LipStaT: The Lip Stabilization Technique—Indications and Guidelines for Case Selection and Classification of Excessive Gingival Display

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Excessive gingival display (EGD) is an esthetic concern affecting a substantial portion of the population. Identification, diagnosis, and classification of all factors resulting in EGD are imperative for its appropriate management. While many authors have described these factors individually, the authors of the current study propose a simple classification, which includes major etiologies of EGD. Where EGD is associated with maxillary lip hypermobility, a proposal of a subclass 1–3 is offered. A "decision-making tree" to help guide clinicians in managing EGD is included. A detailed description of the lip stabilization technique (LipStaT), including indications, surgical guidelines, postsurgical management, and clinical cases with long-term follow-up, is presented. (Int J Periodontics Restorative Dent 2015;35:549–559. doi: 10.11607/prd.2059)

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For diagnostic purposes, smiles have been categorized using the relationship between the lower border of the upper lip and the gingival margin of the maxillary incisors[1,2] as low, normal, and high.[3] Excessive gingival display (EGD) seen while smiling is referred to as having a "gummy smile." EGD is primarily a descriptive term rather than a diagnosis, and can affect a large percentage of the population, with prevalence ranging from 10.5%[1] to 29%.[4] EGD is more prevalent and considered more unesthetic in women than men.[3,5,6]

EGD: Etiology and Diagnosis

A few multifactorial etiologies of EGD are acquired, hereditary, and skeletal in nature.[7–9] Using 228 subjects, Wu et al[10] classified smiles with EGD into four types. When Kokich et al[11] studied the gingiva-to-lip distance, they reported it as noticeably unattractive at 4 mm by laypersons and at 2 mm by orthodontists, whereas others placed the threshold at 1 mm.[6] With the increased scrutiny placed on esthetics today, the present authors believe that the lower threshold of 1 mm is more appropriate and that gingival exposure greater than 1 mm during the dynamic smile can be considered

Table 1 Classification of excessive gingival display (EGD) based on etiology

EGD(A)	EGD(B)	EGD(C)	EGD(D)	EGD(E)
Altered passive eruption	Bony maxillary excess	Conditions causing gingival enlargement	Deficient maxillary lip length	Excessive mobility of maxillary lip

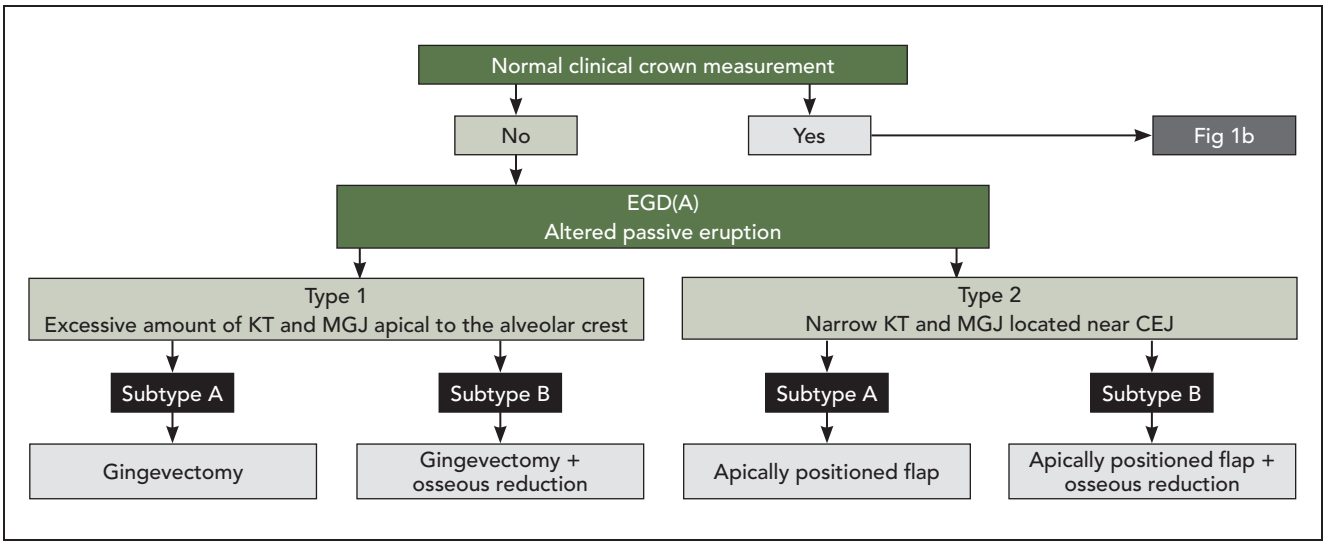

Fig 1a *Classification and management of EGD(A).* KT = keratinized tissue; MGJ = mucogingival junction; CEJ = cementoenamel junction.

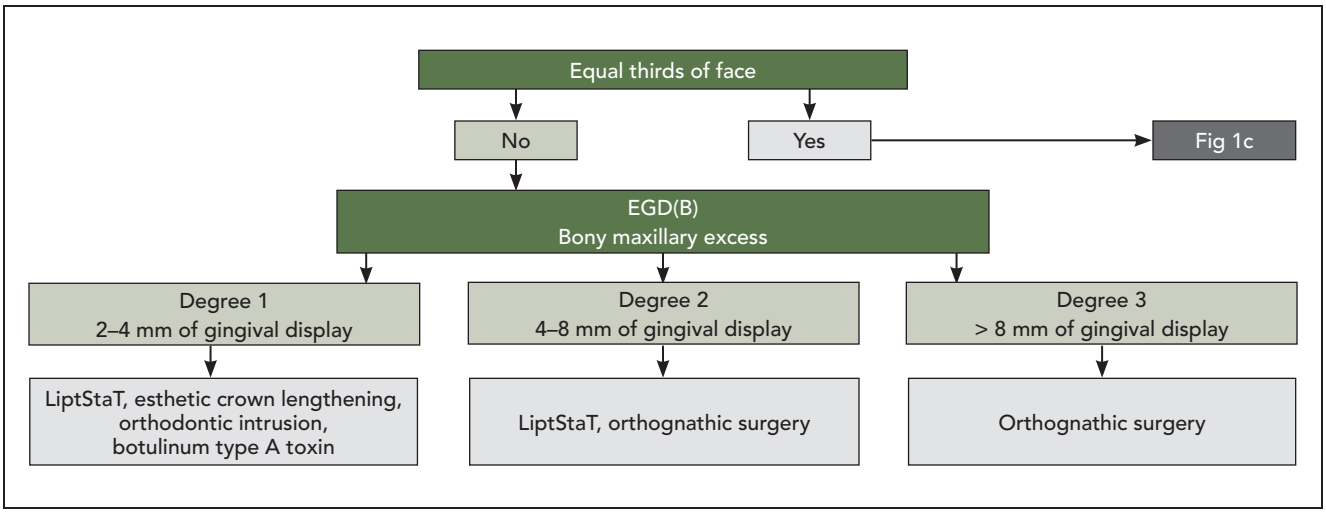

Fig 1b *Classification and management of EGD(B).*

as having EGD. Although the etiology and management of individual components resulting in EGD have been described by others,[12,13] this article presents a simple method of combining the various dental, skeletal, and soft tissue etiologic factors resulting in EGD and classifying them as EGD(A), EGD(B), EGD(C), EGD(D), and EGD(E) (Table 1). The five major categories are subsequently described. A subclassification of EGD(E) is also proposed (related to excessive maxillary lip mobility) as subclasses 1, 2, and 3. A decision tree to help practitioners apply this classification in a systematic manner is included (Fig 1).

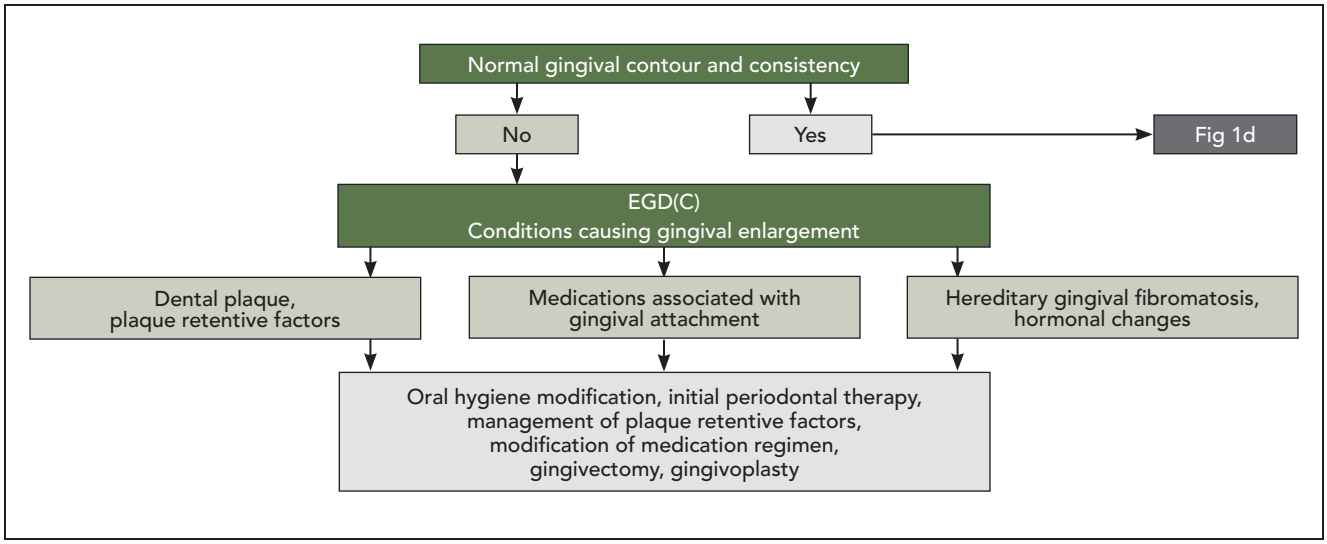

Fig 1c *Classification and management of EGD(C).*

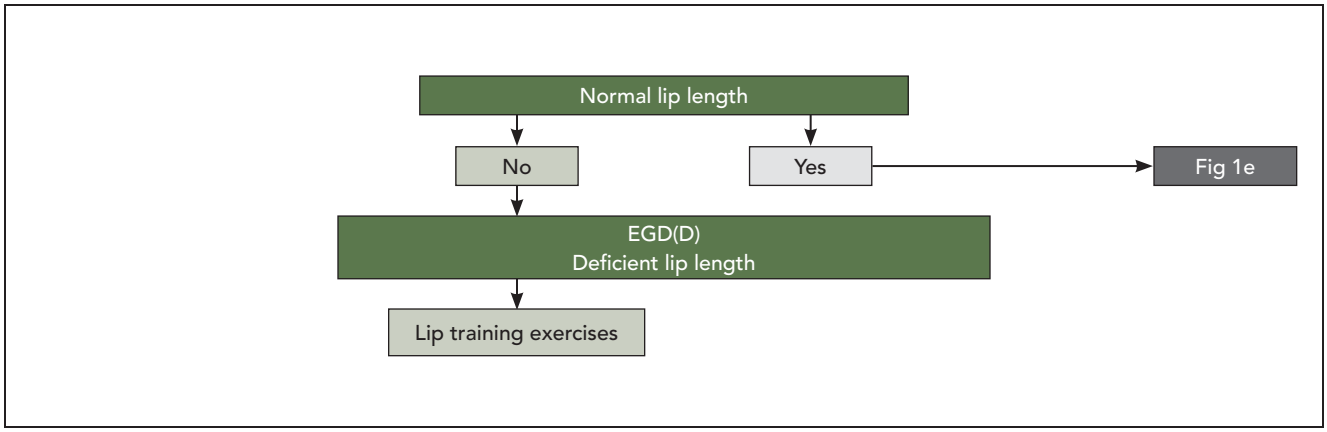

Fig 1d *Classification and management of EGD(D).*

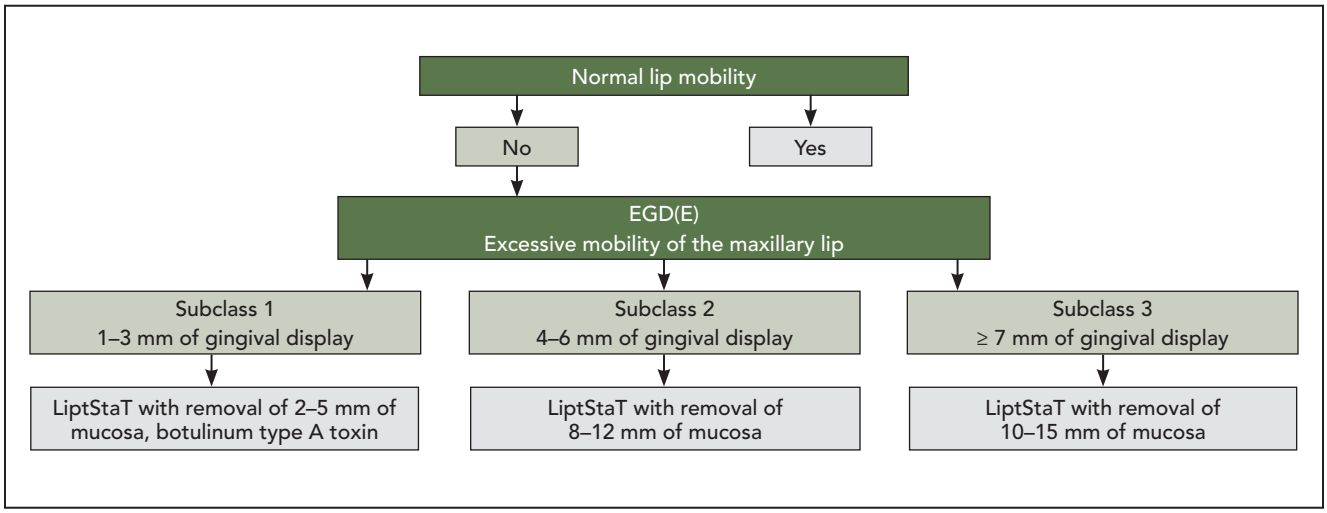

Fig 1e *Classification and management of EGD(E).*

Fig 2 *EGD(A) with short clinical crowns. The teeth appear to have the ideal width-to-length ratio.*

Fig 3 *EGD(B) degree 1 with 2 to 4 mm of gingival display.*

EGD(A) (EGD related to altered passive eruption)

The term altered passive eruption is used to describe clinical situations in which the gingival margin fails to migrate in an apical direction toward the cementoenamel junction (CEJ) after permanent tooth eruption is complete (Fig 2).[14] This finding is considered an aberration in the normal steps of eruption.[15] EGD(A) includes individuals with altered passive eruption. The incidence of this condition is 12% in the general population and may be seen on a single tooth or include multiple teeth.[9]

EGD(B) (EGD related to bony maxillary excess)

The facial height is examined by dividing it into thirds[16] and vertical (bony) maxillary excess is diagnosed when the lower third of the face is longer than the remaining thirds. This results in EGD (Fig 3) because the teeth are located farther from the skeletal maxillary base. A classification based on the amount of gingival and mucosal display in EGD(B) was proposed by Garber and Salama.[7]

EGD(C) (EGD related to conditions causing gingival enlargement)

Gingival enlargement can be the result of microbial plaque-induced chronic inflammation and medications such as cyclosporine, calcium channel blockers, and phenytoin. Factors such as age, demographic variables, genetic predisposition, oral hygiene status, pharmacokinetic variables, and molecular and cellular changes can influence the process of gingival enlargement.[17] Hormonal changes seen in pregnancy and puberty as well as with the use of oral contraceptives have been associated with gingival enlargement. Additional local plaque retentive factors, for example, orthodontic appliances,[18] may be responsible for localized or generalized gingival enlargement. Hereditary gingival fibromatosis, a rare gingival condition, presents as localized or generalized enlargement of the attached gingiva (Fig 4).[19]

EGD(D) (EGD related to deficient maxillary lip length)

The anatomic maxillary lip is measured from the subnasale to the inferior border (Fig 5). When the maxillary lip was measured in a group of 88 North American white orthodontic patients,[3] an average lip length ± standard deviation of 21.2 ± 2.4 mm in young adult women and 23.4 ± 2.5 mm in young adult men was seen. Similarly, a soft tissue cephalometric analysis

Fig 4 *A case of hereditary gingival fibromatosis with the clinical crowns almost entirely covered by gingiva. This can be classified as EGD(C).*

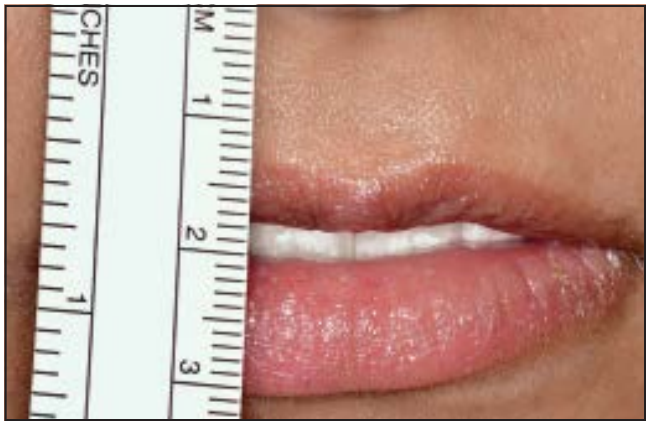

Fig 5 *Length of the upper lip (subnasale to lower border) is smaller than average, resulting in EGD(D).*

measured the upper lip length at 23.4 ± 3.42 mm for men and 20.02 ± 2.89 mm for women.[20] A diagnosis of EGD(D) can be made based on the clinical measurement of the maxillary lip length and an excessive amount of tooth display at rest.

EGD(E) (EGD related to excessive mobility of maxillary lip)

The maxillary lip generally translates 6 to 8 mm from the repose position to the position achieved at a full smile. In some instances, this translation can be one and a half times to twice this normal distance. Excessive mobility of the upper lip is caused by hyperfunction of the lip elevator muscles and often results in EGD. The authors of this study propose the following three subclasses for EGD(E): subclass 1, in which 1 to 3 mm of gingiva is visible in the dynamic smile, and subclass 2 and subclass 3, which display 4 to 6 mm and 7 mm or more of gingiva, respectively (Fig 1e).

Presurgical evaluation for diagnosis and management

The first step in making a diagnosis is to accurately establish the vertical and horizontal extent of the smile. It is important to differentiate between the static and dynamic smiles because the amount of EGD varies significantly between the two types. The dynamic smile is wider than the static smile, is spontaneous, and is usually elicited as a response to emotion. In order to capture the dynamic smile, Sarver and Ackerman[21] introduced a dynamic visualization and quantification process in orthodontic diagnosis and treatment planning by means of video imaging. Next, a detailed intraoral examination, including measurement of the length and width of the anatomical crowns, measurement of the width of keratinized tissue, and location of the mucogingival junction, needs to be completed. A diagnosis of EGD(A) is made when the anatomical crowns are smaller than normally accepted average measurements, the CEJ is at the base of the sulcus, and there is no evidence of incisal wear. The need for osseous recontouring is determined by correlating the distance between the alveolar crest and the CEJ. The intraoral examination would also provide a description of the location of the gingival margin and the contour of marginal and interproximal gingiva. This examination, combined with patient health history information including medications, can help to identify if EGD(C) exists. The next step in determining the exact cause of EGD would be to perform measurements of the upper, middle, and lower thirds of the face. If the

Fig 6a *Clinical presentation of a case of EGD(A).The clinical crown length is less than average.*

Fig 6b *Esthetic crown lengthening with osseous recontouring to achieve ideal tooth proportions.*

Fig 6c *Clinical presentation of a case of EGD(A) managed with a combination of surgical periodontal therapy and restorative dentistry.*

lower third is equal to the other thirds, EGD(B) can be eliminated as a likely contributory factor. If EGD(B) exists, the subclassification can be identified based on the amount of EGD. The next step would be to measure the length of the maxillary lip. If the maxillary lip measurement is shorter than previously described norms, a diagnosis of EGD(D) can be made and lip training exercises prescribed. The amount of translation of the maxillary lip from the rest position to that seen during a dynamic smile is the key to identifying whether EGD(E) is present. An important consideration here would be to distinguish between the static and dynamic smile.[22] It might be prudent to make repeated measurements in a relaxed environment to obtain a dynamic smile. In addition, digital videography to record the dynamic smile can serve as a valuable tool in the management of EGD.[21]

Treatment

Sequencing of treatment in the management of EGD

If EGD(A) is present, esthetic crown lengthening is required to established ideal tooth proportions (Fig 6). The management of EGD(C) is focused on the specific etiology of the enlarged gingiva. Ideal gingival contours, along with ideal tooth length, width, and incisal edge position must be established before any orthognathic surgery. The treatment for EGD(B) is determined based on the amount of gingival display during the dynamic smile. The lip stabilization technique (LipStaT) is the primary indication for EGD(B) (degree 1 and degree 2) as well as EGD(E) subclass 1, 2, and 3. Rubenstein and Kostianovsky[23] first described a technique similar to the LipStaT in 1973. The LipStaT is a very versatile technique and can be used in a wide range of clinical situations with EGD. It is probable that a combination of one or more factors listed in Table 1 can end in EGD, and therefore proper sequencing of treatment is required to achieve the ideal end result. Before proceeding with the LipStaT, all orthognathic, orthodontic, restorative, and initial periodontal therapy must be completed.

Fig 7a *borders of the surgical excision are marked using a surgical marker. The posterior extension is based on the horizontal extent of the dynamic smile. The vertical extension is based on the subclass of EGD(E).*

Fig 7b *The outlined mucosa is removed by partial thickness dissection.*

Fig 7c *Removal of the outlined mucosa exposes the underlying connective tissue. Tissue tags and minor salivary glands are removed to achieve an even contour of the connective tissue.*

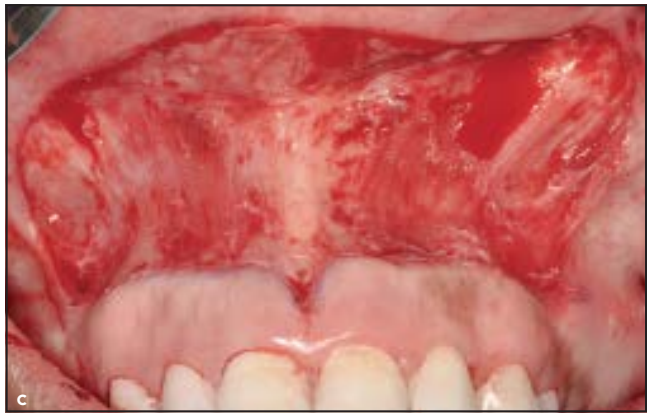

Fig 7d *Suturing is first initiated at the midline using interrupted nonresorbable sutures. A surgical marker can be used to orient the midline. The next sutures are placed midway between the midline and the most distal aspect of the dissection.*

Fig 7e *Additional sutures are then placed approximately 3 mm apart to approximate the wound edges. Final wound closure shows good approximation of edges.*

Description of the LipStaT

The surgical procedure for the LipStaT is initiated after adequate local anesthesia. The borders of the surgical incision area are marked using a surgical marker (Fig 7a). The inferior border is located at the mucogingival junction and is extended laterally based on the horizontal extent of the dynamic smile. The superior border is extended into the vestibule depending on the subclass of EGD(E). The ratio of vertical extension is 2:1, with the incision height

being twice the measurement of EGD at full dynamic smile. Partial thickness incisions are made along the superior and inferior borders and joined with vertical incisions at the posterior aspect. The outlined mucosa is removed by partial thickness dissection, which exposes the underlying connective tissue (Fig 7b). Removal of tissue tags and minor salivary glands is completed to achieve an even contour of the connective tissue (Fig 7c). The midline is marked using a surgical marker. Suturing is first initiated at the midline by placing interrupted sutures using 5-0 or 6-0 nonresorbable material. The next sutures are placed midway between the midline and the most distal aspect of the dissection (Fig 7d). Additional sutures are then placed approximately 3 mm apart to approximate the wound edges (Fig 7e). A combination of 5-0 or 6-0 resorbable and nonresorbable sutures can be used if desired.

Postoperative instructions

Prescriptions for analgesics (ibuprofen, 600–800 mg every 6–8 hours as needed for pain) and chlorhexidine gluconate 0.12% (gentle bathing of the surgical area twice daily for 2 weeks) are given. Antibiotics are recommended only if systemic conditions exist that predispose the patient toward poor wound healing. Instructions are given to apply cold compresses in the form of an ice pack at 20-minute intervals for 24 hours. Additional instructions include avoiding any manipulation or mechanical trauma to the surgical area with recommendations to reduce lip movement while talking or smiling during the first 10 to 14 days after treatment. Oral hygiene can be reinstated after 48 hours. Sutures are normally removed at the 2-week postoperative visit. Most patients report a minor feeling of tightness of the upper lip. There is a marked reduction in EGD after the patient undergoes LipStaT, and the results are noticeable as early as 1 week after the procedure and maintained at follow-up visits.

Complications

Minor complications such as bleeding and loss of sutures can be avoided by paying close attention to wound closure and placing an adequate number of sutures. Wound closure is recommended with multiple interrupted sutures without relying on a single continuous interlocking suture. This technique will prevent wound dehiscence arising from premature loss of a continuous suture. Bruising may occur in cases in which dissection is not limited to the superficial mucosa. Rare complications include the formation of mucocele and unilateral paresthesia.[8,24] Unilateral or bilateral relapse may be seen within the first 6 to 8 weeks after surgery. In cases in which a unilateral relapse results in an asymmetric smile, a surgical revision using the LipStaT can be performed only on the affected side. An additional complication caused by a butterfly incision (narrow width of dissection in the midline) is the appearance of a double lip. This occurs because of inadequate dissection of the mucosa that can appear as a rolled area adjacent to the upper lip during a dynamic smile.

Discussion

The goal of this article is to describe the etiology, management, and treatment of EGD and to provide indications and guidelines for use of the LipStaT in treating EGD. In addition, a new classification that includes a comprehensive categorization of etiologic factors in EGD is proposed (Table 1). A series of flowcharts is also included (Fig 1a–e), which will help practitioners to apply this classification in a systematic manner.

Rubenstein and Kostianovsky[23] first described a technique similar to LipStaT in 1973. Sporadic case reports over the years have maintained an interest in this technique.[24–26] The largest study to investigate the outcomes of a lip repositioning technique was conducted by Silva et al.[27] They proposed maintaining the attachment of the maxillary labial frenum as a modification to the original surgical technique proposed by Rubenstein and Kostianovsky.[23] The authors indicate a desire to maintain the position of the labial midline and to reduce the morbidity associated with this procedure as reasons for the modification. Another alteration proposed by Jacobs and Jacobs[28] described the procedure in seven patients. The authors offered these patients a reversible trial before the surgical procedure by suturing the labial mucosa to the mucogingival

junction. This allowed the individuals to visualize the potential end result. Many reports have confirmed that patients are satisfied with the outcome of treatments aimed at management of EGD. In a patient satisfaction survey, 13 patients who underwent a lip repositioning procedure reported being very satisfied with their smiles even after 2.5 years.[27]

Studies that include dental professionals and laypersons have shown that a minimal gingival display during a full smile is considered attractive by both groups. Kokich et al[11] published a report in which laypersons described the gingiva-to-lip distance of 4 mm as being unattractive. Dental professionals usually have a greater awareness of EGD and are more critical than laypersons.[29,30] Kokich et al[31] stated that the amount of gingiva displayed was considered attractive when it was 3 mm, whereas Geron and Atalia[6] placed the threshold at 1 mm. The present authors concur with this 1-mm threshold (subclass 1 of EGD[E]) and recommend using the Lip-StaT with removal of 2 to 6 mm of mucosa for its management.

A nonsurgical approach to the management of EGD(E) using botulinum toxin type A (BTA) has also been proposed. Polo[32] completed a study using BTA to reduce EGD caused by hyperfunctional upper lip elevator muscles. The mean gingival display (± standard deviation) reduced from 5.2 ± 1.4 mm to 0.09 ± 1.06 mm at 2 weeks. However, the reduction was transitory and the gingival display relapsed to 3 mm at 24 weeks, and the authors predicted a return to baseline at 30 to 32 weeks. This finding was also reported by Indra et al[33] when BTA was used along with Le Fort I osteotomy in a case of EGD(B). The reduction of EGD caused by BTA use was markedly noticeable at 2 weeks and stayed consistent for 2 months but relapsed at the third month evaluation.

Ishida et al[34] described a surgical technique involving a combination approach of myotomy of the levator labii superioris muscle, subperiosteal dissection of the gingiva, subcutaneous dissection of the lip, and frenectomy for correction of EGD(E). The only clinical parameter that was measured was gingival display, which reduced from 5.22 ± 1.48 to 1.91 ± 1.50 at 6 months. One of the disadvantages of this technique is the increased potential for postoperative morbidity and paresthesia because of the aggressive dissection.[8]

The treatment modalities proposed for EGD(E) (BTA, myotomy, and LipStaT) provide similar benefits in terms of gingival display reduction during the initial observation period. Although BTA injection is cited as being less invasive, its effect is short lived and requires repetitive treatment for maintaining the initial outcome. Of the two surgical approaches, LipStaT is less aggressive. Indications for the LipStaT range from mild cases of EGD(B) degree 1 and 2 to EGD(E) subclasses 1, 2, and 3. This technique has the advantage of addressing unilateral EGD with the additional option of reversibility, if necessary, via a vestibular extension procedure.

An additional advantage is limited morbidity compared with myotomy. The most severe complication reported thus far has been the formation of a mucocele and paresthesia.[8,24] Contraindications for the LipStaT include EGD(B) degree 3 and the presence of a narrow band of keratinized tissue.[24,25] As cited previously, one question concerns the stability of the long-term outcome of procedures that reduce mobility of the upper lip. A search of the literature indicates follow-up periods ranging from 6 months to 1 year.[26,27,35] The present authors have followed several cases for periods of up to 4 years after completion of the LipStaT, and this report includes photographs of two such cases (Figs 8 and 9).

Conclusions

The LipStaT is a predictable technique for management of EGD(B) degree 1 and 2 and EGD(E) subclass 1, 2, and 3, along with combination cases of EGD(A) to EGD(E). From a patient perspective, the minimal postoperative morbidity, low incidence of complications, and faster recovery compared with orthognathic surgery and myotomy provide definite advantages. This technique must be used after a thorough presurgical clinical evaluation and proper case selection while using the recommended sequence of dental treatment. LipStaT is a versatile technique to decrease the amount of EGD. Additional clinical trials that involve a larger patient sample are necessary to evaluate the long-term outcomes of this technique.

Fig 8a *A case of EGD(B) degree 2 and EGD(E).The clinical crown lengths and widths are within the normal range, with even gingival contours.*

Fig 8b *Four-year recall after treatment of EGD with the LipStaT. The marked improvement in EGD is noticeable and is maintained during the long-term follow-up.*

Fig 9a *A case of EGD(B) degree 2 previously treated with orthognathic surgery. Scarring from the incision can be seen during the dynamic smile.*

Fig 9b *Four-year follow-up of the LipStaT with complete coverage of intraoral scars.*

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