Radical orbital decompression for severe dysthyroid exophthalmos

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A surgical technique is described for radical decompression of the orbit for dysthyroid ophthalmopathy. The operation should be considered in a patient with proptosis greater than 30 mm bilaterally or one with unilateral proptosis of 10 mm or more than the opposite eye. Such exophthalmos is frequently associated with corneal exposure and ulceration, extreme cosmetic disfigurement, and optic neuropathy. The surgical procedure is performed through a 35-mm lateral skin incision and a lateral canthotomy with subconjunctival dissection. All four walls of the orbit are partially removed. This panorbital decompression procedure has been performed on five patients, with reduction of preoperative proptosis by as much as 17 mm. Complications were minimal. A review of the effectiveness of other orbital decompressive procedures is presented. It appears that the four-wall decompressive procedure offers the maximum degree of orbital reduction.

KEY WORDS: exophthalmos, hyperthyroidism, optic nerve, orbital decompression, thyroid disease, orbit

In 1948, Naffziger published his observations on the neurosurgical aspects of the management of exophthalmos and stated, "Orbital conditions require the attention of the ophthalmologist, and study by him in conjunction with the pathologist, radiologist and neurological surgeon should yield valuable dividends and improved treatment."

For the last 5 years, we have followed Naffziger's admonition and have jointly evaluated all patients with mass lesions in and about the orbit. One of the most challenging conditions encountered has been the extreme proptosis that may occur with dysthyroid orbitopathy. Although medical treatment is successful in most patients with mild to moderate proptosis, surgical decompression of the orbital contents may be required to save vision and to forestall ocular complications in those patients with severe exophthalmos.

This paper summarizes the literature relative to orbital decompressive techniques, and details our decompressive operative approach, which has evolved from our experience with the lateral microsurgical approach to the orbit.12

Review of the Literature

In 1889, Krönlein first described an osteoplastic lateral orbitotomy approach to the retro-orbital space for tumors. This lateral approach was subsequently used by Dollinger, specifically for palliation of the optic neuropathy of Graves' disease. Since then, ophthalmologists, otolaryngologists, and neurosurgeons have all devised various operations for orbital decompression in Graves' disease.

In 1930, Hirsch and Urbanek described a transtemporal removal of the floor of the orbit for decompression of malignant exophthalmos. This bone removal alone, however, provided only limited decompression. In 1930, confronted by a patient with extreme exophthalmos and progressive visual loss, Naffziger removed the orbital roof, the bone over the optic foramen, and part of the greater wing of the sphenoid for decompression. He subsequently recommended this transcranial approach combined with lateral orbital wall removal for marked exophthalmos. MacCarty, et al., confirmed the effectiveness of Naffziger's approach in their large series. Hamby described his transcranial pterional approach, which involved removal of the roof, the lateral wall, and a portion of the greater and lesser wings of the sphenoid bones. He did not, however, remove the floor or the medial wall of the orbit.

In 1939, Kistner followed Sewall's suggestion and performed a frontoethmoidal decompressive procedure that allowed the orbital contents to proptose into...
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the frontal and ethmoid sinuses. Walsh and Ogura,21 in 1948, first employed the transantral approach for decompression of the orbital contents into the maxillary and ethmoid sinuses. Essentially, they removed the medial wall and the floor of the orbit. In their most recent reports, they have described their good results in over 252 patients operated on with this technique.17,18 In 1966, Kroll and Castin9 reported their palliative procedure for dysthyroid exophthalmos, which involved removal of the lateral orbital bone.

In 1979, McCord and Moses13 published their technique for exposure of the inferior orbit through a lateral canthotomy and fornix incision. They discovered that they were able to obtain excellent exposure of the inferior orbital wall as well as the medial wall through a lateral orbitotomy incision. They suggested that this approach could also be helpful for dysthyroid exophthalmopathy.

All of these operations attest to the effectiveness of the various procedures for enlarging the orbital space and for providing some degree of palliation. Few authors, however, discuss in detail the degree of reduction of the proptosis obtained with their respective procedures. The proptosis is rarely reduced by more than 10 mm with any of the operative approaches.

Recently, we have treated several patients with proptosis ranging from 12 to 17 mm, who needed reduction of more than 10 mm. We, therefore, used a modified microsurgical lateral approach to the orbit, which we described in 197612 and have used for tumor removal and biopsy in more than 100 patients. By using a 35-mm incision and a lateral canthotomy, we discovered we could effectively decompress the lateral wall, the roof, the floor, and the medial wall of the orbit; in effect, we performed a panorbital decompression. We have used this approach successfully and have found that it provides the maximum amount of orbital decompression with minimal surgical exposure.

Four-Wall Orbital Decompression

Indications for Orbital Decompression

Although the precise etiology of dysthyroid exophthalmopathy is unknown, the major manifestations of the disease are due to the severe myopathy and increased orbital fat volume. These may result in optic neuropathy, corneal exposure and ulceration, and extreme cosmetic disfigurement. Orbital decompression may be required for one or all of the conditions if more conservative medical management fails.

With our panorbital or four-walled technique, a 10- to 17-mm reduction of proptosis can be obtained. Therefore, if a patient has proptosis greater than 30 mm bilaterally or if there is unilateral proptosis of 10 mm or more greater than the other eye, the four-wall decompressive technique should be considered.

Surgical Technique

Four-wall decompression is performed with the patient under general anesthesia in a supine position. The head is turned approximately 45° to the contralateral side. No hair is shaved. A 35-mm skin incision is made, beginning from the lateral canthal ligament and moving posteriorly toward the pinna of the ear (Fig. 1a). The temporalis fascia is identified, and the skin is then widely undermined superiorly and inferiorly.

The temporalis fascia, but not the muscle, is incised in a T-shaped fashion. A subperiosteal dissection is carried out along the inner and outer surfaces of the lateral orbital wall. The peri orbital fascia should not be perforated. If a tear does occur, a small piece of cottonoid is placed over the rent to prevent herniation of the intraorbital fat.

The temporalis muscle is retracted, and a malleable brain retractor is inserted between the periorbital fascia and the lateral wall of the orbit. The superior and inferior orbital rims are then cut with a Stryker saw. The orbital rim is grasped with a rongeur and broken off from the thinner posterior lateral orbital wall (Fig. 1b).

Additional bone is removed with rongeurs back to the greater wing of the sphenoid. When it is no longer possible to remove the bone with rongeurs, a high-speed air drill is used to thin out and remove the accessible portion of the greater wing of the sphenoid, exposing the temporal dura (Fig. 1c). Bone bleeding is encountered frequently but is easily controlled with bone wax. Next, the periorbita and the orbital contents are depressed inferiorly with a malleable metal retractor. This retractor is inserted over the periorbital fascia after it has been dissected from the roof of the orbit. With the diamond air drill, the bone of the orbital roof is thinned to expose the dura (Fig. 1d). The dura is then dissected intracranially from the orbital roof and protected with small cottonoids. Various-sized small straight and angled rongeurs are used to remove the bone from the orbital roof anteriorly to the orbital rim, medially to the cribiform plate and the lateral margin of the ethmoid sinuses, and posteriorly to the lesser wing of the sphenoid.

After removing the roof and the lateral wall of the orbit, we expose the floor of the orbit through a canthotomy and fornix incision, as described by McCord and Moses.13 Traction sutures or small rake retractors are used to evert the lower lid, after the lateral canthal tendon is severed completely, allowing the lid to evert and stretch outward. Having previously injected the conjunctiva with 0.5% xylocaine and 1:200,000 epinephrine:diluent, scissors or a knife are used to incise the conjunctiva along the fornix area almost throughout its entire inferior width. A separate incision is made through the perio steum just anterior to the inferior orbital rim. A small sharp periosteal elevator is then used to elevate the perio steum from the inferior orbital rim and floor (Fig. 1e). A malleable
Fig. 1. Technique for panorbital decompression through lateral orbitotomy. See text for a description of the procedure.
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ribbon retractor is used to retract and elevate the orbital contents and to expose the entire floor of the orbit.

With the malleable ribbon used as a dissector and a retractor, the ethmoidal and naso-orbital areas are easily exposed. The inferior and medial orbital bone is usually quite thin. With a little pressure it is easy to break through the floor down to the maxillary sinus mucosa. Otherwise, a small diamond drill is applied to thin out the bone, and rongeurs and dissectors are used to separate it from the mucosa. The infraorbital nerve and artery are identified easily after the bone is removed from the mucosa of the maxillary sinus (Fig. If). These structures can be seen running in a lateral to medial direction through the floor of the orbit. Care is needed not to injure the nerve, which should be protected with cottonoids as additional bone is removed. Having completed a generous bone removal posteriorly, one then moves medially to remove the bone over the ethmoid sinuses. Again, an air drill or simple pressure with an instrument or the finger is used to break the bone. It is then removed with rongeurs as far as conveniently possible in all directions (Fig. 1g).

To obtain additional decompression, one may open the periorbital fascia laterally and inferiorly, and with micro- or macrodissecting techniques remove a portion of the orbital fat. The periorbital fascia is not closed. The lateral rim of the orbit is repositioned, but not sutured or wired into place.

The conjunctiva is closed with a running 6-0 absorbable suture, and the lower rim of the lateral canthal tendon is reattached to its cut stump just inside the lateral orbital rim with a 4-0 suture. The lateral skin incision is closed with 3-0 suture material in the temporalis fascia and 6-0 in the skin.

A firm compressive dressing is applied for 24 hours. A tarsorrhaphy is usually not performed. After the dressing is removed, vision and proptosis are measured. Dexamethasone is prescribed immediately before operation in 10- to 20-mg intravenous doses and continued at 4 mg, three times a day, for 3 days.

Operative Results

We have operated on four patients (seven orbits) with severe dysthyroid exophthalmopathy. Preoperative Hertel measurements were all over 30 mm. Reduction of proptosis ranged from 10 to 17 mm postoperatively (Table 1). Visual acuity and visual fields were impaired in only one patient preoperatively, a 68-year-old man with 20/80 visual acuity in the right eye and 20/60 in the left eye (Fig. 2 upper). Postoperatively, his visual acuity was 20/40 in the left eye and 20/30 in the right eye, and his visual fields were near normal (Fig. 2 lower). The postoperative balance assessed by Hertel exophthalmometry showed 1 to 3 mm difference between the eyes or equal. None of the patients has required muscle balancing operations or repair of entropion or ectropion of the lower lid.

![Fig. 2. Visual fields, right eye (left) and left eye (right). Upper: Preoperative visual fields showing marked impairment bilaterally. Lower: Postoperative improvement in visual fields.](image-url)
Complications have been few. In one case, cerebrospinal fluid (CSF) leaked through the incision. This was in a 68-year-old man who had a very thin dura that was densely adherent to the undersurface of the bone. The leakage was treated successfully with CSF drainage via a spinal catheter for 48 hours. In our first case, the infraorbital nerve was lacerated and a sensory deficit was present in the infraorbital nerve distribution, but this was not of consequence to the patient. This complication has been avoided by dissecting the infraorbital nerve more carefully in subsequent patients. The frontal branch of the facial nerve has never been injured. Although the intraoperative dissection is extensive, the cosmetic results are good (Figs. 3 and 4).

Discussion

In 1948, Naffziger stated, "The treatment of certain malignant or eventually pathologically irremovable growths in and about the orbit is lacking in a systematic approach." In considering the alternative techniques to orbital decompression, we find the ophthalmic, otolaryngological, and neurological surgeons all pursuing their own parochial surgical approach.

We are proposing that orbital decompressive procedures be tailored to the patient rather than the patient fitting into a single operative technique. Thus, if the surgical plan is to reduce proptosis by 3 to 10 mm, a two-walled decompression such as that described by Ogura and Thawley or a lateral-wall decompression as described by Hamby and others may be sufficient in patients with or without optic neuropathy.

If, however, the patient has proptosis of 10 mm greater than normal, then a radical four-walled decompression with removal of the orbital roof and part of the greater wing of the sphenoid should be considered. Through a lateral incision, the operative approach may be tailored to the patient's needs, allowing removal of from one to four walls of the orbit. Also, with this technique it is possible to remove orbital fat conveniently and safely for additional decompressive purposes.

Although complications are few, several must be anticipated and prevented. In the immediate postoperative period, excessive conjunctival edema and swelling of the palpebral mucosa are concerns, because of the extent of the periorbital surgery. With a compressive dressing and the application of moist compresses, however, these usually recede within a few days.

Leakage of CSF through the lateral incision must also be prevented. The basal frontal dura is quite thin, and in older patients is adherent to the orbital roof. In some cases, it is impossible to avoid the dura tearing, with the immediate egress of CSF. The periorbital fascia and the orbital contents in most cases will protrude against the superior defect, thus obliterating the fistula. In one of our patients it was

**TABLE 1**

_Hertel measurements in seven decompressed orbits*

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Side of Decompression</th>
<th>Preop Measurement (mm)</th>
<th>Postop Measurement (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>right</td>
<td>38</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>left</td>
<td>38</td>
<td>23</td>
</tr>
<tr>
<td>2</td>
<td>right</td>
<td>31</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>left</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>3</td>
<td>right (VA: 20/80)</td>
<td>38</td>
<td>22 (VA: 20/30)</td>
</tr>
<tr>
<td></td>
<td>left (VA: 20/60)</td>
<td>38</td>
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<td>22</td>
</tr>
<tr>
<td></td>
<td>left</td>
<td>32</td>
<td>21</td>
</tr>
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</table>

* The left eye of the patient in Case 2 was not operated on. VA = visual acuity.
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Fig. 4. Photographs of a 22-year-old patient with 2-year history of progressive proptosis (31 mm) of the right eye. Left: Preoperative photograph. Right: Postoperative result of a four-wall decompression procedure.

necessary to insert a CSF drain for 2 days to prevent further leakage. If the bone resection is taken too far medially and the ethmoidal air cells are entered, CSF rhinorrhea could be a potential hazard.

Another complication in removal of the orbital roof is the postoperative transmission of cranial vascular pulsations to the decompressed eye. In the more than 30 cases in which we have decompressed the orbit and removed the orbital roof, we have yet to observe this complication or have a patient complain of this as a serious problem. We have not found it necessary to replace the orbital roof, providing the dura is intact over the periorbital fascia. This has also been the experience of Derome and Guiot, who have had extensive experience with basal cranial surgery and orbital decompression.

All of our patients have enjoyed improvement in extraocular function or, if normal preoperatively, function has remained normal. Muscle balancing surgery could possibly be required postoperatively, however, if decompression is excessive or inadequate. Despite entering into the maxillary and ethmoid sinuses and, at times, tearing the sinus mucosa, we have had no episodes of sinusitis or orbital cellulitis postoperatively, although this too is a potential complication. We have not found it necessary to use antibiotic therapy pre- or postoperatively.

If the skin is incised and closed correctly, cosmetic results are excellent, and the frontalis branch of the facial nerve will not be injured. The postoperative hospital stay averages 3 to 5 days.

Until the underlying cause of dysthyroid exophthalmos is understood more fully and can be prevented or reversed, orbital decompression as a therapeutic measure will be needed in selected patients. Of the surgical methods now available for enlarging the orbit, the four-walled decompression procedure appears to offer the maximum degree of orbital reduction. It is emphasized again, however, that the operation should be tailored to the patient and not the patient to the operation.

References


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