Botulinum toxin (BTX) has truly revolutionized cosmetic medicine with a 5680% increase in nonsurgical procedures performed from 1997 to 2013 using BTX. The most common areas for BTX treatment are the upper face, including the glabella, forehead, brows, and lateral canthal lines or crow’s feet. In 1987, a serendipitous observation by a patient of Jean Carruthers, MD, an ophthalmologist, spawned the cosmetic use of BTX. The patient, who was receiving BTX-A for blepharospasm, noted a softening of her frown lines. Dr. Carruthers happened to be married to a dermatologist, Alastair Carruthers, MD, so the couple was uniquely positioned to initiate clinical research on the use of BTX in rhytid reduction. They published their first clinical study of BTX for glabellar lines in 1992. Sixteen of 17 patients who completed follow-up had a clear benefit with no major adverse events. It would take another decade to achieve Food and Drug Administration (FDA) approval for this limited indication.

All 3 FDA-approved BTX formulations are now used successfully for the treatment of the upper face, including onabotulinum toxin (Botox), abobotulinum toxin (Dysport), and incobotulinum toxin (Xeomin). Onabotulinum toxin has been FDA approved for treatment of the glabella and lateral canthal lines, and the others are approved for glabella alone. All 3, though, are successfully used to treat all regions of the upper face off-label.

**GLABELLA**

The most common single-unit treatment is the glabella as originally treated by the Carruthers. Although the traditional injection points and standardized dosage is still commonly used and should be the teaching tool for novice injectors, most cosmetic physicians have evolved to tailor dosage and injection points on an individual basis. This includes differences in the anatomy of the muscles, muscle strength, baseline asymmetries, and relation to other units. Also, most important is patient-desired outcome.

Although clinical trials have emphasized the efficacy of the drug with full doses, the frozen and nonmovement of the glabella and upper face including brows is nondesirable for most of our patients today. Thus, the full dosage of 20–30 units of onabotulinum/incobotulinum toxin or 50–60 units of abobotulinum toxin can be reduced to allow movement and expression. This makes it the physician’s responsibility to evaluate the patient at rest and with full movement of the upper facial units. This is accomplished with frown, raising the brows and smile. Glabella muscles, including the corrugator and procerus, can be classified by frown severity as mild, moderate, and severe.
and severe correlating to muscle mass of small, medium, and large. Each can take an individualized dosage (Fig. 1). Dosage, injection points, and dilution can influence movement and reduction of frown lines, brow position, and medial forehead lines.\(^5\) The author has found that a concentrated dilution of BTX is best for glabellar muscle to give more precise placement of the toxin into these deep muscles with little spread (Table 1) (Fig. 2).

**FOREHEAD**

Although the forehead is an off-label usage, it is commonly combined with the glabella for the upper face. Most patients desire a reduction in forehead wrinkles along with treatment of static lines. The dynamics of the forehead and glabella create opposing muscle action. Frontalis muscles are brow elevators, while glabella and orbicularis are brow depressors. The muscles create a balance forming brow shape and position. This must be taken into account when evaluating forehead treatment. The injection points and dosage related to forehead anatomy can change brow position, both desirable and unwanted.

Moderate-to-severe dynamic wrinkles at rest and at maximal frown usually indicate filling material or even surgical intervention may be needed for full forehead and brow correction. Perhaps, more so than any other region of the face, the placement and dosage of toxin can be highly customized, and optimal results are achieved when factors such as forehead height and width, muscular strength, symmetry, and baseline brow position are all incorporated into a treatment plan.

The goal for the treatment of forehead wrinkles is to soften the undesirable lines without causing brow ptosis or eliminating all expressiveness on the upper face. A conservative approach is preferred, informing patients preoperatively that more than 1 treatment may be needed to reach the desired level of wrinkle reduction while avoiding undesirable side effects. Patients are asked to forcefully raise their eyebrows, and the strength of the frontalis is assessed. Any discrepancy in brow position at baseline and at maximal contraction is noted and brought to the attention of the patients. A compensatory downward dose adjustment should be made on the side with the lower eyebrow. In the average brow, 2–4 BTX units or 5–10 Speywood units are injected in 4–6 sites at least 2.5–3.0 cm above the orbital rim. Speywood unit is the proper name for Dysport unit. It is different from BTX unit. Administration more inferiorly greatly increases the risk of brow ptosis. In toxin naïve patients, the authors almost always begin at the lower end of that dosage range. A common strategy is to place the line of injection parallel and inferior to a

### Table 1. BTX-A Dosages for Common Cosmetic Applications (Total Dose and Dose Range Assume Bilateral Treatment, Unless Otherwise Indicated)

<table>
<thead>
<tr>
<th>Indications</th>
<th>Total Usual Dose</th>
<th>No. Injections</th>
<th>Dose Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glabella</td>
<td>50 sU</td>
<td>5 (7 in some men)</td>
<td>40–80 sU</td>
</tr>
<tr>
<td>Forehead</td>
<td>40–50 sU*</td>
<td>4–6</td>
<td>20–70 sU</td>
</tr>
<tr>
<td>Crow’s feet</td>
<td>60 sU</td>
<td>3 per side</td>
<td>30–60 sU</td>
</tr>
<tr>
<td>Lateral eyebrow lift</td>
<td>20 sU</td>
<td>1 per side</td>
<td>10–20 sU</td>
</tr>
<tr>
<td>Lower eyelid wrinkles</td>
<td>8–12 sU†</td>
<td>3–4 per side†</td>
<td>6–14 sU†</td>
</tr>
</tbody>
</table>


*The authors almost always begin with a lower dose in new patients (20–30 sU or 10–12 bU).
†Does not include the optional extra injection 1–2 mm inferior to eyelid margin described in the text.
deep furrow crossing the middle to upper third of the forehead. For high foreheads (typically men) or those with many fine wrinkles, the same total dose may be divided into 2 lines of injection across the forehead separated by 1 cm. A lateral arch to the eyebrow is characteristic of the female brow pattern. This arch can be accentuated in female patients by placing less toxin lateral to the midpupillary line or raising this injection point 1 cm relative to the mid-forehead and central forehead injections. The authors commonly use a V-shaped configuration for injections in women. Although often desirable in women, this should be avoided in men. The pattern for men is usually 1 horizontal line 2 cm or above that including the lateral forehead to prevent the “spock brow.” The V-shaped approach can also produce an excessively arched brow (the mephisto sign or Dr. Spock look) that will require correction with a small dose of additional toxin 1–2 cm superior to the apex of the arch.

The paresis of the depressor muscles of the upper face can elevate the brow correcting mild brow ptosis, restoring a youthful brow arch, and giving the eye a more open appearance. The medial depressor muscles are the glabella complex, whereas the lateral depressor is the orbicular muscle at the lateral position of the brow. Conversely, overtreatment of the medial forehead can have a paradoxical effect on the lateral brow, creating an unnatural elevation (“Spock” appearance). This is prevented by small units placed in the lateral forehead 2 cm above the brow. With recreating brow position, one must be careful to balance position with symmetry and desired outcome. This can be individualized to patient needs and desires.

**BROW AND LATERAL CANTHAL LINES**

The third part of upper face treatment with BTX includes periorbital lines or crow’s feet. Lateral periorbital wrinkling is one of the earliest signs of aging. Hyperkinetic lateral canthal lines are effectively treated with neurotoxin. In older patients, static wrinkling caused by photodamage becomes more prominent and is less responsive to BTX alone. It is important to manage expectations in these patients as they may need a resurfacing procedure in addition to toxin to achieve the desired wrinkle reduction. Crow’s feet are typically treated with 3 equal injections of 2–4 BTX units or 5–10 Speywood units evenly spaced along an arc lying at least 1 cm external to the orbital rim to avoid diffusion to the palpebral portion of the orbicularis oculi or to the levator palpebrae muscle. The middle injection is placed in line with the lateral canthus. Injections flanking this point at 8–10 mm are then placed, but their exact positioning depends on the width of the individual’s canthal lines. The highest crow’s feet injection is inferior to the lateral eyebrow tail injection previously described for a chemical brow lift. The authors commonly lower this superior crow’s feet injection slightly when a crow’s feet treatment and a chemical brow lift are performed concomitantly. The skin of the temple is thin with little subcutis, and the orbicularis oculi is located more superficially than most facial muscles. Injections, therefore, should be intradermal, producing a visible bleb (Fig. 3).

It is increasingly common to treat all 3 areas as an upper face nonsurgical rejuvenation. Not all rhytides of the upper face respond to neurotoxins. Only dynamic or muscle-controlled wrinkles and lines respond to toxin. Fine etched lines and those dependent on redundant and photodamage skin will not improve with neurotoxin alone. It is best to combine treatment with dermal fillers. The physician should warn patients that some lines may not respond to toxin alone and the patient should be re-evaluated in 2 weeks for treatment response and treated then with filler if needed.

Lateral canthal lines can extend beyond the orbital rim, both laterally and inferiorly. They are dependent on the cheek muscles as well and should not be chased with toxin inferior to the zygoma. Inadvertent injection into the zygomaticus muscle can weaken perioral movement and the smile. The inferior and lateral lines can be treated with filler injections, both volumizing and intradermal.

BTX in the upper face is successfully used to correct dynamic wrinkling. Initially, treatment
was a “cookbook” recipe with injection points for glabella, forehead, and periorbits. It is now common practice to individualize dosage, injection points, and dilution based on the patient’s variation in anatomy, muscle mass, asymmetry, and, most importantly, desired outcome. Most patients and physicians target a natural look that softens wrinkles while maintaining facial expressivity. The frozen look is no more desired as we look more toward patient satisfaction by combining toxins with fillers and other nonsurgical cosmetic modalities.

Fig. 3. Crow’s feet injection: the standard 3-point crow’s feet (CF) injection is depicted in (Above) This patient received 5 BTX units (bU) at each point and had an excellent response. (Below, left) A variation that employs the same total dose (20–30 Speywood units or 10–15 bU per side) but divided into 5 smaller injections for broad and wide canthal lines. (Below, right) It is not uncommon for CF to have a significant inferior extension as in the pictured patient. It is imperative not to “chase” CF beyond the zygoma or one risks denervation of the zygomaticus muscles. Reprinted with permission from Cartee TV, Monheit GD. An overview of botulinum toxins: Past, present, and future. Clin Plast Surg. 2011;38:409–426, vi.

REFERENCES