Abstract: The use of botulinum toxin type A for esthetic purposes has been used since 1987, turning out as one of the most popular procedures in aesthetics due to the effectiveness in softening dynamic wrinkles. The nasoglabellar lines or bunny lines are the result of the contraction of the nasal transversus. They can be primary or secondary, the last ones as a result of muscle blockade in glabellar region, generating a compensatory contraction.

As people age the nasal tip tends to fall due to gravity forces and due to the kinetic action of the depressor of the septum muscle. The application of Botox in this area will only have positive results if the ptosis is of muscular cause.

Physical or emotional stress causes the involuntary contraction of the anterior and posterior dilator naris (nasal flutter). Also the injection in these muscles produces the stretching of nostrils of very wide noses, when these muscles are active (they can move the ala).

Hyperhidrosis of the nasal dorsum is diagnosed through the Minor test (iodinated alcohol and starch). The injection is done in dermis until the skin turns white, 1 to 2 UI per injection, separating them by 1cm.

Multiple eccrine hidrocistomas are papula cystic lesion, that were described by Andrew Ross Robinson. At inspection they have a transparent dome through which a blue color is seen, usually confused with blackhead. They are originated in sweat ducts, and come out associated with hyperhidrosis.

Keywords: BOTOX nasal applications, Botulinum toxin, bunny lines, dynamic wrinkles, gingival smile, nasal anatomy, nasal cosmetic procedures, nasal dermatology, nasal dynamics, nasal flutter, nasal hyperhidrosis, nasal muscles, nasal proportions, nasal tip ptosis, nose aesthetics, multiple eccrine hidrocistomas, minimal invasive procedures, muscle blockade, wide nose.

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INTRODUCTION

Since 1987 Botulinum toxin type A has been used to enhance the aesthetic appearance of the upper third of the face (Fig. 1). The main effect is softening of dynamic wrinkles by diminishing mimic muscles contraction. Nowadays, the cosmetic use of botulinum toxin is no longer limited to this area, and has extended to the inferior third of face, neck, and the (medial facial area, and to which is the main subject of this book, the nose.

Botulinum toxin type A popularity has increased in the last years turning to be the most popular aesthetic procedure in the world, according to international scientific societies, mainly due to its safety and predictable results. We have a large experience in botulinum toxin in the nose and other facial areas. In this chapter we
will expose our experience with botulinum toxin type A in nasal muscles.

**NASAL MUSCLES**

According to Latourneau and Daniel [1], the superficial musculoaponeurotic system (SMAS) that covers the nasal dorsum and ala is composed by eight muscles that share common fascias with neighboring areas as lids, cheeks, lips and forehead.

Different authors have classified these muscles on various criteria (Fig. 2 and 3).
Aiach and Levignac [2] classify them according to the level of insertion in relation to the nostrils: above or below. Griesman [3] uses a physiological criterion, dividing them in elevators, depressors, dilators, and constrictors:

- Elevators that shortens the nose and open the nostrils:
  - *Procerus*
  - *Levator labii superioris alaeque nasi*
  - *Anomalus nasi*

- Depressors that enlarge the nose and open nostrils:
  - *Alar nasalis (dilator naris posterior)*
  - *Depressor septi nasi*

- Compressors that enlarge the nose and stretch nostrils:
  - *Transverse nasalis*
  - *Compressor narinum minor*

- Dilators:
  - *Dilator naris anterior*

The *procerus* is originated in the *transverse nasalis* aponeurosis, nasal bones
periosteum and nasal lateral cartilage perichondrium, and ends in glabellar skin. As an elevator it antagonizes the transverse nasalis depressor action.

The levator labii superioris alaeque nasi originates in the medial portion of the orbicularis oculi and the frontal process of the maxilla, inserting down in the nasolabial fold, nasal ala, and skin and muscles of the upper lip. It has a nasal fascicle that covers the origin of the transverse nasalis. The main function is to elevate the nasal ala and open the nostrils.

The anomalous originates in the frontal process of the maxilla inserting in nasal bones, nasal lateral cartilage, the procerus and the transverse nasalis. Is present in 50% of the population.

The alar nasalis, also known as dilator naris posterior, originates in the maxilla over the lateral incisor and inserts in the nasal ala. This muscle opens the nostrils.

The depressor septi nasi originates in the nasal spine of the maxilla inserting in the membranous septum and medial crus of alar cartilages. The contraction of this muscle turns downwards the nasal tip. According to Zide [4] there are some superficial fibers that originates in the orbicularis oris, and insert in the columella, that are responsible of the elevation of the lip as the nasal tip turns down.

The transverse nasalis originates in the maxilla above the incisor fossa, sharing some fibers with the levator labi superioris alaeque nasi, then it inserts in an aponeurosis over the nasal dorsum, joining with the contralateral muscle. The
contraction of this muscle stretches the nasal vestibule by descending the lateral crus of the alar cartilage.

The *compressor narinum minor* is a small muscle that descends from the nasal lateral cartilage to the skin over the nostrils. Is present in 57% of the population. Superficial to this muscle, is the *dilator naris anterior*, whose main function is to open the nostrils. This is a fan shaped muscle that originates in the nasal lateral cartilage and the *transverse nasalis*, and inserts in the caudal border of the lateral crus of the alar cartilage and in nostrils skin. The contraction of this muscle can be felt by compressing the nasal ala between two fingers.

**BOTULINUM TOXIN PROPERTIES**

Clostridium Botulinum is a bacteria that produces different types of toxins. Seven types have been identified known as A, B, C, D, E, F and G. They all produce denervation and atrophy of muscles. The most powerful is toxin A, being the elective treatment of many dystonias. Type B is also available for medical use; it has a faster but shorter effect (Myobloc ®).

We refer to our experience with toxin A commercialized by Allergan with the name of BOTOX® (other products differ in pharmacodynamics and pharmacokinetics).
TOXIN HANDLING

Botulinum toxin is commercialized as crystallized powder that contains 100 UI per vial. Reconstitution should be done with sterile, preservatives free saline solution. The product final concentration depends on the volume used for reconstitution. For cosmetic use in the nasal area, reconstitution of the toxin is recommended to be done with 1ml of saline solution per vial. This avoids diffusion to neighboring muscles preventing undesired effects.

The manufacturer recommends the use within 4 HS after reconstitution, but experience has demonstrated that the reconstituted solution does not loose effectiveness if conserved in a refrigerator at 4°C.

We like to use 0.3ml syringes with 30G needle (Ultrafine II. Becton Dickinson-BD) for precise application. These syringes do not have dead space so no solution is lost, and allows a better dosage, a fundamental aspect in the nasal area.

Botulinum toxin can be injected intramuscular, subcutaneous or intracuticular. Anesthetic cream can be applied locally if the patient is oversensitive. Other way to reduce pain is using cold packs.

SIDE EFFECTS AND PRECAUTIONS

In patients with neuromuscular diseases as myasthenia gravis or amyotrophic lateral sclerosis is relatively contraindicated. Application should be avoided
during pregnancy and lactation. Drug interaction is limited to aminoglycosides, with which a lower dose is recommended. Most of secondary effects are due to toxin diffusion to neighboring muscles. This is preventable using correct doses and injection planes. There are no long term effects described with the toxin. With repeated application the effect can diminish, probably due to antitoxin antibodies.

DOSAGE AND FREQUENCY

The clinical effect of the toxin starts between the second and the fourth day, and regularly lasts for four or five months. Generally, patients that are happy with the result come back to repeat the application when the effect starts to diminish. Stronger muscles require higher doses. When working in small areas, to prevent diffusion to neighboring muscles, reconstitution with lower volumes of saline solution is recommended. As a general rule, the limit per application per session is 400 UI, doses that are only used spastic paralysis. In the nasal region doses never exceed 20 UI.

NASAL APPLICATION

Nasoglabellar wrinkles and bunny lines

Over the lateral wall of the nasal bridge an important percentage of the population have diagonal lines that go towards the nasal ala. This has been the first indication of BOTOX® in the nasal area suggested by Carruthers [5]. This wrinkles or bunny lines can be primary or secondary. The secondary ones,
also known as BOTOX® effect, appear after the treatment with toxin in the glabellar muscles. That is why when treating frown wrinkles is important to advert to patients the possibility of developing compensatory nasoglabellar wrinkles. This compensatory effect develops mostly in women that already have an insinuation of these wrinkles and have an outdoor life, which generates muscle contraction by sun exposure. By blocking frown muscles some people starts contracting involuntarily the \textit{nasalis transverse}. Primary wrinkles are frequent in people that gesticulate a lot, users of heavy glasses, chronic rhinitis and those with clear eyes that try close the lids in response to sun or light. These muscles get hypertrophied and hyper-functional by forced and constant contraction, provoking wrinkles in the thin skin that covers them. They are much frequent in caucasic people, and they get accentuated when they smile, talk or get angry. Men have a thicker skin, thus having less wrinkles.

In patients with previous rhinoplasty botulinum toxin clinical effect less evident, probably due to anatomic changes and muscular scar provoked by surgery.

It is important to differentiate wrinkles provoked by the \textit{transverse nasalis} (described above), from wrinkles provoked by the \textit{procerus}. This last ones, are horizontal lines that appear in the nasal root when the glabellar skin is pull down by the contraction of the \textit{procerus}. By eliminating both of this wrinkles a juvenile and relaxed appearance is obtained in the mid face. When we do not treat simultaneously the nasoglabellar and the glabellar wrinkles, the untreated ones develop compensatory contraction producing a strange effect on nasal image.
Tamura [6] pointed out that in 40% of patients the nasoglabellar wrinkles can be treated with 3 UI injected in each nasal wall in the muscular body. The other 60% of the patients present different patterns of muscular contraction, needing additional 2 UI in neighboring areas. He identifies three patterns of wrinkles that appear within the first four weeks of application: naso-alar, naso-orbicular and naso-ciliar. The naso-alar lines are produced by the contraction of the alar fibers of the levator labii superioris, and must be treated just over the nasal ala. The naso-orbicular and the naso-ciliar are produced by the contraction of the orbicularis oculi.

We inject 2 to 4 UI of botulinum toxin in the transverse nasalis belly where it goes over the nasal bone. Then we observe the evolution, and if necessary perform the corrections following Tamura's recommendation.

**Precaution**

It is important to inject above the naso-facial groove to prevent diffusion of toxin to the levator labii superioris, causing lip ptosis and lip asymmetry. This can cause incompetence of the labial sphincter, creating problems to eat and talk.

Less frequent, but not less important complication is toxin diffusion to the orbicularis oculi, diminishing the pump effect over the lacrimal sac causing tearing. Diffusion to the medial rectus of the eye has been described, causing blurred vision.
It is important to avoid injecting the product in the angular artery, which can cause thrombosis and blindness.

To prevent these complications that are mainly caused by diffusion to neighboring muscles, and for which there is no antidote, it is preferable to avoid any kind of massage in the area after applying the toxin.

Nasal tip ptosis

As people ages, the nasal tip tends to turn downwards partially by the gravity forces and partially caused by the hyperkinetic action of the *depresor septi nasi* muscle over the caudal portion of the nasal septum. When this occurs, appearance turns senile, evil and witch like.

The importance of the *depresor septi nasi* in rhinoplasty has been remarked many years ago. Wright [7] in 1976 noted that an hyperactive muscle contributed to the tip ptosis, and that this phenomenon could be diagnosed by the “smile test”. In 1983, Ham [8] reported that the *depresor septi nasi* was responsible for the tension in nasal tip and dorsum, and recommended this muscle transection to solve the problem. Cachay- Velazquez [9, 10]described in 1992 the “ rhino-gingivo-labial syndrome of the smile”. He points out the importance of dynamic examining of face, which can reveal aesthetic imperfections, not so evident at rest. The rhino- gingivo-labial syndrome of the smile includes:

- Nasal tip ptosis
- Elevation and shortening of the superior lip
- Increased exposure oral mucosa.

The author attributes this syndrome to the *depresor septi nasi* hypertrophy. For the correction he proposes excision of the *depresor septi nasi*, and a partial excision of *orbicularis oris* and *nasalis* muscles through a stab incision. There are no cases of nasal obstruction in the clinical experience of the author, contrary to what Converse [11] exposed about the importance of conserving this muscle.

De Souza Pinto [12] reported his technique called “dynamic rhinoplasty”. He uses a Z-plasty based on the labial bridle and combines relaxation of the medial fascicle of the *depresor septi nasi*, with horizontal or vertical plication of the intermediate fascicle, depending on the length of the superior lip.

The nasal tip ptosis generally coincides with a short superior lip, entity described by Rohrich [13] as the functional unity of the inferior third of the nose. The *depresor septi nasi* and the *levator labii superioris alaeque nasi* are responsible for the muscular forces affecting this area in the dynamic and static models. The *depresor septi nasi* is sometimes considered as part of the *dilator naris*, muscle that originates in the incisor fossa of the maxilla, just below the *orbicularis oris*, and in the mucosa of the superior lip. The *depresor septi nasi* pulls down the nasal septum and ala stretching the nostrils. The interdigitation of this muscle with *dilator naris*, it’s present in a small percentage of the population. In this cases provoke a paradoxical opening of the nostrils when these muscles contract.
together. Due to anatomical variations described above and the multifactorial etiology of the nasal tip ptosis, BOTOX® application will have positive results only when the main cause of the defect is the muscular action. To evaluate the muscular strength is important to observe the functional unity of the inferior third of the nose during forced smile. With this observation we can predict which patients will have a good result with toxin. To perform the procedure we have to pull down the patients upper lip over the teeth's in order to open the nasolabial angle. In this way we elongate the muscle, turning easier the identification of the muscle insertion in the base of the columella, where the needle should be introduced to inject 2 to 4 UI in the subcutaneous to avoid diffusion to the orbicularis oris (Fig. 4). If we are in the presence of a strong muscle additional 2 UI can be used in the mid columella. In patients with interdigitation of the depresor septime nasi and the dilator naris, additional 4 to 5 UI are recommended in
the nasal ala dorsum, inside the *dilator naris*, in order to obtain a better tip projection.

Peres Atamoros [14] created a therapeutic protocol that allows to measure the tip elevation when using BOTOX®. He establishes that for a soft elevation 2 UI must be injected in each *dilator naris* and 2 UI in the *depresor septi nasi* (total of 6UI). For a medium elevation 4 UI should be injected in each point (total of 12 UI). Finally for a strong elevation 6 UI should be injected in each point (total of 18 UI).

In some patients the use of BOTOX® increases the distance between the columellar base and the vermilion border, creating the appearance of a fuller and voluminous lip. It can also correct the gingival smile. If the toxin diffuses laterally in the base of the columella it can affect the *levator labii superioris* and the *orbicularis oris*, provoking an unaesthetic elongation of the superior lip, filtrum flattening and labial sphincter incompetence when talking and drinking.

The use of high doses in the nasal tip can produce an exaggerated opening of the nostrils and a strong elevation of the tip, leaving a unattractive appearance in the frontal view. The clinical effect in this area usually lasts for a shorter time than other parts of the face. The first days after the injection the patient can experience pain in the nasal tip.

In order to obtain satisfactory results in nasal tip ptosis correction, is important to understand the mechanism of the downward rotation of the tip when smiling. This mechanism depends on a functional unity with three components:
1. Cartilage frame (alar and accessory cartilages acting as a unique structure)

2. Muscle engine (\textit{depresor septi nasi} and \textit{levator labii superioris alaeque nasi})

3. Neighboring structures (piriform fossa, valvular mechanism between the lateral and alar cartilages, areolar tissue of nasal dorsum and membranous septum)

BOTOX® application does not replaces surgery in patients with static nasal tip ptosis, but is useful in dynamic ptosis and in other defects caused by an hypetrofic or hyperactive \textit{depresor septi nasi}, and with patients that do not desire a rhinoplasty. Besides BOTOX® can be used temporarily in patients that are evaluating a surgical procedure. The application of toxin is a great combination with other minimal invasive procedures as bioplasty, fillers and nasal rein. It is possible to obtain a reduction of the dynamic nasal tip ptosis, a correction on the shortening of the superior lip and apparent absence of philtrum by using BOTOX® (Allergan Inc. Irvine, California).

When the \textit{depresor septi nasi} contracts the nasal tip descends, making more evident the nasal tip ptosis. According with the interdigitation of this muscle with the \textit{orbicularis oris}, it is classified in three subtypes:

1. Type I: totally inserted in the \textit{orbicularis oris} (62%)

2. Type II: inserted in the periosteum and partially in the \textit{orbicularis oris}
3. Type III: rudimentary muscle or absent.

The *levator labii superioris alaeque nasi* originates in the frontal process of the maxilla and inserts down in skin of the nasal ala and superior lip. Its action is to elevate the superior lip and nasal ala. When contracting together with the *depresor septi nasi* they descend the nasal tip while ascending the nasal ala and superior lip, thus opening the nostrils. Their contraction also produces a horizontal wrinkle, which divides the philtrum, and oral mucosa exposure. Until the discovery of the botulinum toxin, acting over these muscles was only possible through surgical procedures. Now we can, applying 5 UI in the *depresor septi nasi* and 3 UI en each *levator labii superioris alaeque nasi*, attenuate this muscles action, diminishing tip ptosis during smile, leaving the alar insertion in a neutral position. Also the nasal angle opens to 110 to 115 degrees. Satisfaction index in patients is very high and we have not observed serious secondary effects as labial sphincter incompetence or problems with talking.

With Botulinum toxin we can:

1. Correct the balance between the tip and the lip

2. Elongate the superior lip

3. Create the appearance of superior lip fullness

5. Preserve the motor and sensitive innervation of the superior lip.

In patients where the nasal tip ptosis is mainly due to aging the result of BOTOX® is not as good as in young people where the muscular hypertrophy plays a mayor role. Precaution should be taken with patients with long lips and little vermilion, since there is significant risk of lip ptosis after the procedure.

**Nasal flutter**

In some people, naturally or under stress (emotional or physical) present wide movements of nasal flutter that enlarge the nostrils. This nasal flutter can be very embarrassing. Generally people with short and flat nasal bridge with wide nasal ala present more active nasal muscles, which allows them to voluntarily move the nasal ala. The widened nostrils can take different forms expressing in the face moods as anger, fear, worry, fatigue, reprobation or stress.

The nasal flutter is the result of involuntary and repeated contraction of the inferior portion of the *alar nasalis* muscle, also known as *dilator naris posterior*. This muscle is originated in the maxilla over the lateral incisive, is medial to the *transverse nasalis* in the nasolabial sulcus, travels through the nasal ala, and inserts in the caudal portion of the alar cartilage and skin of the nostrils. The medial fibers can join the *depresor septi nasi*. Its main action is to move the nasal ala laterally and downward, opening the nostrils and preventing the ala collapse during inspiration.
The side of the columella and the septum turns visible when the nostrils open exaggeratedly. This unaesthetic appearance gets accentuated with the contraction of the *depresor septi nasi*. In people with wide nasal base and ability to move the nasal ala, a stretching effect is seen in nostrils after applying BOTOX® in the *dilator naris posterior*. The injection of 5 to 10 UI, bilaterally, in the area of greater contraction of the *dilator naris posterior* (over the nasal ala), has diminished the nasal flutter for three to four months (Fig. 5). We have not experienced secondary effects after the use of toxin in this area.
Botox® in nasal dorsum hyperhidrosis

Excessive sweating of the face generally affects areas as forehead, cheeks, scalp, lips, nasal dorsum and ala. This is less frequent than axillary or hands and feet sweating, but is highly detrimental for social and occupational life because it is extremely exposed to sight. Botulinum toxin blocks the liberation of acetylcholine in synapses that regulate the production of eccrine glands. The incidence of this disorder in the population is not known, but statistically is more frequent in man and tend to worsen with aging. The permanent sweat impede the correct application of creams, make up and sun block. And sometimes it makes glasses slide over the wet surface producing local irritation.

In some women local sweating can appear in the pre menopause together with the heat waves that characterize this period. Usually these symptoms disappear spontaneously. Other stimulus for facial sweating are: caffeine, physical activity, stress, seasoned food and heat.
A precise diagnose of the area of sweating can be made through the test of Minor (iodinated alcohol and starch).

To treat this disorder, injections must be intracuticular producing skin whitening and papules, in order to act over glands and not over muscles. This is a painful procedure, so we recommend the use of anesthetic cream, or if the patient is oversensitive a local nerve blocking for the nasal area. The dose is 1 to 2 UI per injection, with 1cm space between them, until covering the whole area of hyperhidrosis (Fig. 6 and 7). It is important to conserve symmetry while working, in order to avoid asymmetry that can affect the muscles. The patient is called back at day 10 after injection to evaluate the results, and if any area is still sweating is corrected. The effects in general lasts for seven months.

**Botox® in the treatment of multiple eccrine hidrocistoma**

Eccrine hidrocystomas is a cystic lesion of sweat gland ducts described by Andrew Ross Robinson in 1983. Incidence is higher in women. Multiple eccrine hidrocystoma are papule- cystic lesion of elevated surface with a blue coloration that is seen through a transparent dome, easily confused with. It is common to find them in the facial area surrounding the eyes, forehead, nose and superior lip. The etiology is a defect in transpiration or insensible perspiration. If ruptured or spontaneously broken, a clear and transparent liquid drains. It is presented in literature as an infrequent disease, but we think that is because of ignorance and misdiagnose with blackhead. This condition worsens with transpiration and
environmental humidity, thus enlarging in summer and reducing in winter.

Fig.7- Application in nasal dorsum for hyperhidrosis pseudo-blackhead.

Based on our experience with botulinum toxin type A for the use of focal hyperhidrosis and the amount of bibliography about the effect of botulinum toxin in parasympathetic fibers, we started using it in this disorder as well [15]. The application is similar to what is described above for hyperhidrosis. Results are excellent with complete reconstitution of the areas treated.

CONFLICT OF INTEREST

None Declare

AKNOWLEDGEMENT

None Declare


