Botulinum Toxin Dosage Template for Frontal Wrinkle Effacement
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Since the first report in the early 1970s, several studies about attenuated botulinum toxin have been published. However, specific data about the pattern of the cutaneous effect produced by its diffusion on the frontal musculature are comparatively scarce, and those that exist are controversial. Many toxin injection techniques for the effacement of frontal wrinkles have been proposed and since modified, aiming for more natural results without the total loss of facial expression movement normally caused by the administration of high doses. Aside from some general guidelines suggested for this procedure, there has been no consensus regarding the exact sites and ideal doses of botulinum toxin injection that provide an ideal result in this area with a satisfactory duration of efficacy.

Motivated by these technical challenges and the need for a teaching tool for plastic surgery residents learning to administer botulinum toxin, the authors developed a safe technique for delivering these injections with a high level of success. This technique includes a mobile template (a denominated “dose disc”) that maps the reach of the “halos” of effect.

Abstract

**Background:** There is no consensus in the literature about the ideal technique for precisely placing botulinum toxin in the frontal facial regions for the most natural posttreatment appearance.

**Objectives:** The authors describe a safe and effective dosage template for botulinum toxin injection (a “dose disc,” which makes it possible to estimate the approximate area to which the action of the toxin dose will reach, thereby guiding the positioning of the injection in a very practical way) for frontal wrinkle effacement, preserving residual movement whenever possible.

**Methods:** Fifty adult patients who presented to the authors’ private clinic between January 2009 and May 2010 with aesthetic concerns about cutaneous expression wrinkles in the frontal region of their faces were selected for this study. Patients were sequentially divided into two groups: Group 1 included the first 15 patients, who underwent injections in the frontal region on the first visit and glabellar injections 15 days later; Group 2 included the subsequent 35 patients, who underwent frontal and glabellar treatment simultaneously. All pretreatment markings in both groups were made with the authors’ “dose disc, which allows for overlap of the “halos” of effect.

**Results:** In the 50 patients included in the study, 317 injections were performed with the dose disc. Two treatment failures occurred (etiology unknown), and five patients presented with failure due to irregular technical positioning of the discs. The latter patients were treated at the beginning of the study and exhibited residual wrinkles. Only one case of complete toxin inactivity was observed. All patients with treatment failures underwent successful correction with additional injections. There was no evidence of palpebral ptosis, eyebrow ptosis, or any other serious diffusion or positioning side effects.

**Conclusions:** A fixed dose disc template can be a useful tool for botulinum toxin injections in the frontal region of the face. Future studies assessing other disc models for different doses and different injection methods are needed, with the goal of establishing a longer duration of the effect and devising similar templates for other facial areas.

**Keywords**

cosmetic medicine, nonsurgical facial rejuvenation, botulinum toxin, injections, wrinkles

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to determine the position of the injections. The disc displays the isolated effect of the toxin and thereby acts as a guide for marking the target areas (Figure 1). These markings generate a precise and individualized group of “halos” outlining the cutaneous effect; the main goal of this planning method is to maximize the preservation of muscular contraction between the eyebrow area and the inferior horizontal wrinkle of the frontal region, obtaining variable degrees of symmetrical local movement. This symmetry is dependent on the patient’s individual anatomy—specifically, the proximity of these two points of reference on the patient’s face. The positioning of the marking is guided by the reach of the dose disc. In this way, the measurements are not fixed but rather are determined by the positioning of the patient’s eyebrow, which, when relaxed, should lie almost at the maximum inferior limit of the toxin’s reach.

We describe the marking and injection procedures below. We believe that this method provides a safe guideline with which to achieve satisfactory results in the aesthetic effacement of frontal wrinkles.

**METHODS**

Fifty adult patients who presented to the authors’ private clinic between January 2009 and May 2010 with aesthetic concerns about cutaneous expression wrinkles in the frontal region of their faces were selected for this study. All patients were in good general health. Exclusion criteria included patients who had received botulinum toxin injections in the last seven months or who presented with contraindications to this treatment. Patients were sequentially divided into two groups: Group 1 included the first 15 patients, who underwent injections in the frontal region on the first visit and glabellar injections 15 days later; Group 2 included the subsequent 35 patients, who underwent frontal and glabellar treatment simultaneously. All treatments were administered by the same surgeon with the same technique as described here.

For frontal injection, the inferior line of reach for each injection was marked first (Figure 2). This mark was made at the midpoint of the lowest frontal wrinkle, close to the glabella, with the patient positioned in dorsal decubitus. First, the patient was instructed to frown, and an initial point was marked below the wrinkle (usually 0.2 cm below). The disc was placed over this point with the patient’s face at rest, and its reach was marked with a marking pencil. The central point of the disc was then marked, indicating the site of the injection. Next, the lateral disc was positioned at a close intersection of 0.2 cm, taking care to maintain a uniform anatomic aspect of the inferior wrinkle, because this changes according to the contour of the frontal muscles (ie, when they are contracted, this will dictate the contour of the eyebrow). Whether straight or arched, the position was constantly monitored from the first marking, maintaining a steady position for measurement throughout the whole inferior line of the dose reach.

Lateral and subsequent markings were performed following these same guidelines, according to the existing wrinkles and the reach of the available dose (determined by the dose disc). Glabellar injections were directed to three points of infiltration: the first and second in the most noticeable portion of the corrugator muscles (close to the eyebrows) and the third on the procerus muscle at the central portion of the glabella. The corrugator outlines were obtained by pinching the target area, and the injection was made while pinching. After the injection, pressure was maintained over the orbit for approximately 15 seconds with the injector’s thumb, as an attempt to prevent progression of the toxin toward the superior orbicular muscles. Fifteen days after the original injection, if necessary, an additional equal dose was administered more laterally to the corrugator muscles.

For the whole frontal region and the glabella, a total dose of 2.5 U per injection site of attenuated botulinum toxin type A (onabotulinumtoxinA) was administered. This was achieved by diluting a vial containing 100 U with 2 mL of sterile nonpreserved saline. For this suggested dose, we devised a dose disc with a 3-cm-diameter pierced in the center, according to the estimated halo of action.

Each injection was administered with a 0.3-mL syringe.
and a 30-gauge needle (Ultra Fine Type II long model, BD, Franklin Lakes, New Jersey). Each intramuscular injection was positioned at a 60° angle in relation to the surface area, and the contents were slowly introduced with controlled pressure, attempting a uniform dispersion over the marked point. Although not always visible or necessary for the success of the procedure, the formation of a uniform, 2-mm-diameter subcutaneous elevation was often perceived and should be considered a sign of standard effective application.

After injection, the markings were removed with an antibacterial detergent, without exerting pressure or massaging the injection sites. If bleeding occurred, a slight and constant pressure was applied, trying not to distort injected volume. We advised patients to avoid excessive head movements in order to maintain the injected dose in the restricted area as much as possible. Physical activities were not permitted for the first 12 hours after treatment. Clinical results are shown in Figures 3 to 8.

Figure 2. (A-D) The patient is marked. (E) This same patient (an 52-year-old woman) is shown preoperatively. (F) Fifteen days after onabotulinumtoxinA injections planned with the dose disc.
RESULTS

In the 50 patients included in the study, we performed 317 injections with the dose disc. Two treatment failures occurred coincidentally above the left eyebrow in two different patients, which resulted in an asymmetrical elevation of the left forehead during the contraction of the frontal musculature. We were unable to determine
whether these results were related to technical error during injection, a lack of diffusion, or inactivity of the toxin. Five patients experienced treatment failures due to irregular technical positioning of the discs. These patients were treated at the beginning of the study and exhibited residual wrinkles. The lessons we learned from treating...

Figure 6. (A) This 42-year-old man presented for the treatment of frontal wrinkles. Preinjection markings are shown at maximal contraction. The patient’s glabellar wrinkles were also treated. (B) Sixteen days after treatment with 12.5 units/2 ml dilution of onabotulinumtoxinA, the patient’s results are shown (again at maximum contraction).

Figure 7. (A) This 35-year-old woman presented for the treatment of frontal wrinkles. Preinjection markings are shown at maximal contraction. The patient’s glabellar wrinkles were also treated. (B) Fifteen days after treatment with 22.5 units/2 ml dilution of onabotulinumtoxinA, the patient’s results are shown (again at maximum contraction).

Figure 8. (A) This 79-year-old woman presented for the treatment of frontal wrinkles. Preinjection markings are shown at maximal contraction. The patient’s glabellar wrinkles were also treated. (B) Fifteen days after treatment with 22.5 units/2 ml dilution of onabotulinumtoxinA, the patient’s results are shown (again at maximum contraction).
these patients resulted in alterations in the positioning of the disc in subsequent patients. Only one case of complete toxin inactivity was observed. All patients with treatment failures underwent successful correction with additional injections.

There was no evidence of eyelid ptosis or any other serious diffusion or positioning side effects in any of the patients from this series. The level of patient satisfaction was considered high, even when minor complications occurred and reinforcement doses were required.

The average number of injection points on the frontal area was 6.34 (range, three to 10). The average dose was 15.85 U. Concerning the duration of action, our follow-up results demonstrated many compliance failures and therefore could not be evaluated quantitatively. However, in comparison to the existing literature, we can subjectively state that there was a satisfactory effect, with a gradual decrease of action over three to five months.6 There were no patient complaints related to early loss of effect.

**DISCUSSION**

The halo of cutaneous effect, also called the “field effect,” corresponds to the treated area observed on the skin resulting from the intramuscular action of botulinum toxin during muscle contraction.2 The controversy surrounding this halo in the frontal region is a matter of discussion among several authors.7-12 However, a clear correlation between anhidrosis and muscle activity that supports the equivalence of results between those two different types of halos (lack of sweating and lack of muscle function) has not been found.2,8,9 In a series of random injections performed by the authors, it was observed that the production of halos of regular, round, or slightly-oval format with millimetric variations between individuals was in agreement with measurements with other published descriptions.7,10,17,18 Based on these data, we developed a medium-sized model for testing the toxin’s effect with intramuscular application, with the assistance of the point-configuration device.5 Named the “dose disc,” this model made it possible to estimate the approximate area to which the action of the toxin dose would reach, thereby guiding the positioning of the injection in a very practical way. There are many factors that can cause variations in dispersion of the toxin according to each patient’s individual anatomy, and these should be considered, particularly when any technique proposes a fixed measurement model for pretreatment injection site marking.2 The results obtained with this technique demonstrate that when injections are placed in a standardized method and associated with combined doses at close proximity points, these small variations were mitigated and were insufficient to impair the final aesthetic effect of the technique, which proved to be very safe, precise, and easy to implement and teach. Furthermore, our results suggest that mapping and adjusting the injection sites as a block ensures that small muscular gaps not covered by the dose reach do not provide enough contraction force to cause undesirable deformities.

The suggested positioning of the dose reach is 0.2 cm below the inferior wrinkle in the frontal region, with the aim of maintaining elevation movement of several degrees in the eyebrow. This effect is maintained because a residue of muscle fibers remains untreated by the toxin, leaving an area of residual activity on the frontal muscle. The marking of the points at certain symmetric positions can provide more or less facial expression in this region, according to the needs and desires of each patient. If the inferior wrinkle is close to the eyebrow, this area of residual activity will be small, and local movement will possibly be hindered; this posttreatment result is common in patients with more wrinkles.

In this series, the total quantity of injected toxin varied according to the treatment area and was coincident with the parameters described in the literature.3,13,14 Patients with broader frontal areas received a larger volume for treatment. This quantity can also vary according to the overlap of the markings and the doses injected. Experience has led us to predict that positioning the “halos” more closely (laterally or superiorly) will lead to format alteration and a longer duration of effect.15 Both the lateral markings and the superior ones can make the procedure more or less concentrated in terms of doses if we were to approximate the central points of application. This variability allows for different application approaches at the injector’s discretion. Studies with other doses and closer positioning are being conducted, noting time control and evaluating the affected area, aiming to improve the technique.

The duration of effect in the frontal region is also a controversial topic. Even though we did not succeed in designing an ideal study method due to inexperience and therefore were unable to evaluate the duration of effect objectively, we believe that our patients’ results lasted, on average, a comparable amount of time to what has been described in the literature with similar doses.3,15-17 The dose and dilution of the toxin, as well as its dose reach measurement, were consistent with the literature, according to the authors’ observations.18,19

Some cases in our series showed small degrees of failure, but this rate was considered acceptable, keeping in mind that the quantity of applied points in this study each corresponded to an isolated test of the dose disc. It is important to emphasize that within the observed failures, only the dispersion failure was related to the validity of our outcomes, the end point of which was to assess the success of the fixed measurement technique. The positioning errors are attributed to the injectors’ learning curve but were included in the study data because they were applied according to the proposed technique. In these patients, the dose reach was placed above the inferior horizontal wrinkle rather than approximately 2 mm in front of it, which resulted in its permanence during frontal muscle contraction. As a result of these misplacements, we modified our technique.

The need for additional doses was evaluated after 15 days. In cases of reach failure due to a dispersion error, we
repeated the previous positioning and applied the same amount of toxin. In cases of persistent wrinkles resulting from a calculation or positioning error, we recommend repositioning of the markings and reapplication of the toxin with the same dose volume previously injected. Until the reach has been determined for other doses, we do not recommend random application of correction points, which would result in inaccurate injection patterns and thereby contribute to asymmetric results.

Our study was designed to test only the frontal muscles. Although not yet confirmed by data, we hypothesize that each muscle reached by the toxin has an intrinsic pattern of diffusion and an ideal matched dose, suggesting that future studies could focus on researching the appropriate patterns in other muscles. The lack of substantial positioning flaws or remarkable complications (such as palpebral ptosis) and the presence of satisfactory results lead us to believe that this technique is both safe and efficacious. Because it provides a more precise plan of injection, the dose disc can become a good ally for cosmetic toxin injections as we continue to search for safer and more natural results.

CONCLUSIONS

A fixed measurement device such as the dose disc applied in this study can assist injectors in designing an injection pattern that is both safe and effective for a variety of patients as long as a standard technique is followed. Future studies assessing other disc models for different doses and different injection methods are needed, with the goal of establishing a longer duration of the effect and devising similar templates for other facial areas.

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