AESTHETIC CONSIDERATIONS IN THE RECONSTRUCTION OF ORBITO-ZYGOMATIC FRACTURES

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AESTHETIC CONSIDERATIONS IN THE RECONSTRUCTION OF ORBITO-ZYGOMATIC FRACTURES (Abstract) **Aim:** The purpose of this study is to present our experience regarding the aesthetic and functional reconstruction of zygomatic bone fractures. **Material and methods:** We retrospectively reviewed the medical charts of 19 patients diagnosed with orbito-zygomatic fractures needing surgical reduction and fixation, in between January 2016 and January 2018. Two of the patients presented late with cosmetic and functional sequelae of fracture malunion. A two-point fixation was performed in most cases. Titanium mesh was used in four comminuted fractures at the level of the zygomatico-alveolar crest and for the reconstruction of orbito-zygomatic fracture sequelae. Reconstruction of the orbital floor was performed in five cases. **Results:** No significant complications were recorded. Good aesthetic outcomes were obtained in all cases regarding the reconstruction of the orbital walls and the restoration of facial symmetry. Because of the accurate anatomic reconstruction, functionality was resumed postoperatively, with diplopia resolving immediately after surgery and in only one case during the three weeks following the procedure. **Conclusions:** The most important aspect regarding the immediate restoration of facial symmetry in fractures of the zygomatic complex is the repositioning of the zygomatic prominence by ensuring adequate fixation and support at the level of the zygomatico-alveolar crest. The restoration of the contour and volume of the orbital area is also important regarding facial aesthetics and with repercussions regarding functionality. The three-dimensional reconstruction of CT (computed tomography) images in complex cases helps understanding the fracture pattern, reduction pathway and selecting the most accurate fixation method. **Key words:** ZYGOMATIC, ORBIT, FRACTURE, RECONSTRUCTION, AESTHETIC.

The role of the zygomatic bone in establishing the uniqueness of facial features is without doubt. The prominence of the cheek region stands for youth and beauty. Due to the projection of the zygomatic body, it is one of the first points of reference when determining facial symmetry. Beauty implies symmetry and therefore, any change in the position of this prominent facial feature will cause obvious asymmetry and will influence the judgement of facial attractiveness. Another important issue is the contribution of the zygomatic bone to the formation of the orbit. The orbital volume and the position of the orbital contents are greatly impacted by the
position and characteristics of the zygomatic bone. An altered position of the eye will be extremely noticeable since maintaining eye contact is one of the most important aspects of human social interactions.

The functional aspect of zygoma malposition is not to be neglected since double vision related to misalignment of the eyes can be extremely bothersome in performing everyday activities. The limitation of mouth opening due to blockage of the coronoid process determined by an inwardly displaced zygoma can also cause functional impairment related to mastication. For all these reasons, sequelae related to zygoma fracture mal-positioning should be avoided whenever possible, since the immediate repair of orbito-zygomatic fractures is always easier to perform and with better results than sequelae surgery.

Being a prominent facial feature, the zygomatic bone is affected in many facial traumatisms, ranking first in some studies (1) and second to mandibular fractures in other studies (2). We present our experience around orbital and zygomatic trauma surgery to aid maxillofacial surgeons in deciding the best treatment method for this common traumatic occurrence. We also provide tips on obtaining the optimum reduction and fixation of orbito-zygomatic fractures for best cosmetic and functional results.

MATERIAL AND METHODS
We retrospectively reviewed the medical charts of patients diagnosed with orbital floor and zygomatic bone fractures in between January 2016 and January 2018. We included only patients who had indication for osteosynthesis due to displaced fractures causing aesthetic and functional deficit.

A total of 19 patients were included, of which 17 men (89.47%), aged between 18 and 71. The etiology involved 10 human aggression cases (52.63%), six traffic accidents (31.58%) and three accidental falls (15.79%). There were three (15.79%) isolated fractures of the orbital floor (blow-out fractures) and 16 (84.21%) orbitozygomatic fractures. Zygoma fractures comprised of 14 (87.50%) tripod fractures and two (12.50%) comminuted fractures. Two patients (10.53%) presented late with malunion and consequent sequelae. Associated lesions were zygomatic arch fractures in four cases (21.05%), nasal bone fractures in three patients (15.79%), occlusal-facial fractures in three cases (15.79%) and mandibular fractures in two patients (10.53%). Signs that indicated the need for surgery consisted of facial asymmetry and sinking of the zygomatic region in 14 patients (73.68%), diplopia in five patients (26.32%), enophthalmia and hypoglobus in three cases (15.79%), restricted eye movements in four patients (21.05%) and restricted opening of the mouth in five cases (26.32%). There was one patient (5.26%) with preoperative posttraumatic cicatricial ectropion. All patients presented with hypoesthesia of the infraorbital nerve.

RESULTS
The reconstruction of the orbital floor was performed using PDS (polydioxanone) mesh in two (10.53%) cases and titanium mesh in three (15.79%) cases of orbital floor fractures. Zygoma fixation was achieved by a two-point fixation in 12 (63.16%) cases - at the level of the zygomatico-alveolar crest and inferior orbital rim. In four (21.05%) cases a three-point fixation was used by placing titanium plates at the level of the zygomatico-alveolar crest (fig. 1, 2), inferior orbital rim and frontal-zygomatic suture. In four (21.05%) patients
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A titanium mesh fixation at the zygomato-alveolar crest was needed due to comminution. The sequelae following fracture malunion were addressed by reconstructing the orbital floor and zygomatic region with titanium mesh. The approaches used for reduction and fixation were the transconjunctival incision for the orbital floor and inferior orbital rim, the external brow incision for the frontal-zygomatic suture and the intraoral horizontal incision located in the superior oral vestibule for the zygomatico-alveolar crest. For the simultaneous access to the orbital floor, the zygoma body and the anterior maxillary sinus wall necessary in wider reconstructions and sequelae cases, a single cutaneous inferior palpebral incision extended to the nasolabial fold was used. In two (10.53%) cases of open fractures, the approach was achieved via the posttraumatic wounds from the cheek area and brow area.

Postoperative periorbital and genian edema and ecchymosis were the most common occurrences. No infections or extrusion of the osteosynthesis material were noted. The facial asymmetry improved following surgery in all cases. The outline of the zygomatic bone was regained, as well as the contour of the orbit (fig. 3-6). In four patients (21.05%) diplopia completely resolved, while one patient (5.26%) had transient diplopia that disappeared after three weeks. Eye movements were in normal ranges following surgery. The amplitude of mouth opening returned to normal after reduction and fixation of the fracture. No cases of orbital hematomas were encountered postoperatively. There were no cases of ectropion related to the transconjunctival incision. In one (5.26%) sequelae case the cicatricial ectropion present preoperatively improved because of reconstructive surgery. A second surgery for soft tissue repositioning using suspension sutures was needed for improving aesthetic and functional results.

Fig. 1. Intraoperative view of the displaced fracture line at the zygomato-alveolar crest in a patient with a zygomatic bone fracture.

Fig. 2. Intraoperative view of the reduced zygomatic bone fracture and fixation using a titanium plate at the level of the zygomatico-alveolar crest.

Fig. 3. Preoperative frontal view of patient with a displaced right zygomatic bone fracture showing facial asymmetry with sinking of the zygomatic area and widened aspect of the right genian region.
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Fig. 4. Inferior preoperative view of the same patient better outlining the sinking of the zygomatic prominence.

Fig. 5. Postoperative frontal view of the patient at two months postoperatively proving the correct positioning of the zygomatic projection and restitution of facial symmetry.

Fig. 6. Inferior postoperative view of the patient at two months postoperatively better outlining the correct position of the zygomatic prominence and presence of facial symmetry.

DISCUSSION

The zygomatic bone is a defining element of individual facial aesthetics since it provides the projection of the cheek region, it contributes to establishing the width of the face and it also provides support for the inferior eyelid. Changes in the position or three-dimensional shape of the zygomatic bone can cause a completely different appearance of the face - a concept used in aesthetic surgery when performing zygomatic bone osteotomies for achieving a more appealing facial contour (3). Trauma can cause unaesthetic changes affecting both the cheek region and the orbital area, since there is also an orbital component to any zygomatic bone fracture that can be clinically apparent considering the fracture fragmentation. The resulting facial asymmetry depends on the type of zygomatic displacement. In most cases a flat appearance of the cheek area will be caused by the interior displacement of the zygoma towards the maxillary sinus. This is usually accompanied by a widening of the face when the zygomatic bone is rotated medially and inferiorly, while a lateral and inward rotation might cause a decreased facial width on the affected side (4). Orbital floor fractures with displacement of the orbital content towards the maxillary sinus can lead to enophthalmos, hypoglobus and related functional disturbances - diplopia, restricted eye movements (5). An inward displacement of the lateral orbital wall could cause diminution of orbital volume, pressure on the orbital content, exophthalmia and restricted eye movements.

Optimal functional and aesthetic results can only be obtained by a proper fracture reduction and fixation. The basis for obtaining the most favorable reduction is set by understanding the fracture pattern and path of displacement. Intraoperatively, the reverse pathway of fracture displacement will be applied to obtain a simple correct
reduction. Although there are several different closed reduction treatment options, they are controversial as they do not allow direct visualization of the zygomatic bone and its articulations (5) sometimes leading to unacceptable or failed reduction. Intraoperative imaging advancement may lead to a more reliable outcome after closed reduction (6).

Information on the degree and direction of displacement, as well as the number of fragments and associated lesions are crucial on deciding the treatment plan and the approaches used. This can be achieved by adequate imaging that allows direct visualization of the fractured bone fragment displacement as a spatial image (6, 7). In our study the three-dimensional reconstruction of Computed Tomography (CT) or Cone Beam Computed Tomography (CBCT) images offered the best understanding of the fracture pattern and translated in positive outcomes regarding facial symmetry restoration. CT examination can also provide information on the presence of soft tissue entrapment or foreign bodies (8) which can impede proper reduction of the fracture if not properly diagnosed and removed. Imaging can also help diagnosing preexisting conditions that could decrease bone strength and lead to pathological fractures of the zygomatic bone in the context of minimal trauma. Mucocele formation in the maxillary sinus is a frequent encounter. In rare cases, they can grow to erode through the walls of the maxillary sinus, including the inferior orbital floor, leading to functional consequences (9) but also decreased bone strength. Such occurrences can complicate the treatment of zygomatic bone fractures by decreasing the available fixation points in quality bone. Titanium mesh reconstruction could be needed for an increased surface coverage and strength.

In the first days after the trauma, radiologic investigations helped decide the indication for surgery, since it is a well-known fact that local posttraumatic edema can mask facial asymmetry. Additionally, diplopia can manifest after the initial three days after trauma, when orbital edema resolved, the volume of the orbital content returns to normal, and any inferior displacement will manifest as double vision. All zygomatic fractures were resolved in the first week or within two weeks after trauma. It is the surgeon’s preference to wait for the resolution of local edema to better estimate the result of the reduction intraoperatively, unless there is indication for emergency surgery, such as orbital apex syndrome. Edema diminution usually happens after the first three days following the traumatism. If more than two weeks passed from the fracture onset due to contraindication or late presentation, surgery was scheduled later for addressing the sequelae of the fracture healed in malposition. Most authors agree on performing the surgery for zygomatic bone reduction and fixation within the first two weeks posttraumatic (4).

The goal of surgery is to achieve proper positioning of the zygomatic prominence and to adequately reconstruct the orbital contour and volume. If the proper reduction is not achieved, the resulting facial asymmetry will be easily seen with a lower position of the zygoma prominence (10). All associated lesions must be addressed, both extraoral and intraoral (11) - the bone contours as support structures as well as the soft tissues as covering structures, but also the integrity, height and contour of the dental arches (12) that contribute to the outcome. The reconstruction must address
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the anatomical repositioning of both hard and soft tissues. The soft tissue rearrangement can be achieved by using intraoperative suspension sutures to the periosteum and performing the layered closure of the postoperative wound (13). Secondary corrections can be performed by lifting the tissues with the help of barbed threads that offer increased support with the advantage of an incisionless procedure (14). Residual volume deficit can be addressed by autologous fat transfer for filling of the involved area (15). Lipofilling can offer additional benefits related to scar softening and decreasing residual postoperative pain (16).

There are differences among surgeons regarding the number of fixation points necessary for zygomatic fractures, choosing between one and four fixation points located at the level of the zygomaticoalveolar crest, the inferior orbital rim, the frontal-zygomatic suture and rarely the zygomatic arch, with or without orbital reconstruction. Kim et al. (17) state that one-point fixation offers satisfactory results when using the zygomatico-zygomatic crest for fixation. Ellstrom and Evans (5) conclude that for a simple fracture, fixation at the level of the zygomatico-zygomatic buttress is sufficient, while for more complex patterns, two or three points of fixation are needed for ensuring the proper positioning of the zygomatic bone. We consider that a two-point fixation (including the zygomatico-zygomatic buttress and inferior orbital rim) is suitable for most displaced zygomatic bone fractures, while a three-point fixation (with an additional plate at the zygomatico-frontal buttress) can improve results for multi-fragmentary fractures. For improved stability and support, fixation at the level of the zygomatic-maxillary crest is crucial. Fixation with this location is also important to best reposition the zygomatic prominence, an important issue in reestablishing facial symmetry. Because it is an inferior point, it will impede tipping of the zygomatic bone towards the maxillary sinus and support the forces applied on the body of the zygoma. Another important fixation point in our view is the inferior orbital rim. Fixation at this level can be subject to errors if there is an undiagnosed displaced fracture of the frontal process of the maxillary bone. In such an occurrence, the medial fixation landmark would be wrong, and fixation would occur in a medially displaced position, leading to improper positioning of the zygomatic prominence and medially widened orbital contour. When an additional fracture of the frontal process of the maxillary bone is identified with the help of preoperative imaging, the zygomatico-frontal suture could be used as a more accurate level of reduction assessment and fixation, together with long plates at the inferior orbital rim, reaching the nasal bones.

We consider that one of the key aspects for the functional reconstruction of comminuted orbito-zygomatic fractures is the adequate restoration of the orbital volume. This objective can only be achieved by the proper restoration of the integrity and contours of the orbital walls. Respecting the medial landmark represented by the intraorbital buttress located at the intersection of the medial orbital wall and the orbital floor, is crucial for ensuring support and a fit containment for the orbital structures (18). Its importance was also noted in performing orbital decompression surgery for Basedow disease (19, 20) when the preservation of this medial orbital buttress decreases the incidence of postoperative diplopia (21). Another anatomical landmark
that must be respected in orbital reconstruction is the posterior orbital ledge, a bone shelf representing the orbital surface of the palatine bone. It behaves as a posterior landmark and support point for the reconstructive material impeding the inferior placement of the reconstructive material and improper restoration of the orbital volume. It also announces the proximity of the orbital apex and optic nerve and the need for increased care during insertion and positioning maneuvers (18).

CONCLUSIONS

As demonstrated in our study, achieving the most favorable outcome in orbitozygomatic fracture surgery depends on the accurate repositioning of the zygomatic prominence. Just as important is to reestablish the dimensions, contour and volume of the orbit, for a symmetric appearance of the eyes. A three-dimensional understanding of the fracture pattern helps decide the most suitable approach, reduction and fixation method. We consider that a minimum of two fixation points ensures stable reduction and fixation, especially when involving the inferior supporting buttress- the zygomaticoalveolar crest. Titanium mesh is a useful tool for comminuted fracture repair allowing the simultaneous spatial reconstruction of bone contours as well as the surface of the orbital floor. The role of the overlying soft tissues is not to be underestimated, especially when wider soft tissue undermining is performed for access, such as in posttraumatic sequelae surgery. From our experience, repositioning the soft tissues at the end of the procedure ensures sufficient volume of the regions overlying the reconstructed skeletal frame for an aesthetic, symmetric aspect.

The aesthetic disturbances determined by zygomatic-maxillary fractures are best outlined in cases of late presentation with fracture malunion. They should be avoided whenever possible by performing immediate fracture reconstruction with proper spatial positioning of both bone structures and overlying soft tissues.

REFERENCES

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