Adjuvant Lateral Canthal Advancement in the Surgical Management of Exophthalmic Eyelid Retraction

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The eye is convergent from the orbital axis when in the primary gaze position; greater projection of the lateral sclera results from the posterior location of the lateral orbital rim relative to the medial orbital rim. If the horizontal tarsal ligamentous band cannot lengthen to accommodate an increasingly exophthalmic globe in thyroid ophthalmopathy, a horizontally tight eyelid with increased exposure of the lateral sclera will result; thus, temporal flare is accentuated. Lateral canthal advancement was developed as an adjuvant procedure to reduce temporal flare in the surgical repair of thyroid-related eyelid retraction. Lateral canthal advancement is a theoretically rational and effective adjunct to retractor recession when horizontal tightness of the eyelid is present. In the horizontally tight eyelid, lateral canthal advancement is effective in enhancing the effect of retractor recession and in reducing temporal flare.

Retraction of the eyelids is the most frequent sign of thyroid ophthalmopathy. The eyelid retraction, when associated with exophthalmos, results from a variable combination of retractor and tarsal ligament band inelasticity and retractor shortening, which do not allow the eyelid to fully stretch over the anterior eye surface with normal protractor tone.1

Upper eyelid retraction is often accentuated laterally. The cause of enhanced lateral upper eyelid retraction (temporal flare) is multifactorial and has not been firmly established. With the eye in the primary gaze position (gaze convergent from the orbital axis), the greater projection and exposure of the lateral sclera beyond the plane of the orbital rim, compared with that of the medial sclera, is caused by the posterior location of the lateral orbital rim relative to the medial orbital rim. This has been suggested as a cause of temporal flare, especially in exophthalmos.2 Other causes have been suggested: lacrimal gland inflammation and fibrosis2; selective fibrosis of the lateral levator aponeurosis3; stronger retracting force of the better-defined lateral horn of the levator aponeurosis4; and lateral fibers of the Müller muscle located between the orbital and palpebral lacrimal gland lobes.5

Lower eyelid retraction also tends to be greater temporally.6,7 This can be best explained by gaze convergent from the orbital axis to the primary gaze position, thus exposing more lateral sclera.1

Many surgical techniques have been described to correct retraction of the upper and lower eyelids.2,6,8-24 Reconstructive surgeons recognize the tendency for eyelid retraction to persist laterally after eyelid retraction repair.2,6,8,10,25 Recommended techniques for the repair of upper eyelid temporal flare include greater recession of the retractors laterally,9-13 division of the lateral horn of the levator aponeurosis,9,12,14,15 horizontal fracturing of the tarsus in the lateral half of the eyelid,2 and medial rotation of the lateral horn of the levator aponeurosis.16 Recommended techniques for the repair of lower eyelid temporal flare include placement of laterally wider spacer material17 and addition of a lateral tarsal strip procedure with a lateral tarsorrhaphy to the retractor recession with spacer material.6 All these techniques involve recession, lengthening, excision, or transposition of the eyelid re-
tractors and consider only the vertical plane of eyelid retraction.
In addition to length and tension within the retractors, horizontal anatomic factors—such as the degree of exophthalmos, horizontal eyelid tension, and lateral canthal angle position—also should be considered in the surgical correction of eyelid retraction. The lateral canthal advancement (LCA) technique was developed for the correction of temporal flare in eyelid retraction associated with exophthalmos and the horizontal tightness of eyelids. It combines LCA with recession of the levator aponeurosis and excision (or recession) of the Müller muscle for upper eyelid retraction and with recession of the eyelid retractors and hard palate mucous membrane grafting for lower eyelid retraction. We describe herein our experience with this technique.

PATIENTS AND METHODS

We reviewed the medical charts of 15 consecutive patients undergoing LCA adjuvant to retractor recession for thyroid-related retraction of upper or lower eyelids between June 1991 and February 1998 by 1 of us (B.N.L.) at the Davis Duehr Dean Clinic or the University of Wisconsin Hospital, Madison. All patients were euthyroid at the time of surgery and had stable eyelid position for at least 6 months before surgery.

Early in this series (until the third patient and the fourth upper eyelid), LCA was preoperatively unplanned. It was used when temporal flare was still present even after maximal lateral recession of the levator aponeurosis and excision of the Müller muscle had been performed (Figure 1). These early procedures were performed on upper eyelids.

In the fourth patient, and in each thereafter, LCA was planned preoperatively. The indication for adding LCA with eyelid retractor recession surgery was the presence of temporal flare and horizontal tightness in an involved eyelid. Horizontal tightness was defined as eyelid margin–corneal distraction of 4 mm or less. All of these patients exhibited exophthalmos. Hertel exophthalmometer measurements were greater than 19 mm, and significant change in eyeball position after development of Graves disease was confirmed by patient autopal-
TRACTORS was performed in the upper eyelid. All patients undergoing lower eyelid surgery, when associated with horizontal tightness of eyelids, underwent LCA in conjunction with retractor recession and hard palate mucous membrane grafting. Elevation of the lower eyelid was technically easier when adjuvant LCA was performed.

Two percent lidocaine hydrochloride with 1:200,000 epinephrine bitartrate was injected superficially into the upper eyelids and deeply down to the periorbita in the lateral canthal area with the patient under monitored intravenous sedation.

The upper eyelid crease and lateral canthotomy site (approximately 10 mm long) were marked. After incision of eyelid skin along the mark, the orbicularis oculi muscle and the distal levator aponeurosis were incised to expose the anterior surface of the tarsus just below the superior border of the tarsus. The orbital septum was opened transversely. The levator aponeurosis was dissected from the superior border of the tarsus and from the underlying Muller muscle sharply. During this procedure, the lateral horn of the levator aponeurosis was divided completely. The Muller muscle was then dissected off from underlying conjunctiva and excised or recessed.

With patient cooperation, eyelid levels and contours were checked. If temporal flare persisted, an LCA for horizontal eyelid lengthening with tension release was performed by using a periosteal flap after lateral canthotomy and superior and inferior cantholysis (Figure 2). After lateral canthotomy and minimal lateral skin incision, the orbicularis oculi muscle over the lateral orbital rim was incised sharply. The superior and inferior crura of the lateral canthal ligament were incised. After exposure of the lateral orbital rim, a large, horizontal, rectangular periosteal flap (8 × 10 mm) was incised with the micropoint tip of the monopolar unit. This flap was elevated, based medially within the lateral orbital rim. The superior and inferior crura were sown to the periosteal flap with interrupted 5-0 polypropylene sutures, with adjustment to achieve adequate eyelid tension. The lateral canthal angle was reformed, and the orbicularis oculi muscle over the lateral orbital rim was closed with 6-0 polyglactin sutures. In more recent cases, LCA was performed similarly as described above through a horizontal skin incision 5 mm lateral to the lateral commissure so that

**SURGICAL TECHNIQUE**

**UPPER EYELID RETRACTION REPAIR**

For upper eyelid retraction repair, recession of the levator aponeurosis, excision or recession of the Muller muscle, and LCA were performed.

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Table 1. Characteristics of Patients Undergoing Upper Eyelid Retraction Repair With Adjunct Lateral Canthal Advancement

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>No.</th>
<th>Median (Range)</th>
</tr>
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<tbody>
<tr>
<td>Patients, No.</td>
<td>12</td>
<td>10 women and 2 men</td>
</tr>
<tr>
<td>Age range (mean), y</td>
<td>30-75 (54.3)</td>
<td></td>
</tr>
<tr>
<td>Eyelids, No.</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Preoperative</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hertel exophthalmometry reading (mean), mm</td>
<td>19.0 to 25.0 (21.0)</td>
<td></td>
</tr>
<tr>
<td>Margin reflex distance, mm</td>
<td>5.5 to 10.5 (8.63)</td>
<td></td>
</tr>
<tr>
<td>Postoperative</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Margin reflex distance, mm</td>
<td>-1.0 to 8.0 (3.28)</td>
<td></td>
</tr>
<tr>
<td>Changes in eyelid height, mm</td>
<td>2.0 to 8.5 (5.35)</td>
<td></td>
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</tbody>
</table>

Table 2. Postoperative Results After Upper Eyelid Retraction Repair

<table>
<thead>
<tr>
<th>Assessment of Results</th>
<th>After Primary Operation With Lateral Canthal Advancement, No. (%)</th>
<th>After Second Operation, No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>8 (40)</td>
<td>13 (65)</td>
</tr>
<tr>
<td>Satisfactory</td>
<td>5 (25)</td>
<td>7 (35)</td>
</tr>
<tr>
<td>Lid height &gt;1 mm from the desired height</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Contour abnormality (temporal flare)</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Poor</td>
<td>7 (35)</td>
<td>0</td>
</tr>
<tr>
<td>Undercorrection</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Overcorrection</td>
<td>5</td>
<td>0</td>
</tr>
</tbody>
</table>

Figure 3. Alternative lateral canthal advancement technique through a lateral palpebral raphe approach with the lateral commissure left intact. The divided lateral canthal ligament is suspended on a periosteal flap.
lateral canthotomy and subsequent repair were avoided (Figure 3).

With minimal sedation, the patient’s eyelid heights and contours were again inspected in primary gaze, upgaze, and downgaze with the patient in the supine position. If adjustment was necessary, further resection of the levator aponeurosis by dissection or advancement of the levator aponeurosis by 5-0 nylon tar- sal aponeurosis suture placement was performed. The pretarsal orbicularis muscle was closed with 7-0 or 6-0 polyglactin sutures in an interrupted fashion, and the eyelid skin was closed with 6-0 fast-absorbing plain gut sutures in a running fash-

LOWER EYELID RETRACTION REPAIR

For lower eyelid retraction repair, resection of the lower eyelid retractors with hard palate mucous membrane graft and LCA were performed. General anesthesia was used to facilitate harvesting of the hard palate mucous membrane graft. Lateral canthal advancement was achieved by periosteal flap lengthening of the canthal ligament after lateral canthotomy and superior and inferior cantholysis (Figure 2).

Two percent lidocaine hydrochloride with 1:100 000 epinephrine was injected into the roof of the mouth, the lower eyelid, and the lateral canthal area. The hard palate mucous membrane graft was harvested with a technique described by Kersten et al.17 Lateral canthotomy and superior and inferior cantholysis were performed as in the upper eyelid retraction repair. After eversion of the lower eyelid with 4-0 silk traction sutures on the eyelid margin, an infratarsal incision was made through the conjunctiva and the lower eyelid retractors, extending from the punctum to the lateral canthus. Dissection between the orbicularis muscle and orbital septum was performed inferi orly to allow the conjunctiva and retractors to maximally recess. A hard palate mucous membrane graft was interposed between the inferior border of the tarsus and the superior edge of the recessed conjunctiva and retractors and sewn in place with interrupted and running 6-0 chronic gut sutures. Creation of a periosteal flap with lengthening of the lateral canthal ligament was followed by reformation of the lateral canthal angle and wound closure as in the upper eyelid retraction repair.

RESULTS

Twelve patients underwent surgical procedures for upper eyelid retraction (4 unilateral and 8 bilateral) and 3 patients for lower eyelid retraction (1 unilateral and 2 bilateral). Thirteen patients (20 upper eyelids) and 6 patients (9 lower eyelids) underwent repair of thyroid-related eyelid retraction without LCA during the study and were excluded from this report. Thus, 48% (12/25) and 33% (3/9) of the patients underwent LCA adjuvant to retractor recession for the upper and lower eyelids, respectively.

The characteristics of patients undergoing upper eyelid retraction repair and the postoperative results are summarized in Table 1 and Table 2.

The indications for surgery were exposure keratopathy in 4 patients (7 eyelids) and symptoms of exposure without evidence of keratopathy in 8 patients (13 eyelids). Five eyes of 3 patients had previously undergone decompression surgery (1 eye, fatty decompression; 2 eyes, 2-wall bony decompression; and 2 eyes, fatty and 2-wall bony decompression). Follow-up varied from 2 to 13 months.

Assessment criteria of postoperative results were as follows: “good” if the contour was good and the postoperative eyelid height was within 1 mm of the desired height (margin reflex distance of 4 mm in bilateral cases and the height of the other eyelid in unilateral cases); “satisfactory” if the eyelid had a variance of more than 1 mm from the desired height or exhibited a contour abnormality but was functionally and cosmetically acceptable; and “poor” if the results warranted reoperation for excessive overcorrection or undercorrection.14

Of the initial 4 eyelids with unplanned LCA, 2 eyelids were considered poor (overcorrected) and the other 2 eyelids were considered satisfactory but overcorrected, too, with good correction of temporal flare. Among the following 16 eyelids with planned LCA, 8 eyelids were considered good. Three eyelids were classified as satisfactory, 2 of which showed persistence of temporal flare. Five eyelids were classified as poor, of which 2 eyelids were undercorrected and 3 eyelids were overcorrected. All of the 7 eyelids with poor results were corrected to good or satisfactory results after a second operation (Figure 4).

Patients undergoing LCA with lower eyelid retraction repair are summarized in Table 3. The indications for surgery were symptoms of exposure with or without evidence of keratopathy in 2 patients (3 eyelids) and aesthetic correction in 1 patient (2 eyelids). Three eyes of 2 patients had previously undergone strabismus surgery (recession of the inferior rectus muscle for hypertropia). Follow-up varied from 6 to 11 months.

Table 3. Summary of Lower Eyelid Retraction Repair With Adjuvant Lateral Canthal Advancement

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients, No.</td>
<td>3 (2 women and 1 man)</td>
</tr>
<tr>
<td>Age range (mean), y</td>
<td>37-66 (49.3)</td>
</tr>
<tr>
<td>Eyelids, No.</td>
<td>5</td>
</tr>
<tr>
<td>Preoperative</td>
<td></td>
</tr>
<tr>
<td>Hertel exophthalmometer reading (mean), mm</td>
<td>21.0-29.0 (24.8)</td>
</tr>
<tr>
<td>Central scleral show, mm</td>
<td>2.0-5.5 (3.3)</td>
</tr>
<tr>
<td>Postoperative</td>
<td></td>
</tr>
<tr>
<td>Central scleral show, mm</td>
<td>0.0-2.0 (0.7)</td>
</tr>
<tr>
<td>Changes in eyelid height, mm</td>
<td>1.5-5.5 (2.6)</td>
</tr>
<tr>
<td>Assessment of results, No. (%)</td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>3 (60)</td>
</tr>
<tr>
<td>Satisfactory</td>
<td>2 (40)</td>
</tr>
</tbody>
</table>
Of the 5 lower eyelids, 3 eyelids (60%) were considered good because the postoperative central scleral shows were 0 mm with no temporal flare. Preoperative and postoperative photographs are presented in Figure 5. Two eyelids of 1 patient were considered satisfactory because the eyelid levels were functionally and cosmetically acceptable despite postoperative central scleral shows of 2.0 or 1.5 mm. Despite these mild undercorrections, the temporal accentuation of the eyelid retraction noted preoperatively was eliminated.

In all of the upper and lower eyelids, no definite complication related to LCA, such as rounding or dystopia of the lateral canthus, was observed.

Exophthalmos can accentuate retraction of the upper and lower eyelids, with the globe serving as a “wedge” to increase the size of the palpebral fissure.2 A higher upper eyelid and a lower lower eyelid result if the horizontal tarsal ligamentous band and the vertical eyelid retractors cannot lengthen to accommodate the anterior globe position with increasing exophthalmos.1

Not all patients with exophthalmos receive orbital decompression because of varying severity, morbidity, cost, and possible complications, such as chemosis, eyelid edema, diplopia, sinusitis, numbness of the upper lip, inferomedial dislocation of the globe, and residual exophthalmos.26-29 With a moderate degree of exophthalmos, many surgeons and patients may be reluctant to perform orbital decompression. Harvey and Anderson8 suggested eyelid surgery, rather than cosmetic orbital decompression, even for patients with marked exophthalmos. Therefore, some patients with thyroid-related eyelid retraction undergo eyelid retraction repair although they have some degree of exophthalmos. According to an incidence cohort of patients receiving treatment for Graves ophthalmopathy reported by Bartley et al.,30 only 6.7% of patients received orbital decompression in contrast to 12.5% of patients who underwent eyelid surgery.

Horizontal lengthening of the eyelids to accommodate exophthalmos occurs primarily in medial and lateral canthal attachments rather than in the inelastic tarsus. In some cases, adequate relaxation of the canthal attachments occurs with exophthalmos and allows anterior displacement of the lateral canthus with coverage of the lateral sclera. Insufficient relaxation of lateral canthal attachments with exophthalmos will result in a relatively posteriorly placed lateral canthus, a horizontally tight eyelid, and increased projection and exposure of sclera laterally; thus, temporal flare is accentuated.

In the surgical correction of eyelid retraction, horizontal eyelid tension should be considered. If horizontal eyelid tightness (in-
creased appositional force between eyelid and globe) is present (lid distraction of ≤4 mm), increased eyelid retractor recession may be required to get an adequate eyelid level, especially laterally. In the lateral upper eyelid, the levator aponeurosis and the Müller muscle bisect the lacrimal gland into palpebral and orbital lobes.\(^5\) Because of the lacrimal gland parenchyma and ductules, wide dissection and maximal recession of the levator aponeurosis and the Müller muscle in the lateral upper eyelid are difficult and risky. Inadequate dissection and recession in this area has been believed to be a cause of postoperative persistence of temporal flare.

In the correction of lower eyelid retraction, it is difficult to elevate the lower eyelid, and undercorrection is common, if exophthalmos is present.\(^31\)

Many techniques described for lower eyelid retraction involve retractor recession from the tarsus with interposition of spacer material, by the conjunctival approach, without lateral canthal detachment.\(^6,8,17,18,22\) With these procedures, it is often technically difficult to recess the lower eyelid retractors enough laterally. If inferior lateral cantholysis is performed, it is often technically easier to recess the lower eyelid retractors and to implant the spacer material. When associated with exophthalmos and eyelid tightness, reattachment of the lateral lower eyelid to the orbital rim may result in failure of eyelid elevation because the eyelid rides posteriorly and inferiorly on the proptotic globe surface.\(^6,20\) Lateral canthal advancement should be performed when reattaching the lower eyelid over the exophthalmic eyeball.

The overcorrections in our early patients with LCA demonstrated the synergistic effect LCA has when combined with retractor recession. We performed adjuvant LCA in the first 3 patients (4 eyelids) of this series to diminish temporal flare. With increased experience, the incidence of overcorrection decreased in the later 16 upper eyelids; only 2 overcorrections and 1 medial ptosis resulted. Two undercorrections and 2 persistent temporal flares (but a satisfactory result) also resulted. Two undercorrected upper eyelids were in a patient with high Hertel exophthalmometer measurements (22.5 and 23.5 mm), which is the most difficult group in which to achieve a satisfactory eyelid position. Intraoperative judgment of vertical eyelid level is made more complex after horizontal loosening of eyelid tension in a fashion similar to that seen after horizontal tightening of the upper eyelid in the floppy eyelid syndrome.

Of the 5 lower eyelids treated, 3 lower eyelids showed good results with no temporal flare. Two lower eyelids showing satisfactory results (undercorrection but no temporal flare) were in a patient with severe exophthalmos (Hertel exophthalmometer readings, 28 and 29 mm), which made elevation of the lower eyelids difficult.

In conclusion, LCA is a theoretically rational and effective adjunct to retractor recession in the correction of thyroid-related eyelid retraction when horizontal tightness of the eyelid is present. In the horizontally tight eyelid, LCA is effective in reducing temporal flare persistent after retractor recession. A horizontally tight eyelid may occur when the tarsal ligamentous band cannot stretch to accommodate exophthalmos.

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Figure 5. Photographs before (A) and 8 months after (B) bilateral lower eyelid retractor recession with hard palate mucous membrane graft and adjuvant lateral canthal advancement showing good results.
REFERENCES


From the Archives of the Archives

A look at the past . . .

Nearly One Hundred Years of the Ophthalmoscope

No instrument in general medicine has influenced and developed a specialty as the ophthalmoscope has done for ophthalmology. On the occasion of my lectures on the physiology of the sense organs, I made a discovery which may be of real value to ophthalmology; it was so simple, requiring no more knowledge than what I had learned of optics in high school, that it is laughable that other people and I could have been so obtuse as not to have recognized it before.