Management of Zygomatico-maxillary-Orbital Fractures (ZMO) and Assessment of Outcomes

Thesis

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LIST OF ABBREVIATIONS

Abbreviation	Meaning
2D-CT	2 dimensional Computed tomography
3D-ct	3 dimensional Computed tomography
CANS	Computer assisted navigational systems
CTA	Computed tomography angiography
DICOM	Digital imaging and communication in medicine
ION	Infra- orbital nerve
NS/CAN	Navigational surgery/computer assisted navigation
RTA	Road traffic accident
SD	Standard Deviation
STL	Stereolithgraphic model
VAS	Visual analogue scale
VSP	Virtual surgical planning
ZF	Zygomatico –frontal
ZMB	Zygomatico-maxillary buttress
ZMC	Zygomatico –maxillary complex
ZMO	Zygomatico-maxillary-orbital
ZS	Zygomatico- sphenoidal
ZT	Zygomatico- temporal

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INTRODUCTION

Fractures of Zygomatic bone and other articulating bones are common in our clinical practice. The term Zygomaticomaxillary complex (ZMC) fractures describes the fractures including zygomatic bone and other articulations with the zygoma as frontal, sphenoidal, maxillary, and temporal bones.

The term zygomatico- maxillary-orbital (ZMO) fractures has been considered a more accurate term when orbital bones are involved. This type of trauma constitutes the most common orbital fractures that clinician meet in their clinics. [1, 2]

Most ZMO fractures can cause functional and cosmotic problems. The functional problems include diplopia, infraorbital nerve dysfunction, as well as trismus.

The cosmetic problems entail midfacial widening, loss of malar projection, and enophthalamous. Not all ZMO fractures cause functional or cosmetic problems, therefor not all ZMO fractures need treatment. So fractures with minimal displacement and cosmetic problems may need to be followed up with no treatment. [1,3,4,5]

There is no standard treatment plan for all ZMO fractures and the treatment varies from one surgeon to another and from one case to another according to degree of severity, displacement, extaocular muscle entrapment, degree of disruption of internal orbital content, and number of articulations involved. [4, 5, 6, 7,8, 9]

When the patient requires surgical intervention, the functional and cosmotic aspects must be addressed. Moreover the choice of the surgical access becomes a critical decision. The surgical approaches utilized in treatment of these fractures can be classified according to anatomical area.

Approaches to infraorbital rim and orbital floor include: subciliary, subtarsal and transconjunctival approaches. Approaches to lateral orbital wall which include the Blepharoplastic upper eyelid incision and lateral eye brow incision. The coronal access provides access to lateral orbital wall, orbital roof, and medial orbital wall. Existing lacerations can be used as a direct access to the traumatized region.

Unfortunately some extraoral incisions as infraorbital, subciliary, and subtarsal can cause some complications. These entail scleral show, lid retraction, and ectropion. Also coronal access is associated with temporal branch paresis and alopecia. (10,11,12,13)

The surgeon should aim to minimize the number of surgical approaches required to minimize the iatrogenic cosmetic deformities.(8)

REVIEW OF LITERATURE

Fractures of the zygomatic complex are among the most frequent in maxillofacial trauma, due to its prominence which predisposes it to bear the brunt of facial injuries, the pattern of which may vary geographically. The zygomatico-maxillary complex functions as a buttress for the face and is the corner stone to a person's aesthetic appearance by both setting mid facial width and providing prominence to the cheek(1). It can best be anatomically described as "tetrapod" as it maintains four points of articulation with the frontal bone, temporal bone, maxilla, greater wing of sphenoid, at the zygomatico frontal (ZF) suture, zygomatico temporal (ZT) suture, zygomaticomaxillary buttress (ZMB), and zygomatico sphenoid (ZS) suture respectively. This tetrapod configuration lends itself to complex fractures. Due to the prominent, mid face location of the cheek fracture of the ZMC represents the second most common type of facial fracture after nasal bone fracture (14,15).

The zygomatic bone contributes significantly to the strength and stability of the mid face. The zygoma is considered a strong buttress of lateral portion of middle third of the facial skeleton(1). It contributes to form the cheek prominence, part of the lateral and inferior orbital rim as well as the orbital floor. Due to its prominent position it is frequently subjected to fracture and dislocation either alone or in combination with other structures of the mid-face such as maxilla, nasoethmoidal and orbital area(16).

The zygomatic complex is important in the function of the globe, facial symmetry and also gives passage to infra orbital nerve that innervates the mid facial region. Fractures of zygomatic complex are among the most frequent in maxillofacial trauma and are involved in 42% of facial fractures and accounts for 64% of all middle third fracture(14). They are the second most common fractures of the face after nasal injuries(17).

The zygomatic bone provides height, width and projection to the face and forms a part of the bony orbit. It also provides attachment to the suspensory ligament of lockwood which support the globe.

The orbit and zygomatic arch [18]

The orbits are paired structures, located on the anterior part of the face and protected by the lids. Each orbit can be compared to a tiny jewel box that has very precious contents, all carefully wrapped in fat tissue[18]. They can also be compared to a main room, to which access is gathered through a pre-chamber, the cavernous sinus[18].

Morphologically, each orbit is a four-sided pyramid with a posterior apex, anterior base and a medially tilted axis. Although simple, this fact constitutes the basis of the human stereoscopic vision and allows for understanding the location of orbital foramina[19].

The zygoma forms part of the floor and lateral wall of the orbit. Furthermore the 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 orbital 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.

In the orbit, all openings are arranged around the base, apex or between the orbital walls. Along the base are the infraorbital and supraorbital canals and the zygomaticofacial foramina; between the roof and the lateral wall are the superior orbital fissure and the lacrimal foramen; between the roof and medial wall are the optic, anterior, and posterior ethmoidal canals; between the lateral wall and floor is the inferior orbital fissure, and between the medial wall and orbital floor is the cranial opening of the nasolacrimal duct[19].

The bones forming the orbit are seven: frontal, ethmoid, lacrimal, sphenoid, zygomatic, palatine, and maxilla. In three out of the four orbital walls, these bones are arranged in pairs, with exception of the medial wall. The largest component of the medial wall is the ethmoid. The quadrangular orbital plate of the ethmoid constitutes the center of the medial orbital wall and separates the orbit from the medially located nasal cavity. The orbital plate of the ethmoid articulates superiorly with the medial edge of the orbital plate of the frontal bone. The anterior and posterior ethmoidal notches that exist in both of these plates, when combined, form the anterior and posterior ethmoidal canals. These canals transmit the ethmoidal branches of the nasociliary nerve of the ophthalmic division of the trigeminal nerve and the branches of the ophthalmic artery that passes further to supply the sinus mucosa and the dura mater of the frontal pole and falx cerebri [(20)].

The cranial openings of the ethmoidal canals are related with the anterior and posterior limits of the ethmoidal cribriform plate and help dividing the nasal cavity roof and anterior fossa floor into frontal, cribriform, and. The ethmoidal canals also help dividing the orbital area into bulbar, retrobulbar, and apical parts. This anatomical fact is useful during intracranial exploration of the anterior fossa and endonasal approaches to the anterior fossa and orbit.

Inferiorly, the ethmoid articulates with the orbital plate of the maxilla. At the most anterior portion of the orbit, the presence of the frontal process of the maxilla, forming most of the medial rim of the orbit, determines the presence of a gap, which is filled in by the upper portion of the lacrimal bone. The upper part of the lacrimal bone is therefore located between the anterior edge of the ethmoid and the frontal process of the maxilla. The lacrimal is a curved plate of bone, which forms the anteromedial 2/3 of the cranial opening of the nasolacrimal duct[(21)].

Posteriorly, the ethmoid articulates with the body of the sphenoid, completing the medial wall of the orbit. Understanding the bony formation of the lateral wall of the orbit is important from the surgical standpoint. The greater wing of the sphenoid faces the orbit, along the exocranial side, and is the anterior limit of the middle cranial fossa, on the endocranial surface.[21]

The zygomatic bone, in contrast, has no cerebral surface. The zygoma faces the orbit and—through its opposite surface— forms the anterior limit of the temporal fossa, where the temporal muscle is located. This anatomical fact is the basis of the lateral orbital approaches, in which by displacing the temporal bone and performing a pure zygomatic osteotomy, orbital lesions can be reached, without the need of a combined, cranio-orbital approach [22].

The combination of the greater sphenoid wing and the zygomatic bone also forms the posterior lip of the inferior orbital fissure. The anterior lip of this fissure is formed mostly by the orbital plate of the maxilla and the posteromedial part is formed by the orbital process of the palatine bone. The palatine bones have a horizontal part, which form the posterior part of the hard palate and a vertical part. The vertical part has a posteromedial process, directed to the sphenoid body—the sphenoid process—and an orbital process, directed anterolaterally, consisting of a single air cell and abutting along the floor of the orbit, between the maxilla and the ethmoid.

The palatine bone pairs thus with the maxilla to form the orbital floor. They face posteriorly, across the pterygomaxillary fissure, the pterygoid processes of the sphenoid bone.

The inferior orbital fissure is an important surgical landmark in the orbit. Through the most medial part of this fissure, the orbit communicates with the pterygopalatine fossa and, through this, with the nasal cavity. Laterally the fissure brings the orbit in contact with the temporal and infratemporal fossae. The lateral part of the fissure is filled only with smooth