




The Lip Repositioning Surgery: A Review of the Technique's Evolution

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Abstract

The lip repositioning technique (LRT) is considered a safe and predictable gummy smile (GS) treatment. However, since Rubinstein and Kostianovsky introduced it in 1973, it has undergone several modifications. This article aims to review and provide a historical compilation of LRT evolution to help clinicians understand each technique's description and the rationale for its modifications to treat GS.

An electronic search was performed in Medline, Scopus, and Cochrane Library up to May 2021 including the terms “lip repositioning,” “lip repositioning technique,” or “lip repositioning surgery” and studies evaluating or discussing the original LRT's modifications in detail. The search had no language or time restrictions. Additionally, a hand-searching of references of all included articles was performed.

Modifications described in the literature include muscle severance, subperiosteal dissection of the gingiva, frenectomies, and the use of adjuvant products. They aim to minimize relapse, morbidity, and improve stability. Discomfort, scar formation, and pain were the most frequent complications reported. The choice to use a modification should be analyzed and customized to the individual patient's needs.

Keywords

- ▶ excessive gingival display
- ▶ gummy smile
- ▶ lip repositioning technique
- ▶ smile

Introduction

According to some authors, the “ideal smile” involves 1 to 3 mm of exposed gingiva.^{1–3} Thus, the excessive gingival display (EGD), also called gummy smile (GS), is an aesthetic problem that may affect a person's appearance.^{4–7} This condition is more frequent in women and during smiling^{8,9} and has a prevalence between 11.8%¹⁰ and 10.57%.¹¹

Typically, a patient is diagnosed with GS or EGD when having a high smile line, showing more than 2 mm of free gingiva.¹² A thorough examination and correct diagnosis are essential to achieve aesthetic and predictable treatment results.¹³ It is necessary to emphasize that before any surgical treatment, the GS etiology must be identified. The GS etiology is often multifactorial, including altered passive eruption

(APE), vertical maxillary excess (VME), anterior dentoalveolar extrusion, gingival enlargement, hypermobile upper lip (HUL), short lip, and asymmetrical upper lip.^{2,9,14,15} When a patient presents gross overbite, VME, or overgrowth of the upper jaw, orthognathic surgery is the first recommended option.⁴ However, most patients refuse this surgery due to its high morbidity and the need to be hospitalized.^{16,17}

The lip repositioning technique (LRT) described for the first time in plastic surgery by Rubinstein and Kostianovsky,¹⁸ is a widely used, effective, safe, and predictable treatment with an average GS reduction of 2.71 mm.^{19,20} The LRT alone could be used when the patient presents a short upper lip, HUL (lip mobility > 8 mm), and VME except for severe cases.^{14,19,21} However, the literature describes several modifications of the original LRT using myotomies,

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subperiosteal dissection of the gingiva, and adjunctive product use.²²⁻²⁴

Therefore, this article aims to review and provide a historical compilation of LRT evolution to help clinicians understand each technique's description and the rationale for its modifications to treat GS.

Materials and Methods

Search Strategy

An electronic search in Medline (via PubMed), Scopus, and Cochrane Library (CENTRAL) was performed up to May 2021 to conduct a comprehensive review of the literature and answer the following questions:

1. What are the different modifications of the original LRT?
2. Which are the basis of the different modifications of the LRT?
3. Which are the main complications of the LRT modifications?

The search strategy included the terms "lip repositioning," "lip repositioning technique," or "lip repositioning surgery" to identify the relevant studies. The search had no language or time restrictions. Additionally, a hand-searching of references of all included articles was performed.

Inclusion/Exclusion Criteria

Randomized or non-randomized clinical trials, case series, and case reports were considered for inclusion if they described a modification of the original LRT.¹⁸ Articles that did not provide suitable detail or description of the technique used were excluded.

The Original Lip Repositioning Technique

Rubinstein and Kostianovsky first presented the LRT in 1972 and published it in the plastic surgery field 1 year later.^{18,25} The surgery was based on a strip of maxillary labial mucosa excision to eliminate the lip "over-excursion" while smiling. The gingival display is measured from the gingival margin to the lower border of the upper lip during smiling (► Fig. 1). This technique performed a turndown flap to close the wound with the lower edge. The distal references of the horizontal incision coincide with the labial commissures' projection during the smile, at the second maxillary molars level. The upper edge of the horizontal incision was placed at the bottom of the upper buccal sulcus, and the lower edge was 2 to 3 mm above the dentoalveolar line sectioning the frenum. The removal of mucosa was partial, leaving the periosteum intact. Finally, the lip was immobilized using plaster or adhesive tape.

Study Selection and Data Extraction

Two independent researchers (K.G. and A.M.) independently performed the search strategy. Titles and abstracts were independently assessed to identify relevant clinical studies. Full-text article screening was performed to identify articles that met the inclusion criteria. Then, the same reviewers extracted data from the selected articles into tables. Any disagreement was resolved by consensus with a third examiner (A.V.).

Included articles were thoroughly assessed for content related to the LRT surgical modification technique. The extracted data included author (year), modifications on the

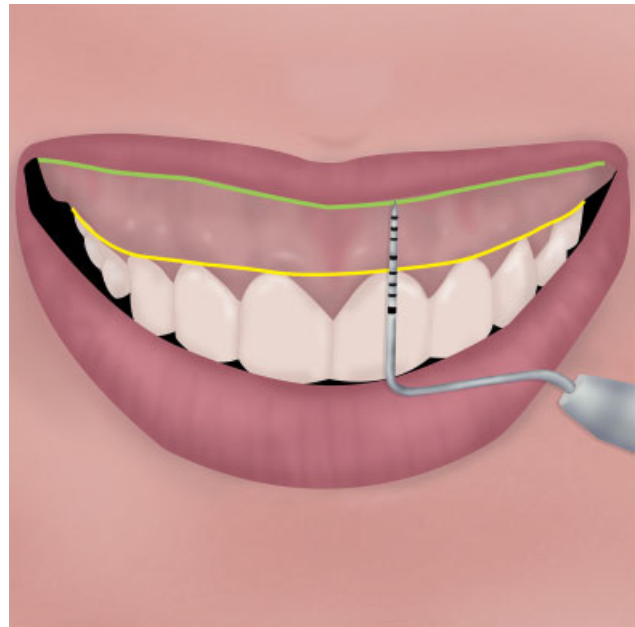


Fig. 1 Illustration of the preoperative gummy smile evaluation.

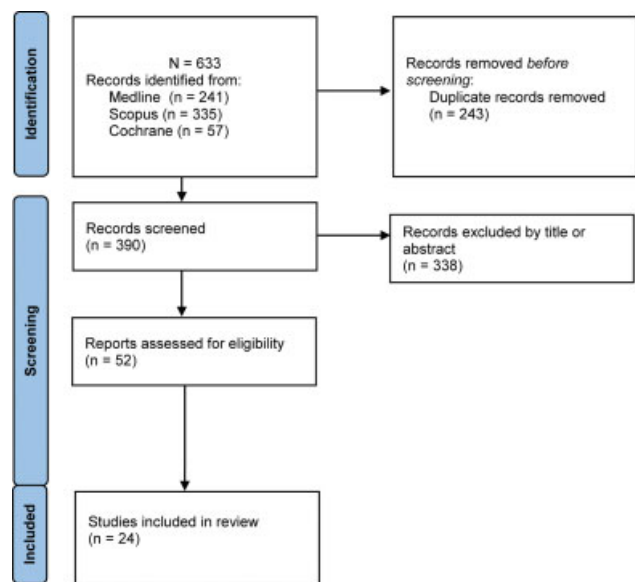


Fig. 2 Flowchart diagram of the study selection.

lower and upper horizontal incision, distal extension references, flap/incision type, information about frenulum section, muscular modifications, and use of adjuvants. Moreover, data were summarized on all postoperative complications.

Results

A total of 633 citations were screened from three databases; 335 from Scopus, 241 from Medline via PubMed, and 57 from Cochrane. ► Fig. 2 shows the flowchart diagram. After the removal of duplicated articles, 390 articles remained for the title and abstract screening. After the full-text assessment, only 23 studies remained for data extraction. The main modifications related to muscle severance or detachment,

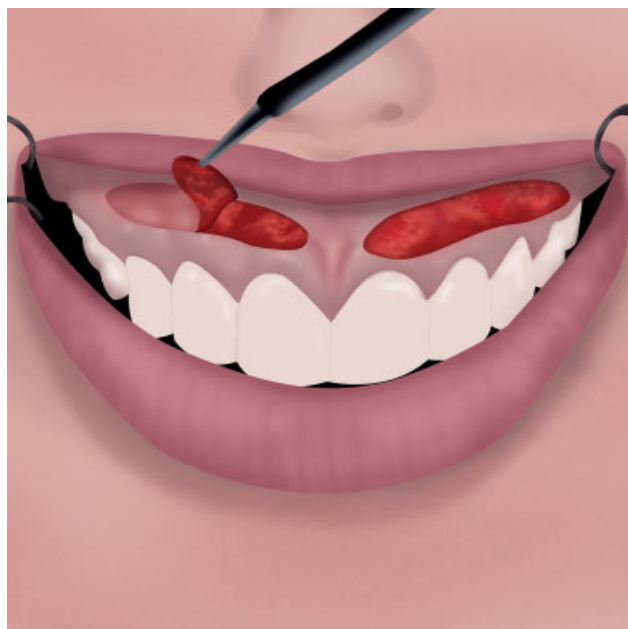


Fig. 3 Illustration showing the surgical removal of the mucosal strips.

frenectomies, the horizontal incision extension, and complications reported are shown in ► **Table 1**.

The lower horizontal incision along the mucogingival junction was the technique of choice. However, concerning the upper horizontal incision, authors report performing it on the sulcus,⁵ the labial mucosa.^{4,26} In contrast, others perform an apical projection to the inferior incision at 5 mm,²⁷ 6 to 8 mm,²⁸ 8 mm,²⁹ 8 to 10 mm,^{29,30} between 10 and 12 mm,^{23,24} or twice the amount of the EGD.^{31–35} The most frequent reference for the distal projection of the horizontal incision was the maxillary first molar.^{21,23,30,32,35,36} Six authors performed a full-thickness incision,^{4,5,21,26,29,37} two reported maintaining the frenulum intact,^{23,35} and one indicated the section of the frenulum depending on the case³² (► **Fig. 3**).

Concerning muscle severance (► **Fig. 4**), the authors recommended muscle detached in cases of short lips,⁴ muscle amputation,^{5,21,24,33,37} and muscle containment with sutures³⁰ In contrast, some authors recommend combining LRT with other therapeutic options to ensure more predictable and stable results. The most common adjuvant used were botulinum toxin (BT)^{28,35} and spacers.^{38,39} LRT with gingivectomy and osteotomy^{26,40–43} was the most frequent associated surgery. ► **Table 2** shows the summary of the adjuvants used in combination with the LRT.

Across all studies, the most frequent postoperative complication was discomfort, scar formation,^{21,23,28,29,31,32,36} and pain.^{18,21,29,36} Other LRT modifications reported swelling,^{28,33} ecchymosis,³⁶ edema of the upper lip and perioral area,^{21,29} minor bleeding,^{21,29} and mucocele formation.³⁶

Discussion

Among the procedures used to improve GS, the LRT reduces the elevator smile muscle's retraction by shortening the

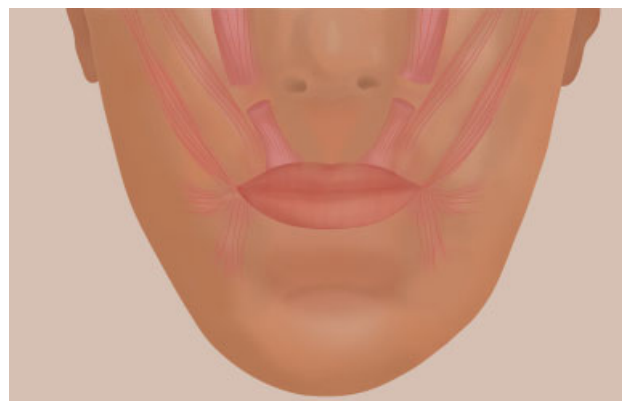


Fig. 4 Illustration of the smile muscles showing amputation of both levator labii superioris muscles. Adapted from Ishida et al.³⁷

vestibule, reducing the EGD when smiling.⁴⁴ It was first presented in 1972, published in the plastic surgery field by Rubinstein and Kostianovsky,^{18,25} and introduced years later in the dental cosmetic area by Rosenblat and Simon.³⁶ This procedure has been suggested for patients requesting a less invasive procedure compared with orthognathic surgery^{16,17} and has evolved significantly over the years.

Litton and Fournier⁴ were the first to review it in 1979, recommending a horizontal incision using the first bicuspid medial side as a reference and a full-thickness flap. They also suggested muscle detached in cases of short lips. Miskinyar⁵ performed the original technique, finding relapses in his patients, and modified it by performing an amputation of the levator labii superioris muscle (LLSM). After reporting that muscle severance improved EGD reduction, different authors started to perform the technique using a full-thickness flap and the levator muscle myotomy.^{21,24,33} They indicated that this method alters the smile muscles' position, avoiding muscle pull.

Ishida et al³⁷ proposed a technique to reduce the elevator of the upper lip muscle function and a frenectomy to lengthen the upper lip. However, it required a subperiosteal dissection through the columella and lateral incisions inside the nostrils. Abdullah et al²⁹ performed a full-thickness incision 4 to 5 mm above the gingival margins from the second premolar level to the contralateral and a parallel line using a surgical caliper at approximately 8 to 10 mm apical to the first incision. After removing the soft tissue strip, the LLSM and depressor septi muscles were released and repositioned in a lower position using circumferential sutures around the canines. Authors who support this modification using myotomy of the LLM reported fewer recurrences and greater postoperative stability than the conventional technique.²⁴ Although myotomy showed a trend of greater reduction in EGD at 6-month follow-up, there are no longer-term data.²⁰

The most frequent postoperative complication was discomfort, scar formation,^{21,23,28,29,31,32,36} and pain.^{18,21,29,36} Other LRT modifications reported were swelling,^{28,33} ecchymosis,³⁶ edema of the upper lip and perioral area,^{21,29} minor bleeding,^{21,29} and mucocele formation.³⁶

Table 1 Lip repositioning technique and surgical modifications

Author, (y)	Lower horizontal incision	Upper horizontal incision	Distal extension reference	Flap/incision type	Frenulum section	Muscular modifications	Use of adjuvants	Complications reported
Rubinstein and Kostianovsky (1973) ²⁵	2 to 3 mm above the dentoalveolar line	At the vestibular sulcus fundus	Projection of the labial commissures Second upper molar	Partial thickness	Yes	N/R	N/R	Mild pain, recurrence
Litton and Fournier (1979) ⁴	In gum, 3–4 mm above upper anterior teeth	Along the inner lip mucosa	Medial side of first bicuspid	Full-thickness flap	Yes	Muscle detached in cases of short lip	N/R	N/R
Miskinyar (1983) ⁵	N/R	Into the sulcus and transversely perpendicular to the bone	N/R	Full-thickness flap	N/R	Total or partial amputation of the levator labii superioris muscle (LLSM)	N/R	Paresthesia
Ellenbogen and Swara (1984) ³⁸	N/R	From columella to the nostril base	nostril base	Supraperiostically	N/R	the levator labii superioris muscle is partially transected	Silicon, cartilage, turbinate bone and supramid spacers	Supramid implant rejection Relapse, funny look complaint.
Rosenblatt and Simon (2006) ³⁶	At the mucogingival junction	10 to 12 mm parallel to the first one, in the labial mucosa	Maxillary first molar	Partial-thickness incision	Yes	N/R	N/R	Minimal ecchymosis and tension, slight pain, scar and mucoccele formation
Ishida et al. (2010) ³⁷	N/R	5-mm incision in the columella between the caudal septum and alar cartilages	Labial commissures	Full thickness	Yes	Muscular dissection	N/R	uneventful
Ribeiro-Junior et al (2013) ²³	1 mm coronal to the mucogingival margin	10 to 12 mm apical and parallel to the first one	Maxillary first molar	Partial-thickness incision	No	No	N/R	Minimal discomfort, minor scar
Jacobs and Jacobs (2013) ³¹	At the mucogingival junction	At a distance based on twice the desired repositioning with a mustache shape, slightly inferior the frenum	Maxillary first molar	No mucosa removal at the trial, then performed a partial-thickness incision.	Yes	No	Suture placing for reversible trial lip repositioning	Mild discomfort
Abdullah et al (2014) ²⁹	4 to 5 mm above the gingival margins	Parallel and 8 to 10 mm apical to the first incision	Second premolar	Full-thickness incision	Yes	Perioral muscle dissection	N/R	Minimal discomfort, tension, mild pain, perioral edema, ecchymosis, bleeding and relapse
Bhola et al (2015) ¹⁴	At the mucogingival junction	Twice the amount of the EGD subclass (E)	The extend of the dynamic smile	Partial thickness	Yes	No	N/R	Minimal morbidity, upper lip tightness
Aly et al (2016) ²⁸	At the mucogingival junction	6–8 mm superiorly the in the vestibule	maxillary second premolar	Partial thickness	Yes	N/R	Botox injection after 2 weeks from the LRT	After LRT: Slight discomfort, minimal bruising and extraoral swelling. After Botox injection: N/R

(Continued)

Table 1 (Continued)

Author, (y)	Lower horizontal incision	Upper horizontal incision	Distal extension reference	Flap/Incision type	Frenulum section	Muscular modifications	Use of adjuncts	Complications reported
Littuma et al (2017) ³⁰	1 mm coronally to the mucogingival line	8–10 mm apical to the mucogingival junction and parallel to the first incision	Maxillary first molar	Partial thickness	Yes	Grasping the bundle of muscle fibers	Suture containment of the smile elevator muscles	Mild pain, tension, and scar formation
Torabi et al (2018) ³²	At the mucogingival junction	In the labial vestibule, at a distance based on twice the gingival display	Maxillary first molar	Partial incision with posterior periosteal incisions (vestibular shallowing)	Depending on the case	N/R	N/R	Minimal discomfort, scar formation
Alammar and Heshmeh (2018) ²¹	1 mm coronal to the mucogingival junction	10 to 12 mm apical and parallel to the lower one	Maxillary first molar	Full thickness	Yes, with a V-shape incision	Dissection of the bony attachments of the perioral muscles	N/R	Scar, tension, minimum of discomfort, ecchymosis, minimal bleeding, moderate edema, pain, flap dehiscence and numbness. Dry mouth and partial relapse
Tawfik et al (2018) ³³	At the mucogingival line	At twice the distance of the preoperative gingival display	Maxillary first molar	Partial thickness	Yes	Blunt dissection of the muscle attachment above the coronal incision	N/R	Slight pain, swelling, scar formation
Vergara-Buenaventura et al (2020) ³⁵	At the mucogingival junction	At twice the distance of the preoperative gingival display	maxil Maxillary first molar lary second premolar Maxillary first molar	Partial thickness	No	No	Botox injection the day after LRT	N/R
Zardawi et al (2020) ²⁷	Along mucogingival junction	5 mm coronal to the mucogingival junction	maxillary second premolars maxillary second premolars	N/R	Yes	Dissection of elevator muscles	N/R	N/R
Duruel et al. (2020) ³⁴	At the mucogingival line	At twice the distance of the gingival display during smiling for each tooth region	Maxillary second premolars	Partial thickness	Yes	Yes, via a periosteal elevation	N/R	N/R
Chacon (2020) ²⁶	2 mm apical to the mucogingival line	At the transition line between the masticatory mucosa and the labial line	Maxillary premolars	First a partial-thickness incision. Then, a separate full-thickness incision is made parallel or at least 5 mm apical to the lower horizontal incision	Yes	Blunt dissection of the lip keeping the muscles intact	N/R	Minimal swelling, limited mobility while smiling

Abbreviation: N/R, not reported.

Table 2 Combination with adjuvants

With spacers	<ul style="list-style-type: none"> • Silicone spacers, cartilage, turbinate bone, and Supramid implants³⁸ • Polymethylmethacrylate-based bone cement fixed³⁹
With products	<ul style="list-style-type: none"> • Botox^{28,35}
With other surgeries	<ul style="list-style-type: none"> • Combination with gingivectomy alone,²³ gingivectomy and ostectomy^{26,40–42}

Rosenblat and Simon³⁶ performed the horizontal incision over the mucogingival line from the first molar sectioning the frenulum. They also recommended that the amount of tissue removed should be twice the amount of gingival tissue exposed with a maximum of 10 to 12 mm. Jacobs and Jacobs³¹ evaluated the LRT with a reversible trial before mucosal cutting using sutures. Then, the incisions and the frenectomy were performed using a high-power diode laser (975 nm, 4 W, CW).

In contrast, some modifications included leaving the maxillary labial frenulum intact. Ribeiro-Junior et al²³ modified the surgical procedure described by Rosenblatt and Simon³⁶ involving two mucosal strip removal, leaving exposed the connective tissue from the midline to the first upper molar and maintaining the frenulum intact. In the same way, Torabi et al³² avoided cutting the frenulum and performed periosteal fenestrations. They used extraoral tapes to stabilize tissues as the original LRT.²⁵ Similarly, Bholal et al¹⁴ published a new GS classification and introduced the lip stabilization technique (LipStaT), avoiding sectioning the frenulum.

Recent modifications aimed to change the mucogingival junction position to a more coronal one without removing a mucosal strip.²⁷ Alternatively, some authors perform a customized calculation based on the amount of gingiva shown for each tooth area³⁴ and smile and papillary exposure.²⁶

Combining the LRT with other approaches such as periodontal plastic surgeries, restorative procedures, or BT injections has been suggested to obtain more predictable and stable results.²⁰ Ellenbogen and Swara³⁸ tried to improve the LRT by partial transection of the LLSM by inserting silicone spacers and Supramid implants into a pocket created by an incision inside the nostrils. Spacers were intended to fill the muscle space to prevent future reinsertion at the same level. However, the authors reported rejection of Supramid implants. Similarly, it has been suggested to use polymethylmethacrylate (PMMA)-based bone cement fixed to the bone with fixation screws in maxillary overgrowth and subnasal skeletal depression, producing a retraction of the upper during smiling.³⁹

In contrast, some authors recommend using the LRT with other therapeutic options in cases of APE, gingival enlargement, and preventing relapse.^{20,27,45} One approach is with gingivectomy,²³ in association with gingivectomy and osteotomy^{26,40–42} and even with digital workflows.⁴⁶

BT type A has been recommended in cases of excessive muscle function and HUL to prevent muscle contraction.⁴⁷

Aly et al suggested using it as an adjuvant 2 weeks after the lip repositioning surgery²⁸ and other authors the day after.³⁵ BT injections produce lip immobilization during the healing phase, providing long-term stability of the LRT.^{28,35}

Conclusion

Many LRT modifications have been described in the literature and aim to improve the original technique somehow. To optimize technique selection, an individualized approach is necessary. Several authors support the use of muscle severance to prevent the smile muscle from returning to its original position. In contrast, others use adjuvant products to prevent muscle movement during the healing process and minimize potential morbidity. The frenulum section's choice and the extension of the horizontal incision should be customized to the individual patient's needs. The combination with other approaches may ensure more predictable and stable results. Finally, clinicians should know the techniques, advantages, and possible complications to ensure better outcomes.

Conflict of Interest

The authors do not have any financial interest in the companies whose materials are included in this article.

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