ORIGINAL ARTICLE

PARADIGM IN AETIOLOGY AND MANAGEMENT OF ZYGOMATIC COMPLEX FRACTURES IN PAKISTAN

Assad Abbas, Iffat Batool Syed, Hasnain Abbas*, Iram Abbas**

Combined Military Hospital, Lahore, *Lahore Medical and Dental College, Lahore, **Ayub Medical College, Abbottabad, Pakistan

Objective: The purpose of this study was to compare the outcome of wire osteosynthesis with bone plating in the management of zygomatic complex (ZMC) fractures. The rationale was to enable the oral and maxillofacial surgeon to select either of the treatment procedure with confidence. **Methods:** In this quasi experimental study, Sixty five patients of ZMC fractures were randomly allocated in groups of bone plating and wire osteosynthesis. This was done through envelope draw method. Three points fixation with either of the treatment modality was undertaken. Titanium bone plating or stain less steel wire osteosynthesis was carried out at frontozygomatic suture, infra orbital rim and at zygomaticomaxillary buttress. **Results:** In this quasi experimental study, three patients failed to follow up. There were 31 patients in each group. Infra orbital step defect was observed in one patient of wire osteosynthesis and two patients of bone plating. Mild facial deformity was observed in two patients of wire osteosynthesis while none in that of bone plating. **Conclusion:** There is insignificant difference of proportion of infra orbital step defect and facial deformity between wire osteosynthesis and bone plating.

Keywords: Zygomatic complex fracture; wire osteosynthesis; titanium bone plating, infra orbital step defect; facial deformity; malar flattening

INTRODUCTION

Zygomatic bone plays an important role in the face for cosmetic and functional reasons with differences in its etiology and treatment modalities between the developing and the developed world.[1] The aetiology depends on the socioeconomic, cultural and environmental factors. Causes include road traffic accident (RTA), violence, falls, industrial accidents, armed robbery and sports.[2] The RTA is the main cause of maxillofacial injuries 48% in Pakistan with a male predilection ratio of approximately 6:1.[3]

Zygomatic fracture requiring no operative treatment ranges from 9% to 50% as seen by Ellis.[4] Khan and Ahmed[5] found percutaneous traction hook method better than Gillies temporal approach. Carter[6] recommends towel clip method for reduction of depressed zygomatic arch fracture. Isolated fractures of unstable zygomatic arch have been successfully stabilized using Kirschner wire by Camilleri.[7]

Mid face fractures by inter osseous wire fixation became popular for unstable or complex fractures in 1940's.[8] In 1971 the introduction of low profile titanium mini plates for facial fractures fixation revolutionized the treatment system.[9] The aim of the present study was to compare the post operative morbidities of wire osteosynthesis with titanium plating following the treatment of ZMC fractures.

MATERIAL AND METHODS

During 29th August 2006 to 28th February 2007 a total of 65 patients of ZMC fractures underwent surgery. Titanium plating was done for 33 patients and 32 patients were treated with wire osteosynthesis. Sampling technique used was non probability, purposive sampling.

Inclusion criteria:

- Patients of ZMC fractures either unilateral or bilateral, diagnosed clinically and with CT scan
- Types of displacement in fractures of the ZMC which had
  - Inward and downward displacement, where Whitnall's tubercle is depressed together with suspensory ligament of Lockwood
  - Inward and posterior displacement where level of suspensory ligament is unchanged
- Patients of all ages and both genders

Exclusion criteria:

- Already treated cases but presenting with mal-union or non-union
- Where floor of orbit is extensively damaged
- Patients with associated other facial and head injuries

The purpose, procedure, risk and benefits were explained to all the patients and written informed consent was taken. Permission to carry out the study was given by the ethical committee of the institute. A random allocation of the patients requiring bone plating and wire osteosynthesis was done through envelop draw method. All procedures were performed by the same surgeon. The mean delay between date of injury and date of operation was 4 days with range of 1–6 days. No patient of bilateral ZMC fracture reported for treatment during this series.

Hardware Used

- Compact micro plates 1.3 straight pure titanium
- Drill bit for threaded hole 1.0 mm cruciform recess
- 1.3 mm cortex screws self tapping pure titanium of 6 mm length
- 1.7 mm emergency screws self tapping titanium of 6 mm length

- Soft stain less steel wire 0.35 mm

All patients were treated under general anaesthesia. Local anaesthesia, 2% lidocaine with 1:100,000 epinephrene was infused prior to incisions at frontozygomatic suture, infraorbital margin and zygomaticomaxillary buttress. According to the draw, either plating or intraosseous wiring was carried out at these three points. Zygomatic bone was held in reduced position by Seldin retractor while wiring or plating was performed. In the wire osteosynthesis procedure, one hole each was made in the fractured and stable segments at infra orbital rim with small round surgical bur, soft stain less steel wire 0.35 mm was passed from the external surface of stable bone and was pulled from internal side, it was again passed from external surface of fractured segment and retrieved from internal side there by creating a figure of eight. At the frontozygomatic and zygomaticomaxillary buttress area two holes each were created on stable and fractured segments, 0.35 mm wire was passed and figure of eight wiring was performed. Fractured segments were aligned, reduced and fixed with tightening of wires. Free ends of wires were inserted into holes of stable bony segments. In the group where bone plating was elected, 1.3 mm 5 holes titanium micro plate was adapted at the fracture line. 1.0 mm drill bit for threaded hole was used and 1.3 mm×6 mm length self tapping screws were applied first on stable bone and later on mobile segment. Two screws on each side of fracture line were inserted. Sequence of plating or wiring was first at frontozygomatic suture, then at infra orbital rim and finally at zygomaticomaxillary buttress. Wound was closed in layers.

Postoperatively, patients' treatment outcome in terms of union of zygomatic bone and facial symmetry were evaluated clinically by surgeon for 5 consecutive days and thereafter fortnightly for 6 weeks. This was further augmented by two postoperative CT scans first one taken a day after surgery and the second 6 weeks after surgery.

- Union of ZMC fracture with respect to infra orbital step defect was measured by manual palpation and by CT images of 2 mm cuts
- Facial symmetry was measured by CT images and clinically by the surgeon using visual analog scale to access residual malar flattening
- Preoperative and postoperative Incisal Edge Distance (IED) which was measured in mm with vernier calliper to evaluate trismus

Statistical analysis was performed through SPSS-13. The continuous response variables like age and IED were presented by Mean±SD and Student's *t*-test was used for comparison of means between two groups. Frequencies and percentages were computed to present all categorical variables like gender, aetiology, displacement, absence of facial deformity and absence of infra orbital step defect. Fisher's exact test was used to compare proportions of absence of infra orbital step defect between two groups as suitable test for cell count <5 in 2×2 table. Chi-square test was used to compare proportions of aetiologies between two groups, and $p<0.05$ was considered statistically significant.

RESULTS

Two patients of bone plating and one patient of wire osteosynthesis did not turn up for follow-up. So, 62 patients, 31 of bone plating and 31 of wire osteosynthesis were included in the study. Among 31 patients who underwent wire osteosynthesis 28 (90.3%) were male and 3 (9.7%) were female. Among 31 patients who underwent bone plating 29 (93.5%) were male and 2 (6.5%) were female. The difference of gender distribution was non-significant ($p=0.833$) between two groups. Mean age of patients who underwent wire osteosynthesis was 33.16±10.93 years and in those who underwent bone plating it was 31.84±14.76 years. Difference of mean age was non-significant ($p=0.690$) between two groups.

RTA was the commonest aetiology that was equally found in both groups, i.e., 67.7%, followed by sport injury, fall and physical assault (Table-1). However pattern of aetiology was statistically non-significant between the groups ($p=0.494$).

Frequency of infra orbital step defect was slightly high in bone plating group than wire osteosynthesis group (6.5% versus 3.2%) whereas 30 (96.8%) patients of wire osteosynthesis and 29 (93.5%) patients did not have infra orbital step defect. Facial deformity was observed in 2 (6.5%) patients of wire osteosynthesis while none of the bone plating group had facial deformity after the treatment.

Preoperative IED was higher in those patients who underwent wire osteosynthesis than those who underwent bone plating (22.71±10.93 versus 15.29±7.98, $p=0.003$) but difference of post-treatment incisal distance (mm) was insignificant between two groups (Table-2). There were non-significant difference of proportions of infra orbital step defect and facial deformity between two treatment groups.

Table-1: **Comparison of etiology of zygomatic complex fractures between patients who underwent wire osteosynthesis and bone plating**

Etiology	Wire osteosynthesis (n=31)	Bone plating (n=31)
Road traffic accident	21 (67.7)	21 (67.7)
Sports injury	5 (16.1)	4 (12.9)
Fall	2 (6.50)	5 (16.1)
Physical assault	3 (9.70)	1 (3.20)

Insignificant difference between two groups ($\chi^2=2.39$, p=0.494).

Table-2: Comparison of incisal edge distance (IED) to access trismus between patients who underwent wire osteosynthesis and bone plating

Incisal edge distance	Wire osteosynthesis (n=31)	Bone plating (n=31)	*p*
Preoperative IED (mm)	22.71±10.93*	15.29±7.98	0.003
Postoperative IED (mm)	39.65±2.88	39.32±3.29	0.683

*Shows statistically significant difference of the means of pre operative IED between two groups

DISCUSSION

The larger ratio in favour of males in this study can be attributed to the fact that majority of ZMC fractures result from RTA, sports, fall and inter-personnel violence where men are more exposed to such hazards. This ratio is comparable to those reported by Adekeye[10], Haider *et al*[11] and Von Hoof[12]. However, Anwar[13] and Zichariades *et al*[14] have reported increase in female ratio to facial fractures in their studies suggesting that women in those societies are more prone to trauma which may be due to their active participation in outdoor activities. The predominant age group in our study was 2nd and 3rd decades which is similar to the previous studies[10,13,15–17].

The aetiological factors of facial fractures have changed over the last 5 decades and they continue to do so.[18] This change in the patterns of maxillofacial trauma has been reviewed by Van Beek and Merkx[19] who have compared their own longitudinal studies from the Netherlands with similar data from Hamburg and Great Britain; all these developed countries show a striking reduction in the broad category of RTAs and the increasing influence of interpersonal violence to facial trauma.[20] Contrary to this, in our study RTA was by far the most common cause of ZMC fractures, followed by sports injury, fall and physical assault. Our results again were totally in contrast to the result of Tadj and Kimble[21], and Israr[22]. This difference validates the point that aetiology of maxillofacial trauma depends on social, cultural, and geographic setup; specifically the zygomatic bone and arch injuries which are generally sustained by fist fights at bar counters. As alcohol consumption is prohibited in our culture, there was no such injury reported in our study. The result of our study is comparable in relation to RTA and facial fractures with those reported by Adekey[10], Van Hoof[12], Anwar[13], Zachariades *et al*[14] and Tanaka *et al*[17]. The high number of maxillofacial injuries due to RTAs in our country is attributed to the lack of road traffic sense among the road users, over speeding, under-age drivers, slow moving vehicles like animal carts on roads, rickshaws, tractor trolleys with agricultural load, compromised mechanical state of public service vehicles and bad condition of roads. On the contrary, strict road traffic regulations, well-trained public transport drivers and adequate seating capacities of public transport, the seat belt legislation and air bag system in developed countries has led to reduction in RTAs.[3]

Trismus usually accompanies zygomatic injuries and is present in 33% to 45% of cases.[23] In our experience there was reduced preoperative IED which was restricted mouth opening due to ZMC fracture. But postoperative IED returned to normal in either of the techniques restoring functions of mastication; indicating thereby accurate reduction and fixation.

Facial deformity was observed in two (6.5%) patients of our series of wire osteosynthesis while none of the patient of bone plating group had facial deformity. In both these cases, patients had adequate mouth opening and functional mastication. The slight residual malar flattening patients were offered augmentation of defect but both the patients themselves were satisfied with their appearance. Insignificant difference between two groups was found by Fisher's Exact test, (p=0.492).

Frequency of infraorbital step defect was comparatively slightly higher in our study in bone plating than wire osteosynthesis. In fact this protuberance was the bulge of plate rather than the actual defect. Removal of plates resulted in resolving the issue. In case of wire osteosynthesis the hump was the callus formation and considerably mild and no treatment was done. Thirty (96.8%) patients of wire osteosynthesis and twenty-nine (93.5%) patients of bone plating groups were observed with tremendous outcome in terms of absence of infraorbital step defect. This confirms that both theses treatment modalities are acceptable in outcome. All patients who had been treated with titanium plates were given the choice of removal of plates once healing had taken place but none other than the two with protuberance opted for this.

Force and direction of injury determines the degree and dimension of displacement, these variables determine the need for no treatment, simple elevation and reduction, semi rigid fixation or rigid fixation.[8] In this study, inward and downward displacement was treated in 19 (61.2%) patients of wire osteosynthesis and 21 (67.7 %) of bone plating where as rest of the patients had inward and posterior displacement.

In the developing countries with meagre resources, the national health policy has low priorities in the annual budget for health. There are only a few qualified oral and maxillofacial surgeons available. The ordinary man has low per capita income and no insurance policies to cover his health bills. He can not afford the cost of treatment and is dependent upon government hospitals for his management where facilities are scarce. On ground the reality is that; under these circumstances the patient with facial trauma is managed with what ever means are available to the surgeon to give the patient self respect, personal image, confidence and functional rehabilitation. We believe that less invasive techniques still have a great role to play in the management of ZMC fracture with analogous out come to that of titanium plating along with much lesser cost. This view is supported by O'Sullivan *et al*[24] who state that a policy of aggressive plating of zygomatic factures would be more expensive than a selective policy because of the expenses associated with ORIF which are prolonged operating time and hospital stay, expensive plating equipment and greater staff requirement. At the same time these expenses may be offset against cost of reoperation rate associated with traditional methods. Covington's[25] ten years series of zygomatic fractures revealed a changing trend towards management of facial fractures by ORIF using low profile mini plates fixation either alone or in

combination with steel wires exhibiting minimal morbidity. Fact remains that gunshot wounds are still treated with intraosseous wires rather than titanium plates.

CONCLUSION

Zygoma is easily exposed to traumatic forces. RTA is the most common cause of ZMC fractures in the developing countries in contrast to developed world due to local traffic customs. Females continue to be less commonly involved in facial trauma in the places where cultural and religious reasons render them less exposed to such hazards. In ORIF whether wire osteosynthesis or titanium plating is elected as the treatment modality for management of ZMC fractures excellent results are produced.

REFERENCES

1. Nayyar MS. Management of Zygomatic Complex Fractures. J Coll Physicians Surg Pak 2002;12(11):700–5.
2. Olasoji MO, Tahir A, Ariobita GT. Changing pictures of facial fractures in Northern Nigeria. Br J Oral Maxillofac Surg 2002;40:140–3.
3. Hussain S, Ahmad M, Khan I, Anwar M, Amin M, Amjad S, *et al*. Maxillofacial trauma: current practice in management at Pakistan Institute of Medical Sciences. J Ayub Med Coll Abbottabad 2003;15(2):8–11.
4. Ellis E. Fractures of the zygomatic complex and arch. In: Fonseca RJ, Walker RV. (Eds). Oral and Maxillofacial Surgery. 3rd ed. Philadelphia: WB Saunders; 2002.p. 571–632.
5. Khan M, Ahmed W. A comparative study of management of Zygomatic bone fracture with Traction hook versus Gillies approach. Pak Armed Forces Med J 2003;53(1):47–50.
6. Carter TG, Bagheri S, Dierks EJ. Towel clip reduction of the depressed zygomatic arch fracture. J Oral Maxillofac Surg 2005;63:1244–6.
7. Camilleri AC, Gilhooly M, Cooke ME. Stablisation of the unstable fractured zygomatic arch with a Kirschner wire. Br J Oral Maxillofac Surg 2005;43:183–4.
8. Adam WM. Internal wiring of facial fractures. Surgery 1942;14:651.
9. Spiessl B, Schargus G, Schroll K. Die stabile Osteosynthese bei Frakturen des unbezahnten Kiefers. Schweiz Mschr Zahnheilk 1971;81:39.
10. Adekeye EO. The pattern of fractures of the facial skeleton in kunduna, Nigeria a survey of 1447 cases. J Oral Surg 1980;49:491–4.
11. Haider Z. Fracture of the zygomatic complex in the south east region of Scotland. Br J Oral Surg 1997;15:265–8.
12. Van Hoof RF, Merkx CA, Stekelenberg EC. The different patterns of fractures of the facial skeleton in four European countries. Int J Oral Surg 1977;6(1):3–11.
13. Bataineh AB. Etiology and incidence of maxillofacial fractures in north of Jordan. Oral Surg Oral Med Oral Path Oral Radiol Endod 1998; 86:31–5.
14. Zachariades BM, Papavassiliou D. The pattern and etiology of maxillofacial injuries in Greece. J Cranio Maxillofac Surg 1990;18(6):251–4.
15. Afzelus LE, Rosen C. Facial fractures a review of 368 cases. Int J Oral Surg 1980;9(1):25–32.
16. Starkhammer H, Olofsson J. Facial fracture: A review of 922 cases with special reference to incidence and etiology. Clin Otolaryngology 1982;7:405–9.
17. Tanaka N, Tomitsuka K, Shionoya K, Andou H, Kimijima Y, Tashiro T, *et al*. Etiology of maxillofacial fractures. Br J Oral Maxillofac Surg 1994;32(1):19–23.
18. Telfer MR, Jane GM, Shepherd JP. Trends in the aetiology of maxillofacial fractures in the United Kingdom (1977-1987). Br J Oral Maxillofac Surg 1991; 29:250–5.
19. Van Beek GJ, Merkx CA. Changes in the pattern of fractures of the maxillofacial skeleton. Int J Oral Maxillofac Surg 1999;28:424–8.
20. Torgerson S, Tornes K. Maxillofacial fractures in Norwagian district. Int J Oral Maxillofac Surg 1992;21:335–8.
21. Tadj A, Kimble FW. Fracture zygomas. ANZ J Surg 2003;73:49–54.
22. Israr N, Shah AA. Retrospective study of zygomatic complex fractures in Sheffield England. Pak Oral Dent J 2001;21(1):50–9.
23. Jungell P, Lindqvist G. Paresthesia of the infrorbital nerve following fracture of the zygomatic complex. Int J Maxillofac Surg 1987;16:363–7.
24. O'Sullivan ST, Panchal J, O'Donoghure JM, Beausang ES, O'Shaughnessy M, O'Connor TPF. Is there still a role for traditional methods in the management of fractures of zygomatic complex? Injury 1998;29(6):413–5.
25. Covington DS, Wainwright DJ, Teichgraeber JE, Parks DH. Changing patterns in the epidemiology and treatment of zygoma fractures: 10 year review. J Trauma 1994;37:243–8.

Address for Correspondence:

Dr. Assad Abbas, Dental Department, Combined Military Hospital, Lahore, Pakistan. **Cell:** +92-321-5514717
Email: assad14@hotmail.com