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Research

Influence of spacing in the upper lateral incisor area on the perception of smile esthetics among orthodontists and laypersons

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ABSTRACT

Background: The aim of this study was to determine the perception of smile esthetics among orthodontists and laypeople with respect to the presence of diastemas in the upper lateral incisor in the mesial, distal, and both surfaces using an oblique smile analysis.
Methods: Two standardized oblique photos of pleasant smiles from two white women were selected. Images were digitally altered to create diastemas in the lateral incisor, in 0.5-mm increments, in the mesial, distal, or both surfaces. Final images were randomly assembled in a photo album, which was given to 120 judges—60 orthodontists and 60 laypersons. Each rater was asked to evaluate the attractiveness of the images on a visual analog scale. The data collected were submitted to statistical analysis by the means of one-way ANOVA with the Tukey post hoc test and the unpaired Student's *t* test.
Results: The most attractive smile was the one without spacing, and the presence of diastemas was considered unattractive by both groups of raters, following a pattern: the greater and the more mesially located, the more unattractive was the smile.
Conclusions: The results of this study suggest that diastemas in the upper lateral incisor area were considered unattractive, following a pattern: the greater and the more mesially located, the more unattractive was the smile.

1. Introduction

In recent years, facial esthetics have become a major focus of the public worldwide. Therefore, to obtain optimal esthetic results, it is of paramount importance for clinicians to follow esthetic guidelines. For many years, these guidelines were based only on authors' opinions rather than on evidence-based literature [1–5].

The concept of beauty is still very subjective and is strongly influenced by not only the opinions of others but also the cultural preferences related to smile characteristics [6,7]. For instance, literature suggests that orthodontists and laypeople have different perceptions of smile esthetics when evaluating a variety of orofacial characteristics and that orthodontists are more sensitive in detecting deviations from ideal than is the general public [8–14].

For the constitution of a harmonic and pleasant smile, the presence or absence of spacing in the esthetic zone is of fundamental importance. Some authors have studied the impact of a midline diastema on smile esthetics [10,15,16]. Kokich et al. [10] found that a small midline diastema between 1.0 and 1.5 mm was not rated as unattractive by orthodontists, general dentists, or laypeople. On the contrary, Rosenstiel and Rashid [15] found that a smile with no midline diastema was preferred by 96.6% of judges when compared to a smile with a 0.5 mm diastema. To support this idea, a similar study digitally created four different unpleasant characteristics in a smile and found that among all variables, the least attractive smile was one with a 1.0-mm midline diastema [16].

Interestingly, all studies conducted regarding the esthetic effect of a midline diastema used smile photographs in the frontal view [10,15,16]. This evaluation is indeed important, but in some cases it does not provide a full view and dynamic evaluation of the smile [17,18]. A different strategy suggested in the literature was to use an oblique or a profile view of the smile [18,19].

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In the managing of esthetic cases, the presence of diastemas, not at the midline but at mesial and distal surfaces of upper laterals, is a common problem. In those situations, an interesting question arises: esthetically, are those spaces going to be recognized? In other words, because literature has shown that small midline diastemas are not considered unattractive [10], does spacing in the upper lateral area follow the same pattern?

The objective of this study was to determine the perception of smile esthetics among orthodontists and laypeople with respect to the presence of diastemas in the upper lateral incisor in the mesial, distal, and both surfaces using an oblique smile analysis.

2. Methods and materials

2.1. Study sample

According to a pilot study, a sample size calculation was undertaken by using Bioestat version 5.0 (4shared, Road Town, British Virgin Islands). On the basis of significance level of alpha = 0.01 and the effect size estimated at 0.95, the sample size was calculated to achieve 80% power. The sample size calculation showed that 54 subjects for each group were necessary.

Two standardized oblique photos displaying pleasant smiles of adult women were selected for this study. Both women had undergone orthodontic treatment, one with no extractions and the other with four first bicuspid extractions. The smiles used in this study were considered highly attractive and followed some of the principles of an ideal smile described in the literature [1–3,5].

The selected image was digitally altered using Adobe Photoshop CS3 (Adobe Systems Inc., San Jose, CA). The photos were manipulated to adjust color, brightness, and contrast, as well as to remove any discoloration in the lips and skin. The image was then condensed to achieve an image with measurements identical to those on the actual patient. Thus, each millimeter measured on the digital and printed image was equivalent to each millimeter measured clinically on the patient, using the upper lateral incisor as a reference. Furthermore, following recommendations from previous literature, the nose and chin were removed to reduce the number of variables on the images [9–13].

Each new image created was altered in 0.5-mm increments in the mesial, distal, or both sides of the laterals. The reference points for these measurements in both mesial and distal surfaces were the middle point of the height of the lateral incisors. In all images, the gingival margins, papillary heights, and the incisal edges were not altered. In all, for both photos used, 10 new images were created (Figs. 1 and 2).

Final images were digital files with a resolution of 300 dots per inch. They were professionally printed using specialized digital equipment (Minilab Digital Frontier 570, Fuji Film, Manaus, Brazil) on standard A4 size format (29.7 × 42 cm) Kodak Edge Generations paper (Kodak do Brasil, Manaus, Brazil). Then a photo album was assembled containing all images from each group in random order.

2.2. Examiner groups

The album was given to 120 judges—60 orthodontists (37 men and 23 women) and 60 laypeople with a college education but no dental background (32 men and 28 women). Each rater was given brief information about the study and was asked to evaluate the attractiveness of the images. Along with the album, each judge received a form with a 100-mm visual analog scale printed for each image, as in previous studies [8–12,14,20]. The scale ranged from "very unattractive" at the far left to "very attractive" at the far right. A line was also printed at the midpoint of each scale to provide a reference line for an average level of attractiveness. All judges marked a point along the scale according to their perception of smile esthetics. The scores were then measured in millimeters by the first author (A.W.M.), with an electronic digital caliper (Starrett, Suzhou, China).

2.3. Statistical analysis

To assess the reliability of the method, six raters from each group were randomly selected. They were asked to evaluate one page of the album on which there were two identical images. Intraclass correlation coefficients were used to compare the scores for those images to determine intrarater agreement. High levels of reliability were found because all coefficients were ≥0.72 for both groups of raters.

The data were submitted to statistical analyses with the software SPSS 16.0 (SPSS Inc., Chicago, IL). Descriptive statistics were reported as means and standard deviations. Differences in the mean scores in the levels of asymmetries were analyzed by using one-way ANOVA with the Tukey post hoc test. To compare the distributions of the mean scores between orthodontists and laypersons, the unpaired Student's *t* test was used. The level of significance was established at 5%.

3. Results and discussion

From the orthodontists' standpoint, the most attractive image among those of the "nonextraction" smile was the one with no spacing (mean 92.72), followed by the 0.5 mm at the distal incisor group (mean 74.01). The least attractive were the group with 1.5-mm diastema at the mesial and distal surfaces (mean 6.37). According to the laypersons' opinions, the most attractive smiles were the one with no spacing (mean 90.45) and the 0.5 mm distal (mean 87.13), whereas the least attractive was the 1.5-mm diastema in the mesial and distal surfaces (mean 14.96) (Table 1).

Similar results were found in the "extraction" smile. For the orthodontists' opinions, the most attractive was the one without spacing, and the least attractive was the 1.5 mm mesial and distal. From the laypersons' standpoint, the most attractive smiles were the one with no spacing and the 0.5 mm in the distal surface, whereas the least attractive was the 1.5 mm mesial and distal (Table 2).

When comparing the perceptions between the orthodontists and laypersons, statistical differences were found in few situations with the latter group, giving higher scores ($P < 0.05$) (Tables 1 and 2).

The presence or absence of spaces in the esthetic zone plays an important role in the perception of smile esthetics. According to the literature, when this space is a midline diastema, it is characterized as a very unattractive feature [15,16]. Because the presence of spaces may occur in the esthetic zone in other areas rather than the midline, our objective was to survey the effect of the presence of spaces in the upper lateral incisor area on the perception of smile esthetics. In general, the results of our study indicate that the presence of diastemas in the upper lateral incisor (mesial, distal, or both surfaces) is considered unattractive, and the most pleasant smile was the one without spacing. This information encourages orthodontists to close the spaces during orthodontic treatments or to refer patients for cosmetic restorations.

The amount and location of the diastemas were also important information regarding the perception of esthetics. When the three areas with diastemas were analyzed, it was found that the greater the space, the less attractive the image was rated, and also that the more mesially located, the more unattractive was the smile. This information corroborates the clinical assumption that diastemas located farther from the midline are more difficult to notice and,

Fig. 1. Nonextraction smile images with 0.5-mm diastema increments. (A) Control. (B) 0.5 mm Mesial. (C) 1.0 mm Mesial. (D) 1.5 mm Mesial. (E) 0.5 mm Distal. (F) 1.0 mm Distal. (G) 1.5 mm Distal. (H) 0.5 mm Mesial and distal. (I) 1.0 mm Mesial and distal. (J) 1.5 mm Mesial and distal.

thus, are less unattractive. In general, for both groups of raters, the smiles with spaces in both surfaces (mesial and distal) were the least attractive, followed by the mesial surface and distal surface. Therefore, from the orthodontic point of view, we recommend the distal surface of the upper lateral incisor as the best area to leave spaces for future restorations. Kokich et al. [10] add that if a restoration were placed in the distal surface, the most overcontouring would be in this area, which will be less noticeable.

The exception was the smile with 0.5 mm in the distal surface, which in the laypersons' opinion did not influence the evaluation process and thus was not recognized as unattractive. This information not only supports the suggestion of leaving a possible

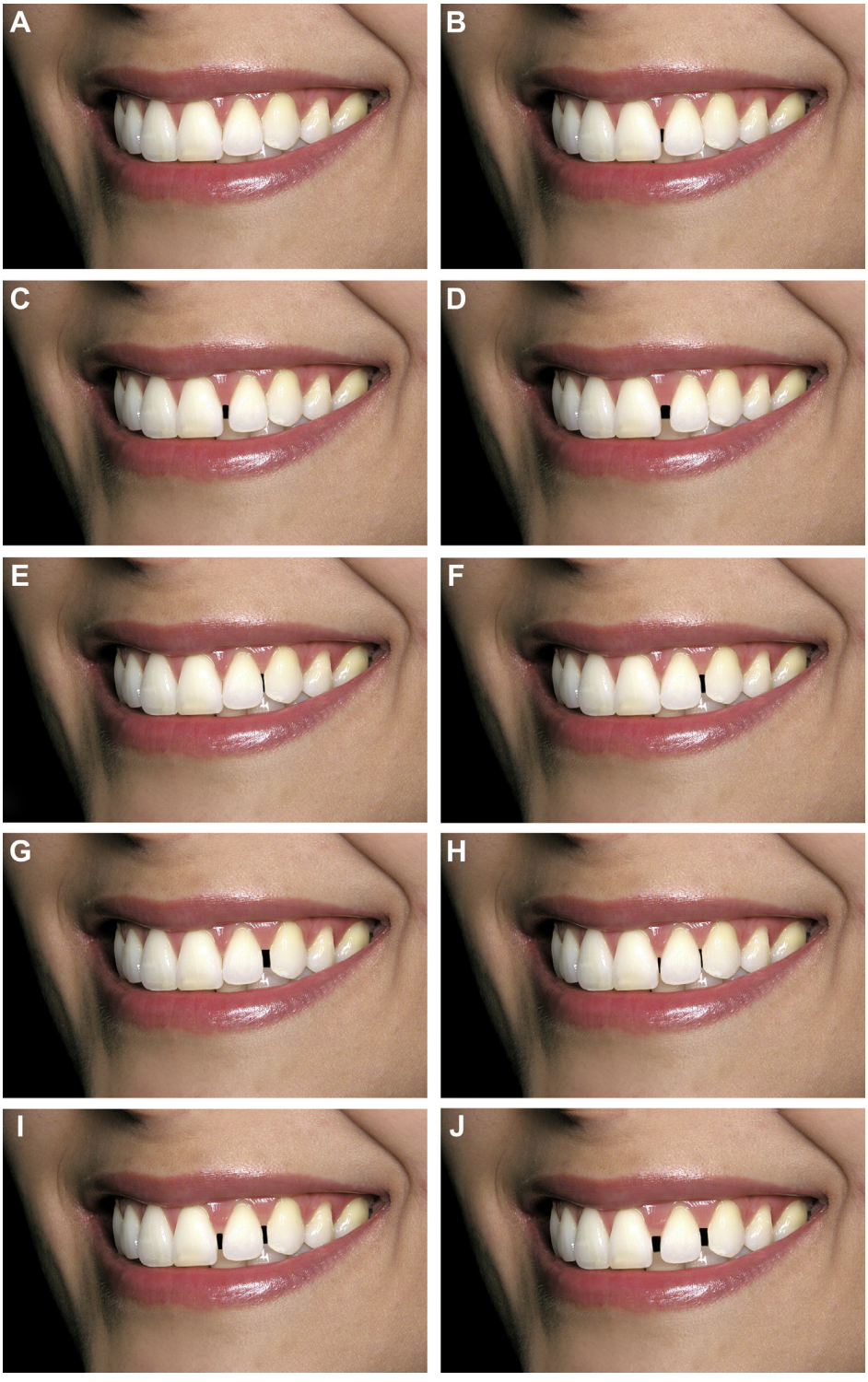

Fig. 2. Extraction smile images with 0.5-mm diastema increments. (A) Control. (B) 0.5 mm Mesial. (C) 1.0 mm Mesial. (D) 1.5 mm Mesial. (E) 0.5 mm Distal. (F) 1.0 mm Distal. (G) 1.5 mm Distal. (H) 0.5 mm Mesial and distal. (I) 1.0 mm Mesial and distal. (J) 1.5 mm Mesial and distal.

diastema in the distal surface of the upper laterals but also questions the need for restorations in this area.

Based on the data from our study, the clinician should first evaluate the etiology of the presence of space at the lateral incisor, such as alterations in this tooth (absent, peg-shaped, small, etc.), Bolton discrepancy, and uncontrolled labial torque during incisor retraction. Secondly, the clinician should locate and measure the amount of space and then decide the best clinical approach—close the space orthodontically, close with cosmetic restorations, or both. Kokich et al. [10] asked, if smaller deviations are not recognized as unattractive in some situations, why refer the patient for cosmetic restorations that would eventually need to be replaced? Our results suggest that small (0.5-mm) cosmetic restorations might reflect an exaggerated concern by dental specialists rather than an esthetic

Table 1
Orthodontists' and laypersons' perceptions of the nonextraction smile

Spacing	Orthodontists			Laypersons			Difference
	Mean	SD	Results*	Mean	SD	Results*	
No spacing	92.72	8.26	A	90.45	7.37	A	–
0.5 Distal (D)	74.01	11.58	B	87.13	8.15	A	†
1.0 Distal (D)	37.8	12.09	D	44.45	15.97	C	–
1.5 Distal (D)	25.32	13.35	E	34.41	10.59	D	†
0.5 Mesial (M)	49.49	12.42	C	61.45	12.27	B	†
1.0 Mesial (M)	19.34	11.27	E,F	27.51	14.18	D,E	–
1.5 Mesial (M)	15.71	10.10	F	26.98	14.73	D,E	†
0.5 M and D	43.95	12.17	C,D	54.28	14.5	B	–
1.0 M and D	18.06	10.41	E,F	24.68	10.05	E	–
1.5 M and D	6.37	8.51	G	14.96	10.73	F	–

SD, standard deviation.
* A > B > C > D > E > F, and smiles with the same letter did not differ from each other.
† Statistical difference between the two group of raters ($P < 0.05$).

need [11]. In addition, literature shows that a composite restoration accumulates more biofilm than natural enamel and also is more prone to discolorations with time [21,22].

In this study, we surveyed orthodontists and laypeople. The first group was selected because previous studies showed that they are the most sensitive group in detecting deviations from ideal [8–11,20]. The latter group was chosen because they are the primary consumers of dental services, instead of practitioners, who are providers of care [23]. In contrast to the literature, in only a few situations were orthodontists more critical in their evaluations. It can be hypothesized that the negative effect of diastemas in the esthetic zone may play a similar role in the perception of smile esthetics among orthodontists and laypeople.

To simulate different clinical conditions, we used close-up photos of orthodontically treated attractive smiles from two very common clinical situations—a nonextraction case and a four-bicuspid-extraction case. The main reason for assessing both smiles was to survey possible differences in the influence of diastemas in the esthetic perception. The results of our study suggest that the preferences of orthodontists and laypeople with respect to the presence of diastemas in the upper lateral incisor were very similar when the extraction and nonextraction smiles were evaluated.

Interestingly, previous studies evaluating the effect of spaces in the esthetic zone (i.e., midline diastema) used smile photographs in the frontal view [10,15,16]. This study used an oblique view because it provides a more dynamic evaluation of the smile and a view similar to that at some moments of interpersonal daily interactions [17]. In addition, because the spaces surveyed were in the upper laterals in the mesial, distal, and both surfaces, a frontal assessment would have compromised the process of evaluating the distal diastemas.

Table 2
Orthodontists' and laypersons' perceptions of the extraction smile

Spacing	Orthodontists			Laypersons			Difference
	Mean	SD	Results*	Mean	SD	Results*	
No spacing	92.64	5.78	A	90.33	6.42	A	–
0.5 Distal (D)	73.92	8.55	B	87.25	4.79	A	†
1.0 Distal (D)	40.53	17.9	C	41.75	11.59	C	–
1.5 Distal (D)	25.45	15.37	D	26.7	13.52	D	–
0.5 Mesial (M)	46.09	10.64	C	57.72	10.26	B	†
1.0 Mesial (M)	18.54	14.32	D,E	27.29	13.88	D	–
1.5 Mesial (M)	14.08	8.64	E,F	20.61	11.93	D	–
0.5 M and D	40.01	10.79	C	41.86	9.41	C	–
1.0 M and D	25.13	9.55	D	26.11	9.92	D	–
1.5 M and D	6.86	8.17	F	10.62	10.51	E	–

SD, standard deviation.
* A > B > C > D > E > F, and smiles with the same letter did not differ from each other.
† Statistical difference between the two group of raters ($P < 0.05$).

Since we used only one smile of a nonextraction case and one of an extraction case from different patients, the establishment of a comparison between those images was not possible. The primary objective was to survey the impact of the presence of diastemas in the upper lateral incisor area in two clinical situations: extraction and nonextraction cases. Although this was not the purpose of this study, literature shows no smile esthetic differences between extraction and nonextraction cases [24,25].

Finally, it is important to remember that because this study used computer-manipulated images from two patients and the opinions of specific groups of individuals, results should be carefully analyzed. As stated by Kokich et al. [10], because the results and conclusions are based on averages, it is difficult to customize this information to a patient due to the subjectivity of smile esthetics evaluation. Therefore, we corroborate their suggestion to discuss the results of this study with patients with diastemas in the upper lateral incisor area and then decide the best treatment approach.

4. Conclusions

The most attractive smile in both types of images (extraction and nonextraction) was the one without spacing, whereas the presence of diastemas in the upper lateral incisor area (mesial, distal, or both surfaces) was considered unattractive following a pattern: the greater and the more mesially located, the more unattractive was the smile.

For the laypeople group, the presence of a 0.5-mm diastema in the distal surface of the upper lateral incisor did not influence the evaluation process and thus was not recognized as unattractive.

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