

Beyond the Common Use of Botulinum Toxin Type A in Aesthetic Surgery

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ABSTRACT

Objective: Beginning in the 1970s, botulinum toxin was used as chemodenervation. During the initial phase of injections the results were sometimes overdone. The standardized techniques and fixed doses written in literature resulted in a lot of patients complaints ranging from the frozen look to an unnaturally expressionless face. We planned a study to prove that individualized asymmetric chemodenervation of facial muscles results in a symmetrical facial contour giving each patient the optimal possible result.

Material and Methods: This retrospective study included 182 cases who were candidate for botulinum toxin type A (Botox; Allergan, Irvine, CA) injection. The patients' ages ranged between 37 and 67 years (45+4 years). Before treatment, the muscular pattern was evaluated individually for each patient, the patient was photographed during repose and during actively moving his/her facial muscles, video tapes for a few seconds of each patient recorded a brief conversation during the active movement of the muscles. The lyophilized botulinum toxin A final concentration was 4 units / 0.1mL to facilitate plotting an assessment sheet for each patient. The dose was recorded on this sheet and a diagram with the variations in sites and variations per dose was recorded. A total of 25 to 100 units were injected for each patient according to his/her needs. Any touch up was done within 2 weeks. Retrospectively, patients were divided in two main groups and 5 subgroups based first on their symmetry before treatment, then their muscular tonicity (kinetic, hyperkinetic and hypokinetic). The doses and sites of injection were customized for each patient.

Results: All 182 patients enrolled in the study completed their treatment course. Both sides were treated in 181 cases and one side was treated in one case (complete paralysis). The symmetrical patients achieved good rejuvenation. In the younger patients group, their faces were enhanced. In the older group, the patients needed combination therapy with fillers and neck and jaw line injections. The transverse glabellar folds were only corrected by injecting the procerus muscle and lateral corrugator leaving the medial part of the corrugator with no botox injection. The decrease in discrepancy between the right and left brow heights before and after injection was achieved in all cases of asymmetry. In cases that had asymmetry due to facial nerve injury, the active side became more relaxed and the contrast between both sides was softened. The complication reported was mild bruising, headache that resolved within one week.

Conclusion: The concept of using botulinum toxin, not only to treat wrinkles, but also for reposition of facial units

and, most recently, to rebalance the entire face has been revolutionary in the area of aesthetic surgery. Successful injection technique is based on a thorough understanding of the actions and anatomy of the facial musculature and the ability to assess and design a plan for each patient individually.

INTRODUCTION

Beginning in the 1970s, botulinum toxin was used to treat strabismus by weakening the extraocular muscles. Carruthers and Carruthers [1] noted that in blepharospasm patients treated with clostridium botulinum toxin, there was a significant decrease in periorbital rhytides and glabellar frown lines. Botox injections then became the standardized technique for facial wrinkle reduction [2,3]. During the initial phase of injections the results were sometimes overdone. The standardized techniques and fixed doses written in books and journals resulted in a lot of patients complaining from the frozen look and their altered facial expressions which varied from a tired look, a surprised look, a devil's look or an unnaturally expressionless face [4].

In young individuals, enhancement of their facial expressions is essential. However, in the older ones, rejuvenation of an alert brighter look to the face is the goal. In addition, the older patients may need injections along their jaw lines and neck together with fillers injection to achieve the best result [4].

Trauma or previous surgery can cause facial asymmetry. A history of facial palsy can also distort the regional symmetry [5]. In healthy individuals, the shape of the eyebrows is dependent on local muscle balance and dynamics [6]. In this population group, excessive muscle dynamics (hyperkinesia of the frontalis or the orbicularis oculi muscles) is by far the most common cause of eyebrow asymmetry. If we observe carefully, asymmetry is the rule not the exception. The habitually raised eyebrow may cause unilateral hyperkinesia of these

muscles, and the mimetic hyperactivity causes asymmetry over a period of time. In rare instances, hyperactivity of one depressor supercilii muscle may pull the medial portion of the eyebrow down [7]. There may also be a strong family history associated with eyebrow asymmetry.

Upper eyelid ptosis can also be the cause of eyebrow asymmetry. To compensate for ptosis, patients elevate the eyebrow on the affected side continuously, which results in eyebrow asymmetry. Furthermore, underlying skeletal asymmetry of the orbital region may be another cause of eyebrow asymmetry. Asymmetry could be also present in the medial brow with irregular glabellar frown lines and transverse frown lines [8].

Many surgical procedures have been described to correct eyebrow asymmetry, including superselective neurotomy, open brow lift, endoscopic brow lift, and unilateral eyebrow elevation. The etiology-oriented treatment for hyperkinesia of these muscles ought to suppress the hyperkinesia, which acts on the eyebrows. Injection of botulinum toxin A (Botox; Allergan, Irvine, CA) is such a treatment modality [9].

The mechanism of the chemical brow lift involves altering the balance between the elevator and depressor muscles of the brow. To achieve elevation, selective chemical denervation of the depressors allows the unopposed action of the elevators to shift eyebrow position [8]. Contour of the eyebrows may also be modified by the positioning of the sites of injection [10,11].

Anatomic considerations (Fig. 1):

An important key to altering brow position is an understanding of the muscular influences on its positions. Depressor muscles of the medial brow include the depressor supercilii, corrugator supercilii, and the procerus. The depressor supercilii, once thought to be part of the orbicularis oculi, is now believed to be a separate entity through the work of Daniel and Landon [12]. This muscle originates in the area of the nasal process of the frontal bone and spans to the medial head of the brow. In addition to being a brow depressor, the corrugator supercilii also moves the eyebrow medially. The orbicularis oculi is the depressor of the lateral brow [10].

The frontalis muscle is the elevator of the brow. The frontalis spans across the forehead from superior temporal crest to superior temporal crest on the other side; however, there may be a central diastasis [10].

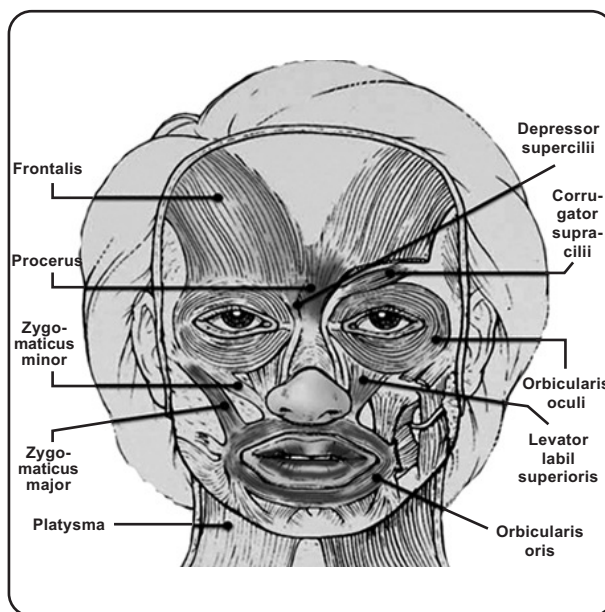


Fig. (1): An in-depth appreciation of the facial muscular anatomy including the function of agonist and antagonist muscles is essential for achieving predictable, effective and aesthetically pleasing effects [10].

Understanding the underlying anatomy and then inspecting each patient for individual variations in the balance of the interplay of these muscles are essential; those allow the physician to modify the asymmetry and to achieve the harmony of facial expressions.

MATERIAL AND METHODS

This retrospective study included 182 cases who were candidate for botulinum toxin type A (Botox; Allergan, Irvine, CA) injection. The patients' ages ranged between 37 and 67 years (45 ± 4 years). Cases were 150 females and 32 cases were males.

Before treatment, the muscular pattern was evaluated individually for each patient. In the first visit, the patient was allowed during the consultation to talk freely while observing the facial expressions. Any exaggerated movement is recorded together with their requests and concerns especially if they had a previous bad experience with botulinum toxin A injection. Then, the patient was photographed during repose and during active facial muscles animations. The active movements were frowning, raising the brows, smiling, squeezing and shutting the eyelids and showing his/her lower teeth by actively moving the lower lip depressors and platysma. Video tapes for a few seconds of each patient recorded a brief conversation during the active movement of the muscles.

The lyophilized botulinum toxin A (Botox; Allergan, Irvine, CA) was dissolved in 2.5mL sterile saline solution to achieve a final concentration of 4 units per 0.1mL. The prepared solution was administered with a 30-gauge needle on an insulin syringe within 24 hours of dilution.

For each patient, an assessment sheet was prepared. The dose was recorded on this sheet and a diagram with the variations in sites and variations per dose was recorded (X represented 4-6mL, the big dot was 2-3mL and the small dot was 1-2mL). A total of 25 to 100 units were injected for each patient according to his/her needs (Fig. 2).

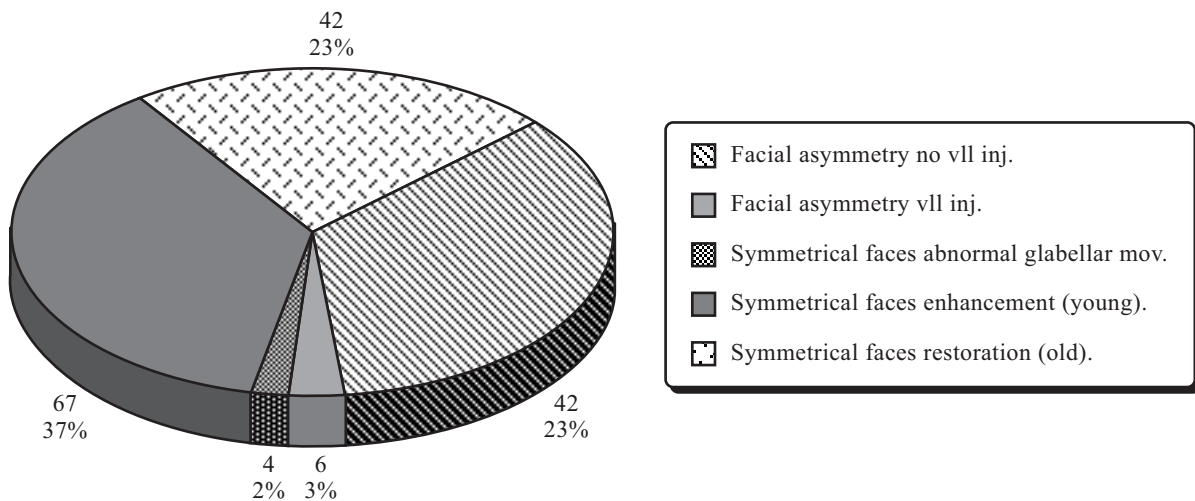
The patient was then allowed to go home with the normal safety instruction for botulinum toxin

A injection. The patients were asked to return after 10 to 14 days for any touch ups and then after 19 to 21 days again for the final assessment and photographs. They are then photographed and video tapes were taken again post treatment. The photographs and videos were then compared before and after treatment. We looked for a more natural balanced look with correction of the asymmetry if present and a more subtle tuning of the facial expressions during talking.

Retrospectively, patients were divided in two main groups (Chart 1) based on their symmetry before treatment. The first group was subdivided according to muscular tonicity (kinetic, hyperkinetic and hypokinetic) into:

Date	Comments	
3/11/07	Botox dil 2.5 ml 55 units C1989C1 25 Apr. 10	

Fig. (2): Example of an assessment sheet of a patient (X represented 4-6 ml, the big dot was 2-3 ml and the small dot was 1-2ml). The doses are individualized for each patient and recorded for future injections.



Groups	Facial asymmetry		Symmetrical faces			Total
	No vll inj.	Vll inj.	Enhancement (young)	Restoration (old)	Abnormal glabellar mov.	
No. of cases	63	6	67	42	4	182

Chart (1): Patients population.

Group I: Asymmetrical faces:

A- Patients who have asymmetry not due to facial nerve injury, 63 cases. (Hyperkinetic; 18 cases, hypokinetic; 3 cases and combination of hypo and hyperkinetic; 42 cases).

Some patients had hyperkinetic muscular tone in one area and hypokinetic pattern in another, so the doses and sites of injection were customized for each patient.

B- Patients who have asymmetry due to facial nerve injury, 6 cases. (Paresis; 3 cases, hemifacial paralysis; 1 cases, and synkinesis; 2 cases).

The second group was sub divided into:

Group II: Symmetrical faces:

A- Younger patients who were candidate for facial enhancement, 67 cases.

B- Older patients who were candidate for combination treatment for facial rejuvenation, 42 cases.

C- Patients with abnormal glabellar movement and/or transverse frown-line, 4 cases.

RESULTS

All 182 patients enrolled in the study completed their treatment course. Both sides were treated in 181 cases and one side was treated in one case (complete paralysis).

The symmetrical patients achieved good rejuvenation. In the young patients group (age range 28-38 years) their faces were enhanced with a more alert expression and softening of the harsh facial lines (Fig. 3).

In the older group (age more than 38 years), the patients needed combination therapy with fillers and neck and jaw line injections. The transverse glabellar folds were only corrected by injecting the procerus muscle and lateral corrugator leaving the medial part of the corrugator with no botox injection (Fig. 4).

The decrease in discrepancy between the right and left brow heights before and after botulinum toxin A injection was achieved in all cases of asymmetry (Fig. 5). The asymmetry in the medial brow was more difficult to correct and was still evident but with a good improvement (Figs. 6 and 7).

In cases that had asymmetry due to facial nerve injury, the active side became more relaxed and the contrast between both sides was softened (Fig. 8).

Only one case had complete paralysis and the normal side was injected. In another 2 cases who complained of synkinesis (one eye used to close excessively during smiling), injection of the lower orbicularis oculi and upper fibers of zygomatic muscle lead to balance of both eyes (Fig. 9).

The complication reported was mild bruising in 12 patients which resolved in the first week after treatment. Twenty patients complained of headache and the cases that were injected with the 100 units (16 cases) complained of tightness in their forehead which resolved after 3 weeks (Table 1).

Table (1): Complications.

No. of cases	Complications	Time of resolving
12 cases	Mild bruising	Within 1 week
20 cases	Headache	Within 1 week
16 cases (100 units/session)	Tightness in forehead	Within 3 weeks

DISCUSSION

Many studies have tackled the use of botulinum toxin type A in treating facial rhytides. However, there are few studies in literature that tackled the difficult cases with asymmetric faces. To our knowledge, the assessment of the facial expression was not done before using videos. Even the study of Tunc and Sinem, on facial asymmetry, did not deal with this problem. They only tried to prove that even with injecting symmetrically (the same doses in the same site), the asymmetric face symmetry could become symmetric. They failed to reach their goals and their photographs were not standardized [9].

The ability of botulinum toxin A to treat hyperfunctional lines of the face depends on the resultant denervation of the facial mimetic muscles. With respect to the dynamic muscular forces affecting the height and the shape of the eyebrows, [7,12,13] a relative weakening of the muscular depressors of the brow (orbicularis oculi, depressor supercillii, procerus, and corrugator muscles) against the only brow elevator, the frontalis muscle, results in a visibly appreciable amount of brow elevation [14]. So, tailoring the doses and varying the sites could be a logical solution to solve these problems especially where treating asymmetries.

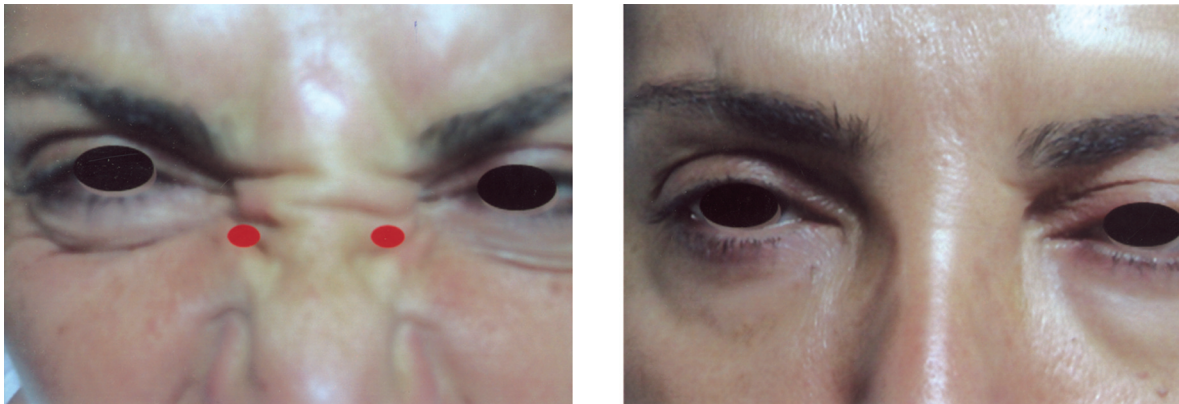


Fig. (3): Female patient, 32 years old with bunny lines, 5 units were injected for each bunny line.



Fig. (4): Female patient, 62 years old, for facial rejuvenation. The forehead, glabella, crows feet and the platysma was injected along the mandibular border. A total of 100 units were used.



Fig. (5-A): Female patient, 43 years old, with a prominent transverse glabellar fold.



Fig. (5-B): Injection sites to correct transverse glabellar fold. The injection was done only in the lateral part of the corrugators omitting the medial part. The procerus was also injected to raise the medial brow. The small dot is 3-4 units and the large dot is 5-6 units.

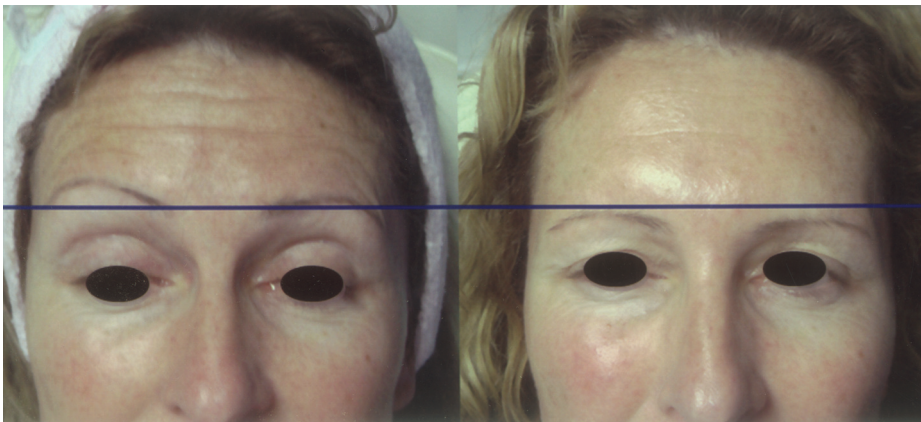


Fig. (6-A): Female patient, 43 years old with eye brow asymmetry. Before and after photographs after injection of 55 units of botox.



Fig. (6-B): Injection pattern in forehead to correct the asymmetry. An extra dose of Botox (2-3 units) is injected in the left orbicularis to further weaken it thus facilitating the work of the lateral part of the frontalis which is left without injection to exert its full force.

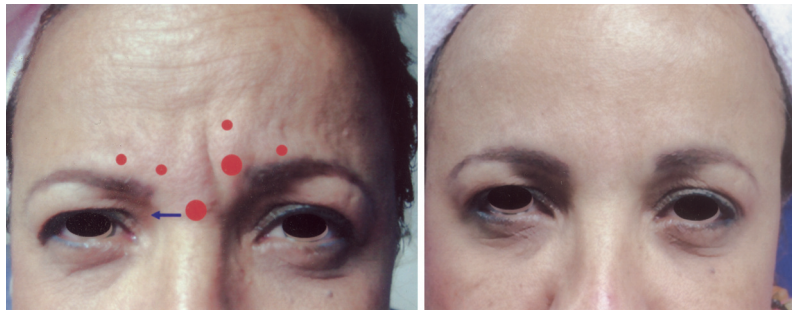


Fig. (7): Female patient, 47 years old, showing asymmetry in the forehead and medial part of the brows. The injection pattern is shown to correct the discrepancy of the medial head of eye brow. The blue arrow is where massage is done to paralyze the depressor supercillii helping in raising the head of the brow on this side only.



Fig. (8): Female patient, 52 years old, showing left hemi-facial paresis. 32 units in right side and 16 unites in left side were injected to decrease the discrepancy between both sides.



Fig. (9): Female patient, 48 years old, showing right synkinesis after a dog bite. Every time she smiled the right eye closes more than the left. Four units in were injected at the lower lateral part of orbicularis to prevent the eye from closing during smiling.

The triggering factor for this study was the high incidence of patient dissatisfaction during the second treatment. They are stunned by the marked effect during their first treatment and they are very pleased. After the second treatment they start to be more critical and notice the limitations, drawbacks and abnormal expression during the second treatment so they start asking for more. They can tell who had botulinum toxin by the abnormal facial expressions or the frozen look and it became a taboo to have these raised eyebrows with the expressionless faces. They want the results to be subtle, elegant and well balanced.

The suggested protocol for all cases is a free hand protocol. First of all, observe the facial expressions during rest and during animations or speech. Any exaggerated expressions are recorded, photographs are then taken at rest and during animation. Then a short video tape is recorded during normal conversation and during actively moving the facial muscles. The botox is then injected and exact dose and site are recorded in patient file on a drawing. The patient then returns after 10-14 days, touch up are done and recorded, and then after 3 weeks. Photographs and videos are repeated until we reach the optimal expressions for each individual patient. This will then be the unique protocol for each patient which is repeated in subsequent cases.

The unilateral injection of botulinum toxin type A for correction of eyebrow asymmetry has been described in the literature discussing facial nerve paralysis cases as well [5]. In one study, the author experienced difficulty in finding the exact dosage to correct the disorder unilaterally without creating a reversed asymmetry [6]. This difficulty was the result of the unilateral treatment of asymmetry.

In our series the 182 patients were successfully treated. A large asymmetry will probably need secondary injections and there will still be some degree of asymmetry. In all the other individuals, an improvement of existing asymmetry was noted.

An exact dose will never be achieved as each individual is unique even in his illness. The importance of assessing the patient after 2 weeks and adjusting gradually the dose for each individual is the only way to get the best result possible. Touch ups are mandatory for the first 2 or 3 times until the optimal dose and sites are achieved. This is like an artist that go back to the painting for touch up on his canvas.

This study only proved what nature has known for a very long time that "there are no strict rules and nothing is absolute". An exact knowledge of the drug is mandatory but only so that one can customize the dose and site for each patient. It is like an artist who is playing with his brush erasing some lines and leaving others and each day making new adjustments.

On the other hand, our photographs demonstrate that significant correction of asymmetry can be achieved statically as well as dynamically. Therefore, a free hand technique that avoids the strict rules and fixed doses should be the standard technique for botulinum toxin A injection.

Even in the symmetrical cases the doses of the toxin has to be modified for each individual to achieve the best result possible with a naturally relaxed pleasant face. We can achieve a more alert look in the young as well as the older patients by injecting by injecting around the eyes in the lower and upper fibers if the orbicularis.

Some patients tend to frown excessively during speech and others tend to raise their brows more. By careful assessment of each individual habit during speech physician can alter the dose to prevent this facial muscular hyperactivity. The transverse nasal line could be also managed by leaving the fibers of the medial corrugator with no injection and only injecting it laterally together with the procerus.

Conclusion:

The concept of using botulinum toxin, not only to treat wrinkles, but also to reposition facial units and, most recently, to rebalance the entire face has been revolutionary in the area of aesthetic surgery. Using botulinum toxin to alter the balance between the elevators and depressors of the eyebrow is a valuable concept in the subject of facial rejuvenation.

Successful injection technique is based on a thorough understanding of the actions and anatomy of the facial musculature and the ability to assess and design a plan for each patient individually.

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