CLINICAL RESEARCH

Modified lip-repositioning technique for the treatment of gummy smile

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Abstract

This article illustrates a new technique for repositioning the lip in the treatment of gummy smile. In particular, it introduces a formula to precisely calculate how much tissue should be eliminated to avoid the recurrence of gummy smile. The modified lip-repositioning technique (MLRT) also involves the microsurgical division of the tissue components (mucosa, periosteum, and bone) as well as the fixation of the surgically modified tissue to the periosteum component. The results of the technique are shown through case presentations of seven patients with follow-up of up to 3 years. Stable results were achieved with no recurrence of gummy smile.

(int J Esthet Dent 2020;15:2–11)
Introduction

A symmetrical, harmonious, and esthetic smile depends on several components, including the teeth, the labial line, and the gingival scaffold. It is important to analyze the individual sizes, shapes, colors, and positions of the teeth. For the upper lip, the labial line should show harmony between the labial border and the papilla; for the lower lip, the upper border should be parallel to the margins of the maxillary incisors.

The smile is influenced by the state of the patient’s gingival health as well as the contours in the interdental spaces, including their shape and thickness. Gummy smile has been defined as an excess of gingival exposure (> 4 mm) when smiling, and in some situations even when the lips are in repose.

Etiologic factors for gummy smile include a short upper lip, hypermobile lip, vertical maxillary excess, anterior tooth overeruption, altered passive/active eruption, gingival overgrowth, race, and gender, among others. In several cases, the condition has to be treated via a multidisciplinary approach consisting of orthognathic surgery, orthodontics, periodontics, and restorative dentistry. However, other less-invasive alternatives have been described, including botulinum toxin, perinasal and perilabial muscle modification, extension of the nasal cartilage using autologous or polytetrafluoroethylene (PTFE) implants, smile camouflage with mini-implants, and various lip-repositioning techniques.

Variations in lip-repositioning procedures include elimination of the mucosal band on both sides of the upper labial frenulum, with or without frenuloplasty/frenectomy, and different types of suture techniques. Unfortunately, besides the need to remove large amounts of soft tissue, most of these techniques lack clear explanations of the areas to be dissected, the amount of submucosal band to be removed, the critical anatomical limits, the location and type of sutures, and the fixation areas to be used to avoid relapse. Furthermore, although some reports have indicated short-term success with modification or detachment of the smile muscles to avoid traction, the clinical experience of the present author has shown the long-term relapse rate for these types of procedures to be as high as 100%.

The aim of this article is to describe a modified lip-repositioning technique (MLRT) that includes reverse vestibuloplasty, split flaps, dissection, and osteoplasty as well as revised suture techniques and materials. This technique avoids myotomy and concentrates on vestibular mucoperiosteal management. The 3-year results from selected cases are presented.

Modified lip-repositioning technique

Initial analyses

1. The first step is to perform an accurate extraoral facial analysis by means of standardized photographs, which allow geometric projection of the facial thirds (Fig 1). Emphasis should be placed on the middle and lower thirds of the face, considering the glabella, bipupillary plane, menton,
and subnasale to project symmetries, asymmetries, deviations, the buccal corridor, biotype, and midline correspondence.

2. The patient’s lip should then be analyzed, including length, mobility, and diameter, both at rest and at maximum smile. Total lip length, measured from the vermilion border to the base of the nose, averages 20 to 24 mm. Maximum lip mobility, measured from rest to maximum smile, averages 7 to 8 mm (Fig 2). The lip diameter from the lower edge to the vermilion line averages 7 to 10 mm (Fig 2).

3. The amount of maxillary central incisor shown at rest varies between 2 and 4 mm, with the latter being most typically desired. On the other hand, the amount of tooth shown during maximum smiling ranges between 50% and 100% from the central incisors to the premolars, and varies widely depending on patients’ teeth as well as their race, age, physiognomy, and phenotype.

4. Extraoral lip mobility analysis is the next step. This should be performed via photographs of the patient from rest to maximum smile. The patient should be positioned in the 12 o’clock position (cephalic to caudal direction), sitting in a 90-degree occlusal plane position with respect to the floor, with the camera pointing toward the chin at a 75-degree angle, to include the tip of the nose (Fig 3).

5. Lastly, intraoral analysis is performed. It is essential to identify a state of full health (ie, no bleeding upon probing, no purulent exudation, and no signs of inflammation) to reliably predict the behavior of the periodontium after treatment. Digital programs such as Digital Smile Design (DSD) or Photoshop Smile Design (PSD) as well as anatomic projections are required (total supracrestal space), which assist to provide predictable outcomes without biologic damage.
Calculation of average tissue to be removed

Several variables are used to guide the clinician in the calculation of the average tissue area to be removed. These are defined as follows:

1. Quantity of keratinized tissue band in millimeters: Subtract the probing depth from the total measurement made from the mucogingival junction (MGJ) to the free marginal border, pulling the lip to maximum display.

2. Total supracrestal space in millimeters: The patient should be anesthetized for this measurement. The probe is then introduced through the bone sounding.

3. Location of the cementoenamel junction (CEJ) of the teeth to be treated: From this location, the presence of altered passive eruption (APE), gingival hyperplasia, inflammation, and altered active eruption (AAE) should be identified.\textsuperscript{39,40}

4. Maximum papilla display (MPD) measured in millimeters: From the peak (vertex) of the interdental most-exposed papilla during smile to the free labial border line of the upper lip during maximum smile\textsuperscript{41} (not necessarily the papilla of the central incisors) (Figs 3 and 4a).

5. Maximum smile exposure (MSE) in millimeters: From the incisal edge of the central incisors to the free labial border line of the upper lip (Fig 4a).

From the above parameters, the following formula can then be used to determine the average width of the mucosal band to be eliminated:

\[
\text{MSE} + \frac{\text{MPD}}{2}
\]

In other words, the sum of the maximum smile exposure and the maximum papillary exposure when smiling, divided between the components of the equation, yields a minimum average of the mucosal band to be excised (Fig 4b).

If clinical crown lengthening is also required in conjunction with lip repositioning, the keratinized band width and total supracrestal space should be addressed. At least 3 mm of total supracrestal space and 2 to 3 mm of the keratinized tissue band must be maintained.

Surgical procedures

The objective must be splitting the compartments as well as their proper fixation and suture using adequate magnification and suturing equipment.

1. If clinical crown lengthening and/or gingivectomy are needed, these procedures should be carried out first in the same surgery using adequate magnification equipment (cases of \( \geq 5 \) mm of gum exposure).

2. Define the lower limit of the band, which should be 2 mm apical to the mucogingival line, thus ensuring a minimum band of keratinized tissue\textsuperscript{39,40} and avoiding visible scars when smiling. This line should be projected equidistantly on all the teeth to be treated, from the central incisors to the distal premolars, if necessary. Thereafter, the band width is measured in the coronoapical direction according to the formula, and with the final limit as the line of transition between the masticatory mucosa and the labial line (top horizontal line in Fig 4c).

3. With a No. 15 blade, a horizontal partial-thickness incision is made at about 15 degrees in the apical direction, crossing the mucosa apically to the central incisors and including the vertex of the labial frenulum (dashed line in Fig 4b and c). A parallel cut is then made in the labial direction at partial thickness (the bevel of the blade must be the guide for the depth of all the involved teeth), to
In other words, the end result will be an apical compartment at full thickness and a coronal compartment at partial thickness to achieve the final fixation to the periosteum zone.

5. Once the band has been removed, the mobility of the lip is verified and then sutured in a coronal direction (Fig 6). The initial suture should be a single knot in the middle, directed to the inner labial line mucosa using 4-0 or 5-0 resorbable sutures, according to the V-Y principle.42,43

6. To secure the displaced lip, the labial submucosal zones are sutured to the periosteal zone in the internal direction of the incisions (labial-coronal direction). The two lateral knots are made in the same labial mucosa to the periosteum,

Fig 4  (a) Maximum smile and papilla exposure in millimeters. From the incisal edge (teal line) to the labial free border (yellow line). (b) Schematic representation of the band to be removed (solid line) – dashes indicate the incision line; arrows indicate the top margins of the band width. (c) First incision (at partial thickness), including the frenulum. (d) The epithelial submucosal band.

finally join the two horizontal incisions with vertical ones, right and left, and thus eliminate the band (Fig 4d). Care should be taken to keep the lip muscles intact, for which a suborbicular mucosal preparation is recommended.

4. A separate full-thickness but narrow horizontal incision is then made parallel to and at least 5 mm apical to the previous coronal partial-thickness incision (Figs 5, 9c, and 14b), which will allow the periosteum to be moved apically in the direction of the anterior nasal spine. Deep, blunt dissection must be made both apically and laterally, dissecting the lip while keeping the muscles intact, to the alar nasal zone, to avoid traction on the perinasal muscles without cutting them.
Results

The results are presented for seven patients (Figs 8 to 14) who were followed up from 6 months up to 3 years postoperatively. The cases include not only the MLRT but also clinical crown lengthening as well as alternative treatments such as DSD and maxillofacial surgery. The patients were analyzed from day 0 with standardized photography protocols and measurements. In all cases, a hygienic phase was carried out before surgery. Where the patient/s needed more

but at the medial, mesial, and distal sectors of the incision, and with simple knots as a tripod guide (Fig 6), internally and externally.

7. For the external sutures, a continues suture is suggested, in the direction of the external mucosa (lip), through the inner periosteum (coronal) and then the external epithelium – starting from the lip through the fixed periosteum, and from one side to the other using reinforced resorbable 4-0 or 5-0 sutures (Figs 7, 9c and d, and 14d and e).

Fig 5  (a) Dissection of the compartments after removal of the mucosal band and (b) blunt dissection to avoid muscle traction. Arrows indicate preserved smile muscles.

Fig 6  First internal knot using the V-Y principle.
than one surgical procedure, the hygienic phase occurred at the single-stage surgery (crown lengthening; MLRT).

The patients were recalled for clinical monitoring on days 5, 10, and 15, then at 3 and 6 months, followed by 1 year and 2 to 3 years. Suture removal took place on day 15 for nonabsorbable sutures, while absorbable sutures remained in place.

The healing of all patients was uneventful. They all presented minimal swelling and reported "some limited mobility when smiling" in the upper lip during the few weeks after the procedure. It is important to note that the maximum smile line showed over-correction immediately postoperative (in fact, it is suggested that this measure be avoided in the assessment of the final result or during postoperative follow-up). The initial healing period extends up to 6 months, at which time relapse should first be evaluated. The author finds that with the MLRT, relapse can be prevented in up to 50% of cases of gum exposure, from the easiest (1 to 7 mm) to the most demanding (> 7 to 15 mm), respectively.
Fig 9a to e  Complete case sequence from maximum papilla display for patient in Figure 8 at 14 months (left) and 18 months (right) after lip modification (from crown lengthening to the dissection of the compartments to final results beyond 18 months).
Fig 10  Results of lip modification in a 27-year-old male patient. (a) Evolution of recovery up to 3 years after surgery. (b) Frontal close-up view.

Fig 11  Results of lip modification and chin advance in a 25-year-old female patient. (a) Evolution over 2 years. (b) Frontal close-up view.
Fig 12  Results of lip modification at 2 years in a 50-year-old female patient.

Fig 13  Results of lip modification at 2.5 years in a 27-year-old female patient.

Fig 14a to h  Complete case evolution from initial extraoral analysis to surgery and early healing to current status and follow-up > 2 years. The procedure controlled the incidence of relapse of gummy smile.
Discussion

Gummy smile represents an esthetic concern for many patients. The multifactorial etiology of the condition should be identified proactively to develop the appropriate treatment approach, given that in most cases a single procedure is insufficient to resolve it.1-11 There is a notable lack of treatment approaches for some etiologic factors, eg, labial hyperactivity. Although the treatment of choice for severe vertical overgrowth is clearly orthognathic surgery, there is no consensus about how much maximum gum exposure can be corrected when using a combination of surgical and other techniques instead of orthognathic surgery.

The most important question concerns how much tissue band should be removed. Most techniques describe only the removal of a mucosal band of tissue, excluding the division of the compartments and without defining exactly how much tissue should be removed to achieve the proper amount of labial displacement, without the need to treat the underlying bone tissue or to divide the tissue into mucosa, periosteum, and bone. In addition, some authors suggest the complete maintenance of the labial frenulum. However, as previously mentioned, the present author has found that the recurrence rate for relapse approaches 100% when conventional techniques are used, including the mucosal band-removal technique described by Simon and colleagues.16 The lack of a fixed coronal anchorage zone at the time of suturing, in addition to the correct location of the mucogingival line, adds to the muscular forces – which translates as recurrence. These factors must be counteracted by microsurgical division of the compartments as well as suturing to an adequate periosteum tissue area. This is the main difference when it comes to the present proposed technique to control recurrence.

The formula proposed in this article is in accordance with anatomical landmarks and precisely guides the practitioner regarding how much tissue band should be eliminated to avoid the recurrence of gummy smile. This process occurs by virtue of the splitting of the compartments and their proper fixation and suturing using adequate magnification and suturing equipment.

Conclusions

Gummy smile can be treated using different multidisciplinary techniques instead of the traditional orthognathic approach of surgery and orthodontics, which patients often prefer to avoid due to the surgical procedure, costs, and time. These different techniques can be employed by virtue of exact and objective measurements that protect the biologic spaces, divide the compartments, and avoid recurrence in the mid and long term. Despite the limitations of this clinical case series, the author strongly advises that gummy smile be treated in a multidisciplinary scenario that includes digital tools such as DSD or PSD, anatomical landmarks, and prosthodontic projections of treatment and surgery techniques in order to achieve predictable esthetic outcomes.

Disclaimer

The author has no financial interests, either directly or indirectly, in the products or information presented in this article.
References


