

Gummy Smile Etiology and Treatment Options

Gummy Smile Etiyoloji ve Tedavi Seçenekleri

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ABSTRACT

A beautiful smile is associated with charm and sympathy. Esthetic expectations have become as important as ensuring a healthy, functional dentition in dentistry. When performing a smile analysis, the position of the upper lip and gingival displacement should be evaluated along with other components of the smile. Excessive gingival display (gummy smile) is one of the conditions that affect the esthetics of the smile negatively. This review aims to evaluate the etiology and treatment options of gummy smile with existing literature information.

Keywords: Excessive gingival display, Gummy smile, Smile evaluation

ÖZ

Güzel gülümseme çekicilik ve sempati ile ilişkilendirilmektedir. Diş hekimliğinde estetik beklentiler, sağlıklı ve fonksiyonel bir dentisyonun sağlanması kadar önemli bir konuma gelmiştir. Gülme analizi yapılırken gülmenin diğer bileşenleriyle beraber üst dudağın konumu ve diş eti görünürlüğü de değerlendirilmelidir. Artmış diş eti görünürlüğü (gummy smile) gülme estetiğini olumsuz etkileyen durumlardan biridir. Bu derlemenin amacı gummy smile etiyojisini ve tedavi yöntemlerini mevcut literatür bilgileriyle değerlendirmektir.

Anahtar Kelimeler: Artmış diş eti görünürlüğü, Gummy smile, Gülme analizi

Introduction

Since ancient societies and cultures up to the present day, the importance of facial esthetics and physical attractiveness has always been significant ¹. Since the esthetic concept is subjective, defining objective criteria for evaluating beauty is challenging. The face is the key factor in a person's physical attractiveness. In studies evaluating facial photographs, it was noted that the eyes and mouth attract the most attention. The reason for this is the mobility of tissues and the presence of color contrasts ². Therefore, the smile is an important element in facial esthetics. In dentistry, esthetic expectations have become as important as achieving a healthy and functional dentition. Studies showed that attractive adults and children exhibit more positive behaviors. They are more confident, dominant, and have less anxiety ^{3,4}. A beautiful smile is associated with attractiveness and sympathy. A smile is extremely important in social relationships ^{5,6}.

A smile is one of the most important facial expressions that occur with the contraction of facial muscles. Smile is not a facial movement that can be categorized in a single category. Emotional and non-emotional facial activities originate from different areas of the brain and the brain uses different motor areas for these activities. From this perspective, there are two types of smile types. The posed smile (social smile) is repeatable and static. It is a smile that is made for greetings without any effort and is not related to emotions. The unposed smile (spontaneous smile) is related to emotions and is made unconsciously. It is dynamic and difficult to repeat ^{7,9}. Smile is defined in two stages. In Stage 1, the levator muscles contract and lift the upper lip until they encounter resistance from the fat in the nasolabial fold. In Stage 2, the muscles lift the upper lip and cheek, overcoming the resistance from the nasolabial fold, and the area around the eyes becomes wrinkled ^{10,11}. Ackerman et. al ⁹ stated that stage 1 is a social smile and stage 2 is a spontaneous smile.

Smile analysis is an important part of orthodontic diagnosis and treatment planning. Smile analysis is a static and dynamic process. Clinical examination, biometric measurements, and patient photographs are evaluated together for diagnosis. The social smile is the smile used in photographs because it is repeatable. The video method is also used for evaluation by recording speech, social smile, spontaneous smile, and rest position ¹²⁻¹⁶. Facial examination is the first part of smile analysis. Facial proportions and asymmetry should be evaluated. Each patient has different skeletal and muscular characteristics. Nasal projection,

skeletal relationships of the jaws, muscular characteristics, and width and length of the lips affect the smile zone. The framework of the smile zone is formed by the lower and upper lips ^{10,17-19}.

Evaluation of the three-dimensional components of the smile is necessary. The fourth dimension that should be evaluated is the changes that will occur over time. Smile evaluation is performed in the frontal, sagittal and oblique dimensions. In the frontal dimension, the vertical (tooth-gingival display, smile line) and transverse characteristics (buccal corridor, arch form, presence of transverse cant) of the smile are evaluated. In the oblique dimension, palatal plane orientation and smile arc are evaluated. In the sagittal dimension, incisor inclinations and overjet are evaluated. The changes that occur over time are as follows: increased length of the philtrum and commissure, decreased incisor display at rest, decreased gingival and incisor display during smile, and decreased tissue elasticity ¹³⁻¹⁵. The lower and upper lips form the framework of the smile. Along with this framework, teeth and gingival tissue constitute the components of the smile. The components of an ideal smile include smile arc, buccal corridor, display of teeth and gingiva, symmetry in dentition, dental midlines, incisor inclinations, and positions, proportions of the upper anterior teeth relative to each other, contact points, embrasures, and gingival esthetics. None of these factors should be evaluated separately. They should all be symmetric and harmonious. ^{4,18,20,21}.

The smile line indicates the position of the upper lip in relation to the upper teeth and the gingiva during a smile ²²⁻²⁴. Tjan et. al ²³ have divided smile into three categories: low, medium, and high. A low smile is when less than 75% of the upper anterior teeth are exposed during a smile. A medium smile is when interproximal gingiva and 75-100% of the anterior teeth are exposed during a smile. A high smile is when all of the upper anterior teeth are exposed, along with some gingiva (Figure 1). A gummy smile is an excessive display of the upper gingiva during a smile ¹⁶. Peck et al. ¹⁶ stated that the prevalence of patients with more than 2 mm of the gingival display was 26%. Tjan et al. (24) reported that a high smile line was observed in 7% of men and 14% of women in their study. A higher smile line is a characteristic of women. A display of 4 mm or more of gingiva is associated with low esthetic scores. A display of 1-3 mm of gingiva is considered acceptable ²⁵⁻²⁷. In patients with gingival display during a smile, the contour, level, and health of the gingiva are important for smile esthetics. There should be harmony between the gingiva in the anterior and posterior regions ²⁸.

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Figure 1. A. High smile B. Medium smile C. Low smile ⁴

In a spontaneous smile, the smile line is, on average, 1 mm more high in the anterior region and 1.5 mm more high in the posterior region compared to a social smile. Moreover, the width between the commissures and therefore the number of visible teeth are also higher. Especially in patients with a gummy smile, the activity of the muscles that lift the upper lip upward is greater than in patients with an average smile ²⁹. A social smile is influenced by the patient's social experiences, emotional background, and embarrassment over the appearance of their smile. Patients use their lips, hands, and head position to mask their smile, resulting in an unnatural smile ²²⁻²⁴.

A study evaluated 228 patients with more than 2 mm of gingival display during a social smile. The patients' ages ranged from 12 to 16. Four types of gummy smiles were observed: Type 1, characterized by a continuous band of gingiva; was observed in 88% of patients. Type 2, representing a gummy smile in the posterior region; was observed in 6% of patients. Type 3, indicating an asymmetric gummy smile; was observed in 4% of patients. Type 4, representing a gummy smile in the anterior region; was observed in 2% of patients. Patients with type 1 gummy smile also underwent to cephalometric evaluation. The cephalometric characteristics observed in these patients are as follows: Class 2 skeletal relationships, vertical growth pattern, mandibular retrognathism, increased maxillary length, labial inclination of upper incisors, increased overbite and overjet, and a shorter upper lip compared to anterior maxillary height ³⁰.

1. Clinical measurements performed for the diagnosis of a gummy smile

Evaluations for a gummy smile should be performed at rest and during a smile ³¹⁻³³. In the rest position, the teeth are not in occlusion and the lips are slightly apart. Perioral muscles are relaxed. The following factors are considered in the evaluation at rest: the amount of upper incisor display, upper lip length, commissure length. In women, on average, 2-4 mm of the upper incisors are exposed at rest, while in men, the amount of exposure is about 2 mm less than in women ³¹. The average lip length is 23 mm in men and 20 mm in women. This measurement is performed from the subnasal to the edge of the upper lip. The length of the commissure is approximately equal to the length of the upper lip ³². In the evaluation during a smile, the amount of gingival display and the upper incisor display should be measured. In the smile of young patients, 75%-100% of the maxillary incisors should be below the line drawn from the commissuras. This is known as the Morley ratio ²⁰. Additionally, the smile arc should be evaluated. In the ideal smile, the curvature of maxillary incisal edges should follow the curvature of the lower lip and lightly touch it ¹⁵. The amount of displacement in the upper lip during a smile is 6-8 mm. In patients with hyperactive lips, this displacement can be 1.5-2 times greater ²². The crown length of the central incisors should also be evaluated. The ideal crown length is approximately 10 mm ³⁴. During the differential diagnosis phase, evaluations performed at rest and during a smile are important (**Figure 2**). The relationships in the rest position should not be overlooked. Changes with age should be taken into account.

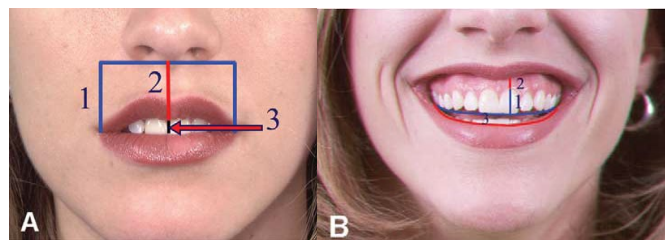


Figure 2. A. Measurements of resting relationships 1, commissure height; 2, philtrum height; 3, interlabial gap and incisor show at rest. B. Measurements of dynamic relationships 1, crown height; 2 gingival display. ¹³

2. Etiology of Gummy Smile

The factors that play a role in the etiology of a gummy smile are as follows: Dentogingival factors (gingival hyperplasia, delayed passive eruption, incisal attrition, dimensional variations), dentoalveolar factors (overeruption of the upper incisors, vertical maxillary excess), muscular factors (short upper lip, hyperactive upper lip). Several of these factors may coexist in patients ^{17,35,36}.

2.1. Dentogingival Factors (Short clinical crown): If the display of the upper incisors is normal at rest, a short clinical crown length of the upper incisors may be the reason for a gummy smile ¹⁷. There are various reasons for the short clinical crown of the upper incisors. It can be caused by dimensional variations, although this is rare. Attrition can also be the reason. If an explorer inserted beneath the marginal gingiva can detect the cemento-enamel junction, the reason for a gummy smile may be incisal attrition or dimensional variation. If the cemento-enamel junction cannot be detected, the gingiva is coronally positioned. There is a difference between the anatomical crown length and the clinical crown length ^{17,37}. Gingival hyperplasia can be one of the reasons for a short clinical crown length. Gingival hyperplasia is caused by inflammation. Dental plaque often leads to this condition. Some medications can also cause gingival hyperplasia. The gingiva is rarely normal in appearance ³⁷. If the gingiva appears healthy, delayed passive eruption should be suspected ¹⁷. Active eruption is the movement of a tooth in an occlusal direction until it contacts the opposing teeth. Passive eruption is the apical movement of the dentogingival unit after the tooth has reached occlusion ³⁸⁻⁴⁰.

The passive eruption phase is divided into 4 classes based on the position of the dentogingival unit: It can be within enamel, within the cemento-enamel junction, or within cement. Both the dentogingival unit and the gingival margin can be within the cement ⁴¹. If the dentogingival unit is located within the enamel in adulthood, delayed passive eruption is considered. Determining when the physiological movement of passive eruption ceases is a challenging issue. The maturation of the dentogingival unit in most individuals occurs around the age of 18-20 ⁴¹. Passive eruption is believed to occur until the age of 12 in the upper incisors. Delayed passive eruption can occur in a single tooth or multiple teeth. Age should be taken into account during diagnosis ⁴⁰.

2.2 Muscular Factors (Hyperactive upper lip, short upper lip): If the normal upper incisor display is present at rest, and the crown length of the upper incisor is normal, hyperactivity of the upper lip is the reason for a gummy smile. It was determined that lip activity is greater in those with a gummy smile compared to those without. If increased upper incisor display is present at rest, and the vertical dimension of the face is normal, a short upper lip is the reason for a gummy smile ¹⁷.

2.3. Dentoalveolar Factors (Overeruption of the upper incisors vertical maxillary excess): If increased upper incisor display is present at rest and the crown length of the upper incisor and the lip length are normal and also there is a difference between the anterior and posterior occlusal planes in the upper jaw, the reason for a gummy smile is overeruption of the incisors. If increased incisor display is present at rest and the crown length of the upper incisor and the lip length are normal and the occlusal plane is harmonious in the upper jaw and there is an increase in the vertical dimension of the face, the reason for a gummy smile is excessive vertical maxillary growth. Cephalometric measurements are also used in diagnosis. ¹⁷

3. Treatment Methods for Gummy Smile

Since the etiology of a gummy smile is multifactorial, accurate diagnosis is the most important stage in treatment planning. The existing reasons in the patient should be identified and treatment planning should be performed. Treatment options include orthognathic surgery, orthodontic treatments, periodontal surgeries, and plastic surgical practices^{17,36}.

3.1. Treatment of Dentogingival Factors (Short clinical crown): Routine periodontal treatments should be carried out in the treatment of gingival hyperplasia, and local irritants should be removed. If the growth in the gingiva is not fully correct, gingivectomy is also considered³⁷. In delayed passive eruption treatment, a crown lengthening procedure should be performed. Surgical crown lengthening is a treatment performed for esthetic and functional reasons, aiming to increase the clinical crown length through the remodeling of the dentogingival unit. Coslet's classification for delayed passive eruption also provides an idea about treatment planning. (Figure 3). According to this classification, delayed passive eruption is divided into two groups. Group 1 has an excessive amount of keratinized gingiva, and group 2 has a normal amount of keratinized gingiva. Each of these groups has two subgroups. Group A has a distance of 1.5-2 mm between the alveolar crest and the cemento-enamel junction, and Group B has approximately the same level between the alveolar crest and the cemento-enamel junction. If the attached gingiva is insufficient, an apically positioned flap will be required. If achieving biological width is necessary, bone resection will be needed⁴⁰⁻⁴². The dentogingival unit consists of 1 mm of connective tissue attachment, 1 mm of epithelial attachment and 1 mm of gingival sulcus. This is referred to as biological width. In the treatment of Group 1A cases, gingivectomy will be sufficient. If only gingivectomy is performed in Group B cases, the gingiva will return to its previous position. The distance between the alveolar crest and the gingival crest should be around 3 mm to preserve the biological width. In cases of Group 1B and 2B, bone resection should be planned for the formation of biological width. Even if the keratinized gingival width is normal, it is reduced when gingivectomy is performed in Group 2 cases. Therefore, an apically positioned flap should be applied in Group 2 cases^{40,41}.

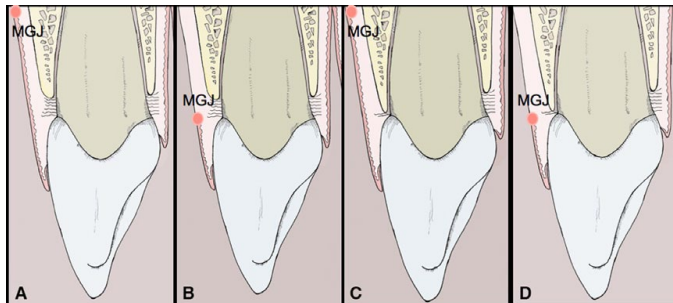


Figure 3. Classification of delayed passive eruption. A. Grup 1A, B. Grup 2A, C. Grup 1B, D. Grup 2B⁴¹

3.2. Treatment of Muscular Factors (Hyperactive upper lip, short upper lip): Various treatment options have been applied in these patients. These include lip repositioning, detachment of lip muscles, myotomy, lip lengthening with rhinoplasty, and botox applications. The basic principle of the lip repositioning technique is to limit the amount of lip elevation by the levator muscles. A half-thickness flap is formed between the lip mucosa and mucogingival junction. Epithelial mucosa is excised. Then, the lip mucosa is sutured to the mucogingival junction. A new mucosal margin is created. The procedure is safe and has minimal side effects. The vestibular sulcus becomes shallower, and the amount of upper lip elevation by the levator muscles decreases. A sufficient keratinized gingiva width is required for the success and stability of treatment (3-4 mm and more)^{43,44}.

Patients with gingival display in a smile between 4-6 mm were divided into two groups. The reason for gummy smile in these patients was either a short upper lip or a hyperactive upper lip. Lip repositioning treatment was applied to one group, and a modified version was applied to the other group. In the modified lip repositioning treatment, a full-thickness flap was used, and the surrounding elevator muscles of the upper lip were dissected. The patients were followed

up for 6 months. It was observed that the treatment results were more stable in patients treated with the modified technique. It was thought that the elevator muscles of the upper lip were effective in relapse⁴⁵. Studies showed that the detachment of lip muscles and the application of myotomy increase stability^{46,47}.

Fourteen female patients with a gummy smile were treated with subperiosteal dissection, myotomy of the levator labii superior muscle, and frenectomy. They were followed up for at least 6 months. Patients with delayed passive eruption and excessive vertical maxillary growth were not included in the treatment. Under local anesthesia, nasal incisions were made, and the gingival mucosa was mobilized from the upper jaw, with the apertura piriformis and 1st molars as boundaries, using a wide subperiosteal dissection. With subcutaneous dissection, the right and left levator labii superior muscles were dissected and divided. Frenectomy was performed to increase the length of the upper lip. The technique was found to be effective⁴⁸.

Non-surgical minimally invasive methods are also available for the treatment of a hyperactive upper lip (49). In patients with hyperactive upper lip muscles, botulinum toxin A is used in treatment. Botulinum toxin A inhibits presynaptic acetylcholine release and provides temporary paralysis in the muscles. Botulinum toxin was applied to 30 gummy smile patients in this study. Follow-up sessions for the patients were scheduled on the 2nd, 4th, 8th, 12th, 16th, 20th, and 24th weeks. Gingival display began to increase from the 2nd week and did not return to baseline at the 24th week. Although the effect of botulinum toxin treatment is temporary, gingival display did not return to baseline levels at 6 months⁴⁹. Hwang et al.⁵⁰ stated that the main muscles responsible for the elevation of the upper lip during a smile are the levator labii superioris alaeque nasi, levator labii superioris, and zygomaticus minor. They defined the center of the triangle formed by the adjacency of these three muscles as the Yonsei point. By applying to this point, the three muscles can be affected. It is a safe and repeatable point for Botox application. It is located at the intersection of approximately 3 cm above the commissure and 1 cm lateral to the alar cartilage. Since the effect of Botox application is temporary, it should be repeated every 6-9 months to maintain the desired esthetic results. Mazzucco and Hexsel⁵¹ identified four different types of gummy smiles and the corresponding muscles responsible for them by evaluating the strength and orientation of the smile muscles. According to this, the levator labii superior alaeque nasi muscle is effective in the gummy smile in the anterior region. Zygomaticus major and minor muscles are effective in the posterior gummy smile. In cases of a gummy smile seen in both anterior and posterior regions, the levator labii superior alaeque nasi, zygomaticus major, and minor muscles are effective. In asymmetric gummy smile cases, only the unilateral levator labii superior alaeque nasi, zygomaticus major, and minor muscles are effective. They injected botulinum toxin into the responsible muscles for gummy smile treatment. The success rates they achieved according to gummy smile types are reported as 96% in the anterior region, 61.06% in the posterior region, 90% in cases where both anterior and posterior regions are involved, and 71.93% in asymmetric cases. Hyaluronic acid injection is also an option that can be applied to reduce the contraction of smile muscles. It is applied from the area where botulinum toxin is performed. The pressure created by the applied hyaluronic acid prevents muscle contraction. Its effect is temporary, but it lasts longer than botulinum toxin.^{52,53}

3.3. Treatment of Dentoalveolar Factors (Excessive Maxillary Incisor Overeruption, Vertical Maxillary Excess) Treatment: In cases of maxillary incisor overeruption and torque loss, orthodontic treatment with incisor intrusion is considered. If there is torque loss in the incisors (palatal crown torque) before incisor intrusion, the torque should be corrected. Thus, the roots of the upper incisors are moved away from the buccal cortical bone and placed in the ideal position within the bone^{54,55}. The smile arc is important for smile esthetics. Care should be taken to avoid flattening of the smile arc during incisor intrusion¹⁵. Auxiliary arches and mini screws can be used during the orthodontic treatment for incisor intrusion. The successful anchorage control of mini screws and their independence from patient cooperation made them popular^{17,54,56}. Low forces should be applied for ideal intrusion movement. The force should pass through the resistance center of the tooth or the tooth group to be intruded⁵⁴. The center of resistance of the upper anterior teeth is located between the canines and laterals. Therefore, it is recommended to place mini screws in these areas for the intrusion of the upper incisors⁵⁷. The inclination of the upper incisors should be

maintained with the position of the mini screws and additional wire bends during intrusion.

In cases of vertical maxillary excess, the main treatment is orthognathic surgery. However, surgical treatment is a challenging approach. Treatment options based on the amount of gingival display that is caused by vertical maxillary excess are available in the classification proposed by Garber and Salama³⁶ If the gingival display is 8 mm or more, orthognathic surgery and, if necessary, periodontal-restorative treatments are applied. If there is 4-8 mm of gingival display, orthognathic surgery and/or periodontal-restorative treatments are applied. The clinical crown length, root length, upper lip length, and upper lip range of movement of the patients are also important in treatment planning. The condition can be camouflaged without orthognathic surgery. If there is 2-4 mm of gingival display, incisor intrusion with orthodontic treatment, orthodontic and periodontal treatments, and restorative and periodontal treatments are applied according to the etiology. Orthognathic surgery provides the correction of jaw and dental relationships, establishment of functional occlusion, and improvement of facial esthetics. In patients with vertical maxillary excess and a long face, intrusion of the upper jaw is always included in the surgical planning. Orthognathic surgery provides satisfactory results for gummy smile treatment, but the amount of maxillary intrusion should be individually planned for each patient⁵⁸. The intrusion of the maxillary dentition with mini screws and mini plates can be an alternative to orthognathic surgery in long face, gummy smile, class 2 (retruded mandibula) adult patients. Of course, the severity of a gummy smile is important. Intrusion of the entire dentition in the maxilla should be planned. Successful results were achieved in cases with borderline vertical maxillary excess using orthodontic treatment supported by mini screws and mini plates^{59,60}. When the upper teeth are intruded, the lower teeth tend to be extruded. Therefore, vertical control of the lower arch should be prioritized. With molar intrusions, there is a forward and upward rotation in the lower jaw. The use of Class 2 elastics is not recommended because they have an extrusive effect⁶¹.

Additional etiology of gummy smile

Wei et al.¹⁹ have defined nasal septum displacement as a new etiological factor. In the study evaluating the relationship between nasal septum cartilage and a gummy smile, 121 gummy smile patients and 150 normal individuals were evaluated in terms of nasal septum cartilage defects. The evaluation was conducted by measuring the amount of upward movement of the columella. A total of 46 gummy smile patients with excessive upward movement of the columella were treated. An autologous graft or implant was used to support the cartilage. The patients were followed up for 6 months after the surgery. Gummy smile decreased from an average of 4.5 mm to 2 mm. The complication rate is low, and the patients' satisfaction rate is high.

CONCLUSIONS

Smile analysis is an important part of orthodontic diagnosis. Smile analysis and design require achieving as much compatibility as possible between the patient's esthetic requirements, and anatomical and physiological limitations. The most important part of gummy smile treatment is the correct diagnosis of etiology. Aggressive treatments should be avoided by taking into account the changes that will occur with age.

Değerlendirme / Peer-Review

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Etik Beyan / Ethical statement

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It is declared that during the preparation process of this study, scientific and ethical principles were followed and all the studies benefited are stated in the bibliography.

Benzerlik Taraması / Similarity scan

Yapıldı - ithenticate

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