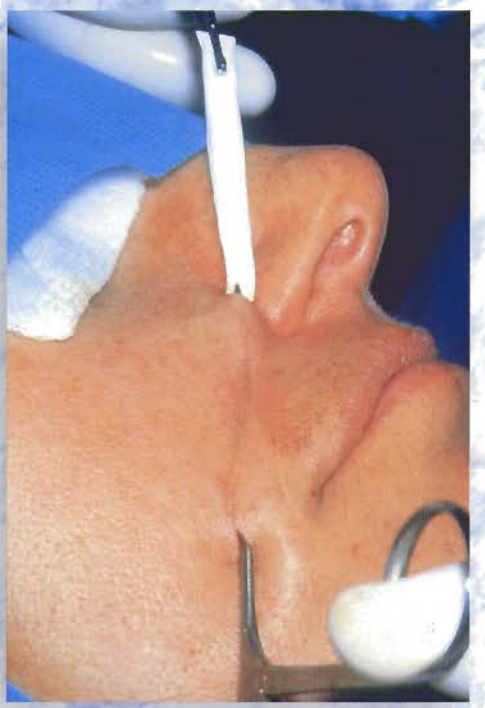
MANAGEMENT OF FACIAL LINES AND WRINKLES



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CHAPTER 19

BOTULINUM TOXIN INJECTIONS FOR FACIAL LINES AND WRINKLES: TECHNIQUE

Andrew Blitzer, William J. Binder, and Mitchell F. Brin

Facial lines and wrinkles have a multifactorial etiology including sun exposure, loss of dermal elastic fibers, skin atrophy, and excessive muscle activity. Hyperfunctional facial lines are caused by the skin pleating when the underlying muscles contract, which is best illustrated when there is a loss of these hyperfunctional lines and creases with the resultant smooth skin surface in patients who have suffered strokes, facial nerve injuries, or Bell's palsy.

Hyperfunctional facial lines bother patients because they may be misinterpreted as anger, anxiety, fear, fatigue, melancholia, and aging. Many procedures have been attempted to correct these lines for patients. Direct surgical excision with primary closure, face-lifts, and forehead-lifts have all been attempted, but

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they usually have minimal effect on the muscle pull and may leave unsightly scars. Other procedures including collagen, silicone, or fat injections have been used to balloon the depressed area of skin and flatten the skin fold. Laser resurfacing has also been advocated by some surgeons for management of skin folds. These procedures, however, do not address the underlying cause, which is the muscle pull.

Botulinum toxin management of patients with hemifacial spasm, facial tics, or facial dystonia produced a diminution of hyperfunctional facial lines. Patients having unilateral injections often return asking for the contralateral side to be injected to give a more youthful appearance. We therefore first reported the cosmetic effect of the toxin in patients who were receiving injections for neurologic disease (1). In a prospective, double-blind study, we demonstrated the efficacy of toxin injections for hyperfunctional facial lines (2). Carruthers (3) at the same time also described botulinum toxin injections as effective management for facial lines and wrinkles.

Botulinum toxin, produced by the bacterium *Clostridia botulinum*, is a most potent neurotoxin. It exerts its effect at the neuromuscular junction, inhibiting the release of acetylcholine, producing a weakness or flaccid paralysis of muscle. Botulinum toxin A (BOTOX) has been approved by the Food and Drug Administration (FDA) as a safe and effective therapy for blepharospasm, strabismus, and hemifacial spasm since December 1989. The National Institutes of Health (NIH) consensus conference of 1990 also included it as safe and effective therapy for the treatment of adductor spasmodic dysphonia, oromandibular dystonia, and torticollis.

Botulinum toxin injections have been found to be a useful adjunct for minimizing or eliminating hyperfunctional facial lines, particularly those of the glabellar region, forehead, and lateral orbit (crow's feet). We have also treated platysmal bands, and hyperactive mentalis muscles with lip pursing. Deep nasolabial lines may be reduced with toxin injections, but the injections may diminish the elevation of the upper lip on smiling, an effect most patients do not want. The toxin does not address the skin lines or wrinkles associated with actinic changes or age-related loss of dermal elasticity or laxity of skin.

The alternatives to botulinum toxin injections have included surgical excision, laser skin resurfacing, or augmentation with fat, collagen, or a variety of alloplastic materials. Forehead-lifts with muscle excision or face-lift procedures also have been used to stretch and smooth the lines. Most of these methods do not address the cause of the fold, which is the hyperactivity of the underlying muscle. In some cases, these surgical procedures can be used in conjunction with botulinum toxin to enhance the cosmetic outcome.

The materials necessary for botulinum toxin treatment are toxin, a standard freezer, sterile saline without preservative, syringes, small-gauge needles (27 and 30), alcohol swabs and gauze, and in many instances, a small electromyograph (EMG) machine, and a hollow-bore, Teflon-coated, monopolar EMG needle. A standard vial of BOTOX (Allergan, Inc., Irvine, CA, U.S.A.) contains 100 units of toxin. The toxin is shipped from the manufacturer on dry ice and should be stored in a freezer at −20°C. The frozen, lyophilized toxin is reconstituted with sterile, nonpreserved saline. We typically dilute the toxin to doses using a volume of 0.1 mL to minimize the diffusion to adjacent muscles. We usually add 4 mL of saline to a vial of toxin, making the dose 25 units per mL or 2.5 units per 0.1 mL. In some patients, a larger dose is needed, and to prevent excess volume, a more concentrated solution is made with 2 mL of saline, making 50 units per mL or 5 units per 0.1 mL.

The patients are first evaluated with a thorough review of their medical history, medications, and prior plastic surgery. A detailed discussion of the patient's facial lines and the botulinum toxin technique and effect then takes place. Standardized photographs are taken of the patient's face at rest and with activity. A rating of the patient's facial lines also is made by the patient and by the physician at rest and with the activity that causes the wrinkling. A 0 to 3 rating scale has been used for evaluation (0, reflecting no facial wrinkles; 1, signifying mild facial wrinkles; 2, denoting moderate facial wrinkles; and 3, representing severe facial wrinkles) (4).

Although there is a paucity of data, patients who are pregnant or lactating should not be injected. In one report of nine patients treated during pregnancy (dose unspecified), one patient gave birth prematurely, although it was thought not related to the drug. Although we have treated some patients with preexisting disorders affecting the neuromuscular junction function, we recommend proceeding with caution in treating patients with conditions such as Eaton–Lambert syndrome, myasthenia gravis, and motor neuron disease. Aminoglycosides interfere with neuromuscular transmission and may potentiate the effect of a given dose of BOTOX. We therefore do not recommend injecting a patient who is concurrently taking aminoglycoside treatment.

Technique

An informed consent must be obtained, and the patient should be informed that BOTOX has been approved by the FDA as safe and effective therapy on-label for blepharospasm, strabismus, and hemifacial spasm. The NIH consensus conference of 1990 also included BOTOX for the treatment of spasmodic dysphonia, oromandibular dystonia, facial dystonia, occupational writer's cramp, and torticollis. Other "off-label" uses of BOTOX include the management of spasticity, tremor, juvenile cerebral palsy, and sphincter hyperfunction. The management of hyperfunctional facial lines is another off-label use.

The patient's face is then marked for the areas of maximal muscle pull causing the bothersome hyperfunctional lines. The area to be injected can then be iced or treated with EMLA to decrease the discomfort associated with the skin penetration by the needle. The toxin is then drawn up in a tuberculin syringe with a hollow-bore, Teflon-coated monopolar EMG needle. This needle is hooked up to the EMG machine, and ground and reference leads are placed on the face. The needle is then placed through the overlying skin to impale the muscle previously marked for injection. The patient is then instructed to accentuate the specific facial expression such as frowning, squinting, or elevating the brow. If the needle is in an active part of the muscle, a loud burst of activity will be heard on the speaker of the EMG machine. If a distant signal is obtained, the needle should be moved until it is in a maximal position, and then the toxin is injected. This is repeated at each spot marked for injection. In some patients with very prominent muscle, or those who have been previously injected, where the muscles are well identified, the injection can be done without EMG by using a 30-gauge needle. After the injection, the patient is asked not to rub or massage the area injected to avoid the excess diffusion of toxin to adjacent muscles and thereby decrease the chance of excess weakness of adjacent facial muscles (Figs. 19-1 to 19-3).

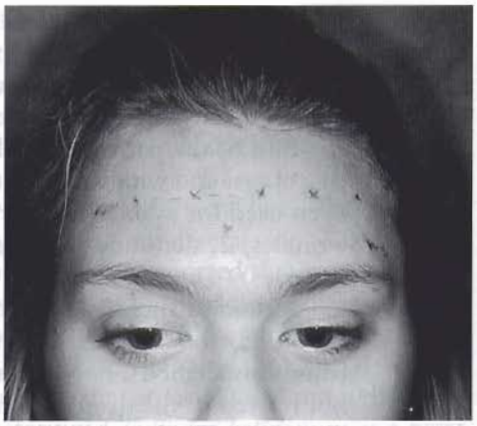

Figure 19-1
A young woman who has bothersome forehead wrinkles. The marks represent areas to be injected with 2.5 units of toxin.

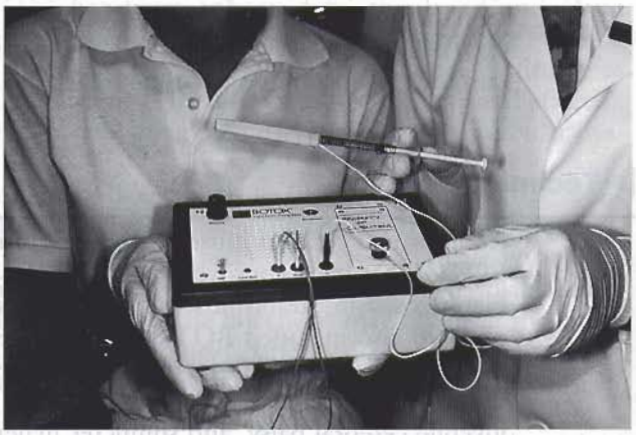

Figure 19-2
A small electromyograph machine that can be used for identification of the most active areas within the muscles during the injections.

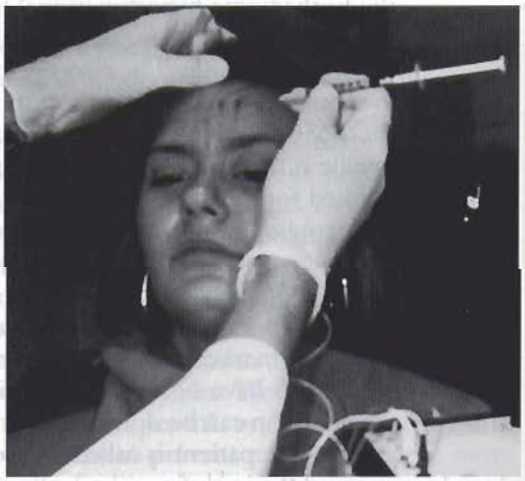

Figure 19-3
The injections being given into the previously marked forehead sites by using the electromyograph machine for guidance.

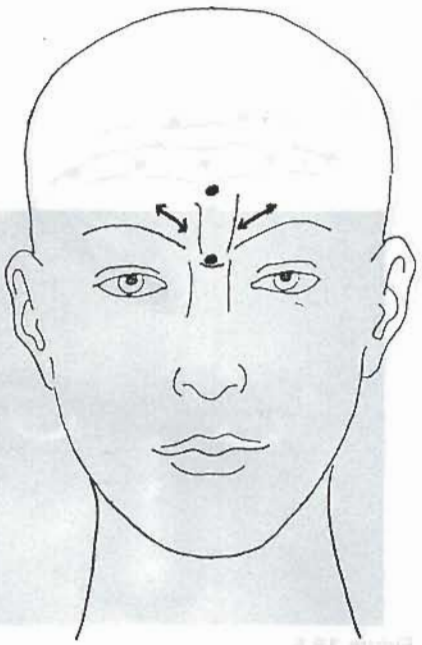

Figure 19-4

Diagram of patient with glabellar lines. The dots show areas marked for injection of 2.5 units. The arrows show the direction of the corrugator. Each arrow represents 2.5 to 5 units of BOTOX.

The glabellar injections manage the hyperactivity of the corrugator and procerus muscles. In our series, we injected 5 to 20 units, with a mean of 11.1 units. We usually start with 2.5 to 5 units in each corrugator and 2.5 into the procerus. The injection of the corrugator should go out lateral enough to encompass the whole muscle without going past the midpupillary line. Too much lateral extension or injections too close to the brow may lead to weakness of the levator muscle and ptosis. The corrugator muscle can be injected with several individual injections, or the muscle can be "skewered" with EMG guidance and then injected on withdrawal of the needle (see Figs. 19-4 to 19-8)

The frontalis injections manage the hyperactivity of the frontalis muscle, which pulls the forehead skin in a vertical direction, creating horizontal pleats in the skin. These should be marked ≈1.5 to 2 cm apart across the forehead. The toxin should not be injected close to the brow, because this may cause brow ptosis or even levator ptosis. Laterally, the toxin injection site is raised away from the brow to leave some functional frontalis muscle, allowing the patient some expressive function of the lateral brow without wrinkling most of the forehead skin. Most of our patients prefer to have some residual expressive movement of the brow. If there are several rows of deep hyperfunctional lines of the forehead, a second row of injections can be planned (see Figs. 19-9 to 19-13). The forehead is then treated with an ice pack and/or EMLA. The underlying frontalis muscle is then injected with EMG guidance to assure accurate needle placement. Each mark is treated with 2.5 units. The dose range for the forehead in our series is 5 to 25 units, with a mean of 17.3 units.

The lateral orbital lines or crow's feet are due to hyperactivity of the orbicularis oculi muscle. This muscle functions in the closing of the eye,

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Figure 19-5

A patient with bothersome glabellar lines before BOTOX injection.

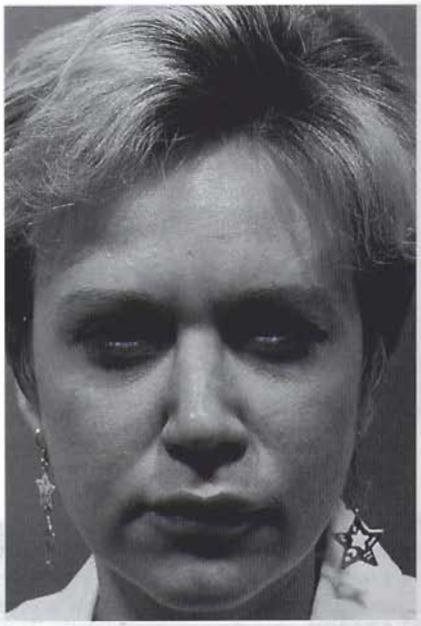

Figure 19-6

The same patient at 1 month after injection. Notice that, even with effort, she is unable to produce the deep glabellar furrows.

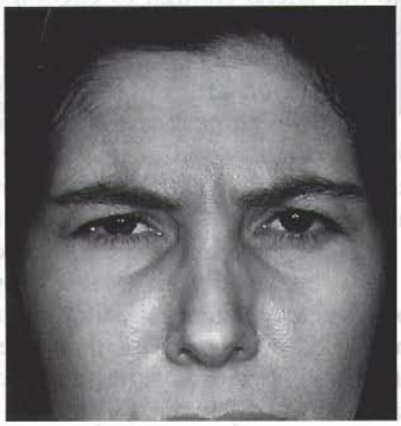

Figure 19-7

Another patient with bothersome glabellar lines during facial function.

Figure 19-8

The same patient as in Fig. 7 at 2 weeks. Notice that there are no glabellar lines despite a significant attempt to produce the lines with action.

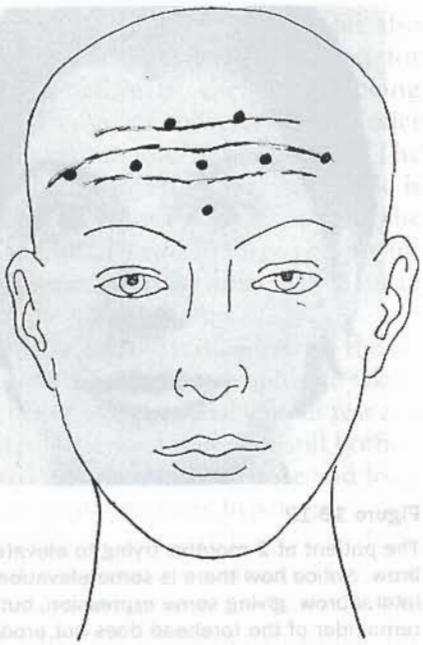

Figure 19-9

Diagram of patient with multiple forehead lines. The dots show the distribution of injections. Each dot represents 2.5 units. Notice how the lateral brow is left with some frontalis function to allow some expressive function.

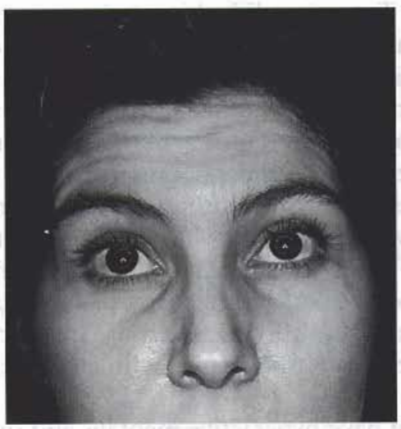

Figure 19-10

The patient elevating the brow and producing bothersome frontal lines (before injection of BOTOX).

Figure 19-11

The patient at 1 month. Notice the flat forehead skin despite attempts at brow elevation.

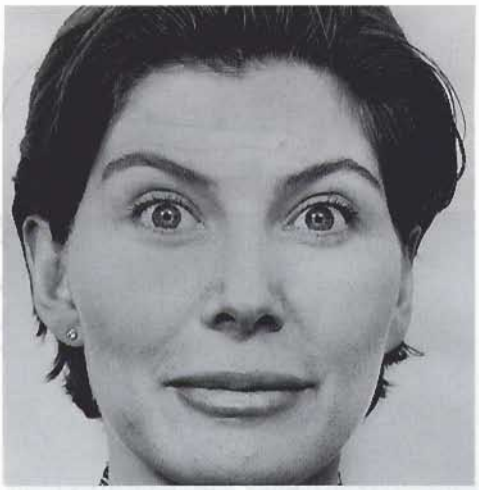

Figure 19-12

The patient at 2 months, trying to elevate the brow. Notice how there is some elevation of the lateral brow, giving some expression, but the remainder of the forehead does not produce any furrows or lines.

Figure 19-13

The patient at rest at 2 months. Notice that even at rest, there is a slight elevation of the lateral brow, giving a minibrow-lift.

blinking, and squinting, but excessive lateral activity will excessively pleat the lateral orbital facial skin, creating the crow's feet. Small amounts of toxin can weaken the lateral aspect of this muscle, thereby decreasing the wrinkling of the skin, without interfering with eye-blink or closure. To accomplish this, marks are made at the lateral canthal line 1 cm from the lateral canthus. The patient is asked to squint, and if there are hyperfunctional lines above the mark, a second mark is made in this superior area. The squint lines below the mark are then addressed with another mark made in this inferior position (see Fig. 19-14). This is done bilaterally. Do not plan injections too close to the eyelids, because this may cause delayed eye closure, decreased blink, excessive tearing, and possible lateral rectus weakness. The marks are made bilaterally, and then the skin is treated with ice and/or EMLA. We start with the EMG-injection technique, and injections are given in the areas previously marked. After a good result, many patients can be managed with a standard 30-gauge needle without EMG. Each site injected uses 2.5 to 5 units. The dose range in our series was 5 to 15 units, with a mean of 6.2 units.

Patients who have excessive lip pursing have hyperactive mentalis and orbicularis oris muscles. This occurs especially after chin implants, and the activity may produce abnormal lip postures and a "peau d'orange" skin. Small amounts of BOTOX (2.5 to 5 units on each side) may be used to prevent this overactivity and improve the skin appearance. The injection is given at a point halfway between the vermilion border of the lower lip and the inferior edge of the mentum, and 0.5 to 1 cm medial to the oral commissure. The EMG technique is used, and the patient is asked to pucker the lips. When the needle is in a very active place within the muscle, the toxin is injected. The toxin should not be injected too close to the lip itself to avoid excessive orbicularis oris weakness with the consequence of drooling.

Patients who have prominent platysmal bands before or after face-lift also may benefit from injections of BOTOX without a submental incision for muscle plication. These injections are performed with the needle being passed through the skin to impale the medial edge of the platysma. Under EMG control, the needle is passed perpendicular to the muscle fibers. The patient can activate this muscle by depressing the lower lip. Once the muscle is skewered with EMG control, it is injected on the way out (see Fig. 19-15). The muscle is injected with 2.5 to 5 units per site, and usually two to three sites are injected on each side. The dose range in our series was 10 to 20 units, with a mean of 15 units.

After the injections are completed, the patient is asked to come back to the office at 2 weeks to reevaluate the effect of the toxin. New photographs are taken, and once again, the patient and physician rate the hyperfunctional lines at rest and with activity on a 0- to 3-point scale. If the hyperfunctional lines are still bothersome to the patient, additional toxin is injected at this time. The dose and location of the additional toxin is related to the areas of persistent hyperactivity and the amount of residual function. When the muscles are adequately weakened and a pleasing facial skin contour has been achieved, the patient is instructed to come back when the facial lines again become prominent. In general this is about 4 to 6 months. In some patients, who have been treated a number of times, the

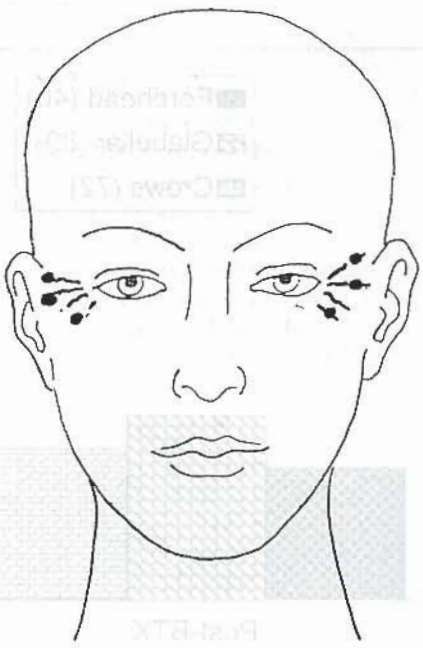

Figure 19-14

Diagram of patient with lateral orbital lines or crow's feet. The dots represent 2.5 units of toxin.

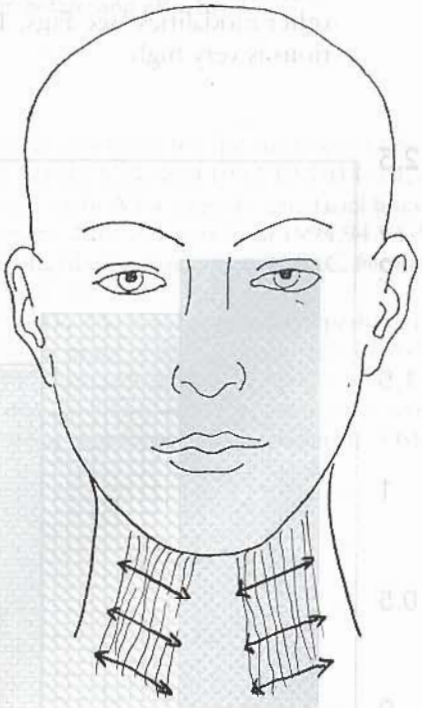

Figure 19-15

Diagram of patient with bothersome platysmal bands. The arrows represent the direction of injection through the muscle. Each arrow usually receives 2.5 units of toxin.

BOTOX effect seems to last for longer and longer periods, perhaps related to behavior modification. The patients may have been conditioned to avoid certain undesirable facial movements, thereby avoiding the excessive pleating of the facial skin.

The complications of the toxin injections may be mild bruising or local pain related to the injection. There also may be weakness of adjacent muscles related to diffusion of toxin. This is related to technique and dose. To minimize this side effect, we use EMG guidance to allow the injection to be placed in the most active place in the muscle. EMG-guided injection maximizes the effect and minimizes the dose. Careful placement of small amounts of toxin will eliminate most of the adjacent muscle weakness. If local adjacent muscle weakness such as ptosis occurs, it will disappear with time. Some have used phenylephrine apraclonidine (Iopidine) eye drops to stimulate Mueller's muscle and minimize the ptosis. There have been no long-term complications or hazards of botulinum toxin use. Muscle biopsies taken from patients after repetitive BOTOX injections have not shown any evidence of permanent atrophy or degeneration. Some patients receiving high doses (≥300 units, such as for torticollis) may develop antibody to toxin. These antibodies block the effect of the toxin, making the patient resistant to further therapy. These antibodies have not produced hypersensitivity reactions or anaphylaxis.

Overall, botulinum toxin injections for hyperfunctional facial lines have been found to be extremely safe and useful alone or in combination with other modalities (see Figs. 19-16 and 19-17). Patient satisfaction with the injections is very high.

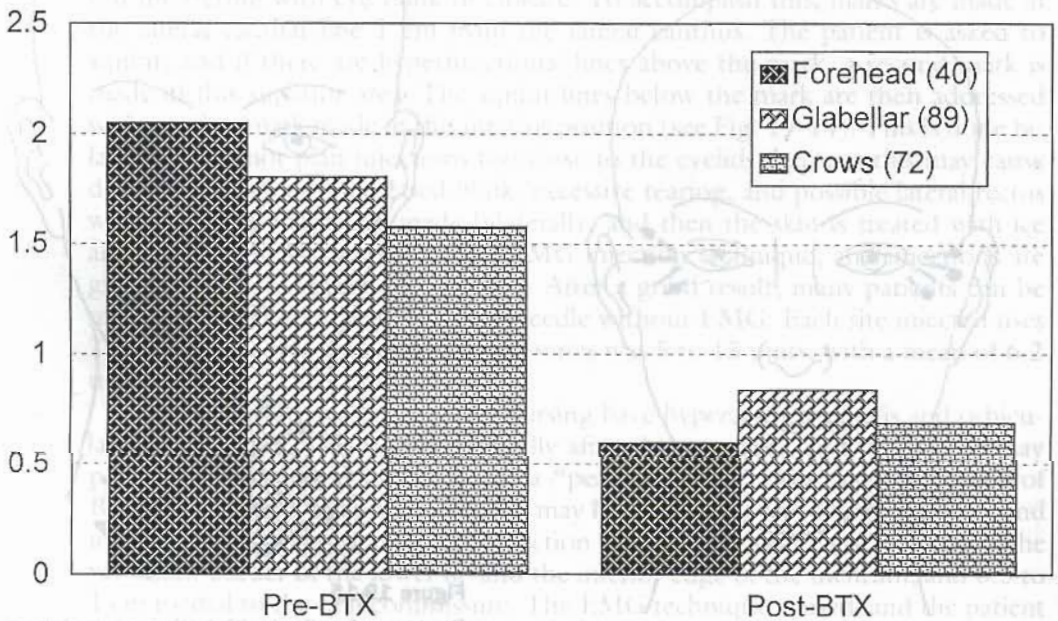

Figure 19-16

Bar graph showing before and after BOTOX injection ratings at rest for forehead, glabellar area, and crow's feet. Notice the significant change after toxin in rating of wrinkles.

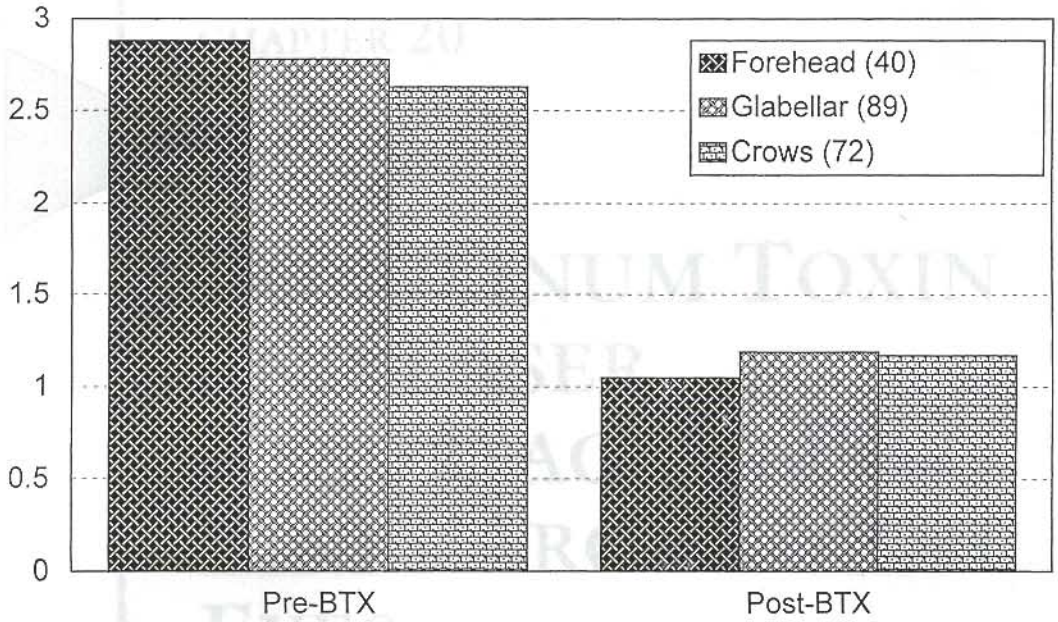

Figure 19-17

Bar graph showing before and after BOTOX injection with action for forehead, glabellar area, and crow's feet. Notice the greater difference between the ratings before and after toxin.

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