



Laser-Assisted Lip Repositioning Surgery: A Modification to The Conventional Technique

Pilar Rocío Blanco Flórez^{1*}, Jessica Alvis Guzmán², Jennifer Orozco Páez³

¹Medical Laser Latinamerica, Santa Marta, Colombia

²Dentist, Cartagena, Colombia

³Dentistry Program, Corporación Universitaria Rafael Núñez, Cartagena, Colombia

*Correspondence to

Pilar Rocio Blanco Flórez,
Address: Cra 21A # 15_75, El
Jardin neighborhood, Santa
Marta, Colombia.
E-mail: doctorapilarblanco@gmail.com

Received: July 7, 2021

Accepted: January 8, 2022

Published online May 16, 2022



Abstract

Introduction: The lip repositioning surgical technique arose with the objective of correcting and harmonizing the act of smiling. Since the conventional technique was published, some modifications of the technique have been proposed in order to counteract postoperative recurrence and to achieve the best esthetic appearance of the smile. The objective of this paper was to describe the laser-assisted lip repositioning technique (laser-assisted LRS) with a 940nm diode laser and 2780nm Er,Cr:YSGG, as a modification to the conventional lip repositioning technique, for the treatment of a gummy smile.

Case Report: The proposed technique consists in achieving the descent of the upper lip by removing the intraoral mucosal band through the laser peeling of oral mucosa, preserving the connective tissue intact for healing by secondary intention. The technique was implemented in two patients with a diagnosis of a gummy smile caused by a short and hyperactive upper lip; the healing process was satisfactory, and there was no bleeding or postoperative edema. Postoperative controls were performed at 3 and 10 months, and no recurrence was found.

Conclusion: the 940nm Diode laser or 2780nm Er,Cr: YSGG laser-assisted lip repositioning technique described here is less invasive than that performed with a conventional scalpel, offers aesthetic results, lower risk of infection and recurrence of the gummy smile in the long term.

Keywords: Gummy smile; Excessive gingival display; Lip; Smiling; Lasers; Diode Laser.

Introduction

A gummy smile is recognized as non-pathological mucogingival overexposure, being considered unattractive when it exceeds 3mm of inserted gingiva.¹ This condition has been shown to affect the patient's self-perception and negatively influence their interpersonal relationships. Antoniazzi et al² demonstrated that the gummy smile negatively impacts individuals' quality of life, the main areas of impact being a functional limitation, psychological discomfort, psychological disability, and social disability.

The lip repositioning surgical technique arose with the objective of correcting and harmonizing the act of smiling. It was first proposed in 1973 by Rubinstein and Kostianovsky³ as part of the literature on plastic surgery, as a surgical procedure with immediate results to correct the gummy smile caused by a lip with hypermobility. Later, in 1979, it was described again by Litton and Fournier,⁴ who performed the technique in a small sample of patients and highlighted the absence of complications during the technique; additionally, they indicated the approach of the lip muscles (separating them from the bone structures where they are inserted) to lower the lip and achieve

a more complete correction in cases where the lip is abnormally short.

Since the publication of the technique, lip repositioning has represented an affordable, aesthetic and outpatient solution for many patients with gummy smiles, in cases whose cause is a short upper lip, hyperactive lip muscles, maxillary vertical excess, or a combination of these.⁵⁻⁷ In recent years, the frequency of these cases has increased, which has made lip repositioning a high demand surgical technique; Andijani and Tatakis⁸ examined 56 patients with a gummy smile, and 75.5% presented an inserted gingiva band ≥ 4 mm; in 45.3% of the cases, the cause was a hypermobile upper lip, and in 34% of the cases, it was a combination of the previously mentioned etiology and passive eruption.

Different modifications have been proposed for the conventional technique. Some of them aim to counteract postoperative recurrence,⁹ improve the aesthetic appearance of the smile and allow the lip to appear fuller and more attractive,¹⁰ while others try to propose less aggressive methods that demonstrate greater sustainability over time compared to the conventional technique.¹¹ Taking advantage of the advances in technology, a new

modification of the technique is presented, based on the use of the Diode laser of 940nm and Er,Cr: YSGG of 2780nm, as surgical instruments; this technique is called laser-assisted lip repositioning surgery (LRS) and its main advantages are minimal invasion to the tissues, absence or minimal bleeding, and therefore better visibility of the operative field; at the postoperative level, it significantly reduces the experience of pain, infection, inflammation and the consumption of analgesics or anti-inflammatory drugs; in the long term, the reduction of recurrence is its main advantage over conventional techniques.

The objective of this article was to describe the laser-assisted LRS technique with a 940nm diode laser and 2780nm Er,Cr: YSGG, as a modification to the conventional lip repositioning technique, for the treatment of a gummy smile, and to present two cases.

Technique Description

The laser-assisted LRS can be performed with either a 940nm Diode laser or a 2780nm Er, Cr: YSGG laser. The objective is to produce the descent of the upper lip through the surgical removal of an intraoral mucosal band using the laser gingival peeling technique; this concept refers to the micro-abrasion effect produced by the laser on the mucous epithelium, keeping the connective tissue intact for healing by secondary intention, and this allows the flap to be tractioned from the vestibule to adhere quickly to the portion of the gingiva that is microabraded. In the second stage, the vestibule is deepened by detaching the muscles from the entire previously demarcated area.

The mucous band removal technique in conjunction with the biostimulant effect of the laser favors hemostasis and stimulates the healing process, allowing immediate, aesthetically satisfactory and long-term sustainable results to be obtained. The surgical protocol is described below:

- Anesthesia:** before anesthetizing it is necessary to carry out antisepsis of the area to be intervened. Subsequently, local anesthesia is applied, a bilateral infraorbital technique is recommended with reinforcement at the level of the premolars or blocking of the anterior superior alveolar branches bilaterally. **Important note:** for procedures performed with a 940nm diode laser, the local anesthetic used must NOT contain a vasoconstrictor (the vasoconstrictor produces ischemia of the tissues, preventing the laser light from being absorbed by the most abundant chromophores in the soft tissue, hemoglobin and oxyhemoglobin, eventually leading to the slowing down or reversal of its mechanism of action).
- Demarcation of the surgical area:** the extension of the band to be removed will be determined by taking into account the horizontal extension of the patient's smile and the height of the exposed gum measured in mm (Figure 1A). It is recommended that the height of the incision correspond to twice the height of the

exposed gum; in this way, if the patient's gummy smile is 4 mm, the height of the band to be cut should be 8 mm.

Using the same surgical instrument (diode laser of 940nm or Er, Cr: YSGG of 2780nm), the cut areas are marked on the previously prepared keratinized mucosa (Figure 1B).

- Programming the surgical protocol on the equipment:**
 - 940nm diode laser (Epic X, Biolase®): 1.6-W power, continuous mode (CW), 4-micron tip - 4 millimeters (4-4) activated.
 - Er, Cr: YSGG 2780nm laser (Waterlase®, Biolase®): power 2.5 W, frequency 50 Hz, Mode: S, air percentage: 20, water percentage: 40, gold handpiece and MC3 sapphire tip. This protocol is ideal for achieving minimal intraoperative bleeding.
 - Gingival peeling and removal of muscle fibers:** the surgical procedure begins by performing *peeling* on the adhered gingiva to remove the previously demarcated band of the mucous epithelium (Figure 1C). Positioning the tip with a 90° angle with respect to the tissue, we can make light brush strokes over the demarcated mucosa. It is recommended to start at the end of one of the hemiarches until approaching the midline, gradually ablating the tissue until the bottom of the buccal sulcus is exposed, and then the vestibule is deepened, encompassing the entire demarcated area from right premolars to left premolars, and the removal of the fibers of the elevator muscles of the upper lip and wing of the nose are removed (common and proper fascicles) to insert them in a lower plane (Figure 1D).
- Each contact of the tip with the tissue should not exceed 15 seconds; between each contact of the tip and the ablated tissue should be cleaned using gauze moistened with water. Once the entire epithelium is removed, it is possible to observe the connective tissue in the entire extension of the intervened area, as a totally clean area, without charring and absence or minimal bleeding.
- Suture:** Verifying the position of the lip, sutures are

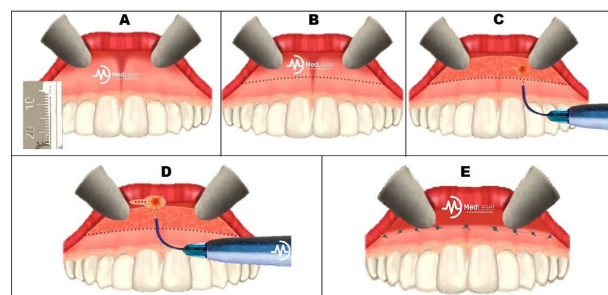


Figure 1. Steps of the Surgical Technique. (A) Measurement of the surgical area; (B) Demarcation of the mucosa band to be removed; (C) Gingival peeling; (D) Detachment of muscle fibers (deepening of the vestibule); (E) Suture.

performed (absorbable chromic catgut type suture is recommended) using the simple stitch technique taking the interdental papillae as a reference, starting with the first suture point at the midline level between teeth #11 and 21, on the initial marking line. The order of the stitches is suggested as follows: 11-12, 21-22, 12-13, 22-23, following this consecutive order until reaching the demarcation area (Figure 1E). Performing the sutures alternating between one hemiarch and another will allow the operator to balance the flap and facilitate tissue control while suturing.

6. **Post-operative:** as postoperative care, the patient is given a liquid diet for 24 hours. In order to reduce inflammation and postoperative pain and to stimulate healing, it is recommended that postoperative therapy be performed with the 940nm Diode laser using the handpiece with an exit area of 2.8 cm² (whitening piece - Epic X, Biolase®). A protocol of 2.0 watts is programmed, and extraoral irradiation is performed in the orbicularis oculi area of the upper lip for two minutes, moving the handpiece from top to bottom (from the nostrils towards the lip) and with slow movements of a single direction from the center of the face towards the ear in contact with the skin without generating pressure. This therapy is recommended to be performed daily for 10 days, on both sides of the face.

Case Presentation

Case 1. Lip Repositioning With a 940nm Diode Laser

A 46-year-old female patient, whose reason for consultation is "I show my gums a lot when I smile," does not refer to any relevant medical or family history for the surgical act. The extraoral clinical examination revealed a symmetrical face but with labial incompetence and overexposure of 8 mm of the gingiva when smiling, extending between the right and left premolars. By evaluating the factors related to overexposure of the gingiva, the diagnosis of a gummy smile due to a short and hyperactive lip was established. Among the treatment options, zenith leveling and lip repositioning were proposed to the patient. Understanding each of the procedures, the patient decided to undergo lip repositioning and zenith leveling in a single surgery. After we explained all the considerations regarding the surgical technique, the patient authorized the procedure by signing an informed consent form.

To perform the surgical procedure, a mouth opener was placed, asepsis and antisepsis of the area were performed, and local anesthesia was applied using 2% lidocaine without epinephrine, implementing a bilateral infraorbital technique with reinforcement at the level of the right and left premolars. Once the area of mucosa to be removed was established by measuring it with a dental millimeter ruler, it was delimited on the surface of the

dry mucosa with the laser tip, at a power of 1 W in CW, with the surgical tip 4-4 (4 microns by 4 mm). The rest of the procedure was carried out following the technique described above step by step (Figure 2).

In order to reduce postoperative pain and inflammation and stimulate healing, an extraoral therapy was performed immediately after surgery with the same laser equipment; for this to happen, the surgical handpiece was changed to a therapeutic handpiece (Figure 2F) with a 2.0-W protocol covering the entire perioral area for 2 minutes. No pharmacological treatment was indicated; instead, 10 postoperative therapies were performed, 1 daily. Control was carried out at 3 and 10 months, and no recurrence was observed.

Case 2. Lip Repositioning With 2780nm Er,Cr: YSGG Laser

A 43-year-old female patient attending consultation reports that she feels dissatisfied with her smile by overexposure of the gingiva when smiling. She did not report significant family medical history for the surgical act, and the extraoral clinical examination revealed lip incompetence. Intraoral examination revealed the exposure of an 8mm keratinized gingiva band when smiling; when evaluating the factors related to the overexposure of the gingiva, the diagnosis of a gummy smile was established due to a short and hyperactive lip. A lip repositioning with an Er,Cr: YSGG 2780nm laser was proposed as a treatment option. Once the procedure was performed and the possible risks were explained to the patient, the patient agreed to undergo surgical treatment by signing an informed consent form.

The procedure followed the same step explained above, but in this case the 2780nm Er,Cr: YSGG laser (Waterlase, Biolase®) was used. The Sapphire MC3 laser surgical tip was used, with a power of 2.5 W in S mode, 50 Hz, 40% water, and 20% air. Extraoral postoperative therapy was performed immediately after the procedure with a 940nm diode laser with a whitening piece with a 2.0-W protocol irradiating the entire perioral area for 2 minutes. After surgery, postoperative photobiomodulation therapy was performed under the same conditions as described in the previous case. 1 therapy was performed daily for 10

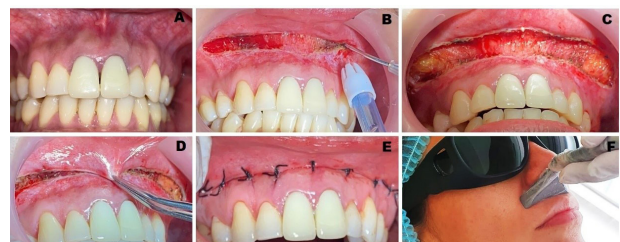


Figure 2. Lip Repositioning With a 940nm Diode Laser. (A) Initial photo; (B and C) Gingival peeling and deepening of the vestibule, showing the exposure of the underlying connective tissue; (D and E) Suture, simple stitch technique; (F) Extraoral analgesic and anti-inflammatory laser therapy after the surgical procedure.

days (Figure 3).

Control was carried out at 3 months and 12 months, and no recurrence was observed (Figure 4).

Discussion

It is estimated that the gummy smile affects between 10.5% and 29% of the world population, being more prevalent in women. It can have a skeletal origin (vertical excess of the maxilla), dentogingival origin (gingival enlargement and altered passive eruption), neuromuscular origin (short or overactive upper lip), or a combination of these. To establish an appropriate treatment plan, a detailed clinical examination is necessary to identify the etiology.^{1,12}

Since the short or overactive upper lip is one of the common etiologies of the gummy smile, the purpose of this report was to describe a variation of the lip repositioning technique for the treatment of the gummy smile. The modification is based, on one hand, on removing the mucous band by means of micro-abrasion of the epithelium (gingival peeling), including the disinsertion of the lip muscles, and the procedure is performed with a 940nm diode laser or 2780nm Er, Cr: YSGG, whose use and indication are relatively new for the lip repositioning technique^{13,14}; the technique does not leave visible scars and is aimed at minimizing post-operative discomfort caused by the scalpel and reducing the recurrence of the gummy smile.

Currently, lip repositioning is usually performed with a scalpel. Although this instrument offers precision cuts

without the risk of causing tissue carbonization, it has some disadvantages, the main one being the absence of intraoperative hemostasis and, therefore, a surgical work field with poor visibility. Also, a postoperative period is characterized in most cases by pain, edema and bruising.¹⁵

This is demonstrated by the study carried out by Alamar et al, who compared, in a sample of 22 patients, the stability of conventional lip repositioning with a more aggressive modified technique proposed by themselves, which comprises a full-thickness flap with myotomy of the elevator muscles. Both techniques were performed with a scalpel. All patients presented a significant reduction of the gummy smile and their appearance improved; however, some patients presented complaints during the postoperative period, which mainly included the exudation of blood through the suture on the first days of surgery, edema at a moderate rate, perioral edema that extended to the lower eyelids (four patients submitted to the modified technique) accompanied by ecchymosis, and mild to moderate pain.⁹ This study revealed the main postoperative complications associated with lip repositioning surgery performed with a scalpel.

As an alternative to this, the great advances in laser science and technology applied to dentistry offer laser equipment as an instrument with a series of biological effects on tissues, which translate into advantages that have been scientifically proven, among which they highlight the control of intraoperative bleeding without generating the secondary effect of tissue carbonization,¹⁶ shortening of operative time, reduction of postoperative pain, swelling and edema,¹⁷ reduction of the risk of infection, and the stimulation of cellular processes to enhance wound repair.¹⁸⁻²⁰

Farista et al¹⁴ reported a case performed with a 940nm diode laser in a 22-year-old woman, highlighting the important benefits of using the laser: the minimal discomfort in the postoperative period, the decrease in intraoperative bleeding compared to the scalpel, and the high acceptability of the procedure by the patient due to its ease and lower morbidity. These authors eliminated the mucous band by ablating the epithelium, leaving the connective tissue exposed; however, they disagreed with the protocol described here since they did not detach the muscle fibers of the elevator muscle of the upper lip and wing of the nose, which is essential to limit lip displacement during the smile and reduce the risk of recurrence. The authors reported the recurrence of the gummy smile in this patient after one year, although not in the same magnitude as the initial condition of the patient; this supports our position on the need to disinsert the muscle fibers to guarantee success of the technique with long-term sustainable results.

For their part, Ganesh et al described a laser-assisted lip repositioning technique, but instead of removing muscle fibers, they tractioned and contained the elevator muscles

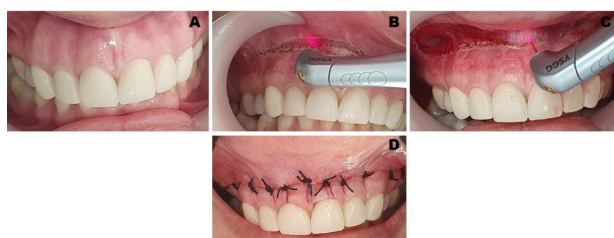


Figure 3. Lip Repositioning With a 2780nm Er, Cr: YSGG laser. (A) Initial photo; (B and C) Gingival peeling and deepening of the vestibule; (D) Suture, simple stitch technique.



Figure 4. Smile before and one year after laser lip repositioning. (A) 940nm diode laser (Epic, Biolase®); (B) Er, Cr: YSGG 2780nm laser (Waterlase, Biolase®).

of the lip at the midline using an absorbable suture. They argued that this muscle traction and restraint help prevent early muscle relapse in patients with a gummy smile. The technique allowed them to obtain an aesthetic result, lip stability, and preservation of gingival height after 1 year.²¹

The proposed technique involves muscle disinsertion, despite the fact that it remains a less invasive and aggressive procedure. The approach performed with a conventional scalpel conditions the operator to perform postoperative management, which in most cases corresponds to pharmacological therapy (anti-inflammatory drugs and antibiotics), chlorhexidine rinses and cryotherapy as adjuvant therapies. Thanks to the residual biological effects of laser light on the tissues, these indications are not necessary in laser-assisted surgeries; instead, photobiomodulation therapy is proposed to control postoperative pain, edema and inflammation, obtaining satisfactory results.

Conclusion

The 940nm diode laser or 2780nm Er,Cr: YSGG laser-assisted lip repositioning technique described here is less invasive than that performed with a conventional scalpel, offers aesthetic results, and lowers the risk of infection and recurrence of the gummy smile in the long term. Likewise, it offers intra- and postoperative comfort for the patient, which is mainly characterized by minimal bleeding and reduction of edema, pain, inflammation, and wound repair time.

Conflict of Interests

None.

Ethical Considerations

Both patients were clearly explained the surgical procedure to be performed and its possible risks, and they voluntarily agreed to receive the treatment by signing an informed consent form. The integrity and privacy of the patients was respected and protected.

References

- Long Han X, Yun SJ, Hui ZV, Etiology-Based HX. Etiology-Based Treatment Strategy for Excessive Gingival Display: Literature Review. *World J Surg Surgical Res.* 2019;1103.
- Antoniuzzi RP, Fischer L de S, Balbinot CEA, Antoniuzzi SP, Skupien JA. Impact of excessive gingival display on oral health-related quality of life in a Southern Brazilian young population. *J Clin Periodontol.* 2017;44(10):996–1002. DOI: doi.org/10.1111/jcpe.12753.
- Rubinstein A, Kostianovsky A. Cosmetic surgery for the malformation of the laugh: original technique. *Prensa Med Argent.* 1973; 60:60-952.
- Litton C FP. Simple surgical correction of the gummy smile. *Plast Reconstr Surg.* 1979;63(3):372–3.
- Gaddale R, Desai SR, Mudda JA, Karthikeyan I. Lip repositioning. *J Indian Soc Periodontol.* 2014;18:254–258. DOI: 10.4103/0972-124X.131349.
- Dym H, Pierre R. Diagnosis and Treatment Approaches to a "Gummy Smile." *Dent Clin North Am.* 2020;64(2):341–9. DOI: 10.1016/j.cden.2019.12.003.
- Tawfik OK, El-Nahass HE, Shipman P, Looney SW, Cutler CW, Brunner M. Lip repositioning for the treatment of excess gingival display: A systematic review. *J Esthet Restor Dent.* 2018;30(2):101–12. DOI:10.1111/jerd.12352.
- Andijani RI, Tatakis DN. Hypermobile upper lip is highly prevalent among patients seeking treatment for gummy smile. *J Periodontol.* 2019;90(3):256–62. DOI:10.1002/JPER.18-0468.
- Alammar A, Heshmeh O, Mounajjed R, Goodson M, Hamadah O. A comparison between modified and conventional surgical techniques for surgical lip repositioning in the management of the gummy smile. *J Esthet Restor Dent.* 2018;30(6):523–31. DOI:10.1111/jerd.12433.
- Sánchez I, Gaud-Quintana S, Stern J. Modified Lip Repositioning with Esthetic Crown Lengthening: A Combined Approach to Treating Excessive Gingival Display. *Int J Periodontics Restorative Dent.* 2017;37(1): e130–4. DOI:10.11607/prd.3124.
- Bhola M, Fairbairn P, Kolhatkar S, Chu S, Morris T, de Campos M. LipStaT: The Lip Stabilization Technique— Indications and Guidelines for Case Selection and Classification of Excessive Gingival Display. *Int J Periodontics Restorative Dent.* 2015;35(4):549–59. DOI: 10.11607/prd.2059.
- Dayakar M, Gupta S, Shivananda H. Lip repositioning: An alternative cosmetic treatment for gummy smile. *J Indian Soc Periodontol.* 2014;18(4):520–3. DOI: 10.4103/0972-124X.138751.
- Gabrić Pandurić D, Blašković M, Brozović J, Sušić M. Surgical treatment of excessive gingival display using lip repositioning technique and laser gingivectomy as an alternative to orthognathic surgery. *J Oral Maxillofac Surg.* 2014;72(2):404-e1. DOI:10.1016/j.joms.2013.10.016.
- Farista S, Yeltiwar R, Kalakonda B, Thakare KS. Laser-assisted lip repositioning surgery: Novel approach to treat gummy smile. *J Indian Soc Periodontol.* 2017;21(2):164–8. DOI: 10.4103/jisp.jisp_411_16.
- Duruel O, Erduran N, Tözüm T. A Modification for Treatment of Excessive Gingival Display: Tooth-Based Lip-Repositioning Technique. *Int J Periodontics Restorative Dent.* 2020;40(3):457–61. DOI: 10.11607/prd.4465.
- Gutiérrez-Corrales A, Rizcala-Orlando Y, Montero-Miralles P, et al. Comparison of diode laser - Oral tissue interaction to different wavelengths. In vitro study of porcine periodontal pockets and oral mucosa. *Med Oral Patol Oral Cir Bucal.* 2020;25(2): e224–e232. DOI: 10.4317/medoral.23317.
- Ortega-Concepción D, Cano-Durán JA, Peña-Cardelles JF, Paredes-Rodríguez VM, González-Serrano J, López-Quiles J. The application of diode laser in the treatment of oral soft tissues lesions. A literature review. *J Clin Exp Dent.* 2017;9(7): e925–e-928. DOI: 10.4317/jced.53795.
- Çayan T, Hasanoglu Erbaşar GN, Akca G, Kahraman S. Comparative evaluation of diode laser and scalpel surgery in the treatment of inflammatory fibrous hyperplasia: A split-mouth study. *Photobiomodul Photomed Laser Surg.* 2019;37(2):91–8. DOI:10.1089/photob.2018.4522.
- Amaral MBF, De Ávila JMS, Abreu MHG, Mesquita RA. Diode laser surgery versus scalpel surgery in the treatment of fibrous hyperplasia: A randomized clinical trial. *Int J Oral Maxillofac Surg.* 2015;44(11):1383–9. DOI: 10.1016/j.ijom.2015.05.015.
- Ryu SW, Lee SH, Yoon HJ. A comparative histological and immunohistochemical study of wound healing following incision with a scalpel, CO 2 laser or Er,Cr:YSGG laser in the Guinea pig oral mucosa. *Acta Odontol Scand.* 2012;70(6):448–54. DOI:10.3109/00016357.2011.635598.
- Ganesh B, Burnice NKC, Mahendra J, Vijayalakshmi R, K AK. Laser-assisted lip repositioning with smile elevator muscle containment and crown lengthening for gummy smile: A Case Report. *Clin Adv periodontics.* 2019;9(3):135–41. DOI:10.1002/cap.10060.