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ORIGINAL ARTICLE

Comparison of Functional Recovery of Infraorbital Nerve Paresthesia Following Open and Closed Reduction of Zygomaticomaxillary Complex Fractures

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ABSTRACT

Objective: To compare the functional recovery of infraorbital nerve paresthesia following open reduction as compared to closed reduction in zygomaticomaxillary complex fracture management.

Study Design: Randomized controlled trial.

Place and Duration of Study: Oral and Maxillofacial Surgery Dept. Dentistry Section, Ayub Medical College & Teaching Hospital, Abbottabad from 1st April 2016 to 30th September 2016.

Methodology: Eighty two patients of infraorbital nerve recovery were included. They were divided in two groups; group A was treated by closed reduction technique, and group B was treated by open reduction with internal fixation technique using mini plates. Permuted blocks of 6 were used to ensure equal representation in both groups. All patients were underwent surgical management within 1-7 days following trauma. Patients were assessed post-surgery for infraorbital nerve recovery.

Results: There were 63.4% males and 36.6% females in group A while 60.9% males and 39.1% females were included in group B with mean age was 28.44±7.15 years in group A and 27.93±7.33 in group B respectively. 51.2% patients have infraorbial nerve recovery in group A while 65.8% have infraorbital nerve recovery in group B.

Conclusion: Closed reduction approach was found to be the best reduction technique and open reduction was effective in terms of stability, prevention of relaps and functional recovery of infraorbital nerve injuries.

Key words: Functional recovery, Infraorbital nerve, Paresthesia, Closed reduction, Zygomaticomaxillary complex fracture

INTRODUCTION

Zygomaticomaxillary complex (ZMC) fractures are most commonly occur as a result of road traffic accidents, among which motorcycle accidents followed by car accidents are most common. Interpersonal violence, falls, bicycle accidents, sports injuries, vehicle pedestrian collisions, work injuries are some of the other causes.[1]

Because of its anatomical projection, the zygomaticomaxillary complex is one of the most commonly injured bones in the facial skeleton. The ZMC fracture is the second most common type of fracture, with nasal bone fractures being the most common. Trauma to the ZMC accounts for 45% of all midfacial fractures and 25% of all facial fractures in the general population.[1,2]

Flattening of the malar prominences, subconjunctival haemorrhage, enophtalmos, restricted ocular movements, double vision, sensory disturbance at the distribution of infraorbital nerve, impaired mandibular surgeons' expertise range of movements, gauging of occlusion, step deformity at frontozygomatic suture, inferior orbital rim, and zygomaticomaxillary buttress are all common clinical features of ZMC.[3,4]

About 30-80% of patients with ZMC fractures experience sensory disturbances in the area of distribution of the infraorbital nerve.[2] Approximately 95% of cases, infraorbital nerve injury occurs as a result of the fracture line passing through the infraorbital canal/foramen resulting in paresthesia, hypoesthesia, or dysesthesia of the lower eyelid, cheek area, lateral nose, upper lip, anterior teeth, and associated gums on the affected side, depending on the severity of the injury.[5,6]

Different factors, such as the type, nature, and extent of the fracture, as well as the patient's preferences and limitations, influence the type of treatment that is provided. Each procedure has its own set of benefits and drawbacks to consider. Closed reduction techniques, such as Gillie's Temporal Approach, Keen's Buccal Sulcus Approach, and Champion's Technique, are relatively quick and cost-effective procedures, and the risks of complications associated with external incisions, manipulations, and fixations are reduced. Asymmetry of the face, persistent paresthesia and diplopia as well as limitations in mandibular movement may indicate the need for a more aggressive approach in the future.[7] Better fixation can be achieved through open reduction and internal fixation with miniplate osteosynthesis; this procedure, however, is both time-consuming and expensive, and may result in prominent facial scars.[8]

The neurosensory deficits occurring due to such fractures heal over a period of time. Paresthesia can be classified into three categories: mild, moderate, and severe, depending on how long it takes for the wound to heal. An injury to the nerve is classified according to the length of time it takes to recover post-operatively. Mild nerve injuries may take two months to recover, while moderate nerve injuries may take as long as year.[9]

Different theories are supported by a variety of different type of evidences. According to one study, nerve recovery is faster and more effective following closed reduction technique.[10] In one study, complete recovery of nerve function was reported in 52% of the patients.[11] There is also evidence that open reduction with rigid internal fixation, which allows for a significantly better restoration of infraorbital nerve function, is superior to closed technique.[12] After treatment with open reduction and internal fixation, approximately 22.1% of patients had persistent nerve dysfunction, with complete recovery occurring in 77.9 % of patients.[13]

Several factors may contribute to nerve injury following fracture, including traction, compression, inflammation, ischemia, and physical damage. In case of open reduction, nerve decompression results in a quicker recovery time.[14] When fracture is reduced, infraorbital nerve hypoesthesia can occur both during the procedure as well as afterward as a postoperative complication. When comparing open reduction with internal fixation and closed reduction, one study showed that those with internal fixation had better infraorbital recovery.[15]

The purpose of this study is to compare the sensory recovery of patients treated with open reduction to those treated with closed reduction, in order to determine which method is most effective for treatment. Due to the fact that there are no comprehensive studies comparing these two treatment modalities in our setup, we will examine the functional recovery of the infraorbital nerve and the determination of any differences in nerve recovery in patients treated by both.

MATERIALS AND METHODS

This randomized controlled trial was carried out in the Department of Oral and Maxillofacial Surgery Department, Dentistry Section, Ayub Medical College & Teaching Hospital, Abbottabad from 1st April 2016 to 30th September 2016 and comprised 82 patients. They were divided in two equal groups and each group comprised 41 patients.

The patients who had unilateral isolated enbloc zygomaticomaxillary complex fractures, diagnosed on clinical examination and on standard Water's View radiograph, male and female gender both between 15-40 years of age, without facial skin lacerations and positive history of paresthesia post-trauma in infraorbital nerve distribution without pretrauma history paresthesia were included. Those patients with comminuted zygomatic bone fractures, other associated facial bone fractures, firearm/gunshot injuries of zygomatic bone were excluded. Patient's demographic data like age and gender were collected. Patients were allocated in two groups by blocked randomization. Permuted blocks of 6 were used to ensure equal representation in both groups. Group A was treated by closed reduction technique and Group B was treated by open reduction with internal fixation technique using mini plate. All patients were underwent surgical management within 1-7 days following trauma. Patients were assessed post-surgery for infraorbital nerve recovery. Follow-up was done after 14 days, 4 weeks and 6 weeks and a final evaluation was made.

The data entered in SPSS-20 for analysis. Chi-square test was used to compare the infraorbital nerve recovery in both groups with P value ≤0.05 considered as significant.

RESULTS

There were 26 (63.4%) males and 15 (36.6%) females in group while in group B, 25 (60.9%) males and 16 (39.1%) females with male to female ratio of 1.7:1 in group A and 1.5:1 in group B. Regarding age groups, there were 23 patients (56%) between 15-28 years and 18 patients (44%) between 29-40 years of group A while in group B, 20 patients (48.8%) between 15-28 years and 21 patients (51.2%) between 29-40 years and mean ages were 28.44±7.15 years in group A and 27.93±7.33 in group B (Table 1).

The infraorbital nerve recovery was recorded in 21 patients (51.2%) and 20 patients (48.8%) had no infraorbital nerve recovery in group A while in group B, 27 patients (65.8%) had infraorbital nerve recovery and 14 patients (34.2%) have no infraorbital nerve recovery. Statistically there was no significant difference between the two groups [P>0.05] [Table 2).

Table 1: Demographic information of the patients in both groups (n = 82)

Variable	Closed reduction technique (n = 41)		Open reduction with internal fixation technique (n = 41)	
	No.	%	No.	%
Gender				
Male	26	63.4	25	60.9
Female	15	36.6	16	39.1
Age (years)				
15 – 28	23	56.0	20	48.8
29 – 40	18	44.0	21	51.2

Table 2: Comparison of infraorbital nerve recovery in both groups (n = 82)

Infraorbital nerve recovery	Closed reduction technique (n = 41)		Open reduction with internal fixation technique (n = 41)	
	No.	%	No.	%
Yes	21	51.2	27	65.8
No	20	48.8	14	34.2

χ^2 = 1.809 P = 0.179

DISCUSSION

The zygomatic region is the most visible aspect of the face aside from the nasal bone and the mandible, making it a prime target for zygomatic complex fractures, the second most common type of facial fracture on the lateral midface.[16]

The zygomaticomaxillary complex (ZMC) plays a key role in the structure, function, and aesthetic appearance of the facial skeleton. Nasal bone injuries are most common, accounting for the majority of cases of midface fractures. There are three different fracture components in the complex, all of which are disrupted by a blow to the malar eminence, which may also result in impingement of the temporalis muscle and cause trismus or damage the infraorbital foramen/nerve resulting in paresthesia within its sensory distribution.[17]

When it comes to zygomatic complex fractures, male had a slightly higher incidence than females i.e. male to female ratio of 1.6:1 (Table 1). The international literatures confirm the results of present study.[18-20] Males between the ages of 15-28 years were most frequently involved, while road traffic accidents were the most common cause. There have been numerous studies demonstrating that young adult males were commonly affected.[21,22] It is imperative to treat patients with facial fractures as soon as the patient's clinical condition allows with a special emphasis on function and aesthetics.[19]

Traffic accidents were found to be the most common cause of zygomaticomaxillary complex fractures in prior epidemiological study[22], and the present study confirms those findings. The mandatory use of seat belts having a significant effects with respect to reducing the number facial injuries in England.[23,24] In Pakistan however seat belt law has not been fully implemented. While interviewing the victims of facial trauma due to road traffic accidents, it was observed that the carelessness, failure to give the right of way and excessive highway speed for competition among drivers and motorcyclists were responsible for an increase in number of zygomatico-maxillary complex fractures.

Two separate approaches were used in this study to assess the recovery of infraorbital nerve function. Infraorbital nerve healing was 51.2% for closed and 65.8% for open reductions (Table 2). Also, our findings were similar and closer to the findings presented by Sakavicius et al[25] and Westermark et al.[26]

Open reduction with internal fixation is a popular fixation technique because of the desirable results. In Netherlands, De Man and Bax[13] found that reduction was important factors in the recovery of sensory disturbances of the infraorbital nerve. Open reduction with internal fixation, according to Vriens and Moos[27], had a superior outcome for infraorbital nerve healing. After open reduction with internal fixation, Sakavicius et al[10] reported that 77.3% of patients' function was fully restored; these results are in similar with the current study. Plate fixation considerably improves the restoration of infraorbital nerve function, according to Benoliel et al[12], who studied the neurosensory changes in the infra-orbital nerve following zygomatic fractures handled in various ways.

Patients who have undergone open reduction and internal fixation are more likely to experience functional nerve recovery. This means that anyone who complains of paresthesia should be treated with open reduction and internal fixation before being sorted out for functional nerve recovery. However, it is also required that every setup should have their surveillance in order to know the frequency of recovery.

CONCLUSION

The improvement in the neurosensory deficit of the infraorbital nerve when treatment in the form of open or closed reduction was applied which facilitated an early recovery of the nerve within a span of one to six months, Closed reduction approach was found to be the best reduction technique and open reduction was effective in terms of stability ,prevention of relapse and functional recovery of infraorbital nerve injuries.

REFERENCES

1. Calderoni R, Guidi M, Kharmandayan P, Nunes P. 7 year institutional experience in the surgical treatment of orbitozygomatic fractures. J Cranio Maxillo Fac 2011;39:593-9.
2. Taewoon Y, Youngwoong C, Jaeyoung C, Yougioon K, Sanghyun N, Primary Infraorbital Foramen Decompression For Zygomaticomaxillary Complex Fracture: Is It Essential? J Cranifac Surg 2016;27:61-3.
3. Thangavelu K, Ganesh NS, Kumar JA, Sabitha S, Nikil. Evaluation of the lateral orbital approach in management of zygomatic bone fractures. J Nat Sci Biol Med 2013;4:117–21.
4. Paul M. Fractures of zygoma, In: Booth PW, Hausamen JE, Schendel SA, eds. Maxillofacial Surgery.2nd ed. St. Louis: Churchill Livingstone, 2007;2; 120-54.
5. Ahmed SS, Bey A, Hashmi GS, Hashmi SH. Neurosensory deficit in cases of zygomatic complex fractures. Curr Neurobiol 2010;1:51-4.
6. Pedemontet T, Basili E. Predictive factors in infraorbital nerve sensory disturbances following zygomaticomaxillary complex fractures. Int J Oral maxillofac Surg 2005;34:503-6.
7. Nyachhyon P, Shah SAA. Management outcomes of zygomaticomaxillary complex fractures. J Nepal Dent Assoc 2010;11:27-31.
8. Muto T, Yahara N, Hashiba T. Reduction & fixation of zygomatic complex fractures using simple external device. Asian J Oral Maxillofac Surg 2010;22:205-07.
9. Akal U, Sayan NB, Yaman Z. Evaluation of neurosensory deficiencies of oral and maxillofacial region following surgery. Int J Oral Maxillofac Surg 2000;29:331-3.
10. Sakavicius D, Juodzbalys G, Kubilius R, Sabalys P. Investigation of infraorbital nerve injury following zygomaticomaxillary complex fractures. J Oral Rehab 2008;35:903-16.
11. Peltomaa J, Rihkanen H, Infraorbital nerve recovery after minimally dislocated facial fractures. EUH Arch Otorhinolaryngol 2000;257:449-52.
12. Benoliel R, Birenboim R, Regev E, Eliav E. Neurosensory changes in the infraorbital nerve following zygomatic fractures. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2005;99:657-65.
13. De Man K, Bax WA. The Influence of the mode of treatment of zygomatic bone fractures on the healing process of the infraorbital nerve. Br J Oral Maxillofac Surg 1988;26:419-25.
14. Kloss FR, Stigler RG, Brandstatter A, Tuli T, Rasse M, Laimer K, et al. Complications related to midfacial fractures: operative versus nonsurgical treatment. Int J Oral Maxillofac Surg 2011;40:33–7.
15. Prachur K, Suhas G, Amit LB, Ram CS. Evaluation of neurosensory changes in the infraorbital nerve following zygomatic fractures. J Maxillofac Oral Surg 2012;11:39-9.
16 Fonseca RJ. Oral and maxillofacial trauma. 1st ed. Philadelphia: WB Saunders; 1991:571.
17 Balakrishnan K, Ebenezer V, Dakir A, Kumar S, Prakash D. Management of tripod fractures (zygomaticomaxillary complex) 1 point and 2 point fixations: a 5-year review. J Pharm Bioallied Sci 2015;7:S242–7.
18 Kurita M, Okazaki M, Ozaki M. Patient satisfaction after open reduction and internal fixation of zygomatic bone fractures. J Craniofac Surg 2010;21:45–9.
19 Chattopadhyay PK. Management of zygomatic complex fracture in armed forces. Med J Armed Forces India 2009;65:128–30.
20 Park BY, Song SY, Yun IS, Lee DW, Rah DK, Lee WJ. First percutaneous reduction and next external suspension with Steinmann pin and Kirschner wire of isolated zygomatic fractures. J Craniofac Surg 2010;21:1060–5.
21 Motamedi MH. An assessment of maxillofacial fractures: a 5-year study of 237 patients. J Oral Maxillofac Surg 2003;61: 61–4
22 Bataineh AB. Etiology and incidence of maxillofacial fractures in the north of Jordan. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1998;86:31–5.
23 Roberts AH, Carroll MJ, Lamb RL. Windscreen injuries and seat belt. Lancet 1983;845:340.
24 Steele RJ, Little K. Effect of seat belt legislation. Lancet 1983; 845:341.
25 Renzi G, Carboni A. Perugini M, Giovanneti F, Becelli R. Post traumatic trigeminal nerve impairment: a retrospective analysis of recovery pattern in a series of 103 consecutive facial fractures. J Oral Maxfac Surg 2004;62:1341-6.
26 Ellis EI, Attar A. An analysis of 2067 cases zygomatic orbital fracture. J Ortal Maxfac Surg 1985;44:417-25.
27 Vriens JP, Moos KF. Morbidity of the infraorbital nerve following orbitozygomatic complex fractures. J Craniomaxillofac Surg 1995;23:363-8.