

ORIGINAL ARTICLE

Reduction of Zygomatic Bone Fracture by Two Different Treatment Protocols

Kinza Mushtaque¹, Muhammad Shahzad¹, Safia², Salman Shams¹, Shabbir Ahmed³, Syed Ghazanfar Hassan¹

¹Oral and Maxillofacial Surgery Department, Liaquat University of Medical and Health Sciences (LUMHS), Jamshoro, ²Sindh Institute of Oral Health Sciences, Jinnah Sindh Medical University Karachi, ³Department of Prosthodontics, Bibi Asifa Dental College, Larkana, Sindh, Pakistan.

ABSTRACT

Background: Zygomatic bone, a malar bone or cheekbone usually works as eye socket. All over the world, around 15 to 20 million people are traumatized with road accidents. Over 50% of these statistics are diagnosed with zygomatic fractured bone. There are different approaches of therapy to treat zygomatic fractured bone. In this research, two approaches have been studied. The Percutaneous Hook approach is extraoral while Keen's approach is intraoral. The objective of this study was to evaluate outcomes of two different treatment protocols (percutaneous bone hook method and Keen's method) for reduction of zygomatic bone fracture.

Methods: This comparative analytical study conducted at the Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Liaquat University Hospital, Hyderabad, Pakistan. Subjects with displaced isolated zygomatic bone fracture were divided in two groups, Group A (Percutaneous Hook Method) and Group B (Keen's Method). The data was analyzed through SPSS and $p < 0.05$ was considered as statistically significant.

Results: Males were predominantly affected in both groups as compared to females i.e., Group A male patients were 22 (73.52%) while in Group B male patients were 23 (79.41%). Road traffic accidents were the most common etiological factor in both groups. There was a significant difference between the groups in diplopia, cheek flattening and mean mouth opening at postoperative 2nd, 4th and 6th week. The obtained p -value=0.01 was less than 0.05; therefore, the results were statistically significant.

Conclusion: It was observed that percutaneous hook method had better outcomes compared to Keen's method in reducing isolated zygomatic bone fracture.

Keywords: Bone Fracture; Treatment Protocols; Zygoma.

Corresponding Author:**Dr. Salman Shams**

Oral and Maxillofacial Surgery Department,
Liaquat University of Medical and Health Sciences,
Jamshoro, Sindh, Pakistan.

Email: salman_omfs@hotmail.com

<https://doi.org/10.36283/PJMD10-3/008>

INTRODUCTION

The zygoma is roughly quadrilateral in shape with convex outer surface and concave inner surface¹. It comprises of frontal bone, temporal bone, maxilla and sphenoid bone and serves the main bridge amongst these structures. Due to its protruding malar prominence, it is vulnerable to injuries quite commonly and predisposes to be the most frequent site of midfacial fractures after fracture of nasal bones¹. This bone also has its role in facial contouring. This complex bone has the delicate as well as compact anatomy due to which cosmetic therapy needs special care when

treated to improve beauty. The architecture of this bone is varied depending on the ethnicity. Moreover, the genetics and admixture are also the main elements in zygomatic bone in terms of beauty or cosmetic features². There are various reasons of this bone fracture. Some common reasons are violence, fall, sports injuries, firearm injury and automobile accidents³. Two methods of correction of this bone fracture have been discussed in this study.

The percutaneous hook method is the open reduction surgery. However, this is dependent on the nature of injury. The operation of percutaneous hook approach

is carried out under anesthesia with the support of CT scan⁴. Following the incision, blunt dissection is made preventing the frontal nerve branches to avoid damage⁵. To ensure the accuracy, the region is again palpated to verify the hook site is positioned correctly⁶. Later, the incision site is stitched. After this procedure, the patient feels comfort immediately and is advised to open and close the mouth. The alignment of bone and during and after or before the opening and closing of mouth is monitored in scan noting the bone continuity. The scan monitoring is also done as post-operative treatment for at least 3 to 6 months. This approach needs the patient to stay more days in the hospital⁷. If proper care is not taken then facial paralysis may occur⁸.

With Keen's intraoral approach the palpability risk is very low according to several studies. In addition to this, this is also highly noticed that less force is needed in the intraoral approach⁹. This approach is considered as most successful in open treatment of zygomatic fractures. The severity of operation is directly proportional to the nature of trauma. However, normally the procedure of this technique required 1cm incision mostly at the upper buccal sulcus, this area is behind the zygomatic buttress, more suitable for the introduction of curved elevator. Mostly this technique is the choice of surgeons^{10,11}. In this procedure, the verification is done by using digital palpation to determine the accurate adjustment of zygomatic arch region⁹.

The main purpose is to treat the isolated Zygomatic bone fracture is to restore the functional stability aesthetic appearance of malar prominence and proper healing of fracture segments, hence the aim of this study was to reduce the zygomatic bone fracture (Percutaneous hook method and Keen's method) to maintain aesthetic, functional stability and proper healing of bony segments.

METHODS

This comparative analytical study with non-probability convenience sampling method was conducted at department of Oral and Maxillofacial Surgery, LUMHS

Jamshoro/Hyderabad. The Ethical Review Committee of the Liaquat University of Medical and Health Sciences had approved the study (LUMHS/REC/569). Study comprised of 68 patients. Sample size for each group was; Group A (percutaneous hook method) = 34 patients, Group B (Keen's method) = 34 patients. Patients with displaced isolated zygomatic bone fractures were confirmed on clinically and radiologically features with age of 18 to 60 years, patients coming through emergency or out patient's department and willing to participate in study were included. Patients with bilateral displaced fractures of zygomatic bone fractures, comminuted zygomatic fractures, and medically compromised patients were excluded from the study.

A written consent was taken from every patient or attendant of the patient. Personal details of patients including name, age, and gender were being recorded on a Performa. Selection of each patient was done by randomized number trial into two groups. The fractures were treated by reduction with transoral (Keen's) approach and percutaneous hook method. Study was conducted after approval from ethical review committee of university. Post operatively, patients of both the group were recalled after two, four and six weeks for the assessment of the functional effects such as post-operative diplopia/eye vision, cheek flattening and mouth opening. Diplopia was assessed based on present or absent. Mouth opening was measured in millimeters by the metallic rural. Cheek flattening was assessed by clinically standing behind the top of the patient head. The data was recorded and analyzed through SPSS and $p < 0.05$ was considered as statistically significant.

RESULTS

In both groups, males were predominantly affected compared to females. In Group A 27 male patients (79.41%) and Group B 25 male patients (73.52%). The frequency distribution is shown in Table 1. Road Traffic accidents were the most frequently reported cause of trauma in both groups i.e., 73.53% in Hook Technique and 76.47% in Keen's group (Table 1).

Table 1: Frequencies of patients according to causes of injuries.

Causes of Injuries	Percutaneous Hook Method n=34			Keen's Method n=34		
	Male	Female	Total n(%)	Male	Female	Total n(%)
Road Traffic Accidents (RTA)	18	7	25 (73.53%)	19	7	26(76.47%)
Fall	-	3	03(8.82%)	1	3	04(11.76%)
Sports Injury	3		03(8.82%)	2	-	02(5.88%)
Assault	1	2	03(8.82%)	1	1	02(5.88%)
Total	22	12	34 (100%)	23	11	34(100%)

In our study the diplopia, cheek flattening and mouth opening at 2nd, 4th and 6th postoperative weeks were considerably better in percutaneous hook technique group compared to Keen's group (Table 2). In the model summary of regression analysis, the values of R, R2 and adjusted R2 [0.994, 0.988 and 0.987] indicate that the dependent variable (assessment of functional effects: percutaneous hook method: post operative: after six weeks) is supported by the independent variables to the tune of 99 percent. p value [0.01] was less than 0.05, therefore the results were statistically significant.

Table 2: Assessment of functional effects through Percutaneous Hook Method and Keen's Method.

Percutaneous Hook Method (n=34)				Keen's Method (n=34)				p-Value			
Preoperatively (Before Treatment)				Postoperatively (After 2 Weeks)							
Diplopia/Eye Vision n(%)		Cheek Flattening n(%)		Mouth Opening (mm) n(%)		Diplopia/Eye Vision n(%)		Cheek Flattening n(%)		Mouth Opening (mm) n(%)	
Present	Absent	Present	Absent	Good	Poor	Present	Absent	Present	Absent	Good	Poor
8 (23.60%)	26 (76.40%)	21 (61.80%)	13 (38.20%)	9 (26.40%)	25 (73.60%)	10 (29.40%)	24 (70.60%)	22 (64.80%)	12 (35.20%)	11 (32.30%)	23 (67.70%)
Postoperatively (After 2 Weeks)				Postoperatively (After 4 Weeks)				Postoperatively (After 6 Weeks)			
Diplopia/Eye Vision n(%)		Cheek Flattening n(%)		Mouth Opening (mm) n(%)		Diplopia/Eye Vision n(%)		Cheek Flattening n(%)		Mouth Opening (mm) n(%)	
Present	Absent	Present	Absent	Good	Poor	Present	Absent	Present	Absent	Good	Poor
4 (11.70%)	30 (88.30%)	4 (11.70%)	30 (88.30%)	21 (61.80%)	13 (38.20%)	6 (17.70%)	28 (82.30%)	7 (20.60%)	27 (79.40%)	20 (58.80%)	14 (41.20%)
Diplopia/Eye Vision n(%)		Cheek Flattening n(%)		Mouth Opening (mm) n(%)		Diplopia/Eye Vision n(%)		Cheek Flattening n(%)		Mouth Opening (mm) n(%)	
Present	Absent	Present	Absent	Good	Poor	Present	Absent	Present	Absent	Good	Poor
2 (5.90%)	32 (94.10%)	2 (5.90%)	32 (94.10%)	28 (82.30%)	6 (17.70%)	4 (11.70%)	30 (88.30%)	5 (14.70%)	29 (85.30%)	26 (76.40%)	8 (23.60%)
Diplopia/Eye Vision n(%)		Cheek Flattening n(%)		Mouth Opening (mm) n(%)		Diplopia/Eye Vision n(%)		Cheek Flattening n(%)		Mouth Opening (mm) n(%)	
Present	Absent	Present	Absent	Good	Poor	Present	Absent	Present	Absent	Good	Poor
1 (2.90%)	33 (97.05%)	2 (5.90%)	32 (94.10%)	32 (94.10%)	2 (5.90%)	3 (8.90%)	31 (91.10%)	4 (11.70%)	30 (88.30%)	29 (85.30%)	5 (14.70%)

DISCUSSION

Our study observed that in both groups, most common etiological factor was road traffic accident and males were more affected than females. The World Health Organization (WHO) also reported that around the world, nearly one million people die every year due to zygomatic bone fracture or their post treatments like reduction of bone etc¹². The 10-15% of the death statistics is reported as the chronic sufferers. In addition to this, the WHO also mentioned that nearly 15-20 million people are injured each year with road accident as the major cause¹³. In England, the statistics revealed that in last six years, the number of suffering individuals of face fractures has increased by 30 and half of them are involved in zygomatic bone fractures¹⁴.

The WHO findings correlate with our finding that road accident is the predominant and most prevalent cause of zygomatic bone fracture. The zygoma occupies a key spot in the anterolateral aspect of the face, contributing to set the midfacial width, and to define the profile and contour of the inferior and lateral orbital borders as well as the cheek prominence¹⁵. This is in line with a number of other studies¹⁶⁻¹⁸. In Asia and other developing countries, road traffic accidents (RTA) have been thoroughly found as most common.

The peered articles suggested that 50% facial trauma cases are involved in displacement or fracture of zygomatic bone¹⁹. There are different treatment models depending on the severity of the bone damage. Many times, the skeletal healing cause the asymmetrical shape of bone and face which in many cases found challenging to fix. In many cases, patients have to undertake surgical procedures as secondary therapy in terms of effective treatment²⁰. There are several common techniques to fix the reduction and the zygomatic bone fractures. There are Keen's, Gillies, Dingman, Buccal sulcus approach and many others. These approaches mostly are open and close reduction approach in terms of surgery for correction. We have studied the two different modes of treatment of intraoral and extraoral. They are percutaneous hook method (extraoral approach) and the Keen's approach (intraoral approach).

The Hook approach is the open surgery^{21,22}. The main advantage of this approach is that the sinus problem and bone movement is not reported. The other approach of correcting zygomatic arch reported for sinus problems^{23, 24}. Keen's approach is found more effective in treating the reduction of zygomatic bone fracture rather than any other approach including percutaneous hook method²⁵. Our study has also confirmed this trend. The patients treated through Keen's method of therapy report-

ed less postsurgical complication and it also takes less time for operation²⁶. In the United Kingdom (UK) and other developed countries, Keen's approach is considered the surgeon's first choice for reduction of zygomatic arch or fractured bone²⁷.

CONCLUSION

The Keen's approach of reducing the zygomatic fractured bone is more suitable for achieving a better outcome. The hook method permitted defined application of traction forces across zygomatic fractures. The fractured bone portion could be pulled in the course precisely opposite to the vector of impact at the time of trauma. Moreover, road traffic accidents were reported to be the main cause of the zygomatic broken bones. In this connection, the city officials should implement the traffic rules and regulations strictly. We are certain that this will help to reduce such accidents.

ACKNOWLEDGEMENTS

The authors acknowledge the help and support of the hospital staff in completing this study.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

ETHICS APPROVAL

The Ethical Review Committee of the Liaquat University of Medical and Health Sciences (LUMHS/REC/569) had approved the study.

PATIENT CONSENT

At the time of data collection patients were informed. Only those patients were included who gave their consent.

AUTHORS' CONTRIBUTION

SGH did the contribution in concept designing. KM and MS did data collection, data analysis, drafting and final approval of the manuscript. SS critically revised the manuscript and data analysis. S did the interpretations of the recorded data. SA revised the manuscript critically. SS did the contribution in data collection and revision.

REFERENCES

1. Khaqani MS, Tavosi F, Gholami M, Eftekharian HR, Khojastepour L. Analysis of facial symmetry after zygomatic bone fracture management. *J Oral Maxillofac Surg.* 2018;76(3):595-604.
2. Yu M, Wang SM. Anatomy, head and neck, zygomatic. *StatPearls [Internet].* 2020 Aug 10.

3. Hwang K, Park JL. Purpose of zygoma reduction: not just for a smaller cheekbone. *J Craniofac Surg*. 2018;29(3):537-538.
4. Kermani H, Tabrizi R, Pournab A. Use of percutaneous access via combination of transconjunctival and lateral canthotomy approach for rigid fixation and reconstruction of the unstable zygomatic arch. *Trauma Mon*. 2016;22(1):1-4
5. Giudice A, Cristofaro MG, De Cicco D, Barca I, Orabona GD, Califano L. Percutaneous reduction of isolated zygomatic arch fractures: A 5-year experience. *J Oral Maxillofac Surg*. 2020;78(6):973-978.
6. Cinal H, Barin EZ, Çakmak MA, Kara M, Yılmaz K, Tan O. Novel surgical technique for repair of zygomatic fractures: Lever technique. *Plast Surg*. 2019;27(2):135-140.
7. Birgfeld CB, Munding GS, Gruss JS. Evidence-based medicine: Evaluation and treatment of zygoma fractures. *Plast Reconstr Surg*. 2017;139(1):168-180.
8. ZotarelliFilho IJ. Meta-analysis of the major clinical fracture results of the zygomatic-maxillary complex with 1-point fixation: success rate and complications [Internet]. 2020 Authorea Preprints [cited 2021 Mar 6]. Available from: <https://www.authorea.com/doi/full/10.22541/au.160037761.13915472>
9. Hammuda A. Intraoral approach for reduction and fixation of infraorbital rim fracture. *Egypt J Oral Maxillofac Surg*. 2018;9(4):179-184.
10. Song SH, Kwon H, Oh SH, Kim SJ, Park J, Kim SI. Open reduction of zygoma fractures with the extended transconjunctival approach and T-bar screw reduction. *Arch Plast Surg*. 2018;45(4):325-332.
11. Hindin DI, Muetterties CE, Mehta C, Boukavalas S, Lee JC, Bradley JP. Treatment of isolated zygomatic arch fracture: Improved outcomes with external splinting. *Plast Reconstr Surg*. 2017;139(5):1162-1171.
12. Mohajerani H, Sadeghi N, Montazemi T, Montazemi A. Zygomatic fractures: A 10-Year retrospective epidemiological study. *Avicenna J Dent Res*. 2017; 9(3):1-7.
13. Sakamoto Y, Ogata H, Shido H, Kishi K. A retrospective analysis of zygomatic fracture etiologies. *JPRAS Open*. 2017;14:23-26.
14. Rana JS, Kaleem H. Frequency, etiology and pattern of midface fractures. *J Pak Dent Assoc*. 2018;27(03):106-109.
15. Marinho RO, Freire-Maia B. Management of fractures of the zygomaticomaxillary complex. *Oral Maxillofac Surg Clin North Am*. 2013;25(4):617-636.
16. Iqbal HA, Chaudhry S. Choice of operative method for management of isolated zygomatic bone fractures; evidence based study. *J Pak Med Assoc*. 2009;59(9):615-618.
17. Ahn Chang H, Youn DH, Suk Choi MS. Wire or hook traction for reducing zygomatic bone fracture. *Arch Craniofac Surg*. 2015;3(16):131-135.
18. Abdullah K, Shahzad M, Bhangwar AW, Hassan SG, Panjabi SK. Isolated zygomatic bone fracture: assessment of outcome by two point fixation. *Prof Med J*. 2020; 27(2):246-250.
19. Jamatia K, Deb R, Debbarma D, Bhanot R, Sahu M, Gahlawat M, *et al*. Reduction of depressed zygomatic arch fracture using dental extraction forcep: A case report with review of literature. *J Adv Med Dent Sci Res*. 2019;7(11):179-182.
20. Shah A, Ilyas M, Khan S. Etiology, treatment and associated symptoms with zygomatic bone fracture. *J Khyber Coll Dent*. 2015;6(1):17-19.
21. Karimi A, Shoohanizad E. The management of zygomatic complex fractures: A review. *J Pharm Res Int*. 2019;27(4):1-6.
22. Harish KM, Tulasidas G, Arthanari B, Bhagat JA. aesthetic outcome of a case of orbital floor fracture treated using a retroseptal transconjunctival approach. *Cureus*. 2019;11(2):1-18.
23. Sudhir MV, Rajasekhar G, Reddy ES, Jesudass G, Laxmi CS, Babu PC, *et al*. Versatility of transconjunctival approach in maxillofacial trauma - A prospective study and review of literature. *J Clin Diagn Res*. 2018;12(8):12-16.
24. Şimşek HO, Özkan G, Demetoğlu U, Gürsoytrak B, Kocatürk Ö. Isolated zygomatic arch fracture: A case report. *Meandros Med Dent J*. 2017;18: 226-230.
25. Malaviya P, Choudhary S. Zygomaticomaxillary buttress and its dilemma. *J Korean Assoc Oral Maxillofac Surg*. 2018;44(4):151-158.
26. Rajkumar K, Mukhopadhyay P, Sinha R, Bandyopadhyay TK. 'Y' modification of the transconjunctival approach for management of zygomatic complex fractures: a prospective analysis. *J Maxillofac Oral Surg*. 2016;15(1):45-51.
27. Budacu C, Nemtoi A, Constantin M, Martu MC, Haba D. Biomaterials used in reduction and fixation of unstable fractures of the zygomaticomaxillary complex. *Mat Plast*. 2017;54(4):773-776.