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Gummy Smile and Treatment with Botulinum Toxin Type A (Botox)

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Abstract

A smile plays an important role in determining a person's initial impression, and its assessment has become integral to clinical evaluation. A smile with an esthetic appearance should be symmetrical and should reveal less than 2 mm of gums when smiling. A gingival smile, gummy smile, or high smile line, is defined as the number of excess gums on the upper jaw exposed. This may have some serious psychological repercussions on the patient, which may sometimes lead them to conceal their smile to avoid "embarrassment." One of the most common methods of treating a gingival smile resulting from an overactive lip is lip reposition as a surgical procedure and the injection of type A (Botox) toxin as an injectable inhibitor of muscle action. However, many patients refrain from surgical treatment because of fear of complications and pain. In this case, injections of botulinum toxin group A are an excellent alternative to surgery. The injection of botulinum toxin takes less time and with the correct dosage and compliance with the protocol of its administration causes much fewer complications. The study presented here is devoted to the disclosure of the potential of this tool in esthetic dentistry.

Keywords: lip repositioning, gummy smile, hyperactive upper lip, excessive gingival display, botulinum toxin type A

1. Introduction

Since facial expression and smile are the main components of nonverbal communication, as they play an important role in creating an initial favorable impression in business and friendly communication; therefore, they are given such importance when conducting a clinical evaluation. It should be borne in mind that when the facial expression changes, it can show pleasure, sympathy, indifference, approval or disgust, amazement or fright, thus various facial defects, including a gummy smile (excessive gingival display), can make it difficult for the patient to build relationships with other people, and if he/she is suspicious, deprive him/her of psychological comfort and contribute to the emergence of various psychological complexes.

In modern society, great importance is attached to the esthetics of appearance, this is what greatly contributed to the development of the elite direction of esthetic

dentistry and cosmetology, the patient's smile has become an important marker of their viability and activity, not to mention its influence of this parameter on the patient's self-confidence, which we mentioned earlier. Various structures of the face and the dentoalveolar system are involved in the formation of a smile, respectively, any defect in them will cause a change in the smile and, most likely, will require correction, that is, certain medical procedures.

A smile that meets high esthetic standards should be symmetrical, it is believed that with a beautiful smile, less than 2 mm of gums should be exposed, not every patient meets this standard, so recently, it has become common for many people to hide their smile when they are happy or photographed. This phenomenon is known as a "gummy smile," which is a large exposure of the gums when smiling, creating an appearance far from pleasant or desirable in the eyes of others.

2. Gummy smile

This excessive exposure of the gums in a full smile occurs as a result of an imbalance in the interaction of the three main components modeling the smile mentioned above—lips, gingiva, and teeth.

Hulsey pointed out that the most attractive smiles were those in which the upper lip reached the level of the gingival edge of upper incisors [1].

Chiche and Pinault concluded that exposure of up to 3 mm of the gingival tissue could still be considered satisfactory [2]. Hunt et al. argued that the acceptable range of gingival exposure was between 0 and 2 mm, with the ideal situation being no exposure at all [3]. Geron and Atalia found that any maxillary gingival exposure above 1 mm would be considered unesthetic [4].

Since other researchers have recently discovered that 3 mm of gum exposure worsen the appearance of the patient, which does not meet the esthetic expectations of modern society, thus 2 mm of gum exposure would be the maximum for an esthetically acceptable smile, and therefore, it can be said that the ideal amount of gum exposure with a full smile is 0–2 mm. In other words, an exposure of up to 3 mm can still be considered esthetically acceptable, but if it is over 3 mm with a full smile, then such a smile should be called a "Gummy smile" or "Gingival smile" [4–6].

The prevalence of a gummy smile is 10–15% at the age of 20–30 years, but with age, due to sagging muscle tissue of the upper lip and its covering with gingival tissue along with part of the teeth of the upper jaw, the incidence decreases. The prevalence of gummy smile varies according to gender. A study found that the amount of gingiva exposed when smiling in females was 1.5–2 mm greater than males, at a rate of 7% in males and 14% in females [7].

3. Treatment of gummy smile caused by dentoalveolar factors

3.1 Treatment of gummy smile caused by shortening the clinical crown length of maxillary anterior teeth

Here, the distinction should be made between the two cases.

If shortness in the clinical length is caused by the gums covering the crowns of maxillary anterior teeth, it is treated with a traditional gingivectomy [8].

If there is a shortening in the clinical crown length of maxillary anterior teeth with normal gingival growth, here it is necessary to remove an amount of the bone as well as treat this case by surgically lengthening the teeth.

One of the criteria that should be followed before starting to lengthen the crowns is the availability of a sufficient amount of attached gingiva of no less than 3 mm to reduce postoperative gingival recession and maintain vital presentation [9].

3.2 Treatment of gummy smile caused by dentoalveolar eruption

Treatment is through orthodontic work, correction of the axis of maxillary anterior teeth, and orthodontic intrusion. Sometimes, surgical intervention might be necessary in cases of deep bite and excessive overjet following a comprehensive clinical and radiographic study.

In other words, bone, periodontal ligament, and soft tissues move with teeth movement, so intrusion helps to improve gummy smiles. On the other hand, with the emergence of orthodontic implants, which are known as temporary anchorage devices, anterior teeth intrusion has become a possibility.

3.3 Treatment of gummy smile caused by gingival hyperplasia

Gingival hyperplasia accompanied by periodontal pockets is treated with conventional surgical resection of the gum, necessary to achieve optimal periodontal condition and reduce the depth of periodontal pockets so that they do not exceed the mucosal-gingival junction.

3.4 Treatment of gummy smile caused by soft tissue factors

Shortening of the upper lip and hyperactivity of levator labii superioris muscle.

Traditional orthodontic surgical methods of treating gummy smile are perceived by patients to be painful and unacceptable methods. Therefore, it was necessary to devise less invasive and more patient-acceptable methods to fulfill esthetic demands. These methods include surgical lip repositioning, injection of botulinum toxin type A (Botox), and maxillary anterior nasal spine implants.

3.4.1 Surgical repositioning of the lip

This is a surgical technique performed under local anesthesia to reposition the lip, which helps to reduce gingival exposure by limiting muscle tension of the levator labii superioris muscle by decreasing the depth of the vestibule. This is achieved through the removal of a spindle-shaped strip of the vestibular fold either with cutting insertions of the levator labii superioris muscle (fully thick slice) [10] or without (partly thick slice) [11].

Indications for surgical repositioning of the lip:

1. Gummy smile caused by shortness of the upper lip or hyperactivity of levator labii superioris muscle.
2. Good oral health and safety of periodontal tissues.
3. Stable systemic health.

4. Sufficient amount of attached gingiva no less than 3 mm.

Contraindications for surgical lip repositioning:

1. Gummy smile caused by structural factors.
2. The amount of attached gingiva is less than 3 mm.
3. Local or systemic contraindications of periodontal surgical procedures.
4. Pregnant and breastfeeding women.
5. Smoking.

3.4.2 Anterior nasal spine implants

Maxillary anterior nasal spine implantation obstructs lifting of the upper lip, which helps to reduce gingival exposure when smiling.

Austin describes this technique; a pocket is created by bilaterally incising and raising the periosteum from the maxillary anterior nasal spine by 10 mm. The pocket is then filled with silicone and the latter is left to solidify and take on the shape of the area. It is then removed, the hard edges trimmed, re-implantation performed, and the pocket sutured. Results were good and patients were fully satisfied. However, during such interventions, infection of the periodontal pocket may occur, and in this case, it will be necessary to remove all its contents and administer antibiotics [12].

3.4.3 Botox injection

3.4.3.1 Botox: concept and history

It is considered one of the non-surgical alternatives to reduce gummy smile caused by the hyperactivity of the levator labii superioris muscle. This technique has become a part of clinical practice [13].

The term Botox is a combination of two words—botulinum and toxin, where the first refers to the name of the microbes from which this substance is extracted, and the second means poison in English. Thus, it consists of substances extracted from the bacterium *Clostridium botulinum* [14, 15].

The Botox known to us today was developed by US ophthalmologist Alan Scott in 1970, who said the following about his product: “When I developed it, I knew that it could do miracles with regard to neurological problems, but I never knew that it might work as a cosmetic substance” [16].

At first, Alan Scott and his colleague Schantz used low doses of serotype BTX A to treat cases of “strabismus” and cases of blepharospasm. Thus, initially, since the 1970s, this drug was used to treat strabismus and then found its application in cosmetology and esthetic medicine.

In 1989, FDA approved Allergan’s BTX A as an effective and safe treatment for blepharospasm, strabismus, hemifacial spasm, and 7th cranial nerve disorders. In April 2002, it obtained approval to treat glabella lines associated with corrugator supercilii and procerus muscles activity. In 2004, it was approved as a treatment for axillary hyperhidrosis [17].

3.4.3.2 Biochemical and physical properties of Botox

Clostridium botulinum, which is a gram-positive, anaerobic spore-forming bacterium, produces multiple exotoxins.

The most stable and potent exotoxin is BTX A. Its median lethal dose in monkeys is 39 U/kg—approximately 2500–3000 U/kg in humans.

BTX A has a neurotoxic effect by suppressing synaptic transmission in cholinergic nerve endings. When it overlaps with presynaptic terminations, it prevents the extracellular release of acetylcholine, that is, it can be used to reduce skeletal muscle tone by binding to a synaptosomal protein (SNAP-25), which inhibits the release of acetylcholine from motor neurons and activates presynaptic repolarization [18]. Side effects are limited to the peripheral nervous system and mainly occur through the neuromuscular junction (NMJ), but it should be noted that the nerve endings of the ganglia can also be affected.

When it affects NMJ's nerve endings, BTX A causes denervation of muscle fibers and triggers reversible paralysis. It should be noted that denervated muscles can atrophy after BTX A administration, but they restore sensitivity to neurotransmission by producing acetylcholine receptors outside the compound. Motor neurons also develop new endings, so if given enough time to recover, they will eventually reverse the paralysis. When BTX A is administered for therapeutic purposes, its effectiveness is limited to a few months [19].

3.4.3.3 Therapeutic applications

The number of therapeutic applications of BTX A has significantly expanded after years of study on humans, for whom local injection of BTX A is the primary treatment for blepharospasm, spastic dysphonia in addition to strabismus and hypersalivation, myoclonus, stuttering, nystagmus, tremor, and focal hyperhidrosis.

3.4.3.4 Botox cosmetic indications

1. Cosmetic procedures to eliminate wrinkles, which account for about 90% of all cosmetic applications of Botox.
2. Elimination of glabellar wrinkles; deep glabellar wrinkles occur due to constant contractions of the glabella muscles arising from various causes.
3. Periorbital wrinkles, for the elimination of which Botox is one of the most suitable means, most often they are formed in old age, due to constant contractions of the circular muscle of the eye.
4. Wrinkles on the forehead; these wrinkles develop with age and due to the habit of raising eyebrows when expressing surprise, patients often seek to get rid of them, as they form an appearance that does not meet their esthetic needs.
5. Correction of the shape of the nose: Botox is used for contour non-surgical rhinoplasty, since when it is administered, the muscles that pull the tip of the nose down are weakened, which allows you to achieve the desired shape of the nose for the patient, due to the action of antagonist muscles.

6. It is used to treat age-related wrinkles on the neck or the so-called “chicken neck.”
7. Botox is also used to treat cervical dystonia, which is a spasm in the neck muscles, in which spasms may occur in the muscles of the hands.
8. It is used for dermal diseases, especially hyperhidrosis in armpits, where it is intradermally injected.
9. Correction of gingival smile resulting from hyperactive upper lip, BTX-A injection exhibits better results than those of surgery and has given safer and more satisfactory cosmetic outcomes [20].
10. Botox can be used to improve the shape of the wound after suturing, it prevents muscle tension at the edges of the wound and promotes the formation of a thinner cosmetic scar [14, 21].

Botox treatment can be recommended to a patient of any age since the appearance of wrinkles is usually associated with high activity of facial muscles, and not with age-related skin changes in patients. Therefore, it is possible to come across patients who are in their twenties. It is worth noting that its result will be much better if Botox is used before the formation of deep wrinkles, which are difficult to remove even during the facelift. The complexity of the procedure depends on the severity, depth and location of wrinkles, and primarily on the quality and thickness of the skin. It should be noted that the use of Botox is limited in the area of the circular muscle of the mouth due to its active participation in the processes of eating and speech formation.

3.4.3.5 Contraindications

Absolute contraindications:

Botox is not used in the following cases:

1. During pregnancy, when intending to become pregnant as well as breastfeeding.
2. In the event of a severe allergy to Botox, which represents a rather small proportion of cases.
3. In case of inflammation or swelling in the area planned for Botox injection.
4. If the patient has a neuromuscular disease.
5. Use of alcohol and aspirin before treatment, it can be carried out no earlier than two weeks after the last intake of these drugs.

Relative contraindications:

1. Amyotrophic lateral sclerosis.
2. Myasthenia gravis.

3. Lambert-Easton syndrome.
4. Respiratory disorders, such as asthma and Bloating.
5. Swallowing problems.
6. Weakness in facial muscles (drooping eyelid, or inability to raise eyebrows).
7. Hemorrhagic and heart problems.
8. Previous Botox administration was carried out less than 4 months ago.
9. Occurrence of various complications with the introduction of Botox in the anamnesis.

Disadvantages of Botox

1. Allergic reactions to this drug, which are quite rare.
2. Incomplete clinical effect from the use of the drug or even asymmetry between the right and left sides of the face; which can be corrected by repeated administration of the drug in the areas indicated 15 days after the first administration.
3. Occurrence of twitching in the muscles located near the site of administration of the drug, lasting for several hours, which subsequently disappears.
4. Ptosis of the upper eyelid, which occurs due to exceeding the dosage of the drug or non-compliance with the drug administration algorithm, according to which the injection site for the correction of frontal wrinkles should be 2 cm above the upper edge of the orbit; this condition disappears by itself two to three weeks after administration of the drug.
5. In rare cases, corneal dryness may occur, lasting for a short period of time, amenable to correction with the help of eye moisturizers.
6. Numbness or burning sensation in the area of administration of the drug, lasting for a short period of time after its administration.
7. Swelling or hyperemia that occurs after administration of the drug, usually passing within an hour after its administration.

Botox is used in dentistry and maxillofacial surgery in the following cases:

1. Pathological TMJ disorders,
2. Bruxism,
3. Masticatory muscle tension disorders,
4. Mandibular muscle spasms,
5. In the treatment of gummy smiles.

3.4.3.6 Gummy smile and treatment with type A botulinum toxin injection

In a pioneering study by Polo [22], botulinum toxin injection to treat gummy smile showed promising results, as it did not require either surgery or anesthesia. Instead, a high cosmetic effect was achieved by reducing the amount of gum exposure by inhibiting and partially blocking by introducing Botox type A into the projection area of the following muscles—the levator labii superioris and the zygomatic muscle [22].

In another study by Polo [23] that involved 30 patients, two points were injected with five units of Botox bilaterally above the levator labii superioris alaeque nasi and zygomaticus minor muscles. Gingival exposure improved by 0.09 mm two weeks after injection.

Hwang [16] performed measurements on corpses to determine the Yonsei point for a single injection of targeted muscles, including the levator labii superioris alaeque nasi. The Yonsei point was determined to be at the center of a triangle formed by the intersection of the muscle's levator labii superioris, levator labii superioris alaeque nasi, and zygomaticus minor muscles, laterally located 1 cm on the transverse plane, and 3 cm above the lip line on the frontal plane in both men and women.

In a 2010 study, Mazzuco and Hexcel classified patients with a gummy smile into three categories:

Anterior gummy smile—a single injection point in the lateral nasolabial fold 1 cm below the levator labii superioris alaeque nasi.

Posterior gingival smile: two injection points—the first in the nasolabial fold at the point of maximum contraction when smiling; the second, 2 cm lateral to the first point at the level of the tragus of the ear (zygomaticus minor and major).

Mixed anterior and posterior gingival smile—both anterior and posterior injection points (levator labii superioris alaeque nasi and zygomaticus minor and major muscles).

Asymmetrical gingival smile—two posterior injection points on the side of the greater gingival exposure and only in the lowest point on the opposite side (zygomaticus minor and major) [15].

Sucupira and Abramovitz [24] used only one injection point 3–5 mm lateral to the nostril, targeting the levator labii superioris alaeque nasi muscle. They reported 84% improvement rate.

As for Suber, he used three injection points: 2 mm lateral to the pterygopalatine fossa at the level of the nasal passage, followed by another 2 mm lateral to the first at the same transverse level, and a third injection 2 mm below and between the first and second sites. The resulting injection sites were drawn as an inverted triangle [25].

Dinker et al. used Botox type A to manage the problem of gummy smile [26].

Aly and Hammouda [27] proposed combining Botox injection and lip repositioning for cases of gummy smile resulting from vertical maxillary excess.

Similarly, Pedron and Mangano [28] discussed the benefit of combining gingivectomy and Botox injection in the management of cases of the gingival smile. They used graded 1 mL 30 G insulin syringes, and, as for type A botulinum toxin, a 100-U vial, along with sodium chloride solution (serum), cotton, and alcohol.

3.4.3.6.1 Type A botulinum toxin injection technique

Injection sites are to be determined in three places on each side through muscular activity (smiling) and probing the extent of contraction to ensure accurate muscle position before injection, given that there might occur minor anatomical site variations with no local anesthesia performed.

Surface facial marks used for locating injection sites according to Suber [25]. The resulting injection sites were drawn as an inverted triangle. The bone marker was the forefront of the maxilla attached to the muscles covering it—levator labii superioris alaeque nasi and zygomaticus minor [25].

The amount of botulinum toxin used for each target muscle was 2.5 units. A 100-unit bottle of dried botulinum toxin type A dissolved by adding 2 mL chloride saline serum under sterile conditions so that the dilution ratio was $\frac{1}{2}$, as each grade on the syringe indicated 1 unit of diluted and injectable Botox.

About 1 mL insulin syringes with 30 G needles to be used for injection [29]. Grover et al. confirmed that 1 mL insulin syringes with 26–30 G needles are preferred for Botox injection since the bevel is much thinner, sharper, and long enough to enable injection in facial muscles. Additionally, the mL-graded syringe makes unit distribution easier [30].

After identifying the three injection sites and without performing local anesthesia, the area to be wiped with cotton moistened with alcohol for cleansing, and then 2.5 units should be injected frontally and bilaterally into each of the three muscles, according to Polo and Sumaya [31].

4. Conclusion

Carrying out injections of botulinum toxin type A for the correction of the gingival smile is a promising direction of esthetic dentistry. Of course, the method is not without individual drawbacks—partial relapses of this condition, requiring repeated administration, edema, the occurrence of compensatory wrinkles, and compensatory facial expressions or allergic reactions. Nevertheless, this method should be recognized as less traumatic compared to surgical intervention, which also has several complications and does not guarantee the absence of relapses of this pathology.

In addition, this method is usually recommended for patients who need correction of the gingival smile for esthetic purposes, who refuse surgical intervention for psychological reasons (fear of the sight of their own blood, the occurrence of pain, fear of notwithstanding a long surgical operation).

We believe that the development of esthetic dentistry will follow the path of developing minimally invasive interventions that achieve a great therapeutic effect with simple techniques such as the implementation of botulinum toxin type A injection.

Conflict of interest

The authors declare no conflict of interest.

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