Evaluation of Long-term Outcomes of Correction of Severe Blepharoptosis with Advancement of External Levator Muscle Complex: Descriptive Statistical Analysis of the Results

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Abstract. Aim: Evaluation of long-term results after aponeurotic blepharoptosis correction with external levator muscle complex advancement. Patients and Methods: We carried out a retrospective study with medical record review of 20 patients (40 eyes) affected by bilateral aponeurotic moderate and severe ptosis who underwent primary surgery between January 2010 and December 2013. Criteria for outcome evaluations included 3-year postoperative follow-up of upper margin reflex index (uMRD) and symmetry. Results: 3-Year postoperative follow-up showed 17 (85%) cases of successful correction of ptosis and three cases (15%) showed partial success. Two eyes showed hypocorrection, while one eye was overcorrected. The symmetry was maintained in all patients except for the oldest. Conclusion: External superior levator advancement is an effective procedure for moderate and severe aponeurotic blepharoptosis correction, and establishes good long-term eyelid position and symmetry.

Normally the lower border of the upper eyelid lies 1.5 mm below the superior corneal limbus (1). Blepharoptosis is defined as an abnormally low position of the upper eyelid margin that may cause visual defects (2). It may require surgical correction both for functional and esthetical appearance. This condition may be mono- or bilateral and can be part of syndromes (3). Blepharoptosis can be classified according to various criteria such as: age of onset (congenital or acquired), etiology (myogenic, neurogenic, aponeurotic, mechanical or traumatic) (4), levator functional excursion and severity. Based on severity, it may be minimal when the distance from the central corneal light reflection to the upper lid margin (upper margin reflex index:uMRD) is ≥2 mm, moderate ≥ 1mm or severe <1 mm (5). Levator functional excursion is determined by measuring the excursion of the upper eyelid margin as the patient looks from down to up, while the eyebrow is manually fixed against the supraorbital rim. It is classified as poor (0-4 mm), moderate (5-10 mm) or good (>10 mm) (6). Aponeurotic ptosis is the most common type of acquired ptosis. It results from involutional changes of the levator aponeurosis due to its gradual stretching or attenuation (Figure 1). Loss of aponeurotic tightness results in a narrow vertical dimension of the palpebral fissure, higher upper eyelid crease and deeper superior sulcus, while levator function usually remains normal. Chronic contact lens use, prior ocular surgery, cataract surgery and traumas are the most common causes of acquired aponeurotic ptosis (7). In this article, we report a retrospective study, conducted between January 2010 and December 2013, with the aim of evaluating long-term outcomes of correction of primary severe aponeurotic ptosis using external levator advancement performed alone or with concurrent blepharoplasty.

Patients and Methods

A retrospective review of medical records of 20 patients (40 eyes), affected by bilateral aponeurotic ptosis who underwent primary surgery between January 2010 and December 2013 was conducted. Demographic information including age, gender, medical history, surgical information and pre- and postoperative digital photographs were collected.

All the patients were examined in sitting position, with primary gaze, and grade of ptosis was evaluated in millimeters. Levator muscle function was determined by measuring the excursion of the eyelid margin as the patient looked from down to up. In order to prevent the frontalis muscle contribution, the eyebrow was manually fixed against the supraorbital rim. All the procedures were

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Key Words: Ptosis, blepharoptosis, ptosis surgery outcome, eyelid surgery, eyelid ptosis correction.
Table I. Demographic data, and preoperative and postoperative measurements.

| Case no. | Age (years) | Gender | Grade of ptosis | uMRD RE (mm) | uMRD LE (mm) | Interlid uMRD difference (mm) | Interlid crease difference (mm) | Interlid show difference (mm) | Outcome | Blepharoptaly |
|----------|-------------|--------|----------------|--------------|--------------|-------------------------------|-------------------------------|-------------------------------|---------|---------------|
| 1        | 67          | M      | RE severe/LE severe | 3.25         | 2.62         | 0.63                          | 0.08                          | 0.74                          | Partial success | No              |
| 2        | 58          | F      | RE severe/LE severe | 4.36         | 4.70         | 0.34                          | 0.42                          | 0.23                          | Success       | No              |
| 3        | 72          | M      | RE severe/LE severe | 4.26         | 3.69         | 0.57                          | 0.43                          | 0.05                          | Success       | Yes             |
| 4        | 77          | F      | RE severe/LE severe | 3.12         | 3.46         | 0.34                          | 0.47                          | 0.37                          | Success       | Yes             |
| 5        | 76          | F      | RE moderate/LE severe | 4.01         | 3.82         | 0.19                          | 0.74                          | 0.30                          | Success       | No              |
| 6        | 56          | F      | RE moderate/LE severe | 4.62         | 4.87         | 0.25                          | 0.09                          | 0.21                          | Success       | Yes             |
| 7        | 77          | F      | RE moderate/LE severe | 4.80         | 5.13         | 0.33                          | 0.60                          | 0.49                          | Partial success | No              |
| 8        | 78          | F      | RE severe/LE severe | 2.06         | 3.96         | 1.90                          | 2.33                          | 0.35                          | Partial success | No              |
| 9        | 33          | F      | RE moderate/LE severe | 4.09         | 4.27         | 0.18                          | 0.14                          | 0.26                          | Success       | No              |
| 10       | 45          | M      | RE moderate/LE severe | 4.19         | 4.66         | 0.47                          | 0.43                          | 1.30                          | Success       | No              |
| 11       | 61          | M      | RE severe/LE severe | 4.58         | 4.22         | 0.36                          | 0.28                          | 0.72                          | Success       | No              |
| 12       | 62          | M      | RE moderate/LE severe | 4.56         | 4.26         | 0.30                          | 0.23                          | 0.63                          | Success       | No              |
| 13       | 56          | M      | RE severe/LE moderate | 4.19         | 4.56         | 0.37                          | 0.36                          | 0.41                          | Success       | No              |
| 14       | 55          | F      | RE severe/LE severe | 4.41         | 4.04         | 0.37                          | 0.47                          | 0.35                          | Success       | Yes             |
| 15       | 77          | F      | RE moderate/LE moderate | 4.41         | 4.24         | 0.17                          | 0.22                          | 0.33                          | Success       | No              |
| 16       | 73          | F      | RE moderate/LE moderate | 4.05         | 4.60         | 0.55                          | 0.82                          | 0.41                          | Success       | Yes             |
| 17       | 71          | F      | RE severe/LE severe | 4.42         | 4.60         | 0.18                          | 0.60                          | 0.28                          | Success       | Yes             |
| 18       | 65          | M      | RE severe/LE moderate | 4.18         | 3.67         | 0.51                          | 0.60                          | 0.29                          | Success       | No              |
| 19       | 37          | F      | RE moderate/LE severe | 3.69         | 4.14         | 0.45                          | 0.78                          | 0.97                          | Success       | No              |
| 20       | 56          | M      | RE severe/LE severe | 4.13         | 3.76         | 0.37                          | 0.48                          | 0.19                          | Success       | No              |

uMRD: upper margin reflex index; RE: right eye; LE: left eye; M: male; F: female.

Surgical procedure. Through an anterior approach the upper levator muscle complex was separated from the upper border of the tarsus. Once isolated, the aponeurosis was shortened according to desired eyelid position (2, 3 or 4 mm of resection for each mm of desired elevation) and then re-fixed to the upper margin of the tarsus.

Statistical analysis. The descriptive statistical analysis of the results was performed using scatterplot graphics which described the possible relation between age, degree of ptosis, concomitant associated blepharoplasty and the average of collected data: uMRD, interlid uMRD, interlid crease difference, interlid show difference.

Results

Out of 20 patients enrolled in the study, eight were males and 12 were females (40 eyes). The age range was 18-78 years, with a median of 56 years. Ten patients showed severe symmetric ptosis, two had moderate symmetric ptosis. Patients with asymmetric ptosis showed both severe and moderate degrees of ptosis. Some cases are shown in Figures 3, 4 and 5.

The 3-years postoperative follow-up showed 17 (85%) cases of success and three cases (15%) of partial success. Overall, 37 eyes (92.5%) had an uMRD ranging between 3.12 mm and 4.87 mm. Two eyes showed hypocorrection: the left eye of case 1 (uMRD=2.62 mm) and the right eye of
case 8 (uMRD=2.06 mm). The left eye of case 7 was overcorrected (uMRD=5.13 mm). Based on criteria selected to evaluate the symmetry, only case 8 was found to be postoperatively asymmetric (interlid uMRD difference of 1.90 mm and interlid crease difference of 2.33 mm, while interlid show difference was 0.35 mm) (Table I).

Among the complications we observed mild lagophthalmos, dry eyes and poor blink in the early postoperative period, which improved several weeks after surgery.

Discussion

Aponeurotic acquired ptosis is an involutional dehiscence, stretching or thinning of the aponeurotic fibers of the levator aponeurosis from the anterior tarsal surface resulting in a lower upper eyelid position with relative obstruction of the superior visual field. Clinically, it appears with a lower resting upper eyelid position, a superior migration of the upper eyelid crease, a narrowing or loss of the vertical palpebral fissure and normal levator muscle excursion. A compensation for the superior visual field loss by the recruitment of the frontalis muscle is often present. In the case of unilateral ptosis, contralateral eyelid retraction can be observed. Surgical repair is usually required to correct these abnormalities. We report our experience with shortening the levator aponeurosis by an anterior approach.
through an eyelid crease incision with or without concomitant blepharoplasty (9).

uMRD seems to be the most involved parameter in long-term partial satisfactory results. This probably depends on a decrease of tensile strength of levator aponeurosis during long-term follow-up. At the 3-year postoperative evaluation, 37 eyes (92.5%) preserved an uMRD of between 3.12 and 4.87 mm with most being between 3.5 and 4.5 mm, while three eyes (7.5%) did not retain MRD in the correct range. In particular, uMRD of the left eye of case 1 was 3.48 mm at 1 year postoperatively and 2.62 mm at 3 years postoperatively, showing a decrease of 0.86 mm thus resulting in hypocorrection of 0.38 mm from the correct range. UMRD of the right eye of case 8 was 3.24 mm at 1 year postoperatively, 2.06 mm at 3 years postoperatively (reduction of 1.18 mm) and was hypocorrected by 0.94 mm. Even if outside the ideal range, the uMRD of both case 1 and 8 were very close to the normal range, diverting from it by less than 1 mm. Although loss of tensile strength of levator aponeurosis was observed at 3 years postoperatively, the difference was not clinically relevant and the symmetric appearance was still globally preserved.

All uMRD outside the ideal range (Figure 6a) was for older patients (>67 years) with a severe grade of ptosis. This

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**Figure 6.** Scatterplot showing upper margin reflex distance (uMRD) (a), and interlid uMRD difference (b), interlid crease difference (c), and interlid show difference (d) between left and right eyes at 3-year follow-up.
may suggest that in older patients affected by severe ptosis, hypercorrection may be useful in maintaining more stable long-term results. Furthermore, cases 1, 7 and 8 did not undergo concomitant blepharoplasty. Blepharoplasty may be useful to stabilize the correction.

The interlid MRD and interlid crease of 39 eyes were inside the ideal range (Figure 6b and c). Only that for the oldest patient (case 8, 78 years old), classified as having asymmetric severe ptosis, was outside the ideal value for both these variables, resulting in asymmetry: the uMRD of her left eye was 2.06 mm with an interlid uMRD of 1.90 mm and interlid crease of 2.33 mm. This may depend on the innervation of the *levator* muscle complex. Since both *levator* muscles are innervated from a single midline nucleus producing equal neural output to both sides, the less-affected eyelid may be capable of maintaining a normal level of elevation due to excessive nerve stimulation determined by the more ptotic eyelid (Hering’s law) (11). Basing on Herring’s anatomy considerations, the unsatisfactory final uMRD results observed in case 7 and 8 may be the result of incorrect preoperative assessment. Finally, Figure 6c and d seem to show less interlid difference in the patients who underwent concomitant blepharoplasty, which seems to reduce asymmetry, with long-lasting results. External *levator* resection enables intraoperative adjustment of the eyelid position. Patient cooperation is strictly necessary to perform ptosis correction adequately and local anesthesia was useful and comfortably achieved this aim (12).

Limitations of the current study lie in its retrospective design. Although our study included a restricted number of cases, to our knowledge there are no other studies based on such long-term follow-up for correction of aponeurotic ptosis.

**Conclusion**

In accordance with a recent study (13), external superior *levator* advancement for blepharoptosis is an effective procedure in establishing good long-term eyelid position and symmetry, with reported success rates of 85%. Despite the limitations of our study, we believe that external *levator* advancement is effective in long-term correction of severe aponeurotic ptosis.

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