Gummy smile correction by different alternatives of lip repositioning techniques (A comparative clinical study)

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Abstract

Background: Excessive gingival display (EGD), frequently called gummy smile (GS), is the term utilized when there is an overexposure of maxillary gingiva throughout the smile.

Aim: To compare the practical effectiveness and postoperative parameters of using different lip repositioning techniques in the management of GS.

Patients and methods: This research has been performed on 16 females, aged between 19 and 30 years, with a mean age of 29.04 ± 0.688 years, suffering from a short hypermobile lip with a gummy smile. All cases have been chosen among individuals visiting the outpatient dental clinic at the Oral Medicine, Periodontology, Oral Diagnosis, and Dental Radiology Department, Faculty of Dental Medicine, Al-Azhar University, Assiut Branch.

Results: There were no changes in attached gingiva thickness in both groups at various intervals (baseline, 1st month, and 3rd month) ($p = 0.539$). Visual Analog Scale (VAS) showed a negative correlation with most parameters except for Gummy Smile, which had a positive correlation. Healing scores had the strongest correlation, negatively correlating with most parameters except for gingival thickness. Gummy smiles are positively correlated with all parameters except healing scores. Gingival width negatively correlated with most parameters except for gummy smile and gingival thickness, which showed positive correlations. Gingival thickness was positively correlated with most parameters except for VAS, which had a negative correlation.

Conclusion: Laser-assisted LRS demonstrated significant advantages over conventional LRS, including lower postoperative pain, improved healing potential, and a greater decrease in gingival display at a six-month monitoring.

Key words: EGD, GS, VAS.

Introduction

Excessive gingival display, frequently referred to as a gummy smile, is an illness indicated by an overexposure of maxillary gingiva throughout smiling. The prevalence of this issue can be related to various etiologies, including anterior dento-alveolar extrusion, altered passive eruption, vertical maxillary excess (VME), and a short hyperactive upper lip **(1, 2)**.

Lip repositioning (LR) is a suggested therapeutic approach for cases exhibiting excessive gingival shows related to a hypermobile lip. The aim of lip repositioning is to diminish the vestibule and restrict the retraction of the lip elevator muscles by exercising a mucosa strip from the maxillary buccal vestibule and attaching the mucosa of the lip to the mucogingival line, thus minimizing gingival show during smiling. **(3).**

The procedure for surgical lip repositioning consists of a single partial-thickness oval incision made in the depth of the upper anterior vestibule. It seeks to reduce upper vestibular depth to restrict smile-controlling muscle pull (orbicularis oris, levator labi superioris, levator anguli oris, and zygomaticus minor) **(4).**

In 1995, the first diode laser for dentistry was introduced. It was an 810 nanometer (nm) diode laser with a peak power of 6 watts **(5).** Nowadays frequencies can be up to 30000 hertz (Hz) and a peak power of 50 watts (W) **(6).**

Diode laser has the advantages of minimal or no anesthetic being required and no harm to dental tissues. Diode laser does not injure the dental pulp. Surgeries are easy to be carried out by diode laser with less discomfort, minimal or no bleeding, and a short healing time with reduced post-operative bleeding and edema **(7).**

The objective of this work was to compare the practical effectiveness and postoperative parameters of using different lip repositioning techniques in GS management.

Patients and methods

This research has been carried out on 16 females, aged between 19 and 30 years, with a mean age of 29.04 ± 0.688 years, suffering from a short hypermobile lip with a gummy smile. The patients have been separated into two equal groups (n = 8) based on the lip repositioning techniques used: Group I (control group), where patients were treated with conventional lip repositioning surgery, and Group II (test group), where patients underwent lip repositioning using a diode laser. All cases have been chosen among cases attending the outpatient dental clinic at the Department of Oral Medicine, Periodontology, Oral Diagnosis, and Dental Radiology, Faculty of Dental Medicine, Al-Azhar University, Assiut Branch.

Inclusion criteria: Cases included in this research were free from any systemic illnesses, following the American Dental Academy (ADA) general guidelines for referring dental cases to specialists and other settings for care. They maintained adequate oral hygiene and exhibited a gummy smile varying between four to six millimeters due to a short upper lip and a hyperactive lip elevator muscle, with lip mobility exceeding eight millimeters.

Exclusion criteria: smokers, medically compromised cases, pregnant or lactating women, patients on oral contraceptive pills, individuals with vertical maxillary excess exceeding 8 mm, those with a history of alcohol or drug abuse, and patients undergoing chemotherapy or radiotherapy.

Methods

Pre-Surgical Preparation and Laser-Assisted Lip Repositioning Technique: All patients underwent an initial non-surgical periodontal phase I therapy, including full-mouth supra and subgingival scaling using hand instruments and an ultrasonic scaler, followed by oral hygiene

instructions to achieve an FMPS of <20%. They were instructed to rinse with chlorhexidine gluconate mouthwash (Orovex) for 30 seconds twice daily and strictly follow oral hygiene measures, including dental flossing and tooth brushing. Pre-antiedematous medication (Alphintern) was prescribed three times daily, one hour before meals, for three days before surgery. A primary diagnosis of vertical maxillary excess and hypermobile upper lip has been conducted for each case, excluding participants with excessive VME (>8 mm). Preoperative clinical photographs were taken, capturing both frontal and profile views of the patient's lip at rest and throughout a maximum spontaneous smile, with EGD documented at both maximum and relaxed smiles utilizing a graduated periodontal probe, measuring from the free gingival margin to the upper lip border. For the laser-assisted lip repositioning technique (Group II), the procedure began with marking incision lines using a surgical marking pen, followed by mucosal removal with a 15C blade. Local anesthetics (two percent lidocaine with 1:80,000 epinephrine) have been used at the operative location. Laser safety protocols were strictly adhered to, necessitating that both the case and therapist wear laser safety glasses specific to the exact laser wavelength. A 980-nanometer diode laser with a 400-µm tip has been utilized in continuous mode at 0.8 to delineate the incision line utilizing Sirolase. A horizontal incision has been executed at the mucogingival junction, accompanied by a second incision ten millimeters parallel to the first, extending to the distal terminus of the last tooth. Laser ablation has been conducted at 2.17W in pulsed mode with a twenty-five-millisecond pulse duration, utilizing mild brush strokes to regulate ablation depth, succeeded by tissue tag removal and saline irrigation. The incision lines have been approximated using interrupted stabilizing sutures at the midline and along the edges to achieve accurate flap alignment.

Postoperative Instructions: Patients were advised to avoid eating or drinking for one-hour post-surgery and to consume soft and cold foods on the first postoperative day. They were instructed to rinse with chlorhexidine gluconate mouthwash (Orovex) for 30 seconds twice daily for 10 days and apply cold fomentation on the day of the operation to minimize edema formation. Medications, including ascorbic acid (Ruta C 602) and analgesics (ibuprofen 200 mg), were prescribed. Patients were scheduled for monitoring the following week to assess wound sutures and healing.

Measurement and Data Analysis: Excessive gingival display (EGD) was measured at maximum and relaxed smiles utilizing a graduated periodontal probe, with clinical photographs taken at baseline and after 1, 3, and 6 months. The width and thickness of attached gingiva were assessed preoperatively and at 1 and 3 months postoperatively by calculating the difference from baseline values. Tissue healing was evaluated using the Healing Index (HI) at 1, 3, and 6 weeks based on tissue color, bleeding on palpation, granulation tissue presence, incision margin healing, and suppuration. Statistical analysis was conducted utilizing SPSS® Version 20, with normality tests applied and appropriate statistical tests such as t-tests, ANOVA, Mann-Whitney, Friedman, and Wilcoxon tests utilized, setting significance at $P \leq 0.05$.

Ethical consideration

The ethical committee of the Faculty of Dental Medicine at Al-Azhar University accepted the research protocol. The study's objective was clearly explained to all participants, and informed consent was received from all cases before the start of the investigation.

Results

Table (1): The mean, ± standard deviation and p-values of visual analog scale of different groups.

Variables	VAS								
	Group I (Surgical)				Group II (Laser)				p-value
	Min	Max	Mean	SD	Min	Max	Mean	SD	
1 day	8.000	10.000	8.875	0.835	3.000	5.000	4.125	0.641	**0.001***
1st week	4.000	8.000	5.625	1.188	1.000	3.000	1.750	0.707	**0.001***
2nd week	2.000	4.000	2.625	0.744	0.000	1.000	0.375	0.518	**0.001***
3rd week	0.000	2.000	1.000	0.535	0.000	0.000	0.000	0.000	**0.001***
p-value	**<0.001***				**<0.001***				

*; significant (p<0.05).

Both Group I (Surgical) and Group II (Laser) showed significant differences in VAS scores across all time points (1 day, 1st week, 2nd week, and 3rd week) with p<0.001. In Group I, significant differences were found between 1 day and the other weeks and between the 2nd and 3rd weeks. Group II showed similar results, except no difference was found between the 2nd and 3rd weeks. Significant variations were also noted among both groups at all time points (p=0.001) (Table 1).

Table (2): The mean, ± SD and p-values of Gummy display in mm of distinct groups.

Variables	Gummy display								
	Group I (Surgical)				Group II (Laser)				p-value
	Min	Max	Mean	SD	Min	Max	Mean	SD	
Baseline	5.000	7.000	6.357	0.748	4.000	7.000	5.357	1.107	**0.071ns**
1 m	2.000	4.000	3.143	0.900	1.000	3.000	2.000	0.816	**0.029***

3 m	2.000	3.000	2.571	0.535	0.000	2.000	1.143	0.690	**0.001***
6 m	2.000	3.000	2.571	0.535	0.000	2.000	1.143	0.690	**0.001***
p-value	**<0.001***				**<0.001***				

* ns; non-significant (p>0.05)

Both Group I (Surgical) and Group II (Laser) showed significant differences in gummy display scores at all time points (Baseline, 1m, 3m, 6m) with p<0.001. Group I had significant differences between baseline and other time points and between 1m and 3m/6m (p=0.030), but no difference between 3m and 6m (p=1). Group II had similar results, with significant variations among baseline and other time points and between 1m and 3m/6m (p=0.001), but no variation among 3m and 6m (p=1). Between groups, no significant variance has been discovered at baseline (p=0.071), but significant differences were observed at 1m, 3m, and 6m (p=0.029, p=0.001, p=0.001) (Table 2).

Table (3): The mean, ± SD and p-values of Width of attached gingiva in mm of different groups.

Variables	**Width of attached gingiva**			
	Min	**Max**	**Mean**	**SD**
Group I (Surgical)	3.000	4.500	3.833	0.516
Group II (Laser)	3.000	4.000	3.583	0.492
p-value	**0.411ns**			

There were no changes in the width of attached gingiva in both groups at the different intervals (Baseline, 1st month, and 3rd month), with a p-value of 0.411 (Table 3).

Table (4): The mean, ± SD and p-values of Width of attached gingiva in mm of different groups.

Variables	**Thickness of attached gingiva**			
	Min	**Max**	**Mean**	**SD**
Group I (Surgical)	1.000	2.000	1.714	0.393
Group II (Laser)	1.000	2.000	1.571	0.450
p-value	**0.539ns**			

ns; non-significant (p>0.05)

There were no changes in the thickness of attached gingiva in both groups at the different intervals (Baseline, 1st month, and 3rd month), with a p-value of 0.539 (Table 4).

Table (5): Spearman correlation for all tested variables.

Variables	**VAS**	**Healing score**	**Gummy smile**	**Width of gingiva**	**Thickness of gingiva**

VAS	**Spearman Correlation**	1.000	-0.801	0.597	-0.056	-0.040
	p-value	-	0.000	0.000	0.708	0.771
Healing score	**Spearman Correlation**	-0.801	1.000	-0.695	-0.076	0.049
	p-value	0.000	-	0.000	0.606	0.718
Gummy smile	**Spearman Correlation**	0.597	-0.695	1.000	0.337	0.065
	p-value	0.000	0.000	-	0.019	0.633
Width of gingiva	**Spearman Correlation**	-0.056	-0.076	0.337	1.000	0.206
	p-value	0.708	0.606	0.019	-	0.161
Thickness of gingiva	**Spearman Correlation**	-0.040	0.049	0.065	0.206	1.000
	p-value	0.771	0.718	0.633	0.161	-

VAS showed a negative correlation with most parameters, except for Gummy smile, which had a positive correlation. The strongest correlation was with healing scores. Healing scores negatively correlated with most parameters, except gingiva thickness, which showed a positive correlation. Gummy smiles were positively correlated with all parameters, except healing scores, which had a negative correlation. The width of gingiva had a negative correlation with most parameters, except for gummy smile and gingiva thickness, which showed positive correlations. Gingiva thickness was positively correlated with most parameters, except VAS, which had a negative correlation (Table 5).

Case presentation

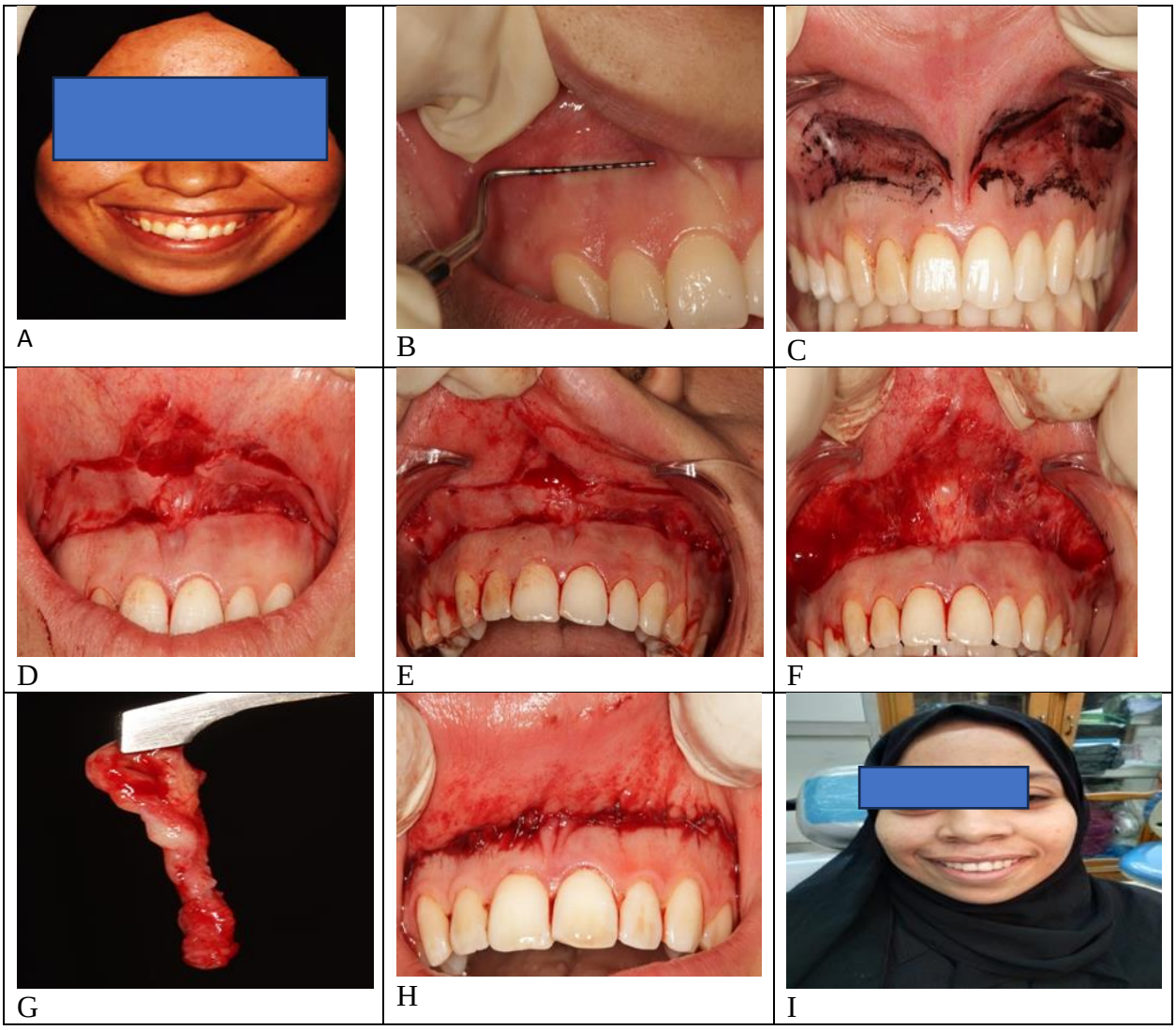
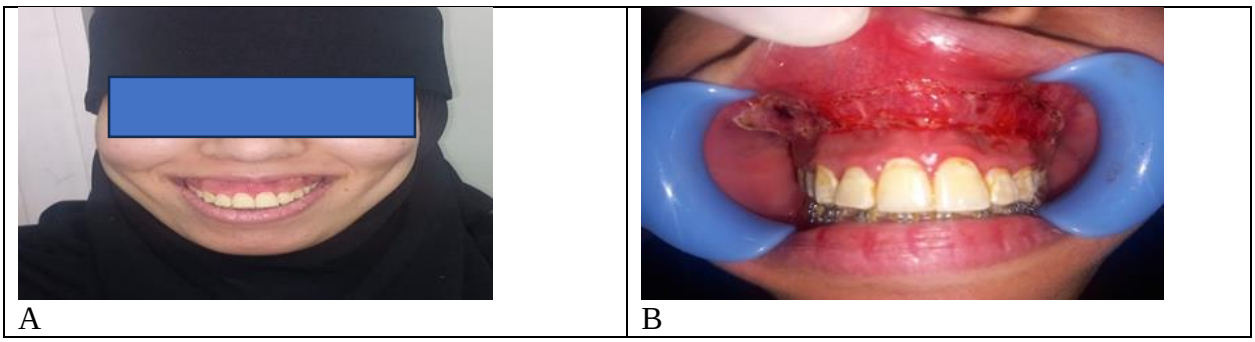


Figure (1): Clinical photographs of a 29-year-old female case with a conventional lip repositioning technique showing (a) excessive gummy display and (b, c) marking incision. Lined by a surgical marking pen. (d.e.f.) Horizontal incision at the mucogingival junction and a 2nd incision at the labial mucosa. (g) Strip of removed mucosa (h) interrupted suture (k) After 6 months.



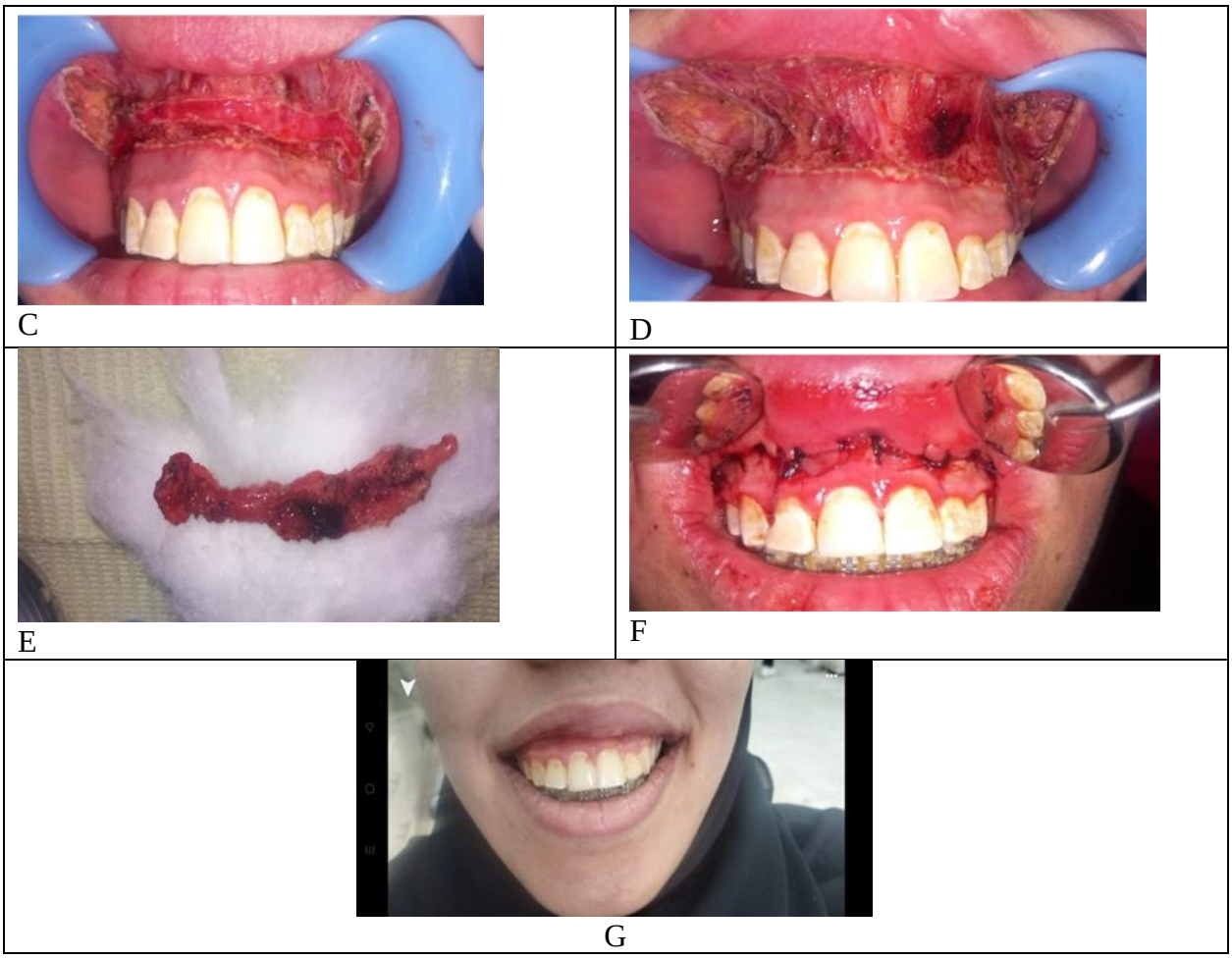


Fig. (2): Clinical photographs of a 29-year-old female patient with the laser-assisted lip repositioning technique showing: (a) An excessive gummy display (b.c.) incision was made by an A980 nm diode laser. (d) Horizontal incision at the mucogingival junction and a 2nd incision at the labial mucosa. (g) Strip of removed mucosa (h) interrupted suture (k) after 6 months.

Discussion

The finding of this present trial showed that the laser-assisted LRS had a significantly lower VAS score after 1 day as well as after 1, 2, and 3 weeks of monitoring. These results are in accordance with the results of previous research, which found that a few postoperative problems, including acute pain, bruising, paresthesia, swelling of the upper lip, and mucocele development, were associated with the older scalpel-based approach. Additionally, the use of laser bandages promotes healing and lessens postoperative pain and inflammation **(8, 9, 10).**

According to earlier research, pain, scarring, and discomfort were the most common postoperative complications. Thus, in the current clinical investigation, the VAS pain scale and healing index were used as comparative criteria for both tested LRS techniques **(11, 12, 13).**

Excessive gingival display is frequently the source of patients' aesthetic problems, as they express dissatisfaction with many features of their smile, including the size and form of their maxillary anterior teeth and the quantity of gingiva visible when smiling. Nonetheless, a significant

limitation associated with the operation is the recurrence of the gummy smile. Therefore, the excessive gingival display was chosen as a comparative parameter in this present clinical trial **(14, 8).**

The attached gingiva's breadth and thickness were measured in this clinical experiment because reports of an insufficient attached gingiva zone could result in a shallow vestibule that may compromise the ability to conduct adequate oral hygiene. Moreover, there is a higher chance of relapses with the operation in thin gingival biotypes **(15, 16).**

The excessive gingival display (gummy smile) is more common in women and occurs during smiling, with a prevalence ranging from 11.8% to 10.57%. According to recent reports, the prevalence of EGD in the general adult population is around 7%, with a much greater frequency among females and Black people. For this reason, regarding the population, only female patients were chosen to participate in this randomized trial **(17, 18).**

Generally**,** the results of the current clinical research indicate that laser-assisted LRS is a potential treatment for gummy smiles. At a 6-month follow-up, the gingival show had significantly decreased. Additionally, a little recurrence was noted throughout the follow-up period. Nevertheless, a recent split-mouth randomized clinical trial. comparing diode laser-performed and conventional (scalpel-performed), and they found that the aesthetic crown lengthening revealed no changes in clinical or patient-reported results, which contradicts the trial's findings **(19).**

Nonetheless, a major limitation associated with the operation is the recurrence of the gummy smile. The result of this present study revealed that there was a significantly lower gingival display observed when laser-assisted LRS was performed in comparison with the conventional scalpel surgery. This results in agreement with the results of previous research by Farista et al. (2017), which exhibited that the use of laser-assisted LRS has superior clinical outcome and can overcome the recurrence problem of the gummy smile **(20).**

Conclusions

Laser-assisted LRS demonstrated significant advantages over conventional LRS, including lower postoperative pain, improved healing potential, and a greater decrease in gingival display at a six-month monitoring.

Recommendations

Further longitudinal diurnal studies are needed to assess recurrence, along with more clinical studies to evaluate various surgical techniques and laser types.

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