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# Surgical Treatment of Excessive Gingival Display Using Lip Repositioning Technique and Laser Gingivectomy as an Alternative to Orthognathic Surgery

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Excessive gingival display (EGD) is a condition in which an overexposure of the maxillary gingiva (>3 mm) is present during smiling. The proper diagnosis and determination of its etiology are essential for the selection of the right treatment modality. Different techniques have been used in cases of hyperactive upper lip: botulinum toxin injections, lip elongations with rhinoplasties, lip muscle detachments, myotomies, and lip repositions. This report presents a case of a young woman with an EGD larger than 10 mm during smiling caused by altered passive eruption, vertical maxillary excess, and a hyperactive upper lip that was treated with a modified lip repositioning technique and laser gingivectomy because she strongly refused orthognathic surgical treatment. A novel addition to the technique is proposed, a reversible trial accomplished just by applying sutures on the borders of the future split-thickness flap, marked using diode laser, before starting the flap incision.

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*J Oral Maxillofac Surg* 72:404.e1-404.e11, 2014

Excessive gingival display (EGD), commonly termed *gummy smile*, is a condition in which there is an overexposure of the maxillary gingiva during smiling; in severe cases, the overexposure is present in repositioning of the mouth and lips.<sup>1</sup> Although some gingival display gives the impression of a youthful smile, a gingival display larger than 3 mm is considered unattractive.<sup>2</sup> According to different investigators, a gummy smile is considered a gingival display from 2 to 3 mm when smiling.<sup>3,4</sup> It can affect about 10.5% of the population,<sup>5</sup> with a female predominance (2:1) and affecting persons 20 to 30 years of age.<sup>6</sup> The incidence of this condition decreases with age as a result of dropping of the upper and lower lips.<sup>2</sup>

The etiology of EGD is various: plaque- or drug-induced gingival enlargement, altered or delayed passive eruption, anterior dentoalveolar extrusion, vertical maxillary excess, short upper lip, a hyperac-

tive upper lip, or a combination of these causes. Proper diagnosis of the etiologic 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. Depending on the classification of the latter, bone surgery also may be required. Anterior dentoalveolar extrusion is treated with orthodontic intrusion and vertical maxillary excess is treated with orthognathic surgery.<sup>7</sup> In the literature, different techniques have been reported for the treatment of the hyperactive upper lip: injections of botulinum toxin,<sup>8</sup> lip elongation associated with rhinoplasty,<sup>9</sup> detachment of lip muscles,<sup>10</sup> myotomy and partial removal,<sup>11,12</sup> and lip repositioning.<sup>13-15</sup>

The lip repositioning technique was first described 1973 by Rubenstein and Kostianovsky<sup>16</sup> as part of medical plastic surgery. Later on, it was introduced

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Received September 23 2013

Accepted October 23 2013

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0278-2391/13/01328-1\$36.00/0

<http://dx.doi.org/10.1016/j.joms.2013.10.016>



**FIGURE 1.** A, Preoperative full face view with relaxed lips. (Fig 1 continued on next page.)

*Gabrić Pandurić et al. Treatment of Excessive Gingival Display. J Oral Maxillofac Surg 2014.*

in dentistry, after being modified in 2006 by Rosenblatt and Simon.<sup>13</sup>

This clinical report presents a case of a young female patient with an EGD larger than 10 mm during smiling caused by a combined etiology of a hyperactive upper lip and altered passive eruption of the frontal maxillary teeth because she refused orthognathic surgery. The treatment plan consisted of a modified lip repositioning technique with a reversible clinical trial<sup>17</sup> and a gingivectomy performed with a diode laser.

## Report of Case

### PATIENT PROFILE, PRESURGICAL EVALUATION, AND CONSENT

A 27-year-old woman reported to the Department of Oral Surgery, School of Dental Medicine, University of Zagreb (Zagreb, Croatia) with the chief complaint of a gummy smile. She reported dissatisfaction with the amount of gingiva exposed while smiling and her treatment goal was to minimize the gingival display during

smiling. The patient's medical history disclosed heart surgery for an aortic valve tumor at 10 years of age. Otherwise, her history was unremarkable, with no medication intake. She did not have active dental or periodontal diseases. There were no contraindications to surgical treatment. During clinical evaluation, it was verified that up to 10 mm of gingiva was displayed during smiling (Fig 1A, B, C). With an exaggerated smile, the patient's teeth were visible from the maxillary right first molar to the maxillary left first molar, with 10 mm of excessive gingival tissue display in the medial line, 8.5 mm in the right canine line, 8 mm in the right first molar line, 7 mm in the left canine line, and 5.5 mm in the left first molar line. During clinical evaluation, a normal upper lip length was found. During smiling, there was 12 mm of lip raising, which led to a diagnosis of a hyperactive upper lip. Tooth evaluation showed discrete short clinical crowns in the maxillary anterior region, and probing showed that the alveolar bone crest was localized 2 to 3 mm apically to the cemento-enamel junction, leading to the diagnosis of altered passive eruption. The final diagnosis was EGD from a combination of altered passive eruption, vertical maxillary excess, and a hyperactive upper lip. After the patient refused orthognathic surgical treatment, a modified lip repositioning technique and concomitant gingivectomy was proposed. The patient was counseled on management options. The patient's expectations were clarified and a realistic outcome was presented, including the possibility of full or partial relapse. Pre-existing asymmetry in the patient's smile was pointed out to her, because of the possibility that it would be more apparent with the lip in closer proximity to the teeth. Written informed consent was obtained after an explanation of the risks, potential benefits, and treatment alternatives. Intra- and extraoral photographs were taken for planning and records.

### SURGICAL PROCEDURE

The treatment plan consisted of reversible lip repositioning and definitive surgical repositioning. One hour before surgery, the patient was given amoxicillin 2 g for prophylaxis owing to her history of cardiac surgical treatment and preoperative analgesics (ibuprofen 600 mg) for pain management. Extraoral and intraoral antisepsis was performed with 2.0% chlorhexidine solution and 0.12% chlorhexidine rinse for 1 minute. Initial anesthesia consisted of bilateral infraorbital blocks (2% lidocaine with 1:200,000 epinephrine). The infraorbital block was used to avoid thickening of the lip and soft tissues with anesthetic fluid, allowing the reversible trial to be a more realistic representation of the projected final result. To begin the reversible lip repositioning, the proposed surgical incision lines were marked with a high-power diode laser



**FIGURE 1 (cont'd).** B, Preoperative enface view. C, Preoperative face profile view.

*Gabrić Pandurić et al. Treatment of Excessive Gingival Display. J Oral Maxillofac Surg 2014.*

(LaserHF, Hager & Werken, Duisburg, Germany) set to 1.5 W using continuous-wave (CW) mode and fiber with an active diameter (core) of 320  $\mu\text{m}$ . When applied to the tissue, the laser beam does not cut the tissue but leaves a dark mark that cannot be smeared or wiped away. Marks are not permanent and fade dur-

ing the next 2 days. Small dashed markings were placed every 5 mm along the line of the proposed incisions. The inferior border was defined by the mucogingival junction from the mesial aspect of the first molars bilaterally. The superior border was placed slightly inferior in the area of the labial frenum,

cresting in the area of the canine, and tapering toward the posterior area, forming moustache-like shape. The distance between the superior and inferior borders was 1.5 the length of the repositioning desired in the patient's smile. Once the area was marked, sutures were used to complete the reversible procedure. Eight 3.0 silk sutures (2 in the frontal part, 1 above the canine area, and 1 between the second premolar and the first molar bilaterally) were placed (Fig 2). Suture design involved a vertical tissue bite taken at the superior border in the movable mucosa, a horizontal tissue bite at the mucogingival junction, and inverting and tucking behind the tissue proposed for excision. At this point, photographs were taken, and the patient was able to evaluate the potential final result using mirror and clinical photographs (Fig 3). She decided immediately to proceed with the surgery. Anesthesia was supplemented with local infiltration, using the same type of local anesthetic, from the maxillary right to the left first molar for hemostatic control. Temporary sutures were removed and the laser spot markings were connected to the line of the planned scalpel incision using a diode laser with the same parameters (Fig 4), owing to possible changes in the direction and angle of the incision line, if necessary. Partial-thickness incisions were made using a scalpel across the superior and then the inferior border, connecting in the posterior molar area bilaterally. Frenectomy using a high-power diode laser (975  $\mu\text{m}$ , 4 W, CW) was performed (Fig 4). The final surgical procedure was initiated on the left side (Fig 5). Two strips of outlined mucosa were removed (Fig 6) by a superficial split-thickness dissection beginning from the frenectomy laser incision for the 2 sides, leaving the underlying connective tissue

exposed. The tissue thickness was approximately 1 mm. Care was taken to avoid damage to any minor salivary glands in the submucosa. High-frequency bipolar forceps (LaserHF, Hager & Werken) were used to control bleeding. The area of frenectomy was approximated along the preoperative laser markings with a simple interrupted suture to ensure symmetry and proper midline placement. The remaining closure bilaterally was completed with continuous interlocking sutures to stabilize the new mucosal margin to the gingiva (Fig 7). Nonresorbable sutures were used (3-0 silk). For further hemostasis, tissues were compressed with wet gauze for 5 minutes. After probing and marking using a Crane-Kaplan pocket marker, gingivectomy in the intercanine area was performed with a high-power diode laser (975  $\mu\text{m}$ , 3 W, 10 ms, 1:2; Fig 8A, B). A soft tissue bandage (Reso-Pac, Hager & Werken) was applied over the entire surgical site. Nonsteroidal anti-inflammatory drugs (ibuprofen 600 mg 3 times daily for 2 days) and oral antibiotics (amoxicillin 500 mg 3 times daily for 7 days) were prescribed after surgery. The patient was instructed to apply ice packs, consume only soft foods during the first postoperative week, avoid any mechanical trauma, brush gently, and minimize lip movements when smiling or talking for the first 2 weeks postoperatively.

#### POSTOPERATIVE FOLLOW-UPS AND CLINICAL RESULTS

The patient was seen the day after surgery for follow-up. She reported good analgesia with the over-the-counter ibuprofen. Periodic follow-ups were



**FIGURE 2.** Reversible clinical trial using silk sutures and diode laser marks.



**FIGURE 3.** Clinical view with reversible trial before surgery.

*Gabrić Pandurić et al. Treatment of Excessive Gingival Display. J Oral Maxillofac Surg 2014.*

scheduled on postoperative days 3 (Fig 9A, B), 5, 10 (Fig 10A, B), and 14, 3 months postoperatively, and 6 months postoperatively, when clinical photographs were taken. Postoperative healing occurred with minimum discomfort, and she reported “tension” on the upper lip and “slight pain” when smiling and talking during the first week after surgery and feeling numbness on the left side of the upper lip. Sutures were removed 10 days later. The suture line healed in the form of scar that was not apparent when the patient smiled, because it was concealed in the upper lip mu-

cosa (Fig 11). Upper lip length (from the nasal base to the superior border of the upper lip vermillion) increased from 10 mm at baseline to 16 mm at postoperative day 14 and 15 mm at 3 and 6 months after surgery. Upper lip vermillion length (from the inferior border of the upper lip) increased from 6 mm at baseline to 10 mm at postoperative day 14 and 3 and 6 months after surgery. The gingival display at baseline was 5.5 to 10 mm and decreased significantly to 2 mm in the medial line and 0 mm (when the lip covered part of clinical crowns) in the canine and molar regions



**FIGURE 4.** Diode laser superficial incision and frenectomy.

*Gabrić Pandurić et al. Treatment of Excessive Gingival Display. J Oral Maxillofac Surg 2014.*



**FIGURE 5.** Intraoral comparison of left side after surgery and right side before surgery.

*Gabrić Pandurić et al. Treatment of Excessive Gingival Display. J Oral Maxillofac Surg 2014.*

bilaterally at postoperative day 14 and 3 and 6 months after surgery. Results from the evaluation of the patient's postoperative discomfort using a visual analog scale (VAS), ranging from 1 for "no pain" to 10 for "pain as bad as could possibly be," were 8 the day after surgery, 3 at postoperative days 3 and 5, 2 at postoperative day 10, and 0 at postoperative day 14. The patient filled out the previously prepared questionnaire for patient satisfaction with the surgical procedure. Preoperatively, she was not satisfied with her smile and with the amount of gingival display, with the opposite effect postoperatively. Postoperatively, she considered the amount of displayed gingival to be "about right" compared with "way too much" preoperatively. In



**FIGURE 6.** Two strips of outlined mucosa removed intraoperatively, with a tissue thickness of approximately 1 mm.

*Gabrić Pandurić et al. Treatment of Excessive Gingival Display. J Oral Maxillofac Surg 2014.*

contrast to the first postoperative week, when she felt tension when talking or smiling and numbness, at 2 weeks and 3 and 6 months postoperatively she felt no tension or numbness. She reported that the worst part of this surgical procedure was the discomfort or inability to move the lip during the first week, and the best part was the improvement of her smile and facial esthetics (Fig 12A, B). Considering the overall experience, she would likely choose to undergo the surgery again.

## Discussion

The lip repositioning technique is an excellent alternative to more costly procedures with higher morbidity rates.<sup>9-12</sup> The lip reposition surgery was originally described in the medical literature by Rubenstein and Kostianovsky in 1973.<sup>16</sup> The LRS originally did not include severing the muscle attachments. Later on, different investigators modified the technique by proposing the detachment of the elevator muscle in cases of a short upper lip,<sup>10</sup> myectomies or partial resection of 1 or 2 levator labii superior muscles,<sup>11</sup> and partial transection of the lip elevator muscles and implantation of an alloplastic or autogenous spacer.<sup>18</sup> All these modifications were made to prevent relapses.

In the past 7 years there have been several case reports and case series in the dental literature describing the use of LRS for the treatment of EGD,<sup>14-17</sup> with the first by Rosenblatt and Simon.<sup>13</sup> There are some differences in the technique among investigators, with some leaving the frenulum intact<sup>14,15</sup> and others including the frenulum in the partial-thickness flap



**FIGURE 7.** Continuous interlocking sutures for stabilization of the new mucosal margin to the gingiva.

*Gabrić Pandurić et al. Treatment of Excessive Gingival Display. J Oral Maxillofac Surg 2014.*

for removal.<sup>13,16,17</sup> Leaving the frenulum intact helps maintain the position of the labial midline, prevent changes in lip symmetry, and decrease the morbidity associated with the procedure,<sup>14,15</sup> but in the authors' opinion limits the possibility of correcting EGD in the region of the maxillary central incisors. Because the present patient had an EGD larger than 10 mm, a large correction had to be performed. In this case, the amount of epithelium for excision was 1.5 times the amount of the EGD. The original plan was to decrease the amount of EGD by 2 times, but with an EGD larger than 10 mm, the superior incision line would be too close to the vermilion border. The scar form after the surgery could violate the smile esthetics. To the best of the authors' knowledge, the amount of the EGD corrected with the LRS technique and crown lengthening reported in this case is the largest described in the literature.<sup>13-17,19</sup>

A novel addition to the technique has been proposed, a reversible trial accomplished just by applying sutures on the borders of the future split-thickness flap before starting the flap incision.<sup>19</sup> In the present case, laser markings were used to depict the position of the incision line. Sutures were placed temporarily connecting the upper and the lower markings, simulating the final result of the treatment. Using this technique, the patient and the surgeon have the opportunity to preview the final result in advance. Because LRS is an elective surgery, it is important that the patient have realistic expectations related to the final result of the surgery. Therefore, the trial modification is a good tool for communication between the surgeon and the patient.

Alternatives to LRS in the treatment of EGD caused by a hyperactive or short upper lip have been proposed by Polo<sup>8,20</sup> and Ishida et al.<sup>12</sup> Polo<sup>20</sup> used botulinum toxin type A to treat 30 patients with EGD. At the second week after injection, the preinjection gingival display of  $5.2 \pm 1.4$  mm decreased to  $0.09 \pm 1.06$  mm. The effect of the botulinum toxin was temporary, and the gingival display gradually increased from the second week to baseline values after the 32nd week. In their technique, Ishida et al<sup>12</sup> combined and modified different procedures: myotomy of the levator labii superioris muscles<sup>11</sup> and subperiosteal dissection<sup>21</sup> associated with a subcutaneous dissection and lip frenectomy.<sup>22</sup> The surgery was performed in 14 patients who showed a decrease of gingival display from  $5.22 \pm 1.48$  at baseline to  $1.91 \pm 1.50$  mm 6 months after surgery.

All 3 techniques produce the same results in decreasing EGD. However, although the botulinum toxin injection<sup>20</sup> is the least invasive treatment, the results are temporary and necessitate frequent retreatments. The approach used by Ishida et al<sup>12</sup> is more aggressive, with higher morbidity compared with LRS.

Some factors restrict the use of LRS. It is contraindicated in the presence of an inadequate amount of attached gingiva in the maxillary anterior sextant. It will cause difficulty in flap design, suturing, and stabilization, which could lead to relapse.<sup>11</sup> In addition, the patient could be left with a shallower vestibule that could compromise the ability to perform adequate oral hygiene.<sup>14</sup> Although LRS is not indicated for severe maxillary excess,<sup>7,14</sup> Humayun et al<sup>19</sup> reported a case of mild maxillary excess treated with LRS.



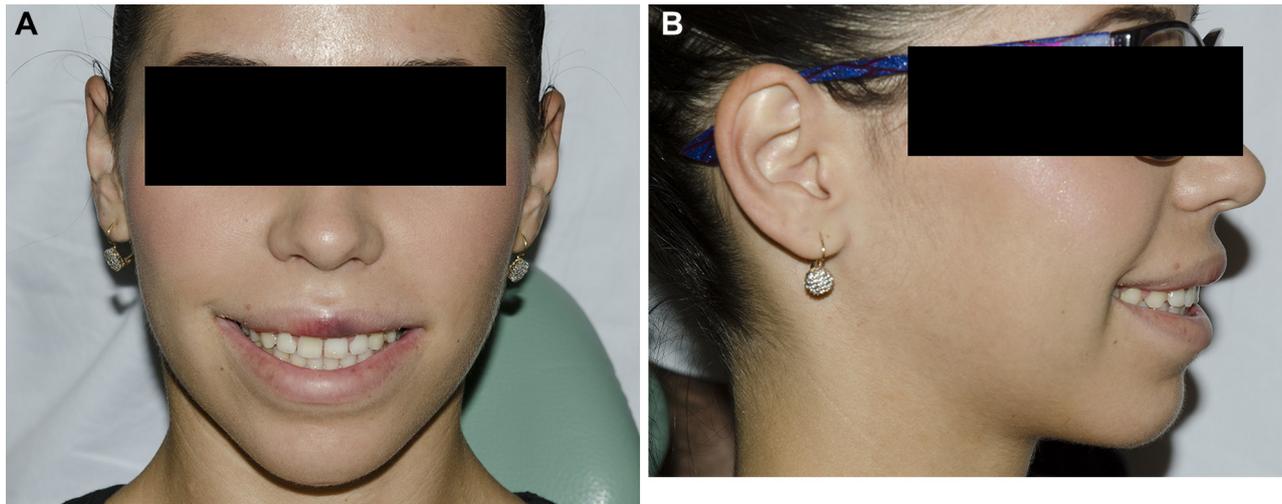


**FIGURE 8.** Immediately postoperatively. A, Enface view. B, Face profile view.

*Gabrić Pandurić et al. Treatment of Excessive Gingival Display. J Oral Maxillofac Surg 2014.*

Rare complications have been described after LRS, such as discomfort, bruising, and swelling of the upper lip.<sup>13,14,17</sup> Rosenblatt and Simon<sup>13</sup> reported on 1 patient with a mucocele that resolved without treatment.

In the first week after surgery, the present patient complained of mild discomfort (according to the VAS, the pain level at the third day after surgery was 3 and completely disappeared within 14 days) and tension



**FIGURE 9.** Follow-up on third postoperative day. A, Enface view. B, Face profile view.

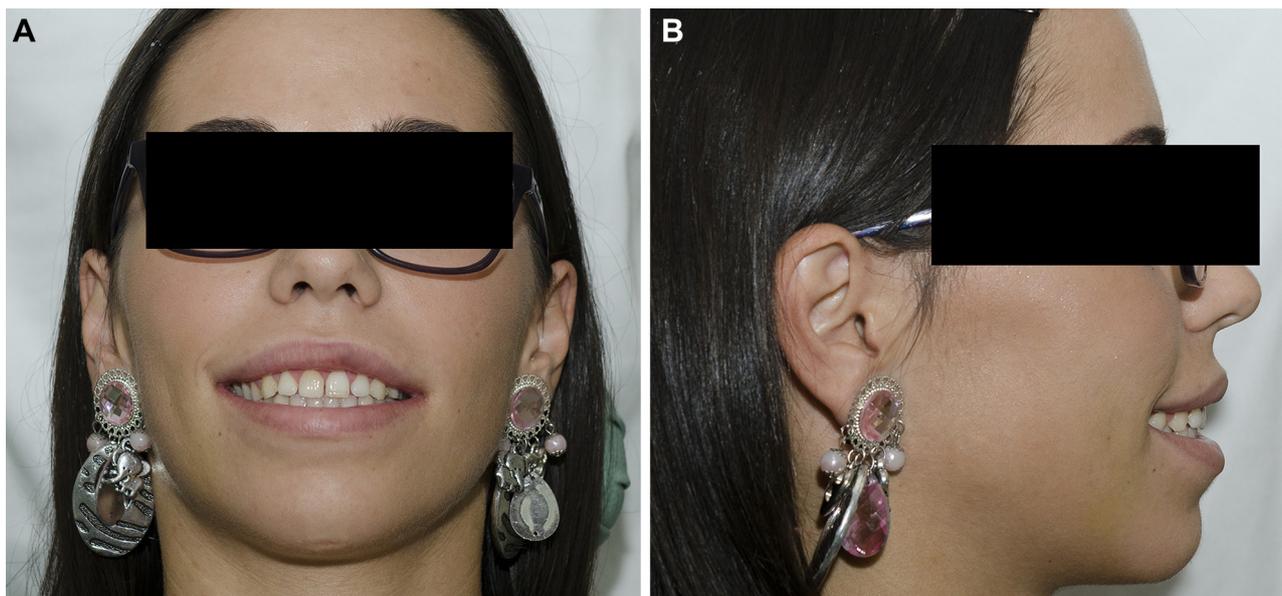
*Gabrić Pandurić et al. Treatment of Excessive Gingival Display. J Oral Maxillofac Surg 2014.*

while talking and smiling and numbness of the left side of the upper lip. On the left half of the upper lip, a hematoma had formed, which disappeared within 2 weeks after surgery.

This case presentation describes the treatment of a young female patient with a combined etiology of EGD: altered passive eruption, vertical maxillary excess, and a hyperactive upper lip. During maximum smiling, the patient had a 10-mm EGD and Class 1A altered passive eruption according to Coslet et al.<sup>23</sup> The first treatment plan proposed to the patient was orthognathic surgery and gingivectomy.

The patient refused orthognathic surgery because the morbidity and potential complication rate associated with orthognathic surgery were not acceptable to her for an elective cosmetic treatment. Therefore, an alternative treatment was proposed: LRS and laser gingivectomy, procedures with low morbidity and good acceptance by patients. With this treatment plan, 2 of 3 etiologic factors of EGD were corrected.<sup>7</sup>

The outcome was successful, with a decrease of EGD from 10 to 1.5 mm in the region of the left and right central incisors, from 8.5 to 0 mm in the right canine region, from 7 to 0 mm in the left canine region, from 8



**FIGURE 10.** Follow-up 10 days after surgery. A, Enface view. B, Face profile view.

*Gabrić Pandurić et al. Treatment of Excessive Gingival Display. J Oral Maxillofac Surg 2014.*



**FIGURE 11.** Intraoral view 10 days after surgery, immediately after suture removal. The suture line healed in the form of scar.

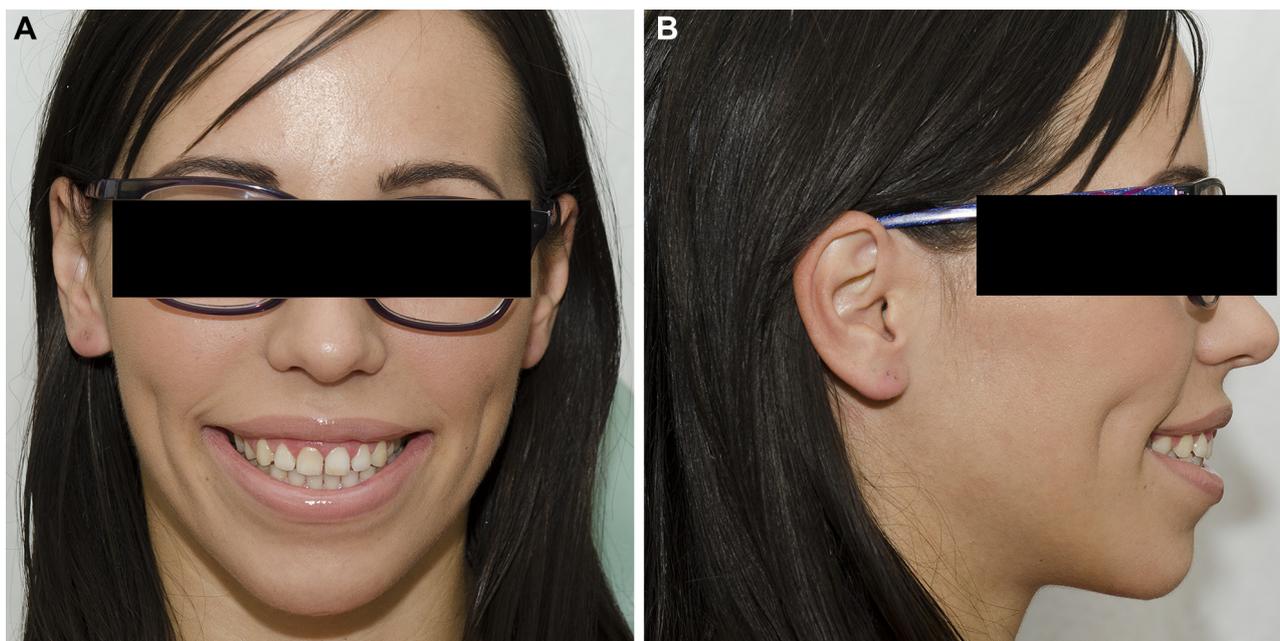
*Gabrić Pandurić et al. Treatment of Excessive Gingival Display. J Oral Maxillofac Surg 2014.*

to 2.0 mm in the right first molar region, and from 5.5 to 1.0 mm in the left molar region at 6-month follow-up.

Silva et al<sup>14</sup> reported high patient satisfaction 2.5 years after surgery, with 70% of patients considering the post-operative amount of gingival display to be “about right” and 90% willing to undergo the procedure again. Hence, LRS is a safe procedure with low morbidity and good acceptance.<sup>14</sup> This was in accord with present case. Based on the questionnaire filled out 3 and 6 months

after surgery, the patient expressed satisfaction with her smile and with the decreased quantity of EGD, stating that she would undergo the procedure again.

LRS might be a valid alternative for the decrease of EGD caused by a hyperactive or short upper lip. Compared with alternative solutions, such as botulinum toxin injections or a combined myotomy procedure, it has a stable result and low morbidity. Furthermore, it is well accepted by patients. This case presentation



**FIGURE 12.** Follow-up 6 months after surgery. A, Enface view. B, Face profile view.

*Gabrić Pandurić et al. Treatment of Excessive Gingival Display. J Oral Maxillofac Surg 2014.*

suggests that LRS combined with laser gingivectomy could be used as a minimally invasive alternative to orthognathic surgery for cases of EGD with a complex etiology.

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