Objective: To present data on a transblepharoplasty technique that provides a safe and reliable brow elevation and glabellar furrow reduction by releasing inferior tethering and weakening the brow depressor muscles.

Design: Nonrandomized retrospective case series and surgical technique description.

Results: One thousand patients who underwent internal brow elevation for cosmesis associated with upper blepharoplasty over the past 9 years were reviewed. Follow-up ranged from 6 months to 9 years. There were no serious long-term complications. All patients experienced forehead hypesthesia, which was temporary in most patients. Only 2 patients complained of prolonged and bothersome forehead hypesthesia lasting longer than 2 years.

Conclusion: The internal brow elevation at blepharoplasty is a reproducibly safe and effective technique to improve eyebrow appearance without fixation.

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Eyebrow position, symmetry, and contour are paramount in the evaluation of the eyelids and face, as the eyebrows dramatically influence facial appearance and convey the physical and emotional state. For decades surgeons have sought to improve eyebrow appearance through various approaches. Most transblepharoplasty techniques recommend periosteal fixation, which limits brow elevation and increases the rate of complications. Coronal forehead-lifts and, more recently, endoscopic elevations have received the bulk of the cosmetic attention. These techniques address brow height and contour and attempt to weaken the medial brow depressor muscles. However, these procedures have several drawbacks. Coronal incisions are time consuming, leave conspicuous scars, cause hair loss, elevate the hairline, and may create significant scalp paresthesia. While endoscopic forehead elevation causes less scarring, it can cause alopecia, paresthesia, and hairline elevation and requires expensive instrumentation. Longevity and achievement of a reliably natural postoperative appearance has been debated. Neither of these techniques are good options in patients with receding hairlines or “tall” foreheads. While these techniques may improve forehead rhytids, botulinum A toxin has become the best treatment for forehead rhytids in patients with adequate brow position.

More patients present for eyelid surgery than for brow-lift, and even those who request brow-lift and those requesting upper facial rejuvenation also require upper blepharoplasty. Most patients who present for eyelid surgery reject an upper facelift if suggested. Standard upper blepharoplasty and/or ptosis repair frequently aggravates brow ptosis by tightening tissues below and raising the upper eyelid margin. We present a technique, the internal brow elevation, to improve eyebrow appearance and position in conjunction with upper blepharoplasty. Suture fixation is not required, and we advise against brow fixation to allow enhanced natural brow elevation rather than restriction of movement. Most other transblepharoplasty techniques recommend periosteal fixation of the brow, which restricts movement of the brow and may create scarring to deep tissues and contour irregularities.

There has been a high level of patient acceptance of internal brow elevation, and it avoids many of the commonly associated complications of brow surgery. No additional incisions beyond the upper blepharoplasty are required. Release of the anterior leaf of the posterior galea and orbital ligament laterally, with removal of the corrugator and depressor supercilii muscles medially, is performed. Sculpting of heavy brow fat pads enhances the elevation. There is no forehead scarring.

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no elevation of the hairline, and no alopecia. We have not encountered overcorrection or patients complaining of a postoperative “surprised” appearance. Temporary forehead hypesthesia is a predictable adverse effect.

Internal brow elevation has high patient acceptance, saves time and cost, and reduces morbidity, while producing enhanced natural elevation of the brow rather than reduced motility from fixation.

METHODS

A retrospective review of 1000 patients in the practice of 1 of the authors (R.L.A.), who had undergone internal brow elevation associated with upper blepharoplasty in the past 9 years, was performed. Informed consent was obtained from each of the subjects in accord with Health Insurance Portability and Accountability Act regulations, and the principles outlined in the Declaration of Helsinki were followed.

ANATOMY

The anatomy and function of the brow is an important consideration in cosmetic surgery. Several forces act segmentally on the eyebrows to create a dynamic equilibrium that determines brow position. The motility of the brow fat pad is an important concept in determining how to best manipulate eyebrow position. Lemke and Sta- sior3 describe the mobile plane within the brow created by a division within the deep galea aponeurotica. The divisions of the deep galea, the anterior leaf and posterior leaf, envelop the brow fat pad (Figure 1). The frontalis muscle and the orbicularis muscle have strong attachments to the frontal bone medially but less so laterally. This dearth of lateral support of the eyebrow and the mobility of the brow fat pad help account for the prevalence of involutional lateral brow ptosis.3

It is useful to divide the discussion of brow ptosis into lateral and medial components. The forces that cause descent of the lateral eyebrow include orbicularis muscle action and the mass effect of the eyelid, brow fat pad, and soft tissues of the temporal forehead. The primary force that elevates the lateral eyebrow is contraction of the frontalis muscle, which is limited by the attenuation of the frontalis muscle lateral to the temporal fusion line of the skull.4 The brow fat pad attachments to the lateral aspect of the supraorbital rim support the brow position in younger patients but weaken and sag in older patients.3 The confluence of the anterior leaf of the deep galea and the superficial temporalis fascia is termed the orbital ligament. The orbital ligament attachment to the superolateral orbital rim tethers the eyebrow and restricts it from full superior mobility (Figure 2A).4 We believe that the orbital ligament functions as a check ligament preventing overaction of the frontalis muscle on the temporal brow. While this check ligament may be useful to limit overelevation of the temporal brow in youth, it only tethers the brow in older patients. As the brow fat pad descends, it places more tension and weight on...
the orbital ligament and anterior leaf of the posterior galea, causing temporal eyelid fullness and further restriction of the frontalis.

We address the lateral eyebrows and eyelids by excising the lateral orbicularis underlying the blepharoplasty skin removal, releasing the orbital ligament and sculpting and debulking the sagging brow fat pads. The release of the anterior leaf of the posterior galea aponeurotica enhances the effect of the frontalis on the lateral eyebrow by reducing restriction. The overall aesthetic improvement is a natural elevation of the lateral brow. Patient selection is paramount for internal brow elevation. Most patients with severe brow ptosis or facial paralysis require more aggressive procedures such as direct brow elevation, small incision elevation techniques, or forehead-lifts. We use periorbital fixation at internal brow elevation only in patients with facial nerve paralysis. Prior to the present study, we used internal fixation at blepharoplasty. We were dissatisfied with the complications, which included restricted brow movement, dimpling of the brow, and irregular contours. It makes poor anatomical sense to fixate and thereby cause the brows to be adynamic.

The medial eyebrow is influenced by a different set of forces. The depressor muscles include the corrugator supercilii, the depressor supercilii, and the medial portion of the orbicularis oculi muscle. These muscle groups cause furrowing of the glabellar skin and base of the nose as well as inferior displacement of the brow. Contracture of the frontalis muscle raises the medial eyebrow and relaxes the glabellar furrows. By weakening the medial eyebrow depressor muscles, the medial brow is elevated and the glabellar furrows are reduced similar to that seen with botulinum A toxin use. Overaggressive elevation of the medial brow, which results in an unattractive “surprised” appearance and can occur with upper face-lifting procedures, has not occurred with internal brow elevation. Compared with other brow procedures, internal brow elevation usually provides less brow elevation but much better weakening of the depressor muscles and furrow reduction. Patients who present for upper face-lift rather than blepharoplasty usually require a more aggressive lift than the technique described herein. However, most patients presenting for eyelid surgery are pleased with the aesthetics and natural appearance of the internal brow elevation.

**SURGICAL TECHNIQUE**

Preoperatively, it is important to design the surgery with the patient in a sitting position. A fine marking pen is used to draw the standard blepharoplasty incision lines and mark the most prominent areas of the brow fat pads. The vertical and horizontal glabellar furrows are then marked for accurate intraoperative orientation. After appropriate sedation, the patient’s upper eyelids are infiltrated with 2% lidocaine hydrochloride with epinephrine bitartrate. A supraorbital block is performed, and the corrugator, procerus, and depressor supercilii muscles are infiltrated, as well as the brow fat pads. The patient’s face is then prepared and draped in sterile fashion.

Blepharoplasty incision and skin muscle excision are performed with care taken to completely remove the orbicularis muscle underlying the temporal skin incision. This enhances the temporal brow elevation by weakening the depressor action of the lateral orbicularis and thinning and lightening the eyelid. Removing this orbicularis muscle also decreases the “crows feet” and helps to avoid the small bump, which may occur at the temporal end of a blepharoplasty incision. After hemostasis is obtained, the anterior leaf of the deep galea overlying the brow fat pad is grasped with forceps (Figure 2B). Manipulating this dense tissue clearly demonstrates the orbital ligament and its tethering effect on the lateral eyebrow. The orbital ligament is transected at its most inferior extent between the lateral canthal tendon and the zygomatofrontal suture. Scissors are used to open the anterior leaf of the deep galea and release it from the periorbital attachments along the superolateral orbit. Underlying brow fat is then sculpted, but oversculpting is to be avoided because it may result in an overly pronounced bony appearance to the orbital rim. The periorbital and the orbicularis muscle underlying the remaining skin must be left intact to avoid adhesions and dimpling of the brow. The nonmobile fat that is adherent to periosteum must also be left intact to maintain a low-friction sliding surface for brow motility. After orbital ligament release and sculpting is completed, the eyebrow is elevated and more mobile. Intraoperatively, the achieved effect can be profound compared with the as yet untreated left contralateral brow (Figure 2C).

If the medial depressor muscles are to be removed, release of the anterior leaf of the posterior galea aponeurotica plane is extended medially (Figure 2D). This is achieved by sliding a blade of a Stevens scissors bluntly, taking care to stay just superior to the bony rim to avoid the supraorbital and supratrochlear neurovascular bundles. After the underlying corrugator is exposed, its oblique fibers are meticulously excised. Lifting the corrugator muscles away from deeper tissues with heavy forceps prior to excision helps to avoid the underlying neurovascular structures. Dissection further medially and inferiorly exposes the depressor supercilii (Figure 3). Depressor supercilii muscles are extirpated and/or transected and weakened with care to avoid the adjacent medial vessels. Blunt dissection under the thick skin between the brows undermines and elevates the glabellar furrows and weakens attachments to the overlying skin. Deeper blunt dissection may also be used to weaken the procerus muscle attachments, but control of bleeding without visualization can be problematic.

Corrugator and depressor supercilii muscle extirpation in combination with the lateral release and debulking produces a natural elevation and sculpting of the eyebrows (Figures 4, 5, 6, and 7). After hemostasis is obtained, blepharoplasty closure is completed as usual. We use interrupted 6-0 plain catgut sutures to allow postoperative fluid egress and have not found it necessary to patch or place drains in the operative sites. Ice packs and ophthalmic ointment are applied. Care must be taken during cleansing of the eyelids in the first 24 hours to avoid bleeding.
RESULTS

We retrospectively reviewed results of internal brow elevation on 1000 patients performed over the last 9 years in one of our practices (R.L.A.). All procedures were performed on patients presenting for blepharoplasty. Many patients also had associated ptosis repair. Long-term follow-up ranged from 6 months to 9 years. Patients presenting for internal brow elevation and corrugator muscle removal with myectomy for blepharospasm or for headache were excluded from this study. Patient selection and preoperative discussion is paramount because internal brow elevation is not adequate for all cosmetic patients. However, we have been pleased with the high level of patient acceptance and satisfaction in our oculoplastic surgery practice. Many patients who rejected a recommended forehead or direct brow-lift accepted the internal brow-lift and were satisfied. Some patients failed to achieve the degree of brow elevation they had expected, but only 5 opted for a secondary forehead-lift. Postoperative swelling, bruising, and wound discharge are often slightly more pronounced compared with standard blepharoplasty.

None of our patients experienced overcorrection or long-term complications from the internal brow elevation with the exception of forehead hypesthesia. Some immediate forehead and brow hypesthesia is present in all patients because the superficial-most branches of the supratrochlear, supraorbital, and lacrimal nerves are invariably transected. Hypesthesia usually resolves in weeks to months and should be discussed preoperatively. Permanent hypesthesia is rare, and bothersome forehead hypesthesia lasting longer than 2 years has been a complaint in only 2 patients.

Figure 3. Corrugator (A) and depressor (B) supercili muscles shown in the forceps during removal.

Figure 4. A, Preoperative photograph showing marked blepharoptosis, bulky brow fat pads, and brow ptosis on both sides; B, postoperatively, the eyebrows are elevated medially and laterally. Sculpted brow fat pads produce “lighter” appearing and elevated eyebrows. The patient had limited ptosis repair and blepharoplasty because of profound dry eye syndrome.

Figure 5. A, Preoperative photograph showing heavy temporal brow fat pads, deep glabellar furrows, and marked facial asymmetry with the right side smaller; B, after sculpting and release of the medial and lateral portions of the eyebrows, the patient has a natural-appearing brow elevation and improvement in the glabellar furrows.
Enhancing brow position and appearance is important in cosmetic blepharoplasty. Elevation of the eyelid margin, as occurs with ptosis surgery and blepharoplasty, further reduces the brow-eyelid margin separation and makes brow ptosis more apparent. Such a patient, who had undergone upper and lower blepharoplasty but no brow ptosis correction, was referred to us. Because of excessive upper and lower eyelid skin removal, the brows are pulled downward, and significant lower eyelid retraction resulted (Figure 8).

Coronal and endoscopic forehead-lift techniques address this problem effectively but not without the well-known drawbacks of additional incisions, lengthier operative time, and use of costly equipment and anesthesia support. Others have described approaches that effectively reduce and limit the number and size of incisions required for forehead rejuvenation, but these approaches still depend on additional incisions and increased costs.

Transpalpebral techniques to address eyebrow ptosis and glabellar furrow reduction have been described.10,11 Most recommend internal fixation of the brow. Niechajev11 described a transpalpebral browpexy approach to address lateral brow ptosis that separates the interdigitizing connections between the orbicularis and frontalis muscles. This is followed by moving and fixing the orbicularis portion more cephalad to the frontalis muscles with nonabsorbable sutures.11 Niechajev11 has reported good long-term success with this technique, but we believe that this approach is technically more difficult compared with our described technique and reduces mobility of the brow. It adds considerable surgical time (30 minutes) to the standard upper blepharoplasty surgical time.11 In contrast, the brow fat sculpting and orbital ligament release takes only a few minutes to address lateral brow ptosis and enhance mobility.

Others have noted the importance of orbital ligament release for lateral brow rejuvenation and medial depressor weakening of the corrugator and depressor supercillii muscles for medial brow ptosis and glabellar furrow reduction, which may be easily addressed through a transpalpebral approach.7,10,12 Glabellar furrow reduction is an important part of forehead rejuvenation, but for lateral brow ptosis we have found our described technique to be effective when performed with or without resection of the medial depressor muscles.

Incorporation of the internal brow elevation reliably improves rather than worsens brow ptosis at upper blepharoplasty, which is its greatest utilization. The greatest limitation is that eyebrow elevation is less than that with endoscopic, coronal, or direct techniques. Another minor

Figure 6. A, Preoperative photograph showing marked brow ptosis, dermatochalasis, and glabellar furrowing; B, excellent postoperative result seen after internal brow elevation, corrugator removal, and upper blepharoplasty.

Figure 7. A, Preoperative photograph showing marked brow ptosis, brow fat pads, and dermatochalasis; B, postoperative photograph showing excellent improvement of her dermatochalasis and brow ptosis after performing internal brow elevation at upper blepharoplasty with corrugator removal.

Figure 8. A patient who had standard upper blepharoplasty without brow ptosis correction. Pronounced brow ptosis is seen with the eyebrows in contact with the upper eyelids.
limitation is that the forehead rhytids are not addressed by the internal brow elevation technique, but they are fortunately not worsened, as can occur with internal fixation techniques. Patients failing to achieve the amount of eyebrow-lift expected are usually satisfied when it is explained both preoperatively and postoperatively that standard upper blepharoplasty and/or ptosis repair performed in cases of brow ptosis generally worsened brow ptosis. Patients have not complained of worsened brow ptosis following the internal brow elevation. Postoperatively, to avoid adhesions that restrict brow movement and elevation, patients are told to gently push their eyebrows upward and outward several minutes each day beginning 3 days after surgery for a month.

Because this is a retrospective review, we have not conducted a long-term detailed analysis of the longevity of the lift. However, we have had only 5 patients request a subsequent endoscopic or direct brow-lift surgery in the follow-up period. All brow-lift procedures fall with time, and internal brow elevation at blepharoplasty is no exception. Many of these patients continued botulinum A toxin injections and other facial rejuvenation treatments (eg, peels) during the follow-up period. Botulinum A toxin may provide a more profound weakening of the medial depressor muscles, but this effect is temporary. Forehead wrinkles are best treated with botulinum A toxin and can be more aggressively treated after internal brow elevation. Occasionally, patients still desire but require less botulinum A toxin in the depressor muscles after surgery. In the present study, some patients chose the internal brow elevation and glabellar reduction, whereas others opted only for the orbital ligament release, anterior release of the posterior galea, and brow fat sculpting.

Internal brow elevation has many advantages over the nonpalpebral incision techniques. Direct and proximal visualization and modification of the brow fat pads and medial eyebrow depressor muscles are provided through a single, well-concealed blepharoplasty incision. Internal brow elevation minimizes scars, cost, surgical time, morbidity, and complications and has a high level of patient acceptance.

Prior to developing the technique described herein, we performed internal suture fixation to the periosteum and frequently violated the fat adherent to the periosteum. We differ from others in that we believe that periosteal fixation is to be condemned because it results in restriction of brow movement, irregular dimpling, adhesions at or above the brow, or even restriction of eyelid closure. All of these complications were seen in our early periosteal fixation patients prior to using the technique described herein. We now recommend internal browpexy with periosteal fixation only with facial palsy.

In summary, internal brow elevation provides a reliably natural appearing brow elevation and furrow reduction, while minimizing scars, adverse effects, cost, and time. Patient selection is paramount, and some patients require more aggressive brow elevation techniques. In our oculoplastic surgery practice, most patients present for eyelid surgery. Internal brow elevation is a natural extension of eyelid surgery and has a high level of patient acceptance and satisfaction with appropriate patient selection.

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