SINGLE POINT FIXATION VS TWO POINT FIXATION IN ZYGOMATIC COMPLEX FRACTURES BY USING TITANIUM MINI PLATE - A COMPARATIVE STUDY

A dissertation submitted

In partial fulfilment of the requirements

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2016-2019

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I hereby declare that this dissertation titled **SINGLE POINT FIXATION VS TWO POINT FIXATION IN ZYGOMATIC COMPLEX FRACTURES BY USING TITANIUM MINI PLATE - A COMPARATIVE STUDY** is a bonafide and genuine research work carried out by me under the guidance of **Dr. K. PRABHUSANKAR, M.D.S.,** Professor, Head of the Department, Department of Oral and Maxillofacial Surgery, Best Dental Science College, Madurai - 625104

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- Alfred North Whitehead

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LIST OF ABBREVIATIONS

ZMC	Zygomatic Complex
FZ	Frontozygomatic
ZM	ZygomaticoMaxillary
PLLA	Poly L-lactide
PGA	Polyglycolide
PDS	Polydiaxanon
RTA	Road TrafficAccident
VAS	Visual Analog Scale
ORIF	Open Reduction Internal Fixation
3D CT	3 Dimensional Computed Tomography
NOE	Naso Orbital Ethmoid

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Introduction

In developing country like India, rapid force of high speed automobiles in poor road conditions, dense population open to the road traffic leading to accidents, family tension triggering to domestic assaults, indifferent neighborhood turning on street brawls, the prevalence of Geo-socio-political feud & sports injuries are the characteristic conditions that spark the incidents of injuries to the facial skeleton.

The zygomatic bone is part of the facial skeleton of mammals, most reptiles, amphibians and birds. But it is absent in living amphibians. In reptiles, the zygomatic bone forms a relatively narrow bar separating the orbit from the inferior temporal fossa. The bone is similarly reduced in birds. Articulation of the zygomatic bone with the squamosal forms the zygomatic arch that serves as the lateral boundary of the temporal fossa. In non mammalian species that have no zygomatic arch, the zygomatic bone called jugal.

The zygomatic bone is derived evolutionarily from the orbital series. In most modern mammals the zygomatic bone forms a large part of the face and usually serves as a bridge that connects the facial skeleton to the neurocranium. Nose & zygoma occupies a prominent portion on the face & so the zygomatic fractures are very common in facial injuries. Either the most common facial fractures or the second in frequency after the nasal fractures.

Fracture and dislocation of this bone causes cosmetic defects and disrupts other ocular and mandibular functions. Fractures of zygomatic complex causes disruption in articulation of zygomatico-maxillary complex, zygomatic complex proper and orbitozygomatic complex. The

high incidence of these fractures in zygoma due to the prominence within the facial skeleton frequently exposes itself to the traumatic forces.

The incidence, cause, age, sex predilection, and educational status of the population was studied. Most studies indicate a male predilection, with a ratio of 4:1 over females. Most authors also agree that the peak incidence of such injuries occurs around the second and third decades of life.

Patterns of facial injury in children differ from those in adults, because of anatomic and physiologic characteristics at different stages of facial development, as well as the extent of paranasal sinus pneumatization and phase of dentition. The overall frequency of facial fractures in children is much lower than that in adults. There is a marked preponderance of boys in the worldwide pediatric population affected by facial fractures. In children, zygomatic complex fractures often are greenstick fractures involving the lateral wall and floor of the orbit.

The causes of zygomatic injury in adults are mostly altercations, whereas in others, motor vehicle accidents account for a more substantial numbers.

Statistics shows that the maxillofacial injury makes up to 52% of all forms of injuries of which road traffic accidents and assaults make up to 34%. The major cause of fractures were motorcycle accidents and other RTAs. In zygomatic fractures caused by altercations, the left zygoma is most commonly affected, persumably owing to the greater incidence of right handed individuals. This predilection disappears in unilateral fractures caused by vehicle accidents. Bilateral fractures of zygoma are uncommon and account for approximately 4%. Bilateral

fractures were more commonly the result of motor vehicle accidents than altercations, indicating that the trauma inflicted in vehicular accidents was more severe than that inflicted in altercations.

Bones of the craniofacial skeleton, whether derived from the neural crest or mesoderm and whether formed intramembranously or endochondrally begin as a group of mesenchymal cells that interact with an epithelia, form a condensation, and then differentiate along either a chondrogenic or osteogenic path. The mineralisation of collagen in the matrix secreted by osteoblasts and the consequent formation of bone is under the control of genes organized into networks.

In addition to influences from genetic signaling, dynamic physical interactions among soft and hard tissues contribute to the generation of complex shapes of facial bones such that the head forms as a set of interacting components contributing to an integrated whole.

Since the gross shape of the face is influenced largely by the underlying osseous structure, the zygoma has an important role in facial contour. Disruption of the zygomatic position also has great functional significance because it creates impairment of ocular and mandibular function. While there is dispute as to the number of such fractures which can be managed by a simple elevation without fixation, there is broad acceptance that fixation is necessary in at least some cases. In such unstable malar fractures, the most significant point is the region of the frontozygomatic suture. For the study purpose here frontozygomatic suture and zygomaticomaxillary suture or the maxillary buttress are selected for fixation point.

Rigid internal fixation has been used in orthopedic surgery as an effective treatment since 1950's. The use of plates and screws applied to the maxillofacial region to obtain stabilization

and fixation of the facial skeleton was introduced by Luhr in the late 1960's, who applied the principles of orthopedics to the treatment of fractured edentulous mandible with good success.

Association of the study of Internal fixation (ASIF) group in Switzerland performed the pioneering work in this area in the late 1970's. They facilitated the creation of special instrumentation and surgical techniques that could be used predictably. However their appliances often produced alterations of facial contour that necessitated their removal.

Recently, many advances have taken placed, such as introduction of mini plates systems. These plates are much smaller and have a lower profile. Facial alterations caused by these plates are uncommon and they rarely necessitate removal. The introduction of this fixation system thus overcome many of the esthetic problems associated with the use of larger plating systems in the maxillofacial region. However, some areas of the face like frontozygomatic suture have little soft tissue overlying the facial skeleton, and in these areas miniplates are still too thick. Furthermore mini plates are frequently palpable under the thin skin of the orbital nasal and frontal regions, and sometimes gives rise to thermal hypersensitivity, both necessitating plate removal. This led to invention of microplating system or absorbable plates and screws.

In the late 1988's Micro systems for internal fixation of maxillofacial fractures were introduced by Luhr because of a growing demand for a smaller systems and the improved technical ability to produce them. Micro dimensioned osteosynthesis plates have the advantage that they can anatomically fix small bone pieces, which was not possible with the earlier wiring techniques or the larger mini plate systems. Wires do not provide three dimension stability, and a mini system has the advantage of stress-fracturing thin bone during screw insertion, or the

screws may be too large to be placed where little bone is protecting anatomic structures, such as the infraorbital nerve, the mental foramen and the tooth root surfaces.

The development of microsystems offered a potential solution to the shortcomings of mini plates. However, the application of microsystems is limited to regions of the craniomaxillofacial region, where loading forces are minimal, especially the thin midfacial region and cranium. In trauma surgery, Micro system have been used for the following regions such as nasoethmoidal fractures of infraorbital area, fractures of the frontal sinus wall, fractures of the mandibular condyle or condylar neck/fractures o the severely atrophic edentulous mandible and reconstruction of the skull.

Only in select Zygomaticomaxillary complex fractures in which severe posterior or lateral displacement is present, zygomatic arch serves as a prime point of alignment. When gross comminution is present at the infraorbital rim or at the zygomatico maxillary buttress, the zygomatic arch serves as a common denominator for the return of normal anatomic relationships.

The proximal end of the sagittally fractured arch is often too thin and narrow to accomodate 2 mm diameter mini screws. Microplating systems for craniomaxillary fractures using micro screws to rigidly fixate the sagittally fractured zygomatic arch to the temporal bone as one of the multipoint fixation with bicoronal approach shall be ideal.

Rest of the situations mini plates and mini screws have been serving the purpose.

Therefore the miniplate technique is performed with minimal effort, more convenient access, and less stripping of the surrounding periosteum than necessary for the traditional superior border wire. Because this is a monocortical technique, there is a less chance for

iatrogenic damage to adjacent teeth by misdirected wire passing burs. Most importantly less manipulation of the fracture segments is required to provide stabilization. Thus the chance of neurovascular injury is decreased and, therefore less postoperative paresthesia and hematoma formation are likely to occur.

The microscrew or microplate system used is low profile(<0.75 mm) . It is fabricated from titanium which unlike stainless steel is extremely biocompatible, non allergic, lightweight, corrosion resistant and does not interfere with current imaging modalities such as radiographic, MRI, or computed axial tomography. Although this technique is more costly than one using wire osteosynthesis, the advantages outweigh this consideration.

The goal of this study was to evaluate the advantages of two point fixation and disadvantages of single point fixation in zygomatic complex fractures with stainless steel/ titanium mini plates& mini screws

AIM

To analyze and compare the stability, aesthetic appearance in zygomatic complex fractures after open reduction in between single point and two point fixation.

Objctives

- To evaluate the stability of single point fixation of ZMC fractures
- To evaluate the stability of two point fixation of ZMC fractures
- To evaluate the aesthetic appearance post operatively after open reduction in single and two point fixation of ZMC fractures
- To study the efficacy of fixation provided by Titanium / Stainless steel micro plates in fixing the ZMC fractures
- To evaluate the post operative healing and stability of fracture
- To evaluate the advantage of micro plates in fixation of ZMC fractures
- To evaluate the complication

Review of Literature

1.Bromley S Freeman, 1962 [30]

The incidence of depressed fractures of the orbital floor associated with injuries of the zygomatic-maxillary complex is greater than oral surgeons recognize. He summarized that the direct exposure to investigate the anatomic position of bony continuity in fractures of the mid facial area has been extended to exploration of the orbital floor. Thin teflon discs have been used to restore the position and free movement of the globe. Floor depression with a loss of orbital contents be replaced accurately by blind elevation with pack or balloon. The direct surgical approach should be preferred. Early surgical intervention means less operative trauma, less scar tissue to be dissected and a minimal impairment of vision.

2.Butow KW et al, 1984 [29]

illustrated modern trends in the therapy of mid-facial trauma, which include the use of miniplates, wire osteosynthesis, and suspension wiring, bone transplantation from the contra-lateral canine fossa for orbital floor reconstruction, as well as the use of lyophilised dura placed over bony defects.

Osteosynthesis and suspension wiring: The emphasis in treatment of facial trauma cases has shifted from external suspension to internal suspension and wire osteosynthesis. .In certain structural alignments the wire osteosynthesis is replaced by miniplate osteosynthesis.

Orbital reconstruction: It has now unanimously been accepted that surgical intervention is necessary for the inspection and reconstruction of the orbital floor. Artificial material such as teflon, silicone rubber, etc., was used in the past. But as per this article the author was used lyophilised dura more extensively in small defects. Bone transplantation from the iliac crest, from the contra-lateral canine fossa, or from the mandibular ramus, with or without lyodura

was indicated in the reconstruction of large comminuted unstable defects. The treatment discussions included in this paper revolved briefly around antral packs, nasal splints, and primary wound care.

3.Gruss JS et al, 1986 [2]

described briefly about the reconstruction the buttress to maintain the position of the maxilla in its correct A-P relation and restoration of the vertical height. The methods of fixation range from wires and miniplates to immediate bone grafts. Direct exposure and fixation of all fracture sites was essential to repair. Minimal complication was reported

4.*Davidson John et al, 1987* [3]

compared the various methods of internal fixation like interfragmentary wiring, mini plate fixation. They divided the internal fixation in to three groups 1.stable, 2. Acceptably stable, 3.unstable. The fixation techniques of interfragmentary wiring, osteosynthesis, and their combinations were compared utilizing in 1- point, 2-point and 3-point fixation. They summarised the **stable** fixation, 3-point fixation using either mini plates alone or interfragmentary wiring alone conferred the greatest stability all methods of fixation. Mixing wires with mini plates diminished the relative stability of three point fixation in a manner proportional to the number of interfragmentary wires used. Two point fixation using osteosynthesis alone conferred a degree of stability comparable to most methods of three point fixation regardless of the site of application the mini plates. certain mini plate / interfragmentary wire combinations also were stable and were characterized by the inclusion of frontozygomatic suture as one of the points of fixation. Methods of internal fixation providing acceptable stability are summarized. The remaining mini plate / inter fragmentary wire combinations and one point fixation of the orbital rim using mini plates. Some **unstable**

methods of internal fixation are summarized which includes two point interfragmentary wiring of the lateral maxillary buttress and one or another point on the orbital rim, one point mini plate fixation lateral buttress and one point inter fragmentary wiring.

5.Rudolf RM Bos et al, 1987 [71]

briefly described that the methods of fixation with resorbable plates and screws for the unstable zygomatic complex fractures and the results given by this a good stability over a long period to enable undisturbed fracture healing. Resorbable plates made up of Poly alpha-hydroxy acids such as PLLA(Poly L-lactide), PGA(Polyglycolide), PDS(Polydiaxanon) The results of the operative treatment were evaluated clinically and radiographically starting immediately after the surgical procedure. Radiographic evaluation started immediately postoperatively and was repeated after three weeks and three months. Quality of anatomic reduction, quality of reduction on the radiographs, sensory disturbance of the infra orbital nerve, diplopia, limitation of the eye movement, limitation of the jaw movement, inflammation or foreign body reaction at the site of the PLLA-plate and palpability of the plate. Result was very much appreciable . Post operative healing of the wound was uneventful with no signs of inflammation or foreign body reaction. All fractures healed satisfactorily based on radiographs.

6.DeMan et al, 1988 [41]

examined 1006 patients with an isolated non comminuted unstable fracture of zygomatic bone are presented 38 patients undergone fixation with intra-osseous wiring and 68 patients with miniplates. Osteosynthesis across the frontozygomatic sutures. It was observed that the use of miniplate in unstable fracture of the malar complex resulted in stable fixation and also increased the chances of infraorbital nerve regeneration.

7.Markus Zingg et al, 1991 [36]

briefly described about the fixation and complications after doing number of cases. They explained as failure to conceptualize the three dimensional anatomy and relationships of the zygoma-lateral orbital complex will undoubtedly lead to inadequate reduction of the fractures. First they thought the three pillars zygomaticofrontal, zygomaticomaxillary buttress & infraorbital rim had to be put in correct position in fracture reduction and fixation . For three dimensional conceptualization considering the exact alignment of the zygomaticofrontal suture, zygomaticomaxillary buttress and infra orbital rim is crucial. The fracture pattern and the correct adaptation of the fragment borders dictate the necessary point fixation to maintain reduction.

8.Markus Zingg et al, 1992 [62]

briefly described the classification of zygomatic complex fractures and their optional treatment modalities. They mentioned about the complications after closed or open reduction of zygomatic complex fractures. They listed as infra orbital nerve dysfunction, maxillary sinus dysfunction, minor & major asymmetry due to inaccurate reduction, Enophthalmus with diplopia, complication related to transconjunctival approach such tarsal lesion, corneal abrasion, entorpion, ectorpion. Finally they described about the post operative infection and resorption and then materials used for orbital reconstruction.

9.Paul N Manson ; 1996 [4]

addressed the amount of stabilization and various approaches to the surgical intervention and their long term follow up. They dealt with two major considerations

1. How much exposure was required for alignment and 2.how much exposure was needed for fixation. They also described six places to align the zygoma. 1.zygomatico maxillary buttress, 2.lateral wall of the orbit, 3.infra orbital rim, 4.zygomatic arch, 5.fronto zygomatic suture and 6.inferior wall of the orbit. These required exposure with at least three incisions if complete exposure is selected. Each anatomic articulation may also be used for fixation, with soft tissue morbidity proportionate to the anatomic area. The best (strongest) points of fixation are obtained (in order) at the zygomaticofrontal suture, the zygomatico-maxillary buttress, the arch, and the inferior rim. Therefore, the challenge is that the best fixation points were not necessarily the best alignment points. Finally, use of the best fixation point for a strong plate always creates a visible silhouette of the plate. For noncomminuted fractures, decreased numbers of incisions can be used with

decreased soft tissue morbidity.

10.Edward Ellis III et al , 1996 [5]

studied about isolated ,unilateral ZMC fractures with minimum 6 weeks post operative follow up . Demographic informations and methods of treatments collected from the medical records. Quality of reduction was assessed by examination of post operative images Stability of repositioned ZMC was assessed by comparing immediate post operative images Cosmetic outcomes were assessed by clinical assessment and examination of photographs. They described the adequacy of reduction, stability of fixation, orbital reconstruction and associated complications in treating ZMC fractures

11.Kevin AS et al, 1997 [6]

mentioned a criteria for selective management of the orbital rim and orbital floor in zygomatic complex and midface fractures. The criteria reported herein allow surgeons to identify the minority ofpatients with midfacial and ZMC fractures who require an orbital exploration for optimal fracture management. Orbital exploration and

its potential complication can be avoided in the majority of patients with ZMC and midface fractures without significantly increasing the risk of morbidity related to the orbital component of their fractures. They concluded that the majority of patients with ZMC or midface fractures did not require an orbital exploration as part of their fracture management. The criteria presented herein for preoperative evaluation of patients with midface trauma allowed us to identify specifically and reliably those patients who did not require an orbital exploration as part of their fracture management and, therefore, spare them the additional operative time and potential complications associated with orbital explortion.

12.Raymond Fonseca, 1998 [72]

Changed the trends in the treatment of Zygomaticomaxillary complex fractures. He described the evolution of the procedures for treatment of these injuries from wire to miniplate semirigid fixation techniques. The development of plate and screw fixation techniques has made previous methods of fixation. The use of as thin a plate as possible has been found to be a sound principle in the management of fractures in the periorbital area. The soft tissue overlying the orbital rim is very thin, thus necessitating a thin plate to prevent visibility. The choice of a 1mm microplate versus a 1.5mm or 2.0 mm miniplate is based on the location and displacement of the fracture. Therefore, the thinner, more adaptable, microplates may be used. The low profile of the miniplates makes their placement at the frontozygomatic suture, infraorbital rim, and zygomatic arch advantageous, whereas the miniplate is indicated for use in fixation of the zygomaticomaxillary buttress. The number of plates placed is also an important variable. Knowing whether a single plate at the zygomaticomaxillary buttress was placed via an intraoral approach or three plates (two along the orbital rim and one at the buttress) were needed would add significantly to our understanding in this area.

13. A F Kovacs et al,2001[7]

A non-randomized prospective study done to establish and justify minimized therapy for zygomatic complex fractures. Patients were examined and classified with conventional routine radiographs. Preoperative symptoms were recorded. Treatment of zygomatic fractures was by percutaneous hook reduction and miniplate fixation along the frontozygomatic suture. Exploration of the orbital floor was carried out only in cases of primary diplopia or comminuted fractures. Post operatively clinical and radiologic assessment of reduction was symmetric and stable in all cases. Exploration of the orbital floor is indicated only in cases of preoperative diplopia. Therefore, a patient with a zygomatic fracture and diplopia should be classified as having a orbitozygomatic fracture.They discussed about various distribution of diagnosis and pre operative symptoms. They also discussed various methods of operating procedures and the post operative recovery. They explained the reasons for minimizing the treatment include the avoidance of multiple surgical approaches, consequent potential infections, additional scars and nerve palsy.

14.Zahur Qayyum et al, 2004 [40]

From this study RTA was the most common cause of ZMC fractures in this part of the country. The reason for this is that there is lack of road sense in road users, poor condition of the vehicles; increase traffic load and poor conditions of roads. There is dire need to improve road conditions, strict enforcement of traffic rules including seatbelt legislation and run compaign to aware road user about the road safety which will decreased the incidence of facial fractures (including ZMC fractures) in developed countries. Regarding to the characteristic of ZMC fractures, flattening of the cheek and subconjunctival hemorrhage is most common finding of this study. As the zygoma occupies the most

prominent position in the facial skeleton so it is easily exposed to traumatic forces which lead to depression of face and a minor periosteal tear leads to subconjunctival hemorrhage. Both these signs are common findings. This study will help the dentists that when they examine patient of facial trauma clinically and if they see depress cheek and subconjunctival hemorrhage they should advise occiptomental radiograph and refer to a specialist for proper management.

15.Ozoemene obuuekwe et al , 2005 [8]

Stated that fractures of the zygomatic complex are among the most frequent in maxillofacial trauma.The zygomatic complex is responsible for the mid-facial contour and for the protection of the orbital contents. The etiology of zygomatic complex fractures include road traffic accidents, assaults, falls, sports and missile injuries. The relative contribution of these factors varies from region to region. Fractures of the zygomatic complex appear commoner in young adult males. Common clinical features of zygomatic complex fractures include diplopia, enophthalmos, subconjunctival ecchymosis, flattening of the cheek, gagging of the occlusion and sensory disturbances. Diagnosis of zygomatic complex fractures is usually clinical, withradiographic confirmation. Although isolated zygomatic complex fractures occur, several studies have shown that fractures of the zygomatic complex are often associated with other maxillofacial injuries. It would appear that there is no consensus opinion regarding the management of zygomatic complex fractures, as some studies have shown that many oral surgeons utilize differing practices in the management of such fractures.

16.Paik-Kwon lee et al, 2006 [9]

briefly explained about the transconjectival approach for two point fixation in infra orbital rim and fronto zygomatic suture area of non comminuted zygomatic complex fractures. The ultimate goal in treating zygomatic complex fracture is to obtain an accurate, stable reduction while minimizing external scars and functional deformity. They present their experiences with a single transconjunctival incision and two-point (inferior orbital rim and frontozygomatic suture) fixation with zygomatic complex fracture which were not comminuted. All patients had transconjunctival approaches with lateral canthal extensions, had an additional small (about less than 2 cm) gingivobuccal incision to achieve an accurate reduction. overall esthetics and functional results were satisfactory with this method has the following advantages in the reduction of ZMC fractures. It leaves only an inconspicuous lateral canthal scar. In addition to the inconspicuous scarring, the main advantage of this method is a direct and full visualization of the lateral and inferior orbital wall to be served as a guidance for an accurate reduction, which makes the reduction more successful. The only drawback we experienced in our method is a little difficulty in reducing the fracture-displaced zygoma because of limited space and a slightly inadequate vector for the elevator. Usually a fractured zygoma is displaced and rotated posteriorly and medially, so an anterior-lateral pull is required. However, the lateral canthal incision is located medially to the zygoma body and lateral pulling of the zygoma body may be a little difficult.

And concluded that the proposed technique is very useful for the treatment of zygomatic complex fracture which was not severely comminuted, because it provided excellent exposure and postoperative stability of the zygoma with a lower incidence of complications, including visible scarring and ectropion.

17.Richard A Hopper et al, 2006 [68]

Stated that computed tomography is commonly used to evaluate patients with blunt facial trauma. With the high definition of the current scanners, even small fractures of the facial skeleton can be visualized. In complex midface injuries, it can be difficult for the radiologist to know which fractures are important to point out to the surgeon. An understanding of the anatomically relevant and surgically accessible craniofacial buttresses is critical for management of these injuries. Naso-orbitoethmoid fractures are classified according to the degree of injury to the medial canthal attachment. If the nasofrontal ducts are disrupted, surgical obliteration of the frontal sinus is needed to prevent formation of a mucocele. Displaced fractures of the zygomaticomaxillary complex often increase orbital volume due to angulation of the lateral orbital wall at the zygomaticosphenoid suture. If the zygomatic arch is severely comminuted or angulated, surgical exposure is indicated. In orbital fractures, the position and shape of the medial and inferior rectus muscles can indicate whether entrapment and diplopia are likely. Pediatric "trapdoor" orbital fractures and fractures of the orbital apex associated with decreasing vision represent surgical emergencies. Le Fort fractures involve disruption of the pterygoid plates from the posterior maxilla; any combination of Le Fort I, II, and III patterns can occur.

18.Petrus Pereira Gomes et al, 2006 [61]

came to conclusion by treating 370 cases zygomatico-orbital complex and zygomatic arch fracture. Epidemiological data including age, gender, etiology, site of injury and details of treatment were collected. The study revealed that the high occurrence is bicycle accidents, assaults and sports. The Garrol-Girard screw was the most common device used to reduce zygomatico-orbital complex fractures because it allows accurate 3-

dimensional positioning. The intra oral approach with fixation at zygomatic-maxillary buttress was used and the other locations as frontozygomatic buttress and infraorbital rim.

19.Bernardo ferreira et al, 2006 [60]

briefly described about the epidemiological research of maxillofacial fractures allows the presentation, patterns of the most affected individuals and the nature of lesions to be outlined according to the region . Treatment evaluation and complication will give more realistic. Road Traffic accidents are clearly important in the series of maxillofacial fractures in developing and developed countries. Motor vehicle, Bicycle accidents are considered to be the most frequent cause of associated injuries in maxillofacial trauma. Populations strongly influenced by work-related accidents in daily life and play accidents.

20.Qing-Bin Zhang et al, 2006 [59]

described the value of the coronal incisions for treating zygomatic complex fractures. Most zygomatic complex fractures can be treated via local incisions, which eliminate the need for a coronal approach especially in the patients who are prone to hair loss. Coronal incisions still should be used for the following indications: comminuted, multiple, late and especially bilateral fractures. They suggest that, with an adequate knowledge of surgical anatomy and some modifications of the coronal incision, a coronal approach will facilitate accurate reduction and fixation of fragments and will allow a superior cosmetic result with minimal or no complications.

21.Asish chakranarayan et al, 2009 [10]

briefly discussed about the efficacy of two point rigid internal fixation in fronto zygomatic and zygomatic buttress regions and post operative surgical outcome. Stable fixation and immobilization of isolated zygomatic complex can be achieved with two point fixation using titanium mini 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.

22.Col PK Chattopadhyay et al, 2009 [58]

discussed briefly about the Motor Vehicle Act (MVA) in India, the use of seatbelts and helmets is compulsory, but the compliance is poor. It is imperative to educate people regarding the use of headgear (crash helmet) and seatbelts while traveling in motorized transport which will go a long way in preventing injuries to facial region. With the introduction of compulsory use of seatbelts in developed nations there is a significant reduction of facial injuries.

23.Bruno Ramos Charcnovic et al, 2009 [11]

described in their publication about the advantages of rigid internal fixation over wire osteosynthesis mini plates in fronto zygomatic area but with some undesirable effects, such as palpability, visibility, and risk of penetration into the anterior cranial fossa. This study suggests that as far as the bone structure is concerned, it is possible to use miniplates at the temporal aspect of the FZ suture. The first hole over the FZ suture

should receive the smallest screws and the other areas can receive screws up to 6 mm. All drillings are made from the temporal fossa to the orbit, and its contents should be protected during the perforations. This new position of the miniplates reduces the risk of perforating the anterior cranial fossa, avoids skin palpation of the miniplates, and can be applied using standard approaches, making it a useful option when miniplate fixation in the FZ area is indicated.

24.Masakazu Kurita et al , 2010 [56]

mentioned the optimize treatment of zygomatic bone fractures, patients subjective evaluations of symptoms are necessary. The visual analog scale (VAS) was used for the quantitative assessment of subjective evaluation for symptoms and treatments in patients who underwent open reduction and rigid fixation. Degree of satisfaction and annoyances resulting from residual symptoms (deformity, pain, paresthesia, and trismus) and incisions used for exposure of the fracture site were investigated using an anonymous postal questionnaire . To assess subjective evaluations for residual symptoms and surgical treatment, charts were retrospectively reviewed, and a postal questionnaire was sent out. The resulting information was finally integrated anonymously with randomly allotted case numbers during processing and was evaluated statistically. From this statistical analysis put up. For quantitative data obtained from each VAS, several statistical analyses were used. All procedures were performed by our statistician (Y.T.) using SAS software (SAS Institute, Cary, NC). For all statistical comparisons, P values G 0.05 were considered statistically significant. Residual symptoms assessed quantitative and qualitative. Annoyance caused by incision also assessed quantitative and qualitative. Three main forms of chronic residual sequelae have been described for zygomatic bone fracture: deformities resulting from malreduction of the zygomatic prominence, enophthalmos from enlargement of the orbital

cavity or soft tissue atrophy, or lower lid retraction; persistent cheek anesthesia or dysesthesia; and trismus.

25.Zahoor Ahmed Rana et al, 2010 [13]

discussed about the injuries in the maxillofacial region are most challenging problems in nowadays. The causes of maxillofacial injuries have changed over the past three to four decades and continue to do so. Road traffic accidents are reported as the main cause of facial injuries in literature from developing countries whereas interpersonal violence remains the leading etiological source in the developed world. With regard to the anatomical sites, mandibular and zygomatic complex fractures account for the majority of all facial fractures and their occurrence varies according to the mechanism of injury and demographic factors, particularly, gender and age.4 The coordinated and sequential collection of information concerning demographic patterns of maxillofacial injuries may assist health care providers to record detailed and regular data of facial trauma. Consequently an understanding of the cause, severity, and chronological distribution of maxillofacial trauma permit clinical and research priorities to be established for effective treatment and prevention of these injuries. This study was developed because there is insufficient literary evidence from our region to accurately illustrate the etiology of these injuries. It is worthwhile to mention here that data on the etiology of maxillofacial injuries is essential to reflect upon the effectiveness of preventive measures, such as the introduction of seat belt and helmet legislations and to evolve further improved regulations.

26.KunHwang,2010 [14]

described about the single point fixation of Tripod fractures of Zygoma through a lateral brow incision to fix in fronto zygomatic region. In this approach, an incision

was used in the lateral brow approximately 1.5 cm in length. Dissection exposes the zygomaticofrontal suture line. A moderately heavy periosteal elevator was passed through the incision behind the malar eminence and into the temporal fossa. The elevator was used to control the position of the zygoma and to reduce it by upward, forward, and outward forces. After reduction, intraoperative zygomaticoaxial views were obtained to see the alignment of the fractured zygoma. Zygomaticofrontal suture was immobilized with plate fixation. The advantages of this method are shortening of operative time, minimum facial scars, and less swelling postoperatively compared with the conventional open reduction and rigid internal fixation. This simple 1-point fixation procedure is not indicated in patients who have ocular conditions such as diplopia or enophthalmos. He applied this method not only to the minimal or moderate displacement of the infraorbital rim (up to 7.7 mm) but also to the comminuted infraorbital rim fractures. He selectively used this method in 14 (20%) of 70 patients with zygomatic fracture. Indications for using 1-point fixation of the tripod fracture are

(1) minimal or moderate displacement of the infraorbital rim in the tripod fracture of the zygoma, (2) no ocular signs of diplopia or enophthalmos, and (3) comminuted infraorbital rim fractures where internal fixation is difficult.

27.Viraj RK et al , 2010 [15]

had devised a modified hemicoronal incision wherein the anterior arm of the incision curves downwards towards the superior wall of the orbit well before it reaches the vertex of the skull within the hairline, thereby forming a ‘‘backcut’’ providing excellent exposure of the entire zygomatic complex and the arch being its major advantage with minimal functional morbidity (temporary facial nerve neuropraxia) which is again temporary. The depth of dissection of this incision remains the same as the conventional hemicoronal approach i.e. upto the superficial temporal fascia. No structures in this region

pose a threat and the results were acceptable with all our patients . The ‘‘modification’’ only lies in the incision which provides additional direct access. This single modified hemicoronal incision gives an excellent access to the fractures, is aesthetic, and is less invasive thereby being quite acceptable for the patients.

28.Toshitaka Muto et al, 2010 [57]

described a suspension techniques to correct zygomatic fractures using the external device. Their technique caused no scar formation, and both traction and fixation were possible. The device is easy to construct and cost-effective. Fractured segments can be readjusted, if necessary. Although our technique has a narrow indication range, it has definite advantages in the case of fractures such as type A fracture with maxillary buttress fractures. The external device, used for both bone traction and fragment fixation, consisted of a Kirschner wire rod (diameter, 3mm)and two suspension units. One end of the wire rod was fixed with an occlusal splint to the maxillary teeth, and the other was fixed with a resin plate to the temporal region. A gauze sheet was used as a cushion to prevent pressure ulcers from developing on the skin between the resin plate and bone. A circumferential wire was passed around the base of the zygomaticotemporal process and tied to the wire rod to provide traction and support for the zygomatic fragments. The Kirschner wire rod was long enough to control and adjust the displacement force on the fractured segments. Postoperatively the distraction unit permitted the minor readjustment of fractured segments.

29.Masakazu Kurita et al, 2010 [12]

They assessed the patient satisfaction by a visual analog scale (VAS) after open reduction and internal fixation of zygomatic bone fractures. To evaluate the patients’ subjective evaluations for optimization of treatments for zygomatic bone

fractures in future, we used the VAS to quantitatively assess subjective evaluations of symptoms and treatments in patients with zygomatic bone fractures who underwent ORIF. The VAS was originally developed for the measurement and assessment of pain. The degree of satisfaction, annoyances resulting from symptoms, and incisions used for exposure of the fracture site were investigated using an anonymous postal questionnaire to patients who had undergone ORIF for zygomatic bone fracture. The questionnaire was originally developed for the assessment of patients' subjective evaluations of treatment and associated symptoms such as deformity, pain, paresthesia, and trismus after ORIF for zygomatic fractures. Quantitative Assessment of total satisfaction and residual symptoms, Qualitative evaluations for residual symptoms like Deformity, Pain, Paresthesia and Trismus were analysed. Then Quantitative Assessment of Annoyance caused by Incisions, Qualitative evaluation for annoyance caused by Incisions.

30.Edward I Lee et al, 2010 [66]

explained about optimal management of ZMC fractures begins with accurate and expedient diagnosis followed by formulation of a treatment plan that accounts for proper reduction of fractured segments to restore facial balance. Finally, surgical expertise is needed to allow for appropriate execution of treatment plan as well as to manage complications arise.

31.Sergio Olate et al, 2010 [65]

briefly described about the various types of surgical approaches and fixation patterns in zygomatic complex fractures. The patient with acceptable post operative reduction of ZC fracture were analyzed because the objective of this research was to relate the pattern of fixation and approach in patients with acceptable postoperative result.

Postoperative evaluation of reduction was assessed by computed tomography and analyzed by the senior authors. Ellis and Kittidumkerng presented a well-developed algorithm where the kind of trauma and sequential surgical approach and fixation could be evaluated, initiating on zygomatico- maxillary buttress, lateral orbit, and infraorbital rim. The zygomaticomaxillary buttress is an important local appropriation for initial stabilization. The fixation of this pillar was used more often than that in other areas. More efficient approach is the intraoral technique and not a lateral eyebrow incision.

32.Kim ST et al, 2011 [1]

described briefly about the single point fixation in the ZM area in zygomatic tripod fractures which can avoid unsightly scars and give high satisfaction with surgical outcomes in selected patients. They divided patients into two groups. Group 1.1-point fixation in ZM area Group 2. 2- point fixation in the ZM and FZ area. Postoperatively they checked 1. Unfavourable scars 2.bony movement, pain, palpability in the FZ area, 3. Satisfaction with surgical outcome 4.presence or absence of surgeries for plate removal. They concluded that 1-point fixation in the ZM area in zygomatic tripod fractures can avoid unsightly scars and give high satisfaction with surgical outcome.

33.Lateef TA et al, 2011 [16]

presented a retrospective study of patients who presented with zygomatic complex fracture for the period of five years. Data was retrived from the department case records and radiographs and patient's information was collected using a designed form. The evaluation included data regarding patient's age, gender, and etiology of fracture. Other data recorded were the clinical findings, associated facial fractures and

treatment methods of zygomatic complex fractures. Plain radiographs and facial computed tomography were used for radiographic analysis.

34.Suresh Menon et al, 2011[69]

described about the ideal surgical approach to treat reduce and rigidly fix zygomatic complex fractures should provide maximum exposure of the fractured segments, minimize potential for further injury to facial structures, and ensure good cosmeticresults. The choice is essentially between local incisions and a coronal approach. Local incisions in two point fixation have been the intra oral vestibular approach to the buttress and the lateral eye brow incision to access the frontozygomatic region. These are ideal incisions in terms of access and aesthetics. A hemicoronal or preauricular approach will provide access to thearch and the frontozygomatic region. The most optimum method of treatment was a 2 point fixation at the frontozygomatic region and the zygomatic buttress region providing adequate stability to the fractures. **It is imperative to educate people regarding the importance of restraints and use of protective headgears/use of seat belts** while traveling in motorised transport which will go a long way in preventing injuries to the facial region.

35.Lakshmi NG et al, 2012 [17]

compared two materials (stainless steel wire and mini plates) for fixation of zygomatic complex fractures. All the fixations carried out through standard Digmen's incision using stainless steel 26 gauge wire and titanium 1.5 mm mini plate system under general anesthesia and evaluated after 2-4 weeks post operatively for facial symmetry, wound healing, functional assessment (mouth opening, diplopia) and sensory disturbances. They concluded as osteosynthesis by mini plates issimple, logical and effective treatment compared to wire osteosynthesis regarding the stability of fracture fragments. But the time

and skill is required for fixation of wire. Wire osteosynthesis will be helpful in emergency surgeries or where the availability of mini plates is not possible.

36.Abrahao Cavalcante, et al 2012 [55]

aim of this study was to describe a modification of the Keen technique that promotes adequate visualization of the infraorbital rim and permits reduction and fixation of this region in cases of zygomatic fractures. The present technique has several advantages such as that (a) only 1 incision is necessary to approach the zygomaticomaxillary buttress and infra orbital rim, (b) it optimizes surgical time, and (c) it avoids periorbital scars. They described the modifications made to the intraoral approach to allow reduction and fixation of the infraorbital rim in zygomatic fractures. Subciliary, subtarsal, and transconjunctival periorbital approaches are excellent alternatives for surgical treatment of orbital floor and infraorbital rim fractures. However, these techniques involve some complications such as hypertrophic scar formation, scleral show, mild lid edema, keratoconjunctivitis, epiphora, ectropion, lagophthalmos, and nasolacrimal injury. For this reason, the related techniques should be precisely indicated. Temporary paresthesia of the infraorbital nerve due to its dissection and elevation is the complication associated with the intraoral approach; however, it depends on the fracture pattern. After correct reduction of the zygomatic complex, the first fixation must be performed on the zygomaticomaxillary buttress, then on the frontozygomatic buttress and infraorbital rim.9 In this technique, after zygomaticomaxillary buttress fixation, the infraorbital rim could be fixed, if necessary.

37.Kim JH et al, 2012 [18]

introduced a new surgical technique of 1- point fixation at the zygomatico-maxillary buttress and to verify its effectiveness using 3 dimensional computed

tomography (3D CT) . The study included 29 patients who underwent 1-point fixation at the zygomatic buttress for zygomaticomaxillary complex fractures without comminution of lateral orbital rim fractures or minimal displacements. Preoperative and postoperative 3D CT scans were obtained to evaluate vertical and horizontal changes of the zygoma, which were analyzed according to preoperative 3D CT finding. Their medical records were reviewed for the following data: age,sex, medical and surgical history, cause of trauma, associated facial fractures, abnormal eye signs before surgery, exploration time, preoperative and postoperative 3D CT findings (ie, comminution and displacement of inferior orbital rim, zygomaticofrontal [ZF] buttress, ZMB, and zygomatic arch), operative findings, and complications. Eye movement, diplopia, and other ophthalmologic signs and symptoms were routinely examined by ophthalmologists before and after surgerys. The patients underwent 3D CT (Somatom Sensation 64; Siemens Medical Solutions) before surgery to evaluate the type and extent of the fracture and at 2 to 6 months after surgery to assess successful reduction. Multidetector CT was performed in the axial position using a 3-mm section thickness, and the coronal and 3D views were then reconstructed using a computer program. The 2 preoperative and postoperative orthogonal aspects were measured. Vertical change (VC), which represents the movement of the bilateral infraorbital rim line, and horizontal change (HC), which represents the movement of the bilateral anterior margin of the fossa temporalis line, in the zygoma were measured on 3D views to assess the effectiveness of 1-point fixation at the ZMB. The Wilcoxon signed rank test was used to compare preoperative and postoperative VC and HC. Postoperative VC and HC according to preoperative 3D CT findings were compared using the Mann-Whitney test. *P* _.05 was considered significant. Data analyses were performed using SPSS for Windows, version 12.0 (SPSS Inc).

38.Walid A Abdullah, 2012 [63]

The aim of the present study was to study the etiologies and patterns of maxillofacial fractures. Motor vehicle accidents were the most common cause of maxillofacial fractures in most age groups, especially in males.

• Mandibular fractures were the most common maxillofacial fractures among patients .

• Parasymphysial fractures were the most common type of mandibular fracture, followed by condylar fractures.

• Zygomatic fractures were the most common type of middle-third facial fracture.

• Males were more prone than females to maxillofacial fractures, perhaps due to the conservative nature.

• Motor vehicle accidents were the most common cause of maxillofacial fractures in most age groups, especially in males and those aged 10–29 years.

• The study findings highlight the high demand for the application of stricter traffic rules to reduce the rate of motor vehicle accidents.

39.Ramesh Candamourty et al, 2013 [19]

described briefly about the treatment variables for the zygomatic complex fractures. Different reduction and fixation approaches were done in selected patients. The best reduction technique is by Gillie's temporal approach followed by miniplate fixation at –

• Frontozygomatic suture via Dingman's approach

• Infraorbital margin, zygomaticomaxillary suture via low infraorbital approach and

• Zygomatic buttress region via the upper buccal sulcus approach.

Three point fixations were preferred in zygomatic complex fractures to avoid rotation of fragment postoperatively in vertical or horizontal axis in unstable displaced fracture. Osteosynthesis by miniplates is a simple, logical and effective treatment compared to wire

osteosynthesis as regard to stability of the fracture segments. This procedure is followed routinely in this department for fractures in this particular region. Though wire osteosynthesis did give satisfactory results when compared to miniplate osteosynthesis, it is still desirable to use miniplate osteosynthesis, as it would give firmer rigidity.

40.Nalini Tripati et al ,2013 [20]

compared the evaluation of stability using titanium and bio-resorbable plates as one point fixation in zygomatic complex fractures. patients were randomly selected and divided in two groups which were further divided into two subgroups (A, B). Group I patients were treated with titanium miniplate at zygomatic buttress and Group II was treated by bio‑resorbable plates. One point fixation was done either at zygomatic buttress or at fronto zygomatic suture and it was observed that both the site have been the most favored site of rigid internal fixation in terms of stability, aesthetics and prevention of rotation of the fracture segment in either vertical or horizontal axis. They conclude that there is no significant difference in postoperative outcomes between two groups, but still bio resorbable system has some advantage over titanium system as these plates resorbs over a period of time and does not cause any interference with growth and postoperative radiotherapy. However, application of biodegradable system demanded a highly précised technique as compared with titanium system.

41.MazenAlmasri , 2013 [64]

concluded the results of the study indicate that RTAs are a major health care threat. RTAs are the major cause of general trauma and MFT in the region. **Younger drivers, careless driving, speeding, and lack of seat belt use are major**

contributors to RTA rates. Males were 10 times more likely to be affected by MFT than females. The magnitude and the severity of these preventable injuries indicate that they are a major threat to the community and health care system in terms of hospital resources, time, and cost, as well as the impacts on the patients and their families. These findings can be used to alert the community and authorities about this issue, leading to the development of community awareness and educational programs. We recommend that **traffic laws in the region be enforced more strongly through speed control strategies, helicopter surveillance, street surveillance cameras**, and the control of heavy truck traffic.

42.Gregor.F.Raschke et al, 2013 [54]

Before undergoing repair of zygomaticomaxillary complex fractures, most patients are worried about their postoperative appearance. Furthermore, there is an ongoing discussion about the selection of the surgical approach to the inferior orbita and resulting eyelid deformities. We present a photo-assisted postoperative evaluation of zygomaticomaxillary complex fracture repair based on reference anthropometric data. Two hundred and twenty-one patients underwent zygomaticomaxillary complex fracture repair. An analysis of standardized postoperative photographs included measurements of eye fissure width and height, lid sulcus height, upper lid height, upper and lower coverage, position of cornea to palpebra inferior, canthal tilt, scleral show, ectropion and entropion. It was clearly distinguished between operated and contralateral eyelid, and whether a transconjunctival or a subciliary approach was performed. Surgery per se significantly influenced eyelid deformities as measured by its impact on eye fissure index, lower iris coverage and rate of scleral show and ectropion. The surgical approach selected significantly affected eye fissure index, lower iris coverage and rate of scleral show, indicating distortion of the lower eyelid. The evaluation of the effects of ZMC fractures and their operative therapy on the periorbital

architecture by using anthropometric data extracted from standardized photographs is exact, reliable and adequate. Lower lid retraction is the most common form of eyelid distortion in these patients. The subciliary approach exhibited a significantly higher rate of lower lid retraction than the transconjunctival approach.

43.Rahul Datta et al, 2014 [21]

did a retrospective study in management of isolated zygomaticomaxillary complex fractures. In surgical management of a ZMC fracture, many authors have proposed a variety of surgical approaches for reduction of the bone. In addition, after the evolution of bone plating systems, a large number of recommendations have been made for stabilization or fixation of these fracture segments. This study presents a retrospective review of isolated ZMC fractures,managed with an individualized approach.

44.Vijay Ebenezer et al, 2014 [24]

evaluate the advantages and efficacy of two point mini plate fixation for the zygomatic complex fractures using lateral eye brow and infra orbital approaches for fixing the fronto zygomatic fracture and infra orbital fracture. The zygomatico-maxillary complex functions as the principle buttress of the face and is the cornerstone to an individual's aesthetic appearance. The zygomatic complex also helps in transmitting the occlusal forces to the skull base. Zygomatic complex fractures are one of the frequently occurring maxillofacial injuries owing to its position and facial contour. Assaults, road traffic accidents and falls are the common causes leading to fracture of the zygomatic bone. Displacement of the fractured fragments leads to aesthetic and functional disturbances. Thorough anatomical knowledge is required to correct the deformity in a better way.

Treatment modality is based on the type and severity of the fracture. Informed written consent was obtained from all the patients. Detailed medical history of the patients was taken at the time of admission. All the patients were treated with 2-point fixation at the fronto-zygomatic suture region and infra-orbital region . They concluded finally two point mini plate fixation at infra orbital and fronto zygomatic region provide better result in term of post operative stability,aesthetics and give resolution of infra orbital paresthesia in ZMC fractures.

45.Srinivas M Susarla et al, 2014 [51]

Patients with ZMC fractures often present with tenderness, ecchymosis and edema over the malar prominence, lateral orbit, upper and lower eyelids, loss of malar projection, and blunting of the lateral canthus relative to the unaffected side. Medially displaced zygomatic arch fractures may impinge on the coronoid process or temporalis tendon, resulting in trismus. Paresthesia in the region of the infraorbital nerve is a common neurosensory finding. Significant involvement of the orbital floor may result in extraocular muscle dysfunction/ entrapment, diplopia, or enophthalmos. Reduction should be performed for displaced fractures that result in trismus, contour asymmetry, or significant orbital floor disruption. The zygomaticomaxillary buttress can be accessed through a gingivobuccal sulcus incision. This incision is typically made 5 mm superior to the mucogingival junction through mucosa and then periosteum. The frontozygomatic suture can be accessed via an upper blepharoplasty incision or a lateral eyebrow incision. The orbital floor can be accessed through a lower eyelid subciliary, subtarsal, or transconjunctival approach. Patient was diagnosed with a left zygomaticomaxillary complex fracture and underwent open reduction and internal fixation via a gingivobuccal sulcus approach. Reduction was achieved using a Carroll-Girard screw . Once reduction was established,

fixation was accomplished using an L-shaped plate at the zygomaticomaxillary buttress and a curvilinear plate at the infraorbital rim after releasing and protecting the infraorbital nerve.

46.***Balakrishnan, Vijay Ebenezer et al, 2015*** [22]

reviewed 5 year case management of tripod fractures in zygomatico maxillary complex with 1-point and 2-point fixation. Data documented were the patient's age, sex, and etiology of the fracture. Other data recorded were the site of fracture (zygomatic bone or arch), associated maxillofacial injuries, clinical presentation, radiographic findings, treatment, duration of follow-up, and complications. This study has shown that closed reduction and internal fixation of ZMC fractures provide adequate reduction of these injuries.This surgical technique results in good bony alignment and esthetics, as measured by postoperative CT scans and patient questionnaires. Significant facial asymmetry requiring surgical revision occurs in 3–4% of patients. Postoperative infection rates are extremely low, and these infections nearly always resolve with oral antibiotics. In general, the long‐term prognosis after repair of ZMC fractures is very good. This study has also shown that road traffic accidents are responsible for most zygomatic complex fractures in our environment. With the introduction of compulsory use of seatbelts in developed nations, there is a significant reduction of facial injuries.[45,46] In India, as per Motor Vehicle Act use of seatbelts and helmets is compulsory, but the compliance is poor. It is imperative to educate people regarding the use of headgear (crash helmet) and seatbelts while traveling in motorized transport which will go a long way in preventing injuries to the facial region.

47.Srinivas M Susarla et al, 2015 [23]

discussed briefly in this study that Orbitozygomaticomaxillary complex (OZMC) fractures are commonly encountered by the craniomaxillofacial trauma surgeon and may, in fact, be the most common type of orbital fracture. Disruption of articulation with the frontal and sphenoid bones causes disruption of the internal orbital skeleton, which can result in diplopia from extraocular muscle swelling or entrapment, or enophthalmos from increased orbital volume. Although there is significant energy transferred to the orbit in these injuries, blindness and intraorbital hematoma are, fortunately, relatively rare complications, typically seen pre- or postoperatively. In this report, we describe the development of acute intraorbital hemorrhage following reduction of a displaced OZMC fracture.

48.S Mohammed, 2015 [67]

explained about the hemicoronal is ideal and best surgical approach to treat ZMC fracture that provides maximum necessary exposure of fractured segments, minimize potential for injury to facial structures, imparts stability after fixation and enable good cosmetic results. Additionally intraoral, vestibular or sub ciliary incision were used for further access. Clinical evaluation including mouth opening, improvement in diplopia, anatomic restoration and radiological assessment of the patients was done on regular follow up.

49.Saeed Nezafati et al , 2015 [50]

documented the etiology and clinical data of patients with fractures of thezygomatic complex and to compare the findings with other studies in the literature Patients and Methods. The findings, compared with similar studies reported in the literature,

support the view that the highest prevalence is in young male patients and, concerning cause, traffic accidents is the most frequent. This present research study was carried out to determine the etiologic factors, symptoms and signs, associated injuries and fracture patterns of zygomatic complex in patients. zygomaticomaxillary complex fractures were divided into 4 types as follows:

Type I: green stick fracture of zygoma

Type II: pure zygomatic arch fracture

Type III: fracture of zygomatic buttress with minimal displacement in the antero-posterior direction

Type IV: fracture of zygomatic buttress with great displacement in the antero-posterior direction. Patients with displacement in the lateral direction were also included in type IV group.

RTA, Falls, Interpersonal violence, Assault and Sports injuries are more common causes for Zygomaticomaxillary complex fractures. Infra orbital nerve paresthesia, step in the inferior orbital rim, sub conjunctival hemorrhage, Restriction in the mouth opening, Diplopia are most common signs and symptoms of ZMC fractures.

50.Linas Zaleckas et al, 2015 [49]

The purpose of the study was to analyze the prevalence, etiology and localization of midfacial fractures. They revealed that the main cause of midfacial fractures was assault. Male patients, aged 15–34, more often sustain midfacial fractures. Due to the severity and complexity of facial trauma, treatment management requires close cooperation of maxillofacial surgeons, neurologists, ophthalmologists and also continued publicity on the importance of preventive strategies. Preventive health care programs should seek measures in

the reduction of aggression and violence in close future involving family, school and community institutions.

51.Sartaj Khan et al, 2015 [37]

The common causes of zygomatic bone fractures, across the globe, are road traffic accidents (RTA), falls, assaults, sports, firearm injury and industrial accidents. These etiological factors depend on the geographic condition, socioeconomic status, and cultural characteristics and era. Road traffic accident is the leading cause of maxillofacial fractures in developing countries, while interpersonal violence is the leading cause in western world. The most common causative factor in adults is the road traffic accident and fall in the younger population. Epidemiological studies have revealed age and sex as important factors that influence the occurrence of maxillofacial trauma. The highest incidence is observed in the age group 21-30 years.The treatment of zygomatic bone fracture varies from none to open reduction and internal fixation at three or four sites depending upon type of fracture.

Zygomatic bone fracture carries a risk of functional and aesthetic impairment and therefore warrants timely management to prevent late or non operative squeals. The purpose of the present study was to evaluate the occurrence of zygomatic bone fracture and its treatment options, preventing later complications. Routine investigations, orthopentogram (OPG), Waters view and CT were performed for every patient supplemented by MRI when necessary. The treatment modalities of zygomatic bone fracture vary from surgeon to surgeon and depends on multiple factors like the timing of presentation, degree of displacement, age of the patient, mouth opening, aesthetics concern, finances and associated systemic diseases. There are different techniques either non surgical or surgical which ranges from simpler close reduction without fixation to open reduction and internal fixation7,14. These techniques included temporal, lateral orbital, intraoral approaches and percutaneous for elevation with

bone hook and external fixation, antral packing with gauze or balloon, intraosseous wiring, bone plating and recently endoscopic assisted reduction and fixation8,13,14. In this study 54% of patients were treated by elevation either through intraoral or extraoral approaches and 46% were treated by open reduction and internal fixation with microplates. Upper eyebrow, infraorbital rim and intraoral vestibular incision were used to expose the fracture sites. No significant complications were noted in these patients.

52.Rohith Sharma et al, 2016 [25]

introduced a modified technique for fixation of zygomatico maxillary complex fractures. To get access the zygomatic buttress intraorally, local anaesthesia is achieved by a posterior superior alveolar nerve block is administered in to the affected side and the area is also infiltrated with local anaesthetic solution. For palatal side, greater palatine block is administered. A horizontal incision of around 2 cm length is made by using a no. 15 blade in the upper buccal sulcus, extending from canine to first molar area. The mucoperiosteal flap is reflected to expose the underlying fracture. With conventional approaches, only the buttress can be exposed up till its attachment to the body of maxilla or at the zygomatico-maxillary suture. In the modification of the incision, a 1 cm long vertical incision is given in the periosteum starting from the base of the zygomatic buttress and carried upwards along the buttress. The periosteum is then reflected sideways to expose the ascending limb of the buttress. With this modification, complete buttress up to the anterior part of the zygomatic arch can be exposed. After attaining adequate access, the zygomatic bone and arch can be elevated using conventional methods. For fixation, we recommend use of a 4-6 hole L-plate rather than a straight plate. Various approaches for reduction and fixation of zygomatic fractures include the Gillie's temporal approach, the hemicoronal and bicoronal approaches, as well as a stab incision over the zygomatic arch region.

53.Kalappa TM et al, 2016 [26]

discussed briefly about the etiology, pattern and management of zygomatico-maxillary complex (ZMC) fractures. Age distribution, gender distribution, etiology, associated injuries, associated maxillofacial fractures, clinical features, distribution of radiographic investigation, radiographic findings associated with ZMC Fractures, pattern of fractures and various modalities of management and surgery were recorded. Circumorbital edema was the commonest clinical feature in ZMC fractures . Keene's approach was the commonest method of zygoma elevation .Two point internal fixation was commonly used . Among two point fixation, frontozygomatic suture and zygomatico-maxillary suture were commonly plated . Among one point internal fixation, zygomatico-maxillary suture was most commonly plated . This study has shown that road traffic accidents have been responsible for most of the ZMC fractures in our geographical area and two point fixation at zygomatico-maxillary suture and fronto-zygomatic suture has been the commonest method of fixation and Keene's approach has been the choicest method for elevation of zygoma.

54.Aydin OZKAN et al, 2016 [52]

Treatment modality in zygomaticomaxillary complex (ZMC) fractures is still controversial. The first concerns the best way for surgical reduction of the fractures. The second is related to the necessity to fix them or not after the reduction, and the third concerns the number of fixation points necessary so that the fractures of the ZMC are stabilized. The common goal of all treatments is an exact three-dimensional restoration of the disturbed anatomy.

Reduction of Zygomatic Complex Fracture Using Combination of Microplate and Miniplate Osteosynthesis. Strong and Sykes propose a combination of systems of miniplates

and microplates in the different buttress of support of the ZMC fracture. They recommend the use of microplates of 1.0 or 1.2 mm in the infra orbital border. They used 0.5 mm thickness microplate to reduction infra orbital fracture. This study using microplate and miniplate combination has given us promising result in the ZMC fractures.

55.Esat Bardhoshi , 2016 [48]

Fractures of the zygomaticomaxillary complex are the second most common of all facial fractures. Several fixation methods have been used over the years, including wire osteosynthesis, lag screw fixation, transfacial Kirschner wire fixation, titanium plate and screw fixation, and more recently, resorbable plating system. Internal fixation with titanium plates and screw provides the most rigid fixation and thus greater immobility of the fracture segments. The degree of immobilization created with titanium plates and screws also allows fixation at fewer anatomic points.

Postoperative Care

As soon as awakened from anaesthesia, patients are evaluated for the presence of vision and the pupils are evaluated for size and reactivity. Postoperative CT scans are generally recommended for all complex cases10. Many patients will have a transient or permanent postoperative infra orbital nerve sensory deficit11. The reported incidence of an immediate postoperative sensory deficit approximates 55%, whereas that of a permanent deficit ranges between 15% and 46%. The current literature suggests that the incidence of infra orbital nerve sensory deficits is related to the degree of fracture displacement. The literature further suggests that fracture reduction within the first week after injury will reduce the incidence of a permanent sensory deficit.

56.Geeta Mishra Tripathi et al, 2016 [39]

Zygomatic bone is a quadrangular bone situated at the lateral midface. Fracture of zygomatic complex is the second most common fracture after nasal bone due to its prominence in lateral midface.The epidemiological survey on the causes and incidence of maxillofacial injuries vary with geographic region, socioeconomic status, culture, region and era. Zygomatic complex fracture accounts for 45% of all midface fractures,This is consistent with 41.48% in our study also. The most common causes of maxillofacial injuries is road traffic accidents, assaults, sports, occupational related injuries, and falls. In our study we found the etiology was RTA (74.43%), assaults (17.1%), and others causes (8.45%). This is well matched with other studies. In our study, males (68.085%), were more effected as compare to females (31.91%). This may be due to higher frequency of consumption of alcohol in males. Alcohol impairs judgment, brings out aggression, often leads to inter-personal violence and road traffic accidents.15,16 The peak incidence of mid-face fracture was found in the age range of 21–30 years, which is in accordance with other studies.The most common symptom was subconjuctival ecchymosis (88.03%).This may be due to tear of periosteum of orbital rim. Buccal sulcus ecchymosis (83. 76%) was the 2nd most common presenting symptom. We found Step deformity in 84.61%, flattening of cheek in 78.63% periorbital ecchymosis in 82.91%, parasthesia in 64.10%, pain in 57.26%, epistaxis in 35. 89%, trismus in 26.49%, and diplopia in 5.98% cases. This results is in accordance with other studies. The main aim of reducing zygomatic fractures is aesthetic and functional restoration of both face and orbit. The criteria of approach were based on the location and type of fractures. Lateral eyebrow incision, infraorbital incision and intraoral vestibular incision were most commonly utilized for surgical exposure. As for the zygomatic arch, Gillies temporal approach was preferred. In some cases, lower eyelid incision with lateral extension were taken in 23 cases (19.65%). These approaches provided best result with minimal

complications such as pain, palpability of implants. Strict legislative measures must be enforced regarding use of the seat belt, wearing of helmet, restricted speed limits and unwavering adherence to traffic rules.

57.Bhasker Yamsani et al, 2016 [47]

This study is to evaluate and review the etiology, incidence, clinical management of ZMC fractures and their efficacy is evaluated in the larger interest of the patients. Three principle buttresses need to be considered in midface fractures. The medial or nasomaxillary buttress reaches from the anterior maxillary alveolus to the frontal cranial attachment. The second is the pterygomaxillary, or posterior buttress, which connects the maxilla posteriorly to the sphenoid bone. The third is the lateral or zygomaticomaxillary buttress. This important buttress connects the lateral maxillary alveolus to the zygomatic process of the temporal bone. These buttresses help give the zygoma an intrinsic strength such that blows to the cheek usually result in fractures of the zygomatic complex at the suture lines. Lothrop was the first to describe an antrostomy approach in which he reached the fractured zygoma through the Highmore antrum below the inferior turbinate. He then was able to rotate the fractured zygoma upward and outward for a proper reduction. This transantral approach is known today as the Caldwell-Luc approach. Gillies described an original approach to reduce a depressed malar bone. He was the first to reach the malar bone through an incision made behind the hairline and over the temporal muscle. The Gillies method remains in use today to elevate the arch. Various approaches for ZMC fractures like Lateral Eye Brow approach, Buccal Sulcus Approach, Gillies Temporal Approach, Maxillary Vestibular Approach, Infra Orbital Approach, Open Reduction and Fixation approaches.

58.Karikal Arvind et al, 2016 [46]

In this study, road traffic accidents are the leading cause for the midfacial fractures. The reasons for this high frequency are difficult to ascertain it may be one or combination of the reasons mentioned here. Inadequate road safety awareness, unsuitable road conditions without expansion of the road breath of narrow roads, violation of speed limits,old vehicles without safety features, failure to wear seat belt and helmets, entry in to opposite traffic lane, violation of the highway code, use of alcohol or other intoxicating agents. In another aspect ZMC fractures can be noticed is gradual increase in assault. According to this data it seems reasonable to assume that Road Traffic legislation enforcement and continuous public education toward the use of restraining devices such as helmet wear and seat belts should be encouraged.

59.So Young Ji et al, 2016 [53]

In this study they explained for zygomaticomaxillary complex (ZMC) fracture many incisions lateral eyebrow, lateral upper blepharoplasty, transconjunctival, subciliary, subtarsal, intraoral, and direct percutaneous approach are useful. A retrospective review was conducted of patients with ZMC fracture at a single institution, fracture type was classified according to the Knight and North classification based on computed tomography (CT) images obtained before surgery. We reviewed various approaches for the treatment of ZMC fractures and discussed about incisions and fixation methods. According to the fracture pattern, various reduction methods were performed. After the operation, we checked X-ray (water's view, zygomatic arch view) or CT, and evaluated the X-ray again after one month. In conclusion, minimal incision, familiar approach and fixation methods of the surgeon are recommended.

60.Sourav Sharma et al, 2017 [27]

explained that the fractuured zygoma biomechanically has six possible directions of motions: rotation around X, Y and Z axis and translation across X, Y and Z axis. They explained wire fixation of zygomatic complex fracture showed unsatisfactory results in terms of accurate reduction and fixation of small fractured fragments. Mini plates have revolutionized the standards of management of maxillofacial fractures by providing rigid internal fixation and ultimately better stability and less complications. Zygomatic bone is attached to adjacent bones and has four suture lines; which are the areas of anatomical weakness . Depending upon the velocity and impact of the trauma; one or many of these sutures are involved in the fracture. The topic of controversy here has been the amount of fixation which is required to precisely stabilize and fix the fractured zygomatic complex. They gave a report of patient with zygomatic complex fracture who was treated by fixation of mini plates at infra orbital rim and fronto-zygomatic suture region. Thus they conclude that two point fixation in Zygomatic complex fractures yields satisfactory post operative stability and aesthetics in addition to resolution of infra orbital paresthesia. Severely displaced zygomatic complex fractures may require additional points of fixation.

61.Ashwin DP et al, 2017 [28]

did a study on assessing the etiology and different treatment modalities of zygomaticomaxillary complex fracture. 46 patients with zygomaticomaxillary complex fracture were selected on the basis of radiographic evaluation severity of displacement was assessed and different treatment modalities. Result carried out in open reduction and internal fixation in 73.9% .In this 1-point fixation in (28.3%), 2-point fixation in (32.6%) and 3-point fixation in (13%).In this study fixation points were either 1-point, 2-point and 3-point depending on the displacement at the fractured sites. Two-point fixation

being the most common, to determine whether there was any post-surgical change in the orientation of plates or displacement of ZMC, immediate post-operative images were compared with those obtained later after one month. There was no incidence of any change among the treated group. Based on this a variety of methods can be used successfully to stabilize ZMC fracture. They conclude that treatment modalities for zygomatic bone fracture depends on the characteristics of the fracture and open reduction and internal fixation with miniplates in 2-points is the most reliable modality providing three dimensional stability.

62.Sourav Sharma et al, 2017

concluded that two point fixation in Zygomatic complex fractures yields satisfactory post operative stability and aesthetics in addition to resolution of infra orbital paresthesia. Severely displaced zygomatic complex fractures may require additional points of fixation. Progressive advent and gradual increase in number of high speed vehicles has led to increased cases of facial trauma. Infra orbital and zygomatico frontal suture approach was used to treat the displaced zygomatic complex fractures. Infra orbital rim incision provided adequate exposure of the fracture site; compressed infra orbital nerve was released from the fractured fragments. Fractured bony segments were accurately aligned and fixed using mini plate.

63.Chao-Ming Wu et al, 2017 [45]

In this study, we compared the function and satisfaction outcome between Bonamates bioabsorbable implant and Leibinger titanium implant. Traditionally, most maxillofacial surgeons perform osteosynthesis with titanium plates and screws for rigid fixation. However, this procedure has certain disadvantages that include the possibility of implant exposure, palpability or loosening of the screws, painful irritation, temperature

sensitization, and radiographic artifacts. To overcome the complications inherent in the titanium implant system, bioabsorbable osteosynthesis has been developed. The use of bioabsorbable plates and screws is an attractive alternative compared with that of the traditional metal plate system. Because bioabsorbable implants are completely resorbed, secondary surgery for removing implants and long-term interference with nerves and the growing skeleton can be prevented. There are 2 types of bioabsorbable plate: homopolymer (Poly-L-lactic acid (PLLA), and polyglycolic acid (PGA)) and copolymer (Lactosorb, BioSorb, and DeltaSystem). Both the bioabsorbable and titanium plate groups had similar outcomes without major complications. The Bonamates plate provides reliable results for isolated, non-comminuted zygomatic fractures in selective cases and presents another optional fixation device for zygomatic fracture. However, a longer follow-up period is required to observe possible long-term complications.

64.Sandhya K et al, 2017 [44]

explained about the role of maxillofacial trauma in head injury and does the presence of faciomaxillary fractures protect the brain from trauma? To document the pattern of maxillofacial trauma and head injury in patients with craniofacial injuries and to identify whether craniofacial fracture patterns predispose patients with maxillofacial fractures to different types of intracranial haemorrhages. Patients presenting with maxillofacial fractures may also have accompanying injuries such as head injury, Studies have reported that patients with multiple facial bone fractures have a higher prevalence of intracranial hematoma. Intracranial hematoma is an acute emergency and immediate decompression can reduce the extent of brain injury. Patients who present with symptoms of intracranial injury such as vomiting, nausea, loss of consciousness, low GCS score are evaluated for head injury. So patients with facial bone fractures at high risk of accompanying intracranial injury. Today,

CT scanning is routinely performed in patients with impaired consciousness or neurological signs. The purpose of the present study is to document the pattern of maxillofacial trauma and head injury. The data was collected after providing emergency lifesaving procedures and stabilising the patient. Age, sex, smell of alcohol, details of the road traffic accident including the use of helmet/seat belt at the time of accident, head injury and the facial bone fracture details were recorded. The facial bone fractures taken into consideration were that of frontal bone, zygomatic complex, isolated zygomatic arch fracture, orbital floor fracture, Lefort I, II, III fractures of maxilla and mandible fracture. Cranial vault fractures, cerebral contusions, epidural haemorrhage, subdural haemorrhage, subarachnoid haemorrhage and intracranial haemorrhage were recorded. Patients were divided into three groups. Group A patients with only facial bone fractures. Group B patients with isolated skull fractures and intracranial haemorrhage group. Group C patients with both facial bone fracture and head injury. Patients with Lefort III fractures and zygomatic complex fractures should be thoroughly evaluated for head injury. They concluded that facial injury should always be of clinical concern with associated brain damage, because it can be a marker for substantial transfer of energy to the brain. Hence a timely detection and prompt treatment of patients with craniofacial fractures is very important.

65.Yoshiaki Sakamoto et al, 2017 [43]

Aim of the current study was to analyze the relationships between the trauma etiologies, the zygomatic fracture patterns, and patient ages. For each patient, the available clinical notes and high-resolution computed tomography scans were reviewed. The “trauma etiologies” were divided into 6 categories: sports, motor vehicle collisions, falls after drinking, falls due to other reasons, assaults, and others. The zygomatic fracture pattern type was classified, based on the zygomaticofrontal suture, as either shear or greenstick. In this

study, the association between sports-related injuries and isolated zygomatic fractures may be explained by the frequency of elbows, shoulders, and balls hitting the zygoma during sporting activities. The results also attest to the value of facial protection equipment for decreasing the energy causing the injuries. This study evaluated the relationships between fracture etiologies, patient ages, and zygomatic fracture severities. Based on this study, possible prevention strategies for zygomatic fractures need to be considered.

66.Thomas Starch-Jenesen et al, 2018 [42]

evaluated the 1-year treatment outcome of zygomatic complex fractures with surgical or nonsurgical intervention. In the present study, a sequential surgical treatment strategy has been used exposing the zygomaticomaxillary buttress as the first approach, followed by either the frontozygomatical junction and/or the infraorbital rim, when adequate anatomic alignment could not be achieved solely by the intraoral approach. In the present study, a sequential surgical treatment strategy has been used exposing the zygomaticomaxillary buttress as the first approach, followed by either the frontozygomatical junction and/or the infraorbital rim, when adequate anatomic alignment could not be achieved solely by the intraoral approach. Surgical intervention and internal fixation is an effective treatment modality of depressed zygomatic complex fractures, whereas a nonsurgical approach is often used for nondisplaced zygomatic complex fractures. The intraoral approach offers the opportunity for direct visualization of the fracture reduction and placement of fixation plates at the zygomaticomaxillary buttress. However, further exposure of the zygomaticofrontal junction or the inferior orbital rim and orbital floor is necessary for severely displaced fractures, which require additional rigid fixation.

67.Xiao Zhang et al, 2018 [70]

In this study, patients divided into two groups one is experimental the other one is control group. The experimental group is treated with surgical navigation and the control group is without navigation. Pre and post operative imaging data were collected and analysed using Geomagic Studio 11 software and Brainlab iPlan CMF 3.0 . Commonly zycomaticomaxillary complex fracture one of the most challenging facial bone freacture is hard to achieve accurate reduction . A more precise reduction was showed in the experimental group according to the measurement results of both the software programs than the control group. They concluded that surgical navigation showed greater value in performing accurate reductions of complicated zygomaticomaxillary complex fractures and restoring the facial contour.

MATERIALS AND METHODS

SUBJECTS

All patients attending in Best Dental Science college and Hospital and Government Rajaji Hospital with ZMC fractures with minimal displacemant.

METHODS

Surgical intervention open reduction and internal fixation under GA

PLACE OF STUDY

MADURAI

SELECTION PROCESS

INCLUSION CRITERIA

Fractures with minimal displacements indicated for open reduction.

Patients Age group 18 - 50 years.

Patient should be available for periodic review.

EXCLUSION CRITERIA

Patients with systemic complications who are not fit to undergo surgical intervention under GA

Patients with comminuted fractures are excluded.

Patients below the age of 18 years are excluded.

Patients with PANFACIAL fractures are excluded.

NUMBER AND NAME OF THE GROUPS

I. Patients treated with 1- point fixation in zygomaticomaxillary buttress region.

II. Patients treated with 2- point fixation in zygomaticomaxillary and frontozygomatic region.

STUDY PARAMETERS

VC- Vertical change which represents the movement of the bilateral infraorbital rim line

HC- Horizontal change which represents the movement of the bilateral anterior margins of the fossa temporalis line.

ARMAMENTARIUM

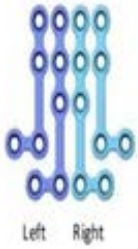
Titanium mini plates- straight, L" plates 1.5 mm

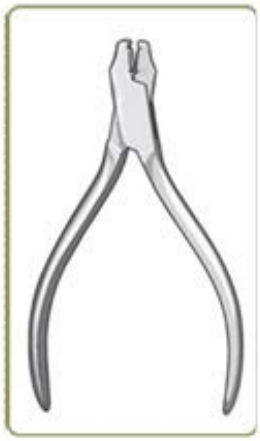
Titanium screws 6 mm, 8 mm

Surgical Screw Holder, Screw Driver and

Basic Surgical Instruments

Plate bender


Left
Right



SURGICAL ANATOMY

Zygomatic bone has two attachments to the cranium and two to the maxilla, they create a large portion of the orbital floors and lateral orbital walls. The two major buttresses of the ZMC are the upper transverse maxillary(across the zygomaticomaxillary and zygomatico-temporal sutures) and the lateral vertical maxillary(across the zygomatico maxillary and frontozygomatic sutures). Zygomatic bone maintains four points of articulation with the frontal bone, temporal bone, maxilla and greater wing of sphenoid. It presents a malar and a temporal surface four processes(frontosphenoidal, orbital, maxillary and temporal) and four borders. The malar surface is convex and perforated near its center by a small aperture, the zygomatical foramen, for the passage of zygomaticofacial nerve and vessels below this foramen a slight elevation which gives origin to the zygomaticus muscle.

The temporal surface, directed posteriorly and medially is concave presenting medially a rough triangular area for articulation with the maxilla and laterally a smooth concave surface the upper part of which forms the anterior boundary of the infratemporal fossa. Near the center of this surface is the zygomaticotemporal foramen for the transmission of the zygomaticotemporal nerve.

The orbital surface forms the lateral part and some of the inferior part of the bony orbit. The zygomatic nerve passes through zygomatic-orbital foramen on this surface. The lateral palpebral ligament attaches to a small protuberance called the orbital tubercle.

Borders

The anterosuperior or orbital border is a smooth, concave and forms a considerable part of the circumference of the orbit.

The anteroinferior or maxillary border is rough and bevelled at the expense of its inner table to articulate with the maxilla, near the orbital margin it gives origin to quadratus labii superioris.

The posterosuperior or temporal border curved like an italic letter f , is continuous above with the commencement of the temporal line, and below with the upper border of the zygomatic arch, the temporal fascia attached to it.

The posteroinferior or zygomatic border affords attachment by its rough edge to the masseter

Articulations

The zygomatic bone articulates with Frontal, Sphenoid, Temporal and Maxilla.

CLASSIFICATION OF ZYGOMATIC COMPLEX FRACTURES

Types of classifications

1.Schjelderup classification

2.Knight and North classification

3.Rowe and Killey classification

4.Spissel and schroll classification

5. Henderson classification

6.Ozyazgen classification

7.Manson classification

8.Fuji and Yamashiro classification

9.Zingg classification

ROWE'S and KILLEY Classification

Type I. No significant displacement

Type II. Fracture of zygomatic arch

Type III. Rotation around horizontal axis- inward or outward displacement

Type IV. Rotation around longitudinal axis-medial or lateral

Type V. Displacement of the complex block-medial/inferior/lateral

Type VI. Displacement of orbitoantral partition

Type VII. Displacement of orbital rim segment

Type VIII. Complex comminuted fracture

Shielderup Classification

Type 1. Displaced zygomatic bone hinged on the maxillary and the frontal attachments

Type 2. Displaced zygoma hinged on maxillary attachments.

Type 3. Displaced zygoma hinged on frontal attachments.

Henderson's Classification

Type 1. Non displaced fractures

Type 2. Isolated zygomatic arch fracures

Type 3. Zygomatic complex fractures but the frontozygomatic suture is undisplaced

Type 4. Zygomatic complex fractures with displacement of the frontozygomatic suture

Type 5. Pure blow-out fractures

Type 6. Fractures of the orbital rim only

Type 7. Comminuted or multiple fractures

For practical use zygomatic fractures should be classified into 3 groups only:

A. Undisplaced fractures: this diagnosis being based on both clinical and radiological examination and furthermore ensured by clinical re-examination when the traumatic edema has subsided

B. Displaced unstable fractures: this diagnosis being based on radiological evidence of comminu-tion ; or wide seperation or displacement at the zygomaticofrontal suture.

C. Displaced post reductively stable fractures this group comprising all other fractures.

VARIOUS TYPES OF SURGICAL APPROACHES

1. Extra oral approach
2. Bicoronal or hemicoronal
3. Gillies temporal approach
4. Superolateral
5. Supraorbital approach or lateral eyebrow
6. Upper eyelid
7. Lower eyelid
8. Infraorbital
9. Subtarsal
10. Subciliary - lower blepheroplasty
11. Transconjunctival
12. Percutaneous

13. Intraoral approach - Balasubramaniam or Keen's

14. Transoral - maxillary vestibular

15. Endoscopic transantral

RESULT

From this table, Since the p value is <0.001** for pain, palpability, aesthetics and satisfaction there is no statistically significant difference between the groups while considering these factors. But the table also shows that there is statistically significant difference in groups while considering the factors-mobility, plate removal and stability. It can further be well explained with the mean rank values. Whichever group has the lowest value can be considered as more efficient or favorable. Also, from the table it is clear that all the patients from group1 and group2 need plate removal. Patient satisfaction is almost the same with both the groups but the mean rank shows that it is good with group1 when compared with group2.

TABLE FOR GROUP - I

S.No	Age	Sex	Pain in FZ area	Mobility in FZ area	Occlusion derangement	Post - Operative edema	Plate removal	Satisfactory Score
1	35	M	No	No	No	No	Yes	9
2	40	M	No	No	No	No	Yes	9
3	59	F	Yes	Yes	Yes	No	Yes	7
4	35	M	No	No	No	No	Yes	9
5	47	F	No	No	No	Yes	Yes	8
6	28	M	No	No	No	No	Yes	9
7	31	F	Yes	Yes	No	No	Yes	8
8	49	M	No	No	No	No	Yes	9
9	51	M	No	No	No	Yes	Yes	8
10	33	M	No	No	No	No	Yes	9
11	29	M	Yes	No	No	No	Yes	9
12	45	M	Yes	No	No	No	Yes	9

TABLE FOR GROUP - II

S.No	Age	Sex	Palpability of the Prosthesis	Paresthesia	Post - Operative scar	Post - Operative Pain	Plate Removal	Satisfactory Score
1	37	F	Yes	No	Yes	Yes	Yes	9
2	65	M	Yes	No	Yes	Yes	Yes	9
3	54	M	Yes	Yes	Yes	Yes	Yes	9
4	65	M	Yes	No	Yes	Yes	Yes	9
5	29	M	Yes	Yes	Yes	Yes	Yes	9
6	44	F	Yes	Yes	Yes	Yes	Yes	9
7	42	M	yes	No	Yes	Yes	Yes	10
8	36	M	No	No	Yes	Yes	No	9
9	27	M	Yes	No	Yes	Yes	Yes	9
10	32	F	Yes	No	Yes	No	Yes	9
11	48	M	Yes	Yes	Yes	Yes	Yes	9
12	28	M	yes	Yes	yes	Yes	Yes	10

STATISTICIAN REPORT

Groups	Age	Sex	Pain	Palpability	Mobility	Premoval	Stability	Esthetic	Satisfaction
1	35	M	N	N	N	Y	B	NS	9
1	40	M	N	N	N	Y	G	NS	9
1	59	F	N	N	Y	Y	G	NS	7
1	35	M	N	N	N	Y	G	NS	9
1	47	F	N	N	N	Y	G	NS	8
1	28	M	N	N	N	Y	G	NS	9
1	31	F	Y	N	N	Y	G	NS	9
1	49	M	N	N	N	Y	G	NS	9
1	51	M	N	N	Y	Y	G	NS	8
1	33	M	N	Y	N	Y	G	NS	9
1	29	M	N	N	N	Y	G	NS	9
2	37	F	Y	Y	N	Y	G	NS	9
2	65	M	Y	Y	N	Y	G	S	9
2	54	M	Y	Y	N	Y	G	S	9
2	65	M	Y	Y	N	Y	G	S	9
2	29	M	Y	Y	N	Y	G	S	9
2	44	F	Y	Y	N	Y	G	S	9
2	42	M	Y	Y	N	Y	G	S	10
2	36	M	Y	N	N	Y	G	S	9
2	27	M	Y	Y	N	Y	G	S	9
2	32	F	N	Y	N	Y	G	S	9
2	48	M	Y	Y	N	Y	G	S	9
2	28	M	Y	Y	N	Y	G	S	10

Groups	Age	Sex	Pain	Palpability	Mobility	Removal	Stability	Esthetic	Satisfaction
Group1	18	Male	NIL	NIL	NIL	YES	POOR	No Scar	Strongly satisfied
Group1	33	Male	NIL	NIL	NIL	YES	Good	No Scar	Strongly satisfied
Group1	48	Female	NIL	NIL	Mobile	YES	Good	No Scar	Moderately Satisfied
Group1	18	Male	NIL	NIL	NIL	YES	Good	No Scar	Strongly satisfied
Group1	33	Female	NIL	NIL	NIL	YES	Good	No Scar	Good Satisfaction
Group1	18	Male	NIL	NIL	NIL	YES	Good	No Scar	Strongly satisfied
Group1	18	Female	YES	NIL	NIL	YES	Good	No Scar	Strongly satisfied
Group1	48	Male	NIL	NIL	NIL	YES	Good	No Scar	Strongly satisfied
Group1	48	Male	NIL	NIL	Mobile	YES	Good	No Scar	Good Satisfaction
Group1	33	Male	NIL	Palpable	NIL	YES	Good	No Scar	Strongly satisfied
Group1	18	Male	NIL	NIL	NIL	YES	Good	No Scar	Strongly satisfied
Group1	33	Male	NIL	NIL	NIL	YES	Good	No Scar	Strongly satisfied
Group2	33	Female	Pain	Palpable	NIL	YES	Good	No Scar	Strongly satisfied
Group2	48	Male	Pain	Palpable	NIL	YES	Good	Scar	Strongly satisfied
Group2	48	Male	Pain	Palpable	NIL	YES	Good	Scar	Strongly satisfied
Group2	48	Male	Pain	Palpable	NIL	YES	Good	Scar	Strongly satisfied
Group2	18	Male	Pain	Palpable	NIL	YES	Good	Scar	Strongly satisfied
Group2	33	Female	Pain	Palpable	NIL	YES	Good	Scar	Strongly satisfied
Group2	33	Male	Pain	Palpable	NIL	YES	Good	Scar	Absolutely satisfied
Group2	33	Male	Pain	Not Palpable	NIL	YES	Good	Scar	Strongly satisfied
Group2	18	Male	Pain	Palpable	NIL	YES	Good	Scar	Strongly satisfied
Group2	18	Male	Pain	Palpable	NIL	YES	Good	Scar	Strongly satisfied
Group2	48	Male	Pain	Palpable	NIL	YES	Good	Scar	Strongly satisfied
Group2	18	Male	Pain	Palpable	NIL	YES	Good	Scar	Absolutely satisfied

Kruskall Wallis Test

	Name of the groups	N	Mean Rank	Chi-Sq	P value
Pain in FZ Area	Group1	12	17.50	15.972	<0.001**
	Group2	12	7.50		
	Total	24			
Palpability in FZ Area	Group1	12	7.50	15.972	<0.001**
	Group2	12	17.50		
	Total	24			
Mobility in FZ Area	Group1	12	13.50	2.091	0.148
	Group2	12	11.50		
	Total	24			
Plate Removal	Group1	12	12.50	0.001	1.000
	Group2	12	12.50		
	Total	24			
Stability	Group1	12	13.00	1.000	0.317
	Group2	12	12.00		
	Total	24			
Esthetics after surgery	Group1	12	7.00	19.462	<0.001**
	Group2	12	18.00		
	Total	24			
Patient Satisfaction	Group1	12	10.25	4.826	0.028*
	Group2	12	14.75		
	Total	24			

**significant at 0.01 level,
*significant at 0.05 level.

Interpretation:

NULL HYPOTHESIS: *There is no significant difference between the groups taken for study regarding the procedure chosen for surgery.*

From this table, Since the p value is <0.001** for pain, palpability, aesthetics and satisfaction there is no statistically significant difference between the groups while considering these factors. But the table also shows that there is statistically significant difference in groups while considering the factors-mobility, plate removal and stability. It can further be well explained with the mean rank values. Whichever group has the lowest value can be considered as more efficient or favourable. Also, from the table it is clear that all the patients from group1 and group2 need plate removal. Patient satisfaction is almost the same with both the groups but the mean rank shows that it is good with group1 when compared with group2.

Red coded: indicates the more efficient group in regard to each factor.

DISCUSSION

In developing countries due to rapid force of high speed automobiles, poor road conditions and overpopulation the road traffic accidents are more and the incidents of injuries to the maxilla facial skeleton are more.

Injuries to the maxillofacial region present one of the most challenging problems for healthcare professionals worldwide. Particular interest is created by the high incidence and diversity of facial lesions. Fractures of the facial skeleton are invariably associated with substantial morbidity, disfigurement, functional deficit and high cost for treatment.

The zygomaticomaxillary complex is an essential element of the facial configuration. The zygoma is a diamond-shaped bone located in the middle third of the face, and has relations with the orbit, the maxilla, and the temporal fossa. It has lateral, orbital, and temporal faces . The four articulations of the zygoma include the frontozygomatic suture (FZS), infraorbital rim, zygomaticomaxillary buttress, and zygomaticotemporal suture[3,13]. Because of its location, it is subjected to trauma more often than any other element of the face except the nose. Although some injuries will involve an isolated orbital rim or antral wall fracture, most injuries will include the zygomatic bone, and thus the term "zygomaticomaxillary" [2]. The consequences of such injuries may involve ocular function, orbital shape, facial esthetics, and mandibular mobility. Trauma of the zygomatic complex constitutes a considerable percentage of all midface fractures and the best treatment time is generally considered to be as early as possible for fractures of the midface . The causes of maxillofacial fractures vary from

country to country and it shows that some of the variations can be attributed to social culture and environmental factors. The majority of fractures were sustained by males between 21 and 40 years old, usually resulting from falls, altercations, and motorcycle accidents.[2,3 12]

The examination is conducted with a cervical spine precaution protocol since the incidence of cervical spine injuries in patients with facial trauma has been reported to be as high as 3%.[4,8] The examination should be detailed and systematic and should include evaluation of the cranial nerves, eyes, ears, and scalp. The face is then inspected and palpated for asymmetry caused by displaced fragments of the facial skeleton and for areas of oedema, ecchymosis, and lacerations.[11,33]

According to classification mentioned earlier in the discussion about the arch fracture, A malar fracture should be suspected if periorbital oedema, ecchymosis of the lower lid, and/or a lateral subconjunctival haemorrhage [5,7,21,35,47](blood shot eye) is present.

A flat malar arch is best assessed from behind the patient's head. To compare symmetry with the opposite side. This is the best appreciated immediately post trauma or a number of days later when the oedema has subsided.

Zygomatic arch fractures can be clinically difficult to diagnose as the only signs may be a dimple palpable on the arch, which may or may not be tender, and or a decreased range of mouth opening.

The patient's range of mouth opening should be greater than 30 mms. If mouth opening or lateral excursions of the mandible are restricted or cause pain a malar fracture should be suspected.

Palpation of the lateral and inferior rim of the orbit to assess the presence of pain or a step deformity; this may be difficult to appreciate when swollen.

To assess if the malar body is tender. Intra orally to assess the malar buttress (bony curve in buccal sulcus above the first and second molar teeth) for tenderness or a step in the curvature again comparing with the opposite side.

Eye injury is very common in mid face trauma; therefore a thorough optholmological examination is mandatory in all suspected malar fractures. An external exam should note any lacerations: assess extraoccular motility visual acuity, visual fields and the pupillary light reflex.

The patient must be assessed for diplopia , opthalmoplegia, hypoglobus(lowered pupillary level), enopthalmos[5,14](sunken eye), and proptosis[5,14,25]. The integrity of the optic nerve must be established even if the eye is closed by soft tissue swelling.

This is accomplished by shining a light over the closed eye and getting the patient to confirm the presence or absence of light. An opthalmological review is essential in the presence of a through and through lid laceration.

Radiographs are used to confirm the clinical picture. The standard views used are the occipitomental 15/30 views and the submento vertical view, which is specific for arch fractures.

Radiographs can be difficult to interpret; therefore a systemic approach should be adopted when interpreting occipitomental films.

Is the maxillary sinus clear? Opacification or fluid levels in the maxillary sinus are suggestive of a fracture.

The sinus orbital outline should be a symmetrical and there should be no evidence of a step in the bony outline.

- Orbital outline
- Sinus outline

- Elephant's trunk (as it looks like one) made up of zygomatic line laterally, which extends along the superior margin of the zygomatic arch, body, and buttress of the zygoma along the lateral wall of the maxillary sinus.

- Coronoid process -- the tip of which should be equidistant from maxillary line on each side.

The most likely areas of fractures on an occipitomental radiographs are known as hotspots. Particular attention must be given to these hotspots while examining and occipitomental x-ray. Although these hotspots are useful the clinician must still fully examin the x-ray.

Surgery is indicated when there is impairment of function - that is limited mouth opening - and/ or when the patient complains of an aesthetic problem - that is , a flattening of one side of the face.

It is not specifically indicated for paresthesia. Surgery is often best deferred until the swelling has settled and the patient can be assessed fully.

In all patients with suspected malar fractures it is best to advise them to avoid nose blowing as this may result in surgical emphysema. The patient should also be advised to avoid pressure on the effected side.

LATERAL ORBITAL WALL AND ZYGOMATIC ARCH FRACTURE

The orbit is pear shaped cavity, with an apex directed posteriorly, medially and slightly upward. The upper, lower walls of the cavity are described as the roof and the floor. It is also bound by medial and lateral walls. The orbital margin (rim) is strong and, superiorly it contains the supraorbital notch / foramen which transmits vessels and nerves.[9,20,35]

The zygoma forms part of the floor and lateral wall of orbit and zygomatic arch is an important feature in the structure and appearance of the face. The malar complex refers to the zygoma and maxillary bones(and therefore forms part of the orbital floor and lateral wall). This plays a key role in the structure and function of the facial skeleton. In addition to providing support for the globe, it is the insertion site for the masseter muscle and protects the temporalis muscle and the coronoid process.

The most common orbital injury is a 'blowout' fracture , usually involving the orbital floor and the medial wall. The malar complex is also commonly fractured in isolation by a blow to that area. The bones are either fractured or dislocated. The strong central part of the bone usually remains intact and the force transmitted to three buttresses, individually or simultaneously(a tripod fracture) resulting in

- An infra orbital fracture
- Displacement of the zygomaticofrontal suture
- Fracture of the zygomatic arch

An isolated lateral wall of the fracture of the orbit is rare, as this is the strongest of the orbital walls. Lateral wall fractures are therefore more commonly seen following significant maxillofacial,trauma involving the malar complex too. High impact, blunt trauma to the cheek causes zygomatic fractures; they are easy to overlook and, if displaced, require treating with in 10days. Usually, a displaced fracture involves the orbitozygomatic complex

- The inferior orbital rim and orbital floor
- The zygomatico-frontal suture
-The zygomaticomaxillary buttress

- Thezygomatic arch

Features

A malar fracture is suspected where there is

- periorbital oedema
- Ecchymosis
- Lateral subconjunctival haemorrhage

Even without a true orbital blowout fracture, entrapment of the orbital contents, enophthalmos, and diplopia with restriction of the eye movement may occur because of the contributions of the zygomatic bone to the orbital floor.

Preorbital and sub conjunctival haemorrhage[17,24,33] occur in around 50% of cases. Other features to note:

- Fracture of the zygoma may or may not be painful to palpation and running a finger along the zygomatic arch may give a feel of a depressed fracture or a small dimple
- The cheek may appear flattened ; To compare symmetry with the opposite side from behind the patient's head - this is most obvious immediately following trauma or several days later once swelling has subsided.

Posterior displacement of the fractured fragment may impair movement of the mandible, causing difficulty with chewing. It is imperative to look for decreased range of mouth opening(normal should be >30 mm)

- Forceful nose blowing can produce subcutaneous emphysema as shown by crepitation or proptosis and visual loss from orbital emphysema[23,72,73].

MANAGEMENT

A conservative approach is normal where there is no displacement of the fracture or minimal displacement without other complications.

Where a patient has multiple injuries or is severely unwell, surgery is often delayed. Damage to the globe takes precedence for repair.

Closed reduction techniques may be used but open reduction is often required.

If displacement is more than minimal or if other structures are involved, an open technique is used, possibly involving plates to stabilize bone. The precise approach will depend upon the injuries seen on the CT film and open surgical reconstruction may also have to be undertaken.

A multidisciplinary approach may be required in complex cases, using expertise from plastic surgery, facio-maxillary surgery, ENT surgeries, and neurosurgery, and depending upon other associated injuries.

A soft diet is usually required.

Attention should be paid to provide good analgesia. Antibiotics are normally prescribed with complex fractures and short course of steroids may be used to reduce inflammation.

Careful follow-up is required to ascertain that there is good functional recovery, including the ability to eat and chew, eye position and normal facial anatomy.

COMPLICATIONS

- Globe injury
- injury to other orbital walls
- Failure to treat, risks cosmetic deformity or limited mandibular movement.

Prognosis

Good prognosis is suggested by;

-Union of bones

-Lack of any deformity

-Full range of mandibular movement.

Authors Fonseca, Rowe and Williams described that ZMC fracture occurs mainly in the sutures connect with the adjacent bones like frontozygomatic suture, zygomatico temporal suture, spheno zygomatic suture and zygomatico maxillary suture. The fracture segment rotates in horizontal axis rotates inwards or medially and outwards or laterally. The same thing was present in vertical axis.

Investigation part para nasal sinus view x-ray, sub mento vertex view x-ray, CT-axial and coronal view , 3D-CT. All other standard routine investigations were carried out which were required for the General Anaesthesia.

Under general anesthesia patients were intubated . After painting and drapping through Keen's or Balasubramaniam approach a mucogingival incision made and flap elevated .

The fracture site was identified and irrigated. Fracture reduced and stabilized with stainless steel/ titanium 2 mm L' Plate with 6mm screws. Flap approximated and sutured with Vicryl. Patient extubated and shifted to post operative ward. Follow up made frequently in post operative ward with questionnaire. These patients were put up and labeled as GROUP - I

These patients are frequently asked about post operative pain, post operative edema, pain in the untreated fractured frontozygomatic area, feel any mobility in that area, occlusion derangement and willingness for plate removal. The satisfactory score was put up. The lower score is worsen and highest score is fully satisfied.

Fully satisfied GROUP - I patients were discharged and asked to report periodically for assessment. Patients who scored below 5 or patients who are all complained about mobility in FZ area and pain in that area and occlusion derangement, were formed a new circle named GROUP - II

GROUP - II Patients again under GA , through lateral orbit incision, flap elevated fracture site identified and irrigated. Fracture reduced and stabilized with SS / Titanium mini plates and 6 mm screws. Flap closure with vicryl in two layers to avoid post operative infections. Patient extubated and shifted to post operative ward. Follow up made frequently with questionnaire .

GROUP - II patients were frequently questioned about the post operative pain, post operative swelling, palpability of the prosthesis, and unsightly scar present in the FZ area

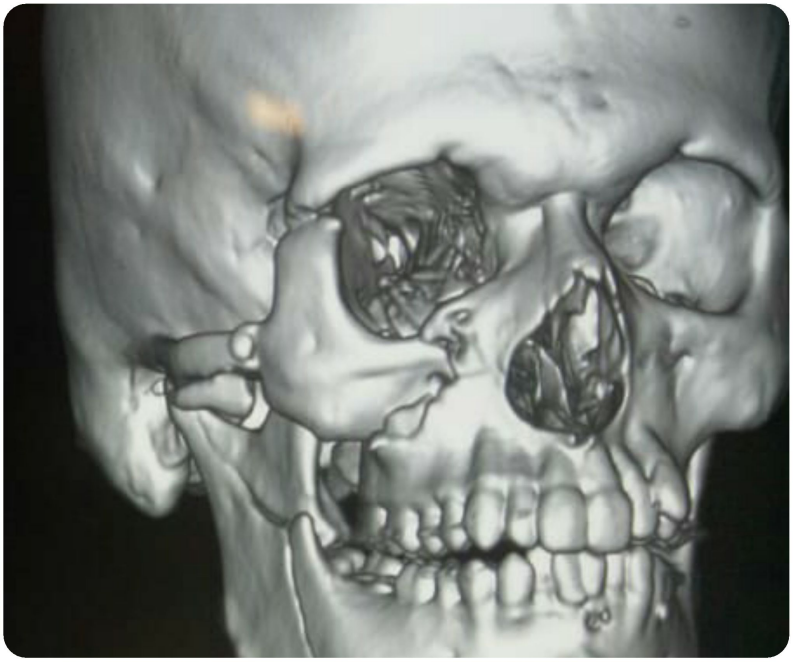
and eagerness in removing the prosthesis present in the surgical site. The satisfactory score put up.

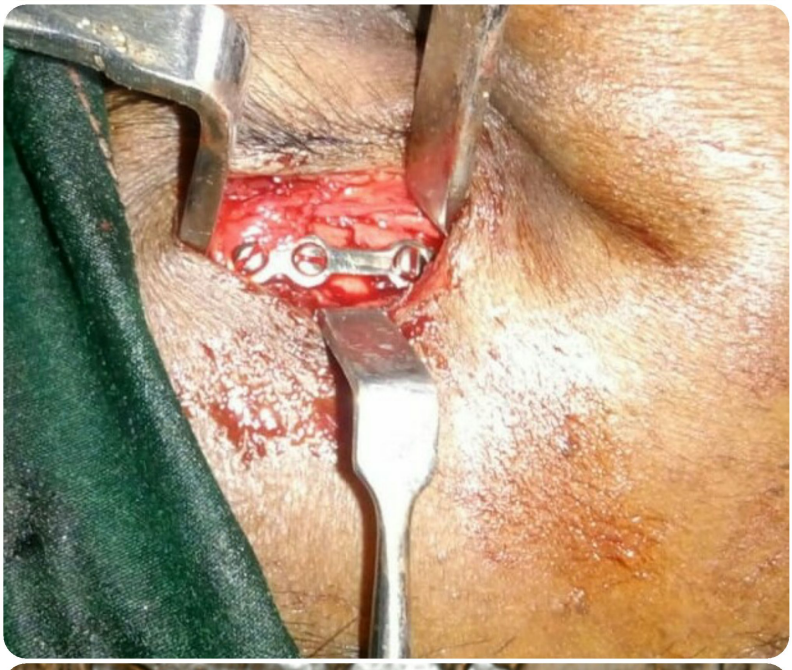
GROUP - I, GROUP - II both group patients were called up for periodical review. They were requested to take CBCT to check the facial prominence on both sides. Photographs were taken for documentation.

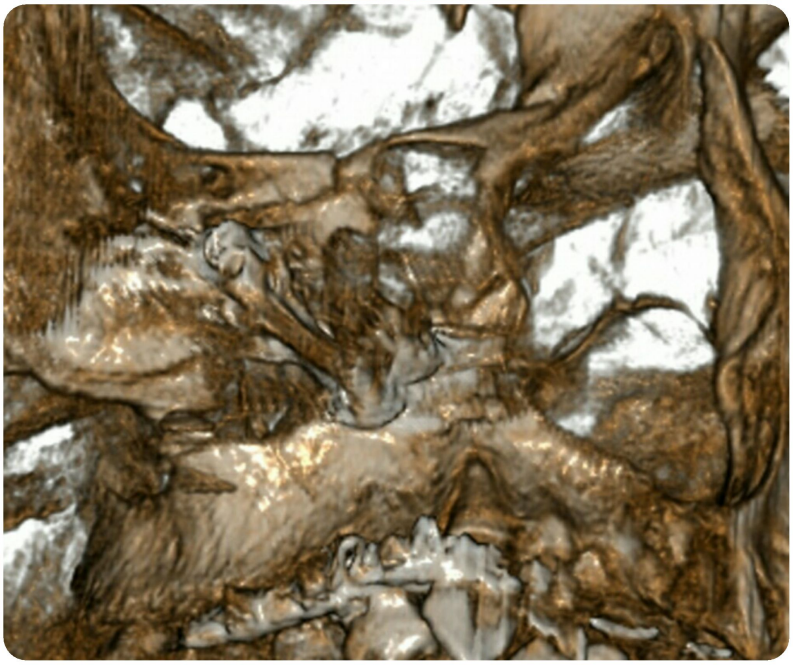
GROUP - I, GROUP - II all satisfactory score were tabled . Statistical analysis done.

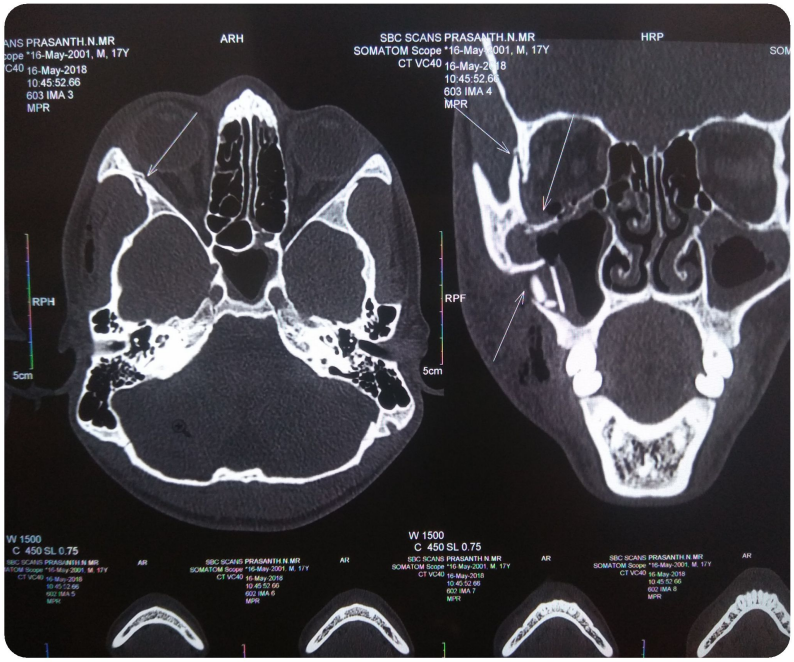
CONCLUSION

Single point fixation in ZM area is better in minimal preoperative bony gap of the FZ area but two point fixation is good rather than single point fixation in large bony gap in FZ area. But the two point fixation patients are unhappy due to scar present in the FZ area and the palpability of the prosthesis in FZ area. To avoid the palpability of the prosthesis micro plates or absorbable plates could be used in FZ area. To avoid multiple surgical incision, potential infection, additional scar and nerve palsy, it is good fixation through intra orally a maxillary vestibular approach (Balasubramaniam's or Keen's Intra oral approach) fixation in ZM buttress is far better in ZMC minimally displaced fractures with minimal post operative complications.



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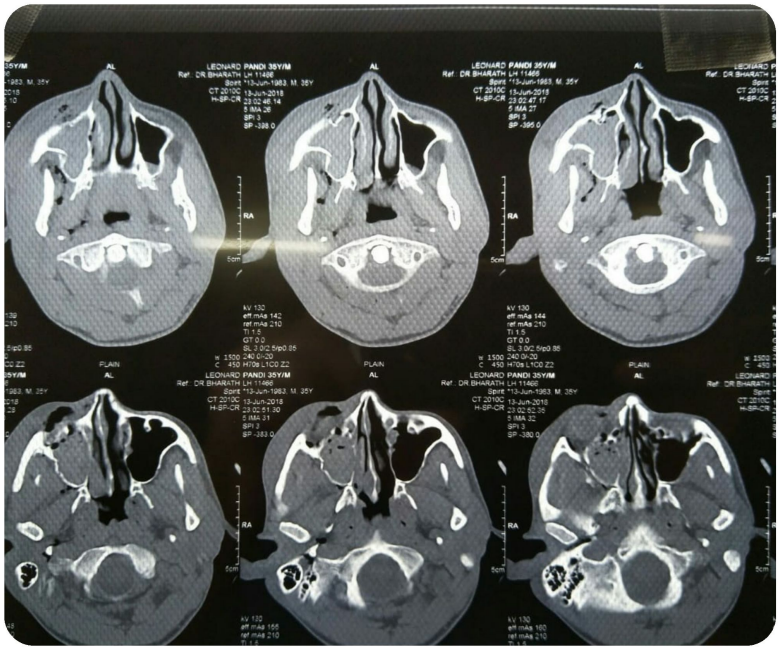

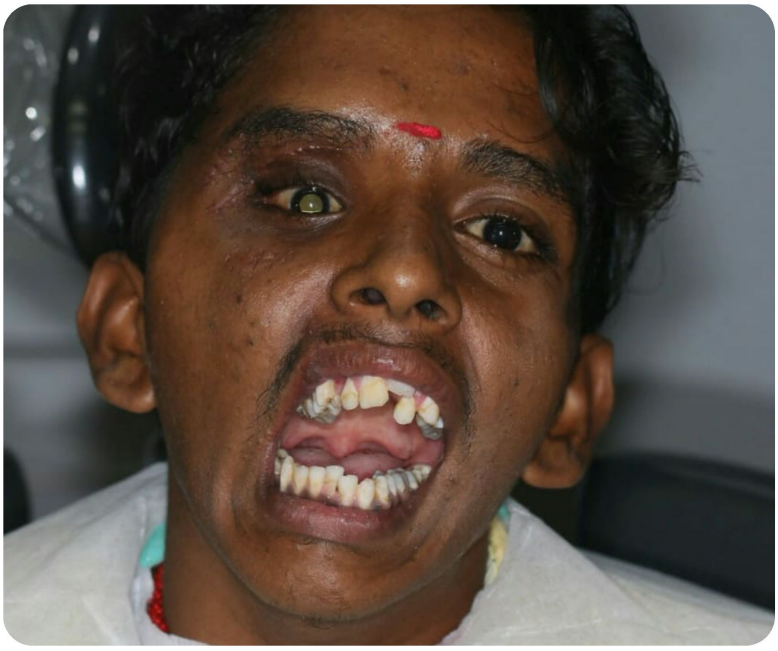

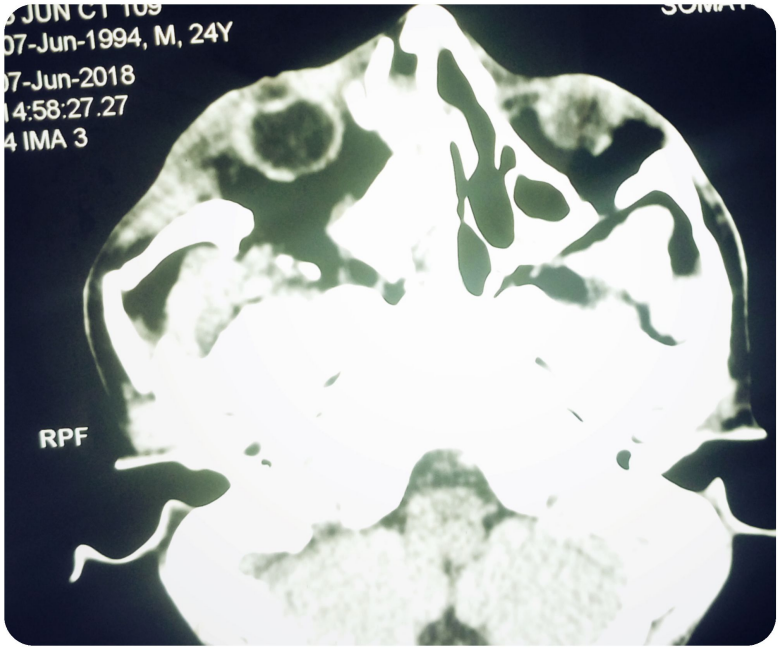
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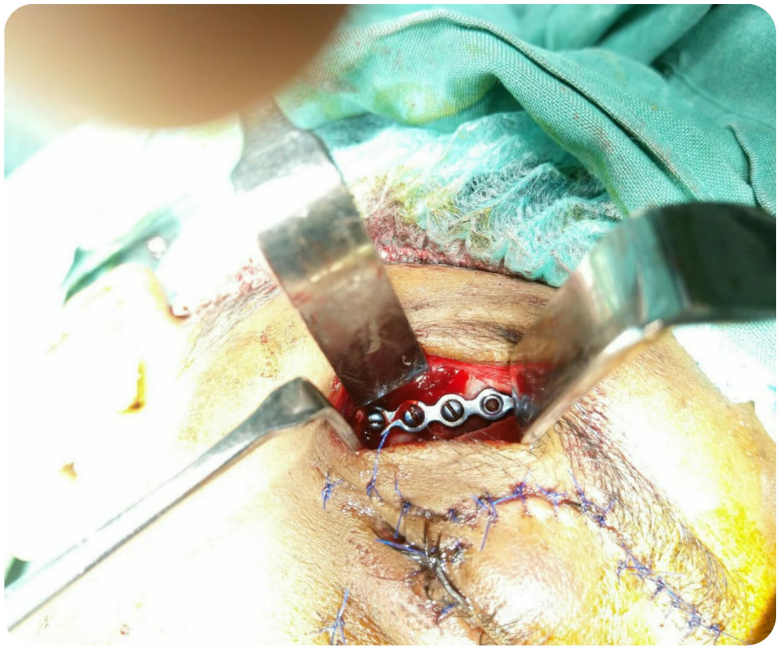

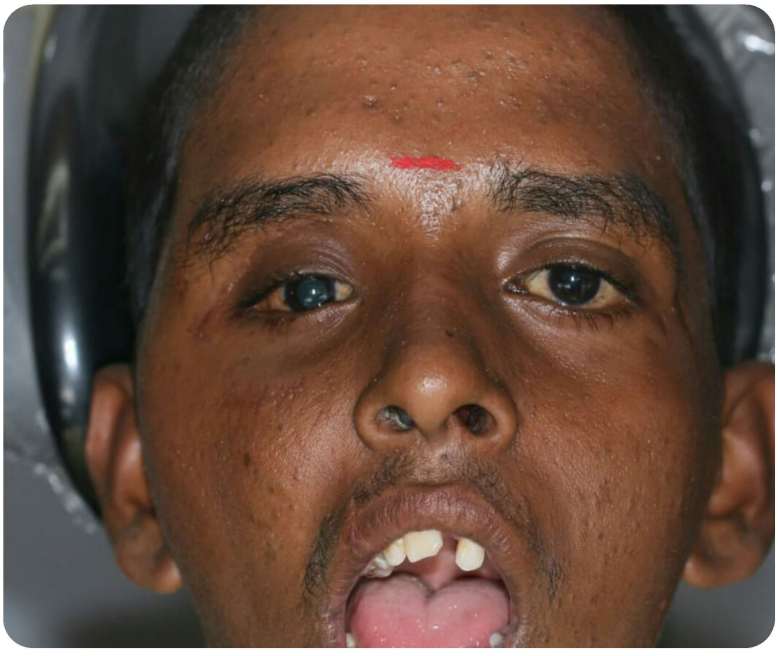

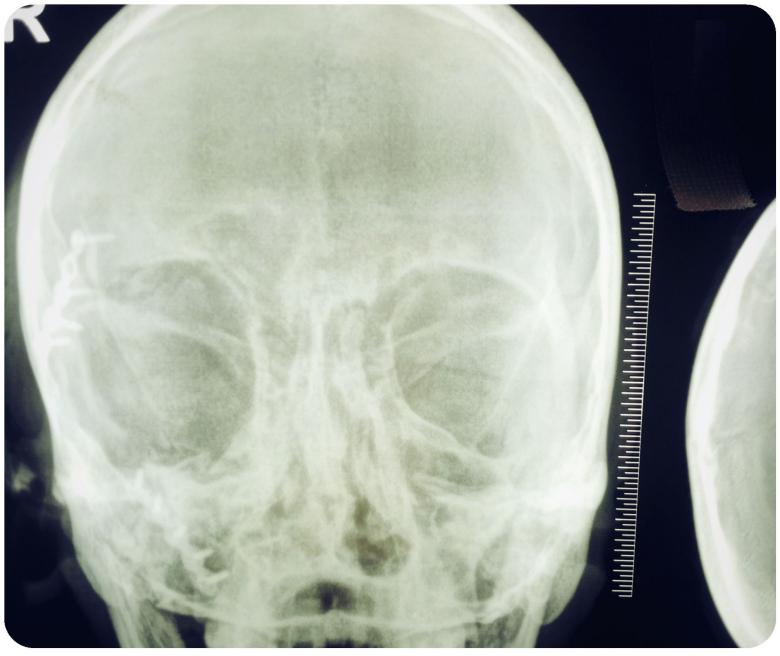

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INSTITUTIONAL ETHICAL COMMITTEE

Best Dental Science College and Hospital
Ultra Nagar, Madurai - 625 104.
RECOGNIZED BY DENTAL COUNCIL OF INDIA, NEW DELHI
AFFLIATED TO THE TAMILNADU Dr. M.G.R MEDICAL UNIVERSITY, CHENNAI)

IRB/IEC Reference No: 2016-STU-BrIII-RJN-20

Project title: Single point fixation verses 2 point fixation of Zygomatic complex fractures by using titanium mini-plate- A comparative study.

Principal Investigator: Dr. P. Rajapandian, PG student

Review: New/Revised/Expedited

Date of Review: 27/09/2016

Date of previous review, if revised application:

Decision of the IEC/IRB:

- Provisional approval to conduct the study is being given
- The results of this study, along with summary are to be submitted for obtaining final approval

Recommended time period: one year (28-09-17)

PRINCIPAL
BEST DENTAL SCIENCE COLLEGE
MADURAI-625104

ETHICS COMMITTEE SIGN. DATE BDSC

INSTITUTIONAL REVIEW BOARD SIGN. DATE BDSC

Signature of Member Secretary

NB:

- **Inform IRB/IEC immediately in case of any issue(s)/adverse events**
- **Inform IRB/IEC in case of any change of study procedure, site and investigator**
- **This permission is only for the period mentioned above**
- **Annual report to be submitted to IEC/IRB**
- **Members of IEC/IRB have right to monitor the trail with prior intimation**

Muha;r;rpapd; tpsf;fk;

(gbtk; -1)

Muha;r;rpapd; ngah;:

fd;d vYk;gpy; Vw;gl;l vYk;G Kwpit mWit rpfpr;irapdhy; xd;W my;yJ mjw;F Nkw;gl;l ,lq;fspy; jfL nghUj;jp mjd;];jpuj; jd;ik kw;Wk; Kf moif ghpNrhjpf;Fk; Muha;r;rp.

tzf;fk;> ,e;j Muha;r;rpapy; gq;Nfw;f cq;fs; rk;kjj;ij njhptpf;FkhW ehq;fs; tpLj;j Ntz;LNfhis Vw;Wf;nfhz;likf;F ed;wp. ,e;j Muha;r;rp njhlh;ghd jfty;fs;> ,jpy; gq;F ngWtjpdhy; cq;fSf;F Vw;glf; $ba mnrsfhpaq;fs;> ghjpg;Gfs; kw;Wk; ed;ikfs; midj;Jk; ,g;gbtj;jpy; nfhLf;fg;gl;bUf;fpd;wd. ,ij ePq;fshfNt gbj;J njhpe;J nfhs;syhk;. my;yJ ePq;fs; tpUg;gg;gl;lhy; ehq;fs; gbj;Jf; fhl;b GhpAk;gb nrhy;tjw;F jahuhf ,Uf;fpNwhk;. VNjDk; Ghpa tpy;iy vd;whYk; my;yJ $Ljy; jfty;fs; Njitnad;whYk;> ehq;fs; cq;fSf;F cjt jahuhf ,Uf;fpd;Nwhk;.

1. ,e;j Muha;r;rpapd; Nehf;fk; vd;d?

   mWit rpfpr;irf;Fg; gpwF cq;fsJ vYk;gpd; cWjpj; jd;ikia kw;Wk; Kf moif Nrhjpg;gJ.

2. ,e;j Muha;r;rp vq;F kw;Wk; ahuhy; nra;ag;gLfpwJ?

   vq;fsJ ng];l; gy; kUj;Jtf; fy;Y}hp kUj;Jtkid kw;Wk; kJiu ,uh[h[p kUj;Jt fy;Y}hp kUj;Jtkidapy;> gy; kw;Wk; Kf mWit rpfpr;irg; gphptpy;> gl;l Nkw;gbg;G khzth; lhf;lh; gh.,uh[ghz;bad; vd;gth; Nguhrphpah;; lhf;lh; gpuGrq;fh; vd;fpw gy; kUj;Jt Nkyjpfhhpapd; fz;fhzpg;gpy; ,e;j Muha;r;rpapid nra;fpd;wdh;.

3. ,e;j Muha;r;rpapy; gq;F ngWtjw;F jhq;fs; vd;id Njh;e;njLf;f fhuzk; vd;d?

   cq;fsJ Nky; jhil fd;dj;J vYk;gpy; Vw;gl;l vYk;G KwpT fhuzkhf cq;fsJ tpUg;gj;ij Nfl;fpNwhk;.

4. ,e;j Muha;r;rpapy; ehd; fl;lhak; gq;F ngw Ntz;Lkh?

,y;iy> ,J cq;fs; tpUg;gj;ij kl;LNk nghWj;jJ. ePq;fs; tpUk;gtpy;iynadpy; cq;fis ,e;j Muha;r;rpapy; <LgLj;j khl;lhh;fs;. Muha;r;rpapy; gq;F ngwhtpl;lhYk;> cq;fSf;F fpilf;f Ntz;ba gy; kUj;Jt mWit rpfpr;irfs; ve;j ghuhgl;rKk; ,y;yhky; njhlh;e;J fpilf;Fk;.

5. ,e;j Muha;r;rpapy; ehd;/ vd; gps;is gq;Nfw;f Ntz;Lkhdhy; vLj;Jf;nfhs;s Ntz;ba nghWg;Gf;fs; vd;d?

mWit rpfpr;irf;Fg; gpwF 4 Kjy; 5 ehl;fs; kUj;Jtkidapy; cs;Nehahspahf jq;fpapUf;f Ntz;Lk;. Muha;r;rpahshpd; vy;yh Nfs;tpfSf;F gjpyspf;f Ntz;Lk;. Njitg;gl;lhy; kw;WnkhU mWit rpfpr;ir Nkw;nfhs;s Ntz;Lk;. jhq;fs; kUj;Jtkidf;F Fwpg;gpl;l fhy ,ilntspfspy; ghpNrhjidf;F mtrpak; tuNtz;Lk;.

6. ,e;j Muha;r;rpapy; gq;F ngWtjpdhy; vdf;F VNjDk; ed;ikfs; cz;lh?

cz;L> mWit rpfpr;irf;F gpwF Fwpg;gpl;l fhy ,ilntspfspy; jpUk;g tUk; NghJ mWit rpfpr;irf;Fg; gpwF Vw;gLk; midj;J FiwghLfSk; fisag;gLk;.

7. ,e;j Muha;r;rpapy; gq;F ngWtjpdhy; vdf;F mnrsfhpaq;fs;> ghjpg;Gfs; Vw;gLkh?

vt;tpj ghjpg;GfSk; Vw;glhJ. Mdhy; rpy mnrsfhpaq;fs; ,Uf;Fk;. mWit rpfpr;ir Nkw;nfhz;l ,lj;jpy; typ tPf;fk; ,U ehl;fSf;F ,Uf;Fk;.

8. ,e;j Muha;;r;rpapy; gq;F ngWk; vdf;F/ vd; gps;isf;F VNjDk; rd;khdk; toq;fg;gLkh?

,y;iy> rpfpr;ir kl;LNk Nkw;nfhs;sg;gLk;. rd;khdk; VJk; toq;fg;gl khl;lhJ.

9. ,e;j Muha;r;rpapy; gq;F ngWtijAk;> vd;idg; gw;wpa tptuq;fisAk; NtW ahUf;Fk; njhpahky; ,ufrpakha; itf;fg;gLkh?

Mk;> ,ufrpakhf itf;fg;gLk;.

10. ,e;j Muha;r;rpapd; KbTfs; gq;F ngWgtUf;F njhptpf;fg;gLkh? tpUk;gpdhy; vq;fsplkpUe;J ngw;Wf;nfhs;syhk;.

11. ,e;j Muha;r;rpapy; ,Ue;J tpUg;gj;jpw;Nfw;g ve;NeuKk;> ehd; tpyfpf; nfhs;s KbAkh?
Mk;> ve;NeuKk; tpyfpf; nfhs;syhk;.

Nehahspapd; ngah; kw;Wk; Kfthp

ifnahg;gk; / ,lJ if
ngUtpuy; Nuif

Muha;r;rpahshpd; jfty;
gh. ,uh[ghz;bad;
KJfiy khzth;>
gy; kw;Wk; Kf mWit rpfpr;ir gphpT **ifnahg;gk;**
ng];l; gy; kUj;Jtf; fy;Y}hp>
njhiy Ngrp vz;: 98421 52731

Muha;r;rpapy; gq;F ngWk; Nehahsp / cwtpdh; mspf;Fk; xg;Gjy; gbtk;
(gbtk; -2)

Muha;r;rpapd; ngah;:

fd;d vYk;gpy; Vw;gl;l vYk;G Kwptpid mWit rpfpr;ir nra;J xd;W my;yJ mjw;F Nkw;gl;l ,lq;fspy; jfL nghUj;jp vYk;gpd;];jpuj;jd;ik kw;Wk; Kf moif ghpNrhjpf;Fk; Muha;r;rp.

..... vd;fpw vdf;F ,e;j Muha;r;rpapd; KO tpguq;fSk; vd; jha;nkhopapy; vdf;F GhpAk;gb tpsf;fp $wg;gl;lJ. ,ijg;gw;wp KOikahf njhpe;J nfhz;Nld;. vdf;F kaf;f kUe;J %yk; kaf;fkilar;nra;J mWit nra;J nfhs;s rk;kjk; njhptpf;fpd;Nwd;. kaf;f kUe;jpdhy; Vw;gLk; mnrsfhpaq;fs; midj;Jk; vdf;F tpsf;fp $wg;gl;lJ. NkYk;> mWit rpfpr;irapdhy; Vw;gLk; midj;J mnrsfhpaq;fs; gw;wpAk;> vdf;F tpsf;fp $wg;gl;lJ.

ehd;> vdf;F / vd; gps;isf;F ,e;j Muha;r;rpapy; gq;F nfhz;L mWit rpfpr;ir nra;J nfhs;s vd; RaepidTld; KOikahf rk;kjpf;fpNwd;. NkYk; ,e;j Muha;r;rpapy; vd;Dila gq;fpid njhpe;J nfhz;Nld;. NkYk;> vd; xj;Jiog;igAk; mspf;fpNwd; vd;W cWjp mspf;fpNwd;.

gq;F ngWgthpd; ngah; kw;Wk; Kfthp

ifnahg;gk; / ,lJ if
ngUtpuy; Nuif

Muha;r;rpahshpd; jfty;
gh. ,uh[ghz;bad;
KJfiy khzth;>
gy; kw;Wk; Kf mWit rpfpr;ir gphpT **ifnahg;gk;**
ng];l; gy; kUj;Jtf; fy;Y}hp>
njhiy Ngrp vz;: 98421 52731

INFORMATION SHEET FOR THOSE WHO PLAN TO PARTICIPATE IN

THIS RESEARCH PROJECT

FORM 1

NAME OF THE RESEARCH PROJECT: SINGLE POINT FIXATION VS TWO POINT FIXATION IN ZYGOMATIC COMPLEX FRACTURES - A COMPARATIVE STUDY

We welcome you and thank you for having accepted our request to consider whether you/ your child/ your ward can participate in our study. This sheet contains the details of the study; the possible risks, discomforts and benefits for the participants. You can read and understand yourself; if you wish, we are ready to read and explain the same to you. If you do not understand anything or if you want any more details we are ready to provide the details.

Information to the participants:

What is the purpose of the study?

To estimate the stability after the fixation by either single point fixation or two point fixation in zygomatic complex fractures management.

Who / where this study is being conducted?

This study is being conducted by Dr. P. Rajapandian Post Graduate student belonging to Department of Oral and Maxillofacial Surgery under the guidance of

Prof. Dr. K. PrabhuSankar., M.D.S., Head of the Department.

Why am I being considered as one of the participant?

Because of the fracture present in the zygomatic complex.

Should I definitely have to take part in this study?

No. If you do not wish to participate, you will not be included in this study. Also the dental treatments will continue without any prejudice.

If participating in this study, what are the responsibilities of the participant?

The participant may have to follow some simple rules. should stay 4-5 days post operatively and answer one questionnaire in detail. After that if necessary one more surgery to be done to stabilize the fracture. patient must come periodically for review.

Are there any benefits for the participants?

Yes. Fracture site reduced and treated and restored functionally and cosmetically and reviewed periodically to analyze post operative complications.

Will there be any discomfort / risk to the participants?

No risks. but some discomforts may be there.

Research discomfort : Minimal pain, minimal discomfort.

Will the participant be paid for the study?

No. The participant will not be paid.

While participating in this study, will the personal details of the participant be kept confidential?

Yes. Confidentiality will be maintained.

Will the participant be informed of this study's results and findings?

Yes. if needed , the participant can get details from us.

Can the participant withdraw from this study at any time during the study period?

Yes. The participant can withdraw at any time during the study period.

INFORMED CONSENT

Form for Getting Informed Consent for those Participating in the Research Project

(Form 2)

NAME OF THE RESEARCH PROJECT : SINGLE POINT FIXATION VS TWO POINT FIXATION IN ZYGOMATIC COMPLEX FRACTURE - A COMPARATIVE STUDY

I, the participant/ parent/ guardian,

.....

..... have been informed about the details of the study in my own language.

I, the participant/ parent/ guardian, have understood the details about the study.

I, the participant/ parent/ guardian, know the possible risks and benefits for me/ my child/ my ward, by taking part in the study.

I, the participant/ parent/ guardian understand that I can withdraw from the study at any point of time and even then , I/ my child/ my ward will continue to get the medical treatment as usual.

I, the participant/ parent/ guardian understand that I/ my child/ my ward will not get any payment for taking part in this study.

I, the participant/ parent/ guardian will not object if the results of this study are getting published in any medical journals, provided my/ my child's/ my ward's personal identity is not reviewed.

Annexure - IV

I know what I am/ my child/ my ward is supposed to do by taking part in this study and I, the participant/ parent/ guardian assure that full co-operation will be given for this study.

Signature/ Thumb impression of the participant/ parent/ guardian:

(Name and address)

.....

.....

.....

Signature/ Thumb impression of the witness:

(Name and address)

.....

.....

.....

Name & Signature if the investigator

.....

.....

ULTRA'S BEST DENTAL COLLEGE AND HOSPITAL, MADURAI

DEPARTMENT OF ORAL AND MAXILLOFACIAL SURGERY

THESIS CASE SHEET PROFORMA

Name of the Operator : Date:

Name of the Guide :

Name of the Patient : OP No:

Age : Occupation:

Gender : Marital Status:

Address : Date of Operation:

Chief complaint :

Present Medical History:

Past Medical History :

Personal History :

Family History :

Clinical Examination :1.General Examination

2.Local Examination

Extra oral

Intra Oral

Vomited : yes /no

Shock : Absent/ Mild/Severe

Airway :Clear/Obstructed Alcohol: yes/no

Vital Signs : Pulse

Blood pressure

Temp

Respiratory Rate

Level of Consciousness: Fully respond

Respond to simple command

Respond to Painful stimuli

Can not respond to stimuli

Amnesia : Pretraumatic

Post traumatic

Remote

Cerebral Irritation: Little/ None /Severe

Neck Stiffness : yes/no

Cranial Nerves :

Diplopia :

Muscle Tone:

Coordination:

Sensory loss :

Hemorrhage :

Laceration :

Tissue loss:

Abrasion:

Edema :

Ecchymosis:

Contour Defects:

CSF Leak : Nose/ Ear

Cranium :

Orbital Margins:

Nasal Bones :

Zygoma :

Condyles :

Mandibular Border :

Compression Test :

Maxilla :

INTRA ORAL:

Missing Teeth

Teeth to be Extracted:

Teeth unsuitable for splinting:

Roots present:

Fractured Teeth :

ORAL HYGEINE : Good/ Fair/ Neglected

OCCLUSION at present

Prior to accident

Fracture Site

Maxilla Mandible Other facial bones

LACERATION / ECCHYMOSIS

X - ray's Required :

Oblique Mandible	Occlusal	Dental
PA Jaws	OPG	TOWNES
OCCIPITOMENTAL	15" - 30"	Lateral Skull

Impressions :

Photographs :

Any other Injuries

Soft Tissue Injuries :

Summary of Injuries

Skeletal

Soft Tissue

Investigations

Haemogram

Blood group

Annexure - V

X- rays