Influence of Sex on the Perception of Oral and Smile Esthetics with Different Gingival Display and Incisal Plane Inclination

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Abstract: This study was designed to determine the esthetic perception of men and women to variations in upper and lower gingival display at smile and speech and to incisal plane tilting. Composed photographs of smile and speech with varying amounts of gingival exposure of the upper and lower teeth and gingiva at smile and at speech and with varying degrees of incisal plane tilting were rated for attractiveness by two groups of lay people. The images were presented as male or female images. A total of 300 questionnaires, including 7500 images, were evaluated by 100 subjects. The results showed that images were scored as less attractive as the amount of upper and lower gingival display was increased during smile and speech. The amount of gingival exposure graded in the esthetic range was up to one mm for the upper incisors and zero mm for the lower incisors. Incisal plane tilting was graded as unesthetic when above two degrees of deviation from the horizontal. Male and female evaluators scored images differently with upper gingival exposure. Female evaluators gave statistically significant higher scores than male evaluators to upper gingival exposure images at smile and speech of both males and females, suggesting that females are more tolerant of upper gingival exposure. Images were scored differently when presented as male or female images. Female images were scored lower by both male and female evaluators, suggesting that additional efforts should be taken in female patients to achieve an esthetic result. (Angle Orthod 2005;75:778-784.)

Key Words: Gummy smile; Esthetic orthodontics

INTRODUCTION

One of the most important aspects of dental and facial esthetics is the vertical anterior tooth display.¹ Esthetic judgment is made by viewing the patient from the front in dynamic states like conversation, facial expressions, and smiling.

Tjan and Miller² in a study of the full smiles of 454 students, aged 20–30 years, divided the smile line into three types: a high smile line, revealing the complete

maxillary incisors and a continuous band of the gingiva; an average smile, revealing 75–100% of the maxillary incisors; and a low smile, revealing less than 75% of the maxillary incisors.

The high smile line, defined as gingival smile line (GSL) or gummy smile (GS), commonly provokes strong concern from clinicians. Orthodontists and surgeons are conditioned to see a GS as esthetically undesirable.^{3,4} Treatment alternatives of GS include various combinations of orthodontics periodontal and surgical therapy, depending on the diagnosis of the GS.

Because the effective correction of excessive gingival display is not a conservative orthodontic treatment, but a combined interdisciplinary treatment,⁵⁻⁷ or sometimes an invasive surgical procedure, the most important factor to be considered is whether the GS should be treated or not. As Peck and Peck⁸ claimed "We orthodontists tend to forget that facial esthetics is a subject that interests all people everywhere, and the ultimate source of esthetic values should be the people and not just ourselves."

The GS is not necessarily unesthetic in the eyes of

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Evaluators Sex	Male			Female		
Images Sex	Male	Female	Total	Male	Female	Total
Number of evaluators	26	24	50	23	27	50
Evaluators mean age	36.0000	26.5000	31.4400	39.0000	26.3333	32.1600
SD	14.02854	11.56456	13.64441	12.76002	11.80613	13.70142

TABLE 1. Description of Evaluators

the public. Many actors, models, and beauty contestants, especially women, expose gingival tissue at smile and are still considered beautiful people with beautiful smiles. Kokich et al⁹ used female smiles and found that lay people were unable to detect an incisal plane tilting until it was three mm, and gingival exposure was classified as noticeable unattractive only at four mm.

The dilemma whether to treat the GS or not is further emphasized by the effect of aging on gingival display. The lip coverage of the maxillary incisors tends to increase with age,¹⁰ and high smiles will normally diminish with age.¹¹ Therefore, the GSL may be considered a youthful characteristic. The increased lip coverage of the upper incisors with age improves the smile esthetics of individuals with GSL while deteriorating the oral esthetics of intermediate or low smile lines creating less exposure of the incisors and an older appearance. The effect of aging on the lower gingival display is the opposite, with the lower gingival display increasing with age.¹²

Another aspect of the dilemma of treating GSL is the probable sex difference. According to van der Geld and van Waas's literature search,¹³ it appears that the smile line was, on average, situated higher among women than among men.

A social aspect of the GSL subject that has not been studied yet is a possible difference between men and women in the perception of oral esthetics of each of the two sexes.

Therefore, the purpose of this study is to compare the perception of oral esthetics of men and women, during smile and speech, evaluated by men and women lay evaluators, in different gingival display situations above upper incisors and below lower incisors and in different angles of incisor plane inclination.

MATERIALS AND METHODS

A total of 75 virtual pictures composed of photographs of lips superimposed on photographs of teeth were included in the study. Two different photographs of lips were used, one at smile and the other during speech saying the syllable "Shaa." One photograph of the dentition with good dental alignment and symmetry was used for all the pictures. Computer software developed for this study modified the pictures by moving the teeth within the lip frame.

The pictures were divided into three groups, each including 25 pictures.

The first group, defined as the smile group (G1), included 25 images with the lip frame performing a social smile. The pictures were modified by moving the teeth within the lip frame by one-third mm from picture to picture, beginning with maximal lower incisors gingival exposure of two mm to maximal upper incisors gingival exposure of 3.3 mm.

The second group, defined as the speech group (G2), included 25 images with the lip frame during speech saying the syllable Shaa. The pictures were modified by moving the teeth within the lip frame the same way as in the previous group.

The third group, defined as the incisor plane tilting group (G3), included 25 images with the lip frame performing a social smile. The pictures were modified by rotating the dentition from a parallel position to the upper lip margin, in one-third degree increments from zero inclination to four degrees in both clockwise and counterclockwise directions. Zero inclination was defined as parallelism of the line connecting the most gingival point of the upper lateral incisors' crowns to the upper lip margin. Rotation of the dentition was performed around the midpoint of this line.

The images were randomized and rated for attractiveness by two groups of lay people. The evaluators were adult, middle-class lay people who came for routine dental treatment in two dental offices. One group of 51 evaluators (27 females and 24 males) were asked to judge the images for attractiveness as female photographs ("female"), and the other 49 (23 females and 26 males) were asked to judge the images for attractiveness as male photographs ("male"). The evaluators had to score each image on a 1 to 10 esthetics scale. Grade 1 is least acceptable esthetically, and grade 10 is the most acceptable esthetically. A total of 300 questionnaires, including 7500 images, were evaluated by 100 lay subjects. Table 1 describes the age and the sex of the evaluators.

Statistics

Descriptive statistics included means and standard deviations. Two-way analysis of variance (ANOVA)



FIGURE 1. Smile scores by all evaluators to all evaluated images: gingival exposure (in -mm) and lip coverage (in +mm).



FIGURE 2. Speech scores by all evaluators to all evaluated images: gingival exposure (in -mm) and lip coverage (in +mm).

with repeated measures tests were conducted on the scores given by the evaluators to examine the influences of sex of the evaluator and the sex of the evaluated images on the perception of attractiveness. Cluster analysis was used to identify the most attractive and the least attractive images. Age differences between evaluators of female images and evaluators of male images were tested by *t*-test. The correlations between age and scores were tested using Pearson's correlation coefficients.

The scores were also standardized to overcome the influences of subjective tendency of generosity or miserliness and differences of range in scoring by the following formula:

Standardized score = (actual score - average

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score)/standard deviation. These scores were used for testing attractiveness of all images by all evaluators.

RESULTS

The evaluators of female images were significantly younger than the evaluators of the male images (P < .001); however, no significant correlation was found between the age of the evaluator and the evaluation scores.

Figures 1 through 3 demonstrate the standardized mean scores given by the evaluators to each of the 25 images of both female and male images in the smile group (Figure 1), speech group (Figure 2), and incisor plane inclination group (Figure 3).



FIGURE 3. Incisor plane inclination scores by all evaluators to all evaluated images. Incisor plane inclination: clockwise rotation (in -degrees) and counterclockwise (in +degrees).



FIGURE 4. Image 12 with the highest attractiveness score.

According to cluster analysis and as can be demonstrated from Figure 1, the most attractive smile images (standardized mean above 0.5) are images 9– 14, representing lip coverage around zero to two mm of the upper central incisors and one to 2.6 mm lip coverage of the lower central incisors' crown. The highest mean score for smile was given to image 12 (Figure 4), which presents lip coverage about 0.5 mm of the maxillary central incisors' crown and lower lip coverage of about two mm of the mandibular lower central incisors' crowns.

The unattractive images are those with lower gingival exposure of the mandibular central incisors' crowns above zero (Figure 5) and images with exposure of at least one mm of gingiva above the maxillary central incisors' crowns (Figure 6).

The most attractive speech images (standardized mean above 0.5) are images 9–15 (Figure 2), representing images with around 0–2 mm lip coverage of the upper central incisors' crowns and 1–3 mm lip coverage of the lower central incisors' crowns.

The highest mean score for speech images was giv-



FIGURE 5. Exposure of more than a third of the papilla below the mandibular incisors.



FIGURE 6. Exposure of more than 1.5 mm of gingiva above the maxillary incisors.

en to image 12 (Figure 2), which presents lip coverage of about 0.5 mm of the maxillary central incisors' crowns and about two mm of the lower central incisors' crowns (Figure 7).

Tilting of the incisal plane was noticed, according to Figure 3, only for images 20–25 and images 1, 2, and 6 (standardized mean below zero), with more than two

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FIGURE 7. The highest attractiveness score during speech was given to image 12.

degrees of deviation from parallelism to both clockwise and counterclockwise rotation.

Table 2 and Figure 8 describe the differences in scoring of male and female smile images. The images were statistically examined all together as one group of images and separately for the group of images presenting upper or lower gingival exposure (above zero). Gingival exposure was defined as the position of the lip at the gingival border of the upper or lower central incisors or more apically.

The results show that all female images were given lower scores than male images. The differences were statistically significant for images that showed upper gingival exposure of 0–3.3 mm (P = .021), for images that showed lower gingival exposure of 0–2 mm (P = .045), and also for the combined group of all smile images including those with lip coverage of the upper and lower incisors (P = .001).

Lower scores for female images were also given to most of the images in the incisor plane inclination questionnaire (23 of 25 images) and for the speech images in the esthetic acceptable range (images with standardized mean scoring above zero). For the speech and cant images, these differences were not statistically significant.

Table 3 describes the differences between male and female evaluators in scoring maxillary gingival exposure at smile of male and female images. Two-way ANOVA revealed significant effects of the sex of the evaluator on the scores (P = .029). Male evaluators gave statistically significant lower scores than female evaluators to upper gingival exposure images, and fe-





FIGURE 8. Smile images mean scores by sex of the evaluated image.

TABLE 3. Comparison of Maxillary Gingival Exposure Scoring by the Sex of the Evaluator

Maxillary Gingival Exposure at Smile (0–3.3 mm)	Mean Score for Female Images	Mean Score for Male Images	Mean Score for Male and Female Images
Male evaluators Female evaluators	$\begin{array}{r} 3.41 \pm 1.48 \\ 3.95 \pm 1.48 \end{array}$	$\begin{array}{r} 3.99\ \pm\ 1.62\\ 4.88\ \pm\ 1.86\end{array}$	$\begin{array}{c} 3.71 \pm 1.56 \\ 4.88 \pm 1.71 \end{array}$



FIGURE 9. Smile images mean scores by sex of the evaluator and sex of the evaluated image.

male images were given statistically significant lower scores than the same male images by both male and female evaluators (Table 3).

Figure 9 describes graphically that the highest scores for upper gingival exposure (images 19–25)

	Upper Gingival Exposure (0–3.3 mm) Mean Score ± SD	Lower Gingival Exposure (0–2 mm) Mean Score ± SD	All Smile Images Mean Score \pm SD
Male images	4.41 ± 1.78	4.78 ± 1.90	5.71 ± 1.29
Female images	3.69 ± 1.48	4.06 ± 1.51	4.92 ± 0.99
Р	.021	.045	.001

were given by female evaluators to male images, and the lowest scores to upper gingival exposure were given by male evaluators to female images. However, the interaction between the sex of the evaluator and the sex of the evaluated image in scoring was of no statistical significance (P = .597).

For lower gingival exposure (images 1–4), male evaluators gave about the same scores to male and female images, whereas female evaluators gave higher scores to male images compared with female images. This interaction between the sex of the evaluator and the sex of the evaluated images was of borderline statistical significance.

DISCUSSION

Several studies and articles are focused on creating standards for "smile analysis."^{14–18} Most of the studies that evaluated oral and dental esthetics used heterogenic groups of females and males as evaluators,⁹ and usually, a female smile was evaluated.

This study focused on two specific aspects of smile esthetics: the amount of upper and lower gingival exposure in dynamic states of smile and speech and the incisal plane tilting. The uniqueness of this study is the differentiation by the sex of the evaluator and by the sex of the evaluated image.

Peck et al⁴ and Tjan and Miller² found that low smile lines are a predominantly male characteristic (2.5 to one male to female) and a high smile line is predominantly female (two to one female to male). Vig and Brundo¹⁰ found sexual dimorphism. Maxillary anterior tooth display was found almost twice as often in women as in men, the men displayed much more of the mandibular incisors, and females were found to be twice as likely as males to have a GS.

Because of the sexual dimorphism in the smile line, we expected that the perception of esthetics will be dependent on the development of a "form concept."⁸ The meaning of the form concept is that the more frequent we observe a particular facial pattern, the more likely we perceive it as "correct." We expected that upper excessive gingival display will be more acceptable as esthetic for female images, whereas lower excessive gingival display will be more acceptable for male images. This hypothesis was not confirmed in our study. Images were scored as less attractive as the amount of upper and lower gingival display was increased during smile and speech for both sexes of images.

However, evaluation of speech and smile esthetics was very much dependent on the sex of the evaluator. The results indicate that upper excessive gingival display is more accepted by female evaluators as an esthetic feature for both female and male images. It means that females, that may include female orthodontists, are more tolerant to upper gingival exposure, which is a more predominant feature in women.

The perception of dental and smile esthetics was also dependent on the sex of the evaluated image. Although female and male images were the same images, presented to the evaluators as different images, female images were given lower scores than male images for each of the 25 smile images, for most of the images in the incisor plane inclination questionnaire, and for the speech images in the acceptable range. These results suggest that higher oral and dental attractiveness is expected from women than from men, by both sexes.

The evaluators had difficulty in scoring the incisor plane inclination images. Tilting of the incisal plane was noticed, according to Figure 3, only for images with more than two degrees of deviation from parallelism to both clockwise and counterclockwise rotation. Scoring was also influenced dramatically by the amount of tilting of the previous image. This seems to be the reason for scoring above the standardized mean of images 3 to 5.

The amount of upper gingival display detected as unesthetic at smile and speech in our study was one mm above the maxillary central incisors' gingival border. This result is close to the findings of Peck et al⁴ who compared 27 men and women with very prominent gingival smiles, defined as two mm or more of maxillary gingival exposure above the central incisor at maximum smile. Kokich et al⁹ evaluated female smiles and found that three mm of gingival display was considered as unesthetic by the lay people. The difference in the results may be attributed to variations in the esthetic views of different populations.

In our study, the results show that any level of lower gingival display below the mandibular incisors' crowns was considered unacceptable as well. The low scoring of images with exposure of lower teeth and gingiva could be expected because exposure of lower teeth and gingiva is a sign of aging¹².

The results of our study suggest that the orthodontic treatment that is focused on esthetics should take special care of female patients, who are more esthetically criticized by both females and males. Gingival exposure was found an unesthetic feature, especially in the lower arch and above one mm in the upper.

However, because the amount of gingival display that is acceptable esthetically can vary widely, the patient's view and preferences should be the major parameter in the decision-making process of treatment planning.

CONCLUSIONS

• Female smile images were scored lower by both male and female evaluators, suggesting that higher

oral and dental attractiveness is expected from women than from men.

- Upper gingival exposure at smile and speech was graded in the esthetic range up to one mm. The esthetic range for the lower incisor exposure was with no gingival exposure at all.
- Images were scored less attractive as the amount of upper and lower gingival display was increased during smile and speech.
- Incisal plane tilting was graded as unesthetic with above two degrees of deviation from the horizontal in both directions.

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