JOURNAL ARTICLE

Extended Use of Botulinum Toxin Type A in Facial Aesthetic Surgery

Author Notes

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Issue Section: Articles

In facial aesthetic surgery, we perform operations that may at times have short-lived but positive aesthetic effects. When suboptimal results do occur in aesthetic surgery, for example, with laser skin resurfacing, they may relate less to inadequate execution and more to the failure to eliminate some or all causative factors such as exposure to the sun, poor nutrition, smoking, and hyperfunctional facial musculature.

Lines typically occur from muscular contractions in facial expressions that involve a multitude of complex coordinated actions of various facial muscles. Hyperfunctional facial muscular contraction tends to be a long-standing, partially involuntary action. Pretreatment of target areas with botulinum toxin type A (Botox®; Allergan Inc., Irvine, CA) may not only temporarily eliminate the facial lines produced by increased muscular activity, but also may improve the effect of the surgical or laser resurfacing procedure. Pretreatment with Botox® before laser exfoliation may allow for smoother skin resurfacing by eliminating the hyperfunctional component during healing.

We now better understand how to treat these facial lines with chemodenervation. In 1992 I reported on the use of botulinum toxin type A not only as a primary treatment for glabellar frown lines but also as a supplemental adjunct for autologous injectable collagen (Autologen®; Collagenesis Inc., Beverly, MA) for soft tissue augmentation in certain facial regions.[1] Since then, I have found chemodenervation to be useful as a primary modality to temporarily eliminate facial lines and furrows caused by hyperfunctional muscles and as an adjunct and "fortifier" for a variety of facial aesthetic procedures, including laser skin resurfacing, canthoplasty, brow lifts, and soft tissue augmentation.

After several years of experience in CO_2 laser skin resurfacing, many of us have come to realize that in spite of excellent execution of skin resurfacing, rhytids tend to recur commonly in very specific areas; these include periocular rhytids (crow's-feet), perioral rhytids ("smoker's lines"), as well as horizontal and vertical (glabellar) forehead furrows.

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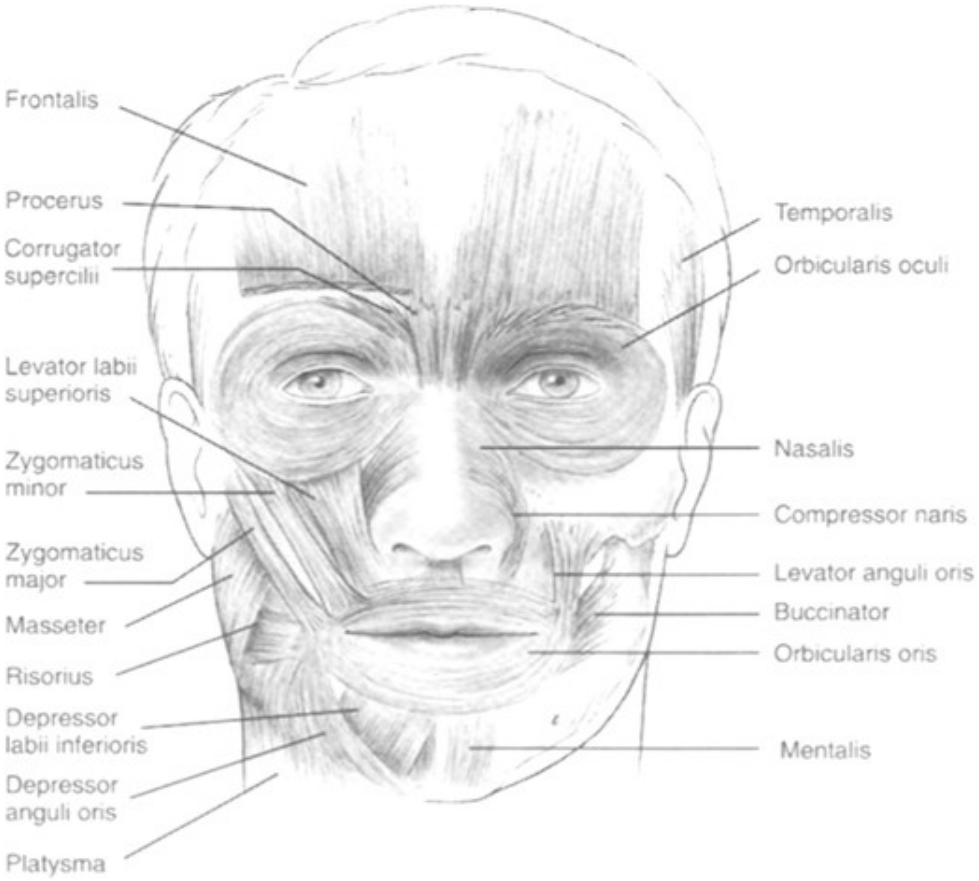
An understanding of the pertinent functional anatomy of facial expression is crucial for appropriate orientation and sound treatment rationale. Facial muscles, along with most of the body musculature, have a functional protagonist and antagonist. This concept was applied in the original use for botulinum toxin type A by Scott et al.,[2] who proposed its use for the treatment of strabismus. Scott et al.[2] injected the antagonist eye muscles with the toxin to weaken their effect and cause improved ocular alignment by enhancing the function of the protagonist muscle. In facial musculature, for aesthetic enhancement, the frontalis muscle, the orbital

aspects of the orbicularis oculi muscles, the corrugator, and the procerus muscles can all be treated with Botox® to achieve various effects. The frontalis muscle is the primary elevator of the eyebrow; its antagonist at the lateral eyebrow is the orbital portion of the orbicularis oculi (i.e., the orbicularis acts as a lateral eyebrow depressor). In the medial aspect of the eyebrow (the head), the corrugator supercilii, and to a smaller degree the procerus muscles, act as the antagonist to the frontalis muscles (Figure 1).

Figure 1.

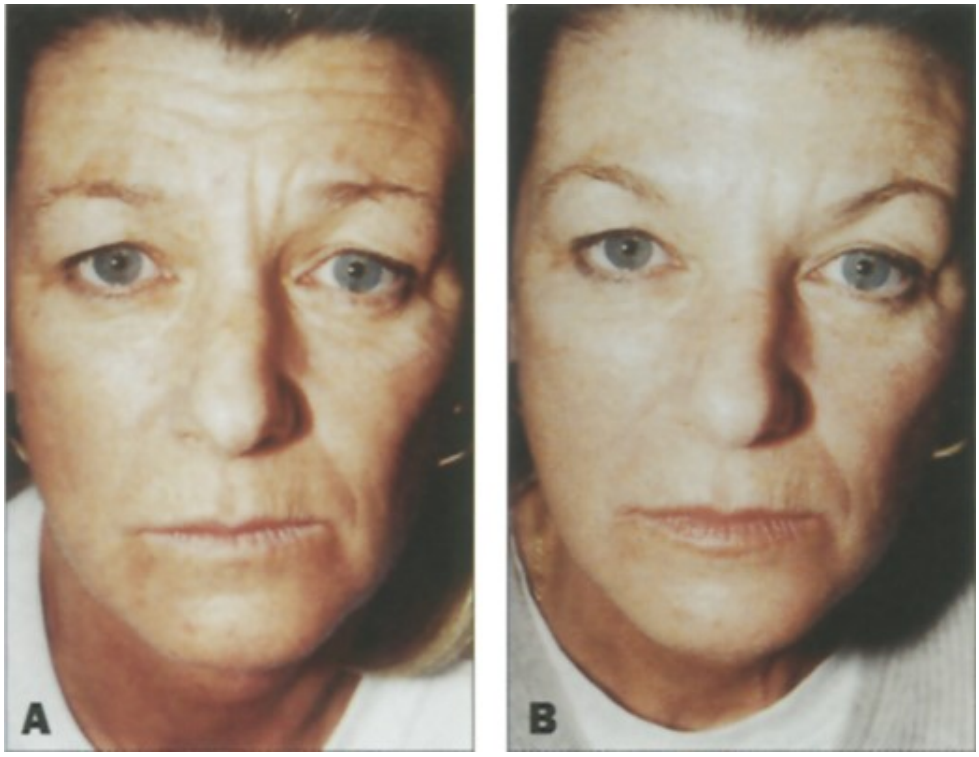


Schematic representation of the pertinent facial musculature.

Weakening a muscle's antagonist typically will augment the primary function of that muscle, which can have certain effects on the position of the overlying soft tissue. For example, weakening the lateral orbital orbicularis muscle can bring about a slight lateral eyebrow elevation because the frontalis no longer has to act on its antagonist (Figure 2). Similarly, the levator muscles of the lip and the orbicularis oris are antagonists to each other. Weakening the lip

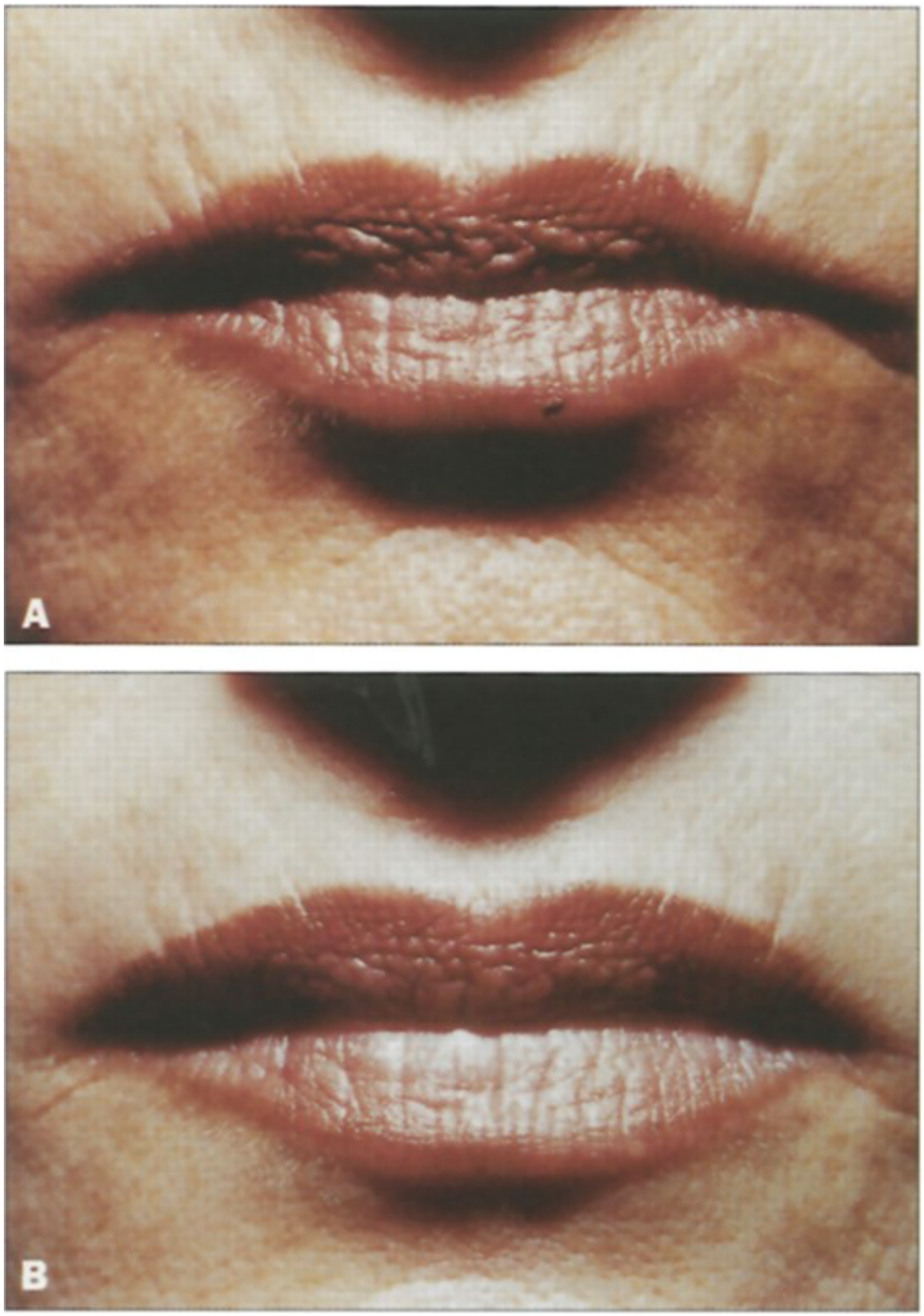
(sphincter) not only allows for slight elevation of the soft tissue (which may in some patients result in the undesirable accentuation of the nasolabial fold), it also allows for a reduction of the perioral rhytids (by reducing the effects of the sphincter), a slight eversion of the lip margin, and a pseudoaugmentative effect (Figure 3).

Figure 2.



A, Patient exhibits undesirable forehead furrows and “flat brows” due, in part, to relative lateral eyebrow ptosis and lack of eyebrow contour. **B**, One month after Botox® treatment to the lateral subbrow orbital orbicularis muscles, glabella, and central mid-forehead.

Figure 3.

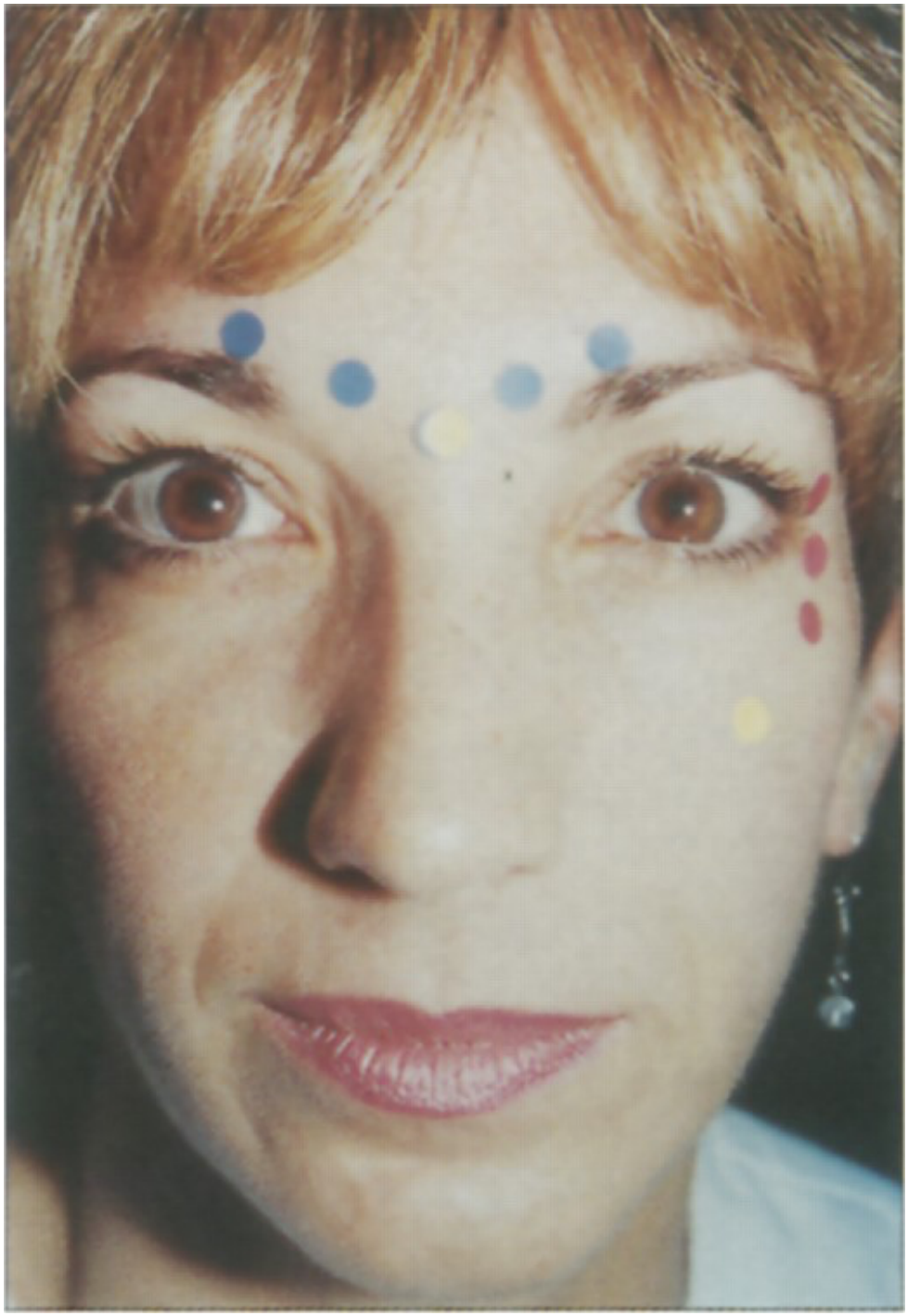


A, Perioral rhytids. **B**, One month after Botox® treatment to the upper lip (1.5 units were injected on each side of the noted upper lip rhytids). Note the horizontal widening of Cupid's bow and the slight pseudoaugmentative lip eversion.

Injections of Botox® as a primary or adjunctive procedure (Figure 4) are administered in typical doses 2.5 to 5.0 units per site in the glabellar region (Figure 5), lateral canthus (Figure 6), forehead (Figure 7), and cheek, as described by the author in previous reports.[3] It is advisable to administer a lesser dose in the lips to prevent patients from experiencing

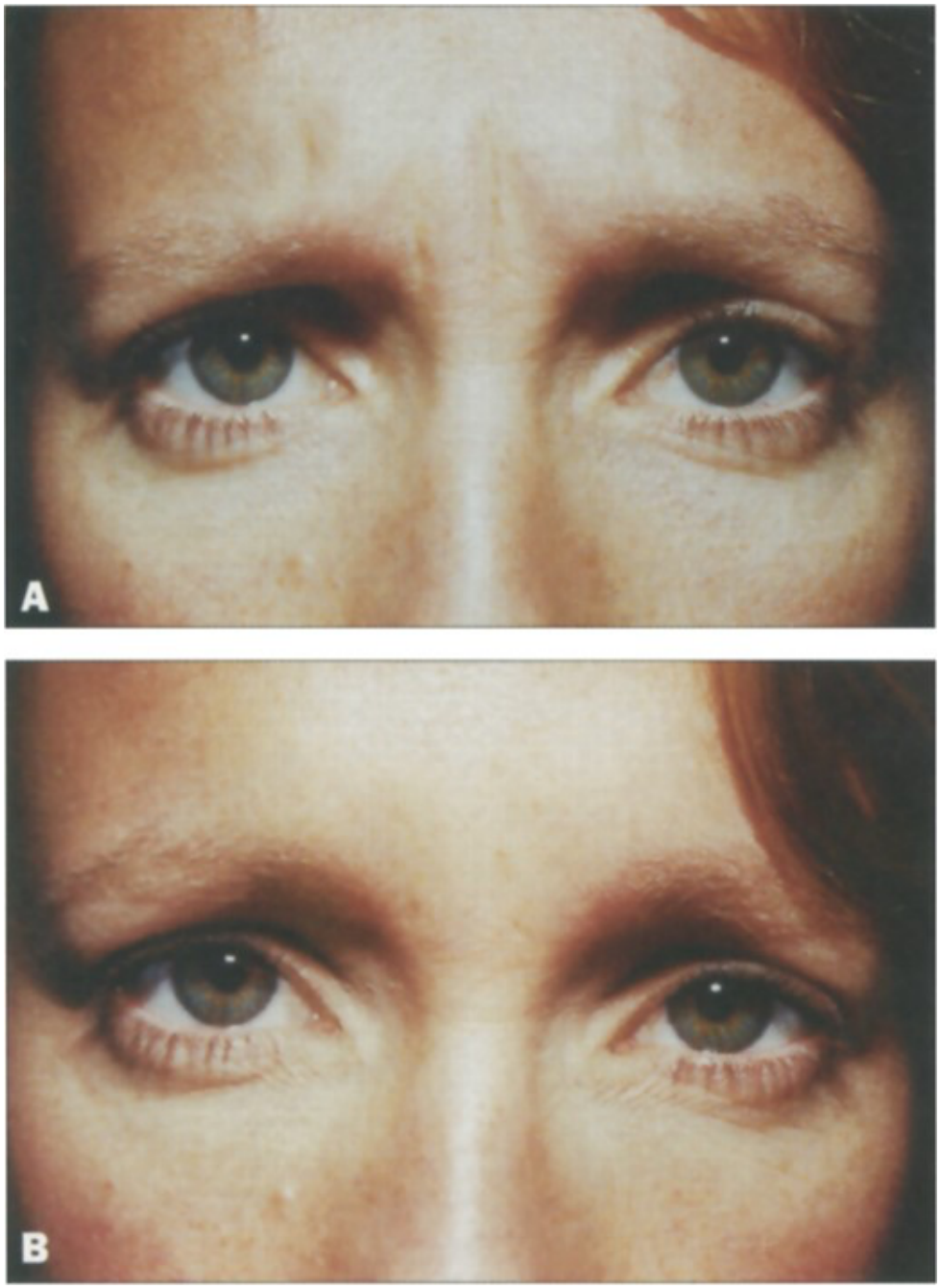
difficulty in eating. An injection of approximately 1.0 to 1.5 units per site is administered, on either side of the perioral rhytid, limiting the total dose to no greater than 8.0 units and confining it to only the upper lip (Figure 3). The response to this dosage can be variable, and it is recommended that inexperienced users in most situations initially administer the Botox® at a slightly lower dose.

Figure 4.



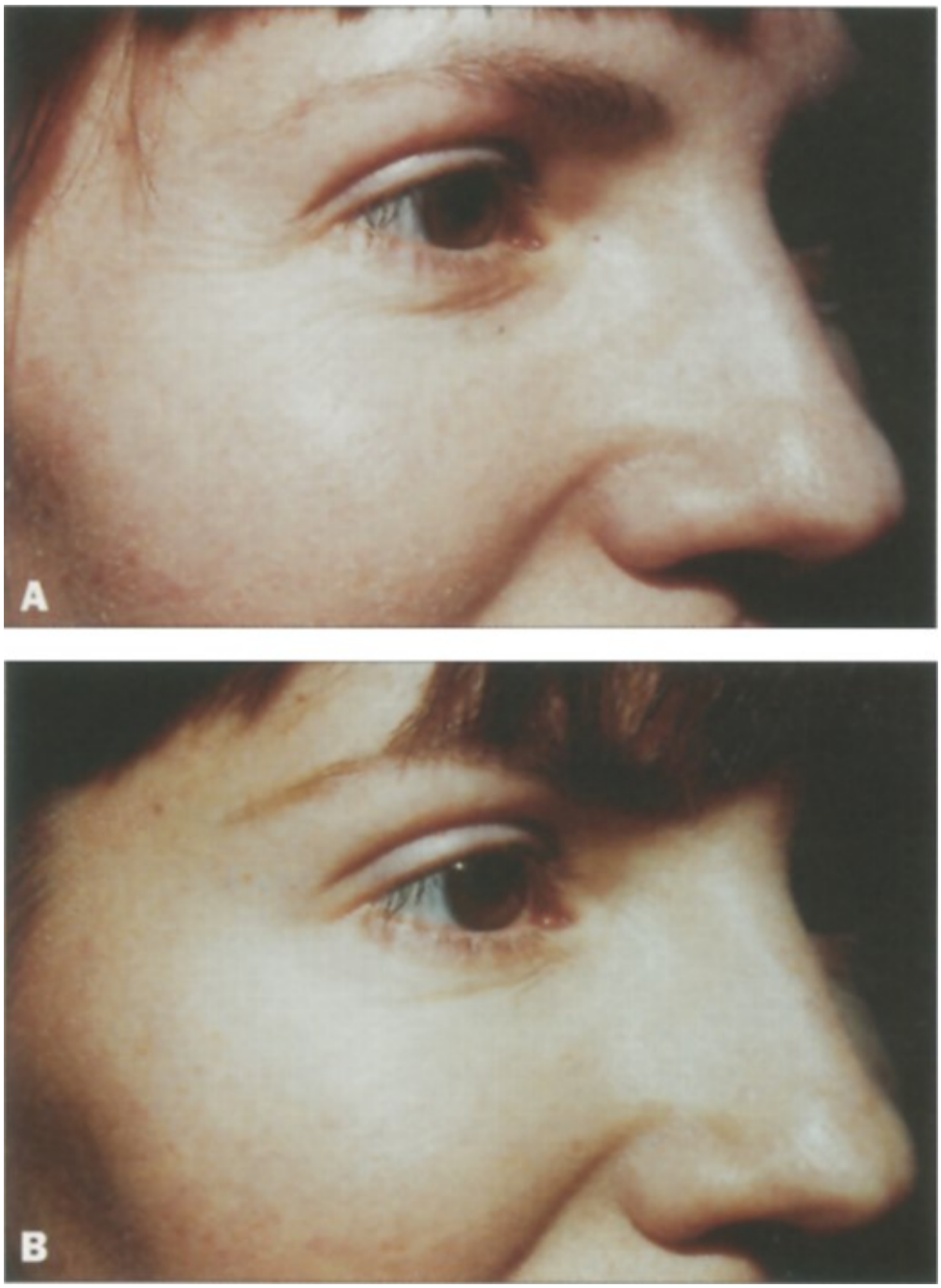
Typical areas of injection of Botox® to the periorbital region.

Figure 5.



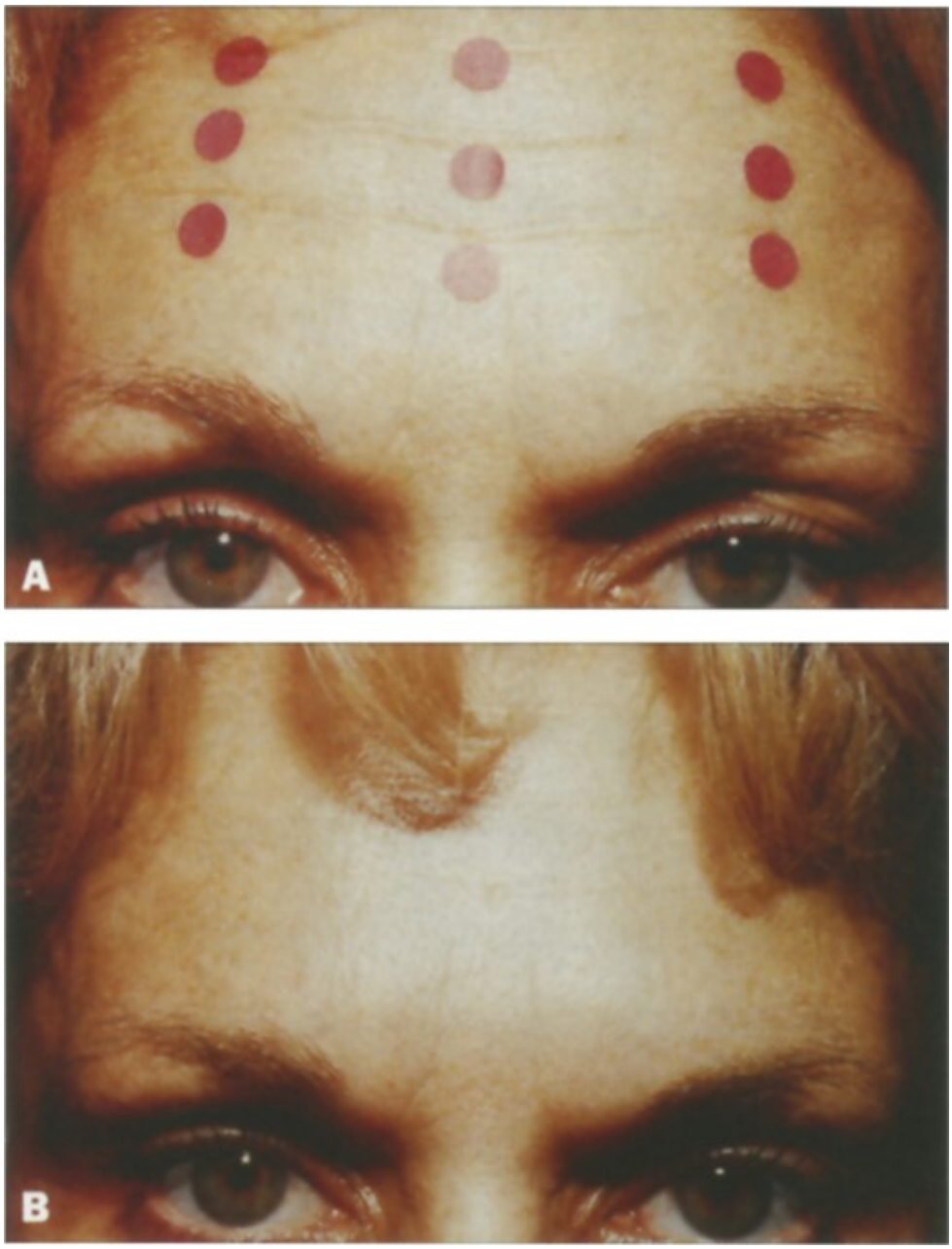
A, Glabellar frown line with animation, preinjection. **B**, One month after injection of Botox® to the corrugators only (2.5 units per injection site).

Figure 6.



A, Lateral canthal rhytids. **B**, One month after injection of Botox® at the lateral canthus (2.5 units per injection site).

Figure 7.



A, Typical sites of injection for horizontal forehead furrows. **B**, One month after injection of Botox® to these sites (2.5 units per injection site).

Electromyography is generally cumbersome and unnecessary. The onset of positive aesthetic effects of Botox® when used as a primary modality for facial rhytids produced by hyperfunctional muscular activity can be seen from within 24 hours to 1 week after treatment and can last between 3 to 6 months in most areas. The improved effects with chemodenervation when Botox® is used as adjunctive therapy are usually appreciated by the patients when they return for their scheduled procedure in the following weeks. I have observed, however, that the duration of the effects of Botox®

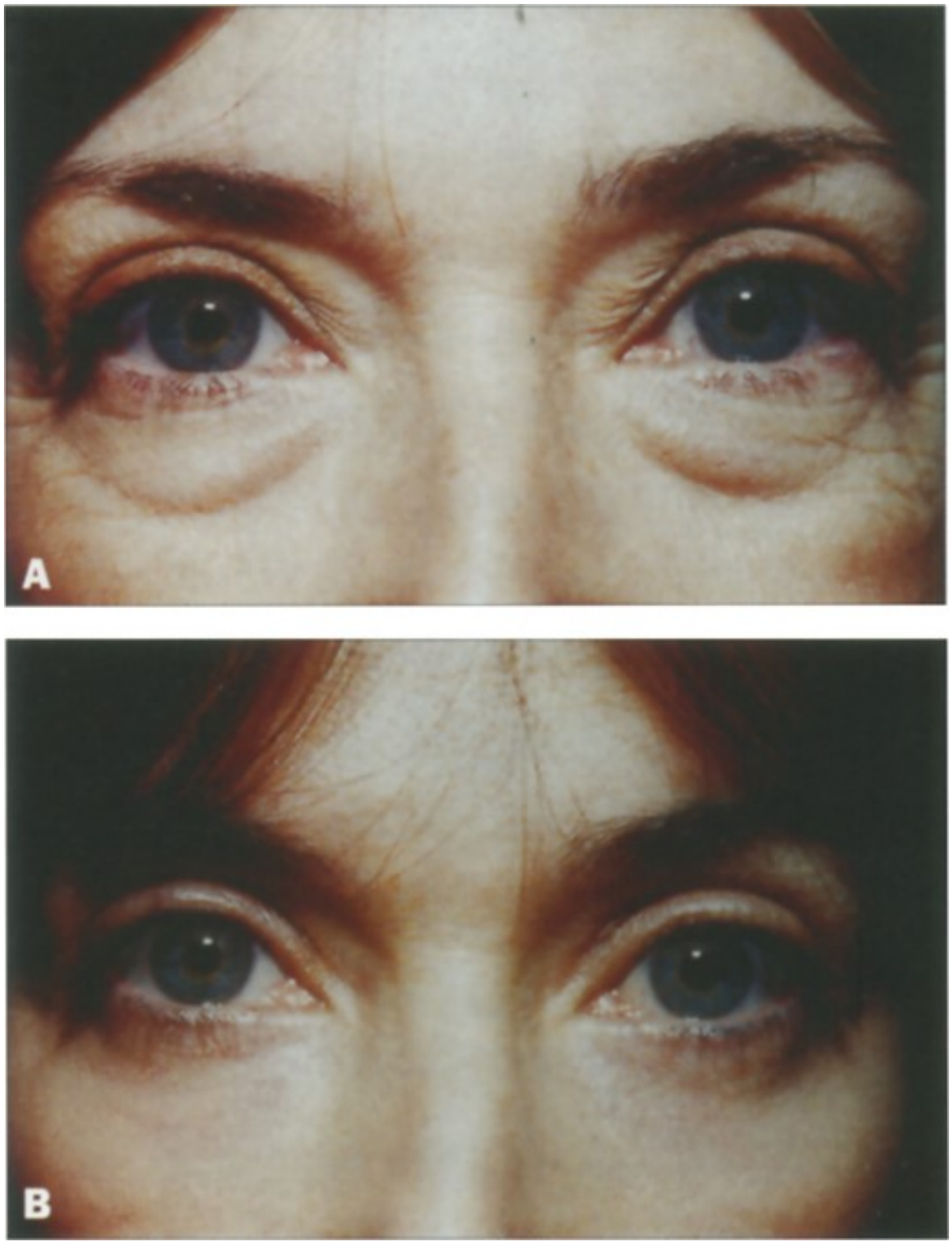
in patients who undergo subsequent laser resurfacing or surgery shortly after treatment is somewhat shortened for reasons that are not fully understood.

My results with laser resurfacing in certain areas can be improved with chemodenervation. Laserbrasion (without chemodenervation) performed in areas such as the lateral canthus (crow's-feet), where there is the usual hyperfunctional muscular component to the rhytid formation, often ends in a suboptimal result because the surgeon failed to first address and treat the dynamic aspect related to the pathologic condition. To enhance the results in such regions, Botox® is administered approximately 1 week before laser resurfacing to the periocular/lateral canthus region (Figure 4) in a dose of 2.5 units per site. For treatment of the perioral region (along the vermillion border), the dose is typically reduced to 1.0 to 1.5 units per site. Surgeons must also take care to avoid injecting the toxin too close to the lower eyelid margin, especially in patients with lower eyelid laxity; these patients are at risk for development of lower eyelid retraction and ectropion, unless canthopexy is performed concurrently with laserbrasion.

Beneficial effects have also been seen with canthopexy. As with other aesthetic procedures, failures can relate to lack of maintained fixation. This is well noted in the lateral tarsal strip procedure, in which long-term diminishing of the horizontal palpebral aperture is common. This is possibly due in part to the lack of fixation of the newly disinserted and reapproximated lateral retinaculum. The orbicularis muscle in this region also acts as a sphincter and in its many functions yields a medial force to the lateral canthus, which is important in assisting in the tear pump. By weakening the lateral canthal orbicularis muscle with chemodenervation, we may not only improve the lateral canthal rhytids, but we may also diminish the medial migratory effect, which may allow sufficient time for the retinaculum to “heal” well into the desired position. This has been extremely useful in patients with moderate eyelid laxity and dense periocular

rhytids who may benefit from a lateral retinacular canthoplasty or suspension procedure[4,5] combined with laser skin resurfacing (Figure 8). The doses and administration (Figure 4) are the same as they are for the treatment of lateral canthal rhytids, except that they are given closer to the lateral retinaculum.

Figure 8.



A, Before surgery and administration of Botox®. **B**, Four months after upper and lower blepharoplasty, transpalpebral lateral retinacular suspension, and CO_2 laser resurfacing. Botox® was given 1 week before surgery.

The brow lift—whether an "open" (coronal) brow lift, endoscopic brow lift, or direct method—may also benefit from pretreatment with chemodenervation. Weakening the antagonist brow depressors (corrugators and procerus-medially and orbicularis-laterally) with Botox® may promote a better and higher position of the eyebrow in a relatively controllable fashion. When Botox® is only given laterally, it may enhance a temporal arch to the eyebrow, if desired. It is administered selectively to the medial brow depressors to treat severe medial brow ptosis.

Botox can enhance the effect and longevity of all forms of injectable soft tissue augmentation agents, including intradermal collagen and subdermal fat. The improved effects are most noted in the glabella, periobita, and lips. The dosages are as previously discussed for the treatment of rhytids and are administered approximately 1 week before the procedure.

Concerning the use of collagen injections, my experience has been limited to injection of autologous human collagen tissue matrix (Autologen®) to the glabella, horizontal furrows at the bridge of the nose, and lips, and injection of autologous fat to the lateral eyebrow. The presumed mechanisms of action and enhanced effects are due to the diminished microextrusion and reduced mechanical inflammatory stress on the implant from focal muscular contraction.

Side effects such as blepharoptosis, lower eyelid ectropion, and (rarely) diplopia[6] have been reported with the use of Botox®. Significant brow ptosis has also been seen in patients who have undergone chemodenervation for eradication of horizontal forehead furrows. Fortunately most of these negative effects can be avoided with careful application of the toxin and a better understanding of the functional muscular anatomy. At times, however, these unwanted effects can occur even with what appears to have been satisfactory execution and may relate to distant diffusion of the drug. Side effects typically have a much shorter duration because the affected target muscle usually receives a smaller drug dose.

In some instances this may relate to slightly altered anatomy from previous surgery. I believe that one can limit the unwanted effects of Botox® by limiting the volume at each site (no more than 0.1 ml per site), thereby minimizing the distant spread of the injected diluent. Additionally, I have not found it necessary to instruct patients regarding any change in their activity after the injection is administered.[7] In fact, cosmetics may be reapplied immediately after injection without any adverse effect.

There is still no consensus about the longevity of the potency of Botox® once it is reconstituted. Although the package insert infers that the potency may be diminished after 4 hours of reconstitution, some have observed effective application of the toxin even 30 days later.[8] On the basis of my experience, Botox® seemingly maintains its full strength for 24 to 48 (maximum) hours after reconstitution, but it has an incalculable (to date) diminishing effect after 48 hours. This may relate to some variability in the consistency of the total number of units in each vial, the number of times the vial is left to warm to room temperature, patient variability in response, and injection technique.

It has been postulated that repeated use of Botox® may cause long-term beneficial effects such as atrophy of the target hypertrophic muscle. I have observed occasionally what seems to be an overall improvement over time in some patients who return at less frequent intervals for this maintenance. Whether this is due to local muscle atrophy, improvement of the overlying skin, or dermal contour defect with continued use has yet to be determined. Additionally, true "atrophy" may not occur in instances where the function of the muscle resumes normal activity periodically, that is, Botox® is injected into a target muscle that exhibits temporary paralysis; however, reinjection is not again performed until the muscle resumes nearly normal activity.

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Author notes

Dr. Fagien is the chairman of the medical advisory board of Collagenesis, Inc. (makers of Autologen® and Dermalogen®)