Efficacy of two point rigid internal fixation in the management of zygomatic complex fracture

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Abstract

Purpose To evaluate the efficacy of two point rigid internal fixation in the immobilization of zygomatic complex fractures.

Patients and methods 30 patients with zygomatic complex fractures were managed by open reduction and internal fixation using titanium mini bone plate screws at the frontozygomatic and zygomatic buttress region. This prospective study was carried out at the Department of Oral & Maxillofacial Surgery, Armed Forces Medical College (AFMC), Pune, India between 1st August 2005 to 1st August 2007. Isolated unilateral zygomatic complex fractures of less than six weeks duration were included in the study.

Result Clinically and radiologically satisfactory results were achieved in all 30 patients using two point rigid internal fixation at the frontozygomatic and zygomatic buttress region of zygomatic complex fracture.

Conclusions Stable fixation and immobilization of isolated zygomatic complex can be achieved with two point fixation using titanium mini bone plate and screws at the frontozygomatic and zygomatic buttress region of zygomatic complex fracture. Postoperative complications like scarring, ectropion and neurological deficit can be avoided by not using infraorbital rim as the third point of fixation.

Keywords Frontozygomatic suture · Zygomatic buttress · Two point fixation

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Introduction

The zygomatic bone occupies a prominent position in the facial skeleton and plays a key role in determining the facial width as well as acting as a major buttress of the midface between the maxilla and the cranium [1]. It has several important articulations in the midface and forms a significant portion of the orbital floor and lateral orbital wall. In addition it meets the zygomatic process of the temporal bone to form the zygomatic arch. Despite being sturdy, its prominent location makes it prone to injury as in interpersonal violence, fall and road traffic accidents [2]. A moderate force may result in an undisplaced or minimally displaced fracture whereas a more severe force frequently results in inferiorly, medially and posteriorly displacement of the zygoma. Occasionally, however a direct blow to the arch results in

an isolated depressed fracture of the arch only. Secondary to a thorough clinical examination, a radiographic evaluation of the fracture is mandatory and may include both plain films and a Computerized Tomographic (CT) scan. Although paranasal view on plain films generally suffices, CT scan is gradually replacing plain films as the ‘gold standard’ in both evaluation and treatment planning. Management of zygomatic complex fracture is controversial. Historically closed reduction was the method of choice for management of all zygomatic complex fractures. Most of the techniques involved exerting pressure under the malar eminence and lifting the fragment in alignment. Treatment outcomes were frequently unsatisfactory fraught with complications like persistent diplopia, malunion and significant residual deformity [3]. Therefore the management of these

fractures has evolved remarkably over the past few decades to a more proactive open reduction and rigid mini bone plate internal fixation [4] required for early rehabilitation and prevention of complications befitting the gross displacement observed in contemporary pattern of injury in fractured zygomatic complex. With minimization being the watchword in today’s surgical practice opinions differ on how many points of fixation are ideal for achieving a clinically acceptable result. However because of the diverse clinical and radiological presentation, a generalization of the treatment plan is not possible. Our study was aimed to evaluate the efficacy of two point rigid internal fixation. Fixation was done at the frontozygomatic and zygomatic buttress region after verification of anatomical reduction at the frontozygomatic, zygomatic buttress and infraorbital rim clinically. Subsequently

Fig. 1 Gender distribution

Fig. 2 Complications

Fig. 3 Preoperative - frontal view

Fig. 4 Preoperative - worms view

Fig. 5 Preoperative radiograph

Fig. 6 Intraoperative - fixation at zygomatic buttress

Fig. 7 Intraoperative - fixation at frontozygomatic region

Fig. 8 Postoperative radiograph

Fig. 9 Postoperative - frontal view

assessing radiologically for stability and alignment, and clinically for functional and esthetic outcome.

Material and methods

This prospective study was carried out at the Department of Oral and Maxillofacial Surgery, Armed Forces Medical College (AFMC), Pune, India between 1st August 2005 to 1st August 2007. Patients were selected from those reporting with craniofacial trauma to the OPD of

Department of Dental Surgery, AFMC, Pune, India and Casualty Department of the Command Hospital (Southern Command) Pune, India. The selection criteria include isolated zygomatic complex fractures of less than six weeks duration presenting with no restriction in ocular movement and no diplopia in patients that have had no surgical intervention for injuries of the upper and midface.

Thorough preoperative assessments including routine hematological investigation were carried out in all patients in the preparation for surgery under general

anesthesia (nasoendotracheal intubation). Following part preparation using strict aseptic protocol, transoral vestibular incision was placed extending from canine to molar region after infiltrating with 2 ml of 1:200,000 adrenaline solution on the involved side. Mucoperiosteal flap was raised to expose the fracture at the zygomatic buttress. Ipsilateral lateral brow incision was marked using sterile methylene blue dye. Incision was made and flap raised to expose the fracture at the frontozygomatic region. In all cases a Molt's periosteal elevator was passed

Table 1 Age distrubution

Age group	No. of cases	Percentage
10–20	02	6.6%
20–30	15	50%
30–40	04	13.3%
40–50	07	23.3%
50 – above	02	6.6%

Table 2 Aetiology

Aetiology	No. of cases	Percentage
Road traffic accident	25	83.3%
Fall	03	10%
Sports related injuries	02	6.6%

Table 3 Clinical features

Clinical feature	No. of cases (%)
Flattening of malar prominence	29 (96.6%)
Tenderness	28 (93.3%)
Inability of chew	26 (86.6%)
Subconjunctival hemorrhage	26 (86.6%)
Pain	25 (83.3%)
Infraorbital paresthesia	25 (83.3%)
Circumorbital ecchymosis	23 (76.6%)
Swelling	21 (70.0%)
Epistaxis	20 (66.6%)
Abrasion	16 (53.3%)
Trismus	12 (40.0%)
Ptosis	07 (23.0%)
Flattening of zygomatic arch	03 (10.0%)

beneath the body of the zygoma and the fracture mobilized and reduced to its anatomical position. The reduction was maintained by keeping the periosteal elevator in place and maintaining pressure and was verified by inspection at the frontozygomatic region and the zygomatic buttress region and by palpation at the infraorbital rim and zygomatic arch. Reduced fracture was fixed at the zygomatic buttress using an 'L' shaped titanium mini bone plate with two screws on each side of the fracture line and at the frontozygomatic region using a 4 or 5 hole straight titanium mini bone plate with two screws on each side of the fracture line. Hemostasis was achieved and incision close using 3–0 vicryl and silk sutures. Postoperatively Inj Ampicillin 500mg iv AST 8 hourly for 5 days, Inj Dexamethasone 4mg iv 12 hourly tapered over 4 days, Inj Pentazocine 30 mg im 12 hourly for 1 day, Inj Ondencetron 4 mg iv 12 hourly for 1 day, Tablet Ibuprofen 400mg + Tablet Paracetamol 325 mg tid from 2nd day for 5 days and Tablet Chymotrypsin 200,000 AU tid for 5 days were prescribed. The patients were

reviewed clinically daily for the next five days, discharged and subsequently reviewed at six weeks recall visit.

Results

A total of 30 patients (29 males and 1 female) aged 18 to 61 years met the inclusion criteria (Table 1/ Fig. 1) with peak age incidence being between 20 to 30 years. Most patients 25(83.3%) sustained fractures due to Road Traffic Accidents (RTA) (Table 2). In 16(53.3%) patients fractures involved the right side in the remaining cases the left side was involved. The clinical signs and symptoms observed are shown in Table 3. Since majority of the cases managed were referred from peripheral service hospitals the average time taken from the date of injury to surgical intervention was 10 days. Postoperatively, cases were reviewed clinically and radiologically by comparing preoperative and postoperative radiographs i.e. paranasal sinus view and submentovertex view to assess alignment and approximation of fractures fragments

which was found satisfactory in all cases. Review after six weeks comprised of clinical and radiological evaluation. Clinically the stability of the malar prominence, infection, wound dehiscence, foreign body reaction, neurological deficit, ocular disturbance, and palpability of implant was considered. Two patients presented with a complaint of palpable implant at the frontozygomatic region three months after surgery. The bone plate and screws were removed under local anesthesia from the frontozygomatic region only. One patient presented with pain and swelling on the involved side of the face one month after surgery. Diagnosed as a case of periimplantitis the plates and screws form both the frontozygomatic and zygomatic buttress were removed under local anesthesia. However the reduction was found stable after removal of fixation device. The signs and symptoms had resolved by the 7th postoperative day except infraorbital paresthesia which persisted in five cases and gradually resolved over a period of three to five months (Fig. 2).

Discussion

The incidence of zygomatic complex fractures peaks around the 2nd and 3rd decade in males and 4th and 5th decade in females with fractures being more common in males in a ratio of approximately 4:1 over females [5]. In our study the age of the patient ranged from 18 to 61 years with a peak incidence in the age group of 20 to 30 years. 80%(25) patients in our study sustained zygomatic complex fracture secondary to RTA (Table 2) 53.3%(16) cases sustained fracture on the right side.

The zygomatic bone provides height, width and projection to the face and forms a part of the bony orbit. It also provides attachment to the suspensory ligament of lockwood which supports the globe [6]. An inferiorly displaced fracture of the zygoma produces an antimongoloid slant and accentuation of the supratarsal fold of the upper eyelid and may result in disturbed ocular function, orbital shape and facial esthetics [1]. Evaluation of a patient with a zygomatic complex fracture includes evaluation of bony injuries and the status of surrounding soft tissues i.e. eyelids, canthal ligaments, globe, cranial nerve II to VI. Visual acuity should be ascertained and ophthalmological consultation obtained in doubtful cases. However in our study none of the patients presented with altered visual

acuity both pre and postoperatively. zygomatic complex fracture can cause periorbital edema and circumorbital ecchymosis (Fig. 3). Subconjunctival hemorrhage with an indistinguishable posterior extent is indicative of breach in orbital periosteum which may be suggestive of an underlying fracture. The incidence of subconjunctival hemorrhage in our study was 86.6 % (Table 3).

The infraorbital nerve travels in the infraorbital groove and canal in close proximity to the zygomatic bone. As reported by Taicher et al. [7] there may be paresthesia, anesthesia over the cheek, lateral nose, upper lip and maxillary anterior teeth resulting from injury to the infraorbital nerve, the reported incidence of which is about 30 to 80%. The infraorbital nerve involvement in our study compared to the reported incidence was slightly higher at 83.3% (Table 3).

Trismus may be a finding when zygomatic arch is medially displaced. Epistaxis is also a common finding due to the involvement of the maxillary sinus manifesting as nasal bleed [8]. In our study the 40% patients complained of difficulty in opening the mouth and 66.6% complained of nasal bleed (Table 3).

Subsequent to a detailed history and close inspection, palpation of the orbital rim and the zygomatic arch should be done in an orderly fashion. Tenderness, a step-off or discontinuity of the bony frame may be indicative of fracture. Intraorally, ecchymosis in the buccal vestibule, tenderness or disruption in the zygomatic buttress may be elicited. The range of mandibular motion should be evaluated to rule out impingement of the zygoma or the zygomatic arch on the coronoid process of the mandible. In isolated zygomatic arch fracture a depression may be seen and or palpated anterior to the tragus of the ear. Pain and restricted mandibular range of movement are commonly seen in these injuries whereas orbital signs are usually absent. In our study 10% patients presented with flattening of the zygomatic arch (Table 3).

According to Zachariades et al. [4] the management of zygomatic complex fracture depends on the degree of displacement and the resultant esthetic and functional deficit. Management may therefore range from simple observation of resolving edema, diplopia and paresthesia to a more aggressive open reduction and internal fixation. Pozatek et al. [9] proposed criteria for selection of patients with zygomatic complex fracture for surgical intervention. Depending on the intensity of the impact the fractures of the

zygomatic complex could be isolated, simple and undisplaced as seen in low energy impact cases or they could be displaced and rotated at one or more points around vertical and horizontal axis as seen in present day medium and high velocity type injuries. The fractures may be dislocated enbloc or comminuted, which may be further aggravated by the pull of the attached muscles, thus making closed reduction of these fractures ineffective. The closed reduction modality for zygomatic complex fractures consists of elevation of the zygoma by any of the various indirect methods i.e. Dingman's, Keen's, Gillie's, Poswillo's and Lothrop's. However these closed treatment modalities frequently tend to yield unsatisfactory results as the displaced fractures along vertical and horizontal axis require fixation for stability [3].

In our study the following clinical features were indicative of warranting surgery - flattening of the malar prominence (96%), paresthesia over distribution of infraorbital nerve (86%) and restricted mouth opening (40%).

According to Manson et al. [10] the zygomatic buttress can be effectively use to align the fractured fragments where as the frontozygomatic suture region is a favourable site for rigid fixation of the fracture. In our study also we have used the zygomatic buttress (Fig. 6) to effectively realign the fractured fragments and the frontozygomatic suture site (Fig. 7) for rigid fixation to achieve stability and a favourable esthetic and functional outcome. However, infraorbital exploration was done only in cases with comminuted fractures or those with gross involvement of the orbital floor.

The lack of directional control and factors like insufficient contact area, fracturing of bone in case of excessive tightening and healing by secondary intention were the problem areas in the management of the zygomatic complex fracture initially with wire osteosynthesis [11]. The development of monocortical miniplates and screws which consisted of plates which were malleable and miniaturized for maxillofacial fracture fixation resolved problems associated with wire osteosynthesis [12]. Currently, the basic classes of biomaterials used for rigid internal fixation of the zygomatic complex fracture are metals and polymers with metals being more popular due to their high strength, adaptability, availability and cost effectiveness as compared to the newer polymers [13].

The presence of solid compact bone in the midface at the frontozygomatic region, infraorbital margin and zygomatic buttress has been used for rigid internal fixation with

mini bone plates and screws at these sites in the management of zygomatic complex fractures [14], and hence rigid internal fixation at one, two, three and four points has been advocated by various workers. Although Champy et al. reported satisfactory results with a single point fixation of the zygomatic complex fracture at the frontozygomatic suture region [15] further studies concluded that a single point of fixation failed to address the three dimensional rotation in zygomatic complex fractures [16]. To achieve better and predictable stabilization, recommendations have been made to rigidly fix the fractured zygomatic complex at more than one point i.e. two, three and four points. The advocates of three point fixation base their contention on the fact that a tripod is a minimum requirement for stability [12], also since the zygomatic complex fracture has been described as a quadripod fracture recommendations to rigidly fix the same at the four points i.e. the frontozygomatic region, the infraorbital region, the zygomatic buttress and the zygomatico-sphenoid region has also been advocated [17]. However with 'minimization' being the watchword in current clinical practice [3] two point fixation of the zygomatic complex fractures is becoming the preferred treatment modality which is producing satisfactory results in most cases barring those fractures which are grossly comminuted and displaced and are deemed unstable with two points of fixation.

Here again, opinions vary on the two points to be rigidly fixed and various combinations have been reported e.g. the frontozygomatic along with the zygomatic buttress [16], zygomatic buttress along with infraorbital [18] and frontozygomatic along with infraorbital [15]. The infraorbital rim may not be a preferred choice for mini bone plate osteosynthesis as there are no functional loads in this area, and though compact the bone at the infraorbital rim is so thin that only few threads of the screw can be anchored [19]. Also, infraorbital exploration for rigid fixation may result in lower eyelid problems e.g. ectropion and a perceptible scar [18].

The present study advocates two point fixation of the zygomatic complex at the frontozygomatic and the zygomatic buttress region after a three point evaluation of reduction of the fractured segments at the frontozygomatic, infraorbital and zygomatic buttress region. The frontozygomatic and zygomatic buttress are preferred for rigid internal fixation because of the stability provided against rotation and correct

alignment to pretraumatic state respectively (Fig. 8 and 9). Also the fact that the approach has an esthetic outcome as the scars is well hidden intraorally and in the eyebrow [15] also avoiding the problems of ectropion and neurological disturbance associate with infraorbital exploration [18].

Apart from the above mentioned complications associated with specific approaches the surgical management of the zygomatic complex fracture is associated with other complications like edema, circumorbital ecchymosis, subconjunctival hemorrhage, diplopia, ptosis, enophthalmos, mechanical restriction of ocular movement, retrobulbar hemorrhage [20] herniation of the lacrimal gland between the fractured frontal and zygomatic bone ends [21], blindness [22], sensory disturbances of the infraorbital nerve [7], palpable plates and screws, pain, infection or loosening of the fixation device [23]. In our study two patients complained of a palpable implant at the frontozygomatic region postoperatively after three months and one case presented with pain and swelling after a month (Fig. 2). The plate and screws at the frontozygomatic region were removed under local anesthesia in the patients complaining of palpable implant. However, on exploration one screw each at the frontozygomatic and zygomatic buttress region was found loose, in the patient presenting with swelling and pain, suggestive of implant rejection. Plates and screws both at the frontozygomatic and zygomatic buttress were removed under local anesthesia in the patient presenting with post operative pain and swelling. However in the above mentioned three cases the reduced fractured fragments were found to be stable after the removal of the implants. In five patients the infraorbital nerve paresthesia persisted postoperatively for three to five months following which it completely resolved gradually (Fig. 2).

On the basis of careful and detailed preoperative and postoperative observations, the above mentioned two point fixation protocol was found to be an effective method of rigid internal fixation in terms of restoring esthetics and function in the management of zygomatic complex fractures and the results obtained were satisfactory in all patients.

Conclusion

Stable fixation and immobilization of isolated zygomatic complex fracture can be achieved with two point fixation using titanium mini bone plates and screws at the

frontozygomatic and the zygomatic buttress region. Postoperative complications like scarring, ectropion and neurological deficit can be avoided by not using the infraorbital rim as the third point of fixation.

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