Gummy smile: clinical parameters useful for diagnosis and therapeutical approach

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In the analysis of the characteristics of a pleasant smile, a gummy smile has negative components, which most affect the esthetics of non-verbal communication. For this purpose a proposed classification based upon etiopathogenetic criteria as useful indications for a therapeutical approach is given. The nature of a high smile line can be: dento-gingival, connected to an abnormal dental eruption, which is revealed by a short clinic crown; muscular, caused by an hyperactivity of the elevator muscle of the upper lip; dento-alveolar (skeletal), due to an excessive protuberance or vertical growth of the jawbone (maxillary); lastly, a mixed nature, in the presence of more than one of the above described factors. The diagnosis of gummy smile must be precocious and based, with reference to specific parameters, upon a careful analysis of the etiopathogenetic factors and the degree of seriousness of the alteration. A correct treatment plan must contemplate the possibility of an orthognatodontic, orthopedic and/or surgical therapeutic resolution considering the seriousness and complexity of the gums exposures (high smile line) in connection with the age of the subject.

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INTRODUCTION

he conditions of a smile are the main reasons for the patients to go to an orthodontist. The parameters usually used to establish orthodontic conditions undervalued the aesthetic objectives and considered them hard to modify and to individualize. Among the main goals of treatment plan, ideal occlusion has been privileged, believing that the first molar and canine properly occluding gave a smile improvement.

If this were true for many of labio-dental characteristics (overjet reduction, crowding resolution or space closing), however some of these, such as gum exposition, could be made worse.

The purpose of this study was to check pleasant smile features, giving specific parameters to make early diagnosis and providing a right therapy of gummy smile. Gummy smile or "horse smile" or "high smile line" or "gingival smile line" is a condition charac-

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terized by excessive exposure of maxillary gingival during smiling. A true smile is a complex gesture. Analyzing the problem from a facial aspect, the smile begins as the corners of the mouth extend laterally. At the beginning, lips tend to remain in contact, except for people who have a short upper lip.

As the smile expands and approaches laughter the lips separate, mouth angles curve upwards and superior teeth are exposed to view. As the angles of the mouth extend and the lips separate, the mesial half of the maxillary first molars and the mandibular second premolar may be exposed, while the front upper lip lifts up reaching the superior incisive collar.²

According to the dental traditional literature there are three categories of smile line:³

- normal smile line, when during smile teeth have been showed and inferior rim of upper lip discovered 1-2 mm of free gum;
- low smile line, when the inferior rim of upper lip covered over then 25% of superior incisive crown;
- high smile line, when inferior rim of upper lip discovered over 2 mm of free gum.

Normally between upper lip and superior incisive collar (smile line) there should not be free gum over 2 mm. If this is the case, then smile is defined "gummy". Causes for gummy smile could be different. It could be caused by hereditary, congenital or acquired factors.

The smile starts with contractions of muscle bundles originating from nasiolabial fold and upper lip levator muscles, which fibers by the fold inserted to upper lip.⁴ Medial muscle bundles pull the upper lip upward on anterior teeth level and lateral muscle bundles pull the upper lip upward on posterior teeth level. The lip then meets resistance at the fold because of the heavy cheek fat. The fold deepens. The levators, notably the zygomatic major and the levator superior, rise the lip, fold and cheek to a higher level.⁵ In the final stage of smile, contraction of periocular muscles caused a winking of the eyes. Furthermore everyone has an anatomical and functional muscular variability of nasolabial fold and this could change the individual capacity to show gum during smile.⁶

Sometimes gummy smile has been related to a specific morphological pattern, characterized by palatal plane post-rotation, a higher divergence of mandibular plane on cranial base, an excessive maxillary length, a short crown of maxillary incisive and a short length of upper lip.^{8,9} Among them the only parameter with statistical significance was the maxillary length or the distance between subnasal point and incisal border. This measure showed maxillary vertical excess and according to a case control study,¹⁰ in subjects with high smile line it was higher 2-3 mm than in controls. Vertical maxillary excess (VEM) had to be valued on molar level, which during smile was under lip commeasure.

According to Peck *et al.*⁶ studies, overbite and overjet excesses are associated to clinical check of gummy smile. In subjects with moderate and heavy II classes, lip resisted to lowering during age.¹¹ Excessive gum exposure could be associated to a pathological passive eruption with a modifiable relationship between gum and amelo-cementic junction so that a great part of anatomic crown has been covered by the gum.¹² Clinically in this case the anatomic crown had a square form for gum covering tooth and the smile had a large space from the inferior border of the upper lip to the tooth. Peck *et al.*⁶ discovered a moderate statistical correlation between clinical crown length and smile line position: a high smile line is associated to short clinical crown and vice versa.⁹

PROCEDURES

It was not difficult to recognize gummy smile, but it can be more complex defining its nature and entity. There were clinical and photometrical parameters to evaluate dento-gingival, gingival, anatomical and functional relationships by which this unaesthetic smile could be described.

A good diagnosis could be done and a right treatment plan could be set up only after a complete analysis. Moreover, in young subjects and for some alterations, these parameters helped the dentist to plan a early therapy for a risky situation, so that in years to come a surgery solution would be unnecessary.

The gummy exposure valuation would be clinical and photometrical. Analysis had to be performed during maxim smile, both in frontal view and profile. With the aim to allow a easier reproducibility of this performance, patients were required to smile several times.

Parameters have been classified into structural, occlusal and labio-gingival-dental parameters.

Structural parameters focused on facial typology: symmetry, face and third inferior vertical dimension and sagittal relationship between maxillary and jaw.¹³ Maxillary length measurement in millimeters was done to discover how clockwise rotation or vertical dimension of this structure compromised gummy exposure. This parameter has been measured as the distance from subnasal (Sn) point to incisal margin (Incision Ic).

Occlusal parameters considered interincisal relationship, as the maxim distance in millimeters between mesial-incisive corners of central superior and inferior corresponding incisors, on sagittal (overjet) and vertical (overbite) plan. Increased overjet and overbite, in fact, seemed to be associated to gum exposure. Occlusal plan inclination has been valued frontally by shaking ice-stick in horizontal position and it could be responsible of a dental exposure asymmetry during the action of smiling.

The third parameter concerned clinical crown length that was defined as long, medium and short. It was calculated as the distance between incisor and gingival margin. Clinical crown of central incisive was of 11 mm \pm 2, if it were completely erupted. If tooth clinical crown was under 8 mm then it was defined as short. Tooth crown inclination was an immediate element in the assessment of smile.

Labio-gingival-dental parameters considered smile general assessment. Smile has been classified as low, medium and high.

Smile was low if the central incisor clinical crown (superior of left) was covered by lip over 1/3; smile was medium if it discovered up to 100% of crown and 2 mm of gum. Smile was high, if it found to be over 2 mm of gum. Smile line indicated gum exposure in millimeters.

These parameters have been measured during maximal smile as the distance between upper lip and incisive collar. For this recording an imaginary vertical axis passing through middle face has been used.

The value was 0 if it was perpendicular at this axis and passed through incisor collar. The value was positive if upper lip passed above this line and the value was negative if upper lip passed underneath this line. Another parameter concerned upper lip length, calculated as the distance between subnasal point (Sn) and upper lip at rest and at maximum smile. The fourth parameter recorded the distance between upper lip and central incisor margin at rest and at maximal smile (Stomion -Incision Index).

The last parameter concerned interlabial gap or the distance between upper and lower lip at rest and during

maximal smile. 15 Therefore, the relationship between lip and smile length in these two positions could be useful for establishing nature of gummy smile. In fact, it could be related to upper lip levator hyperactivity or to short upper lip.

Gummy exposure index consisted of three aspects: gingival relationship was good and so therapy would not modify labio-dental position; if nevertheless overbite was excessive inferior incisive intrusion would be used, according to Ricketts, to open the bite.

If gingival exposure was 1-3 mm then orthodontic treatment would not modify this condition. For a gummy smile therapy aesthetic elements had to be valued. If gingival exposure was over 3mm, then a treatment plan had to consider this aspect.

GUMMY SMILE classification

This classification grouped cases of gummy smile in relation to etio-pathogenetical factors:

- Dento-gingival gummy-smile, if there was an altered passive eruption of teeth;
- Muscular gummy smile, if there was a hyperactivity of upper lip muscle and of great zygomatic;
- Dento-alveolar gummy smile, if there was an excessive vertical descent;
- Mixed gummy smile, if more than one of these conditions appeared.

Dento-gingival gummy smile

Altered passive eruption was classified into two groups: type 1, in which there was a gingival excess between muco-gingival junction and free gingival margin: type 2, when there was a normal dimension of supporting gum. These two types were different according to the clinical approach, therapy and histology. Moreover, type 1 and 2 could be subdivided into A and B classes on the basis of bone crest and amelo-cementic junction distance. When this space was over 1.5 mm, it was categorized as class A. In this case, a so-called "biological distance" or the space for connective tissue attachment appeared. When this distance was absent then passive eruption was classified as class B.

Muscular gummy smile

In this case there was a hyperactivity of elevator muscles (upper lip elevator and zygomatic); in fact upper lip length was not reduced either in study-group or in control group.

Dento-alveolar gummy-smile

Dento-alveolar factors were associated to maxillary excessive protrusion in sagittal and vertical directions. Clinically, maxillary excessive protrusion in sagittal dimension has been considered as an increased overjet. However, maxillary excessive protrusion in vertical dimension could be seen as an increased dimen-



Figure 1. Case 1 showing excessive gingival exposure from vertical maxillary growth.

sion of distance between subnasal point (Sn) and incisor point (Ic).

In this case the main feature was an excessive growth of alveolar bone and it was independent of sagittal disharmony. Moreover, alterations could be considered only in vertical incisor position, in mandibular plane inclination or in both. Dento-alveolar height was influenced directly by maxillary incisor position and indirectly by mandibular plane inclination. Therefore, incisor maxillary position and increased divergence had some implications on gingival components and then on smile aesthetics.

Mixed gummy smile

In this case, all the conditions in which gingival exposure was caused by more then one factor were included. The frequency of the influence of one factor and its percentage was not known.

The most frequent aspect clinically observed was a vertical maxillary excess, associated to short clinical crowd, while muscular factors appeared more independent of other factors.

CASES

Case 1. A 9-year-old male showed, after analysis, an excessive gingival exposure previously due to vertical maxillary growth. The position of the incisors was brought back to normal by an intrusion arc, in order to achieve the desired changes (Figures 1 to 4).

Case 2. An 8 year-old female sought orthodontic treatment in order to correct malocclusion and to improve her appearance. After the analysis described earlier, she showed aspects of gummy smile given by excessive anterior and gingival posterior display (5-6 mm) with maxillary protrusion (class II/ 1div). To achieve an ideal aesthetic smile line, it was necessary to reduce maxillary protrusion by orthodontic treatment ^{16,17} (Figures 5, 6).

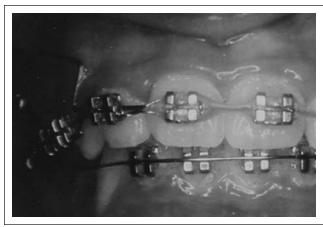


Figure 2. Case 1 treated with intrusion arch on fixed orthodontic appliance.



Figure 4. Case 1 showing Class I in molar and cuspid teeth.



Figure 6. Case 2 post orthodontic treatment with improved smile.

Case 3. A 9-year-old girl sought a diagnosis for orthodontic treatment. After her analysis, done according to the method described earlier, she had a gummy smile caused by excessive vertical maxillary growth associated with an altered passive eruption of dentalgingival junction.



Figure 3. Case 1 post orthodontic treatment with teeth in normal position.



Figure 5. Case 2 Gummy smile from excessive anterior and gingival posterior display with maxillary protrusion.



Figure 7. Case 3 gummy smile caused by excessive vertical maxillary growth with altered passive eruption of dental-gingival junction.

The orthodontic treatment with the intrusion arc was performed to reduce dental-alveolar hyperplasia. Post-treatment evaluation revealed that a gingivectomy of 3mm should be sufficient to achieve the proper length of teeth and gingival margins in harmony with the upper lip (Figures 7 to 11).

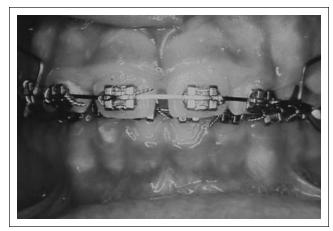


Figure 8. Case 3 fixed orthodontic appliances with intrusion arch.



Figure 9. Case 3 with improved smile.

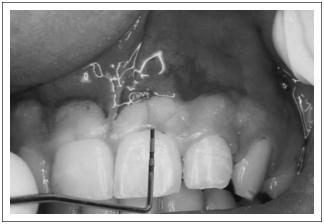


Figure 10. Case 3 with perioprobe measuring gingival depth for gingivectomy.



Figure 11. Case 3 with improved smile post treatment.

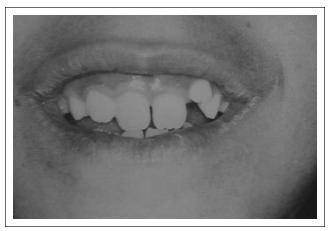


Figure 12. Case 4 gummy smile with excessive gingival exposure from vertical maxillary growth.

Case 4. An 11-year-old male presented gummy smile with excessive gingival exposure in the front and in the back due to vertical maxillary growth. Since the subject was hyperdivergent after radiographs analysis, it was necessary to use full vertical headgear to reduce the maxillary hyperplasia (Figures 12 to 15).

CONCLUSION

The aim of the dentist is to improve facial and smile aesthetics and function, acting on lip-gingival-dental features. The resolution of this dental and skeletal disharmony restores dental and dental-alveolar smile harmony. Gingival smile could not be improved after therapy because it had its own therapeutic and diagnostic identity. Interception and resolution of gingival exposure require the use of specific parameters to identify nature of alteration and to define its entity. Dentists have to quantify and to create facial aesthetic parameters to assess objectively what is pleasant and what is not. This is necessary to link aesthetic values to concrete and measurable aspects and not only to subjective views.

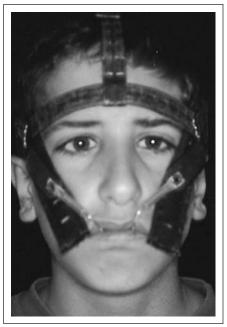


Figure 13. Case 4 with vertical headgear to reduce maxillary hyperplasia.



Figure 14. Case 4 showing the intraoral view of how the headgear attaches to the fixed orthodontic appliances.



Figure 15. Case 4 post treatment showing improved smile.

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