction for proper healing, du Verney took advantage of the mechanical forces of the masseter and temporalis muscles on the zygoma in his approach to closed reduction techniques.

Early diagnosis and treatment offers the best convenience to restore the pre injury structural relationships. An understanding of various types of ZMC fractures, and the anatomic and physiologic factors that affect their stability, is paramount to the development of a sound treatment plan.

A study performed by Dingman and Natvig demonstrated that most of the zygoma fractures treated with closed reduction technique and later re-examined were more severe than they had appeared clinically or by radiographic evaluation<sup>10</sup>. It appeared that although the fracture was reduced at one point, the bone became displaced again because of extrinsic forces. Therefore, they concluded that most displaced fractures of the zygoma should be treated by open reduction and direct wire fixation.

Osteosynthesis became a reality for facial fractures in the 1970s. The Swiss AO group and Association for the Study of Internal Fixation developed miniplate fixation.

The success of Miniplate was supported further by Michelet et al and others, who continued to develop techniques for reduction and fixation of facial fractures using miniplates<sup>11</sup>. For unstable, displaced fractures of the zygoma, Miniplate were found to accurately stabilize the bones with minimal complications. The complications noted were attributed to surgical technique rather than the plating system.

The use of two-point fixation and three-point fixation in ZMC fractures has always been debated in the field of craniofacial trauma. Two-point fixation has been quoted by many authors in the English literature with its advantages. And have been used by surgeons predominately for fixation of the ZMC region at frontozygomatic suture (FZ) and infraorbital region (IOR/ ZMB). Three point fixations of ZMC fractures, as quoted by many surgeons, not only give adequate anatomic reduction but better post op stability of the fractured segments.

In our study, age group of the patient varies from 18-55 years with mean age of 28.2 years for the 2 point group and 36.3 years for the three point group .

Hence age group of our study is similar with the study of **Covington D.S.**<sup>12</sup>, who found that in 243 patients with ZMC fracture mean age was 31.9 years.

In our study, all patients were male. This observation was somewhat similar with study done by **Ellis et al**<sup>13</sup>, who reported 80.2% of incidence of male predominance. Road traffic accidents (RTA), were the most common cause of ZMC fractures accounting for 80% of the cases, while 10% resulted from fall and 10% accounted from assault in our study. This observation was confirmed with study carried out by **K. Balakrishnan et al**<sup>14</sup>, who found that out of 245 patients with the ZMC fractures, RTA was the major etiological factor in 183 (74.69%)

patient, while in 12.65% of the patient assault was the cause and 10.61% of the case resulted from fall.

According to **Row and Killey**<sup>15</sup>, limitation of mouth opening resulted from mechanical obstruction by zygomatic bone or arch impinging on coronoid process of the mandible. In our study all patients were having limited mouth opening, however this improved after the initial edema subsided in 20% of patients.

The surgical treatment of ZMC fracture varies from surgeon to surgeon and also depending on the type of fracture and circumstances. In our study ORIF with Two Point Miniplates Fixation was at FZ approach; other point for mini-plate fixation was ZMB fixation. Three point fixation points were the FZ, the ZMB and the IOR.

The surgeon should remember that the plate has to be strong enough to withstand the forces acting at each fracture site. **Trindade, P. A. K. et al**<sup>16</sup> recommend use of the 1.5 system if available, because thicker miniplates can eventually cause discomfort to the patient. Therefore, in our study we used 1.5 mm thickness titanium miniplate for fracture fixation without any hardware complications.

Operative time to manage a ZMC fracture also plays an important deciding factor when choosing an appropriate and adequate method of fixation. In our study, the operative time required to achieve two-point fixation was ranging from 45 minutes to 65 minutes with a mean time of 56.5 minutes whereas the three point fixation ranged from 90 minutes to 110 minutes with a mean time of 110 minutes. This finding is concurrent with that of **Nasr et al**<sup>17</sup>. Who stated that two point fixation took 71 minutes and three point fixation took 93 minutes on average.

The ZMC fracture has its share of complications in the form of bone and soft tissue infection, malunion, delayed union, nonunion and plate exposure. In our study we

followed complication scores of the mandibular fracture osteosynthesis given by **Vedran Ulgesic et al**<sup>4</sup>. In our 3rd month follow up none of our patient had complications like soft tissue and bone infection, fractured fragments mobility or trismus. In our study few patients had pain and edema after 1<sup>st</sup> week post op follow up, after 3<sup>rd</sup> month follow up none of patients were having pain or edema.

Frontal and basal skull view of the patients in our study were done at post op follow up visits to assess malar depression and globe abnormalities. The evaluation of malar asymmetry was done in accordance with the classification system proposed by **Holmes and Methews**<sup>6</sup>. In our study, patients treated with 2 point fixation, at the end of 3 months, reported 10% mild asymmetry whereas patients with 3 point fixation reported no asymmetry at the end of 3rd month. These results are concurrent with that of **Parasher and Ramesh**<sup>18</sup>, who reported that vertical dystopia and enophthalmos is higher in two-point fixation.

**Prashar et al (2007)**<sup>18</sup> conducted a study on 22 patients with ZMC fracture and treated them with 2- and 3-point fixations respectively. Patients were evaluated clinically for vertical dystopia and enophthalmos and radiographically for zygomatic complex projection and height. The patients treated with 2-point fixation showed a significant increase in postoperative vertical dystopia and mean enophthalmos along with a significant deficit in malar projection and height. The postoperative results in patients treated with 3-point fixation were better than those treated with 2- point fixation.

**Rana et al.(2012)**<sup>1</sup> concluded that assessment of objective post fixation variables, i.e. vertical dystopia, and malar height show statistically significant enhancement in outcome attesting to better inherent stability of three-point fixation. Considering zygomatic



bone fracture as a tetra pod fracture they recommend that for laterally displaced and unstable fractures rigid internal fixation should be done at least at three points using miniplate.

**Esat Bardhoshi (2016)**<sup>19</sup> explained that the majority of poor outcomes are associated with the management of displaced ZMC fractures, resulting from inadequate treatment. Insufficient exposure and reduction of the ZMC fragment and failure to restore orbital volume results in facial asymmetry and exophthalmos. For these reasons displaced fractures are best managed by open reduction and fixation at 2 to 3 points. In the absence of comminution or instability at the zygomatic arch, reduction under direct visualization plus fixation at the FZ suture, ZMB, and IOR remains the treatment of choice. After the reduction, facial symmetry is immediately obtained.

**Punjabi et al(2016)**<sup>20</sup> in their study included 10 women and 10 men aged 18- 30 years in whom the function (mouth opening, diplopia, vertical dystopia and enophthalmos) and esthetic (malar prominence) problems were identified preoperatively. They concluded from this study that three point fixation is most effective and safe method for reduction of fracture of zygomatic bone.

**Nasr et al.(2017)**<sup>17</sup> in their study included 20 patients who were treated with ORIF using two-point fixation technique and 20 patients who were treated with ORIF using three-point fixation technique. They concluded three-point fixation technique is the standard fixation technique of ZMC fracture.

**Gadkari et al. (2019)**<sup>21</sup> stated that the injuries can result in both functional (diplopia, trismus, and paraesthesia) and aesthetic deformities (midfacial widening, malar flattening and globe malposition). They concluded that three point fixation is superior to two-point fixation in

reducing malar asymmetry in zygomaticomaxillary complex fractures.

On the basis of above discussed studies and our outcome, we can suggest that 3 point fixation gives better results when compared to 2 point fixation.

### **Conclusion**

We conclude with limited period of follow up that three-point Miniplate fixation sets the standard in fixation of isolated and minimally displaced ZMC fractures as it yields promising results in management in terms of postoperative stability, aesthetics, and prevents post reduction rotation or clinical displacement with improvement in ocular vertical dystopia and malar eminence.

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