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Fracture of the zygomaticomaxillary complex: etiology and treatment

Abstract

Zygomaticomaxillary complex (ZMC) bone fractures are traumas frequently encountered in the field of oral and maxillofacial surgery and traumatology, resulting from medium to high energy impacts in the middle third of the face. These fractures can cause aesthetic and functional deformities. Accurate diagnosis is fundamental for clinical management and is usually based on clinical and imaging tests, with computed tomography (CT) being the gold standard. This study aims to describe the kinetics and approaches of CZM trauma according to the literature. A search of recent literature was carried out using the PubMed and SciElo databases with the terms: "Zygomatic bone", "Maxillary bone" and "Bone fractures", covering articles from the last ten years, in Portuguese and English, and 15 articles were selected based on the established inclusion and exclusion criteria. The main etiologies of CZM trauma are traffic accidents, physical assaults, falls from a height and sporting activities, while the treatment of complications from this type of injury depends on the severity, location, age and presence of associated comorbidities. Treatment can range from observation and monitoring for non-displaced fractures to surgical procedures to realign the bone fragments in order to re-establish symmetry and functionality of the face and associated noble structures.

Keywords: zygomatic bone, maxillary bone, bone fractures

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Ana Carolina Plado Barreto de Almeida,[1] Francisco Jean Magalhães Farias,[2] Rodrigo Carvalho de Souza,[3] Raphaela França,[3] Roberto Gomes[3]

[1]Faculdade do Estado do Rio de Janeiro (UERJ), Brazil
[2]Universidade Federal Fluminense (UFF), Brazil
[3]Hospital Municipal Lourenço Jorge, Brazil

Correspondence: Ana Carolina Plado Barreto de Almeida, Faculdade do Estado do Rio de Janeiro (UERJ), Brazil, Email anacarolinaplad@gmail.com

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Introduction

The zygomatic bone is a prominent anatomical structure in the upper-middle third ofthe face that plays a fundamental role in facial support and contour, serving as a structural framework for the orbital cavity and contributing to the formation of the lateral wall and orbital floor.[1] The zygomatic bone has a dense body thickness and delicate projections that connect with adjacent bones. This conformation can suffer complete disruption due to high-energy mechanical impacts dissipated through this bone architecture, resulting in fracture of the zygomaticomaxillary complex (CZM).[2]

The anatomical arrangement of the CZM is established by means ofzygomatic-frontal, zygomatic-maxillary and zygomatic-sphenoidal communication through homonymous sutural joints, and also forms part of the infraorbital margin, lateral wall and orbital floor and zygomatic arch.[3]

The maxilla is an important structure in the viscerocranial framework system, as it is related superiorly to the frontal bone, posteriorly to the sphenoid, palatine, lacrimaland ethmoid bones, medially to the nasal bone, vomer and inferior nasal concha, and laterally to the zygomatic bone, forming with it the CZM, which is of fundamental importance in structuring the upper-middle third of the face.

The origin of maxillofacial fractures includes traffic accidents, physical attacks, falls and sports-related trauma. However, there is a regional and sociodemographic variation in the incidence of maxillofacial fractures, which can be attributed to economic aspects, cultural traditions and environmental conditions.[4–10]

During the growth phase of the viscerocranium, the midface undergoes a significantprocess of expansion and ossification during adolescence, especially during the growth spurt, characterized by flexible skeletal sutures, developing dentition and thicker soft tissues. This contributes to a lower incidence of mid-facial fractures in young athletes compared to older adolescents and adults.[11]

The main clinical symptoms of zygomatic complex fractures include diplopia, enophthalmos, ophthalmoplegia, periorbital hematoma, sinking of the facial prominence and paresthesia of the skin in the infraorbital region. This study aims to describe the kinetics and approaches of CZM trauma according to literature findings, such traumatology is frequently encountered in emergency services. Knowledge of the anatomical arrangement and trauma kinetics of the CZM is essential for oral and maxillofacial surgeons and the team involved in urgent and emergency care, in order to enable correct early diagnosis and subsequent specialized treatment to ensure a favorable prognosis.

Methodology

A systematic search was carried out in the Medline database through the PubMed and SciElo platforms, using the following terms: "Zygomatic bone", "Maxillary bone"and "Bone fractures", the PRISMA statement protocol (2020) was followed for the initial selection of articles and subsequent reading of the abstracts. Literature review articles published in the last ten years, published in Portuguese and English, were included, and case report articles and articles repeated in the databases were excluded, resulting in the selection of 14 articles specific to the topicfor this analysis. After reading the abstracts, 25 articles were selected, of which 18 were selected for full reading and, finally,15 studies were classified to make up the reference literature according to the aforementioned criteria.

Results

According to Chukwulebe, S. et al., trauma to the MCZ accounts for 8.2% of all facial fractures. Among the causes, automobile accidents, especially motorcycles and cars, account for 8.8%, physical assaults for 7.7%, falls from a height for 8.5%, sports activities for

8.1%, accidents at work for 11.5% and incidents involving firearms for 3.6%.[12]

In general, there are three treatment options for CMZ fractures: a conservative approach, consisting of closed reduction without fixation, and an open reduction approach, i.e. surgical, with fixation at one or more support points. Surgical treatmentaims to achieve anatomical restoration and a stable position to guarantee the best aesthetic and functional results. Restoration of the fracture can therefore be carried out using closed reduction or open reduction according to the individualization of the case.[13]

Closed reduction is a frequently used treatment approach for CMZ fractures. The stability of the reduction is sustained by the bone support between the fragments, considering the absence of significant muscle strength in the CMZ, therefore favorable prognosis, and choice for non-surgical reduction. However, a disadvantage of this technique is the limited view of the fracture site.[14]

Open reduction, with surgical access, should be considered in unstable situations or when closed reduction is not feasible, such as distant bone fragments or unfavorable fractures, according to the authors. Those who support this approach argue that open reduction, without the need for fixation, enables reduction with directvision, since the periosteum is incised and elevated to expose all the fracture lines. Itis important to note that in some cases, multiple approaches may be necessary to expose all the fracture lines. However, a complete exposure of the fractured segments and a detailed overview are not required in all types of fractures. When open reduction is the chosen option, standardtreatment usually involves the use of titanium plates and screws to ensure stability.[13–15]

In the literature, it has not yet been definitively established whether the number of fixation points has an impact on the quality of the anatomical restoration, stabilityover time and the possibility of complications.[16]

Different authors have proposed that the number of fixation points to be used should be determined taking into account various factors, including the displacementof the fractured segment, the type of fracture and the stability achieved after reduction. Some have indicated that a single fixation point is sufficient to provide stability, while others have stated that multiple fixation is essential to avoid subsequent displacement, which can lead to facial asymmetries. The question of how many fixation points are needed in fractures of the CMZ fractures is still not entirely clear. Furthermore, it remains to be seen whether the number of fixation points influences the quality of theanatomical reduction, stability over time and the risk of complications.[17,18]

Surgical intervention is an effective treatment modality for depressed fractures of thezygomatic complex, while the non-surgical approach is often used for non-displaced fractures for non-displaced fractures. Most fractures of the zygomatic complex can be treated by an intraoral approach alone and rigid fixation in the zygomaticomaxillary buttress. Additional exposure of the zygomatic-frontal junction or inferior orbital ridge is required for severely displaced fractures, which require additional fixation.[19]

Discussion

Due to the kinetics of trauma in high-intensity impacts against the middle and upperthird of the face, the clinical history is of paramount importance, once the patient has been stabilized, regarding the patient's level of consciousness due to the likelihoodof the brain being affected by the dissipation of forces, their ability to accurately report the traumatic event, the type of injury (high-velocity or low-velocity), high-velocity injuries being more likelyto result in complex fractures affecting severalareas of the facial skeleton, and the mechanism of injury (blunt or penetrating).

Blunt injuries generally affect local structures, while penetrating injuries are more likely to involve deeper neurovascular structures. The physical examination should include a complete assessment of the head and neck region, focusing on the following aspects: ophthalmological examination: check visual acuity, pupillary reaction, ocular muscles, sclera and cornea, evaluate the facial skeleton for steps or flattened areas, examine dentition and occlusion, perform a neurological examinationto check the function of the infraorbital and facial nerves, document abrasions or lacerations in the soft tissues around the orbit and observe lateral canthal dystopia, which can indicate serious fractures. This comprehensive assessment is essential for determining the appropriate treatment plan in cases of CZM 24 injuries.

The main signs and symptoms of CZM trauma are enophthalmos, diplopia, deepening or displacement of the infraorbital rim, ophthalmoplegia, exophthalmos, ecchymosis and periorbital hematoma. In addition, patients may experience paresthesia in the region of the skin innervated by the infraorbital nerve.[12]

Low-energy fractures show minimal displacement and are often incomplete in certain sutural joints, with surgical treatment rarely being necessary. Medium-energy fractures are more frequent, involving complete displacement of the joints and generally requiring surgical intervention. High-energy injuries, which are less common, are often associated with other facial fractures and have complex characteristics, such as comminution of the orbital and maxillary walls. In more extensive cases, in addition to accesses close to the fracture line, coronal access may be necessary for a larger surgical field and thus adequate treatment.[20]

Maxillofacial computed tomography is essential to confirm the diagnosis and assist in surgical planning, recording possible simultaneous facial fractures. It is vital to observe ipsilateral fractures, as they can go unnoticed and influence the outcome of treatment. Simultaneous fractures in the naso-orbito-ethmoidal complex (NOE) are linked to less favorable results after treating fractures of the CZM. Fractures in regions suchas the sphenoid or frontal bone can complicate the correction of the MVC fracture and should be carefully evaluated in the images.[21] Retrobulbar entrapment or hematoma requires urgent surgical action. Otherwise, treatment can wait up to two weeks for the edema to subside. However, delays of more than three weeks may require osteotomies to adjust the zygoma and result in less favorable outcomes.[22]

Isolated zygomatic arch fractures, treatment is recommended in the presence of trismus or significant visible deformity. It is vital to understand that not all CZM fractures require intervention. Those with minimal displacement, without functional oraesthetic impairment, generally do not require surgery.[23]

Isolated fractures of the zygomatic arch, which account for 10% of zygomatic fractures, can arise from a direct impacton the side of the face. This fracture is distinct from those affecting the lateral orbital wall. The most vulnerable point of the zygomatic arch is about 1.5 cm behind the zygomaticotemporal suture. The common pattern of zygomatic arch fractures is segmental, occasionally involving the zygomaticotemporal suture, with potential buckling or displacement of the bone fragments, which can lead to trismus and discomfort when chewing.[24,25]

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Depressed fractures of the zygomatic arch or CZM can result in trismus due to the impact of the arch on the coronoid process of the mandible, adhesions between the arch and the coronoid process or direct injuries to the muscles of mastication.[26] In addition, displaced zygomaticomaxillary fractures can cause flattening and widening of the midface, often requiring surgical treatment with open reduction through minimal access incisions.[3]

Open surgery of the zygomatic arch is rarely performed on isolated fractures of the CZM, due to the requirement for a coronal cut and the danger of damaging the frontal branch of the facial nerve, which passes through the zygomatic arch to reach the frontal muscle. In situations of panfacial fractures, where a coronal cut may be necessary to access frontal sinus fractures or mixed Le Fort fractures, the zygomaticarch can be targeted to help correct and stabilize the zygoma. An alternative technique to the zygomatic arch can be through a pre-auricular cut. In both techniques, it is essential to be meticulous to avoid damaging the facial nerve.[27–29]

CZM fractures are an important prevalence of facial trauma, especially when mechanical impacts are generated in the middle and upper thirds of the face. These fractures have a significant impact on aesthetics and facial function. Secondary problems can arise as a result of inadequate corrections, late interventions or lack of adequate treatment.[30,31]

Secondary procedures in CZM focus on correcting the alignment and projection of the zygoma, as well as treating irregularities in the orbit.[16] These procedures can range from zygomatic readjustment osteotomies in more complex cases to subtle adjustments to the malar projection, performed using grafts and soft tissue augmentation and elevationprocedures.[32]

Conclusion

Trauma to the CZM is an important and frequently occurring condition, either isolated or associated, which, when not properly managed, can lead to serious functional and aesthetic consequences. Surgical intervention and appropriate management are crucial to ensure restoration of facial anatomy and maintenance of the physiology of associated structures such as vision, mastication and breathing. Recognizing the importance of early diagnosis, as well as understanding the correct treatment techniques, is vital for healthcare professionals, ensuring that patients affected by this fracture receive the necessary care and return to their normal lives with as few sequelae as possible.

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Conflicts of interest

The authors declare no conflicts of interest.

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