Diagnosis and treatment modalities of altered passive eruption: Review and a case report of gummy smile

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ABSTRACT

In today’s society, an increasing number of people have become aware of the esthetic appeal and symmetry between the crown length and gingival exposure. Fulfilling the patients’ expectations has created new esthetic and clinical challenges. Many causes may result in short clinical crowns which include coronal destruction resulting from traumatic injuries such as incisal attrition, caries, tissue hypertrophy, or a phenomenon known as altered passive eruption. This article will be covering classifications and treatment protocols of the altered passive eruption. It will also present a case diagnosed according to Coslet et al. classification and surgically treated to restore esthetics and gingival health of our patient. This case report’s objective is to highlight the importance of accurate diagnosis of “gummy smile” and the correlated treatment modalities that will ultimately improve the smile esthetics of patients without otherwise injuring dental tissues and in consequence, restoring optimal gingival health and esthetics.

Keywords: Altered passive eruption (APE), Gummy smile, Mucogingival surgery, Short clinical crowns

INTRODUCTION

Altered passive eruption (APE) is a fairly common condition characterized by gingival margins located incisal to the tooth cervical convexity, which makes the crown appear shorter and squarer, this condition is frequently perceived as being unaesthetic. Successful treatment of short clinical crowns depends upon the practitioner’s ability to adequately diagnose the precise etiology and to conduct an adequate and proper course of treatment, taking into consideration the biological width and dentogingival junction (DGJ) [1].

The treatment protocol is based on considerations of periodontal, esthetic, and prosthetic nature. Additionally, the relationship between the gingiva and alveolar crest becomes vital for proper diagnosis and treatment. This article describes a case of altered passive eruption and how periodontal plastic surgery can reshape the attachment apparatus, restore the correct biological width, remove the excessive gingival display and expose the correct teeth dimensions.

The tooth eruption comprises two phases: active eruption phase and passive eruption phase.

Active tooth eruption is defined as the occlusal movement of the tooth as it develops from the alveolar bone into the occlusal/incisal plane location. The eruption phase ends when the tooth contacts an antagonist; however, it may continue with occlusal wear or loss of antagonist [1–3].

On the contrary, passive tooth eruption is defined by the apical migration of gingival tissue covering the crown of the tooth. When this occurs, the lengths of the clinical crowns increase as the epithelial attachment migrates apically, and the migration occurs in four distinct stages [1, 2].
The normal relation of gingival margin of the cement enamel junction (CEJ) is generally considered to be at or near the CEJ in the fully erupted tooth of an adult. However, there is a debate in the literature as to what should be considered a normal physiologic passive eruption and it is commonly agreed that exposure of cementum is considered pathologic. The (APE) occurs when the margin of gingiva is malposition incisally/occlusally on the anatomic crown and does not approximate the cementoenamel junction [2].

Coslet et al. [2] have classified the altered passive eruption into two main classes according to the relationship of the gingiva to the anatomic crown and furthermore subdivided those classes according to the position of the osseous crest. The two types are subdivided into four categories: IA, IB and 2A, 2B. Clinically, this displays a shortened clinical crown and a smile exhibiting excess gingiva. However, there are four etiologies of excessive gingival tissue include hyper-mobile/short upper lip, compensatory eruption/alveolar dental extrusion, vertical maxillary excess, and altered passive eruption. A mixture of etiologies often happens at the same time [4]. Incisally located gingival margin leads to diminished protection from the trauma of oral function. If the gingival margin is on the convex facial surface of the enamel, this will result in no protection from the excursion of food during mastication and it may contribute to chronic inflammation of the bulbous marginal gingiva and gingival hyperplasia may develop as a result of chronic irritation [1].

CASE REPORT

After evaluation, the dimension of the clinical crowns concerning the gingival margin, the periodontal status, probing depth, clinical attachment loss, bleeding on probing, and excluding the contribution of lip position, hypermobility, and premaxilla elongation, the altered passive eruption diagnosis was established (Figure 1A). The gingival sulcus was determined to be 3 mm deep on teeth #4, #5, #7, #8, #9, #10, #12, and #13. However, on teeth #6 and #11, a depth of 5 mm was measured, and the CEJ could not be detected with an explorer. This case was graded as Type I, taking into consideration the volume of keratinized gingiva (Figure 1B and C). After administering labial and palatal infiltration, bone sounding with the periodontal probe was performed through the sulcus, which led to a subclassification Type IB.

A sub-marginal incision was performed on each treated tooth from the upper right second premolar to the maxillary left second premolar using a 15c blade (Figure 2A). Only the buccal site was involved in the operation. Care has been taken to keep interproximal papillae fully in situ. Upon intrasulcular incisions, the secondary flap was removed using a sharp curette (Figure 2B). Then a full-thickness flap with a small periosteal elevator was raised. Exposure to bone was limited to 4–5 mm (Figure 2C). As a rule, the flap to the mucogingival junction was elevated. A minimal osseous resection was performed when the distance was <1 mm to create a scalloped bone profile with a range to the CEJ of at least 2 mm. The bony crest was preferably formed parallel with the CEJ. Osteoplasty was performed when needed (Figure 2C). The exposed root surface was then carefully planned only at the buccal treated sites to remove any residual implanted fibers. At interproximal locations, care was taken to protect the attachment apparatus. The flap was sutured slightly coronal to the CEJ level (Figure 3A) to obtain primary closure using disrupted resorbable sutures. A follow appointment was given to the patient after one week of the procedure and after three months. The outcomes of this case showed the process was effective with no residual gingival recession or regrowth, stable improvement of crown length compared to the baseline, and high patient satisfaction (Figure 3B).

DISCUSSION

A healthy 31-year-old male presented to the MetroHealth Medical Center department of dental medicine complained: “I have short teeth, and I am showing gum when I smile.” Various clinical conditions
result in an excessive showing of gingival tissue while smiling [2]. Every successful treatment plan must include a proper diagnosis of the condition’s true etiology with a clear understanding of the complex of dental-gingival and its divergence from the standard [5]. In situations where a high smile line is detected, and an excessive gingival is showing, a “gummy smile” usually exists. There are various treatment choices, depending on the causes of the gingival showing and the patient’s limitation. Vertical maxillary excess can be diagnosed using cephalometric analysis. Orthodontics and orthognathic surgery can be utilized to treat the maxilla whenever maxilla elongation is caused by skeletal dysplasias [6]. For other cases where reduced tooth size and a high lip line are present, periodontal correction treatments are usually the preferred choice to eliminate the gummy smile [7]. This approach can be applied in cases where altered passive eruption makes a normal-sized tooth look shorter. The reason behind APE manifestations is when the pellicle fails to recede to the level of cementoenamel junction [7]. Consequently, the tooth will appear small because the gingival portion, where the enamel is normally exposed, of enamel remains covered with gingival tissues [6].

Altered passive eruption defined as “the gingival margin in the adult is located incisal to the cervical convexity of the crown and removed from the cementoenamel junction of the tooth” per Goldman and Cohen [8].

Classically, the passive phase has been divided into four types depending on the DGJ’s position for the cementoenamel line [9]: (a) the DGJ is located on the enamel; (b) the epithelial attachment is located on the enamel and also on the root surface; (c) the epithelial attachment is entirely located on the cement root; and (d) both the epithelial attachment and gingival margin lie apical to the cementoenamel junction (Figure 4). While the first stage is considered to be physiological, the remaining three are a result of pathological periodontal processes.

Regarding pathogenesis of APE, many factors have been proposed as causes behind its occurrence. First, interocclusal interference on the part of the gingival tissue during tooth eruption can be one of the causes. Moreover, the presence of thick and fibrotic keratinized gingiva tend to recede more slowly than thin biotype gingival tissue during the passive phase, and even genetic factors where certain hereditary tendencies in families with individuals presenting APE. Additionally, a bone crest close to the cementoenamel junction could impede gingival migration during the passive phase of eruption [10].

The classification depends firstly on the relationship between the gingiva and the clinical crown, secondly on the relationship between the CEJ and the bone crest. Therefore, classification was subdivided as following [11]:

- **Type I**: the gingival margin is incisal to the CEJ, the dimension of keratinized gingiva is wider than usual, and clinical crowns are short.
- **Type II**: the dimension of the gingiva from the gingival margin to the mucogingival junction appears normal. The free gingival margin is incisal or occlusal to the CEJ and the mucogingival junction is positioned at the CEJ.
- **Subtype A**: the distance of alveolar crest to CEJ is approximately 1.5 mm; in such cases a normal attachment can be found.
- **Subtype B**: the alveolar crest is at the level of the CEJ or above.

Consequently, types of APE can be either IA, IIA, IB, or IIB (Figure 5).

The diagnosis of APE is made on a collective clinical and radiographic examination, it begins with analyzing the repose during a natural smile followed by analyzing the gingival display, the alveolar crest level, as well as the lip line of the patient. The average lengths of the maxillary lip in repose measure 20–22 mm in female and 22–24 mm in male from beneath the nose to the wet border of the maxillary lip.

In addition, the CEJ of individual teeth are detected with the help of an explorer. The average length of a central incisor is 10.5 mm and the distance from the gingival crest to the alveolar crest will approximate 3 mm. This includes 1 mm for sulcus depth, 1 mm for epithelial attachment and 1 mm for connective tissue attachment. However, nature requires approximately 2 mm for both epithelial and connective tissue attachment between the CEJ and alveolar crest. Subsequently, if the CEJ is more apically located or cannot be detected in the sulcus, then a diagnosis of APE can be made. The periodontal biotype should be also taken into consideration while planning the surgical procedure [12]. Considering this, a determination can be made whether a gingivectomy alone will suffice or a gingival flap will be needed with or without ostectomy [1]. Hence, the diagnosis and subsequent classification

Figure 4: Four classic stages of passive eruption, left to right, stages 1–4 [2].

Figure 5: Four types of altered passive eruption [2].
of APE is of uttermost importance and this will result in correct treatment. Moreover, it is crucial to preserve the biologic width to optimize the cosmetic result [13].

The choice of the periodontal surgical procedure depends on the gingival architecture, level of crestal bone, gingival biotype, and the amount of keratinized tissue [14]. According to Dolt and Robbins treatment options [1]:

1. **Gingivectomy**: Whenever 3 mm gingival tissue or greater exists from bone to gingival crest, and an adequate zone of attached gingiva will remain after surgery, then gingivectomy can be conducted. The first incision should be determined on the gingiva at the diagnosed level of the CEJ. The initial incision should follow the normal gingival architecture and record the zenith point of each tooth so that the highest point of the gingival margin is slightly distal to the center of the tooth. Tissue is only removed from the facial surfaces and the interdental papilla is left undisturbed. Gingivectomy approach is used for type IA.

2. **Apically positioned flap**: When diagnostic examinations reveal osseous levels close or at the CEJ, a gingival flap with ostectomy is needed. The first incision either can be done as external gingivectomy incision which is described for the gingivectomy or as a sulcular incision depending on the symmetry of the gingival heights of the anterior teeth. In case gingiva is asymmetric, gingivectomy-type incision is indicated, where preoperative tissue contours are symmetric, a sulcular incision can be made. A full thickness flap is elevated beyond the mucogingival junction in order to expose the level of the CEJ and crestal bone. Bone removal is then performed until the crestal bone is 2.0–2.5 mm from the CEJ. The crestal bone architecture should exactly follow the desired soft tissue architecture. The gingiva is apically repositioned to the CEJ level and sutured. This approach can be utilized to IB, IIA, and IIB types depending on the gingival symmetry and bone level.

3. **Orthodontic repositioning**: Orthodontic forced eruption or intrusion can be sometimes used when gingival asymmetry is detected on one or more anterior teeth. In cases of traumatic fracture of a tooth or previously prepared crown margin tooth that is covered by gingival soft tissue where biological width is detected, orthodontic repositioning is most commonly indicated. However, caution should be exercised during orthodontic treatment to ensure that invasion of the biologic width of teeth is not compromised by placement of the brackets too gingivally [15]. A crown lengthening procedure is done through ostectomy to ensure 3 mm range from the crest of alveolar bone to gingival margin following 2–3 months orthodontic retention. Forced eruption ranges from 2 to 3 mm. Orthodontic intrusion is required in case of overeruption of the gingival alveolar complex due to absence of interocclusal stop for one or more of the anterior teeth. Through intrusion, the gingival-alveolar complex will recede with anterior teeth intrusion movement. Noteworthy, intrusion is one of the most challenging procedures and the most time consuming. Longer time of retention of the intruded teeth will be needed to prevent relapse.

Considering the esthetic greater emphasis in dentistry today, it is necessary to properly identify APE during any dentofacial examination and to aim for optimal gingival health and esthetics [16].

### CONCLUSION

It is important to include APE in the differential diagnosis when the patient complains resemble a “gummy smile” or “small front teeth.” Short clinical crowns may also be the result of APE, a condition that is frequently ignored. Fundamental understanding of dental and soft tissue relationships must be used to diagnose and treat APE. Establishing proper crown length and preserving biological width are essential to gingival health and restorative procedures. When suspected APE, bone sounding is a valuable tool for the diagnostic, though surgery may be the most reliable method for a harmonious perio-restorative interface.

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Carole Wehbe – Conception of the work, Design of the work, Acquisition of data, Interpretation of data, Drafting the work, Revising the work critically for important intellectual content, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved
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Conflict of Interest

Authors declare no conflict of interest.

Data Availability

All relevant data are within the paper and its Supporting Information files.

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