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Author : Lina Maria, and Rini Octavia Nasution
DOI : 10.32734/tm.v2i1.2695
Electronic ISSN : 1234-1234
Print ISSN : 1234-5678

Volume 2 Issue 3 – 2025 TALENTA Conference Series: Tropical Medicine (TM)

TM Conference Series 02 (2025)
TALENTA Conference Series
Available online at https://talentaconfseries.usu.ac.id

Efficacy Of Modified Lip Repositioning for The Management Of Excessive Gingiva Display: A Scoping Review

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Abstract

Since the excessive gingival display (EGD) that occurs when smiling is generally thought to be unsightly, many patients are seeking therapy for this problem. Lip repositioning is one procedure employed to address excessive gingival display. The purpose of the study is to review the most recent research on surgical lip repositioning (LRS) efficacy and its modifications for managing excessive gingival display (EGD). Discussion: Out of 959 articles that were found through keyword-based search, 149 were filtered based on study design and desired period range, then became 6 of literature based on the corresponding titles and abstracts and 4 of literature based on full text. The efficacy of LRS was assessed, and four modifications were identified to manage EGD. Lip repositioning surgery (LRS) is a minimally invasive alternative for treating excessive gingival display (EGD). Modified approaches, such as myotomy and internal dual muscle traction, have shown superior results over traditional techniques. Using periosteal sutures and periosteal sutures can also significantly reduce EGD compared to standard LRS after one year, suggesting improved outcomes for correcting EGD. Conclusion: The conventional lip repositioning operation and the modified lip repositioning treatment result in positive patient outcomes at 6 and 12 months of follow-up by reducing excessive gingival display. Nevertheless, the modified technique outperforms the conventional one in terms of postoperative stability and relapse.

Keywords: Lip reposition; Smile; Excessive gingival display; Gummy smile

1. Introduction

'Pink' or periodontal aesthetics refers to the appearance and health of the gingival, which is an essential aspect of the overall appearance of a smile.[1] A smile is a significant indicator of beauty, leading individuals with an attractive smile to be perceived as more appealing, intelligent, and socially favored.[2] Dale Carnegie emphasized that smiling is one of the most crucial methods of cultivating friendships and exerting influence over others. A captivating grin can be a valuable personal attribute.[3] The gingival display describes the typical exposure of the gingival tissues around the top front teeth when smiling. Research indicates that a range of 14% - 70% of females and 7% - 38% of males exhibit excessive gingival display (EGD), meaning they have a grin that shows a significant amount of gingival tissue. On average, females have a significantly higher likelihood of having a broad smile than males, regardless of age or ethnic background. When the amount of gingival shown during a smile is between 1 and 2 mm, it is considered a desirable feature. However, if the amount of gingival shown surpasses this range, it is referred to as excessive gingival display (EGD), making the smile less beautiful.[4]

Selection and peer-review under responsibility of Seminar Periodental Update 5 2024
p-ISSN: 1234-5678, e-ISSN: 1234-1234, DOI: 10.32734/tm.v2i1.2695

A "gummy smile" (GS), also called excessive gingival show, is a prevalent aesthetic concern among dental patients. Excessive gingival reveal during smiling is frequently perceived as unsightly, prompting numerous patients to seek solutions to this problem. When the gingival tissue is observed to be greater than 3 to 4 mm thick while smiling, it is identified as a gummy smile. This condition is nonpathological. Teeth, lips, gingival architecture, and maxilla are anatomic indicators contributing to GS. Usually, a gummy smile (GS) has multiple contributing factors. The following conditions may be the cause of an EGD: a small space between the upper and lower lips; excessive and hyperactive lip movement; a short visible tooth segment; protrusion of the teeth and surrounding bone; aberrant gum tissue growth; an excessively high upper jaw; and an overgrowth of gum tissue.[5,6]. Identifying the underlying reason accurately is essential to creating a successful treatment plan.[7]

Lip repositioning surgery (LRS) is recommended for treating a gummy smile (GS). The objective of LRS is to limit the backward movement of the muscles responsible for beaming upwards. LRS narrows the space between the lips and gingiva.

Reducing the amount of gum that is visible when smiling.[8] In 1973, Rubinstein and Kostianovsky devised a process as an alternate treatment for GS. This procedure aimed to prevent the need for orthognathic surgery, a more intrusive operation known to have various problems. The surgical procedure entailed removing mucosa from the labial side of the alveolar mucosa, with the resulting wound margin being sutured to the mucogingival junction to diminish the vestibule's size. Typically, the width of the excised mucosa is approximately twice the width of the existing gingival dimension. The recent confirmation of the vestibule's shortening as a long-term treatment effect restricts the upward movement of the lip when smiling. It leads to a reduction in gingival display.[4] Later, others explained the same method with slight alterations, intended to remove a portion of the mucosa and stitch it at a different level. This helps restrict the pulling force of the lip elevator muscles.[9] A significant disadvantage of this surgical procedure is the relapse, which results in nearly complete restoration of the amount of gum exposed before the operation.[10] Therefore, other authors have suggested numerous improvements to the original technique to address this limitation.[11] An additional potential complication is midline displacement during the suturing process due to removing the labial frenum. To address this issue, a modified lip repositioning surgery has been suggested. This procedure tries to preserve the frenum, hence preventing this particular risk.[12]

2. Methods

The Preferred Reporting Items (PRISMA) principles were followed in this scoping review.[13,14] The PICO scheme comprises adults with a GS/EGD (population) of at least 3 mm. LRS, as described by Kostianovsky and Rubin Stein, or any alteration of the traditional LRS (intervention), was altered in the following ways:

- Modification LRS with muscular amputation
- Modification LRS with severance muscle (myotomy)
- Modification LRS with muscle containment using sutures (iMTA)
- Modification of Periosteal suturing with LRS.

Comparison: Treatment with a different LRS than the intervention. Result: The efficacy of LRS was quantified in millimeters by comparing the mean differences in gingival display exposure (EGD) between preoperative and postoperative periods. This was conducted at 6 and 12 months

2.1. Methods

This scoping review uses the Joanna Briggs Institute (JBI) approach using population, concept, and context (PCC) to guide the development of the research question and the eligibility criteria (Table 1) to assist in selecting appropriate papers. Efficacy of modified lip repositioning surgery (LRS) for managing excessive gingival display (EGD). Different types of studies were included, such as (a) randomized clinical trials (RCT), (b) full-paper studies with results published within the past decade, (c) subjects diagnosed with excessive gingival display (EGD/GS), (d)

assessment of the effectiveness of modified lip repositioning surgery; and (e) adult subjects who are at least eighteen years old.

The following were the exclusion criteria: (a) cases outside of LRS in the treatment of EGD /GS; (b) non-randomized clinical studies; (c) review articles; (d) case reports; (e) studies conducted in a language other than English.

Table 1. Eligibility Criteria

PCC Framework	Inclusion criteria	Exclusion criteria
Population	- Participants were diagnosed with excessive gingival display (EGD/ GS). - Participants should be at least 18 years old.	- Participants who are not diagnosed with excessive gingival display (EGD-GS) - Participants under the age of 18. - Studies with animals
Concept	- The LRS was modified in the following manner: - Modification LRS with muscular amputation - Modification LRS with severance muscle (myotomy) - Modification LRS with muscle containment using sutures (iMTA) - Modification of Periosteal suturing with LRS.	- Cases outside of LRS in the treatment of EGD /GS
Context	Participants diagnosed with EGD were selected from the outpatient clinics At the College of Dentistry.	N/AN/A
Language	English publications	Non-English publications

2.2. Search Strategy

An electronic search was conducted in MEDLINE (via PubMed), Google Scholar, and ScienceDirect for this comprehensive review. For each database, the search strategy involves using the following keywords: (lip reposition) AND (smile) AND (excessive gingival display) OR (gummy smile). This is followed by applying an English publication period filter from 2014 – 2024.

2.3. Data Extraction

Data extraction was put into practice for research that met the requirements for inclusion. Name, year of publication, type of treatment for excessive gingival display, number of individuals, age range, and comparison of treatment outcomes between lip repositioning surgery (LRS) and its modifications were among the data reported. Each study's documented difference and percentage reduction in excessive gingival display were retrieved. Every time a follow-up was conducted, the outcomes were also documented. The follow-up period varies between six and twelve months.

2.4. Quality Assessment

Quality assessment of the methodology carried out in each study is essential for understanding the study results. The quality of each study was assessed using JBI's Checklist for Randomized Controlled Trials.[15] Aspects evaluated were the protocol of randomization and allocation of subjects, whether participants and examiners were blinded to the intervention, how subjects were treated during treatment, follow-up procedures, methods of outcome measurement, and statistical analysis used.

3. Result

3.1. Characteristics of the study

After conducting a keyword search, a total of 959 articles were identified. Subsequently, 149 articles were obtained after filtering according to the desired period and study design. In addition, 699 articles were excluded due to their irrelevant titles and abstracts, while 2 were excluded due to the absence of full text. Consequently, this literature review included only four articles. Figure 1 illustrates the PRISMA flow diagram of study selection. [7,16,17]

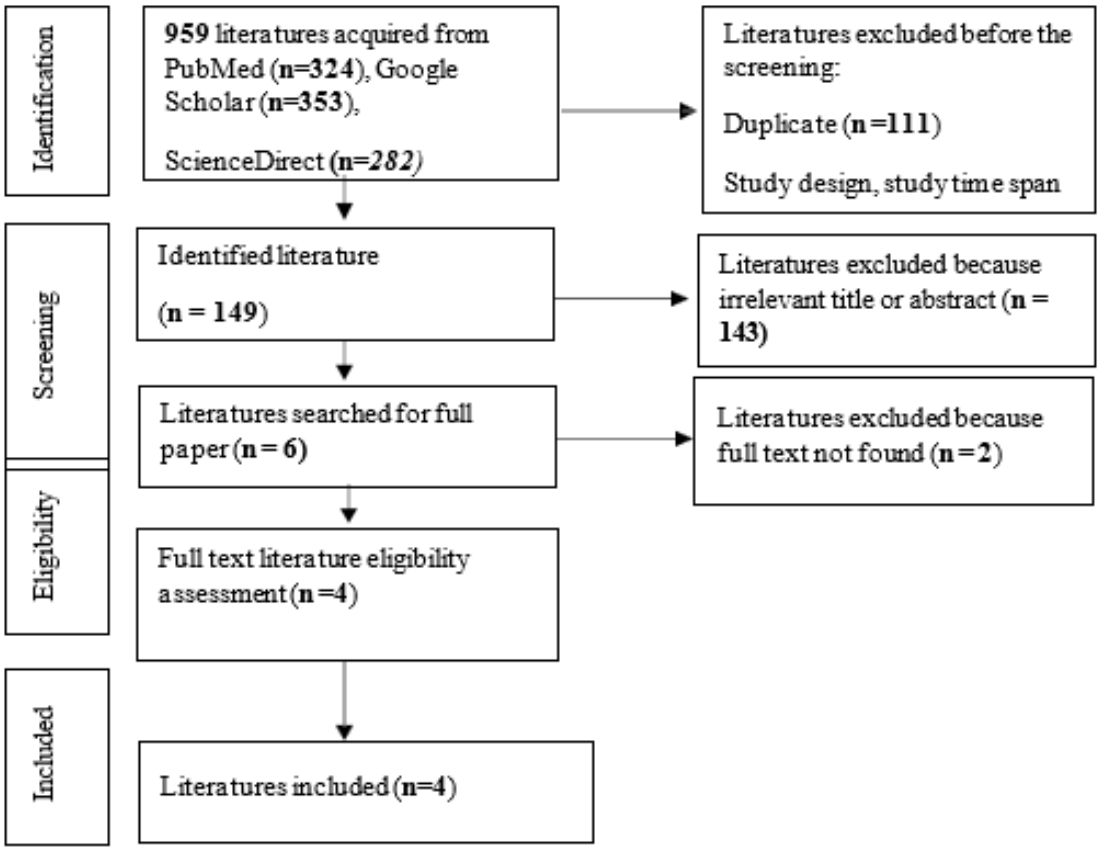

Figure 1. PRISMA study selection flow diagram

Author (Years)	Participants	LRS Description Technique Main Modification		Follow Up	Preoperative Gingival Display (Baseline)	Post-operative Gingival Display	Relapse
Alamar et al (2018)	22 patients G1: 11 G2: 11	G1: refers to the Conventional Techniques. G2: refers to a modified technique	G2: the myotomy lip elevator muscle perioral musculature was separated from the bone G1 muscle severance	6 months	G1: 5.82 ± 0.87mm G2: 6.36 ± 1.12mm	G1 6 months: 3.27 ± 0.79mm G2 6 months: 2.45 ± 1.13mm	G1 two patients with full relapse 6 months post-operatively G2 minor relapse in certain situations six months after surgery
Tawfik et al (2018)	20 patients G1: 10 G2: 10	G1: having a myotomy ellipse incision of partial thickness made using a blade G2: partial-thickness elliptical incision without myotomy	G2: whole frenulum muscle retention and mucoperio steal suturing in the internal dual muscle traction approach smile behaviour	12 months	G1: 6.29 ± 2.6mm G2: 4.31 ± 1.12mm	G1 6 months: 3.42 ± 1.23mm G1 12 months: 3.57 ± 1.62mm G2 6 months: 2.21 ± 1.00mm G2 12 months: 2.73 ± 1.28mm	NR

Author (Years)	Participants	LRS Description Technique Main Modification		Follow Up	Preoperative Gingival Display (Baseline)	Post-operative Gingival Display	Relapse
Hazzaa et al (2021)	20 patients G1: 10 G2: 10	G1: operation modified lip repositioning (MLR) G2: modification LRS with muscle containment using sutures. Internal Dual Muscle Traction Approach (iMTA)	G2: periosteal simple interrupted suture	12 months	G1: 4.30 ± 0.82mm	G1 6 months: 2.35 ± 0.53mm G1 12 months: 2.70 ± 0.48mm G2 6 months: 1.40 ± 0.46mm G2 12 months: 1.60 ± 0.52mm	NR
Al Jasser et al (2023)	200 patiens G1: 100 G2: 100	G1: represents the LipStaT technique G2: Periosteal simple interrupted suture		12 months	G1: 5.27 ± 0.75mm G2: 5.36 ± 2.20mm	G1 6 months: 2.27 ± 0.70mm G1 12 months: 3.70 ± 1.70mm G2 6 months: 2.35 ± 0.80mm G2 12 months: 2.48 ± 0.80mm	The EGD tended to climbed significantly from the 6-months to the 12-months check point for the control group, as compared to the test group, which showed a very slight, non significant

3.2. Modification LRS with muscular amputation [7]

Results of a modified LRS study that utilized a full-thickness membrane and the levators labii muscle in 22 patients between the ages of 18 and 38 who experienced a gummy smile. Patients were generally content with the procedures; however, both groups reported experiencing a "tension feeling" in the upper lip during the early healing phase. Most patients in both groups reported moderate edema, which cleared within seven days. Four patients who underwent the modified method experienced two weeks of persistent ecchymosis and perioral edema extending to the lower eyelids. Two patients underwent flap dehiscence monitoring during the modified lip repositioning procedure. During the initial two weeks following the procedure, the patients were instructed to reduce the movement of their upper lips when speaking or beaming. The modified technique only recorded numbness in three patients; however, it progressively dissipated within the first three weeks following the surgery.

According to his study's findings, the modified and traditional methods of lip repositioning surgery differed significantly in the reduction of gingival display at one and six months after surgery. The new technique showed successful outcomes at 1 and 6 months of 85.4% and 61.5%, respectively, while the standard technique produced 61.9 % and 42.03%, respectively. One and six months after surgery, the improved approach reduced gingival display more than the standard procedure. After a modified lip repositioning procedure, the outcomes were consistent for up to six months, and there was a significant difference ($P<0.05$) between the LRS group and the modified group at one and six months after the procedure, and there was only a modest relapse in a few patients. Compared to the original LRS group, the modified LRS group has a more significant gingival decrease in the first and sixth months after surgery. At 1, 3, and 6 months postoperatively, the gingival show decreased by 3.64, 3.27, and 2.55 mm in the LRS (group 1) and 5.45, 4.09, and 3.91 mm in the modified group (group 2).[7]

3.3. Modification LRS with muscle severance (myotomy) [16]

Compared to the baseline of 6.29 mm, LRS with myotomy resulted in a substantial reduction in EGD of 3.00 mm at 3 months, 3.42 mm at 6 months, and 3.57 mm at 12 months. Classical lip repositioning demonstrated a comparable decrease in EGD at 3, 6, and 12 months; however, the results deteriorated over time. The classical technique exhibited no significant difference, whereas the myotomy group attained a statistically superior reduction in philtrum length. The myotomy group experienced a slower rate of decline than the classical technique, which implies that muscle severance yielded a more consistent outcome. The myotomy group exhibited more edema than the classical group, and patients experienced a more significant amount of postoperative swelling. The study implies that muscle severance may be a more effective method for obtaining a more stable result, providing a more stable outcome.

3.4. Modification LRS with muscle containment using sutures (iMTA and MPS) [18]

This study aimed to determine how well MLR works for treating EGD, either by itself or combined with an internal dual muscular traction approach (iMTA). The smile lift muscles are pulled in with this method, and a musculo-periosteal suturing (MPS) is also used. The muscles that move the smile were pulled away from the bone and then pulled back during the healing process using traction. The 20 patients in this group were between 20 and 29. All of the subjects said they had pain and swelling after surgery for a short time, between 3 and 5 days. None of the people who took part talked about any problems that came up while the wounds were healing. Only four cases in group 2 (iMTA) said they felt a little tension in their smile for three to five weeks after the treatment.

Group 2 (iMTA) had a mean EGD of 1.35 mm at the 3-month, 1.4 mm at the 6- month, and 1.6 mm at the 12-month follow-up. At three, six, and twelve months, the EGD difference was statistically significant compared to the baseline. After a full year, the decrease was more noticeable. When comparing the variations at three and six months, no significant difference was found, despite the fact that every time point was checked for one.

When comparing the EGD in both groups at 12 months, the results of group 2 (iMTA) and group 1 (LRS) were (1.6 mm ± 0.52) and (2.7 mm ± 0.48), respectively. Between the two groups, a statistically significant difference was seen at the 3-, 6-, and 12-month intervals. By comparing the outcomes at three, six, and twelve months, the stability of the results attained within each group was evaluated. Both groups' outcomes at each succeeding time interval showed a decline. It appears that (iMTA and MPS) provided more consistent findings because the test group's rate of decrease was higher than the control group's. Finally, at 12 months, there was a significant improvement in both groups' self-reported patient satisfaction levels ($P<0.05$).

3.5. Modification Periosteal suturing with LRS [19]

This research aimed to assess the effectiveness of two variations of lip repositioning surgery (LRS) in addressing excessive gingival display (EGD). The study included 200 female participants, divided equally between two groups: the control group underwent standard LRS. In contrast, the test group underwent Modified LRS, incorporating periosteal sutures to stabilize the adjusted lip position. EGD measurements, recorded in millimeters (mm), were monitored at four distinct intervals to evaluate treatment outcomes. After one year, the average EGD for the test group was 2.48 ± 0.86 mm, while it was 3.77 ± 1.76 mm for the control group. Statistical analysis comparing the EGD measurements between the test and control groups showed a significant decrease in EGD for the test group ($P < 0.05$) compared to the control group after one year. These findings indicate that Modified LRS with periosteal sutures resulted in a statistically significant reduction in EGD compared to standard LRS after one year, suggesting it may offer improved outcomes for correcting EGD.[18]

4. Discussion

Lip repositioning surgery (LRS) presents a promising alternative for treating EGD without resorting to more invasive procedures like orthognathic surgery. It is particularly recommended for patients with mild anomalies who prefer minimally invasive techniques over orthodontic treatment or botulinum toxin injections.[20] However, it is crucial to note that LRS may not be suitable for individuals with severe vertical maxillary excess (VME) of degrees II (4 to 8 mm) or III (more than 8 mm).[20,21]

This review aimed to evaluate modified approaches of LRS reported in current literature for treating excessive gingival exposure. The primary goal of these modifications is to reduce the risk of relapse, a significant complication of traditional LRS techniques, and address other potential issues such as discomfort and restricted upper lip movements. Some concerns exist regarding long-term complications like paresthesia reported in a few cases.[22]

The scoping review focused on modifications of lip repositioning surgery (LRS), explicitly involving muscular amputation (myotomy), muscle containment with sutures (iMTA), and periosteal suturing. According to the findings, LRS with myotomy showed statistically superior results to traditional techniques, with outcomes remaining more consistent over 12 months. Alammar et al. compared conventional and modified approaches, highlighting that the modified technique incorporating myotomy was more sustainable and associated with a lower relapse rate. This suggests that myotomy combined with muscle containment can yield more favorable outcomes and help maintain the improvements.[23] However, the review emphasizes the necessity for further well-organized comparative clinical trials to conclusively establish the efficacy of myotomy/muscle containment compared to conventional approaches. The small number of studies and inconsistent available evidence point to essential gaps that require further investigation in order to fully validate these conclusions.[7]

Hazza's research indicates that an internal dual muscle traction technique (iMTA) utilized in lip repositioning surgery (LRS) can effectively reduce excessive gingival display brought on by hypermobility of the upper lip lift muscle. The study reported satisfactory and aesthetically pleasing results, with sufficient stability observed at the one-year follow-up. This dual approach presents a viable and innovative alternative for correcting EGD, mainly aimed at achieving favorable treatment outcomes, ensuring reasonable patient acceptance, and simplifying the

procedure. Comparatively, the conventional LRS technique yielded less satisfactory outcomes regarding patient satisfaction than the technique employing sutures to contain the muscle. Using sutures for muscle containment during LRS may lead to improved aesthetic results and higher patient satisfaction levels. Overall, Hazza's findings highlight iMTA as a promising method within the realm of LRS for addressing EGD induced by hypermobility of the upper lip lift muscle, offering advantages in outcome quality, patient acceptance, and procedural simplicity.[18]

To accomplish this, a modified Jasser incision of partial thickness must be made to remove a strip of mucosa from the maxillary vestibule (LRS with periosteal suturing). After that, the mucogingival line is sutured to the lip tissue. Several studies have shown that this operation has beneficial and favorable physical results.[24] But even with these advantages, a lot of people relapse six to twelve months after surgery. Some sources recommend removing the attachment to prevent the lip muscle from returning to its original position, which may reduce stress on the flap during stitching. Another technique involves using an autogenous or alloplastic separator to prevent the muscles responsible for smiling from reconnecting. Unlike traditional LRS, which typically reduces excessive gingival display (EGD) by 2 to 3 mm, recent studies have shown that Modified LRS can produce results that endure up to the one-year follow-up. Patients who underwent periosteal suturing during LRS were likely to recommend the treatment, noting higher satisfaction with the muscle containment technique using sutures compared to traditional methods. Nevertheless, further well-designed research must confirm and validate these findings conclusively. [19,25]

5. Conclusion

The conventional lip repositioning operation and the modified lip repositioning treatment both result in positive patient outcomes at 6 and 12 months of follow-up by reducing excessive gingival display. However, this modified method offers more stability and less relapse after surgery.

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