Endoscopic Endonasal Repair of Orbital Floor Fracture

Katsuhisa Ikeda, MD; Hideaki Suzuki, MD; Takeshi Oshima, MD; Tomonori Takasaka, MD

Background: High-resolution endoscopes and the advent of endoscopic instruments for sinus surgery provide surgeons with excellent endonasal visualization and access to the orbital walls.

Objective: To demonstrate repair of orbital floor blowout fractures through an intranasal endoscopic approach that allows repair of the orbital floor fracture and elevation of the orbital content using a balloon catheter without an external incision.

Design: This study was a retrospective analysis of 11 patients who underwent surgical repair of orbital floor fractures from September 1994 to June 1997. There were 10 male patients and 1 female patient, aged 12 to 32 years (mean age, 24 years). These patients had undergone primary repair of pure orbital blowout fractures and were followed up at least 6 months after surgery.

Results: There were no intraoperative or postoperative complications. Nine patients showed a complete improvement of their diplopia. Two patients with posterior fractures showed persistent diplopia, which was well managed by prisms.

Conclusion: Endoscopic repair of the orbital floor blowout fracture using an endonasal approach appears to be a safe and effective technique for the treatment of diplopia.


RESULTS

The orbital floor blowout fracture is characterized by the involvement of only the wall of the orbit with an intact orbital rim after blunt trauma. Medial orbital wall fractures are known to occur concomitantly with floor fractures. Recent clinical studies have recommended prompt surgical repair in patients with large fractures (>50% of the orbital floor) and in those with disability diplopia or enophthalmos of greater than 2 mm, or both, 10 to 14 days after trauma. Surgical repair of the blowout fracture includes the transorbital approach and transcandral approach. High-resolution endoscopes and the advent of endoscopic instruments for sinus surgery can now provide the surgeon with excellent endonasal visualization and access to the orbital walls. Yamaguchi et al first reported the application of an endoscopic endonasal technique to the reconstruction of a blowout fracture of the medial orbital wall. We report herein the surgical repair of orbital floor fractures using an endoscopic endonasal approach.

Demographic and clinical patient profiles are given in the Table. There were no intraoperative or postoperative complications. All patients had some improvement in their diplopia by 2 weeks. Based on the degree of diplopia, scores of 0 to 3 (severe = 3, moderate = 2, slight = 1, none = 0) were assigned in each field of gaze. A total score of 27 was possible. In 8 patients, the diplopia in all fields of gaze was almost completely resolved by 2 months. Three patients continued to have slight vertical diplopia in the reading position (Figure 2). Computed tomographic findings and endoscopic observations during surgery indicated that the patients with persistent diplopia after surgery had posterior fractures with entrapped extraocular muscles. Six months after surgery, 1 of these 3 patients had no diplopia in any position whereas the other 2 patients with residual diplopia in the primary gaze could obtain good alignment with the use of prisms.

All patients showed a notable improvement in results of the Hess screen test.
PATIENTS AND METHODS

This study was a retrospective analysis of 11 patients undergoing surgical repair of orbital floor fractures from September 1994 to June 1997. There were 10 male patients and 1 female patient, aged 12 to 32 years (mean age, 24 years). These patients had undergone primary repair of pure orbital blowout fractures and were followed up at least 6 months after surgery. One patient showed a combined fracture of both medial and inferior walls, whereas the inferior wall was involved in the other 10 patients. Preoperative and postoperative orthoptic measurements were recorded. Forced duction testing was performed before and after surgery.

The indications for surgery included disabling diplopia 2 weeks after trauma and large fracture size as determined by computed tomographic scans and/or magnetic resonance images. At the time of surgery, all patients had restriction in forced duction testing. Surgical repair of blowout fractures was performed in 3 patients under local anesthesia and in 8 patients under general anesthesia. Surgery was performed with the patient's head slightly elevated. The head was turned slightly toward the surgeon. For topical anesthesia, 4% lidocaine hydrochloride was used. With both local and general anesthesia, the operative site was injected with 1% lidocaine hydrochloride with 1:100,000 dilution epinephrine, and the nose was packed with epinephrine-soaked (1:5000 dilution) cotton pads and gauzes. An infundibulotome was first performed, whereby the medial infundibular wall was removed with a sickle knife. The uncinate process was then subluxed medially and removed with forceps. The maxillary ostium was generously enlarged to provide optimal exposure of the orbital floor. A 30° or 70° endoscope was used to identify the orbital floor fracture. The region of the orbital floor fracture was carefully skeletonized using curved forceps. Bony fragments and periorbita, which entrapped the orbital contents, were minimally removed and opened, respectively, until improvement of forced duction testing during surgery. A ureteral balloon catheter was inserted into the maxillary sinus through the ostium. Eight to twelve milliliters of physiological saline solution was introduced into the balloon at the tip of the catheter, which elevated the orbital contents out of the fracture depression (Figure 1). The catheter was removed 10 to 14 days after surgery. When removal of the catheter resulted in an exacerbation of diplopia or enophthalmos, the catheter was left in the maxillary sinus for an additional few days.

Figure 1. The endoscopic endonasal approach to the orbital blowout fracture. A, Enlargement of the maxillary natural ostium. B, Removal of bony fragments and opening of periorbita entrapped by the orbital contents. C, Insertion of the ureteral balloon catheter into the maxillary sinus through the ostium and elevation of the orbital contents.

After surgery, Figure 3 shows typical charts of the preoperative and postoperative Hess screen test in a representative case.

Postoperative computed tomographic scans or magnetic resonance images were not obtained routinely since they all showed steady clinical improvement. Figure 4 shows preoperative magnetic resonance images in a representative case, in which the right orbital contents are prolapsed from the orbital floor. The postoperative image (Figure 5) demonstrates that the extruded orbital contents were effectively resolved and that the inferior rectus returned to a more normal position, consistent with the resolution of the patient's diplopia.
The advent of endoscopic techniques has greatly enhanced surgeons’ ability to operate on orbital structures through the nose. Orbital decompression, drainage of subperiosteal abscess, endoscopic dacryocystorhinostomy, and optic nerve decompression can be safely and effectively performed without external incision. Endoscopic endonasal repair of orbital floor fractures affords the surgeon excellent visualization for safe removal of bony fragments and correction of periorbita in the orbital floor. In contrast to the transantral approach, the endoscopic approach avoids postoperative infraorbital nerve hypesthesia. Another advantage of the endoscopic approach is that it results in less intraoperative blood loss and shorter hospitalization than the transantral and transorbital approaches. Because implants of silicone sheets or metallic mesh to support the orbital content are not needed, inflammatory reactions against foreign bodies are reduced.

There is a controversy about the timing of surgical repairs for blowout fractures. Smith and Regan advocated surgical repair of any blowout fracture within 7 to 10 days. On the other hand, Putterman recommended delaying surgery for at least 4 to 6 months. Similarly, Emery et al failed to show a significant difference in the incidence of enophthalmos between the surgical and nonsurgical groups. During the past decade, many studies have advocated early surgical exploration in patients with large fractures and in those with disabling diplopia or enophthalmos.

The excellent visualization of the fractured orbital floor provided by the endoscope may enable better manipulation than that afforded by the naked eyes. The fracture location is one of the important factors that determines the persistence of diplopia. The inferoposterior orbital fat tissue is fibrous and dense with connective tissue septae that attach to the extraocular muscles. If this residual fat is trapped by a posterior floor fracture, diplopia may easily result. One of 3 cases with a posterior floor fracture in this study could be repaired under endoscopic control.

### Patient Profiles

<table>
<thead>
<tr>
<th>Patient No./Sex/Age, y</th>
<th>Side</th>
<th>Mechanism of Injury</th>
<th>Site of Fractures</th>
<th>Clinical Findings</th>
<th>Medical Therapy</th>
<th>Time From Trauma Until Operation, d</th>
<th>Type of Anesthesia</th>
<th>Follow-up, mo</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/M/12</td>
<td>R</td>
<td>Fight</td>
<td>OF</td>
<td>D, EE, O</td>
<td>S</td>
<td>14</td>
<td>G</td>
<td>6</td>
</tr>
<tr>
<td>2/M/32</td>
<td>L</td>
<td>Assault</td>
<td>OF</td>
<td>D, E, H</td>
<td>S</td>
<td>15</td>
<td>L</td>
<td>8</td>
</tr>
<tr>
<td>3/M/30</td>
<td>L</td>
<td>Assault</td>
<td>OF</td>
<td>D, H</td>
<td>None</td>
<td>47</td>
<td>L</td>
<td>6</td>
</tr>
<tr>
<td>4/M/14</td>
<td>R</td>
<td>Fight</td>
<td>OF</td>
<td>D</td>
<td>S</td>
<td>23</td>
<td>G</td>
<td>7</td>
</tr>
<tr>
<td>5/M/13</td>
<td>L</td>
<td>Fight</td>
<td>OF</td>
<td>D, E</td>
<td>S</td>
<td>42</td>
<td>G</td>
<td>6</td>
</tr>
<tr>
<td>6/F/38</td>
<td>L</td>
<td>MVC</td>
<td>OF</td>
<td>D, EE</td>
<td>S</td>
<td>27</td>
<td>L</td>
<td>8</td>
</tr>
<tr>
<td>7/M/28</td>
<td>L</td>
<td>Softball</td>
<td>OF</td>
<td>D, EE</td>
<td>S</td>
<td>21</td>
<td>G</td>
<td>6</td>
</tr>
<tr>
<td>8/M/17</td>
<td>R</td>
<td>Football</td>
<td>OF</td>
<td>D, EE</td>
<td>None</td>
<td>25</td>
<td>G</td>
<td>8</td>
</tr>
<tr>
<td>9/M/34</td>
<td>R</td>
<td>Snowboard</td>
<td>OF</td>
<td>D</td>
<td>S</td>
<td>20</td>
<td>G</td>
<td>6</td>
</tr>
<tr>
<td>10/M/29</td>
<td>R</td>
<td>MVC</td>
<td>OF, LP</td>
<td>D, EE, O</td>
<td>None</td>
<td>24</td>
<td>G</td>
<td>8</td>
</tr>
<tr>
<td>11/M/19</td>
<td>R</td>
<td>MVC</td>
<td>OF, LP</td>
<td>D, EE, O</td>
<td>None</td>
<td>20</td>
<td>G</td>
<td>10</td>
</tr>
</tbody>
</table>

* R indicates right; L, left; MVC, motor vehicle crash; OF, orbital floor; LP, lamina papyracea; D, double vision; EE, eyelid ecchymosis; O, ophthalmoplegia; E, enophthalmos; H, hypesthesia to the infraorbital nerve; S, corticosteroid; G, general anesthesia; and L, local anesthesia.

Figure 2. Preoperative and postoperative scores of diplopia.

Figure 3. Preoperative (A) and postoperative (B) Hess screen test results in a representative case. S indicates superior; I, inferior; M, medial; and L, lateral.

©1999 American Medical Association. All rights reserved.
The use of the endoscope may improve the success rate of surgical repairs of diplopia even in cases of posterior floor fracture.

In conclusion, we performed surgical repair of orbital floor fractures using an endoscopic endonasal approach. The endoscopic approach provided better visualization of the fractured structures of the orbital floor, enabled meticulous manipulation of the repair, and reduced intraoperative and postoperative complications.

Accepted for publication September 29, 1998.

Reprints: Katsuhisa Ikeda, MD, Department of Otorhinolaryngology, Tohoku University School of Medicine, 1-1 Seiryomachi, Aoba-ku, Sendai 980-8574, Japan (email: ikeda@orl.med.tohoku.ac.jp).
REFERENCES