

Laser-assisted Lip Repositioning for Gummy Smile

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ABSTRACT

Aim: The present study was carried out to evaluate the efficacy of laser-assisted lip repositioning for gummy smile correction.

Materials and methods: This was a prospective study with sample size of 10 patients with a gummy smile of more than 3 mm. Clinical assessment of pre- and postoperative lip length at rest and at smile was done. Analysis of variance (ANOVA), Tukey test and Chi-square test were used for statistical tabulation.

Results: On assessing, the mean value of pre-op gingival display was 5.4 mm, postoperative 6 months showed a mean value of 1.9 mm. The results were statistically significant. Measurement of lip length showed pre-op mean value of 19.20 mm at rest and 14.20 mm at smile; postoperative results at 6 months was estimated at 20.1 mm at rest and 15.7 mm while smiling, $p=0.460$ lip length at rest and $p=0.082$ lip length at smile.

Conclusion: It is an efficient technique for correction of gummy smile and an excellent alternative to more costly procedures with high morbidity rates. It is also minimally invasive with minimal postoperative swelling and pain. But extensive research is definitely imperative so as to increase its range of application.

Keywords: Diode laser, Gummy smile, Lip repositioning.

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INTRODUCTION

Smile is very important for facial expression and depends not only on dental aspects, such as size, shape, color, and position, but the amount of visible gingival tissues as well.¹

Teeth, gums, and lips are the three main components which influence the esthetics of smile and the smile itself. Proper proportion and arrangement of these three elements define an attractive smile. A normal smile is one in which the upper lip rested at the height of the gingival margin

of the maxillary incisor, and this was noted by Prasad.² Gummy smile is a condition where in there is an excessive display of maxillary gingiva (>3 mm) on smiling. Though some gummy smile gives an impression of a youthful smile, a gingival display of larger than 3 mm seems unattractive.³ Gummy smile ranges from mild, moderate, and advanced, to severe. Based on the excessive contraction of muscles involved, Mazzuco classified gummy smile into anterior, posterior, mixed, or asymmetric.

According to the degree of exposure of the teeth and gums, Goldstein classified the smile line (consisting of the lower edge of the upper lip during the smile) into three types: high, medium, and low.²

The accurate diagnosis and determination of the etiology associated with gummy smile are essential for the implementation of a right treatment modality.

The etiology for gummy smile can be due to soft tissue causes, such as short upper lip and hyperactive upper lip or may be due to hard tissue causes, such as dentoalveolar extrusion, vertical maxillary excess, or a combination of both these entities; 10.5% of the population could be affected by gummy smile, with female predominance. Different techniques have been used in case of gummy smile: botulinum toxin injections, lip elongations with rhinoplasties, lip muscle detachments, myotomies and lip repositions, orthognathic surgery, etc. The techniques that are used to correct this have involved a lot of tedious surgical procedures, being traumatic to the patient as well, and proving to be expensive also. Thus, this study undertakes to check the efficacy of the chair-side lip repositioning technique using laser for correction of gummy smile under local anesthesia. Compared with the conventional techniques, the laser is a viable alternative for many intraoral soft tissue surgical procedures.³

Diode lasers are highly beneficial due to their ability to selectively and precisely interact with the target tissues. They emit laser light with a wavelength ranging from 810 to 980 nm in the near infrared spectrum of the electromagnetic radiation which is highly absorbed in hemoglobin and other pigments.

Clinicians are able to minimize the amount of bacteria and other pathogens in the surgical field and achieve good hemostasis in the case of soft tissue procedures using laser.

The purported advantages of lasers over conventional surgery include increased coagulation that yields a dry surgical field and better visualization; tissue surface

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sterilization and, therefore, reduction in bacteremia; the ability to negotiate curvatures and folds within tissue contours; postoperatively decreased swelling, edema, and scarring; decreased pain; faster healing response; and increased patient acceptance.²

A reversible trial accomplished by just applying sutures on the border of the future split thickness flap is a novel addition to the technique that has been proposed. This procedure is simple, associated with low morbidity, and cost-effective as well. Furthermore, it is well accepted by patients.³ The purpose of this study was to appraise the upper lip soft tissue changes in the vertical dimension of both rest and maximum smile and investigate the maximum gingival exposure on smiling.⁴ Thus, surgical lip repositioning using laser is an effective procedure to reduce gummy smile and the long-term stability of the results remains to be the same.

AIMS AND OBJECTIVES

The aim of this study was to evaluate the efficacy of laser-assisted lip repositioning for gummy smile correction. Clinical assessment of pre- and postoperative lip length at rest and at smile, postoperative pain, and swelling and patient satisfaction were evaluated.

MATERIALS AND METHODS

Study Setting

This study was done on patients who visited the Department of Oral & Maxillofacial Surgery, Krishnadevaraya College of Dental Sciences & Hospital, Bengaluru, Karnataka, India.

Study Design

In this study, 10 patients with gummy smile more than 3 mm underwent laser-assisted lip repositioning under local anesthesia. All patients were informed about the study and consent was taken for the same. Routine blood investigations were carried out.

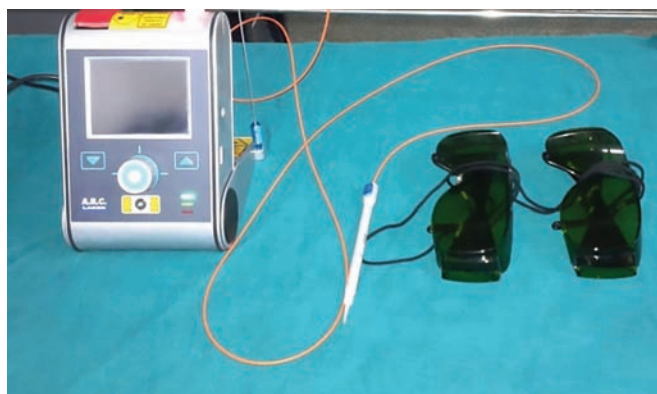


Fig. 1: Sirona diode laser

Material used

- Diode laser (Sirona Laser) (Fig. 1)
- Vernier caliper
- 4-0 Vicryl

Inclusion Criteria

- Patient willing for the treatment.
- Patient having gummy smile more than 3 mm (Fig. 2).
- Patient with no dental/skeletal etiology.

Exclusion Criteria

- Patient not willing for treatment.
- Patients with dental proclination.
- Patient with vertical maxillary excess.
- Medically compromised patient.

SURGICAL PROCEDURE

The treatment plan consisted of reversible mock lip repositioning and definite surgical repositioning. Initial anesthesia consisted of bilateral infraorbital nerve blocks. To begin the reversible lip repositioning, the proposed surgical incision lines were marked with marking ink. Once the area was marked, sutures were used to complete the reversible trial. After final surgery, anesthesia was supplemented, and temporary sutures were removed. Strips of outlined mucosa were removed by a superficial split thickness dissection, using a high-powered diode laser 975 nm, 4 W, CW, leaving the underlying connective tissue exposed. Care was taken to avoid damage to any minor salivary glands in the submucosa. Closure was completed with continuous interlocking sutures to stabilize the new mucosal margins in the gingival. Resorbable sutures were used (4-0 Vicryl). For hemostasis, tissues were compressed with wet gauze for 5 minutes. Analgesics and antibiotics were prescribed after surgery.

Preoperative

Figure 2 shows gummy smile pre-op photo.



Fig. 2: Gummy smile of 4 mm

Reversible Trial

Reversible trial marking was done as shown in Figure 3.

Final Surgery

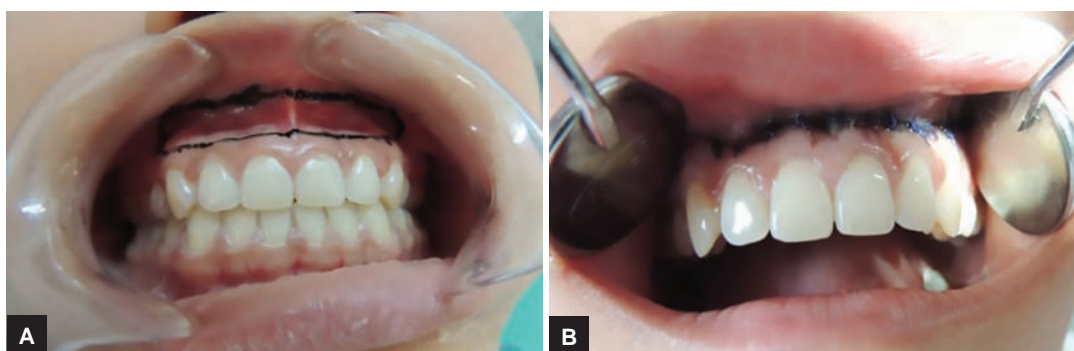
Final surgery was done (Figs 4 to 6).

Evaluation Criteria

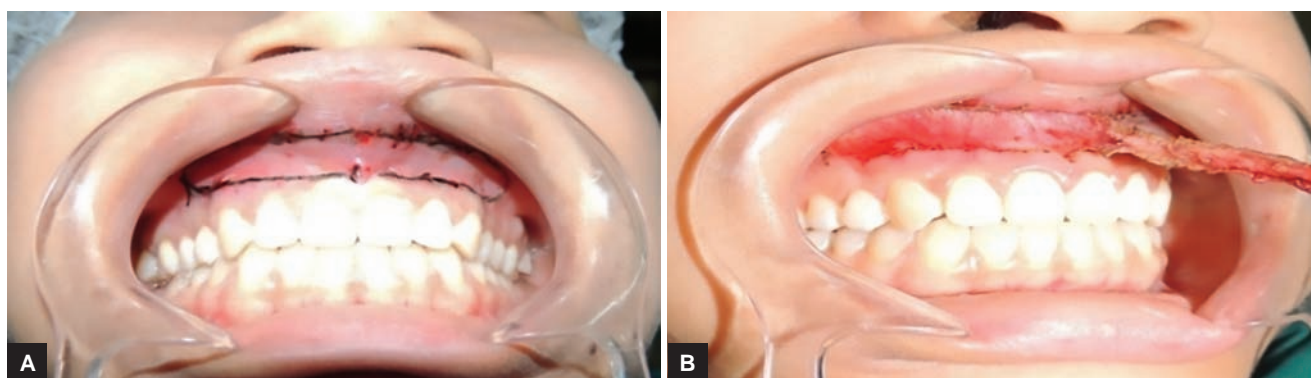
Complications

- Postoperative pain assessed by visual analog scale (VAS)
 - It is a method of rating pain.

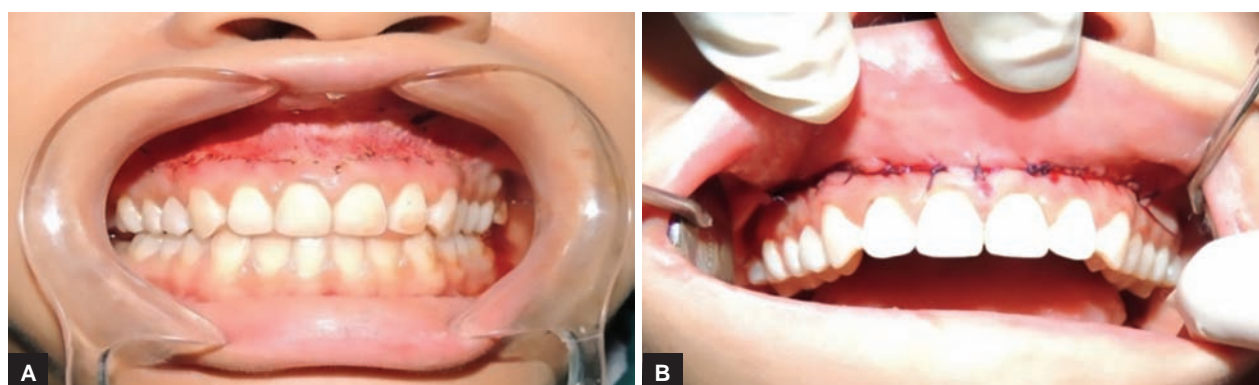
- It consists of 10 cm line with “no pain” at one end and “worst pain” at the other end.
- Patient indicates the magnitude of pain by marking an appropriate point along the line.
- The distance is then measured and recorded for comparison.
- It is measured 8 hours and 24 hours postoperatively.
- Evaluation of swelling
 - It was noted on the day of surgery, 1st, 3rd, and 7th postoperative days.
 - 0: no swelling
 - 1: mild swelling
 - 2: moderate swelling
 - 3: severe swelling



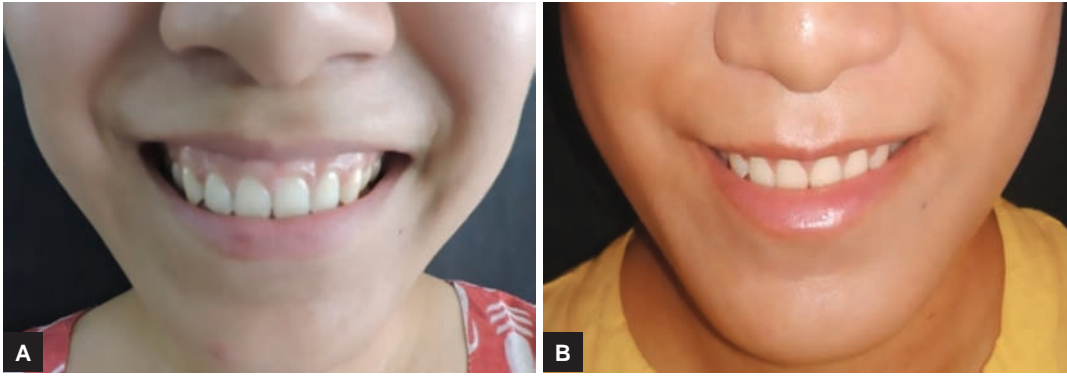
Figs 3A and B: (A) Initial marking. (B) Reversible lip repositioning



Figs 4A and B: (A) Markings placed. (B) Stripping of mucosa



Figs 5A and B: (A) Strip of mucosa removed. (B) Suturing done with Vicryl 4-0



Figs 6A and B: (A) Preoperative view. (B) Postoperative view

Statistical Analysis

The following methods of statistical analysis have been used in this study. Data were entered in Microsoft excel and analyzed using Statistical Package for the Social Sciences, version 10.0.5 package.

The results were averaged (mean + standard deviation) for continuous data, and number and percentage for dichotomous data are presented in tables and graphs.

One-way

One-way ANOVA was used to test the difference between groups. Analysis of variance is a technique by which the total variation is split into two parts, one between groups and the other within groups. If “F” value is significant, there is a significant difference between group means. Then, further pairwise comparison between the groups was tested using Tukey test. The formula used was:

$$F = \frac{MS_{\text{betweengroups}}}{MS_{\text{Within groups}}}$$

where MS = mean sum of square

Proportions Compared using Chi-square Test of Significance

Chi-square (χ^2) test for (r × c) tables.

a, b,.....h are the observed numbers.

N is the grand total

$$\chi^2 = N \left[\frac{1}{t_1} \sum_1^c \frac{a_1^2}{n_1} + \frac{1}{t_2} \sum_1^c \frac{b_1^2}{n_1} + \dots + \frac{1}{t_r} \sum_1^c \frac{h_1^2}{n_1} - 1 \right]$$

DF = (r-1)*(c-1), where r = rows and c = columns

DF = Degrees of freedom (number of observations that are free to vary after certain restrictions have been placed on the data)

In all the above tests, p-value of less than 0.05 was accepted as indicating statistical significance.

RESULTS

The present study was done in the Department of Oral and Maxillofacial Surgery, Krishnadevaraya College of Dental Sciences & Hospital, Bengaluru, Karnataka, India. Laser-assisted lip repositioning technique for gummy smile treatment more than 3 mm was done.

Patients were in the age group of 21 to 45 years with 9 females and 1 male. All patients were assessed clinically. Clinically, patients were checked for pain (using VAS) and swelling postoperatively (Fig. 7). The measurement for gummy smile and lip length at rest and at smile was done preoperatively, and on 2nd week, 4th week, 3rd, and 6th month postoperatively.

Age Distribution of Patients

In the age-wise distribution of the patients, six patients (60%) belonged to the age group of 21 to 25 years, three patients (30%) belonged to the age group of 25 to 30 years, while one patient (10%) belonged to 40 to 45 years.

Gender Distribution of Patients

In the gender-wise distribution of patients, most of the patients (90%) were females and 10% were males.

Assessment of Complications

Pertaining to postoperative pain assessed by VAS, on the 1st day, the mean value was 3.20, on the 3rd day, the mean value was 0.20, and on the 7th day, the mean value was 0.00, indicating that there was significant reduction in pain, and the result was statistically significant (p = 0.01).

The swelling assessed in the 1st, 3rd, and 7th postoperative days (p = 0.01) proved to be statistically significant.

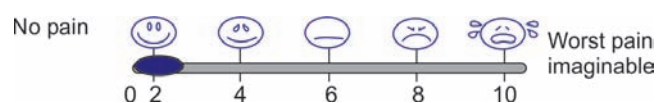
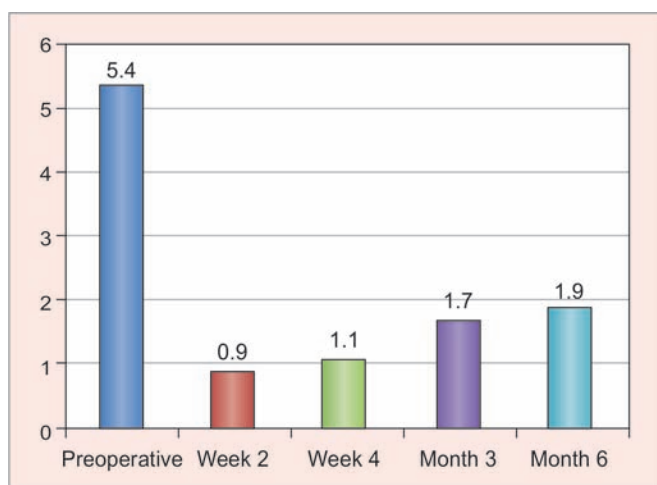
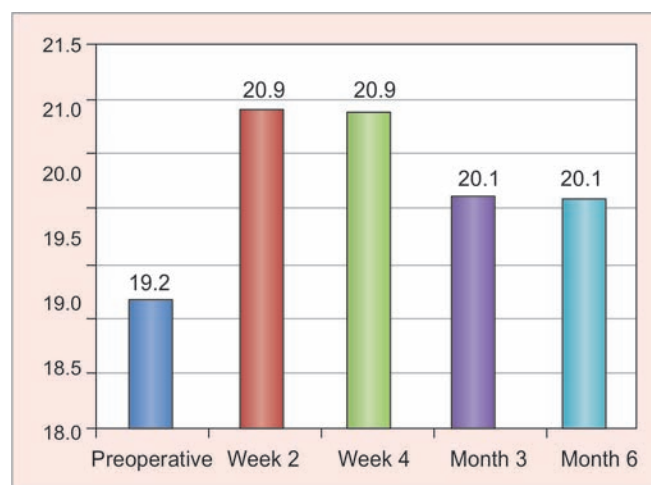


Fig. 7: Visual analog scale



Graph 1: Comparison of mean gingival display (mm) at various time intervals



Graph 2: Comparison of mean lip length at rest at various time intervals

Patient Satisfaction

Majority of the patients (80%) were satisfied and 2 patients (20%) were somewhat satisfied.

Measurement of Gingival Display

The mean value of pre-op gingival display was 5.400; postoperative 6 months gave a statistically significant result here ($p = 0.01$) (Graph 1).

Measurement of Gingival Display at Rest and at Smile

Preoperative mean value was 19.20 at rest and 14.20 at smile; postoperative results at 6 months ($p=0.460$), lip length at rest ($p = 0.082$), lip length at smile give a statistically insignificant result, but clinically, as the values were less than 2 mm, it was clinically significant (Graphs 2 and 3).

DISCUSSION

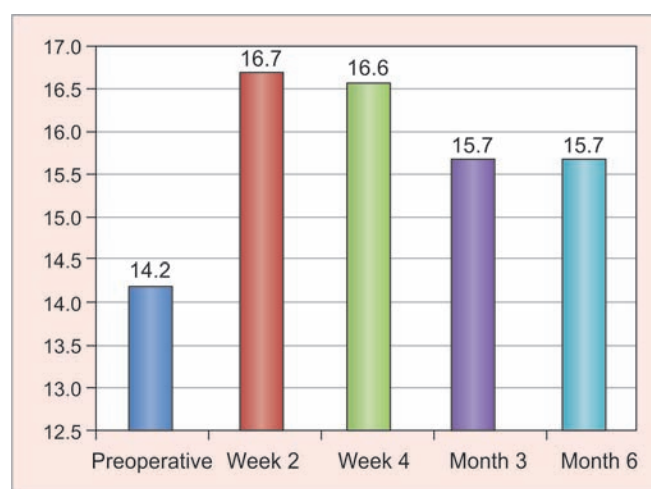
“Smile,” a person’s ability to express a range of emotions with the structure and movement of the teeth and lips, can often determine how well a person can function in society.⁵

When more than 3 mm of gingiva is visible, it is known as a gummy smile.

The etiology of excessive gingival display is various: plaque or drug-induced gingival enlargement, altered or delayed passive eruption, anterior dentoalveolar extrusion, vertical maxillary excess, short upper lip, a hyperactive upper lip, or a combination of these causes.

Proper diagnosis of the etiological factor is essential for the selection of the right treatment protocol.

Plaque or drug-induced gingival enlargement and altered or delayed passive eruption are treated with periodontal surgery.



Graph 3: Comparison of mean lip length smile at various time intervals

Anterior dentoalveolar extrusion is treated with orthodontic intrusion and vertical maxillary excess is treated with orthognathic surgery.

Hyperactive upper lip is treated with injections of botulinum toxin, lip elongation associated with rhinoplasty, detachment of lip muscles, myotomy and partial removal, and lip repositioning.³

Other various soft tissue surgical procedures like frenectomies, gingivoplasty, vestibuloplasty, and depigmentation were performed by using diode lasers and they achieved significant results.²

In this study, surgical procedure consisted of reversible lip repositioning and definite surgical repositioning. Initial anesthesia consisted of bilateral infraorbital nerve blocks. To begin the reversible lip repositioning, the proposed surgical incision lines were marked with marking ink. Once the area was marked, sutures were used to complete the reversible trial. After final surgery, anesthesia was supplemented. Temporary sutures were removed. Strips of outlined mucosa were removed by a superficial

split thickness dissection, using a high-powered diode laser 975 nm, 4 W, CW, leaving the underlying connective tissue exposed. Care was taken to avoid damage to any minor salivary glands in the submucosa. Closure was done using continuous interlocking sutures to stabilize the new mucosal margins in the gingiva. Resorbable sutures were used (4-0 Vicryl).³

The benefits of this technique compared with other procedures are it is economical, has minimal postoperative pain and swelling, good patient acceptance and satisfaction, and is a minimally invasive procedure for gummy smile.³

Another study by Ishida et al⁶ had reported an alternative to lip repositioning surgery in the treatment of excessive gingival display caused by a hyperactive or short upper lip. Polo used botulinum toxin type I for patients with excessive gingival display. The effect of the botulinum toxin was temporary, and the gingival display gradually increased from the 2nd week to baseline values after the 3rd week. In their technique, Ishida et al combined with modified different procedures: myotomy and subperiosteal dissection and lip frenectomy.

All three techniques produce the same results in decreasing excessive gingival display. However, although the botulinum toxin injection is the least invasive treatment, the results are temporary and necessitate frequent retreatment. The approach used by Ishida et al is more aggressive, with higher morbidity compared with our procedure.³

Another study reported by Shiva Prasad et al² demonstrated that patient with excessive gingival display can be safely, easily, and effectively treated with minimal to no discomfort in the dental office by gingivectomy using diode laser, resulting in better gingival shape, contour, scalloping, and gingival margin being regained.

Scalpel repair was found to be equivalent to or better than laser repair as a result of thermal damage to the tissues, which was proven by another study conducted; but also advocated the clinical use of low-level diode laser as an alternative to scalpel incision and suture repair.⁷

Some factors restrict the use in the presence of an inadequate amount of attached gingival in the maxillary anterior sextant, as it will cause difficulty in flap design, suturing, and stabilization, which could lead to relapse, and a shallow vestibule that may compromise the ability to perform adequate oral hygiene.

Lip repositioning surgery is also not indicated for severe maxillary excess, as it may lead to relapse.

In our technique, lip repositioning surgery might be a valid alternative solution compared with the other procedures, it has a stable result, and low morbidity. Furthermore, it is well accepted by patients.

Swelling

Less bleeding and swelling were seen using laser due to sealing of the small blood vessels and lymphatic vessels.^{8,9} Postoperatively, the swelling had reduced which was statistically significant.

Pain

Lesser postoperative pain using laser may be due to the protein coagulum that is formed on the operated surface, thereby acting as a biological dressing and sealing the ends of the sensory nerves.¹⁰

Patients' Satisfaction

Postoperatively, 80% of the patients were satisfied with the procedure and 20% were somewhat satisfied.

Based on the postoperative evaluation of patients, it can be said that laser-assisted lip repositioning technique can be an effective treatment modality for gummy smile treatment when measured in terms of parameters like pain, swelling and patients comfort. This procedure has its own advantages and disadvantages. This study is based entirely on clinical parameters.

CONCLUSION

Thus, the conclusion derived from this study is as follows:

- Trial modification accomplished just by applying suture is important in simulating the final result of the treatment. Patient and surgeon have the opportunity to preview the final results in advance.
- Diode laser gives a clear and bloodless field.
- It has a good patient acceptance and satisfaction.
- Minimal postoperative swelling and pain were noted.
- Lip repositioning technique has postoperative patient comfort with low morbidity.
- The technique can be very effectively carried out under local anesthesia.
- The technique is economical to the patient.

Since we got a clinically satisfactory results, we can conclude that the laser-assisted lip repositioning for gummy smile proves to be an efficient technique for the correction of gummy smile. It can be used as an excellent alternative to more costly procedures with high morbidity rates. It is also minimally invasive with minimal postoperative swelling and pain. But extensive research is definitely imperative so as to increase its range of application.

In future, we can look forward to witness the laser-assisted lip-repositioning procedure for correction of gummy smile extensively alone or in combination with other surgical procedures.

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