Although excellent results may be achieved in the management of many orbital floor injuries with standard transconjunctival or transcutaneous approaches, visualization of the posterior edge of the orbital floor or medial wall defect may be challenging at times. We describe our experience using endoscopic examination of the orbital floor through maxillary sinus approaches during the repair of selected orbital floor fractures. Owing to the posterosuperior angulation of the orbital floor, these approaches allow better visualization of the posterior edge of fractures involving the posterior portion of the orbital floor than do the standard transconjunctival approaches, and they facilitate confirmation that all orbital soft tissues have been elevated from the fracture site. We have used these techniques successfully in 9 patients with fractures involving either the posterior portion of the orbital floor or the medial wall or both.

An important goal of orbital fracture repair is the complete removal of herniated orbital soft tissues from the fracture site. In achieving this goal it is helpful to visualize each edge of the orbital defect before placing the orbital floor implant. In our experience, it is sometimes difficult to visualize the posterior aspect of the orbital floor defect when orbital exploration is performed solely through a transconjunctival subperiosteal approach. This is due to the posterosuperior angulation of the orbital floor relative to the anterior orbital rim. In such cases we have found it useful to concurrently perform a maxillary antrostomy to allow better visualization of the posterior aspect of the orbital floor. With this approach, it is possible to make sure that all orbital soft tissues have been removed from the fracture site, and to confirm that the orbital contents remain in the desired position following orbital implant placement.

More recently, we have employed endoscopic examination of the orbital floor through an antrostomy approach or through an endoscopic ethmoidectomy to visualize the posterior, medial, and lateral borders of the floor defect. Advantages of this approach include the following: (1) enhanced illumination of the surgical field, (2) simultaneous visualization of the fracture site by multiple members of the surgical team, and (3) facilitated documentation of the surgical procedure via still photography or videography. We have used this technique successfully in 9 patients. The advantages and limitations of this approach will be discussed and the surgical technique demonstrated. Our experience suggests that maxillary sinus antrostomy and endoscopic ethmoidectomy may be useful adjuncts in orbital floor fracture repair.

REPORT OF A CASE

A 45-year-old man was struck in the left periorbital region with a softball while pitching in a game. He sustained a laceration of the eyelid that was repaired by the referring physician. Visual acuity was measured at 20/20 OD and 20/25 OS. Intraocular pressures were within normal limits. The left pupil was 6 mm and fixed, from a sphincter tear, and there was no afferent pupillary defect. There was a resolv-
ing subconjunctival hemorrhage in the left eye and 3 mm of left globe ptosis. Hertel exophthalmometry measurements were 21 mm OD and 17 mm OS with a base of 103. There was decreased sensation in the V2 distribution on the left. Extraocular movements were full in the right eye and limited in all fields of gaze in the left eye, especially the upgaze and downgaze (Figure 1). There was diplopia in all fields of eccentric gaze. Computed tomographic scan of the orbits revealed a fracture of the medial wall and floor, with bone fragments impinging on the medial rectus (Figure 2). There was also a fracture of the medial wall of the maxillary sinus and a deviated septum.

**SURGICAL PROCEDURE**

In the usual procedure, the patient is placed in a slight degree of reverse Trendelenberg position. The nasal mucosa is decongested with oxymetazoline hydrochloride or 4% cocaine hydrochloride. Local anesthetic is infiltrated into the lateral nasal sidewall under endoscopic visualization. A standard 4-mm straight nasal telescope is used to remove the uncinate process on the involved side. The maxillary ostium is identified and enlarged to its bony limits, and then a side-biting forceps is used to enlarge it anteriorly but short of the thicker bone covering the nasolacrimal duct. At this point, the endoscope can be passed into the maxillary ostium. A telescope angled at 25° or 30° will provide more lateral visualization if necessary.

In this patient’s case, entrapment of the medial rectus muscle was detected in the posterior ethmoid labyrinth on endoscopic examination and computed tomography. Therefore, we first performed a limited ethmoidectomy. The fractured bulla ethmoidalis and basal lamella were removed. Care was taken to leave the lamina papyracea intact until the posterior ethmoidal labyrinth was well defined. Traction on the medial rectus via a 4-0 silk suture identified the impinging fragments of bone in the posterior ethmoid labyrinth. A limited removal of these fragments was performed to release the medial rectus muscle. The middle turbinate was left intact. Following this, the maxillary antrostomy was widened until the telescope could pass through it.

We then used a standard transconjunctival approach to the inferior orbital rim to explore the orbital floor. The size and extent of the fracture was identified, and bony fragments were removed. Using the endoscope through the maxillary antrostomy for direct visualization, a custom-made titanium mesh orbital implant was then placed to space the defect in the floor and medial wall. The endoscope was used to guide the implant into proper position, to identify that it was resting on stable posterior support, although away from the annulus of Zinn and the optic nerve, and to ensure that the posterior edge of the implant did not compromise posterior orbital soft tissues (Figure 3). The orbital implant was then secured with screws to the anterior orbital rim and the incision was closed in standard fashion (Figure 4).
Nguyen and Sullivan\textsuperscript{2} performed an analysis of cadaveric specimens of the orbit. They found that as one moves posteriorly toward the optic canal the shape of the walls of the orbit changes from ovoid near the rim, to a more rectangular, then to a more triangular shape. They dispute the idea that there are "safe" distances along the orbital wall for which dissection can be carried out. These safe measurements do not account for many variations that exist in different orbits (eg, race or sex). The endoscope is extremely useful in this setting to safely identify the posterior edge of the orbital implant and to allow identification of a stable posterior ledge of bone on which the implant may be placed. In an extensive fracture extending to the posterior wall of the maxillary sinus, endoscopic visualization may ensure that the implant is placed in the position of the normal orbital floor without compromise of the posterior orbital soft tissues.

Many techniques and variations on them have been described for the repair of orbital fractures. Gray et al\textsuperscript{5} managed all pure blow-out fractures and complicated blow-out fractures with the maxillary sinus approach. An antrostomy was performed through the anterior wall of the maxillary sinus, and then digital pressure was used to reduce the orbital fracture. Among the advantages of this procedure are direct visualization of the infraorbital nerve and foramen. Copeland and Meisner\textsuperscript{7} and Hayasaka et al\textsuperscript{8} all advocated a combined transconjunctival and transantral approach to the orbit, also noting that the alveolar wall bone can be used as an orbital implant.

Use of the nasal telescope can limit the size of the Caldwell-Luc approach necessary to visualize the orbital floor. More importantly, if an intranasal maxillary antrostomy approach is used, the Caldwell-Luc procedure can often be avoided. An endoscope passed into the maxillary antrostomy will alone provide excellent visualization of the posterior orbital floor, which is the most difficult area to visualize transconjunctivally, and will ensure excellent postoperative drainage of the maxillary sinus (Figure 8).

The endoscope can be used to increase illumination, to allow simultaneous visualization of the operating field by all members of the surgical team, and to record the procedure on videotape. More important, endoscopic visualization of the defect following implant placement may allow the surgical team to ensure in a dynamic fashion that there is no residual orbital soft tissue entrapment, as traction is applied to sutures placed under the inferior and/or medial rectus.

In our series of 9 patients, maxillary sinus antrostomy and endoscopic ethmoidectomy techniques allowed improved visualization of the posterior aspect of the fracture. This resulted in enhanced accuracy of orbital implant placement and an ability to confirm the complete reduction of entrapped orbital soft tissues.

Complications of maxillary sinus antrostomy and limited endoscopic ethmoidectomy may include hemorrhage, cerebrospinal fluid rhinorrhea, damage to un-
erupted teeth in pediatric patients, and prolonged operative time. No complications associated with these procedures were observed in the current series, and it was our impression that these techniques enhanced the safety of manipulating the posterior orbital tissues during orbital fracture repair.

Many orbital floor fractures may be repaired with excellent results using standard transconjunctival or subciliary techniques. In view of the potential complications, complexity, and potential expense associated with endoscopic techniques, it seems appropriate to use the latter techniques on a selected, case-by-case basis.

**CONCLUSIONS**

Endoscopic visualization of fractures of the posterior aspect of the orbital floor and medial orbit may facilitate safe and secure placement of the orbital implant while ensuring that there are no residual orbital soft tissues incarcerated within the fracture site. The increased accuracy in contouring the orbital implant afforded by this technique may decrease the risk of postoperative enophthalmos due to posttraumatic orbital volume expansion. The use of the endoscope allows the surgeon to minimize the extent of additional medial orbital incisions, and may reduce the uncertainty of implant placement along the posterior portion of the orbital floor. Many orbital fractures may be satisfactorily visualized and repaired with the standard transconjunctival or infraorbital approaches to the orbital floor without the use of endoscopic techniques. Our experience suggests that endoscopic visualization may be useful in the repair of more complex fractures involving the posterior orbital floor and/or medial wall.

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