

Esthetic Periodontal Considerations in Orthodontic Treatment — The Management of Excessive Gingival Display

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A b s t r a c t

This paper examines various esthetic periodontal considerations during orthodontic treatment. The management of excessive gingival display caused by altered passive eruption is reviewed, with emphasis on causes, recognition, diagnosis and surgical management of this problem. A case of orthodontic treatment of excessive gingival display associated with altered passive eruption of the maxillary incisors is reviewed to demonstrate appropriate management. With proper diagnosis, soft-tissue periodontal procedures after completion of orthodontic treatment can enhance the patient's final appearance.

MeSH Key Words: crown lengthening/methods; epithelial attachment/physiopathology; malocclusion therapy

© J Can Dent Assoc 2003; 69(6):368–72
This article has been peer reviewed.

Various published reports discuss the management of gingival display to provide an esthetically pleasing smile.^{1–18} In recent years, more attention has been given to the problem of excessive gingival display^{2,3,5,10–15} and the potential of plastic periodontal surgical procedures to enhance the smile line. Garber and Salama¹² have suggested that the relationships among 3 primary components — the teeth, the lip framework and the gingival scaffold — determine the esthetic appearance of the smile. Previously, perceptions of dental esthetics by the public and dental professionals were related principally to alterations of the teeth;¹² however, this perception has changed, and there is now increased emphasis on smile enhancement through cosmetic dentistry, in particular plastic periodontal procedures.^{1–18}

Excessive gingival display is a condition characterized by excessive exposure of the maxillary gingiva during smiling, commonly called a “gummy smile.”^{1,4,7,14} This condition is caused primarily by a skeletal deformity in which there is vertical excess of the maxillary tissue, a soft-tissue deformity in which there is a short upper lip or a combination of the 2.^{1,4,10,12} Another cause of excessive gingival display is insufficient clinical crown length.^{1,4,9–15} Evaluation of clinical

crown length is important because it may be the principal cause of excessive gingival display.^{1,4,9–15} Common causes of short clinical crowns include coronal destruction resulting from traumatic injury, caries or incisal attrition, as well as coronally situated gingival complex resulting from tissue hypertrophy or a phenomenon known as altered passive eruption.¹⁴

The protocol for diagnosing and managing excessive gingival display in orthodontic cases may not be apparent. The aims of this paper are to describe normal eruption, the normal smile line and normal gingival architecture and to suggest methods of dealing with excessive gingival display, in particular the soft-tissue management of altered passive eruption. The principles of management are exemplified by a case report.

Variables Influencing Gingival Display

Before any treatment is initiated, an understanding of normal eruption, gingival architecture and maxillary development is necessary. In a person with healthy dentition, each tooth and its alveolus actively emerges from its crypt.^{8,19} The teeth continue to erupt through the gingiva until they make occlusal contact with the teeth in the

opposing arch. This stage is followed by passive eruption, the apical migration of the dentogingival unit adjacent to the cemento-enamel junction (CEJ).^{8,19}

Passive eruption can be divided into 4 stages according to the relationship between the epithelial attachment and the CEJ.¹⁹ In stage 1, the epithelial attachment—the junctional epithelium—rests on the enamel surface. In stage 2, the epithelial attachment rests on the enamel surface and the cemental surface apical to the CEJ. In stage 3, the epithelial attachment rests on the cemental surface, and in stage 4, inflammation causes the epithelial attachment to migrate apically.

Throughout passive eruption, the width of the junctional epithelium diminishes,^{8,15,19} and the width of the connective tissue attachment remains fairly constant (mean 1.07 mm⁸). Normally, the junctional epithelium averages 0.97 mm.⁸ Together, these tissues have an average minimal dimension of 2.04 mm, commonly called the biologic width.⁸ When passive eruption does not progress past stage 1 or stage 2, it is referred to as altered passive eruption. In this situation, the gingival margin does not migrate to its final position on the cemental surface. Instead, it remains positioned on or near the enamel surface. The occurrence of altered passive eruption is unpredictable, but the frequency in the general population is about 12%.^{8,15,19} The gingiva of any patient with altered passive eruption is usually healthy in the absence of plaque.¹³

Smile analysis is an important part of the diagnostic regimen in cases of altered passive eruption. Several authors have outlined the following principles for analysis of the smile.^{2,5,10,12,18}

- The elevation of the maxillary lip for posed (staged) and unposed (involuntary) smiles should be determined.
- Most clinicians evaluate the posed smile for gingival harmony, which has been described as the gingival margins of the maxillary teeth being positioned parallel to or following the form of the upper lip.
- The smile arc reflects the position of the maxillary incisors relative to the lower lip; ideally the incisal edges of the maxillary incisors follow the curvature of the lower lip.
- In the transverse dimension, the teeth extend posteriorly and laterally to fill the buccal vestibule.

In summary, under normal circumstances the maxillary gingival line follows the maxillary lip line and the maxillary incisal line follows the mandibular lip line (Figs. 1a and 1b). Vertical maxillary excess can occur when there is excessive growth of the maxilla.^{12,13,20} If a “gummy smile” occurs when the incisal and occlusal planes are coincident, maxillary surgery is usually required to correct vertical overdevelopment of the maxilla.^{5,6,20} Surgical management of the gummy smile has been described previously.^{20–22} Clinical

examination and radiographic interpretation of cephalograms generally permit the clinician to correctly diagnose vertical maxillary excess. Even if the patient chooses not to undergo maxillary surgery, gingival surgery may help to improve the esthetic result and provide a reasonable compromise for the patient.²³ The timing of gingival surgery is debatable. Orthodontic treatment typically precedes periodontal therapy, since extrusion or intrusion of teeth may influence gingival harmony. Dolt and Robbins¹³ recommended that, if the clinical crowns are short as a result of altered passive eruption, clinical crown lengthening should be performed before orthognathic surgery. However, Garber and Salama¹² have suggested a two-phase approach: initial gingival surgery before the orthognathic procedure, with a second possible alteration of gingival display following orthognathic surgery. The definitive diagnosis of the type of gummy smile determines the treatment.

Esthetic Periodontal Surgery

The type of periodontal surgical procedure depends on a number of factors. If the osseous level is appropriate, if there is more than 3 mm of tissue from bone to gingival crest and if it is determined that an adequate zone of attached gingiva will remain after surgery, a gingivectomy is indicated.¹³ To help in outlining the initial incisions, a symmetric stent made of acrylic may be used as a surgical guide.^{7,13} A full-thickness bevelled incision, accompanied by removal of tissue from the facial surface with the papillary tissue left undisturbed, completes the gingivectomy.^{4,7,9,11–13} If the diagnostic procedures reveal osseous levels approximating the CEJ, a gingival flap with ostectomy is indicated.^{4,7,9,11–13} The initial incision can be similar to that for gingivectomy or it can be sulcular. If the gingival heights of the anterior teeth are asymmetric, the initial incision should be a gingivectomy-type incision so that the final tissue contour will be symmetric. If the preoperative tissue contours are symmetric, a sulcular incision can be used and the flap apically repositioned. The inferential incision should always be a sulcular incision, leaving the papilla totally intact interproximally. A full-thickness flap is reflected beyond the mucogingival junction, and the positions of the CEJ and crestal bone are verified visually. Ostectomy is then performed so that the crestal bone is approximately 2.5 to 3.0 mm from the CEJ, which provides for a biologic width that is physiologically adequate. The bony architecture should exactly reflect the desired soft-tissue architecture. The gingiva is then repositioned apically to the CEJ and sutured.^{4,7,9,11–13}

Case Report

A 15-year-old female was referred from a general practitioner to the Graduate Orthodontic Clinic at the University of Western Ontario for orthodontic care. The chief complaint was “crooked teeth.” The general medical history

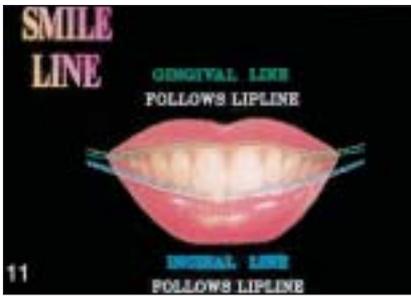


Figure 1a: In people with esthetically pleasing smile lines, the maxillary gingival line follows the lip line and the maxillary incisal line follows the mandibular lip line. Reprinted from Garber and Salama,¹² with permission from Munksgaard.



Figure 1b: Clinical example of the smile line of an esthetically pleasing smile.



Figure 2a: In a 15-year-old female with “crooked teeth,” extraoral evaluation revealed good facial esthetics, a straight facial profile and a mesio gnathic facial type.



Figure 2b: Frontal view of patient.



Figure 3: There was excessive maxillary gingival display and altered passive eruption of the maxillary left central incisor (tooth 21).

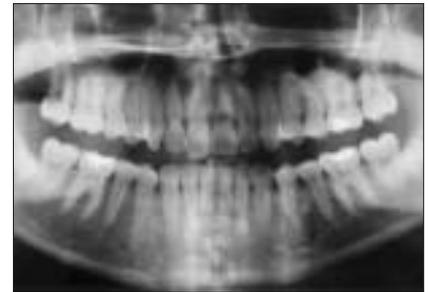


Figure 4: Panoramic radiograph of patient.



Figure 5: Cephalogram of patient.



Figure 6a: The orthodontic goals were achieved with an acceptable occlusal result (left view).



Figure 6b: Acceptable occlusal result (right view).



Figure 7: Gingival smile line after orthodontic treatment.



Figure 8: Postoperative intraoral view.



Figure 9: An esthetically pleasing smile line was achieved after orthodontics and periodontal surgery (5 years after treatment).

was not significant, and there was no family history of oral or dental anomalies. Extraoral evaluation revealed good facial esthetics, a straight facial profile and a mesio gnathic facial type (Figs. 2a and 2b). On full smile, the patient presented 3–4 mm of gingival display. There was excessive display of the maxillary gingiva and altered passive eruption of the maxillary left central incisor (tooth 21) (Fig. 3). There was lip competence at rest and a slightly prominent soft-tissue pogonion. Intraoral examination revealed a Class I deep-bite malocclusion in the permanent dentition. The patient had a 2 mm overjet and a 95% overbite. The DMF was low, but oral hygiene was poor. There was no history of extractions of the permanent dentition or dental anomalies in the primary dentition.

Radiographic examination revealed that all permanent teeth were present (Fig. 4), excluding the maxillary third permanent molars (teeth 18 and 28). Radiologic examination revealed no neural or bony abnormalities. The root of the maxillary second bicuspid (tooth 25) was dilacerated. A dome-shaped soft-tissue mass was present in the left antrum; this might have represented a maxillary mucous retention cyst (Fig. 4). Analysis of the cephalogram (Fig. 5) revealed a Class I skeletal pattern (SNA = 84, SNB = 81, ANB = 3) with normal vertical face height and retroclined maxillary and mandibular incisors (U1-SN = 89, L1-MP = 83).

Treatment Plan

A nonextraction treatment plan was established to manage the patient's malocclusion. The following treatment sequence was planned:

- 1) Improvement of oral hygiene.
- 2) Use of fixed edgewise appliances and preadjusted appliance system.
- 3) Proclination of incisors.
- 4) Application of intrusion mechanics.
- 5) Periodontal consultation to manage excessive gingival display.
- 6) Use of retainers.

The orthodontic goals were achieved, with an acceptable occlusal result (Figs. 6a and 6b); however, gingival harmony was not achieved. The upper left second bicuspid (tooth 25) had minimal attached gingiva, which might have been the result of plaque and possible trauma in this area.

Periodontal Assessment and Management

After completion of the orthodontic treatment, the patient was referred to a periodontal practice for management of the smile line (Fig. 7). Diagnostic records, including study models and photographs, were obtained. A smile analysis indicated that the patient had a crown size discrepancy between the 2 maxillary incisors and a mild case of altered passive eruption. The esthetic periodontal procedure was explained and informed consent obtained.

Surgical exposure of the crown and gingival recontouring were completed by lifting a full-thickness mucoperiosteal flap from the maxillary right first premolar (tooth 14) to the maxillary left first premolar (tooth 24). The alveolar crest was less than 1 mm distant from the CEJ. Osteotomy with a surgical bur was performed with constant saline irrigation, and osteoplasty was completed with a chisel and osseous files. To minimize interdental tissue recession, a palatal flap was not raised during the surgical procedure. Mucoperiosteal flaps were closed with 4-0 silk and a CE-2 needle (Fig. 8); vertical mattress periosteal sutures were used. The sutures were removed 7 days after the procedure, and the patient was followed at 6-week intervals for the next 6 months. The treatment outcome was considered successful, and an esthetically pleasing smile was achieved. The photograph in Fig. 9 was taken more than 5 years after treatment and although the final result is not perfect, there was significant improvement over this interval.

Discussion

The first step in diagnosing altered passive eruption is to observe the patient in repose and smiling naturally.^{10,12,13,18} Several authors^{2,10,12–14} have suggested evaluating the smile for the amount of incisor and gingival display and the transverse dimension of the smile, whereas Sarver¹⁸ suggested evaluating the patient with a posed (voluntary) and unposed (involuntary) smile. If there is an excessive display of gingiva during the smile, further diagnostic data are required. First, the length and activity of the upper lip must be evaluated. If the gummy smile is due solely to inadequate lip length or hyperactivity, no treatment is indicated.¹³ Some degree of gingival display may be esthetically pleasing and, according to Sarver,¹⁸ may be considered youthful (one characteristic of aging is to show less of the maxillary incisors, so a greater incisal display may indicate youth). With the lips in repose, males typically show less of the maxillary incisors and more of the mandibular incisors than females.^{2,18}

The clinician should then attempt to locate the CEJ to determine the presence or absence of altered passive eruption.^{11,12,13,15} If the CEJ is located in a normal position in the gingival sulcus, then the patient does not have altered passive eruption. In this situation, the short teeth are due to incisal wear or a variation of normal anatomy.^{5,10,13,14} Periapical radiographs of the teeth involved will provide evidence of adequate root length and bony support and may serve as a guide for locating the CEJ.¹⁴

There is no predictable procedure available to correct a short or hyperactive lip; therefore, communicating this diagnosis to the patient allows for realistic treatment expectations.¹³ Dentoalveolar extrusion occurs when the maxillary incisors overerupt. As the teeth erupt, the alveolar bone and the gingiva move down with the teeth.¹³ Dentoalveolar extrusion is commonly treated by means of orthodontic

intrusion.^{10,12,13} For each millimetre that the tooth is intruded, the gingival margin moves apically the same distance.⁵ The amount of intrusion needed is estimated by measuring pretreatment differences in the gingival heights.^{5,10}

Ideally, the smile should expose a minimal amount of gingiva, the gingival contour should be symmetric and in harmony with the upper lip, the anterior and posterior segments should be in harmony and the teeth should be of normal length.¹ Because of the various factors involved, a multidisciplinary approach is essential for successful treatment of the gummy smile.

Conclusions

With correct diagnosis of and appropriate therapy for excessive gingival display, dental esthetics can be improved, as demonstrated by the case reported here. The disciplines of oral surgery, orthodontics, periodontics and restorative dentistry all play a role in the treatment of excessive gingival display. ♦

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The authors have no declared financial interests.

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