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ORIGINAL ARTICLE

# Clinical and psychological impact of lip repositioning surgery in the management of excessive gingival display

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**Abstract** *Background:* Excessive gingival display (EGD), also known as a gummy smile, is characterized by overexposure of the maxillary gingiva on smiling. EGD can cause embarrassment and reduce patient satisfaction. This study aimed to evaluate the clinical and psychological effects of lip repositioning surgery on the management of EGD.

*Methodology:* This experimental study enrolled 14 patients with EGD who had undergone a modified lip repositioning technique, which comprised moving two strips of mucosa bilaterally to the maxillary labial frenum and repositioning the new mucosal margin coronally. The extent of gingival display (GD), lip mobility (LM), total lip length (TLL), lip length (LL), and internal lip length (ILL) was measured at baseline and 6 months postoperatively. The pre-operative psychological assessment was conducted using the social appearance anxiety scale (SAAS) scores, whereas the postoperative assessment was conducted using SAAS and visual analog scale (VAS) scores at 1 week, 3 months, and 6 months postoperatively.

*Results:* Among the clinical parameters, TLL increased by 2.0 ± 1.038, LL increased by 2.28 ± 0.99, ILL reduced by 2.78 ± 1.36, LM reduced by 3.21 ± 1.12, and GD reduced by

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3.14 ± 0.77 at 6 months postoperatively. Among the psychological parameters, SAAS reduced by 31.42 ± 1.907 from the baseline to 6 months, whereas the VAS score reduced to 3.14 ± 0.27 at 6 months postoperatively.

*Conclusion:* A significant reduction in GD, which is largely dependent on strict case selection, pain, and social anxiety was observed in this study, indicating that lip repositioning surgery is effective in managing EGD.



## 1. Introduction

Good facial esthetics, teeth esthetics, and smile are essential factors that result in psychological well-being and social acceptance (Shah et al., 2022; Niraula et al., 2021; Rokaya et al., 2015). The gingival zenith (GZ) and gingival display (GD) are important determinants of the appearance of a smile (Humagain et al., 2016; Silva et al., 2021).

According to the Tjan classification, a high smile is characterized by the exposure of the full length of the incisors along with some amount of gingiva (Tjan et al., 1984). A gummy smile, also known as an excessive gingival display (EGD), is characterized by the exposure of > 3–4 mm of the gingival tissue during smiling, leading to esthetic disharmony (Dym and Pierre, 2020). A gingiva-to-lip distance of ≥ 4 mm during smiling was considered unattractive by both dentists and the general population in a study assessing dental esthetics (Garber and Salama, 1996). The social significance of an attractive smile, as well as the negative impact of EGD, is the reason why patients with EGD seek treatment (Gargiulo et al., 1961). The mentolabial sulcus is also an important aspect of the lower facial esthetics (Rokaya et al. 2018). The sulcus was classified as deep, average, and shallow. The average mentolabial sulcus angle 118.19° ± 12.28°, in male is 119.43° ± 9.99°, and in female is 117.61° ± 13.23°.

Understanding the etiology of EGD will aid in selecting the best treatment modality for each patient (Dym and Pierre, 2020). Esthetic crown lengthening, with or without osseous reduction, is the treatment of choice for altered passive eruptions (Garber and Salama, 1996), whereas orthognathic surgery is the treatment of choice for vertical maxillary excess (Simon et al., 2007). The anatomic maxillary lip is measured from the subnasale to the inferior border of the upper lip, and it is usually considered short when the lip is < 15 mm in length (Silberberg et al., 2009). Surgical intervention or orthodontic intervention is required to correct anterior dentoalveolar extrusion (Silberberg et al. (2009).

Excessive mobility or hypermobility of the upper lip is another major cause of a gummy smile. The upper lip rises by 6–8 mm from rest on smiling; in contrast, a hyperactive upper lip may rise up to twice this distance (Robbins, 1999). Hyperactivity of the elevator muscles of the upper lip, i.e., the zygomaticus minor, levator anguli oris, orbicularis oris, and levator labii superioris, can lead to excessive mobility (Bhola et al., 2015; Tawfik et al., 2017).

Lip repositioning surgery is a versatile surgical option for the treatment of EGD, mainly in patients with lip hypermobility and bony maxillary excess. This study aimed to evaluate the clinical and psychological effects of lip repositioning surgery on the management of EGD.

## 2. Materials and methods

The study was designed as a pre-and post-experimental study, which falls under the category of non-randomized controlled trials. The study population consisted of patients with EGD who were referred to the Department of Periodontics, Kathmandu University School of Medical Sciences (KUSMS), Dhulikhel.

This study was approved by the Institutional Review Committee of the Kathmandu University, School of Medical Sciences (Ref: 220/19). Consent was taken from all participants before surgery. The inclusion criteria were as follows: age > 18 years, gingival display of > 4 mm, no history of smoking, no history of systemic or periodontal diseases, and lip mobility of > 8 mm. The exclusion criteria were as follows: the presence of systemic disease that can affect the periodontium, an ability or unwillingness to cooperate, and pregnancy and lactation. Purposive and convenience sampling techniques were used in this study.

The sample size was determined using the formula [$n = \{(Z\alpha + Z\beta)\ ^2s^2\}/d^2$], where n is the sample size, Zα is the z deviate corresponding to the α error rate (1.96 for 95% reliability), Zβ is the z deviate corresponding to the β error rate (1.28 at 90% power), S is the standard deviation taken from the previous study, and d is the mean difference between the two groups (Kim, 2016).

An estimated sample size of 14 was obtained using the above-mentioned formula where 2.2 was the standard deviation obtained from a previous study by Silva et al. (Silva et al., 2013) after adding an attrition rate of 10%.

### 2.1. Clinical parameters

The total lip length (TLL), lip length (LL), gingival display (GD), lip mobility (LM), and internal lip length (ILL) were measured at baseline and 6 months postoperatively (Figs. 1–2). TLL (Roy, 2016) was measured from the base of the nose to the inferior border of the vermilion border of the upper lip. LL (Roy, 2016) was measured from the base of the nose to the superior border of the vermilion border of the upper lip. GD (Roy, 2016) was measured from the most inferior portion of the vermilion border of the upper lip to the gingival margin of the right maxillary central incisor. LM (Roe et al., 2012), defined as the amount of lip movement that occurs when a patient smiles, was calculated by subtracting the incisal exposure at rest from the dento-gingival exposure during maximum smiling. TLL, LL, GD, and LM were measured with a millimeter index using a University of North Carolina (UNC)-15 probe or a reference ruler held in place. ILL, or the vestibular depth, was measured using a commercially avail-

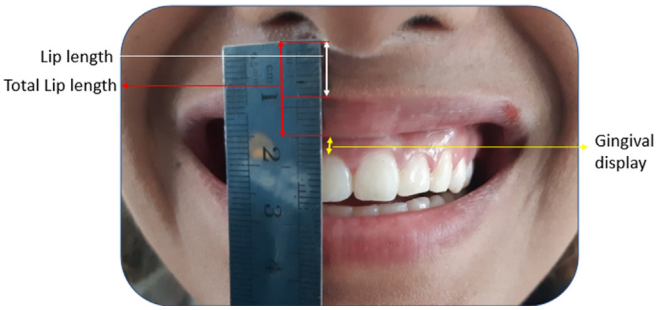


**Fig. 1** Clinical parameters.

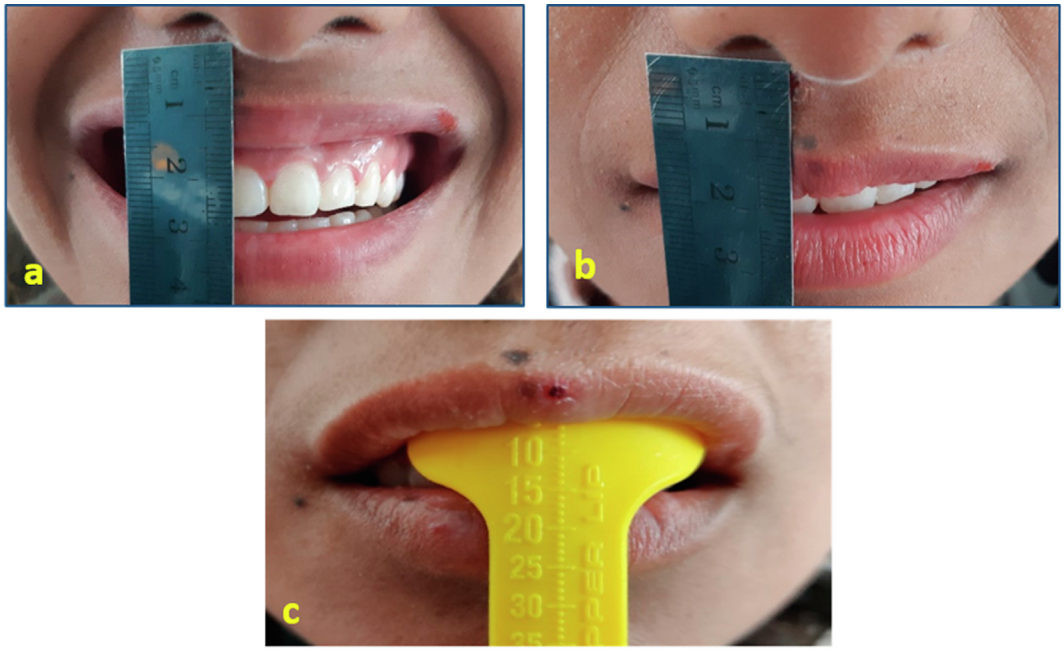


**Fig. 2** (a) Dento-gingival exposure during maximum smile. (b) Dento-gingival exposure during rest [lip mobility = a-b]. (c) Internal lip length.

able internal lip ruler (Massad Edentulous Lip Ruler, Nobilium) or a UNC-15 probe. The internal lip ruler was slightly modified such that the most superior portion was at the 0 mm demarcation and did not interfere with the maxillary labial frenum. The ILL measurements were recorded at rest (Roy, 2016).

### 2.2. Psychological parameters

The visual analog scale (VAS) was used to evaluate postoperative pain (Wessel and Tatakis, 2008). The social appearance anxiety scale (SAAS) score was used to evaluate appearance-related anxiety (Hart et al., 2008).

### 2.3. Procedure

The baseline clinical parameters were recorded after screening and diagnosis. The surgical procedure followed in this study has been described previously in the studies by Bhola et al. (Bhola et al., 2015) and Ribeiro et al. (Ribeiro-Júnior et al., 2013). The inferior border was located at the mucogingival junction. The lateral extension of the incision was determined based on the horizontal extension of the dynamic smile. The vertical height of the incision was twice the EGD measurement during the full dynamic smile. A partial-thickness incision was made along the superior and inferior borders and converged with the vertical incisions at the posterior aspect using a No. 15 Bard-Parker blade. The incisions were converged at the central incisor region, avoiding the maxillary labial frenum (Fig. 3a). Subsequently, the epithelium was carefully separated to expose the underlying connective tissue within the outline (Fig. 3b). The incision lines were approximated using interrupted stabilization sutures. A chlorhexidine mouth rinse, in addition to antibiotics and analgesics, was prescribed depending on the clinical scenario. The patients were advised to place cold packs extra-orally to reduce postoperative swelling and minimize lip movement. The patients were reviewed 7–10 days after suture removal. The TLL, LL, GD, LM, and ILL were measured 6 months postoperatively. Preoperative psychological assessment was conducted using SAAS, whereas postoperative psychological assessment was conducted at 1 week,


**Fig. 3** (a) Partial thickness dissection with the labial frenum intact. (b) Removal of a strip of epithelium. (c) Pre-operative smile. (d) Postoperative smile. (e) Pre-operative smile- 2nd case. (f) Postoperative smile- 2nd case.

3 months, and 6 months using VAS and SAAS. SAAS consisted of 16 items that were scored on a five-point scale. The first item was reverse-coded, with higher scores indicating greater social appearance anxiety (Hart et al., 2008).

### *2.4. Statistical analysis*

Five clinical parameters were evaluated, and psychological parameters were evaluated using two questionnaires. The Kolmogorov-Smirnov and Shapiro–Wilk tests were used to assess the normality of the data. The analysis revealed that the data were normally distributed.

## 3. Result

### *3.1. Demographic data*

Fourteen patients were included in the study based on the inclusion criteria. The study participants were 13 females and one male aged 20–30 years.

### *3.2. Clinical parameters*

The difference between the clinical parameters at baseline and those measured at 6 months postoperatively was highly statistically significant ($p < 0.001$ obtained using the paired *t*-test) (Table 1). The major highlights of the clinical parameters were the post-operative increase in TLL, LL whereas a post-operative decrease in GD, LM, and ILL.

### *3.3. Psychological parameters*

The SAAS scores at baseline; the SAAS scores at 1 week, 3 months, and 6 months postoperatively; and the VAS scores at 1 week, 3 months, and 6 months postoperatively were evaluated and analyzed using ANOVA. The differences between the scores were found to be statistically significant (Table 2). Multiple comparisons were performed using Tukey's post-hoc test after ANOVA (Table 3).

## 4. Discussion

Smile is considered unattractive when a distance of $\geq 4$ mm between the lip and gingiva is present (Kokich et al., 1999). There are wide arrays of etiological factors and management options for EGD. Despite having several etiologies, the prevalence of a hypermobile upper lip (HUL) is extremely high among patients with EGD; therefore, a large proportion of patients with EGD may benefit from treatment modalities aimed at limiting the hypermobility of the upper lip (Andijani and Tatakis, 2019).

**Table 1** Clinical parameters at baseline and 6 months postoperatively.

| Clinical parameters | Pre-treatment (baseline) (Mean ± Standard deviation) | 6 months postoperatively (Mean ± Standard deviation) | Mean difference (Baseline and 6 months postoperatively) | p-value |
|---|---|---|---|---|
| Total lip length | 17.14 ± 1.61 | 19.14 ± 1.791 | 2.0 ± 1.038 | < 0.001* |
| Lip length | 9.79 ± 2.08 | 12.07 ± 2.129 | 2.28 ± 0.99 | < 0.001* |
| Internal lip length | 8.93 ± 1.97 | 6.14 ± 1.51 | 2.78 ± 1.36 | < 0.001* |
| Lip mobility | 9.21 ± 1.36 | 6 ± 1.79 | 3.21 ± 1.12 | < 0.001* |
| Gingival display | 4.21 ± 0.42 | 1.07 ± 0.82 | 3.14 ± 0.77 | < 0.001* |

*p-value < 0.001 indicating high statistical significance according to paired *t*-test.

**Table 2** The mean SAAS and VAS scores at different intervals.

| Questionnaires | Pretreatment (baseline) (Mean ± Standard deviation) | 1 week postoperatively (Mean ± Standard deviation) | 3 months postoperatively (Mean ± Standard deviation) | 6 months postoperatively (Mean ± Standard deviation) | p-value |
|---|---|---|---|---|---|
| Visual analog scale (VAS) | X | 3.29 ± 0.914 | 1.21 ± 0.802 | 0.14 ± 0.363 | < 0.001* |
| Social appearance anxiety scale (SAAS) | 56.50 ± 0.5.958 | 51.14 ± 6.678 | 29.64 ± 4.031 | 25.07 ± 2.336 | < 0.001* |

*p-value < 0.001 indicated high statistical significance according to ANOVA.

Botulinum toxin injections and lip repositioning surgery are the primary options for the treatment of EGD caused by HUL; orthognathic surgery is another option. However, botulinum toxin injections do not have a permanent effect and must be repeated every few months, whereas orthognathic surgery is an invasive procedure (Polo, 2005; Tawfik et al., 2017). In contrast, lip repositioning surgery is a less invasive and permanent procedure for the treatment of EGD.

Lip repositioning surgery was first described by Rubinstein and Kostianowsky in 1973 (Kostianowsky and Rubinstein, 1976). Various modifications have been made to this procedure. For instance, Ribeiro-Junior et al. (2013) modified the original technique such that the upper labial frenum was preserved to maintain the labial midline and reduce postoperative morbidity (Silva et al., 2013). The present study used the surgical technique described by Bhola et al. and incorporated the modification of maintaining the frenum, as described by Ribeiro-Junior et. al and was satisfactory.

This study aimed to compare clinical parameters, such as GD, before and after lip repositioning surgery and assess the potential psychological impact of the procedure. The findings of the present study revealed that lip repositioning successfully reduced the gingival display in all included patients with minimal morbidity which is similar to the findings of many clinical studies (Silva et al., 2013; Duruel et al., 2020; Roy, 2016) and a systematic review done by Tawfik et al. in 2017). In addition, an increase in LL and TLL is in accordance with the results of the previous clinical studies conducted (Silva et al., 2013; Roy, 2016). There was a decrease in ILL and LM which is in accordance with the previous study (Roy, 2016; Suh et al., 2020).

The psychological parameters like VAS and SAAS were also evaluated which yielded positive results at 6 months postoperatively. The decrease in pain and social appearance anxiety was similarly reported in previously published literature (Roy, 2016).

Regarding the complications, minor scarring along the suture line was observed in all patients after several weeks of healing. Almost all patients reported mild discomfort, tension, and slight pain on smiling during the first postoperative week, whereas some reported moderate swelling that resolved completely within 6–7 days. Similar side effects were seen in previous studies(Gabrić Pandurić et al., 2014; Abdullah et al., 2014). However, some complications reported in previous studies, such as a mucocele, paresthesia, and transient paralysis (Rosenblatt and Simon, 2006) were not seen in this study.

Relapse can occur after lip repositioning surgery (Rosenblatt and Simon, 2006; (Rubinstein and K. A., 1973; Ribeiro-Júnior et al., 2013). Although complete relapse was not observed during the 6-month follow-up period in the present study, asymmetry during smiling could have been a significant complication. This complication was prevented by maintaining the labial frenulum intact at the midline throughout the surgical procedure.

The findings of the current study showed improvements in the clinical and psychological parameters. The results of the present study demonstrated that the outcomes of lip repositioning surgery are stable even after 6 months and well-received by patients who have undergone the procedure. The current technique employed can be considered less invasive and more conservative as supported by previous literature as well (Silva et al., 2013),(Simon et al., 2007).

Nevertheless, this study has some limitations. One of the limitations of the current study is the study population taken which was heterogeneous, with females being the major population agreeing to the lip repositioning surgery which is in accordance with the fact that females are more esthetically critical compared to males (Geron and Atalia, 2005).

**Table 3** The mean difference in the SAAS and VAS scores at different intervals.

| Mean difference between different interval | Visual analog scale (VAS) | | Social appearance anxiety scale (SAAS) | |
|---|---|---|---|---|
| | Mean difference | p-value | Mean difference | p-value |
| Baseline and 1 week postoperatively | X | X | 5.35 | 0.034** |
| Baseline and 3 months postoperatively | X | X | 26.85 | < 0.001* |
| Baseline and 6 months postoperatively | X | X | 31.429 | < 0.001* |
| 1 week and 3 months postoperatively | 2.07 | < 0.001* | 21.5 | < 0.001* |
| 1 week and 6 months postoperatively | 3.14 | < 0.001* | 26.071 | < 0.001* |
| 3 months and 6 months postoperatively | 1.07 | 0.001** | 4.57 | 0.090 |

*p-value < 0.001 indicated high statistical significance according to the Tukey post-hoc test.
**p-value < 0.05 indicated high statistical significance according to the Tukey post-hoc test.

There are limited clinical studies that have examined the efficacy of lip repositioning surgery for the treatment of EGD. Therefore, additional clinical studies are required to confirm the stability and validity of these findings as well because the study results were compared with limited existing literature. In addition, the sample size was limited. Furthermore, the follow-up period was short and could have been extended.

## 5. Conclusion

In conclusion, the findings of this study suggest that lip repositioning surgery resulted in a statistically significant improvement in GD. The psychological scales indicated a reduction in pain and social anxiety. Thus, lip repositioning surgery can be regarded as a treatment modality with a high success rate for the treatment of EGD.

## Ethical statement

Ethical clearance was obtained from the institutional review committee, Kathmandu University School of Medical Sciences (Ref: 220/19). Informed consent was taken from all the subjects before surgery.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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