

# Current Use of Cosmetic Toxins to Improve Facial Aesthetics

Lindsay E. Janes, M.D.  
Lauren M. Connor, M.D.  
Amir Moradi, M.D.  
Mohammed Alghoul, M.D.

Chicago, Ill.; and San Diego, Calif.



**Learning Objectives:** After studying this article, the participant should be able to: 1. Compare and contrast the various types of botulinum toxin on the market. 2. Appropriately select patients for treatment with cosmetic botulinum toxin. 3. Understand the common injection patterns for treating various regions of the face with cosmetic botulinum toxin. 4. List the complications associated with treating various regions of the face with cosmetic botulinum toxin.

**Summary:** Nonsurgical rejuvenation of the face with botulinum toxin is one of the most commonly performed procedures in the United States. This article reviews the current evidence in treating different regions of the face: upper face, lower face, masseter, and platysma. Dosing and complications associated with different facial regions are reviewed. (*Plast. Reconstr. Surg.* 147: 644e, 2021.)

Since the inception of its aesthetic applications during treatment of blepharospasm patients in the late 1980s,<sup>1</sup> the use of cosmetic botulinum toxin has exploded, from 786,911 procedures reported by board-certified plastic surgeons alone in 2000 to 7,230,967 reported in 2017.<sup>2</sup> Botulinum neurotoxin functions by blocking the docking and fusion of soluble *N*-ethylmaleimide-sensitive factor attachment protein receptor proteins at the neuromuscular junction.<sup>3,4</sup> Given the mechanism of action, botulinum toxin is recommended for the treatment of dynamic wrinkles. There are eight known serotypes of botulinum neurotoxin (A, B, C1, C2, D, E, F, and G), of which types A and B are used clinically.<sup>5</sup> The first three commercially available, U.S. Food and Drug Administration–approved formulations of type A botulinum neurotoxin are the most commonly known: onabotulinumtoxinA (Botox; Allergan U.S.A., Madison, N.J.), abobotulinumtoxinA (Dysport; Galderma Laboratories, LP, Fort Worth, Texas), and incobotulinumtoxinA (Xeomin; Merz Pharmaceuticals, LLC, Greensboro, N.C.). All three formulations are U.S. Food and Drug Administration approved for use in the glabellar region, and Botox is also approved for use on lateral canthal and forehead lines.<sup>6–8</sup> Newer formulations include prabotulinumtoxinA (Jeuveau; Daewoong Pharmaceuticals, Seoul, Republic of

Korea), which was approved by the U.S. Food and Drug Administration in February of 2019 for the glabella,<sup>9</sup> and daxibotulinumtoxinA (Revance Therapeutics, Inc., Nashville, Tenn.), which has anticipated U.S. Food and Drug Administration approval in 2020 and claims to provide results lasting 28 weeks. Botulinum neurotoxin is a category C medication for both pregnant and breastfeeding patients.<sup>6–8</sup> Patients with neuromuscular diseases (e.g., myasthenia gravis, Eaton-Lambert syndrome) are not suitable candidates for botulinum neurotoxin treatment, and medications such as aminoglycosides, penicillamine, quinine, and calcium channel blockers can potentiate the effects of botulinum neurotoxin and should be used with caution (Table 1).<sup>6,10</sup>

**Disclosure:** Dr. Alghoul is on the advisory board for Allergan. Dr. Moradi has relationships with Allergan (consultant, advisory board, faculty, clinical research investigator), Merz Aesthetics (consultant, advisory board, member of steering committee, European expert summit, clinical research investigator), Galderma (consultant, advisory board, clinical research investigator), Skin Medica (consultant, advisory board, clinical research investigator), BTL (consultant, speaker, clinical research investigator), Lutronic (consultant, speaker, clinical research investigator), Alastin (consultant, clinical research investigator; stockholder), and Evolus (honorarium recipient).

From the Division of Plastic Surgery, Northwestern Feinberg School of Medicine; and Moradi M.D.

Received for publication September 4, 2019; accepted November 12, 2020.

Copyright © 2021 by the American Society of Plastic Surgeons  
DOI: 10.1097/PRS.0000000000007762

Related digital media are available in the full-text version of the article on [www.PRSJournal.com](http://www.PRSJournal.com).

**Table 1. Quick Reference Guide for Injection of Botulinum Toxin**

Indications	Dosage	Potential Complications	Pearls
Upper face (glabella, frontalis, OO)	Frontalis: 10–20 U Glabella: 20–25 U Lateral orbicularis: 6–12 U each side Lower lid: 1–2 U each side	<ul style="list-style-type: none"> <li>Brow ptosis</li> <li>Upper eyelid ptosis</li> <li>Double vision</li> <li>Ectropion</li> </ul>	<ul style="list-style-type: none"> <li>Should not treat frontalis in isolation, to avoid brow ptosis.</li> <li>Lateral OO injections should be shifted inferiorly in patients with already high lateral brows.</li> <li>Avoid injecting lateral OO too inferiorly to prevent diffusion to zygomaticus and inhibition of smile.</li> <li>Before performing lower lid injections, perform a snap-back test. Injections should be avoided in any patient with lower lid laxity. Do not perform these injections on patients with scleral show.</li> <li>Avoid lip corners/modiolus to avoid drooling and drooping of lateral lip.</li> <li>Avoid midline of upper lip to prevent the flattening of Cupid's bow.</li> </ul>
Perioral (OO, mentalis, and DAO)	OO: 4–6 U each lip DAO: 2–5 U each side Mentalis: 4–10 U	<ul style="list-style-type: none"> <li>Weakness with speech</li> <li>Oral incompetence</li> <li>Oral asymmetry</li> <li>Drooling</li> </ul>	
Mentalis	15–25 U per side in Caucasian women 30–50 U per side in East Asian women. Male patients may need 10 U or so more than their female counterparts	<ul style="list-style-type: none"> <li>Weakness with chewing</li> <li>Loss of full smile because of diffusion of toxin to risorius and levator anguli oris</li> <li>Xerostomia</li> <li>Asymmetry</li> <li>Speech disturbances</li> <li>Dysgeusia</li> <li>Dysphagia and dysphonia (associated with doses greater than 50 U or deeper injection)</li> </ul>	<ul style="list-style-type: none"> <li>The dose of Botox depends on the bulk of the muscle being treated. Caucasian patients may require less than East Asian patients.</li> <li>Male patients may need 10 BU or so more than their female counterparts.</li> </ul>
Platysma	10–25 U per band (2–5 U per injection administered into 5 evenly based sites per band). No more than 50 U should be injected at one time.		To assess whether or not a patient is a good candidate for BoNT jaw contouring, the platysma should be contracted. If the mandibular border disappears with contraction, treatment is likely to be successful.

OO, orbicularis oris; DOA, depressor anguli oris; BU, botulinum units; BoNT, botulinum neurotoxin.

### Intradermal or Subcutaneous versus Intramuscular Injection

In a split-face randomized prospective study of 19 patients who underwent botulinum toxin A treatment of the forehead, subcutaneous injection demonstrated equivalent efficacy to intramuscular injection as measured by eyebrow height and patient satisfaction surveys, with less patient-reported pain.<sup>11</sup> Only three patients experienced bruising (two who received intramuscular injection and one who received subcutaneous injection), which is not sufficient to make a comparison. Intradermal injection of botulinum toxin has been reported to have similar efficacy in rhytide treatment as intramuscular injection with additional improvements in skin texture and midface lifting.<sup>12,13</sup>

### Dilution

Product dilution often varies, with many practitioners anecdotally reporting that a more dilute volume leads to a softer appearance. Manufacturer recommendations are as follows: Botox dilution of 100 U in 2 ml, Xeomin dilution of 100 U in 0.25 to 5 ml, and Dysport dilution of 300 U in 0.6 to 3 ml.<sup>6–8</sup> Larger volumes at lower concentrations do have a greater spread of product as would be expected, but many studies report equivalent outcomes with both higher and lower concentrations.<sup>14–16</sup> Carruthers et al.<sup>15</sup> injected 30 botulinum units into the glabellar region in 80 women at four different concentrations and demonstrated no significant differences in the Facial Wrinkle Scale scores as recorded by trained observers and by patients. However, the more dilute concentrations did have a higher incidence of adverse effects, including local swelling and brow ptosis. Thus, lower concentrations can be used for larger, broader muscles such as the frontalis or platysma, but higher concentrations should be used when more focused treatment is desired, such as for the lateral orbicularis oculi or the depressor anguli oris. Several studies have reported that higher doses of toxin produce longer lasting results<sup>17,18</sup>; however, this benefit must be weighed against the potential risk of adverse effects. An emerging technique, high-dose microfocused botulinum toxin injections, limits the field of effect by injecting higher doses in lower volumes.<sup>19</sup> Although this technique may help safely extend the duration of action without adverse events, further outcomes research must be performed.

### Dose Equivalence of Botox Units, Dysport Units, Xeomin Units

Dose equivalence between the main botulinum neurotoxin products, Botox, Dysport, and Xeomin,

remains the subject of controversy even after almost 30 years of clinical use. In general, the Botox-to-Dysport ratio is most commonly reported at a conversion of 1:2 to 1:3, although there are some reports of conversion at 1:6.<sup>20–22</sup> The Botox-to-Xeomin ratio is reported at a 1:1 ratio.<sup>23</sup> However, it has been increasingly noted that, based on treatment area, technique, dilutions, and injection patterns, the formulations are not interchangeable by any single conversion ratio.<sup>17,24–27</sup> Thus, although 1:3 Botox-to-Dysport and 1:1 Botox-to-Xeomin ratios may be good starting points, each practitioner will likely modify their dosing as they become more experienced with each product and the areas treated.

### Product Diffusion by Brand

Dysport is thought to have a greater range of diffusion for a given volume. In a study of 20 subjects with hyperhidrosis with half of the face injected with 0.06 cc of Botox and half with 0.06 cc of Dysport at a 1:2.5 ratio, Dysport produced a larger area of anhidrosis than Botox in 93 percent of mediomedial or laterolateral comparisons of the two products at individual time points.<sup>28</sup>

### Reconstitution and Storage

The Botox, Dysport, and Xeomin prescribing information sheets instruct reconstitution in sterile, preservative-free 0.9% sodium chloride, administration within 24 hours of reconstitution, and single use only.<sup>6–8</sup> However, implementing such use in practice generates significant cost and waste, which has led to several studies demonstrating similar safety and efficacy of preserved saline, multiple access using sterile technique, and storage as a reconstituted solution for at least 7 weeks.<sup>29–32</sup> Xeomin is the only botulinum toxin that is free from complexing proteins and can be stored at room temperature.<sup>8</sup>

## UPPER FACE (FOREHEAD, GLABELLA, PERIORBITAL)

### Physical Examination and Facial Analysis

The upper face is one of the most commonly requested areas for nonsurgical facial rejuvenation. Before injection of botulinum toxin in the upper face, a full assessment of the patient's face must be considered, including evaluation of the following:

- Static versus dynamic rhytides should be considered carefully for potential combination treatment with laser, chemical peels, or fillers.
- Brow shape and position, especially brow ptosis or asymmetries.

- Muscle strength for different muscle groups should be assessed and the dose adjusted accordingly.
- Constriction of the lateral orbital area.
- Eye shape asymmetries and lower eyelid laxity.
- Ethnicity.
- Age.
- Patient desire for retained facial expression.

Examination should be performed with the patient in the upright position. Evaluation

of brow position, eye shape, and rhytide severity should be performed in these three areas together, as injection of one can affect the other areas and lead to unwanted effects if not placed carefully (Fig. 1). [See Video 1 (online), which demonstrates treatment of the forehead and periorbital area. (Courtesy of Mohammed Alghoul, M.D. Informed consent for publication of video/photographs was obtained.)] In older patients, it is critical to assess whether frontalis muscle contraction is compensating for levator palpebrae muscle weakness.



**Fig. 1.** Before (*above*) and after (*below*) injection of botulinum toxin to the frontalis, glabella, and crow's feet. (Courtesy of Mohammed Alghoul, M.D. Informed consent for publication of photographs was obtained.)

## Anatomy and Technique

### Forehead and Glabellar Rhytides, Brow Position, and Shaping

Successful treatment of forehead and glabellar rhytides requires understanding the force balance between the single brow elevator (frontalis), several medial brow depressors (corrugator supercilii, procerus, medial portion of orbicularis oculi), and the single lateral brow depressor (lateral orbicularis oculi). While treating rhytides, one should be mindful not to disturb the balance between these opposing muscle forces and create an unwanted effect such as brow ptosis or upper lid ptosis.

Treatment of forehead rhytides has been described with many patterns of injection, the most common of which are highlighted in Figure 2.<sup>33–39</sup> In a randomized controlled trial, injection at the midforehead was shown to be more effective in

rhytide reduction but induced greater brow ptosis than injection closer to the hairline.<sup>34</sup>

Widely accepted treatment of glabellar rhytides involves five injection points in a V-shaped pattern targeting the procerus, oblique head of corrugator supercilii (medial eyebrow), transverse head of corrugator supercilii (mid-eyebrow), and depressor supercilii (Figs. 2 through 4). However, it has been observed that how patients use their glabellar muscles varies, and optimal results can be achieved by tailoring injection patterns to the patient.<sup>40–42</sup> The corrugator is thickest in the medial portion above the medial canthus and becomes thinner laterally.<sup>43–46</sup> The medial origin is on average 2.9 mm from the nasion and the lateralmost extension is on average 43.3 mm from the nasion and 7.6 mm from the lateral orbital rim.<sup>45</sup> Medially, it lies deep to the frontalis, and therefore medial corrugator injections should be placed deeply within the substance of the muscle.

#### Frontalis

- Injection pattern recommended by Facial Aesthetics Consensus Committee (de Maio et al<sup>33</sup>)
  - Lateral injection points (circled are optional depending on brow position and lateral extent of frontalis)
- Jabbour et al<sup>34</sup> compared injection patterns and based on the effect on brow position recommended:
- (V Pattern): Best treatment of forehead lines but greater brow depression
  - ▲ (Upper Forehead Pattern): Least brow depression though less effective treatment of forehead lines

#### Eye Shaping

- Dr. Fagien<sup>35</sup> described the use of botulinum toxin for eye shaping utilizing .5 – 1.5BU per injection
- Pre-septal is the safest injection to open the eye aperture and reduce rhytides
  - For cosmetic patients, pre-tarsal injection should be limited to patients with orbicularis oculi hypertrophy
- Flynn et al<sup>36</sup> described a single injection 3mm below the lash line with 2 BU. They demonstrated this injection opened the eye aperture .5mm at rest and 1.3mm at full smile

#### Chemical Browlift

- Jabbour et al<sup>34</sup>. 5 BU per injection point
- ▲ Huang et al<sup>37</sup>. 2.5 BU to each lateral orbicularis site▲ and 5 BU to the corrugator muscle at each medial eyebrow (circled)○

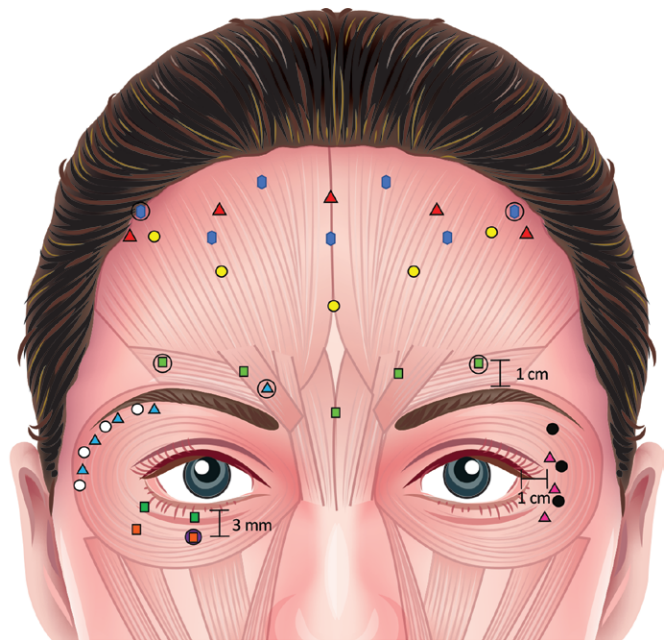
#### Glabella

- Widely accepted V-shaped pattern with 5 injection points. It is recommended to stay at least 1 cm above the superior orbital rim to prevent diffusion and ptosis
- The muscle is much thinner laterally, thus the circled sites can inject fewer units or skip if concern about altering brow shape

#### Crow's Feet with or without Brow Elevation

- ▲ Isolated treatment of crow's feet
- Treatment of crow's feet plus brow elevation (injected sites shifted more superiorly)

Injection points should be 1cm from orbital rim  
 Note proximity of inferior injection to zygomaticus major- injection too far inferiorly can cause weakness of smile  
 (de Maio et al<sup>33</sup>, Matarraso et al<sup>38</sup>, Qaqish et al<sup>39</sup>)



**Fig. 2.** Common patterns of injection for the upper face. BU, botulinum units.



**Fig. 3.** Treatment of brow asymmetry with botulinum toxin. (Courtesy of Amir Moradi, M.D. Informed consent for publication of photographs was obtained.)

Botulinum toxin can also be used in these areas to address brow shape and position. A subtle chemical brow lift can be achieved through selective injection of brow depressors. Injection of superolateral orbicularis oculi with (1 to 4 botulinum units) has been shown to raise the brow up to 3 mm, which can also be used to even asymmetric brows.<sup>37,39,47–49</sup> In addition to superolateral orbicularis oculi injection, enhancing the arch of the eyebrows can be achieved by injecting the lateral frontalis with a lower dose than the medial frontalis.<sup>49</sup>

Adverse events of treatment of forehead/glabella rhytides include asymmetry, bruising, and eyelid ptosis if there is migration of botulinum toxin to the levator palpebrae superioris. To avoid ptosis, the provider should (1) keep injection 1 cm above the brow and within the substance of the muscle; (2) use digital pressure over the supraorbital rim with the noninjecting hand to reduce the risk of diffusion; and (3) point the needle superiorly, away from the orbit. However, if ptosis occurs despite these strategies, 0.5% apraclonidine eye drops can be prescribed at a dosage of one to two drops three times per day. This is an alpha-adrenergic receptor agonist that causes contraction of the Müller muscle. There is a risk of causing miosis and closed angle glaucoma in susceptible individuals, and providers should assess the patient's ophthalmic medical history before prescription.<sup>50</sup>

#### Lateral Canthal Lines (Crow's Feet)

Lateral canthal lines are created by contraction of the lateral orbicularis oculi. In addition to elimination of lateral canthal lines, injection in this area can also be used to open up (vertically expand) the lateral orbital area to create a

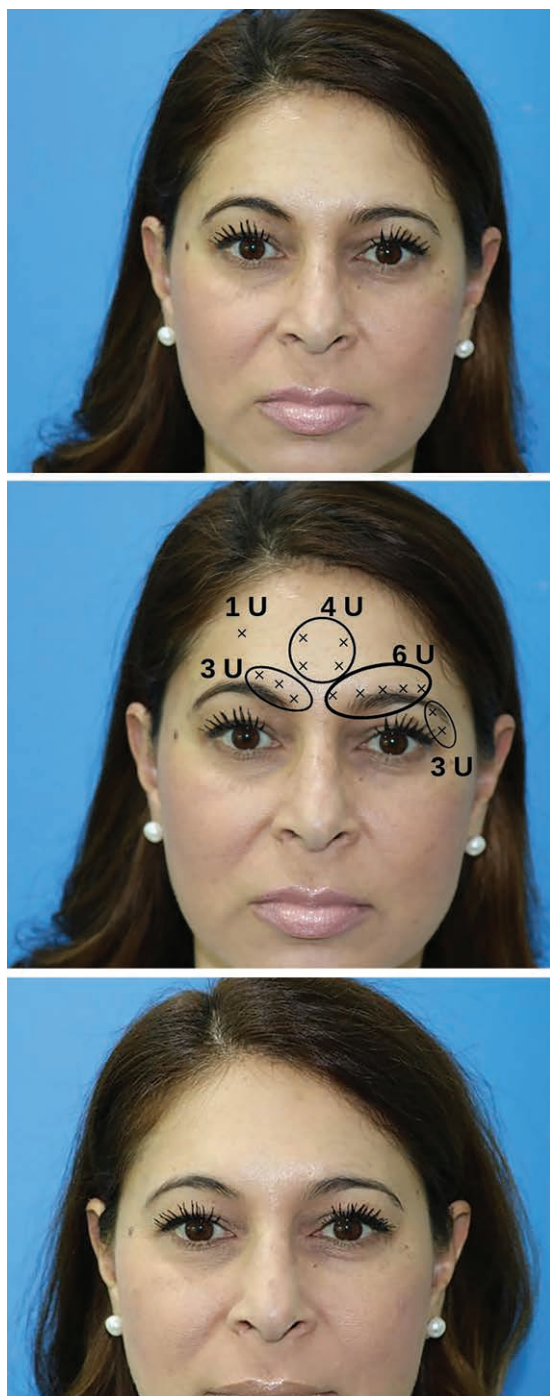
more youthful appearance of the eyes (Fig. 5). Treatment of this area has become a primary focus of treatment in the senior author's (M.A.) practice, as it accomplished several goals in one treatment: (1) vertical expansion of the lateral orbital area, (2) elevation of the tail of the brow, (3) decreased lateral orbital constriction during animation (mainly smiling), and (4) improved lateral orbital lines (crow's feet)

The muscle is very superficial in this area; thus, injections should be subdermal, producing a characteristic skin wheal. The injections should be 1.5 cm away from the lateral canthus to prevent spread of the product toward the extraocular muscles, leading to diplopia.<sup>38</sup> Injection points can be shifted higher if the goal is also to raise the brow, or lower if the patient does not want their brow shape altered. However, injections should not be placed lower than the superiormost aspect of the zygomatic arch to prevent diffusion into the zygomaticus major and inhibition of smile.<sup>38</sup>

A double-blind, randomized, placebo-controlled study assessed the effects of 18, 12, 6, or 3 botulinum units of botulinum toxin type A or placebo injected into the lateral orbicularis oculi and found that higher doses had increased magnitude and duration of affect, with no significant improvement at doses higher than 12 botulinum units of botulinum toxin type A.<sup>17</sup>

#### Eye Shaping

In addition to opening of the lateral orbital area by injecting the lateral orbicularis oculi as discussed above, botulinum toxin can also be used to improve eye shape and lower eyelid position.<sup>35</sup> Patients undergoing eye shaping with neurotoxin should be carefully screened for lower lid



**Fig. 4.** Treatment of brow asymmetry with botulinum toxin. (Courtesy of Amir Moradi, M.D. Informed consent for publication of photographs was obtained.)

laxity, upper eyelid ptosis, and dry eye, as injection can worsen these conditions if not screened for appropriately. Epiphora can result from reduced lower eyelid tone that compromises the lacrimal “pump” function of the medial orbicularis oculi.<sup>51</sup>

For lower eyelid injections, the two potential locations are the pretarsal orbicularis oculi and

the preseptal orbicularis oculi. The pretarsal orbicularis oculi functions mostly for involuntary eye closure and has a lesser effect on rhytide development or soft-tissue malposition.<sup>48</sup> Injection of pretarsal orbicularis is typically used in patients with blepharospasm but can be used cosmetically in patients with lower lid orbicularis hypertrophy, injected at the midpupil. For lower lid rhytides, however, treatment should be directed more toward the preseptal orbicularis, with two injection points: lateral and midpupil. A single injection 3 mm below the lash margin with 2 botulinum units of botulinum toxin type A has been shown to increase the palpebral aperture at rest by 0.5 mm and 1.3 mm at full smile.<sup>36</sup>

### PERIORAL (ORBICULARIS ORIS, MENTALIS, DEPRESSOR ANGULI ORIS)

#### Physical Examination and Facial Analysis

The muscular anatomy of the lower face is complex and must be approached carefully to avoid oral incompetence and asymmetry. The goal of neurotoxin use in the lower face is generally reduced muscle strength, without complete inhibition. During aging, the lateral portions of the lips recede, the distance between the columella and upper lip vermilion border increases, and the substance of the vermillion rolls inside.<sup>52</sup> Chronic contraction of these muscles leads to vertical perioral rhytides, or “smoker’s lines,” melo-mental folds, or “marionette lines,” and dimpling of the skin over the chin, giving the chin a peau d’orange appearance. Often, these areas are first treated with filler, using botulinum neurotoxin as an adjunct. Overview of injection technique is highlighted in Figure 6.<sup>53–61</sup>

#### Anatomy and Technique

##### Orbicularis Oris

It is critical to assess whether perioral rhytides are static or dynamic before treatment, as only dynamic rhytides can be treated with botulinum toxin. One should be cautious when treating the orbicularis oris in certain professions (e.g., musicians who play wind instruments and scuba divers). Static rhytides can be addressed with filler or skin resurfacing. Treatment of vertical perioral rhytides requires the patient to contract the orbicularis oris, puckering the lips. Toxin should be injected adjacent to the vertical rhytides, either intramuscularly or subcutaneously.<sup>52,53</sup> Each site should receive approximately 0.5 to 1 botulinum units of toxin. Injection should occur along the vermillion border<sup>60</sup> (Fig. 6).



**Fig. 5.** Before (*above*) and after (*below*) injection of botulinum toxin into the lateral orbicularis oculi. Images show face relaxed (*left*) and with smile (*right*). Note the increased opening of the eye aperture with this treatment. (Courtesy of Mohammed Alghoul, M.D. Informed consent for publication of photographs was obtained.)

For orbicularis oris, most cases reported in the literature use 0.5 to 1 botulinum units of botulinum neurotoxin at each injection site, with total doses of 4 to 6 botulinum units per lip.<sup>25,52,53,59,62</sup> One study report success with higher doses up to 18 botulinum units, although doses above 7 botulinum units were associated with difficulty announcing /p/ and /b/ sounds and eating foods such as soup.<sup>63</sup> Cohen et al. conducted a randomized, double-blind trial comparing doses of 7.5 and 12 botulinum units to treat perioral rhytides. They showed that the lower dose was effective and caused fewer adverse events compared with the higher dose.<sup>64</sup>

### Depressor Anguli Oris

Injection of the depressor anguli oris for treatment of melomental folds is difficult because its medial border overlaps with the depressor labii inferioris and its lateral border is adjacent to the risorius and zygomaticus major muscles. The majority of complications in this region occur because of an inadvertent effect on the depressor labii inferioris. Patients are most commonly asked to frown to aid in the location of the muscle

(*Fig. 6*).<sup>52,53,62</sup> [**See Video 2 (online)**, which displays treatment of the depressor anguli oris. (Courtesy of Amir Moradi, M.D. Informed consent for publication of photographs was obtained.)]

There are several anatomical articles that clearly demonstrate the location of the depressor anguli oris as it relates to the neighboring muscles.<sup>65–67</sup> The depressor anguli oris originates close to the mandible inferiorly and inserts into the modiolus superiorly. The depressor labii inferioris crosses over laterally at the inferior half of the depressor anguli oris. The superior half has the least amount of exposure to the surrounding musculature. Using facial landmarks, a safe zone can be drawn (*Fig. 6*).<sup>56</sup> Another useful landmark is the visible melomental wrinkle, which Trévidic et al. demonstrated occurs in the middle of the upper part of the depressor anguli oris muscular body.<sup>60</sup>

### Mentalis

The easiest technique for the mentalis is injection of 4 to 10 botulinum units directly into the insertion point of both bellies centrally on the



**Orbicularis Oculi**

• First determine if they are functional rhytides by having patient pucker. If rhytides deepen, they may benefit from injection of BoNT. Injections should be equally spaced on either side of rhytides along vermilion border. Each site should receive 0.5-1.0 BU<sup>53</sup>.

**Gummy Smile**

▲ “Yonseil Point”, Hwang et al<sup>54</sup> injected 3U at point that centers the vectors of the levator labii superioris, levator labii superioris alaeque nasi, and zygomaticus major. This point is identified 1cm lateral to the ala and 3cm above lateral commissure

■ Sucupira et al<sup>55</sup> injected an average of 1.95U per side 3-5mm lateral to each ala, which reduced gingival display by an average of 3.04mm

**DAO Technique 1 (Drawn on Right Side)**

An anatomical cadaver study (Choi et al<sup>56</sup>) suggested that the following steps

should be followed to identify the safest injection area:

- (1) Identify the modiolus by palpating the cheek (Approximately 11mm lateral to commissure) ●
- (2) Draw a vertical line through the modiolus
- (3) Draw an oblique line with an angle of 30 degrees on the medial side of the modiolus
- (4) draw and oblique line with an angle of 45 degrees on the lateral side of the modiolus.

The fan shaped area bounded by the oblique lines and inferior margin of the mandible is the safest and most effective site for injection.

**Depressor Septi Nasi**

● Dayan et al<sup>57</sup> and Ghavami et al<sup>58</sup> report success with 1-5 BU injection at each nasal base. An alternative technique that utilizing an injection site at nasal tip is pictured in Figure 10.

**Mentalis**

Should stay at least 1cm inferior to mental sulcus to avoid oral incompetence due to migration to orbicularis oculi.

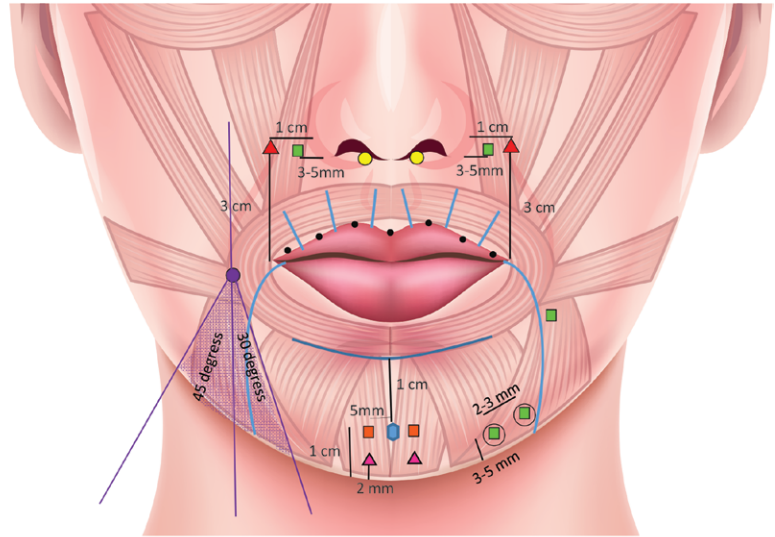
Two injection sites

- ▲ Gart et al<sup>59</sup> recommends 2mm above mandibular border
- Trevidic<sup>60</sup> recommends 1cm above mandibular border
- Single Injection Site 1 cm above mandibular border (Gart et al<sup>59</sup>, Carruthers<sup>61</sup>)

**DAO Technique 2 (Drawn on Left Side)**

Trevidic<sup>60</sup> recommended 3 injections with 2 to 5BU each

- Superior Injection point is always behind the marionette line and should be kept superficial
- The other two injection points should be placed anterior to the mandibular cutaneous ligament (tethering structure at the anteriormost aspect of jaw/ marionette line)
  - Should be 3-5mm above mandibular border and 2-3 mm apart
  - Tip of needle goes deep 3-4 mm until making contact with bone at muscle origin



**Fig. 6.** Common patterns of injection for the lower face. BoNT, botulinum neurotoxin; BU, botulinum units; DAO, depressor anguli oris.

mandible.<sup>25,53,61,62</sup> However, some practitioners prefer to inject each muscle separately, which can be accomplished by injecting 2 mm to 1 cm above the tip of the chin, 5 mm laterally from the midline on each side. It is important to stay at least 1 cm inferior to the mental sulcus to avoid oral incompetence caused by toxin migration to the orbicularis oris<sup>53</sup> (Fig. 7).

**Gummy Smile**

Excessive gingival display, or gummy smile, is defined as exposure of greater than 2 mm above the dental line when smiling. Muscles thought to be involved include the levator labii superioris, levator labii superioris alaeque nasi, zygomaticus minor, and zygomaticus major. Many variations with several injection points to these muscles have been reported,<sup>68</sup> but more recent alternative approaches with a single injection have demonstrated success,

with an average reduction in gingival display by an average of 3.04 mm<sup>55</sup> (Fig. 6). More advanced practitioners could consider recommendations by Mazzuco and Hexsel that advocate classification and treatment of the gummy smile by four different types<sup>69</sup>: (1) excess show anterior to the canines, (2) excess show posterior to the canines, (3) mixed, and (4) asymmetric.

**Depressor Septi Nasi**

Patients presenting with dynamic tip ptosis and excessive upper lip shortening with smile can be treated with injection into the depressor septi nasi. The muscle fibers originate at the incisive fossa for the maxilla and insert onto the nasal septum just posterior to the medial crus of the lower lateral cartilage; thus, injection points have been described at both the nasal base and the nasal tip (Figs. 6 and 10).<sup>57,58,70</sup>

Downloaded from http://journals.lww.com/plasreconsurg by 2F7RmWMOshHs1UJfpmY85b0d4sVh/OfogQO5/sIQGz0qd ofIge 1NSaW+7osSuHaek853AM3S.RMMBjwBozW/cG/+ZZTdlAs/SvBFoc1wK8Bsr28YnLeuwBmlLk2suUQIBhGCOaKv0DNIXB OOnhg8qpfAL/Bm5m4skzm58HY = on 11/12/2023



**Fig. 7.** Before (*right*) and after (*left*) injection of botulinum toxin into the depressor anguli oris. (Courtesy of Mohammed Alghoul, M.D. Informed consent for publication of photographs was obtained.)

## MASSETER

### Physical Examination and Facial Analysis

Patients presenting with strong jaw lines and/or a square face with a desire to change their face shape can benefit from injection of neurotoxin into the masseter (Figs. 8 and 9). Patients should be evaluated for parotid hypertrophy, as this can also contribute to the impression of a widened mandible.<sup>71</sup> Patients should be asked about symptoms of headache, jaw clenching, or teeth grinding, as these patients may require more botulinum neurotoxin and have a shorter duration of action. Potential complications include jowling if high doses are used in an elderly patient with skin laxity, paradoxical bulging during mastication, loss of asymmetric smile caused by diffusion into the risorius, or difficulty with mouth opening.<sup>72</sup>

### Anatomy and Technique

The masseter muscle arises as three heads from the length of the zygomatic arch. Key structures to avoid in this area include the parotid gland, the marginal mandibular nerve, and other branches of the facial nerve such as its buccal branch. Where the three heads cross each other represents the thickest part of the muscle that can be palpated when patients clench their teeth.<sup>71</sup> Figure 10 summarizes recommendations for injection landmarks based on prior anatomical studies.<sup>60,73,74</sup> As shown in Video 3, injection in the masseter should occur below a line of safety drawn from the lateral commissure to the tragus. [See Video 3 (online), which displays treatment of the masseter. (Courtesy of

Mohammed Alghoul, M.D. Informed consent for publication of photographs was obtained.)]

### Dosing Considerations

The dose of botulinum neurotoxin depends on the bulk of the muscle being treated. One study demonstrated that Caucasian patients required less than East Asian patients and women required less than men.<sup>75</sup> Initial doses of 15 to 25 botulinum units per side are recommended in Caucasian women, whereas East Asian women may require 30 to 50 botulinum units per side. Men may need 10 botulinum units or so more than their female counterparts.<sup>75,76</sup> In Western patients, aesthetic improvement has been demonstrated to last 9 to 12 months, whereas the functional improvement from bruxism lasted 6 to 7 months.<sup>75</sup>

## PLATYSMA

### Physical Examination and Facial Analysis

Treatment of the platysma is indicated in patients who are seeking improvement in the contour of their jawline or softening of the anterior platysmal bands but do not need a lower face rhytidectomy. Jawline contouring with botulinum toxin is likely to be successful if the mandibular border disappears with platysma contraction on examination.<sup>77</sup> In treatment of platysmal bands and horizontal neck rhytides, the degree of muscle flaccidity and hypertrophy are the factors that most influence success rates.<sup>78</sup> The practitioner should carefully analyze whether the rhytides are caused by hyperactive platysmal action versus skin laxity.



**Fig. 8.** Before (right) and after (left) injection of botulinum toxin into the masseter. Note the subtle change in facial shape. (Courtesy of Mohammed Alghoul, M.D. Informed consent for publication of photographs was obtained.)

The patient with significant skin laxity will not gain improvement from botulinum toxin alone.

### Anatomy and Technique

The platysma is a broad, thin muscle that originates in the deltopectoral fascia and first inserts along the inferior border of the mandible, and the remaining fibers continue upward, interdigitating with fibers of the depressor anguli oris, the lower lip, the depressor labii inferioris, and the superficial musculoaponeurotic system.<sup>78</sup> With aging, the cervical skin loses elasticity, more submental fat becomes visible, and the platysma separates anteriorly to become two diverging vertical bands.<sup>77</sup>

Treatment requires the patient to contract the platysma muscle. The examiner then grasps each band between the thumb and index finger and injects 2 to 5 botulinum units at five sites approximately 1 cm apart, including down to where the platysma meets the clavicle.<sup>53</sup> It is important to keep the injection in the superficial platysma and avoid deeper injection.

Alternatively, the Microbotox technique has demonstrated efficacy in this treatment area.<sup>79</sup>

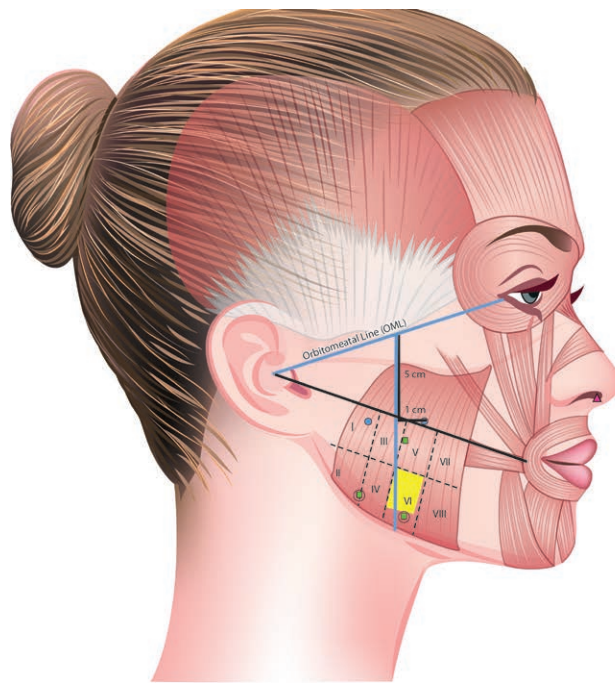
Microbotox, first described by Wu in 2015, is the systematic injection of multiple microdroplets (at 0.8- to 1.0-cm intervals) of diluted onabotulinumtoxinA into the dermis or the interface between the dermis and the superficial layer of facial muscles.<sup>80</sup> The intent is not to completely paralyze the underlying facial muscles but to weaken the superficial fibers that insert into the undersurface of the skin and lead to fine lines and wrinkles on the face and neck. Comparison of this technique with standard injection deep into the platysmal bands (Nefertiti lift) demonstrated that the Microbotox technique induced greater improvement in jowling and overall neck soft-tissue ptosis, whereas the standard injection provided greater improvement when banding was the primary concern.<sup>79</sup>

### Dosing Considerations

Dosing in the platysma region should be approached to minimize adverse events such as dysphagia, dysphonia, and weakness of the sternocleidomastoid muscles. Most modern publications recommend avoiding these complications



**Fig. 9.** Before (right) and after (left) injection of botulinum toxin into the masseter. Note the more dramatic change in facial shape. (Courtesy of Mohammed Alghoul, M.D. Informed consent for publication of photographs was obtained.)



**Fig. 10.** Common patterns of injection for the masseter.

**Masseter Injection Techniques**

*Technique 1: Kaya et al<sup>73</sup>*

1. Draw Orbitomeatal line (OML)- line from tragus to lateral palpebral fissure
2. Draw VL line- line from midpoint of OML to angle of mandible
3. Mark halfway down VL (about 5cm). Injection points should be 1cm anterior and 1cm posterior to VL line

*Technique 2: Trevidic<sup>60</sup>*

- Three injection points made in a triangle shape
- Two inferior points spaced about 1.5cm apart following a line 5mm above and parallel to the border of the mandible
  - Third point is at the apex of the triangle, 2cm above the previous points

*Technique 3: Hu et al<sup>74</sup>*

- Draw a line from tragus to chelion. Feel the borders of the masseter and draw eight equal compartments. Recommended most efficient injection into the center of compartment VI and >7.4mm above the angle of the mandible, as this was the location of the marginal mandibular nerve
- Recommended avoiding areas I and II and the parotid gland overlies these areas

**Depressor Septi Nasi**

- ▲ Redaelli et al<sup>70</sup> injects the depressor septi nasi with 1.5U per side, just under the nasal tip at the beginning of the columella. This targets the muscle closer to its insertion site and they feel decreases the risk of diffusion to orbicularis oculi. An alternative approach is pictured in Figure 6.

by using superficial injection techniques and by not exceeding more than 50 botulinum units in one session.<sup>52,60,81</sup> Doses of 75 to 100 botulinum units have been reported to produce weakness in the neck flexors and dysphagia.<sup>82</sup> Carruthers and Carruthers reported one patient treated with 60 botulinum units who developed such profound dysphagia she required a nasogastric tube for 6 weeks until she regained the ability to swallow.<sup>52,83</sup> Higher doses should be approached with extreme caution and patient counseling.<sup>84</sup>

**CONCLUSIONS**

Injection of botulinum toxin is a safe and effective procedure for the treatment of dynamic rhytides. Careful facial analysis should be used to correct asymmetry and avoid unintended changes to facial harmony. This article serves as a reference for starting doses and patterns of injection to help the beginner provider successfully introduce cosmetic botulinum toxin into their practice.

**Mohammed Alghoul, M.D.**  
675 North St. Claire Street, Suite 19-250  
Chicago, Ill. 60611  
mohammed.alghoul@abdalmmedical.com  
@alghoulplasticsurgery

**PATIENT CONSENT**

*Patients provided written consent for the use of their images.*

**REFERENCES**

1. Carruthers JD, Carruthers JA. Treatment of glabellar frown lines with *C. botulinum*-A exotoxin. *J Dermatol Surg Oncol.* 1992;18:17–21.
2. American Society of Plastic Surgeons. 2017 plastic surgery statistics report. Available at: <https://www.plasticsurgery.org/documents/News/Statistics/2017/plastic-surgery-statistics-full-report-2017.pdf>. Accessed August 21, 2020.
3. Barinaga M. Secrets of secretion revealed. *Science* 1993;260:487–489.
4. Söllner T, Rothman JE. Neurotransmission: Harnessing fusion machinery at the synapse. *Trends Neurosci.* 1994;17:344–348.
5. Rosales RL, Bigalke H, Dressler D. Pharmacology of botulinum toxin: Differences between type A preparations. *Eur J Neurol.* 2006;13(Suppl 1):2–10.
6. Allergan, Inc. Botox Cosmetic AI. OnabotulinumtoxinA: Full prescribing information. Available at: <https://media.allergan.com/actavis/actavis/media/allergan-pdf-documents/product-prescribing/20190626-BOTOX-Cosmetic-Insert-72715US10-Med-Guide-v2-0MG1145.pdf>. Accessed March 1, 2021.
7. Dysport. AbobotulinumtoxinA: Full prescribing information. Available at: [https://www.galderma.com/us/sites/g/files/jcdfhc341/files/2020-11/1066038%20Dysport%20PI.pdf?\\_ga=2.98258518.878584266.1614617021-1744198382.1614617021&\\_gac=1.128997502.1614617021-Cj0KCQjAwKBBhCXARIsACTePW9eYUXazZJF-ZINacrRD IUAIq57D5MleB6v1qo8otBWEo8MylASIGaAsj8EALw\\_wcB](https://www.galderma.com/us/sites/g/files/jcdfhc341/files/2020-11/1066038%20Dysport%20PI.pdf?_ga=2.98258518.878584266.1614617021-1744198382.1614617021&_gac=1.128997502.1614617021-Cj0KCQjAwKBBhCXARIsACTePW9eYUXazZJF-ZINacrRD IUAIq57D5MleB6v1qo8otBWEo8MylASIGaAsj8EALw_wcB). Accessed March 1, 2021.
8. Xeomin. IncobotulinumtoxinA: Full prescribing information. Available at: <https://www.xeomin.com/pdf/xeomin-medication-guide.pdf>. Accessed March 1, 2021.
9. U.S. Food and Drug Administration. Jeuveau FDA approval letter. Available at: [https://www.accessdata.fda.gov/drug-satfda\\_docs/nda/2019/761085Orig1s000Approv.pdf](https://www.accessdata.fda.gov/drug-satfda_docs/nda/2019/761085Orig1s000Approv.pdf). Accessed January 14, 2020.

Downloaded from http://journals.lww.com/plasreconsurg by 2FRmWmShs1UJfpmYas5b04sVh/OfqoQ5y5iGz0qd dfIgeINSAW+7ossuHaeK853AM3S.RMMMywBzWzCGS+zZTDIsySjWBFOcIwKB8sr23yNleuwBmlLk2suUQIBhGCOaKv0DNIXB ONhg8qBpFAL/Bm5m4skzmj58HFY = on 11/12/2023

10. Klein AW. Contraindications and complications with the use of botulinum toxin. *Clin Dermatol*. 2004;22:66–75.
11. Gordin EA, Luginbuhl AL, Ortlip T, Heffelfinger RN, Krein H. Subcutaneous vs intramuscular botulinum toxin: Split-face randomized study. *JAMA Facial Plast Surg*. 2014;16:193–198.
12. Petchngaovilai C. Midface lifting with botulinum toxin: Intradermal technique. *J Cosmet Dermatol*. 2009;8:312–316.
13. Sapra P, Demay S, Sapra S, Khanna J, Mraud K, Bonadonna J. A single-blind, split-face, randomized, pilot study comparing the effects of intradermal and intramuscular injection of two commercially available botulinum toxin A formulas to reduce signs of facial aging. *J Clin Aesthet Dermatol*. 2017;10:34–44.
14. Hsu TS, Dover JS, Arndt KA. Effect of volume and concentration on the diffusion of botulinum exotoxin A. *Arch Dermatol*. 2004;140:1351–1354.
15. Carruthers A, Bogle M, Carruthers JD, et al. A randomized, evaluator-blinded, two-center study of the safety and effect of volume on the diffusion and efficacy of botulinum toxin type A in the treatment of lateral orbital rhytides. *Dermatol Surg*. 2007;33:567–571.
16. Hankins CL, Strimling R, Rogers GS. Botulinum A toxin for glabellar wrinkles: Dose and response. *Dermatol Surg*. 1998;24:1181–1183.
17. Lowe NJ, Ascher B, Heckmann M, Kumar C, Fraczek S, Eadie N; Botox Facial Aesthetics Study Team. Double-blind, randomized, placebo-controlled, dose-response study of the safety and efficacy of botulinum toxin type A in subjects with crow's feet. *Dermatol Surg*. 2005;31:257–262.
18. Harii K, Kawashima M. A double-blind, randomized, placebo-controlled, two-dose comparative study of botulinum toxin type A for treating glabellar lines in Japanese subjects. *Aesthetic Plast Surg*. 2008;32:724–730.
19. Joseph J. Understanding field of effect of botulinum toxins: A simple equation highlights how cosmetic experts have been “doing it wrong” for 30 years. *Mod Aesthet*. 2018;May/June:28.
20. Hambleton P, Pickett AM. Potency equivalence of botulinum toxin preparations. *J R Soc Med*. 1994;87:719.
21. Hexsel D, Brum C, do Prado DZ, et al. Field effect of two commercial preparations of botulinum toxin type A: A prospective, double-blind, randomized clinical trial. *J Am Acad Dermatol*. 2012;67:226–232.
22. Karsai S, Raulin C. Current evidence on the unit equivalence of different botulinum neurotoxin A formulations and recommendations for clinical practice in dermatology. *Dermatol Surg*. 2009;35:1–8.
23. Dressler D, Mander G, Fink K. Measuring the potency labeling of onabotulinumtoxin A (Botox) and incobotulinumtoxin A (Xeomin) in an LD50 assay. *J Neural Transm (Vienna)*. 2012;119:13–15.
24. Lowe NJ, Shah A, Lowe PL, Patnaik R. Dosing, efficacy and safety plus the use of computerized photography for botulinum toxins type A for upper facial lines. *J Cosmet Laser Ther*. 2010;12:106–111.
25. Lowe NJ, Yamauchi P. Cosmetic uses of botulinum toxins for lower aspects of the face and neck. *Clin Dermatol*. 2004;22:18–22.
26. Lee SH, Wee SH, Kim HJ, et al. Abobotulinum toxin A and onabotulinum toxin A for masseteric hypertrophy: A split-face study in 25 Korean patients. *J Dermatolog Treat*. 2013;24:133–136.
27. Lee JH, Park JH, Lee SK, et al. Efficacy and safety of incobotulinum toxin A in periocular rhytides and masseteric hypertrophy: Side-by-side comparison with onabotulinum toxin A. *J Dermatolog Treat*. 2014;25:326–330.
28. Trindade de Almeida AR, Marques E, de Almeida J, Cunha T, Boraso R. Pilot study comparing the diffusion of two formulations of botulinum toxin type A in patients with forehead hyperhidrosis. *Dermatol Surg*. 2007;33:S37–S43.
29. Alam M, Dover JS, Arndt KA. Pain associated with injection of botulinum A exotoxin reconstituted using isotonic sodium chloride with and without preservative: A double-blind, randomized controlled trial. *Arch Dermatol*. 2002;138:510–514.
30. Alam M, Yoo SS, Wrone DA, White LE, Kim JY. Sterility assessment of multiple use botulinum A exotoxin vials: A prospective simulation. *J Am Acad Dermatol*. 2006;55:272–275.
31. Hexsel DM, De Almeida AT, Rutowitsch M, et al. Multicenter, double-blind study of the efficacy of injections with botulinum toxin type A reconstituted up to six consecutive weeks before application. *Dermatol Surg*. 2003;29:523–529; discussion 529.
32. Hexsel D, Rutowitsch MS, de Castro LC, do Prado DZ, Lima MM. Blind multicenter study of the efficacy and safety of injections of a commercial preparation of botulinum toxin type A reconstituted up to 15 days before injection. *Dermatol Surg*. 2009;35:933–939; discussion 940.
33. de Maio M, Swift A, Signorini M, Fagien S. Facial assessment and injection guide for botulinum toxin and injectable hyaluronic acid fillers: Focus on the upper face. *Plast Reconstr Surg*. 2017;140:265e–276e.
34. Jabbour SF, Awaida CJ, ElKhouri JS, et al. The impact of upper face botulinum toxin injections on eyebrow height and forehead lines: A randomized controlled trial and an algorithmic approach to forehead injection. *Plast Reconstr Surg*. 2018;142:1212–1217.
35. Fagien S. Temporary management of upper lid ptosis, lid malposition, and eyelid fissure asymmetry with botulinum toxin type A. *Plast Reconstr Surg*. 2004;114:1892–1902.
36. Flynn TC, Carruthers JA, Carruthers JA. Botulinum-A toxin treatment of the lower eyelid improves infraorbital rhytides and widens the eye. *Dermatol Surg*. 2001;27:703–708.
37. Huang W, Rogachefsky AS, Foster JA. Browlift with botulinum toxin. *Dermatol Surg*. 2000;26:55–60.
38. Matarasso SL, Matarasso A. Treatment guidelines for botulinum toxin type A for the periocular region and a report on partial upper lip ptosis following injections to the lateral canthal rhytids. *Plast Reconstr Surg*. 2001;108:208–214; discussion 215–217.
39. Qaqish C. Botulinum toxin use in the upper face. *Atlas Oral Maxillofac Surg Clin North Am*. 2016;24:95–103.
40. Sheu M. My personal experience with botulinum toxin. In: Issa M, Tamura B, eds. *Botulinum Toxins, Fillers and Related Substances Clinical Approaches and Procedures in Cosmetic Dermatology*, Vol 4. Cham, Switzerland: Springer; 2019. [https://doi.org/10.1007/978-3-319-20253-2\\_36-2](https://doi.org/10.1007/978-3-319-20253-2_36-2).
41. de Almeida AR, da Costa Marques ER, Banegas R, Kadunc BV. Glabellar contraction patterns: A tool to optimize botulinum toxin treatment. *Dermatol Surg*. 2012;38:1506–1515.
42. Kim HS, Kim C, Cho H, Hwang JY, Kim YS. A study on glabellar wrinkle patterns in Koreans. *J Eur Acad Dermatol Venerol*. 2014;28:1332–1339.
43. Macdonald MR, Spiegel JH, Raven RB, Kabaker SS, Maas CS. An anatomical approach to glabellar rhytids. *Arch Otolaryngol Head Neck Surg*. 1998;124:1315–1320.
44. Benedetto AV, Lahti JG. Measurement of the anatomic position of the corrugator supercilii. *Dermatol Surg*. 2005;31:923–927.

45. Janis JE, Ghavami A, Lemmon JA, Leedy JE, Guyuron B. Anatomy of the corrugator supercilii muscle: Part I. Corrugator topography. *Plast Reconstr Surg*. 2007;120:1647–1653.
46. El-Khoury JS, Jabbour SF, Awaida CJ, Rayess YA, Kechichian EG, Nasr MW. The impact of botulinum toxin on brow height and morphology: A randomized controlled trial. *Plast Reconstr Surg*. 2018;141:75–78.
47. Frankel AS, Kamer FM. Chemical browlift. *Arch Otolaryngol Head Neck Surg*. 1998;124:321–323.
48. Fagien S. Botulinum toxin type A for facial aesthetic enhancement: Role in facial shaping. *Plast Reconstr Surg*. 2003;112(Suppl):6S–18S; discussion 19S–20S.
49. Sundaram H, Kiripolsky M. Nonsurgical rejuvenation of the upper eyelid and brow. *Clin Plast Surg*. 2013;40:55–76.
50. King M. Management of ptosis. *J Clin Aesthet Dermatol*. 2016;9:E1–E4.
51. Sorenson EP, Urman C. Cosmetic complications: Rare and serious events following botulinum toxin and soft tissue filler administration. *J Drugs Dermatol*. 2015;14:486–491.
52. Carruthers J, Carruthers A. Aesthetic botulinum A toxin in the mid and lower face and neck. *Dermatol Surg*. 2003;29:468–476.
53. Rohrich RJ, Janis JE, Fagien S, Stuzin JM. The cosmetic use of botulinum toxin. *Plast Reconstr Surg*. 2003;112(Suppl):177S–188S; quiz 188S, 192S; discussion 189S–191S.
54. Hwang WS, Hur MS, Hu KS, et al. Surface anatomy of the lip elevator muscles for the treatment of gummy smile using botulinum toxin. *Angle Orthod*. 2009;79:70–77.
55. Sucupira E, Abramovitz A. A simplified method for smile enhancement: Botulinum toxin injection for gummy smile. *Plast Reconstr Surg*. 2012;130:726–728.
56. Choi YJ, Kim JS, Gil YC, et al. Anatomical considerations regarding the location and boundary of the depressor anguli oris muscle with reference to botulinum toxin injection. *Plast Reconstr Surg*. 2014;134:917–921.
57. Dayan SH, Kempiners JJ. Treatment of the lower third of the nose and dynamic nasal tip ptosis with Botox. *Plast Reconstr Surg*. 2005;115:1784–1785.
58. Ghavami A, Janis JE, Guyuron B. Regarding the treatment of dynamic nasal tip ptosis with botulinum toxin A. *Plast Reconstr Surg*. 2006;118:263–264.
59. Gart MS, Gutowski KA. Overview of botulinum toxins for aesthetic uses. *Clin Plast Surg*. 2016;43:459–471.
60. Trévidic P, Sykes J, Criollo-Lamilla G. Anatomy of the lower face and botulinum toxin injections. *Plast Reconstr Surg*. 2015;136(Suppl):84S–91S.
61. Carruthers J, Fagien S, Matarasso SL; Botox Consensus Group. Consensus recommendations on the use of botulinum toxin type a in facial aesthetics. *Plast Reconstr Surg*. 2004;114(Suppl):1S–22S.
62. Wu DC, Fabi SG, Goldman MP. Neurotoxins: Current concepts in cosmetic use on the face and neck—Lower face. *Plast Reconstr Surg*. 2015;136(Suppl):76S–79S.
63. Semchyshyn N, Sengelmann RD. Botulinum toxin A treatment of perioral rhytides. *Dermatol Surg*. 2003;29:490–495; discussion 495.
64. Cohen JL, Dayan SH, Cox SE, Yalamanchili R, Tardie G. OnabotulinumtoxinA dose-ranging study for hyperdynamic perioral lines. *Dermatol Surg*. 2012;38:1497–1505.
65. Shimada K, Gasser RF. Variations in the facial muscles at the angle of the mouth. *Clin Anat*. 1989;2:129–134.
66. Hur MS, Hu KS, Cho JY, et al. Topography and location of the depressor anguli oris muscle with a reference to the mental foramen. *Surg Radiol Anat*. 2008;30:403–407.
67. Hur MS, Kim HJ, Lee KS. An anatomic study of the medial fibers of depressor anguli oris muscle passing deep to the depressor labii inferioris muscle. *J Craniofac Surg*. 2014;25:614–616.
68. Suber JS, Dinh TP, Prince MD, Smith PD. OnabotulinumtoxinA for the treatment of a “gummy smile”. *Aesthet Surg J*. 2014;34:432–437.
69. Mazzucco R, Hexsel D. Gummy smile and botulinum toxin: A new approach based on the gingival exposure area. *J Am Acad Dermatol*. 2010;63:1042–1051.
70. Redaelli A. Medical rhinoplasty with hyaluronic acid and botulinum toxin A: A very simple and quite effective technique. *J Cosmet Dermatol*. 2008;7:210–220.
71. Wu WT. Botox facial slimming/facial sculpting: The role of botulinum toxin-A in the treatment of hypertrophic masseteric muscle and parotid enlargement to narrow the lower facial width. *Facial Plast Surg Clin North Am*. 2010;18:133–140.
72. Peng HP, Peng JH. Complications of botulinum toxin injection for masseter hypertrophy: Incidence rate from 2036 treatments and summary of causes and preventions. *J Cosmet Dermatol*. 2018;17:33–38.
73. Kaya B, Apaydin N, Loukas M, Tubbs RS. The topographic anatomy of the masseteric nerve: A cadaveric study with an emphasis on the effective zone of botulinum toxin A injections in masseter. *J Plast Reconstr Aesthet Surg*. 2014;67:1663–1668.
74. Hu KS, Kim ST, Hur MS, et al. Topography of the masseter muscle in relation to treatment with botulinum toxin type A. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 2010;110:167–171.
75. Liew S, Dart A. Nonsurgical reshaping of the lower face. *Aesthet Surg J*. 2008;28:251–257.
76. Goodman G. The masseters and their treatment with botulinum toxin. In: Carruthers A, Carruthers J, eds. *Botulinum Toxin: Procedures in Cosmetic Dermatology*. 4th ed. Edinburgh: Elsevier; 2018:153–160.
77. Levy PM. Neurotoxins: Current concepts in cosmetic use on the face and neck—Jawline contouring/platysma bands/neckline lines. *Plast Reconstr Surg*. 2015;136(Suppl):80S–83S.
78. Matarasso A, Matarasso SL, Brandt FS, Bellman B. Botulinum A exotoxin for the management of platysma bands. *Plast Reconstr Surg*. 1999;103:645–652; discussion 653–655.
79. Awaida CJ, Jabbour SF, Rayess YA, El Khoury JS, Kechichian EG, Nasr MW. Evaluation of the Microbotox technique: An algorithmic approach for lower face and neck rejuvenation and a crossover clinical trial. *Plast Reconstr Surg*. 2018;142:640–649.
80. Wu WT. Microbotox of the lower face and neck: Evolution of a personal technique and its clinical effects. *Plast Reconstr Surg*. 2015;136(Suppl):92S–100S.
81. Raspaldo H, Niforos FR, Gassia V, et al.; Consensus Group. Lower-face and neck antiaging treatment and prevention using onabotulinumtoxin A: The 2010 multidisciplinary French consensus—Part 2. *J Cosmet Dermatol*. 2011;10:131–149.
82. Carruthers A, Carruthers J. Clinical indications and injection technique for the cosmetic use of botulinum A exotoxin. *Dermatol Surg*. 1998;24:1189–1194.
83. Carruthers J, Carruthers A. Practical cosmetic Botox techniques. *J Cutan Med Surg*. 1999;3(Suppl 4):S49–S52.
84. Yiannakopoulou E. Serious and long-term adverse events associated with the therapeutic and cosmetic use of botulinum toxin. *Pharmacology* 2015;95:65–69. **F2–F4**