

Open Reduction and Internal Fixation versus Closed Reduction for managing Zygomatic Complex Fractures: Comparison of Surgical Interventions on Orthodontic Occlusion

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Abstract

Objective: The aim of this study is to evaluate and compare the occlusal outcome following closed reduction (CR) and open reduction with internal fixation (ORIF) for managing zygomatic complex fractures.

Methodology: A cross-sectional comparative study design was employed. Sixty patients with zygomatic complex fractures were treated; thirty were managed through open reduction while remaining thirty were managed through closed reduction technique. Experienced orthodontists used standardized occlusal images to perform the follow-up evaluation of the occlusion at 6 months and 1 year interval and rated the occlusion as optimal (normal) or poor (malocclusion). The data was collected and analyzed using SPSS 23.0

Results: There was statistically insignificant difference in the occlusal outcome as assessed by the experienced orthodontists between the two assessed groups at 6 months and 1 year follow-up. The Chi-square frequency table showed no difference between the closed versus open reduction group for gender ($p=.341$).

Conclusions: This study found that managing zygomatic fractures with either closed reduction or open reduction and internal fixation produced similar occlusal outcomes. This suggests that oral and maxillo-facial surgeons can use both techniques to manage zygomatic complex fractures while taking other factors into consideration.

Keywords: Orthodontic occlusion, Zygomatic fractures, Open reduction, Closed reduction.

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Introduction

The zygomatic complex keeps pivotal position in the oro-facial region.¹ The fractures of this complex are around half of the midface fractures and they are

considered second most common fractures of the bones of the face.² The etiology of these fractures is predominantly linked to blunt trauma, with various causes identified across different populations such as road side accidents, accidental falls, assaults, work related injuries, and sports injuries.²

The main clinical features of zygomatic complex fractures include tenderness, ecchymosis and edema over the malar prominence, loss of malar projection, blunting of the lateral canthus, diplopia, or enophthalmos, and trismus.^{3,4} Paresthesia in the region of the infraorbital nerve is another common neurosensory finding.³ Diagnosis of zygomatic complex fracture is usually

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established on the basis of detailed history, clinical examination, along with radiographic assessment and confirmation by CT imagery.⁴ Several therapeutic techniques have been utilized to restore the zygomatic complex and its integrity following fracture of this region. The zygomatic complex fractures with insignificant or trivial dislodgement are commonly addressed through conservative management (non-surgical) whereas the decision to intervene surgically should be based on signs and symptoms and presence of functional impairment.^{3,4}

Closed reduction is suitable for minor, non-displaced fractures or isolated zygomatic arch injuries while ORIF is the gold standard for displaced, complex, or functionally impairing fractures, offering more stable and predictable results.⁵⁻⁷

The rationale of the study is that evidence necessary to guide clinical decision-making in managing zygomatic complex fractures is deficient regarding occlusal outcomes of open reduction (ORIF) versus closed reduction (CR) for managing zygomatic complex fractures (ZCFs). Therefore, this study was designed with goal to evaluate and compare the occlusal outcome of ORIF versus CR for managing ZCFs. This study may provide valuable insight into the occlusal outcome associated with each approach and long-term stability and may contribute to the evidence necessary to guide clinical decision-making in managing zygomatic complex fractures.

Methodology

This research was executed at Fauji Foundation Hospital, Shalamar Medical and Dental College, and de'Montmorency College of Dentistry after taking informed consent from the patients and after taking institutional ethical approval. Following patients were included: Adults aged 18-60 years, diagnosed with zygomatic complex fractures (confirmed through clinical and radiographic examination), medically fit and

no gross pre-treatment skeletal mal-relationship of jaws. Following patients were excluded: Pediatric or elderly patients, patients with multiple facial fractures or significant involvement of other facial structures (e.g., mandibular fractures), pregnancy, and active infections or chronic medical conditions (e.g., immune-compromised states).

WHO sample size calculator was used for sample size calculation. Difference between the 2 groups i.e., open vs close reduction was calculated as 3.8mm (estimated Standard deviation of 7 mm) with eighty percent power of study, confidence level at 5 percent, a minimum sample size of 60 (30 per group) was obligatory. The sampling technique was consecutive (non-probability) type, in which, sixty (60) successive persons with zygomatic complex fractures were selected.

The patients who met selection criteria and gave the consent were placed in either open or closed reduction group (30 each) as indicated by the demand of nature of zygomatic fracture.⁶ PNS radiograph of face & CT scans verified the fractures of the zygomatic complex along with other diagnostic aids. The open and closed reduction procedure was performed as per standard oral surgery approach.^{6,9} Following the procedure, both the groups were given same post-op instructions and functional exercises/physiotherapy to follow.

The follow up evaluation of occlusal outcome was done using standardized occlusal photographs by orthodontists. The occlusion was evaluated and compared in both the groups by orthodontists at 6 months and 1 year.^{6,9} The expert orthodontists evaluated the standardized occlusal pictures and evaluated the occlusion as optimal (regular) or poor (malocclusion). The occlusion was assessed through Andrew's Six keys of Occlusion. To reduce the element of biasness orthodontists who did occlusal evaluation kept unaware about the treatment received by the patient. Data analysis was done with SPSS software

version 23.0 and data regarding occlusal outcome was collected. To find out the intra-rater reliability, the orthodontist was asked to rate the occlusion of same selected cases on photographs on different occasions at least 3 days apart and the results of Chronbach’s alpha showed that scores did not reflect any noteworthy statistical difference (alpha = 0.94, p <0.001)

The proportion of poor occlusions to total occlusions was determined for both the groups to establish disparities amongst the study groups. Z scores were calculated for independent proportion samples for the open and closed reduction groups. The scores were analyzed to ascertain statistical significance by utilizing z table. The difference between the closed versus open reduction group for gender was ascertained by utilizing Chi-square frequency tables. The p value ≤0.05 was considered as substantial.

Result

A total of 60 patients who met selection criteria and gave the consent were placed in open or closed reduction group (30 in each group). Zygomatic complex fracture was due to the road traffic accidents (33%), patients, bike accidents (20%), falls (16%), sports injuries (11%), and workplace accidents (5%). Chi-square frequency table was utilized to find out difference between the closed versus open reduction group for gender (Table I).

Characteristic	Open Reduction Group (n 30)	Close Reduction Group (n 30)	P value
Gender			
Male	13	15	1.433
Female	17	15	
Side			
Right	16	14	1.351
Left	14	16	

Table I: The Characteristics of Selected Patients

There was statistically insignificant difference between the groups for the consequence of poor occlusion at 6 months and 1 year follow-up (Table II).

Characteristic	Open Reduction Group (n 30)	Close Reduction Group (n 30)	P value
6month			
Patients with Poor Occlusions	04	05	3.55
Total Observed Patients	30	30	4.88
% Poor Occlusions	13.33%	16.66%	3.67
1 Year			
Patients with Poor Occlusions	1	02	3.78
Total Observed Patients	30	30	4.11
% Poor Occlusions	3.33%	6.66%	4.76

Table II: Comparison of occlusion at post-zygomatic fracture management through closed vs. open reduction

The occlusal comparison is shown in Figure I.

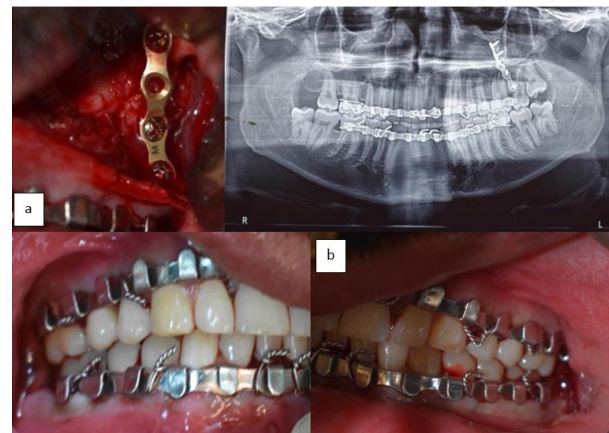


Fig. I: Comparison of occlusion following reduction (a). Open Reduction (b). Close Reduction

Discussion

Zygomatic complex fractures rank among the most prevalent type in midface area, and the management aims to restore normal facial appearance, prevent functional impairment and re-establishment of the facial malar contour.⁸ The zygomatic complex embraces four integral structural components, interlinked by sutural junctions with the

frontal, sphenoid, temporal, and maxillary bones. Maintaining precise alignment at these sutural interfaces is paramount to safeguarding facial symmetry, ocular positioning, and functional integrity. Disruption can precipitate distortions in aesthetics of facial region, functional deficits, and long-term sequelae.^{9,10}

In managing fractures of zygomatic complex, two primary approaches are taken in to consideration: Open along with internal fixation and closed approach.¹¹ The closed approach outlined is more conservative than open reduction since it does not involve surgical incisions, which reduces the risk of complications such as infection or scarring and this procedure can be performed under local anesthesia or conscious sedation with minimal pain and other post-surgical issues⁷, however, closed reduction does not provide the same level of control over fracture alignment as open reduction so therefore, close reduction is generally effective only for simple or minimally displaced fractures.⁷

The open reduction technique allows oral surgeons to directly visualize the fracture site, which is critical for achieving precise anatomical restoration, and provides superior control over fracture alignment, which is crucial for achieving optimal cosmetic and functional outcomes.⁸ The open reduction is typically indicated for displaced, comminuted, or complex fractures where significant misalignment occurs or when fractures extend into critical areas.^{9,10}

Studies show that ORIF often yields superior cosmetic results and minimizes post-operative complications such as malocclusion compared to closed reduction.¹²⁻¹⁴ One of the study found that 85% of patients achieved superior cosmetic results with ORIF compared to 60% with closed reduction. While recovery time is shorter for closed reduction, ORIF tends to yield higher long-term patient satisfaction due to more accurate fracture reductions leading to better functional recovery.¹⁵ Few investigations have

revealed that for the adequate enactment of the preprocedural frameworks for fracture reduction, a 3D visualization approach via computed navigation system is mandatory.^{15,16}

In current study the statistically insignificant difference was noted amid the groups for the outcome of occlusion. The outcomes mirror the conclusions of the previously published articles.¹⁶⁻¹⁸ The reason can be linked to the improvement of occlusal state over time and this is in agreement with the findings of study by Worsaae & Thorn, but they conducted the study on mandibular fractures.¹⁷ According to the study by Ellis et al, it is not mandatory or surprising that poor occlusion occur with same frequency in open reduction as compared with closed reduction because although, open reduction and internal fixation seat condyles to its pre-fracture position or close to the normal position but this also depends on ability of oral surgeon to perform an optimal reduction and sustainability of fixation over time.¹⁴

In the current study the closed and open reduction procedure was performed as per standard oral surgery approach.⁶⁻⁹ Following the procedure, both the groups were given same post-op instructions and functional exercises/physiotherapy to follow which is in accordance with the study by Worsaae & Thorn.¹⁷ In this study, the follow up evaluation of occlusal outcome was done using standardized occlusal photographs by orthodontist, whereby orthodontist evaluated the occlusion using standardized photographs and rated the occlusion as optimal (normal) or poor (malocclusion), this methodology of occlusal comparison is in accordance with the study by Ellis et al.¹⁸ Within, the limitations of current study the results showed that regarding occlusal outcome there is no difference between open versus closed reduction and both can be regarded as an effective treatment modality for zygomatic fractures with equivalent occlusal outcome.

There are several limitations of this study such as noticing occlusal outcome only, small sample size, single centric study and quasi-experimental approach. Future studies are suggested with longer-term follow-up, multi-center trials, and comparative studies involving more diverse fracture patterns to further refine the indications for each approach.

This study suggests that regarding occlusal outcome there is no difference between open versus closed reduction and both can be regarded as an effective management approach for zygomatic fractures with equivalent occlusal outcome. Clinical decision-making should be based on the nature of the fracture, the patient's overall health, and their preferences.

Conclusion

This study found that managing zygomatic fractures with either closed reduction or open reduction and internal fixation produced similar occlusal outcomes. This suggests that oral and maxillo-facial surgeons can use both techniques to manage zygomatic complex fractures while taking other factors into consideration.

Ethical Approval

The study was approved by the Research Ethics committee of Fauji Foundation Hospital, Lahore. (EC Ref No. RCD-10-25-159)

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This study received no grant from any funding agency, commercial, or not-for-profit sectors.

Conflict of Interest

It is declared that the authors don't have any conflict of interest.

Authors' Contribution

AR: Article writing, data collection

MA: Critically reviewed the manuscript, data analysis

JAC: Article writing, data analysis.

MWT: Critically reviewed the manuscript, data analysis

HSM: Data collection and analysis

MJ: Data collection and analysis

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