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# Assessment of two-point versus three-point microplate fixation in zygomaticomaxillary complex fractures

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**Abstract:**
Zygomaticomaxillary complex (ZMC) fractures are frequent injuries that impact mastication, ocular function and facial contour. Therefore, it is of interest to compare the two-point and three-point fixation utilizing microplates. A total of 56 patients were split into two equal groups of 28 at random. Microplates were used for two-point fixation at the frontozygomatic area and zygomaticomaxillary buttress in Group I. Microplates were used for three-point fixation at the infraorbital rim, frontozygomatic area and zygomaticomaxillary buttress in Group II. Intraoperative stability, interincisal mouth opening was assessed post operatively. Thus, three-point fixation had less post-operative problems and improved post-operative facial assessment. However, there was no statistically significant variation in the overall complication rates.

**Keywords:** Internal fixation (IF), open reduction (OR), three-point fixation, two-point fixation, zygomaticomaxillary complex (ZMC) fracture

**Background:**
Because of the zygomatic region's prominence, fractures of the zygomaticomaxillary complex (ZMC) are among the most frequent maxillofacial injuries **[1]**. Fractures of the zygoma, which derives from the Greek word "Zygon," have been reported as early as 1670 B.C. **[2]**. The zygoma is an important part of facial structure, appearance and function. Zygoma articulates with the frontal, maxillary, temporal and sphenoid bones through five essential processes. Force transmission through its processes causes disruption at weak articulations and ZMC fracture patterns are dependent on the direction and amplitude of the force. Young adult males are more likely to sustain ZMC fractures as a result of falls, assaults and auto accidents **[3, 4]**. Precise three-dimensional anatomical restoration is the aim, although management is still debatable **[5]**. The best treatment for unstable fractures is open reduction and internal fixation (ORIF) **[6, 7]**. External incisions are made for the infraorbital rim and frontozygomatic suture, while intraoral access is used for the zygomaticomaxillary buttress **[8]**. Benefits of microplates include less soft tissue damage, little palpability and flexibility **[9]**. Therefore, it is of interest to compare the two-point and three-point fixation utilizing microplates.

**Materials and Methodology:**
In order to treat zygomaticomaxillary complex fractures, a randomized controlled trial (RCT) with a parallel-group design was carried out in Oral and Maxillofacial Surgery the Department at NIMS Dental College & Hospital, Jaipur, from March 2024 to November 2025. 56 individuals with zygomaticomaxillary complex fractures who met certain inclusion criteria were included in the clinical trial. Before enrolment, each subject gave their informed consent. On March 20, 2024, protocol number IEC/P-552/224 received ethical approval. Inclusion criteria were; Patients between 18 to 50 years, both male and female, patients with zygomatic complicated fracture and ASA I and II were included. Patients with prior face fractures who were referred for reconstructive surgery, patients who were medically compromised and patients who did not give their consent were excluded. A standard proforma was used to gather data and patients were told about the study in their native tongue before giving their informed consent. All required haematological investigations were carried out and pre-operative, intraoperative and post-operative photos were obtained. They were split into two equal groups of 28 patients each at random: Group I (two-point fixation): fixation at the frontozygomatic (FZ) region and zygomaticomaxillary buttress. Group II (Three-point fixation): fixation at the infraorbital rim, FZ region and zygomaticomaxillary buttress.

**Procedure:**
Following intubation, a throat pack was used and sterile gauze and ointment were used to protect the eyes. After cleaning with 5% povidone iodine, patients were draped and the oral cavity was irrigated with both povidone iodine and regular saline. Intraoral and extraoral incisions, including pre-existing lacerations, were used to access fractures, which were then infused with 2% lignocaine and 1:80,000 adrenalines. The fracture site and infraorbital neurovascular bundle were revealed by subperiosteal dissection. Intermaxillary fixation or manual approximation was used to reduce fractures. Internal fixation with 0.4–0.6 mm microplates was applied to Group I in the frontozygomatic (FZ) and zygomaticomaxillary buttress (ZMB) regions. The Group II also included the infraorbital rim. Monocortical screws were inserted after screw holes were bored using a guide sleeve to avoid heat damage. Following fixing, the maxillomandibular fixation was withdrawn, the site was irrigated. The wound was closed in two layers using 5-0 Prolene for the skin and mucosa and 3-0 Vicryl for the deeper tissue. The stability of the repositioned zygomaticomaxillary fracture was examined intraoperatively by digital manual palpation to decide whether fixation devices were required. A vernier calliper was used to measure mouth openness prior to surgery and at follow-up intervals of one and three months. The obtained data was statistically analysed using Student's paired and unpaired t-tests.

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Frontal and bird's-eye views were used to assess malar asymmetry. Malar asymmetry was evaluated using the Holmes and Mathew's classification.

**[1]** **Grade 1**: Excellent esthetic outcome; no apparent scar formation or malar asymmetry
**[2]** **Grade 2**: Excellent esthetic outcome with very little scar formation and malar asymmetry upon close examination.
**[3]** **Grade 3**: Minimal scar development, obvious malar asymmetry and poor cosmetic outcome
**[4]** **Grade 4**: Visible scar formation and severe malar asymmetry

**Results:**

Following the clinical study's conclusion, measurements and data from every patient were tallied for statistical analysis and observational data was generated by comparing the two groups (Group I and II). The following variables were used to assess and compare the treatment outcomes of two different approaches: Stability throughout surgery, facial evaluation, interincisal mouth opening and problems following surgery. **Table 1** indicates the association of intra-operative stability among Group A and Group B. In Group A, 19 patients were intra-operatively stable and 9 were unstable, whereas in Group B, 23 patients were stable and 5 were unstable. Overall, 75% of patients demonstrated intra-operative stability. The discrepancy in intra-operative stability between the two groups was not statistically considerable ($p = 0.217$), indicating comparable intra-operative stability in both groups. **Table 2** presents the inter-group comparison of post-operative facial aesthetic outcomes at one week, four weeks and twelve weeks using the Mann–Whitney U test, as facial aesthetic outcomes were graded on an ordinal scale (Grade 1 = best outcome, Grade 3 = poorest outcome). At the 1-week follow-up, Group I had a higher mean rank (31.52) compared to Group II (25.48). Since a lower mean rank indicates better facial aesthetics, Group II showed superior facial aesthetic outcomes at 1 week and the variation was statistically considerable ($p = 0.041$). At the 4-weeks follow-up, the mean ranks of Group I (29.00) and Group B (28.00) were almost identical, indicating that both groups had comparable facial aesthetic outcomes, with no statistically considerable variation ($p = 0.788$). At the 12-weeks follow-up, Group I again showed a higher mean rank (31.00) compared to Group II (26.00), indicating that Group II showed better facial aesthetic outcomes at 12 weeks, with the variation reaching borderline statistical significance ($p = 0.05$). Overall, Group II showed better post-operative facial aesthetic outcomes at early and late follow-up periods, while both groups were comparable at the intermediate follow-up. **Table 3** compares post-operative mouth opening between Group I and Group II at 1 week, 4 weeks and 12 weeks using the independent t-test. At 1 week, the mean mouth opening was 24.93 ± 3.23 mm in Group A and 26.93 ± 2.49 mm in Group II. The difference was statistically significant ($p = 0.012$), with Group B showing greater mouth opening. At 4 weeks, Group I showed a mean mouth opening of 30.96 ± 3.24 mm, while Group II showed 34.93 ± 2.49 mm. This difference was highly statistically considerable ($p < 0.001$), again indicating better mouth opening in Group B. At 12 weeks, the mean mouth opening increased to 36.11 ± 3.60 mm in Group I and 40.96 ± 2.55 mm in Group II. The inter-group difference remained highly statistically considerable ($p < 0.001$). Overall, Group B showed significantly greater post-operative mouth opening at all follow-up intervals. **Table 4** shows the inter-group comparison of post-operative complications at 1 week, 4 weeks and 12 weeks using the Mann–Whitney U test. Post-operative complications were graded on an ordinal scale (0 = nil, 1 = mild, 2 = moderate), where a lower score and lower mean rank indicate fewer and less severe complications. At the 1-week follow-up, Group I had a mean rank of 30.84, while Group B had a lower mean rank of 26.16, indicating that Group II experienced fewer and less severe complications, although the difference was not statistically considerable ($p = 0.237$). At the 4-weeks follow-up, mean ranks were 29.00 for Group I and 28.00 for Group II, showing no meaningful difference in complication severity between the two groups ($p = 0.739$). At the 12-weeks follow-up, both groups showed identical mean ranks (28.50), indicating that post-operative complications were comparable between the groups ($p = 1.00$). Overall, Group II showed fewer early post-operative complications, while both groups showed similar complication profiles at later follow-up intervals.

**Table 1:** Inter group comparison of intra-operative stability

| | | Intra-Operative Stability | | Total | P-Value |
|---|---|---|---|---|---|
| | | Stable | Unstable | | |
| Group | I | 19 | 9 | 28 | |
| | II | 23 | 5 | 28 | |
| Total | | 42 (75%) | 14 (25%) | 56 | 0.217 |

**Table 2**: Inter group comparison of post-operative facial aesthetic (mann whitney u test)

| | Group | N | Mean Rank | Sum of Ranks | P Value |
|---|---|---|---|---|---|
| | I | 28 | 31.52 | 882.5 | |
| Post-OpFacial-Aesthetic1Week | II | 28 | 25.48 | 713.5 | 0.041 |
| | I | 28 | 29 | 812 | |
| Post-Op Facial-Aesthetic4 Weeks | II | 28 | 28 | 784 | 0.788 |
| Post-Op Facial | I | 28 | 31 | 868 | 0.05 |
| Aesthetic 12 Weeks | | | | | |

**Table 3**: Inter group comparison of Post-operative Mouth opening (Independent T test)

| | Group | N | Mean | Std. Deviation | Std. Error Mean | P Value |
|---|---|---|---|---|---|---|
| Post-Op-Mouth-Opening | I | 28 | 24.93 | 3.231 | 0.611 | |
| 1Week (mm) | II | 28 | 26.93 | 2.493 | 0.471 | 0.012 |
| Post-Op-Mouth-Opening | I | 28 | 30.96 | 3.237 | 0.612 | |
| 4Weeks (mm) | II | 28 | 34.93 | 2.493 | 0.471 | <0.001 |
| Post-Op-Mouth-Opening12Weeks (mm) | I | 28 | 36.11 | 3.604 | 0.681 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | II | 28 | 40.96 | 2.546 | 0.481 | <0.001 |

**Table 4**: Inter group comparison of post-operative complications (Mann Whitney U test)

| | Group | N | Mean Rank | Sum of Ranks | P value |
|---|---|---|---|---|---|
| **Post-Op-Complications -1 Week** | I | 28 | 30.84 | 863.5 | |
| | II | 28 | 26.16 | 732.5 | 0.237 |
| **Post-Op-Complications -4 Weeks** | I | 28 | 29 | 812 | |
| | II | 28 | 28 | 784 | 0.739 |
| **Post-Op-Complications-12 Weeks** | I | 28 | 28.5 | 798 | |
| | II | 28 | 28.5 | 798 | 1 |

**Discussion:**

ZMC fractures are among the most common injuries in maxillofacial trauma due to the prominent and exposed position of the zygomatic region, which increases its susceptibility to facial injury **[10]**. The zygomaticomaxillary complex (ZMC) is an essential part of the midfacial skeleton. It contributes to facial structure, function and aesthetic contour. Numerous management approaches, from open reduction with internal fixation employing various fixation techniques to closed reduction without fixation, have been documented over the years. Fifty six patients were divided into two treatment groups at random for this study: two-point fixation (Group A) and three-point fixation (Group B). The participants ranged in age from 18 to 50. Group A's mean age (41.89 ± 11.16 years) was substantially greater than Group B's (32.25 ± 6.65 years) ($p < 0.001$). Eight females and twenty males made up Group A, while seven females and twenty-one males made up Group B. Gender distribution was similar amongst the groups ($p = 0.763$), with males making up 73.21% of cases overall. Previous epidemiological investigations of face fractures have revealed a similar male prevalence **[11]**. Digital palpation was used to evaluate intraoperative stability following reduction in order to ascertain whether fixation was necessary. 23 patients in Group B and 19 patients in Group A showed stability; there was no discernible variation between the groups ($p = 0.217$). In total, intraoperative stability was shown in 75% of instances. Improved stability with three-point fixation in complicated fractures has been documented by Sansgiri *et al.* **[12]**. Frontal and bird's-eye views were used to assess facial aesthetic results and the Holmes and Mathew's classification was used to score malar asymmetry. Group B outperformed Group A in terms of aesthetics after one week ($p = 0.041$). Results were similar between groups at four weeks ($p = 0.788$). Group B once more demonstrated better outcomes at 12 weeks, with results that were marginally statistically significant ($p = 0.05$). All things considered, three-point fixation produced better early and late aesthetic results. A vernier caliper was used to measure the maximum mouth opening. At one week ($p = 0.012$), four weeks ($p < 0.001$) and twelve weeks ($p < 0.001$), Group B showed much larger mouth opening, suggesting better functional recovery. An ordinal scale was used to score post-operative problems, such as discomfort, edema, malar flattening and wound infection. The differences were not statistically significant at one week ($p = 0.237$), four weeks ($p = 0.739$), or twelve weeks ($p = 1.00$), despite Group B exhibiting fewer early problems. At a later follow-up, both groups displayed comparable complication profiles. Although its smaller cross-sectional area leads to a larger stress distribution, biomechanical studies indicate that microplates offer stability similar to miniplates in preserving fracture reduction and resisting displacement. Improved palpability and aesthetics are desired in areas with thin soft tissue coverage, such as the frontozygomatic area, nasomaxillary region and infraorbital rim **[12]**. The ideal number of fixation sites for ZMC fractures is still up for debate and depends on the displacement and severity of the fracture. Three-point fixation at the frontozygomatic suture, infraorbital rim and zygomaticomaxillary buttress offers the greatest resistance to physiological stresses, according to experimental research by Aydin and Yakup biophysical analysis revealed similar results **[13]**. The most precise and satisfying post-operative outcomes are obtained by aligning the fracture at three points and fixing it at two stable points **[14]**. According to Yadav *et al*., three-point fixation had fewer post-operative problems and improved post-operative facial evaluation **[15]**. Three-point fixation has been found to require more time and money **[16]**. For more straightforward injuries, two-point fixation is a dependable choice that strikes a balance between minimal invasiveness and functional recovery, while three-point fixation is still the norm for complex fractures **[17]**.

**Conclusion:**

Three-point microplate fixation provided superior functional and cosmetic benefits compared with two-point fixation in the therapy of zygomaticomaxillary complicated fractures. Additionally, there was a considerable increase in post-operative mouth opening at every time point, indicating improved functional recovery. The groups' incidence of complications and intraoperative stability were comparable.

**Advancement to knowledge:**

Three-point fixation is still the gold standard for stabilizing complex, comminuted, or displaced zygomaticomaxillary complex (ZMC) fractures, according to recent developments in the clinical literature. On the other hand, for minimally displaced or non-comminuted fractures, two-point fixation is acknowledged as a very successful, less invasive option.

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