The management of zygomatic complex fractures: a literature review

Abstract

The face symmetry has prominent role in the human body after injuries and accident. The zygomatic region is important factor in the facial injuries. Because of its position, its fracture is the 2nd common mid-facial bone fractured. 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. Healing of the inadequately supported soft tissues leads to malposition of landmarks, shrinkage and thickening. The zygomatic bone fracture and coronoid process impingement leads to restricted mouth opening. Interruption in zygomatic position has psychological, aesthetic and functional effects which impairs ocular and mandibular function. Therefore, diagnose and properly management of the zygomatic bone injury is important. Skeletal healing of displaced zygomatic bone fragments after inadequate fracture reduction and fixation consequences facial asymmetry. So, the aim of the current literature review was to determine the etiology, incidence, clinical findings and treatment of zygomaticomaxillary complex fractures. Numerous surgical approaches have been used by surgeons, but there are different ideas for the best one.

Keywords: Zygomatic complex fractures, Management

Introduction

The face is most vulnerable position in the human body in the injury and accidents. The anatomic importance of the zygomatic region predisposes it in the facial injuries (Salentijn et al. 2013). The lateral mid structure of the facial skeleton supports by zygoma (Gong et al. 2017). 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). Zygomaticomaxillary has key role in protecting maxillary sinus, temporal fossa and zygomatic arch as well as eye and orbital cavity. The most common type of the facial fractures is zygomaticomaxillary 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 zygomaticomaxillary complex fractures.

Material and Methods

The keywords used for the literature search for this review was peer-reviewed articles following keywords: Zygomaticomaxillary × complex × fractures × etiology × incidence × clinical findings × treatment. Related articles were also scrutinized. Hand search was also driven. The search was carried out using Biological Abstracts, Chemical Abstracts, and the data bank of the PubMed and Medline database updated to 2018. The references found in the search were then studied in detail.

Zygomaticomaxillary Complex Fractures

The fracture of the zygomatic arch bone, impairs coronoid process and leads to restriction mouth opening. Disruption of the zygomatic position has psychological and aesthetic effect which impairs ocular and mandibular function (Sonone et al. 2015). The masseter muscle be made of of three superimposed layers which blend anteriorly gains attachment from zygoma and the zygomatic arch. The superficial layer arises from maxillary process of zygomatic bone and from the anterior two-third of the lower border of the zygomatic arch (Carter et al. 2005). The middle layer rises from the deep surface of the anterior two-third of the zygomatic arch. The deep layer arises from the deep surface of the arch. The primary cause of post reduction displacement of the zygoma is contraction of this muscle. Due to the attachment of the temporalis fascia to the superior aspect of the arch, internal fixationis unnecessary even in mildly displaced fractures as the fascia will immobilize the fragments effectively (Czerwinsk et al. 2008). The zygomaticomaxillary complex fractures has different severity (Ellis and Perez, 2014). Minimal to severe displacement reported for the zygomaticomaxillary complex. Also, based on the severity, they affect internal orbital disruption and entrapped the extraocular muscles. Thus, treatment plan should be developed for an individualized each zygomaticomaxillary complex fracture (Ellis and Perez, 2014). Despite improvements and innovations have been done in diagnostic and management of the malar bone fracture, the adequate reduction and patient satisfaction is still unsolved problem. Because of the location of the malar bone, it plays an important role in facial symmetry (Carter et al. 2005). Incorrect primary reconstruction of the facial skeleton is the underlying problem of post-traumatic facial deformity. Subsequent healing of the inadequately supported soft tissues leads to shrinkage, thickening and malposition of the landmarks. This resultant soft tissue deformity has implications for the technique and outcome of every secondary correction (Czerwinsk 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). Numerous surgical approaches have been used by surgeons, but there are different ideas for the best one (Birgfeld et al. 2017). Keen's approach, Gillies' approach, bicoronal scalp flap approach or the more popular Dingman's approach are the commonest methods for treatment of the zygomatic complex fracture (Rana et al. 2012). To establish mid facial symmetry for evaluation of treatment outcome, the most prominent point of the zygoma have been used (Birgfeld et al. 2017). Differences among the left and right halves of the face and bilateral structures are communal outcomes in healthy individuals and rarely cause esthetic complaints (Nur et al. 2016). Several studies have been published based on the diagnosis, analysis and The trans oral (Keen's) approach provides direct access to the zygomatic arch. It allows for an intraoral incision 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, introducing oral flora into the infratemporal fossa increases infection rates. 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). No facial scars and simple to perform are the main advantages of this technique. Three principle buttresses need to be considered in midface fractures. The nasomaxillary buttress reaches from the anterior maxillary alveolus to the frontal cranial attachment (Friedrich and Henning, 2004). The maxilla posteriorly connects to the sphenoid bone via the pterygomaxillary buttress. The zygomaticomaxillary buttress connects the lateral maxillary alveolus to the zygomatic process of the temporal bone. Fracture lines usually run through the infraorbital rim and extend to the inferior orbital fissure. The fracture line continues 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 the zygomatic arch (Czerwinsk et al. 2008). Application of the Gillie's temporal approach for zygomatic arch fracture reduction 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 confirmation of reduction with tactile sensation (Priya et al. 2014).

How much fixation and where it will be applied depending on the extent of the articulations comminution and displacement. Based on the reports, there is no designed comparison research to provide meaningful for zygomatic bone fracture (Rana et al. 2012). Restore and maintain pre-injury facial skeletal configuration is the goal treatment of zygomatic fractures

(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 frontozygomatic suture and inferior orbital rim leads persistent lateral rotation in the anterior maxillary buttress region and terminates to intra-orbital volume expansion behind the axis of globe. The upper buccal sulcus approach was recommended as initial method for all types of zygomatic fractures except arch and rim fractures (Yanagisawa 1973). It is a fast, simple technique and less force was required for elevation than external approach. During the surgery operation, buccal fat pad was not enough for dehiscence to occur. Open reduction and internal fixation of displaced zygoma fractures attempt to define the simplest method for achieving post reduction stability (Rana et al. 2012). In almost cases to access the zygomatic complex fractures using, open reduction was recommended the lateral eyebrow approach. Advantages of this method are inconspicuous scar and providing direct access to the zygomatico-frontal region (Yamsani et al. 2016). Gillies temporal approach are used to arch fractures and occasionally to assist in the reduction of the zygomaticomaxillary complex fractures (Yamsani et al. 2016). The vestibular and lower eyelid approaches are frequently used. Complications associated with maxillary vestibular approach is approximately 20% (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 providing a wide exposure to the zygomaticomaxillary complex. The temporal approach added advantage of reconstruction of the depression over the zygoma region with temporalis flap and eliminates the need of a second procedure (Yamsani et al. 2016).

Reports for the zygomatic complex fractures

Ellis et al. (1996) reported 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 road traffic accident was the most common cause of the injury in patients (Yamsani et al. 2016). The high incidence of the zygoma fractures attributed to the motor vehicle accidents and lack of safety measures. Mouth opening limitation or lateral excursion from mechanical obstruction by the zygomatic bone or arch impinging on coronoid process of the mandible (Row and Killey, 1970) and this restriction 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 application of the surgical treatment of zygomatic bone fracture using two points fixation versus three-point fixation, Rana et al.

(2012) reported postoperative complication like decreased malar height and vertical dystopia was more common in two-point fixation-treated patients than three-point fixation. Based on their report, internal fixation using three-point fixation by mini plates is the best method for treatment of zygomatic bone fractures. The three-point fixation (FZ suture, inferior orbital rim and zygomaticomaxillary buttress) using either mini plates alone or interfragmentary wiring conferred the greatest stability (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). Comparison of numerous surgical approaches and their complications have done objectively by outcome measurements which requires protocol management and long-term follow up. In a 12-year evaluation of methods used in the treatment of zygomaticomaxilary complex fractures, Zachariades and Mezitis (1998) reported Semirigid fixation with miniplates offers the most reliable method for the treatment of zygomatico-orbital complex fractures. The increased cost and occasionally the necessity to remove the hardware are the main disadvantages of the method. Surgical methods of zygomaticomaxillary complex fracture fixation have evolved over the years, beginning with wires for osteosynthesis. However, wire osteosynthesis is not as effective as plating systems in maintaining reduction of zygomaticomaxillary complex fractures (Ellstrom and Evans, 2013). Traditional teaching recommends three-point fixation for zygomaticomaxillary complex fractures. However, an algorithm proposed by Ellis and Kittidumkerng recommends a step-wise process in the treatment of zygomaticomaxillary complex fractures (Rodriguez et al. 2012). Alternative approaches to zygomaticomaxillary complex fractures observe soft-tissue preservation (Ellstrom and Evans, 2013). Minimizing soft-tissue morbidity is the goal of skeletal fixation. Type of the fracture and opinion of the surgeon impresses soft-tissue approaches and required buttresses to fixate (Czerwinski et al. 2005). A brow incision lead to noticeable scarring. Lower eyelid exposures leads to entropion or ectropion (Raschke et al. 2013). The coronal approach provides exposure to the zygomatic arch and lateral orbital rim to treat severe zygomaticomaxillary complex fractures (Lee et al. 2010). Facial nerve injury, temporal fat pad injury, alopecia and scalp necrosis are the main complications of this approach (Lee et al. 2010). It is reported one plate on the superolateral orbital rim through a lateral brow incision had good results in patients (Hwang, 2010).

Single-plate fixation is typically limited to non-comminuted zygomaticomaxillary complex fractures without ocular symptoms. Zygomaticomaxillary complex fracture treatment should be tailored on a patient-by-patient basis. All fracture is different and these variances warrant frequent combinations of approaches and fixation approaches. It appears that the surveyed population would commonly employ approaches through the mouth and eyelid for treatment of a zygomaticomaxillary complex fracture (Hwang, 2010).

In conclusion, assessment of the zygomatic bone position in relation to the cranial base posteriorly and the midface anteriorly, is the key to the acute repair of mid facial fractures. Secondary reconstruction of posttraumatic deformities of the orbitozygomatico- maxillary complex remains a major surgical challenge.

It needs to notice, although the frequency of facial asymmetry in patients with zygomatic arch fracture is higher, it seems Patients' awareness of this fact can decrease their dissatisfaction (Khaqani et al. 2018). It is worth mentioning that the type of zygomaticomaxillary complex fracture greatly influences the outcome of zygomaticomaxillary complex fracture treatment. Kim et al. (2014) also reported a higher degree of asymmetry for comminuted zygomaticomaxillary complex fractures.

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