

A Standardized Technique for Gummy Smile Treatment Using Repeated Botulinum Toxins: A 1-year Follow-up Study

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Summary: The present study was performed to evaluate the effect of repeated botulinum toxin injections and their long-term effects, using a customized injection point and dosage technique in the treatment of excessive gingival display. Twenty women who had gummy smile due to hypermobility of the upper lip or gingival display, ranging from 4 to 6 mm, were included in the study. All patients were injected with Botox injections at different injection points according to the type of smile. Pre- and postoperative measurements were taken by measuring digitally the gingival display at smiling, using Adobe Photoshop software via standardized digital photographs. Patients were followed up at 14 days, 4 months, 8 months, and 12 months. Postoperative measurements showed marked improvement at 14-day follow-up, with a significant reduction in the amount of gingival display. Relapse, however, occurred at 4 months and later. For excessive gingival display, Botox is an effective treatment that lasts for 2–3 months, with almost complete relapse at 4 months. We concluded from the results of our study that, despite repeated Botox injections at two follow-up intervals (4 and 8 months), the theory that repeated Botox injections may offer a permanent effect is still questionable. (*Plast Reconstr Surg Glob Open* 2022;10:e4281; doi: [10.1097/GOX.0000000000004281](https://doi.org/10.1097/GOX.0000000000004281); Published online 25 April 2022.)

INTRODUCTION

The search for aesthetic excellence has become a major target in standard dental treatment and in oral and maxillofacial surgery.¹ The beauty of the smile depends on several factors, including the teeth size, form, and position. However, as much as we focus on the white showing “teeth,” we must also emphasize on the pink showing, which is the gingiva. Both the white and pink showing should be harmonious with each other and with the conformation of the lips. Excessive pink showing (in other terms, excessive gingival display) has always been one of the main complaints of gummy smile patients, especially female patients. Such a situation affects such patients in many ways, with social relationships being one of them.^{2,3}

Because gummy smile has drawn much attention in recent years, several treatment modalities have been advocated for such a condition, ranging from aggressive lines

of treatment, such as Le Fort I, which are associated with numerous complications and high morbidity rates, to the least invasive modality (which is more conservative, effective, and much safer), which involves the application of botulinum toxin.⁴⁻⁶

Botulinum toxin is synthesized by the gram-positive anaerobic bacterium *Clostridium botulinum*. It inhibits the release of acetylcholine at the neuromuscular junction, thus preventing muscle contraction. There are seven distinct serotypes of Botox (A, B, C1, D, E, F, and G).⁷ Subtype A is the most used clinically and the most potent as well. Botox has been used for therapeutic or cosmetic purposes. The therapeutic uses of Botox are treatment of bruxism, temporomandibular joint disorders, myofascial pain, sialorrhea, strabismus, and hyperhidrosis, and the cosmetic purposes of the same include treatment of forehead wrinkles, glabellar complex, crow’s feet, depressed mouth corners, and platysma bands.^{8,9}

Botulinum toxin has been introduced for treatment of the lower third of the face, and has been effective in

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treating cases with excessive gingival display, especially those with hypermobility of the upper lip.^{10–13}

Mazucco and Hexsel suggested in their study that although Botox is a temporary line of treatment, its repeated application may yield a permanent result, where they strongly defended their theory based on the concept that muscle relaxation for a longer duration may offer a permanent relaxation to that muscle.⁴ This has sparked an interest in conducting our study.

MATERIALS AND METHODS

Twenty women in the age range of 25–45 complaining of excessive gingival display were included in the study. The patients presented with good general health and were free from any periodontal diseases. Upon clinical examination, they showed gingival display more than 3 mm. All patients were carefully examined, and only patients with upper lip hypermobility and gingival display from 4 to 6 mm were enrolled in the study. Those patients who had vertical maxillary excess or active periodontal diseases, and those who were allergic to any of the constituents of Botox or were immunocompromised were excluded from the study. All patients in our study signed a written informed consent.

Upper lip hypermobility is diagnosed by measuring the length of the upper lip at rest and while smiling. The upper lip normally translates from rest to smiling at a range of 6–8 mm, but in hypermobility cases, the lip translates twice as far.¹³

Preoperative Measurements

The vertical distance from the free gingival margin of the central incisor to the lower border of the upper lip was measured digitally to assess gingival display while smiling.¹⁵

Digital Photography

All patients were photographed using a Nikon D700 DSLR digital camera, where standardization was achieved by fixing all variables every time during photography. These variables included the camera position in space, the relationship between camera and the patient, and the settings of the camera. Serial photographs of each patient were taken at every follow-up interval, with a ruler included in the photograph as a reference for standardization of the required measurements.

Each photograph was opened using Adobe photoshop CS6. The ruler tool was selected to measure the liner measurements. A centimeter on the ruler included in the photograph was measured by the ruler tool by pressing the left mouse button and shift key at the same time to ensure pure vertical direction of the ruler tool, and then dragging the mouse downward to the end point of the centimeter. This measure of the centimeter shows the magnification factor in the image. For example, if the centimeter in the photographs measured 2 centimeters on the ruler tool, the photograph is magnified two times. Any measurement in the photograph was then multiplied by the calculated factor, yielding the true measurement of the required parameters.

Takeaways

Question: Can repeated botulinum toxin injections through a customized injection point and a standardized dosage protocol provide a satisfactory result in gummy smile treatment?

Findings: The proposed technique provides a temporary satisfactory result for treatment of gummy smile patients.

Meaning: This technique provides a good aesthetic outcome; however, the longevity of the effect is questionable.

BOTULINUM TOXIN ADMINISTRATION

Vial Reconstitution

A 100 unit vial botulinum toxins was utilized, and the vial was reconstituted with a 2 ml saline free of preservative. The vial was used within the first 4 hours to ensure maximum effectiveness of the Botox. All patients were prepared for the injection by applying EMLA cream topically to provide numbness and relief of pain during the



Fig. 1. Mixed gummy smile case, where the black dot shows the yonsei point injection, and blue and yellow dots show the injection for zygomaticus major muscle.

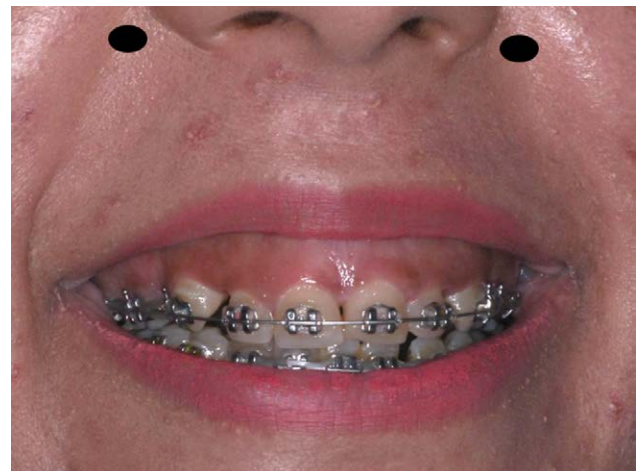


Fig. 2. Anterior gummy smile case, where the black dot shows the yonsei point injection.

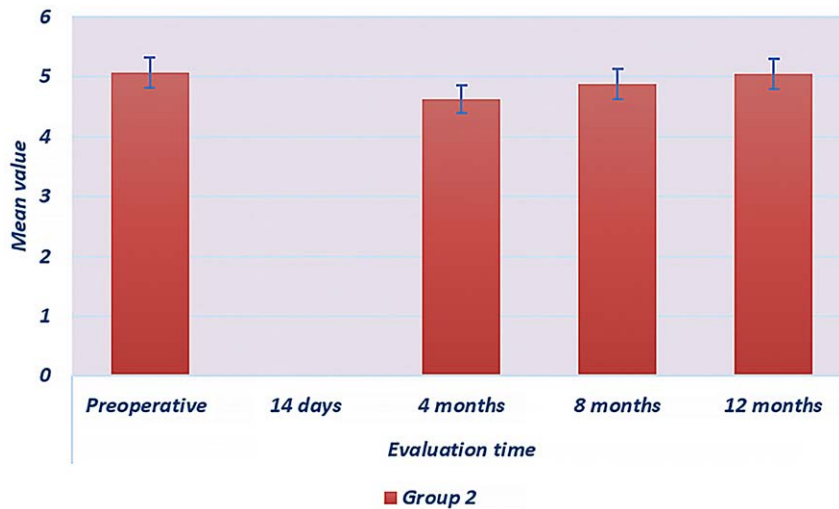


Fig. 3. Column chart showing gingival display at smiling, with mean values recorded as function of evaluation time.

injection. The point for neurotoxin injection was marked using an indelible pencil. Patients with mixed gummy smile were injected at the same point in addition to two other points corresponding to the insertion of the zygomaticus muscle, which are a point slightly above the deepest point of contraction at the nasolabial fold, and the other point was midway between the ala of the nose and the oral commissure at the level of the lower edge of the tragus point midway between the other two points (Fig. 1). On the other hand, patients with anterior gummy smile were injected at a point 1 cm lateral to the ala of the nose, where the neurotoxin units were injected using a BD microfine plus insulin syringe (Fig. 2). The dose of the toxin was calculated depending on the amount of the gingival display, where a 1 mm gingival display equals 1 unit of neurotoxin (eg, if a patient had a 4 mm gingival display, 4 units of neurotoxin were applied). This applies to the Yonsei point only; however, for the other two points (in case of mixed gummy smile), the patient received only half the dose (eg, Yonsei point 4 units, the middle point 2 units, the third point 2 units). At 4-month and 8-month follow-ups, all patients received additional Botox injections.

Postoperative Instructions

All patients were instructed not to engage in any physical activity and to avoid bending their head forward or

washing their face or putting on make up, especially during the first hour after the injection. No medications were prescribed.

Postoperative Assessment

There were 14-day, 4-month, 8-month, and 12-month follow-up visits, and in each visit, the amount of gingival display was assessed.

Statistical Analysis of the Data

Data were presented as mean, SD (SD) for values. Data were explored for normality by checking the data distribution and using Kolmogorov-Smirnov and Shapiro-Wilk tests. One-way and two-way ANOVA were used to study the effect of group and evaluation time on mean values. Tukey’s post-hoc test was used for pairwise comparisons when ANOVA test is significant. The significance level was set at $P = 0.05$, and the confidence interval was set at 95%. Statistical analysis was performed using Graph Pad InStat (Graph Pad, Inc.) software for windows (Fig. 3) (Table 1).

Postoperative Clinical Evaluation

There were no signs of edema, bruising, or pain reported by any of the patients.

RESULTS

Results showed that a marked reduction in the gingival display occurred at the 14th day of follow-up, followed by a marked increase in the amount of gingival display at 4 months of follow-up. The increase remained at 8 months and 12 months, where all patients returned to baseline. Moreover, we have to emphasize that complete relapse occurred at the 4-month follow-up. (See Video [online], which displays the case presentation showing the follow-up sessions.)

This can be explained numerically as follows: the mean value of the average gingival display was 5.07 mm,

Table 1. Mean Values and SDs of Gingival Display at Smiling (mm) Recorded as a Function of Evaluation Time

Variables	Statistics	
		Study Group
Evaluation time	Preoperative	5.07 ± 0.35
	14 days	0.00 ± 0.00
	4 months	4.62 ± 0.98
	8 months	4.88 ± 0.38
	12 months	5.04 ± 0.37
Statistics	Pvalue*	<0.0001

*Significant: $P < 0.05$; nonsignificant: $P > 0.05$.

and at 14 days follow-up, it became 0.00 mm, which was a significant change, whereas it was nonsignificant after 4, 8, and 12 months because at the 4-month follow-up, the mean value increased to reach 4.62 mm, and a slight increase occurred at 8 months to reach 4.88 mm. At 12 months, it became 5.04, which is somehow like baseline, putting into consideration that there was no clinical change in gingival display from baseline or improvement at 4-month follow-up and thereafter, despite the numerical changes.

DISCUSSION

The gummy smile is conceptualized by the exposure of more than 3 mm of gingival display during smiling, where women are the most commonly affected gender. This can be explained by the fact that men tend to have a longer lip length.

Several etiological factors are associated with a gummy smile such as vertical maxillary excess, dento-alveolar extrusion, short upper lip, upper lip hypermobility, and altered passive eruption. All these factors can occur separately or together and determine the type of treatment to be used.

Botulinum toxin is highly indicated in gummy smile cases with upper lip hypermobility. It is the first choice for treatment of such conditions due to its safety and fast effect, in addition to being a less-invasive approach, when compared with other surgical interventions such as muscle myotomy.

BTX-A therapy has a significant effect on the reduction of the gingival display after application, but its results fade gradually with time. Many authors suggest that repeated Botox injections may offer a permanent result due to long-term muscle relaxation, where the muscles get adapted to this state of being relaxed. However, none of the studies have put this theory into scientific practice to achieve the level of scientific evidence.

Several studies showed results like those of our study regarding the aspect of evaluating Botox injection in treatment of gummy smile,^{1,3,10,16,17} but others showed results that disagreed with our results.¹⁸ In all the mentioned studies, none of them reported the effect of repeated Botox applications through follow-up intervals, as they all gave only one dose of Botox.

The effect of repeated neurotoxin injections was evaluated in this study using a customized injection point and dosage technique over two follow-up injections at 4- and 12-month intervals. Results did not show any improvement, nor there was any long-term effect through a 1-year follow-up, suggesting that this theory is not applicable up to 1 year.

CONCLUSIONS

The application of botulinum toxin is a noninvasive technique and is an alternative to other surgical procedures. It produces pleasing results when applied properly

for up to 14 days and its effect lasts from 2 to 3 months. The technique is a useful adjunct for smile improvement and produces good results for patients who have gummy smiles.

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