

External Levator Advancement vs Müller's Muscle–Conjunctival Resection for Correction of Upper Eyelid Involutional Ptosis

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- **PURPOSE:** To compare external levator advancement and Müller's muscle–conjunctival resection (conjunctivomullerectomy, or CJM) for correction of upper eyelid involutional ptosis.
- **DESIGN:** Retrospective, nonrandomized, comparative interventional case series.
- **METHODS:** Review of medical records of 159 patients (272 surgical procedures) who underwent external levator advancement or CJM was performed. **MAIN OUTCOME MEASURES:** Functional and cosmetic outcome, marginal reflex distance one (MRD1), and surgical complications.
- **RESULTS:** A total of 159 patients (51 men, 108 women, mean age 70 years) underwent 272 surgical procedures for upper eyelid ptosis; concurrent blepharoplasty was performed in 141 cases. MRD1 increased an average of 1.6 (± 1.5) mm, from 0.8 mm (± 1.2) preoperatively to 2.3 mm (± 1.2) postoperatively ($P < .001$). Fifteen patients (5.5%) underwent reoperation for residual ptosis, nine (18%) in the external levator advancement group, two (3%) in the CJM group, three (8%) in the external plus blepharoplasty group, and one (1%) in the CJM plus blepharoplasty group ($P < .001$). Patients who underwent external levator advancement had significantly more severe ptosis preoperatively but attained similar eyelid position postoperatively as compared with CJM patients. Complications included overcorrection in four cases (1.4%), lagophthalmos of 1 mm in 10 (3.6%), and pyogenic granuloma in two (<1%).
- **CONCLUSIONS:** External levator advancement and CJM performed alone or with concurrent blepharoplasty are effective treatments for upper eyelid ptosis. Residual ptosis or postoperative eyelid retraction occurs in up to 20% of cases and can be addressed successfully with a

second operation. (*Am J Ophthalmol* 2005;140:426–432. © 2005 by Elsevier Inc. All rights reserved.)

INVOLUTIONAL BLEPHAROPTOSIS OCCURS IN THE ELDERLY population as a result of levator aponeurosis dehiscence from the anterior tarsal surface or stretching and thinning of the aponeurotic fibers, resulting in a lowered upper eyelid position and a relative obstruction of the superior visual field.^{1–3} Clinically, patients present with a lower resting upper eyelid position, a superior migration of the upper eyelid crease, and narrowing or loss of the vertical palpebral fissure height in downgaze and normal levator muscle excursion.⁴ Recruitment of frontalis muscle to raise the eyebrow and compensate for a superior visual field loss can ensue,⁵ and contralateral eyelid retraction can be apparent in cases of asymmetric or unilateral ptosis.⁶

Surgical repair is usually required to reattach the levator aponeurosis to the anterior face of the tarsal plate with or without shortening of the aponeurosis. This can be achieved by means of an anterior approach through an eyelid crease incision. Posterior, transconjunctival resection of the Müller's muscle and conjunctiva has also been used to correct mild to moderate upper eyelid ptosis.^{3,7–15}

The purpose of the current study is to compare the functional and cosmetic outcome after external levator advancement or Müller's muscle–conjunctival resection (conjunctivomullerectomy, or CJM) with or without concurrent blepharoplasty.

METHODS

A RETROSPECTIVE REVIEW OF MEDICAL RECORDS OF ALL patients who underwent surgery for upper eyelid involutional ptosis either with or without blepharoplasty between January 1999 and December 2003 was performed. The data retrieved included age, gender, type of surgery, preoperative and postoperative digital photographs, visual acuity, marginal reflex distance one (MRD1; represents the dis-

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TABLE 1. Demographics of 159 Patients (272 Eyelids) Operated on for Involutional Blepharoptosis at the Jules Stein Eye Institute, January 1999 Through December 2003

Variable	Value
Gender	
Male	51 (32%)
Female	108 (69%)
Age (y): mean (\pm SD) [range]	70 (\pm 12) [37–93]
Visual acuity: mean [range]	20/30 [20/15–HM]
Levator excursion (mm): mean (\pm SD)	14 (\pm 2.6)
Preoperative use of eyedrops	55 (20%)
Preoperative reduced bells	24 (9%)
Follow-up (mos): mean (\pm SD) [range]	8.2 (\pm 9.5) [3–48]
HM = Hand motion.	

tant between the inferior margin of the upper eyelid and the pupillary light reflex in primary position of gaze, measured in millimeters), lagophthalmos, and surgical complications. Patients were examined 1 day, 1 week, and 1, 3, 6, and 12 months postoperatively and every year thereafter. Postoperative measurements at the last follow-up visit were used for comparison. All surgeries were performed by two of us (R.A.G. and J.D.M.). The study complies with the policies of the local institutional review board.

Cosmetic outcome was graded on the basis of final eyelid position, eyelid crease, and eyelid symmetry, on an arbitrary scale of 0 to 3, with 0 indicating excellent results, 1 good results, 2 poor results, and 3 reoperation either for residual ptosis or for overcorrection and consecutive eyelid retraction. Cosmetic results were considered excellent when eyelid attained good position postoperatively, with good eyelid contour and crease, and both upper eyelids were at the same height or with no more than 1 mm of difference. If results were not satisfactory in one of these parameters, cosmetic score was good. If outcome was not satisfactory in two or more of these parameters, cosmetic score was poor.

All patients who were scheduled for CJM underwent pharmacologic elevation of the ptotic eyelid with phenylephrine 10% instilled in the inferior cul-de-sac. The MRD1 was assessed before and 10 minutes after instillation of phenylephrine eyedrops. Resection was planned according to the desired eyelid position, keeping in mind that the height attained with the phenylephrine test can be achieved with 8.25 mm conjunctival–Müller’s muscle resection.¹² We performed 4 mm of Müller’s muscle and conjunctival resection for each 1 mm of desired elevation; tarsus was not removed during the procedure. We performed external levator advancement in the following cases: patients with more severe ptosis, no response on the phenylephrine test, patients with ocular surface disease, and the presence of a superior filtering bleb.

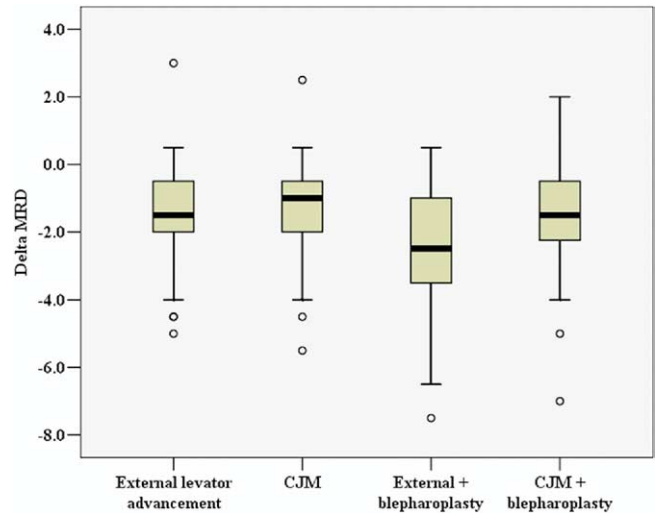


FIGURE 1. Box plot showing change in marginal reflex distance one (Δ MRD) in four groups of patients with involutional ptosis: external levator advancement (N = 51), Müller’s muscle–conjunctival resection (CJM, N = 80), external levator advancement with blepharoplasty (N = 37), and CJM with blepharoplasty (N = 104). All surgeries were performed at the Jules Stein Eye Institute between 1999 and 2003. Patients who underwent external levator advancement (alone or with concurrent blepharoplasty) had more severe ptosis preoperatively but attained similar eyelid position postoperatively as compared with CJM patients; this is reflected by higher values of Δ MRD.

If ptosis correction was performed concomitantly with blepharoplasty, it was done after the skin muscle flap was excised. Patients who required bilateral surgery were operated on simultaneously on both upper eyelids.

Statistical analysis was performed with the paired samples *t* test to evaluate preoperative and postoperative visual acuity, intraocular pressure, and MRD1. One sample *t* test was used to evaluate change in these variables by calculating delta values. The independent samples *t* test was used to assess the difference in these parameters and in cosmetic outcome score between different groups of patients. χ^2 nonparametric test was used to evaluate the distribution of outcome and reoperation rate for different surgeries (CJM vs external levator advancement with or without upper eyelid blepharoplasty). The Fisher exact test was used to evaluate difference in overcorrection rate between different groups. Pearson bivariate correlation was used to examine the influence of age on parameters such as preoperative MRD1, visual acuity, and Δ MRD1. One-way analysis of variance (ANOVA) was used to compare functional and cosmetic outcome in all four groups of patients (external levator advancement vs CJM either with or without blepharoplasty). We realize that we use an arbitrary scale of 0 to 3 for cosmetic outcome, but we assume the change in each point in the 0 to 4 scale is equivalent (that is, change from 0 to 1 is equal to change from 1 to 2 or 2 to 3). If these assumptions are not met,

TABLE 2. Change in Marginal Reflex Distance One (MRD1, mm) and Reoperation Rate for 159 Patients (272 Eyelids) Operated on for Blepharoptosis at the Jules Stein Eye Institute, 1999–2003*

Group	N	Preop MRD	Postop MRD	Delta MRD	Reoperation Rate (%)
External levator advancement	51	0.5	2.0	-1.5	18%
CJM	80	1.1	2.5	-1.3	3%
External + blepharoplasty	37	0.1	2.6	-2.5	8%
CJM + blepharoplasty	104	0.9	2.3	-1.5	1%

CJM = Conjunctivomullerectomy.

*Patients underwent Müller's muscle–conjunctival resection (conjunctivomullerectomy) or external levator advancement, alone or with concurrent blepharoplasty.

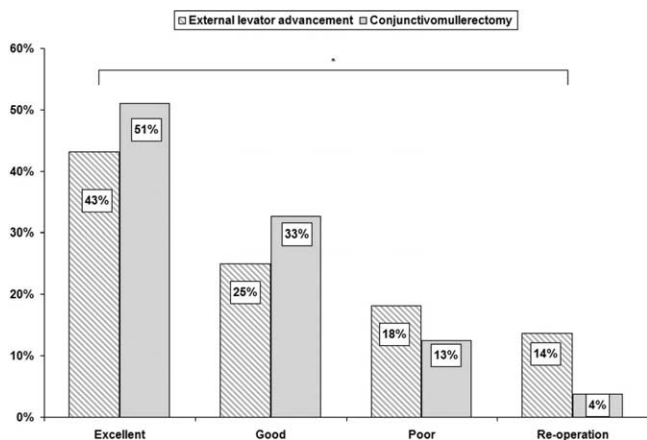


FIGURE 2. Outcome of blepharoptosis surgery in 159 patients (272 eyelids) at the Jules Stein Eye Institute, 1999 through 2003. Eighty-eight eyelids underwent external levator advancement, and 184 eyelids underwent Müller's muscle–conjunctival resection, alone or with concurrent blepharoplasty. Cosmetic outcome was graded on the basis of final eyelid position, eyelid crease, and eyelids symmetry, on an arbitrary scale of 0 to 3, with 0 indicating excellent results, 1 good, 2 poor and 3 reoperation either for residual ptosis or for overcorrection and consecutive eyelid retraction. * $P < .01$, χ^2 analysis.

then the P values are approximate. Statistical analysis was performed with Microsoft Excel (Microsoft Corporation, Redmond, Washington, USA) and SPSS (SPSS, Inc, Chicago, Illinois, USA) programs. Conversion of Snellen acuity to logarithm of minimal angle of resolution (logMAR) values was performed.

RESULTS

ONE HUNDRED AND FIFTY-NINE PATIENTS (51 MEN, 108 women, mean age 70 years) underwent 272 surgical pro-

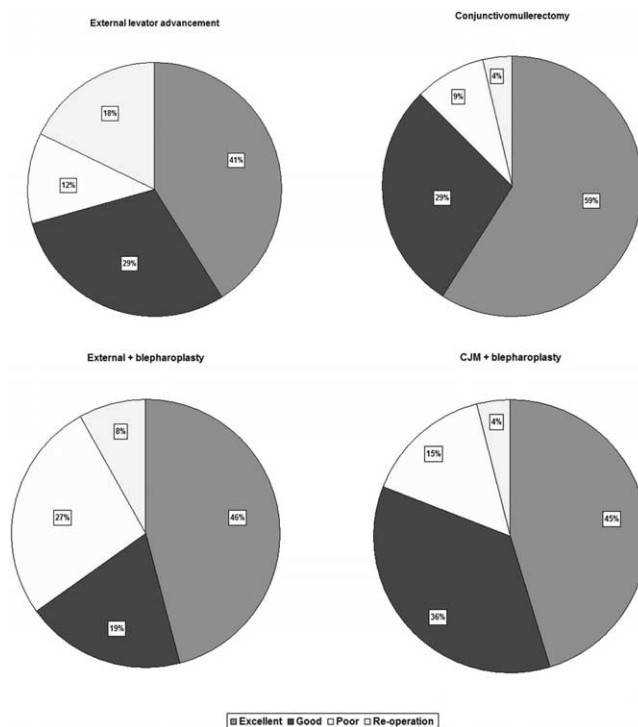


FIGURE 3. Outcome of blepharoptosis surgery in 159 patients (272 eyelids) at the Jules Stein Eye Institute, 1999 to 2003. Eighty-eight eyelids underwent external levator advancement (37 with blepharoplasty and 51 alone), and 184 eyelids underwent Müller's muscle–conjunctival resection (104 with blepharoplasty and 80 alone). Cosmetic outcome was graded on the basis of final eyelid position, eyelid crease, and eyelids symmetry, on an arbitrary scale of 0 to 3, with 0 indicating excellent results, 1 good results, 2 poor results, and 3 reoperation either for residual ptosis or for overcorrection and consecutive eyelid retraction. Patients who underwent Müller's muscle–conjunctival resection attained a better cosmetic outcome and had a lower reoperation rate ($P < .01$, χ^2 analysis). CJM = conjunctivomullerectomy.

cedures for upper eyelid ptosis. One hundred forty-one eyelids underwent concurrent blepharoplasty. Bilateral surgery was performed in 113 patients (71%). External levator advancement was performed in 88 eyelids and CJM in 184 eyelids. Demographics of the study population are summarized in Table 1.

MRD1 increased an average of 1.6 mm (± 1.5), from 0.8 mm (± 1.2 , range 0.5 to 3.0) preoperatively to 2.3 mm (± 1.2 , range 1.0 to 6.0) postoperatively ($P < .001$, one sample t test for Δ MRD1). Visual acuity remained stable after surgery (Δ logMAR of -0.0012 , $P = .88$, one sample t test). Older patients had a more severe ptosis preoperatively ($R = 0.56$, $P < .001$, for change in MRD1, Pearson bivariate correlation). Similarly, older patients had lower preoperative visual acuity, but this correlation was less powerful ($R = 0.3$, $P < .001$).

Patients who underwent external aponeurosis surgery had more ptotic eyelids preoperatively (MRD1 0.33 [± 1.5]

TABLE 3. Functional and Cosmetic Outcome for 159 patients (272 Eyelids) Operated on for Blepharoptosis at the Jules Stein Eye Institute, 1999–2003*

Variable	Value
Surgery	
External levator advancement	51 (19%)
CJM	80 (29%)
Blepharoplasty + external	37 (14%)
Blepharoplasty + CJM	104 (38%)
Delta MRD1 [†] (mm) mean (±SD)	1.6 (±1.5), <i>P</i> < .001
Cosmetic outcome	
Excellent	132 (49%)
Good	82 (30%)
Poor	39 (14%)
Reoperation [‡]	19 (7%)
Complications	
Eyelid retraction	4 (1.4%)
Lagophthalmos, 1 mm	10 (3.6%)
Pyogenic granuloma	2 (0.8%)

CJM = Conjunctivomullerectomy; MRD1 = marginal reflex distance, measured from the upper eyelid margin to the pupillary light reflex (in mm).

*Patients underwent Müller's muscle–conjunctival resection (conjunctivomullerectomy) or external levator advancement alone or with concurrent blepharoplasty.

[†]Difference between MRD1 preoperatively to MRD1 postoperatively in mm; *P* was calculated using one sample *t* test.

[‡]Reoperation either for residual ptosis or for eyelid retraction.

mm vs 1.0 [±0.9] mm, *P* < .001, independent samples *t* test) but attained a similar MRD1 postoperatively (2.3 [±1.6] mm vs 2.4 [±1.0] mm in the CJM group, *P* = .6). Therefore the change in MRD1 postoperatively was higher for the external approach group (1.9 [±1.7] mm vs 1.4 [±1.3] mm in the CJM group, *P* = .02). This was also the case for patients who underwent external levator advancement with blepharoplasty (preoperative MRD1 0.1 mm, postoperative MRD1 to 2.6 mm) and CJM with blepharoplasty (preoperative MRD1 0.9 mm, postoperative MRD1 to 2.3 mm). The change in MRD1 (Δ MRD) for all four groups is shown in Figure 1 and in Table 2. Change in visual acuity and intraocular pressure was similar in both groups.

Patients who underwent CJM had a better cosmetic outcome than patients who underwent external levator advancement (mean outcome 0.7 for CJM vs 1.0 for external levator advancement, *P* = .01, independent samples *t* test). Similarly, when applying χ^2 analysis, a higher percentage of CJM patients attained excellent and good outcome (51% and 33%, respectively) as compared with external levator advancement patients (43% and 25% in each category). Additionally, a lower percentage of CJM patients attained a poor outcome or underwent reoperation for residual ptosis or for overcorrection or

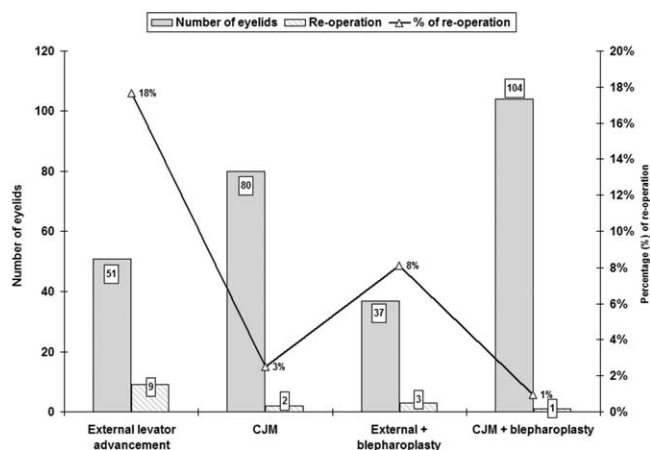


FIGURE 4. Reoperation rate for residual ptosis in 159 patients (272 eyelids) at the Jules Stein Eye Institute, 1999 through 2003. Fifty-one eyelids underwent external levator advancement, and 80 eyelids underwent Müller's muscle–conjunctival resection (CJM) as the first surgical procedure. External levator advancement with blepharoplasty was performed in 37 eyelids, and CJM with blepharoplasty was performed in 104 eyelids. Reoperation rate was the lowest (4%) in patients undergoing CJM either with or without blepharoplasty (*P* = .007, χ^2).

residual eyelid retraction (13% and 4%, respectively) as compared with external levator advancement patients (18% and 14% in each category) (*P* = .009, χ^2 analysis) (Figure 2).

When evaluating outcome in all four groups of patients (CJM vs external levator advancement either with or without upper blepharoplasty), preoperative MRD1 and change in MRD1 were statistically significantly different between groups (*P* < .001 and *P* = .002, respectively, one-way ANOVA); this most likely stems from the lower MRD1 value in patients who underwent external approach ptosis surgery (Table 2). Patients in the CJM group attained better cosmetic outcome (outcome score of 0.6 for CJM and 0.8 for CJM with blepharoplasty) than patients in the external levator advancement group (outcome score of 1.1 and 1.0, respectively, *P* = .02, one-way ANOVA). This was also the case when nonparametric χ^2 analysis was applied, and better cosmetic outcome was found in the CJM groups (*P* = .007, χ^2) (Figure 3, Table 3).

Fifteen patients (5.5% of all procedures) had reoperation for residual ptosis; this was more apparent in patients undergoing external levator advancement without blepharoplasty, with 9 of 51 eyelids (17.6%) needing reoperation (Table 2). Patients who underwent CJM either with or without blepharoplasty had the lowest reoperation rate (1% and 2.5%, respectively), whereas patients undergoing external levator advancement with blepharoplasty had a reoperation rate of 8.1%; these differences were statistically significant (*P* < .001, Fisher exact test) (Figure 4).

Complications included overcorrection and consecutive eyelid retraction in four patients (1.4%); three underwent

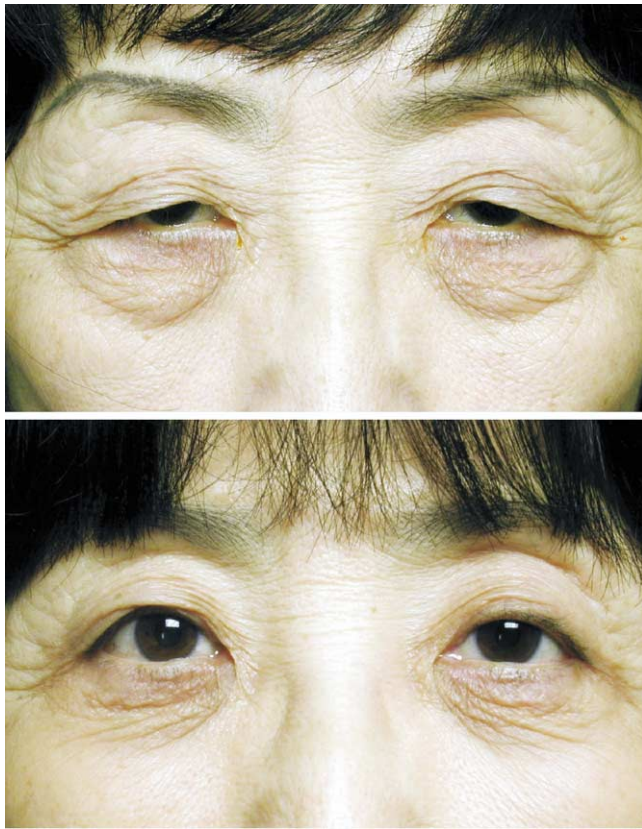


FIGURE 5. A 62-year-old woman with bilateral upper eyelid involutional ptosis and dermatochalasis (top). She underwent bilateral Müller's muscle–conjunctival resection and upper blepharoplasty. (Bottom) Three months postoperatively, functional and cosmetic outcome is good, but there is right upper eyelid retraction due to surgical overcorrection. The patient underwent surgery to correct right eyelid retraction, but there was no improvement in eyelid position postoperatively.

CJM and one underwent external levator advancement. Three of these patients underwent successful correction of eyelid retraction; in one patient surgery to correct eyelid retraction was unsuccessful (Figure 5). Patients who underwent CJM had a higher chance of overcorrection and postoperative upper eyelid retraction ($P < .001$, Fisher exact test). Ten cases (3.7%) showed mild lagophthalmos (<1 mm) postoperatively. Pyogenic granuloma developed in two cases ($<1\%$), and prolonged eyelid edema developed in three cases (1%) but subsided spontaneously.

DISCUSSION

THIS STUDY SUPPORTS PREVIOUS REPORTS THAT EXTERNAL levator advancement and Müller's muscle–conjunctival resection performed alone or with concurrent blepharoplasty are both effective in correction of involutional upper eyelid ptosis.^{7,10,13–19} Reoperation rate for residual ptosis is low in CJM ($<3\%$) and can be as high as 17% in external

ptosis repair. Overcorrection and eyelid retraction is not common (1.4%) but may be more prevalent in CJM. Cosmetic outcome, based on eyelid contour, eyelid crease, and eyelid symmetry, may be higher in CJM, even more so when performed concomitantly with upper blepharoplasty. However, it is important to realize that the two groups differ in the degree of ptosis preoperatively; patients who underwent CJM had minimal ptosis to start with as compared with patients who underwent external levator advancement. This may have caused a selection bias; therefore, it is anticipated that the CJM group had a lower reoperation rate and better cosmetic outcome. Keeping that in mind, our results emphasize the relatively successful outcomes in both cases.

External levator advancement for blepharoptosis is an effective procedure in establishing good eyelid position, with reported success rates of 70% to more than 95%.^{16,17,20–23} In a recent study,²⁰ 828 patients who were operated on for blepharoptosis by superior levator advancement were evaluated. Eighty percent of the patients attained satisfactory results, defined as postoperative MRD1 greater than 2.0 mm and less than 4.5 mm with less than 1 mm of asymmetry between two eyelids. Reoperation rate was 8.7% in all patients, 5.2% of unilateral and 13% of bilateral cases. Other studies describe a reoperation rate of 2.5% and an overcorrection rate of 3.4% with external levator advancement.²⁴ We had a similar reoperation rate of 5.5% for all patients, but rates of 8.1% and 17.6% for patients undergoing external levator advancement either with or without blepharoplasty, respectively. This discrepancy may be related, at least in part, to the fact that levator advancement patients had a more severe ptosis preoperatively as compared with CJM patients. Interestingly, overcorrection and eyelid retraction were more prevalent in CJM patients, but the rate of overcorrection for all patients was relatively low (1.4%).

Excellent results have also been reported with Müller's muscle–conjunctival resection for blepharoptosis.^{7,19,25–27} Several mechanisms contribute to eyelid elevation attained with this procedure; these include vertical shortening of the posterior lamella, plication or advancement of Müller's muscle, and levator aponeurosis and cicatricial changes.^{25,28–30} External levator resection enables intraoperative adjustment of the eyelid position, whereas CJM requires careful preoperative planning of the desired tissue to be excised. This is aided by instillation of phenylephrine 10% or 2.5%, which stimulates the sympathetically innervated Müller's muscle, causing it to contract, shorten, and elevate the eyelid. We believe that if the eyelid fails to respond to the phenylephrine test, an alternative procedure such as external levator resection should be performed.²⁵

Our patients who underwent CJM attained better cosmetic results based upon eyelid contour, eyelid crease, and eyelid symmetry as compared with patients who underwent external levator advancement. It is

possible that with the use of a Putterman clamp, a more accurate advancement of levator aponeurosis is performed without altering the eyelid contour or eyelid crease.²⁷ This finding may also reflect the fact that the CJM group had a much lower degree of ptosis preoperatively. Most patients in the current study, however, regardless of type of surgery performed, attained excellent or good cosmetic results. Interestingly, overcorrection and consecutive eyelid retraction were more prevalent in CJM patients, but because only four patients were operated on for overcorrection, any conclusion in that regard may be inaccurate.

Our reoperation rate after external levator advancement was 18% when performed alone and 8% when performed with concurrent blepharoplasty. Selection of patients in the current study may influence this relatively high reoperation rate. Patients who underwent external levator advancement had significantly more severe ptosis preoperatively as compared with patients who underwent CJM and we believe that with a similar degree of ptosis, both surgeries may result in good functional and cosmetic outcome. Previous studies demonstrate excellent results for levator advancement with blepharoplasty.³¹

Limitations of the current study stem from its retrospective design. Patients who underwent external levator advancement had significantly lower preoperative MRD1 as compared with CJM patients and hence had more severe levator dehiscence. Postoperatively, these patients attained MRD1 similar to that of CJM patients, implying that external levator advancement with intraoperative adjustment of eyelid position is a powerful surgical procedure that can be performed in any degree of involutional ptosis with good levator excursion. This is not the case, however, for CJM, which was performed in our patients with less severe ptosis. The Schirmer test and tear breakup time were not performed routinely in all patients. Several investigators believe that excision of conjunctiva may damage the accessory lacrimal glands of Wolfring, situated in the upper tarsal border, which may aggravate dry eyes.²⁷ Others³² have found no effect of eyelid ptosis repair by CJM on tear production. Despite the limitations, we believe that our study, along with previously published data, supports that external levator advancement and Müller's muscle-conjunctival resection performed alone or with concurrent blepharoplasty are effective in correcting involutional blepharoptosis.

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