The Management of Orbitozygomatic Fractures

Larry H. Hollier, M.D., James Thornton, M.D., Pat Pazmino, M.D., and Samuel Stal, M.D.

Dallas, Texas

Learning Objectives: After studying this article, the participant should: 1. Understand the radiographic and clinical diagnoses of orbitozygomatic fractures. 2. Know the surgical approaches to the orbitozygomatic fracture and the indications for each. 3. Understand the rationale behind the type of fixation used. 4. Have a basic understanding of the most common complications arising from orbitozygomatic fracture treatment and the methods of managing these complications.

Orbitozygomatic injuries are among the most common fractures encountered by the plastic surgeon. Appropriate management depends on an accurate diagnosis, focusing on the physical examination and data from computed tomography scans. One must pay particular attention to the orbital component of this injury, as it is from this that so much of the morbidity relating to these fractures is incurred. As with all facial fractures, accurate reduction is paramount to a successful outcome. As many buttresses as are necessary should be visualized to ensure an anatomic reduction. The amount and location of fixation depend on the fracture anatomy. A successful outcome may be expected if these basic principles are followed. ([Plast. Reconstr. Surg. 111: 2386, 2003.]

Orbitozygomatic fractures are among the most common facial injuries presenting to the plastic surgeon’s office. The surgeon involved in the care of these patients should have a keen understanding of the pertinent aspects of the physical examination, particularly with respect to the ophthalmologic findings. Failure to appreciate difficulties with vision or extraocular motion may be interpreted as postoperative complications. Appropriate preoperative work on these patients includes axial and coronal computed tomography scans, with particular attention paid to degree of displacement and internal orbital injuries. The surgical approach should be individualized according to severity of the fracture and associated injuries, but it should always focus on anatomical reduction of the malar position and the orbital anatomy. Only by doing so can one avoid complications such as malar malposition and, perhaps most importantly, enophthalmos. Secondary correction of these problems tends to be much more difficult than avoidance by correct fracture repositioning.

DIAGNOSIS

Radiography

When one is asked to evaluate a suspected orbitozygomatic fracture, it is not uncommon to be presented with a set of plain radiographs. Although these may give some indication that a fracture is present, particularly in Water’s view, plain films are inadequate for a full evaluation. All patients in whom an orbitozygomatic fracture is reasonably suspected should undergo axial and coronal computed tomography scans. When reviewing the scans, particular attention should be paid to the lateral orbital wall (Fig. 1). A classic orbitozygomatic fracture requires a fracture through the lateral orbital wall, which represents articulation of the zygoma with the greater wing of the sphenoid. Because this articulation is so broad, it provides a good location to assess degree of displacement or malposition of the fractured fragment. When evaluating the axial scan, one should also note the status of the zygomatic arch and try to determine the degree of comminution present at the zygomaticofrontal suture, the infraorbital rim, and the zygomatico-
maxillary buttress. Severe comminution may have a significant impact on the planned surgical treatment, requiring a coronal incision to expose and align the arch.

Coronal computed tomographic images are useful in evaluating orbitozygomatic injuries, particularly the orbital component. This evaluation is important, because large defects of the orbital floor or medial wall require reconstruction to prevent enophthalmos. In addition, the computed tomographic scan may demonstrate entrapment of the periorbita or extraocular muscles that may require operative release. However, it is critical to remember that obtaining coronal cuts requires hyperextension of the neck. Many patients with significant facial trauma are unable to hyperextend the neck because of the possibility of a cervical spine injury. In such situations, the surgeon has the option of requesting that the radiologist reformat the axial cuts into a reconstructed coronal series. These reformatted images will not be of the same quality as direct coronal images, but they will still provide significant information (Fig. 2). When reformatting is planned, it is helpful to obtain the axial cuts with 1- to 1.5-mm spacing to provide more data for accurate and concise reformations. Without coronal images, the degree of injury to the orbital floor is difficult to assess.

Physical Examination

The physical examination of patients with orbitozygomatic injuries may be difficult because of swelling from the soft-tissue injury. Swelling frequently conceals any recession of the malar eminence or enophthalmos caused by displacement of the fracture. However, certain findings should be elicited. Point tenderness and bone step-off should be assessed and correlated with radiographic findings. Anesthesia in the distribution of the infraorbital nerve should be carefully evaluated. Many patients will not have sensation over the cheek preoperatively, which should be brought to their attention to avoid postoperative concerns. The same is true for trismus. Many patients with significant malar injuries will have some pain and difficulty in opening the mouth because of impingement of the coronoid process by the displaced malar fragment. This pain may be slow to resolve postoperatively, but it almost always does so without specific intervention.

Perhaps the most important part of the preoperative surgical examination is the ophthalmologic assessment. The zygoma constitutes the floor and lateral wall of the orbit and, as such, is always involved in the fracture. In addition, the medial wall is frequently fractured. Consequently, findings such as diplopia or other motility disturbances are not uncommon. In many cases, this is the result of nonmechanical factors, such as contusion of the extraocular muscles or swelling, which resolve over time. However, entrapment of the muscles in the orbital fracture also occurs, which may influence the decision to proceed with surgery or the timing of surgery.

Of particular concern is the finding of trau-
matic optic neuropathy, which has been reported in 2 to 5 percent of patients sustaining severe facial trauma. Although in its most severe presentation the patient may lose vision, the findings may be as subtle as diminished color perception. One may also find an afferent pupillary defect in the affected eye; that is, the pupil fails to constrict with direct light stimulation but constricts normally in a consensual response when light is directed in the contralateral eye. Optic nerve injury may result from either mechanical or ischemic insults. Although fracture fragments may directly damage the nerve or globe, indirect mechanisms are likely more common. The firm attachment of the dural sheath to the optic nerve at its entrance into the optic foramen makes the nerve particularly susceptible to shear force injuries here. Such injuries may be seen when the head is subjected to rapid deceleration. Studies show that forces originating as far away as the frontal area can be transmitted and concentrated at the optic foramen. Although the management of optic neuropathy is controversial and beyond the scope of this article, many practitioners administer steroids initially to minimize swelling and defer surgical intervention to allow vision to stabilize.

SURGERY

In general, nondisplaced malar fractures may be managed nonsurgically. Patients should be cautioned against excessive pressure on the fractured side and must be followed up closely. Displaced fractures should generally be surgically reduced and plated. However, controversy exists regarding the amount of exposure and fixation required. Although in the past, wide exposure and visualization of all buttresses was advocated, many investigators currently advocate selective buttress exposure. This is largely because of an appreciation for the potential morbidity to the soft tissues after multiple incisions and wide subperiosteal exposure, particularly in the periorbital region. When there is no fracture of the orbital rim, floor, or medial wall that requires reconstruction, and when alignment of the fracture can be achieved without visualizing this area, then reduction and fixation may be possible using a gingivobuccal sulcus incision alone. However, it takes a great deal of surgical experience and judgment to explore the buttresses selectively. In general, to restore the orbitozygomatic architecture most accurately, one should explore and properly align the zygomaticofrontal articulation, infraorbital rim, and zygomaticomaxillary buttress. By aligning these three articulations, the surgeon can accurately reduce the fracture to its anatomical location.

It is appropriate at this point to discuss the indications for exposure of the zygomatic arch, because this is an important component in many fractures. The vast majority of orbitozygomatic fractures do not require coronal exposure and plating of the arch. In most patients, the above three buttresses provide adequate information to align the fracture. However, when these buttresses are comminuted, or when there is concern that the fracture is not anatomically reduced after exposure of the above articulations, visualization and alignment of the arch component of the orbitozygomatic fracture provides invaluable information in setting both the transverse and vertical positions of the zygoma. When exposed for orbitozygomatic fractures, the arch should be plated first. It must be remembered that the zygomatic arch is essentially a straight structure; the common error of reconstructing this as a gentle curve usually results in malar recession and enophthalmos (Fig. 3).

Incisions

The incision in the gingivobuccal sulcus provides excellent exposure of the maxillary component of the fracture. Dissection should first be accomplished along the zygomaticomaxillary and nasomaxillary buttresses to the level of the infraorbital rim. This allows one to expose the

![Fig. 3. Zygomatic arch incorrectly reconstructed as a curve rather than a straight line, resulting in enophthalmos and malar recession.](image)
bone on either side of the infraorbital nerve, minimizing the risk of damage to this structure.

At this point, an elevator should be placed beneath the arch through the intraoral incision and an attempt should be made to reposition the fracture. This serves two purposes. First, it facilitates dissection of the lower eyelid, because a significantly displaced infraorbital rim may lead to some confusion over the proper plane of dissection. Second, should the fracture be anatomically reduced with this maneuver, plating the zygomaticomaxillary buttress may be all that is necessary as long as the internal orbit does not need to be explored.

Typically, after intraoral exposure, the lower eyelid incision is made. The choice of which approach to use through the lower eyelid depends largely on the surgeon’s experience. However, transcutaneous approaches, particularly the subciliary, are associated with a higher risk of lower lid retraction postoperatively. This can be minimized if one performs the incision at a lower point on the lid, as in the subtarsal approach. Many surgeons prefer the transconjunctival approach to the lower eyelid because of its association with a lower risk of lid retraction. With this approach, it may be necessary to perform a lateral canthotomy to facilitate exposure. At the end of the procedure, an appropriate lateral canthoplasty must be performed. In inexperienced hands, lateral canthal malposition or asymmetry may be an issue.

The transconjunctival approach may be performed in either the preseptal or postseptal plane. The postseptal approach is the most direct and has the advantage of completely avoiding dissection within the lid, minimizing the risk of retraction. However, with this approach, the surgeon must contend with the septal fat within the field of dissection. The preseptal approach avoids this.

In exposing the zygomaticofrontal articulation, some authors have advocated dissection using a lateral extension of the lower eyelid incision. Using either a transcutaneous or a transconjunctival approach with this extension, the zygomaticofrontal suture may be visualized by dissecting up along the lateral orbital rim. However, this may result in a more prolonged duration of swelling in the upper lid, resulting in a “hooded” appearance for a period of time.

Many surgeons prefer to use a separate incision for the zygomaticofrontal buttress, which is most typically an extension of the supratarsal fold laterally. This is well concealed and provides excellent exposure. The often-described Dingman incision in the lateral aspect of the eyebrow generally results in a poorer scar and should not be used.

**Reduction**

Perhaps the greatest error made in all of facial fracture surgery is in improper reduction. The single most useful maneuver that can be performed to facilitate proper reduction is aggressive mobilization of the fracture fragment. Frequently, the malar segment is affected by the trauma. As a result, it is difficult to align any of these buttresses because of the immobility of the bone. Mobilization can be achieved by inserting an elevator intraorally underneath the posterior aspect of the zygoma behind the arch. With slow, sustained, upward traction, the fragment may be gradually mobilized.

Yet another option is placement of a bone screw, which is sometimes referred to as a Carroll-Girard screw (Fig. 4). To do this, a no. 11 blade is used to make an approximately 2-mm incision over the prominence of the cheek. Using spreading dissection with a hemostat, a path is tunneled to the prominence of the zygoma. A self-drilling bone screw is then placed into the malar prominence and is used as a handle to disimpact the fragment. Alternatively, the screw may be placed into the superior aspect of the zygoma through the lower eyelid incision. Subsequently, the screw may also be used to align the articulations properly. Use of this technique is typically necessary only for those fractures that present with some difficulty in mobilization or alignment.

**Plating**

Much discussion is in the literature regarding the size and number of plates necessary to
adequately fixate orbitozygomatic fractures.20–21 There is no question that the zygomaticomaxillary buttress should be plated with the largest plate to maximize stability. Plates used here should accommodate 1.5- or 2.0-mm diameter screws. Plate palpability is not an issue here. It is the zygomaticofrontal articulation and the infraorbital rim that most frequently present with problems with palpable plates. As such, plates in these locations should be smaller and should accommodate screws approximately 1 to 1.5 mm in diameter. If possible, it is also helpful to place the infraorbital rim plate on the superior aspect of the bone rather than anteriorly, where it is more easily felt.

The number of plates necessary is also controversial and should be individualized according to the patient’s fracture. As a rule, the less stable the fracture, the more extensive the fixation required. Fractures that are relatively stable once reduced may be adequately fixated using a single plate, usually at the zygomaticomaxillary buttress. In higher-energy fractures, a greater degree of fixation is usually necessary. The order of fixation in these cases is important because it may affect the alignment of the fracture. Once the fracture has been mobilized, we prefer to place a small plate or a wire first at the level of the zygomaticofrontal suture. This sets the vertical position of the fracture fragment while still allowing some rotational motion and further reduction. After this, the infraorbital rim plate is applied while ensuring that the articulation and zygomaticomaxillary buttress are well aligned. Before placing these plates, one can further check the accuracy of reduction by sliding an elevator down the lateral orbital wall to feel for articulation with the greater wing of the sphenoid. Because this articulation is so broad, any malalignment will manifest as an irregularity in this region. The zygomaticomaxillary buttress plate is typically the last one applied.

Once the fracture has been plated, attention is usually turned to the orbital component of the injury. Most frequently, it is the orbital floor or medial wall that has been injured. Indications for surgery in these situations include large defects, presence of early enophthalmos, or mechanical entrapment of the extraocular muscles or periorbita in the fracture site. A large variety of materials have been used to reconstitute these defects. Although cranial bone grafts have certainly been widely and successfully used, implants made of titanium and porous polyethylene have also proved effective.

It should be remembered that at the termina-
tion of the procedure, the eye on the fractured side should be slightly more forward than the contralateral globe. Symmetry of the two eyes at the end of surgery almost certainly ensures subsequent enophthalmos once swelling resolves. In such cases, it is likely that the volume of the orbit has been increased by an inaccurate reduction of the malar fracture or the orbital floor.

Great care should be taken in closing these fractures to prevent subsequent secondary soft-tissue deformities. Closure of the periorbita should always be performed initially. After this, resuspension of the cheek soft tissues is critical in preventing asymmetry.22 This is typically done by suture suspension of the periorbita of the cheek to drill holes in the inferior orbital rim or to the plates in this region. This also provides support for the lower eyelid and may reduce the risk of lid retraction. When a lateral canthotomy has been performed, meticulous care must be given to the lateral canthopexy. The lateral canthus should be affixed to the inner aspect of the orbital rim periorbita superiorly. When doing this, it is helpful to use a P-2 needle because of its small size and curvature.

**Complications**

*Diplopia*

Diplopia is a troubling and not uncommon complication of malar fractures that is reported in 3.4 to 8 percent of cases.23–25 It is perhaps most problematic when in the primary field of vision. Diplopia occurring only at the extremes of gaze is generally better tolerated. This complication may be caused by simple swelling or contusion of the extraocular muscles or their supplying nerves, in which case the diplopia should resolve over time. A normal, forced duction test at the end of the surgery makes this scenario more likely. The biggest concern, however, is entrapment of the extraocular muscles or periorbita in the orbital floor or medial wall component of the injury. When in question, a postoperative computed tomography scan should help rule this out. If no mechanical cause for the diplopia is found, the surgeon and an ophthalmologist should follow up the patient conservatively while allowing the injury to resolve over 3 to 6 months. Should diplopia persist, rebalancing the extraocular muscles may be required.

*Persistent Cheek Anesthesia*

Many patients will experience numbness of the cheek overlying the malar fracture secondary to
nerve damage. A total of 24 percent of patients in Zingg et al.'s series experienced this problem. Although the infraorbital nerve is the most frequent source of the symptoms, involvement of the zygomaticofacial or zygomaticotemporal nerves may further contribute to numbness. As long as the nerve is seen to be intact at the time of the fracture reduction, sensation usually improves and the patient should be counseled accordingly. In the occasional persistent cases, mechanical impingement of the nerve should be suspected and the patient should be offered nerve decompression.

**Enophthalmos**

Enophthalmos is perhaps the most troubling complication after surgery for orbitozygomatic fractures. When there is a significant orbital floor or medial wall component to the injury, enophthalmos may be caused by malposition of the zygoma, inadequate reconstruction of the internal orbit, or a combination of the two. A not uncommon problem is plating the zygoma to an unrecognized displaced hemi-naso-ethmoid fragment at the infraorbital rim. However, even when the malar fragment is improperly reduced, patients rarely complain about malar asymmetry (Fig. 5); rather, most patients focus on globe asymmetry. When enophthalmos is seen in the postoperative period, a repeated computed tomographic scan should be performed. If the orbit needs correction, it should be reconstructed accurately in a second surgical procedure. Most frequently, the problem is caused by implants or grafts being placed straight back into the maxillary antrum, rather than superiorly into the orbital cone with the natural inclination of the orbital floor.

When the computed tomographic scan reveals that the zygoma has been reduced improperly, the surgeon has two choices. One is to reoperate on the zygoma, which typically has been plated too far laterally and posteriorly and must be corrected to a more medial, anterosuperior position. In the early postoperative period, this is relatively easy because the plates need only be removed for the fragment to be repositioned. However, in the late postoperative period once healing has occurred, osteotomy is required. If malar asymmetry is not to be addressed, one may simply augment the orbital volume to bring the eye forward. This may be done by placing alloplast or autogenous grafts in the orbit inferolaterally, thus correcting the eye to a more anterior position. In late postoperative cases, many surgeons advocate wide subperiosteal dissection of the orbit to facilitate this, even using a coronal incision for exposure.

**The Future**

There is little question that a significant improvement will be seen in postsurgical results in orbitozygomatic injuries when the fracture can be more accurately positioned intraoperatively. Even in the most experienced hands, improper reduction of severely comminuted fractures can occur. To this end, there has been a great deal of interest in intraoperative radiography. Stanley demonstrated the feasibility of performing computed tomographic scans during surgery to aid in positioning the fracture. He
found that this allowed intraoperative changes to be made in the placement of the fracture fragment and in the position of bone grafts within the orbital cone. He also believed that the scanner would prove beneficial in allowing the surgeon to perform a more limited dissection of the fracture, avoiding problematic incisions such as that in the lower eyelid. Demianczuk and Antonyshyn reported on the use of a "frameless stereotactic system" that allows for intraoperative navigation using a positioning rod. When the rod is held on the anatomical area of interest, the monitor displays the computerized tomographic image.

Use of the endoscope is also becoming more popular as a tool for assessing damage to the orbital floor and medial wall, thus avoiding a lower eyelid incision. Although this technique requires a fairly steep learning curve, it holds promise in increasing the accuracy of orbital reconstruction. Advances such as these should significantly improve the surgeon's ability to reconstruct severe facial injuries and avoid the troubling stigma of the imperfect reduction.

Larry H. Hollier, Jr., M.D.
6701 Fannin Street, 8th Floor Houston, Texas 77030
Lhollier@aol.com

REFERENCES

The Management of Orbitozygomatic Fractures

By Larry H. Hollier, M.D., James Thornton, M.D., Pat Pazmino, M.D., and Samuel Stal, M.D.

1. PROPER ALIGNMENT OF WHAT STRUCTURE MOST ACCURATELY REFLECTS ANATOMICAL REDUCTION OF THE ZYGOMATIC FRACTURE?
   A) Infraorbital rim
   B) Zygomaticofrontal buttress
   C) Zygomaticomaxillary buttress
   D) Sphenoid articulation
   E) Zygomaticotemporal buttress

2. THE MOST COMMON CAUSE OF TRAUMATIC OPTIC NEUROPATHY IS:
   A) Fracture extension through the optic canal
   B) Bone fragment impinging on the optic nerve outside the optic canal
   C) Thrombosis of the retinal artery
   D) Shear forces resulting in edema
   E) Retinal detachment

3. THE INCISION SITE USED FOR EXPOSURE OF MALAR FRACTURES THAT IS ASSOCIATED WITH THE GREATEST POSTOPERATIVE MORBIDITY IS THE:
   A) Upper buccal sulcus
   B) Upper eyelid
   C) Lower eyelid
   D) Coronal scalp
   E) Lateral brow

4. THE PLAIN RADIOGRAPHIC VIEW THAT IS MOST USEFUL IN THE DIAGNOSIS OF MALAR FRACTURES IS THE:
   A) Townes
   B) Water’s
   C) Caldwell
   D) Submentovertex
   E) Lateral profile

5. PLATE PALPABILITY IS LEAST PROBLEMATIC AT WHICH OF THE FOLLOWING LOCATIONS:
   A) Zygomaticofrontal suture
   B) Zygomaticomaxillary buttress
   C) Zygomatic arch
   D) Infraorbital rim
   E) Superior orbital rim

To complete the examination for CME credit, turn to page 2502 for instructions and the response form.