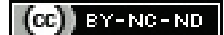


Treatment of Excessive Gingival Display using CAD-CAM Guided Aesthetic Crown Lengthening and Surgical Lip Repositioning as an Alternative to Orthognathic Surgery: A Case Report

APEKSHA ANNIGERI¹, ABHIRAMI SURESHBABU², VINAYAK KUMBHOJKAR³, NIVETHITHA DIVAKARAN⁴



ABSTRACT

Excessive Gingival Display (EGD), commonly known as a gummy smile, is a significant aesthetic concern. The factors responsible for EGD include altered passive eruption, a short or hyperactive upper lip, vertical maxillary excess, or a combination of these. The classic treatment for severe cases of vertical maxillary excess and EGD is orthognathic surgery. However, Aesthetic Crown Lengthening (ACL) and Lip Repositioning (LR) can offer a conservative, minimally invasive and reliable alternative for treating EGD. This case report focuses on managing EGD using a conservative, minimally invasive mucosal strip surgical technique for a 23-year-old female patient who presented with a severe gummy smile. Management was planned with a combination of ACL and LR. A CAD-CAM milled surgical guide was designed and printed by superimposing Stereolithography (STL) files of digital impressions, photographs and Digital Imaging and Communications in Medicine (DICOM) files from a Cone-beam Computed Tomography (CBCT) scan to provide a suitable and predictable reference for ACL. The LR was performed by resecting a mucosal strip and coronally repositioning the upper lip, thereby reducing the depth of the upper vestibule to restrict lip elevation during smiling, which in turn reduces the gingival display. A substantial reduction of 4 mm of gingival display was seen post-operatively. ACL and LR aided with CBCT can be considered a safe and conservative treatment option for EGD.

Keywords: Aesthetic smile line, Computer-aided design and computer-aided manufacturing, Gummy smile

CASE REPORT

A 23-year-old female patient reported to the Department of Periodontology with the chief complaint of excessive display of gums while smiling. The patient had no co-morbidities and had undergone orthodontic treatment three years ago, but she refused orthognathic surgery. Extraoral examination showed no facial asymmetry and her lips were competent. Intraoral examination revealed a width of attached gingiva measuring 10 mm and upon smiling, a gingival display of 7 mm was observed [Table/Fig-1].



[Table/Fig-1]: Preoperative normal smile.

The smile line extended from the right maxillary second premolar to the left maxillary second premolar. A lateral cephalogram was used to assess her maxillary profile, which indicated the presence of vertical maxillary excess. The patient was informed in detail about the risks, benefits and treatment alternatives before planning the procedure. Intraoral and extraoral photographs, CBCT scans and blood investigations were conducted for planning and documentation.

A surgical guide was fabricated with the aid of an intraoral scan, CBCT and photographs. DICOM files were converted to STL format and superimposed with STL files acquired from the intraoral scan [Table/Fig-2]. The level of the cemento-enamel junction was marked to guide the gingivectomy incision line using design software.



[Table/Fig-2]: CAD-CAM milled surgical guide.

Oral prophylaxis was performed and the patient was advised to use 0.2% Chlorhexidine Gluconate mouthwash for seven days. A 2% Betadine solution was used for full mouth disinfection and the local tissues were anaesthetised with 2% lignocaine hydrochloride containing 1:80,000 epinephrine. The surgical guide was placed in position and a 15c blade was used to make internal bevel incisions along the superior border of the window of the guide [Table/Fig-3]. A total of 2 mm of crown lengthening was performed from the right maxillary second premolar to the left maxillary second premolar [Table/Fig-4].



[Table/Fig-3]: Surgical guide placement.



[Table/Fig-6]: Stripping of mucosa for Lip Repositioning (LR).



[Table/Fig-4]: After Aesthetic Crown Lengthening (ACL).



[Table/Fig-7]: Midline suture placed for stabilisation.

The ACL was followed by LR surgery. An indelible pencil was used to demarcate the surgical site, which extended from the mucogingival junction to 10-12 mm superiorly into the vestibule. A partial thickness flap was raised from the right maxillary first molar to the left maxillary first molar [Table/Fig-5].



[Table/Fig-5]: Marking of surgical area for Lip Repositioning (LR).



[Table/Fig-8]: Suture given along the incision line.

The incisions made involved the labial frenum and were joined in an elliptical pattern, followed by de-epithelialisation to expose the underlying connective tissue. The muscular and mucosal attachments were then stripped to limit the retraction of the lip [Table/Fig-6].

The midline suture was first placed to approximate the parallel incision lines, stabilise the lip and establish proper positioning of the lip midline [Table/Fig-7]. This was followed by the placement of simple interrupted sutures along the incision borders [Table/Fig-8].

Postoperative instructions and medications were provided, which include Amoxicillin 500 mg to be taken twice daily for three days, Aceclofenac 100 mg, Paracetamol 325 mg and Serratiopeptidase 15 mg. The patient was scheduled to return for suture removal after seven days [Table/Fig-9].

Postoperative symptoms included mild discomfort, mild swelling of the upper lip for two weeks and a slight feeling of tension in the surgical area when smiling. Follow-up examinations to assess



[Table/Fig-9]: One week follow-up.

the gingival display were conducted at one, three and six months postoperatively [Table/Fig-10-12].

The ACL resulted in an adequate clinical crown and an ideal curvature of the gingiva in the aesthetic zone. The LR yielded a substantial reduction of 4 mm in gingival display, resulting in a narrow vestibule with restricted pull of the upper lip [Table/Fig-13].



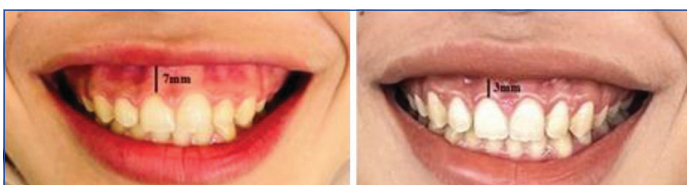
[Table/Fig-10]: One month postoperative.



[Table/Fig-11]: Three months postoperative.



[Table/Fig-12]: Six month postoperative.



[Table/Fig-13]: Images showing pre and postoperative reduction in gingival display.

DISCUSSION

An aesthetic smile can positively influence the psychological perception of an individual. EGD, otherwise known as a gingival smile, is defined as the condition where the visible gingiva is ≥ 3 mm. The prevalence of EGD is between 10.5% and 29% and is most common among women [1]. It can stem from factors such as gingival enlargement, an asymmetrical upper lip, a hyperactive upper lip, a short lip, vertical maxillary excess and altered passive eruption [2].

When smiling, an excessive pull on the upper lip leads to greater exposure of both the teeth and the gingiva. In such cases, surgical LR can be advised to lessen the retraction of the upper lip, thereby decreasing gingival display. This technique was first described in 1973 by Rubinstein AM and Kostianovsky AS as part of aesthetic plastic surgery and has shown encouraging results [3].

The present case report describes a simple corrective treatment to decrease EGD through a combination of ACL and LR.

The results from a systematic review conducted by Tawfik OK et al., indicated that LR improved EGD by 3.4 mm, making it a reliable alternative treatment option for EGD [3]. In 2022, Mendoza-Geng A et al., reported in their systematic review and meta-analysis that an approximate EGD reduction of -3.06 mm, -2.91 mm and -2.76 mm was achieved at 6, 12 and 36 months, respectively, using only LR.

The management of LR combined with periosteal suturing reported the maximum reduction in EGD of 5.22 mm and 4.94 mm at six and 12 months, respectively [4]. It is important to obtain even margins and a zenith following ACL. A CAD-CAM milled surgical guide was fabricated to reduce the risk of under- or over-contouring the gingival margins. The advantages of using this technique include an optimal fit, ease of fabrication and time efficiency [5]. One of the disadvantages of freehand surgery is the difficulty in determining the position of the gingival level after the flap is elevated. The guide provides accurate dimensions for soft and hard tissue removal and is an important clinical consideration for treatment since gingival recession might be caused by excessive bone removal [6]. In a case report published by Coachman C et al., a successful result of a digitally designed double guide for crown lengthening was shown and the patient exhibited a favourable outcome even after a 1-year follow-up [7]. A case report depicting a 22-year-old female with a gummy smile was corrected using a 3D-printed surgical guide for crown lengthening based on cone beam computed tomography measurements, which showed a satisfactory outcome six months after surgery as well. This technique provided a simplified method of generating a surgical guide with predictable results by relying on the existing tooth anatomy rather than diagnostic waxing [8].

The use of a 3D digital guide is reliable, accurate and aids in the quick management of complicated periodontal cases [9]. However, partial and complete relapse have been reported with the original technique [10]. Therefore, to enhance predictability and long-term stability in this case, we involved the labial frenum to avoid relapse and achieved satisfactory results.

In the present case, authors attained a reduction of 4 mm in the gingival display with no significant relapse, which is consistent with the results observed in studies conducted by Simon Z et al., and Humayun N et al., [11,12].

Younespour S et al., reported in a systematic review that an average reduction in EGD of 2.68 mm at six months and 2.52 mm at 12 months was achieved when treating with LR surgery [13]. Silva CO et al., demonstrated effective management of EGD, where 13 patients treated with a modified LR technique showed a reduction of 4.4 ± 1.0 mm at three months and it remained the same until the end of six months [14].

The long-lasting stability of the results from surgical LR is appreciated and can be considered a potential alternative treatment option for aesthetic rehabilitation.

CONCLUSION(S)

Surgical LR is an effective method to decrease EGD by positioning the upper lip in a more coronal position, thereby reducing the hyperactivity of the lip. In the present case, ACL in combination with LR was found to be a safe, conservative alternative for the treatment of EGD and a reduction of gingival display by 4 mm was successfully achieved. The functional and aesthetic requirements of the patient were met with the help of CAD-CAM and the patient was satisfied with the outcome of the procedure.

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PARTICULARS OF CONTRIBUTORS:

1. Lecturer, Department of Periodontics, Kaheer's KLE VK Institute of Dental Sciences, Belgaum, Karnataka, India.
2. Postgraduate Student, Department of Periodontics, Kaheer's KLE VK Institute of Dental Sciences, Belgaum, Karnataka, India.
3. Professor, Department of Periodontics, Kaheer's KLE VK Institute of Dental Sciences, Belgaum, Karnataka, India.
4. Postgraduate Student, Department of Periodontics, Kaheer's KLE VK Institute of Dental Sciences, Belgaum, Karnataka, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Apeksha Annigeri,
Lecturer, Department of Periodontics, Kaheer's KLE VK Institute of Dental Sciences,
Nehru Nagar, Belagavi, Belgaum-590010, Karnataka, India.
E-mail: apekshaannigeri@gmail.com

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