

# Does the vertical position of maxillary central incisors in men influence smile esthetics perception?

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**Introduction:** The aim of this study was to investigate whether there is any influence on the perception of smile esthetics among orthodontists and laypersons, with regard to different vertical positions of the maxillary central incisors. **Methods:** Frontal smile photographs digitally altered at full-face view and close-up view of 2 adult men aged between 20 and 30 years were used. Six vertical positions of the central incisors were created, with changes of 0.5 mm. The images were randomly assembled in an album that was presented to 53 orthodontists and 53 laypersons, who evaluated the attractiveness of the images by using visual analog scales. Comparison among the images was performed using 1-way analysis of variance, with Tukey post-hoc test. To compare the distribution of the mean scores between the full-face and close-up smile views, and between orthodontists and laypersons, the Student *t* test was used. The level of significance was established at 5%. **Results:** The best evaluations presented the following: (a) the gingival margins of the central incisors corresponded to, or were up to, 1 mm below the line of the canine gingival margins, and (b) the incisal step between the central and lateral incisors was from 1.0 to 2.0 mm. The smiles considered least attractive showed (a) the central incisor gingival margins were 1.0 mm above or 1.5 mm below the canine gingival margins, and (b) no step, or a step of 2.5 mm, between the central and lateral incisors. **Conclusions:** The results of this study suggested that, in men, slightly extruded central incisors were esthetically more attractive than intruded incisors. (Am J Orthod Dentofacial Orthop 2019;156:485-92)

The quest for excellent dentofacial esthetics is a reality in contemporary society.<sup>1,2</sup> In view of this, there has been a great deal of discussion about the importance of the smile with respect to the dentofacial aspect and the social and psychological benefits of improvements in smile esthetics.

Among the relevant aspects of a smile, previous studies have suggested that the central incisor gingival margins must coincide with the gingival margins of the canines and must be slightly above the lateral incisor gingival margins.<sup>3-7</sup> This reference was used as the starting point for studies<sup>8,9</sup> that evaluated 6 different

vertical positions of the maxillary central incisors. The authors observed that the most attractive smiles presented 2 notable characteristics: (1) central incisor gingival margins corresponding to the lateral gingival margins, and both were 0.5 mm below the line of the canine gingival margins, and (2) the incisal step between the central and lateral incisors was 1.0-1.5 mm.<sup>8,9</sup>

Although in previous studies the authors investigated what would be the most attractive vertical position of the central incisors, these studies were conducted in young women.<sup>9-11</sup> Therefore, some questions still remain: What would these findings be if men were evaluated instead of women? Are there differences in the perception of smile esthetics with regard to different vertical steps of maxillary central incisors relative to other front teeth in men?

The aim of this study was to investigate the influence of different vertical positions of the maxillary central incisors in an analysis of full-face and close-up views of the smile on the perception of smile esthetics in men between orthodontists and laypersons.

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All authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest, and none were reported.

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**Table I.** Characteristics of the smiles used in this study

Altered vertical positions	Central incisors gingival margins	Central incisors edges	Amount of gingival display (mm)
A: -1.0 mm	1.0 mm above the canines	Matching the lateral incisors	0
B: -0.5 mm	0.5 mm above the canines	0.5 mm below the lateral incisors	0.5
C: 0.0 mm	0 mm above the canines	1.0 mm below the lateral incisors	1.0
D: +0.5 mm	0.5 mm below the canines	1.5 mm below the lateral incisors	1.5
E: +1.0 mm	1.0 mm below the canines	2.0 mm below the lateral incisors	2.0
F: +1.5 mm	1.5 mm below the canines	2.5 mm below the lateral incisors	2.5

## MATERIAL AND METHODS

This study was approved by the Federal University of Bahia, Salvador, Bahia, Brazil. All the study participants signed the Term of Free and Informed Consent.

A pilot study was conducted to define the sample size, using the nonpaired Student *t* test with 80% power, an effect size equal to 0.90 and a bilateral alpha level of 5%.<sup>1,2,8</sup> The estimate showed that the sample should be composed of a minimum number of 53 persons in each group of examiners.

A total of 12 full-face images of the smile, and 12 close-up images of the smile of 2 men (man 1 and man 2), aged between 20 and 30 years, were used. Their maxillary anterior dentition was healthy and showed absence of restorative procedures.

These photographs were manipulated in Adobe Photoshop CS5.1 (Adobe, San Jose, Calif), with the width to height proportion of the central incisor corrected to 80%, a proportion of 70% between the anterior teeth, a gingival exposure of 1.0 mm, a convex arch of smile, and an intermediate buccal corridor.<sup>5</sup> In addition, on 1 side of the image, the gingival margin of the canines was leveled to that of the central incisors, and that of the lateral incisors 0.5 mm below this line.<sup>9,10</sup> The incisal step between the central and lateral incisor was established at 1.0 mm. After these changes, the manipulated side was duplicated and transferred to the other side, making the image perfectly symmetrical, which was denominated position 0 mm. From this image, the vertical position of the central incisors was changed, as described in Table I, generating 6 full-face images (Figs 1 and 2) and 6 images of the close-up smile (Figs 3 and 4) for each man in the study. The positions were denominated as follows: 0.0, +0.5, +1.0, +1.5, -0.5, and -1.0, according to vertical position changes of the central incisors. Alterations in the extrusion direction were labeled as positive and those in the intrusion direction were labeled as negative.

The top limit of the full-face image was a region a little above the top of the head, and the bottom limit, the base of the neck. The close-up image of the mouth exclusively showed the image of this area, discarding the nose and chin.<sup>1,2,8,9,12</sup>

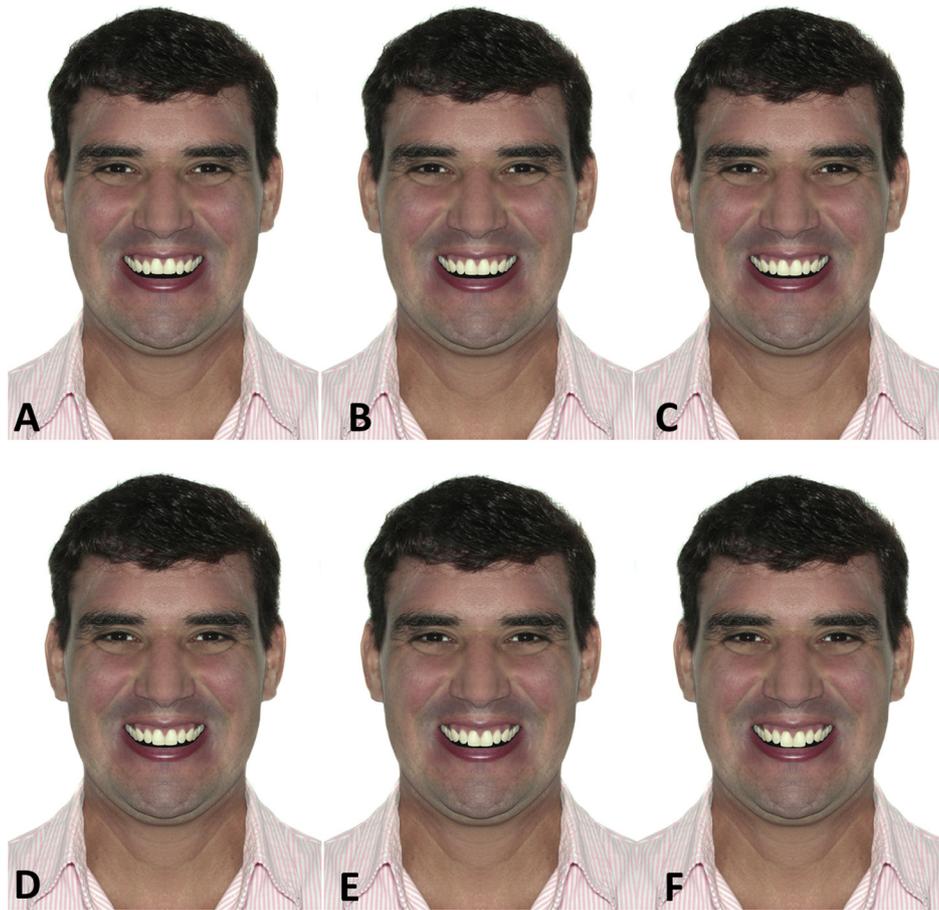
To guarantee calibration of the images, the width of the previously measured maxillary left central incisor was used; thus, each millimeter of the image during manipulation corresponded to each millimeter of the image that was printed on paper, characterizing a magnification of 1:1.<sup>1,2,8-10,12</sup> Subsequently, an album in size A3 (29.0 × 42.0 cm), containing 24 pages, was prepared, in which all the images were individually and randomly distributed.

The album was evaluated by 53 orthodontists and 53 laypersons, who had completed their university-level education, with the exception of dentists, together with printed simulations of 24 rulers (visual analog scale), which were identified with the number and letter corresponding to each image. All evaluators marked a point along the scale according to their perception of smile esthetics. The visual analog scale was 10 cm long; on its extreme left were the words “very unattractive,” and on the extreme right “very attractive.” The distance between the mark made by the evaluator and the point on the extreme left was measured with an electronic digital caliper (Starrett; Suzhou, China) and served as measurement, in millimeters, of the degree of attractiveness of the image evaluated, indicating the score of each examiner.<sup>13</sup>

The data collected were analyzed with the software SPSS version 16.0 (Statistical Package for Social Sciences; SPSS Inc, Chicago, Ill.). The statistical descriptions were reported as means and standard deviations. Comparison of the 6 images containing the different vertical positions of the central incisors was performed using 1-way analysis of variance, with Tukey post-hoc test. To compare the distribution of the mean scores between the full-face and close-up smile views, and between orthodontists and laypersons, the Student *t* test was used. The level of significance was established at 5%.<sup>2,14,15</sup>

## RESULTS

When comparing assessments of full-face with close-up views, no statistically significant difference was found ( $P > 0.05$ ) in most situations (20 out of 24) (Tables II-V). By virtue of this finding, the images of



**Fig 1.** Full-face smile photographs of man 1. Six vertical positions of central incisors, from intrusion to extrusion denominated: **A**,  $-1.0$  (1 mm of intrusion); **B**,  $-0.5$  (0.5 mm of intrusion); **C**,  $0.0$  (position 0 mm); **D**,  $+0.5$  (0.5 mm of extrusion); **E**,  $+1.0$  (1 mm of extrusion); **F**,  $+1.5$  (1.5 mm of extrusion).

the close-up smile were used as a reference to address the results.

In the evaluation of close-up smiles for man 1 and 2, described in Tables VI and VII, respectively, the orthodontists considered that the most attractive smiles were those with the positions 0 mm, +0.5 mm, and +1.0 mm, without a statistically significant difference among them. The least attractive smile was perceived as that at  $-1.0$  mm. Laypersons considered that the most attractive smiles were those at 0 mm, +0.5 mm, and +1.0 mm, whereas they considered the worst smile to be at  $-1.0$  mm for both men.

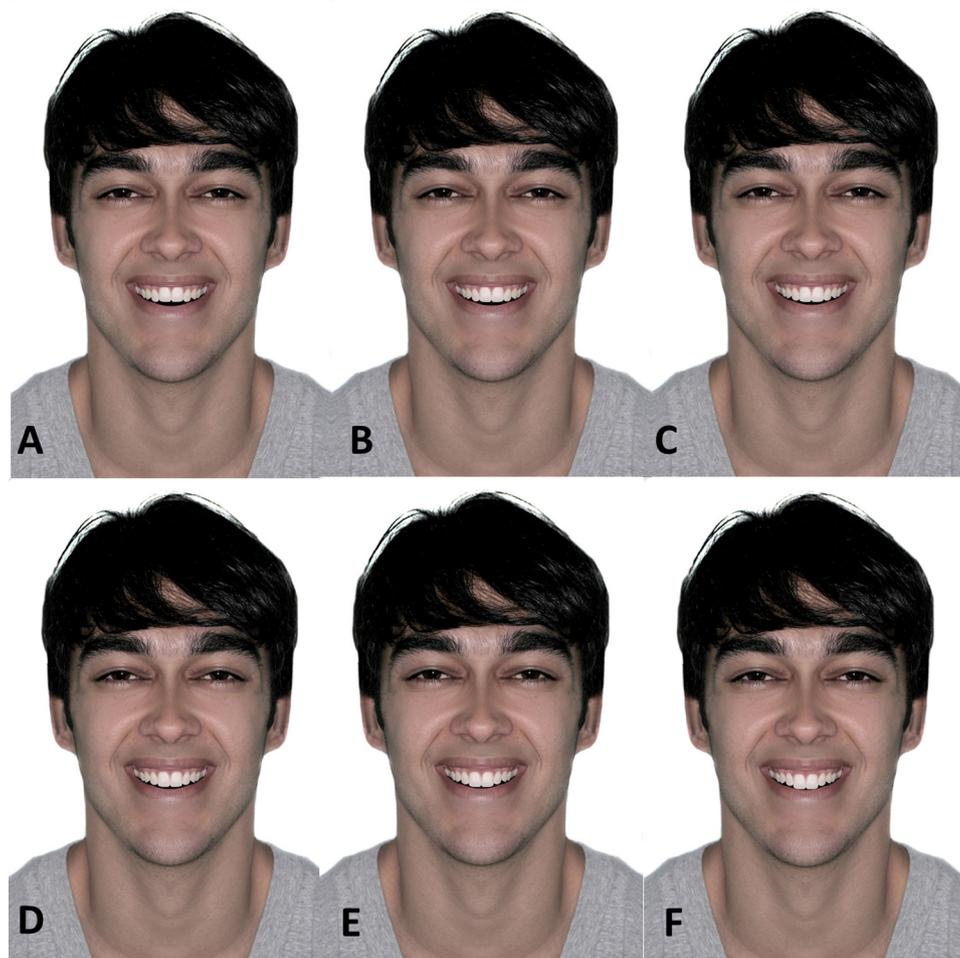
In the comparison between orthodontists and laypersons, in most situations (9 out of 12) there was no statistically significant difference. Most situations in which statistical differences occurred were in those of

the less attractive smiles (positions  $-0.5$  mm and  $-1.0$  mm), to which laypersons attributed higher scores.

## DISCUSSION

Different studies have endeavored to establish esthetic parameters for patients who wish for improvements in smile esthetics. Although great advancements have been made in this field, there is a notable predominance of studies that have researched female parameters.<sup>16-20</sup> However, few studies were found that researched the esthetic characteristics of men's smiles.<sup>2,11,12,21</sup> This emphasizes the unprecedented nature of our study in evaluating the vertical position of the maxillary central incisors in men.

This study evaluated the vertical step of maxillary central incisors relative to other front teeth. Analysis of the data found showed that this characteristic greatly



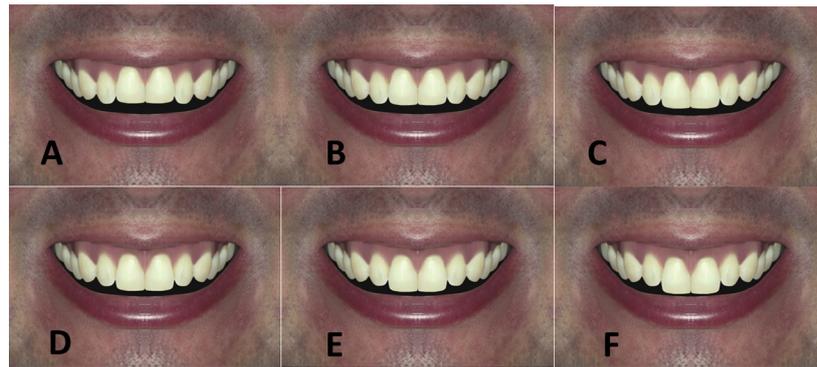
**Fig 2.** Full-face smile photographs of man 2. Six vertical positions of central incisors, from intrusion to extrusion denominated: **A**,  $-1.0$  (1 mm of intrusion); **B**,  $-0.5$  (0.5 mm of intrusion); **C**,  $0.0$  (position 0 mm); **D**,  $+0.5$  (0.5 mm of extrusion); **E**,  $+1.0$  (1 mm of extrusion); **F**,  $+1.5$  (1.5 mm of extrusion).

affected perception of smile esthetics. The results demonstrated that the smiles considered most attractive were those that presented the gingival margin of the central incisors corresponding to those of the canines, or up to 1 mm below this line; gingival exposure of 1.0 mm to  $-2.0$  mm in the region of the central incisors, complying with the limits of normality proposed by the literature.<sup>14,18,19</sup> Therefore, although gingival exposure increases, slight extrusion of the maxillary central incisors may enhance the perception of smile esthetics.

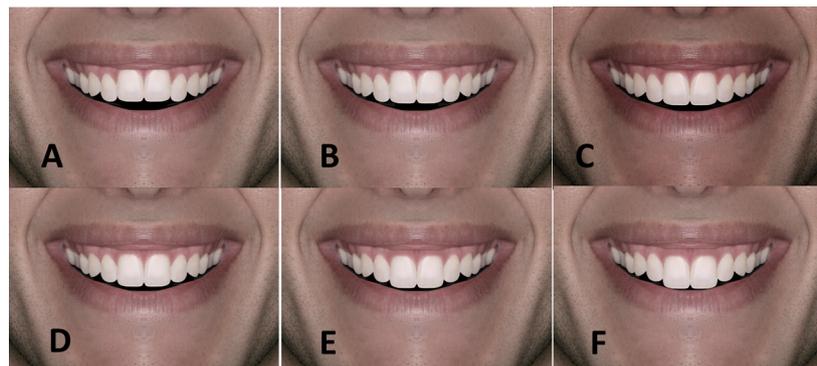
When evaluating the incisal step, the highest scores were attributed to the smiles that had a step between the central and lateral incisor of 1.0 mm–2.0 mm, and the lowest scores were attributed to smiles without a step between these teeth. The only published study that researched this characteristic in men,<sup>11</sup> found a central-to-lateral step of 1 mm, partly corroborating

our findings. The literature mainly reports studies on women's smiles.<sup>9,10,17</sup> Our findings were in partial agreement with a published study<sup>17</sup> that found an ideal step of 1.4 mm between the central and lateral incisors. However Machado et al<sup>10</sup> proposed that the most attractive smiles would be those that presented a step of 1.0 mm–1.5 mm between these teeth, similar to the results of Menezes et al.<sup>9</sup> Those findings are most valuable because they demonstrated a tendency of convergence of esthetic perception in men and women, questioning the tendency followed for a long time, based on clinical opinions that recommended men's smiles should present smoother steps between the central and lateral incisors than those of women's smiles.<sup>4,22</sup>

The results found here have vast clinical application for diagnosis and esthetic planning of men's smiles in different dental specialties, for example, prosthodontics, cosmetic



**Fig 3.** Close-up smile photographs of man 1. Six vertical positions of central incisors, from intrusion to extrusion denominated: **A**,  $-1.0$  (1 mm of intrusion); **B**,  $-0.5$  (0.5 mm of intrusion); **C**,  $0.0$  (position 0 mm); **D**,  $+0.5$  (0.5 mm of extrusion); **E**,  $+1.0$  (1 mm of extrusion); **F**,  $+1.5$  (1.5 mm of extrusion).



**Fig 4.** Close-up smile photographs of man 2. Six vertical positions of the central incisors, from intrusion to extrusion denominated: **A**,  $-1.0$  (1 mm of intrusion); **B**,  $-0.5$  (0.5 mm of intrusion); **C**,  $0.0$  (position 0 mm); **D**,  $+0.5$  (0.5 mm of extrusion); **E**,  $+1.0$  (1 mm of extrusion); **F**,  $+1.5$  (1.5 mm of extrusion).

dentistry, and orthodontics.<sup>6,7</sup> The guidelines proposed here could improve communication with patients and among colleagues with regard to the fabrication of dental prosthesis and cosmetic restorations in anterior teeth because the results suggest that the same criteria established for women apply to men.<sup>8,9,11</sup>

From the orthodontic point of view, the findings of this research are of high relevance. By analyzing Tables VI and VII, the scores attributed to the smiles with values of  $+0.5$  mm compared with values of  $-0.5$  mm resulted in completely different esthetic perceptions, for both groups of raters. This demonstrated the preference for slight extrusion rather than slight intrusion of the maxillary central incisors, corroborating the findings for women's smiles in previous studies.<sup>8,9,11</sup> For the orthodontist, this information involves taking decisions in planning of orthodontic bracket bonding, because a slight extrusion could

greatly enhance smile esthetics, whereas a slight intrusion could depreciate its esthetic aspect.<sup>8-10</sup>

The methodology for identifying the ideal vertical position of the maxillary central incisors may be complex because when the position is changed, the position of the incisal edges, the design of the gingival margins, and the amount of gingival display, are modified. To evaluate the step between the central and lateral incisor, in some studies, instead of changing the vertical position of the central incisors, the size of the teeth is changed. In those studies the authors do not take into account the fact that changing the gingival margins and incisal edges also changes the length to width proportions, thereby losing the focus on the variable to be evaluated. The method elected in this study for manipulating the photographs of the smile could be compared with previously conducted studies.<sup>8,9,18</sup>

**Table II.** Mean and SD of the attractiveness of the images in full-face and close-up views of man 1 smiles for laypersons

Variable (mm)	Full-face view		Close-up view		P
	Mean	SD	Mean	SD	
-1.0	3.00	2.30	3.37	2.38	0.260
-0.5	4.64	2.61	4.62	2.48	0.938
0.0	5.55	2.73	5.39	2.56	0.614
+0.5	4.78	2.74	5.28	2.70	0.092
+1.0	4.84	2.57	5.22	2.68	0.270
+1.5	4.14	2.78	4.13	2.57	0.875

Unpaired Student *t* test (*P* < 0.05).

**Table III.** Mean and SD of the attractiveness of the images in full-face and close-up views of man 1 smiles for orthodontists

Variable (mm)	Full-face view		Close-up view		P
	Mean	SD	Mean	SD	
-1.0	2.13	1.68	2.43	1.95	0.088
-0.5	3.40	1.95	4.13	2.02	0.001*
0.0	5.66	2.21	5.98	2.00	0.433
+0.5	5.90	2.26	6.21	2.17	0.113
+1.0	5.76	2.00	6.08	2.03	0.178
+1.5	3.89	2.02	4.66	1.98	0.063

\*Unpaired Student *t* test (*P* < 0.05).

Similar to other authors,<sup>1,2,8,9,14</sup> we have used manipulated photographs of 2 men. Our results have shown that individual features of each evaluated photograph did not affect the evaluators' opinions because the most attractive smiles were those with the positions of 0 mm, +0.5 mm, and +1.0 mm, and the least attractive smiles were considered those with the positions of -1.0 mm in both men (Tables VI and VII).

When comparing the evaluation of full-face and close-up views of the smile, no significant difference (*P* > 0.05) was found in most situations. Other authors found this same result.<sup>1,2,8-10</sup> Thus, it can be hypothesized that other components of the face, such as eyes, nose, and hair, do not significantly influence the assessment of smile esthetics.

It is important to remember that, when changing the vertical position of the maxillary central incisors, mandibular function must be assessed. The extrusion or intrusion of these teeth may affect the lateral excursive and protrusive mandibular movements. Therefore, before making any vertical change in the maxillary central incisors to enhance the smile esthetics, mandibular function must be meticulously evaluated. Moreover, occlusal adjustments may possibly be necessary.<sup>8,9</sup>

**Table IV.** Mean and SD of the attractiveness of the images in full-face and close-up views of man 2 smiles for the laypersons

Variable (mm)	Full-face view		Close-up view		P
	Mean	SD	Mean	SD	
-1.0	4.73	2.21	4.62	2.18	0.695
-0.5	5.46	2.09	6.18	2.09	0.056
0.0	6.39	2.20	7.55	1.68	<0.001*
+0.5	6.49	2.28	7.32	2.19	0.054
+1.0	6.94	2.00	6.93	2.19	0.976
+1.5	6.48	2.03	6.02	2.57	0.278

\*Unpaired Student *t* test (*P* < 0.05).

**Table V.** Mean and SD of the attractiveness of the images in full-face and close-up views of man 2 smiles for the orthodontists

Variable (mm)	Full-face view		Close-up view		P
	Mean	SD	Mean	SD	
-1.0	2.89	1.96	2.59	1.97	0.070
-0.5	3.61	2.15	4.33	2.43	0.002*
0.0	6.10	1.97	6.98	1.94	<0.001*
+0.5	7.52	1.95	7.40	2.01	0.627
+1.0	7.24	1.85	7.28	2.07	0.877
+1.5	6.87	1.84	6.30	2.14	0.054

\*Unpaired Student *t* test (*P* < 0.05).

Orthodontists and laypersons were recruited as evaluators. The former group was elected by virtue of previous results, which suggested that this group was the most critical in detecting deviations from that considered ideal.<sup>2,12,14-16,21</sup> However, the laypersons group is of utmost importance because they represent the target public for these treatments.<sup>11</sup> As a rule, laypersons and orthodontists do not show statistically significant differences in evaluating the most attractive smiles. However, the orthodontists were shown to be more demanding in their evaluations of less attractive smiles compared with laypersons, which is consistent with the findings in previous studies conducted with young women.<sup>9-11</sup>

Finally, it is worth emphasizing that the results of this study are evaluations of digitally manipulated photographs, without considering the dynamics of speech and the smile, under the eye of specific groups of evaluators. Because esthetic evaluation is of a subjective nature, it is imperative that planning of the vertical position of incisors must be individually discussed with patients, to ascertain their expectations on conclusion of the treatment.<sup>18</sup>

**Table VI.** Mean and SD of the attractiveness of man 1 smiles

Variable (mm)	Orthodontists			Laypersons			Orthodontists × laypersons
	Mean	SD	Results*	Mean	SD	Results*	Difference
-1.0	2.43	1.95	D	3.37	2.38	B	0.0296 <sup>†</sup>
-0.5	4.13	2.02	C	4.62	2.48	A,B	0.5083
0.0	5.48	2.00	A,B	5.39	2.56	A	0.8308
+0.5	6.21	2.17	A	5.28	2.70	A	0.0544
+1.0	6.08	2.03	A	5.22	2.68	A	0.0658
+1.5	4.66	1.98	B,C	4.13	2.57	B	0.2373

\*ANOVA with the Tukey post-hoc test ( $P < 0.05$ ). Smiles with the same letter did not differ from each other; <sup>†</sup>Statistical difference between the 2 groups of raters ( $P < 0.05$ ).

**Table VII.** Mean and SD of the attractiveness of man 2 smiles

Variable (mm)	Orthodontists			Laypersons			Orthodontists × laypersons
	Mean	SD	Results*	Mean	SD	Results*	Difference
-1.0	2.59	1.97	D	4.62	2.18	C	<0.0001 <sup>†</sup>
-0.5	4.33	2.43	C	6.18	2.09	B	<0.0001 <sup>†</sup>
0.0	6.98	1.94	A,B	7.55	1.68	A	0.1081
+0.5	7.40	2.01	A	7.32	2.19	A	0.6657
+1.0	7.28	2.07	A	6.93	2.19	A,B	0.4078
+1.5	6.30	2.14	B	6.02	2.57	B	0.5505

\*ANOVA with the Tukey post-hoc test ( $P < 0.05$ ). Smiles with the same letter did not differ from each other; <sup>†</sup>Statistical difference between the 2 groups of raters ( $P < 0.05$ ).

## CONCLUSION

Based on the findings of this research, it was possible to conclude the following:

1. The smiles considered most attractive were those that presented the following features: central incisor gingival margins corresponding to those of the canine, or were 0.5 mm–1.0 mm below; a step from 1 mm to 2 mm between the central and lateral incisor, and gingival exposure of 1.0 mm–2 mm.
2. The smiles with the worst scores presented the following characteristics: central incisor gingival margins 1.0 mm above or 1.5 mm below the canine gingival margins, and the absence of step between the central and lateral incisor.
3. For the smiles with the best evaluations, in most situations, orthodontists and laypersons presented no statistically significant difference ( $P > 0.05$ ). Nevertheless, most situations in which statistical differences occurred were relative to the less attractive smiles, in which laypersons were less strict in their judgment ( $P > 0.05$ ).
4. In general, there was no statistically significant difference ( $P > 0.05$ ) between the evaluations of the full-face and close-up smile views.

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