

REVIEW

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Evolving techniques in orbital decompression of thyroid orbitopathy

ABSTRACT

Objective

To review recent advances in orbital decompression reported in recent literature.

Method

A review of literature regarding orbital decompression published in English was performed. Special attention was given to articles published from 2000 to 2005. These were analyzed along with several earlier important papers on orbital decompression.

Results

Techniques in orbital decompression have continued to evolve through the years. Orbital decompression in the setting of Graves' orbitopathy is generally indicated for reversal of proptosis complicated by corneal exposure, compressive optic neuropathy, orbital congestion, and increasingly, for disfiguring proptosis. Advances in technique are mainly in the category of incision placement, selection of walls for decompression, and prevention of new-onset diplopia.

Conclusion

Techniques in orbital decompression continue to evolve. Significant changes have occurred over the last decade in the indications for decompression, the incisions used to gain access, and the bony surfaces selected for removal.

Keywords: *Thyroid orbitopathy, Exophthalmos, Orbital decompression*

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THYROID orbitopathy is an extra-thyroidal manifestation of Graves' disease. It is believed to be autoimmune in origin resulting in the accumulation of hydrophilic mucopolysaccharides and collagen in the orbital soft tissues, particularly the extraocular muscles. The disease process can present with varying degrees of activity and severity. Moderate disease activity presents with persistence of lid retraction, lagophthalmos, and proptosis, accompanied by soft-tissue changes, swelling, and intermittent myopathy with an active course that usually settles within 6 months to a year. Fulminant course with significant infiltration, inflammation, and scarring characterizes the most severe form in the infiltrative stage.¹ These patients may present with significant proptosis, conjunctival congestion, restrictive myopathy, elevated intraocular pressure, exposure keratopathy, and compressive optic neuropathy. Fortunately, optic neuropathy occurs only in approximately 5% of patients with thyroid orbitopathy.² Treatment options for patients in the infiltrative stage may include corticosteroids, radiation therapy, or surgical decompression. When possible, orbital decompression is usually delayed until the active inflammatory phase has been quiescent for approximately 6 months.

Techniques in orbital decompression have continued to evolve through the years. Orbital decompression in the setting of Graves' orbitopathy is generally indicated for reversal of proptosis complicated by corneal exposure, compressive optic neuropathy, orbital congestion, and increasingly, for disfiguring proptosis. Advances in technique are mainly in the category of incision placement, selection of walls for decompression, and prevention of new-onset diplopia. It is the purpose of this paper to review recent advances in orbital decompression.

METHODOLOGY

A review of literature regarding orbital decompression published in English was performed. Special attention was given to articles published from 2000 to 2005. These were analyzed along with many past important papers in orbital decompression.

RESULTS

Approaches to the Bony Orbit

Orbital decompression using the transantral approach became the procedure of choice following its initial report by Walsh and Ogura in 1957.³ This approach, however, was accompanied by a high incidence of new-onset postoperative diplopia. A recent study reported that among patients with Graves' orbitopathy without diplopia who underwent transantral decompression for optic neuropathy, 53% developed new-onset diplopia.⁴ Because of this, many surgeons have advocated other approaches.

The medial wall has been approached using the Lynch incision.⁵ But this incision typically results in a cosmetically unappealing scar. The introduction of the endoscope in intranasal surgery has permitted a route that avoids cutaneous incision.⁶ Others have preferred using the transconjunctival⁷ or transcaruncular⁸⁻¹⁰ approach. These approaches provide excellent access to the medial wall and obviate the need for additional instrumentation and cost.

Lateral-wall decompression may be achieved using an extended upper-lid-crease incision, extended canthotomy, or coronal approach.¹¹ The coronal approach offers good exposure but makes the surgery more extensive. Few surgeons currently use the coronal approach for access to the lateral wall. Performing an extended lateral canthotomy provides excellent access to the lateral wall but may result in postoperative alteration of the lateral canthus. The upper-lid crease has the advantage of being relatively direct and having an excellent cosmetic result.

The floor can be removed by using an infraciliary incision, endoscopically, or by the transconjunctival route. The infraciliary approach is generally avoided because of the possibility of scar formation, cicatricial ectropion, and lower-lid retraction. This is particularly a consideration in thyroid eye disease where lid retraction is often problematic. The floor can be effectively approached by extending a transcaruncular incision into the fornix when performing a medial-wall decompression. Also, a lateral canthotomy approach can be extended to remove the floor along with the lateral wall. A customized single incision was proposed by Dailey and coworkers to perform a three-wall decompression.¹² This was achieved by extending the lateral canthotomy incision into the inferior fornix, forming a "swinging eyelid flap" previously described by McCord in 1981.¹³

Removal of the orbital roof is avoided since it does not provide significant volume expansion and compromises the protection of the intracranial fossa. Previously advocated neurosurgical removal of the roof was accompanied by numerous complications.

Bone Decompression

Several types of surgical decompression are available. Each procedure is individualized to the patient's clinical presentation, anatomic features, and to the surgeon's preference. The degree of proptosis preoperatively has a large bearing on which wall to decompress. The most common patterns of bone removal include isolated lateral-wall, inferomedial, medial- and lateral-wall, and the three-wall decompression. As a rough guideline, one can achieve an estimated 2 to 3 mm of proptosis reduction per wall of decompression. In treating patients with compressive optic neuropathy, it is necessary to perform an adequate apical

decompression, which can be achieved through a medial⁹ or lateral approach.¹⁴ Many surgeons favor medial decompression in the setting of significant compressive optic neuropathy.

Many authors have reported regarding the prevention of new-onset postoperative diplopia. Some prefer a balanced medial- and lateral-wall decompression^{5,14} while one study reported a decreased incidence of postoperative diplopia after performing lateral-wall decompression with fat removal.¹⁵

It is generally accepted that avoiding removal of the infraorbital floor decreases the incidence of diplopia after decompression. If it is necessary to remove the orbital floor to achieve a maximal proptosis reduction, it is recommended to leave the inferomedial orbital strut.¹⁶ Fat decompression is especially appropriate if the orbital-fat compartment is preferentially expanded relative to the extraocular muscles which can be seen on preoperative computed tomography (CT).

A balanced decompression, in which the medial and lateral walls are removed, is widely accepted to provide excellent decompression and to decrease the incidence of new-onset diplopia. This technique decreases shifting of intraorbital contents by providing space on both sides of the orbit. Leone and colleagues reported in 1989⁵ a proptosis reduction of 4 to 7 mm. This approach included removal of the lateral wall after a canthotomy incision and a medial canthal incision to access the medial wall. Leaving the orbital floor intact provided support for the orbital contents and lessened the chance for severe extraocular-muscle imbalance. Recent works have reported similar success with less invasive incisions.^{8,17-21}

Medial-wall decompression can be achieved readily using either transcaruncular approach or endoscopic approach. The transcaruncular approach to the medial orbit and ethmoid sinus has for many surgeons replaced the transcutaneous medial canthal (Lynch) incision, since it provides good exposure through a cosmetically superior incision.⁸⁻¹⁰ The endoscopic approach also allows for excellent visualization and access to the medial wall.⁶ But it requires additional instrumentation, skill in the use of the endoscope, and an intimate knowledge of intranasal anatomy. Lateral-wall decompression may be achieved through an extended canthotomy, extended upper-lid-crease incision, or through a coronal approach. The first two approaches are advantageous since the incisions blend with naturally occurring skin lines.

Employing an endoscopic approach to the medial wall and an extended upper-eyelid-crease incision for lateral-wall decompression, Vaseghi and colleagues reported a mean proptosis reduction of 4.4 mm.¹⁷ Their values varied depending on the indication for surgery. For those who underwent surgery for cosmetically objectionable

proptosis, Hertel measurements improved by 4.1 mm. For those with threatened vision, the improvement measured 4.8 mm. Three (12%) of their 26 patients developed new-onset diplopia. Graham and associates performed balanced decompression using an endoscopic or transcaruncular approach to the medial wall and a lateral canthal incision for the lateral wall.¹⁸ Their average Hertel improvement was 4.1 mm with no worsening of preexisting diplopia. However, they noted 4 out of their 40 patients developed new-onset diplopia. With similar approach Kacker and cohorts reported a 5.9-mm mean proptosis reduction accompanied by 16% new postoperative diplopia.¹⁹

Kikkawa and coworkers proposed a graded orbital decompression depending on the severity of proptosis.²⁰ For exophthalmometry reading between 22 and 25 mm, they performed a lateral-orbital and medial-wall decompression with fat removal. Surgical access was achieved by a transcaruncular approach and lateral canthotomy. In 21 orbits, they were able to achieve a mean reduction of 6 mm in Hertel measurements with only one patient developing new-onset diplopia after the surgery.

A three-wall decompression achieves additional reduction of exophthalmos of more than 25 mm. Kikkawa²⁰ reported an average of 8.9-mm reduction in exophthalmometry reading when performing lateral-, medial-, and posterior-orbital-floor decompression with lateral-orbital-rim advancement, and fat decompression. Despite maximal proptosis reduction, they reported no new-onset diplopia among these patients. White et al.²¹ performed a transnasal endoscopic medial wall and floor with simultaneous lateral orbital decompression resulting in a 4.2-mm reduction of proptosis, and Dailey et al.¹² achieved a mean of 5-mm reduction with their single incision, three-wall decompression. Most advocate the retention of inferomedial orbital strut when removing the medial and inferior orbital wall to help prevent new-onset postoperative diplopia.¹⁶

Goldberg et al. recently advocated the use of lateral-wall-only decompression with removal of intraconal fat to decrease the postoperative incidence of diplopia. In their hands, this was superior to the balanced approach with respect to onset of new motility disturbances.¹⁵ Kikkawa²⁰ performed a similar approach when exophthalmometry readings were less than 22 mm. Kacker used isolated lateral-wall decompression for asymmetric proptosis, moderate extraocular hypertrophy, and severe proptosis.¹⁹

Fat Decompression

Removal of intraorbital fat in conjunction with bony removal is now often performed. Moore described fat decompression technique in 1920 to reduce orbital tissue volume.²² Olivari²³ achieved a mean proptosis recession

of 5.9 mm with removal of up to 6 cm³ of fat. More recently, Kazim et al.²⁴ showed successful reversal of optic neuropathy after orbital-fat decompression. They performed fat decompression alone on eight orbits of five patients. With removal of 5 to 7 cc of fat, Hertel measurements improved an average of slightly over 3 mm (1.5 to 4 mm). In all cases, optic neuropathy was reversed and there were no cases of postoperative diplopia, enophthalmos, globe ptosis, and anesthesia. They concluded that fat decompression is an effective surgical alternative to bony decompression in patients with enlarged orbital-fat compartment and in whom extraocular-muscle enlargement is not the solitary cause of optic neuropathy. Some recent reports combine fat removal instead of adding another wall for resection. Combining lateral-wall decompression with orbital-fat removal was found by Goldberg's group to induce less incidence of diplopia compared to a medial- and lateral-wall removal.¹⁵ Orbital-fat removal can be most easily performed in the inferolateral quadrant of the orbit, which is relatively devoid of critical structures.

SUMMARY

Techniques in orbital decompression continue to evolve. Significant changes have occurred over the last decade in the following areas: the indications for decompression, the incisions that are used to gain access, and the bony surfaces that are selected for removal.

Indications for orbital decompression include corneal exposure, compressive optic neuropathy, congestive symptoms and, increasingly, correction of disfiguring proptosis.

The removal of the medial and lateral walls has been shown to be effective in reducing proptosis and in relieving compressive symptoms, as well as lessening the incidence of new-onset postoperative diplopia. Removal of the lateral wall and intraconal fat may also be more effective in preventing postoperative strabismus. Removal of three walls (medial, lateral, and floor) along with orbital fat is performed for high-grade proptosis. Some have proposed removal of orbital fat alone which can also be effective for decompression with reduced complications of extraocular motility disturbance. Others prefer combined bone and fat removal, and have proposed that removal of orbital fat obviates the need for removal of an additional wall.

Incisions that avoid or minimize cutaneous scar formation are now preferred. The upper-lid-crease approach, lateral canthotomy, transconjunctival, and transcaruncular approaches offer adequate exposure of the intended orbital wall for decompression without the cosmetically unappealing scar from a Lynch or an infracliliary incision. Infracliliary incisions may also cause cicatricial ectropion or worsen lower-lid retraction. The

introduction of endoscopic techniques in orbital surgery offers an alternative approach without a cutaneous incision.

No single technique is optimal for all patients. The surgical plan should be customized, based on clinical and radiologic findings and on the experience of the surgeon. The last 5 years have brought exciting developments in orbital decompression with improved results and decreased morbidity.

References

1. Rootman J. *Diseases of the Orbit*. Philadelphia: Lippincott Williams & Wilkins, 2002; 169-212.
2. Lucarelli MJ, Shore JW. Management of thyroid optic neuropathy. *Int Ophthalmol Clin* 1996; 36:179-193.
3. Walsh TE, Ogura JH. Transantral orbital decompression for malignant exophthalmos. *Laryngoscope* 1957; 67: 544-568.
4. Soares-Welch CV, Fatourachi V, Bartley GB, et al. Optic neuropathy of Graves' disease: results of transantral orbital decompression and long-term follow-up in 215 patients. *Am J Ophthalmol* 2003; 136: 433-441.
5. Leone CR Jr, Priest KL, Newman RJ. Medial- and lateral-wall decompression for thyroid ophthalmopathy. *Am J Ophthalmol* 1989; 108:160-166.
6. Kennedy DW, Goodstein ML, Miller NR, Zinreich SJ. Endoscopic transnasal orbital decompression. *Arch Otolaryngol Head Neck Surg* 1990; 116: 275-282.
7. Goldberg RA, Lessener AM, Shorr N, Baylis H. The transconjunctival approach to the orbital floor and fat: a prospective study. *Ophthalm Plast Reconstr Surg* 1990; 6: 241-246.
8. Balch KC, Goldberg RA, Green JP, et al. The transcaruncular approach to the medial orbit and the ethmoid sinus. *Facial Plast Surg Clin North Am* 1998; 6: 71-77.
9. Chang EL, Bernardino CR, Rubin PA. Transcaruncular orbital decompression for management of optic neuropathy in thyroid-related orbitopathy. *Plast Reconstr Surg* 2003; 112: 739-747.
10. Shorr N, Baylis HI, Goldberg RA, Perry JD. Transcaruncular approach to the medial and orbital apex. *Ophthalmology* 2000; 107: 1459-1463.
11. Tarrus-Montaner S, Lucarelli MJ, Lemke BN, Dortzbach RK. The surgical treatment of Graves' orbitopathy: a decade of progress. *Ophthalmol Clin North Am* 2000; 13: 693-704.
12. Dailey KL, Tower RN, Dailey RA. Customized, single-incision, three-wall orbital decompression. *Ophthalm Plast Reconstr Surg* 2005; 21: 1-10.
13. McCord Jr. Orbital decompression for Graves' disease: exposure through lateral canthal and inferior fornix incision. *Ophthalmology* 1981; 88: 533-41.
14. Rootman J, Stewart B, Goldberg RA. *Orbital Surgery: A Conceptual Approach*. Philadelphia: Lippincott-Raven, 1995; 353-384.
15. Goldberg RA, Perry JD, Hortalez V, Tong JT. Strabismus after balanced medial plus lateral wall only orbital decompression for dysthyroid orbitopathy. *Ophthalm Plast Reconstr Surg* 2000; 16: 271-277.
16. Goldberg RA, Shorr N, Cohen MS. The medial orbital strut in the prevention of post decompression dystopia in dysthyroid ophthalmopathy. *Ophthalm Plast Reconstr Surg* 1992; 8: 32-34.
17. Vaseghi M, Tarin TT, Levin PS, Terris DJ. Minimally invasive orbital decompression for Graves' ophthalmopathy. *Ann Otol Rhinol Laryngol* 2003; 112: 57-62.
18. Graham SM, Brown CL, Carter KD, et al. Medial and lateral orbital-wall surgery for balanced decompression in thyroid disease. *Laryngoscope* 2003; 113: 1206-1209.
19. Kacker A, Kazim M, Murphy M, et al. "Balanced" orbital decompression for severe Graves' orbitopathy: technique with treatment algorithm. *Otolaryngol Head Neck Surg* 2003; 128:228-235.
20. Kikkawa DO, Pompanich K, Cruz RC Jr., et al. Graded orbital decompression based on severity of proptosis. *Ophthalmology* 2002; 109: 1219-1224.
21. White WA, White WI, Shapiro PE. Combined endoscopic medial and inferior orbital decompression with transcutaneous lateral orbital decompression in Graves' orbitopathy. *Ophthalmology* 2003; 110: 1827-1832.
22. Moore RF. Exophthalmos and the limitation of the eye movements of Graves' disease. *Lancet* 1920; 2: 701.
23. Olivari N. Transpalpebral decompression of endocrine ophthalmopathy (Graves' Disease) by removal of intraorbital fat: experience with 147 operations over 5 years. *Plast Reconstr Surg* 1991; 87: 627-643.
24. Kazim M, Trokel SL, Acaroglu G, Elliot A. Reversal of dysthyroid optic neuropathy following orbital-fat decompression. *Br J Ophthalmol* 2000; 84: 600-605.