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Correction of Gummy Smile by Surgical Lip Repositioning with Myotomy versus Botox Injection Technique

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ABSTRACT

Purpose: This study aimed to compare surgical lip repositioning with myotomy and Botox injection in treatment of patients with excessive gingival display. **Subjects and Methods**: A sample of 10 female patients with age range (19-42) year-old with excessive gingival display greater than 2 mm were randomly allocated into 2 groups, Group I: patients were treated with surgical lip repositioning with myotomy. Group II: patients were treated with Botox injection. Treatment changes were evaluated for each group and compared between groups. Data were collected and analyzed using paired t-test for each group and student t-test to compare between groups at baseline, 3, 6 and 9 months. **Results**: Results of intragroup comparisons of gingival display revealed a significant difference between values at 3, 6 and 9 month intervals ($p<0.001$). When compared at baseline, 6 and 9 months time points, the results at 3 months were better. Both groups showed deterioration of the outcomes obtained over time. Botox group values in gingival display had returned to base line at 9 months in contrast to surgical repositioning suggesting that the surgical lip repositioning combined with myotomy resulted in a more stable outcome. The amount of post-operative pain measured in Botox injection group (0.60±0.89) was significantly lower than that of surgical lip repositioning group (5.40±1.14) ($p<0.001$). **Conclusion:** surgical lip repositioning with myotomy and Botox injection give satisfactory results in gummy smile patients in terms of reducing gingival display. However, surgical lip repositioning has more stable results for more than 9 months.

KEYWORDS

Gummy smile, Lip repositioning, Botox.

- Paper extracted from Doctor thesis titled "Laser Assisted Correction of Gummy Smile by Gingivectomy and Lip Repositioning Versus Botox Injection Technique".

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INTRODUCTION

Excessive gingival display during smiling (EGD), often known as gummy smile, occurs when the gingiva is visible for more than 2 mm when smiling. Excessive gingival display resulted in an unaesthetic smile that gained an increased attention in modern dentistry in recent years. There are multiple etiologic factors including lip length and activity, vertical maxillary excess and altered passive eruption. Accurate diagnosis of the etiology is the key to establish the best treatment modality to enhance the aesthetics [1].

Excessive gingival display can be attributed to altered passive eruption which resulted in short clinical crowns due to excessive gingival overlap, whereas the distance between the bone crest and the cemento-enamel junction is normal. The ideal treatment in this situation is gingivectomy. Usually there is interplay between many factors in the etiology of gummy smile so, the management should be an interdisciplinary approach [2].

Excessive gingival display can be a result of vertical maxillary excess (VME), in which this bony excess can be treated with LeFort I maxillary osteotomies. Orthognathic surgery is associated with high morbidity and must be performed in a hospital under general anesthesia. When the etiology is vertical maxillary excess or a hypermobile lip, lip repositioning might be employed to correct excessive gingival display. The operation can be performed under local anesthetic and is regarded a safe and effective method of eliminating excessive gingival display with high satisfaction reported up to 2 years after treatment [3].

Lip repositioning with or without myotomy was investigated in various studies. There was a conclusion that lip repositioning associated with myotomy resulted in a greater reduction in gingival display and a more a long-term stable result with a high level of patient satisfaction. In both the classic and myotomy groups, an increase in lip length and limited lip mobility was also found [4].

In cases of accurate diagnosis, lip repositioning can be a beneficial strategy for treatment of EGD; nevertheless, in cases of sever maxillary excess (EGD >8 mm), unfavorable results can occur. The myotomy/muscle containment procedure can lead to better outcomes and more consistent results compared to the conventional approach [4,5].

The lip-repositioning technique is promising with less aggressiveness and few postoperative complications. Researchers have employed a variety of strategies to repair gingival smiles; nevertheless, it is critical to make an accurate diagnosis to ensure that the most appropriate approach is employed for each etiology, or that two or more treatment modalities are employed when necessary to achieve the goal. Periodontal aesthetic surgery, which involves crown lengthening and lip repositioning, is an interesting, noninvasive alternative for the treatment of excessive gingival display and results in a harmony of the natural smile [6].

Botulinum toxin type 1, also known as Botox (BTX), is a toxin used in the treatment of gummy smile in cases of muscular hyperfunction of upper lip. Because many patients seeking an attractive smile with minimally invasive procedure, Botox gained a great attention in recent years as an effective method in the treatment of individuals who had a gummy smile. Botox temporarily improve gummy smile with high degree of patient satisfaction and improve their quality of life [7].

The Digital Smile Design (DSD) protocol using PowerPoint software was developed by Coachman to allow digital image editing, including the insertion of lines, forms, and measurements to clinical and laboratory images, also, a short video is used to capture the patient smile. The photographs are inserted into the slide presentation to analyze the patient smile and achieve the desired crown length. The DSD allow for better esthetic diagnosis and communication with the patient. The smile design also was used to fabricate a surgical stent through

conventional wax-up, this surgical stent served as an important reference for gingivectomy procedure[8].

Since esthetic dentistry has become a major interest for many patients, the goal of this randomized clinical trial was to evaluate the surgical lip repositioning procedure with muscle severance to the technique of Botox injection in correction of gummy smile.

SUBJECT AND METHODS

Ten Gummy smile female patients with excess gingival display 3-8 mm and hypermobile upper lip were selected from the clinic of Oral medicine, Periodontology, Diagnosis and Radiology, Faculty of Dental Medicine for Girls, Al-Azhar University, Cairo, Egypt [9]. All the procedures were explained for each patient and informed consent was signed. Ethics Committee Approval Code (REC-ME-19-01) was obtained from Research Ethics Committee of Faculty of Dental Medicine for Girls Al-Azhar University.

Inclusion criteria: Subjects were adult females with age range 19 to 40 years free from any systemic diseases, having hypermobile lip with excessive gingival display 3-8 mm on smiling and with good oral hygiene [9].

Study grouping: Subjects were randomly assigned into two groups. Randomization was performed by the research team through assigning a code number to each patient and randomly included to one of the two groups. The study participants were blinded to the group they were assigned to and the operator was blinded until the beginning of the surgery. **Group (1)**: Surgical lip repositioning was performed and **Group (2):** Botox injection was done.

Preoperative procedures: The upper lip length was measured at rest and at maximum smile using a ruler from the subnasal to the lower border of the vermilion at the region of the upper left central incisor. A periodontal probe and a digital caliber were used to measure gingival display from the lower border of the vermilion of the upper lip to the gingival zenith of the upper left central incisor at maximum smile. A periodontal probe was used for probing of the gingival sulcus, when the gingiva covered a portion of the clinical crown, gingivectomy procedure was performed first guided by a surgical stent. The surgical stent was performed according to the digital smile design (DSD) workflow and the amount of gingival display was measured after the gingivectomy procedure was done.

Surgical Protocol: In Group (1), Lip repositioning was performed in the first group according the surgical procedure performed according to the standard surgical protocol [10]. Local infiltration was used to establish anesthesia, and the surgical region was drawn with an indelible pencil. The first incision was performed following the mucogingival junction, which extend from the right first molar to the left first molar. The position of second horizontal incision was made parallel in the labial mucosa at a distance double the measured preoperative gingival display from the mucogingival junction. The two vertical incisions were then connected at each end by making an elliptical pattern, a partial-thickness flap was excised with a scalpel, muscle severance was made by blunt dissection of the muscle attachment above the level of the coronal incision, and the muscle fibers were pushed upwards with a periosteal elevator figure (1). Then, continuous interlocking sutures were made to fill the space and prevent the muscle fibers from reattachment at the same site of insertion by 5-0 polyglycolic restorable suture. Complete closure was achieved by approximating the two incision lines using 4-0 polyglycolic restorable sutures.

Botox Injection Protocol: In Group (2), Botulinum toxin (Allergan, Irvine, CA) was used. Injections was made intramuscularly at both sides, each side 2.5 unites. The elevator muscles of the upper lip, (levator labii superioris [LLS], levator labii superioris alaeque nasi [LLSAN], and zygomaticus minor [ZMi]) converge into the lateral

area of the ala of the nose. The center of the triangle that was formed by these muscles was suggested to be a suitable point for injection and termed the ''Yonsei point''. The mean horizontal distance from the ala was about 1 mm and the mean vertical distance from the lip line (the line that connected both commissures) was 3 mm.

Figure (1) Surgical lip repositioning &gingivectomy

Postoperative procedures: For subjects who had undergone lip repositioning procedure, antibiotic 1 gram twice per day for one week, analgesic twice per day for one week, anti-inflammatory tablets three times per day for one week and antiseptic mouthwash was given twice per day for two weeks.

Postoperative instructions: For the first 24 hours, apply ice packs to the upper lip area, limit lip motions specially when smiling for the first week, and avoid any trauma.

Follow up: Patients were recalled 1 week after the procedures to assess healing and to report any postoperative complications as postoperative pain. The patient's discomfort or pain was rated using a numerical pain scale with 0 (no pain), 5 (moderate discomfort), and 10 (extreme pain). Patients were contacted for follow-up at 3, 6, and 9 months. Excess gingival show was measured in millimeters with the patient in a maximum smile at 3, 6, and 9 months. Photographs were taken, as well as clinical assessments and questionnaires.

Statistical Analysis

The mean and standard deviation (SD) values were used to represent numerical data. Shapiro-Wilk's test was used to test for normality. Independent t-test was used to compare parametric data while, Mann-Whitney U test was used to compare ordinal data. In all tests, the significance level was set to $p<0.05$ IBM® SPSS® Statistics Version 26 for Windows was used to conduct the statistical analysis.

RESULTS

Results of intergroup comparisons presented in table (1) showed that no significant difference was observed between both groups regarding lip length at rest or maximal smile and the amount of gingival display in different follow-up intervals ($p>0.05$). However, the amount of post-operative pain measured in Botox injection group (0.60 ± 0.89) was significantly lower than that of surgical lip repositioning group (5.40 ± 1.14) ($p<0.001$). The intragroup comparisons revealed a significant difference in values of gingival display at different intervals in surgical lip repositioning group ($p<0.001$). Post hoc pairwise comparisons for surgical lip repositioning group showed that values measured at baseline were significantly higher than values measured at 3,6 and 9 months and the values measured at 3 months were significantly lower than other values ($p<0.001$). While for Botox injection group they showed that values measured at 3 months were significantly lower than values found at 6 and 9 months intervals ($p<0.001$). Mean values of gingival display in both groups were presented in table (1).

When compared to the baseline, the reduction in measured EGD was statistically significant at 3, 6, and 9 months; when comparing the three time periods together in each group, there was a statistical significance difference. When compared to the 6 and 9 month time points, the results at 3 months were better. Statistical analysis revealed a decrease in the data obtained over time.

Table (1): *Intergroup comparison*

Parameter	Time	(Mean±SD)		p-value
		Surgical lip repositioning	Botox injection	
Lip length at rest (mm)	Baseline	23.00±1.58	23.00±1.87	1.000
Lip length at maximal smile (mm)	Baseline	14.80±1.10	14.40±1.52	0.645
Gingival display (mm)	Baseline	5.20±0.84	4.60±1.52	0.461
	3 months	1.80±1.10	1.80±2.05	1.000
	6 months	2.80±1.10	3.60±1.67	0.397
	9 months	3.20±1.10	4.60±1.52	0.133
Post-operative pain	1 week	5.40±1.14	0.60±0.89	<0.001*

** significant difference (p<0.05)*

By comparing the results obtained at 3, 6, and 9 months, the stability of each group's outcomes was determined. The results obtained by both groups has decreased at each successive time point. When comparing the results obtained at 3 months to those obtained at 9 months, the change in each group was extremely statistically significant. The surgical lip repositioning group rate of decline was less than that when compared to the Botox group as the Botox group values had returned to base line values at 9 months suggesting that the surgical lip repositioning with myotomy achieved a more a stable result for longer time period.

DISCUSSION

Excessive gingival display, commonly known as "gummy smile", results in an unaesthetic smile that is undesirable by many people and have a negative impact on the quality of life causing psychological and social discomfort, on the other side attractive smile can improve the quality of life. Excessive gingival display (EGD) is diagnosed when more than 2 mm of the gingiva is exposed on maximal natural smile. In aesthetic dentistry, many treatment approaches have been used for the management of a gummy smile, as lip repositioning, Botox injection, orthognathic surgery, gingivectomy as well as aesthetic crown lengthening were used for multiple etiologic factors [11].

Careful patient assessment, preoperative recording and analysis of data represent a key stone for accurate diagnosis and treatment of EGD. Excessive gingival display can be attributed to both altered passive eruption and hypermobile upper lip. A combination of lip–repositioning technique and laser-assisted crown lengthening were used in management of vertical maxillary excess cases resulted in esthetically enhanced smiles [12].

Muscle severance was developed in response to complaints of relapse or poor results with the original method. Gummy smiles are caused by hyperactivity of the elevator muscles of the upper lip in about 20% of patients, so a myotomy of the upper lip elevator muscles (zygomaticus minor, levatoranguli, orbicularis oris, and levator labii superioris) is a conservative surgery for limiting the muscle pull that resulted in reduction of the upper vestibular depth of with considerable results and less postoperative complications [13].

Lip repositioning with or without myotomy was investigated and the authors concluded that lip repositioning with myotomy can produce greater reduction in gingival display and the results were more stable over time with greater satisfaction of the patients. They also recorded increase in lip length and limitation in lip movement in both classic and myotomy groups [4].

The adjunctive use of Botox to surgical lip repositioning had been investigated in series of cases. Their results showed that Botox could be used as a useful adjunct to surgical lip repositioning in treatment of a gummy smile associated with moderate vertical maxillary excess and hypermobile upper lip for enhancement of aesthetics and improvement of patient satisfaction as surgical intervention alone may provide inadequate results in moderate VME with the advantage of faster recovery compared to the orthognathic surgery [14].

In the present study BTX injection was made to lip elevator muscles (LLSAN, LLS and ZM). Orbicularis Oris (OO) muscle could be the site of BTX injection in the correction of gummy smile and give good results regarding patient satisfaction. Although, it requires a low toxin dose and the result appear more early after injection but, many additional basic face expressions and actions are controlled by the OO muscle (e.g: swallowing, sucking, or kissing and other activities done by subjects during their daily lives) as a result, any discomfort or difficulties caused by the BTX injection such as future muscular weakening or paralysis of the muscle should be taken in mind when choosing the OO site as the location of injection [15].

Results of the present study showed that, at 3, 6, and 9 months postoperatively, there was significant decrease in gingival display. The outcomes remained stable for up to 6 months after surgery in both groups and for 9 months in surgical lip repositioning group. Complete relapse had occurred in Botox patients, while partial relapse was noticed in surgical lip repositioning patients without any complete relapse in any of the patients. These findings matched those of earlier research on Botox injections and lip repositioning surgery [4] [14].

In the present study, Wong-Baker FACES Pain Rating Scale (WBS)was used for recording the pain rate. The questionnaire of Numerical Rating Scale (NRS) rated the patient pain on a scale from 0 to 10, with 0 indicated no pain and 10 reflected the most severe pain. The degree of post-operative pain experienced in Botox injection patients was greatly lower than that in surgical lip repositioning patients[16,17].

CONCLUSION

The surgical lip repositioning procedure with myotomy of elevator lip muscles and Botox injection provided satisfactory results in treatment of gummy smile patients in terms of reducing gingival display. However, lip repositioning had more stable results for more than 9 months.

RECOMMENDATIONS

Further studies are required to evaluate the stability of results for longer periods of follow-up after lip repositioning procedures. Greater sample size is required also for better assessment of results.

DECLARATION STATEMENT

There is no conflict of interest.

There was no fund received in this study.

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