Effect of Unilateral Blepharoptosis Repair on Contralateral Eyelid Position

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Purpose: This study evaluates the effect of unilateral blepharoptosis repair on contralateral eyelid position and assesses the relation between preoperative eyelid height interdependence, consistent with Hering law, and surgical outcome.

Methods: The medical records of 54 patients (21 men, 33 women; mean age, 65 years) who underwent external levator advancement for unilateral aponeurotic blepharoptosis were reviewed for preoperative and postoperative margin reflex distance (MRD) of the nonoperated eye. To assess the relation between preoperative Hering dependence (mechanical elevation of the ptotic eyelid causing a decrease in contralateral eyelid height) and postoperative eyelid position, the change in MRD of the nonoperated eye was compared between subjects who on preoperative evaluation did (n = 18) and did not (n = 36) demonstrate eyelid height interdependence, using the 2-sample t test.

Results: After unilateral blepharoptosis repair, the mean (± SD) change in contralateral MRD was −0.2 ± 0.8 mm. There was no significant difference in contralateral MRD change in subjects with and without preoperative Hering dependence (−0.3 ± 0.8 mm versus −0.2 ± 0.9 mm, respectively, p = 0.78). Seventeen percent (9 of 54) of patients had a contralateral MRD decrease of more than 1 mm. Three patients (5.6%) required contralateral blepharoptosis repair within 1 year of initial surgery.

Conclusions: After levator advancement for unilateral blepharoptosis, roughly 17% of patients will have a decrease in contralateral eyelid height of more than 1 mm, with 5% of patients requiring surgical repair during the first postoperative year. The degree of change in contralateral eyelid height cannot be reliably predicted by preoperative assessment of Hering dependence.

Surgical outcome after blepharoptosis repair has been well documented.1–4 However, focus has largely been on the operated eye, with little to no attention to contralateral eyelid, which may have a compensatory change in position (Figure). In one report, Bodian§ found that 9% of patients had a decrease in contralateral eyelid height of 1 mm or more and postulated a relation to Hering law. Additional reports have emphasized this interdependence of eyelid height.5–11 Preoperative evaluation of Hering dependence, mechanical elevation of the ptotic eyelid

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resulting in a decrease of contralateral upper eyelid height, has been suggested as a method to identify patients who are likely to have development of ptosis of the nonoperated upper eyelid after unilateral blepharoptosis repair. 6–10 This study was designed to determine the effect of unilateral blepharoptosis repair on contralateral eyelid position. We also evaluated the relation between preoperative eyelid height interdependence, consistent with Hering law, and surgical outcome.

METHODS

Using the computer database at the Cincinnati Eye Institute, 1,451 eyes in 1,009 adult patients who consecutively underwent external levator superioris aponeurosis advancement surgical repair for blepharoptosis were identified during the 10-year study period between January 1, 1990, and December 31, 1999. The medical records of 153 patients were selected and reviewed. This sample consisted of patients with last names starting with the letters A through D. All selected medical records were reviewed for the following criteria: 1) unilateral external levator advancement was performed, 2) a decrease in upper eyelid height by history and visual field testing, 3) levator function was normal, and 4) an appropriate evaluation for alternative causes had been completed. Patients were excluded if they had previous upper eyelid surgery including blepharoplasty or had a medical condition that might influence eyelid height, including thyroid disease and myasthenia gravis. History of contact lens wear and intraocular surgery were not consistently available; therefore, patients with blepharoptosis secondary to age-related involution, contact lens wear, and intraocular surgery could not be accurately differentiated and are grouped together. By evaluating patients who underwent unilateral repair, patients with true unilateral and those with asymmetric bilateral ptosis in whom only one eyelid was ptotic enough to require surgical correction are probably both included. To address this, separate analyses of patients with a preoperative margin reflex distance (MRD) in the nonoperated eyelid of 3.0 mm or more and those with an MRD of less than 3.0 mm were performed.

The medical records of selected patients were reviewed for preoperative and postoperative MRD of the nonoperated eye and the presence of Hering dependence on preoperative examination. MRD was measured to the nearest 0.5 mm clinically with a millimeter ruler; however, to avoid confusion, results are expressed to the nearest 0.1 mm and not rounded to the nearest 0.5 mm. Postoperative MRD measurements taken between 6 weeks and 6 months after surgery were averaged. Preoperative clinically apparent eyelid height interdependence (Hering law dependence) was considered present if mechanical elevation of the ptotic eyelid resulted in a decrease of contralateral upper eyelid height. This is assessed, with the patient fixated on a distant target, by mechanically elevating the ptotic eyelid and observing the contralateral eyelid for a change in MRD. Any appreciable decrease in eyelid position is considered positive. If no change is observed after 30 to 60 seconds, the test is considered negative. Although this test was performed routinely, the magnitude of the effect was not consistently documented and could not be evaluated. The mean change in contralateral MRD and the percentage of patients with a postoperative decrease of more than 1 mm were determined for patients with and without preoperative Hering dependence and compared by means of the 2-sample t test and Fisher exact test, respectively. To assess the possibility that observed changes in MRD were due to variation in measurements or normal mild fluctuations in eyelid position, we compared the proportion of patients with a decrease in MRD of more than 1 mm with those with and increase of more than 1 mm.

RESULTS

Table 1 summarizes mean preoperative and postoperative eyelid positions for the 54 patients (21 men, 33 women; mean age, 65 years) undergoing unilateral blepharoptosis repair. One patient required levator reces-
sion for initial overcorrection, and the final eyelid position was used for data analysis. Overall, the mean change in MRD of the nonoperated eye was a decrease of 0.2 ± 0.8 mm. Twenty-one (39%) had a decrease, 20 (37%) had no change, and 13 (24%) had an increase in postoperative MRD measurement compared with preoperative value. Nine patients (17%) had a decrease of more than 1 mm and 3 (5.6%) underwent contralateral blepharoptosis repair within 1 year of initial surgery. No patients had a measured increase in eyelid position of more than 1 mm. The disparity in the proportion of patients with a decrease in MRD of more than 1 mm (9 of 54) was significantly different from the proportion with a measured increase of more than 1 mm (0 of 54, p < 0.01). This strongly suggests that the measured changes were not entirely due to a variation in measurement or fluctuation in eyelid position.

Table 2 summarizes the results for patients with (n = 18) and without (n = 36) clinically apparent eyelid height interdependence (Hering dependence) on preoperative evaluation. The mean change in MRD of the nonoperated eye was only slightly greater for patients with than without Hering dependence (0.3 ± 0.8 mm vs. 0.2 ± 0.9 mm, p = 0.78). There were slightly fewer patients with a large decrease, more than 1 mm, in the Hering group than the non-Hering group (11% vs. 19%, p = 0.44). In both groups, 5.6% of patients underwent blepharoptosis repair for induced ptosis in the contralateral eyelid within 1 year of initial surgery. The mean (± SD) asymmetry in eyelid position, before surgical correction, in patients with and without observable Hering effect was similar (2.4 ± 1.5 mm vs. 2.0 ± 0.8 mm, p = 0.23). The severity of blepharoptosis in the Hering group was slightly greater than the non-Hering group (MRD of 0.5 ± 1.5 mm vs. 1.1 ± 1.0 mm, respectively). This disparity approached but did not achieve statistical significance (p = 0.08). There was no significant difference (p = 0.88) in the change in contralateral eyelid position in patients with a preoperative MRD of the nonoperated eyelid of 3.0 mm or more (−0.25 ± 0.9 mm, n = 34) and those with an MRD less than 3.0 mm (−0.21 ± 0.8 mm, n = 20).

**TABLE 1.** Mean upper eyelid position in operated and nonoperated eyelids after unilateral blepharoptosis repair

<table>
<thead>
<tr>
<th>Eyelid</th>
<th>Preoperative MRD (mm ± SD)</th>
<th>Postoperative MRD (mm ± SD)</th>
<th>Change (mm ± SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operated eyelid</td>
<td>0.9 ± 1.2</td>
<td>2.9 ± 1.1</td>
<td>2.0 ± 1.3</td>
</tr>
<tr>
<td>Nonoperated eyelid</td>
<td>3.1 ± 0.9</td>
<td>2.8 ± 1.1</td>
<td>−0.2 ± 0.8</td>
</tr>
</tbody>
</table>

MRD indicates margin reflex distance.

**TABLE 2.** Change in contralateral upper eyelid position after unilateral blepharoptosis repair in patients with and without clinically apparent eyelid height interdependence (Hering dependence) on preoperative evaluation

<table>
<thead>
<tr>
<th>Hering dependence</th>
<th>Mean change in contralateral eyelid position (mm ± SD)</th>
<th>Surgical correction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hering present</td>
<td>−0.3 ± 0.8</td>
<td>11% (n = 2)</td>
</tr>
<tr>
<td>Absent present</td>
<td>−0.2 ± 0.9</td>
<td>19% (n = 7)</td>
</tr>
<tr>
<td>Total</td>
<td>−0.2 ± 0.8</td>
<td>17% (n = 9)</td>
</tr>
</tbody>
</table>

Differences between groups were not statistically significant.

**DISCUSSION**

Our data indicate that after unilateral levator advancement, contralateral eyelid height decreases on average 0.2 ± 0.8 mm, with 17% having a decrease of more than 1 mm. In our study group, 5% required surgical repair during the first postoperative year. Assessment of Hering dependence before surgery did not reliably identify patients who would have a postoperative contralateral change in MRD (Table 3).

After successful surgical repair of unilateral blepharoptosis, Bodian reported a contralateral eyelid droop of 1 mm or more in 11 of 115 patients (9.6%). These patients had blepharoptosis from a variety of causes and were treated with a variety of surgical techniques; roughly one half were reported to have involutional/aponeurotic ptosis. Of the 11 patients with contralateral eyelid droop, 6 had aponeurotic blepharoptosis, giving an estimated 10% (6 of 57.5) with an induced decrease in contralateral eyelid height of 1 mm or more. This is slightly less than our study group, in which 17% had a decrease of more than 1 mm. Bodian postulated that postoperative decrease in upper eyelid height of the nonoperated eye was a manifestation of a previously masked, subclinical blepharoptosis, attributable to Hering law.

Hering law of equal innervation postulates that equal and simultaneous innervation is sent to paired yoke muscles. Although Hering described his law of equal innervation to the extraocular muscles, later observers have sought to apply Hering law to the levator palpabrae superioris. When a patient attempts to clear the visual axis from asymmetric blepharoptosis in the more ptotic eye, this will induce increased innervation to both levators, with resultant contralateral upper eyelid retraction, possibly masking mild blepharoptosis. With surgical elevation of the more ptotic eyelid, innervation to both levator superioris muscles lessens, which may manifest the masked contralateral ptosis after surgery.
TABLE 3. Eyelid position before and after unilateral levator advancement of patients who subsequently underwent surgical correction of ptosis of the contralateral upper eyelid

<table>
<thead>
<tr>
<th>Patient No.</th>
<th>Preoperative MRD (mm)</th>
<th>Postoperative MRD (mm)</th>
<th>Change in MRD (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Operated eye</td>
<td>Opposite eye</td>
<td>Operated eye</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>2</td>
<td>1.5</td>
<td>4.0</td>
<td>3.5</td>
</tr>
<tr>
<td>3</td>
<td>0.5</td>
<td>2.0</td>
<td>3.5</td>
</tr>
</tbody>
</table>

MRD indicates margin reflex distance.

Preoperative evaluation of Hering dependence has been suggested as a method to evaluate the presence of masked contralateral blepharoptosis and predict which patients are likely to have ptosis of the nonoperated upper eyelid after unilateral blepharoptosis repair. The presence or absence of Hering law eyelid height interdependence can be evaluated by elevating the ptotic eyelid to a normal position with a finger or cotton swab and observing the contralateral eyelid for any decrease in MRD. Similar to previous reports, 6-7 33% of our study group demonstrated Hering dependence on preoperative evaluation. However, this correlated poorly with postoperative contralateral upper eyelid height. There was no significant difference in the mean change in contralateral MRD in subjects with and without preoperative Hering law interdependence (−0.3 ± 0.8 mm versus −0.2 ± 0.9 mm, p = 0.78). Moreover, although not statistically significant, a larger proportion of patients in the non-Hering group had a decrease of more than 1 mm than in the Hering group, 19% versus 11%, respectively. The percentage of patients who underwent contralateral blepharoptosis surgery within 1 year of initial surgery for the induced ptosis was identical: 5.6% in both groups.

The number of patients with a negative Hering test, who had a postoperative decrease in MRD of the contralateral eyelid, emphasizes the inability to identify all patients who will have development of contralateral blepharoptosis. However, intuition holds that a patient with a markedly positive preoperative Hering evaluation would be at increased risk. The seeming lack of an association in our study population might be due to additional factors. Because patients were not prospectively randomly assigned, those with asymmetric bilateral blepharoptosis with obvious Hering dependence might have been more apt to be treated with initial bilateral levator advancement. Additionally, the preoperative Hering effect was not quantified. It seems premature to definitively exclude the possibility that a large Hering effect is not predictive. Last, negative results should be interpreted guardedly with any relatively small study group; the Hering-positive group consisted of 18 patients. Therefore, although our data are sufficient to conclude that every patient who will have development of contralateral blepharoptosis cannot be identified, evaluating Hering dependence may prove to have some usefulness.

A potential influencing factor that we did not evaluate is ocular dominance. One might predict a more pronounced effect on contralateral eyelid position when correcting blepharoptosis of the dominant eye. Although eye dominance was not routinely assessed or documented, assuming our study group to be reflective of the general population, the majority of patients were probably right-eye dominant. In a meta-analysis of more than 50,000 subjects, Bourassa et al. 12 found that roughly 70% of people are right-eye dominant. Were eye dominance to largely effect results, one would anticipate the subgroup of patients with a large decrease in contralateral eyelid position to be skewed to those with blepharoptosis of the right eye. This was not observed; of the 9 patients with more than 1 mm decrease in contralateral upper eyelid position, 3 had initial repair of the right and 6 of the left eye. Although this suggests a limited role if any, the exact effect of eye dominance remains to be determined.

This study is limited by the potential for bias inherent in all retrospective studies. For example, patients with blepharoptosis related to contact lens wear or intraocular surgery could not be accurately identified and are analyzed together with patients with age-related involution. Preoperative and postoperative pictures were not consistently available; therefore, all measurements are based on chart records and not photos, which may have a lesser degree of accuracy. However, a decrease of more than 1 mm was chosen because this degree of change is unlikely to be due to variability in measurement alone. Also, the diagnosis of “unilateral” was based largely on the choice of surgical correction (unilateral or bilateral), and several patients had an MRD in the “normal” eye as low as 2 mm, probably representing asymmetric bilateral ptosis.
Despite this, these results are found in patients with significant blepharoptosis in one eye only and should not be referred to patients with bilateral blepharoptosis. Moreover, intraoperative adjustment was performed with the patients awake. By tailoring the degree of elevation in part to achieve symmetry, the number of patients with postoperative asymmetry or contralateral drop may have been lessened. Last, alternate methods of evaluating the presence of Hering law, such as quantification, may prove more effective in predicting the effect of unilateral ptosis repair on the contralateral eyelid position.

In closing, our data provide a framework for counseling patients regarding expected surgical results. Roughly 17% of patients will have a decrease in contralateral eyelid height of more than 1 mm, with 5% of patients requiring surgical repair during the first postoperative year. The degree of change in contralateral eyelid height cannot consistently be predicted by preoperative assessment of Hering eyelid height interdependence.

REFERENCES