



Creating Lift in the Lower Face With Botulinum Toxin A Treatment: An Anatomical Overview With Videos and Case Studies Illustrating Patient Evaluation and Treatment

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Abstract

Background: Relaxation of depressor muscles in the lower face with botulinum toxin A (BoNT-A) can create a lifting effect and dramatically improve jawline contour and resting facial expression. Even with the recent increase in interest in lower face rejuvenation, BoNT-A is a relatively under-recognized tool for treatment of this area. When treating the lower face, an understanding of anatomy and the relationship between the facial muscles is especially important, as injection patterns must be customized for consistently positive outcomes.

Objectives: This study was aimed to provide basic knowledge of the activities of the muscles in the lower face and neck and to describe the basis for injecting BoNT-A to create lift in this area. Expert guidance for injection is also provided.

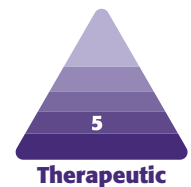
Methods: As part of a continuing medical education course on differentiating botulinum toxin products, a panel of 4 expert physician injectors participated in a live webinar to discuss the implications of increasing toxin use.

Results: The practical guidance in this manuscript is based on the most frequently requested information by audience members and the information considered critical for success by the authors. The authors outline the functional anatomy of the lower face most relevant for BoNT-A treatment and case studies as well as methods for patient evaluation and injection technique are also provided. Videos showing treatment planning and injection technique for the lower face and neck are included.

Conclusions: BoNT-A is an important nonsurgical tool for creating lift in the lower face.

Level of Evidence: 5

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Since the introduction of botulinum toxin A (BoNT-A) as a treatment for dynamic lines, BoNT-A injections have become an integral part of any facial aesthetics practice. Neurotoxin procedures are the most common nonsurgical cosmetic procedure performed in the United States, with over 1.7 million injections performed in 2019.¹ Innovation in the field has led to the expansion of ways in which BoNT-A can be used in rejuvenation, and its use has expanded well beyond the FDA-approved indications to include

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alternative dilution and dosing practices, tailored injection patterns to accommodate individual variations in anatomy, and treatment of multiple facial areas and platysmal bands. Furthermore, the average age of patients seeking treatment with BoNT-A has steadily decreased over recent years, leading to a patient population which requires a much broader range of approaches to neuromodulation. Of interest, this decrease in age has given rise to research illustrating that long-term repeated treatment can prevent formation of dynamic lines to some degree.^{2,3} Overall, regardless of patient age or treatment area, the goal of treatment is to eliminate lines and distortions apparent in repose, to address any asymmetries, and to minimize dynamic lines while treating such that natural movement and dynamic expression are maintained.

While much of the research on BoNT-A is focused on glabellar and canthal lines, kinetic lines (apparent during activity but not at rest), hyperkinetic lines (due to a higher degree of muscle contraction), and hypertonic lines (due to incomplete relaxation) can be treated by relaxation of the contributing musculature in multiple different areas of the face.^{4,5} For the lower face in particular, relaxation of depressor muscles can create a lifting effect and dramatically improve jawline contour and resting facial expression.⁶ Requests for noninvasive treatment of the lower face are common in clinical practice, and BoNT-A is an under-recognized tool for treatment of this area. However, when treating the lower face, an understanding of anatomy and the relationship between the facial muscles is especially important, as injection pattern must be customized in order to have consistently positive outcomes. Here, the authors outline the functional anatomy of the lower face most relevant for BoNT-A treatment, discuss methods for treatment planning, and review several case studies in which these techniques are applied.

METHODS

As part of a continuing medical education event series launched on October 18th, 2021 on differentiating BoNT-A toxins, a team of 4 experts in plastic surgery and dermatology gave a series of lectures on differentiating BoNT-A products in clinical practice, which culminated in a roundtable discussion. The lectures detailed facial anatomy, the basic science of BoNT-A, protein purification and product differentiation, immunogenicity, and a discussion of how these features impact clinical differentiation in real-world clinical practice. Because treatment of the lower face and neck is a procedure that can offer tremendous benefit, but also holds additional risk due to the complexity of the anatomy, the faculty decided to dovetail a discussion of the differentiating factors discussed with guidance on how to use BoNT-A to treat the lower face and neck. This manuscript includes an overview of anatomy, and several instructional videos which detail treatment planning

and injection technique. The number of lecture attendees (virtual) totaled just over 300 at the time of this writing. All patients whose images are shown here were treated according to Good Clinical Practice and signed releases for their photographs to be displayed. Written consent was provided, by which the patients agreed to the use and analysis of their data.

RESULTS

Functional Anatomy

The mimetic muscles of face are different from most other skeletal muscles in that some of them have their origin on bone and insert directly into the dermis or intercalate with other muscles, and are not separated from the skin by a layer of fascia.^{7,8} This unusual attachment of the facial muscles enables them to coordinate facial expression and movement of the overlying skin.⁹ Muscle groups can include agonistic, antagonistic, and synergistic muscles, which can exert opposing forces and tensions both at rest and during expression.⁷ The brow elevators and depressors are the most commonly cited agonist/antagonist muscle pair; however, in the lower face, the antagonistic effects of the levator anguli oris and zygomaticus major against the depressor activity of the depressor anguli oris (DAO) and the platysma muscle are also important, in particular for management of aging in the lower face. The zygomaticus minor and levator labii superioris alaeque nasi also play key roles as elevators in smile formation.¹⁰

While it is tempting to think about the impact of single muscles or muscle groups on the overlying skin (and resultant dynamic lines), the muscles of the face do not operate in isolation. The variable tension (and direction of that tension) imposed by motion in other facial areas can further affect the overall outcome of muscle contraction within a single group. Importantly, the nature of the interactions within and between different muscle groups is not static, but changes over time based on the age, which is related to resting tension and excursion of facial muscles, the tension and elasticity of the overlying skin, and underlying skeletal changes. For example, the ability of a given muscle to return to rest after contraction can be diminished by loss of skin elasticity. In the lower face, the action of the platysma, DAO, and mentalis (each of which have insertion points in the lower lip), as well as the orbicularis oris, risorius, levator anguli oris, depressor labii inferioris (DLI), and zygomaticus major each contribute to an individual's resting and dynamic expressions (Figure 1). BoNT-A injection into the DAO, mandibular border, and/or platysmal bands can give rise to a lifting effect and restore more youthful muscle dynamics at rest and during expression.

An in-depth knowledge of the anatomy of the lower face is particularly important for determining the best injection patterns for individual patients and avoiding complications.

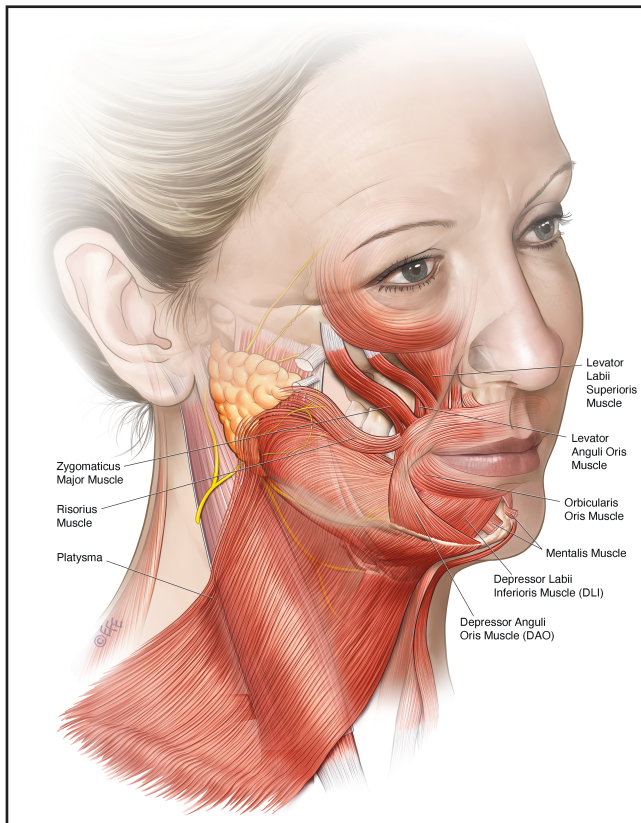


Figure 1. Muscles of the lower face which contribute to an individual’s resting and dynamic expressions. Published with permission from Illustrator Levent Efe.

The musculature of the lower face carries out a range of functions, including talking, eating, drinking, and expressivity, and the muscles themselves often have unclear borders and exist in layers. Knowledge of these muscles and their actions as well as their relationships to surrounding anatomy is critical for proper injection technique and avoiding unwanted side effects (SEs). Diffusion of toxin into untargeted muscles within the lower face can produce effects such as difficulty speaking/smiling, and asymmetrical facial movement.¹¹ In the platysma, the effects can be significant and can include dysphagia and dysphonia. These SEs interfere with critical daily function, and so should be diligently prevented. The best effect is achieved when the platysmal bands, platysma along the mandible, and the DAO are treated together, as each of these areas contributes to downward pull on the lower face. In the sections below, anatomy, treatment planning, safety, and outcomes are discussed.

Botulinum Toxin in the Lower Face—Treatment Planning

Before treating the patient, it is important to plan injection location and toxin dose. With regard to the product itself,

reconstitution and injection volumes can be used to control local dose. A more targeted effect can be achieved using a smaller volume of more concentrated product. For example, when treating the DAO, a more concentrated injection can prevent diffusion and inadvertent inactivation of the levator anguli oris and zygomaticus. For the neck in particular, very superficial (nearly intradermal), concentrated injections are ideal because diffusion can occur not only along the x- and y-axis, but also along the z-axis. Especially when treating thinner muscles, diffusion into a deeper layer can cause unwanted relaxation of nontarget muscles. The platysma is the most superficial of the facial muscles, and is also very thin (~1 mm), making targeted treatment of particular importance.

First, evaluation of the muscles at rest and at maximum contraction allows for assessment of muscle volume, location, and insertion points. Analysis of dynamic lines under maximum contraction permits the injector to infer the role of specific muscles in the generation of dynamic lines and allows for planning customized injection patterns. While standard injection patterns are commonly used in clinical trials and are used by some in clinical practice, these patterns are based on “average” anatomy and do not take into account basic interpersonal differences in anatomical structure or muscle volume. In reality, this average is representative of few individuals. Videos 1 and 2 provide an extensive discussion of patient evaluation, locating muscle insertion points, and marking and injection of the lower face. Regardless of the area to be injected, patients should be marked while in the upright position both in repose and with maximum contraction. Most patients have some form of facial asymmetry, so injection patterns are generally not the same on both sides of the face. This is the case for the 31-year-old patient in Figure 2 (injected in Video 3 with 100 U INCO in 2.5 mL). As injections are administered, immediate removal of the marks can help to avoid inadvertent reinjection of the same point.

Treating the Depressor Anguli Oris

The DAO arises from the mandible and inserts into the modiolus, which acts on the corner of the mouth. The hyperactivity of the DAO muscle can pull downward on the modiolus, turning the corner of the mouth downward, giving rise to the commonly encountered complaint of “looking angry” or “tired.” The marionette folds are also deepened by the contraction of the DAO, which can amplify the negative impact of its hyperactivity on facial appearance. By treating the DAO (2.5-2.5 U per side with incobotulinum toxin A [INCO; Xeomin, Merz Pharmaceuticals GmbH, Frankfurt, Germany], onabotulinum toxin A [ONA; Botox, Allergan Inc., Irvine, CA], or prabotulinumtoxin A [PRA; Jeuveau, Evolus Inc., Newport Beach, CA] or 5.0 U per side of abobotulinum



Video 1. Watch now at <http://academic.oup.com/asjopenforum/article-lookup/doi/10.1093/asjof/ojac034>

toxin A [Dysport, Ipsen Pharma, Wrexham, UK]), the levator anguli oris and zygomaticus major muscles will pull up the corner of the mouth, so that it is in a more balanced, elevated position.

Understanding of the zones of action for each individual muscle is important for avoiding complications. Targeted injection of BoNT-A into the DAO can be challenging because its medial border overlaps with the DLI (a deeper and more medial muscle) which, if inadvertently injected, can lead to lower lip inversion. The lateral border of the DAO is adjacent to the risorius, zygomaticus major, and platysma muscles, and inadvertent injection/diffusion lateral of the DAO leads to loss of treatment effect (Figure 1). The buccinator muscle is also located deep beneath the upper region of the DAO. While the location of the DAO is often apparent when the corners of the mouth are pulled down, it can also be located by palpating the modiolus and locating its center line, and injecting within a fan shape located at $<45^\circ$ lateral and $<30^\circ$ medial of this central modiolus line.¹² There are 2 common DAO injection sites, one just medial to the base of the marionette line on the mandibular border, and the other in the middle of the marionette line.¹³ The direction and depth of the needle are key to precise, controlled placement of treatment in these areas. The DAO should be injected superficially, and it is important to note that because the area along the mandibular border has more neuromuscular junctions, injection of the same number of units along the mandibular border is less efficient than if injected superiorly due to the fewer number of units in the superior position.¹⁴ When injecting the DAO at the mandibular border, gentle lateral massage immediately afterwards can help prevent diffusion of the toxin into the DLI. Additional strategies for prevention and treatment of DAO complications are shown in Table 1.

Injections for a 31-year-old female patient are shown in Videos 3 and 4. Figure 3 demonstrates before and after (2 weeks postinjection) pictures of injection of the DAO



Video 2. Watch now at <http://academic.oup.com/asjopenforum/article-lookup/doi/10.1093/asjof/ojac034>

and mentalis in a patient without significant platysma involvement.

Importantly, treatment of the lower face need not necessarily include the DAO if the injector is not confident they are able to consistently locate and inject this muscle precisely. Indeed, the Nefertiti lift does not necessarily include injection of the area medial to the labiomandibular fold, as the lifting potential of injections along the mandibular border and in the mentalis are not dependent upon treatment of the DAO.⁶ If the injector wishes to avoid the DAO, injections should not be anterior to the line where the nasolabial fold would cross the mandible if extended to this point. However, the DAO has a strong impact on commissures, and treatment of the DAO is an important element to achieving global improvement to the lower face. When discussing treatment of the lower face, it is important to educate patients about the increased relative risk of SEs for treatment of the DAO separately from general discussion of risk for lower-face treatment.

Mentalis

The mentalis muscle is the only elevator of the lip and chin.⁵ Its fibers run vertically from their origin at the mandible to the medial chin. The mentalis is often treated to mitigate chin wrinkles or dimpling which results from adherence of the skin to subcutaneous tissue. The most common indication for mentalis treatment is in the aging female, in cases where the chin soft tissue rotates up secondary to mandibular recession and looks “witchy.” Treatment with BoNT-A allows the tissue to soften and drop back. The 31-year-old female patient treated in Video 1 is injected in the mentalis muscle. Most often, there are 2 injection points, with 2.5 U each, delivered where dimples are apparent at contraction. The needle entry point is at the dimples, but the needle needs to be directed medially, up and deep along the muscle belly. When treating hyperactive dimples, injections should be superficial and into the dimple itself.



Figure 2. A 31-year-old female patient (A) before and (B) 8 weeks after botulinum toxin A (BoNT-A) injection to correct slight facial asymmetry.

Treatment of the Platysma in the Neck and Jawline

The platysma is the broad, thin, muscular component of the superficial musculoaponeurotic system (SMAS). The platysma originates at the clavicle from the fascia, extends over the anterolateral face of the neck and mandibular border, and intersects with the mimetic depressors in the lower face. BoNT-A treatment of the platysma along the lower lateral jaw line relaxes this depressor muscle, relieving downward tension, and indirectly elevating the lower face (Figures 4, 5). Most often, patients are treated with 3 to 4 injections of 2.5 units each along the mandible 1.5 cm apart, often in combination with treatment of the DAO. Treatment planning which includes injection of the platysma along the mandibular boarder to release tension in the lower face in a 31-year-old female patient is included in Video 1 and for a 57-year-old female patient in Video 3.

Treatment of the Platysmal Bands

Platysmal bands are a hallmark of aging in the neck, and become more pronounced with time as the subcutaneous issue thins and changes in muscle tone occur. These bands can also become more apparent in patients after face or neck lifts. When both areas of the platysma are treated with neuromodulators, the surface of the neck is



Video 3. Watch now at <http://academic.oup.com/asjopenforum/article-lookup/doi/10.1093/asjof/ojac034>

smoothed and the downward pull on the lower face initiated by this muscle is relieved.

To plan treatment of the platysmal bands, the patient should be evaluated at maximum contraction and the injections planned along the prominent bands. A more concentrated dose of BoNT-A should be used for the platysma to minimize diffusion (eg, 2.0 mL of saline to reconstitute 100 U of incobotulinum toxin; 0.05 mL [2.5 U] per injection point), and injected along the length of the platysmal bands approximately 1 cm apart, for a total of 75 to 100 U. Injection into the platysma should be superficial. When injecting, the injector should pick up the muscle and move it away from the underlying structures prior to the intradermal,

Table 1. Strategies for Prevention and Treatment of DAO Complications

Complication	Prevention	Treatment
Lower lip inversion (DLI injection)	Inadvertent DLI injection is the most common DAO injection complication and will result in the opposite side of the lower lip sitting lower, especially in animation. Avoid injection too medially in DLI.	Weakening of the orbicularis oris on the side sitting lower: inject 0.5-1 U intradermally
Problems with eating	Likely caused by injection too deep in middle of belly, affecting buccinator muscle. Avoid high doses.	Waiting
Problems with speaking	Likely caused by DLI interference. Avoid injections near the lip.	Waiting
Hematoma (facial artery)	Avoid deep injections.	Direct pressure

DAO, depressor anguli oris; DLI, depressor labii inferioris.

superficial injection. Loupes are recommended to ensure superficial placement. If the toxin diffuses into deeper layers, the strap muscles underneath the platysma may be affected and could cause dysphonia and dysphagia. The duration of treatment is about 3 to 4 months, shorter than treatment in the face, likely due to the size of the platysma. The 57-year-old female patient in [Video 2](#) received injections in the platysmal bands.

Differentiating Toxins for Treatment of the Lower Face

While toxins can be differentiated based on potency, total protein content, and potential for immunogenicity, their efficacy in clinical practice is very similar.¹⁵ It is of the general opinion of the authors that while the subtle nuances in product performance may be explained by environmental differences in manufacturing or other processes, injector experience with a specific toxin and knowledge of anatomy sufficient to permit treatment customization is what drives real-world efficacy of BoNT-A products. However, the topic of immunogenicity is one that warrants discussion.

In clinical practice, decreased effect or nonresponse is often due to compensatory changes in muscle activity due to aging or adaptation, inadequate dosing (which can be due to manufacturing inconsistencies), failure to accurately identify and inject the muscles, and changes in patient expectations.¹⁶ However, in patients who previously responded to treatment, but now consistently require a higher dose at more frequent intervals, development of neutralizing antibodies to BoNT-A should be considered as a possible culprit. While studies have shown that the



Video 4. Watch now at <http://academic.oup.com/asjopenforum/article-lookup/doi/10.1093/asjof/ojac034>

association between the presence of neutralizing antibodies (nAbs) and BoNT-A resistance is imperfect, their presence is indicative of an immune response to the BoNT-A protein.^{17,18}

The risk of nAb development increases with BoNT-A therapy duration, dose, and shorter dosing interval, with dose having the greatest apparent impact on formation.¹⁸ To date, clinical recommendations around nAb formation are limited to avoiding early redosing, using the smallest effective dose, and using toxin products without accessory proteins. Given the impact of duration on risk of nAb development, for the younger patient seeking treatment for concerns around skin quality and the earliest signs of aging, there is an opportunity to educate about prevention and sun care, and many issues can be addressed with topical treatments and lifestyle modifications. As the number of indications and uses for BoNT-A increase, it is important to be aware that the dose administered for treatment of multiple areas for aesthetic purposes can approach and easily surpass doses for therapeutic indications, which have rates of nAb development higher than the (~1% or lower) reported for aesthetic indications.^{19,20}

While a granular understanding of nAb formation and activity is of interest, in practice, the nonresponding patient, in the absence of any other potential explanation, can be managed as having nAbs. In the absence of repeated injection/exposure, BoNT-A nAb titer decreases over time. The average time to nAb-negative status is 30 months, but can be several years, depending on the patient.^{21,22} In practice, a complete nonresponder may elect to take a “toxin holiday” of around 2 years. Importantly, exposure of the seronegative patient to the same toxin can prompt reemergence of nAbs,²² so retreatment should be approached with caution and a toxin preparation lacking accessory/complexing proteins is ideal. In the interim, serotype B toxin is another option; however, this toxin is more expensive and has a shorter duration of effect, and it is difficult to assess whether absence of nAb cross-reactivity is



Figure 3. A 58-year-old female (A, C) before and (B, D) 2 weeks after injection of the mentalis and depressor anguli oris without significant involvement of the platysma. Each dot signifies injection of 2.5 U of incobotulinum toxin A.

universal or varies between patients. Partial responders generally require increasing amounts of toxin or need to receive toxin more frequently over time. For these patients, a switch to incobotulinum toxin A is prudent due to its decreased overall protein amount. Because the nontoxin proteins may serve as an adjuvant in the immune response against the toxin itself, eliminating the adjuvant may address the immunogenicity. This approach is supported by clinical evidence in other indications, but should be further explored in a systematic way in aesthetics to inform management.²³⁻²⁵

DISCUSSION

Lifting the lower face with BoNT-A treatment is an important tool for facial rejuvenation. Knowledge of anatomy is imperative for treatment customization, which

dramatically improves outcomes in real-world clinical practice. Treatment must be tailored to individual patients to account for anatomic variability, and expert knowledge of facial anatomy is required to take into account the relationship of the primary agonist with antagonistic and synergistic muscles within the muscle group. As discussed above, optimal treatment often requires management of multiple muscle groups and deliberate treatment of muscles which contribute to expressions characteristic of aging. When considering the toxin to use, the most important factor is the skill of the injector and familiarity with the individual product, more so than any one product vs another. For the issue of immunogenicity, there is a need for more proactive collection of data on the treatment of nonresponders and antibody development, as well as whether switching to a formulation free of complexing proteins can serve as a safe option for retreatment.



Figure 4. A 65-year-old female (A, C) before and (B, D) 4 weeks after injection with botulinum toxin A (BoNT-A) in the depressor anguli oris and platysma along the mandibular border to reduce the tensioning effect of the platysma fibers on the lower face. Each dot signifies injection of 2.5 U of incobotulinum toxin A.

CONCLUSIONS

Overall, experienced practitioners should be able to achieve safety, efficacy, and patient satisfaction with all BoNT-A formulations, and experience with all available products will allow practitioners to understand the nuances with each product, in particular for treatment of the lower face.

Supplemental Material

This article contains supplemental material located online at www.asjopenforum.com.

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Disclosures

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Figure 5. A 70-year-old female (A, C) before and (B, D) 2 weeks after injection with botulinum toxin A (BoNT-A) in the depressor anguli oris and mandibular border to reduce the tensioning effect of the platysma fibers. Each dot signifies injection of 2.5 U of incobotulinum toxin A.

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