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Research Article

AN ATTRACTIVE SMILE – THE POWER OF FIRST IMPRESSION

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A B S T R A C T

Introduction: In this study, we aimed to verify whether different levels of maxillary central incisors incisal edges and gingival display affects influence the perception of smile attractiveness and this perception according to groups of orthodontists, dentists, orthodontic patients, and prosthodontists. **Methods:** A frontal photographs of the smile of 1 man and 1 woman showing the gingival contours of the incisors and the canines were digitally altered, creating steps from 0, 0.5, 1, 1.5, 2.0 mm, with and without gingival exposure. The 20 pictures were shown in random order to 240 evaluators divided into 4 groups who were asked to provide attractiveness scores on visual analog scales. **Results:** Both the steps (P\0.001) and the gingival exposure (P\0.05) had statistically significant influences on the evaluations in all groups. There was also a statistically significant difference (P\0.001) between the evaluations of orthodontists with the dentists and orthodontic patients groups. **Conclusions:** The most accepted vertical relationship of incisor borders was the 1.0-mm step. There were significant differences in the evaluation of orthodontists when compared with dentists, orthodontic patients groups, and no significant difference was detected between orthodontists and prosthodontists groups. The gingival display altered significantly the esthetic perception of the smiles evaluated. There were significant differences between the evaluations of the smiles of the man and the woman.

INTRODUCTION

Smile, is defined as a facial expression characterized by upward curving of the corners of the mouth, is of ten used to indicate pleasure, amusement, or derision[1] The smile is the cornerstone of social interaction and also influences a person's perceived attractiveness.

Esthetics, derived from the Greek word *aisthetikos*.[2]The common notions about facial esthetics are usually based on subjective opinions rather than proven scientific data. Qualification and quantification of beauty are not easy. An estimation of the perception of beauty is a requisite in orthodontics because diagnosis and treatment planning should be based on scientific evidence from studies involving the measurement of beauty.[3] Social environment influences patients' concerns about their facial, or more particularlysmile, esthetics rather than by their dentists or orthodontists. It has been observed that culture, social status, and education level are factors that considerably affect the evaluation of esthetics.[4]

Orthodontic planning should be based on the esthetic demands of the patient, in contrast to function-driven treatment plans[5,6]that create functionally perfect, although not necessarily esthetic, smiles.[7]An adequate smile arch, with incisors aligned in acurve parallel to the lower lip contour, is an important factor in the construction of an attractive smile.[8-10]In the formation of a more pleasant smile the vertical position of the incisors is of paramount importance.[9,11] any authors have already been considered straight or reversed smile lines to be less attractive[6,12] whereas convex lines are considered more beautiful and youthful.[13]

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during the planning, bonding, and finishing procedures. The patient's or the referring clinician's expectations of what is more attractive do not always coincide with the orthodontist's concepts.[14,15] even though some studies suggest that there is no difference among evaluator groups.

It is important to address the relationship of the incisal borders for a more esthetic smile, among not only orthodontic patients and orthodontists but also dentists and prosthodontists. In this way, orthodontists may have a reference to support the communication with those groups, helping to achieve common treatment goals. Considering these issues, in this study we aimed to determine:

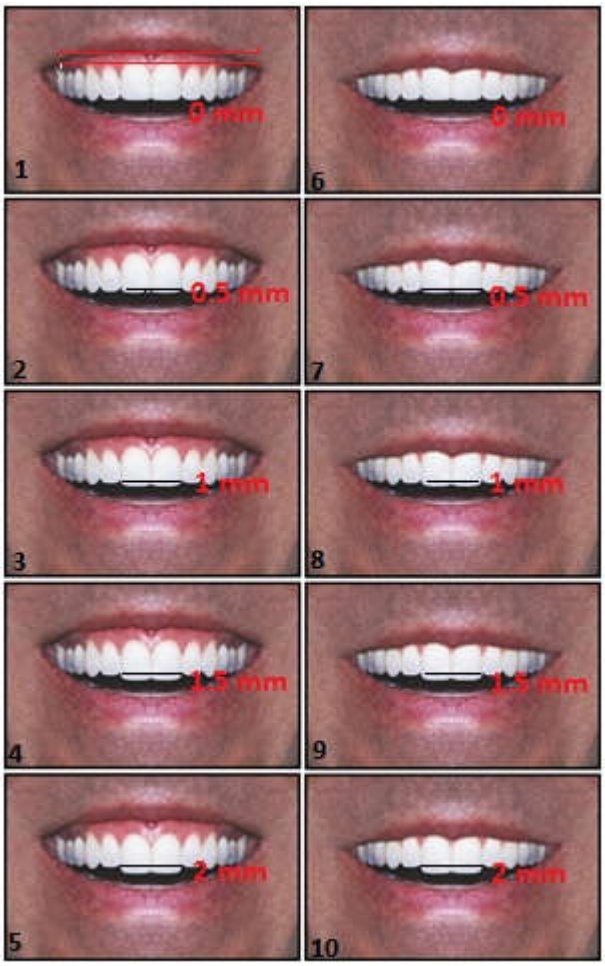
1. The most accepted vertical relationship of incisor borders,
2. Whether there is a difference in the esthetic perceptions among different groupsi. eorthodontists, dentists, orthodontic patients, and prosthodontists.
3. Whether gingival display alters this perception, and
4. Whether there are differences between the evaluations of the smiles of men and women.

MATERIALS AND METHODS

The photographs of smile of 2 volunteers-a man and a woman—showing the gingival contours of the maxillary teeth had 1 side digitally altered with Adobe Photoshop (version CS5; Adobe Systems, San Jose, Calif) to adjust the proportion of the teeth according to the literature. Distractions, such as color, shape, and size alterations, of the teeth and surrounding structures were removed. The volunteers signed a release form

for use of their images for scientific research by the Department of Orthodontics. The new manipulation simulated changes to the vertical relationship of the incisor borders, varying from 0.0to 2.0 mm in 0.5-mm steps exclusively by extrusion of the central incisors. No alterations were made to the crown length or the height-width ratio of the incisors. To precisely graduate the vertical movement, the realincisors of the volunteers were measured with a digital Caliper (Lotus). A virtualruler was then calibrated in proportion to the measurement in the software to standardize the 0.5-mmincrements.

We made another manipulation, which consisted of downward movement of the upper lip so that all gingival contours of the canines and the incisors were hidden on the 2.0-mm extrusion of the central incisors. The side that was manipulated was then mirrored to ensure perfect symmetry. All manipulations were made by the same operator and resulted in 20 images, 10for each sex (Figs 1 and 2). The sample size was calculated with G*Power software, considering an alpha error of 0.01, 80% power, and 0.25 effect size. The total sample size suggested was 239 subjects. Then, 60 evaluators were recruited in each of 4 groups (orthodontists, dentists, orthodonticpatients, and prosthodontists), resulting in 240 evaluators.[16,17]



Without gingival display With gingivalDisplay

Fig 1 Smiles of the man after manipulation.

As inclusion criteria, the evaluators were required to be between 18 to 60 years old, with no sex distinction. Participants in the orthodontic patients group were required be involved in active orthodontic treatment at the clinic of the Department of Orthodontics. They were randomly selected from among students in courses at the college. The members of the dentist group were required to have graduated and topractice any specialty other than orthodontics. The group of orthodontists included specialists who worked with fixed orthodontics techniques.

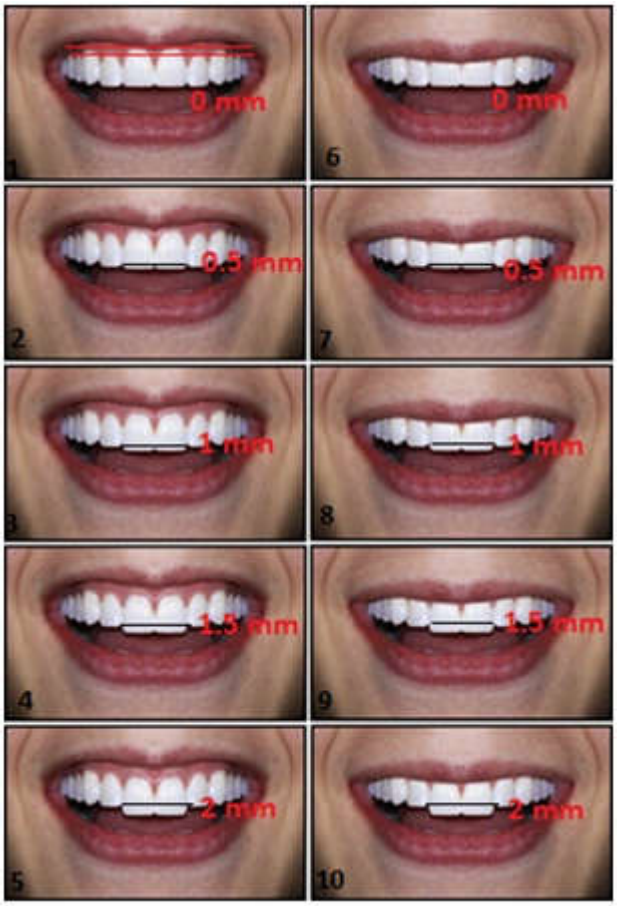


Fig 2 Smiles of the woman after manipulation.

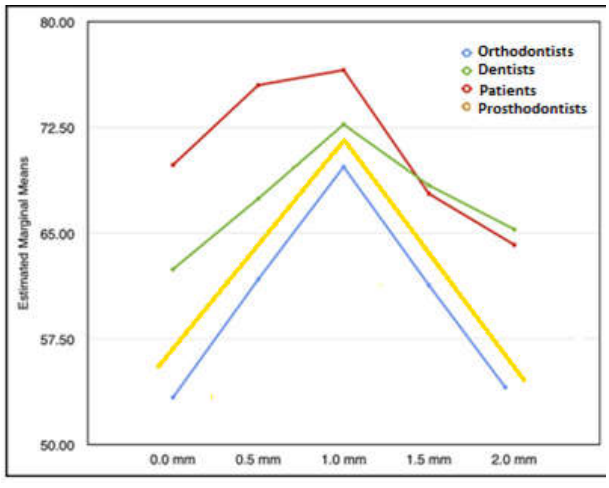


Fig 3 Estimated marginal means of the steps, according to the evaluator groups.

Dentists, dental students, and spouses of dentists were excluded from the orthodontic patient groups. All volunteers provided informed consent. To grade smile attractiveness, a sheet with 20 visual analog scales (VAS) 100 mm wide was used, with zero(0 mm) as the most unattractive and 100 (100 mm) as the most attractive. The measurements were made with the same digital caliper by the same operator.

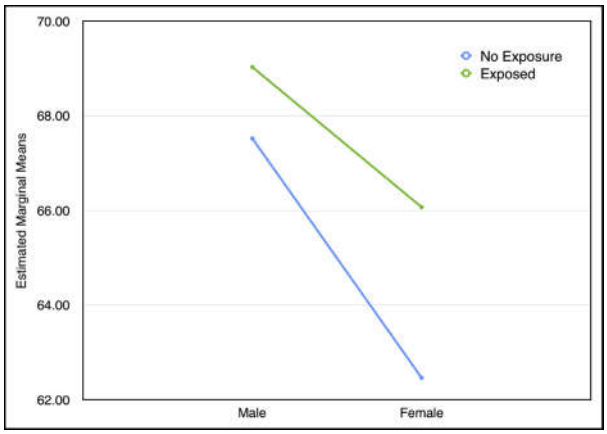


Fig 4 Estimated marginal means of the steps,according to the variations in gingival exposure.

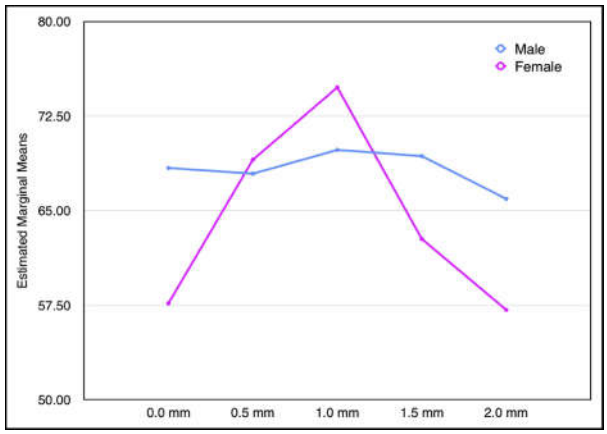


Fig 5 Estimated marginal means of the steps, according to sex variations.

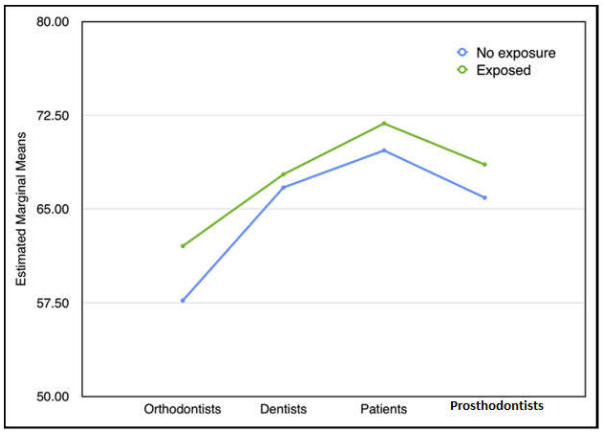


Fig 6 Estimated marginal means per evaluator group, according to the gingival exposure variations

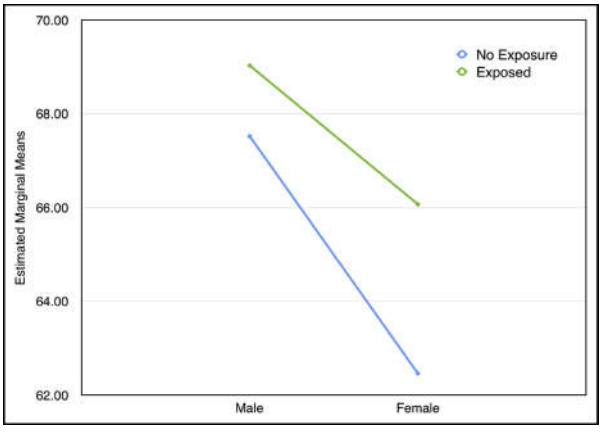


Fig 7 Estimated marginal means for sex, according to the gingival exposure variations.

Table I Demographic distribution of the sample by groups
Sex Age(y)

Group	*N*	*Male*	*Female*	*Mean*	*Minimum*	*Maximum*
Orthodontists	60	20	40	37.82 ±08.67	25	58
Dentists	60	20	40	37.98 ±06.21	29	55
Patients	60	17	43	30.85 ±07.95	20	55
Prosthodontits	60	19	41	35.11±08.11	21	58
Total	240	71	169	33.94 ±10.02	18	59

Table II Mean scores for each picture (per group and total)

Picture	*Orthodontists*	*Dentists*	*Patients*	*Prosthodontists*	*Total*
MN00	57.06 6 18.28	64.58 6 15.85	71.57 6 16.68	69.19 6 16.16	65.60 6 17.56
MN05	55.30 6 20.24	65.59 6 14.72	73.81 6 14.48	70.41 6 15.01	66.27 6 17.57
MN10	67.72 6 17.82	68.34 6 18.67	73.60 6 15.13	68.90 6 17.72	69.64 6 17.43
MN15	64.65 6 17.50	70.30 6 13.98	71.56 6 16.22	70.43 6 14.22	69.24 6 15.69
MN20	61.11 6 18.81	70.50 6 14.52	69.61 6 17.20	66.23 6 17.96	66.86 6 17.48
ME00	65.26 6 15.37	69.85 6 16.32	73.70 6 17.22	75.87 6 14.95	71.17 6 16.40
ME05	64.55 6 15.83	67.47 6 13.34	75.50 6 14.75	70.79 6 14.96	69.57 6 15.20
ME10	68.05 6 19.13	67.45 6 16.06	76.19 6 14.54	68.28 6 17.20	69.99 6 17.09
ME15	67.08 6 19.93	68.60 6 15.04	69.92 6 16.45	72.09 6 14.33	69.42 6 16.58
ME20	56.61 6 18.84	66.06 6 14.73	67.45 6 17.93	69.89 6 14.39	65.00 6 17.02
FN00	40.10 6 16.76	53.61 6 15.13	61.37 6 22.43	58.16 6 19.41	53.31 6 20.23
FN05	53.18 6 15.38	61.23 6 16.42	68.62 6 18.38	60.38 6 18.89	60.85 6 18.07
FN10	68.94 6 17.39	78.03 6 12.99	77.01 6 14.32	71.11 6 17.21	73.77 6 15.97
FN15	56.10 6 12.12	68.27 6 13.80	66.12 6 19.20	62.69 6 16.94	63.30 6 16.33
FN20	52.56 6 16.61	66.73 6 15.71	63.55 6 22.84	61.53 6 18.25	61.09 6 19.18
FE00	50.95 6 17.25	61.69 6 16.59	72.70 6 17.50	62.56 6 19.96	61.98 6 19.36
FE05	73.85 6 13.48	75.47 6 12.67	84.01 6 14.77	75.58 6 16.41	77.23 6 14.86
FE10	74.07 6 12.95	77.00 6 12.82	79.42 6 15.37	72.60 6 14.97	75.78 6 14.23
FE15	57.37 6 14.55	66.36 6 13.25	63.52 6 20.23	61.62 6 18.30	62.22 6 17.03
FE20	42.57 6 14.40	57.76 6 16.50	56.03 6 24.90	56.28 6 18.12	53.16 6 19.76

M,Male;F,female;N,noexposure;E,exposed;00,0mm;05,0.5mm;10,1.0mm;15,1.5mm;20,2.0mm.

10 manipulated pictures of each model were assembled in a presentation. After a brief explanation of the study and how to use the VAS, a slide with all pictures of the male model's smile in increasing order ofincisal steps was displayed for 20 seconds as a calibration method. After that, the same 10 pictures were shown, one by one, in random order. The transition was automatic after 15 seconds of display. The same procedure was then repeated for the smiles of the woman. The exact wording given to the evaluators was this: "Please give grades to the following pictures according to their attractiveness, from 1 to 10 as extremely attractive. The grades can be marked at any point of the scale, as shown in the example. The transition of pictures is automatic. There will be 10 pictures of each person, which will be displayed, at first all together for 20 seconds, and then in random order, one by one, for 15 seconds each. The grading must be done when they are displayed one by one. It is not allowed to reevaluate the pictures." The evaluators were not told at any point which characteristics would be altered in the pictures. To compensate for printing distortions on the VAS sheet, the first VAS of each page was measured, and each score was adjusted proportionally.

Statistical Analysis

Descriptive statistics used frequencies, means, standard deviations, maximums, and minimums (Table I). Repeated-measures analysis of variance (SPANOVA)with the Turkey post hoc test at a 5% significance level was conducted, considering factors 1 between-groups (evaluator group) and 3 within-subjects (smile model sex, in cisal step, and gingival contour exposure).

Three judges from each group were asked to reevaluate the 20 photographs at least 2 months after the first test. A correlation test was taken, and a coefficient of0.833 (83.3%; 95%

confidence interval, 0.782-0.872) was found, ensuring reliability.

RESULTS

The sample was composed of 240 evaluators (Table I), 29.6% men and 70.4% women. The means for each picture, grouped and divided by the evaluator group, are shown in Table II. The highest ranked pictures without gingival exposure were the1.0-mm step for both sexes. For the pictures with gingival exposure, the 0.0-mm step for the smile of the man and the 0.5-mmstep for the smile of the woman received the highest grades. The estimated marginal means of the SPANOVA allowed for the evaluation of each factor, eliminating the interference of the others. A great reduction in the standard deviation was observed. This occurred because in the descriptive statistics, the means referred to 1 picture, which was a combination of all factors analyzed by the 240 evaluators, producing a mean of 240 scores.

The graphic representations of the variations on the estimated marginal means, when crossing group versus step, gingival exposure versus step, sex versus step, gingival exposure versus groups, and gingival exposure versus sex, whether statistically significant or not, can be seen in Figures 3 to 7.

DISCUSSION

Although it was affirmed that the esthetic impact of smile visualization is smaller when the whole face is displayed,[18,19] some studies have shown no significant difference in esthetic evaluation when the framing changed between the whole face or just the smile.[20-22]

For this reason, we conducted this study with photographs of smiles to reduce the distraction of other facial characteristics and to increase the focus on local alterations.[23] The photographs were taken in a way that the maxillary incisors were against a dark background, resembling speech and spontaneous smiling and increasing the contrast. The VAS is a reliable[24] and commonly used scoring method in health research to generate parametric data from subjective notions, such as pain, anxiety, and attractiveness, even though there is a tendency for some evaluators not to use the whole scale.[19,23] They tend to score around the central values, especially in comparative studies. This occurs because the evaluator is afraid of giving a high score to a situation in case he likes the next one better. In order to control this effect in this study, we showed a composition of all pictures of each model for 20 seconds before the evaluations, so that the evaluator would be calibrated to the more and less attractive pictures.

Since we used male and female models for the smiles, conclusions about the sex variations may reflect characteristics of the picture acquisition (inclination, framing, colors) or anatomic features of that person, not necessarily dependent on the model's sex. Because of this, the results should be viewed only as tendencies to be confirmed in future studies with more smiles from each sex.

Highest scores were provided by the orthodontic patients among the groups. As suggested in some studies during treatment, patients receive much information about the goals to be achieved, making them more analytical with regard to smiles.[18] This is a possible explanation for the higher grades because the smiles analyzed did not exhibit orthodontic problems.

It was also shown that the means for orthodontic patients and dentists were similar, perhaps because both groups tended to focus on the more general characteristics of the smile, such as the proportions, color, and shape of the teeth, since they were not influenced by the orthodontic aspect. The orthodontists and prosthodontists showed lower mean scores. This was understandable because the factors analyzed in this study are fundamental for evaluation of orthodontic and prosthodonticstreatment results, so they tended to be more strict in their evaluations. One can see that their preferences are more homogeneous and that they tolerate fewer deviations from what they consider to be correct. There is a great separation between the means for each step when compared with the other groups.

Significant discrepancies between the smiles with and without gingival exposure, was shown by all groups, except for the dentists, who gave similar scores for both cases. Perhaps this strengthens the idea that they are more concerned about the intrinsic characteristics of the smile, such as dental esthetics, placing less emphasis on the relationship with other structures, such as gums and lips.

One can notice that for the extreme values (0.0 and 2.0 mm), gingival exposure causes evident variations, probably because of the variations of the gingival contours with extrusion of the central incisors. This alteration is unesthetic because it breaks the harmony of smile lines.[8,9,11] This disharmony disappeared when the gingival contour was hidden by the lip, making the step between incisal borders more significant for judgment. It has been verified that the position of the maxillary front teeth and maxillary gingival exposure have definitive effects on the esthetic perception of a smile.[16]

In that perception the variations of gingival exposure produced statistically significant differences. Especially in the pictures of the female model, the smiles with gingival exposure received better scores. Other studies demonstrated that smiles with some gingival exposure tended to be considered more attractive and young.[11,24] In this study, we aimed to turn an original smile with gingival exposure into as mile that could hide the gingival contour but not to quantify the amount of gum exposure or simulate the characteristics of more or less tooth display in vertical excess of the maxilla or a relaxed lip position.

The means for the 0.0-mm and 0.5-mmsteps had large variations when the gingival contour was exposed strengthens the hypothesis that alterations in the gingival contour are as important as the incise step in patients with gingival exposure.[22] Especially in patients with a gummy smile this should be considered during planning and bonding, the mean for the 0.5-mm step in this case was slightly higher than the mean for the 1.0-mm step; although this difference may not be statistically significant, it may indicate a tendency of clinical relevance.

Distinct behavior can be seen when the effect of sex variation is added: the highest means for the smiles of the man and the woman without gingival exposure corresponded to 1.0-mm step, but for the smiles with gingival exposure, the highest means corresponded to the 0.0-mm step for the man and 0.5-mm step for the woman. Some studies have stated that steps varying from 1.0 to 1.5 mm are recommended for women, and steps from 0.5 to 1.0 mm are recommended for men.[6,12] Our

findings reinforce the hypothesis that more convex smile arches better characterize attractive smiles for women and flat smiles are more accepted for men.[23-25]

When this concept was verified in the groups, the orthodontists showed more homogeneity, preferring the1.0-mm step in every variation of sex and gingival exposure tested. This is likely because orthodontists are better trained to observe this particular characteristic. When analyzing a smile, they may be more centered on the relationship between the central and lateral incisors than on its influence on the many factors of the smile. Orthodontists and prosthodontists showed almost similar preferences.

For dentists, the preferred smiles of the women with and without gingival exposure had a 1.0-mm step, whereas for the men, the higher means corresponded to the 0.0-mm step with gingival exposure and the1.5-mm step without gingival exposure. These finding simply the significance of the role of the gingival contour on this evaluation for dentists.

Orthodontic patients selected 1.0-mm step in every situation, except for the smile of the woman with gingival exposure, where they significantly preferred 0.5-mm step. This may indicate that orthodontic patients are closer to orthodontists in their preference than dentists, even though there was no statistical significance in this comparison.

In general, the smiles of the women got lower scores than those of men, but this may have been due to the specific characteristics of pictures, not necessarily because of the sex of the model in the picture. The smile means of the man varied considerably lesser than means of woman. This suggests a greater influence of the in cisal step variation on the smiles of women.

It has been described that more curved smile arches had better results along with more gingival display and straighter arches were scored higher when there was less gingival display; this is different from the results of our study.[23,26,27] Bigger steps were better evaluated without exposure and smaller steps received better scores with gingival exposure. This could be justified by the harmony of the gingival contour that is broken by the extrusion of the central incisors, proving the important role played by the gingival contour in the composition of an attractive smile.

Because there were no variations in the positions of canines and lateral incisors, which would represent a true change in smile arch, display of a step between the gingival contour of the incisors in a smile with gingival exposure had a negative impact on esthetic evaluations.

CONCLUSIONS

1. The most accepted vertical relationship of incisorborders was the 1.0-mm step.
2. There were significant differences in the evaluation of orthodontists when compared with dentists, orthodontic patients groups, and no significant difference was detected between orthodontists and prosthodontists groups.
3. The gingival display altered significantly the esthetic perception of the smiles evaluated.
4. There were statistically significant differences between the evaluations of the smiles of men and women.

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