Botulinum A Toxin for (Expressionistic) Ptosis Overcorrection After Frontalis Sling

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**Summary:** Botulinum A toxin was injected into the frontalis muscle in two patients with complete third nerve palsies to limit intermittent upper lid retraction after a frontalis sling procedure. This form of lid retraction is noted during periods of active facial movement with frontalis muscle contraction. Although upper lid position may be symmetric when the facial muscles are adynamic, the upper lid may retract during periods of active facial expression. This type of lid retraction was corrected using Botulinum A toxin injections into the frontalis muscles, without affecting the lid position when the facial muscles are adynamic. Both improvement in appearance and intermittent exposure were noted in both cases. Additionally, a blunting of the transverse forehead creases occurred over a defined area after this injection, representing a clinical example of a denervation field produced by a point injection of botulinum toxin. **Key Words:** Botulinum A toxin—Frontalis sling—Ptosis—Frontalis muscle—Chemodenervation.

The frontalis sling procedure is useful for the correction of blepharoptosis with fair to poor levator function (1–3). The procedure involves placing autogenous or synthetic material between the frontalis muscle and the pretarsal portion of the anterior lamella of the upper eyelid (1–3). The force generated by the occipitofrontalis muscle is transmitted to the upper lid, effecting elevation of the lid and correction of the ptosis. The usual function of the occipitofrontalis muscle is to generate the force governing brow position and the transverse creases of the forehead. Because the procedure converts the action of upper lid elevation to one of the muscles of facial expression, the position of the upper lid can be altered by expressionistic facial movements, particularly during excitation, smiling, and laughter. Because common emotional gestures involve involuntary contraction of the frontalis muscle, an intermittent overcorrection of upper lid ptosis can occur after a successful sling procedure even if the lid positions are symmetric with adynamic facial muscle tone. In social circumstances when facial expression is used in common communication, such overcorrection can be most apparent and displeasing. More importantly, if the frontalis sling is used in patients with poor Bell’s phenomena such as third nerve palsy, intermittent retraction during more dynamic expressionistic facial movement can aggravate symptoms of exposure keratopathy.

This article will demonstrate the phenomena of expressionistic overcorrection and its management in two cases using botulinum A toxin. In both cases, the ptosis was secondary to total third nerve palsy, and botulinum toxin injection into the frontalis muscle resulted in relief of signs and symptoms of intermittent exposure keratitis common after frontalis sling in this clinical situation.

**CASE REPORTS**

Case 1

A 21-year-old man had unilateral congenital ptosis in the left eye and involuntary facial tic (congenital involuntary facial spasm). He underwent levator resection at age 8 years, which resulted in
minimal improvement. Another attempt at levator resection was made at age 10 years, and also resulted in undercorrection. Because of persisting ptosis and poor levator function, a unilateral frontalis sling procedure was elected at age 19 years.

His involuntary facial movement disorder was associated with elevation of the brow associated with intermittent stuttering. Although most pleased with his eyelid appearance with facial muscles at rest (Fig. 1A), he noted intermittent lid retraction during the involuntary facial movements (Fig. 1B and C). Additionally, he noted intermittent lid retraction during dynamic facial expressions such as seen during laughter or other active expressions.

Case 2

A 37-year-old psychologist presented in 1978 with proptosis, ptosis, visual loss in the right eye, and diplopia. The examination revealed a paralytic ptosis with ophthalmoplegia secondary to involvement of the third cranial nerve.

Computed tomography revealed a mass at the orbital apex. A craniotomy was performed in 1979, which revealed a schwannoma that was completely resected. After craniotomy, a frontalis sling procedure using autogenous fascia lata was needed to correct a complete ptosis. This effectively corrected the ptosis for 10 years. Because of intermittent corneal irritation and decreased motility from oculomotor nerve paralysis, a bandage contact lens was needed. The patient’s Bell’s phenomena and motility had been poor after craniotomy.

In 1988 a recurrence of the schwannoma was diagnosed, which necessitated repeated craniotomy. The tumor was totally removed through subfrontal craniotomy; however, complete ptosis followed the neurosurgical procedure. Repeat autogenous fascia lata frontalis suspension was performed. Postoperatively, lid position was noted to be very symmetric with no evidence of overcorrection when the patient had resting facial muscular tone (Fig. 2A). Hypotropia (10 prism diopters) was noted in the primary position in the right eye. The lid margin to corneal light reflex distance measured 3.5 mm OD.

Although pleased with the surgical results, the patient complained that in social circumstances, during which time she would smile or sustain any positive emotional facial expression, there would be an apparent excess of elevation of the right eyelid, which she found to be disfiguring (Fig. 2B). Additionally, she complained of intermittent irritation of the right eye, and photophobia. A bandage contact lens had been used by the patient for several years for symptomatic relief.

Because of her cosmetic complaints and past history of exposure related to poor Bell’s phenomena and decreased extraocular motility, botulinum A toxin was injected over the midposition of the frontalis muscle to reduce the amplitude of contraction of one frontalis muscle during dynamic facial expressions.

The purpose of this injection, as explained to the patient, was to relieve undesirable lid retraction during these periods of facial expression. She received a total of 7.5 IU—2.5 IU in each injection location (Fig. 2C).

When seen 2 weeks after the injection, marked improvement in eyelid retraction was noted during dynamic facial expressions (Fig. 2D). Additionally, there appeared to be no change in the position of the upper eyelid when the facial muscles were in the resting state. Furthermore, she stated that the eye felt more comfortable with less surface irritation after the injections were given.

She also remarked that she was pleased with the diminished transverse creases in the upper forehead, and requested that additional toxin be placed on the contralateral side to reduce the prominence of the transverse forehead creases (Fig. 2C and D). Because this seemed to be a reasonable request, an additional 5 IU of botulinum A toxin was given to the contralateral side of the forehead. When evaluated 2 weeks after this injection, substantial obliteration of the transverse forehead creases had been noted (Fig. 2C). She found this to be a pleasing incidental effect of the therapy.

Three months after injection, there appeared to be a sustained beneficial effect from the toxin injections to the frontalis muscle. A second injection produced similar improvement in symptoms of exposure keratitis and diminished lid retraction. After 10 months, this patient found both improvement in her personal appearance as well as substantial improvement in ocular irritation. She desired to continue with this form of therapy even if it entailed repeated injections.

Case 3

A 25-year-old woman sustained severe closed head injury at 19 years of age. Severe cerebellar damage was sustained in the injury as well as basilar skull
fractures, resulting in complete bilateral third nerve palsy. Because neither eye demonstrated any evidence of third nerve regeneration after 2 years and because there was complete ptosis, an autogenous fascia lata frontalis sling was established on the right eye, setting the upper lid margin at the level of the visual axis to avoid exposure.

For 4 years, there was only minimal complaint of irritation in the right eye. However, 5 years after the sling procedure, she complained of severe intermittent ocular pain and blurred vision. Slit-lamp examination demonstrated substantial exposure keratopathy. The margin to reflex distance measured 2.5–3.0 mm; however, in casual conversation, the upper lid would retract to the limbus as she would smile or use her facial muscles to convey any expression. The fascia lata sling was surgically loosened, bringing the margin to reflex distance to 1.5–2.0 mm. Despite this surgical effort, signs and symptoms of exposure continued. The degree of lid retraction during facial expression was improved after surgery but was still present. In an effort to mitigate the lid retraction, she was treated with 20 IU of botulinum A toxin into the right frontalis muscle to reduce this muscle's contractile amplitude during active facial expression.

Three weeks after this injection, less pain and photophobia were noted as well as substantial improvement in exposure keratopathy on slit-lamp examination. The patient remained asymptomatic for the next 3 months and desired a repeat botulinum toxin injection for ocular comfort.

The transverse forehead creases were obliterated in the region of botulinum toxin injections, and a discernible decrease in brow elevation could be noted with dynamic facial movements.

**DISCUSSION**

When evaluating patients with ptosis, levator function evaluation is important in choosing the correct surgical procedure. When levator function is considered to be good (>10 mm), procedures in which levator shortening or levator advancement are generally performed (1–3). When levator function is fair (7–10 mm), the surgeon will often choose a procedure in which the levator muscle is shortened, however, with guarded prognosis. When levator function is poor (<6 mm), the sling procedure usually becomes the primary modality of surgical intervention (1–3). The disadvantages of frontalis sling procedures include lid lag, undercorrection,
lagophthalmos, absorption of fascia lata material, upper lid position asymmetry, and overcorrection.

Overcorrection can be caused by placing too much tension on the sling intraoperatively. However, even if the sling is appropriately adjusted and the lid position is noted to be normal in the postoperative period, with the frontalis and other facial muscles at resting position, there are patients who have intermittent overcorrection (lid retraction) during dynamic facial expressions. The lid margin position is then driven by natural contractions of the occipitofrontalis muscle during common facial movements. The cases presented here represent examples of this clinical situation. The phenomenon was most apparent in the first case because this patient experienced high-amplitude involuntary contraction of the facial muscle as a component of a movement disorder. Any effort to surgically loosen the sling in the postoperative period to correct this condition may result in lowering of the lid in the resting position and possible worsening of the ptosis. Theoretically, during active facial expression, partial weakening of the frontalis muscle can diminish the amplitude of intermittent overcorrection occurring with the eyelid during expressionistic movements of the face. This concept was the proposed basis for using botulinum A toxin for this type of eyelid retraction.

Some patients will have brow elevations during conversational speech, whereas others will not have such facial movements. Facial movement characteristics influence the average lid position after
frontalis sling procedures as demonstrated in this case study and appeared to be important in the occurrence of exposure keratitis in both patients.

Botulinum A toxin acts by blocking the release of acetylcholine to the presynaptic membrane of the neuromuscular junction (4–6). The effects after the initial block of acetylcholine include collateral axonal sprouting at the preterminal motor axon, neuromuscular junction atrophy, and eventual reinnervation of the injected muscle after a period of 3–6 months (4–6). The toxin’s effect on muscle contraction is usually partial and can be adjusted by altering the dose (7). Although having a temporary effect, the toxin is useful in treating movement facial disorders, including essential blepharospasm, Meige’s disease, aberrant regeneration of the facial nerve, and hemifacial spasm (7–10). Patients with these conditions require repeated injections, which is a limitation in this form of therapy.

Injection sites are important in limiting complications and producing the most beneficial response (7,9,10). Regional toxin spread into the muscular portion of the levator can result in ptosis after upper lid orbital involvement and inferior oblique involvement can result in diplopia after lower lid injection. Point injections over the frontalis muscle are sufficiently distant from orbital structures to make these complications unlikely. Ideal injection sites in the frontalis muscle remain to be determined but should accomplish a homogeneous effect on the muscle and limit toxin diffusion into the orbit. The midposition of the frontalis muscle several centimeters away from the orbit was empirically chosen.

It was found that the toxin has a direct effect on the generation of the transverse forehead creases in both cases (11). The transverse forehead creases result from occipitofrontalis and temporoparietalis muscle tone and are accentuated during active contraction of these muscles. These creases were diminished after injection of the toxin. Apparently, altering the contractile state of the frontalis muscle with botulinum toxin influences the prominence of the forehead crease both at rest and during active contraction as well as force transmitted to the upper lid from this muscle (Fig 2A–D). This observation may be useful in providing a method of making the forehead creases more symmetrical in patients with facial paralysis (12).

Point injections of botulinum toxin have been demonstrated to produce a denervation field from the site of injection using acetylcholinesterase stain-

ing in animal models (7). The distinct area of forehead transverse crease obliteration produced by a point injection of botulinum toxin demonstrated in a circular configuration supports the concept of denervation field and gradient produced by botulinum toxin in the clinical setting.

This particular application of the toxin has been found useful in the postoperative period in a patient with a frontalis sling with intermittent overcorrection due to a habitual tendency to elevate the brow during conversational speech and normal dynamic facial expression. Although the amplitude of muscle frontalis muscle contraction and intermittent lid retraction was reduced, the lid margin to corneal light reflex distance did not change in the resting position. The toxin injection offers a method of dealing with lid retraction in this clinical situation without loosening the sling, and offers a potentially reversible modality of therapy that can be adjusted by altering dose.

It appears that botulinum A toxin may have a role in the postoperative management of frontalis slings in which there may be overcorrection or intermittent overcorrection with dynamic facial expressions or in which exposure keratopathy occurs when the lid is in a desirable position with the frontalis muscle at rest. In situations of patients who complain of intermittent lid retraction due to dynamic movements of the brow effected by frontalis muscle contraction, frontalis muscle injection with botulinum A toxin may be considered. Also, more importantly, when exposure results after frontalis sling surgery in patients with third nerve palsy without obvious overcorrection, this form of therapy may be considered to reduce the amplitude of lid retraction during dynamic facial expressions, therefore minimizing corneal exposure.

REFERENCES


