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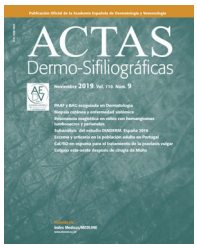

REVIEW

[Translated article] Botulinum Toxin for Esthetic Use in Facial and Cervical Regions: A Review of the Techniques Currently Used in Dermatology

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KEYWORDS
Neuromodulators;
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Abstract Botulinum toxin infiltration is one of the most widely performed esthetic procedures at the esthetic dermatology office. Although infiltrative techniques have been known for quite a few years, several changes have been described so far, mainly based on anatomical knowledge.

There are consensus guidelines available for injecting neuromodulators where one can see both the doses of toxin indicated for each muscle and the injection techniques. After a systematic review of the articles currently available, this article intends to summarize the infiltration techniques described both for the face and neck, while considering new anatomical considerations, new injection techniques published to date, and pearls and tricks for a better understanding of how to inject the botulinum toxin and improve our injection techniques. In our opinion it is important to treat the lower third to complement the treatment of the upper third and, in some patients, the partial blocking of some muscles of the middle third. With this comprehensive treatment of face and neck muscles we can achieve more natural and harmonious results.

PALABRAS CLAVE
Neuromoduladores;
Toxina botulínica;
Rejuvenecimiento

Toxina botulínica con fines estéticos en zonas facial y cervical: una revisión de las técnicas empleadas en dermatología

Resumen La infiltración de toxina botulínica es uno de los procedimientos estéticos más realizados en la consulta de dermatología estética. Las técnicas infiltrativas se conocen desde años, aunque diversas modificaciones se han descrito hasta ahora, basadas sobre todo en los conocimientos anatómicos.

Existen guías de consenso de inyección de los neuromoduladores donde se pueden consultar tanto las dosis de toxina indicadas en cada músculo como las técnicas de inyección. Con este artículo pretendemos, tras hacer una revisión sistemática de artículos, resumir las técnicas

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de infiltración descritas tanto en la cara, como en el cuello, teniendo en cuenta las nuevas consideraciones anatómicas, las nuevas técnicas de inyección publicadas, así como perlas y trucos que nos permitan comprender mejor la inyección de la toxina botulínica, y mejorar nuestras técnicas de inyección. Consideramos importante el tratamiento del tercio inferior como complemento al tratamiento del tercio superior, y en algunos pacientes el bloqueo parcial de algunos músculos del tercio medio, de manera que el tratamiento integral de los músculos de la cara y del cuello nos permita conseguir resultados más naturales y armónicos.

Introduction

Botulinum toxin injection for facial rejuvenation is an increasingly demanded technique. There are different toxins authorized for esthetic use in Spain: Vistabel® (onabotulinumtoxin A), Bocouture® (incobotulinumtoxin A), Azzalure® (abobotulinumtoxin A), Alluzience® (abobotulinumtoxin A), and Letybo® (letybotulinumtoxin A). They all share the same mechanism of action, based on blocking the release of acetylcholine at the neuromuscular junction. Their differences are due to the accompanying molecules that stabilize the drug, modifying its presentation form (lyophilized or liquid), storage temperature, or immunogenicity.

The indication of botulinum toxin in the product technical data sheet is variable. Vistabel® and Bocouture® are the only ones with an indication for the frontal, glabellar, and orbicular regions. No toxin is approved for use in the middle third, lower third, or cervical region.

The goal of this article is to review the different infiltration techniques described so far for the treatment of both the facial and cervical regions with botulinum toxin, considering anatomical factors. A systematic approach is proposed for the treatment of the different muscles of the face and neck, describing the infiltration points, depth, and recommended doses. The units referred to are those of onabotulinumtoxin A. Additionally, recommendations and precautions are included, depending on the characteristics of each patient.

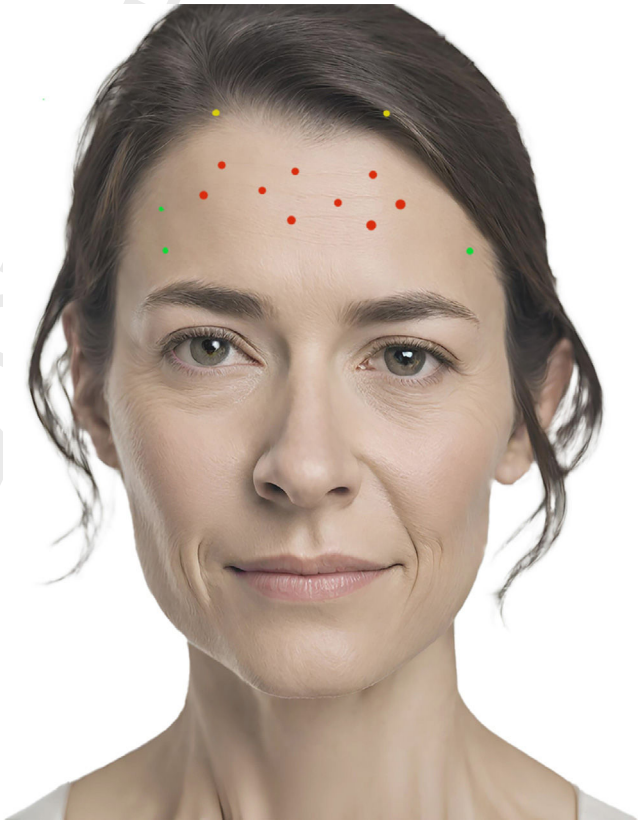

Figure 1 Zigzag infiltration points of the frontal muscle (red), treatment points for lateral frontal wrinkles (green), and frontal elevation points (yellow).

Frontal muscle

Anatomy

It is the only facial elevator muscle. A bimodal movement has been described based on an imaginary line, known as the convergence line or Line C, which divides it into 2 parts: an upper part responsible for lowering the eyebrows, and a lower part responsible for their elevation. This line is located 3 cm above the orbital rim in men and 4 cm in women. It typically coincides with the second horizontal wrinkle from the scalp implantation line.[1]

Contraction of the frontal muscle is responsible for horizontal wrinkles on the forehead.

Position

Zigzag infiltrations are considered ideal, with the points marked according to the individual contraction pattern. They are distributed along the temporal fusion lines,[2] with a lower margin positioned 1.5 cm above the eyebrow at the mediopupillary line and 1.5–2 cm at the lateral zone of the muscle. This lower margin prevents diffusion to the eyelid elevator muscle (Fig. 1).

Infiltrations above the convergence line block the downward movement of the frontal muscle; the lower ones block the elevation of the eyebrows.[3]

Dose and depth of infiltration

The recommended doses range from 8 to 20 IU (international units) of onabotulinumtoxin A. Deep infiltrations, below the subfrontal fascia, are more effective.[4] The action halo of 2 IU of botulinum toxin is 1.5 cm.[5]

Above the convergence line, infiltrations should be deep, with a total of 2–4 IU per point. Below Line C, infiltrations should be subdermal with 0.5–2 IU per injection to maintain some eyebrow elevation function.

Recommendations and precautions

1. Some functionality of the frontal muscle should be preserved to avoid a ''frozen'' look.
2. In men, due to greater muscle mass, higher doses are recommended.[6]
3. In patients with dermatochalasis or ptosis of the eyebrows, lower doses should be considered.
4. Mephisto's sign or look. This occurs when, after infiltrating the frontal muscle, there is excessive activity of its lateral portion. Three patterns of contraction of the frontal muscle's lateral portion are described to avoid its appearance:
   - Type 1: No wrinkles in contraction or rest. No correction with infiltration of toxin in the lateral portion of the frontal muscle is needed.
   - Type 2: Wrinkles present in contraction in the upper part of the lateral frontal muscle. Requires 1–2 IU infiltration in the area where the most wrinkles are seen.
   - Type 3: Wrinkles present in contraction across the entire lateral portion of the frontal muscle. Infiltration of 1 IU is recommended in the upper part of the lateral frontal, and 1 IU in the lower part, always 0.5–1 cm above the lowest wrinkle. These should be avoided in older patients who use the frontal muscle for eyebrow and eyelid elevation.[7]
5. Arched concentric wrinkles that resemble the Wi-Fi icon (Wi-Fi lines): These correspond to very marked supraciliary wrinkles, either naturally or after blocking the medial part of the frontal muscle. Treatment includes infiltration below the described lower margin, with 1–2 very superficial points of 0.5–1 IU.
6. Elevation points. These aim to paralyze the cranial portion of the frontal muscle and consequently elevate the forehead. They correspond to 2 points on each side of the forehead, both 1.5 cm above the hairline: the first at the mediopupillary vertical line; the second, at the vertical line from the inner eye corner. A total of 8 IU per point is recommended.[8]

Glabellar complex

Anatomy

It is formed by 3 muscles: the corrugator, procerus, and depressor superciliar. The hyperfunction of the corrugator is responsible for vertical medial wrinkles. Horizontal wrinkles at the nasal root are due to the contraction of the procerus muscle, while diagonal medial wrinkles around the eyebrow and inner canthus are due to the contraction of the depressor supercilii muscle.[9]

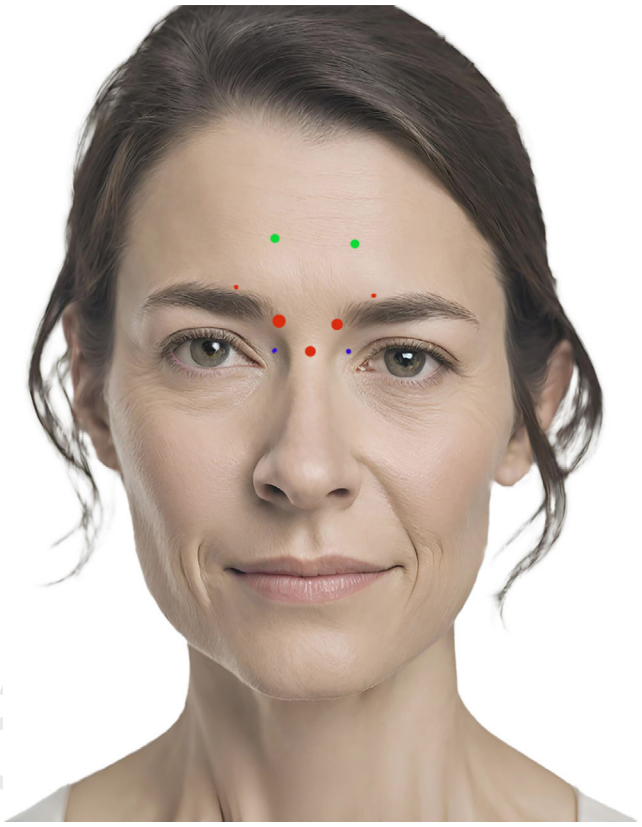

Figure 2 Treatment points for the glabella with the one21 (One21) technique (red and green), 3 points of an alternative technique with only 3 points (large red), infiltration points of the depressor superciliary muscle (blue).

Position

Almeida proposes treatment using 5–7 points depending on the contraction pattern. He describes the following patterns: ''U'' (the most common in women), ''V'' (the most common in men), converging arrows, Omega, and inverted Omega.[10] The incidence rate of eyelid ptosis in Almeida's technique is 3.1% (Fig. 2).

The ''One21'' technique, considered a variation of Almeida's, proposes treatment with between 3 and 12 points. It includes infiltration of the frontal muscle in its lower medial portion.

Cotofana suggests treatment of the glabellar complex with only 3 deep infiltration points at the insertion of the procerus and corrugator muscles. By treating only the medial part of the muscles, the risk of diffusion to the frontal muscle and ptosis of the eyebrows and/or eyelids is reduced.

Dose and infiltration depth

The recommended doses for the glabellar complex range between 13 IU and 26 IU.

The procerus muscle should be injected deeply, almost in contact with the bone, with 4 IU up to 6 IU. The injection site is located in the middle of the line that connects to the can-

thal ligaments. In patients with long corrugators, a second site may be required, 1 cm above, with a more superficial injection of 2 IU.

The infiltration of the corrugator muscle varies according to the technique:

- Following the ''One21'' technique, a first infiltration should be performed at the medial origin of the muscle. This site is located on the vertical line from the inner canthus, 1 cm above the orbital rim. The infiltration should be deep with doses of 4 IU up to 6 IU. The second point addresses the treatment of the lateral part of the muscle and is located at the midpoint between the vertical lines of the inner canthus and the mediopupillary line, 1 cm above the orbital rim. This point should be infiltrated more superficially, with a dose of 2 IU up to 5 IU. For patients requiring infiltration of the medial and lower portion of the frontal muscle, another injection point is performed at the inner canthus, 2 cm above the eyebrows, coinciding with the lowest wrinkle on the forehead. Infiltration should be at the superficial-medium level with 1 IU up to 2 IU.[11]
- Following Cotofana's technique, a single infiltration should be performed from the medial insertion of the muscle. It should be deep, in contact with the bone, with a total of 4 IU up to 6 IU. Some patients with long corrugators may need 2 additional points at the upper edge of the middle eyebrow. These infiltrations should be very superficial with 1 IU up to 3 IU per infiltration.[12]

Treatment of the depressor supercilii muscle should be administered in patients with closely spaced and depressed eyebrows or with oblique J-shaped lines at the inner canthus. It is performed using an infiltration point 1–1.5 cm above the canthal ligament, at a superficial level, with 1 IU up to 2 IU per injection.[13]

Orbicularis oculi muscle

Anatomy

The orbicularis oculi muscle controls eye opening. In addition, along with the glabellar complex and the frontal muscle, it influences eyebrow position. The contraction of the lateral portion of the muscle is responsible for the appearance of horizontal wrinkles known as ''crow's feet.''

The approach to the orbicularis oculi muscle differs between its lateral and medial portions.

Lateral portion treatment: ''Crow's feet'' and eyebrow position

Position

The classic approach involves 3 points: one located 1.5 cm lateral to the external canthal ligament; the other 2, one inferior and one superior to the former, are located more medially[14] (Fig. 3, left side of the face).

Five patterns of crow's feet wrinkles have been described.[15] The injection points are marked at the areas of maximum contraction of the orbicularis muscle with the patient in a forced smile position. It is recommended to inject between 2 and 6 points, located 1 cm lateral to the orbital rim or 1.5 cm lateral to the canthal ligament, to prevent diffusion to muscles involved in ocular globe movement. In patients with a complete or extended contraction pattern, a second line of more lateral points may be required.

Figure 3 Left side with infiltration points for the orbicularis oculi muscle to treat external corner wrinkles. Classic points (red), lower edge point (blue), and points for lower eyelid wrinkles (yellow). Right side with points for eyebrow elevation (pink points) and points for ocular opening (green points).

Dose and infiltration depth

Injections should be superficial, with a total of 2 IU up to 3 IU per point.

Recommendations and precautions

1. Avoid excessively high doses to prevent a ''frozen'' smile appearance.
2. In patients with eyelid bags or increased laxity of the subcutaneous tissue, injections below the external canthal ligament should be avoided, and lower doses should be used.
3. Treatment for lower palpebro-malar wrinkles should be performed with more medial and superficial injections of 0.5 IU up to 1 IU to prevent diffusion to the zygomaticus major muscle, which may cause an asymmetrical smile.[16]

4. Eyebrow tail elevation: To achieve greater elevation of the eyebrow tail, 2–3 infiltrations can be performed below the eyebrow, in its superolateral portion, without crossing the mediopupillary line. Infiltrations should be superficial, with a total of 1 IU up to 2 IU per point[17,18] (Fig. 3, upper right side of the face).

Medial portion treatment: eye opening

Position

It should be injected at a point located 2 mm from the ciliary margin and at the mediopupillary zone. In some patients, a second point may be necessary just at the external corner of the eye (Fig. 3, right side of the face).

Dose and infiltration depth

Infiltrations should be superficial, with doses of 1 IU up to 2 IU to prevent toxin migration to the orbital septum.[19]

Recommendations and precautions

1. Avoid in elderly patients, those with eyelid surgical procedures, ectropion, dry eye, or morning eyelid edema.[20]

Nasal muscles

Anatomy

Nasal muscles are the nasalis muscle and the levator labii superioris alaeque nasi (LLSAN). Their hyperactivity, along with that of the inner portion of the orbicularis oculi muscle, is responsible for the appearance of nasal scrunch wrinkles (Bunny lines), which are typically more prominent after blocking the glabellar complex.

Position

The patient should be examined by asking them to forcibly show the upper dental arch or to make a displeased expression (Fig. 4).

Treatment of nasal muscles is performed with 6 points that form a U on the nasal pyramid.[21] The nasalis muscle is blocked at the lateral nasal pyramid, always at the mid level of the line connecting the inner canthus of the eye and the nasal wing. The LLSAN is blocked at the lower portion of the nasal pyramid, at the beginning of the nasogenian groove. The inner portion of the orbicularis oculi muscle is blocked at a point next to the nasal root, close to the inner canthus.[22]

Dose and infiltration depth

The injections should be superficial, with a total of 2 IU up to 3 IU for the nasalis muscle, 1 IU up to 2 IU for the inner portion of the orbicularis oculi muscle, and 1 IU up to 2 IU for blocking the LLSAN.

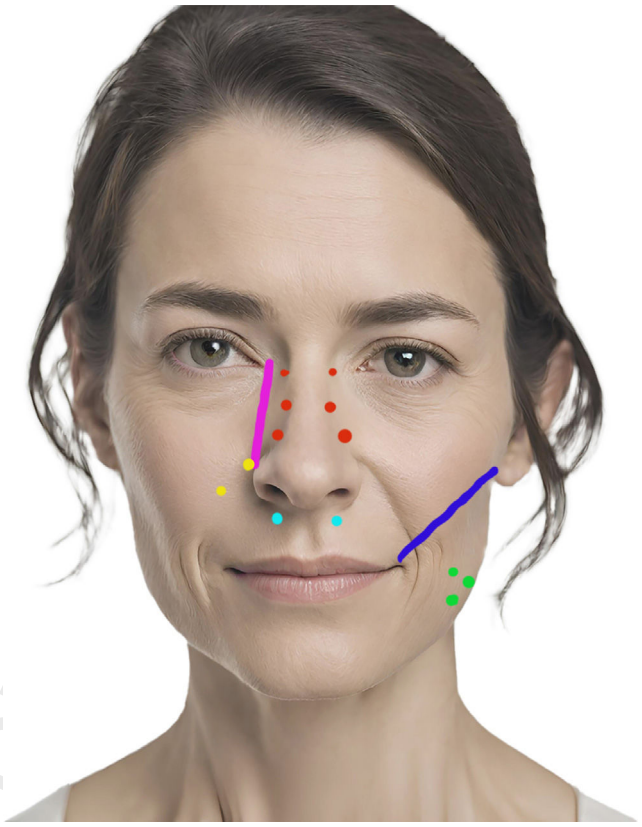

Figure 4 Central nasal area with safety line and infiltration points for nasal wrinkles (red), on the left side, classic treatment points for gingival smile (yellow), alternative points for gingival smile at orbicularis oris muscle level (light blue). Bottom right of the image with points forming a triangle to treat the masseter (green) and safety line (dark blue).

Recommendations and precautions

1. Gingival smile. This occurs due to excessive contraction of the LLSAN muscle. Treatment is administered with an injection point at the beginning of the nasogenian groove, located 1 cm superior and 2–3 mm lateral to the nasal opening. In more severe cases, a second point is required 1 cm lateral and 1 cm inferior to the former, at the intersection of the mediopupillary line and the nasogenian groove, coinciding with the convergence of the LLSAN and the zygomaticus minor muscle.[23] Gingival smile can also be treated by infiltrating the orbicularis oris muscle with 2 symmetrical injection points, located 5 mm below the center of each nostril. This technique is easier and has less risk of diffusion,[24] although some authors consider it less effective.[25] The doses used are 1 IU up to 2 IU per injection point, at a medium depth (Fig. 4, left side).
2. An incorrect approach may elongate the lip and cause a false smile.[26]
3. Nasal tip elevation. This can be achieved by blocking the depressor septi muscle with an infiltration of 2 IU up to 3 IU at a medium depth at columella level.[27]

Masseter muscle

Anatomy

Treatment of the masseter muscle is indicated for patients with bruxism or those with a pronounced mandibular angle.

Position

A safety line is described that connects the mouth corner to the earlobe. Injections above this line can cause diffusion to muscles involved in chewing. The classic approach involves 3 points in the shape of a triangle: 2 inferior points located 1 cm from the mandibular border, and a third superior point forming the apex.[28] Alternatively, multipuncture techniques and those based on a single central injection point at the convergence of the masseter muscles have been described[28] (Fig. 4, right side of the face).

Dose and infiltration depth

In most patients, 24 IU is enough. Higher doses (up to 40 IU) may be used for greater pain reduction and longer-lasting effects.[29] Injections should be deep to avoid retrograde diffusion to more superficial muscles such as the risorius or platysma.

Recommendations and precautions

1. Flaccidity may worsen after masseter muscle treatment.
2. There is a compensatory increase in the volume of the temporalis muscle, reducing the hollowing of the temporal fossa.[30]

Orbicularis oris muscle

Anatomy

The contraction of the orbicularis oris muscle is responsible for the appearance of vertical wrinkles around the mouth, known as ''barcode lines.''

Position

Treatment is administered with 2–4 points located at the vermilion border or, at most, 1–2 mm above it. The injection points are marked at areas of maximum contraction of the orbicularis muscle with the lips contracted in a kissing position. They should be spaced laterally, at least, 5 mm from the philtrum, and 5 mm from the mouth corner (Fig. 5).

Dose and infiltration depth

Injections should be superficial, with 1 IU up to 2 IU per point.

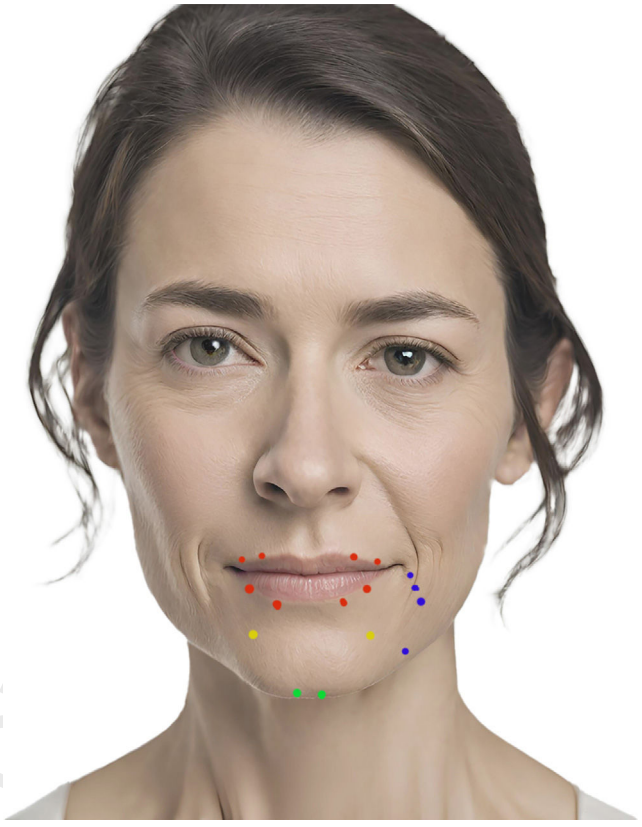

Figure 5 Infiltration point for the orbicularis oris (red) and mentalis muscles (green), infiltration points for the DAO, with the 3 upper-point technique or the classic technique with one upper point next to the commissure and the lower point on the mandibular border (blue), and infiltration points for the DLI (yellow points).

Recommendations and precautions

1. Within the first 2–3 weeks after injection, difficulty in blowing or mild incontinence when drinking may occur.
2. The lips may evert slightly, which can be beneficial for thin lips.[31]

Mentalis muscle

Anatomy

Mobilization of the mentalis muscle causes the appearance of orange peel skin on the chin and/or prominence of the labiomental fold.

Position

Injections are performed at a single point along the chin midline or else, at 2 different points 5 mm laterally from the midline[32] (Fig. 5).

Dose and infiltration depth

Injections should be deep, almost in contact to the bone, with doses between 4 IU up to 10 IU for complete treatment of the muscle.[33]

Precautions

Subdermal touch-up injections of 1 IU up to 3 IU may be needed centrally to avoid diffusion to the depressor of the lower lip (DLI).[34]

Depressor anguli oris muscle

Anatomy

The contraction of the depressor anguli oris (DAO) muscle is responsible, along with the platysma, for the downward pull of the labial commissure, contributing to the appearance of the melolabial folds or ''marionette lines.''

Position

Treatment of the DAO is administered with 2 points, one superior and one inferior, located on a line drawn among the nasal wing, the oral commissure, and the mandibular border.[31] The former point addresses the upper part of the muscle and is located 1 cm lateral and inferior to the oral commissure, slightly lateral to the marionette line. The lower part of the DAO is treated from a second point 1 cm superior to the mandibular border, lateral to the mental foramen and medial to the mandibular ligament (Fig. 5).

Alternatively, it can be treated only at its proximal part with 3 upper points forming a descending line underneath the oral commissure.[35]

Dose and infiltration depth

Doses of 2 IU up to 4 IU are recommended for treating the DAO. Injections should be superficial, with a total of 1 IU up to 2 IU per injection.

Recommendations and precautions

1. To correctly identify the DAO, the muscle can be palpated before treatment by asking the patient to show their lower dental arch.
2. There is a risk of diffusion to the DLI, which could cause the contralateral lower lip to descend when smiling.[36] If this happens, it can be corrected by injecting 1 IU up to 2 IU into the DLI on the side where the commissure is descending.
3. Treatment of DAO should be administered along with the upper portion of the platysma for optimal results.

Platysma muscle

Anatomy

The platysma muscle has a bimodal movement. The upper portion, along with the DAO, is responsible for the downward pull of the labial commissure and the appearance of the melolabial folds or ''marionette lines''.[37] The lower portion of the platysma pulls the neck upward. Its hyperfunction causes platysmal bands, while the loss of tone causes horizontal neck wrinkles.[38]

The approach to the platysma muscle has different objectives depending on whether its upper or lower portion is being treated.

Treatment of the upper portion: melolabial folds or ''marionette lines'' and jaw contour

Position

Treatment is administered using the Toxin lift and Nefertiti lift techniques, which are based on 2 lines of points, superior and inferior, along the mandibular line. Injections are performed at 3–4 points in each line, distributed between the insertion of the DAO and the mandibular angle.[39,40] Alternatively, it can be treated with 4 points forming a line 1 cm above the mandibular border. The first point is located medially, at the height of the oral commissure, with the other 3 points being located more laterally, closer to the mandibular angle[41] (Fig. 6).

Dose and infiltration depth

Injections should be administered at 4–8 points with superficial doses ranging from 2 IU up to 5 IU, with a total dose of 20 IU.

Treatment of the lower portion: platysmal bands and horizontal neck wrinkles

Position

The treatment of prominent platysmal bands is performed using 2–6 points located on each band, spaced 1.5–2 cm apart.[42]

Treatment of horizontal neck wrinkles is administered using 5–10 points, spaced 1–1.5 cm apart, in 1 or 2 lines following the wrinkles.[43]

Dose and infiltration depth

Injections should be superficial, with doses of 1 IU up to 3 IU per point for platysmal bands and 1 IU up to 2 IU for horizontal wrinkles.

Figure 6 Infiltration points for the mandibular border (red), platysmal bands (pink), and horizontal wrinkles (blue). Note: The image of the model has been generated by artificial intelligence.

Recommendations and precautions

1. Errors in the approach to the lower portion of the platysma can cause swallowing issues and dysphonia due to diffusion to the infrahyoid muscles. Doses > 50 IU should be avoided, as well as injections in the central neck area where platysmal muscle fibers are less abundant.
2. Treatment of platysmal bands should be avoided in patients with excessive flaccidity.
3. The infiltration technique is easier with the patient seated or semi-reclined.

Conclusions

Although botulinum toxin infiltration for esthetic purposes has been in practice for years, updates and changes based on the study of the anatomy and function of the muscles involved have been developed and should be known and applied. Being a generally safe treatment, the adverse effects due to excessive doses or unwanted diffusion to adjacent muscles must be understood.

Some patients may request treatment only for the upper third of the face or specific areas such as the LLSAN muscle for correcting a gingival smile. However, it is important to take a comprehensive approach to the face and neck to achieve more natural and harmonious results. Therapeutic approach should be individualized, assessing the patient both at rest and in contraction to correctly locate the injection points and avoid treating certain muscles in case of contraindications.[44]

Conflicts of interest

None declared.

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