

## **The management of zygomatic complex fractures: a review**

### **Abstract**

The face symmetry has prominent role in the human body after injuries and accident. The zygomatic region is important factor in the injuries face. Due to its location, its fracture is the 2<sup>nd</sup> frequent fractured bone of mid-facial. Zygomatic bone fractures are more abundant in young males and its incidence and etiology is different based on location. Post-traumatic facial deformity is the most incorrect reconstruction of the facial skeleton. Inadequate healing of the supported soft tissues lead to malposition of landmarks, shrinkage and thickening. The zygomatic bone fracture and coronoid process impingement lead to restricted mouth opening. Interruption in zygomatic position has psychological, aesthetic and functional effects which impairs the function of mandible and ocular tissue. Therefore, diagnose and properly management of the zygomatic bone injury is important. Healing displaced fragments of zygomatic bone after inadequate fixation and reduction of fracture consequences facial asymmetry. There is a lack of information about evaluation of benefits and costs of different zmc fracture methods So, this literature review was done to characterize the etiology, incidence, clinical findings and results of different treatment trends of zygomaticomaxillary complex fractures. Surgeons have been utilized numerous approaches, but there are different ideas for the best one.

**Keywords:** Zygomatic complex fractures, Management, [Zygomatic Fractures](#)

### **Introduction**

Due to Zygomatic bone prominancy, Zmc fractures are the second most common fractures after nasal bone fractures.(Rana et al 2012) but there has not been a single best trend in treating of these fractures (Farber et al. 2016) So we decided to do a litrature review on zmc fractures and its different treatment trends in articles. The face is most vulnerable position in the human body in the injury and accidents. The importance of anatomic region of the zygomatic bone apt it to the facial injuries (Salentijn et al. 2013). The lateral mid structure of the facial skeleton supports by zygoma (Gong et al. 2017). Zygomatic bone is the most prominent part of lateral face and has articulations with Maxilla, Temporal, Frontal and Sphenoid bones.(Rana et al 2012). Despite the high rate of the head, face and neck injuries there is little attention on the etiology of maxillofacial injuries (Birgfeld et al. 2017).

Zygomaxillary has key role in protecting maxillary sinus, temporal fossa and zygomatic arch as well as eye and orbital cavity. The most frequent type of the facial fractures is zygomaxillary complex fractures (Hwang et al. 2012). So, this literature review as a part of Ph.D thesis aimed to determine the etiology, incidence, clinical findings and treatment of the zygomaxillary complex fractures.

### **Material and Methods**

For this review, literature search performed using keywords of peer-reviewed articles as follows: Zygomaxillary × complex × fractures × etiology × incidence × clinical findings × treatment. Related articles were also deeply investigated. Beside electronic-searching, hand-searching was also done. Biological Abstracts, Chemical Abstracts, PubMed and Medline databases updated to 2018 were used for conducting the search. All the references of the search result were then studied in details.

### **Zygomaxillary Complex Fractures**

Fracture in Zygomatic bone and its articulations is called Zygomaxillary complex or Zmc or orbitozygomatic fracture.(Rana et al 2012). Most people involved in this type of fractures are male individuals in their second or third decade of their lives(Bhasker2016). The fracture of the zygomatic arch bone, impairs coronoid process and leads to restriction of mouth opening. Disruption of the zygomatic position has psychological and aesthetic effect which impairs ocular and mandibular function (Sonone et al. 2015). Three superimposed layers composed the masseter muscle which connects mandible and cheekbone. The superficial layer arises from of zygomatic bone maxillary process and two-third the zygomatic arch frontal lower margin give rise to superficial layer (Carter et al. 2005). The middle layer originates from the zygomatic arch. The deep layer arises from the deep surface of the arch. The main cause of zygoma post reduction displacement is contraction of this muscle. In moderate displaced fractures, placement of temporalis fascia to the arch superior makes the internal fixation unnecessary, due to the ability of fascia to stabilize the fragments effectively (Czerwinski et al. 2008). The zygomaxillary complex fractures has different severity (Ellis and Perez, 2014). Minimal to severe displacement reported for the zygomaxillary complex. Also, based on the severity, they affect internal orbital disruption and entrapped the extraocular muscles. Thus, each individualized zygomaxillary complex fracture should receive a specific treatment plan (Ellis and Perez, 2014). Innovative diagnosis and treatment strategies for the improvement of malar bone fracture have been carried out, but the adequate reduction and patient satisfaction is still

unsolved problem. Facial symmetry affected by the malar bone due to its location (Carter et al. 2005). Every facial post-traumatic deformity is faced with inaccurate facial skeleton primary reconstruction. Landmarks misplacement, thickening and shrinkage are the results of inadequately supported soft tissues subsequent healing. This deformity of soft tissue can be utilized for every secondary correction outcome (Czerwinski et al. 2008).

### **Fracture Management**

Reconstruction and positioning of the zygomaticomaxillary complex in facial esthetics is known as critical challenge for maxillofacial surgeons (Salentijn et al. 2014). Surgeons have been used numerous surgical procedures, but there are different ideas for the best one (Birgfeld et al. 2017). Various approaches including Gillies', Dingman's, Keen's and bicoronal scalp flap are the most common methods for treatment of the zygomatic complex fracture (Rana et al. 2012). The most important spot of the zygoma have been implicated to establish mid facial symmetry for evaluation of treatment outcome (Birgfeld et al. 2017). In healthy individuals, differences among the both halves of the face and two-sided composition are frequent and scarcely lead to aesthetic complaints (Nur et al. 2016). Several studies investigated the diagnosis and analysis of different methods and revealed that the trans oral (Keen's) approach provides a direct access to the zygomatic arch. Intraoral incision would be allowed and there is no risk of scar alopecia compared to the temporal (Gillie's) approach (Sonone et al. 2015). **Surgical management of the zygomaticomaxillary complex fractures (Gong et al. 2017)**. However, infection rates would be increased by oral flora introduction into the infratemporal fossa. Temporal fossa approach described by Gilles et al. in 1927 and became popular method for treatment of the isolated arch fractures (Daabiss et al. 2011). The main advantages of this technique are its simple procedure and leaving no trace of scars. Midface fractures are required to be supported by three basic buttresses. The frontal maxillary alveolus connects to the anterior cranial attachment through the nasomaxillary buttress (Friedrich and Henning, 2004). The maxilla posteriorly connects to the sphenoid bone via the pterygomaxillary buttress. The lateral maxillary alveolus connected to the zygomatic process of the temporal bone by zygomaticomaxillary buttress. Fracture lines extend through the infraorbital rim to the inferior orbital fissure and find its way to the zygomatic sphenoid suture and frontozygomatic suture line (Friedrich and Henning, 2004). The Gillie's approach is an open approach and considered for the decrease in the zygomatic arch (Czerwinski et al. 2008). Gillie's temporal technique for reducing fracture of zygomatic arch is simple, effectiveness cos and acceptable method (Sonone et al. 2015). Reduction at zygomatic arch

region in zygomatico-maxillary complex fracture is due to its direct elevation of the arch using elevator and tactile sensation for reduction confirmation (Priya et al. 2014).

The extent and the region of fixation depends on the articulations comminution and displacement expansion. Based on the reports, there is no designed comparison research to provide meaningful for zygomatic bone fracture (Rana et al. 2012). The aim of zygomatic fractures treatment is to provide and maintain the arrangement of pre-injury facial skeleton. (Priya et al. 2014). The reposition of the zygoma at three locations is essential to achieve three dimensions (Pearl et al. 1992). Also, decrease at the inferior orbital rim and frontozygomatic suture leads to continuous lateral rotation in the region of anterior maxillary buttress and ceases to the expansion of intra-orbital volume behind the globe axis. The upper buccal sulcus approach was recommended as primary technique for various types of zygomatic fractures except the fractures of rim and arch (Yanagisawa 1973). It is a fast, simple technique and needs much less force for elevation than external approach. During the surgery operation, buccal fat pad was not enough for dehiscence to occur. For reaching post reduction stability, the simplest method was tried to be defined by open reduction and internal fixation of dislocated zygoma fractures (Rana et al. 2012). In almost cases to access the zygomatic complex fractures, using open reduction was recommended by lateral eyebrow approach. Advantages of this method are providing invisible scar and direct access to the zygomatico-frontal region (Yamsani et al. 2016). Gillies temporal approach are used to arch fractures and sometimes to help the reduction of zygomaticomaxillary complex fractures (Yamsani et al. 2016). The vestibular and lower eyelid approaches are frequently used. Maxillary vestibular approach is associated with approximately 20% complications (Sonone et al. 2015). The zygomaticomaxillary complex fractures was found to be laterally rotated, and temporal approach is extended preauricular. Recontouring of arch and zygomaticomaxillary buttress expanding exposure to the zygomaticomaxillary complex. The temporal approach provided depression reconstruction with temporalis flap over the area of zygoma and diminishes a second procedure necessity (Yamsani et al. 2016).

### **Reports for the zygomatic complex fractures**

Ellis et al. (1996) reported that incidence of male predominance was 80.2 % at 30 years of age. Zygomatic complex fractures happened approximately at age of 21 and 40 years and the most frequent cause of individual injuries was road traffic crashes. (Yamsani et al. 2016). The high rates of the zygoma fractures incidence attributed to the motor vehicle accidents and lack of safety measures. Mouth opening limitation or lateral deflection of zygomatic bone or

mandible arch impinging on coronoid process (Row and Killey, 1970) reported by 70 percent of patients (Yamsani et al. 2016). The fixation required to prevent displacement should not higher than isolated zygomatic arch fracture (Yamsani et al. 2016). In implication of the zygomatic bone fracture surgical treatment via two-point fixation against three-point fixation, Rana et al. (2012) reported that individuals treated with two-point fixation experienced complications following surgical operation like reduced malar height and vertical dystopia than three-point fixation patients. Based on their report, the best strategy treating fractures of zygomatic bone is internal three-point fixation using mini plates. The significant stability achieved by three-point fixation including FZ suture, zygomaticomaxillary buttress and inferior orbital rim through either interosseous wiring or just mini plates (Davidson et al. 1990). On analysis of outcome of zygomatic fracture management, Senthilkumar e al. (2017) reported the most common procedure was 2-point fixation. Post-operatively, trismus infraorbital anesthesia, malar asymmetry and orbital dystopia was improved in patients. The most common complication was plate extrusion. The type of management depends on clinical and radiological features. Computed tomography scan axial and coronal section of facial bones shows the severity of fractures not all patients need operative intervention (Senthilkumar e al. 2017). Protocol management and long-term follow up enable us to measure outcomes objectively and compare different surgical methods and following complications. In a 12-year assessing treatment methods used for zygomaticomaxillary complex fractures, Zachariades and Mezitis (1998) reported that Semirigid fixation with miniplates provides the highest reliability for zygomatico-orbital complex fractures treatment. Infrequent urgency to remove hardware and the high cost are the essential disadvantages of the method. Over the years, zygomaticomaxillary complex fracture fixation procedures have been developed, initiating with osteosynthesis wiring. However, wire osteosynthesis is not effective compared to plating systems in zygomaticomaxillary complex fractures reduction maintenance (Ellstrom and Evans, 2013). Conventional teaching suggests three-point fixation for zygomaticomaxillary complex fractures. Nevertheless, Ellis and Kittidumkerng suggests a step-wise process algorithm in the zygomaticomaxillary complex fractures treatment (Rodriguez et al. 2012). Soft-tissue preservation is another procedure to zygomaticomaxillary complex fractures (Ellstrom and Evans, 2013). Minimizing soft-tissue morbidity is the goal of skeletal fixation. Fracture type and the surgeon opinion define the soft-tissue approaches and required the fixation of buttresses (Czerwinski et al. 2005). A brow incision leaves a considerable scarring. Exposures of lower eyelid results in entropion or ectropion (Raschke et al. 2013). The coronal method provides subjection of the zygomatic arch and lateral orbital

rim to treat severe zygomaticomaxillary complex fractures (Lee et al. 2010). the main complications of this approach are facial nerve injury, temporal fat pad injury, necrosis of alopecia and scalp (Lee et al. 2010). It has been reported that insertion of one plate through a lateral brow incision on the superolateral orbital rim had good outcomes in patients (Hwang, 2010). Ocular symptoms is not associated with single-plate fixation which is typically limited to non-comminuted zygomaticomaxillary complex fractures. Treatment of zygomaticomaxillary complex fracture should be personalized based on each patient. Different variations of fracture warrant numerous combinations of fixation approaches. Surveyed population revealed that they would frequently employ procedures through the mouth and eyelid for zygomaticomaxillary complex fracture treatment (Hwang, 2010). In conclusion, the main solution for the acute repair of mid facial fractures is precise evaluation of the zygomatic bone location regarding the cranial base posteriorly and the midface anteriorly. One of the great challenges of posttraumatic deformities of the orbitozygomaticomaxillary complex is the secondary reconstruction which remains unsolved.

It needs to notice, patients' awareness of the fact that individuals with zygomatic arch fracture have higher prevalence of facial asymmetry, it can increase their satisfaction (Khaqani et al. 2018). It is noteworthy that the zygomaticomaxillary complex fracture type significantly impacts its treatment outcome. Kim et al. (2014) also showed that comminuted zygomaticomaxillary complex fractures have a higher level of asymmetry.

### Conclusion

At last, our conclusion based on this literature review is that Zmc fractures are more happening in less secure roads and in societies with lower cultural levels. there is not a single method with similar result to treat the ZMC fractures. The treatment plan should be based on individual desire and severity of trauma and displacement, considering optimal fixation via minimally invasive approaches.

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