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Correction of excessive gingival display: Lip repositioning with/without myotomy

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Abstract
Background: A conservative and reversible surgical procedure for treating excessive gingival exposure is lip repositioning (LR) (EGD).
Purpose: The research compares two LR methodologies. 1) Comparing the amount of gingival display reduction (GDR) following LR without (Group 1) versus with (Group 2) myotomy, stratified according to the cause of the EGD, is one of the aims. Comparing the gingival display rebound (GDRB), patient compliance, and morbidity are the other two comparisons.
Methods: To ascertain whether the patient's EGD was caused by a single or multiple factors, diagnostic data were gathered prior to surgery. Digital callipers were used to measure the gingival display (GD), lip length (LL), and vermillion border length (VB) before and after surgery (up to six months later). The LL shift, VB change, GDRB, and GDR were the primary efficacy parameters. Using a grin questionnaire and a visual analogue pain scale, secondary outcomes were evaluated (VAS). The collected data were analysed using xyz for scaled parameters and ANOVA for metric parameters in SPSS (version 25.0). The p-value cutoff for statistical significance was established at 0.05.
Results: Integrating the results of the two operations revealed an overall average GDR of 2.63mm (SD = 0.291 mm), an overall average decline in LL of 1.58mm (SD 0.592mm), and an overall average rise in VB width of 1.1mm (SD = 0.211mm). The two surgical methods had statistically significant variations in GDR and GDRB, with the myotomy group having a higher average GDR and a lower GDRB. Between the two surgical methods, there were no statistically significant differences in either patient satisfaction or patient morbidity.
Conclusion: Therapeutic interventions for patients with EGD include LR with and without myotomy. According to our research, executing a myotomy boosts total GDR, prevents GDRB, and enhances outcomes in several causes.

Keywords: excessive, myotomy, EGD

Introduction

The need for aesthetics has greatly expanded in recent years due to rising patient awareness and the quest for the perfect smile. The process of achieving the ideal smile is challenging and necessitates careful treatment planning and a multidisciplinary approach (Donitza, 2008) [6]. The term "gummy smile" or "excess gingival display" (EGD) refers to a smile that exposes more than 1.5 to 2 mm of gingiva (Robbins, 1999) [18]. Broadly speaking, this excessive exhibition leads to an ugly smile. Gummy grins are thought to affect 7% of males and 14% of women (Tjan, 1984).

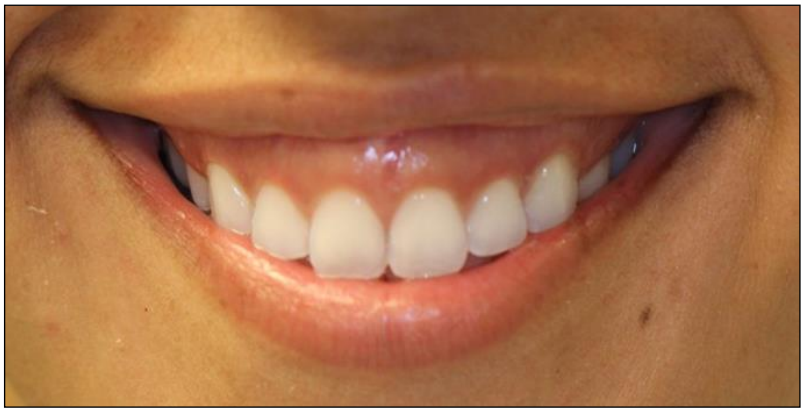

Fig 1: Excessive gingival display

Any one of a number of causative variables could be to blame for this illness, or their combined effects could (Robbins, 1999) [18]. Dentoalveolar disparities and issues affecting facial proportion are often factors related to teeth (non- dentoalveolar discrepancies). Issues that are associated to teeth can be quickly and effectively assessed and treated. Those pertaining to face proportions, however, are not. The classification and appropriate treatment for etiologic variables connected to facial proportions are poorly covered in the dentistry literature. They will be thoroughly addressed in order to comprehend the contrasts between these two sets of etiologic variables.

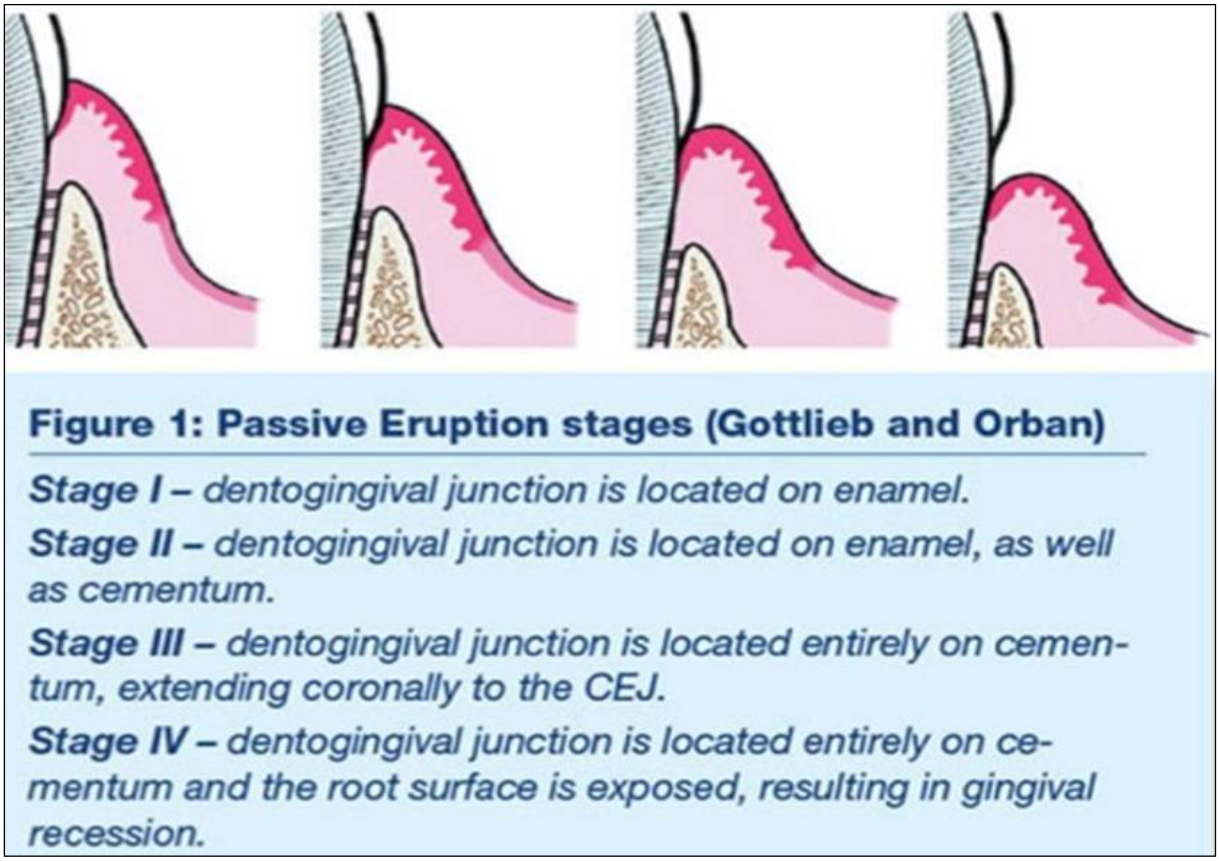

Fig 2: Four steps of passive eruption (Gottlieb, 1933) [8]

Dentoalveolar extrusion and altered passive eruption are dental conditions that cause EGD (APE). Anterior teeth with curved or concave gingival lines in reference to the horizon are signs of dentoalveolar extrusion (Robbins, 1999) [18]. Any tooth in the mouth may be affected by this problem, which may be brought on by incisal wear, lack of opposing teeth, anterior teeth that are not properly in touch with their opposing teeth, or a developmental anomaly. Dentoalveolar extrusion can be treated with functional crown lengthening surgery, orthodontic intrusion using temporary anchorage devices, or surgically aided orthodontics, after which the teeth are replaced at the proper position for the incisal edge. First passive eruption must be defined in order to completely explain the concept of APE.

The biological process of a maturing tooth's regular eruption along the dental lamina was initially termed as passive eruption (Gottlieb, 1933) [8]. Passive eruption involves 4 phases, according to Gottlieb and Orban (See Figure 2). Until it stabilizes at the cemento-enamel junction, passive eruption causes an apical shift in the total dento-gingival junction (CEJ). It around age of 15, this method generally comes to a stop (Morrow L, 2000) [13].

APE, on the other hand, develops when the marginal gingiva and dento-gingival junction are not correctly positioned incisally and coronal to the CEJ (Goldman, 1968). Using the width of keratinized tissue (Type) and the measurement from the CEJ to the alveolar crest (A or B), Coslet developed an APE classification system (Coslet, 1977) [4]. A large band of keratinized tissue is seen in Type 1 while a small band (defined as less than 2mm of keratinized tissue) is present in Type 2. A "B" subclass implies 0 mm between the CEJ and alveolar crest, whereas a "A" subtype suggests a normal distance from the CEJ to the alveolar crest (1.5mm). Short clinical crowns, undetectable CEJs, and EGD are all symptoms of this disease.

Related to dentoalveolar extrusion, this ailment has a well-established treatment procedure that includes gingivectomy (Type 1A or Type 1A or B; Type 2A), an apically positioned flap (Type 1A or B; Type 2A), or cosmetic crown lengthening surgery (Type 1A, B; Type 2 A, B). Therefore, it is evident that the tooth-related characteristics support a clear diagnostic, categorization scheme, and set of succinct therapeutic treatment recommendations. The purpose of the research is to contrast two surgical methods for lip repositioning in EGD patients.

Primary Objectives

1) Comparing the amount of gingival display reduction (GDR) following LR without (Group 1) versus with (Group 2) myotomy, stratified according to the cause of the EGD, is one of the aims. 2) Examining the gingival display rebound (GDRB) between the two procedures from three to six months after surgery 3) To assess the two approaches' effects on subject satisfaction and morbidity (pain and edoema).

Primary Hypothesis

In comparison to patients who only have lip repositioning, individuals who also undergo myotomy will experience a statistically superior outcome (an increase in GDR and a decrease in GDRB).

Secondary Objective

To evaluate the use of LR with myotomy with LR without myotomy in terms of subject satisfaction and subject morbidity (pain and edoema). A statistically significant difference in satisfaction (smile score) and morbidity will not be reported by subjects who get LR with and without myotomy, according to the secondary hypothesis (pain and swelling).

Material and Methods

20 subjects were recruited according to the following inclusion and exclusion
Criteria for the study:
Inclusion Criteria:
Exclusion Criteria:

1. Subjects who, upon full smile, have more than 2mm gingival display apical to theCEJ of #9. 2.Subjects who are 18 yearsold or older 3.Subjects with natural dentitionon the upper anterior teeth 4.Subjects with good oral hygiene 5. Subjects who can speak English	1.Subjects who smoke morethan 10 cigarettes a day by report. 2.Subjects withuncontrolled diabetes (defined as a HbA1c > 6.5%). Level willbe recorded by report or confirmed by medicalconsult with physician if patient is not aware of their current HbA1c level. 3.Subjects with less than 2mm of attached gingiva measured intraorally with UNC-15periodontal probe. 4.Subjects who have been diagnosed with periodontitisand/or gingival recession byreport. 5. Subjects who arepregnant by report. 6. Subjects who are on blood thinners by report or by consult with physician ifpatient is unsure of medications.

Subjects were randomly allocated to sample 1 (no myotomy) or group 2 (myotomy) by an excel randomizer following research acceptance and patient approval. The person doing the intra-oral measurements and the surgeon were not given this data (until the day of surgery). Additionally, baseline diagnostic data was gathered. This initial diagnostic data comprised:

1. Standardized frontal and profile clinical photos for the best smile and calm. The Robbins approach, in which patients are instructed to relax their facial muscles and utter "M" or "Emma," was used to recreate the repose smile. letting their lips naturally separate following vocalisation. Patients were instructed to grin completely in an effort to mimic the "Duchenne" smile, which fully contracts all of the smiling muscles (Duchenne, 1862). In his seminal study, Duchenne used electrodes to directly activate the muscles of the grin; this was not done in our investigation. Rather, we applied the Robbins method, which is discussed in more detail below.
   *The identical lens setup and distance from the subject were used to standardise the photographs.
2. Using digital videography to capture a spontaneous smile in motion (only for research purposes)
3. The gingival presentation assessed using a digital calliper is the gingival display measured from the CEJ of tooth #9 to the most superior point of gingival display when smiling fully.
   The method described by Robbins, in which the patient's zygomatic arch is tapped while the subject says the letter "E," was used to standardise this measurement.
4. Measuring of the LL using a digital calliper (in repose, from the tip of the nose to the superior border of the maxillary lip at its highest point, apical to #9)
   VB width measuring with a digital calliper (measured in repose from the superior border of the dry vermillion border to the inferior dry vermillion border).
5. Detectability of CEJ (by periodontal charting or with a dental explorer)

6. Lip mobility (measured from repose to full smile)
1. To summarize, the height of the central incisor is taken, the patient is placed in repose, and the amount of the tooth that can be seen in repose (measured from the incisal edge) is calculated. A negative value is shown if the lip completely covers the incisal edge. The amount of gingiva/tooth revealed is then assessed with the patient smiling fully. In order to establish the patient's overall lip mobility, these two measurements are then merged (Robbins, 1999) [18].
2. 1) Female patients had a urine pregnancy test. * This measurement was made before the radiographic procedure, which involved a lateral cephalometric x-ray, unless the subject reported being surgically sterile or being at least 60 years old and post-menopausal for at least two years.
3. Lateral Cephalometric X-Ray
4. Smile Questionnaire.

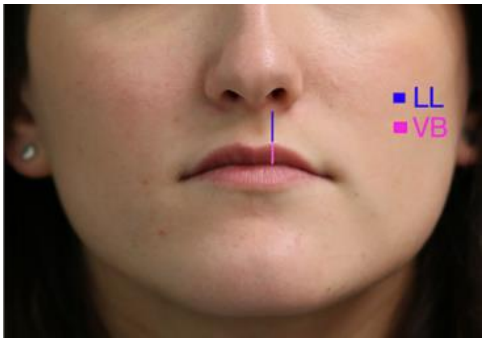

Fig 3: LL and VB measurements

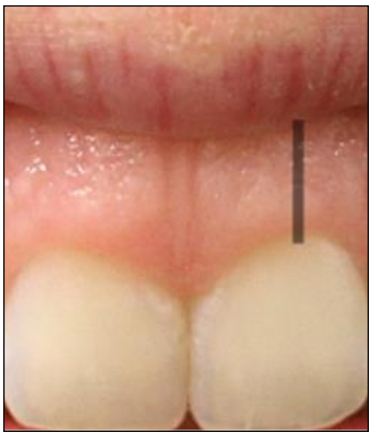

Fig 4: EGD measurement at full smile

The Initial Smile Questionnaire given to the patients can be seen in Figure 4

Questionnaire (Pre-Treatment)

1. Do you feel that your teeth are too long or too short?	YES	NO
2. Do your gums show too much when you smile?	YES	NO
3. Are you self-conscious when you smile?	YES	NO
4. Do you hide your smile when you have your picture taken?	YES	NO
5. Would you like to change your smile?	YES	NO
6. Has anyone ever suggested that you have your smile fixed?	YES	NO
7. Rate your smile on a scale from 1-10		

1 2 3 4 5 6 7 8 9 10

Fig 5: Questionnaire (Pre-Treatment)

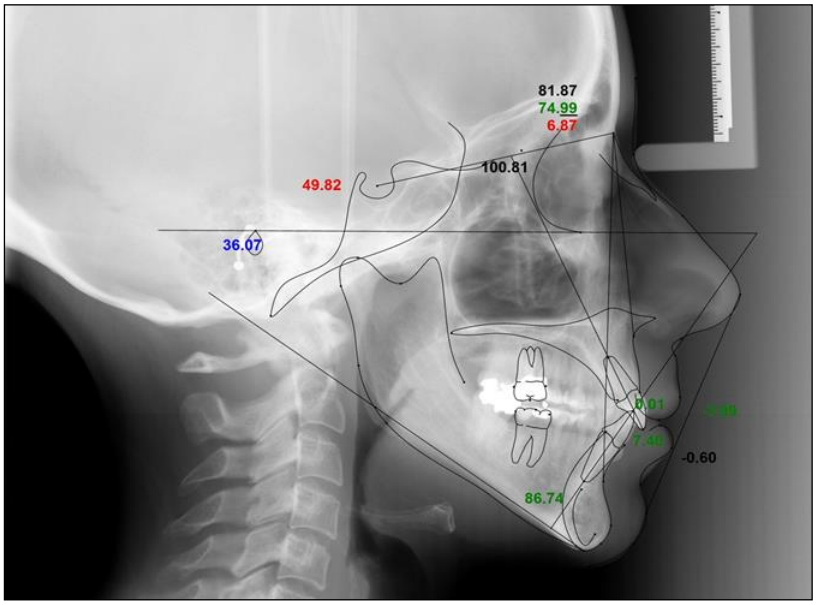

Fig 6: Sample lateral cephalometric tracing

Surgical Procedure

All LR surgeries were completed by a single surgeon. For a basic schematic of the surgery please see Figure 9 and 10. For full color photos depicting the different groups please see Figures 13 and 14.

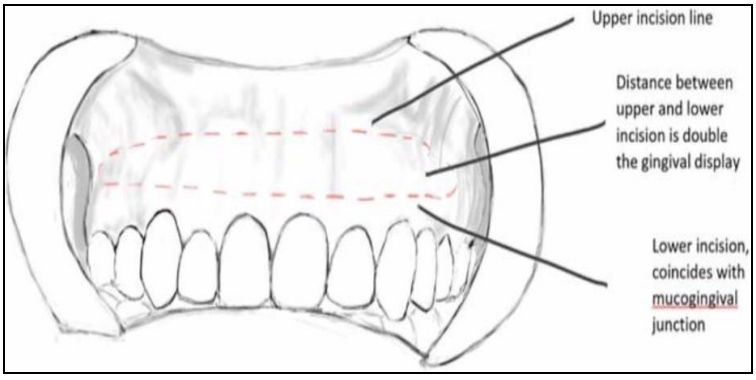

Fig 7: Group 1 (no myotomy) (Tawfik JERD 2018)

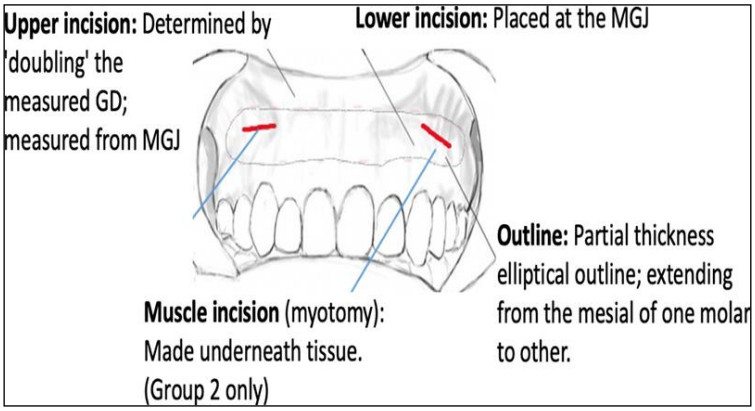

Fig 8: Group 2 (myotomy)

The conventional dental infiltration approach (4% septocaine with 1:200,000 epinephrine) was used to anaesthetize the patients intra - operative.

The position and distance of the incision lines were determined by measuring the amount of extra gingival show. Using a surgical pen, the incision lines' locations were indicated. The superior incision was established by doubling the patient's measured gingival display at full smile, and the inferior incision was situated at the mucogingival line/junction.

A number 15c blade was used to cut the outline in one half thickness elliptical incision. A bed of exposed connective tissue was left in its place when the strip of defined mucosa was removed. It was carefully avoided

that any little salivary glands in the submucosa would be harmed. The surgical assistance now advised the operator whether or not there would be a muscle severance. Muscle severance was performed by making a single incision along the muscles exposed in the area for the group getting myotomy.

The periosteum was kept intact while the muscles were then forced by blunt dissection. Following myotomy, 5-0 Vicryl suspension sutures were stitched from the superior periosteum to the inferior incision margin. Suspension sutures left a void that prohibited muscles from immediately reattaching. To achieve symmetry and precise midline placement, the area of the frenectomy was first approximated before final suturing. Bilateral closure was then accomplished using resorbable 5-0 Vicryl sutures. For closure, interrupted or continuous sutures were used to join the connected gingiva to the superior periosteum. All subjects received the following postoperative instructions and prescriptions:

1. Medications

a. Analgesic TID for 1 week: Ibuprofen 800mg, TID or Acetaminophen 1000mg TID

b. Antiseptic mouthwash (0.12% chlorhexidine gluconate mouthwash) 10 mL for 1 min BID for 2 weeks (no "swishing" only gentle agitation by head movement).

2. Instructions

a. Applying ice packs for the first 24 hours

b. Avoiding any mechanical trauma

c. Minimizing lip movements when smiling or talking for one week

The patients was required to complete a VAS for post-operative pain and swelling at the first follow-up appointment, which was scheduled for 7–10 days after the initial consultation (See Figure 11). Within 14–21 days, the second follow-up visit was scheduled for suture removal. After three and six months, respectively, the third and fourth follow-up appointments were made. At both the 3 and 6 month follow-up visits, the standardised static and dynamic pictures and digital calliper measures were repeated. At the six-month checkup, a post-treatment smile questionnaire was taken.

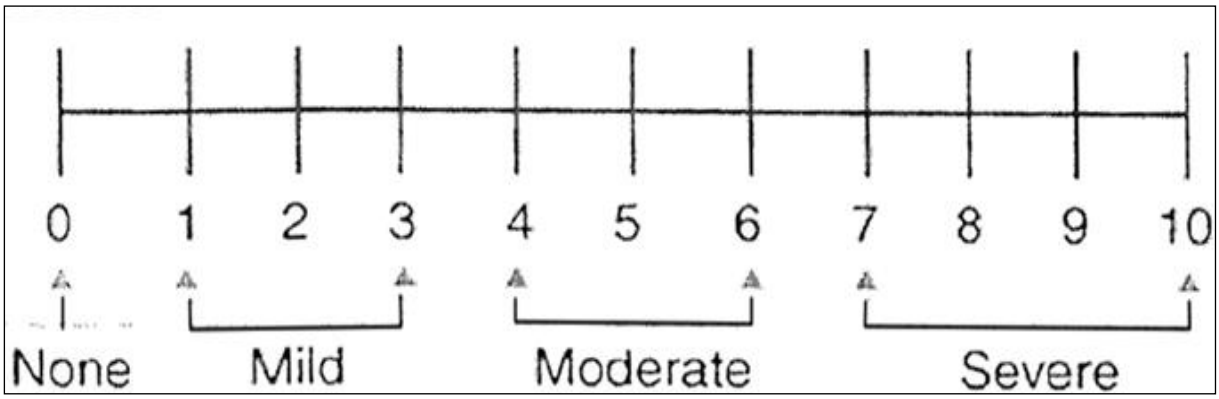

Fig 9: Pain scale (VAS)

Patient Flow & Measurements		Baseline	Surgery	7-10 days post op	14-21 days post op	3 months post op	6 months post op
EGD Etiology Determination	CEJ detectability	x					
	Lateral Cephalometric X-Ray	x					
	Lip Mobility	x					
	Standardized Static and Dynamic Photos	x		x		x	x
Digital Caliper Measurements	Gingival Display	x				x	x
	Lip Length	x				x	x
	Vermillion Border	x				x	x
Patient Reported Outcomes	Pain Score (VAS)			x			
	Smile Questionnaire	x					x
	Suture Removal				x		

Fig 10: Patient flow

Surgical Photos

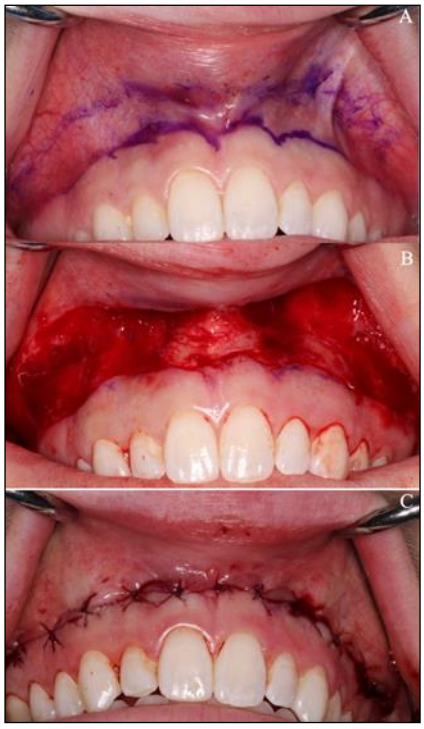

Fig 11: Group 1 (no myotomy)

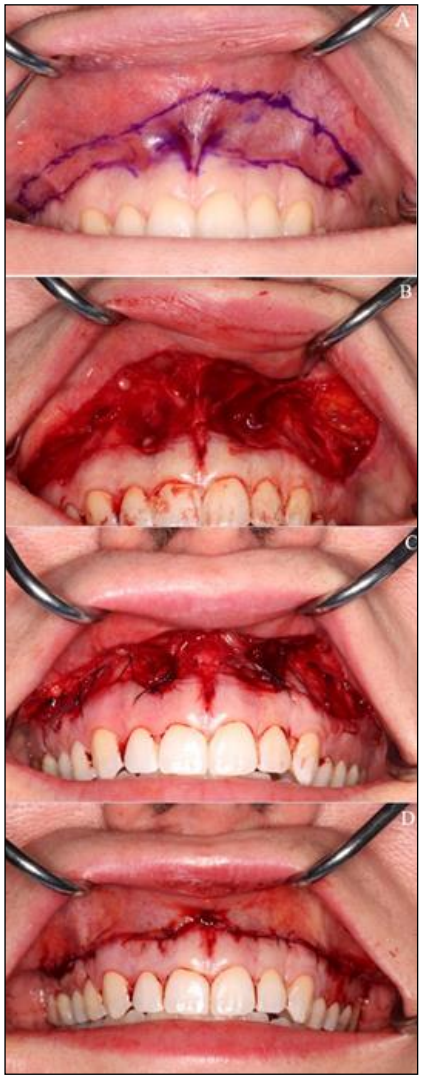

Fig 12: Group 2 (myotomy) Note that lips were unevenly stretched during photo in figure A

Statistical Analysis

The collected data were analysed using xyz for scaled parameters and ANOVA for metric parameters in SPSS (version 25.0). The p-value cutoff for statistical significance was established at 0.05. To ascertain the distribution of the present EGD aetiology, a frequency table was produced. Based on earlier research (Gupta 2010, Polo 2011, and Tawfik 2018), power was set at 0.8, and an estimated total sample size of 20 (10 each group) was generated.

Discussion

The researchers are not aware of any other studies that seek to relate a patient's EGD aetiology to the clinical outcomes of an LR operation as of this writing in the dental literature. The researchers assume that as this is the first research of its kind, more research will be done in the future to determine which LR surgical techniques are most effective for particular patients. The authors hypothesise that various etiologies for EGD will have greater clinical outcomes with particular LR surgical methods, much like in the treatment of any disease. According to a comprehensive review by Tawfik, gingival presentation improved on average by 3.4 mm (95% confidence interval: 3.0-3.8 mm) (Tawfik, 2018). The GDR in this study was a little lower than the systematic survey's average.

The considerable relapse that was observed in individuals with all four etiologies of EGD in Group 1 is thought by the authors to be the cause of this (reference Figure 21). The overall average discovered suffered a significant decline as a result of this relapse, which calls for more research. To clear up any misunderstandings, a thorough explanation of the differences between Robbin's lip dimensions and those used in this study is necessary. Robbin's measurements involve the length of the combined philtrum and vermillion border to determine if a patient has an HL or SL. These parameters were utilised to identify the cause of the patient's EGD. But in our investigation, the LL measurement taken at the beginning and after surgery only included the philtrum length.

The VB width was determined independently. The authors of our study used this distinction between the two measurements to help them explain how LR affects the anatomy of the upper lip. According to our study, the LR treatment does, as initially stated by Rubinstein & Kostianovsky, restrict the retraction of the smiling muscles, but it also reduces the length of the philtrum (measured as LL in our study) and widens the vermillion boundary. Regarding the survey's follow-up period, follow-up for LR ranged from one week to four years (Rao, 2015; Bhola, 2015). Even though they are unrelated to the LR, standard wound healing investigations can be used to determine whether six months is sufficient time to assess the stability of the operation. Split thickness flaps are used in LR procedures, hence Staffileno's seminal paper on wound healing can be used to understand connective tissue healing. Four beagle dogs were given split thickness flaps as part of the investigation, and a straightforward H&E histological analysis was carried out. According to the research, the connective tissue fibres were fully developed by 60 days (Staffileno, 1962) [23]. Consequently, the connective tissue would be entirely attached. Maffulli offers a system for classifying muscle injuries, a schedule for recovery, and an expected return date for athletes to their individual sports. Our blunt dissection of the levator labii superioris muscle to its new position would be classified as a Type 4 injury, or a subtotal muscle tear, by all classifications (Maffulli, 2013). ISMuLT (Italian Society of Muscles, Ligaments, and Tendons) guidelines define a category 4 injury as either a complete tear of the muscle belly or a sub-total tear with more than 50% breakage of surface fibres. First before athlete can return to their specific sport following treatment for a Type 4 injury, at least 60 days must pass for the injury to heal. Consequently, the six months of recovery at its new inferior position, allotted for in our follow up would be considered sufficient healing time for the levator labii superioris to return to normal function.

Conclusion

Treatments available for individuals with EGD include LR with and without myotomy. Our research demonstrates that conducting a myotomy improves the total GDR attained and discourages GDRB. Additionally, our data adds to these conclusions by showing that LR with myotomy should be taken into account to dramatically enhance GDR in patients with VME I & II, HL, or all 4 etiologies (VME + HL + SL + APE).

Last but not least, Tawfik 2018 performed a randomised clinical research contrasting LR with or without a myotomy using a similar study design. Our original study findings are comparable to those of this randomised clinical trial in that it was discovered that conducting a myotomy in addition to LR increased overall gingival display reduction. But Tawfik's research

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