



DIFFERENTIAL DIAGNOSIS AND TREATMENT OF EXCESS GINGIVAL DISPLAY

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Excess gingival display, commonly described as the "gummy smile," has received increased emphasis in the dental literature in recent years. There are several etiologies for this condition, including lip length and activity, clinical crown length, dentoalveolar extrusion, and vertical maxillary excess. For this reason, it is essential that a differential diagnosis be developed so that a specific therapy or group of treatments can be developed for a patient. It is the purpose of this article to describe a differential diagnosis for excess gingival display as well as recommendations for treatment.

Excess gingival display, which is commonly described as the "gummy smile," has recently received increased emphasis in the dental literature.¹⁻⁷ This heightened awareness has been driven, at least in part, by the profession's desire to address the aesthetic and functional needs of the patient. Tjan et al have reported that approximately 7% of men and 14% of women have excess gingival display in full smile.⁸ Excess gingival display is a descriptive term rather than a diagnosis, which would mandate the initiation of a specific therapy. While numerous factors may cause excess gingival display, it is common for the condition to occur as a result of an interplay of several etiologies. For these reasons, it is essential that a

differential diagnosis be developed. This article describes a differential diagnosis for excess gingival display and reviews recommendations for treatment.

Diagnosis

In order to perform a proper diagnosis, the clinician must possess an understanding of facial aesthetics. The first parameter that requires evaluation is face height. When measured in repose (Figure 1), the length of the middle third of the face should equal the length of the lower third.⁹ The midface is measured from glabella, the most prominent point of the forehead between the eyebrows, to subnasale, the point below the nose. The lower face is measured from subnasale to soft tissue menton, which is the lower border of the chin.

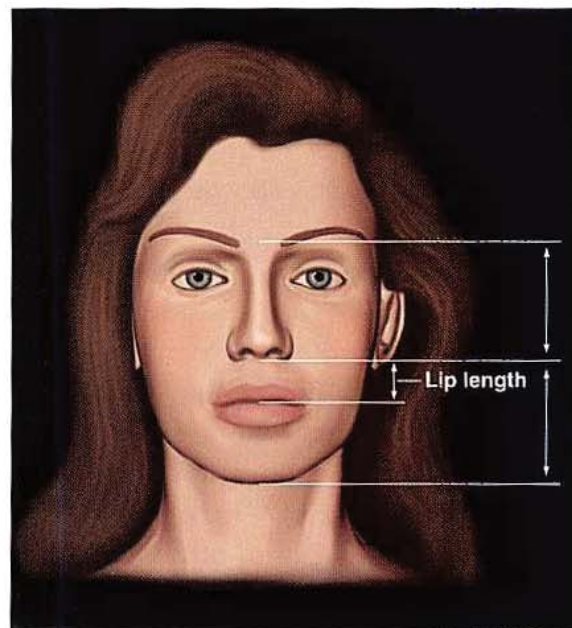


Figure 1. The middle third of the face, measured from glabella to subnasale, should equal the lower third of the face, measured from subnasale to lower border of the chin.

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Once the height of the patient's face has been evaluated, the maxillary lip length should be determined. Measured in repose from subnasale to its inferior border, the average length of the maxillary lip is 20 mm to 22 mm in young adult females and 22 mm to 24 mm in young adult males.¹⁰ When the maxillary lip is in repose, approximately 3 mm to 4 mm of the maxillary central incisors are displayed in young adult females (Figure 2); approximately 2 mm less is exhibited in young adult males.¹¹ As the patient ages, the maxillary lip tends to lengthen. Due to this anatomic change, the maxillary incisors become less visible and the lower incisors become more exposed when the lips are in repose. When the patient exhibits a full smile, the maxillary lip should move to the tooth-gingiva interface on the maxillary central incisors and canines (Figure 3). If the maxillary lip exposes more than 1.5 mm to 2 mm of marginal gingiva, the excess gingival display causes an aesthetic compromise. During full smile, the incisal edges of the maxillary anterior teeth should be parallel to the curvature of the lower lip and lightly touching (but not covered by) this lip (Figure 3). If the incisal edges do not follow the lower lip, as is exhibited by a reverse smile line, the resulting negative space is an aesthetic detractor. The crown length of the maxillary central incisor, which generally measures 10 mm to 11 mm,¹² is subsequently measured as the final component of the clinical analysis. Using these parameters, it is possible to determine the etiology of excess gingival display in a particular patient.

Short or Hyperactive Maxillary Lip

If a patient with excess gingival display presents with a maxillary lip measurement that fails to achieve the prescribed norms (Figures 4 and 5), the aesthetic compromise may be attributed, at least in part, to insufficient lip length. If the face height, gingival levels, lip length, and length of the central incisors are all within acceptable limits in a patient with excess gingival display, the likely etiology is a hyperactive maxillary lip. In the youthful adult female, 3 mm to 4 mm of the maxillary central incisors are displayed in repose; in full smile the entire clinical crown, which is 10 mm to 11 mm, is exposed. Consequently, the maxillary lip should generally translate approximately 6 mm to 8 mm from repose to full

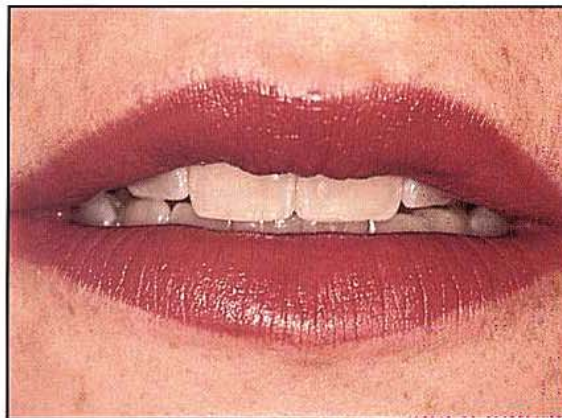


Figure 2. Three millimeters to 4 mm of the incisal edge of the maxillary central incisors are displayed in repose in the young adult female.

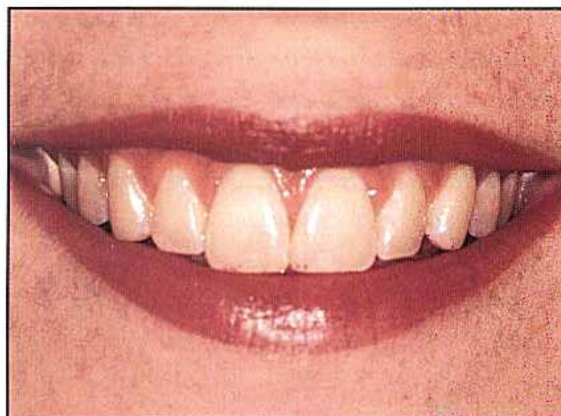


Figure 3. In full smile, the maxillary lip moves to the tooth-gingiva interface on the central incisors and canines. The incisal edges of the maxillary anterior teeth should parallel the mandibular lip.

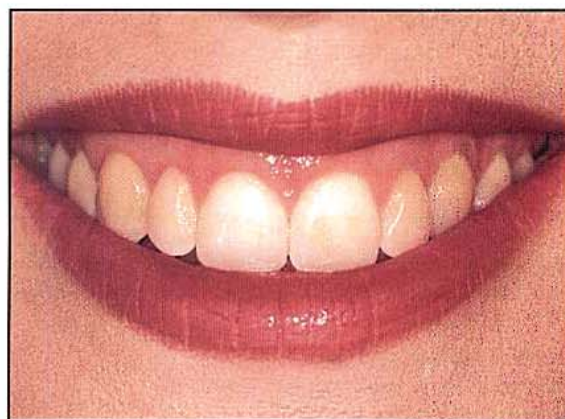


Figure 4. Excess gingival display in the young adult female. Note the superior position of the maxillary lip in relation to the tooth-gingiva interface on the central incisor and canine teeth.

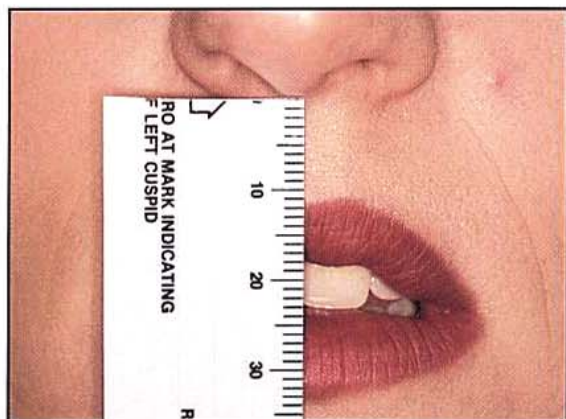


Figure 5. Maxillary lip measurement of 18 mm, as determined from subnasale point of origin.



Figure 6. Preoperative facial view of excess gingival display caused by altered passive eruption.

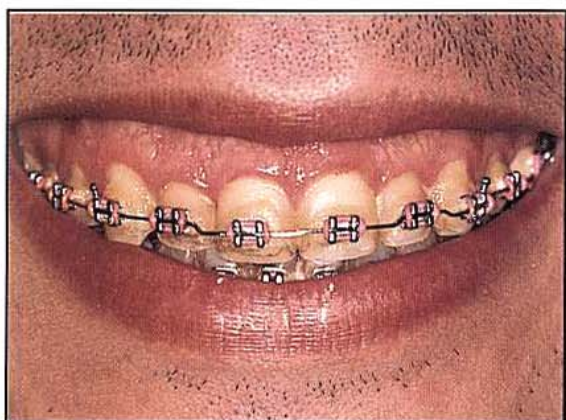


Figure 7. Facial view of the patient preoperatively. Note the position of the gingiva in relation to the clinical crowns.

smile; a patient with a hyperactive maxillary lip, however, may translate 1.5 to 2 times the normal distance. No dental treatment currently exists to predictably correct a short or hyperactive maxillary lip, although facial plastic surgery procedures are available. It is important, however, to make this diagnosis when restorative treatment is planned for the anterior dentition. The patient must be aware that the restorative treatment will not correct, and may accentuate, the excess gingival display.

Altered Passive Eruption

Short maxillary central incisors (less than 9 mm) can be attributed to several factors (eg, normal variation in length, incisal edge wear, excess gingival coverage). Although central incisors with insufficient crown length do occur naturally, this is a rare finding. A more common etiology is loss of incisal edge length due to incisal wear. In order to measure lost tooth length, the distance between the cemento-enamel junction and the incisal edge should be determined and subtracted from accepted norms, which vary from 10 mm to 11 mm for the central incisors. This approximates the degree of incisal edge loss based on the mean length of a maxillary central incisor. Alternatively, a worn incisor can be waxed to its proper incisal edge contour on a diagnostic model; the length of any added wax can then be measured.

Reduced clinical crown length can also be caused by excess gingival coverage. While this may occur due to gingival hyperplasia, the gingiva and its contours rarely appear normal in such a circumstance. When the gingiva demonstrates a healthy appearance and the reduced crown length of the central incisor cannot be completely explained by incisal edge wear, a presumptive diagnosis of altered passive eruption is made.⁴ In the normal eruptive process, the maxillary central incisor emerges through the gingiva and continues to actively erupt until it contacts the opposing dentition. At this point, a significant portion of the anatomic crown remains covered by gingival tissue. As the patient ages, a greater degree of the anatomical crown is exposed by the apical migration of the gingival tissue. The process, which is termed passive eruption, continues through adolescence until the gingival margin is positioned within 1 mm to 2 mm of the cemento-enamel junction. Inexplicably,

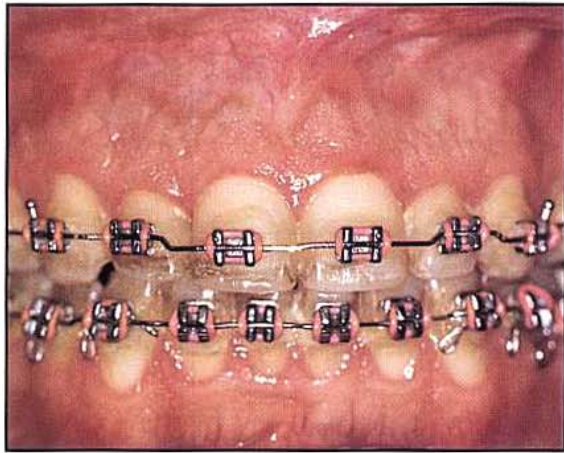


Figure 8. Retracted facial view of a patient with excess gingival display.

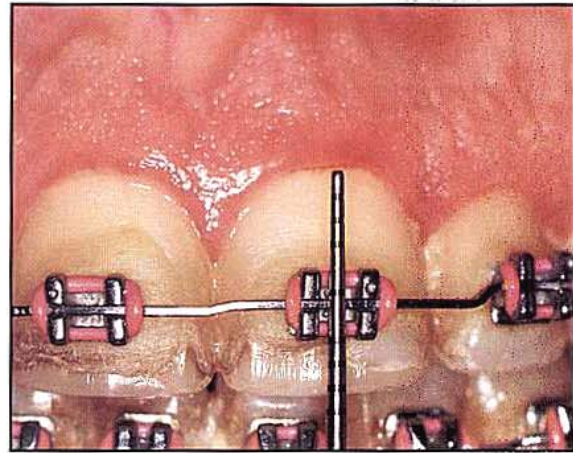


Figure 9. The length of the maxillary central incisor was determined to be 9 mm.

normal passive eruption does not occur in some patients; this complication results in a short clinical crown due to excess gingival coverage. This condition is termed "altered passive eruption" or "delayed passive eruption" (Figures 6 through 9).¹³ Although Volchansky and Cleaton-Jones reported that the gingival levels are relatively stable in the maxillary central incisors by age 12,¹⁴ it may not be prudent to diagnose altered passive eruption until growth is complete. In order to diagnose altered passive eruption, the tip of an explorer is placed beneath the marginal gingiva in an attempt to locate the cemento-enamel junction. If the cemento-enamel junction can be felt, then the reduced crown height is caused by normal variation, incisal edge wear, or a combination of the two. If the cemento-enamel junction cannot be located, however, it is presumably covered by the attachment apparatus, and a diagnosis of altered eruption is made.

While the treatment of altered passive eruption involves surgical crown lengthening,^{1,4,15} further diagnosis is required to determine the proper surgical procedure. Once local anesthesia has been administered, bone sounding is performed. A periodontal probe is placed midfacially in the gingival sulcus and pushed through the attachment apparatus until the alveolar crest is engaged. The distance from the gingival crest to the crest of alveolar bone is approximately 3 mm,^{16,17} and has been termed the "biological width" (Figure 10).¹⁸

Once bone sounding has been performed, the width of the attached gingiva is measured. A periodontal probe

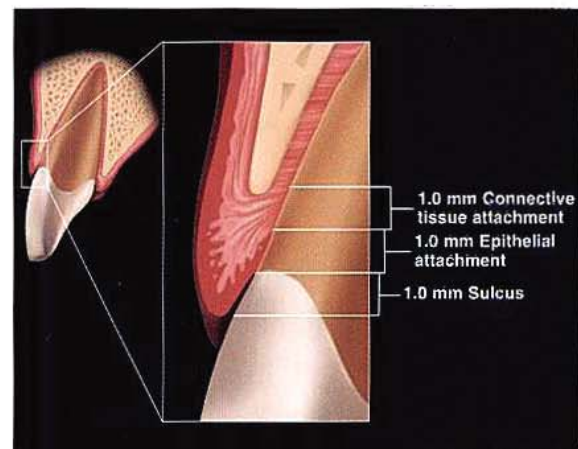


Figure 10. Diagram of biological width. Note the position of the connective tissue attachment, epithelial attachment, and gingival crest in relation to the alveolar crest.

is placed on the mucosa above the corresponding dentition perpendicular to the long axis of the teeth. The probe is moved incisally until the mucosa rolls as it approaches the mucogingival junction. The distance from the mucogingival junction to the marginal gingiva is subsequently determined. The width of the unattached marginal gingiva, measured from the free gingival margin to the base of the sulcus, is subtracted from the total width of the keratinized tissue to determine the width of the attached gingiva.

The appropriate surgical procedure may be selected by evaluating the dimensions of the attached gingiva and the biological width. Gingival health requires a minimum of approximately 3 mm from gingival crest to alveolar crest. Therefore, if a patient presents with 4 mm of tissue from

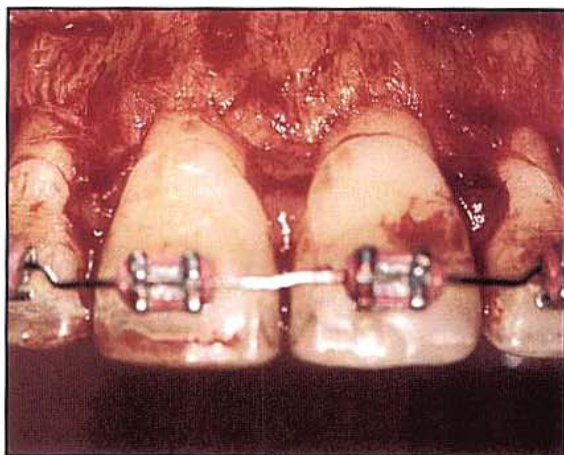


Figure 11. A full-thickness flap is reflected, and facial bone is removed to establish a distance of 2 mm to 2.5 mm from the cemento-enamel junction to the alveolar crest.

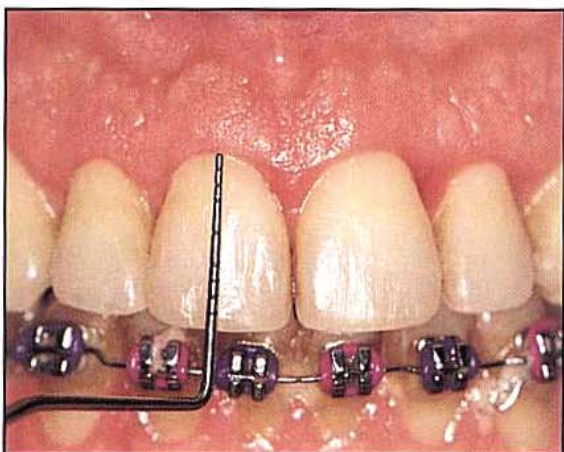


Figure 12. Facial view 8 weeks postoperatively demonstrates the increased height (11 mm) of the maxillary central incisors.

the gingival crest to the alveolar crest, then 1 mm can be excised with a gingivectomy procedure, while respecting the 3 mm minimum. Prior to the initiation of any excisional procedure, however, the clinician must ensure that adequate attached gingiva (approximately 3 mm) will remain following the gingivectomy. In this example, if marginal gingiva in excess of 1 mm is excised and the bone and overlying soft tissue are of normal thickness, the soft tissue will eventually grow back until the 3 mm distance from gingival crest to alveolar crest is reestablished.

Altered passive eruption more commonly presents with a distance of 3 mm from the gingival crest to the alveolar crest. Gingival tissue excised with a gingivoplasty or gingivectomy procedure will eventually grow back to its previous position due to the surgical impingement of



Figure 13. Postoperative facial view at 16 months exhibits excellent tissue healing and stability.

the biological width. Therefore, in this more common situation, attention must be directed to the underlying bone. A full-thickness mucoperiosteal flap is reflected, which generally reveals the presence of the osseous crest that is near or contiguous with the cemento-enamel junction. Since no biological requirement exists for the removal of interproximal bone, the facial interdental papillae are not reflected with the flap. Using high-speed rotary instruments and hand chisels, bone is removed from facial line angle to facial line angle until the distance from cemento-enamel junction to alveolar crest is established at 2 mm to 2.5 mm (Figure 11). The distal extent of the flap is determined by the amount of posterior gingival tissue that is exposed during a full smile. The flap generally extends bilaterally to the mesial surfaces of the first molar teeth. Following the completion of the osteotomy procedure, the tissue is replaced slightly coronal to the cemento-enamel junction and sutured. A periodontal probe can subsequently be inserted beneath the flap to verify that the distance from gingival crest to alveolar crest is approximately 3 mm. Once the flap has been sutured, minor gingival recontouring can be accomplished with electrosurgery in an attempt to develop precise gingival symmetry. When the relationship between the bone and overlying gingiva is understood and respected, the gingiva generally heals with minimal coronal or apical movement (Figures 12 through 14). It is often necessary, however, to perform minor tissue recontouring once initial healing has occurred 6 weeks postoperatively.



Figure 14. Facial view of the patient 16 months post-operatively. Note the enhanced aesthetics achieved upon completion of the osteotomy and gingival recontouring.

Dentoalveolar Extrusion

Dentoalveolar extrusion occurs when one or more maxillary anterior teeth overerupt. This condition generally arises due to lack of an adequate opposing occlusion, and most commonly occurs in patients with a Class 2 malocclusion. As the maxillary incisors continue to erupt, the corresponding alveolar complex moves down with the teeth. In a patient with proper aesthetics, the extension of an imaginary line from maxillary canine to canine at the tooth-gingiva interface should also pass through the tooth-gingiva interface of the maxillary central incisors. In dentoalveolar extrusion, however, the incisors overerupt, which compromises the position of the gingiva and supporting bone. When this occurs, the line that represents the tooth-gingiva interface between the canines becomes concave as it dips to contact the tooth-gingiva interface at the central incisors (Figure 15). In addition, the incisal edges of these teeth may be hidden by the lower lip in full smile due to this overeruption of the maxillary incisors. It is through this process of overeruption of the maxillary anterior teeth that excess gingival display may occur (Figure 16).



Figure 15. Dental floss is extended from canine to canine at the tooth-gingiva interface. The maxillary incisors have overerupted, which has resulted in a concave gingival line. This is the common appearance of dentoalveolar extrusion.



Figure 16. Preoperative view of a female patient with dentoalveolar extrusion.

The treatment for dentoalveolar extrusion involves the movement of the overerupted teeth into their original positions.¹⁹ This can be accomplished either orthodontically or surgically with a segmental osteotomy (Figure 17). Whether orthodontic or surgical treatment is selected, occlusion must be restored to allow for stable anterior occlusal stops, and long-term retention is commonly required.

Vertical Maxillary Excess

Using the aforementioned aesthetic criteria, clinical evaluation can be used to identify vertical maxillary excess in patients with excess gingival display. If the lower face is longer than the midface, vertical maxillary excess may be the etiology of the excess gingival display. As with dentoalveolar extrusion, the incisal edges of the maxillary anterior teeth may also be hidden by the lower lip in full smile. The tentative diagnosis is confirmed with cephalometric radiographs.



Figure 17. Postoperative view of the patient following the segmental osteotomy to impact the four maxillary anterior teeth.

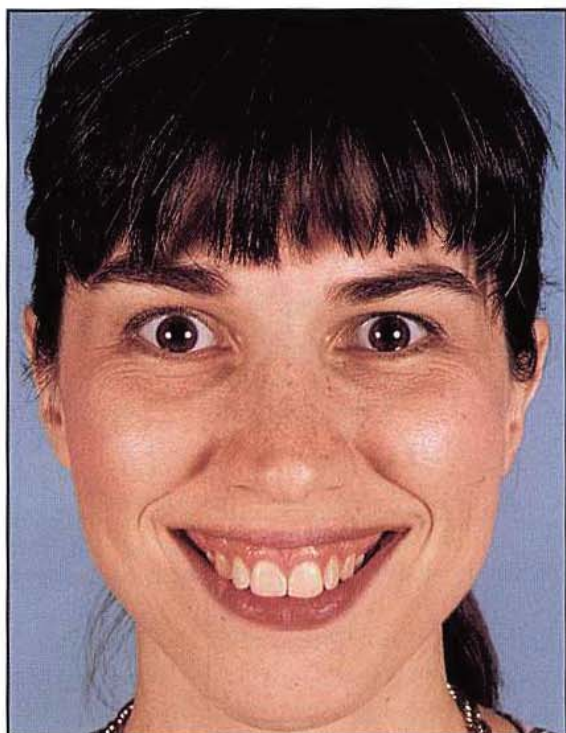


Figure 18. Preoperative facial view of a patient who presented with vertical maxillary excess.

Orthognathic surgery is generally required to treat vertical maxillary excess (Figures 18 and 19).¹⁹ A wedge of maxillary bone is removed and the maxilla is impacted to a predetermined position. In some instances, the mandible will autorotate into occlusion and requires no surgery. It is sometimes necessary, however, to perform a mandibular osteotomy in order to establish a stable occlusal relationship.



Figure 19. Postoperative facial view of a patient following maxillary impaction and mandibular advancement surgery.

Multiple Etiologies

It is not unusual for a patient with excess gingival display to present with multiple etiologies. While this complicates the formulation of a treatment plan, multiple etiologies are not a significant concern when the previously discussed diagnostic procedures are applied. For example, it is not uncommon for a patient with vertical maxillary excess to also present with altered passive eruption. In this circumstance, gingival surgery is first accomplished to determine the ultimate length of the clinical crowns. The orthognathic diagnosis is then accomplished using radiographs, models, and a dynamic facial evaluation. This examination should record maxillary incisal edge position in repose and full smile, exposure of the maxillary anterior teeth in repose and full smile, and the position of the high lip line during full smile. Once the diagnostic phase is completed, a comprehensive treatment plan that utilizes orthodontic and orthognathic surgery can be formulated and implemented.

Conclusion

This article has described the characteristics of an aesthetic smile, and has highlighted the role of face height,

lip length and activity, tooth-gingiva relationships, and tooth length in the development of an optimal postoperative result. The condition termed excess gingival display has also been described in relation to conventional aesthetic parameters. Based on the accurate diagnosis of a patient's condition, this article has presented a series of procedures that may be utilized to treat altered passive eruption, dentoalveolar extrusion, and vertical maxillary excess. When these factors are recognized during the initial diagnosis, it is possible to predictably enhance the aesthetics and ensure long-term stability with comprehensive therapy.

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