

Excessive Gingival Display- An Overview

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Abstract

Excessive gingival display (EGD) is an esthetic concern and is a common cause for patient dissatisfaction. The patient will usually complain of small maxillary teeth or a ‘gummy smile’. The condition is characterized by an overexposure of the gingiva during smiling. There is an apparent excess of gingiva to tooth ratio resulting in an unaesthetical smile.

Keywords: Excessive Gingival Display, Gummy Smile, Crown Lengthening, Lip Repositioning, Orthognathic Surgery.

The importance of an attractive smile and its effect on positive self-image cannot be overemphasised. There are several etiological factors responsible for the presence of a ‘gummy smile’. Gummy smile can occur due to many reasons such as vertical maxillary excess, excessive gingival overgrowth, altered passive eruption,

anatomically short upper lip, hypermobile muscles of the upper lip, or a combination of any of these factors. Patients who have gingival and skeletal deformities will require a multidisciplinary approach to treatment. The clinician must examine the dynamic relationship between a patient’s teeth, gingiva and lips while smiling. An average smile reveals 75% to 100% of the maxillary anterior teeth and the interproximal gingiva only. A normal gingival display between the inferior border of the upper lip and the gingival margin of the anterior teeth during a smile is 1-2 mm. An excess of 3mm gingival display is usually considered unattractive and affects a fairly large population with a reported prevalence between 10.5% and 29%. This could be due to an individual or a combination of causes. It is imperative to establish the correct etiology for the excessive gingival display.

Although numerous factors cause excess gingival display, it is common for the condition to occur as a result of interplay of several etiologies. Etiological factors resulting in gummy smile can be:

1. **Skeletal (vertical maxillary excess)**
2. **Gingival (passive eruption)**
3. **Muscular (hyper functional upper lip)**

It is essential to analyze several characteristics: Symmetry of lips and face during smile; gum exposure; level of gingival margins; alignment of gingival margins (size of teeth and proportions) and smile-line [3] Treatment options range from Le fort I osteotomy, crown lengthening, intrusion, myectomy to muscle resection etc.

Etiology

Excessive gingival display has several possible etiologies. First, it may be a result of delayed eruption, wherein the gingiva fails to apically migrate over the maxillary teeth to a position 1 mm coronal to the cemento-enamel junction. In these patients, the normal tooth dimensions and dentogingival relations are restored by way of an esthetic crown lengthening procedure through soft and possibly hard tissue resection. It is a treatment modality which is well documented to treat an excessive gingival display and improve the patient's smile.

Jaw deformities can also cause excessive gingival display. A vertically maxillary excess is a developmental abnormality of the maxilla in which there is an excessive vertical dimension of the midface and is usually accompanied with incompetent lips. An orthognathic surgery is the treatment of choice here to restore normal occlusal relationships and reduce gingival display. The drawback of this treatment modality is the requirement of patient hospitalization and its possible association with significant morbidity and post-operative complications.

Another possibility could be compensatory eruption of the maxillary teeth with accompanying coronal migration of

the attachment apparatus, which includes the gingival margins. Orthodontic leveling of the gingival margins of the maxillary teeth could be one possible treatment option. Another option could be resective surgery but this can cause exposure of the narrow root surface, entailing a restoration.

Excessive labial retraction of the elevator smile muscles namely zygomaticus minor, levatorangulioris, orbicularis oris and levator labii superioris upon smiling can also lead to an increased gingival display and can be effectively treated by a simple lip repositioning procedure. Botulinum toxin type A injections can also be considered for correction if a patient's gummy smile is a result of hyperactivity of the elevator muscles of the upper lip. This toxin is a powerful paralyzing agent that acts at the level of the neuromuscular junction by inhibiting the release of acetylcholine causing a chemo-denervation leading to the reduction of muscle activity. However, this neuromuscular approach for correction is not popular because of the transitory nature of the results.

Treatment

Aesthetic Crown Lengthening: Crown lengthening is performed for aesthetic improvement and this surgical procedure can establish an accurate bone width and correct gingival asymmetries.

Gingivectomy or gingivoplasty procedures are performed with or without osseous recontouring for esthetic crown lengthening to expose the needed additional tooth structure; therefore, a minimum of 2 to 5 mm of keratinized tissue is necessary to ensure the gingival health. The management of the papilla is another important aspect of the surgery. The level of the alveolar crest must be determined prior to any considerations regarding aesthetic crown lengthening. Bone sounding is performed to determine the thickness of the soft tissue layer and location of the alveolar crest. The interproximal

bone should be carefully removed in order to maintain the anatomic structures, so that the interproximal tissues are allowed to coronally proliferate; the papilla should replace the distance from the bone crest to the base of the contact area (about 5 mm or less). In conclusion, crown lengthening surgery is a viable option for improving esthetic appearance. However, to plan a crown lengthening procedure, the whole periodontal condition of the patients and their hygiene habits should be evaluated. Furthermore, an accurate diagnostic and interdisciplinary approach is mandatory for obtaining improved and predictable results in esthetic areas.



Figure 1: Pre-operative



Figure 2: Post-operative

A new classification system was introduced by based on the dynamic relationship between the alveolar crest position and the anticipated gingival margins post operatively and an analysis of the possible clinical

scenarios to help organize the diagnostic process was performed.

Table No 1

Proposed Classification System for Aesthetic Crown Lengthening Procedures	
Classification	Characteristics
Type 1	Type I aesthetic crown lengthening is characterized by sufficient gingival tissue coronal to the alveolar crest, allowing the surgical alteration of the gingival margin levels without need for osseous recontouring. A gingivectomy or gingivoplasty procedure will usually suffice to establish the desired gingival margin position.
Type 2	Type II aesthetic crown lengthening is characterized by soft tissue dimensions that allow the surgical repositioning of the gingival margin without exposure of the osseous crest, but nevertheless in violation of the biologic width.
Type 3	Gingival excision to the desired clinical crown length will expose the alveolar crest. In type III aesthetic crown lengthening, bone sounding may reveal a scenario where repositioning the gingival margin will result in exposure of the osseous crest. This is an unacceptable complication that precludes the completion of any gingivectomy procedures prior to surgical bone contouring.
Type 4	Gingival excision will result in inadequate band of attached gingiva. Type IV aesthetic crown lengthening is reserved for scenarios where the degree of gingival excision is compromised by an insufficient amount of attached gingiva. Ideal margin position,

therefore, can only be achieved through the use of an apically positioned mucoperiosteal flap, regardless of the need for osseous contouring. Attempting to establish the desired clinical crown length solely with tissue excision will result in an inadequate residual band of attached gingiva under these circumstances.



Figure 3: Changes in tooth dimensions and gingival display of three cases from baseline (a), immediate postoperative (b), 3 months (c), and 12 months (d) after the crown lengthening surgery.

Lip Repositioning: Lip repositioning is a conservative surgical technique used to treat a ‘gummy’ smile’. This procedure is relatively shorter, less aggressive and has fewer post-operative complications when compared with other procedures that have higher morbidity rates such as orthognathic surgeries to manage excessive gingival display.

This technique was originally described in the plastic surgery literature in 1973, several variations in surgical lip repositioning have been reported since. The initial

procedure did not include severing of the muscle attachment after a flap resection. To avoid relapse and allow for tension free-suturing myectomies are performed to detach the muscle attachment.

A strip of mucosa from maxillary buccal vestibule is removed. A partial thickness flap is created between the upper lip musculature and the mucogingival junction, ultimately the lip mucosa is sutured to the mucogingival line, resulting in a narrower vestibule. This restricts the muscle pull, thereby reducing gingival display during smiling.

Another method to prevent reattachment of the smile muscles is to use an alloplastic or autogenous separator. This spacer is placed between the elevator muscles of the lip and the anterior nasal spine and thus prevents superior displacement of the repositioned lip.

This procedure has also been performed along with rhinoplasty. The nasal approach allows both surgical procedures to be combined and should be undertaken only if rhinoplasty is to be performed and if the patient seeks a remedy for excessive gingival display.

There are also cases reports of lip repositioning combined with depigmentation and crown lengthening, frenectomy and crown lengthening in a single visit. Laser has been used for certain lip repositioning procedures in combination with crown lengthening. The long-term stability of the results remains to be seen, but it is a promising alternative treatment modality in esthetic rehabilitation.



Figure 4: Retracted view with digitally created incision outline.



Figure 7: Continuous interlocking sutures in placesuturing.



Figure 5: Exposed submucosa after after removal of epithelial discard.



Figure 8: Postoperative retracted view after one year



Figure 6: Stabilization sutures



Figure 9: Post-operative smile after one year.

Orthognathic Surgery

Dentofacial deformities are corrected by orthosurgical procedures for the enhancement of facial esthetics. A gummy smile caused by vertical maxillary excess and dentofacial disharmony will require a surgical approach and cannot be treated satisfactorily with adjunctive nonsurgical approaches such as botulinum toxin A injection or a crown lengthening procedure or temporary anchorage devices (TDAs). The treatment of choice for vertically maxillary excess is the reduction of the maxillary vertical excess by Le Fort I osteotomy with superior maxillary repositioning. Further-more if the excessive gingival display is not associated with a severe three-dimensional skeletal discrepancy, the intrusion of the anterior teeth using TDAs may be indicated provided that the anterior esthetic occlusal plane and smile arc are well preserved. Because not all dentofacial deformities are alike, hence different treatment modalities were developed. New developments in surgical orthodontics have added a new dimension in the field, assuring patient's satisfaction.

The use of screw mechanics for achieving the effect of a Le Fort I impaction of the maxilla was proposed by Lin [20] using multiple screws. This procedure has been termed by Paik *et al.*[21] as "slow impaction" of maxilla as it mimics the effects produced by Le Fort I maxillary surgery.

A bi-jaw surgical intervention has also been advocated to correct the deficiencies in all three planes of space. The assessment of the treatment outcomes showed well-aligned dentition. Extraorally, the patient demonstrated a harmonious smile and well-balanced facial profile and competent lips.

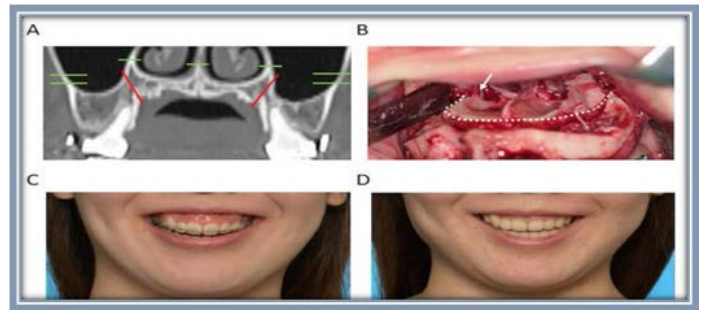


Figure 10: Patient being treated for a gummy smile. A: CT image at the molar region. Osteotomy lines shows Le Fort I (green) and horseshoe (red). B: perioperative photograph of horseshoe osteotomy. C and D: frontal view pictures of preoperative and postoperative full smile. Dotted line, osteotomy line; arrow, descending palatine arter

Orthodontic Treatment

The orthodontic correction with mini screws is indicated for an intrusive root movement of incisors. Their use, in combination with a continuous arch, is an effective and reliable therapeutic modality for torque control and intrusion of upper incisors.

Recent improvements in the design of the aligners have been made to improve the leveling of the Spee Curve with incisor ingression and premolar and molar egression, allowing correction of excessive gingival exposure during the smile.

Early orthodontic treatment associated with vertical control can decrease the malocclusion, improve the prognosis, as well as enhance the appearance.

The treatment objectives include reducing the patient's excessive gingival display, creating a normal overbite and overjet relationship.



Figure 11: Pre-operative



Figure 12: During treatment



Figure 13: Post-operative

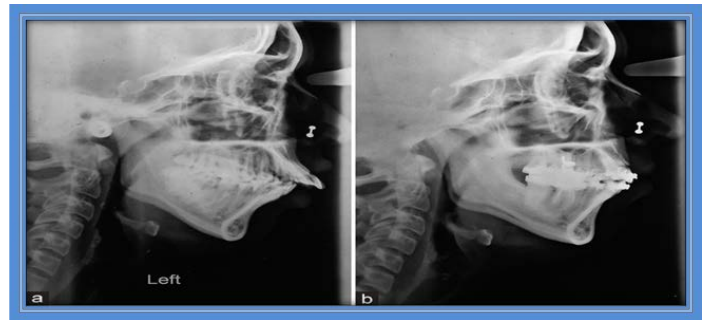


Figure 14: Lateral ceph

Discussion

Lip repositioning technique was first described by Rubeinstein and Kostianovsky in 1973. In 2010, Ishida et al., reported a case series of 14 patients in which myotomy of levator labii superioris and lip repositioning was carried out showing excellent results of reduction in EGD from $5.22 \pm 1.48\text{mm}$ to $1.91 \pm 1.5\text{mm}$ with a 6 month follow up period. [29]

Garber and Salama proposed a classification system based on degree of gingival display. For degree 1 (2 to 4mm display) Lip repositioning, Esthetic crown lengthening, and Botox were suggested; while for moderate display degree 2 (4 to 8 mm) Lip stabilization or Orthognathic surgery and for severe EGD degree 3 ($> 8\text{mm}$) only Orthognathic surgery, is recommended. [30] Jacobs et al. in 2013 did a study on 7 patients with LASER assisted lip repositioning technique which brought the EGD from $5.3 \pm 1.1\text{mm}$ to $1.1 \pm 2.5\text{mm}$. The results proved excellent alternative to more costly and time consuming treatments for EGD with follow up of 3 years. [31] The surgical procedure yielded great results by achieving a greater degree of gingival coverage to hide the gummy smile. Also, there were no potential complications reported after 1-month period. The chief complaint of a gummy smile was completely resolved by modified lip repositioning surgical procedure. The quality of life was improved as the procedure met the esthetic demands of the patient.

Surgical correction of vertical maxillary excess: Rekow et al. reported in a randomized control clinical trial that after the surgery of the maxillary impaction, the mandible self-rotates to a new anterior and superior position towards the original position. [20]

In conclusion After Le Fort I osteotomy and mandibular self-rotation, the condyle remained stable occupying a new anterior-superior position in mandibular fossa. At 9-month postoperative follow-up, the patient remained asymptomatic with respect to TMJ and the tooth occlusion remained stable. [20,21,22]

Relapse rates after upper molar intrusion reportedly range from 10% to nearly 30%. In a case report Sugawara and colleagues observed an average 30% relapse of the lower posterior teeth after miniscrew-anchored posterior intrusion. [21]

Crown lengthening: Researches say that the lengthening of the clinical crown and subsequent osteotomy/osteoplasty are also a part of the "gummy smile" treatment. Ribeiro et al. (2014) emphasize that in cases of altered passive eruption, it is necessary the application of the osteoplastic technique to regularize the bone in the anterior maxilla. This procedure, in addition to the improvement of aesthetics, allows a better adaptation of the superior lip. [25] Other authors also recommend the increase of the clinical crown at the anterior superior sextant, through osteotomy and osteoplasty, to correct the altered passive eruption. In 2014 a case series conducted by Dharsiyani K. et al performed gingivectomy with and without bone resection and after a period of 6 months it was found that there was a gain in crown length of about 2mm per tooth. [26,27]

Table 2

Authors and year	Type of Study	Sample	Surgical Technique	Follow-up	Results
Rossi, R. et al. 2008	Clinical Case Reports	2 patients	Open flap gingivectomy with bone resection	6 months	Patients were satisfied with the treatment. The smile line and quantity of soft tissue were aesthetically pleasing after six months.
Cairo, F. et al. 2012	Case Series	11 patients	Open flap gingivectomy with bone resection	6 months	All patients were satisfied with the final clinical results.
Narayan, S. et al. 2011	Clinical Case Reports	2 patients	Gingivectomy with and without bone resection	2 months	Both techniques demonstrated good aesthetic results.
Ribeiro, FV et al. 2014	Randomized controlled clinical trial	28 patients	Gingivectomy with and without open flap	12 months	There was no significant difference between the techniques for the criteria evaluated: Visible plaque index, Bleeding on probing index, Relative position of gingival margin, Relative Clinical Insertion Level, Probing Depth, Bleeding on Probing, height of keratinized gingiva. The patient's perception and aesthetic appearance were also evaluated and the results were similar for both techniques.
Dharsiyani, K. et al. 2014	Case series	5 patients	Gingivectomy with and without bone resection	6 months	In all the elements undergoing surgery the clinical crown was lengthened. At the end of six months, there was a gain in crown length of about 2mm per tooth.

Healing was uneventful in all treated sites with no flap dehiscence or lack of primary closure. All patients were satisfied of the final clinical outcomes. No gingival recession and no sites with probing depth >3 mm was detectable at the treated sites after 6 months.[29]

Conclusion

Gummy Smile is a condition in which an increasing awareness has been noticed recently. Therefore, it is attracting more attention from all the clinicians to find the best solutions with the least complications and relapse, as well as the most satisfying results for every patient. Additional unified standards of accepting and not accepting the amount of gingival exposure might be better to help with diagnosing and deciding whether to perform surgery or consider the gingival exposure as acceptable. This should be decided considering the ethnic origin and trying to collect a wider range of opinions, not only taking experts' view because they will judge more critically. This could be done by performing a greater statistical analysis regarding this topic, including more people to evaluate and judge. In addition, clear prediction planning of moving the maxilla to improve the condition of Gummy Smile, taking into account if it is resulted from vertical maxillary excess alone or with bimaxillary protrusion, would be of a great benefit to perform a well-planned surgery. This surgery should be done according to certain principles and criteria, not depending upon each surgeon's

experience or preference. To reach this stratified surgical plan, this literature review suggests further studies to design a prediction formula of moving the maxilla, following certain calculations regarding the amount of vertical maxillary excess, bimaxillary protrusion, x-rays, and considering opinions of experienced surgeons to get the best aesthetic results.

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