Influence of gingival exposure on the smile esthetics*

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Abstract

Objective: The purpose of this study was to evaluate the influence of gingival exposure on smile esthetics and to compare different opinions among orthodontists, clinicians and laypersons. **Methods:** Photographs of smiling faces of a male and a female subject were manipulated on the computer with different gingival exposure levels, ranging from 4 mm of gingival exposure to 4 mm of upper lip incisor coverage. The photographs were printed in actual size of the face, and randomly analyzed by 30 orthodontists, 30 clinicians and 30 laypersons. The faces were rated as very poor, poor, regular, good and very good according to the smile attractiveness. **Results:** The most attractive female smile, judged by the orthodontists, clinicians and laypersons, was the one where the upper lip rests on the gingival margin of the upper incisor, showing the whole incisor crown (P≤0.05). For the male subject, the most attractive smile according to laypersons, was the one with the upper lip resting on the gingival margin of the crown of the maxillary incisor; while orthodontists and clinicians considered both the upper lip on the gingival margin of the maxillary incisor's crown and 2 mm upper lip incisor coverage as the most esthetics (P≤0.05). **Conclusion:** Smile attractiveness is influenced by the gingival exposure, and different opinions are observed among orthodontists, clinicians and laypersons.

Keywords: Esthetics. Smile. Gingival exposure.

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INTRODUCTION

The smile is one of the most important facial expressions and essential for expressing joy, pleasure, mood and gratefulness.[10] The quantity of dental and gingival vertical exposure during smiling is one of the characteristics of interest for smile esthetics.[13]

Gingival smile occurs due to a combination of variables such as: Maxillary vertical excess, high muscular ability to elevate the superior lip when smiling, increased interlabial spacing during resting, and increased overjet and overbite. Variables like upper lip length, clinical crown length, and angles of the mandibular and palatal planes do not seem to influence on the gingival smile.[10] On the other hand, short upper lip and short clinic crown length may contribute for gingival exposure.[4]

Depending on diagnosis, gingival smile treatment may rely on orthodontic, periodontal and surgical therapies.[2]

Although many orthodontists and clinicians consider gingival smiles as non-desired,[7,10] this characteristic might not necessarily be unaesthetic to the public eyes.[2,4] The aim of the present study was to assess which level of gingival exposure is considered more esthetic for males and females, and to compare the differences in opinion among orthodontists, clinicians and laypersons in relation to the gingival exposure for the smile esthetics.

MATERIAL AND METHODS

One female (FS), 21 year-old, and one male (MS), 23 year-old, students of dentistry at the UFSC, presenting aligned teeth and balanced facial proportions were selected for this research. The informed consent was obtained. Color photographs were obtained of full face in frontal view and with spontaneous smile, using a Canon Rebel XT (Japan) camera. The original photographs were manipulated with the software Adobe Photoshop CS 8.0, and the resting position of the upper lip in relation to the maxillary incisors was modified. These modifications provided 5 levels of gingival exposure, being: 4 mm coverage of the maxillary incisors by the upper lip measured from the gingival margin (-4 mm); 2 mm coverage of the maxillary incisors by the upper lip (-2 mm); upper lip at the level of the maxillary incisors gingival margin (0 mm); 2 mm gingival exposure (+2 mm), and 4 mm gingival exposure (+4 mm) (Figs 1 and 2). The ten photographs, five from each individual, were printed in actual size of the face and were randomly organized and interposed in an album.

Evaluators were composed of 90 people, being 30 orthodontists, 30 clinicians and 30 laypersons. Photographs were evaluated through a questionnaire following 5 esthetics interpretations: Very poor, poor, regular, good and very good (Table 1). The mean age of the orthodontists was 37.6 years (minimum of 23 and maximum of 53 years). The clinicians presented mean age of 29.8 years (minimum of 21 and maximum of 45 years); while the laypersons group (no dental academic education) presented mean age of 33.9 years (minimum of 18 and maximum of 52 years).

STATISTICAL METHODOLOGY

A descriptive analysis of the evaluated photographs was performed and one score was created for each evaluation (Table 1), which was used in the statistical analysis.

Three-way ANOVA for repeated measures assessed possible statistical differences and interactions among the level of gingival exposure (-4 mm, -2 mm, 0 mm, 2 mm, 4 mm), the evaluator category (orthodontist, clinician and layperson) and the gender of the evaluated subject (male or female). The evaluated photographs were paired in relation to the evaluator. T-test was later performed for the variables presenting statistical difference through ANOVA, aiming to perform a more detailed analysis through a two

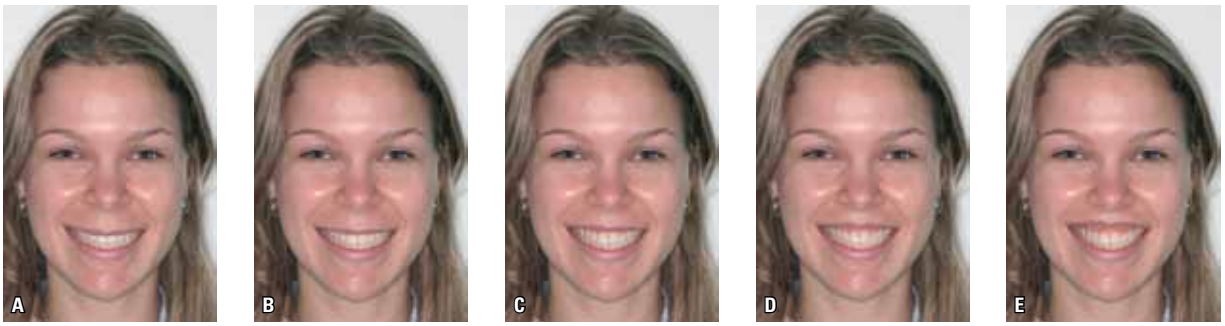

FIGURE 1 - FS photographs. **A**) -4 mm, **B**) -2 mm, **C**) 0 mm, **D**) +2 mm, **E**) +4 mm.

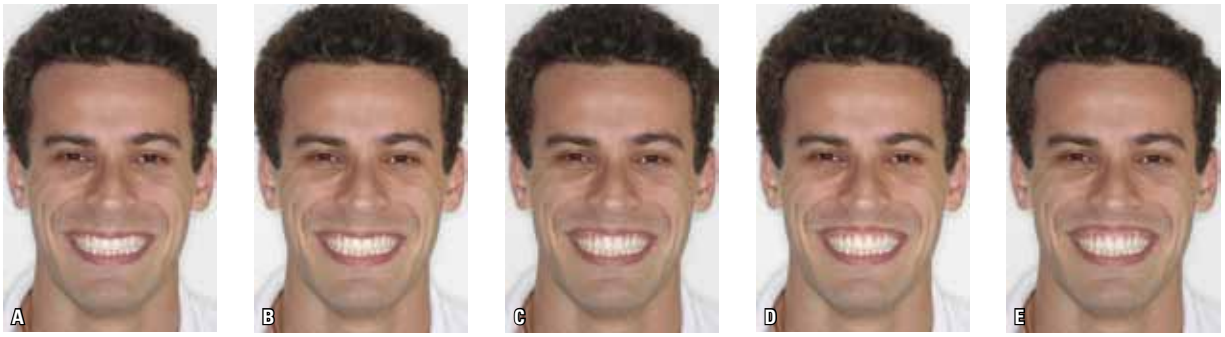

FIGURE 2 - MS photographs. **A**) -4 mm, **B**) -2 mm, **C**) 0 mm, **D**) +2 mm, **E**) +4 mm.

Photograph evaluation	Score
Very poor	1
Poor	2
Regular	3
Good	4
Very good	5

TABLE 1 - Scores used by the evaluators for each photograph.

by two comparison of the means. The significance level was set at 5% for both tests (P≤ 0.05).

RESULTS

Table 2 shows the frequency of evaluations and mean scores resulting from these frequencies.

Interactions among gender, gingival exposure and evaluator were assessed by means of ANOVA F test at the level of significance of 5% (P<0.05). Multiple comparisons test was employed to assess these interactions (Table 3).

Table 4 presents the comparison among the gingival exposure evaluations for each evaluator category, obtained from the FS and MS photographs. The t test was employed for data analysis.

DISCUSSION

The present results (Tables 3 and 4) showed that orthodontists, clinicians and laypersons considered the smile with the upper lip resting on the gingival margin of the maxillary incisors (0 mm) as being the most esthetic for the female subject (FS) (P<0.05). On the other hand, for the male subject (MS), laypersons considered the most esthetic smile the one with upper lip at the level of gingival margin of the maxillary incisors (0 mm), while orthodontists and clinicians considered more esthetic the smiles with upper lip resting at the gingival margin (0 mm) or covering the maxillary incisors in 2 mm (P<0.05).

TABLE 2 - Descriptive analysis for each gingival exposure and each group of evaluator, for the analysis of the female (FS) and the male subject (MS) photographs.

	Gingival Exposure	Type of Evaluation	Frequency of Evaluations					Scores Mean±SD
			Very poor	Poor	Regular	Good	Very good	
FS	-4 mm	Orthodontist	8	19	3	0	0	1.83±0.59
		Clinician	13	10	2	5	0	1.97±1.10
		Layperson	6	13	8	3	0	2.27±0.91
	-2 mm	Orthodontist	3	11	12	4	0	2.57±0.86
		Clinician	1	11	8	10	0	2.90±0.92
		Layperson	0	7	11	9	3	3.27±0.94
	0 mm	Orthodontist	0	1	2	14	13	4.30±0.75
		Clinician	0	1	4	14	11	4.17±0.79
		Layperson	0	1	1	14	14	4.37±0.72
	+2 mm	Orthodontist	1	4	11	14	0	3.27±0.83
		Clinician	0	2	8	16	4	3.73±0.78
		Layperson	1	1	5	15	8	3.93±0.94
	+4 mm	Orthodontist	12	11	4	2	1	1.97±1.07
		Clinician	12	13	2	3	0	1.87±0.94
		Layperson	6	10	7	7	0	2.50±1.07
MS	-4 mm	Orthodontist	1	7	15	5	2	3.00±0.91
		Clinician	1	9	12	8	0	2.90±0.84
		Layperson	1	5	11	10	3	3.30±0.99
	-2 mm	Orthodontist	0	5	12	11	2	3.33±0.84
		Clinician	0	7	13	6	4	3.23±0.97
		Layperson	0	4	10	12	4	3.53±0.90
	0 mm	Orthodontist	0	1	10	15	4	3.73±0.74
		Clinician	0	2	11	15	2	3.57±0.73
		Layperson	0	2	6	14	8	3.93±0.87
	+2 mm	Orthodontist	2	6	11	7	4	3.17±1.12
		Clinician	3	13	9	4	1	2.57±0.97
		Layperson	2	8	11	8	1	2.93±0.98
	+4 mm	Orthodontist	10	13	5	2	0	1.97±0.89
		Clinician	14	13	1	1	1	1.73±0.94
		Layperson	9	13	6	1	1	2.07±0.98

Another study assessed 454 smiles of 20-30 year-old students.[15] Smiles were divided into three groups: High smile, the one exposing the whole gingivo-incisal length of the incisors crowns and a continuous area of gingiva; mean smile, revealing 75 to 100% of the maxillary incisors crown and the interproximal gingiva; low smile, revealing less than 75% of the maxillary anterior teeth. The most esthetics results were detected for the mean smile, with total exposure of the incisors' crowns and interproximal gingiva.

Chiche and Pinault[1] reported that exposure of the whole crown of maxillary incisors and

TABLE 3 - Mean scores of the evaluations according to evaluator type, gingival exposure and gender. The statistical significance was determined by the t test.

Gingival exposure	Photographs	Orthodontist Mean±SD	Clinician Mean±SD	Layperson Mean±SD
-4 mm	FS	1.83±0.59 ^{Aa}	1.97±1.10 ^{Aa}	2.27±0.91 ^{Aa}
	MS	3.00±0.91 ^{Ab}	2.90±0.84 ^{Ab}	3.30±0.99 ^{Ab}
-2 mm	FS	2.57±0.86 ^{Aa}	2.90±0.92 ^{ABa}	3.27±0.94 ^{Ba}
	MS	3.33±0.84 ^{Ab}	3.23±0.97 ^{Aa}	3.53±0.90 ^{Ab}
0 mm	FS	4.30±0.75 ^{Aa}	4.17±0.79 ^{Aa}	4.37±0.72 ^{Aa}
	MS	3.73±0.74 ^{Ab}	3.57±0.73 ^{Ab}	3.93±0.87 ^{Ab}
+2 mm	FS	3.27±0.83 ^{Aa}	3.73±0.78 ^{Ba}	3.93±0.94 ^{Ba}
	MS	3.17±1.12 ^{Aa}	2.57±0.97 ^{Ab}	2.93±0.98 ^{Ab}
+4 mm	FS	1.97±1.07 ^{Aa}	1.87±0.94 ^{Aa}	2.50±1.07 ^{Ba}
	MS	1.97±0.89 ^{Aa}	1.73±0.94 ^{Aa}	2.07±0.98 ^{Ab}

Different UPPERCASE letters indicate statistical difference within the same line, detected by the t test at 5% significance level.
Different LOWERCASE letters indicate statistical difference within the same group of gingival exposure, detected by the t test at 5% significance level.
(FS= Female subject. MS= Male subject).

TABLE 4 - Comparison of gingival exposure mean scores according to gender and evaluator category. The statistical significance was determined by the t test.

Evaluator Category	Photographs	-4 mm Mean±SD	-2 mm Mean±SD	0 mm Mean±SD	+2 mm Mean±SD	+4 mm Mean±SD
Orthodontist	FS	1.83±0.59 ^{a}	2.57±0.86 ^{b}	4.30±0.75 ^{c}	3.27±0.83 ^{d}	1.97±1.07 ^{a}
	MS	3.00±0.91 ^{a}	3.33±0.84 ^{ab}	3.73±0.74 ^{b}	3.17±1.12 ^{a}	1.97±0.89 ^{c}
Clinician	FS	1.97±1.10 ^{a}	2.90±0.92 ^{b}	4.17±0.79 ^{c}	3.73±0.78 ^{d}	1.87±0.94 ^{a}
	MS	2.90±0.84 ^{ac}	3.23±0.97 ^{ab}	3.57±0.73 ^{b}	2.57±0.97 ^{c}	1.73±0.94 ^{d}
Layperson	FS	2.27±0.91 ^{a}	3.27±0.94 ^{b}	4.37±0.72 ^{c}	3.93±0.94 ^{d}	2.50±1.07 ^{a}
	MS	3.30±0.99 ^{a}	3.53±0.90 ^{a}	3.93±0.87 ^{b}	2.93±0.98 ^{c}	2.07±0.98 ^{d}

Different LOWERCASE letters indicate statistical difference within the same line, detected by the t test at 5% significance level. (FS= Female subject. MS= Male subject)

1 mm of gingiva is esthetically ideal. However, 2-3 mm of exposure may be esthetically acceptable. Mackley,[8] studying the evaluation of facial photographs with smiling faces by orthodontists and laypersons, found that more esthetic smiles were those with upper lip at the level of the gingival margin of the maxillary incisors. This fact was also observed by Hulsey[3] in photographs evaluated by laypersons. Hunt et al[4] observed that laypersons determined the most esthetic smile that with no gingival exposure (0 mm); however, the variation between +2 mm to -2 mm was relatively low. Laypersons according to Geron e Atalia,[2] considered maxillary incisors covered 0.5 mm by upper lips as the most esthetic smiles. Kokich et al,[5] found similar results to ours, that laypersons, clinicians and orthodontists found the smile more esthetic when the upper lip rests on the gingival margin (0 mm) or when covering the incisors crown in 2 mm.

For the present study (Tables 3 and 4), smiles with upper lip covering 4 mm of the maxillary incisors' crowns or with 4 mm gingival exposure

were the least esthetic for the female subject according to orthodontists, clinicians and laypersons (P≤0.05). For the male subject, the least esthetic smile was the one presenting 4 mm gingival exposure, through the evaluation of orthodontists, clinicians and laypersons (P≤0.05).

Three and four millimeters gingival exposures were progressively related to less attractive smiles in a study by Hunt et al.[4] Low scores for esthetic smiles were obtained by the study of Hulsey[3] when 2 mm gingival exposure or incisor coverage by the upper lip greater than 2 mm were observed. However, the study did not assess the influence of gingival exposure greater than 2 mm or incisor coverage lower than 2 mm. The measurements varied from 2 mm incisor coverage by the upper lip to 6 mm gingival exposure in another study by Kokich et al[5]. The least esthetic smile in this case was the one associated with 6 mm gingival exposure. According to Geron and Atalia,[2] least attractive smiles presented gingival exposure starting from 1 mm, being 3.3 mm the least esthetic one.

Peck et al[10,11,12] found that 1 mm or greater gingival exposure is a characteristic predominantly observed for female subjects, with a frequency rate of two women for each man. They also found that 2 mm or greater incisor coverage by the upper lip is predominantly observed in male subjects, with a frequency of 2.5 men for each woman. Vig and Brundo[16] also detected sexual dimorphism: Gingival smile and maxillary anterior teeth exposure 2.5 times more frequently observed in women, while men presented 2.5 times more frequent exposure of mandibular incisors in comparison to women. Moreover, the upper lip is positioned 1.5 mm more apically in women than in men.[11] Vig and Brundo[16] stated the sexual dimorphism is also detected with resting lip, as men tend to expose 1.91 mm of the maxillary incisors, compared to 3.40 mm in the female group.

Although the present study did not aim to compare different genders in relation to gingival exposure, but to determine the acceptable levels for each one, photographs with smile presenting incisor coverage by the upper lip received higher scores for the male subject in comparison to the female subject (P≤0.05). The group -2 mm did not differ in relation to gender according to the clinicians. Photographs with gingival exposure and lip resting on the gingival margin (0 mm) received higher scores for the female subject (P≤0.05). On the other hand, when considering the evaluators groups, there was no statistical difference between genders for the group +4 mm when evaluated by clinicians and for the groups +2 mm and +4 mm when evaluated by orthodontists.

No statistical difference was detected in both genders for the 4 mm incisors coverage (Tables 3 and 4) according to orthodontists, clinicians and laypersons. However, the female subject received lower scores in comparison to the male (P≤0.05). The scores were considered bad for the female subject and regular for the male.

For the 2 mm incisors crown coverage (Tables 3 and 4), orthodontists scored lower than laypersons for the female subject (P≤0.05), while no statistical difference was detected for the male subject among orthodontists, clinicians and laypersons. Laypersons and orthodontists scored lower the female subject's photographs in comparison to the male ones (P≤0.05). The scores were between poor and regular for the female subject in our study, similarly as observed by Hulsey,[3] where 2 mm upper lip coverage was considered unaesthetic. However, the assessment of gingival level in this last study varied only from +2 mm to – 2 mm. The same measurements varied from regular to good for the male subject in our study. This was similarly reported by Kokich et al[5] when evaluated by orthodontists, clinicians and laypersons, or when evaluated by laypersons according to Geron and Atalia[2] and Hunt et al.[4]

For the 0 mm group, with the upper lip resting on the gingival margin of the maxillary incisors (Tables 3 and 4), there was no statistical significant difference among orthodontists, clinicians and laypersons; although the female photographs were scored higher in comparison to the male photographs (P≤0.05). The 0 mm measurement was considered between good and very good for the female subject and between regular and good for the male subject. Smile with lip resting on the gingival margin was considered esthetic by laypersons, clinicians and orthodontists according to Kokich et al,[5] by laypersons and orthodontists according to Mackley,[8] and by laypersons in accordance to Geron and Atalia,[2] Hulsey[3] and Hunt et al.[4]

Orthodontists scored lower (P≤0.05) for the female subject comparing to clinicians and laypersons for the 2 mm gingival exposure (Tables 3 and 4). There was no statistical difference among scores from orthodontists, clinicians and laypersons for the male subject (P≤0.05). The obtained score in the present study was evaluated between regular and good for the female subject, and similarly classified as esthetic by Kokich et al[6] according to orthodontists, clinicians and laypersons, and also for laypersons according to Hunt et al.[4] The obtained scores were from poor to regular for the male subject, similarly assessed as unaesthetic by laypersons according to Hulsey.[3] Geron and Atalia[2] also reported that laypersons considered unattractive smile when any gingival exposure starting from 1 mm is observed. According to Kokich et al,[5] although orthodontists considered 2 mm gingival exposure unattractive, clinicians and laypersons considered the smile as being esthetic.

Laypersons rated smiles with 4 mm gingival exposure with higher scores for the female subject (Tables 3 and 4) in comparison to orthodontists and clinicians (P≤0.05). No statistical difference was detected for the male subject according to orthodontists, clinicians and laypersons. Laypersons scored higher for the female subject (P≤0.05). The present score was considered poor for the female subject, and between very poor and poor for the male subject. Similarly to our results, Kokich et al[5] reported that 4 mm gingival exposure was determined as unattractive by orthodontists, clinicians and laypersons; and also according to laypersons in a study by Hunt et al.[4] On the other hand, Kokich et al[6] reported that although orthodontists determined unaesthetic smiles with gingival exposure starting at 3 mm, clinicians and laypersons considered an esthetic smile even with gingival exposure of 4 mm.

Increased maxillary incisors exposure is a youth characteristic, while increased mandibular incisors exposure is an elder characteristic,[17] once gingival exposure of the maxillary incisors tend to decrease with age.[12,14] Vig and Brundo[16] performed a study with different age groups (29-39, 39-49, 49-59 and over 60 years of age) and detected a decreased maxillary incisors exposure and a gradual increase on exposure of mandibular incisors while in rest. Incisors coverage increases with age, improving esthetics of gingival smiles and worsening esthetics of mean and low smiles, leading to an older appearance.[12]

This change is due to gravity effects on the upper and lower lips. The deepening of perioral tissues is partially due to flattening, stretching and decrease elasticity of skin[9] and lower facial muscle tone leading to decreased lips movements.[7,8] Some factors such as sunlight speed up these changes.[12]

For a better understanding of this study one must take into consideration the age group of the studied subjects. Thus, the presented data should be related to youth. Other studies with individuals of different age groups should be conducted in order to provide conclusions for different age groups.

CONCLUSIONS

According to the opinion of orthodontists, clinicians and laypersons, smile attractiveness is influenced by the quantity of gingival exposure The most attractive smile for the female subject was observed when the upper lip rested on the gingival margin of the maxillary incisors, according to the opinion of the three evaluators categories. For the male subject, laypersons considered smiles with upper lip resting on the gingival margin of the maxillary incisor as being more esthetic. Orthodontists and clinicians considered esthetic the smiles with the upper lip resting on the gingival margin of the maxillary incisors or when the upper lip covers the gingival area of the maxillary incisors in 2 mm.

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