

An Overview of the Cosmetic Treatment of Facial Muscles with a New Botulinum Toxin

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SUMMARY Botulinum toxin (BTX) is used nowadays in a much more differentiated way with a much more individualized approach to the cosmetic treatment of patients. To the well known areas of the upper face new indications in the mid and lower face have been added. Microinjection techniques are increasingly used besides the classic intramuscular injection technique. BTX injections of the mid and lower face require small and smallest dosages. The perioral muscles act in concert to achieve the extraordinarily complex movements that control facial expressions, eating, and speech. As the mouth has horizontal as well as vertical movements, paralysis of these perioral muscles has a greater effect on facial function and appearance than does paralysis of muscles of the upper face, which move primarily in vertical direction. It is essential that BTX injections should achieve the desired cosmetic result with the minimum dose without any functional discomfort. In this paper the three-year clinical experience with average dosages for an optimal outcome in the treatment of facial muscles with a newly developed botulinum toxin type A (Xeomin®) free from complexing proteins is presented.

KEY WORDS: botulinum toxin A, upper, mid and lower face, microinjections

INTRODUCTION

Botulinum toxin A, produced by *Clostridium botulinum*, an anaerobic, gram-positive organism, prevents the release of acetylcholine at the neuromuscular junction of striated muscle fibers causing flaccid paralysis. By weakening certain facial muscles that are responsible for creating unwanted rhytides and which are functionally not necessary the negatively perceived lines of facial expressions lines are ameliorated.

In Germany there are three different botulinum toxin A (BTX-A) products on the market, which differ in the amount of protein and of the albumin added. For Vistabel® (Botox®) and Dysport®, the ratio of dosage units is close to 1:3. For the new German Xeomin®, which is completely free from complexing proteins and can be stored at room temperature, the ratio of dosage units compared to Botox® is 1:1, as neurological studies have shown.

The BTX-A toxins are available as drugs through the following brands and companies:

- Botox® (100 U), and for cosmetic use Vistabel® (50 U) is marketed by Allergan Inc. (Irvine, California, USA).
- Dysport Reloxin® (500 U) and Dysport Cosmetics® (500 U) are manufactured by Ipsen Ltd. (Maidenhead, Berkshire, UK).
- Xeomin® (100 U) is marketed by Merz Pharmaceuticals, Frankfurt/M., Germany.

Only Vistabel® and Dysport® are licensed for the cosmetic indication for treatment of the glabella. The dosage that is referred to in this article refers to treatment with Xeomin®.

It is essential that BTX-A injections should achieve the desired cosmetic result with the minimum dose without any functional discomfort.

Injections of the mid and lower face with BTX require small and smallest dosages. The perioral muscles act in concert to achieve the extraordinarily complex movements that control facial expressions, eating, and speech. As the mouth has horizontal as well as vertical movement, paralysis of these perioral muscles has a greater effect on facial function and appearance than does paralysis of muscles of the upper face, which move primarily in vertical direction.

The habitual use in different ways of two symmetric muscles may sometimes be detected by asymmetric facial lines. In the lower face these asymmetries are more difficult to detect and are only revealed after treatment with BTX when asymmetries might become more obvious and may lead to discomfort with the patient's expressions. It is therefore mandatory to observe patient's expressions before treatment with BTX, especially in the lower face.

Injecting physicians are increasingly aware that BTX treatment is also an adjunct to other cosmetic

therapies such as soft tissue augmentation and skin resurfacing.

The way BTX-A is now used in the treatment of facial muscles has changed through experience. The "frozen look" is no longer targeted; a natural look is desired by the patients. Before treatment, the muscular pattern and the use of different facial muscles of the individual has to be evaluated.

The main target muscles for BTX-A in the upper face are:

- corrugator muscle
- procerus muscle
- frontal muscle
- orbicular orbital muscle
- depressor superciliary muscle

THE USE OF BOTULINUM TOXIN IN TREATING UPPER FACE MUSCLES

The "frown"

The muscles of the glabella area are contracted if the patient expresses anger or concern. Contracting the corrugator muscle will draw the eyebrows down and result in a menacing expression, creating vertical lines between the eyebrows. Contracting the procerus muscle will induce horizontal lines between the eyebrows.

The total dose for treatment with BTX is distributed over 5 to 7 injection points covering all the muscles involved in the formation of the "frown" (1-3). One injection point with 5 U is used to treat the procerus muscle. Two more injections points in the corrugator muscle are located medially 0.5 cm above the medial edge of the orbital bone. One additional lateral injection point on each side with 5 U each is used to treat the lateral part of the corrugator muscle (Fig. 1a, b). The total dose will be about 25-40 U (4). Men usually need higher dosages. Complications are very scarce and may



1a



1b

Figure 1. (a) The frown before treatment; (b) typical expression after BTX treatment.



2a 2b

Figure 2. (a) Crow's feet before treatment; (b) the result after treatment (5 injection points (IP) with 3 U Xeomin®/IP).

result in eyelid ptosis or eyebrow ptosis (5). The latter may occur if the position of the eyebrow is already low before treatment and if the occipito-frontal muscle, which is an elevator and maintains the eyebrow in place, is overtreated.

Forehead lines

The usual action of the frontal muscle is to raise the eyebrows, expressing fright and surprise. To prevent eyebrow ptosis, it is suggested to treat only the upper half of the forehead with 4-6 injection points (6) and a total dose of 10-15 U of Xeomin®. The lateral points determine the degree of movements of the eyebrows. If more medially placed, they will allow for elevation of the lateral part of the eyebrows (female pattern).

Brow lift

The eyebrows have one elevator, the frontal muscle, and three opponents as depressors: the corrugator muscle, the procerus muscle and the orbicular muscle of the eye. In women, high arching eyebrows positioned above the supraorbital rim are usually attractive, but usually not in men where the eyebrow lies at the rim. Elevating the

eyebrows at their medial, central or lateral aspects can be achieved with the proper technique (7). Elevating the lateral part of the eyebrow can be achieved with one injection at the end of the eyebrow into the upper lateral part of the musculus orbicularis pars orbitalis. Multiple, very superficial (intradermal) injections along the hair of the eyebrow with very low doses of 0.3 to 0.5 U of Xeomin® will lift the whole eyebrow.

Crow's feet

Eyes are the most important area in the upper face. The presence of lateral canthal lines, caused by the contraction of the orbicular muscle of the eye, gives a tired and fatigued appearance. Depending on the extension of the lines, one or two rows of three injection points with a total dose of 9-15 U of Xeomin® are necessary to relax the lateral portion of the orbicular muscle of the orbit (Fig. 2a, b), which is also useful for lifting the lateral aspect of the eyebrow (8-10). Injections into the lowest extensions of the crow's feet at the level of the greater zygomatic muscle may cause asymmetric smile and excessive blocking of the palpebral portion may impair the lacrimal pump mechanism resulting in dry eyes.

The main target muscles for BTX injections in the mid face are:

- transverse part of the nasal muscle
- depressor muscle of nasal septum
- medial part of the levator muscle of upper lip and ala of nose

PERIORAL AND CHIN REGION, AND NECK REGION

The main target muscles for BTX in the lower face are (Fig. 3a, b):

- orbicular muscle of mouth



3a



3b

Figure 3. (a) Marionette lines before treatment; (b) the result after treatment with 4 U Xeomin® in each depressor muscle of angle of mouth.

- depressor muscle of angle of mouth
- musculus mentalis
- platysma muscle

The use of BTX-A in treating dynamic rhytides of the mid and lower face has to consider the anatomic situation of the different muscles involved in this area that interact closely with each other. Doses and volumes should be kept low to avoid side effects (11). Patients should have reasonable expectations what can be achieved with BTX-A treatment.

After evaluating the patient's wishes and having obtained an indication for the use of BTX-A, the target muscles should be visualized by having the patient repeatedly contract and relax the area. During contraction the muscles of the lower face can be palpated between the examiner's digit and thumb. Usually much smaller doses are used for the lower face than for the upper face.

"Bunny lines" of the upper third of the nose are caused by contraction of nasal muscle and appear sometimes after treatment of the glabella region, the so-called "Botox sign".

Doses and injection technique: each side 3-5 U of Xeomin® in one single injection or divided into two, relatively high on the bony dorsum of the nose.

Nasolabial folds

The levator muscle of upper lip and ala of nose belongs to the group of muscles that elevate the upper lip. The medial part of its fibers inserts in the skin of the ala nasi and is activated when flaring the nostrils.

Doses and injection technique: since this muscle is also a component of the upper group of the muscles acting on the mouth, it is crucial only to inject the nasal part of it with 1-2 U of Xeomin® into the skin over the bony part of the nose in order to avoid diffusion of BTX into the lip elevator part, which might result in lip ptosis.

Perioral rhytides are caused and accentuated by the contraction of the orbicular muscle of mouth, which consists of two parts: pars labialis and pars marginalis. Repeated pursing such as smokers do produces vertical lines around the mouth. The mouth is capable of an incredible variety of movements and attitudes resulting from the complicated muscle system acting on the lips, the labial mucosa and the perioral area. These muscles can be divided into the encircling orbicular

muscle of mouth, the upper group of the lip elevators and angle retractors, and the lower group of lip depressors and commissure retractors. These muscles tend to join together and insert into the orbicular muscle of mouth, which itself has no bony attachment or cartilaginous support. Main actions are: to draw the lips together, to pull the corners of the mouth together, to pull the lips against the teeth, and puckering. It is a major muscle of facial expression as well as speech and its muscular movements are required during swallowing.

Doses and injection technique: after examination of the contraction force of the two parts of the orbicular muscle, the minimal dose of 4 U of Xeomin® divided in 4 injection points is distributed along the margin of the upper lip or placed more in the upper outer quadrant (12). This will result in increased lip fullness, broadening and widening of the lip, but also in a reduced contraction force. As with all BTX-A treatments, dosages and placement of the injections are variable. Overdosage will result in having difficulties on whistling, sipping from a straw, puckering, drooling, oral incompetence with an asymmetric smile, and with pronunciation of the "b" and "p" letters.

Marionette lines

The downward "drool grooves" at the angles of the mouth creating the marionette lines are caused by the action of the depressor muscle of angle of mouth, which acts to depress and to retract the corner of the mouth. This creates a permanent look of anger and frustration. It pulls down the corners of the mouth and produces the marionette lines and an expression of sadness. Doses and injection technique: 3-5 U of Xeomin® directly into the belly of the depressor muscle of angle of mouth (Fig. 3a, b). The muscle can be localized by palpating it between two fingers while the patient pronounces "iii". Watch for asymmetries that can be accentuated by the treatment with BTX-A. It is mandatory not to inject too medially to avoid diffusion into the lip depressor muscles. Best results with BTX-A are achieved by injecting into the lower and mid third of the muscle where fibers of the platysma, which also exert pull at the corners of the mouth, are intertwined.

"Popply chin"

Contraction of the musculus mentalis, the deepest muscle in this group, creates the appearance of a deformation like an "apple dumpling", occurring mostly with expression and talking. Especially



4a



4b

Figure 4. (a) Platysma bands before treatment; (b) platysma bands after treatment with 60 U Xeomin® total dose. Note improvement of platysma bands, cheek lines and redistribution of submandibular fat pad after treatment.

in elderly patients this deformity of the skin of the chin can look unattractively. Musculus mentalis is not only responsible for wrinkling the skin at the chin and for protruding the lower lip, but also for the horizontal mental crease.

Dose and injection technique: 5-10 U of Xeomin® can be injected into each side of the chin anteriorly to the tip of the mandible. Since this is a symmetric muscle, symmetric injections should be applied.

THE PLATYSMA

The platysma tightens the skin of the neck and produces platysma bands determined by the degree of medial development and midline proximity of the left and right muscles. It is also responsible for the horizontal "necklace" lines. With aging, new adipose tissue can accumulate in the submental region. Besides the platysmal bands and other signs, the aging neck can also display skin laxity.

Doses and injection technique: 1-2 U of Xeomin® are injected 1-2 cm apart along the platysma bands in vertical direction along each necklace line (Fig. 4a, b). It is important to inject subcutaneously and not too deeply to avoid diffusion to the sternocleidomastoid muscle. Treating the platysma in older patients will reduce the pull on the corners of the mouth, but large doses of BTX-A are necessary. For optimal results in older necks with large platysmal bands, a combination of modalities may be required. The effect lasts for 3-5 months and the cost-effectiveness relation has to be considered. Treatment with BTX-A is no alternative modality to neck lift.

CONCLUSION

To obtain optimal results in treating the mid and lower face with BTX-A, one has to fully understand

the complicated functional anatomy of this region to comprehend in the individual patient the benefits, limitations and potential side effects after the treatment with BTX-A. Because of the highly functional nature of the target muscles for eating, speaking and communication by expression, the treatment has to be conservative and cautious, beginning with low doses.

In contrast to the upper face where BTX is mostly used as monotherapy, the use of BTX-A in the lower face is more often used as an adjunctive to fillers or other skin rejuvenation and skin resurfacing modalities (14). The changes of the skin after various laser skin resurfacing and deep chemical peels last for many years and correlate clinically with improvement in rhytidosis. The habitual use of muscles of facial expression will eventually refold the new dermal collagen created by skin resurfacing modalities and thus prevent the development of the new collagen bundles parallel to the skin surface. Regular postoperative injections with BTX that weaken the muscles producing the expression lines prolong and refine the outcome of skin resurfacing.

At the beginning, BTX-A was used along the principles of the same doses and injection sites for everybody, but in recent years the treatment with BTX-A in cosmetic use is much more differentiated and reflects today a more individualized approach, with the aim of global rejuvenation, the BT "face lift". Frequent reports of potential novel uses of BTX-A in facial musculature indicate that we only stand at the beginning of its use in cosmetic medicine.

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