Transpalpebral Approach to the Corrugator Supercilii and Procerus Muscles

David M. Knize, M.D.

Denver, Colo.

The most effective method for treating glabellar area skin contour irregularities produced by hyperactive corrugator supercilii and/or procerus muscles is resection of the former and at least transection of the latter. The usual surgical approach is a coronal incision, which produces recognized sequelae of scalp or prefrontal hairline scarring and scalp dysesthesia; potential complications include injury to the frontal branch of the facial nerve, postoperative alopecia, and excessive recession of the frontal hairline.

Hyperactive corrugator supercilii muscles may be excised and procerus muscles transected without a coronal incision. These muscles can be treated through an upper blepharoplasty incision without compromise to the blepharoplasty procedure. A transpalpebral technique as performed on 40 patients followed 6 to 24 months is described, and the cadaver and nerve block studies upon which this technique is based are discussed. The postoperative cosmetic improvement of the glabellar area is comparable in appearance with that achieved from a coronal incision approach. (*Plast. Reconstr. Surg.* 95: 52, 1995.)

The word *glabella* derives from the Latin word *glabellus,* meaning "hairless and smooth."[1] In the aging face, this usually hairless area is rarely smooth. Glabellar skin creases and/or the stern appearance produced by bulging medial eyebrows are often the primary cosmetic concern of patients requesting treatment for facial aging.

Twenty years ago, surgeons attempting procedures to rejuvenate the aging face generally ignored the facial skin surfaces superior to the orbital area. Then the forehead lift was introduced[2–4] and later refined[5–10] to treat the glabellar area by excision of the hyperactive corrugator supercilii muscle and the hyperactive procerus muscle. Today, the coronal forehead lift is a standard complement to blepharoplasty and lower facial plasty procedures. Even for patients with satisfactory eyebrow position and smooth forehead skin whose only forehead cosmetic complaint is glabellar skin creasing and/or bulging medial eyebrows, the coronal incision approach is used to treat the corrugator supercilii muscle and the procerus muscle. The coronal incision causes scalp dysesthesias and scalp or prefrontal hairline scarring, as well as the potential complications of injury to the frontal branch of the facial nerve, hair loss, and excessive elevation of the frontal hairline. This paper describes a method to treat hyperactive corrugator supercilii muscle and procerus muscle without the usual sequelae or potential complications of a coronal incision. We accomplish this using a transpalpebral approach through an upper blepharoplasty incision without compromise to the blepharoplasty technique.

Anatomic Studies (Figs. 1 and 2)

Fresh cadaver dissections were done on 20 half-head specimens to study muscle and nerve structures acting on the glabellar region. Corrugator supercilii muscle mass varied widely in different specimens, but its origin was constant; it always originated from the frontal bone near the superomedial orbital rim anterior and slightly cephalad to the trochlea of the superior oblique extraocular muscle (see Fig. 1). From its origin, the corrugator supercilii muscle passed superiorly and laterally through the frontalis and orbicularis oculi muscles before inserting into the medial half of the eyebrow skin. In most specimens, the area of insertion

From the Division of Plastic and Reconstructive Surgery, Department of Surgery, at the University of Colorado School of Medicine. Received for publication August 19, 1993; revised May 12, 1994.

Presented at the Annual Meeting of the American Society for Aesthetic Plastic Surgery, in Dallas, Texas, on April 19, 1994.

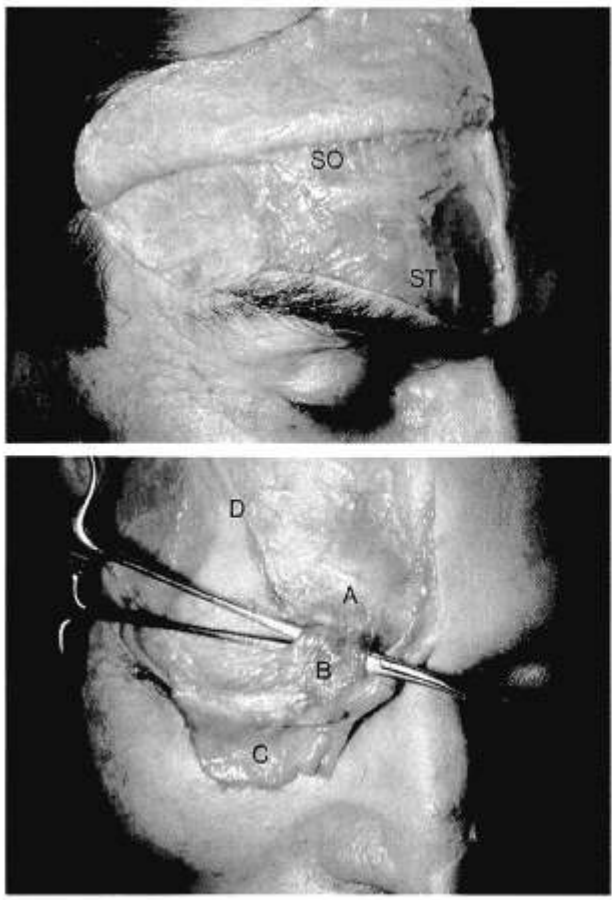


FIG. 1. Cadaver specimen. (*Above*) Exposed frontalis muscle. The supratrochlear nerve branches (*ST*) course from the medial eyebrow level over the surface of the muscle toward the scalp. The branches of the superficial division of the supraorbital nerve (*SO*) have a wide, fanlike pattern over the frontalis muscle. (*Below*) A hemostat is under the corrugator supercilii muscle (*B*) with the eyebrow skin, orbicularis oculi muscle, and the detached inferior frontalis muscle (*C*) reflected onto the cheek. The corrugator supercilii muscle takes its origin from the frontal bone near the superomedial orbital rim (*A*) and inserts into the eyebrow skin after passing through the frontalis and orbicularis oculi muscles. The deep division of the supraorbital nerve (*D*) runs between the galea aponeurotica and the pericranium toward the scalp.

FIG. 2. (*Above*) Procerus muscle (*P*) originates from the nasal bone and inserts variably into the skin between the paired frontalis muscles with some overlap of the frontalis muscles. (*Below*) The right side of the transected, thin procerus muscle is elevated with the forceps.

extended also to the skin immediately superior to the medial eyebrow.

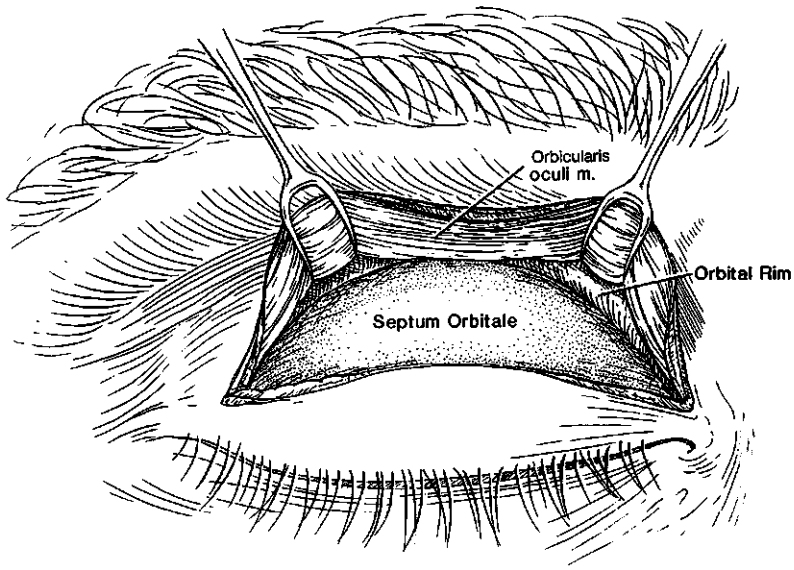
The thin, flat procerus muscle originated from the nasal bone and inserted into the glabellar and lower midforehead skin between the paired frontalis muscles. The width of the insertion varied and overlapped the medial frontalis muscle edges in most specimens (see Fig. 2). The muscle mass in different specimens was variable, but less so than that of the corrugator supercilii muscle.

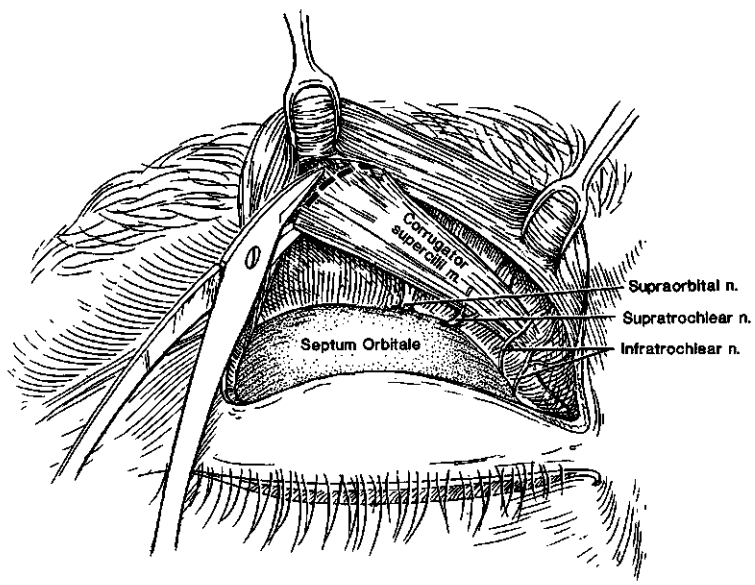
The nerves of surgical importance in the area are the supraorbital, supratrochlear, and infratrochlear nerves and the corrugator supercilii muscle and procerus muscle motor branches. The supraorbital nerve consistently ran cephalad deep to the corrugator supercilii muscle immediately after exiting the supraorbital rim, either from a foramen just superior to the rim or from a notch in the middle third of the rim.

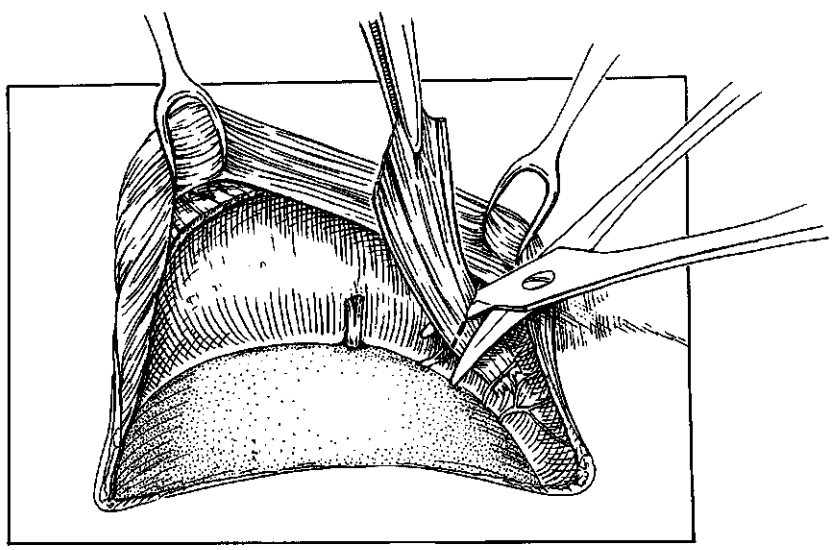
The supratrochlear nerve exited the orbit just lateral to the corrugator supercilii muscle's bony origin, entered the muscle, and divided into three to four smaller branches. These branches coursed cephalad on or just deep to the anterior surface of the corrugator supercilii muscle and then penetrated the frontalis muscle and ran on its medial ipsilateral surface toward the scalp (Fig. 1, *above*).

Multiple weblike branches from the infratrochlear nerve were always present on the medial side of the corrugator supercilii muscle near its origin. These nerve branches were not seen to enter the corrugator supercilii muscle.

Motor nerve supply for the corrugator supercilii muscle consisted of two to four small


Orbicularis oculi m.
Orbital Rim
Septum Orbitale


Corrugator supercilii m.
Supraorbital n.
Supratrochlear n.
Infratrochlear n.
Septum Orbitale



branches that were found to enter the muscle's lateral end just before the corrugator supercilii muscle passed into the frontalis and orbicularis oculi muscles. These branches could be traced back to the frontal branch of the facial nerve. At least part of the motor nerve supply to the procerus muscle entered the deep surface of that muscle's superior third.

Selective block of the supraorbital, supratrochlear, and infratochlear nerves and the frontal branch of the facial nerve were done on 10 living subjects. Each nerve block was done with 1.0 cc of 1% lidocaine without epinephrine solution. Block of the supraorbital nerve as it exited the orbital rim produced anesthesia of the ipsilateral upper eyelid skin, ipsilateral forehead skin except for a midline vertical strip (less than 1 cm wide), and that portion of the ipsilateral frontoparietal scalp from the rim of the temporal fossa to the midline.

Block of the supratrochlear nerve produced anesthesia of the midforehead skin without affecting scalp sensation. The forehead sensory area of the supraorbital nerve almost overlapped that of the supratrochlear nerve in most subjects. A block of the infratrochlear nerve produced numbness between the medial canthus of the eye and the nasal bridge; in no case was forehead skin affected. (The supraorbital and supratrochlear nerves are branches of the frontal nerve. The infratrochlear nerve is a branch of the nasociliary nerve. Both the frontal and the nasociliary nerves originate from the ophthalmic branch of the trigeminal nerve.[11])

Block of a frontal branch of the facial nerve paralyzed both the ipsilateral corrugator supercilii muscle and the ipsilateral half of the procerus muscle. (The motor nerve to the corrugator supercilii muscle has been described coming off the zygomatic branch of the facial nerve, but this finding could not be confirmed in our living subjects or cadaver specimens.)

SURGICAL TECHNIQUE

After completing the upper blepharoplasty skin excision, a 4- to 5-mm transverse section of orbicularis oculi muscle with its underlying thin fascial layer is excised to expose the septum orbitale. Two double hooks facilitate elevation of the orbicularis oculi muscle off the septum orbitale superiorly to the supraorbital rim using blunt scissors spreading dissection, as shown in Figure 3 (*above*). Continued dissection anterior to the orbital rim exposes the corrugator supercilii muscle, which is identified by the axis of its fibers (Fig. 3 *center*). Gentle, blunt scissors or hemostat dissection defines the superior and inferior corrugator supercilii muscle edges and the muscle's mass. Local nerves are identified by their orientation to the bony origin of the muscle. The supratrochlear nerve enters the corrugator supercilii muscle from the lateral side and divides into three to four branches that course upon or just beneath the muscle's anterior surface. The nerves seen on the medial side of the corrugator supercilii muscle origin are branches of the infratrochlear nerve which do not enter the muscle.

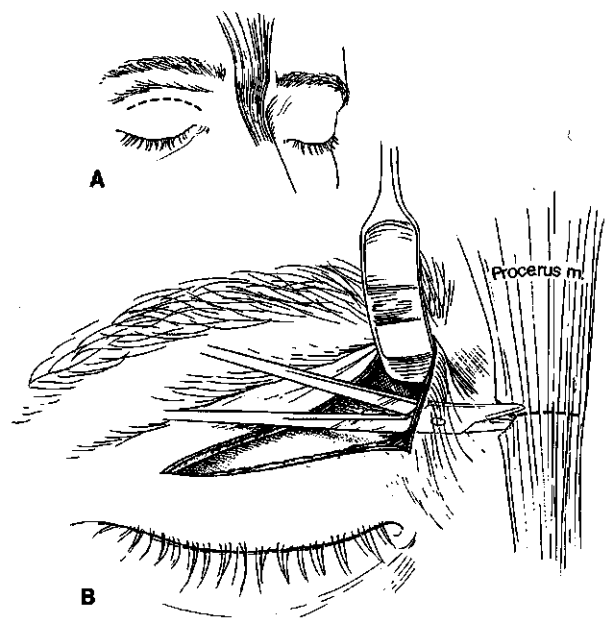


FIG. 4. (*A*) Procerus muscle orientation to the blepharoplasty incision. (*B*) The procerus muscle is transected through the same blepharoplasty incision approach used for the corrugator supercilii muscle excision.

FIG. 3. (*Above*) With the skin and orbicularis oculi muscle elevated, the deep surface of the orbicularis oculi muscle is exposed, and dissection proceeds to the superior orbital rim. (*Center*) The corrugator supercilii muscle can be identified by the axis of its fibers. Gentle, blunt dissection above and below the muscle will define its mass. The lateral end of the corrugator supercilii muscle is transected just as the muscle passes into the plane of the frontalis and orbicularis oculi muscles. The supraorbital nerve is safely deep to the plane of the transection. The supratrochlear nerve branches are always lateral and the infratrochlear nerve branches are always medial to the corrugator supercilii muscle origin. (*Below*) After resecting the lateral segment of the muscle just lateral to the level of the supratrochlear nerves, the remaining medial segment of the muscle can be carefully avulsed from its bony origin with a fine-tip hemostat, leaving the supratrochlear nerve branches intact. The supraorbital nerve courses cephalad deep to the level of dissection.

The corrugator supercilii muscle is transected at the level that it passes into the plane of the frontalis and orbicularis oculi muscles. Elevating the transected lateral muscle end away from the orbital rim with forceps protects the deeper supraorbital nerve (Fig. 3, *below*) as the lateral corrugator supercilii muscle segment is then resected just lateral to the level of the supratrochlear nerves. The remaining medial corrugator supercilii muscle segment may be gently avulsed from its bony origin with a fine-tip hemostat. Transected fibers of this friable muscle retract, facilitating the process of freeing the more resilient supratrochlear nerve branches that pass through the medial corrugator supercilii muscle. Magnification may be helpful. Usually, a prominent vein is encountered within the medial muscle mass. This vein may be dissected free without bleeding, but if not, it can be carefully cauterized with a fine-tip forceps. To prevent injury to the trochlea or tendon of the superior oblique muscle, dissection posteriorly from the point of origin of the corrugator supercilii muscle must be avoided.

Generally, use of fascial or other graft material placed over the corrugator supercilii muscle

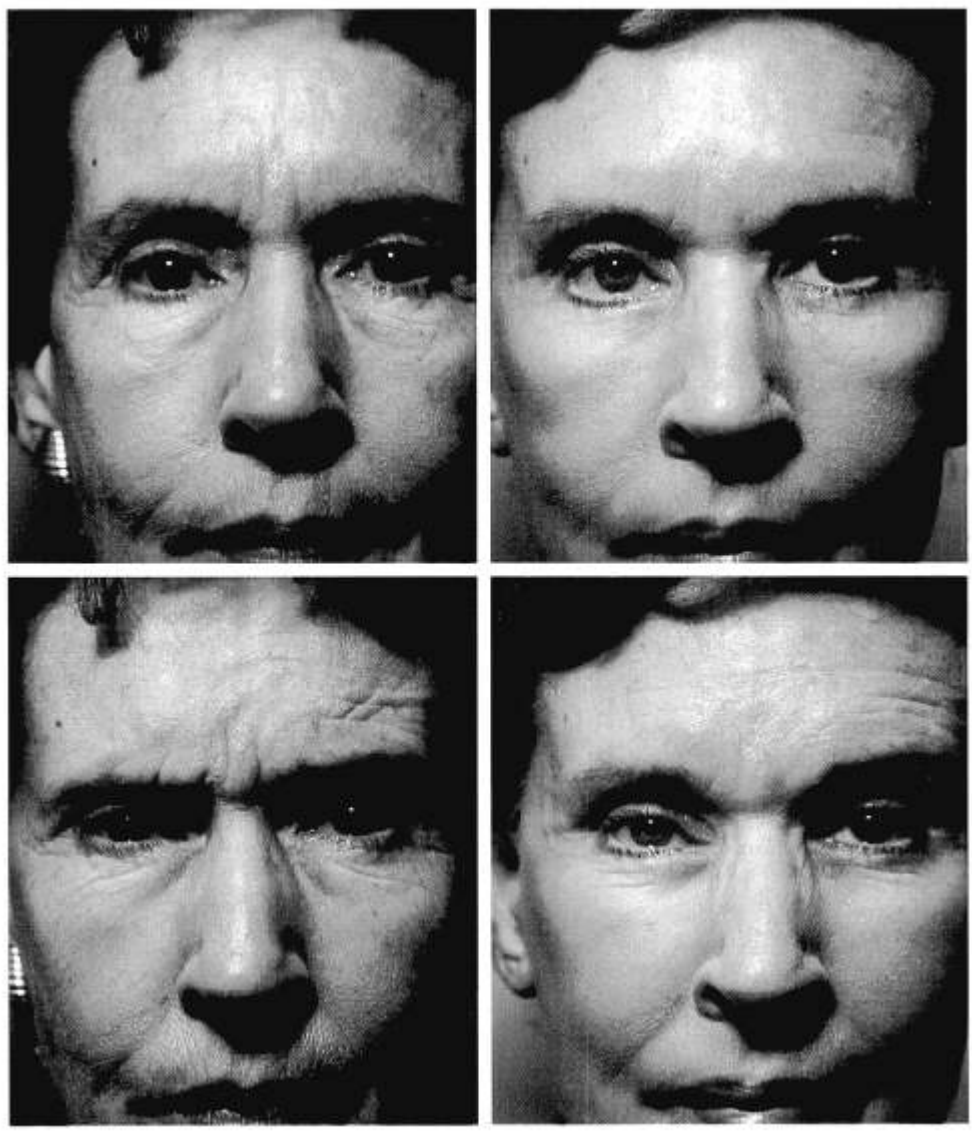


FIG. 5. (*Above, left*) Preoperative view with the patient's eyebrows in resting position. (*Above, right*) One year postoperative view of upper blepharoplasty with transpalpebral corrugator supercilii muscle resection. Lower blepharoplasty and facial plasty with temporal lifts also were done. (*Below, left*) Preoperative view with corrugator supercilii muscle activiated. (*Below, right*) One-year postoperative view with patient forcefully attempting to activate the corrugator supercilii muscle. Procerus muscle (untreated in this case) function remains.

resection site is unnecessary. However, if there is concern that the muscle resection might cause an overlying skin depression, graft material such as temporalis fascia may be used.

If the patient has transverse glabellar or dorsal nasal skin creases produced by procerus muscle action, this muscle as well may be treated through the blepharoplasty incision. The medial orbicularis oculi muscle is elevated, and a scissors is used to dissect bluntly toward the nasal bridge (Fig. 4). The procerus muscle is transected with a small scissors at the level of the radix of the nose, taking care to cut those muscle fibers just under the skin and those just over the nasal bone. A hemostat is passed from one medial blepharoplasty incision to the other over the radix of the nose, and a 2.5 × 1.5 cm graft of temporalis fascia is pulled across the nasal dorsum. The lateral edges of the graft are fixed with 6-0 Vicryl sutures to soft tissue under the medial end of each blepharoplasty incision. Then the hemostat is used within the tunnel to distribute the fascial graft evenly over the area of the retracted cut procerus muscle edges. The blepharoplasty is then completed in the usual manner.

RESULTS

The transpalpebral corrugator supercilii muscle resection technique has been performed in 40 patients followed for 6 to 24 months. In 10 of these patients, the procerus muscle transection and fascial grafting technique was additionally done. In each patient, excellent control of the hyperactive muscles was obtained (Figs. 5 to 8), and these patients were consistently pleased with the cosmetic effect.

A transient decrease in sensation of a narrow vertical band of midforehead skin from manipulation of the supratrochlear nerve branches was seen in all patients. Decreased sensation of the skin from the medial canthus onto the proximal nasal bridge also was seen occasionally when the infratrochlear nerve branches were manipulated. Skin sensation in both areas usually returned within 8 weeks. No

FIG. 6. (*Above*) Preoperative view with patient's eyebrows in resting position. (*Center*) One-year postoperative view of transpalpebral procerus muscle transection and fascial grafting over the transected muscle edges. The corrugator supercilii muscle also was transected (no muscle was resected). Note improvement in skin contour. (*Below*) One-year postoperatively, the patient can fully activate the previously transected corrugator supercilii muscles. When the corrugator supercilii muscle is treated only with transection rather than excision, muscle function can be expected to return.

FIG. 7. (*Above, left*) Preoperative view with eyebrows in resting position. Although this patient has minimal glabellar skin creasing, the bulging medial eyebrow is produced by increased corrugator supercilii muscle tone. (*Above, right*) One-year postoperative view of facial plasty with temporal lift component and blepharoplasty with corrugator supercilii muscle transpalpebral resection. The procerus muscle was not treated. Note smoother medial eyebrow contour. (*Below, left*) Preoperative view with patient contracting the corrugator supercilii muscle. (*Below, right*) One-year postoperative view with patient forcefully attempting to contract the corrugator supercilii muscle. The untreated procerus muscle's function remains.

sensory change of the skin in the distribution of the supraorbital nerve was found. There were no cases of infection, hematoma formation, or injury to the superior oblique muscle or its trochlea. If the corrugator supercilii muscle was incompletely resected (i.e., not resected to the level that the corrugator supercilii muscle passes into the plane of the frontalis and orbicularis oculi muscles laterally and not completely avulsed from bone medially), some of our earlier postoperative patients could contract the residual corrugator supercilii muscle again within 3 to 4 months. This produced a localized, hornlike prominence along the eyebrow. No recurrence of procerus muscle effect occurred after muscle transection (without excision) and fascial overgrafting.

DISCUSSION

Ideally, the surgeon should have in his or her armamentarium a variety of approaches to any anatomic problem and then select the most

FIG. 8. (*Above, left*) Preoperative view with eyebrows in resting position. (*Above, right*) One-year postoperative view of chemical peel of lower face from level of lower eyelids and upper blepharoplasty with transpalpebral corrugator supercilii muscle resection. (*Below, left*) Preoperative view with patient contracting her corrugator supercilii muscle. (*Below, right*) One-year postoperative view with patient forcefully attempting to contract her corrugator supercilii muscle.

appropriate one to treat the individual case at hand. For the problem of hyperactive corrugator supercilii muscle and/or procerus muscle, a coronal incision approach generally has been used. In patients with well-positioned lateral eyebrows, acceptably smooth forehead skin, or, especially, a high frontal hairline, an alternative approach to the corrugator supercilii muscle and/or the procerus muscle is desirable. The transpalpebral technique done in conjunction with a blepharoplasty is a direct approach to these muscles without leaving additional skin scarring, as advocated by Castanares.[5]

Excellent exposure of the corrugator supercilii muscle can be obtained. The supratrochlear and infratrochlear nerve branches lie on or near the anterior surface of this muscle, so this nerve can more easily be identified and protected than with the coronal incision technique or the endoscopic technique,[12] which approaches the superior and posterior surfaces of the corrugator supercilii muscle.

Supraorbital nerve injuy with corrugator supercilii muscle resection did not occur. This nerve runs deep to the corrugator supercilii muscle, which can be lifted away from the nerve

while removing the muscle (see Fig. 3, *below*). This nerve did not run within the corrugator supercilii muscle in any of the cadaver specimens.

It is important to resect the corrugator supercilii muscle completely. Laterally, the muscle must be transected just as it passes into the plane of the frontalis and orbicularis oculi muscles. Doing so ensures that the motor nerve branches that enter the corrugator supercilii muscle just medially to this plane will be resected with the muscle; otherwise, the residual lateral muscle segment could retain motor nerve supply and continue to function. Lateral corrugator supercilii muscle transection at the proper level denervates that portion of the corrugator supercilii muscle passing through the frontalis and orbicularis oculi muscles to insert into the eyebrow dermis, resulting in subsequent atrophy of that portion. It is equally important to completely avulse the medial segment of the corrugator supercilii muscle from its bony origin, because any residual medial segment can later contract. This medial segment either has a separate motor nerve supply not grossly apparent or it can become reenervated. Any unresected corrugator supercilii muscle can produce a hornlike prominence of the eyebrow after 3 to 4 postoperative months.

Unlike for the corrugator supercilii muscle (see Fig. 6), transection rather than excision of the procerus muscle has been adequate treatment. Placement of a fascial graft over the retracted muscle edges appears to stabilize their positions and prevent rejoining of the procerus muscle segments. This subcutaneous graft also may reinforce the overlying skin to resist creasing.

Because glabellar skin is often marked with creases and/or bulging from increased corrugator supercilii muscle resting tone or the proximal nasal dorsum is furrowed from increased procerus muscle resting tone, many blepharoplasty patients can benefit from a smoother glabellar area skin surface when the transpalpebral approach to the corrugator supercilii muscle and/or the procerus muscle is used as an adjunctive procedure to blepharoplasty. The technique is not a substitute for the forehead lift when ptotic lateral eyebrows or forehead lines require treatment, but it is a useful tool for treating hyperactive corrugator supercilii and/or procerus muscles. Suspension forces from a coronal incision forehead lift may contribute to making the glabellar area smoother, but muscle ablation appears to be essential. In our experience, the effect on the glabellar skin, medial eyebrow, and proximal-dorsal nose produced by corrugator supercilii muscle resection and procerus muscle transection and overgrafting using the transpalpebral approach is comparable with the change obtained from the coronal incision approach, with fewer unwanted postoperative side effects.

David M. Knize, M.D.
3555 South Clarkson Street
Englewood, Colo. 80110

REFERENCES

1. Gove, P. B. (Ed.). *Webster's Third New International Dictionary*. Springfield, Mass.: G. & C. Merriam Company, 1966. P. 961.
2. Hunt, H. L. *Plastic Surgery of the Head, Face and Neck*. Philadelphia: Lea & Febiger, 1926.
3. Pangman, W. J., II, and Wallace, R. M. Cosmetic surgery of the face and neck. *Plast. Reconstr. Surg.* 27: 544, 1961.
4. Gonzalez-Ulloa, M. Facial wrinkles—Integral elimination. *Plast. Reconstr. Surg.* 29: 658, 1962.
5. Castanares, S. Forehead wrinkles, glabellar frown lines, and ptosis of the eyebrows. *Plast. Reconstr. Surg.* 34: 406, 1964.
6. Johnson, J. B., and Hadley, R. C. The Aging Face. In J. M. Converse (Ed.), *Reconstructive Plastic Surgery*. Philadelphia: Saunders, 1964. P. 1337.
7. Vinas, J. C., Caviglia, C., and Cortinas, J. L. Forehead rhytidoplasty and brow lifting. *Plast. Reconstr. Surg.* 57: 445, 1976.
8. Connell, B. F., Lambros, V. S., and Neurohr, G. H. The forehead lift: Techniques to avoid complications and produce optimal results. *Aesthetic Plast. Surg.* 13: 217, 1989.
9. Bruck, J. C., Baker, T. J., and Gordon, H. Facial mimics and the coronal brow lift. *Aesthetic Plast. Surg.* 11: 199, 1987.
10. Rudolph, R., and Miller, S. H. Do forehead lifts lift or unfurl? *Aesthetic Plast. Surg.* 16: 1, 1992.
11. Williams, P. L., Warwick, R., Dyson, M., and Bannister, L. H. (Eds.). *Gray's Anatomy*, 37th Ed. London: Churchill-Livingstone, 1989.
12. Core, G. B., Vasconez, L. O., Askren, C., Yamamoto, Y., and Gamboa, M. Coronal face-lift with endoscopic techniques. *Plast. Surg. Forum* 15: 227, 1992.