

Factors Affecting Smile Esthetics

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ABSTRACT

Smiling has been one of the areas that draw the interest of orthodontists due to esthetic concerns in recent years. It should be understood what an ideal smile is and which factors affect it, and these should certainly be reflected in the orthodontic treatment plan. The purpose of this review is to describe smiling and to examine factors affecting smile and smile evaluation methods.

KEY WORDS: Ideal Smile, Smile Esthetics, Smile Line

INTRODUCTION

A beautiful and attractive smile is among the important targets of orthodontic treatment and is provided with an ideal smile line. Smile is affected by certain factors in addition to ideal smile line, such as buccal corridors, gingival display, arch width, tooth shapes, asymmetries, and age.¹ This review article examines the factors affecting smile and smile evaluation.

IDEAL SMILE

Well-aligned teeth and a beautiful smile are the two most important targets of orthodontic treatment. A beautiful and attractive smile is provided with an ideal smile line. The smile line is the relation between the incisal edge curvature of the maxillary anterior teeth and the curvature of the upper edge of the lower lip. What is ideal in a smile is that these curvatures should be parallel to each other.¹

Parallel alignment of maxillary incisors' incisal edge curvature and the lower lip's upper edge curvature during smiling is the precondition for a "consonant" smile. Therefore, if the maxillary incisors' incisal edge curvature is flatter than the lower lip's upper edge curvature during smiling, this smile is called "nonconsonant." Another precondition for a consonant smile is that maxillary incisors should be entirely visible during smiling.²

Maulik and Nanda³ examined the effect of orthodontic treatment on the smile line in young adults with dynamic records. They concluded that

the smile line did not get flatter as it was expected, it got even more parallel to the lower lip curvature.

In an ideal smile, besides this parallel alignment, minimum buccal corridors and gingival display should be provided, first molar teeth should not be visible, and the width between the upper canines should be equal to the nose width.^{4,5}

SMILE EVALUATION

Static records, dynamic records, and records comprised of direct biometric measurements are obtained to evaluate the smile at the beginning of orthodontic treatment. Static records are intraoral and extraoral photographs routinely taken from patients. All photograph records are static records. The universal standard in extraoral photographs is the frontal view at rest position, frontal smile view, and profile view at rest position.⁶ Although these static views are sufficient for diagnostic evaluation, they are not sufficient for display and quantitative evaluation of the smile. For smile evaluation, photographic records should include the more advanced techniques of dynamic records and direct biometric measurements. Dynamic records are obtained by digital videography method, while direct biometric measurements are made on close-up smile photographs.⁷

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Sarver and Ackerman⁷ suggest inclusion of smile from profile, 3/4 smile, close-up frontal smile, and close-up 3/4 smile to the standard 3 extraoral photographs for a better evaluation. The “smile index” value created by Ackerman *et al.*⁸ and Ackerman⁹ can be calculated from the close-up frontal smile photograph. This value is obtained by dividing the distance between the commissures by the interlabial distance in the smile. It allows detecting the age-dependent smile changes in the same patient or comparing smiles in different patients.^{8,9}

Tarantili *et al.*,¹⁰ indicated that a single photograph could not be sufficient in esthetic evaluation and orthodontic treatment planning as a result of their study in which they evaluated spontaneous smile dynamically. However, Schabel *et al.*¹¹ evaluated smile esthetics by comparing clinical photography and digital videography. As a result of their study, they reported that digital videography provided too much information in evaluation of the dynamic characteristic of the smile, but the standard digital photography method was still sufficient for evaluation of the smile after treatment.

Dynamic records of smile and speech are obtained by digital videography. Digital video and computer technology allows taking 30 views per second. Sarver and Ackerman⁷ indicate that taking 5-second videos from patients at the beginning and at the end of treatment is sufficient. They suggest saying “*Chelsea eats cheesecake on the Chesapeake*” in English and smiling thereafter during video recording. It is indicated that it is possible to evaluate smiles by selecting the view that is the closest to natural smile from the patient’s video.⁸

McNamara *et al.*¹² evaluated soft and hard tissue factors that affected esthetics with the digital videography method in growing patients who were brought to the clinic for orthodontic treatment. As a result of their study, they concluded that the most important factor affecting a beautiful smile was the vertical width of the lips, and the vertical width of the upper lip was determined by the position of the maxillary incisor.

Dynamic digital video clips also allow us to classify the smile of the patient. According to the classification by Rubin,¹³ there are 3 types of smiles. The first is called “commissure smile” or “Mona Lisa smile,” and the patient’s lip corners move upward depending on the contraction of the *zygomaticus major* muscle. The other one is called “canine smile,” and the entire upper lip moves upward with

smiling. The third type is called “complex smile,” and in addition to the upward movement of the upper lip, the lower lip moves downward.

Direct biometric measurements are, on the other hand, millimetric measurements on a close-up smile photograph that allow the clinician to evaluate the lip-tooth relationship. This evaluation gains importance when reflected in the orthodontic treatment plan. At the same time, it is possible to evaluate age-dependent changes and repeatability of the smile with these measurements. Philtrum and commissura height, distance between lips at rest, visible amount of incisors at rest and while smiling, crown height and gingival display can be calculated with direct biometric measurements.⁷ Among them, maxillary incisor display at rest position is a highly important parameter. Subtelny¹⁴ indicates that if a patient has 3-mm gingival display while smiling or 3-mm incisor display at rest, intrusion of maxillary incisors or maxillary impaction is necessary.

FACTORS AFFECTING IDEAL SMILE

Buccal Corridors

One of the factors that affect the smile is the absence or presence of buccal corridors, in other words, the spaces between buccal surfaces of posterior teeth and lip corners. Numerous studies were conducted to evaluate the factors that affect the buccal corridor width and the relationship between the presence of buccal corridors and smile esthetics.¹⁵⁻¹⁷

Yang *et al.*¹⁸ examined hard and soft tissues affected by buccal corridor width on dental models, lateral cephalograms, and smile photographs. As a result of their study, no difference was detected between extraction and nonextraction treatments in terms of buccal corridor width. However, they examined that the vertical growth pattern of the face, visible amount of the upper incisors, and the total size of the tooth material affected the buccal corridor width and indicated negative correlation.

Maulik and Nanda,³ in their study on dynamic smile in young adults, detected that buccal corridors diminished with rapid maxillary expansion treatment.

In a study of Moore *et al.*,¹⁵ the effects of buccal corridors on the attraction of the smile were evaluated by nonspecialist individuals. At the end of the study, the presence of minimum buccal corridors was found more attractive in both men and women, and the presence of buccal corridors was listed among orthodontic problems.

In another study of Martin *et al.*,¹⁷ the effects of buccal corridors on the attraction of the smile were evaluated by both nonspecialists and orthodontists, and the difference between these 2 groups was investigated. The study showed that both nonspecialists and orthodontists preferred narrow buccal corridors to wider ones. Orthodontists preferred tooth display between first molar and first molar over display between second premolar and second premolar in terms of attraction during smiling, while nonspecialists found tooth display between second premolar and second premolar more attractive. Unlike nonspecialists, orthodontists marked asymmetric smiles as less attractive than symmetric smiles.

Parekh *et al.*¹⁶ studied the effects of both the smile line and variations of buccal corridors on smile attraction in both men and women on nonspecialists and orthodontists. As a result, both groups found the smiles in which the smile line was parallel to the lower lip and the buccal corridors were at minimum more attractive. Less attractive smiles were those in which the smile line was flatter against the lower lip and the buccal corridors were wide. Accordingly, it was concluded that attention should be paid not to make the smile line flatter with orthodontic treatment. On the contrary, it was also concluded that flattening of the smile line reduced the undesired unesthetic effects of wide buccal corridors.

loi *et al.*,¹⁹ in their study on orthodontists and dentistry students, preferred wide smiles with narrow buccal corridors over narrow- and medium-grade smiles with wide buccal corridors.

In another study on Korean and Japanese dentistry students, loi *et al.*²⁰ evaluated the effects of buccal corridors on smile esthetics and compared the opinions of 2 groups. Similar to the results of other studies, they indicated that both groups preferred wide smiles over narrow- and medium-grade smiles.

Ritter *et al.*²¹ evaluated the effects of buccal corridors on esthetics in smile photographs by comparing the opinions of orthodontists and nonspecialists. However, they concluded that these negative spaces did not affect esthetic evaluation in smile photographs in contrast with the previous studies.^{15-17,19,20}

Roden-Johnson *et al.*²² also concluded that the presence of buccal corridors did not affect smile esthetics in their study on both orthodontists and nonspecialists. They also evaluated the effect of the arch form on smile esthetics and obtained differenc-

es between groups. While dentists found smiles with wide arches more attractive than smiles of individuals who did not receive treatment, orthodontists found the smiles of individuals with wide arches more attractive than those of individuals who had narrow arches and did not receive treatment. Nonspecialists, on the other hand, did not prefer any of these arch forms.

Gingival Display

One of the factors that affect the smile is the amount of gingival display during smiling. Increase of gingival display is called "gummy smile." "Gummy smile" is an undesired condition in an ideal smile. "Gummy smile" can occur due to vertical overgrowing of the maxilla, increase in overjet and overbite, and short length of the upper lip or incisor crowns.²³ However, Peck and Kataja²⁴ and Peck *et al.*²⁵ reported in their study that the length of the upper lip and crown length of incisors did not affect "gummy smile."

Polo²⁶ aimed to provide neuromuscular correction by using *Botulinum* toxin type A, in other words the Botox substance, thus providing smile esthetics by reducing the excessive gingival display in "gummy smile" cases with hyperfunction of the muscles contracting the upper lip upward during smiling. He injected *Botulinum* toxin type A under sterile conditions to 30 patients with "gummy smile." He made the injections in the right and left half of the face in the *levator labii superius alaeque nasi* muscle, the *levator labii superius* muscle, and the *zygomaticus minor* muscle. He examined his patients at weeks 2, 4, 8, 12, 16, 20, and 24 and evaluated the change in the amount of gingival display. Recurrence was observed starting from the second week, but no recovery to the initial position was provided. According to the result of this study, it can be concluded that Botox injections can be highly effective in the correction of "gummy smile" cases induced by hyperfunction of the muscles contracting the upper lip upward during smiling. However, it should be kept in mind that a certain part of the effect is temporary.

Numerous studies were conducted with an aim to evaluate the relation between the gingival display and smile esthetics.²⁷⁻²⁹ loi *et al.*,²⁷ evaluated the effects of the amount of gingival display on smile esthetics and reviewed the differences between the opinions of orthodontists and dentistry students as well as between male and female participants. The gingival display varied between -5 mm and +5 mm

in the evaluated smile photographs. The results of the study showed that while no difference was obtained between male and female participants, certain differences were noted between the opinions of orthodontists and dentistry students. The students were found to be less tolerant against "gummy smile." That is to say, while orthodontists found 0 mm gingival display the most attractive, dentistry students found the smile in which the lip covered the upper incisor teeth by 2 mm the most attractive.

Hunt *et al.*²⁸ examined the effect of gingival display on smile esthetics and attraction on nonspecialists. The visible amount of gingiva varied between -2 mm and +4 mm in the photographs they used. The results showed that the smiles in which all the incisors were visible and the gingival visibility was 0 mm were found to be the most attractive ones. The smiles in which the gum was visible by more than 2 mm were classified as less attractive.

Geron and Atalia²⁹ evaluated the effects of both maxillary and mandibular gingival display and the incisal plane inclination on smile esthetics. They also evaluated the difference between opinions of male and female participants. According to the results of the study, gingival display was considered esthetic at 0 mm in the lower incisors and up to 1 mm in the upper incisors. Asymmetric inclinations (cant) up to 2 mm on the incisal plane were considered esthetic. Female participants gave higher points for gingival display in maxillary incisors. According to this result, female participants were found to be more tolerant to gingival display.

Arch Width

The arch width is another factor that affects smile esthetics. It is suggested that smile esthetics can be modified depending on the contraction of the arch due to extraction and nonextraction orthodontic treatments. Various studies were made in this context.³⁰⁻³⁴ Witzig and Spahl³⁰ and Dierkes³¹ claim that dental arches get contracted in extraction cases and thus, the smile esthetics reduces. Johnson and Smith³² indicate that dental view during smile and smile esthetics are similar in extraction and non-extraction treatment patients.

Kim and Gianelly³³ evaluated the arch width and smile esthetics on dental models and frontal photographs in extraction and nonextraction orthodontic treatment patients. As a result of their study,

they concluded that contraction of dental arches was not a routine result of extraction treatments and thus, neither extraction nor nonextraction orthodontic treatments affected the smile esthetics.

Işıkşal *et al.*³⁴ evaluated smile esthetics in individuals who received and did not receive orthodontic treatment. They included in their study 25 extraction orthodontic treatment patients, 25 nonextraction orthodontic treatment patients, and 25 individuals with ideal occlusion who did not receive orthodontic treatment and evaluated opinions of orthodontists, plastic surgeons, artists, dentists, and parents of patients. As a result of the study, no difference was obtained between the individuals with ideal occlusion who did not receive orthodontic treatment and individuals with Class 1 relation by receiving extraction or nonextraction treatment in terms of smile esthetics. They indicated that the transversal character of smile had little effect on attraction. However, they reported that maxillary gingival display and anterior teeth positions had an important effect on smile esthetics.

Tooth Shape

Another factor that affects smile esthetics is the shape of the tooth. Various opinions have been asserted on tooth shape until now. For instance, Williams³⁵ indicated that the tooth shape should be evaluated along with the facial form. However, the opinion of choosing the tooth shape depending on the facial form is not supported in the literature. At the same time, numerous studies did not find any correlation between a present or artificial tooth shape and the form of the face.³⁶⁻³⁸ Another opinion that was popular in the past is using soft-edged, round-shaped teeth for women and angled, square-shaped teeth for men.^{39,40} Studies in this context are limited today. Anderson *et al.*⁴¹ evaluated the relation between an esthetic smile and tooth shapes by comparing the opinions of restorative dentists, orthodontists, and nonspecialists. Orthodontists found the smiles of women with round and round-square formed incisors more attractive, and restorative dentists preferred those with round incisors. Nonspecialist individuals did not distinguish between the incisor forms. In men, all 3 groups found the smiles with square-round formed incisors more esthetic. At the same time, independent of the tooth form, all 3 groups found the smiles of female patients more attractive than those of men.

Asymmetries

Dental asymmetries affect the smile esthetics negatively. However, studies in this field are limited. One of them is the study conducted by Pinho *et al.*⁴² on orthodontists, prosthodontists, and nonspecialists. In this study, asymmetry of the maxillary incisor in the gingival margin of the tooth, asymmetry due to wear of the cusp tip of the canine, and asymmetry due to dental midline shift were evaluated, and the effects of these conditions on smile esthetics were reviewed. Differences were obtained as a result of the study. While orthodontists and prosthodontists indicated that the asymmetry of 0.5 mm in the gingival margin of the maxillary incisor affected the smile esthetics, this value was 2 mm for nonspecialist individuals. All 3 groups were of the opinion that wear of the cusp tip of the maxillary canine did not affect the smile esthetics. For the dental midline shift, orthodontists indicated that 1 mm or higher values negatively affected the smile esthetics, and prosthodontists indicated that 3 mm or higher values negatively affected the smile esthetics. Nonspecialists did not distinguish the dental midline shift. According to the result of this study, considering the difference between the opinions of the groups, it was concluded that the patient's opinion should also be taken into account in orthodontic treatment planning.

Age

Age has become one of the factors that affect smiling and smile esthetics due to changes it brings in the mouth and facial area. Geld *et al.*⁴³ examined individuals from 3 different age groups (20–25 years, 35–40 years, and 50–55 years) at rest position, during spontaneous smiling, and during speech with the digital videography method and evaluated the changes and effects of aging on both upper and lower lips. As a result of the study, they reported that the height of the maxillary lip line was reduced in both cases, and this decrease was about 2 mm in spontaneous smile. The lip line height was measured as the visible gingival height in the anterior maxilla during smile, speech, or at rest position. Other changes observed with aging were determined as increase in mandibular incisor display at rest position, increase in the upper lip length by 4 mm, and thus, decrease in the maxillary teeth display during smiling. Considering these results, it can be concluded that smile esthetics is negatively affected by aging. Orthodontic treatment should be

planned by taking the changes brought by aging into account.

Desai *et al.*⁴⁴ examined the effects of aging with the digital videography method. In their study, they evaluated the upper lip length and upper lip width during smile and at rest, maxillary incisor display and the amount of interlabial space during smile, presence of buccal corridors, the distance between the commissures at rest, the smile height, the smile line, and the smile index. They executed these examinations on 5 groups separated by age range (15–19 years, 20–29 years, 30–39 years, 40–49 years, 50 years and over). According to the results of the study, the maxillary incisor display diminished by about 1.5–2 mm by increased age. Again depending on aging, the smile index (the distance between the commissures during smile/interlabial space) increased significantly; in other words, the smile contracted vertically and enlarged transversally. No individual at 50 years of age or over had a high smile, and none of the individuals from the age group of 15–19 years was found to have low smile. Considering all of the dynamic measurements in this study, it can be concluded that sufficiency of the muscles that allow the smile decreases by increasing age.

CONCLUSION

A vast number of studies have revealed that smile esthetics is affected by the width of buccal corridors, gingival display, arch width, tooth shape, dental asymmetries, and age factors. These findings indicate that providing a good functional occlusion is not sufficient alone to obtain satisfactory results with orthodontic treatments. Consequently, it is necessary to provide smile esthetics that is appreciated by the patients much more today and to include the factors affecting smile esthetics in orthodontic treatment planning accordingly.

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