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Botox as an adjunct to lip repositioning for the management of excessive gingival display in the presence of hypermobility of upper lip and vertical maxillary excess

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ABSTRACT

Background: Excessive gingival display (GD) is a frequent finding that can occur because of various intraoral or extraoral etiologies. This work describes the use of a mucosal repositioned flap for the management of a gummy smile associated with vertical maxillary excess (VME) and hypermobility of the upper lip followed by injection of Botox.

Materials and Methods: Seven female patients in the age range of 17–25 years presented with a gummy smile. At full smile, the average GD ranged from 6 to 8 mm. A clinical examination revealed hypermobility of the upper lip. A cephalometric analysis pointed to the presence of VME. The mucosal repositioned flap surgery was conducted followed by injection with botulinum toxin type A (Botox) 2 weeks postsurgically.

Results: After 4 weeks, results were definitely observed with a decrease from 8 mm gingival exposure to 3 mm, which was considered as normal GD for an adult during smiling.

Conclusion: For patients desiring a less invasive alternative to orthognathic surgery, the mucosal repositioned flap is a viable alternative. Moreover, Botox is a useful adjunct to enhance the esthetics and improve patient satisfaction where surgery alone may prove inadequately in moderate VME.

Key Words: Botox, gum, lip, repositioning, smiling

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INTRODUCTION

A smile is an important nonverbal method of communication and is an interaction between the teeth, the lip framework, and the gingival scaffold.[1] When an excessive amount of gingiva is visible while smiling, this condition is commonly referred to as a "gummy smile." In a sample of over 450 adults, aged 20–30 years, 7% of men and 14% of women were found to have a gummy smile.[2]

Goldstein classified the smile line (consisting of the lower edge of the upper lip during the smile) according to the degree of exposure of the teeth and gums into three types: High, medium, or low gummy smiles (GSs) ranged from mild, moderate, and advanced, to severe.[3] Rosemarie Mazzuco and Hexsel classified gummy smile into anterior, posterior, mixed, or asymmetric based on the excessive contraction of muscles involved. The authors conclude that it is important to identify the type of GS and therefore the main muscles involved so that the correct injection technique of Botox can be used.[4]

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Excessive gingival display (GD) is a clinical finding with many etiologies and may include extraoral or intraoral components. Some extraoral causes of a gummy smile are vertical maxillary excess (VME), hypermobile upper lip (HUL), or a short upper lip. A visual diagnosis of VME is made when the lower third of the face is longer than the remaining thirds; cephalometric analysis (COGS) can be used as an additional aid.[5] VME can often be treated alone by orthognathic surgery. A Le Fort I procedure down fractures the maxilla, allowing for segmentalization and three-dimensional repositioning of the dentoalveolar complex.[6] Most patients who undergo this procedure require a hospital stay and a few days for recovery. Postoperative complications can include significant swelling, edema, bruising, and discomfort.[7] In some cases of VME, a multidisciplinary approach with either orthognathic surgery, orthodontic treatment, periodontal treatment, or restorative dentistry is required.[1]

Excessive GD can also be seen in patients with a short upper lip (measured from the subnasale to the inferior border of the upper lip). The average length of the maxillary lip is 20–22 mm in young adult females and 22–24 mm in young adult males.[8] Hypermobility of the upper lip is caused by hyperfunction of the lip elevator muscles and often results in excessive GD.[9] HUL is considered the primary etiologic factor in excessive GD when the maxillary lip length is within a normal range, and the lower third of the face is proportionate to the remaining thirds.

The best orthodontically treated patients may not be satisfied by the treatment if soft tissue problem is not corrected. Patients desire to look good not only in a static pose but also during dynamic facial expression. Treatment for the most extraoral or intraoral cause of gummy smile, with the exception of a short or hypermobile lip has been well documented. Various surgical and nonsurgical modalities have been described in the treatment of gummy smile which includes Lefort I osteotomy, crown lengthening procedures, maxillary incisor intrusions, microimplants, headgears, self-curing silicone implant injected at anterior nasal spine (ANS) with myectomy, and partial resection of levator labii superioris with muscle repositioning. However, these procedures do not help in reducing the hyperactivity of the muscles and therefore, nonsurgical treatment may be a desirable option.[10-12]

Recently, the injection of botulinum toxin type A (Botox) has been suggested for treatment of HUL, but this may only provide temporary benefits. Botulinum toxin has been widely used for the treatment of various conditions associated with pain and excessive muscle contraction since the 1970s. Clostridium botulinum is an anaerobic bacterium responsible for its production. Among the eight different serotypes of botulinum toxin that exists, Type A (BTX-A) is the most potent and the most commonly used clinically.[13]

This work presents cases of moderate VME which was treated with lip repositioning for lip lengthening adjunct with Botox in an effort to recreate smile.

MATERIALS AND METHODS

Seven female patients in the age range of 17–25 years had a short upper lip with VME but were not willing for surgery. Patients presented to the clinic with the chief complaint of excessive GD.

Inclusion criteria

Pretreatment photographs clearly showed the presence of excessive GD with hyperactive upper lip elevator muscles. Six to eight millimeters of gingival exposure was seen in the incisor region during wide smile which was the main cause for concern for the patient. The upper lip was 20 mm long at rest [Figure 1], which led to a diagnosis of a hyperactive upper lip and incompetent lips.

Exclusion criteria

Pure skeletal VME, bimaxillary protrusion.

Presurgical cephalometric analysis

COGS showed the skeletal class II pattern with prognathic maxilla with anterior vertical excess between 4 and 18 mm and a posterior excess between 3 and 5 mm.

During the initial visit, all written forms and consents were explained to the patient and signed accordingly. Patient's medical history was reviewed as well. Our research has been conducted in full accordance with the World Medical Association Declaration of Helsinki in 1975 as revised in 2000, and the study has been independently reviewed and approved by an Ethics Committee Review Board at Future University.

Surgical procedure

The infraorbital block was used to avoid thickening of the lip and soft tissues with anesthetic fluid, allowing the surgery to be a more realistic representation of the projected final result.

The surgical area was demarcated with the help of an indelible pencil. The surgical area started at the mucogingival junction and extended 6–8 mm superiorly in the vestibule. Incisions were made in the above mentioned surgical area, and both superior and inferior partial thickness flaps were raised from the maxillary left central incisor to maxillary left second premolar. The incisions were then connected with each other on the distal end in an elliptical outline [Figure 2a]. The epithelium was then removed within the outline of the incision, leaving the underlying connective tissue exposed [Figure 2b and c]. The parallel incisions were

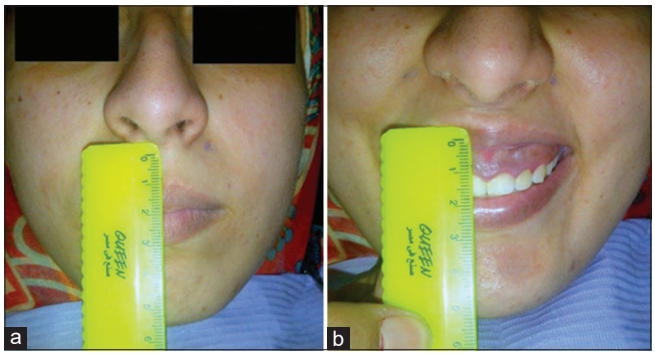

Figure 1: (a) The length of upper lip, when measured from subnasale to the vermilion border was 20 mm. (b) Preoperative image of the dynamic smile, which extends to the mesial aspect of the first molar, showing 5–7 mm of gingival display.

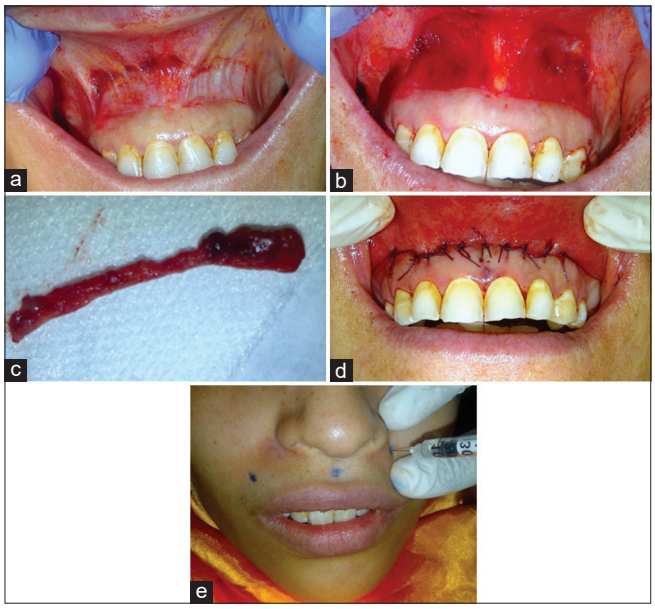

Figure 2: (a) The first incision was made at the mucogingival junction. (b) Exposed submucosa after removal of the epithelial discard. (c) Excised mucosal strip. (d) Stabilization sutures in place. (e) Two weeks after lip repositioning surgery, 2.5 units of Botox were then injected at two sites per side in both overlapping points.

approximated with interrupted stabilization sutures at the midline and other locations along the borders of the incision to ensure proper alignment of the lip midline with the midline of the teeth; the amount of tissue excision should be double the amount of GD that needs to be reduced, with a maximum of 10–12 mm of tissue excision. Then, sutures were used to approximate both flaps [Figure 2d]. The sutures were resorbable in nature; care should be taken regarding proper alignment of the midline of the first and second incision lines (lip midline and teeth midline). Pressure is applied until hemostasis is achieved. The patient was discharged with all postsurgical instructions and medications for 5 days which included analgesic (ibuprofen 600 mg q.i.d daily for 2 days), antibiotic (amoxicillin 500 mg tax deducted at source t.i.d for 5 days), along with cold packs extraorally to decrease postsurgical swelling. Postoperative symptoms usually include some mild discomfort for several days and a feeling of "tension" when the patient smiles. Loose sutures are removed over a period of 4 weeks, and the remaining sutures are left to be resorbed on their own.

Botox injection

Postsurgery although there was a significant improvement in the patient facial profile and smile, there was still about 5 mm gingival exposure during a smile. The dissatisfaction expressed by the patient led us to consider another treatment option. Injecting Botulinum toxin type-A (Botox) was discussed with the patient who was very receptive to the idea which targeted his chief complaint of gummy smile.

Before injecting the solution, the patient underwent a standardized photographic session. A digital camera (Nikon D 60) was used to take the close up perioral, as well as frontal smiling photographs. To standardize the technique, a fixed patient camera distance, a cephalometric head holder, and natural head position were used, care was taken to capture a nonposed spontaneous smile. A measuring scale was used for standardization of the photographs. Adobe Photoshop software was used for the measurements. Botox allergic test was done in each individual prior to Botox injection. After 2 weeks from the surgical procedure, 1 ml tuberculin or insulin syringes can be used as it gauges the dose accurately in minute quantities also.[14,15] Almost all of the injections were intramuscular and not subcutaneous.

Botox was diluted according to the manufacturer's recommendations to provide 2.5 units per 0.1 ml by

adding 4.0 ml normal saline solution to 100 units of vacuum-dried clostridium botulinum toxin type-A. Under sterile conditions, 2.5 units were then injected at two sites per side in both overlapping points of the right and left levator labii superioris alaeque nasi, levator labii superioris, zygomaticus minor, and levator labii superioris muscle sites [Figure 2e]. The sites for injection were determined to ensure accurate locations of the muscle. This was carried out by asking the patient to smile and simultaneously palpate the muscles on contraction.[13] A skin marker was used to mark the injection points to reduce the risk of asymmetry. Patients were recalled at 2, 4 weeks and then, once every month for 4 months to record the changes. Follow-up examinations should reveal reduced GD.

RESULTS

At the 1-week postoperative visit, the patients reported very slight discomfort, with minimal postoperative bruising and extraoral swelling. At the 2-week postoperative visit, the GD on smiling reduced to 2 mm [Figure 3]. The patients were followed up, and the results were found to be stable. The results of this clinical trial were analyzed both by clinical evaluation of gummy smile and with pre- and post-operative photographs. Facial photographs were recorded after 2-week posttreatment using the same equipment. The extreme effort was placed on obtaining standardized, unposed, spontaneous smiles. Remarkable improvement in the lip profile was seen and gummy smile reduced to a normal range.[2]

Figure 3: (a) Preoperative image of the dynamic smile, with moderate maxillary excess at maximal smile position, and an average of 7 mm excessive gingival display was recorded. (b) Postoperative smile after a lip repositioning procedure. (c) Three months after "Botox lip stabilization" treatment. (d) Preoperative at a maximal smile (profile view). (e) Six months after Botox lip stabilization at the maximal smile (profile view).

All patients began to show improvement approximately 15 days after the injections [Figure 3]. After 4 weeks, results were definitely observed with a decrease from 8 mm gingival exposure to 3 mm, which was considered as normal GD for an adult during smiling. The results were markedly noticeable at 2 weeks.[2] The photographs were loaded on to Adobe Photoshop for the purpose of measurements. Reference points (RP) were identified on the photographs and measurements were done. The following measurements (called A, B and C) were recorded as RP1-median point on the lower margin of the upper lip: (A: RP1 to superior border of upper lip vermilion; B: RP1 to inferior border of upper lip vermilion; and C: inferior border of upper lip vermilion border to junction of the gingiva with maxillary right central incisor crown along its own midline). At A–B, i.e., from the lowest margin of the upper lip to the gingival margin, there was no exposure of gingiva. At A–C, there was a 3 mm reduction in exposure from the lowest margin of the upper lip to the incisal edge [Table 1].

DISCUSSION

The cause for GSs can be of skeletal, dentoalveolar, or soft tissue in origin. The skeletal type is caused by excessive growth of the maxilla in the vertical direction and is commonly associated with the long face syndrome.[5] This condition is often corrected with orthognathic surgery. Dentoalveolar type could be treated by using microimplants. However, this form of treatment will require fixed mechanotherapy at the same time. For the patient whose gummy smile was mainly caused due to hyperactive lip muscles, treatment with Botox was considered as an alternative treatment approach.

The surgical correction of the short upper lip and gummy smile by gingivectomy was an alternative treatment, but they are not routinely used to treat hyperfunctional upper lip elevator muscle. Lefort I osteotomy with superior impaction is most commonly adopted to treat skeletal VME, and the most common limitation of this procedure is the congestion of nasal airway function.[16]

Surgical lip repositioning is an effective procedure to reduce GD by coronally positioning the upper lip. In the present case, surgical lip repositioning technique

Table 1: Measurements of gingival exposures pre- and post-lip repositioning adjunct to Botox

Case number	Measurements	Pretreatment (mm)	2 weeks (mm)	4 weeks (mm)	2 months (mm)	3 months (mm)	4 months (mm)
1	A-B	7	0	0	0	2	3
	A-C	17	12	12	12	14	15
2	A-B	6	0	0	0	0	2
	A-C	17	10	10	10	10	12
3	A-B	5	0	0	0	0	1
	A-C	16	9	9	9	9	10
4	A-B	7	0	0	0	0	2
	A-C	16	10	10	10	10	11
5	A-B	8	0	0	0	0	2
	A-C	18	11	11	11	11	12
6	A-B	5	0	0	0	0	2
	A-C	15	9	9	9	9	10
7	A-B	8	0	0	0	0	3
	A-C	18	11	11	11	11	13

was carried out successfully with tangible results as a dental procedure. Surgical lip repositioning holds promise as an alternative treatment modality in esthetic rehabilitation.[17] This surgical procedure was designed to be shorter, less aggressive, and was thought to have fewer postoperative complications compared to orthognathic surgery. The procedure was advocated again by Litton and Fournier for the correction of excessive GD in the presence of a short upper lip.[18] This was accomplished by detaching the muscles from the bony structures to coronally position the upper lip, and no complications were reported. In the cases under discussion, however, even correcting the vertical dimension to the desired extent would still leave a gummy smile due to the hypertonic lip.

Botulinum toxin type-A (Botox) aids to inhibit releasing acetylcholine by blocking the neuromuscular transmission and binding to acceptor sites on motor or sympathetic nerve terminals. This inhibition occurs as the neurotoxin cleaves SNAP-25, a protein integral to the successful docking and release of acetylcholine from vesicles in nerve endings. When injected intramuscularly at therapeutic doses, it produces partial chemical denervation of the muscle, resulting in localized reduction in muscle activity.[19,20] After injecting botulinum toxin in both sides, reduction in excessive GD was noticed with maximum effect following 2 weeks.

Because of a relapse in results, Miskinyar modified the original technique but did not report when or how much relapse had occurred.[21] Muscle resection was thought to eliminate muscle regeneration making the results more permanent. The author reported that one patient experienced postoperative paresthesia that lasted 2.5 months. In a significant number of patients, reduced gum exposure after several applications of botulinum toxin has been noticed even after the effect of the drug has declined. This fact can be explained by the decrease in muscle strength that is likely to occur after several consecutive applications of botulinum toxin for any particular indication making it last for a longer period of time. It is important that the physician identifies such cases, in subsequent applications, and reduces the dose to avoid an exaggerated effect.[4]

Proper diagnosis and an appropriate case selection are critical for the success of any surgical procedure. Contraindications to mucosal repositioning flap include the presence of a minimal zone of attached gingiva, which can create difficulties in flap design, stabilization, suturing, and severe VME. Degree II VME has gingival and mucosal display of 4–8 mm, whereas >8 mm of soft tissue display is seen in degree III VME. Both categories of VME require a multiple interdisciplinary approach, which may include orthognathic and periodontal surgery or restorative treatment. Previous reports have alluded that thin biotypes have a higher likelihood of relapse.[17,22] Our patient had a medium biotype, which may have contributed to the stability of results seen at 1 year.

We report on the use of a minimally invasive surgical procedure for the management of a gummy smile associated with moderate VME (degree II) and HUL. It is less invasive, has fewer postoperative complications, and provides a faster recovery compared to the orthognathic surgery. The mucosal repositioned flap aims to reduce GD by shortening the vestibular depth and Botox aims to the neuromuscular correction and

the slight relapse of the surgical procedure. We report on the short-term stability of our results at the 1-year follow-up, the results were extremely satisfactory for both the patient and the orthodontist. Even though Botox has a transitory effect, 6 months posttreatment the gummy smile was still seen to be within the normal range. Hence, depending on the cause and the needs of the patient, this treatment approach could well be used as an alternative procedure for faster and minimally invasive treatment of gummy smile.

CONCLUSION

Surgical lip repositioning is an innovative and effective way to improve the gummy smile of the patient. This technique is an easy and cost-effective technique to produce a satisfactory result for the patient. As opposed to various other surgical procedures, Botox has proven to be a minimally invasive, effective alternate for the correction of gummy smile caused by the upper lip elevator muscles. It, therefore, can be a useful adjunct to enhance the esthetics and improve patient satisfaction where surgery alone may prove inadequate in moderate VME.

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Conflicts of interest

The authors of this manuscript declare that they have no conflicts of interest, real or perceived, financial or non-financial in this article.

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