MINIMIZATION OF ZYGOMATIC COMPLEX FRACTURE TREATMENT – A PROSPECTIVE STUDY

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Certificate

This is to certify that ***Dr. KARTHIKEYAN. D,*** *Post Graduate Student (2008-2011) in the Department of Oral and Maxillofacial Surgery, Tamilnadu Government Dental College & Hospital, Chennai has done this dissertation titled* ***"MINIMIZATION OF ZYGOMATIC COMPLEX FRACTURE TREATMENT – A PROSPECTIVE STUDY"*** *under my direct guidance and supervision in partial fulfillment of the regulations laid down by the Tamilnadu Dr. M.G.R. Medical University, Chennai for M.D.S., Branch–III Oral and Maxillofacial Surgery, Degree Examination.*

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I dedicate this study to my parents, my wife, brother and sister.

*Last but not the least I would like to seek the **blessings of the Almighty** without whose grace this endeavour wouldn't have been possible*

DECLARATION

I, **Dr. KARTHIKEYAN. D**, do hereby declare that the dissertation titled **"MINIMIZATION OF ZYGOMATIC COMPLEX FRACTURE TREATMENT – A PROSPECTIVE STUDY"** was done in the Department of Oral and Maxillo Facial Surgery, Tamil Nadu Government Dental College & Hospital, Chennai 600 003. I have utilized the facilities provided in the Government dental college for the study in partial fulfillment of the requirements for the degree of **Master of Dental Surgery** in the speciality of Oral and Maxillofacial Surgery **(Branch-III)** during the course period **2008-2011** under the conceptualization and guidance of my dissertation guide**, Prof. Dr. B. SARAVANAN, MDS.**

I declare that no part of the dissertation will be utilized for gaining financial assistance for research or other promotions without obtaining prior permission from the Tamil Nadu Government Dental College & Hospital.

I also declare that no part of this work will be published either in the print or electronic media except with those who have been actively involved in this dissertation work and I firmly affirm that the right to preserve or publish this work rests solely with the prior permission of the Principal, Tamil Nadu Government Dental College & Hospital, Chennai 600 003, but with the vested right that I shall be cited as the author(s).

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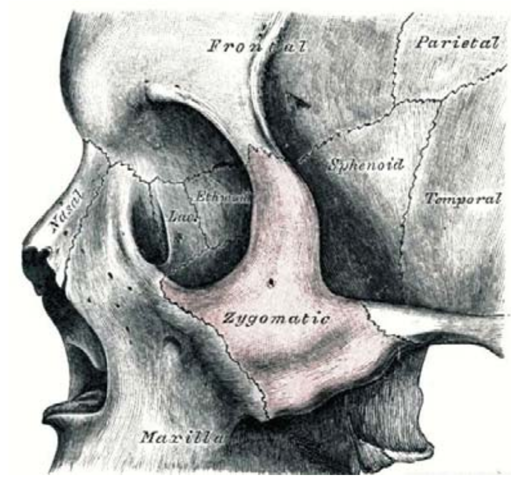
CONTENTS

INTRODUCTION

The zygoma is a thick and strong bone that articulates with the frontal, sphenoid, temporal and maxillary bones and contributes significantly to the strength and stability of the midface.[1] The bony architecture of the middle third of the face has developed as a mechanical adaptation of the skull to masticatory forces. These forces are transmitted to the base of the skull through a system of vertically oriented bony buttresses.



The zygomaticomaxillary buttress bears the greatest occlusal load and is referred to by the orthodontists as the *key ridge*.[2] The intact zygoma plays an important role in maintaining the height, width and posteroanterior projection of the middle third of the face.

However, the prominence of the zygoma and its location on the facial skeleton renders it susceptible to external trauma and is frequently fractured alone or along with other bones of the midface.[3] Zygomatic fractures include any injury that disrupts to various degrees the five articulations of the zygoma with the adjacent craniofacial skeleton, namely the zygomaticofrontal suture, the infraorbital rim, the zygomaticomaxillary buttress, the zygomatic arch and the zygomaticosphenoid suture, and hence these fractures are called zygomaticomaxillary complex or zygomatic complex (ZMC) fractures. And the commonly used terms *trimalar or tripod* fractures are therefore inaccurate. The inaccurate term reflects an inability to easily identify the zygomatico-sphenoid portion of the injury, before the advent of computed tomography[4].

Zygomatic complex fractures represent the second most common facial fracture after nasal fractures. Trauma of the zygomatic complex constitutes 45% of all midface fractures.[5] The incidence, cause, age and sex predilection of zygomatic injuries vary, depending on patient demographics. But the two major causes include motor vehicle accidents and assault injuries. Disruption of the anatomy of the zygoma also has great functional significance because it creates impairment of ocular and mandibular function. Therefore for both cosmetic and functional reasons, it is imperative that zygomatic injuries be properly and fully diagnosed and adequately treated.

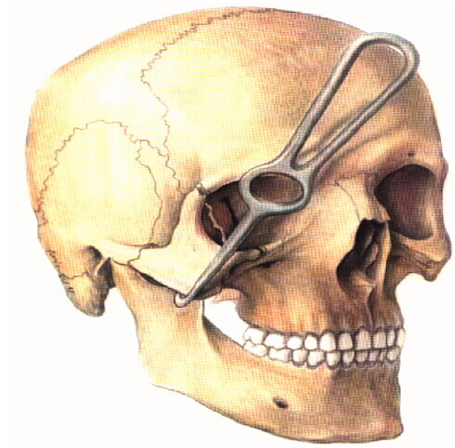
Although a great volume of literature exists on the treatment of these injuries, there is no consensus, because the zygoma may be fractured in a variety of patterns with variable involvement of fracture sites and variable patterns of comminution and as a result, a wide variety of treatment recommendations have evolved.

Treatments range from minimal reduction maneuvers without fixation to complicated types of open reduction involving multiple points of exposure and fixation. So obviously, a multitude of methods must be effective in the management of ZMC injuries.[6] Several techniques may be used to obtain reduction of the displaced bone. A simple, speedy and effective technique is the use of a specially designed traction hook by direct extra-oral application.

In the 1970s, introduction of miniplate osteosynthesis revolutionized the treatment of zygomatic complex fractures. Rigid internal fixation is regarded as the modality with the most reliable results. More stable fixation can be provided with plate and screw fixation than with wire fixation.[7]

This study analyses zygomatic complex fractures treated, by following the concept of minimized therapy using "***Stacey malar hook***" for reduction and miniplates for fixation.

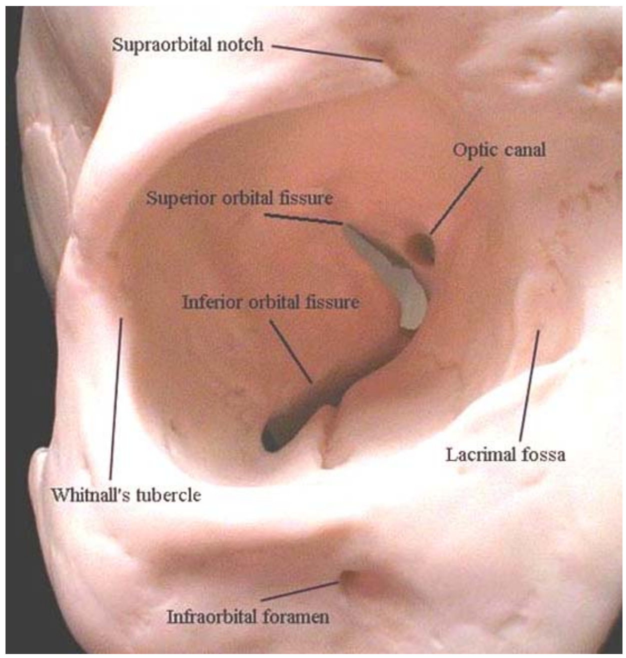
AIM OF THE STUDY



The aim of this prospective study is to establish and justify minimized therapy, to obtain good esthetic and functional results in zygomatic complex fractures, by percutaneous hook reduction and miniplate fixation under local anesthesia.

SURGICAL ANATOMY

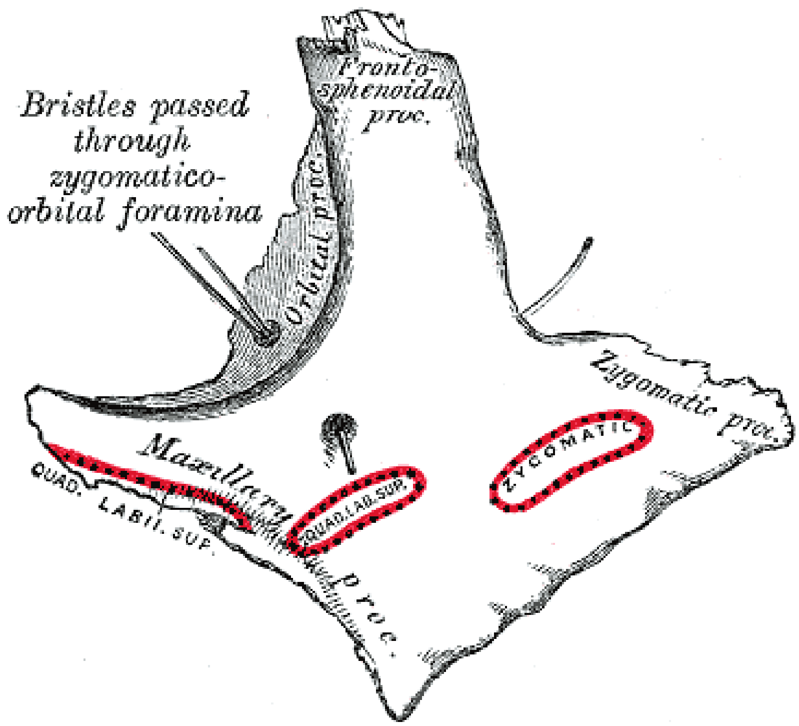
The zygoma articulates with the temporal, sphenoid, frontal and maxillary bones and is a roughly quadrilateral mass with projections. By virtue of its attachments to adjacent bones, the zygoma forms the lateral wall and floor of the orbital cavity and the roof and lateral wall of maxillary sinus, and it participates in the formation of the zygomatic and temporal fossae.



The zygoma provides attachment for the masseter muscle across the inferior surface of the zygomatic arch and zygomatic tuberosity. The temporalis muscle passes beneath the arch, and the zygomaticus major and minor muscles support the oral commisure, taking origin from the anterior surface of the malar eminence. The zygomatic head of the levator labii superioris originates just above the infraorbital foramen.

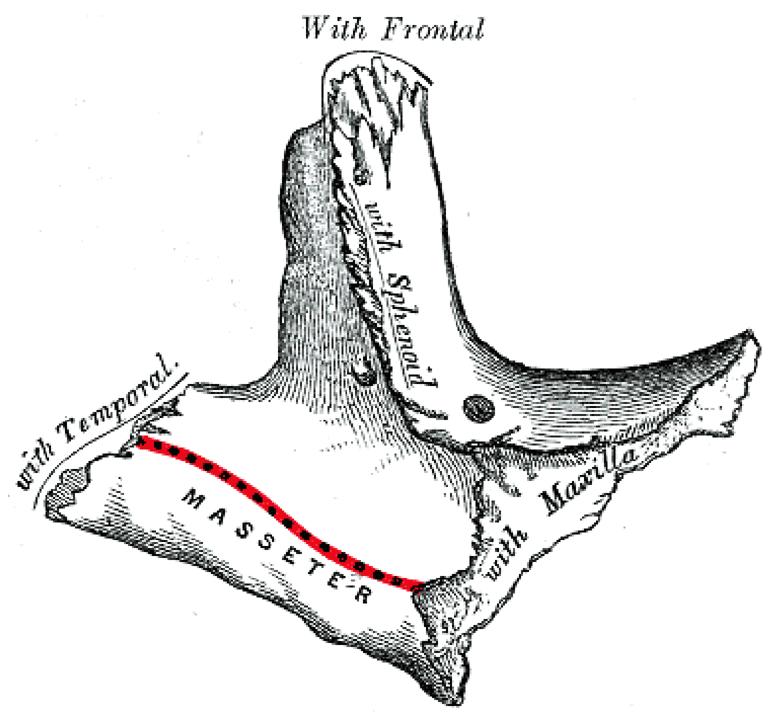
The marginal tubercle or Whitnall’s tubercle lies just inside the orbital margin, just below the frontozygomatic suture. It receives the attachment of the lateral canthal ligament, Lockwood's suspensory ligament and lateral "horn" of the levator.

Several nerves transit the zygoma. The zygomatic nerve is a branch of the maxillary division of the trigeminal nerve and enters the orbit through the inferior orbital fissure. The nerve divides into two branches; a zygomatic ofacial nerve that emerges from the orbit onto the face via the zygomatic ofacial foramen



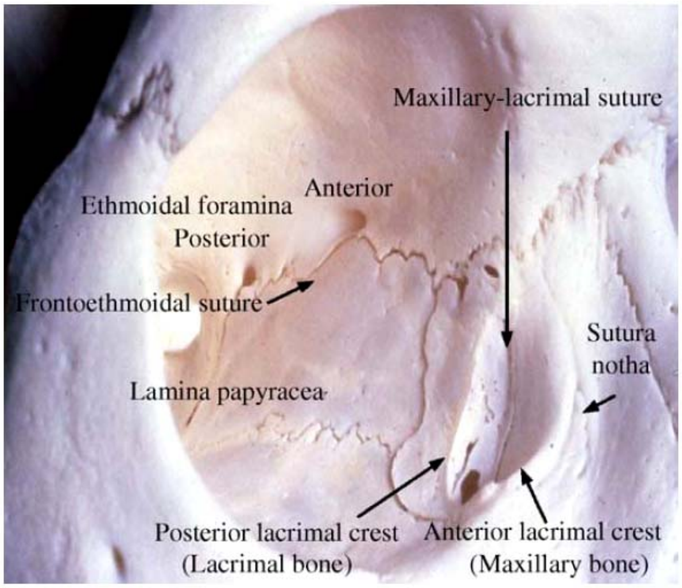
and supplies skin overlying the cheek prominence and a zygomaticotemporal nerve that enters the temporal fossa via the zygomaticotemporal foramen on the deep surface of the zygoma and supplies sensation to the anterior part of the temple area.

The infraorbital groove and foramen are within the maxilla and not the zygoma, but they warrant mention because they often are disrupted in zygomatic fractures and familiarity with their anatomy is worthwhile. The infraorbital nerve is the largest cutaneous branch of the maxillary division and travels across the maxilla from the orbit through the infraorbital groove to exit onto the face via the infraorbital foramen. This important foramen is 10mm inferior to the rim, parallel to the medial surface of the cornea in straightforward gaze. The infraorbital nerve has



branches that travel within bone in the anterior wall of the maxilla to the upper teeth and cutaneous branches that supply the ipsilateral nose, lower eyelid, and upper lip. The nerve therefore contains osseous and cutaneous branches, any of which may be affected by a fracture, singularly are in combination.[8]

All zygomatic complex fractures involve the orbital floor, and therefore an understanding of orbital anatomic features is essential for those treating these injuries. The orbit is a quadrilateral pyramid that is based anteriorily. The lateral and medial walls converge posteriorly at the orbital apex. The roof is composed of the frontal bone and lesser wing of the sphenoid. The medial wall consists of the frontal process of the maxilla, the lacrimal bone, the orbital plate of the ethmoid, and a small portion of the sphenoid body.



The orbital floor slopes inferiorly and is the shortest of the orbital walls, averaging 47mm. It is composed of the orbital plate of the maxilla, the orbital surface of the zygomatic bone, and the orbital process of the palatine bone. The lateral orbital wall is the thickest and is found by the zygomatic and sphenoid bones.

The position of the globe in relation to the horizontal axis is maintained by Lockwood's suspensory ligament. This attaches medially to the posterior aspect of the lacrimal bone and laterally to the Whitnall's tubercle (which is 1cm below the fronto-zygomatic suture on the inner aspect of the frontal process of the zygoma). The shape and location of the medial and lateral canthi of the eyelid is maintained by the canthal tendons. The lateral canthal tendon also attaches to Whitnall's tubercle. The medial canthal tendon has an attachment both to the anterior and posterior lacrimal crests. ZMC fractures are often accompanied by antimongoloid (downward) cant of the lateral canthal region caused by displacement of the tendon.[9]

REVIEW OF LITERATURE

Incidence and Etiology

A.D.Hitchin and S.T. Shuker in 1973[10] analyzed case histories of patients with zygomatic bone fractures treated at the Eastern Regional Board (Scotland) hospital for 10 years. They found that the zygomatic fractures due to fights, fall and sports show a high incidence affecting the left side more than the right side bone and road traffic accidents affected the right side bone more than the side bone.

Balle V, Christensen PH in 1982[11] studied one hundred and five patients with zygomatic fractures. The main cause of fracture was violence, followed by road traffic accidents, fall and sports related injuries. They did not find the X-ray subdivision by Knight and North useful in the evaluation of the stability of the fractures.

Nakano Y, Nakamura.T in 1990[12] state that the occurrence of maxillofacial bone fracture has gradually increased. There were 259 cases of maxillofacial bone fracture from 1981 to 1988 in which 14 cases were fractures of zygomatic bone and zygomatic arch. Pathognomonic symptoms were infra-orbital neuro paralysis, trismus and recess of the buccal region. The incisions for open reduction were applied in the lateral brow, the lower eyelid or intraoral approach. ‘U’ shaped elevator was used for the reduction and miniplates and stainless steel wires were used for fixation.

Covington.D.S, Parks.D.H in 1994[13] presented a 10 year retrospective review of 259 zygoma fracture to highlight changes in epidemiology and treatment. Motor vehicle related trauma resulted in a majority of the injuries (80. 6%) with a high incidence of multiple facial fractures (43.2%). The proportion of fractures receiving open reduction and internal fixation (ORIF) remained relatively constant (46.3%). There was a trend towards the use of the lateral maxillary buttress. The need for orbital floor exploration decreased by almost half, possibly reflecting improved preoperative radiological evaluation

Behcet Erol et al in 2004[14] analyzed retrospectively the demographic distribution treatment modalities, and complications of maxillofacial fractures in 2901 patients It was found that facial fractures were most frequent in males (77.5%) and in the 0-10 year age group; they tended to be more frequent during summer (36.3%); and traffic accidents were the most common aetiological factor (38%). 77.9% of cases were treated with conservative methods, and 22.1% with one or more internal fixation techniques. The most favoured technique was miniplate osteosynthesis; the complication rate associated with internal fixation was 5.7%.

Assessment

Kristensen S, Tveteras K in 1986[15] did a retrospective study of zygomatic fractures in order to analyze late complications and to evaluate the different radiographic classifications. The study comprises 109 patients with 111 zygomatic fractures. The etiology was violence in 39% and road traffic accidents in 28%. Associated fracture of the craniofacial skeleton occurred in 42% of the patients. 72 patients were available for the follow up study. Malar flattening was found in 16% of the patients operated on. 34% of the patients had sensory disturbances, 6% had enophthalmos and 1% had diplopia.

G.R.Ogden and J.G.Cope in 1988[16] did a survey of the fractures involving the zygomatic complex to provide information on whether postoperative radiograph is necessary in their management. They proposed that preoperative radiographs are absolutely essential for the proper assessment of the extent of injury of facial skeleton. They concluded their study by saying that in order to avoid unnecessary patient exposure to ionizing radiation the clinical judgment alone is sufficient for post-operative evaluation.

A.Al-QurainyandL.E.Stasen et al in 1991[17] carried out a study on the type of injury sustained by the incidence and severity of subsequent eye movement and to identify the risk factors involved to determine the prognosis for the restoration of the binocular vision. They concluded that early surgical reconstruction of midfacial fracture with conservative management of concomitant mobility disorders resulted in very few patients having diplopia in the long run.

Classification

Knight JS, North JF in 1961[18] classified zygomatic fractures by the direction of displacement on a Waters' view radiograph. They classified 120 fractures into 6 groups, hypothesizing that stability after reduction might be related to the direction of displacement. The 6 groups are as follows,

Group 1 : Nondisplaced fractures

Group 2 : Arch fractures

Group 3 : Unrotated body fractures

Group 4 : Medially rotated body fractures

Group 5 : Laterally rotated body fractures

Group 6 : Complex fractures, these have additional fractures across the body of the zygoma

P.M.Finly, K.P.Wardbooth, K.F.Moos in 1984[19] discussed the complication encountered during the treatment of unstable zygomatic complex fractures with antral packs and external pins. They followed the Henderson classification system which is as follows

Type 1 – undisplaced fracture

Type 2 – zygomatic arch fracture only

Type 3 – tripod fracture with fronto-zygomatic suture intact

Type 4 – tripod fracture with separation of fronto- zygomatic suture

Type 5 – pure blow-out fracture

Type 6 – orbital rim fracture

Type 7 – comminuted fracture

There is no displacement of the body of zygoma in Types 1, 2, 5 and 6. In types 3,4and 7 displacements occurs and once reduced, fixation is required to stabilize the fragments.

Manson PN, Markowitz B, Mirvis S, Dunham M, Yaremchuk M in 1990[20] classified fracture patterns as low, middle, or high energy, defined solely by the pattern of segmentation and displacement in the CT scan. Exposure and fixation relate directly to the fracture pattern for each anatomic area of the face, including frontal bone, frontal sinus, zygoma, nose, nasoethmoidal-orbital region, midface, and mandible. Fractures with little comminution and displacement were accompanied by subtle symptoms and required simple treatment; middle-energy injuries were treated by standard surgical approaches and rigid fixation. Highly comminuted fractures were accompanied by dramatic instability and marked alterations in facial architecture; only multiple surgical approaches to fully visualize the "buttress" system provided alignment and fixation. Classification of facial fractures by (1) anatomic location and (2) pattern of comminution and displacement define refined guidelines for exposure and fixation.

Zingg M, Laedrach K, et al in 1992[21], presented a treatment guideline based on a simple classification of zygomatic fractures. The emphasis is placed on the indications for closed and open reduction, consistent methods of three-dimensional alignment and fixation, and the management of concomitant infraorbital rim and orbital floor fractures. Postoperative results with regard to infraorbital nerve and maxillary sinus dysfunction, malar asymmetry, and orbital complications in the treatment of 1,025 consecutive zygomatic fractures are presented. Their classification system is based on anatomic points and divides fractures into 3 categories: category A includes isolated fractures of 1 of the 3 processes of the zygomatic bone. These processes are the temporal process, which forms the zygomatic arch (A1), the frontal process, which forms the lateral orbital wall (A2), and the maxillary process, which forms the infraorbital rim (A3). Category B represents fractures of all 3 processes, rendering the zygomatic bone detached from the facial skeleton. Category C is the same as type B, but with fragmentation, including the body of the zygoma.

A.F. Kovacs, M. Ghahremani in 2001[22] did a prospective study to establish and justify minimized therapy for zygomatic complex fractures. 52 consecutive patients were examined and classified with conventional routine radiographs. Treatment of zygomatic fractures was by percutaneous hook reduction and miniplate fixation along the frontozygomatic suture and they had excellent results. They also proposed a classification system and terminology. It is as follows

1. Zygomatic fractures – A lateral midface fracture in one fragment with fracture lines along the lateral orbital margin, orbital floor and infraorbital margin, facial sinus wall to the zygomaticomaxillary crest and the zygomatic arch. It can be dislocated or not; the reconstruction of the orbital floor can be obtained by reduction of zygomatic bone alone.
2. Orbitozygomatic fracture – In addition to the definition of the zygomatic bone fracture, the clinical symptom of primary diplopia has to be present. The reconstruction of the orbital floor cannot be obtained by reduction of the zygomatic bone alone, so orbital floor reconstruction is mandatory.
3. Comminuted zygomatic bone fracture – In addition to the fracture lines mentioned earlier, other fracture lines are present, creating multiple fragments. Reconstruction of the orbital floor is necessary whether or not primary diplopia is present.

Decision on treatment plan

Richard W. Branca in 1970[23] explained the healing of the zygoma fractures by a hypothesis concerning the induction mechanism in facial fractures. He made a conclusion that the final repair in zygomaticomaxillary complex fracture is a combination of fibrous and bony union.

Gerlock AJ, Sinn DP in 1977[24] enforces that a better understanding of the mechanisms by which clinical signs and symptoms are produced is a prerequisite to the correct appreciation of radiographic features. Radiographs of facial trauma are no different in this respect. This paper describes the specific clinical finding associated with each displaced bony fragment of the zygomatic complex fracture.

Winstanley R.Pin 1981[25] **describes** a series of cases of ZMC fractures, studied to see if a change to a more extensive surgical intervention was justified. The surgical anatomy of the cheek bone complex was studied and certain protective features which determine the pattern of fracture were noted. Treatment plan which takes into account these facts were suggested. Some observations were made on diplopia and enophthalmos and a plea is made for caution in accepting the concept of “blowout” fracture.

Fain J, Peri G, Verge P, Thevonen D in 1981[26] stated that in certain orbito-zygomatic fractures, a fronto-zygomatic plate by means of a single eyebrow incision after repositioning of the cheek bone, the other fracture sites remodel themselves spontaneously due to the action of adjacent soft tissues. Success depends on the experience of the surgeon.

Rinehart G.C, Marsh J.L, Bresina. S in 1989[27] emphasizes that open reduction and internal fixation of displaced zygomatic complex fractures are necessary to avoid immediate and delayed facial disfigurement.

Zing.M, Laedrach.K, Chen.J in 1992[28] gave a treatment guideline based on a simple classification of ZMC fracture. The emphasis is placed on the indications for closed and open reduction, consistent methods of three dimensional alignment and fixation and management of concomitant infraorbital rim and orbital floor fracture. Postoperative results with regard to infraorbital nerve and maxillary sinus dysfunction, malar asymmetry and orbital complications in the treatment of 1025 consecutive zygomatic fractures are presented.

Westermark.A, Jensen J, Sindet Pedersen S in 1992[29] reviewed the results obtained with different modalities of treatment employed in isolated fractures of the ZMC.73 patients were reexamined with respect to infraorbital nerve function. The results obtained suggested that the incidence of hypoesthesia of the infraorbital nerve following fracture of the ZMC can be reduced if rigid fixation is applied.

Rod.J.Rohrich and Denton Watumull in 1994[30] evaluated retrospectively the long term results of the plate and wire fixation with a high volume of cranio-maxillofacial fractures. The long term experimental study demonstrated that miniplates maintain the osseous volume of bone grafts and prevent the non union at bone graft contact points better than wires. They confirmed that rigid internal fixation is superior in minimizing or preventing long term sequelae of facial fracture.

Edward Ellis and WinaiKittidumkerng in 1996[31] did a retrospective study to evaluate the adequacy of reduction and stability of fixation of isolated zygomaticomaxillary complex (ZMC) fractures treated by various methods over a five year period. They concluded that a variety of techniques can be used to produce a satisfactory outcome. The four most important considerations in treating ZMC fracture are proper reduction, adequate stabilization, adequate orbital reconstruction when necessary and proper handling of periorbital soft tissues. They were able to use one-point fixation in many of their cases, none of their patients showed post reduction displacement regardless of the number of fixation devices used.

A.J. Sidebottom, T.C. Lord in 1998[32] did a study to investigate the effect of introducing a one-view occipitomental15^{o} view screening policy into the Accident and Emergency department of a district general hospital. 625 patients had midfacial radiographic screening over a one year period. Only eight patients required further views to confirm diagnosis

Shumrick K.A, Cambell A.C in 1998[33] **emphasizes** the importance of reducing and fixing the facial buttress involved in ZMC fracture and recommends orbital exploration on a selective basis. Criteria are given to decide which patient requires orbital rim and floor exploration. If a patient's fracture does not meet these criteria, the fracture is managed by exploring, reducing and stabilizing the major facial buttresses involved without performing an orbital exploration. 97 patients with ZMC fractures were examined and treated with selective orbital rim and floor exploration. Most patients could be managed without the need for orbital exploration and all were felt to have good fracture reduction and stability.

A.F. Kovacs, M. Ghahremani in 2001[34] did a prospective study to establish and justify minimized therapy for zygomatic complex fractures. 52 consecutive patients were examined and classified with conventional routine radiographs. Treatment of zygomatic fractures was by percutaneous hook reduction and miniplate fixation along the frontozygomatic suture and they had excellent results.

Edward Ellis and Likith Reddy in 2004[35] did a retrospective study to determine the status of internal orbit before and after reduction of ZMC fractures when treated without internal orbital reconstruction. They concluded that the preoperative CT scan can be used to assess the amount of internal orbital disruption. When there is minimal or no soft tissue herniation and minimal disruption of the internal orbit, ZMC reduction is adequate treatment.

Anatomic studies

Michel.F.Zide and Jeffery W.U in 1990[36] did an anatomical study to assess the safe position to place the screw holes for the stabilization of zygomatic fractures in the fronto-zygomatic region. They found that when drilling perpendicular to the bone, the drill should be placed at an acute angle to the forehead to prevent cranial encroachment. It was found that 6mm screws could be safely used above the lateral frontal sutures.

Reher P, Duarte GC in 1994[37] did a study of the frontozygomatic region to determine an anatomic basis for the use of miniplates in this area. Plaster models were obtained from 35 adult skulls and were sectioned at six defined points. Osseous thickness measurements were made perpendicular to the bony surface. Measurements to determine the risk of penetrating the cranial cavity were also done. The results showed that above the frontozygomatic suture 5mm screws should be used, below the suture 7mm screws can be used. The risk of penetrating the cranial cavity occurs 10mm above the suture.

Treatment methods

Walter W.Crowe in 1952[38] reported about treatment of depressed fractures of the zygomatic bone using steel hook for reduction. The diagnosis of fracture was done based on history, local appearance, palpation and roentgenographic features. The signs and symptoms were facial swelling, depression or flatness of the face, limitation of the mandibular movement resulting from muscular spasm or mechanical obstruction, ecchymosis, unilateral nasal hemorrhage, infraorbital paresthesia, diplopia and emphysema.

G.Kenneth Lewis in 1953[39] discussed a method of restoring the facial contour with rib cartilage or cancellous bone combined with excision of the involved coronoid process for the treatment of old depressed fractures of zygoma with impingement on the coronoid process of the mandible.

Vernard R. Jackson et al in 1956[40] recommended balloon technique in the reduction of the depressed orbital and comminuted fractures of the zygomatic bone and anterior surface of the maxilla. The air pressure in the balloon can be controlled and regulated easily and further alignment can easily be accomplished. They stated that cosmetic results are excellent since no external incisions are necessary and the intra nasal opening into the antrum heals readily.

Raymond E. Bourdeaux in 1957 [41] developed a modified urethral sound for reduction of isolated zygomatic complex fractures to prevent lateral movement of the urethral sound in the region of operator's wrist to assure a maximum direct pull force.

Kai Lund in 1971[42] evaluates the long-term result after closed reduction of fractures of the zygoma by Gilles temporal approach. He achieved quite satisfactory results.

Podoshin and M.Fradis in 1974[43] suggested a method for the reduction of fractured zygoma by the use of Foleys catheter.

David poswillo in 1976[44] described the reduction of the malar complex fracture by direct extra –oral application of a specially designed traction hook. He describes the intersection of two imaginary lines, one dropped vertically from the outer canthus and the other drawn horizontally from the ala of the nose. The skin hook is to be inserted at this point to engage the infratemporal surface of the zygoma. The advantage includes the speed and effectiveness of the reduction of the fracture following a line of withdrawal almost identical to that occurring during fracture impaction. The strohymeyer bone hook is used most widely for this procedure, although a large number of zygomatic hooks have been described. He reported that there is no evidence of the wound on skin of the cheek after thirty days and elaborated on the short operating time (less than five minutes) and simple anesthetic methods.

Altonen M, Kohonen A, Dickhoff K in 1976[45] followed fifty two patients with zygomatic fracture. The patients were examined clinically and roengenologically one to four years after treatment. Of these fifteen patients were treated with bone fixation, twenty six with antral packing using plastic tubing. Internal wiring proved to be better than antral packing when restoration of function of the infraorbital nerve, position of the eye, symmetry of the palpebral fissure and final cosmetic results were considered. The study revealed that the reduction results were more exact with internal fixation than with antral packing.

K.W.Butow and J.H.Eggert in 1984[46] discussed the modern trend in the therapy of maxillofacial trauma which includes wire osteosynthesis, miniplates, bone transplantation for orbital floor reconstruction and the use of lyophilized dura placed over bony defects. They treated the fracture of fronto-zygomatic suture by a single four hole miniplate to stabilize the quadrimalar fracture. They preferred wire osteosynthesis in displaced fracture of the inferior orbital margin.

Bienfait. A, Monballiu G, Depoorter. M in 1984[47] tell their experience in the management of ZMC fractures based on 168 cases treated in the Plastic Surgery Unit of Bruges between January 1971 and August 1980. The symptomology and treatment of those fractures are discussed according to the type of fracture. The importance of early treatment and the necessity of osteosynthesis when the fronto-zygomatic suture is distracted are discussed. The use of a silastic sheet for blow-out fracture is advocated.

Holmes K.D, Mathews B.L in 1989[48] described the use of a sub labial incision for direct visualization and alignment of the fracture lines at the infraorbital rim and lateral maxillary buttress. When coupled with single miniplate fixation of the zygoma across the frontozygomatic suture the sub labial approach resulted in improved reduction of the fracture with rigid stabilization.

Medvedev Lu A, Sivolapov K.A in 1993[49] analyzed the results of surgical treatment of 78 patients with zygomatico-orbital injuries. Miniplates of titanium nickelide with thermo-mechanical memory were employed for fracture fixation. Surgical strategy based on osteosynthesis with the use of such devices provides a reliable fixation of bone fragments and makes the operation less traumatic

Tarabichi M in 1994[50] described and evaluated trans-sinus reduction and one point miniplate fixation of zygomaticomaxillary buttress for the treatment of tripod malar fracture. A consecutive sample of 17 patients presenting with isolated tripod malar fracture over a 42 month period were studied. Miniplate fixation of the zygomatico-maxillary buttress was then performed, bridging over an area of bone loss and comminution of the orbital rim is crucial for the stability of the reduced zygoma

A.G.Symth in 1995[51] described a modification of titanium miniplate for the reduction of unstable fracture of malar complex

D.A.Mitchell and S.P.R.Macleod et al in 1995[52] recommended the use of side by side microplate multipoint fixation to increase the total screw to bone contact in addition to improving geometric stability and an impalpable method of long term fixation

Cyrus Mohammadinezhad et al in 2009[53] did a study to evaluate the minimally invasive therapy in cases of zygomatic fractures. Different methods of internal fixation of simple displaced zygomatic fractures, such as wiring, miniplate, and screw fixation were compared for post reduction rotational stability caused by muscular forces. They showed that treatment of an isolated zygomatic bone fracture according to aesthetic and functional requirements can be achieved by insertion of a single miniplate at the lateral rim of the orbit.

Kun Hwang et al in 2010 [54] analyzed cases treated by lateral brow incision and 1-point fixation and to introduce the criteria for application of this selective approach. The result was that the 3-point fixation provided the best stability, but at least 1 miniplate fixation of only the frontozygomatic suture was also acceptable in providing stability of the fractured zygoma.

Comparison studies

Desloovere. C, Meyer Brieting.E, in 1988[55], states that at the university ENT clinic Frankfurt, 105 patients with zygomatic fractures were treated from 1980 to 1986. 45 patients were treated with a maxillary sinus stent, part of them in combination with wire osteosynthesis. Miniplate osteosynthesis was performed in 30 patients, comparing the long term results of these methods with pre and post operative radiological and functional data. Patients with miniplate osteosynthesis did better than with other modality of treatments. In orbital floor fractures the degree of enophthalmos was more severe in those patients where only reduction was done.

Davidson.J, Nickerson. D, Nickerson B in 1990[56] has analyzed different methods of internal fixation of simple displaced fracture of the zygoma in an attempt to define the simplest method of achieving post- reduction stability. Twenty five combinations of interfragmentary wiring and miniplate and screw fixation of fractured zygoma on human skulls were compared for post-reduction rotational stability against stresses simulating muscular forces that act to displace the zygoma. Analysis of the data suggests that while three point fixation using miniplates allows for virtually no displacement. Two point fixation and in certain cases one point fixation provides acceptable stability.

Wilfred.G.Schilli in 1991 [57] reported that in simple fractures of the ZMC without great comminution, the use of one dynamic compression plate in the fronto-zygomatic suture area is sufficient.

Dal Santo F, Ellis E , Throckmorton GS in 1992 [58] did a study to compare masseter muscle force in 10 male controls with that in 10 male patients who had sustained unilateral zygomaticomaxillary complex (ZMC) fractures. Calculation of muscle force was based on measured bite force, electromyogram, and radiographic determination of muscle vectors. It was found that the masseter muscle in patients with ZMC fractures developed significantly less force than masseter muscle in controls. Following fracture, the masseter force slowly increased, but at 4 weeks following surgery the majority of patients were still well below control levels. The results of this study cast uncertainty on the role of the masseter muscle in postreduction displacement of the fractured ZMC.

Richard.M.Carr and Robert.M.Mathor in 1997[59] did a study to review the experience with early and delayed repair of the orbitozygomatic complex fracture and developed guidelines for repair based on the timing and extent of injury. They concluded that orbito-zygomatic fracture can be repaired up to 21 days post injury using primary reduction and fixation technique. Osteotomies are required after 21 days and can be used successfully up to 4 months post injury. After 4 months repair requires onlay bone grafting.

Jan.P.M.Virens and H.W.VanderGlas et al in 1998[60] did a study on the sensory disturbances following orbitozygomatic complex fractures in relation to the type of the fracture and the method of treatment. They concluded the study by saying that the degree of sensory disturbance of patients who underwent orbital floor reconstruction was intermediate compared to patients with closed and open reduction respectively

Zachariades N, Mezitis M in 1998[61] evaluated the efficacy of the current methods in the treatment of the fractures of ZMC. 1277 patients with fractures of ZMC and 196 patients fractures of the zygomatic arch were admitted between 1984 and 1995 were evaluated. The Gillies approach was used in 514 cases, interosseous wiring in 89 cases, bone plate osteosynthesis in 322 cases, Roger-Anderson pins in 180 cases, antral packing in 17 cases and elevation with a hook in 28 cases. The best results were achieved with the use of semi rigid fixation with miniplates applied at one or more sites in the fractured complex. They concluded that semi rigid fixation with miniplate offers the most reliable method available today for the treatment of zygomatico-orbital complex fracture and has practically replaced every other method in their institution.

Rafael Benoliel et al did a study in 2005[62] to document the neurosensory changes in the infraorbital nerve following zygomatic fractures managed in various ways. Neurosensory function was assessed with calibrated nylon monofilaments, electrical stimulation, heat detection thresholds and response to pin prick in the infraorbital, supraorbital and mental nerve regions. The study concurs with previous studies in finding that plate fixation allows for significantly better restoration of infraorbital nerve function.

Complications

E.W.B Varley et al in 1955 [63] presented a case of traumatic orbital apex syndrome following delayed reduction of zygomatic fracture. The severe infraorbital hemorrhage lead to complete loss of vision. The immediate decompression of the orbit via the maxillary antrum and intra-arterial injection of papavarine to the central retinal was achieved by cannulating the supraorbital artery.

J. Cornah in 1983[64] described treatment of a malar bone fracture complicated by the development of lower eyelid abscess, dehiscence and discharge from the temporal wound and prolapsed necrotic temporal fascia following Gillies temporal approach. He found that the spread of antral infection through the comminuted roof into orbit, lower eyelid and the temporal fossa would be facilitated by the potential subperiosteal space. Early incision and drainage with appropriate antibiotic was given for management.

P.M.Finly, K.P.Wardbooth, K.F.Moos in 1984[65] discussed the complication encountered during the treatment of unstable zygomatic complex fractures with antral packs and external pins. They followed the Henderson classification system. They showed that the complications with antral packs were high incidence of infraorbital dysesthesia, due to excess pigmentum iodoform composition in the pack. They showed that antral packing was less satisfactory and had an increased morbidity that was statistically significant

Andrew Bernard and Donald Sadowsky in 1986[66] reported a case of monocular blindness secondary to a non-displaced malar fracture. They concluded that the blindness was sequelae of orbital apex syndrome which is an extension of superior orbital fissure syndrome involving the optic foramen and optic nerve resulting in retrobulbar neuritis, papilledema and blindness.

Robert Campbell et al in 1994[67] **reported** a case of asystole and bradycardia during extraorbital surgery and reviewed the literature on stimulation of the trigeminovagal reflex.

M.G.Gilhooly and D.T.Falconer et al in 1995[68] reported a case of orbital subperiosteal abscess complicating a minimally displaced ZMC fracture. The made the diagnosis by the interpretation of the lateral skull radiographs. They treated the subperiosteal abscess by drainage in infraorbital and medial canthal incisions and antibiotic therapy

METHODOLOGY

Patients and methods

This prospective study was conducted on thirty five patients, who reported with unilateral zygomaticomaxillary complex fracture at the Department of Oral and Maxillofacial Surgery, Tamilnadu Government Dental College and Hospital, Chennai-3, between June 2010 and November 2010.

Demographic data collected from the patients includes age, sex, residential address, profession, mode and etiology of injury, medico-legal status, usage of helmet (if due to RTA), time of injury, time period elapsed from the time of injury to initialization of treatment and complications.

All the patients were treated, as level-1 office surgical procedure under local anesthesia. Follow up was done periodically for about 90-120 days.

Ethical approval was obtained from the ethical committee of the hospital and informed consent in regional language (Tamil) was obtained from each participant.

Patients with unilateral zygomatic bone fractures, irrespective of cause, age and sex were included in the study.

Patients having associated head injuries, multiple facial fractures, bilateral zygomatic bone fractures, severe comminuted fracture of zygomatic bone, diplopia, loss of visual acuity, blow-out and blow-in fractures were excluded.

Neurological and ophthalmological examination and assessment was done, and fitness obtained for all the patients. The neurological assessment was done in the Department of Neurology, Government General Hospital, Chennai; the ophthalmological assessment was done in the Regional Institute of Ophthalmology, Egmore, Chennai.

Blood investigations, urine analysis and tests for HIV antibodies (ICTC) were done for all the patients. All patients were assessed for any co-morbid illness and if found to have any, appropriate measures were taken.

Blood investigations included the following

- Total cell count
- Differential count
- ESR
- Platelet count
- Haemoglobin percentage
- Bleeding time
- Clotting time

The urine investigations included the following

- Sugar
- Creatinine
- Albumin

Detailed history was taken and physical examination was carried out for all the patients.

Even though Occipitomental view (paranasal sinus) was the standard radiograph used for pre and post-operative radiographic evaluation, CT scans were used for quite a number of patients. Miniplates of 2mm diameter and screws of 6mm length and 2mm diameter were used in all the cases requiring fixation.

CASE SHEET

History and clinical examination

1. Case No.
2. Date of Injury/ presentation to the department
3. Time elapsed
4. Name
5. Age/Sex
6. Occupation
7. Address
8. Telephone no
9. CHIEF COMPLAINT
10. HISTORY OF PRESENTING ILLNESS
    a. Date of Injury
    b. Date of presentation to our unit
    c. Time elapsed from the time of injury to initialization of the treatment
    d. Etiology of trauma
        i. Road Traffic accidents/ Usage of helmet
        ii. Alleged Assaults
        iii. Fall
        iv. Sports related injuries

v. Others

11. Past Medical History
12. 12.Past Dental History
13. Drug History and History of Allergy
14. Family History
15. Social History
16. Personal History
17. Previous Surgeries under Local anesthesia

General Examination

-Anemia

-Jaundice

-Cyanosis

-Clubbing

-Edema

-Lymphadenopathy

-CVS

-RS

-CNS

-GIT

LOCAL EXAMINATION

Extraoral Examination

Inspection

-Facial asymmetry / loss of malar prominence

-Edema

-Abrasion

-Laceration

-Soft tissue Loss

-Ocular injuries

-Ocular displacement

Exophthalmos

Enophthalmos

Unequal Pupillary level

-Displacement of the palpebral fissure (Mongoloid/Anti-Mongoloid slant)

-Limitations in Eye movements

-Diplopia

-Circumorbital ecchymosis

-Circumorbital edema

-Subconjunctival haemorrhage

-Mouth Opening

-Jaw movement

-Signs of infection

Palpation

-Tenderness/Pain

-Crepitus

-Mobility

-Step deformity

-Paresthesia

INTRAORAL EXAMINATION

Inspection

-Trismus

-Teeth Present

a. Missing

b. Avulsed

c. Subluxated

-Oral Hygiene-Good/Fair/Poor

-Occlusion- Normal/Deranged

-Open Bite

- Step Deformity

- Soft tissue laceration

-Hematoma/ ecchymosis in the upper canine region

- Exposed bone

-Signs of infection

Palpation

-Mobility of teeth

-Insensibility of the anterior teeth

-Mobility of # Segment

-Deformity of the zygomatic buttress

-Tenderness

-Step deformity

CLINICAL IMPRESSION

INVESTIGATIONS

Radiographs

-Occipitomental view

-Submentovertex projection

CT scan

Axial/ coronal sections with 3D reconstruction

RADIOGRAPHIC IMPRESSION

FINAL DIAGNOSIS

TREATMENT PLAN

COMPLICATIONS / OUTCOMES

SURGICAL PROCEDURE

All the patients were prepped and draped to ensure a sterile field. Skin markings, to determine the point of application of the hook, were made prior to administration of the local anesthesia to prevent distortion of the markings. The point of application of the hook is determined, by drawing a vertical line from the outer canthus of the eye and a horizontal line from the middle of the ala of the nose. The point of intersection of these lines marks the point of application of the hook. A standard syringe with a 24-gauge needle was used to inject 2cc of 2% lignocaine with 1:100000 adrenaline over the frontozygomatic and zygomaticotemporal sutures as well as over the infraorbital rim via a transcutaneous approach. Afterwards, an intraoral injection was used to anesthetize the zygomaticomaxillary buttress and perform an infraorbital block. Finally, the area underlying the stab incision and the trajectory path of the Stacey malar hook were infiltrated down to the malar bone.

Several minutes later, a stab incision using a 15 no. blade was performed at the point of intersection. This stab incision is oriented along the relaxed skin tension lines of the face to maximize the

esthetic outcome. The hook is inserted percutaneously just under the zygoma. And it is important to confirm the tip placement of the hook on the undersurface of the body of the zygoma to avoid the thin bony wall of the posterior maxilla.

After an incision (1.5 cm) at the lateral eyebrow and exposure of the fracture at the frontozygomatic suture, the zygoma is reduced percutaneously. Reduction is controlled at the lateral orbital rim by inspection and at the infraorbital rim, the zygomatic arch and the zygomaticomaxillary crest by palpation.

A vector of direction opposite to the one having created the fracture is applied in a controlled manner. This direction is approximated by the history of trauma, physical examination and pre-operative radiographic findings. The index finger of the operator’s hand is placed over the infraorbital rim to fully appreciate reduction of the zygoma. A to and fro motion may be necessary to disimpact the malar complex sometimes. An audible click may sometimes be heard once reduction is accomplished.

Then, internal fixation was carried out with one miniplate (diameter 2 mm) and four screws (diameter 2 mm, length 6 mm) along the lateral orbital rim.

Patient is observed for an hour and discharged when stable. They were instructed to avoid pressure over the cheek and to sleep in a semi seated position for a couple of days. Furthermore a soft diet recommended for the same duration.

OBSERVATION AND RESULTS

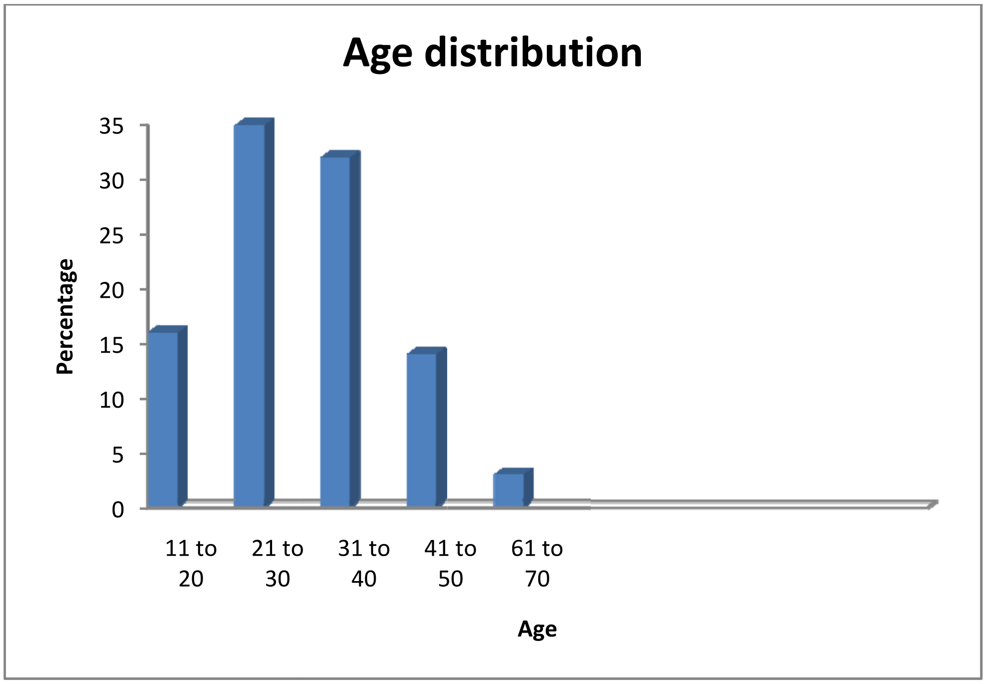
1. Demographic data

No. of cases and time period

Thirty five patients received treatment for unilateral zygomaticomaxillary complex fracture from June 2010 to November 2010.

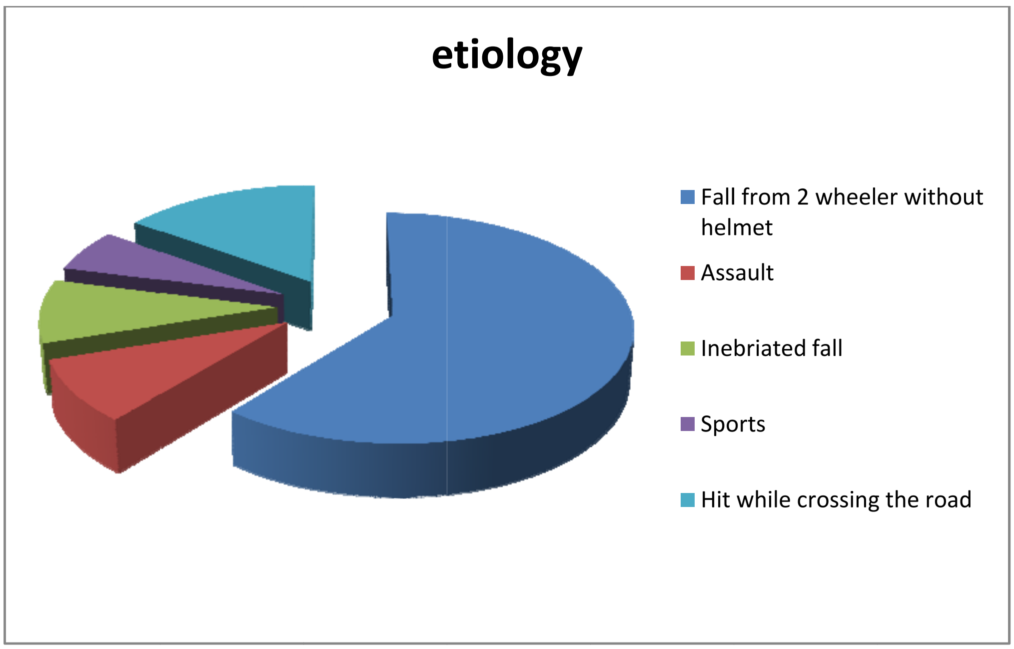
Age and Gender distribution

The majority of the patients were male (94%, female 6%). The age decades in which fractures were most common were, in decreasing order of frequency, 21-30 group (35%), 31-40 group (32%), 11-20 group (16%), 41-50 group (14%), 61-70 group (3%).



Etiological factor

Accidents involving two wheeled motor vehicles were the most common, followed by accidents involving pedestrians, while crossing the road. Interpersonal violence and fall in inebriated state had almost equal distribution followed by, to a lesser extent sports related injuries.



Knight and North classification

The classification given by Knight and North has been used in this study and fracture types in decreasing order of frequency were, Group V (46%), Group IV and Group VI (19%), Group I and III (8%)

2. Treatment and Complications

To focus on orbitozygomatic complex fractures, we have excluded reduction results of isolated zygomatic arch fractures, which are also routinely reduced under local anesthesia. Most of the patients included in this prospective study were male, with a mean age of 31 years. All patients had a preoperative Occipitomental view (Paranasal sinus) radiograph, and a limited number of patients had CT scan taken. All the patients had zygomatic fractures without orbital involvement. Most of the patients were treated within 10 days following trauma, but a few reported a little late. Mean delay from diagnosis to operation was 2 days. Most of the patients found the procedure to be acceptable, but a few had some discomfort during surgery.

The post- operative results were evaluated based on subjective and objective signs and symptoms. Post-operative Occipitomental radiograph was taken for all the patients, and CT was done for limited number of patients. None of the patients developed any hyperpigmentation or scar in the region where the hook was applied. The scar was imperceptible in most of the cases, in the frontozygomatic region.

The various signs and symptoms including pain, trismus, subconjunctival and periorbital ecchymosis, malar depression, neurosensory disturbance of the ipsilateral infraorbital nerve resolved to greatly acceptable levels in most of the cases, within a span of weeks. There was no second operation in any of the cases for the purpose of reduction and fixation.

One patient complained of, being able to feel-through the stainless steel miniplate, and it was removed at the end of 4 weeks. One patient came back with fractured miniplate used for fixation, following a hit by a cricket ball in the frontozygomatic suture area. But, no new fracture was detected. And the old fracture had stabilized by then, and was undisplaced.

One patient developed infection in the frontozygomatic region, at the end of 3 weeks and the miniplate was removed and appropriate measures taken, following which the infection subsided. 5 patients did not turn up for long term follow up, but even for these patients the immediate post-operative results looked promising.

DISCUSSION

The methods of treating a fractured malar bone recommended by the various experts includes, simple digital manipulation under general anesthetic, external manipulation by means of a cow-horn dental forceps grasping the edges of the bone, traction and elevation by means of wire or heavy bone elevators passed through small local external incisions, and elevation via incision in the mucosa of the gingival sulcus at the canine fossa.

Since Duverney first described the fractured zygoma, numerous methods have been suggested for treating it. These treatments range from non intervention and observation to open reduction and internal fixation.[69] Perhaps the four most important considerations in treating ZMC fractures are proper reduction, adequate stabilization, adequate orbital reconstruction (when necessary), and adequate handling/positioning of periorbital soft tissues.[70]

The decision to intervene should be based on signs, symptoms, and functional impairment. The decision need not be made hastily because ZMC fractures are not emergencies, and treatment can be delayed if necessary.

One must be aware that ZMC fractures can result from both high and low energy injuries. Those resulting from altercations seem to be more linear in character and displaced en bloc. These fractures can frequently be treated with limited exposure, simple reduction, and simple methods of fixation.

The fact that so many methods are available for both the reduction and the fixation of zygomatic fractures indicates that no one technique is always superior to the others. Few if any techniques are always satisfactory for every type of zygomatic fracture, so the surgeon's judgment and ability to apply a satisfactory technique or techniques to a given fracture are the deciding factors in whether the patient receives appropriate treatment. It should be stressed that satisfactory results can be achieved with the use of a number of techniques. It is not so much the actual technique, but the proper application of principles, that produces satisfactory results.

There are still unsolved questions with regard to treatment of zygomatic fractures: when is the best time for treatment? , what is the best surgical modality of treatment? , when is an orbital floor reconstruction indicated? , and how long does remission of symptoms take? [71]

Early diagnosis and treatment offers the best opportunity to restore the preinjury structural relationships. However, concomitant life-threatening injuries, misdiagnoses, or inadequate initial treatment can lead to delay in repair and secondary complications that usually require more complex methods of management.

Sidebottom et al,[72] have previously shown that one Occipitomental 15^0 view is sufficient for screening the majority of cases of midfacial injury. This study utilizes Occipitomental views radiograph as the standard radiograph for all the cases, both pre and post operatively.

Richard M. Carr and Robert H. Mathog[73] showed that Orbitozygomatic fractures can be repaired up to 21 days post injury using primary reduction and fixation techniques. Osteotomies are required after 21 days and can be used successfully up to 4 months post injury. After 4 months, successful repair requires onlay bone grafting.

The patients of this study were operated, on an average 6 days after the trauma because of delay in presentation and the need to obtain consent from the ophthalmologist. This interval seems to very favourable for another reason: swelling and hematomas, which might hinder palpatory control of the surgical reduction. These are diminished after a time period and therefore, a very short interval seems to be neither practical nor desirable.

The most important principle in treating fractures, especially those of the face, is proper reduction. If the bone is not placed into the correct position, stabilization becomes superfluous. Zingg et al[74] in reviewing 946 ZMC fractures treated by a variety of means, including 164 treated by “closed reduction,” found a 13% incidence of malar asymmetry.

Fractures that were successfully treated also were reduced by a variety of means. This indicates that many techniques can produce favorable results, but when performed improperly, all can also result in poor reduction.

Recommendations in the literature for reduction of ZMC fractures range from closed reduction methods to 4 point surgical exposure. Incisions used to expose the lateral orbital, infraorbital, and zygomaticomaxillary buttress (intraorally) areas not only take time but also have the potential to produce complications of their own regardless of the zygomatic fracture for which they are being employed. However, surgical exposure of the frontozygomatic region is quite helpful. And this study utilizes this approach.

The advantages of using the hook include the speed and effectiveness of reduction of the fracture, following a line of withdrawal almost identical to that occurring during inward impaction. The direct application of a withdrawal force is believed to preserve many of the fragile bone spicules on the margins, spicules that contribute to post reduction stability by their re-engagement in the reduced position. Methods of elevation that employ an oblique force for disimpaction, e.g. the Gillies method;

often move the fractured margins across each other with a shearing force, thus damaging the osseous projections. It is believed that direct traction reduction can decrease the incidence of post-reduction instability.

When impaction has been severe and treatment delayed for days or weeks, direct application of a traction force will frequently succeed where other techniques for reduction fail. When the stab incision is made as described, there is no evidence of the wound on the skin of cheek after 3 weeks.

The short opening time (usually less than 5 minutes overall) permits the use of simple anaesthetic methods and precludes the necessity for endotracheal intubation. Reduction can be achieved without difficulty in the seated conscious patient anaesthetized locally by infiltration of lignocaine.[75]

Edward Ellis III and Likith Reddy[76] showed that ZMC fractures are almost always associated with fractures of the internal orbit. Typically, a fracture line extends from the inferior orbital fissure anteromedially along the orbital floor predominantly through the orbital process of the maxilla, toward the infraorbital rim. In its course, the infraorbital canal is usually crossed, as the fracture extends through the infraorbital rim. These injuries are associated with various degrees of comminution of the floor of the orbit. Often, orbital soft tissues are displaced through the defect into the maxillary sinus. Because of the increase in orbital volume that can result from orbital floor disruption, internal orbital reconstruction has been a vital component of the treatment of some ZMC fractures. However, it is clear that not all ZMC fractures require internal orbital reconstruction, the difficulty is determining which ones do and which ones do not. A point of continued debate is when and under what circumstances do orbital defects require reconstruction. Although computed tomography (CT) scans have allowed the surgeon to assess the amount of internal orbital disruption that has occurred, there is no universal agreement on how much internal orbital disruption can exist while not requiring internal orbital reconstruction to prevent enophthalmos. When there is minimal or no soft tissue herniation and minimal disruption of the internal orbit, ZMC reduction is adequate treatment.

Another question is the restoration of the function of the traumatized infraorbital nerve. This damage is very frequent due to zygomatic fractures, because the fracture line crosses the infraorbital foramen or the infraorbital canal in 95% of the cases. From the surgical point of view it is clear that routine exposure and reduction of the infraorbital rim and the orbital floor bear the risk of additional trauma to the nerve, even if great care is taken. The present study shows that the described technique was able to sufficiently decompress the infraorbital nerve. For this purpose it does not seem to be necessary to apply rigid fixation to the infraorbital rim as Westermark et al[77] described. A longer interval between trauma and operation time caused a slower improvement of nerve sensitivity but did not impair the result at the end of follow up.

Rafael Benoliel, Ravit Birenboim, Eran Regev and Eli Eliav,[78] in their study say that, in most cases fracture lines involve the infraorbital (IO) foramen, canal, or fissure. Therefore, fractures of the zygomatic complex are characterized by sensory neuropathy (specifically hypoesthesia) in the area of innervations of the IO nerve both as a presenting symptom and as a postoperative complication

This study concurs with previous studies in finding that plate fixation allows for significantly better restoration of infraorbital nerve function. Chronic neuropathic pain following zygomatic fractures is rare. In conclusion, most cases of IO nerve dysfunction following zygomatic fractures will recover by 6 months.

Nicholas Zachariades, Michael Mezitis, and Demetrius Anagnostopoulos[79] in their study emphasize that in recent years the use of semirigid fixation has altered the traditional methods of treatment of fractures of the zygomaticomaxillary complex. Miniplates offer better stabilization at the fracture site, can be easily adapted, and are placed passively, allowing normal tension and flexion. In selected cases, they may even be placed under local anesthesia, thus reducing the hospitalization time and expense. Miniplates do not allow compression but are rigid due to the increased surface area between the screws and the bone, the increased three-dimensional stability, and the rigidity of the plate itself.

Semirigid fixation with miniplates offers the most reliable method available today for the treatment of zygomatico-orbital complex fractures and has practically replaced every other method. One of the most controversial topics in maxillofacial surgery is the amount of fixation that is necessary to prevent postreduction displacement of the fractured ZMC.

Reasons for minimizing treatment include the avoidance of multiple surgical approaches, consequent potential infections, additional scars and nerve palsy. It could be demonstrated that a symmetric reconstruction of the malar prominence could be achieved by the described technique. The result remained stable until ultimate bony consolidation, corresponding to experimental findings in human skulls comparing different methods of internal fixation, where one miniplate at the frontozygomatic suture line was the minimum requirement for stable fixation. The fixation of the frontozygomatic suture is the most vital in resisting rotation of the zygoma under chewing forces.

The masseter muscle has often been implicated as a primary cause of postreduction displacement of the fractured ZMC. It was assumed to be capable of exerting sufficient inferiorly directed force on the fractured ZMC to cause movement, even after surgical insertion of fixation devices. However, this contention has never been proven. There is no evidence in the literature that postreduction displacement of a ZMC fracture has occurred in patients.

Ellis and Kittidumkerng [80] reviewed a series of isolated ZMC fractures treated by a number of different approaches and fixation schemes both immediately and several weeks after repair and found no evidence of postreduction instability in any patient.

In a study done by Dal Santo et al, [81] it was found that masseter muscle developed notably less force in patients who had ZMC fracture than in control subjects. The results of this study cast doubt on the role of the masseter muscle in postreduction displacement of the fractured ZMC and indicate that potentially minimum amounts of fixation are required for such injuries.

Several other studies in the literature have used ZMC repositioning without fixation with good results, verifying that fixation requirements are less than advocated by some. Fixation with one bone plate has been advocated by several surgeons in a certain percentage of ZMC fractures, either at the zygomaticomaxillary buttress or more commonly, at the frontozygomatic area.

Champy et al, used a single bone plate at the frontozygomatic area in 342 isolated ZMC fractures and found that only 6 (1.8%) had an unsatisfactory result.

Tarabichi et al, [82] Covington et al, [83] Shumrick et al, [84] Ellis and Kittidumkerng [85] and a lot of others were able to use one-point fixation with extremely good results.

This study achieves this objective of achieving stable results with minimized therapy in the management of fractured zygomaticomaxillary complex, using hook reduction and one-point fixation.

SUMMARY AND CONCLUSION

This study was conducted in the Department of Oral and Maxillofacial Surgery, Tamilnadu Government Dental College, Chennai-3.

Thirty five cases of fractured zygomaticomaxillary complex were chosen and were treated by reducing with Stacey malar hook, and one-point fixation with stainless steel miniplate under local anesthesia. The results obtained have been gratifying. The merits and demerits of this procedure have been discussed.

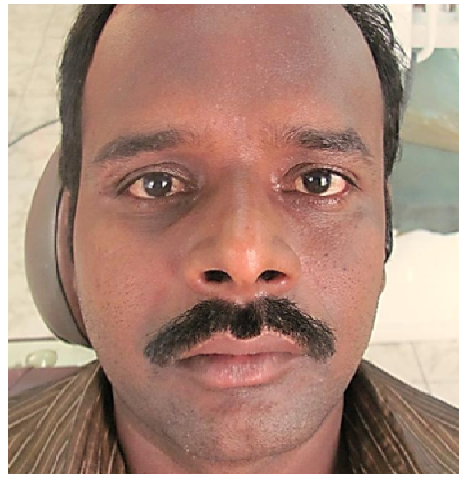
Based on the study, the following conclusions are made,

- Two wheeler accidents (without helmets) are the major cause of lateral middle third facial fractures.
- Use of the hook and one-point fixation, allows fracture management to be conducted as a level I office procedure.
- The technique followed is cost effective.
- The frontozygomatic region allows for both, visualization of the fracture reduction as well as for fixation.
- The use of miniplate in one of the strongest buttresses of the face allows for stable results with minimized treatment.

It can be concluded that zygomatic bone fractures can sufficiently be treated by hook reduction and an internal fixation with one miniplate at the lateral orbital rim. Additional plates at the infraorbital rim or in the region of the zygomaticomaxillary crest are indicated only in cases where the zygomatic bone cannot be reduced by hook reduction and single location fixation. This is by definition necessary only in cases of comminuted fractures. The very small fragments in the region of the facial wall of the maxillary sinus heal without problems as it is well known from the sinus or orthognathic operations. The same has to be postulated for fragments of the orbital floor.

The use of minimized therapy in the management of isolated zygomaticomaxillary complex fractures is therefore quite justified as the advantages far outweigh the disadvantages.

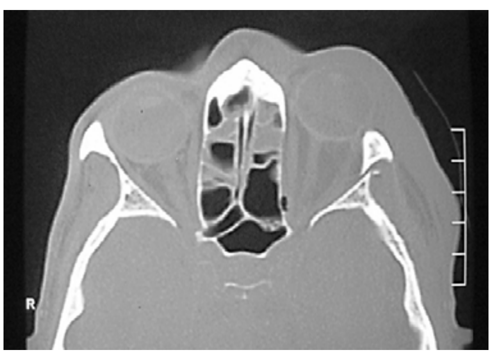
Pre-Operative Post-Operative

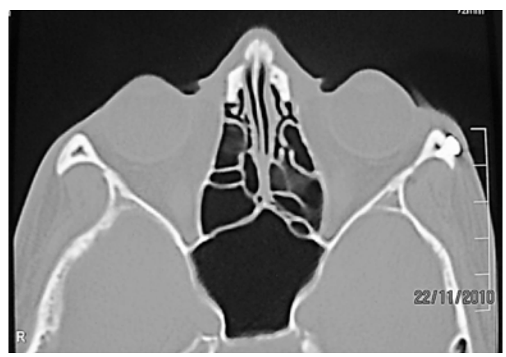


Pre-Operative Post-Operative

Pre-Operative

Post-Operative





Pre-Operative

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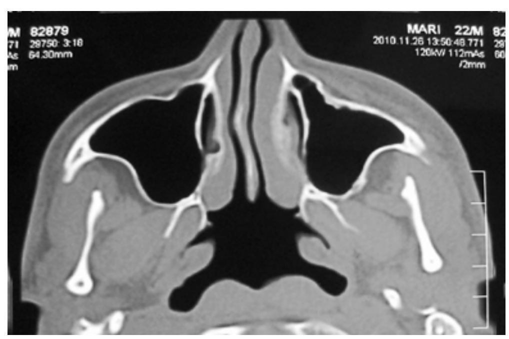

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